

Disparate Impact and Disproportionate Burden Mitigation Analysis Results

Addressing Adverse Impacts on Minority and Low-income Communities through TIP Programming

During the development of the Boston Region Metropolitan Planning Organization's (MPO) 2023 Long-Range Transportation Plan (LRTP), *Destination 2050*, we (MPO staff) conducted a Disparate Impact and Disproportionate Burden (DI/DB) analysis to determine if minority and low-income populations would be disproportionately impacted by the projects, in the aggregate, in the LRTP compared to nonminority and non-low-income populations, respectively. These impacts are assumed to occur by 2050, if all the projects are built. Disparate impacts—adverse impacts on minority populations—and disproportionate burdens—adverse impacts on low-income populations—were identified for several metrics:

- Access to jobs by transit (low-income population)
- Access to healthcare by transit (low-income and minority populations)
- Access to all parks by highway (low-income population)
- Average travel time by roadway (minority population)
- Average travel time by transit (minority population)

As is required by federal regulations, the MPO must mitigate these disparate impacts and disproportionate burdens, which we are doing through the projects funded in its capital program, the Transportation Improvement Program (TIP). To initiate this process, we conducted an initial DI/DB Mitigation Analysis in the fall of 2023 and winter of 2024. This document describes the results of that analysis.

DEFINITIONS

- **Disparate Impact:** a facially neutral policy or practice that disproportionately affects members of a group identified by race, color, or national origin, and that may involve a denial of benefits or an imposition of burdens
(This definition refers only to minority populations.)
- **Disproportionate Burden:** disproportionately high and adverse effects
(In the MPO's DI/DB analysis, this definition refers only to low-income populations.)
- **Minority Population:** people who identify as non-White and/or Hispanic/Latino/a
- **Low-income Population:** people whose family income is less than or equal to 200 percent of the federal poverty level for their family size
- **Baseline Scenario:** the initial scenario run for the DI/DB Mitigation Analysis, which is based on projects assumed to be in the FFYs 2025–29 TIP as of December 31, 2023 (including projects funded in the FFYs 2024–28 TIP that are presumed to be funded in the FFYs 2025–29 TIP and new projects submitted for funding)
- **DI/DB LRTP Analysis:** an analysis used to determine if implementation of the projects included in the LRTP would result in disparate impacts and disproportionate burdens
- **DI/DB Mitigation Analysis:** an analysis that evaluates a collection of TIP projects with the metrics for which the DI/DB LRTP analysis found disparate impacts or disproportionate burdens to determine whether the TIP projects would mitigate the impacts

About the DI/DB Mitigation Analysis

We conducted the DI/DB Mitigation Analysis using Conveyal, an analytical tool that assesses the ability of people to reach destinations within a given travel time. This first analysis was run on a Baseline Scenario to give the MPO and other interested parties a foundation for comparison when Conveyal is run for the final Federal Fiscal Years (FFYs) 2025–29 TIP scenario.

The Baseline Scenario included projects funded in the FFYs 2024–28 TIP that are presumed to continue to be funded in the FFYs 2025–29 TIP, as well as those projects submitted for funding in the FFYs 2025–29 TIP as of December 31, 2023. It does not reflect projects submitted after that date, or any changes to project readiness or design of existing projects. In addition, some projects were not included due to their negligible impacts in terms of access or travel time metrics. For a full list of projects included in the analysis, see Appendix B—Project Lists.

As with the DI/DB LRTP Analysis, the DI/DB Mitigation Analysis assessed the impacts of projects, in the aggregate, and compared these impacts between two pairs of population groups:

- Minority and nonminority populations
- Low-income and non-low-income populations

Notably, the analysis was not directly concerned with the absolute project impacts on a population group (such as an increase in travel time), but rather how that increase or decrease compared to the paired population group. So, for example, if the minority and nonminority populations are both expected to experience longer travel times if the projects are constructed, there would only be a disparate impact if the increase for the minority population was greater than the increase for the nonminority population. This is not to say that the increase in travel time for both populations should not be concerning, just that it is not the purview of a DI/DB analysis.

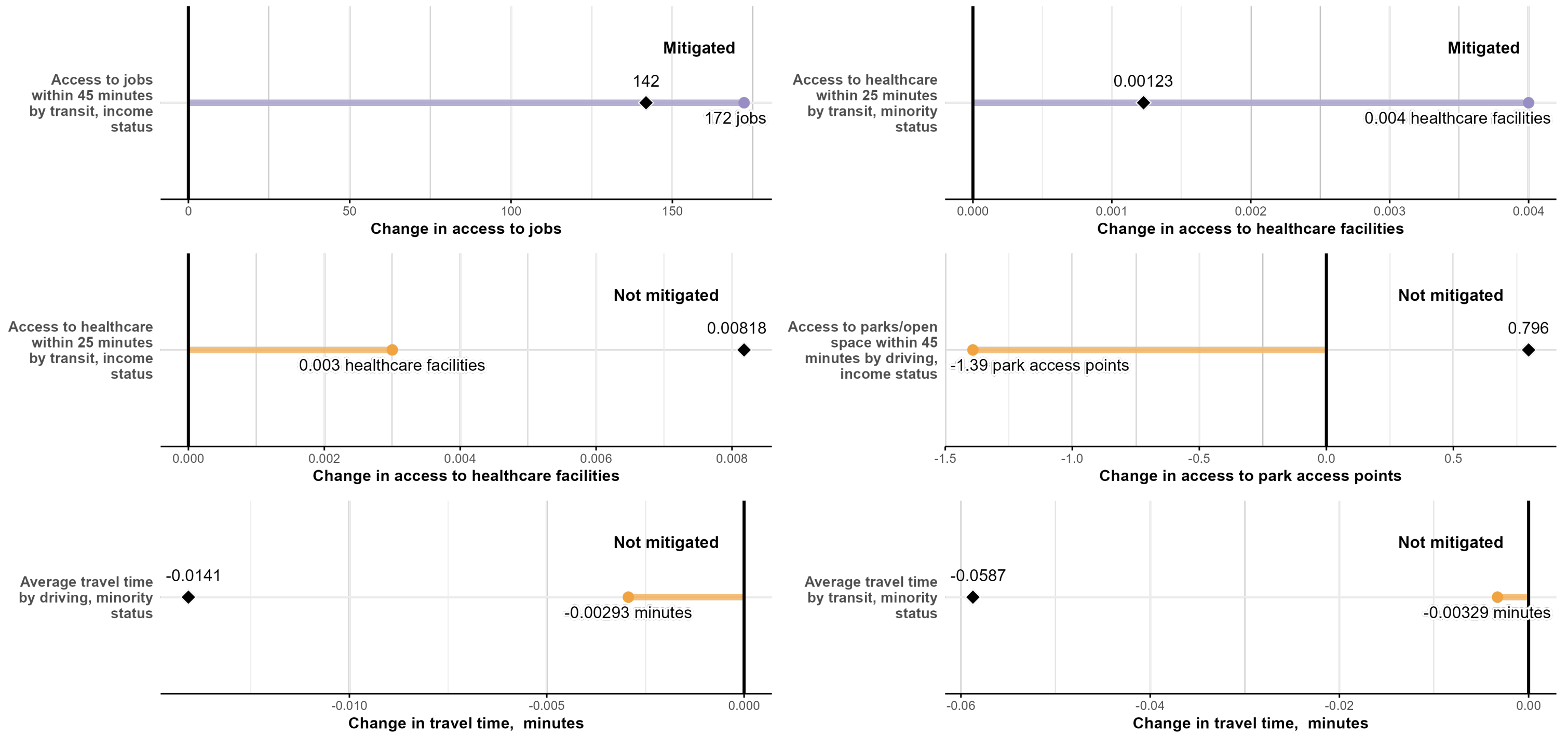
Note that the analysis was only run on the group of MPO Regional Target-funded projects, not individual projects—therefore we did not identify the impacts of specific projects. In addition, when multiple projects are run in a scenario, their interactions may lead to different results than if each project were analyzed individually.

DI/DB Mitigation Analysis Results

The results show the change in access to opportunities or travel time for each population group that we would expect to see if the projects in the Baseline Scenario were constructed. Note that the analysis results are based on current project design information—actual impacts may differ if designs change. The charts show the amount that needs to be mitigated—the difference in impacts (for example, number of jobs) between the minority and nonminority and between low-income and non-low-income populations. They then show whether the projects in the Baseline Scenario would benefit the minority or low-income populations to the extent that these differences are mitigated.

We can see that two of the six metrics—*access to jobs within a 45-minute transit trip* for the low-income population and *access to healthcare within a 25-minute transit trip* for the minority population—would be mitigated, whereas the other four metrics would not. Note that three of the four metrics are heading in the right direction—while not fully mitigated, they show improvements for low-income or minority populations. These metrics are *access to healthcare within a 25-minute transit trip for the low-income population*, *average travel time by driving for the minority population*, and *average travel time by transit for the low-income population*. Finally, the metric for *access to parks/open space* is going in the wrong direction as it shows access decreasing more for the low-income population than for the non-low-income population.

Figure 1
TIP Project Contribution to DI/DB Mitigation



DI/DB Mitigation Goal ◆

Mitigation Result ● Mitigated ● Not mitigated

Figure 2
Summary of Projected TIP Project Impacts on DI/DB Metrics

Metric	Population Type	Impact to the EJ population	Impact to the non-EJ population	Impact of TIP Projects	Do TIP projects contribute to mitigation need?	How much benefit for the EJ population is needed to mitigate the DI/DB?	How do TIP projects impact the EJ population relative to the non-EJ population?	Do TIP projects mitigate the DI/DB?
Access to jobs within 45 minutes by transit	Income status	EJ benefit	non-EJ benefit	TIP projects increase access for EJ population more than the non-EJ population.	Yes	142 jobs	172 jobs	Mitigated
Access to healthcare within 25 minutes by transit	Minority status	EJ benefit	non-EJ benefit	TIP projects increase access for EJ population more than the non-EJ population.	Yes	0.00123 healthcare facilities	0.004 healthcare facilities	Mitigated
Access to healthcare within 25 minutes by transit	Income status	EJ benefit	non-EJ benefit	TIP projects increase access for EJ population more than the non-EJ population.	Yes	0.00818 healthcare facilities	0.003 healthcare facilities	Not mitigated
Access to parks/open space within 45 minutes by driving	Income status	EJ burden	non-EJ burden	TIP projects decrease access for EJ population more than the non-EJ population.	No	0.796 park access points	-1.39 park access points	Not mitigated
Average travel time by driving	Minority status	EJ benefit	non-EJ burden	TIP projects decrease travel time for EJ population more than the non-EJ population.	Yes	-0.0141 minutes	-0.00293 minutes	Not mitigated
Average travel time by transit	Minority status	EJ benefit	non-EJ burden	TIP projects decrease travel time for EJ population more than the non-EJ population.	Yes	-0.0587 minutes	-0.00329 minutes	Not mitigated

Next Steps

As the MPO works to develop a final programming scenario for the FFYs 2025–29 TIP, staff will run an updated DI/DB Mitigation Analysis to determine the extent to which the disparate impacts and disproportionate burdens will be mitigated. The MPO does not need to accomplish full mitigation in the FFYs 2025–29 TIP. This initial analysis was focused on investigating Conveyal’s utility for DI/DB mitigation, and further work will be done over the next year to develop an overall process for establishing when and how mitigation is accomplished. There are several complexities to consider, particularly the different timeframes of the TIP and LRTP—the LRTP has a 20-year horizon and contains projects whose funding schedules may significantly change within that time frame, whereas the TIP has a four-year horizon with projects ready for implementation. This year, the MPO can begin to track the progress of the metrics for which there are disparate impacts and disproportionate burdens and develop a better understanding of what would be required for the mitigation process.

Additionally, we are currently conducting a study, *Applying Conveyal to TIP Project Scoring*, to develop the *destination access* evaluation criteria. Once criteria are established, the MPO will be able to evaluate projects individually for destination access impacts and, therefore, have a better idea which projects could contribute to mitigating remaining disparate impacts and disproportionate burdens in future TIPs. This would allow the MPO to evaluate projects separately—through project scoring—as well as together—through a DI/DB Mitigation Analysis.



Appendix A—Technical Appendix

This appendix provides more detail on how the DI/DB Mitigation Analysis was conducted.

How does the DI/DB Mitigation Analysis differ from the DI/DB LRTP Analysis?

The DI/DB LRTP Analysis was conducted using the MPO’s travel demand model (TDM23), while the DI/DB Mitigation Analysis was conducted using Conveyal. We chose to use Conveyal for the mitigation analysis because it is a faster, more flexible tool, ideal for use during the development of the TIP. To minimize the differences between the two analyses, we took measures to obtain compatible results.

- We replicated the TDM23 process as closely as possible with Conveyal. We used the same metrics and data sources for those metrics (for example, the same destination data—see Appendix B).
- We set Conveyal parameters to be as close as possible to TDM23—such as having trips leave at the same time of day and using congestion to reflect roadway conditions.

We also accounted for several key differences that affect analysis results and how we interpret them:

- Conveyal is a potential-based analysis (it reflects the potential for a person to make a trip regardless of other factors that may affect a person’s ability to make a trip, such as car ownership or need to take the trip), while TDM23 reflects estimated travel demand that is derived from a variety of household characteristics, such as auto ownership.
- Conveyal uses hundreds of grid cells (250 meters by 250 meters) overlaid across the geography of the Boston region as trip origins, while TDM23 uses transportation analysis zone (TAZ) centroids as trip origins.

- Conveyal analyzes demographics through a process called dasymetric mapping that applies demographic data from census tracts to Conveyal’s grid cells, while TDM23 applied demographic data from the census to TAZs.
- Conveyal uses a full representation of the region’s transportation network, while TDM23 uses a simplified version of the network.
- Conveyal uses General Transit Feed Specification (GTFS) schedules from December 2022, while TDM23 uses GTFS schedules from 2019 (the Green Line Extension, for example, was open in December 2022 but not in 2019).
- Conveyal uses demographic data directly from the 2018–22 American Community Survey (ACS) and 2020 Census, while TDM23 used 2018–22 ACS and 2020 Decennial Census data that were applied to TAZs.

Because of these differences, outputs (such as travel time) of the two processes cannot be compared directly. To compare the results of the LRTP DI/DB Analysis and DI/DB Mitigation Analysis, we developed a conversion factor for each metric to convert the TDM23 outputs into Conveyal units. This factor was developed by comparing the difference, for each metric, between the transportation network without MPO investments in TDM23 and the network in Conveyal.

Full results of the *Destination 2050* DI/DB analysis can be found at:

<https://www.bostonmpo.org/data/pdf/plans/LRTP/destination2050/Destination-2050-LRTP.pdf#page=277>.

How were disparate impacts and disproportionate burdens identified in the LRTP?

The MPO’s [DI/DB Policy](#) describes how the MPO identifies disparate impacts and disproportionate burdens. In sum, if the minority or low-income population is likely to be impacted more negatively than the respective nonminority or non-low-income population—which can be a denial of benefits or an imposition of burdens—then there is a disparate impact or disproportionate burden. When making this determination, the policy considers any uncertainty that is inherent to transportation modeling processes and tools.

Which metrics were analyzed?

The DI/DB Mitigation Analysis focused on six metrics for which there were disparate impacts and disproportionate burdens identified in *Destination 2050*:

- **Access to jobs by transit**—access to all jobs in the region within a 45-minute transit trip
- **Access to healthcare by transit**—access to healthcare facilities within a 25-minute transit trip and a 45-minute drive trip
- **Access to parks by driving**—access to parks at least one-half acre in size within a 45-minute drive
- **Average travel time by roadway**—includes all drive trips
- **Average travel time by transit**—includes trips by rapid transit, light rail, commuter rail, and ferry

Destination access metrics examine how many destinations people can reach within a given travel time—travel times are set based on the average travel time in the Boston region to that destination as calculated either from the American Community Survey (access to jobs) or by using the MPO’s travel demand model (all others). Average travel time metrics consider the average travel times for all trips for that mode that begin or end in the Boston region, from TAZ centroid to TAZ centroid.

How were destinations defined?

Destinations are defined in different ways for each destination access metric:

- **Access to jobs and healthcare metrics**—These metrics are defined as the number of jobs or healthcare facilities people can access. Healthcare facilities are not normalized by any factor; regardless of the size, number of healthcare providers, or patients served, each location is considered one facility for the purposes of this analysis.
- **Access to parks**—Because of the varying size of parks, rather than measuring access to the park itself, we identified access to the park’s access points, defined as where a park intersects with the roadway network. This allows us to measure access to the locations where people actually enter the park, better reflecting how parks are accessed and used. We can also think of them as “opportunities,” because, strictly speaking, we are measuring the opportunity for a person to access a park via one of the many access points, not the one park as a unit.

What are the destination data sources?

Job data are from LODES 2019 data that are compiled by the US Census Bureau. Parks data are from the December 2021 [MassGIS Protected and Recreational Open Space file](#). Healthcare data are from a combination of the following:

- [MassGIS Acute Care Hospitals](#), December 2018
- [MassGIS Community Health Centers](#), October 2019
- [Massachusetts Department of Public Health Care Facility Licensure and Certification](#), February 2022

We are currently compiling an online repository of the methodology and data sources used in the DI/DB Mitigation Analysis. This document will be updated with the link once it is live.



Appendix B—Project Lists

This appendix lists the projects included in the DI/DB LRTP Analysis and the DI/DB Mitigation Analysis.

What types of projects were included and how do they differ?

- **DI/DB LRTP Analysis:** This analysis included all projects listed in the LRTP that are MPO Regional Target-funded projects (funded with the MPO's discretionary dollars).
- **DI/DB Mitigation Analysis:** This analysis included the following projects:
 - Projects funded in the FFYs 2024–28 TIP that will also be funded in the FFYs 2025–29 TIP and that can be modeled in Conveyal
 - Projects submitted for funding consideration beginning in the FFYs 2025–29 TIP by December 31, 2023, and that can be modeled in Conveyal
 - The following types of projects were not included:
 - Design pilot projects, as there is not enough project information to represent them in Conveyal
 - Projects that do not change travel speed and/or add new links to the transportation network and/or change roadway geometry (such as bike racks)
 - Microtransit, as currently these projects cannot be modeled in Conveyal
 - Bikeshare, as currently these projects cannot be modeled in Conveyal

We are currently working on developing the ability to add microtransit and bikeshare projects to Conveyal and anticipate including these projects in future DI/DB Mitigation Analyses.

Note that not all aspects of a project can be modeled in Conveyal. Conveyal is responsive to changes in travel speed, the addition and removal of travel links (such as a new shared-use path), and changes in roadway geometry (such as the removal of a travel lane). Only those projects that have at least one of these elements are included in the analysis. We are continuing to explore Conveyal's ability to model more project types and characteristics; in future analyses additional projects will be added as feasible.

Why are there more projects in the DI/DB Mitigation Analysis than in the DI/DB LRTP Analysis?

The TIP and the LRTP contain different types of projects. The LRTP contains a fiscally constrained list of regionally significant projects that are expected to be built in the region in the next 20 years. Broadly speaking, a regionally significant project is one that is on a facility that serves regional transportation needs—at a minimum, all principal arterial highways and fixed guideway transit. Projects in the TIP are ones that the MPO is committing to fund, which may include projects listed in the LRTP if the MPO has elected to fund them, as well as other projects that are not considered regionally significant but that the MPO believes are important to the region. Therefore, the TIP includes many more projects than those listed in the LRTP.

Table B-1
DI/DB Mitigation Analysis Project List

MassDOT Project ID	Proponent	Project Name
608436	Ashland	Rehabilitation and rail crossing improvements on Cherry Street
606453	Boston	Improvements on Boylston Street, from intersection of Brookline Avenue and Park Drive to Ipswich Street
609532	Chelsea	Targeted safety improvements and related work on Broadway, from Williams Street to City Hall Avenue
609257	Everett	Reconstruction of Beacham Street
605168	Hingham	Improvements on Route 3A from Otis Street/Cole Road, including Summer Street and rotary; Rockland Street to George Washington Boulevard
610544	Peabody	Multiuse path construction of Independence Greenway at I-95 and Route 1
609252	Lynn	Rehabilitation of Essex Street
608051	Wilmington	Reconstruction on Route 38 (Main Street), from Route 62 to the Woburn city line
608067	Woburn	Intersection reconstruction at Route 3 (Cambridge Road) and Bedford Road and South Bedford Street
605743	Ipswich	Resurfacing and related work on Central and South Main Streets
608940	Weston	Intersection improvements Boston Post Road (Route 20) at Wellesley Street
608045	Milford	Rehabilitation on Route 16, from Route 109 to Beaver Street
609204	Belmont	Community Path, Belmont component of the MCRT (Phase I)
605857	Norwood	Intersection improvements at Route 1 and University Avenue/ Everett Street
612989	Boston	Bridge preservation, B-16-066 (38D), Cambridge Street over MBTA

(Table B-1 cont.)

MassDOT Project ID	Proponent	Project Name
609437	Salem, Peabody	Boston Street improvements
608954	Weston	Reconstruction on Route 30
610662	Woburn	Roadway and intersection improvements at Woburn Common, Route 38 (Main Street), Winn Street, Pleasant Street, and Montvale Avenue
606226	Boston	Reconstruction of Rutherford Avenue, from City Square to Sullivan Square
610932	Brookline	Rehabilitation of Washington Street
611983	Chelsea	Park Street and Pearl Street reconstruction
609246	Lynn	Rehabilitation of Western Avenue (Route 107)
613088	Malden	Spot Pond Brook Greenway
607981	Somerville	McGrath Boulevard construction
610691	Natick	Cochituate Rail Trail extension, from MBTA station to Mechanic Street
610666	Swampscott	Rail Trail construction
S12827	Wakefield	Main Street corridor improvement project
S12826	Westwood, Norwood	Reconstruction of Canton Street to University Drive, including rehabilitation of N-25-032=W-31-018
612963	Bellingham	Roadway rehabilitation of Route 126 (Hartford Road), from 800 feet north of the I-495 NB off ramp to Medway town line, including B-06-017
TBD	Malden	Canal Street bicycle lanes
610823	Quincy	Intersection improvements at Willard Street and Ricciuti Drive

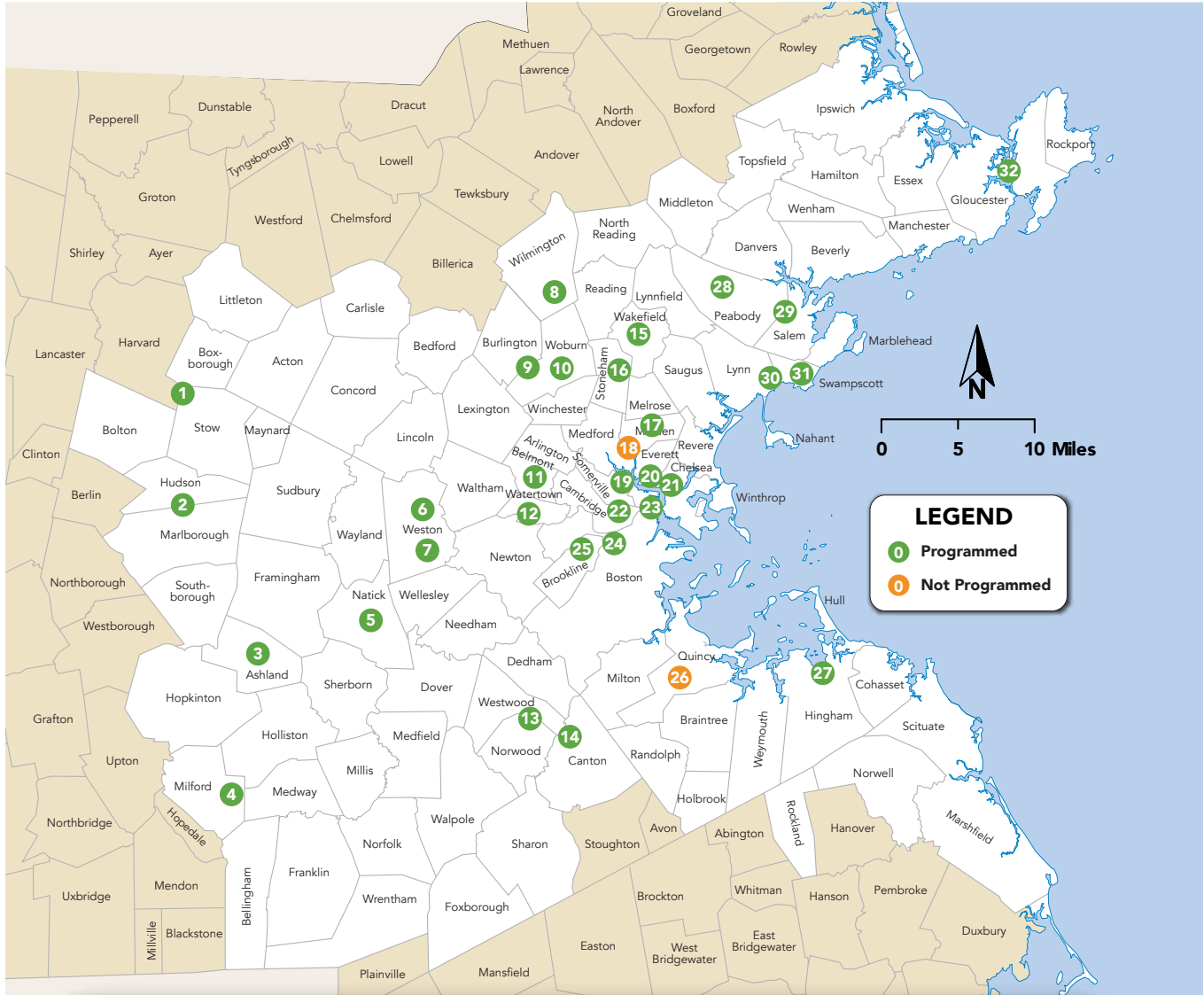
MBTA = Massachusetts Bay Transportation Authority. MCRT = Massachusetts Central Rail Trail. TBD = to be determined.

Table B-2
DI/DB LRTP Analysis Projects

MassDOT Project ID	Proponent	Project Name
605857	Norwood	Intersection improvements at Route 1 and University Avenue/ Everett Street
603739	Wrentham	I-495/Route 1A Ramps
606226	Boston	Reconstruction of Rutherford Avenue from City Square to Sullivan Square
607981	Somerville	McGrath Boulevard
606109	Framingham	Intersection improvements at Route 126 and Route 135/MBTA and CSX Railroad
TBD	Lexington	Route 4/225 (Bedford Street) and Hartwell Avenue

MBTA = Massachusetts Bay Transportation Authority. TBD = to be determined.

Figure B-1 Locations of DI/DB Mitigation Projects



- | | | |
|--|--|---|
| 1 Montachusett Regional Transit Authority Microtransit Service | 12 Pleasant Street Shuttle Service Expansion | 23 Reconstruction of Rutherford Avenue, from City Square to Sullivan Square |
| 2 MWRTA: Catchconnect Microtransit Service | 13 Intersection Improvements at Route 1 and University Avenue/Everet Street | 24 Improvements on Boylston Street, from Intersection of Brookline Avenue & Park Street to Ipswich Street |
| 3 Rehabilitation and Rail Crossing Improvements on Cherry Street | 14 Reconstruction of Canton Street to University Drive, including Rehab of N-25-032=W-31-018 | 25 Rehabilitation of Washington Street |
| 4 Rehabilitation on Route 16, from Route 109 to Beaver Street | 15 Main Street Corridor Improvement Project | 26 Main Street Corridor Improvement Project |
| 5 Cochituate Rail Trail Extension, from MBTA Station to Mechanic Street | 16 Stoneham Shuttle Service | 27 Improvements on Route 3A from Otis Street/Cole Road including Summer Street and Rotary; Rockland Street to George Washington Boulevard |
| 6 Intersection Improvements at Boston Post Road (Route 20) at Wellesley Street | 17 Spot Pond Brook Greenway | 28 Multi-Use Path Construction of Independence Greenway at I-95 and Route 1 |
| 7 Reconstruction on Route 30 | 18 Canal Street Bicycle Lanes | 29 Boston Street Improvements |
| 8 Reconstruction on Route 38 (Main Street), from Route 62 to the Woburn City Line | 19 Bridge Preservation, B-16,066 (38D), Cambridge Street over MBTA | 30 Rehabilitation of Essex Street |
| 9 Intersection Reconstruction at Route 3 (Cambridge Road) and Bedford Road and South Bedford Street | 20 Reconstruction of Beecham Street | 31 Swampscott Rail Trail Construction |
| 10 Roadway and Intersection Improvements at Woburn Common, Route 38 (Main Street), Winn Street, Pleasant Street, and Montvale Avenue | 21 Chelsea-Park Street and Pearl Street Reconstruction | 32 CATA On Demand Microtransit Service Expansion |
| 11 Community Path, Belmont Component of the MCRT (Phase 1) | 22 McGrath Boulevard Construction | |

Figure B-2
Locations of DI/DB LRTP Projects

