

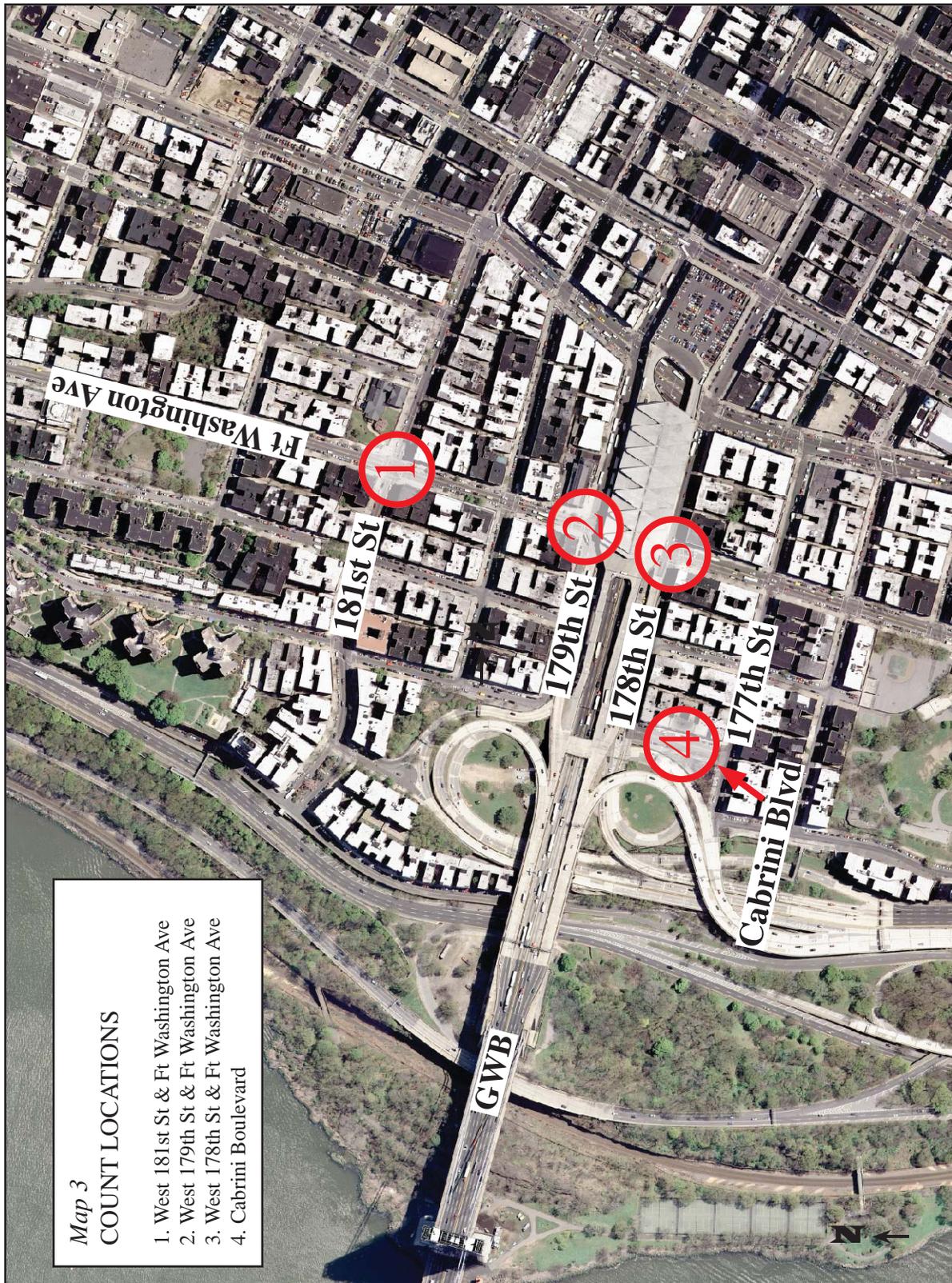
Traffic Operations

The operation of signalized intersections within the study area was analyzed applying the methodologies presented in the 2000 Highway Capacity Manual (HCM2000). These procedures evaluate signalized intersections for average delay per vehicle and level of service (LOS). The capacity analysis methodology separates an intersection approach into lane groups on the basis of the movements occurring during each signal phase. The lane groups are then analyzed to determine the specific vehicular capacity and LOS. This analysis requires the following input parameters: intersection geometry, lane utilization, number and width of travel lanes, on-street parking conditions, locations of bus stops, number of buses stopping per hour, vehicle turning movements, vehicle classification, conflicting pedestrian movements, traffic signal cycle length, and allocation of green time.

Table 2 - Level of Service Delay Times

Flow Quality	Description
Level A	Describes operation with very low delay, i.e., less than or equal to 10 seconds per vehicle. This occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
Level B	Describes operation with delay in the range of >10-20 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
Level C	Describes operation with delay in the range of >20-35 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, although some may still pass through the intersection without stopping.
Level D	Describes operation with delay in the range of >35-55 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, longer cycle lengths, or high v/c ratios. Many vehicles stop and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
Level E	Describes operation with delay in the range of >55-80 seconds per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.
Level F	Describes operation with delay in excess of 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with saturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.
Source:	<i>Highway Capacity Manual</i> , Transportation Research Board, National Research Council, Washington, D.C., 2000

The operating characteristics of signalized intersections can be estimated and evaluated by analyzing capacity and performance. The capacity of an intersection represents the throughput of a facility (i.e., the maximum number of vehicles that can be processed in one hour). Capacity analysis produces the volume-to-capacity ratio (v/c ratio) which presents the proportion of capacity (supply) utilized by the existing traffic volume (demand). High v/c ratios (>0.85) indicate some traffic congestion, and low v/c ratios (<0.60) indicate a smooth traffic flow.



The performance of an intersection is based on the estimated average delay time (i.e., the average stopped time per vehicle) for each vehicle utilizing a roadway segment. Delay time is determined by the capacity of a lane group, the amount of green time allotted to a lane group, and the signal cycle length. Delay time is the factor which determines the LOS for a lane group. Short delays correspond to a good LOS while long delays correspond to a poor LOS. For example, an average delay of up to ten seconds per vehicle is categorized as LOS A, and an 80 second delay is categorized as LOS F. In New York City, an LOS of mid-D, corresponding to average delay of 45 second, is considered acceptable. The table on the previous page describes the LOS definitions for signalized intersections.

The traffic analysis was performed to assure the feasibility of any recommendations to the intersections and any improvements to pedestrian, bicycle, and motorized vehicle movements. Two-hour manual counts were conducted at the three selected intersections on Ft. Washington Avenue at West 178th Street, West 179th Street, and West 181st Street during the morning 7:00AM - 9:00AM (AM), midday 12:00PM - 2:00PM (MD) and evening 4:00PM - 6:00PM (PM) periods on June 19, 2007. The traffic analysis (LOS, v/c ratio, delay) focused on the peak hour of traffic volume which typically represents the most critical period of operation and the highest capacity requirements. The peak hours were identified as 8:00AM - 9:00AM, 12:30PM - 1:30PM, and 5:00PM - 6:00PM. Signal timing, cycle length and phasing were obtained from the New York City Department of Transportation. Cabrini Boulevard is unsignalized from West 177th Street to West 178th Street and is controlled by a stop sign for vehicles traveling northbound on Cabrini Boulevard at West 178th Street. Traffic volumes, turning movements and vehicle classifications were recorded during the counts.

The LOS capacity analysis of existing conditions indicates that the three signalized intersections operate at LOS C or better with less than 35 seconds of delay during all peak hours. However, two intersection approaches operate at LOS E, which is considered unacceptable for New York City, with one approach operating at LOS E during the AM and PM peak hours. These approaches are:

- The northbound Ft. Washington Avenue left-thru approach at West 179th Street operates at LOS E with a delay of 66.3 seconds per vehicle and a v/c ratio of 0.99 during the weekday PM peak hour.



- The westbound West 181st Street left-thru-right movements approach at Ft. Washington Avenue operates at LOS E with a delay of 68.4 seconds per vehicle and a v/c ratio of 0.94 during the weekday AM peak hour.
- The westbound West 181st Street left-thru-right movements approach at Ft. Washington Avenue operates at LOS E with a delay of 73.6 seconds per vehicle and a v/c ratio of 0.97 during the weekday PM peak hour.

The table below shows the signal timing at the signalized intersections in the study area.

Table 3

Signal Timing for Study Area Intersections (in seconds)						
Ft. Washington Avenue		Green Period	Amber Period	All Red Period	Offset	Cycle
at West 181st St	Phase A	49	3	2	32	90
	Phase B	31	3	2		
at West 180th St	Phase A	49	3	2	32	90
	Phase B	31	3	2		
at West 179th St	Phase A	40	3	2	32	90
	Phase B	40	3	2		
at West 178th St	Phase A	40	3	2	32	90
	Phase B	40	3	2		

Vehicular Volumes

The table below shows the motorized vehicle volumes at three signalized intersections along Ft. Washington Avenue at West 178th Street, West 179th Street, and West 181st Street.

Table 4

Vehicular Volumes at Signalized Intersections										
Intersection	Approach	AM 7:00-9:00am			MD 12:00-2:00PM			PM 4:00-6:00PM		
		L	T	R	L	T	R	L	T	R
Ft. Washington Avenue & West 178th Street	Eastbound	80	860	135	70	825	95	80	760	185
	Northbound	~	200	65	~	180	60	~	375	65
	Southbound	95	280	~	80	180	~	70	175	~
	TOTALS	175	1340	200	150	1185	155	150	1310	250
Ft. Washington Avenue & West 179th Street	Westbound	45	355	50	45	225	45	50	370	35
	Northbound	90	145	~	130	135	~	235	175	~
	Southbound	~	185	140	~	165	55	~	155	140
	TOTALS	135	685	190	175	525	100	285	700	175
Ft. Washington Avenue & West 181st Street	Eastbound	45	115	120	30	130	75	25	105	70
	Westbound	115	95	35	75	90	20	130	120	30
	Northbound	30	95	75	45	105	60	55	125	70
	Southbound	80	200	85	85	125	50	55	125	60
	TOTALS	270	505	315	235	450	205	265	475	230

Vehicular Volumes

The two tables below show the motorized vehicle volumes at Cabrini Boulevard between West 177th Street and West 178th Street. There are two northbound travel lanes on Cabrini Boulevard at this location and they are separated by a two-foot wide raised median (see Photos 25 and Photo 26). The tables below distinguish the two lanes by calling the lane on the west side of the median “West Curb” and the lane on the east side of the median “East Curb”.

Table 5

Total Vehicular Volumes at Cabrini Boulevard				
Location	Northbound	AM 7:00-9:00am	MD 12:00-2:00PM	PM 4:00-6:00PM
Between West 178th Street & West 177th Street	East Curb	42	62	54
	West Curb	5	6	17
	TOTALS	47	68	71

Table 6

Peak Hour Vehicular Volumes at Cabrini Boulevard				
Location	Northbound	AM Peak Hour 8:00-9:00am	MD Peak Hour 12:30-1:30PM	PM Peak Hour 5:00-6:00PM
Between West 178th Street & West 177th Street	East Curb	21	30	23
	West Curb	2	1	5
	TOTALS	23	31	28

West Curb

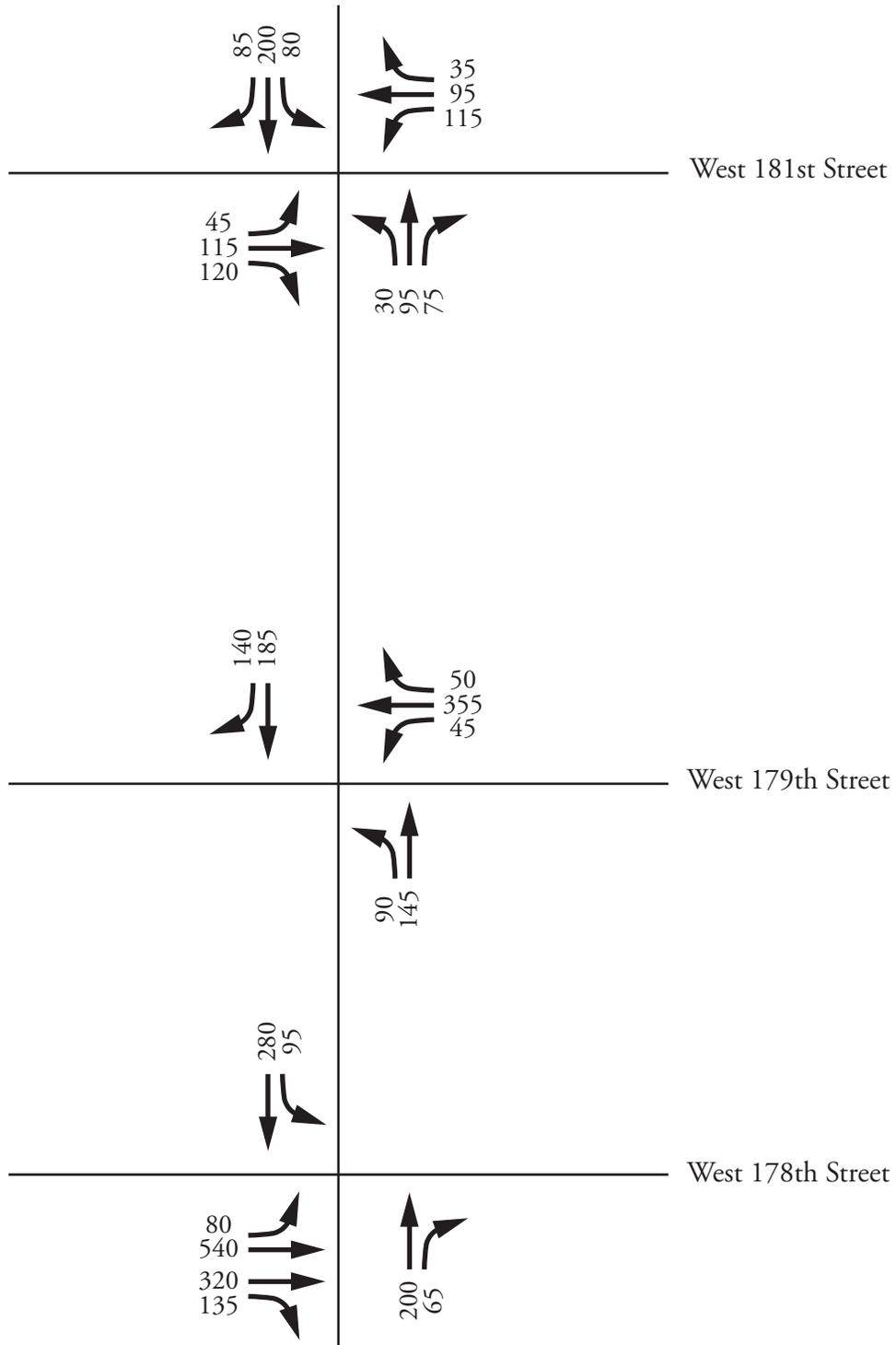


East Curb

Vehicular Volumes - AM Peak Hour Traffic Volumes - 8:00AM to 9:00AM

Table 7

Ft. Washington Avenue

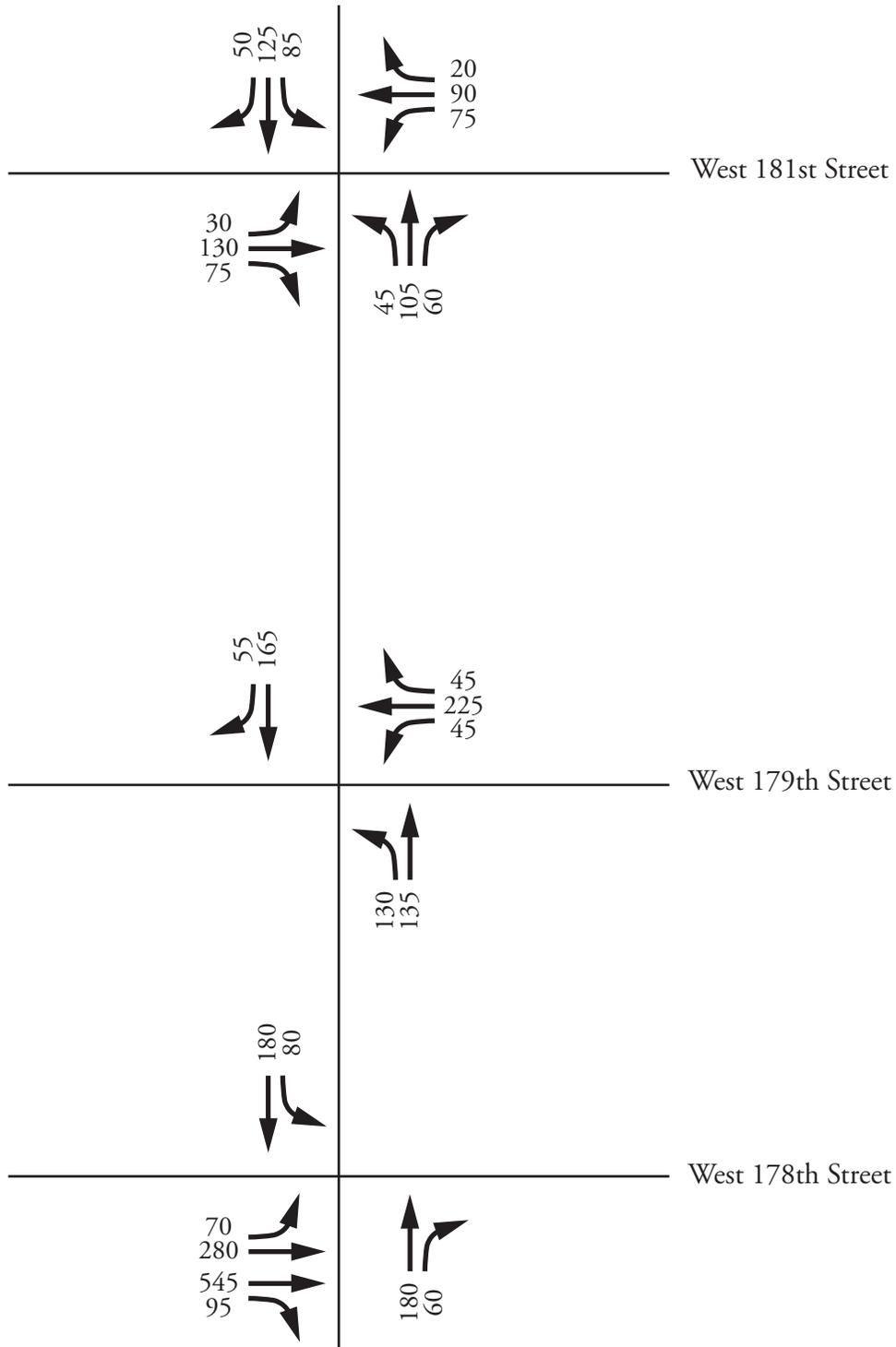




Vehicular Volumes - MD Peak Hour Traffic Volumes - 12:30PM to 1:30PM

Table 8

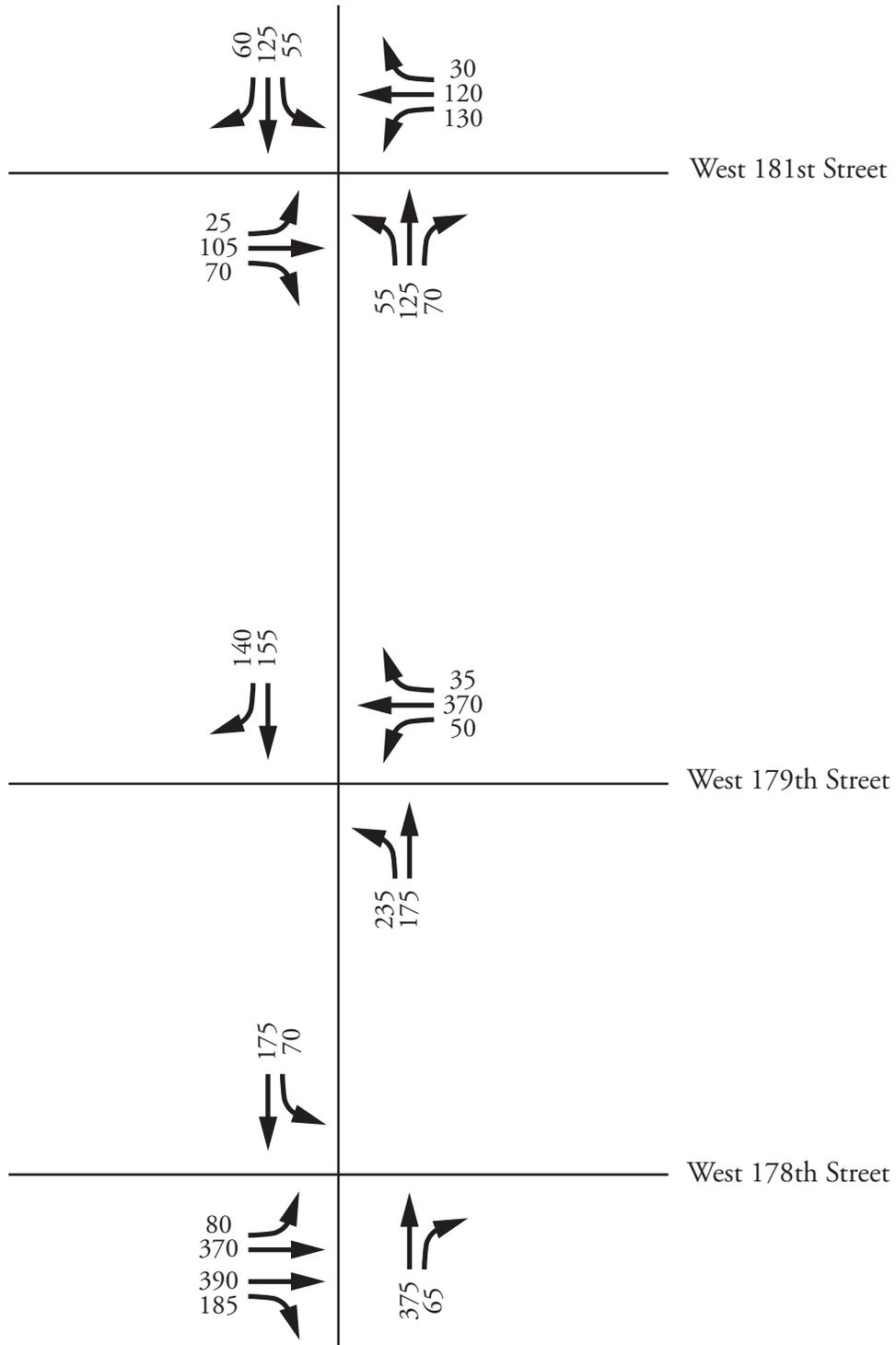
Ft. Washington Avenue



Vehicular Volumes - PM Peak Hour Traffic Volumes - 5:00PM to 6:00PM

Table 9

Ft. Washington Avenue



Vehicular Level of Service (LOS) - West 178th Street

The following table shows the motorized vehicle level of service at the signalized intersection of Ft. Washington Avenue and West 178th Street during the peak hours.

Table 10

Intersection	Movement	AM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 178th Street				
Eastbound	LTR	0.50	18.6	B
Northbound	TR	0.40	18.4	B
Southbound	TL	0.77	31.4	C
		Intersection Delay = 21.4 LOS = C		

Intersection	Movement	MD		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 178th Street				
Eastbound	LTR	0.42	17.5	B
Northbound	TR	0.36	18.0	B
Southbound	TL	0.54	22.3	C
		Intersection Delay = 18.4 LOS = B		

Intersection	Movement	PM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 178th Street				
Eastbound	LTR	0.43	17.7	B
Northbound	TR	0.63	23.3	C
Southbound	TL	0.61	25.1	C
		Intersection Delay = 20.2 LOS = C		

Vehicular Level of Service (LOS) - West 179th Street

The following table shows the motorized vehicle level of service at the signalized intersection of Ft. Washington Avenue and West 179th Street during the peak hours.

Table 11

Intersection	Movement	AM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 179th Street				
Westbound	LTR	0.40	17.8	B
Northbound	LT	0.52	22.0	C
Southbound	TR	0.49	20.1	C
		Intersection Delay = 19.5 LOS = B		

Intersection	Movement	MD		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 179th Street				
Westbound	LTR	0.31	16.9	B
Northbound	LT	0.57	23.0	C
Southbound	TR	0.32	17.2	B
		Intersection Delay = 19.0 LOS = B		

Intersection	Movement	PM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 179th Street				
Westbound	LTR	0.41	18.1	B
Northbound	LT	0.99	66.3	E
Southbound	TR	0.44	19.2	B
		Intersection Delay = 34.8 LOS = C		

Vehicular Level of Service (LOS) - West 181st Street

The following table shows the motorized vehicle level of service at the signalized intersection of Ft. Washington Avenue and West 181st Street during the peak hours.

Table 12

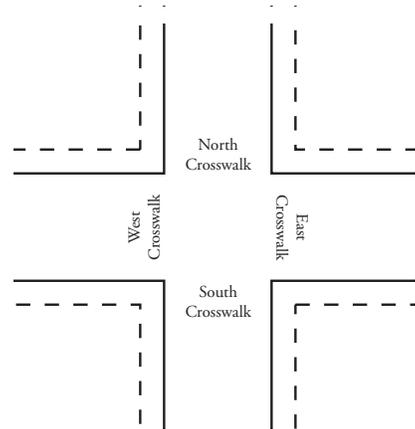
Intersection	Movement	AM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 181st Street				
Eastbound	LTR	0.78	40.6	D
Westbound	LTR	0.94	68.4	E
Northbound	LTR	0.33	12.8	B
Southbound	LTR	0.59	17.5	B
		Intersection Delay = 34.0 LOS = C		

Intersection	Movement	MD		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 181st Street				
Eastbound	LTR	0.63	31.6	C
Westbound	LTR	0.60	31.9	C
Northbound	LTR	0.35	13.0	B
Southbound	LTR	0.47	15.1	B
		Intersection Delay = 22.4 LOS = C		

Intersection	Movement	PM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 181st Street				
Eastbound	LTR	0.54	28.9	C
Westbound	LTR	0.97	73.6	E
Northbound	LTR	0.44	14.5	B
Southbound	LTR	0.41	13.8	B
		Intersection Delay = 34.8 LOS = C		

Pedestrian Counts - West 181st Street

Pedestrian counts were taken during three two-hour time periods at the three signalized intersections at Ft. Washington Avenue and West 181st Street, West 179th Street, and West 178th Street during the morning (AM), midday (MD) and evening (PM) periods in June of 2007. The diagram at right shows the crosswalk pedestrian movements that were recorded at each intersection.



The West 181st Street intersection has the highest pedestrian volumes in our study area with the south crosswalk and the west crosswalk movements having the highest pedestrian volumes at this intersection. This is most likely due to pedestrians accessing the “A” subway station entrance located on the southwest corner of the intersection and because the northeast corner of the intersection is dominated by a large church instead of the small businesses that front the rest of West 181st Street. This intersection also has the most pedestrian accidents.



Photo 38 - Ft. Washington Avenue and West 181st Street intersection.

Pedestrian Counts - West 181st Street

Table 13

Pedestrian Counts: Ft. Washington Avenue & West 181st Street AM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
7:00-7:15AM	15	11	31	34
7:15-7:30	19	17	23	34
7:30-7:45	31	28	50	62
7:45-8:00	54	34	41	68
8:00-8:15	40	45	39	64
8:15-8:30	28	34	31	69
8:30-8:45	28	38	42	60
8:45-9:00	33	36	40	52
TOTAL	248	243	297	443

Pedestrian Counts: Ft. Washington Avenue & West 181st Street MD				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
12:00-12:15PM	49	62	110	77
12:15-12:30	84	56	88	64
12:30-12:45	68	46	97	65
12:45-1:00	54	50	88	60
1:00-1:15	53	58	90	54
1:15-1:30	32	58	75	70
1:30-1:45	27	47	98	69
1:45-2:00	56	40	92	64
TOTAL	423	417	738	523

Pedestrian Counts: Ft. Washington Avenue & West 181st Street PM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
4:00-4:15PM	67	45	87	90
4:15-4:30	49	55	96	87
4:30-4:45	60	52	85	67
4:45-5:00	70	49	121	81
5:00-5:15	61	52	110	84
5:15-5:30	63	56	91	88
5:30-5:45	73	52	95	84
5:45-6:00	71	80	114	82
TOTAL	514	441	799	663

Pedestrian Counts - West 179th Street

The east crosswalk and the west crosswalk have the highest pedestrian volumes at this intersection with the east crosswalk having over 40% more volume than the west. The west crosswalk is also the most problematic of the four because of the unusual street geometry combining the George Washington Bridge on-ramp with West 179th Street. The street is 51 feet wide. The street mirrors the intersection of Ft. Washington Avenue and West 178th Street which has a George Washington Bridge off-ramp.

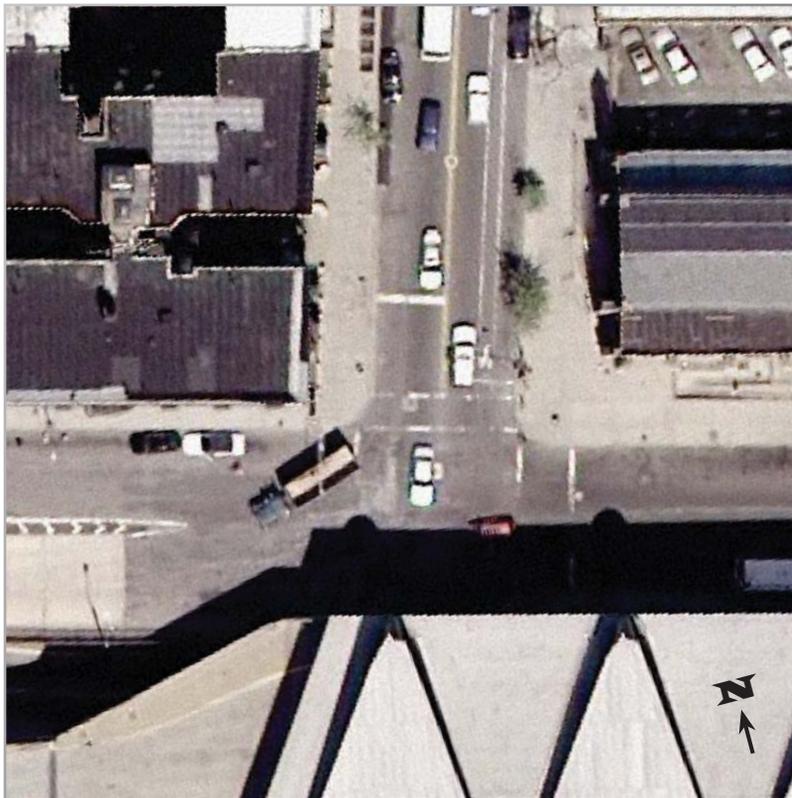


Photo 39 - Ft. Washington Avenue and West 179th Street intersection.

Pedestrian Counts - West 179th Street

Table 14

Pedestrian Counts: Ft. Washington Avenue & West 179th Street AM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
7:00-7:15AM	21	62	7	29
7:15-7:30	30	50	9	39
7:30-7:45	21	46	3	38
7:45-8:00	30	52	11	34
8:00-8:15	31	46	4	47
8:15-8:30	42	73	6	59
8:30-8:45	11	72	12	33
8:45-9:00	14	73	4	26
TOTALS	200	474	56	305

Pedestrian Counts: Ft. Washington Avenue & West 179th Street MD				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
12:00-12:15PM	12	62	15	24
12:15-12:30	20	54	10	20
12:30-12:45	12	65	11	25
12:45-1:00	8	38	14	29
1:00-1:15	22	43	13	24
1:15-1:30	15	61	15	22
1:30-1:45	31	72	12	34
1:45-2:00	24	47	5	26
TOTALS	144	442	95	204

Pedestrian Counts: Ft. Washington Avenue & West 179th Street PM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
4:00-4:15PM	28	62	6	57
4:15-4:30	14	61	10	34
4:30-4:45	24	72	19	41
4:45-5:00	27	76	6	51
5:00-5:15	29	81	14	71
5:15-5:30	35	69	12	51
5:30-5:45	17	89	11	55
5:45-6:00	19	83	12	46
TOTALS	193	593	90	406

Pedestrian Counts - West 178th Street

The pedestrian volumes at this intersection are similar to the volumes at West 179th Street. The east crosswalk and the west crosswalk have the highest pedestrian volumes at this intersection with the east crosswalk having more than double the volume than the west crossing. The east crosswalk had the highest pedestrian volumes of all the crosswalks in the study.



Photo 40 - Ft. Washington Avenue and West 178th Street intersection.

Pedestrian Counts - West 178th Street

Table 15

Pedestrian Counts: Ft. Washington Avenue & West 178th Street AM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
7:00-7:15AM	7	70	14	25
7:15-7:30	13	94	7	33
7:30-7:45	17	90	16	36
7:45-8:00	14	86	10	40
8:00-8:15	18	72	10	53
8:15-8:30	17	131	16	60
8:30-8:45	10	116	18	48
8:45-9:00	7	119	11	39
TOTALS	103	778	102	334

Pedestrian Counts: Ft. Washington Avenue & West 178th Street MD				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
12:00-12:15PM	8	89	16	31
12:15-12:30	3	50	14	16
12:30-12:45	9	78	11	28
12:45-1:00	11	72	17	28
1:00-1:15	13	64	17	32
1:15-1:30	7	49	25	22
1:30-1:45	2	67	23	18
1:45-2:00	18	63	21	47
TOTALS	71	532	144	222

Pedestrian Counts: Ft. Washington Avenue & West 178th Street PM				
Time Periods	North X-Walk	East X-Walk	South X-Walk	West X-Walk
4:00-4:15PM	11	84	33	58
4:15-4:30	16	96	66	60
4:30-4:45	12	96	58	55
4:45-5:00	13	107	23	74
5:00-5:15	6	134	19	73
5:15-5:30	10	146	27	76
5:30-5:45	7	73	26	34
5:45-6:00	2	112	32	52
TOTALS	77	848	284	482

Pedestrian Signal Timing at Signalized Intersections

The pedestrian crosswalks and crossing times were measured and verified at each intersection studied. All crossing times met federal guidelines for pedestrian walking speed requirements.

Table 16

Pedestrian Signal Timing & Walking Speeds at Signalized Intersections				
Intersections	Crosswalk Width	Pedestrian Phase	Pedestrian Phase Needed	Sufficient Crossing Time
Ft. Washington Avenue and West 181st Street				
North Crosswalk	44 ft.	28 secs	17-20 secs	Yes
South Crosswalk	44 ft.	28 secs	17-20 secs	Yes
East Crosswalk	41 ft.	47 secs	16-19 secs	Yes
West Crosswalk	41 ft.	47 secs	16-19 secs	Yes
Ft. Washington Avenue and West 179th Street				
North Crosswalk	44 ft.	35 secs	17-20 secs	Yes
South Crosswalk	44 ft.	35 secs	17-20 secs	Yes
East Crosswalk	41 ft.	37 secs	16-19 secs	Yes
West Crosswalk	52 ft.	37 secs	20-22 secs	Yes
Ft. Washington Avenue and West 179th Street				
North Crosswalk	44 ft.	27 secs	17-20 secs	Yes
South Crosswalk	44 ft.	27 secs	17-20 secs	Yes
East Crosswalk	40 ft.	47 secs	15-18 secs	Yes
West Crosswalk	50 ft.	47 secs	19-21 secs	Yes
The pedestrian phase needed to cross the street safely is a walking rate calculated at 3.5 ft per second curb-to-curb plus 7 second steady walk minimum; and from top of ramp (+6 ft) to curb at other side to equal 3 ft per second.				

Recommendations

The following pages detail a variety of proposed recommendations for this project. Below is a summary of these recommendations.

Summary

Ft. Washington Avenue and West 181st Street

1. Post more pedestrian warning signage
 - a. Westbound left turn
 - b. Southbound left turn
2. Create daylighting on westbound approach
 - a. Restrict curbside parking
3. Install stop lines at all approaches

Ft. Washington Avenue and West 179th Street

1. Build and extend median to west crosswalk
2. Consider adding left turn only lane for northbound approach
 - a. Consider moving bus stop 100 feet north

Ft. Washington Avenue and West 178th Street

1. Build permanent median to crosswalk
2. Add street markings on GWB off-ramp
3. Add left turn only lane for southbound approach

Cabrini Boulevard between West 177th Street and West 178th Street

1. Redesign Cabrini Blvd. between West 177th Street and West 178th Street
 - a. Install complex pedestrian ramps at Cabrini Blvd and West 177th Street
 - b. Add green space to George Washington Bridge Park
 - c. Improve the design of the memorial park
 - d. Create Class 1 greenway
 - e. Install signage and markings to separate pedestrians and bicycles
 - f. Create entrance to GWB greenway
 - g. Widen greenway to a minimum 10' along West 178th Street

Ft. Washington Avenue and West 177th Street

1. Create Class 2 bike lane

Recommendations - Ft. Washington Avenue and West 181st Street

Ft. Washington Avenue and West 181st Street

1. Post yield to pedestrian signage at intersection

To improve pedestrian safety, alert drivers to pedestrian activity, and reduce conflicts between users, pedestrian signs should be posted at this intersection. Pedestrian signage is a practical and cost-effective way to improve pedestrian safety and calm traffic. The accident data suggests that vehicles making left turn movements at this intersection are involved with the majority of pedestrian accidents. The westbound approach to the intersection of West 181st Street to Ft. Washington Avenue has an LOS E with a delay of 73.6 seconds mainly due to the heavy left turn movements. This delay can cause frustration between user groups. Signage such as the NYCDOT SR-1113 (Photo 41 - an equilateral triangle pointing downward, with red background, white “Yield To” lettering and white pedestrian figure) should be posted at the southwest corner facing east (see Photo 41) for eastbound left turning vehicles. Also post signage on the southeast corner of the intersection facing north for southbound left turning vehicles (Photo 43). There is no existing pedestrian signage at these locations.



Photo 41



Photo 42 - Proposed location of signage at southwest corner of Ft. Washington Avenue and West 181st Street intersection.



Photo 43 - Proposed location of signage at southeast corner of Ft. Washington Avenue and West 181st Street intersection.

Recommendations - Ft. Washington Avenue and West 181st Street

2. Create daylighting on the westbound approach

Daylighting is defined as the removal of on-street parking and/or standing for approximately 100 feet (4-5 vehicles) from an intersection to provide for an additional moving lane. Currently there is metered parking along the north curb of West 181st Street up to the intersection with Ft. Washington Avenue (see Photo 44). These metered spaces can be adapted into a no standing zone from 7AM to 7PM or more selectively from 7AM to 10AM and 4PM to 7PM during the morning and evening peak hours when the westbound approach has significant delays. Currently the westbound left-thru-right approach has an AM peak hour LOS E with a delay of 68.4 seconds and PM peak hour LOS E with a delay of 73.6 seconds. With the recommended daylighting, the AM delay decreases from 68.4 seconds to 28.1 seconds with an LOS change from E

Photo 44 - Proposed location of daylighting on north curb of West 181st Street. Image shows a line of cars waiting to turn left at the traffic signal with vehicles parked against the curb.



to C. The PM delay decreases from 73.6 seconds to 29.9 seconds with an LOS change from E to C. The MD peak hour delay was also improved but not as significantly as the other peak hours. The daylighting and restriping recommendation improves delays, LOS, and functionality of the westbound approach and for the entire intersection (see Table 17 on the following page).

Recommendations - Ft. Washington Avenue and West 181st Street

Table 17

Ft. Washington Avenue & West 181st Street	Movement	AM		
		v/c ratio	Delay	LOS
Existing Westbound	LTR	0.94	68.4	E
		Intersection Delay = 34.0 LOS = C		
Recommended Westbound	TR	0.28	22.8	C
	L	0.57	34.1	C
			28.1	C
		Intersection Delay = 24.8 LOS = C		

Ft. Washington Avenue & West 181st Street	Movement	MD		
		v/c ratio	Delay	LOS
Existing Westbound	LTR	0.60	31.9	C
		Intersection Delay = 22.4 LOS = C		
Recommended Westbound	TR	0.23	22	C
	L	0.40	28.2	C
			24.5	C
		Intersection Delay = 20.8 LOS = C		

Ft. Washington Avenue & West 181st Street	Movement	PM		
		v/c ratio	Delay	LOS
Existing Westbound	LTR	0.97	73.6	E
		Intersection Delay = 34.0 LOS = C		
Recommended Westbound	TR	0.30	23.0	C
	L	0.64	38.0	C
			29.9	C
		Intersection Delay = 21.7 LOS = C		

Recommendations - Ft. Washington Avenue and West 181st Street



Photo 45 - The westbound approach with the recommended left turn lane.

3. Install stop lines at all approaches

Stop lines are used to indicate the point where vehicles are required to stop in compliance with a traffic control signal. They are street markings that increase visibility for all users by pushing vehicles back off the crosswalk and make drivers aware that they must share the road. Daylighting on the westbound approach will create two travel lanes and the increased visibility will ensure the safety of pedestrians in the crosswalks. Stop lines should be two feet wide and placed at all four approaches.

Recommendations - Ft. Washington Avenue and West 179th Street

Ft. Washington Avenue and West 179th Street

1. Build and extend median to crosswalk

The median dividing the George Washington Bridge on-ramp and West 179th Street should be extended east to the crosswalk (Map 3). This will make a tighter and smaller radius for vehicles which is beneficial to pedestrians crossing the street. The existing large radius and excess space enables vehicles to drive faster as they make their turning movements and when they are accessing the on-ramp. The median can also serve as a pedestrian refuge island. The northbound approach left-turn vehicle movement to the GWB on-ramp is heavily used and has an existing LOS E, a v/c ratio of 0.99, and a delay of 66.3 seconds. The median will enable pedestrians to have a safe place while crossing the street at this location. The design of the median should take into consideration the turning movements of heavy vehicles and trucks accessing the on-ramp, but the existing truck route (Highway 9) is on West 179th Street which is the westbound through movement at this intersection (which is not a turning movement). The other heavy vehicle movement at this intersection is the bus movement from the westbound approach making the left turn to southbound Ft. Washington Avenue. The recommended median extension will have no effect on this bus movement.

To discourage the illegal and unsafe movement of pedestrians walking on the 3-foot curb on the GWB vehicle on-ramp (Photo 48), the recommended median extension should either have no available sidewalk for pedestrians or a widened and improved ramp to the pathway. The PANYNJ should have a better and safer plan to gain access to the north pathway when the south pathway is closed.



Photo 46 - West 179th Street's median can also be extended to the crosswalk.



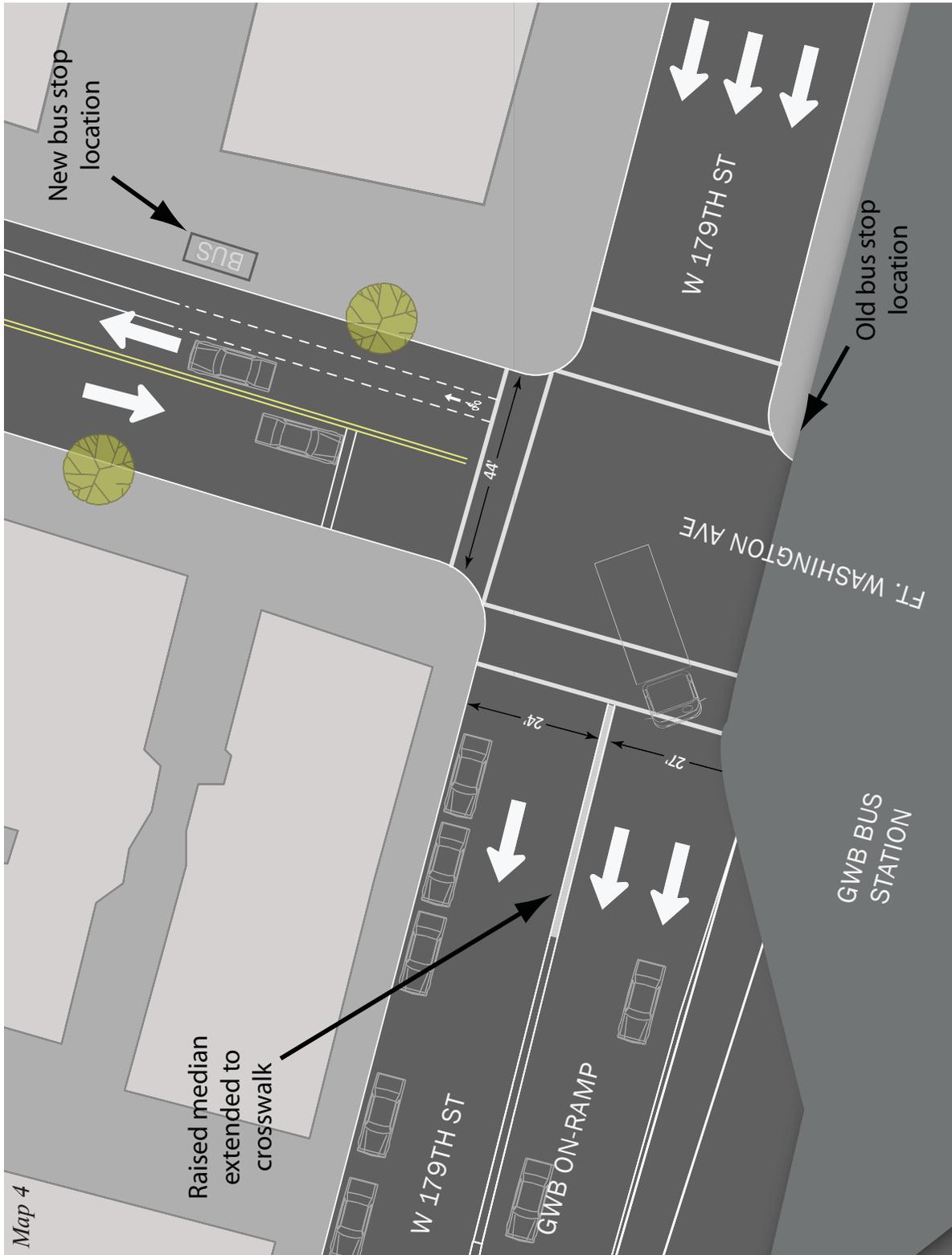
Photo 47 - West 178th Street and the off-ramp median with temporary jersey construction barriers extending closer to the crosswalk.



Photo 48 - The existing median on the on-ramp median has a space that pedestrians are using to illegally access the north pathway.



Recommendations - Ft. Washington Avenue and West 179th Street



Map 4

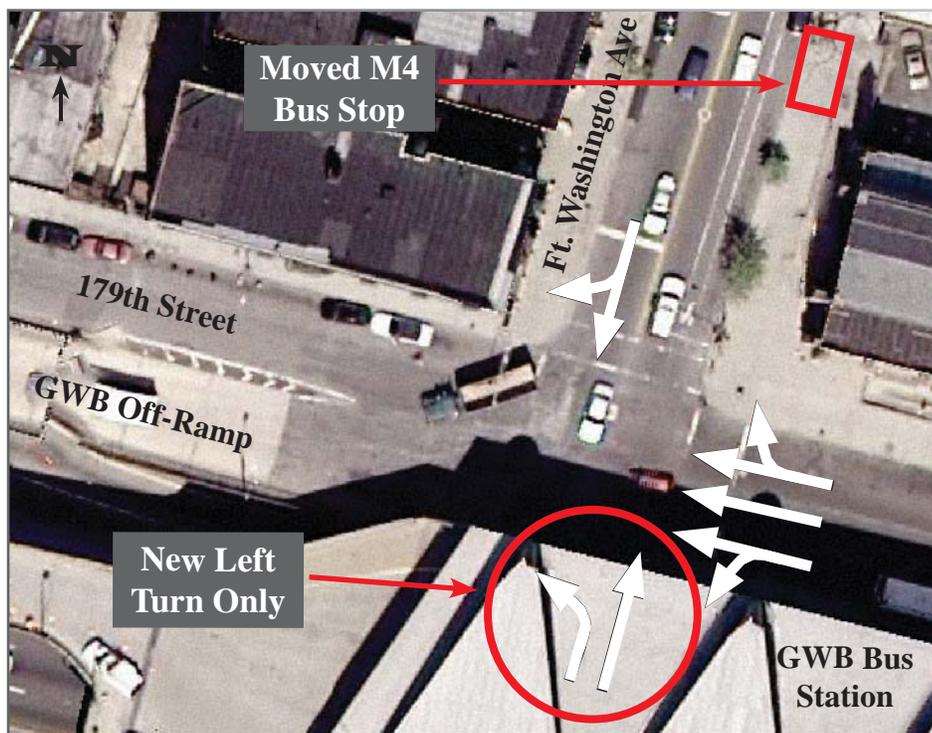
Recommendations - Ft. Washington Avenue and West 179th Street

2. Consider adding left turn only lane for northbound approach
 - a. Consider moving bus stop

Currently the intersection's northbound one-lane left-thru approach movement operates at LOS E with a delay of 56.2 seconds and a v/c ratio of 0.96 during the PM peak hour. This is mainly due to the number of vehicles making left turns onto the GWB on-ramp. With the recommended restriping and addition of a left turn lane and through movement lane, the northbound PM peak hour approach operates at LOS C with only a 28 second delay. The delay for the entire intersection in the PM peak hour improves from 34 seconds to 21.8 seconds. This recommendation also improves LOS and delays for northbound approaches during AM and MD peak hours (Table 18).

There is no parking along the east curb of Ft. Washington Avenue between West 179th Street and West 178th Street, but there is a M4 bus stop and a taxi stand. The bus stop is at the southeast corner of the intersection and approximately 114 feet north of the taxi stand (Photo 50-51). Moving the bus stop across the intersection will improve the functionality of the intersection (Photo 49). There is a no parking street regulation for about 90 feet at this location and no parking spaces will be lost. Although the taxi stand is underutilized - during field work and observations it was unused - it would not interfere with the recommended new left turn lane and through lane movements.

Photo 49



Recommendations - Ft. Washington Avenue and West 179th Street

Table 18

Ft. Washington Avenue & West 179th Street	Movement	AM		
		v/c ratio	Delay	LOS
Existing Northbound	LTR	0.49	20.9	C
		Intersection Delay = 19.5 LOS = B		
Recommended Northbound	L	0.34	19.5	B
	T	0.22	16.1	B
			17.4	B
		Intersection Delay = 18.4 LOS = B		

Ft. Washington Avenue & West 179th Street	Movement	MD		
		v/c ratio	Delay	LOS
Existing Northbound	LTR	0.55	22.4	C
		Intersection Delay = 22.4 LOS = C		
Recommended Northbound	L	0.37	19.3	B
	T	0.20	15.8	B
			17.5	B
		Intersection Delay = 17.2 LOS = B		

Ft. Washington Avenue & West 179th Street	Movement	PM		
		v/c ratio	Delay	LOS
Existing Northbound	LTR	0.96	56.2	E
		Intersection Delay = 34.0 LOS = C		
Recommended Northbound	L	0.77	36.6	D
	T	0.25	16.5	B
			28.0	C
		Intersection Delay = 21.8 LOS = C		

Recommendations - Ft. Washington Avenue and West 179th Street



Photo 50 - The location of the underutilized taxi stand.



Photo 51 - This is the location of the M4 bus stop. If the bus stop is moved north to the other side of this intersection, LOS and delays will improve at this location. Also, in very close proximity, there is an existing M4 bus stop a half-block south between West 178th Street and West 177th Street.

Recommendations - Ft. Washington Avenue and West 178th Street

Ft. Washington Avenue and West 178th Street

1. Build permanent median to crosswalk
2. Add street markings on GWB off-ramp

The existing median consists of temporary jersey construction barriers. Replace the barriers with a permanent median that extends to the crosswalk. This will give pedestrians a refuge island between the GWB off-ramp and West 178th Street.

Adding street markings to the eastbound approach from the George Washington Bridge off-ramp is a practical and cost-effective way to improve pedestrian safety and better regulate vehicle movements. Paint Turn and Through Lane-Use Arrow and Through Lane Use-Arrow.



Photo 52 - This image has been modified to show recommended street markings on the GWB off-ramp.

3. Add left turn only lane for southbound approach

Currently the intersection's southbound left-thru approach movement operates at LOS C with a delay of 31.4 seconds and a v/c ratio of 0.77 during the AM peak hour. While the delays for this approach are acceptable at all three peak hours, the left turn movement is dominated by buses (Bx11, Bx13, Bx36, M98 Limited) that queue up and wait to make the turn. With the recommended restriping and addition of a left turn lane and through movement lane, the LOS and delays of the southbound approaches will all improve with the AM peak hour being the most significant improvement from an LOS C and 31.4 second delay to a LOS B and 17.4 second delay (Table 19). The M4 bus stop located midblock on the west curb could remain and still have the added left turn lane. But this location under the bus station is dark and congested and we recommend that the bus stop be moved a half block south between West 178th Street and West 177th Street where the entire block is designated as a no parking zone.

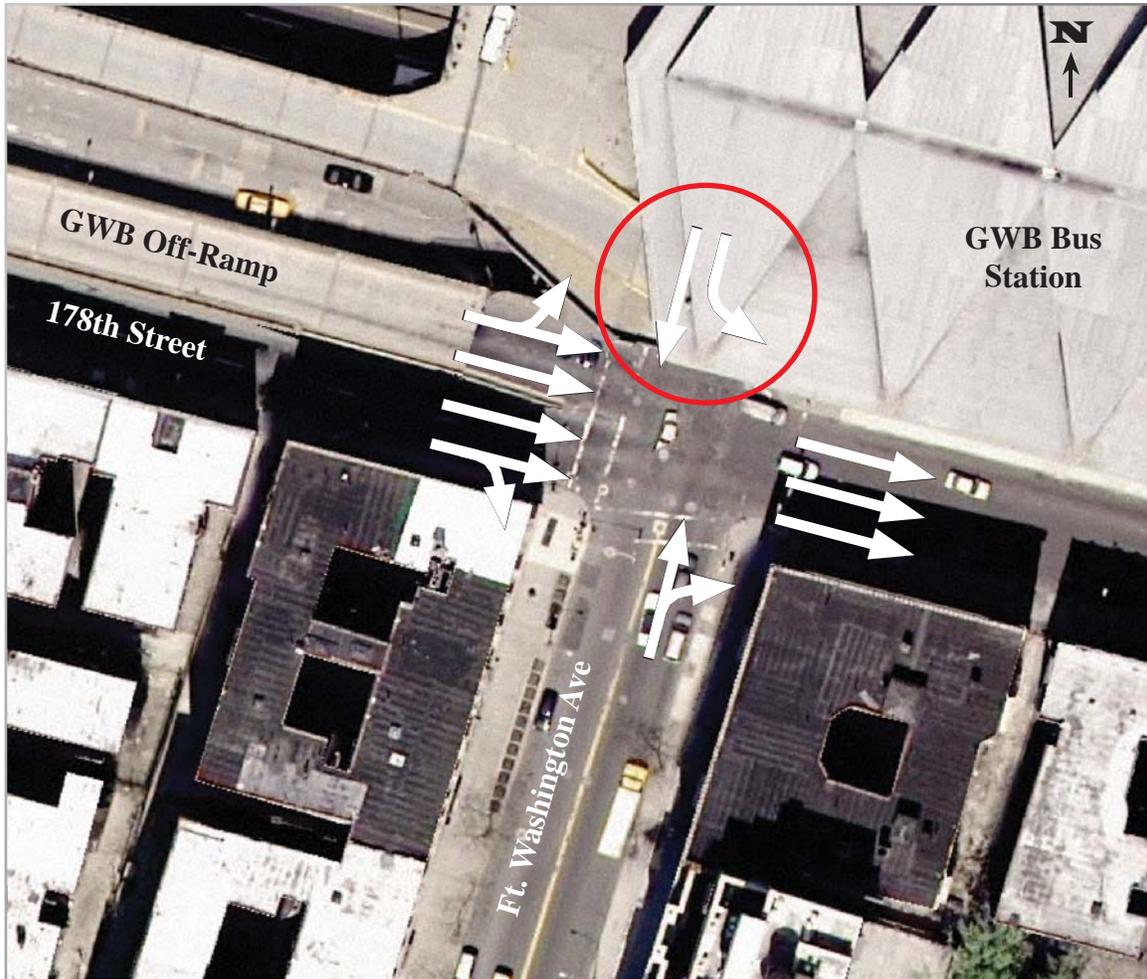
Recommendations - Ft. Washington Avenue and West 178th Street

Table 19

Ft. Washington Avenue & West 178th Street	Movement	AM		
		v/c ratio	Delay	LOS
Existing Southbound	LT	0.77	31.4	C
		Intersection Delay = 21.4 LOS = C		
Recommended Southbound	L	0.42	22.0	B
	T	0.43	19.0	C
			17.4	B
		Intersection Delay = 18.8 LOS = B		
Ft. Washington Avenue & West 178th Street		MD		
	Movement	v/c ratio	Delay	LOS
Existing Southbound	LT	0.54	22.3	C
		Intersection Delay = 18.4 LOS = B		
Recommended Southbound	L	0.34	19.9	B
	T	0.27	16.7	B
			17.6	B
		Intersection Delay = 17.7 LOS = B		
Ft. Washington Avenue & West 178th Street		PM		
	Movement	v/c ratio	Delay	LOS
Existing Southbound	LT	0.61	25.1	C
		Intersection Delay = 20.2 LOS = C		
Recommended Southbound	L	0.46	26.1	C
	T	0.25	16.5	B
			28.0	C
		Intersection Delay = 19.4 LOS = B		

Recommendations - Ft. Washington Avenue and West 178th Street

Photo 53 - The intersection of Ft. Washington Avenue and West 178th Street with the added left turn only movement.



Recommendations -

Cabrini Boulevard between West 178th Street & West 177th Street

Redesign Cabrini Blvd. between West 177th Street and West 178th Street

- a. Install complex pedestrian ramps at Cabrini Blvd and West 177th Street
- b. Add green space to George Washington Bridge Park
- c. Improve the design of the memorial park
- d. Create Class 1 greenway
- e. Install signage and markings to separate pedestrians and bicycles
- f. Create entrance to GWB greenway
- g. Widen greenway to a minimum 10' along West 178th Street

The current configuration of Cabrini Boulevard between West 177th Street and West 178th Street is obsolete and should be redesigned. This section of Cabrini Boulevard should be designed to give more green space to the George Washington Bridge Park and to provide better access to the George Washington Bridge pedestrian and bicycle greenway. This connection between New York and New Jersey is very important because it is the only non-motorized connection for pedestrians and bicyclists between Manhattan and New Jersey. Redesigning Cabrini Boulevard as outlined in this report will result in no loss of parking spaces and the loss of one travel lane. Because vehicle traffic at this location is very light with AM peak hour traffic at 23 vehicles, MD peak hour traffic at 31 vehicles and PM peak hour traffic at 28 vehicles, a single travel lane is sufficient to adequately process the traffic flow. There appears to be no utility or sewer conflicts connected to the existing raised median.

Build a complex pedestrian ramp at the northeast corners of Cabrini Boulevard and West 177th Street (Photo 54) and a pedestrian ramp at the northwest corner (Photo 55). This will meet Federal Guidelines established by the American with Disabilities Act of 1990 (ADA). Because of the conflict with existing utilities, the northeast corner has a utility pole and a collapsed sewer grate that has created a sunken pit, this corner will require a complex pedestrian ramp. The utilities (sewer grate and fire hydrant) located on the northwest corner are further away from the corner where a new pedestrian ramp would be built so a complex pedestrian ramp is not needed.

Designing a greenway at this location will enhance the GWB Park which is a destination for people in the neighborhood. While doing counts and fieldwork at this location, many families with children were observed using the playground as well as other individuals with passive recreational uses (reading, sitting, etc.). The memorial section of the park (Photo 32) can be redesigned to be more connected to the larger park with a more reverent and advantageous location. This could be done by removing the chain-link fencing between the parks, opening up the location of the memorials so that people can access the site by walking up and viewing them, setting the memorials

Recommendations - Cabrini Boulevard between West 178th Street & West 177th Street

Photo 54 - Because of the existing utilities on the northeast corner of Cabrini Boulevard and West 177th Street, a complex pedestrian ramp is required on the corner.

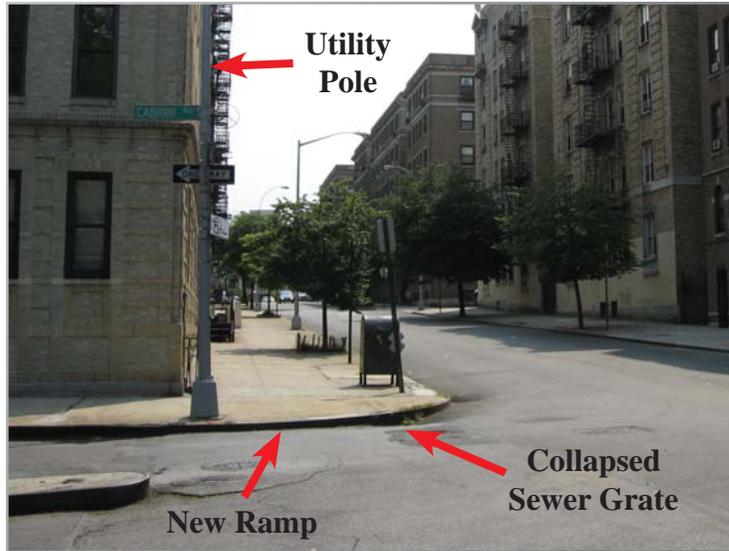
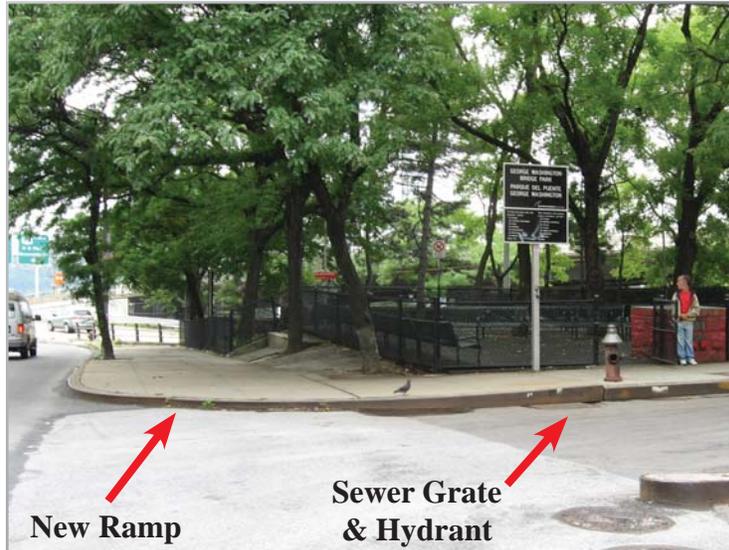


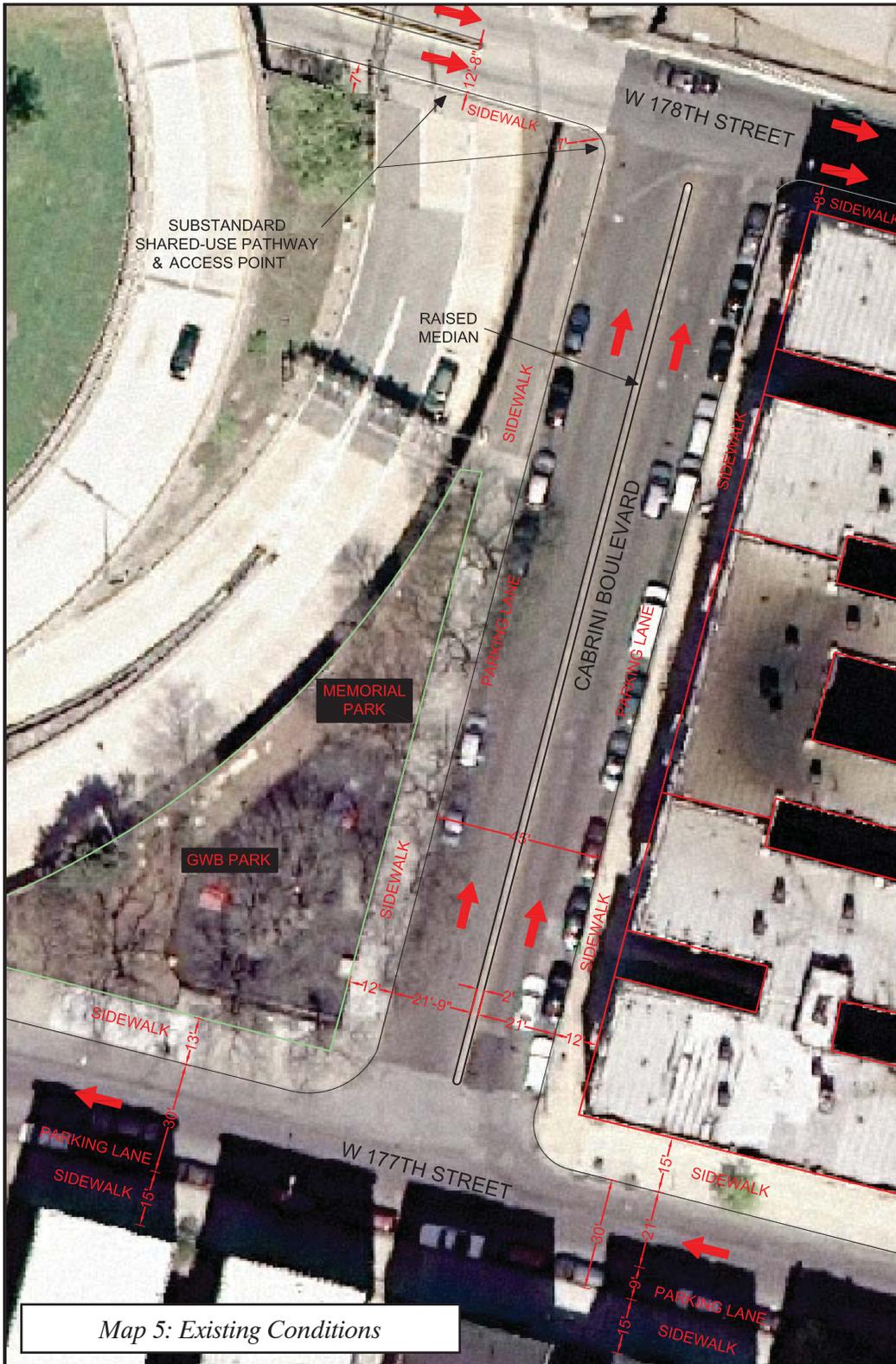
Photo 55 - The northwest corner of Cabrini Boulevard and West 177th Street requires a regular pedestrian ramp because existing utilities are located further from the corner.



up on a raised platform, and pushing them back against the bridge structure.

On the following two pages is the existing conditions map of Cabrini Boulevard (Map 4) and the recommended improvements (Map 5). Signage and street markings are also needed to separate users and reduce conflicts.

Recommendations - Cabrini Boulevard between West 178th Street & West 177th Street



Recommendations - Cabrini Boulevard between West 178th Street & West 177th Street



Map 6: Recommendations

**Recommendations -
Cabrini Boulevard between West 178th Street & West 177th Street**

Photo 56: Existing Conditions



**Recommendations -
Cabrini Boulevard between West 178th Street & West 177th Street**

Photo 57: Enhanced image with Recommendations



Recommendations - Cabrini Boulevard between West 178th Street & West 177th Street

The access point to the George Washington Bridge greenway is located about 145 feet west of Cabrini Boulevard and West 178th Street. The south sidewalk along West 178th Street (Photo 58) is the greenway connector from the off-street route and the bridge ramp. This greenway connector varies in width from 7 feet to 9 feet wide and should be designed to meet AASHTO standards by widening it to a minimum 10 feet wide and expanding the entrance to accommodate all users and reduce conflicts. AASHTO recommends a minimum width of 10 feet for a shared use pathway. With the creation of the greenway along Cabrini Boulevard, the entrance will also be greatly improved; however, the pathway on West 178th Street must also be widened by taking available roadway from the two off-ramps shown in Photo 59. The off-ramp nearest the greenway varies in width from 12 feet 8 inches to 16 feet wide. The northern off-ramp has a painted median along one side and jersey barriers between the two off-ramps. Also, a barrier should be placed between the greenway and the vehicle off-ramps to ensure the safety of pathway users.



Photo 58 - This corner with a curb cut is the transition area for the GWB pathway where pedestrians accessing the bridge intersect with cyclists moving from on-street to off-street. The bridge portion of the GWB greenway begins 145 feet west of this curb cut.



Photo 59 - Looking west at the two vehicle off-ramps. The ramp on the left in the photo is a minimum 12 feet 8 inches wide while the other ramp has a painted striped median (also see Photo 27). There is available space in each off-ramp that can be added to the greenway.

Recommendations - West 177th Street

Ft. Washington Avenue and West 177th Street

1. Create Class 2 bike lane

Bicycle lanes have a traffic calming effect on streets and this will make the area more accessible and friendly to pedestrians. A NYCDOT report, the *Oriental Boulevard Bicycle Lane Impacts*, found that vehicle speeds were reduced by 6% to 16% after the striping of an on-street bicycle lane. Bicycle lanes also make vehicles drive in a more predictable manner because the roadway has been narrowed. Adding a 5-foot bike lane to the 30-foot wide West 177th Street will not take away a parking lane or a travel lane. If the existing parking lane is given a generous 9 feet, adding the bicycle lane will reduce the travel lane from 21 feet to 16 feet. The option of adding a 4-foot painted buffer lane to the bike lane is also recommended because this will add space between the bicycles and vehicles by reducing the travel lane to a standard width of 12 feet.

Photo 60 - Enhanced image with recommended bike lane.



Conclusion

The Upper Manhattan Pedestrian Project presents the findings from the study of intersections around Ft. Washington Avenue and the George Washington Bridge in the Washington Heights area of Manhattan. The analysis and evaluation of existing conditions within the study area resulted in a number of proposed improvements. The recommendations in this report include physical and operational improvements in order to improve pedestrian safety, mobility and access as well as bicycle and vehicle operations. These improvements include new signage, street markings, street lighting, sidewalk extensions, traffic calming measures, standardization of intersections, cross-walk markings, median extensions, and installation of greenway and bicycle facilities.

The implementation of recommendations put forth in this study related to pedestrians, bicycle and vehicular traffic should be coordinated by the Department of Transportation while recommendations related to bus movements should be coordinated by the New York City Transit Authority. All recommendations related to the George Washington Bridge, including the bus station, the park and the greenway, should be coordinated by the Port Authority of New York and New Jersey. The Department of City Planning will continue to work with the various city agencies involved in this project and community members to implement the recommendations in this report.

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