



## BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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Stephanie Pollack, MassDOT Secretary and CEO and MPO Chairman  
Karl H. Quackenbush, Executive Director, MPO Staff

### *MEMORANDUM*

**DATE** May 21, 2015  
**TO** Boston Region Metropolitan Planning Organization  
**FROM** Karl H. Quackenbush  
CTPS Executive Director  
**RE** Work Program for: MBTA 2016 National Transit Database: Data  
Collection and Analysis

#### Action Required

Review and approval

#### Proposed Motion

That the Boston Region Metropolitan Planning Organization, upon the recommendation of the Massachusetts Bay Transportation Authority, vote to approve the work program for MBTA 2016 National Transit Database: Data Collection and Analysis presented in this memorandum

#### Project Identification

##### Unified Planning Work Program Classification

Technical Support/Operations Analysis Projects

##### CTPS Project Number

14345

##### Clients

Massachusetts Bay Transportation Authority  
*Project Supervisor: Melissa Dullea*

##### CTPS Project Supervisors

*Principal: Annette Demchur*  
*Manager: Andrew Reker*

##### Funding

Future MBTA contract

## Impact on MPO Work

The MPO staff has sufficient resources to complete this work in a capable and timely manner. By undertaking this work, the MPO staff will neither delay the completion of nor reduce the quality of any work in the UPWP.

## Background

For many years, in support of the MBTA's National Transit Database (NTD) submittals to the Federal Transit Administration (FTA), CTPS has produced passenger-miles and boardings estimates for the MBTA's bus and trackless trolley mode. In state fiscal year (SFY) 1996, the scope of the analysis expanded to include the heavy rail and light rail transit modes. In SFY 2000, the scope expanded further to include the MBTA commuter rail mode. Since SFY 2001, CTPS has also produced passenger-miles and boardings estimates for the MBTA's purchased-service bus routes (that is, routes for which the MBTA contracts with a private carrier to provide the service). Beginning in SFY 2014, at the request of the FTA, the MBTA reclassified some of its bus routes as bus rapid transit for NTD reporting.

In SFY 2014, the FTA permitted the MBTA to use its automatic passenger counter (APC) data for reporting to the NTD. This year, for its directly operated services, the MBTA will use its APC data to estimate the unlinked passenger-trips and passenger-miles traveled on its buses and its bus rapid transit vehicles; therefore, manual data collection for these modes is no longer necessary.

For purchased services, CTPS began collecting full-route ridecheck data in SFY 2010 rather than collecting data on a random sample of trips. It was determined that the methodology employing full-route ridechecks satisfies the FTA's requirement that the true values for passenger-miles and boardings have a 95 percent probability of falling within 10 percent of the estimates. In addition, this methodology provides ridership and schedule adherence data for each purchased bus route that could be used for planning purposes. In SFY 2016, CTPS will continue to use full-route ridechecks to estimate total passenger-miles and boardings.

## Objectives

The objectives of this project are to develop estimates of passenger-miles and boardings for MBTA directly operated transportation modes, including trackless trolley, heavy rail, and light rail. CTPS will also develop an estimate of the average passenger trip length for the commuter rail mode and estimates of passenger-miles and boardings for contracted MBTA local bus service, and will review the MBTA's APC-derived passenger-miles and boarding estimates for the bus and bus rapid transit modes.

The data that will form the basis of these estimates will be collected in a variety of ways:

- Full-route ridechecks on buses used for contracted MBTA local bus service and trackless trolleys
- MBTA APC data
- Fare-mix counts from automated-fare-collection (AFC) faregates at stations and from fareboxes on vehicles
- Passenger surveys on the heavy rail mode, light rail mode, and gated portions of the bus rapid transit mode to determine origin-destination information
- Inferred origin-destination information based on AFC data
- Commuter rail ridership data from passenger counts conducted by the MBTA or its contractors or from the MBTA's mobile ticketing vendor

## Work Description

### Task 1 Develop Sampling Plans

For the heavy rail mode, light rail mode, and gated portions of the bus rapid transit mode, staff will develop a sampling plan for passenger surveys that will ensure that there is a random selection of stations over the entire year for all days of the week and all time periods.

For light rail service at surface stops, onboard observations are necessary because not all passengers interact with fare collection equipment when boarding Green Line and Mattapan High-Speed Line vehicles. Counts of passengers boarding through rear doors and failing to interact with the farebox will be conducted. For each car, it may be necessary to have two ridecheckers: one to count the number of rear boardings and the other to count the number of passengers boarding through the front door by category, those who interact with the farebox and those who do not interact with the farebox (flash-pass trips, children, and fare evaders). Staff will develop a sampling plan that will ensure that these observations are conducted on surface light rail over the entire year for all days of the week and all time periods.

For the trackless trolley mode and purchased bus services, staff will develop sampling plans for conducting full-route ridechecks on each route. CTPS staff members will perform these ridechecks, on each scheduled trip for each route one time over the course of a single quarter during the 2016 state fiscal year. The selection of quarters will be determined by CTPS staffing availability.

No direct data collection is planned for commuter rail. As in previous years, CTPS will use conductor audits or data from the MBTA's mobile ticketing vendor.

CTPS will collect as much data as possible through electronic means. CTPS's mobile devices support the following CTPS-developed applications:

- Passenger origin-destination surveys
- Faregate noninteraction counts
- Surface light rail rear-door boarding counts
- Surface light rail front-door passenger counts, including farebox noninteraction counts
- Bus and trackless trolley farebox counts and farebox noninteraction counts
- Bus and trackless trolley boardings and alightings by stop
- Inferred heavy and light rail origin-destination data by station

#### *Products of Task 1*

- Sampling plans for SFY 2016 passenger surveys
- Sampling plan for surface-light-rail SFY 2016 observations
- Sampling plans for bus and trackless trolley for SFY 2016 ridechecks

#### **Task 2 Collect Data**

The ridecheck assignments generated by the sampling plans created in Task 1 for purchased bus and trackless trolley will be executed. CTPS will conduct full-route ridechecks on these modes using mobile devices, will classify how passengers pay for their trips, and, where applicable, will note the number of passengers who do not interact with the farebox. CTPS will also conduct passenger surveys at each of the survey locations, and will conduct counts of the numbers of passengers passing through faregates, including counts of those who do not interact with the faregates, at station survey locations that have faregates. Along Green Line and Mattapan Line surface routes, onboard counts of passengers, including those who do not interact with the farebox, will be conducted.

Ridechecks, passenger surveys, and passenger counts will be performed by CTPS personnel, using mobile devices where practicable. The data collected on ridechecks will be uploaded directly to the CTPS bus ridership information database, where they will be checked for completeness and accuracy. Passenger survey results and passenger count data will be uploaded directly to a different database, where they will also be checked for completeness and accuracy.

The MBTA will provide CTPS with detailed AFC data for all of the MBTA's modes for which data exist.

#### *Products of Task 2*

- Passenger survey results
- Farebox- and faregate-noninteraction data

- Passenger count data for surface light rail, purchased bus, and trackless trolley
- AFC data on total boardings for all modes
- Ridecheck data
- APC data for unlinked passenger-trips and passenger-miles traveled
- Detailed AFC data by transaction

### Task 3 Process Ridecheck, Passenger Survey, and Passenger Count Data

CTPS will process the ridecheck, passenger survey, and passenger count data, including farebox- and faregate-noninteraction data.

#### *Product of Task 3*

Processed ridecheck, passenger survey, and passenger count data

### Task 4 Estimate Passenger-Miles and Boardings

#### *Subtask 4.1 Estimate Passenger-Miles and Boardings for Directly Operated Services*

CTPS will obtain information on the total numbers of passengers boarding at subway stations on the heavy rail and light rail modes from the MBTA through AFC faregate passenger counts. Factors that account for the number of transfers between each mode will then be estimated based on the findings of the origin-destination passenger surveys conducted in Task 2 and the processed AFC data. Additionally, a faregate noninteraction factor will be developed from the observations at station survey locations. These factors will be applied to the AFC faregate counts to estimate the total number of unlinked heavy rail and light rail riders attributable to subway boardings.

For light rail surface stops, counts of passengers boarding through rear doors and failing to interact with the farebox will be used to develop a farebox noninteraction factor. This factor will be applied to the AFC farebox counts of the total number of passengers on surface light rail. Additional factors will be applied to account for transfers made to other light rail lines or to heavy rail lines, resulting in estimates of the total of unlinked light rail and heavy rail riders attributable to light rail surface boardings.

For the heavy rail and light rail modes, the origin-destination data generated by the passenger surveys, and the processed AFC data, will be converted into estimates of the average passenger-miles per transit mode. The average passenger-miles per passenger will be multiplied by the total number of passengers to yield estimates of the total number of passenger-miles for each mode. CTPS will also generate an estimate of passenger-miles using its origin-destination model.

For the MBTA's bus and bus rapid transit modes, CTPS will assess the MBTA's estimates of passenger-miles traveled and unlinked passenger trips.

For the commuter rail modes, ridership counts will provide the basis for the estimate of passenger boardings. In the past two years, because conductor audit data were not available, CTPS obtained anonymized origin-destination data from the MBTA's mobile ticketing vendor. This dataset was sufficient for estimating the average passenger-miles traveled per trip. However, CTPS does not produce estimates of unlinked passenger trips for commuter rail, and does not expect to conduct any direct observation on the commuter rail mode.

#### *Subtask 4.2 Estimate Passenger-Miles and Boardings for Purchased Bus Services*

CTPS will produce estimates of passenger-miles and boardings using revenue data from the MBTA and output from CTPS's bus ridership information database. Estimates of the average farebox deposit will be generated, along with the average passenger trip length, which is based on ridecheck observations. The total boardings will be estimated by dividing the average farebox deposit into the total revenue. Total passenger-miles will be calculated by multiplying the total boardings by the average passenger trip length.

#### *Product of Task 4*

Estimates of passenger-miles and boardings for all MBTA modes

#### **Task 5 Document Results**

The results of Task 4 and the methodology of the study will be documented in a series of three technical memoranda: one for purchased bus services, one for directly operated services, and one for the commuter rail mode. The technical memoranda will describe the data collection and analysis processes and will present a summary of the results.

#### *Product of Task 5*

Three technical memoranda

#### **Task 6 Assist with the Compliance Audit**

The FTA requires an independent auditor to review and verify the MBTA's directly operated bus and rail passenger-miles and boardings estimates. As the agency responsible for these estimates, CTPS will provide any materials and assistance necessary for the audit.

## Estimated Schedule

It is estimated that this project will be completed 17 months after the notice to proceed is received. The proposed schedule, by task, is shown in Exhibit 1.

## Estimated Cost

The total cost of this project is estimated to be \$125,483. This includes the cost of 93.9 person-weeks of staff time, overhead at the rate of 91.82 percent, and travel. A detailed breakdown of the estimated costs is presented in Exhibit 2. Approximately 5 percent of the funds will be spent in SFY 2015, 80 percent in SFY 2016, and 15 percent in SFY 2017.

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**Exhibit 2**  
**ESTIMATED COST**  
**MBTA 2016 National Transit Database: Data Collection and Analysis**

<b>Direct Salary and Overhead</b>											<b>\$124,983</b>
Task	Person-Weeks							Direct Salary	Overhead (91.82%)	Total Cost	
	M-1	P-5	P-4	P-3	P-1	Temp	Total				
1. Develop Sampling Plan	0.1	0.0	0.0	2.2	1.5	0.0	3.8	\$3,754	\$3,447	\$7,200	
2. Collect Data	1.2	0.0	0.5	1.6	20.0	55.0	78.3	\$47,648	\$43,750	\$91,398	
3. Process Ridecheck, Passenger Survey, and Passenger Count Data	0.0	0.0	0.0	0.8	0.8	1.0	2.6	\$2,001	\$1,837	\$3,839	
4. Estimate Passenger-Miles and Boardings	0.0	0.0	2.0	2.4	0.0	0.0	4.4	\$5,287	\$4,854	\$10,141	
5. Document Results	1.5	0.2	0.3	2.4	0.0	0.0	4.4	\$6,026	\$5,533	\$11,559	
6. Assist with Compliance Audit	0.0	0.0	0.0	0.4	0.0	0.0	0.4	\$441	\$405	\$845	
Total	2.8	0.2	2.8	9.8	22.3	56.0	93.9	\$65,156	\$59,826	\$124,983	
<b>Other Direct Costs</b>											<b>\$500</b>
Travel										\$500	
<b>TOTAL COST</b>											<b>\$125,483</b>

**Funding**  
 Future MBTA contract