Stormwater Climate Adaptation Plan Report for the City of Takoma Park, Maryland

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Low Impact Development Center

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1. Executive Summary

Decades of development coupled with aging infrastructure and increasing storm intensity has left traditional stormwater management systems with inadequate capacity to handle common rainfall events. This study explores the potential of Green and Grey Infrastructure improvements to mitigate the impacts of changes in rainfall intensity and development on stormwater runoff and stormwater management in the City of Takoma Park, Maryland. There are many national efforts to integrate Green Infrastructure as a non-structural control into mitigation of the 100-year 24-hour flood event and management of the 100-year floodplain (EPA, 2020). Temporary upland flooding is occurring around storm drain inlets and pipes due to increased and more intensive runoff. Some areas of the City are also experiencing significant overland flooding that is impacting private properties and infrastructure. This study focuses on new approaches to help evaluate and predict the effects of climate change on the upland sections of urbanized watersheds.

Humans have been influencing the land use of the United States for thousands of years. In the last few centuries urbanization has caused extensive changes to the land surface through the construction of impervious surfaces such as roads and buildings. To accommodate the excess stormwater runoff, and to move stormwater out of urbanized areas in a safe and rapid manner, stormwater management systems were sized using engineering formulas. Most of the formulas for sizing pipes that are still in use today are based on these simple equations that account for the intensity of the rainfall, size of the drainage area, and type of land use (Burian & Edwards, 2012). Advancements in rainfall data collection and reporting, computing power, satellite imagery of land uses and storms, statistical methods, and calibrated water flow monitoring stations have allowed for the development of more robust watershed models that allow us to look at drainage systems in real time or make more accurate projections of the effects of different types of storm events within a watershed. Historically the methods for determining the impacts of storms have been based on statistical analysis and projections based on past events. One of the challenges for urban communities is how to manage and convey the increase in intensity, volume, and frequency of these new types of storm events associated with climate change in heavily developed areas with limited undeveloped space or access to stormwater infrastructure.

The results of this study show that many areas in the City of Takoma Park have been impacted by increasing storm intensities and that the existing storm drain infrastructure in some cases is not able to accomodate increased capacity demands.

2. Introduction

The following is a Stormwater Climate Adaptation Plan and Infrastructure Improvement Report for the City of Takoma Park. The purpose was to increase awareness on climate change issues and identify how Green Infrastructure can be used in the City to help mitigate the effects of increasing frequency, intensity, and duration of rainfall on localized flooding and other changes to local climate such as changing weather patterns and increasing temperatures. The project was divided into four (4) tasks.

Task One – Provide a suite of stormwater management solutions for private and public property. It is envisioned that this will provide much-needed public information that the City can post to our website to help residents understand options for stormwater management.

Task Two – Review flood-prone areas of the City and select approximately 20 locations to develop initial recommendations for addressing stormwater impacts. This analysis will use GIS information, satellite imagery, and field visits. Two of these locations will be studied in detail to illustrate the possible reduction in run-off volume through the implementation of the recommended measures.

Task Three – Provide a list of proposed incentives and Code changes that the City may want to consider to enhance stormwater requirements, both at the City level and to recommend to the County level.

Task Four – Establish a dashboard on the City's website that will enable property owners to estimate the amount of run-off produced by various types of storm events based on the amount of pervious and impervious surface within their property. The dashboard will also include links to available city incentive and State grant programs.

3. Overview of Takoma Park's Development and Growth

The City of Takoma Park borders Washington D.C. to the southwest, Prince George's County to the east, and Silver Spring to the north. Figure 1 shows the location of watersheds within the City. It was first incorporated as a City in 1890. The City straddled the lines of Montgomery and Prince George's County until the Prince George's County portion was officially annexed into Montgomery County in 1997.

The population of Takoma Park was 17,610 as of the 2021 American Community Survey 5-year estimates and has remained relatively stable over the last ten years. Figure 2 is a summary of house construction by decade, and Figure 2 shows residential development in the City by decade (M-NCPPC, 2018).

Takoma Park is zoned primarily for residential land use, with smaller clusters of commercial, industrial, and mixed-use areas. Figure 3 shows the approximate distribution of land uses.

Although somewhat fragmented, the City has a well-established tree canopy and network of open space and trails. Figure 4 shows the tree canopy and major parks in the City.

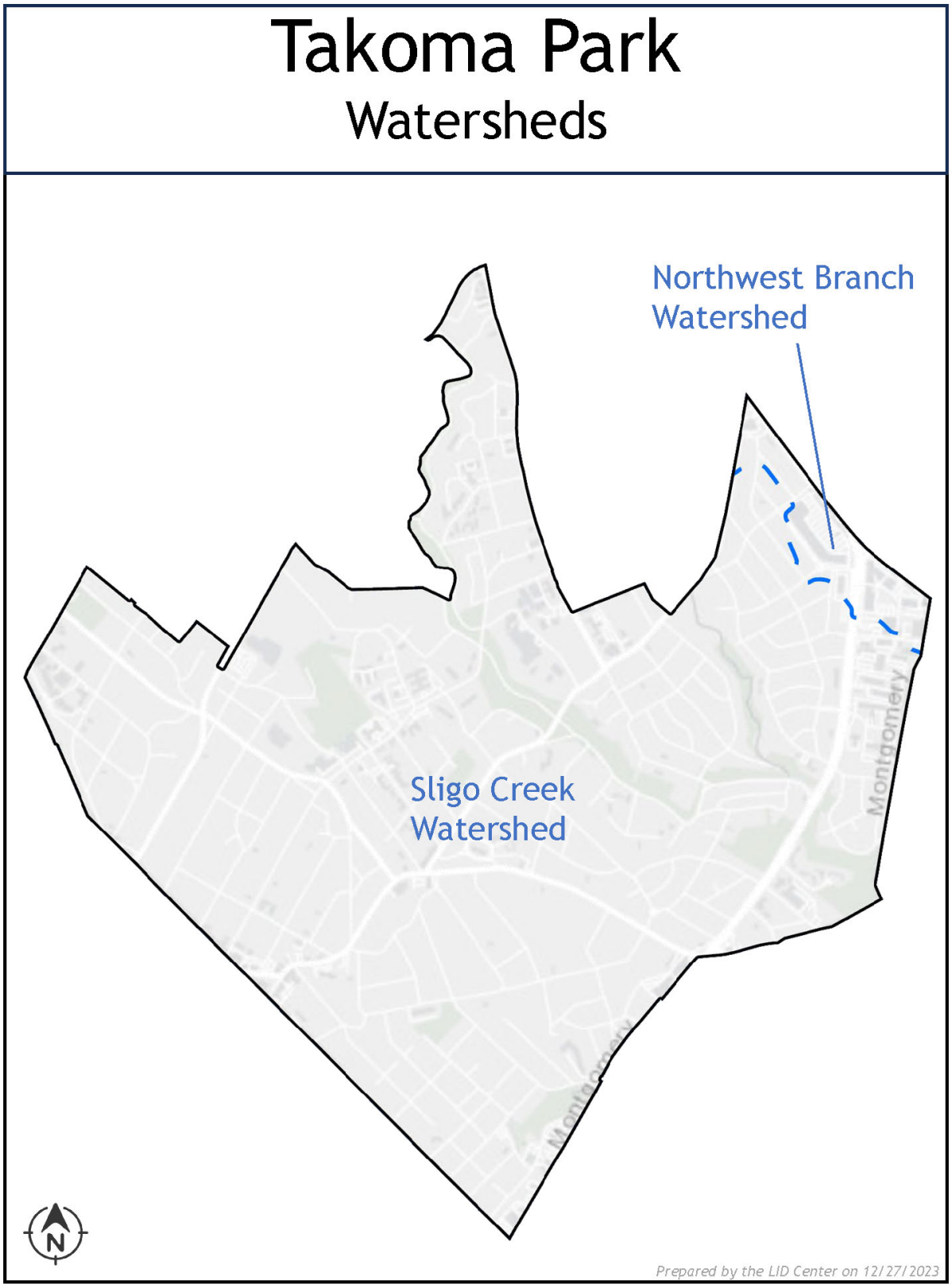

Figure 1: Takoma Park Watersheds

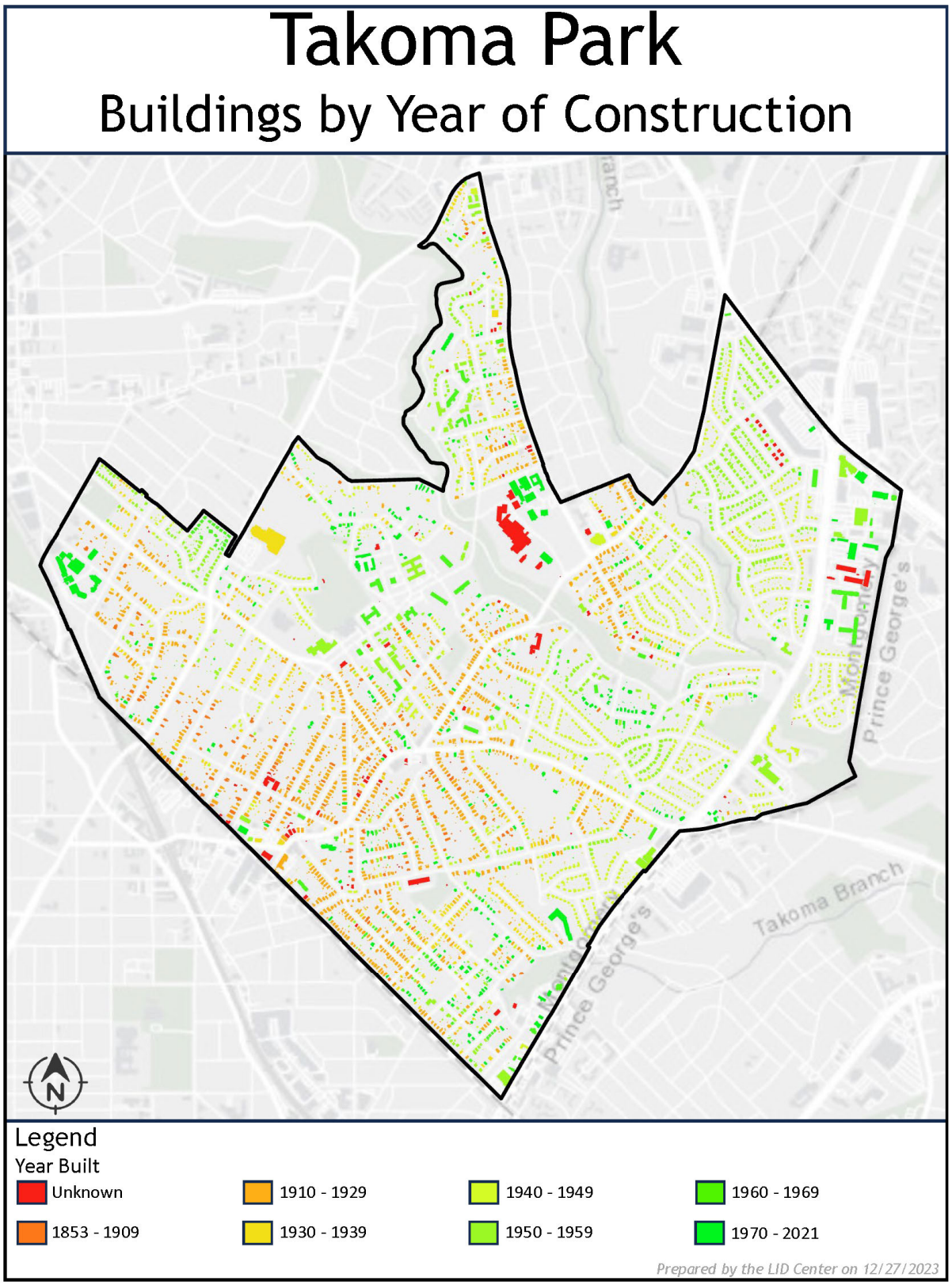

Figure 2: Takoma Park Development by Decade (M-NCPPC, 2018)

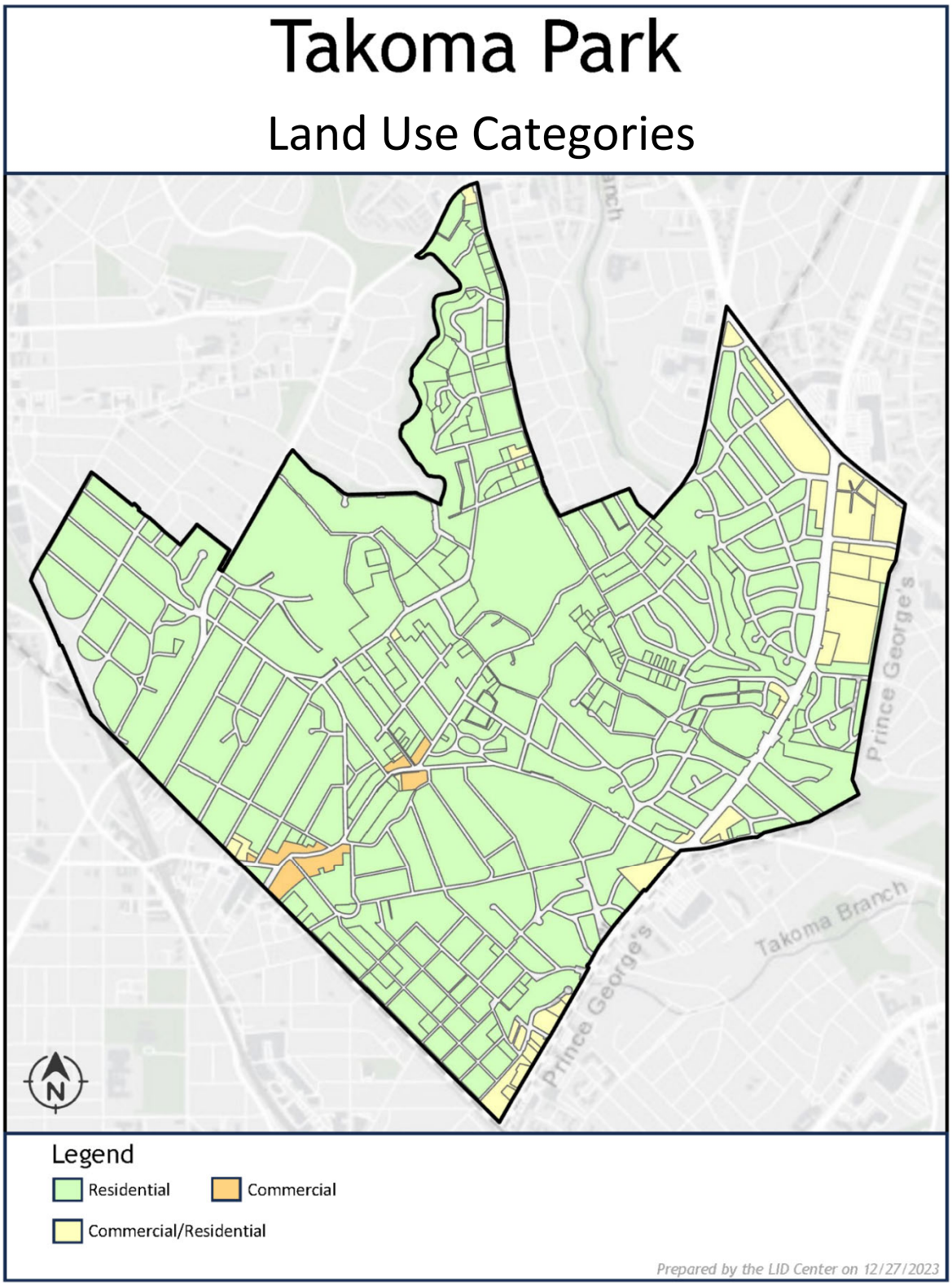

Figure 3: Takoma Park Zoning

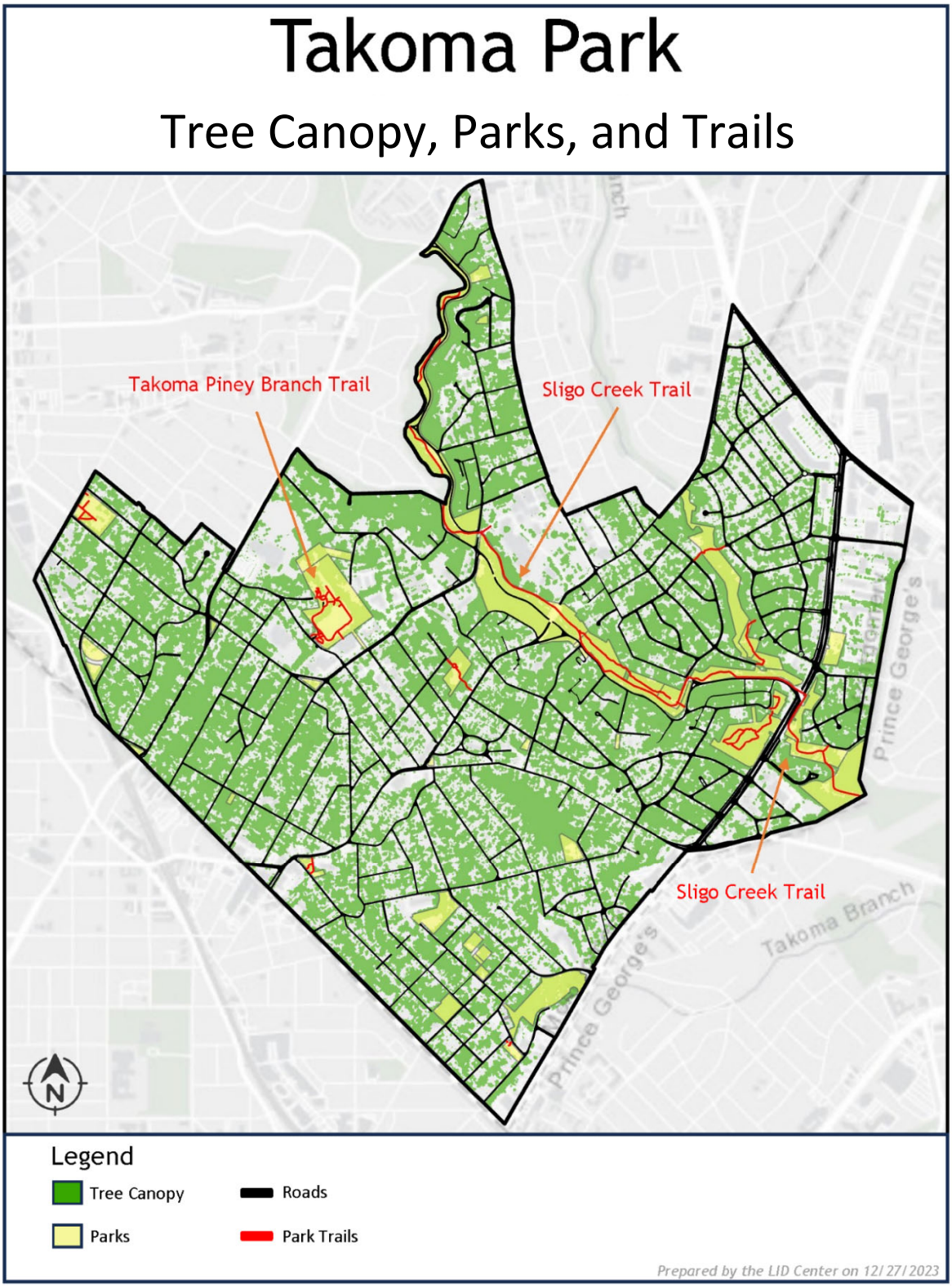

Figure 4: Takoma Park Tree Canopy and Major Parks

4. Existing Storm Drain Infrastructure and Conditions

The City of Takoma Park lies within the Anacostia River Watershed.

The storm drainage infrastructure in the City of Takoma Park is complex and is managed by several public agencies. The storm drainage infrastructure has been managed by the City since the 1980's. There are several state roads that traverse the City. The storm drain system in the state right-of-way, such as along MD RTE 410, is maintained by the Maryland State Highway Administration (MDOT SHA). The Washington Suburban Sanitation Commission managed the storm drainage system in the City until 1987 when the system was transferred to the City. There are also some systems on private property that are maintained by the City that may or may not have an official stormwater easement. Many of these are legacy pipes from a time when regulations were very different; these systems present a unique challenge for stormwater management within the City. Some of this was previously unmapped until the City completed the recent GIS mapping effort. The City has undertaken a multi-year effort to digitize all storm drain systems into the GIS database.

The drainage system, regardless of ownership, consists of structures such as inlets to capture the water, and manholes at pipe junctions or intersections, along with pipes, open channels, and swales to convey the water. There are 1,312 known public storm drain structures within the City limits; 1,082 are City maintained and the other 230 structures are in SHA right-of-way. The GIS information is complete for the majority of the system, but there are some areas that are missing invert elevations or pipe sizes.

Note that portions of the system that may have been constructed privately are not shown.

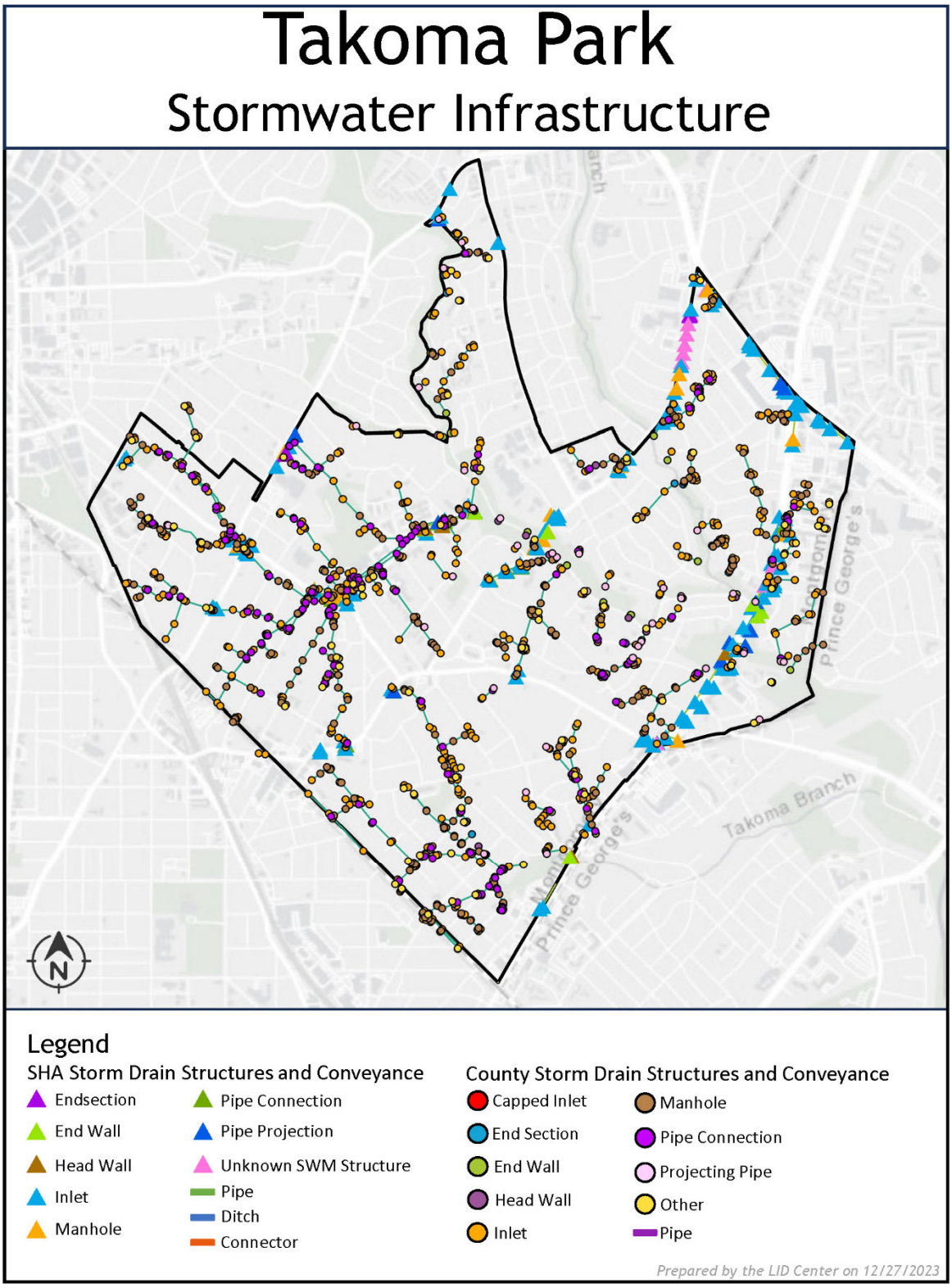

Figure 5: Storm Drain System

5. Modeling for Climate Change

Climate change has already had a significant impact on our precipitation patterns. Figure 6 shows the percentage increase in intense storm events (defined as the heaviest 1% of all daily events) from 1958 to 2012 (Walsh et al. 2014a). The DC metro area lies on the divide between the Northeast and the Southeast regions.

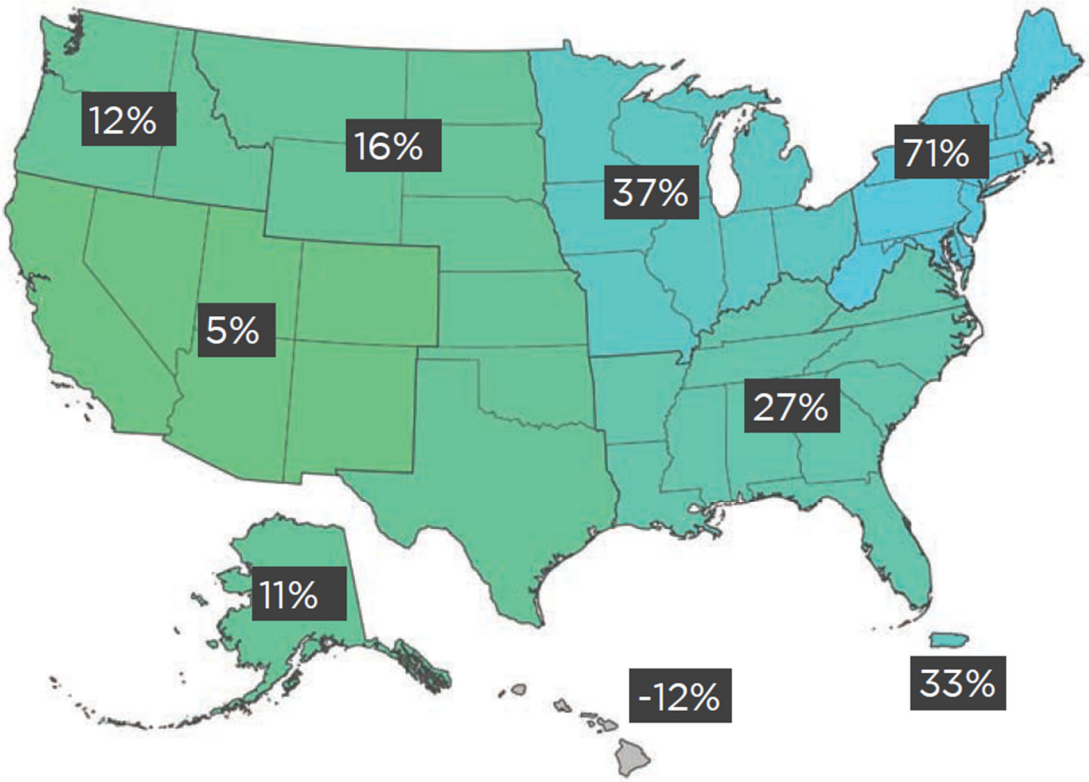

Figure 6: Increase in Intense Storm Events

The frequency and intensity of extreme precipitation events are projected to increase over time. In a study of the District of Columbia it was found that the District currently receives an average of 10 days per year with greater than 1 inch of rain in a given 24-hour period, and an average of 1 day per year with greater than 2 inches of rain in a 24-hour period. By the end of the 2020s, the number of days per year with more than 1 inch of rainfall per 24-hour period is expected to be 11 days. That number is projected to increase to 12 days by the 2050s and 13 days by the 2080s. The number of days per year with more than 2 inches of rainfall per 24-hour period is expected to increase to 3 days per year by the end of the 2020s, an average of 3.5 days per year by the 2050s, and between 3.5 to 4.5 days per year by the 2080s (DC DOEE, 2021).

Floodplains and Localized Flooding

A small portion of the City is within the boundaries of the 100-year floodplain. The 100-year floodplain is the water surface elevation that results from a storm event that has a 1 in 100 (1%) chance of being met in any given year. Building construction and roads are restricted in these areas, but historic structures and roads may exist. There is also a 500-year flood boundary. That has a 1 in 500 (0.2%) chance of being met

or exceeded in any given year. Figure 7 is a map of the 100-year and 500-year floodplain limits in Takoma Park. The FEMA floodplain area is in the vicinity of Sligo Creek Parkway in the Northern portion of the City.

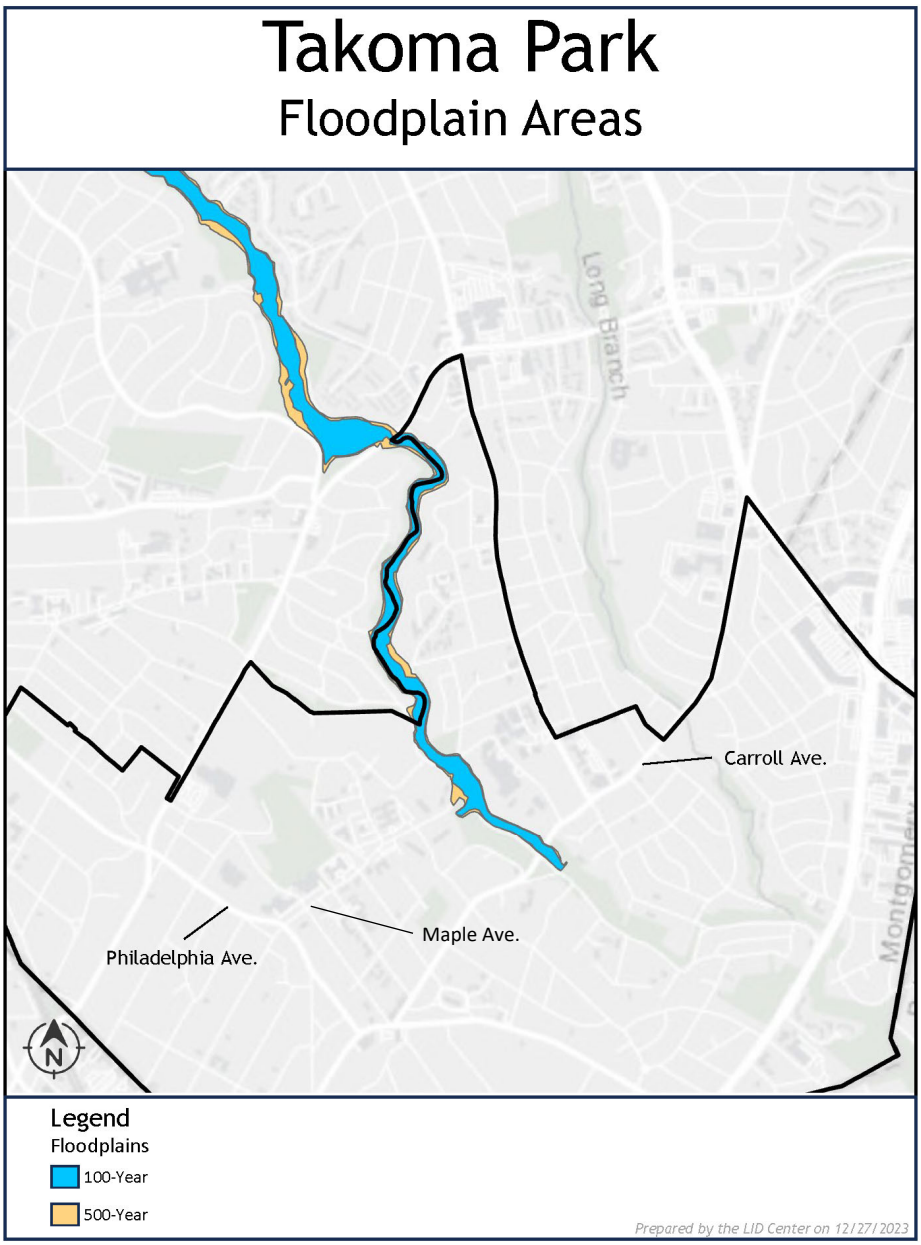

Figure 7: 100-year and 500-year Floodplain Limits in Takoma Park

Data indicates that these 100-year events are occurring more frequently and will rise above current elevations and horizontal extent with the increasing impacts of climate change (DC DOEE, 2021).

Another type of flooding is often called “Nuisance Flooding” where there is a temporary inconvenience such as blocked roads or temporary flooding of a yard. These nuisance flooding areas are not located within the 100-year floodplain and are often limited to local upland areas. They are often not reported or

tracked or mapped because they are outside of the 100-year limits. Given climate change and predictions of increased rainfall, it is reasonable to assume that many upland areas of the City will be subjected to more frequent flooding due to the increased intensity and volume of stormwater overwhelming the drainage system.

6. Modeling Effort Objectives

PCSWMM, a proprietary version of the EPA Storm Water Management Model (SWMM) was used to supplement field visits and reports from the City Public Works and residents to help determine where the existing storm drain system may be inadequate to handle the emerging trends in rainfall intensity. PCSWMM is an advanced hydraulic model that is used to analyze complex urban open and piped drainage systems. The storm events were modeled based on recent storm data (period of record). PCSWMM was also utilized to model the impacts of a 25% increase in peak rainfall intensity over a shortened time duration to account for climate change. The first goal was to identify "choke points" in the existing system. Examples of choke points include undersized pipes or structures that may be undersized.

Various mitigation or prevention scenarios were considered after reviewing model results to determine if upgrading the Grey Infrastructure (pipes, inlets, and manholes) or Green Infrastructure (bioswales, tree boxes, tree planting, bioretention cells, and permeable pavement) would be effective at reducing flooding and improving water quality. Restoration and mitigation efforts were prioritized based on safety, keeping emergency routes open, property protection, extent of flooding, and impacts to water quality.

While modeling future storm events is an emerging science, one approach is to model several appropriate storm events and then use best professional judgement and comparisons with other events and studies to calibrate and verify the model. For this report, four (4) storms were selected for analysis. Each storm event was run through three (3) scenarios to produce additional insight into the capacity challenges. The storm events and scenarios are:

- Storm Event One: 10-year 24-hour storm event. The conveyance of the runoff from the 10-year 24-hour storm event is the current standard for drainage systems. This is used as a benchmark to compare against the increased rainfall and to assess if there are any systems undersized for the current design storm.
- Storm Event Two: 10-year 6-hour storm event. This model scenario significantly decreases the duration of the storm event but maintains the recurrence interval. The rainfall in this scenario is more like a thunderstorm or flash storm event with significant rainfall volume over a short period of time. This is similar to present-day rainfall patterns that are experienced in the region.
- Storm Event Three: Twenty-five (25) percent increase in the rainfall hydrograph for the 10-year 24-hour storm event. This storm event is used to give a "ballpark" estimate of the increased volume and intensity of stormwater runoff that can be expected in one or more of the climate change scenarios.
- Storm Event Four: Twenty-five (25) percent increase in the rainfall hydrograph for the 10-year 6-hour storm event. This storm event is used to give a "ballpark" estimate of the increased volume and intensity of stormwater runoff that can be expected in one or more of the climate change scenarios.

- Scenario One: The first scenario was a control scenario. This simply modeled the conveyance of the selected storm event with no changes to the model. These results were used to compare the scenario results and assess the impact of intensity increases or maintenance impacts.
- Scenario Two: Upstream pipes sized to pass the storm. Upstream pipes were enlarged to determine the impact on pipe systems and open channels at the bottom of the watershed. This exercise was done to show potential downstream impacts of upstream improvements.
- Scenario Three: The third scenario showed all water getting to the large culverts at the bottom of the system. This scenario was meant to model a case where upstream inlets and pipes were maximized to pass the storm and evaluate what impact this could have at the downstream end of the system.

7. Determining the Stormwater Impacts of Climate Change

The City Department of Public Works, using input from citizens and council, supplied a list of twenty potential target watersheds for the study. Due to the time and budget limits of the project, it was determined that only a portion of these areas would be modeled and studied in detail. A portion of the Takoma Branch Watershed, part of the Sligo Creek Watershed, was selected as a high-impact and suitable area to model. This area displays many of the typical stormwater and nuisance flooding concerns in the City. A proprietary version of the Storm Water Management Model (SWMM) was used to determine the impacts on the conveyance system. SWMM is an advanced stormwater model that can use continuous simulation, or analysis of multiple succeeding storm events. It can also be used to measure the peak runoff from sheet flow, channels, and pipe system networks. Another advantage is that the user can rapidly change scenarios or time periods for the analysis and uses many of the same engineering equations as the one-time peak flow events that are evaluated in traditional stormwater management analysis. This facilitates communication between technical reviewers and watershed planners. One of the disadvantages of the model is that it does not identify the flow path and increase in peak overland flow from systems that are surcharged and backing up over the ground, such as through an inlet that is undersized or a pipe at capacity. This occurred in several of the scenarios. In those instances, the project team recognized that some of the runoff is not “captured” in the model and that area should be evaluated for risk of flooding impacts and as a potential location for mitigation measures. Additional scenarios were run to model downstream areas as if no flow was “lost” to surcharge or system capacity.

The model is used to calculate the amount of rainfall that is generated from the land uses within each sub drainage area that is collecting water to a conveyance system of pipes and channels. Impervious areas, such as roads, sidewalks, roofs, and driveways have a greater potential than grassed and vegetated areas to generate runoff. The modeled area had a drainage area of 276.05 acres, 43% of which is impervious cover. A portion of this drainage comes from the neighboring District of Columbia where some storm drains along Eastern Avenue connect to the City of Takoma Park storm drain system. The major categories of impervious surface are buildings and transportation including roads, parking lots, and sidewalks.

Figure 8 shows the different types of impervious surfaces in the City. The areas in white are either grass or trees.

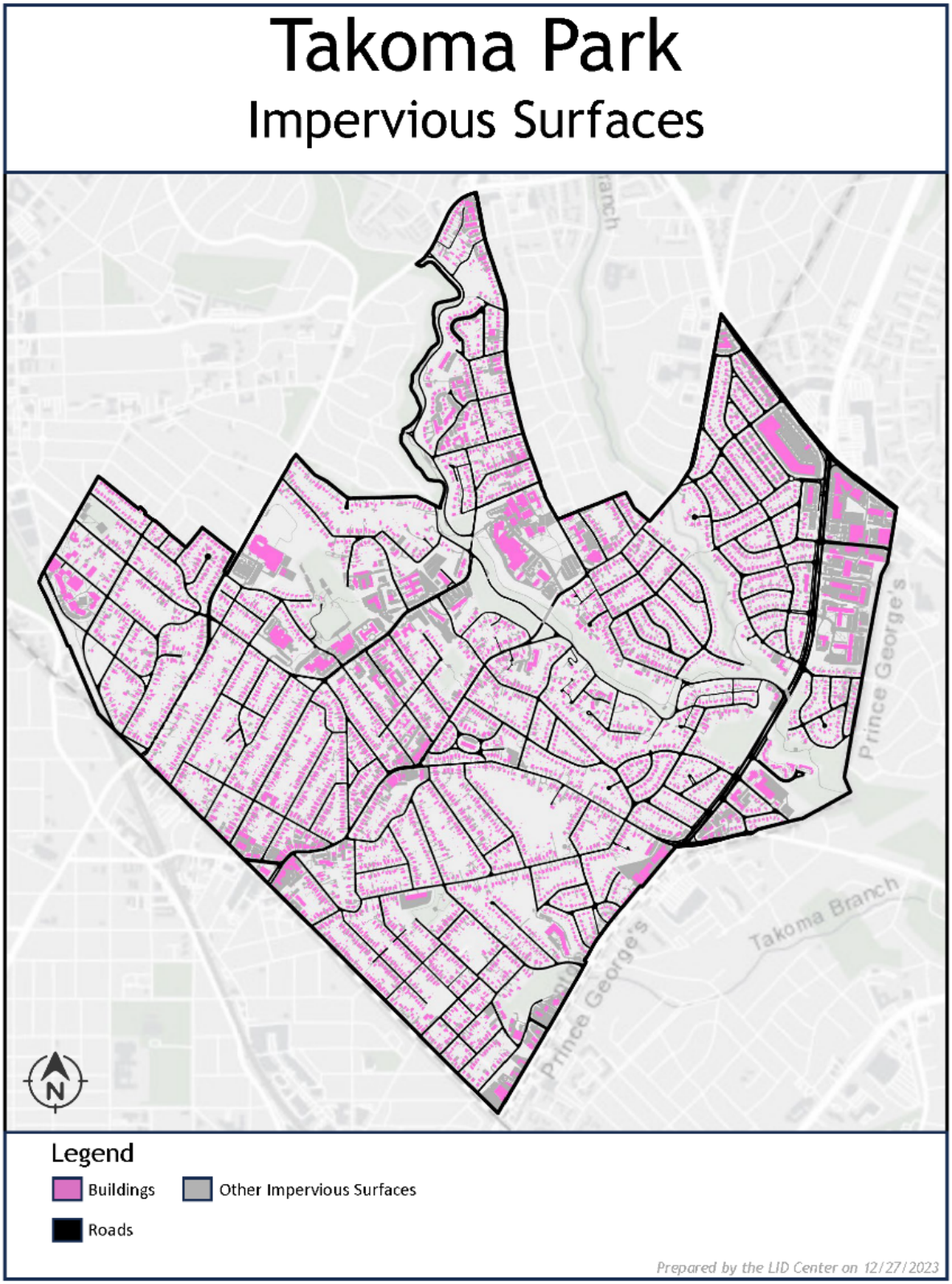

Figure 8: Impervious Surfaces in Takoma Park

The network of drainage areas, structures (inlets and manholes), pipes, and open channels are shown in Figure 9. Each structure, conduit, and junction are assigned an alphanumeric label. This entire system drains to a single outfall where a recent stream restoration has been performed on a tributary to Sligo Creek. The areas within the District of Columbia were delineated using GIS contours, but detailed storm drain data was not available. The model assumes that this water enters the Takoma Park storm drain system via the DC storm drains along Eastern Avenue for which we were able to obtain some data. When data was not available, linear interpolation and best practices were used to estimate pipe size, material, and slope. Pipes were assumed to be similar in size and materials to adjacent pipes. This method was utilized to fill in any gaps in the data set.

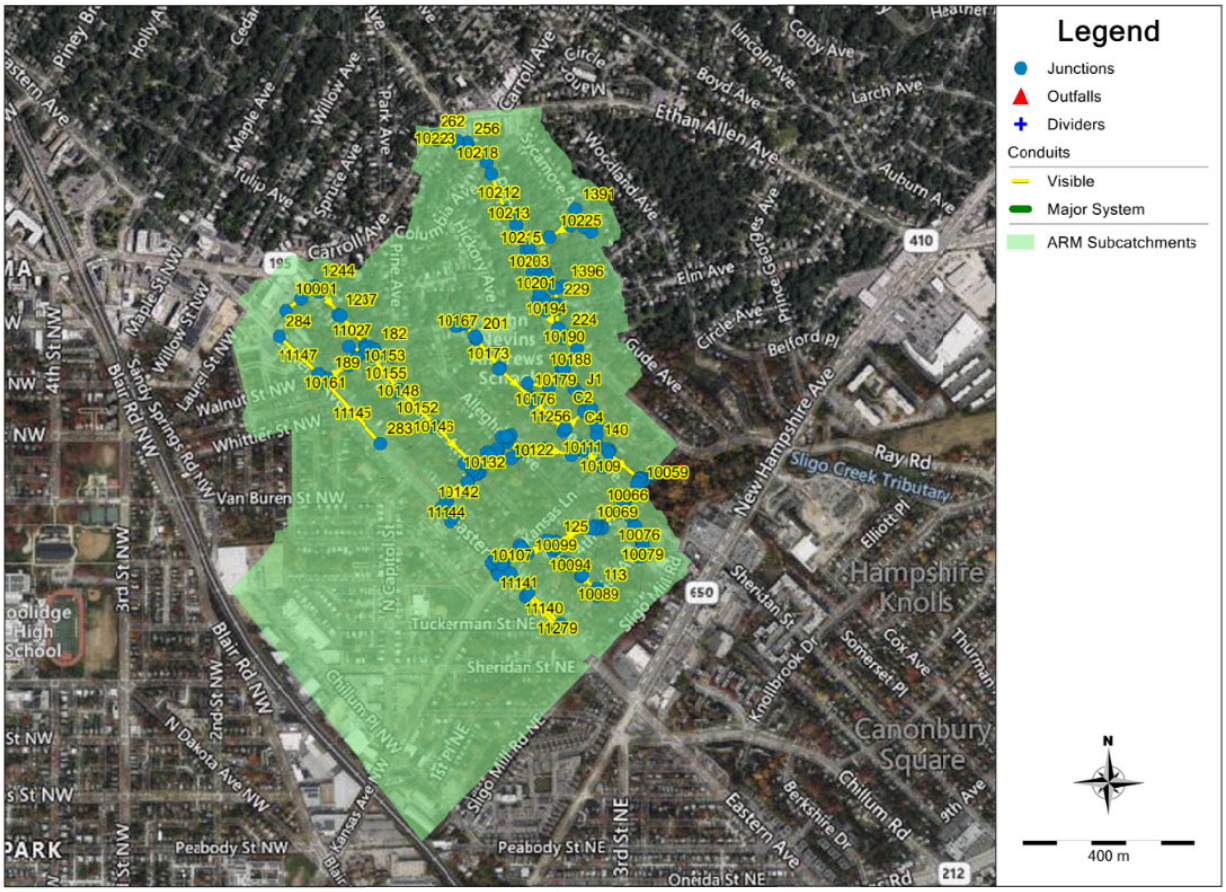

Figure 9: SWMM Model Schematic

8. Model Results

The four (4) storm events and three (3) scenarios were run through the drainage network to determine the existing and projected capacity and then some trial scenarios of mitigation measures were run to evaluate whether the addition of grey and green infrastructure may have a positive impact. The key findings of the results are described below.

- The 10-year 24-hour storm event: This is the rainfall event that is currently used to design storm drain systems. The model shows that the system currently overflows near the intersection of Westmoreland Avenue and 4th Avenue; in the area of 2nd Avenue between Allegheny Avenue and Westmoreland Avenue; and near the intersection of Columbia Avenue and Poplar Avenue.
- The 10-year 6-hour storm event: This represents a more intense rainfall event which occurs in a shorter duration. It was selected because it more closely resembles storms that may be happening with increased frequency This event causes a similar response that the 10-year 24-hour event does but there is reduced capacity in the pipe system due to the additional and more intense runoff. Some of the pipes connected to curb inlets around the City may be impacted by a higher intensity rain event.
- The 25% increase in intensity scenario shows that the system reaches capacity sooner, and that more nodes flood. The model assumes that any runoff that cannot enter the system "disappears." Due to this, it is likely that the system would have more severe flooding than the model may indicate. Additional flooding nodes are present along Westmoreland Avenue, Cockerille Avenue, Sycamore Avenue, and at the confluence of the large underground box culverts near Takoma Branch at the bottom of the system.
- The upsized pipe scenarios were run to simulate what would happen lower in the system if systemwide infrastructure improvements were implemented for undersized pipes and inlets. This scenario revealed a possible capacity issue near the intersection of Cockerille Avenue and 4th Avenue where the large culverts combine to discharge to Takoma Branch. Further investigation would be needed to determine if this would be a practical or effective upgrade in the future.

The following figures (Figure 10, Figure 11, Figure 12, Figure 13) show some examples of the modeling results. Shown are locations and nodes, storm drain structures such as inlets or manholes, where localized flooding may occur based on model results. The model can also reveal areas where there may be a capacity bottleneck even if localized flooding is not expected in that area.

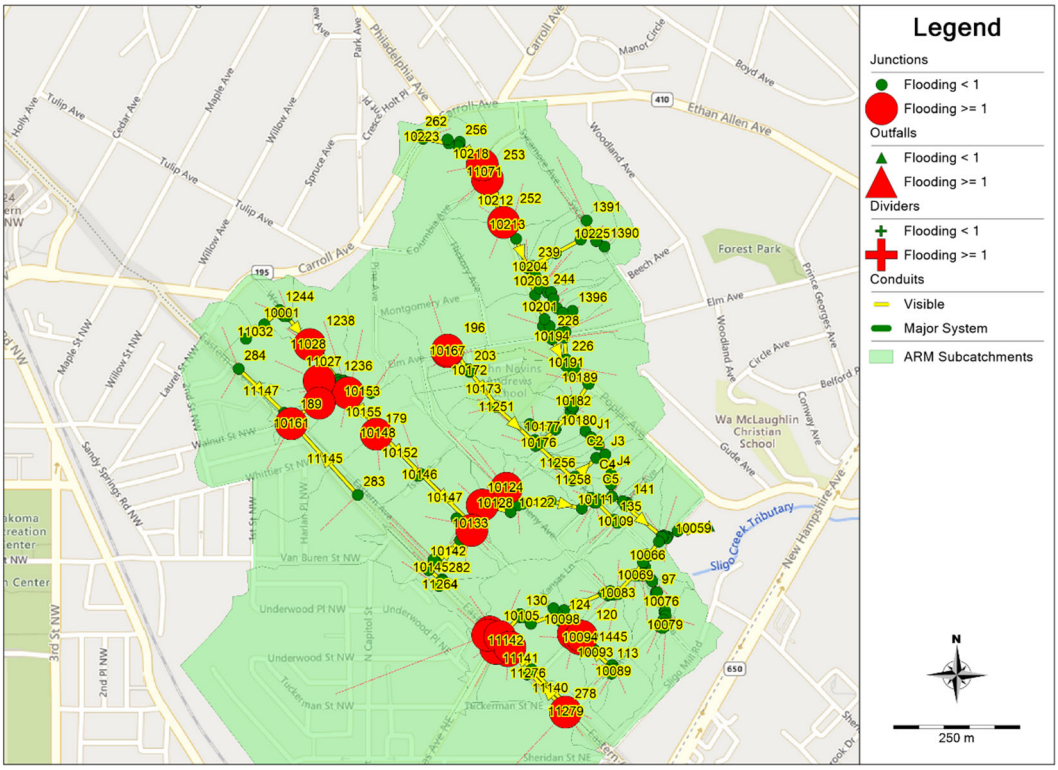

Figure 10: 10-Year 24-Hour Storm Event

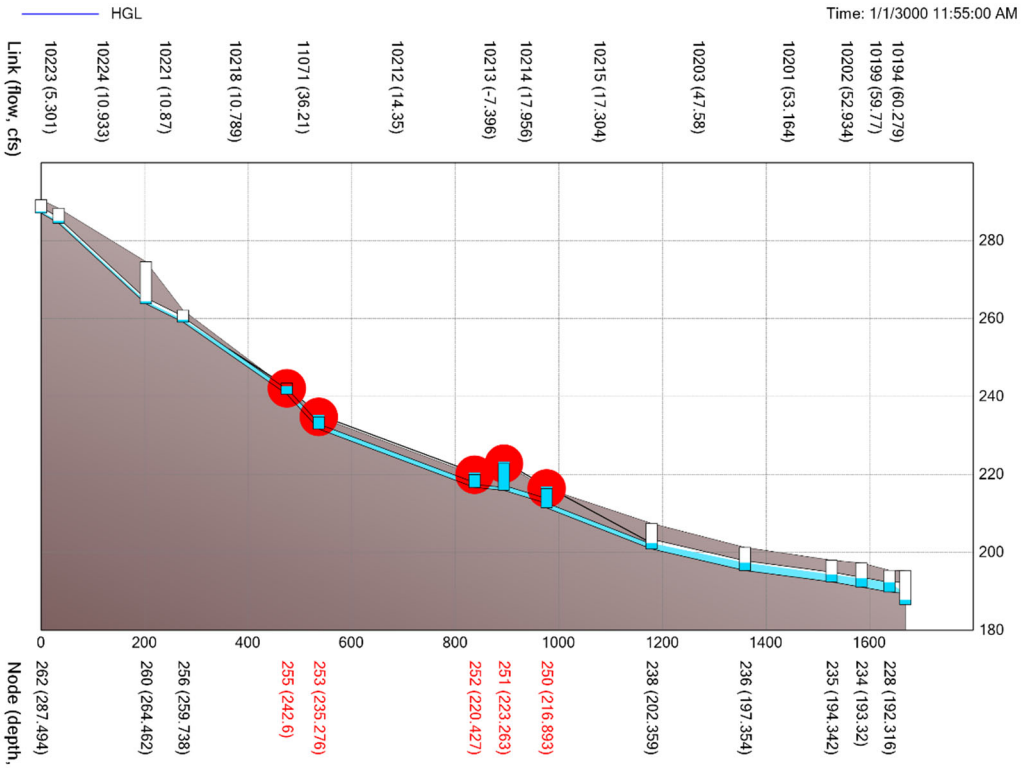

Figure 11: 10-Year 24-Hour Future Storm Event

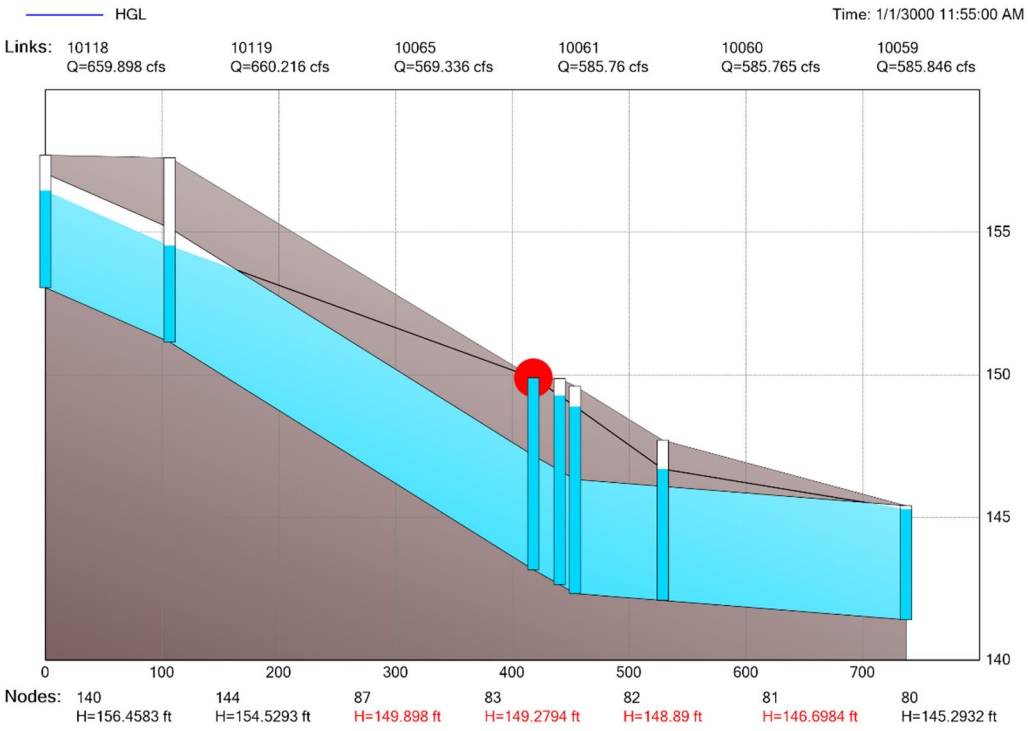

Figure 12: Upstream improvements Scenario

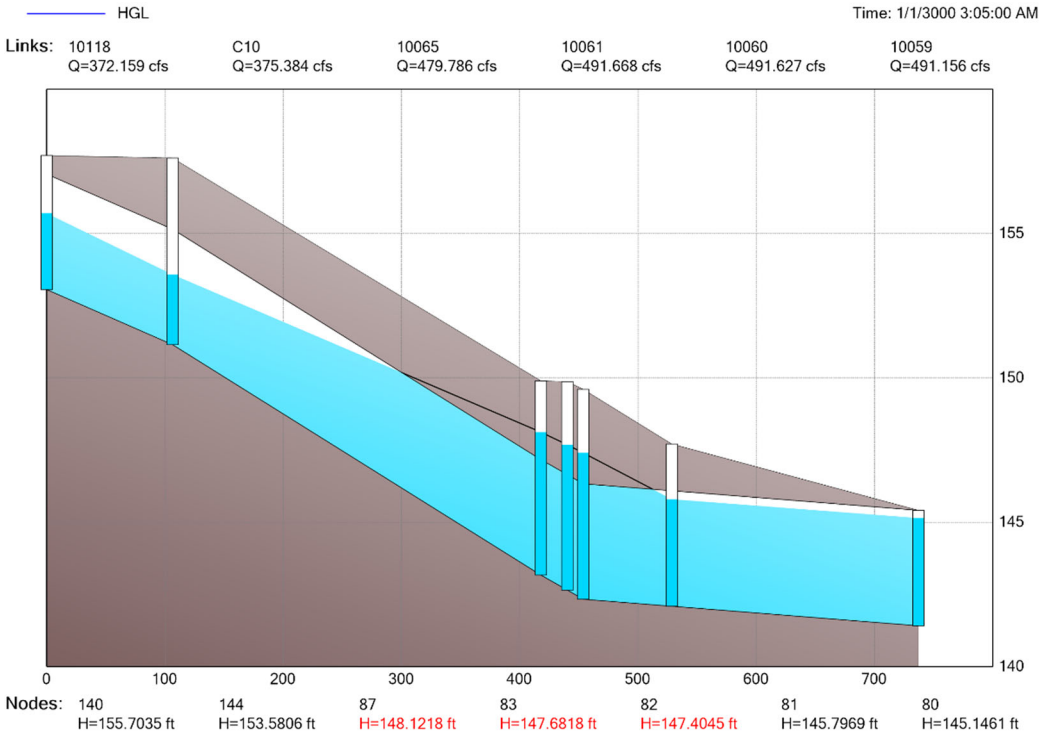

Figure 13: 10-Year 6-Hour Storm Event

9. Recommendations

There are many metrics and approaches to prioritizing the use of Green and/or Grey Infrastructure to help mitigate and reduce the impacts of stormwater runoff. The residents of the City of Takoma Park already have a strong understanding and commitment to Green Infrastructure and the City has invested in many projects including bioretention and filter devices. The Department of Public Works has also performed numerous Grey Infrastructure upgrades throughout the City to help alleviate localized flooding and improve stormwater management.

The priorities are also governed by the potential for existing flooding based on the current conditions. The team used the model, site visit results, and input from DPW to assess potential projects. Ownership of the area affected by the flooding was also considered. Public properties are a priority because of permissions and equity in project selection. The following are the key recommendations that may reduce or mitigate the impacts of the different scenarios. Additional information about each recommendation can be found in Appendix 'A' Takoma Branch Watershed Resiliency Projects.

Table 1. Takoma Branch Potential Resiliency Projects

#	Project Name	Location	Scope	Flood Reduction Benefit	Water Quality Benefit	Priority	Time frame	Cost
1	Circle Woods Stream Inflow Replacement and Wetlands BMP	Circle Woods	Large	Large	Large			~$750,000 - $1,000,000
2	Circle Avenue and Poplar Avenue Drainage Improvements	Circle Avenue and Poplar Avenue	Small	Moderate	Small			~$150,000 - $300,000
3	Lake Street BMP and Peak Flow Attenuation System	Lake Street	Moderate	Moderate	Moderate			~$200,000 - $400,000
4	2nd Avenue Inlet Improvements	2nd Avenue between Alleghany Avenue and Westmoreland Avenue	Small	Moderate	Small			~$50,000 - $100,000
5	Columbia Avenue and Poplar Avenue BMP and Peak Flow Attenuation System	Columbia and Poplar	Moderate	Moderate	Moderate			~$100,000 - $300,000
6	VFW Parking Lot Green Drainage Improvements	VFW Parking Lot	Moderate	Moderate	Moderate			~$200,000 - $400,000
7	Orchard Avenue Green Street	Orchard Avenue	Large	Large	Large			~$750,000 - $1,250,000
8	Estrellitas Montessori BMP	Estrellitas Montessori School	Moderate	Moderate	Moderate			~$200,000 - $400,000
9	Hickory Avenue Uphill Storm Drain Extension	Hickory Avenue and Elm Avenue	Moderate	Moderate	Small			~$250,000 - $500,000
10	Citywide Inlet Upgrades	Takoma Park	Large	Large	Small			$10,000 - $20,000 *Per inlet

10. Code Review

The City of Takoma Park has a thorough and modern Stormwater Management Code. The LID Center reviewed the Code and has determined that some small adjustments may yield positive results for the community. The findings of this review are as follows.

- **Remove the Groundwater Recharge Requirement**
  - Groundwater recharge can be an important part of maintaining a well-functioning watershed. In the case of the City of Takoma Park the groundwater table is very high throughout the city. Firsthand accounts from homeowners and the Department of Public Works indicate that groundwater concerns are increasing in the city which may be due to broader climactic shifts in weather patterns. Forcing groundwater recharge could locally worsen some of these problems.
- **Adjust the 5,000 sf Minimum Requirement for Stormwater Review**
  - The City Code is consistent with most parts of the State of Maryland to require stormwater permits for projects that disturb a minimum of 5,000 sf of land area. The City could consider altering this requirement so that smaller residential projects fall under a category for a 'minor' review. This could give the City an opportunity to perform several remedies such as:
    - Encourage homeowners to connect downspouts to storm drain systems
    - Prevent discharge of runoff or sump pumps to downhill neighbors
    - Inform homeowners of potential concerns such as garages that are below grade or the need to install waterproofing with their project
  - This review should be minor in nature as to not burden the homeowners with significant costs or technical burdens.

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Appendix A: Takoma Branch Watershed Resiliency Projects

Appendix A identifies 10 potential resiliency projects that could address stormwater drainage concerns within the Takoma Branch Watershed. Projects were developed based on field investigation with Takoma Park DPW and affected residents, desktop analysis of GIS data, and SWMM (Stormwater management modeling) results. The type and scope of each project vary.

These projects are graded by the magnitude of the scope, cost, flood control benefits, and water quality benefit. The scope of the project was graded as small, medium, or large based on the anticipated impacts and square footage of the project during construction. The costs are based on high level estimate of required construction and based on prices at the time this report was written. The cost and material/labor prices can fluctuate greatly so this number should be confirmed and validated before project initiation. Flood control benefits were evaluated by considering the scale of the flood impact (large amounts of flooding or small amounts of floods), and the number of people or businesses effected. A large flood control benefit will address a larger amount of water that impacts a higher number of residents. The water quality benefit is based on the impervious area that may be treated through the project and the impervious acre treatment credits that the project could generate.

Generally, each project involves design and construction. Some projects require a preliminary feasibility assessment. Cost estimates were completed assuming the full proposed scope of design and construction will be carried out. Projects may be scaled down as desired by the City and thus may be less expensive than estimated. These projects were assessed and estimated based on GIS data which is more general than field run data. Projects and impacts should be confirmed with field run data. A summary of the projects can be found in Table 1. Takoma Branch Potential Resiliency Projects.

Table 1. Takoma Branch Potential Resiliency Projects

#	Project Name	Location	Scope	Flood Control Benefit	Water Quality Benefit	Priority	Time frame	Cost
1	Circle Woods Stream Inflow Replacement and Wetlands BMP	Circle Woods	Large	Large	Large			~$750,000 - $1,000,000
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7	Orchard Avenue Green Street	Orchard Avenue	Large	Large	Large			~$750,000 - $1,2500,000
8	Estrellitas Montessori BMP	Estrellitas Montessori School	Moderate	Moderate	Moderate			~$200,000 - $400,000
9	Hickory Avenue Uphill Storm Drain Extension	Hickory Avenue and Elm Avenue	Moderate	Moderate	Small			~$250,000 - $500,000
10	Citywide Inlet Upgrades	Takoma Park	Large	Large	Small			$10,000 - $20,000 *Per inlet

Takoma Branch Potential Projects

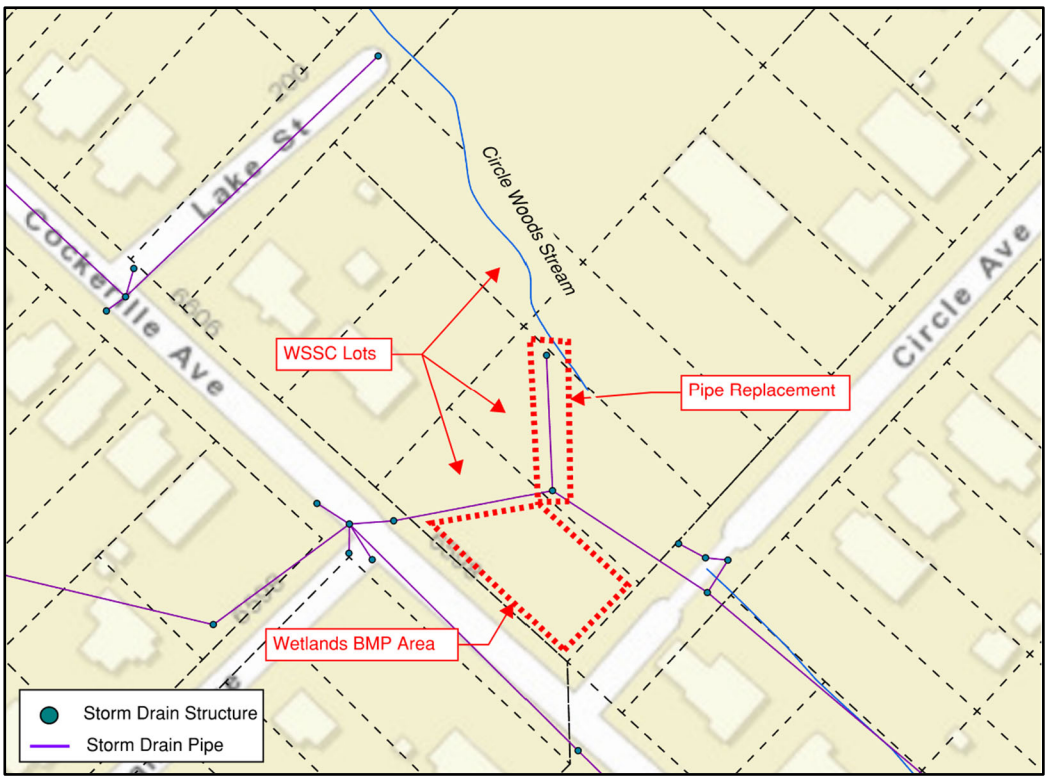
Project #	**1**
Project Name	**Circle Woods Stream Inflow Replacement and Wetlands BMP**
Location	**Circle Avenue and Cockerille Avenue Intersection**
Project Scope	Large
Flood Reduction	Large
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$750,000-$1,000,000
Coordinating Agencies	WSSC

Problem Description:

- The Circle Woods stream overflows the 48" inflow pipe during large storm events. This has led to substantial surface flooding of the surrounding residential properties, Circle Avenue, and downhill Cockerille Avenue properties. Takoma DPW has taken action to limit flooding by installing a high curb along Circle Avenue and a small culvert under the Circle Avenue asphalt path. These measures have been effective in limiting excessive downhill flooding; however, the area directly around the stream inflow still experiences flooding when stream levels rise. LID Center's preliminary stormwater modeling results suggest the stream inflow pipe could benefit from an increased capacity. The pipes in this area are on undeveloped WSSC lots with a large open grass area. WSSC plans to sell their properties in this area and the City has notified WSSC of their interest in acquiring the lots.

Project Recommendation:

- Purchase the WSSC lots if feasible and use the area for stormwater management. Replace the 48" pipe stream inflow with a large box culvert at least 6' wide and 4' high. The culvert will allow for increased capacity and decreased head losses as the stream enters the pipe system. A more detailed hydrologic and storm drain analysis will be required as part of the design.
- Design and install a large wetlands BMP in the open grass area. The BMP will store stormwater runoff thereby reducing overland flooding and peak flows in the storm drain system. The wetlands system will also filter stormwater pollutants and provide impervious area restoration credits towards the City's NPDES permit requirements. The BMP may be designed to take runoff from the road and/or divert flow from the nearby storm drain culverts. A detailed engineering assessment will be required to determine the size and configuration of this facility.


Lake St
Cockerille Ave
Circle Woods Stream
Circle Ave
WSSC Lots
Pipe Replacement
Wetlands BMP Area
Storm Drain Structure
Storm Drain Pipe

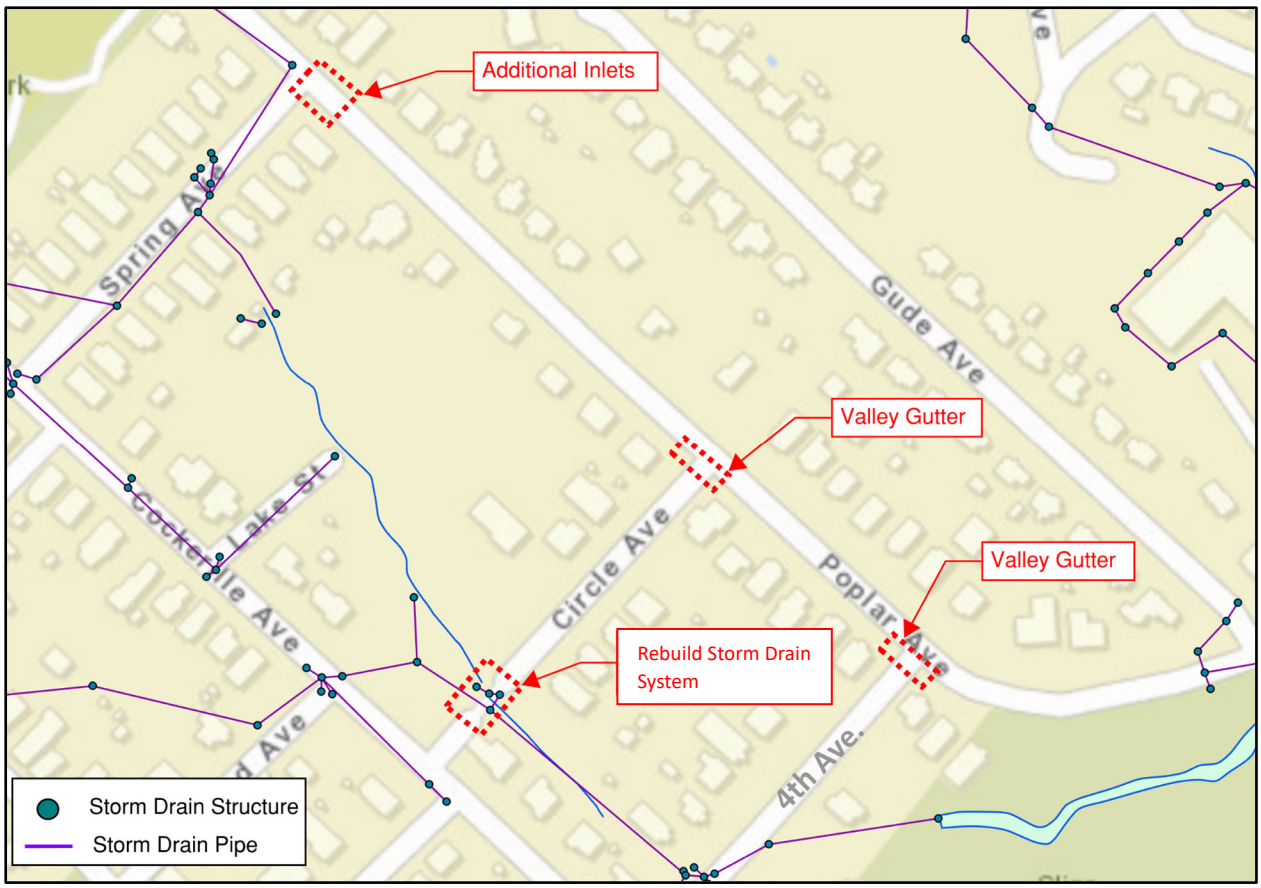
Project #	**2**
Project Name	**Circle Avenue and Poplar Avenue Drainage Improvements**
Location	**Circle Avenue and Poplar Avenue**
Project Scope	Small
Flood Reduction	Moderate
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$150,000 - $300,000
Coordinating Agencies	N/A

Problem Description:

- The low points of Spring Avenue, Circle Avenue, and 4th Avenue often flood during large storm events. Stormwater runoff from Poplar Avenue flows downhill onto each of the three roads. The low point of Circle Avenue floods from surrounding stream overflow and roadway runoff. Water does not easily drain into the small inlet and runoff often flows onto the residential lots downhill. At the low point of Spring Avenue and 4th Avenue stormwater can overflow the inlets and pond in the road, occasionally causing overflow onto the adjacent residential properties. Takoma DPW has recently upgraded inlets on Spring Avenue to improve drainage and plans to upgrade inlets on 4th Avenue as well.

Project Recommendation:

- Rebuild the drainage infrastructure at the low point of Circle Avenue. Remove the small culvert under the asphalt walkway and abandon the small inlet behind the asphalt path and close the inflow curb cut to it. Install inlets on either side of the dead end and in the adjacent grass area and install pipes to connect all inlets. Adjust road grades and curbs as needed to facilitate drainage to the inlets. The abandoned inlet may be able to be converted to a manhole type structure for connection to the existing culvert. If this is not feasible, install a new field connection from the inlets to the culvert. Modify the driveway apron grades along Circle Avenue as needed to keep stormwater flow in the roadway. An engineer should be consulted in the drainage redesign efforts.
- Install valley gutters along Poplar Avenue across the Circle Avenue and 4th Avenue intersections to redirect flow towards the outfall further east on Poplar Avenue. Enlarge the inlet on Poplar Avenue as needed. Proceed with plans to upgrade the inlets at the low point of 4th Avenue. Install a pair of curb inlets on the east side of the intersection of Spring Avenue and Poplar Avenue and connect into the nearby manhole. The inlets will intercept runoff that currently flows down to Spring Avenue. This will reduce ponding at the low point of Spring Avenue during large storm events. A hydrologic analysis will be needed to confirm the pipes in this area have capacity for the additional stormwater flow from the new inlets.


Additional Inlets
Valley Gutter
Valley Gutter
Rebuild Storm Drain System
Gude Ave
Circle Ave
Poplar Ave
4th Ave.
Spring Ave
Lake St
Storm Drain Structure
Storm Drain Pipe

Project #	3
Project Name	**Lake Street BMP and Peak Flow Attenuation System**
Location	**Lake Street**
Project Scope	Moderate
Flood Reduction	Moderate
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$200,000 -$400,000
Coordinating Agencies	N/A

Problem Description:

- The stormwater outflow from the Lake Street outfall contributes to flooding downstream at the stream inflow point and along Circle Avenue and 4th Avenue. Lake Street is a publicly owned paper street with open space to install flood control infrastructure.

Project Recommendation:

- Design and install a surface BMP in conjunction with an underground peak flow attenuation system adjacent to the Lake Street storm main. The storage system will alleviate peak flows in the downstream storm drain system while the BMP will provide a water quality benefit as well as a modest storage benefit. A detailed engineering assessment will be required to determine the size and configuration of each facility.

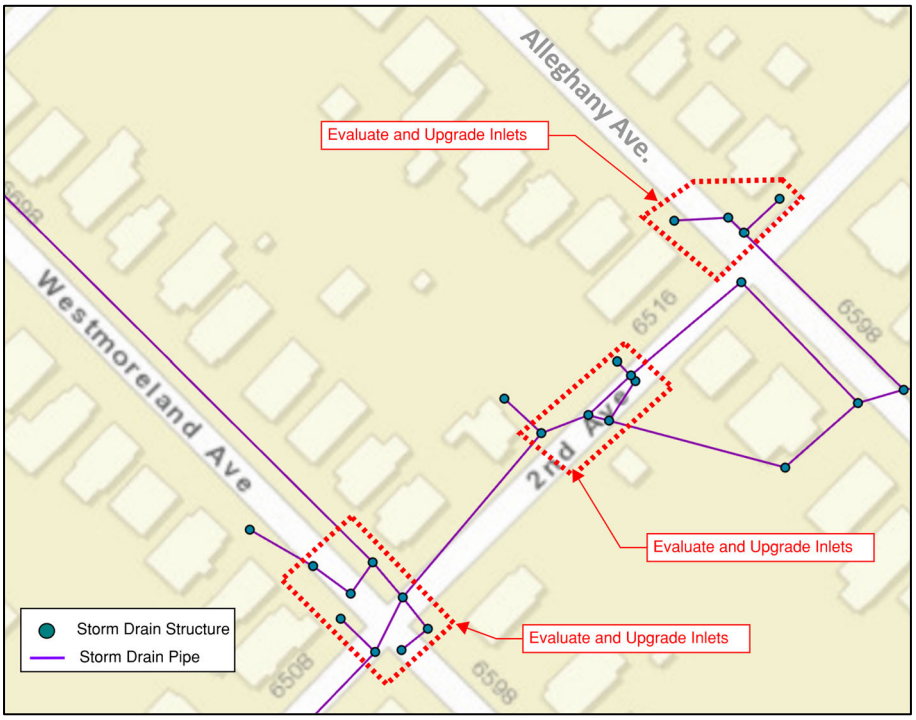
Project #	**4**
Project Name	**2nd Avenue Inlet Improvements**
Location	**2nd Avenue between Alleghany Avenue and Westmoreland Avenue**
Project Scope	Small
Flood Reduction	Moderate
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$50,000 -$100,000
Coordinating Agencies	N/A

Problem Description:

- The low point of 2nd Avenue between Alleghany Avenue and Westmoreland Avenue floods during large storms. Water has ponded multiple feet and caused traffic hazards. There is an old 48" storm main that goes through private property near a house. Takoma DPW has installed a 24" public pipe and a weir wall in the inlet structure that the two pipes outflow from in order to divert flow away from the 48" pipe under private property.

Project Recommendation:

- Evaluate all existing inlets at the Westmoreland Avenue and Alleghany Avenue intersections to ensure they are properly capturing water to limit runoff downhill to 2nd Avenue. Upgrade any inlets that do not provide sufficient drainage. Modify the weir wall in the inlet on 2nd Avenue to allow increased flow into the 48" pipe through private property. This will increase the capacity of the storm drain system in this area.



Project #	**5**
Project Name	**Columbia and Poplar BMP and Peak Flow Attenuation System**
Location	**Columbia Avenue and Poplar Avenue Intersection**
Project Scope	Small
Flood Reduction	Moderate
Water Quality Benefit	Moderate
Priority	TBD
Timeframe	TBD
Cost	~$100,000 -$300,000
Coordinating Agencies	N/A

Problem Description:

- Stormwater runoff from Columbia Avenue collects at the intersection with Poplar Avenue and flows down the road. LID Center's preliminary stormwater modeling results suggest the storm drain pipes in this area may benefit from increased capacity. Takoma DPW has already successfully installed a bump-out bioretention BMP at the intersection. The large three-way intersection provides additional space for a BMP.

Project Recommendation:

- Install a bump out filtration-type BMP at the intersection in conjunction with an underground peak flow attenuation system. A detailed engineering assessment will be required to determine the size and configuration of these facilities. A flow splitter device should be installed to direct runoff to the attenuation system only during peak flow events.

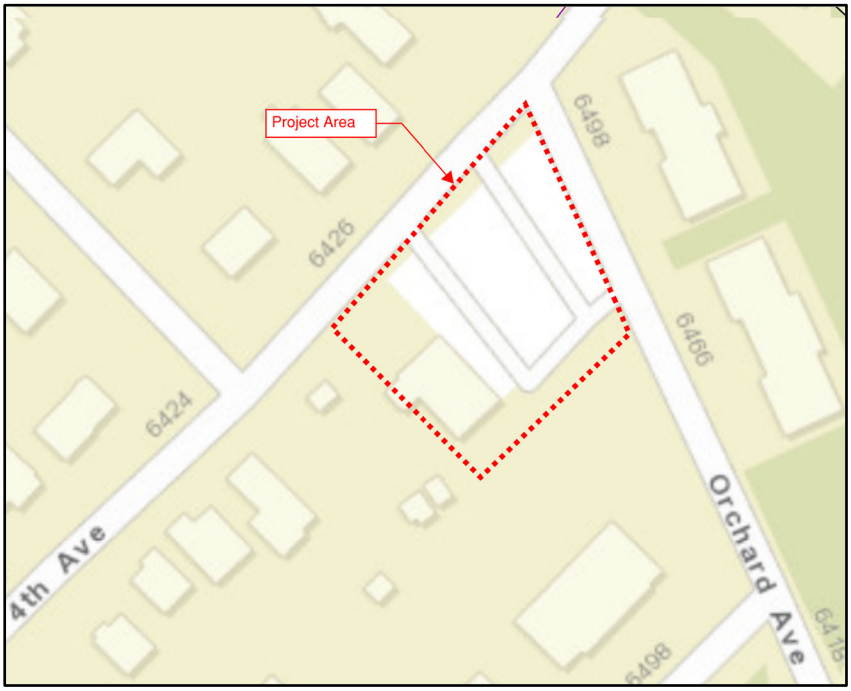
Project #	**6**
Project Name	**VFW Parking Lot Green Drainage Improvements**
Location	**VFW Parking lot**
Project Scope	Moderate
Flood Reduction	Moderate
Water Quality Benefit	Moderate
Priority	TBD
Timeframe	TBD
Cost	~$200,000 -$400,000
Coordinating Agencies	VFW Property owners

Problem Description:

- The VFW parking lot is a large impervious area near the bottom of the Takoma Branch watershed's stream valley. The lot produces a significant quantity of overland runoff. Field observations suggest that there could be bypass of the nearby curb inlets which would contribute to the flooding issues at the 4th Avenue low lying area.

Project Recommendation:

- Engage and partner with property owners to implement a green drainage improvement project. Install curbs and inlets around the parking lot to capture runoff. Regrade the asphalt as needed to redirect surface runoff. Install a filtration-type BMP such as a swale to provide a modest flood reduction and water quality benefit for the area. An underground peak flow attenuation system could also be used as an alternative to a surface BMP. An engineer should be consulted in the drainage and BMP design efforts.



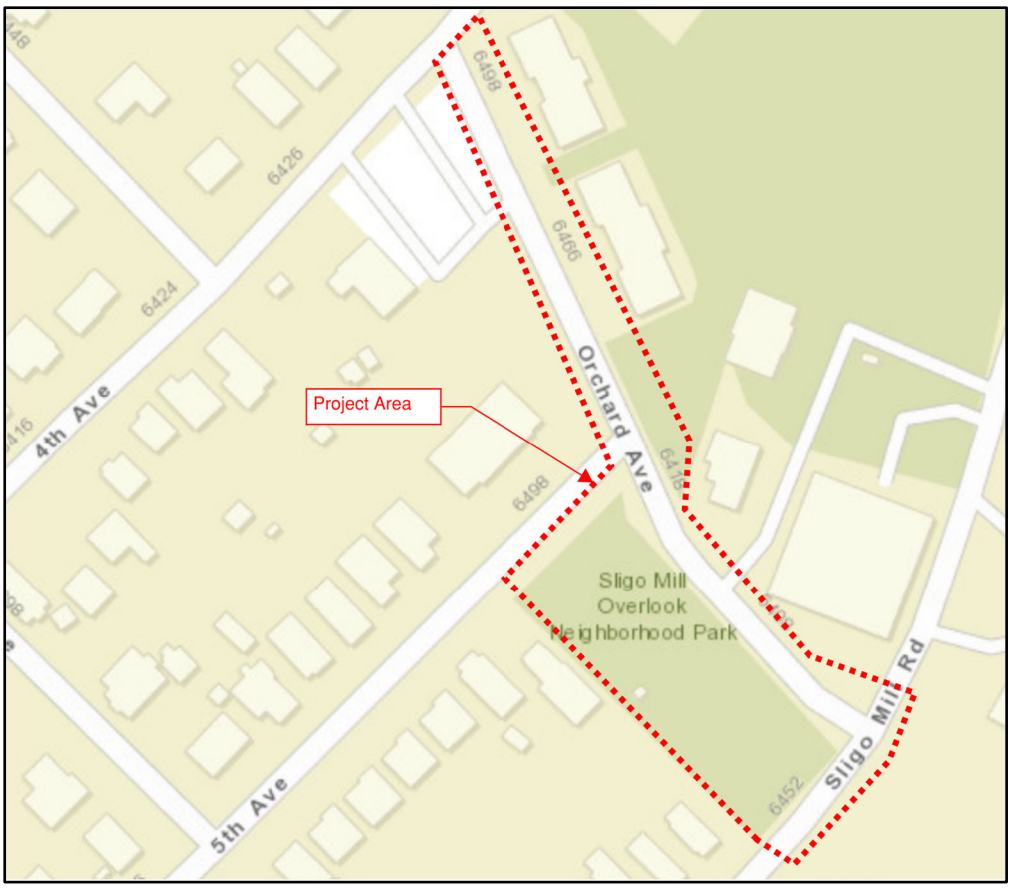
Project #	**7**
Project Name	**Orchard Avenue Green Street**
Location	**Orchard Avenue**
Project Scope	Large
Flood Reduction	Large
Water Quality Benefit	Large
Priority	TBD
Timeframe	TBD
Cost	~$750,000 - $1,250,000
Coordinating Agencies	M-NCPPC

Problem Description:

- Orchard Avenue connects to 4th Avenue near the bottom of the Takoma Branch watershed's stream valley. At the uphill end of Orchard Avenue there are impervious commercial and industrial lots that are a significant source of the runoff down Orchard Avenue. There is minimal storm drain infrastructure in this area. LID Center's preliminary stormwater modeling results suggest the storm drain system in this area may benefit from increased capacity. Parallel to the Orchard Avenue storm main there is a 60" pipe for excess stormwater storage that has become defunct due to sediment infill. Takoma DPW has already begun renovating this area through the Sligo Mill Overlook Park redevelopment and there is more opportunity to uplift the area through adjacent green infrastructure and street beautification. A green street project will go together with the existing environmental motif of Sligo Mill Park's community garden and the Takoma Branch natural area.

Project Recommendation:

- Design and install green infrastructure along Orchard Avenue and Sligo Mill Overlook Park. Multiple streetside and bump out filtration-type BMPs can be installed on the uphill end of Orchard Avenue to provide a modest flood reduction and water quality benefit. Storm drain inlets and pipes can be included with the BMPs to decrease runoff downhill and increase the capacity of the existing system. The existing 60" storage pipe should be fully cleaned and modified so that it can be used as a functional peak flow attenuation system. A pretreatment system can be installed to limit sediment inflow to the pipe. Street beautification including tree plantings and landscaping can also be installed where feasible in order to provide community aesthetics.


Project Area
Orchard Ave
4th Ave
5th Ave
Sligo Mill Rd
Sligo Mill
Overlook
Neighborhood Park
6498
6466
6426
6424
6452

Project #	**8**
Project Name	**Estrellitas Montessori BMP**
Location	**Estrellitas Montessori School**
Project Scope	Moderate
Flood Reduction	Moderate
Water Quality Benefit	Moderate
Priority	TBD
Timeframe	TBD
Cost	$200,000 - $400,000
Coordinating Agencies	Estrellitas Montessori School

Problem Description:

- The Estrellitas Montessori School is a large impervious area contributing to stormwater runoff into the downstream storm drain system. The large property may have areas that are suitable for stormwater management devices that can alleviate flooding downstream.

Project Recommendations:

- Engage and partner with the private property owner to implement a stormwater BMP project. Conduct an initial BMP feasibility assessment and subsequent BMP design. Filtration type BMPs may be feasible in some of the open grass areas around the property and a peak flow attenuation system may be feasible underneath the parking lot. Install one or both as deemed appropriate during the initial assessment. A detailed engineering analysis will be required for any design plans.

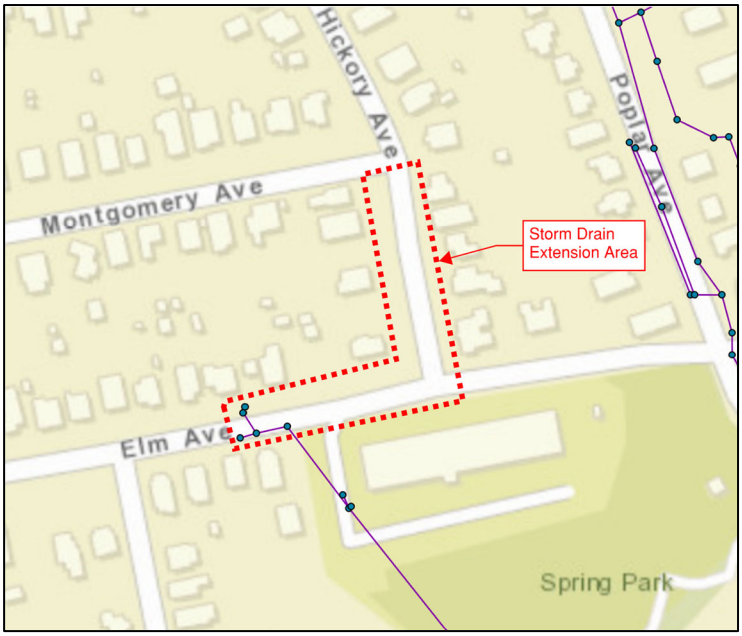
Project #	**9**
Project Name	**Hickory Avenue Uphill Storm Drain Extension**
Location	**Hickory Avenue between Elm Avenue and Montgomery Avenue**
Project Scope	Moderate
Flood Reduction	Moderate
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$250,00-$500,000
Coordinating Agencies	N/A

Problem Description:

- There is minimal storm drain infrastructure in the uphill areas of the Takoma Branch watershed, specifically along Hickory Avenue The primary inflow points of the storm drain systems at Elm Avenue near the Estrellitas Montessori school has a large drainage area from this upland area. LID Center's preliminary stormwater modeling results suggest some of these primary inflow points to the storm drain system could benefit from increased capacity uphill of this area.

Project Recommendation:

- Conduct a desktop assessment to determine the benefit and feasibility of installing storm drain infrastructure along Hickory and Elm Avenue uphill of the existing storm drain system at Elm Avenue. Additional inlets and pipes can reduce overland flooding, provide additional storage, and reduce peak flow. The capacity of the downstream system will need to be verified via a hydrologic analysis in order to justify diverting any substantial amounts of stormwater runoff. Depending on the results of the study, perform a subsequent design and installation of the new storm drain system extension. In coordination with this project, it may be valuable to pursue projects #3 (Lake Street BMP) and #8 (Estrellitas Montessori BMP) to offset the increase in flows due to diverting additional stormwater to the Elm Avenue/Cockerille Avenue storm main.


Hickory Ave
Poplar Ave
Montgomery Ave
Storm Drain
Extension Area
Elm Ave
Spring Park

Project #	**10**
Project Name	**Citywide Inlet Upgrades**
Location	**Takoma Park**
Project Scope	Large
Flood Reduction	Large
Water Quality Benefit	Small
Priority	TBD
Timeframe	TBD
Cost	~$10,000 – $20,000 per inlet upgrade
Coordinating Agencies	N/A

Problem Description:

- There are a large number of older and smaller inlets around Takoma Park that do not drain well. DPW has successfully begun the process of replacing and enlarging these inlets. This project should continue and follow a few general guidelines.

Project Recommendation:

- Assess the condition and inflow capacity of inlets in areas with reports of flooding.
- All replaced inlets should have a minimum 10' width when feasible.
- Replace or restore any curb inlets with a less than 6" opening. The road and gutter can be rebuilt to provide an adequate opening, or the inlet can be fully replaced if appropriate.
- Primary inflow inlets can include a large catch basin chamber and/or weir wall to slow stormwater release into the outflow pipe. (Note: Inlets at pipe junctions should not include any weir wall or structure within the catch basin.)

Low Impact Development Center

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Study Area 1 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 1
Site Visit Date: 2/13/2023

The LID Center visited study area 1 on 2/13/2023 with the Takoma Park DPW and residents of the affected properties. Residents have observed wet backyards. The findings of the site visit are as follows.

There is an area of standing water on the sidewalk in front of 7708 Takoma Avenue. The residents of the nearby properties indicated that this typically occurs after any rain event and takes a few days to evaporate. Residents also mentioned consistently wet yards that do not infiltrate well during and after storms. This is an indication of a high groundwater table, but this has not been confirmed. The residents did not report any water groundwater seepage into their basements, so the impact of the groundwater to structures appears to be minimal. The residents also reported that runoff from the backyards flows between the houses and does not create a flooding risk. There is a stormwater management Bioretention facility located behind Montgomery College building adjacent to the 7708 Takoma Avenue backyard. This Bioretention has been installed recently and according to residents has decreased surface runoff from the Montgomery College lot to the extent that there is minimal, if any, runoff from the lot anymore. According to the City's records, the bioretention has a liner that restricts groundwater seepage out of the bioretention. The facility also has an underdrain that connects to a 15" pipe which connects to the storm main pipe on New York Avenue.

LID Center Recommendations

The following strategies may be useful for residents looking to address drainage issues in Study Area 1. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Conservation landscaping and tree planting may be used to reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet areas of a yard may be converted into conservation landscape areas and planted with native species adapted to wet conditions. This type of landscaping provides improved infiltration and

water uptake as compared to grass. Additionally, tree planting can also reduce yard wetness as the roots can soak up a large amount of water from the ground.

French drains can be utilized to help alleviate groundwater issues in this area. A french drain system is comprised of a perforated underdrain pipe within a gravel trench. The area on top of the gravel trench can be covered with topsoil and grass so that the system is not visible in the yard. The French drain would be placed in the area where there is groundwater seeping to the surface. The underdrain pipe should outflow to the public right of way curb or connect into the public storm drain if possible. Permission from the City of Takoma Park is required for these connections. The underdrain can outflow to another area of the yard as long as it is not directed towards another property; however, this method is not preferable.

Study Area 2 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 2
Site Visit Date: 2/13/2023

The LID Center visited study area 2 on 2/13/2023 with the Takoma Park DPW and residents of the affected properties. There has been flooding where the stream flows into the storm drain headwall. Water would overflow onto Baltimore Avenue properties. The stream brings significant amounts of sediment and leaf litter. The findings of the site visit are as follows.

There is a stream that flows through private homeowners' backyards and into a headwall at the paper street between Baltimore Avenue and Philadelphia Avenue where it enters the city storm drain system. There is a large headwall and weir riser control structure at the inflow point for the stream. Both appear to be functional and in good condition. According to DPW officials, the city rebuilt this inflow structure in 2014. The headwall and its opening were enlarged and the weir riser control structure was added. Since this project there have been no visible signs of flooding and the city has not received any complaints about flooding. The area seems to no longer be flood prone. Some private properties adjacent to the stream have a moderate amount of yard waste and debris piled near the stream which could cause blockage of the weir if they were to be washed into the stream.

LID Center Recommendations

It was determined from field investigation that the flooding along the Baltimore Avenue lots has likely been resolved through Takoma Park DPW storm drain improvement projects. The area should be monitored for any persistent flooding that may require action by DPW. The weir inflow may require periodic clearing of debris. It may be beneficial for DPW to provide homeowners in the area some educational materials to deter the stockpiling of yard waste near the stream, as such practices can cause storm drain obstructions and organic pollution.

Study Area 3 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 3
Site Visit Date: 2/13/2023

The LID Center visited study area 3 on 2/13/2023 with the Takoma Park DPW and residents of the affected properties. The location for the area of concern follows the storm pipe in the backyards along Philadelphia Avenue. Findings of the site visit are as follows.

There is a swale valley over the top of the public storm main behind the 302-314 Philadelphia Avenue houses. The swale ends at a curb inlet between 7418 and 7420 Holly Avenue. The curb inlet brick back wall has a small non-conventional opening at the bottom for inflow from the swale. The opening is only a few inches high. There has not been significant flooding of the swale according to residents. However, the inlet opening could be enlarged to provide improved drainage. Additionally, there is some damage to the brick inlet wall that should be repaired. There is a tree planted over top of the storm drain pipe behind the inlet that should be removed as it will interfere with storm drain pipe integrity.

The grading of Birch Avenue lots slopes down towards the Cedar Avenue lots. The resident of 7408 Cedar Avenue reported significant stormwater runoff flows around his house and his neighbors' houses coming from the uphill Birch Avenue lots. He also reported excessive runoff flows along Cedar Avenue during heavy rainstorms. There were no visible indications of flooding or issues with storm drain infrastructure in the area.

LID Center Recommendations

Takoma DPW may consider rebuilding the storm drain catch basin structure between 7418 and 7420 Holly Avenue. Bricks in the broken sections of the back wall should be replaced. A standard weir opening at the back of the inlet should be included and sized for the 10-year storm. Additionally, the tree over the storm main should be carefully removed in order to prevent roots from damaging the pipe. The City should first check records for a stormwater management easement in this area.

The following strategies may be useful for residents looking to address stormwater issues in Study Area 3. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Residents of Cedar Avenue could install swales or berms which can direct the flow of stormwater runoff safely through a property and into the public right-of-way where there is suitable storm drain infrastructure. A swale is a shallow channel that conveys stormwater. Swales may be vegetated, filled with stone, or lined with hardened materials such as concrete. A vegetated swale is ideal in most residential areas from a functional and aesthetic standpoint; however, swales situated on steep slopes or in areas that receive large stormwater flows may require more stable materials such as stone or concrete. Berms are small, long mounds and are typically built from earthen materials. Berms act as a barrier to keep water flowing along a desirable path. To assure overland flow paths work effectively, they must always maintain a consistent downhill slope in the desired direction.

It is important that residents collaborate to address stormwater issues in this area. Cedar Avenue residents may need to engage their uphill neighbors on Birch Avenue so that they can work together to direct runoff safely to a public roadway. Birch Avenue residents may consider installing roof downspout leaders directed to the Birch Avenue curb. If a house is downhill of the road, then a downspout leader collection pipe would need to be installed through the downhill neighbor's yard and outlet at the Cedar Avenue curb. Birch Avenue residents could also use a sump pump to move stormwater uphill to the road. Any pipes discharging at the curb will require permission from the City. If feasible, Birch Avenue residents may also consider land grading, which involves directing the slope of their lawns and paved areas toward the roadway.

Study Area 4 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 4
Site Visit Date: 2/8/2023

The LID Center visited study area 4 on 2/8/2023 with the Takoma Park DPW and residents of the affected properties. The homes on Mississippi Avenue and Elwyn Ct. receive extensive runoff from the properties on the uphill slope along Ritchie Avenue. Many of the homeowners have done drainage projects in their yards to divert water around their houses. The findings of the site visit are as follows.

There is a steep slope down from the Ritchie Avenue lots towards the Mississippi Avenue and Elwyn Ct. lots. The residents reported that stormwater runoff from Ritchie Avenue continuously flows towards their houses. There are several areas where homeowners have installed rock swales and other flow diversion methods to prevent water from flooding their homes and yards.

LID Center Recommendations

The following strategies may be useful for residents looking to address stormwater issues in Study Area 4. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Residents of Elwyn Ct. and Mississippi Avenue should continue to install overland flow diversion methods to control the runoff coming from the Ritchie Avenue properties. Some of the residents in the area have already implemented vegetated and stone swales. Swales are shallow channels in the ground which create a flow path through the resident's property to the public right-of-way. Due to steep slopes in this area, it is likely that swales may require hardened materials (e.g. stone or concrete) to prevent soil erosion. Berms, which are small ridges typically built from earthen materials, may also be effective in diverting water around a house.

It is important that residents collaborate to address stormwater issues in this area. Elwyn Ct. and Mississippi Avenue residents may need to engage their uphill neighbors on Ritchie Avenue so that they can work together to direct runoff safely to a public roadway. Ritchie Avenue residents may consider installing roof downspout leader pipes that outlet to the curb. Depending on the slopes of the property, the leader pipes may be able to discharge to the curb in front of their property. If a house is downhill of the road, then a downspout leader collection pipe may need to be installed through the downhill neighbor's yard and outlet at the Mississippi Avenue or Elwyn Ct. curb. Ritchie Avenue residents could also use a sump pump to move

stormwater uphill to the road. Any pipes outletting at the curb will require permission from the City. If feasible, Ritchie Avenue residents may also consider land grading, which involves altering the slope of their lawns and paved areas toward the roadway.

Study Area 5 Report

Site Visit Summary:

Location: Takoma Park, MD
Study Area: 5
Site Visit Date: 2/8/2023

The LID Center visited study area 5 on 2/8/2023 with the Takoma Park DPW and residents of the affected properties. The city reported that there is a sloped hillside and gulley that brings a lot of water down to Hilltop Rd. The road can get covered with extensive mud during high-volume events and there is standing water on the street after heavy rains. The findings of the site visit are as follows.

The parking lot of 116 Geneva Avenue slopes downhill towards the lower driveway off Geneva Avenue. The back corner of the asphalt parking lot is undermined and in danger of collapsing. The hillside between the parking lot and driveway is badly eroded. There are indications of water channelizing down the hillside from the corner or the driveway. Behind 122 and 124 Geneva Avenue there is a wood retaining wall that is stabilizing the hillside, although there are some areas above it that appear eroded. The driveway near 210 Geneva Avenue slopes down to a gulley between the 207 and 203 Hilltop Avenue houses and the gulley outlets at Hilltop Rd. The gulley does not appear to have any signs of erosion. Hilltop Rd. is flat at the gulley outlet point and there is no storm drain infrastructure to drain the road in this area.

LID Center Recommendations

Takoma DPW may consider installing an inlet near the gully outflow point on Hilltop Rd. to facilitate drainage of the roadway. The storm drain inlet would require an outflow pipe under the road and to outfall into Sligo Creek. This work would need to be coordinated with M-NCPPC. DPW may also consider installing a curb along Hilltop Avenue to limit hillside erosion and mud washing into the street between Mississippi Avenue and Geneva Avenue.

Residents of Study Area 5 may use several strategies together to address runoff and erosion along the Geneva Avenue driveway. A professional contractor should be consulted to determine the best approach to the drainage problem in this area.

Residents could install swales and private storm drains to convey runoff from the hillside to the gulley. A swale is a shallow channel that concentrates and conveys stormwater. Swales constructed with stone or concrete may be useful to convey water down the hillside without causing further erosion. Storm drain inlets could also be installed at the downhill edge of the

parking lot and along the driveway to collect stormwater that flows down the hill. A storm drain pipe would need to be connected to any inlet and outflow to the gulley between 203 and 207 Hilltop Avenue or to the curb at Geneva Avenue. Collaboration with the uphill parking lot property owner would be necessary to any facilitate drainage improvements on the property.

Residents may also consider installing additional retaining walls with conservation landscaping to stabilize eroded areas of the hillside. Conservation landscaping is the use of planting beds with native deep-rooted plants that creates a more natural vegetative area. This type of landscaping provides improved soil stabilization as compared to grass. Conservation landscaping alone may not be effective, and thus should be used in conjunction with retaining walls. A structural engineer may need to be consulted depending on the extent of the wall design.

Study Area 6 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 6
Site Visit Date: 2/8/2023

The LID Center visited Study area 6 on 2/8/2023 with the Takoma Park DPW and residents of the affected properties. There are large amounts of runoff coming from a parking lot onto properties along Kennebec Avenue. The findings of the site visit are as follows.

The commercial parking lot near the corner of Flower Avenue and Erie Avenue behind the businesses appears to slope towards the Kennebec private lots. The commercial buildings at the intersection appear to have downspouts in multiple locations around the building. It is possible some of this water would runoff towards the Kennebec Avenue backyards. Residents of 713 and 711 Kennebec Avenue reported significant stormwater runoff 3-4" high flowing across the backyards of 717 to 711 Kennebec Avenue and then flowing over the 711 Kennebec driveway out to the road. There are no storm drain inlets on Erie Avenue and Flower Avenue in this area so the runoff from these roads continues down Kennebec where it can overtop the curb during large storms. Runoff from the road has entered the 713 Kennebec Avenue driveway. According to DPW, the house at 717 Kennebec Avenue was replaced in 2004. The original property had a slab foundation that cracked, possibly due to poor drainage. The new construction required installation of numerous stormwater features including dry wells and underground water storage. Neighbors report ongoing surface runoff originating from the rear of the property, which seems to be from the parking lots behind the adjacent properties on Erie Avenue.

LID Center Recommendations

Takoma Park DPW should construct a raised driveway apron to prevent runoff from the public right of way flowing onto the 713 Kennebec Avenue driveway. The driveway apron height should match the 6" curb as closely as possible. This work should be coordinated with the resident.

Takoma DPW may consider facilitating a discussion with the commercial property owners regarding runoff from their properties. Drainage from these properties should be directed towards Erie Avenue so that it does not flow onto the Kennebec Avenue residential properties. All roof downspouts should have leader pipes directed to Erie Avenue If feasible, the parking lot pavement could be regraded to slope towards Erie Avenue. The commercial lot owners could also install private storm drains to collect runoff along the back edge of their properties. The

storm drains may be able to go through the residential properties and outlet at the Kennebec Avenue curb or connect into a new residential private storm drain system. This type of drainage system would require collaboration between residents and commercial property owners.

The following strategies may be useful for residents looking to address stormwater issues in Study Area 6. A professional contractor should be contacted to determine the best approach to the drainage problem in this area.

The residents along 711-721 Kennebec Avenue can utilize swales or berms to mitigate the runoff flowing from the Flower Avenue & Erie Avenue properties. Swales and berms are two drainage strategies which direct runoff safely through a property and into the public right-of-way. A swale is a shallow channel that concentrates and conveys stormwater. A vegetated swale may be preferable in this area to provide increased water infiltration. Berms are small ridges typically built from earthen materials. Berms act as a barrier to keep water flowing along a desirable path. To assure overland flow paths work effectively, they must always maintain a consistent downhill slope in the desired direction.

Residents may also consider installing private storm drain systems in conjunction with overland flow paths. Private storm drains systems consist of pipes and inlets intended to drain water from the surface and direct it to the roadway or a public storm drain. Any connection into public right of way requires permission from the city. In this area a multi-property private storm drain system may be more effective than individual property storm drains. This cross-property drainage strategy will require coordination between neighboring residents.

Study Area 7 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 7
Site Visit Date: 1/30/2023

The LID Center visited study area 7 on 1/30/2023 with the Takoma Park DPW and residents of the affected properties. There are reports of flooding on private properties. The findings of the site visit are as follows.

The houses along the west side of Jackson Avenue from Boyd Avenue to Lincoln Avenue experience stormwater runoff flooding and consistent groundwater seepage flows. The stormwater flows downhill from Boyd Avenue and in large storms overtops the driveway apron of 334 Boyd Avenue and continues through the backyards along the 7400 block of Jackson Avenue. The city installed a 5' curb inlet downhill of the 334 Boyd Avenue driveway to better drain the road in this area. The block also receives lots of runoff from the uphill Boyd Avenue properties due to the steep slopes of the surrounding area. The residents have reported groundwater in multiple spots along the block as well. This creates consistent wetness in yards and low flow of water runoff downhill. The wetness compounds the surface stormwater issue by preventing infiltration of rainfall. According to the City, there are small drain pipes installed by private property owners that connect into the storm drain main on Jackson Avenue but they do not seem to be helping to drain the Jackson Avenue lots effectively and may be clogged or collapsed. The private storm drains were not able to be observed during this field visit.

Additionally, residents and city reported considerable runoff from the Mar Thoma. Church parking lot onto Jackson-Boyd Park and the 349 Boyd Avenue property. There is a concrete swale at the top of the park that was built to intercept the parking lot runoff, but according to residents it is not particularly effective. The city is developing a plan to build an inlet near the swale and connect it to the nearest storm drain pipe.

LID Center Recommendations

Takoma Park DPW plans to install an inlet at the end of the concrete swale and pipe it to the nearest storm drain inlet near the top side of the Jackson Boyd playground. This should reduce runoff through Jackson-Boyd Park. DPW may also consider working with the church property owners to address the runoff from the parking lot directly. A public storm drain inlet could be installed directly adjacent to the property line and allow for the church owners to regrade the pavement towards the inlet or install a private inlet and pipe connected into the public inlet.

To improve conditions on the even side of the 7400 block of Jackson Avenue, DPW could raise the driveway apron of 334 Boyd Avenue to prevent roadway runoff from flowing down the driveway during large storms. This work should be coordinated with the resident.

The following strategies may be useful for residents looking to address drainage issues in Study Area 7. Collaboration between uphill and downhill neighbors will increase the effectiveness of any drainage control practice. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Conservation landscaping and tree planting may be used to reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet areas of a yard may be converted into conservation landscape areas and planted only with native species adapted to wet conditions. This type of landscaping provides improved infiltration and water uptake as compared to grass. Additionally, tree planting functions similarly to soak up excess groundwater.

French drains may be used to reduce groundwater seepages in this area. French drain systems comprise a perforated underdrain pipe within a gravel trench. The area on top of the gravel trench can be covered with topsoil and grass so that the system is not visible in the yard. The French drain would be placed in the area where there is groundwater seeping to the surface. The underdrain pipe should outflow to the public right of way curb or connect into the public storm drain if possible. Permission from the City of Takoma Park is required for these connections. The underdrain can outflow to another area of the yard as long as it is not directly towards another property; however, this method is not preferable.

To mitigate stormwater runoff through the backyards of Jackson Avenue, residents may consider installing as swales or berms to safely convey surface flow through a property. Swales are small channels in the ground, that can be vegetated or covered in stone or concrete. Berms are small ridges, typically made from earthen materials, intended to keep runoff from flowing into undesirable areas. Residents may also consider maintenance of any of their existing private storm drains or installing new private storm drain systems. Any connection into public right of way requires permission from the city.

Study Area 8 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 8
Site Visit Date: 1/30/2023

The LID Center visited study area 8 on 1/30/2023 with the Takoma Park DPW and residents of the affected properties. There are reports of flooding on private properties. The findings of the site visit are as follows.

The houses along the east side of Jackson Avenue from Boyd Avenue to Lincoln Avenue experience stormwater runoff flooding and consistent groundwater seepage flows. The stormwater flows downhill from Aspen Avenue and Boyd Avenue lots and continues downhill along the entire block. The residents reported groundwater springs in multiple spots along the block as well. This creates consistent wetness in yards and low flow of water runoff downhill. The wetness compounds the stormwater issue by preventing infiltration of stormwater runoff. According to the City, there is an old clay private drainpipe along the backyards of the entire block that connects into the storm drain system manhole near the 7411 Jackson Avenue property. The terracotta clay pipe is thought to be broken, collapsed, or blocked by sediment in several locations throughout its length through the backyards. The pipe was not able to be observed.

LID Center Recommendations

The following strategies may be useful for residents looking to address drainage issues in Study Area 8. Collaboration between uphill and downhill neighbors will increase the effectiveness of any drainage control practice. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Jackson Avenue residents should consider a maintenance project to repair and upgrade the existing private storm drain. Takoma Park DPW may want to encourage residents to pursue this project. Coordination between neighboring residents will be required. A professional contractor should be consulted to evaluate the condition of the pipe and the extent of the repairs needed as well as any modifications that may be beneficial to create an effective and sustainable drainage system. Additional inlets or trench drains as well as lawn grading may improve drainage.

Conservation landscaping and tree planting may be used to reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet

areas of a yard may be converted into conservation landscape areas and planted only with native species adapted to wet conditions. This type of landscaping provides improved infiltration and water uptake as compared to grass. Additionally, tree planting functions similarly to soak up excess groundwater.

French drains may be used to reduce groundwater seepages in this area. French drain systems comprise a perforated underdrain pipe within a gravel trench. The area on top of the gravel trench can be covered with topsoil and grass so that the system is not visible in the yard. The French drain would be placed in the area where there is groundwater seeping to the surface. The underdrain pipe should outflow to the public right of way curb or connect into the public storm drain if possible. Permission from the City of Takoma Park is required for these connections. The underdrain can outflow to another area of the yard as long as it is not directly towards another property; however, this method is not preferable.

Study Area 9 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 9
Site Visit Date: 2/8/2023

The LID Center visited study area 9 on 2/8/2023 with the Takoma Park DPW and residents of the affected properties. There are reports of underground springs in backyard of Carroll Avenue houses leading to drainage issues for Davis Avenue houses. The findings of the site visit are as follows.

There were no clear signs of flooding or drainage issues in this area. The City has not had any recent communication with the current homeowners. Initial reports of backyard flooding and groundwater springs occurred many years ago.

Recommendations

No Recommendations.

Study Area 10 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 10
Site Visit Date: 2/8/2023

The LID Center visited study area 10 on 2/8/2023 with the Takoma Park DPW and residents of the affected properties. There are reports of runoff flowing onto the paper street dead end of Davis Avenue and Jackson Avenue, eroding the surface along the hill. The findings of the site visit are as follows.

The grading of the intersection of Davis Avenue and Garland Avenue slopes down towards the paper street driveway adjacent to the 7309 property. The driveway slopes directly downhill from the road so any runoff from the road flows down the driveway. The residents reported large flows of water flowing down the driveway creating erosion and flooding problems. The 7309 Garland Avenue property owner installed a rock swale and amended the bottom of the driveway with a curb to divert driveway runoff into this swale. The swale runs to the end of the paper street until it reaches MNCPPC property near the Long Branch Stream.

LID Center Recommendations

Takoma Park DPW should consider constructing a raised driveway apron to prevent runoff from Garland Avenue flowing down the driveway. The driveway apron height should match the 6” curb as closely as possible. A portion of the paper street driveway would need to be regraded to match the apron elevation. Additionally, DPW could regrade the Davis Avenue and Garland Avenue intersection in order to direct water southeast along Garland Avenue A valley gutter across Davis Avenue could facilitate flow in this direction and would limit the amount of asphalt that would require replacement. A topographical survey should be done to determine the existing grades at the intersection prior to any construction.

Study Area 11 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 11
Site Visit Date: 1/30/2023

The LID Center visited study area 11 on 1/30/2023 with the Takoma Park DPW and residents of the affected properties. In this area runoff from surrounding properties concentrates into the backyards on Larch resulting in standing water and wet yards. There is a private clay pipe with some small openings in several yards that discharges out to the nearby stream. The findings of the site visit are as follows.

The houses along the north side of Larch Avenue from Lincoln Avenue to Hayward Avenue experience stormwater runoff flooding and consistent groundwater seepage flows. The stormwater flows downhill from Lincoln Avenue and Colby Avenue lots and continues downhill along the entire block. The residents reported groundwater springs in multiple spots along the block as well. This creates consistent wetness in yards and low flow of water runoff downhill. The wetness compounds the stormwater issue by preventing infiltration of stormwater runoff. According to the city, there is an old clay private drain pipe along the backyards of 806 to 812 Larch Avenue. There is a grate inlet in poor condition in the 812 Larch Avenue backyard. This inlet seems to be an inflow point for the clay pipe, but this could not be confirmed. Water is seeping up from the inlet and creating a small stream flow along the 812 house. This water could present a hazard to the structural foundation of the house. The water continues downhill and dries up once it gets to the property line. There is a small PVC drain outlet near the sidewalk along the stream, but it is unclear if this is from the clay pipe or not. There is a restored stream area adjacent to the 812 property where there are multiple small PVC drain pipe outlets. There is believed to be a perforated PVC pipe from the property at 812 Larch to the Hayward stream outfall. The city has indicated it is willing to allow for private drain outlets to the stream.

LID Center Recommendations

The following strategies may be useful for residents looking to address drainage issues in Study Area 11. Collaboration between uphill and downhill neighbors will increase the effectiveness of any drainage control practice. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Larch Avenue residents should consider a maintenance project to repair and upgrade the existing private storm drain. Coordination between neighboring residents would be required because the system spans multiple properties. Additional inlets and lawn grading can reduce

flooding through the backyards. Takoma Park DPW should encourage residents in this effort and provide necessary resources for an outfall into the stream valley. A professional contractor should be consulted to evaluate the condition of the pipe and the extent of the repairs needed as well as any upgrades that may be beneficial.

Conservation landscaping and tree planting may be used to reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet areas of a yard may be converted into conservation landscape areas and planted only with native species adapted to wet conditions. This type of landscaping provides improved infiltration and water uptake as compared to grass. Additionally, tree planting functions similarly to soak up excess groundwater.

French drains may be used to reduce groundwater seepages in this area. French drain systems comprise a perforated underdrain pipe within a gravel trench. The area on top of the gravel trench can be covered with topsoil and grass so that the system is not visible in the yard. The French drain would be placed in the area where there is groundwater seeping to the surface. The underdrain pipe should outflow to the public right of way curb or connect into the public storm drain if possible. Permission from the City of Takoma Park is required for these connections. The underdrain can outflow to another area of the yard as long as it is not directly towards another property; however, this method is not preferable.

Study Area 12 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 12
Site Visit Date: 1/30/2023

The LID Center visited study area 12 on 1/30/2023 with the Takoma Park DPW. There is ponding that occurs in a yard on Devonshire based on the topography of the area. There is also a lot of underground water surfacing in the area. The findings of the site visit are as follows.

There is a low-lying wetland area on the undeveloped lower lot of the 703 Devonshire Avenue double lot property. There is a grate inlet with a non-standard cover that does not appear to properly drain the area. According to the city, the inlet does have an outflow pipe that connects to the public storm drain system along the road. There appeared to be a small spring emerging from the hillside near 706 Auburn Avenue backyard and forming a small stream downhill to the wetlands area. The 703 house is under construction and the yard appears to be wet and contributing to some runoff towards the wetlands area. It was unclear if the runoff from the 703 lot is related to the construction or not. The 707 Devonshire Avenue property has reported yard and basement flooding. There is very little elevation change from the wetlands area to the 707 house. According to the city, many homeowners in this area have installed sump pumps. This area appears to function as a wetland and drainage could be enhanced. The City could consider approaching the property owner of the undeveloped lot to discuss possible improvements to enable more storage and recharge.

LID Center Recommendations

Takoma Park DPW may consider facilitating a drainage improvement project on the double lot of 703 Devonshire Rd. The grate inlet should be replaced with a functional inlet and the surrounding area should be graded appropriately. Conversion of the low-lying area into a wetlands BMP could also be useful to reduce flooding in the area.

The following strategies may be useful for residents looking to address drainage issues in Study Area 12. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

French drains can help reduce groundwater impacts in this area. French drain systems are comprised of a perforated underdrain pipe within a gravel trench. The area on top of the gravel trench can be covered with topsoil and grass so that the system is not visible in the yard. The French drain would be placed in the area where there is groundwater seeping to the surface.

The underdrain pipe should outflow to the public right of way curb or connect into the public storm drain if possible. Permission from the City of Takoma Park is required for these connections. The underdrain can outflow to another area of the yard as long as it is not directly towards another property; however, this method is not preferable. Due to the particularly high groundwater in this area, French drains alone may not resolve the problem. In order to prevent groundwater intrusion into the basement of the 707 Devonshire Avenue property and other surrounding properties with similar issues, residents should install exterior waterproofing membranes around their home's foundation. Basement sump pumps connected into to the public storm drain system may also be necessary if not already in place.

Conservation landscaping and tree planting may also be used to reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet areas of a yard may be converted into conservation landscape areas and planted only with native species adapted to wet conditions. This type of landscaping provides improved infiltration and water uptake as compared to grass. Additionally, tree planting can also reduce yard wetness as the roots can soak up a large amount of water from the ground.

Study Area 13 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 13
Site Visit Date: 1/23/2023

The LID Center visited study flood area 13 on 1/23/2023 with the Takoma Park DPW and residents of the affected properties. Runoff from the uphill properties inundate the downstream properties. The city has installed additional inlets and pipes in the intersection at Elm & Prince Georges to capture street flow that used to pond on the street. The findings of the site visit are as follows.

There is a 15" pipe outfall in the backyard of 6913 Prince George's Avenue. This originates from an inlet along the driveway of 6917 Prince George's Avenue property. A rock swale goes from the outfall through the backyards of 6913 and 6911 lots. This swale appears to be limiting any flooding and erosion for these properties. There were many dead trees observed in the 6903 and 6905 Prince Georges Avenue backyards. Downhill of the swale, the water continues to flow through backyards and eventually out 600 Elm Avenue lot where the city has observed water flowing over the property's brick retaining wall into the public right-of-way. There is GIS record of an inlet on the 6903 property that connects to the public system, but this could not be observed. It is also in line with the swale. Given the reports of flooding downhill from the inlet it is likely that this inlet is not functional.

LID Center Recommendations

Takoma Park DPW may consider investigating the publicly maintained inlet in the 6903 backyard to determine if it is properly draining the area. The inlet should be sufficient to drain the area and limit runoff through any other properties.

Residents of Prince George's Avenue may consider extending the rock swale though downhill backyards so that the water can outflow near the public right of way rather than into another resident's yard. Neighbor collaboration would be necessary to continue the swale project. The swale can be extended to the public inlet in the 6903 backyard if the inlet is functional or out to Elm Avenue if it cannot be used.

Study Area 14 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 14
Site Visit Date: 1/23/2023

The LID Center visited flood area 14 on 1/23/2023 with the Takoma Park DPW and residents of the affected properties. A stream channel ends in a few inlets behind the two houses and there is a high water levels during heavy rain events. The findings of the site visit are as follows.

There is a small stream that flows into the public storm drain system behind the 514 Elm Avenue house. The inflow point for the stream is a 24” VCP pipe that appears to have limited capacity for when the stream levels rise. This could create a choke point that would result in the stream overflowing and flooding the downhill areas. There is also a small culvert bridge over the stream about 10 feet from the inflow to storm drain pipe. This is another choke point that would restrict flow and cause overflow. The stream banks are eroding very close to the 514 Elm Avenue deck. The 512 Elm Avenue property has the low point of the entire area and has reports of high flood levels during large storms. There is a public inlet on their property that seems to be functional. According to the Takoma Park DPW, the inflow for the inlet is a 30" box culvert and the outflow is 30" circular pipe. Additionally, the residents of 515-519 Elm Avenue, along the south side of the road, have experienced overflow flooding from road runoff collecting at the Elm Avenue sump. The inlets appear to be functional, so there is likely a capacity limitation with the storm drain pipes in the area. According to the GIS data, the inlet on the south side of the Elm Avenue low point has an inflow pipe that is 42" and an outflow pipe that is 36". This condition should be field confirmed.

LID Center Recommendations

Takoma Park DPW may consider a few improvements to the existing storm drain infrastructure in this area. At the stream inflow point, a standard headwall and upsized pipe could be installed to limit stream overflow onto the surface of the adjacent properties. Additionally, it may be beneficial to raise the small walking bridge over the stream in order to limit flow restriction when the stream levels rise. All work in this area would need to be coordinated with the property owners. Takoma Park DPW may also consider upsizing the inlets at the low point to limit ponding in the road during large storms. Additional uphill inlets to the west of the Elm Avenue low point could also be beneficial to reduce roadway flooding. Driveway aprons may need to be raised if residents voice concerns about overflow from the road.

Takoma Park DPW may also consider evaluating the storm main from the stream inflow point to the connection with the Prince George's Avenue main. Condition and capacity should be assessed to determine if any upgrades are needed. Pipe sizes should be field verified. Any downstream pipe that is smaller than an upstream pipe should be upsized accordingly.

Study Area 15 Report

Site Visit Summary
Location: Takoma Park, MD
Study Area: 15
Site Visit Date: 1/23/2023

The LID Center visited study area 15 on 1/23/2023 with the Takoma Park DPW and residents of the affected properties. There are wet backyards and lots of subsurface water as well as runoff in rain events. This drains to a City-owned area at the corner of Circle and Prince Georges. The City has done extensive work there to create a catchment basin to receive the piped stormwater flow from the entire area above. The findings of the site visit are as follows.

There were reports from residents of springs in backyards along Elm Avenue although these could not be observed. This creates consistently wet yards and prevents infiltration so that any rain event will cause excessive runoff. The 517 Elm Avenue property has installed a rock swale with an underdrain through their yard and the underdrain has connections from other nearby homeowners' downspouts and sump pumps. The water continues to flow through the backyards towards a small channel near the corner of the 519 lot. There are many small drain pipe outlets near this channel, including the rock swale underdrain pipe. The channel continues in the public area and into a low area with a small pond type BMP near the intersection of Prince George's Avenue and Circle Avenue. There is a 24" pipe inflow from the Prince George's Avenue inlets. The BMP appears to be functional and there are no reports of this area flooding. There is a grate inlet for overflow that appear to be in good condition.

LID Center Recommendations

The residents in study area 15 can use several of the following strategies to address drainage issues in the backyards. A professional contractor should be contacted to determine the best approach to the drainage problem on a specific property.

Residents may consider working collaboratively to extend the rock swale uphill and downhill along the backyard property lines to better convey outflow from the existing underdrain and many roof leaders to the public BMP at Prince George's Avenue and Circle Avenue. Additionally, the existing French drain type system on the 517 property should be monitored and maintained as needed to continue effective groundwater and stormwater drainage. The underdrain pipe could be replaced with a larger pipe if groundwater problems remain a concern for residents in the area. Additionally, French drains could be installed on other properties and outflow to the backyard swale as well.

Conservation landscaping and tree planting may be used to further reduce yard wetness. Conservation landscaping is the use of planting beds designed to create a more natural vegetative area. Wet areas of a yard may be converted into conservation landscape areas and planted only with native species adapted to wet conditions. This type of landscaping provides improved infiltration and water uptake as compared to grass. Additionally, tree planting can also reduce yard wetness as the roots can soak up a large amount of water from the ground.

Study Area 16 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 16
Site Visit Date: 1/23/2023

The LID Center visited flood area 16 on 1/23/2023 with the Takoma Park DPW and residents of the affected properties. This area receives a lot of water from the backyards of the properties on Sycamore as well as lots of water down Poplar. The City recently replaced a failed pipe and added inlets at the last 3 houses on Poplar Avenue near Elm Avenue and also put in a back curb and raised a driveway on Poplar to catch run-off and bring it out to the street to an adjacent inlet and of the street. The findings of the site visit are as follows.

There are a series of new inlets and a swale installed by the city in the low-lying area backyards of 7001-7009 Poplar Avenue where there was frequent flooding. These inlets appear to be to provide proper drainage for the area. There is also a new curb along the 7013 driveway that will direct runoff from uphill properties towards the road and further prevent runoff into the low-lying area. The inlets along the road appear to be in good condition and there are no reports of storm drain capacity issues in the immediate area. There are reports of road runoff spilling into the 7001-7009 driveways. The driveway aprons of these properties slope down from the road such that large storms could easily create runoff flowing from public to private property. Poplar Avenue is situated in a stream valley with steep slopes on either side so there will likely continue to be large volumes of runoff from the surrounding properties.

LID Center Recommendations

Takoma Park DPW has done extensive work to upgrade storm drain infrastructure through the backyards of the Poplar Avenue lots. DPW should monitor the area and take any necessary action if any flooding persists. DPW should consider raising the elevation of the sidewalk, curb and driveway aprons in front of 7001-7009 Poplar Avenue to limit overflow of roadway runoff onto residential properties. Additionally, the inlets on the south end of the block should be evaluated for enlargement to allow for better roadway drainage during large storms.

Study Area 17 Report

Site Visit Summary

Location: Takoma Park, MD
Flood Area: 17
Site Visit Date: 1/20/2023

The LID Center visited flood area 17 on 1/20/2023 with the Takoma Park DPW and residents of the affected properties. There is excessive flooding at the low point of Spring Avenue. The findings of the site visit are as follows.

The residents reported that runoff often overflows the inlets at the sump of Spring Avenue and flows onto private property. This mainly occurs onto the 213 Spring Avenue driveway where it creates a flooding hazard on the property. The water flows down the driveway and towards the stream outfall behind the 211 property. The outfall into the stream is a 48” x 60” culvert which conveys runoff from about 22.5 acres and was sized for the 10-yr storm according to DPW. The stream at the outfall appears to be in good condition. There was a stream restoration project previously done that appears to have been a great benefit for the area. It is important to note that Spring Avenue sits at the bottom of a stream valley; the same one that is along Poplar Avenue. Residents also reported runoff coming from the Montessori school parking lot and through Spring Park although this could not be confirmed through field observations.

LID Center Recommendations

Takoma Park DPW may consider a drainage improvement resiliency project along Poplar Avenue to address flooding concerns in and around Study Area 17. Refer to Project #2 in Appendix A for details. Additional resiliency projects in other areas of the Takoma Branch watershed may further alleviate flooding in Study Area 17. See Appendix A for a list of all proposed resiliency projects. Takoma Park DPW may also consider further upgrades to the inlets at the low point of Spring Avenue to improve roadway drainage.

Study Area 18 Report

Site Visit Summary

Location: Takoma Park, MD
Flood Area: 18
Site Visit Date: 1/20/2023

The LID Center visited flood area 18 on 1/20/2023 with the Takoma Park DPW and residents of the affected properties. There is excessive flooding at the low point of Circle Avenue between Poplar Avenue and Cockerille Avenue. The findings of the site visit are as follows.

The stream from the outfall at Spring Avenue continues behind private properties and into a 48" inflow pipe near 316 Circle Avenue. The pipe appears to be relatively small for the stream size and may be susceptible to restricting larger flows. The residents and DPW reported that the inflow does overflow and causes the stream to surcharge the pipe above ground onto the low0lying area adjacent to 316 Circle Avenue and the open WSSC lot. Previously runoff would overflow to Circle Avenue and continue through private properties to 4th Avenue until DPW installed a curb along the north side of Circle Avenue to limit the water from flowing out. There is still some outflow from this area so a small culvert type pipe was installed under the Circle Avenue dead end connection walkway. There is a small non-standard inlet at the low point of Circle Avenue that is blocked with debris. This inlet often overflows and, along with the culvert, results in overflow flooding continuing behind the 6507 and 6505 Cockerille Avenue properties according to residents and DPW officials. Additionally, road runoff often spills over the 307 Circle Avenue driveway and contributes further to the flooding behind the 307 Circle Avenue and 6507 and 6505 Cockerille Avenue houses. A manhole on the WSSC lots near the low-lying area is where two branches of the storm drain systems from 2nd Avenue and Spring Avenue stream combine. The flooding problems occurring in Area 18 are associated with similar problems in Areas 17 and 19.

LID Center Recommendations

Takoma Park DPW may consider three resiliency projects to address flooding concerns in and around Study Area 18. Refer to Appendix A for details on each project.

- Project #1 - The Circle Woods stream inflow pipe can be replaced with a larger culvert to limit stream overflow. A wetlands BMP can be built in the open grass space to collect any overflow runoff from the area and provide stormwater storage.
- Project #2 - A small-scale drainage improvement project on Circle Avenue can reduce surface flooding of the surrounding properties.

- Project #3 - A BMP and underground storage system can be installed under Lake St. to increase the capacity of the overall storm drain system and limit downstream flooding.

Additional resiliency projects in other areas of the Takoma Branch watershed may further alleviate flooding in Study Area 18. See Appendix A for a list of all proposed resiliency projects.

Study Area 19 Report

Site Visit Summary

Location: Takoma Park, MD
Flood Area: 19
Site Visit Date: 1/20/2023

The LID Center visited flood area 19 on 1/20/2023 with the Takoma Park DPW and residents of the affected properties. There is flooding in this area due to volumes beyond the capacity of the storm drain system. The findings of the site visit are as follows.

The piped stream from Circle Avenue continues to 4th Avenue where it combines with another piped stream. This is the bottom of the Takoma Branch storm drain system. According to city provided GIS data, a 6.5'x4' culvert combines with a 7'x4' culvert into a 6.5'x4' culvert. The piped stream outfalls behind 4th Avenue into Takoma Branch as a 12'x4' culvert. During large storms there is overland flow from the Circle Avenue area through residential backyards and also down 4th Avenue from the west. Large volumes of water flood the sump of 4th Avenue and overflow onto adjacent properties including the 6505, 6509, and 6515 4th Avenue. The flooding here seems to be due to a mix of general location, pipe capacity limitations, and uphill storm drain inflow deficiencies.

LID Center Recommendations

Takoma Park DPW may consider three resiliency projects to address flooding concerns in and around Study Area 19. Refer to Appendix A for details on each project.

- Project #2 - A small-scale drainage improvement project on Poplar Avenue and Circle Avenue can reduce runoff downhill to 4th Avenue.
- Project #6 - A drainage improvement project on the VFW parking lot can decrease flooding at 4th Avenue. DPW would need to engage the property owners to initiate the project.
- Project #7 - A green street project along Orchard Avenue and Sligo Mill Overlook Park can reduce runoff to 4th Avenue.

Additional resiliency projects in other areas of the Takoma Branch watershed may further alleviate flooding in Study Area 19. See Appendix A for a list of all proposed resiliency projects.

Study Area 20 Report

Site Visit Summary

Location: Takoma Park, MD
Study Area: 20
Site Visit Date: 1/20/2023

The LID Center visited flood area 20 on 1/20/2023 with the Takoma Park DPW and residents of the affected properties. The findings of the site visit are as follows.

This location has experienced rapid flooding during high volume storm events that have resulted in water levels of 18 to 24 inches collecting at the low point of the 2nd Avenue between Westmoreland Avenue and Alleghany Avenue. This has created a hazard for vehicles parked along the street or driving through during a high volume rain event. The storm drain pipes in this area do not seem to have capacity to convey large storm events. Flow from Alleghany will often bypass the inlets and flow onto 2nd Avenue according to residents. There are multiple features of the storm drain structures and pipes in this area that may be causing head losses and as a result contributing to flooding. The manhole between the 2nd Avenue inlets use to “pop up” during large storms, indicating head loss in the pipe system. The manhole cover was replaced with a grate top, so it no longer pops up. The inlet on the south side of 2nd Avenue has two outflow pipes. One old 48” pipe is under private property and a newer pipe goes along 2nd Avenue towards Alleghany Avenue with a sharp bend. There is a weir wall in the inlet to divert flow towards the public 24” storm drain. The weir wall may be causing head loss within the inlet. According to the DPW the pipe under the private properties also has a non-standard bend. This could be causing head loss as well. The storm drain system from this area combines with the piped stream at Circle Avenue further downstream. The entire system seems to be undersized for large storms.

LID Center Recommendations

Takoma Park DPW may consider an inlet improvement resiliency project to address flooding concerns in and around Study Area 20. Refer to Project 4 in Appendix A for details.

Takoma Park Study Area 1

Site Visit Notes

Bioretention BMP behind Montgomery College Building. According to residents, the Bioretention has alleviated surface runoff from the lot. The bioretention has an underdrain and connects to the 15" pipe that goes out to New York Ave. The bioretention also has a filter fabric liner to prevent groundwater seepage out of the media.

Runoff from 608 Philadelphia Ave lot flows to Takoma Ave. properties.

These three properties have consistently wet backyards. There is minimal infiltration during rain events, which creates ponding and increased runoff flows between the houses. This seems to be be due to a high groundwater table in the area.

There is ponding water on the sidewalk in front of 7708 Takoma Ave. According to residents, this usually happens after any rain storm and last a few days.

Montgomery College Building

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 1

Recommendations

It was determined from field investigation that the drainage issues along the Takoma Ave. lots are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include conservation landscaping and french drains. Refer to the resident guidance pamphlet and the Study Area 1 Report for details.

CHICAGO AVE
NEW YORK AVE
FENTON ST
CSX TRACK 1 RAIL
METRORAIL TRACK B1 RAIL
CSX TRACK 2 RAIL
TAKOMA AVE
PHILADELPHIA AVE
MARGARET DR
BOSTON AVE
608
703
7714
7710
7708
7704
7700

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Ditch
- Pipe

Storm Drain Structures
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 2

Site Visit Notes

The paper street and downhill properties would flood during large storms when the stream would overflow the headwall. A new headwall and weir control structure were built by Takoma DPW in 2014 and there have been no reports of flooding since then.

The stream is entirely on private property. There appeared to be a lot of yard waste and debris piled near the stream.

7436 and 7438 Baltimore Ave. properties used to receive overflow from the stream prior to the restoration project.

TAKOMA AVE
NEW YORK AVE
BOSTON AVE
PHILADELPHIA AVE
BALTIMORE AVE
HODGES LN
CHESTNUT AVE
BUFFALO AVE
ALBANY AVE
PINEY BRANCH RD

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Head Wall
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

N

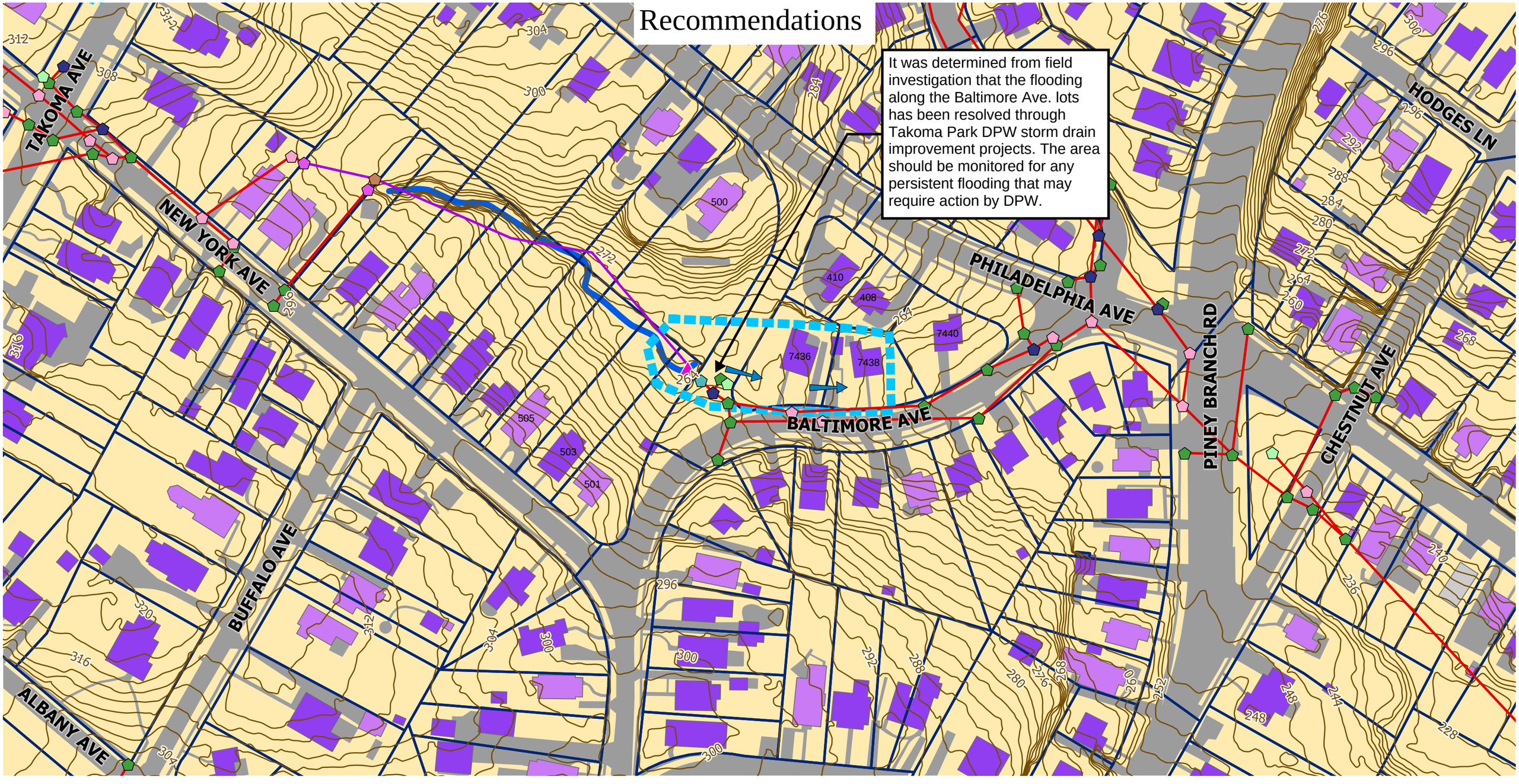
1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 2

Recommendations

It was determined from field investigation that the flooding along the Baltimore Ave. lots has been resolved through Takoma Park DPW storm drain improvement projects. The area should be monitored for any persistent flooding that may require action by DPW.



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Head Wall
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 3

Site Visit Notes

Tree planted over top of storm drain pipe.

Swale valley through yards leads to the back wall of a curb inlet brick catch basin. The catch basin back wall has a very small non-conventional opening at the bottom. The bricks on the back of the inlet are slightly damaged and in need of repair. There are no reports of flooding affecting the properties in this area.

Resident of 7408 Cedar Ave reported that stormwater from Birch Ave. lots flows downhill onto Cedar Ave. lots and results in large concentrations of water moving between houses. This issue is particularly bad around 7406 and 7408 Cedar Ave houses.

Resident of 7408 Cedar Ave reported that there is frequently large flows of water along Cedar Ave. during rain events.

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Head Wall
- Inlet
- Manhole Structure
- Bend
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

N

1 inch = 150 feet

0 75 150 300 US Feet

Takoma Park Study Area 3

Recommendations

Takoma Park DPW should remove the tree over top the storm main in order to prevent roots from damaging the pipe assuming there is a relevant stormwater easement for the area.

Takoma Park DPW may consider repairing the brick catch basin structure and installing a standard weir on the back wall that is sized for the 10-year flow.

It was determined from field investigation that the drainage issues along the Cedar Ave. lots are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include overland flow paths and roof leaders. Neighbor collaboration may be necessary to limit cross property runoff. Refer to the resident guidance pamphlet and the Study Area 3 Report for details.

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Head Wall
- Inlet
- Manhole Structure
- Bend
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

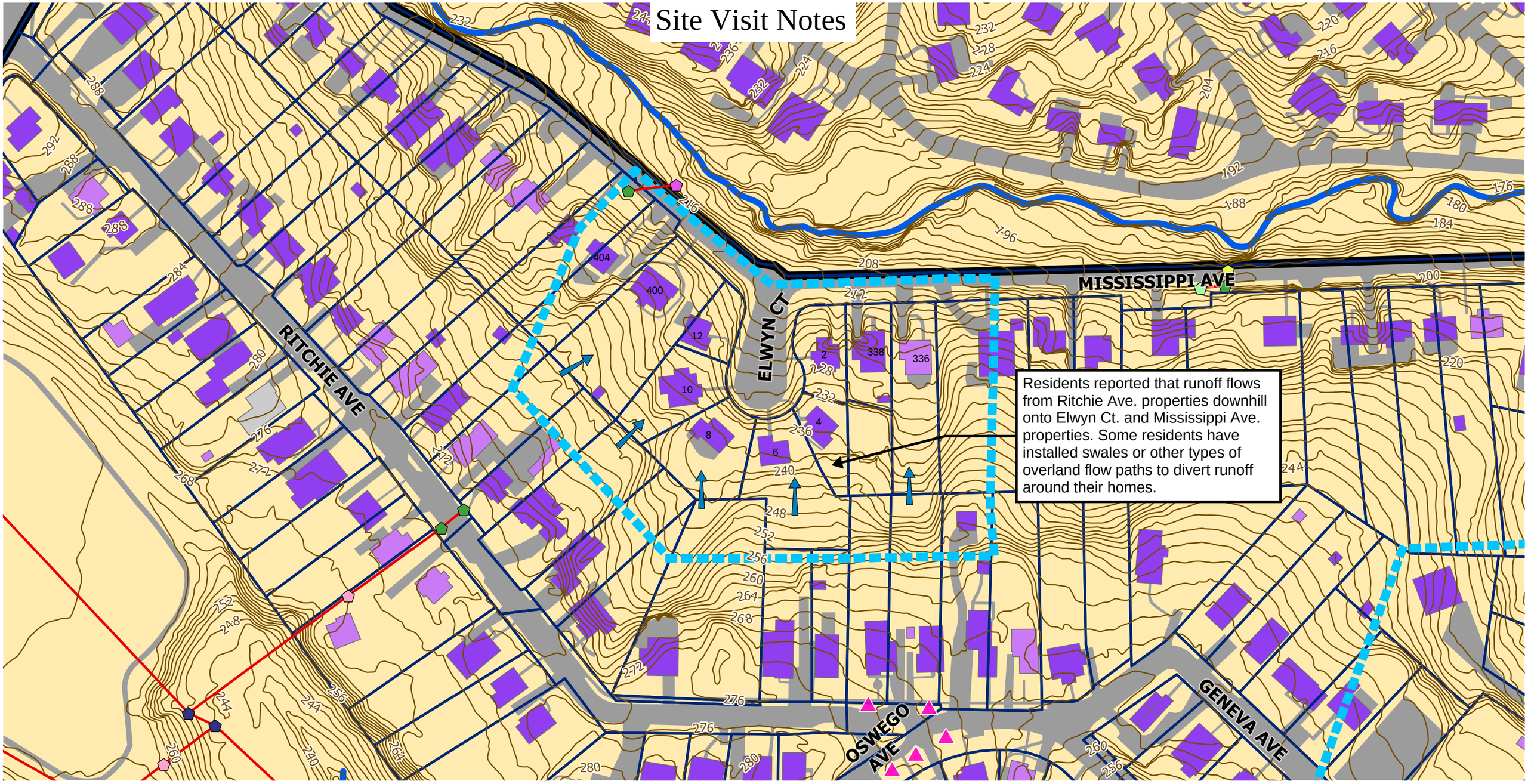
N

1 inch = 150 feet

0 75 150 300 US Feet

Takoma Park Study Area 4

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 4

Recommendations

It was determined from field investigation that the drainage issues along the Elwyn Ct. and Mississippi Ave. lots are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include overland flow paths and downspout leaders. Neighbor collaboration may be necessary to limit cross property runoff. Refer to the resident guidance pamphlet and the Study Area 4 Report for details.

RITCHIE AVE
ELWYN CT
MISSISSIPPI AVE
OSWEGO AVE
GENEVA AVE

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 5

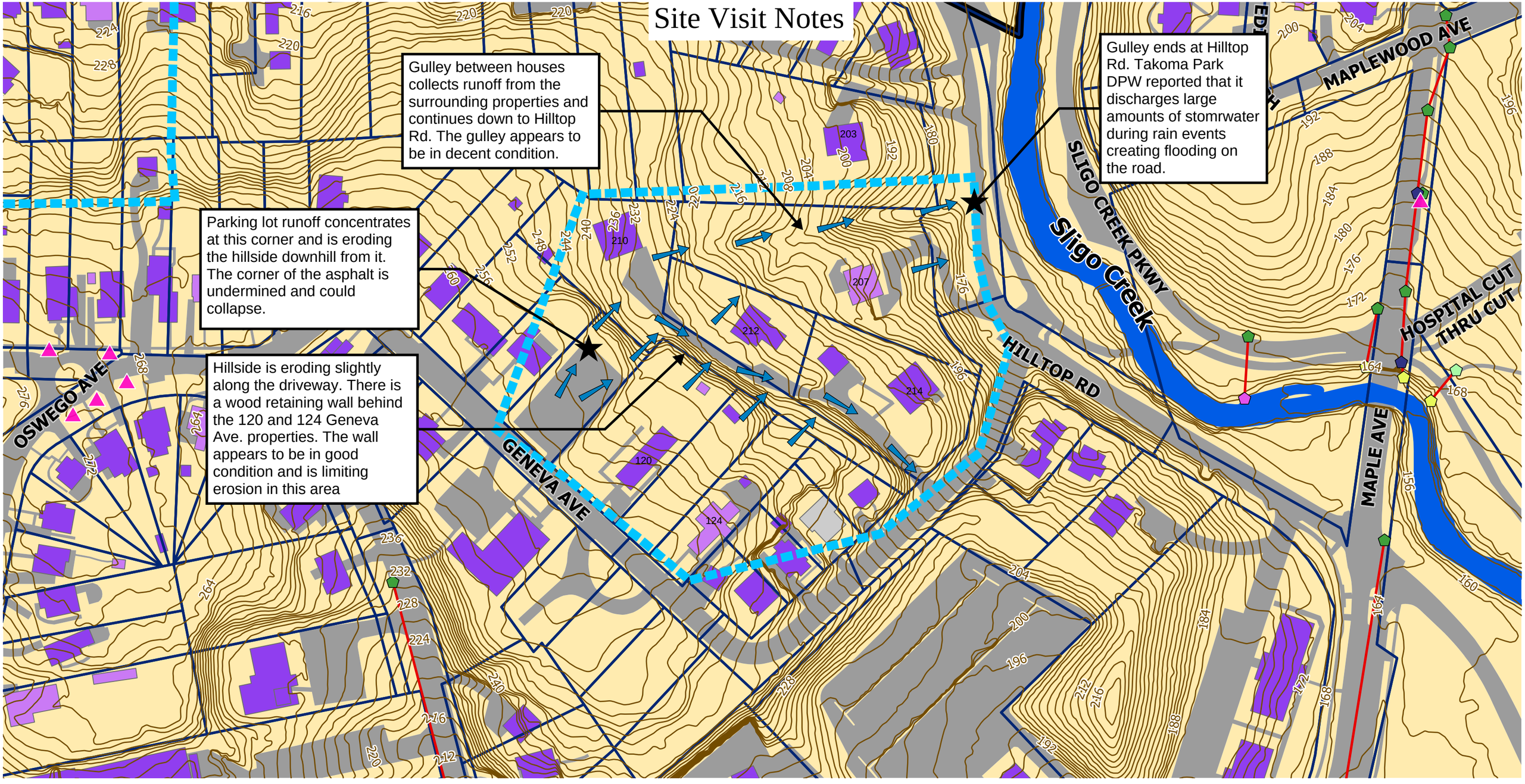
Site Visit Notes

Gulley between houses collects runoff from the surrounding properties and continues down to Hilltop Rd. The gulley appears to be in decent condition.

Parking lot runoff concentrates at this corner and is eroding the hillside downhill from it. The corner of the asphalt is undermined and could collapse.

Hillside is eroding slightly along the driveway. There is a wood retaining wall behind the 120 and 124 Geneva Ave. properties. The wall appears to be in good condition and is limiting erosion in this area

Gulley ends at Hilltop Rd. Takoma Park DPW reported that it discharges large amounts of stormwater during rain events creating flooding on the road.



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- End Wall
- Inlet
- Pipe Connection
- Pipe Direction
- Projecting Pipe

- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

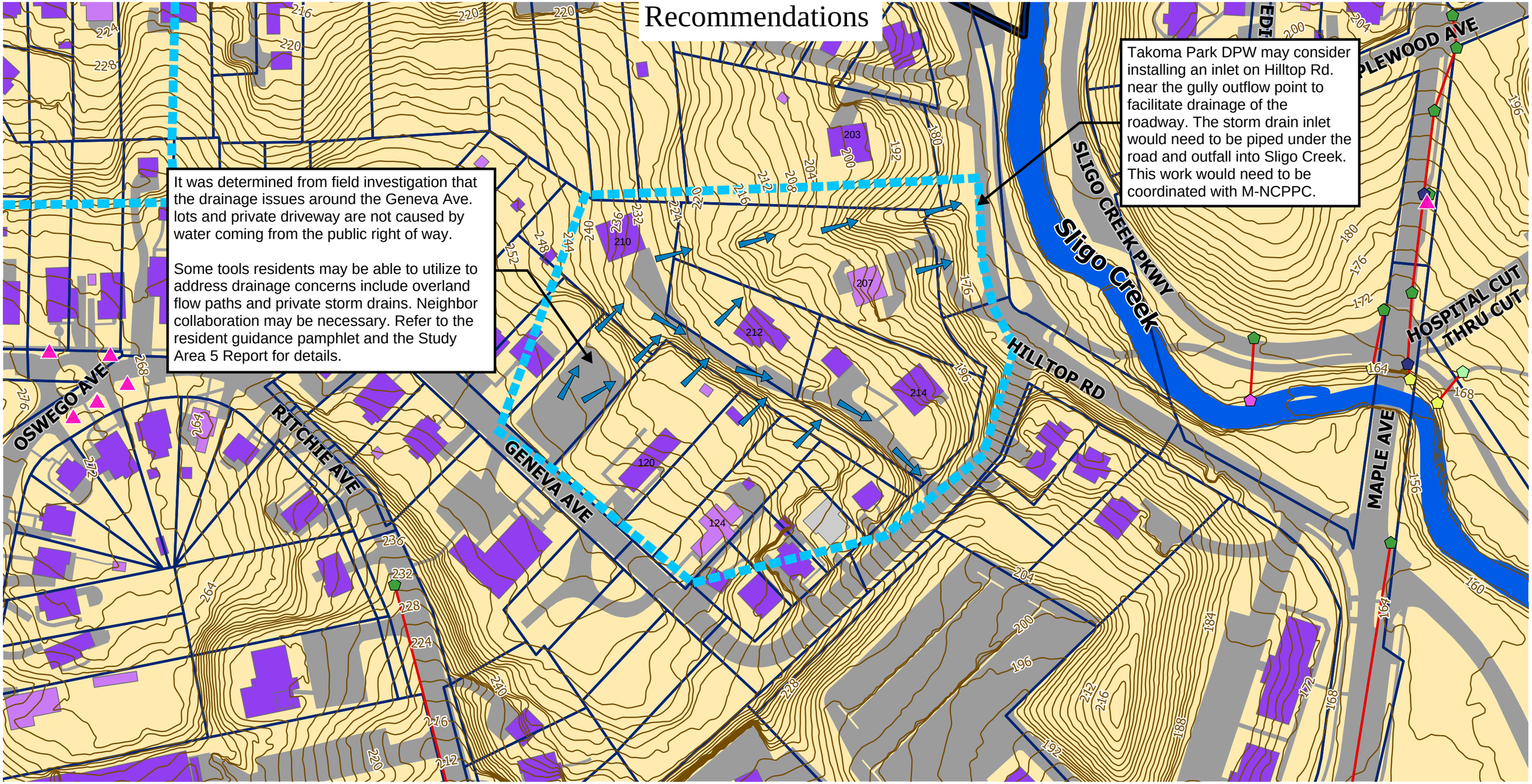
Takoma Park Study Area 5

Recommendations

It was determined from field investigation that the drainage issues around the Geneva Ave. lots and private driveway are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include overland flow paths and private storm drains. Neighbor collaboration may be necessary. Refer to the resident guidance pamphlet and the Study Area 5 Report for details.

Takoma Park DPW may consider installing an inlet on Hilltop Rd. near the gully outflow point to facilitate drainage of the roadway. The storm drain inlet would need to be piped under the road and outfall into Sligo Creek. This work would need to be coordinated with M-NCPPC.



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- End Wall
- Inlet
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 6

Site Visit Notes

717 Kennebec Ave. home previously had a foundation failure. The new homeowner rebuilt the property with lots of drainage infrastructure. The drains on the property outflow towards the 715 Kennebec Ave. property.

Stormwater from the road has overtopped the curb and entered the 713 Kennebec Ave. driveway during large storms.

711 Kennebec Ave. property driveway is the bottom of the flow path where stormwater accumulates and flows out to Kennebec Ave. 711 Kennebec Ave. homeowners have installed some brick barriers to block flooding into the house.

The 717 to 711 Kennebec Ave. lots report stormwater runoff 3-4" high during large rain storms.

There is no storm drain infrastructure in this area so stormwater from Erie and Flower continues down to Kennebec. There are some small Bioretention BMPs along Flower Ave. but they do not have any overflow drain structure.

Residents report that commercial buildings and parking lots create runoff towards the 721-711 Kennebec lots.

HOUSTON CT
HOUSTON AVE
ROANOKE AVE
KENNEBEC AVE
FLOWER AVE
ERIE AVE
SLIGO CREEK PKWY
EDINBURGH LN
MAPLEWOOD AVE

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- End Wall
- Inlet
- Manhole Structure
- Pipe Direction

- Runoff Flow Path
- Point of Concern

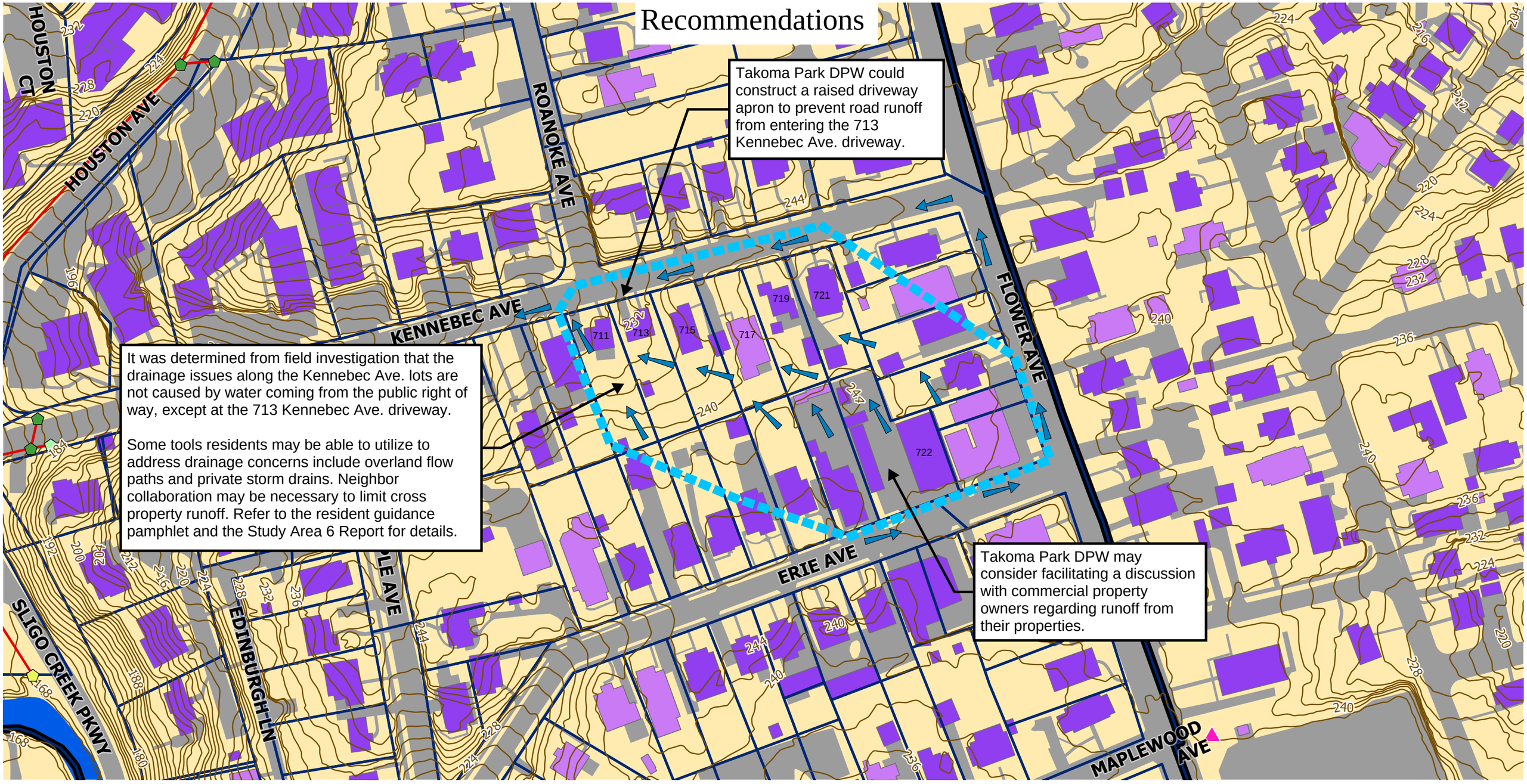
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 6

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- End Wall
- Inlet
- Manhole Structure
- Pipe Direction
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 7

Site Visit Notes

Stormwater accumulates and flows downhill through steep backyards.

There is groundwater seepage at some points along the hill that are causing consistent wetness in yards and a low flow of runoff.

Road runoff flow spills onto private driveway and continues downhill in large storms.

Takoma DPW installed a 5' curb inlet here.

Lots of runoff comes from the church parking lot into the park and adjacent residential property. Takoma Park DPW has installed a concrete swale and retaining wall, but runoff concerns persist according to residents. DPW plans to install an inlet here and connect it to the nearest storm drain.

CARROLL AVE
ASPEN CT
COLBY AVE
JACKSON AVE
LINCOLN AVE
BOYD AVE
WINCHESTER AVE
MANOR CIR
MANOR DR
7414
7412
7408
7406
7404
7400
349

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction

- Runoff Flow Path
- Point of Concern

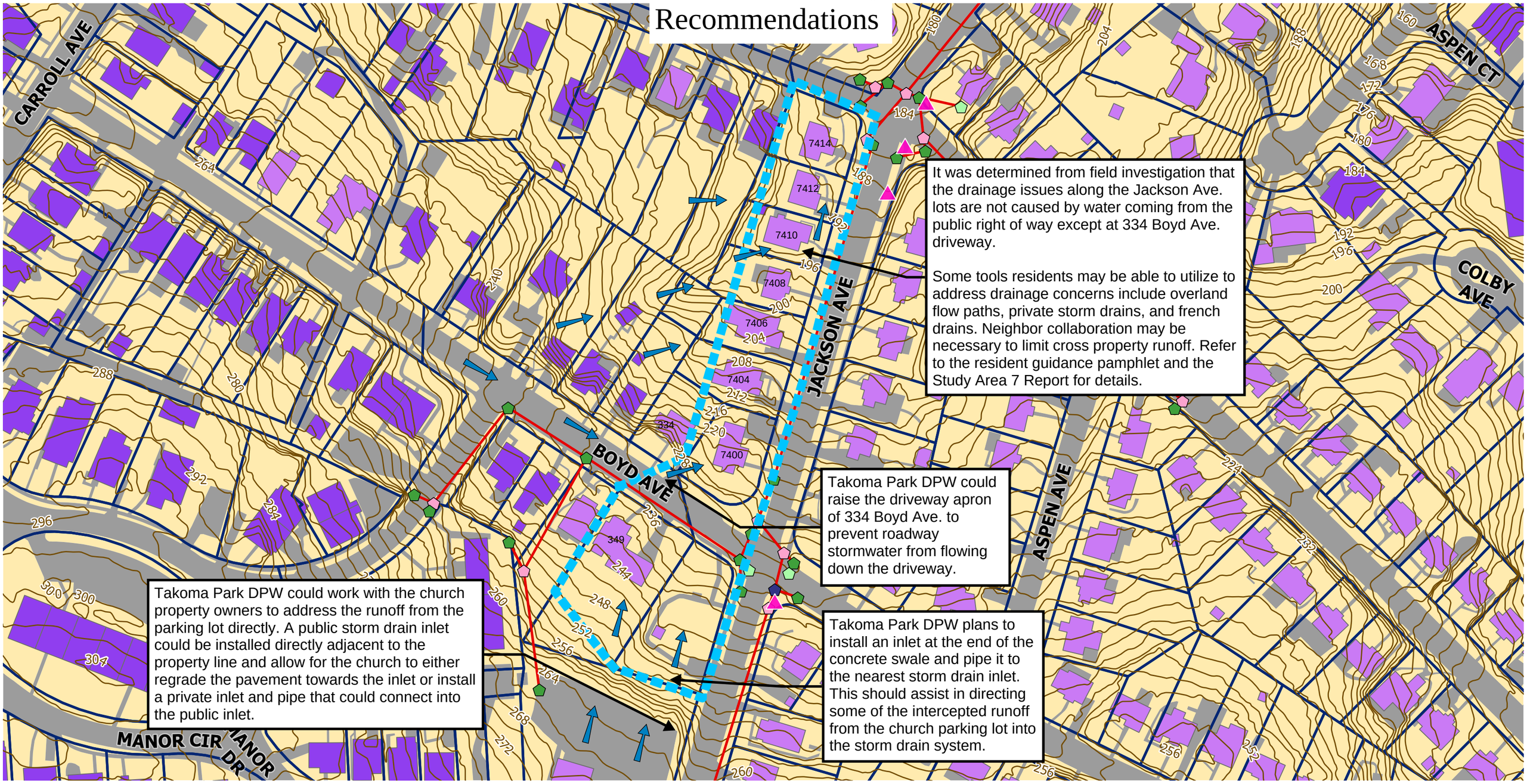
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 7

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

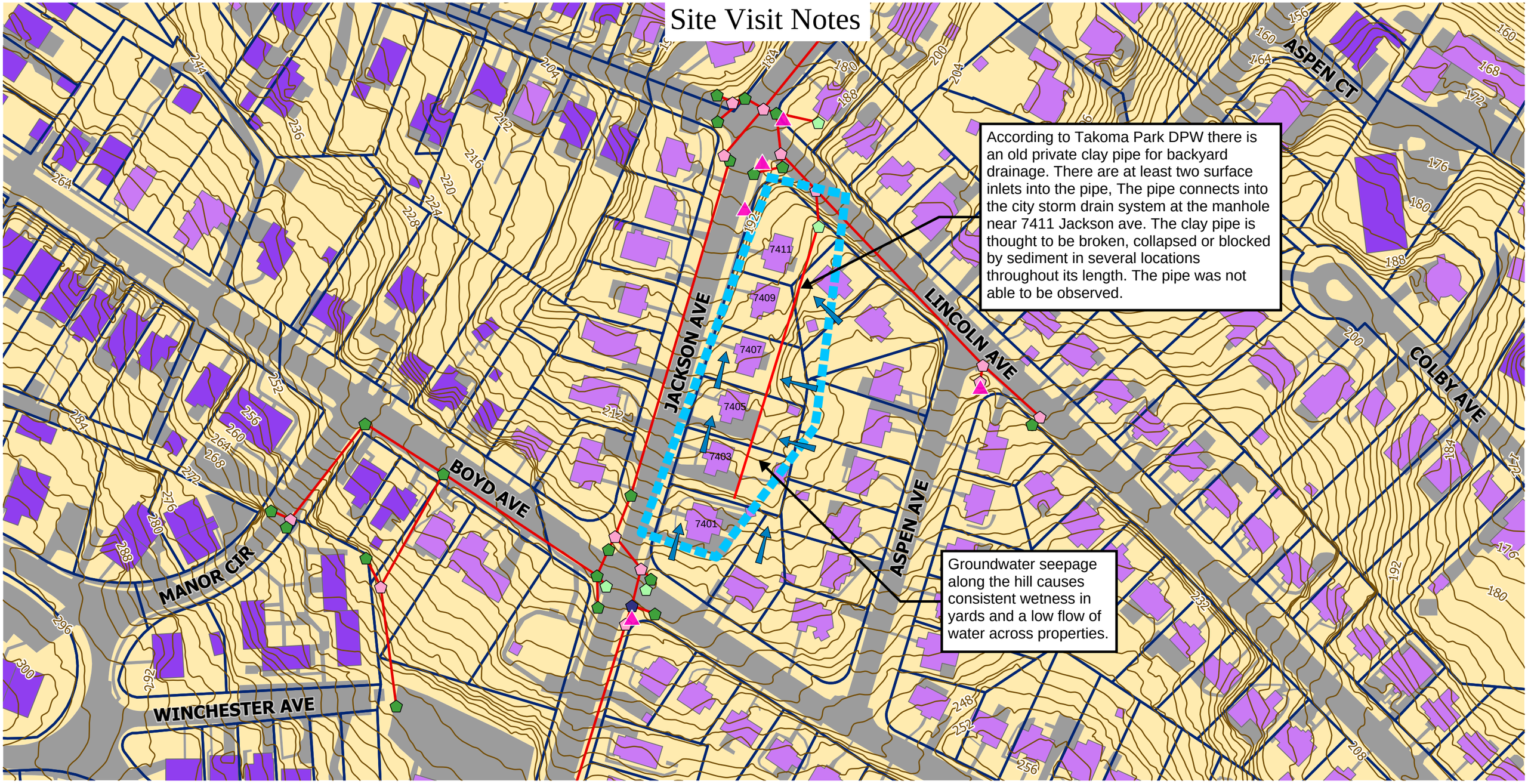
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 8

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

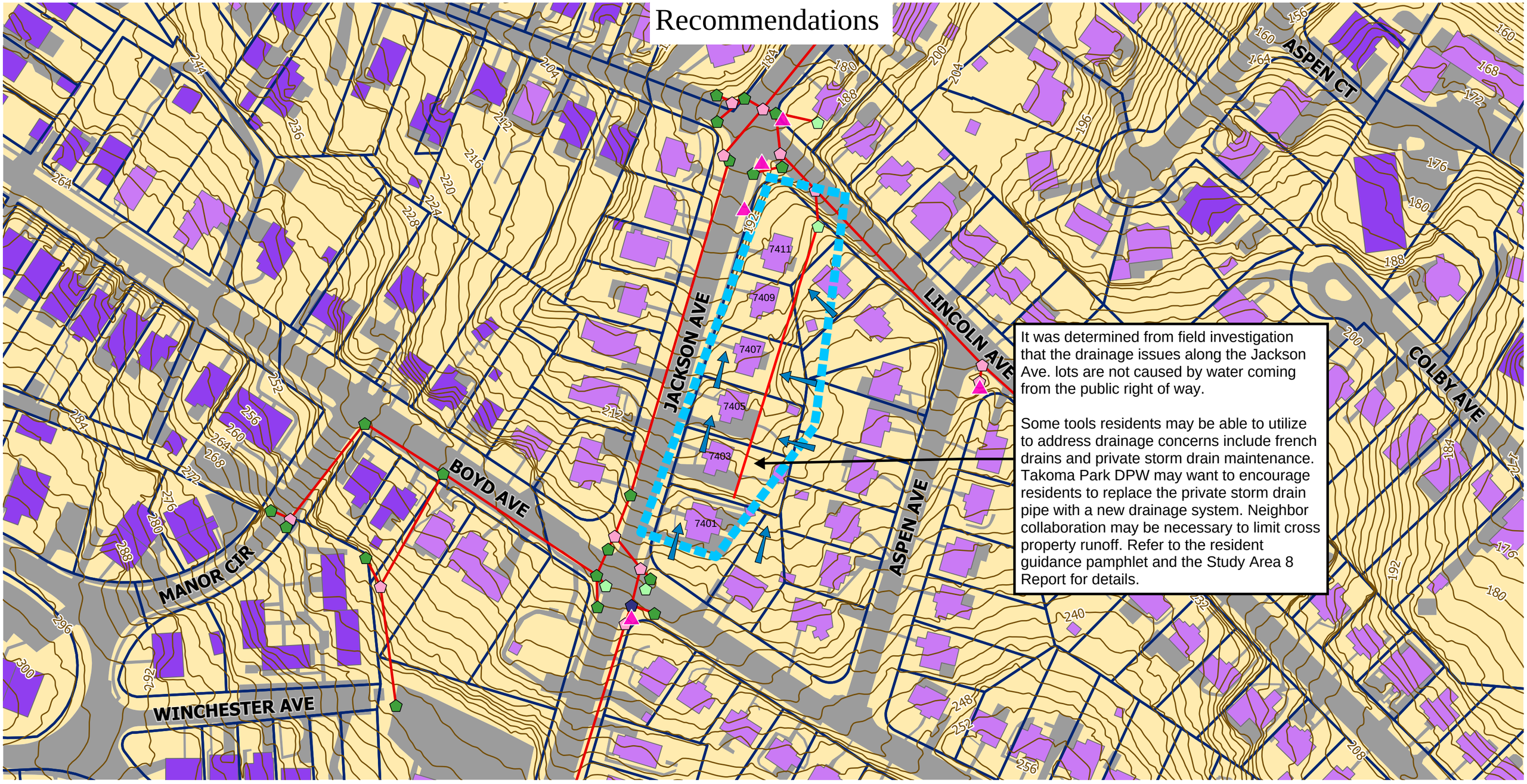
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 8

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 9

Site Visit Notes

There were no clear signs of flooding or drainage issues. Takoma Park DPW has not had any recent communication with the current homeowners. Initial reports of backyard flooding and groundwater springs occurred many years ago.

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Direction

- Runoff Flow Path

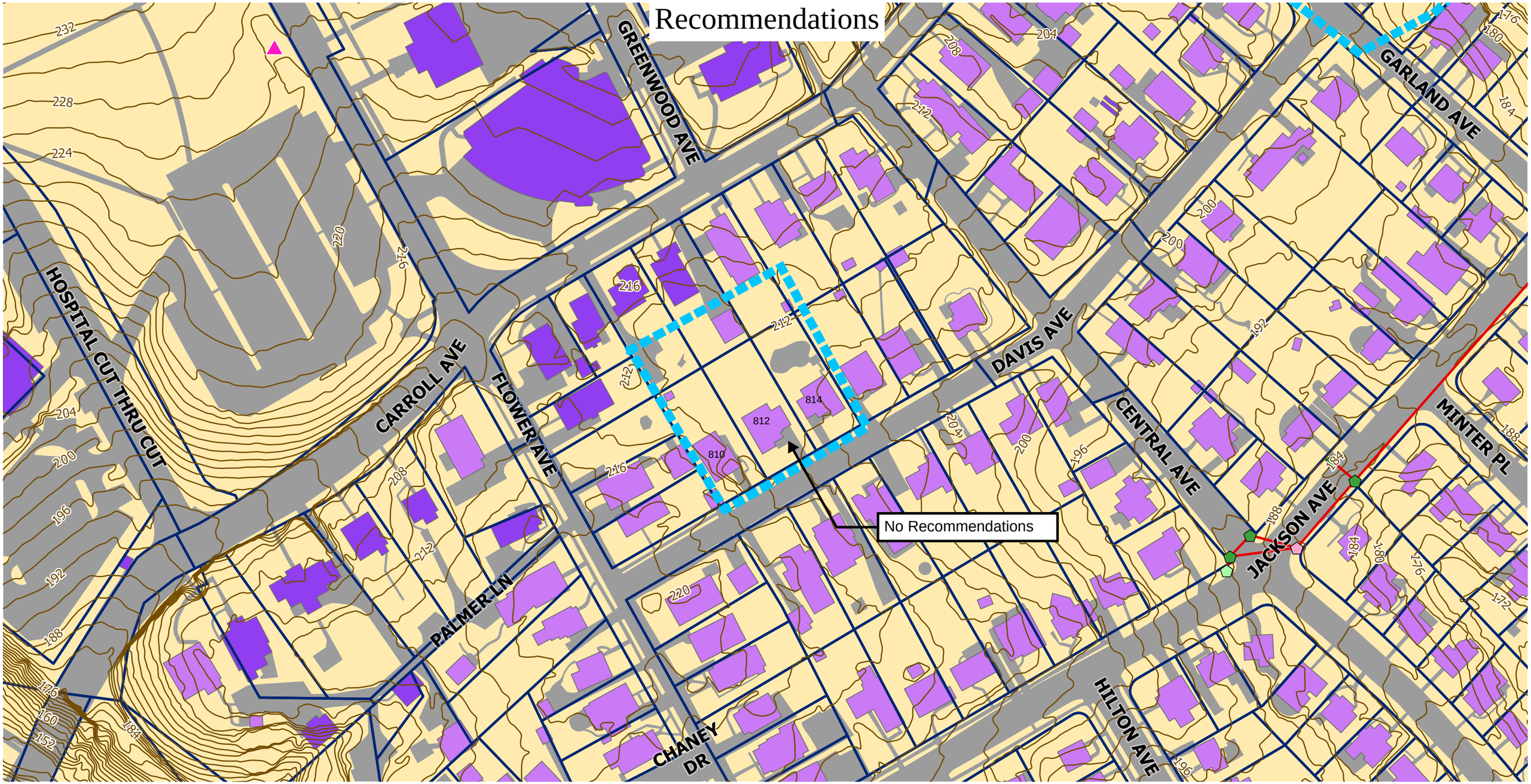
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 9

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Direction

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

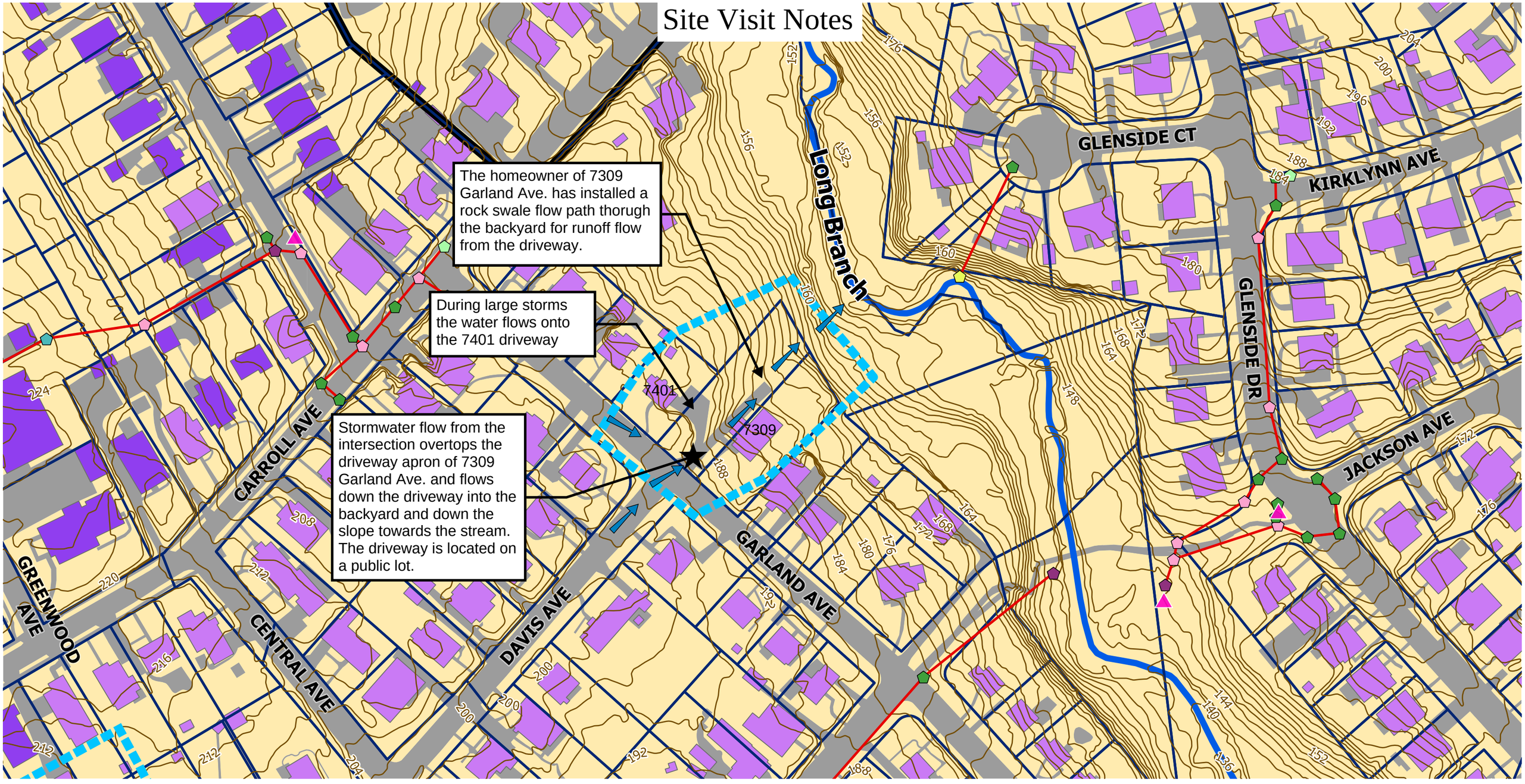
Takoma Park Study Area 10

Site Visit Notes

The homeowner of 7309 Garland Ave. has installed a rock swale flow path thorugh the backyard for runoff flow from the driveway.

During large storms the water flows onto the 7401 driveway

Stormwater flow from the intersection overtops the driveway apron of 7309 Garland Ave. and flows down the driveway into the backyard and down the slope towards the stream. The driveway is located on a public lot.



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- Endsection
- End Wall
- Head Wall
- Inlet
- Manhole Structure
- Pipe Direction

- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 10

Recommendations

Takoma Park DPW should construct a raised driveway apron to prevent runoff from Garland Ave. flowing down the driveway.

Takoma Park DPW could regrade the Davis Ave. and Garland Ave. intersection to direct water southeast along Garland Ave. A valley gutter across Davis Ave. could facilitate flow in this direction.

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Endsection
- End Wall
- Head Wall
- Inlet
- Manhole Structure
- Pipe Direction

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 11

Site Visit Notes

There is a small stream of water flooding the 812 Larch Ave. backyard. The water continues downhill along the backside of the house and towards the property line where it dries up. The water seems to flow up from an old grate inlet that may be connected to the clay drainage pipe.

Groundwater seeps out of hillside at multiple locations causing consistent yard wetness and low flow of water from property to property. This is especially prevelant at the bottom of the hill.

Old private clay pipe for backyard drainage of Larch Ave. properties

Successful restored stream. There are multiple small PVC drain pipe outlets along the stream bank wall. There is believed to be a perforated PVC pipe from the property at 812 Larch to the Hayward stream outfall. Takoma Park DPW is willing to allow for additional private drain outlets into the stream.

Small PVC drain pipe outlet near sidewalk. It was unclear if this is from the private clay pipe or not but it is in line with where the pipe could be.

The 810 Larch Ave. property installed dry wells that seem to have alleviated the wetness on their property. It was not clear where the outflow point is.

Stormwater runoff flows from Colby and Lincoln Ave. lots due to slopes in the area. Water flows downhill through private properties

CHERRY AVE
COLBY AVE
HAYWARD CT
LINDEN CIR
LARCH AVE
BOYD AVE
BOYD CT
HAYWARD
GLAIZEWOOD CT
802
804
806
808
810
812

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Ditch
- Pipe

Storm Drain Structures
- End Wall
- Head Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Projecting Pipe

- Runoff Flow Path
- Point of Concern

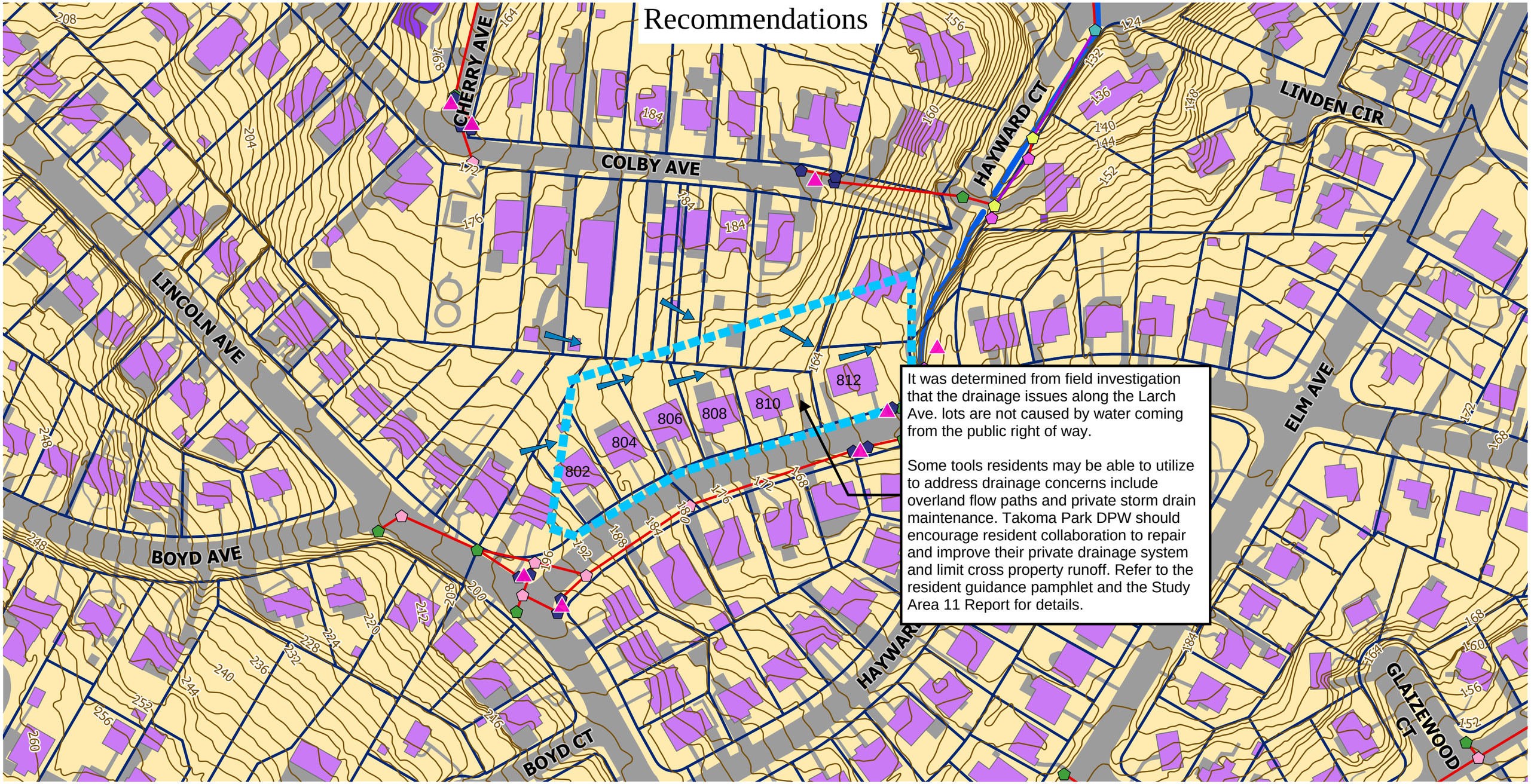
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 11

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- End Wall
- Head Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Projecting Pipe

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 12

Site Visit Notes

The 703 Devonshire house is under construction. The yard is wet and there is runoff from the lot. It is unclear if it is related to construction or not.

Groundwater seepage from this point is creating a small stream flowing downhill. There is groundwater seepage occurring at multiple other spots on the hillside.

Yard and basement flooding on 707 Devonshire property.

Low lying wetlands area, receives surface flow and groundwater seepage flows. There is a grate inlet with a non-standard top that does not appear to properly drain the surrounding area. The inlet has an outflow pipe that connects to the public storm pipe along the road according to DPW.

703

707

BOYD CT

LINCOLN AVE

HAYWARD AVE

ELM AVE

GLAIZEWOOD CT

GLAIZEWOOD AVE

LARCH AVE

DEVONSHIRE RD

KENTLAND AVE

NEW HAMPSHIRE AVE

ETHAN ALLEN AVE

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 12

Recommendations

Takoma Park DPW may consider engaging the 703 Devonshire Rd.property owner to discuss replacement of the grate inlet or creation of a wetlands BMP area.

It was determined from field investigation that the drainage issues along the Devonshire Ave. lots are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include french drains and conservation landscaping. Refer to the resident guidance pamphlet and the Study Area 12 Report for details.

BOYD CT
LINCOLN AVE
HAYWARD AVE
GLAIZEWOOD CT
GLAIZEWOOD AVE
LARCH AVE
DEVONSHIRE RD
KENTLAND AVE
AUBURN AVE
NEW HAMPSHIRE AVE
ETHAN ALLEN AVE
703
707

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Runoff Flow Path

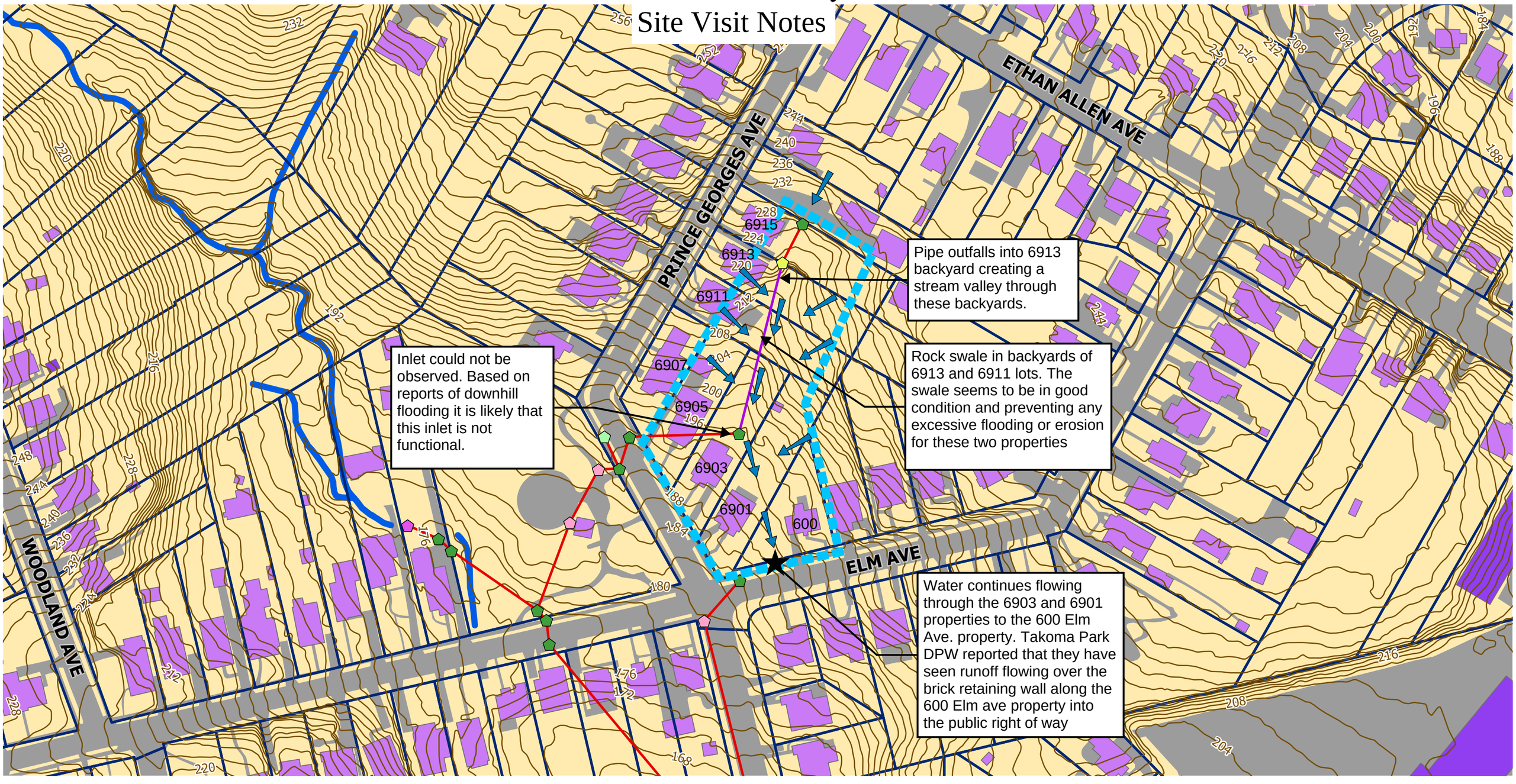
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 13

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- End Wall
- Inlet
- Manhole Structure
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

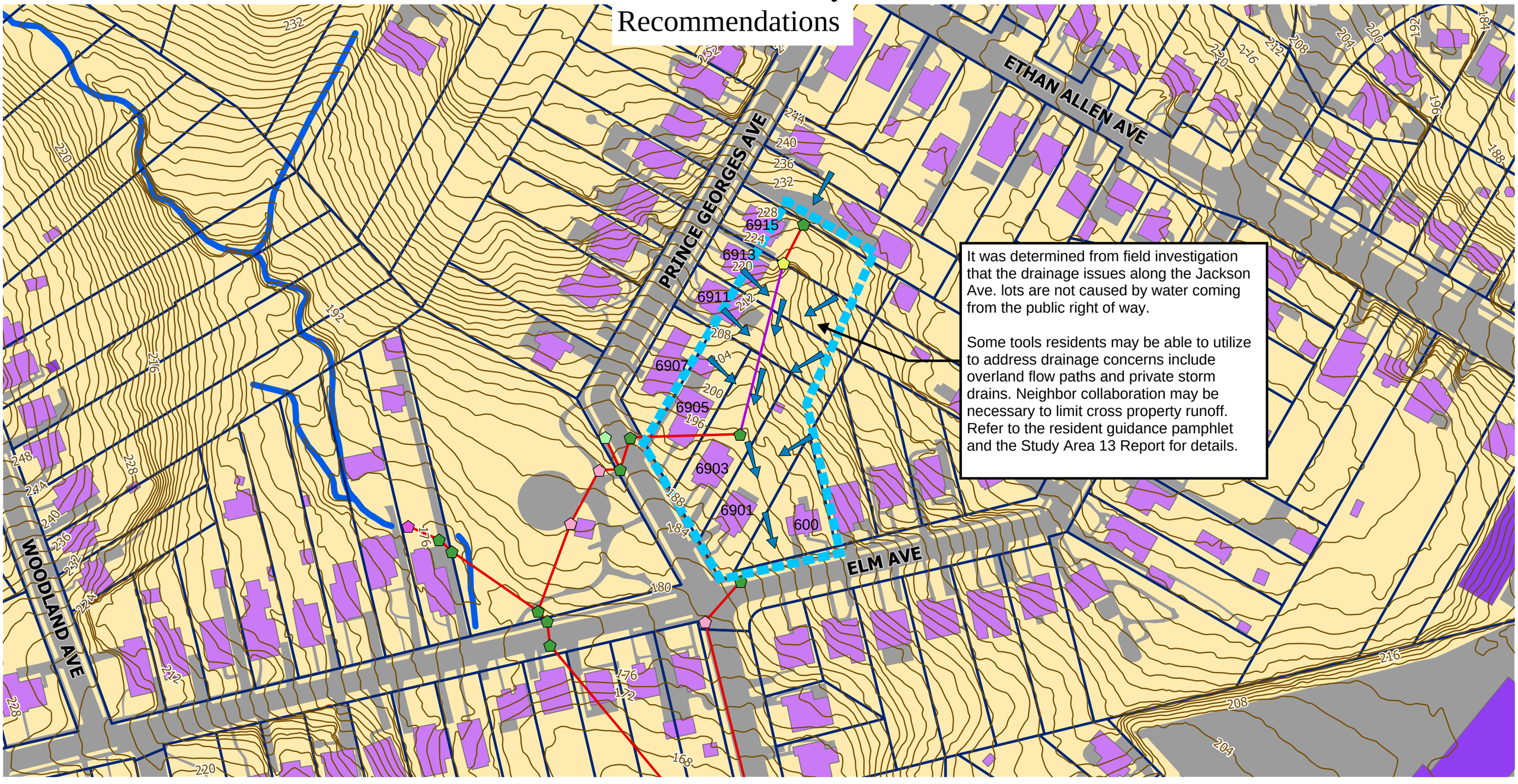
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 13

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- End Wall
- Inlet
- Manhole Structure
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

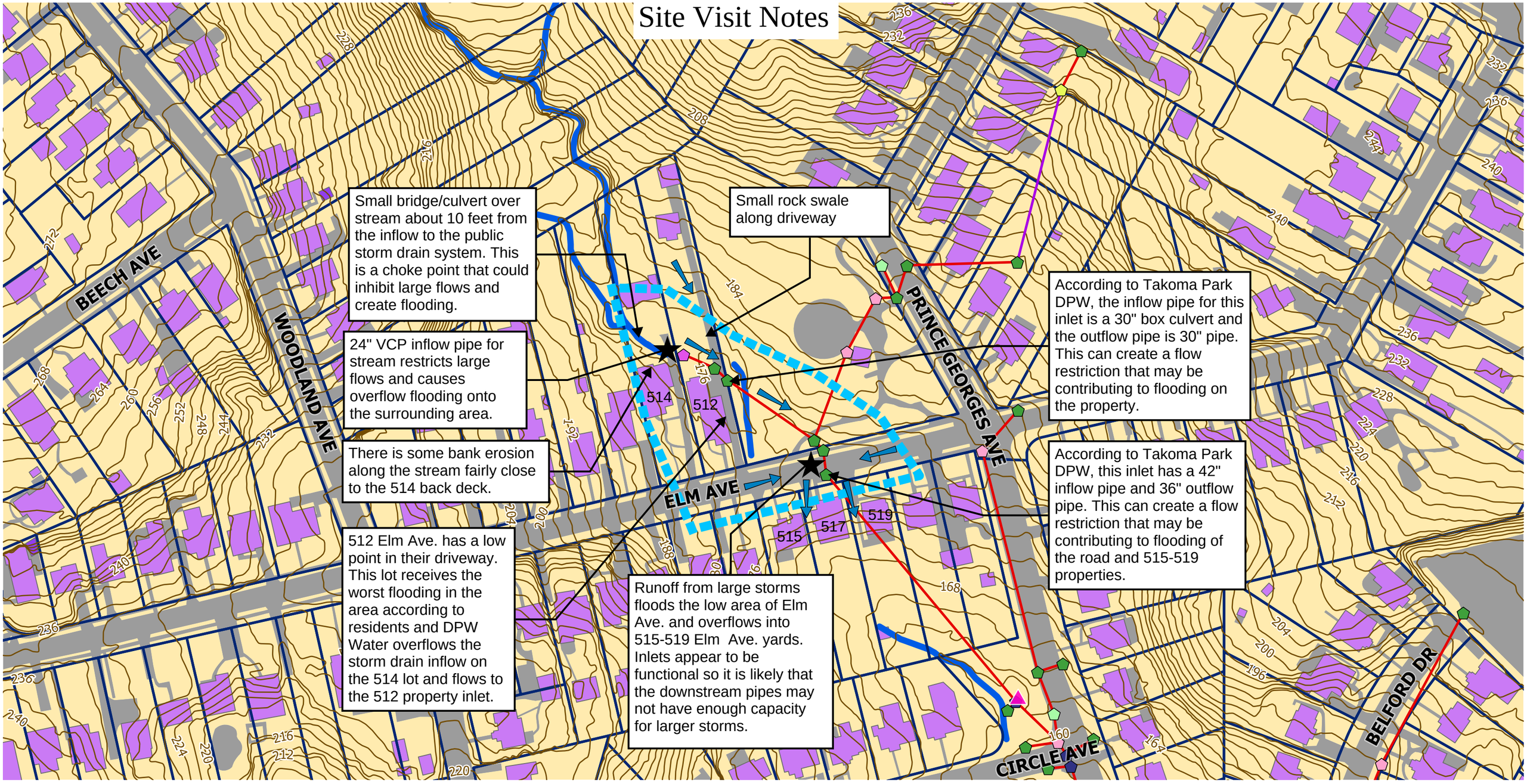
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 14

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

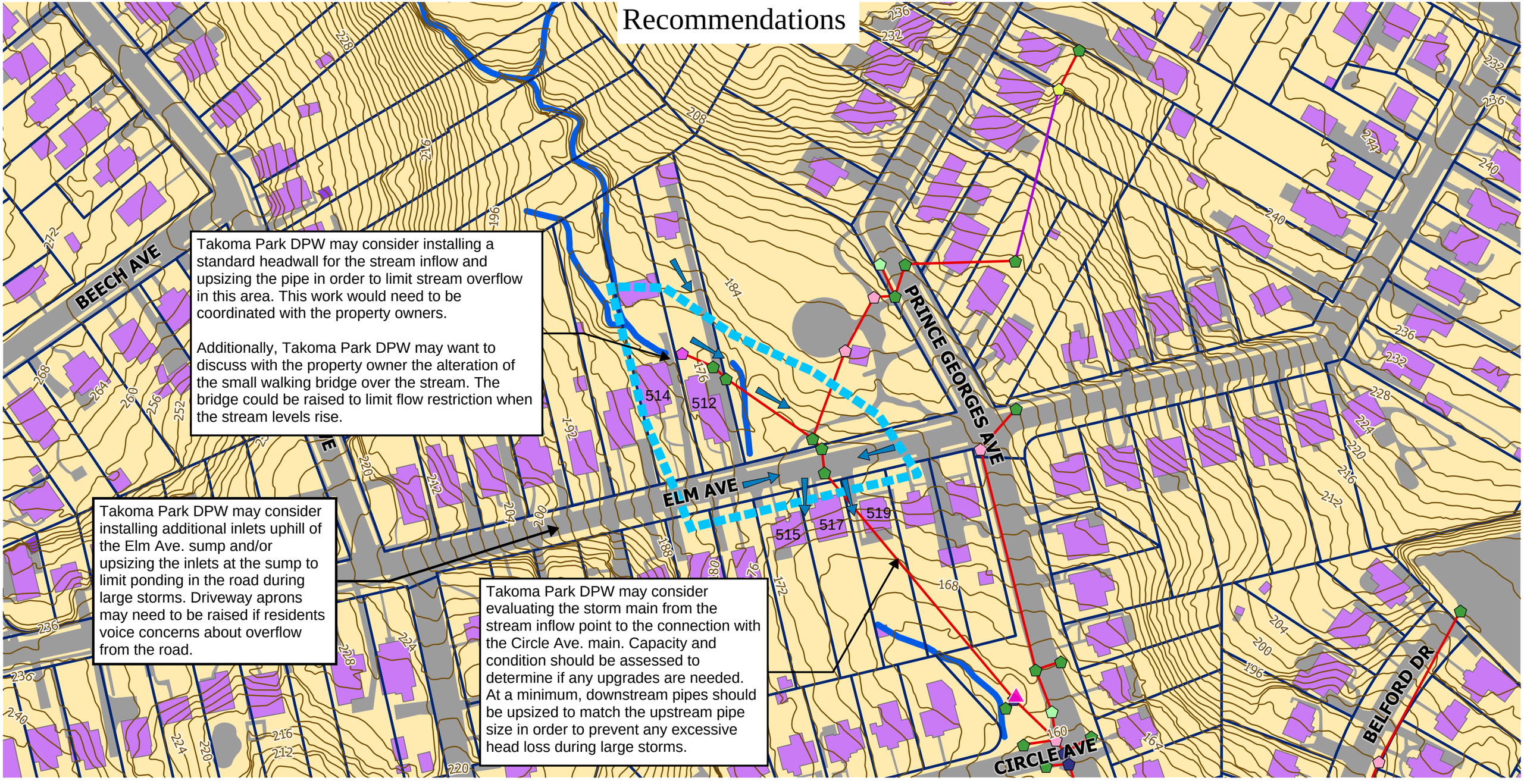
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 14

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

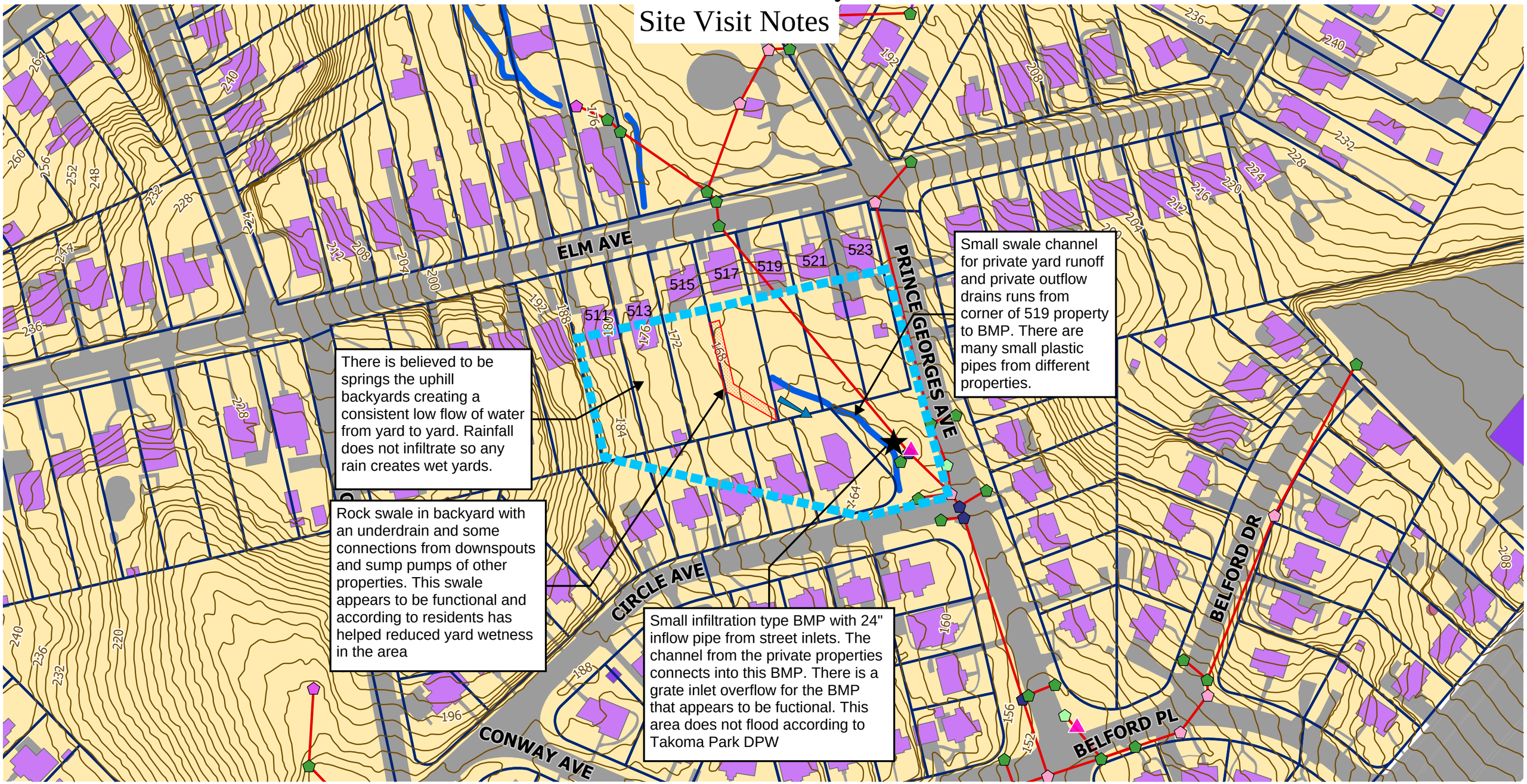
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 15

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable
- Uncertain

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 15

Recommendations

It was determined from field investigation that the drainage issues along the Jackson Ave. backyards are not caused by water coming from the public right of way.

Some tools residents may be able to utilize to address drainage concerns include french drains and overland flow paths. Neighbor collaboration may be necessary to limit cross property runoff. Refer to the resident guidance pamphlet and the Study Area 15 Report for details.

ELM AVE
PRINCE GEORGES AVE
CIRCLE AVE
CONWAY AVE
BELFORD DR
BELFORD PL

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Ditch
- Pipe

Storm Drain Structures
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path

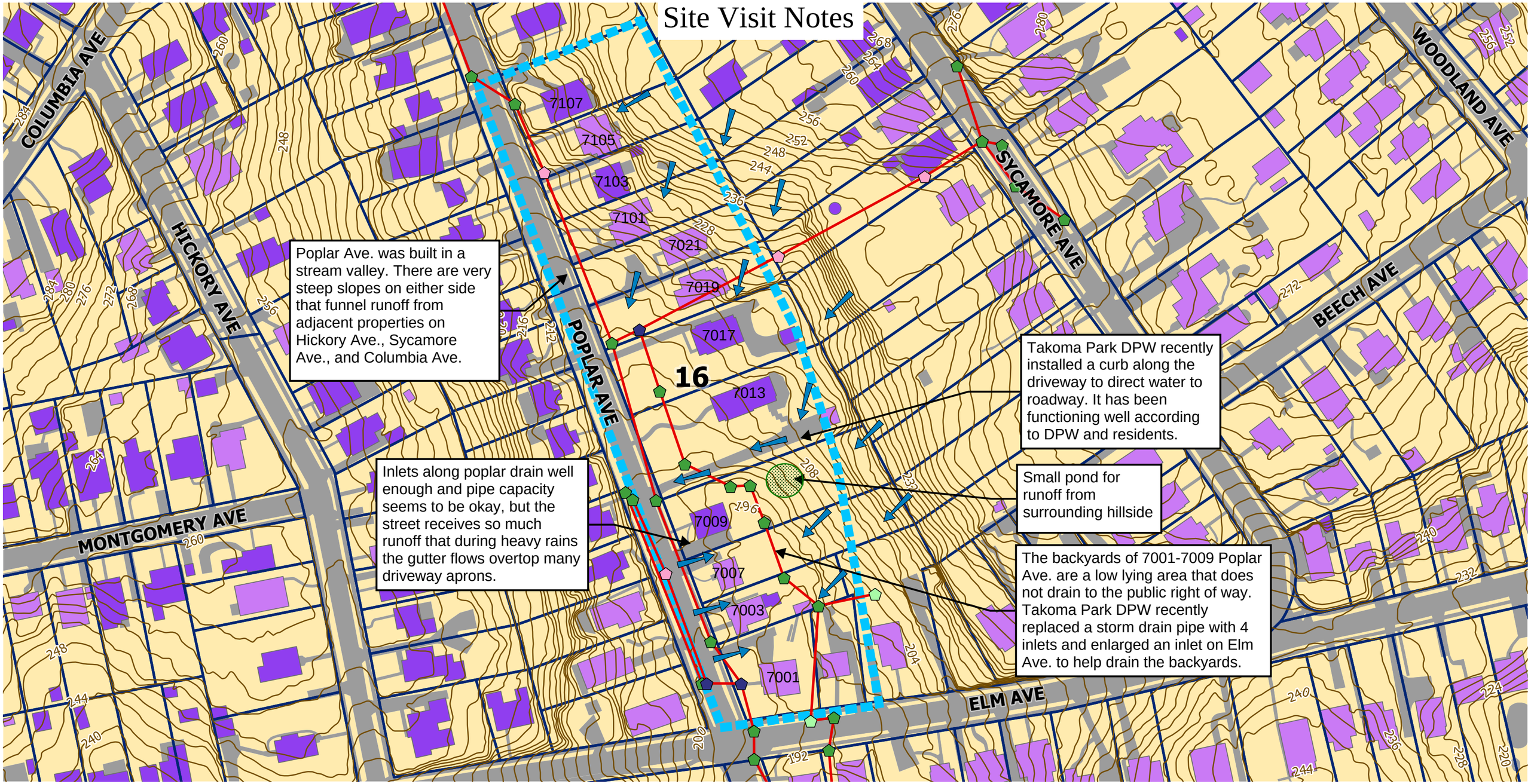
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 16

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction

- Runoff Flow Path

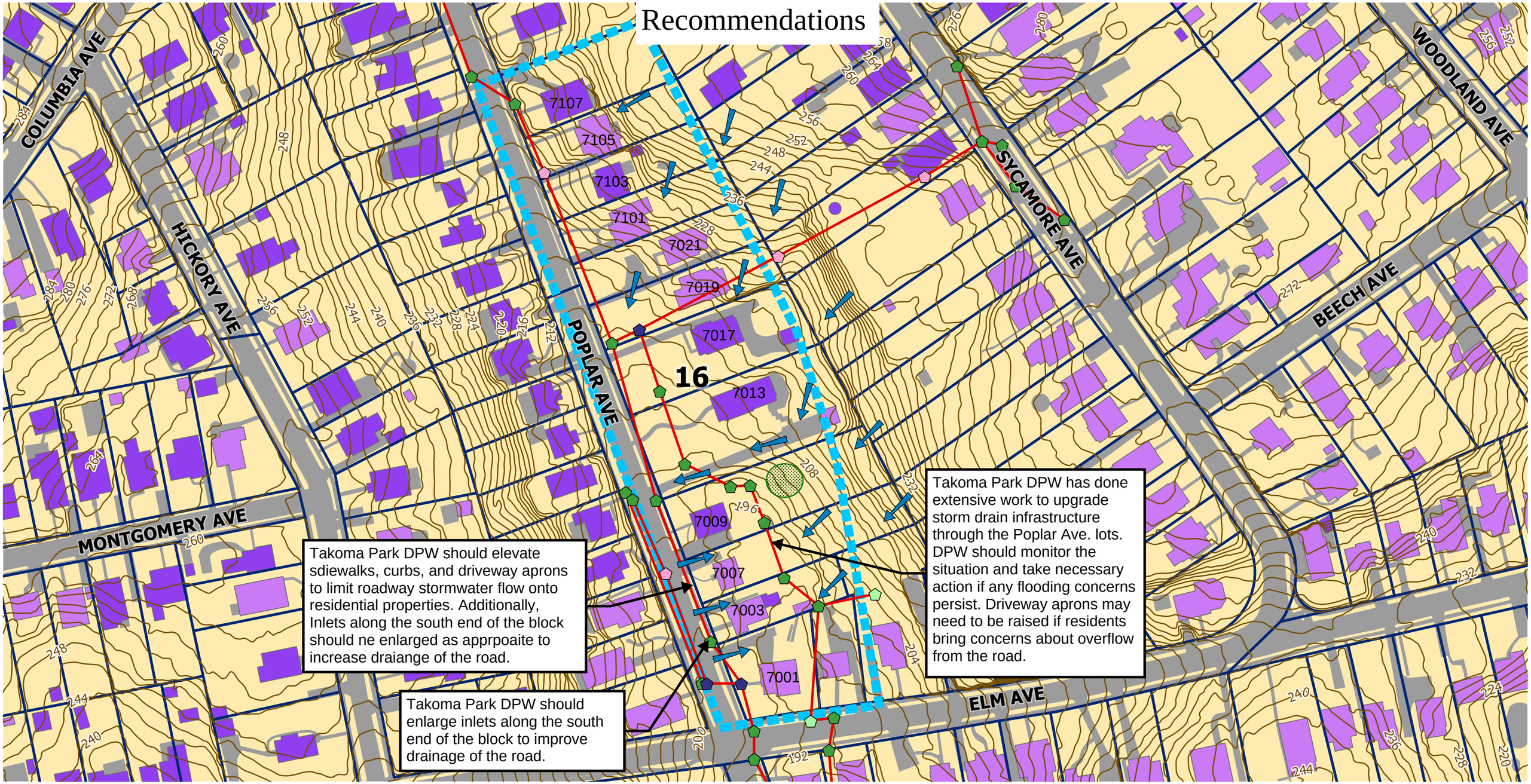
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 16

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction

- Runoff Flow Path

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 17

Site Visit Notes

Residents have reported runoff from the school downhill through the park.

Spring Ave. was built on a stream valley. This is the continuation of the stream valley from Poplar Ave.

4'x5' box culvert outfall for about 22.5 acres. The culvert is sized for the 10-yr storm according to the Takoma Park DPW.

Stream bank stabilization project was completed in 2013. The stream appears healthy. There are no signs of extensive flooding or erosion.

Inlets at the sump of Spring Ave. can overflow and cause runoff onto the private properties. This has caused serious flooding concerns for the 211 and 213 property. Takoma Park DPW has upgraded the inlets in this area, but there are still concerns about overflows.

ELM AVE
1ST AVE
ALLEGHENY AVE
COCKERTILLE AVE
2ND AVE
SPRING AVE
POPLAR AVE
GUDE AVE
CIRCLE AVE

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof
- Flat
- Gable

Storm Drain Conveyance
- Pipe

Storm Drain Structures
- Endsection
- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

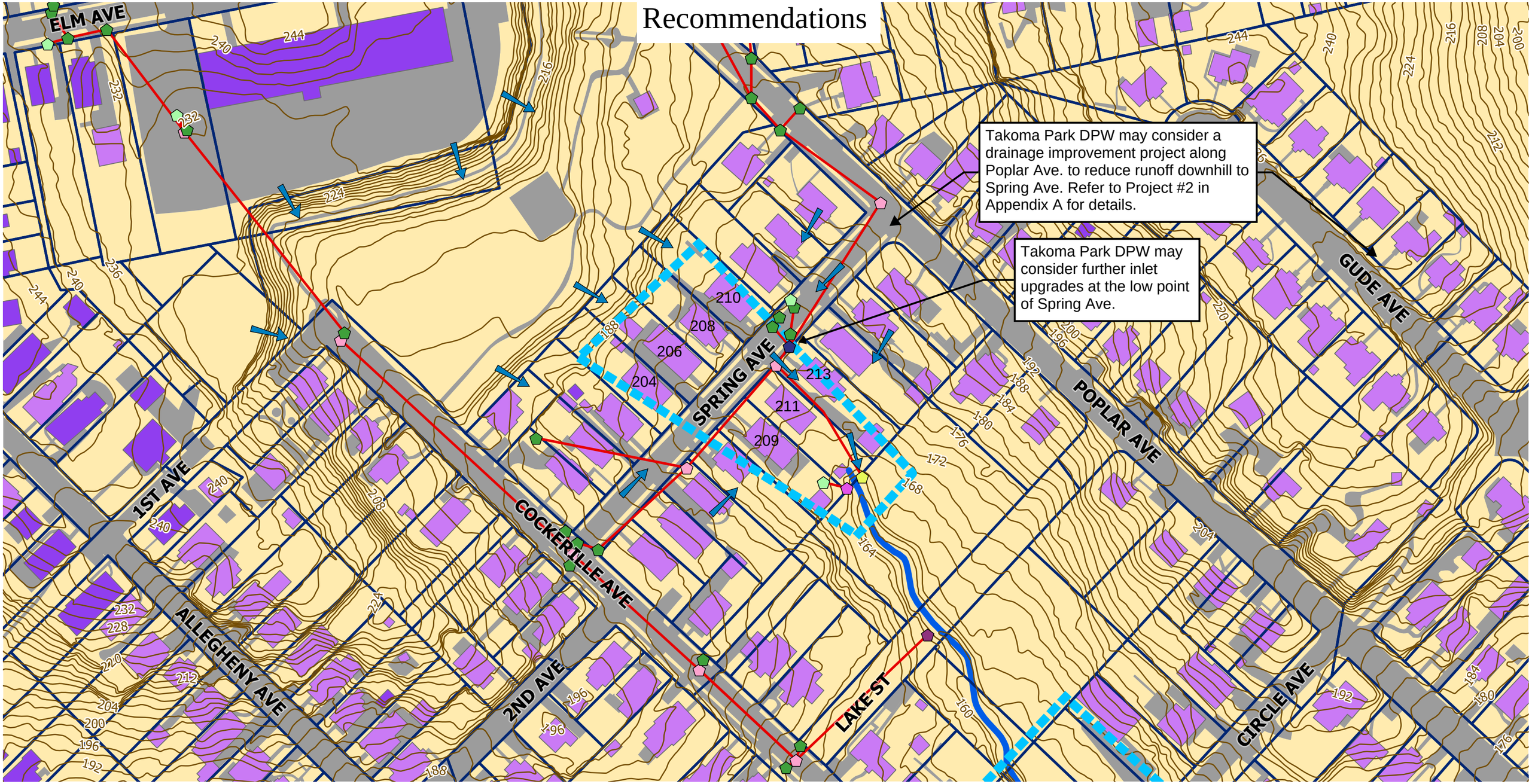
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 17

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Pipe

Storm Drain Structures

- Endsection
- End Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 18

Site Visit Notes

48" diameter inflow pipe for the stream is a choke point. When the stream level gets high during large storms the stream overflows onto surrounding properties.

This low lying area used to overflow and water would continue flowing across circle and all the way to 4th Ave. Takoma Park DPW installed a high curb along Circle ave to limit the overflow. Some water still flows through the culvert

Road runoff often spills into the 307 driveway and continues behind 6507 and 6505 Cockerille.

Low lying grass area floods from stream overflows during large storms. This is a WSSC owned lot.

Culvert under asphalt walkway allows water from WSSC lot to drain towards the small inlet. The culvert feeds into a small swale.

Inlet is small and blocked with debris. It receives a lot of flow from Circle Ave. and frequently overflows. The drainage in this area does not appear to be optimal.

316
309
307
6507
6505

SPRING AVE
2ND AVE
LAKE ST
COCKERILLE AVE
ALLEGHENY AVE
CIRCLE AVE
GUDE AVE
4TH AVE

Low Impact Development Center

Property Lines
2 ft Contours (2020)
Study Area
Stormwater BMPs
Roads, Sidewalks, Driveways, etc.
Pervious Surfaces
Streams

Buildings by Roof
Flat
Gable

Storm Drain Conveyance
Ditch
Pipe

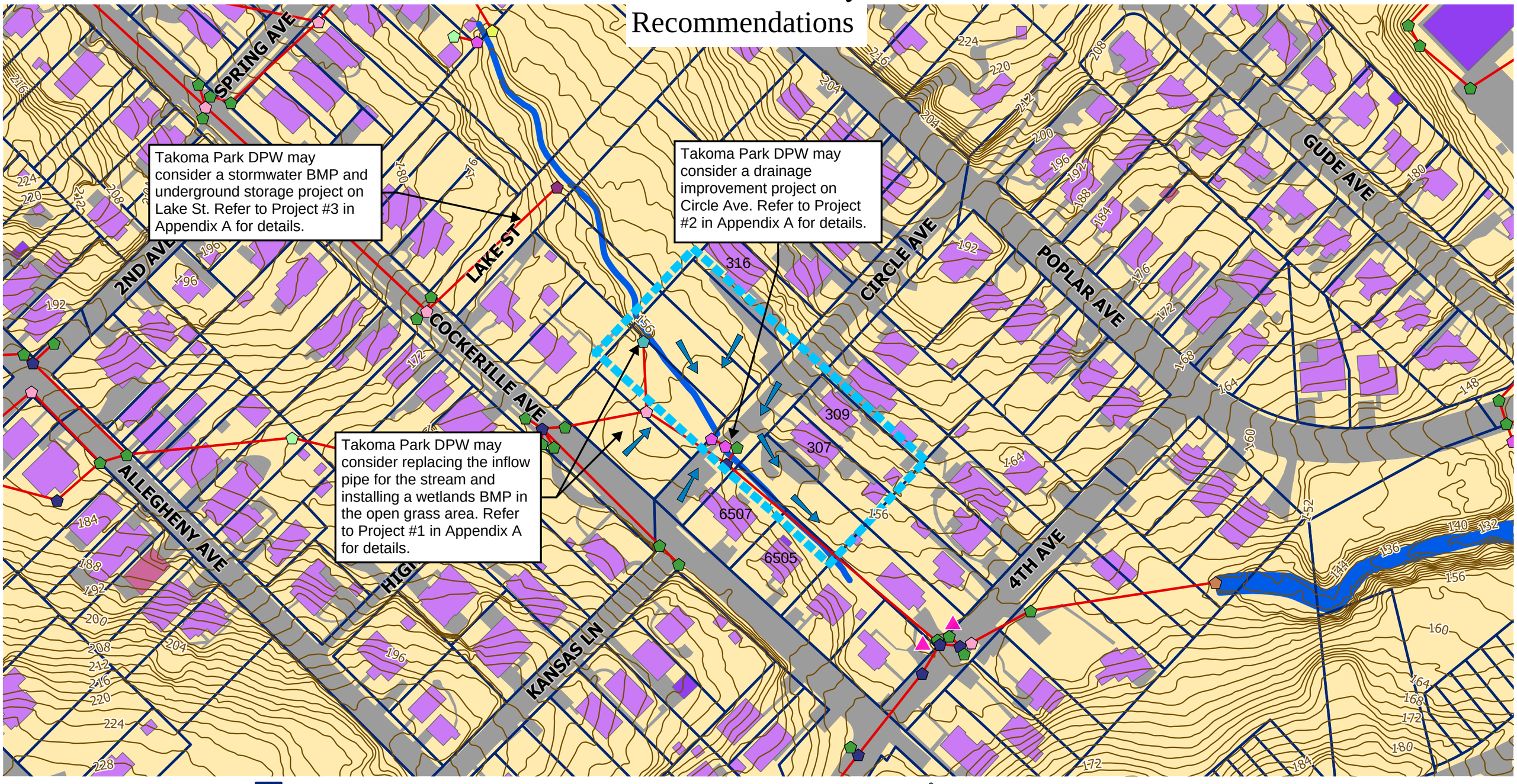
Storm Drain Structures
Endsection
End Wall
Head Wall
Ditch Intersection
Inlet
Manhole Structure
Pipe Connection
Pipe Direction
Projecting Pipe

Runoff Flow Path
Point of Concern

N
1 inch = 100 feet
0 50 100 200 US Feet

Takoma Park Study Area 18

Recommendations



Low Impact Development Center

Property Lines
2 ft Contours (2020)
Study Area
Stormwater BMPs
Roads, Sidewalks, Driveways, etc.
Pervious Surfaces
Streams

Buildings by Roof
- Flat
- Gable
- Not Applicable
- Uncertain

Storm Drain Conveyance
- Ditch
- Pipe

Storm Drain Structures
- Endsection
- End Wall
- Head Wall
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe

Runoff Flow Path
Point of Concern

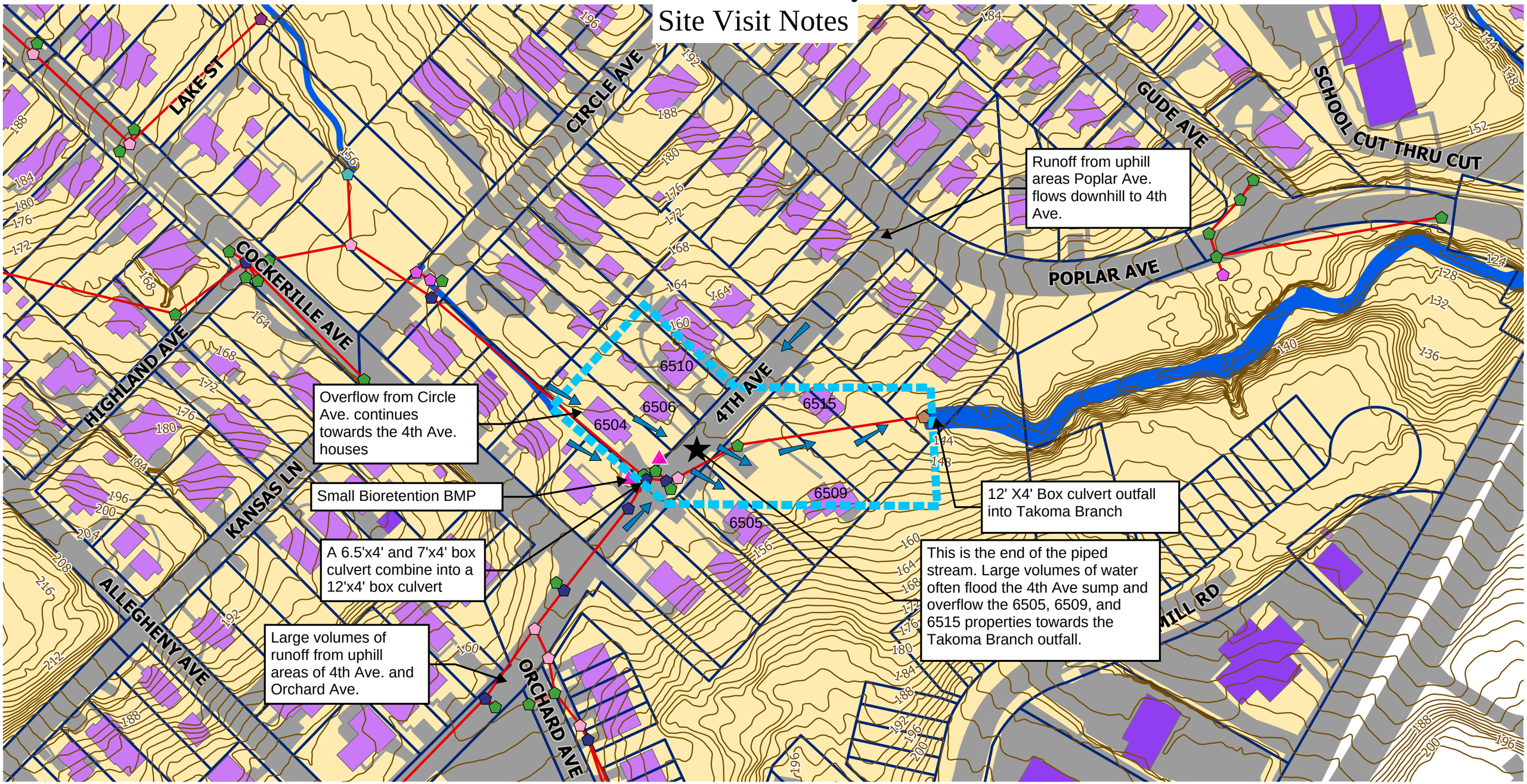
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 19

Site Visit Notes



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Endsection
- Head Wall
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

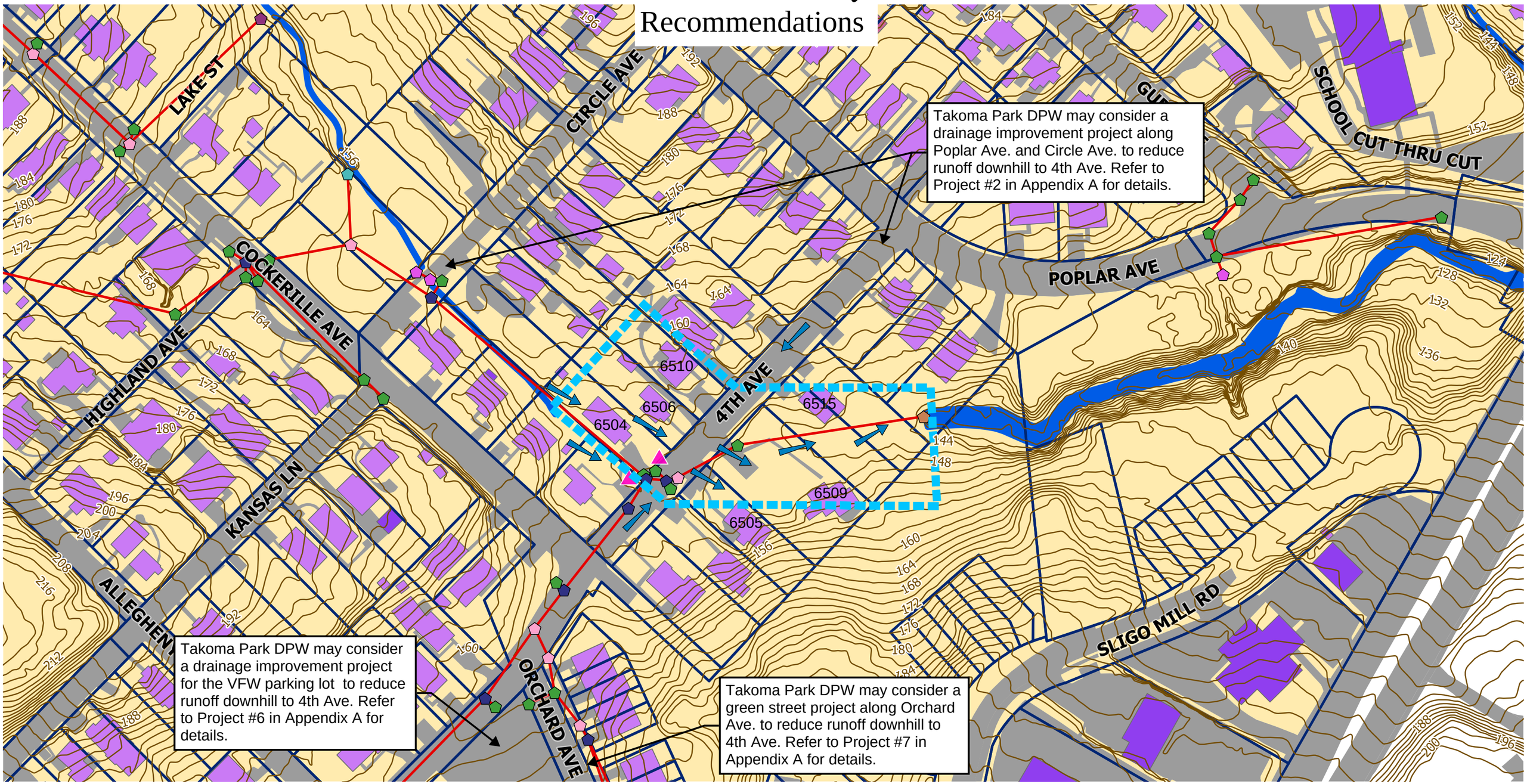
N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 19

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Stormwater BMPs
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams

Buildings by Roof

- Flat
- Gable
- Not Applicable
- Uncertain

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Endsection
- Head Wall
- Ditch Intersection
- Inlet
- Manhole Structure
- Pipe Connection
- Projecting Pipe
- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Takoma Park Study Area 20

Site Visit Notes

The sump of 2nd Ave. floods during large storm events. Water levels of 18 to 24 inches have been reported, which has created a hazard for vehicles parked along the street or driving through during the storm.

Manhole used to pop open from overflow during large storms. DPW has replaced the cover with a grate so it does not pop up.

Inlet has a weir wall to divert most flow into newer pipes along 2nd Ave. and avoid overflowing old pipes under private properties.

According to Takoma Park DPW the pipe under private property has a sharp bend.

1ST AVE
WESTMORELAND AVE
EASTERN AVE SERVICE RD
2ND AVE
ALLEGHENY AVE
COCKERILLE AVE
LAKE ST
HIGHLAND AVE
KANSAS LN
Washington D.C.
6600
6518
6516
6510

Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof
- Flat
- Gable
- Uncertain

Storm Drain Conveyance
- Ditch
- Pipe

Storm Drain Structures
- Endsection
- Head Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe

- Runoff Flow Path
- Point of Concern

N

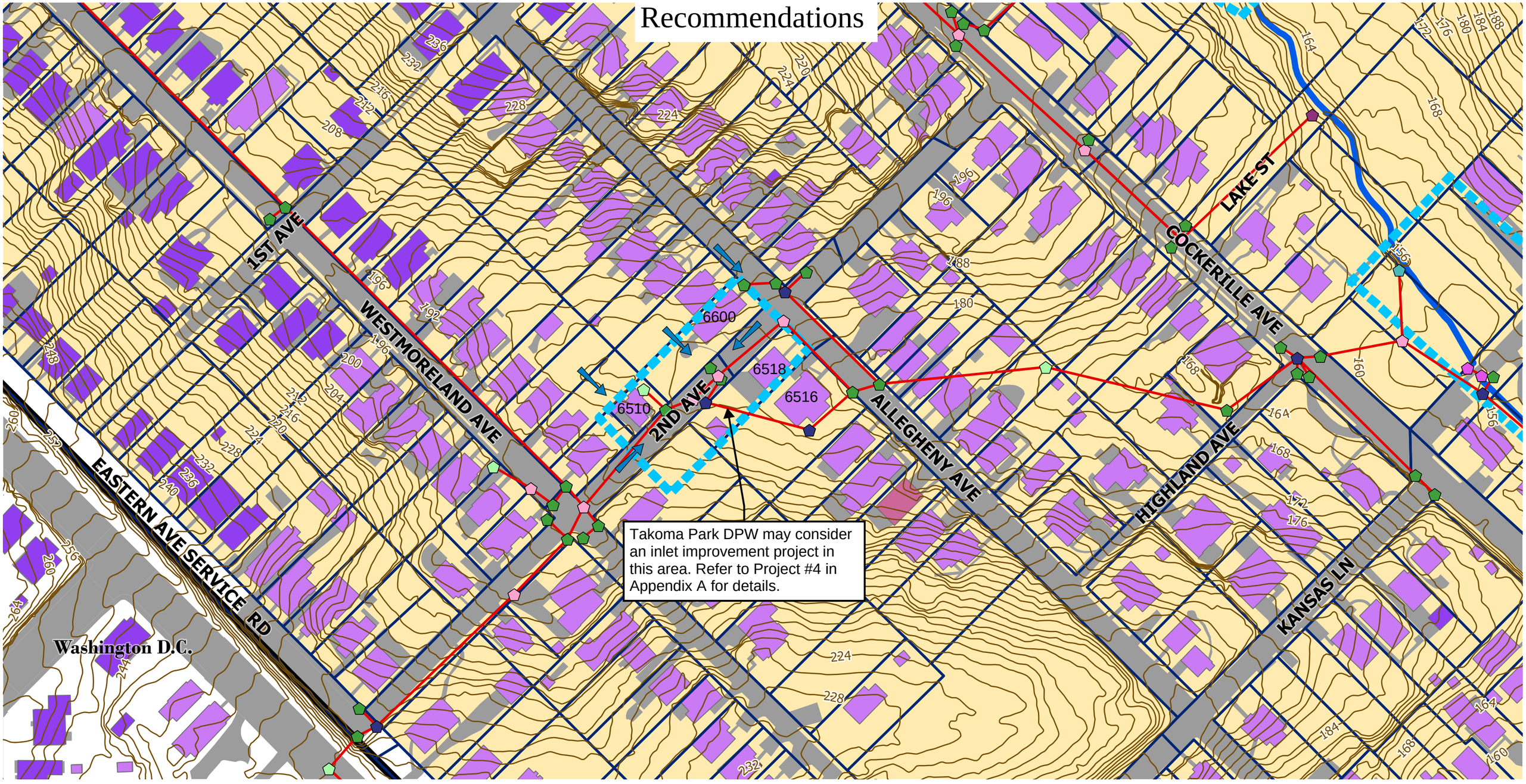
1 inch = 100 feet

0 50 100 200 US Feet

Note: Pervious surface layer is confined to the City boundary.

Takoma Park Study Area 20

Recommendations



Low Impact Development Center

- Property Lines
- 2 ft Contours (2020)
- Study Area
- Roads, Sidewalks, Driveways, etc.
- Pervious Surfaces
- Streams
- City Boundary

Buildings by Roof

- Flat
- Gable
- Uncertain

Storm Drain Conveyance

- Ditch
- Pipe

Storm Drain Structures

- Endsection
- Head Wall
- Inlet
- Manhole Structure
- Pipe Connection
- Pipe Direction
- Projecting Pipe

- Runoff Flow Path
- Point of Concern

N

1 inch = 100 feet

0 50 100 200 US Feet

Note: Pervious surface layer is confined to the City boundary.

Takoma Park Homeowner's Guide to Residential Drainage

When it rains or snow melts, the water either soaks into the ground or flows downhill towards lower-lying areas where it enters the storm drain or local waterways.

"Soft" or "permeable" surfaces such as lawns, gardens, and forests allow water to soak into the ground. The composition of the underlying soil determines how quickly water will infiltrate. A sandy soil will allow rapid infiltration of rain, whereas soils with a higher clay content have a much slower infiltration rate.

In more developed areas such as Takoma Park, there are fewer opportunities for the rain or snowmelt to soak into the ground. Natural landscapes get replaced by buildings, roads, parking lots, and other impermeable surfaces, leaving the water with fewer places to go. Land development converts permeable land to impermeable surfaces which increases stormwater runoff

In steep terrain, stormwater runoff can accumulate as runoff from upslope properties flows onto downslope properties.

Many older cities and towns, such as Takoma Park, were built in steep stream valleys. Streams are dynamic, natural systems that can regularly flood above the normal low-flow level, shifting their position over time as banks erode and sediments are deposited in new locations. The land area into which water flows when it overtops streambanks is called the "floodplain."

Some natural streams in Takoma Park have been diverted into buried pipes to confine and convey the water flow. These are referred to as "piped streams." Piped streams allow for land development in stream valleys; however, they have a more limited capacity than aboveground streams. These stormwater pipes can sometimes overflow during large rainstorms.

Prepared by LID Center 3/11/2024

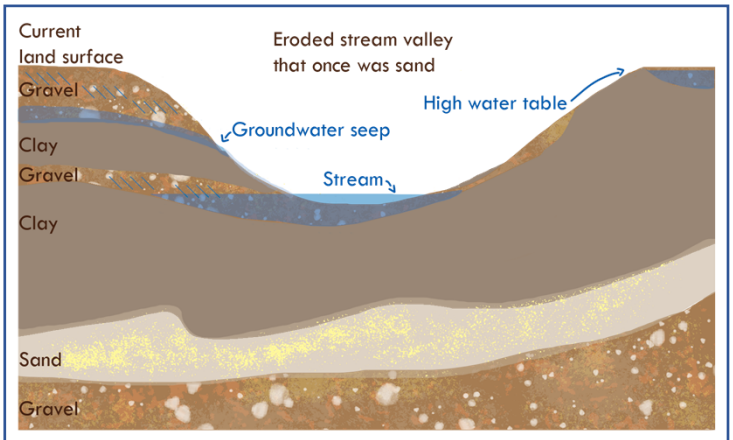
Management of Stormwater Runoff and Groundwater Flows

Public roadways are designed to manage stormwater. Curbs, gutters, storm drain inlets, and underground pipes consolidate runoff and convey water to treatment installations or natural waterbodies. Directing stormwater runoff from private properties to the road or public storm drain system is the most effective way to control residential flooding. Permission from the City of Takoma Park must be granted before tying private drainage into public stormwater infrastructure.

Groundwater travels through the soil similar to runoff traveling through a yard, but at a very slow rate. When groundwater is intersected by a drop in surface elevation water will emerge from the soil surface. Groundwater seeps are common in many parts of Takoma Park due to the high groundwater table and hilly terrain. Management of groundwater issues often involves the installation of underground pipes to redirect water. Conservation landscaping and other planting practices can help to manage high groundwater when it impacts yards.

Runoff and groundwater often flow from one property to another. Neighbors must work collaboratively to manage this runoff effectively. Collective employment of connected management techniques within and among properties will yield the best results.

The public storm drain system is designed to carry stormwater away from developed areas and prevent flooding.
Image Credit: MinnPost – www.minnpost.com



Groundwater movement underground is often affected by composition of underlying geology.
Image Credit: LID Center

Prepared by LID Center 3/11/2024

Stormwater Runoff Management Techniques

<u>Technique #1:</u> Ensure that Positive Drainage is Maintained through Site Grading

Lawns and paved surfaces should be sloped or graded to maintain positive drainage. Surface runoff should be able to flow away from homes and other structures, preferably toward the public right-of-way. Maintaining positive drainage may require the use of techniques like swales to direct runoff. Care must be taken to avoid changes that cause runoff to flow to a neighboring property.

Grading can be used to maintain positive drainage without directing runoff to neighboring properties.
Image Credit: City of Edmonton, AB, Canada

<u>Technique #2:</u> Direct and Reinforce Flow Path

Homeowners can manage overland flow by creating a swale for water to follow. A depressed path lined with erosion-resistant material such as stone will help to slow water and reduce erosion. Vegetation can be used to further stabilize paths and reduce flow velocity. Harder armoring may be necessary on steep slopes. Consult a professional landscape contractor to determine the best approach for your property.

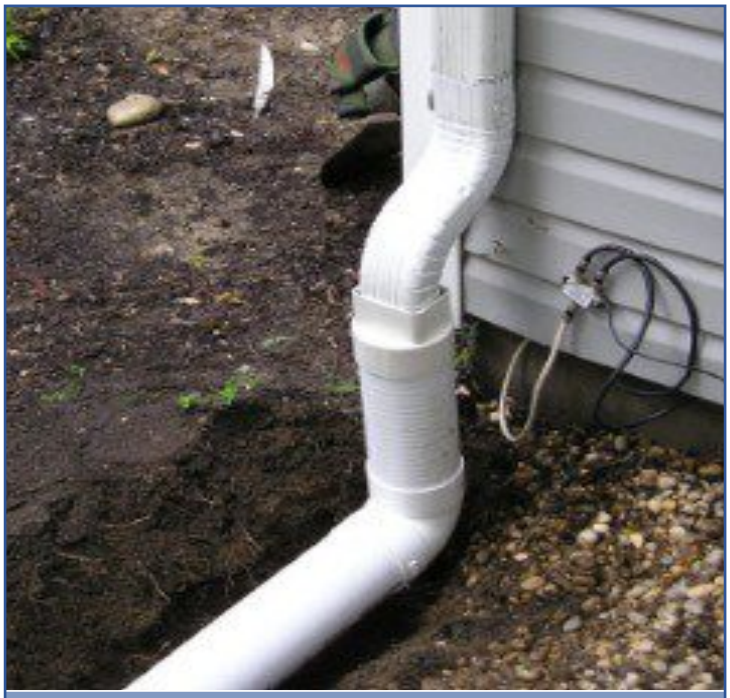
Swales can be used to direct storm water flows and reduce erosion.

Prepared by LID Center 3/11/2024

Stormwater Runoff Management Techniques

<u>Technique #3:</u> Install Downspout Leader Pipes

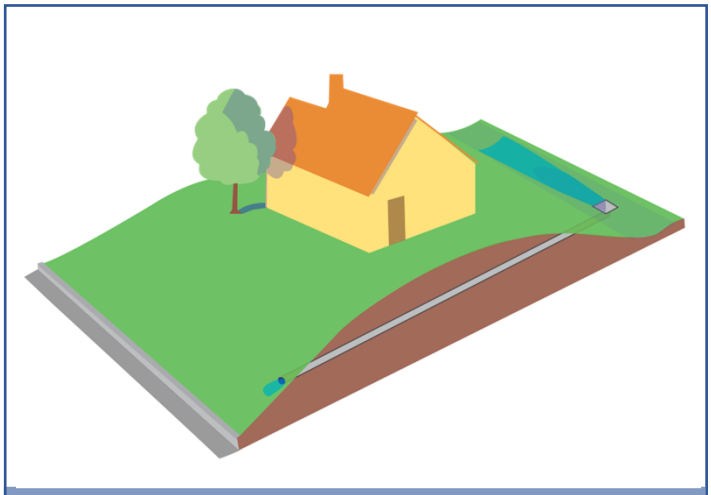
Downspout leader pipes are extensions that can be attached to existing downspouts to carry roof runoff further away from building foundations. They can be buried underground, and with permission of Takoma Park DPW, may discharge into the road gutter. Discharging water in this manner helps to prevent runoff from flowing downhill into a neighbor's yard or around your foundation.



Leader pipes can be used to extend downspouts beyond building foundations.
Image Credit: LID Center

<u>Technique #4:</u> Install a Private Storm Drain System

Installation of a private storm drain system may be valuable in situations where large volumes of runoff need to be drained from a property, or where water is trapped by topography. Private storm drain systems typically consist of an inlet and an underground pipe which carries water to the public right of way. To solve larger drainage issues across many properties, the private storm drain system may need to span several lots and involve multiple inlet points. Installation should be coordinated between property owners, and a professional contractor should be consulted. Private drainage should be connected to a public storm drain pipe when possible but can also outlet at the curb. All connections to public infrastructure require permission from the Takoma Park DPW.



Private storm drain systems can be used to direct water when grading cannot .
Image Credit: LID Center

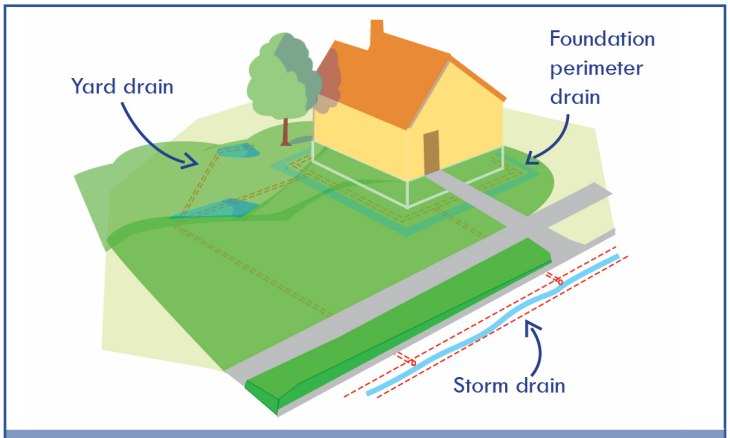
Prepared by LID Center 3/11/2024

Groundwater Management Techniques

<u>Technique #1:</u> Install Underdrains

Installation of underdrains is a common method for managing groundwater issues on your property.

Underdrain systems typically consist of a perforated pipe set in a gravel trench. The groundwater level around the pipe is reduced as water that enters is carried to a location where it can drain away. A sump pump may be necessary to move the water, depending on the topography of the land. The underdrain should connect to a public storm drain pipe if possible. Where such a connection cannot be made, it can outlet to the road gutter, but this is not ideal as it may create consistently wet conditions on the street. As with all stormwater management, any connection to public stormwater infrastructure must be approved by Takoma Park DPW.



Underdrains can be used to manage groundwater issues. Image Credit: Adapted from the Prince George's County Homeowner's Guide to Drainage Problems and Solutions

<u>Technique #2:</u> Protect Building Foundations with Exterior Waterproofing

The application of waterproof membranes to the exterior of a building's foundation can prevent water from seeping into basement walls. Several waterproofing options are available to homeowners including wraps, painted coatings, and chemical soil injections. Consult a waterproofing expert for advice on membrane materials and installation.

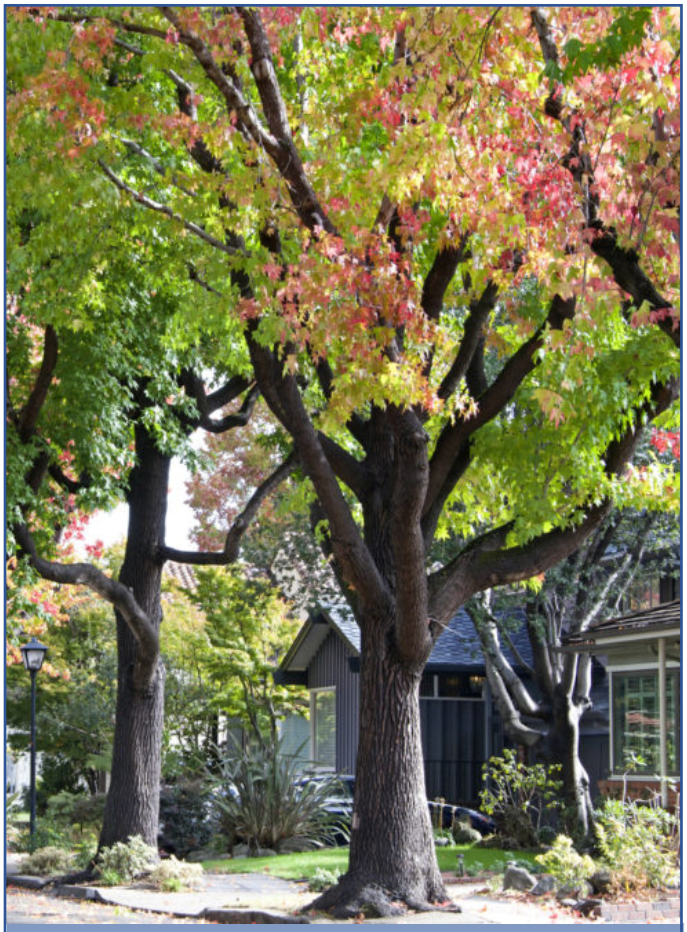
Exterior waterproofing membranes protect a home's foundation from groundwater intrusion.

Prepared by LID Center 3/11/2024

Groundwater Management Techniques

<u>Technique #3:</u> Plant Trees

Planting trees is a simple and natural way to address groundwater issues, with many added benefits. Along with groundwater uptake, trees stabilize and improve soils, produce oxygen, sequester carbon, cool urban areas, and support biodiversity. Be sure to plant trees that can thrive in the conditions on your property.



As they grow, trees uptake large amounts of groundwater.
Image credit: Courtesy of southkingmedia.com

<u>Technique #4:</u> Install Conservation Landscaping

Conservation landscaping is the practice of working with natural ecological systems to establish plantings of native species. By planting species that are adapted to the ecological conditions of a site, homeowners can create gardens of thriving plants that will utilize groundwater and reduce ponding.

Conservation landscaping is an accessible technique that can be readily applied by almost any property owner. For areas that experience prolonged inundation or are consistently saturated, plants that are adapted to wet soils should be selected. In areas that receive high intensity runoff, reinforced flow paths can be used in conjunction with plantings.

Conservation landscaping can be employed to absorb groundwater and mitigate saturated conditions.
Image Credit: LID Center

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Green Infrastructure Best Management Practices

The term “green infrastructure” applies to installations that utilize natural ecological processes to slow and filter stormwater runoff. Small-scale green infrastructure best management practices (BMPs) can be very effective in reducing runoff volumes, minimizing erosion, and improving water quality, especially when installed on multiple properties throughout a watershed.

BMP #1: Pavement Removal

Pavement removal reverses the impact of impervious surface installation. When pavement is removed, rain can once again soak into the soil, reducing a property’s contribution to stormwater runoff. Montgomery County accepts and recycles concrete and other paving materials at the Shady Grove Processing Facility and Transfer Station.

Pavement removal before (left) and after (right).
Image credit: Chesapeake Bay Trust

BMP #2: Permeable pavement

When selecting the surface materials for landscape features such as driveways, paths, and patios, consider using permeable pavement. A variety of options are commercially available, including interlocking pavers that provide gaps for water to reach the ground underneath, porous pavers, and grided modules that allow grass to grow within the paving framework. All of these provide a stable, reinforced surface for parking, walking, or gathering, while simultaneously allowing infiltration.

Permeable paving systems allow infiltration of water.
Image credit: Landscape East and West

Green Infrastructure Best Management Practices

BMP #3: Rainwater Harvesting

Rainwater harvesting is a practice that is suitable for almost any residential property. By temporarily storing rain that falls on rooftops in rain barrels (small capacity) or cisterns (large capacity), stormwater runoff is reduced; water can be released into the soil between storms. Harvested water is non-chlorinated and can be used to irrigate plantings and supply water features such as fountains or ponds. Cisterns and rain barrels need to be drained between storm events to provide storage for the next storm. If water is not being used for other applications, low-flow outflows can be used for passive drainage between storms. Tanks must include an overflow outlet, which can be directed to the curb with permission from the Takoma Park DPW.

Cisterns can be used to harvest and utilize rainwater.
Image credit: Innovative Water Solutions – watercache.com

BMP #4: Rain Gardens

The first inch of runoff, referred to as "the first flush," carries around 80%-90% of the pollutants from the land. Rain gardens are slight depressions positioned in the landscape to receive and filter the first flush of runoff from a given drainage area. A common practice is to locate raingardens so that roof downspouts can flow into them.

Raingardens may not be appropriate in areas with groundwater problems because they promote infiltration of stormwater runoff. Before installing a rain garden or similar practice you should have your property evaluated by a stormwater professional.

Raingardens capture and filter stormwater runoff.
Image credit: Jason Johnson, Natural Resource Conservation Service, USDA