

Metrobus Service Evaluation Study

Pershing Drive-Arlington Boulevard Line

Routes 4A, 4B, 4E, 4H

Technical Memorandum #4

Recommendations

June 2013



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1.0 Introduction

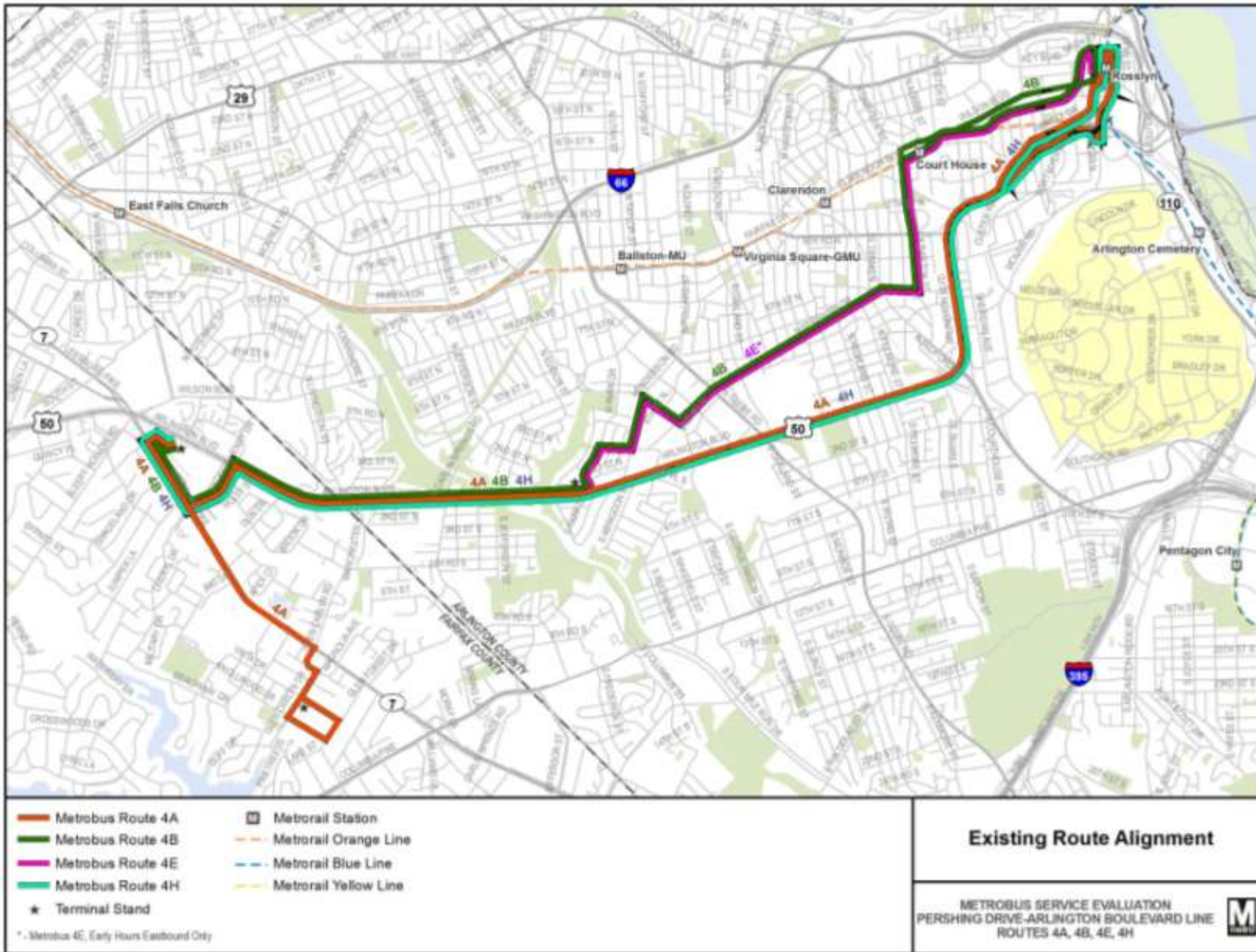
Outlined in this document are proposed service and physical improvement modifications for the Metrobus Pershing Drive-Arlington Boulevard Line (Routes 4A, 4B, 4E, and 4H, or the “4 Line”).

The sources of these recommendations include the Transit Service Assessment, the Traffic Operations Assessment, ridership data, the bus stop analysis, and bus operator interviews. The recommendations included in this document are the result of an iterative process that included feedback from the public and the study’s Project Management Team in order to finalize a set of preliminary recommendations developed during the study process.

Each recommendation contained in this document includes analysis that helps estimate the cost and ridership impacts associated with the recommendation’s implementation as well as other data and graphics to support reader understanding of the recommendation.

Figure 1.1 shows the existing Metrobus 4 Line.

Figure 1.1: Existing 4 Line Routes



2.0 Recommendation #1 – Improvements to Service Hours

An analysis of WMATA’s Service Guidelines used for this evaluation showed that the 4 Line’s hours of service are adequate for weekdays. However, the guidelines state that on Saturdays, the first trip of the day should arrive at its final destination terminal no later than 7:00 am, and that the last trip of the day should start no earlier than 10:00 pm. Also, on Sundays, the last trip in either direction should start no earlier than 10:00 pm.

Currently, the first Saturday westbound trip for Route 4B arrives at Seven Corners at 7:49 am, and the first Saturday westbound trip for Route 4H (soon to be 4A) arrives at Seven Corners at 7:13 am. And the first Saturday eastbound trip for Route 4H (4A) arrives at Rosslyn at 7:15 am. The last Saturday westbound trip for Route 4B departs Seven Corners at 6:25 pm and the last eastbound trip for Route 4H (4A) departs Rosslyn at 5:25 pm.

Currently on Sundays, the last westbound 4B trip departs Seven Corners at 9:45 pm and the last eastbound 4B trip departs Rosslyn at 9:05 pm.

2.1 Adjust Weekend Spans of Service

Recommendation #1: Adjust the 4 Line’s weekend schedules to meet WMATA’s service guidelines. This includes:

Saturday

- 1) Changing the departure time of the first 4B westbound trip from 7:25 am to 6:36 am, which will allow the bus to arrive at Seven Corners at 7:00 am.
- 2) Changing the departure time of the first 4H (4A) westbound trip from 6:55 am to 6:42 am, which will allow the bus to arrive at Seven Corners at 7:00 am.
- 3) Changing the departure time of the first 4H (4A) eastbound trip from 6:56 am to 6:41 am, which will allow the bus to arrive at Rosslyn at 7:00 am.
- 4) Changing the departure time of the last 4H (4A) westbound trip from 6:25 pm to 10:00 pm.
- 5) Changing the departure time of the last 4H (4A) eastbound trip from 5:25 pm to 10:00 pm.

Sunday

- 1) Changing the departure time of the last 4B westbound trip from 9:45 pm to 10:00 pm.
- 2) Changing the departure time of the last 4B eastbound trip from 9:05 pm to 10:00 pm.

Table 2.1: Estimated Cost of Adjusting Weekend Schedule

	Cost to Make Weekend Service Meet Span of Service Guideline		
	Saturday	Sunday	Total
Daily Revenue Hours	7.85	1.48	-
Daily Platform Hours	8.79	1.66	-
Annual Days	52	52	104
Annual Platform Hours	457	86	544
Annual Cost*	\$50,290	\$9,503	\$59,793

*Based on a cost per hour of \$110

3.0 Recommendation #2 – Improvements to Frequency

WMATA’s Service Guidelines indicate that service frequency for urban radial routes such as those in the 4 Line must be at least:

- Every 15 minutes during peak periods (weekdays 6:00 am-9:00 am and 3:00 pm-7:00 pm);
- Every 30 minutes all other times.

For this analysis, the 4 Line was split into four segments:

1. Culmore to Seven Corners (Mostly 4A only; 4A, 4B, 4H north of Patrick Henry Drive)
2. Seven Corners to Park Drive (4A, 4B, 4H)
3. Park Drive to Rosslyn via Pershing Drive (4B, 4E)
4. Park Drive to Rosslyn via Arlington Blvd (4A, 4H)

Table 3.1 illustrates the current 4 Line combined service frequency in minutes, by segment.

Table 3.1: Combined Service Frequencies by Day of Week and Direction

Day of Week & Direction	Time Period	Culmore to Seven Corners (Mostly 4A, part of 4B, 4H)	Seven Corners and Park Drive (4A, 4B, 4H)	Park Drive to Rosslyn via Pershing (4B, 4E)	Park Drive to Rosslyn via Arlington Blvd (4A, 4H)
Weekday WB	AM Peak – 6:00 am-8:59 am Criterion: 15 minutes	30	15	30	30
	Midday – 9:00 am-2:59 pm Criterion: 30 minutes	66	30	55	66
	PM Peak – 3:00 pm-6:59 pm Criterion: 15 minutes	34	13	30	18
	Late Evening – 7:00 pm-12:00 am Criterion: 30 minutes	2 Trips, 38 minutes apart	21	50	43
Weekend WB	All day Saturday Criterion: 30 minutes	--	35	55	58
	All day Sunday Criterion: 30 minutes	--	63	64	--
Weekday EB	AM Peak – 6:00 am to 8:59 am Criterion: 15 minutes	30	15	30	30
	Midday – 9:00 am – 2:59 pm Criterion: 30 minutes	55	30	55	55
	PM Peak – 3:00 pm-6:59 pm Criterion: 15 minutes	34	16	30	30
	Late Evening – 7:00 pm-12 am Criterion: 30 minutes	--	25	50	50
Weekend EB	All day Saturday Criterion: 30 minutes	--	35	57	52
	All day Sunday Criterion: 30 minutes	--	65	63	--

An analysis of the 4 Line scheduled revealed that combined service frequency meets WMATA’s criteria only about half the time. Periods in which the guidelines are not met are shown above in red.

3.1 Adjust Headways

Apart from the analysis above, input obtained from the rider survey, focus group, and public meetings indicated that a lack of frequency was the top issue for riders of the 4 Line.

Recommendation #2: Add trips to reduce headways on the 4 Line to meet WMATA’s service guidelines. Additional trips will have the added benefit of improving on-time performance since the additional trips will result in lower passenger-per-trip numbers and a decrease in bus stop dwell time.

Table 3.2 is a schedule of the one-way trips required for the 4 Line to meet WMATA’s service guidelines for frequency. Adding the number of trips indicated in Table 3.2 will allow the 4 Line’s frequency of service to improve from current headways to every 15 minutes during peak periods (6:00 am to 9:00 am and 3:00 pm to 7:00 pm on weekdays) and every 30 minutes all other times.

Table 3.3 shows the number of hours, operating cost, and number of vehicles required to meet the frequency standards for the 4 Line.

Whereas **Table 3.3** shows the estimated cost of reducing headways on weekends only for Recommendation #2, **Table 3.4** shows the estimated cost of making weekend service on the 4 Line meet WMATA’s frequency guidelines if Recommendation #1 is implemented.

Table 3.2: Estimated Number of Extra One-Way Trips to Reduce Headways

Variation	Direction	Weekday				Saturday	Sunday
		AM Peak	Midday	PM Peak	Late Evening		
4A	EB	6	6	6	0	0	0
4A	WB	6	6	3	0	0	0
4B	EB	6	6	9	5	15	13
4B	WB	6	6	7	4	15	13
4H	EB	0	0	0	0	10	0
4H	WB	0	0	0	3	11	0
Total		24	24	25	12	51	26

Table 3.3: Estimated Hours and Cost of Reducing Headways

	Weekday	Saturday	Sunday	Total
Daily Revenue Hours	53.15	22.37	13.00	-
Daily Platform Hours	59.53	25.05	14.56	-
Annual Days	261	52	52	365
Annual Platform Hours	15,537	1,303	757	17,597
Cost Per Hour	\$110.00	\$110.00	\$110.00	\$110.00
Annual Cost	\$1,709,049	\$143,290	\$83,283	\$1,935,622

Table 3.4: Estimated Hours and Cost of Having Weekend Service Meet Frequency Guidelines

	Saturday	Sunday	Total
Daily Revenue Hours	14.52	11.52	-
Daily Platform Hours	16.26	12.90	-
Annual Days	52	52	104
Annual Platform Hours	845	671	1,516
Cost Per Hour	\$110.00	\$110.00	\$110.00
Annual Cost	\$93,000	\$73,780	\$166,780

4.0 Recommendations #3, 4, and 5 – Improvements to Reliability

After frequency, reliability was the most-reported issue among respondents to the rider survey and participants at public events. Many riders said that 4 Line buses often come late, sometimes early, and sometimes not at all. Lack of adherence to the schedule was verified by WMATA's on-time performance data. The next three recommendations are designed to address reliability problems on the 4 Line.

4.1 Evaluate the Need to Add Run Time to Schedule

WMATA added run time on weekdays in June 2012, and for Sundays in December 2012. The additional running time has greatly improved on-time performance on this line. However, on-time performance is still a concern along this line. The recommendation to evaluate the potential addition of run time to 4 Line schedules is based on two sources of information. First, Metro's own data on actual run times was compared to current scheduled run times; this was reported in detail in the *4 Line Transit Assessment*. In most cases, buses on the 4 Line arrived at their terminals between -2 and +7 minutes (Metro's standard to be considered "on-time"). However, there were times of day in which buses were consistently shown not to arrive during the time prescribed in Metro's guidelines. The most notable time periods were:

- 4A weekdays, PM peak: late 17 percent of the time;
- 4B weekdays, AM and PM peaks: late 19 percent and 15 percent of the time;
- 4B Saturdays, late 14 percent of the time in the AM, 24 percent at midday, and 20 percent in the PM;
- 4H Saturdays, late 12 percent of the time in the AM, 21 percent at midday, and 20 percent in the PM;
- 4B Sundays, late 11 percent of the time at midday and 23 percent in the PM.

Bus operators at Four Mile Division were the second source of information about run time issues. The drivers interviewed about the 4 Line indicated that there are a number of factors that delay trips, including poorly timed signals, difficulty re-entering the flow of traffic on Arlington Boulevard, delivery vehicles on Wilson and Clarendon Boulevards, pedestrian activity in Rosslyn, and an overall increase in traffic volume as population has increased in Arlington. Running time may be impacted based on construction along Arlington Boulevard which is causing delays along Arlington Boulevard as well as causing more traffic to use Pershing Drive.

Recommendation #3: Re-evaluate the need for further run time additions. After construction is complete along Arlington Boulevard, and after enough time has elapsed to acquire new on-time performance data, WMATA should re-examine trip times to determine whether more minutes are needed to bring the 4 Line up to the authority's standards for reliability.

4.2 Increase Supervision

One of the recommendations that has consistently appeared in every Metrobus study over the past 6 years is the potential addition of dedicated supervision. The rationale behind this recommendation is that the presence of a supervisor dedicated to one line at certain times of day would help buses adhere to the schedule and maintain adequate headway separation. In previous Metrobus studies, one or two supervisors were assigned to a line to monitor on-time performance, communicate with

operators about delays and detours, and work proactively to address potential problems along the line before they happen.

Recommendation #4: Place a supervisor at Seven Corners Transit Center. The reasons for placing the supervisor at Seven Corners are that a supervisor is already located at Rosslyn Metro, and that a supervisor at Seven Corners would be able to monitor bus activity for Routes 28A and 28X and the 1 Line routes.

Some of the weakest times of day for on-time performance on the 4 Line are on weekends. This is in contrast to most other Metrobus studies in which supervisors were recommended to monitor their line during the AM and PM peaks on weekdays – usually the time periods that lack schedule adherence the most. WMATA will need to determine whether a dedicated supervisor is warranted 7 days a week for the 4 Line.

Supervisors would be asked to derive actions from a “playbook” of contingencies, to be determined, and report on a monthly basis the on-time performance of the line and actions taken to improve it.

WMATA estimates that a full-time equivalent supervisor costs \$80,000 per year.

4.3 Terminate Route 4A at Seven Corners

The final recommendation that would address reliability is to terminate Route 4A at Seven Corners instead of Culmore. This would theoretically make the route more reliable because buses would not get stuck in traffic along Leesburg Pike. This would only affect service on weekdays as no 4 Line services operate to Culmore during the weekend.

4A riders west of Seven Corners would be negatively affected by this recommendation. Riders along Leesburg Pike would be forced to transfer from a 28A or 28X bus to 4 Line bus at Seven Corners. And residents of the Culmore neighborhood would no longer have a route that would take them directly to Rosslyn without transferring.

Based on ridecheck information: 213 weekday, 76 Saturday, and 47 Sunday boardings and alightings occur between Culmore and Seven Corners, or 10.65 percent of all boardings and alightings along the 4 Line. (This does not include activity at Seven Corners itself.) 7.83 percent of all 4 Line riders are using the service between Culmore and Seven Corners only (157 weekday, 56 Saturday, and 34 Sunday boardings and alightings).

This means that 56 weekday riders, 20 Saturday riders, and 12 Sunday riders (or 2.8 percent of all 4 Line riders) would need to transfer as a result of this recommendation. To mitigate these impacts, Metro is working on new service plans to link the Culmore area to the surrounding destinations.

Additional outreach would be done to obtain the input from 4A riders south of Seven Corners before this recommendation is implemented. It is difficult to say at this time whether riders in the Culmore/Leesburg Pike area would be in favor of the recommendation to terminate Route 4A at Seven Corners, as no participants at the focus group or public meetings said they live or work in that area.

Recommendation #5: Change the western terminal of Route 4A from Culmore to Seven Corners Transit Center.

Table 4.1 shows the cost savings of Recommendation #5.

Table 4.1: Estimated Cost Savings of Terminating Route 4A at Seven Corners

	Minutes	Trips	Total Minutes	Hours	Daily Total Minutes	Daily Total Hours	Daily Total	Annual Total (251 days)
Eastbound	9	1	9	0.15	179	2.98	6.87	1,724
	10	6	60	1.00				
	8	13	104	1.73				
	6	1	6	0.10				
Westbound	10	2	20	0.33	233	6.87	6.87	1,724
	9	5	45	0.75				
	12	14	168	2.80				
Annual Cost (based on \$110 per platform hour)								\$189,640

5.0 Recommendation #6 – New Limited-Stop Service

Although capacity and crowding are generally not issues on the 4 Line, riders expressed during the public involvement process a desire for faster trips and bus service that could take them directly to downtown DC. Metro already runs several “Y” route services from Virginia into the District (e.g., 7Y, 16Y), and this recommendation would present a similar option for riders of the 4 Line.

5.1 New Route 4Y Limited-Stop Service, Bypassing Rosslyn

Recommendation #6: Implement a new Metro Extra 4Y service.

This new overlay route would be a peak-period/peak-direction service between Fairfax Inova Hospital or Dunn Loring Metro Station and Metro Center. Five eastbound trips would operate during the AM peak period and five westbound trips would operate in the PM peak period, with service operating every 30 minutes. Based on ridecheck information, approximately 78 percent of peak period riders are traveling in the peak direction (eastbound in the AM and westbound in the PM), thus there would be a very small market for reverse peak service. The route would travel primarily along Arlington Boulevard and bypass Rosslyn. **Figure 5.1** shows a map of the new Route 4Y. The rationale behind this idea is that:

- It would offer a one-seat ride for passengers traveling to Downtown DC who otherwise would have to alight at Rosslyn and transfer to a Blue or Orange Line train.
- It would provide more capacity on the 4A portion of the 4 Line, and narrow combined headways further for many current 4A riders who are not traveling to Rosslyn.
- It would add capacity and a one-seat ride for 1A-B-Z riders going to Downtown DC (riders who live along Arlington Boulevard west of Seven Corners).
- It would provide a faster means of moving along Arlington Boulevard than the existing 4 Line or 1 Line.
- Limited-stop services improve travel time for passengers by 15 percent
- It would create a new link to downtown Washington, DC for riders from the Dunn Loring and Merrifield areas.

Rosslyn Station represents approximately 1/3 of all boarding and alighting activity on the 4 Line. The purpose of the 4Y would be to provide a one-seat ride for passengers that currently change to other services, either Metrorail or other Metrobus services that serve the District of Columbia. Transfer data provided by WMATA shows that 78.8 percent of 4 Line riders transfer at Rosslyn.

Advantages for riders of the potential limited-stop 4Y service include travel time savings and an increase in 4 Line service for passengers west of Seven Corners. Travel time to and from Federal Triangle station would be less with the 4Y than with using a local 4 Line route and transferring to Metrorail. (Travel time between Arlington Boulevard & Pershing Drive and Metro Center via the 4 Line and Metrorail is approximately 20 minutes. This is based on 9 minutes travel by bus from Arlington Boulevard and Pershing Drive to Rosslyn Metro Station, 4 minutes from the time the bus arrives at Rosslyn to the time when a passenger boards the Metrorail train, and 7 minutes Metrorail travel time from Rosslyn to Metro Center. This is the same as the additional 20 minutes running time estimate for the 4Y from this location.) In addition, riders whose trips originate west of Seven Corners would also see an increase in 4 Line service since all trips would be full length.

Table 5.1 shows the estimated cost of a potential 4Y weekday limited-stop service including running time calculations and vehicle requirements.

Table 5.1: Estimated Cost of Limited-Stop Service

Western Terminal at Inova Fairfax Hospital	Route 4Y EB	Route 4Y WB
Current 4H Running Time	22	22
No service to Rosslyn	6	6
85% of Running Time	14	14
Extension to Inova Fairfax Hospital	26	26
Extension to Metro Center	20	20
Total 4Y Running Time	60	59
Daily Trips	5	5
Daily Revenue Hours	5	5
Daily Platform Hours	6	6
Annual Platform Hours	1,460	1,440
Cost per Hour	\$110	\$110
Annual Cost	\$160,642	\$158,364
Total Annual Operating Cost	\$319,006	
Capital Cost (4 vehicles at \$604,994 per vehicle)	\$2,419,976	
Total Annual Cost	\$2,738,982	

Western Terminal at Dunn Loring Metro	Route 4Y EB	Route 4Y WB
Current 4H Running Time	22	22
No Service to Rosslyn	6	6
85% of Running Time	14	14
Extension to Dunn Loring	29	31
Extension to Metro Center	20	20
Total 4Y Running Time	63	65
Daily Trips	5	5
Daily Revenue Hours	5	5
Daily Platform Hours	6	6
Annual Platform Hours	1,523	1,585
Cost per Hour	\$110	\$110
Annual Cost	\$167,475	\$174,308
Total Annual Operating Cost	\$341,783	
Capital Cost (4 vehicles at \$604,994 per vehicle)	\$2,419,976	
Total Annual Cost	\$2,761,759	

Service to both Dunn Loring and Hospital	Route 4Y EB	Route 4Y WB
Current 4H Running Time	22	22
No Rosslyn	6	6
85% of Running Time	14	14
Extension to Dunn Loring via Hospital	38	38
Extension to Metro Center	20	20
Total 4Y Running Time	72	72
Daily Trips	5	5
Daily Revenue Hours	6	6
Daily Platform Hours	7	7
Annual Platform Hours	1,750	1,750
Cost per Hour	\$110	\$110
Annual Cost	\$192,529	\$192,529
Total Annual Operating Cost	\$385,089	
Capital Cost (4 vehicles at \$604,994 per vehicle)	\$2,419,976	
Total Annual Cost	\$2,805,065	

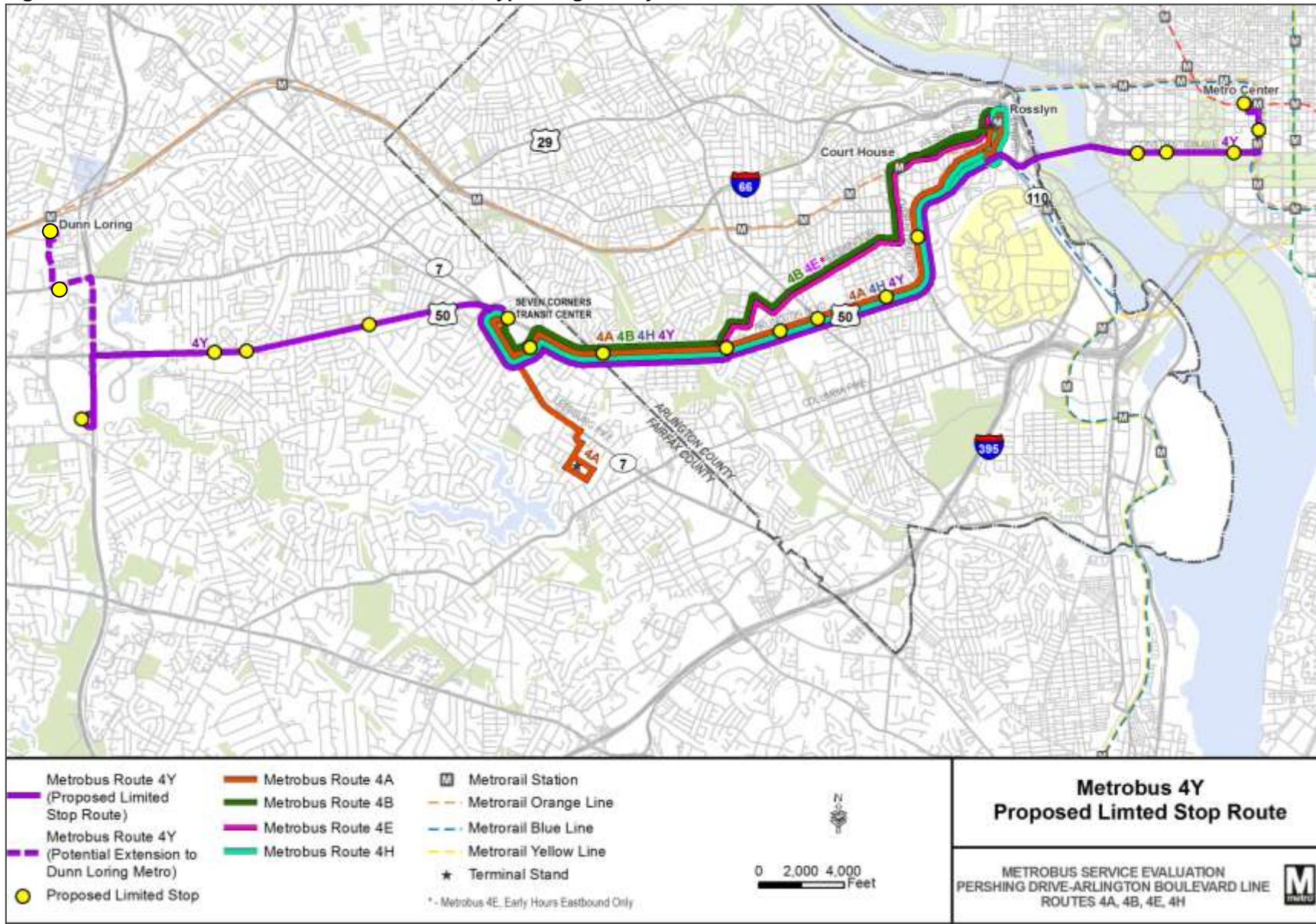
All three options in **Table 5.1** assume four vehicles in each direction based on requiring 30 minutes of deadhead to get back to the beginning of the line. For capital costs, three vehicles would need to be purchased for each option, based on peak-direction service, the estimated run time of each trip, and deadhead time back to the point of origin.

Bus stops for Route 4Y were determined based on four variables. The first variable was bus stop ridership, based on the most recent ridecheck information available for the 4 Line and the 1 Line. The second variable was transfer opportunities to other services. The third variable was providing service to major generators. The final variable was bus stop spacing, with 13 bus stops over 10 miles resulting in spacing of roughly 0.75 miles between stops. **Table 5.2** shows suggested bus stops for the 4Y and associated ridership based on the most recent ridecheck. This analysis estimates that 25 percent of riders at each stop would use 4Y service during the peak period in the peak direction.

Table 5.2: Proposed Limited-Stop Route 4Y Bus Stops

Stop Location	Routes Served	Eastbound		Westbound	
		On	Off	On	Off
Dunn Loring	1B	34	0	0	52
Inova Fairfax Hospital	1A, 1Z	54	11	10	32
Lee Highway & Gallows Road	1B	34	5	3	6
Arlington Boulevard & Allen Street	1A, 1B, 1Z	56	4	6	30
Arlington Boulevard & Graham Road	1A, 1B, 1Z	44	7	7	95
Arlington Boulevard & Annandale Road	1A, 1B, 1Z	50	25	30	36
Seven Corners Transit Station	1A, 1B, 1Z, 4A, 4B, 4H	47	103	123	50
Patrick Henry Drive between Lee Highway & Arlington Boulevard	4A, 4B, 4H	33	5	5	23
Arlington Boulevard & Montague Street	4A, 4B, 4H	69	4	-	-
Arlington Boulevard & Manchester Street	4A, 4B, 4H	-	-	2	29
Arlington Boulevard & Park Drive/Street	4A, 4H	23	4	0	7
Arlington Boulevard & George Mason Drive	4A, 4H	19	3	6	14
Arlington Boulevard & Glebe Road	4A, 4H	10	2	1	9
Arlington Boulevard & Fillmore Street	4A, 4H	22	2	3	9
Arlington Boulevard & Pershing Drive	4A, 4H	9	9	2	4
Total		504	184	198	396
Projected 4Y Virginia Ridership		126	46	50	99
Average Virginia Ridership per 4Y Trip		26	9	10	20

Figure 5.1: Recommended Metro Extra Route 4Y, Bypassing Rosslyn



6.0 Recommendation #7 – Improvements to Route Simplicity

An idea that came out of the project team meetings for this evaluation was eliminating the Route 4E and 4H designations. Public outreach conducted indicated that riders were confused as to why the 4E and 4H existed, since they follow the same pattern as the 4B and 4A, respectively.

6.1 Eliminate Route 4E and 4H Designations

Recommendation #7: Rename all 4E trips 4B or 4B/, and rename all 4H trips 4A or 4A/*

- This will simplify the 4 Line and make the service easier for riders to understand.
- No service cuts are proposed as part of this recommendation.
- During implementation, WMATA should consider an outreach campaign to ensure that riders are aware of the change in service.
- Bus operator training should be conducted at Four Mile Division to ensure that drivers are aware of the changes and remember to adjust the destination signs accurately.

**Assumes that a 4A/ service operating only between Rosslyn and Seven Corners would be necessary if Recommendation #5 does not go forward.*

7.0 Recommendation #8 – Improvement to Bus Stop Distances

In the *4 Line Transit Assessment*, an analysis was done of the distance between 4 Line bus stops and WMATA's guidelines for the ideal stop-to-stop distance. In the first step of the analysis, all stops on the four routes were evaluated to determine whether each stop was too close to the stops adjacent to it based on the WMATA guidelines for distance between stops (WMATA guidelines state that there should be four to five stops per mile, or approximately 0.2 to 0.25 miles apart). Next, a determination was made about whether the distance between stops would exceed WMATA guidelines if a stop identified in step 1 is eliminated (in other words, step 2 is meant to determine if the remaining stops adjacent to the eliminated stop would become too far apart if the stop identified in step 1 is removed). Based on this two-step process, the stops that WMATA may want to consider for consolidation based on the WMATA distance between stop guidelines were identified. 4 Line stops identified in this two-step process are shown in **Table 7.1**.

7.1 Stops to be Considered for Elimination or Consolidation

Bus stops that are too close together can result in significant passenger inconvenience based on slower travel speeds and a “stop and start” rider experience as buses are slowing down to stop even before they have fully accelerated from the stop just served. Because of the negative impacts of stops too close together, WMATA has developed guidelines for distance between bus stops. These guidelines state that the ideal number of bus stops per mile should be four to five, meaning stops spaced approximately 0.2 to 0.25 miles apart.

As part of the analysis to complete the project's *Transit Service Assessment*, stops that do not meet this distance between stops guideline were identified as candidates for potential consolidation.

Recommendation #8: Begin the stop consolidation process. WMATA has a detailed process to determine which of the potential candidate bus stops identified in the tables should be consolidated with other stops. In general, there are three steps that Metro follows when making bus stop consolidation and elimination. The first step is an evaluation of boarding and alighting activity at each candidate stop, the extent of improvements and passenger amenities at each candidate stop and the proximity of each candidate stop to unique facilities such as a medical facility, hospital, school or elderly housing. This recommendation is the first step in the process. The second step is a further detailed review of the proposed bus stops for consolidation/elimination using additional criteria and input in consultation with jurisdictional partners and other stakeholders. The third and final step is an extensive public outreach effort to present the recommended changes riders and get further input from users of the stop.

Table 7.1: Candidate Stops for Elimination/Consolidation

Westbound Candidate Stops	Boardings/A lightings	Eastbound Candidate Stops	Boardings/A lightings
Wilson + Pierce	12/4	W. Glen Carlyn + Argyle	2/0
Wilson + Quinn	2/1	Leesburg Pike + Glen Carlyn (N)	1/0
Wilson + Rhodes	4/1	Arlington Blvd + Highland	4/0
Wilson + Troy	0/1	Arlington Blvd + Garfield	1/0
Pershing + Washington Blvd	5/6	Arlington Blvd S/R + Queen	3/5
Pershing + Edgewood	3/2	Arlington Blvd S/R + Nash	1/3
Pershing + Oakland	1/0	Park + 1st	9/3
Pershing + Quebec	2/14	Park + 2nd	3/0
Pershing + Thomas	8/8	2nd + Henderson	10/1
George Mason + Pershing	6/14	Pershing + Piedmont	13/4
George Mason + Henderson	0/2	Pershing + Oakland	5/1
Henderson + George Mason	4/2	Pershing + Edgewood	2/2
Henderson + N 3rd	5/5	Pershing + Washington Blvd	5/5
N 2nd + Wakefield	0/6	Pershing + Danville	2/3
Arlington Blvd + Garfield	1/6	Barton + Clarendon Blvd	2/14
Arlington Blvd + Hudson	1/3	Clarendon Blvd + Courthouse	4/2
Arlington Blvd + Jackson	0/4	Clarendon Blvd + Pierce	1/11
Arlington Blvd + Columbia Gardens Cemetery	0/1		
Patrick Henry + Brook	5/13		
Leesburg Pike + Glen Carlyn	0/6		
Vista + Lake	0/3		

8.0 Recommendation #9 – Improvements to Bus Stop Amenities

WMATA’s Bus Stop Guidelines are based on a hierarchy in which every bus stop (termed a basic stop) should have a basic set of passenger amenities. This section makes recommendations for the repair or addition of amenities based on data collection performed for the *Transit Assessment*.

8.1 Sidewalks/Landing Pads

WMATA requires that all bus stops have a sidewalk and landing pad for passengers to stand on while waiting for the bus. A field visit verified that 52 out of 149 stops on the 4 Line (35 percent) were missing a sidewalk, a bus stop pad, or both. Arlington County’s Bus Stop Program Manager will investigate all Arlington stops listed in **Table 8.1** as having a missing sidewalk or landing pad.

Table 8.1: Stops Requiring a Sidewalk or Landing Pad (S = needs sidewalk; P = needs pad)

Westbound Stop	S	P	Board-ings	Eastbound Stop	S	P	Board-ings
Wilson Blvd + Court House		X	25	Pershing + George Mason		X	34
Patrick Henry + Arlington Blvd		X	23	Pershing + Thomas		X	26
6166 Leesburg Pike		X	22	Barton + 9th		X	14
Pershing + Thomas		X	8	Pershing + Irving		X	7
Henderson + 3rd		X	5	Arlington Blvd + Irving		X	7
Patrick Henry + Leesburg Pike		X	3	Pershing + Oakland		X	5
Arlington Blvd + Hudson		X	1	Arlington Blvd + Edison		X	4
Lake + Knollwood		X	1	Arlington Blvd + Highland		X	4
2nd St + Wakefield		X	0	Park + 2nd		X	3
Arlington Blvd + Jackson		X	0	Barton + Clarendon Blvd		X	2
Vista + Glen Carlyn		X	0	Arlington Blvd + Garfield		X	1
6017 Vista		X	0	Arlington Blvd + Meade		X	0
Vista + Lake		X	0	Arlington Blvd + Manchester	X	X	50
6026 Knollwood		X	0	Arlington Blvd + Park	X	X	25
2nd + Park	X		0	Arlington Blvd + Glebe	X	X	13
Arlington Blvd + Fairfax	X	X	6	Arlington Blvd + Henderson	X	X	12
Arlington Blvd + Montague	X	X	5	Park + 1st	X	X	9
Arlington Blvd + Courthouse	X	X	2	Leesburg Pike + Glenmore	X	X	6
Arlington Blvd + Pershing	X	X	1	Arlington Blvd + Columbus	X	X	3
Arlington Blvd + Garfield	X	X	1	Arlington Blvd + Washington	X	X	2
Arlington Blvd + Rdwy to Glebe	X	X	1	Arlington Blvd + Meeting	X	X	2
Leesburg + Munson Hills Apts	X	X	1	Wilson + Nash	X	X	54
Leesburg Pike + Glenmore	X	X	1	Clarendon + Oak	X	X	0
Arlington Blvd + Henderson	X	X	0	Castle Pl + Castle Rd	X	X	2
Arlington Blvd + Park	X	X	13	Arlington Blvd + Castle	X	X	12
Leesburg Pike + Rio	X	X	0	Arlington + Olin	X	X	6

Notes: Arlington County has made the following comments:

1) Westbound Wilson Blvd & Courthouse Rd: Arlington County bus shelter maintenance staff will move the magazine stands to provide an unobstructed 5' x 8' area. The County’s Bus Stop Program manager will investigate the potential for improvements.

2) Eastbound Pershing Drive & George Mason Drive: This stop is being improved by Arlington County. Design has been finished and we are currently working on resolving easement issues before proceeding with the project. Improvements have been reviewed with the WMATA Bus Stop Coordinator and will include a sidewalk extension, landing area and new shelter.

3) Westbound Arlington Boulevard & Park Street: This stop will be improved as a part of Arlington County's Decal Fee Streetscape project.

8.2 Information Cases

A field visit identified the location of all information cases along the line. All stops with more than 50 boardings per day that do not currently have an information case were identified as candidates for immediate installation. All stops with more than 20 boardings per day that do not currently have an information case were identified as candidates for future (long-term) installation. 105 out of 149 stops (70 percent) were missing bus information cases along the 4 Line, and nine of those stops qualified for installation of an information case. **Table 8.2** lists the stops requiring an information case in the near-term and long-term.

Table 8.2: Stops Requiring an Information Case

Westbound Stop	Boardings	Eastbound Stop	Boardings
Immediate Installation			
Pershing & Glebe	56	Patrick Henry & Arlington Blvd	78
		Arlington Blvd & Manchester	50
Future/Long-Term Installation			
Wilson Blvd & Veitch	35	Pershing & George Mason	34
Barton & 10th	20	Arlington Blvd & Fillmore	28
		Pershing & Thomas	26
		Barton & Pershing	21

8.3 Trash Receptacles

A field visit identified the location of all trash receptacles along the line. All stops with more than 25 boardings per day that do not currently have a trash receptacle were identified as candidates for installation. Currently 41 of 149 bus stops (27.5 percent) have a trash receptacle. Candidates for a trash receptacle are listed in **Table 8.3**.

Table 8.3: Stops Requiring a Trash Receptacle

Stop	Direction	Boardings
Patrick Henry & Arlington Blvd	Eastbound	78
Glen Carlyn & Vista (Culmore)	Eastbound/ Westbound	64
Patrick Henry & Brook	Eastbound	39
Glen Carlyn & Belleview	Eastbound	29
Arlington Blvd & Park Drive	Eastbound	25

8.4 Shelters/Benches

WMATA's Guidelines indicate that any stop with more than 50 boardings is a candidate for a shelter and bench. Currently 47 of 149 bus stops (31.5 percent) have both a shelter and a bench, while an additional 4 bus stops (2.7 percent) only have seating. The total number of bus stops that have seating is 51 bus stops (34.2 percent). **Table 8.4** lists the one 4 Line stop that is a candidate for a shelter and bench.

Table 8.4: Candidate for a Shelter/Bench

Stop	Direction	Boardings
Patrick Henry & Arlington Blvd	Eastbound	78

8.5 Bus Stop Flags

All bus stops should have flags that identify the location of the bus stop. Currently four out of 149 stops (3 percent) were missing bus stop flags. **Table 8.5** provides a list of stops that are missing bus stop flags.

Table 8.5: Stops Requiring Bus Stop Flags

Westbound Stop	Boardings	Eastbound Stop	Boardings
Arlington Blvd + Courthouse	2	Arlington Blvd + Columbia Gardens Cemetery	2
Arlington Blvd + Fairfax	6		
Arlington Blvd + Pershing	6		

Recommendation #9: Install or repair required bus stop amenities.

Table 8.6 provides a list of estimated costs for recommended improvements to amenities.

Table 8.6: Bus Stop Amenities, Estimated Costs

Unit	Quantity	Cost per Unit	Total Cost
Bus Shelter and Bench	1	\$10,000	\$10,000
Bus Stop Flag	4	\$100	\$400
Information Case (Immediate Installation)	3	\$200	\$600
Information Case (Future Installation)	6	\$200	\$1,200
Bus Stop Landing Pad	51	\$1,500	\$76,500
Trash Receptacle	5	\$1,000	\$5,000
Total			\$93,700

9.0 Summary of Traffic Operations and Recommended Improvements

Traffic operational issues for the 4 Line were identified based on bus operator notes and consultant field observations/analysis during the AM and PM peak periods. Details on 4 Line traffic operational issues are contained in Technical Memorandum 2: *Traffic Operations*, and are summarized in this section. Traffic issues and recurring points of delay identified along the two lines corridors are shown in **Figure 9.1**. In some cases, traffic issues have already been addressed, and the measures taken are documented below. In other cases, recommendations are made for further improvements.

a. Signal Timing and Phasing

Bus delays were observed at several locations along the 4 Line alignment, listed as follows.

- **Arlington Boulevard and Carlin Springs Road** – Long signal cycles were observed along eastbound and westbound Arlington Boulevard Access Road at Carlin Springs Road during both AM and PM peak periods. Buses were observed waiting for over a minute at the signal with minimal cross-traffic passing through the intersection.
- **Arlington Boulevard and Patrick Henry Drive** – Long queues and signal cycles were observed at the intersection of Arlington Boulevard and Patrick Henry Drive during both AM and PM peak periods. Westbound buses were observed waiting for several minutes at the signal and through multiple signal cycles to make the left turn from Arlington Boulevard onto Patrick Henry Drive. This wait was due to a short left turn signal and long queues which were observed spilling over the queue lane and into the adjacent thru traffic lane. Eastbound buses were observed waiting for several minutes at the signal due to long queues to make the right turn from Patrick Henry Drive onto Arlington Boulevard.
- **Leesburg Pike and Patrick Henry Drive** – Long queues and signal cycles were observed along southbound Leesburg Pike and Patrick Henry Drive during both AM and PM peak periods. Buses were observed waiting for several minutes at the signal and through multiple signal cycles to make the left turn from Leesburg Pike onto Patrick Henry Drive.
- **Pershing Drive and Washington Boulevard** – Long signal cycles were observed along eastbound and westbound Pershing Drive at Washington Boulevard during both AM and PM peak periods. Buses were observed waiting for over a minute at the signal.
- **Pershing Drive and Glebe Road** – Long signal cycles were observed along eastbound Pershing Drive at Glebe Road during both the AM peak period. Buses were observed waiting for over a minute at the signal.
- **Pershing Drive and George Mason Drive** – Long signal cycles were observed along westbound Pershing Drive at George Mason Drive during both AM and PM peak periods. Buses were observed waiting for over a minute at the signal.
- **Park Drive and Arlington Boulevard** – Long signal cycles were observed along westbound Park Drive at Arlington Boulevard during both AM and PM peak periods. Buses were observed waiting for several minutes at the signal.

According to Arlington County, most of the traffic signals along the corridor have recently been optimized resulting in the intersections operating at optimal operating conditions. Any further changes to signal timings will have an unacceptable impact on level of service. Cross-traffic and pedestrian volumes were incorporated into the signal optimization. Construction on Arlington Boulevard is impacting travel times and Pershing Drive is carrying additional traffic due to detours related to Arlington Boulevard construction.

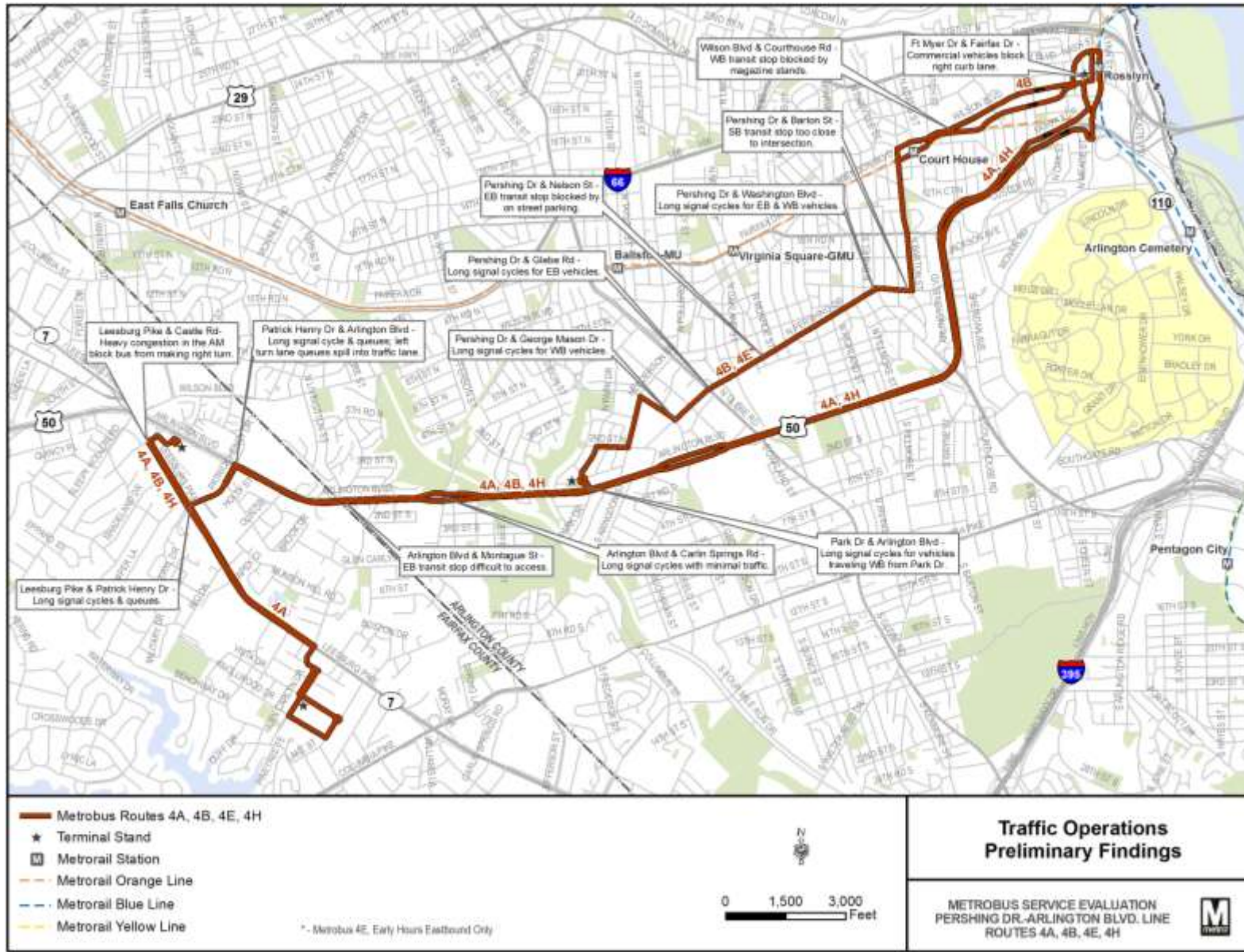
b. Transit Stop Location and Parking Restrictions

- **Wilson Boulevard and Courthouse Road** – The transit stop along westbound Wilson Boulevard at Courthouse is blocked by magazine stands. All riders had to exit out the front door, which caused the bus to miss the signal. The magazine stands also block ADA access to the bus. **Recommendation 10a: The magazine stands should be moved to a location that does not block the bus.**
- **Barton Street and Pershing Drive** – The transit stop along southbound Barton Street at Pershing Drive is close to the intersection. The curb at the intersection bulbs out, and thus the bus is forced to make a difficult wide turn onto Pershing Drive from the stop. **Recommendation 10b: Consider moving this bus stop onto Pershing Drive just west of Barton Street.** This will also impact ART Route 45.
- **Arlington Boulevard and Montague Street** – 4A and 4B buses were observed bunching on eastbound Arlington Boulevard at the Montague Street bus stop. The stop features a bus pull off lane and vehicles were observed having a difficult time entering the right traffic lane. Delays and bunching are not significant enough at this bus stop to warrant modification.
- **Pershing Drive and Nelson Street** – The transit stop along eastbound Pershing Drive at Nelson Street has on street parking available in front of the bus stop sign. Buses drive past the stop in order to access the curb lane. Buses are also forced to load/unload passenger in the road right of way. **Recommendation 10c: Contact Arlington County Police to ask for enhanced parking enforcement at this location.**

c. Intersection Conflicts

- **Fort Myer Drive and Fairfax Drive** – Commercial vehicles accessing the loading dock at 1616 Fort Myer Drive were observed blocking the right curb lane. Buses were forced to move into the left lane and then make an immediate right onto Fairfax Drive. This issue cannot be mitigated.
- **Leesburg Pike and Castle Road** – Heavy congestion during the AM peak period blocked buses from making the right turn from Leesburg Pike onto Castle Road causing buses to sit through multiple signal cycles. The congestion is attributed to backup delays at the Seven Corners intersection. This issue cannot be mitigated.

Figure 9.1: Traffic Operations Findings



10.0 Executive Summary of All Recommendations

This section lists all recommendations for the 4 Line:

1. Adjust the 4 Line's weekend schedules to meet WMATA's service guidelines.
2. Add trips to reduce headways on the 4 Line to meet WMATA's service guidelines.
3. Re-evaluate the need for further run time additions.
4. Place a supervisor at Seven Corners Transit Center.
5. Change the western terminal of 4A from Culmore to Seven Corners Transit Center.
6. Implement a new Limited-Stop Route (4Y) that bypasses Rosslyn.
7. Rename all 4E trips 4B or 4B/, and rename all 4H trips 4A or 4A/.
8. Begin the bus stop consolidation process.
9. Install or repair required bus stop amenities.
10. Work with local agencies to make traffic-related improvements:
 - a. The magazine stands at Wilson & Courthouse should be moved to a location that does not block the buses.
 - b. Consider moving the bus stop at Barton & Pershing onto Pershing Drive just west of Barton Street.
 - c. Contact Arlington County Police to ask for enhanced parking enforcement at Pershing & Nelson.