



TECHNICAL MEMORANDUM

DATE: April 26, 2021
TO: Steve Poftak, General Manager, Massachusetts Bay Transportation Authority
FROM: Steven Andrews, Central Transportation Planning Staff
RE: SFY 2022: Fare Equity Analysis Results

When considering changes to fares, the Massachusetts Bay Transportation Authority (MBTA) undertakes a process to evaluate the impacts of the proposed changes. The analysis for state fiscal year (SFY) 2022 was conducted with the assistance of the Central Transportation Planning Staff (CTPS), which is the staff of the Boston Region Metropolitan Planning Organization (MPO). CTPS examined the impacts of proposed fare changes on fare equity.

CTPS used an elasticity-based spreadsheet model known as the Fare Elasticity, Ridership, and Revenue Estimation Tool (FERRET) along with ad hoc analyses to estimate the effects of the fare changes. This document, while providing some information on revenue impacts, is focused on fulfilling the MBTA's responsibility to conduct a fare equity analysis, as required by Title VI of the Civil Rights Act of 1964 (Title VI), to determine if the fare changes would result in disparate impacts for minority populations or disproportionate burdens for low-income populations.

In CTPS's fare equity analysis, which was completed using pre-pandemic ridership levels, or intra-pandemic levels scaled to pre-pandemic levels, CTPS compared the relative fare decreases between riders who are classified as minorities and all riders, and between riders who are classified as low-income and all riders. **CTPS applied the MBTA's disparate-impact and disproportionate-burden policies and identified a disproportionate benefit to non-low-income riders. CTPS did not identify a disproportionate impact to minority riders.**

1 FARE CHANGE PROPOSAL

The MBTA is planning three changes to its fares and fare structure:

1. lowering the Outer Express bus fares to match the Inner Express bus fares
2. providing Youth Pass riders access to discounted express bus fares

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

3. providing Youth Pass riders access to discounted commuter rail and ferry fares

Few Outer Express bus routes remain in the MBTA's system and setting the fares to those of the Inner Express routes simplifies the MBTA's fare structure. Expanding Youth Pass user access to commuter services will correspondingly expand the ability of those riders to access more of the MBTA system.

2 FARE EQUITY ANALYSIS

2.1 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 a 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.”

2.2 MBTA Title VI Disparate Impact/Disproportionate Burden Policy

2.2.1 Policy Thresholds

The MBTA’s January 30, 2017, Disparate Impact/Disproportionate Burden (DI/DB) Policy 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:

Minority Average Fare Decrease < 90% × All-Rider Average Fare Decrease
 Minority Average Fare Increase > 110% × All-Rider Average Fare Increase

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:

Low-income Average Fare Decrease < 90% × All-Rider Average Fare Decrease
 Low-income Average Fare Increase > 110% × All-Rider Average Fare Increase

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 then current FTA guidance.

Where potential disparate impacts are identified, the MBTA will provide a meaningful opportunity for public comment on any 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

2.2.2 Demographics and Definitions

Demographics

The systemwide demographic profile in Table 1 shows how the MBTA's ridership characteristics, in terms of minority and low-income status, vary by mode. Minority and low-income profile data of the MBTA's ridership are from the 2015–17 MBTA Systemwide Passenger Survey report published in May 2018.

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 and/or were 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.

**Table 1
Demographic Profiles of MBTA Riders by Mode**

Mode	Minority	Nonminority	Low-Income	Non-Low-Income
Rapid Transit	30.8%	69.2%	26.5%	73.5%
Bus and Trackless Trolley	48.0%	52.0%	41.5%	58.5%
Silver Line	41.7%	58.3%	24.9%	75.1%
Commuter Rail	14.6%	85.4%	6.8%	93.2%
Commuter Ferry and Boat	1.7%	98.3%	3.7%	96.3%
Total	34.3%	65.7%	28.8%	71.2%

MBTA = Massachusetts Bay Transportation Authority.
Source: 2015–17 MBTA Systemwide Passenger Survey.

2.3 Datasets, Data Collection Efforts, and Descriptions

CTPS used three primary datasets in the fare equity analysis:

- CTPS FERRET output
- 2015–17 MBTA Systemwide Passenger Survey
- 2021 MBTA Youth Pass User Survey

FERRET is an elasticity-based spreadsheet model. CTPS has used this model in the past to provide inputs to the fare-increase analysis process. FERRET takes existing ridership in the form of unlinked trips by mode, fare-payment type, and fare media as inputs. The MBTA provides CTPS with ridership data from the automated fare collection (AFC) system. For modes that are not part of the AFC system, the MBTA provides data (most notably, sales data for transit passes) to estimate ridership. CTPS used the output data from the SFY 2021 fare change analysis to estimate the base revenue, ridership, and average fares.

The 2015–17 MBTA Systemwide Passenger Survey report, published in May 2018, included 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 Silver Line bus rapid transit line; the commuter rail system; the bus system; and the ferry system. The survey asked questions regarding trip origins and destinations, and (most important to this equity analysis) 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/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. The systemwide survey results were used in conjunction with FERRET to estimate the number of trips made by riders using each fare type, and the magnitude of the fare changes for low-income, minority, and all riders.

Because the model's ridership values are in trips and the survey's values are in riders, CTPS used the survey responses for the frequency of travel, fare type, and minority/income status to translate surveyed riders into trips per surveyed rider by fare type and by minority status and income status. Table 2 provides a snapshot of fare type usage by demographic group. A more complete accounting of the demographics of riders using affected fares is included within each fare change section.

The 2021 MBTA Youth Pass User Survey was distributed to 2,091 Youth Pass holders in March 2021; 499 Youth Pass users responded to the survey. This survey asked Youth Pass users about the modes they use and their travel patterns. The overwhelming majority of Youth Pass respondents were classified as either riders who were minorities or riders who lived in low-income households. This survey used the same income thresholds and rider classifications as those used in the systemwide passenger survey.

Table 2
Minority, Low-Income, and All Riders Using
Each Principal Fare-Payment Type

Fare-Payment Type	Price Existing	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	\$ 55.00	2,441,000	1,876,000	4,651,000	1.8%	1.5%	1.3%
Local Bus (Adult)	\$ 1.70	6,622,000	5,725,000	13,714,000	4.8%	4.7%	3.8%
Local Bus (Senior)	\$ 0.85	1,357,000	2,308,000	3,245,000	1.0%	1.9%	0.9%
Local Bus (Student)	\$ 0.85	1,145,000	969,000	1,501,000	0.8%	0.8%	0.4%
Local Bus (CharlieTicket)	\$ 2.00	409,000	495,000	745,000	0.3%	0.4%	0.2%
Local Bus (Cash)	\$ 2.00	888,000	1,084,000	1,739,000	0.6%	0.9%	0.5%
Express Bus							
Inner Express Pass	136.00	728,000	344,000	2,090,000	0.5%	0.3%	0.6%
Inner Express (Adult)	4.25	171,000	183,000	488,000	0.1%	0.1%	0.1%
Inner Express (Senior)	2.10	26,000	31,600	69,600	0.0%	0.0%	0.0%
Inner Express (Student)	2.10	22,000	31,600	34,600	0.0%	0.0%	0.0%
Inner Express (CharlieTicket)	5.25	9,100	11,300	15,600	0.0%	0.0%	0.0%
Inner Express (Cash)	5.25	24,600	41,000	64,900	0.0%	0.0%	0.0%
Outer Express Pass	168.00	125,000	17,900	359,000	0.1%	0.0%	0.1%
Outer Express (Adult)	5.25	11,000	7,700	95,800	0.0%	0.0%	0.0%
Outer Express (Senior)	2.60	NR	NR	15,300	0.0%	0.0%	0.0%
Outer Express (Student)	2.60	NR	NR	1,100	0.0%	0.0%	0.0%
Outer Express (CharlieTicket)	5.25	NR	NR	2,500	0.0%	0.0%	0.0%
Outer Express (Cash)	5.25	NR	NR	4,200	0.0%	0.0%	0.0%
Bus and Rapid Transit							
Bus and Rapid Transit (Adult)	2.40	2,776,000	2,308,000	6,679,000	2.0%	1.9%	1.9%
Bus and Rapid Transit (Senior)	1.10	474,000	824,000	1,347,000	0.3%	0.7%	0.4%
Bus and Rapid Transit (Student)	1.10	360,000	313,000	483,000	0.3%	0.3%	0.1%
Bus and Rapid Transit (CharlieTicket)	4.90	4,000	4,900	7,900	0.0%	0.0%	0.0%
Rapid Transit							
LinkPass	90.00	27,279,000	19,430,000	79,588,000	19.8%	15.9%	22.1%
Senior/TAP Pass	30.00	5,516,000	7,230,000	12,225,000	4.0%	5.9%	3.4%
Youth Pass	30.00	716,000	653,000	1,000,000	0.5%	0.5%	0.3%
Student 7-Day	30.00	8,582,000	7,628,000	11,813,000	6.2%	6.2%	3.3%
1-Day Pass	12.75	625,000	582,000	783,000	0.5%	0.5%	0.2%
7-Day Pass	22.50	24,550,000	23,361,000	36,022,000	17.8%	19.1%	10.0%
Rapid Transit (Adult)	2.40	10,801,000	8,287,000	32,996,000	7.8%	6.8%	9.2%
Rapid Transit (Senior)	1.10	906,000	1,668,000	3,714,000	0.7%	1.4%	1.0%
Rapid Transit (Student)	1.10	918,000	873,000	1,331,000	0.7%	0.7%	0.4%
Rapid Transit (CharlieTicket)	2.90	4,203,000	5,008,000	13,054,000	3.0%	4.1%	3.6%
Rapid Transit (Cash)	2.90	42,000	42,700	203,000	0.0%	0.0%	0.1%
Commuter Rail							
Zone 1A-10 Pass	\$90.00-\$426.00	5,581,000	2,174,000	31,124,000	4.0%	1.8%	8.7%
Zone 1A	\$ 90.00	1,492,000	676,000	4,604,000	1.1%	0.6%	1.3%
Zone 1	214.00	372,000	37,800	1,853,000	0.3%	0.0%	0.5%
Zone 2	232.00	580,000	204,000	4,526,000	0.4%	0.2%	1.3%
Zone 3	261.00	703,000	261,000	4,723,000	0.5%	0.2%	1.3%
Zone 4	281.00	729,000	216,000	4,380,000	0.5%	0.2%	1.2%
Zone 5	311.00	392,000	215,000	2,400,000	0.3%	0.2%	0.7%
Zone 6	340.00	670,000	272,000	4,343,000	0.5%	0.2%	1.2%
Zone 7	360.00	341,000	128,000	2,034,000	0.2%	0.1%	0.6%
Zone 8	388.00	292,000	151,000	2,196,000	0.2%	0.1%	0.6%
Zone 9	406.00	6,400	8,400	43,000	0.0%	0.0%	0.0%
Zone 10	426.00	3,500	4,500	23,300	0.0%	0.0%	0.0%

Fare-Payment Type	Price Existing	Annual Usage in Unlinked Trips			Annual Usage Share of Group Total		
		Minority	Low- Income	All Riders	Minority	Low- Income	All Riders
Zone 1A–10 Single Ride	\$2.40–\$13.25	1,323,000	862,000	10,749,000	1.0%	0.8%	3.0%
Interzone 1–10 Pass	\$90.00–\$237.00	20,100	8,400	126,700	0.0%	0.0%	0.0%
Interzone 1–10 Single Ride	\$2.75–\$6.75	44,400	28,900	360,500	0.0%	0.0%	0.1%
Ferry							
Commuter Boat Pass	\$329.00	12,900	19,600	352,000	0.0%	0.0%	0.1%
F1: Hingham	9.75	5,600	NR	433,000	0.0%	0.0%	0.1%
F2: Boston	9.75	13,800	20,800	285,000	0.0%	0.0%	0.1%
F2: Cross Harbor	9.75	NR	NR	1,200	0.0%	0.0%	0.0%
F2: Logan	9.75	NR	NR	31,200	0.0%	0.0%	0.0%
F4: Inner Harbor	3.70	NR	700	257,000	0.0%	0.0%	0.1%
Free Transfers and Other Fares							
In-station Transfers	No Cost	2,441,000	1,876,000	4,651,000	1.8%	1.5%	1.3%
AFC Noninteraction ¹	No Cost	6,622,000	5,725,000	13,714,000	4.8%	4.7%	3.8%
Free trips ²	No Cost	1,357,000	2,308,000	3,245,000	1.0%	1.9%	0.9%
Short fares ³	Variable	1,145,000	969,000	1,501,000	0.8%	0.8%	0.4%
					0.3%	0.4%	0.2%

Notes: Values greater than 100,000 are rounded to the nearest 1,000. Values less than 100,000 are rounded to the nearest 100. Percentages are calculated using unrounded values. NR indicates that no riders from a given classification responded to the survey.

¹ AFC noninteraction is an estimate of the number of riders who do not interact with the AFC system. The noninteraction categories include children aged 11 or younger, who are not required to pay a fare when riding with an adult; MBTA employees who are waved onto vehicles or otherwise bypass the AFC equipment; passengers who are allowed by MBTA employees to enter the paid area of a station without interacting with the AFC equipment; passengers who show an operator a valid pass rather than interacting with the farebox; passengers who board certain vehicles via the rear door; and passengers who simply do not pay a fare (not all of these categories apply to every mode).

² Free trips include people who are not required to pay a fare. Some of these people pay with the Blind Access Card.

³ Short fares are fares paid less than the full fare.

AFC = Automated fare collection. NR = No response. SFY = state fiscal year. TAP = Transportation Access Pass.

Source: Central Transportation Planning Staff.

2.4 Equity Analysis and Results

2.4.1 Analysis of Fare Changes

The analysis of the proposed fare changes was completed in three parts, one for each of the proposed fare changes, based on output from the SFY 2021 iteration of FERRET, the 2015–17 MBTA Systemwide Passenger Survey, and the 2021 MBTA Youth Pass User Survey.

The MBTA's policy is to measure the relative difference in the existing and proposed average fares. CTPS used output from the SFY 2021 iteration of FERRET to estimate the existing average fare by rider classification (minority/nonminority and low-income/non-low-income). Then, CTPS progressively adjusted the average fare to account for each proposed fare change component.

Eliminating the Outer Express/Inner Express Fare Differential

Using data from the 2015–17 MBTA Systemwide Survey along with output from FERRET, staff estimated the pre-pandemic number of trips made by Outer Express bus riders by fare type. CTPS multiplied the savings per trip by the

number of trips using that fare to estimate the total savings by rider classification. Table 3 presents a summary of these calculations.¹ By subtracting this revenue from the total revenue by rider classification, CTPS was able to estimate the pre-pandemic change in the average fare by rider classification.

Table 3
Pre-Pandemic Revenue Changes from Lowering Outer Express Bus Fares to the Same Level as Inner Express Bus Fares

Rider Classification Fare Type	Existing Fare	Proposed Fare	Change	Sales Estimate	Change of Revenue
Minority Riders					
Outer Express Pass (in units sold)	\$168.00	\$136.00	-\$32.00	3,203	-\$102,495
Outer Express (Adult)	\$5.25	\$4.25	-\$1.00	10,994	-\$10,994
Outer Express (Senior)	\$2.60	\$2.10	-\$0.50	NR	\$0
Outer Express (Student)	\$2.60	\$2.10	-\$0.50	NR	\$0
Outer Express (CharlieTicket)	\$5.25	\$4.25	-\$1.00	NR	\$0
Outer Express (Cash)	\$5.25	\$4.25	-\$1.00	NR	\$0
Subtotal					-\$113,489
Low Income Riders					
Outer Express Pass (in units sold)	\$168.00	\$136.00	-\$32.00	460	-\$14,714
Outer Express (Adult)	\$5.25	\$4.25	-\$1.00	7,682	-\$7,682
Outer Express (Senior)	\$2.60	\$2.10	-\$0.50	NR	\$0
Outer Express (Student)	\$2.60	\$2.10	-\$0.50	NR	\$0
Outer Express (CharlieTicket)	\$5.25	\$4.25	-\$1.00	NR	\$0
Outer Express (Cash)	\$5.25	\$4.25	-\$1.00	NR	\$0
Subtotal					-\$22,396
All Riders					
Outer Express Pass (in units sold)	\$168.00	\$136.00	-\$32.00	9,217	-\$294,950
Outer Express (Adult)	\$5.25	\$4.25	-\$1.00	95,757	-\$95,757
Outer Express (Senior)	\$2.60	\$2.10	-\$0.50	15,350	-\$7,675
Outer Express (Student)	\$2.60	\$2.10	-\$0.50	1,123	-\$561
Outer Express (CharlieTicket)	\$5.25	\$4.25	-\$1.00	2,510	-\$2,510
Outer Express (Cash)	\$5.25	\$4.25	-\$1.00	4,152	-\$4,152
Subtotal					-\$405,606

NR = No response.

Source: SFY 2021 FERRET output. Central Transportation Planning Staff.

¹ Table 6, shown at the end of this section, includes the results of estimating the effects of all of the changes on the average fare.

Providing Youth Pass Riders Access to Discounted Express Bus Fares

To estimate the effects of providing Youth Pass riders access to discounted express bus fares, CTPS used records from the MBTA’s AFC system coupled with data from the 2021 MBTA Youth Pass User Survey.

CTPS began by tallying the number of Youth Pass riders who used the Inner or Outer Express bus routes for express bus travel between July 2019 and February 2020 (just before the COVID-19 pandemic significantly affected travel patterns). CTPS estimated the fare savings per trip associated with the proposed change by subtracting the full price from the discounted price. When conducting this analysis, CTPS reclassified the discounted and full priced Outer Express fares as Inner Express fares to control for some double counting between portions of the analysis. In order to create a base year that reflected pre-COVID-19 travel behavior, CTPS scaled the ridership and revenue values to represent what Youth Pass ridership may have been for the remainder of SFY 2020 if the pandemic did not occur. Finally, the demographics of the 2021 MBTA Youth Pass User Survey respondents who reported using express buses were used to distribute the revenue to the four rider classifications (minority, nonminority, low-income, and non-low-income).

Table 4 presents a summary of these calculations.²

Table 4
Pre-Pandemic Revenue Changes from Providing Youth Pass Riders Access to Discounted Express Bus Fares

Rider Classification	Percent of Trips	Annual Trips	Discounted Revenue	Full-Fare Revenue	Change of Revenue
Minority	95.3%	3,088	\$5,950	\$12,589	-\$6,639
Nonminority	4.7%	152	\$293	\$620	-\$327
Low-income	87.9%	2,848	\$5,487	\$11,610	-\$6,123
Non-low-income	12.1%	392	\$756	\$1,599	-\$843
All Riders	100.0%	3,240	\$6,243	\$13,209	-\$6,966

AFC = automated fare collection. MBTA = Massachusetts Bay Transportation Authority.
Source: MBTA AFC system output: July 2019 to February 2020. 2021 MBTA Youth Pass User Survey.

Providing Youth Pass Riders Access to Discounted Commuter Rail and Ferry Fares

To estimate the effects of providing Youth Pass riders access to discounted commuter rail and ferry fares, approximately half of the price of the full-priced

² Table 6, shown at the end of this section, includes the results of estimating the effects of all of the fare changes on the average fare.

fares, CTPS used mTicket activation records from the MBTA's Youth Pass Commuter Rail pilot program coupled with data from the 2021 MBTA Youth Pass User Survey. Because the pilot for this fare change was started during the COVID-19 pandemic when riders were travelling less often and fewer people were participating in the Youth Pass program, these values were scaled to represent travel levels prior to the pandemic.

CTPS began by calculating the number of Youth Pass riders and associated revenue savings for those who made commuter rail trips between July 2020 and March 2021. CTPS estimated the revenue savings per trip by subtracting the equivalent full price from the discounted price. Because Youth Pass users already pay a discounted fare on Zone 1A travel, these trips were excluded from the analysis. CTPS scaled the partial year data to estimate total annual travel, used the 2021 MBTA Youth Pass User Survey to scale up the mTicket fares to represent all fare types (that is, cash or ticket window purchase), and used the 2021 MBTA Youth Pass User Survey to estimate the ratio of Youth Pass ferry trips to Youth Pass commuter rail trips. Finally, the demographics of 2021 MBTA Youth Pass User Survey respondents who reported using the commuter rail or ferry systems were used to distribute the revenue to the four different rider classifications.

CTPS, attempting to scale the ridership and revenue values to a "pre-COVID-19" base, scaled the result to represent what Youth Pass ridership may have been in a typical, non-pandemic year. This scaling was based on the decrease in ridership between the first halves of SFY 2020 and SFY 2021—the only months available with comparable overlapping data.

Table 5 presents a summary of these calculations.³

³ Table 6, shown at the end of this section, includes the results of estimating the effects of all of the changes on the average fare.

Table 5
Providing Youth Pass Riders Access to
Discounted Commuter Rail and Ferry Fares

Rider Classification	Percent of Trips	Annual Trips	Discounted Revenue	Full-Fare Revenue	Change of Revenue
<i>Unscaled (Pandemic)</i>					
Minority	93.2%	3,704	\$15,901	\$32,199	-\$16,298
Nonminority	6.8%	270	\$1,159	\$2,347	-\$1,188
Low-income	99.4%	3,951	\$16,959	\$34,343	-\$17,383
Non-low-income	0.6%	23	\$100	\$203	-\$103
All Riders	100.0%	3,240	\$17,060	\$34,546	-\$17,486
<i>Scaled to Pre-Pandemic</i>					
Minority	93.2%	13,310	\$57,136	\$115,701	-\$58,565
Nonminority	6.8%	970	\$4,164	\$8,433	-\$4,268
Low-income	99.4%	14,196	\$60,940	\$123,403	-\$62,463
Non-low-income	0.6%	84	\$361	\$731	-\$370
All Riders	100.0%	14,280	\$61,301	\$124,134	-\$62,833

Note: Scaled values are scaled up by 3.59 to represent a “pre-COVID-19” baseline that matches the other fare changes. This value is based on Youth Pass user ridership changes before and during the pandemic.

AFC = automated fare collection. MBTA = Massachusetts Bay Transportation Authority.

Sources: MBTA mTicket data: July 2020 to March 2021. MBTA AFC data: Youth Pass user travel quantities by month: July 2019 to December 2021. 2021 Youth Pass User Survey.

Summary of All Changes

CTPS estimated the proposed average fare by rider classification for the fare change proposals by subtracting the change in revenue from the existing revenue by rider classification and dividing the result by the number of trips made by riders in the corresponding rider classification. Table 6 contains the result of this calculation. CTPS chose to use a pre-pandemic base year for this equity analysis to ensure the validity of the results after the pandemic ends. This is expected to be a conservative choice. If the analysis had been conducted using a pandemic base year, the pandemic Youth Pass commuter rail and ferry estimates would need to be combined with pandemic estimates of express bus ridership and revenue. The MBTA reports a ridership decrease of about 90 percent on Outer Express Bus routes due in part to service reductions and suspensions (from about 1,640 rides per weekday in February 2020 to about 157 rides per weekday in February 2021). This is larger than the estimated 77 percent decrease in Youth Pass ridership on commuter rail and ferry during the pandemic (from 14,280 to 3,240 as shown in Table 5). As a result, the equity analysis results would potentially be more favorable using a pandemic base year, with a smaller relative benefit to Outer Express bus riders and a larger relative benefit to Youth Pass commuter rail riders.

Table 6
Pre-Pandemic Change of Revenue by Fare Change and for All Fare Changes

Rider Classification	Existing Number of Trips	Existing Revenue	Existing Average Fare	Change of Revenue: Decrease Fares on Express Bus	Change of Revenue: Youth Fares on Express Bus	Change of Revenue: Youth Fares on CR/Ferry	Total Revenue Change	Proposed Revenue	Proposed Average Fare	Percent Change: Average Fare
Scaled for COVID-19										
Minority	137,400,000	\$197,500,000	\$1.4374	-\$113,489	-\$6,639	-\$58,565	-\$178,693	\$197,321,307	\$1.4361	-0.09%
Low-Income	122,300,000	\$155,300,000	\$1.2698	-\$22,396	-\$6,123	-\$62,463	-\$90,982	\$155,209,018	\$1.2691	-0.06%
All Riders	353,000,000	\$675,900,000	\$1.9147	-\$405,606	-\$6,966	-\$62,833	-\$475,405	\$675,424,595	\$1.9134	-0.07%

Note: Existing number of trips and existing revenue are based on the values reported in the CTPS memorandum "SFY 2021: Fare Equity Analysis Results," dated May 21, 2020. Scaled values (*Change of Revenue: Youth Fares on CR/Ferry*) are scaled up by 3.59 to represent a "pre-COVID-19" baseline that matches the other fare changes. This value is based on Youth Pass user ridership changes before and during the pandemic.

CR = Commuter Rail. CTPS = Central Transportation Planning Staff. SFY = state fiscal year.

Source: Central Transportation Planning Staff.

2.4.2 Results from Applying the DI/DB Policy Thresholds

The results of the equity analysis, shown in Table 7, show that there is no disparate impact on minority riders and a potential disproportionate benefit to non-low-income riders when considering the relative fare changes.

**Table 7
Pre-Pandemic Existing and Proposed Average Fares and Price Change**

Rider Classification	Existing Average Fare	Proposed Average Fare	Percentage Price Change	DI/DB Ratio
Minority	\$1.4374	1.4361	-0.09%	129%
Low-Income	\$1.2698	1.2691	-0.06%	83%
All Riders	\$1.9147	1.9134	-0.07%	—

DI/DB = disparate impact and disproportionate burden.
Source: Central Transportation Planning Staff.

Application of the disparate-impact threshold to the combined pre-pandemic results shows that the relative decrease in the average fare for minority riders is 129 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 83 percent of the relative decrease in the average fare for all riders.

Because the average fare decreases for minority riders are greater than 90 percent of the average fare decrease for all riders—the threshold defined by the DI/DB Policy—CTPS does not find a potential disparate impact on minority populations. However, because the average fare decreases for low-income riders are less than 90 percent of the average fare decrease for all riders, CTPS finds a potential disproportionate benefit for non-low-income populations.

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