



TECHNICAL MEMORANDUM

DATE: July 11, 2022
TO: Lynsey Heffernan and Steven Povich, Massachusetts Bay Transportation Authority
FROM: Blake Acton, Central Transportation Planning Staff
Emily Domanico, Central Transportation Planning Staff
Bradley Putnam, Central Transportation Planning Staff
RE: MBTA Boston Free Bus: Fare Equity Analysis Results

When considering changes to fares, the Massachusetts Bay Transportation Authority (MBTA) undertakes a process to evaluate the equity impacts of the proposed changes. At the request of the MBTA, the Central Transportation Planning Staff (CTPS), which serves as staff to the Boston Region Metropolitan Planning Organization (MPO), examined the equity impacts of eliminating fares on MBTA bus Routes 23, 28, and 29. CTPS used an agent-based ridership model based on the systemwide ridership survey, which is described in more detail in section 4.3.

This document fulfills the MBTA's responsibility to conduct a fare equity analysis, as required by Title VI of the Civil Rights Act of 1964 (Title VI). The objective of this analysis is to determine if eliminating fares on these routes would result in disparate impacts for minority populations or disproportionate burdens for low-income populations.

In this analysis, CTPS compared the impacts of relative fare changes between riders classified as minorities and riders classified as low-income to all riders. Since eliminating fares on these routes represents an overall fare decrease, this analysis assesses whether non-minority or non-low-income populations would disproportionately benefit from these changes. CTPS concludes that eliminating fares on Routes 23, 28, and 29 results in neither a disparate impact to minority riders nor a disproportionate burden to low-income riders; therefore, these changes are in accordance with the MBTA's disparate-impact and disproportionate-burden policies.

1 FARE CHANGE PROPOSAL

From March 1, 2022, to February 29, 2024, the MBTA will not charge fares to customers who board bus Routes 23, 28, or 29. This program is funded by the City of Boston and builds on the Route 28 free-fare pilot program that began on August 29, 2021, which was originally set to end on February 28, 2022. The pilot

Civil Rights, nondiscrimination, and accessibility information is on the last page.

will not affect pre-existing transfer rules, so riders who transfer to rapid transit or other MBTA services still pay standard fares. Additionally, users of The RIDE paratransit service who begin and end trips within three quarters of a mile of these three routes will also not be charged a fare. Evaluating the fare equity impacts of eliminating fares on The RIDE is outside the scope of this analysis and is not included in this document.

2 REQUIREMENTS

Title VI of the Civil Rights Act of 1964 prohibits discrimination, either intentionally or unintentionally, by recipients of federal financial assistance based on race, color, or national origin. To comply with Title 49 of the Code of Federal Regulations (CFR) Section 21.5(b) (2), 49 CFR Section 21.5(b) (7), and Appendix C to 49 CFR Part 21, the MBTA must evaluate any fare changes to fixed-route modes prior to implementation to determine if the proposed changes would have a discriminatory effect. The Federal Transit Administration (FTA) provides guidance for conducting fare equity analyses in FTA Circular 4702.1B (“Circular”), Section IV.7.b. Prior to making a permanent fare change, the MBTA must analyze any available information generated from ridership surveys that indicates whether minority and/or low-income riders would be disproportionately more likely than overall riders to use the mode of service, payment type, or payment media that would be subject to a fare change. In addition, the MBTA must describe the datasets and collection methods used in its analysis.

The Circular states that the transit provider shall

- determine the number and percentage of users of each fare media subject to change;
- review fares before and after the change;
- compare the relative cost burden impacts of the proposed fare change between minority and overall users for each fare media; and
- compare the relative cost burden impacts of the proposed fare change between low-income and overall users for each fare media.

Under Title VI and other directives, the FTA requires that transit agencies develop a policy to assess whether a proposed fare change would have a disparate impact on minority populations or disproportionate burden on low-income populations. The FTA Title VI guidelines define disparate impact as “a facially neutral policy or practice that disproportionately affects members of a group identified by race, color, or national origin, where the recipient’s policy or practice lacks a substantial legitimate justification and where there exists one or more alternatives that would serve the same legitimate objectives, but with less disproportionate effects on the basis, of race, color, or national origin.” The guidelines define disproportionate burden as “a neutral policy or practice that disproportionately affects low-income populations more than non-low-income populations.”

3 MBTA TITLE VI DISPARATE IMPACT/DISPROPORTIONATE BURDEN POLICY

3.1 Policy Thresholds

The MBTA's January 30, 2017, *Disparate Impact/Disproportionate Burden (DI/DB) Policy*¹ explains the methodology to be used for fare equity analyses:

“For all fare changes, the MBTA will compare the percentage change in the average fare for minority and overall riders and for low-income and overall riders. For fare-type changes across all modes, the MBTA will assess whether minority and low-income customers are more likely to use the affected fare type or media than overall riders. Any or all proposed fare changes will be considered in the aggregate and results evaluated using the fare DI/DB threshold, below. The MBTA's threshold for determining when fare changes may result in disparate impacts or disproportionate burdens on minority or low-income populations, respectively, is 10%.”

MBTA Disparate Impact/Disproportionate Burden (DI/DB) Policy

The policy thresholds are encapsulated in the following equations. A disparate impact would be found if the average fare decrease for minorities is less than 90 percent of the average fare decrease for all riders, or if the average fare increase for minorities is greater than 110 percent of the average increase for all riders:

$$\begin{aligned} \text{Minority Average Fare Decrease} &< 90\% \times \text{All-Rider Average Fare Decrease} \\ \text{Minority Average Fare Increase} &> 110\% \times \text{All-Rider Average Fare Increase} \end{aligned}$$

A disproportionate burden would be found if the average fare decrease for low-income riders is less than 90 percent of the average fare decrease for all riders, or if the average fare increase for low-income riders is greater than 110 percent of the average increase for all riders:

$$\begin{aligned} \text{Low-income Average Fare Decrease} &< 90\% \times \text{All-Rider Average Fare Decrease} \\ \text{Low-income Average Fare Increase} &> 110\% \times \text{All-Rider Average Fare Increase} \end{aligned}$$

The DI/DB Policy also describes the steps the MBTA will take when disparate impacts or disproportionate burdens are identified:

“Upon finding a potential disparate impact on minority populations from a proposed fare change, the MBTA will analyze alternatives/revisions to the proposed change that meet the same goals of the original proposal. Any proposed alternative fare change would be subject to a fare equity analysis. The MBTA will implement any proposal in accordance with the current FTA guidance. Where potential disparate impacts are identified, the MBTA will provide a meaningful opportunity for public comment on any

¹ Massachusetts Bay Transportation Authority, “Disparate Impact/Disproportionate Burden (DI/DB) Policy” (2017). <https://cdn.mbta.com/sites/default/files/2017-11/1-30-17%20-%20MBTA%20DIDB%20Policy%20-%20Final.docx>.

proposed mitigation measures, including any less discriminatory alternatives that may be available. Upon finding a potential disproportionate burden on low-income populations from a proposed fare change, the MBTA may take steps to avoid, minimize, or mitigate these impacts, where practicable.”

MBTA Disparate Impact/Disproportionate Burden (DI/DB) Policy

3.2 Minority and Low-Income Populations

Respondents to the 2015–17 MBTA Systemwide Passenger Survey were classified as having minority status if they self-identified as a race other than White or as Hispanic or Latino/Latina. Respondents whose household income was less than \$43,500—the income category from the survey that most closely matched 60 percent of the median household income for the MBTA service area from the 2013 American Community Survey—were classified as low-income.

4 METHODS

4.1 Study Area

Routes 23, 28, and 29 have similar north-south alignments that connect the Roxbury, Dorchester, Mattapan, and nearby neighborhoods with many other MBTA transit services. Connecting MBTA services include the rapid transit routes of the Orange Line, Red Line, and Mattapan Trolley, and the Silver Line, as well as the commuter rail routes of the Fairmount Line, Providence/Stoughton Line, and Franklin/Foxboro Line.

Table 1 presents the demographics of Routes 23, 28, and 29. According to the 2015–17 MBTA Systemwide Passenger Survey, the proportions of minority and low-income riders on these routes represent a much greater proportion of riders than on the MBTA system overall. When combined, riders on these routes are approximately 89.8 percent minority and 59.9 percent low-income compared to the systemwide average of 25.9 percent minority and 20.5 percent low-income. Although the age of the MBTA passenger survey and the relatively low sample sizes (presented as “N” in Table 1) are potential weaknesses of our methodology, we believe the current demographics of these routes have not shifted enough to alter the outcome of this analysis. Furthermore, fare equity analyses are insensitive to small demographic changes since they are pass-fail tests. So, as long as the demographic profile of the no-fare routes have remained more minority and low-income than the systemwide average, the results would remain unaffected.

Evidence that demographics have not significantly changed can be found in the results of the City of Boston’s Fare-Free Pilot Program survey in Table 1. Compared to the MBTA passenger survey, the Boston survey exhibits a minor decline of 3.8 percent in the proportion of minority riders and a moderate increase of 11.7 percent in the proportion of low-income riders. Nevertheless, for the purposes of a fare equity analysis these are minor demographic differences

which suggest that the 2015–17 MBTA Systemwide Passenger Survey is sufficient for this analysis.

**Table 1
Rider Demographics by Route**

Route	N	Minority	Nonminority	Low-Income	Non-Low-Income
2015–17 MBTA Systemwide Passenger Survey					
Route 23	116	87.8%	12.2%	56.1%	43.9%
Route 28	86	92.1%	7.9%	61.9%	38.1%
Route 29	31	90.9%	9.1%	68.2%	31.8%
Routes 23, 28, 29	229	89.8%	10.2%	59.9%	40.1%
Systemwide	37,642	25.9%	74.1%	20.5%	79.5%
Fall 2021 City of Boston Route 28 Fare-Free Pilot Survey					
Route 28	239	88.3%	11.7%	73.6%	26.4%

Note: These results exclude survey respondents who chose to not report their race or income.

N = number of survey respondents.

Source: 2015–17 MBTA Systemwide Passenger Survey, reweighted for the Agent-Based Ridership Model by Central Transportation Planning Staff.

Additionally, Table 4 in the appendix provides the systemwide unlinked passenger trips and fare type usage by demographic group after reweighting the passenger survey. Also, in the appendix Table 5 presents the same information, but only includes surveys that are affected by the proposed fare change.

4.2 2015-17 MBTA Systemwide Passenger Survey

The 2015–17 MBTA Systemwide Passenger Survey report², published in May 2018, includes a survey of all of the transit modes provided by the MBTA—the heavy rail Red, Blue, and Orange Lines; the light rail Green Line and Mattapan Trolley; the bus rapid transit Silver Line; the commuter rail system; the bus system; and the ferry system. The survey asked questions regarding trip origins and destinations, fare payment method, trip frequency, race, ethnicity, and income.

CTPS first launched the survey online and advertised its availability throughout the MBTA system. When the response rate to the online survey slowed, staff distributed the survey on paper forms at stations and stops and on vehicles. To compensate for differences in response rates among services, responses from each unlinked trip segment were weighted in proportion to the number of typical daily boardings for a corresponding station, group of stations, route, or route segment.

² Central Transportation Planning Staff, “2015–17 MBTA Systemwide Passenger Survey” (2018).
https://www.ctps.org/dv/mbtasurvey2018/2015_2017_Passenger_Survey_Final_Report.pdf.

4.3 Agent-Based Ridership Model

For this analysis, CTPS utilized the agent-based fare equity model that we developed for the state fiscal year (SFY) 2023 fare equity analysis.³ This memorandum briefly describes the fundamentals of the agent-based model followed by a description of changes to the model that are unique to this analysis. Refer to the *SFY 2023: Fare Equity Analysis Results* technical memorandum for a comprehensive description of the model.

The model primarily relies on self-reported travel patterns and demographics from the 2015–17 MBTA Systemwide Passenger Survey and estimates the impact of fare changes to existing riders and, therefore, does not consider induced demand when projecting trips and revenue associated with fare changes. The agent-based model estimates the annual travel costs of each survey then assigns them weights that represent the number of annual passenger trips they represent. Survey weights are determined using SFY 2018 ridership and revenue values followed by adjustments to reduce the potential impact of poor sampling. Next, the model determines the total revenue by demographic by multiplying annual travel costs by the weight. Finally, annual revenue is divided by the number of annual passenger trips to find the average fare by demographic.

For this analysis, CTPS modified two components of the agent-based model as presented in the *SFY 2023: Fare Equity Analysis Results* memorandum. First, CTPS removed the step of estimating survey respondents' sensitivity to changed fare products. This was done because the elimination of fares is an automatic savings for single-ride payers and provides a transparent and attractive option for pass-holders who only ride free bus routes to discontinue their transit passes. CTPS also estimated savings for riders who could potentially reduce their monthly travel costs by switching from a pass to a single-ride payment. These are pass-holding riders who report using at least one of the no-fare routes and whose potential cost savings of switching to single-ride payment increases due to the elimination of fares. Due to the very small number of survey respondents who fit these criteria, these surveys were manually allocated outside of the sensitivity switching model framework, with final revenue savings comprising approximately 6 percent of the total.

The second change to the agent-based model was to rebalance survey weights to match the ratio of ridership between fare and no-fare routes using fall 2021 bus ridership.⁴ This rebalancing better represents ridership on Routes 23, 28, and 29 in the passenger survey by boosting the survey weights of no-fare riders by a factor of 2.6 and the reducing weights of fare riders by a factor of 0.95. The difference between factors indicates that no-fare routes are underrepresented in

³ CTPS technical memorandum "SFY 2023: Fare Equity Analysis Results," dated March 9, 2022.

⁴ MBTA "Automated Passenger Counter (APC) Composite Day", dated Fall 2021.

the survey, meaning that if the rate of survey responses more closely matched bus ridership by route, then we would expect approximately two and half times more survey responses from those who ride Routes 23, 28, and 29.

Finally, to create a more consistent and accurate baseline, ridership for Route 28 was reduced since fares were eliminated on Route 28 in August 2021, thereby inflating its fall 2021 ridership levels. Route 28 ridership was adjusted by assuming its ridership between 2019 and 2021 recovered at the same rate as the systemwide average across all MBTA bus routes. This adjustment had the effect of reducing Route 28’s fall 2021 ridership by approximately 28 percent.

5 RESULTS

Table 2 summarizes the approximate annual revenue impact of eliminating fares on Routes 23, 28, and 29 by protected population and for all riders. Results show a decline in annual revenue and the average fare across all populations. Average fares for minority riders exhibit an overall 0.95 percent decline with a slightly greater decline of 1 percent among low-income riders. This contrasts with the significantly lower decline of 0.26 percent exhibited among all riders.

Table 2
Summary of Revenue Changes by Population for Proposed Fare Change

Rider Classification	Existing Number of Trips	Existing Revenue	Existing Average Fare	Total Revenue Change	Projected Revenue	Projected Average Fare	Percent Change: Average Fare
Minority	129,800,000	\$169,900,000	\$1.3093	-\$1,614,944	\$168,285,056	\$1.2969	-0.95%
Low-Income	110,000,000	\$130,000,000	\$1.1720	-\$1,306,521	\$127,693,479	\$1.1603	-1.00%
All Riders	353,100,000	\$675,200,000	\$1.9120	-\$1,747,851	\$673,452,149	\$1.9071	-0.26%

Note: Revenue and ridership figures are based on a pre-COVID-19 year. They are not scaled to reflect ridership recovery scenarios.

Source: MBTA Automatic Fare Transactions, processed by Central Transportation Planning Staff.

The results of the equity analysis, presented in Table 3, show that the proposed fare changes would neither produce a disparate impact on minority riders nor a disproportionate burden to low-income riders. Additionally, there is not a disproportionate benefit to all riders relative to minority or low-income riders.

Application of the disparate-impact threshold shows that the relative decrease in the average fare for minority riders is 367 percent of the relative decrease in the average fare for all riders. Application of the disproportionate-burden threshold shows that the relative decrease in the average fare for low-income riders is 388 percent of the relative decrease in the average fare for all riders. The average fare decrease for both minority and low-income riders is greater than 90 percent of the average fare decrease for all riders—the threshold defined by the DI/DB Policy. Therefore, CTPS concludes the elimination of fares on these routes will

not have a disparate impact on minority riders or a disproportionate burden on low-income riders.

Table 3
Existing and Projected Average Fares and Price Changes

Rider Classification	Existing Average Fare	Projected Average Fare	Percent Price Change	DI/DB Ratio
Minority	\$1.3093	\$1.2969	-0.95%	367%
Low-Income	\$1.1720	\$1.1603	-1.00%	388%
All Riders	\$1.9120	\$1.9071	-0.26%	—

Note: Percent changes in average fares and DI/DB ratios are calculated prior to rounding.

DI/DB = disparate impact and disproportionate burden.

Source: Central Transportation Planning Staff.

Appendix: Tables 4 and 5

The Boston Region Metropolitan Planning Organization (MPO) operates its programs, services, and activities in compliance with federal nondiscrimination laws including Title VI of the Civil Rights Act of 1964 (Title VI), the Civil Rights Restoration Act of 1987, and related statutes and regulations. Title VI prohibits discrimination in federally assisted programs and requires that no person in the United States of America shall, on the grounds of race, color, or national origin (including limited English proficiency), be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination under any program or activity that receives federal assistance. Related federal nondiscrimination laws administered by the Federal Highway Administration, Federal Transit Administration, or both, prohibit discrimination on the basis of age, sex, and disability. The Boston Region MPO considers these protected populations in its Title VI Programs, consistent with federal interpretation and administration. In addition, the Boston Region MPO provides meaningful access to its programs, services, and activities to individuals with limited English proficiency, in compliance with U.S. Department of Transportation policy and guidance on federal Executive Order 13166.

The Boston Region MPO also complies with the Massachusetts Public Accommodation Law, M.G.L. c 272 sections 92a, 98, 98a, which prohibits making any distinction, discrimination, or restriction in admission to, or treatment in a place of public accommodation based on race, color, religious creed, national origin, sex, sexual orientation, disability, or ancestry. Likewise, the Boston Region MPO complies with the Governor's Executive Order 526, section 4, which requires that all programs, activities, and services provided, performed, licensed, chartered, funded, regulated, or contracted for by the state shall be conducted without unlawful discrimination based on race, color, age, gender, ethnicity, sexual orientation, gender identity or expression, religion, creed, ancestry, national origin, disability, veteran's status (including Vietnam-era veterans), or background.

A complaint form and additional information can be obtained by contacting the MPO or at http://www.bostonmpo.org/mpo_non_discrimination.

To request this information in a different language or in an accessible format, please contact

Title VI Specialist
Boston Region MPO
10 Park Plaza, Suite 2150
Boston, MA 02116
civilrights@ctps.org

By Telephone:

857.702.3702 (voice)

For people with hearing or speaking difficulties, connect through the state MassRelay service:

- **Relay Using TTY or Hearing Carry-over:** 800.439.2370
- **Relay Using Voice Carry-over:** 866.887.6619
- **Relay Using Text to Speech:** 866.645.9870

For more information, including numbers for Spanish speakers, visit <https://www.mass.gov/massrelay>

APPENDIX: TABLE 4

Table 4
Systemwide Fare Payment Type and Unlinked Trips by Group

Fare-Payment Type	Annual Usage in Unlinked Trips			Annual Usage Share of Group Total		
	Minority	Low-Income	All Riders	Minority	Low-Income	All Riders
Local Bus						
Local Bus Pass	2,383,000	1,758,000	5,200,000	1.8%	1.6%	1.5%
Local Bus (Adult)	9,739,000	9,405,000	24,060,000	7.5%	8.5%	6.8%
Local Bus (Senior)	1,828,000	3,520,000	5,004,000	1.4%	3.2%	1.4%
Local Bus (Student)	1,455,000	1,142,000	1,999,000	1.1%	1.0%	0.6%
Express Bus						
Express Bus Pass	922,000	350,000	2,800,000	0.7%	0.3%	0.8%
Express Bus (Adult)	237,000	244,000	895,000	0.2%	0.2%	0.2%
Express Bus (Senior)	14,000	1,000	99,000	0.0%	0.0%	0.0%
Express Bus (Student)	NR	20,000	40,000	0.0%	0.0%	0.0%
Bus and Rapid Transit						
Bus and Rapid Transit (Adult)	3,005,000	2,715,000	7,275,000	2.3%	2.5%	2.1%
Bus and Rapid Transit (Senior)	415,000	768,000	1,346,000	0.3%	0.7%	0.4%
Bus and Rapid Transit (Student)	371,000	327,000	497,000	0.3%	0.3%	0.1%
Rapid Transit						
LinkPass	30,710,000	20,749,000	98,458,000	23.7%	18.8%	27.9%
Senior/TAP Pass	5,960,000	8,115,000	14,773,000	4.6%	7.4%	4.2%
Student 7-Day/ Youth Pass	14,042,000	10,435,000	15,568,000	10.8%	9.5%	4.4%
1-Day Pass	742,000	691,000	1,007,000	0.6%	0.6%	0.3%
7-Day Pass	28,967,000	27,276,000	44,381,000	22.3%	24.8%	12.6%
Rapid Transit (Adult)	13,179,000	9,754,000	54,572,000	10.2%	8.9%	15.4%
Rapid Transit (Senior)	588,000	1,175,000	4,186,000	0.4%	1.1%	1.2%
Rapid Transit (Student)	949,000	1,178,000	1,951,000	0.7%	1.1%	0.6%
Commuter Rail						
Zone 1A–10 Pass	5,545,000	2,152,000	30,091,000	4.3%	2.0%	8.5%
Zone 1A–10 Single Ride	1,693,000	1,121,000	15,616,000	1.3%	1.0%	4.4%
Interzone 1–10 Single Ride	54,000	172,000	559,000	0.0%	0.2%	0.2%
Interzone 1–10 Pass	31,000	13,000	112,000	0.0%	0.0%	0.0%
Ferry						
Commuter Boat Pass	20,000	23,000	330,000	0.0%	0.0%	0.1%
F1 and F2: Outer Harbor	NR	NR	678,000	0.0%	0.0%	0.2%
F4: Inner Harbor	NR	NR	NR	0.0%	0.0%	0.0%
Free Transfers and Other Fares						
In-station Transfers	6,000,000	5,402,000	17,479,000	4.6%	4.9%	5.0%
Free trips	914,000	1,550,000	4,149,000	0.7%	1.4%	1.2%

Notes: Values are rounded to the nearest 1,000. Percentages are calculated using unrounded values. The figures for free trips include people who are not required to pay a fare. Riders who pay with a Blind Access Card are categorized as free trips.

NR = No response or insufficient responses. TAP = Transportation Access Pass.

Source: Central Transportation Planning Staff.

APPENDIX: TABLE 5

**Table 5
Affected Riders Fare Payment Type and Unlinked Trips by Group**

Fare-Payment Type	Annual Usage in Unlinked Trips			Annual Usage Share of Group Total		
	Minority	Low-Income	All Riders	Minority	Low-Income	All Riders
Local Bus						
Local Bus Pass	110,000	73,000	110,000	7.6%	6.5%	7.4%
Local Bus (Adult)	204,000	96,000	204,000	14.1%	8.6%	13.7%
Local Bus (Senior)	135,000	135,000	135,000	9.3%	12.0%	9.1%
Express Bus						
Express Bus Pass	10,000	10,000	10,000	0.7%	0.9%	0.7%
Express Bus (Adult)	NR	NR	NR	0.0%	0.0%	0.0%
Rapid Transit						
LinkPass	90,000	28,000	127,000	6.2%	2.5%	8.6%
Senior/TAP Pass	145,000	146,000	146,000	10.0%	12.9%	9.8%
Student 7-Day/ Youth Pass	479,000	479,000	479,000	33.1%	42.6%	32.2%
7-Day Pass	274,000	159,000	274,000	18.9%	14.1%	18.4%
Commuter Rail						
Zone 1A-10 Pass	2,000	NR	2,000	0.1%	0.0%	0.1%

Notes: Values are rounded to the nearest 1,000. Percentages are calculated using unrounded values.

NR = No response or insufficient responses. TAP = Transportation Access Pass.

Source: Central Transportation Planning Staff.