BOSTON REGION METROPOLITAN PLANNING ORGANIZATION
Richard A. Davey, MassDOT Secretary and CEO and MPO Chairman
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE June 6, 2013

TO Boston Region Metropolitan Planning Organization

FROM Karl H. Quackenbush
CTPS Executive Director

RE Work Program for: MBTA 2014 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 2014 National Transit Database: Data Collection and Analysis in the form of the draft dated June 6, 2013.

Project Identification

Unified Planning Work Program Classification

Technical Support/Operations Analysis Projects

CTPS Project Number

To be determined

Clients

Massachusetts Bay Transportation Authority
Project Supervisor: Melissa Dullea

CTPS Project Supervisors

Principal: Annette Demchur
Manager: Steven Andrews

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 other 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 system. In state fiscal year (SFY) 1996, the scope of the analysis expanded to include the heavy rail and light rail transit systems. In SFY 2000, the scope expanded again to include the MBTA commuter rail system. 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, the FTA has asked the MBTA to report some of its bus routes as bus rapid transit (referred to in the NTD as RB).

For its directly operated services, this year the MBTA would like to use its automatic passenger counter (APC) data to estimate the unlinked passenger-trips and passenger-miles traveled on its buses (listed in the NTD as motor bus). This would reduce the sample size of, and the costs associated with, ridechecks needed for the motor bus mode. However, the FTA will need to approve the MBTA's use of APC data. If the FTA does not allow the MBTA to use its APC data for this purpose, CTPS will employ the methodology it has used in past years. The present work program describes both the old and new methodologies.

For purchased services, in SFY 2010, CTPS began collecting full-route ridecheck data rather than collecting data on a random sampling of trips. It was determined that the methodology employing full-route ridechecks satisfies the FTA 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 can be used for other planning purposes. In SFY 2014, 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 motor bus, trackless trolley, heavy rail, light rail, and bus rapid transit. CTPS will also verify MBTA estimates of the average passenger trip length for the commuter rail mode. In addition, CTPS will develop estimates for contracted MBTA local bus service.

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

- Ridechecks on buses (including buses used in contracted MBTA local bus service) and trackless trolleys, conducted in both the ongoing bus data collection program and in supplementary data collection
- Electronic passenger fare-mix counts from automated fare-collection (AFC) faregates at heavy rail and light rail subway stations and fareboxes on motor bus and trackless trolley routes
- Fare-mix counts of passengers on surface light rail, including counts of passengers boarding through rear doors or otherwise failing to interact with the farebox
- Passenger surveys on the heavy rail and light rail systems and on the Silver Line Waterfront to determine origin and destination information
- Commuter rail ridership data via passenger counts

Work Description

Task 1 Develop Sampling Plans

For the heavy rail and light rail systems, as well as the Silver Line Waterfront service, a sampling plan for passenger surveys will be devised to ensure a random selection of stations across all parts of each system 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. Two ridecheckers will be necessary: one to count the number of rear boardings and the other to note the number of passengers boarding through the front door who do not interact with the farebox (flash-pass trips, children, and fare evaders). A sampling plan will be devised to 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 bus and bus rapid transit systems, sampling plans for ridechecks will be devised to ensure a random selection of trips across all parts of the systems over the entire year for all days of the week and time periods. Ridecheckers will also note the number of passengers who board through rear doors or otherwise fail to interact with the farebox. Alternatively, if the FTA allows the MBTA to use APC data to estimate unlinked passenger-trips and passenger-miles, a non-random sample of trips on APC-equipped buses will be selected and ridechecked—ridecheckers will also note the number of passengers who board through rear

doors or otherwise fail to interact with the farebox. These trips will be selected to represent all days of the week and time periods.

For the trackless trolley system and purchased bus services, sampling plans will be developed to conduct full-route ridechecks of each route. These ridechecks will involve CTPS staff members' riding each scheduled trip for each route once over the course of a single quarter in SFY 2014. The specific quarter will be determined based on CTPS staffing availability.

No direct data collection is planned for commuter rail. However, a sampling of some trips may be necessary to verify the current figures.

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

- Light rail, heavy rail, and Silver Line Waterfront passenger surveys
- Faregate noninteraction count
- Surface light rail rear-door boarding count
- Surface light rail front-door farebox noninteraction count
- Bus and trackless trolley farebox noninteraction count
- Bus and trackless trolley boardings and alightings by stop

Products of Task 1

- Heavy rail and light rail sampling plans for SFY 2014 passenger surveys
- Surface-light-rail sampling plan for SFY 2014 observations
- Bus and trackless trolley sampling plans for SFY 2014 ridechecks

Task 2 Collect Data

The passenger survey assignments generated by the sampling plans created in Task 1 for bus, bus rapid transit, purchased bus, and trackless trolley will be executed. CTPS will conduct passenger surveys at each of the heavy rail, light rail, and Silver Line Waterfront survey locations. Counts of the numbers of passengers passing through faregates, including counts of those who do not interact with the faregates, at station survey locations will also be conducted. Along Green Line and Mattapan High-Speed Line surface routes, onboard counts of passengers, and specifically those who do not interact with the farebox, will be conducted. CTPS will also conduct ridechecks on trackless trolley and purchased bus trips using mobile devices, will classify how passengers pay for their trip, and, where applicable, will note the numbers of passengers who do not interact with the farebox.

One of two possible methodologies will be used to collect data on buses. One method would require CTPS staff to ridecheck a non-random set of APC-equipped buses. The MBTA would provide CTPS with APC-derived passenger-miles and passenger counts for the trips that CTPS ridechecks. The other

method would use CTPS staff to ridecheck a larger, random sample of trips. The former method would require the FTA to approve the MBTA's use of APC data. If FTA approval is not granted, the latter method will be used.

If the MBTA were to use APC data as the basis of its to report to the NTD, CTPS would obtain from the MBTA the number of motor bus trips operated, by route, time of day, and APC-equipped status, and the unlinked passenger-miles and passenger-miles traveled for APC-equipped buses.

All ridechecks, passenger surveys, and passenger counts will be performed by CTPS personnel, using mobile devices. 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 similarly be checked for completeness and accuracy.

AFC data will be requested from the MBTA for total heavy rail and light rail subway station boardings, as well as for total surface light rail, motor bus, and trackless trolley boardings. In addition, AFC data will be requested for total farebox deposits for each sampled bus and trackless trolley trip.

Products of Task 2

- Passenger survey results for heavy rail, light rail, and Silver Line Waterfront stations in electronic form
- Passenger count data for surface light rail, motor bus, and trackless trolley in electronic form
- AFC data on total boardings for light and heavy rail stations and surface light rail, motor bus, and trackless trolley routes
- AFC revenue data for motor bus and trackless trolley fareboxes for ridechecked trips
- Ridecheck data in electronic form

If APC data are used:

- APC data on non-random ridechecked motor bus trips
- APC data on unlinked passenger-trips and passenger-miles traveled by time of day and route
- Information regarding the number of trips operated, by route, time of day, and APC-equipped status

Task 3 Clean, Code, and Enter Passenger Count and Ridecheck Data

CTPS will clean the heavy rail and light rail passenger survey data as necessary after downloading them into a spreadsheet program. The program will allow for the processing of the origin-destination data, as well as the other data included on the survey form. The passenger count and farebox-noninteraction data for

surface light rail, motor bus, and trackless trolley will also be entered into a spreadsheet for processing. Ridecheck data will also be cleaned.

Products of Task 3

- Heavy rail and light rail passenger survey data in electronic form
- Surface light rail, motor bus, and trackless trolley passenger count and farebox-noninteraction data in electronic form
- Cleaned ridecheck data in electronic form

Task 4 Estimate Passenger-Miles and Boardings

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

Information on the total numbers of passengers boarding at subway stations on the heavy rail and light rail systems will be obtained 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 origin-destination passenger surveys conducted in Task 2. 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 total 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 total passengers on surface light rail; the results will then be increased to account for transfers made to other heavy rail or light rail lines, resulting in estimates of total unlinked light rail and heavy rail riders attributable to light rail surface boardings.

Meanwhile, the origin-destination data generated by the passenger surveys will be converted into estimates of the average passenger-miles per passenger for both the heavy rail and light rail systems. This conversion will make use of procedures developed a number of years ago for the Systemwide Rapid Transit Passenger Survey. Multiplying the average passenger-miles per passenger by the total number of passengers will yield estimates of total passenger-miles for each mode.

If the method of collecting motor bus data is used in which non-random ridechecks on APC-equipped buses are conducted, CTPS will verify that the ridecheck data are consistent with the APC data. Systemwide APC data will be used to estimate unlinked passenger-trips and passenger-miles. Information on the number of trips operated by APC-equipped vehicles and

non-APC-equipped vehicles will be obtained from the MBTA to assist in this process.

If the other method of collecting motor bus data is used, in which random ridechecks are conducted, a farebox noninteraction factor developed via the ridecheck sample will be applied to the AFC farebox count of total motor bus and trackless trolley passengers to estimate total boardings. Total passenger-miles will be estimated, as in previous years, using the ridecheck sample of trips to develop an average trip distance: this distance multiplied by total boardings results in total passenger-miles.

For the commuter rail system, ridership counts will provide the basis for the estimate of passenger boardings. Counts by station, in conjunction with data indicating the percentage of alightings prior to North Station and South Station, will provide the basis for the estimate of average passenger trip length.

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

Estimates of passenger-miles and boardings will be produced using revenue data from the MBTA and output from the CTPS bus ridership information database. Specifically, estimates of the average farebox deposit will be generated, along with the average passenger trip length based on ridecheck observations. By dividing the average farebox deposit into total revenue, an estimate of total boardings may be made. Multiplying this total by the average trip length yields total passenger-miles.

Product of Task 4

- Estimates of passenger-miles and boardings for all MBTA modes discussed above

Task 5 Document Results

The results of Task 4 and the methodology of the study will be documented in a technical memorandum. If non-random ridechecks on APC-equipped buses are used to estimate passenger-miles and boardings, the memorandum will include a statistical analysis confirming that the true values for passenger-miles and boardings have a 95 percent probability of falling within 10 percent of the estimates, as required by the FTA. If the APC data are used, the memorandum will document the results of the APC comparison.

Product of Task 5

- Technical memorandum describing the data collection and analysis processes, summarizing results, and presenting a statistical analysis of the results

Task 6 Assist with 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

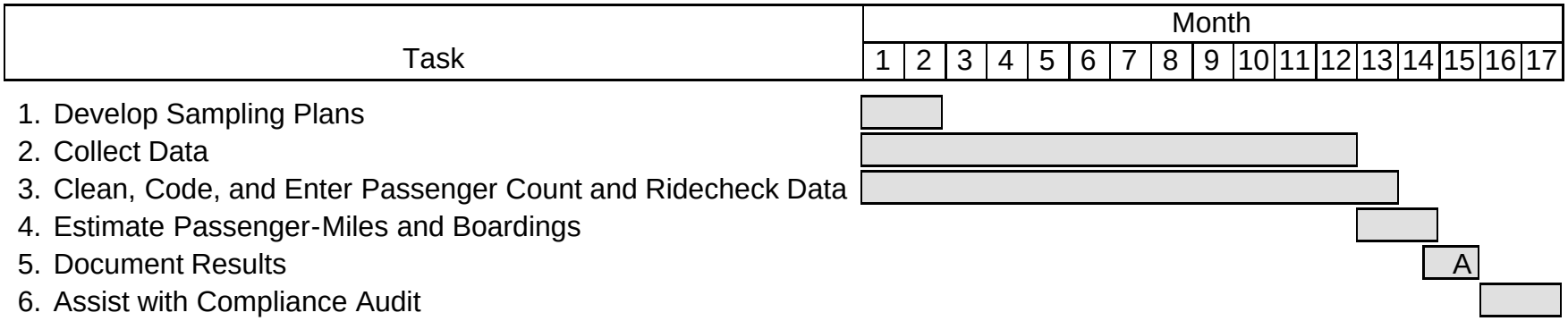
It is estimated that this project will be completed in November 2014 (or approximately 17 months after the notice to proceed is received). The proposed schedule, by task, is shown in Exhibit 1.

Estimated Cost

The total cost of this project if the APC data are not used is estimated to be $121,492. This includes the cost of 88.9 person-weeks of staff time, overhead at the rate of 96.58 percent, and travel. A detailed breakdown of estimated costs for this option is presented in Exhibit 2. If the FTA approves use of the APC data, the total cost of the project is estimated to be $107,767. This includes the cost of 76.6 person-weeks of staff time, the same overhead rate, and travel. A detailed breakdown of estimated costs for this option is presented in Exhibit 3.

KQ/SPA/spa

Exhibit 1
ESTIMATED SCHEDULE
MBTA 2014 National Transit Database: Data Collection and Analysis -- If APC data are not used



Products/Milestones

A: Technical Memorandum

Exhibit 2
ESTIMATED COST
MBTA 2014 National Transit Database: Data Collection and Analysis -- If APC data are not used

Direct Salary and Overhead	**$120,742**

Task	Person-Weeks								Direct Salary	Overhead (96.58%)	Total Cost
	M-1	P-5	P-4	P-3	SP-3	SP-1	Temp	Total			
1. Develop Sampling Plans	0.1	0.7	0.0	1.0	2.1	0.0	3.0	6.9	$5,497	$5,309	$10,807
2. Collect Data	0.2	0.0	0.0	0.4	9.4	28.4	27.1	65.5	$39,731	$38,372	$78,104
3. Clean, Code, and Enter Passenger Count and Ridecheck Data	0.0	0.0	0.0	4.1	3.8	0.0	2.1	10.0	$8,306	$8,022	$16,328
4. Estimate Passenger-Miles and Boardings	0.0	0.0	0.0	3.1	0.0	0.0	0.0	3.1	$3,247	$3,136	$6,383
5. Document Results	1.6	0.0	0.2	1.3	0.0	0.0	0.0	3.1	$4,325	$4,177	$8,502
6. Assist with Compliance Audit	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	$314	$304	$618
Total	1.9	0.7	0.2	10.2	15.3	28.4	32.2	88.9	$61,421	$59,321	$120,742

Other Direct Costs	**$750**
Travel	$750

TOTAL COST	**$121,492**

Funding
Future MBTA Contract

Exhibit 3
ESTIMATED COST
MBTA 2014 National Transit Database: Data Collection and Analysis -- If APC data are used

Direct Salary and Overhead	**$107,017**

Task	Person-Weeks								Direct Salary	Overhead (96.58%)	Total Cost
	M-1	P-5	P-4	P-3	SP-3	SP-1	Temp	Total			
1. Develop Sampling Plans	0.1	0.7	0.0	1.0	2.1	0.0	3.0	6.9	$5,497	$5,309	$10,807
2. Collect Data	0.2	0.0	0.0	0.4	7.9	22.9	21.1	52.5	$32,073	$30,976	$63,049
3. Clean, Code, and Enter Passenger Count and Ridecheck Data	0.0	0.0	0.0	4.3	3.8	0.0	2.2	10.3	$8,564	$8,271	$16,835
4. Estimate Passenger-Miles and Boardings	0.0	0.0	0.0	3.5	0.0	0.0	0.0	3.5	$3,666	$3,541	$7,207
5. Document Results	1.6	0.0	0.2	1.3	0.0	0.0	0.0	3.1	$4,325	$4,177	$8,502
6. Assist with Compliance Audit	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	$314	$304	$618
Total	1.9	0.7	0.2	10.8	13.8	22.9	26.3	76.6	$54,440	$52,578	$107,017

Other Direct Costs	**$750**
Travel	$750

TOTAL COST	**$107,767**

Funding
Future MBTA Contract