Chapter 4

Service Standards and Policies

Systemwide Service Standards [FTA C4702.1A, V. 2.a.]

To guard against discriminatory service design or operation, the new circular requires that the MBTA adopt quantitative systemwide service standards and systemwide service policies, which may not be based on a quantitative threshold.

Systemwide standards are required for vehicle load, vehicle headway, on-time performance, service availability, and the distribution of transit amenities. Standards for the first four categories are found in the *Service Delivery Policy*. This policy, first adopted in 1996, was created to implement objective standards and consistent decision-making procedures for evaluating existing and proposed services. Since 1996, the *Service Delivery Policy* has been revised three times: in 2002, 2004, and 2006. These revisions were proposed during the development of the 2002, 2004, and 2006 Service Plans, and were discussed and commented on at the public meetings and hearings that were held for all three service plans. The proposed revisions were also posted on the MBTA's website, through which additional public comments were accepted. All revisions were ultimately approved by the MBTA Board of Directors before taking effect. Any future revisions to the service standards found in the *Service Delivery Policy* will also undergo a public-review process and MBTA Board approval.

Vehicle Load

The MBTA's vehicle load standard applies to the maximum number of passengers allowed on a service vehicle in order to ensure the safety and comfort of customers. The load standard is expressed as the ratio of passengers to the number of seats on the vehicle, and it varies by mode and by time of day. The following description of vehicle load standards is quoted directly from the 2004 update of the *Service Delivery Policy*.

> As indicated in the Frequency of Service Standard, the level of service provided by the MBTA is primarily a function of the demand for that service, as demonstrated through the number of customers utilizing the service at different times during the day. On weekends and during some weekday time periods, most MBTA services operate with sufficient frequency to provide every passenger with a seat. However, at the heaviest weekday travel times or locations some passengers will need to stand.
>
> During time periods when some passengers will be standing, the MBTA will provide sufficient service so that vehicles are not excessively crowded. The purpose of the Vehicle Load Standard is to define the levels of crowding that are acceptable by mode and time period. The time periods used by the MBTA for all modes, for both the Frequency of Service and Vehicle Load Standards, are defined earlier in this chapter (see Frequency of Service Standard).
>
> Because heavy and light rail in the core area are heavily used throughout the day, some standees can be expected during all time periods. For the purposes of this policy, the core area, as it relates to the heavy rail and light rail Vehicle Load Standard, is defined as follows [Table 9 in the *Service Delivery Policy* is called Table 4-1 in this report.]:

Table 4-1: MBTA Core Area Boundaries

Light Rail & Heavy Rail Core Area

Blue Line	Bowdoin to Maverick
Orange Line	Back Bay to North Station
Red Line	Kendall to South Station
Green Line	All underground stations as well as Lechmere and Science Park

By mode and time period, the acceptable levels of crowding are shown in the following table. The load standards in the table are expressed as a ratio of the number of passengers on the vehicle to the number of seats on the vehicle.[1] To determine whether a service has an acceptable level of crowding, the vehicle loads are averaged over specified periods of time. Due to scheduling constraints and peaking characteristics, some individual trips may exceed the load levels expressed in the standards.

For most modes the load standards shown represent average maximum loads over any time period on weekdays and over the whole day on weekends. For bus, on weekdays the loads cannot exceed the standard when averaged over any 30-minute segment of an Early AM, AM Peak, Midday School or PM Peak period, or any 60-minute segment of a Midday Base, Evening, Late Evening or Night/Sunrise period. On weekend days, the loads cannot exceed the standard when averaged over any 60-minute segment of the whole service day.

Table 4-2: Vehicle Load Standards by Mode

[Called Table 10 in the *Service Delivery Policy*]

Mode	Time Period	Passengers/ Seats**
Bus*	Early AM, AM Peak, Midday School & PM Peak	140%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Surface routes	100%
	Tunnel portions of BRT routes	140%
Green Line	Early AM, AM Peak, Midday School & PM Peak	225%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Core Area	140%
	Surface	100%
Red Line #1 & 2 Cars	Early AM, AM Peak, Midday School & PM Peak	270%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Core Area	140%
	Outside Core Area	100%
Red Line #3 Cars	Early AM, AM Peak, Midday School & PM Peak	334%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Core Area	174%
	Outside Core Area	100%
Orange Line	Early AM, AM Peak, Midday School & PM Peak	225%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Core Area	140%
	Outside Core Area	100%

(continued)

[1] For Bus, Light Rail and Heavy Rail, the Vehicle Load Standard is based on the ratio of passengers to seated capacity at maximum load. For Commuter Rail and Ferry services, the load standard is based on the ratio of boarding passengers per vehicle to seated capacity.

Table 4-2 *(continued)*

Mode	Time Period	Passengers/ Seats**
Blue Line	Early AM, AM Peak, Midday School & PM Peak	225%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	
	Core Area	140%
	Outside Core Area	100%
Commuter Rail	Early AM, AM Peak, Midday School & PM Peak	110%
	Midday Base, Evening, Late Evening, Night/Sunrise & Weekends	100%
Ferry	Inner Harbor – All time periods	125%
	Outer Harbor – All time periods	100%

*For the purposes of the Vehicle Load Standard, "bus" encompasses all rubber-tired vehicles, including diesel, CNG, trackless trolley, dual-mode, etc.
**For Bus, Light Rail and Heavy Rail, the Vehicle Load Standard is based on the ratio of passengers to seated capacity at maximum load. For Commuter Rail and Ferry services, the load standard is based on the ratio of boarding passengers per vehicle to seated capacity.

In addition to looking at loads within time periods, the MBTA will routinely evaluate loads at the beginning and end of the service day to determine whether changes in frequency and/or span of service are warranted. The Net Cost/Passenger Standard will be used as one means of flagging routes that may be candidates for such changes.

Vehicle Headway

Vehicle headway—or frequency of service—is an indication of the time interval between vehicles on a route that allows passengers to gauge how long they will have to wait for the next vehicle. Vehicle headway varies by mode and time of day, just as vehicle load does. The following description of frequency-of-service standards is quoted directly from the 2004 update of the *Service Delivery Policy*.

> To maintain accessibility to the transportation network within a reasonable waiting period, the MBTA has established minimum frequency of service levels for each mode, by time of day. On less heavily traveled services, these minimum levels dictate the frequency of service, regardless of customer demand.
>
> Table 4 [called Table 4-3 in this report] shows the weekday Time Period definitions used by the MBTA for all modes for both the Frequency of Service and Vehicle Load Standards. Because travel patterns on the weekend are different than on weekdays, specific time periods are not defined for Saturdays and Sundays. Table 5 [called Table 4-4 in this report] shows the Minimum Frequency of Service levels for each mode by time period.

Table 4-3: MBTA Weekday Time Period Definitions

Time Period	Definition
Early AM	6:00 AM – 6:59 AM
AM Peak	7:00 AM – 8:59 AM
Midday Base	9:00 AM – 1:29 PM
Midday School	1:30 PM – 3:59 PM
PM Peak	4:00 PM – 6:29 PM
Evening	6:30 PM – 9:59 PM
Late Evening	10:00 PM – 11:59 PM
Night/Sunrise	12:00 AM – 5:59 AM

Table 4-4: Minimum Frequency of Service Standards

Mode	Weekday Time Periods	Minimum Frequency*
Bus**		
Local/Community Rts.	AM & PM Peak	30-minute headway
	All Other Periods	60-minute headway (Mid-day policy objective of 30-minute headway in high density areas)
	Saturday & Sunday – all day	60-minute headway
Express/Commuter Rts.	AM Peak	3 trips in the peak direction
	PM Peak	3 trips in the peak direction
Key Routes	AM & PM Peak	10-minute headway
	Early AM & Midday Base/ School	15-minute headway
	Evening & Late Evening	20-minute headway
	Saturday – all day	20-minute headway
	Sunday – all day	20-minute headway
Light Rail/Heavy Rail	AM & PM Peak Periods	10-minute headway
	All Other Periods	15-minute headway
	Saturday & Sunday – all day	15-minute headway
Commuter Rail	AM & PM Peak Periods	3 trips in peak direction
	All Other Periods	180-minutes in each direction
	Saturday – all day	180-minutes in each direction
Ferry/Commuter Boat	AM & PM Peak Periods	30-minute headway in peak direction
	Off-Peak Periods	120-minute headway

*The Minimum Frequency of Service standards are primarily expressed as "Headways," which indicate the number of minutes scheduled between trips on a route.
**For the purposes of the Frequency of Service standard, "Bus" encompasses all rubber-tired vehicles, including diesel, CNG, trackless trolley, dual-mode, etc. The definitions of types of bus routes are found in Chapter 2.

On heavily used services, the minimum frequency of service levels may not be sufficient to meet customer demand. When load levels indicate that additional service is warranted, as defined in the Vehicle Load Standard, the frequency of service will be increased to provide a sufficient number of vehicles to accommodate passenger demand.

On-Time Performance

In 2006, a number of changes to the standards in the *Service Delivery Policy* were adopted. These included a complete revamping of the schedule-adherence standards for bus services, since the previous standards were not useful for effectively diagnosing on-time performance problems. One major addition to the new bus standards is adherence to midroute time points. Use of this new measure is being phased in as CAD/AVL (computer-assisted design [CAD] and automated-vehicle-location [AVL]) equipment becomes available for effective data collection.

The updated standards for schedule adherence, as they appear in the 2006 update of the *Service Delivery Policy*, are quoted below.

Schedule Adherence Standards vary by mode and provide the tools for evaluating the on-time performance of the individual MBTA routes/services within each mode. The Schedule Adherence Standards also vary, based on frequency of service; because, passengers using high-frequency services are generally more interested in regular, even headways than in strict adherence to published timetables, whereas, on less frequent services passengers expect arrivals/departures to occur as published.

Bus Schedule Adherence Standards: The environment in which buses operate makes it difficult to provide bus service with the same degree of precision that is possible for some other modes. Therefore, the Schedule Adherence Standards for bus routes are designed to ensure that routes operate as reliably as possible—given their uncertain environment—without early departures, chronic delays, or unpredictable wait and/or travel times.

The Bus Schedule Adherence Standards establish two separate thresholds to measure on-time performance. The first measures the on-time performance of each trip on the route. The second measures the on-time performance of the route itself, based on the percent of trips throughout the day that operate on time.

1. **Bus Trip Tests:** To determine whether or not individual trips on a route are on time, the MBTA uses two different tests. These tests are based on the type of service, as determined by its frequency. For the purposes of the Bus Schedule Adherence Standards, the two types of services are defined as follows:

    - **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 ≥10 minutes). For scheduled departure services, customers generally time their arrival at bus stops to correspond with the specific scheduled departure times.

    - **Walk-Up Service:** A route is considered to provide walk-up service for any part of the day in which it operates more frequently than one bus every 10 minutes (headway <10 minutes). For walk-up service, customers can arrive at a stop without looking at a schedule and expect only a brief wait. There are two important indicators of on-time performance for walk-up service. One is how evenly spaced the buses are, and the other is how closely the actual duration of the trip approximates the scheduled travel time.

A route might operate entirely with walk-up service, entirely with scheduled departure service, or with a combination of both throughout the day. Because any given route may have both types of service, each trip is measured individually to determine whether or not it is on time, according to the type of service that it provides. Therefore, there are two separate trip tests that are applied to the trips on any given route before the whole route can be tested for Schedule Adherence.

- **On Time Test for Scheduled Departure Trips:** To be considered on time, any trip with a leading headway scheduled for 10 minutes or more must meet all of the following conditions:

    - The trip must start between 0 minutes before and 3 minutes after its scheduled departure time.

- The trip must leave the route midpoint(s) between 0 minutes before and 7 minutes after its scheduled departure time (midpoints are calculated only for routes on which the data is collected using CAD/AVL).

- The trip must arrive at its destination between 3 minutes before and 5 minutes after its scheduled arrival time.

◊ **On Time Test for Walk-Up Trips:** To be considered on time, any trip with a leading headway scheduled for less than 10 minutes must meet all of the following conditions:

- The trip must start within 25% of its scheduled headway (but not necessarily within 25% of its scheduled departure time). For example, if "trip A" is scheduled to start at 7:30 AM and the route's next trip "trip B" is scheduled to start at 7:38 AM, trip B has an 8-minute scheduled headway. Therefore, trip B must start 6 to 10 minutes after trip A actually starts to be considered on time.

- The trip must leave the midpoint(s) within 50% of its scheduled headway (midpoints are calculated only for routes on which the data is collected using CAD/AVL). Continuing the above example, if trip B is scheduled to leave a midpoint 8 minutes after trip A is scheduled to leave it, then trip B must leave the midpoint 4 to 12 minutes after trip A actually departs the midpoint to be considered on time.

- The trip's running time must be within 20% of its scheduled running time. *Continuing the above example, if trip B is scheduled to take 30 minutes from the beginning of the route to the end, the actual trip time must be 24 to 36 minutes to be considered on time.*

2. **Bus Route Test**: The second part of the Bus Schedule Adherence Standard determines whether or not a route is on time, based on the proportion of trips on the route that are on time over the entire service day (regardless of which types of trips they are).

◊ **On Time Test for a Bus Route:** For a Bus Route to be considered on time, 75% of all trips on the route (in both directions) over the entire service day must pass their trip on-time tests.

Table 4-5: Summary of Bus Schedule Adherence Standard

[Called Table 6 in the *Service Delivery Policy*]

Trip Test	Beginning of Route	Mid-Route Time Point(s)*	End of Route
Scheduled Departure Trips (Headways ≥ 10 minutes):	Start 0 minutes early to 3 minutes late	Depart 0 minutes early to 7 minutes late	Arrive 3 minutes early to 5 minutes late
Walk-up Trips (Headways <10 minutes):	Start within 25% of scheduled headway	Leave within 50% of scheduled headway	Running time within 20% of scheduled running time
Route Test	**For any given bus route to be in compliance with the Schedule Adherence Standard, 75% of all trips on must adhere to the above measures over the entire service day.**		

*For Schedule Adherence, mid-route time points will be used only for routes on which the on-time performance data has been collected using CAD/AVL equipment.

Exceptions:

- Express routes that serve only two points do not have a midpoint. Other routes must have at least one midpoint. The MBTA will add additional time points to certain routes based on their distance, running time and frequency.
- Express routes may arrive more than 3 minutes early at their final destinations.
- A schedule may note that certain trips will not leave until another vehicle arrives and allows passengers to transfer. (For instance, the last bus trip of the day might wait for passengers from the last train of the day.) When applying the standard to these trips the scheduled departure, midpoint and arrival times may be shifted forward by the amount of time the bus had to hold for connecting passengers.
- If a series of trips alternate 9- and 10-minute headways, they may all be considered walk-up trips.
- The first trip of the day, which does not have a leading headway, is considered a scheduled departure trip.

Light Rail & Heavy Rail Schedule Adherence Standards: As with frequent bus services, passengers on light rail and heavy rail do not rely on printed schedules, but expect trains to arrive at prescribed headways. Therefore, schedule adherence for light rail and heavy rail is measured similarly to the way in which frequent bus service is measured. The percent of individual trips that are on time is calculated, based on a measure of how well actual headways correlate to scheduled headways. In addition, the percent of trip times that correspond to scheduled trip times is measured.

Two different measures are used to evaluate headway performance. For surface light rail and heavy rail, Schedule Adherence is measure based on the percent of trips that operate within 1.5 scheduled headways. For example, a trip with a 4-minute headway would be considered late if the observed headway were greater than 6 minutes (1.5 x 4 minutes). Because the headways in the core area for light rail are less than two minutes, Schedule Adherence is measured by the percent of trips with headways less than 3 minutes. Table 7 [called Table 4-6 in this report] provides a summary of the Schedule Adherence standards for Light Rail and Heavy Rail services.

Table 4-6: Schedule Adherence Standards for Light Rail & Heavy Rail

Mode	Headway Performance	Trip Time Performance
Light Rail – Surface	85% of all trips operated within 1.5 scheduled headways over the entire service day.	95% trips operated within 5 minutes of scheduled total trip time over the entire service day.
Light Rail – Subway	95% of all service operated with headways less than 3 minutes over the entire service day.	95% of all trips operated within 5 minutes of scheduled trip time over the entire service day.
Heavy Rail	95% of all trips within 1.5 headways over the entire service day.	95% of all trips operated within 5 minutes of scheduled trip time over the entire service day.

Commuter Rail & Ferry/Commuter Boat: The Schedule Adherence standards for Commuter Rail and Ferry/Commuter Boat measure the percent of trips that depart/arrive within 5 minutes of scheduled departure/arrival times. These standards reflect the long distances and wide station spacing of commuter rail, and the absence of intermediate stations on most boat services. Table 8 [called Table 4-7 in this report] shows the Schedule Adherence standards for Commuter Rail and Ferry/Commuter Boat services.

Table 4-7: Schedule Adherence Standards for Commuter Rail & Ferry/Commuter Boat

Mode	Standard
Commuter Rail	95% of all trips departing and arriving at terminals within 5 minutes of scheduled departure and arrival times
Ferry/Commuter Boat	95% of all trips departing and arriving at ports within 5 minutes of scheduled departure and arrival times

Service Availability (Coverage)

The MBTA's coverage guidelines are only for the bus and rapid transit system service area, where customers are most likely to walk to transit. The guidelines are established to indicate the maximum distance that a passenger who lives in a densely populated area should need to walk to access some transit service (regardless of the mode). The following description of the coverage guidelines is quoted directly from the *Service Delivery Policy*.

> An important aspect of providing the region with adequate access to transit services is the geographic coverage of the system. Coverage is expressed as a guideline rather than a standard, because uniform geographic coverage cannot always be achieved due to constraints such as topographical and street network restrictions. In addition, coverage in some areas may not be possible due to the infeasibility of modifying existing routes without negatively affecting their performance.

The Coverage guidelines are established specifically for the service area in which bus, light rail, and heavy rail operate, as riders most frequently begin their trips on these services by foot. Because commuter rail is usually accessed via the automobile, the coverage guidelines do not apply in areas where commuter rail is the only mode provided by the MBTA.

Table 4-8: Coverage Guidelines

Service Days	Minimum Coverage
Weekdays & Saturday	Access to transit service will be provided within a ¼ mile walk to residents of areas served by bus, light rail and/or heavy rail with a population density of greater than 5,000 persons per sq/mile.
Sunday	On Sunday, this range increases to a $^1/_2$ mile walk.

Distribution of Transit Amenities

The new Title VI circular requires that the MBTA adopt service standards for the distribution of various transit amenities, including bus shelters, benches, timetables, route maps, trash receptacles, intelligent transportation systems (ITS), elevators, escalators, and park-and-ride facilities. Each of these amenities is described below.

Bus Shelter Placement

There are essentially three categories of bus shelters in the MBTA system. The first category is MBTA-owned and managed: shelters that are purchased, installed, and maintained by the MBTA. Historically, most shelters were of this variety. More recently, two other categories of shelters, both of which are privately owned, have been placed at MBTA bus stops. For stops located in the city of Boston, the City entered into a contractual agreement with Wall USA to provide shelters that are manufactured, owned, and maintained by Wall. These shelters display advertisements, and the cost of their upkeep is paid for through advertising revenues. Outside of Boston, the MBTA entered into an agreement with a different company, Cemusa, to provide shelters in other municipalities. The manufacture, placement, and maintenance of these shelters are also supported by advertising revenues. Although the MBTA does not set standards for privately owned shelters, it coordinates with both companies to ensure that the placement of their shelters does not disadvantage minority and low-income areas.

In 2005, the MBTA updated its standards for determining the eligibility of bus stops for shelter placements, regardless of the source. The following description of how decisions are made for bus shelter placements is quoted directly from the *2005 Bus Shelter Policy*.

A. Purpose

The purpose of this policy is to provide guidance for the placement of MBTA bus shelters and to establish a procedure for evaluating shelter requests. In areas or locations where the MBTA, or its contractors, are the primary suppliers of shelters at bus stops, placements will be evaluated using two steps:

(1) Conformance with eligibility standards, and
(2) a site suitability test.

Central to any placement decision will be a commitment to meeting the requirements of Title VI of 1964 Civil Rights Act as defined in the FTA Circular C 4702.1. Title VI ensures that MBTA services are distributed in such as manner that minority communities

receive benefits in the same proportion as the total service area. This policy in no way establishes a requirement for placement, since all placements will be dependent on available resources.

B. Background

The previous shelter policy was established in 1984, having been extracted from the 1977 Service Policy for Surface Public Transportation. This older policy considered three major factors when evaluating stops: number of boardings, frequency of service, and percentage of persons using the stop that were elderly or had disabilities.

The current policy continues to include these important measures; however, it more systematically quantifies each factor in determining eligibility.

C. Evaluation Procedure

MBTA Operations will be responsible for evaluating placement requests and ensuring compliance with Title VI.

The first step in the evaluation process is a determination if the bus stop conforms with shelter eligibility standards. As in the previous shelter policy, the number of boardings at a bus stop is a major determinant for eligibility. As described in the table below, all bus stops that meet the required number of boardings will be eligible. However, a number of other criteria can also be considered. To standardize the process, the various types of criteria have been given values. The following table lists all criteria to be factored into an assessment of eligibility for each bus stop and the value associated with each criterion. A site must receive a total of 70 points to be considered eligible under this policy.

Table 4-9: Shelter Eligibility Criteria for MBTA Bus Stops

[This table did not have a title or number in the *Service Delivery Policy*.]

Eligibility Criteria	Points
60+ Average weekday daily boardings (ADB)	70
50-59 ADB	60
20-49 ADB	40
Less than 20 ADB	30
MBTA initiative to strengthen route identity	20
Seniors, disabled, medical, social service, or key municipal facility in close proximity to stop	15
Official community recommendation	10
Bus route transfer point	10
Infrequent service (minimum of 30minute peak/ 60minute off peak headway)	10
Poor site conditions (weather exposure etc.)	5
Shelter promotes adjacent development/increased ridership	5
Passing Score:	**70**

Any bus stop that has more than 60 boardings is eligible for a shelter, with an automatic score of 70 points. For bus stops with fewer boardings, a combination of the factors listed above will be considered in determining eligibility. Operations will keep records of all requests that document the assignment of scores. All bus stops that currently have shelters will be grandfathered into the program without need for additional analysis.

The second step in the evaluation process is the site suitability test. There are physical and practical requirements that must be met before a shelter can be placed. These include:

(1) Property ownership,
(2) abutter approval,
(3) compliance with the Americans with Disabilities Act requirements,
(4) adequate physical space and clearances,
(5) close proximity to an existing bus stop, and
(6) community approval

D. Reporting

The Operations Department will retain the necessary documents to ensure correct application of the policy. The Service Planning Department and CTPS will submit the required Title VI reports. Title VI ensures that MBTA services are distributed in such as manner that minority communities receive benefits in the same proportion as the total service area.

In terms of the shelter policy, once a bus stop is eligible for a shelter it will be included in all analyses for Title VI purposes, until such time that it is indicated otherwise. Consequently, all bus stops with 60 or more boardings will be included in Title VI reports, as well as any bus stops with less than 60 boardings that meet the 70-point eligibility requirement. Any bus stop that meets the eligibility standard, but is found not to meet the site suitability test, will be noted and not included in the analysis. Bus stops in the MBTA service area that have pre-existing shelters, but do not meet the policy requirements, will be noted and included in the total comparisons.

Benches

It is the MBTA's policy that all bus shelters have benches, whether the shelters are provided by the MBTA or through one of the two private companies (Wall and Cemusa) that install shelters under contract to individual municipalities. Benches are also provided at all subway and light rail station platforms, with the exception of certain Green Line surface stops where the platform is too narrow to accommodate a bench.

Timetables and Route Maps

Historically, the MBTA did not post timetables (schedules) in bus shelters; however, the MBTA requires that Cemusa, which provides bus shelters to municipalities outside of Boston, post bus timetables in all of their shelters. In addition, timetables are provided at all bus stops located at terminals, and pole-mounted "tubes" and/or "cubes" with timetable information are located at most stops on Key Bus Routes. Transit maps are provided at all Cemusa and Wall shelters.

Neighborhood Maps and Trash Receptacles in Rapid Transit Stations

The neighborhood map program involves the placement of two types of maps at rapid transit stations that have bus connections: (1) neighborhood maps, showing major landmarks, bus routes, the street network, the one-half-mile walking radius around the station, green space, pathways,

and accessible station entrances; and (2) more detailed maps that show all bus routes that serve a particular station, along with service frequency information.

The objectives that the program hopes to accomplish at each station include: (1) providing route and schedule information for bus routes serving that station, (2) placing the transit station in the context of the surrounding neighborhood, and (3) highlighting the areas around the station that are within easy walking distance.

Where space allows, one or both maps are placed at stations with bus connections. The maps are also generally installed at new or renovated stations, regardless of whether or not a station has bus service. Due to space constraints, maps are not located at many surface Green Line stops.

The MBTA provides bombproof trash barrels at all high-volume stations on the rapid transit system.

Intelligent Information Systems (ITS): Automated Fare Collection (AFC) Fare Gates and Fare Vending Machines

The automated fare-collection system was rolled out during 2006. The number and location of fare gates and fare vending machines to be placed at each rapid transit station were determined based on the number of customers entering the station, the number of station entrances, and the general configuration and available space at the station.

Retail sales outlets were initially placed so that they would be convenient to customers who use the Key Bus Routes, as they are the most heavily used routes in the system and operate in the urban core, where minority and low-income populations are most prevalent.

The AFC equipment relays monitoring data on device status to the AFC Central Computer System, which is located at 10 Park Plaza. These data are also available to AFC field technicians via workstations located in each of the booths in the subway system formerly used by toll collectors, and at each of the locations used by AFC farebox technicians to store fares collected on buses and the Green Line.

Each AFC device is monitored for cash and ticket levels so that Revenue Service personnel and management can schedule the necessary resources to maintain the ticket and coin levels in all devices.

The MBTA has established performance metrics that are based on the availability for use of the fare gates and fare vending machines.

- The minimum acceptable device availability threshold is 95%.
- The device availability goal is 98%.

Intelligent Transportation Systems (ITS); Variable Message Signs (VMS)

The MBTA currently has three different types of electronic message signs in use on the bus rapid transit (BRT), rapid transit, and commuter rail systems. These include: (1) signs that display public-service announcements, (2) signs that alert passengers that trains are approaching and arriving at the station, and (3) signs that count down the number of minutes until the next vehicle arrives at the station.

Bus Rapid Transit VMS

VMS that count down the minutes until the arrival of the next BRT vehicle are placed at 18 of the 22 stops on Silver Line Washington Street. There is one sign at each end of the route—one at Dudley Station and one at Temple Place—and one sign at each of the 16 new stops (8 per direction) on Washington Street. These VMS were installed as a part of the Washington Street reconstruction/Silver Line ITS project and were bound to the project in two key ways. First, as part of

station construction, this project included construction of kiosks along Washington Street that were used to house the signs. Second, Washington Street service has a dedicated fleet that wirelessly relays vehicle location data to a central computer, so that the arrival time can be displayed on the VMS.

Rapid Transit VMS

The MBTA is currently installing 256 VMS at rapid transit stations throughout the system and plans to have these in place by March 2009. Two of the stations that are undergoing renovations, Maverick and Copley, will not have VMS installed through this project, but will have VMS installed as a part of the rehabilitation work. Through the agreement between the MBTA and the Boston Center for Independent Living (BCIL), signs are located at each set of fare gates and on inbound and outbound platforms. The exact locations and quantities of signs were determined through field observations of existing conditions and needs at each station.

Two types of VMS will be in use: those that display next-train information, and those that display only public-service announcements. All Red, Orange, and Blue Line stations are being equipped with electronic message signs that display “next train approaching” and “next train arriving” messages. The information displayed on these signs is triggered through the train’s signal system. Because the Green Line has a different type of signal system than the other rapid transit lines, next-train signs cannot be used at this time on that line. However, VMS that display public-service information will be installed at stations in the Green Line central subway and on the Green Line’s D Branch. Due to the lack of power and communications connections to stations on the B, C, and E Branches of the Green Line, no VMS can be used at those stations in the near term.

Commuter Rail VMS

In the early 1990s, “Passenger Information Centers" (blue boxes approximately 2 by 3 feet in size) that displayed a one-line message were installed at stations on the Framingham/Worcester Line. There was only one message center at each station located on or near the inbound platform. These signs were primitive at best and were essentially large pagers.

In 1997, in conjunction with the opening of the Old Colony’s Middleborough/Kingston Line, “PENTA” LED (light-emitting diode) message boards were installed at all stations on those lines. Although these signs used the current technology of that period, they had limited display capability—only one message at a time could be shown, with no more than 99 characters per message. PENTA signs were also installed at the new stations on the Framingham/Worcester Line west of Framingham, and on the Newburyport/Rockport Line at the new stations in Ipswich, Rowley, and Newburyport.

A project to install new passenger information signs at all commuter rail stations (with the exception of Silver Hill, Plimptonville, and Foxboro) was initiated in 2000. All of the “blue box” passenger information centers were replaced with these newer signs; at least one sign was added on each inbound platform, and, at stations with mini-high platforms, an additional sign was added. The PENTA signs were not replaced, however. The new signs can display multiple messages and have a capacity of up to 1,600 characters. All signs are installed on the inbound platforms in order to serve the greatest number of customers, as they travel inbound during the morning peak period.

Currently a new next train sign project is underway. This $5.3 million project will upgrade all signs and utilize state-of-the-art global-positioning-system (GPS) technology to automatically display next-train arrival information at stations. Additionally, the system will make automatic station announcements onboard the train, consistent with the Americans with Disabilities Act (ADA) requirements. Evidence of the new system will be seen starting in 2009, and full implementation should be completed by the second quarter of 2011.

Elevators and Escalators

The MBTA contracts for the complete maintenance, service testing, and inspection of all transit system and facility elevators and escalators. There are 167 escalators and 153 elevators in operation, for a total of 320 pieces of equipment under this contract. This equipment is maintained by KONE Inc., in accordance with an all-inclusive contract, which is one of the largest conveyance-system contracts ever issued in the Commonwealth of Massachusetts. KONE is currently two-and-a-half years into a new maintenance contract.

New equipment is introduced to the transit system via the Design and Construction Department. Elevators and escalators are included as part of Design and Construction's overall station modernization and improvement program. Over the next five years, approximately 25 pieces of these types of equipment will be added to the transit system.

Elevators and escalators provide a vital access to the system, particularly for persons with disabilities. In 2006 the MBTA formalized a partnership with the Boston Center for Independent Living (BCIL) through a consent agreement that sets operational protocols and standards, as well as a proactive agenda for making the transit system more accessible. The MBTA is working toward the goal of making the system a model for accessibility within the U.S. transit industry. More than $170 million is allocated in the Authority's current Capital Investment Program (almost 5% of the capital budget) for accessibility enhancements including redundant elevator installation, completion of the key station program, elevator/escalator maintenance, and wayfinding improvements. In addition, the MBTA has adopted an organization-wide commitment and desire to comply not only with the letter but also the spirit of the Americans with Disabilities Act, with the complete understanding that all people with disabilities must have every opportunity to be fully participating members of our community and that fundamental to this opportunity is the right and ability to use public transportation in an equal, effective, and dignified manner.

The MBTA has implemented a proactive maintenance program to keep equipment safe and operational. Maintenance specifications are defined to cover all equipment components. The MBTA's Maintenance Control Center (MCC) tracks all elevator and escalator service requests, which are transmitted to the MCC via MBTA personnel and field inspectors. The MCC transmits the service-request information to the elevator/escalator maintenance contractor via a computer terminal, and the contractor then dispatches maintenance personnel to perform repairs. The causes of equipment failures vary, as well as the length of time required to repair them.

Distribution of Station Parking

While the supply of parking is only one element of transit access, it is particularly important in the commuter rail system, where 54% of users drive to stations to access service. Through the Program for Mass Transportation, the MBTA applied evaluation criteria prioritizing capital improvement parking programs. The evaluation standards are:

- Customer access – Quality of auto access to the station parking lot from major arterial roadways
- Land and air rights – MBTA ownership of (or access to) land and/or air rights for expansion of the parking facility
- Projected demand – Magnitude of expected future demand for parking at the station
- Potential utilization – Ability of potential parking expansion to meet the needs of projected demands
- Cost per parking space – Expected cost per parking space, in either a surface lot or garage
- Environmental status – Barriers to parking expansion resulting from existing environmental issues
- Ease of construction – Barriers to parking expansion resulting from issues such as space constraints, land acquisition issues, and challenging terrain

Systemwide Service Policies [FTA C4702.1A, V. 3.a.]

The new circular requires systemwide service policies for vehicle assignment and for transit security. Policies differ from standards in that policies are not necessarily based on a quantitative threshold.

Vehicle Assignment

Vehicle assignment refers to the process by which vehicles are placed in garages and assigned to routes throughout the system. The policies used for vehicle assignment vary by mode and are governed by various operational characteristics and constraints.

Bus Vehicle Assignment

The MBTA's bus fleet consists of 33 electric trackless trolleys; 360 compressed-natural-gas (CNG) vehicles; 32 dual-mode vehicles; 348 emission-control diesel (ECD) vehicles; and 215 older diesel buses. Currently, the procurement program for an additional 155 ECD vehicles has been finalized. These vehicles are currently being delivered, and all of them are expected to be in service by the fall of 2008. Many of the older diesel buses (94 and 95 Series Nova) will be retired as new ECD vehicles become available. The MBTA has acquired over 500 clean-fuel vehicles to provide new service on Silver Line Washington Street bus rapid transit (BRT) routes and to replace the oldest diesel vehicles in the fleet. In accordance with the September 1, 2000, Administrative Consent Order, Number ACO-BO-00-7001, issued by the Commonwealth of Massachusetts, the Department of Environmental Protection (DEP), under the Executive Office of Environmental Affairs (now the Executive Office of Energy and Environmental Affairs), the MBTA will, "Insofar as possible, operate lowest emission buses in the fleet in transit dependent, urban areas with highest usage and ridership as the buses enter the MBTA bus fleet." Table 4-10 provides additional information on the vehicles in the bus fleet.

In general, each bus is assigned to one of nine MBTA bus storage and maintenance facilities and operates only on routes served by the garage to which it is assigned. Daily, within each garage, individual vehicles are not assigned to specific routes, but circulate among routes based on a number of operating constraints and equipment criteria. The following section summarizes the guidelines used by inspectors when assigning vehicles in the current bus fleet to routes.

Table 4-10: Bus Fleet Roster

Propulsion	Active Vehicle	Year Built	Builder	Air Cond.	Accessible	Over-Hauled	Length	Width	Seats	Planning Capacity
Straight Electric	5	1976	Flyer	N	No	Mini - 96, 99	40'	102"	44	61
	28	2003-04	Neoplan	Y	Ramp	None	40'	102"	31	43
Diesel Series 60 500HP (dual-mode)	24	2004-05	Neoplan	Y	Ramp	None	60'	102"	47	65
	8	2005	Neoplan	Y	Ramp	None	60'	102"	38	~65
CNG Cummins C8.3	175	2004	NABI	Y	Ramp	None	40'	102"	39	54
	124	2003	NABI	Y	Ramp	None	40'	102"	39	54
CNG Series 60 400 HP	44	2003	Neoplan	Y	Ramp	None	60'	102"	57	79
CNG Series 50G	15	2001	New Flyer	Y	Ramp	None	40'	102"	39	54
	2	1999	New Flyer	Y	Ramp	None	40'	102"	39	54
Diesel Catepillar C9	193	2004-05	Neoplan	Y	Ramp	None	40'	102"	38	53

(continued)

Table 4-10 *(continued)*

Propulsion	Active Vehicle	Year Built	Builder	Air Cond.	Accessible	Over-Hauled	Length	Width	Seats	Planning Capacity
Diesel Series 50	237	1994-95	TMC/Nova BUS	Y	Lift	2004-05	40'	102"	40	56
Diesel Cummins ISL	155	2006-07	New Flyer	Y	Ramp	None	40'	102"	39	54
Diesel Cummins ISL	On order	2008	New Flyer	Y	Ramp	None	40'	102"	39	54

28 Trackless Trolleys

The trackless trolley fleet currently consists of 28 new vehicles. These vehicles are limited to use on three routes, in Belmont, Cambridge, and Watertown, where overhead catenary lines provide electric power. The vintage 1976 Flyer vehicles will be retired, except for 5 vehicles that are maintained for contingencies.

360 Compressed-Natural-Gas (CNG) Buses

This fleet is composed of 316 40-foot nonarticulated vehicles and 44 60-foot articulated vehicles. Service is currently provided on Route 39 and Silver Line Washington Street with the 60-foot vehicles, all of which are housed at the Southampton facility; 17 of the 44 60-foot vehicles are dedicated to the Silver Line. Most of the 316 40-foot buses are housed at the Arborway and Cabot garages; they provide service on many routes in the urban core. With the exception of the vehicles at Southampton, which currently serve only three routes, inspectors assign these buses daily, on a random basis, within each garage.

563 Diesel Buses

The diesel buses are assigned to the suburban garages, as well as to the Albany Street and Charlestown garages. Of the 348 new ECDs in the fleet, 155 are New Flyer vehicles and 193 are Neoplan vehicles. These ECDs have been divided among the following facilities: Charlestown (162), Lynn (78), Quincy (61), Fellsway (10), Albany (28), and Cabot (9) garages. In addition to 348 new ECD vehicles, a second order, for 155 additional New Flyer ECD vehicles, has been executed. These vehicles are scheduled for delivery in the summer or fall of 2008. Many of the 215 older (94 and 95 Series) Nova vehicles will be retired as new ECD vehicles become available.

Due to their unique markings, the three crosstown bus routes use a dedicated fleet of 20 vehicles, all of which are diesel buses that were built in 1994 or 1995. These routes provide a limited-stop, circumferential service that complements the radial rail system.

32 Diesel-Electric (Dual-Mode) Buses

All of the new 60-foot, articulated dual-mode vehicles are designed for operation on the Waterfront portion of the new Silver Line BRT service between South Station, various locations in South Boston, and Logan Airport.

Light Rail and Heavy Rail Vehicle Assignment

The MBTA operates light rail vehicles on the Ashmont-Mattapan extension of the Red Line—the Mattapan High Speed Line—and on all four branches of the Green Line: B–Boston College; C–Cleveland Circle; D–Riverside; and E–Heath Street.

Type 7 Green Line vehicles can be operated on any Green Line branch. However, all of the Type 8 cars are currently assigned to the B, C, and E branches. Type 8 cars will be introduced on the D Branch pending a review of track conditions on the branch by the Department of Public Utilities.

The Mattapan High Speed Line has weight, curve, and power limitations that prevent the use of current Green Line light rail vehicles. Instead, PCC (President's Conference Committee) cars are

used for that line. All of the PCCs have recently undergone extensive rehabilitation, including the replacement of major structural components. These cars were equipped in 2008, for the first time, with air conditioners. Table 4-11 lists the vehicles in the light rail fleet.

Table 4-11: Light Rail Fleet Roster

Line	Type/Class of Vehicle	Fleet Size	Year Built	Builder	Length	Width	Seats	Planning Capacity
Mattapan High Speed Line	"Wartime" PCC	10	1945-46	Pullman Standard (USA)	46'	100"	40	84
Green Line	Type 7 (1)	94	1986-88	Kinki-Sharyo (Japan)	74'	104"	46	104
Green Line	Type 7 (2)	20	1997	Kinki-Sharyo (Japan)	74'	104"	46	104
Green Line	Type 8	95	1998-2007	Breda (Italy)	74'	104"	44	99

Heavy rail vehicles are operated on the three subway lines: the Red Line, Orange Line, and Blue Line. The specific operating environments of these lines prevents one line's cars from operating on another line; therefore, each line has its own dedicated fleet.

Because there are no branches on the Orange Line or the Blue Line, and there is only one type of Orange Line car and one type of Blue Line car, no distribution guidelines are necessary for either of these lines. The Blue Line is in the process of introducing a new replacement fleet, and for a short time span in 2008 and 2009, both older cars and new cars will be in service on the line. The Red Line has two branches, and operates using three types of cars. There are no set distribution policies for the assignment of Type 1, 2, and 3 cars to the two Red Line branches (Ashmont and Braintree). All three types are put into service on both branches as available. Table 4-12 lists the vehicles that are currently in the heavy rail fleet.

Table 4-12: Heavy Rail Fleet Roster

Line	Type/Class of Vehicle	Fleet Size	Year Built	Builder	Length	Width	Seats	Planning Capacity
Blue Line	No. 4 East Boston	70	1978-80	Hawker-Siddeley (Canada)	48' 10"	111"	42	95
	No. 5 East Boston	94 on order	2007/2008	Siemens	48' 10"	111"	42	95
Orange Line	No. 12 Main Line	120	1979-81	Hawker-Siddeley (Canada)	65' 4"	111"	58	131
Red Line	No. 1 Red Line	74	1969-70	Pullman Standard (USA)	69' 9 3/4"	120"	63	167
	No. 2 Red Line	58	1987-89	UTDC (Canada)	69' 9 3/4"	120"	62	167
	No. 3 Red Line	86	1993-94	Bombardier (USA)	69' 9 3/4"	120"	52	167

Planning and design are underway for the next generation of vehicles for the Red and Orange Lines as well as for accommodation of expanded Green Line service associated with the Commonwealth's commitment to extend the Green Line to Somerville and Medford by December 2014.

Commuter Rail Vehicle Assignment

Vehicle assignments are developed to based on specific standards of commuter rail service. These standards include providing a minimum number of seats for each scheduled trip, providing one functioning toilet car in each trainset, maintaining the correct train length to accommodate infrastructure constraints, and providing modified vehicles, when necessary, for a specific operating environment. The MBTA strives to assign its vehicles as equitably as possible within the equipment and operational constraints of the system.

Railroad Operations operates a 377-route-mile regional rail system in the Boston metropolitan area composed of 13 lines that serve 125 stations. The existing system consists of two separate rail networks: a five-route northern system, which operates north and east from North Station to terminals at Rockport, Newburyport, Haverhill, Lowell, and Fitchburg; and an eight-route southern system, which operates south and west from South Station to terminals at Worcester, Needham, Franklin, Attleboro, Providence, Stoughton, Readville, Middleborough, Kingston, and Plymouth. Trains operate in a push-pull mode, with the locomotive leading (pull mode) when departing Boston and the control car leading when arriving in Boston.

The commuter rail coach fleet is composed of four types of coaches and two types of locomotives, which are assigned to the 13 commuter rail routes. Both coaches and locomotives have a service life of 25 years. Table 4-13 lists the vehicles in the current fleet.

Train consists are assembled based on minimum seating capacity to meet the morning and evening peak-period requirements. Presently the MBTA commuter rail contract operator is contractually required to have 122 coaches in 22 north-side trains and 213 coaches in 33 south-side trains. Most train consists generally are not dedicated to a specific line, but are cycled throughout the system (either north or south). The following vehicle characteristics must also be considered when assigning vehicles:

- **Kawasaki Coaches (bilevel)** – There is no specific policy restricting the use of these vehicles in the commuter rail system. Currently they are used exclusively in the south-side commuter rail system, since it carries approximately 65% of the total boardings of the system. The bilevel coaches offer substantially more seating than the single-level coaches. This allows Railroad Operations to maintain consist seating capacity while minimizing the impacts of platform and layover facility constraints. The MBTA intends to purchase only bilevel coaches in future procurements in order to accommodate increasing ridership demands and to allow for greater flexibility when scheduling vehicle assignments.
- **Messerschmitt-Bolkow-Blohm (MBB) Coaches**– Every train consist has at least one MBB coach equipped with toilet facilities. MBB blind-trailer coaches have also been modified to guarantee priority seating for eight wheelchair spaces on all trains on the Worcester Line commuter rail line in accordance with agreements made at the time of the commuter rail extension to Worcester. There are only 14 trains that are cycled on the Worcester Line daily; however, 33 coaches were modified to provide for greater vehicle assignment flexibility.
- **Old Colony Lines** – The coaches used for service on the Old Colony lines (Middleborough/Lakeville, Kingston/Plymouth, and Greenbush) are equipped with power doors, as all of the stations on these lines have high platforms. This enables a crew member to control the operation of the doors in the consist from any coach via the door control panel. Portions of the Kawasaki, Pullman, and MBB coach fleets have had the power doors activated to meet this requirement.
- **Advanced Civil Speed Enforcement System (ACSES)** – All control coaches and locomotives operating on the Providence Line must be equipped with a functioning ACSES system. ACSES is a Federal Railroad Administration (FRA)–mandated requirement. All locomotives except the GP40 series have ACSES installed and functioning. The GP40 locomotives have ACSES installed but have not yet been qualified to use it. The Bombardier control coaches do not have ACSES installed as of yet, and therefore are limited to the north-side service. There are more locomotives and control coaches equipped with ACSES than are required to meet the daily Attleboro scheduled trips. This provides for greater flexibility in vehicle assignments.
- Every train consist must have a control coach.

All coaches in the commuter rail fleet are equipped with similar amenities, the exception being the MBB coaches, which are equipped with toilets; therefore, the primary variation among coaches is age. For the purpose of periodic monitoring, an assessment of compliance for vehicle assignment will be completed each year based on the average age of a trainset for a specified time period.

Table 4-13: Commuter Rail Fleet Roster

Manufacturer	Fleet Size	Date	Classification*	Rebuilt	Seats
Pullman	57	1978–79	BTC-1C	1995–96	114
MBB	33	1987–88	BTC-3		94
MBB	34	1987–88	CTC-3		96
Bombardier A	40	1987	BTC-1A		127
Bombardier B	54	1989–90	BTC-1B		122
Bombardier C	52	1989– 90	CTC-1B		122
Kawasaki	50	1990–91	BTC-4		185
Kawasaki	25	1990–91	CTC-4		175
Kawasaki	17	1997	BTC-4		182
Kawasaki	15	2001–02	BTC-4		182
Kawasaki	33	2005–07	BTC-4C		180

*BTC = Blind Trailer Coach; CTC = Control Trailer Coach

Modernization of the commuter rail fleet is currently underway through the procurement of 28 locomotives and 75 bilevel coaches that will be delivered in 2012/2013.

Transit Security

This is the first Title VI report in which recipients are required to report on transit security measures that are taken to protect employees and the public against any intentional act or threat of violence or personal harm, either from criminal activities or terrorist acts. The following section summarizes the security measures for which the MBTA has developed and implemented policies.

Placement of Callboxes at Stations

The locations for placement of callboxes at MBTA stations are selected as part of the Crime Prevention Through Environmental Design (CPTED) program, which is governed by the following MBTA guidelines:

> "Crime Prevention Through Environmental Design (CPTED) is the proper design and effective use of the built environment which may lead to a reduction in the fear and incidence of crime, and an improvement of the quality of life."
>
> – National Crime Prevention Institute

> CPTED theories contend that law enforcement officers, architects, transit and city planners, landscape and interior designers and resident volunteers can create a climate of safety in a community, right from the start. CPTED's goal is to prevent crime through designing a physical environment that positively influences human behavior – people who use the area regularly perceive it as safe, and would-be criminals see the area as a highly risky place to commit crime.

> CPTED studies ways to design physical spaces to reduce undesired behavior and crime. It can be used when developing new areas, reviewing plans, or revising existing space. CPTED is helpful with large projects such as multi-unit housing, transit systems, parks, business centers and shopping centers, as well as single family homes and offices.

The Four Strategies of CPTED

1. **Natural Surveillance** - A design concept directed primarily at keeping intruders easily observable. This can be promoted by features that maximize visibility of people, parking areas and building entrances: doors and windows that look out on to streets and parking areas; pedestrian-friendly sidewalks and streets; front porches; adequate nighttime lighting.

2. **Territorial Reinforcement** - Physical design can create or extend a sphere of influence. Users then develop a sense of territorial control while potential offenders, perceiving this control, are discouraged. This can be promoted by features that define property lines and distinguish private spaces from public spaces using landscape plantings, pavement designs, gateway treatments, and "CPTED" fences.

3. **Natural Access Control** - A design concept directed primarily at decreasing crime opportunity by denying access to crime targets and creating in offenders a perception of risk. This can be gained by designing streets, sidewalks, building entrances and neighbor hood gateways to clearly indicate public routes and discouraging access to private areas with structural elements.

4. **Target Hardening** - Accomplished by features that prohibit entry or access, such as window locks, dead bolts for doors, interior door hinges.

An example of CPTED:

Loitering is not a very common occurrence in Boston, but when it is reported in or around the Massachusetts Bay Transportation Authority's (MBTA) major transportation centers, the MBTA and the MBTA Transit Police address the issue quickly. The MBTA Transit Police Department provides security and law enforcement for the entire MBTA system and works closely with the MBTA in using CPTED methods. An example of this can be seen in making physical changes to bus stops and benches to deter loitering. By adding seat dividers, each individual seated at a bus stop bench have a clear defined area that temporarily belongs to them, while at the same time the seat dividers deter individuals from taking over an entire bench by sprawling their body across as if to use the bench as a bed. Most implementations of CPTED occur solely within the "built environment" to dissuade offenders from loitering. These tactics have been proven to dissuade those who loiter in and around transportation centers.

Transit Facility Safety and Security Review

The concept of Crime Prevention through Environmental Design (CPTED) has evolved as a means to reduce the opportunities for crimes to occur. This is accomplished by employing physical design features that discourage crime, while at the same time encouraging legitimate use of the environment. CPTED design considerations, which have been employed in recent years by transit agencies in the design of safer public facilities, such as transit stations and bus stops, can be used to secure and harden elements of an agency's infrastructure from hazards and threats. Major elements of the CPTED concept are defensible space, territoriality, surveillance, lighting, landscaping, and physical security planning. These facilities include transit stops, transit stations and vehicle storage yards.

- **Access Management**
  Controlling who (or what) may access restricted areas and assets in the system plays an important role in protecting transit infrastructure from all of the major threats identified in this section. A core principle of access management is that

valuable assets are protected behind multiple "layers" of secure spaces, with security measures becoming more stringent for deeper layers. Access control may focus on discerning between employees and visitors, on maintaining locks, on screening for weapons, or on barring unauthorized vehicle entry to a transit property. Access management techniques may include procedures and policies, physical barriers, identification and credentialing technology, security personnel, communications systems, surveillance, and intrusion-detection systems.

- **Surveillance**
  Surveillance can include closed-circuit televisions, security personnel, or vigilant bus operators/drivers or station clerks, who are often the first line in security defense. The presence of agency staff can deter an attack. The presence of surveillance equipment acts as a deterrent not only because an area is being watched remotely, but also because activities are recorded and intruders are aware of the possibility of detection and capture. Surveillance is also useful in warding off attacks upon remote, unmanned infrastructure, such as communications towers and power substations. Transit agencies should consider what combination of equipment and personnel are needed to achieve optimal security coverage. Placement should be based on the volume of human and vehicular traffic, the layout of the watched or guarded asset, as well as the location of any blind spots resulting from overlapping or peripheral areas.

- **Facility Inspection**
  Safety and security reviews should also include inspection of all facilities with special attention directed to:
  - Hazardous material storage, security and record-keeping
  - Fuel storage and servicing
  - Personnel safety equipment (e.g. automatic defibrillators, eye wash stations, first aid and blood borne pathogen kits)
  - Fire prevention (e.g., fire extinguishers, alarms, sprinklers)
  - Maintenance infrastructure (e.g., pits, lifts, electrical feeds, no-walk areas, parts storage)
  - Lighting
  - Entrances, exits, intrusion detection, CCTV
  - Communication equipment
  - Sensitive employee and customer information
  - High-risk facilities and activities near transit facilities and operations
  - Emergency supply cabinet or shed (food, water, medical, generator)
  - Perimeter fencing, physical barriers, barricades
  - Utility mains/shutoffs
  - Traffic calming

Placement of Surveillance Cameras on Buses

In 2006, the MBTA began placing cameras on some buses for surveillance and crime-prevention purposes. All buses that have been purchased since then are equipped with cameras, and all buses in future procurements will have cameras.

Security Inspection Program

In response to the terrorist attacks of September 11, 2001, in the United States, and subsequent terrorist attacks in other countries, the MBTA Transit Police developed a station inspection program through which searches of passengers' handbags, briefcases, and other carry-on items can be implemented. The purpose of this program is to deter passengers from carrying explosives or

other weapons onto MBTA vehicles; and the Transit Police are currently scheduling random inspections throughout the system. The full text of the policy, which is spelled out in General Order No. 2006-12, Chapter 152, of the MBTA Transit Police department manual, can be found in Appendix B of this report. Some of the provisions dictated by this policy include the requirement that supervisors record the race and gender of passengers who are inspected to assure that there is no actual or perceived bias-based profiling. In addition, the Police Department must translate information regarding inspections into multiple languages, and will use the Department's contracted "Language Line" interpreter service when inspecting a non-English-speaking passenger.


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Chapter 5

Service and Fare Changes

Requirement to Evaluate Service Changes [FTA C4702.1A, IV. 4.a.(1)]

Service Changes Since 2005

The MBTA's Service Delivery Policy, as revised in 2006, defines major service changes as ones that will have a significant effect on riders, resource requirements, route structure, or service delivery, including:

- Major service restructuring
- Implementation of new routes or services
- Elimination of a route or service
- Elimination of part of a route
- Span of service changes greater than one hour

With the exception of new services associated with a major capital investment, major service changes are generally evaluated and implemented through development of the Biennial Service Plan. As a part of the service-planning process, the MBTA has incorporated the Title VI Level of Service analysis for vehicle load, vehicle headway, and on-time performance into the evaluation of the changes proposed in each preliminary and final service plan. The Quality of Service analysis is performed before the final service recommendations are implemented to ensure that, overall, the service changes do not disadvantage minority and low-income populations.

Since the 2005 Title VI report was completed, the MBTA has implemented the following major service changes:

Fall 2005: The Night Owl pilot program was discontinued due to high costs and low ridership.

Spring 2006: Bus Route 245 was changed to serve the Quarry Street apartment buildings in Quincy, adding six minutes to the trip times. In addition, one hour of service was added at the end of the day on Saturdays.

Winter 2007:

- Service on Route 60 was extended into Chestnut Hill Mall.
- The Saturday span of service on Routes 40 and 50 was extended two hours by eliminating the last two Route 40 trips and the last two Route 50 trips, and replacing them with four 40/50 loop trips.
- Service on Route 5 was extended to JFK/UMass Station in the outbound direction.
- Fall 2007: Sunday Service was added on Route 90.
- The Greenbush commuter rail line was opened for service.

Requirement to Evaluate Fare Changes [FTA C4702.1A, IV. 4.a.(1)]

Evaluation of Proposed 2007 Fare Increase

In 2007, the MBTA restructured its fares to simplify them and to take advantage of new flexibilities offered by the new fare-vending technology that became operational in the same time frame. Also at that time, the MBTA raised its fares to help close a budget gap. As a part of the analysis for the proposed fare restructuring and increase, the Central Transportation Planning Staff (CTPS) of the Boston Region Metropolitan Planning Organization (MPO) looked at the effects these changes would have on transit users in environmental- justice communities. The following text is from *Technical Report: Impact Analysis of a Potential MBTA Fare Increase and Restructuring in 2007*.

ENVIRONMENTAL JUSTICE IMPACTS

Definition of Environmental Justice Neighborhoods

To assess the impacts of the potential 2007 fare increase and restructuring on minority and low-income communities, an environmental justice impacts analysis was undertaken. Environmental justice neighborhoods were identified based on a methodology developed from Federal Transit Administration guidance to the MBTA's ongoing Title VI program and past practice of the Boston Region MPO. First, the income levels and percentages of minority populations in all traffic analysis zones (TAZs) in the region were identified. Low-income TAZs were then defined as areas with income levels at or below 75% of the MBTA service area median household income ($41,850). Minority TAZs are those in which the non-white or Hispanic population is greater than the average for the MBTA service area (approximately 20%). Any TAZ which qualifies as either minority or low-income is considered an environmental justice community.

Equity Determination of Proposed Fares

After identifying the minority and low-income communities, the equity of the system's fare structure and levels was assessed, in terms of both the existing and proposed conditions, using the Boston Region MPO's regional travel demand model. Under the current fare structure, the average fare for low-income TAZs is estimated to be $1.15, which is $0.04 below the systemwide average[1] of $1.19. The estimated average fare for minority TAZs is lower, at $1.11. Under the proposed fare increase and restructuring, the average fares for low-income and minority TAZs are estimated to be $1.43 and $1.38, respectively, while the systemwide average is estimated to be $1.46. Table 11 compares these average fare values and Table 12 [called Table 5-1 in this report] compares the monetary increases associated with each category.

[1] "Systemwide" refers to the entire modeled area of the regional travel-demand model, which encompasses the entire bus, rapid transit, and commuter rail networks.

Table 5-1: Existing and Proposed Average Fares for Environmental Justice TAZs

	Existing Average Fare	Proposed Average Fare
Low-income TAZs	$1.15	$1.43
Minority TAZs	1.11	1.38
Systemwide Average	1.19	1.46

Table 11 [called Table 5-2 in this report) indicates that the proposed fare structure and fare levels, as well as the current structure and prices, do not place a disproportionate burden on environmental justice communities. Indeed, low-income and minority TAZs pay lower average fares than the systemwide average. In moving from the existing to the proposed fare structure, as shown by Table 12, the difference between the monetary increase in average fares paid by low-income and minority TAZs and the systemwide average is less than $0.012. Since these differences are approximately equal for each of the three categories shown in Table 12, the proposed fare structure maintains lower fares on average for environmental justice communities. Note that pass users typically pay lower average fares than customers who pay for one ride at a time. This benefits the MBTA's most committed ridership and those who are transit-dependent.

Table 5-2: Projected Absolute Changes in Fares for Low-Income and Minority TAZs

	$ Change in Fare
Low-income TAZs	+ $0.281
Minority TAZs	+ 0.273
Systemwide Average	+ 0.269

Comparative Percentage Changes in Average Fare

While the proposed fare structure clearly does not place a disproportionate burden on environmental justice communities, as described above, one may note that when the absolute price changes shown in Table 12 are converted to percentage changes, minority and low-income neighborhoods appear to experience slightly higher impacts than the system as a whole. The systemwide increase in revenue per trip projected by the travel demand model equals 22.5%, while the percentage change estimated for low-income TAZs is 24.4% and for minority TAZs is 24.7%. However, these differences should be understood with two qualifications.

First, since the existing average fare for environmental justice communities is lower than the systemwide average, the nearly equal absolute price increases shown in Table 12 will affect these environmental justice communities relatively more on a percentage basis. Second, even though the regional travel demand model has no defined margin of error, it is reasonable to assume that such differences, or at least part of such differences, may lie within the inevitable error of a model trying to predict human behavior. This margin of error applies as much to the average fare values shown in Tables 11 and 12 as to the differences in the percentage changes.

In an effort to better understand the cause of this difference in percentage changes, several attempts were made to reduce or eliminate them by modeling variations on the proposed fare structure. None of these attempts was entirely successful, either alone or in combination, at eliminating them; however, each did have the effect of lowering the absolute changes in average fares for environmental justice communities, and therefore, the percentage changes as well. Reducing rapid transit prices from the original proposal, for example, did reduce the percentage differences slightly. This is because there is a greater proportion of environmental justice TAZs than systemwide TAZs within a one-mile radius of rapid transit stations. Thus any decrease in rapid transit prices will affect environmental justice communities relatively more than the system, thereby reducing, but not eliminating, the difference between their estimated percentage change in average fare and that of the system as a whole.

The inability of price adjustments to totally eliminate the modeled differences in percentage increases suggests that the proposed structural changes to fare payment categories, irrespective of any price increases, may be contributing factors. It should be noted that several aspects of the proposed fare structure were incorporated to promote equity upon recommendations of the MBTA Rider Oversight Committee. These new features actually appear to result in relatively higher percentage price changes for environmental justice communities, according to the model. The step-up transfer, for example, was intended by the Rider Oversight Committee to eliminate the perceived penalty faced by riders who live beyond a reasonable walking distance to rapid transit and must therefore transfer between bus and rapid transit. Under the current fare structure, these residents pay a bus fare plus a rapid transit fare, for a total of $2.15, when transferring. The step-up transfer will lower the cost of this trip to $1.70, undoubtedly benefiting many transit-dependent low-income and minority residents, especially those in sections of Dorchester (such as the Grove Hall and Four Corners neighborhoods) and all of the City of Chelsea, who tend to transfer between bus and rapid transit.

However, the regional travel demand model projections suggest that this transfer privilege would actually benefit non-low income and non-minority communities more (since a greater proportion of non-environmental justice TAZs lie outside the radius of rapid transit stations that is considered to be a reasonable walking distance by the model). In addition, the elimination of premium fare zones on the rapid transit system in Newton, Quincy, and Braintree was intended by the Rider Oversight Committee to simplify the fare structure and make it easier to understand. However, the model projects that this simplification would provide greater benefits to residents of non-low income and non-minority TAZs, thus lowering the systemwide average percentage increase in comparison to that of environmental justice TAZs.

While these efforts to explore various adjustments to the proposed fare structure are instructive, no changes are ultimately necessary in the context of environmental justice or Title VI considerations. First, the results shown above in Tables 11 and 12 clearly indicate that environmental justice communities will continue to pay average fares that are less than the systemwide average, even after the implementation of the proposed fare increase and restructuring. Second, each of the potential adjustments suggested above is inconsistent with the intent of the proposed structural changes to create a simpler and fairer pricing system. In particular, the proposed step-up transfer responds to the legal mandate included in the MBTA enabling legislation to provide free or substantially reduced transfers between bus and rapid transit. This was a key component of the MBTA's discussions regarding the fare structure with the Rider Oversight Committee, whose participation and recommendations consistently emphasized a concern for equity--Per those recommendations, a single fare of $1.70 will now allow one to travel from one end of the core network to the other on any combination of bus or rapid transit routes: one trip equals one fare.



Chapter 6

Service Monitoring

Requirement to Monitor Transit Service [FTA C4702.1A, V.5.]

The revised FTA Circular 4702.1A requires that, to comply with Title VI, recipients must undertake periodic service-monitoring activities to compare the level and quality of service provided to predominantly minority and low-income areas with service provided in other areas. Although the circular requires that monitoring be conducted every three years at a minimum, the MBTA conducts annual monitoring to ensure that potential problems are found and rectified in a timely fashion. The following two tables present the framework for the MBTA's Title VI monitoring procedures. The subsequent text reports the findings of the most recent Title VI data collection and analysis.

Table 6-1: MBTA Title VI Level-of-Service Monitoring

Service Indicator	Department(s) Responsible	Planned Frequency of Compliance Assessments
1. Vehicle Load, Vehicle Headway, and On-Time Performance		
• Bus	Service Planning	Every 2 years
• Heavy Rail & Light Rail	Subway Operations & Service Planning	Every 2 years
• Commuter Rail	Railroad Operations	Every 2 years
• Data Collection - Bus	CTPS	Ongoing
2. Transit Access		
• All Modes	Service Planning	Every 2 years
3. Distribution of Transit Amenities		
• Bus shelters, benches, timetables, and route maps	Operations and Services Development	Annually
• Neighborhood maps	Operations and Services Development	Annually
• Trash receptacles	Operations and Services Development	Annually
• AFC fare gates & fare vending machines	AFC	Annually
• Variable message signs	Subway, Silver Line, & Railroad Operations	Every 3 years
• Station elevator & escalator location & operability	Operations Support	Annually
• Station parking & utilization	Long-Range Planning	Annually

(continued)

Table 6-1 *(continued)*

Service Indicator	Department(s) Responsible	Planned Frequency of Compliance Assessments
4. Vehicle Assignment		
• Bus	Bus Operations	Annually
• Heavy Rail & Light Rail	Subway Operations	Annually
• Commuter Rail	Railroad Operations	Annually
5. Transit Security		
• Callboxes	Transit Police	Every 3 years
• Surveillance cameras	Bus Operations & Transit Police	Every 3 years
• Passenger inspections	Transit Police	Annually

Table 6-2: MBTA Title VI Quality-of-Service Monitoring

Travel Pattern Analysis	Department Responsible	Planned Frequency of Compliance Assessments
All modes	Service Planning	Every 2 years

Option A: Level-of-Service Monitoring

For the Level-of-Service monitoring of MBTA services, all bus routes, rapid transit lines, and commuter rail lines must be designated as minority or nonminority and as low-income or non-low-income. In the previous circular (FTA C4702.1), a route was defined as minority if it had one-third of its route miles in minority census tracts. Using this definition, some express bus routes and commuter rail lines were designated as minority, even though they did not stop in the minority census tracts through which they passed. Therefore, the MBTA developed an alternative way of defining minority routes for these services: routes were designated as minority if one-third of the stops/stations were in minority census tracts.

Because the new circular does not specify exactly how routes should be defined as minority and low-income, CTPS explored methods that would avoid the problems encountered when using route miles. The method selected is based on the percentage of boardings on a route that occur at stops/stations in minority and low-income census tracts. CTPS evaluated different ridership thresholds in several ways, including mapping the routes, comparing the new definitions with the route-mile definitions, relying on a good working knowledge of the system, and applying professional judgment to determine a new threshold. Using this new definition, for the purposes of this report, all bus routes, rapid transit lines, and commuter rail lines are defined as minority or low-income if 40% of boardings occur in minority or low-income census tracts. Appendix C lists all bus, rapid transit, and commuter rail lines and indicates their minority and low-income status.

Vehicle Load, Vehicle Headway, and On-Time Performance

Bus and Trackless Trolley

Through its regular service-planning process, the MBTA Service Planning Department evaluates the performance of all bus routes in relation to the Authority's *Service Delivery Policy*, which includes service standards for vehicle load, vehicle headway (frequency of service), and on-time performance (schedule adherence). In keeping with the *Service Delivery Policy*, minor service

changes are made routinely in response to changes in service demand, whereas major changes can only be made through a Service Plan. Every two years, all bus routes (with the exception of those that were subject to major restructuring in the previous Service Plan) are evaluated through a comparative analysis for all of the service standards in the *Service Delivery Policy*. Based on this analysis, proposed changes to existing services, as well as suggestions for new services, are compiled into a Preliminary Service Plan. The goals of the Service Plan are to bring all routes into compliance with the service standards to meet changing demands for transit services. The draft plan is presented to the public in a variety of ways, including public meetings and hearings. Based on public input, additional service changes may be made before the final recommendations are compiled, approved, and implemented.

The following table shows the vehicle load and frequency of service performance that would result from the changes that are proposed in the *Preliminary 2008 Service Plan*. Because all low-income routes are also minority routes, a separate analysis for routes that are both minority and low-income is not necessary.

Table 6-3: Bus—Vehicle Load and Frequency of Service

	Vehicle Load: % of Routes Passing the Standard			Frequency of Service: % of Routes Passing the Standard		
	Weekday	**Saturday**	**Sunday**	**Weekday**	**Saturday**	**Sunday**
Minority	88.1%	91.2%	91.8%	81.0%	91.2%	78.7%
Nonminority	95.4%	95.0%	94.7%	62.1%	81.7%	73.7%
Low-income	92.9%	86.4%	80.0%	78.6%	95.5%	75.0%
Non-low-income	91.6%	94.3%	96.2%	69.9%	84.9%	77.2%
Systemwide	91.8%	93.0%	92.9%	71.3%	86.7%	76.8%

As can be seen in Table 6-3, on weekdays, Saturdays, and Sundays, the percentage of minority routes that pass the vehicle load standard is lower than the percentage of nonminority routes passing the standard. In addition, the percentage of low-income routes that pass the vehicle load standard is lower than for non-low-income routes on Saturdays and Sundays. For frequency of service, the percentage of routes that pass the standard is higher for minority routes than for nonminority routes on all days of the week, and the percentage of low-income routes that pass the standard is higher than the percentage of non-low-income routes that pass on weekdays and Saturdays.

Historically, schedule adherence data were collected through direct observations. Due to the size of the MBTA bus system, data for each route were collected on only one composite day every two or more years. The ongoing installation of a CAD/AVL system on buses allows the MBTA to collect data for each route on a daily basis at multiple timepoints. The Service Planning Department has been using this increased volume of data to refine current public timetables that better reflect actual running times along an entire route to improve the printed schedules used by customers.

The current schedule-adherence standard was written in anticipation of the CAD/AVL rollout. However, as the Service Planning Department has begun to apply the existing standard using the new data, it has become apparent that the schedule-adherence standard needs more refinement to be used to evaluate the performance of a bus route over its entire length as well as to compare the performance of each bus route with all others. Therefore, a modification of the schedule-adherence standard has been proposed that would be based on the proportion of monitored timepoints at which the bus is on time for all scheduled trips over the effective period of a set of timetables. The schedule-adherence results reported in the *Preliminary 2008 Service Plan* use

this revised methodology and are based on data collected over the entire fall 2007 period. Using this new technique, a bus route is considered to meet the schedule-adherence standard if 75% of all measured timepoints are on time.

The following table reports the schedule-adherence performance of all routes evaluated in the *Preliminary 2008 Service Plan*, showing the percentage of timepoints at which buses were on time. Because these percentages could not be predicted based on the service improvements proposed in the *Preliminary 2008 Service Plan*, the numbers reported below represent the current schedule adherence. Because all low-income routes are also minority routes, a separate analysis for routes that are both minority and low-income is not necessary.

Table 6-4: Bus – On-Time Performance

	Schedule Adherence: % of Timepoints at Which Routes Are On Time		
	Weekday	**Saturday**	**Sunday**
Minority	60.0%	63.4%	65.3%
Nonminority	59.4%	60.6%	63.1%
Low-income	59.5%	60.9%	63.7%
Non-low-income	59.7%	62.3%	64.7%
Systemwide	59.7%	62.1%	64.5%

As can be seen in Table 6-4, on weekdays, Saturdays, and Sundays, minority routes outperform nonminority routes, and the performance of low-income routes is slightly lower than non-low-income routes. However, ongoing adjustments to the public timetables based on the new CAD/AVL data should improve the schedule adherence on all routes. In addition, increases in service frequency that are proposed in the Service Plan to reduce crowding can also be expected to improve schedule adherence.

Heavy and Light Rail: Vehicle Load, Headway, and Schedule Adherence

For the purposes of Title VI, the MBTA's three heavy rail lines (Red Line, Blue Line, and Orange Line) are considered minority and non-low-income; therefore, comparative monitoring of minority vs. nonminority and of low-income vs. non-low-income service performance is not necessary.

However, the light rail system, which includes the four branches of the Green Line, and the Mattapan High Speed Line, shows variability in the minority and low-income status, with the Green Line B and E Branches being classified as both minority and low-income, and the C and D Branches being classified as neither minority nor low-income. The Green Line central subway and the Mattapan Line are minority, but are not low-income.

Table 6-5: Heavy and Light Rail – Minority and Low-Income Status

Line	Branch	Minority	Low-Income	Both
Light Rail				
Green	B	Y	Y	Y
	C	N	N	N
	D	N	N	N
	E	Y	Y	Y
Mattapan (Red)		Y	N	N
Heavy Rail				
Red		Y	N	N
Blue		Y	N	N
Orange		Y	N	N

To monitor the light rail system, Green Line trains were observed inbound at Copley Station between 6:00 AM and 9:00 PM on July 2, 2008, and outbound at Arlington Station between 6:00 AM and 9:00 PM on July 1, 2008. The Mattapan High Speed Line was observed inbound and outbound at Ashmont Station on July 8, 2008.

Vehicle load standards for light rail, as defined in the *Service Delivery Policy*, allow for loads equal to 225% of the seated capacity in the Early AM, AM Peak, Midday School, and PM Peak periods. During all other time periods (Midday Base, Evening, Late Evening, Night/Sunrise, and Weekends), loads in the core area should not exceed 140% of seated capacity.

Using a five-point rating system, with "1" equal to an empty train and "5" equal to full crush load, the average observed load for all Green Line branches and the Mattapan High Speed Line during the peak periods of both days combined was 2.8. During the off-peak period, the average load was 2.5.

Table 6-6 shows that, for minority branches, the average peak load was 2.8, and for low-income branches the average peak-load was 3.17, while for all branches it was 2.9. The average off-peak load for minority branches was 2.4, and the average off-peak load for low-income branches was 2.61, while the average load for all branches was 2.4. Since the 225% load factor allowed during peak periods equates roughly to an observed load rating of 4, and the 140% load factor allowed during the off-peak period equates roughly to an observed load rating of 3, none of the branches— neither the minority, the low-income, the nonminority, nor the non-low-income branches— exhibits violations of the vehicle load standard.

With respect to scheduled headways, almost all light-rail service meets the MBTA service standards for frequency of service. Those standards are headways of 10-minutes or less in the peak, and 15-minutes or less at all other times. The only light-rail service that does not meet the frequency standards is the Mattapan High Speed Line, a minority route. This route operates every 30 minutes on Sunday mornings before 10:00 AM, but is in compliance at all other times.

Light-rail-surface schedule adherence policies call for 85% of all trips to operate at intervals less than or equal to 1.5 times the scheduled headway. All individual Green Line branches and the Mattapan Line met the schedule-adherence policy based on observations from automatic-vehicle identification systems.

Table 6-6: Light Rail Vehicle Load

	Average Vehicle Load*	
Line Classification	**Peak Periods**	**Off-Peak Periods**
Minority	2.80	2.36
Nonminority	3.02	2.37
Low-income	3.17	2.61
Non-low-income	2.70	2.16
Total	2.90	2.36

** Numbers shown are based on observations that use a rating scale of 1 to 5, where 1 equals an empty train and 5 equals full crush load.*

Commuter Rail: Vehicle Load, Vehicle Headway, and Schedule Adherence

As a part of its ongoing planning process, every six months Railroad Operations evaluates the performance of commuter rail services against the MBTA's standards for vehicle load, vehicle headway, and schedule adherence. Through contractual agreement, the commuter rail operating contractor, Massachusetts Bay Commuter Railroad Company (MBCR), provides the data used for this analysis. Based on the analysis, minor schedule changes are implemented to improve service in areas with a demonstrated need. Minor changes may also result from passenger suggestions forwarded to the "Write to the Top" campaign, and can be accomplished by, but are not limited to one or more of the following: (1) adjusting schedule times, (2) increasing service with additional trips (e.g., express service), and (3) redistribution of equipment. Major service changes, such as service expansion or line extensions, require approval by the MBTA Board of Directors and capital funding prior to implementation.

For the purposes of Title VI monitoring, Railroad Operations completes compliance assessments for vehicle load, vehicle headway, and on-time performance (OTP) twice a year, before implementing the schedule changes that are made as a part of the regular planning process. If the assessment of the proposed changes demonstrates that service on minority routes does not comply with Title VI requirements, Railroad Operations develops, within the operating constraints of commuter rail, a solution that minimizes or eliminates Title VI noncompliance before changes are implemented. These biennial assessments are utilized once every two years for the periodic Level of Service and Quality of Service compliance assessments.

Vehicle Load

The purpose of this assessment was to determine if the service provided for both minority and nonminority users is consistent with our stated objectives. For the purpose of monitoring Title VI compliance, Railroad Operations performed an assessment for vehicle load, schedule adherence, and vehicle assignment.

The MBTA commuter rail loading standard during peak periods, as indicated in the *Service Delivery Policy*, is 110% of the seating capacity. This standard was increased in December 2002, from 100%, for improved equity in the stated guidelines of the MBTA.

MBCR utilizes an electronic rail operations management system to provide consist information and ridership details, and to monitor performance. Passenger counts are reported by the train crews for each trip and input into the system along with consist information. This information is independently verified twice annually, as required by the Operating contract. This independent audit of passenger counts is generally considered more accurate and was used for this report. This information was summarized to develop vehicle-load percentages for each peak-period train.

The AM and PM peak-period information was collected for the purpose of this analysis. Table 6-7 shows the ratios of passengers to seats on all commuter rail lines. The commuter rail Load Standard allows up to 110% of a seated load during peak hours and assumes that all passengers will have a seat during off-peak. All of the minority and nonminority routes pass the Load Standard. None of the commuter rail lines is classified as low-income.

Vehicle Headway

All of the commuter rail lines pass the MBTA's Frequency of Service Standard during peak and off-peak periods on weekdays. However, only three of the nonminority pass on Saturdays, and neither of the minority routes pass on Saturday (the Fairmount Line does not have Saturday service). All of the lines that fail the standard on Saturday do so because the first trip in the morning does not arrive by 8:00 AM. The MBTA commuter rail department will evaluate ways in which to ensure that all routes pass the standard on Saturdays.

Table 6-7: Commuter Rail – Vehicle Load Percentage, Spring 2008

		Ratio of Passengers to Seats	
Status	**Line**	**AM Peak**	**PM Peak**
Minority	Fairmount	11%	10%
	Middleborough	71%	70%
Nonminority	Rockport	91%	68%
	Newburyport	72%	70%
	Haverhill	68%	65%
	Lowell	64%	79%
	Fitchburg	70%	56%
	Worcester	71%	76%
	Needham	71%	63%
	Franklin	59%	83%
	Attleboro	80%	92%
	Kingston	71%	86%
	Stoughton	77%	50%
	Greenbush	52%	46%

Schedule Adherence

The MBTA's *Service Delivery Policy* sets a schedule-adherence standard of 95% for all trains arriving at their final terminals within 5 minutes of scheduled arrival times. The Commuter Rail Operating Agreement specifies bench marks for different on-time performance, and subjects the contract operator to a penalty for any train that arrives at its final terminal more than 4 minutes and 59 seconds late when the OTP for the line on which that train operated is less than 95.00% for that day.

MBCR collects and records the OTP data of all revenue trains on a daily basis and maintains it in the rail operations management system. Reports are generated that provide statistics on trains scheduled, trains operating on time, and OTP each day. Because this information is readily available, the data for the 12-month period for state fiscal year 2008 ending June 30, 2008, were reviewed.

As indicated in Table 6-8 below, there were no routes that met or exceeded the schedule-adherence standard of 95% for that period.

Table 6-8: Commuter Rail – Schedule Adherence, July 2007–June 2008

Status	Line	Percentage of Trips that Pass the Schedule Adherence Standard
Minority	Fairmount	67%
	Middleborough	83%
Nonminority	Rockport	81%
	Newburyport	84%
	Haverhill	79%
	Lowell	91%
	Fitchburg	80%
	Worcester	72%
	Needham	76%
	Franklin	65%
	Attleboro	76%
	Kingston	88%
	Stoughton	75%
	Total system	79%

The commuter rail system has been negatively affected by a number of factors that caused lower-than-usual on-time performance systemwide. These factors include, but are not limited to:

- Operational restrictions over several bridges, including the Merrimack River bridge in Haverhill, the Route 62 bridge in Concord, and the Massachusetts Avenue and Columbia Road bridges on the Fairmount Line
- Numerous failures of the Beverly drawbridge during peak periods due to damage caused by a private barge's having struck the draw span
- Random power surges from National Grid power lines in the Lawrence-to-Haverhill area as well as the Revere and Lynn areas, causing numerous service disruptions
- Delays on one commuter rail line that can have a residual negative impact on one or more other lines, as the most efficient use of trains requires that they be used on multiple lines throughout the day

- A number of CSX track maintenance projects resulting in poor performance on the Worcester Line for a number of months
- The opening of the Greenbush Line which, while very successful, required significant process changes and coordination between Amtrak and the MBCR maintenance facility at Southampton Street Yard
- Additional traffic between Boston's South Station and the midday maintenance/layover facility in Readville Yard on the Fairmount Line
- The ongoing three-plus-year revitalization project on the Fairmount Line, which has significantly contributed to delays on all lines on the south side, most notably in the evening peak period
- A lengthy track tie replacement project on the Franklin Line that lasted over two months and impacted all south-side lines

To resolve some of the commuter rail OTP problems in the near term, a number of significant changes were made to the schedules in April. These helped dramatically on the Greenbush and other Old Colony lines, but proved less effective on other lines, including the Fairmount Line. However, the solutions to some of the problems can only be mitigated over time. The Fairmount Line project, the Merrimack River Bridge project, the Medford Hillside drainage project, and others will continue for at least two more years. The Fairmount project, which will improve service capacity and reliability, includes major bridge reconstruction and signal system upgrades, as well as four new stations that will increase access to transit in minority neighborhoods. The MBTA is investigating the possibility of adding service on the Fairmount Line that could be introduced when the infrastructure work is complete in 2011. This could include weekend service and more frequent weekday service.

To ensure that the current public timetables accurately reflect the service as it is provided, Railroad Operations, working closely with MBCR, will make changes to all commuter rail schedules in October 2008. These schedule changes will include, where and when necessary, temporary alternate transportation to lessen the impact of scheduled construction projects, such as the Fairmount, Merrimack River, and Medford Hillside projects.

Service Availability (Coverage)

To meet the MBTA's Transit Coverage guideline, in service areas with residential densities greater than 5,000 people per square mile, transit service—of any mode—should be accessible within one-quarter mile. The analysis for this report was completed by measuring one-quarter mile via the street network (rather than "as the crow flies") to realistically assess the distance that an individual might have to walk to access transit service at a bus stop or rail stop/station.

As can be seen in Table 6-9 below, for high-density census tracts within the Bus/Rapid Transit Service area, 86% of street-miles in minority areas meet the Transit Coverage guideline; however, only 74% of street miles in nonminority areas meet the coverage guideline. Likewise, 89% of street miles in low-income areas meet the coverage guideline, while only 78% of street-miles in non-low-income areas meet the guideline, and 90% of areas that are both minority and low-income meet the guideline, as compared to 74% of areas that are neither minority nor low-income.

Lack of transit coverage in high-density MBTA service areas is generally due to operational constraints imposed by street configurations or other physical barriers. Although some high-density nonminority census tracts, such as all of Winthrop and part of Medford, as well as one minority census tract in Milton, appear on the map (Figure 6-1) not to have access to local transit services, these areas are provided with coverage through private contract carriers that are subsidized by the MBTA. Because these routes are not coded in the analysis, the coverage numbers in Table 6-8 appear slightly lower than they should.

Table 6-9: Transit Coverage within the Bus and Rapid Transit Service Area

Areas with >5,000 people/ square mile	Total Street Miles	Bus Market		Subway Market		Bus + Subway Market		Comm. Rail Market		Market – All Modes	
		Street Miles	% of Total	Street Miles	% of Total	Street Miles	% of Total	Street Miles	% of Total	Street Miles	% of Total
Minority	1,351	1,165	86%	193	14%	1,177	87%	82	6%	1,180	87%
Nonminority	1,869	1,382	74%	120	6%	1,403	75%	60	3%	1,409	75%
Low-income	380	340	89%	79	21%	342	90%	43	11%	343	90%
Non-low-income	2,840	2,207	78%	233	8%	2,238	79%	100	4%	2,246	79%
Both minority & low-income	358	321	90%	76	21%	322	90%	43	12%	324	91%
Not both	2,862	2,226	78%	237	8%	2,258	79%	100	3%	2,265	79%
Total	3,220	2,547	79%	313	10%	2,580	80%	143	4%	2,589	80%

Distribution of Transit Amenities

Bus Shelters

For the purposes of monitoring Title VI compliance, the Operations and Services Development Department is responsible for the Level of Service assessment for bus shelters. This assessment is completed on an annual basis to evaluate whether the distribution and condition of bus shelters in minority and low-income areas are commensurate with the distribution and condition of shelters in nonminority and non-low-income areas.

Shelter Location

Operations and Services Development maintains records on the location of existing bus shelters and tracks the installation of new ones, including those that are installed by the MBTA, Wall USA, and Cemusa. Both Wall and Cemusa are private companies that install bus shelters that they purchase and maintain using revenues earned from the sale of advertising space on the shelters. Wall USA shelters are located exclusively in the city of Boston, and Cemusa shelters are located in a number of other cities within the MBTA service area. MBTA shelters are sometimes installed at bus stops where advertising is not viable.

For this report, CTPS analyzed the data provided by Operations and Services Development with respect to the location of shelters in minority areas, low-income areas, and areas that are both low-income and minority. The bus stops inside each of these three types of areas have a greater percentage of shelters than outside the respective areas, and than throughout the system as a whole. Under the MBTA's shelter placement policy, any bus stop with average daily boardings of more than 60 is eligible for a new shelter placement. CTPS therefore analyzed data for shelters located at stops that meet this threshold. As can be seen in Table 6-10 below, whether looking at all bus stops or at bus stops with the policy threshold of greater than 60 average daily boardings, the percentage of minority stops with shelters is higher than the percentage of nonminority stops with shelters. Likewise, the percentage of low-income stops with shelters is higher than the percentage of non-low-income stops with shelters, and the percentage of stops that are both minority and low-income with shelters is greater than the percentage that is not both with shelters. Figure 6-2 shows the location of all shelters in relation to minority and low-income areas in the MBTA's urban fixed-route service area.

FIGURE 6-1
MBTA Title VI Report

Transit Accessibility by
Minority and Low-Income Status:
Urban Fixed-Route Service Area

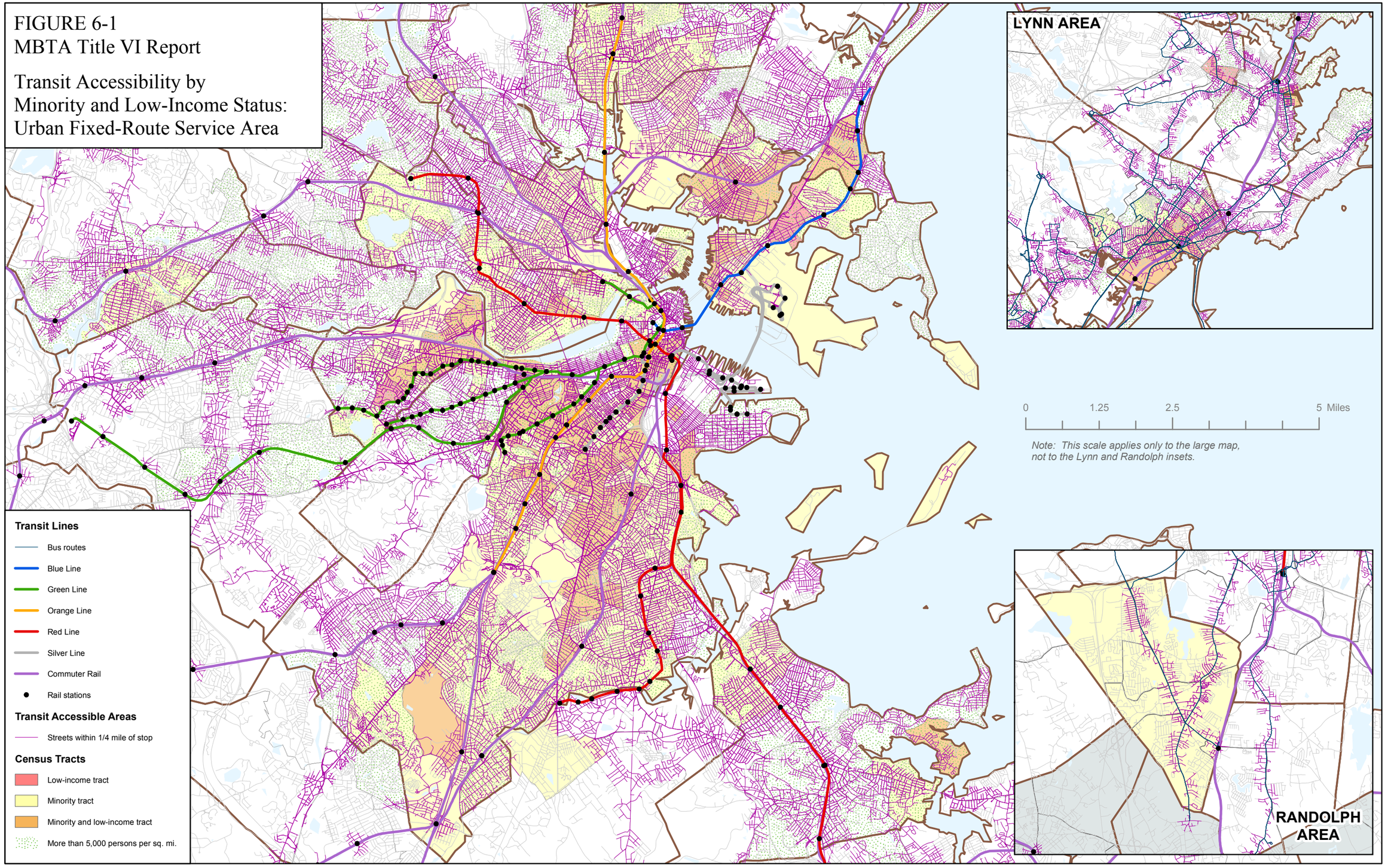
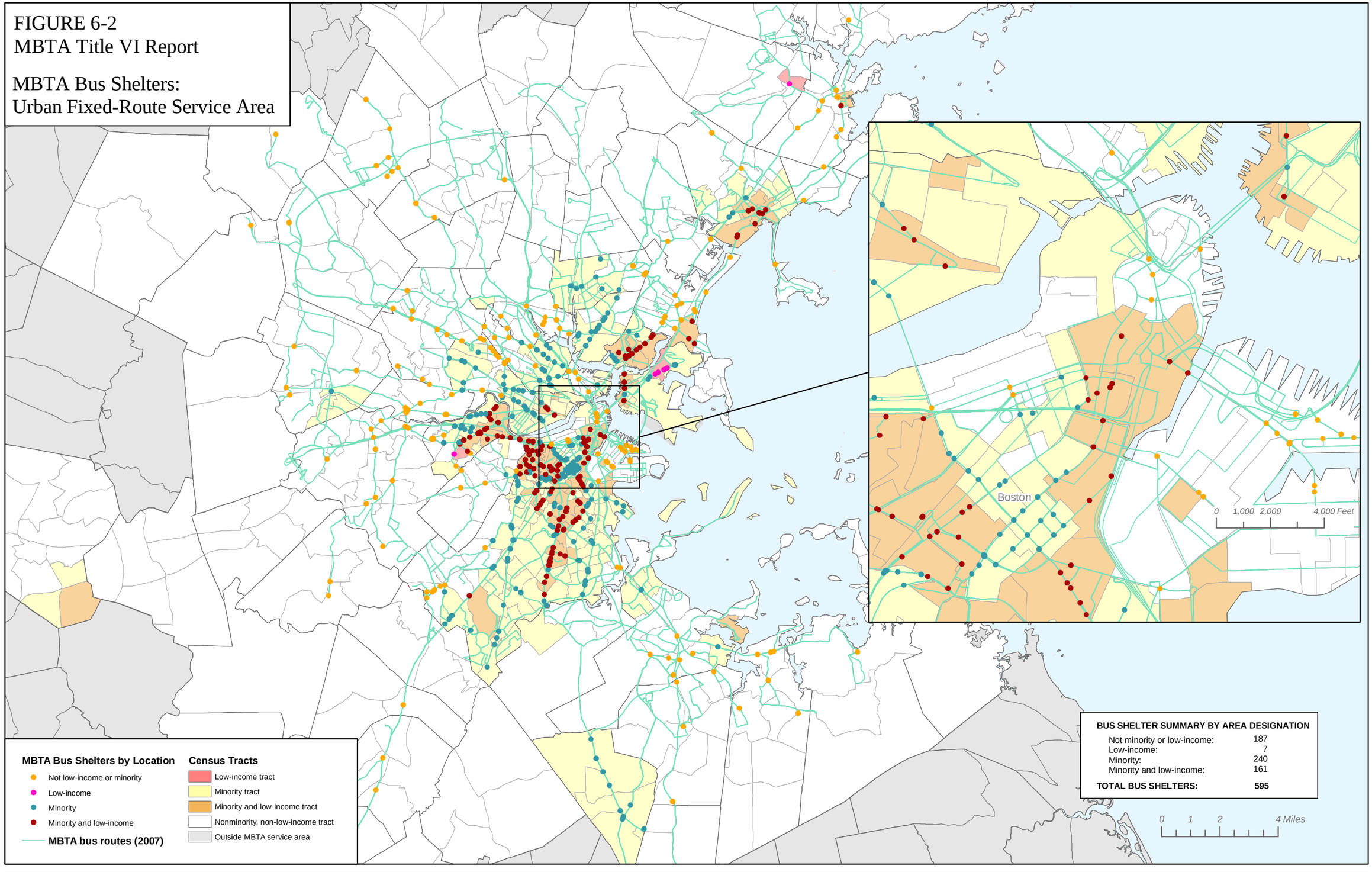


FIGURE 6-2
MBTA Title VI Report

MBTA Bus Shelters:
Urban Fixed-Route Service Area



MBTA Bus Shelters by Location
- Not low-income or minority
- Low-income
- Minority
- Minority and low-income
- MBTA bus routes (2007)

Census Tracts
- Low-income tract
- Minority tract
- Minority and low-income tract
- Nonminority, non-low-income tract
- Outside MBTA service area

BUS SHELTER SUMMARY BY AREA DESIGNATION

Not minority or low-income:	187
Low-income:	7
Minority:	240
Minority and low-income:	161
TOTAL BUS SHELTERS:	**595**

Table 6-10: 2008 Bus Shelter Location – Bus Stops with Shelters

	All Bus Stops			Stops with Average Daily Boardings >60		
	Total Stops	Stops with Shelters	% of Stops with Shelters	Total Stops	Stops with Shelters	% of Stops with Shelters
Minority	3,024	425	13%	704	279	37%
Nonminority	4,853	207	4%	323	89	24%
Low-income	814	181	21%	274	108	35%
Non-low-income	7,063	451	6%	753	260	32%
Both minority & low-income	787	174	21%	272	107	35%
Not both	7,090	458	6%	755	261	32%
Systemwide	7,877	632	8%	1,027	368	33%

Bus Shelter Condition

In addition to monitoring the location of bus shelters for the purpose of Title VI, the MBTA also monitors the condition of bus shelters.

Wall USA and Cemusa inspect and clean their shelters twice a week and make repairs as needed. They also respond to complaints that are submitted to the MBTA and address each problem within 24 hours. The MBTA assumes no responsibility for these shelters or their maintenance. However, the MBTA is responsible for the condition of the shelters it owns. Inspection and maintenance of MBTA shelters occurs on a regular basis, and additional repairs and cleaning are performed by the MBTA in response to customer complaints and bus operator reports.

To ensure Title VI compliance for bus shelter condition, CTPS inspects all shelters annually, regardless of ownership. CTPS collected data throughout 2007 to evaluate shelters on the following characteristics: roof condition, condition of side panels, presence of graffiti/vandalism, and shelter cleanliness. For every shelter, each characteristic was given a rating of 1 to 3, with 1 representing a “good” condition and 3 representing a “poor” condition. A composite score was then assigned to each shelter based on its worst rating. Thus, if a shelter received ratings of 1 for roof and side panel condition, 2 for vandalism, and 3 for shelter cleanliness, it would receive a composite score of 3.

As can be seen from the data displayed in Table 6-11, both minority and low-income shelters, as well as shelters that are designated both low-income and minority, generally score better than the shelters not so designated. The only difference between the scores that is statistically significant is in the graffiti/vandalism category.

Table 6-11: 2008 Bus Shelter Conditions – Average Scores for all Shelters

	Roof Condition	Sides Condition	Graffiti/ Vandalism	Shelter Cleanliness	Composite Score
Minority	1.00	1.06	1.07*	1.07	1.13
Nonminority	1.02	1.04	1.12	1.08	1.17
Low-income	1.01	1.06	1.02*	1.09	1.13
Non-low-income	1.01	1.05	1.11	1.06	1.15
Both minority & low-income	1.01	1.05	1.02*	1.10	1.13
Not both	1.01	1.05	1.11	1.06	1.15

* *Indicates that the difference is statistically significant.*

An additional metric of analysis for bus shelter condition is the percentage of shelters with certain attributes; specifically, whether the following exist at the shelter location: a sign, a bench, a timetable, and a map, as well as whether the timetable and map are legible and current. CTPS collected data for each of these metrics and the results are presented in Table 6-12. In general, minority and low-income shelters, as well as shelters designated both low-income and minority, have a higher percentage of signs, benches, and maps that are both legible and current than shelters not so designated. The difference is the opposite, however, in most categories of the timetable attribute. The MBTA will take steps to ensure that timetables are current and legible at minority and low-income shelters.

Table 6-12: 2008 Bus Shelter Conditions – Average Percentages of Shelters

	Sign	Bench	Timetable			Map		
	Exists	Exists	Exists	Legible	Current	Exists	Legible	Current
Minority	97.0%	98.8%	26.6%	36.3%	35.9%	79.1%	87.8%	88.8%
Nonminority	96.4%	96.9%	23.0%	41.5%	37.4%	44.1%	79.8%	81.4%
Low-income	98.8%	98.2%	19.5%	26.4%	27.0%	85.8%	89.0%	89.0%
Non-low-income	96.0%	98.1%	27.8%	42.8%	40.6%	60.8%	84.4%	86.2%
Both minority and low-income	98.8%	98.1%	20.4%	27.7%	28.3%	87.0%	89.8%	89.8%
Not both	96.1%	98.2%	27.3%	41.8%	39.7%	60.7%	84.1%	85.8%

Neighborhood Maps and Trash Receptacles at Rapid Transit Stations

Through the neighborhood map program, maps that show bus connections are provided at rapid transit stations with bus service. Neighborhood maps are also generally installed at all new or renovated stations, regardless of the availability of lack of availability of bus service. As can be seen in Table 6-13, the percentage of minority stations that provide neighborhood maps is higher than the percentage of nonminority stations that have maps. However, the percentage of low-income stations with maps is lower than the percentage of non-low-income stations in which maps have been placed. The MBTA will evaluate where additional maps can be placed to make the distribution at stations in low-income areas equitable with the distribution at non-low-income stations.

Table 6-13: Stations with Neighborhood Maps

Station Classification	Stations	# with Maps	% with Maps
Minority	84	36	43%
Nonminority	56	18	32%
Low-income	32	11	34%
Non-low-income	108	43	40%
Systemwide	140	54	39%

Bombproof Trash Receptacles

As indicated in Chapter 4, stations with high-volume use are equipped with bombproof trash receptacles. As can be seen in Table 6-14, for both rapid transit and commuter rail, the percentage of minority stations is higher than the percentage of nonminority stations with bombproof trash barrels, and the percentage of low-income stations is higher than the percentage of non-low-income stations with bombproof trash barrels. This is not true for commuter boat stations; however, there are only 2 minority and 4 nonminority stations served by commuter boat, and none of the 6 stations is designated as low-income.

Table 6-14: Placement of Bombproof Trash Receptacles

Mode	Station Classification	Stations	# of Stations with Bombproof Trash Barrels	% of Stations with Bombproof Trash Barrels
Rapid Transit	Minority	90	37	41%
	Nonminority	58	21	36%
	Low-income	35	14	40%
	Non-low-income	113	44	39%
Commuter Rail	Minority	30	2	7%
	Nonminority	101	2	2%
	Low-income	11	1	9%
	Non-low-income	120	3	3%
Commuter Boat	Minority	2	0	0%
	Nonminority	4	1	25%
	Low-income	0	0	0%
	Non-low-income	6	1	17%

Automated Fare Collection (AFC): Fare Gates and Fare-Vending Machines

In January 2007, the MBTA fully introduced new fare media and fare collection equipment throughout the bus and subway systems, replacing turnstiles with electronic fare gates and tokens with CharlieCards and CharlieTickets. Between January 2007 and June 2008, 2.4 million CharlieCards were distributed; 1.2 million of these are currently in active use. As of July 2008, CharlieCard penetration rate was 68% of the 22 million bus and subway trips purchased. Also as of mid-2008, approximately 90% of riders were taking advantage of best-value fares by using stored value on a CharlieCard, or by purchasing a time-based pass on a CharlieCard or CharlieTicket.

As discussed in Chapter 4, all rapid transit stations are now equipped with fare gates and fare vending machines (FVM). Therefore, there is no need to analyze the distribution of these technologies throughout the system.

In terms of equipment operability, the MBTA has established performance metrics that are based on the availability for use of the fare gates and fare vending machines.

- The minimum acceptable device availability threshold is 95%.
- The device availability goal is 98%.

As can be seen in Table 6-15, for cashless FVM, for full-service FVM, and for high-speed fare gates, the average percentage of device in-service time equals or exceeds the minimum acceptable device availability threshold at all stations, regardless of minority and low-income status. However, for ADA-compliant fare gates, the average percentage of device in-service time is lower than the minimum acceptable device availability threshold at all stations. Given this level of performance throughout the system, the MBTA will evaluate ways to ensure a higher operability rate for ADA fare gates. These gates are of particular importance, as they provide the only access to stations for persons in wheelchairs.

Table 6-15: Fare Gate and Fare Vending Machine (FVM) Operability

Device Type	Station Classification	Total Devices	% In Service
Cashless FVM	Minority	103	96%
	Nonminority	42	97%
	Low-income	37	98%
	Non-low-income	108	95%
	Total	145	96%
Full-service FVM	Minority	208	95%
	Nonminority	98	95%
	Low-income	69	96%
	Non-low-income	237	95%
	Total	306	95%
ADA Gates	Minority	91	93%
	Nonminority	39	91%
	Low-income	36	92%
	Non-low-income	94	92%
	Total	130	92%
High-speed Gates	Minority	234	96%
	Nonminority	108	97%
	Low-income	84	97%
	Non-low-income	258	96%
	Total	342	96%

AFC Retail Sales Terminals

As can be seen in Table 6-16, the percentage of Retail Sales Terminals (RST) in minority areas is higher than the percentage of RST in nonminority areas. However, the percentage of RST in low-income areas is lower than the percentage of RST in non-low-income areas. (Because all low-income areas with RST are also minority, no additional analysis is necessary to compare the percentage of RST in areas that are both minority and low-income with the percentage in areas that are not both.) The MBTA will evaluate where additional RST can be placed to make the distribution in low-income areas equitable with the distribution in non-low-income areas. Figure 6-3 shows the distribution of RST in the urban fixed-route service area.

Table 6-16: Distribution of Retail Sales Terminals (RTS)

Location Classification	# of locations with RST	% of total RST locations
Minority	94	58%
Nonminority	68	42%
Low-income	41	25%
Non-low-income	121	75%
Total RST locations	162	58%

Variable Message Signs (VMS)

VMS: Bus Rapid Transit (BRT)

The BRT system in Boston consists of two currently unconnected parts of the Silver Line: Silver Line Washington Street and Silver Line Waterfront. Taken together, 58% of the stations/stops on the Silver Line are in minority census tracts, 26% are in low-income tracts, and 23% are in census tracts that are both minority and low-income. However, most of the stations that are classified as minority and low-income are on Silver Line Washington Street. In fact, all of the stations on Silver Line Washington Street are in minority census tracts, and half of these are also low-income. Further, the stations that are not classified as being in low-income tracts are directly adjacent to tracts that are low-income.

When taken as a whole, 61% of minority stations/stops on the Silver Line have VMS, 63% of low-income stations/stops have VMS, and 71% of stations/stops that are both minority and low-income are equipped with VMS.

VMS: Rapid Transit

All rapid transit stations on the Red Line, Blue Line, and Orange Line have, or will soon have, variable-message signs that alert customers to the approach and arrival of trains. Therefore, 100% of minority and low-income stations will have VMS.

As is discussed in Chapter 4, the type of signal system used on the Green Line cannot trigger next train information for display on VMS. However, VMS showing public service information will be installed at stations in the Green Line central subway and on the D Branch. Due to the lack of power and communication connections to stations on the B, C, and E Branches of the Green Line, no VMS signs can be used at these stations in the near term.

Table 6-17 below shows minority and low-income analysis of VMS at all rapid transit stations (Red, Blue, Orange, and Green Line). The percentage of minority and low-income stations that have VMS is lower than the percentage of nonminority and non-low-income stations with VMS. However, due to the nature of the signal system on the Green Line is changed, this cannot be resolved in the near term.

Table 6-17: Rapid Transit Stations with VMS

Stations	Total	# with VMS	% with VMS
Minority	98	75	77%
Nonminority	84	67	80%
Low-income	45	30	67%
Non-low-income	137	112	82%
Total	182	142	78%

VMS: Commuter Rail

All commuter rail stations have VMS, with the exception of two that are not located in minority or low-income census tracts. Therefore, 100% of minority and low-income commuter rail stations are equipped with VMS. A project currently underway will upgrade all of the existing signs with ones that will display "next train" information. Installation of the new signs will begin in 2009, and full implementation should be completed by the second quarter of 2011.

Elevators and Escalators

For the purposes of monitoring Title VI compliance, the Operations Support Department is responsible for the Level of Service assessment of elevators and escalators. This is completed on an annual basis to evaluate whether the distribution and operability of station elevators and escalators in minority and low-income areas is commensurate with the distribution and operability of station elevators and escalators in nonminority and non-low-income areas.

The complete maintenance, service testing, and inspection of all elevators and escalators in the transit system and in other MBTA facilities are outsourced to a private maintenance contractor. Elevator and escalator service requests are transmitted from the MBTA to the contractor, which dispatches maintenance personnel to perform repairs. On a daily basis, Operations Support keeps records regarding station escalator and elevator maintenance activity and hours of operation.

Elevator and Escalator Performance

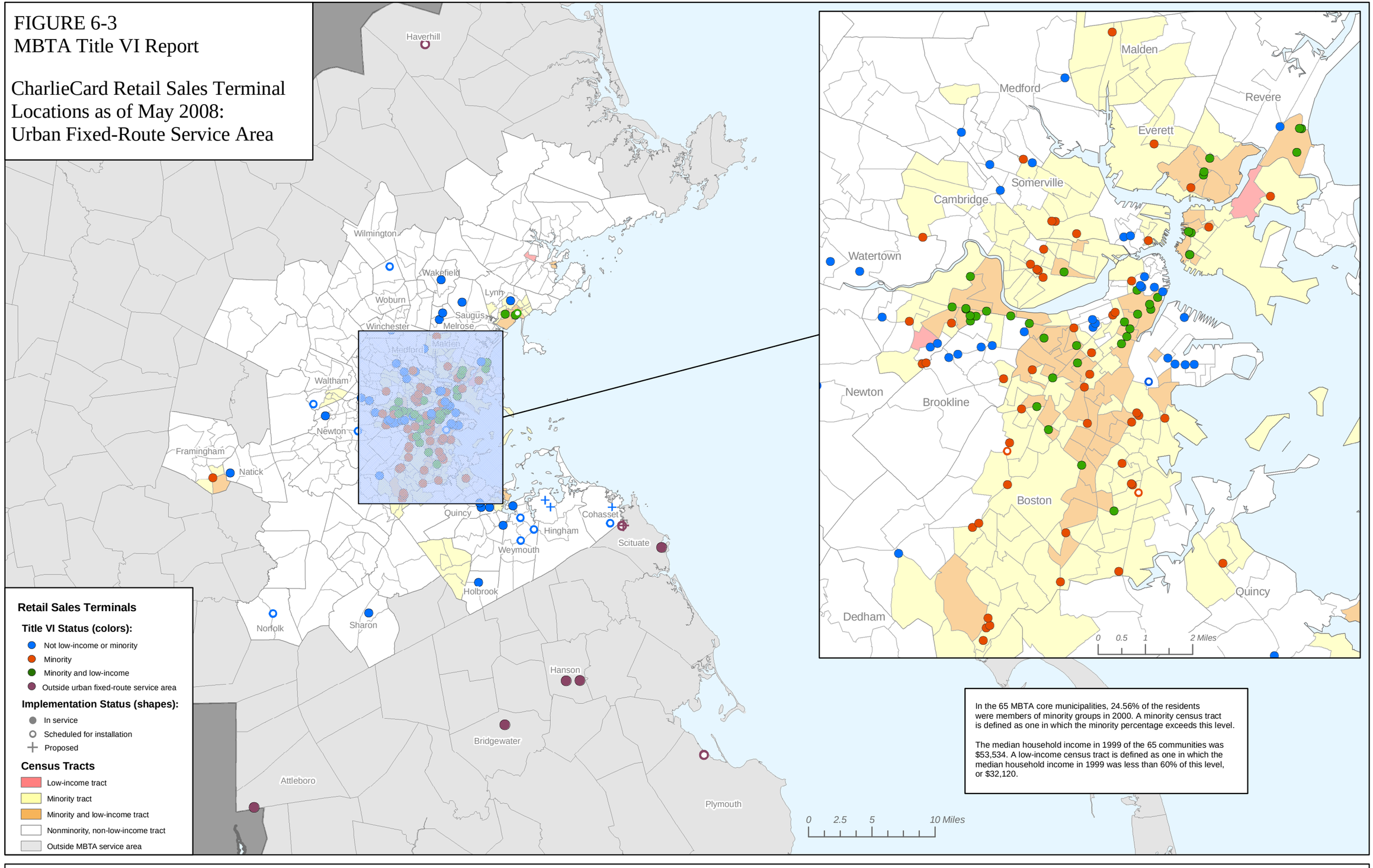
For the purposes of monitoring Title VI compliance, the Operations Support Department is responsible for the annual Level of Service assessment of elevators and escalators. On a daily basis, Operations Support keeps records of station escalator and elevator maintenance activity and hours of operation. In an effort to determine the average length of time each elevator and escalator was out of service, CTPS examined the data provided by Operations Support on equipment failure service calls that were placed between April 1, 2007, and April 1, 2008.

Tables 6-17 and 6-18 present data on elevator and escalator repair time, out-of-service time, and incident rates, respectively. The first data column in each table compares the average repair time per incident (the total number of revenue-hours between the went-out-of-service and returned-to-service times[1] for each service call) for minority vs. nonminority stations and for low-income vs.

[1] Elevator out-of-service time is defined as the total number of revenue-hours an elevator was out of service, meaning that it does not include the 4.5 hours of nonrevenue time, from approximately 1:00 AM to 5:30 AM.

FIGURE 6-3
MBTA Title VI Report

CharlieCard Retail Sales Terminal Locations as of May 2008:
Urban Fixed-Route Service Area



Retail Sales Terminals

Title VI Status (colors):

- Not low-income or minority
- Minority
- Minority and low-income
- Outside urban fixed-route service area

Implementation Status (shapes):

- In service
- Scheduled for installation
- Proposed

Census Tracts

- Low-income tract
- Minority tract
- Minority and low-income tract
- Nonminority, non-low-income tract
- Outside MBTA service area

In the 65 MBTA core municipalities, 24.56% of the residents were members of minority groups in 2000. A minority census tract is defined as one in which the minority percentage exceeds this level.

The median household income in 1999 of the 65 communities was $53,534. A low-income census tract is defined as one in which the median household income in 1999 was less than 60% of this level, or $32,120.