Intersection Improvements
Upper Manhattan Pedestrian Project

City of New York
Department of City Planning
Transportation Division
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Project Description

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 the city. This report recommends a number of 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, median extensions, and installation of greenway and bicycle facilities.

The Department of City Planning's (DCP) Transportation Division completed this planning document as part of a larger Congestion Mitigation Air Quality (CMAQ) funded pedestrian study called Intersection Improvements. The other study is the Gansevoort/Highline Pedestrian Project which was completed in late 2007. This report, Upper Manhattan Pedestrian Project, focuses on improving pedestrian facilities and enhancing pedestrian safety in the Washington Heights neighborhood around Ft. Washington Avenue, the George Washington Bridge and the George Washington Bridge Bus Station.

Intersection Improvements seeks to recommend and implement physical and operational improvements in order to enhance pedestrian safety; provide better pedestrian access to subways, local bus routes, and the bus depot; strengthen pedestrian connections to major destinations/employers and new office and retail development in urban renewal areas and empowerment zones; improve
links to historic districts, landmarks, and cultural destinations; improve connections to river crossings; and improve ease of access to the waterfront and open spaces.

This report, in addition to many others, can be found on the DCP website at www.nyc.gov/html/dcp/html/transportation/main.shtml.

Site Selection

This CMAQ-funded project focuses on improving pedestrian routes and facilities in Upper Manhattan with a study area north of West 155th Street encompassing the entirety of Community Board 12. Initially, DCP looked at a variety of possible locations to be studied which included the following criteria: sites with substandard or deteriorating conditions; links to the waterfront, open spaces and greenways; high accident nodes; access to subways and local bus stops; connections to major destinations; connections to employment and retail destinations; links to historic districts, landmarks, and cultural centers; connections to bridge crossings; pedestrian, vehicular and bicycle routes; and major east-west and north-south corridors.

DCP reviewed projects in the area that are currently being studied for transportation improvements or are slated to be studied so as not to duplicate services. This list includes the following: Sherman Creek zoning and transportation study; St. Spyridon Parochial School safety report; the reconstruction of St. Nicolas Avenue from 170th Street to 193rd Street; reconstruction of Broadway from 125th Street to 178th Street; reconstruction of step streets; Highbridge over the Harlem River; reconstruction of Tenth Avenue from W. 206th Street to W. 218th Street; the 181st Transportation Study; Fort Washington Park improvements and renovations including pedestrian and bicycle pathways; and the George Washington Bridge Bus Station redevelopment.

After reviewing a list of possible locations with the New York City Department of Transportation (DOT), the Ft. Washington Avenue corridor around the George Washington Bridge was selected. The criteria used to choose these intersections were: pedestrian accidents, traffic congestion, bridge access, green/open space and the overall opportunity to improve the sites. After mapping some initial site locations, the study identified one target area for pedestrian improvements: the area around the George Washington Bridge. The study area for this report is the corridor of Ft. Washington Avenue from West 177th Street to West 181st Street; and Cabrini Boulevard from West 177th Street to West 178th Street including the connection to George Washington Bridge pedestrian pathway.

The intersections studied are: the three signalized intersections at Ft. Washington and West 181st Street, Ft. Washington and West 179th Street, and Ft. Washington and West 178th Street; two unsignalized intersections at Cabrini Boulevard and West 178th Street and Cabrini Boulevard and West 177th Street; and some of the roads connecting and between the intersections.

Photo 1 - Aerial photo of the intersections examined in this report.

The five intersections studied are:

1. Ft. Washington and West 181st Street (signalized)
2. Ft. Washington and West 179th Street (signalized)
3. Ft. Washington and West 178th Street (signalized)
4. Cabrini Boulevard and West 178th Street (unsignalized)
5. Cabrini Boulevard and West 177th Street (unsignalized)

Neighborhood Description

The intersections studied in this report are located in Community Board #12 of Manhattan. Community Board #12 includes the neighborhoods of Washington Heights, Inwood, Fort George, and Sherman Creek. The area is bounded by the Harlem River to the north and east, the Hudson River to the west and West 155th Street at the southern end; encompassing 2.9 square miles or 1,887 acres. The population of Community Board #12 is 208,414 with 74% of Hispanic Origin, 14% White Nonhispanic, and 8% Black Nonhispanic (2000 Census). The total population has risen 10% from 1980 to 1990 and 5% from 1990 to 2000. Income support levels are at 46% (96,179 people) while the borough of Manhattan is at 25% and New York City is 32%. Of the 46% receiving income support, 67,106 people are receiving only Medicaid, 17,943 are receiving Supplemental Security Income, and 11,130 are on Public Assistance. The land use in Manhattan Community Board #12 (Map #1) is dominated by parks and open space (49.9% at 30,024 ft^2) as compared to New York City (25.1%) and the borough of Manhattan (25.1%). This can be attributed to Inwood Hill Park, Fort Tryon Park, Fort Washington Park, Highbridge Park, Riverside Park, and Jay Hood Wright Park and other smaller sites. Multi-family residential is the next predominant land use covering 20.3% of the area (12,213 ft^2) followed by Mixed Residential and Commercial with 9.1% (5,443 ft^2). The land use is rounded out by Institutions (8.5%), Commercial/Office (3.0%), Transportation/Utility (2.7%), Parking Facilities (2.3%), Vacant Land (2.0%), Miscellaneous (1.4%), 1-2 Family Residential (0.5%), and Industrial (0.3%). There are 70,576 total households with family households at 65% and nonfamily households at 35%. There are 3.52 persons per family and 2.90 persons per household. Of the total households, 94% are renter occupied.

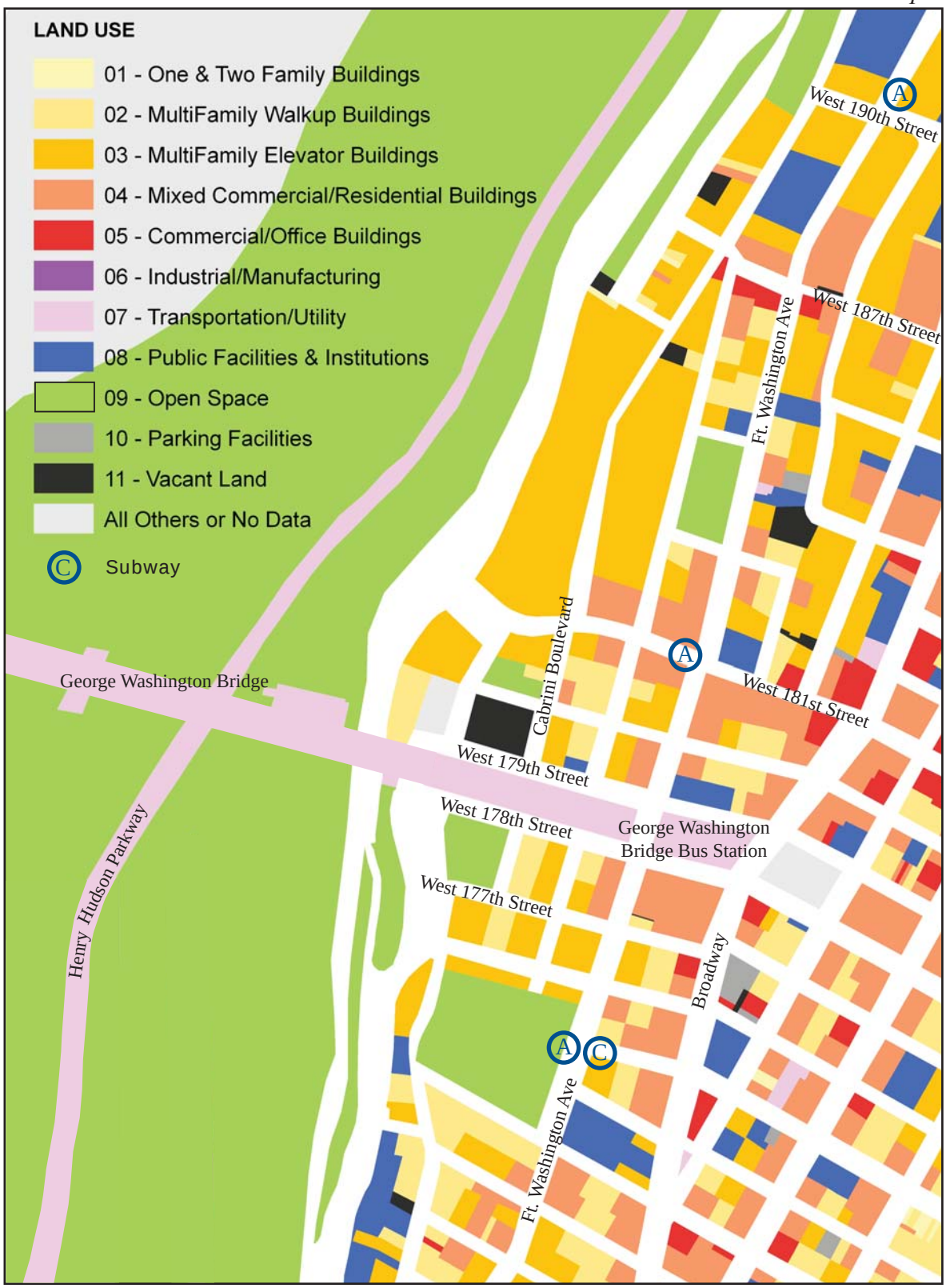
Transportation Network

The study area for this report, along the western edge of Community Board #12, is the corridor of Ft. Washington Avenue from West 177th Street to West 181st Street; and Cabrini Boulevard from West 177th Street to West 178th Street including the connection to George Washington Bridge pedestrian pathway. The transportation network in the study area is dominated by the nexus between local trips, commuters, the George Washington Bridge Bus Station and drivers using the George Washington Bridge and its various on- and off-ramps and connections to the Washington Bridge, the Alexander Hamilton Bridge, U.S. Highway 9, the Henry Hudson Parkway, and the Harlem River Drive.

Bus

The Bx11, Bx13, and Bx36 buses travel back and forth across the Harlem River on the Washington Bridge at West 181st Street. These three buses loop around the George Washington Bridge Bus Station traveling west on West 179th Street, turning south on Ft. Washington Avenue and then turning eastbound onto West 178th Street. These

Map 1


LAND USE
01 - One & Two Family Buildings
02 - MultiFamily Walkup Buildings
03 - MultiFamily Elevator Buildings
04 - Mixed Commercial/Residential Buildings
05 - Commercial/Office Buildings
06 - Industrial/Manufacturing
07 - Transportation/Utility
08 - Public Facilities & Institutions
09 - Open Space
10 - Parking Facilities
11 - Vacant Land
All Others or No Data
C Subway
West 190th Street
West 187th Street
Ft. Washington Ave
Cabrini Boulevard
West 181st Street
George Washington Bridge
West 179th Street
West 178th Street
George Washington Bridge Bus Station
West 177th Street
Henry Hudson Parkway
Broadway
Ft. Washington Ave

buses have a layover area on West 179th Street between Ft. Washington Avenue and Broadway. These buses often platoon at the intersection of Ft. Washington Avenue and West 178th Street traveling southbound as they wait to make the left turn (eastbound) onto West 178th Street. The M4 bus runs the length of Ft. Washington from West 159th Street up to the Fort Tryon Park and the Cloisters. The M98 Limited also runs along Ft. Washington Avenue to Midtown making a similar loop around the George Washington Bridge Bus Station along West 179th Street and West 178th Street.

The George Washington Bridge Bus Station opened on January 17, 1963 and is located at 4211 Broadway between West 178th Street and West 179th Street. The three-level bus station offers commuter services (including minibus and jitney) to and from New Jersey and upstate New York, as well as long distance destinations. It has a direct passageway to the A train subway station at West 175th Street. The station, administered by the Port Authority of New York and New Jersey (PANYNJ), is currently undergoing a renovation in order to modernize services and increase retail opportunities. According to the PANYNJ, approximately 17,500 passengers on about 930 buses use the facility on a weekday, and the station handled 5,222,000 passengers on about 309,000 buses in 2006.

Pedestrian

The main entrance to the George Washington Bridge Bus Station is located on Broadway, but there is also activity at the western entrance on Ft. Washington Avenue. Pedestrian activity in the study area has the highest volumes around two locations: West 181st Street and Ft. Washington Avenue; and at the George Washington Bridge Bus Station. The pedestrian volumes are due to the confluence of the A Train stop at West 181st Street and Ft. Washington Avenue and the commercial and retail activities on West 181st Street.

The George Washington Bridge greenway running along the southern side of the bridge is a shared-use path for pedestrians and bicyclists. This off-street, separated pathway is the only pedestrian and bicycle connection between Manhattan and New Jersey. Field observations determined that there are more cyclists than pedestrians using the pathway. PANYNJ had previously closed the south pathway for an indeterminate amount of time and re-opened the north pathway. Currently, the north pathway is closed and the south pathway is open.

Subway

The New York City Transit A Train (8th Avenue Express) has full-time stops at West 175th Street and West 181st Street. The West 175th Street station has an exit on the corners of West 177th Street and Ft. Washington Avenue as well as connections to the George Washington Bridge Bus Station. The West 175th Street station is wheelchair accessible. The West 181st Station has seen a slow but consistent increase in weekday

riderships from 2000 (9,107 riders) to 2006 (9,605 riders) in 2006, a 5% increase. The morning commute from 7am to 10am saw 43% of total riders entering the station. The West 175th Station also showed increases in weekday ridership from 2000 (11,184 riders) to 2006 (12,090 riders) with an increase of 8%.

Bicycle

Ft. Washington Avenue has a Class 2[1] on-street bike lane running from West 160th Street up to the Cloisters with two breaks in the lane from West 165th Street to West 168th Street and from West 176th Street to West 181st Street. There is a southbound Class 2 bike lane on Haven Avenue starting at West 177th Street to West 169th Street. The George Washington Bridge greenway features an off-street, separated pathway that many bicyclists use for commuting and for long-distance rides to connect from the waterfront greenways in Manhattan (Hudson River Greenway Route 9A, East River Esplanade, etc.) to New Jersey (River Road Route, State Route 9W) and other bicycle routes and parks along the Hudson River Valley.

Map 2 - Bicycle and greenway facilities in the study area (NYC Cycling Map).

1 There are three general classifications for bicycle facilities. Class 1 facilities are off-street paths that are separated from the roadway and delineated by pavement markings and regulatory signage. These facilities are usually shared with other users (runners, walkers, etc.) and often referred to as greenways. Class 2 facilities are on-street, stiped lanes that are designated for bicycles only and delineated by pavement markings and signage. Class 3 facilities are on-street routes that are only accompanied with signs. Recently, bicycle symbols and directional arrows have been added to the roadway on some Class 3 facilities in the city.

Accident Summary

The table below is a summary of accidents along the Ft. Washington Avenue corridor in our study area. The data is from the New York State Department of Motor Vehicles (NYSDMV) from January 1, 2004 through December 31, 2006. The intersections with the most reportable accidents[1] are Ft. Washington Avenue and West 178th Street with twenty-six and Ft. Washington Avenue and West 181st Street with nineteen.

Table 1

Cumulative Three-Year Accident Data 2004-2006				
Ft. Washington Avenue Intersections	Reportable Accidents	Pedestrian Accidents	Bicycle Accidents	Injuries
at 181st Street	19	10	2	23
at 181st/180th Street Midblock	4	0	1	4
at 180th Street	4	1	0	4
at 180th/179th Street Midblock	1	0	0	0
at 179th Street	7	0	2	7
at 178th Street	26	4	3	32
at 178th/177th Street Midblock	1	0	0	0
at 177th Street	11	3	2	11
TOTAL	73	18	10	81

Ft. Washington Avenue and West 181st Street recorded the highest number of pedestrian accidents at ten which accounts for over 50 percent of all reportable accidents at that intersection. Overall all of the locations, pedestrian accidents account for 25 percent of all reportable accidents.

There were no reportable accidents on Cabrini Boulevard from West 177th Street and West 178th Street.

1 The NYSDMV designates motor vehicle accidents as reportable if they result in physical damages of $1,000 or more or if there is an injury or fatality. Pedestrian and bicycle accidents are reportable by their very nature.

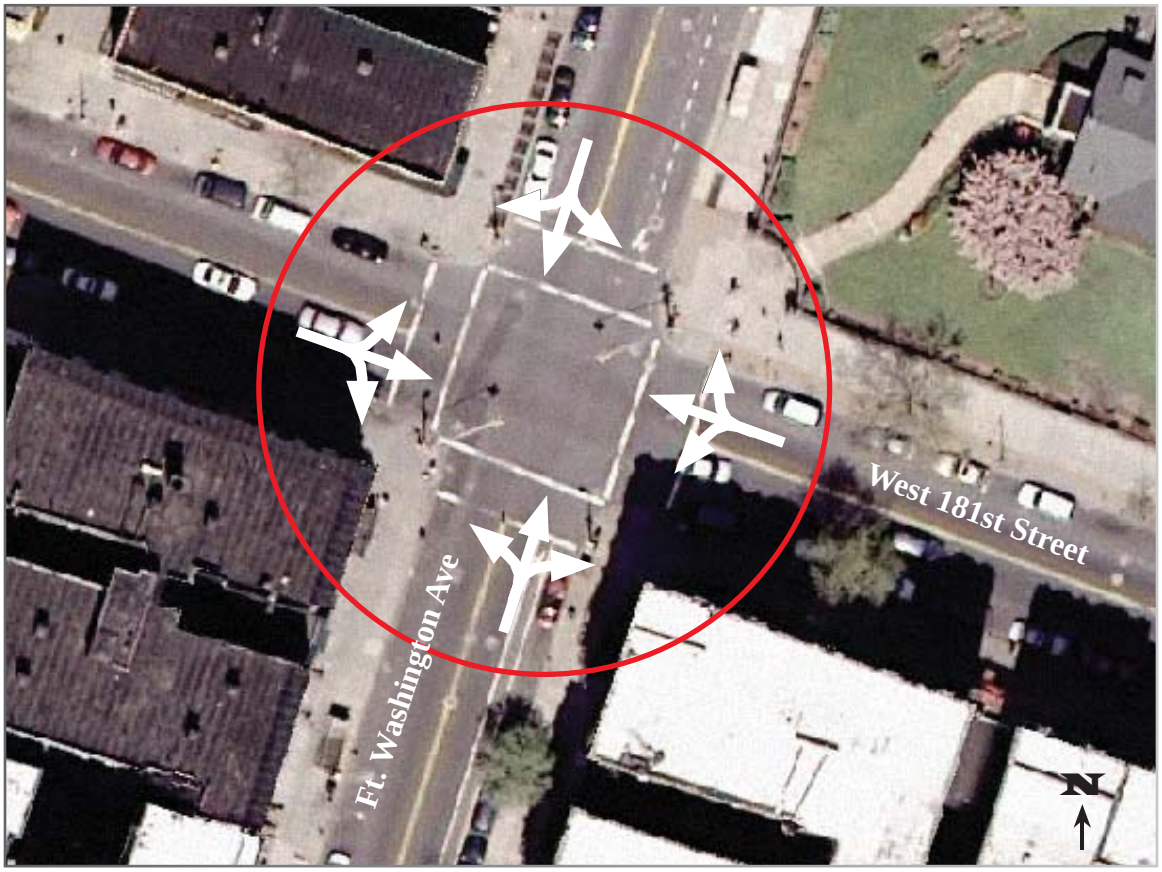
Existing Conditions

Ft. Washington Avenue & West 181st Street

Ft. Washington Avenue at West 181st Street is a signalized intersection with four regular crosswalks with curb cuts at each corner (Photo 2). Ft. Washington Avenue is 43 feet 6 inches wide with one northbound and one southbound vehicle travel lane and one 5-foot Class 2 northbound bicycle lane. There is curbside parking on each side of the street. Along Ft. Washington Avenue, there is a bus stop for the M4 and M98 at the northeast corner and posted street sweeping parking regulations are No Parking 11AM to 12:30PM Tuesday and Friday on the east side and No Parking 11AM to 12:30PM Monday and Thursday on the west side. The sidewalk on the east side is 18 feet 4 inches wide and 17 feet 9 inches wide on the west side. There is an "A" Train subway station located at the southeast corner of the intersection.

West 181st Street is 41 feet wide with one eastbound and one westbound travel lane. Curbside metered parking is on each side of the street. The sidewalks along West 181st Street are 19 feet wide. This intersection has the highest pedestrian volumes and

Photo 2 - The intersection of Ft. Washington Avenue and West 181st Street.



the most pedestrian accidents (10) in the study area. There were 19 reportable accidents at this intersection (2004-2006) and 53% involved pedestrians and 11% (2) involved bicycles. Out of the 10 reportable accidents with pedestrians, 6 involved vehicles making left turns.

Photo 3 - The northeast corner of the intersection of Ft. Washington Avenue and West 181st Street. The northbound bike lane starts again and is located next to a bus stop.

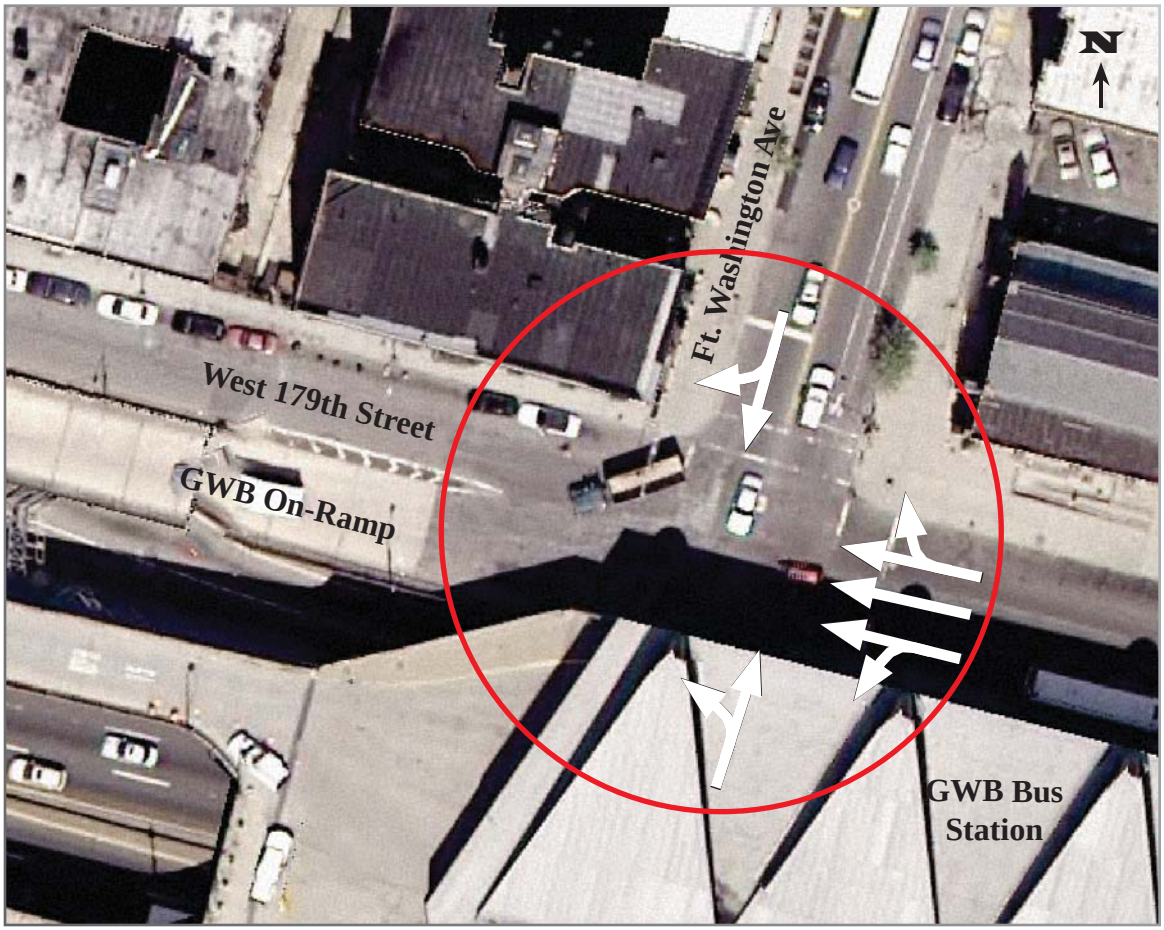
Photo 4 - Looking east on West 181st Street. The single lane is for three movements: left, through and right turn.

Photo 5 - The southwest corner of the intersection and pedestrians in the southern crosswalk.

Existing Conditions
Ft. Washington Avenue & West 179th Street

Ft. Washington Avenue continues to be a two-way street with one northbound and one southbound vehicle travel lane (Photo 6). Ft. Washington Avenue is 44 feet wide with one northbound 5-foot Class 2 bike lane. The intersection with West 179th Street is signalized with four regular crosswalks with curb cuts at each corner. Curbside parking is permitted on Ft. Washington Avenue north of West 179th Street with regular street sweeping regulations. However, a "No Parking Anytime" regulatory sign prohibits curbside parking on the east curb for approximately 120 feet in front of Holyrood Church. South of West 179th Street, under the George Washington Bridge Bus Station, there is No Standing Anytime with a Taxi Stand and an M4 bus stop on the east curb. The west curb is on a 14-foot, 9 inch raised sidewalk median with a restricted access 19-foot travel lane. West 179th Street is one way westbound with three vehicle travel lanes with no curbside parking along the north curb east of Ft. Washington Avenue. There are many bus movements in this area due to the George Washington Bridge Bus

Photo 6 - The intersection of Ft. Washington Avenue and West 179th Street.



Station and the New York City Transit bus stops and layover area (see bus section on page 1-4) and the south curb of West 179th Street east of Ft. Washington Avenue is a bus layover (Photo 7). On the west side, there is one travel lane on West 179th Street and two George Washington Bridge on-ramp travel lanes (Photo 7). The two on-ramp travel lanes measure a total of 27 feet wide and the West 179th Street travel lane is 24 feet wide with curbside parking on the north side only.

A George Washington Bridge on-ramp (Photo 6 and Photo 8) for cars and trucks is located on the west side of the intersection (the off-ramp is located one block south on West 178th Street). Subsequently, the LOS for the northbound movement at this intersection in the PM peak hour is "E" with a delay of 66 seconds due to the left-turning vehicles accessing the on-ramp. This intersection has a PM peak hour delay at 35 seconds and LOS of "C" (see Traffic Operations page 3-1).

Photo 7 - East of Ft. Washington Ave., West 179th Street has three travel lanes, no parking on the north curb and a bus layover on the south curb.

There are no reported pedestrian accidents at this intersection in 2004-2006. There are four clearly visible east-facing, red "Yield To [Pedestrian Symbol]" regulatory signs (NYCDOT SR 1113) at each corner of the intersection which may have helped contribute to the fewer number of pedestrian accidents (Photo 9). There are access issues related to pedestrians and bicyclists trying to use the pathway

Photo 8 - The west crosswalk that crosses the GWB on-ramp and West 179th Street.

Photo 9 - Looking southwest at the intersection at the GWB Bus Station and two "Yield To [Pedestrian Symbol]" signs.

along the northern side of the GWB to New Jersey. The PANYNJ frequently closes the regular greenway along the southern side of the GWB for bridge work and maintenance and users are directed to take the pathway along the northern side. Pedestrians see the white gate entrance and walk up a 3-foot sidewalk along a GWB westbound vehicle on-ramp to reach the pathway while cyclists ride back and forth (Photo 10). The white gateway, leading directly to Ft. Washington Avenue, suggests that this used to be the access point to the pathway. The current entrance to the northern pathway is further down West 179th Street via a stairway (Photo 11). It is unclear whether the PANYNJ plans to have both pathways open in the future, one pathway, or separate bicycles and pedestrians similar to the Manhattan Bridge where bicycles are on the north side of the bridge and pedestrians travel along the south side. The median dividing the GWB on-ramp and West 179th Street does not extend to Ft. Washington Avenue (Photos 12-13) as it does with the off-ramp located at West 178th Street. This creates a very large open space for vehicles to make wide turns at higher speeds.

Photo 10 - The red arrow indicates the white gate entrance to the northern GWB pathway that leads to the 3-foot sidewalk.

Photo 11 - The red arrow indicates the official access point to the GWB pathway via West 179th Street.

Photo 12 - Looking west at the striped median dividing the on-ramp from West 179th Street.

Photo 13 - Looking east from the striped median dividing the on-ramp & West 179th Street.

Existing Conditions
Ft. Washington Avenue between West 179th Street & West 178th Street

Along Ft. Washington Avenue between West 179th Street and West 178th Street is a very short block that is located over the Trans Manhattan Expressway and underneath the GWB Bus Station. There is no curb side parking on either curb but there is an M4 bus stop on each side (Photo 14) and a Taxi Stand on the west curb. During fieldwork, no taxis were observed using the taxi stand (Photo 15). The overhead lighting seems to be inadequate as it is always dark and uninviting underneath the bus station. There is a restricted access lane for authorized vehicles along the west side of the street (Photos 16-17). The median between this lane and Ft. Wahington Avenue functions as a sidewalk and a waiting area for the M4 bus. A police officer is often parked close to West 178th Street and GWB off-ramp.

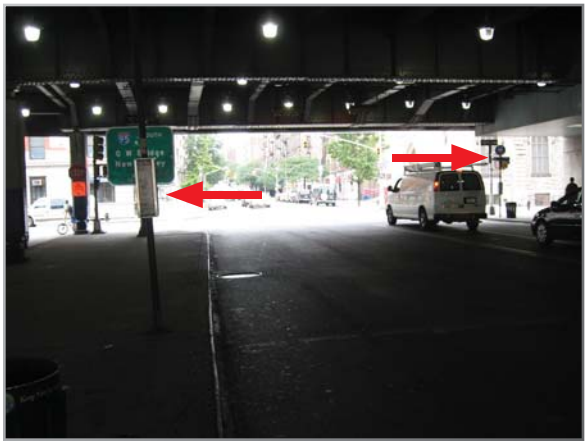


Photo 14 - The red arrows indicate the M4 bus stops.

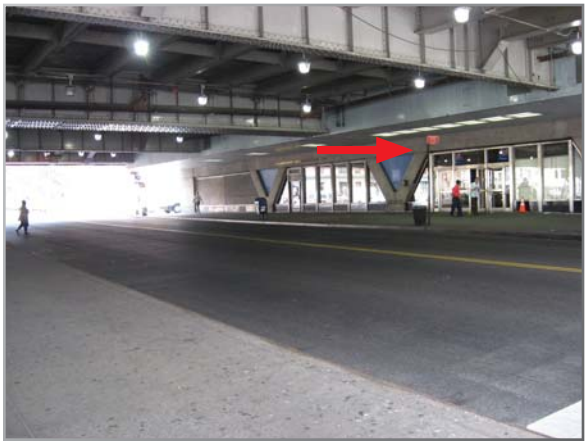


Photo 15 - The red arrow indicates the Taxi Stand in front of one of the entrances to the bus station.

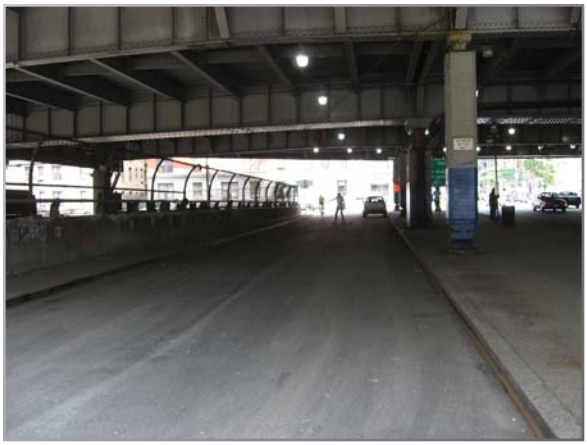


Photo 16 - Looking north at the restricted access lane.

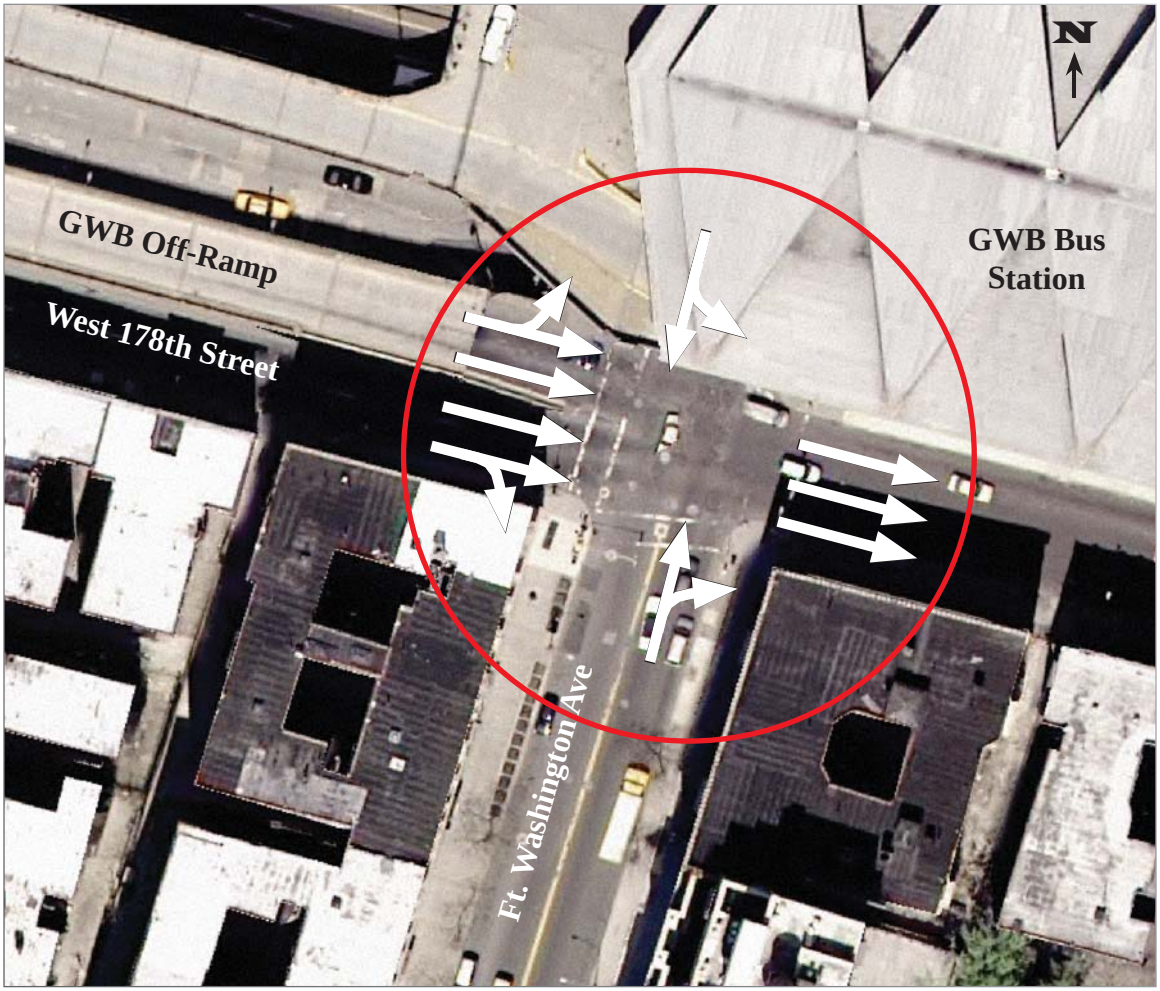
Photo 17 - Looking south at the restricted access lane.

Existing Conditions
Ft. Washington Avenue & West 178th Street

West 178th Street is one way eastbound with two travel lanes and no curbside parking (Photo 18). As West 178th Street approaches the intersection with Ft. Washington Avenue, a George Washington Bridge off-ramp with two additional eastbound travel lanes descends to the same intersection with Ft. Washington Avenue. This creates four eastbound travel lanes. Concrete barriers are placed between West 178th Street and the George Washington Bridge off-ramp. The four travel lanes merge into three lanes east of Ft. Washington Avenue. This section of West 178th Street eastward to Broadway is part of U.S. Highway 9 which is also a truck route.

Vehicles traveling eastbound on West 178th Street to Ft. Washington Avenue can continue east through the intersection or turn right (southbound): no left turn

Photo 18 - The intersection of Ft. Washington Avenue and West 178th Street.



(northbound) movement is permitted. Vehicles traveling eastbound on the George Washington Bridge off-ramp can continue east through the intersection or turn left (northbound): no right turn (southbound) is permitted. During field observations at this intersection, a police officer was often parked in the restricted access lane underneath the bus station facing the intersection. There are many regulatory signs posted at and preceding the intersection such as mandatory lane control signs and turn prohibition signs, as well as lane markings. This suggests that the eastbound vehicle movements are problematic with drivers on West 178th Street attempting to make the left turn movement onto Ft. Washington Avenue northbound and George Washington Bridge off-ramp vehicles attempting the prohibited right turn movement onto Ft. Washington Avenue southbound. Despite the turn restrictions, the police presence and the quantity of signage, over the duration of the manual vehicle counts undertaken for this project, 26 vehicles made the illegal left turn movement and 12 vehicles made the illegal right turn movement.

Photo 19 - Vehicles at the eastbound through movement at the Ft. Washington Avenue and West 178th Street intersection.

Photo 20 - The east sidewalk recorded the highest pedestrian volumes in our study.

This intersection has the highest number of total reportable accidents in our study area at 26. There were four reportable pedestrian accidents and three bicycle accidents. The detailed accident reports usually contain incomplete information, but the reports indicate that: all three bicycle accidents involved eastbound vehicles; three of the pedestrian accidents were at night; two of the pedestrian accidents were during raining and wet weather and road conditions; one pedestrian accident was attributed to a bus making an improper right turn while one had a pedestrian crossing against the signal. The vehicular volumes at this intersection were the largest in our study area and the eastbound through movement across Ft. Washington Avenue from West 178th Street and the bridge off-ramp (Photo 19) has the highest volumes for a single movement at 860 vehicles in the AM peak hour for the eastbound through movement (see Traffic Operations for a more detailed discussion). The east crosswalk at this intersection also recorded the highest pedestrian volumes (Photo 20).

There is one pedestrian oriented sign at the intersection with a "Yield To [Pedestrian Symbol]" regulatory sign facing north at the southeast corner of the intersection for vehicles making left turn movements from southbound Ft. Washington Avenue. Vehicle signage restricting turning movements are visible to drivers on the GWB off-ramp and West 178th Street (Photos 21-22). The left turn restriction is only for drivers on West 178th Street and the right turn restriction is only for drivers on the GWB off-ramp. Photo 22 shows four MUTCD R3-1 regulatory signs indicating no right turn for the GWB off-ramp traffic. The sign is visible from West 178th Street where the photo was taken. The R3-2 no left turn sign at the right is for vehicles on West 178th Street.

The West 178th Street approach to the intersection has clear street markings: a Turn and Through Lane-Use Arrow; and a Through Lane-Use Arrow (Photo 23) while the GWB off-ramp approach to the intersection has no street markings (Photo 24).

Photo 21 - Regulatory signs for vehicles.

Photo 22 - Signs for the GWB off-ramp visible to drivers on West 178th Street.

Photo 23 - Street markings on West 178th Street.

Photo 24 - The GWB off-ramp approach to the intersection with no street markings.

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

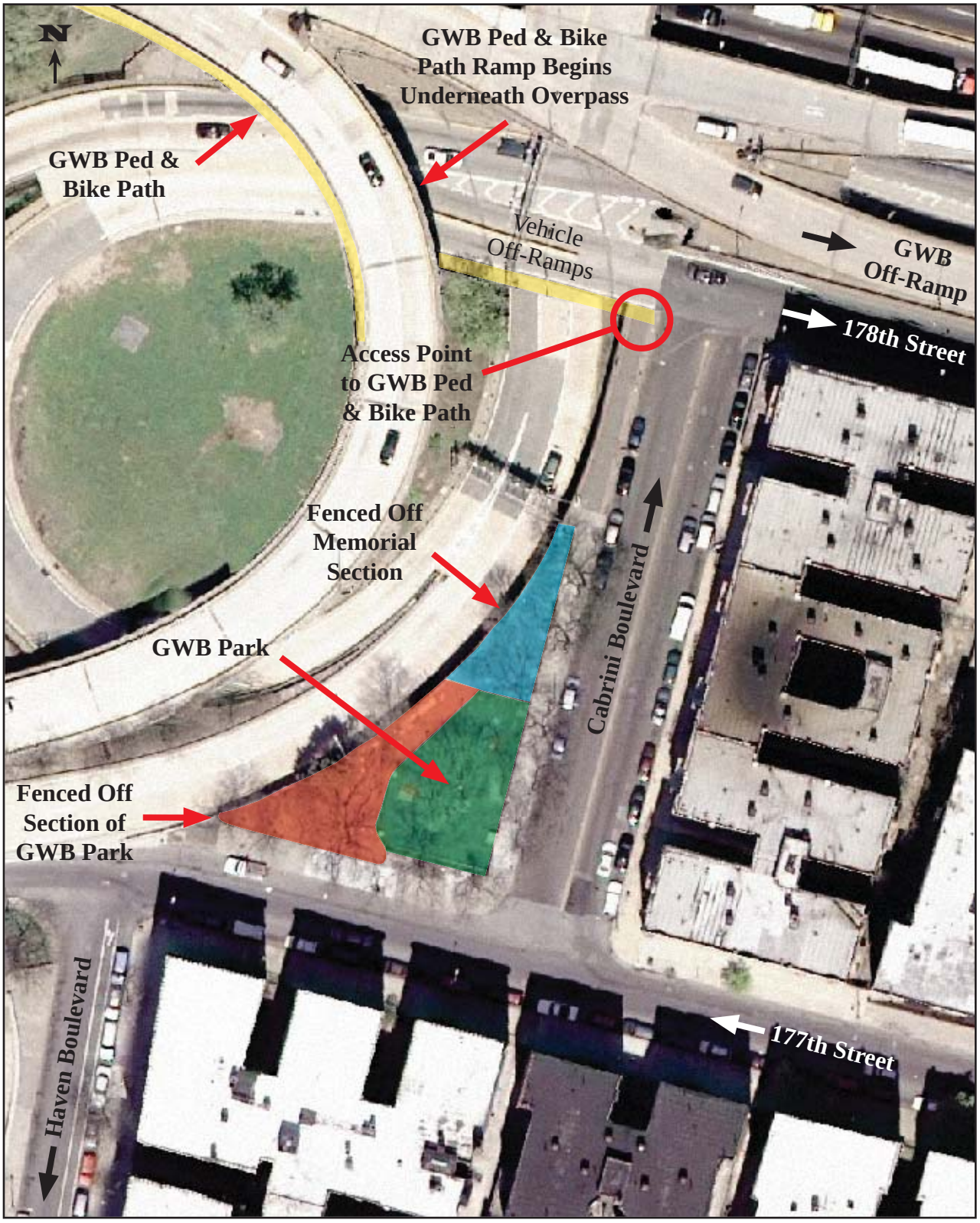
Cabrini Boulevard between West 177th Street and West 178th Street is one short block approximately 260 feet in length. The Boulevard is one-way northbound and dead ends at the George Washington Bridge and the Trans Manhattan Expressway. There are two travel lanes divided by a two-foot raised median (Photos 25-26). Most likely this was once a bi-directional street. Cabrini Boulevard makes a "T" intersection with West 177th Street and also with West 178th Street. Peak hour vehicle volumes were very low in this area (see Traffic Analysis). Curbside parking is permitted on each side of the Cabrini Boulevard but not along the median. Photo 29 shows the entrance

Photo 25 - The raised median dividing Cabrini Boulevard between West 177th Street and West 178th Street.

Photo 26 - During street sweeping hours, vehicles double park along one of the curbs.

to the George Washington Bridge pedestrian and bicycle pathway which is the only non-motorized connection between Manhattan and New Jersey. The pathway leading up to the bridge and the entrance at the southwest corner of Cabrini Boulevard and West 178th Street is an existing city sidewalk converted into a shared use pathway (Photos 28-29) and does not meet the American Association of State Highway and Transportation Officials (AASHTO) criteria for a shared used path. The existing pathway varies in width from 5 feet at the transition point where bicyclists go from on-street to off-street to 9 feet further down the pathway. AASHTO recommends a shared use path be 10 feet wide. There are no markings or signage to indicate where pedestrians and bicyclists should be located on the pathway or that the pathway is shared between pedestrians, joggers, bicyclists, etc. Also, because the pathway is bi-directional and narrow, there should be a better barrier between the pathway and roadway.

Photo 27 - Cabrini Boulevard between West 177th Street and West 178th Street.



Existing Conditions
Cabrini Boulevard and West 178th Street Pathway Entrance

Photo 28 - Looking east toward Cabrini Boulevard at the existing pathway that must be shared between pedestrians and bicycles. The pathway varies in width from 7 feet to 9 feet, but is consistently under 10 feet wide. There are very few signs and no markings leading to the bridge pathway.

Photo 29 - The entrance to the off-street pathway to the George Washington Bridge. The red arrow indicates where the bridge pathway begins, approximately 145 feet west of this pedestrian ramp. The inset image shows the only sign near the entrance indicating the bridge pathway. This sign is also visually obstructed behind a pole.

Photo 30 - Looking west at the entrance to the access point to the GWB pathway. The redesign of this area is an excellent opportunity to improve this pedestrian and greenway connection. There is no indication that this is the entrance to the GWB greenway.

Photo 31 - Vehicles on both exit ramps as they merge into West 178th Street. There is enough space on the roadway to add width to the existing pathway. The lane on the left varies in width from 12 feet 8 inches to 16 feet. The lane on the right is wider with a painted median.

Existing Conditions
George Washington Bridge Park

The George Washington Bridge Park is a very small pocket park located at the west corner of Cabrini Boulevard and West 177th Street. This park is mainly used by nearby residents. During fieldwork at this location, many families with children and strollers were observed using the park as well as people enjoying other passive recreation (reading, eating, talking, etc.). At the northern tip of the park are three boulders with plaques: Memorial Park dedicated to Port Authority employees who died on 9/11; a memorial to those who perished on American Airlines Flight 587 on 11/12/01; and a plaque dedicated in 1969 to the civil achievements of Louie Stern (Photo 32). Surrounded by chain-link fencing, there is no access to this memorial park. The three plaques must be viewed from the sidewalk and standing behind the fence. The fencing creates inaccessible green space in the park (Photo 27). There are no pedestrian ramps at either corner of Cabrini Boulevard and West 177th Street and Photo 34 shows the northwest corner by the park.

Photo 32 - The three memorials.

Photo 33 - The seating area and playground in the park.

Photo 34 - Wide sidewalks and fenced-off green space create an opportunity for expanding the park.

Existing Conditions
West 177th Street Broadway to Cabrini Boulevard

West 177th Street is 30 feet wide and one way westbound from Broadway to Haven Avenue. Curbside parking is permitted on the south side of the street with No Parking Tuesday and Friday from 11:30 AM to 1 PM. There are "No Parking Anytime" signs posted from Broadway to Haven Avenue along the north curb leaving a very wide single travel lane (Photo 36). The only signalized intersection in this segment is at the intersection of Ft. Washington Avenue and West 177th Street. At this intersection there are crosswalks at all four crossings, stop lines on three, and pedestrian ramps at all four locations. West 177th Street is the proposed bike route to the George Washington Bridge greenway in the New York City Bicycle Master Plan.

Photo 35 - Looking south at Ft. Washington Avenue and West 177th Street intersection and a partially obstructed sign to the GWB greenway.

Photo 36 - A 30-foot wide roadbed with curbside parking along one curb.

Photo 37 - Looking east at the east corner of the intersection of Cabrini Blvd and West 177th Street during street sweeping. There are no curb cuts at this location.

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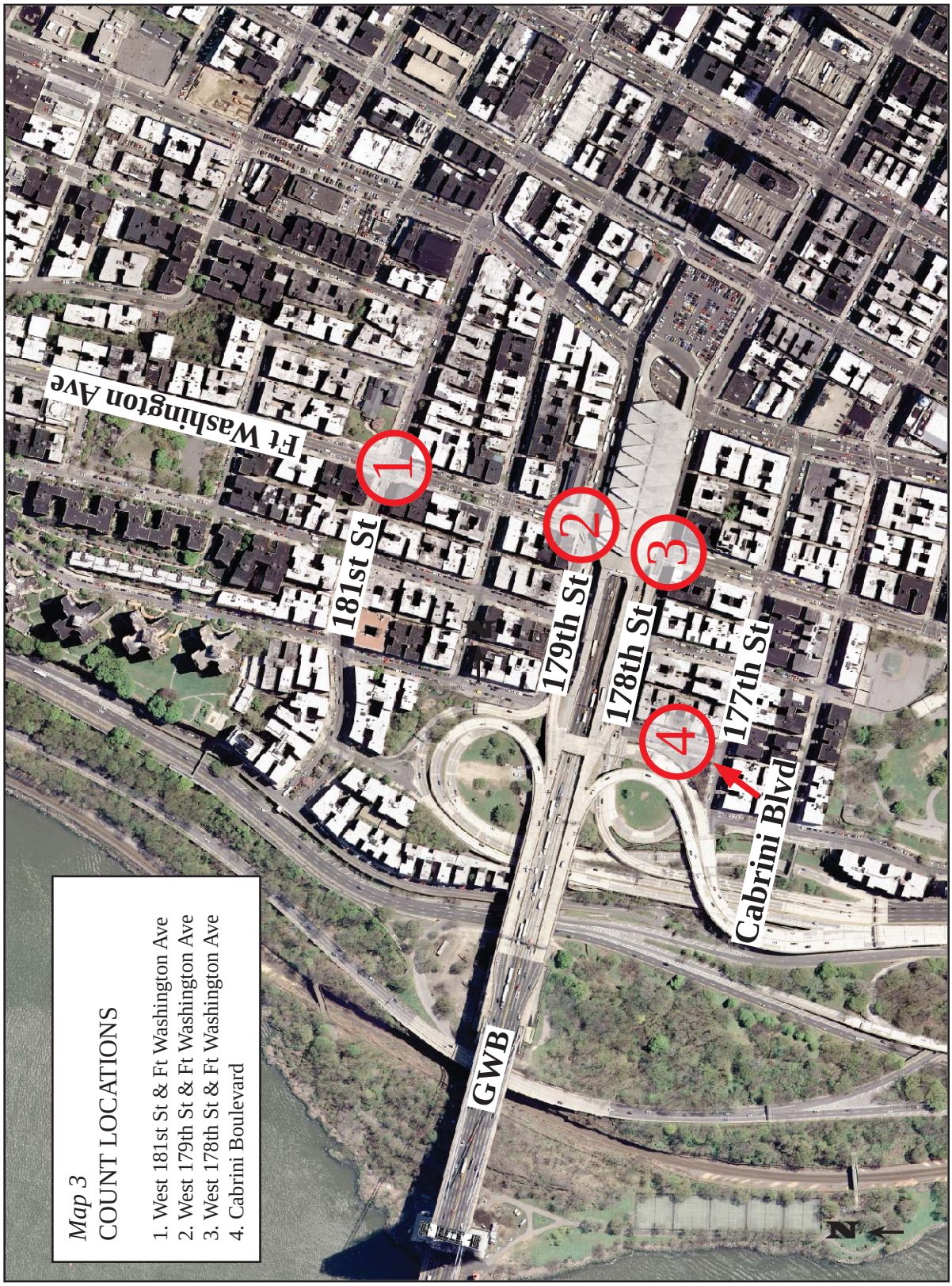
Traffic Operations

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:	*Highway Capacity Manual*, 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.


Map 3
COUNT LOCATIONS
1. West 181st St & Ft Washington Ave
2. West 179th St & Ft Washington Ave
3. West 178th St & Ft Washington Ave
4. Cabrini Boulevard
Ft Washington Ave
181st St
179th St
178th St
177th St
Cabrini Blvd
GWB
1
2
3
4
N

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

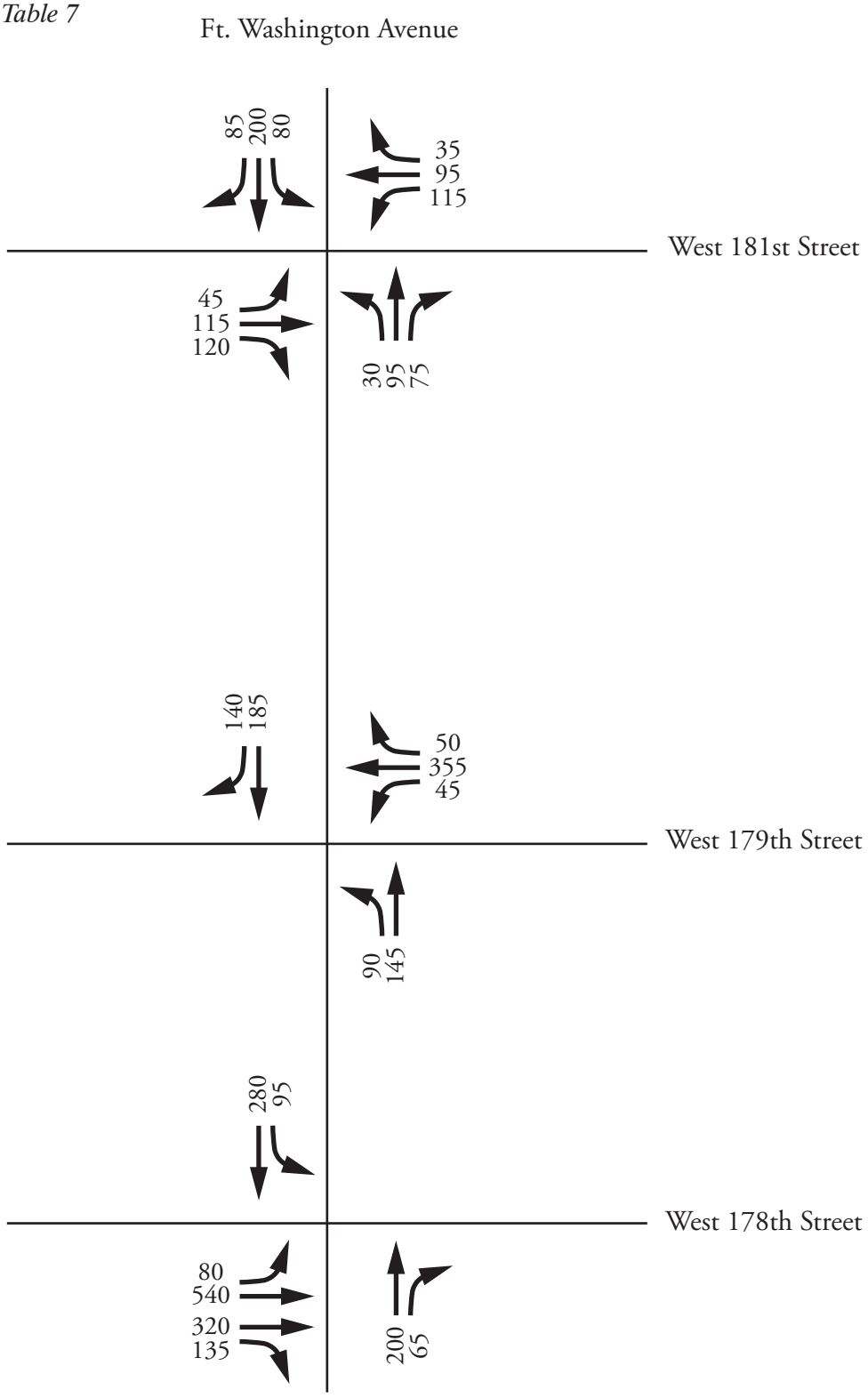
Peak Hour Vehicular Volumes at Cabrini Boulevard				
Location	**Northbound**	**AM Peak Hour** 8:00-9:00am	**MD Peak Hour** 12:30-1:30PM	**PM Peak Hour** 5:00-6:00PM
Between West 178th Street & West 177th Street	East Curb	21	30	23
	West Curb	2	1	5
	TOTALS	23	31	28

West Curb

East Curb

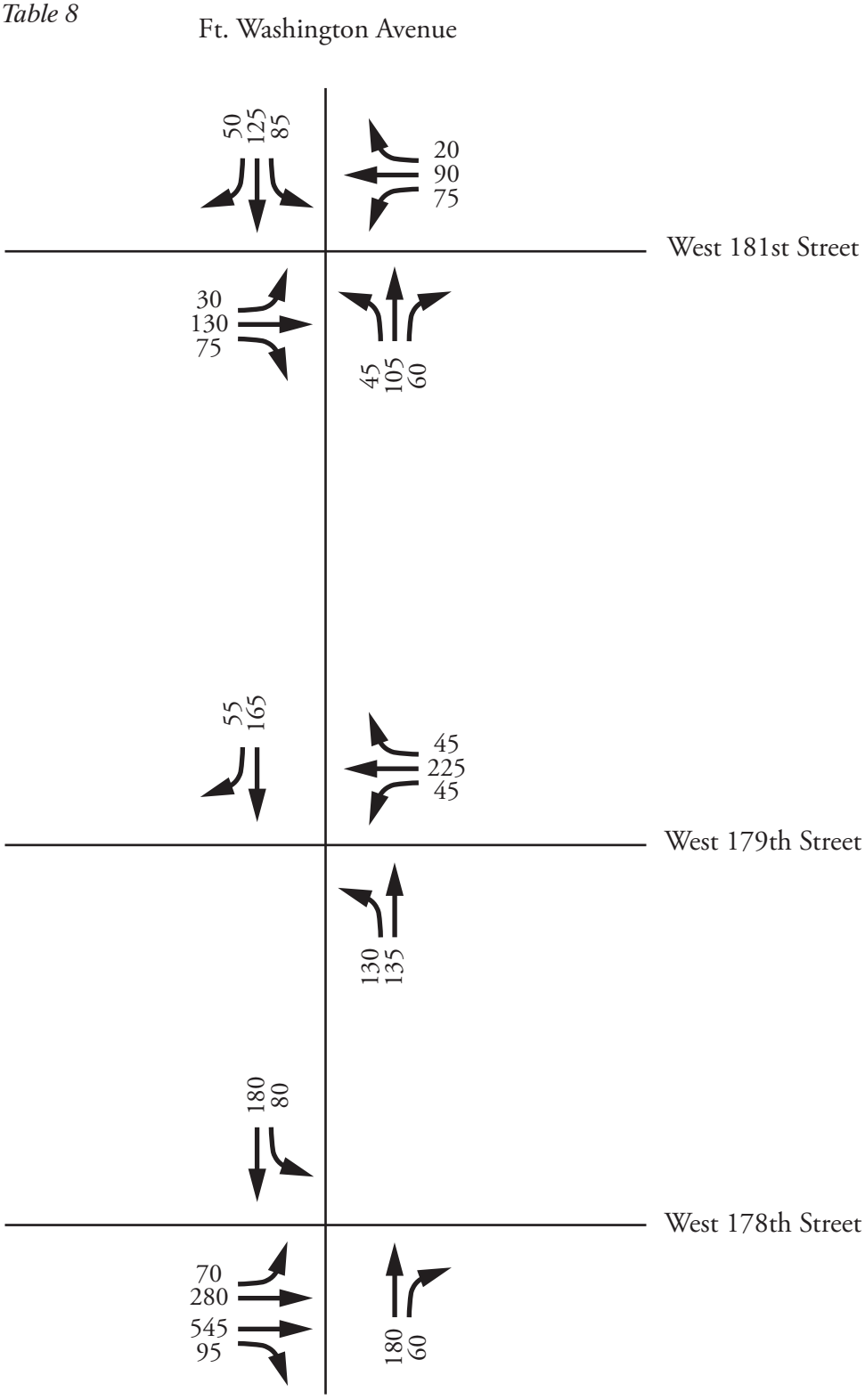
Vehicular Volumes - AM Peak Hour Traffic Volumes - 8:00AM to 9:00AM

Table 7



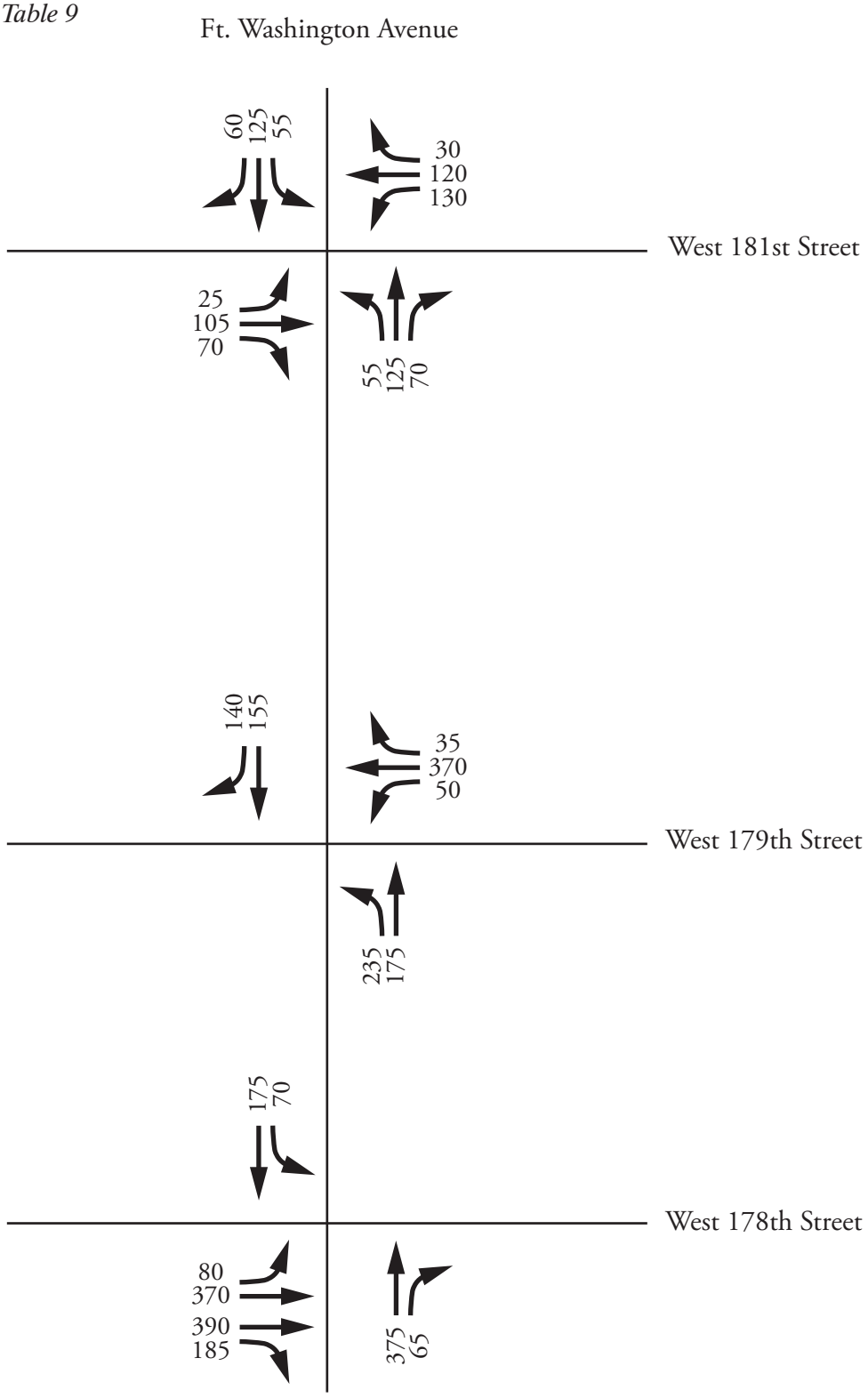
Vehicular Volumes - MD Peak Hour Traffic Volumes - 12:30PM to 1:30PM

Table 8



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

Table 9



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

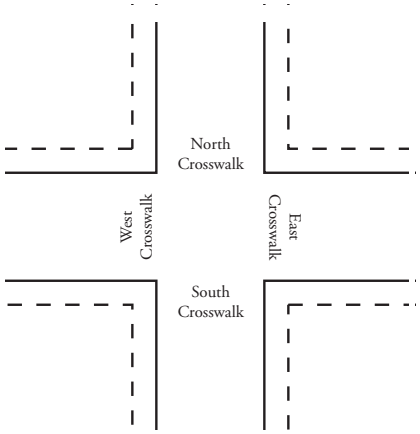
Intersection	Movement	AM		
		v/c ratio	Delay	LOS
Ft. Washington Ave & 181st Street				
Eastbound	LTR	0.78	40.6	D
Westbound	LTR	0.94	68.4	E
Northbound	LTR	0.33	12.8	B
Southbound	LTR	0.59	17.5	B
		Intersection Delay = 34.0 LOS = C		

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.

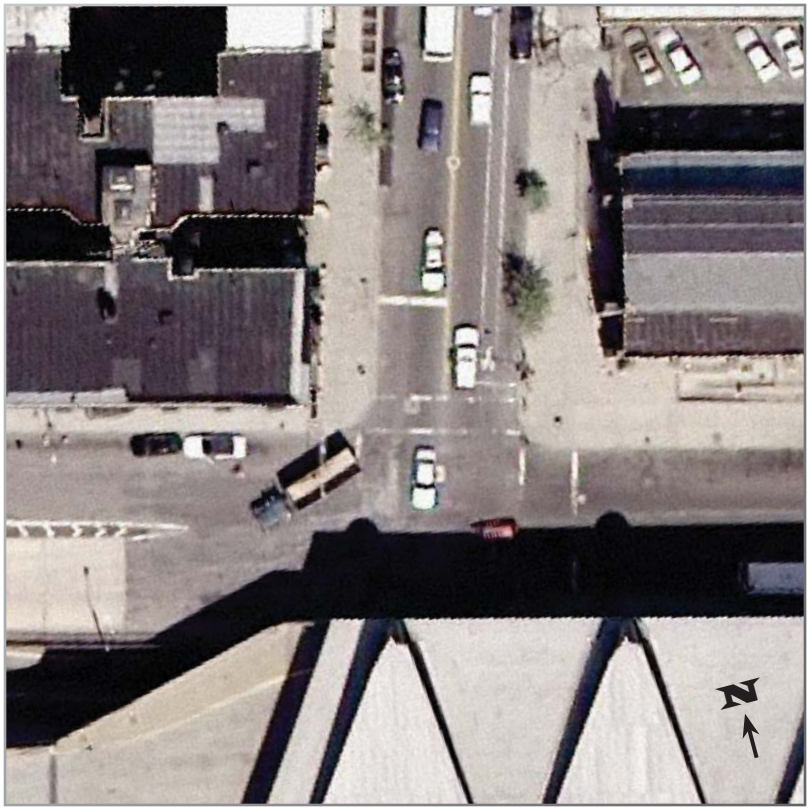


Photo 39 - Ft. Washington Avenue and West 179th Street intersection.

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

Photo 41

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 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

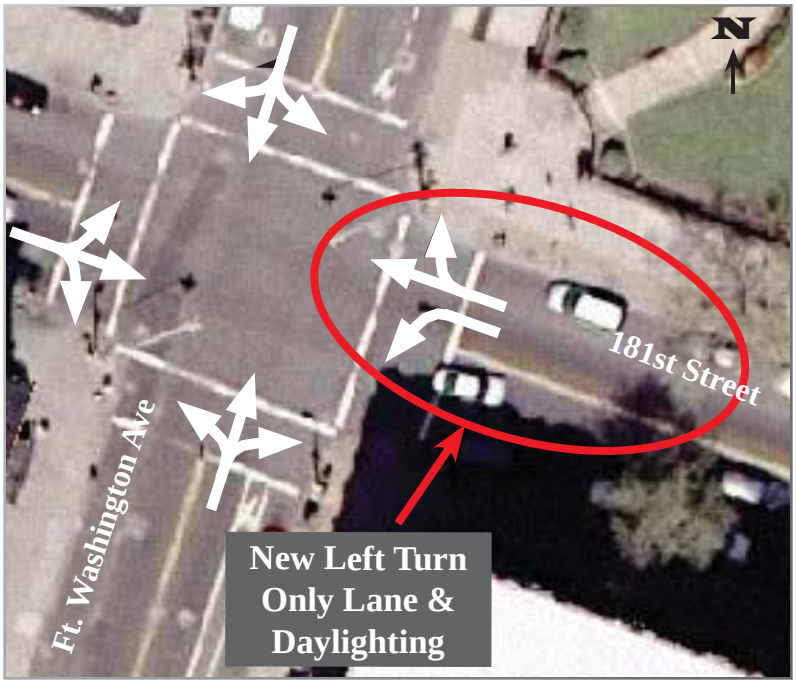


Photo 45 - The westbound approach with the recommended left turn lane.

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.

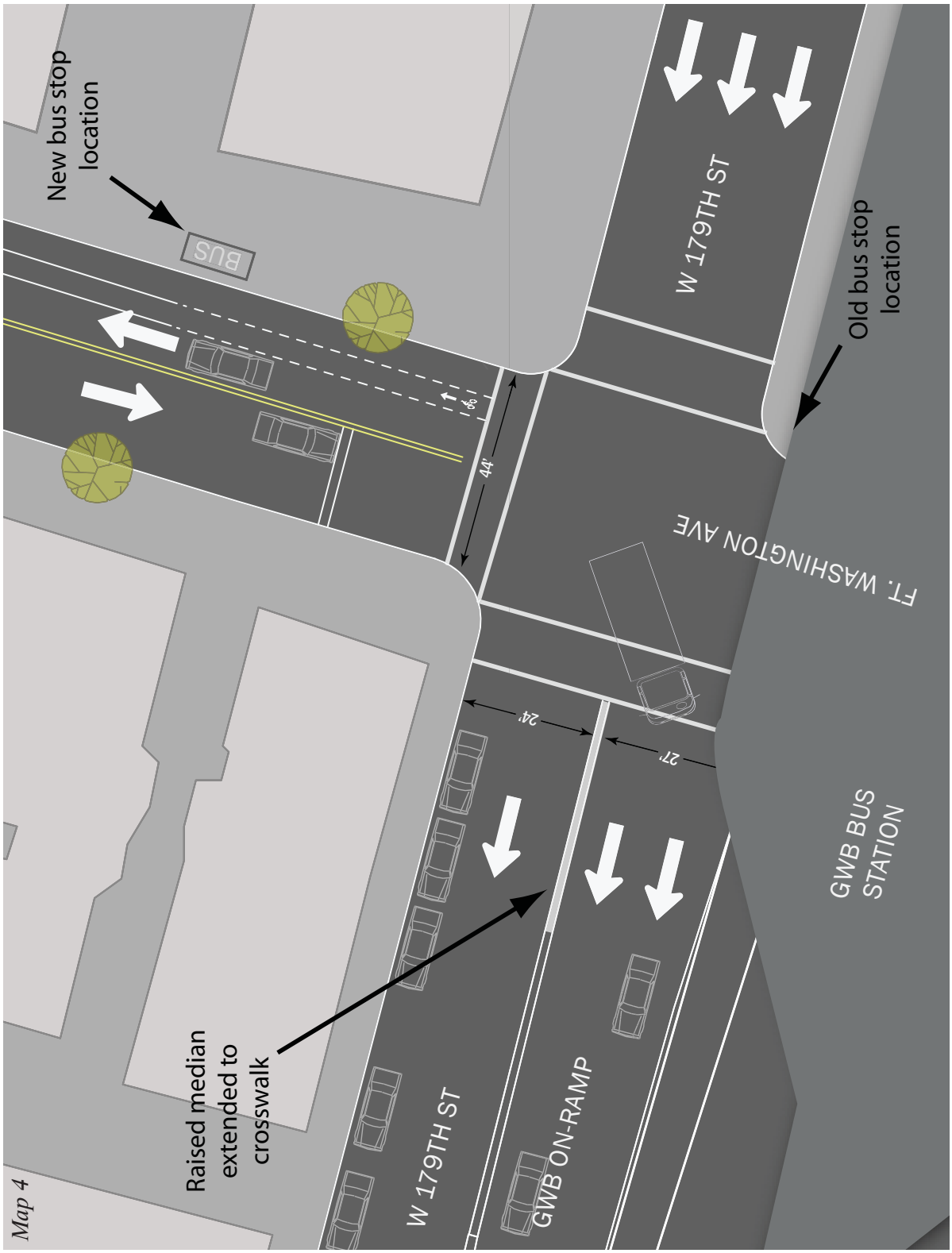
Photo 46 - West 179th Street's median can also be extended to the crosswalk.

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

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 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



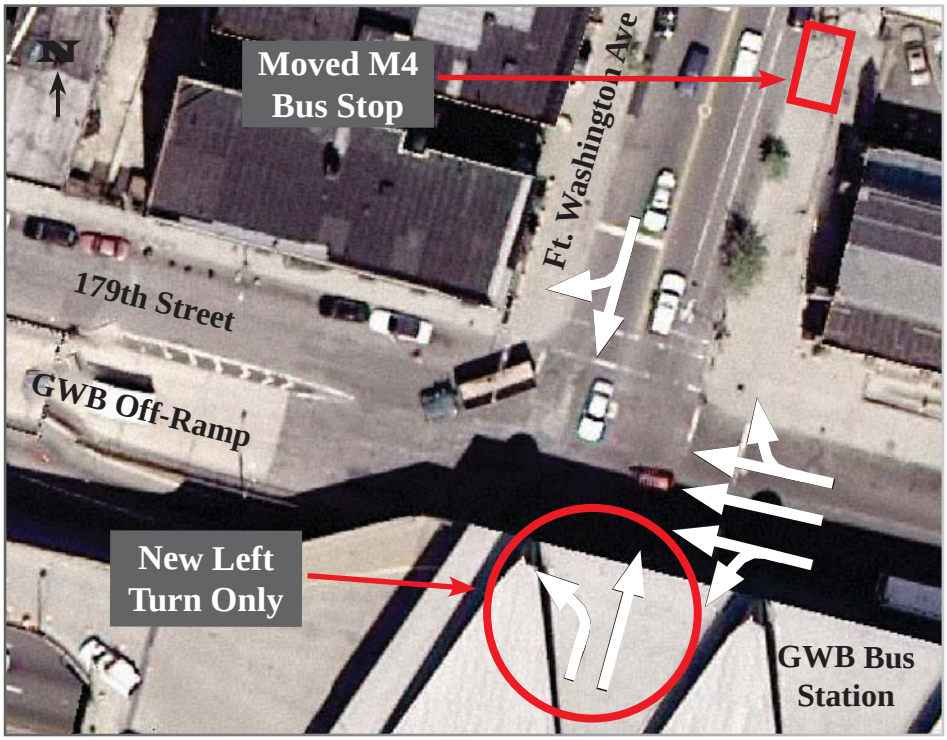
Recommendations - Ft. Washington Avenue and West 179th Street

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

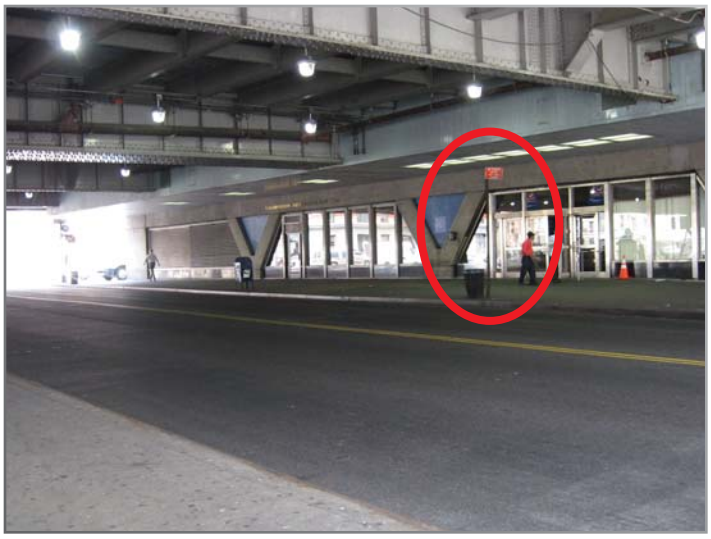


Photo 50 - The location of the underutilzed taxi stand.

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

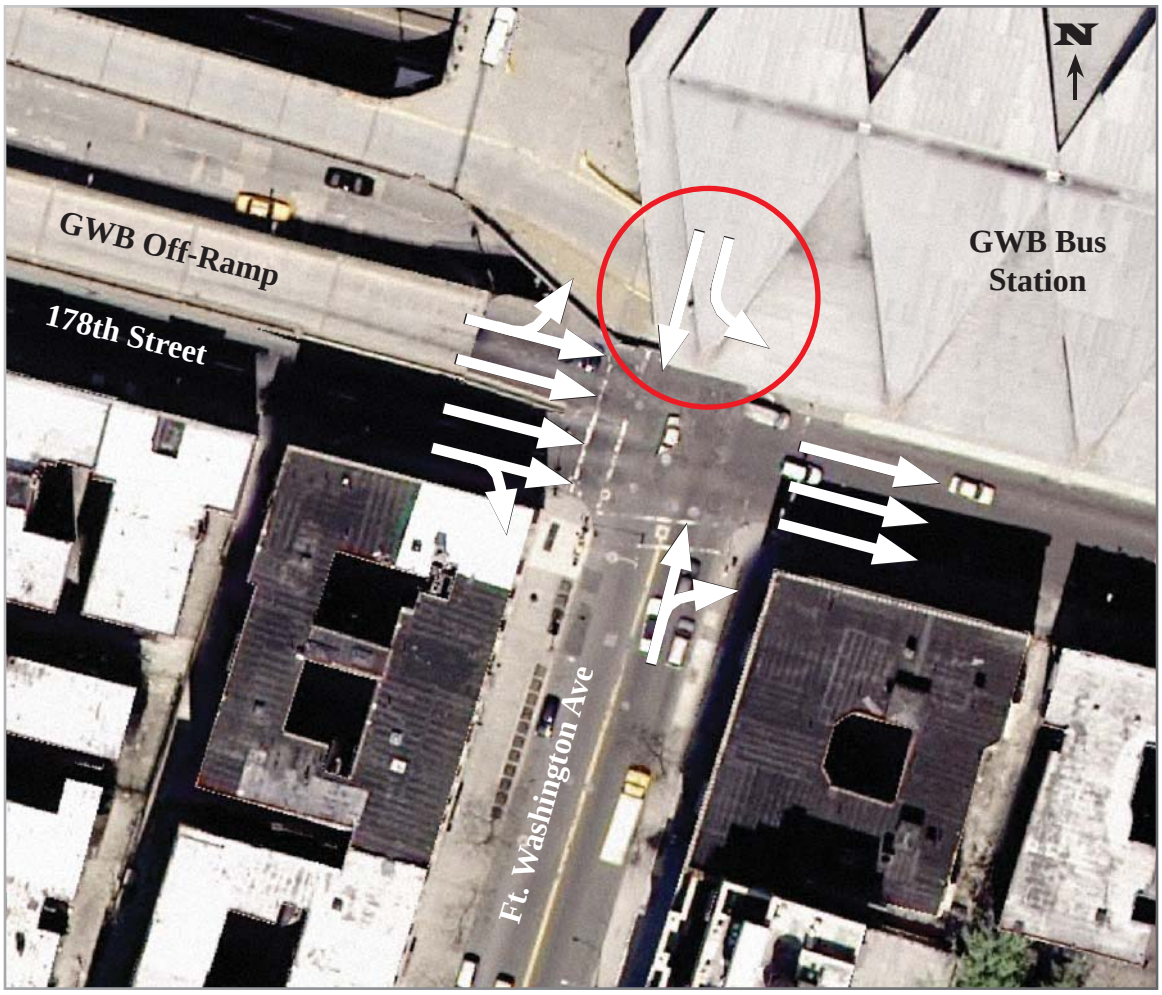
Ft. Washington Avenue & West 178th Street	Movement	AM		
		v/c ratio	Delay	LOS
Existing Southbound	LT	0.77	31.4	C
		Intersection Delay = 21.4 LOS = C		
Recommended Southbound	L	0.42	22.0	B
	T	0.43	19.0	C
			17.4	B
		Intersection Delay = 18.8 LOS = B		

Ft. Washington Avenue & West 178th Street	Movement	MD		
		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	Movement	PM		
		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.

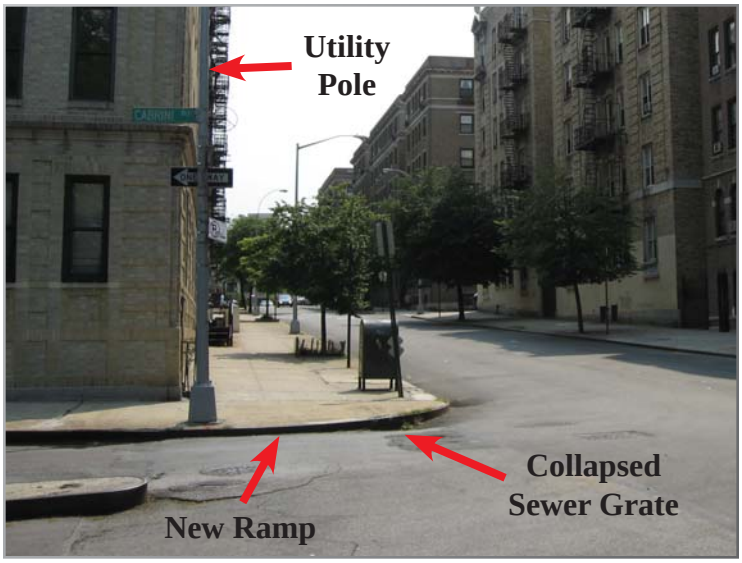
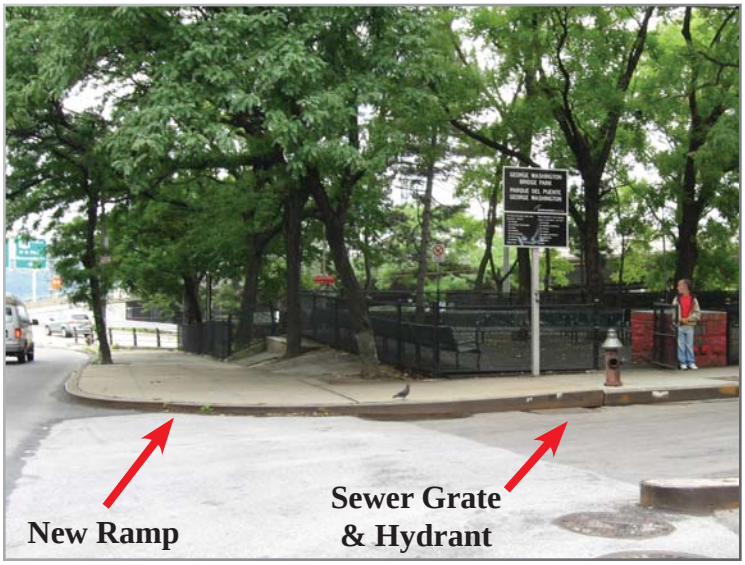


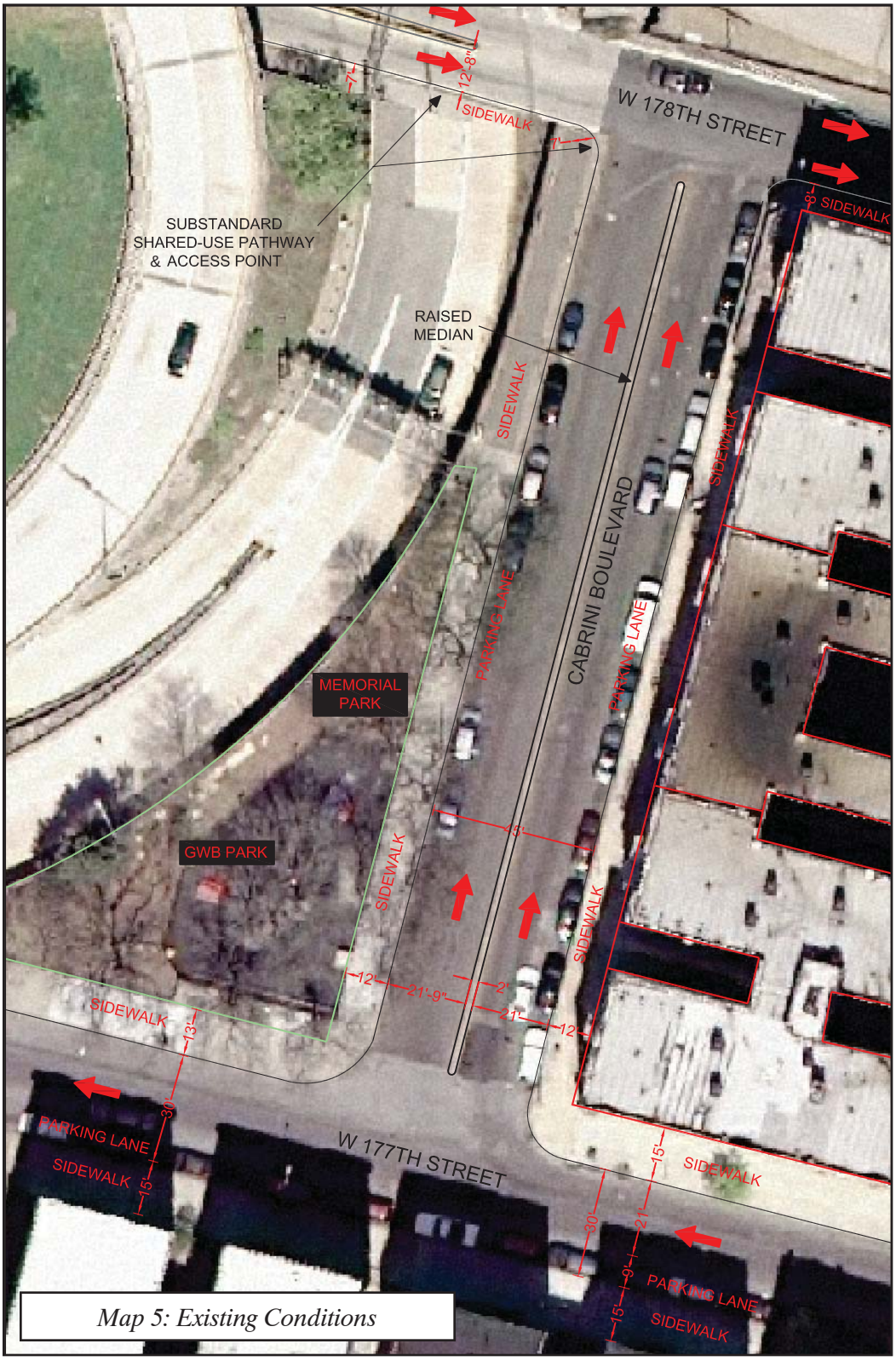
Photo 55 - The northwest corner of Cabrini Boulevard and West 177th Street requires a regular pedestrian ramp because existing utilities are located further from the corner.



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



Map 5: Existing Conditions

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, crosswalk 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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