Appendix 1.13 Operating & Maintenance Cost Estimates

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10.1 Introduction

This technical memorandum describes the inputs and results that were used to develop the preliminary, high-level, order of magnitude, future one-year operating and maintenance (O&M) costs for the three selected Feasible Alternatives: Bus Rapid Transit (BRT), Light Rail Transit (LRT) and Commuter Rail (CR), as documented in the Task 10 Operation & Maintenance Cost Methodology Technical Memorandum (O&M Methodology).

These results provide a comparison of projected O&M costs among these Feasible Alternatives, which were developed using 2019 dollars and can be escalated as necessary for future build years. This memorandum is organized beginning with the Feasible Alternatives, operational definitions of the short list alternatives, four-supply variable model development, and estimated Operations and Maintenance Costs.

10.2 Feasible Alternatives

As part of Task 9 of this study, Fatal Flaw screening criteria were applied to the 14 initial alternatives that were developed earlier in the study, with three alternatives advanced for further study as Feasible Alternatives, as they met four of the study's goals and objectives. An outline of these three alternatives - BRT, LRT and CR – are shown in **Table 1**. For more details, see the Technical Memorandum Task 9: Fatal Flaw Screening Results.

Table 1: Feasible Alternatives

Alternative	Alternative Mode	Guideway Location	Specified service frequency (headways), in minutes		Propulsion Power
			Peak	Off-Peak	
CR	**COMMUTER RAIL**	Pair of dedicated commuter rail tracks	5	10 - 20	Electric 3rd (Rail)
LRT	**LIGHT RAIL TRANSIT (LRT)**	Pair of dedicated LRT tracks	5	10-20	Electric Overhead Catenary System (OCS)
BRT	**BUS RAPID TRANSIT (BRT)**	2 lane busway	5	10-20	Battery Electric bus with terminal charging

All three alternatives serve up to 20 stations along the IBX service alignment extending from Bay Ridge in Brooklyn to Jackson Heights in Queens and share the same common western terminus as 4th Av Station. The BRT and LRT modes leave the IBX right of way (ROW) at Roosevelt Avenue, run on street along Roosevelt Avenue to terminate at the Jackson Heights-Roosevelt Avenue subway station complex. The CR alternative remains within and terminates on the IBX ROW at Roosevelt Avenue.

The following sections describe the proposed operational characteristics and O&M cost estimates for each of the three Feasible Alternatives.

10.3 Operational Characteristics

Proposed operational parameters were defined for each alternative as part of the Task 10 work on the study. The O&M Methodology assumes calculation of the following for each Feasible Alternative:

- Annual vehicle operating hours
- Annual vehicle operating miles
- Peak fleet size, including spare vehicle requirements
- Number of guideway lane miles/track miles.

The summary of the above, as well as other pertinent characteristics that feed into the above calculations, are provided below. More detail can be found in **Task 10.6 Operations Characteristics Memorandum**.

10.3.1 BRT

The proposed schedule provides the annual revenue miles and hours, and determined the required peak BRT vehicles to operate the BRT alternative. **Table 2** below shows the schedule that feeds into the annual BRT trips and miles. Some trips (at 17 miles) have been assumed to deadhead to/from the maintenance facility, while other trips (at 15 miles) do not.

Table 2: Proposed BRT Schedule, Including Distance and Travel Time

Schedule Times					
Monday – Friday (headway in min)	**Weekday Trips**	**Miles per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 6am - 20	36	17	612	48	1,728
6am - 7am - 10	12	17	204	48	576
7am - 10am - 5	36	17	612	48	1,728
7am - 10am - 5	36	15	540	45	1,620
10am - 4pm - 10	72	17	1,224	48	3,456
4pm - 7pm - 5	36	17	612	48	1,728
4pm - 7pm - 5	36	15	540	45	1,620
7pm - 12am - 10	60	17	1,020	48	2,880
Totals	324		5,364		15,336
Sat, Sun & Holidays (headway in min)	**Weekend/Holiday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 7am - 20	36	17	612	48	1,728
7am - 12am - 10	216	17	3,672	48	10,368
Totals	252		4,284		12,096

The proposed Bus Rapid Transit service would operate with the characteristics as shown in **Table 3**, which feed into the O&M cost estimating model as described in the O&M Methodology.

Table 3: BRT Operational Characteristics

Operational Characteristic	Total
Round trip running time (mins)	101
Peak headway (mins)	5
Peak vehicles required (not including spares)	22
Annual Revenue Miles	1,836,900
Annual Revenue Hours	87,246
Busway Miles (total both directions)	30

The BRT alternative has 24 unstaffed[1], as described in **Section 10.2** . Although unstaffed, labor would be still be required for cleaning, maintenance and maintenance of station elements, such as elevators/escalators, servicing TVMs, etc.

The fare collection method for BRT assumes the use of Proof of Payment, barrier free (no turnstiles), fare collection consistent with other North American BRT systems and somewhat similar to NYCT's Select Bus Service[2]. The fare collection costs are part of Revenue Vehicle Hours cost factor.

For the BRT alternative only, the two "protect" buses have been included in the peak vehicle requirement because these two buses are part of the revenue service fleet; they are needed to cover for buses that need terminal recharging that exceeds the 5-minute peak period terminal turn time. Thus, the round-trip BRT running time includes the terminal layover time.

[1] BRT will originate/terminate at the Jackson Heights-Roosevelt Avenue intermodal complex. While the BRT platform will be unstaffed, NYCT staff is available inside the subway headhouse. This applies to the LRT alternative as well.

[2] BRT is assumed to use OMNY and other NFC enabled payment methods, which eliminates the need to insert a MetroCard into a fare machine to get a printed receipt. Instead, OMNY and NFC enabled devices can be directly scanned by roving fare inspectors to confirm validity. This applies to the LRT and CR alternatives as well.

10.3.2 LRT

The proposed schedule provides the annual revenue miles and hours, and also determines the required peak LRT vehicles to operate the LRT alternative. LRT vehicles will be comprised of three-car consists. **Table 4** below shows the schedule that feeds into the annual LRT trips and miles. As with the BRT mode, some of the trips have been assumed to deadhead to/from the maintenance facility.

Table 4: Proposed LRT Schedule, Including Distance and Travel Time

Schedule Times					
Monday – Friday (headway in min)	**Weekday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 6am - 20	36	15	540	46	1,656
6am - 7am - 10	12	15	180	46	552
7am - 10am - 5	36	15	540	46	1,656
7am - 10am - 5	36	14	504	43	1,548
10am - 4pm - 10	72	15	1080	46	3,312
4pm - 7pm - 5	36	15	540	46	1,656
4pm - 7pm - 5	36	14	504	43	1,548
7pm - 12am - 10	60	15	900	46	2,760
Totals	324		4,788		14,688
Sat, Sun & Holidays (headway in min)	**Weekend/Holiday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 7am - 20	36	15	540	46	1,656
7am - 12am - 10	216	15	3,240	46	9,936
Totals	252		3,780		11,592

The proposed Light Rail Transit service would operate with the characteristics shown in **Table 5**, which feed into the O&M cost estimating model as described in the O&M Methodology. The 24 proposed stations would be unstaffed. Although unstaffed, labor would still be required for cleaning, maintenance and maintenance of station elements, such as elevators/escalators, servicing TVMs, etc.

The fare collection method for LRT assumes the use of Proof of Payment, barrier free (no turnstiles), fare collection consistent with operating practices for the Hudson Bergen Light Rail system (NJ Transit) and other North American LRT systems The fare collection costs are part of Revenue Vehicle Hours cost factor.

Table 5: LRT Operational Characteristics

Operational Characteristic	Total
Round trip running time (mins)	96
Peak headway (mins)	5
Peak vehicles required (3-car consists, not including spares)	57
Annual Revenue Miles	1,634,724
Annual Revenue Hours	83,573
Guideway Miles (total both directions)	30

The LRT alternative has a total of 24 proposed stations, as described further in **Section 10.2** .

10.3.3 Commuter Rail

The proposed schedule provides the annual revenue miles and hours and determines the required peak commuter rail cars to operate the CR alternative. Trains will be comprised of four-car consists. **Table 6** below shows the schedule that feeds into the annual commuter rail trips and miles. As with the other two modes, some trips assume deadheading to/from the maintenance facility.

Table 6: Proposed CR Schedule, Including Distance and Travel Time

Schedule Times					
Monday – Friday (headway in min)	**Weekday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 6am - 20	36	15	540	47	1,692
6am - 7am - 10	12	15	180	47	564
7am - 10am - 5	36	15	540	47	1,692
7am - 10am - 5	36	14	504	46	1,656
10am - 4pm - 10	72	15	1080	47	3,384
4pm - 7pm - 5	36	15	540	47	1,692
4pm - 7pm - 5	36	14	504	46	1,656
7pm - 12am - 10	60	15	900	47	2,820
Totals	324		4,788		15,156
Sat, Sun & Holidays (headway in min)	**Weekend/Holiday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 6am - 20	36	15	540	47	1,692
6am - 12am - 10	216	15	3,240	47	10,152
Totals	252		3,780		11,844

The proposed commuter rail service would operate with the characteristics shown in **Table 7**, which feed into the O&M cost estimating model as described in the O&M Methodology. The 24 proposed stations would be unstaffed, as described in **Section 10.2** . Although unstaffed, labor would be still be required for cleaning, maintenance and maintenance of station elements, such as elevators/escalators, servicing TVMs, etc.

Fare collection method for CR assumes the use of Proof of Payment, barrier free (no turnstiles), fare collection. This type of fare collection for commuter rail would be new for the NYC area, but has been successfully used by other US and global commuter rail systems, including Caltrain (San Francisco), Metrolink (Los Angeles), Metrolinx (Toronto), RTD (Denver)—to name a few. The fare collection costs are part of Revenue Vehicle Hours cost factor.

Table 7: CR Operational Characteristics

Operational Characteristic	Total
Round trip running time (mins)	102
Peak headway (mins)	5
Peak vehicles required (4-car consists, not including spares)	80
Annual Revenue Miles	1,634,724
Annual Revenue Hours	86,017
Guideway Miles (total both directions)	30

The CR alternative has a total of 24 proposed stations, as described further in **Section 10.2** .

10.4 Four-Supply Operations and Maintenance Cost Model inputs

As defined in the O&M Methodology, the latest available (2019) NTD submissions were used to develop unit costs to estimate O&M costs for each of the three Feasible Alternatives[3]. For all three Feasible Alternatives, a four-supply variable model was used to estimate the O&M costs, using the following unit costs:

- Cost per vehicle revenue hour
- Cost per vehicle revenue mile
- Cost per vehicle required in maximum service
- Cost per guideway mile

The calculations of service statistics and units of service is based on the proposed service plan developed for each alternative, as described above. The following tables indicate the unit costs for revenue hour, revenue miles, and peak vehicles as developed, based on existing operating systems. While guideway O&M costs were developed for each system as shown below, the proposed BRT alternative has additional cost input assumptions for its dedicated guideway, as noted below. The LRT and CR guideway costs are assumed to be consistent with these similar systems.

10.4.1 BRT Operating Expense Unit Costs Development

BRT Unit costs were based upon NYCT's existing Select Bus Service (SBS) operations. As noted above, these SBS routes do not operate within a dedicated guideway or feature dedicated BRT stations, so separate annual unit costs were developed for guideway, based upon a range of BRT systems provided in the NTD, as well as from cost estimates developed for BRT guideways on other New York City projects, such as the MTA's recent Staten Island West Shore and Utica Avenue transit studies.

Costs assume the full cost for maintaining a busway and includes street sweeping, snow clearance, busway lighting, pavement repairs, etc. Each BRT station O&M cost accounts for cleaning and repairs, station lighting, snow removal from public walkways and platforms, cost of elevator and/or escalator maintenance, Passenger Information Displays (PIDs) maintenance, etc. The annual O&M costs for BRT guideway are as follows:

- Cost per mile of guideway: $50,000
- Cost per station: $150,000

[3] Due to a data anomaly with revenue vehicle hours in 2019 for Long Island Rail Road, the NTD data for commuter rail was drawn from the 2018 LIRR data set.

Table 8: BRT Operating and Maintenance Expense Items ($2019)

BRT2	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 30,751,401			
Other Salaries and Wages	$ 4,551,496			
Fringe Benefits	$ 25,761,976			
Services	$ 347,485			
Vehicle Operations Materials and Supplies				
Fuel and Lubricants		$ 2,587,067		
Tires and Tubes		$ 468,537		
Other Materials/Supplies		$ 213,972		
Miscellaneous			$ 889,131.00	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 9,457,959		
Fringe Benefits		$ 6,172,122		
Services		$ 190,423		
Vehicle Maintenance Materials and Supplies				
Fuel and Lubricants		$ 155,249		
Tires and Tubes		$ 29,907		
Other Materials and Supplies		$ 2,817,792		
Miscellaneous		$ 43,416		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 2,802,552
Fringe Benefits				$ 1,899,173
Services				$ 1,487,133
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 200,870
Miscellaneous				$ 3,433
General Administration				
Other Salaries and Wages			$ 2,833,769	
Fringe Benefits			$ 2,943,588	
Services			$ 1,636,224	
Other Materials and Supplies			$ 582,237	
Utilities			$ 393,732	
Casualty and Liability			$ 3,563,337	
Miscellaneous Expense			$ 287,374	
TOTAL Costs	$ 61,412,358	$ 22,136,444	$ 13,129,392	$ 6,393,161
2019 Units	517,519	3,382,426	181	65
2019 Cost/Unit for BRT2	$ 118.67	$ 6.54	$ 72,538.08	$ 98,965.34

Source: 2019 Operating Expenses workbook, NTD, (downloaded January 2021)

10.4.2 LRT Operating Expense Unit Costs Development

LRT unit costs were based upon New Jersey Transit's light rail service and are shown in **Table 9**. NJ TRANSIT's Hudson Bergen Light Rail Transit (HBLRT) served as a proxy for the IBX's LRT Alternative because they share similar physical and operational characteristics, such as extensive use of dedicated ROW with segments of street running, identical LRT vehicle types, similar on-train staffing, unstaffed stations, proof of payment fare collection, climatic conditions and comparable New York metropolitan area labor rates. Additionally, HBLRT is operated under a Design Build Operate Maintain (DBOM) contract and has costs comparable to a contracted IBX LRT service.

Table 9: Operating and Maintenance Expense Items ($2019)

LRT2	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 2,540,218			
Other Salaries and Wages	$ 2,493,514			
Fringe Benefits	$ 3,108,275			
Services	$ 326,577			
Vehicle Operations Materials and Supplies				
Other Materials/Supplies		$ 34,566		
Utilities		$ 722,980		
Miscellaneous			$ 28,969.00	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 1,616,199		
Fringe Benefits		$ 1,054,641		
Services		$ 27,379		
Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies		$ 1,084,266		
Miscellaneous		$ 8,959		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 3,026,326
Fringe Benefits				$ 1,870,918
Services				$ 1,174,436
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 599,292
Miscellaneous				$ 19,039
General Administration				
Other Salaries and Wages			$ 1,636,976	
Fringe Benefits			$ 1,060,090	
Services			$ 636,660	
Other Materials and Supplies			$ 91,967	
Utilities			$ 520,084	
Casualty and Liability		$ 172,587		
Taxes			$ 1,774	
Miscellaneous Expense			$ 97,467	
TOTAL Costs	$ 8,468,584	$ 4,721,577	$ 4,073,987	$ 6,690,011
2019 Units	51,294	507,528	14	14
2019 Cost/Unit for LRT2	$ 165.10	$ 9.30	$ 290,999.07	$ 477,857.93

Source: 2019 Operating Expenses workbook, NTD, (downloaded January 2021)

10.4.3 CR Operating Expense Unit Costs Development

CR unit costs were based upon Long Island Rail Road (LIRR) service and are shown in **Table 10**. LIRR data was used as a basis for the cost inputs for the CR Alternative. It should be noted that the LIRR has a higher cost structure than the proposed IBX, given its greater on-train staffing (3+ train crew) than is proposed for IBX (two-person train crew). IBX also proposes smaller, simpler stations than some LIRR stations (such as large transfer and/or terminal stations as Penn Station, Woodside, Jamaica, Long Beach, Babylon, Ronkonkoma, etc.). The commuter rail costs could vary if an independent contractor were to operate the system.

To provide a conservative cost estimate, the LIRR current costs were used, recognizing that there is potential to reduce O&M costs if new work rules were negotiated and implemented by either the MTA or a contract operator to reduce train crew size and to streamline and provide more flexible work rules and other operating efficiencies.

Table 10: CR Operating and Maintenance Expense Items ($2019)

CR4	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 169,607,504			
Other Salaries and Wages	$ 84,749,718			
Fringe Benefits	$ 143,958,021			
Services	$ 13,933,572			
Vehicle Operations Materials and Supplies				
Fuel and Lubricants		$ 15,494,818		
Other Materials/Supplies		$ 1,234,064		
Utilities		$ 68,254,282		
Miscellaneous			$ 13,039,922	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 242,222,211		
Fringe Benefits		$ 147,385,120		
Services		$ 11,678,365		
Vehicle Maintenance Materials and Supplies				
Fuel and Lubricants		$ 2,475,639		
Other Materials and Supplies		$ 100,677,543		
Miscellaneous		$ 2,250,561		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 159,844,492
Fringe Benefits				$ 67,874,013
Services				$ 22,469,420
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 31,242,354
Miscellaneous				$ 25,359,837
General Administration				
Other Salaries and Wages			$ 55,313,613	
Fringe Benefits			$ 29,587,654	
Services			$ 21,912,955	
Other Materials and Supplies			$ 5,208,599	
Utilities			$ 15,273,695	
Casualty and Liability		$ 54,788,865		
Miscellaneous Expense			$ 1,189,711	
TOTAL Costs	$ 412,248,815	$ 646,461,468	$ 141,526,149	$ 306,790,116
2019 Units	2,207,645	67,942,021	1,026	632
2019 Cost/Unit for CR4	$ 186.74	$ 9.51	$ 137,939.72	$ 485,504.22

Source: 2019 Operating Expenses workbook, NTD, (downloaded January 2021)

10.5 Estimated O&M Costs

The tables below present the estimated annual O&M costs for the BRT, LRT, and CR alternatives. Note that total costs have been rounded to the nearest thousand. They are shown in 2019$ as calculated, as well as escalated to 2020$ and 2045$ (build year) for comparison. A 3% annual growth rate was applied to escalate the estimated O&M cost to future years.

Table 11: Estimated BRT O&M Costs

Item	Units	Cost/Unit	Total
Vehicle Revenue Hours	87,246	$118.67	$10,353,000
Vehicle Revenue Miles	1,836,900	$6.54	$12,022,000
Peak Vehicles Required	22	$72,538	$1,596,000
Guideway Miles*			
Busway Miles (total both directions)	30	$50,000	$1,500,000
Stations	23	$150,000	$3,450,000
TOTAL (2019$)			***$28,921,000***
TOTAL (2020$)			***$29,789,000***
TOTAL (2045$)			***$62,371,000***

**The BRT Guideway Miles cost was developed based on the NYCT Staten Island West Shore AA, and assumes the full cost for maintaining a busway including street sweeping, snow clearance, busway lighting, pavement repairs, etc. Each BRT station O&M cost accounts for cleaning and repairs, station lighting, snow removal from public walkways and platforms, cost of elevator and/or escalator maintenance, Passenger Information Displays (PIDs) maintenance, etc.*

Table 12: Estimated LRT O&M Costs

Item	Units	Cost/Unit	Total
Vehicle Revenue Hours	83,573	$165	$13,798,000
Vehicle Revenue Miles	1,634,724	$9.30	$15,208,000
Peak Vehicles Required	57	$290,999	$16,587,000
Guideway Miles (including stations)*	30	$477,858	$14,336,000
TOTAL (2019$)			***$59,929,000***
TOTAL (2020$)			***$61,727,000***
TOTAL (2045$)			***$129,242,000***

**LRT Guideway Miles cost includes those items indicated in Table 9, such as Non-Vehicle maintenance materials (stations), as well as salaries and benefits.*

Table 13: Estimated CR O&M Costs

Item	Units	Cost/Unit	Total
Vehicle Revenue Hours	86,017	$186.74	$16,062,000
Vehicle Revenue Miles	1,634,724	$9.51	$15,554,000
Peak Vehicles Required	80	$137,940	$11,035,000
Guideway Miles*	30	$485,504	$14,565,000
TOTAL (2019$)			***$57,216,000***
TOTAL (2020$)			***$58,932,000***
TOTAL (2045$)			***$123,392,000***

**CR Guideway Miles cost includes those items indicated in Table 10, such as Non-Vehicle maintenance materials (stations), as well as salaries and benefits.*

Addendum: O&M Costs for 2.5 Minute BRT Service

The following tables reflect a possible increase in peak BRT service from the 5-minute assumed in this technical memo to a 2.5 minute headway to provide adequate capacity to handle projected peak period BRT ridership. Under this change in frequency, Tables 1, 2, 3 and 11 in this technical memo would be replaced by the following modified tables:

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Table 14: Feasible Alternatives with 2.5 Minute Peak BRT Service

Alternative	Alternative Mode	Guideway Location	Specified service frequency (headways), in minutes		Propulsion Power
			Peak	Off-Peak	
CR	**COMMUTER RAIL**	Pair of dedicated commuter rail tracks	5	10 - 20	Electric 3rd (Rail)
LRT	**LIGHT RAIL TRANSIT (LRT)**	Pair of dedicated LRT tracks	5	10-20	Electric Overhead Catenary System (OCS)
BRT	**BUS RAPID TRANSIT (BRT)**	2 lane busway	**2.5**	10-20	Battery Electric bus with terminal charging

Table 15: Proposed BRT Schedule, Including Distance and Travel Time with 2.5 Minute Peak BRT Service

Schedule Times					
Monday – Friday (headway in min)	**Weekday Trips**	**Miles per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 6am - 10'	**72**	17	1,224	48	3,456
6am - 7am - 5'	12	17	204	48	576
7am - 10am - 2.5'	**72**	17	1,224	48	3,456
7am - 10am - 2.5'	**72**	15	1,080	45	3,240
10am - 4pm - 5'	**144**	17	2,448	48	6,912
4pm - 7pm - 2.5'	**72**	17	1,224	48	3,456
4pm - 7pm - 2.5'	**72**	15	1,080	45	3,240
7pm - 12am - 10'	60	17	1,020	48	2,880
Totals	**576**		**9,504**		**27,216**
Sat, Sun & Holidays (headway in min)	**Weekend/Holiday Trips**	**Miles Per Trip**	**Miles Per Day**	**Travel Time (min)**	**Time Per Interval (min)**
12am - 7am - 20	36	17	612	48	1,728

7am - 12am - 10	216	17	3,672	48	10,368
Totals	252		4,284		12,096

Table 16: BRT Operational Characteristics with 2.5 Minute Peak BRT Service

Operational Characteristic	Total
Round trip running time (mins)	101
Peak headway (mins)	**2.5**
Peak vehicles required (not including spares)	**44**
Annual Revenue Miles	**2,884,320**
Annual Revenue Hours	**137,340**
Busway Miles (total both directions)	30

Table 17: Estimated BRT O&M Costs with 2.5 Minute Peak BRT Service

Item	Units	Cost/Unit	Total
Vehicle Revenue Hours	**137,340**	$118.67	**$16,298,000**
Vehicle Revenue Miles	**2,884,320**	$6.54	**$18,877,000**
Peak Vehicles Required	**50**	$72,538	**$3,627,000**
Guideway Miles*			
Busway Miles (total both directions)	30	$50,000	$1,500,000
Stations	23	$150,000	$3,450,000
TOTAL (2019$)			**$43,752,000**
TOTAL (2020$)			**$45,065,000**
TOTAL (2045$)			**$94,355,000**

**The BRT Guideway Miles cost was developed based on the NYCT Staten Island West Shore AA, and assumes the full cost for maintaining a busway including street sweeping, snow clearance, busway lighting, pavement repairs, etc. Each BRT station O&M cost accounts for cleaning and repairs, station lighting, snow removal from public walkways and platforms, cost of elevator and/or escalator maintenance, Passenger Information Displays (PIDs) maintenance, etc.*

Appendix: Estimated O&M Costs Calculation Sheet (Digital printout)

BRT	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 30,751,401			
Other Salaries and Wages	$ 4,551,496			
Fringe Benefits	$ 25,761,976			
Services	$ 347,485			
Vehicle Operations Materials and Supplies				
Fuel and Lubricants		$ 2,587,067		
Tires and Tubes		$ 468,537		
Other Materials/Supplies		$ 213,972		
Miscellaneous			$ 889,131.00	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 9,457,959		
Fringe Benefits		$ 6,172,122		
Services		$ 190,423		
Vehicle Maintenance Materials and Supplies				
Fuel and Lubricants		$ 155,249		
Tires and Tubes		$ 29,907		
Other Materials and Supplies		$ 2,817,792		
Miscellaneous		$ 43,416		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 2,802,552
Fringe Benefits				$ 1,899,173
Services				$ 1,487,133
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 200,870
Miscellaneous				$ 3,433
General Administration				
Other Salaries and Wages			$ 2,833,769	
Fringe Benefits			$ 2,943,588	
Services			$ 1,636,224	
Other Materials and Supplies			$ 582,237	
Utilities			$ 393,732	
Casualty and Liability			$ 3,563,337	
Miscellaneous Expense			$ 287,374	

TOTAL Costs	$ 61,412,358	$ 22,136,444	$ 13,129,392	$ 6,393,161
2019 Units	517,519	3,382,426	181	65
2019 Cost/Unit for BRT2	$ 118.67	$ 6.54	$ 72,538.08	$ 98,965.34

LRT2	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 2,540,218			
Other Salaries and Wages	$ 2,493,514			
Fringe Benefits	$ 3,108,275			
Services	$ 326,577			
Vehicle Operations Materials and Supplies				
Other Materials/Supplies		$ 34,566		
Utilities		$ 722,980		
Miscellaneous			$ 28,969.00	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 1,616,199		
Fringe Benefits		$ 1,054,641		
Services		$ 27,379		
Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies		$ 1,084,266		
Miscellaneous		$ 8,959		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 3,026,326
Fringe Benefits				$ 1,870,918
Services				$ 1,174,436
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 599,292
Miscellaneous				$ 19,039
General Administration				
Other Salaries and Wages			$ 1,636,976	
Fringe Benefits			$ 1,060,090	
Services			$ 636,660	
Other Materials and Supplies			$ 91,967	
Utilities			$ 520,084	
Casualty and Liability		$ 172,587		
Taxes			$ 1,774	
Miscellaneous Expense			$ 97,467	
TOTAL Costs	$ 8,468,584	$ 4,721,577	$ 4,073,987	$ 6,690,011
2019 Units	51,294	507,528	14	14
2019 Cost/Unit for LRT2	$ 165.10	$ 9.30	$ 290,999.07	$ 477,857.93

CR4	Assignment of Expense Items			
	Revenue Vehicle Hours	Revenue Vehicle Miles	Peak Vehicles	Guideway
Vehicle Operations Labor				
Operator Salaries and Wages	$ 169,607,504			
Other Salaries and Wages	$ 84,749,718			
Fringe Benefits	$ 143,958,021			
Services	$ 13,933,572			
Vehicle Operations Materials and Supplies				
Fuel and Lubricants		$ 15,494,818		
Other Materials/Supplies		$ 1,234,064		
Utilities		$ 68,254,282		
Miscellaneous			$ 13,039,922	
Vehicle Maintenance Labor				
Other Salaries and Wages		$ 242,222,211		
Fringe Benefits		$ 147,385,120		
Services		$ 11,678,365		
Vehicle Maintenance Materials and Supplies				
Fuel and Lubricants		$ 2,475,639		
Other Materials and Supplies		$ 100,677,543		
Miscellaneous		$ 2,250,561		
Non-Vehicle Maintenance Labor				
Other Salaries and Wages				$ 159,844,492
Fringe Benefits				$ 67,874,013
Services				$ 22,469,420
Non-Vehicle Maintenance Materials and Supplies				
Other Materials and Supplies				$ 31,242,354
Miscellaneous				$ 25,359,837
General Administration				
Other Salaries and Wages			$ 55,313,613	
Fringe Benefits			$ 29,587,654	
Services			$ 21,912,955	
Other Materials and Supplies			$ 5,208,599	
Utilities			$ 15,273,695	
Casualty and Liability		$ 54,788,865		
Miscellaneous Expense			$ 1,189,711	

TOTAL Costs	$ 412,248,815	$ 646,461,468	$ 141,526,149	$ 306,790,116
2019 Units	2,207,645	67,942,021	1,026	632
2019 Cost/Unit for CR4	$ 186.74	$ 9.51	$ 137,939.72	$ 485,504.22