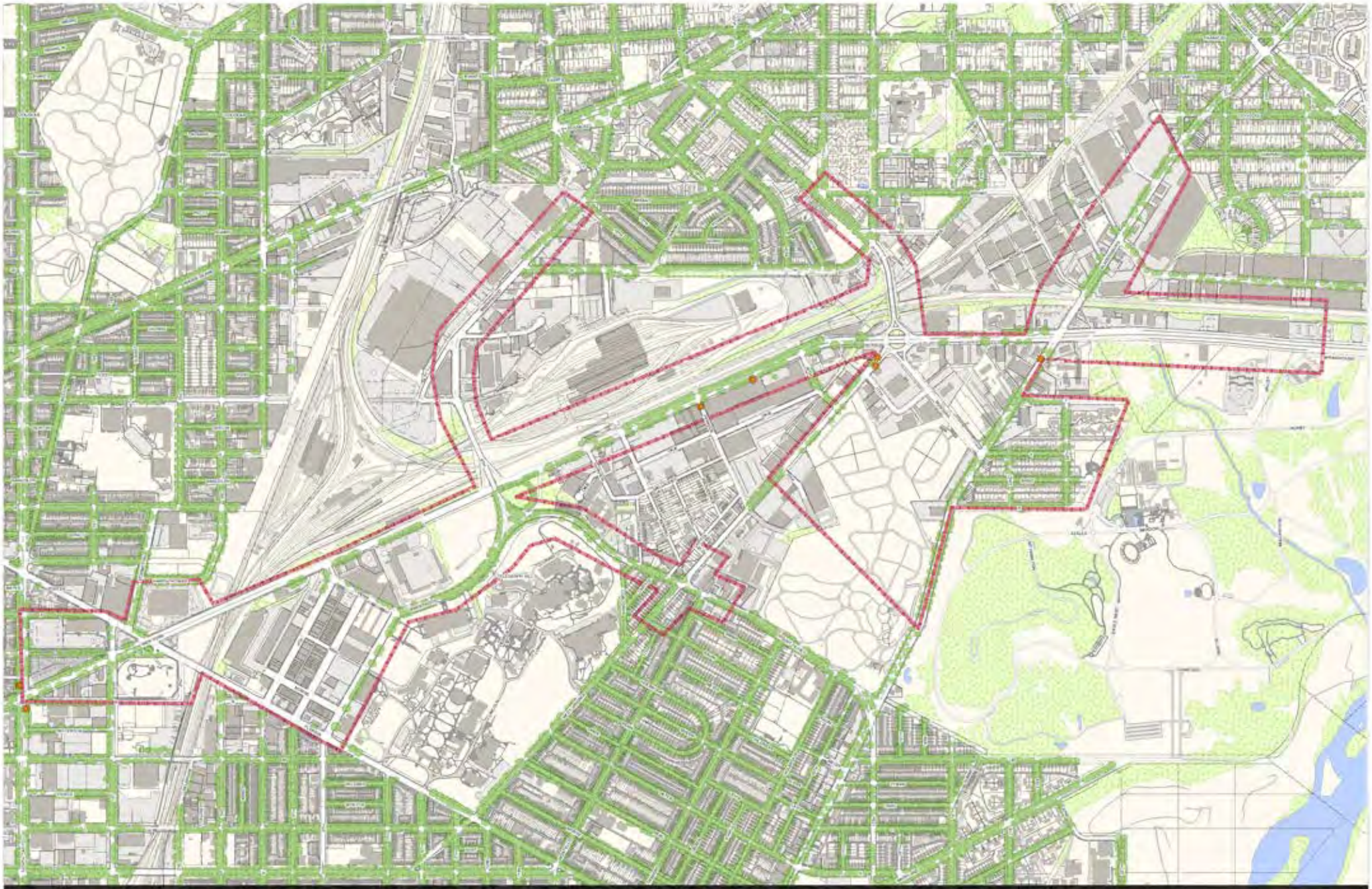

District of Columbia
Office of Planning

New York Avenue Green Infrastructure Assessment >

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Contents

Executive Summary

Project Overview

The following is an assessment of green infrastructure opportunities and methods for improving multi-modal transportation (e.g. trails, sidewalks, busses, trolleys, etc.) along the New York Avenue Corridor from North Capitol Street NE to Bladensburg Road NE. The focus of the assessment is to determine potential opportunities for implementation in and along the public right-of-way of New York Avenue, as well as key transportation and public properties in the surrounding planning area. This includes the neighborhoods of the Ivy City, Trinidad, Gallaudet University, Brentwood, and North of Massachusetts Avenue (NoMa). The assessment was performed in two phases. Phase One provides the basis and criteria for the selection of appropriate strategies and techniques and the selection of sites for the assessment. Phase Two offers specific recommendations and implementation strategies for the assessment.

Green infrastructure can be defined as natural and constructed stormwater Best Management Practices (BMPs) that mimic the natural hydrologic cycle to capture, treat, and potentially use stormwater runoff from public and private properties. These practices are incorporated into the design and construction of streets, trails, schools, and public and private properties as new and/or retrofit projects in order to create a network of green practices that can help protect and restore watershed functions and health. The application of these techniques at the site development or project level is called Low Impact Development (LID). Practices include, but are not limited to, rain gardens, permeable pavements, and green roofs.

Green infrastructure practices have multiple benefits besides stormwater management functions. Design elements such as green roofs on buildings can be used to enhance property values, (Ichihara and Cohen, 2010). Trees can provide shade and cooling, improve air quality at the local level, and create an improved perception of a street or neighborhood (Pataki Diane E., 2011). The effect and overall value of the multiple benefits can be determined by using the Triple Bottom Line (TBL) approach (Elkington, 1994). This approach aides decision makers and stakeholders by considering the social, economic, and environmental benefits of projects rather than just the construction life-cycle costs. The application of the TBL approach is important in the New York Avenue Corridor because of the potential opportunities that exist for integration of green technologies into planned and on-going improvements to the transportation infrastructure as well as public and private redevelopment projects. These green techniques will help protect and restore the Anacostia and Potomac Rivers and tributaries, enhance and facilitate the experience of walking, biking, and using public transportation, and help create a sustainable and attractive gateway to the District of Columbia.

Project Goals

The goal of this assessment is to develop an environmentally progressive and sustainable foundation for infrastructure and development to occur along the New York Avenue Corridor by providing planners, stakeholders, and decision makers with recommendations on strategies for the integration of green infrastructure into proposed and potential projects. The main building blocks of the foundation are strategies and techniques that are effective at improving water quality from stormwater pollution, have high ancillary economic, social, and other environmental benefits, and can help create, accommodate, or facilitate multi-modal transportation and green transportation opportunities.

The green infrastructure assessment evaluates the potential to integrate green infrastructure into the recommendations of existing planning documents and significant public and private projects in the corridor; develops green infrastructure criteria that

are applicable to the corridor and then ranks and prioritizes potential projects; provides recommendations on how to improve multi-modal access and connectivity within the corridor; provides conceptual design drawings that can demonstrate and showcase the potential strategies and techniques; provides information that can be used to improve public perceptions of the corridor and make it more economically viable for investment through the use of green strategies and techniques; and develops implementation recommendations and scenarios that can be used by the development community, residents, property owners, stakeholders, and decision makers.

Key Project Recommendations

The key project recommendations focus on implementation strategies and techniques that range from application throughout the corridor to site-specific projects. Each recommendation provided was chosen based on the site or area's existing condition and how it ranked against the green infrastructure criteria that were developed through this effort. They have been categorized into the following four areas:

- General - These are recommendations that can be applied throughout the corridor, such as reducing the number of curb cuts for site access, reconstructing alleys with permeable pavements, and using rain garden curb bump-outs at residential street intersections to treat stormwater and help calm traffic.
- Transportation - These are improvements to bus stop locations and design that improve accessibility, safety, and incorporate green techniques for cooling, lighting, and appearance.
- Multi-Use Trail - These are the potential realignments, connections, and physical improvements that facilitate use, community connectivity, safety, and the appearance of the street or neighborhood.
- Area-Specific Recommendations - These are strategies and techniques for individual streets, land uses, or neighborhoods that have a high potential to achieve one or more of the key assessment criteria and objectives and will help establish the area as a recognizable green infrastructure area or gateway reducing the volume of stormwater runoff and redesigning some of the traffic circles in the corridor are examples.

The purpose of *Phase One: Existing Conditions and Criteria* is to develop the baseline economic, social, and environmental criteria that will be used to identify and select green infrastructure and transportation projects for *Phase Two: Recommendations*. Phase One includes an evaluation of the existing conditions, an evaluation of existing relevant studies, and the development of project and site selection criteria that can be used to achieve the assessment goals and objectives.

Phase One: Existing Conditions and Criteria

Existing Conditions

The existing conditions inventory and evaluation was used to determine the physical, land use, and transportation factors that influence the potential for implementation of green infrastructure and multi-modal transportation improvements in the assessment area. The information was gathered through reviews of existing studies and reports, input from DC agency staff, and site and field investigations. This effort includes investigations in six areas:

- Location and Context - These are descriptions of the existing lands uses, neighborhoods, and planning areas used in the assessment.
- Relevant Capital Improvement Projects - These are recently constructed or planned improvements to the transportation network.
- Focus Areas - This is the identification of general locations where the project team conducted further investigations to determine candidate sites for potential projects.
- Existing Bus Routes and Stops - This is an examination of the existing access and function of the networks and stops and an identification of opportunities for potential improvement.
- Existing Trail and Pedestrian Circulation - This is an examination of potential realignments, geometric improvements, and connectivity throughout the corridor.
- Green Infrastructure Site Opportunities and Constraints - This is an evaluation of the stormwater management system, physical features, and regulatory conditions that are used to determine

the potential of a site to manage stormwater.

Location and Context

The New York Avenue Green Infrastructure Assessment is bordered by North Capitol Street NE to the west, Bladensburg Road NE to the east, Ivy City, Trinidad, and Gallaudet University to the south, and the CSX rail yard and Langdon to the north. Figure 1 is a map of the assessment area, which is approximately 500 acres in size, and the zoning overlay.

The areas that are parallel or adjacent to New York Avenue are primarily zoned for either commercial or industrial uses. Specifically, 54 percent of the study area (270 acres) is zoned for commercial land uses, 23 percent (115 acres) is zoned for industrial land uses, and the remaining 23 percent (115 acres) is divided among government, residential, and university land use zones. Table 1 is a summary of the zoning categories listed in Figure 1.

Following Figure 1 are brief descriptions of the local neighborhoods and other areas that are the focus for the study. These are the locations within the corridor that were considered as candidate areas for further investigation and recommendations. The focus areas and their boundaries were determined by an evaluation of the physical conditions of the area, including physical boundaries (e.g. rail yards, bridges, slopes, etc.), land uses, and zoning categories. The descriptions include key green infrastructure and transportation opportunities, major zoning categories, and constraints from the initial field investigations conducted by the project team.

Table 1: Summary of Zoning Categories in Project Area (District of Columbia Office of Zoning)

Zone	Summary
C-2-A	Low density mixed use development (office, retail, and housing)
C-2-B	Medium density mixed use development
C-3-C	Medium density mixed use development that is mostly non-residential
C-M-1	Low bulk commercial and light manufacturing
C-M-2	Medium bulk commercial and light manufacturing
C-M-3	High bulk commercial and light manufacturing
D/R-4	Diplomatic Overlay District on Single family residential, churches, and public schools
LO/C-M-1	Langdon overlay on low bulk commercial and light manufacturing
M	General industrial
R-1-B	Detached single family residential
R-3	Single family residential (including detached, semi-detached and row dwellings)
R-4	Single family residential, churches, and public schools
R-5-A	Single family residential, detached and semi-detached dwellings
R-5-D	Medium to high density general residential uses, single family, flats and apartment buildings

Local Residential Neighborhoods and Residential Land Uses

Ivy City

Ivy City is located to the south of the project area and zoned R-4 due to being primarily residential. There are currently no bike lanes along West Virginia Avenue NE or Mount Olivet Road NE. Sidewalks in Ivy City are generally in good condition, however, bus stop shelters are located within the sidewalk areas and limit pedestrian flow, while in other locations shelters are absent.

Trinidad

Trinidad is to the south of New York Avenue NE and zoned R-4. Trinidad is one of the primary residential neighborhoods that would benefit from the implementation of green infrastructure strategies and techniques that facilitate pedestrian

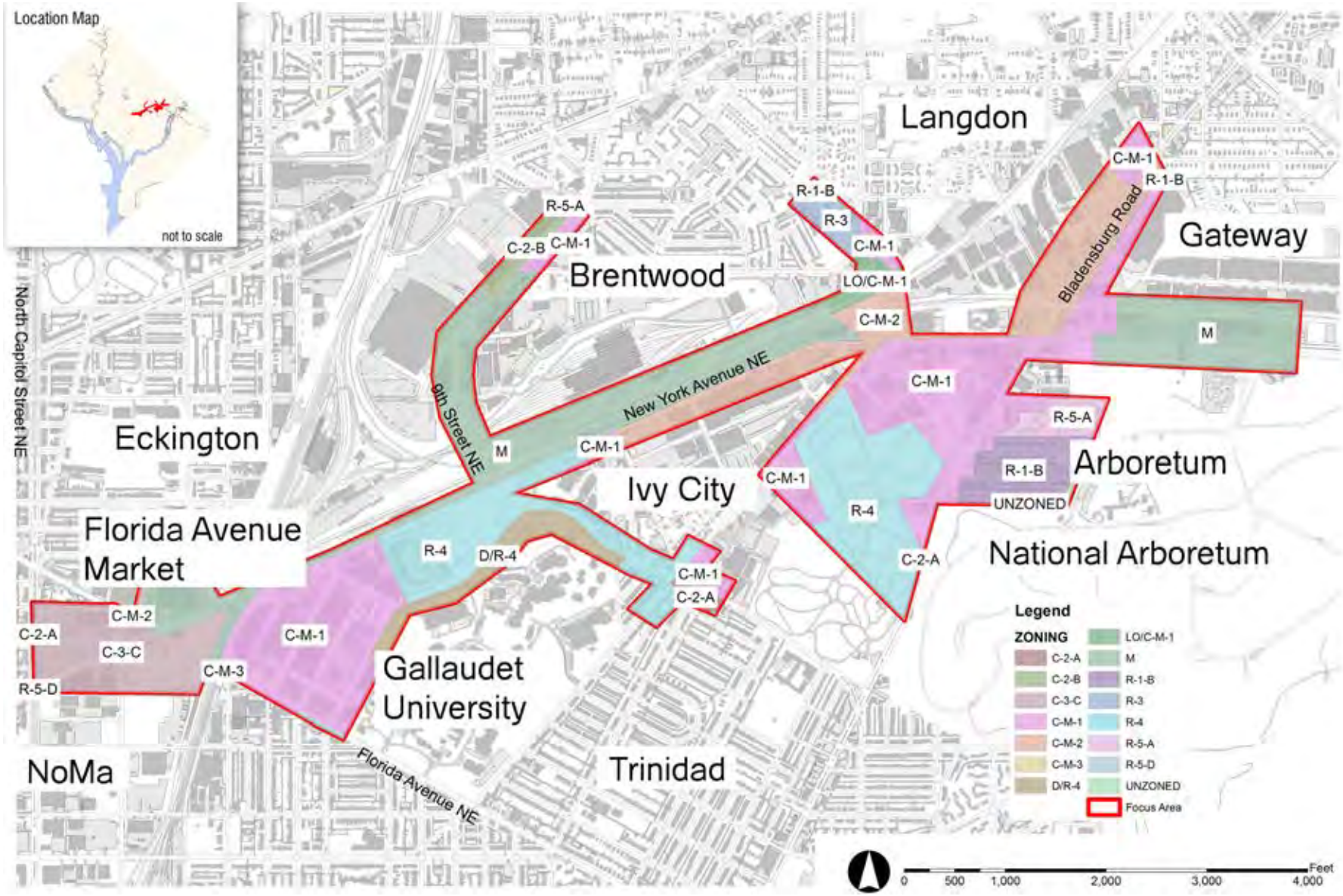

Figure 1: Neighborhood Location Map with Zoning. (Source: LID Center & DCRA)

access and circulation. Sidewalks in this neighborhood are narrow or not connected. This results in pedestrians having to step into the travel lanes. Figure 2 shows a sidewalk along West Virginia Avenue NE that is blocked by utilities and a tree. Curb bump-outs could preserve existing vegetation while allowing adequate accessibility.

Gallaudet University
The portion of Gallaudet University within the assessment area is zoned D/R-4. It includes on-site housing and has significant areas of green space that can be retrofitted for green infrastructure techniques such as soil amendments, rain barrels, and reforestation.

Brentwood
This area is bordered by Rhode Island Avenue NE to the north, New York Avenue NE to the south, Brentwood Road NE and the rail yard to the west, and Montana Avenue NE to the east. It is zoned M, R-3, and C-M-1.

The Rhode Island Avenue-Brentwood Metro Station is the closest station to the area. Residents from the Postal Corridor, Warehouse area, and Montana Avenue area also use this station, and must travel through the Brentwood area to access it. The predominant land uses in Brentwood along New York Avenue NE are dominated by the CSX rail network. There are only two crossings to the main New York Avenue Corridor: the 9th Street Bridge NE and Montana Avenue NE. A revitalization project on the 9th Street Bridge is currently underway and will improve pedestrian connections to Brentwood.

Figure 2: Sidewalk Impediment on West Virginia Avenue NE. (Source: Google Maps Street View)

NoMa
Located at the west end of the assessment area, NoMa is at the corner of North Capitol Street NE and New York Avenue NE. The NoMa neighborhood, which consists of office, retail, and residential development, includes a diverse mix of zoning categories but is predominately zoned C-3-C. There are many vacant lots and areas with poor pedestrian access and circulation. NoMa is currently undergoing a transition from warehouse to mixed-use land uses that will present opportunities for the implementation of green infrastructure.

Relevant Capital Projects

New York Bridge NE Revitalization
The New York Avenue NE Bridge revitalization project began design in 2009. The project is for the bridge over the CSX Railroad at Florida Avenue NE. The revitalization project is the largest American Recovery and Reinvestment Act of 2009 (ARRA) stimulus project within the District. The $36.5 million project includes extensive repair work to preserve the bridge's underside, deck, and roadway from North Capitol Street NE to Bladensburg Road NE. The project began construction in April of 2011.

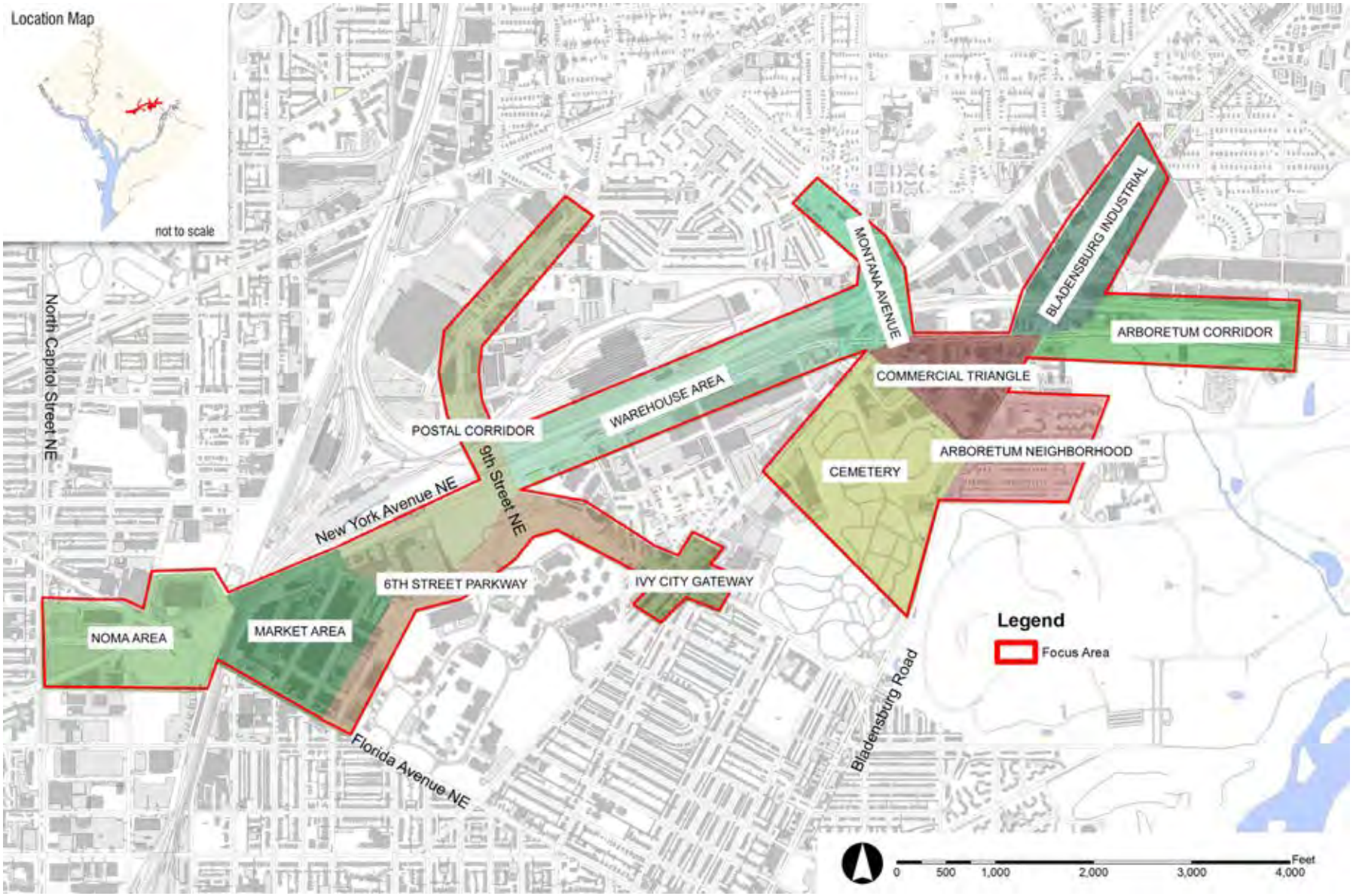

Figure 3: Focus Area and Project Boundary Map. (Source: LID Center & DC GIS)

Safety Improvements of 1st Street NE and Florida Avenue NE
DDOT has approved a roadway improvement project at the intersection of 1st Street NE, New York Avenue NE, and Eckington Place NE. The project includes new circulation patterns, traffic signalization improvements, cross walks, and sidewalks. The project is nearing completion at the time of this writing.

9th Street Bridge NE Over New York Avenue NE
This project consists of the replacement of the 9th Street Bridge NE over New York Avenue NE and CSX Railroads. The project is currently under construction and includes enhanced pedestrian accessibility and lighting across the bridge. The project is scheduled to be completed in December 2012.

Metropolitan Branch Trail
The Metropolitan Branch Trail (MBT) is a proposed 8 mile multi-use trail that runs from the Silver Spring Metro Station in Maryland to Union Station in the District of Columbia. The trail generally follows the path the Metro Red Line. The MBT will help to complete a regional network of trails by connecting the Capital Crescent Trail in Silver Spring, the National Mall near Union Station, and the proposed Fort Circle Parks trail. A portion of the trail between 1st Street NE and 3rd Street NE in the assessment area is already completed.

DDOT Green Alleys
DDOT is currently designing and constructing a series of green alley permeable pavement demonstration projects. The planning and design of these projects is being funded by the MS4 Stormwater Permit Enterprise Fund. The construction of the alleys is being funded under the American Resource Recovery Act through the Clean Water State Revolving Fund that is managed by USEPA.

Focus Areas

Florida Avenue Market Area
The Florida Avenue Market Area is located at the west end of the corridor. It is bounded by Florida Avenue NE, New York Avenue NE, 6th Street NE, and Penn Street NE. It is zoned C-M-1 and is mostly comprised of warehouses and food distribution centers. The Florida Avenue Market Area plan proposes a landscaped median, linear park, and promenade on the north side of New York Avenue NE. This will include bike lane that has a connection to the Metropolitan Branch Trail (MBT). The connection to the MBT would be a critical element of providing connectivity for the area.

Postal Corridor
The Postal Corridor runs along 9th Street NE and is zoned M, C-2-B, C-M-1, and R-5-A. The 9th Street NE overpass is one of only three major crossings at New York Avenue NE that can provide access and connectivity for the neighborhoods and land uses in the assessment area. The existing postal facilities and parking lots have the potential for LID retrofits such as permeable pavements and bioretention cells.

6th Street Parkway NE
This street runs between the northeastern boundary of the Florida Avenue Market Area and Gallaudet University at Penn Street NE to Florida Avenue NE. There is a National Park Service maintenance facility to the northeast that is zoned as the R-4 residential zone. The street can be an important pedestrian corridor that links Florida Avenue NE to the 9th Street NE overpass and areas to the east.

Warehouse Area
This area runs along New York Avenue NE between the 9th Street NE overpass and Montana Avenue NE. It is zoned M, C-M-1, and C-M-2 and primarily consists of large warehouse or industrial uses. The area is mostly impervious with little green space because of the high density of roads and large roofed areas. The existing sidewalks are narrow and the high number of trucks and vehicles block or impede walking along the narrow sidewalks.

Ivy City Gateway
Ivy City is a small but centrally located residential neighborhood that is zoned R-4, C-M-1, and C-2-A. It is bounded by West Virginia Avenue NE, Mount Olivet Road NE, and New York Avenue NE. There are numerous opportunities to use green infrastructure elements for traffic calming and to establish the area as a green community. A strong pedestrian linkage or trail should be made to the park at the intersection of West Virginia Avenue NE, Mount Olivet Road NE, and Capitol Avenue NE.

Montana Avenue
The intersection of Montana Avenue NE, West Virginia Ave NE, and New York Avenue NE is a major transportation feature along the corridor. The zoning around the circle at the intersection is R-1-B, R-3, C-M-1, LO/C-M-1, and C-M-2. The circle and the surrounding land uses have significant potential to establish the area as a green focal point, or green gateway to the city.

Commercial Triangle
This area is located on the south side of New York Avenue NE and is bordered by the Mount Olivet Cemetery, West Virginia Avenue, and Bladensburg Road NE. The area is zoned C-M-1. The majority of the land uses have high percentages of impervious surfaces. There is currently a proposal to build a major shopping center within the area.

Cemetery
The Mount Olivet Cemetery area is bordered by Montana Avenue NE to the north, Bladensburg Road NE to the east, Mount Olivet Road NE to the south, and West Virginia Avenue NE to the west. The area is zoned R-4. There is a police vehicle storage and maintenance lot and some commercial or industrial businesses that are located at the northwest corner of the area that are zoned C-M-1.

Bladensburg Industrial
The Bladensburg Industrial area runs along Bladensburg Road NE from New York Avenue NE to 28th Street NE. It is zoned C-M-1, C-M-2, and R-1-B. The areas to the west and east of the corridor that are near New York Avenue NE are highly industrial in nature. The area transitions to residential land uses towards the northeast. Bladensburg Road NE is a major connection from the city to the suburbs of Maryland. The pedestrian connection that crosses under the railroad tracks is in poor condition, but has significant potential for enhancement.

Arboretum Corridor
This portion of the assessment area runs along the boundary of New York Avenue NE and the National Arboretum. The arboretum is a federal land use and unzoned. There are industrial and warehouse land uses at the end of the corridor. The sidewalk along the arboretum is poorly maintained. The north and south sides of New York Avenue NE are connected by an underpass at 36th Place, which can be developed as an important connection between the National Arboretum and areas to the north.

Arboretum Neighborhood
This is an established single family residential neighborhood that is located directly west of the National Arboretum. It is zoned R-1-A. The neighborhood includes a small recreation center. There are newly installed sidewalks along several of the streets. There are numerous opportunities for curb bump-outs and pervious alleys.

Existing Conditions for Bus Routes and Stops

This section provides an evaluation of bus routes and stops that serve the New York Avenue Corridor between North Capitol Street NE and the District-Maryland border. The first part of this section focuses on the overall routes. The second part provides general recommendations on the design of the stops and potential relocations and improvements at specific locations.

Bus Routes
The evaluation of the bus routes focuses on

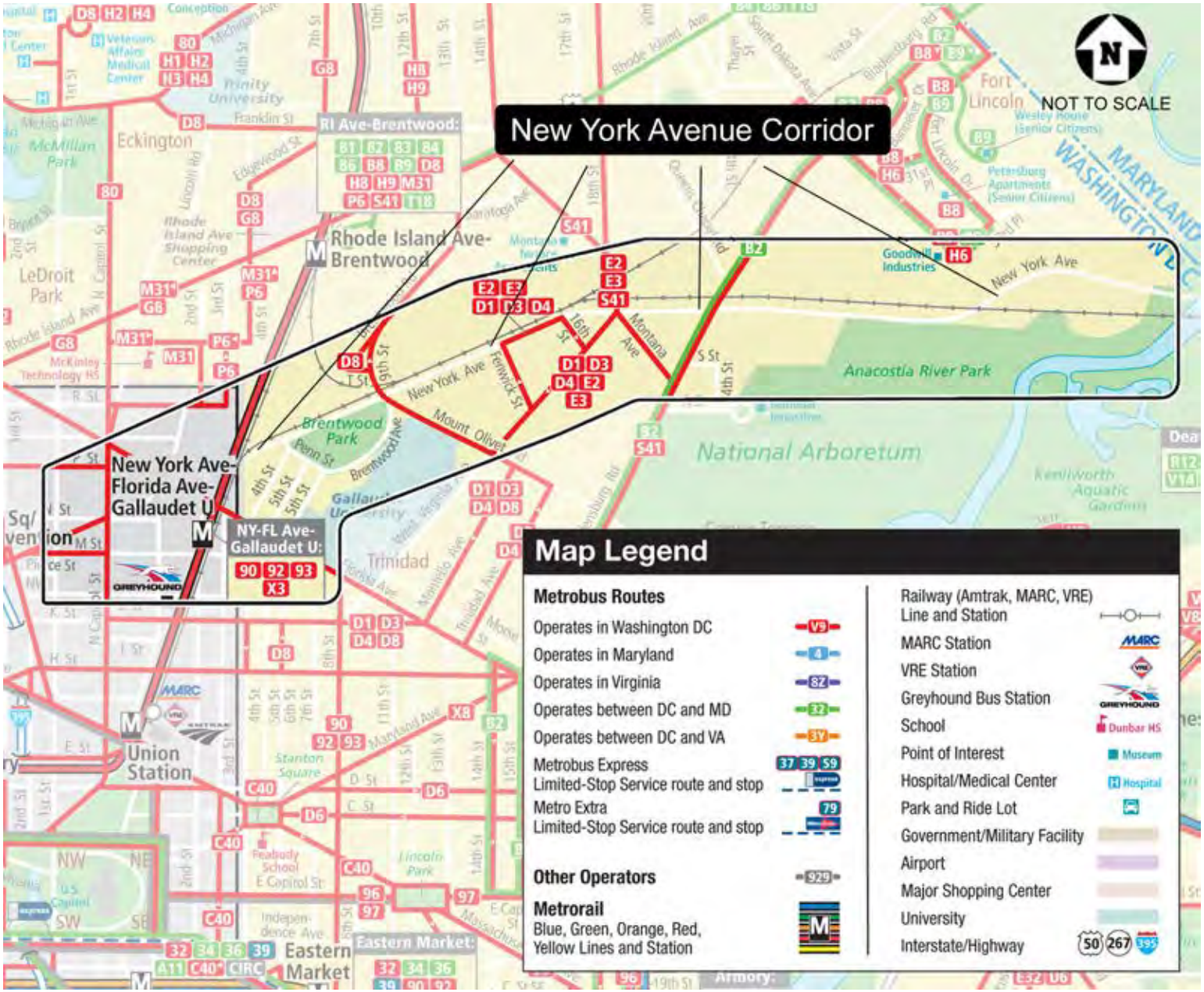

Figure 4: New York Avenue NE Corridor Bus Route Map. (Source: WMATA)

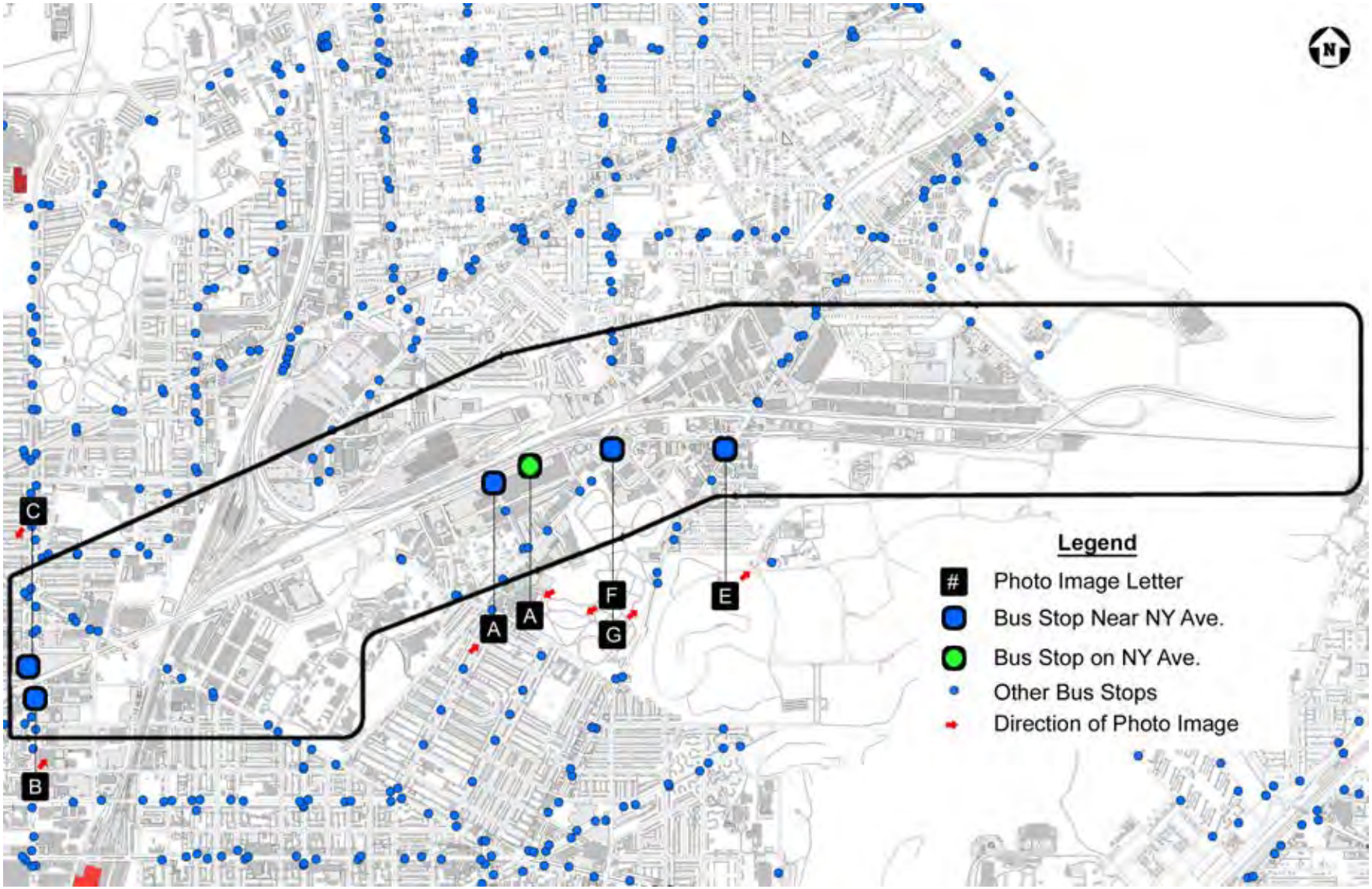

Figure 5: New York Avenue NE Corridor Bus Stop Map.
(Source: DDOT, WMATA)

service and ridership information on bus routes that operate along New York Avenue NE, bus routes that cross New York Avenue NE, bus stops on New York Avenue NE, and bus stops that are one block off of New York Avenue NE. Figure 4 is a map of the bus routes. Figure 5 is a map of the location of the bus stops. The area of bus service that runs along New York Avenue to the east of North Capitol Street NE to the District border at New York Avenue NE has limited bus service. There is currently only one bus stop that is directly on New York Avenue NE in the assessment area. This stop acts as a hub that services several crossing routes. The only area where the buses run along New York Ave NE is from Fenwick Street NE to 16th Street NE. Several bus routes cross New York Avenue NE and have stops on or near where they cross. These routes provide weekday and weekend service with headways between ten and 30 minutes. Table 2 is a summary of the routes, service hours, headway time, and ridership information for bus routes that stop on New York Avenue NE. Table 3 is a summary of the routes, service hours, headway time, and ridership information for bus routes that cross New York Avenue NE.

There are currently limited patron destinations, population densities, and employment and retail centers along New York Avenue NE within the assessment area. Therefore, additional transit routes

Table 2: Bus Route Information for Routes that Stop on New York Avenue NE

Route Number	Route Name	Service Hours	Headway	Average Weekday Ridership*
E2 & E3	Military Road-Crosstown Line	Weekdays & Weekends 6AM-1AM	15-30 Minutes	6,354
D1 & D3	Sibley-Stadium Armory	Weekdays & Weekends 4AM-1AM	15-30 Minutes	6,378
D4	Ivy City-Union Station	Weekdays & Weekends 4AM-1AM	15-30 Minutes	1,287

*Average daily ridership for entire route for March 2010 (Source: WMATA)

Table 3: Bus Route Information for Routes that Cross New York Avenue NE

Route Number	Route Name	Service Hours	Headway	Average Weekday Ridership*
80	North Capitol Street Line	Weekdays 4AM-2AM / Weekends 5AM-1AM	10-20 Minutes	8,303
P6	Anacostia-Eckington Line	Weekdays & Weekends 24-Hour Service	15-30 Minutes	3,622
B2	Bladensburg Road-Anacostia Line	Weekdays at 3:50PM, 3:55PM & 4:00PM	5 Mintures	7,245

*Average daily ridership for entire route for March 2010 (Source: WMATA)

Figure 6: New York Avenue NE Corridor Bus Stop Photo A – Southern side of New York Avenue NE between 16th Street NE and Fenwick Street NE. (Source: Google Maps Street View)

Bus Stop Image B: North Capitol Street bus stop for routes 80 & P6 on east side of North Capitol Street south of New York Avenue NE (looking north)

Bus Stop Image D: Fenwick Street bus stop for routes E2, E3, D1, D3 &, D4 on east side of Fenwick Street south of New York Avenue NE (looking north)

Bus Stop Image C: North Capitol Street bus stop for route 80 on west side of North Capitol Street north of New York Avenue NE (looking south)

Bus Stop Image E: Bladensburg Road bus stop for routes B2 & S41 on east side of Bladensburg Road south of New York Avenue NE (looking north)

Figure 7: New York Avenue NE Corridor Bus Stop Photos B-E. (Source: Google Maps Street View)

Bus Stop Image F: West Virginia Avenue Bus Stop for Routes E3, E3 & S41 on west side of West Virginia Avenue south of New York Avenue (looking south)

Bus Stop Image G: West Virginia Avenue Bus Stop for Routes E2, E3 & S41 on east side of West Virginia Avenue south of New York Avenue (looking north)

Figure 8: New York Avenue NE Corridor Bus Stop Photos F-G. (Source: Google Maps Street View)

are not currently warranted. However, the New York Avenue Corridor will eventually be redeveloped with an additional mix of uses and densities along the corridor. These future developments would drive the potential for regular bus service, as well as limited stop services, connecting downtown, the Fort Lincoln neighborhood, and Maryland.

Bus Stop Locations

The bus stop on New York Avenue NE near Fenwick Street NE is shown as Stop A on Figure 5. A picture of the stop is shown on Figure 6. The stop has a shelter, bench, and route information. This stop also provides a lay-by area adjacent to New York Avenue NE that allows buses to pull over from the eastbound New York Avenue NE traffic stream to drop off and pick up passengers. The remaining stops located adjacent to New York Avenue NE are shown in Figures 7 and 8 and depict a range of amenities from signs to shelters with route information and benches.

Existing Bicycle and Trail Opportunities

The following section is an evaluation of the opportunities to develop multi-use trails and improve existing pedestrian and bicycle access, connectivity, and conditions. The evaluation includes a review of the existing standards, coordination with mass transit operations, and potential usage from the different land uses within the assessment area.

Multi-Use Trail Standards

The DDOT Design and Engineering Manual (2009) specifies that shared use paths, or those that are designated as a path shared by cyclists, pedestrians, and other non-motorized users be physically separated, or buffered, from the roadway. These shared paths are designated as multi-use trails in this assessment. The standards are that they should have a minimum width of ten feet, with a buffer of five feet where possible. If a horizontal buffer is not possible, the manual suggests the consideration of a vertical barrier to provide protection for trail users from the roadway. A minimum buffer of two feet is required from the edge of the path to vertical obstructions such as trees, utility poles, and fences.

The Guide for the Development of Bicycle Facilities also recommends a minimum width of ten feet. It should be noted that a width of eight feet is acceptable for short distances where a wider path is not possible (AASHTO, 1999). The guide also suggests a minimum of two feet of buffer space on each side of the trail.

Multi-Use trail recommendations discussed in this assessment should be assumed to meet the DDOT and AASHTO standards and guidelines, except where noted otherwise.

Overall Corridor Evaluation

Roadway, Bicycle and Pedestrian Accommodations

New York Avenue NE is entirely contained within the District of Columbia, from North Capitol Street NE to the eastern edge of the District, where the roadway becomes John Hanson Highway through the state of Maryland. New York Avenue NE is a six-lane highway that is a signed and numbered route (Route 50) on the US Highway system. Portions of the highway are divided by raised medians (concrete and brick) or twin yellow stripes.

Generally, there is a continuous concrete sidewalk along the south side of New York Avenue NE, while the north side has some sections of sidewalk, located mostly within the eastern portion of the study area. Sidewalks are generally narrow (less than six feet wide) but in good repair, however, there are locations where sidewalks have been displaced by tree roots or other causes. This creates a challenging situation for persons with disabilities, parents pushing strollers, or others with mobility limitations. In addition, some portions of New York Avenue NE have extensive commercial and industrial use, resulting in many driveways that pedestrians must cross.

There are currently no dedicated bicycle facilities along the corridor, although bicyclists have been observed riding on the sidewalk and occasionally in one of the travel lanes. The Metropolitan Branch Trail intersects the corridor at its western edge, and there are planned on-road bicycle facilities in the NoMa neighborhood, also on the western edge of the study area. In addition, many bicyclists use the internal road network at the National Arboretum for recreation and exercise, but the majority of those people currently drive to the Arboretum with their bikes loaded on racks. The planned Anacostia Riverfront Trail will run to the east of the study area and is currently under construction.

Transit

Currently, transit service is provided by Washington Metropolitan Area Transit Agency (WMATA) Metro. The New York Avenue/Florida Avenue/Gallaudet U Metro Station is located close to the western project limit of Florida Avenue NE. There are several Metrobus stops along the corridor that are described in more detail in the Transit Existing Conditions section.

Land Use

Much of the corridor is bounded on the north by rail lines and the Union Station rail yard. This rail activity essentially impedes access to and from destinations to the north of New York Avenue NE along the corridor, with the exception of a few connections at Brentwood Parkway NE, Michigan Avenue NE, and South Dakota Avenue NE. Most of the direct connections to New York Avenue NE are from the neighborhoods and businesses on the south side of the corridor.

Florida Avenue NE to New York Avenue Bridge NE

Roadway and Pedestrian Accommodations

In this section of the corridor, New York Avenue NE is a six-lane divided roadway with a brick or concrete median. There are continuous sidewalks along both sides of New York Avenue NE from Florida Avenue NE to the eastern terminus of the bridge. Both sidewalks are relatively narrow (six feet maximum) and are not buffered from the roadway, except on the bridge, where a concrete median with railing provides a buffer from traffic. In addition, the sidewalk sections on the bridge are protected on the outmost side with a curving fence to prevent pedestrians from falling over the side of the bridge. It should be noted that this bridge over the Amtrak rail lines is currently being replaced using American Reinvestment and Recovery Act (ARRA) funding, and the proposed design essentially replicates the existing lane and sidewalk configuration. Because construction is underway now, there is no opportunity to alter the current designs for the bridge.

Land Use

The land use in this area is primarily the Amtrak and WMATA rail yards and tracks. Most of the surrounding land in this section is undeveloped. The Metropolitan Branch Trail runs parallel to the WMATA tracks on the west side and then runs below New York Avenue NE and continues south towards downtown.

New York Avenue Bridge NE to Penn Street NE

Roadway and Pedestrian Accommodations

New York Avenue NE is a six-lane roadway in this section of the corridor. It is divided only by a double yellow line. There is a seventh lane (eastbound) to the east of the bridge, but it only exists for a few hundred yards, ending at Penn Street NE. The sidewalks on both sides of New York Avenue NE terminate at the edge of the bridge. There are worn paths that begin on both sides at the end of the sidewalk, which indicates pedestrian usage along the corridor.

Land Use

The Amtrak tracks turn east and run parallel to New York Avenue NE north of the bridge. Much of the land north of New York Avenue NE is largely undeveloped. A personal storage warehouse is located just east of the bridge on the south side of New York Avenue NE.

Penn Street NE to Brentwood Parkway

Roadway and Pedestrian Accommodations

New York Avenue NE is a six-lane roadway divided by a double yellow line in this section of the assessment area. The sidewalk on the south side of New York Avenue NE begins again in this section near the west side of Penn Street NE. There is a small landscape strip with street trees that provides a buffer from the roadway. There is limited space between the street and the edges of adjacent buildings. The worn path observed in the previous section of this corridor on the north side of New York Avenue NE ends in this area.

Land Use

This section of New York Avenue NE includes several hotel properties and commercial businesses. Most are located on the south side of the corridor. Development opportunities on the north side continue to be limited due to the Amtrak tracks which parallel New York Avenue NE.

Brentwood Parkway NE to West Virginia Avenue NE/Montana Avenue NE

Roadway and Pedestrian Accommodations

New York Avenue NE is a six-lane roadway divided by a brick median in this section of the corridor. The sidewalk on the south side of New York Avenue NE continues through this section. There is a landscape buffer with street trees and limited clearance from building edges. A street tree buffer strip also exists on the north side of New York Avenue NE, but there is no accompanying sidewalk until east of 16th Street NE. The sidewalk in that area continues to the traffic circle at the intersection of West Virginia Ave NE and Montana Ave NE. The sidewalk is narrow and is often partially blocked with utility poles.

An inactive railroad bridge crosses the corridor just west of the West Virginia Avenue NE/Montana Avenue NE traffic circle but does not constrain the existing sidewalks on New York Avenue NE. While there is the potential to utilize the bridge as a trail connection to neighborhoods north and south of the New York Avenue Corridor, the bridge does not currently connect with any existing bicycle or pedestrian facilities that would provide access beyond the bridge. This potential connection should be re-evaluated as new development occurs along the corridor.

Land Use

This section of New York Avenue NE includes mostly commercial businesses along the south side. There are a minimal number of driveways for pedestrians to cross, with the exception of a large gas station at the western corner of the traffic circle that has four large driveway entrances. A series of parking lots run along most of the north side of this section. One lot is used as overflow parking for a nightclub. The others appear to be used for storage of equipment, trailers, and supplies related to the railroad tracks. The sidewalk begins on the north side of New York Avenue NE, alongside a hotel at 16th Street NE.

West Virginia Avenue NE/Montana Avenue NE to the National Arboretum Property

Roadway and Pedestrian Accommodations

New York Avenue NE is a six-lane roadway divided by a brick median in this section of the corridor. Sidewalks are present on both sides of the corridor from West Virginia Avenue NE to Bladensburg Road NE. There are intermittent street tree planting strips and buffers from the roadway. Sidewalks continue along until east of the intersection with Bladensburg Road NE, ending at the first few properties.

East of Bladensburg Road NE, New York Avenue NE becomes a limited access freeway. The speed limits increase to 45 MPH. A frontage road on the south side of the corridor provides access to the New York Avenue NE entrance to the National Arboretum. East of the Arboretum, a slip lane provides access to the Washington Times property.

Land Use

This section of New York Avenue NE includes mostly commercial businesses along both sides of the corridor. Several

businesses have multiple access driveways. To the east of Bladensburg Road NE, a large portion of the south frontage is occupied solely by the National Arboretum. There is a small residential neighborhood on the western border of the Arboretum. The north side of New York Avenue NE in this area is occupied by a large hotel and several warehouses.

Table 4: Soils Group Classifications (USDA, 1986)

HSG Soils Group	Soil Texture	Infiltration Rate (inches per hour)
A	Sand, loamy sand or sandy loam	Greater than 0.30
B	Silt loam or loam	0.15 to 0.30
C	Sandy clay loam	0.05 to 0.15
D	Clay loam, silt clay loam, sandy clay, silty clay or clay	Less than 0.05

Green Infrastructure Site Opportunities

The location of green infrastructure elements is dependent on many factors, including the built and the natural environment. Built environment constraints include, but are not limited to, physical elements such as buildings, structures, parking, utilities, roads, zoning, building codes, political and neighborhood concerns, construction and road standards, property boundaries, and land use restrictions (easements). Urban soil areas are typically highly disturbed because of past and present development. Natural areas that are not disturbed in urban areas were often not able to be developed because of physical limitations, (e.g. ground water, poor soils, slopes, etc.) or they were prescribed as park land or other restricted uses. The most constraining physical features for green infrastructure strategies and techniques are typically soils conditions and hydrology, or drainage. This is because green infrastructure is based on replicating natural hydrology functions, which is dependent on the ability of soils to absorb water and the drainage patterns to the facilities.

Soils

The following is a description of the soils characteristics and their implications for the implementation of green infrastructure in the assessment area. LID landscape practices can be classified as those that filter or infiltrate, or as hybrid devices that have both functions. For a system such as a bioretention cell or permeable pavement to function as an infiltration device, the soils must have the capability to absorb the excess water that is not absorbed by the media or the plants. Soils with high sand content generally have the capacity to absorb excess runoff. Soils with a high clay or silt content, urban compacted soils, high groundwater, and shallow depth to bedrock are conditions that limit the ability for an LID practice to be used as an infiltration device. Some infiltration may occur in these areas, especially in smaller and more frequently occurring storm events, but it is important to have underdrains in the LID facilities so that they do not become inundated for long periods of time after storm events that have high volumes of runoff. Long-term inundation will affect the health of the plant materials for vegetated practices and will not allow other practices to manage or filter subsequent rainfall events.

The soils along the New York Avenue Corridor are representative of most of the highly developed areas of the city. The soil types in the study area are shown in Figure 9. Due to the highly disturbed nature of the area, the soils map should be used as a general guide for planning purposes. Field investigations are required to determine the potential for infiltration practices because of the extreme level of variability of disturbance on each site.

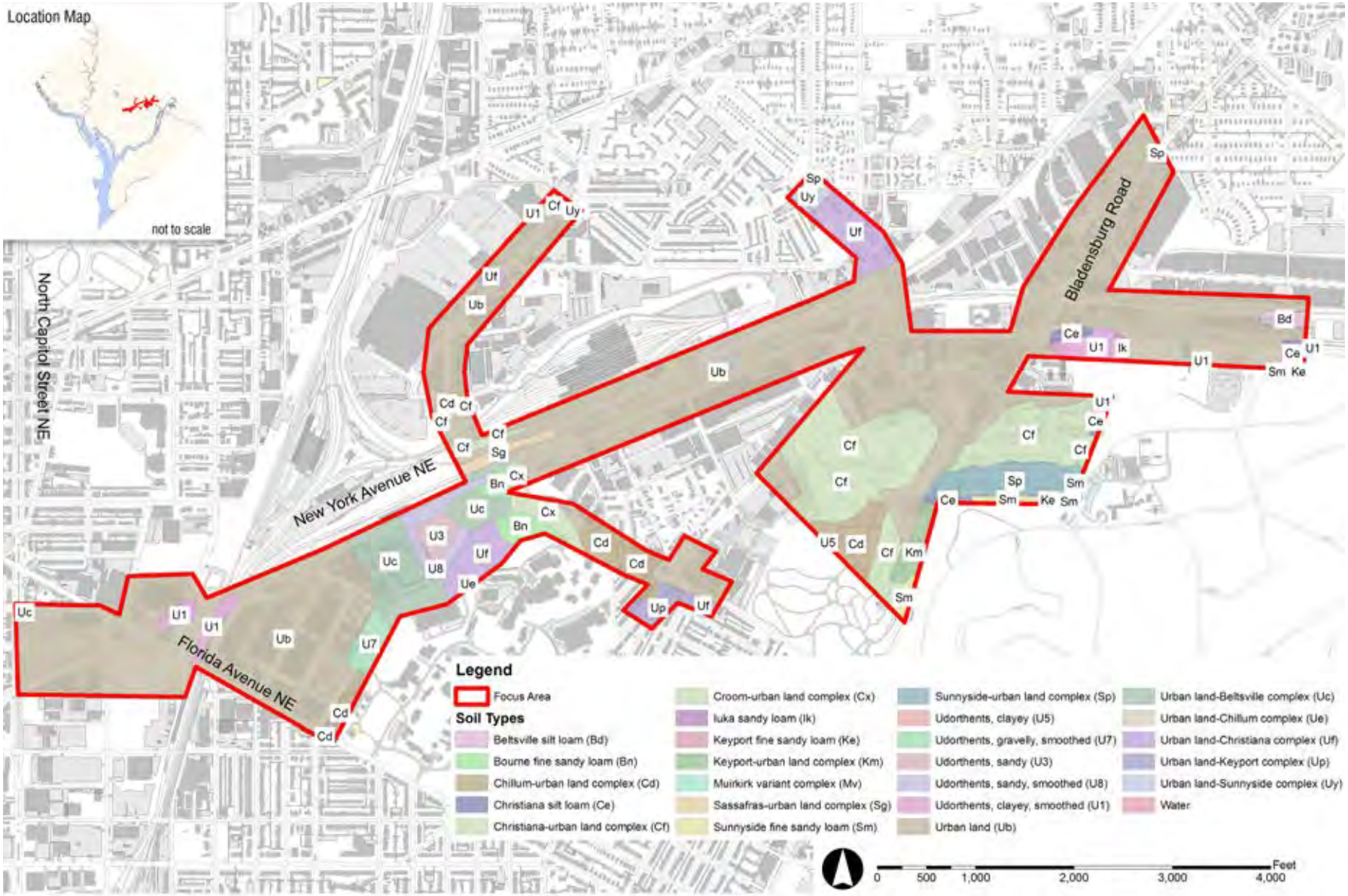

Figure 9: Soils Map. (Source: LID Center, USDA)

The ability of a soil to infiltrate stormwater is based on the Hydraulic Soils Group (HSG) classification (USDA, 1986). Each soil type in the District is categorized as HSG A, B, C, or D. HSG A has the highest infiltration and rate of water transmission potential and HSG D has the lowest. Factors such as high water tables also contribute. Table 4 is a classification summary of the drainage characteristics of different soil groups. The predominant soils type is Urban Land (Ub) or Urban Land Complex (eg. Uc, Ue, Uf, etc.), which still has recognizable characteristics of the natural soils. This soils type comprises approximately 45 percent of the study area. Urban lands are areas where there is over 80 percent coverage by impervious areas, such as parking, buildings, and roads. Thorough investigations of the soils properties are required in these areas because of the disturbed nature of the soils, which may include significant compaction and fill. Generally, these areas have poor potential for infiltration.

Approximately 20 percent of the study area is comprised of urban disturbed soils. These soils may have some of the natural drainage and engineering properties intact, but due to the areas being developed and graded, further investigation is required. Approximately 10 percent of the soils in the study area are classified as HSG B. These soils do have potential for infiltration, but more detailed studies are required due the variability in site conditions. Approximately 10 percent of the area is composed of Udorthents, or urban fill soils. These soils can contain significant percentages of trash and debris and are often highly compacted. Detailed studies of these areas are required to determine the infiltration capacity, but they are typically very restrictive.

The remainder of the soils in the area are urban land complexes that contain a significant percentage, generally over 15 percent, of undisturbed soils. These areas have been highly developed with housing, commercial, office, and warehouse/ industrial uses. The undisturbed areas are typically open or green spaces that were not developed due to physical or land use restrictions. Physical restrictions include, but are not limited to, steep slopes and high groundwater. Land use restrictions include, but are not limited to, setbacks and green space requirements. Most of these soils are classified as HSG C. These soils have marginal infiltration potential and will require a detailed soils investigation due to the amount of disturbance. Less than 10 percent of the soils are urban land complexes that are classified as HSG B.

The soils report shows that there is only limited potential for infiltration or reduction of stormwater runoff volume and rate in the corridor from larger storm events through the use of landscape practices. There is the potential to infiltrate runoff from smaller more frequently occurring storm events, but volume reduction would have to be achieved through the use of cisterns or other building techniques. The landscape practices would primarily function as peak flow reduction devices during large storm events. The reduction in runoff volume and rate would be a function of the amount of storage, or size, of the facility and the outlet structure in the facility. There are some limited areas of soils that have the potential for infiltration, but further field investigations are required.

Drainage and Stormwater

The study area drains to both the Combined Sewer System (CSS) and the Municipal Separate Storm Sewer System (MS4). The CSS receives stormwater runoff and sewage from streets and private property and conveys them to the Blue Plains wastewater treatment plant. During large rainfall events the plant and drainage system may not be able to handle the amount of runoff and the system overflows into the streets, properties, and the Anacostia River. The untreated sewage in the runoff can cause serious health and environmental problems and economic damage. The CSS system is managed by DC Water. The approach to reduce the volume of runoff is contained in the Long Term Control Plan (LTCP) through the use of underground storage tunnels and

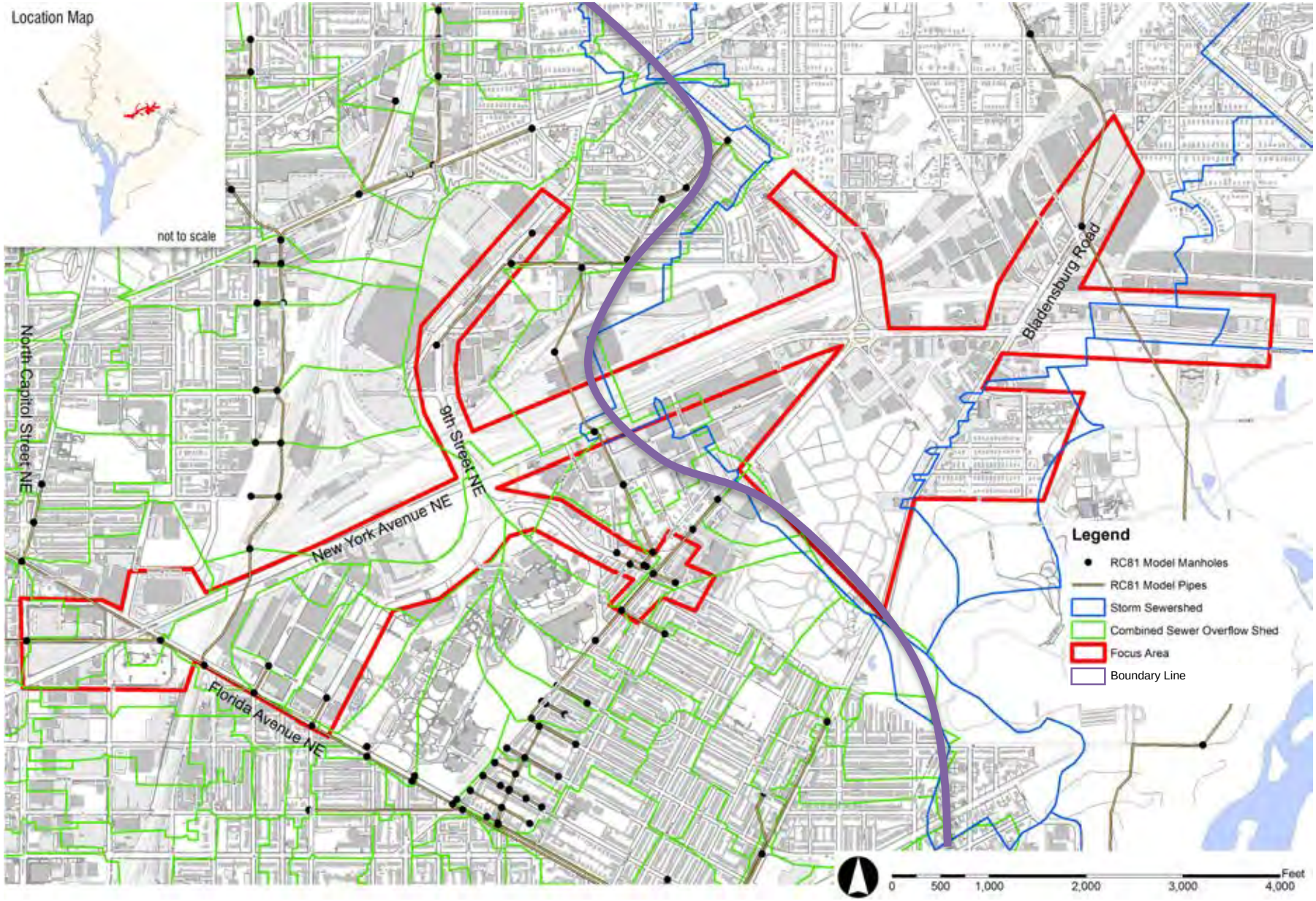

Figure 10: Overall Map Showing Combined Sewer Overflows and Separate Sewer Overflow Areas for Stormwater Analysis. (Source: LID Center & DC GIS)

LID and green infrastructure techniques.

The MS4 system is managed by the District Department of the Environment (DDOE). This system discharges stormwater to the Anacostia River and is regulated by a National Pollution Discharge Elimination System (NPDES) permit. The permit requires that new construction for roads and site development incorporate Best Management Practices (BMPs) to filter and reduce pollution from runoff from impervious surfaces, such as roads, roofs, sidewalks, and parking lots. This includes trash, metals and oils from automobiles, sediment, nitrogen from airborne deposition and lawns, and other pollutants that are typically found in stormwater runoff.

The division between the CSS and the MS4 crosses New York Avenue NE between the 9th Street NE overpass and Montana Avenue NE. It runs at approximately a 30 degree angle to the south roughly along Fenwick Street NE and then parallel to Mount Olivet Road NE through the middle of the Mount Olivet Cemetery. The line to the north runs through the rail yard to near the intersection of 17th Street NE and Montana Avenue NE. The area to the south of the line, towards downtown, is in the CSS area. It includes the Brentwood Road NE portion of the study area. The area to the east and north is in the MS4. Figure 10 is a composite of maps showing the combined sewer (CSS) and separate sewer (MS4) systems.

The hydrology and hydraulics of the CSS have been well-studied by DC Water and there is significant information on the performance and capacity of the system to convey stormwater flows to Blue Plains. There is a large trunk line that runs down Florida Avenue NE. The trunk line is served by several smaller branches. The largest ones within the study area come from the rail yard to the north of New York Avenue NE, from West Virginia Avenue NE north of Florida Avenue NE and up to Brentwood Road NE, and from Bladensburg Road NE north of Florida Avenue NE.

The system has been previously modeled and calibrated through monitoring at key intersections for the 100-year and the 15-year six-hour storm events. The drainage areas studied in the model are fairly large and the study points are generally located at the larger street intersections or at the bottom of drainage sub-sheds for larger land uses or clusters of development. Detailed hydrology and hydraulic studies will be required to look at individual sites or blocks. The modeling information can be used to make general or planning level determinations on the effectiveness of practices to reduce flows with those sub-sheds (USDA, 1986). The 100-year is modeled to predict the flows and overflows during large infrequent storm events. The 15-year storm was modeled for normal system capacity. This area was evaluated in The Green Build-out Model (Limnotech, Inc., 2007). The results generally showed a reduction of flows of approximately 10 to 15 percent with full implementation of green infrastructure techniques. The assumptions include different levels of implementation for public and private lands. These assumptions were used in the final analysis and planning phases of the project. DC Water provided additional modeling of the one-year and the two-year six-hour storm events for this study. The one-year and two-year storm volumes are frequently occurring storm events.

The current MS4 regulations require the management of the first one-half inch of runoff for water quality and, if the system capacity is adequate, detention of the 15-year 24-hour storm event. The current MS4 permit letter of agreement, dated August 1, 2008, specifies that the District will incorporate green infrastructure and LID into their stormwater programs for retrofits and new construction on private and public lands. For public roads, or DDOT construction projects, the water quality standard of the management of the first one-half inch of runoff is required. This can be provided in the right-of-way through the use of the Anacostia Waterfront Transportation Standards. The use of these

techniques will be incorporated into the final planning design. There are currently new stormwater standards for the District that are in the evaluation phase. The newly proposed standards will require the retention of approximately 1.2 to 1.4 inches of runoff. Since the adoption of these proposed regulations is unknown at the time of the study, they will not be explicitly included in the final analysis.

Relevant Studies and Reports

Relevant reports, plans, and studies were identified by DC agency staff and the project team. The studies were reviewed to evaluate if green infrastructure had been considered or applied. If the document did not include specific green infrastructure or multi-modal transportation recommendations the project team reviewed the existing language for opportunities to include green infrastructure and multi-modal transportation benefits.

Florida Avenue Market Study
The Florida Avenue Market Small Area Plan (FAM) was completed by the District Office of Planning in 2007 (Office of Planning, 2007). The purpose of the plan was to examine the existing infrastructure, economic vitality, and historic significance of the area in order to develop potential recommendations for redevelopment. The general guidelines in the plan include many LID techniques. There are opportunities within the general recommendations to enhance or reinforce the green infrastructure components. Listed below are some of the specific areas of the study that support green infrastructure and some potential interpretations of the plan that would reinforce the implementation of green infrastructure:

The "*Sustainability-How environmentally sustainable is the site?*" section includes statements on the District of Columbia's commitment to green technology. Due to the area's dense coverage of building and impervious surfaces, the study suggests that attention be paid to "high performance building design, energy efficiency, storm water management, air quality management, environmental noise reduction and the careful placement of sustainable, usable and attractive open space."

The study recommends connections be made to the Metropolitan Branch Trail and the development of multi-use trails in the corridor. This is consistent with the District of Columbia Bicycle Master Plan (District Department of Transportation, 2005).
In the Development Framework section, under Land Use and Development Recommendations, the study recommends that large shade trees and large tree boxes be used in the area to create a green canopy. The study also recommends that all streetscape designs require LID best management practices.

NoMa Vision Plan and Development Strategy
The NoMa Plan focuses on innovative planning, high performance building design, and building a sustainable neighborhood as integral parts of the vision for this small area plan (Office of Planning, 2006). The NoMa plan recommends using LID techniques to addresses stormwater management, energy efficiency, and to help improve air quality. The study also recommends the use of Leadership in Energy and Environmental Design (LEED™) as a guide for new construction projects to help develop the area as a "Green Zone." Many LID techniques, such as rainwater capture and reuse, green roofs, and bioretention can be used to satisfy LEED™ rating requirements.

NoMa Streetscape Matrix Guidelines
The NoMa Streetscape Guidelines provide recommendations on street widths, trees, furniture, and construction methods for the streetscapes within the NoMa area (Office of Planning, 2009). These recommendations are used by DDOT, the Office of Planning, and the development community to insure consistency in the design and construction of vehicular, pedestrian, and

bicycle circulation. No specific LID features or locations are highlighted within this document. Areas for tree boxes, street parking, and walkways could incorporate LID techniques.

NoMa Public Space and Water Management Study

This study provides general recommendations for the implementation of BMPs (Office of Planning, 2011). The BMPs are categorized by applicability for specific land uses, potential effectiveness, potential areas for incorporation, potential costs, community and environmental benefits, and the recommended scale of implementation.

New York Avenue Corridor Study

The New York Avenue Study (NYAS) was completed in 2006 (District Department of Transportation, 2006). The study proposes six different zoning changes along New York Avenue NE from Bladensburg Road NE to North Capitol Street NE. The environmental sections of the report state that the transportation improvements and land use changes will potentially increase the amount of impervious surfaces in the corridor through the construction of lane widening. The study also states that trees may have to be removed to accommodate construction. The study does not address specific approaches to mitigate the stormwater effects of these changes.

Table 5: Hickey Run Restoration Inventory (Anacostia River Watershed Restoration Plan)

Map ID	Site Location Name	Ownership	General Description of Proposed Actions
4	Maintenance yard in National Arboretum off of Azalea Lane NE, Washington, DC	Public	LID Bioretention
13	1716 17th Street NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
17	1940 Montana Avenue NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
40	Tomkins Builders, 2220 25th Place NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter
41	Christ Apostolic Church, 2130 24th Place NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter
42	Transit Employees Federal Credit Union, 2000 Bladensburg Road NE, Washington, DC	Public	LID Bioretention, LID Rain Garden
44	1816 Adams Street NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
45	Edwin Street NE / Lawrence Avenue NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
56	U-Haul Moving Supplies, 1750 Bladensburg Road NE, Washington, DC	Private	LID Bioretention
57	Yellow Cab Company, 1636 Bladensburg Road NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter
58	Parkway Plaza Apartments, 1835-1855 22nd Street NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter, LID Rain Garden
59	Budget Motor Inn, 1615 New York Avenue NE, Washington, DC	Private	LID Bioretention
60	Hess Gas Station, 1891 New York Avenue NE, Washington, DC	Public	LID Bioretention
61	1844 Bladensburg Road NE, Washington, DC	Public	LID Bioretention
63	Exxon Gas Station, 2230 New York Avenue NE, Washington, DC	Private	LID Bioretention
64	McDonald's Restaurant, 2228 New York Avenue NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter
66	Checkers, 2300 New York Avenue NE, Washington, DC	Private	LID Bioretention
69	Days Inn, 2600 New York Avenue NE, Washington, DC	Private	LID Bioretention, LID Tree Box Filter
70	CITGO Service Station, 2500 New York Avenue NE, Washington, DC	Private	LID Bioretention
73	2382 Bladensburg Road NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
74	2122 Queens Chapel Road NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage
77	2850 V Street NE, Washington, DC	Private	Sand Filter, Underground Pipe Storage

DC Green Jobs Final Report

This report identifies the potential for the creation of green collar jobs for construction and maintenance activities throughout the District of Columbia (Office of Planning, 2008). The criteria in the report can be used to help determine the economic impact of the construction and maintenance of LID techniques.

Anacostia River Watershed Restoration Plan-Hickey Run Restoration Inventory

This report is on potential stormwater management retrofit sites in the Hickey Run watershed (U.S. Army Corps of Engineers, 2009). A list of potential stormwater sites

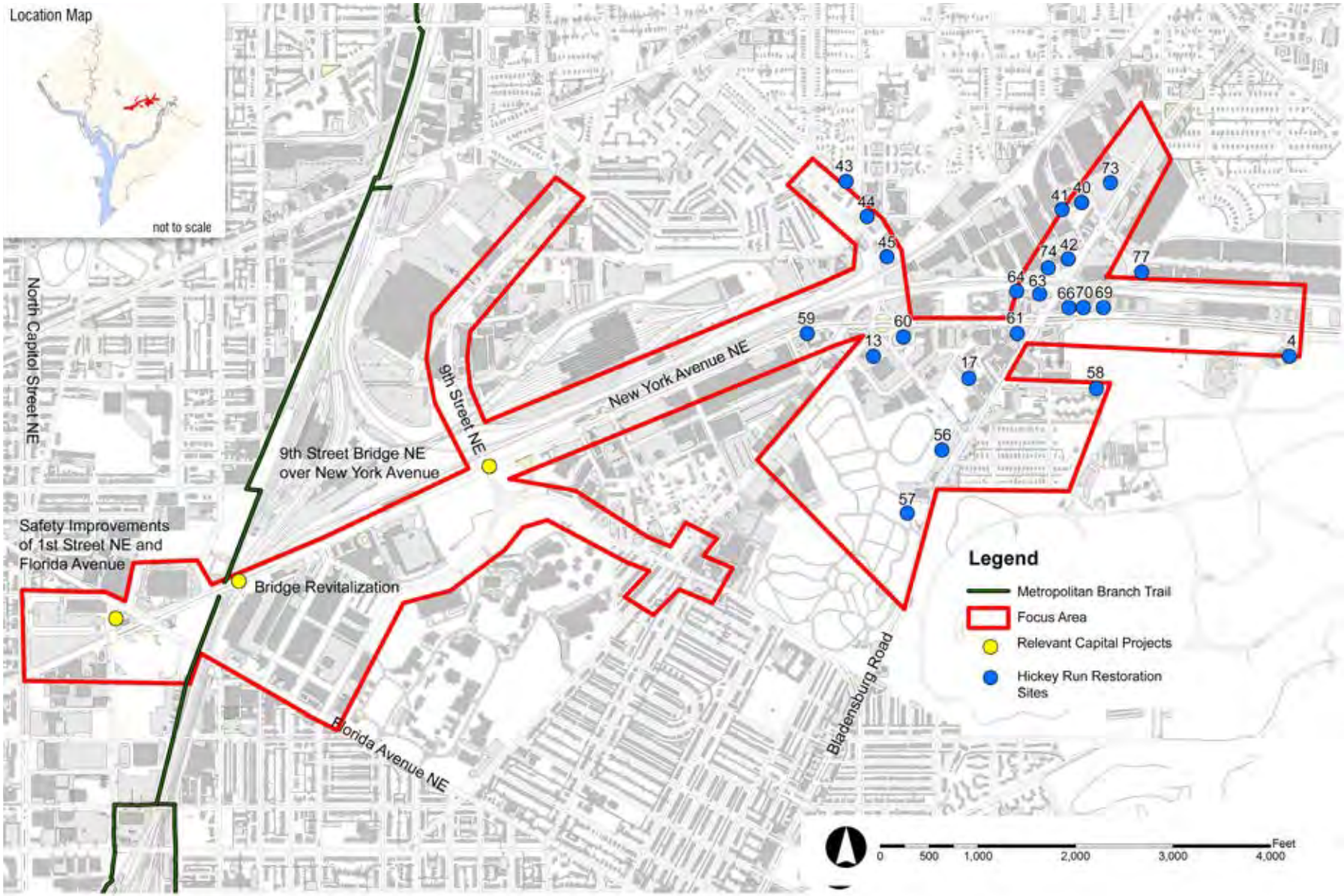

Figure 11: Relevant Capital Projects and Hickey Run Restoration Sites That Lie Within the Project Boundary. (Source: LID Center, DC GIS, and Anacostia River Watershed Restoration Plan-Hickey Run Restoration Inventory)

that lie within the project boundary are shown in Figure 11 and outlined in Table 5. The Hickey Run watershed is at the eastern boundary of the study area. The study includes and evaluation of the existing conditions and the potential stormwater benefits and costs of the retrofits.

District of Columbia Bicycle Master Plan
This plan includes overall recommendations on the location and construction of bicycle routes in the District of Columbia (District Department of Transportation, 2005). The plan identifies the New York Avenue Corridor as a potential bicycle trail connection route that can connect Mt. Vernon Square, which is to the west of the assessment area, with the National Arboretum and the Anacostia River Trail System, which are to the east of the study area. The plan also recommends bridge or ferry connections between the National Arboretum and Kenilworth Park. This would create additional connections to parks and other facilities in the Deanwood and Kingman Park neighborhoods, as well as the state of Maryland.

District of Columbia Pedestrian Master Plan
This plan identifies potential locations for walking trails within the corridor (District Department of Transportation, 2009). The plan identifies the section of New York Avenue from Pennsylvania Avenue NW in downtown to Penn Street NE as a major pedestrian thoroughfare. The plan recommends priority improvements, such as sidewalk repairs and widening, street crossing improvements, and signalization improvements. The plan proposes focusing improvements on the south sidewalk on New York Avenue NE in the section of plan overlap (from Florida Avenue NE to Penn Street NE).

Green Infrastructure Site Selection Criteria

Sustainable infrastructure development that is based on the TBL approach includes the consideration of social, aesthetic, economic, human health, and other environmental benefits. The project team developed criteria for ranking and prioritization of projects based on these principles. The criteria are quantitative, qualitative, or a combination of both. The criteria were developed as 19 metrics that were then grouped into 5 categories:

- Project Parameters - These factors evaluate the implementation as public sector projects and those that can have immediate impact to reduce CSOs.
- Social Function - These factors promote overall community and sustainable planning goals.
- Human Health - These factors focus on localized air quality benefits and the reduction of heat island effects.
- Environmental Function - These are focused on hydrologic function and other benefits, such as carbon footprint reduction.
- Economic Function - These factors are considerations for green jobs, avoidance of potential stormwater cleanup costs, and the potential impact on property values.

The following are detailed descriptions of each category and metric that is used to rank and prioritize potential projects.

Project Parameters

This category includes criteria on the ease and time required for implementation. The GIS system and information from DC Water was used to develop the baseline conditions for the evaluation.

CSS Boundary
Proposed projects are reviewed to determine whether or not they are based within or outside the CSS system. Location is important not only for the potential of funding through the Long Term Control Plan, but also due to the serious health and property impacts of CSOs.

DC Government Ownership
Project locations on DC government

property, such as road right-of-ways, maintenance facilities, schools, and parks are important because of the long timeframes and coordination issues with constructing projects on private properties.

Project Timeline
The project timeline is determined by the consideration of the typical timeframe required to implement a project based on the type of construction activity, location, and land use.

Social Benefits Criteria

These criteria help determine how the project can meet the objectives of the overall master plan, any local area plans or studies, or sustainability goals. These criteria were developed from the review of the existing planning documents and studies, as well as site visits.

Green Reference Point
This criterion is qualitative in nature and refers to areas that create a reference point or signature that is identifiable to the community or the visitor, or areas that act as either a foundation or demonstration, that can be a model for the area.

Neighborhood Connectivity
Neighborhood connectivity is a qualitative benefit and refers to a project's ability to promote walking, biking, and use of transit and to create or link spaces. Projects are ranked in terms of their ability to provide connectivity and to support pedestrians and multi-modal transportation options. Parameters include the presence/absence of bike facilities, lanes, location of nearby trails, the walking distance to bus stops, the presence/absence of shelters at bus stops, and headway. Projects are ranked as either having a low, medium, or high ability to provide neighborhood connectivity.

Plan Conformance
The final metric evaluated under social benefits involves whether or not a project conforms to existing master plan/ area recommendations or helps with neighborhood or area improvements.

Human Health Criteria

Green infrastructure results in positive effects on human health through improving air quality and reducing the urban heat island (UHI) effect at the local level. These criteria were developed from literature on green infrastructure health benefits.

Improved Air Quality
Trees and vegetation improve air quality by filtering airborne pollutants such as particulate matter and ozone. Likewise, reduced energy consumption results in decreased emissions from power generation facilities. These air quality improvements can reduce the incidence and severity of respiratory illness. Changes in ambient air quality due to green infrastructure techniques that increase the number of trees and similar vegetation can be evaluated using standard models (US Forest Service's UFORE model) that take into account local conditions. Based on information from these models, corresponding avoided health effects due to increased vegetation and the economic value of the avoided health effects can be determined.

Avoidable air pollution-related health effects that can be quantified include

- premature mortality;
- onset of irreversible chronic bronchitis;
- heart attacks;
- hospital admissions (non-fatal) for respiratory and cardiovascular conditions;
- emergency room visits for asthma;
- respiratory symptoms (days of illness); and
- work loss days and school absence.

In Philadelphia, on average, every tree planted as part of Philadelphia's green infrastructure strategy would result in avoided health effects of $32.32 per year, at full tree maturation [i.e., benefits increase to $32.32 per year, on average, as the tree matures over time] (Stratus

Table 6: Selection Criteria for Assessing Identified New York Avenue Green Infrastructure Projects

○ -low/short
◐ -medium
● -high/long
✓ -yes
⊗ -no
NA -not applicable

Proposed Project	Project Parameters			Social Function			Human Health		Environmental Function							Economic Function			
	Within CSO (Y/N)	DC Government Property (Y/N)	Project Timeline (S/M/Ln)	Green Reference (L/M/H)	Neighborhood Connectivity (L/M/H)	Conformance with Master Plan/ Area Rec.s (Y/N)	Improved Air Quality (L/M/H)	Heat Stress Reduction (L/M/H)	Links ROW to Private Property (Y/N/NA)	Site Suitability (L/M/H)	Volume Reduction Benefit (L/M/H)	Peak Flow Attenuate (L/M/H)	Groundwater Recharge (L/M/H)	Water Quality & Ecological Benefit (L/M/H)	Carbon Footprint Reduction (L/M/H)	Local Green Jobs (Y/N)	Avoided Stormwater Treatment Costs (L/M/H)	Increased Property Values (Y/N)	Overall Rating (L/M/H)
Bus Stop A	⊗	✓	○	◐	●	✓	○	○	✓	●	○	○	○	○	○	⊗	○	✓	○
Bus Stop B	⊗	✓	○	◐	●	✓	○	○	✓	◐	○	○	○	○	○	⊗	○	✓	○
Bus Stop C	⊗	✓	◐	◐	●	✓	○	○	✓	◐	○	○	○	○	○	⊗	○	✓	◐
Bus Stop D	⊗	✓	◐	◐	●	✓	○	○	✓	●	○	○	○	○	○	⊗	○	✓	◐
Bus Stop E	✓	✓	●	◐	●	✓	○	○	✓	●	○	○	○	○	○	⊗	○	✓	◐
Bus Stop F	✓	✓	◐	◐	●	✓	○	○	✓	●	○	○	○	○	○	⊗	○	✓	◐
Bus Stop G	✓	✓	○	◐	●	✓	○	○	✓	◐	○	○	○	○	○	⊗	○	✓	○
Multi-use trail, south side of New York Avenue NE	⊗	✓	◐	◐	●	✓	●	○	NA	●	○	○	○	◐	●	✓	◐	✓	◐
Multi-use trail connection - proposed New York Ave NE multi-use trail & Metropolitan Branch Trail	⊗	⊗	◐	◐	●	✓	●	○	NA	◐	○	○	○	◐	●	✓	○	✓	◐
Multi-use trail,Florida Avenue NE to New York Avenue Bridge NE	⊗	✓	◐	◐	●	✓	●		NA	●	○	○	○	NA	●	✓	NA	✓	○
Multi-use trail,New York Avenue Bridge NE to Penn Street NE	⊗	✓	◐	◐	●	✓	●	○	NA	●	○	○	○	○	●	✓	○	✓	◐
Multi-use trail, Penn Street NE to Brentwood Parkway NE	⊗	✓	◐	◐	●	✓	●		NA	●	○	○	○	○	●	✓	○	✓	○
Multi-use trail, Brentwood Pkwy NE to West Virginia Ave NE/ Montana Ave NE	⊗	✓	◐	◐	●	✓	●	◐	NA	●	○	○	○	◐	●	✓	○	✓	◐
Entrance to Florida Avenue Market off New York Avenue	⊗	✓	◐	◐	●	✓	○	○	✓	●	●	●	●	○	○	✓	○	✓	●
Montana Circle Bioretention	✓	✓	●	●	●	✓	◐	◐	NA	●	●	●	●	●	◐	✓	●	✓	●
Montana Circle Curb Cuts	✓	✓	◐	◐	●	✓	●	◐	✓	●	●	◐	◐	●	●	✓	●	✓	●
DC Property Yard at MontanaAvenue NE	✓	✓	◐	◐	◐	✓	●	◐	✓	●	●	●	●	●	◐	✓	●	✓	●
Mount Olivet Road and Capitol Avenue NE	⊗	✓	◐	◐	●	✓	◐	◐	✓	●	●	●	●	◐	◐	✓	◐	✓	●

Consulting, 2009). This estimate is based on a model specific to the mix of tree species in Philadelphia; however, benefits are expected to be relatively similar for the DC area.

Increased green space helps lower ambient temperatures. Green techniques that are incorporated on and around buildings helps shade and insulate buildings from wide temperature swings. This moderating effect decreases the energy needed for heating and cooling. Diverting stormwater from wastewater collection, conveyance and treatment systems also reduce the amount of energy needed to pump and treat the water. This results in reduction of emissions of greenhouse gases and other air pollutants (Stratus Consulting, 2009).

Heat Stress Reduction

Trees, green roofs, and bioretention areas create shade. This reduces the amount of heat-absorbing materials, such as pavements and roofs. The vegetated areas also emit water vapor which cools hot air and reduces the urban heat island effect. This helps to reduce heat stress-related fatalities and morbidity events during extreme heat waves. Reduction in heat stress-related fatalities due to increased urban vegetation has been modeled at the citywide level in Philadelphia by using standard methods developed and applied for relevant federal agencies (Stratus Consulting, 2009). In Philadelphia, it was found that, over a 40-year analysis period, implementation of green infrastructure to treat runoff from 50 percent of impervious area would result in a reduction in 196 heat-related fatalities. Based on EPA estimates, this would result in $1.1 billion in present value benefits. Due to model uncertainties, the relatively small scale of the individual projects, and insufficient data, it is not feasible to directly quantify the benefits of improved air quality and reduced urban heat stress associated with implementation of the New York Avenue Green Infrastructure Assessment. However, it is evident that, together, these projects will result in improved human health conditions. Individual projects can be ranked in terms of the human health benefits they will provide based on number of trees planted, or total green area.

Table 7: Regional Trail Ridership (DDOT, Arlington County)

Trail	Approximate Annual Ridership
Capital Cresent	2,163,000
Metropolitan Branch Trail	365,000
Arlington Memorial Bridge (near Mt. Vernon Trail)	1,081,000
Custis Trail	2,543,000

Environmental Function Criteria

Seven criteria are used to evaluate a project's environmental benefit. The first six evaluate projects based on their potential stormwater function, while the latter one focuses on carbon reductions. These criteria were developed from the existing local studies and reports and national data on ecosystem function and values.

Links ROW to Private Property for Public Road Construction Projects

Most of the runoff from private properties in the study area drains to the combined or the separate sewer system that runs within the public right-of-way. The right-of-way typically consists of the travel lanes, including adjacent sidewalk and tree box areas, up to the building frontage. Stormwater management for private projects is typically managed within the property boundaries. Facilities may be located within the DDOT right-of-way behind the curb, if there is a maintenance agreement in place. This must be evaluated on an individual project basis, as this policy is currently under review.

The width of the right-of-way varies

according to the neighborhood or classification of the roadway. In older neighborhoods or areas, sidewalks may or may not be present and there may be mature trees that would preclude any significant physical alteration of the area behind the curb line. Existing underground utilities also may restrict the ability to locate facilities in these areas.

Site Suitability

Site suitability refers to the physical conditions that affect the potential of the site to accommodate the green infrastructure practices. The numerous factors that influence or affect the ability of a project to include green infrastructure in urban redevelopment areas are highly variable. An extensive checklist was developed for each site or project. The checklist was developed concurrently with the site selection and ranking so that it reflects the specific conditions in the watershed. Listed below are some of the representative key factors that influence site suitability:

- Soils conditions - Soils with high clay content generally have poor infiltration and structural capacity.
- Subsurface conditions - Sites may be brownfields, which would restrict infiltration because of contamination issues. Infiltration areas may need linings or barriers when they are located near building foundations.
- Surface drainage - Drainage patterns and the drainage area will influence the location of the practices. LID practices are distributed controls that manage small drainage areas. They should not be located in areas where they can be overwhelmed by the volume of runoff.
- Vegetation - Mature street trees may physically restrict construction near the street edge for tree boxes or bump-outs. Property owners may "claim" ownership of them.
- Maintenance of traffic - Construction that occurs in or adjacent to the right-of-way may be disruptive to the neighborhood for extensive periods of time.
- Utilities - Underground utilities may restrict subsurface construction or be too expensive to relocate.
- Parking and access - Features such as curb bump-outs may reduce parking areas.

Stormwater

The site selection criteria for stormwater effectiveness is based on criteria for volume reduction, peak flow reduction, and water quality and ecological benefits. Pollution from stormwater can be generated from runoff from impervious areas (e.g. roads, roofs, parking lots, etc.) and pervious surfaces (e.g. lawns, landscaping, ball fields). The pollution can be treated through the use of filtering devices called Best Management Practices (BMPs) or through the reduction of runoff volume through infiltration into the soil or by the capture and use of rainwater.

Current regulations require the filtering of the first one-half inch of runoff from impervious areas. That translates to approximately 1,800 cubic feet (c.f.) per acre, or an area roughly one foot deep and about 42 feet square. This first one-half inch washes off a significant amount of the pollutant load. This is required for DDOT projects and all other private and public sector construction. In most cases detention of runoff to reduce the peak flows from storm events is also required on private and public projects outside of the street right-of-way. This is done to preserve or restore the capacity of the drainage system. The proposed new stormwater standards would require storage and infiltration of approximately the first 1.2 inches of runoff, or slightly less than the treatment of 2.2 times the water quality volume. An analysis of different development scenarios with new regulations applied to the projects showed minimal increases in costs for the new requirements. This is partially because the current regulations already require an extensive amount of storage for the existing detention requirements (Industrial Economics, 2010).

This analysis used the current stormwater management standard for DDOT projects that requires the treatment of one-half inch of runoff from impervious areas as the basis for site selection. This is because the majority of the projects are related to street retrofit construction or improvements that are associated with redevelopment. A more detailed analysis, one that would include the routing of the flows, would be required to size the facilities beyond a planning level analysis. Private projects, such as the police vehicle maintenance yard, would require a more extensive hydrologic analysis and larger storage volume requirements if it was to be built as a new site.

Priority was given to areas that could treat large amounts of impervious surfaces or where techniques could be used to reduce some of the volume of runoff. Some of the management techniques, such as bioretention, do have some benefit in reducing peak stormwater flows and stormwater runoff volume, particularly in small frequently occurring storm events. This is because the soil media in the bioretention areas can absorb water and make it available for plant uptake, slow infiltration into the poor soils in the project area, or evaporation can occur.

Volume Reduction Benefit
The ability of specific techniques to reduce runoff water volume is a key indication of their effectiveness in protecting stream health. This metric evaluates each project's ability to respond to rainfall and return rain to the ground and to the atmosphere under a low intensity storm event.

Peak Flow Reduction
Reducing peak flows, along with the total volume of runoff, reduces downstream impacts as well as initial capital costs, and the operation and maintenance costs of flood control infrastructure.

Water Quality and Ecological Benefit
A core objective of green infrastructure projects is to improve water quality and aquatic ecosystems in the local area. Green infrastructure techniques infiltrate runoff close to its source and help prevent pollutants from being transported to nearby surface waters. Once runoff is infiltrated into soils, plants and microbes can naturally filter and break down many common pollutants found in stormwater. In addition, green infrastructure limits the frequency of sewer overflow events by reducing runoff volumes and by delaying stormwater discharges.

Studies have shown that people are willing to pay to improve water quality and aquatic ecosystems. These improvements result in some level of "nonuse" benefit which, in this case, stems from the inherent value that individuals place on water quality and habitat improvements. A frequently discussed basis for nonuse value is the desire to maintain the functioning of specific ecosystems. Examples of this include King and Mazzotta's 2005 publication, "Ecosystem Valuation," available at www.ecosystemvaluation.org, and the Harpman et al. 1994 publication entitled, "Nonuse Economic Value: Emerging Policy Analysis Tool."

Willingness to pay for green infrastructure and LID programs that improve water quality and enhance aquatic ecosystems can be significant. For example, a study conducted by Stratus Consulting for the City of Philadelphia, entitled "A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds," estimated that Philadelphia residents would be willing to pay about $10 to $16 per household per year for improvements in water quality and aquatic ecosystems that would be achieved by using green infrastructure techniques to treating runoff from 50 percent of impervious area in the city. Over the 40-year analysis period for this study, the total estimated citywide value of this benefit amounted to $330 million (Stratus Consulting, 2009).

Due to insufficient data and the relatively small improvement in overall water quality that will result from each green

infrastructure project in the New York Avenue Corridor, this benefit will not be quantified in monetary terms. However, individual projects can be ranked based on their potential for improving water quality and aquatic ecosystems (e.g., based on amount of stormwater treated, proximity to sensitive water bodies, etc.).

Energy Savings and Carbon Footprint Reduction

As noted in the discussion on human health, green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling. Diverting stormwater from wastewater collection, conveyance, and treatment systems also reduces the amount of energy needed to pump and treat the water.

Reduced energy use, in turn, reduces emissions of greenhouse gases, including carbon dioxide (CO2), from power plants. Increased carbon sequestration due to added vegetation also results in a lower carbon footprint. In addition, projects that encourage the use of alternative transportation (e.g., bicycles) or public transportation reduce CO2 emissions from vehicles to the extent that individuals use the trails in lieu of using their cars to commute to places within the city.

Various studies have estimated the energy savings associated with reduced heating and cooling due to shading from trees and insulation from green roofs, including USDA 2007's publication, "Assessing Urban Forest Effects and Values" (http://nrs.fs.fed.us/pubs/rb/rb_nrs007.pdf) and Doshi's 2005 report for the City of Toronto entitled "Environmental Benefits and Costs of Green Roof Technology". Findings from these studies can be adapted to individual green infrastructure projects. In addition, engineering estimates or water treatment plant data can provide information on avoided energy costs associated with reduced stormwater treatment. The value of these savings can be determined based on current energy prices.

Changes in CO2 emissions associated with reduced energy use can be determined based on average CO2 emission factors for a city, state, or region's electricity sector. The amount of carbon sequestered by trees, vegetated bioretention areas, and other green infrastructure techniques can also be estimated based on existing research. For example, the USDA's UFORE model estimates the CO2 storage capacity for many species of trees. In 2007, the United Kingdom's Department of Environment, Food and Rural Affairs (DEFRA) provided an estimate of 4.9 metric tons (MT) of CO2 sequestered per 1,000 square meters of green area, per year.

Savings in CO2 emissions can be valued using a "social cost of carbon" calculation. The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present. Estimates on the social cost of carbon range from $3 to $95 per MT CO2. The often-cited Stern Review on the Economics of Climate Change estimates a social cost of carbon at $85 per MT CO2 (Stern, 2006).

According to data from the USEPA, the District of Columbia is currently in nonattainment for ozone pollution as well as fine particles in the air (http://www.epa.gov/oaqps001/greenbk/ancl.html). Trails provide opportunities for residents and visitors to travel by bicycle or foot, reducing the number of motor vehicle trips. Since a motor vehicle uses approximately 500 gallons of gas per year and produces an average of 5.5 metric tons of greenhouse gas emissions per year, shifting even a modest number of trips from cars to foot or bicycle would be beneficial in reducing both energy consumption as well as the District's carbon footprint. In addition, a trail along New York Avenue NE may allow many community residents to reach their destinations more quickly by bicycle due to the chronic traffic congestion along the roadway in the morning and evening rush

hours.

Projects that encourage biking or walking, such as multi-use trail projects, can also improve air quality to the extent that individuals use the trails in lieu of using their cars to commute to places within the city. Many of the proposed multi-use trail projects involve improving upon existing trails, or entail alternating between the existing sidewalk and a portion of the current roadway. Thus the number of new commuter trips on the trails is difficult to determine. However, improved aesthetics will likely encourage some additional use of the trail for commuting and recreation, resulting in additional human health benefits. Because the trails are located mostly beside or along the roadway, the number of people using the trail for pleasure will not likely be significant.

According to a 2008 traffic study by the District of Columbia Department of Transportation, this section of the New York Avenue Corridor carries between 52 and 86 thousand motor vehicles per day. Extrapolated over a year, this equates to between 19 million and 31.4 million vehicle trips per year.

Building a trail along the corridor has the potential to shift some of those trips from motor vehicles to bicycles. Citywide, the average bicycle mode share for all trips is 1.5 percent, and the share of commute trips (trips to/from work) is 3.3 percent. Therefore, an assumption can be made that at least 1 percent of all trips along the corridor could shift to biking, resulting in trail ridership rates of between 190,000 and 314,000 per year. This translates to a potential greenhouse gas emission reduction of between 87 and 114 metric tons per year, assuming a trail of approximately one mile.

These ridership figures are well within the range of ridership rates for other trails in the DC metropolitan area. As Table 7 reflects, the Metropolitan Branch Trail, which is a relatively new trail, carries approximately 365,000 bicyclists per year. The Custis Trail in Arlington County, which parallels Interstate 66, carries approximately 2.5 million bicyclists per year. If a trail along New York Avenue NE and US 50 were available to Maryland commuters, the

Table 8. Studies Estimating Property Value Increases Associated with LID/GI

Study	*Summary of study*	Estimate (% increase in value)
Ward et al. (2008)	Estimates effect of LID on adjacent properties relative to those farther away, in King County (Seattle), WA.	3.5–5.0%
Shultz and Schmitz (2008)	Proxies LID effects by looking at differentials for neighborhoods with clustered open spaces and greenways in Omaha, NE.	Greenways: 1.1–2.7%; clustered open space: 0.7–1.1%
McPherson et al. (2006)	References an uncited study that looks at the differentials between properties with ample trees vs. no trees or few trees.	3–7%
Wachter and Wong (2006)	Estimates the effect of tree plantings on property values for select neighborhoods in Philadelphia.	2% (intrinsic value of trees)
Anderson and Cordell (1988)	Uses sales data from Athens-Clarke County (GA) to estimate the value of trees on residential property. Looks at differences between houses with five or more front yard trees and those that have fewer.	3.5–4.5%
Braden and Johnston (2003)	Uses meta-analysis of studies to estimate several benefit categories related to on-site stormwater retention (green approach/LID) for managing stormwater.	0–5%
Lindsey, Man, Payton, and Dickson (2004)	Estimates the effect that trail vicinity has on home sales.	11%

ridership potential is significant.

Economic Function Criteria

Economic Benefit
Three criteria have been identified to evaluate economic benefit: the ability to create green jobs, the impact on stormwater treatment costs, and the impact on property values. These criteria were developed from the evaluation of the existing studies and reports and national data that is applicable to the project.

Local Green Jobs
Specialized labor is required for construction of conventional stormwater management solutions (e.g., boring, tunneling). Such skilled laborers might typically be already employed in the construction field. Green infrastructure creates the opportunity to hire local laborers, who might otherwise be unemployed, for landscaping and restoration activities. This benefit will apply to portions of the New York Avenue Green Infrastructure Assessment that will make use of local green infrastructure trained workers with minimal experience. To quantify this benefit and/or rank projects accordingly, it is necessary to evaluate the number of workers, length of employment, and project operation and maintenance requirements.

In addition to providing environmental benefits, investments in bicycle and pedestrian infrastructure have been shown to have significant employment benefits as well. A recent study (http://www.bikeleague.org/resources/reports/pdfs/baltimore_Dec20.pdf) of infrastructure investments in Baltimore, Maryland found that $1 million invested in bicycle and pedestrian infrastructure creates approximately 11-14 jobs, while $1 million invested in conventional road infrastructure creates just seven jobs (Garrett-Peltier, Heidi, 2010).

Avoided Stormwater Treatment Costs
Stormwater that will be infiltrated as a result of the project is currently collected and conveyed into the city's sewer system for treatment. Projects associated with the New York Avenue Green Infrastructure Assessment will therefore provide benefits in terms of avoided stormwater treatment costs. This benefit can be quantified using information on the amount of stormwater that will be infiltrated, as well as the current cost of treatment. Alternatively, projects will be ranked in this category based on the amount of stormwater treated.

Increased Community Aesthetics, Reflected in Higher Property Values
Trails, trees, and other vegetation improve urban aesthetics and community livability (e.g., by providing recreation opportunities, improved air quality, and other benefits), and studies show that residential property values are higher when these amenities are present. For example, many studies have indicated that the presence of a bike path or trail increases property values (Racca and Dhanju 2006).

More research is needed in quantifying the benefits of LID and trails; therefore, the pool of studies from which to choose is somewhat small. However, existing relevant literature suggests a range of benefits from green stormwater infrastructure, or LID, from zero percent to seven percent. This implies the average property value will also increase anywhere from zero percent to seven percent due to LID/green infrastructure additions to the surrounding landscape. Table 8 provides a summary of six studies on the effect of LID that would be applicable to projects implemented in the DC area, given their similar contexts. All six studies estimate a bundle of benefits associated with trees/LID/green stormwater management in general. As shown in Table 8, these studies generally estimate property value increases mostly range from two to five percent, with a midpoint of 3.5 percent.

Table 8 also provides examples of studies that show the impact of trails on nearby residential properties. Research has shown that trails can provide economic benefits in a variety of ways. For example, as shown in Table 8, a 2004 paper in the Journal of

Park and Recreation Administration (http://journals.sagamorepub.com/ebooks/jprabackissues/jpra223555/Article5.pdf) found that homes within ½ mile of a trail sold for an average of 11 percent more than similar homes located more than ½ mile from a trail. A 2006 study conducted by Racca and Dhanju found that the presence of a bike path within 50 meters of a property tended to increase values by about 4 percent.

In addition to increases in property values, trails can benefit local businesses. A study in Lodi, California found that investments in trail and streetscape improvements generated positive sales benefits for nearby retailers, as people tend to shop at more stores, spend more time per trip, and return to the area more often. Locally, many realtors are capitalizing on the proximity to the Metropolitan Branch Trail and it is featured prominently in the sales literature for commercial and residential properties near the trail.

While it is possible to assess increases in the value of residential properties affected by the proposed New York Avenue Corridor Assessment projects using the number of residential properties affected by each project and the average property value within the project area, this type of information is difficult to obtain without extensive spatial analysis and access to DC Assessor's data. Thus, this benefit will not be quantified given the scale of this research. However, qualitative information on the differences in property values by neighborhood or planned project can be used to compare projects. Projects can be compared not only based on which ones will provide the largest benefit (i.e., areas that currently have higher property values, and where a 3.5 percent increase would yield the highest benefit), but also based on where property value increases might be needed most (e.g., low-income neighborhoods).

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Phase Two: Recommendations

Introduction

Phase Two provides recommendations for implementation. The implementation strategy is based on the site selection criteria, potential funding, and implementation time frames that are described at the end of this section. Nineteen specific projects were selected for ranking and prioritization. General recommendations were not ranked according to the site criteria because these improvements may be more widespread or difficult to quantify. Table 6 is a list summary of the ranking and prioritization of the projects. Table 9 at the end of this section is a summary of the potential time frames for implementation of all of the recommendations. Each section provides a brief description of the category and the criteria that was applied to the selection of the project or strategy. There are four categories:

- *General Recommendations* - Suggestions that can be applied throughout the corridor.
- *Public Transportation* - Improvements to bus stop locations and design.
- *Multi-Use Trail* - Potential relocations, connections, and improvements to enhance safety and access.
- *Area-Specific Recommendations* - Recommended green infrastructure strategies and techniques for recognizable landmarks (e.g., intersections, community entrances, vistas, etc.), large land use areas, bus stops, trails, and specific properties and streets.

General Recommendations

General recommendations are those that can be applied almost "universally" throughout the assessment areas. These are green infrastructure strategies and techniques that enhance or promote bus and multi-use trail use. These can be applied as new construction projects, retrofits, or maintenance activities for public and/or private sector projects.

Public Road and Right-of-Way Options

The following are recommendations for the pavement areas or access driveways to public streets and alleys. These can be done as retrofit projects or they can be associated with new construction and development projects.

Limit Curb Cuts

New York Avenue NE has a significant number of curb cuts and accesses that can be consolidated or eliminated. While adequate curb cuts are important for commercial activity, the appropriate reduction of curb cuts and vehicular access can also enhance the image of the corridor without a detrimental effect on either commercial activity or traffic flow. This will also increase pedestrian and cyclist safety by decreasing vehicular conflicts. The reduction in pavement area for the driveway access to a site can be used to install bioretention areas to treat run-off from parking areas and commercial sites, such as gas stations. This new open space can be used to enhance the visual experience of driving through the corridor and can be used to provide street trees and other green elements. Future developments that consolidate multiple properties should reduce curb cuts along these properties without adversely effecting traffic flows on New York Avenue NE.

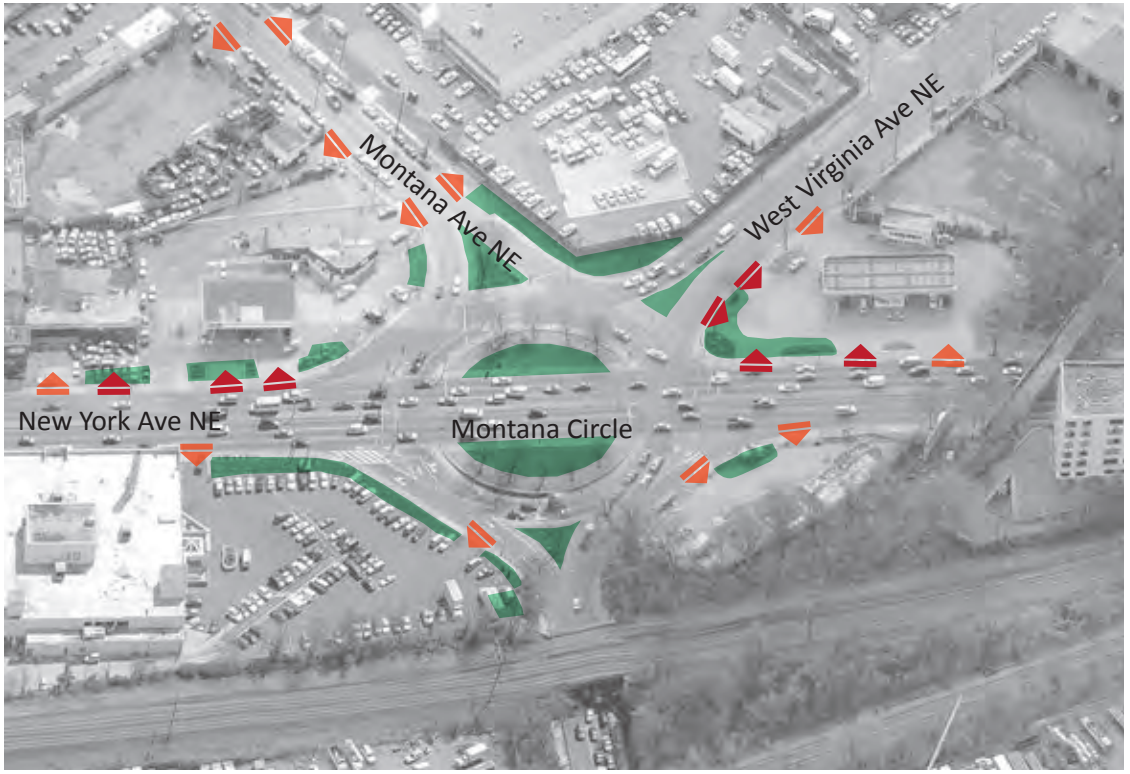


Figure 12: Curb Cuts at Montana Circle. (Source: Google Maps)

Curb Bump-outs

Curb bump-outs with bioretention cells can be used to intercept water that flows to the inlets at the intersections of the street. They also act as traffic calming devices and can be used to help provide green elements in the middle of blocks or long streets.

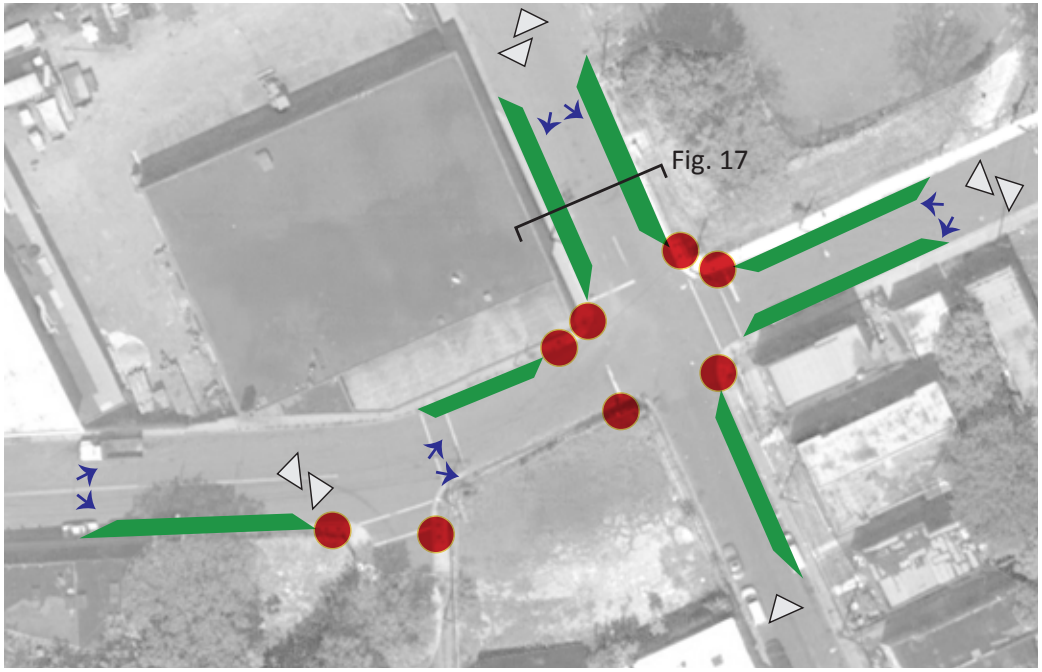


Figure 13: Location Plan for Typical Curb Bump-outs near Low Point of Roadway in Neighborhood. (Source: Google Maps)

Legend
- LID Bump-outs
- Direction of Water Flow
- Storm Drain Inlets
- Direction of Vehicular Traffic

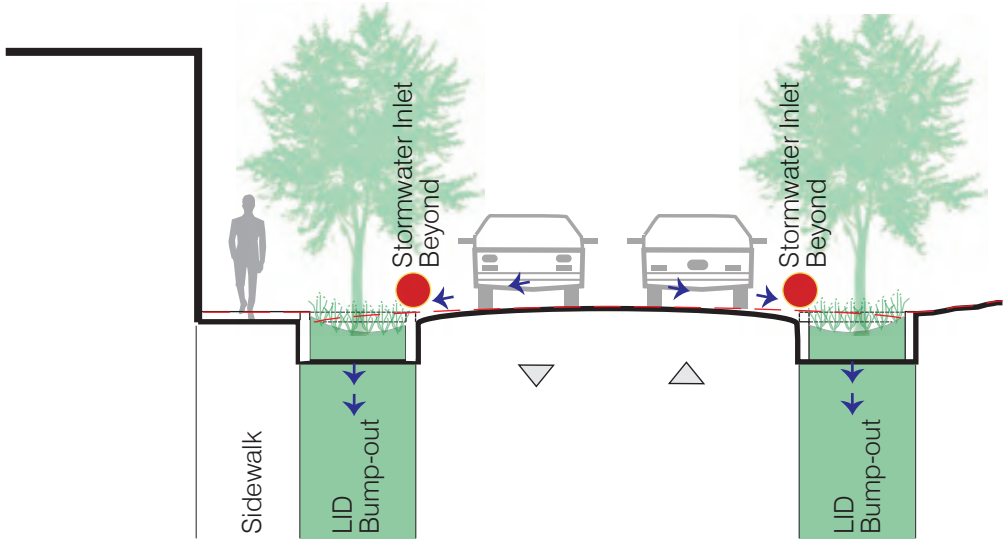


Figure 14: Typical Street Section: Curb Bump-out.

Figure 15: Bioretention Bump-outs. (Source: Portland Bureau of Environmental Services)

Green Alleys

Alleyways exist between most of the residential blocks and in between blocks of commercial properties. These areas can be retrofitted with permeable pavement surfaces to create green alleys. A green alley can collect stormwater runoff in the alley for infiltration, filtration, and detention. It can also be used to treat runoff from adjacent properties, if the storage capacity in the permeable area and the soils are sufficient to handle the additional flows. If the relative topographic grade of the street and alley allows, a green alley can even accommodate a portion of street runoff while removing pollutants associated with roadways.

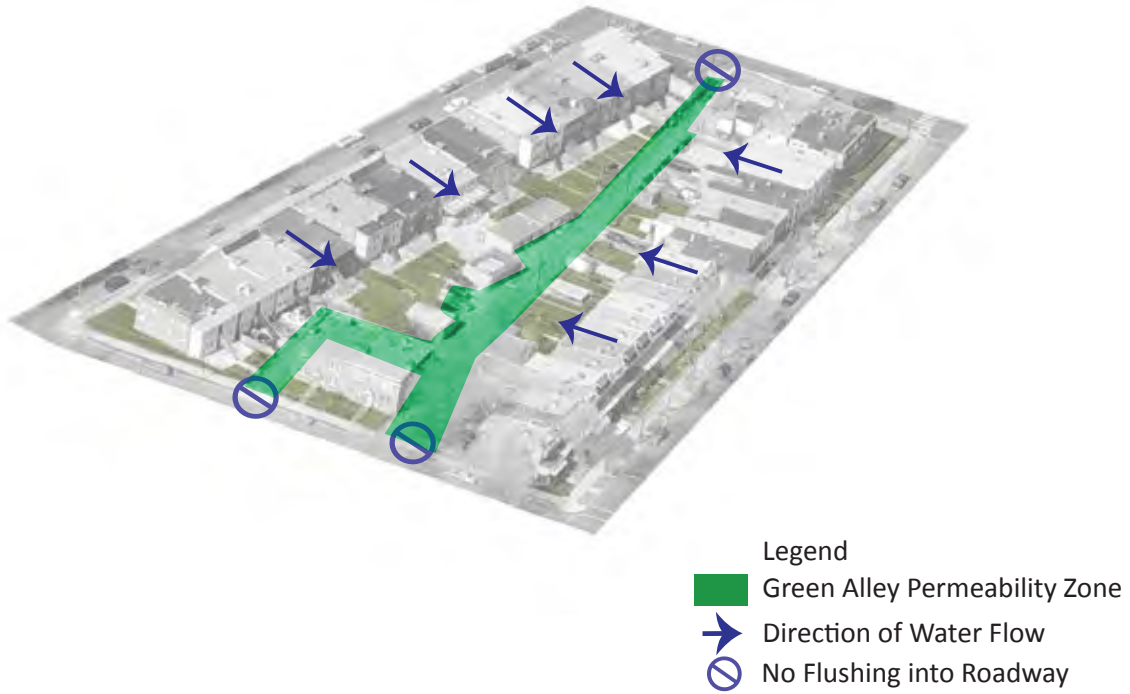


Figure 16: Typical Green Alley Hydrological Configuration.

Figure 17: Green Alley. (Source: City of Vancouver, Canada)

Figure 18: Pervious Pavers. (Source: DDOE RiverSmart Homes)

Green Alleys

DDOT is currently designing and constructing a series of green alley permeable pavement demonstration projects. The planning and design of the projects is being funded by the MS4 Stormwater Permit Enterprise Fund. The construction of the alleys is being funded under the American Resource Recovery Act through the Clean Water State Revolving Fund that is managed by USEPA. These projects could be applied in the residential areas adjacent to the corridor.

Figure 19: Concrete with Porous Asphalt Median. (Source: City of Chicago)

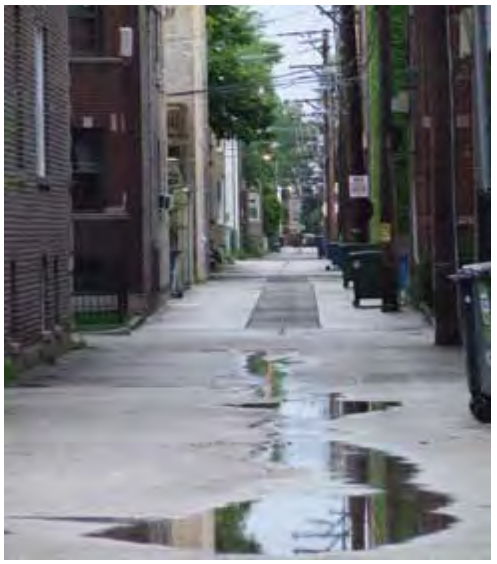


Figure 20: Foreground: Impervious Concrete Alley Background: Green Alley at left. (Source: City of Chicago)

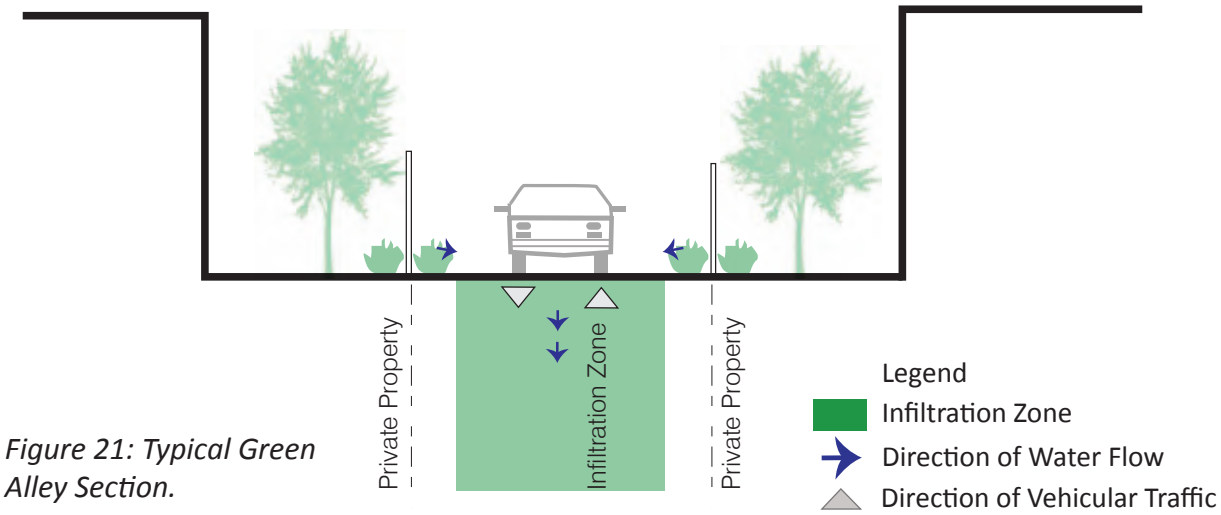


Figure 21: Typical Green Alley Section.

Figure 22: Structural Grass Paving. (Source: Heartstone, Inc.)

Private Property LID Options

There are numerous opportunities to implement green infrastructure on private property. It can be done as maintenance and repair activities, grants from the District and other funding sources, and through redevelopment activities. For example, the District Department of the Environment's District-wide RiverSmart Homes Program offers incentives to homeowners and businesses that are interested in reducing stormwater runoff from their properties through the use of green technologies. Current and previous funding has been provided for the planting or construction of four types of green technologies:

- Shade Trees
- Rain Barrels
- Pervious Pavers
- Rain Gardens

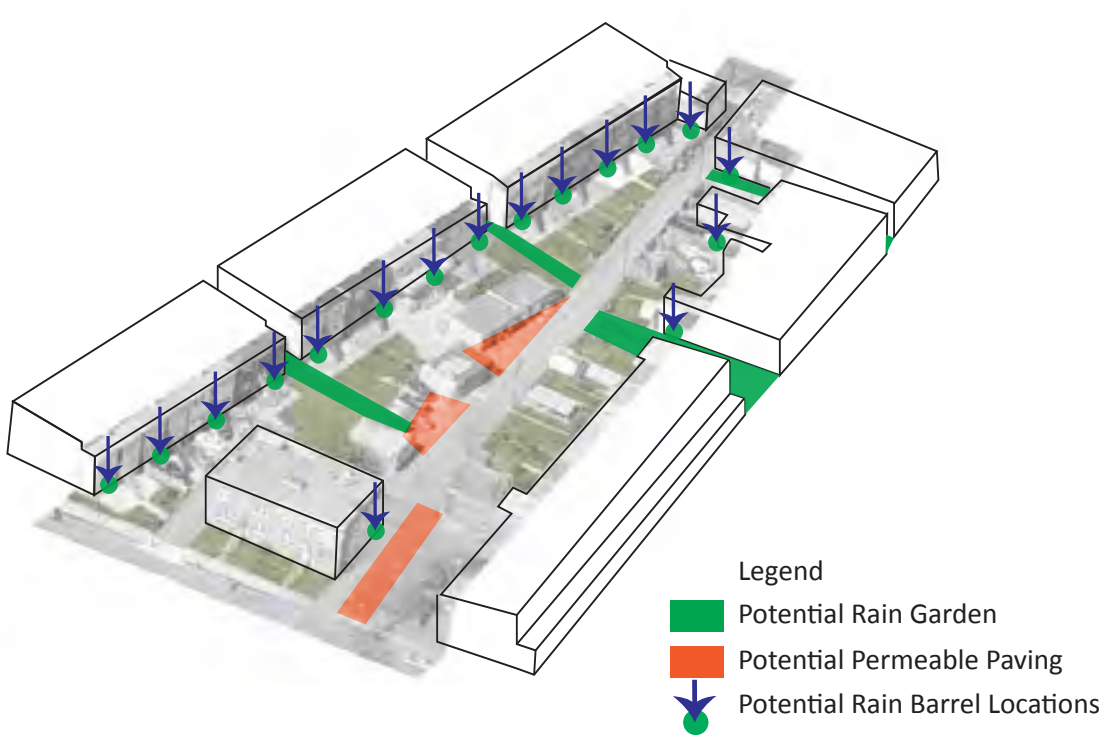


Figure 23: Potential Areas Outside the Alley Right-of-Way for Rain Harvesting and Infiltration.

Figure 24: Pervious Pavers/Rain Garden. (Source: DDOE RiverSmart Homes)

Figure 25: Rain Barrels. (Source: Central Minnesota Water Education Alliance)

Pavement and Parking

Parking lots, medians, and private property adjacent to the right-of-ways offer excellent potential for the installation of bioretention facilities around the perimeter of the parking area. At this time, private properties should manage their own stormwater without the use of the public right-of-way. This policy, however, is under review. Retrofitting existing parking lots and impervious surfaces may prove challenging in some cases in terms of complete redesign.

New developments have more flexibility in terms of integrated stormwater management. Stormwater BMPs should be required for new developments including perimeter bioswales, to provide continuity within the New York Avenue focus area.

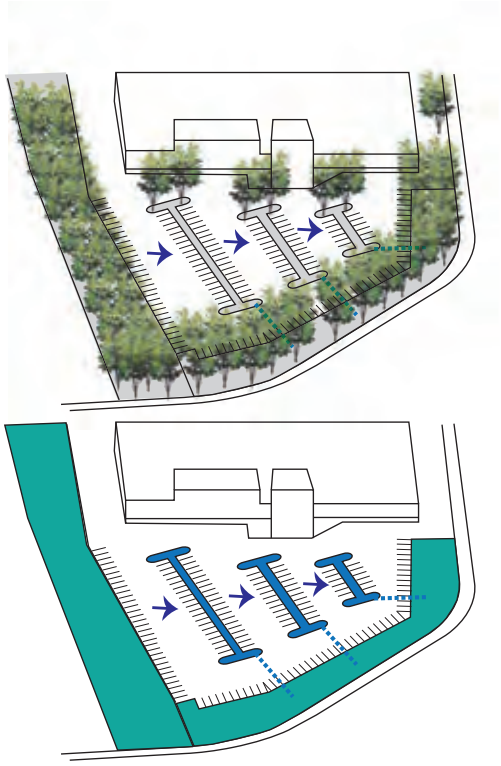


Figure 26: Right-of-way Adjacent Bioretention Area.

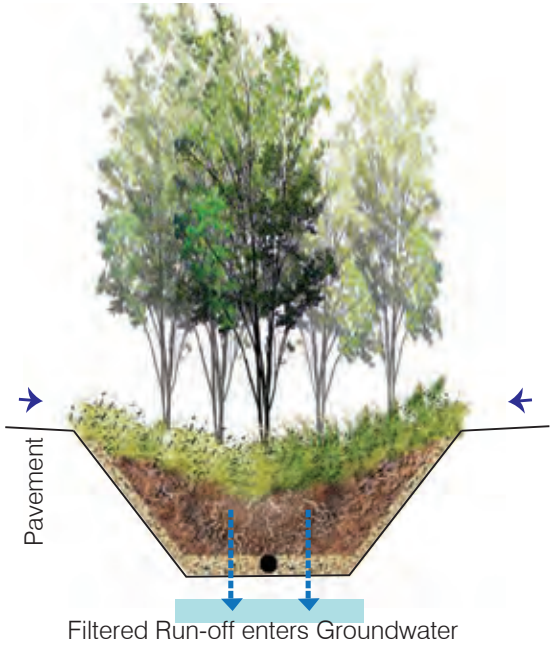


Figure 27: Bioretention Section.

Figure 28: Parking Lot with Bioretention in Prince George's County, MD. (Source: LID Center)

Landscape Amenities

The character of the New York Avenue NE focus area can be improved in many locations with the installation of landscape amenities. Bioretention areas have their own landscape character due to its location in the landscape, and the type and density of plant materials used. The visual impact of roadways and parking lots can be improved by updating or increasing street tree and tree box planting areas. Barren and eroded slopes that are next to roadways can be landscaped with native shrubs, grasses, and ground covers to reduce erosion. Evasive and non-native plantings can be replaced with reforestation projects. Unused parking lots or vacant lots can likewise be planted with native plants and trees as interim uses that can reduce runoff and heat island effects.

Figure 29: Capitol Hill Rain Garden. (Source: LID Center)

Figure 30: Constitution Square, Washington, DC (Source: www.sitefocus.com)

Figure 31: U.S. EPA Rain Garden. (Source: DDOE)

Landscape Identity

A significant portion of the New York Avenue NE Corridor is bounded by the rolling pastoral and wooded landscapes of the Mount Olivet Cemetery and the National Arboretum that are both located on the north east sides of the corridor. Drivers that enter from Maryland and the northwest are funneled into the New York Avenue NE Corridor under bridges and through the adjacent wooded hillsides. Trees can be planted in packed clusters or clumps within the bioretention areas of the corridor. The concentrated distribution of trees throughout the site will serve as a landscape identity unique for commercial areas in DC, and will serve the District in meeting its tree canopy goals.

Figure 32: National Arboretum. (Source: http://good-times.webshots.com)

Figure 33: National Arboretum. (Source: http://outdoors.webshots.com)

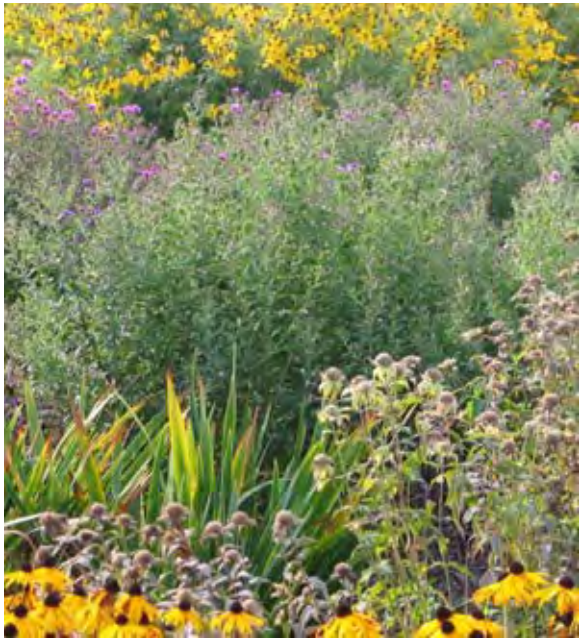


Figure 34: Bayscape Planting. (Source: DDOE RiverSmart Homes)

Signage and Branding

Commercial businesses rely heavily on signage to create distinct business messages and to attract customers. Signs on buildings and storefronts are the most common way of reflecting the commercial message to consumers. The business signs that will be constructed along New York Avenue NE will, to a large degree, shape the character of the area. Proposed signage should utilize sustainable energy sources and should be constructed of sustainable materials. For example, sign makers offer 100 percent recyclable alternatives to PVC banner material, offering signs that eliminate adhesives, and use water-based UV curable inks. The energy used to power signs should be offset either by built-in or on-site renewable sources. Digital Reflective Ink technology can also have a great impact for less energy used than some other methods of lighting signs.

Figure 35: Branding: Fresh Kills Park, NYC. (Source: New York City Dept of Parks and Recreation)

Figure 36: Wind and Solar Powered Billboard, Times Square. (Source: Ricoh Company, Ltd.)

Figure 37: DC USA, Washington, DC. (Source: http://dccondoloft.com)

Green Roof Implementation on large roof areas/Big Box Retail

Green roofs offer many benefits for buildings and the local environment. In addition to the stormwater functions of retaining rainfall from small storm events and filtering airborne pollutants in larger events, there are other energy, economic, social, and environmental benefits. This includes insulating and moderating building temperatures, removing carbon dioxide from the atmosphere, and cooling the environment through evapotranspirtation. Green roofs can also extend the life cycle of the roof membrane.

Reconsiderations should also be made about the sprawling typology of big box developments themselves. With the increasing cost of land acquisition, consolidation of multiple yet autonomous retail stores into a stacked mega-box or vertical power retail center can reduce the amount of land required by up to 80 percent. With several different types of these stores in the same place, greater cross-shopping can be anticipated. This increases profitability and offsets the amount of parking required. Because of its sheer size and presence, the mega-box has increased advertising potential beyond what one store could accomplish alone.

Figure 38: Green Roof: Department of Transportation HQ, Washington DC. (Source: DDOT)

DC USA—a local precedent—is the city's largest retail complex, and famed as a primary component in the revitalization of the Columbia Heights neighborhood. Adjacent to Columbia Heights Metro, the complex is marked by vertically stacked construction, showing the retail site as an excellent example of well-considered big box development. A one thousand space underground parking garage, paid for by the District, worked as an incentive to the developer to move a previously planned above-ground parking lot underground. However, due to the urban location, and proximity to transit, the 1,000 subgrade parking spaces proved to be an unnecessarily large quantity.

Figure 39: Green Roof: ASLA HQ, Washington DC. (Source: ASLA)

Figure 40: DC USA, Washington, DC. (Source: flickr.com)

Transportation Recommendations

Bus Stop Recommendations Synopsis

The bus stops within the New York Avenue Corridor were studied in order to determine how they may be modified or relocated to help facilitate use and to see whether the potential exists for implementing green strategies at these bus stops.

The design guidelines from WMATA/ DDOT do not permit intensive landscaping within the bus zones in order to allow for comfortable and safe access to and from the buses. The allowance of space that is available for LID installations would prove to be too small (assuming there are no alterations made to traffic lanes) to have a significant impact, given the volume of runoff and pollutants from the roadway and surrounding impervious areas. In order to accommodate this volume, a larger-scale, more comprehensive solution will be necessary to be considered effective.

There are physical improvements to the bus zones and bus stops that can improve and compliment the character of the corridor. Sustainable technologies such as green roofs could be installed on the shelters in order to intercept and manage the runoff. Photovoltaic solar cells could be installed on shelters in order to power improved visibility and accessibility at those bus stops which have shelters. Further recommendations for the specific bus stops are illustrated in pages 52-59.

Bus Stop A

1: Add photovoltaic solar cells on shelter.

2: Replace and re-grade existing concrete lay-by and install new standard granite curb. Painted ‘bus box’ graphic in lay-by.

3: Plant large four inch caliper hardy shade trees and understory shrubs in available planters.

4: Expanded planting of understory shrubs can occur along New York Avenue NE except where bus landing zones are required. WMATA requires a five by eight foot unobstructed Americans with Disabilities Act (ADA) landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

Figure 41: A: New York Avenue Bus Stop for Routes E2, E3, D1, D3 & D4 - Looking Southwest. (Source: Google Maps Street View)

Figure 42: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Photovoltaic Cells
- Vegetation
- Bus Lane Improvement

District of Columbia Office of Planning

Bus Stop B

1: Expand sidewalk to right-of-way, allowing pedestrians to move safely behind LID buffer.

2: Install narrow LID with bus landing zones at curb near North Capitol Street NW to filter runoff from sidewalk. WMATA requires a five by eight foot unobstructed ADA landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

3: Apply painted 'bus box' graphic in right turn lane.

4: Plant medium-sized two inch caliper hardy trees and understory shrubs in existing and new planters along North Capitol Street NW.

* The sidewalk dimension is not wide enough to accommodate a shelter in this location.

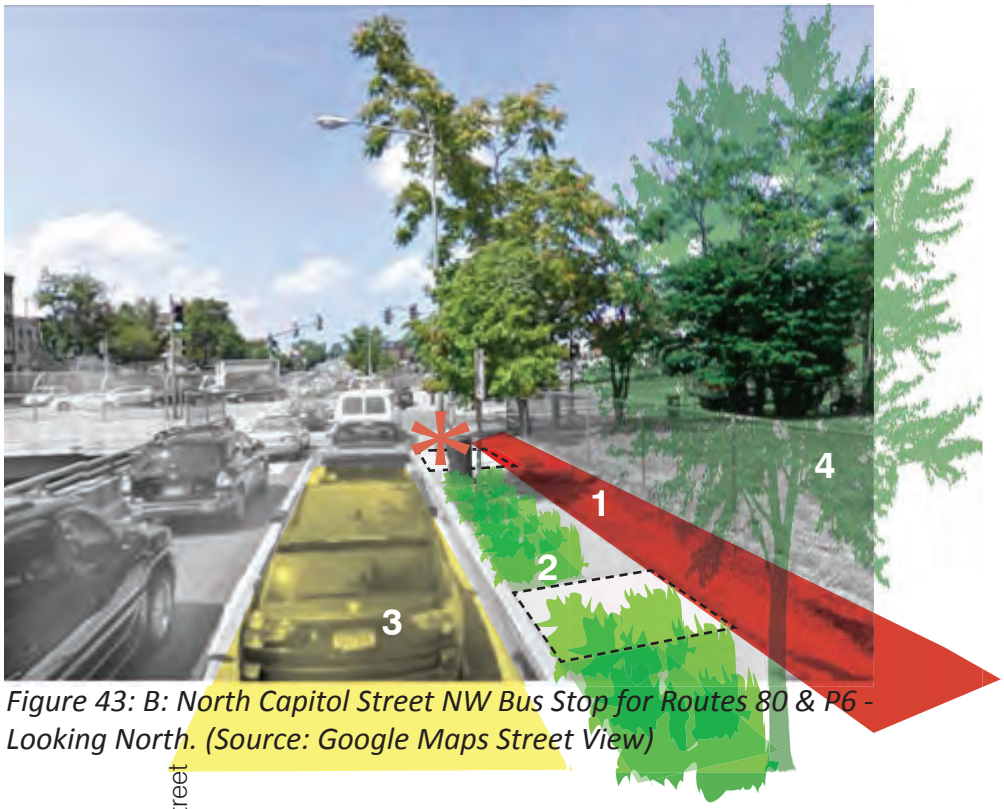


Figure 43: B: North Capitol Street NW Bus Stop for Routes 80 & P6 - Looking North. (Source: Google Maps Street View)

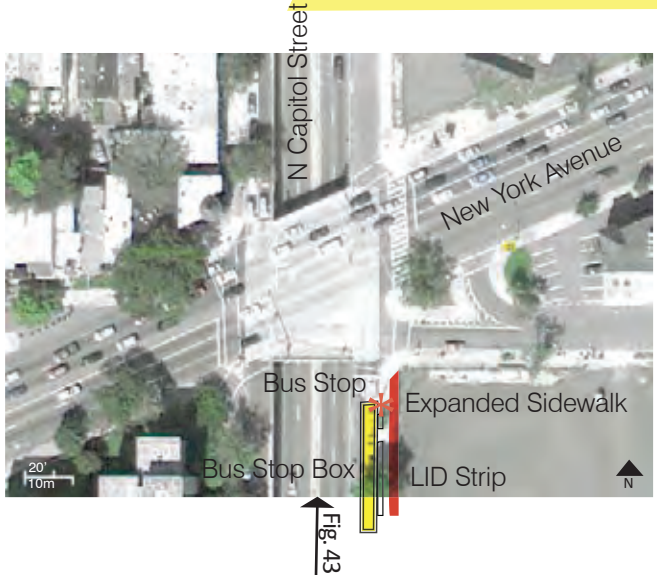


Figure 44: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Sidewalk Improvement
- Vegetation
- Bus Lane Improvement
- * Additional Note Regarding Bus Stops and Shelters

Bus Stop C

1: Apply painted ‘bus box’ graphic in right lane.

2: Plant large four inch caliper hardy shade trees and small shrubs in existing planters along North Capitol Street NW adjacent to bus zone. Planting must allow space for bus landing zones. WMATA requires a five by eight foot unobstructed ADA landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

* The sidewalk dimension is not wide enough to accommodate a shelter in this location.

Figure 45: C: North Capitol Street NW Bus Stop for Route 80 - Looking Southwest. (Source: Google Maps Street View)

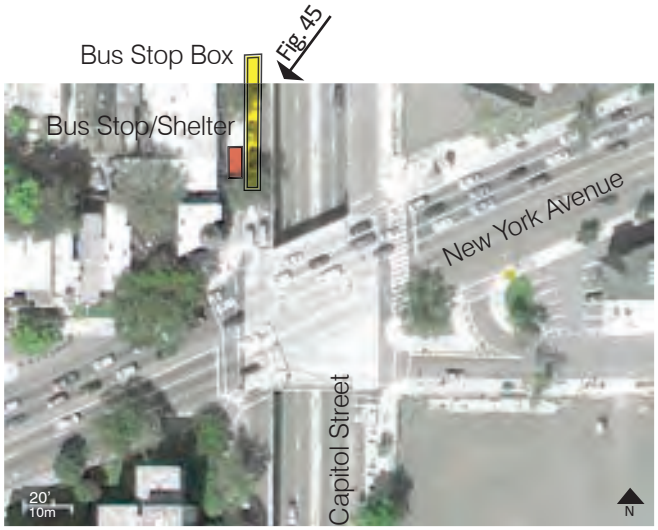


Figure 46: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Vegetation
- Bus Lane Improvement
- * Additional Note Regarding Bus Stops and Shelters

District of Columbia Office of Planning

Bus Stop D

1: Construct bump-out into parking lane to allow for shelter.

2: Plant large four inch hardy shade trees and understory shrubs in new planters along Fenwick Street NE adjacent to bus zone. Planting must allow space for bus landing zones. WMATA requires a five by eight foot unobstructed ADA landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

* Install shelter only if bump-out is constructed.

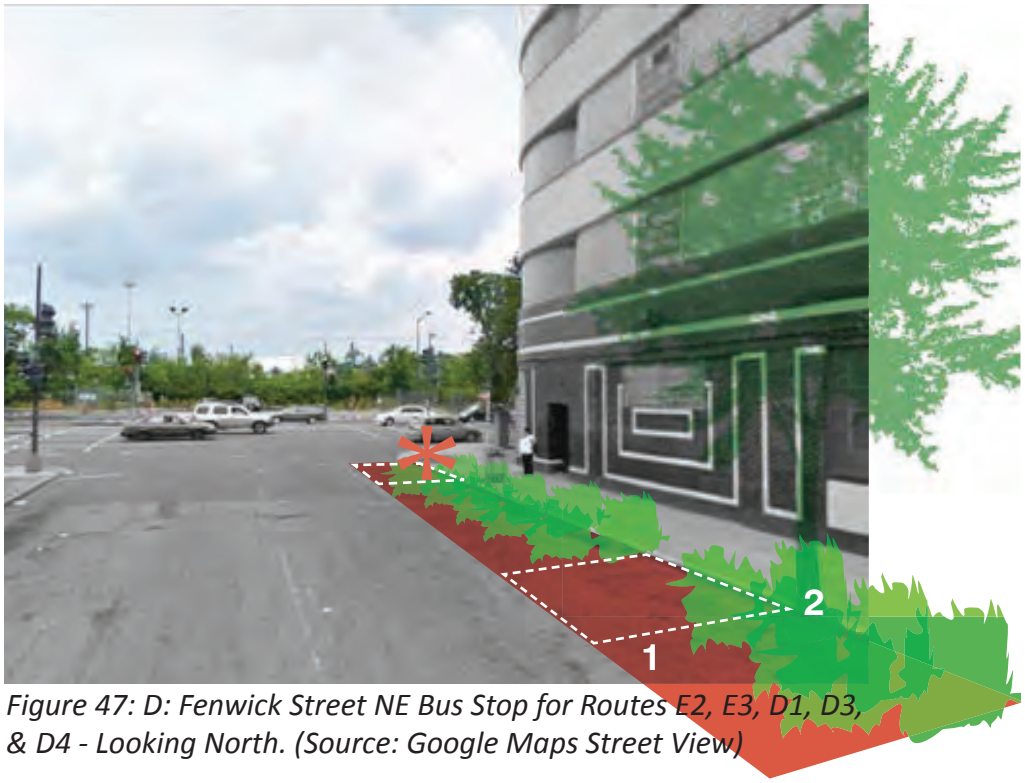


Figure 47: D: Fenwick Street NE Bus Stop for Routes E2, E3, D1, D3, & D4 - Looking North. (Source: Google Maps Street View)

Figure 48: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Sidewalk Improvement
- Vegetation
- * Additional Note Regarding Bus Stops and Shelters

Bus Stop E

1: Add photovoltaic solar cells on shelter roof to power shelter amenities (See page 54 for list of shelter amenities).

2: Apply painted 'bus box' graphic in right lane.

3: Plant large four inch hardy shade trees and small shrubs in new narrow planters along Bladensburg Road adjacent to bus zone. Planting must allow space for bus landing zones. WMATA requires a five by eight foot unobstructed ADA landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

Figure 49: E: Bladensburg Road NE Bus Stop for Routes B2 & S41 - Looking North. (Source: Google Maps Street View)

Figure 50: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Photovoltaic Cells
- Vegetation
- Bus Lane Improvement

District of Columbia Office of Planning

Bus Stop F

1: Install three to four foot sidewalk away from West Virginia Avenue NE.

2: Install LID with medium-sized two inch caliper hardy ornamental tree(s) at curb near West Virginia Avenue NE to filter runoff from roadway.

* Relocate bus stop to the immediate south away from service station driveways.

Figure 51: F: West Virginia Avenue NE Bus Stop for Routes E2, E3 & S41 - Looking South. (Source: Google Maps Street View)

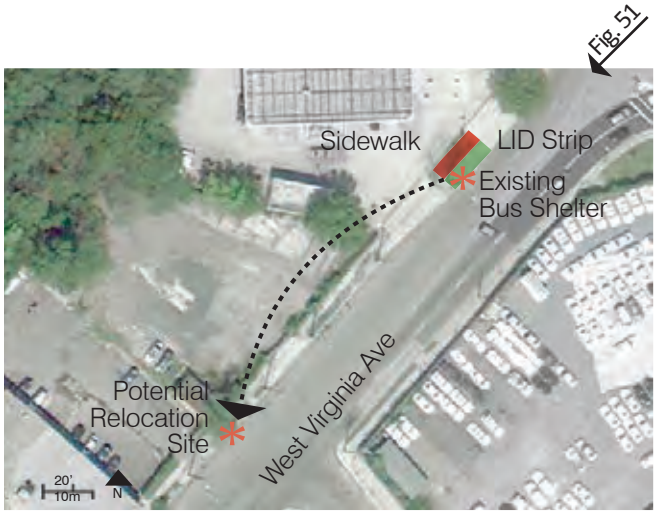


Figure 52: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Sidewalk Improvement
- Vegetation
- * Additional Note Regarding Bus Stops and Shelters

Bus Stop G

1: Apply painted ‘bus box’ graphic in right lane.

2: Plant large four inch caliper hardy shade trees and small shrubs in existing planters along West Virginia Avenue NE adjacent to bus zone. Planting must allow space for bus landing zones. WMATA requires a five by eight foot unobstructed ADA landing pad for the front door of the bus and a 30-40 foot clear area for rear door egress.

* The sidewalk dimension is not wide enough to accommodate shelter.

Figure 53: G: West Virginia Avenue NE Bus Stop for Routes E2, E3, & S41 - Looking North. (Source: Google Maps Street View)

Figure 54: Bus Stop Location Plan. (Source: Google Maps)

Legend

- Vegetation
- Bus Lane Improvement
- * Additional Note Regarding Bus Stops and Shelters

Bus Stop Amenities

While the surface area of bus stops are small, installing two inch thick pregrown extensive greenroofs on them helps intercept and treat runnoff while making the process accessible to people utilizing the space.

Many amenities or innovations for bus stops require a power source in order to perform. Photovoltaic solar cells located on the roof of bus stops in other cities have provided the necessary power for the following amenities.

1 Power LED lights for night users and advertising panels.

2 Power an LED message board that gives Metrobus schedule updates.

3 Operate a Wi-Fi router.

4 Power “Push-to-Talk” features which reads the Metrobus information aloud for visually impaired travelers

Figure 55: Conceptual WMATA Standard Bus Shelter Modified for Extensive Green Roof and Photovoltaic Solar Roof Cells. (Source: Google Maps Street View)

Figure 56: Photovoltaic Cells on Bus Shelter - Example from San Francisco.

Figure 57: GreenRoof on Bus Shelter - Example from San Francisco.

San Francisco’s use of a curvilinear shape on the roof of a bus shelter allowed solar cells to perform well regardless of sun angle. Repeating curves (Fig.B) were found to be more structurally sound than a flat surface (Fig. A).

Multi-Use Trail Recommendations

The multi-use trail recommendations are for the integration and implementation of trails that can accommodate pedestrians and bikes within the assessment area. The recommendations include specific geometric and trail cross section proposals for each area, strategies for connecting to the surrounding areas, and enhancements and features along the trail. The recommendations are provided for the overall assessment area along New York Avenue and six sub, or focus areas. The sub areas are as follows:

- Florida Avenue NE to the New York Avenue Bridge NE over Amtrak tracks
- New York Avenue Bridge NE to Penn Street NE
- Penn Street NE to Brentwood Parkway NE
- Brentwood Parkway NE to West Virginia Avenue NE/Montana Avenue NE
- West Virginia Avenue NE/Montana Avenue NE to National Arboretum

Overall Assessment Area Recommendations

Multi-Use Trail Design

The trail should be located on the south side of New York Avenue NE. Locating a trail on the south side will accommodate shorter trips between neighborhoods and destinations along New York Avenue NE. This will also minimize the need for residents living south of the corridor to cross New York Avenue NE to reach the trail. Generally, the trail will be developed through the widening of existing sidewalks. There are two locations (discussed in more detail later in this chapter) where trail development will involve converting low use deceleration lanes to trail purposes. It should be noted that there are no recommendations for removing travel lanes that carry vehicular through-traffic. Generally, the existing vegetated buffer along the corridor will be maintained. Some buffer areas will be widened further or a buffer will be added where there is none.

It is also recommended that the trail be constructed with permeable materials, such as pervious concrete or pervious asphalt, to improve runoff infiltration and to showcase the use of these materials.

Future studies should explore the feasibility of installing a multi-use trail on the north side of the New York Avenue Corridor. A trail located on this side could reduce travel time along the corridor as it would require fewer road and driveway crossings. In addition, connections to the proposed Fort Lincoln New Town development to the northeast of the study area (east of South Dakota Avenue NE) may be easier to accomplish with a trail on the north side.

Multi-Use Trail Connections

A connection between the proposed multi-use trail on New York Avenue NE and the Metropolitan Branch Trail (MBT) should be created in the undeveloped land between New York Avenue NE to the north and Florida Avenue NE to the south. The MBT is at a higher elevation through this section (crossing Florida Avenue NE on a bridge rather than at-grade) and a connection is easier to construct, whereas south of Florida Avenue NE the trail begins to transition down before connecting with the New York Avenue Metrorail Station entrance on N Street NE.

A connection should also be created on the eastern end of the proposed multi-use trail on New York Avenue NE with the Anacostia Riverfront trail system. This could be located on the eastern bank of the Anacostia River and could eventually connect to potential future trails in Maryland that would be parallel to Route 50 from Cheverly to New Carrollton. An improved crossing of the Anacostia could be cantilevered off of the Route 50 bridge or the Amtrak bridge. The feasibility of the crossing would require and extensive study.

Pocket Green Spaces

Pocket green spaces could be created

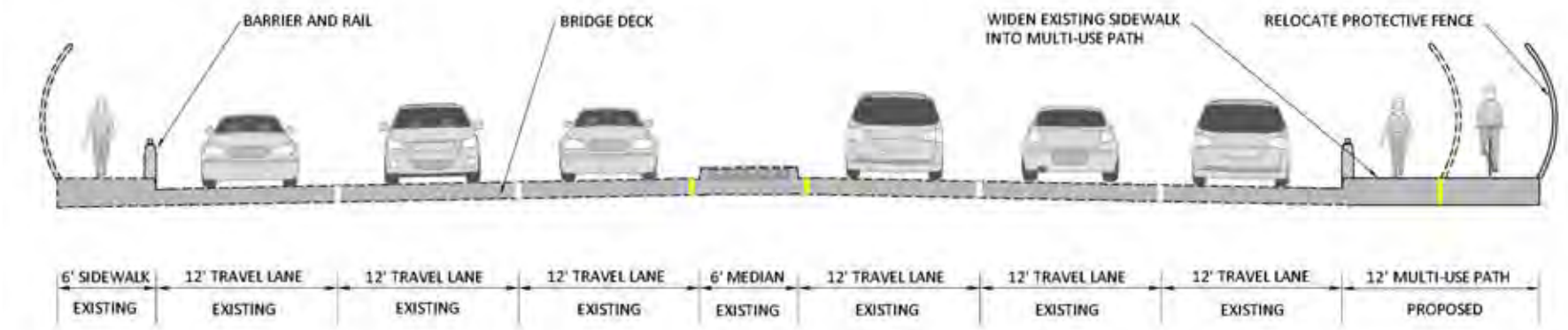


Figure 58: Cross Section with Widened Trail at New York Avenue NE Bridge over Amtrak Railroad Tracks, Looking East.

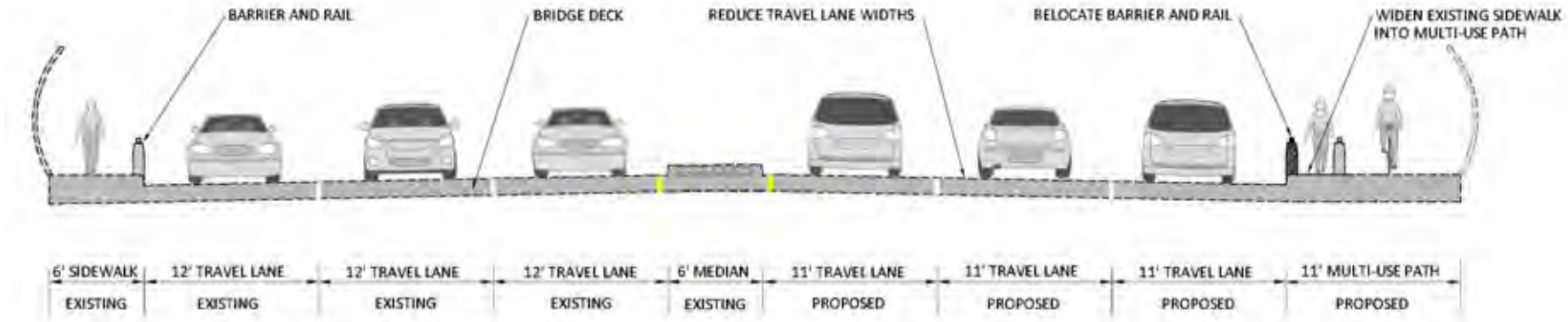


Figure 59: Cross Section with Cantilevered Trail at New York Avenue NE Bridge over Amtrak Railroad Tracks, Looking East.

where there is adequate space between the multi-use trail and buildings, fences, or other physical structures. These vegetative zones could reduce stormwater runoff and improve the visual experience for trail users. These zones should not hinder views of signs, business entrances, and other important features. Proper maintenance of these zones will be imperative to maintain trail user comfort and safety.

Florida Avenue NE to New York Avenue Bridge NE

Multi-Use Trail

In this section of the trail the sidewalks are too narrow to safely accommodate pedestrians and bicyclists together. Additional width is not available in the existing configuration on the bridge. The sidewalk on the south side should be widened to a minimum of 11 feet to accommodate pedestrians and bicyclists in both directions. One option (see Figure 58) may require cantilevering structures, depending on the existing structural supports of the bridge. The fencing on the outer edge should be relocated to the outer edge of the new trail. The sidewalk on the north side will remain unchanged and will continue to accommodate pedestrian traffic. A second option is to reduce the width of all six vehicle travel lanes from

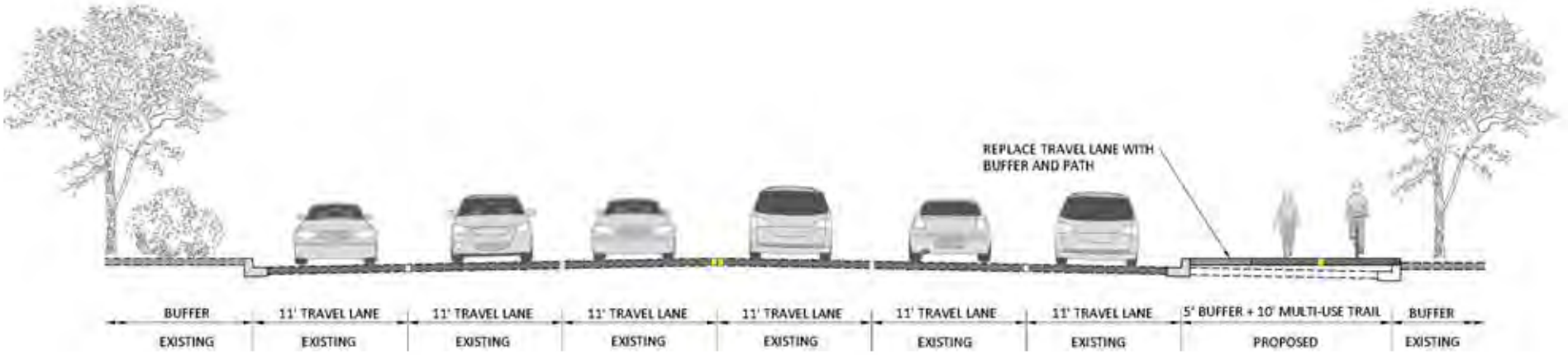


Figure 60: Cross Section West of Penn Street NE, Looking East.

12 feet to 11 feet and allocate the 6 foot gain in width to the sidewalk on the south side to create a trail, while maintaining the sidewalk width on the north side. A third option involves reducing the width of the eastbound travel lanes only, from 12 feet to 11 feet, and allocating the resulting 3 feet to the sidewalk on the south side to create a trail, maintaining the sidewalk on the north side for pedestrian traffic (see Figure 59).

The New York Avenue Bridge NE over the Amtrak tracks is currently being replaced, and the new bridge will have essentially the same overall width and cross section as the existing bridge. The second and third options presented above for narrowing lanes (lane diets) to accommodate a wider multi-use trail on the south side of the bridge should be feasible and relatively straightforward to implement on the new bridge. The cantilevered trail option would be more costly to construct and may not be feasible, depending on the structural design of the new bridge.

New York Avenue Bridge NE to Penn Street NE Recommendations

Multi-Use Trail

The seventh lane in this section appears to be unnecessary for vehicular movement. It is less than 200 yards long and does not appear to accommodate pull-off uses such as buses or loading. It is recommended that the seventh lane be reallocated for the multi-use trail. In this scenario, the curb would be relocated to the outer edge of the sixth travel lane, and a buffer should be included to separate the trail from the roadway (see Figure 60).

Penn Street NE to Brentwood Parkway NE Recommendations

Multi-Use Trail

The existing sidewalk on the south side should be replaced with the multi-use trail up to the vacant park property that is directly east of the National Park Service maintenance facility. The existing street tree buffer strip should be maintained but may need to be removed or narrowed at certain spots in order to accommodate the necessary width for the multi-use trail. A retaining wall may be required on the south side of the trail because the land slopes up away from New York Avenue NE. At the park property the trail should be separated from the sidewalk that parallels New York Avenue NE on the south side of the existing tree so the trees can be saved (see Figure 61).

Multi-Use Trail Connections
Trail connections into the park space and up to Brentwood Parkway NE should be provided. Where the trail passes under the Brentwood Parkway NE bridge, the available space narrows between the bridge abutment and the roadway. The multi-use path may need to reconnect with the sidewalk at this point; it appears that the newly constructed Brentwood Parkway NE bridge will provide sufficient space for a shared use facility.

Brentwood Parkway NE to West Virginia Avenue NE/Montana Avenue NE Recommendations

Multi-Use Trail
The existing sidewalk on the south side should be replaced with the multi-use trail. The existing buffer should be maintained but it may need to be removed or narrowed in certain spots to accommodate the necessary width for the multi-use trail. Some of the driveways at the gas station should be consolidated in order to reduce conflicts between motorists and trail users.

On the north side of New York Avenue NE, the parking lots, which appear to be a transitional or temporary use, could be used for the implementation of low cost or interim LID stormwater management improvements, such as rain gardens or swales. These would improve water quality as well as provide significant aesthetic improvements. These areas could be converted to a linear park with amenities such as landscaping, benches, public art, and possibly stationary exercise equipment such as chin up bars. This park could include a train-oriented theme in order to capitalize on the proximity to the rail yard. Because of the location's proximity to the busy roadway, sound protection such as transparent glass walls similar to those used to separate the trail from the roadway on the Wilson Bridge, or water features that generate noise, could be used to buffer the road noise.

Multi –Use Trail Connections
This linear park could include a separate pathway that would connect with the sidewalk on the north side of New York Avenue NE at the hotel property (see Figure 62).

West Virginia Avenue NE/ Montana Avenue NE to the National Arboretum Property Recommendations

Multi-Use Trail
The existing sidewalk on the south side between West Virginia Avenue NE and Bladensburg Road NE can be replaced with a multi-use trail. The existing buffer should be

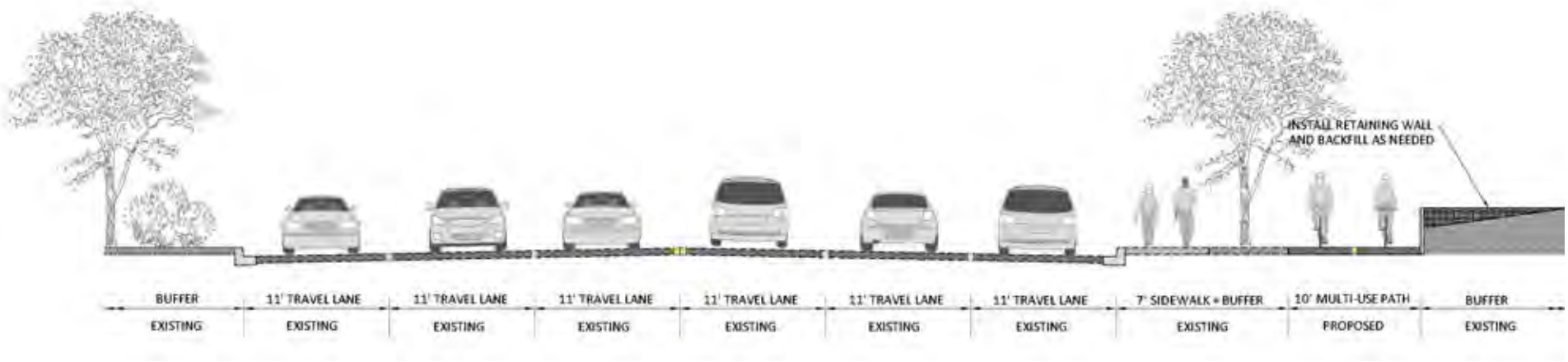


Figure 61: Cross Section West of Brentwood Parkway, Looking East.

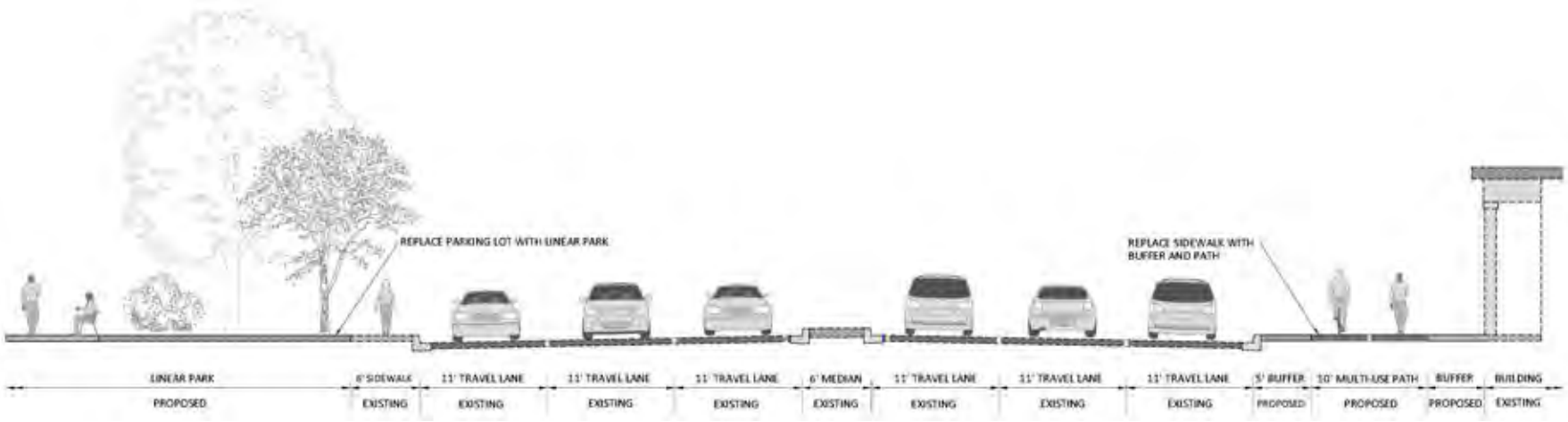


Figure 62: Cross Section West of Fenwick Street NE, Looking East.

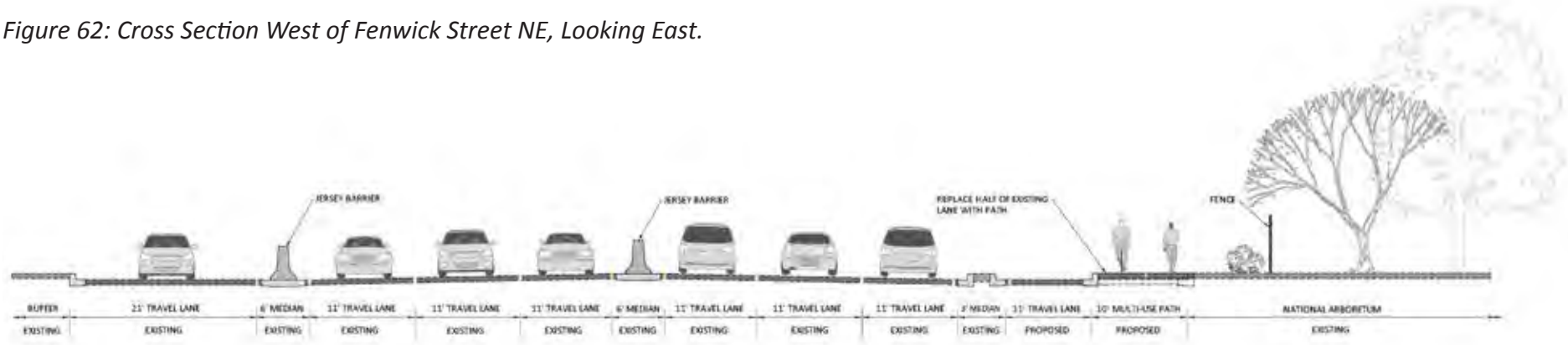
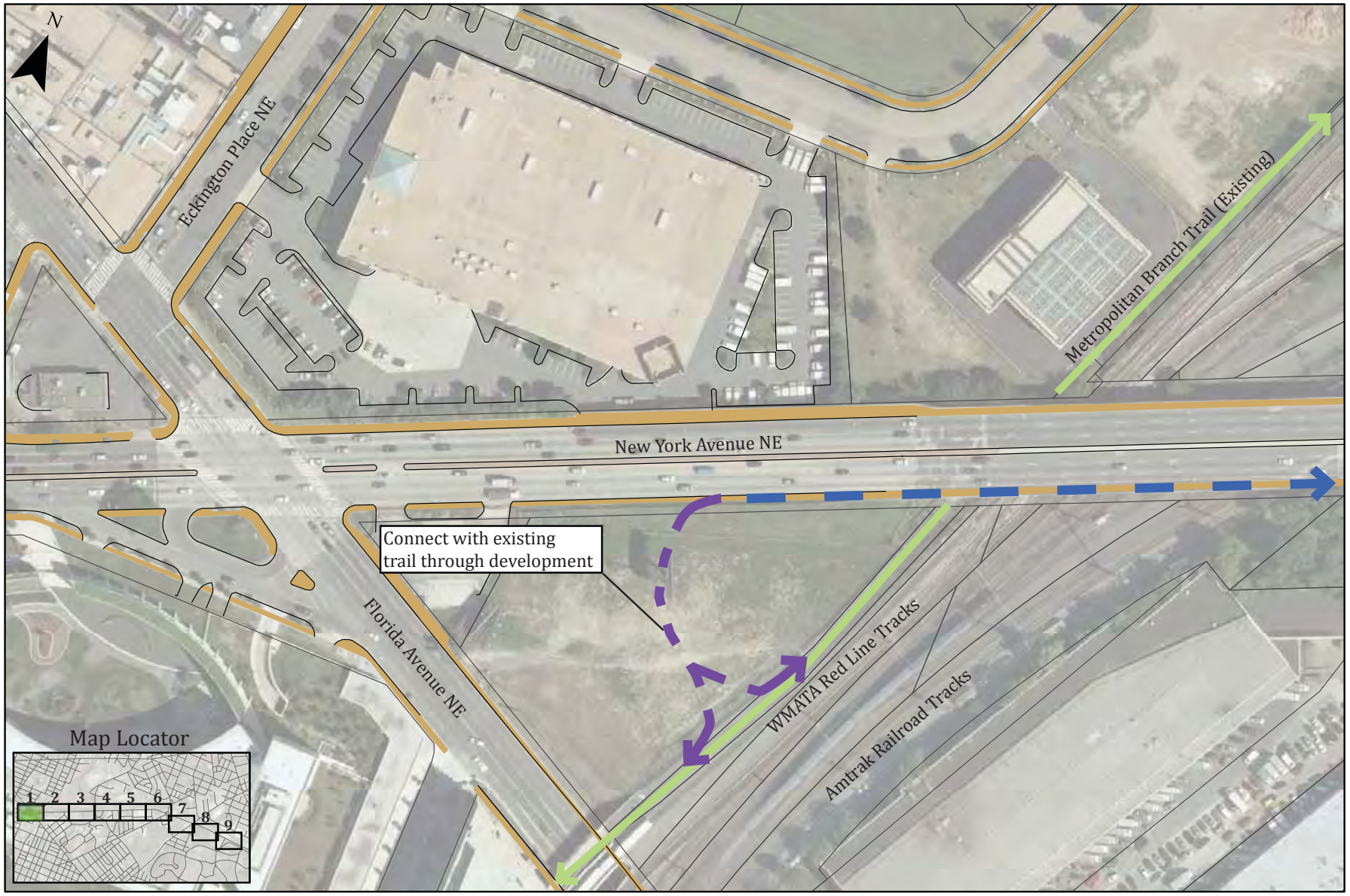


Figure 63: Cross Section West of the National Arboretum, Looking East.

maintained but may need to be removed or narrowed at certain spots in order to accommodate the necessary width for the multi-use trail. Some of the driveways at the gas station should be consolidated or closed in order to reduce conflicts between motorists and trail users. East of Bladensburg Road NE, it is recommended that the multi-use trail transition from the sidewalk space on the south side of New York Avenue NE to the service lane on the south side of the corridor. The travel lane appears to be at least 22 feet wide; it is recommended that 10 feet of roadway be re-allocated for the trail. A buffer is not likely to fit without encroaching onto National Arboretum property (see Figure 63). The narrowing of the vehicular lane with the right-of-way will contribute to traffic calming and provide a more comfortable experience for trail users. An additional option is to coordinate with the National Arboretum for the trail installation in order to gain additional space and create a buffer between the roadway and trail. It is recommended that the trail continue onto the National Arboretum property by connecting with the existing pedestrian entrance that is directly adjacent to the vehicular entrance gate.

Multi-Use Trail Connections

The segment of New York Avenue NE east of the Arboretum is out of the study area for this project. However, there are several key destinations in this stretch including the existing and proposed developments at Fort Lincoln, the Anacostia River Trail, and a proposed route extending from Cheverly, MD to New Carrollton, MD and ultimately the Washington, Baltimore and Annapolis (WB&A) Trail in Glenarden, MD which should be considered in future trail expansions.



Legend

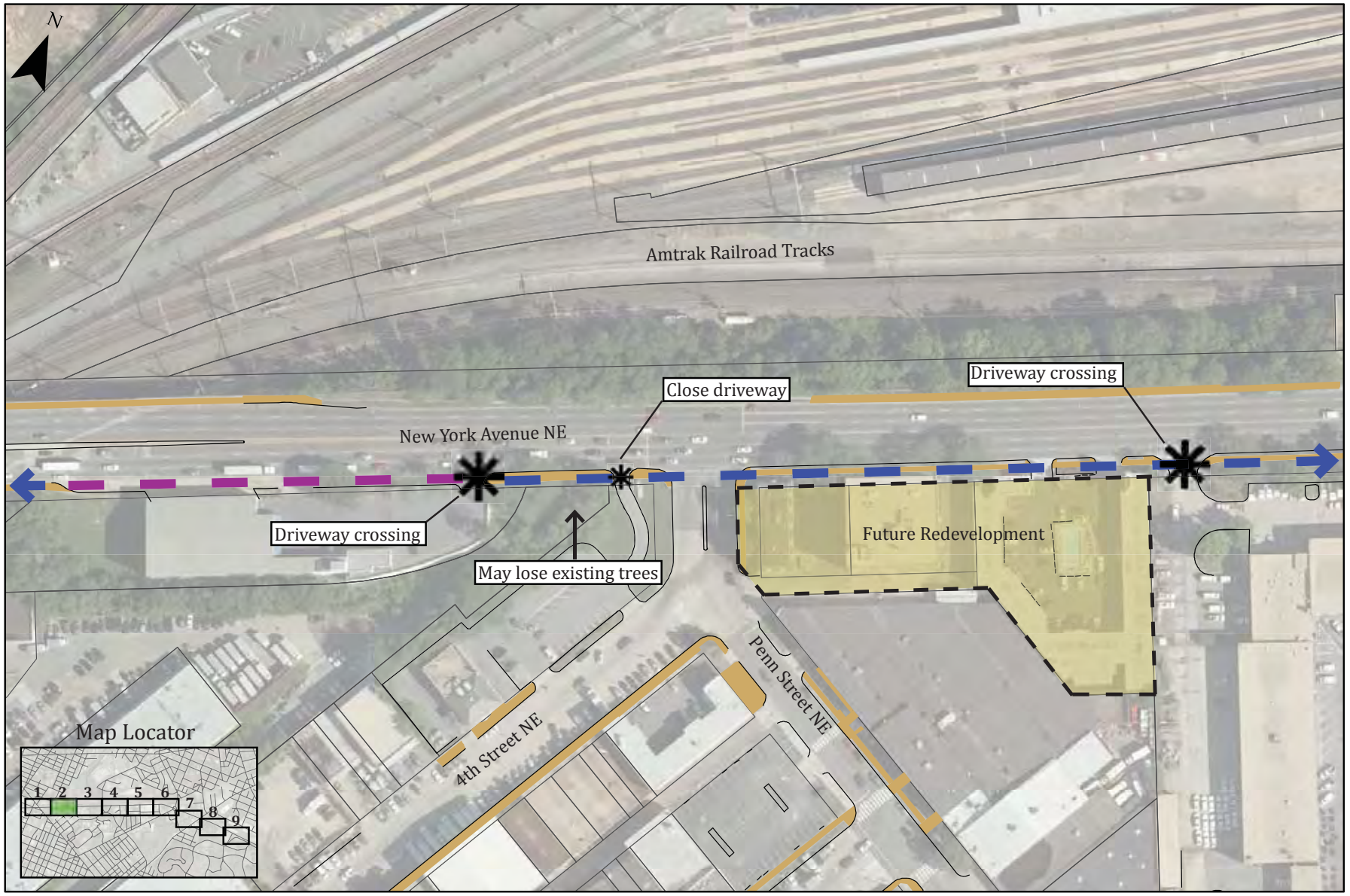
- Existing Sidewalks
- Replace Sidewalk with Multi-Use Trail
- Replace Sidewalk and Buffer with Multi-Use Trail
- Install Multi-Use Trail Separate from Sidewalk
- Reallocate Roadway Space for Multi-Use Trail
- Conflict Point or Pinch Point

0 100 200 400 Feet

1 inch equals 150 feet

Map 1

District of Columbia
Office of Planning



Legend

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- Conflict Point or Pinch Point

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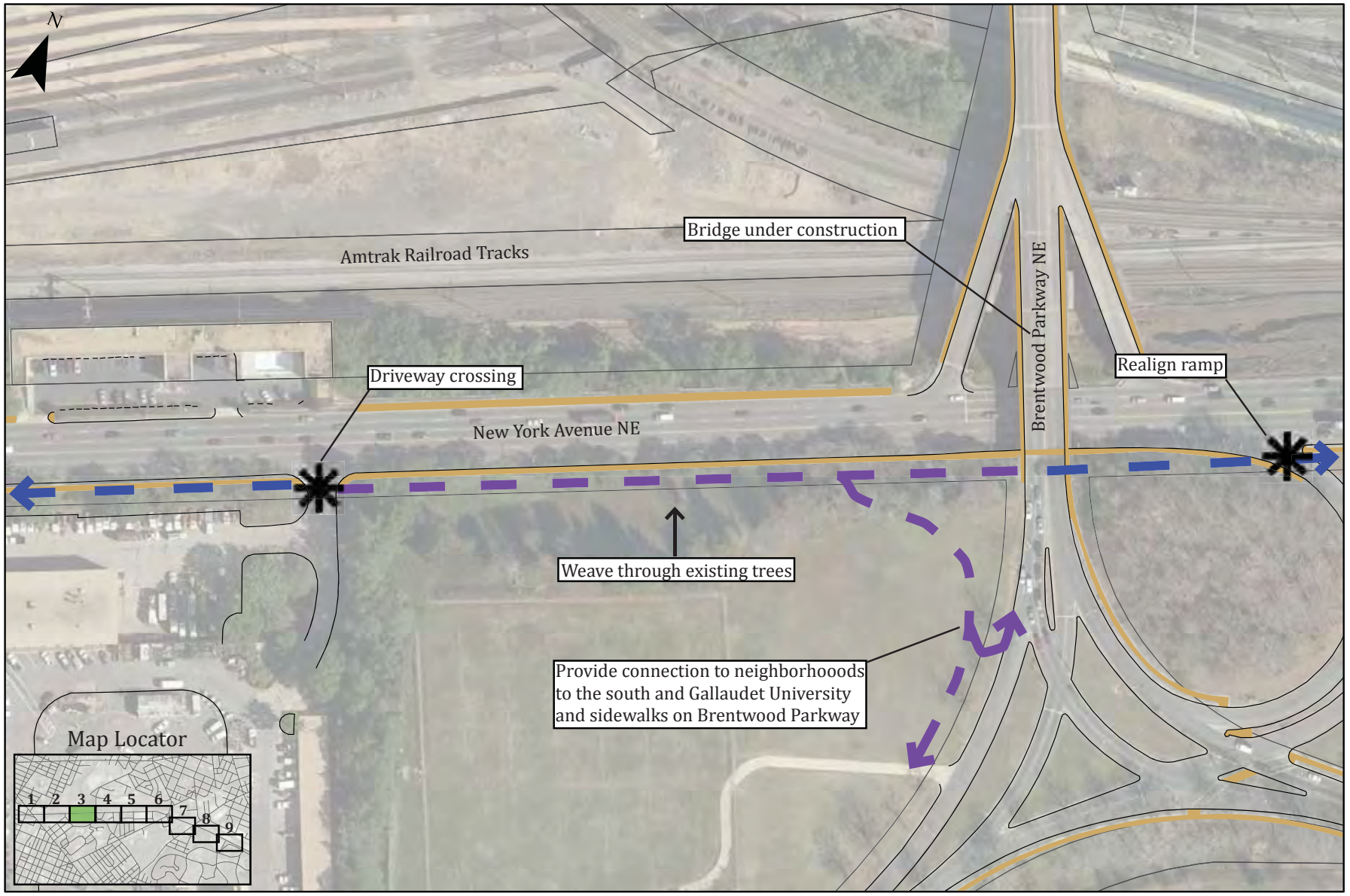
1 inch equals 150 feet

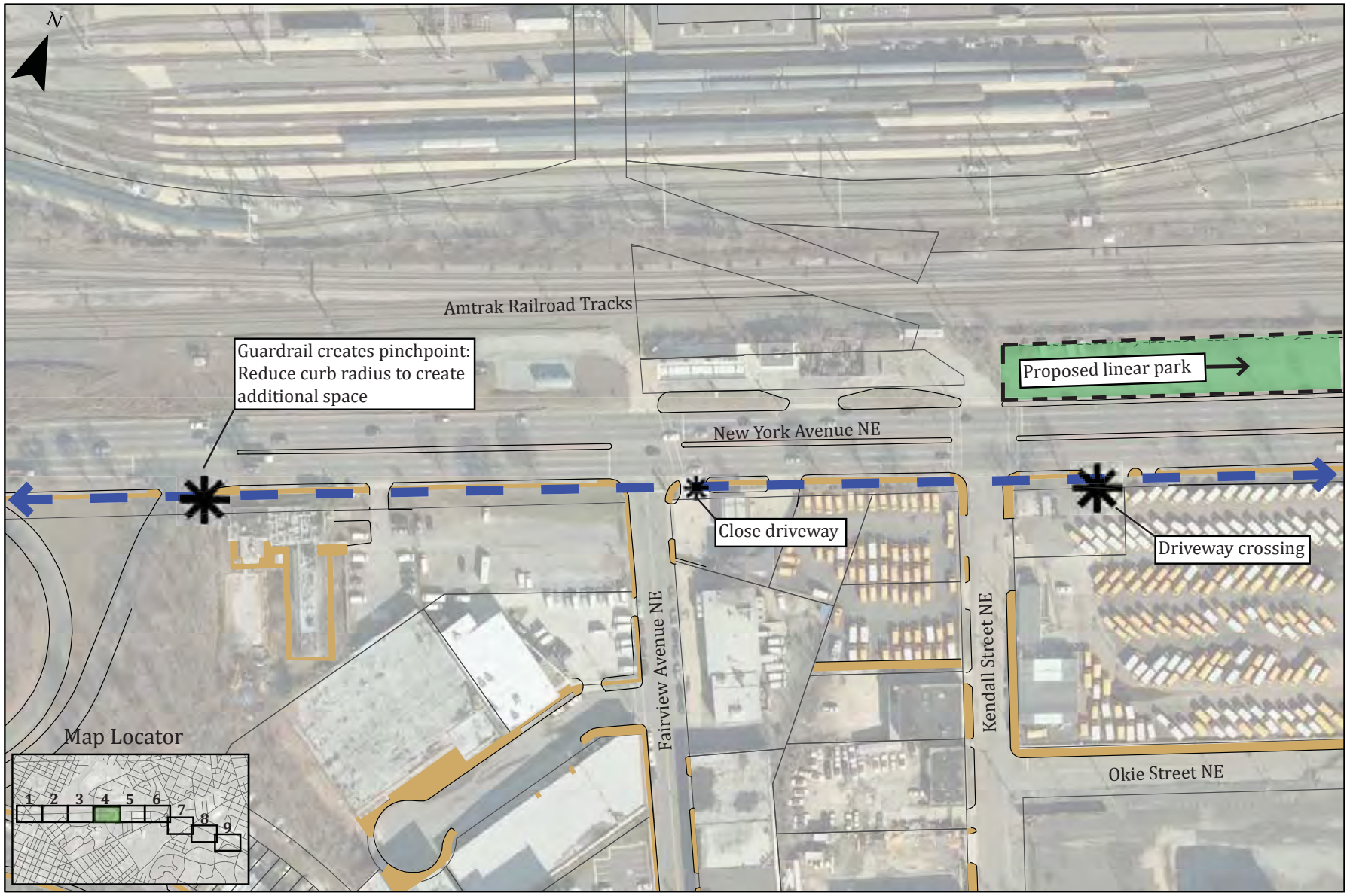
Map 2

District of Columbia Office of Planning



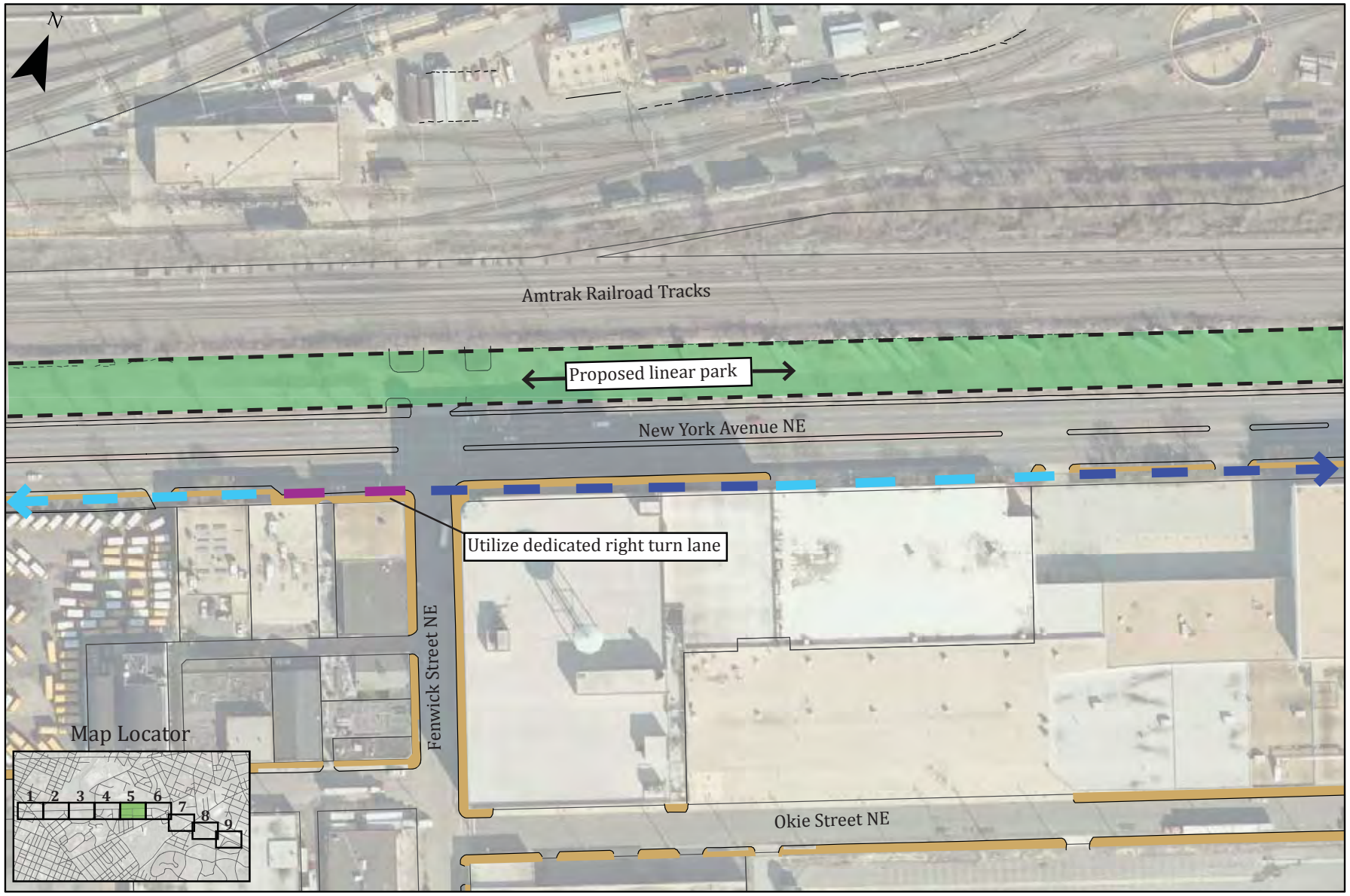
Map 3

District of Columbia Office of Planning



Map 4

District of Columbia Office of Planning



Legend

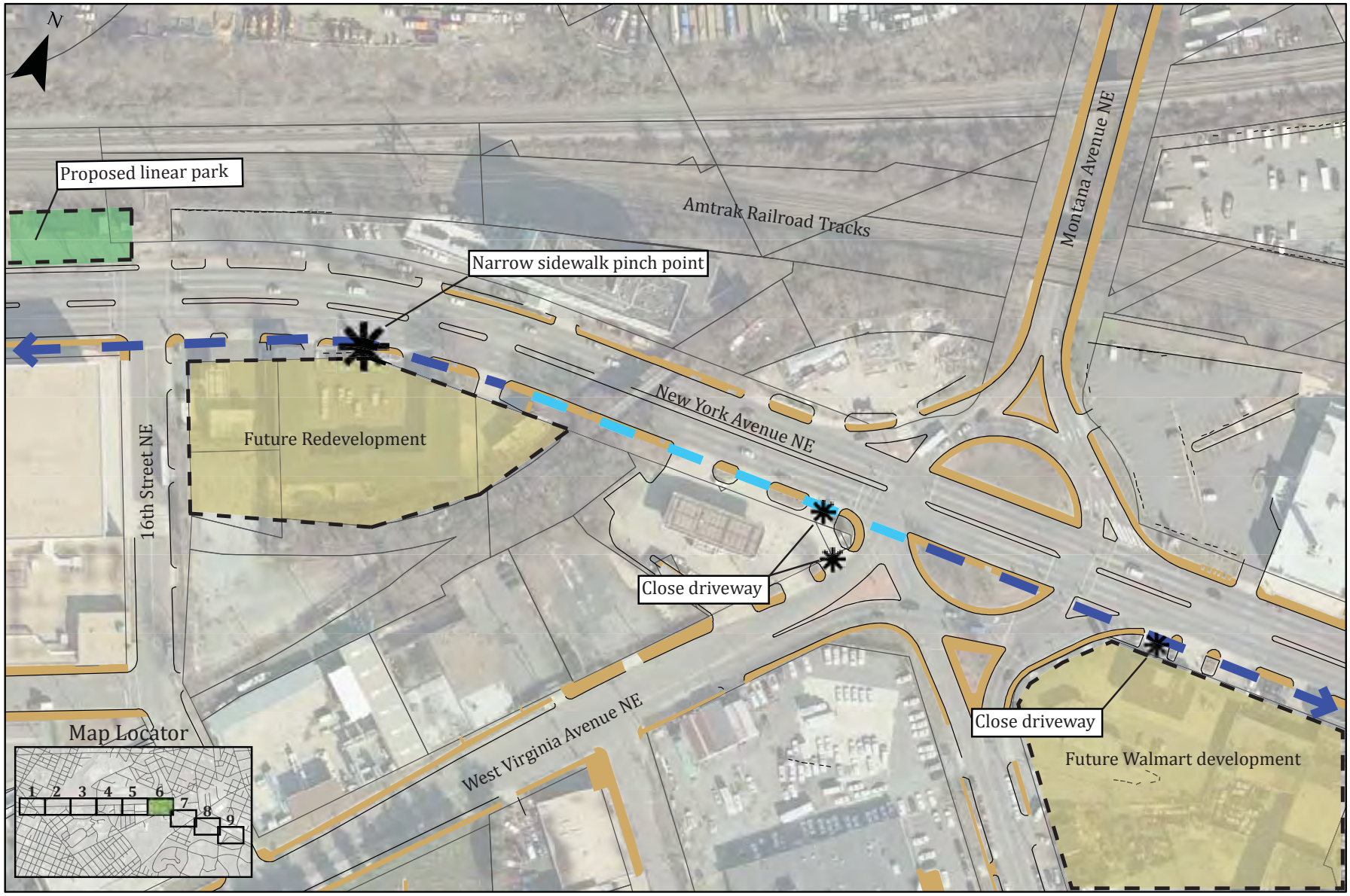
- Existing Sidewalks
- Replace Sidewalk with Multi-Use Trail
- Replace Sidewalk and Buffer with Multi-Use Trail
- Install Multi-Use Trail Separate from Sidewalk
- Reallocate Roadway Space for Multi-Use Trail
- Conflict Point or Pinch Point

0 100 200 400 Feet

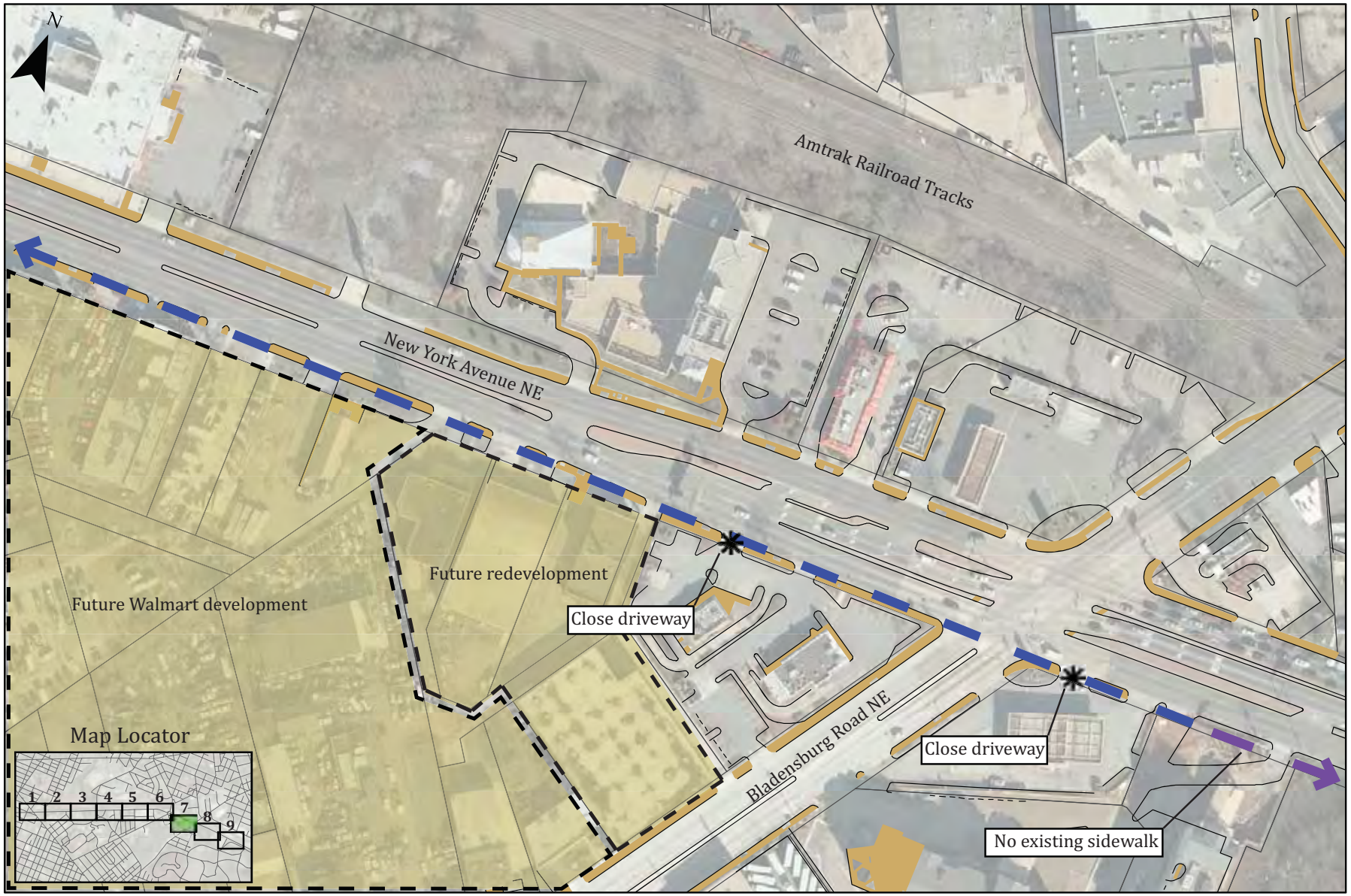
1 inch equals 150 feet

Map 5

District of Columbia Office of Planning


N
Proposed linear park
Amtrak Railroad Tracks
Montana Avenue NE
Narrow sidewalk pinch point
New York Avenue NE
16th Street NE
Future Redevelopment
Close driveway
Close driveway
Future Walmart development
West Virginia Avenue NE
Map Locator
1 2 3 4 5 6 7 8 9
Legend
Existing Sidewalks
Replace Sidewalk with Multi-Use Trail
Replace Sidewalk and Buffer with Multi-Use Trail
Install Multi-Use Trail Separate from Sidewalk
Reallocate Roadway Space for Multi-Use Trail
Conflict Point or Pinch Point
0 100 200 400 Feet
1 inch equals 150 feet

Map 6



Legend

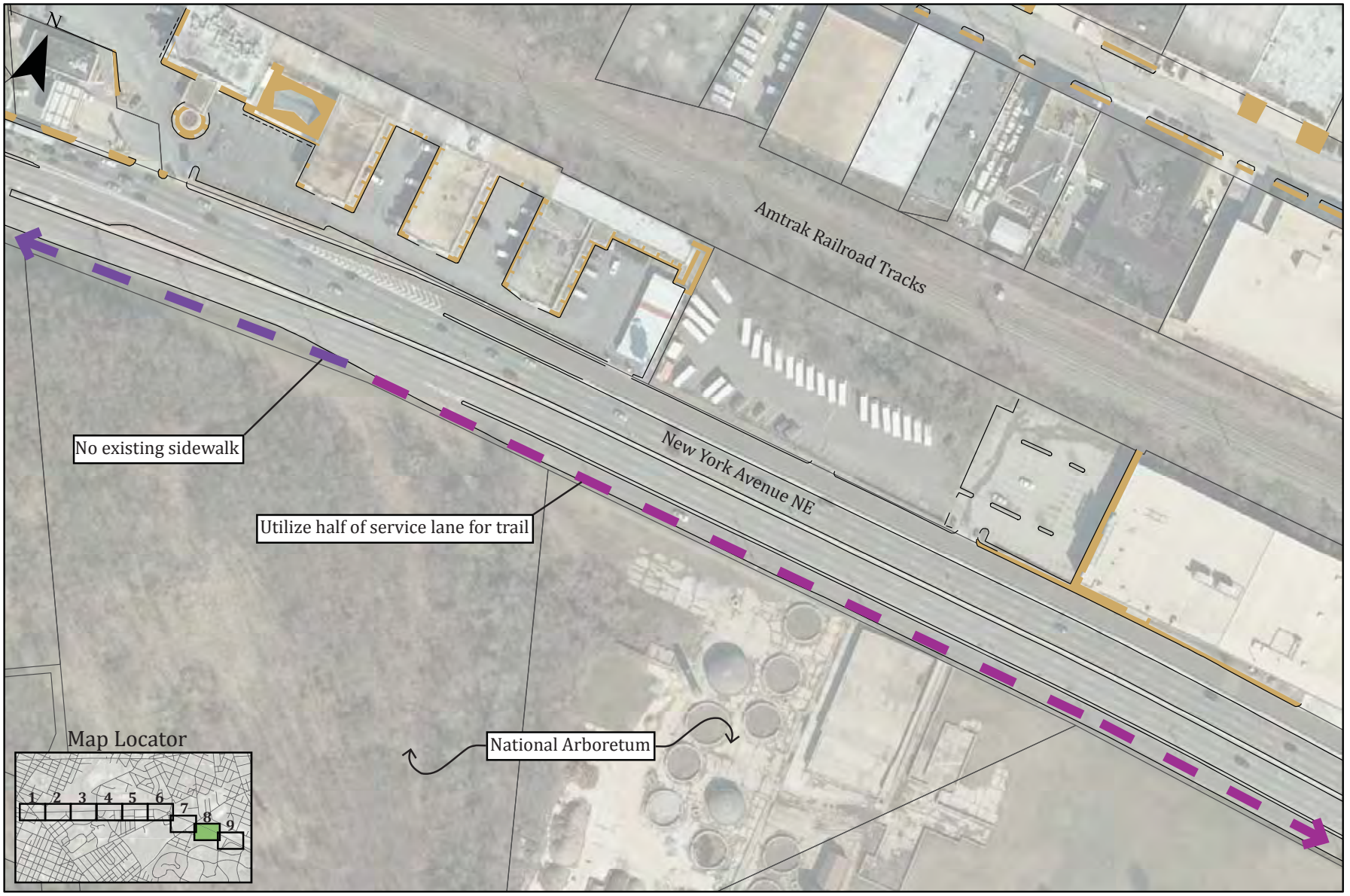
- Existing Sidewalks
- Replace Sidewalk with Multi-Use Trail
- Replace Sidewalk and Buffer with Multi-Use Trail
- Install Multi-Use Trail Separate from Sidewalk
- Reallocate Roadway Space for Multi-Use Trail
- Conflict Point or Pinch Point

0 100 200 400 Feet

1 inch equals 150 feet

Map 7

District of Columbia Office of Planning



Legend

- Existing Sidewalks
- Replace Sidewalk with Multi-Use Trail
- Replace Sidewalk and Buffer with Multi-Use Trail
- Install Multi-Use Trail Separate from Sidewalk
- Reallocate Roadway Space for Multi-Use Trail
- Conflict Point or Pinch Point

0 100 200 400 Feet

1 inch equals 150 feet

Map 8

District of Columbia Office of Planning