



Exploring the Potential for Using Conveyal in Transportation Improvement Program Project Evaluations



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The preparation of this document was supported by the Boston Region Metropolitan Planning Organization through MPO Planning and \$5303 Contract #14004.

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March 2025



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Abstract

The Boston Region Metropolitan Planning Organization (MPO) provides funding for transportation projects through its Transportation Improvement Program (TIP). Projects considered for programming on the TIP are evaluated based on how well they address the MPO's goals, as set forth in its Long-Range Transportation Plan (LRTP). An LRTP for the region is produced every four years and project evaluation criteria are updated to reflect changes to the MPO's goals and to ensure that the MPO continues to fund projects through the TIP that are consistent with its priorities.

This report discusses the results of an MPO study to inform an update to project evaluation criteria that would be used to assess how transportation projects affect peoples' ability to access destinations. MPO staff explored the suitability of Conveyal, a destination access analysis tool, to support that effort by using it to analyze 11 sample TIP projects that represent the types of projects that the MPO funds. These analyses provided staff with an understanding of how Conveyal could be used to evaluate projects for impacts to destination access and for evaluating the equitableness of these impacts. Based on the results, staff developed a set of test evaluation criteria that assess the change in access for the region's population to everyday destinations. The report includes a discussion of factors to consider when using Conveyal for TIP project scoring and a recommendation to conduct further testing of Conveyal to address additional questions that emerged from this study, using projects proposed for the Federal Fiscal Years 2026–30 TIP.

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Executive Summary

ES.1 Background and Study Goals

This study explored the feasibility of using Conveyal, a destination access tool, to evaluate projects proposed for funding in the Boston Region Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP) based on how the projects could change the ability of people to access various types of destinations.

Specific goals of this study were as follows:

- Test various analysis parameters and transportation project elements in Conveyal to better understand the feasibility of evaluating these projects based on how they change access for the Boston region population and for environmental justice (EJ) populations.
- Run Conveyal on a set of 11 sample TIP projects that represent the type of projects the MPO funds to inform the development of potential project evaluation criteria for destination access.
- Use the results of these analyses to develop potential destination access criteria and scores with which to evaluate projects proposed for MPO funding in the TIP.

The MPO staff undertook this study to inform updates to the TIP project evaluation criteria and ensure they reflect changes to goals set in the MPO's Long-Range Transportation Plan (LRTP). With the adoption of each LRTP, the MPO updates its goals to reflect its evolving priorities and the region's transportation needs. In the most recent LRTP, *Destination 2050*, the MPO added a new goal focused on *access and connectivity* and revised an existing goal for *transportation equity* (TE) to focus on addressing disparities in transportation impacts among EJ and other transportation-disadvantaged populations.

Existing TIP criteria related to destination access are qualitative, considering the proximity of projects relative to areas of concentrated development. Conveyal is a tool that can be used instead to quantify how projects would affect destination access for people using the transportation system, providing greater consistency and comparability of results.

This study focused on access by transit, bicycling, and walking and rolling, but not driving, for two reasons. One is that these are the modes that Conveyal is best suited to analyze based on the types of projects the MPO funds. While roadway expansion—such as highway widening or construction of a new road—can be modeled in Conveyal, the MPO does not fund these types of projects. Instead, the MPO invests in local roadway projects that focus on improvements that alleviate local congestion, create multimodal connections, and improve safety. Smaller scale improvements such as these are more challenging to represent in Conveyal due to the quality and consistency of the data required to model both existing roadway conditions and proposed improvements. This approach is consistent with the MPO's goals, which emphasize advancing a multimodal transportation system for the Boston region and addressing driving conditions through means other than expansion. The MPO has other criteria to evaluate mobility and congestion relief for roadway projects.

Destination access has recently emerged as an important indicator of the effectiveness and quality of a transportation network. It measures the ease of reaching a destination within a given travel time by a particular travel mode. As such, results can be compared across modes. Conveyal is one of an emerging market of tools that support these analyses. Previously, the MPO staff had reviewed other destination access tools and found Conveyal to be well suited to the MPO's needs. Through the use of Conveyal in other work, staff identified several aspects of Conveyal that lend it to being used to evaluate projects proposed for funding in the TIP:

- It uses project data that is readily available to staff.
- It has a fast processing time.
- It can be used to analyze access for different transportation modes.
- It can be used to analyze access for different demographic groups.
- It has a relatively easy learning curve.
- It can be used to analyze and compare impacts of transportation projects.

ES.2 Developing a Methodology to Evaluate Changes in Destination Access

Based on the tests of different project elements, staff identified those that can and cannot be modeled in Conveyal. Projects with the following improvements generally can be modeled:

1. Changes in roadway speed (such as the addition of a new lane (speed increase) or the addition of traffic-calming elements (speed decrease)
2. Construction of new infrastructure (such as a sidewalk)
3. Changes in transit service, including service increases, decreases, removal, or alterations

Project elements that cannot be modeled include those that do not have a direct impact on travel speeds or include a new infrastructure or transit service. In addition, at this time staff could not model bikeshare expansion in Conveyal.

Staff tested 11 sample projects in Conveyal that represent the types of projects the MPO funds on which to analyze changes destination access. Staff selected four types of destinations to analyze access to: jobs, healthcare, essential places, and parks and open space. To systematically analyze and compare destination access impacts, staff assigned three variables to each destination type: travel mode, travel time threshold, and time period:

- **Travel mode:** The travel mode is the means by which a trip is taken—in this study, either walking or rolling, transit, or bicycling. Transit includes subway, light rail, commuter rail, bus, microtransit, and ferry.
- **Travel time threshold:** The travel time threshold is the maximum number of minutes from an origin to the destination of a trip for it to be considered accessible.
- **Time period:** The time period refers to the time of day for which travel to a particular destination is analyzed. The time period has a bearing on the traffic congestion assumed to occur during the trips to those destinations.

For each of the 11 sample TIP projects, staff ran scenarios in Conveyal: (1) a baseline scenario that included the existing transportation networks but not the proposed project, and (2) a series of build scenarios for different travel mode and destination combinations that included the existing transportation networks plus the improvements from the proposed project.

A Conveyal run produces the number of destinations that can be reached from any point of origin—in this case, anywhere in the Boston region—within the travel time threshold. Conveyal also calculates the difference in the number of destinations that are accessible between the baseline and associated build scenarios—this is the change in access that the project is estimated to cause.

While knowing the change in the number of destinations that can be reached is a useful metric, it does not factor in the number of people who would be affected by the project. Therefore, after running Conveyal, staff determined the per person percent change in access for each project. In this report, that metric is called the *population-weighted percent change in access*. This metric represents the average for the entire population of the Boston region, which allows for both the regional impact to be assessed and projects of different sizes to be compared. It also ensures that impacts that are further from the project are not discounted because of distance from the project area. This approach was also used to compare the change in access for EJ populations to that of their non-EJ population counterparts.

Table ES-1 shows the analysis of population-weighted percent change in access for the 11 sample projects, which have been anonymized.

Table ES-1
Population-weighted Percent Change in Access for Sample TIP Projects

Project	Investment Program	Change in Access to Essential Places by Bicycle, Walking, or Rolling	Change in Access to Parks and Open Space by Bicycle, Walking, or Rolling	Change in Access to Healthcare by Transit	Change in Access to Jobs by Bicycle, Walking, or Rolling	Change in Access to Jobs by Transit
1	Complete Streets	0.16%	0.19%	-0.03%	0.19%	-0.01%
2	Complete Streets	0.00%	0.00%	N/A	0.00%	N/A
3	Complete Streets	0.20%	0.06%	N/A	0.22%	N/A
4	Complete Streets	0.00%	0.00%	0.00%	0.00%	0.00%
5	Community Connections: Microtransit Pilot	N/A	N/A	0.04%	N/A	0.04%
6	Community Connections: Microtransit Pilot	N/A	N/A	0.62%	N/A	0.26%
7	Bicycle and Pedestrian Connections Pilot	0.03%	0.03%	N/A	0.02%	N/A
8	Complete Streets	N/A	N/A	0.01%	N/A	0.00%
9	Intersection Improvements	0.00%	0.00%	N/A	0.01%	N/A
10	Bicycle Network and Pedestrian Connections	0.09%	0.17%	N/A	0.14%	N/A
11	Complete Streets	0.12%	0.03%	0.00%	0.01%	0.00%

N/A = Not applicable.

Notes: The result used for bicycle and walking or rolling travel modes was whichever mode had a greater change in access. An N/A indicates that the destination is not applicable to the investment program or the project does not affect that mode.

Source: Boston Region MPO.

These results show small percentage changes in access because the analysis evaluates access for the entire Boston region's population; however, at that scale the changes represent an improvement for many people. A low percent change still indicates the project provides significant benefits, especially to those who live nearest a project where changes to access are greatest. Additionally, in many cases a negative or zero result is due to traffic being slowed due to traffic-calming safety measures.

ES.3 Exploration of Destination Access Project Evaluation Criteria

Running Conveyal on sample TIP projects demonstrated its potential for analyzing changes in access resulting from transportation projects. It also allowed staff to identify additional questions about the methodology that merit further exploration. Therefore, staff recommend phase two testing take place during the remainder of FFY 2025 prior to recommending destination access criteria to use to evaluate projects for funding. Staff developed a set of initial test destination access criteria for evaluating projects proposed for TIP funding that staff will test and refine during this second phase.

The test destination access criteria listed in Table ES-3 would replace several existing criteria that relate to destination access, shown in Table ES-2.

Table ES-2
Potential Replacements for Existing Criteria

Criteria	Goal Area(s) or Category	Applicable Investment Programs
Project addresses safety concerns near to key public community assets.	Access and Connectivity	B&P; CS; II
The project improves navigability at or along the work area through signage.		B&P; CS; II
The project improves access to open space or sites for active recreation.	Clean Air and Healthy Communities	B&P; CS
Bicycle lanes expand access to an existing surface transportation facility	Climate Change Mitigation	CC (BL)
Project connects to existing residential, commercial, or mixed-use developments ¹	Connectivity	CC (MP)
Project sites are near to existing areas of concentrated development or public spaces.		CC (BS); CC (BL); CC (BR)
Project increases access to open space or other natural sites.		CC (MP)
Project improves intermodal connections and the ability of users to navigate those connections	Mobility and Reliability	TT
Project improves pedestrian safety near a high-utility corridor for pedestrians		B&P; CS; II
Project improves safety near a high-utility corridor for micromobility users		B&P; CS; II

¹ The criteria “Project connects to existing residential, commercial, or mixed-use developments” and “Projects sites are near to existing areas of concentrated development or public spaces” have been consolidated into one criterion starting in the FFYs 2026–30 TIP.

B&P = Bicycle Network and Pedestrian Connections. CC (BL) = Community Connections (Bike Lanes). CC (BR) = Community Connections (Bike Racks). CC (BS) = Community Connections (Bikeshare). CC (MP) = Community Connections (Microtransit Pilot). CS = Complete Streets. II = Intersection Improvements. TT = Transit Transformation.

Source: Boston Region MPO.

These test criteria were developed based on the range of impacts on destination access demonstrated by the sample projects and are designed to advance the MPO's Access and Connectivity and TE goals. They give points to projects that improve access to key destinations by transit, walking or rolling, and bicycling. The test criteria evaluate access to each destination in two ways:

- The population-weighted percent change in access for the entire population of the Boston region.
- Whether EJ populations would have a better percent change than their respective non-EJ populations.

Table ES-3 shows the test destination access criteria and associated scores. These would be further tested in the second phase of this work.

Table ES-3
Test Destination Access Criteria and Scoring

Investment Program	Access to Jobs Criteria		Access to Healthcare Criteria	Access to Parks and Open Space Criteria	Access to Essential Places Criteria	Scoring Values
	The project increases access to jobs by transit.	The project increases access to jobs by walking or bicycling.	The project increases access to healthcare by transit or microtransit.	The project increases access to parks/open space by active transportation modes.	The project increases access to essential places by walking or bicycling.	-1 Change in access < 0% +0 Change in access = 0% +1 Change in access = 0.01% to 0.1% +2 Change in access = 0.1% to 0.2% +3 Change in access > 0.2%
	The project prioritizes access to jobs by transit for EJ populations.	The project prioritizes access to jobs by walking and bicycling for EJ populations.	The project prioritizes access to healthcare by transit or microtransit for EJ populations.	The project prioritizes access to parks/open space by active transportation modes for EJ populations.	The project prioritizes access to essential places by walking or bicycling for EJ populations.	Compared to non-EJ populations... +2 Both EJ populations have a better change in access +1 One EJ population has a better change in access, the other has an equal change -2 One EJ population has a worse change in access -4 Both EJ populations have a worse change in access
Complete Streets	✓	✓	✓	✓	✓	
Intersection Improvements	✓	✓	✓	✓	✓	
Bicycle Network and Pedestrian Connections		✓		✓	✓	
Transit Transformation	✓		✓			
CC Program: Bikeshare Support		✓		✓	✓	
CC Program: Microtransit Pilot		✓	✓			
CC Program: Bike Lanes		✓		✓	✓	

CC = Community Connections. EJ = Environmental justice.

Source: Boston Region MPO.

The more information that project proponents provide in their applications, the more accurate their projects could be modeled in Conveyal. At a minimum, proponents would need to provide a diagram of the changes proposed. Ideally, this would consist of either a photo of the study area, a 25 percent design plan, or another type of visual representation. Other useful information would include (as applicable) planned traffic-calming elements; what sides of the road planned sidewalks or bicycle lanes will be located; where or which lanes are being added or removed; and details about a new transit route, such as stop locations and start and end times.

Staff applied the test destination access criteria to the same 11 sample projects analyzed earlier in the study. Scores for each project can be found in the body of this report. Lower scores do not indicate that a project is not worthwhile to fund—a project may provide benefits other than improving access that are critical to a community. The MPO's project evaluation criteria are framed such that projects can receive points for a variety of different benefits and are not expected to receive a full score in all criteria. The scoring will be further assessed and refined in phase two testing before developing a final recommendation to the MPO.

ES.4 Conclusion

Overall, staff found Conveyal to be effective at analyzing destination access. However, additional questions about the methodology emerged during the study. Key areas for further exploration include the following:

- Developing destination access metrics and evaluation at the local level
- Representing bikeshare projects in Conveyal
- Refinement of assumptions about how different project elements affect changes in travel speed
- Comparing existing project scores and scores from the test destination access criteria

Staff recommend a second phase of this study in FFY 2025 to further evaluate Conveyal and test criteria.

Chapter 1 — Background and Study Goals

This study explored the feasibility of using Conveyal, a destination access analysis tool, to help understand how projects proposed for funding in the Boston Region Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP) could change the ability of people to access destinations.¹

Specific goals of this study were as follows:

- Test various analysis parameters and transportation project elements in Conveyal to better understand the feasibility of evaluating these projects based on how they change access for the Boston region population and for environmental justice (EJ) populations.²
- Run Conveyal on a set of 11 sample TIP projects that represent the type of projects the MPO funds to inform the development of potential project evaluation criteria for destination access.
- Use the results of these analyses to develop potential destination access criteria and scores with which to evaluate projects proposed for MPO funding in the TIP.³

1.1 Background

The MPO carries out the federally required metropolitan transportation planning process in the Boston region. The MPO develops a Long-Range Transportation Plan (LRTP) every four years that sets a 20-year vision, goals, and objectives for transportation in the region. These goals and objectives guide the types of transportation infrastructure projects the MPO funds over the subsequent four years. With each new LRTP, the goals and objectives are updated and new ones established to reflect the evolving transportation priorities and needs of the Boston region.

The MPO's 2023 LRTP, *Destination 2050*, included some updates to the existing goals and the addition of several others. These goals are shown in Figure 1, along with the associated objectives, which detail specific, measurable outcomes that support achieving each goal.


¹ In this study, "access" and "accessibility" refer to the ability of people to reach destinations from their place of residence, hence the term "destination access."

² EJ populations are as follows:

- Minority populations (people who identify as Black or African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, and/or Hispanic or Latino)
- Low-income populations (people whose income is less than 200 percent of the federal poverty level)

³ The criteria developed for the study would be for those projects seeking MPO funding; projects in the TIP that are funded by other agencies go through those agencies' evaluation processes before being added to the TIP.

Figure 1 Destination 2050 Goals and Objectives

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="background-color: #4CAF50; color: white; padding: 10px; text-align: center;"> VISION STATEMENT The Boston Region Metropolitan Planning Organization envisions an equitable, pollution-free, and modern regional transportation system that gets people to their destinations safely, easily, and reliably, and that supports an inclusive, resilient, healthy, and economically vibrant Boston region. </div> <div style="text-align: right;">  </div> </div>	
GOALS	OBJECTIVES
EQUITY	
Facilitate an inclusive and transparent transportation-planning process and make investments that eliminate transportation-related disparities borne by people in disadvantaged communities.	<ul style="list-style-type: none"> Facilitate an inclusive and transparent engagement process with a focus on involving people in disadvantaged communities.* Ensure that people have meaningful opportunities to share needs and priorities in a way that influences MPO decisions. Eliminate harmful environmental, health, and safety effects of the transportation system on people in disadvantaged communities. Invest in high-quality transportation options in disadvantaged communities to fully meet residents' transportation needs.
* Disadvantaged communities are those in which a significant portion of the population identifies as an MPO equity population—people who identify as minority, have limited English proficiency, are 75 years old or older or 17 years old or younger, or have a disability—or has low income.	
SAFETY	
Achieve zero transportation-related fatalities and serious injuries and improve safety for all users of the transportation system.	<ul style="list-style-type: none"> Eliminate fatalities, injuries, and safety incidents experienced by people who walk, bike, roll, use assistive mobility devices, travel by car, or take transit. Prioritize investments that improve safety for the most vulnerable roadway users: people who walk, bike, roll, or use assistive mobility devices. Prioritize investments that eliminate disparities in safety outcomes for people in disadvantaged communities.
MOBILITY AND RELIABILITY	
Support easy and reliable movement of people and freight.	<ul style="list-style-type: none"> Enable people and goods to travel reliably on the region's transit and roadway networks. Prioritize investments that address disparities in transit reliability and frequency for people in disadvantaged communities. Reduce delay on the region's roadway network, emphasizing solutions that reduce single-occupancy-vehicle trips, such as travel demand management. Prioritize investments that reduce delay on the region's transit network. Support reliable, safe travel by keeping roadways, bridges, transit assets, and other infrastructure in a state of good repair, and prioritize these investments in disadvantaged communities. Modernize transit systems and roadway facilities, including by incorporating new technology that supports the MPO's goals, such as electric-vehicle technologies.
ACCESS AND CONNECTIVITY	
Provide transportation options and improve access to key destinations to support economic vitality and high quality of life.	<ul style="list-style-type: none"> Improve multimodal access to jobs, affordable housing, essential services, education, logistics sites, open space, and other key destinations. Prioritizing transportation investments that support the region's and the Commonwealth's goals for housing production, land use, and economic growth. Increase people's access to transit, biking, walking, and other non-single-occupancy-vehicle transportation options to expand their travel choices and opportunities. Prioritize investments that improve access to high quality, frequent transportation options that enable people in disadvantaged communities to easily get where they want to go. Close gaps in walking, biking, and transit networks and support interorganizational coordination for seamless travel. Remove barriers to make it easy for people of all abilities to use the transportation system, regardless of whether they walk, bike, roll, use assistive mobility devices, or take transit.
RESILIENCY	
Provide transportation that supports sustainable environments and enables people to respond and adapt to climate change and other changing conditions.	<ul style="list-style-type: none"> Prioritize investments to make the region's roadway and transit infrastructure more resilient and responsive to current and future climate hazards, particularly within areas vulnerable to increased heat and precipitation, extreme storms, winter weather, and sea level rise. Prioritize resiliency investments in disadvantaged communities and in areas that bear disproportionate climate and environmental burdens. Prioritize investments in transportation resiliency that improve emergency access and protect evacuation routes. Prioritize investments that include nature-based strategies such as low-impact design, pavement reduction, and landscape buffers to reduce runoff and negative impacts to water resources, open space, and environmentally sensitive areas.
CLEAN AIR AND HEALTHY COMMUNITIES	
Provide transportation free of greenhouse gas emissions and air pollutants and that supports good health.	<ul style="list-style-type: none"> Reduce transportation-related greenhouse gases, other air pollutants, and growth in vehicle-miles traveled by encouraging people and goods to move by non-single-occupancy-vehicle modes. Support transit vehicle electrification and use of electric vehicles throughout the transportation system to reduce greenhouse gases and other air pollutants. Prioritize investments that address air pollution and environmental burdens experienced by disadvantaged and vulnerable communities. Support public health through investments in transit and active transportation options and by improving access to outdoor space and healthcare.

Updated: February 2, 2023

As new goals are established and existing ones updated, MPO staff identify gaps in knowledge or processes and tools that can assist the MPO in progressing toward the goals. Staff develop studies and other planning activities that explore one or more of the objectives in-depth and propose actions for addressing the goal and how these actions can be integrated into MPO work.

One way in which the goals and objectives are integrated into MPO work is through the criteria the MPO uses to select transportation projects to fund in its TIP, a five-year, rolling capital plan. The TIP describes how federal funds will be spent on transportation projects in the Boston region, both projects that the MPO funds and those funded by other transportation agencies in the region, such as the Massachusetts Department of Transportation. To support decisions the MPO makes on which projects to fund, staff develop and employ criteria to evaluate projects seeking funding. Staff update these criteria after the adoption of each LRTP to ensure projects are advancing that would help the MPO meet the goals and objectives documented in the LRTP.

Following the adoption of *Destination 2050*, MPO staff identified areas of the project evaluation criteria that could be revised or strengthened to reflect the updated goals and objectives. One such goal was newly added—Access and Connectivity—and an accompanying objective that relates to destination access:

Improve multimodal access to jobs, affordable housing, essential services, education, logistics sites, open space, and other key destinations.

Another goal—Transportation Equity (TE)—was revised to focus on eliminating transportation-related disparities borne by equity populations, including minority and low-income populations.⁴ A couple of recent work efforts supported these changes. A 2022 MPO study, *Identifying Transportation Inequities in the Boston Region*, used Conveyal to assess how equitable access is to various types of destinations for equity populations.⁵ The study found that minority and low-income populations have access to fewer destinations in the Boston region than their counterparts. Similarly, the MPO's Disparate Impact and Disproportionate Burden (DI/DB) analysis, which assesses impacts that may result from

⁴ MPO defines equity populations as follows:

- Minority populations (people who identify as Black or African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, and/or Hispanic or Latino)
- Low-income populations (people whose income is less than 200% of the federal poverty level)
- People with limited English proficiency
- Older adults (75 years and older)
- Youth (18 years and younger)
- People with disabilities

⁵ Destinations analyzed included jobs, healthcare, higher education, essential places, and parks and open space.

projects in the LRTP, found that projects in *Destination 2050* could result in disparities in access for minority and low-income populations. These results demonstrate the need to address disparities in destination access.

Destination 2050's goals also included a stronger emphasis on enhancing the region's multimodal transportation network and increasing the travel options available to everyone in the region. Objectives related to some goals were strengthened and others were added.

This study emerged from this context. Having used Conveyal successfully, staff explored the feasibility of using it to help understand how projects proposed for MPO funding in the TIP may change destination access, including for minority and low-income populations.⁶ This report discusses the study findings and provides recommendations for next steps.

1.2 Destination Access and Conveyal

1.2.1 What is Destination Access?

Destination access is a metric used to indicate the usefulness of the transportation network to the people who rely on it for traveling to work, school, social activities, or to access basic needs such as healthcare. It measures the ease by which people can access destinations such as these by identifying the number of destinations people can access within a given travel time by a given travel mode. It is an important metric because unlike conventional transportation metrics such as vehicle-miles traveled, it directly evaluates how well the transportation network serves the main purpose of transportation, to connect people to places. Further, it is an ideal metric for a multimodal transportation system as it can evaluate access via multiple travel modes and demonstrate how well-connected the transportation network is; the lack of transit service or of sidewalks in a community, for example, limits the ability to reach destinations.⁷

⁶ The DI/DB mitigation analysis assesses whether projects funded in the TIP would mitigate the disparate impacts identified in the LRTP DI/DB analysis.

⁷ While this report is concerned with transportation, destination access is also a function of land use. Access is affected by the density and number of both destinations and residents. For the purposes of this study, staff assumed land use remains constant.

1.2.2 What is Conveyal?

Conveyal is one of an emerging market of tools that assesses access to destinations. Using the transportation network and a set of origins and destinations as the main inputs, the online platform calculates the number of destinations reachable within a given travel time.⁸

Staff have used Conveyal in two recent MPO work efforts:

- The 2022 study *Identifying Transportation Inequities in the Boston Region*, which found that Conveyal worked well for evaluating access for the existing transportation network and could be used to identify disparities in access for different demographic groups.
- To support the mitigation of disparate impacts and disproportionate burdens in the Federal Fiscal Years 2025–29 TIP, which informed this study’s approach to modeling individual transportation projects in Conveyal.

1.3 Destination Access in Planning: A Review of the Practice

Staff reviewed four peer agencies to understand the state of the practice for incorporating destination access into project evaluation criteria and inform the approach in this study. These agencies are known to be leaders in the practice. Two are MPOs that are similar in size to the Boston Region MPO—the Atlanta Regional Commission (ARC) and Philadelphia’s Delaware Valley Regional Planning Commission (DVRPC)—and two are state departments of transportation—the California Department of Transportation (Caltrans) and Virginia Department of Transportation (VDOT). These agencies largely focus on access to jobs when evaluating projects for destination access.

Tools and methodologies for measuring destination access vary between agencies, suggesting that there is not a common practice for assessing destination access. Caltrans uses Conveyal, ARC uses an in-house GIS tool, and DVRPC uses a travel demand model for its Pennsylvania TIP (which only evaluates major regional projects).

Since Caltrans was the only agency reviewed that used Conveyal, its methodology was particularly relevant. When evaluating a project, Caltrans analyzes access changes for every mode, including biking, walking and rolling, transit, and driving.⁹ More specifically, Caltrans

⁸ Conveyal differs from some travel modeling tools in that it does not consider travel demand factors that may affect the ability or willingness of a person to make a trip, such as cost, household socioeconomics, and traveler preferences.

⁹ Caltrans’s use of Conveyal for roadway projects differs from that proposed for the Boston Region MPO in this study. Caltrans typically uses Conveyal to analyze access on major roadways, for which data are more readily available. The MPO funds smaller scale projects for which data are less available; therefore, staff do not recommend using it for those projects.

used Conveyal to assess changes to accessibility for each project and weighted access by population in the project area, ensuring that projects only scored well if they provide benefits where people live, an approach that MPO staff adopted in this study. Caltrans' approach to using Conveyal to score projects informed the approach in this study.

Caltrans staff explained that changes in population-weighted access were quite small for individual projects, typically increasing access by less than one percent. Multimodal projects tended to score the highest since the change to access from each travel mode was analyzed individually and a project's final score was the sum of the results of each mode. Projects often targeted areas where there was limited or no transit, walk, or bike service or infrastructure, so a large increase in accessibility compared to the existing automobile network service could be expected.

This chapter grounds the study in the MPO's previous work with Conveyal, the goals and objectives set forth in *Destination 2050*, and the current practice in destination access analyses. The *Destination 2050* goals and objectives demonstrate the need to explore new ways to integrate and assess destination access in MPO work and the importance of addressing equitable access.

Chapter 2—Developing a Methodology to Evaluate Changes to Destination Access

This chapter summarizes the methodology staff developed and employed to explore using Conveyal to evaluate how projects proposed for funding in the Transportation Improvement Program (TIP) may change destination access. (See Appendix A for a more detailed description of the methodology.) While the Boston Region Metropolitan Planning Organization's (MPO) previous work with Conveyal demonstrated its promise for analyzing changes in access for the regionwide transportation network, this study investigated its potential for understanding the impacts of individual projects. Staff's approach to exploring a methodology for doing so was as follows:

1. Test several analysis parameters and project elements to develop a methodology for modeling transportation projects.
2. Test a sample of TIP projects that represent the types of projects the MPO funds to understand potential destination access criteria for projects proposed for MPO funding in the TIP.

2.1 Testing Conveyal Parameters and Project Elements

Conveyal requires the user to set several parameters to reflect the project elements that would affect access. Before running Conveyal on the sample projects, staff tested various parameters and explored how to model different project elements. (Project elements are components of transportation projects, such as bicycle lanes, that are modeled in Conveyal. Analysis parameters are settings in Conveyal that define how a project is represented in Conveyal, such as transit frequency or walk speed.) The results of this testing informed the development of the methodology used in this study to understand destination access impacts.

Based on these tests, staff identified the types of transportation elements that can and cannot be analyzed for destination access at this time. Projects with the following improvements can be modeled and analyzed:

- Changes in roadway speed (such as the addition of a new lane [speed increase] or the addition of traffic-calming elements [speed decrease])
- Construction of new infrastructure (such as a sidewalk)
- Changes in transit service, including service increases, decreases, removal, or alterations

There are several types of projects the MPO funds that cannot be analyzed with Conveyal because they do not include any of the above:

- Bike rack installation
- Wayfinding signage
- Bus vehicle replacements
- Updates to stations, stops, or transit hubs that do not include new travel structure or transit services

In addition, bikeshare stations (both replacement and new stations) also cannot be analyzed using Conveyal at this time because of analytical complexities. Staff are working with those at Conveyal to explore possible methods for analyzing changes in access from bikeshare stations.

2.2 Testing Sample Projects in Conveyal

Each year, project proponents seeking funding through the TIP submit applications to a specific MPO investment program.¹⁰ The MPO assesses each application based on the relevant evaluation criteria for each investment program. The application questions vary by investment program, reflecting the different evaluation criteria that may be applied. Typical application packages include a description of the project's scope, a geospatial reference for the project limits, the latest estimate of project cost, and, if available, the latest functional design report. Information provided in applications can be used to modify Conveyal's transportation network to represent elements that could impact destination access.

¹⁰ The MPO's investment programs, defined every four years through the LRTP, direct funding to priority areas to help the MPO achieve its vision and goals. The projects that are funded through each program may vary by type (such as intersection improvements versus shared-use path construction), scale, transportation mode, and funding source. They also communicate to potential project proponents the types of projects that the MPO is interested in funding. The following investment programs were established in the most recent LRTP *Destination 2050*:

- Bicycle Network and Pedestrian Improvements
- Complete Streets
- Intersection Improvements
- Transit Transformation
- Community Connections (includes Bikeshare Support, Bicycle Lanes, Wayfinding Signage, Microtransit Pilot, and Bicycle Racks programs)

2.2.1 *Selecting Test Projects*

Staff selected 11 sample TIP projects on which to test run Conveyal to

- understand the magnitude in changes in access that could be expected from different types of projects,
- inform the development of potential TIP project evaluation criteria for destination access,
- develop a methodology for running Conveyal that could be replicated for future project evaluation, and
- better understand Conveyal's effectiveness as a tool for evaluating potential TIP projects for changes in destination access.

The limitations to representing projects in Conveyal informed the projects staff selected as test projects. Staff selected projects that had elements that could be modeled in Conveyal as described above and that represented the range of the different types of projects that the MPO funds. Staff did not include projects that only affect drive access. While Conveyal can be used to analyze large-scale roadway improvements, such as highway widening, the data required to model the types of local roadway improvements the MPO funds are of limited consistency. At an individual project level, at this time Conveyal is best suited for evaluating changes in access for people using transit, bicycling, or walking and rolling.¹¹

This approach is also consistent with the MPO's LRTP goals and objectives to invest in a multimodal transportation system. The MPO's current goals and objectives emphasize enhancing transportation infrastructure and services for people riding transit, bicycling, and walking and rolling, which is reflected in the types of projects funded in the MPO's investment programs. Driving conditions such as congestion are addressed through other roadway improvements rather than roadway expansion and are evaluated with other project selection criteria. For these reasons, staff ran Conveyal on projects that contain at least one transit, bicycling, or walking and rolling improvement.

2.2.2 *Setting up a Destination Access Analysis*

To systematically analyze and compare destination access impacts, staff assigned three variables to each destination: time period, travel time thresholds, and travel modes. They reflect, in general, when and how these trips are likely to be made, as shown in Table 1, and are consistent with other destination access work staff does for the MPO.

¹¹ Staff use Conveyal in other MPO work to analyze drive access—however, they analyze the combined impacts of all projects, an approach that is better suited for the amount of project data that are available.

Table 1
Destinations Analyzed in Conveyal

Destination	Destination Variables					Time Periods
	Access by Transit Analyzed?	Access by Bike Analyzed?	Access by Walking and Rolling Analyzed?	Transit Travel Time Thresholds	Bicycle and Walking and Rolling Travel Time Thresholds	
Jobs	✓	✓	✓	45 minutes	30 minutes	6:30 AM - 9:30 AM
Healthcare	✓	✗	✗	30 minutes	N/A	6:30 AM - 9:30 AM
Essential Places	✗	✓	✓	N/A	15 minutes	6:30 AM - 9:30 AM
Parks and Open Space	✗	✓	✓	N/A	15 minutes	11:00 AM - 3:00 PM

Notes: Travel time thresholds are not hard cut-offs; destinations beyond the threshold counted toward the count of destinations that are considered accessible, but less than those within the threshold. The longer it takes to reach a destination, the less it counts in the final count of accessible destinations.

N/A = Not applicable.

Source: Boston Region MPO.

Travel Modes

Staff analyzed three travel modes: transit, bike, and walk and roll. Each travel mode requires uploading a travel network on which trips in Conveyal are routed between origins and destinations.

Transit Trips

The transit network and trip schedules were sourced from December 2022 General Transit Feed Specification files for each major transit operator in the MPO region.¹² It included fixed-route bus, subway (light and heavy rail), commuter rail, shuttle, or ferry. Microtransit schedules came directly from project applicants or were developed by staff based on publicly available schedules. Transit trips consisted of in-vehicle time, access and egress time (including waiting), and transfer time between transit legs, with up to two transfers permitted.¹³

¹² The General Transit Feed Specification (GTFS) is a common data format for public transit schedules. See Appendix A for the full list of GTFS data sources used in this study.

¹³ Access time is the walk or roll time between the origin and the first transit leg of the trip. Egress time is the walk or roll time between the last transit leg of the trip.

Bicycling, and Walking and Rolling Trips

Staff used OpenStreetMap from November 2023 to represent bicycling and walking and rolling trips in Conveyal.¹⁴ The bicycle network was limited to network segments with a level of traffic stress (LTS) of one or two (out of four) to reflect bicycle routes that are suitable for most adults.¹⁵ Bicycling speed was set at nine miles per hour, while walking and rolling speed was set at three miles per hour. Staff incorporated elevation costs for all of these modes, which resulted in slower speeds on routes with hills.

Destination Types

Staff analyzed access to four types of destinations.¹⁶ Destination data sources can be found in Appendix A.

- **Jobs:** This category includes all job locations in the Boston region.
- **Healthcare:** This category includes community health centers, clinics, acute care hospitals, and urgent care centers.
- **Essential places:** These are neighborhoods that contain a collection of commercial and civic uses that provide basic needs. They are defined as clusters of healthcare destinations (hospitals, community health centers, clinics, and pharmacies), civic destinations (town halls, libraries, and post offices), and food destinations (grocery stores and farmers markets). An essential place is a cluster that contains destinations from at least two destination categories and where there are at least five total destinations.
- **Parks and open space:** This category includes publicly accessible parks whose purpose is conservation and/or recreation. They must be at least partly in the Boston region with an area of at least one half-acre.

Time Periods

Time periods reflect changing traffic conditions throughout the day. Time periods are assigned to a destination based on when trips are most often made there or when traffic is often the greatest. It only affects bus and microtransit trips.

¹⁴ OpenStreetMap provides map data for many digital resources, such as websites, software products, and mobile apps.

¹⁵ In general, roads with an LTS of one or two are low speed residential roads with a speed limit of 25 mph or less or a higher speed road (but not a highway) that has an off-street bike path. See: <https://docs.conveyal.com/learn-more/traffic-stress#analyzing-lts>.

¹⁶ These metrics were first developed and analyzed as part of *Identifying Transportation Inequities in the Boston Region* and chosen because of their importance to peoples' everyday well-being. They have subsequently been analyzed in the TIP and LRTP DI/DB analyses to assess destination access among equity populations.

Travel Time Thresholds

Travel time thresholds dictate how long a trip can take between an origin and a destination for the destination to be considered accessible.¹⁷ These values are consistent with the MPO's other destination access work, as well as practices at other planning agencies.¹⁸ In setting these thresholds, staff sought to capture the outer bound of a reasonable transit trip to that destination in the Boston region. These travel times do not represent the "ideal" length of the trip component but rather represent what could be reasonably assumed to make the destination "accessible" for a person. Many trips would be under these thresholds. Transit thresholds apply to all transit modes, as Conveyal does not allow setting different thresholds for each one.

For transit trips, the overall travel time thresholds included any combination of access, egress time, transfer, and in-vehicle time. For each trip, the times for the access, egress, and transfer legs were set at a maximum of 15 minutes each. Since in Conveyal the threshold must be the same for all three, staff erred on the side of a more generous value to capture those where people are willing to walk or roll longer to reach a station.

Representing Project Elements in Conveyal

Staff made assumptions of how various project elements impact travel speeds. The assumptions are averages and actual impacts may differ between different transportation projects depending on the project locations and the mix of improvements included. Table A-1 in Appendix A describes how project elements were modeled in Conveyal.

Project elements that cannot be modeled have the potential to affect access but require prohibitive amounts of time to incorporate and/or data that is not available to staff. This is a common challenge with any transportation model—no model can fully represent all the nuances of a transportation project in real life. This affected the types of projects that can be modeled in Conveyal, as well as the decision not to model projects that only make improvements for driving.

¹⁷ Staff used *decay weighting* when determining the accessibility of destinations. Destinations beyond the threshold counted toward the count of destinations that are considered accessible, but less than those within the threshold. Decay weighting replicates real-world travel decisions in that people may still choose to travel for a longer time than the threshold time to reach a destination but prefer one that is closer. The longer it takes to reach a destination, the less it counts in the final count of destinations that are accessible. See Appendix A for more details.

¹⁸ These thresholds have been used by the other transit agencies reviewed as part of this study, among others.

2.2.3 Conducting a Destination Access Analysis

For each of the sample TIP projects, staff ran two scenarios in Conveyal: a baseline scenario that included the existing transportation networks but not the proposed project, and then a series of build scenarios for different travel mode and destination combinations that included the existing transportation networks plus the improvements from the proposed project. This was done for each destination listed in Table 1.

Each Conveyal run produced the number of destinations that can be reached from any point of origin in the Boston region within the travel time threshold and the estimated change in access caused by the project. While this is useful information, it does not factor in the number of people who would be affected by the project—a project with many people living nearby will likely affect more people than a project with fewer people nearby. Therefore, for each Conveyal run staff calculated the per person percent change in access for the population of the entire Boston region and for environmental justice (EJ) populations. This is referred to as *population-weighted percent change in access* in this report.

This metric represents the average change in access for the entire Boston region population, to both assess the regional impact and to allow projects to be compared against each other regardless of their size. It compares the number of accessible destinations between the baseline scenario (where the project is *not* built) and the build scenario (where the project *is* built). This metric can be represented with the following formula, where B = access if the project is *not* built and P = the change in access if the project *is* built:

$$\left(\frac{(P - B)}{B} \right) \times 100$$

2.2.4 Analysis Results

This section summarizes results from the analysis of the 11 sample TIP projects, using the methodology described in this chapter. Table 2 shows the population-weighted percent change in access for each destination listed in Table 1 for each of the sample TIP projects.

Table 2
Population-weighted Percent Change in Access for Sample TIP Projects

Project	Investment Program	Change in Access to Essential Places by Bicycle, Walking, or Rolling	Change in Access to Parks and Open Space by Bicycle, Walking, or Rolling	Change in Access to Healthcare by Transit	Change in Access to Jobs by Bicycle, Walking, or Rolling	Change in Access to Jobs by Transit
1	Complete Streets	0.16%	0.19%	-0.03%	0.19%	-0.01%
2	Complete Streets	0.00%	0.00%	N/A	0.00%	N/A
3	Complete Streets	0.20%	0.06%	N/A	0.22%	N/A
4	Complete Streets	0.00%	0.00%	0.00%	0.00%	0.00%
5	Community Connections: Microtransit	N/A	N/A	0.04%	N/A	0.04%
6	Community Connections: Microtransit	N/A	N/A	0.62%	N/A	0.26%
7	Bicycle and Pedestrian Connections	0.03%	0.03%	N/A	0.02%	N/A
8	Complete Streets	N/A	N/A	0.01%	N/A	0.00%
9	Intersection Improvements	0.00%	0.00%	N/A	0.01%	N/A
10	Bicycle and Pedestrian Connections	0.09%	0.17%	N/A	0.14%	N/A
11	Complete Streets	0.12%	0.03%	0.00%	0.01%	0.00%

N/A = Not applicable.

Note: The result used for bicycle or walking and rolling was whichever mode had a greater change in access. An N/A indicates that the destination is not applicable to the investment program or the project does not impact that mode.

Source: Boston Region MPO and Conveyal.

Although these percentages are small, as averages in many cases they represent several thousand people. Additionally, while percent changes are small on an individual project level, impacts are greater when all projects are considered together. The MPO's TIP equity analysis, conducted every year on all MPO-funded TIP projects, provides a full assessment of the destination access impacts of the entire TIP program.

The analysis results show a negative or zero percent change in access for some projects, a result of the types of elements included in these projects such as traffic calming or other safety measures that may reduce roadway speeds but provide critical benefits in some of the MPO's other goal areas. The benefits of these projects would be captured in the scoring criteria consistent with the other MPO goals they address.

The methodology developed and analyses run in this study help explore how Conveyal could be used to analyze changes to destination access for some projects proposed for MPO TIP funding. The results of the analyses on 11 sample TIP projects show the range of percent changes in access that could be expected when evaluating projects proposed for funding at a regional scale. However, staff recognize that regionwide metric masks local improvements that are important for understanding the community-level impacts of the project. Therefore, staff recommend further exploring developing a destination access metric that assesses changes in access at the local level.



Chapter 3—Exploration of Destination Access Project Evaluation Criteria

This chapter explores a set of test destination access criteria that could be used with Conveyal to evaluate projects proposed for funding in the Boston Region Metropolitan Planning Organization's (MPO) Transportation Improvements Program (TIP). The sample TIP projects analyzed in Chapter 2 are presented as a test to demonstrate how project evaluation could proceed. Given the novelty of the criteria and some remaining questions about the methodology, staff recommend a further phase two test using the projects submitted for the federal fiscal years (FFYs) 2026–30 TIP. This test would take place during the spring and summer of FFY 2025, with staff presenting recommendations to the MPO prior to the development of the FFYs 2026–31 TIP.

3.1 Existing Destination Access Criteria

The MPO's TIP project evaluation criteria are organized by goal area, which are updated for each Long-Range Transportation Plan (LRTP) to reflect changing transportation needs in the Boston region and MPO priorities. The following are the goal areas established in the 2023 LRTP, *Destination 2050*:

- Safety
- Mobility and Reliability
- Transportation Equity
- Access and Connectivity
- Clean Air and Healthy Communities
- Resiliency

Several investment programs define the types of projects the MPO funds:

- Complete Streets
- Intersection Improvements
- Bicycle Network and Pedestrian Connections
- Transit Transformation
- Community Connections (includes Bicycle Lane, Bicycle Rack, Bike Share Support, Microtransit Pilot, and Wayfinding Signage programs)

Criteria associated with the goal areas vary under the MPO's different investment programs to reflect the different purposes of each program. For example, because the Transit Transformation investment program is used to fund transit improvements, the criteria for this program are focused on evaluating transit improvements.

In phase two testing, the proposed destination access criteria would replace several existing criteria that relate to destination access. Destination access criteria are currently distributed throughout several goal areas because they are related to various aspects of these goal areas, which are identified in Table 3.

Table 3
Potential Replacements for Existing Criteria

Criteria	Goal Area(s) or Category	Applicable Investment Programs
Project addresses safety concerns near to key public community assets.	Access and Connectivity	B&P; CS; II
The project improves navigability at or along the work area through signage.		B&P; CS; II
The project improves access to open space or sites for active recreation.	Clean Air and Healthy Communities	B&P; CS
Bicycle lanes expand access to an existing surface transportation facility	Climate Change Mitigation	CC (BL)
Project connects to existing residential, commercial, or mixed-use developments (1)	Connectivity	CC (MP)
Project sites are near to existing areas of concentrated development or public spaces.		CC (BS); CC (BL); CC (BR)
Project increases access to open space or other natural sites.		CC (MP)
Project improves intermodal connections and the ability of users to navigate those connections	Mobility and Reliability	TT
Project improves pedestrian safety near a high-utility corridor for pedestrians		B&P; CS; II
Project improves safety near a high-utility corridor for micromobility users		B&P; CS; II

1 The criteria “Project connects to existing residential commercial, or mixed-use developments” and “Projects sites are near to existing areas of concentrated development or public spaces” have been consolidated into one criterion starting in the FFYs 2026–30 TIP.

B&P = Bicycle Network and Pedestrian Connections. CC (BL) = Community Connections (Bike Lanes). CC (BR) = Community Connections (Bike Racks). CC (BS) = Community Connections (Bikeshare). CC (MP) = Community Connections (Microtransit Pilot). CS = Complete Streets. II = Intersection Improvements. TT = Transit Transformation.

Source: Boston Region MPO.

Under the existing scoring system, evaluation largely relies on qualitative data, obtained from reviews of parcel maps, planning documents, and correspondence with local planners. Projects are given additional points if they are in areas with a greater share of equity populations than the regional average. During phase two testing, the project scores from the proposed criteria would be compared with the scores from qualitative assessment to understand how scores would change under a new, quantitative approach.

3.2 Test Destination Access Criteria

The goal of developing new, quantitatively assessed destination access criteria is to recognize projects that improve access, whether by building new multimodal infrastructure, implementing new transit services, or improving transit throughput, as well as those that demonstrate improvements in access for environmental justice (EJ) populations. Under the test criteria, most projects would receive destination access scores due to the types of projects that can be modeled in Conveyal. This approach is standard MPO practice—criteria are customized to the type of project being evaluated.

The criteria proposed for further testing would do the following:

- **Evaluate access to specific destinations**—jobs, healthcare, parks and open space, and essential places. Several of the existing criteria only examine access to areas of development, without specifying the land use.
- **Be consistent with other MPO equity-related analyses**, including that for the TIP. This would allow the MPO to identify projects that address disparate access for EJ populations and promote equitable transportation.
- **Include all criteria in the Access and Connectivity goal area** rather than be distributed across the goal areas as the current ones are.
- **Be analyzed with Conveyal**. This would allow the MPO to quantify changes in access using a replicable method and establish consistency in scoring across transit, walking and rolling, and bicycling modes.
- **Allocate more points to destination access criteria**. Points would be reallocated from the former destination access criteria. The number of points allocated to destination access would vary between investment programs based on the relevance to aims of each.
- **Evaluate changes in access for EJ populations** to determine if the project would promote equitable access. This would help the MPO address disparities in access and make progress toward achieving the MPO's Transportation Equity goal.
- **Apply only to transit, walking and rolling, and biking modes**. Related criteria for driving would not be changed for the reasons described in Chapter 2.

3.2.1 Scoring System for Further Testing of Destination Access Criteria

In the second phase, each destination/travel mode combination would be evaluated in two ways:

- How the project changes access to the destination for the overall population of the Boston region
- How changes in access for EJ populations compares to their non-EJ population counterparts

Evaluating Access for the Overall Population

The scoring system to be tested was informed by the results of the analyses of the sample TIP projects, with a scale that reflects the magnitude of the change in access identified in these results. Projects would be scored based on their *population-weighted percent change in access*, the metric identified in Chapter 2. This metric would establish a common scoring scale, regardless of project size or location. The test scoring scale is shown in Table 4.

Projects that increase access would receive up to three points, while projects that reduce access would have one point subtracted from their score.

Table 4
Scoring Scale for Test Destination Access Criteria

Total Population Weighted Percent Change in Access	Points
At least 0.2%	+3
At least 0.1% up to 0.2%	+2
At least 0.01% up to 0.1%	+1
At least 0.0% up to 0.01%	0
Less than 0.0%	-1

Source: Boston Region MPO.

This scoring scale would apply to each of five subcriteria, shown in Table 5. Each project would be scored based on how it changes access to the four destination types that were analyzed in Chapter 2—jobs, healthcare, parks and open space, and essential places. Only the criteria with the travel modes that are relevant to the projects in an investment program would be analyzed to reflect the purpose of that investment program.

Table 5
Test Destination Access Criteria and Scoring

Investment Program	Access to Jobs Criteria	Access to Healthcare Criteria	Access to Parks and Open Space Criteria	Access to Essential Places Criteria	Scoring Values
	The project increases access to jobs by transit.	The project increases access to jobs by walking or bicycling.	The project increases access to healthcare by transit or microtransit.	The project increases access to parks/open space by active transportation modes.	The project increases access to essential places by walking or bicycling.
					-1 Change in access < 0% +0 Change in access = 0% +1 Change in access = 0.01% to 0.1% +2 Change in access = 0.1% to 0.2% +3 Change in access > 0.2%
	The project prioritizes access to jobs by transit for EJ populations.	The project prioritizes access to jobs by walking and bicycling for EJ populations.	The project prioritizes access to healthcare by transit or microtransit for EJ populations.	The project prioritizes access to parks/open space by active transportation modes for EJ populations.	The project prioritizes access to essential places by walking or bicycling for EJ populations.
					Compared to non-EJ populations... +2 Both EJ populations have a better change in access +1 One EJ population has a better change in access, the other has an equal change -2 One EJ population has a worse change in access -4 Both EJ populations have a worse change in access
Complete Streets	✓	✓	✓	✓	✓
Intersection Improvements	✓	✓	✓	✓	✓
Bicycle Network and Pedestrian Connections		✓		✓	✓
Transit Transformation	✓		✓		
CC Program: Bikeshare Support		✓		✓	✓
CC Program: Microtransit Pilot		✓	✓		
CC Program: Bike Lanes		✓		✓	✓

CC = Community Connections. EJ = environmental justice.

Source: Boston Region MPO.

Staff propose using these criteria to consider the bicycling and walking or rolling travel modes together (referred to as active transportation). A project would be scored on whichever of these two modes shows the greatest change in access. Increases in walk and roll access are often in the context of shared-use paths. In that case, such increases are simultaneously reflected in improvements to access for bicyclists.

Evaluating Disparities in Access for Environmental Justice Populations

In addition to criteria that assess changes in access for the overall Boston region population, the proposed test criteria would assess changes in access for EJ populations because of existing disparities in access and historic underinvestment in communities in which these populations are predominant. These criteria would also support the disparate impact and disproportionate burden (DI/DB) mitigation analysis that staff conduct each year for the TIP by identifying projects that address disparities in access for minority and/or low-income populations.¹⁹

These criteria, shown in Table 6, assess the relative change in access between the EJ and non-EJ populations. Table 6 indicates how points would be assigned to a project. In the future testing phase, projects would receive points if at least one EJ population had a better change in access than the non-EJ population counterpart. This approach would aggregate the impacts on both EJ populations together for one score. If both EJ populations had a greater change in access compared to their non-EJ counterparts, then the project would get two points. If one had a greater change in access and the other an equivalent change in access, then the project would get one point. If both EJ populations had equivalent changes in access compared to their non-EJ population counterpart the project would get zero points. If one EJ population gets a worse change in access the project score would get a two-point deduction, and if both did it would get a four-point deduction.

¹⁹ The disparate impacts and disproportionate burdens that the MPO must mitigate include the following:

- access to jobs by transit (low-income population)
- access to healthcare by transit (low-income and minority populations)
- access to parks and open space by driving (low-income population)
- average travel time by driving (minority population)
- average travel time by transit (minority population)

More information can be found at

<https://bostonmpo.org/data/pdf/plans/LRTP/destination2050/Destination-2050-LRTP.pdf>.

Table 6
Scoring Scale for Test Environmental Justice Criteria

Project Score	Compared to the Non-EJ Population, the EJ Population has a...		
	Worse Change in Access	Equal Change in Access	Better Change in Access
+2			For both EJ populations
+1		For one EJ population	For one EJ population
0		For both EJ populations	
-2	For one EJ population		
-4	For both EJ populations		

EJ = Environmental justice.

Source: Boston Region MPO.

3.2.3 Project Information Needed to Model Projects in Conveyal

The more information that project proponents provide in their applications, the more accurately their projects can be modeled in Conveyal. At a minimum, proponents would provide a diagram of the changes proposed. Ideally, this would consist of either a photo of the study area, a 25 percent design, or another type of visual representation. Other useful information about specific elements of the projects would include the following:

- Shared-use path
 - Whether the path is being built on one side of the street or both
 - Where the path diverts from the existing street network
- Bus lane
 - The precise location of the bus lane(s), including which side(s) of the street
- Sidewalk or pedestrian crossing
 - The precise location of the sidewalk(s), including which side(s) of the street
 - Confirmation that the sidewalk is new or a reconstruction of an existing sidewalk
- Traffic calming and road diet
 - Which traffic-calming elements are being built
 - Whether there is there a lane reduction
- Additional travel lane(s)

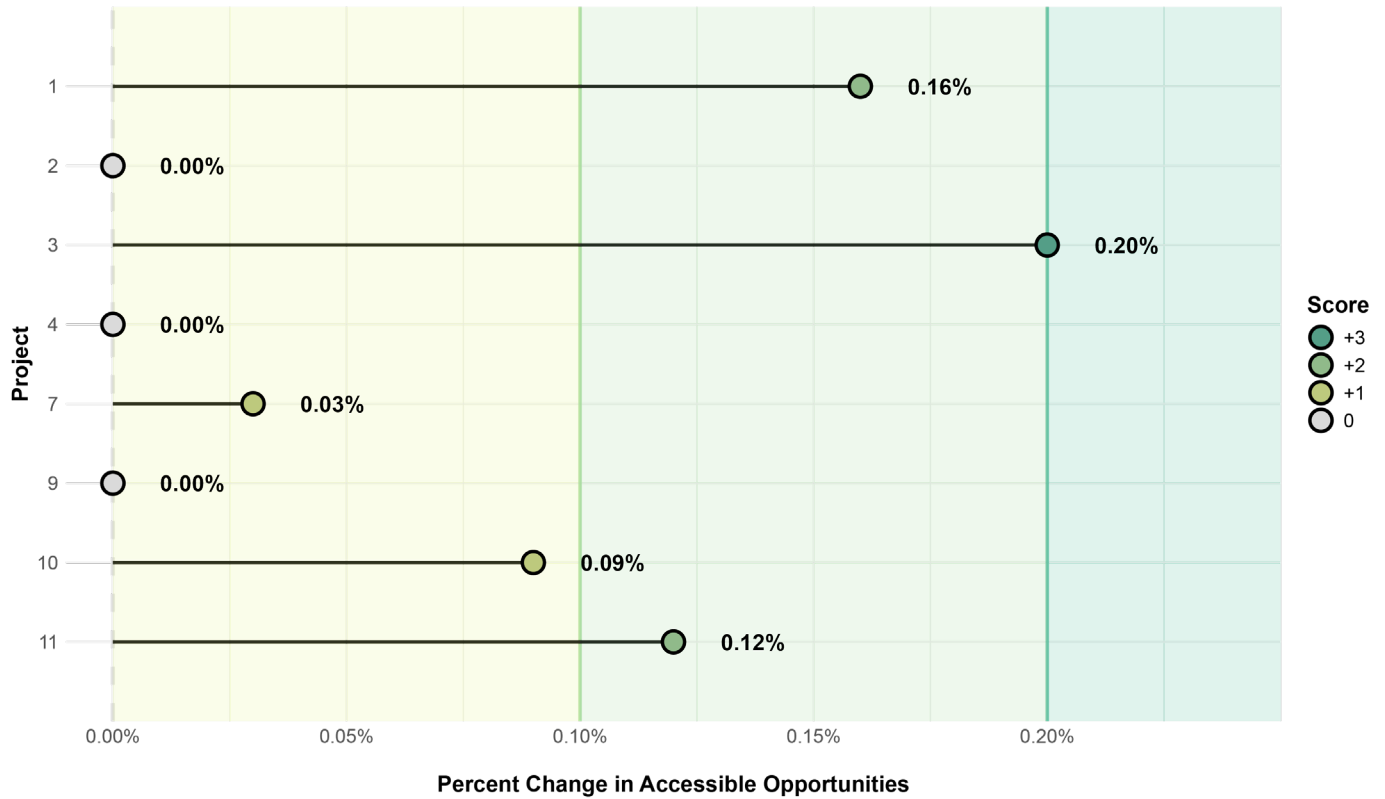
- Location of the road segment(s) with additional travel lanes, and which side(s) of the street they are on
- The number of additional travel lanes added
- The number of travel lanes that existed before the project, and on which segment(s) and side(s) of the street
- Roundabouts
 - Geometry of roundabout
 - Daily service volumes
- New turning lane
 - Location of the new turning lane, including the side of the street
- New bus or shuttle service
 - Information about the location of the route, including the stops
 - Information about the shuttle schedule:
 - The clock times vehicles are scheduled to arrive at stops
 - Route start and end times
 - The days the shuttle is active
 - Dwell times at stops
 - Whether there are multiple shuttles running at once (for both directions)
 - Expected headways by time of day
- Bike lane
 - Project geometry
 - Where the bike lanes are being built, including the side of the street

3.3 Sample Project Scores

3.3.1 Overall Population Sample Project Scores

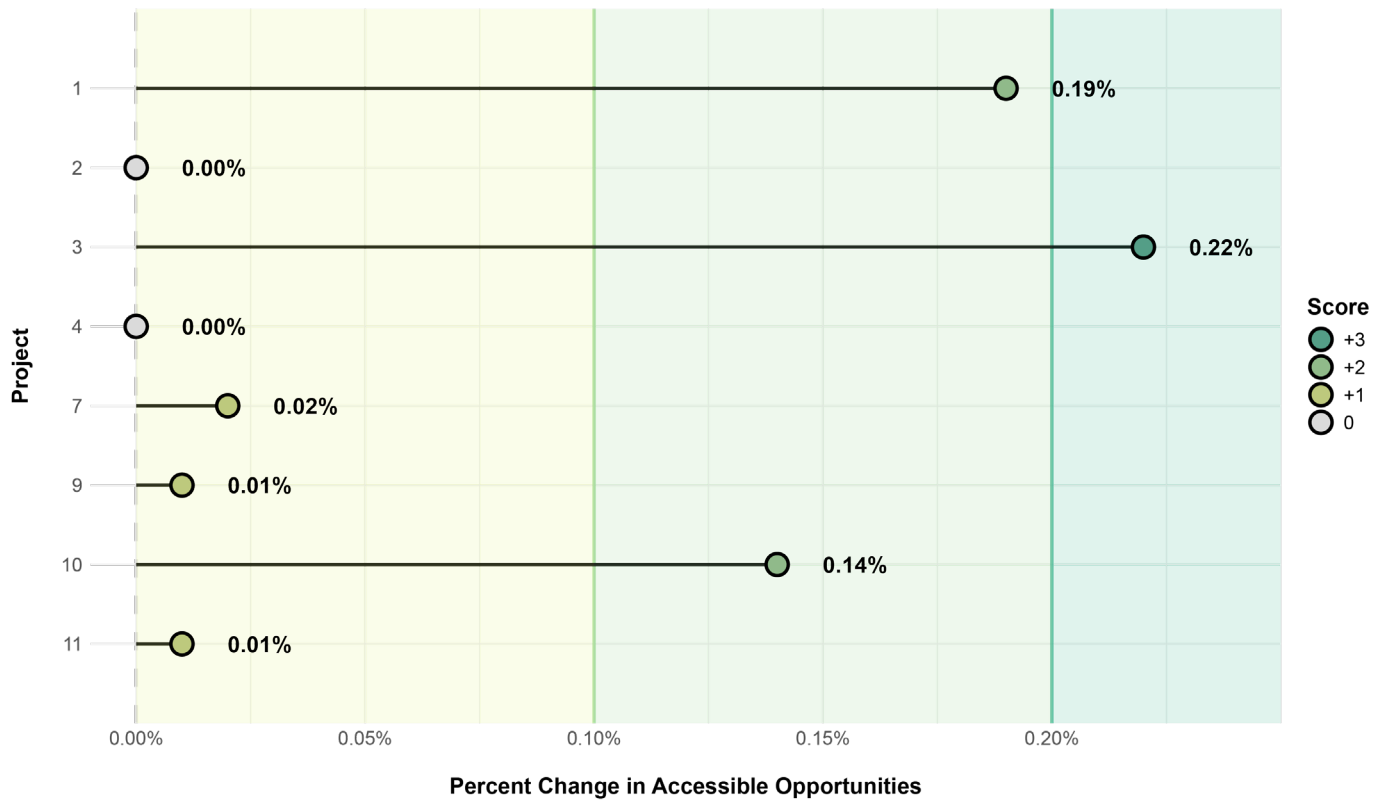
Staff applied the test destination access criteria to the sample TIP projects. Figures 2 through 6 show the scores using the scoring system described above, applied to analysis results described in Chapter 2. Projects were only scored if they included improvements related to the travel mode and if the criteria were applicable to its investment program.

Figure 2
**Overall Population Criteria Scores: Access to Essential Places,
by Active Transportation**



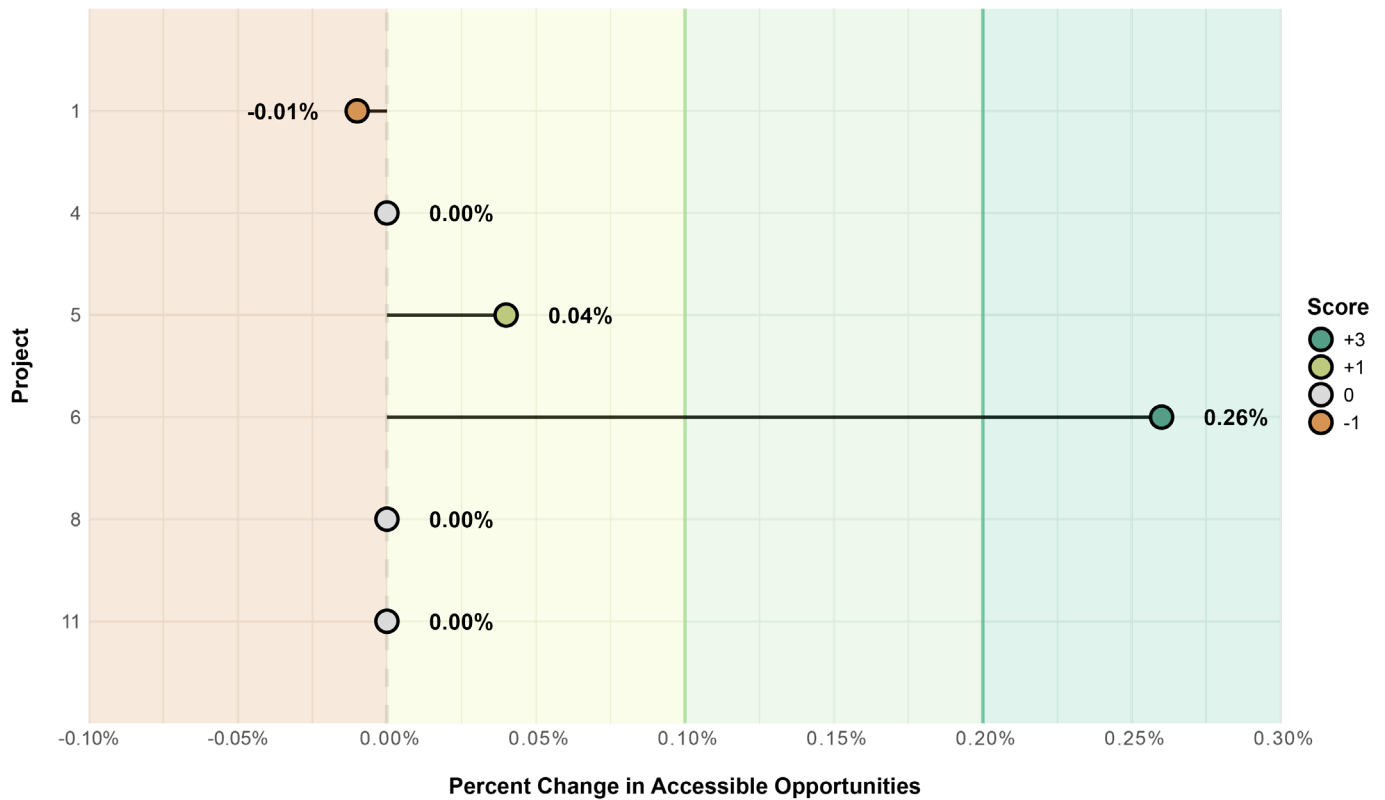
Source: Boston Region MPO and Conveyal.

Figure 3
Overall Population Criteria Scores: Access to Jobs, by Active Transportation



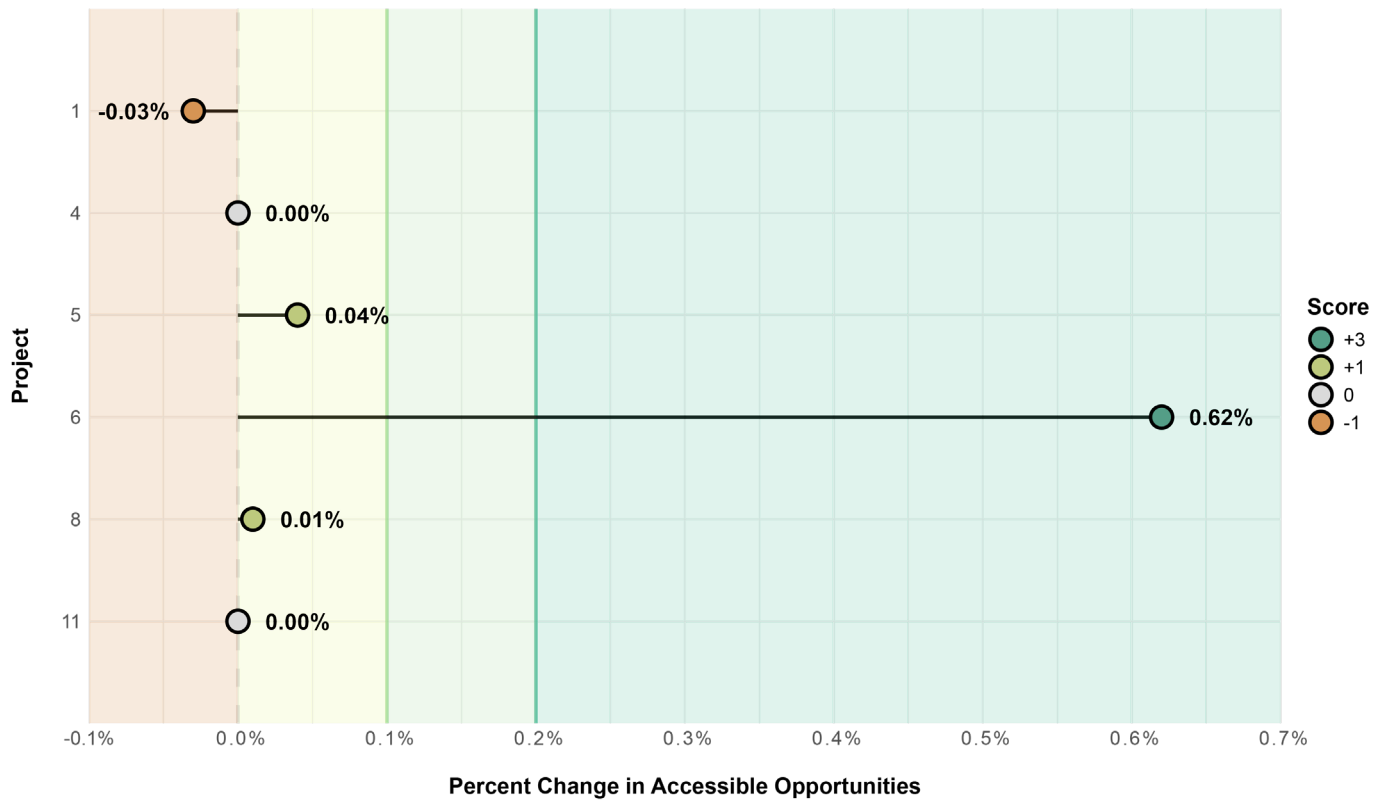
Source: Boston Region MPO and Conveyal.

Figure 4
Overall Population Criteria Scores: Access to Jobs, by Transit



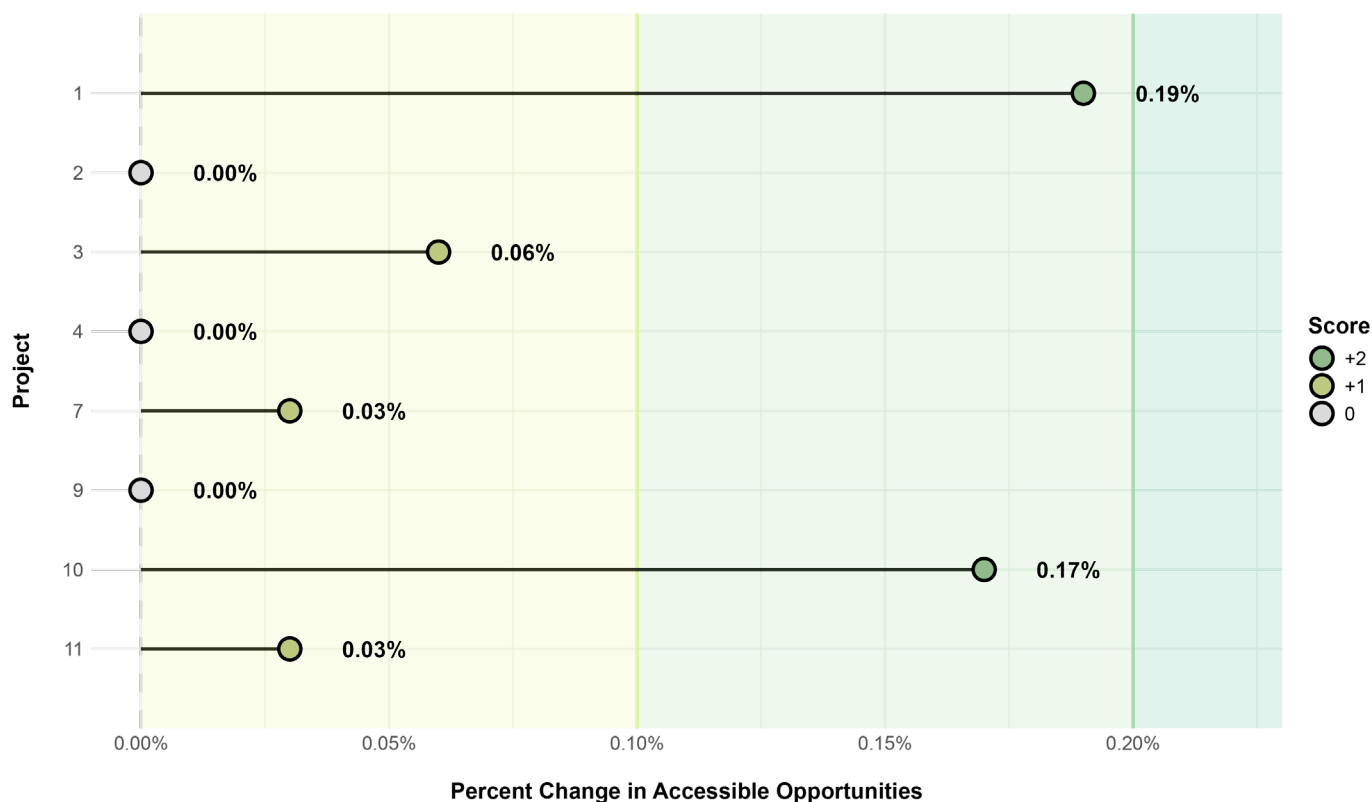
Source: Boston Region MPO and Conveyal.

Figure 5
Overall Population Criteria Scores: Access to Healthcare, by Transit



Source: Boston Region MPO and Conveyal.

Figure 6
**Overall Population Criteria Scores: Access to Parks and Open Space,
 by Active Transportation**



Source: Boston Region MPO and Conveyal.

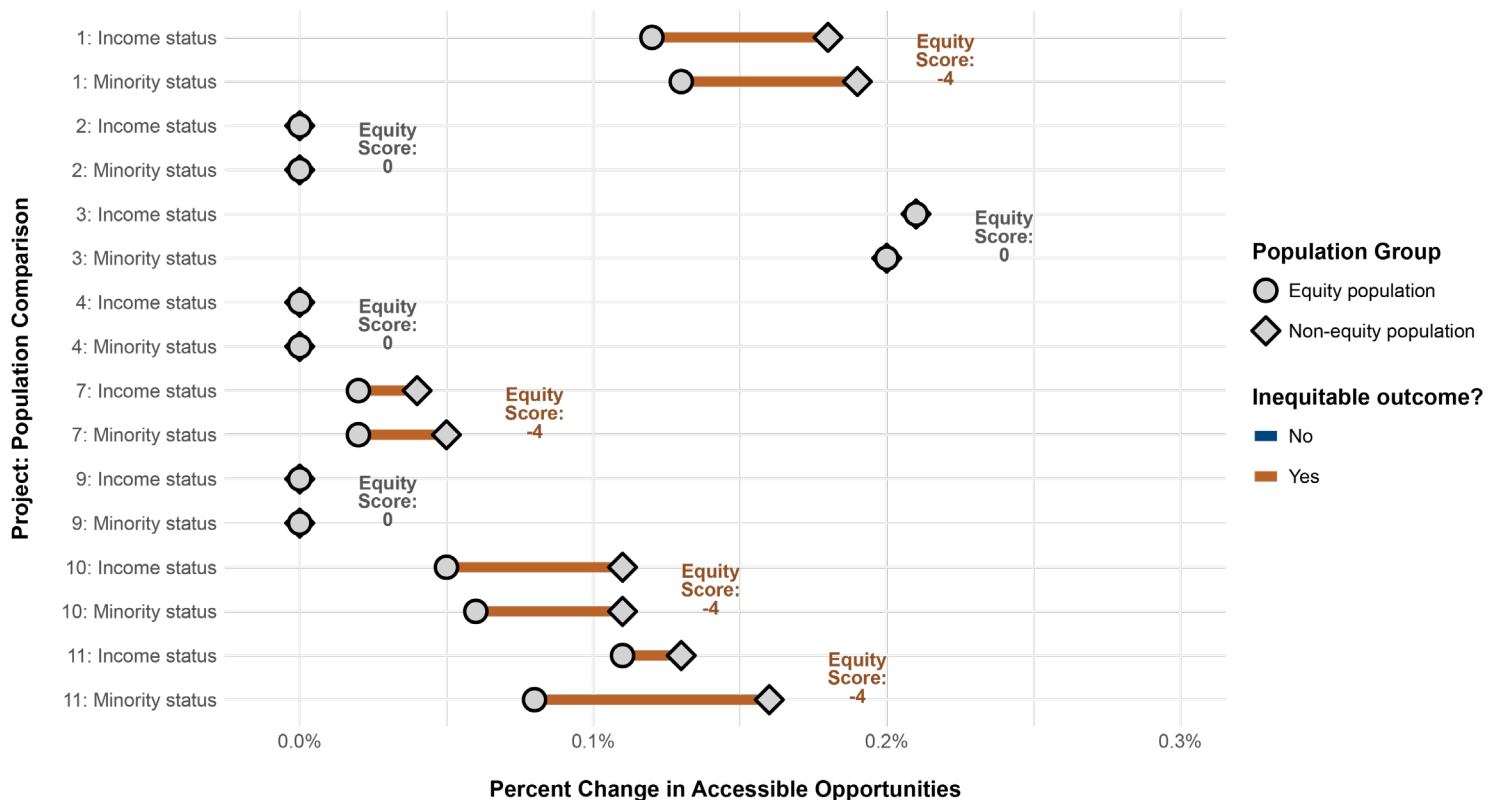
Project scores are affected by the elements included in a project and project information received from proponents. A project evaluation can only record changes to access if there are changes to roadway speeds, new travel infrastructure is added or removed, or a transit service is added, removed, or altered. A project may include other elements that do not fall into these categories that affect access indirectly, but for which staff lacked sufficient data to model in Conveyal.

3.3.2 Environmental Justice Population: Sample Project Scores

Figures 7 through 11 show the test EJ destination access criteria scores for the 11 sample TIP projects and how they compare to the overall population access score. Scores are affected by where minority and low-income populations live within the region in relation to the project and the project's expected change to access. In some cases, projects may receive zero points for the overall access score but a positive or negative equity score. This happens when improvements are greater in areas with higher shares of EJ populations but lesser in other areas.²⁰

Figure 7

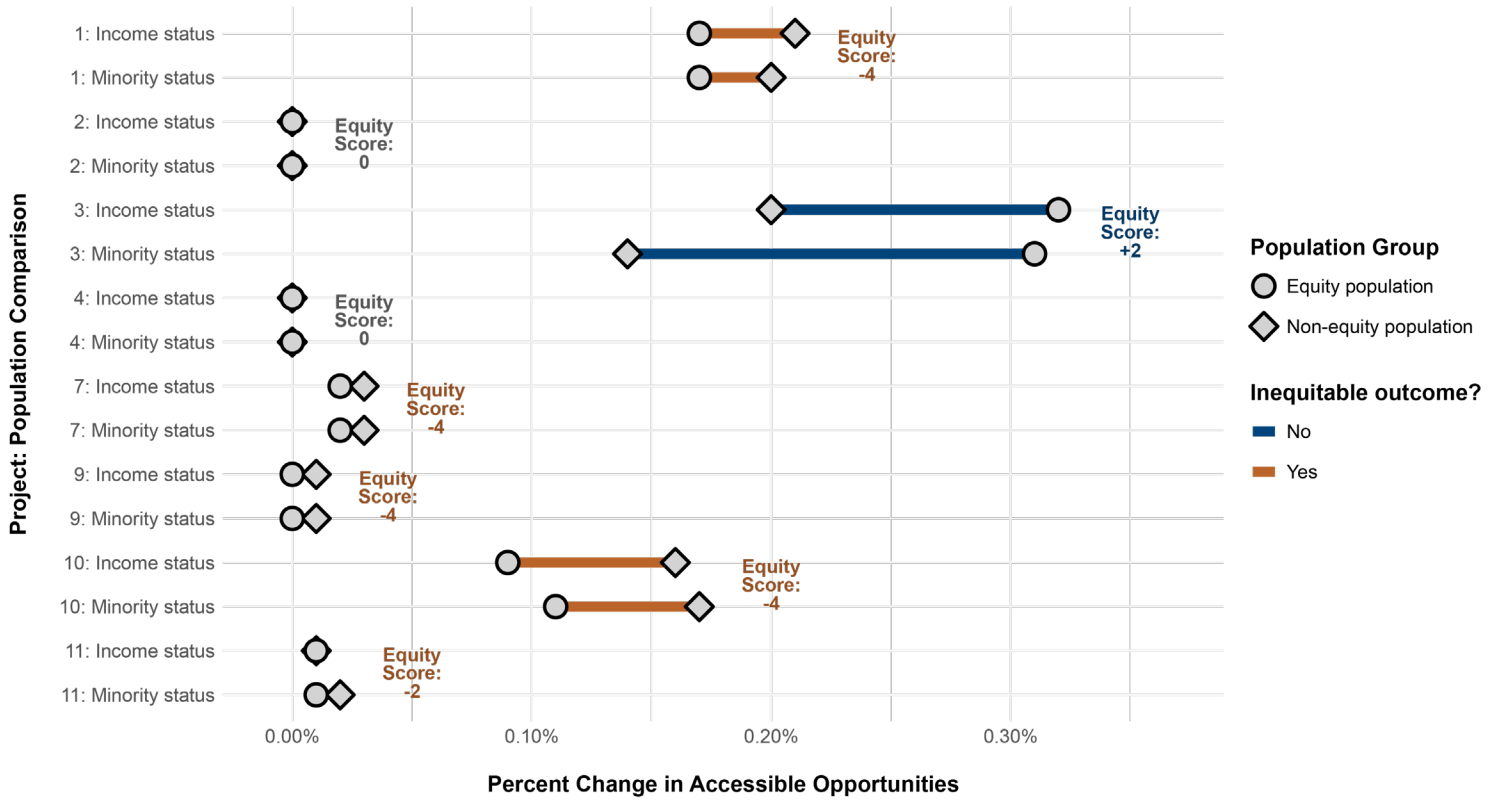
Environmental Justice Criteria Scores: Active Transportation Trip to Essential Places



Source: Boston Region MPO and Conveyal.

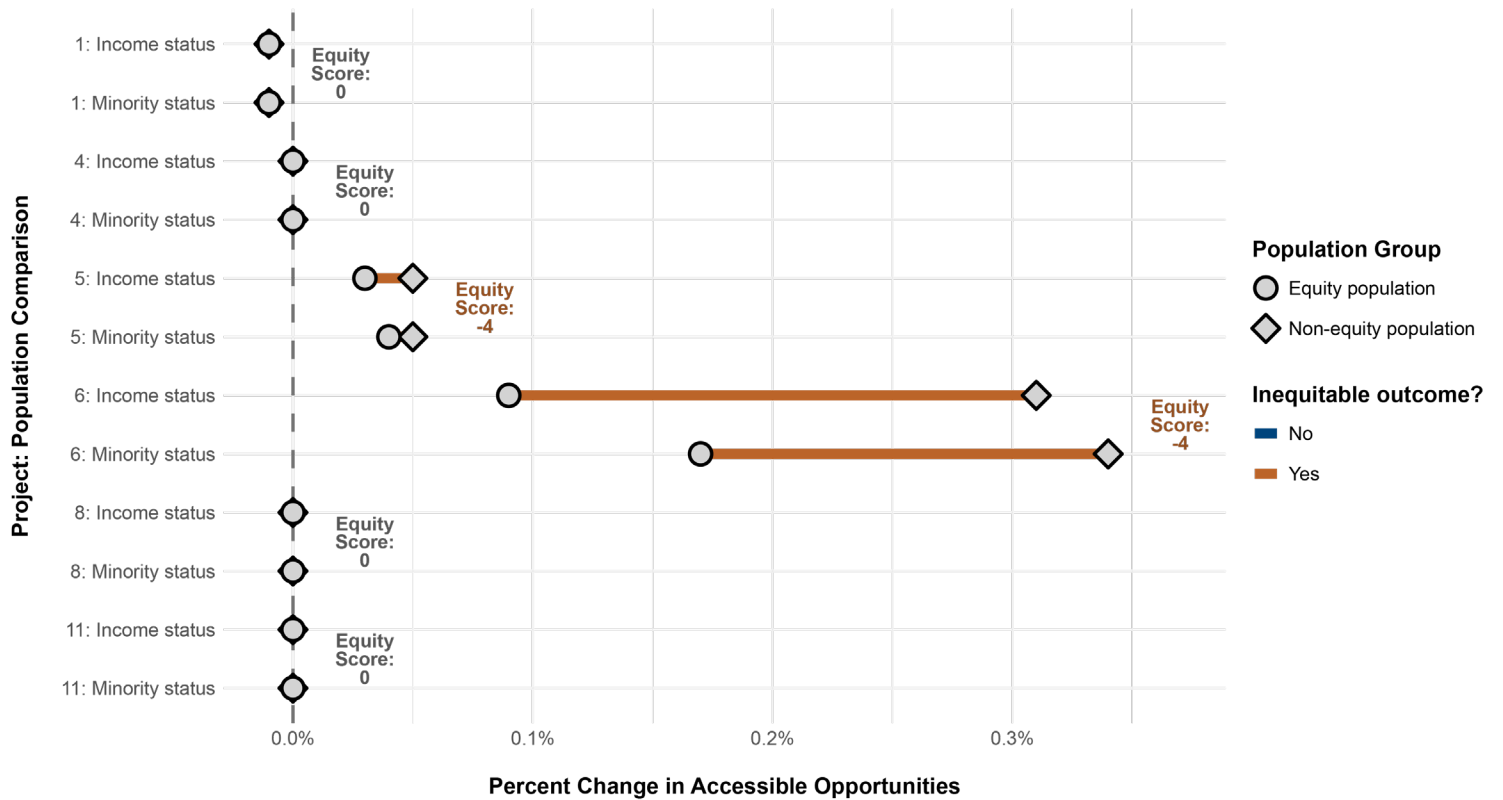
²⁰ For an example and more detail on how this could occur, see Appendix A.

Figure 8
Environmental Justice Criteria Scores: Active Transportation Trip to Jobs



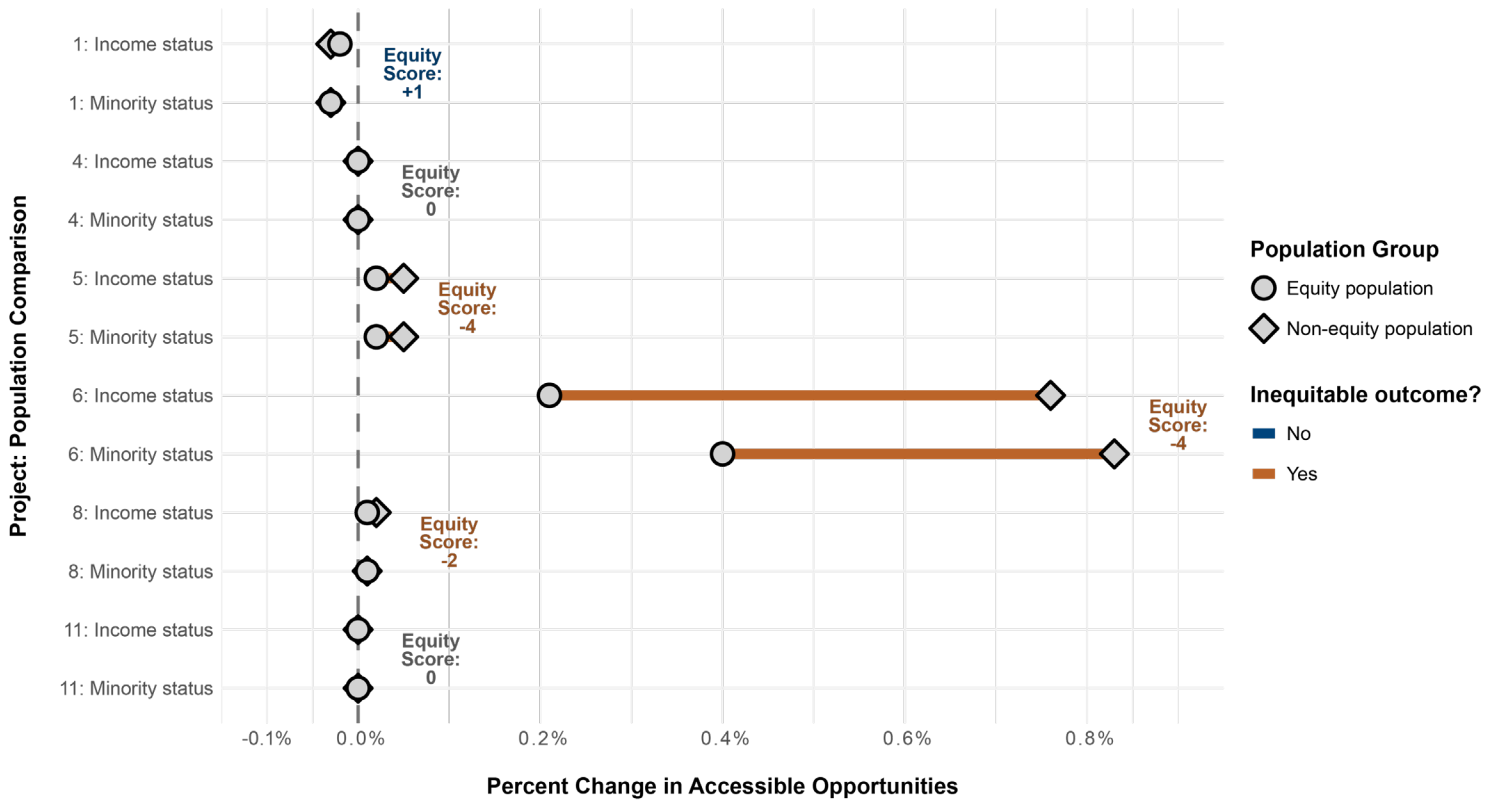
Source: Boston Region MPO and Conveyal.

Figure 9
Environmental Justice Criteria Scores: Public Transit Trip to Jobs



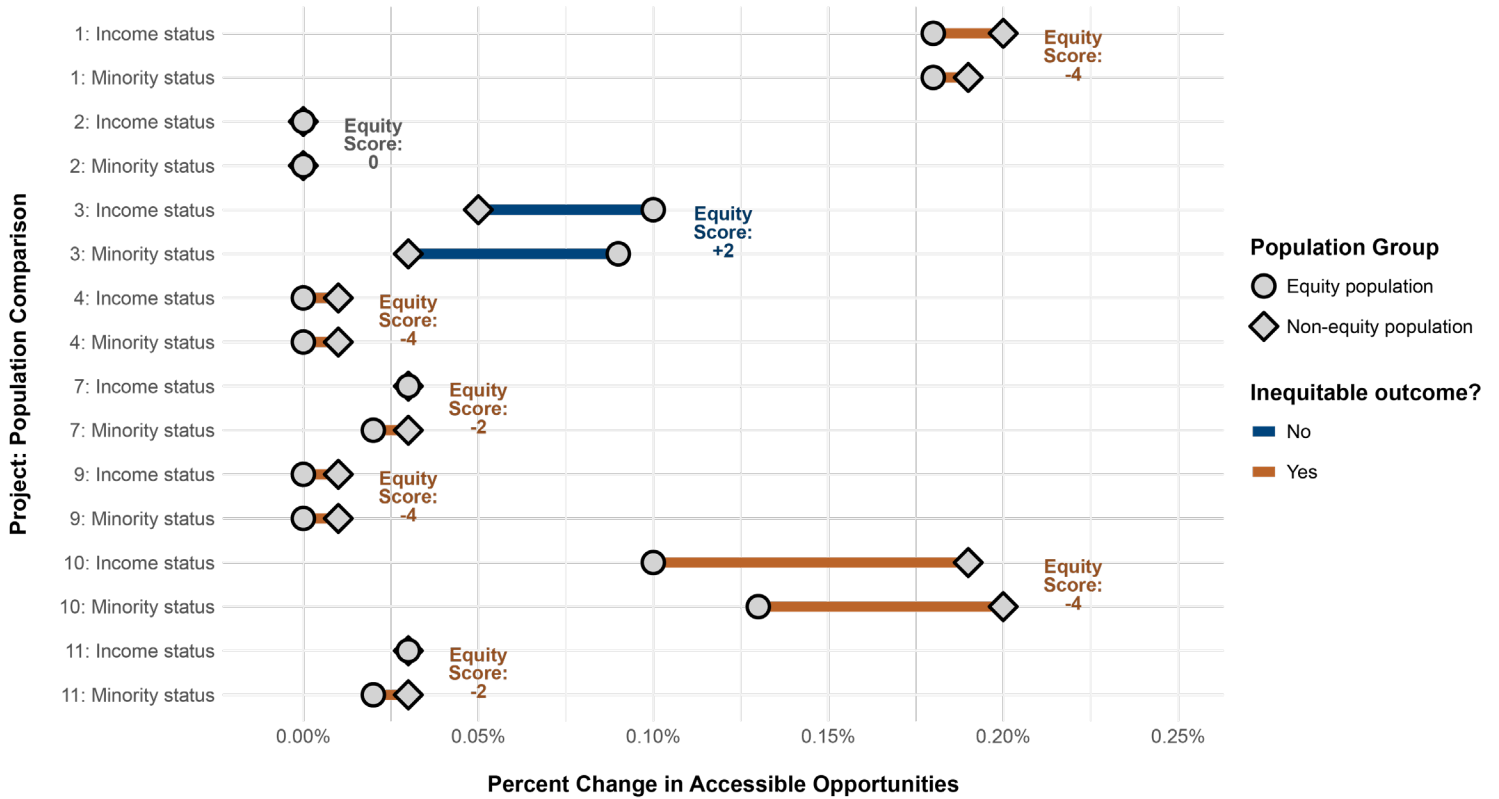
Source: Boston Region MPO and Conveyal.

Figure 10
Environmental Justice Criteria Scores: Public Transit Trip to Healthcare



Source: Boston Region MPO and Conveyal.

Figure 11
Environmental Justice Criteria Scores: Active Transportation Trip to Parks and Open Space



Source: Boston Region MPO and Conveyal.



Chapter 4 — Conclusion and Recommendations

The goal of this study was to explore the use of Conveyal to analyze destination access for projects applying for funding through the Boston Region Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP). Staff ran Conveyal on 11 sample TIP projects that represent the range of different types of projects the MPO funds. The analyses demonstrated the magnitude of changes in access that could be expected from TIP projects when modeled in Conveyal.

During this study, staff found the potential to use Conveyal to evaluate projects proposed for MPO funding in the TIP, for the following reasons:

- Conveyal has short run times, which is important to be able to score projects within the short period of time staff have to complete project evaluation.
- Conveyal can analyze most of the project types that the MPO funds and produces a metric that can be used to evaluate these projects, allowing them to be compared regardless of size or location.
- Conveyal can analyze impacts of projects of any size (assuming information about their designs are available), including the smaller-scale projects that the MPO typically funds. This flexibility means it can also be used to evaluate the combined impacts of all TIP projects for the TIP's Disparate Impact and Disproportionate Burden mitigation analysis. By using the same tool, the MPO can identify projects that would address disparities in access.
- In general, project applications provide the information staff need to be able to represent and analyze projects in Conveyal.
- With minimal post-processing, staff can analyze the change in access for different demographic groups, allowing staff to develop criteria that evaluate whether changes in access are equitable for EJ populations.

Due to the limited availability of data for analyzing certain types of projects in Conveyal, some projects that the MPO funds would not be scored. These include projects that include improvements that only improve drive access, wayfinding signage projects, bicycle racks, or bikeshare expansion and replacement.

Staff do not recommend using Conveyal to evaluate impacts to drive access at this time, reflecting the MPO's focus on multimodal projects in its LRTP goals and objectives, as well as the lack of available data needed to conduct such an analysis as discussed in Chapter 2. Other project evaluation criteria will continue to be used to assess other ways projects address drive access by reducing congestion, improving roadway condition, redesigning

geometry to move traffic more efficiently, and promoting mode shift by providing robust non-automobile transportation options. Staff will continue to build out criteria in these areas.

Based on the results of the analyses of the sample TIP projects, staff developed destination access criteria to test certain projects proposed for funding in the TIP. However, this is a new area of project evaluation and questions remain about the methodology that staff proposed addressing in a second phase. In this second phase, staff would further test Conveyal and the criteria developed for this study on projects the Federal Fiscal Years (FFYs) 2026–30 TIP. Key areas for further exploration include the following:

- Exploration of destination access metrics and evaluation at the local level
- Representation of bikeshare projects in Conveyal
- Refinement of assumptions about how different project elements affect changes in travel speed
- Comparison of project scores under the existing and test destination access criteria
- Explore the feasibility of incorporating Conveyal into the scoping of MPO-led planning studies

This second phase will allow staff to refine criteria and propose recommended destination access criteria for use in subsequent TIPs. Staff will undertake this work in the remainder of the FFYs 2025 and report back to the MPO with further recommendations.

Appendix A — Detailed Methodology

Appendix A provides detailed information on the methodology and data sources that the Boston Region Metropolitan Planning Organization (MPO) staff used to run Conveyal for this study.

A.1 Estimating Change in Vehicle Travel Speeds

Staff assumed that some project elements would influence roadway travel speeds for transit (for example, a lane reduction). The relative impacts of these project elements were chosen based on the advice of planning staff who have extensive experience observing projected speed impacts of these elements from traffic modeling tools.

To model the estimated change in speeds that result from these project elements, staff synthesized local travel speeds from the Replica platform to derive a baseline.¹ Replica provides estimates of observed speeds along roadway segments during a given time period that considers traffic congestion. When modeling a project, staff referenced the baseline speed along the affected roadway during the relevant time period (for example, weekday AM peak) and modeled an adjustment that considered the cumulative impact of relevant project elements. Depending on the specifications of the project application, staff applied different speed adjustments along different segments of the roadway (for example, one segment may have a new bike lane, while another segment may also have new sidewalks).

A.2 Modeling Microtransit

Due to how microtransit is represented in Conveyal, all microtransit services were represented as first- and last-mile services that connect to fixed-route transit, rather than door-to-door taxi-like services, regardless of the actual service model. This approach is consistent with the types of microtransit services that the MPO seeks to fund—projects that act as first- and last-mile shuttles that connect riders of fixed-route transit to their home or other destination. In any case where a microtransit service does provide door-to-door service, Conveyal may underestimate changes in access for areas with fewer fixed-route transit stops compared to those where transit stops are more plentiful. MPO staff will continue working with staff at Conveyal improving the representation of microtransit.

¹ Replica data was sourced in 2023 and reflects 2022 estimated travel speeds.

A.3 Project Elements Modeled in Conveyal

Staff made assumptions as to how various project elements impact travel speeds. They reflect a close estimate of the relative changes across a variety of changes to the transportation network and are based on past project work focusing on infrastructure interventions' impacts on travel time.

Table A-1
Modeling Methods of Project Elements

Project Element	Anticipated Effects	Modeling Methods
New Sidewalk	-Increase pedestrian network coverage -Slow motor vehicle travel on adjacent roadways	-Add pedestrian link -Decrease adjacent roadway speeds for cars and transit by 5%
New Shared-Use Path	-Increase bicycle and pedestrian network coverage	-Add bicycle and pedestrian link
New Fixed-Route Bus or Shuttle Service	-Increase transit network coverage	-Add transit route and trip schedule
New Microtransit Service	-Increase microtransit service area coverage	-Add microtransit pickup and dropoff areas
Bike Lane	-Increase bicycle network coverage -Slow motor vehicle travel on adjacent roadways	-Update the LTS for roadway segment -Decrease adjacent roadway speeds for cars and transit by 5%
Bus Lane	-Speed up transit travel on roadway -Slow car travel on roadway	-Increase roadway speeds for transit by 30% -Decrease roadway speeds for cars by 30%
Traffic Calming with Lane Reduction	-Slow motor vehicle travel on roadway	-Decrease roadway speeds for cars and transit by 30%
Traffic Calming without Lane Reduction	-Slow motor vehicle travel on roadway	-Decrease roadway speeds for cars and transit by 10%
New Turning Lane	-Speed up motor vehicle travel on roadway	-Increase roadway speeds for cars and transit by 5%
Roundabout Reconfiguration	-Change travel speeds for motor vehicle travel on roadway	-Change roadway speeds for cars and transit by a factor that is dependent on the characteristics of the project
Additional Travel Lane(s)	-Speed up motor vehicle travel on roadway	-Increase roadway speeds for cars and transit by a factor that is dependent on the characteristics of the project ¹

(Table A-1 cont.)

Project Element	Anticipated Effects	Modeling Methods
Resilience Planning for Flooded Roadway	-Re-enables access to the roadway segment by all modes	-Remove link from network for all modes as the baseline condition, and restore the link for the proposed condition

LTS = Level of traffic stress.

¹ The factor is provided by transportation planners with extensive experience modeling roundabout reconfigurations with traffic analysis tools.
Source: Boston Region MPO.

A.4 Project Elements Not Modeled in Conveyal

As Conveyal's primary purpose is to model changes in destination access, staff only modeled project elements that were projected to have a direct impact on travel speeds, travel routes, or transit service. Some project elements were not modeled because they have uncertain impacts on travel time and/or a lack of available reference data. Additionally, other project elements were not modeled because they do not change the capacity or speed of the transportation network. The following list includes common project elements that staff did not model:

- Pedestrian maintenance improvements
- Reconstruction of existing infrastructure (for example, pavement reconstruction)
- Lengthening of turn lanes
- Signal additions
- New bike racks
- Removal of turning restrictions
- New turning restrictions
- Shortened pedestrian crossings
- ADA improvements at transit stations
- Transit signal priority
- Floating bus stops
- Bus queue-jump lanes

On a case-by-case basis, where a project has multiple improvements that would be assumed to work together synergistically to achieve a larger goal (for example, a series of bus route improvements or several traffic-calming improvements), staff modeled the projected impact on some of these elements in tandem.

A.5 Data Sources

A.5.1 General Transit Feed Specification

To represent the transit network in the Boston region, staff used the General Transit Feed Specification files from December 2022 from the following transit operators:

- Massachusetts Bay Transportation Authority:
https://cdn.mbtta.com/archive/archived_feeds.txt
- Brockton Area Transit:
<https://transitfeeds.com/p/massdot/94/20221208>
- Cape Ann Transportation Authority:
<https://transitfeeds.com/p/massdot/95/20221202>
- Greater Attleboro and Taunton Regional Transit Authority:
<https://transitfeeds.com/p/massdot/98/20221008>
- Lowell Regional Transit Authority:
<https://transitfeeds.com/p/massdot/99/20221206>
- Merrimack Valley Regional Transit Authority:
<https://transitfeeds.com/p/massdot/100/20221118> (weekday)
<https://transitfeeds.com/p/massdot/100/20221217> (weekend)
- Metrowest Regional Transit Authority:
<https://transitfeeds.com/p/massdot/101/20221212>
- Montachusett Regional Transit Authority:
<https://transitfeeds.com/p/massdot/102/20221210>
- Lexpress:
<https://www.lexingtonma.gov/documentcenter/view/7027>
- MassPort and Logan Express:
<https://www.transit.land/feeds/f-drt3-909983/versions/8fc2b52f822b45a0781be35062b2e9246a414433>

A.5.2 Destination Locations

Table A-2 describes the destinations that staff used for this analysis and their data sources. Staff chose a subset of destinations that have been used in other Conveyal modeling work at the MPO, including the 2022 study *[Identifying Transportation Inequities in the Boston Region](#)*. The destinations reflect a range of applicable trip types and purposes for those traveling within the Boston region.

Table A-2
Destination Data

Destination	Description	Data Sources
Jobs	Job locations as of 2021.	LEHD LODES (provided by Conveyal's import tool)
Healthcare	Community health centers, clinics, acute care hospitals, and urgent cares.	-MassGIS Community Health Centers -Mass.gov Licensed Clinics -MassGIS Acute Care Hospitals -Google Maps Urgent Care Centers
Parks and Open Space	Publicly accessible open space opportunities whose primary purpose is conservation and/or recreation. Open spaces include those at least partly in the MPO region with an area of at least a half-acre. Opportunities are routed to points where the open space and the walkable or bikeable roadway networks intersect.	MassGIS Protected and Recreational Open Space
Essential Places	Destinations that reflect the basic needs that the public requires access to on a regular basis. Ten "essential destinations" were chosen and fall within three categories: healthcare, civic, and food destinations. An "essential place" is a cluster of destinations that contains at least two destination categories and where there are at least five destinations. Clusters are linked by a maximum distance of 161 meters in the Inner Core subregion or 483 meters in other subregions.	Healthcare: -MassGIS Community Health Centers -Mass.gov Licensed Clinics -MassGIS Acute Care Hospitals -SAMHSA FindTreatment Locator -Massachusetts Department of Public Health Retail Pharmacies Civic: -MassGIS Town Halls -MassGIS Libraries -USPS Post Offices Food: -MassGIS Farmer's Markets -MAPC Grocery Stores

LEHD = Longitudinal-Employer and Household Dynamics. LODES = Origin-Destination Employment Statistics. MAPC = Metropolitan Area Planning Council. MassGIS = Massachusetts Bureau of Geographic Information. SAMHSA = Substance Abuse and Mental Health Services Administration. USPS = United States Postal Service.

Source: Boston Region MPO.

A.6 Weighting Accessible Destinations by Travel Time

To reflect the observed accessibility of destinations, staff weighted the number of accessible destinations by their travel time rather than specifying a hard cutoff. Staff weighted accessible destinations by using fixed exponential decay functions that varied by trip type, detailed in Table A-3.²

Table A-3
Decay Functions by Destination and Travel Mode

Modes Analyzed	Destination			
	Jobs	Healthcare	Essential Places	Parks and Open Space
Transit	22.5 minute half-life	15 minute half-life	N/A	N/A
Bike	15 minute half-life	N/A	7.5 minute half-life	7.5 minute half-life
Walk	15 minute half-life	N/A	7.5 minute half-life	7.5 minute half-life

N/A = Not applicable.

Source: Boston Region MPO and Conveyal.

A fixed exponential decay function assigns a value to a destination; for example, if the travel time to one destination is half as long as the travel time to another destination, then the destination with the shorter travel time will be valued twice as much. The decay function's half-life allows staff to specify a time interval for this weighting. For example, for a public transit trip to jobs, a job that is 22.5 minutes away is weighted twice as much as a job that is 45 minutes away. In other words, if someone can reach only one job by transit that is 22.5 minutes away (weighted as 0.5), and two jobs by transit that are 45 minutes away each (weighted as 0.5/2 each), the total accessible destinations would be calculated as 1 ($0.5 + (0.5/2) + (0.5/2) = 1$). While these three jobs are all "accessible," this weighting considers that reaching destinations more quickly is more desirable and has a stronger perceived impact.

² "Decay Functions," Conveyal, accessed November 18, 2024, <https://docs.conveyal.com/learn-more/decay-functions>.

A.7 Dasymetric Population Mapping Methodology

The Conveyal output is a raster grid map—each cell acts as an origin, containing the number of destinations that can be accessed throughout the region from that starting point. Since demographic data are available as polygon vector data, staff used binary dasymetric interpolation to allocate the demographic data to the grid cells based on two filters: residential road and land cover classification.

Dasymetric mapping is an interpolation technique to distribute large area geographic data from one geography to a more precise geography given some assumptions about land use—for example, taking census tract-level demographic data and estimating the population by raster grid cell based on road geography and impervious surface data. This process brings demographic estimates to a smaller spatial unit.

Once dasymetric mapping was applied, staff used Conveyal outputs to calculate the estimated number of destinations accessible per person through a weighted average. For environmental justice (EJ) and non-EJ populations, staff calculated this weighted average by multiplying the percent of the population that is EJ and non-EJ by the estimated number of accessible destinations within the grid cell and found the weighted average across all grid cells. These calculations allowed staff to determine whether EJ populations had a better or worse change in access than their non-EJ population counterparts.

A.8 Population Weighting and Rounding Effects on Project Scoring

When calculating the total *population weighted percent change in access* metric for the proposed destination access criteria, staff considered a change to the nearest hundredth of a percent (0.01%). This metric applies to both the criteria for the entire MPO region's population and for the equity-related access criteria, where the metric is calculated within each demographic group and compared. As a result, a project may receive a non-zero score for the overall population criterion but a zero score for the EJ population criterion. This is due to projected changes being more significant for one or two demographic groups, depending on the demographics of the affected project area, than for the overall population. Additionally, rounding can affect the results: if the weighted percent change in access is less than 0.005 percent, it is rounded to 0.00 percent (no change), while if a weighted percent change in access is between 0.005 percent to 0.009 percent, it is rounded to 0.01 percent (positive change).

Table A-4 demonstrates a case where the total population of the MPO region and the EJ populations did not have a significant enough estimated change in access to meet the rounding threshold, while the non-EJ populations did. As the estimated change for the non-EJ population was slightly higher than the EJ population and met the rounding threshold, the percent difference metric was negative, partially contributing to a negative EJ score.

Table A-4
Rounding the Estimated Change in Access to Parks and Open Space
for a Bike Trip from a Sample TIP Project

Population Group	Average Parks and Open Space Opportunities Accessible Before Project	Average Parks and Open Space Opportunities Accessible After Project	Percent Change (Unrounded)	Percent Change (Rounded) ¹	Percent Difference (Rounded) ²
EJ Population	107.730	107.731	0.001%	0.00%	-0.01%
Non-EJ Population	80.769	80.775	0.007%	0.01%	
Total MPO Population	90.597	90.601	0.004%	0.00%	N/A

¹ Metric used as input for equity access score

² Metric used as input for overall population access score

N/A = Not applicable.

Source: Boston Region MPO and Conveyal.

