

BEDFORD HIGHWAY FUNCTIONAL PLAN

Appendix D - Transit Performance Analysis

The following subsections present the findings from the analysis of the on-time performance for each of the previously defined transit routes. Note that the analysis primarily investigates buses that are late, which is defined as buses arriving at a stop more than three (3) minutes behind schedule, which is consistent with Halifax Transit's on-time performance standard. Also, only the portion of the bus route that is travelling along Bedford Highway is investigated. However, where a significant part of the route travels on other roadways, additional stops were also included to identify potential causes of delay that cascade onto the Bedford Highway. Typically, the additional stops consisted of one stop before, and one stop after the bus enters/ leaves the subject corridor.

Route 39

Table 1 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 1 - Total Number of Buses per Period - Route 39

AM	PM	Midday
Inbound		
4	4	14
Outbound		
4	4	14

The percentage of late buses per period, are shown in Exhibit 39-2 and 39-3 of **Appendix C** for buses travelling in the inbound and outbound directions, respectively. Based on the exhibits, the following observations can be made:

Route 39 Inbound:

- Overall, once a bus enters the corridor, the number of late occurrences does not generally decrease;
- During the AM period, 90-100% of buses arrive late to bus stops along Bedford Highway. However, a high percentage of buses (70%) are already behind schedule before they turn onto Bedford Highway. Based on the transit data provided by HRM, the information shows that a number of buses leave the Lacewood Terminal behind schedule (approximately 14 minutes on average). As the bus travels along the route, there are some improvements on transit travel times; however, there is consistent delays experienced at the Flamingo Drive Before Bedford Highway stop;
- There is a significant increase in the percentage of late buses after Flamingo Drive during the AM and midday periods. Signal delay experienced by buses making the eastbound right-turn movement at the intersection of Flamingo Drive may be a factor that caused this increase in delay; and
- A significant percentage of buses are experiencing operational issues at MSVU during all analysis periods.

Route 39 Outbound:

- Similar to the inbound direction, the buses enter the study corridor are already behind schedule;

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- Buses are experiencing operational issues during both the AM and PM periods. As shown, 70-90% of buses are arriving more than three minutes behind schedule at all stops along the corridor;
- Midday operations are better than the AM and PM periods. However, a significant amount of delay is incurred at the MSVU stop, resulting in 40% of buses operating behind schedule by the time they exit Bedford Highway; and
- Similar percentages of buses arrive behind schedule at the MSVU stop, and the stop on Flamingo Drive after Bedford Highway. This indicates that the northbound left-turn movement at the signalized intersection of Flamingo Drive does not have a significant impact on schedule adherence.

Route 66

Table 2 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 2 - Total Number of Buses per Period - Route 66

AM	PM	Midday
Inbound		
4	4	14
Outbound		
4	4	14

The percentage of late buses per period, are shown in Exhibits 66-2 and 66-3 of **Appendix C** for buses travelling in the inbound and outbound directions, respectively. Based on the information summarized in the exhibit, the following observations can be made:

Route 66 Inbound:

- During all periods, there is an increase in the percentage of buses behind schedule between Dartmouth Road and Dartmouth Road After Wardour Street. Signal delay experienced by buses making the southbound left-turn movement at the intersection of Bedford Highway at Dartmouth Road may contribute to the delay;
- During the AM period, transit operations are generally good. Less than 10% of buses arrive late to bus stops located along Bedford Highway; and
- During the PM period, 80% of buses arrive more than three minutes behind schedule at all four stops located on Bedford Highway. However, 90% of buses are leaving Cobequid Terminal behind schedule. As a result, scheduling of this route may need to be reviewed, as operations along this section of the Bedford Highway corridor are generally good.

Route 66 Outbound:

- During both the AM and midday period, there is an increase in the number of buses that are late between Dartmouth Road after North Street, and Bedford Highway after Dartmouth Road. Between these stops, buses and general traffic are using a dual-lane channelized right-turn to merge onto Bedford Highway from Dartmouth Road. The right turn channelization begins approximately 60 metres from the westbound stopbar. Based on the Synchro analysis, the westbound left turn queues are projected to extend past this point. As a result, the left

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turning vehicles may impede vehicles attempting to enter the dual-channelized right turn lane and contribute to the delay experienced by the transit vehicle within this section. To further delay transit vehicles, merging into northbound traffic may also be difficult due the existing geometry of the channelized right turn lanes; and

- During the PM period, similar to buses traveling in the inbound direction, 90% of buses travelling in the outbound direction are behind schedule before they enter the Bedford Highway corridor. Furthermore, operations along Bedford Highway during this period are consistent. This indicates that the operational problems along this route are not on Bedford Highway.

Route 80

Route 80 spans the entire study area corridor, travelling along Bedford Highway between Cobequid Terminal to the north, and Joseph Howe Drive to the south. As Route 80 is one of the longer routes, additional analysis was undertaken to determine in greater detail, where along the corridor transit buses are consistently experiencing operational issues.

Table 3 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 3 -Total Number of Buses per Period - Route 80

AM	PM	Midday
Inbound		
8	4	14
Outbound		
4	8	18

For buses travelling in the inbound direction, the percentage of late buses per period, are shown in Exhibit 80-2. Exhibits 80-3 and 80-4 are box plots that illustrate the distribution of inbound buses that are more than three minutes late, during the AM and PM periods. The boxes represent the interquartile range. The bottom of the box corresponds with how many minutes behind schedule 25% of buses arriving at that stop are, and the top of the box corresponds with how many minutes behind schedule 75% of buses arriving at that stop are. The centre-line (i.e. the transition between the orange box and the grey box) represents the median. The lines extending from the box show the range of bus arrivals. The highest point of the line highlights the maximum difference between when a bus was scheduled to arrive at the stop, and when the bus actually arrived at the stop. Note that the portion of the route that travels along Bedford Highway is highlighted in blue.

Exhibits 80-5 through Exhibit 80-7, found in **Appendix C**, illustrate the percentage and distribution of late buses travelling in the outbound direction. The variation in travel times is typically more pronounced in the AM and PM peak periods. As a result, the Midday period is not included in the below summary. Based on the information summarized in the exhibits, the following observations can be made:

Route 80 Inbound:

- During the AM period, transit operations are generally good along the corridor between Cobequid Terminal and Lodge Drive. As shown, less than 10% of buses are behind schedule

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for this section. South of Lodge Drive, buses are progressively encountering increasing amounts of delay. From Exhibit 80-2, it can be seen that approximately 90% of buses are behind schedule by the time they reach Flamingo Drive;

- As illustrated in Exhibit 80-3 during the AM period, buses begin to fall behind schedule around Lodge Drive, with a significant amount of delay being incurred at each successive stop. On average, buses are running approximately 10 minutes late between Torrington Drive and Bayview Road. However, within this section, there is a significant variation in how late the buses are, which may be attributable to the buses operating in mixed traffic as traffic volumes are high in this section. Within this segment, some buses can be up to 28 minutes behind schedule;
- During the PM period, buses begin to experience schedule delays around Union Street with a spike in the number of late buses at Moirs Mill Road (60%). Operations are consistent between Moirs Mill Road and Glenmont Avenue, and improve after Glenmont Avenue. Between 30-40% of buses arrive more than 3 minutes behind schedule in the south end of the corridor, with a slight spike at MSVU;
- Exhibit 80-4 highlights the operational issues beginning at Union Street more clearly. While the percentage of buses arriving late between Union Street and Moirs Mill Road appears relatively low in Exhibit 80-2; they are arriving, on average, approximately five minutes late. Between Union Street and Lodge Drive there is high variation in how late buses arrive, with some arriving almost 15 minutes behind schedule. After Lodge Drive, buses are more consistent in their operations; however, a significant number of buses are behind schedule in this section; and
- Transit operations inbound during the midday period are consistent throughout the corridor with less than 20% of buses arriving late, with the exception of stops at Moirs Mill Road, Glenmont Avenue, and MSVU.

Route 80 Outbound:

- Exhibits 80-6 and 80-7 illustrate that while delay is incurred along the entirety of the route, the highest delay, and the greatest variation in delay, occurs along Bedford Highway, in both the AM and PM periods;
- Transit operations are poor during all analysis periods. A high percentage of buses are already behind schedule when they enter Bedford Highway at Joseph Howe Drive. The percentage of buses that are late entering the corridor range from 50% during the Midday to 100% during the PM period. Exhibits 80-6 and 80-7 show that in both the AM and PM periods, a significant amount of delay is incurred at Joseph Howe Drive before Dutch Village Road (i.e. the stop just before buses enter Bedford Highway), and buses are unable to recover while travelling along Bedford Highway;
- During the AM period, buses are typically between five and ten minutes behind schedule along the entire Bedford Highway corridor. The percentage of late buses decreases towards the north end of the corridor. This indicates that operations in the north end are better and buses are able to make up some time. However, Exhibit 80-6 shows that while there are improvements as buses exit the Bedford Highway, there are still a significant number of buses arriving more than 30 minutes behind schedule; and

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- During the PM period, between 90% and 100% of buses arrive late, with the exception of the section in the north between Dartmouth Road and Cobequid Road. Within this section of the Bedford Highway, buses are still late the majority of the time. On average, buses are 15 minutes behind schedule.
- There is a significant variance in how late buses are, with buses ranging from less than five minutes late to more than 45 minutes late. While the percentage of buses that are late decreases after Dartmouth Road, this is also the section of Bedford Highway that has experienced the highest amount of delay, with some buses arriving more than 45 minutes behind schedule.

Route 81

Table 4 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 4 - Total Number of Buses per Period - Route 81

AM	PM	Midday
Inbound		
4	4	14
Outbound		
4	4	14

Similar to Route 80, additional analysis was undertaken for Route 81 to determine in greater detail where along the corridor transit buses are consistently experiencing operational issues. For buses traveling in the inbound direction, the percentage of late buses per period, are shown in Exhibit 81-2. Exhibit 81-3 and Exhibit 81-4, found in **Appendix C**, are box plots that illustrate the distribution of inbound buses that are more than three minutes late, during the AM and PM periods.

Exhibits 81-5 through 81-7 illustrate the percentage and distribution of late buses travelling in the outbound direction. Note that the portion of the route that travels along Bedford Highway is highlighted in blue. Based on the information summarized in the exhibits, the following observations can be made:

Route 81 Inbound:

- During the AM period, buses begin to fall behind schedule after Lodge Drive. A significant amount of delay is incurred between Lodge Drive and Kent Avenue, and between Kearney Lake Road and Torrington Drive;
- Exhibit 81-3 illustrates how buses are progressively encountering increasing amounts of delay after Kearney Lake Road. On average, during the AM period, buses are running more than ten minutes late between Kearney Lake Road and Bayview Road, and more than 90% of buses are behind schedule by the time they reach Torrington Drive. There is also a significant amount of variation in how late the buses are in the southern section, which may be attributable to the buses operating in mixed traffic. Within this segment, some buses can be 35 minutes behind schedule;
- Exhibit 81-4 illustrates the consistency of operations during the PM period. Approximately 80% of buses are running late, and are 18 minutes behind schedule, on average along the

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Bedford Highway corridor. Exhibit 81-2 shows operations are slightly improved between Tall Trees Lane and Kearney Lake Road.

- From Exhibit 81-5 during the PM period, there is a significant variation in how late buses arrive at a stop (between three and 33 minutes). However, the amount of variation between stops along the corridor is consistent. This indicates that operations along Bedford Highway are generally consistent, meaning there are no bottlenecks that cause significant delays. Similar to the other routes reviewed, buses are behind schedule prior to arriving to Bedford Highway.

Route 81 Outbound:

- During the AM period, approximately 50% of buses are behind schedule when they turn onto Bedford Highway at Joseph Howe Drive. Operations along Bedford Highway are good, resulting in buses progressively arriving closer to their scheduled arrival time. As a result, only 10% of buses are behind schedule by the time they turn from Bedford Highway onto Larry Uteck Boulevard. Exhibit 81-6 further illustrates this operational improvement as the variation in how late buses are is significantly smaller for this portion of the route; and
- During the PM period, 80%-90% of buses are consistently late along the entire portion of Bedford Highway. There is a significantly higher variation in how late the buses are during this period, with some buses arriving more than 30 minutes behind schedule. Buses are, on average, 18 minutes behind schedule.

Route 82 (Peak Service Only)

Table 5 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions. Note that Route 82 runs peak service only (i.e. runs inbound during the AM period and outbound during the PM period along). There is no service during the midday period along the Bedford Highway.

Table 5 - Total Number of Buses per Period - Route 82

AM	PM	Midday
Inbound		
4	-	-
Outbound		
-	4	-

Similar to Route 80 and 81, additional analysis was undertaken for Route 82 to determine in greater detail where along the corridor transit buses are consistently experiencing operational issues. The percentage and distribution of late buses traveling inbound during the AM period are shown in Exhibit 82-2 and Exhibit 82-3, respectively. The percentage and distribution of outbound buses during the PM period are shown in Exhibit 82-4 and Exhibit 82-5, respectively. These exhibits are found in **Appendix C**. Based on the information summarized in the exhibits, the following observations can be made:

Route 82 Inbound:

- In general, transit operations for Route 82 are reflective of transit operations for Route 80. During the AM period, transit operations are generally good along the corridor between

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Cobequid Terminal and Lodge Drive. South of Lodge Drive, buses are progressively encountering increasing amounts of delay. 100% of buses are running behind schedule by Forest Hill Drive;

- There is a large increase in the percentage of late buses between the bus stops before and after Kearney Lake Road. This indicates that signal delay at Kearney Lake Road may significantly impact transit operations;
- On average, buses are running approximately 10 minutes late between Kearney Lake Road and Bayview Road. Within this section, there is also significant variation in how late the buses are, with some buses operating more than 35 minutes behind schedule. The wide variation may be attributable to the buses operating in mixed traffic. This is consistent with operations along Route 80.

Route 82 Outbound:

- Between 90 and 100% of buses are operating more than three minutes behind schedule along the entire Bedford Highway corridor. From Exhibit 82-3, operations are slightly worse between Watervista Lane and Lodge Drive on the south end, and between Dartmouth Road and Rocky Lake Road on the north end;
- As shown in Exhibit 82-5, the portion of Route 82 with the highest amount of delay is the section along Bedford Highway. On average, buses are running 12 minutes late along the entire Bedford Highway corridor. There is also a significant variance in how late buses are, with buses ranging from less than five minutes late to more than 45 minutes late. The amount of variation is higher in the north end of the corridor (north of Moirs Mill Road). This is consistent with Route 80 operations and may be attributable to the higher concentration of driveways that front onto the corridor, and the single lane in either direction along Bedford Highway within this segment; and
- Buses are delayed a significant amount between Windsor Street After Connaught Avenue and Bedford Highway Before Bayview Road. This may be attributable to congestion on the bridge near the highway ramps.

Route 89

Table 6 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 6 - Total Number of Buses per Period - Route 89

AM	PM	Midday
Inbound		
4	4	5
Outbound		
4	4	4

The percentage of late buses per period, are shown in Exhibit 89-2 and 89-3, found in **Appendix C**, for buses travelling in the inbound and outbound directions, respectively. Based on the information summarized in the exhibits, the following observations can be made:

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Route 89 Inbound:

- In general, operations in the inbound direction are good during all analysis periods, with the majority of buses arriving on schedule;
- The highest percentage of late buses occurs at the beginning of the route, at Cobequid Terminal. A review of the schedule for Route 89 may be required, in particular during the midday period. However, buses are able to recover and arrive on schedule as they progress along their route. This may be a result of the route being interlined at Cobequid Terminal with Routes 82 and Routes 88; and
- The stop before Union Street has the highest percentage of late buses along Bedford Highway, and may be attributable to the high concentration of driveways in the segment between Dartmouth Road and Union Street.

Route 89 Outbound:

- During the AM period, there are no buses arriving more than three minutes behind their scheduled time;
- During the midday period, less than 10% of buses arrive more than three minutes behind schedule, with the exception of the stops after Dartmouth Road and after Oakmount Drive; and
- In general, between 20% and 40% of buses are running late during the PM period. Operations are improved in the section between Lindsay Hill and Hatchery Lane, and deteriorate between Dartmouth Road and Cobequid Road. Similar to Routes 80, 81, and 82, this may be attributable to the higher concentration of driveways and the single lane in either direction along Bedford Highway within this segment.

Route 90

Table 7 outlines the total number of buses that run during the defined AM, PM, and midday periods in both the inbound and outbound directions.

Table 7 - Total Number of Buses per Period - Route 90

AM	PM	Midday
Inbound		
4	4	14
Outbound		
4	4	14

The percentage of late buses per period, are shown in Exhibit 90-2 and Exhibit 90-3, found in **Appendix C**, for buses travelling in the inbound and outbound directions, respectively. Note that outbound data was only provided for September 24, 25, and 28. Based on the information summarized in the exhibits, the following observations can be made:

Route 90 Inbound:

- More than 50% of buses are late during all analysis periods. However, between 60% and 90% of buses are behind schedule before they turn onto Bedford Highway; and

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- A higher percentage of buses are behind schedule south of Forest Hill Drive.

Route 90 Outbound:

- Bus operations during the AM period are generally good. Less than 30% of buses are behind schedule, with the exception of buses arriving at the MSVU stop;
- During the midday peak, 70% of buses are behind schedule between Bayview Road and Torrington Drive. North of Torrington Drive, operations improve and a significant number of buses are able to get back on schedule with less than 30% running behind schedule by Larry Uteck Boulevard; and
- Operations along Bedford Highway during the PM period are consistent, with a slight improvement near Larry Uteck Boulevard.

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Exhibit 66-2: Percentage of Late Buses per Period – Route 66 (Inbound)

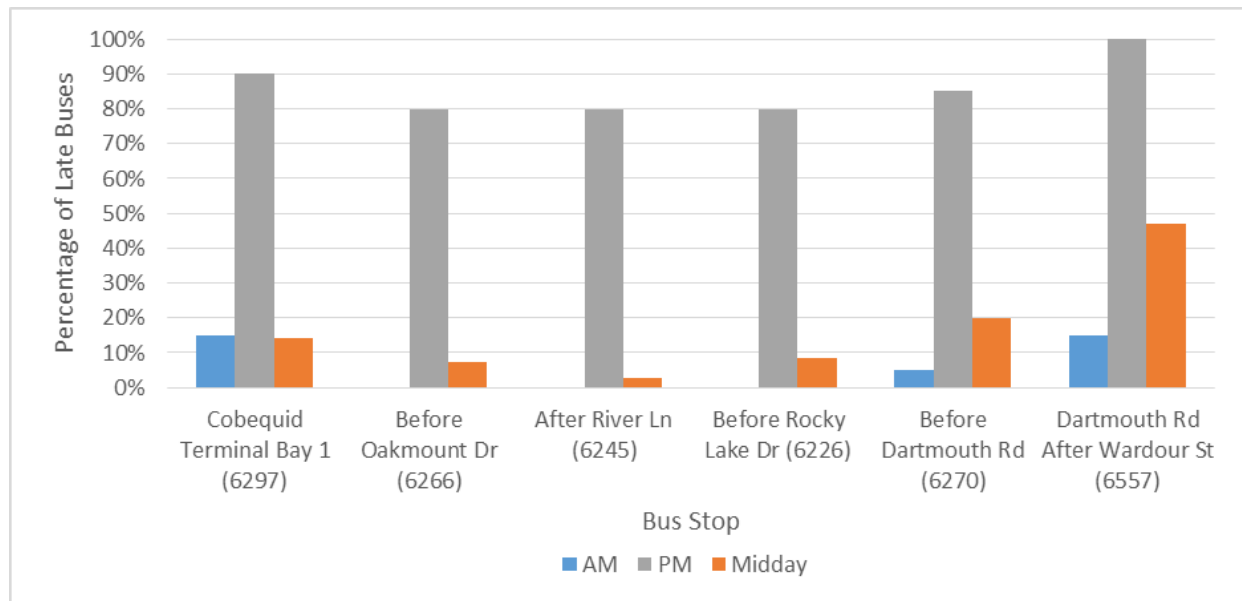
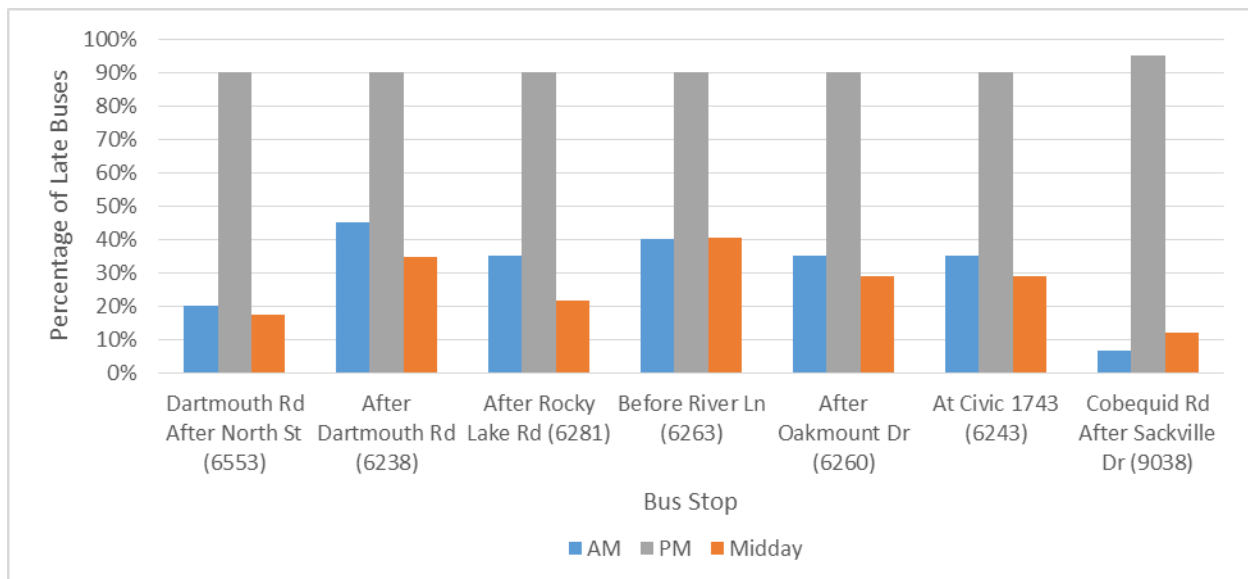


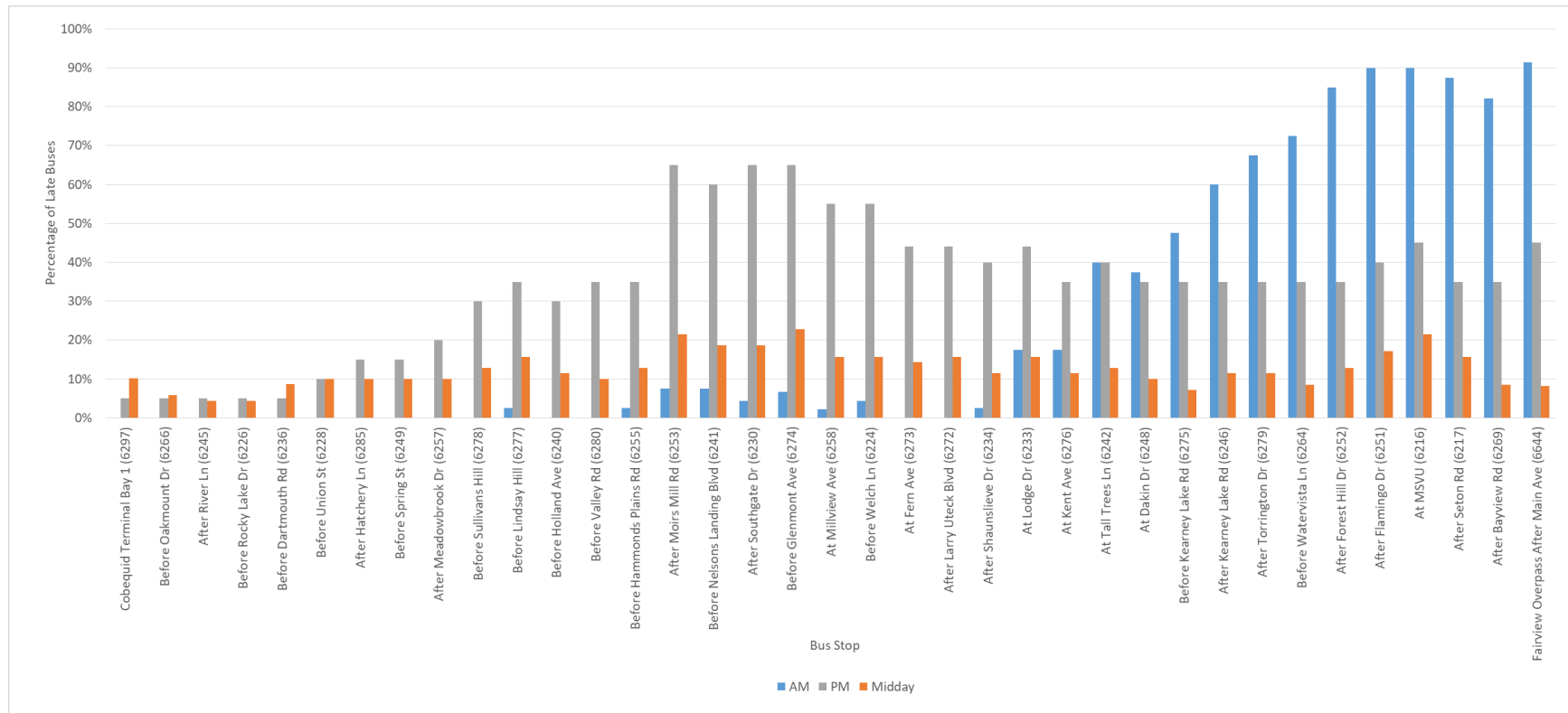
Exhibit 66-3: Percentage of Late Buses per Period – Route 66 (Outbound)



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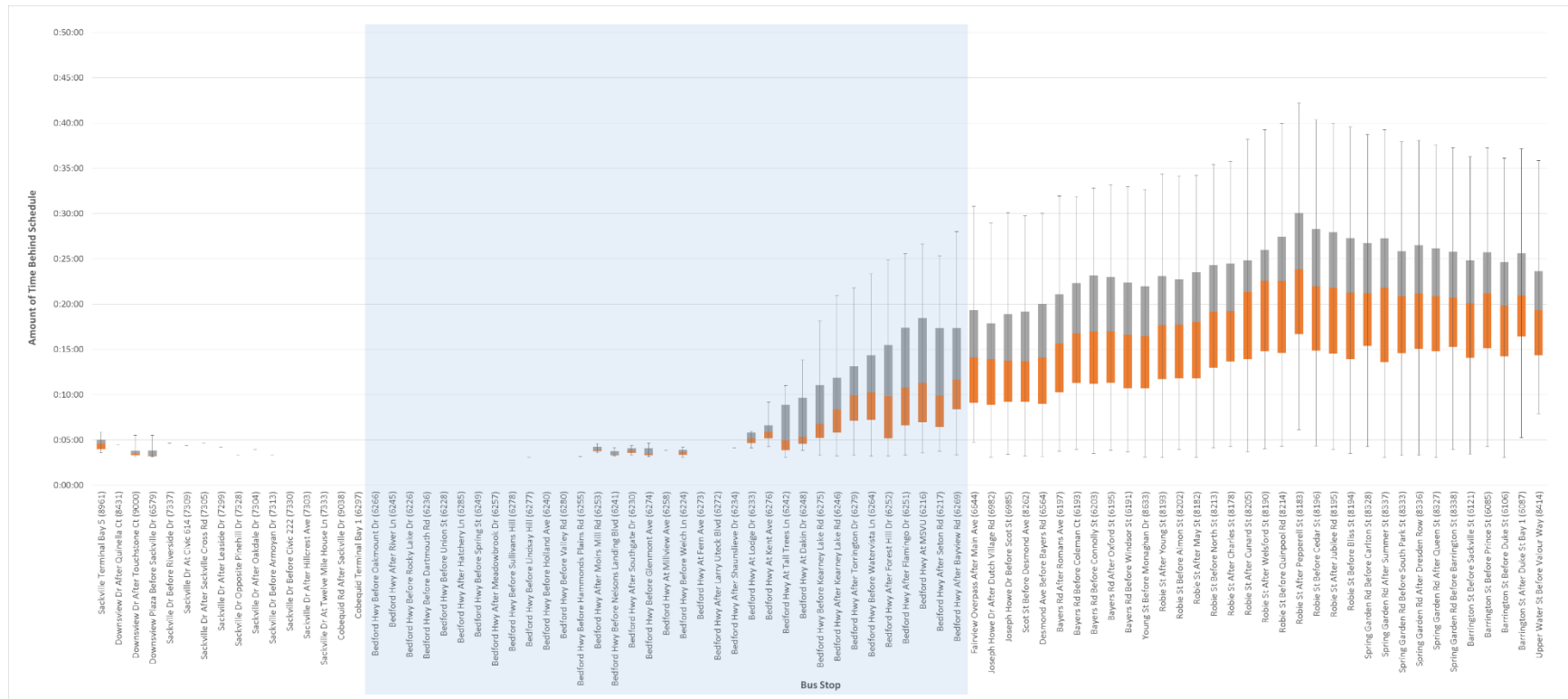
Exhibit 80-2: Percentage of Late Buses per Period – Route 80 (Inbound)



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Exhibit 80-3: Distribution of Buses > 3 min Late by Bus Stop – Route 80 (Inbound) – 7:00 a.m. to 9:00 a.m.

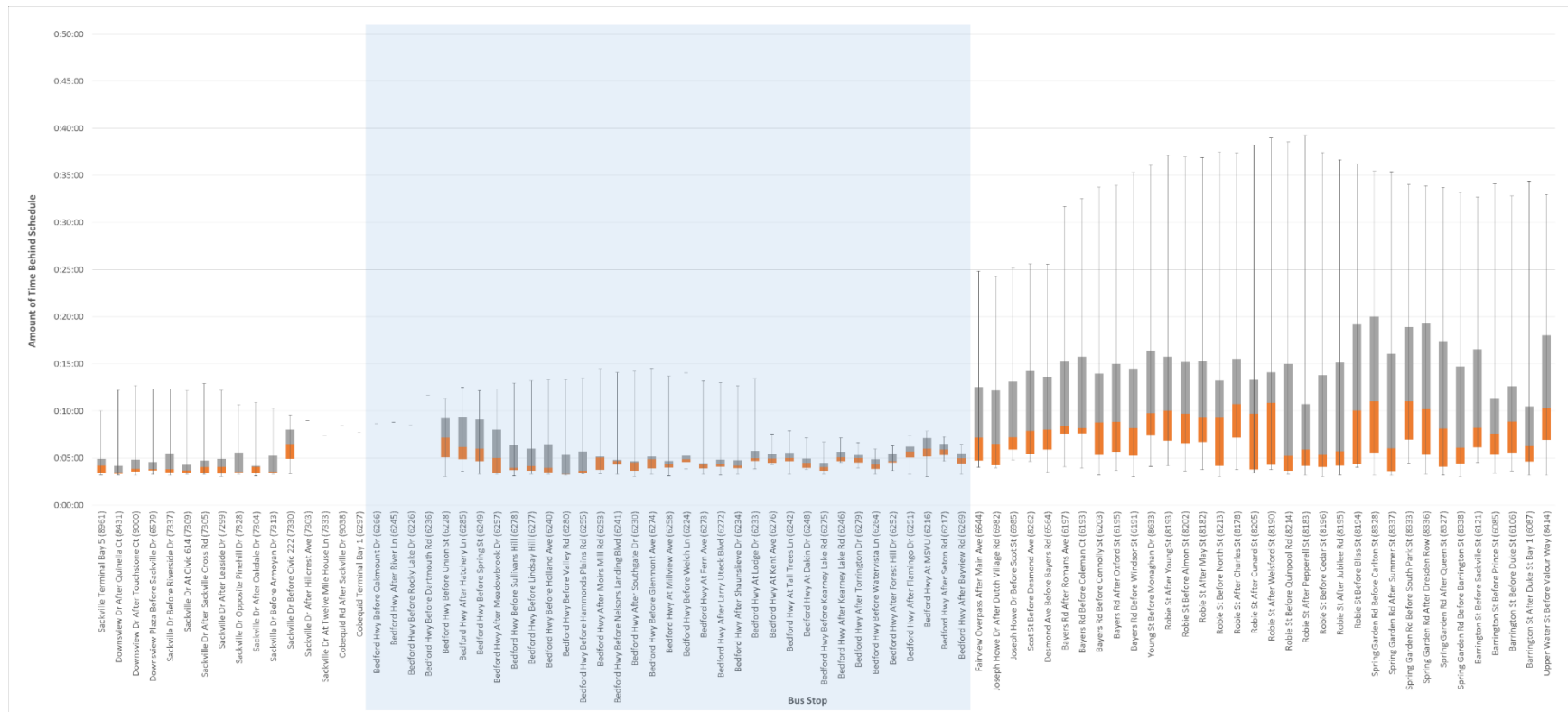


* The portion of the route that travels along Bedford Highway is highlighted in blue

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Exhibit 80-4: Distribution of Buses > 3 min Late by Bus Stop – Route 80 (Inbound) – 4:00 p.m. to 6:00 p.m.

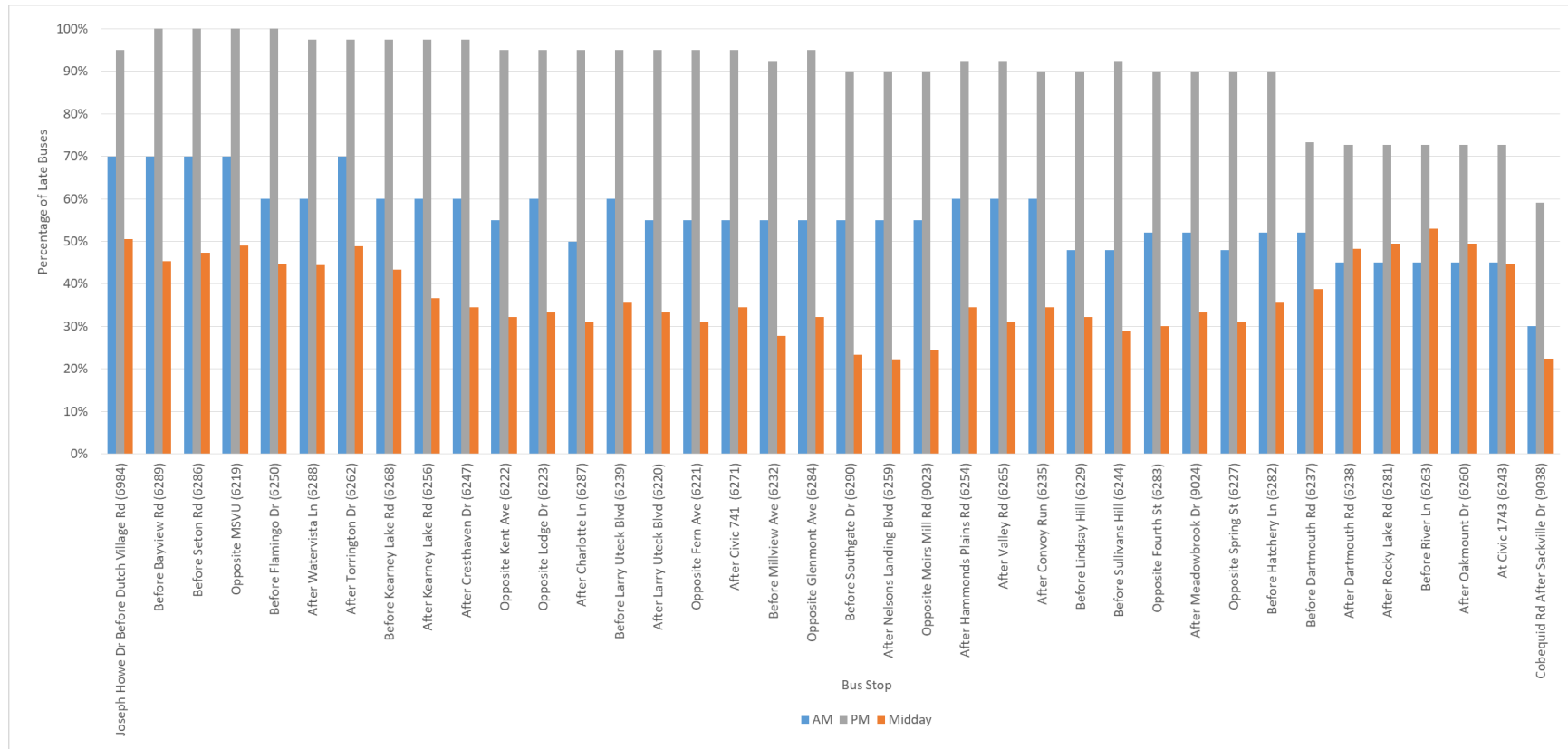


* The portion of the route that travels along Bedford Highway is highlighted in blue

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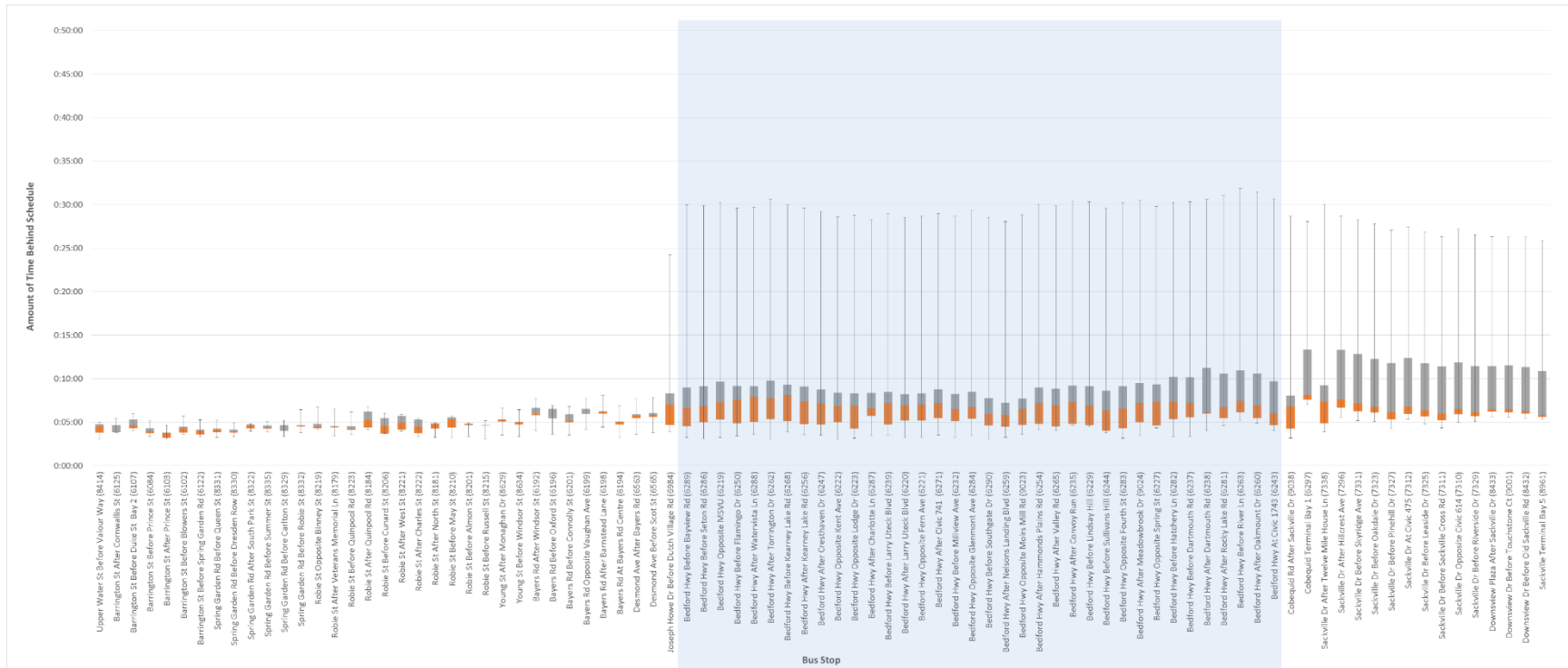
Exhibit 80-5: Percentage of Late Buses per Period – Route 80 (Outbound)



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Exhibit 80-6: Distribution of Buses > 3 min Late by Bus Stop – Route 80 (Outbound) – 7:00 a.m. – 9:00 a.m.

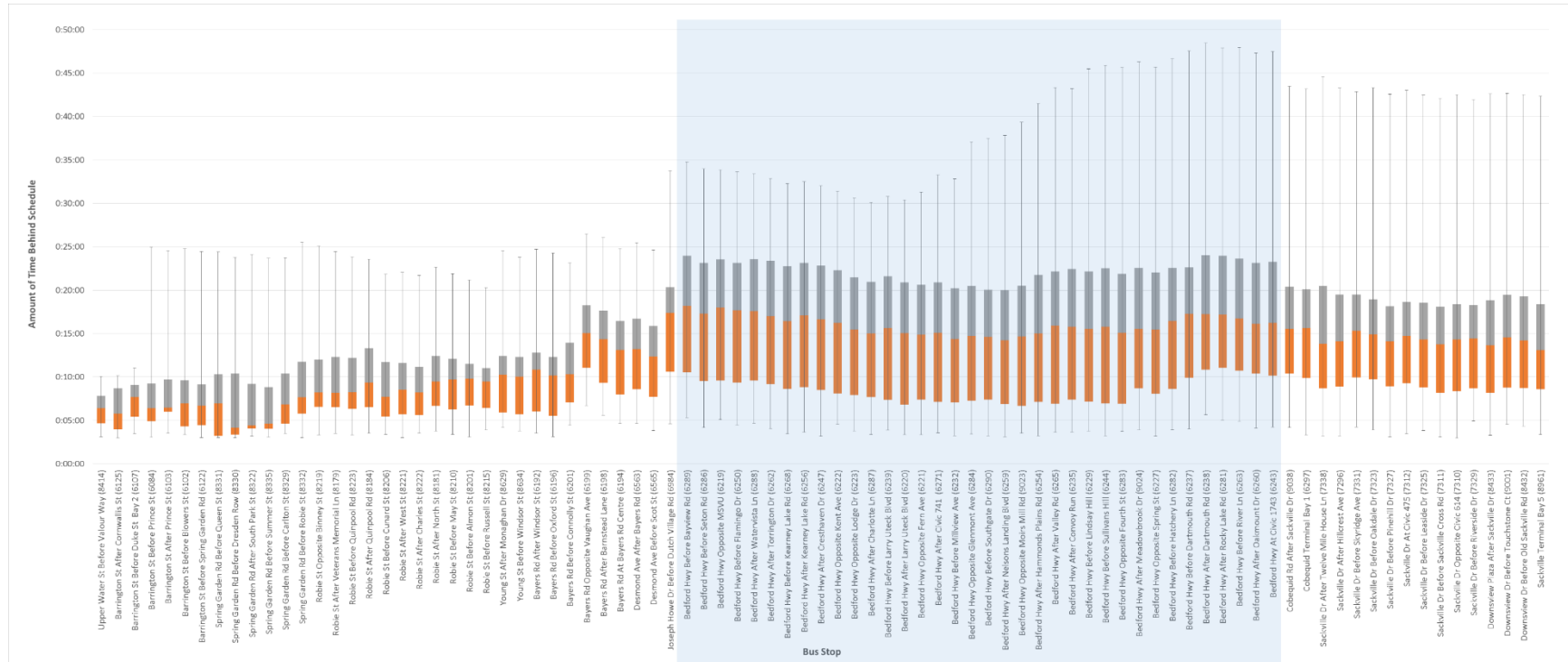


* The portion of the route that travels along Bedford Highway is highlighted in blue

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Exhibit 80-7: Distribution of Buses > 3 min Late by Bus Stop – Route 80 (Outbound) – 4:00 p.m. – 6:00 p.m.

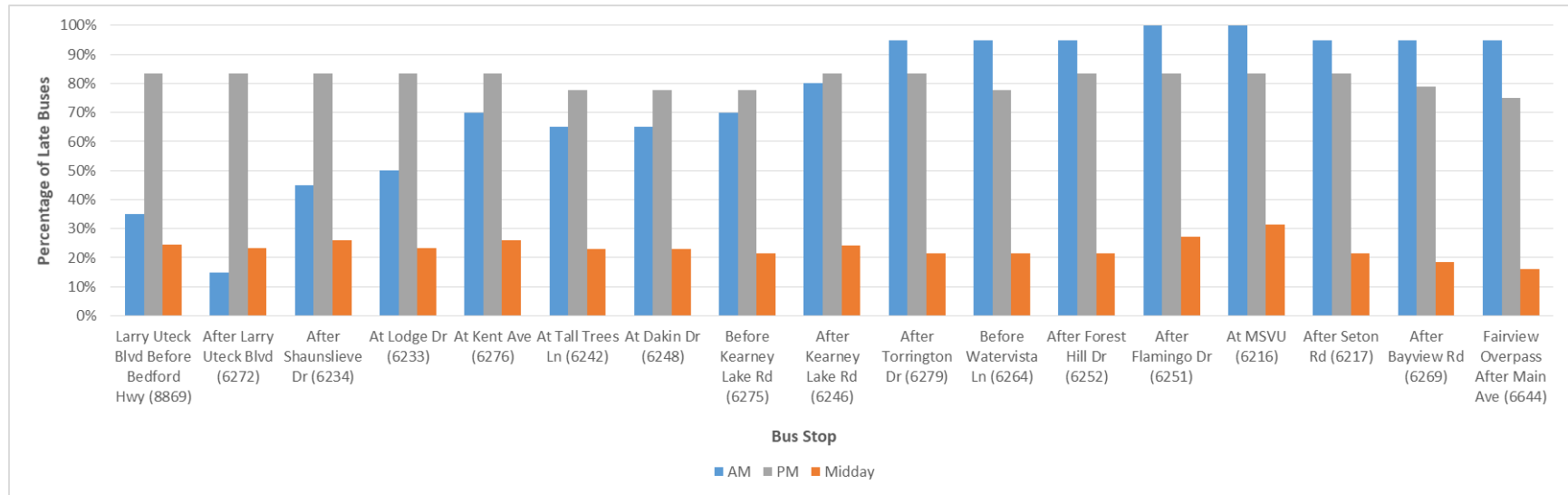


* The portion of the route that travels along Bedford Highway is highlighted in blue

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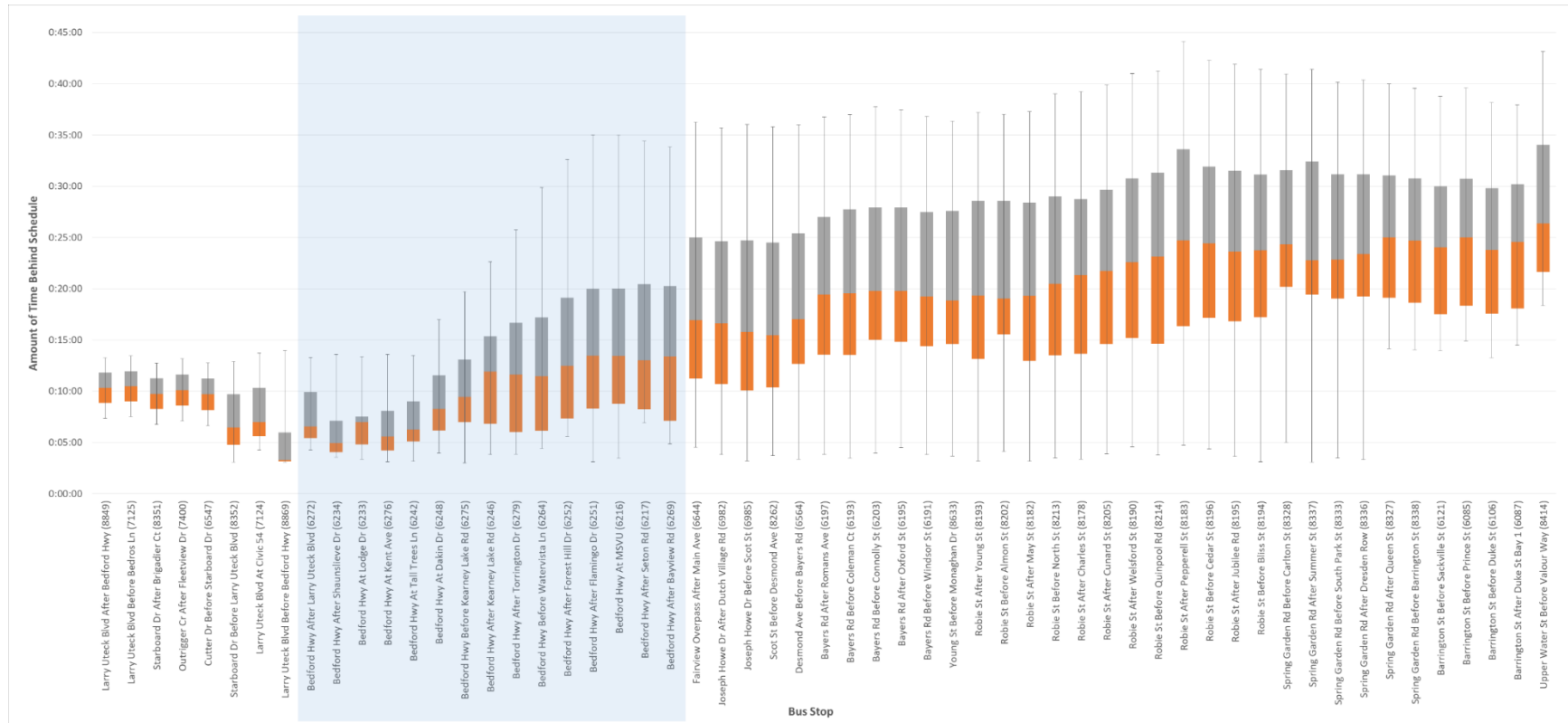
Exhibit 81-2: Percentage of Late Buses per Period – Route 81 (Inbound)



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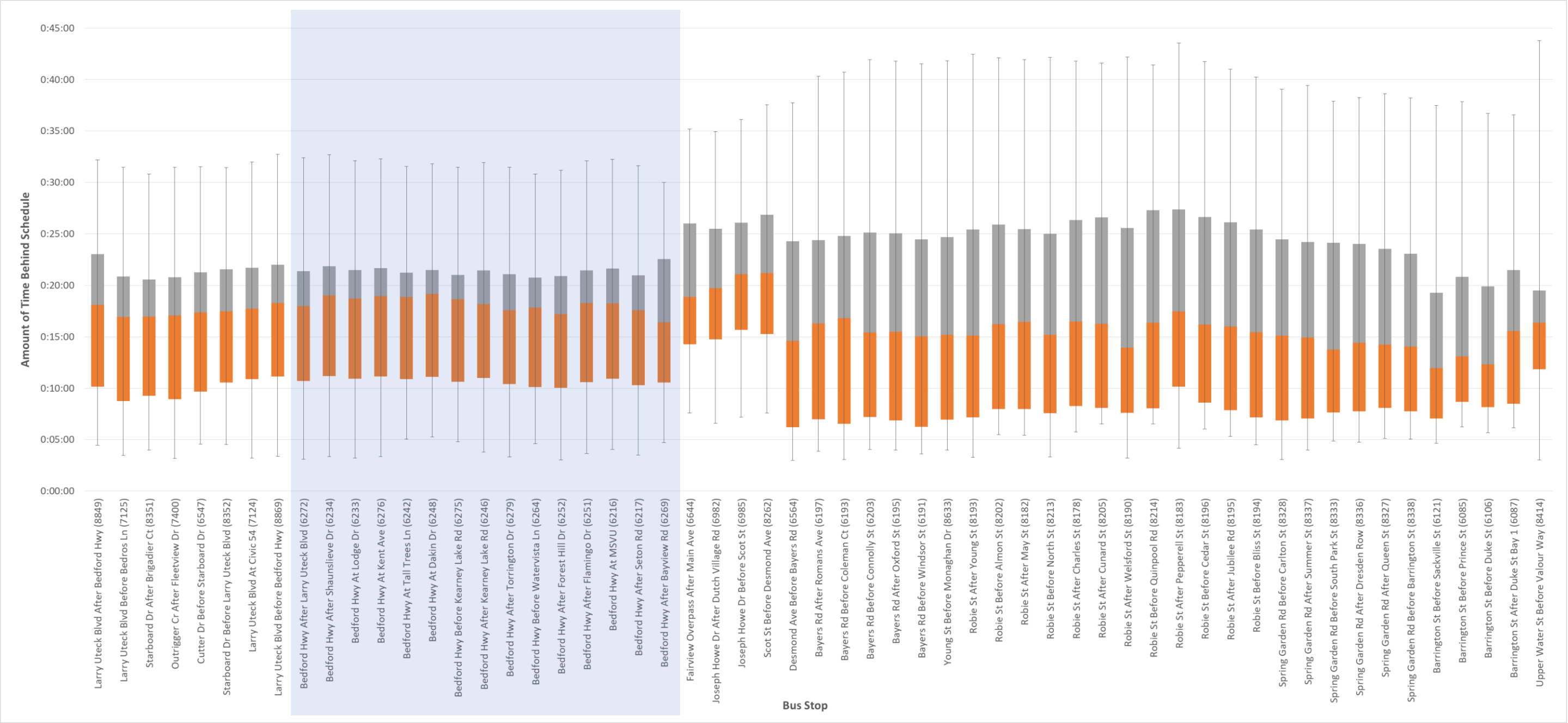
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Exhibit 81-3: Distribution of Buses > 3 min Late by Bus Stop – Route 81 (Inbound) – 7:00 a.m. – 9:00 a.m.



* The portion of the route that travels along Bedford Highway is highlighted in blue

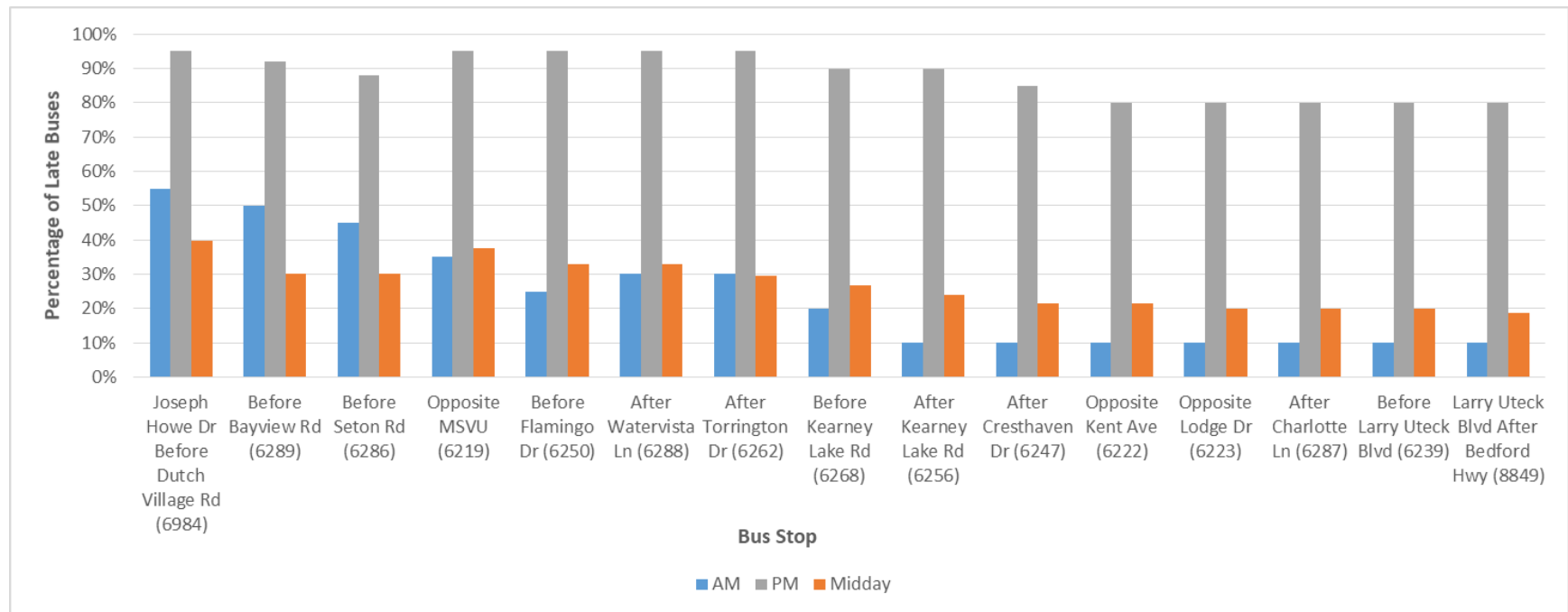
Exhibit 81-4: Distribution of Buses > 3 min Late by Bus Stop – Route 81 (Inbound) – 4:00 p.m. – 6:00 p.m.



* The portion of the route that travels along Bedford Highway is highlighted in blue

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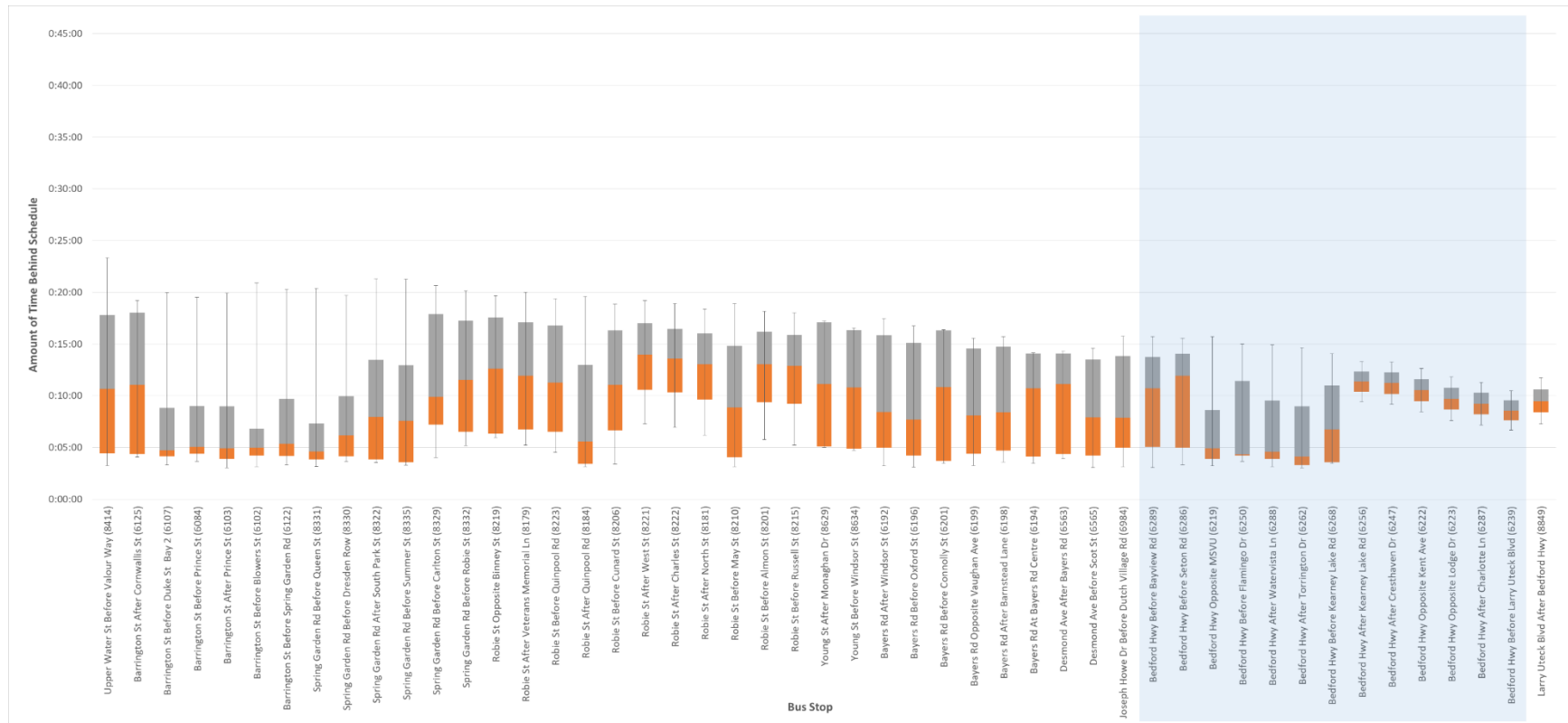
Exhibit 81-5: Percentage of Late Buses per Period – Route 81 (Outbound)



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Exhibit 81-6: Distribution of Buses > 3 min Late by Bus Stop – Route 81 (Outbound) – 7:00 a.m. – 9:00 a.m.

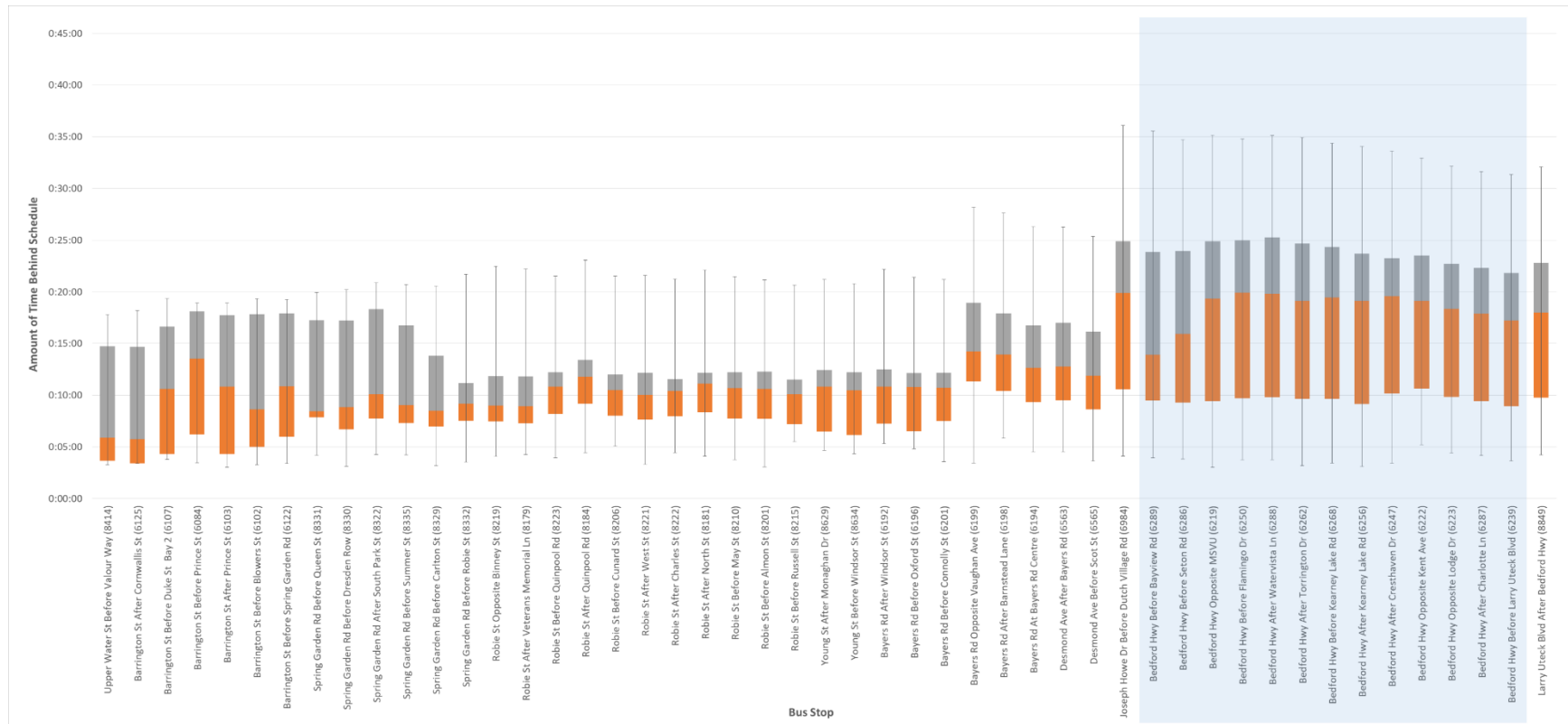


* The portion of the route that travels along Bedford Highway is highlighted in blue

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Exhibit 81-7: Distribution of Buses > 3 min Late by Bus Stop – Route 81 (Outbound) – 4:00 p.m. – 6:00 p.m.



* The portion of the route that travels along Bedford Highway is highlighted in blue

Exhibit 82-2: Percentage of Late Buses During the a.m. Period – Route 82 (Inbound)

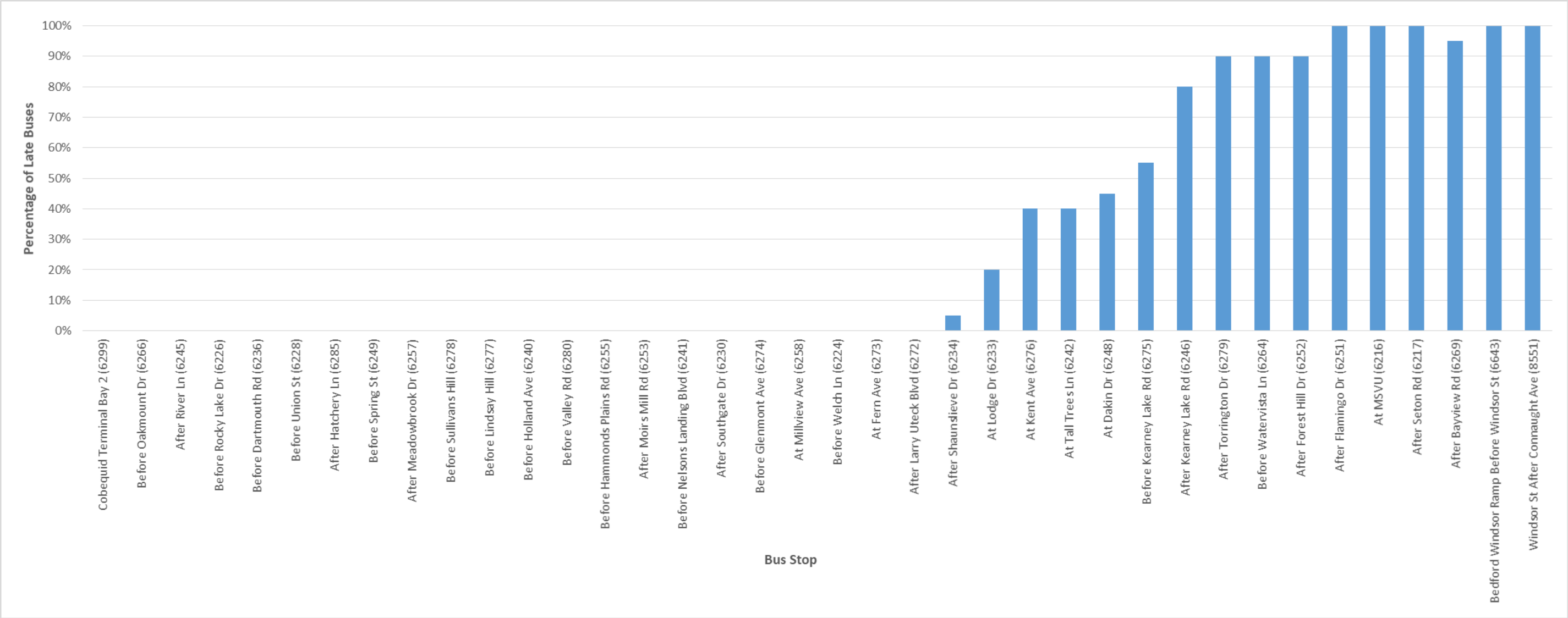
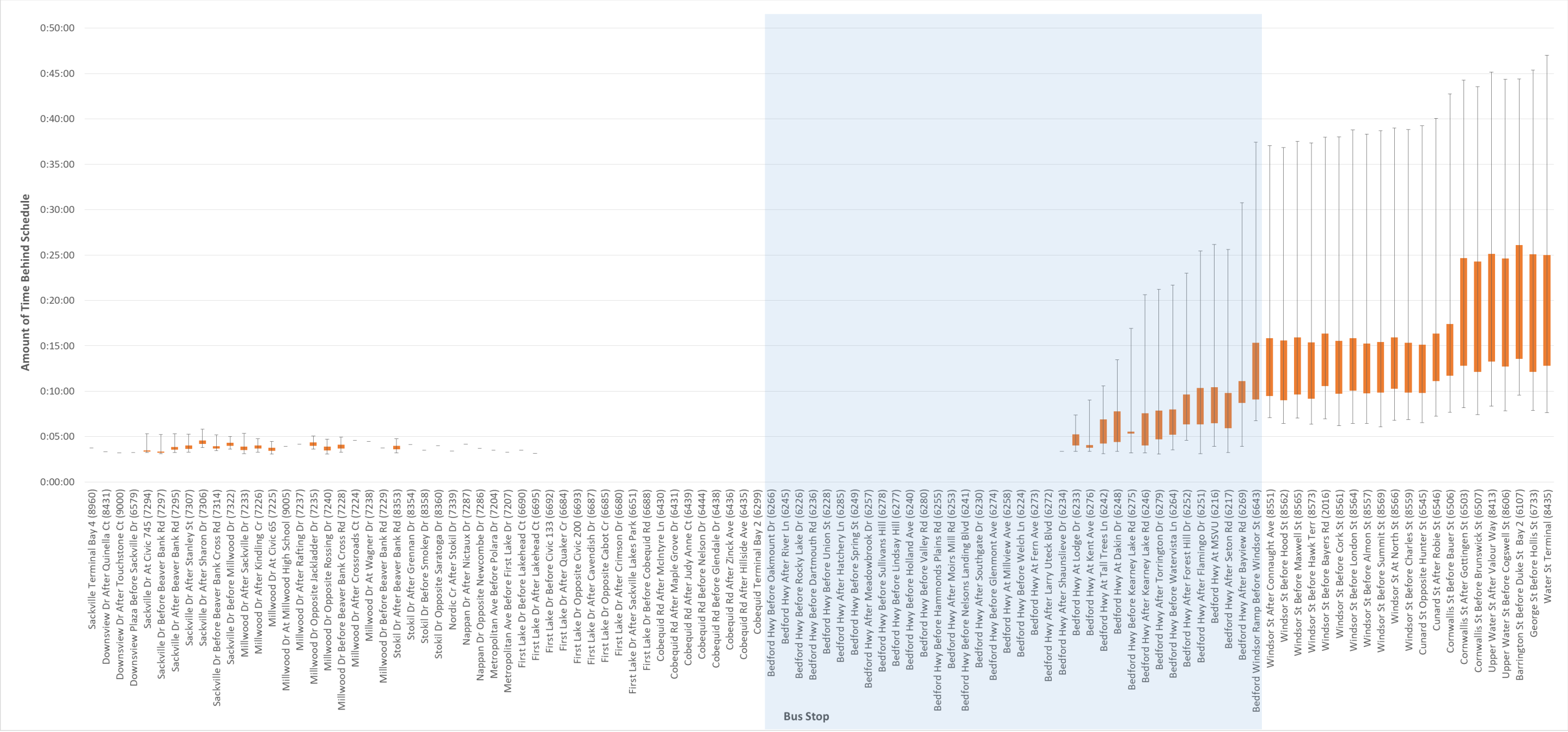


Exhibit 82-3: Distribution of Buses > 3 min Late by Bus Stop – Route 82 (Inbound) – 7:00 a.m. – 9:00 a.m.



* The portion of the route that travels along Bedford Highway is highlighted in blue

Exhibit 82-4: Percentage of Late Buses During the p.m. Period – Route 82 (Outbound)

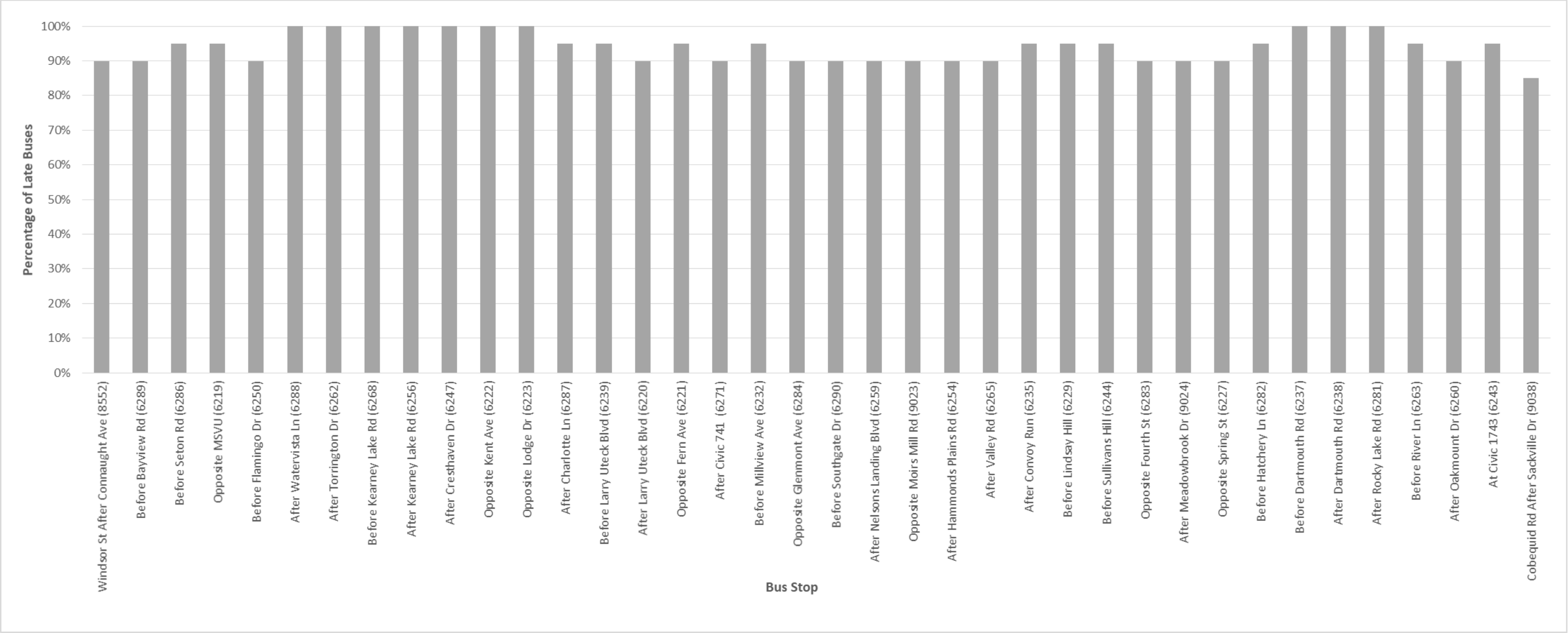
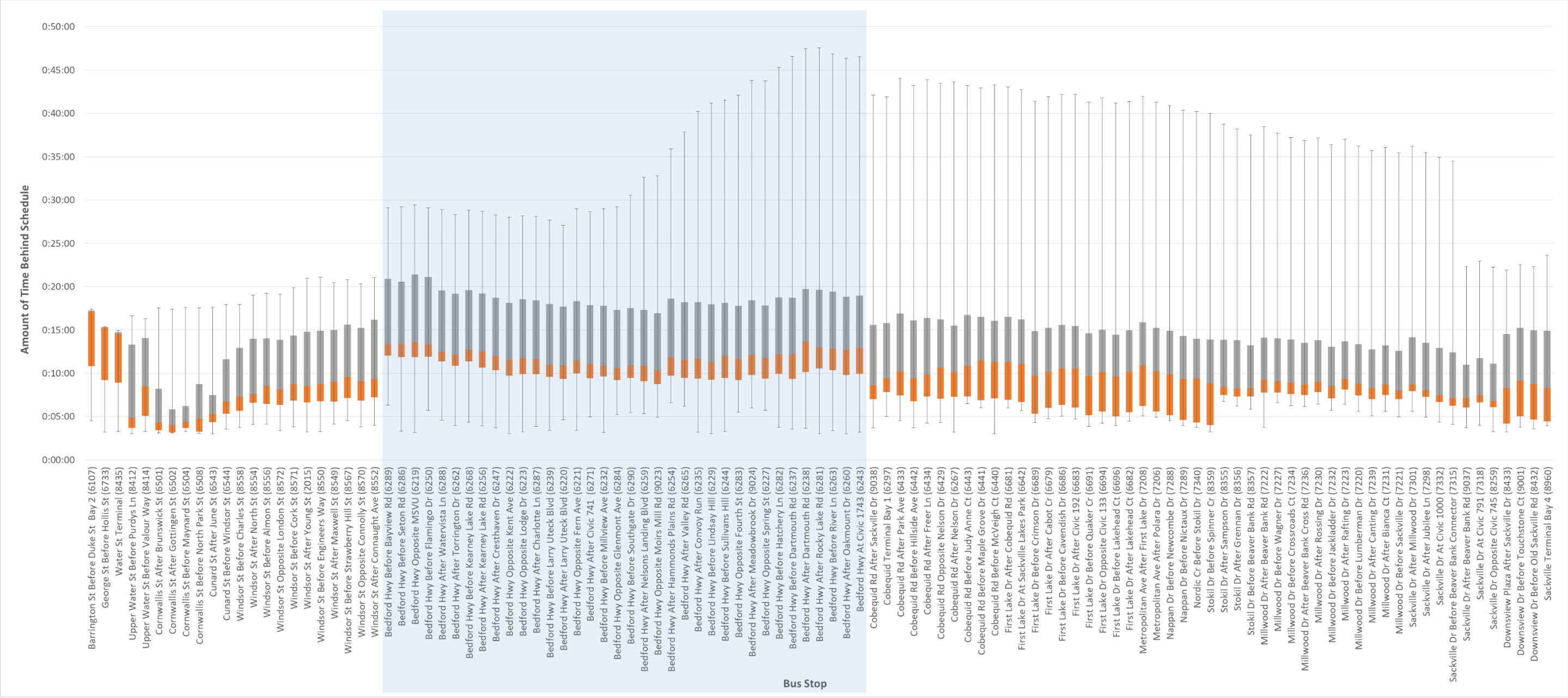


Exhibit 82-5: Distribution of Buses > 3 min Late by Bus Stop – Route 82 (Outbound) – 4:00 p.m. – 6:00 p.m.



* The portion of the route that travels along Bedford Highway is highlighted in blu

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Exhibit 89-2: Percentage of Late Buses per Period – Route 89 (Inbound)

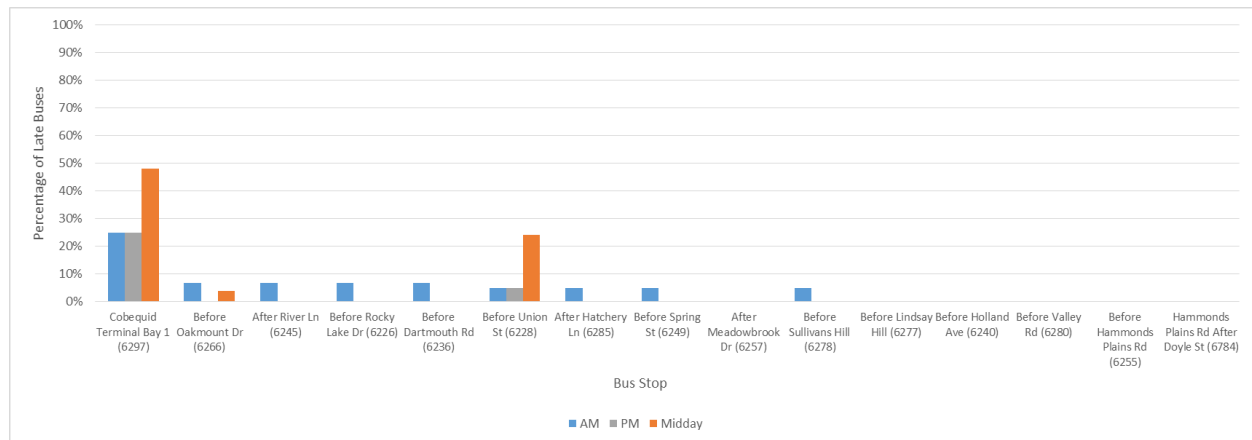
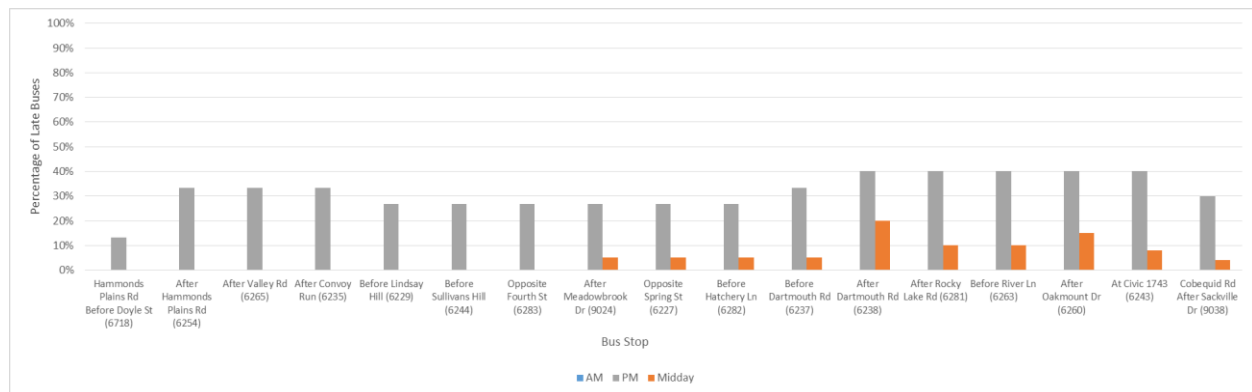


Exhibit 89-3: Percentage of Late Buses per Period – Route 89 (Outbound)



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Exhibit 90-2: Percentage of Late Buses per Period – Route 90 (Inbound)

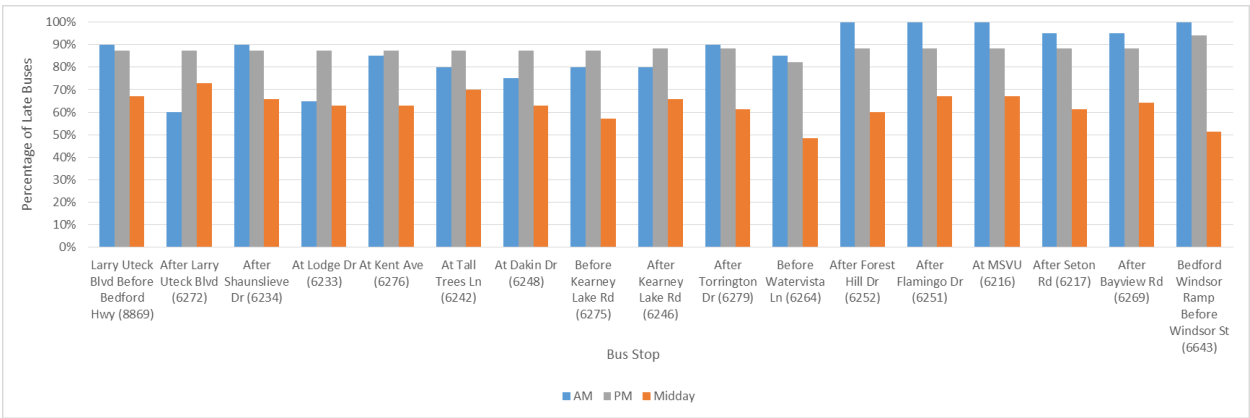


Exhibit 90-3: Percentage of Late Buses per Period – Route 90 (Outbound)p

