



TECHNICAL MEMORANDUM

DATE: May 21, 2020
TO: Steve Poftak, General Manager, Massachusetts Bay Transportation Authority
FROM: Steven Andrews, Central Transportation Planning Staff
RE: SFY 2021: 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) 2021 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 revenue and 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 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 without consideration of the changes to travel patterns resulting from the COVID-19 pandemic, staff 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 found neither the presence of a disparate impact nor a disproportionate burden.**

Assuming riders do not substantially change their travel patterns when activities resume in the period of recovery from COVID-19, CTPS expects the proposed changes to decrease future annual fare revenue by less than \$7 million when elasticity of demand with respect to fares is accounted for. While ridership is likely to increase as a result of the proposed fares, CTPS does not expect it to grow substantially.

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

1 FARE CHANGE PROPOSAL

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

1. Lowering CharlieTicket and cash fares to the same level as CharlieCard fares (eliminating the CharlieTicket and cash fare differential)
2. Allowing step-up transfers between the Fairmount Line (commuter rail) and the bus and rapid transit systems (at South Station)
3. Offering reduced fares for commuter rail trips inside Zone 1A for Youth Pass holders

Eliminating the CharlieTicket and cash fare differential is a step toward preparing for the MBTA's new automatic fare collection (AFC) system. The other two proposed changes are designed to increase the usage of the Fairmount Line with integrated fare media.

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
- 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:

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

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 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.

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

Mode	Minority	Non-Minority	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%

Source: 2015–17 MBTA Systemwide Passenger Survey.

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 is 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.

2.3 Datasets, Data Collection Efforts, and Descriptions

CTPS used two primary datasets in the fare equity analysis:

- CTPS FERRET output
- 2015–17 MBTA Systemwide Passenger 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 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. For the version of FERRET used in this analysis, CTPS used the output data from the SFY 2020 fare change analysis as the input data. Using these input data, FERRET employs elasticities and diversion factors to model a range of possible impacts resulting from changes in the MBTA’s 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 did not capture riders of the MBTA's purchased-service bus routes; the MBTA is currently planning to conduct a supplemental survey effort to collect data about these routes. 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.

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 using FERRET and the 2015–17 MBTA Systemwide Passenger Survey.

The MBTA's policy is to measure the relative difference in the existing and proposed average fares. CTPS used 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 change.

Eliminating the CharlieTicket and Cash Fare Differential

Using data from the 2015–17 MBTA Systemwide Survey along with output from FERRET, staff estimated the number of trips made by riders using CharlieTickets and cash to pay their fare. CTPS multiplied the savings per trip by the number of trips using that fare to estimate the total savings by rider classification and concomitant revenue decreases. Table 3 presents a summary of these calculations.

By subtracting this revenue from the total revenue by rider classification, CTPS was able to estimate the change in the average fare by rider classification. 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 2
Minority, Low-Income, and All Riders Using
Each Principal Fare-Payment Type

Fare-Payment Type	Price		Change		Annual Usage in Unlinked Trips			Annual Usage Share of Group Total		
	Existing	Proposed SFY 2021	Absolute	Percent	Minority	Low-Income	All Riders	Minority	Low-Income	All Riders
Local Bus										
Local Bus Pass	\$ 55.00	\$ 55.00	\$ 0.00	0.0%	2,441,000	1,876,000	4,651,000	1.8%	1.5%	1.3%
Local Bus (Adult)	\$ 1.70	\$ 1.70	\$ 0.00	0.0%	6,622,000	5,725,000	13,714,000	4.8%	4.7%	3.8%
Local Bus (Senior)	\$ 0.85	\$ 0.85	\$ 0.00	0.0%	1,357,000	2,308,000	3,245,000	1.0%	1.9%	0.9%
Local Bus (Student)	\$ 0.85	\$ 0.85	\$ 0.00	0.0%	1,145,000	969,000	1,501,000	0.8%	0.8%	0.4%
Local Bus (CharlieTicket)	\$ 2.00	\$ 1.70	\$ (0.30)	-15.0%	394,000	477,000	718,000	0.3%	0.4%	0.2%
Local Bus (Cash)	\$ 2.00	\$ 1.70	\$ (0.30)	-15.0%	856,000	1,045,000	1,676,000	0.6%	0.9%	0.5%
Express Bus										
Inner Express Pass	136.00	136.00	0.00	0.0%	728,000	344,000	2,090,000	0.5%	0.3%	0.6%
Inner Express (Adult)	4.25	4.25	0.00	0.0%	171,000	183,000	488,000	0.1%	0.2%	0.1%
Inner Express (Senior)	2.10	2.10	0.00	0.0%	26,000	31,600	69,600	0.0%	0.0%	0.0%
Inner Express (Student)	2.10	2.10	0.00	0.0%	22,000	31,600	34,600	0.0%	0.0%	0.0%
Inner Express (CharlieTicket)	5.25	4.25	(1.00)	-19.0%	8,700	10,800	14,900	0.0%	0.0%	0.0%
Inner Express (Cash)	5.25	4.25	(1.00)	-19.0%	23,500	39,100	61,900	0.0%	0.0%	0.0%
Outer Express Pass	168.00	168.00	0.00	0.0%	125,000	17,900	359,000	0.1%	0.0%	0.1%
Outer Express (Adult)	5.25	5.25	0.00	0.0%	11,000	7,700	95,800	0.0%	0.0%	0.0%
Outer Express (Senior)	2.60	2.60	0.00	0.0%	NR	NR	15,300	0.0%	0.0%	0.0%
Outer Express (Student)	2.60	2.60	0.00	0.0%	NR	NR	1,100	0.0%	0.0%	0.0%
Outer Express (CharlieTicket)	7.00	5.25	(1.75)	-25.0%	NR	NR	2,400	0.0%	0.0%	0.0%
Outer Express (Cash)	7.00	5.25	(1.75)	-25.0%	NR	NR	3,900	0.0%	0.0%	0.0%
Bus and Rapid Transit										
Bus and Rapid Transit (Adult)	2.40	2.40	0.00	0.0%	2,776,000	2,308,000	6,679,000	2.0%	1.9%	1.9%
Bus and Rapid Transit (Senior)	1.10	1.10	0.00	0.0%	474,000	824,000	1,347,000	0.3%	0.7%	0.4%
Bus and Rapid Transit (Student)	1.10	1.10	0.00	0.0%	360,000	313,000	483,000	0.3%	0.3%	0.1%
Bus and Rapid Transit (CharlieTicket)	4.90	4.10	(0.80)	-16.3%	4,000	4,900	7,900	0.0%	0.0%	0.0%
Rapid Transit										
LinkPass	90.00	90.00	0.00	0.0%	27,279,000	19,430,000	79,588,000	19.8%	15.9%	22.2%
Senior/TAP Pass	30.00	30.00	0.00	0.0%	5,516,000	7,230,000	12,225,000	4.0%	5.9%	3.4%
Youth Pass	30.00	30.00	0.00	0.0%	716,000	653,000	1,000,000	0.52%	0.54%	0.28%
Student 7-Day	30.00	30.00	0.00	0.0%	8,582,000	7,628,000	11,813,000	6.2%	6.3%	3.3%
1-Day Pass	12.75	12.75	0.00	0.0%	625,000	582,000	783,000	0.5%	0.5%	0.2%
7-Day Pass	22.50	22.50	0.00	0.0%	24,550,000	23,361,000	36,022,000	17.8%	19.2%	10.0%
Rapid Transit (Adult)	2.40	2.40	0.00	0.0%	10,801,000	8,287,000	32,996,000	7.9%	6.8%	9.2%
Rapid Transit (Senior)	1.10	1.10	0.00	0.0%	906,000	1,668,000	3,714,000	0.7%	1.4%	1.0%
Rapid Transit (Student)	1.10	1.10	0.00	0.0%	918,000	873,000	1,331,000	0.7%	0.7%	0.4%
Rapid Transit (CharlieTicket)	2.90	2.40	(0.50)	-17.2%	4,028,000	4,799,000	12,509,000	2.9%	3.9%	3.5%
Rapid Transit (Cash)	2.90	2.40	(0.50)	-17.2%	40,100	40,800	194,000	0.0%	0.0%	0.1%
Commuter Rail										
Zone 1A-10 Pass	\$90.00-	\$90.00-	\$0.00-	0.0%-	5,581,000	2,174,000	31,124,000	4.1%	1.8%	8.7%
	\$426.00	\$426.00	\$0.00	0.0%						
Zone 1A	\$ 90.00	\$ 90.00	\$ 0.00	0.0%	1,492,000	676,000	4,604,000	1.1%	0.6%	1.3%
Zone 1	214.00	214.00	0.00	0.0%	372,000	37,800	1,853,000	0.3%	0.0%	0.5%
Zone 2	232.00	232.00	0.00	0.0%	580,000	204,000	4,526,000	0.4%	0.2%	1.3%
Zone 3	261.00	261.00	0.00	0.0%	703,000	261,000	4,723,000	0.5%	0.2%	1.3%
Zone 4	281.00	281.00	0.00	0.0%	729,000	216,000	4,380,000	0.5%	0.2%	1.2%
Zone 5	311.00	311.00	0.00	0.0%	392,000	215,000	2,400,000	0.3%	0.2%	0.7%
Zone 6	340.00	340.00	0.00	0.0%	670,000	272,000	4,343,000	0.5%	0.2%	1.2%
Zone 7	360.00	360.00	0.00	0.0%	341,000	128,000	2,034,000	0.2%	0.1%	0.6%
Zone 8	388.00	388.00	0.00	0.0%	292,000	151,000	2,196,000	0.2%	0.1%	0.6%
Zone 9	406.00	406.00	0.00	0.0%	6,400	8,400	43,000	0.0%	0.0%	0.0%
Zone 10	426.00	426.00	0.00	0.0%	3,500	4,500	23,300	0.0%	0.0%	0.0%

Fare-Payment Type	Price		Change		Annual Usage in Unlinked Trips			Annual Usage Share of Group Total		
	Existing	Proposed SFY 2021	Absolute	Percent	Minority	Low-Income	All Riders	Minority	Low-Income	All Riders
Zone 1A-10 Single Ride	\$2.40-	\$2.40-	\$0.00-	0.0%-	1,323,000	862,000	10,749,000	1.0%	0.8%	3.0%
	\$13.25	\$13.25	\$0.00	0.0%						
Interzone 1-10 Pass	\$90.00-	\$90.00-	\$0.00-	0.0%-	20,100	8,400	126,700	0.0%	0.0%	0.0%
	\$237.00	\$237.00	\$0.00	0.0%						
Interzone 1-10 Single Ride	\$2.75-	\$2.75-	\$0.00-	0.0%-	44,400	28,900	360,500	0.0%	0.0%	0.1%
	\$6.75	\$6.75	\$0.00	0.0%						
Ferry										
Commuter Boat Pass	\$329.00	\$329.00	\$0.00	0.0%	12,900	19,600	352,000	0.0%	0.0%	0.1%
F1: Hingham	9.75	9.75	0.00	0.0%	5,600	NR	433,000	0.0%	0.0%	0.1%
F2: Boston	9.75	9.75	0.00	0.0%	13,800	20,800	285,000	0.0%	0.0%	0.1%
F2: Cross Harbor	9.75	9.75	0.00	0.0%	NR	NR	1,200	0.0%	0.0%	0.0%
F2: Logan	9.75	9.75	0.00	0.0%	NR	NR	31,200	0.0%	0.0%	0.0%
F4: Inner Harbor	3.70	3.70	0.00	0.0%	NR	700	257,000	0.0%	0.0%	0.1%
Free Transfers and Other Fares										
In-station Transfers	No Cost	No Cost			17,422,000	15,796,000	45,989,000	12.7%	13.0%	12.8%
AFC Noninteraction ¹	No Cost	No Cost			7,712,000	7,712,000	22,260,000	5.6%	6.3%	6.2%
Free trips ²	No Cost	No Cost			1,153,000	1,608,000	3,845,000	0.8%	1.3%	1.1%
Short fares ³	Variable	Variable			1,393,000	1,685,000	2,935,000	1.0%	1.4%	0.8%

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 responses to the 2015-17 MBTA Systemwide Passenger Survey. SFY = State fiscal year. TAP = Transportation Access Pass.

Source: Central Transportation Planning Staff.

Table 3
Revenue Changes from Lowering CharlieTicket and
Cash Fares to the Same Level as CharlieCard Fares

Rider Classification	Mode	Fare	Existing Fare	Proposed Fare	Trip Estimate	Change of Revenue
Minority	Bus	CT	\$2.00	\$1.70	394,497	-\$118,349
Minority	Bus	Cash	\$2.00	\$1.70	856,368	-\$256,910
Minority	RT	CT	\$2.90	\$2.40	4,027,902	-\$2,013,951
Minority	RT	Cash	\$2.90	\$2.40	40,116	-\$20,058
Minority	Bus and RT	CT	\$4.90	\$4.10	4,028	-\$3,223
Minority	IEX	CT	\$5.25	\$4.25	8,685	-\$8,685
Minority	IEX	Cash	\$5.25	\$4.25	23,452	-\$23,452
Minority	OEX	CT	\$7.00	\$5.25	0	\$0
Minority	OEX	Cash	\$7.00	\$5.25	0	\$0
Subtotal						-\$2,444,628
Low Income	Bus	CT	\$2.00	\$1.70	477,255	-\$143,177
Low Income	Bus	Cash	\$2.00	\$1.70	1,044,922	-\$313,477
Low Income	RT	CT	\$2.90	\$2.40	4,799,350	-\$2,399,675
Low Income	RT	Cash	\$2.90	\$2.40	40,795	-\$20,397
Low Income	Bus and RT	CT	\$4.90	\$4.10	4,871	-\$3,897
Low Income	IEX	CT	\$5.25	\$4.25	10,788	-\$10,788
Low Income	IEX	Cash	\$5.25	\$4.25	39,126	-\$39,126
Low Income	OEX	CT	\$7.00	\$5.25	0	\$0
Low Income	OEX	Cash	\$7.00	\$5.25	0	\$0
Subtotal						-\$2,930,537
All Riders	Bus	CT	\$2.00	\$1.70	718,291	-\$215,487
All Riders	Bus	Cash	\$2.00	\$1.70	1,676,431	-\$502,929
All Riders	RT	CT	\$2.90	\$2.40	12,508,757	-\$6,254,379
All Riders	RT	Cash	\$2.90	\$2.40	193,794	-\$96,897
All Riders	Bus and RT	CT	\$4.90	\$4.10	7,904	-\$6,323
All Riders	IEX	CT	\$5.25	\$4.25	14,903	-\$14,903
All Riders	IEX	Cash	\$5.25	\$4.25	61,936	-\$61,936
All Riders	OEX	CT	\$7.00	\$5.25	2,362	-\$4,134
All Riders	OEX	Cash	\$7.00	\$5.25	3,908	-\$6,839
Subtotal						-\$7,163,827

CT = CharlieTicket. RT = Rapid Transit. IEX = Inner Express. OEX = Outer Express.
Source: Central Transportation Planning Staff.

Allowing Step-Up Transfers between the Fairmount Line and the Bus and Rapid Transit Systems

To estimate the impacts of allowing step-up transfers—that is, transfers where a rider only pays the difference between the more expensive fare and the less expensive fare—between the Fairmount Line and the bus and rapid transit systems, CTPS generated unique queries to apply to the 2015–17 MBTA Systemwide Passenger Survey.

CTPS identified the proportion of surveyed respondents who used the Fairmount Line, transferred to or from a bus route or the rapid transit system, and used a pay-per-ride fare (approximately 5 percent of Fairmount Line riders).¹ These riders would save either \$1.70 when transferring to or from a bus route or \$2.40 when transferring to or from the rapid transit system under the proposed fares.² CTPS multiplied the percentage of trips meeting these criteria in each rider classification by an estimate of the total number of annual Fairmount Line trips (690,098). The result of multiplying the savings per trip by the estimated number of trips by riders who would benefit yields the net savings.

Table 4 presents a summary of these calculations. 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.

¹ This share is expected to increase as a result of the change in the transfer policy; however, this fare equity analysis focuses on the impacts to current riders rather than potential riders.

² A bus trip to the Fairmount Line currently costs \$4.10 (\$1.70 + \$2.40). Regardless of direction, this trip would cost \$2.40 under the proposal. A rapid transit trip to the Fairmount Line currently costs \$4.80 (\$2.40 + \$2.40). This trip would cost \$2.40 under the proposal.

Table 4
Revenue Changes from Allowing Step-up Transfers Between
the Fairmount Line and the Bus and Rapid Transit Systems

Rider Classification	Transfer Type	Per Trip Savings	Share of Trips	Trip Estimate	Change in Revenue
Minority	None	NA	33.0%	227,396	\$0
Minority	Free	\$0.00	15.8%	109,014	\$0
Minority	Bus	\$1.40	0.0%	0	\$0
Minority	Rapid Transit	\$2.40	1.5%	10,177	-\$24,424
Subtotal					-\$24,424
Nonminority	None	NA	32.5%	224,293	\$0
Nonminority	Free	\$0.00	13.4%	92,463	\$0
Nonminority	Bus	\$1.70	1.3%	8,737	-\$14,853
Nonminority	Rapid Transit	\$2.40	2.6%	18,019	-\$43,245
Subtotal					-\$58,097
Total					-\$82,521
Low-income	None	NA	8.9%	61,879	\$0
Low-income	Free	\$0.00	4.6%	31,702	\$0
Low-income	Bus	\$1.70	0.5%	3,698	-\$6,287
Low-income	Rapid Transit	\$2.40	0.5%	3,698	-\$8,876
Subtotal					-\$15,162
Non-Low-Income	None	NA	58.4%	404,392	\$0
Non-Low-Income	Free	\$0.00	22.8%	155,561	\$0
Non-Low-Income	Bus	\$1.70	0.9%	5,827	-\$9,906
Non-Low-Income	Rapid Transit	\$2.40	3.4%	23,342	-\$56,021
Subtotal					-\$65,927
Total					-\$81,089

Note: If the value in the "Per Trip Savings" column is equal to "\$0.00," this indicates that the rider used a pass that provides free transfers.

Source: 2015–17 MBTA Systemwide Passenger Survey. MBTA Fairmount Line ridership estimates.

Offering Reduced Fares for Commuter Rail Trips Inside Zone 1A for Youth Pass Holders

The survey data is inadequate regarding Youth Pass holders who would use Zone 1A commuter rail stations, so CTPS conducted this analysis using data from the 2015–17 MBTA Systemwide Passenger Survey on all 21-year-old or younger Zone 1A commuter rail riders, regardless of whether they used a Youth Pass. Given the limited market penetration of the Youth Pass program, the population of riders included in this analysis is almost certainly greater than the

population that would actually benefit. The scale of the results of the analysis suggest that obtaining a more precise estimate of the number of these riders using a Youth Pass would not affect the conclusions of this study.

Staff estimated the proportion of Zone 1A commuter rail riders who were 21 years old or younger by rider classification. Staff multiplied these proportions by the number of Zone 1A commuter rail trips to estimate the number of trips made by riders in each classification. Multiplying the number of trips by the savings per trip (\$2.40 - \$1.10 = \$1.30) yields the total savings by riders in each rider classification.³

Table 5 presents a summary of these calculations. 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
Revenue Changes from Offering Reduced Fares for
Commuter Rail Trips Inside Zone 1A for Youth Pass Holders**

Rider Classification	Age	Trip Estimate	Change in Revenue
Minority	Under 18	22,689	-\$29,495
Minority	18 to 21	20,616	-\$26,801
Subtotal			-\$56,297
Nonminority	Under 18	12,381	-\$16,095
Nonminority	18 to 21	10,270	-\$13,351
Subtotal			-\$29,446
Total			-\$85,742
Low-income	Under 18	0	\$0
Low-income	18 to 21	11,371	-\$14,782
Subtotal			-\$14,782
Non-low-income	Under 18	25,028	-\$32,537
Non-low-income	18 to 21	31,710	-\$41,222
Subtotal			-\$73,759
Total			-\$88,542

Source: 2015–17 MBTA Systemwide Passenger Survey.

³ This savings per rider result is based on the assumption that every rider uses a pay-per-ride fare product to receive the maximum benefit per trip. Along with the artificially large population pool, this assumption increases the change in revenue value and produces a result that is higher than it will actually be.

Summary of All Changes

One can estimate the proposed average fare by rider classification for these 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.

**Table 6
Change of Revenue by Fare Change and for All Fare Changes**

Rider Classification	Existing Average Fare	Existing Number of Trips	Existing Revenue	Change of Revenue: Eliminate Differential	Change of Revenue: Fairmount Line Transfers	Change of Revenue: Youth Pass Zone 1A	Total Revenue Change	Proposed Revenue	Proposed Average Fare	Percent Change: Average Fare
Minority	\$1,456	137,421,282	\$200,063,207	-\$2,444,628	-\$24,424	-\$56,297	-\$2,525,348	\$197,537,859	\$1.437	-1.3%
Low Income	\$1,294	122,318,315	\$158,231,645	-\$2,930,537	-\$15,162	-\$14,782	-\$2,960,481	\$155,271,164	\$1.269	-1.9%
All Riders	\$1,935	353,018,725	\$683,250,081	-\$7,163,827	-\$82,521	-\$88,542	-\$7,334,890	\$675,915,192	\$1.915	-1.1%

Note: When an analysis would provide different estimates of the "All Riders" change of revenue, largely because some respondents did not respond to every survey question, staff chose the more conservative, larger "All Rider" revenue change estimate.
Source: Central Transportation Planning Staff.

2.4.2 Results from Applying the Disparate-Impact and Disproportionate-Burden Policy Thresholds

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

**Table 7
Existing and Proposed Average Fares and Price Change**

Rider Classification	Existing Average Fare	Proposed Average Fare	Percentage Price Change
Minority	\$1.456	\$1.437	-1.3%
Low-income	\$1.294	\$1.269	-1.9%
All Riders	\$1.935	\$1.915	-1.1%

Note: The values in this table are rounded to the nearest cent or the nearest tenth of a percent. All calculations were performed using unrounded values.
Source: Central Transportation Planning Staff.

Application of the disparate-impact policy threshold shows the relative decrease (or the change taken as a percentage of the initial fare) in the average fare for minority riders is 118 percent of the relative decrease in the average fare for all riders.

Application of the disproportionate-burden policy threshold shows the relative decrease in the average fare for low-income riders is 174 percent of the relative decrease in the average fare for all riders.

Because the average fare decreases for minority and low-income riders are greater than 90 percent of the average fare decrease for all riders, the threshold defined by the Disparate Impact/Disproportionate Burden Policy, CTPS does not find a disparate impact on minority populations or disproportionate burden for low-income populations.

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