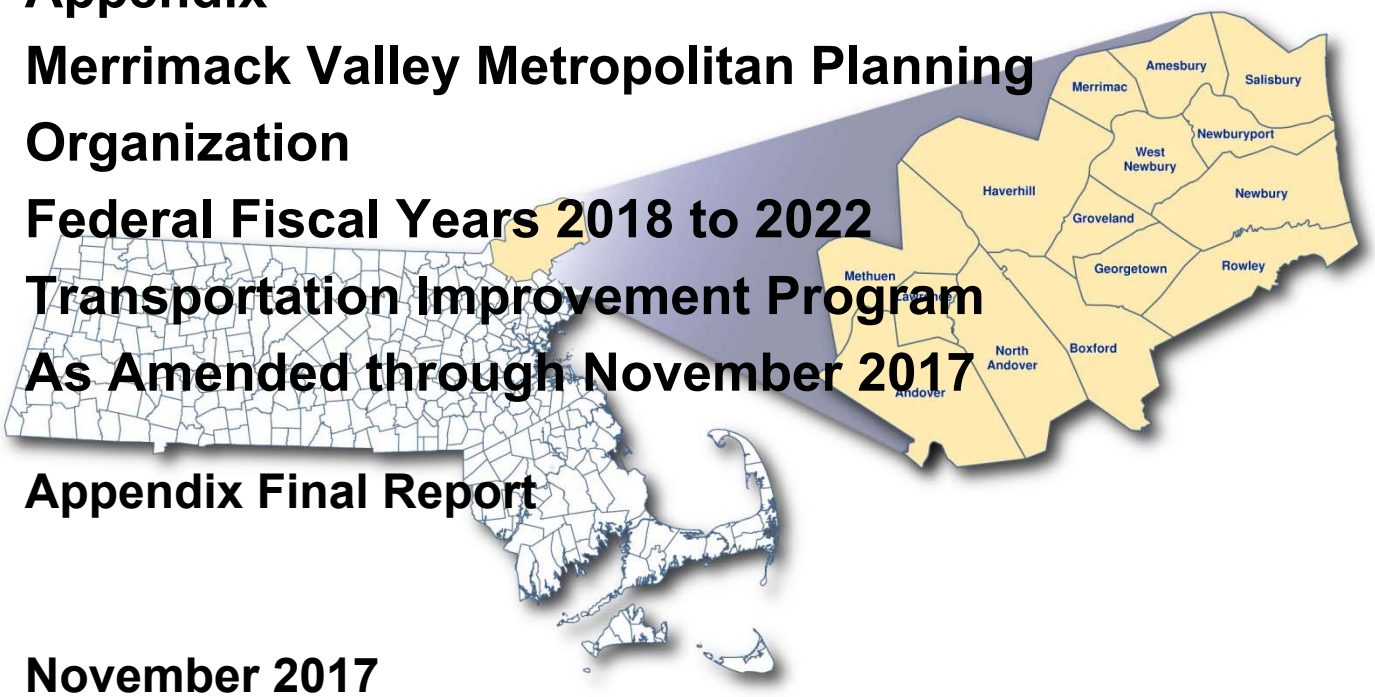
Appendix
Merrimack Valley Metropolitan Planning Organization
Federal Fiscal Years 2018 to 2022 Transportation Improvement Program
As Amended through November 2017



Appendix Final Report

November 2017

Prepared by the Merrimack Valley Planning Commission

This document was prepared by the Merrimack Valley Planning Commission under Contracts #95416, #MA-80-010 and #MA-80-011 with MassDOT and with the assistance of the Merrimack Valley Regional Transit Authority, MassDOT, the Federal Highway Administration and the Federal Transit Administration.

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Appendices

Appendix A and B: Other Regional Priorities

Appendix A Other Regional Priority Bridge Projects

Merrimack Valley Metropolitan Planning Organization
FFY 2018-2022 Transportation Improvement Program
Implementing Agency: MassDOT

Bridges That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year:

ID	Location	Project Description	Highway District	Estimated Total Project Cost
602322	Ames.	Amesbury - Bridge Replacement, A-07-008, Oak Street Over the B&M Railroad (Abandoned Line)	4	$1,000,000
	And.	Andover - Rehab. Bridge (A-09-001) Route 28 (North Main Street) Over the Shawsheen River	4	
605418	And.	Andover - Bridge Preservation, A-09-028, Chandler Road over I-93	4	$3,450,000
606522	And.	Andover - Bridge Rehabilitation, A-09-036, I-495 over ST 28 (SB), A-09-037, I-495 over B&M and MBTA, A-09-041, I-495 over ST 28 (NB)	4	$22,706,948
605304	Hav.	Haverhill- Bridge Replacement, H-12-007 & H-12-025, Bridge Street (SR 125) over the Merrimack River and the Abandoned B&M RR (Proposed Bikeway)	4	$63,437,220
604839	Law.	Lawrence – Bridge Replacement, L-04-027, Lowell Street over B&M Railroad	4	$4,473,000
	Law.	Lawrence - Bridge Rehabilitation, L-04-042, South Union Connector over South Street	4	

Appendix A Other Regional Priority Bridge Projects (Continued)

Merrimack Valley Metropolitan Planning Organization
FFY 2018-2022 Transportation Improvement Program
Implementing Agency: MassDOT

Bridges That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year:

ID	Location	Project Description	Highway District	Estimated Total Project Cost
	Nbypt.	Newburyport - Bridge (N-11-002) State Route 113 (High Street) Over Railroad	4	
	Nbypt.	Newburyport - Bridge (N-11-014) State Route 1A (High Street) over US 1	4	
607115	Nbypt.	Newburyport - Bridge Repairs, N-11-015, Washington St. over US 1	4	$1,400,000

Appendix B Other Regional Priority Roadway Projects

Merrimack Valley Metropolitan Planning Organization
FFYs 2018-2022 Transportation Improvement Program By Town

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year:

ID	Location	Project Description	District	Estimated Total Project Cost
608336	Andover	Andover – Reconstruction on Route 133 (Lowell Street), from Lovejoy Road to Route 28 (North Main Street) TEC = 11.00	4	$7,245,000
607708	Andover/ Lawrence	Andover - Lawrence - Resurfacing and related work on Route 28 TEC = 5.22	4	$1,062,600
606721	Boxford	Boxford - Reconstruction of Route 133 (Washington Street) from North Andover town line to Main Street TEC = 5.60	4	$5,172,164
	Boxford	Boxford Reconstruction of Route 97 from Georgetown to Topsfield (2 miles)	4	$3,785,000
607540	Boxford	Boxford - Border to Boston Trail TEC = 3.32	4	$4,174,500
604950	George.	Georgetown – Park & Ride lot construction at I-95 and Route 133 Interchange TEC = 3.78	4	$3,276,594
	Haverhill	Haverhill -Intersection Improvements Route 110 and Elliot Way	4	
	Haverhill	Haverhill – Widen Route 97 (Broadway) from Computer Drive to Forrest Street	4	

Appendix B Other Regional Priority Roadway Projects (Continued)

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year:

ID	Location	Project Description	District	Estimated Total Project Cost
607711	Haverhill	Haverhill - Resurfacing and related work on Route 125 (from N. And. TL to Boston Rd) TEC = 5.80	4	$1,062,600
608761	Haverhill	Haverhill – Intersection Reconstruction on Route 108 (Newton Road) at Route 110 (Kenoza Avenue and Amesbury Road) TEC = 8.03	4	$1,944,000
608788	Haverhill	Haverhill – Reconstruction of North Avenue TEC = 8.00	4	$12,200,000
608721	Haverhill	Haverhill – Corridor Improvements on Water Street (Route 97/113), from Ginty Boulevard/Mill Street to Lincoln Boulevard/Riverside Avenue TEC = 7.98	4	$8,050,000
	Haverhill	Haverhill – Buttonwoods Trail	4	$2,000,000
602339	Haverhill	Haverhill-Historic Waterfront Walkway Phase II (Construction)	4	$3,110,184
	Lawrence/ North Andover	Lawrence - North Andover - Reconstruction of Route 114 from South Union St. in Lawrence to Rt. 125 (Andover St.) in North Andover TEC = 12.8	4	$16,300,000

Appendix B Other Regional Priority Roadway Projects (Continued)

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year:

ID	Location	Project Description	District	Estimated Total Project Cost
	Lawrence	Lawrence - Construct Multi-use Trail along old M&L Branch ROW from Methuen line to Merrimack Street	4	
	Lawrence	Lawrence - Reconstruct Merrimack Street from Parker Street to South Union Street TEC = 9.68	4	
	Methuen	Methuen – Reconstruction of Route 110 from Burnham Road to Woodland Street	4	
	Newburyport	Newburyport -Route 1 Rotary Reconfiguration	4	
608029	Newburyport	Newburyport - Intersection Improvements Route 1 at Merrimac Street TEC = 7.22	4	$2,400,000
	North Andover	North Andover - Machine Shop Village improvements	4	
	North Andover	North Andover – Reconstruction of Mass. Ave. and Sidewalks (from Osgood St. to I-495)	4	
605694	North Andover	North Andover - Resurfacing and related work Route 125 TEC = 7.45	4	$7,910,592
	North Andover	North Andover - Signals and turn lanes at Mass Ave. and I-495 NB and SB Ramps	4	
602202	Salisbury	Salisbury - Reconstruction of Route 1 (Lafayette Road) TEC = 8.10	4	$6,330,819

Appendix C Transportation Evaluation Criteria Summary

Appendix C Transportation Evaluation Criteria Summary

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
OPP		Lawrence –North Andover - Reconstruction of Rt. 114 from I-495 to Rt. 125 (Andover St.)		30,000	5.2	3.00	3.00	3.00	1.80	1.50	0.50	**12.80**
TIP	608095	North Andover – Reconstruction of Rt. 114 from Rt. 125 (Andover St.) to Stop & Shop	$14,950	30,000	4.8	2.50	2.75	2.67	1.00	1.50	0.75	**11.17**
OPP	608336	Andover – Rt. 133 reconst. Lovejoy Road to Shawsheen Square (inc. Shawsheen Square)	$7,245	12,773	4.4	2.00	2.75	2.00	1.00	1.75	1.50	**11.00**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
OPP		Lawrence – Merrimack St. (Parker St. to South Union St.)		9,654	0.6	2.50	1.25	1.33	1.6	2.25	0.75	**9.68**
OPP	602202	Salisbury – Reconstruction of Route 1 (Lafayette Road)	$6,331	12,147	4.8	1.50	2.00	2.00	0.60	1.5	0.5	**8.10**
OPP	608761	Haverhill - Intersection Improvements at Rt. 110 / Rt. 108	$1,944	NA	NA	1.00	1.75	1.33	1.20	1.75	1.00	**8.03**
OPP	608788	Haverhill - Reconstruction of North Ave. from Main St. to NH stateline	$12,200	13,172	4	2.50	1.75	1.00	2.00	0.00	0.75	**8.00**
OPP	608721	Haverhill - Corridor Improvements on Water St. from Ginty Blvd / Mill St. to Lincoln Ave./ Riverside Ave.	$8,050	20,200	2	1.05	1.75	1.33	1.40	1.25	0.75	**7.98**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
TIP	606159	North Andover – Intersection Improvements Route 125 at Mass. Ave.	$3,640	30,284	NA	1.50	1.75	2.00	1.20	0.75	0.75	**7.95**
OPP	605694	North Andover – Route 125 Resurfacing and related work	$8,255	20,400	9.4	2.50	1.00	1.00	1.20	1.25	0.50	**7.45**
OPP	608029	Newburyport – Intersection Improvements Rt. 1 at Merrimac St.	$2,400	24,850	NA	2.00	0.50	2.67	0.80	1.00	0.25	**7.22**
TIP	608027	Haverhill – Bradford Rail Trail extension	$1,088	NA	NA	0.50	1.50	1.00	2.40	1.25	0.50	**7.15**
TIP	602418	Amesbury – Reconstruction of Elm Street	$11,600	12,436	3.4	1.50	0.50	1.33	0.40	1.50	0.75	**5.98**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
TIP	605020	Salisbury – Multi-use Trail Extension (Border to Boston Trail), includes new bridge S-02-004	$5,919	NA	NA	1.00	1.25	1.33	0.80	0.75	0.75	**5.88**
OPP	607711	Haverhill – Resurfacing and related work Rt. 125	$1,063	19,224	4.1	2.00	0.75	1.00	0.80	0.75	0.50	**5.80**
OPP	606721	Boxford - Route 133 (North Andover TL to Main St.)	$5,172	6,149	2.9	1.50	1.00	1.00	0.60	0.50	1.00	**5.60**
OPP	607710	Salisbury – Resurfacing and related work Route 1A	$2,300	11,411	8.0	2.00	0.75	1.00	0.60	0.75	0.50	**5.60**
OPP	607708	Andover / Lawrence – Route 28 resurfacing and related work	$1,063	19,728	4.0	2.50	0.25	0.67	0.80	0.50	0.50	**5.22**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
TIP	607542	Georgetown – Square to By-field (Northern) section of Bor-der to Boston Trail	$3,876	NA	NA	0.50	1.25	0.67	0.80	1.50	0.50	**5.22**
TIP	607541	Georgetown- Boxford– south of Square to Georgetown Road (Southern) section of Border to Boston Trail	$1,735	NA	NA	0.50	1.25	0.67	0.80	1.25	0.75	**5.22**
TIP	605753	Groveland – Route 97 (Parker Rd. to Gardner St.)	$3,600	13,500	1.8	1.50	0.50	1.00	0.40	1.00	0.50	**4.90**
TIP	608298	Groveland Community Trail	$1,765	NA	NA	0.50	1.25	0.67	1.20	1.00	0.25	**4.87**
TIP	608809	Lawrence – North Andover resurfacing of Route 114	$8,722	32,900	2.8	1.50	0.25	0.67	0.80	0.50	0.25	**3.97**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2018-2022)
OPP	604950	Georgetown – Park & Ride Construction at I-95 and Route 133 Interchange	$3,277	NA	NA	0.00	1.75	0.33	0.20	0.75	0.75	**3.78**
OPP	607540	Boxford – section of Border to Boston Trail	$4,175	NA	NA	0.50	1.00	0.67	0.40	0.50	0.25	**3.32**

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Appendix D Sample Project Evaluation Worksheet

Sample Project Evaluation Worksheet
Merrimack Valley Planning Commission and MassDOT Evaluation Criteria
Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336
Project Cost: $7,245,000 AADT: 12,773 Distance: 2.2 Linear Lane Miles: 4.4

Condition	Score	Additional Comments
A. Magnitude of pavement condition improvement.	2	PNF indicates longitudinal & lateral pavement cracking, utility patch failure, shoving and rutting of pavement along route.
B. Magnitude of improvement of other infrastructure.	2	Current shoulder width 0' to 2', project to increase shoulder width to 4' or 5' for bikes and > safety for pedestrians, upgrade signals, drainage improvements
Condition Average	**2.0**	

Mobility	Score	Additional Comments
A. Effect on magnitude and duration of congestion.	3	Adding left turn lanes at intersection at MA-133/ Lovejoy /Greenwood. Also Rt 133/ Rt 28 improvements
B. Effect on travel time and connectivity / access.	2	Widening shoulder, realigning Rt 133/ Lovejoy and adding left turn lanes.
C. Effect on other modes using the facility.	3	Widening shoulder for bicycles, sidewalks on both sides.
D. Effect on regional and local traffic.	3	Widening shoulder, adding left turn lanes. Additional connector I-495 to I-93. NHS roadway.
Mobility Average	**2.75**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Safety and Security	Score	Additional Comments
A. Effect on crash rate compared to State average.	3	PNF Rt 133/ Lovejoy / Greenwood has a crash rate of .94, District 4 average is .78 and the arterial between two signalized intersections is 3.8, Avg. is 2.12. Have had 1 pedestrian with injuries and 1 bicycle crash. HSIP eligible per MassDOT "Crash Cluster" 2 intersections.
B. Effect on bicycle and pedestrian safety.	2	Widening shoulder for bicycles, sidewalks on both sides.
C. Effect on transportation security and evacuation routes/	1	Is an NHS roadway. Is an evacuation route.
Safety and Security Average	**2.00**	

Community Effects and Support	Score	Additional Comments
A. Residential effects: ROW, noise, aesthetics, cut through traffic, and other.	2	For the most part all within ROW. General appearance and less noise from better pavement conditions.
B. Public, local government, legislative, and regional support.	2	
C. Effect on service to minority or low-income neighborhoods. (Title VI and EJ)	0	Not Title VI or EJ area.
D. Other impacts / benefits to minority or low-income neighborhoods. (Title VI and EJ).	0	Not Title VI or EJ area.
E. Effect on development and redevelopment of housing	1	
Community Effects and Support Average	**1.00**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Land Use and Economic Development	Score	Additional Comments
A. Business effects; ROW, noise, traffic, parking, freight access, other.	2	Improve access to existing businesses.
B. Sustainable development effects. Consistent with MVPGS.	2	Access to MVPGS Rolling Green Regional PDA. Improves transportation choice (walk/bike) for area residents.
C. Consistent with regional land-use and economic development plans and PGS.	2	Access to MVPGS Rolling Green Regional PDA. Improves transportation choice (walk/bike) for area residents.
D. Effect on job creation.	1	Should provide better access to Brickstone Square State PDA.
Land Use and Economic Development Average	**1.75**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Environmental Effects	Score	Additional Comments
A. Air quality / Climate effects. GHG Impact Description – Assumed Nominal Decrease in Emissions from Other Improvements	2	Adding bike lanes and sidewalks. Reducing delays at intersections.
B. Water quality/supply effects; wetlands effects.	1	There will be deep sump catch basins
C. Historic and cultural resources effects.	3	Shawsheen Village Historic District
D. Effect on wildlife habitat and endangered species.	0	Not endangered species habitat area.
Environmental Effects Average	**1.5**	
Overall Project TEC score	**11.00**	

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Appendix E Greenhouse Gas (GHG) Monitoring and Evaluation

2018-2022
Transportation Improvement Program
Greenhouse Gas Monitoring and Evaluation

Introduction

This section summarizes the greenhouse gas (GHG) impacts that are anticipated to result from the projects that are included in this FFY 2018 – 2022 Transportation Improvement Program (TIP). It includes a summary of the state laws and policies that call for reducing greenhouse gas in order to mitigate global climate change, actions that are being taken to respond to these state laws and policies, the role of regional planning and TIP development in reducing GHG emission and tracking these reductions, and the projected GHG emission impacts from the projects programmed in the TIP.

State Policy Context

The Global Warming Solutions Act (GWSA), which was signed into law in August 2008, makes Massachusetts a leader in setting aggressive and enforceable GHG reduction targets, and implementing policies and initiatives to achieve these targets. In keeping with the law, on December 29, 2010 the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, released the Massachusetts *Clean Energy and Climate Plan for 2020*. In December 2014 the Department of Environmental Protection issued new regulations that require Metropolitan Planning Organizations to quantify impacts from project investments, track progress towards reductions, and consider impacts in the prioritization of GHG impacts from project investments. The targets for overall statewide GHG emissions are:

- By 2020: 25 percent reduction below statewide 1990 GHG emission levels, and
- By 2050: 80 percent reduction below statewide 1990 GHG emission levels

GreenDOT Policy

The transportation sector is the single largest emitter of greenhouse gases, accounting for over a third of GHG emissions, and therefore the transportation sector is a key focus of the *Clean Energy and Climate Plan*. MassDOT's approach to supporting the implementation of the plan is set forth in its GreenDOT Policy Directive, a comprehensive sustainability initiative that sets three principal objectives:

- **Reduce greenhouse gas (GHG) emissions.** MassDOT will achieve this by taking GHG emissions into account in all of its responsibilities, from strategic planning to project design and construction and system operations;
- **Promote the healthy transportation modes of walking, bicycling, and public transit.** MassDOT will achieve this by pursuing multi-modal, "complete streets" design standards; providing choice in transportation services; and by working with MPOs and other partners to prioritize and program a balance of projects that serve drivers, pedestrians, bicyclists, and public transit riders, and
- **To support smart growth development.** MassDOT will achieve this by working with MPOs and other partners to make transportation investments that enable denser, smart growth development patterns that support reduced GHG emissions.

GreenDOT Policy and Metropolitan Planning Organizations

The Commonwealth's thirteen metropolitan planning organizations (MPOs) are integrally involved in helping to achieve the GreenDOT goals and supporting the GHG reductions mandated under the GWSA. The MPOs are most directly involved in helping to achieve the GHG emissions reductions under the second goal – to promote healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments – and assist in the third goal by supporting smart growth development patterns through the creation of a balanced multi-modal transportation system. This will be realized through the transportation goals and policies espoused in the Regional Transportation Plans (RTPs), the major projects planned in the RTPs, and the mix of new transportation projects that are programmed and implemented through the TIPs. The GHG tracking and evaluation processes enable the MPOs to identify the anticipated GHG impacts of the planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects.

Regional GHG Tracking and Evaluation in RTPs

MassDOT coordinated with MPOs and regional planning agency (RPA) staffs on the implementation of GHG tracking and evaluation in development of each MPO's 2035 RTPs, which were adopted in September 2011. This collaboration has continued for the MPO's 2040 RTPs and FFYs 2018-2022 TIPs.

Working together, MassDOT and the MPOs have attained the following milestones:

- Modeling and long-range statewide projections for GHG emissions resulting from the transportation sector. Using the Boston MPO's regional model and the statewide travel demand model for the remainder of the state, GHG emissions

were projected for 2021 no-build and build conditions, and for 2035 no-build and build conditions.
- All of the MPOs included these GHG emission projections in their RTPs, along with a discussion of climate change and a statement of MPO support for reducing GHG emissions as a regional goal.

Project-Level GHG Tracking and Evaluation in the Transportation Improvement Program

It is also important to monitor and evaluate the GHG impacts of the transportation projects that are programmed in the MPO Transportation Improvement Programs (TIP). The TIP includes both the larger, regionally-significant projects from the RTPs, which have already had their aggregate GHG impacts calculated and reported in the RTP, as well as smaller projects that are not included in the RTP but that may nevertheless have impacts on GHG emissions. The principal objective of this tracking is to enable the MPOs to evaluate expected GHG impacts of different projects and to use this information as a criterion for prioritizing and programming projects in future TIPs.

In order to monitor and evaluate the GHG impacts of TIP projects, MassDOT and the MPOs have developed the following approach for identifying anticipated GHG impacts and quantifying GHG impacts of projects, when appropriate, through the TIP. Different types of projects will have different anticipated GHG emissions impacts. The different project categories are outlined on the next two pages with this region's project tracking sheets on the third page.

Calculation of GHG Impacts for TIP Projects

The Office of Transportation Planning at MassDOT provided the spreadsheets that are used for determining Congestion Management and Air Quality (CMAQ) eligibility. These spreadsheets require the same inputs as the CMAQ calculations, and have been adapted to provide CO_2 impacts. The data and analysis required for these calculations is available from functional design reports that should be submitted for projects that would produce a measurable GHG impact.

- **Projects with Quantified Impacts**
    - **RTP Projects -** Major capacity expansion projects would be expected to have a significant impact on GHG emissions. However, these projects are included in the RTPs and analyzed using the statewide model or Boston regional model, which would reflect their GHG impacts. Therefore, no independent TIP calculations are required.

- **Quantified Decrease in Emissions -** Projects that would be expected to produce a measurable decrease in emissions. The approach for calculating these impacts is described below. These projects should be categorized in the following manner:

    - **Quantified Decrease in Emissions from Traffic Operational Improvement -** An intersection reconstruction or signalization project that is projected to reduce delay and congestion.
    - **Quantified Decrease in Emissions from Pedestrian and Bicycle Infrastructure -** A shared-use path that would enable increased walking and biking and decreased vehicle-miles traveled (VMT).
    - **Quantified Decrease in Emissions from New/Additional Transit Service -** A bus or shuttle service that would enable increased transit ridership and decreased VMT.
    - **Quantified Decrease in Emissions from a Park and Ride Lot** - A park-and-ride lot that would enable increased transit ridership/ increased ridesharing and decreased VMT.
    - **Quantified Decrease in Emissions from Bus Replacement** A bus replacement that would directly reduce GHG emissions generated by that bus service.
    - **Quantified Decrease in Emissions from Complete Streets Improvements**
      Improvements to roadway networks that include the addition of bicycle and pedestrian accommodations where none were present before.
    - **Quantified Decrease in Emissions from Other Improvement**

- **Quantified Increase in Emissions –** Projects that would be expected to produce a measurable increase in emissions.

- **Projects with Assumed Impacts**

    - **No Assumed Impact/Negligible Impact on Emission -** Projects that do not change the capacity or use of a facility (e.g. a resurfacing project that restores a roadway to its previous condition, or a bridge rehabilitation/replacement that restores the bridge to its previous condition) would be assumed to have no GHG impact.

- **Assumed Nominal Decrease in Emissions -** Projects that would be expected to produce a minor decrease in emissions that cannot be calculated with any precision. Examples of such projects include roadway repaving or reconstruction projects that add a new sidewalk or new bike lanes. Such a project would enable increased travel by walking or bicycling, but there may be no data or analysis to support any projections of GHG impacts. These projects should be categorized in the following manner:
  - **Assumed Nominal Decrease in Emissions from Sidewalk Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Bicycle Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Intelligent Transportation Systems (ITS) and/or Traffic Operational Improvements**
  - **Assumed Nominal Decrease in Emissions from Other Improvements**

- **Assumed Nominal Increase in Emissions -** Projects that would be expected to produce a minor increase in emissions that cannot be calculated with any precision.

Regional Greenhouse Gas Impact Summary Tables for FFYs 2018 – 2022 TIP

The following tables summarize the calculated quantitative and assumed qualitative impacts of the projects included in the regional FFYs 2018 – 2022 TIP by year.

FFYs 2018 to 2022 Projects GHG Tracking Summary

2018 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼	Additional Information▼
606159	NORTH ANDOVER- INTERSECTION & SIGNAL IMPROVEMENTS AT ROUTE 125 & MASSACHUSETTS AVENUE	$ 3,640,038	Quantified	482,727	Quantified Decrease in Emissions from Traffic Operational Improvement	$ 3,640,038	
605020	SALISBURY - MULTI-USE TRAIL EXTENSION (BORDERS TO BOSTON TRAIL)	$ 5,918,500	Quantified	18,631	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 5,918,500	

2018 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼	Additional Information▼
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 31,600,000	Qualitative		No assumed impact/negligible impact on emissions	$79,000,000	AC yr 1 of 4. Sum Year 1 Cost = $31,600,000. Total Project Cost = $79,000,000
608809	LAWRENCE - NORTH ANDOVER - RESURFACING AND RELATED WORK ON ROUTE 114	$ 8,722,560	Qualitative		Qualitative Decrease in Emissions	$ 8,722,560	
607737	AMESBURY- SALISBURY- TRAIL CONNECTOR @ I-95	$ 2,574,805	Quantified	3,972	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 2,574,805	
	2018 Total GHG emissions			505,330			

2019 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
602418	AMESBURY- RECONSTRUCTION OF ELM STREET	$ 7,207,810	Quantified		Quantified Decrease in Emissions from Complete Streets Project	$12,064,000	AC yr 1 of 2. Quantified decrease in emissions shown in FFY 2020.
608298	GROVELAND- GROVELAND COMMUNITY TRAIL, FROM MAIN STREET TO KING STREET	$ 1,835,573	Quantified	2,710	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 2,672,677	
MV0001	FLEX TO FTA FOR MVRTA NEW BUS UPGRADE TO CLEANER FUEL BUSES	$ 698,541	Qualitative		Qualitative Decrease in Emissions	$ 698,541	

2019 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12 039, I-495 (NB & SB) - OVER MERRIMACK RIVER	$ 21,000,000	Qualitative		No assumed impact/negligible impact on emissions	$79,000,000	AC yr 2 of 4. Sum Year 2 Cost = $21,000,000. Total Project Cost = $79,000,000
608792	NEWBURYPORT - IMPROVEMENTS AT NOCK MIDDLE SCHOOL & MOLIN UPPER ELEMENTARY SCHOOL (SRTS)	$ 1,593,600	Qualitative		Qualitative Decrease in Emissions	$ 1,593,600	
	2019 Total GHG Emissions			2,710			

2020 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
602418	AMESBURY- RECONSTRUCTION OF ELM STREET	$ 4,856,190	Quantified	1,335	Quantified Decrease in Emissions from Complete Streets Project	$ 12,064,000	AC yr 2 of 2.
608027	HAVERHILL - BRADFORD RAIL TRAIL EXTENSION, FROM ROUTE 125 TO RAILROAD STREET	$ 1,176,240	Quantified	422	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,176,240	

2020 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 21,000,000	Qualitative		No assumed impact/negligible impact on emissions	$ 79,000,000	AC yr 3 of 4. Sum Year 3 Cost = $21,000,000. Total Project Cost = $79,000,000
607541	GEORGETOWN-BOXFORD- BORDER TO BOSTON TRAIL, FROM GEORGETOWN ROAD TO WEST MAIN STREET	$ 1,874,028	Quantified	2,667	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,874,028	
	2020 Total GHG emissions			4,424			

2021 Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605753	GROVELAND- RECONSTRUCTION OF ROUTE 97 (SCHOOL STREET) FROM PARKER STREET TO GARDNER STREET	$ 4,049,510	Qualitative		No assumed impact/negligible impact on emissions	$ 4,049,510	
608095	NORTH ANDOVER- CORRIDOR IMPROVEMENTS ON ROUTE 114, BETWEEN ROUTE 125 (ANDOVER STREET) & STOP & SHOP DRIVEWAY	$ 6,290,405	Qualitative		Qualitative Decrease in Emissions	$ 16,816,717	Not yet enough information to generate an estimate. AC Year 1 of 3.

2021 Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 5,400,000	Qualitative		No assumed impact/negligible impact on emissions	$ 79,000,000	AC yr 4 of 4.
608494	NEWBURY - NEWBURYPORT - SALISBURY - RESURFACING AND RELATED WORK ON ROUTE 1	$11,854,752	Qualitative		No assumed impact/negligible impact on emissions	$ 11,854,752	
607542	GEORGETOWN-NEWBURY-BORDER TO BOSTON TRAIL (NORTHERN GEORGETOWN TO BYFIELD SECTION)	$ 4,341,120	Quantified	15,682	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 4,341,120	
	2021 Total GHG emissions			15,682			

2022 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
608095	NORTH ANDOVER-CORRIDOR IMPROVEMENTS ON ROUTE 114, BETWEEN ROUTE 125 (ANDOVER STREET) & STOP & SHOP DRIVEWAY	$10,467,929	Qualitative		Qualitative decrease in emissions	$16,816,717	Not yet enough information to generate an estimate. AC Year 2 of 3.
	2022 Total GHG emissions						

2018 Merrimack Valley Region Transit GHGs

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005637	ADA Operating Expense	$ 1,413,370	Qualitative		No assumed impact/negligible impact on emissions	$ 1,413,370
5307 ► RTD0005638	Preventive Maintenance Expense	$ 3,152,905	Qualitative		No assumed impact/negligible impact on emissions	$ 3,152,905
5307 ► RTD0005639	Refurbish Engine/ Trans 8 Model Year 2012 Buses	$ 264,000	Qualitative		No assumed impact/negligible impact on emissions	$ 264,000
5307 ► RTD0005642	Operating Assistance	$ 643,010	Qualitative		No assumed impact/negligible impact on emissions	$ 643,010
5307 ► RTD0005643	Short Range Transit Planning	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	$ 100,000
5307 ► RTD0005656	Replace 6 Model Yr 2004 Buses Delivery 2018	$ 2,689,500	Quantified	15,661	Quantified Decrease in Emissions from Bus Replacement	$ 2,689,500

2018 Merrimack Valley Region Transit GHGs

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005662	Replace 1 Model Yr 2013 Support Vehicle	$ 47,750	Qualitative		No assumed impact/negligible impact on emissions	$ 47,750
Other NFA ► RTD0005665	Newburyport Intermodal Transit Facility Year 1	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	$ 5,000,000

2019 Merrimack Valley Region Transit GHGs

MassDOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005640	Preventive Maintenance Expense	$ 3,250,095	Qualitative		No assumed impact/negligible impact on emissions	$ 3,250,095
5307 ► RTD0005641	ADA Operating Expense	$ 1,456,420	Qualitative		No assumed impact/negligible impact on emissions	$ 1,456,420
5307 ► RTD0005644	Short Range Transit Planning	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	$ 100,000
5307 ► RTD0005645	Operating Assistance FY 2020	$ 780,250	Qualitative		No assumed impact/negligible impact on emissions	$ 780,250
5307 ► RTD0005657	Purchase 3 new 35' buses delivery 2019	$ 1,344,750	Qualitative		No assumed impact/negligible impact on emissions	$ 1,344,750

2019 Merrimack Valley Region Transit GHGs

MassDOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005663	Replace 1 Model Yr 2013 Support Vehicle	$ 49,000	Qualitative		No assumed impact/negligible impact on emissions	$ 49,000
Other NFA ► RTD0006082	Newburyport Intermodal Transit Facility Year 2	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	$ 5,000,000

2020 Merrimack Valley Region Transit GHGs

MassDOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005646	Preventive Maintenance	$ 3,347,595	Qualitative		No assumed impact/negligible impact on emissions	$ 3,347,595
5307 ► RTD0005647	Non Fixed Route ADA Para Serv	$ 1,500,110	Qualitative		No assumed impact/negligible impact on emissions	$ 1,500,110
5307 ► RTD0005648	Short RangeTransit Planning	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	$ 100,000
5307 ► RTD0005649	Operating Assistance	$ 924,950	Qualitative		No assumed impact/negligible impact on emissions	$ 924,950
5307 ► RTD0005658	Replace 3 Model Yr 2007 buses delivery 2020	$ 1,371,645	Quantified	7,830	Quantified Decrease in Emissions from Bus Replacement	$ 1,371,645

2021 Merrimack Valley Region Transit GHGs

Mass DOT /FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0005653	Preventive Maintenance	$ 3,448,020	Qualitative		No assumed impact/negligible impact on emissions	$ 3,448,020
5307 ► RTD0005654	Non Fixed Route ADA Para Serv	$ 1,545,115	Qualitative		No assumed impact/negligible impact on emissions	$ 1,545,115
5307 ► RTD0005655	Short RangeTransit Planning	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	$ 100,000
5307 ► RTD0005659	Replace 9 Model Yr 2009 buses delivery 2021	$ 4,197,240	Quantified	24,356	Quantified Decrease in Emissions from Bus Replacement	$ 4,197,240
5307 ► RTD0005660	Operating Assistance	$ 1,017,450	Qualitative		No assumed impact/negligible impact on emissions	$ 1,017,450
5307 ► RTD0005661	Replace 16 Model Yr 2015 vans with new	$ 1,094,560	Quantified	33,516	Quantified Decrease in Emissions from Bus Replacement	$ 1,094,560

2022 Merrimack Valley Region Transit GHGs

MassDOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼
5307 ► RTD0006084	Preventive Maintenance	$ 3,551,455	Qualitative		No assumed impact/negligible impact on emissions	$ 3,551,455
5307 ► RTD0006085	Non Fixed Route ADA Para Serv	$ 1,591,460	Qualitative		No assumed impact/negligible impact on emissions	$ 1,591,460
5307 ► RTD0006086	Short RangeTransit Planning	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	$ 100,000
5307 ► RTD0006087	Operating Assistance	$ 1,047,970	Qualitative		No assumed impact/negligible impact on emissions	$ 1,047,970
5307 ► RTD0006088	Replace 6 Model Yr 2011 buses delivery 2023	$ 2,911,200	Quantified	16,237	Quantified Decrease in Emissions from Bus Replacement	$ 2,911,200

Amesbury Reconstruction of Elm Street **CMAQ Air Quality Analysis**

CMAQ Air Quality Analysis Worksheet for Complete Streets Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality:** Amesbury

Project: **# 602418 Reconstruction of Elm Street**

Step 1: Calculate New Walk and Bike Miles Traveled:

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

				User Input (blank for default)	Default
A.	Facility Length **(L)**:	1.1	Miles		
B	Types of Improvements Implemented:	Both	(select Pedestrian, Bicycle, or Both)		
B.	Service Area Radius for Bicycling **(RB)**:	0.5	Miles		0.5
C.	Service Area Radius for Walking **(RW)**:	0.25	Miles		0.25
D.	Service Area of Community(ies) **for Bicycling (SAB)**: L * 2RB = SAB	1.13	Sq. Miles		
E.	Service Area of Community(ies) **for Walking (SAW)**: L * 2RW = SAW	0.565	Sq. Miles		
F.	Land Area of Neighborhoods Served **(AN)**: Popula-	11.2	Sq. Miles		
G.	tion of Neighborhoods Served **(PN)**:	7,137	Persons		
H.	Population Density of Neighborhoods Served **(PD)**:	637	Persons/Sq. Mile		
I.	Population Served by Facility for Bicycling **(PB)**: PD * SAB = PB	720	Persons		
J.	Population Served by Facility for Walking **(PW)**: PD * SAW = PW	360	Persons		
K.	Trips per Person per Day in Service Area **(T)**:	4.7	Trips		4.7
L.	Baseline Bicycle Mode Share in Service Area **(MSB)**:	0.6%	Percent		

Amesbury Reconstruction of Elm Street **CMAQ Air Quality Analysis (Cont.)**

M.	Baseline Walk Mode Share in Service Area **(MSW)**:	4.7%	Percent		
N.	Relative Increase in Service Area Bicycle Mode Share from Improvements **(BI)**:	30.0%	Percent		30.0%
O.	Relative Increase in Service Area Walk Mode Share from Improvements **(WI)**:	7.5%	Percent		7.5%
P.	New Bike Trips **(BT)**: PB * T * MSB * BI = BT	6	1-Way Trips/Day		
Q.	New Walk Trips **(WT)**: PW * T * MSW * WI = WT	6	1-Way Trips/Day		
R.	Average Bike Trip Length (**LB**):	2.3	Miles		2.3
S.	Average Walk Trip Length (**LW**):	0.7	Miles		0.7
T.	New Bike and Walk Miles of Travel **(BWM)**:	18	Miles per Day		
	Step 2: Calculate the VMT Reduction:				
U.	Prior Drive Mode Share of New Bike and Walk Trips **(MSD)**:	59.0%	Percent	59%	
V.	VMT Reduced per Day **(VMTR)**: BWM * MSD = VMTR	11	Miles per Day		
W.	VMTR * Operating Days Per Year 16 * 365 =	3,942	VMTR Per Year		
	If the Vehicle Miles Traveled Reduction is known enter in the box to the right.		VMTR Per Year		
	Note: A manual entry of the VMTR will override the calculated cell.				

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.1	**0.3**	**8.4**	**1,335.5**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,000,000	/	0.1	=	**$8,355,241**
Summer NOx	$1,000,000	/	0.3	=	**$3,058,798**
Summer CO	$1,000,000	/	8.4	=	**$118,866**
Summer CO2	$1,000,000	/	1,335.5	=	**$749**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Amesbury Salisbury Trail Connector at I-95 **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2018**

MPO: **Merrimack Valley** **Municipality: Amesbury, Salisbury**

Project: **# 607737 Amesbury Salisbury Trail Connector at I-95**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A	Facility Length **(L)**:	1.0	Miles	
B	Service Area Radius **(R)**:	1.0	Miles	(Default = 1)
C	Service Area of Community(ies) **(SA)**: L * 2R = SA	2	Sq. Miles	
D	Total Land Area of Community(ies) **(T)**:	42.15	Sq. Miles	
E	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	4.7%		
F.	Total Population of Community(ies) **(TP)**:	25,579	Persons	
G	Population Served by Facility **(P)**: LA * TP = P	1,214	Persons	
H	Total Number of Households in Community(ies) **(HH)**:	10,501	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	498	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	13,733	Persons	
K	Workers Per household **(WPHH)**: W / HH = WPHH	1.31	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	652		
M	Population Density of the Service area **(PD)**: P / SA = PD	607	Persons Per Sq. Mile	

Amesbury Salisbury Trail Connector at I-95 **CMAQ Air Quality Worksheet (Cont.)**

N If the bicycle and pedestrian commuter mode share is known, enter the percentage at t **(BMS)** 3.3%

If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.

http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 22 One-Way Trips

P Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 37 One-Way Trips

(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 58.6 VMTR Per Day

B VMTR * Operating Days Per Year 58.6 * 200 = 11,724 VMTR Per Year

If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year

Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Amesbury Salisbury Trail Connector at I-95 **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.4	**1.0**	**25.0**	**3,971.6**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$2,677,798	/	0.4	=	**$7,523,308**
Summer NOx	$2,677,798	/	1.0	=	**$2,754,233**
Summer CO	$2,677,798	/	25.0	=	**$107,030**
Summer CO2	$2,677,798	/	3,971.6	=	**$674**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality: Georgetown, Boxford**

Project: **# 607541 Georgetown-Boxford Border to Boston Trail**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	2.0	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	36.5	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	11.0%		
F.	Total Population of Community(ies) **(TP)**: Popu-	16,579	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	1,817	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,828	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	639	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,647	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.48	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	948		
M.	Population Density of the Service area **(PD)**: P / SA = PD	454	Persons Per Sq. Mile	

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the right. **(BMS)** 0.8%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 7 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 12 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 39.4 VMTR Per Day

B. VMTR * Operating Days Per Year 39.4 * 200 = 7,872 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.2	**0.7**	**16.8**	**2,666.9**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,874,028	/	0.2	=	**$7,840,800**
Summer NOx	$1,874,028	/	0.7	=	**$2,870,465**
Summer CO	$1,874,028	/	16.8	=	**$111,547**
Summer CO2	$1,874,028	/	2,666.9	=	**$703**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020**

MPO: **Merrimack Valley** **Municipality: Georgetown, Newbury**

Project: **# 607542 Georgetown-Newbury Border to Boston Trail**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	3.6	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	7.2	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	36.3	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	19.8%		
F.	Total Population of Community(ies) **(TP)**: Popu-	15,088	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	2,993	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,808	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,152	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,055	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.39	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	1,598		
M.	Population Density of the Service area **(PD)**: P / SA = PD	416	Persons Per Sq. Mile	

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the ri **(BMS)** 1.5%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 24 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 40 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 231.5 VMTR Per Day

B. VMTR * Operating Days Per Year 231.5 * 200 = 46,290 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
1.4	**3.8**	**98.8**	**15,681.6**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$4,341,120	/	1.4	=	**$3,088,934**
Summer NOx	$4,341,120	/	3.8	=	**$1,130,838**
Summer CO	$4,341,120	/	98.8	=	**$43,945**
Summer CO2	$4,341,120	/	15,681.6	=	**$277**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020**

MPO: **Merrimack Valley** **Municipality:** Groveland

Project: **Groveland Community Trail Project # 608298**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	2.2	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4.4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	8.9	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	49.4%		
F.	Total Population of Community(ies) **(TP)**:	6,646	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P	3,286	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	2,385	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,179	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	3,405	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH	1.43	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	1,683		
M.	Population Density of the Service area **(PD)**: P / SA = PD	747	Persons Per Sq. Mile	

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the righ **(BMS)** 0.4%

If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 7 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 11 One-Way Trips

(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 40.0 VMTR Per Day

B. VMTR * Operating Days Per Year 40.0 * 200 = 7,999 VMTR Per Year

If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year

Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.2	**0.7**	**17.1**	**2,709.9**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$2,672,677	/	0.2	=	**$11,004,874**
Summer NOx	$2,672,677	/	0.7	=	**$4,028,811**
Summer CO	$2,672,677	/	17.1	=	**$156,560**
Summer CO2	$2,672,677	/	2,709.9	=	**$986**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality:** **Haverhill**

Project: **# 608027 Bradford Rail Trail Extension from Route 125 to Railroad Street**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	0.2	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	0.4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	33	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	1.2%		
F.	Total Population of Community(ies) **(TP)**: Popu-	62,079	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	752	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	23,781	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	288	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	30,696	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.29	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	372		
M.	Population Density of the Service area **(PD)**: P / SA = PD	1,881	Persons Per Sq. Mile	

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the ri **(BMS)** 3.1%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 12 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 20 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 6.2 VMTR Per Day

B. VMTR * Operating Days Per Year 6.2 * 200 = 1,246 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.0	**0.1**	**2.7**	**422.0**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,176,240	/	0.0	=	**$31,101,222**
Summer NOx	$1,176,240	/	0.1	=	**$11,385,951**
Summer CO	$1,176,240	/	2.7	=	**$442,461**
Summer CO2	$1,176,240	/	422.0	=	**$2,787**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

North Andover - Intesection & Signal Improvements Route 125 & Mass. Ave. **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

FILL IN SHADED BOXES ONLY

TIP YEAR **2018**

MPO: **Merrimack Valley** **Municipality:** **North Andover**

Project: **# 606159 Intersection & Signal Improvements at Route 125 & Massachusetts Avenue**

Step 1: Calculate Existing AM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	+	Thru (Vol / PHF)		X delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	=	Total approach delay
Rt 125	NB	134	0.95	18.1	=	2,553	+	350	0.95	17.1	=	6,300	+	12	0.95	12.2	=	154	=	9,007
Rt 125	SB	36	0.95	27.6	=	1,046	+	610	0.95	30.8	=	19,777	+	114	0.95	30.8	=	3,696	=	24,519
Mass Ave	EB	92	0.95	51.8	=	5,016	+	411	0.95	51.8	=	22,410	+	185	0.95	12.6	=	2,454	=	29,880
Mass Ave	WB	8	0.95	23.5	=	198	+	458	0.95	23.5	=	11,329	+	21	0.95	23.5	=	519	=	12,047
																		Total Intersection Delay/Seconds	=	**75,453**

North Andover - Intesection & Signal Improvements Route 125 & Mass. Ave. **CMAQ Air Quality Analysis Worksheet (Cont.)**

Step 2: Calculate Existing PM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)	X	delay per veh	=	Total move. delay	+	Thru (Vol / PHF)	X	delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)	X	delay per veh	=	Total move. delay	=	Total approach delay
Rt 125	NB	304	0.95	54.1	=	17,312	+	800	0.95	47.1	=	39,663	+	17	0.95	10.5	=	188	=	57,163
Rt 125	SB	13	0.95	29.4	=	402	+	580	0.95	23.7	=	14,469	+	97	0.95	23.7	=	2,420	=	17,292
Mass Ave	EB	93	0.95	120.6	=	11,806	+	542	0.95	120.6	=	68,805	+	182	0.95	14.6	=	2,797	=	83,409
Mass Ave	WB	37	0.95	259.9	=	10,122	+	476	0.95	259.9	=	130,224	+	19	0.95	259.9	=	5,198	=	145,544
																		Total Intersection Delay/Seconds	=	**303,407**

Step 3: The spreadsheet automatically chooses the peak hour with the longer total intersection delay for the next step in the analysis.

Peak Hour: PM Total Intersection Delay: 303,407

Step 4: Calculate the existi PM Peak Hour Total Intersection Delay with Improvements:

Street Name	Dir	Left-Turns (Vol / PHF)	X	delay per veh	=	Total move. delay	+	Thru (Vol / PHF)	X	delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)	X	delay per veh	=	Total move. delay	=	Total approach delay
Rt 125	NB	304	0.95	34.0	=	10,880	+	800	0.95	21.3	=	17,937	+	17	0.95	21.3	=	381	=	29,198
Rt 125	SB	13	0.95	27.5	=	376	+	580	0.95	37.9	=	23,139	+	97	0.95	37.9	=	3,870	=	27,385
Mass Ave	EB	93	0.95	31.0	=	3,035	+	542	0.95	47.4	=	27,043	+	182	0.95	47.4	=	9,081	=	39,159
Mass Ave	WB	37	0.95	46.8	=	1,823	+	476	0.95	20.9	=	10,472	+	19	0.95	20.9	=	418	=	12,713
																		Total Intersection Delay/Seconds	=	**108,454**

North Andover - Intesection & Signal Improvements Route 125 & Mass. Ave. **CMAQ Air Quality Analysis Worksheet (Cont.)**

Step 5: Calculate vehicle delay in hours per day:

	(	Delay in seconds	X	Hours per day)	/	Seconds per hour	=	Delay in hours / day
Existing peak hour intersection delay	(	303,407	X	10	)	/ 3600	=	842.8
Peak hour intersection delay w/ improvements	(	108,454	X	10	)	/ 3600	=	301.3

Step 6: MOVES 2014a emission factors for idling speed: AM or PM **PM**

2020 Summer VOC Factor grams/hour	2020 Summer NOx Factor grams/hour	2020 Winter CO Factor grams/hour	2020 Summer CO2 Factor grams/hour
0.249	**0.630**	**3.569**	**3565.610**

Step 7: Calculate net emissions change in kilograms per day:

	Delay in Hours per Day	Summer VOC Emissions kilograms/day	Summer NOx Emissions kilograms/day	Winter CO Emissions kilograms/day	Summer CO2 Emissions kilograms/da
Existing Conditions	842.8	0.210	0.531	3.008	3,005.09
With Improvements	301.3	0.075	0.190	1.075	1,074.18
Net Change		**-0.135**	**-0.341**	**-1.933**	**-1,930.91**

Step 8: Calculate net emissions change in kilograms per year (seasonally adjusted)

	Net change per day (kg)		Avg. weekdays per year		Seasonal adj. factor		Adj. net change in kg per year
Summer VOC Emissions	-0.135	X	250	X	1.019	=	**-34.326**
Summer NOx Emissions	-0.341	X	250	X	1.019	=	**-86.845**
Winter CO Emissions	-1.933	X	250	X	0.981	=	**-474.091**
Summer CO2 Emissions	-1,930.907	X	250	X	1.000		**-482,726.774**

Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost	/	Adj. net change in kg per year	=	First year cost per kilogram
Summer VOC	$3,785,640	/	-34.326	=	**110,284**
Summer NOx	$3,785,640	/	-86.845	=	**43,591**
Winter CO	$3,785,640	/	-474.091	=	**7,985**
Summer CO2	$3,785,640	/	-482,726.774	=	**8**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Salisbury Multi-Use Trail Extension (Borders to Boston) **CMAQ Air Quality Analysis**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2018**

MPO: **Merrimack Valley** **Municipality:** **Salisbury**

Project: **# 605020 Salisbury Multi-use Trail Extension (Borders to Boston Trail)**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	2.3	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4.6	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	15.4	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	29.9%		
F.	Total Population of Community(ies) **(TP)**: Popu-	8,672	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	2,590	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	3,446	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,029	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	4,360	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.27	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	1,302		
M.	Population Density of the Service area **(PD)**: P / SA = PD	563	Persons Per Sq. Mile	

Salisbury Multi-Use Trail Extension (Borders to Boston) **CMAQ Air Quality Analysis (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the **(BMS)** 3.4%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 44 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 75 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 275.0 VMTR Per Day

B. VMTR * Operating Days Per Year 275.0 * 200 = 54,995 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
1.7	**4.6**	**117.4**	**18,630.6**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$6,155,240	/	1.7	=	**$3,686,512**
Summer NOx	$6,155,240	/	4.6	=	**$1,349,608**
Summer CO	$6,155,240	/	117.4	=	**$52,446**
Summer CO2	$6,155,240	/	18,630.6	=	**$330**

Merrimack Valley RTA Replace 6 (2004) Buses with 6 (2018) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2018** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #BCG0005656 # RTD0004954 - Replace 6 (2004) Buses with 6 (2018) Buses

Emission Rates in grams/mile at assumed operating speed bin of : 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Model Year					
Existing Model* =	2004	1.734	7.542	3.180	1,200.600
New Bus Purchase** =	2018	0.048	0.764	0.275	1133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted: Unrestricted

Change (Buy-Base)	-1.686	-6.778	-2.905	-67.370

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	/ operating days per year	= fleet miles per day
202,140		1.15	232,461	**304**	765

Merrimack Valley RTA Replace 6 (2004) Buses with 6 (2018) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-1.686	1,000	765	1.0188	**-1.313**
Change in Summer NOx	-6.778	1,000	765	1.0188	**-5.280**
Change in Winter CO	-2.905	1,000	765	0.9812	**-2.180**
Change in Summer CO2	-67.370	1,000	765	1.0000	**-51.516**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-1.313	304	-399.298
Summer NOx	-5.280	304	-1605.242
Winter CO	-2.180	304	-662.604
Summer CO2	-51.516	304	-15660.898

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	reduction per year in kg	= annual cost per kg
Summer VOC	**$2,725,755**	**12**	399.298	**$569**
Summer NOx	**$2,725,755**	**12**	1605.242	**$142**
Winter CO	**$2,725,755**	**12**	662.604	**$343**
Summer CO2	**$2,725,755**	**12**	15660.898	**$15**

Template Prepared by Office of Transportation Planning Updated March 2016

Merrimack Valley RTA Replace 6 (2004) Buses with 6 (2018) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #BCG0005658 # RTD0004956 - Replace 3 (2007) Buses with 3 (2020) Buses

Emission Rates in grams/mile at assumed operating speed bin of : 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	Summer VOC (grams/mile)	Summer NOx (grams/mile)	Winter CO (grams/mile)	Summer CO2 (grams/mile)
Existing Model*	=	2007	0.115	3.750	0.659	1,200.600
New Bus Purchase**	=	2020	0.048	0.764	0.275	1133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted: Unrestricted

Change (Buy-Base)	-0.067	-2.986	-0.384	-67.370

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	perating days per year	= fleet miles per day
101,070		1.15	116,231	**304**	382

Merrimack Valley RTA Replace 6 (2004) Buses with 6 (2018) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.067	1,000	382	1.0188	**-0.026**
Change in Summer NOx	-2.986	1,000	382	1.0188	**-1.163**
Change in Winter CO	-0.384	1,000	382	0.9812	**-0.144**
Change in Summer CO2	-67.370	1,000	382	1.0000	**-25.758**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.026	304	-7.934
Summer NOx	-1.163	304	-353.589
Winter CO	-0.144	304	-43.793
Summer CO2	-25.758	304	-7830.449

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$1,456,620**	**12**	7.934	**$15,300**
Summer NOx	**$1,456,620**	**12**	353.589	**$343**
Winter CO	**$1,456,620**	**12**	43.793	**$2,772**
Summer CO2	**$1,456,620**	**12**	7830.449	**$16**

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Updated March 2016

Merrimack Valley RTA Replace 9 (2009) Buses with 9 (2021) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2021** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #BCG0005659 - Replace 9 (2009) Buses with 9 (2021) Buses

Emission Rates in grams/mile at assumed operating speed bin of : 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2009	0.115	3.750	0.659	1,203.080
New Bus Purchase**	=	2021	0.048	0.764	0.275	1133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted Unrestricted

Change (Buy-Base)	-0.067	-2.986	-0.384	-69.850

Calculate fleet vehicle miles per day:

Revenue miles per year	X eadhead factor	= fleet miles per year	/ operating days per year	= fleet miles per day
303,210	1.15	348,692	**304**	1,147

Merrimack Valley RTA Replace 9 (2009) Buses with 9 (2021) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.067	1,000	1,147	1.0188	**-0.078**
Change in Summer NOx	-2.986	1,000	1,147	1.0188	**-3.489**
Change in Winter CO	-0.384	1,000	1,147	0.9812	**-0.432**
Change in Summer CO2	-69.850	1,000	1,147	1.0000	**-80.119**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.078	304	-23.802
Summer NOx	-3.489	304	-1060.767
Winter CO	-0.432	304	-131.380
Summer CO2	-80.119	304	-24356.101

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$3,357,795**	**12**	23.802	**$11,756**
Summer NOx	**$3,357,795**	**12**	1060.767	**$264**
Winter CO	**$3,357,795**	**12**	131.380	**$2,130**
Summer CO2	**$3,357,795**	**12**	24356.101	**$11**

Template prepared by the Office of Transportation Plannning Updated March 2016

Merrimack Valley RTA Replace 16 (2015) Vans with 16 (2021) Vans

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2021** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #BCG0005661 - Replace 16 (2015) Vans with 16 (2021) vans

Emission Rates in grams/mile at assumed operating speed bin of : 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2015	0.008	0.058	2.014	501.185
New Bus Purchase**	=	2021	0.003	0.025	0.593	435.854

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted: Unrestricted

Change (Buy-Base)	-0.005	-0.033	-1.421	-65.331

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	operating days per year	= fleet miles per day
450,016		1.14	513,018	**304**	1,688

Merrimack Valley RTA Replace 16 (2015) Vans with 16 (2021) Vans (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.005	1,000	1,688	1.0188	**-0.009**
Change in Summer NOx	-0.033	1,000	1,688	1.0188	**-0.057**
Change in Winter CO	-1.421	1,000	1,688	0.9812	**-2.353**
Change in Summer CO2	-65.331	1,000	1,688	1.0000	**-110.250**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.009	304	-2.613
Summer NOx	-0.057	304	-17.248
Winter CO	-2.353	304	-715.294
Summer CO2	-110.250	304	-33515.995

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	eduction per year in kg	= annual cost per kg
Summer VOC	**$875,650**	**4**	2.613	**$83,768**
Summer NOx	**$875,650**	**4**	17.248	**$12,692**
Winter CO	**$875,650**	**4**	715.294	**$306**
Summer CO2	**$875,650**	**4**	33515.995	**$7**

Template prepared by the Office of Transportation Plannning Updated March 2016

Merrimack Valley RTA Replace 6 (2011) Buses with 6 (2022) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2022** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #BCG0006088 - Replace 6 (2011) Buses with 6 (2022) Buses

Emission Rates in grams/mile at assumed operating speed bin of : 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2011	0.109	1.222	0.338	1,203.080
New Bus Purchase**	=	2022	0.048	0.764	0.275	1133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted Unrestricted

Change (Buy-Base)	-0.061	-0.458	-0.063	-69.850

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	operating days per year	= fleet miles per day
202,140		1.15	232,461	**304**	765

Merrimack Valley RTA Replace 6 (2011) Buses with 6 (2022) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.061	1,000	765	1.0188	**-0.048**
Change in Summer NOx	-0.458	1,000	765	1.0188	**-0.357**
Change in Winter CO	-0.063	1,000	765	0.9812	**-0.047**
Change in Summer CO2	-69.850	1,000	765	1.0000	**-53.413**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.048	304	-14.447
Summer NOx	-0.357	304	-108.469
Winter CO	-0.047	304	-14.370
Summer CO2	-53.413	304	-16237.401

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$2,911,200**	**12**	14.447	**$16,793**
Summer NOx	**$2,911,200**	**12**	108.469	**$2,237**
Winter CO	**$2,911,200**	**12**	14.370	**$16,883**
Summer CO2	**$2,911,200**	**12**	16237.401	**$15**

Template prepared by the Office of Transportation Plannning Updated March 2016

Appendix F Completed Highway and Transit Projects GHG Summary

Merrimack Valley Region MPO Completed Highway Projects GHG Summary

MassDOT Project ID ▼	MassDOT Project Description ▼	Total Program-med Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Additional Description ▼	Fiscal Year of Contract Award (2015 and forward) ▼
606161	HAVERHILL - IMPROVEMENTS ON MAIN STREET (ROUTE 125)	$ 3,635,519	Quantified	16,491	Quantified Decrease in Emissions from Traffic Operational Improvement	Advertised 9/17/2016 Notice to Proceed 4/12/17	2017
606503	NEWBURYPORT CLIPPER CITY RAIL TRAIL ALONG THE CITY BRANCH (PHASE II)	$ 4,061,158	Quantified	34,996	Quantified Decrease in Emissions from Bicycle and Pedes-trian Infrastructure	Advertised 9/19/2015 Notice to Proceed 4/1/2016	2016

Merrimack Valley Region MPO Completed Transit Projects GHG Summary

FTA Activity Line Item ▼	Transit Agency ▼	Project Description ▼	Total Cost ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Fiscal Year Programmed (2015 and forward) ▼
	MVRTA	Purchase -Replacement: Vans 11 Model Year 2009 Delivery 2015	$ 627,000	Quantified	41,814	Quantified Decrease in Emissions from Bus Replacement	2015
111202	MVRTA	Replace 10 of 17 Model Year 2004 Transit Buses with new buses (Delivery 2016)	$4,200,000	Quantified	12,557	Quantified Decrease in Emissions from Bus Replacement	2015
111215	MVRTA	Replace 5 Model Year 2011 Paratransit Vehicles (Delivery 2016)	$ 320,000	Quantified	15,992	Quantified Decrease in Emissions from Bus Replacement	2016
111202	MVRTA	Replace 7 Model Year 2004 Buses with new	$2,989,000	Quantified	18,271	Quantified Decrease in Emissions from Bus Replacement	2017

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Appendix G List of Acronyms

MVMPO List of Commonly Used Acronyms		
A	AADT	Average Annual Daily Traffic
	AASHTO	American Association of State Highway Transportation Officials
	ABP	MassDOT Accelerated Bridge Program
	AC	Advance Construction
	ADA	Americans with Disabilities Act (1990)
	ADT	Average Daily Traffic
	ARRA	American Recovery and Reinvestment Act (of 2009)
	AQ	Air Quality
B	B to B	Border to Boston Rail Trail
	BR, BR-On, BR-Off	Bridge Rehabilitation or Replacement (On- or Off-National Highway System)
C	(C)	Type of Project = Capital Improvement
	3C	Continuing, Comprehensive and Coordinated (Transportation Planning)
	CAAA	Clean Air Act Amendments of 1990
	CFR	Code of Federal Regulations
	CIP	Capital Investment Plan
	CLF	Conservation Law Foundation
	CMAQ	Congestion Mitigation and Air Quality Improvement Program
	CMP	Congestion Management Process
	CMR	Code of Massachusetts Regulations
	CNG	Compressed Natural Gas
	CO	Carbon Monoxide

D	DEP	Department of Environmental Protection
	DOT	Department of Transportation
	DPW	Department of Public Works
E	EB	Eastbound
	EIR	Environmental Impact Report
	EIS	Environmental Impact Statement
	EJ	Environmental Justice
	ENF	Environmental Notification Form
	E.O.	Executive Order (of the Governor of the Commonwealth)
	EPA	U.S. Environmental Protection Agency
F	FA	Federal-Aid
	FAPRO	Federal Aid Program Reimbursement Office
	FAST Act	Fixing America's Surface Transportation Act legislation signed into law December 4, 2015
	FHWA	Federal Highway Administration
	FTA	Federal Transit Administration
	FY	(State) Fiscal Year
	FFY	Federal Fiscal Year
G	GANs	Grant Anticipation Notes
	GHG	Greenhouse Gas
H	HPP	USDOT High Priority Project
	HSIP	Highway Safety Improvement Program

I	IM	Interstate Maintenance
	ITS	Intelligent Transportation System
	ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
L	LEP	Limited English Proficiency
	LOS	Level of Service
	LTA	Local Technical Assistance
M	(M)	Type of project = Maintenance
	MAP-21	Moving Ahead for Progress in the 21st Century legislation signed into law July 6, 2012
	MassDOT	Massachusetts Department of Transportation
	MCAD	Massachusetts Commission Against Discrimination
	MEPA	Massachusetts Environmental Policy Act
	M.G.L.	Massachusetts General Laws
	MOA	Memorandum of Agreement
	MOD	Massachusetts Office on Disabilities
	MOU	Memorandum of Understanding
	MPO	Metropolitan Planning Organization
	MVMPO	Merrimack Valley Metropolitan Planning Organization
	MVPC	Merrimack Valley Planning Commission
	MVPGS	Merrimack Valley Priority Growth Strategy
	MVRTA	Merrimack Valley Regional Transit Authority
N	(N)	Type of project = other, not capital expense, or operating expense, but other such as planning or design

	NAAQS	National Ambient Air Quality Standards
	NARC	National Association of Regional Councils
	NB	Northbound
	NEPA	National Environmental Policy Act
	NFA	Non-Federal Aid
	NHS	National Highway System
	NMCOG	Northern Middlesex Council of Governments
	NOx	Nitrogen Oxide
	NPRM	Notice of Proposed Rulemaking (Federal Register)
O	(O)	Type of Project = Operating Expense
	O&M	Operations and Maintenance
P	PCI	Pavement Condition Index
	PDA	Priority Development Area
	PL	(Metropolitan) Planning Funds
	PMS	Pavement Management System
	PPP	Public Participation Plan
	PRC	(MassDOT) Project Review Committee
	PSAC	Project Selection Advisory Council
	PS&E	The Plans, Specifications and Estimate to be used by contractors to bid on construction proposals
R	RGGI	Regional Greenhouse Gas Initiative
	ROW	Right-of-Way
	RPA	Regional Planning Agency
	RPMS	Regional Pavement Management System
	RTA	Regional Transit Authority
	RTP	Regional Transit Plan

S	SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
	SB	Southbound
	SD	Structurally Deficient
	SGR	State of Good Repair
	SIP	State (Air Quality) Implementation Plan
	SOV	Single Occupancy Vehicle
	SPR	Statewide Planning and Research Funds
	STBG	Surface Transportation Block Grant Program
	STIP	Statewide Transportation Improvement Program
	STP	Surface Transportation Program
T	TA	Transportation Alternatives
	TAP	Transportation Alternatives Program
	TCSP	Transportation and Community System Preservation Grant Program
	TDM	Transportation Demand Management
	TEA-21	Transportation Equity Act for the 21st Century
	TEC	Transportation Project Evaluation Criteria
	TIP	Transportation Improvement Program
	TMA	Transportation Management Area
	TMC	Turning Movement Count
	TOD	Transit-Oriented Development
	TRB	Transportation Research Board
U	UPWP	Unified Planning Work Program
	USDOT	U.S. Department of Transportation

V	V/C	Volume/Capacity Ratio
	VMT	Vehicle Miles Traveled
	VOC	Volatile Organic Compound
W	WB	Westbound

Massachusetts Executive Orders		
EO	526	Nondiscrimination, Diversity, Equal Employment Opportunity and Affirmative Action
EO	12898	Environmental Justice in Minority and Low Income Populations, February 1994
EO	13166	Improving Access to Programs (and Services) for persons with limited English Proficiency

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Appendix H Key to Maps Showing Locations of Transportation Projects

Appendix H Key to Maps Showing Locations of Transportation Projects

Map Number	Project Number	City/Town	Project Description
1	602418	Amesbury	Amesbury – Reconstruction of Elm Street
1	607737	Amesbury/ Salisbury	Amesbury – Salisbury Trail Connector at I-95
2	607541	Georgetown-Boxford	Georgetown – Boxford Border to Boston Trail from Georgetown Road to West Main Street (Route 97)
2	607542	Georgetown-Newbury	Georgetown– Newbury Border to Boston Trail (Northern Georgetown to Byfield Section)
3	608298	Groveland	Groveland- Groveland Community Trail, from Main Street to King Street
3	605753	Groveland	Groveland- Reconstruction of Route 97 (School Street) from Parker Street to Gardner Street
4	608027	Haverhill	Haverhill- Bradford Rail Trail Extension, from Route 125 to Railroad Street
5	605306	Haverhill	Haverhill – Bridge Replacement, H-12- 039, I-495 (NB & SB) over Merrimack River
6	608809	Lawrence / North Andover	Resurfacing Rt.114 from I-495 to Middleton Townline

Appendix H Key to Maps Showing Locations of Transportation Projects (Continued)

Map Number	Project Number	City/Town	Project Description
7	608494	Newbury / Newburyport / Salisbury	Resurfacing of Route 1
8	RTD – 5219	MVRTA	Newburyport – Intermodal Transit Parking Facility Construction
8	608792	Newburyport	Newburyport SRTS Middle and Elementary Schools
9	608095	North Andover	North Andover- Corridor Improvements on Route 114, between Route 125 (Andover Street) & Stop & Shop driveway
10	606159	North Andover	North Andover – Intersection & Signal Improvements at Route 125 & Massachusetts Avenue
11	605020	Salisbury	Salisbury - Multi-use Trail Extension (Borders to Boston Trail)

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Appendix I Comments Received on Draft 2018 to 2022 TIP

Comments Received on Draft MVMPO 2018-2022 TIP

MVRTA Comment: Correction needs to be made – FY 2022 – delivery of 6 new buses to replace 6 model year 2011 delivery should be in year 2023 not 2022 – the RTACAP will then be available in State FY 2023 – that's why there is $0 under State and the $582,240 under local (the place holder number).
Response: Change made.

MassDOT Comments: The MassDOT comments are contained in the two page letter that follows on pages 97 and 98.
Response: The requested changes have been made.
Please note that the changes related to "the error in the Total Quantified Impact field at the bottom of the sheet" do not relate to the Draft document sent out to public review. These changes have been made to a template of projects MassDOT prepares, the Draft document itself did not have errors in the Total Quantified GHG numbers.

MassDOT Additional Comment: MassDOT additionally commented that the project description of project # 605306 has been changed from "Haverhill – Superstructure Replacement, H-12-039, I-495 (NB & SB) over Merrimack River" to "Haverhill – Bridge Replacement, H-12-039, I-495 (NB & SB) over Merrimack River".
Response: The change has been made.

FHWA Comments: The FHWA comments are contained in the chart titled "TIP Review Checklist" on pages 99 to 106 below. The column labeled "Responses" are the responses to the FHWA "Comments" column.
Repsonse: The reponses to FHWA comments are in the "Responses" column. Two new tables have been added to the document in response to the FHWA comments.

The first is in the Performance Measures section, the table starts on page 13 of the Main document and lists all of the programmed projects and which Federal performance target(s), the project will help meet.

The second is in the Equity Analysis section on page 129 of the Main document, the table summarizes the percent of population in Title VI / EJ communities relative to the percent of Federal highway funding programmed. This table illustrates consistency between the percent of population in Tilte VI / EJ areas and the percent of funding in those areas.

Conservation Law Foundation ("CLF") Comments: See letter on pages 107 to 108.

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

May 15, 2017

Karen Sawyer Conard, Executive Director
Merrimack Valley Planning Commission
160 Main Street
Haverhill, MA 01830

Dear Ms. Conard:

The Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP) has reviewed the draft 2018-2022 Transportation Improvement Program (TIP) released by the Merrimack Valley Metropolitan Planning Organization (MPO) on April26, 2017. The following MassDOT comments include both general guidance and specific comments on the MPO's 3C planning process related to the content of this document as released for public review.

Please note the following comments specific to the information contained in the MPO's draft 2018-2022 TIP.

Narrative

- Pages 10-12- Please maintain font consistency

Federal Highway Project Listing

FFY 2021

- 608095 – Please follow Advanced Construction (AC) nomenclature in Additional Information
- 607542- Please change MPQ to Merrimack Valley

GHG Impacts

2018 Highway Tab

- 608809 – label as qualitative decrease
- Please address the error in the Total Quantified Impact field at the bottom of the sheet.

2019 Highway Tab

- 608792 – label as qualitative decrease
- 602418 – GHG impacts should be shown in the last year of funding
- Please address the error in the Total Quantified Impact field at the bottom of the sheet.

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

2020 Highway Tab

- 602418 – GHG impacts should be shown in the last year of funding
- Please address the error in the Total Quantified Impact field in Section 2C at the bottom of the sheet.

Completed Highway projects

- Please add fiscal years.

Equity Analysis

- Equity analysis provides data but does not include a conclusion. Please add narrative to conclude the results of the analysis and explain if the program is equitable.

Sincerely,

David Mohler
Executive D rector
Office of Transportation Planning

Cc: Jeffrey McEwen, Division Administrator, Federal Highway Administration
Mary Beth Mello, Regional Administrator, Federal Transit Administration
Paul Stedman, District 4 Highway Director
Astrid Glynn, Rail and Transit Division Administrator

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
Does the TIP cover a period of at least four years and is it updated every four years or more frequently? 450.326(a)	YES				
Is the TIP cycle compatible with the STIP cycle? 450.326(a)	YES				
If a non-attainment or maintenance area, has the MPO made a conformity determination? 450.326(a)			X		
Were all interested parties given a reasonable opportunity to comment on the TIP as required by 450.316(a) & 450.326(b)?	YES			Solicitation plan is comprehensive;In Process	
Was the TIP made available for public review and in accessible formats, including the Web? 450.326(b) & 23 CFR 450.316(a)				PDF is not widely considered an acessible format because it is not readable by older screen readers. Can the MPO provide an html version too?	Originally software issues prevented a readable conversion to html. The issues have been resolved and therefore an html version will be created.

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
Were performance targets clearly identified (450.306(d)) and is there a method to evaluate progress? 450.326 (c)			X	Performance targets under the new rule are being developed by MassDOT and the MPOs. The discussion beginning on page 10 does not contain information about performance monitoring and the effectiveness of the previous TIP in meeting any established targets. A monitoring and reporting system that demonstrates the previous TIP's effectiveness in meeting those targets will need to be included in this section, if not provided elsewhere in the TIP. Although this may not be an absolute requirement at this time. I would encourage more discussion to help shape this section as a template for the next TIP.	A paragraph has been added to page 12 of the Main document - "Monitoring Progress in Meeting Targets".

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
Does the TIP include a description of its anticipated effect in achieving performance targets, linking investment priorities to targets? 450.326(d)			X	There will need to be a discussion on how the investment priorities in this TIP serve to meet the performance targets.	A table of highway projects programmed in this TIP has been added with a column that lists the Federal Performance Target(s) that the project will help meet. (Pages 13 to 16 of the Main document).
Does the TIP include both capital and non-capital projects (or project phases)? 23 CFR 450.326(e)	X				
Does the TIP include all regionally significant projects, regardless of funding source? 23 CFR 450.326(f)	X				

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
Does the TIP include for each project or phase (e..g. preliminary engineering, enviroronment/NEPA, right-of-way, design or construction) the following: sufficient descriptive material (i.e. type of work, termini and length) to identify the project or phase; estimated total project cost, or a project cost range, which may extend beyond the four years of the TIP; the amount of Federal funds proposed to be obligated during each program year (for the first year, this includes the proposed category of Federal funds and source(s) of non-Federal funds, for the second, third and fourth years, this includes the likely category or possible categories of Federal funds and sources of non-Federal funds; and identification of the agencies responsible for carrying out the project or phase; In nonattainment or maintenance areas: 1) identification or TCM projects in the SIP; and 2) must be in sufficient detail to make an air quality analysis; In areas requiring ADA paratransit and key station plans, identify projects that will support the implementaiton of these plans. 23 CFR 450.326(g)	X				

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
In nonattainment or maintenance areas, are project classifications consistent with the "exempt project" classifications contained in the EPA regs (40 CFR Part 93, Subpart A) ? 450.326(h)					
Are the projects or project phases identified in the TIP consistent with the approved metropolitan transportation plans? 23 CFR 450.326(i)				It would be helpful to explain any variances in programming from the project flow identified in the MTP.	A paragraph has been added on page 9 of the Main document.
Does the TIP contain a financial plan that demonstrates how the approved TIP can be implemented? 23 CFR 450.326(j)	X				

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
Does the financial plan identify all public and private funding sources that are reasonably expected to be available? 23 CFR 450.326(j)	X			The plan could be more clear about target funds available vs. target funds programmed. The roll-up of all funds makes it difficult to distinguish.	The Summaries of Highway Funding Categories on pages 90 to 94 of the Main document have been updated to include a separate Target Funding section and subtotals. This information is also on the first page of each year in the project listings in "Section 1A Fiscal Constraint Analysis" following "Section 1A Regionally Prioritized Projects" where the projects using Regional Target Funding are listed.
If the financial plan includes an recommendations for new funding sources, are strategies to ensure their availability identified? 23 CFR 450.326(j)			X	not discussed	
Does the financial plan reflect revenue and cost estimates in "year of expenditure dollars", using an inflation rate based on reasonable financial principles and information? 23 CFR 450.326(j)	X				
Does the TIP demonstrate financial constraint and is it maintained by year? 23 CFR 450.326(k)	X				

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
In nonattainment or maintenance areas, are projects included in the first 2 years s limited to those for which funds are available or committed? 450.326(k)			X		
Does the TIP identify the criteria and process for prioritizing projects for inclusion in the TIP and any changes in priorities from previous TIPs? 23 CFR 450.326(n)(1)	X				
Does the TIP list major projects from the previous TIP that were implemented and identify any significant delays in the planned implementation of major projects? 23 CFR 450.326(n)(2)	X			It doesn't appear that Part C.3. include a status of all projects in the region? Wouldn't you want the status to square with the programmed funding allocated throughout the region, similar to what you estimated/programmed in the financial plan? Because you layout the financial plan to include investments with both target and non-target funds, I would suggest a status table on non-target State projects as well.	All previous first year (2017) projects, both Target and Statewide were included in the table in community order, the table is now separated into two tables, Target Projects and Statewide Projects.
If a non-attainment or maintenance area, does the TIP describe the progress in implementing any required TCMs, in accordance with 40 CFR Part 93? 23 CFR 450.326(n)(3)			X		

TIP Review Checklist

23 CFR 450.326 --"DEVELOPMENT AND CONTENT OF THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP)					
	YES	NO	N/A	COMMENTS	Responses
If a nonattainment or maintenance area, is the MPO in a conformity lapse period (12-month)?		X		See 450.326(o) for specifics	
Were all projects that were advanced in place of others within the first 4 years of the TIP, subject to the project selection requirements of 450.332? 450.326(p)	X				
Does the TIP include a self-certification signed by the MPO and the State certifying that the metropolitan transportation planning process is being carried out in accordance with all applicable requirements? 23 CFR 450.334(a)	X			Item #5 of the self-certification should reflect current authorization FAST ACT. See 23 CFR 450.336(a)	Change made.

Additional Notes:

Page 9--TIP requirements are now at 450.326, rather than 450.324. Change made

clf
conservation law foundation

For a thriving New England

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May 18, 2017

BY EMAIL

Anthony Komornick
Transportation Program Manager
Merrimack Valley Metropolitan Planning Organization
c/o Merrimack Valley Planning Commission
160 Main Street Haverhill, MA 01830 akomornick@mvpc.org

Re: Merrimack Valley Metropolitan Planning Organization
Draft FY2018-2022 Transportation Improvement Program

Dear Mr. Komornick:

Conservation Law Foundation ("CLF") submits these comments for consideration by the Central Massachusetts Regional Planning Commission ("MPO") during the written comment period for the Draft 2018-2022 Transportation Improvement Program ("TIP"). CLF is a non-profit, member-supported regional environmental organization working to conserve natural resources, protect public health, and promote thriving communities for all throughout New England. CLF has long advocated for enhanced public transportation in New England.

CLF supports a balanced TIP that enhances public transportation, pedestrian and bicycle infrastructure, increases mobility for all, and protects the environment. As such, we support projects such as the following:

- Project ID # 605020 in FY 2018 which extends the Border to Boston trail in Salisbury.
- Project ID # 607737 in FY 2018 which constructs a trail connector at I-95 in Amesbury.
- Project ID # 608298 in FY 2019 which extends the Groveland Community Trail from Main Street to King Street.
- Project ID # MV0001 in FY 2019 which flexes funds for MVRTA new bus upgrade to cleaner fuel buses.
- Project ID # 608792 in FY 2019 which implements improvements at Nock Middle School & Molin Upper Elementary School.

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- Project ID # 608027 in FY 2020 which extends the Bradford Rail Trail from Route 125 to Railroad Street in Haverhill.

- Project ID #607541 in FY 2020 which extends the Border to Boston trail from Georgetown Road to West Main Street (Route 97) in Georgetown and Boxford.

- Project ID # 607542 in FY 2021 which extends the Border to Boston Trail from Northern Georgetown to the Byfield section in Georgetown and Newbury.

CLF applauds the MPO for dedicating flex funding to purchase hybrid buses in support of regional transit. In fact, CLF often highlights this laudable action to other MPOs in the Commonwealth. Looking forward, CLF hopes to see further investment in the Merrimack Valley Regional Transit Authority and completion of the Border to Boston Trail.

Thank you for your consideration of these comments. If you have any questions, I can be reached by phone at (617) 850-1702 or by email at alemelin@clf.org

Sincerely,

Anne C. Lemelin
Legal Fellow/Attorney

Appendix J October 2017 Amendments and Comments

MVMPO FFYs 2018-2022 Transportation Improvement Program
October 2017 Proposed Amendments

October 2017 Proposed Amendment # 1:

Amend Highway project # 605306 (Haverhill – Bridge Replacement, H-12-039, I-495 (NB & SB) over Merrimack River) to increase total project cost to $116,603,655 from $79,000,000 and add a fifth year to the project so that it is Advance Construction in FFYs 2018 to 2022, funded with Statewide NHPP-On System Funds, $23,320,731 per year for five years.

Comments:

No comments were received on Proposed Amendment # 1.

October 2017 Proposed Amendment # 2:

Amend to Add project # 608852 (Lawrence – Replace Superstructure of Bridge L-04-021 Rte. 114 over Shawsheen River) to FFY 2022 to be funded with Statewide Bridge Program Systematic Maintenance Funding.

Comments:

MassDOT District 4 stated that this superstructure replacement project was proposed for funding using District Maintenance funds, however it was brought to the attention of the distributor of the funds that this bridge requires more than maintenance and actually needs to be widened to reduce a bottleneck, a project which will cost much more than the $2,040,000 available in the maintenance fund.

The City of Lawrence provided comments in the letter on the following page.

Response:

Proposed Amendment # 2 was Tabled while the District and the City address the funding issues.

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DANIEL RIVERA
Mayor & CEO

November 27, 2017

Anthony Komornick
Transportation Program Manager
Merrimack Valley Planning Commission
160 Main Street
Haverhill, MA 01830

Re: Potential Amendments to FFYs 2018-2022 Transportation Improvement Program (TIP)

Dear Mr. Komornick,

At the October 25 MVMPO meeting, MassDOT requested the addition of a new bridge project (#608852) to the FFY 2022 element of the Transportation Improvement Program document that will replace the superstructure of Bridge L-04-021, which carries Route 114 over the Shawsheen River in Lawrence.

The City is fully supportive of upgrading the functionally obsolete bridge which is a major chokepoint on Route 114, especially given the high volume of traffic generated by its proximity to I495 and nearby commercial and institutional uses. However, rather than replacing the superstructure we ask the improvement to include additional travel lanes and sidewalks.

While this would increase the project cost, the investment would be more in keeping with the actual needs of the region and better address public safety and congestions issues for both Lawrence and North Andover. The City of Lawrence urges the inclusion of this project on the TIP and will assist in seeking any additional resources, including National Highway Performance Program (NHPP) funds, National Highway System (NHS) funds, state earmark, etc. to make the project become much more effective.

Sincerely,

Daniel Rivera
Mayor