SUMMARY MEMORANDUM:

POPULATION, LAND USE, AND RIDERSHIP CHANGES

UPDATE TO THE 2010 DEIR FOR THE RED LINE/BLUE LINE CONNECTOR

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massDOT
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1. Introduction

In 2010, Massachusetts Department of Transportation (MassDOT) conducted a study to evaluate the connection of the Massachusetts Bay Transportation Authority's (MBTA's) Red Line and Blue Line in Boston. The Red/Blue Line Connector Project consisted of extending the Blue Line beyond its current terminus at Bowdoin Station along Cambridge Street to the Red Line at Charles/ MGH Station. In March 2010, MassDOT submitted a Draft Environmental Impact Report (DEIR) pursuant to the Massachusetts Environmental Policy Act (MEPA). In May 2010, MEPA approved the DEIR. At the time, MassDOT had not identified funding for the construction of the Project.

Recent changes in development and growth in Revere, East Boston, and Cambridge, as well as advancements in construction technologies, have generated a renewed interest in revisiting the need for the Red/Blue Line Connector. MassDOT's Office of Transportation and Planning (OTP), working with the MBTA, has initiated a study to reassess the Project by revisiting previous assumptions developed during the 2010 DEIR.

The purpose of this memorandum is to update the data and assumptions regarding population, land use, and ridership from the 2010 DEIR's Purpose and Need. The 2010 DEIR focused primarily on four Census tracks surrounding the Cambridge Street corridor project area. However, due to their current access to the Blue and Red lines, the communities in this area would likely not have a large effect on demand for and use of the connection. This memorandum expands analysis to include neighborhoods in Cambridge, East Boston, and Revere, as the Project would most affect these communities' ability to travel between locations on the Blue Line and locations on the Red Line.

Key findings of this memorandum include:

Increased Rate of Population Growth: Cambridge, East Boston, and Revere experienced rapid growth to varying degrees between 2010 and 2016, with East Boston seeing the largest percentage increase in both population and households. Growth in all three areas could indicate a larger level of demand for a Red-Blue connection, depending on the travel patterns of the populations. The number of passengers using Logan Airport, accessible by the Blue and Silver Lines of the MBTA, has also significantly increased since 2010. However, Massport data show the proportion of passengers using the Blue Line has decreased in this time, meaning the total number of riders from the Airport has remained largely the same.

Increased Density: Since 2010, there has been an increase in high-density residential and commercial development in Cambridge, East Boston, and Revere reflective of their population and household growth. Development is expected to continue in these areas. In East Boston, this may include the large-scale development of Suffolk Downs, which may have a significant effect on transit demand.

Demand for the Connection is Difficult to Project from Current Data Sources: Current MBTA data demonstrate that trips connecting between the Red and Blue lines to key destinations represent a small fraction (less than 5%) of total trips using these lines. However, these data may not capture the full extent of current demand, as some MBTA riders complete portions of their trips on other modes (bicycle, walking, etc.) and some travelers use other modes for the full trip. Furthermore, as reflected in the demographic and land use trends, the overall ridership on both the Red and Blue Lines is increasing. An estimated 4 minutes of travel time savings (including the elimination of a transfer) in each direction could increase demand for a direct connection between the Red and Blue Lines. The incorporation of new regional population and employment forecasts into the Boston area's regional travel demand model was not yet complete as of this reassessment.

2. DEIR Purpose and Need

As noted in the 2010 DEIR, the stated purpose of the Red/Blue Line Connector Project is to boost transit ridership, reduce automobile travel through Downtown Boston, improve air quality, reduce congestion in the existing Downtown transfer stations, and improve mobility and access to jobs and health care for residents of East Boston, Revere, Winthrop, and Chelsea.

The Red Line and Blue Line do not connect anywhere in the MBTA system. As a result, riders traveling between points on the Blue Line (the Boston waterfront, East Boston, Logan Airport, Revere) and points on the Red Line (Cambridge, Somerville, South Boston, Quincy) must first transfer to the Green or Orange Lines in order to complete their trip. This transfer penalty may reduce ridership and increase congestion at other Downtown Boston stations.

3. Area Population and Projections

Residents along the fast-growing Red and Blue Line corridors are likely the most important source of demand for the proposed project. Passengers accessing and arriving at Logan Airport are another potential beneficiary, though the proportion of travelers using the Blue Line has been falling since 2010. Since the 2010 DEIR, neighborhoods in Cambridge, East Boston, and Revere, as well as Logan Airport, have experienced significant growth. In the case of the residential areas, the 2016 population levels have exceeded or are approaching the projections for 2030.

The project would also affect residents of the four census tracts in the Cambridge Street corridor surrounding the project site, although this area would likely not contribute significantly to increased ridership as the residents already have easy access to both the Red and Blue Lines.

The following section describes these demographic changes in all five areas: Cambridge Street in Downtown Boston, East Boston, Revere, Cambridge, and Logan Airport. Additionally, this section reviews the population projections from the development of the 2010 DEIR and how they compare to both current conditions and more recent population projections.

3.1. Changes in Population Since DEIR

The 2010 DEIR focused exclusively on the immediate project area (Cambridge Street), and presented population totals based on U.S. Census 2000 data, as well as projections for 2010 and 2030 based on the Metropolitan Area Planning Council (MAPC) January 2006 projections. These data assumed population growth of less than 3% through 2010 and 2030 and household growth of approximately 4% for the same time periods.

The actual population growth for the project area between 2000 and 2016 was over 17%, far exceeding the estimate used in the 2010 DEIR. Although the 2010 DEIR did not analyze the population and land use of the East Boston neighborhood or in Cambridge and Revere, understanding the historic and projected growth of these areas is critical to understanding the potential benefits of the Red/Blue Line Connector. Table 1 shows that these areas along the Red and Blue Lines have all experienced significant growth in population, households, or both between 2000 and 2016, indicating there is a growing pool of potential transit riders who may benefit from a direct Red-Blue connection.

Table 1 – Comparison Population and Household Changes

	2000 Data	2010 Data	Growth (2000 to 2010)	2016 Data	Growth (2010 to 2016)	Growth (2000 to 2016)
Cambridge Street Area						
Population	17,747	19,318	+8.9%	20,835	+7.9%	+17.4%
Households	10,430	12,234	+17.3%	12,575	+2.8%	+20.6%
East Boston						
Population	38,413	40,508	+5.5%	46,208	+14.1%	+20.3%
Households	14,326	14,651	+2.3%	17,254	+17.8%	+20.4%
Cambridge						
Population	101,355	103,506	+2.1%	108,757	+5.1%	+7.3%
Households	42,615	44,032	+3.3%	48,627	+10.4%	+14.1%
Revere						
Population	47,283	50,008	+5.8%	53,165	+6.3%	+12.4%

Source: U.S. Census and Massport

Key context for the data presented in Table 1 include:

- **Cambridge Street Area:** Population in the area increased by almost 9% and the number of households increased by over 17% between 2000 and 2010. The 2016 American Community Survey (ACS) data for the study area shows that population growth continued at a similar rate between 2010-2016 while households grew at a slower rate than in the prior 10 years.
- **East Boston:** According to the Boston Planning and Development Agency (BPDA), the East Boston neighborhood has experienced the largest absolute gain in population among all city neighborhoods between 1980 and 2010. This trend is reflected in the 5.5% growth in population between 2000 and 2010 and, even more so, in the 14% growth between 2010 and 2016. The number of households, which is an important indicator for potential transit ridership, grew from 14,651 to 17,254 (18%) between 2010 and 2016. Population density for the overall East Boston neighborhood is skewed due the large areas of uninhabited land at Logan Airport and at Suffolk Downs. However, the three census tracts in the Maverick Square area had an average population density of 26,427 people/square mile in 2010, similar to the population density of the Downtown Boston portion of the project area and more than twice as much as the City of Boston as a whole.
- **Revere:** The City of Revere saw a population growth rate of 5.8% between 2000 and 2010 (Table 3). Per the ACS, the 2016 population of Revere increased to 53,165, a growth rate of 6.3% since 2010 and over 12% since 2000. According to the 2010 Census, the two census blocks including and adjacent to the Blue Line Revere Beach and Wonderland Stations had a population density of 15,973 people per square mile.
- **Cambridge:** Cambridge saw a growth rate of 2.1% between 2000 and 2010. Population data from the ACS showed that the 2016 population of Cambridge increased to over 108,000 residents, a 5.1% growth since 2010 and more than 7% growth since 2000. The ACS also showed that while Cambridge saw growth in the number of households between 2000 and 2010 (3.3%), it saw eve more growth since 2010-2016 resulting in an overall household growth rate of 14.1% for the period between 2000 and 2016. According to the 2010 Census, the population density of the City of Cambridge in 2010 was 16,355 people per square mile.

3.2. Passenger Change – Logan Airport

Despite significant growth in the number of passengers at Logan Airport since 2010, the number of passenger using the Blue Line to access or depart the Airport has remained nearly the same over this time period (Table 2). This signifies that airport passengers are decreasingly relying on the Blue Line for ground transportation.

Table 2 – Logan Airport Passenger Growth and use of the Blue Line

	2010	*2016*	*Change*
Passengers at Logan (enplaning and deplaning)	27.4 million	36.2 million	+32.2%
Blue Line to/from Logan (%)	4.0%	3.1%	-0.9%
Estimated Riders using Blue Line to/from Logan[1]	1.04 million	1.07 million	+2.5%

In 2010, 27.4 million passengers used Logan Airport and by 2016 this number had grown by 32.3% to a total of 36.2 million passengers.[2] The Massachusetts Port Authority (Massport) expects the number of passengers will continue to grow in the next 10 to 20 years, as the number of passengers in 2017 had already met the 2006 low-end projections for 2020.[3]

People traveling to or from Logan Airport have a number of ground transportation options including: private vehicles, rental vehicles, taxis, transportation network company service (uber/lyft), the Logan Express Bus or other express buses (e.g. regional buses), the MBTA Blue Line, the MBTA Silver Line, MBTA ferry service, water taxis, hotel or car services, and others. According to the 2016 Massport Passenger Ground-Access Survey, 3.1% of passengers used the MBTA Blue Line, compared to 3.3% using the Silver Line, and 69.5% using private vehicles options (including taxis and transportation network company services). These figures are similar to those from 2010, when 4.0% of passengers used the Blue Line, 3.1% use the Silver Line, and 70.0% used private options. The estimated percentage of passengers using the Blue Line in 2016 and 2010 translates to around 1.07 million riders and 1.04 million riders, respectively, entering the T at Airport Station from Logan Airport, demonstrating fairly consistent usage across the years.[4] MBTA data collected at the Airport Station gates corroborate these data, showing that 1.15 million riders entered the Station from the Logan Airport side in 2016 and 1.16 million in 2010.[5] As Table 2 illustrates, the increase in riders accessing the Blue Line at Airport Station from the Logan Airport gates is significantly smaller than the growth in the total number of passengers using Logan Airport.

[1] Estimate is based on 95% of the total passengers at Logan, as Massport estimates that 5% of passengers use Logan to connect to other flights and therefore are not accessing ground transportation.

[2] Massport Monthly Airport Traffic Summary, December 2016.

[3] In 2006, Massport projected Logan Airport would serve between 38.3 and 49.5 million passengers by 2020. In 2017, it served 38.4 million, reaching the low end of the projection. Massport will likely release projections for 2030 in the Spring of 2019.

[4] These figures are based on Annual passenger statistics, accounting for the fact that around 5% of passengers at Logan are connecting, rather than beginning or terminating their air travel.

[5] These MBTA data may underestimate the number of passengers, as many are traveling with children and may enter without tapping unintentionally since they are not familiar with the system. However, these data also include employees at Logan Airport using the Blue Line and riders from the local neighborhood entering at this gate, rather than the Bremen Street entrance. These data are not available for 2010.

3.3. Future Population Projections

In January 2014, MAPC released their updated population and housing demand projections for Metro Boston.[6] These projections were based on a dynamic model of future population, household, and housing demand for Metro Boston and its municipalities. Because this was a regional model and projections were based on municipal boundaries, the population projections for the project area are based on percentages of the actual Boston population projected onto the anticipated growth of population across the City. This was consistent with the method used to generate the projections used in the 2010 DEIR based on the 2006 MAPC Housing and Employment Projections. The projections included two different growth scenarios, 1) Status Quo, and 2) Stronger Region, which includes the following:

- The Status Quo scenario is based on the continuation of existing rates of births, deaths, migration, and housing occupancy.
- The Stronger Region scenario explores how changing trends could result in higher population growth, greater housing demand, and a substantially larger workforce.

Based on MAPC projections, the growth in population recently seen in Boston is expected to continue. Table 3 shows the population projections for the Cambridge Street corridor and a comparison of the projections presented in the 2010 DEIR and the more recent 2014 MAPC projections. The Status Quo scenario projected a population of 20,797 in 2030 and the Stronger Region scenario projected a population of 22,190 in 2030. The population in 2016 (20,835) had already surpassed the projections for the 2030 Status Quo scenario.

Table 3 – Population Projections for Project Area (Cambridge Street Corridor)

	2000 Actual	2010[1] DEIR Projection	2030[1] DEIR Projection	2010 Actual	MAPC 2030 (Status Quo)[1] Projection	MAPC 2030 (Stronger Region)[1] Projection	2016 Actual
Population	17,747	18,205	18,707	19,318	20,797	22,190	20,835

[1]Population projections are based on percentage of overall Boston population

Table 4 shows the 2000, 2010, and 2016 population data (U.S. Census) for East Boston, Cambridge, and Revere and shows the MAPC projections for the Status Quo and Stronger Region scenarios for these communities. The recent growth in the East Boston neighborhood has outpaced those projections as the 2016 population (46,208) is greater than what was projected for the 2030 Status Quo (43,609) and is very close to the 2030 Stronger Region (46,530). The growth in Cambridge has not been as dramatic as East Boston, but it appears to be outpacing the 2014 MAPC projections. While the overall 2016 population (108,757) did not surpass the 2030 Status Quo (110,623), the 2016 households (48,627) have eclipsed the 2030 Status Quo (46,270) and are approaching the Stronger Region (49,640). Revere has not experienced the amount of growth seen in East Boston and Cambridge, but is on pace with the MAPC projections and, as detailed in Section 4, continued growth is anticipated in all of these communities.

[6] MAPC Growth Projections https://www.mapc.org/learn/projections/

Table 4 – Population Projections for East Boston, Cambridge, and Revere

	2000 Actual[1]	2010 Actual[1]	MAPC 2030 (SQ)	MAPC 2030 (SR)	2016 Actual[1]
East Boston					
Population	38,413	40,508	43,609	46,530	46,208
Households	14,326	14,651	16,534	17,496	17,254
Cambridge					
Population	101,355	103,506	110,623	118,625	108,757
Households	42,615	44,032	46,720	49,640	48,627
Revere					
Population	47,283	50,008	63,028	66,737	53,165
Households	20,181	20,454	26,060	27,513	21,584

[1]Source: U.S. Census

4. Changes in Land Use Since the DEIR

The project is located in a dense urban environment that has experienced a shift in land use towards increased high-density residential developments paired with compatible commercial, office, and light industrial uses. The section below presents the changes in the area that have occurred since the DEIR.

4.1. MAPC MassBuilds Database

MAPC provided MassDOT with development data from the MassBuilds database. MassBuilds is an online, interactive repository of past, present, and planned developments – from large to small, commercial to residential – across the Commonwealth. MassBuilds lets users explore certain details of development projects and search by geography, project status, development size, and year of completion.

The data that was provided included development projects since the 2010 DEIR through 2040 in various stages of planning, permitting, and construction. Due to the nature of the open source format of the data, the information is for very high-level analysis only, is not identified on an individual case-by-case basis, and loses locational accuracy at a detailed scale. As such, the below table presents the data in larger geographic boundaries based on the zip code for East Boston and the municipal boundaries for Cambridge and Revere.

Table 5 - Recent and Projected Development Data - MassBuilds

	Housing Units	Commercial (sf)*	Retail (sf)
East Boston	3,987	1,845,663	225,090
Cambridge	17,942	20,180,687	425,607
Revere	2,300	2,070,580	797,480

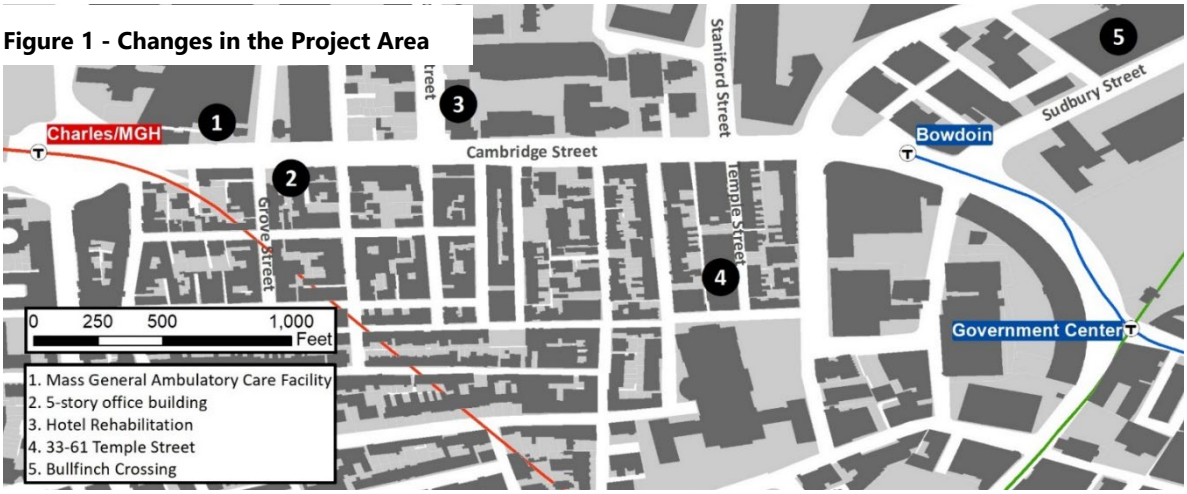
*For the purposes of this table, commercial includes industrial, office, institutional, and hotel square footage.

Source: MassBuilds

4.2. Cambridge Street Study Area

Prior to the 2010 DEIR, the entire Cambridge Street corridor had undergone substantial streetscape improvements, including repaving and repairing the street, landscaping, traffic calming measures, pedestrian walkway improvements, and sidewalk widening. To provide a direct comparison with the

Figure 1 - Changes in the Project Area



analysis done in the 2010 DEIR, this section analyzes the parcel level development of the Cambridge Street corridor that has occurred since that analysis.

As shown on Figure 1, Massachusetts General Hospital has converted over 100 feet of frontage along Cambridge Street from plaza space into the multi-story 8,000 square feet Russell Museum of Medical History. The hotel located at the Cambridge Street / Blossom Street intersection underwent a complete rehabilitation but has maintained its primary use type. At the time of the 2010 DEIR, one of the few remaining downtown gas stations was located at 296 Cambridge Street. That parcel has since been converted into a five-story, 30,000 square feet office building. As part of its plan to consolidate its campus, Suffolk University sold two of its buildings at 33-61 Temple Street, located about 400 feet south of Cambridge Street, which are being redeveloped into 75 condos with 60 parking spaces.

Another project of note is Bullfinch Crossing. While this project is outside of the Cambridge Street corridor, it is located less than 1,000' from Bowdoin Station and represents a significant shift in land use in the area. This project is currently under construction and will create six new high-rise and mid-rise buildings over two city blocks at the Congress Street/Merrimac Street/Sudbury Street intersections, including the demolition of the 2,300 space Government Center Parking Garage. When complete, the project will total 4.9 million square feet of mixed-use development with over 800 residential units and 1,160 parking spaces.

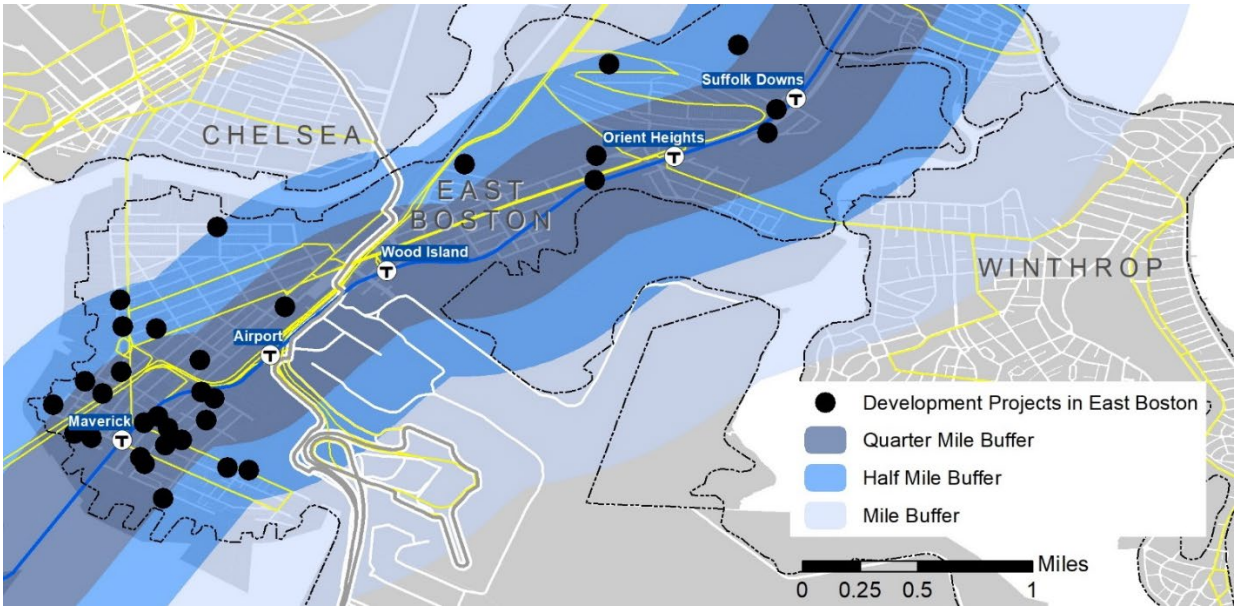


Figure 2 – Recent/Proposed Development Projects in East Boston ***(Source: BPDA)***

4.3. East Boston

As described previously, the East Boston neighborhood has seen significant population growth since 2000. The area along the Blue Line corridor is a dense urban residential/mixed use neighborhood and the development has occurred via infill, rehabilitation, and particularly the more recent expansion of multi-family, high density residential in the Jeffries Point, Maverick Square, and Eagle Hill waterfront areas. Almost all of the East Boston neighborhood is located within a half mile of a Blue Line station. In addition, the MBTA Silver Line provides a connection to the Seaport District from Airport Station and several local MBTA bus routes serve the neighborhood.

According to the BPDA, there are over 30 development projects (including Suffolk Downs, discussed below) in the East Boston neighborhood that are either approved, under review, under construction, or recently completed.[7] Not including the Suffolk Downs project, there is almost 3 million square feet of development proposed or in the pipeline in East Boston. The large majority of that, approximately 2.5 million square feet, is currently proposed as residential. On average, these projects propose an average of 0.85 parking spots per unit.

Suffolk Downs – HYM Investment Group is currently preparing development plans for the former Suffolk Downs site. The site is split between Boston and Revere and located adjacent to two Blue Line Stops (Suffolk Downs and Beachmont). The multi-phased proposal includes up to 11 million square feet of residential, office, and retail/hotel buildings, including between 7 and 10,000 residential units, across 109 acres. Despite proximity to the Blue Line and MBTA bus service, the residential units will have access to parking and the project will include parking for its retail spaces. These factors indicate that residents and visitors alike may have the opportunity to use cars as their primary means of transportation, affecting the projected use of the Blue Line. This project is still under review. Phase 1 was approved in February of 2018 and includes just over 500,000 square feet of office space.

4.4. Cambridge

Since the 2010 DEIR, the City of Cambridge has maintained the steady growth that was seen in the ten years preceding the 2010 DEIR analysis. The city provided data showing almost 75 projects across three categories: (1) recently completed, (2) permit granted, or (3) in permitting. The development projects included over 5,600 residential units, over 3.7 million square feet of office space, and over 1.3 million square feet of institutional space.[8] As shown in Figure 3, over half of these proposed projects are located within a quarter mile of the Red Line and most are within a half mile.

Kendall Square – Kendall Square has seen a significant amount of development over the past few years and continues to grow. One important site not included in the City of Cambridge project database is the Volpe National Transportation Systems Center, a 14-acre site that the Massachusetts Institute of Technology (MIT) is planning to redevelop and densify.[9] In October 2017, Cambridge City Council approved rezoning for the site that would enable the development of 1,400 housing units and 1.7 million square feet of commercial space, which will likely include retail, office, and lab space.

Alewife Area – The area around Alewife is also expected to see development in the coming years, beyond the projects included in the City's database (Figure 4). Preliminary information from the Envision Cambridge process, a community-wide process to develop a comprehensive plan, found that 60% build out of the area would result in more than 2,000 housing units and more than 9,000 jobs.

[7] These City-provided data differ from the MassBuilds data because MassBuilds is projecting future development and is not only based on current or recently completed projects.

[8] These City-provided data differ from the MassBuilds data because MassBuilds is projecting future development and is not only based on current or recently completed projects.

[9] Although this site is not included in the City of Cambridge numbers, it is included in the MassBUILDs information cited in Table 5.

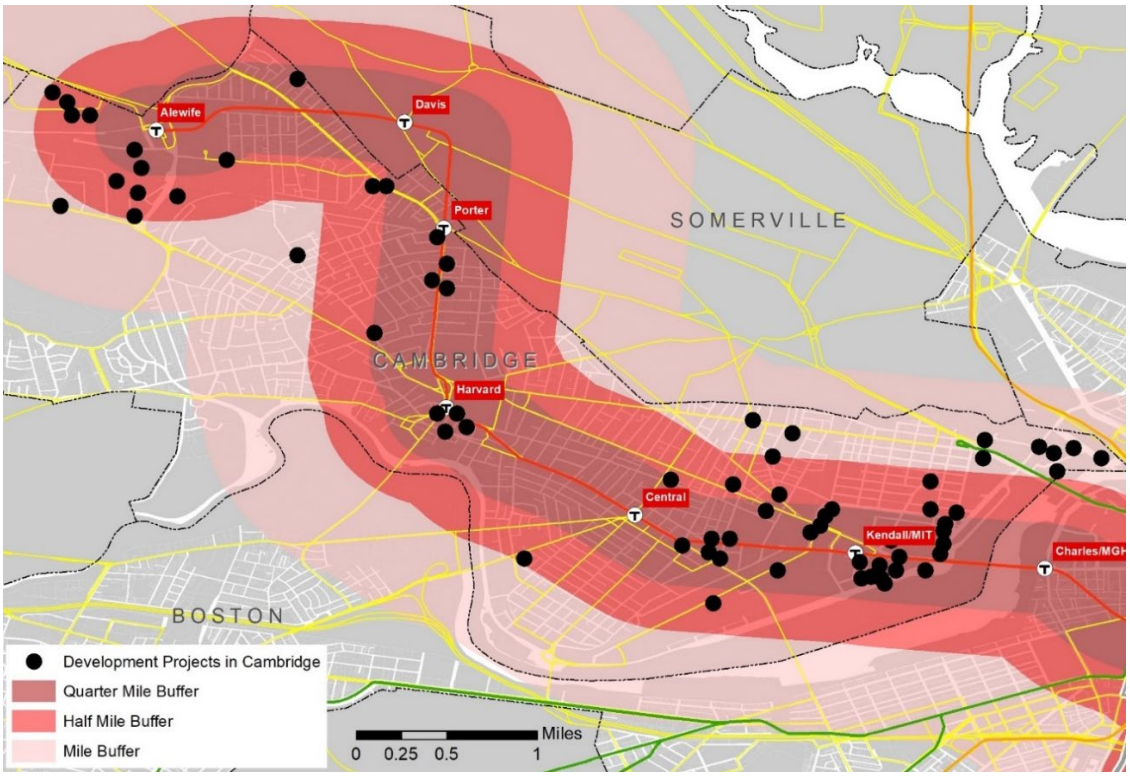


Figure 4 - Development Projects Proposed in Cambridge ***(Source: City of Cambridge)***

4.5. Revere

The City of Revere provided information on anticipated development between 2017-2021 that includes projects in three phases: (1) near completion, (2) in construction, or (3) in planning/permitting. There are over 30 development projects included in these phases.[10] More than half of these are located within a half mile of a Blue Line station and ten are within a quarter mile. The majority of the proposed development consists of residential development with over 2,500 units proposed in the City through the year 2021.

Wonderland Area – Several sites in close proximity to Wonderland station not included in the City of Revere project database may be redeveloped in the coming years. First, Atlantic Management Company of Framingham, in partnership with VMD Companies of North Andover, purchased the former 819,800-squarefoot site of the NECCO candy company. The new owners plan to redevelop the site for advanced manufacturing, robotics, bio-technology, and e-commerce, purposes which have a close connection to development in the Kendall Square area. The City of Revere has rezoned the area to enable this use. Second, the 34-acre former Race Track adjacent to Wonderland is comparable in size to Suffolk Downs and available for redevelopment. Though there are no plans currently in place, development of the property could spur redevelopment of other adjacent sites includes Wonderland Ballroom and the MBTA surface parking lot.

[10] These City-provided data differ from the MassBuilds data because MassBuilds is projecting future development and is not only based on current or recently completed projects.

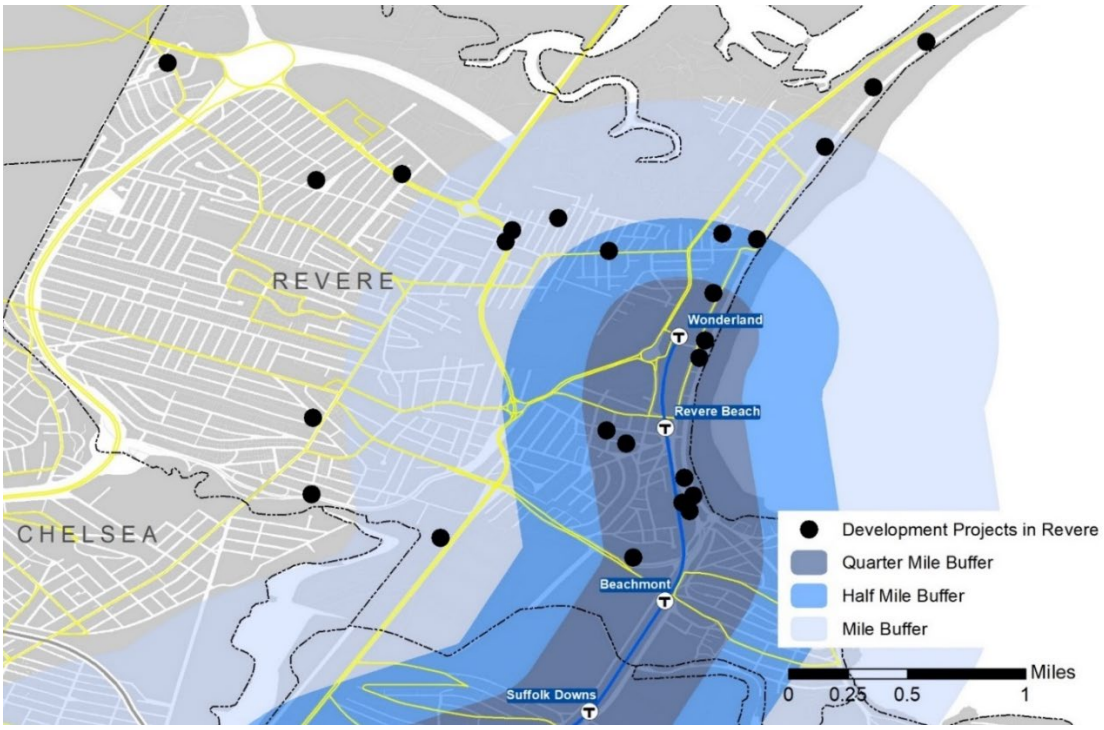


Figure 5 - Development Proposed in Revere through 2021 ***(Source: City of Revere)***

5. Transit Ridership

To understand the potential demand for the project, a review of current trips using both the Red and Blue Lines, recent overall growth in ridership, and the estimated travel time savings of the project was conducted.[11] Riders currently making this trip would benefit from decreased travel time and one less transfer. In addition, other riders and non-riders may change their travel patterns as a result of the new direct connection.

The MBTA's Origin-Destination-Transfer (ODX) model uses ridership data to infer origins, destinations, and transfers of individual trips.[12] This model provides the average weekday, Saturday, and Sunday trips occurring on the MBTA between any two stops (or aggregated to the bus route or rapid transit line level). The data from this tool, which did not exist during the development of the DEIR, are used to understand the number of riders current connecting between the Red and Blue Lines.

5.1. Current Red-Blue Connection Trips

The following tables illustrate the average weekday trips that incorporate a Red to Blue transfer. The analysis identified these trips by selecting destinations along the Red and Blue Lines and summing all the trips to these destinations which originate on relevant parts of the Blue or Red Line and connecting bus routes. The destinations include all stations on the Red Line north of and including Charles MGH (all of which have job centers, including service jobs), Aquarium Station (Blue), and Airport Station (Blue). Several destinations on the Red Line are important job centers, as Charles MGH, Kendall, and Harvard provide access to 353,031 jobs within half a mile of the stations.[13] Similarly, the Aquarium station is within half a mile of 398,272 jobs[14] and Logan Airport employs more than 17,000 people and provides access to air travel for 37 million passengers per year.[15] For the destinations on the Red Line, the analysis sums riders from Blue Line stations north of and including Aquarium (as those beginning their journey at the other stations have alternatives to reach the Red Line), and buses that exclusively serve the Blue Line, as bus routes that also connect to downtown or Orange Line stations are less certain to be benefit from a Red/Blue connection. Similarly, for destinations on the Blue Line, the analysis sums riders from the Red Line stations north of and including Charles MGH, and buses exclusively serve the Red Line.[16]

Table 6 shows the results for the Red Line destinations, demonstrating that on the average weekday 2.6 percent (around 2,300) of the approximately 88,500 trips ending north of Park Street on the Red Line began on the Blue Line or a connecting bus route. Table 7 demonstrates that on the average weekday, 4.3

[11] The ridership analysis included in the DEIR presented the Blue Line data in more detail than the Red Line data and the assessment below reflects that focus.

[12] The MBTA ridership data is based on CharlieCard and ticket transactions, which occur when a rider enters or transfers within the system. Since the MBTA system does not require riders to "tap out" of the system, the model uses an algorithm to infer each trip's origin, destination, and any transfers. The results are also scaled up to account for cash transactions and non-interaction factors. For more details about the ODX algorithm, please refer to this blog post. The origin-destination-transfer (ODX) data used in the report are from the Fall of 2016.

[13] 2015 Longitudinal Employer-Household Dynamics (LEHD) data

[14] Some of these jobs may be closer to other MBTA rapid transit stops (South Station (Red), State Street (Orange)).

[15] 2015 LEHD data, Massport, 2016 and 2017 data

[16] The analysis did not account for trips originating on the southern side of the Red Line, as these riders would not save time traveling beyond the Downtown core of the system and making the multi-floor proposed transfer at Charles MGH.

percent (around 500) of the approximately 11,500 trips ending their trips at Aquarium or the Airport began their journey on the Red Line at or north of Charles/MGH or a connecting bus route.

These data provide insight into the number of people currently relying exclusively on the MBTA to complete trips who are likely to benefit from a direct Red-Blue connection, but does not account for trips between these areas that may use the MBTA for only a portion of the journey,[17] trips using personal vehicles, or any increase in potential trips between these origins and destinations that may result from the proposed transfer.

[17] Some trips may use alternate modes (biking, walking, etc.) to complete or begin their journey and therefore the MBTA data would not reflect their complete journey.

Table 6 - Average Weekday Blue Line and Connecting Bus Route Trips to Red Line Destinations. Source: MBTA ODX Model.

Blue Line Stops + Bus Connections	Charles MGH	Kendall	Central	Harvard	Porter	Davis	Alewife	Total
114	0.2	0.5	1.8	1.3	0.3	0.3	0.3	3.8
116	3.1	23.7	24.4	23.2	5.6	6.5	4.9	74.3
117	2.2	20.8	20.4	24.0	6.6	7.5	4.2	67.3
119	1.2	5.6	4.5	5.4	1.8	0.6	2.4	16.7
120	1.0	6.5	6.7	7.9	1.5	1.8	0.9	22.1
121	0.2	4.2	1.5	4.5	0.2	0.4	0.2	10.3
411	1.7	8.2	5.6	3.6	1.2	1.3	0.9	19.2
439	0.2	0.3	0.1	0.5	0.0	0.0	0.0	1.0
441	0.8	2.4	3.7	5.9	1.9	0.6	1.4	12.9
442	0.2	1.4	1.1	1.3	0.2	0.2	1.3	3.9
455	0.8	5.7	5.2	6.1	1.0	1.6	1.2	17.8
Blue Line North of Aquarium	74.9	488.3	434.5	605.8	125.9	159.2	120.8	2,009.4
Aquarium	*4.4*	*21.2*	*20.3*	*35.8*	*9.8*	*9.8*	*20.6*	*122.0*
Maverick	*19.0*	*127.8*	*143.0*	*159.6*	*34.0*	*48.8*	*32.9*	*565.1*
Wood Island	*3.8*	*30.7*	*30.1*	*35.2*	*5.5*	*11.2*	*5.8*	*122.3*
Airport	*10.8*	*82.4*	*79.8*	*105.7*	*25.8*	*32.1*	*25.2*	*361.8*
Orient Heights	*11.7*	*51.2*	*45.5*	*69.8*	*13.0*	*19.7*	*7.2*	*218.1*
Suffolk Downs	*0.9*	*5.4*	*4.5*	*7.9*	*1.3*	*1.3*	*0.9*	*22.2*
Beachmont	*6.7*	*47.1*	*30.0*	*49.2*	*12.0*	*9.1*	*5.0*	*159.2*
Revere Beach	*6.9*	*50.4*	*44.5*	*74.9*	*9.6*	*17.2*	*10.8*	*214.2*
Wonderland	*10.6*	*72.1*	*36.9*	*67.7*	*14.8*	*10.0*	*12.5*	*224.5*
Blue Line + Bus Connections Total	**86.5**	**567**	**509**	**689**	**146**	**180**	**139**	**2,318**
Total to Destination	**11,240**	**17,403**	**14,858**	**15,256**	**8,316**	**10,822**	**10,664**	**88,559**
% from Blue Line + Bus Connections of Total	**0.8%**	**3.3%**	**3.4%**	**4.5%**	**1.8%**	**1.7%**	**1.3%**	**2.6%**

Table 7 - Average Weekday Red Line and Connecting Bus Route Trips to Key Blue Line Destinations. Source: MBTA ODX Model.

Red Line Stops + Bus Routes	Aquarium	Airport	Total Blue Line Destinations
62	0.4	3.0	3.3
64	0.8	0.6	1.4
67	0.1	0.1	0.1
68	0.0	0.1	0.1
70	0.5	7.1	7.6
70A	0.1	1.5	1.6
71	1.7	8.5	10.2
72	0.3	2.5	2.8
73	1.4	10.2	11.5
74	0.3	1.7	2.0
75	0.1	0.6	0.7
76	0.3	2.2	2.5
77	0.9	10.9	11.9
78	0.2	4.9	5.1
79	0.1	1.2	1.2
83	0.1	0.7	0.9
84	0.0	0.3	0.3
85	0.3	0.2	0.5
94	0.2	0.7	0.9
96	0.1	0.4	0.5
350	0.1	6.1	6.2
Red Line North of MGH	82.9	341.3	424.2
Charles MGH	*5.4*	*15.5*	*21.0*
Kendall Square	*16.1*	*72.2*	*88.2*
Central Square	*14.7*	*72.6*	*87.3*
Harvard Square	*23.8*	*102.0*	*125.8*
Porter Square	*6.2*	*23.4*	*29.6*
Davis	*5.7*	*32.1*	*37.8*
Alewife	*10.9*	*23.5*	*34.4*
Red Line + Bus	**91**	**405**	**496**
Total to Destination	**4,718**	**6,742**	**11,460**
Percent of Total	**1.9%**	**6.0%**	**4.3%**

5.2. Changes in Blue Line Ridership Since DEIR

The Blue Line ridership data analyzed as part of the 2010 DEIR was based on the most recently available information in the 2007 MBTA Blue Book and then forecasted using the CTPS travel demand model. According to the 2010 DEIR, the Blue Line carried nearly 61,000 daily riders in 2006.

The CTPS model follows the traditional four-step travel-modeling process of trip generation, trip distribution, mode choice, and trip assignment. This modeling process is employed to estimate future daily transit ridership, primarily on the basis of demography and the characteristics of the transportation network. Based on the CTPS projections, the daily Blue Line ridership for the No-Build Alternative was projected to be 64,500 in 2008, an increase of almost 7% from 2006, and 73,000 in 2030, an increase of almost 20% over 2006 levels. The 2010 DEIR Preferred Alternative was projected to have a Blue Line weekday ridership of 77,200 in 2030. This is an increase of over 26% from the 2006 level.

Table 8 – 2010 DEIR Blue Line Ridership Data

	2006	2008 No Build (2010 DEIR)	Growth (2006 to 2008)	2030 No Build (2010 DEIR)	Growth (2006 to 2030)	2030 Preferred Alternative (2010 DEIR)	Growth (2006 to 2030)
Blue Line Weekday Ridership	61,000	64,500	7%	73,000	20%	77,200	26%

Source: 2010 Red Line/Blue Line Connector DEIR

As shown in Table 9, the MBTA's Office of Performance Management and Innovation (OPMI) provided data for ridership since the 2010 DEIR was developed. According to this data, the weekday ridership for the Blue Line was 63,225 in 2013 and 67,526 in 2017. The 2013 data was based on a combination of the CTPS survey data and the MBTA Automated Fare Collection (AFC) database. The 2017 data was based on a combination of the AFC database and OPMI's ODX tool.

Table 9 - Current Blue Line Ridership

	2013	2017
Blue Line Weekday Ridership	63,225	67,256

Source: OPMI

Table 10 compares the actual ridership data to the No Build and Preferred Alternative projections identified in the 2010 DEIR. The ridership on the Blue Line has increased since the 2010 DEIR analysis and continues to grow at a pace similar to what was projected. The significant increase in the population growth rate along the Blue Line corridor points to the potential for an even greater increase in ridership.

Table 10 – 2010 DEIR Blue Line and Actual Ridership Data Comparison

	2006 Actual	2008 No Build (2010 DEIR)	2013 Actual	2017 Actual	2030 No Build (2010 DEIR)	2030 Preferred Alternative (2010 DEIR)
Blue Line Weekday Ridership	61,000	64,500	63,225	67,256	73,000	77,200

5.3. Changes in Red Line Ridership since DEIR

According to the 2010 DEIR, the Red Line carried approximately 214,000 daily riders in 2006 and presented projections of future demand. The projections, which were also developed with the regional travel model of CTPS, showed daily Red Line ridership for the No-Build Alternative projected to be 252,600 in 2030, an increase of more than 15% over 2006 levels. According to data received from OPMI, the weekday ridership for the Red Line was 272,685 in 2013 and 267,204 in 2017, exceeding the 2010 DEIR No Build 2030 projections.

Table 11 - Red Line Weekday Ridership Data

	2006	2013 Actual	2017 Actual	2030 No Build (2010 DEIR)
Red Line Weekday Ridership	214,000	272,685	267,204	252,600

6. Potential Benefits of the Red-Blue Connector

6.1. Transit Travel Time Savings

Travel time savings for trips between the Red and Blue lines are one of the benefits of the project. The Red–Blue Connector Project will save riders an estimated 4 minutes in each direction (Table 12). The current transfer between the two lines requires a connection on either the Green Line (Government Center to Park Street) or the Orange Line (State Street to Downtown Crossing). According to current MBTA schedules and estimates, the fastest way to make this connection is using the Green Line and during peak periods when service is running as scheduled, the travel time from a Blue Line train arriving at Government Center to a Red Line train at Charles/MGH takes approximately 11 minutes. The transfer resulting from the proposed project would require 2 more minutes on the Blue Line to reach the new Charles MGH station and then 2.5 minutes for transferring to the Red Line platform, due to longer vertical (below ground to above ground) and horizontal distances to make the transfer.

Table 12 Estimated Travel Time Savings from Red-Blue Connector

Current Transfer: Government Center to Charles MGH	***Time***	***Proposed Transfer: Government Center to Charles MGH***	***Time***
Transfer BL to GL platform	1 min	BL trip from GC to Charles	2 min
Avg wait for Green Line	1.5 min	Transfer BL to RL platform	2.5 min
GL trip from Government Center to Park	2 min	Avg wait for Red Line	2.5 min
Transfer GL to RL platform	2 min		
Avg. wait for Red Line	2.5 min		
RL trip from Park to Charles	2 min		
Total Travel Time	**11 min**		**7 min**