5.3 Long Term

5.3.1 DC Clean Rivers Project

5.3.1.1 Technical Objectives

DC Water is implementing its Long Term Control Plan (LTCP) for the District's combined sewer system through the DC Clean Rivers Project (DCCR). The DCCR is comprised of a system of tunnels and diversion sewers for the capture of Combined Sewer Overflows (CSOs) to Rock Creek and the Anacostia and Potomac Rivers for treatment at DC Water's Blue Plains Advanced Wastewater Treatment Plant. Implemented under a Federal Consent Decree between the United States, the District Government and DC Water, the DCCR is divided into several contract divisions.

DCCR's Tunnel Boring Machine (26-ft in Diameter).

The TBM will be used to excavate tunnels through a variety of soil and rock layers

5.3.1.2 Design Approach

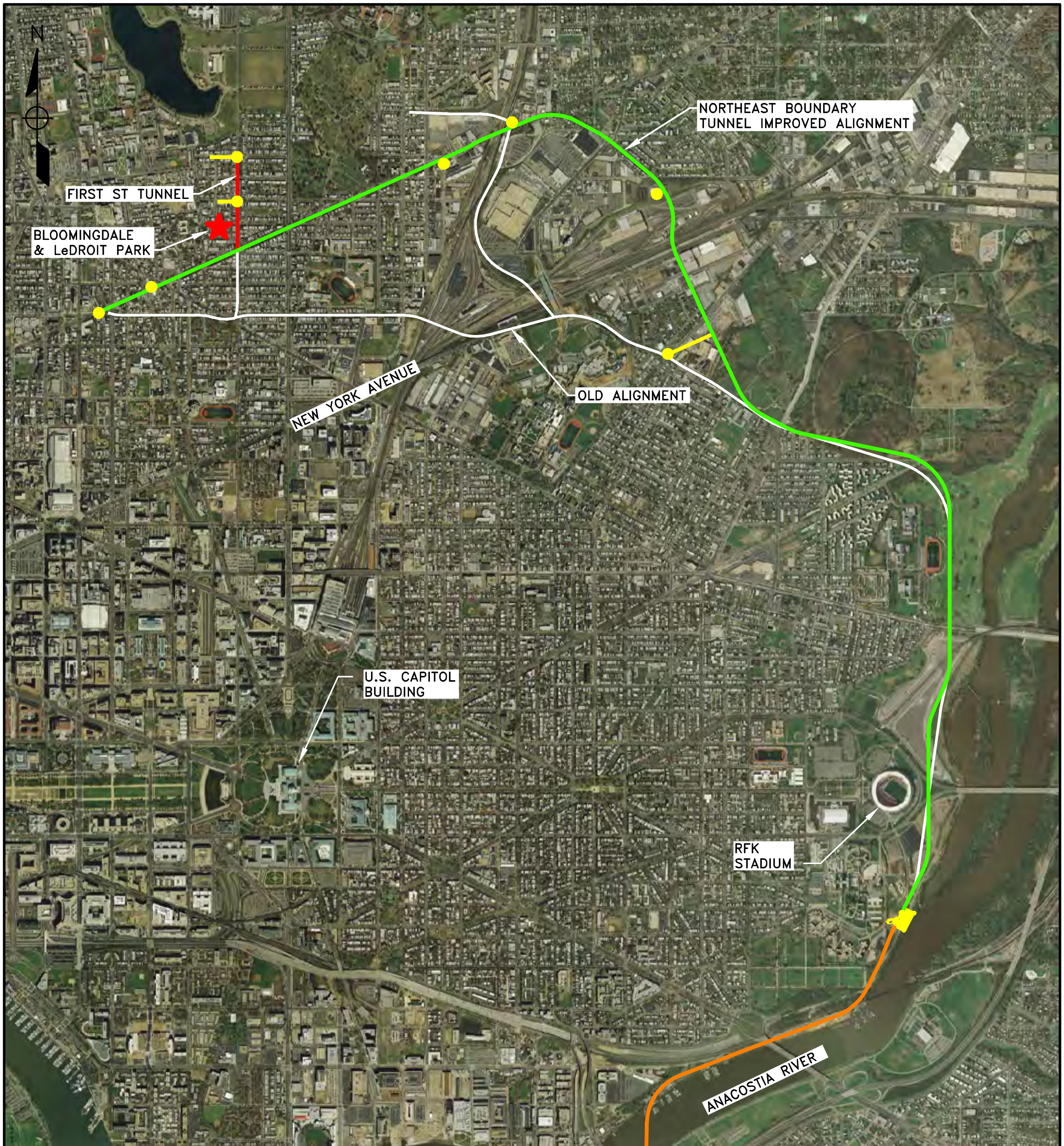
The Northeast Boundary Tunnel and Branch Tunnels will provide additional storage for CSOs and will relieve street and basement flooding in the Northeast Boundary area. The work will extend from Robert F. Kennedy Stadium to the Rhode Island Avenue Metro Station, and then along Rhode Island Avenue to Sixth Street, NW. The original alignment proposed under DC Water's Facility Plan was re-evaluated to provide an alignment that could be constructed on an expedited schedule (Figure 5-15).

The main tunnel, known as the Northeast Boundary Tunnel (NEBT), will be approximately 26,600 feet (5 miles) in length, 23 feet in diameter and located between 50 and 150 feet underground. Branch tunnels will extend from the main tunnel, including one along First Street NW, to connect to sewer diversion facilities that will be constructed in chronic flood areas. The NEBT system will include as many as ten shafts primarily used for diverting Combined Sewer Overflows to the tunnel for subsequent treatment at Blue Plains AWWTP. Diversion drop shafts will have diameters of approximately 20 feet and will be excavated from the ground surface to the depth of the tunnel. Near each trunk sewer, a diversion chamber will be constructed to divert wastewater from the existing trunk sewer to the drop shaft.

5.3.1.3 Expected Effects

By the year 2025, the entire project will reduce CSOs annually by 96 percent throughout the system and by 98 percent for the Anacostia River alone. The Northeast Boundary Tunnel and the Branch Tunnels, like other projects constructed under the DCCR, will be designed to collect and convey stormwater runoff for up to a 15-year rainfall event. This means that sewer backups and surface flooding (in Bloomingdale and LeDroit Park) would not occur during the design storm.

The $2.6 billion fully constructed Clean Rivers Project will reduce combined sewer overflows by over 98% in the Anacostia River alone, relieve flooding in the northeast area of the District, and is part of the strategy for reducing nitrogen in the Potomac.



LEGEND

NORTHEAST BOUNDARY TUNNEL (NEBT)
FIRST STREET TUNNEL
ANACOSTIA RIVER TUNNEL (ART)
DIVERSION SEWERS

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MAYOR'S TASK FORCE REPORT
ON THE PREVENTION OF FLOODING
IN BLOOMINGDALE AND LeDROIT PARK

NORTHEAST BOUNDARY TUNNEL PROJECT ALIGNMENT

DATE: DECEMBER 2012 | FIGURE 5–15

5.3.1.4 Implementation and Associated Costs

The total estimated project cost is over $600 million. Construction of the Northeast Boundary Tunnel and the Branch Tunnels is scheduled to begin as early as 2016 and will be completed by 2025 in accordance with the Consent Decree. If implemented, the First Street Branch Tunnel will be placed in service following completion and startup of the entire project.

Based on fast track design and procurement, and a commitment of support from District, the Northeast Boundary Tunnel could be completed by 2022. These are major projects with an estimated cost of more than $500 million that will be constructed in dense urban areas. Identifying the right of way for the tunnel and surface facilities, obtaining the necessary property and easements, and obtaining construction staging areas and permits for construction are critical to being able to construct the project in accordance with the schedules presented here.

These projects cannot be constructed according to the schedules shown without the commitment from District agencies to act as project stakeholders by providing the following:

- City Administrator appoints a champion. The champion assembles and leads a Task Force of key officials from District agencies, and is empowered to direct agencies on project related issues.
- District agencies dedicate staff to support the project, and who are authorized to make decisions on behalf of the agency. The agency representatives may be located with the project design team to facilitate close coordination.
- DC Water obtains power of Eminent Domain and District exercises power of Eminent Domain as necessary to obtain land for the project.
- District grants all necessary easements to DC Water.
- District grants necessary District property to DC Water for permanent facilities and for construction.
- District provides expedited permits with dedicated staff.
- District allows necessary street closures, work hours, etc. for construction operations.
- Permit fees are waived.
- District allows street closures, reasonable work hour restrictions, and other coordination for construction operations.
- District facilitates parking mitigation in construction zones.
- District provides financial assistance including waiving permit fees and help to secure Federal funding to limit water & sewer rate increases.

A number of permits will be required throughout construction of stormwater storage facilities at the McMillan site and the First Street Tunnel. Table 5-14 identifies key permits that typically take up to four months to obtain. The stakeholder relationship and assistance from District agencies described above will be essential for processing permits expediently.

Table 5-14: Key Permits for Construction of the Northeast Boundary Tunnel

Agency	Permit	Typical Time to Obtain	Scope
DDOE	SEC/SWM Approval	4-8 weeks	Site work at McMillan site and in streets
DDOE	Soil Boring Approval	4-16 weeks	Subsurface investigation in First Street
SHPO	Permit Condition Letter	4 weeks	Site work at McMillan site and in streets
DDOT	Construction	6-12 weeks	Maintenance of traffic and support of excavation for all work in streets
WMATA	Permit Condition Letter	4-8 weeks	Site work and tunneling near WMATA facilities at Rhode Island Ave Metro
DCRA	Building Permit	3-6 weeks	Site construction trailers
DCRA	Support of Excavation	4-8 weeks	Site work at McMillan
DCRA	Foundation to grade	4-8 weeks	Site work at McMillan

5 Alternatives to Address Flooding

5.1 Short Term

5.1.1 Goals for Short-Term Remedial Measures

Short-term remedial measures are technologies or engineering solutions designed to provide immediate benefits for protection of property against sewer backups and surface flooding. Successful strategies will prevent stormwater from damaging properties or keep stormwater runoff from entering the sewer system. These strategies do not involve any improvements to the capacity of the sewer system itself because of the time involved in implementation. Those strategies are discussed in medium and long-term mitigation strategies. Many of the short-term mitigation strategies presented have already been implemented to some degree. Each strategy was evaluated based on design approach, expected effect, implementation, and cost.

The strategies evaluated included the following:

- Section 5.1.2 Backwater Valves
- Section 5.1.3 Engineering Consultations
- Section 5.1.4 Removable Barriers
- Section 5.1.5 Rain Barrels
- Section 5.1.6 Green Infrastructure
- Section 5.1.7 Catch Basins
- Section 5.1.8 Detention Vaults

5.1.2 Backwater Valve Rebate Program

5.1.2.1 Technical Objectives

A backwater valve, also referred to as a backflow preventer, is a device that blocks sewage from passing through the connecting sewer lateral and into a home's fixtures. Backwater valves are installed on a home's sewer lateral, and allow the homeowner to close off the property's sewer lateral connection to the main sewer line (Figure 5-1).

Under normal dry weather conditions, sewage flows by gravity towards its end destination at the Blue Plains Wastewater Treatment Plant. During heavy storms, large volumes of stormwater combine with sanitary waste already flowing in the collection system, resulting in the pipes filling to and over their capacity. The high pressure generated by large volumes of water flowing through the sewer pipes, combined with open sewer lateral connections to homes, result in sewage flowing backwards through the sewer lateral and into a home's plumbing fixtures. This situation primarily occurs when there is both a great deal of water flowing through the combined sewer pipes, and when basement fixtures connected to the sewer lateral are at an elevation *below* the collection pipe elevation.

Backwater valves block this flow, preventing wastewater from entering a building during times when the sewer system's capacity is exceeded (Figure 5-2). Automatic and manual devices are available. However, if the device is closed, the resident must not use the toilet, sink, shower, washer, dishwasher or any appliance that discharges wastewater. If a backwater valve is installed, it is important to inspect and maintain it regularly to ensure proper operation.

Figure 5-1: Schematic of Backwater Valve Installation and Use

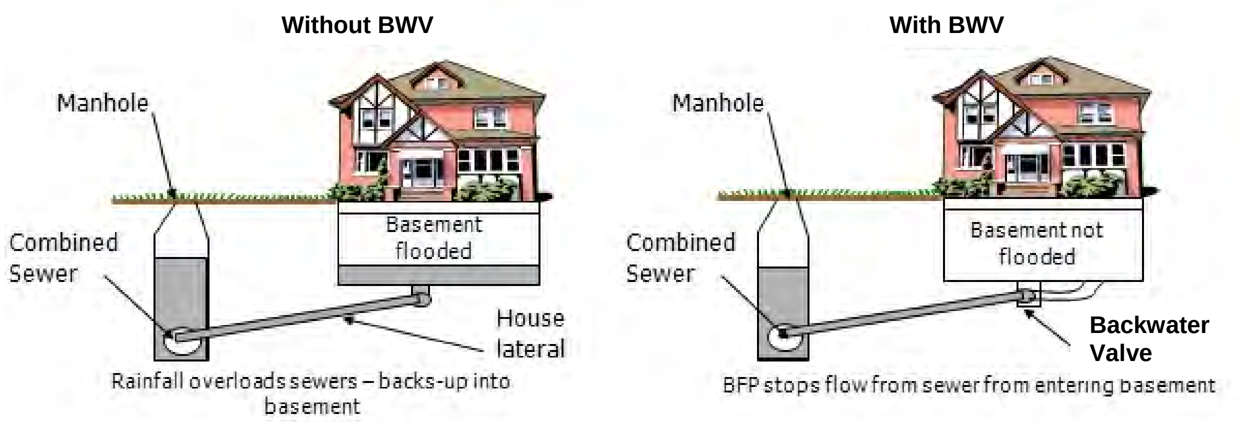
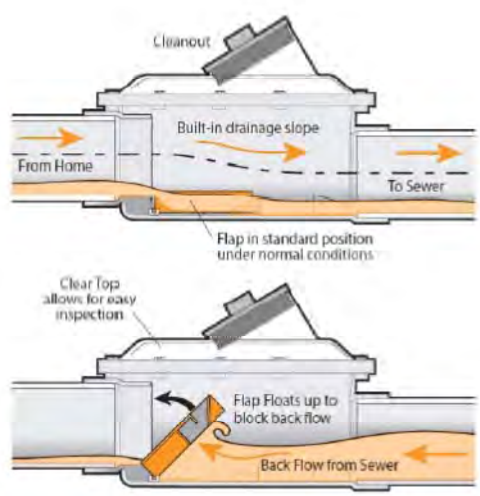


Figure 5-2: Backwater Valve Schematic



5.1.2.2 Expected Effects

Backwater valves offer a reliable means of protecting individual properties from the effects of sewer backups. When installed, used, and maintained properly, they will keep sewage from backing up through plumbing fixtures. While backwater valves are a useful tool, there are some drawbacks to their installation that can actually cause these devices to have a detrimental effect on homes. If a home's downspout is connected to the sewer lateral and the backwater valve is closed, stormwater will be unable to flow into the sewer system and the home will be at risk of flooding. For this reason, backwater valves are typically installed beneath the building's lowest floor (Figure 5-3) as opposed to outside of the building where downspouts may connect to the sewer lateral. Additionally, if the backwater valve is closed and the homeowner uses one of their kitchen or bathroom fixtures or appliances, the resulting wastewater will be unable to pass through the backwater valve and could put the home at risk of flooding.

Understanding these key concepts regarding the proper installation and use of backwater valves, therefore, is extremely important.

Backwater valves do not protect buildings from surface flooding. Also, backwater valves do not make sewer backups or surface flooding worse for nearby properties. The volume of sewage blocked from entering a basement is relatively insignificant compared to the volume of sewage in the sewer system that is causing sewer backups. Therefore, installation of even several hundred backwater valves would not adversely impact buildings that do not have backwater valves.

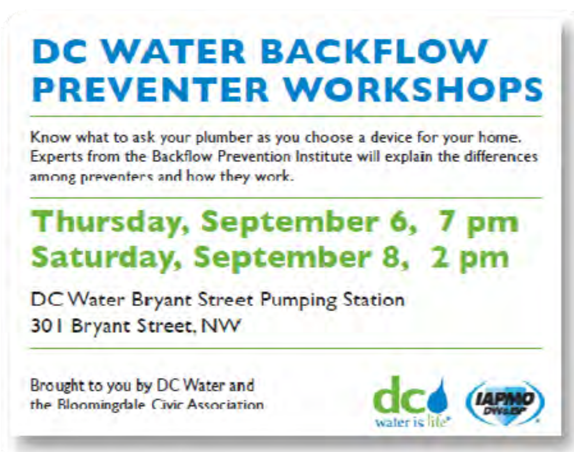
Figure 5-3: Installation of backwater valve into basement (Source: Multi-Drain, Inc.)

5.1.2.3 Implementation

DC Water retroactively implemented a Backwater Valve Rebate Program on July 1, 2012, which offers to cover 90 percent of the cost of the device and installation, up to $3,000. Homes in the affected flooding area were evaluated for eligibility for the rebate program, based on address and engineering criteria. The engineering analysis for program eligibility was based largely on hydraulic model predictions of properties in Bloomingdale and LeDroit Park that could potentially be impacted by the recent storms, and calibrated by including properties that were known to have experienced sewer backups. The analysis identified 847 eligible properties (Figure 5-4). Properties that did not meet the criteria may be re-assessed at the property owner's request.

Eligible properties were sent information about the program and application forms. If a resident installed a preventer after July 1, 2012, they may submit an itemized receipt from a DC licensed plumber and the barcode from the box of the device to DC Water for reimbursement. The rebate program and DC Plumbing Code requires a permit for this work, which must be obtained by a DC-licensed Master Plumber. (This applies to the installation of the valve itself, not to the preparation or any floor work.) If a resident had a backwater valve installed by a non-DC licensed plumber after July 1, but before DC Water announced this program, they must do the following to qualify for the rebate:

- Get a DC-licensed Master Plumber to pull a permit for the work that was already performed.
- Submit the work to a DCRA inspection as part of the permit process.
- Present DC Water with the approved inspection along with the rest of the rebate paperwork.



DC Water and Bloomingdale Civic Association hosted workshops to explain the benefits of backwater valves

DC Water held two free homeowner workshops with the Bloomingdale Civic Association, featuring experts from the

BACKFLOW PREVENTER REBATE PROGRAM ELIGIBILITY ANALYSIS FOCUS AREA

MEETS ELIGIBILITY CRITERIA

DOES NOT MEET ELIGIBILITY CRITERIA

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MAYOR'S TASK FORCE REPORT
ON THE PREVENTION OF FLOODING
IN BLOOMINGDALE AND LeDROIT PARK

BACKWATER VALVE
REBATE PROGRAM

DATE: DECEMBER 2012	FIGURE 5-4

Backflow Prevention Institute. The goal of these workshops was to explain the causes of sewer lateral backups, identify techniques to protect your home from sewer lateral backups, and identify and explain the proper use of backwater valves.

Participation in this program is voluntary. To date, less than 30 property owners have applied, indicating a very low participation rate compared to the over 800 that were deemed eligible for program participation based on engineering criteria. Some residents have indicated that installation costs sometimes far exceed the rebate limit.

Future implementation of the program could increase the rebate to $5,000, be made mandatory for properties most at risk for sewer backups, or could be expanded to include properties at risk from backups during larger storm events. Implementation of the program on a mandatory basis for the most at-risk properties would include the more than 100 properties that reported sewer backups and could potentially include up to 200 properties with retroactive reporting after a program announcement. Such a mandatory program would cost up to $1,000,000. The program could further broaden the participation criteria to include properties within the larger area north and west of Bloomingdale and LeDroit Park that are predicted to be at risk of sewer backups during up to a 15-year storm, or properties that simply have a plumbing fixture or drain that is below the elevation of the next upstream manhole cover in the public sewer. This broader program could potentially include more than 6,000 properties. If implemented on a voluntary basis and assuming a 15% participation rate, the program could cost up to $5,000,000. Together, the mandatory and broadened voluntary programs could cost up to $6,000,000.

DC Water currently funds and manages the backwater valve rebate program, which does not have a defined end date. Management is currently being turned over to DCRA, and the future funding source has not been determined. The program would remain an effective means to properties from sewer backups until long term remedial measures are constructed to increase the sewer system capacity (refer to Section 5.3).

5.1.3 Engineering Consultations

5.1.3.1 Technical Objectives

Following the July storms, DC Water procured an engineering firm to provide consulting services to residents in Bloomingdale and LeDroit Park. Upon the request of the individual homeowner or resident, consultants conduct inspections by walking the outside perimeter of the property. Consultants investigate possible causes of overland flooding, and recommend flood control actions that the homeowner may take to prevent future surface flooding.

5.1.3.2 Design Approach

DC Water generated a floodproofing guide, focused on identifying the sources of overland flooding, for consultants to distribute to residents during the overland flooding home consultations. The floodproofing booklet offers guidance for three basic approaches to home flood control: keep the water out, keep the water away, and keep your system working. Measures to achieve these goals are explained and include solutions such as gutters, downspouts, splash pads, yard grading, sealing cracks, raised steps, sump pump systems, backwater valves, and others.

In addition to the floodproofing guide, the homeowner receives a detailed engineering report with recommendations for their specific property within seven days of the consultation. These recommendations include, but are not limited to, yard re-grading measures, floor drain valve/plug, and door barriers. The post-consultation report contains sketches of the property with specific suggestions for multiple types of flood mitigation techniques. DC Water will keep these records by request for future homeowners.

5.1.3.3 Implementation

Consultations were offered at no charge to the homeowner beginning in mid-August, and are proposed to continue for as long as there is an interest in the service. Each consultation takes approximately 90 minutes, and appointments are available from 7 a.m. to 7 p.m., Monday through Saturday.

DC Water currently funds and manages the program. The approximate cost of each consultation is $750. The program is particularly effective for property owners that are most at risk to the impacts of surface flooding. However, even though more than 50 property owners have requested and received consultations to date, a relatively small number of these properties actually experienced surface flooding (see Section 3.3). Based on known and predicted areas of surface ponding and flooding, up to 800 properties may actually experience some adverse impacts. Continuation of the program would likely require funding to serve up to 100 properties in order to meet demand at participation rates of 10% to 15%, costing up to $75,000. The program could be combined with other surface flood mitigation programs, such as Removable Barriers (Section 5.1.4 below), which would require consultations to implement customized solutions.

5.1.4 Removable Barriers

5.1.4.1 Technical Objectives

The purpose of removable barriers is to keep water out of the basement or street level ground floor of individual buildings. Considered a dry floodproofing technique, removable barriers are used to protect structures from overland flooding during the event of heavy rainfall. However, they do not protect against sewer backups. These devices are easily installed and can be inexpensive in relation to other permanent floodproofing measures, such as elevated entrance steps.

5.1.4.2 Design Approach

During the July and September flood events, several residents reported interior flooding from surface water that exceeded curb heights and ran across walkways or yards into buildings. Another concern expressed by residents was flooding caused by vehicles driving through flood water and sending a wake across sidewalks. There are several types of household door guards available to mitigate impacts from these forms of overland flooding. Removable barriers are typically made from a single piece of rigid plastic, aluminum, or steel that can be placed across doorways and other low-level openings. A permanent bracket must be installed

Heavy floodwaters exceed curb heights and sidewalks (Photo taken July 11, 2012) across the door threshold and up each side of the doorway for one to three feet which frames the flood barrier. This device protects the doorway or window opening, but does not protect the adjacent façade or foundation. The goal of the device is to provide an alternative to sand bags and is applicable for single and double doors.

Typical single door frame removable flood barrier

Removable door barriers are meant to be simple, self-contained devices. The panel can be installed within five minutes and requires no special skills. The initial installation of the permanent bracket should be done by a qualified contractor and can be completed within two hours assuming there aren't major complications. The bracket threshold is ADA compliant so it can remain in place during dry weather. Residents can store the panels in their homes and insert them easily. For example, the panels could be inserted when leaving for several hours if rain is predicted that day, or a resident at home could observe street conditions and wait until flooding is imminent before inserting the panel. There is little inconvenience if flooding does not occur. The removable barriers do not require electricity to activate, so they will work if there is no power.

Deciding whether or not installing a removable barrier is appropriate for a property will require careful consideration and outside consultation. The functional and cosmetic changes to a property associated with removable barrier installation include access, appearance, and landscaping. Therefore, the property owner's preferences need to be incorporated into the customized design and installation of each removable barrier system. Issues that should be addressed include:

- Aesthetics Concerns – Although physical and economic considerations may determine feasible removable barrier measures for individual buildings, the property owners may consider other factors such as aesthetics equally or more important.
- Economic Considerations – The cost of acquiring and installing removable barriers depends on a variety of factors, including the building's condition, the design flood elevation, the choice of materials and their local availability, the availability and limitations of local labor, other site specific issues (e.g., soil conditions and flooding levels), special considerations for historic properties, and other hazards. All of these considerations may affect the total cost to the homeowner.
- Risk Consideration – Knowing the exceedance probability of floods and the design flood levels will assist the property owner in evaluating the pros and cons of removable barriers specific to their home. Removable barriers may be unnecessary for properties located above the sidewalk level, thus site-specific evaluation is necessary.

5.1.4.3 Expected Effect

The expected impact from widespread implementation of removable barriers in Bloomingdale and LeDroit Park can only be estimated through on-site engineering consultations that would assess the need for removable barriers for individual households. However, data from DC Water's Flooding Survey for Bloomingdale and LeDroit Park Customers and anecdotal accounts on the locations of severe overland flooding and ponding offer a preliminary sense of the focus area for implementation. These locations would include:

- Properties bounded by First Street, Second Street, Randolph Place, Florida Avenue NW;
- Properties bounded by First Street, Rhode Island Avenue, and Seton Place NW;
- Properties bounded by Second Street, Rhode Island Avenue, and T Street NW;
- Properties bounded by First Street, Second Street, Thomas Street, and T Street NW;
- Properties bounded by First Street, Second Street, U Street, and Thomas Street NW;
- Properties bounded by First Street, Flagler Place, W Street, and V Street NW;
- Properties bounded by Flagler Place, Second Street, Adams Street, and W Street NW,
- Properties bounded by First Street, Flagler Place, Adams Street, and W Street NW,
- Properties on both sides of First Street NW from Florida Avenue NW to Bryant Street NW;
- Properties on the south side of Channing Street NW from North Capitol Street to First Street NW;
- Properties on both side of Adams Street NW from North Capitol Street to Second Street NW;
- Properties on the west side of Flagler Place NW from U Street NW to W Street NW;
- Properties on the north side of U Street NW from First Street NW to Second Street NW;
- Properties on the south side of Seaton Place NW from First Street NW to Second Street NW;
- Properties on the north side of T Street from Second Street NW to Third Street NW;
- Properties on the north side of Florida Avenue NW from Third Street NW to T Street NW; and
- Properties on the east side of Florida Avenue NW from V Street NW to Sherman Avenue NW.

If implemented to include all of the locations listed above, removable barriers could benefit 800 properties. However, removable barriers do not protect against sewer backups, and therefore only constitute part of the solution to the flooding problems in Bloomingdale and LeDroit Park. A complete assessment of the effectiveness of removable barriers would involve an analysis of off-site flooding impact, although presumably, the magnitude of such an effect would be negligible. Removable barriers may concentrate runoff to nearby properties, and create diversions in the natural drainage pattern. With these considerations in mind, a strategic plan for removable barrier implementation would involve site-specific evaluation at the neighborhood scale.

5.1.4.4 Implementation and Associated Costs

A comprehensive program for removable barriers would identify properties within the affected region that have already been, or are anticipated to be affected by overland and surface flooding. Individual properties would need to be evaluated for all door openings through which floodwater can enter the building. Removable barrier height would be determined based on the predicted or known historical water surface elevation, and additional retrofitting activities may be warranted based on property-specific building structure and material requirements. Because removable barrier systems are customized for individual properties, the cost of delivery and installing also varies depending on each property owner's specific needs and selected manufacturer. Estimated itemized costs are summarized below (Table 5-1) and represent what a homeowner or business owner could expect to pay per unit for various types of removable barriers and exterior flood proofing. For examples of removable barrier products, refer to Appendix 6: Flood Mitigation Technologies.

Table 5-1: Itemized Costs per Household for Removable Barriers

Mitigation Option	Size	Delivered Cost	Installation Cost	Total Cost Range
Single Doorway	40” Length, 10” to 30” Height	$150 to $970	$0 to $130	$150 to $1,100
Double Doorway	72” Length, 10” to 30” Height	Approx. $790	$0 to $130	$790 to $920
Perimeter Flood Proofing	160’ Length 24” Height	Approx. $2,000	Approx. $4,160	Approx. $6,160

Popular manufacturers include “Precision Doors and Hardware,” “Flood Panel,” and “PS Doors.” Barriers can fit single door frames or double door frames, and can have different heights depending on water depth during past floods. Barrier materials also affect price. Installation cost varies because some owners may attempt to install the bracket themselves, although hiring a qualified professional is strongly recommended. Again, additional barriers for other doors, windows, and low-level openings would be at increased cost. Floodproofing of the building’s walls up to 24 inches is also estimated above, but the extent required will vary by building.

Due to the individualized nature of removable barrier installation, cost, and effectiveness, the implementation of a Removable Barrier Program would involve multiple components. These components, detailed below, would include an economic mechanism that would incentivize at-risk properties to consider removable barrier installation, engineering consultations with customized recommendations for installation, and informational workshops staged at the community level.

Rebate Program – To offset a portion of the costs associated with removable barrier installation, a program for removable barriers would include a rebate. A rebate program would be offered to residents that meet eligibility requirements, and could be designed similarly to DC Water’s current Backwater Valve Rebate Program. Eligibility criteria may include:

- An engineering consultation report that identifies all water entry locations where removable barriers and other floodproofing measures, such as sealants, may be required;
- Proof that a backwater valve has been properly installed or will be installed to ensure that the property is adequately protected from sewer backups;
- Proof of attendance of at least one workshop about initial installation, operation and maintenance provided by the District or DC Water;
- Proof of a household emergency operation plan;
- Proof of an annual self or professional inspection and maintenance plan; and
- A permit from DCRA, if required.

Individual Property Consultations – Removable barriers are part of the flooding solution insofar that they protect the openings of properties. However, they do not protect the adjacent façade or foundation of buildings, and will not completely protect an individual property from overland flooding. Building material considerations may require additional retrofitting, since removable barrier brackets cannot be attached to vinyl siding, and standard brick must be sealed first to provide effective flood protection. Buildings that are structured with traditional wood frame walls may not benefit from removable barrier systems at all if flooding occurs at significant depths. In such cases, a door barrier will not be useful without retrofitting the building's foundation and sides.

Individual consultations with a qualified engineer or manufacturer's representative are necessary to determine the benefits of a removable barrier system. Some manufacturers' representatives are available at a rate of about $1,200 per day (Flood Panel, LLC), but it may be possible to complete several evaluations in one day, reducing the cost per building. These consultations could be made a part of the DC Water Engineering Consultations that have already been offered to residents affected by the July and September flood events (see Section 5.1.3 above).

Installation Workshops and Training Seminars – Training seminars and workshops could be offered to educate homeowners on the proper use and maintenance of their removable barrier system. These would be held at a centralized location within the community in order to serve as many property owners as possible. One manufacturer, PS Doors, has quoted one-day training seminars to cost $1,900. Seminars would demonstrate proper installation and storage techniques.

Program implementation would also take into account existing code and regulatory requirements. Most codes and regulations that regulate building activities, such as Construction Codes, Flood Hazard Rules, Zoning regulations, Erosion and Sediment Control and Stormwater Management regulations, are implemented and enforced with the intent of protecting public health and safety. The resident or homeowner is responsible for inserting and removing the barrier and, once installed, it will impede access. Therefore, if implemented for entire neighborhood blocks within Bloomingdale and LeDroit Park, the removable barrier program will need to be coordinated with the fire department, police department, and EMS.

Considering the precedents that have already been established for this program through the Backwater Valve Rebate Program and the engineering consultations offered by DC Water, a Removable Barrier Program could be implemented within a reasonably short time span. Although removable barriers do not protect against sewer backups, a program of this size would reduce the impacts of surface flooding and directly benefit residents eligible for program participation. As identified through reports of overland flooding and ponding, large scale implementation of the program would include 800 properties. The recommended rebate for this program would be 90% of costs, up to $3000, which would cover the cost of a doorway barrier installation and an allowance for perimeter barriers or other floodproofing measures. The total Removable Barrier Program cost for implementation at 100 properties, assuming a participation rate of between 10% and 15%, would be $300,000.

5.1.5 Rain Barrel and Cistern Initiative (Targeted Neighborhoods)

5.1.5.1 Technical Objectives

To help control full-scale flooding in the Bloomingdale and LeDroit Park neighborhoods, DC Water and the District Department of the Environment (DDOE) have established the District's Rain Barrel/Cistern Program. Rain barrels and cisterns are effective at capturing localized stormwater runoff on individual homeowners' properties, typically from rooftops via rain gutters. Through this program, DDOE will offer residents the option of selecting a rain barrel or cistern to help reduce the stormwater runoff that can flow from their properties and into streets, which in turn reduces larger flooding problems.

5.1.5.2 Design Approach

Rain barrels capture runoff from rooftops for later use around the home or garden

The Rain Barrels Initiative for Bloomingdale and LeDroit Park is based on the RiverSmart Homes program that is in place City-wide. The RiverSmart program offers homeowners up to two 130-gallon rain barrels. Rain barrels are installed above ground adjacent to homes and are connected to downspouts. During rainfall events, rooftop runoff is stored in the rain barrels. The collected rain water can then be used for irrigation or otherwise drained during dry periods to create more storage for the next rainfall event. For the targeted areas in the Bloomingdale and LeDroit Park neighborhoods, under the new initiative DDOE is offering rain barrels or larger cisterns of up to 500 gallons for residents to choose from.

5.1.5.3 Expected Effect

As many as 250 properties may be served under funding for the current initiative. Based upon an average of 250 gallons of cistern or rain barrel capacity installed per property, DDOE expects to be able to catch 62,500 gallons of stormwater during each storm. Although this work has actively involved residents in the solution to flooding issues in Bloomingdale and LeDroit Park, it is understood that these low-tech efforts, on their own, will not solve the flooding issues. In order to expand the efficacy of this type of solution, additional cisterns could be installed in the Bloomingdale neighborhood but also in the upper area of the sewershed (Section 5.2.6).

5.1.5.4 Implementation and Associated Costs

DDOE is spearheading the fast-track action of deployment of rain barrels and cisterns in the Bloomingdale and LeDroit Park neighborhoods. The program was implemented and began accepting applications on October 1, 2012. DDOE began conducting stormwater audits of properties in late September. During the audit, the DDOE auditor and the homeowner come to agreement on the type and size of cistern that is desired and is appropriate for a homeowner’s yard. As part of the audit, DDOE educates homeowners on the need to empty the barrels prior to each rainstorm. Additional education comes from DDOE’s nonprofit partner, DC Greenworks, who speak to homeowners about proper usage of cisterns during the installation process. DDOE also adds participants to the agency’s community email list, which sends out maintenance reminders and other green tidbits for the homeowner’s information.

Deployment of this program is currently occurring in areas delineated by DC Water as having been impacted by flooding in the past. Once an audit is complete, the information is being transferred to DC Greenworks, who arranges with the homeowner to install the rain barrel or cistern. The cisterns are typically installed within three to four weeks of the homeowner’s initial phone call to request an audit. Installations began in late October and will continue through November and likely into December until funding or demand has been expended. As of early November, approximately 120 audits were completed, and demand seems to be tapering off.

The $45 co-pay that is typically charged to the homeowner under the RiverSmart Program is not being collected under the present initiative in Bloomingdale and LeDroit Park. Also, after-hours and weekend services are being provided to accommodate the schedules of homeowners. DC Water is funding the project with $250,000 through an MOU with DDOE. The typical installed cost of a rain barrel or cistern under the initiative is $1,000. Based on lower-than-expected participation, the total funding and benefit may not be utilized.

5.1.6 Small Scale Stormwater Retention Projects (Green Infrastructure)

5.1.6.1 Technical Objectives

Green infrastructure (GI) measures can intercept stormwater runoff at or near its source, allowing relatively small facilities to contribute significantly in aggregate to controlling or reducing stormwater runoff. In addition, GI offers other benefits such as reduced heat island effect, aesthetic improvements, increased property values and other benefits. Strategies considered for short-term implementation in Bloomingdale and LeDroit Park include bioretention (or rain gardens) and pervious paving. While both technologies help reduce overland flooding, they do not reduce sewer backups.

The purpose of bioretention basins is to capture and hold surface runoff so that it does not enter the storm sewer network. They typically consist of shallow depressions six to twelve inches deep that are planted with grass, small shrubs, or trees, and have amended soils to readily absorb water. Ideal applications are medians, tree boxes, and areas with excessive pavement. This technology is capable of treating very small volumes of immediately local surface water. Bioretention basins will need to be implemented in several locations in the Bloomingdale and LeDroit Park communities for them to be helpful with flood mitigation.

Permeable (or porous) paving allows rainwater to seep through the paved surface and into the soil below

One of the primary sources of stormwater runoff is paved area. Permeable pavement provides a paved surface while allowing water to pass through to a stone base where it is stored until the stormwater either soaks into the ground or drains through an underdrain once the flooding has passed.

5.1.6.2 Design Approach

DDOT studied the flood-prone areas near Rhode Island Avenue and First Street NW for potential green infrastructure implementation, and selected the triangle park at the intersection of T Street NW on the 100 block of Rhode Island Avenue for a bioretention basin (Figure 5-5). This location is based on reports of past flooding, street geometry, underground utilities, and community input. Other options will continue to be investigated for feasibility. This area will help remove ponding water from adjacent streets and sidewalks and allow stormwater to gradually drain into the storm sewer once the flooding has passed.

Native plants diminish the use of pesticides, herbicides, and fungicides, thereby promoting cleaner water quality

INTERSECTION OF RHODE ISLAND AVE AND 1ST STREET NW

KEY:
1 PERMEABLE PAVEMENT + UNDERGROUND STORAGE
2 RAIN GARDEN + UNDERGROUND STORAGE
3 UNDERGROUND STORAGE
4 CATCH BASIN RETROFIT

FLORIDA AVE NW

KEY:
1 CATCH BASIN RETROFITS AND REPLACE INLETS

MAYOR'S TASK FORCE REPORT
ON THE PREVENTION OF FLOODING
IN BLOOMINGDALE AND LeDROIT PARK

DDOT'S BLOOMINGDALE AND LeDROIT PARK INFRASTRUCTURE IMPROVEMENTS

DATE: DECEMBER 2012 | FIGURE 5-5

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DRAWING ID: L:\LTCP\11\1110 - DIV J\01 - PRE-DESIGN\700 - CADD\CURRENT\EXHIBITS\BLOOMINGDALE\FIGURE 5-5 DDOT'S INFRASTRUCTURE IMPROVEMENTS.DWG

Bioretention areas are designed to drain within 72 hours so mosquitoes cannot breed. The underdrain discharge piping, which connects to the combined sewer system, will be equipped with check valves in order to ensure that sewage backflow will not enter the filter media when the sewer surcharges during flood events.

Bioretention practices include rain gardens, bio-swales, vegetated filter strips, and tree box filters

Source: The Low Impact Development Center, Inc.

Some key advantages and disadvantages to bioretention are noted as follows.

Advantages:

- Captures small amount of overflow.
- Receives runoff from several very small areas.
- Reduces immediately adjacent ponding of water.
- Stores water and allows it to drain into ground, or into storm drains after peak flow passes.
- Water drains quickly enough that mosquitoes can't breed. Bioretention area remains dry except during storms.

Disadvantages:

- Can be washed out during flooding.
- Plants must be durable.
- Will not eliminate flooding.
- For Bloomingdale and LeDroit Park, only effective if applied throughout the neighborhood.
- Does not protect against wastewater backflows.
- Could become a sanitary concern if bioretention area fills with wastewater during flooding.

Meeting invitation to inform Bloomingdale community of a local paving project

Permeable pavement is intended to capture immediately adjacent surface water from small areas. Optimal locations include existing paved areas where water collects, such as parking lanes, alleys, and some sidewalks. It is not applicable to streets and other areas with heavy traffic. Underground utilities and depth to groundwater will also limit where permeable pavement can be placed.

DDOT has selected the alley behind Mount Bethel Baptist Church off of First Street for permeable pavement. A permeable surface will be constructed from the entrance at First Street extending for about 140 feet. The center portion of the alley will be permeable, and the edges will be traditional brick; however, the color will be uniform. There will also be a storage pipe under this permeable brick to store water. A traditional stone bed is not adequate for water storage due to adjacent utilities.

The underdrain discharge piping, which connects to the combined sewer system, will be equipped with check valves to ensure that sewage backflow will not enter the filter media when the sewer surcharges during flood events. Permeable pavement must be kept clean to prevent clogging. On average, it should be swept twice per year with a vacuum sweeper, but more frequent sweeping may be required if the pavement is subjected to sediment-laden flood water. Additional equipment may be needed depending on the size and location of permeable pavement areas constructed.

Some key advantages and disadvantages to pervious paving are noted as follows.

Advantages:

- Captures small amount of overflow.
- Receives runoff from several very small areas.
- Reduces immediately adjacent ponding of water.
- Stores water and allows it to drain into ground, or into storm drains after peak flow passes.

Disadvantages:

- Will not eliminate flooding.
- In this case, only effective if applied throughout the neighborhood.
- Does not protect against wastewater backflows.
- Potential risk of sediment from wastewater clogging pores with repeated flooding.
- Requires street sweeping and vacuuming approximately twice per year.

5.1.6.3 Expected Effect

Green infrastructure can play a supporting role in the overall flood reduction solution, but will not provide large scale flood mitigation. The bioretention basin planned for the intersection at T Street, which is currently under design, will likely detain over 1,500 gallons of stormwater. The pervious paving system planned for the alley behind the Church is also under design, and will likely detain over 1,500 gallons of stormwater. This is a small volume in comparison to the millions of gallons of stormwater runoff that cause flooding, but serves as a representative project that could be replicated throughout the drainage area, and at a larger scale, provide a much more significant impact.

5.1.6.4 Implementation and Associated Costs

DDOT will begin the first phase of installation in the vicinity of Rhode Island Avenue and First Street NW. This is expected to take approximately six months to complete several areas, depending on weather, with a projected completion date of March 31, 2013. Surveying has already been completed, and design is underway.

Construction of permeable pavement will require temporary closure of adjacent parking spaces and either partial or entire sidewalk width. Notices will need to be provided ahead of time. Deliveries to businesses will have to be coordinated so that a clear access path is maintained on necessary days. Trash and recycling collection schedules will need to be discussed with DPW and possibly altered to facilitate construction. Owners may need to place containers in a different spot for collection. Alleys will likely not be accessible throughout construction duration, which could last a couple of weeks. This will affect deliveries in alleys, parking/back yard access, and private contractors' schedules. All construction depends on weather.

The project is being funded by DC Water for $1,100,000 through an MOU with DDOT. The green infrastructure portion of the work, including design and construction, is approximately $370,000. Based on estimated unit costs for green infrastructure technologies implemented by the RiverSmart Program, WERF, and the EPA, the average cost for permeable pavement is $15 per square foot. The average cost for bioretention basins is $32.50 per square foot. These unit costs, for construction only and not including design, could possibly be realized if the project were expanded on a larger scale.

5.1.7 Catch Basins

5.1.7.1 Technical Objectives

Catch basins are typical components of the permanent surface drainage infrastructure. Their purpose is to collect rainwater runoff and convey it to the underground storm drain pipes for transmission either to nearby water bodies or water treatment facilities. Catch basins are technically simple, consisting of a concrete box with a curb opening or grate opening to catch water. The District uses standard double catch basins measuring three feet, six inches wide by nine feet, eight inches long by seven feet deep. For areas with large volumes of runoff, additional catch basins are employed to drain a specific street section. The structures are not intended for water storage or throttling; however, there is some minimal storage capacity within the basin.

5.1.7.2 Design Approach

DDOT has evaluated the Bloomingdale and LeDroit Park neighborhoods for locations that could benefit from additional, relocated, or replacement catch basins. Candidate sites are those which have excessive surface runoff that overwhelms the existing basins even though the underground storm pipes still have capacity. Additional pipe capacity can be determined by visually observing the inlet during surcharge to see if there is turbulent flow or swirling water, which indicates that water is getting into the receiving pipe. This is similar to how water behaves in a bath tub after removing the drain plug. Another way to check capacity is to survey the sewer network and then run a computer simulation of a rain storm. Both of these techniques have been used for siting potential new catch basin locations. Catch basins can then be easily installed along existing pipes without any special design. Additionally, once installed, there is no operational requirement. There are no valves to open or flood gates to activate.

Crews remove debris from catch basins

Advantages

- Can help to drain low-lying areas where water collects.
- Easily connect to existing storm pipes beneath streets.
- No special design needed.

Disadvantages

- Only work if there is capacity in the receiving pipe.
- Water can come up out of catch basins and flood roadway if receiving pipes are over-loaded.
- There is risk of additional wastewater on streets.

- Inconsequential added water storage capacity.
- Will not reduce wastewater backflows into buildings.

DDOT has identified six initial locations for new or expanded catch basins. Four are in the 500 Block of Florida Avenue and two are in the Unit block of T Street NW in the vicinity of First Street and Rhode Island Avenue.

5.1.7.3 Expected Effects

Catch basins are not intended for flood control, and understanding their limitations for this use is critical. Most importantly, if the storm drainage pipes beneath the street are over capacity, then adding catch basins will have no effect. Since Bloomingdale and LeDroit Park are in combined sewersheds, any catch basins will allow combined wastewater to back up into streets when the pipes are overloaded. Further, these structures can only control surface water. They do not reduce wastewater backflows into buildings. They also do not increase wastewater backflows into buildings due to the self-leveling characteristic of water. If water runs down a curb gutter to a low spot where water is collecting, it will add pressure (or "water weight") to the catch basins and pipes and force water to back up into the underground pipe network until it achieves equilibrium. The mass of water in the pipes balances with the pressure of water that is ponding on the street. If new catch basins are added and water gets into the pipe network faster, then the water mass in the pipe network will increase until it balances with the water sitting on the street. Nevertheless, catch basins provide minor storage volume, and given the scale of flooding in these neighborhoods any storage is insignificant. Each double basin can hold approximately 105 cubic feet (788 gallons) of water. Given the scale of flooding in these neighborhoods, catch basins cannot be used as a means to detain large volumes of water.

5.1.7.4 Implementation and Associated Costs

Although these drainage structures are commonly available, installing one requires advanced coordination like any other infrastructure project. One catch basin takes approximately two days to complete. Residents and business owners must be notified of parking and travel lane restrictions, as well as noise, dust, and accessibility inconveniences. Surveying and design of the catch basins on Florida Avenue has already been completed, and design of catch basins on Rhode Island Avenue is underway. The catch basins on Florida Avenue are scheduled to be completed by November 30.

Construction of a proposed grate inlet at the alley entrance on the south side of Florida Avenue between Fifth and Sixth Streets NW may limit alley access during construction. As with permeable pavement construction in alleys, coordination with DPW will be necessary for collection of trash and recycling. Residential deliveries will also be affected.

The project is being funded by DC Water for $1,100,000 through an MOU with DDOT. The catch basin portion of the work, including design and construction, is approximately $155,000. The cost to install a catch basin includes labor, equipment, and materials, as well as less tangible costs such as additional driving time through the work zone, additional time for pedestrians having to use less convenient crosswalks and sidewalks, and lost business during construction due to people avoiding construction areas.

5.1.8 Detention Vaults

5.1.8.1 Technical Objective

Detention vaults are underground chambers that catch, hold, and detain stormwater from immediately entering storm sewer pipes. The vaults can be proprietary tanks made specifically for stormwater detention, or they can be a series of standard concrete pipes with a control outlet that will gradually release the water once flooding has passed. Street catch basins can be redirected to flow into detention tanks with outlet control devices, which will reduce the peak flows reaching the sewer line. Detention vaults reduce surface flooding by capturing and storing runoff that would otherwise flow into streets. As a result, properties located downstream of detention vaults also receive protection from overland flooding.

5.1.8.2 Design Approach

DDOT has initiated a pilot project that would place a detention facility beneath the median on Rhode Island Avenue between First Street and Second Street NW. The preliminary design accounts for a storage volume of approximately 50,000 gallons. The median has minimal utility conflicts and is wide enough to allow installation without causing significant impacts to street traffic. This location has been subject to flooding that overtopped the curb, entered businesses and residences, and damaged vehicles. This project is already underway as a short-term mitigation strategy, and could be expanded upon in the medium-term for other locations throughout Bloomingdale and LeDroit Park. Neighborhood intersections and street lengths with reported surface ponding could be targeted for detention vault implementation.

5.1.8.3 Expected Effects

Detention vaults will provide some immediate surface flooding and ponding relief to neighborhood blocks directly adjacent to the vaults, and could reduce flooding for some downstream properties. However, they will not provide large scale flood mitigation. The 50,000-gallon detention facility currently under design for the median in Rhode Island Avenue is a relatively small volume in comparison to the millions of gallons of stormwater runoff that cause flooding. It is difficult to quantify the exact number of properties that would be positively affected through implementation. The DDOT project represents a short-term remedial measure that could support a more comprehensive overall flood mitigation strategy.

5.1.8.4 Implementation

DDOT will begin the first phase of installation in the vicinity of Rhode Island Avenue and First Street NW. This is expected to take approximately six months to complete, depending on weather, with a projected completion date of March 31, 2013. Surveying has already been completed, and design is underway.

Construction will likely require closing both inside lanes along Rhode Island Avenue while the work zone is active during each day. Parking lane restrictions should be anticipated to maintain traffic flow and to accommodate construction equipment. Construction time for the detention vaults will vary depending on weather, traffic control, and construction phasing restrictions.

The project is being funded by DC Water for $1,100,000 through an MOU with DDOT. The detention storage portion of the work, including design and construction, is approximately $575,000.

5.1.9 Summary of Short Term Remedial Measures

Table 5-2 presents a summary of the short-term remedial measures evaluated in this report. Backwater valves provide the greatest benefit for properties that experience sewer backups. The cost is significant for each property where backwater valves are installed, and the total cost to implement this strategy over the affected area could approach $6,000,000. Removable barriers provide the greatest benefit for properties impacted by surface flooding, but relatively few properties experienced surface flooding according to current reporting. The cost is significant for each property where removable barriers are installed. Other strategies have a lower direct benefit to properties, but are nonetheless worthwhile for consideration because they support the goals of delaying stormwater runoff from entering the sewer system or collecting runoff from the surface more efficiently.

Table 5-2: Summary of Short Term Remedial Measures

<table>
<tr><th>Section</th><th>Alternative</th><th>Reduces Sewer Backups</th><th>Reduces Impacts of Surface Flooding</th><th>Stormwater Detention Provided (gallons)</th><th>Public / Private Space</th><th>Magnitude of Benefit</th><th>Cost</th></tr>
<tr><td>5.1.2</td><td>Backwater Valves</td><td>Yes</td><td>No</td><td>0</td><td>Private</td><td>High</td><td>$1M to $6M</td></tr>
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<tr><td>5.1.5</td><td>Rain Barrels</td><td>No</td><td>Yes</td><td>62,500</td><td>Private</td><td>Low</td><td>$250,000</td></tr>
<tr><td>5.1.6</td><td>Green Infrastructure</td><td>No</td><td>Yes</td><td>>3,000</td><td>Public</td><td>Low</td><td>$370,000</td></tr>
<tr><td>5.1.7</td><td>Catch Basins</td><td>No</td><td>Yes</td><td>0</td><td>Public</td><td>Low</td><td>$155,000</td></tr>
<tr><td>5.1.8</td><td>Detention Vaults</td><td>No</td><td>Yes</td><td>>18,000</td><td>Public</td><td>Low</td><td>$575,000</td></tr>
</table>

5.2 Medium Term

5.2.1 Goals for Medium Term Mitigation Strategies

Medium-term mitigation strategies are engineering systems designed to provide a significant reduction in the number of properties that experience sewer backups and surface flooding. Successful strategies will either keep stormwater runoff from entering the sewer system, or will divert sewer flow from the sewer system to storage facilities or other trunk sewers with available capacity. The medium term mitigation strategies presented herein are evaluated for performance during the 5-year rainfall event, as well as under the actual storms experienced in 2012. These strategies are also evaluated for relative cost, constructability, and implementation timeline.

The strategies that were evaluated included the following:

- Section 5.2.2 Storage at McMillan Sand Filtration Site
- Section 5.2.3 McMillan Storage and Flagler Place Pump Station
- Section 5.2.4 McMillan Storage and First Street Tunnel
- Section 5.2.5 Conveyance to Tiber Creek

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5.2 Medium Term

5.2.1 Goals for Medium Term Mitigation Strategies

Medium-term mitigation strategies are engineering systems designed to provide a significant reduction in the number of properties that experience sewer backups and surface flooding. Successful strategies will either keep stormwater runoff from entering the sewer system, or will divert sewer flow from the sewer system to storage facilities or other trunk sewers with available capacity. The medium term mitigation strategies presented herein are evaluated for performance during the 5-year rainfall event, as well as under the actual storms experienced in 2012. These strategies are also evaluated for relative cost, constructability, and implementation timeline.

The strategies that were evaluated included the following:

- Section 5.2.2 Storage at McMillan Sand Filtration Site
- Section 5.2.3 McMillan Storage and Flagler Place Pump Station
- Section 5.2.4 McMillan Storage and First Street Tunnel
- Section 5.2.5 Conveyance to Tiber Creek

- Section 5.2.6 Rain Barrels (Upstream Installation)
- Section 5.2.7 Green Infrastructure Expansion
- Section 5.2.8 Catch Basin Inlet Restrictors
- Section 5.2.9 Inflatable Flood Walls

5.2.2 Storage at McMillan Sand Filtration Site

5.2.2.1 Technical Objectives

During large rainfall events, a stormwater or combined sewage storage facility could hold a large volume of stormwater runoff during a rainfall event. Decreasing the volume of stormwater entering the collection system would reduce the peak flow in the sewer system, and consequently, reduce the possibility of sewer backups and surface flooding. The McMillan Sand Filtration Site, located immediately upstream of the Bloomingdale and LeDroit Park neighborhoods, contains several underground basins that could be retrofitted for detaining large volumes of flow diverted from the sewer system.

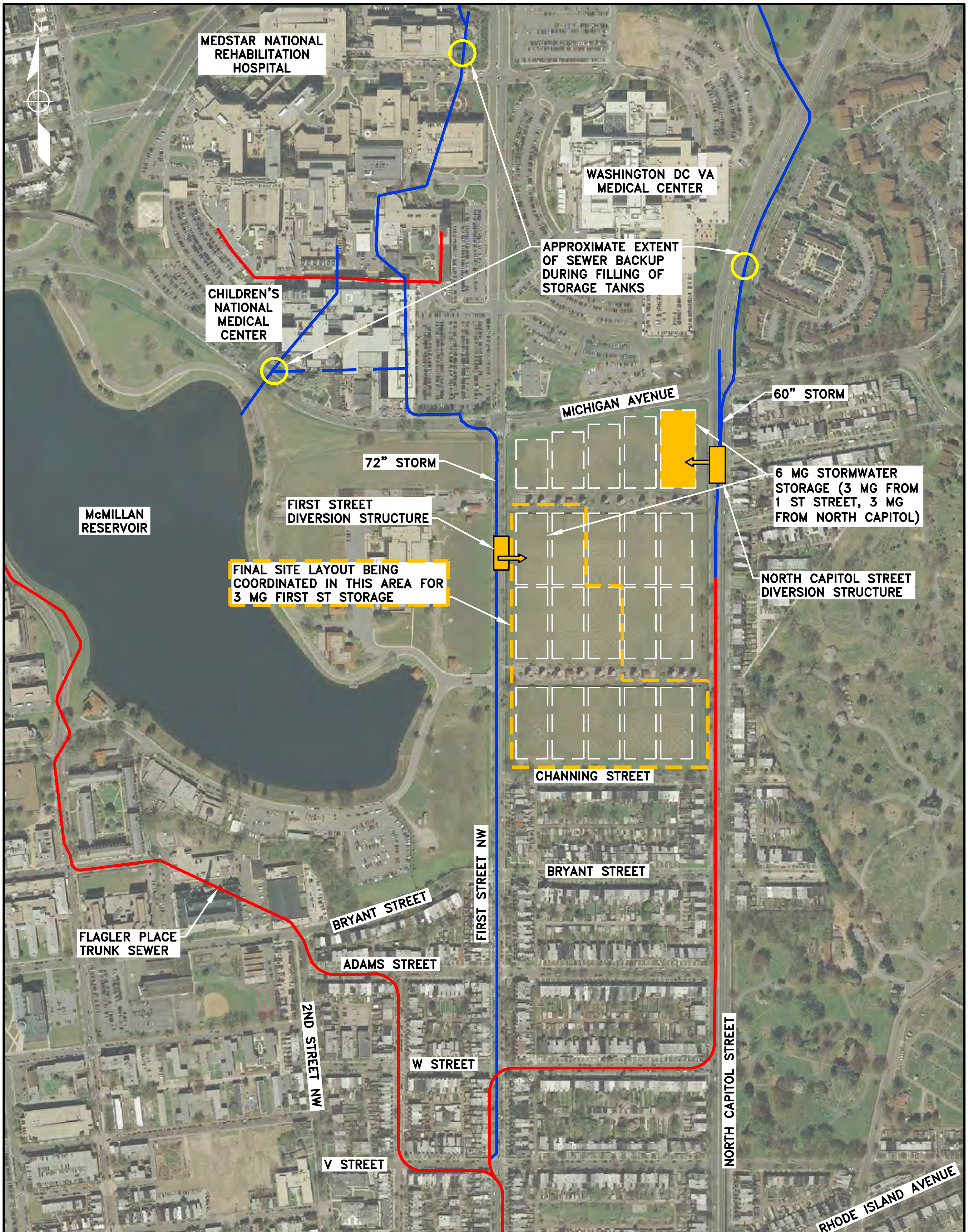
5.2.2.2 Design Approach

The McMillan Sand Filtration Site consists of 20 separate underground basins that were once used as part of a slow-sand water filtration system. The basins are constructed primarily of unreinforced concrete. Each basin could be used to provide approximately three million gallons of storage. Stormwater flow could be directed to the underground basins via two separate sewer lines: a 72 inch trunk sewer along First Street NW, and a 60 inch trunk sewer along North Capitol Street. In order to control the flow into the McMillan site, sewer diversion structures around each of the trunk sewers will be constructed in the middle of the street. The diversion structures may feature automated sluice gates equipped with level sensors or an orifice system which would not depend on electricity or sophisticated sensors to operate. In addition, a separate overflow protection system could be constructed to provide discharge by gravity for flows larger than the design storm.

To connect the diversion structures to the McMillan storage basins, interconnector pipes will be necessary, and will likely consist of inflow pipes and discharge pipes. Filling of the underground basins would be accomplished by gravity. The trunk sewers on First Street and North Capitol Street would begin filling upstream to the same elevation as the basins. The point of diversion would account for existing catch basins located along the trunk sewer, to ensure that filling of the trunk sewer and basins would not overflow into the streets. The existing trunk sewers would need to be inspected for structural integrity and would likely require some rehabilitation prior to being integrated into the storage system.

Based on the District's engineering condition assessment for the McMillan site in 2000 (Appendix 7), the existing basins along the west side and north side of the site are in fair to good structural and geotechnical condition. For the medium term, these basins can be considered for stormwater storage because they will save on costs and construction time compared to the rehabilitation necessary to use other basins that are currently in poor condition.

Refer to Figure 5-6, which shows the proposed underground basins that would be utilized if only two basins were utilized for the McMillan Storage alternative (and in conjunction with other alternatives). The northeast corner basin stands out as the best choice to divert flow from the 60 inch storm sewer along North Capitol Street, based on the following criteria:



MAYOR'S TASK FORCE REPORT
ON THE PREVENTION OF FLOODING
IN BLOOMINGDALE AND LeDROIT PARK

McMILLAN STORAGE

DATE: DECEMBER 2012

FIGURE 5-6

- Based on the District's engineering report dated in 2000, this basin is a Type II basin that has been deemed structurally and geotechnically sound in its existing condition. This basin will require minimal rehabilitation for stormwater storage over the projected medium-term mitigation target period of 10 years.
- With some moderate structural work, this basin may also be suitable for permanent storm retention pending the District's long-term proposal for the site.
- This basin is targeted as a basin that is to be preserved permanently in order to maintain the historic character of the McMillan Slow Sand Filtration site, as outlined in the developer's plan that has been presented to the District.
- This basin is adjacent and in close proximity to the 60 inch storm sewer on North Capitol Street.
- This location is upstream of where combined sewage joins with stormwater, ensuring that only stormwater is diverted. The storage of combined sewage would introduce additional design challenges compared to storing stormwater.
- This location allows the filling of underground basins at an elevation that does not risk overflowing through catch basins onto the street.

Either one of the middle-west basins along First Street NW are a good choice to store stormwater from the 72 inch storm line on First Street NW, based on the following criteria:

- Based on the District's engineering report dated in 2000, these basins are Type II basins that has been deemed structurally and geotechnically sound in its existing condition. These basins will require minimal rehabilitation for stormwater storage over the projected medium-term mitigation target period of 10 years;
- With some moderate structural work, these basins may also be suitable for permanent storm retention pending the District's long-term proposal for the site;
- These basins are adjacent and in close proximity to the 72 inch storm sewer on First Street NW.
- This location allows the filling of underground basins at an elevation that does not risk overflowing through catch basins onto the street.

Any use of the McMillan site for storage will require work on the underground basins at the McMillan site. Sand will be removed from the old filter basins so that a new concrete surface can be installed in the bottom of the tanks. Shotcrete will also be applied to the walls to provide waterproofing and crack repair. Tank dividing walls will be strengthened for an end wall condition and the adjacent unused basins will be demolished. Use of adjacent tanks reduces the number of walls that have to be reinforced for an end wall condition. It also reduces the number of adjacent basins to be demolished.

A flushing apparatus would be incorporated into the storage basin to ensure a total flush-out of the basin after each use (expected to occur twice a year). A preliminary review of existing utilities in First Street NW and in North Capitol Street indicates that protection of utilities is a consideration, but there do not appear to be any conflicts that would prevent the construction of sewer diversion facilities.

5.2.2.3 Expected Effectiveness

The diversion of sewer flows to the McMillan site was hydraulically modeled to determine the downstream impacts of storing a range of stormwater volumes. Modeling results show that implementing maximum storage as described with no other mitigation measures will result in lower ponding depths at some locations, but the Flagler Place Trunk Sewer is still predicted to surcharge above grade, leading to sewage in the street for the 5-year design storm. Sewage backups are likely to occur if the HGL is predicted to remain above the pipe crown. Table 5-3 shows model results for diverting the stormwater flow from the two trunk sewers under 5-year and 15-year rainfall events. Additional mitigation measures need to be put in place to divert flow from the Flagler Place Trunk Sewer, which could further improve conditions on Flagler Place and downstream.

5.2.2.4 Implementation and Cost

This alternative is envisioned to be implemented as part of a comprehensive mitigation project in order to be successful for medium-term flood relief. As explained in sections 5.2.3 and 5.2.4, when implemented with projects that relieve flow from the Flagler Place Trunk Sewer, the maximum benefit can be achieved using only two underground basins. The estimated cost for building the diversion facilities and rehabilitating the underground basins and trunk sewers is $12,000,000. Appendix 8 presents a summary of estimated costs. The project could be designed and constructed by Spring 2014, and completion by this date would be dependent on cooperation from District agencies acting as project stakeholders to help speed the permitting process and facilitate timely construction.

Table 5-3: Predicted Efficacy of Storage at McMillan Site

Condition	Design Storm (6-hour duration)	Major Components	Average Ponding Depth (inches)			HGL Depth Above(+) or Below(-) Grade (feet)*			Mitigates Sewer Backups	Mitigates Surface Flooding
			RI Ave Bet 1st & 2nd	Flagler Place & V St	U St & 1st St	RI Ave & 1st St	Flagler Place & V St	U St & 1st St		
Existing Conditions	5-year	Existing Conditions	22”	8”	4”	-2.4’ (pipe crown - 5.4’)	3.2’ (pipe crown -6.6’)	-1.2’ (pipe crown -6.6’)	No	No
Storage	5-year	• Divert all storm-water flow from First Street Trunk Sewer into 4.4 million gallons storage • Divert all storm-water flow from North Capitol St. Trunk Sewer into 5.7 million gallons storage	16”	8”	3”	-3.8’	1.2’	-4.7’	No	No
Storage	5-year	• Divert all storm-water flow from First Street Trunk Sewer into 2.6 million gallons storage • Divert all storm-water flow from North Capitol St. Trunk Sewer into 2.7 million gallons storage	16”	8”	3”	-3.5’	1.7’	-4.1’	No	No
Existing Conditions	15-year	Existing Conditions	25”	13”	6”	-2.1’	4.1’	-0.6’	No	No
Storage	15- year	• Divert all storm-water flow from First Street Trunk Sewer into 5.7 million gallons storage • Divert all storm-water flow from North Capitol St. Trunk Sewer into 7.0 million gallons storage	19”	12”	3”	-3.4	2.2	-3.8	No	No

*Negative (-) depths indicate below ground elevation; the smaller the number, the closer the HGL is to the street level.

5.2.3 McMillan Storage and Flagler Place Pump Station

5.2.3.1 Technical Objectives

This design alternative would entail storage of both stormwater and combined sewage flow at McMillan. In addition to stormwater diverted from North Capitol Street and First Street NW as described in section 5.2.2, up to three million gallons of combined sewage would be diverted to an additional existing basin that would be structurally retrofitted and waterproofed to contain sewage (Figure 5-6).

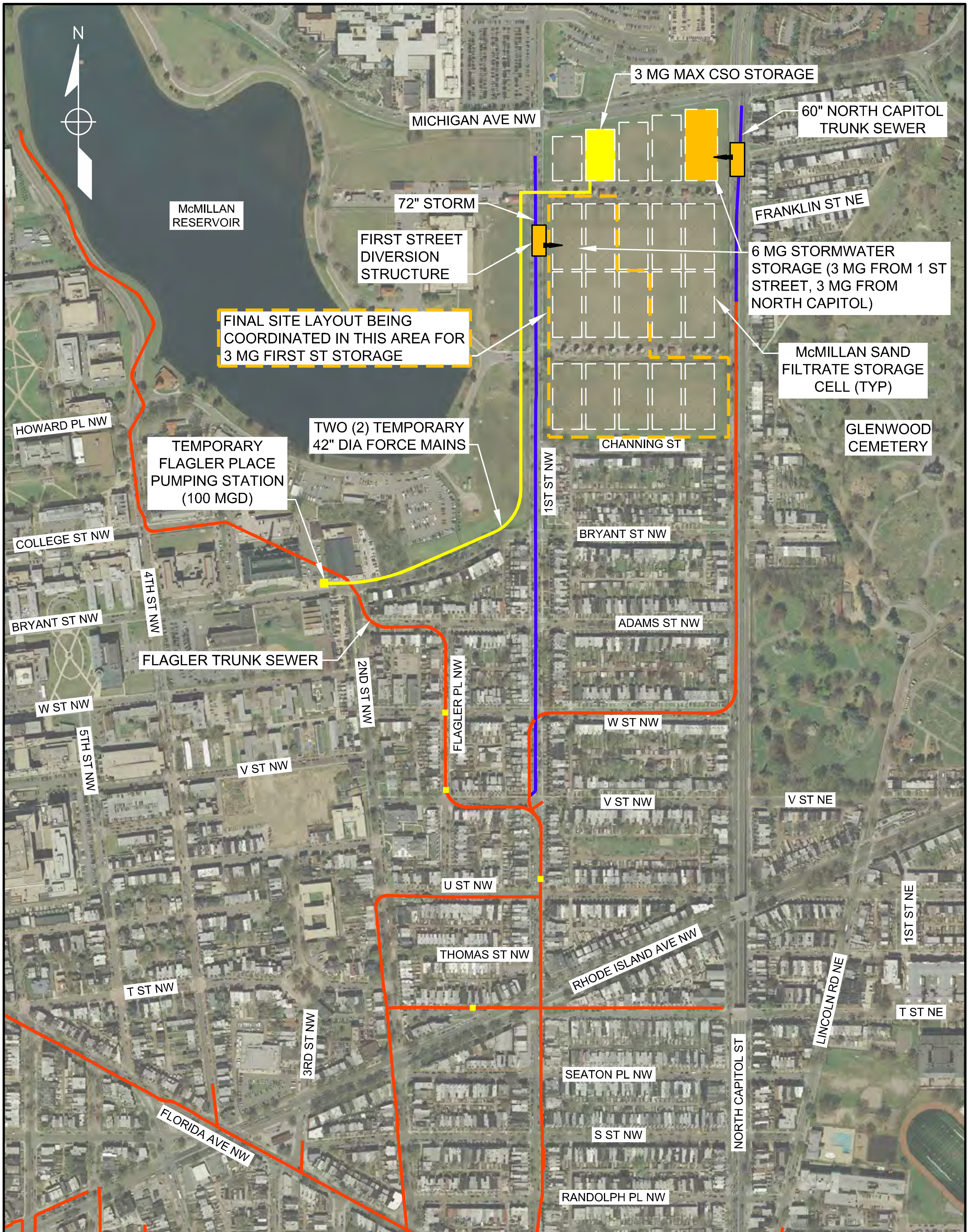
In order to reduce or eliminate surcharging along Flagler Place and First Street near Rhode Island Avenue under the 5-year design storm, it is necessary to divert a peak flow rate of approximately 100 mgd from the Flagler Place Trunk Sewer. One way this can be accomplished is to construct a pump station which will intercept flow from the surcharged trunk sewer before it passes through the Bloomingdale and LeDroit Park area. The pump station will pump the intercepted flow to the McMillan site.

The most promising location for the intercepting pump station would be near the Bryant Street (Potable) water pumping station at Second and Bryant Streets. Figure 5-6 shows a representation of the proposed pump station location, force main piping that will connect the pump station to the McMillan site, and the receiving storage basin at McMillan.

5.2.3.2 Design Approach

The key considerations for implementing a pump station of this magnitude consist of the choice of location for the intercepting pump station, the size (footprint) of the pump station required, and the length, diameter and route of piping that will connect the pump station to the McMillan site. In order for the pump station to provide the maximum benefit, the pump station must be located where it can intercept flows before they can enter the areas that are vulnerable to flooding. Locating the pump station on the Flagler Place Trunk Sewer, upstream of Second and Adams Streets, will provide maximum benefits. The pump station will require a footprint of approximately 31feet by 35 feet. The Bryant Street pump station location shown on Figure 5-7 would suit the requirements well and would also minimize the length of pipe which would need to be installed. The pump station can be located on DC Water property and be operated with minimal disruption to a residential area.

Any location further upstream on the Flagler Place Trunk Sewer would require additional length of force main to route around the McMillan Reservoir. Table 5-4 lists the options considered for designing the pump station. A temporary pump station option was explored, but is not thought to be feasible due to the high suction lift required.



MAYOR'S TASK FORCE REPORT
ON THE PREVENTION OF FLOODING
IN BLOOMINGDALE AND LeDROIT PARK

McMILLAN STORAGE AND FLAGLER PLACE PUMP STATION OPTION

DATE: DECEMBER 2012 | FIGURE 5-7

Table 5-4: Flagler Place Pump Station Implementation Alternatives

Pump Station Alternative	Pump Station Description	Force Main Configuration	Advantages	Disadvantages
Alternative A	Submersible Pumps, Permanent Pump Station 35x30	Micro-tunnel (Pipe Jacking)	Avoids utility conflicts. Less disruptive installation.	Requires pipe jacking pits.
Alternative B	Submersible Pumps, Permanent Pump Station 35x30	Open Cut Force Main	Conventional construction techniques.	Local disruptions for construction with pipe/utility conflicts.
Alternative C	Temporary Bypass Pump Station	Overland Temporary HDPE Bypass Piping	Low initial cost. Quick implementation. Minimal disruptions to install.	Higher recurring/yearly cost. Aesthetics of overland pipe.

5.2.3.3 Expected Effect

Constructing a pump station in conjunction with temporary storage at the McMillan site would provide significant flow relief in the Flagler Place and First Street Trunk Sewers where it is needed most. Reductions in the flow and depth of surcharge in the Flagler Place Trunk Sewer, which is provided through inclusion of a pump station, would translate into reductions in the frequency and magnitude of basement backups and surface flooding in Bloomingdale and LeDroit Park.

Table 5-5 compares the flooding impacts under existing conditions and with development of storage at the McMillan Site with a large pump station at Flagler Place. The predicted ponding levels are reduced to less than 6 inches for the 5-year design storm. Pipes still surcharge slightly throughout the neighborhood during the 5-year rainfall event, but much less than under current conditions.

Table 5-5: Predicted Efficacy of Storage at McMillan Site with Flagler Pump Station

Condition	Design Storm (6-hour duration)	Major Components	Average Ponding Depth (inches)			HGL Depth Above(+) or Below(-) Grade (feet)			Mitigates Sewer Backups	Mitigates Surface Flooding
			RI Ave Bet 1st & 2nd	Flagler Place & V St	U St & 1st St	RI Ave & 1st St	Flagler Place & V St	U St & 1st St		
Existing Conditions	5-year	Existing Conditions	22”	8”	4”	-2.4’ (pipe crown -5.4’)	3.2’ (pipe crown -6.6’)	-1.2’ (pipe crown -6.6’)	No	No
Storage w/ Flagler Pump Station	5-year	• Divert all storm-water flow > 15 mgd from First Street Trunk Sewer into 1.7 million gallons storage • Divert all storm-water flow > 15 mgd from North Capitol Street Trunk Sewer into 1.4 million gallons storage • Pump 1.5 million gallons combined sewage from Flagler to McMillan site • Add four new storm inlets at key surface ponding locations	1”	2”	3”	-4.5’	-4.6’	-6.6’	Some	Yes

Modeling showed that once capacity was created in the trunk sewers, some areas still experienced surface ponding from a lack of inlet capacity. In order to reduce ponding levels to nearly insignificant levels, surface inlets were incorporated into the model and would have to be constructed as part of this project in order to realize the predicted benefits. Further reduction of the HGL (and sewer backups) is possible by increasing the storage volume at McMillan and/or increasing the pump station size.

5.2.3.4 Implementation and Cost

The Flagler Place Pump Station would need to be a relatively large pump station (capacity of 80-120 mgd). The proposed location on Bryant Street is located near a combined sewer force main and a wet well near potable water storage. The force main alignment will require construction along Bryant Street and First Street and coordination with the USACE, who owns and operates the adjacent McMillan water storage reservoir. The diversion structure construction will require partial closures at First Street and North Capitol Street.

Another significant disadvantage with this alternative is that the pump station and force main would become unnecessary after the long-term solution (Northeast Boundary Tunnel) is implemented. Construction would cause various levels of disruption, and the size and costs associated with its construction will limit the storm size that the pump station could accommodate. Water and utility conflicts at Bryant Street could force a reduction in the pump station’s size or increase the cost of implementation.

Assuming construction takes place on a 24/7 basis, substantial completion of the McMillan storage component could be completed by Spring 2014 and the Flagler Place Pump Station and accompanying force main could be completed by September 2014.

The estimated cost associated with the McMillan Storage with Flagler Place Pump Station is between $29 million and $34 million including the pump station, the force main, rehabilitation of underground basins at McMillan, and a premium for emergency procurement. The cost varies depending on which configuration of underground basins is used, and how the pump station is constructed. Refer to Appendix 8 for a detailed cost summary of various alternatives.

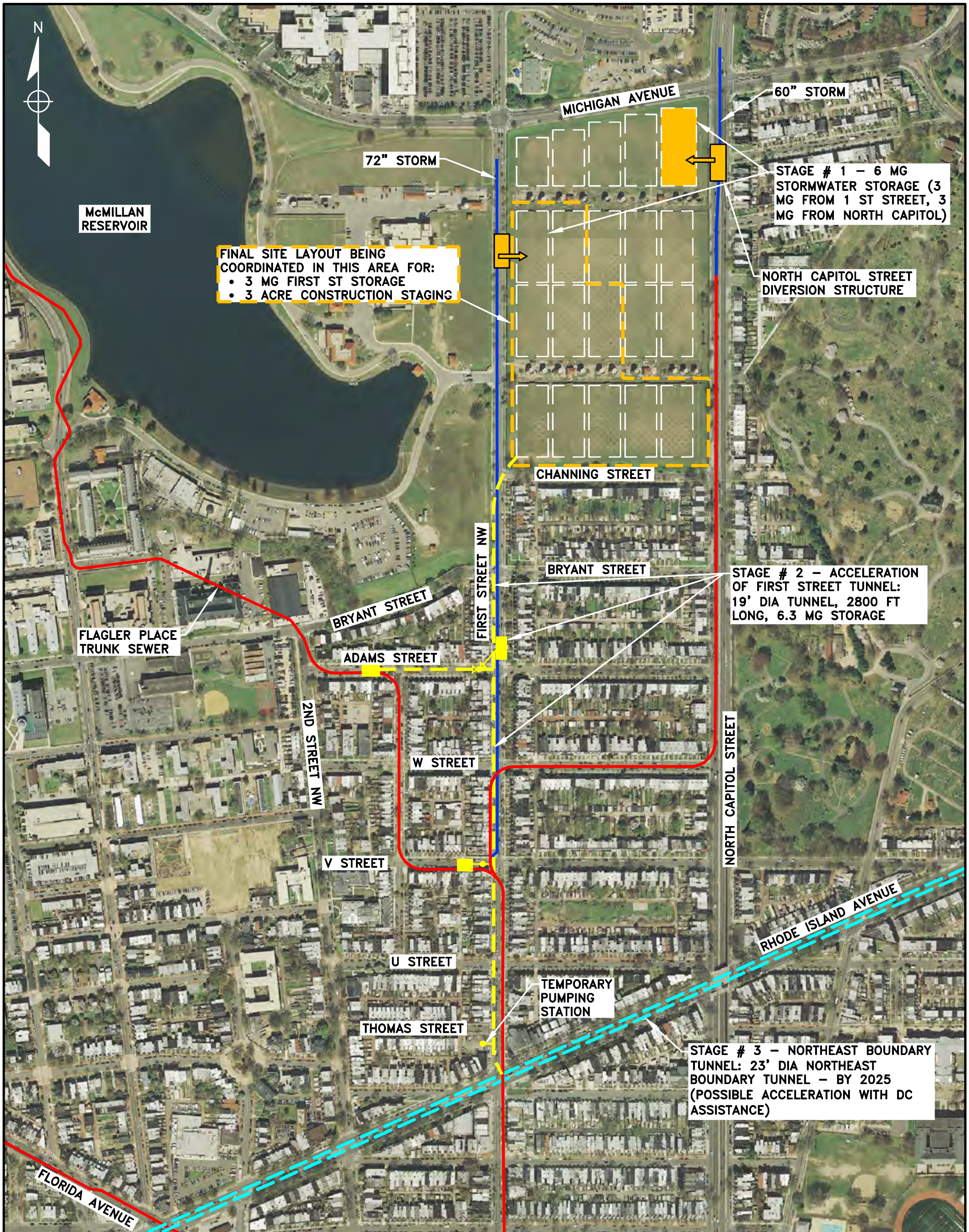
5.2.4 McMillan Storage and First Street Tunnel

5.2.4.1 Technical Objectives

This design alternative would include storage of stormwater at McMillan, and storage of combined sewage in a tunnel. In addition to stormwater diverted from North Capitol Street and First Street NW as described in section 5.2.2, up to six million gallons of combined sewage would be diverted to a tunnel constructed under First Street NW. Combined sewage would be diverted at three locations, including from Flagler Place Trunk Sewer, which would create capacity in the trunk sewers and relieve surface flooding and sewer backups (Figure 5-8).

5.2.4.2 Design Approach

The First Street Tunnel planned as part of the future Northeast Boundary Tunnel system constructed under the DC Clean Rivers project would be constructed ahead of schedule. The tunnel was originally planned to be between 8 and 12 feet in diameter, but would be increased to 19 feet or more to provide adequate storage. Until the NEBT is constructed, the First Street Tunnel would not have a connection to convey sewage flow downstream for treatment, and would be used during the medium-term for storage only.



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McMILLAN STORAGE & FIRST STREET TUNNEL OPTION (RECOMMENDED)

DATE: DECEMBER 2012

FIGURE 5-8

Combined sewage would be diverted to the tunnel from the existing trunk sewers, including the Flagler Place Trunk Sewer, from three diversion facilities. After storms pass, the tunnel will be pumped out using a small dewatering pump station (5 to 10 mgd capacity). The ideal location for this small pump station would be near Rhode Island Avenue, which is the downstream end of the tunnel that will connect to the future NEBT. An existing parking lot adjacent to the Windows restaurant off of First Street offers a possible site.

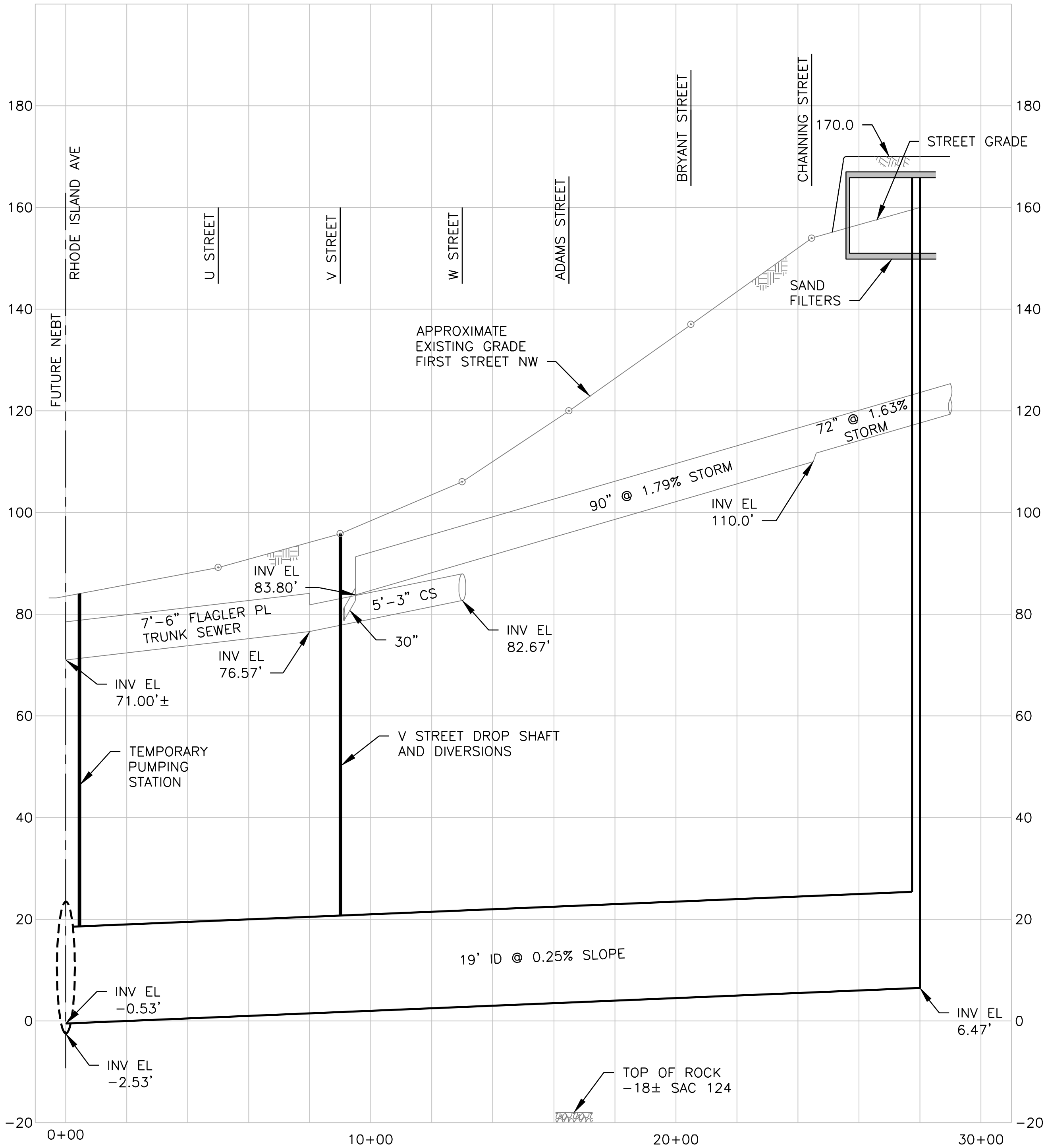
In order to construct the tunnel at the required depth, a large-diameter (approximately 50 feet) shaft would be constructed to remove subsurface material from the tunnel excavation. Figure 5-9 illustrates the proposed tunnel profile, which shows the tunnel depth. The shaft would also provide access for the tunnel boring machine. It is anticipated that this drop shaft would be located on the southern portion of the McMillan site. Approximately three acres is needed for construction staging, but only 1/4-acre is needed for permanent facilities. The existing underground basins in the proposed staging area would be demolished and removed to prepare the site for construction.

To provide the required storage, the First Street Tunnel would be constructed at a larger diameter and longer length than originally proposed as part of the Clean Rivers project. In addition, the drop shaft on the McMillan site would not be required in the original plan. Diversion structures from the nearby trunk sewers will be required and will be constructed on residential streets. Two of these three structures were planned as part of the original DCCR project.

5.2.4.3 Expected Effects

Constructing a First Street Tunnel in conjunction with temporary storage at the McMillan site is predicted to greatly reduce sewer backups and surface flooding up to the 15-year rainfall event. Table 5-6 compares the flooding impacts under existing conditions and with development of storage at the McMillan site with a First Street Tunnel. The predicted ponding levels are reduced to less than six inches. Under many scenarios, pipes do not surcharge, indicating a great reduction in the risk of sewer backups.

Modeling showed that once capacity was created in the trunk sewer, some areas still experienced surface ponding from a lack of inlet capacity. In order to reduce ponding levels to nearly insignificant levels, surface inlets were incorporated into the model and would have to be constructed as part of this project in order to realize the predicted benefits.



PROFILE

HORIZONTAL SCALE: 1"=500'
VERTICAL SCALE: 1" = 30'

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MAYOR'S TASK FORCE REPORT
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McMILLAN STORAGE AND FIRST ST NW TUNNEL PROFILE−RECOMMENDED OPTION

DATE: DECEMBER 2012 | FIGURE 5-9

Table 5-6: Predicted Efficacy of Storage at McMillan Site with First Street Tunnel

Condition	Design Storm (6-hour duration)	Major Components	Average Ponding Depth (inches)			HGL Depth Above(+) or Below(-) Grade (feet)			Mitigates Sewer Backups	Mitigates Surface Flooding
			RI Ave Bet 1st & 2nd	Flagler Place & V St	U St & 1st St	RI Ave & 1st St	Flagler Place & V St	U St & 1st St		
Existing Conditions	5-year	Existing Conditions	22”	8”	4”	-2.4’ (pipe crown -5.4’)	3.2’ (pipe crown -6.6’)	-1.2’ (pipe crown -6.6’)	No	No
Storage w/ First Street Tunnel	5-year	• Divert storm-water flow from First St Trunk Sewer into 3 MG storage • Divert storm-water flow from North Capitol St Trunk Sewer into 3 MG storage • Divert 2.8 MG combined sewage from Adams St and V St into Tunnel • Add four new storm inlets at key surface ponding locations	1”	2”	3”	-6.4’	-7.7’	-9.2’	Yes	Yes
Storage w/ First Street Tunnel	5-year	• Divert storm-water flow from North Capitol St Trunk Sewer into 3 MG storage • Divert 3.4 MG combined sewage from Adams St, V St and First St into Tunnel • Add four new storm inlets at key surface ponding locations	1”	2”	3”	-5.7’	-7.6’	-8.6’	Yes	Yes
Existing Conditions	15-year	• Existing Conditions	25”	13”	6”	-2.1’	-4.1’	-0.6’	No	No
Storage w/ First Street Tunnel	15-year	• Divert stormwater flow from First St Trunk Sewer into 3 MG storage • Divert stormwater flow from North Capitol St Trunk Sewer into 3 MG storage • Divert 5.2 MG combined sewage from Adams St, V St and First St into Tunnel • Add four new storm inlets at key surface ponding locations	1”	3”	3”	-5.7’	-7.3’	-8.7’	Yes	Yes
Storage w/ First Street Tunnel	15-year	• Divert stormwater flow from North Capitol St Trunk Sewer into 3 MG storage • Divert 6.4 MG combined sewage from Adams St, V St and First St into Tunnel • Add four new storm inlets at key surface ponding locations	1”	3”	3”	-5.2’	-7.3’	-8.1’	No (6 MG Tunnel Capacity is Exceeded, so predicted results would not be realized)	Yes

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5.2.4.4 Implementation and Cost

Based on fast track design and procurement, stormwater storage at the McMillan site could be completed by the Spring of 2014. The First Street Tunnel could be completed by the Spring of 2016. The McMillan storage and First Street Tunnel are major projects that will be constructed in a dense urban area. Identifying the rights of way for the tunnel and surface facilities, obtaining the necessary property and easements, and obtaining construction staging areas and permits for construction are critical to being able to construct the project in accordance with the schedules shown.

These projects cannot be constructed according to the schedules shown without the commitment from District agencies to act as project stakeholders by providing the following:

- City Administrator appoints a champion. The champion assembles and leads a Task Force of key officials from District agencies, and is empowered to direct agencies on project related issues.
- District agencies dedicate staff to support the project, and who are authorized to make decisions on behalf of the agency. The agency representatives may be located with the project design team to facilitate close coordination.
- DC Water obtains power of Eminent Domain and District exercises power of Eminent Domain as necessary to obtain land for the project.
- District grants all necessary easements to DC Water.
- District grants necessary District property to DC Water for permanent facilities and for construction.
- District provides expedited permits with dedicated staff.
- District allows necessary street closures, work hours, etc. for construction operations.
- Permit fees are waived.
- District allows street closures, reasonable work hour restrictions, and other coordination for construction operations.
- District facilitates parking mitigation in construction zones.
- District provides financial assistance including waiving permit fees and help to secure Federal funding to limit water & sewer rate increases.

A number of permits will be required throughout construction of stormwater storage facilities at the McMillan site and the First Street Tunnel. The stakeholder relationship and assistance from District agencies described above will be essential for processing permits expediently. Table 5-7 identifies key permits that typically take up to four months to obtain.

The estimated project cost for this alternative is $144 million. The cost to develop stormwater storage facilities at the McMillan site is the same as described previously. The cost of the tunnel system is more expensive than that previously budgeted as part of the DC Clean Rivers project. Additional costs are attributed to acceleration of the schedule, and the larger diameter and extension of the tunnel to provide increased storage capacity for medium-term use. The DC Clean Rivers project team is currently evaluating the cost comparison. A detailed cost estimate of the First Street Tunnel is included in Appendix 8.

Table 5-7: Key Permits for Construction of Storage at McMillan Site with First Street Tunnel

Agency	Permit	Typical Time to Obtain	Scope
DDOE	SEC/SWM Approval	4-8 weeks	Site work at McMillan site and in streets
DDOE	Soil Boring Approval	4-16 weeks	Subsurface investigation in First Street
SHPO	Permit Condition Letter	4 weeks	Site work at McMillan site and in streets
DDOT	Construction	6-12 weeks	Maintenance of traffic and support of excavation for all work in streets
DCRA	Building Permit	3-6 weeks	Site construction trailers
DCRA	Support of Excavation	4-8 weeks	Site work at McMillan
DCRA	Foundation to grade	4-8 weeks	Site work at McMillan

5.2.5 Conveyance to Tiber Creek

5.2.5.1 Technical Objectives

This alternative would establish a hydraulic connection from the First Street Trunk Sewer to the Tiber Creek Sewer that would provide relief for the sewer collection system in the Bloomingdale and LeDroit Park neighborhoods. The re-routing of sewer flows would take advantage of available sewer capacity in the Tiber Creek Sewer.

5.2.5.2 Design Approach

Three scenarios were evaluated for feasibility for connecting the Northeast Boundary area to Tiber Creek. In the first scenario, a 200 mgd pump station was proposed and modeled at First Street NW, just south of V Street NW. In the model, the pump effluent is transferred to the Tiber Creek sewer near North Capitol Street and K Street NW. The design flow rate was selected in accordance with recent modeling in order to divert the amount of flow required to create enough capacity in the trunk sewer to mitigate sewer backups and surface ponding. Figure 5-10 shows an overview of this scenario.

In the second scenario, the Technical Committee examined the removal of an existing trunk sewer bulkhead in the First Street Trunk Sewer, south of Florida Avenue. Removing the bulkhead provides a downstream connection to the Tiber Creek Sewer. In addition to removing the bulkhead, the system was assumed to be connected to Tiber Creek using the alignment of a pipe segment that has been abandoned. Figure 5-11 shows an overview of this scenario.

A siphon underneath (and disconnected from) the NEBTS was also examined as a third scenario, similar to the second scenario. Using a siphon as a direct connection to Bloomingdale could potentially require a relief sewer and increased inlet capacity to be put in place in order to reduce ponding and increase pipe capacity.

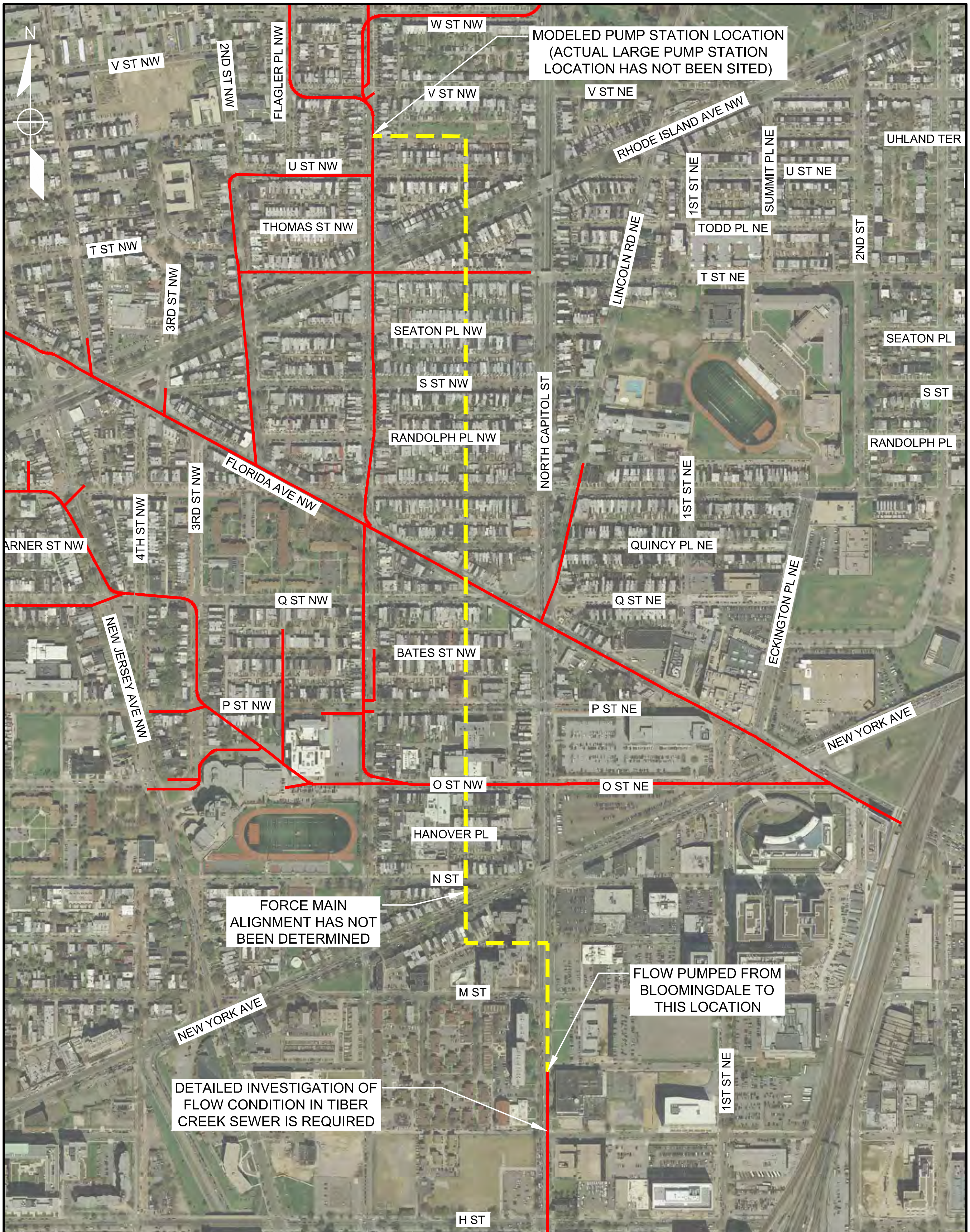
Based off of preliminary analysis of different scenarios for conveyance to Tiber Creek Sewer, this alternative effectively provides pipe capacity relief to the NEBTS. If used in conjunction with another mitigation measure within the focus area, such as a relief sewer extending along the Flagler Place Trunk Sewer and increased inlet capacity, this option could result in reduced ponding and increased pipe capacity. However, because implementation would entail connecting only to the NEBTS, this option would not provide relief to the entire affected region. Only neighborhoods directly connected to the NEBTS would benefit. Additionally, the full impact of extra flow to the area along the Tiber Creek Sewer extending to the Main and O Street Pumping Stations needs to be evaluated before further consideration can be made.

5.2.5.3 Expected Impact

All of the hydraulic modeling scenarios showed improvements in the pipe capacity and surface ponding in the Bloomingdale neighborhood. Because the system in the Bloomingdale neighborhood, north of Florida Avenue is undersized, any connection to Tiber Creek would need to be done in conjunction with mitigation measures within the Bloomingdale neighborhood or upstream of the Bloomingdale neighborhood. The impact that this sewer modification would have on pipe capacity or flooding issues downstream of the Bloomingdale area was not fully evaluated for this exercise to determine initial feasibility.

5.2.5.4 Implementation and Cost

The project would take more than three years to construct due to various constructability challenges. Large diameter sewers would need to be constructed in a very dense urban area. Many utility relocations would be required, and potentially additional rights-of-way would need to be created. A detailed cost estimate was not performed. Based on the known project scope, the estimated cost is likely more than $20 million.



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LAYOUT FOR CONVEYANCE TO
TIBER CREEK SEWER OPTION

DATE: DECEMBER 2012 | FIGURE 5–10

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MAYOR'S TASK FORCE REPORT
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IN BLOOMINGDALE AND LeDROIT PARK

BULKHEAD REMOVAL AND RECONNECTION TO TIBER CREEK SEWER OPTION

DATE: DECEMBER 2012 | FIGURE 5–11

5.2.6 Rain Barrels (Upstream Installation)

5.2.6.1 Technical Objectives

In order to expand the efficacy of the District's Rain Barrel/Cistern Initiative in Bloomingdale and LeDroit Park, additional cisterns could be installed in the upper portion of the sewershed. Capturing stormwater upstream would lessen the volume of water flowing to the affected neighborhoods and other flood-prone, low-lying areas.

5.2.6.2 Design Approach

The broader sewershed of Bloomingdale and LeDroit Park consists of more than 1,100 acres. Stormwater runoff from this area upstream of these neighborhoods exacerbates the flooding problems (Figure 5-12). The western subshed of the Northeast Boundary drainage area, which impacts capacity in the NEBTS immediately downstream of Bloomingdale, is approximately 100 acres. Together, these drainage areas contain more than 10,000 buildings. Control of stormwater from this area is key to preventing flooding. Lot-level retrofitting in conjunction with a program to encourage homeowners to install cisterns would contribute to the overall stormwater detention strategy in the drainage area.

5.2.6.3 Expected Effects

If DDOE expands its existing rebate to include cisterns for residents in the Bloomingdale, LeDroit Park, and adjacent drainage areas described above, a maximum participation rate of 10%, or roughly 1,000 residences, could be expected to take part in the program. Based upon an average of 275 gallons of capacity per rain barrel or cistern, DDOE expects to be able to catch up to 275,000 gallons of stormwater during each storm event under an expanded program.

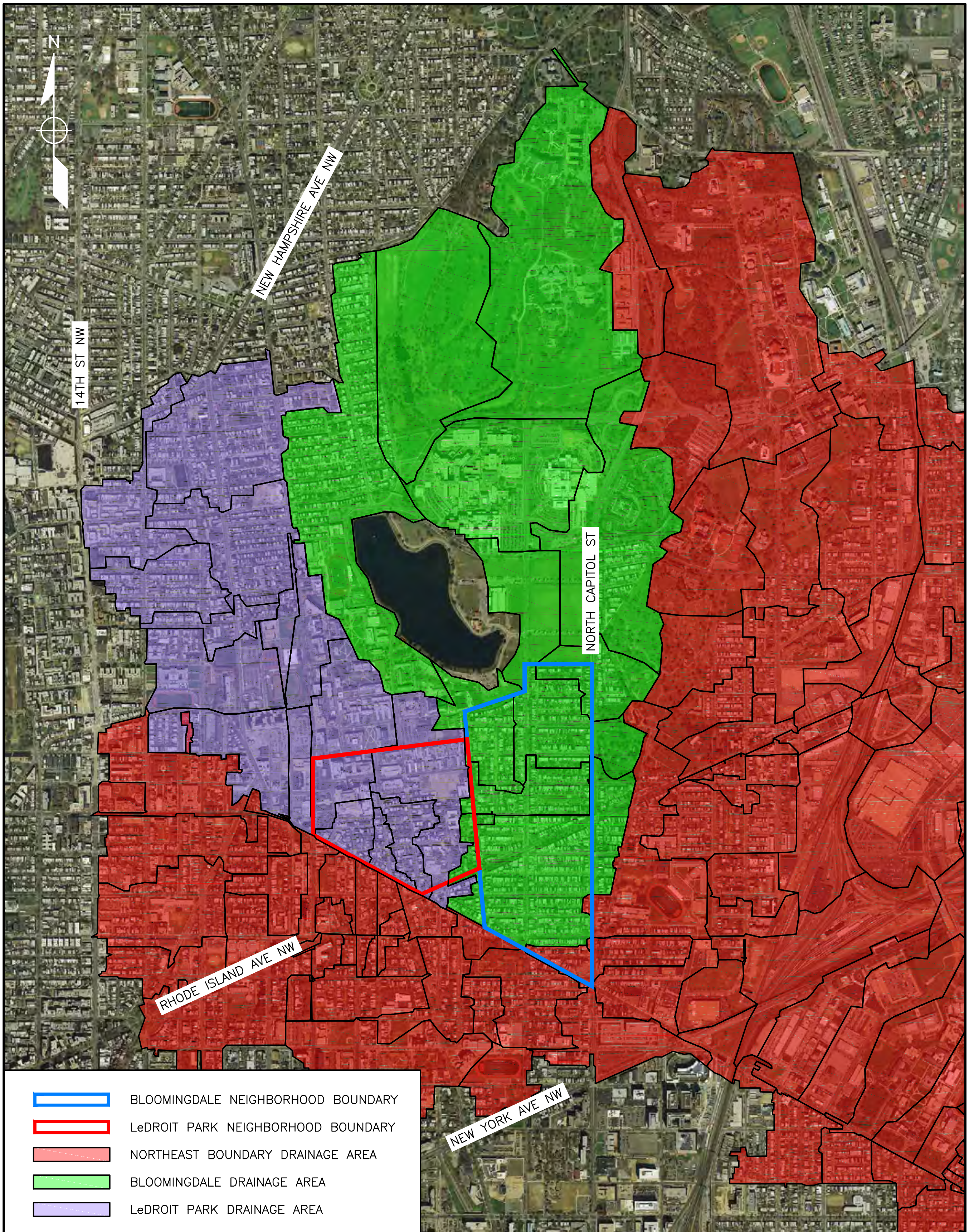
5.2.6.4 Implementation and Associated Costs

In order to build upon the existing Rain Barrel/Cistern Program, DDOE could offer a subsidy of approximately 80% of the cost of cisterns to qualified homeowners in the broader sewershed. DDOE has an existing rebate program for rain barrels. However, this rebate would be specific to the greater Bloomingdale and LeDroit Park sewershed and would provide a higher rebate amount. The cost of cisterns ranging from 130-530 gallons breaks down to $1.25-1.35/gallon of storage. Should the District provide an 80% rebate, then the cost of the program would be on average $1.08/gallon of stormwater retained. This is much lower than the average cost of $4/gallon captured through the current Bloomingdale/LeDroit Park Rain Barrel/Cistern Program, which includes installation services.

132-gallon cistern, with dimensions of 51″ x 27″

Source: oca.dc.gov

For an average of 275 gallons capacity per cistern, the cost to fund the rebate for 1,000 participating homeowners would be up to $300,000 depending upon the level of participation.



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IN BLOOMINGDALE AND LeDROIT PARK

MAP OF BLOOMINGDALE AND LeDROIT PARK BOUNDARIES

DATE: DECEMBER 2012

FIGURE 5–12

5.2.7 Green Infrastructure Expansion

5.2.7.1 Technical Objectives

As described in Section 5.1.6, green infrastructure (GI) measures are being proposed by DDOT in the vicinity of Rhode Island Avenue and First Street NW as a short term measure to provide immediate relief in this area of the Bloomingdale neighborhood. Comprehensive GI implementation throughout Bloomingdale and LeDroit Park was considered as a part of the medium term strategy. In an urban setting like the Bloomingdale/LeDroit Park neighborhoods, examples of GI facilities include green roofs, rain gardens, porous pavement, and bioretention systems such as rain gardens, curb bump-outs, and street trees. GI measures can intercept stormwater runoff at or near its source, allowing relatively small facilities to contribute significantly in aggregate to controlling or reducing stormwater runoff, thereby reducing flooding. In addition, GI offers other benefits such as reduced urban heat island effect, aesthetic improvements, increased property values and other benefits.

5.2.7.2 Design Approach

A holistic review of the entire Bloomingdale/LeDroit Park neighborhood has identified many opportunities for capturing stormwater in the upstream areas of these neighborhoods before it can flow to the critical low-lying areas along Rhode Island Avenue. In capturing stormwater before it is allowed to pool at the low points of Bloomingdale and LeDroit Park, GI can also provide relief to storm and combined trunk sewers that eventually convey flows to the NEBTS. GI measures that appear to be applicable based on site visits include the following:

Permeable paving in alleyways: Permeable paving allows rainwater to infiltrate through the paved surface and into the ground. Alleyways and parking lots along the areas of most intense surface flow are proposed locations for permeable paving. Targeted areas include the alleys between Channing Street and V Street NW, on the east side of First Street NW. Opportunities also exist in alleyways between Bryant Street and Thomas Street NW, on the west side of First Street NW.

Rain gardens at various locations: Rain gardens are planted areas with depressions for water to collect, and are planted with water-tolerant plant material. Open spaces that are publicly owned have been identified as ideal locations for rain gardens, the most prominent being Anna J. Cooper Circle.

Curb bump-out rain gardens: Placing rain gardens in new curb bump-outs can take advantage of space in the street that is unused by parking. Furthermore, the placement of these curb bump-outs directly intercept water flowing through the gutter created by the street and the curb. Numerous opportunities were identified along First and Second Streets NW as well as North Capitol Street NW.

Along Nannie Helen Burroughs Corridor is a curb cut feature integrated with a bioswale

Source: The Low Impact Development Center, Inc.

Bioswales: Bioswales are long planted depressions that can collect water over long distances. The area south of McMillan Reservoir and the old sand filtration field have been identified as areas where stormwater can be captured before flowing further downhill to the south.

Tree box filters: Tree box filters are catch basins which collect water similar to a conventional storm drain, but filter water through a soil bed and root system of a shrub or street tree. These are proposed throughout Bloomingdale and LeDroit Park. Their compact nature in size (typically five by five feet) requires a precise field survey to best site each device.

Tree filters located on DC Water's Bryant Street Pumping Station facility

Tree Planting: Tree planting increases soil infiltration and is applicable throughout the drainage area.

Green roofs: Rooftop collection practices include rainwater harvesting facilities such as green and blue roofs, rain barrels, and cisterns. Green roofs are roof areas that are covered with soil substrate and a variety of plants. Blue roofs consist of a series of trays that are filled with gravel ballast in order to capture and detain a significant volume of rainfall. Several buildings in LeDroit Park have the potential for green roof installations.

Green roof at American Society of Landscape Architects Headquarters, DC

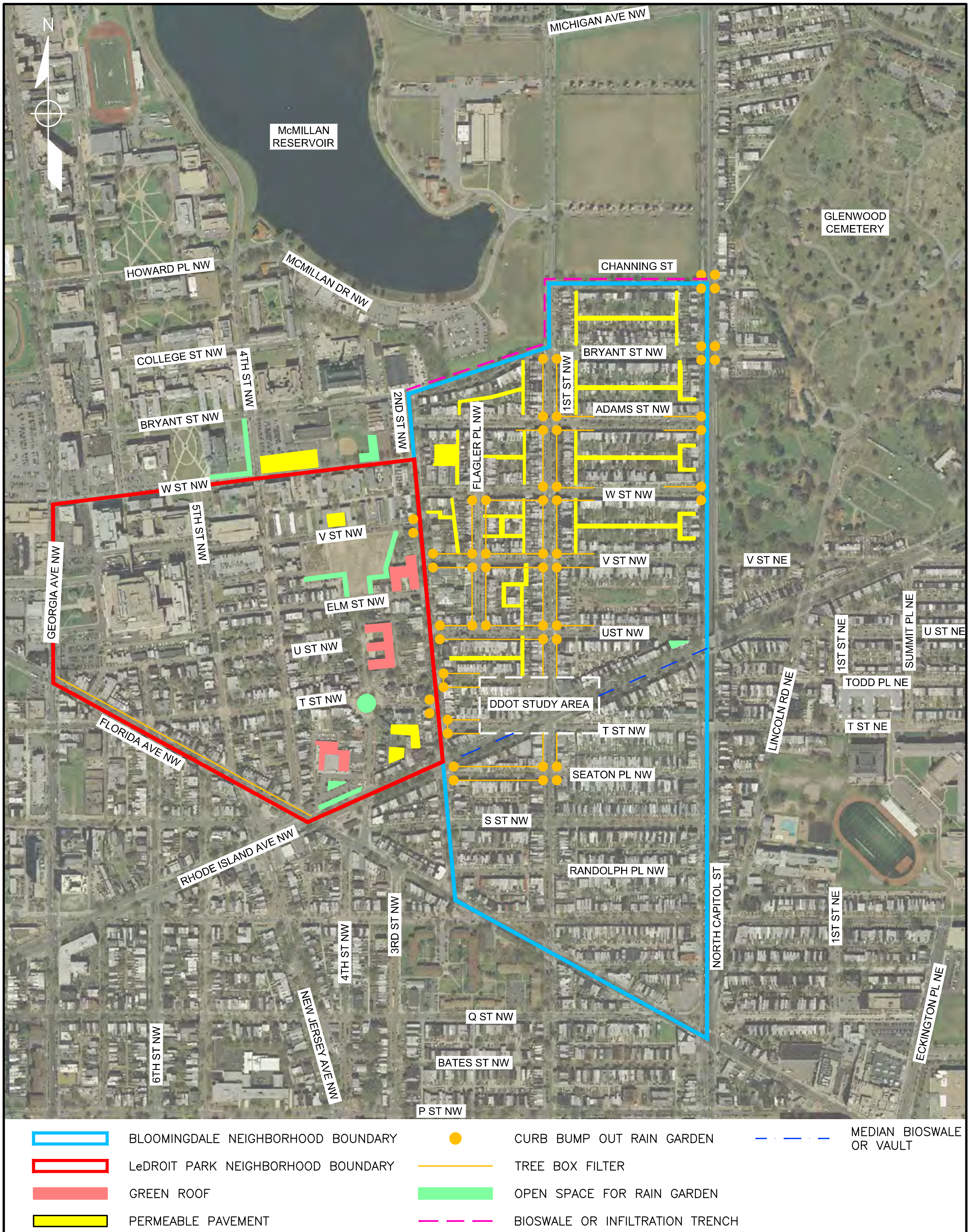
GI can be constructed both in the immediate flood areas and the tributary drainage area. Figure 5-12 shows the tributary drainage area for Bloomingdale and LeDroit Park, while Figure 5-13 shows the locations where GI may be feasible in the immediate areas affected by flooding.

5.2.7.3 Implementation and Cost

Section 5.1.6 summarizes some of the implementation barriers to GI, and the same considerations will affect implementation of medium-term GI. Implementation challenges to GI include:

- Lack of space available in dense urban areas
- Conflicting uses for space such as parking versus curb bump-outs
- Poor soils that prohibit significant infiltration
- Conflicts with utilities
- Unclear operation and maintenance costs and requirements for GI
- Steep learning curve since GI has not been constructed in the District on a large scale as of yet

Projected costs for GI are based DC Water's Technical Memorandum No. 7: *Green Infrastructure Screening Analysis for the Potomac River and Rock Creek* (DC Clean Rivers Project; July 11, 2012). The unit costs for each technology are shown in Table 5-8. An average value of $325,000 per impervious acre treated at 1.2 inch depth of infiltration was assumed for overall application of GI.



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IN BLOOMINGDALE AND LeDROIT PARK

CANDIDATE GI SITES IN BLOOMINGDALE AND LeDROIT PARK

DATE: DECEMBER 2012 | FIGURE 5–13

Table 5-8. Costs of GI Measures

GI Practice	Const Cost	Unit	Constr. Cost ($/acre installed)	Constr. cost ($/imp Ac Treated)	Rounded Capital Cost ($/imp ac treated, $000)	Comments
Pervious Pavement (pavers)	$30.00	sf	$ 1,306,800	$ 290,400	$ 407	Assumes 9" depth of effective storage layer, 60% void space which stores 3.37 gal/sf. System treats 4.5 sf of impervious area per sf of pervious pavement at 1.2"rain. Retrofit installation with underdrain tied into existing SW system, demo existing road/alley.
Bio-retention Basins	$42.00	sf	$ 1,829,520	$ 101,640	$ 143	Assumes 36" depth of effective storage layer, 60% void space which stores 13.46 gal/sf. System treats 18 sf of impervious area per sf of bioretention at 1.2" rain. Retrofit installation with underdrain tied into existing SW system, demo existing road/alley.
Green Roof (extensive)	$27.00	sf	$ 1,176,120	$ 1,176,120	$ 1,647	Green Roof sized to treat 1.2", extensive green roof.
Street Trees	$18.00	cf	$ 180,000	$ 201,667	$ 282	Assumes 6'x6'x6' tree pit.
Rain Barrels, Downspout Disconnect	$22.44	cf	$ 97,749	$ 97,749	$137	
Cisterns/ Rain Barrels	$5.00	gal	$ 162,914	$ 162,914	$ 228	
Overall Value For Planning					$ 325	

Notes:

Capital cost = 1.4 x construction cost and includes legal, fiscal, engineering, construction management, legal and administrative costs. (ENR CCI = 9291)

Table 5-9 summarizes the amount of impervious area that exists in the drainage areas and reasonable ranges of GI application. GI application ranging from 2% to 10% implementation are based on applying GI on public land as well as conservative values of application rates that may be achievable.

Table 5-9: GI Parameters

Drainage Area	Total Acres	Impervious Area Acres	Capital Cost @$325,000/ Impervious Acre
Bloomingdale	724	320	
LeDroit Park	405	279	
Total		599	
Impervious acres treated @ 2% GI		12	$4M
Impervious acres treated @ 5% GI		30	$10M
Impervious acres treated @ 10% GI		60	$20M

5.2.8 Catch Basin Inlet Restrictors

5.2.8.1 Technical Objectives

This alternative is designed to allow less water to enter the collection system in areas where flooding is not a significant issue. Mechanical devices that restrict flow would be installed on catch basins in advance of predicted heavy rainfall events. Instead of contributing to filling pipes underground, rainwater is conveyed by streets and other pathways along the surface before it enters the collection system in an area that has capacity to convey the runoff. Water flowing over the ground surface typically flows slower than water in the pipe. Therefore, peak flow rates in the sewers are reduced, which reduces the potential for sewer backups and surface flooding from surcharged sewers. Figure 5-14 indicates the area of reduced inlet capacity.

5.2.8.2 Design Approach

In this alternative, inlets in the drainage area upstream of Bloomingdale would be restricted with mechanical devices that could convey 20% of the maximum inlet design capacity. Inlet restrictors are fast and cost-effective to implement, and are easy to remove after other mitigation measures are in place. However, they may also cause increased ponding in areas outside of the existing flood area. To be effective, catch basin inlet restrictors would need to be implemented in conjunction with increased inlet capacity in chronic flooding areas.

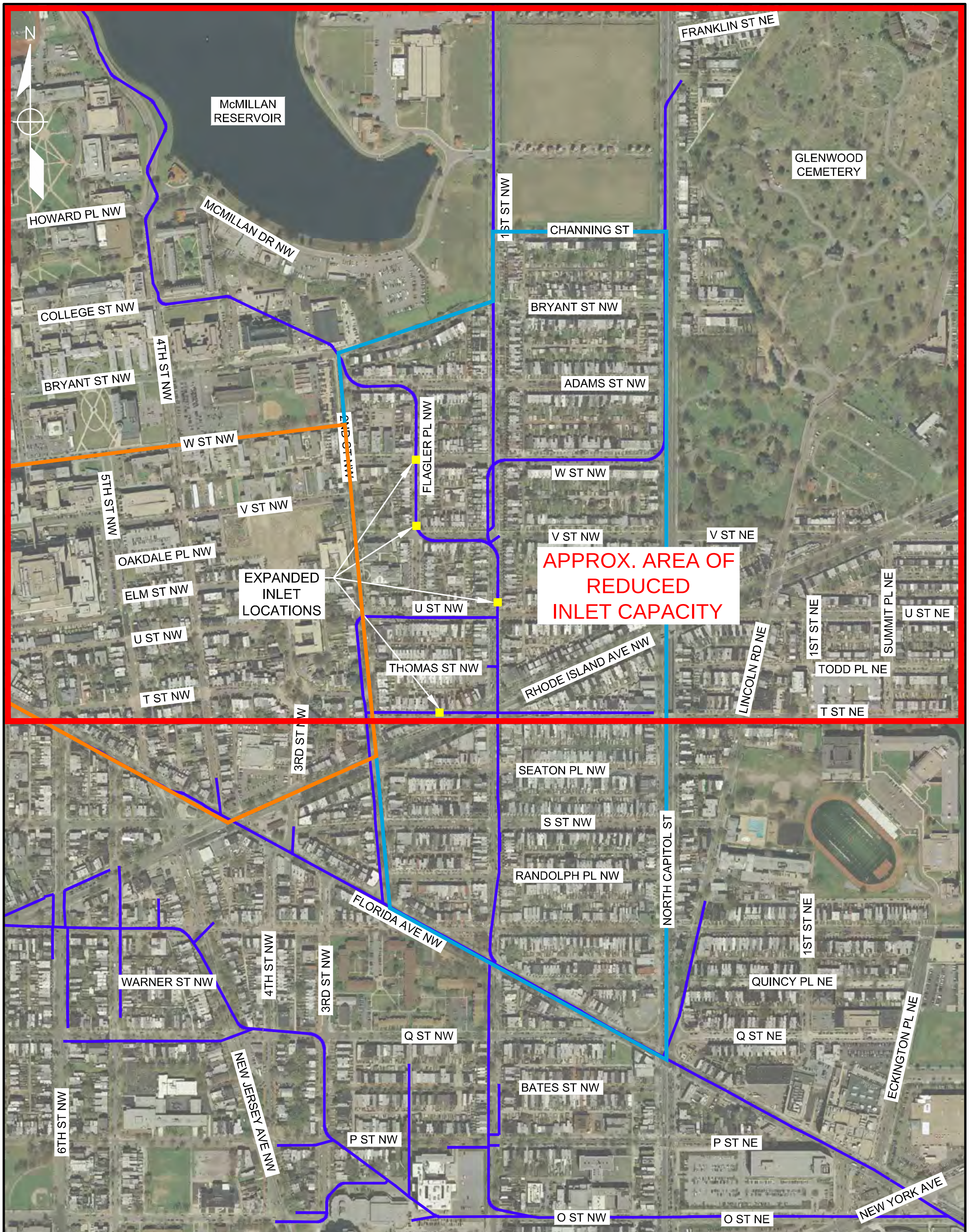

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DIAGRAM OF PLANNED LOCATIONS FOR CATCH BASIN INLET RESTRICTORS

DATE: DECEMBER 2012	FIGURE 5–14

5.2.8.3 Expected Effects

A preliminary scenario for this alternative was modeled and predicted a reduction of surface ponding and some reduction of sewer pipe surcharging, indicating a potential for reduced sewer backups. The model lacked detailed topography for the entire drainage area. An extensive field survey would be needed to gather topographical data. Without such data, the model cannot predict the flow routes that water would take on the streets, which would enable the model to confirm this option's feasibility. If hydraulic feasibility is confirmed, operational feasibility would need to be evaluated to determine if inlet restrictors could be deployed within the constraints of storm forecasting and operations staff capacity.

Due to the great degree of uncertainty in risks associated with widespread implementation of this technology throughout the drainage area, this alternative was deemed impractical. The potential risk of worsening surface flooding by restricting flow from the sewer system outweighs the potential benefits that inlet restrictors would provide through surface diversion.

5.2.9 Inflatable Flood Walls

5.2.9.1 Technical Objectives

There are numerous manufacturers who offer flood control dams that can be used to temporarily contain or re-direct flood water. Conceptually, the barriers are large tubes made of flexible material such as heavy duty nylon or PVC that can be rolled out and filled with water prior to a flood. They can be deflated after the flood has passed or left in place if additional floods are anticipated. These temporary barriers are often used in emergency situations where it is not practical to install a permanent flood wall or levy due to time constraints, logistical challenges, or funding availability.

Inflatable flood barriers are available for a variety of specific applications. Sizes range from 12 inches to several feet depending on the severity of flooding and site conditions. They are generally meant for large-scale use, such as construction sites, or for protecting critical facilities such as hospitals and power stations. Inflatable flood walls can also be tailored to smaller sites.

5.2.9.2 Design Approach

Based on the storm modeling conducted by DC Water and eyewitness accounts of recent storms, flood water depth ranged from 0.5 feet to two feet on local streets. Inflatable barriers can be used to line one or both sides of a street to contain water that would otherwise top street curbs. Barriers can also be used to contain water in a makeshift storage pond. A continuous dam can be achieved by either overlapping barrier segments or connecting them depending on the manufacturer.

Barriers are available in lengths from about five to 100 feet, and heights from one to four feet. For this particular case, barrier lengths of 50 feet and 100 feet with heights of one, two, and three feet are most applicable. The total estimated requirement is 4,000 linear feet. Table 5-10 lists flood wall heights and dimensions.

Table 5-10: Inflatable Flood Wall Weights and Dimensions for Roadway Application

Inflated Height (inches)	Controllable Water Depth (inches)	Inflated Weight	Inflated Width (ft)
12	9	116 lbs/ linear ft	2.25
24	18	466 lbs/ linear ft	4.5
36	27	1,091 lbs/ linear ft	7

Data from Hydrological Solutions, Inc., except "inflated weight" was calculated.

5.2.9.3 Expected Effects

A network of inflatable barriers installed to contain the roadway areas most severely impacted by flooding could possibly detain up to 1.35 million gallons of surface water. The stormwater and combined sewage that currently spills over sidewalks and into buildings would be contained within the dams. Table 5-11 below shows the estimated detained area and volume from inflatable flood wall implementation. The inflatable barriers would do nothing to prevent sewer backups.

Table 5-11: Inflatable Flood Wall Implementation Volume

Mitigation Option	Size	Detained Area (square feet)	Detained Volume (gallons)
Inflatable Dam, for 9" Water Depth	10 @ 50' Length, 12" Height	10,000	56,000
Inflatable Dam, for 18" Water Depth	20 @ 50' Length, 24" Height	20,000	225,000
Inflatable Dam, for 18" Water Depth	20 @ 100' Length, 24" Height	80,000	900,000
Inflatable Dam, for 27" Water Depth	10 @ 50' Length, 36" Height	10,000	168,000
Total		120,000	1,349,000

5.2.9.4 Implementation and Cost

Although they are effective, inflatable barriers are a considerable challenge within an urban environment. The first step in setting up these systems requires the clearing of all obstacles from affected streets. This includes vehicles, dumpsters, and construction equipment. Unresponsive owners would warrant the City to tow vehicles. Further, displaced vehicles would need safe temporary parking, preferably a nearby garage or lot that could be used just for this purpose. All of this requires a tremendous amount of time and coordination prior to a flood when time is critical and limited. Barriers would have to be retrieved from storage at a nearby location and delivered to the requisite sites, then unrolled, and filled.

Barriers for roadway use can be stored, deflated, and rolled up on pallets for distribution. They can be filled using a fire hydrant or water truck within 30 minutes. Manufacturers estimate that it takes 30 minutes for a 4-person crew to set up 50 feet of barrier. This equates to 10 total hours using four, four-person crews to deploy all 4,000 linear feet. The barriers cannot be easily moved once filled.

Large barriers will take up significant street width, and may require soil anchors to prevent shifting. Soil anchors measure 36 inches long, ¾ inches thick, and have four-inch helical disks. Conflicts with utilities and pavement surfaces should be expected. If soil anchors are needed based on manufacturer recommendations, they will need to be sited and installed well in advance and will become permanent fixtures.

Once the barriers are laid out and filled with water, they will create a continuous obstacle for emergency vehicles, utility vehicles, city vehicles, transit busses, automobiles, and pedestrians. A detailed detour plan for emergency vehicles will have to be developed and practiced.

If the City acts cautiously and deploys the barriers, there is the chance that flooding will not happen during a storm. This results in lots of wasted drinking water and unnecessary inconvenience. These actions represent a substantial effort prior to a storm that requires equal responsibility from homeowners, businesses, and the City. Barrier deployment also requires consideration of catch basin location, because the water used to inflate the barriers will need somewhere to drain. Flooding is possible if several barriers are deflated simultaneously and the receiving catch basins are covered by the barriers themselves.

Another concern is neighborhood safety. Homeowners may not be able to remain in their homes when barriers are in use due to inaccessibility. Intentional damage to barriers is possible and will result in flooding if there is a breach. An additional five hours is needed to retrieve barriers after flooding has passed. If barriers have been exposed to wastewater, then additional time will be needed for sanitation before storage can occur.

Table 5-12: Inflatable Flood Wall Costs for Neighborhood-Wide Implementation

Mitigation Option	Size	Delivered Cost (each)	Total Material Cost	Installation Labor Cost (each)	Installation Cost per Event
Inflatable Dam, for 9” Water Depth	10 @ 50’ Length, 12” Height	$1,350	$13,500	$150	$1,500
Inflatable Dam, for 18” Water Depth	20 @ 50’ Length, 24” Height	$1,750	$35,000	$150	$3,000
Inflatable Dam, for 18” Water Depth	20 @ 100’ Length, 24” Height	$2,950	$59,000	$300	$6,000
Inflatable Dam, for 27” Water Depth	10 @ 50’ Length, 36” Height	$2,650	$26,500	$150	$1,500
Total			$134,000		$12,000

5.2.10 Summary of Medium Term Remedial Measures

Table 5-13 presents a summary of the medium-term remedial measures evaluated in this report. Storage at the McMillan site with a First Street Tunnel provides the greatest total benefit for properties that experience sewer backups as well as those that experience surface flooding. The total cost to implement this strategy is estimated to be $152,000,000. Approximately $105,000,000 is included in the DC Clean

Rivers project budget for construction of the First Street Tunnel, which is already proposed as part of the Northeast Boundary Tunnel and Branch Tunnels project. Other alternatives for large scale engineering and construction projects, which involve large pump stations or several thousand feet of surface construction, are either impractical or do not have a comparable cost/benefit ratio.

Rain barrels and other green infrastructure have a lower direct benefit to properties, but are nonetheless worthwhile for consideration because they support the goals of delaying stormwater runoff from entering the sewer system or collecting runoff from the surface more efficiently. Other smaller scale alternatives have been deemed impractical due to design and operational challenges that cannot likely be overcome.

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Table 5-13: Summary of Medium-Term Remedial Measures

Alternative/ Report Section #	Reduces Sewer Backups	Reduces Impacts of Surface Flooding	Stormwater Detention Provided (gallons)	Protects Downstream Properties	Practical	Magnitude of Benefit	Cost
Section 5.2.2 Storage at McMillan	No	Yes	6,000,000	Yes	Yes	Med	$12,000,000
Section 5.2.3 McMillan Storage with Flagler Place Pump Station	Yes	Yes	9,000,000	Yes	No	High	>$36,000,000
Section 5.2.4 McMillan Storage with First Street Tunnel	Yes	Yes	12,500,000	Yes	Yes	High	$144,000,000
Section 5.2.5 Conveyance to Tiber Creek	Yes	Yes	0 (see note 1)	Yes	No	Med	>$20,000000
Section 5.2.6 Rain Barrels	No	Yes	275,000	No	Yes	Med	$300,000
Section 5.2.7 Green Infrastructure Expansion	No	No	780,000	Yes	Yes	Low	$10,000,000
Section 5.2.8 Catch Basin Inlet Restrictors	No	Yes	0 (see note 2)	No	No	Med	$300,000
Section 5.2.9 Inflatable Flood Walls	No	Yes	1,300,000 (see note 3)	No	No	Med	$134,000 (see note 4)

Notes:

1. Stormwater detention is not the objective of this strategy. Conveys combined sewer flow through alternate routes to reduce peak flow rates in the affected area.
2. An undetermined volume of stormwater is effectively detained in the streets below curb height.
3. Stormwater “detained” in streets.
4. Does not include operational cost of $12,000 per deployment.

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5.3 Long Term

5.3.1 DC Clean Rivers Project

5.3.1.1 Technical Objectives

DC Water is implementing its Long Term Control Plan (LTCP) for the District's combined sewer system through the DC Clean Rivers Project (DCCR). The DCCR is comprised of a system of tunnels and diversion sewers for the capture of Combined Sewer Overflows (CSOs) to Rock Creek and the Anacostia and Potomac Rivers for treatment at DC Water's Blue Plains Advanced Wastewater Treatment Plant. Implemented under a Federal Consent Decree between the United States, the District Government and DC Water, the DCCR is divided into several contract divisions.

DCCR's Tunnel Boring Machine (26-ft in Diameter).

The TBM will be used to excavate tunnels through a variety of soil and rock layers

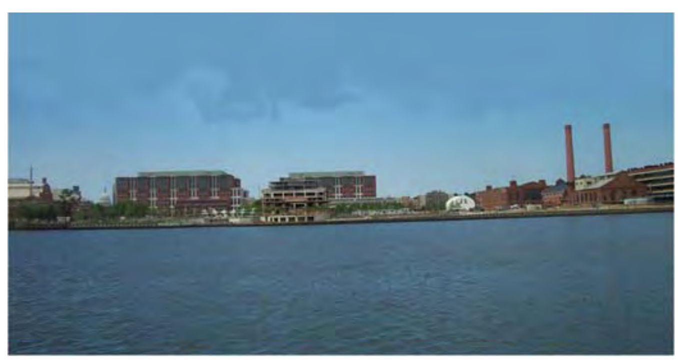
5.3.1.2 Design Approach

The Northeast Boundary Tunnel and Branch Tunnels will provide additional storage for CSOs and will relieve street and basement flooding in the Northeast Boundary area. The work will extend from Robert F. Kennedy Stadium to the Rhode Island Avenue Metro Station, and then along Rhode Island Avenue to Sixth Street, NW. The original alignment proposed under DC Water's Facility Plan was re-evaluated to provide an alignment that could be constructed on an expedited schedule (Figure 5-15).

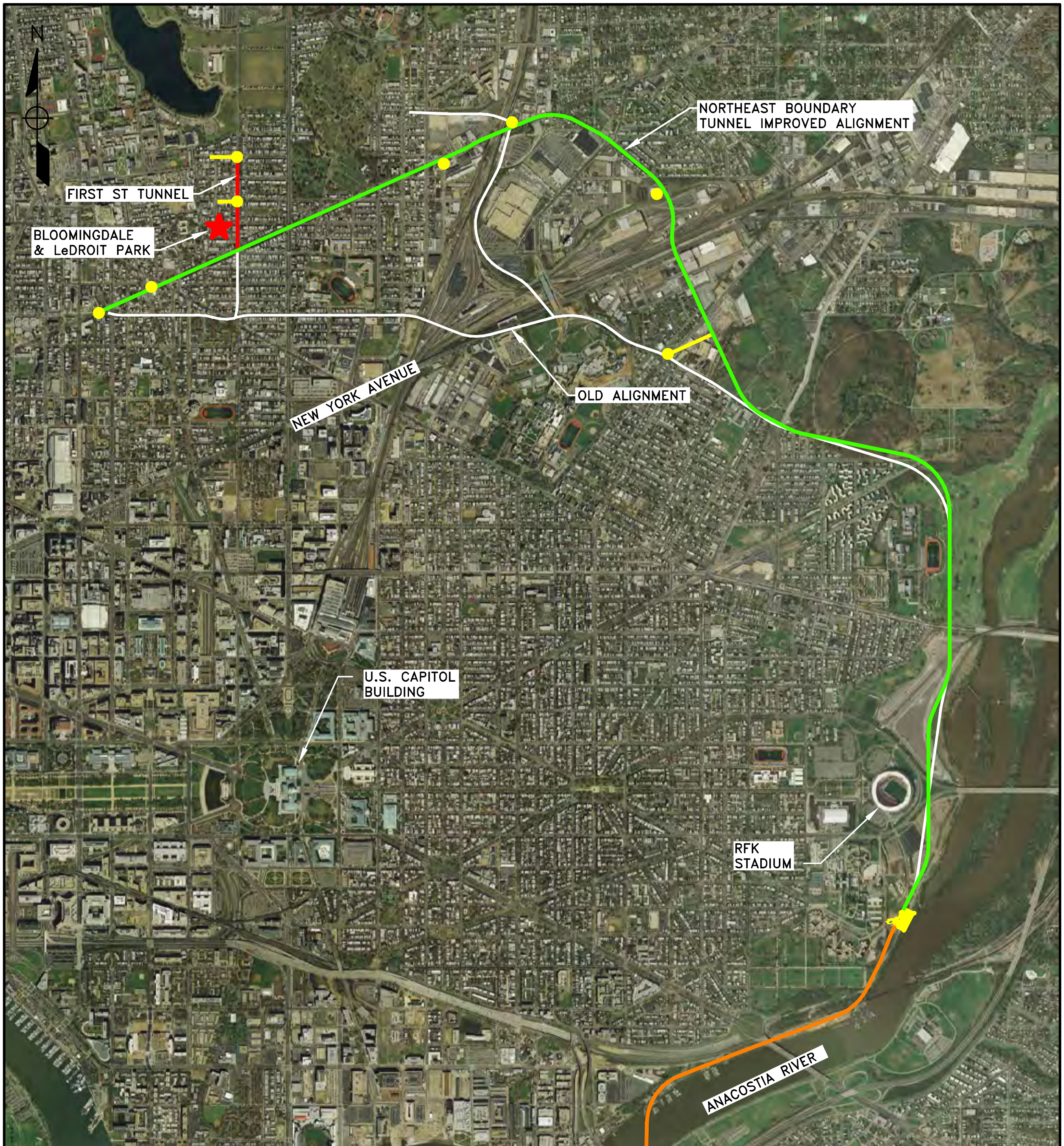
The main tunnel, known as the Northeast Boundary Tunnel (NEBT), will be approximately 26,600 feet (5 miles) in length, 23 feet in diameter and located between 50 and 150 feet underground. Branch tunnels will extend from the main tunnel, including one along First Street NW, to connect to sewer diversion facilities that will be constructed in chronic flood areas. The NEBT system will include as many as ten shafts primarily used for diverting Combined Sewer Overflows to the tunnel for subsequent treatment at Blue Plains AWWTP. Diversion drop shafts will have diameters of approximately 20 feet and will be excavated from the ground surface to the depth of the tunnel. Near each trunk sewer, a diversion chamber will be constructed to divert wastewater from the existing trunk sewer to the drop shaft.

5.3.1.3 Expected Effects

By the year 2025, the entire project will reduce CSOs annually by 96 percent throughout the system and by 98 percent for the Anacostia River alone. The Northeast Boundary Tunnel and the Branch Tunnels, like other projects constructed under the DCCR, will be designed to collect and convey stormwater runoff for up to a 15-year rainfall event. This means that sewer backups and surface flooding (in Bloomingdale and LeDroit Park) would not occur during the design storm.



The $2.6 billion fully constructed Clean Rivers Project will reduce combined sewer overflows by over 98% in the Anacostia River alone, relieve flooding in the northeast area of the District, and is part of the strategy for reducing nitrogen in the Potomac.



LEGEND

- NORTHEAST BOUNDARY TUNNEL (NEBT)
- FIRST STREET TUNNEL
- ANACOSTIA RIVER TUNNEL (ART)
- DIVERSION SEWERS

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IN BLOOMINGDALE AND LeDROIT PARK

NORTHEAST BOUNDARY TUNNEL PROJECT ALIGNMENT

DATE: DECEMBER 2012 | FIGURE 5–15

5.3.1.4 Implementation and Associated Costs

The total estimated project cost is over $600 million. Construction of the Northeast Boundary Tunnel and the Branch Tunnels is scheduled to begin as early as 2016 and will be completed by 2025 in accordance with the Consent Decree. If implemented, the First Street Branch Tunnel will be placed in service following completion and startup of the entire project.

Based on fast track design and procurement, and a commitment of support from District, the Northeast Boundary Tunnel could be completed by 2022. These are major projects with an estimated cost of more than $500 million that will be constructed in dense urban areas. Identifying the right of way for the tunnel and surface facilities, obtaining the necessary property and easements, and obtaining construction staging areas and permits for construction are critical to being able to construct the project in accordance with the schedules presented here.

These projects cannot be constructed according to the schedules shown without the commitment from District agencies to act as project stakeholders by providing the following:

- City Administrator appoints a champion. The champion assembles and leads a Task Force of key officials from District agencies, and is empowered to direct agencies on project related issues.
- District agencies dedicate staff to support the project, and who are authorized to make decisions on behalf of the agency. The agency representatives may be located with the project design team to facilitate close coordination.
- DC Water obtains power of Eminent Domain and District exercises power of Eminent Domain as necessary to obtain land for the project.
- District grants all necessary easements to DC Water.
- District grants necessary District property to DC Water for permanent facilities and for construction.
- District provides expedited permits with dedicated staff.
- District allows necessary street closures, work hours, etc. for construction operations.
- Permit fees are waived.
- District allows street closures, reasonable work hour restrictions, and other coordination for construction operations.
- District facilitates parking mitigation in construction zones.
- District provides financial assistance including waiving permit fees and help to secure Federal funding to limit water & sewer rate increases.

A number of permits will be required throughout construction of stormwater storage facilities at the McMillan site and the First Street Tunnel. Table 5-14 identifies key permits that typically take up to four months to obtain. The stakeholder relationship and assistance from District agencies described above will be essential for processing permits expediently.

Table 5-14: Key Permits for Construction of the Northeast Boundary Tunnel

Agency	Permit	Typical Time to Obtain	Scope
DDOE	SEC/SWM Approval	4-8 weeks	Site work at McMillan site and in streets
DDOE	Soil Boring Approval	4-16 weeks	Subsurface investigation in First Street
SHPO	Permit Condition Letter	4 weeks	Site work at McMillan site and in streets
DDOT	Construction	6-12 weeks	Maintenance of traffic and support of excavation for all work in streets
WMATA	Permit Condition Letter	4-8 weeks	Site work and tunneling near WMATA facilities at Rhode Island Ave Metro
DCRA	Building Permit	3-6 weeks	Site construction trailers
DCRA	Support of Excavation	4-8 weeks	Site work at McMillan
DCRA	Foundation to grade	4-8 weeks	Site work at McMillan