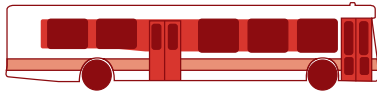


APPENDIX B





APPENDIX B

GREENHOUSE GAS MONITORING AND EVALUATION

BACKGROUND

The Global Warming Solutions Act of 2008 (GWSA) requires statewide reductions in greenhouse gas (GHG) emissions of 25 percent below 1990 levels by the year 2020, and 80 percent below 1990 levels by 2050. As part of the GWSA, the Executive Office of Energy and Environmental Affairs developed the Massachusetts Clean Energy and Climate Plan, which outlines programs to attain the 25 percent reduction by 2020—including a 7.6 percent reduction to be attributed to the transportation sector.

The Commonwealth's 10 MPOs and three non-metropolitan planning regions are integrally involved in helping to achieve GHG emissions reductions mandated under the GWSA. The MPOs work closely with the Massachusetts Department of Transportation (MassDOT) and other involved agencies to develop common transportation goals, policies, and projects that will help to reduce GHG emissions levels statewide, and meet the specific requirements of the GWSA regulation, *Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation* (310 CMR 60.05). The purpose of this regulation is to assist the Commonwealth in achieving its adopted GHG emissions reduction goals by requiring the following:

- MassDOT to demonstrate that its GHG emissions reduction commitments and targets are being achieved
- Each MPO to evaluate and track the GHG emissions and impacts of both its Long-Range Transportation Plan (LRTP) and Transportation Improvement Program (TIP)
- Each MPO, in consultation with MassDOT, to develop and use procedures to prioritize and select projects for its LRTP and TIP based on factors that include GHG emissions and impacts

The Commonwealth's MPOs are meeting the requirements of this regulation through the transportation goals and policies contained in their 2016 LRTPs, the major projects planned in their LRTPs, and the mix of new transportation projects that are programmed and implemented through their TIPs.

The GHG tracking and evaluation processes enable the MPOs and MassDOT to identify the anticipated GHG impacts of the planned and programmed projects, and to use GHG impacts as criteria to prioritize transportation projects. This approach is consistent with the GHG emissions reduction policies that promote healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle, and pedestrian investments, as well as policies that support smart growth development patterns by creating a balanced multi-modal transportation system.

REGIONAL TRACKING AND EVALUATING LONG-RANGE TRANSPORTATION PLANS

MassDOT coordinated with MPOs and regional planning agencies to implement GHG tracking and to evaluate projects during the development of the LRTPs that were adopted in September 2011. This collaboration continued during the development of the LRTPs and amendments adopted in 2016, and for the TIPs produced for federal fiscal years (FFYs) 2016–19, 2017–21, 2018–22, 2019–23, and 2020–24. Working together, MassDOT and the MPOs have attained the following milestones:

- As a supplement to the 2016 LRTPs and Amendment One to the Boston Region MPO's LRTP, *Charting Progress to 2040*, the MPOs have completed modeling and developed long-range statewide projections for GHG emissions produced by the transportation sector. The Boston Region MPO's travel demand model and the statewide travel demand model were used to project GHG emissions levels for 2018, 2019, and 2020 No-Build (base conditions). These projections were developed as part of amendments to 310 CMR 60.05 (adopted in August 2017 by the Massachusetts Department of Environmental Protection) to demonstrate that aggregate transportation GHG emissions reported by MassDOT will meet established annual GHG emissions targets.
- All of the MPOs have discussed climate change, addressed GHG emissions reduction projections in their LRTPs, and prepared statements affirming their support for reducing GHG emissions as a regional goal.

TRACKING AND EVALUATING THE TRANSPORTATION IMPROVEMENT PROGRAM

In addition to monitoring the GHG impacts of projects in the LRTP that will add capacity to the transportation system, it also is important to monitor and evaluate the GHG impacts of all transportation projects that are programmed in the TIP. The TIP includes both the larger, capacity-adding projects from the LRTP and smaller projects, which are not included in the LRTP but that may affect GHG emissions. The principal objective of this tracking is to enable the MPOs to evaluate the expected GHG impacts of different projects and to use this information as criteria to prioritize and program projects in future TIPs.

In order to monitor and evaluate the GHG impacts of TIP projects, MassDOT and the MPOs have developed approaches for identifying anticipated GHG emissions impacts of different types of projects. Since carbon dioxide (CO₂) is the largest component of GHG emissions overall and is the focus of regulation 310 CMR 60.05, CO₂ has been used to measure the GHG emissions impacts of transportation projects in the TIP and LRTP.

All TIP projects have been sorted into two categories for analysis: 1) projects with quantified CO₂ impacts, and 2) projects with assumed CO₂ impacts. Projects with quantified impacts consist of capacity-adding projects from the LRTP and projects from the TIP that underwent

a Congestion Mitigation and Air Quality Improvement (CMAQ) program spreadsheet analysis. Projects with assumed impacts are those that would be expected to produce a minor decrease or increase in emissions, and those that would be assumed to have no CO₂ impact.

Travel Demand Model

Projects with quantified impacts include capacity-adding projects in the LRTP that were analyzed using the Boston Region MPO's travel demand model set. No independent calculations were done for these projects during the development of the TIP.

Off-Model Methods

MassDOT's Office of Transportation Planning provided spreadsheets that are used to determine projects' eligibility for funding through the CMAQ program. Typically, MPO staff uses data from projects' functional design reports, which are prepared at the 25-percent design phase, to conduct these calculations. Staff used these spreadsheets to calculate estimated projections of CO₂ for each project, in compliance with GWSA regulations. These estimates are shown in Tables B-1 and B-2. A note of "to be determined" is shown for those projects for which a functional design report was not yet available.

As part of the development of the FFYs 2020–24 TIP, analyses were done for the types of projects described below. A summary of steps performed in the analyses is provided.

Traffic Operational Improvement

For an intersection reconstruction or signalization project that typically reduces delay and, therefore, idling, the following steps are taken:

- Step 1: Calculate the AM peak hour total intersection delay (seconds)
- Step 2: Calculate the PM peak hour total intersection delay (seconds)
- Step 3: Select the peak hour with the longer intersection delay
- Step 4: Calculate the selected peak hour total intersection delay with improvements
- Step 5: Calculate the vehicle delay in hours per day (assumes peak hour delay is 10 percent of daily delay)
- Step 6: Input the emissions factors for arterial idling speed from the US Environmental Protection Agency's Motor Vehicle Emission Simulator (MOVES)
- Step 7: Calculate the net emissions change in kilograms per day
- Step 8: Calculate the net emissions change in kilograms per year (seasonally adjusted)
- Step 9: Calculate the cost effectiveness (first year cost per kilogram of emissions reduced)

Pedestrian and Bicycle Infrastructure

For a shared-use path that would enable more walking and biking trips and reduce automobile trips, the following steps are taken:

- Step 1: Calculate the estimated number of one-way trips based on the percentage of workers residing in the communities served by the facility and the communities' bicycle and pedestrian commuter mode share
- Step 2: Calculate the reduction in vehicle-miles traveled per day and per year (assumes each trip is the length of the facility and that the facility operates 200 days per year)
- Step 3: Input the MOVES emissions factors for the average commuter travel speed (assumes 35 miles per hour)
- Step 4: Calculate the net emissions change in kilograms per year (seasonally adjusted)
- Step 5: Calculate the cost effectiveness (first year cost per kilogram of emissions reduced)

Bus Replacement

For a program that replaces old buses with new buses that reduce emissions or run on cleaner fuel, the following steps are taken:

- Step 1: Input the MOVES emissions factors for the average bus travel speed (assumes 18 miles per hour) for both the old model year bus and the new model year bus
- Step 2: Calculate the fleet vehicle-miles per day based on the vehicle revenue-miles and operating days per year
- Step 3: Calculate the net emissions change in kilograms per year (seasonally adjusted)
- Step 4: Calculate the cost effectiveness (first-year cost per kilogram of emissions reduced)

Other Types of Projects

Calculations may be performed on the project types listed below; however, there are no projects of these types in this TIP:

- New and Additional Transit Service: A new bus or shuttle service that reduces automobile trips
- Park-and-Ride Lot: A facility that reduces automobile trips by encouraging high-occupancy vehicle (HOV) travel via carpooling or transit
- Alternative Fuel Vehicles: New vehicle purchases that replace traditional gas or diesel vehicles with alternative fuel or advanced technology vehicles
- Anti-Idling Strategies: Strategies that include incorporating anti-idling technology into fleets and using light-emitting diode (LED) lights on trucks for the purpose of illuminating worksites

- **Bike-share Projects:** Programs in which bicycles are made available for shared use to individuals on a short-term basis, allowing each bicycle to serve several users per day
- **Induced Travel:** Projects associated with a roadway capacity change that gives rise to new automobile trips
- **Speed Reduction Projects:** Projects that result in slower vehicle travel speeds and, therefore, reduced emissions
- **Transit Signal Priority Projects:** Technology at signalized intersections or along corridors that affect bus travel times
- **Truck Stop Electrification:** Technology that provides truck drivers with necessary services, such as heating, air conditioning, or appliances, without requiring them to idle their engines

ANALYZING PROJECTS WITH ASSUMED IMPACTS

Qualitative Decrease or Increase in CO₂ Emissions

Projects with assumed CO₂ impacts are those that could produce a minor decrease or increase in emissions, but the change in emissions cannot be calculated with any precision. Examples include a bicycle rack installation, Safe Routes to School project, or transit marketing or customer service improvement. These projects are categorized as producing an assumed nominal increase or decrease in emissions.

No CO₂ Impact

Projects that do not change the capacity or use of a facility—for example, a resurfacing project that restores a roadway to its previous condition, or a bridge rehabilitation or replacement that restores the bridge to its previous condition—are assumed to have no CO₂ impact. More details about these projects, including a description of each project’s anticipated CO₂ impacts, are discussed in Chapter 3. The following tables display the GHG impact analyses of projects funded in the FFYs 2020–24 Highway Program (Table B-1) and Transit Program (Table B-2). Table B-3 summarizes the GHG impact analyses of highway projects completed in FFY 2019. Table B-4 summarizes the GHG impact analyses of transit projects completed in FFY 2019. A project is considered completed when the construction contract has been awarded or the transit vehicles have been purchased.

Table B-1
Greenhouse Gas Regional Highway Project Tracking

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO ₂ Impact (kg/yr) | GHG Impact Description |
|--------------------|---|-------------------|------------------------------------|---|
| 608229 | Acton - Intersection and signal improvements at Kelley's Corner | Quantified | 111,958 | Quantified decrease in emissions from Complete Streets project |
| 607748 | Acton - Intersection and signal improvements on Route 2 and Route 111 (Massachusetts Ave) at Piper Rd and Taylor Rd | Qualitative | | Qualitative decrease in emissions |
| 609222 | Arlington – Spy Pond Sediment Removal | Qualitative | | No assumed impact/negligible impact on emissions |
| 604123 | Ashland - Reconstruction on Route 126 (Pond St) from Framingham town line to Holliston town line | Quantified | 148,097 | Quantified decrease in emissions from Complete Streets project |
| 607738 | Bedford - Minuteman Bikeway extension from Loomis St to the Concord town line | Quantified | 21,098 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 608948 | Bellingham - Franklin – Southern New England Trunk Trail (SNETT) Construction | Quantified | TBD | TBD |
| 608887 | Bellingham - South Main St (Route 126) - Douglas Dr to Mechanic St reconstruction (Route 140) | Quantified | 24,363 | Quantified decrease in emissions from Complete Streets project |
| 608911 | Belmont - Improvements at Wellington Elementary School (SRTS) | Qualitative | | Qualitative decrease in emissions |
| 608347 | Beverly - Intersection improvements at 3 locations: Cabot St (Route 1A/97) at Dodge St (Route 1A), County Way, Longmeadow Rd and Scott St, McKay St at Balch St and Veterans Memorial Bridge (Route 1A) at Rantoul, Cabot, Water, and Front Sts | Quantified | 582,422 | Quantified decrease in emissions from traffic operational improvement |
| 608348 | Beverly - Rehabilitation of Bridge St | Quantified | 387,153 | Quantified decrease in emissions from Complete Streets project |
| 606902 | Boston - Bridge Reconstruction/Rehab, B-16-181, West Roxbury Parkway over MBTA | Qualitative | | No assumed impact/negligible impact on emissions |
| 604173 | Boston - Bridge replacement, B-16-016, North Washington St Bridge over the Boston Inner Harbor | Qualitative | | No assumed impact/negligible impact on emissions |
| 606728 | Boston - Bridge replacement, B-16-365, Bowker Overpass over Storrow Drive (eastbound) | Qualitative | | No assumed impact/negligible impact on emissions |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 2)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|---|--------------------------|--|---|
| 606476 | Roadway, Ceiling & Wall Reconstruction, New Jet Fans, and other Control Systems in Sumner Tunnel | Qualitative | | No assumed impact/negligible impact on emissions |
| 608614 | Boston - Bridge substructure repairs, B-16-179, Austin St over I-93 ramps, MBTA commuter rail and Orange Line | Qualitative | | No assumed impact/negligible impact on emissions |
| 606453 | Boston - Improvements on Boylston St, from Intersection of Brookline Ave and Park Dr to Ipswich St | Quantified | 1,920,790 | Quantified decrease in emissions from Complete Streets project |
| 607759 | Boston - Intersection improvements at the VFW Parkway and Spring St | Qualitative | | Qualitative decrease in emissions |
| 608943 | Boston - Neponset River Greenway (Phase 3) | Quantified | 239,055 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 606226 | Boston - Reconstruction of Rutherford Ave, from City Square to Sullivan Square | Quantified | | L RTP project included in the statewide model |
| 608197 | Boston - Superstructure replacement, B-16-107, Canterbury St over Amtrak/ MBTA | Qualitative | | No assumed impact/negligible impact on emissions |
| 607888 | Boston-Brookline - Multi-use path construction on New Fenway | Quantified | 54,724 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 609090 | Boston-Milton-Quincy - Highway lighting system replacement on Interstate 93, from Neponset Ave to the Braintree split | Qualitative | | No assumed impact/negligible impact on emissions |
| 608608 | Braintree - Highway Lighting Improvements at I-93/Route 3 Interchange | Qualitative | | No assumed impact/negligible impact on emissions |
| 608482 | Cambridge-Somerville - Resurfacing and related work on Route 28 | Qualitative | | No assumed impact/negligible impact on emissions |
| TBD | Canton - Bridge Replacement, C-02-042, Revere Court over East Branch Neponset River | Qualitative | | No assumed impact/negligible impact on emissions |
| 609053 | Canton-Dedham-Norwood - Highway lighting improvements at Interstate 93 and Interstate 95/Route 128 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608484 | Canton-Milton - Resurfacing and related work on Route 138 | Qualitative | | No assumed impact/negligible impact on emissions |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 3)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|--|--------------------------|--|---|
| 608611 | Canton-Milton-Randolph - Replacement and rehabilitation of the highway lighting system at the Route 24 and Interstate 93 interchange | Qualitative | | No assumed impact/negligible impact on emissions |
| 608599 | Canton-Sharon-Foxborough-Norwood-Walpole – Storm water improvements along Route 1, Route 1A, and Interstate 95 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608078 | Chelsea - Reconstruction on Broadway (Route 107) from City Hall to Revere city line | Quantified | 93,278 | Quantified decrease in emissions from Complete Streets project |
| 605287 | Chelsea - Route 1 Viaduct rehabilitation (southbound/northbound) on C-09-007 and C-09-011 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608007 | Cohasset - Corridor improvements and related work on Justice Cushing Highway (Route 3A) from Beechwood St to Henry Turner Bailey Rd | Quantified | 5,849 | Quantified decrease in emissions from Complete Streets project |
| BN1800 | Community Transportation Program | Quantified | TBD | TBD |
| 608495 | Concord-Lexington-Lincoln - Resurfacing and related work on Route 2A | Qualitative | | No assumed impact/negligible impact on emissions |
| 608818 | Danvers - Resurfacing and related work on Route 114 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608378 | Danvers-Topsfield-Boxford-Rowley - Interstate maintenance and related work on Interstate 95 | Qualitative | | No assumed impact/negligible impact on emissions |
| 607899 | Dedham - Pedestrian improvements along Bussy St | Quantified | 3,331 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 607901 | Dedham - Pedestrian improvements along Elm St and Rustcraft Rd corridors | Quantified | 14,046 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 608596 | Essex - Superstructure replacement, E-11-001 (2TV), Route 133/Main St over Essex River | Qualitative | | No assumed impact/negligible impact on emissions |
| 607652 | Everett - Reconstruction of Ferry St, South Ferry St and a portion of Elm St | Quantified | 435,976 | Quantified decrease in emissions from Complete Streets project |
| 609257 | Everett - Rehabilitation of Beacham St, from Route 99 to Chelsea city line | Quantified | 4,038 | Quantified decrease in emissions from Complete Streets project |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 4)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO ₂ Impact (kg/yr) | GHG Impact Description |
|--------------------|---|-------------------|------------------------------------|--|
| 608210 | Foxborough-Plainville-Wrentham-Franklin – Interstate maintenance resurfacing work on Interstate 495 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608480 | Foxborough-Walpole - Resurfacing and related work on Route 1 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608228 | Framingham - Reconstruction of Union Ave, from Proctor St to Main St | Quantified | -217,978 | Quantified increase in emissions |
| 608889 | Framingham - Traffic Signal Installation at Edgell Rd and Central St | Quantified | 233,257 | Quantified decrease in emissions from Complete Streets project |
| 609402 | Framingham-Natick - Resurfacing and Related Work on Route 9 | Qualitative | | No assumed impact/negligible impact on emissions |
| TBD | Hamilton - Bridge Replacement, Winthrop Street over Ipswich River | Qualitative | | No assumed impact/negligible impact on emissions |
| 605168 | Hingham - Intersection Improvements at Route 3A/Summer Street Rotary | Quantified | 284,736 | Quantified decrease in emissions from Complete Streets project |
| 608498 | Hingham-Weymouth-Braintree - Resurfacing and related work on Route 53 | Qualitative | | No assumed impact/negligible impact on emissions |
| 606501 | Holbrook - Reconstruction of Union St (Route 139), from Linfield St to Centre St and Water St | Quantified | 4,097 | Quantified decrease in emissions from Complete Streets project |
| 607428 | Hopedale-Milford - Resurfacing and intersection improvements on Route 16 (Main St), from Water St west to approximately 120 feet west of the Milford/Hopedale town line and the intersection of Route 140 | Quantified | 201,148 | Quantified decrease in emissions from Complete Streets project |
| 606043 | Hopkinton - Signal and intersection improvements on Route 135 | Quantified | 1,298,625 | Quantified decrease in emissions from Complete Streets project |
| 607977 | Hopkinton-Westborough - Reconstruction of Interstate 90/ Interstate 495 interchange | Quantified | | L RTP project included in the statewide model |
| 601607 | Hull - Reconstruction of Atlantic Ave and related work | Quantified | 6,586 | Quantified decrease in emissions from Complete Streets project |
| 605743 | Ipswich - Resurfacing and related work on Central and South Main Sts | Quantified | 4,356 | Quantified decrease in emissions from Complete Streets project |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 5)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|---|--------------------------|--|---|
| 609054 | Littleton - Reconstruction of Foster St | Quantified | 1,140 | Quantified decrease in emissions from Complete Streets project |
| 608443 | Littleton/Ayer - Intersection improvements on Route 2A at Willow Rd and Bruce St | Quantified | 52,102 | Quantified decrease in emissions from traffic operational improvement |
| 609254 | Lynn - Intersection Improvements at Two Intersections on Broadway | Quantified | 73,291 | Quantified decrease in emissions from traffic operational improvement |
| 602077 | Lynn - Reconstruction on Route 129 (Lynnfield St), from Great Woods Rd to Wyoma Square | Quantified | 12,761 | Quantified decrease in emissions from Complete Streets project |
| 609252 | Lynn - Rehabilitation of Essex St | Quantified | 411,394 | Quantified decrease in emissions from Complete Streets project |
| 607477 | Lynnfield- Peabody - Resurfacing and related work on Route 1 | Qualitative | | No assumed impact/negligible impact on emissions |
| 609060 | Lynnfield-Peabody-Danvers - Guide and traffic sign replacement on Interstate 95/Route 128 (Task 'A' interchange) | Qualitative | | No assumed impact/negligible impact on emissions |
| 604952 | Lynn-Saugus - Bridge replacement, L-18-016=S-05-008, Route 107 over the Saugus River (AKA – Belden G. Bly Bridge) | Qualitative | | No assumed impact/negligible impact on emissions |
| 608275 | Malden - Exchange St Downtown Improvement Project | Quantified | 13,519 | Quantified decrease in emissions from Complete Streets project |
| 608146 | Marblehead - Intersection improvements at Pleasant St and Village, Vine, and Cross St | Quantified | 531 | Quantified decrease in emissions from traffic operational improvement |
| 608566 | Marlborough - Improvements at Route 20 (East Main St) at Curtis Ave | Qualitative | | Qualitative decrease in emissions |
| 608467 | Marlborough - Resurfacing and related work on Route 20 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608637 | Maynard - Bridge replacement, M-10-006, carrying Florida Rd over the Assabet River | Qualitative | | No assumed impact/negligible impact on emissions |
| 608835 | Medford - Improvements at Brook Elementary School | Qualitative | | Qualitative decrease in emissions |
| 608522 | Middleton - Bridge Replacement, M-20-003, Route 62 (Maple Street) over Ipswich River | Qualitative | | No assumed impact/negligible impact on emissions |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 6)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | | GHG Impact Description |
|---------------------------|---|--------------------------|--|-----|---|
| 608045 | Milford - Rehabilitation on Route 16, from Route 109 to Beaver St | Quantified | -38,500 | | Quantified increase in emissions |
| 607342 | Milton - Intersection and signal improvements at Route 28 (Randolph Ave and Chickatawbut Rd) | Qualitative | | | Qualitative decrease in emissions |
| 606635 | Needham-Newton - Reconstruction of Highland Ave, Needham St and Charles River Bridge, N-04-002, from Webster St (Needham) to Route 9 (Newton) | Quantified | 1,186,210 | | Quantified decrease in emissions from Complete Streets project |
| 608610 | Newton - Steel superstructure cleaning (full removal) and painting of N-12-055 | Qualitative | | | No assumed impact/negligible impact on emissions |
| 609066 | Newton - Weston - Multi-Use Trail Connection, from Recreation Road to Upper Charles River Greenway including Reconstruction of Ped Bridge N-12-078=W-29-062 | Quantified | TBD | TBD | |
| 608866 | Newton-Weston - Steel superstructure cleaning (full removal) and painting of 3 bridges: N-12-051, W-29-011, and W-29-028 | Qualitative | | | No assumed impact/negligible impact on emissions |
| 608609 | Newton-Westwood - Steel superstructure cleaning (full removal) and painting of 2 bridges: N-12-056 and W-31-006 | Qualitative | | | No assumed impact/negligible impact on emissions |
| 608052 | Norwood - Intersection and signal improvements at Route 1 (Providence Highway) and Morse St | Qualitative | | | Qualitative decrease in emissions |
| 605857 | Norwood - Intersection improvements at Route 1 and University Ave/ Everett St | Quantified | 1,092,131 | | Quantified decrease in emissions from traffic operational improvement |
| 606130 | Norwood - Intersection improvements at Route 1A and Upland Rd | Quantified | 72,964 | | Quantified decrease in emissions from traffic operational improvement |
| 608567 | Peabody - Improvements at Route 114 at Sylvan St, Cross St, Northshore Mall, Loris Rd, Route 128 interchange, and Esquire Dr | Qualitative | | | Qualitative decrease in emissions |
| 609211 | Peabody - Independence Greenway Extension | Quantified | 36,651 | | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 609101 | Peabody - Pavement preservation and related work on Route 128 | Qualitative | | | No assumed impact/negligible impact on emissions |

**Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 7)**

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|---|--------------------------|--|---|
| 608933 | Peabody - Rehabilitation of Central St | Quantified | 150,913 | Quantified decrease in emissions from Complete Streets project |
| 609058 | Peabody to Gloucester - Guide and traffic sign replacement on Route 128 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608569 | Quincy - Intersection improvements at Route 3A (Southern Artery) and Broad St | Qualitative | | Qualitative decrease in emissions |
| 608707 | Quincy - Reconstruction of Sea St | Quantified | -30,437 | Quantified increase in emissions |
| 608208 | Quincy-Milton-Boston - Interstate maintenance and related work on Interstate 93 | Qualitative | | No assumed impact/negligible impact on emissions |
| 609396 | Randolph - Milton - Resurfacing and related work on Route 28 | Qualitative | | No assumed impact/negligible impact on emissions |
| 609399 | Randolph - Resurfacing and related work on Route 28 | Qualitative | | No assumed impact/negligible impact on emissions |
| 607305 | Reading - Intersection signalization at Route 28 and Hopkins St | Quantified | 7,088 | Quantified decrease in emissions from traffic operational improvement |
| 608205 | Reading to Lynnfield - Guide and Traffic Sign Replacement on a Section of I-95 (SR 128) | Qualitative | | No assumed impact/negligible impact on emissions |
| 608743 | Salem - Improvements at Bates Elementary School | Qualitative | | Qualitative decrease in emissions |
| 608817 | Salem-Lynn - Resurfacing and related work on Route 107 | Qualitative | | No assumed impact/negligible impact on emissions |
| 608079 | Sharon - Bridge Replacement, S-09-003 (40N), Moskwonikut St over Amtrak/ MBTA | Qualitative | | No assumed impact/negligible impact on emissions |
| 608562 | Somerville - Signal and Intersection Improvements on I-93 at Mystic Ave and McGrath Highway | Quantified | TBD | TBD |
| BNI570 | Somerville-Medford - Green Line Extension Project - extension to College Ave with the Union Square spur | Quantified | | LRTP project included in the statewide model |
| 605342 | Stow - Bridge replacement, Route 62 (Gleasondale Rd) over the Assabet River | Qualitative | | No assumed impact/negligible impact on emissions |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 8)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|---|--------------------------|--|---|
| 608255 | Stow - Bridge Replacement, S-29-011, Box Mill Road over Elizabeth Brook | Qualitative | | No assumed impact/negligible impact on emissions |
| 608164 | Sudbury - Bike path construction (Bruce Freeman Rail Trail) | Quantified | 49,903 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 608895 | Sudbury - Stow - Hudson – Mass Central Rail Trail Wayside | Quantified | TBD | TBD |
| 607761 | Swampscott - Intersection and signal improvements at Route 1A (Paradise Rd) at Swampscott Mall | Qualitative | | Qualitative decrease in emissions |
| 607329 | Wakefield-Lynnfield - Rail Trail Extension, from the Galvin Middle School to Lynnfield/Peabody town line | Quantified | 158,032 | Quantified decrease in emissions from bicycle and pedestrian infrastructure |
| 602261 | Walpole - Reconstruction on Route 1A (Main St), from the Norwood town line to Route 27, includes W-03-024 over the Neponset River | Quantified | 230,473 | Quantified decrease in emissions from Complete Streets project |
| 608564 | Watertown - Intersection improvements at Route 16 and Galen St | Qualitative | | Qualitative decrease in emissions |
| 607777 | Watertown - Rehabilitation of Mount Auburn St (Route 16) | Quantified | 536,769 | Quantified decrease in emissions from Complete Streets project |
| 609102 | Wenham-Manchester-Essex-Gloucester - Pavement preservation and related work on Route 128 | Qualitative | | No assumed impact/negligible impact on emissions |
| 607327 | Wilmington - Bridge replacement, W-38-002, Route 38 (Main St) over the B&M Railroad | Qualitative | | No assumed impact/negligible impact on emissions |
| 608929 | Wilmington - Bridge replacement, W-38-003, Butters Row over MBTA | Qualitative | | No assumed impact/negligible impact on emissions |
| 608703 | Wilmington - Bridge Replacement, W-38-029 (2KV), ST 129 Lowell St over I-93 | Qualitative | | No assumed impact/negligible impact on emissions |
| 609253 | Wilmington - Intersection Improvements at Lowell St (Route 128) and Woburn St | Quantified | 494,197 | Quantified decrease in emissions from Complete Streets project |
| 608051 | Wilmington - Reconstruction of Route 38 (Main St), from Route 62 to the Woburn City Line | Quantified | 492,160 | Quantified decrease in emissions from Complete Streets project |
| 608791 | Winchester - Improvements at Vinson-Owen Elementary School | Qualitative | | Qualitative decrease in emissions |

Table B-1
Greenhouse Gas Regional Highway Project Tracking (cont. 9)

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|---------------------------|--|--------------------------|--|---|
| 607244 | Winthrop - Revere St Roadway Improvements | Quantified | 252,816 | Quantified decrease in emissions from Complete Streets project |
| 604996 | Woburn - Bridge replacement, W-43-017, New Boston St over MBTA | Quantified | | LRTP project included in the statewide model |
| 603739 | Wrentham - Construction of Interstate 495/Route 1A ramps | Quantified | 1,233,486 | Quantified decrease in emissions from traffic operational improvement |

Greenhouse Gas Regional Highway Project Tracking

CO₂ = carbon dioxide; GHG = greenhouse gas; kg = kilogram; LRTP = Long-Range Transportation Plan; TBD = to be determined; yr = year.

Table B-2
Greenhouse Gas Regional Transit Project Tracking

| Regional Transit Authority | Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description |
|-----------------------------------|---|--------------------------|--|---|
| CATA | Rehab/renovate-repave parking lot | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| CATA | Acquire - Shop equipment/software maintenance | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| CATA | Preventative maintenance | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MBTA | Bridge and Tunnel Program | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MBTA | Green Line Extension Project – Extension to College Avenue with the Union Square Spur | Quantified | 0 | L RTP project included in the statewide model |
| MBTA | Stations and Facilities | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MBTA | Bus Program | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MBTA | Elevator and Escalator Program | Qualitative | 00 | No assumed impact/negligible impact on emissions |
| MBTA | Revenue Vehicle Program | Qualitative | TBD | Quantified decrease in emissions from bus replacement |
| MBTA | Systems/Signal Upgrade Program | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MWR TA | Acquisition of Bus Support Equipment/Facilities | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MWR TA | Mobility Management | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MWR TA | Non-Fixed Route ADA Paratransit Services | Qualitative | 0 | No assumed impact/negligible impact on emissions |
| MWR TA | Terminal, Intermodal (Transit) | Qualitative | 0 | No assumed impact/negligible impact on emissions |

ADA = Americans with Disabilities Act; CO₂ = carbon dioxide; GHG = greenhouse gas; kg = kilogram; L RTP = Long-Range Transportation Plan; TBD = to be determined; yr = year.

Table B-3
Greenhouse Gas Regional Highway “Completed” Project Tracking

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO2 Impact (kg/yr) | GHG Impact Description | FFY of Contract Award |
|---------------------------|--|--------------------------|-------------------------------|---|------------------------------|
| 29492 | Bedford-Billerica - Middlesex Turnpike improvements, from Crosby Dr north to Manning Rd, includes reconstruction of B-04-006 (Phase III) | Quantified | L RTP | L RTP project included in the statewide model | 2017 |
| 604761 | Boston - Multi-Use Trail Construction (South Bay Harbor), from Ruggles Station to Fort Point Channel | Quantified | 767,491 | Quantified decrease in emissions from bicycle and pedestrian infrastructure | 2017 |
| 607309 | Hingham- Reconstruction and related work on Derby St, from Pond Park Rd to Cushing St | Quantified | -113,400 | Quantified decrease in emissions from Complete Streets project | 2017 |
| 604810 | Marlborough - Reconstruction of Route 85 (Maple St) | Quantified | 589,680 | Quantified decrease in emissions from Complete Streets project | 2017 |
| 607754 | Milton - Intersection and Signal Improvements at Granite Ave and Squantum St | Quantified | | TBD | 2017 |
| 602165 | Stoneham - Signal and intersection improvements at Route 28/North St | Quantified | 139,709 | Quantified decrease in emissions from traffic operational improvement | 2017 |
| 607999 | Revere – Improvements at Garfield Elementary and Middle School (SRTS) | Qualitative | | Qualitative Decrease in Emissions | 2017 |
| 608004 | Watertown - Safe Routes to School (Hosmer Elementary) | Qualitative | | Qualitative Decrease in Emissions | 2017 |
| 608003 | Weymouth - Safe Routes to School (Pingree Elementary) | Qualitative | | Qualitative Decrease in Emissions | 2017 |
| 601630 | Weymouth- Abington - Reconstruction and Widening on Route 18 (Main St), from Highland Pl to Route 139 | Quantified | L RTP | L RTP project included in the statewide model | 2017 |
| 604935 | Woburn - Reconstruction of Montvale Ave, from Interstate 93 interchange to Central St (approximately 1,850 feet) | Quantified | 98,885 | Quantified decrease in emissions from Complete Streets project | 2017 |
| 607732 | Cochituate Rail Trail, Phase Two, Including Pedestrian Bridge, N-30-014, Over Route 9 and F-07-033=N-03-029 over Route 30 | Quantified | 62,441 | Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure | 2018 |

| MassDOT Project ID | MassDOT Project Description | GHG Analysis Type | GHG CO2 Impact (kg/yr) | GHG Impact Description | FFY of Contract Award |
|--------------------|--|-------------------|------------------------|---|-----------------------|
| 608013 | Quincy - Intersection Improvements at Sea St and Quincy Shore | Quantified | 701,528 | Quantified decrease in emissions from traffic operational improvement | 2018 |
| 608352 | Salem - Canal Street Rail Trail construction (Phase 2) | Quantified | 6,651 | Quantified decrease in emissions from bicycle and pedestrian infrastructure | 2018 |
| 607507 | Wakefield - Bridge Deck Replacement, W-01-021 (2MF) Hopkins Street over I-95 / ST 128 | Qualitative | | Qualitative Decrease in Emissions | 2018 |
| 606134 | Boston- Traffic Signal Improvements on Blue Hill Ave and Warren St | Qualitative | | Qualitative Decrease in Emissions | 2019 |
| 608651 | Braintree- Adaptive Signal Controls on Route 37 (Granite St) | Qualitative | | Qualitative Decrease in Emissions | 2019 |
| 605110 | Brookline- Intersection and signal improvements at Route 9 and Village Square (Gateway East) | Quantified | 67,056 | Quantified decrease in emissions from Complete Streets project | 2019 |
| 600518 | Hingham - Intersection improvements at Derby St, Whiting St, and Gardner St | Quantified | -145,683 | Quantified increase in emissions | 2019 |
| 607133 | Quincy - Superstructure Replacement, Q-01-039, Robertson St over I-93/US I/SR 3 | Qualified | | No assumed impact/negligible impact on emissions | 2019 |
| 604989 | Southborough - Reconstruction of Main St (Route 30), from Sears Rd to Park St | Quantified | 231,813 | Quantified decrease in emissions from Complete Streets project | 2019 |
| 608823 | Wellesley- Newton- Weston - Pavement Resurfacing and Related Work on I-95 | Qualitative | | No assumed impact/negligible impact on emissions | 2019 |

Greenhouse Gas Regional Highway “Completed” Project Tracking

CO₂ = carbon dioxide; GHG = greenhouse gas; kg = kilogram; LRTP = Long-Range Transportation Plan; yr = year

Table B-4
Greenhouse Gas Regional Transit “Completed” Project Tracking

| Regional Transit Authority | Project Description | GHG Analysis Type | GHG CO₂ Impact (kg/yr) | GHG Impact Description | FFY of Contract Award |
|-----------------------------------|---|--------------------------|--|---|------------------------------|
| CATA | Buy replacement 30-foot buses (3) | Quantified | 1,278 | Quantified decrease in emissions from bus replacement | 2017 |
| MWRTA | Non-fixed route ADA paratransit vehicles (4) | Quantified | 6,653 | Quantified decrease in emissions from bus replacement | 2017 |
| CATA | Buy replacement 30-foot buses (3) | Quantified | 60,730 | Quantified decrease in emissions from bus replacement | 2018 |
| MWRTA | Buy replacement - less than 30-foot CNG buses (6) | Quantified | -125,266 | Quantified decrease in emissions from bus replacement | 2018 |
| MWRTA | Buy Replacement paratransit vehicles (9) | Quantified | 23,069 | Quantified decrease in emissions from bus replacement | 2018 |
| MBTA | Bus replacement, 40-foot hybrid buses (194) | Quantified | 1,216,492 | Quantified decrease in emissions from bus replacement | 2019 |
| MWRTA | Buy Replacement, Capitol Bus (3) | Qualitative | 5,681 | Quantified decrease in emissions from bus replacement | 2019 |

ADA = Americans with Disabilities Act; CO₂ = carbon dioxide; GHG = greenhouse gas; kg = kilogram; yr = year.