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SUBJECT:	DCR – Arborway Improvements Project – Updated Traffic Counts and Analysis		

Executive Summary

The Arborway Improvements Project (the Project) was initiated by the Department of Conservation and Recreation (DCR) with a core set of goals:

- Improve safety and accessibility for all corridor users;
- Create continuous and comfortable bicycle and pedestrian connections between Forest Hills and Jamaica Pond;
- Maintain and provide accessibility to the historic features within the corridor;
- Apply low-impact design solutions; and
- Improve open spaces along the Arborway.

Design and Traffic Analysis Considerations

The work on this project began in spring 2020 amidst the initial stages of the COVID-19 pandemic, where daily traffic volumes for all users were dramatically reduced. Due to the pandemic, the traffic data collection program initially planned for March 2020 was postponed until traffic volumes could normalize. As instructed by DCR, the design team analyzed the Existing, No-build, and Build Conditions per Massachusetts Department of Transportation (MassDOT) and Boston Transportation Department (BTD) guidelines for pandemic traffic analysis with available 2014 and 2017 volume data. In coordination with DCR, *Howard Stein Hudson (HSH)* used the results of this analysis to advance four conceptual design alternatives for the project area that were socialized with elected officials, the general public, and project stakeholders groups via two public meetings and one public workshop. These meetings and targeted one-on-one meetings between DCR and stakeholder groups provided direct feedback that informed the advancement of the current preferred alternative (Alternative 5). Design features of Alternative 5 include:

- Kelley and Murray Circles converted to signalized intersections;



- Added signalized pedestrian and bicycle crossings to provide continuous corridor connectivity;
- Maintenance of access for abutters on side streets and the carriageways;
- Signals timed to:
 - Manage queues to discourage cut-through traffic on local streets;
 - Minimize travel time impacts; and
 - Manage queue progression; and
- High-quality multimodal facilities.

As the pandemic's impact lessened in 2022 and 2023, traffic volumes returned to pre-pandemic levels which allowed HSH to conduct new traffic counts in early 2023. This technical memorandum presents the traffic analysis results for the Alternative 5 using 2023 traffic data.

Benefits

The design of Alternative 5 presents a transportation network that provides continuous, high-quality pedestrian and bicycle facilities between Forest Hills and Jamaica Pond. It converts the existing circular intersections to signalized traffic control while adding new signalized pedestrian and bicycle crossings throughout the corridor. The results significantly increase accessible park space, and modify traffic circulation to encourage regional traffic to travel in a main barrel within the Arborway. The design provides an approach to minimize conflicts and improve safety amongst and between modes while reducing vehicular speeds wherever possible. Alternative 5 experiences travel time decreases in both the a.m. peak hour (Center Street Eastbound approach to any destination) and the p.m. peak hour (Centre Street Eastbound, Pond Street Eastbound, Jamaica Way Southbound approaches to any destination). It also presents the opportunity to enhance the urban tree canopy with maintainable design treatments and reallocates green space to places that can be enjoyed by the community of users of the Arborway.

Challenges

The traffic analysis results comparing Alternative 5 against the future No-build Condition exhibit operations that are similar (a.m. peak hour) or see an improvement (p.m. peak hour) over the future No-build Condition, with travel times showing similar changes. This is due to the balance set on providing adequate access for all modes, limited storage for turning movements to limit impacts to mature trees, and speed management practices applied to improve safety for all users. Congestion impacts are most noticeable for these movements: Centre Street westbound at Upper Arborway and



Murray Circle, Upper Arborway northbound, Orchard Street southbound and Arborway northbound left to Centre Street westbound (p.m. peak hour only).

Traffic Operations Outcomes

Figure 1 and **Figure 2** compare travel times between existing conditions (with future volumes) and Alternative 5. The results indicate that most traffic through the corridor will experience reduced travel times during peak hours, though smaller volume movements may see increases. These changes reflect a balance of the corridor's various needs. The following points should be considered when reviewing these figures and this memorandum's findings:

- Major corridor signals at Murray Circle and Kelley Circle have a two-minute cycle, allowing drivers to clear the area within one or two cycles.
- Signals provide protected movements for all modes and major vehicle movements.
- Signals can reduce speeds by timing major movements to match a slower speed. While Arborway is posted at 25 mph, vehicles currently travel at 40 mph or more throughout the day.

Figure 1. a.m. Peak Hour Travel Time Changes within the Arborway Project Corridor

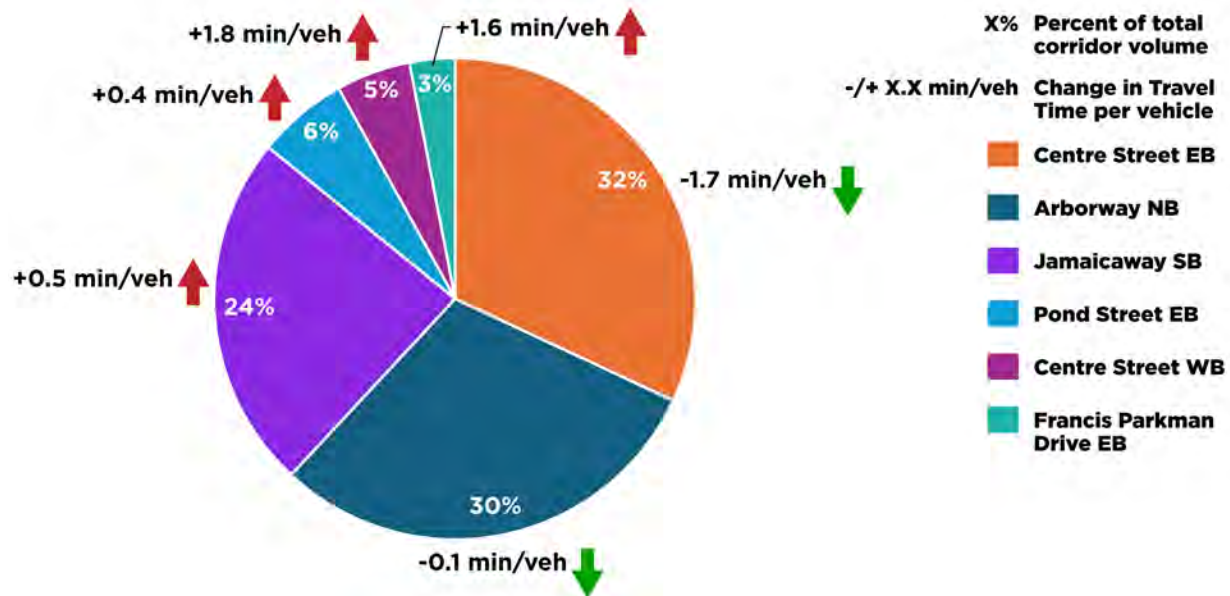
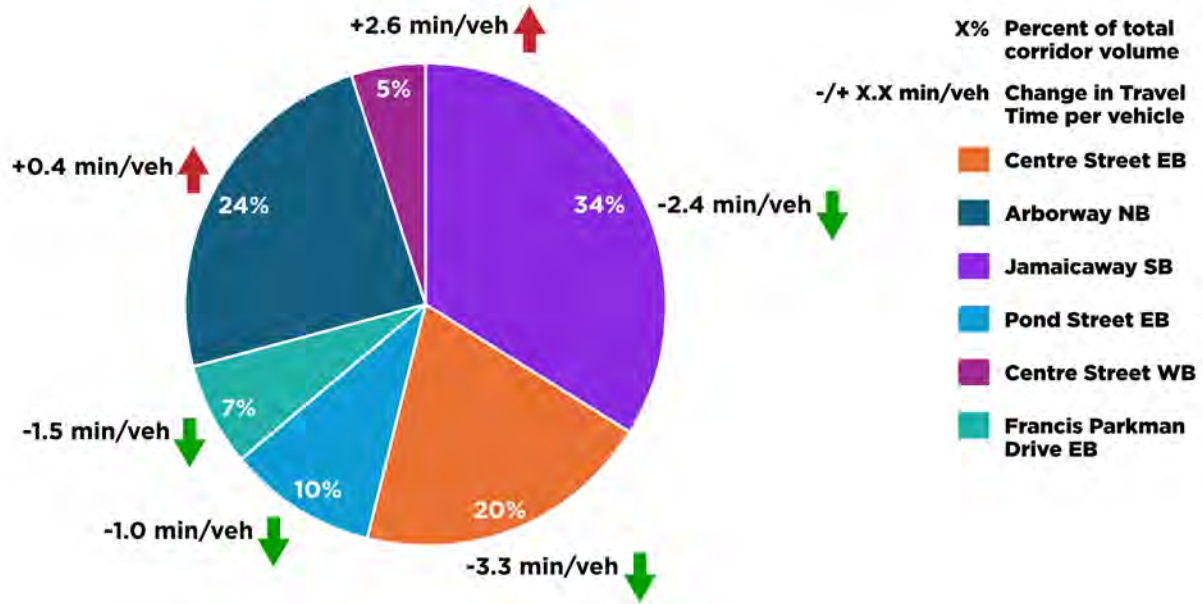




Figure 2. *p.m. Peak Hour Travel Time Changes within the Arborway Project Corridor*





Introduction

This memorandum presents the existing condition observations, new traffic counts collected in January and February 2023, summarizes VISSIM analysis methodology, presents updated existing conditions traffic analysis of the Arborway project corridor, summarizes and graphically presents the preferred alternative's proposed roadway network and pedestrian and bicycle connectivity improvements, and provides updated traffic analysis results for the current preferred design alternative (Alternative 5). The updates to the existing traffic conditions also reflect the pavement marking changes implemented by DCR in summer 2021 from Kelley Circle to south of Murray Circle and the Arboretum driveway.

Existing Conditions (2023)

Corridor-wide Changes

Since the start of the project in spring 2020, the Arborway project corridor underwent significant changes in summer 2021, which are summarized below:

- The Carriageways on both sides of the Arborway were reconfigured from two travel lanes and a shoulder that accommodated bicycles to one travel lane and a buffered bicycle lane;
- Pavement markings were added within Murray Circle, which previously had no markings. These markings now indicate the appropriate lane usage throughout the Circle, effectively reducing its width and delineating two distinct lanes around it;
- The approaches to Murray Circle were provided lane use pavement markings and signage. These markings and signage allow drivers to select the appropriate lane before entering the Circle;
- Lane use pavement marking arrows were added to the northbound approach of the Arborway signal with Centre Street and Prince Street. These markings indicate that only one lane can continue through to the northbound Carriageway, while the other lane can only turn left towards Murray Circle and access the main Arborway barrel; and
- Arborway Southbound, south of Murray Circle, had been reduced from two travel lanes to a single travel lane with a buffered bike lane in 2021. However, in fall 2023, DCR reverted a portion of the lane reduction – from the Murray Circle exit to just past the pedestrian mid-block crossing south of the Arboretum driveway. As this change occurred after the new counts and field observations conducted in winter 2023, and it significantly alters traffic flow in the area, it has not been incorporated into the existing or No-build Conditions. The



removal of the lane reduction has resulted in a substantial change in the number of vehicles processed, necessitating a redo of the winter 2023 counts to accurately reflect the updated traffic conditions at the Circle.

Figure 3 shows a side-by-side comparison of the 2020 and 2021 conditions, focusing on the area around Murray Circle, as it saw the most significant changes. The new conditions created by the above-mentioned changes have been used to update the existing conditions with existing and future volumes, otherwise called the No-build Condition.



Figure 3. *Arborway at Murray Circle and Surrounding Area – 2020 vs 2021*





NEW TRAFFIC VOLUMES (2023)

Automatic Traffic Recorder (ATR) counts were collected along the Arborway and on the connecting streets. The data were collected between Wednesday, February 8, 2023, and Saturday, February 11, 2023. A seasonal adjustment factor was not applied to these counts, as no new factors have been developed by regional planning agencies after the pandemic.

HSH also collected Turning Movement Counts (TMCs) on Tuesday, January 24, 2023, from 7:00 a.m. to 6:00 p.m., at seven intersections (listed below) within the project area, and included vehicular, bicycle, and pedestrian volumes:

- 1) Jamaicaaway at Eliot Street;
- 2) Arborway at Francis Parkman Drive;
- 3) Arborway at Pond Street and Cataumet Street, including the turns into the U-turn to Arborway Northbound;
- 4) Murray Circle (all entrance and exit legs);
- 5) Arborway Northbound at Centre Street and Prince Street; and
- 6) Centre Street at Upper Arborway and Orchard Street.

Figure 4 presents the locations of the ATRs and TMCs graphically. The raw count data can be provided upon request.

AVERAGE DAILY TRAFFIC

The average daily traffic variations for three key locations within the project corridor are presented in **Figure 5** through **Figure 7**. The remaining locations' graphs can be provided upon request.

Table 1 summarizes the data and includes Average Daily Traffic (ADT), peak-hour percentage, and the 85th percentile speeds throughout the corridor.

CORRIDOR-PEAK HOUR

Due to the length of the corridor and the number of intersections within the project area, the a.m. and p.m. peak hours differ at each intersection. Using the TMC data, one common a.m. and one common p.m. peak hour was calculated to be used for the entire project area. The a.m. peak hour was chosen to be between 7:30 a.m. and 8:30 a.m., and the p.m. peak hour was chosen to be between 4:30 p.m. and 5:30 p.m. The peak hour traffic volumes are shown in **Figure 8**, whereas the peak hour pedestrian and bicycle volumes are shown in **Figure 9**.



Figure 4. *ATR and TMC Locations*

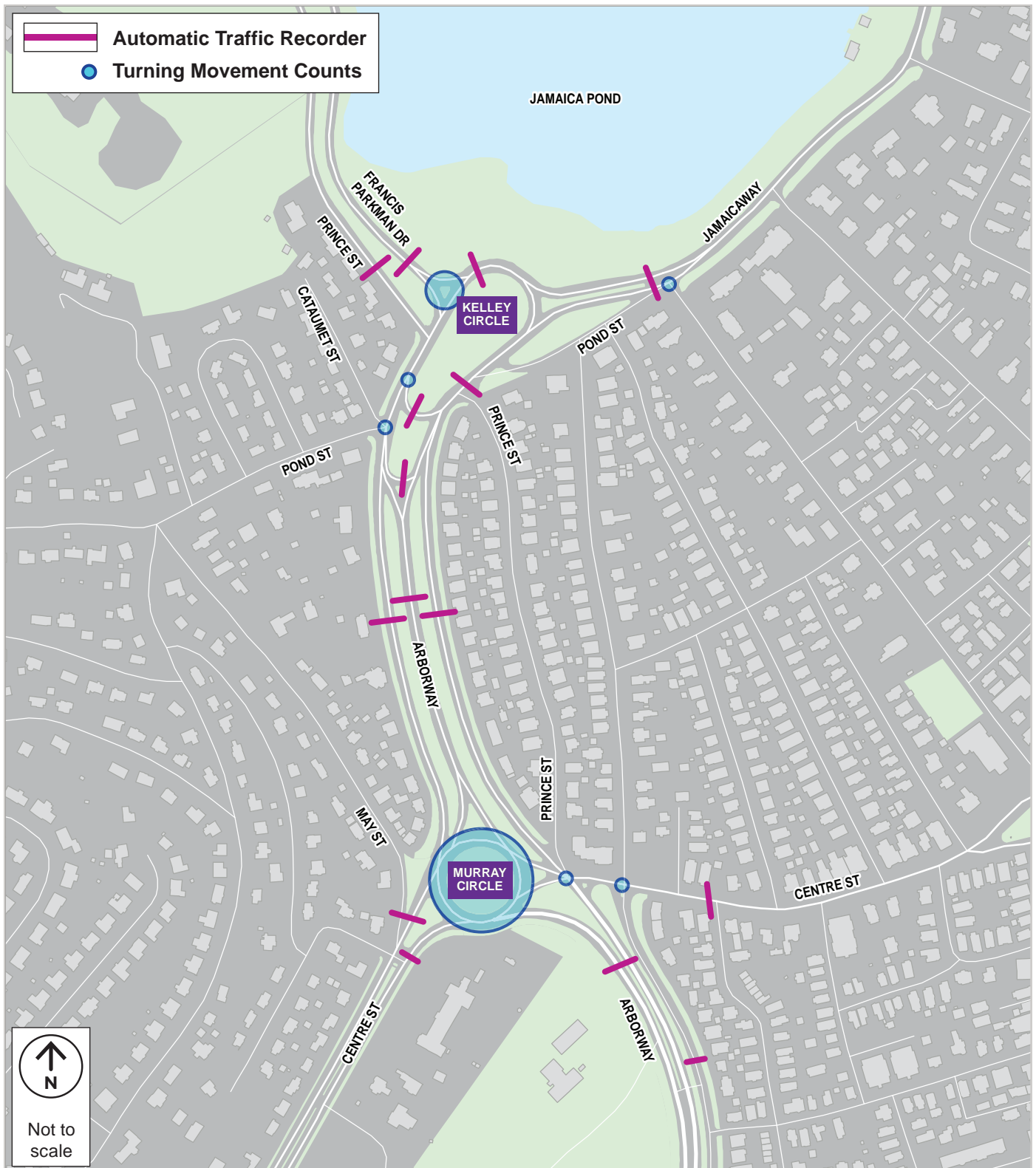




Figure 5. *Jamaicaway, South of Eliot Street - Average Daily Traffic*

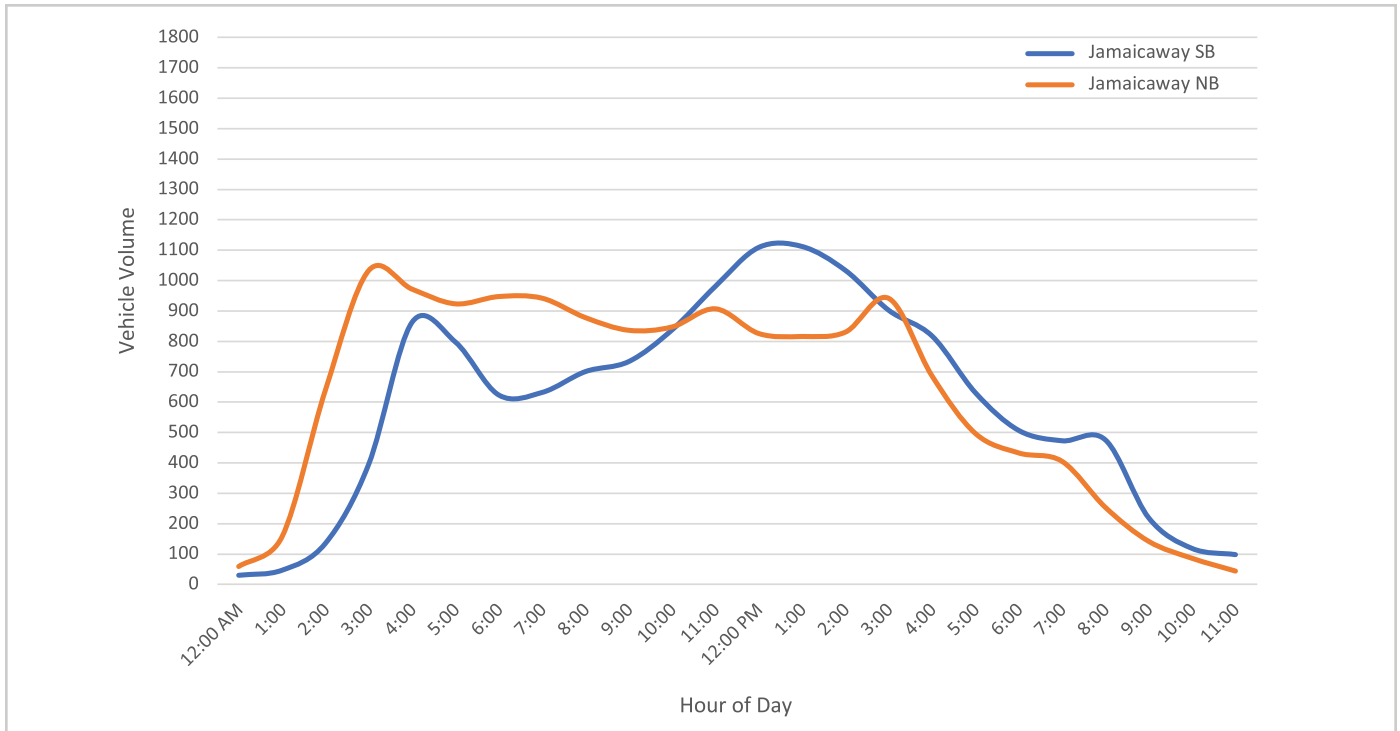


Figure 6. *Centre Street, West of Murray Circle - Average Daily Traffic*

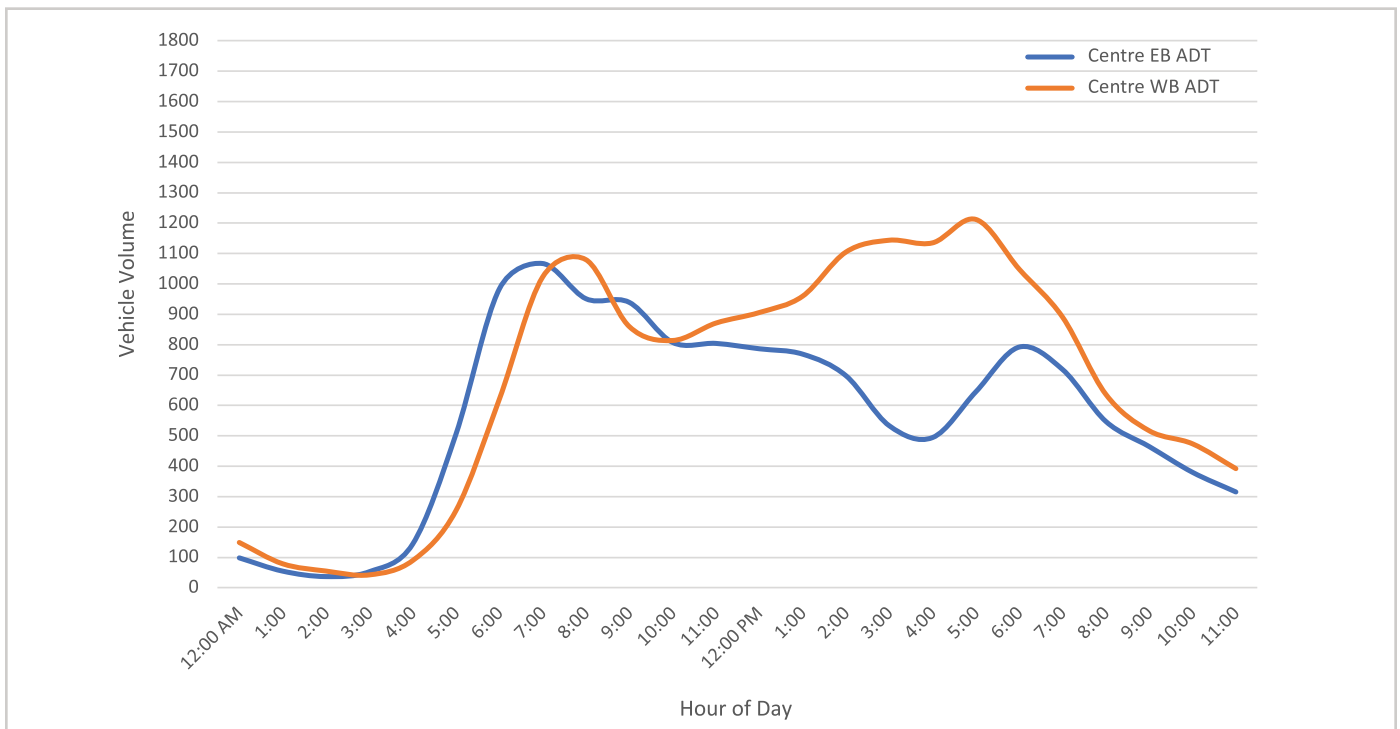
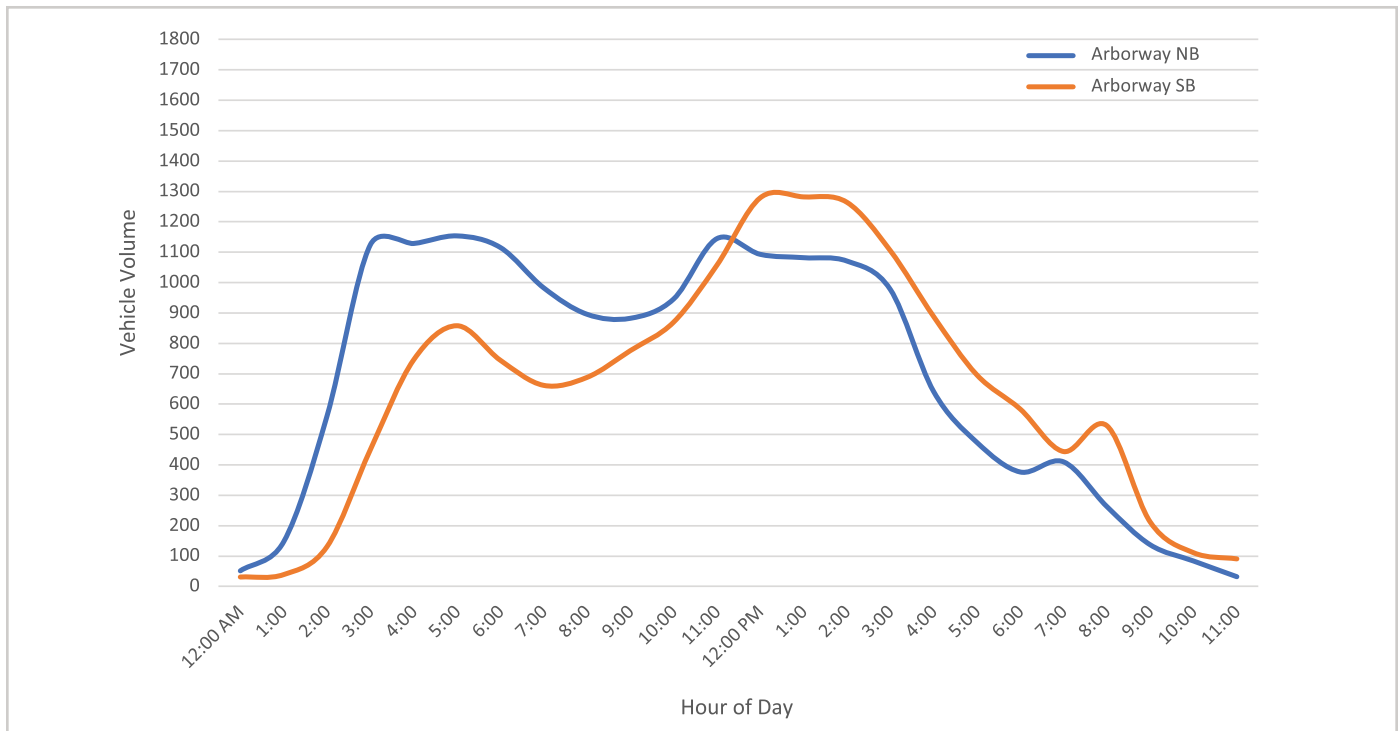




Figure 7. *Arborway, South of Murray Circle - Average Daily Traffic*





As can be seen in the Average Daily Traffic figures provided, all ATRs captured the number of vehicles each of the different roadways within the study corridor can process through an average day, except for Centre Street in the eastbound direction, and only between 3:00 – 4:00 p.m., where there was a noticeable drop in vehicles processed. Knowing that Murray Circle experiences congestion in the evening, and especially on the Centre Street eastbound approach to the Circle, this drop represents the effect of that congestion and indicates that the Centre Street eastbound approach is able to process only around 500 vehicles in an hour, instead of the approximately 1100 vehicles it can process in the morning.

Table 1. Average Daily Traffic Data – Arborway Corridor

Location	Average Daily Weekday Traffic Volume (vehicles per day)	K Factor	85%-ile speed (miles per hour)
Jamaicaway, South of Eliot Street			
Northbound	15,080	7.2%	34.8
Southbound	14,260	8.4%	34.1
Total	29,340	7.8%	-
Arborway SB, North Francis Parkman Drive			
Southbound	17,890	6.1%	21.8
Arborway NB, North of Prince Street			
Westbound	21,580	7.1%	32.8
Francis Parkman Drive, West of Arborway			
Eastbound	3,000	9.1%	26.5
Westbound	5,240	12.2%	28.0
Total	8,240	11.1%	-
Prince Street, West of Arborway			
Eastbound	500	20.5%	16.7
Pond Street, West of Arborway			
Eastbound	2,530	13.1%	31.1
Westbound	4,300	8.7%	30.5
Total	6,830	10.3%	-



Location	Average Daily Weekday Traffic Volume (vehicles per day)	K Factor	85%-ile speed (miles per hour)
Arborway, North of Murray Circle			
Northbound	9,650	9.3%	42.1
Southbound	12,760	10.2%	37.0
Total	22,410	9.7%	-
Carriageway NB, North of Murray Circle			
Northbound	10,670	8.1%	47.6
Carriageway SB, North of Murray Circle			
Southbound	11,400	8.1%	42.4
Centre Street, West of Murray Circle			
Eastbound	13,570	7.9%	29.8
Westbound	16,340	7.4%	28.9
Total	29,910	7.7%	-
Centre Street, East of Upper Arborway			
Eastbound	3,950	8.6%	29.0
Westbound	3,910	8.0%	37.4
Total	7,860	8.3%	-
Upper Arborway, North of Custer Street			
Northbound	1,100	11.1%	28.3
Southbound	740	11.3%	28.5
Total	1,840	11.2%	-
Arborway, South of Murray Circle			
Northbound	16,750	8.6%	42.6
Southbound	15,530	8.0%	42.1
Total	32,280	8.3%	-



Figure 8. *Existing (2023) Conditions Turning Movement Volumes, Weekday a.m. and p.m. Peak Hours*

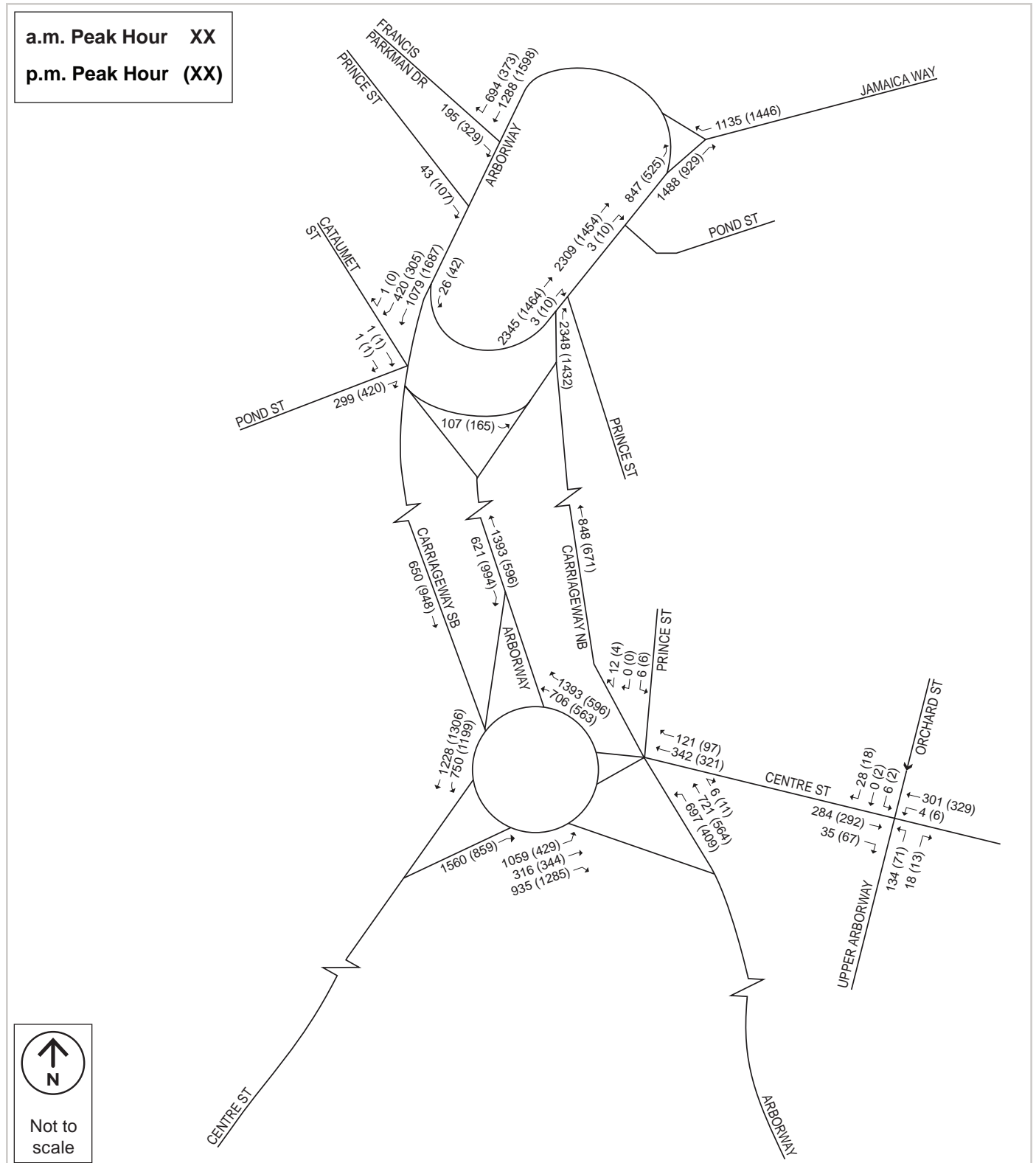
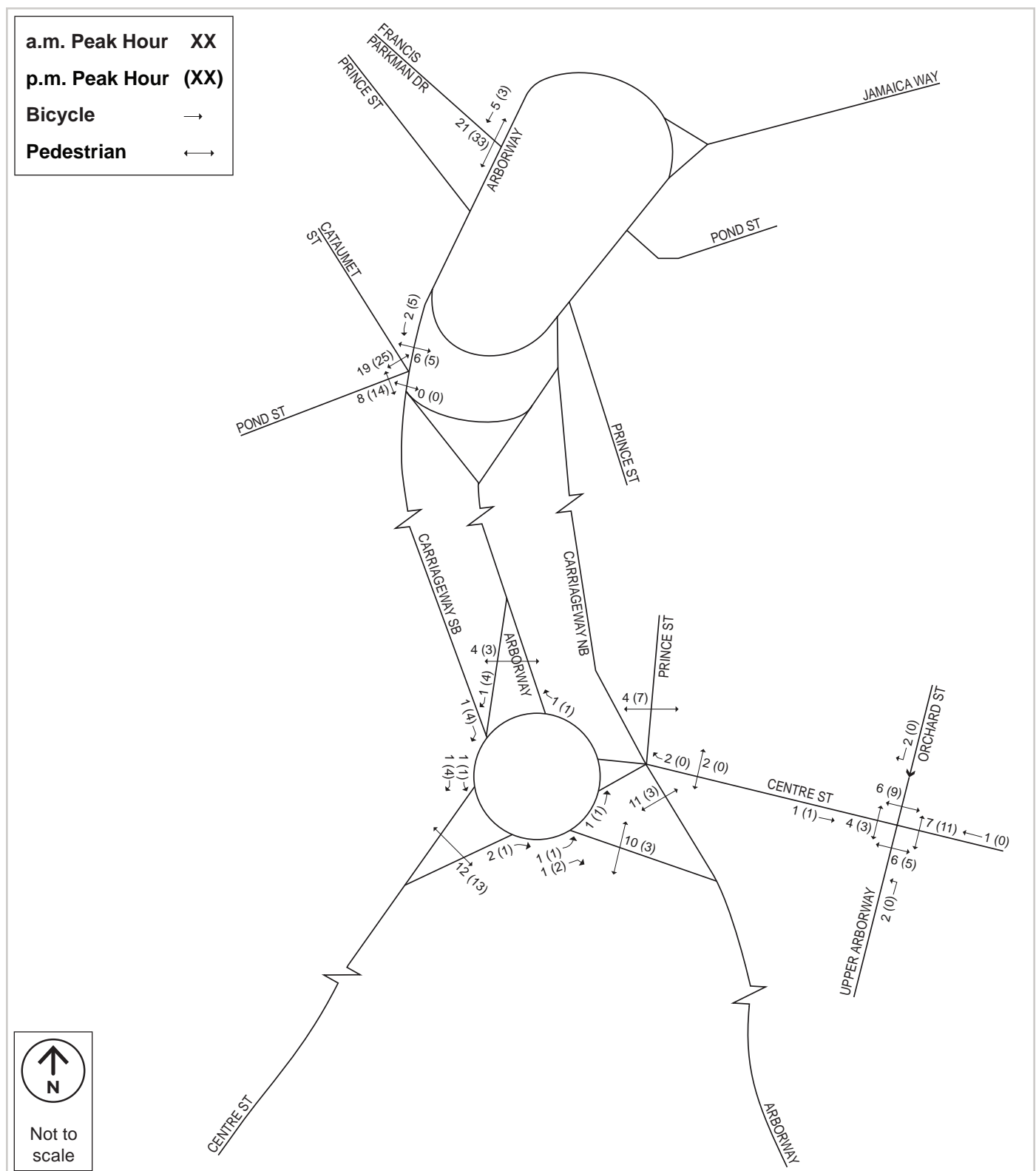




Figure 9. *Existing (2023) Conditions Pedestrian and Bicycle Volumes, Weekday a.m. and p.m. Peak Hours,*





Field Observations and Streetlight Data

QUEUES

Field observations of the project area, focusing on queue lengths and driver behavior, were conducted on the same day as the TMCs – Tuesday, January 24, 2023 – and between 7:00 a.m. and 9:00 a.m. in the morning and 4:00 p.m. and 6:00 p.m. in the evening.

During the a.m. peak hour, traffic flowed smoothly at Kelley Circle and the Jamaicaaway entrance, with minimal delays and queues at the Jamaicaaway approach. Vehicles from the Arborway northbound approach often entered the outside lane, leading to the right turn into Francis Parkman Drive. During the p.m. peak hour, queues formed on the Jamaicaaway entrance to Kelley Circle, which went beyond the Eliot Street intersection and the horizontal curve on Jamaicaaway, while traffic on the Arborway northbound approach flowed smoothly without any issues. Vehicles were still observed entering the right-most lane that leads to Francis Parkman Drive, but switching to the middle lane when they could, so they could continue southbound.

During the a.m. peak hour and at the Francis Parkman Drive and Prince Street approaches, vehicles entered Arborway southbound with little delay, except when a queue formed at the Arborway southbound/Pond Street/Cataumet Street signal. Short queues formed but cleared quickly once traffic on Arborway southbound began moving. At the Arborway Southbound/Pond Street/Cataumet Street signalized intersection, any queues cleared within one cycle, but long queues often formed on the Arborway southbound leg due to high volume. The opposite was true during the p.m. peak hour and at the signalized intersection, with the Arborway Southbound approach experiencing queues that went beyond the Arborway Southbound intersection with Francis Parkman Drive. This occurred frequently during the p.m. peak hour and Francis Parkman Drive and Prince Street vehicles had to wait for a safe gap within the queued vehicles on Arborway Southbound to enter Arborway.

Continuing to Murray Circle, during the a.m. peak hour, vehicles on the Arborway southbound and Carriageway southbound approaches were observed to rarely yield before entering the Circle, and any queues on these two roadways dissipated quickly. The Centre Street eastbound approach had queues reaching at least the Louders Lane intersection; the queue appeared to extend further but the view was obstructed by the horizontal curve west of that intersection. The Centre Street westbound approach to Murray Circle operated efficiently and any queues that formed and went past the Orchard Street and Upper Arborway intersection dissipated quickly, without creating delays on those two side streets. During the p.m. peak, the Arborway southbound and Carriageway southbound approaches did experience queueing that reached Kelley Circle, but vehicles kept



entering Murray Circle without much delay. However, this condition still created some friction at the Centre Street eastbound approach, which experienced similar queues to the a.m. peak.

Finally, the Arborway northbound approach to the Centre Street/Prince Street intersection queues extended past the midblock crosswalk adjacent to the Arnold Arboretum access road during the a.m. peak hour. At the same time, the Centre Street eastbound queues spilled back into Murray Circle, while Prince Street had minimal queueing. The Upper Arborway northbound approach experienced little queueing, while Centre Street westbound queues were dependent on the Centre Street westbound queues at the Arborway northbound/Prince Street intersection. Centre Street vehicles gave the right-of-way to Upper Arborway vehicles to access Centre Street when the queue was going beyond the intersection. However, these conditions didn't exist during the p.m. peak hour, with each approach flowing smoothly through this area.

DRIVER BEHAVIOR

Most drivers in the project area followed the rules of the road, with some exceptions observed. Drivers on Arborway southbound and Carriageway southbound approaches entered circulating traffic at Murray Circle by accepting short gaps, and Carriageway southbound drivers ignored the marked buffer and bike lane and drove as a two-lane road. Some Arborway northbound drivers disregarded lane use markings and signs by continuing through to Carriageway northbound onto the Arborway from the inside lane, but this was less frequent than the behavior observed on Carriageway southbound.

Drivers on the northern and northwestern section of Kelley Circle frequently change lanes and weave after passing the Jamaicaway approach (circulating vehicles) or entering Kelley Circle (entering vehicles) due to the outside lane becoming a right-turn-only lane to access Francis Parkman Drive. The alignment of the Jamaicaway approach to Kelley Circle is such that it guides both entering lanes towards the outside lane, thus causing some lane switching to occur as soon as vehicles enter Kelley Circle. Similarly, circulating vehicles from Arborway northbound need to change lanes to the outside lane if they want to continue onto Francis Parkman Drive, creating a weave movement.

STREETLIGHT AND GOOGLE MAPS TRAVEL TIME DATA

HSH utilized Streetlight data to collect travel time information throughout the project area. Streetlight Insight is a mobile GPS data aggregation platform which, to utilize it, virtual gates were set up at the boundaries of the study area, like the ATR locations, and Streetlight was able to process GPS data for the vehicle trips that passed through each gate to determine the travel times through the study area. Data from January 2022 (most recent year available on the platform) were



pulled for the a.m. peak between 6:00 – 10:00 a.m. and p.m. peak between 3:00 – 7:00 p.m. The data were then divided between the average weekday (between Tuesday and Thursday). However, it seems that there were some discrepancies in the travel time data provided by Streetlight for certain origin-destination pairs of Centre Street eastbound and westbound, Jamaica Way southbound, and Francis Parkman Drive eastbound. Streetlight either did not record enough data points for the travel times for some pairs or showed faster travel times than was observed.

To address this and the variability of travel times through the area, HSH used Google Maps to supplement the missing or incompatible data. Google Maps uses historical data to estimate travel times and can either provide a range, based on the different travel times experienced, or a single value, if not much variation exists in that travel time. **Table 2** summarizes the travel times that were collected by Streetlight and Google Maps. The travel times presented in **Table 2** were used to calibrate the existing conditions VISSIM models. Additional discussion on calibration of the VISSIM models can be found in the following section.



Table 2. Streetlight and Google Maps Travel Time Data

Origin-Destination	Streetlight		Google Maps	
	a.m. Peak Hour Travel time (minutes)	p.m. Peak hour Travel time (minutes)	a.m. Peak Hour Travel time (minutes)	p.m. Peak hour Travel time (minutes)
From Arborway Northbound				
To Jamaicaway Northbound	2.9	2.5	3.0 – 7.0	3.0
To Pond St Westbound	2.9	2.4	3.0 – 7.0	4.0
To Centre St Westbound	2.3	1.9	3.0	3.0
From Centre St Eastbound				
To Arborway Southbound	1.1	-	2.0	2.0 – 6.0
To Centre St Eastbound	1.3	1.5	2.0	3.0
To Pond St Westbound	2.0	3.9	2.0 – 6.0	5.0
To Jamaicaway Northbound	1.9	2.0	4.0	2.0 – 6.0
From Centre St Westbound				
To Centre St Westbound (east of Murray Circle)	1.2	1.2	2.0	2.0
From Pond St Eastbound				
To Jamaicaway Northbound	2.1	2.1	2.0	3.0
To Centre St Eastbound	1.7	-	3.0	2.0 – 6.0
To Arborway Southbound	1.6	2.2	2.0	3.0
From Jamaicaway Southbound				
To Arborway Southbound	2.1	2.6	3.0	2.0 – 7.0
To Centre St Westbound	1.9	2.1	3.0	2.0 – 6.0
To Pond St Westbound	1.0	1.4	2.0	2.0
From Francis Parkman Drive				
To Centre St Westbound	1.4	1.9	2.0	3.0
To Arborway Southbound	1.8	2.2	2.0	3.5



VISSIM Operational Analysis

Due to the complexity of the study area, as well as the variety of functional classification and control of the roadways within the study area, VISSIM (version 2023) was primarily used to analyze the operations of the roadways. This section explains the methodology for creating the existing conditions model in VISSIM and presents the results of the analysis.

METHODOLOGY/MODEL CALIBRATION

VISSIM requires seeding time to fill the network with vehicles and get the signals to operate as coded in the model. Once the seeding time is completed, VISSIM requires a recording time, which is the period it starts recording the traffic operational metrics including the volumes, delay, queues, and travel times. For this traffic analysis, the seeding time was set for 30 minutes, and the recording time was set for one hour, for a total of 1.5 hours of simulation.

To recreate in VISSIM the existing condition within the study area, all the inputs needed were derived from the January and February 2023 ATRs and TMCs, the field observations, and Streetlight (origin-destination and travel times) collected data sets. Those inputs included:

- Peak hour volumes
- Heavy-vehicle percentages
- Vehicle origin-destination numbers
- Vehicular speeds on Jamaicaaway, Arborway, the Carriageways, Centre Street on either side of Murray Circle, and all side streets impacted by the project, and including:
 - Reduced speed areas to simulate reduction in speed when turning at an intersection or approaching either Kelley or Murray Circle.
 - Desired speed points to mark speed change locations between Jamaicaaway, Arborway, and the local streets.
 - Desired speed distributions developed from existing ATR speed information.
- Link behavior:
 - The northern section of Kelley Circle was specifically modeled to assist vehicles in changing lanes to reach their intended destinations. This section of Kelley Circle sees frequent lane-changing due to the alignment of the Jamaicaaway approach with the right-turn-only lane that leads to Francis Parkman Drive, while most drivers intend to stay on Arborway and go southbound. Given the interaction between vehicles observed on the field, the following parameters were changed in an iterative manner to match this condition:
 - The average standstill distance, from 6.56 to 9.16;



- The additive part of safety distance, from 2.00 to 1.05;
 - The multiplicative part of safety distance, from 3.0 to 4.33;
 - The maximum deceleration for trailing vehicle, from -9.84 ft/s² to -13.12 ft/s²;
 - The waiting time before diffusion, from 60 seconds to 120 seconds;
 - The advanced merging was checked on; and
 - The cooperative lane change was checked on with maximum speed difference set at 6.71 mph from 10 mph, and maximum collision time set to 5 seconds from 10 seconds.
- Driver Behavior including:
 - Lane change distances throughout the project area to allow sufficient time for vehicles to change lanes and better match field observations.
 - Safety reduction, gap factors, and anticipated routes for conflict areas
 - Safety reduction value reduced from 1.5 to 0.2, to simulate the immediate entering of vehicles from Carriageway and Arborway southbound, and from Centre Street eastbound into Murray Circle.
 - Front and rear gaps were reduced from 0.5 to 0.2 at the locations mentioned previously, to simulate the smaller gaps that vehicles were accepting to enter the congested roadway.
 - Changed anticipated routes to 100% (default is 0%) for all Murray and Kelley Circle entry legs, allowing entering vehicles to anticipate if a circulating vehicle is exiting before crossing in front of them.
- Queue capture rate:
 - Queue capture rate was changed from default values to begin recording a queue at 6 mph or below and stop recording once vehicles achieve 12 mph (defaults values are 3.1 mph and 6.2 mph respectively).
 - Maximum queue length was increased from the default of 1640.4 feet to 2,000 feet, as queues on Centre Street, west of Murray Circle, and Arborway southbound toward Murray Circle were observed to extend beyond the default value.
 - Start of Delay Segment was changed from the default of 328.1 feet to 1000 feet, to account for the long queues at the Centre Street eastbound approach to Murray Circle.

After the existing VISSIM model was created and checked against observations, data collection points were created within the model to record its performance. Namely, the following outputs were recorded from VISSIM and checked against the existing condition:

- Entering and exiting volumes (vehicles per hour);



- Speeds throughout the study area (in miles per hour);
- Queue lengths (in feet);
- Travel times of specific origins and destinations (in minutes);
- Intersection Level of Service (LOS); and
- Delay (in seconds per vehicle).

VISSIM MODEL TRAVEL TIME RESULTS

Table 3 summarizes the travel times for the same movements summarized in **Table 2**. The existing condition VISSIM travel times represent the average of ten different VISSIM runs to account for variation and randomization of vehicle behavior. When comparing the VISSIM a.m. peak hour travel times to the Streetlight and Google Maps data from **Table 2**, most VISSIM travel times fall within 15% to the Streetlight or Google Maps travel times. However, there are some routes that vary by half a minute or more from the Streetlight and Google Maps travel times. During the field observations, it was recorded that Centre Street eastbound approach to Murray Circle experiences congestion and rolling queues that reached Louders Lane and could be longer (couldn't see beyond the hill at Louders Lane), and the signal at the Arborway Southbound/Pond Street/Cataumet Street intersection also caused delay for the vehicles headed southbound.

When comparing the VISSIM p.m. peak hour travel times to Streetlight and Google Maps data from **Table 2**, most VISSIM travel times are within acceptable range. However, there are some routes which vary by a minute and up to two and a half minutes from the Streetlight and Google travel times. During the field observations, it was recorded that the corridor experiences congestion on the Carriageway southbound approach to Murray Circle during the p.m. peak hour, and experiences rolling queues that reach back to Kelley Circle. This queueing causes some friction at the Arborway Southbound/Pond Street/Cataumet Street intersection, that often leads to queues on Arborway Southbound that reach the Jamaicaway entry to Kelley Circle. The VISSIM model also shows this, but more severely than what is experienced, as the VISSIM p.m. peak travel times from Jamaicaway, Francis Parkman Drive, and Pond Street were within 30% of the Streetlight and Google Maps travel times. This congestion affects the Jamaicaway travel times through the corridor as can be seen from the VISSIM results.



Table 3. Existing (2023) VISSIM Travel Times for Major Movements

Origin-Destination	a.m. Peak Hour Travel time (minutes)	p.m. Peak hour Travel time (minutes)
From Arborway Northbound		
To Jamaicaway Northbound	3.3	2.5
To Francis Parkman Drive	3.4	3.1
To Pond St Westbound	3.9	4.2
To Centre St Westbound	3.0	2.0
From Centre St Eastbound		
To Arborway Southbound	3.2	4.0
To Centre St Eastbound	3.4	3.9
To Francis Parkman Drive	3.9	5.1
To Pond St Westbound	4.6	6.3
To Jamaicaway Northbound	3.9	4.6
From Centre St Westbound		
To Jamaicaway Northbound	1.9	1.6
To Centre St Westbound (east of Murray Circle)	1.4	1.1
From Pond St Eastbound		
To Jamaicaway Northbound	1.7	3.6
To Centre St Westbound	1.7	3.9
To Arborway Southbound	2.3	4.6
From Jamaicaway Southbound		
To Arborway Southbound	3.0	6.5
To Centre St Westbound	2.3	5.6
To Francis Parkman Drive	0.9	3.8
To Pond St Westbound	1.5	4.9
From Francis Parkman Drive		
To Centre St Westbound	1.7	4.1
To Arborway Southbound	2.4	4.8



VISSIM MODEL CAPACITY ANALYSIS

Traffic operations are determined through an analysis of intersection LOS calculations. LOS, at signalized and unsignalized intersections, is typically calculated using the traffic operational analysis methodology of the Transportation Research Board's (TRB's) 2022 *Highway Capacity Manual, 7th Edition* (HCM) criteria, presented in **Table 4**. VISSIM outputs, as recorded by the model, are summarized in **Table 5**, which provides the LOS, delay, average, and maximum queues (in feet) recorded after the models were run 10 times to account for variation in traffic conditions.

Table 4. *Level of Service Criteria*

Level of Service	Average Stopped Delay (sec.) Signalized Intersections	Average Stopped Delay (sec.) Unsignalized Intersections
A	0.0–10.0	0.0–10.0
B	10.1–20.0	10.1–15.0
C	20.1–35.0	15.1–25.0
D	35.1–55.0	25.1–35.0
E	55.1–80.0	35.1–50.0
F	>80.0	>50.0

Source: Highway Capacity Manual, 7th Edition. Transportation Research Board.



Table 5. Existing (2023) Conditions Capacity Analysis – a.m. and p.m. Peak Hours

Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Jamaicaway at Eliot St (signalized)	A	8.4			E	61.1		
Jamaicaway NB thru thru/right	A	9.1	31	487	A	9.0	22	292
Jamaicaway SB thru thru	A	6.0	28	324	F	106.4	439	509
Jamaicaway SB/Arborway NB (unsignalized)	A	8.9			D	49.1		
Jamaicaway SB right right	B	12.1	61	397	E	66.8	370	483
Arborway NB left left	A	4.1	2	199	A	9.7	20	370
Francis Parkman Dr/Arborway SB (unsignalized)	A	3.6			D	37.3		
Francis Parkman EB right	A	3.6	20	311	C	24.4	219	331
Arborway SB right	A	5.0	5	161	F	98.8	247	355
Arborway SB thru thru	A	3.4	19	281	C	29.7	194	301
Prince St/Arborway SB (unsignalized)	A	3.2			B	16.2		
Prince St EB right	A	5.3	1	41	E	64.7	41	228
Arborway SB thru thru thru	A	3.1	16	184	B	13.1	100	201
Arborway SB/Pond St/Cataumet St (signalized)	C	21.7			E	57.1		
Pond EB left/thru/right	D	48.0	90	439	F	172.4	499	579
Cataumet SEB left/thru/right	E	59.9	1	24	F	81.4	1	23
Arborway SB thru thru	B	17.7	104	290	D	31.7	205	295
Arborway SB right	B	18.0	104	290	D	35.7	205	295
Arborway NB/South U-Turn (unsignalized)	A	1.4			A	0.8		
U-turn EB left	A	3.0	2	121	A	1.5	1	109
Arborway NB thru thru	A	1.3	0	0	A	0.6	0	0
Arborway NB/North U-Turn (unsignalized)	A	0.7			A	1.9		
U-turn EB left	C	16.7	1	71	C	25.9	3	76
Arborway NB thru thru thru	A	0.6	0	46	A	1.0	5	324
Arborway SB/Carriageway SB/Murray Circle (unsignalized)	B	14.6			D	32.8		
Murray Circle WB thru thru	A	2.3	3	140	A	1.9	1	97
Arborway SB right right	B	10.3	37	300	C	22.0	108	501
Carriageway SB right	D	31.7	156	777	E	66.9	466	1338
Centre St EB/Murray Circle (unsignalized)	F	98.3			F	87.6		
Centre EB right right	F	152.9	1052	1137	F	189.8	671	993
Murray Circle SB thru thru	A	5.6	20	283	A	5.1	26	279
Arborway NB/Centre St/Prince St (signalized)	D	43.3			C	24.3		
Centre EB left	D	34.2	72	379	C	21.0	51	368



Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Centre EB thru	C	26.9	72	379	B	19.8	51	368
Centre WB thru/right	B	18.2	59	154	B	12.7	31	144
Arborway NB left	E	63.3	370	699	C	28.6	144	605
Arborway NB thru/right	D	46.5	370	699	D	32.4	144	605
Prince SB left/right	D	52.6	6	56	D	52.2	3	49
Upper Arborway/Centre St/Orchard St (unsignalized)	F	69.6			A	7.7		
Centre EB thru/right	A	1.0	3	160	A	0.9	3	166
Centre WB left/thru	D	30.9	68	372	B	11.8	32	305
Upper Arborway NB left/right	F	295.9	317	584	B	17.2	7	119
Orchard SB left/thru/right	C	21.7	5	65	A	7.3	1	42
Arborway SB/Arboretum Driveway (unsignalized)	A	2.6			A	3.6		
Arboretum EB right	A	4.7	0	2	B	10.0	0	0
Arborway SB thru/right	A	2.6	2	216	A	3.7	12	367
Arborway/Mid-Block Crossing (signalized)	B	20.0			A	2.6		
Arborway NB thru thru	B	17.6			A	3.5	17	287
Arborway SB thru	C	28.4	241	729	A	1.3	18	182
Centre WB/Murray Circle (unsignalized)	A	2.7			A	1.2		
Centre WB thru thru/right	A	1.5	5	259	A	0.6	0	50
Murray Circle left/thru thru	A	3.5	12	208	A	1.5	2	104



Most intersections operate at LOS D or better during the peak hours. However, the following intersections or movements operate at LOS E or F and experience queue spillback:

INTERSECTION MOVEMENTS

- Jamaicaaway/Eliot Street
 - Jamaicaaway southbound approach operates at LOS F during the p.m. peak hour.
- Jamaicaaway/Kelley Circle
 - Jamaicaaway southbound approach to Kelley Circle operates at LOS E during the p.m. peak hour.
- Arborway southbound/Francis Parkman Drive
 - Arborway southbound approach operates at LOS E during the p.m. peak hour.
- Arborway southbound/Pond Street/Cataumet Street
 - Pond Street eastbound approach operates at LOS F during the p.m. peak hour.
- Murray Circle
 - Centre Street eastbound approach operates at LOS F during both a.m. and p.m. peak hours.
 - Carriageway southbound approach operates at LOS E during the p.m. peak hour.
- Upper Arborway/Centre Street/Orchard Street
 - Upper Arborway northbound approach operates at LOS F during the a.m. peak hour.

QUEUES

- Murray Circle
 - Centre Street eastbound approach queues are approximately a quarter mile in length during the a.m. peak hour, reaching Louders Lane, and under a quarter mile in the p.m. peak hour
- Jamaicaaway/Eliot Street
 - The Jamaicaaway southbound approach queues past the Burroughs Street intersection during the p.m. peak hour.
- Jamaicaaway/Kelley Circle
 - The Jamaicaaway southbound approach queues through the Eliot Street intersection during the p.m. peak hour.
- Arborway southbound/Pond Street/Cataumet Street
 - The Pond Street eastbound approach queue reaches the May Street intersection during the p.m. peak hour.
- Murray Circle



- The Carriageway southbound approach queues back to Kelley Circle and the Arborway southbound/Pond Street/Cataumet Street intersection during the p.m. peak hour.
- The Centre Street eastbound approach queues up to Louders Lane during the a.m. peak hour and are just short of Louders Lane during the p.m. peak hour.

EXISTING CONDITIONS RESULTS SUMMARY

With the calibration discussed in this section, the results show that the calibrated VISSIM model closely resembles the existing conditions in the corridor at the time of the data collection. In particular, the model shows the congestion experienced on Centre Street eastbound (a.m. and p.m. peaks), Jamaicaaway, Francis Parkman Drive, and Pond Street (p.m. peak only), via the long queues and long travel times for those movements.

Future (2033) Conditions

Future traffic volumes were estimated and analyzed to determine the operations of the intersection under two conditions:

- No-build – Future traffic volumes with existing geometry, and
- Build – Future traffic volumes with geometric and timing improvements throughout the study area.

These two future conditions are discussed in the sections following.

NO-BUILD CONDITIONS (2033)

ESTIMATION OF FUTURE TRAFFIC VOLUMES

Following the same methodology as the May 2021 Conceptual Design Report (CDR), no background growth was applied to the existing 2023 traffic volumes, as the City of Boston's guidance recommends incorporating only trip generation associated with permitted development projects within a half mile of the project area. The nearby developments that were considered were the following:

- **The Residences at Forest Hills**, a six-story, mixed-use development with approximately 250 residential rental units, approximately 4,070 square feet of retail space, and 140 parking spaces.
- **50 Stedman Street**, a three-story, approximately 21-unit residential building with parking for 21 vehicles.



- **35 Brookley Road**, a four-story residential building with 45 rental units and parking for 19 vehicles.

Traffic volumes generated by these developments are presented in **Figure 10** and the total future traffic volumes used for the analysis are shown in **Figure 11**. The No-build conditions VISSIM travel times and capacity analysis during the weekday a.m. and p.m. peak hours are presented in **Table 6** and **Table 7**, respectively. The volumes generated by the proposed developments are minor; therefore, the increase in travel times in the a.m. and p.m. peak hours is minor as well. Most intersections operate at LOS D or better during the peak hours. The intersections with movements that operated at LOS E and F had long queues that spilled back to adjacent intersections, experience those conditions in the future as well.

FUTURE NO-BUILD RESULTS SUMMARY

Similar to the existing conditions, the future analysis of the corridor without any improvements continues to show congestion on Centre Street, Jamaicaaway, Francis Parkman Drive, and Pond Street, by showing longer queues and even longer travel times through the corridor.



Figure 10. *Proposed Development Generated Volumes, a.m. and p.m. Peak Hours*

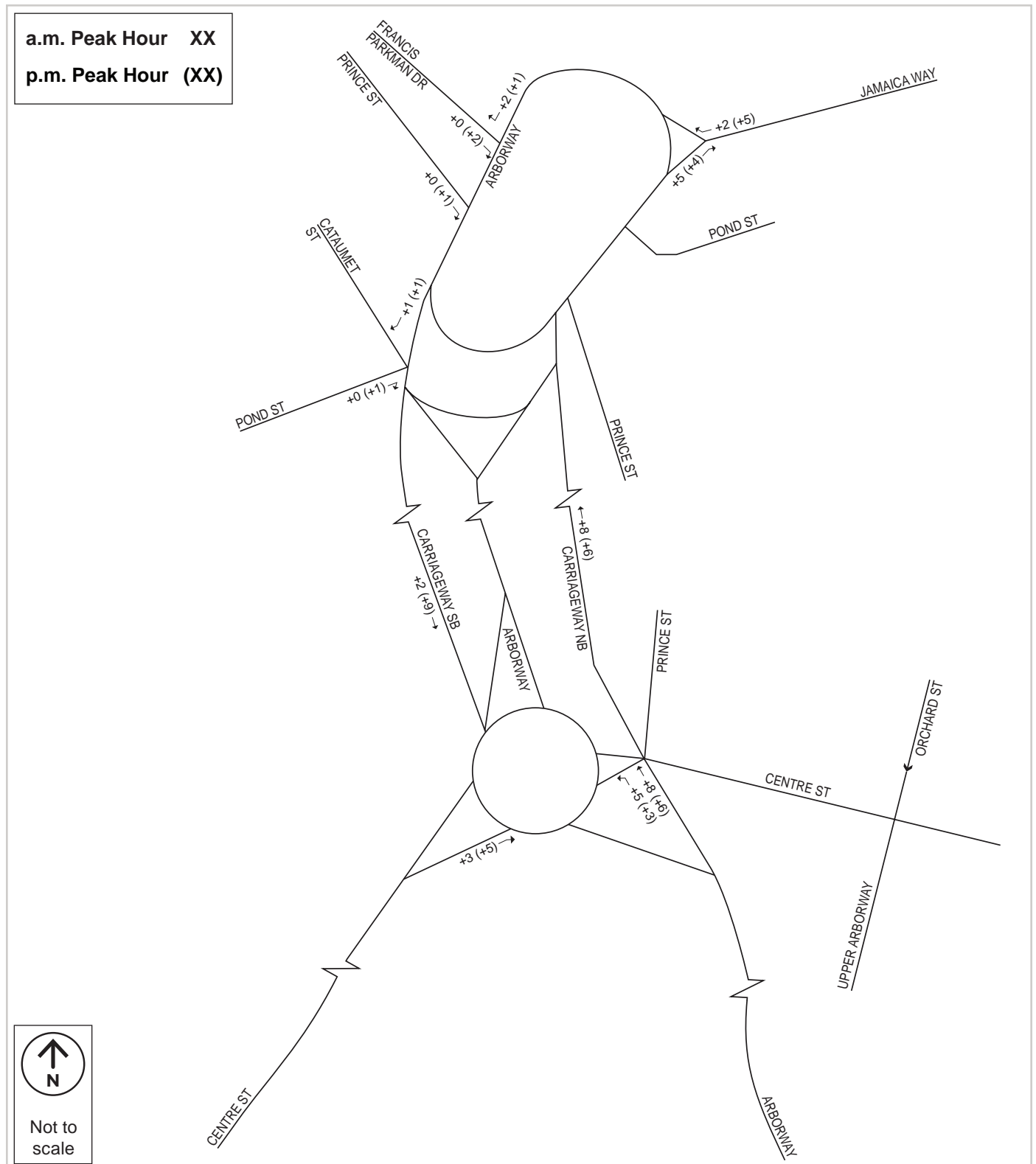




Figure 11. *Future No-build (2033) Conditions Turning Movement Volumes, Weekday a.m. and p.m. Peak Hours*

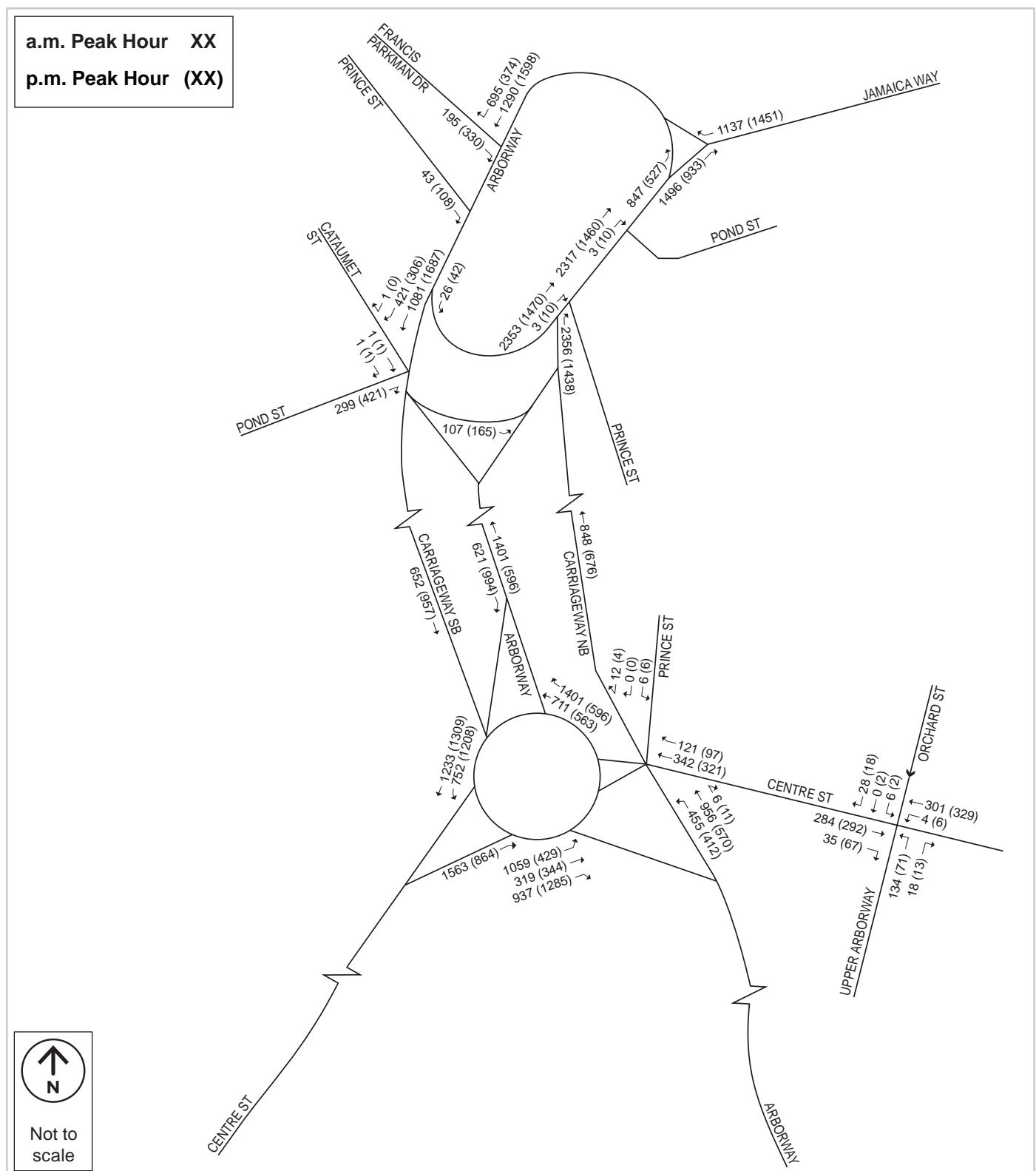




Table 6. No-build VISSIM Travel Times for Major Movements

Origin-Destination	a.m. Peak Hour Travel time (minutes)	p.m. Peak hour Travel time (minutes)
From Arborway Northbound		
To Jamaicaway Northbound	3.2	2.5
To Francis Parkman Drive	3.2	3.1
To Pond St Westbound	3.7	4.3
To Centre St Westbound	2.8	2.0
From Centre St Eastbound		
To Arborway Southbound	3.9	4.5
To Centre St Eastbound	3.4	3.8
To Francis Parkman Drive	4.0	5.0
To Pond St Westbound	4.5	6.2
To Jamaicaway Northbound	3.9	4.5
From Centre St Westbound		
To Jamaicaway Northbound	2.0	1.6
To Centre St Westbound (east of Murray Circle)	1.5	1.1
From Pond St Eastbound		
To Jamaicaway Northbound	1.6	3.5
To Centre St Westbound	1.7	3.7
To Arborway Southbound	2.3	4.4
From Jamaicaway Southbound		
To Arborway Southbound	3.0	6.6
To Centre St Westbound	2.3	5.7
To Francis Parkman Drive	0.9	3.9
To Pond St Westbound	1.5	5.3
From Francis Parkman Drive		
To Centre St Westbound	1.6	4.1
To Arborway Southbound	1.5	5.0



Table 7. No-build (2033) Conditions Capacity Analysis – a.m. and p.m. Peak Hours

Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Jamaicaway at Eliot St (signalized)	A	8.7			E	62.8		
Jamaicaway NB thru thru/right	A	9.9	35	424	A	9.1	22	276
Jamaicaway SB thru thru	A	6.4	31	347	F	112.6	447	518
Jamaicaway SB/Arborway NB (unsignalized)	A	9.0			D	52.0		
Jamaicaway SB right right	B	12.5	64	415	E	71.8	381	487
Arborway NB left left	A	3.9	1	187	B	10.1	24	393
Francis Parkman Dr/Arborway SB (unsignalized)	A	3.3			D	43.8		
Francis Parkman EB right	A	3.4	19	299	C	25.9	230	335
Arborway SB right	A	3.4	3	122	F	116.1	277	359
Arborway SB thru thru	A	3.3	18	269	D	32.9	204	305
Prince St/Arborway SB (unsignalized)	A	2.7			B	18.6		
Prince St EB right	A	3.1	0	35	E	76.6	48	246
Arborway SB thru thru thru	A	2.7	14	183	B	14.8	110	196
Arborway SB/Pond St/Cataumet St (signalized)	C	21.3			E	58.0		
Pond EB left/thru/right	D	37.7	88	406	F	187.8	493	580
Cataumet SEB left/thru/right	E	61.1	1	24	E	65.1	0	23
Arborway SB thru thru	B	17.2	102	289	D	33.6	216	297
Arborway SB right	B	17.5	102	289	D	37.8	216	297
Arborway NB/South U-Turn (unsignalized)	A	1.5			A	0.8		
U-turn EB left	A	3.3	2	100	A	1.4	1	117
Arborway NB thru thru	A	1.3	0	0	A	0.6	0	0
Arborway NB/North U-Turn (unsignalized)	A	0.7			A	2.0		
U-turn EB left	B	16.1	1	47	D	30.6	0	40
Arborway NB thru thru thru	A	0.6	1	111	A	1.1	5	332
Arborway SB/Carriageway SB/Murray Circle (unsignalized)	B	16.2			C	26.0		
Murray Circle WB thru thru	A	2.3	3	125	A	1.8	1	110
Arborway SB right right	B	10.6	39	306	B	19.2	95	449
Carriageway SB right	D	36.1	186	834	D	51.2	341	1208
Centre St EB/Murray Circle (unsignalized)	F	98.5			F	84.6		
Centre EB right right	F	152.9	987	1069	F	181.4	647	956
Murray Circle SB thru thru	A	5.9	23	279	A	4.8	23	274
Arborway NB/Centre St/Prince St (signalized)	D	43.3			C	24.1		



Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Centre EB left	D	43.1	79	380	C	23.3	53	376
Centre EB thru	C	27.6	79	380	B	18.7	53	376
Centre WB thru/right	B	18.5	53	155	B	12.3	31	140
Arborway NB left	E	63.2	371	702	C	29.0	140	599
Arborway NB thru/right	D	45.9	371	702	D	31.8	140	599
Prince SB left/right	D	51.5	6	60	D	50.8	3	53
Upper Arborway/Centre St/Orchard St (unsignalized)	F	84.2			A	7.6		
Centre EB thru/right	A	1.1	3	172	A	0.9	3	172
Centre WB left/thru	D	33.2	84	400	B	12.0	32	297
Upper Arborway NB left/right	F	374.7	390	660	B	16.4	7	106
Orchard SB left/thru/right	B	18.8	4	67	A	5.6	1	49
Arborway SB/Arboretum Driveway (unsignalized)	A	2.0			A	3.8		
Arboretum EB right	A	4.2	0	0	A	9.3	0	0
Arborway SB thru thru/right	A	1.9	0	0	A	3.9	15	500
Arborway/Mid-Block Crossing (signalized)	B	12.6			A	2.6		
Arborway NB thru thru	C	20.4	169	586	A	3.4	17	286
Arborway SB thru	A	0.2	0	0	A	1.3	18	181
Centre WB/Murray Circle (unsignalized)	A	2.8			A	1.3		
Centre WB thru thru/right	A	1.6	8	326	A	0.6	0	47
Murray Circle left/thru thru	A	3.5	11	205	A	1.5	2	133



BUILD CONDITIONS (2033)

The preferred alternative, called Alternative 5, is shown graphically in **Figure 12**. **Figure 13** displays the future traffic volumes under the proposed geometry which is anticipated to shift regional through traffic off the Carriageways and onto the Arborway mainlines. **Figure 14** displays the rerouted pedestrian and bicycle movements, based on the proposed shared use path and new intersection created under the preferred alternative. A brief description of the proposed changes with the project area follows:

- The Arborway northbound and southbound barrels will no longer be separated by Kelley Circle. The Arborway southbound barrel will move to the east side of Kelley Circle;
- Kelley Circle will be reconstructed to provide one signalized intersection that connects the old Arborway southbound barrel with the new Arborway, providing both northbound and southbound access. The repurposed old Arborway southbound barrel will provide connections for all modes between Francis Parkman Drive, Prince Street, Pond Street, Cataumet Street and the new Arborway, as well as to the side streets to the east of Arborway;
- Under the new Kelley Circle signalized intersection, left turns from Pond Street to Francis Parkman Drive will be prohibited to provide for an overlapping Arborway southbound right-turn which helps with operations at the Kelley Circle intersection. The prohibited left turns can use Rockwood Street to the west of May Street to access Perkins Street and their destinations. The Pond Street to Francis Parkman Drive movement is a small volume movement (13 vehicles in the a.m. peak hour and 17 vehicles in the p.m. peak hour), that rerouting it to Rockwood Street is not expected to cause any issues.
- Murray Circle will be reconstructed into a signalized intersection and Arborway northbound will be realigned to provide a fourth intersection approach. The Arborway southbound and Centre Street westbound approaches will prohibit left turns, but will accommodate these movements with a new U-turn through the Centre Street median on the west leg of the intersection;
- The Centre Street at Hillcroft Street signal will be upgraded to add a traffic signal phase that will create a gap on the Centre Street eastbound flow for the U-turns mentioned above to enter Centre Street and complete their maneuver;
- Both Carriageways will be dead-ended on both ends, but will allow access and egress at those locations for emergency vehicles and local traffic (Carriageway southbound only). General access for all modes to and from Arborway will be at the proposed midblock crossing between the Kelley Circle and Murray Circle intersections. This new intersection will allow right-in and right-out movements only during the peak traffic hours, and allow left turns during the off-peak hours. During the peak hours, vehicles that will need to reverse direction and access a Carriageway can do so at the U-turn provided on Centre Street, west of Murray Circle, and



by turning left from Pond Street to Carriageway southbound via the proposed access/egress point;

- Pedestrian and bicycle accommodations will be provided at all signalized intersections;
- A new midblock crossing between Murray and Kelley will be provided; and
- A shared-use path is proposed that will connect the paths around Jamaica Pond, through Kelley Circle, connecting onto the median between Carriageway southbound and Arborway, and leading into Murray Circle.



Figure 12. *Preferred Alternative*





Figure 13. *Future Build (2033) Conditions Turning Movement Volumes, Weekday a.m. and p.m. Peak Hours*

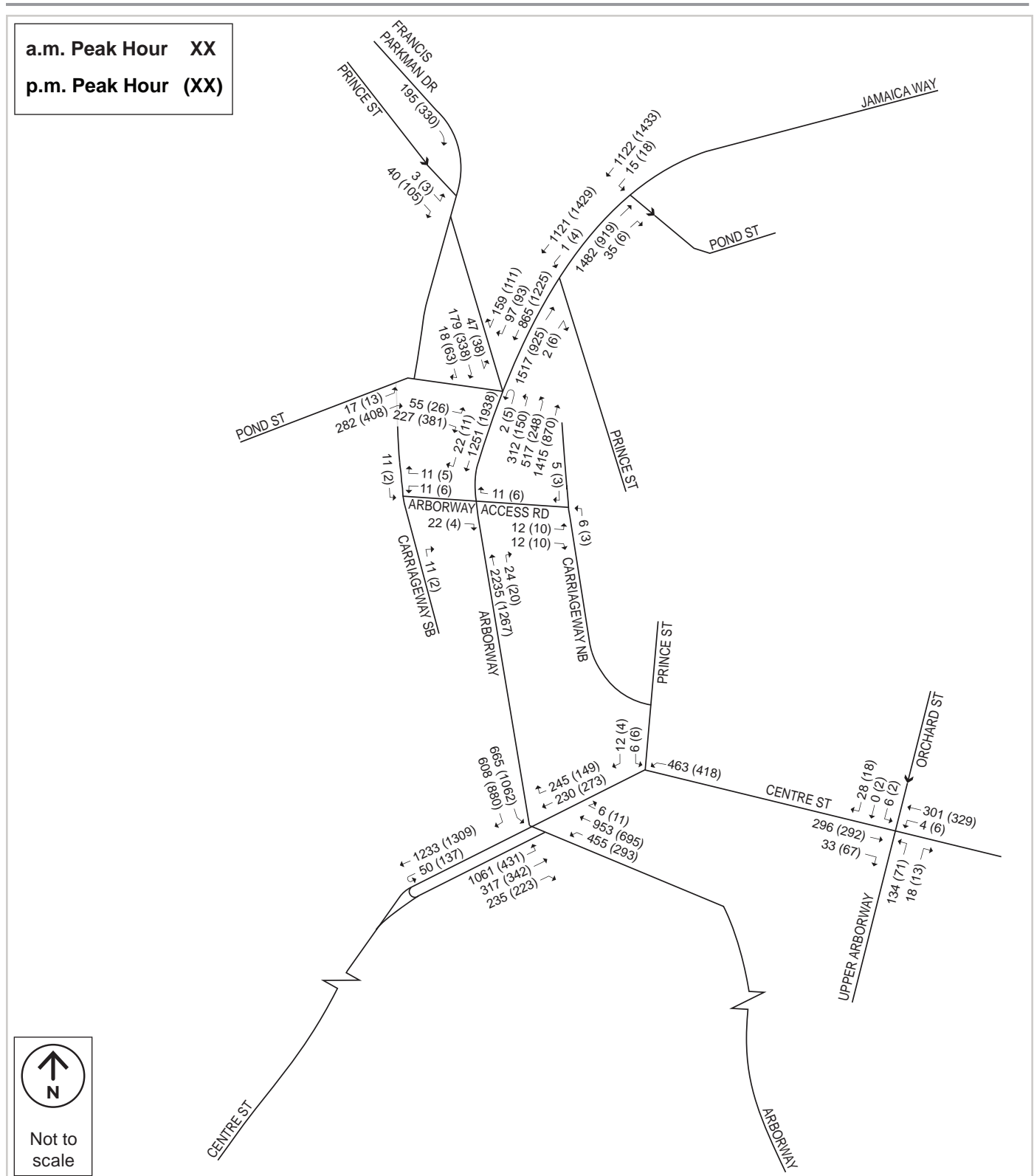
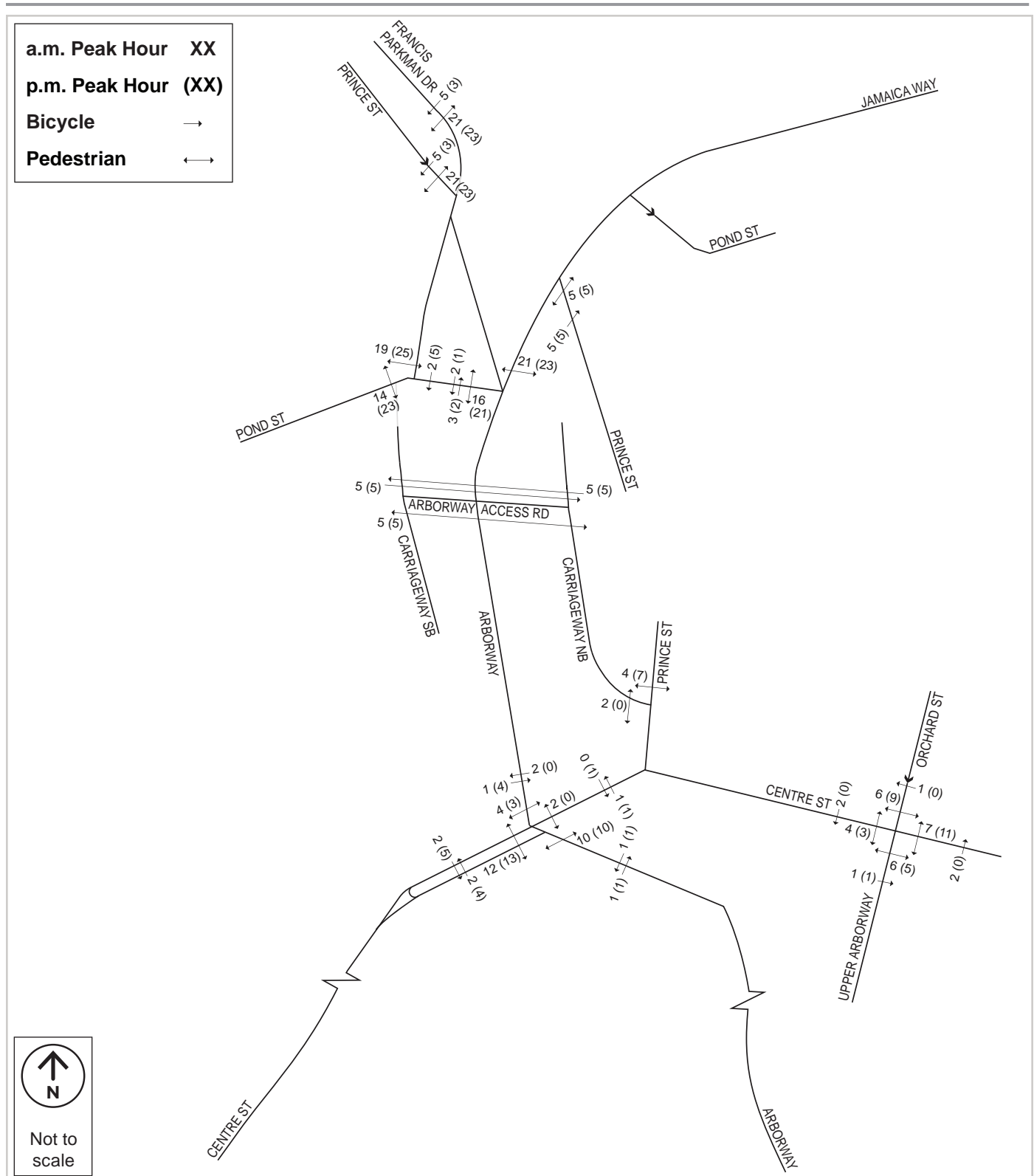




Figure 14. *Future Build (2033) Conditions Pedestrian and Bicycle Volumes, Weekday a.m. and p.m. Peak Hours*





VISSIM MODEL CALIBRATION FOR BUILD CONDITIONS

The preferred alternative creates new merging areas along the Arborway. The new traffic signals proposed include exclusive turning lanes which will impact the driver behavior at Kelley Circle and Murray Circle intersections. These changes necessitated the following driver behavior and lane change distance adjustments to more accurately model the proposed conditions:

■ Link Behavior

- A new link behavior for the merge condition was created. That merge condition required the following parameters to change:
 - The average standstill distance, from 6.56 to 5.65;
 - The additive part of safety distance, from 2.00 to 1.68;
 - The multiplicative part of safety distance, from 3.0 to 4.13;
 - The maximum deceleration for own and trailing vehicles, from -9.84 ft/s² to -11.20 ft/s²;
 - The distance over which the deceleration occurs for own and trailing vehicles from 100 feet for both to 200 feet and 25 feet;
 - The advanced merging was checked on;
 - The safety distance reduction factor was changed from 0.60 to 0.10;
 - The maximum deceleration for cooperative braking from -9.84 ft/s² to -15 ft/s²; and
 - The cooperative lane change was checked on with maximum speed difference set at 20 mph from 10 mph, and maximum collision time set to 5 seconds from 10 seconds.

■ Lane Change Distance

- The emergency stop distance and lane change distance parameters were changed from default values for the following movements:
 - At Murray Circle:
 - Centre Street Eastbound dual left turn lanes – emergency stopping distance was set to 60 feet and lane change distance to 1,000 feet;
 - Arborway Southbound dual right turn lanes – emergency stopping distance was set to 60 feet and lane change distance to 840 feet;
 - Arborway Southbound dual through lanes – emergency stopping distance was set to 60 feet and lane change distance to 1,000 feet; and
 - Arborway Northbound left turn lane – emergency stopping distance was set to 372 feet;
 - At Kelley Circle Intersection:



- Arborway Northbound left turn lane – emergency stopping distance was set to 350 feet and lane change distance to 1,000 feet;
- Arborway Southbound right turn lane – emergency stopping distance was set to 60 feet and lane change distance to 1,000 feet; and
- Francis Parkman Drive Southbound dual left turn lanes – emergency stopping distance was set to 250 feet.

The VISSIM travel times and capacity analysis for the weekday a.m. and p.m. peak hours under the preferred alternative are presented in **Table 8** and **Table 9** respectively.

Under the Preferred Alternative, during the a.m. peak, 62% of vehicles on the Arborway corridor will see a travel time decrease of 0.1–1.7 minutes per vehicle (min/veh), with Centre Street eastbound (32%) and Arborway northbound (30%) experiencing the most significant reductions (1.7 and 0.1 min/veh, respectively). The remaining 38% of vehicles will face a travel time increase of 0.4–1.8 min/veh, primarily affecting Centre Street westbound (5%) and Francis Parkman Driveway eastbound (3%) with increases of 1.8 and 1.6 min/veh, respectively.

In the p.m. peak, 71% of vehicles will benefit from a 1.0–3.3 min/veh travel time decrease, led by Centre Street eastbound (20%) and Jamaica Way southbound (34%) with reductions of 3.3 and 2.4 min/veh, respectively. The remaining 29% of vehicles will see an increase of 0.4–2.6 min/veh, notably on Centre Street westbound (5%) and Arborway northbound (24%) with increases of 2.6 and 0.4 min/veh, respectively.



Table 8. Build Condition VISSIM Travel Times for Major Movements

Origin-Destination	a.m. Peak Hour Travel time (minutes)	p.m. Peak hour Travel time (minutes)
From Arborway Northbound		
To Jamaicaway Northbound	3.2	3.7
To Francis Parkman Drive	4.3	3.7
To Pond St Westbound	4.0	3.4
To Centre St Westbound	3.3	4.1
From Centre St Eastbound		
To Arborway Southbound	2.3	2.1
To Centre St Eastbound	1.8	1.4
To Francis Parkman Drive	4.0	2.7
To Pond St Westbound	3.7	2.4
To Jamaicaway Northbound	3.6	2.8
From Centre St Westbound		
To Jamaicaway Northbound	5.4	5.8
To Centre St Westbound (east of Murray Circle)	4.6	5.3
From Pond St Eastbound		
To Jamaicaway Northbound	2.3	2.4
To Centre St Westbound	2.8	3.2
To Arborway Southbound	3.5	3.7
From Jamaicaway Southbound		
To Arborway Southbound	3.9	4.2
To Centre St Westbound	3.4	3.8
To Francis Parkman Drive	1.8	1.9
To Pond St Westbound	1.6	1.7
From Francis Parkman Drive		
To Centre St Westbound	3.4	3.9
To Arborway Southbound	4.3	4.4

Table 9. Preferred Alternative (2033) Capacity Analysis Results – a.m. and p.m. Peak Hours

Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Jamaicaway at Eliot St (signalized)	A	8.7	-	-	B	11.4	-	-
Jamaicaway NB thru thru/right	A	9.9	35	424	A	2.7	2	76
Jamaicaway SB thru thru	A	6.4	31	347	B	16.1	82	470
Arborway/Pond St Extension	A	0.3	-	-	A	0.6	-	-
Arborway NB thru thru/right	A	0.1	0	0	A	0.1	0	0
Arborway SB left	B	12.2	1	46	B	18.2	1	195
Arborway SB thru thru	A	0.0	0	0	A	0.0	0	0
Arborway/Prince St	A	0.3	-	-	A	0.3	-	-
Arborway NB thru thru/right	A	0.2	0	2	A	0.3	0	0
Arborway SB left	A	6.1	0	7	A	6.4	0	17
Arborway SB thru thru	A	0.0	0	0	A	0.0	0	0
Arborway/Pond St/Francis Parkman Dr	D	36.5	-	-	D	50.8	-	-
Pond EB left/thru/right	D	52.9	44	120	E	66.5	62	120
Pond EB right	B	14.8	44	120	C	28.4	62	120
Arborway NB u-turn/left	E	56.9	208	620	D	48.7	164	616
Arborway NB thru thru	D	41.3	208	620	D	46.6	164	616
Arborway SB thru thru	D	36.7	152	620	D	53.5	356	860
Arborway SB right	D	44.7	152	620	D	43.2	356	860
Francis Parkman SB left	E	69.4	68	249	E	77.8	127	278
Pond St/Cataumet St (unsignalized)	A	6.2	-	-	C	21.8	-	-
Pond EB left/thru thru	A	6.4	11	174	C	23.8	57	220
Pond WB thru/right	B	14.3	0	5	A	0.0	0.0	10
Cataumet SB left/thru/right	A	3.5	9	285	D	34.2	0	17
Arborway/Access Road West/Access Road East/Midblock Crossing	A	7.0	-	-	B	12.6	-	-
Arborway NB thru thru/right	A	5.9	39	523	A	3.6	15	309
Arborway SB thru thru/right	A	8.6	36	330	C	19.1	144	624
Access West right	B	14.2	1	43	F	51.6	1	34
Access East right	B	10.6	1	54	A	6.7	0	15
Carriageway West (SB)/Access Road West	A	1.1	-	-	A	1.2	-	-
Access West WB	A	0.2	10	107	A	0.3	24	109
Carriageway West NB thru/right	A	2.3	0	19	A	0.0	0	0
Carriageway West SB left/thru	B	5.4	0	38	C	15.0	1	16
Carriageway East (NB)/Access Road East	A	0.8	-	-	A	0.6	-	-



Intersection/Movement	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)	LOS	Delay (sec/veh)	Average Queue (feet)	Maximum Queue (feet)
	a.m. Peak Hour				p.m. Peak Hour			
Access East EB	A	0.2	1	91	A	0.1	0	89
Carriageway East NB thru/right	A	3.5	0	11	A	2.9	0	2
Carriageway east SB left/thru	A	1.0	0	11	A	0.7	0	14
Murray Circle (signalized)	E	57.1	-	-	D	52.1	-	-
Centre EB left left	D	37.8	149	324	D	35.7	86	315
Centre EB thru	B	11.3	149	324	C	23.7	86	315
Centre EB right	B	19.2	149	324	D	32.7	86	315
Centre WB thru thru/right	E	73.4	178	299	E	78.5	183	291
Arborway NB left	F	98.5	234	545	F	146.7	182	425
Arborway NB thru thru/right	D	45.5	234	545	C	22.4	182	425
Arborway SB thru thru	F	88.5	314	777	E	58.2	371	808
Arborway SB right right	E	68.1	314	777	D	45.0	371	808
Centre St/Hillcroft St/WB U-Turn	D	37.8	-	-	B	11.9	-	-
Centre EB left/thru thru	E	67.5	487	828	C	24.8	68	407
Centre WB U-turn	E	72.8	44	459	E	67.4	84	460
Centre WB thru thru/right	B	12.9	38	406	A	5.9	33	488
Hillcroft SB left/right	D	45.1	1	42	D	46.4	2	55
Upper Arborway/Centre St/Orchard St (unsignalized)	F	155.7	-	-	F	91.5	-	-
Centre EB thru/right	A	1.5	3	162	A	0.7	0	88
Centre WB left/thru	F	147.2	334	460	F	180.4	383	457
Upper Arborway NB left/right	F	>180.0	588	762	F	111.0	67	258
Orchard SB left/thru/right	F	145.5	31	156	F	>180.0	43	147
Arborway/Mid-Block Crossing (signalized)	A	6.0	-	-	B	10.8	-	-
Arborway NB thru	A	1.0	16	123	A	1.2	13	113
Arborway SB thru	B	11.4	28	334	B	17.1	60	407
Arborway/Arboretum Driveway (unsignalized)	B	14.6	-	-	A	8.7	-	-
Arboretum EB left/right	C	29.0	1	29	D	35.7	2	51
Arborway NB left/thru	C	24.2	309	1844	C	27.9	109	556
Arborway SB thru/right	B	18.0	160	973	A	0.8	1	74

¹Southbound queues at these left-turn locations are coming from the signal at Arborway/Pond Street/Francis Parkman Drive and it is not spillback from the median left turns.

²Centre Street eastbound at Murray Circle delays and queues are better represented by the Centre Street/Hillcroft Street/Centre Street WB U-turn intersection, as that approach experiences queue spillback during the a.m. peak hour.

³Arborway NB approach to Murray Circle delays and queues are better represented by the Arborway/Arboretum Driveway intersection, as approach experiences queue spillback during both a.m. and p.m. peak hours.



As shown in **Table 9**, conditions at most of the project corridor intersections (new or old) will experience an improvement in operations except for the following intersections:

- **Murray Circle** –The proposed signal at this intersection is expected to operate at an LOS E during the a.m. peak hour only, due to the impacted movements of Centre Street westbound approach, Arborway northbound left-turn, and Arborway southbound approach.
- **Upper Arborway/Centre Street/Orchard Street** – This unsignalized intersection is expected to operate at LOS F during both a.m. and p.m. peak hours, due to the expected congestion on the Centre Street westbound approach at the Murray Circle intersection.

QUEUES

Under the preferred alternative, queues on the Arborway mainline are expected to spill back to adjacent intersections from the Pond Street/Francis Parkman Drive intersection and to the proposed mid-block crossing on Arborway between Kelley Circle and Murray Circle (a.m. and p.m. peaks), as well as to the Eliot Street intersection (p.m. peak hour). At Murray Circle, Centre Street westbound queues are expected to spill back to the Upper Arborway and Orchard Street intersection (a.m. and p.m. peaks), and Centre Street eastbound queues are expected to spill through the Hillcroft Street intersection. While this Centre Street eastbound queue seems concerning, the signal changes at the Hillcroft Street signal, as well as coordination with the proposed Murray Circle signal, will allow for all movements to proceed through both intersection, thus the travel time and delay improvements mentioned in the previous sections.

PREFERRED ALTERNATIVE RESULTS SUMMARY

As the results in this section show, while the Preferred Alternative sees some long queues, which are comparable to today's conditions, it is able to process all of the counted and added volumes (from proposed developments) and actually realize some travel time reductions for specific movements in each peak hour, two examples being Centre Street eastbound in both the a.m. and p.m. peaks, and Jamaica Way southbound in the p.m. peak.



Summary

The updated traffic analysis presented in this memo shows the Existing and No-build conditions still favor vehicular operations for most parts throughout the project corridor, as most roadways operate with acceptable levels of delays and queues, with the exceptions being Centre Street eastbound (a.m. peak hour) and Jamaicaaway southbound (p.m. peak hour). While there are buffered bicycle lanes on the Carriageways, around the southern part of Murray Circle, Centre Street (east of Murray Circle only), and Arborway southbound, there are still gaps in the bicycle network through the project area and vehicles were observed to violate the pavement markings and utilize the buffered bike lane during peak congestion periods. The pedestrian accommodations are not up to current standards and lack ADA compliance at some locations. Pedestrian crossings at signalized intersections today can lack pedestrian signalization, pedestrians crossing along Murray Circle legs must compete with high-speed traffic and long crossings, and pedestrians must walk long distances to get to a crossing and access either Carriageway, decreasing the walkability of the area.

The preferred alternative aims to balance the needs of road users by providing protected crossings at all existing and proposed intersections, while also completing any missing connections for pedestrians and cyclists within the corridor, and to increase the feel of a parkway, per DCR's stated agency objective, by taking away extra pavement space and transforming it into green space.



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