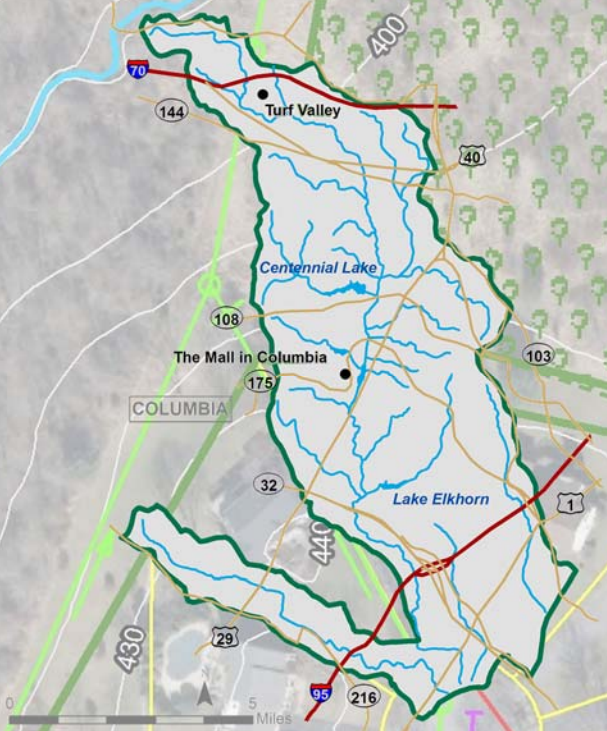
Little Patuxent River
Watershed Assessment



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Prepared for:
Howard County,
Department of Public Works,
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clean H2OWARD
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EXECUTIVE SUMMARY

Howard County, Maryland, is required to develop Watershed Assessments to identify specific restoration opportunities to provide greater treatment of stormwater from urban impervious areas and to reduce pollutant loads associated with urban runoff. In 2014-2015, Howard County's Stormwater Management Division sponsored this assessment of the Little Patuxent Watershed within Howard County in order to (1) assess current conditions and (2) recommend watershed restoration opportunities. Employing GIS and field investigations, the project team recommended a suite of opportunities including upgrades to existing stormwater Best Management Practices (BMPs), new BMPs, tree plantings, stream restoration, and stabilization of stormwater outfalls. In all, this assessment yielded 760 potential projects and produced concept plans for 109 of the top-ranked opportunities identified.

The Little Patuxent Watershed in Howard County encompasses an area of 59 square miles. Impervious cover represents about 25.6% of the watershed, a level at which stream degradation is often observed. Residential land use makes up the largest proportion of the watershed area (41.0%), followed by commercial/industrial/institutional use (18.6%) and forest cover (21.1%). Only 4% of sites assessed historically were in Good biological condition and 11% were rated as Fair, with the remainder Poor to Very Poor.

GIS data, including data compiled from studies previously conducted within the Little Patuxent watershed, were used as the first step to identify candidate retrofit and restoration sites for further investigation in the field. Candidates initially selected were reviewed by Howard County staff to finalize the suite of field sites to be visited. In all, 530 sites and 50 stream miles were selected for field investigation, and another 72 sites previously assessed in other studies were slated for desktop assessments.

Field data collection was customized for each of the five site types and focused on assessing current conditions and identifying and describing restoration opportunities. Field data were collected with mobile tablet devices via an ESRI ArcCollector application. Some previously visited sites were evaluated via desktop assessment only, making use of prior data collected. In total, 600 sites and 50.2 stream miles were assessed. More than 800 initial watershed restoration recommendations were proposed based on field and desktop observations.

A standardized method was developed for comparing, ranking, and prioritizing the proposed project opportunities identified. Projects were ranked in two ways. First, each project was ranked against all other projects of the same type. Second, all projects were pooled together and ranked against one another, to enable ranking across project type, and to determine those projects that should be taken to the next design stage.

Ranking criteria were developed within the following categories of factors:

- Permit contribution – how a project will help towards the County meeting the impervious surface treatment requirements and pollutant reduction goals;
- Biological uplift – if a project will provide additional benefits, such as building onto existing green infrastructure or protecting wetlands;

- Programmatic benefit – how project has added value such as visible demonstration projects or public education; and
- Feasibility – estimation of the ease or difficulty of project implementation, including public versus private ownership, site accessibility, or whether a repair is already required at a site.

For the pooled project type ranking, scores were based on permit contribution criteria—specifically, acres of impervious treatment, pollutant load reduction, and cost per acre of impervious treatment—along with a combined score for the remaining three factor categories.

Ranking scores were used to select the 109 highest-ranked projects for concept plan development at this time, out of 760 potential projects. A four-page concept plan was developed for each of the projects, providing location information, description of existing condition (including photos), details of the proposed project (including a design drawing), implementation information (such as utility constraints and other nearby projects), potential impervious treatment credits, and cost estimate. The following numbers of project concepts were developed: 15 BMP Conversions, 10 New BMPs, 19 Tree Plantings, 20 Outfall Stabilizations, and 45 Stream Restorations.

A pollutant load model was created first to quantify nitrogen, phosphorus, and sediment loadings and loading rates to the Little Patuxent River with the watershed's existing and planned BMPs, based on the County's BMP inventory geodatabase as of November 12, 2015. Further, this model was used to calculate the expected nutrient and sediment loading reductions that would occur based on implementation of restoration opportunities identified as part of the watershed assessment. Pollutant load calculations and removals by BMPs were completed for (1) the local TMDL for sediment, and (2) the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment.

Results included a summary of estimated pollutant load reductions for the implementation of recommended projects, including how reductions were credited, pollutant removal efficiencies, potential load reductions, and units available for restoration. Results for the Bay TMDL indicate that the target load reduction for total phosphorus of 17.2% is easily met with a 54% load reduction; the sediment load reduction target is also met since the phosphorus target is met. These goals are met primarily due to stream restoration and its associated reductions using the interim reduction rates. Actual phosphorus and sediment reduction could be different, depending on the actual design implemented for these projects. The total nitrogen target of 9.4% is not met by the full suite of recommended projects, since there is only a 7.1% reduction achieved if all BMPs are implemented. For the local sediment TMDL, the target goal of 48.1% is achieved with a total reduction achieved of 62% if all BMPs were to be implemented.

The assumed implementation of potential restoration BMPs show how they would approach or exceed the required percent reduction for nitrogen, phosphorus, and sediment loads needed to meet water quality standards for this watershed as specified by the local and Chesapeake Bay TMDLs. Additional reductions may also be achieved through restoration actions not included in this analysis such as street sweeping, erosion and sediment control, and public education and outreach efforts (e.g., watershed trash and recycling campaign, conservation landscaping, pet waste education). These may be added as progress toward TMDL goals is tracked over the next several years.

ACKNOWLEDGEMENTS

The Little Patuxent Watershed Assessment report was prepared by Versar staff: Nancy Roth, Mark Voli, Brenda Morgan, Stephen Schreiner, Allison Brindley, Ben Fertig, Ginny Rogers, and Alexi Boado.

The complete Little Patuxent Watershed Assessment effort was a collaborative effort among the Howard County Stormwater Management Division; Versar, Inc.; KCI Technologies, Inc.; McCormick Taylor; Biohabitats; Stormwater Management and Consulting; and Straughan Environmental, Inc. The following individuals were among those instrumental in providing field assessments and field reports, GIS/technical support, data analysis, quality control, technical review, and preparation of concept plans.

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1. INTRODUCTION

1.1 Overview

Howard County, Maryland, is required to develop Watershed Assessments to identify specific restoration opportunities to provide greater treatment of stormwater from urban impervious areas and to reduce pollutant loads associated with urban runoff. In 2014-2015, Howard County's Storm Water Management Division sponsored this assessment of the Little Patuxent River Watershed within Howard County in order to (1) assess current conditions and (2) recommend watershed restoration opportunities. This report documents the Watershed Assessment for Little Patuxent River Watershed, which yielded 760 potential projects and produced concept plans for 102 of the top-ranked opportunities identified. The suite of recommended opportunities includes upgrades to existing Best Management Practices, BMPs, new BMPs, tree plantings, stream restoration opportunities, and stabilization of stormwater outfalls.

1.2 Background

Howard County continues to implement significant controls on stormwater discharges under its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit (MDE 2014a) and other Clean Water Act requirements. In addition, the County conducts programs supporting watershed restoration and environmental sustainability that include (1) protection of water resources, (2) public outreach, (3) new investment in stormwater management, (4) development of a Watershed Protection and Remediation Fee, (5) development of a Countywide Implementation Strategy for addressing pollutant reductions and (6) preparation of assessments for individual watersheds.

Howard County programs

- Protect water resources
- Welcome public input and feedback
- Invest in stormwater management
- Remediate stormwater
- Assess, prioritize, and fund restoration opportunities

As Howard County continues to increase its watershed planning efforts to comply with its MS4 permit and meet other water resource goals, detailed watershed plans will be developed for the entire county. While previous watershed assessments have been completed for many areas of the county, the current round of assessments and plans incorporate a focus on addressing MS4 permit requirements. Plans include development of a detailed inventory of projects that can be undertaken to restore impervious surface area that has not already been restored to the maximum extent practicable (MEP) and to reduce nutrients and sediment in stormwater runoff. In addition, the expected pollutant load reductions of proposed projects are modeled, and the amounts of impervious surface area equivalent acres restored are calculated.

The Little Patuxent Watershed is located in the center of Howard County (Figure 1-1). The MS4 area under the jurisdiction of Howard County includes the majority of the County, with the exception of state and federal lands, as shown, and other properties which have industrial stormwater discharge NPDES permits, not visible at this map scale.

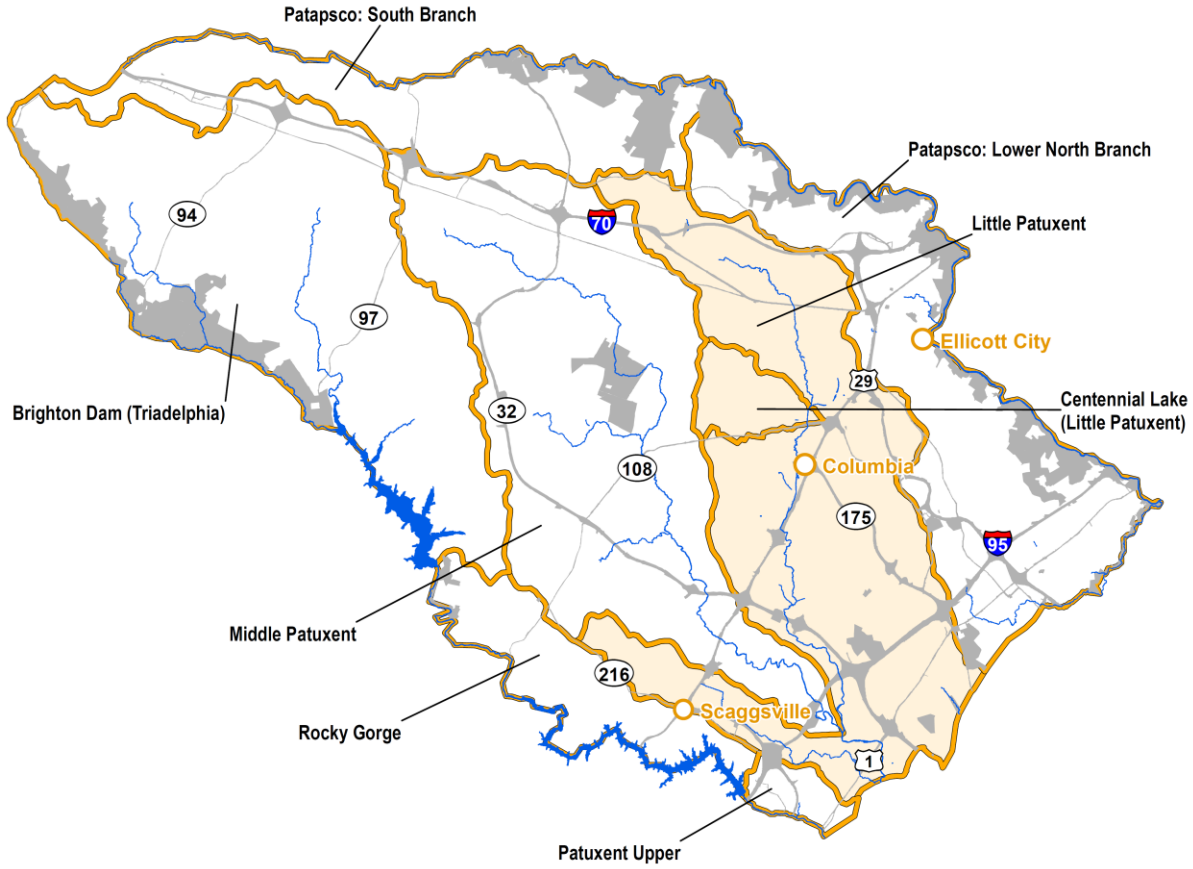


Figure 1-1. Major watersheds of Howard County, Maryland, with Little Patuxent Watershed highlighted. The MS4 permit for Howard County includes the entire county with the exception of areas under other jurisdictions. On this map, federal lands, state highway lands, and other state lands are shown in gray; other properties which have industrial stormwater discharge NPDES permits are also not within the County MS4 but are not visible at this map scale.

Previously, Howard County prepared the following assessments and plans within the Little Patuxent Watershed. Results and recommendations from these projects were incorporated into the present study.

- General Watershed Restoration Assessments and Strategy (WRAS) and Stream Corridor Assessments (SCAs) for
  - Little Patuxent (Howard County 2002; Maryland Department of Natural Resources 2001)
  - Dorsey Run and Hammond Branch 2003 SCAs
  - Upper Little Patuxent SCA (USACE 2008)

- Specific watershed plans with restoration projects
  - Centennial Lake and Wilde Lake (Center for Watershed Protection and Tetra Tech 2005)
  - Downtown Columbia (Howard County 2010)
  - Columbia Watershed Management Plan / Lake Elkhorn (Versar 2009)
  - Upper Little Patuxent (KCI Technologies, Inc. 2009)
  - Countywide Dry Pond and Extended Detention Pond Retrofit study (Versar 2013a)
  - Countywide identification of Low Impact Development (LID) Retrofit and Tree Planting opportunities on County properties (Versar 2013b)

Citizen complaints also provided a source of potential restoration projects and were included in the current study.

1.3 Regulatory Context

Howard County has several watersheds where pollutant loading limits have been established by the State of Maryland and approved by the U.S. Environmental Protection Agency (EPA), through quantitative assessment studies under the Clean Water Act.

1.3.1 Water Quality Impairments

Section 303(d) of the 1972 Clean Water Act requires states to develop and periodically update a list of impaired waters that fail to meet applicable state water quality standards, which are defined by their designated uses. States must also establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for waters on the impaired waters 303(d) list. According to EPA, a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet state water quality standards. TMDLs can be developed for a single pollutant or group of pollutants of concern which generally include nutrients, sediment, bacteria, metals, and pesticides. To meet TMDL targets, pollutant loads from point and nonpoint sources must be reduced by implementing a variety of control measures.

Several watersheds in Howard County are listed as impaired for various pollutants in the Maryland 2014 Integrated Report (formerly known as the 303(d) list of impaired waters) prepared by the Maryland Department of the Environment (MDE 2014b, http://www.mde .maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2014IR.aspx). Impairment listings reflect the inability to meet water quality standards for the designated uses for a water body. Impairment in tidal receiving waters is related to pollutants coming from entire watersheds; therefore, TMDLs developed for these segments will require watershed pollutant load reductions. Water Quality Assessments (WQAs) are performed to determine if the pollutant of concern is actually impairing the waters. If it is determined that the pollutant of concern is not contributing to water impairment, a report documenting the findings is submitted to EPA for concurrence.
Based on these listings, there are a number of water body segments in the Little Patuxent Watershed that MDE has identified as potentially impaired (Table 1-1). Of these, two have had water quality assessments performed, showing that they are not impaired; one is impaired and

will need a TMDL in the future; and three have completed TMDLs, all for phosphorus or sediment.

Table 1-1. MDE Water Quality Impairment Listings and Status of Local Impairments and TMDLs in the Little Patuxent Watershed in Howard County, not including the overall Chesapeake Bay TMDL

Impairment	Applicable Segment	Status	Approval Date
Chlorides	Little Patuxent	WQA - Impaired	
Eutrophication	Little Patuxent	WQA – Not Impaired	March 2010
Cadmium	Little Patuxent	WQA – Not Impaired	July 2009
Sediment	**Little Patuxent**	**TMDL completed**	**September 2011**
Sediment	**Little Patuxent-Centennial**	**TMDL completed**	**April 2002**
Phosphorus	**Little Patuxent-Centennial**	**TMDL completed**	**April 2002**

1.3.2 Local Total Maximum Daily Loads (TMDLs)

Nitrogen, phosphorus and sediment reductions are driven by federal and state regulations under the Clean Water Act. Overall, Howard County must address seven approved local TMDLs in six of its watersheds, as well as the Chesapeake Bay Watershed TMDL (Table 1-2). The present watershed study addresses both local and Chesapeake Bay TMDL targets for the Little Patuxent Watershed. The watershed of Centennial Lake is within Little Patuxent; however, MDE's Stormwater WLA list for Howard County does not include a separate WLA for Centennial Lake, so it is not modeled separately here (see wlat.mde.state.md.us/ByMS4.aspx). The present project addressed the local sediment TMDL for Little Patuxent and the nitrogen, phosphorus, and sediment Chesapeake Bay TMDLs in the Howard County portion of the Little Patuxent River Watershed.

Table 1-2. Approved TMDLs in Howard County (as of September 8, 2015). Those affecting the Little Patuxent Watershed are shown in bold text.

Watershed	TMDL Constituent
Patapsco Lower North Branch	Fecal coliform (Dec. 2009) Sediment (Sept. 2011)
Baltimore Harbor* (assumed superseded by Bay TMDL)	Nitrogen/Phosphorus (Dec. 2007)
Little Patuxent	**Sediment (Sept. 2011)**
Little Patuxent – Centennial Lake	**Sediment (Apr. 2002)** **Phosphorus (Apr. 2002)**
Patuxent River Upper	Sediment (Sept. 2011)
Patuxent River Upper – Brighton	Phosphorus (Nov. 2008) Sediment (Nov. 2008)
Patuxent River Upper – Rocky Gorge	Phosphorus (Nov. 2008) Sediment (Nov. 2008)
Chesapeake Bay	**Nitrogen (Dec. 2010)** **Phosphorus (Dec. 2010)** **Sediment (Dec. 2010)**

1.3.3 Chesapeake Bay Total Maximum Daily Load (TMDL)

The Chesapeake Bay TMDL, established by the EPA in 2010, sets pollution limits for nitrogen, phosphorus, and sediment in the Chesapeake Bay Watershed. These bay-wide pollution limits are a response to the slow progress by states within the watershed to limit their pollutants to levels which meet water quality standards in the Bay and its tidal tributaries. Total limits set in the Bay TMDL for the states of Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia are "185.9 million pounds of nitrogen, 12.5 million pounds of phosphorus and 6.45 billion pounds of sediment per year—a 25% reduction in nitrogen, 24% reduction in phosphorus and 20% reduction in sediment" (EPA 2010). The TMDL also sets "rigorous accountability measures" for state compliance.

When EPA established the Chesapeake Bay TMDL, a historic and comprehensive "pollution diet" for nutrients and sediment, it set forth rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region's streams, creeks, and rivers (EPA 2010). Concurrent with the development of the Bay TMDL, EPA charged the Bay watershed states and the District of Columbia with developing watershed implementation plans (WIPs) to provide adequate "reasonable assurance" that the jurisdictions can and will achieve the nutrient and sediment reductions necessary to implement the TMDL within their respective boundaries. Maryland's Phase 2-WIP provided a series of proposed strategies that will collectively meet the 2017 target (60% of the total nutrient and sediment reductions needed to meet final 2025 goals).

Stormwater runoff is a primary contributor of nutrients and sediment from watersheds in Howard County. Substantial nitrogen, phosphorus, and sediment reductions from stormwater runoff will be required to meet local and Chesapeake Bay TMDLs for these watersheds. (TMDLs for other pollutants will be addressed later.) The Chesapeake Bay TMDL analysis determined that a roughly 15% reduction in nitrogen and phosphorus loads from urban stormwater discharges in Howard County is necessary to meet Bay water quality standards. A roughly 20% reduction in sediment is needed from the urban portions of the watersheds to meet water quality standards in the local streams and rivers.

1.3.4 Pollutant Load Reduction Targets

Within Little Patuxent Watershed, the load reductions in sediment and nutrients needed within the urban portion of the watershed to achieve the reduction targets in the Chesapeake Bay and Local TMDLS are summarized in Table 1-3.

1.3.5 Howard County MS4 Permit

Howard County is one of five medium and five large municipalities in Maryland that are regulated by a Phase I MS4 permit (Section 402(p) of the Water Quality Act of 1987 and NPDES Permit Application Regulations for Storm Water Discharges of November 16, 1990). The Maryland State Highway Administration also is under an NPDES MS4 permit. Howard County's first permit went into effect on April 17, 1995.

Table 1-3. Watershed load reductions required by Chesapeake Bay and Local TMDLs for Little Patuxent Watershed (from wlat.mde.state.md.us/ByMS4.aspx)

River Basin/TMDL name	% Reduction	Baseline Year
Little Patuxent		
Bay Total Nitrogen	9.4	2009
Bay Total Phosphorus	17.2	2009
Bay Sediment	**	2009
Local Sediment	48.1	2005

** Bay sediment TMDL assumed met if TP target is met

Under Howard County's current MS4 permit (Permit Number 11-DP-3318, MD0068322, issued December 18, 2014), the County is required to develop Watershed Assessments and Restoration Plans to identify specific restoration opportunities to address pollutant reductions in approved TMDLs. One condition of the County's MS4 permit is implementation of TMDL load reduction allocations in the County's watersheds. This applies to all current local TMDLs, as well as any new TMDLs approved by EPA. Such new TMDLs could be developed for any watersheds in the County that have listed water quality impairments.

Specifically, the 2014 MS4 permit for Howard County (MDE 2014a) states:

> *Howard County shall annually provide watershed assessments, restoration plans, opportunities for public participation, and TMDL compliance status to MDE. A systematic assessment shall be conducted and a detailed restoration plan developed for all watersheds within Howard County. … watershed assessments and restoration plans shall include a thorough water quality analysis, identification of water quality improvement opportunities, and a schedule for BMP and programmatic implementation to meet stormwater WLAs included in EPA approved TMDLs.*

In concert with these efforts, the County has developed a Countywide Implementation Strategy (CIS). The CIS evaluates potential management recommendations and anticipated pollutant reduction strategies and is being updated concurrently with this watershed assessment. As described previously, several past watershed-specific plans have recommended restoration projects that have already been completed, while other restoration projects are currently being implemented.

These past and ongoing efforts contributed to the preparation of the current Watershed Assessment for the Little Patuxent Watershed, which was tailored to address the latest MS4 requirements. This assessment and plan were specifically designed to assess current water quality conditions and identify the most effective management measures to reduce stormwater pollutant loads to address both the Chesapeake Bay TMDL and local sediment TMDL in Little Patuxent Watershed. The assessment and plan have been developed in accordance with the new permit requirements and provides Howard County with a list of projects where restoration of impervious surface area can be achieved.

Howard County's MS4 permit, PART IV.E.1, includes the following provisions regarding watershed assessments:

a. *By the end of the permit term, Howard County shall complete detailed watershed assessments for the entire County. Watershed assessments conducted during previous permit cycles may be used to comply with this requirement, provided the assessments include all of the items listed in PART IV.E.1.b below. Assessments shall be performed at an appropriate watershed scale (e.g., Maryland's hierarchical eight or twelve-digit sub-basins) and be based on MDE's TMDL analysis or an equivalent and comparable County water quality analysis.*

b. *Watershed assessments by the County shall:*

   i. *Determine current water quality conditions;*

   ii. *Include the results of a visual watershed inspection;*

   iii. *Identify and rank water quality problems;*

   iv. *Prioritize all structural and nonstructural water quality improvement projects; and*

   v. *Specify pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs.*

The permit also requires an impervious area assessment, prepared by the County, which sets the target for treatment of 20% of the County's impervious area that has not been treated to the Maximum Extent Practicable (MEP). This target was considered in development of the watershed plan, such that the benefits of implementing individual projects were computed in terms of impervious acres treated, or equivalent acres treated, as per MDE guidance (MDE 2014c), and the suite of recommended projects is able to be evaluated against the 20% goal.

In the permit, PART IV.E.2.b includes the following specifications for restoration plans:

b. *Within one year of permit issuance, Howard County shall submit to MDE for approval a restoration plan for each stormwater WLA approved by EPA prior to the effective date of the permit. The County shall submit restoration plans for subsequent TMDL WLAs within one year of EPA approval. Upon approval by MDE, these restoration plans will be enforceable under this permit. As part of the restoration plans, Howard County shall:*

   i. *Include the final date for meeting applicable WLAs and a detailed schedule for implementing all structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives necessary for meeting applicable WLAs;*

   ii. *Provide detailed cost estimates for individual projects, programs, controls, and plan implementation;*

   iii. *Evaluate and track the implementation of restoration plans through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs; and*

iv. *Develop an ongoing, iterative process that continuously implements structural and nonstructural restoration projects, program enhancements, new and additional programs, and alternative BMPs where EPA approved TMDL stormwater WLAs are not being met according to the benchmarks and deadlines established as part of the County's watershed assessments.*

This report provides details on the methods and results of a comprehensive process for identifying, assessing, and prioritizing existing and new restoration opportunities in the Howard County portion of the Little Patuxent Watershed.

The CIS described previously in this section will serve to meet the requirement for a restoration plan.

1.4 Report Structure

This report documents the process employed for identifying, assessing, and prioritizing existing and new restoration opportunities in the Howard County portions of the Little Patuxent Watershed. The report is organized into seven chapters along with four appendices, each highlighting an aspect of the overall project.

Chapter 1: Introduction provides context for the project and describes the regulatory drivers for watershed assessment and pollutant reduction planning, as well as the overall structure of this report.

Chapter 2: Assessment of current watershed condition highlights key information regarding the condition of the Little Patuxent Watershed. This condition includes information about physical characteristics such as impervious cover, existing stormwater BMPs, and assessments of stream biota and habitat, e.g., the Benthic Index of Biotic Integrity (BIBI) and Rapid Bioassessment Protocol (RBP) habitat assessments. This chapter also provides background information about the Little Patuxent Watershed and brief summary information from previous assessments completed in the study area. Finally, it describes the five types of potential restoration opportunities considered in this study for assessment, ranking, prioritization, and estimated pollutant load reduction. These restoration opportunity types are (1) BMP conversion, (2) proposed new BMPs, (3) tree planting, (4) stream restoration, (5) outfall stabilization.

Chapter 3: Desktop analysis explains the process used to synthesize and analyze past data in order to select sites for field investigation. It also describes the creation of a geodatabase to be populated by consultant teams in the field.

Chapter 4: Field assessments delves into the field work methodology, calibration, and QA/QC employed by consultant teams conducting the fieldwork within the geographic scope of this study. Assessment data, including the desktop revisits of previously assessed sites and public

input/feedback, are reported for each of the five types of potential restoration opportunities in the Little Patuxent Watershed, and are depicted spatially and in tabular form.

Chapter 5: Restoration project ranking and prioritization sequences the steps and results of scoring and ranking individual potential restoration opportunities among all the individual opportunities of that type (e.g., BMP conversions, new BMPs, etc.). Further, this chapter details the scoring and comparative ranking of individual opportunities across all five types of potential restoration for prioritization. By identifying the high priority opportunities, this process produced a more limited set of candidates for development of Concept Plans, which are included as four-page summaries in Appendix H.

Chapter 6: Pollutant load modeling reports the calculations of potential pollutant loading reductions. Pollutant loads for nitrogen, phosphorus, and sediment were modeled at the planning level for the Little Patuxent Watershed. Anticipated pollutant load reductions for the Little Patuxent Watershed were modeled for both the Chesapeake Bay TMDL and the local TMDL for sediment.

Chapter 7: References documents other works cited throughout the report.

Appendices: Additional details are provided in nine appendices. These include:

A. Inventory of GIS Data
B. Descriptions of BMP Types
C. Field Protocols and Data Collection Guide
D. Electronic Data Collection Protocols
E. Landowner Notification Letter
F. Field Reports from Consultant Field Teams
G. Tables Listing Individual Retrofit and Restoration Opportunities, with Scores and Rankings
H. Individual Concept Plans for Top-ranked Opportunities
I. Stormwater BMP Conversions and New Stormwater BMPs Proposed for the Little Patuxent Watershed and Potential Pollutant Load Reductions, for Individual Sites

2. ASSESSMENT OF CURRENT WATERSHED CONDITIONS

This chapter describes the current conditions in the Little Patuxent Watershed, including information from geographic information system (GIS) data and existing stream monitoring efforts. GIS data were compiled from Howard County and other sources for use throughout the watershed assessment and planning process; see Appendix A for an inventory of GIS data gathered. The initial watershed characterization and desktop assessment step is described in this chapter. Subsequent chapters detail the remaining steps of the project, for which GIS was integral: GIS screening analysis to select sites for field visits, planning and conducting field investigations, prioritization of restoration opportunities identified, and development of concept plans.

2.1 General Information

Little Patuxent Watershed in Howard County (Figure 2-1) encompasses an area of 59 square miles (37,727 acres). The watershed includes 9,688 impervious acres, 9,043 acres of woods, and 190 miles of streams.

2.2 Impervious Surfaces

Studies have shown a correlation between the amount of impervious surface within a watershed and stream quality (e.g., Schueler et al. 2009). Impervious surfaces, including roads, parking areas, roofs, and other paved surfaces, prevent precipitation from naturally infiltrating the ground. This prohibits the natural filtration of pollutants and conveys concentrated, accelerated stormwater runoff directly to the stream system. Consequently, stormwater runoff from impervious surfaces can cause stream erosion and habitat degradation from the high energy flow. Furthermore, such runoff is likely more polluted than runoff generated from pervious areas.

Percent impervious cover is the most commonly used single measure of urban impacts to streams. Schueler (2008) defines the following general categories, using the Impervious Cover Model (Figure 2-2, adapted from Schueler et al. 2009) describing the general relationship between the amount of impervious cover in a watershed and stream quality:

- Sensitive Streams: 2 - 10% impervious cover
- Impacted: 10 - 24%
- Damaged (Non-Supporting): 25 - 59%
- Severely Damaged (Urban Drainage): 60% or more

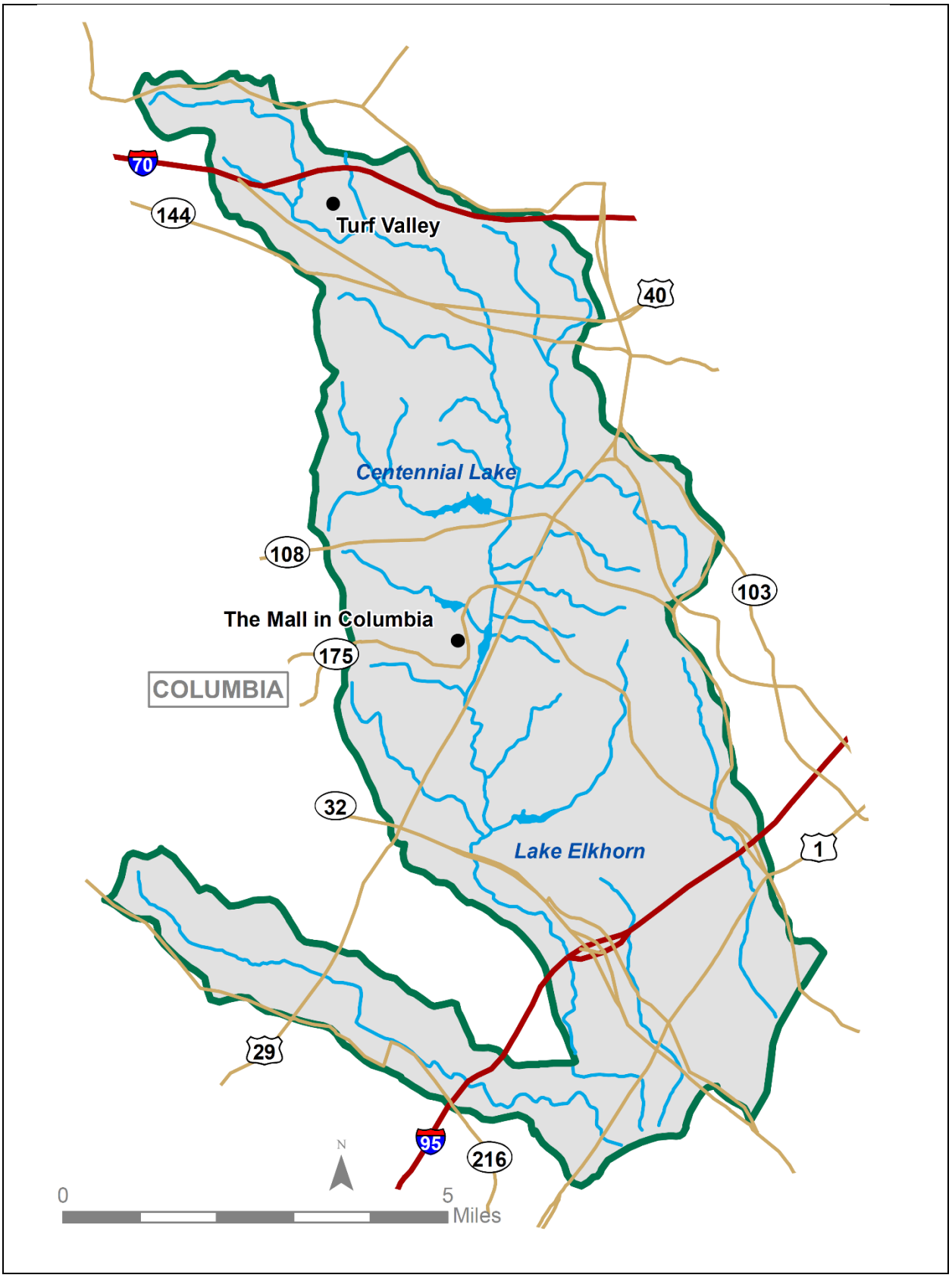


Figure 2-1. Little Patuxent River Watershed in Howard County, Maryland

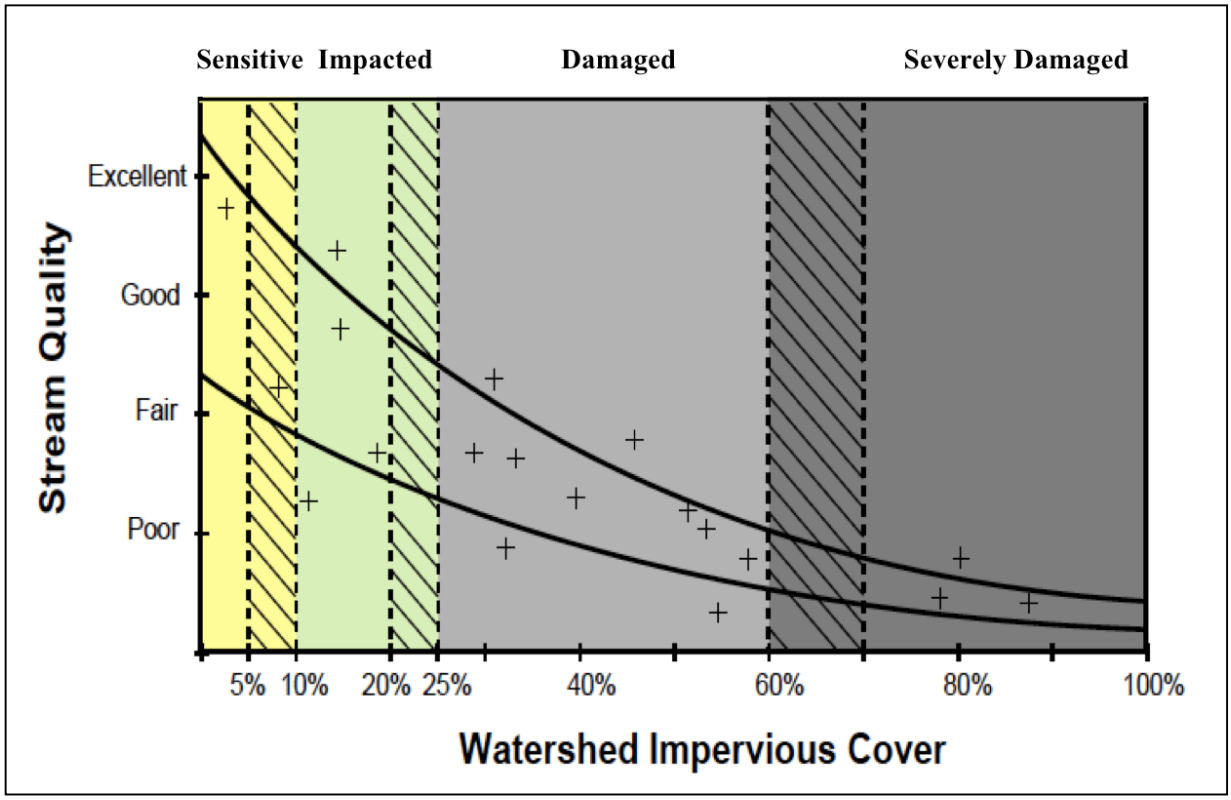


Figure 2-2. Impervious Cover Model (adapted from Schueler et al. 2009)

Howard County's impervious cover data were used to map and quantify impervious cover within the Little Patuxent Watershed (Figure 2-3). The 2014 impervious layer, based on 2013 planimetric data, includes roads, parking lots, driveways, major buildings, bridge decks, sidewalks, pathways, and swimming pools. In all, impervious cover represents about 25.6% of the Little Patuxent Watershed.

While the Impervious Cover Model provides a general indication of stream conditions under varying degrees of impervious cover, it does not explicitly account for the effectiveness of BMPs that are in place to treat runoff from those impervious areas. Existing BMPs provide treatment of water quantity and/or quality for much of the developed, impervious area in Little Patuxent. According to recent Howard County data, there are 1,746 stormwater BMPs treating approximately 47% of the impervious area in Little Patuxent Watershed. Figure 2-4 shows impervious cover and areas treated by existing BMPs (based on BMP drainage areas available in Howard County's database, as of June 2015).

Howard County's current MS4 permit requires restoration of an additional 20% of impervious cover, countywide, not already restored to the MEP. Following MDE guidance (MDE 2014c), impervious cover not restored to the MEP can be defined, in practice, as any impervious acres not draining to BMPs constructed after 2001. After 2002, Maryland regulations and local ordinances began requiring BMPs to address a specific suite of volumes equivalent to providing water quality treatment to the MEP.

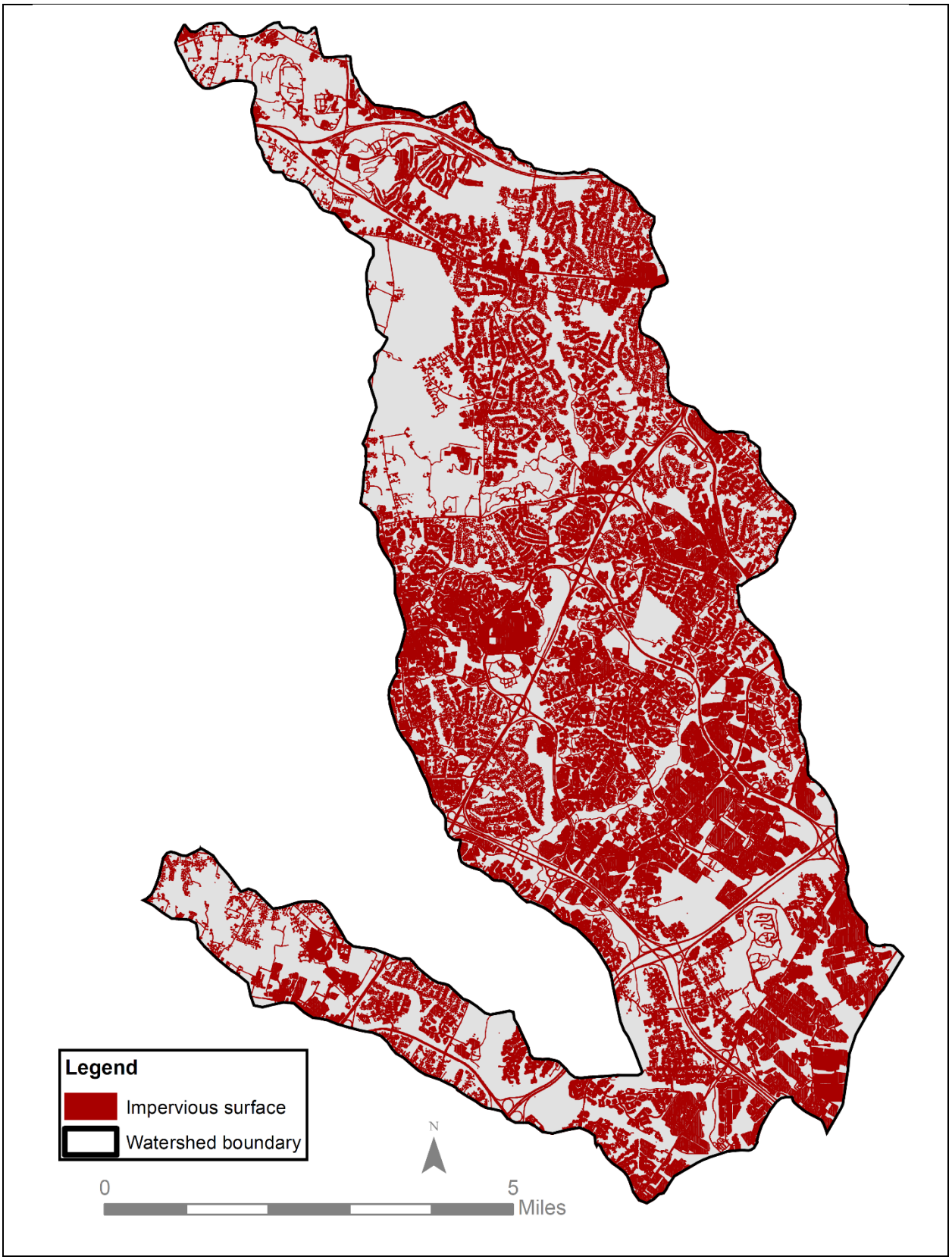


Figure 2-3. Impervious surface in Little Patuxent Watershed (Howard County 2014 impervious data)

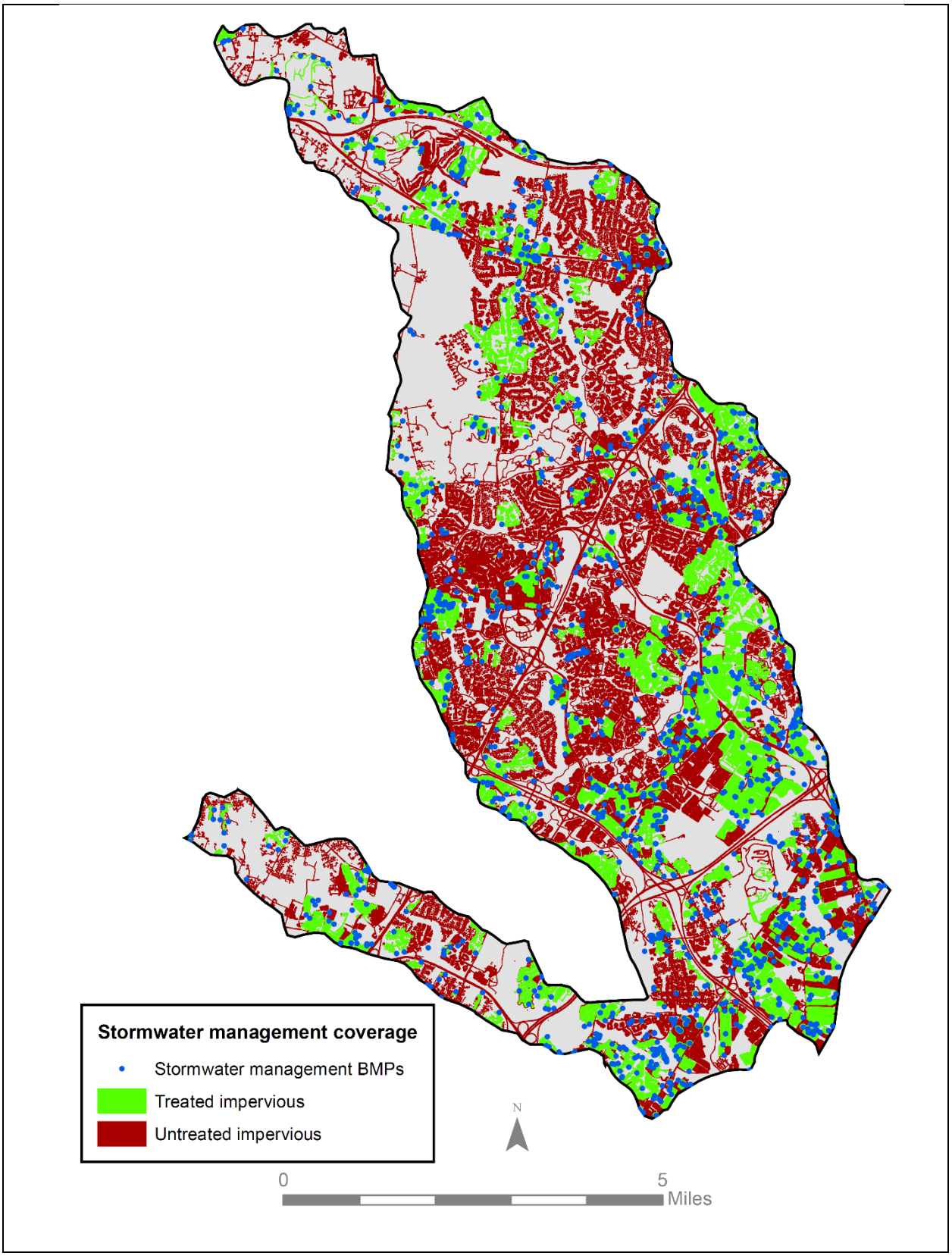


Figure 2-4. Treated and untreated impervious surface in Little Patuxent Watershed, along with stormwater BMP locations

2.3 Land Use

Land use within Little Patuxent Watershed was derived from Maryland Department of Planning, 2010 data (Figure 2-5). Residential land use makes up the largest proportion of area (41.0%), followed by commercial/industrial/institutional use (18.6%), primarily in the southern half of the watershed. Forest cover makes up 21.1% of the watershed area, much of that along stream corridors and the Little Patuxent mainstem.

Future land use will be influenced by zoning (Figure 2-6). The area is largely planned for development, including a predominance of residential and commercial uses, as well as the New Town designation for the planned community of Columbia in the central part of the watershed. Some areas in the northern part of the Little Patuxent Watershed and the upper part of Hammond Branch are designated as Rural Residential.

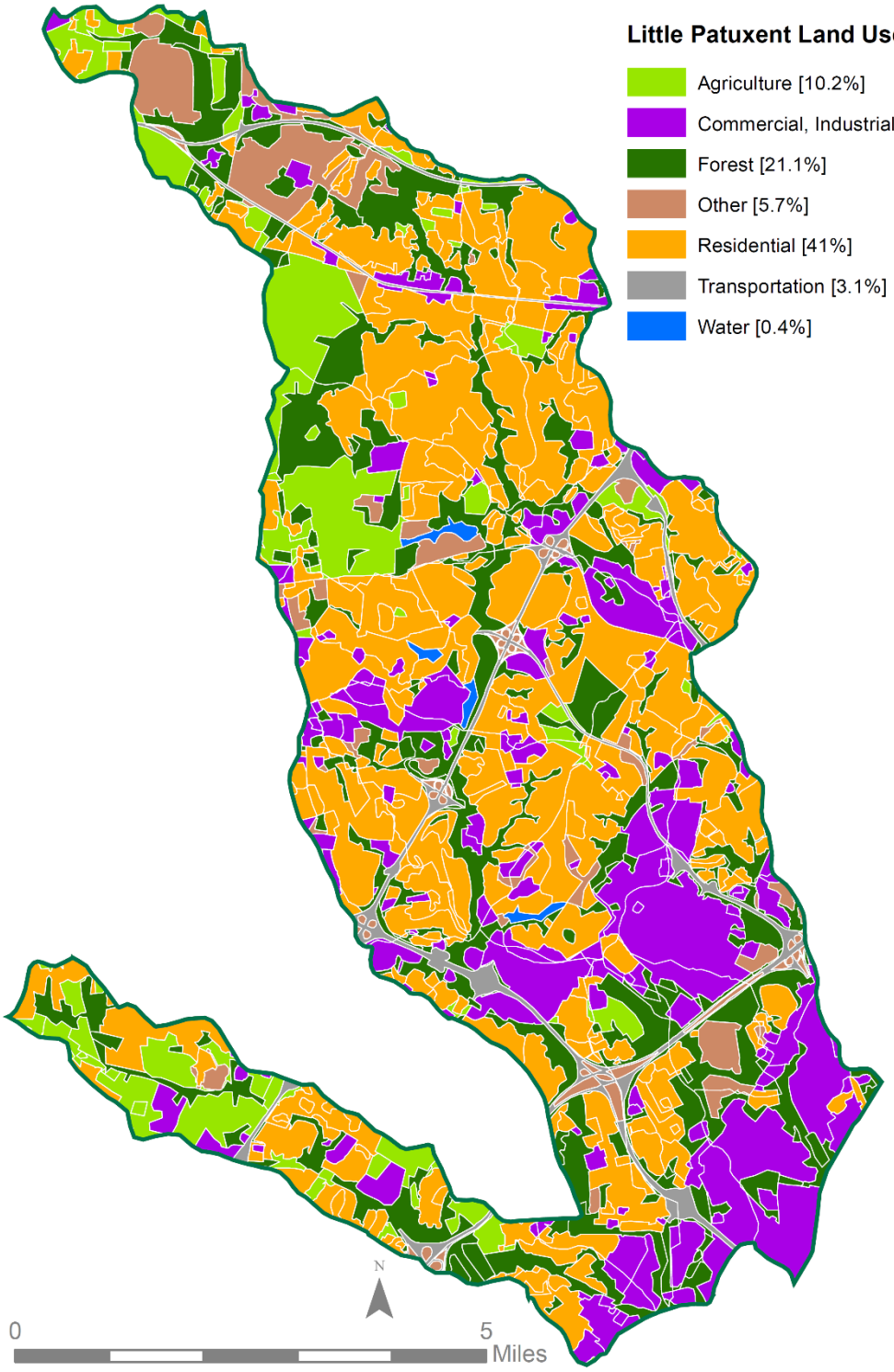
2.4 Soils

Soil conditions are important when evaluating how a watershed affects water quantity and quality in streams and rivers. Soil type and moisture conditions impact how land may be used and its potential for infiltration or various types of plants. Howard County's GIS soils layer was used for the soils data analysis and is a representation of the Howard County Soil Survey.

The Natural Resource Conservation Service (NRCS) classifies soils into four hydrologic soil groups based on runoff potential. Runoff potential refers to the tendency of soils to produce surface runoff; it is the opposite of infiltration capacity (i.e., the ability for the soil to absorb precipitation). Soils with high infiltration capacity will have low runoff potential, and vice versa. Infiltration rates are highly variable among soil types and are also influenced by disturbances to the soil profile (e.g., land development activities). For example, urbanization in watersheds with high infiltration rates (e.g., sands and gravels) will have a greater impact than urbanization in watersheds consisting mostly of silts and clays, which have low infiltration rates. Factors that affect infiltration rate include soil permeability (influenced mostly by texture and structure), slope, degree of soil saturation, and percentage of leaf litter cover. The four hydrologic soil groups are A, B, C, and D, where group A soils generally have the lowest runoff potential and Group D soils have the greatest.

Brief descriptions of each hydrologic soil group are provided as follows. Further explanation of each can be found in the U.S. Department of Agriculture (USDA)/NRCS publication, Urban Hydrology for Small Watersheds, also called Technical Release 55 (USDA 1986).

- Group A soils include sand, loamy sand, or sandy loam types. These soils have a high infiltration rate and low runoff potential even when thoroughly wet. These consist mainly of deep, well to excessively drained sands or gravel. These soils have a high rate of water transmission.



Group B soils include silt loam or loam types. They have a moderate infiltration rate when thoroughly wet. These soils mainly consist of somewhat deep to deep, moderately well to

Figure 2-5. Land use in Little Patuxent Watershed

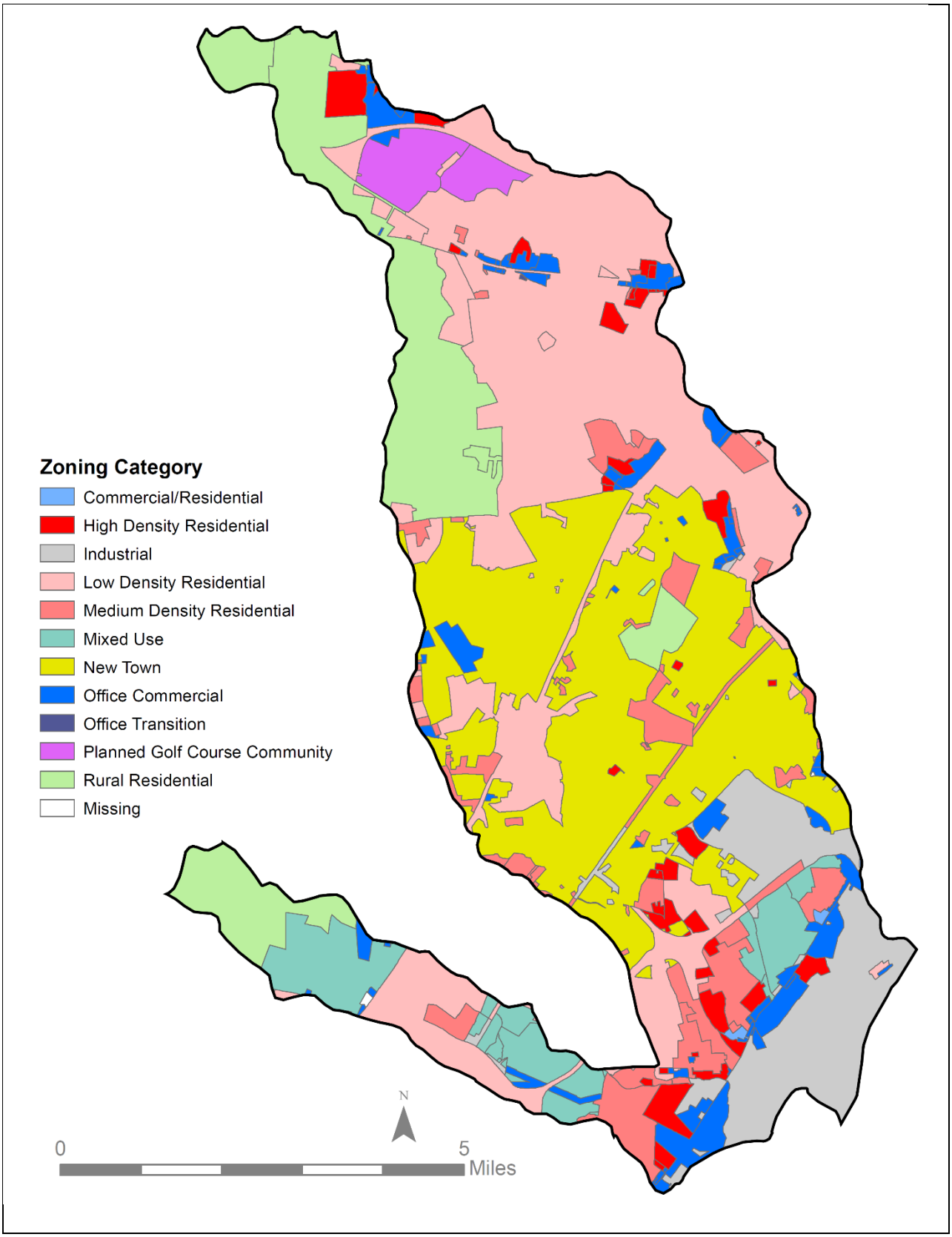


Figure 2-6. Zoning in Little Patuxent Watershed

well drained soils with moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

- Group C soils are sandy clay loam. These soils have a low infiltration rate when thoroughly wet. These types of soils typically have a layer that hinders downward movement of water and soils with moderately fine or fine texture. These soils have a low rate of water transmission.
- Group D soils include clay loam, silty clay loam, sandy clay, silty clay, or clay types. These soils have a very low infiltration rate and high runoff potential when thoroughly wet. These consist mainly of clays with high swell potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission.

As shown in Figure 2-7, the majority of area in the Little Patuxent Watershed falls into soil groups with higher runoff potential, in hydrologic groups C and D. The low infiltration rates of these soils mean that they are more susceptible to flooding and provide a poor porous medium for stormwater ponds and Environmental Site Design (ESD) opportunities, so opportunities should be considered carefully, using local-scale information. Some parts of the Upper Little Patuxent and the upper part of Hammond Branch have a predominance of better drained, B soils.

2.5 Stream Condition

Howard County conducts biological monitoring at randomly selected stations in its Countywide monitoring program which began in 2001. The Little Patuxent Watershed consists of the Lower Little Patuxent, Middle Little Patuxent, Upper Little Patuxent subwatersheds, as well as Dorsey Run and Hammond Branch. With the exception of Hammond Branch and Dorsey Run, which were last sampled in 2009, the watershed was sampled most recently in 2013. In addition, the Maryland Department of Natural Resources (DNR) Maryland Biological Stream Survey (MBSS) has performed stream monitoring statewide since 1995, using similar monitoring methods as the County. Since 2000, the DNR Stream Waders volunteer program has performed benthic macroinvertebrate monitoring throughout the County. The results of all of these assessments are shown in Figure 2-8.

Of the 281 sites in Little Patuxent Watershed, only 10 (4% of sites) were in Good condition, 31 (11%) were rated Fair, 79 (28%) were rated Poor, and 160 (57%) rated Very Poor. Some good sites were found in the Upper Little Patuxent subwatershed and upper reaches of Hammond Branch. However, most sites in Lower Little Patuxent subwatershed and Dorsey Run were in poor to very poor condition.

Stream habitat condition was also evaluated by Howard County using EPA's Rapid Bioassessment Protocol (RBP) for habitat assessment. Of the 124 sites assessed (Figure 2-9), only one site (less than 1% of sites) was rated as comparable to reference condition (the highest scoring category). Seventeen (14%) sites were rated as supporting, 48 (39%) as partially supporting, and 58 (47%) as not supporting (the lowest scoring category), indicating that many streams in the Little Patuxent Watershed show evidence of habitat degradation.

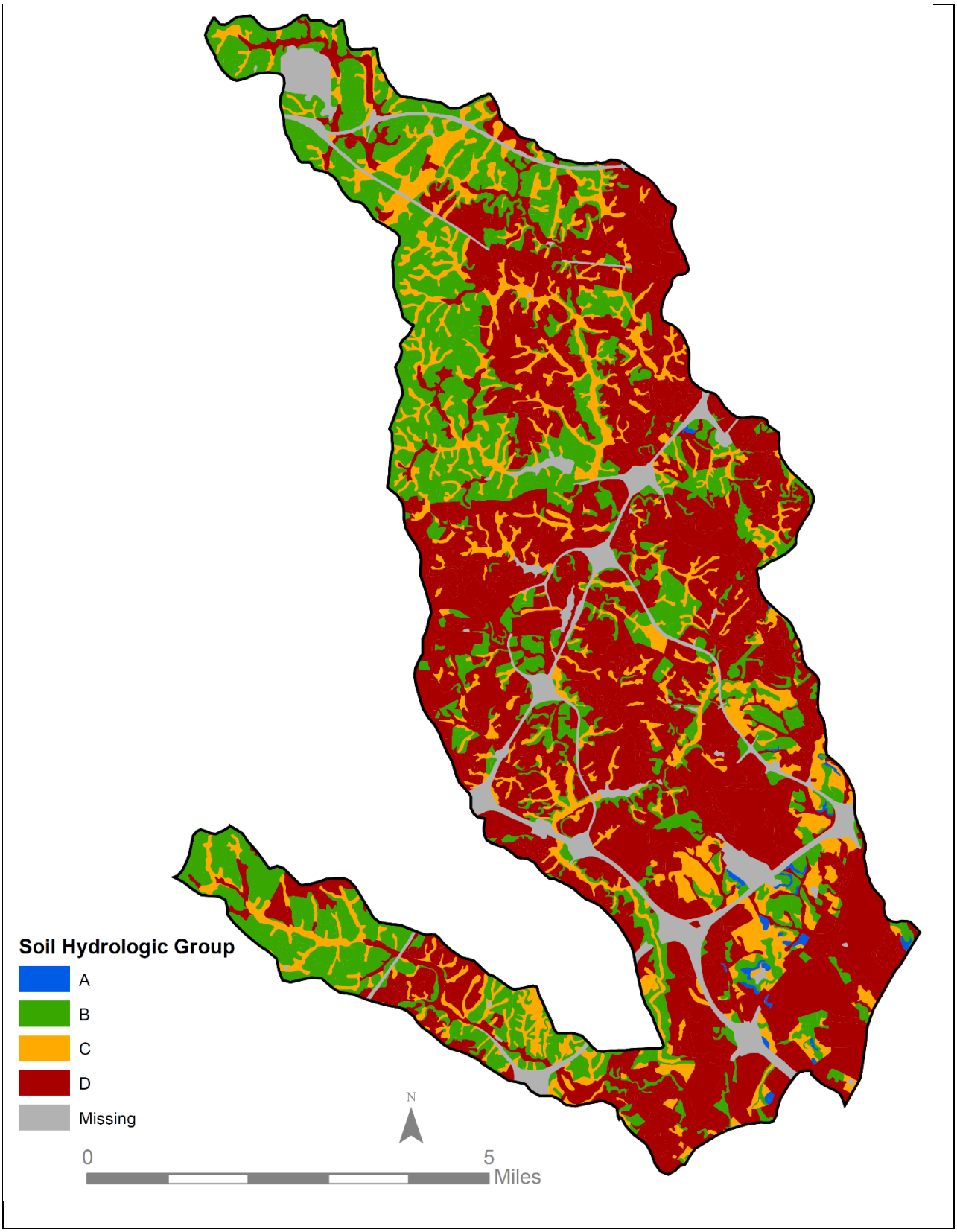


Figure 2-7. Soil hydrologic groups in Little Patuxent Watershed

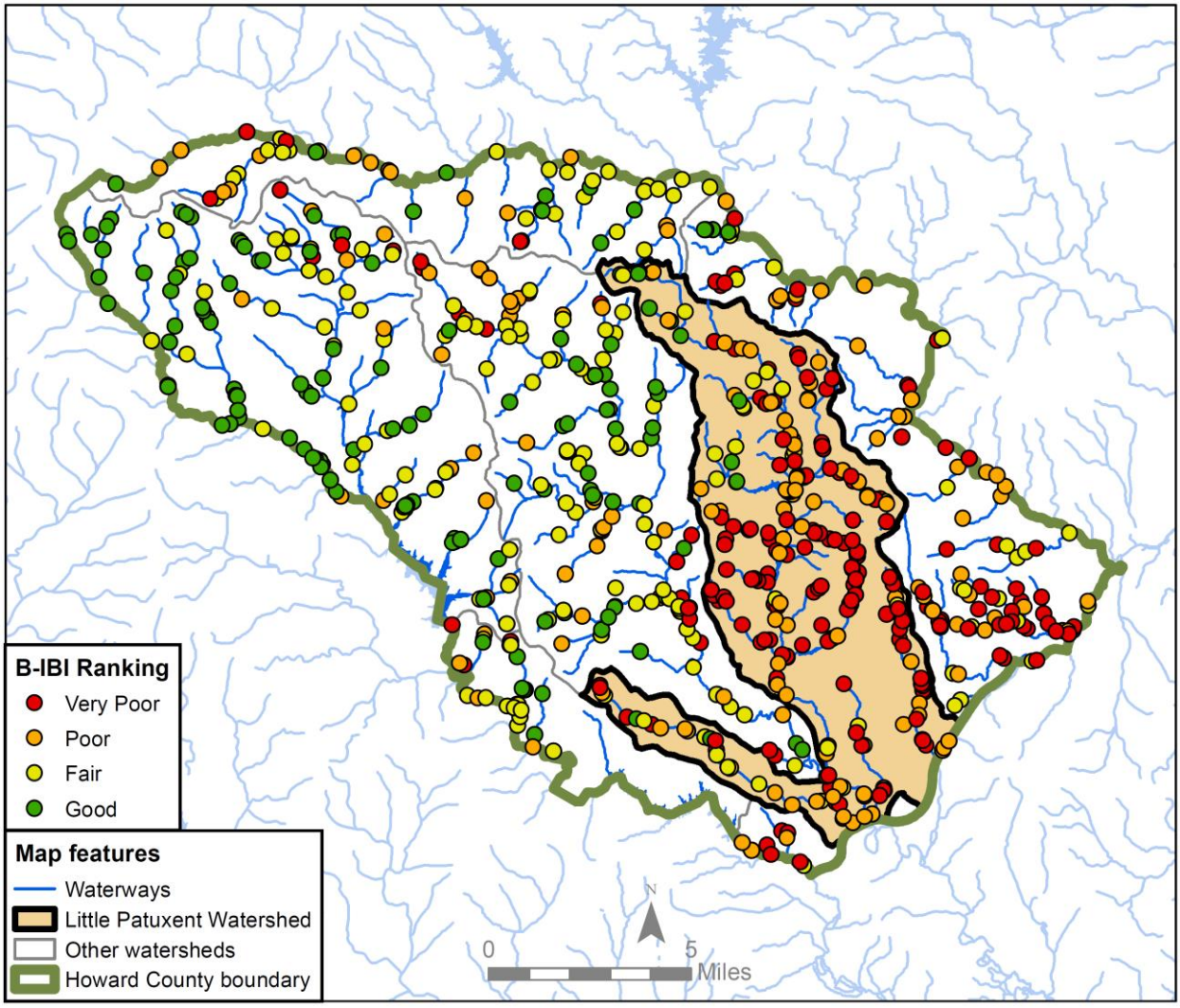


Figure 2-8. Benthic Index of Biotic Integrity ratings, at sites assessed by Howard County, MBSS, and Stream Waders in Little Patuxent Watershed, 1995 - 2013

While stream conditions vary across the county, degradation is more prevalent in the heavily developed urban areas. This reflects the history of urban and suburban development prior to effective stormwater management regulations. Watershed condition is generally better in the more rural parts of the county, but stream degradation still occurs in these areas as a result of large lot development and agricultural impacts. By reducing the adverse effects of stormwater runoff throughout the county, the process of watershed assessment, restoration planning, and implementation of prioritized BMPs should improve the water quality condition in Little Patuxent Watershed over time.

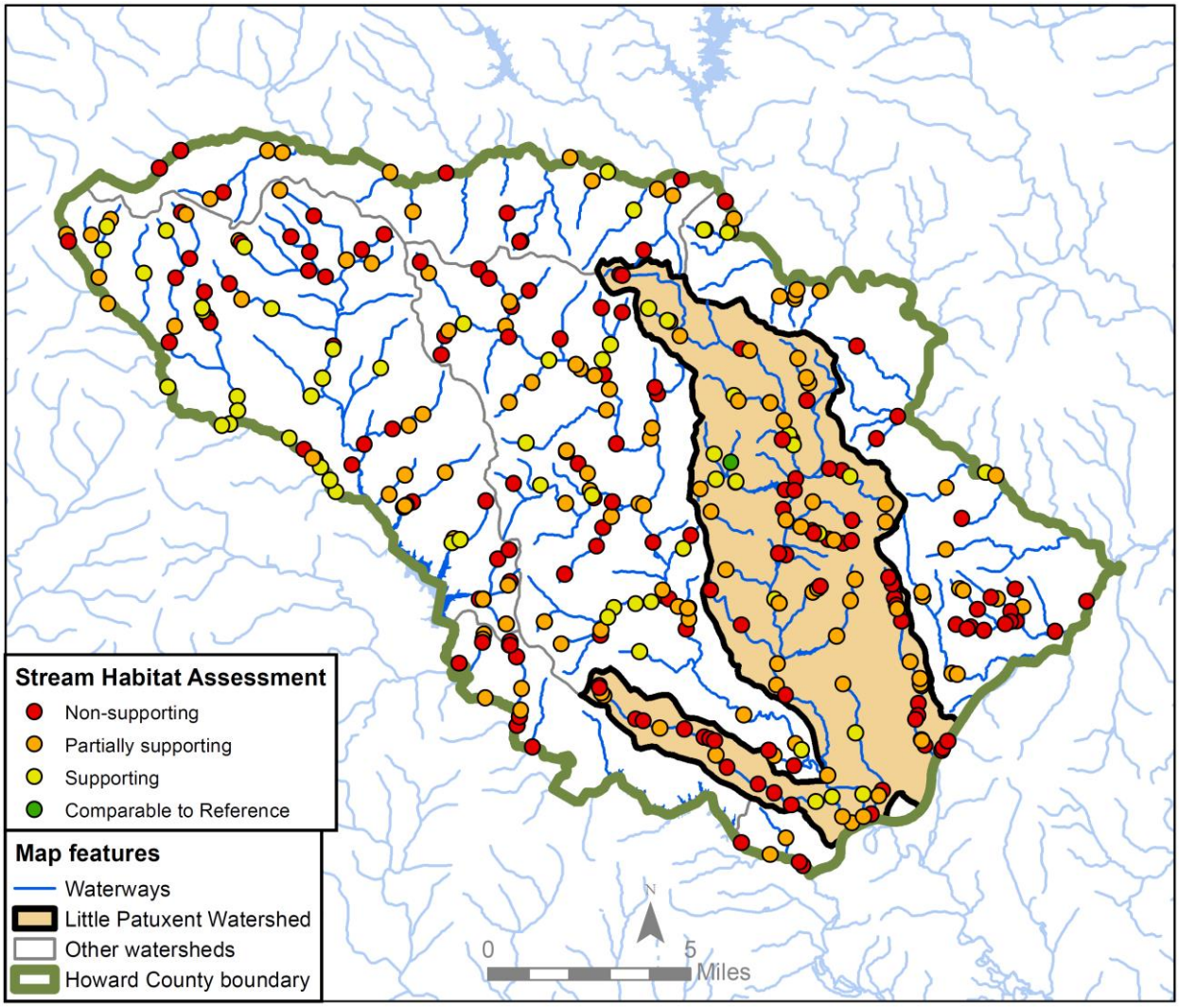


Figure 2-9. Habitat Assessments based on Rapid Bioassessment Protocol for habitat, at sites monitored by Howard County in Little Patuxent Watershed, 2003-2013

2.6 Previous Assessments Completed in the Study Area

As previously described, Howard County has been developing inventories of restoration projects since 1999. These include individual projects, some of which have already been completed, and others identified in the following watershed plans that covered portions of the Little Patuxent Watershed:

Stream Corridor Assessment (SCA) of the Little Patuxent River (Maryland DNR 2001)

A SCA was conducted as part of an overall assessment of the condition of the Little Patuxent Watershed and the streams within it. The assessment identified 1,090 environmental problems within the watershed, which included pipe outfalls, tree blockages, inadequate buffers, erosion sites, fish blockages, channel alterations, exposed pipes, unusual conditions, trash dumping, and

in/near stream construction. A total of 229 ponds and 89 representative habitat sites were also documented during the assessments. This study excluded the Dorsey Run and Hammond Branch subwatersheds, but similar SCA studies were conducted in these subwatersheds in 2003 and documented 126 and 195 environmental problems, 56 and 31 pond sites, and 15 and 25 representative habitat sites, respectively. GIS data for all environmental problems, ponds, and representative sites were available for the desktop analysis portion of this Little Patuxent Watershed assessment study.

Centennial Lake and Wilde Lake in Little Patuxent (CWP/TetraTech 2005)

A watershed management plan was developed for the Centennial Lake and Wilde Lake Watersheds in 2005 as a result of a watershed prioritization study conducted under Howard County's June 2000 to June 2005 NPDES permit term. A combination of field reconnaissance and public input resulted in specific restoration and protection efforts being recommended for each of the watersheds. For the Centennial Lake Watershed, the final proposed restoration projects included over 1 mile of forested stream restoration through two floodplain reconnection projects, and a series of stream buffer restoration projects, the creation of 10 to 12 acres of forested wetlands, the creation of 0.5 acre of meadow buffer restored around the lake, and the implementation of 8 stormwater retrofits to treat approximately 18 acres of untreated impervious area. For the Wilde Lake Watershed, the final proposed projects included approximately 0.5 mile of stream restoration/rehabilitation, and the implementation of 15 to 20 priority stormwater retrofits for 40 to 50 acres of untreated or poorly treated impervious area. GIS data for features collected during field assessments and the final project recommendations were available for the desktop analysis portion of this Little Patuxent Watershed assessment study.

Downtown Columbia (Biohabitats 2008, for General Growth Properties,)

Watershed assessments were conducted in the Symphony Stream and Lake Kittamaqundi Watersheds in 2008 in order to identify stormwater retrofit and riparian corridor restoration opportunities. Assessments were conducted on more than 60 stormwater retrofit sites throughout the two watersheds, which resulted in 49 BMP conversion and new BMP recommendations. Additionally, more than two miles of stream assessments were conducted throughout the two watersheds, which resulted in 10 riparian corridor restoration recommendations. GIS data for the final retrofit and restoration sites were available for the desktop analysis portion of this Little Patuxent watershed assessment study.

Lake Elkhorn in Little Patuxent (Versar 2009, for Columbia Association)

During 2008 and 2009 a watershed assessment was conducted in the Lake Elkhorn Watershed in conjunction with the Columbia Association (CA) Columbia Watershed Management Plan. RRI assessments were conducted at 24 sites within the Lake Elkhorn Watershed and resulted in the development of 18 concept plans. Concept plans consisted of BMP conversion, new BMP, and stream restoration sites. Approximately 30 reforestation sites on CA and public land were also identified during the study. GIS data for all sites investigated during the course of the study were available for the desktop analysis portion of this Little Patuxent Watershed assessment study.

Upper Little Patuxent (KCI 2009)

A watershed management plan was developed for the Upper Little Patuxent Watershed in 2009 as a result of impervious area restoration requirements outlined in Howard County's June 2005 NPDES permit. RRI assessments and desktop analysis of reforestation sites identified 184 candidate project sites, which included a combination of BMP conversions, new BMPs, stream restorations, outfall stabilizations, and reforestation plantings. Concept plans were developed for high priority sites, which included 17 pond conversions, 17 new bioretention areas, 7 new ponds/shallow marshes, 15 stream restoration/outfall stabilization projects, and 22 reforestation projects. GIS data for all sites investigated during the course of the study, including SCA data collected by the U.S. Army Corps of Engineers, were available for the desktop analysis portion of the Little Patuxent Watershed assessment.

In 2013, Howard County completed the following two countywide surveys for potential restoration projects:

Howard County LID Retrofits and Tree Planting Study (Versar 2013a)

In 2012 and 2013 Howard County conducted a study to identify Low Impact Development (LID) opportunities on Howard County-owned properties, including Board of Education land, in order to meet NPDES permit and Chesapeake TMDL impervious area treatment and pollutant load reduction obligations. RRI assessments were conducted at 80 sites throughout the County. Concept plans were developed for 34 unique LID (or micro-BMP) opportunities on 22 different parcels. These LID projects would treat 73 acres, including 42 acres of impervious cover. In addition to the LID projects, 32 tree sites were selected for tree planting projects. GIS data for all sites investigated during the course of the study were available for the desktop analysis portion of this Little Patuxent Watershed assessment study.

Howard County Dry Pond and Extended Detention Pond Retrofits Study (Versar 2013b)

In 2012 and 2013 Howard County conducted a study to identify existing private and public flood control dry-ponds and existing extended detention flood control ponds that could be upgraded to provide or enhance water quality control, in order to meet NPDES permit and Chesapeake TMDL impervious area treatment and pollutant load reduction obligations. RRI assessments were conducted at 140 ponds throughout the County. Concept plans were developed for 52 ponds, which treat 1,184 acres, including 343 acres of impervious cover. GIS data for all sites investigated during the course of the study were available for the desktop analysis portion of this Little Patuxent Watershed assessment study.

2.7 Best Management Practices: Opportunities for Retrofit and Restoration

There were five types of retrofit and restoration opportunities considered for the current watershed assessment: (1) upgrading or retrofitting existing BMPs, (2) proposing new BMPs, (3) planting trees, (4) restoring streams, and (5) stabilizing storm drain outfalls. Howard County

has implemented BMPs and other watershed management practices since the 1980s. The initial focus of stormwater management was detention of large flows to reduce flooding. Subsequent designs addressed water quality treatment and stream channel protection in accordance with revised State and County design criteria. Most recently, "green" BMPs known as ESD or green stormwater infrastructure are being encouraged for new development and to facilitate restoration of watersheds. Maryland stormwater regulations for new and re-development will require that stormwater management provide for control of water quantity and quality using the latest guidelines.

The following categories of stormwater and watershed management practices were considered in this watershed assessment study as the major strategies to address Howard County's local and Chesapeake Bay TMDL goals and NPDES MS4 impervious surface area restoration requirements. Each has the potential to yield quantifiable benefits in stormwater quality and in quantity control for channel protection and flooding.

1. Conversion of dry ponds and extended detention dry ponds to modern facilities with greater pollutant removal efficiencies, which include:

    - Extended detention dry ponds (if dry pond is present and no other viable option is available)
    - Extended detention wet ponds / wetlands (ED, WP), shallow wetlands
    - Bioretention
    - Non-bioretention filtering practices
    - Infiltration practices
    - Swales
    - Addition of pre-treatment or post-treatment BMPs within existing dry or wet pond boundaries
    - New BMP retrofits outside of existing dry or wet pond boundaries but which would drain into an existing pond or capture and treat stormwater just outside of the existing pond (e.g. step pool conveyance).

2. Retrofitting untreated impervious with new stormwater BMP facilities, which include:

    - Extended detention dry ponds
    - Extended detention wet ponds / wetlands (ED, WP), shallow wetlands
    - Bioretention
    - Non-bioretention filtering practices
    - Infiltration practices
    - Swales
    - Green roofs
    - Replacement of impervious cover with pervious pavement
    - Impervious cover removal

- Rain barrels
- Rain gardens
- Rooftop disconnection

3. Reforestation of stream buffers and upland areas
4. Restoring degraded stream channels for erosion control and enhanced nutrient processing
5. Restoring degraded ephemeral and intermittent outfall channels through stabilization techniques which include:
    - Rip Rap stabilization
    - Step Pool Stormwater Conveyance (SPSC) / Regenerative Stormwater Conveyance (RSC) stabilization
    - Installing a drop structure or other stabilization of the outfall channel

2.7.1 BMP Conversions

Stormwater pond conversions can include the following general options for the re-design of existing stormwater ponds to provide additional water quantity control or water quality treatment:

- Increasing storage capacity by additional excavation.
- Providing water quality treatment features at facilities that currently have only water quantity control, if the space is available. Examples include: micropools, sediment forebays, or constructed stormwater wetlands.
- Modifying or replacing existing outlet controls to reduce the discharge rate from the stormwater management facility.
- Where soil types are appropriate, adding infiltration (sometime referred to as exfiltration) features to promote groundwater recharge and improve pollutant removal.
- Where water quality flows can be split or separated from larger events, vegetated areas with engineered soils and underdrain, referred to as bioretention, can sometimes be retrofit into an existing pond as pretreatment or post treatment and yield a significant increase in pollutant removal efficiency.
- Installing proprietary settling, filtering or hydrodynamic devices in parking lots or other areas with a large percentage of impervious area to trap sediments, trash and petroleum products before they flow into a pond. These tend to have low pollutant removal efficiencies but can be good options in the highly urban context, particularly where subterranean treatment is the only option.

Specifically, the following types of conversions are recommended.

- ***Conversion of Dry Stormwater Management Detention Ponds*** to extended detention dry ponds or extended detention wet pond/wetlands or conversion to ponds with infiltration capability, where soils permit. These BMPs typically treat the largest area of impervious

cover because they have the largest drainage areas and were originally built as a low cost option for flood control, channel protection and/or water quality control. Conversion of these existing devices is among the most cost effective of pollutant reduction measures because the existing ponds do not require acquisition of new property, the pipe infrastructure is already in place, most of the excavation is already complete, maintenance responsibilities and easements have already been established and because stormwater flows already concentrate at these devices. Pollution reduction credits may depend on specific design characteristics affecting both runoff time and treatment. Possible constraints regarding these options include acceptance by local residents and pond owners of the proposed pond's aesthetics, the revised maintenance, and the costs.

- Dry and Wet Extended Detention (ED) Basins are depressions that temporarily store ("detain") runoff and release it at a prescribed rate via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ED ponds, which contain standing water permanently. As such, they (ED type) are similar in construction and function to simple dry or wet detention basins which are primarily for flood control or channel protection, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness by increasing residence time of pollutants which encourages settling of sediments and allows more time for biological and physical processing of nutrients.
- Urban Infiltration Practices are depressions created to allow the collection and infiltration of stormwater in order to trap sediments and nutrients in soil media and simultaneously recharge groundwater aquifers. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Infiltration basins and trenches cannot be constructed on poor soils, such as C and D soil types. These urban infiltration practices may include vegetation and sand which increases the removal of phosphorus by 5% on average compared to infiltration practices without sand or vegetation.

2.7.2 New BMPs

New stormwater management features involve placing new stormwater management ponds, including extended detention dry ponds, urban infiltration ponds, and constructed wetlands and wet ponds at locations that currently have no stormwater quantity or quality controls or where existing BMPs are inadequate and where space is available for a new BMP. Ponds are the traditional method of controlling stormwater flows and the opportunity to retrofit new SWM ponds is not common in the developed environment. However, the resulting benefits to flow volume, velocity control, and water quality improvement can be significant. Benefits may vary depending on the specific design features of the individual ponds.

Micro-BMPs (LID) include the use of innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source. Distributed Micro-BMPs features are a series of smaller landscape features that function as retention/detention areas integrated with developed areas. Micro-BMPs include bioretention areas and rain gardens created by excavating a depression and backfilling with engineered media, mulch, and vegetation. These planted

shallow basins temporarily pond stormwater runoff, filter it through the bed components and treat it through biological and biochemical reactions within the soil matrix and root zones of the plants. Micro-BMPs are suitable for stormwater runoff control for new development and re-development projects, which strive to mimic "woods in good condition" and are often paired with ponds in order to meet flood control and channel protection objectives. Practices in this category are variously called ***green stormwater infrastructure***, ***ESD***, or ***LID***. These also include such practices as bioswales or wet swales which both treat and convey stormwater.

The suite of available ESD practices is diverse and many are advocating for a more expansive use of lower-cost vegetation and tree-based practices, especially near outfalls, within existing conveyances, adjacent to parking lots, and as green streets. In general, ESD practices most conducive to residential landscapes include rain gardens (typically in front yards), permeable pavement (typically for driveways), rainbarrels or cisterns, turf conversion or sustainable landscaping, dry wells, green roofs, tree canopy, soil decompaction, and pavement removal. ESD opportunities in rights-of-way may include bioretention (in medians, cul-de-sac islands, street bump outs, adjacent open space, as well as behind curbs or sidewalks), permeable pavement (in parking or bike lanes, sidewalks), turf conversion or sustainable landscaping, street trees (including tree pits), and step-pool stormwater conveyances in roadside channels.

Impervious cover removal may be an option in areas where existing parking surfaces or other paved surface are not currently needed. In some cases, large parking surfaces were previously built in commercial and institutional developments for events that occur very infrequently. Potentially, these areas could be converted to turf, thus reducing overall impervious cover and thereby reducing runoff. Pervious concrete or asphalt surfaces are another option that can be employed where appropriate.

2.7.3 Tree Planting

Reforestation consists of the following two types of tree planting, both of which provide ancillary benefits of enhancing wildlife and amenity values. Planting trees reduces runoff through interception and uptake/transpiration of precipitation, while also providing soil stability, heat island reduction and wildlife habitat benefits.

- Riparian Forest Buffers are areas of trees, shrubs, and other vegetation adjacent to a body of water. The riparian area, typically at least 35 feet wide (on each side of a stream), is managed to maintain the integrity of stream channels, and to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediment, nutrients, and other chemicals. Planting trees and enhancing existing streamside vegetation with native varieties of trees, shrubs, and wildflowers restores many of the water quality, wildlife, and aesthetic benefits associated with riparian buffers. Vegetation filters sediments and other pollutants from stormwater runoff, moderates water temperatures in streams, and provides shelter and food to both terrestrial and stream organisms. This BMP converts urban or agricultural land to forest land and provides a nitrogen, phosphorus, and sediment reduction benefit proportional to the amount of land converted.

- Upland Tree Planting is planting trees on currently urban or other open pervious areas at a rate that would produce a forest-like condition over time. Benefits include reductions in nutrient and sediment runoff as well as improvements in wildlife habitat and aesthetics.

2.7.4 Stream Restoration

Stream restoration is used to improve the ecosystem condition in degraded streams by restoring the natural hydrology and landscape of a stream and by enhancing habitat and water quality. Streams damaged by erosive flows, excess sedimentation, and disruptive human activities are often not capable of re-establishing a stable form. Preferred techniques to repair these damaged or degraded streams are based on mimicking natural stream channels and the range of natural variability exhibited by nearby stable streams. Termed ***natural stream channel design***, such repairs focus on establishing natural stream channel shape, size, and habitat features. Restoration can range from minor repairs to restore bank stability to complete reconstruction of the stream channel. Stream restoration also provides significant ancillary benefits through habitat enhancement and improved ecosystem services.

Incised stream channels are often targeted for stream restoration projects due to the accelerated stream bank erosion and loss of aquatic habitat caused by the instability of incised channels. Rosgen (1997) proposes four priority channel design options for restoring incised stream channels, where Priority 1 is the most preferred, and Priority 4 is the least preferred:

- **Priority 1.** Re-establish the stream channel on the historic floodplain.
- **Priority 2.** Establish a lower floodplain elevation and a new stream channel at the existing channel-bed elevation.
- **Priority 3.** Widen the floodplain at the existing bankfull stage elevation by excavating a new floodplain bench on one or both sides of the existing incised channel
- **Priority 4.** Stabilize the existing stream bed and banks in place using typical stabilization structures and methods.

Credits may vary depending on the type of stream restoration undertaken. According to MDE's accounting guidance for impervious area credits (MDE 2014c), stream restoration is credited at a rate of 1 acre impervious equivalent per 100 linear feet of stream restored. Nutrient and sediment load reductions associated with stream restoration may be estimated using rates derived from regional studies. The Chesapeake Bay Program's Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Schueler and Stack 2014) has defined these rates, which are acceptable for watershed planning purposes (for further details, see Section 6.7). However, recognizing that every stream restoration project is unique with respect to its design, stream order, landscape position and function, the Panel developed four protocols for determining

pollutant reduction credits for individual projects, once site-specific design details are known. These protocols are as follows (from Schueler and Stack 2014):

- ***Protocol 1: Credit for Prevented Sediment during Storm Flow.*** *This protocol provides an annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that would otherwise be delivered downstream from an actively enlarging or incising urban stream.*

- ***Protocol 2: Credit for Instream and Riparian Nutrient Processing during Base Flow.*** *This protocol provides an annual mass nitrogen reduction credit for qualifying projects that include design features to promote denitrification during base flow within the stream channel through hyporheic exchange within the riparian corridor.*

- ***Protocol 3: Credit for Floodplain Reconnection Volume.*** *This protocol provides an annual mass sediment and nutrient reduction credit for qualifying projects that reconnect stream channels to their floodplain over a wide range of storm events.*

- ***Protocol 4: Credit for Dry Channel Regenerative Stormwater Conveyance (RSC) as an Upland Stormwater Retrofit****. This protocol provides an annual nutrient and sediment reduction rate for the contributing drainage area to a qualifying dry channel RSC project. The rate is determined by the degree of stormwater treatment provided in the upland area using the retrofit rate adjustor curves developed by the Stormwater Retrofit Expert Panel.*

An individual stream restoration project may qualify for credit under one or more of the protocols, depending on its design and overall restoration approach.

2.7.5 Outfall Stabilization

Step Pool Stormwater Conveyances / Regenerative Stormwater Conveyances are open-channel conveyance systems that convert surface stormwater flow to shallow ground water flow through surface pools and subsurface sand seepage filters (Anne Arundel County 2012). These practices can be used to stabilize degraded ephemeral and intermittent channels while also providing water quality treatment for the contributing drainage area, allowing for pollutant removal opportunities that do not exist with traditional outfall stabilization techniques. Specific site conditions will dictate whether these practices are appropriate. Pollutant reductions for regenerative stormwater conveyances will be credited using the Expert Panel's Protocol 4, as described previously.

Other Stabilization Practices. Where step pool conveyances are not feasible, simpler outfall channelization practices such as riprap or drop structures may be implemented to reduce erosion.

3. DESKTOP ANALYSIS AND FIELD SITE SELECTION

3.1 Identifying and Assembling GIS Data

A suite of GIS data, including data compiled from studies previously conducted within the Little Patuxent Watershed, was used to identify and select candidate retrofit and restoration sites for further investigation in the field. Section 2.6 contains a list of those prior studies along with a description of the types of GIS data that were available to be used in this desktop analysis, while Appendix A lists GIS data compiled from Howard County and other sources.

3.2 Conducting Desktop Analysis - Methods

3.2.1 BMP Conversion Assessment

Howard County GIS data were used to identify BMPs that could be converted to a design with increased pollutant removal efficiencies. Recent improvements to the County's stormwater BMP facility database were available, including BMP drainage area polygons, indicators of conversion status, and other updates that had been completed by Howard County in 2014 and early 2015. This desktop analysis was conducted with the most complete BMP database update available at the time, in early January 2015.

Age of BMPs was a key factor in selection of facilities with conversion potential. MDE's Impervious Accounting guidance (MDE 2014c) reflects the stormwater design guidelines instituted with the Maryland 2000 Stormwater Manual:

> *The baseline year for the impervious area assessment shall be 2002, which is the year that the Manual was fully implemented. BMPs designed in compliance with the water quality volume (WQv) treatment criteria found in the Manual are considered to provide quality treatment to the MEP. Therefore, the impervious area draining to BMPs designed and approved in accordance with the Manual is considered treated and does not need to be counted toward restoration requirements.*

Therefore, as an initial step, all dry pond and extended detention dry ponds in the County's stormwater BMP facility database with pre-2002 built dates qualified as BMP conversion candidate sites. To further narrow down the pool of remaining BMP conversion candidates, all BMPs located in parcels with plan year dates of 2002 or later—i.e., as noted on the County's Site Development Plan (SDP) and Final Plan for public roads (FPlan)—were eliminated from consideration. Of the remaining BMPs, those with a conversion status in the County's project database of planned, selected for concept, under construction, or complete were removed, which reduced the total number of BMP conversion candidates.

During a two day review of all sites selected via the GIS desktop analysis, Howard County Stormwater Management staff had a chance to remove sites where conditions were known to be not conducive for a project. The County also had a chance to add sites that citizens had brought to the County's attention. In the end, a total of 133 sites in Little Patuxent were selected for BMP Conversion assessment field visits, and 61 sites were selected for BMP Conversion desktop assessments. Desktop assessments were reserved for sites of interest that had been previously visited during three recent County studies conducted to identify retrofit and restoration opportunities: Upper Little Patuxent Watershed Management Plan (KCI 2009), Howard County Low Impact Development (LID) and Tree Planting Summary Report (Versar 2013a), and Howard County Dry Pond and Extended Detention Pond Retrofits Summary Report (Versar 2013b). These desktop assessments were included to put all previously studied sites into the same frame of reference, so that previously identified opportunities could be ranked and evaluated alongside the new opportunities identified during this Watershed Assessment.

3.2.2 New BMP Assessment

Prior to 1982, when the State's first Stormwater Management law was passed, there were no requirements for quantity or quality control of urban runoff. This means that when land development occurred before this law's enactment, there were very few BMPs built to control the runoff from new impervious surfaces. Controlling runoff from impervious surfaces in areas of older development presents unique challenges – there must be adequate open space available for a new BMP and the open space must be in the correct landscape location for receiving impervious runoff (or costly changes need to be made to site grading or stormwater infrastructure to re-direct runoff to the available open space). Because of this, when selecting assessment sites for new BMPs, efforts were made to limit assessments to areas where implementation of new practices would allow for treatment of significant areas of impervious surface.

The County's latest planimetric GIS layers (including buildings, parking lots, driveways and major sidewalks) were combined to identify where there were contiguous blocks of impervious surface. These blocks of impervious were then overlaid with the drainage areas treated by current or planned BMPs; the potential pool of candidates was limited to those areas not treated by an existing or planned BMP, as per the County's BMP and Water Quality Improvement Projects data. A list and geodatabase of candidate sites were prepared for presentation to Howard County staff during a site-by-site review of opportunities selected by the GIS desktop analysis.

After initial site identification, in an effort to identify candidate sites distributed across the study area, different size thresholds for candidate sites were considered (ranging from 0.5 to 2 acres). These thresholds corresponded to the variations in age of development across the study area, i.e., areas with more recent development had fewer and smaller blocks of uncontrolled impervious cover and therefore a smaller size threshold would be required to generate a number of candidate sites comparable to other areas. In the end, during the desktop site review, it was decided to set a universal threshold of greater than one acre for candidate impervious block size, in order to concentrate new BMP implementation to where it would be most beneficial and cost effective.

Initially, County-owned secondary roads and minor highways with a 50 foot pervious buffer were considered for the candidate pool. Per discussions with Howard County during the GIS

desktop review, road site candidates would be limited to those with median strips wide enough for BMP installation. Upon further review, the determination was made to not include road sites as candidates for assessment in this study, because of the anticipated difficulties in identifying large enough impervious areas and finding sufficient space for water quality treatment.

The final selection of candidate new BMP sites yielded 188 sites in Little Patuxent Watershed for field investigation.

3.2.3 Stream Restoration Assessment

Howard County GIS data were used to isolate stream segments within the Little Patuxent Watershed where environmental problems are known to exist. First, Howard County's stream centerline layer was used to select stream segments for restoration consideration. A stream segment was defined as a stream polyline that is uninterrupted by junctions or confluences with other stream polylines, whether it be a lower order stream flowing into the segment of interest, or this segment flowing into a higher order stream. A total of 860 stream segments were identified within the Little Patuxent Watershed using this method.

Specific GIS data were used to identify stream segments containing known problems, particularly where erosion had been observed, such that sites would be good candidates for further investigation of restoration potential. Past data that were used as the first step to flag potential sites included: erosion and channel alteration points from past stream corridor assessment (SCA) studies, bank stability scores collected during annual Countywide biological monitoring surveys conducted every spring (years 2001-2014), and open pervious areas within 35 foot riparian buffers contained within the County's MS4 area. A complete list of GIS layers used in this analysis, including the corresponding study if applicable, is presented in Table 3-1.

The presence of one or more SCA erosion, SCA channel alteration, or Countywide biological sites within a stream segment that met the scoring criteria noted in Table 3-1 qualified the associated stream segment as a stream restoration assessment candidate site. A total of 196 segments extending approximately 66 miles were identified as candidates using these criteria. Stream segments that lacked a forested riparian buffer were also considered for the final pool of stream restoration assessment candidate sites. The acreage of open pervious area within the 35 foot riparian buffer was calculated for each stream segment within the study areas. This value, normalized by dividing by stream length, was assigned as one indicator of the stream segments' potential for restoration. Stream segments that had an open pervious acreage to stream segment length (miles) ratio of 6 or greater were retained as candidate sites. In addition to the segments already identified for erosion and alteration issues, a total of 66 segments extending approximately 6 miles were retained as candidates for their lack of forested riparian area.

During a two-day review of sites selected by the GIS desktop analysis, staff from Howard County's Stormwater Management Division had a chance to remove sites where stream restoration work was already completed or planned, or sites where conditions were known to be not conducive for a restoration project. The County staff also had a chance to add sites that citizens had brought to the County's attention that had not made the initial list of candidates. In

the end, a total of 190 sites within the Little Patuxent Watershed extending approximately 50 miles were selected for stream restoration assessment field visits.

Table 3-1. Past studies and GIS data used to identify stream channel problems

Study Name	GIS Data Used	Criteria for Problem Sites
Upper Little Patuxent Watershed Management Plan (SCA) - 2009	Layer of points collected during Stream Corridor Assessment (SCA)	Erosion points with Severity of 1, 2 or 3 Channel Alteration points with Severity of 1, 2 or 3
Dorsey Run SCA	Layer of erosion and channel alteration points collected during SCA	Erosion points with Severity of 1, 2 or 3 Channel Alteration points with Severity of 1, 2 or 3
Little Patuxent SCA	Layer of erosion and channel alteration points collected during SCA	Erosion points with Severity of 1, 2 or 3 Channel Alteration points with Severity of 1, 2 or 3
Hammond Branch SCA	Layer of erosion and channel alteration points collected during SCA	Erosion points with Severity of 1, 2 or 3 Channel Alteration points with Severity of 1, 2 or 3
Countywide Biological Monitoring	Layers of sites visited as part of the County's biological monitoring program	Bank Stability score of 1-5 for either the right or left bank.
County Open Pervious Land Cover	Layer of open pervious area within Howard County	Open pervious area occurring within the 35 foot riparian buffer contained within the County's MS4 area.

3.2.4 Tree Planting Assessments

Howard County GIS data were used to identify parcels that are good candidates for tree planting projects. The Countywide property layer was used to select all public and County-owned property within the Little Patuxent Watershed that also fall within the County's MS4 area. Of the public and County-owned properties, those that had one or more of the following characteristics were selected:

- Parcels containing large open pervious area(s), particularly adjacent to existing forest. This was noted via visual inspection of aerial photographs
- Properties that had been visited in previous tree planting studies or efforts, but did not have a project status of proposed, concept, or completed

- Parcels containing a point representing an inadequate buffer in the County's SCA data sets
- Parcels containing a wetland of palustrine forested, shrub/scrub, or emergent types, as identified within MD DNR's wetland GIS data layer
- Parcels containing an open pervious streamside area of significant length or connectivity to existing forest. This was noted via visual inspection of aerial photography and through analyzing 35-foot stream buffers in the MDP GIS data for Agriculture or Urban pervious areas.

During a comprehensive review of sites selected by the GIS desktop analysis, Howard County Stormwater Management Division staff had a chance to remove sites where conditions were known to be not conducive for a tree planting project. As an additional step following this meeting, staff of the Howard County Recreation and Parks department were also provided with maps and given the opportunity to review the candidate sites and remove/add sites based on their local knowledge of sites and proximity to known Forest Conservation Areas (FCAs). Parcels with FCAs were not necessarily excluded, since in many cases the FCA made up a portion of the property, while potential opportunities for additional tree planting were located elsewhere on the parcel. In the end, a total of 29 sites within the Little Patuxent Watershed were selected for Tree Planting assessment field visits, and 5 sites that had been visited in previous studies were also selected for Tree Planting desktop assessments.

3.2.5 Outfall Stabilization Assessments

GIS data from previous watershed studies, BMP inspections, and Illicit Discharge Detection and Elimination (IDDE) investigations were used to identify an initial pool of outfall stabilization candidates. The GIS data were used to select outfalls that had been previously identified as having an erosion issue. Table 3-2 provides a list of the studies and their associated GIS data used to obtain an initial pool of 194 candidate outfalls within the Little Patuxent Watershed. Outfalls were removed from the initial pool of candidates if they were associated with an outfall stabilization project identified in a previous study or were within Howard County's Water Quality Improvement Project database as a planned or completed project. Table 3-3 provides a list of past studies and their associated GIS data used to remove candidate outfalls from the initial pool. The stream restoration projects listed in Howard County's Water Quality Improvement Project database were also considered as projects that may narrow down the pool of candidates. Howard County Stormwater Management staff determined that additional outfalls were to be excluded from the pool of candidate sites due to their proximity to planned stream restoration projects, which further narrowed down the candidate pool.

Several of the candidate outfalls were close enough to another candidate outfall that it was possible that they were the same outfall surveyed during multiple studies or over multiple IDDE investigations. All obvious duplicate outfalls were removed prior to the merging of candidate outfall GIS layers from previous studies, but the duplication of several proximate outfalls could not be verified due to a lack of a unique identifier and inconsistencies with surveyed outfalls matching the location of outfalls and pipes contained within the County's stormwater infrastructure GIS layers. In order to get a sense of which outfalls might be duplicates, a 25-foot buffer was created around each candidate outfall. A count of the number of candidate outfalls

that fell within each 25-foot buffer was calculated, and buffers with a count of greater than one resulted in the removal of the assumed duplicate outfall points. In the end, a total of 180 outfalls within the Little Patuxent Watershed were selected for Outfall Stabilization Assessments.

Table 3-2. Past studies and GIS data used to identify candidate outfalls

Study Name	GIS Data Used	Criteria for Problem Sites
2000, 2002-2014 IDDE*	IDDE Outfalls Geodatabases	Erosion = Moderate or Severe
BMP Inspections*	Howard County BMP inspection spreadsheet	Candidate = 3 or 4 on a 4 point scale
Upper Little Patuxent Watershed Management Plan (SCA) - 2009	Layer of points collected during Stream Corridor Assessment (SCA)	Erosion Cause = Pipe Outfall
Dorsey Run SCA	Layer of erosion points collected during SCA	Erosion Cause = Pipe Outfall
Little Patuxent SCA	Layer of erosion points collected during SCA	Erosion Cause = Pipe Outfall
Centennial Lake Unified Stream Assessment (USA) – 2005	Layer of points collected during USA	All outfall issues noted during the assessments
Wilde Lake USA – 2005	Layer of points collected during USA	All outfall stabilization sites noted during assessments
Wilde Lake Retrofits - 2005	Proposed Retrofit Projects Layer	TYPE = Outfall Stabilization OR Plunge/Step pool
Columbia Association (CA) Watershed Management Plan – 2008/2009	Project Site Points Layer	Tier = 2 Report was reviewed to determine which Tier 2 projects had outfall stabilization recommended
Dry Pond Study –2013*	Layers of ponds visited during Task 1 and Task 2 of Dry Pond Study	Ponds that fell within the Little Patuxent Watershed that had outfall channel issues noted during the assessments

* Study identified additional outfalls that fell outside of the study areas. Results were clipped to the study area.

Table 3-3. Past studies and GIS data used to exclude candidate outfalls

Study Name	GIS Data Used	Criteria
Howard County Water Quality Improvement Projects	BMP point layer in Howard County Projects Database	BMP Type = SPSC OR Outfall
General Growth Properties (GGP) Downtown Columbia Study - 2008	GGP Retrofits Layer	Type = Wooded Wetlands and Regenerative Stormwater Conveyance
CA Watershed Management Plan – 2008/2009	Project Site Points Layer	Tier = 1 Note: Report was reviewed to determine which Tier 1 projects had outfall stabilization recommended
Upper Little Patuxent Watershed Management Plan - 2009	Restoration Sites Point Layer	Type = Stream Restoration/Outfall Stabilization OR Stream, Bank, Outfall Stabilization OR Outfall Stabilization/Restoration AND Concept Plan = Yes

3.3 Desktop Analysis Summary - Results

Tables 3-4 and 3-5 show the final breakdown of sites selected for field and desktop assessments. The final number of sites that were actually assessed, which are presented in Chapter 4, do not match the numbers shown in these tables for two reasons. First, in addition to the sites selected through the desktop analysis, field teams had the ability to add new sites that they found in the field, increasing the number of assessed sites. Second, some of the sites selected through the desktop analysis were not able to be visited due to issues such as property owner constraints and sites not being found, decreasing the number of assessed sites. Explanations of why sites could not be assessed can be found in the consultant field reports located in Appendix A.

Table 3-4. Number of sites selected for field assessments in the Little Patuxent Watershed

Assessment Type	Number of Sites (or Stream Miles)
BMP Conversions (# of BMP facilities)	133
New BMPs for untreated impervious (# of sites)	188
Stream Restorations (# of stream miles)	50
Tree Planting (# of sites)	29
Outfall Stabilization (# of outfalls)	180
Total	**530 sites + 50 stream miles**

Table 3-5. Number of sites selected for desktop assessments in the Little Patuxent Watershed

Assessment Type	Total Number of Sites
BMPs Conversion	61
New BMP	6*
Tree Planting	5
Total	**72**

*One site ultimately evaluated in the field

4. FIELD ASSESSMENTS

Field assessments were conducted in early 2015 to gather data on existing conditions in the Little Patuxent Watershed and to recommend sites with potential restoration and stormwater retrofit opportunities. Teams from four consultant groups were assigned portions of the Little Patuxent Watershed to assess (Figure 4-1). Northern Little Patuxent was assessed by KCI Technologies, Southern Little Patuxent by Versar, Hammond Branch by Biohabitats, and Dorsey Run by McCormick Taylor. Additional desktop assessments were performed by Versar and KCI.

4.1 Field Methods and Calibration

4.1.1 Field Protocols

Howard County Watershed Assessment field protocols were developed by Versar, in consultation with Howard County Stormwater Management Division and the other three consultant teams. Data collection was customized for each of the five site types and focused on (1) assessing current conditions and (2) identifying and describing restoration opportunities.

Specific protocols for each type in many instances drew from existing methodologies, but with customization to ensure that data collected in the field met the needs for this project. Custom data collection protocols were developed to document the following types of assessments and recommendations.

- **Conversion of existing stormwater BMPs** - methods were derived from the Center for Watershed Protection's Retrofit Reconnaissance Investigation (RRI) protocol, from the Urban Subwatershed Restoration Manual 3 (CWP 2007);
- **Establishment of new stormwater BMPs for impervious surfaces not currently treated** - also from RRI (CWP 2007);
- **Tree planting** - methods were drawn from Pervious Area Assessments (PAA), Unified Subwatershed and Site Reconnaissance, Manual 11 (CWP 2005) and Urban Reforestation Site Assessment (URSA), Urban Watershed Forestry Manual, Part 3: Urban Tree Planting Guide (CWP 2006);
- **Stream restoration** - methods were a combination of Stream Corridor Assessment (SCA, Yetman 2001) for characterizing erosion and other stream features, EPA's Rapid Bioassessment Protocol (RBP, Barbour et al. 1999) for habitat assessment, Rosgen (1996, 2001) methods for Bank Erosion Hazard Index (BEHI) and other geomorphic indicators; and
- **Outfall stabilization** - methods were primarily derived from the SCA protocols.

A complete field packet was distributed to each of the consultant teams to ensure that assessments were being conducted in a consistent manner. The packet included guidance on naming sites added in the field, a list of sites with special notes that field crews were to read prior to assessing the sites, a field assessment decision flow chart, field names and domains for field

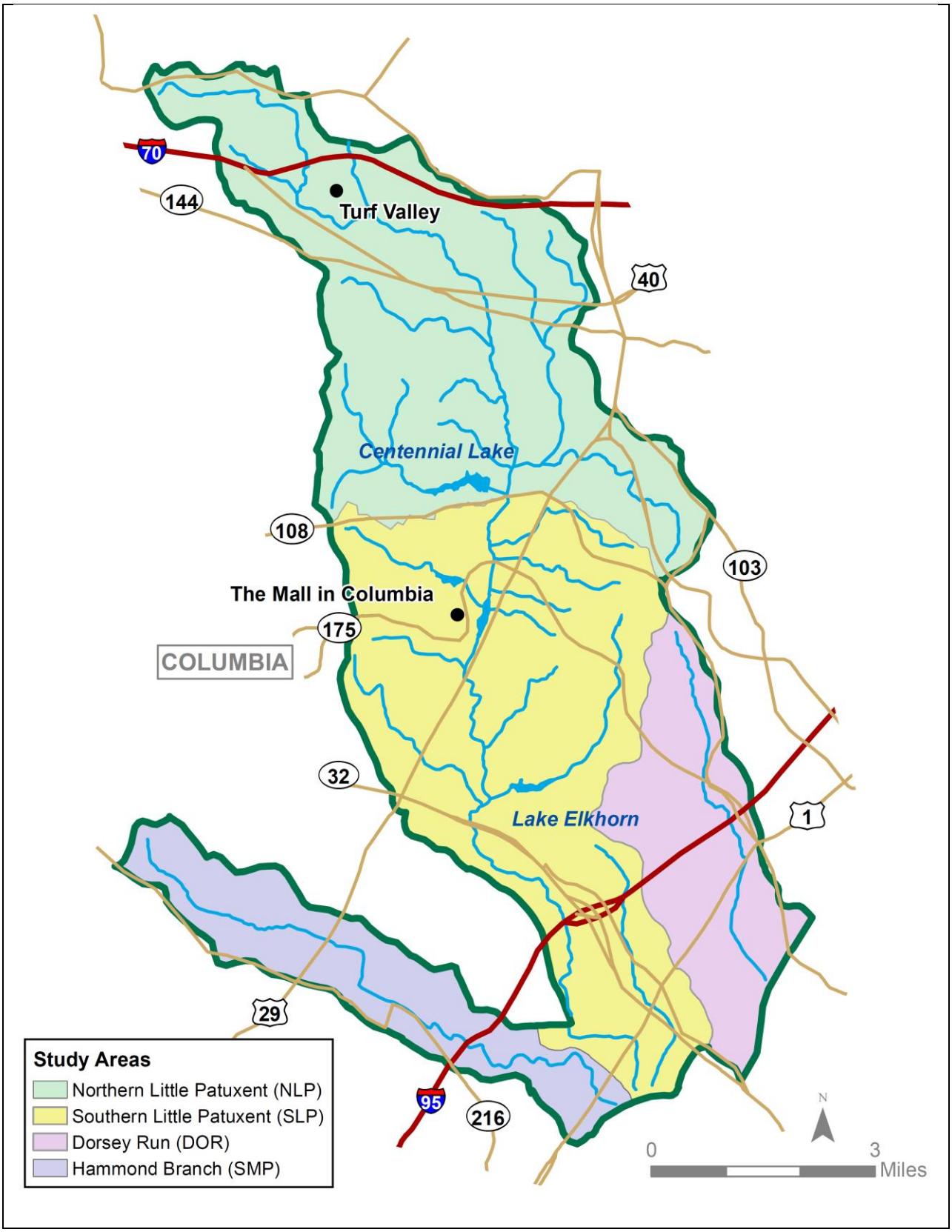


Figure 4-1. Study areas for spring 2015 site assessments within the Little Patuxent Watershed

assessment layers, Rapid Bioassessment Protocol habitat scoring sheets, and Bank Erosion Hazard Index (BEHI) diagrams. A complete copy of the packet can be found in Appendix C.

4.1.2 Electronic Data Collection

Field assessment data were collected with mobile tablet devices through the ESRI ArcCollector application. Digital photographs were taken at each assessment site and appended to the database. The electronic collection of data allowed for data to be entered directly into a geodatabase in the field and removed the step of having to manually enter data from paper datasheets in the office. ESRI Web Maps that were linked to the field assessment geodatabases were accessed from desktop computers to complete desktop assessment data entries, and to edit the field data. An ArcCollector Field Data Collection Instructions packet was developed and distributed to each of the consultant teams to be used as a reference guide while working with the geodatabases and the associated background data layers. A complete copy of the packet can be found in Appendix D.

4.1.3 Calibration of Field Teams

Prior to beginning data collection, two field assessment calibration days were held to ensure that field personnel from each of the consultant teams were familiar with the methods being used to collect field data and to create a consistent perspective among all consultant personnel for recording field observations. The first calibration day covered BMP Conversion, New BMP, and Tree Planting field assessment protocols, and was held on January 22, 2015. The second calibration day covered Stream Restoration and Outfall Stabilization field assessment protocols, and was held on January 29, 2015. Each of the calibration days consisted of a review, discussion, and revisions to field assessment protocols in the morning, followed by a review of data download, collection, and upload procedures with the tablets and the ArcCollector application in the afternoon. Brief visits to representative field sites for each of the five assessment types were also conducted.

4.1.4 Landowner Permissions

Once the complete list of field sites was created (see Section 3.3), an Excel file was created listing all properties containing field sites, along with property ownership data derived from county tax assessment data. The parcel address was used to identify the owner or local resident who would be contacted via a notification letter. The following steps were taken to refine the mailing list:

- For public property (e.g., county-owned parklands, schools), County staff confirmed that sites were accessible and no letter was sent.
- School system personnel were contacted separately, through the Howard County Public Schools Assistant Manager for Grounds. Field staff were also instructed to visit the school office, upon arrival at each school site, in order to present identification and sign in.
- Parcels containing more than one site were reduced to a single entry, to avoid duplicate mailings.

- For multiple-tenant commercial properties, a single letter was sent for the whole unit.
- Multi-owner or publicly accessible facilities (e.g., a commercial complex that would be readily accessible from a parking lot) were removed from the mailing list.
- Howard County staff reviewed the list and removed a small number of properties that would not be amenable to site visits. These parcels were clearly noted for the field crews' information, within the ArcCollector application.
- Howard County staff developed an umbrella agreement with Columbia Association, providing blanket permission for all sites on Columbia Association properties.
- Sites on agricultural properties were reviewed by the Soil Conservation District staff, who helped identify appropriate sites to visit, prior to letters being sent.
- In a few cases, County staff made direct contact with managers of larger properties (e.g., Turf Valley golf course, Alpha Ridge landfill) to coordinate permission and access to those sites.
- Parcels without address information were removed from the mailing list.

Howard County Stormwater Management Division staff developed a letter to send to property owners (see Appendix E). All letters sent, or the landowner review process performed by the County, were tracked in an Excel table for all sites and parcels. County staff sent out letters and field staff were instructed to wait an initial period of two weeks after letters were sent before beginning field work on private properties, to allow time for responses to be received by the County.

A web-based map was developed by the project team for County staff to use in recording permission responses and kept up-to-date as responses were received. Data fields were added to the data for each parcel to capture permission status (Granted, Notify Prior to Accessing, or Denied), comments, and contact name, address, and phone/email information. The map was color-coded to reflect parcel permission status. All information was readily available to field crews through the web map and ArcCollector application.

4.1.5 Field and Desktop Data Collection

The four field teams collected data during the period of March through May 2015. Teams communicated with Versar and County staff as needed to answer questions that arose about BMP data, site access, or other issues. Data were collected using field tablets, by working locally (with daily backups) or by collecting data live, on-line, and saving directly to the server.

In addition to the field assessments, two of the consultant teams (Versar and KCI) conducted desktop reviews of sites that were visited during the Upper Little Patuxent Watershed Management Plan study (KCI) and the Howard County Dry Pond study (Versar). Desktop assessments consisted of BMP Conversion, New BMP, and Tree Planting sites for KCI, and BMP Conversion sites for Versar. All of the KCI desktop assessment sites were located within the Northern Little Patuxent study area, whereas the Versar desktop assessment sites were located throughout both Little Patuxent study areas. Data for desktop assessment sites were

entered using the same data system along with field data, based on information available from prior studies and, in a few cases, a brief field visit.

4.1.6 Field Summary Reports

At the conclusion of the field visits, the consultant teams were asked to prepare a field summary report, summarizing field and desktop assessments completed, including the following information:

- Summary of the number of field assessments completed, by type;
- If there were sites that could not be assessed in the field, a summary of primary reasons;
- Comments about data or assumptions made;
- Summary of the number of recommendations made at field sites, with initial field rating of restoration potential (high, medium, or low);
- General comments about the types of recommendations made;
- List of sites reported to Howard County for follow-up because of suspected illicit discharges, safety concerns, or other reasons;
- Other comments/explanations related to data collected; and
- Summary of sites evaluated via desktop assessments.

Consultant team Field Summary Reports are included in Appendix F.

4.1.7 Field Data Quality Assurance/Quality Control

At the completion of the field and desktop assessments, all of the data for a given area were copied from the ESRI ArcGIS Server and sent to each of the consultant teams in the form of a file geodatabase. Each team had an opportunity to make any additions or edits to the geodatabases before they were sent to Versar for Quality Assurance/Quality Control (QA/QC). Once the file geodatabases were received, Versar went through each and checked for logical data (e.g., checking for stream bed particle size distributions that do not sum to 100%), use of correct site IDs, matching assessment and recommendation data, and overall completeness. Once the QA/QC process was complete, all of the file geodatabases were merged into a single personal geodatabase that could be used for the prioritization analysis.

4.2 Summary - Little Patuxent Watershed Field and Desktop Site Assessments

Table 4-1 provides a tally of the assessments conducted in Little Patuxent Watershed, for each of the five assessment types. Examples of field conditions observed are shown in the photographs in Figures 4-2 to 4-6. Locations of BMP Conversion, New BMP, Stream Restoration, Tree Planting, and Outfall Stabilization Assessment sites are shown in Figures 4-7 to 4-9. All field and desktop assessment site locations are shown in these maps.

Table 4-1. Number of assessments completed in the Little Patuxent Watershed

Type	Number of Sites (or miles) Assessed
BMP Conversion Field Assessments	129
New BMP Field Assessments	177
Stream Restoration Field Assessments	50.2
Tree Planting Field Assessments	44
Outfall Stabilization Field Assessments	191
Total Field Assessments	**541 sites + 50.2 stream miles**
BMP Conversion Desktop Assessments	51
New BMP Desktop Assessments	4
Tree Planting Desktop Assessments	4
Total Desktop Assessments	**59 sites**
Total Assessments	**600 sites + 50.2 stream miles**

Figure 4-2. Typical Dry Pond (left) and Extended Detention Dry Pond (right) evaluated during BMP Conversion Assessments

Figure 4-3. Typical untreated impervious surface (left) and a potential location for a new BMP facility (right) observed during New BMP Assessments

Figure 4-4. Typical degraded stream channels observed during Stream Restoration Assessments

Figure 4-5. Typical tree planting opportunities found along stream corridors (left) and adjacent to existing forest (right)

Figure 4-6. Typical degraded outfall channels observed during Outfall Stabilization Assessments

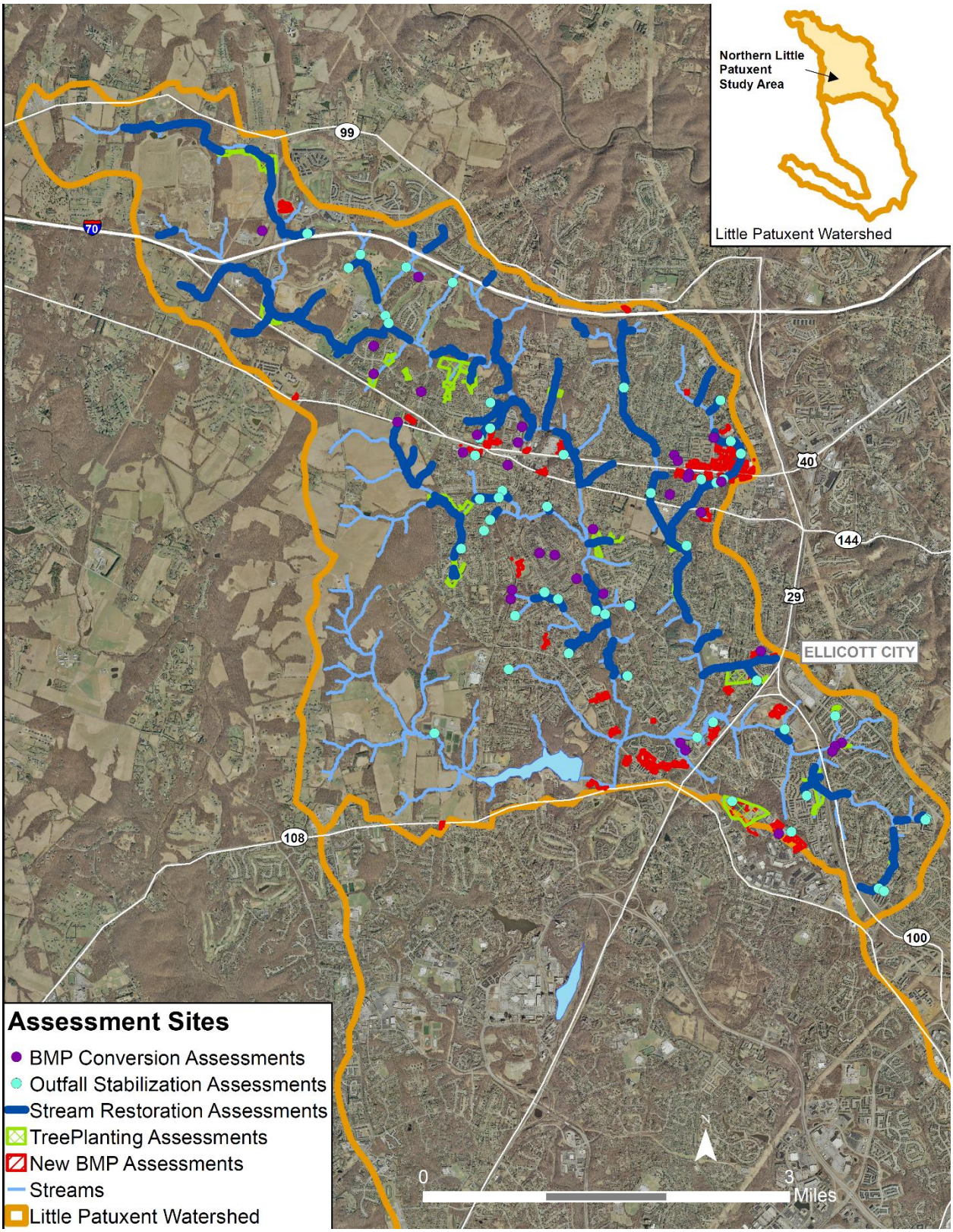


Figure 4-7. Location of assessments conducted in the Northern Little Patuxent Study Area

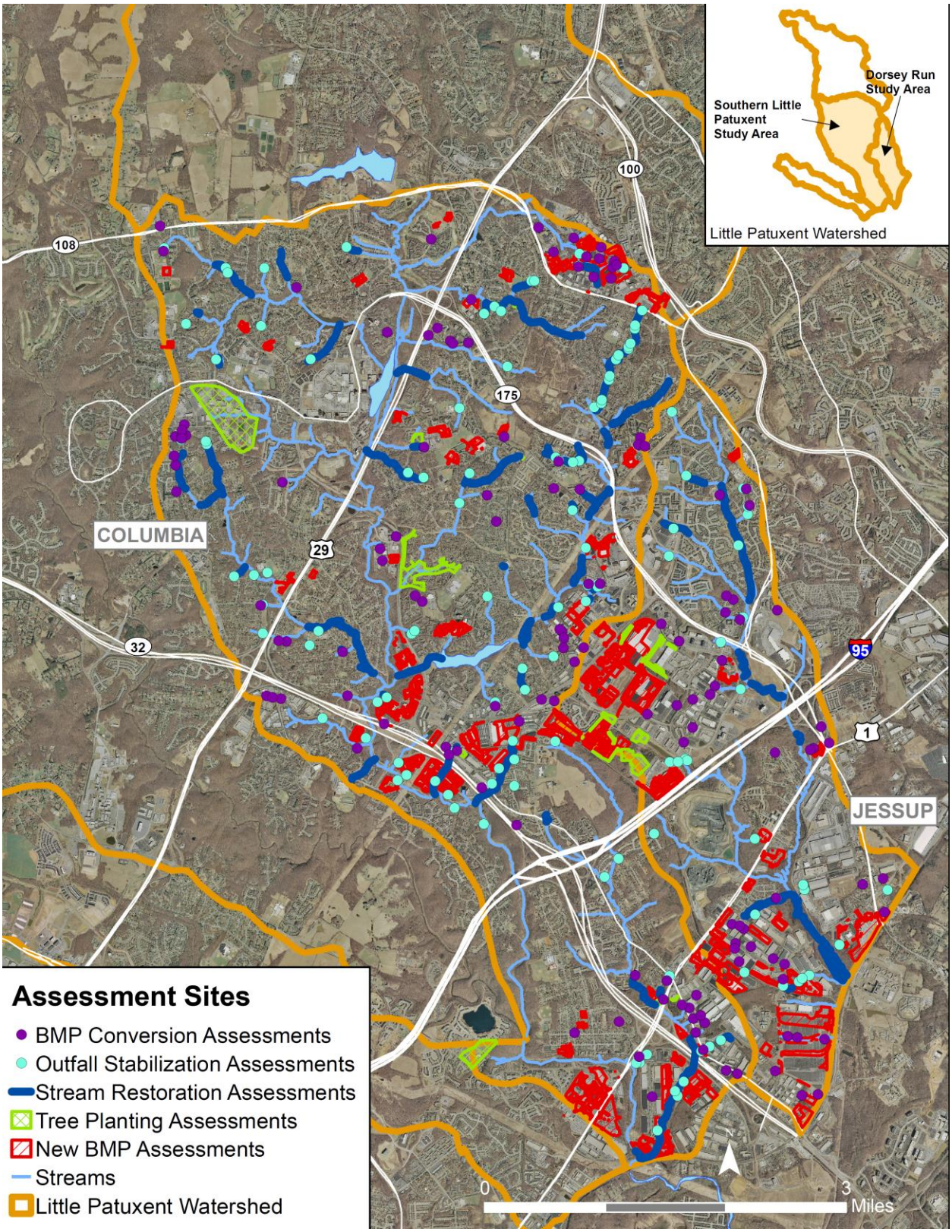


Figure 4-8. Location of assessments conducted in the Southern Little Patuxent Study Area, including Dorsey Run

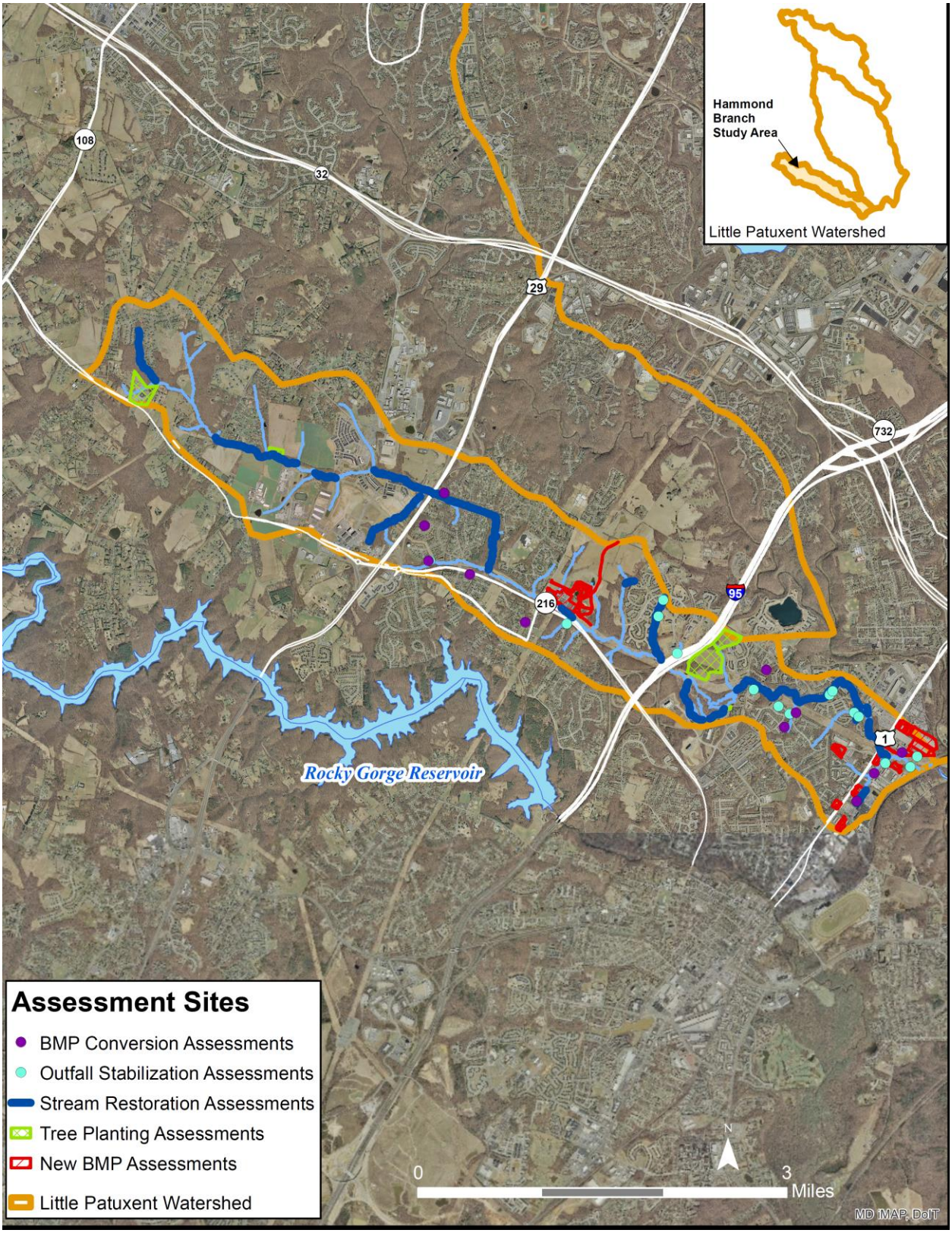


Figure 4-9. Location of assessments conducted in the Hammond Branch Study Area

4.2.1 BMP Conversion Assessments

A total of 129 BMP Conversion Assessments were conducted in the field, and an additional 51 BMP Conversion Assessments were conducted as desktop assessments. All BMP facilities evaluated for conversion potential were existing dry ponds (Figure 4-2, left) or extended detention dry ponds (Figure 4-2, right), with the exception of one wet pond. Types of BMP conversion options proposed during field and desktop assessments are discussed in Section 2.7. The majority of BMP Conversion Assessment sites were located in the Southern Little Patuxent study area due to its higher density of impervious surfaces.

4.2.2 New BMP Assessments

A total of 177 New BMP Assessments were conducted in the field, and an additional 4 New BMP Assessments were conducted as desktop assessments. The majority of areas evaluated for BMP retrofits consisted of business parks with large buildings surrounded by parking and driving surfaces for employees, customers, and deliveries. Other types of sites evaluated included schools, community centers, and apartment buildings. Representative photos of New BMP Assessment sites are shown in Figure 4-3. Similar to BMP conversion Assessment sites, the majority of New BMP Assessment sites were located in the Southern Little Patuxent study area due to its high density of untreated impervious surfaces.

4.2.3 Stream Restoration Assessments

A total of 50.2 miles of Stream Restoration Assessments were conducted in the field. The majority of stream channels evaluated consisted of degraded 1st and 2nd order perennial streams (Figure 4-4). Several intermittent and ephemeral channels were also evaluated, as well as a short section of the mainstem of the Little Patuxent River.

4.2.4 Tree Planting Assessments

A total of 44 Tree Planting Assessments were conducted in the field, and an additional 4 Tree Planting Assessments were conducted as desktop assessments. Tree Planting Assessments conducted for sites selected during the desktop analysis primarily consisted of open pervious space located on County-owned land (Figure 4-5, right). Several Tree Planting Assessments were conducted in riparian open pervious areas (Figure 4-5, left) that were noted while conducting Stream Restoration Assessments; these riparian sites added were primarily on private property.

4.2.5 Outfall Stabilization Assessments

A total of 191 Outfall Stabilization Assessments were conducted in the field. The assessed outfalls ranged in size from 4 to 120 inches in diameter, though over 50% of outfalls fell in the 18-36 inch size range. Photos of representative outfalls assessed during the study are shown in Figure 4-6. The majority of the outfalls assessed during the study were located in the Southern Little Patuxent due to its higher density of impervious surfaces and stormwater infrastructure.

4.3 Summary - Little Patuxent Watershed Restoration and Retrofit Recommendations

Locations of recommendations for BMP Conversion, New BMPs, Stream Restoration, Tree Planting, and Outfall Stabilization made based on field and desktop assessments are shown in Figures 4-10, 4-11, and 4-12. For all recommendations made, field crews assigned an initial assessment of restoration potential, rating the recommendation as High, Medium, or Low potential, based on field findings and other available information and observations. Table 4-2 summarizes the total numbers and restoration potential ratings for all recommendations made within the Little Patuxent Watershed.

Table 4-2. Summary of recommendations in the Little Patuxent Watershed

Type	Number of Recommendations	High Potential Sites	Medium Potential Sites	Low Potential Sites
BMP Conversion Field Recommendations	117	65	43	9
New BMP Field Recommendations	388	128	164	96
Stream Restoration Field Recommendations	147	65	64	18
Tree Planting Field Recommendations	58	33	13	12
Outfall Stabilization Field Recommendations	86	39	38	9
Total Field Recommendations	**796**	**330**	**322**	**144**
BMP Conversion Desktop Recommendations	48	32	14	2
New BMP Desktop Recommendations	4	3	1	0
Tree Planting Desktop Recommendations	6	3	3	0
Total Desktop Recommendations	**58**	**38**	**18**	**2**
Total Recommendations	**854**	**368**	**340**	**146**

4.3.1 BMP Conversion Recommendations

A total of 117 BMPs were recommended for conversion in the field, and an additional 48 BMPs were recommended for conversion during the desktop assessments. The majority of the proposed BMP conversion options consisted of wet ponds, wetlands, extended detention, bioretention, and non-bioretention filtering practices. Multiple conversion options were identified at the majority of the assessed sites.

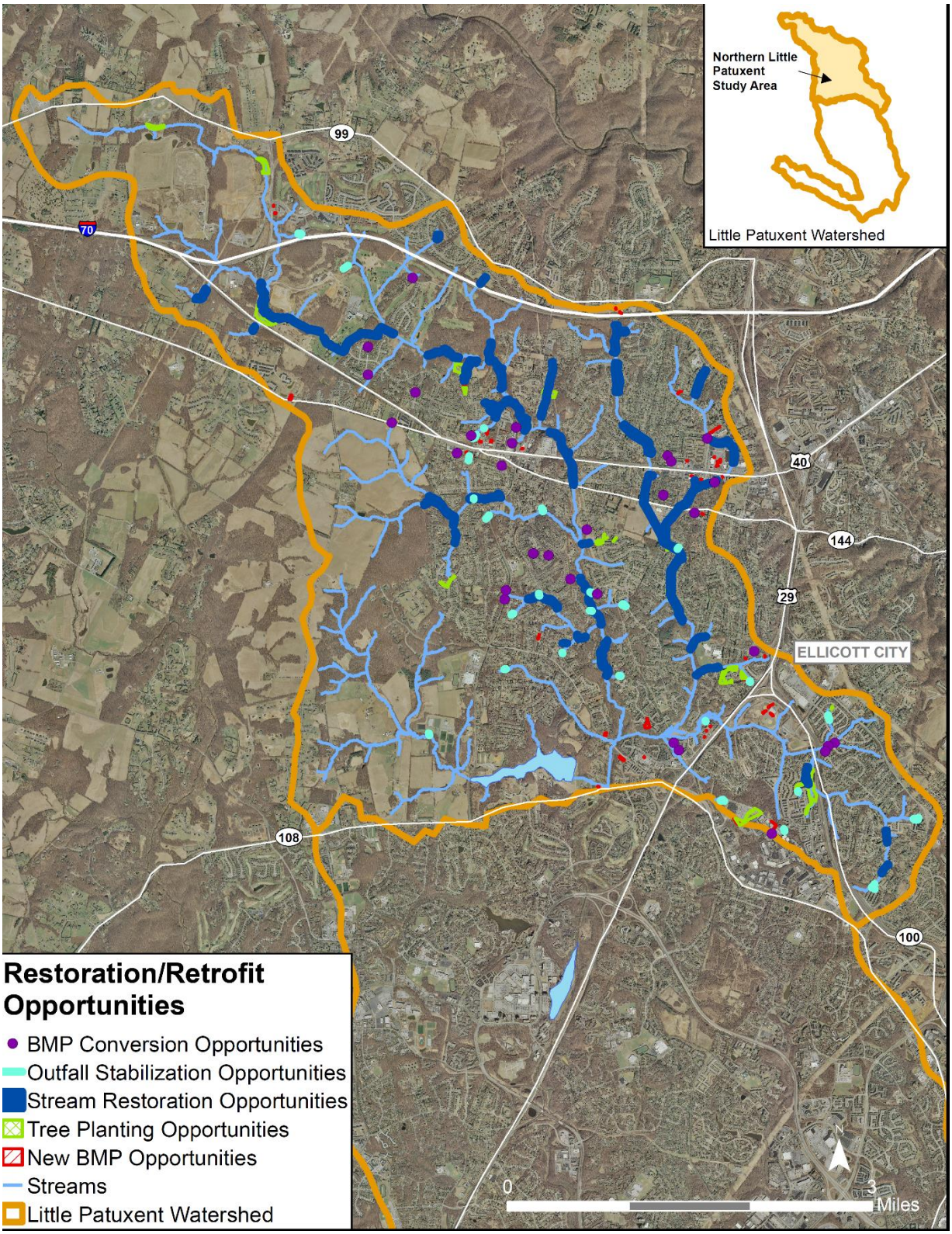


Figure 4-10. Location of restoration and retrofit opportunities in the Northern Little Patuxent Study Area

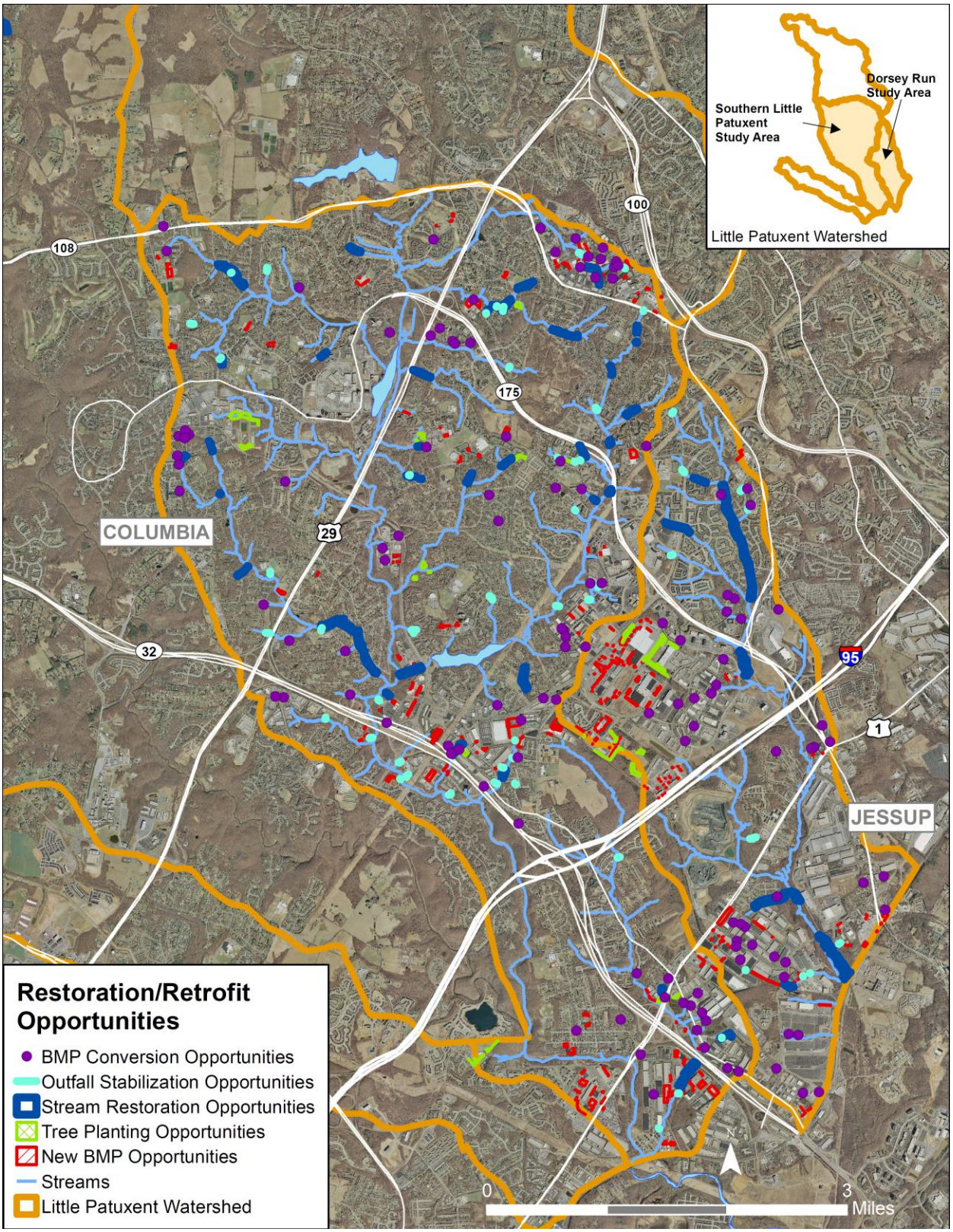


Figure 4-11. Location of restoration and retrofit opportunities in the Southern Little Patuxent Study Area, including Dorsey Run

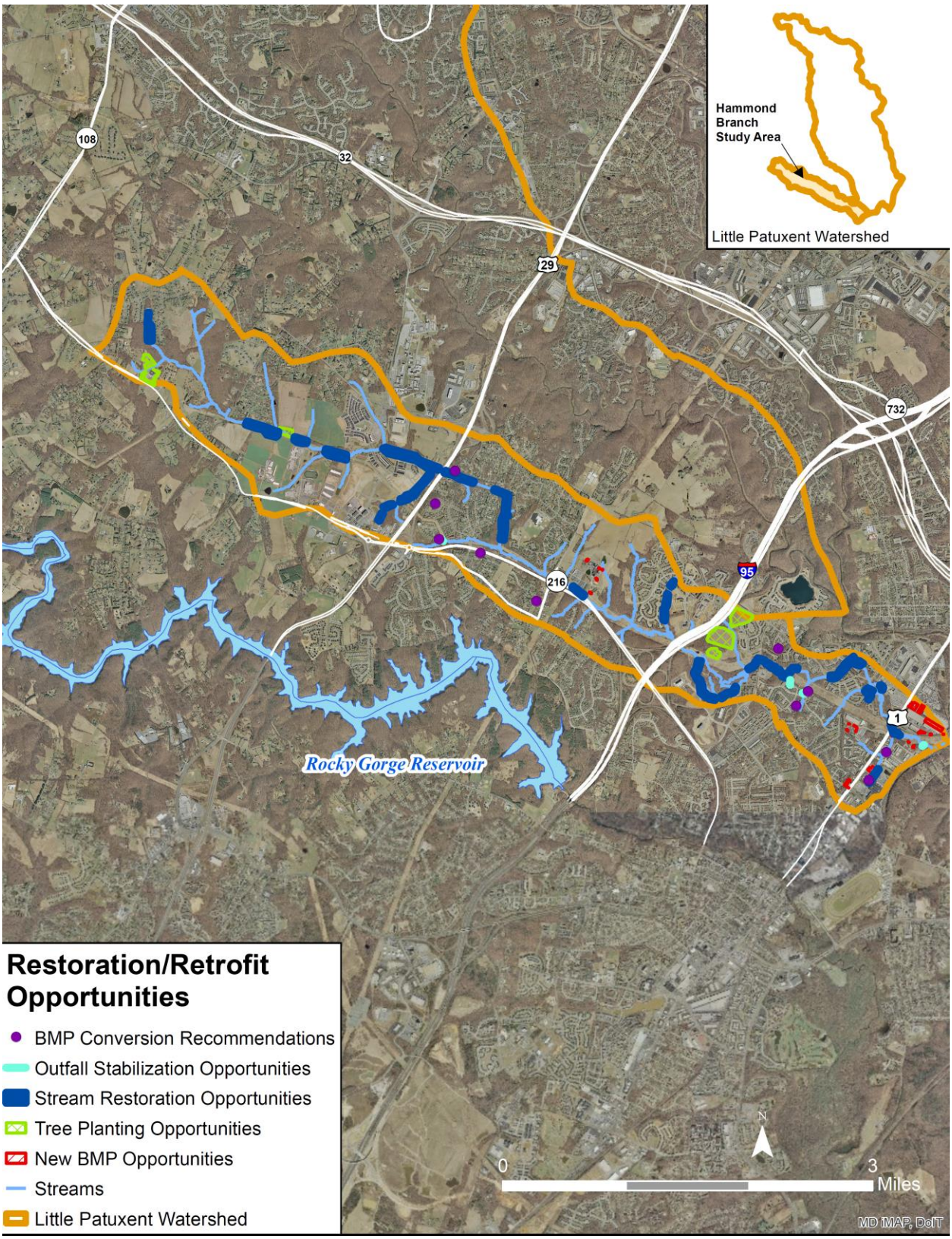


Figure 4-12. Location of Restoration and Retrofit Opportunities in the Hammond Branch Study Area

4.3.2 New BMP Recommendations

A total of 388 New BMP Recommendations were proposed in the field, and an additional 4 New BMP Recommendations were proposed for desktop sites. The majority of the proposed BMP facilities consisted of bioretention and non-bioretention filtering practices. Multiple New BMP facilities were recommended at most of the assessed sites.

4.3.3 Stream Restoration Recommendations

A total of 147 Stream Restoration Recommendations were proposed in the field. The total length of the proposed projects is approximately 25 miles. In general, stream reaches recommended for restoration contained either one (or multiple) instance(s) of severe bank erosion, or consistent minor to moderate bank erosion along with unsuitable instream habitat and threatened infrastructure (e.g., exposed utility pipes, power line poles located in the stream channel, etc.). In addition, several concrete channels were recommended for removal.

4.3.4 Tree Planting Recommendations

A total of 58 Tree Planting Recommendations were proposed in the field, and an additional 6 Tree Planting Recommendations were proposed for desktop sites. Tree planting areas ranged in size from approximately 0.25 acres to 20 acres. The majority of the Tree Planting Recommendations were between 1 and 5 acres in planting area, and the total area of all proposed tree planting projects is approximately 117 acres.

4.3.5 Outfall Stabilization Recommendations

A total of 86 Outfall Stabilization Recommendations were proposed in the field. The majority of the proposed outfall stabilization projects consisted of regenerative stormwater conveyances and were located in areas with high amounts of impervious cover.

4.4 Public Input and Feedback (Additional Sites)

Field assessment results were presented during a set of public meetings that were held by Howard County Stormwater Management Division in June 2015. During the meetings, citizens had the opportunity to review assessment findings and recommendations developed to date, and to bring issues to the attention of the County that could be investigated as additional BMP Conversion, New BMP, Stream Restoration, Tree Planting, or Outfall Stabilization Assessment sites. Meetings included a County presentation of background information, an overview of the watershed assessment process, and highlights of findings to date. During an interactive discussion period, County and consultant team staff were available to talk with participants about particular sites or concerns. Large map display posters and data tablets were available for viewing field assessment data and recommendations. As a result of the citizen input, one additional site was assessed, though it was not recommended as a potential project location.

5. RESTORATION PROJECT RANKING AND PRIORITIZATION

5.1 Ranking Methods - Overview

During the various field assessments, crews determined which locations were best suited for potential projects, as reported in Chapter 4. In all, 760 potential projects were identified. The large list of possible projects they generated, as well as the multiple goals this watershed assessment aims to address (e.g., impervious surface treatment, pollutant reductions, etc.), makes it challenging to select the best projects for implementation. To address this challenge, an automated, standardized method was developed for comparing, ranking, and prioritizing the projects. This method relied on a combination of data collected in the field, the known costs and benefits of various BMP types, and GIS analyses. The method was applied to select a set of projects for which concept designs were developed; it can be used in the future to choose additional project for design, as needed.

Projects were ranked in two different ways, the details of which will be discussed in more detail in the next sections. First, each project was ranked against all other projects of the same type. This will allow Howard County, for example, to target grant funding that must be applied to forest canopy improvement to the areas in the watershed that were identified as having the best tree planting opportunities. This type of ranking also allows for the incorporation of more specialized ranking factors. For example, the length and severity of erosion at an outfall is a useful way to compare stabilization projects, but would not apply to rankings that also include tree planting sites or locations for new BMP installations.

Second, all projects were pooled together and every potential project was ranked against each other. In this way, the County can compare the relative costs and benefits of the complete project list. This list can help to determine those projects which have the highest potential value and should be taken to the next design stage, as well as aid in modeling scenarios to determine which combination of projects will help to meet TMDL and other goals, and at what cost.

Ranking factors included the amount of impervious area restoration that would be achieved by the project (Table 5-1) and other benefits and constraints. There were some factors that were generally applicable across all project types (see details noted as level “A” in Tables 5-2 through 5-5). Level “A” factors were divided into four main categories:

- Permit contribution – how a project will help towards the County meeting the impervious surface restoration requirements in its NPDES MS4 permit, as well as its TMDL goals
- Biological uplift – if a project will provide additional benefits, such as building onto existing green infrastructure or protecting wetlands
- Programmatic benefit – if a project has value beyond its primary functional purpose, such as visible demonstration projects or public education

- Feasibility – estimation of the ease or difficulty of project implementation, including public versus private ownership, site accessibility, or whether a repair is already required at a site providing an opportunity to minimize costs by upgrading the facility during the course of other required construction activities

Each factor was scored according to various criteria (see Tables in Section 5.2 and 5.3). The sum of all the factor scores was used to rank each project, with higher total scores representing higher priority projects. A table of all projects, with scores, is found in Appendix G.

5.1.1 Impervious Area Credits

For all opportunities identified, the potential benefits in terms of impervious area restoration credit were calculated in accordance with MDE's accounting guidance (MDE 2014c). For stormwater BMPs, according to MDE criteria the target is treatment of the water quality volume (WQv), typically associated with the 1-inch rainfall event. When the practice is able to provide treatment for the full WQv, full impervious area credit is given based the total impervious area within the BMP drainage area. When less than 1 inch of rainfall is treated, impervious area treatment credit is based on the proportion of the full WQv treated. For alternative BMPs such as tree plantings and stream restoration, impervious acre equivalents were calculated based on factors provided by MDE (2014c), as summarized in Table 5-1. Impervious acre credits (and impervious acre equivalents, for alternative BMPs) are used to plan for and estimate progress toward meeting the 20% impervious area restoration requirement in Howard County's MS4 Permit (MDE 2014a).

Table 5-1. Impervious acre credits for alternative BMPs (from MDE 2014c)

BMP	Notes	Impervious Acre Equivalent
Reforestation on Pervious Urban	Survival rate of 100 trees/acre or greater; at least 50% of trees have two-inch diameter or greater (4.5 feet above ground).	0.38 acre credit / acre reforested
Impervious Urban to Pervious	Remove pavement and provide vegetative cover for 95% of area.	0.75 acre credit / acre revegetated
Impervious Urban to Forest	Survival rate of 100 trees/acre or greater; at least 50% of trees have two-inch diameter or greater (4.5 feet above ground).	1.00 acre credit / acre reforested
Regenerative Step Pool Storm Conveyance (SPSC)	Located in dry or ephemeral channels; impervious area credit is based on runoff depth treated. When less than 1 inch of rainfall is treated, a proportion of credit is taken.	1.00 acre credit / impervious acre treated, based on treating 1 inch of rainfall.
Stream Restoration	Planning level estimate	0.01 acre credit / linear foot restored
Outfall Stabilization	Stabilization or repair of localized areas of erosion below a storm drain outfall; max credit is two acres per project.	0.01 acre credit / linear foot restored

5.2 Ranking and Prioritization Within Project Types

5.2.1 BMP Conversions and New BMPs

The similar nature of these two project categories led to them sharing a set of ranking criteria (Table 5-2), though they were ranked separately. Prior to scoring and ranking, some projects were eliminated from the candidate pool. Pond conversion candidates that seemed to be naturally converting to a wetland facility were not included in the ranking, as it was unlikely that the County would want to disturb an area that was already providing additional water quality benefits. Howard County intends to focus on projects that would have larger-scale benefits, and so new BMP projects that were determined to address less than 2 acres of impervious surface were also removed from the ranking.

Table 5-2. Ranking factors, criteria and scoring for BMP conversion and new BMP projects

	Factor	Criteria	Score
A. Factors for all site types			
1. Permit contribution			
1.a	Acres of impervious treatment	> 10 acres	20
		5 - 10 acres	15
		1 - 5 acres	10
		< 1 acre	5
1.b	Pollutant load reduction factor (Sum of % load reductions for TN, TP, and sediment)	181 - 260	10
		101 - 180	6
		0 - 100	3
1.c	Cost per acre of impervious treatment	< $50,000	10
		$50,000 - $100,000	8
		$100,000 - $200,000	5
		> $200,000	2
2. Biological uplift			
2.a	BMP in a subwatershed with 45-65% of sites with IBI scores below degradation threshold	Yes	5
		No	0
2.b	BMP is within 500 feet of Green Infrastructure Network or Tier II waters	Yes	5
		No	0
3. Programmatic benefit			
3.a	Site has educational value and/or is visible for public demonstration	Yes	2
3.b	Site is near 2 or more other potential projects allowing for easier monitoring and demonstration of benefit	Yes	3
4. Feasibility			
4.a	Ease of access	Easy	10
		Moderate	6
		Difficult	3
4.b	Conflicts with infrastructure or other site constraints	None	10
		Some	6
		Many	3
4.c	Adverse impacts to nearby trees	Minimal	10
		Moderate	6
		Significant	3

Table 5-2. (Continued)

	Factor	Criteria	Score
4.d	Ownership – public vs. private	Public	10
		Private, other	0
4.e	Pond/infrastructure already in need of repair	Yes	15
4.f	Field assessment – high potential for restoration/retrofit	Yes	5

5.2.2 Tree Plantings

In the case of tree plantings, there were a few minor variations from the standard factor scoring. In the case of structural and pond BMPs, there are many different types, allowing for a wide range of pollutant reduction efficiencies per drainage acre and costs per unit treatment across different projects. In the case of tree planting projects, these values would be the same across all projects; for this reason factors 1.b and 1.c were not scored (Table 5-3). Additionally, for tree planting projects, where the impact to surrounding trees would not be a concern, the level of site preparation required for planting was substituted as a factor (see 4.c in Table 5-3).

Table 5-3. Ranking factors, criteria and scoring for tree planting projects

	Factor	Criteria	Score
A.	**Factors for all site types**		
	1. Permit contribution		
1.a	Acres of impervious treatment	> 2 acres	20
		0.75 - 2 acres	15
		0.38 - 0.75 acres	10
		< 0.38 acres	5
1.b	Pollutant load reduction factor (Sum of % load reductions for TN, TP, and sediment)	N/A – same for all sites	
1.c	Cost per acre of impervious treatment	N/A – same for all sites	
	2. Biological uplift		
2.a	Planting in a subwatershed with 45-65% of sites with IBI scores below degradation threshold	Yes	5
		No	0
2.b	Planting is within 500 feet of Green Infrastructure Network or Tier II waters	Yes	10
		No	0
2.c	Planting is within 100 feet of wetlands	Yes	5
		No	0
	3. Programmatic benefit		
3.a	Site has educational value/visible for public demonstration	Yes	2
3.b	Site is near 2 or more other potential projects allowing for easier monitoring and demonstration of benefit	Yes	3
	4. Feasibility		
4.a	Ease of access	Easy	10
		Moderate	6
		Difficult	3
4.b	Conflicts with infrastructure or other site constraints	None	10
		Some	6
		Many	3

Table 5-3. (Continued)

	Factor	Criteria	Score
4.c	Site preparation required before planting	None	10
		Minimal	8
		Moderate	5
		Extensive	2
4.d	Ownership – public vs. private	Public	10
		Private, other	0
4.e	Infrastructure in need of repair	N/A	
4.f	Field assessment – high potential for restoration/retrofit	Yes	5

5.2.3 Outfall Stabilizations

Outfall stabilization projects, for the purposes of ranking, were divided into broad categories: traditional stabilizations (e.g., riprap) and step pool stormwater conveyances (SPSC, or regenerative stormwater conveyances, RSC). These two methods of stabilization vary greatly from one another in both cost and benefit and were thus used to help differentiate the projects in scoring (Table 5-4). Beyond the standard level "A" ranking factors, an additional level "B" factor was included, in order to characterize the length and severity of erosion each project would address.

Table 5-4. Ranking factors, criteria and scoring for outfall stabilization projects

	Factor	Criteria	Score
A.	**Factors for all site types**		
	1. Permit contribution		
1.a	Acres of impervious treatment	1.5 - 2 acres	20
		1 - 1.5 acres	15
		0.5 - 1 acres	10
		< 0.5 acres	5
1.b	Pollutant load reduction factor (Note: standard outfall stabilizations receive no pollution reduction credits)	SPSC	10
		All other types	0
1.c	Cost per acre of impervious treatment (Note: Riprap is the less expensive option and receives more points)	Riprap	10
		SPSC	3
		All other types	0
	2. Biological uplift		
2.a	Stabilization in a subwatershed with 45-65% of sites with IBI scores below degradation threshold	Yes	5
		No	0
2.b	Stabilization is within 500 feet of Green Infrastructure Network or Tier II waters	Yes	5
		No	0
2.c	Stabilization is within 100 feet of wetlands	Yes	5
		No	0
	3. Programmatic benefit		
3.a	Site has educational value/visible for public demonstration	Yes	2
3.b	Site is near 2 or more other potential projects allowing for easier monitoring and demonstration of benefit	Yes	3

Table 5-4. (Continued)

	Factor	Criteria	Score
	4. Feasibility		
4.a	Ease of access	Easy	10
		Moderate	6
		Difficult	3
4.b	Conflicts with infrastructure or other site constraints	None	10
		Some	6
		Many	3
4.c	Adverse impacts to nearby trees	Minimal	10
		Moderate	6
		Significant	3
4.d	Ownership – public vs. private	Public	10
		Private, other	0
4.e	Outfall/infrastructure already in need of repair	Yes	15
4.f	Field assessment – high potential for restoration/retrofit	Yes	5
B.	**Erosion factor**		
1	Length and severity of erosion (Length of erosion in feet x erosion severity rating)	> 1,000	15
		500 – 1,000	10
		< 500	5

5.2.4 Stream Restorations

As noted for the tree planting project ranking discussed in Section 5.2.1, pollutant reduction efficiencies and costs per unit treatment are the same among all stream restoration projects, and therefore 1.b and 1.c were not scored (Table 5-5). Beyond the standard level "A" ranking factors, two additional levels of factors were incorporated into the stream restoration prioritization. A level "B" factor was included, similar to that used for the outfall stabilization ranking, which characterizes the length and severity of erosion each project would be able to address. Three level "C" factors were also included, which address factors unique to streams, such as habitat quality and other problems identified during stream corridor assessments.

Table 5-5. Ranking factors, criteria and scoring for stream restoration projects

	Factor	Criteria	Score
A.	**Factors for all site types**		
	1. Permit contribution		
1.a	Acres of impervious treatment	> 9 acres	20
		6 – 9 acres	15
		3 – 6 acres	10
		< 3 acres	5
1.b	Pollutant load reduction factor (Sum of % load reductions for TN, TP, and sediment)	N/A – same for all sites	
1.c	Cost per acre of impervious treatment	N/A – same for all sites	
	2. Biological uplift		
2.a	Restoration in a subwatershed with 45-65% of sites with IBI scores below degradation threshold	Yes	5
		No	0

Table 5-5. (Continued)

	Factor	Criteria	Score
2.b	Restoration is within 500 feet of Green Infrastructure Network or Tier II waters	Yes	5
		No	0
2.c	Restoration is within 100 feet of wetlands	Yes	5
		No	0
	3. Programmatic benefit		
3.a	Site has educational value/visible for public demonstration	Yes	2
3.b	Site is near 2 or more other potential projects allowing for easier monitoring and demonstration of benefit	Yes	3
	4. Feasibility		
4.a	Ease of access	Easy	10
		Moderate	6
		Difficult	3
4.b	Conflicts with infrastructure or other site constraints	None	5
		Some	3
		Many	1
4.c	Adverse impacts to nearby trees	Minimal	10
		Moderate	6
		Significant	3
4.d	Ownership – public vs. private	Public	10
		Private, other	0
4.e	Already in need of repair	N/A	
4.f	Field assessment – high potential for restoration/retrofit	Yes	5
	B. Erosion factor		
1	Length and severity of erosion (Length of bank erosion in feet x erosion severity rating)	> 300	15
		100 - 300	10
		< 100	5
	C. Stream condition factors		
1	Average BEHI score (length-weighted) along reach	46 - 50	10
		40 - 45	8
		30 - 39	6
		20 - 29	4
		< 20	2
2	Average Habitat Assessment score (length-weighted) within a reach rated site as non-supporting or only partially supporting aquatic biota	Yes	5
3	Number of other problems along reach (exposed pipes, pipe outfalls, unusual conditions, etc.)	Other problems > 2	10

5.3 Ranking and Prioritization Across All Project Types

In order for a fair comparison of all projects, factors were limited to those that were common to all project types (level "A"), as shown in Table 5-6. Due to minor variations in the number of factors used for the different project types (e.g., factor 4.e, which determines if repairs are already recommended at an existing facility, only applied to outfalls and BMP conversions) the sum of individual scores for categories 2 through 4 were converted to a proportion so that each

project was judged based on highest possible score for its own project type. After looking at the final ranked list of all projects, the County determined a cut-off score, above which all projects would be considered for concept plans.

Table 5-6. Ranking factors, criteria and scoring used for ranking all projects and selecting projects for concept plans

	Factor	Criteria	Score
A. Factors for all site types			
	1. Permit contribution		
1.a	Acres of impervious treatment	> 10 acres	10
		5 – 10 acres	8
		3 – 5 acres	5
		1 – 3 acres	4
		< 1 acre	2
1.b	Pollutant load reduction factor (Sum of % load reductions for TN, TP, and sediment)	201 - 260	10
		151 - 200	6
		1 - 150	3
		0	0
1.c	Cost per acre of impervious treatment	< $50,000	10
		$50,000 - $100,000	8
		$100,000 - $200,000	5
		> $200,000	2
	2. Biological uplift ***3. Programmatic benefit*** ***4. Feasibility***		
2.a – c 3.a – c 4.a – f	Sum of scores, as a proportion of total possible points (Note: Total possible points is dependent of type of site)	> 0.8	10
		0.6 - 0.8	8
		0.4 - 0.6	6
		0.2 - 0.4	4
		0.01 - 0.2	2
		0	0

5.4 Concept Plans

After the County approved the results of the ranking (Table 5-7), a four-page concept plan was developed for each of the highest ranked projects. These concept plans included:

- Location information (including a site locator map),
- Existing site conditions (including photos),
- Details of the proposed project (including a concept design drawing),
- Implementation information, such as utility constraints and other nearby projects,
- Potential impervious treatment and pollutant reduction credits, and
- Cost estimate.

Each concept plan provides a complete picture of the potential project, including costs and benefits. They may be used by the County to communicate with the public about a particular

project, to apply for a grant for funds to move forward with project implementation, or to aid in the allocation of funds during the County's budget process. The complete set of concept plans is available in Appendix H.

Table 5-7. Number of projects, by type, selected for concept plans in Little Patuxent Watershed

Project Type	Number of Concept Plans Developed
BMP Conversions	15
New BMPs	10
Tree Plantings	19
Outfall Stabilizations	20
Stream Restorations	45
Total	109

6. POLLUTANT LOAD MODELING

Howard County has implemented stormwater BMPs since the 1980s. The initial focus of stormwater management was retention and detention of large flows to reduce flooding. Subsequent designs have addressed water quality treatment, infiltration, and stream channel protection. Here, calculations are presented of the nitrogen, phosphorus, and sediment loadings and loading rates to the Little Patuxent River with the existing and planned BMPs, based on the County's BMP database as of November 12, 2015. Existing BMPs are those that have already been installed while planned BMPs are those indicated as "planned" in the database but have not yet been built. Further, calculations are presented of the nutrient and sediment loading reductions that would occur based on implementation of restoration opportunities that were identified as part of the watershed assessment presented herein (see Chapters 1-5).

Existing pollutant loads and projected reductions in loads were calculated for the application of various BMPs. The pollutant load model is spreadsheet-based and is comparable to the Maryland Assessment Scenario Tool (MAST) for calculating annual pollutant loads. The models account for the reductions by a suite of BMPs. As the first step, the model calculated existing pollutant loads using MAST loading rates at the scale of the Maryland-designated 8-digit watershed (i.e., Little Patuxent), combined with the latest county watershed land use (explained in detail below), followed by treatment with existing and planned stormwater management practices. In the second step, the model subtracted the reductions expected from future practices from the remaining existing loads using the pollutant reduction values provided in MAST, derived from the Chesapeake Bay Watershed Model. Each future practice type was compared to the pollution load reduction targets to estimate implementation effectiveness.

The pollutant load calculations and removals by BMPs were completed for the watershed for the Bay TMDL and separately for the local TMDLs. Note that Howard County land use was used in conjunction with the MAST model loading rates to calculate the loads of nitrogen, phosphorus, and sediment for the Little Patuxent Watershed. This included both a local TMDL for sediment and the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment.

For each pollutant, the model was run under existing conditions with existing and planned BMPs to determine the baseline load. While the baseline period for the Bay TMDL is 2010, the local TMDL baseline starts at 2005 for the Little Patuxent. Each BMP installed as of the baseline year was assumed to be operating as intended and included in the baseline based on the "as-built date". Next, model runs were conducted for each restoration practice and its associated pollutant load reductions. For simplicity, the restoration options for each TMDL target are shown in tables with the incremental and cumulative reductions associated with the following BMPs:

- Baseline of projects completed or planned after the TMDL baselines
- Proposed conversion of dry ponds to various upgraded practices
- Proposed conversion of extended detention ponds to various upgraded practices
- Proposed New Structural BMPs
- Proposed Tree Plantings

- Proposed Stream Restoration
- Proposed Outfall Stabilization

Using these models, provisional sets of the BMPs most likely to be feasible and cost-effective are included for the watershed. The selected combination of BMPs are thus evaluated against all TMDL targets in the watershed. The sections that follow describe this process in detail, but the basic steps are listed as follows:

1. MAST output of watershed-specific and land use-specific pollutant loadings were used to calculate baseline loading rates in pounds per acre for pervious and impervious urban areas (combined County MS4 and non-regulated urban categories for these areas). Federal, State Highway Administration (SHA), other State lands, agriculture, and water areas were included for comparison, but only forested area rates were applied where needed for some of the calculations.

2. A custom modeling spreadsheet was prepared to present the baseline calculations with watershed-specific loading rates as described above.

3. For the Bay TMDL baseline, the benefit was estimated for BMPs installed or planned for installation since the Bay TMDL model run, based on the county database of BMPs from 2010 to present.

4. For the local TMDL baseline, the benefit was estimated for BMPs installed or planned for installation since the applicable TMDL was developed, based on the county database for the year applicable to each local TMDL.

5. To estimate future load reductions, the benefits were calculated for proposed new BMPs, dry pond and extended detention pond conversions, tree plantings, stream restoration, and outfall stabilization (regenerative stormwater conveyances).

6.1 Loads and Rates (Model Tab T0)

Pollutant loading analyses for Maryland-designated 8-digit watersheds located entirely or in part within Howard County (e.g., Little Patuxent Watershed) are intended to assess the impacts of current development on water quality. To support these analyses, watershed-specific pollutant loading rates were derived for nitrogen, phosphorus, and sediment based on MAST for Howard County (www.mastonline.org). MAST results from the 2010 Progress scenario were used to develop current loadings rates for all land uses. Land use types were aggregated as listed in Table 6-1.

Table 6-1. MAST (Devereaux, 2011) land use aggregations for calculating pollutant loading rates for total Nitrogen, Total Phosphorus, and sediment

MAST Land Use Name	Aggregated Land Use Group
Alfalfa	Agriculture
Animal feeding operations	Agriculture
County Phase I/II MS4 impervious*	Impervious
County Phase I/II MS4 pervious*	Pervious
Degraded riparian pasture	Agriculture
Federal impervious	Impervious
Federal pervious	Pervious
Forest*	Forest
Harvested forest	Forest
Hay with nutrients	Agriculture
Hay without nutrients	Agriculture
Hightill with manure	Agriculture
Hightill without manure	Agriculture
Nonregulated extractive	Impervious
Nonregulated impervious developed*	Impervious
Nonregulated pervious developed*	Pervious
Nursery	Agriculture
Pasture	Agriculture
Regulated construction	Impervious
Regulated extractive	Impervious
Regulated industrial facility impervious	Impervious
Regulated industrial facility pervious	Pervious
SHA Phase I/II MS4 impervious	Impervious
SHA Phase I/II MS4 pervious	Pervious
State Phase II MS4 impervious	Impervious
State Phase II MS4 pervious	Pervious
Water	Water

* These land uses were used for estimating the loading rates for BMP benefit estimation

Detailed land use information for the Howard County watersheds was derived from a combination of Howard County's land use (received from Howard County Department of Planning and Zoning in June 2011), forest cover, and larger waterways and water body data sets; and the MDP's 2010 Land Use/Land Cover data set. For areas where the County land use data set was missing information, or identified parcels as undeveloped, for urban and agricultural types, the associated MDP data were used to complete the data coverage. Approximately 30% of the parcels with MDP land use classifications were confirmed with comparisons to aerial photography of the same time period before accepting the data set elements as replacements for the missing County data. For the purposes of watershed-scale pollutant loading analyses, a consolidated version of land use classifications was used, since loading rates do not differ significantly between certain land use classes (e.g., various forest types). The land use/land cover categories present in the study-area-wide data set and the corresponding MAST land use classes used for the pollutant loading analyses are summarized in Tables 6-2a and 6-2b.

Table 6-2a. Reclassification of Howard County 2011 land use data groups to MAST land use for Howard County watersheds

Howard County Land Use Groups	MAST Land Use Type
11, 12, 13, 14, 15, 16, 17, 18, 19 Residential	Urban*
21 Commercial	Urban*
31 Industrial	Urban*
32 Manufacturing	Urban*
33 Transportation, communication, and utilities	Urban*
41 Government	Urban*
42, 43 Institutional	Urban*
44 Recreation, parks, courses, and clubs	Urban*
45 Institutions, hospitals, churches, and cemeteries	Urban*
51-1 Farmland	Agriculture
51-2 Woodland	Forest and wetlands
61 Miscellaneous	Urban*
10, 20, 30, 40 Undeveloped	N/A

* These categories were split into pervious urban and impervious urban areas using Howard County's impervious cover (roads and buildings, parking lots, driveways, sidewalks, paved paths, etc.) GIS layers.

Table 6-2b. Reclassification of Howard County 2011 land use data and MDP 2010 Land Use/Land Cover to MAST land use for Howard County watersheds

MDP Land Use/Land Cover Classification	MAST Land Use Type
191 Very low density residential (agriculture)	Urban*
192 Very low density residential (forest)	Urban*
11 Low density residential	Urban*
12 Medium density residential	Urban*
13 High density residential	Urban*
14 Commercial	Urban*
15 Industrial	Urban*
16 Institutional	Urban*
17 Extractive	Urban*
18 Open urban land	Urban*
21 Cropland	Agriculture
22 Pasture	Agriculture
41 Deciduous forest	Forest and wetlands
43 Mixed forest	Forest and wetlands
44 Brush	Forest and wetlands
50 Water	Water
60 Wetlands	Forest and wetlands
73 Bare ground	Urban*
80 Transportation	Urban*

* These categories were split into pervious urban and impervious urban areas using Howard County's impervious cover (roads and buildings, parking lots, driveways, sidewalks, paved paths, etc.) GIS layers.

Consolidated land uses were used to determine the total acreage for each land use category in the watershed. These were multiplied by the corresponding loading rates derived from MAST. Resulting annual pollutant loads for total nitrogen, total phosphorus, and sediment from the watershed are summarized by land use. Estimates provide baseline nutrient loads before implementation of restoration projects and will allow a better assessment of both progress made to date and further progress needed to meet TMDL goals for urban stormwater runoff pollutant reduction. Annual nutrient and sediment loads for the Little Patuxent Watershed Bay TMDL are summarized in Table 6-3 and for the local TMDL in Table 6-4. These tables also include nitrogen, phosphorus, and sediment loading rates (lbs/ac/yr). The total pollutant load estimate will be used to estimate necessary reductions to meet local and Chesapeake Bay TMDL goals.

Table 6-3. Existing (2010) Annual Pollutant Loads within Little Patuxent Watershed (02131105) for the Chesapeake Bay TMDL

Land Use	County Area (acres)	Nitrogen		Phosphorus		Sediment	
		Rate (lbs/ac/yr)	Load (lbs/yr)	Rate (lbs/ac/yr)	Load (lbs/yr)	Rate (lbs/ac/yr)	Load (lbs/yr)
Urban Impervious	8,002	15.62	124,974	1.99	15,930	2,013.7	16,113,753
Urban Pervious	16,152	9.93	160,351	0.29	4,714	286.2	4,622,235
Agricultural	1,853	7.81	14,468	0.97	1,790	720.9	1,335,588
Forest	9,468	3.49	33,029	0.08	740	194.4	1,840,996
Water	425	9.37	3,980	0.61	260	0.0	0
Totals	35,900		336,802		23,434		23,912,572
Total Urban	24,155		285,325		20,644		20,735,988

Table 6-4. Existing (2010) Annual Pollutant Loads within Little Patuxent Watershed (02131105) for the local sediment TMDL

Land Use	MAST 2005 Area (acres)	Nitrogen		Phosphorus		Sediment	
		Rate (lbs/ac/yr)	Load (lbs/yr)	Rate (lbs/ac/yr)	Load (lbs/yr)	Rate (lbs/ac/yr)	Load (lbs/yr)
Urban Impervious	6,620	16.11	106,683	1.66	11,010	1,551.5	10,271,289
Urban Pervious	18,189	9.65	175,585	0.34	6,249	239.6	4,358,188
Agriculture	2,077	16.56	34,387	1.65	3,430	1,008.3	2,094,074
Forest	8,101	3.64	29,509	0.08	635	184.9	1,498,031
Water	79	13.11	1,038	0.61	48	0.0	0
Totals	35,067		347,203		21,372		18,221,582
Total Urban	24,810		282,269		17,259		14,629,477

6.2 Existing Stormwater Management (Model Tab T1)

The following sections present a quantitative analysis of pollutant removal capabilities of existing and potential BMPs to estimate reduction in nutrient loads from urban runoff in this watershed. The removal efficiencies used to estimate pollutant reductions are based on the August 5, 2015 version of MAST (www.mastonline.org). Table 6-5 presents the removal efficiency rates used in this analysis for structural BMPs except as noted elsewhere in the text; where there are multiple rates for a BMP type based on soil group and the soil group is not known, the removal rate used was for the soil group most likely to be proposed for that BMP type. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant reduction capabilities. A summary of overall pollutant load reduction estimates is presented at the end of this section.

Howard County has implemented many capital improvement projects in the county's various watersheds including stream restoration, stormwater facility conversions, and retrofits (new BMPs in drainage areas where none were previously installed). Pollutant loads were estimated based on the contributing drainage area (DA) and the corresponding project type's land use-specific pollutant loading rates. Load reduction is calculated as the product of the pollutant load and removal efficiency. For existing and planned BMPs, pollutant removals are shown in Table 6-5. For stream restoration projects, nutrient reduction credits are based on the length of stream restored. Existing SWM facilities in the county's watersheds include dry ponds, infiltration and filtration practices, extended detention, proprietary BMPs, and other types of SWM facilities (e.g., underground detention). For local TMDLs, some of which were developed based on data collected more than 10 years ago, existing and planned BMPs that were added to the county database since development of that TMDL were included in the calculations. Here, "planned" BMPs refers to those listed in Howard County's BMP database as planned, but that are not yet built. This does not include newer recommendations, such as those BMPs proposed as a result of the current watershed assessment. The work done to create the Bay TMDL takes into account all BMPs implemented through 2009; this was the most recent year that there was BMP implementation data at the time that the Bay TMDL was published. All BMPs on the ground at that time were credited toward the allocations. Any BMPs added after 2009 are included in the calculations presented here (Table 6-6). The Little Patuxent Watershed has a local TMDL for sediment, with a baseline year of 2005. Thus, any BMPs added after 2004 are included in Table 6-7.

Pollutant reductions for existing and planned BMPs were calculated based on the approximate pollutant load received from the DA and removal efficiencies (RE) used in MAST for the various types of SWM faculties. The equation used to estimate nutrient and sediment load reductions for a particular type of SWM facility is expressed as

[#(lbs/ac/yr)*DA (acres)]*RE (%)

Table 6-5. BMP efficiencies used in MAST for the land use and hydro-geomorphic region applicable to Howard County (County MS4). From http://www.mastonline.org/Documentation.aspx.

BMP	BMP Short Name	Nitrogen Effectiveness (%)	Phosphorus Effectiveness (%)	Sediment Effectiveness (%)
Bioretention/raingardens - A/B soils, no underdrain	BioRetNoUDAB	80	85	90
Bioretention/raingardens - A/B soils, underdrain	BioRetUDAB	70	75	80
Bioretention/raingardens - C/D soils, underdrain	BioRetUDCD	25	45	55
Bioswale	BioSwale	70	75	80
Dry Detention Ponds and Hydrodynamic Structures	DryPonds	5	10	10
Dry Extended Detention Ponds	ExtDryPonds	20	20	60
MS4 Permit-Required Stormwater Retrofit	RetroSWM	25	35	65
Permeable Pavement w/ Sand, Veg. - A/B soils, no underdrain	PermPavSVNoUDAB	80	80	85
Permeable Pavement w/ Sand, Veg. - A/B soils, underdrain	PermPavSVUDAB	50	50	70
Permeable Pavement w/ Sand, Veg. - C/D soils, underdrain	PermPavSVUDCD	20	20	55
Permeable Pavement w/o Sand, Veg. - A/B soils, no underdrain	PermPavNoSVNoUDAB	75	80	85
Permeable Pavement w/o Sand, Veg. - A/B soils, underdrain	PermPavNoSVUDAB	45	50	70
Permeable Pavement w/o Sand, Veg. - C/D soils, underdrain	PermPavNoSVUDCD	10	20	55
Stormwater Management by Era 1985 to 2002 MD	SWMEra8502	17	30	40
Stormwater Management by Era 2002 to 2010 MD	SWMEra0210	30	40	80
Stormwater to the Maximum Extent Practicable (SW to the MEP)	E3SWMNew	50	60	90
Street Sweeping 26 times a year-acres (formerly called Street Sweeping Mechanical Monthly)	StreetSweep	3	3	9
Urban Filtering Practices	Filter	40	60	80
Urban Forest Buffers	ForestBufUrban	25	50	50
Urban Infiltration Practices w/ Sand, Veg. - A/B soils, no underdrain	InfiltWithSV	85	85	95
Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	Infiltration	80	85	95
Vegetated Open Channels - A/B soils, no underdrain	VegOpChanNoUDAB	45	45	70
Vegetated Open Channels - C/D soils, no underdrain	VegOpChanNoUDCD	10	10	50
Wet Ponds and Wetlands	WetPondWetland	20	45	60

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the previous equation. The pollutant loading rates shown for Total Nitrogen, Total Phosphorus, and Sediment, each expressed as number of lbs/ac/yr, represent the impervious and pervious urban rates used in the pollutant loading analysis for each watershed (Tables 6-3 and 6-4) since this represents the likely sources of runoff being treated. Note that impervious and pervious urban loading rates are based on MAST. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Table 6-5. The total pollutant load reduction expected from existing and planned BMPs is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in the Tables that follow.

Table 6-6. Existing Stormwater Management Practices in the Little Patuxent Watershed installed after 2009, showing potential pollutant load reductions applicable to the Bay TMDL.

SWM Facility Type	Imper-vious DA (acres)	Perv-ious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
			Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
BioRetention, A/B soils, no underdrain	0.00	0.00	0.0	80%	0.0	0.0	85%	0.0	0.0	90%	0
BioRetention, A/B soils, with underdrain	19.38	15.36	455.2	70%	318.6	43.1	75%	32.3	43,418.7	80%	34,735
BioRetention, C/D soils, with underdrain	36.32	29.54	860.4	25%	215.1	80.9	45%	36.4	81,582.0	55%	44,870
BioSwale	1.22	4.79	66.6	70%	46.6	3.8	75%	2.9	3,824.5	80%	3,060
Dry Ponds	58.84	109.88	2,009.7	5%	100.5	149.2	10%	14.9	149,925.9	10%	14,993
Extended Dry Ponds	17.25	45.83	724.5	20%	144.9	47.7	20%	9.5	47,859.1	60%	28,715
Urban Filtering Practices	35.42	40.23	952.5	40%	381.0	82.2	60%	49.3	82,831.1	80%	66,265
Urban Infiltration Practices, w/o S/V, A/B soils	20.63	13.22	453.5	80%	362.8	44.9	85%	38.2	45,334.1	95%	43,067
Urban Infiltration Practices, w/o S/V, C/D soils	27.34	25.13	676.4	85%	575.0	61.8	85%	52.5	62,238.3	95%	59,126
Urban Infiltration Practices, w S/V, A/B soils	16.50	7.70	334.0	85%		35.1	85%		35,420.3	95%	
Urban Infiltration Practices, w S/V, C/D soils	1.06	0.45	21.1	85%	17.9	2.2	85%	1.9	2,268.8	95%	2,155
Permeable Pavement, w/o S/V, UD, C/D soils	1.19	0.17	20.3	10%	2.0	2.4	20%	0.5	2,441.0	55%	1,343
Step Pool Stormwater Conveyance	3.63	3.42	56.7	57%	32.3	7.2	66%	4.8	7,311.5	70%	5,118
Vegetated Open Channels - C/D soils, no UD	0.49	0.26	10.2	10%	1.0	1.0	10%	0.1	1,058.8	50%	529
Wet Ponds	220.21	317.15	6,587.5	20%	1,317.5	530.9	45%		534,173.4	60%	320,504
BioRetention, A/B soils, no underdrain	0.00	0.00	0.0	80%	0.0	0.0	85%	0.0	0.0	90%	0
Total	**459.62**	**613.15**	**13,231**		**3,516**	**1,093**		**243**	**1,099,990**		**624,692**

Table 6-7. Existing Stormwater Management Practices in the Little Patuxent Watershed installed after 2004, showing potential pollutant load reductions applicable to the local sediment TMDL.

SWM Facility Type	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
			Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
BioRetention, A/B soils, no underdrain	0.00	0.00	0.0	70%	0	0.0	75%	0	0.0	80%	0
BioRetention, A/B soils, with underdrain	29.76	26.08	731.3	5%	37	58.5	10%	6	52,421.4	10%	5,242
BioRetention, C/D soils, with underdrain	51.24	50.24	1,310.6	20%	262	102.5	20%	20	91,529.6	60%	54,918
BioSwale	34.90	60.96	1,150.9	40%	460	79.0	60%	47	68,754.6	80%	55,004
Dry Ponds	135.87	167.90	3,810.2	80%	3,048	283.6	85%	241	251,025.6	95%	238,474
Extended Dry Ponds	57.96	119.67	2,089.2	20%	418	137.5	45%	62	118,598.4	60%	71,159
Urban Filtering Practices	62.91	77.91	1,765.9	70%	1,236	131.4	75%	99	116,277.2	80%	93,022
Urban Infiltration Practices, w/o S/V, A/B soils	48.16	43.11	1,192.2	80%	954	94.9	85%	81	85,049.6	90%	76,545
Urban Infiltration Practices, w/o S/V, C/D soils	42.45	30.41	977.6	80%	782	81.0	85%	69	73,147.4	90%	65,833
Urban Infiltration Practices, w S/V, A/B soils	16.50	7.70	340.1	85%	289	30.1	85%	26	27,438.0	90%	24,694
Urban Infiltration Practices, w S/V, C/D soils	7.17	1.55	130.6	85%	111	12.5	85%	11	11,504.2	90%	10,354
Step Pool Stormwater Conveyance	3.63	3.42	58.5	57%	33.4	6.0	66%	4.0	5,633.4	70%	3,943
Permeable Pavement, w/o S/V, no underdrain, C/D soils	1.19	0.17	20.8	10%	2.1	2.0	20%	0.4	1,884.1	55%	1,036
Vegetated Open Channels - A/B soils, no UD	0.15	0.00	2.4	45%	1.1	0.2	45%	0.1	232.7	70%	163
Vegetated Open Channels - C/D soils, no UD	0.49	0.26	10.4	10%	1.0	0.9	10%	0.1	820.8	50%	410
Wet Ponds	624.14	901.71	18,762.2	20%	3,752	1,347.7	45%	606	1,184,400.9	60%	710,641
Total	**1116.52**	**1491.09**	**32,353**		**11,387**	**2,368**		**1,272**	**2,088,718**		**1,411,438**

6.3 Stormwater Management Pond Conversions (Model Tab T2)

This analysis calculates the anticipated pollutant load reductions that would result from implementing stormwater facility conversions, as per the opportunities identified in the watershed assessment (see Section 4.3.1). Results are presented for all opportunities identified, including those with and without concept plans.

Some dry ponds and extended detention dry ponds can be converted to facilities with higher capacity for nutrient removal. Pollutant reductions for these SWM pond conversions are calculated based on the approximate pollutant load received from the DA and the increase in RE based on BMP efficiencies in MAST for detention and extended detention facilities (See Table 6-5). The equation used to estimate nutrient and sediment load reductions for SWM pond conversion is expressed as

[#(lbs/ac/yr)*DA (acres)]*RE (%)

The pollutant load received from the drainage area contribution to the SWM pond is denoted by the first expression in brackets in the equation above. Similar to existing SWM, the pollutant loading rates, # lbs Total Nitrogen/ac/yr, # lbs Total Phosphorus/ac/yr, or # lbs Sediment ac/yr, represent the impervious and pervious urban rates in the pollutant loading analysis (Tables 6-3 and 6-4) since this represents the likely sources of runoff being treated. The increased pollutant removal capacity is represented by the third expression in the equation above. This is the difference between percent pollutant removal efficiencies of the facilities, based on CBP guidance shown in Table 6-5. A summary of SWM pond conversion load reduction calculations and results are shown in Table 6-8.

Additionally, each individual BMP conversion project is listed in Appendix I, Table I-1.

Table 6-8. Stormwater Management Facility (SWM) conversions proposed for the Little Patuxent Watershed and potential pollutant load reductions, summarized by MAST category

Pollutant	Impervious DA for Conversion (acres)	Pervious DA for Conversion (acres)	Original Removal Efficiency	New Removal Efficiency	Increase in Efficiency	Max Potential Load Reduction (lbs/yr)
Dry Ponds to BioSwale, with concepts						
TN	3.47	9.13	5%	70%	65%	94
TP	3.47	9.13	10%	75%	65%	6
Sediment	3.47	9.13	10%	80%	70%	6,716
Dry Ponds to Extended Dry Ponds, with concepts						
TN	42.06	45.41	5%	20%	15%	166
TP	42.06	45.41	10%	20%	10%	10
Sediment	42.06	45.41	10%	60%	50%	48,849
Dry Ponds to Wet Ponds, with concepts						
TN	38.42	79.20	5%	20%	15%	208
TP	38.42	79.20	10%	45%	35%	35
Sediment	38.42	79.20	10%	60%	50%	50,014
Extended Dry Ponds to Filter, with concepts						
TN	8.81	10.63	20%	40%	20%	49
TP	8.81	10.63	20%	60%	40%	8
Sediment	8.81	10.63	60%	80%	20%	4,156
Extended Dry Ponds to Wet Pond, with concepts						
TN	9.76	8.04	20%	20%	0%	0
TP	9.76	8.04	20%	45%	25%	5
Sediment	9.76	8.04	60%	60%	0%	0
Dry Ponds to Bioretention with underdrain and A/B soils, without concepts						
TN	4.97	2.26	5%	70%	65%	65
TP	4.97	2.26	10%	75%	65%	7
Sediment	4.97	2.26	10%	80%	70%	7,452
Dry Ponds to Bioretention with underdrain and C/D soils, without concepts						
TN	4.12	8.18	5%	25%	20%	29
TP	4.12	8.18	10%	45%	35%	4
Sediment	4.12	8.18	10%	55%	45%	4,783
Dry Ponds to Swale, without concepts						
TN	6.33	3.93	5%	70%	65%	90
TP	6.33	3.93	10%	75%	65%	9
Sediment	6.33	3.93	10%	80%	70%	9,714
Dry Ponds to Extended Dry Ponds, without concepts						
TN	18.81	38.94	5%	20%	15%	102
TP	18.81	38.94	10%	20%	10%	5
Sediment	18.81	38.94	10%	60%	50%	24,511
Dry Ponds to Urban Filtering Practices, without concepts						
TN	64.96	61.19	5%	40%	35%	568
TP	64.96	61.19	10%	60%	50%	74
Sediment	64.96	61.19	10%	80%	70%	103,818

Table 6-8. (Continued)

Pollutant	Impervious DA for Conversion (acres)	Pervious DA for Conversion (acres)	Original Removal Efficiency	New Removal Efficiency	Increase in Efficiency	Max Potential Load Reduction (lbs/yr)
Dry Ponds to Infiltration Practices w/o Sand, Veg., without concepts						
TN	5.83	15.14	5%	80%	75%	181
TP	5.83	15.14	10%	85%	75%	12
Sediment	5.83	15.14	10%	95%	85%	13,655
Dry Ponds to Wet Ponds, without concepts						
TN	186.37	261.54	5%	20%	15%	826
TP	186.37	261.54	10%	45%	35%	157
Sediment	186.37	261.54	10%	60%	50%	225,065
Extended Dry Ponds to Bioretention with underdrain and A/B soils, without concepts						
TN	1.69	4.26	20%	70%	50%	34
TP	1.69	4.26	20%	75%	55%	3
Sediment	1.69	4.26	60%	80%	20%	924
Extended Dry Ponds to Bioretention with underdrain and C/D soils, without concepts						
TN	7.77	14.47	20%	25%	5%	13
TP	7.77	14.47	20%	45%	25%	5
Sediment	7.77	14.47	60%	55%	-5%	-989
Extended Dry Ponds to Biowale, without concepts						
TN	6.85	2.40	20%	70%	50%	65
TP	6.85	2.40	20%	75%	55%	8
Sediment	6.85	2.40	60%	80%	20%	2,896
Extended Dry Ponds to Urban Filtering Practices, without concepts						
TN	18.04	34.44	20%	40%	20%	125
TP	18.04	34.44	20%	60%	40%	18
Sediment	18.04	34.44	60%	80%	20%	9,238
Extended Dry Ponds to Infiltration Practices w/o Sand, Veg., without concepts						
TN	3.31	8.22	20%	80%	60%	80
TP	3.31	8.22	20%	85%	65%	6
Sediment	3.31	8.22	60%	95%	35%	3,159
Extended Dry Ponds to Stormwater to the MEP - Step Pool Stormwater Conveyance, without concepts						
TN	1.66	4.37	20%	57%	37%	26
TP	1.66	4.37	20%	66%	46%	2
Sediment	1.66	4.37	60%	70%	10%	459
Extended Dry Ponds to Wet Ponds, without concepts						
TN	144.21	131.54	20%	20%	0%	0
TP	144.21	131.54	20%	45%	25%	81
Sediment	144.21	131.54	60%	60%	0%	0

6.4 New Stormwater Control Measures (Model tab T3)

This analysis calculates the anticipated pollutant load reductions that would result from implementing new BMPs, as per the opportunities identified in the watershed assessment (see Section 4.3.2). Results are presented for all opportunities identified, including those with and without concept plans.

New BMPs are proposed to capture and treat runoff from impervious surfaces (e.g., buildings, parking lots, alleys) which are currently untreated. Pollutant reductions for new BMPs are calculated based on the approximated pollutant load received from the DA and RE of these structural BMPs. The equation used to estimate nutrient and sediment load reductions for new BMPs is expressed as

[# (lbs/ac/yr)*DA (acres)]*RE (%)

The pollutant load received from the drainage area contributing to the BMP is denoted by the first expression in brackets in the equation above. The pollutant loading rates shown, # lbs Total Nitrogen/ac/yr, # lbs Total Phosphorus/ac/yr, or # lbs Sediment/ac/yr, are the pervious and impervious urban rates used in the pollutant loading analysis (Tables 6-3 and 6-4) since this represents the source of runoff being treated. Pollutant removal efficiencies are those from Table 6-5. A summary of these BMP load reduction calculations and results are shown in Table 6-9.

Additionally, each individual new BMP project is listed in Table I-2 in Appendix I.

Table 6-9. Proposed Stormwater Management (SWM) facilities for the Little Patuxent Watershed showing potential pollutant load reductions summarized by MAST category type and those with and without concept designs

SWM Facility Type	Impervious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
			Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
Bioretention with underdrain on CD soils, Concepts	4.63	2.22	80.6	25%	20.2	9.9	45%	4.4	9958	55%	5477
Filter, Concepts	12.99	0.88	142.7	40%	57.1	26.1	60%	15.7	26409	80%	21127
Wet Pond, Concepts	15.85	9.56	306.6	20%	61.3	34.3	45%	15.5	34652	60%	20791
Bioretention with underdrain on AB soils, No Concepts	5.37	4.31	120.7	70%	84.5	12.0	75%	9.0	12053	80%	9642
Bioretention with underdrain on CD soils, No Concepts	47.68	16.82	736.1	25%	184.0	99.8	45%	44.9	100824	55%	55453
BioSwale, No Concepts	22.38	12.63	419.4	70%	293.6	48.2	75%	36.2	48684	80%	38947
DryPonds, No Concepts	1.15	0.34	16.8	5%	0.8	2.4	10%	0.2	2416	10%	242
Filter, No Concepts	152.07	30.00	1978.2	40%	791.3	311.5	60%	186.9	314806	80%	251845
Infiltration, No Concepts	8.30	3.57	138.2	80%	110.5	17.6	85%	14.9	17740	95%	16853
Permeable Pavement, NoSV, NoUD, No Concepts	21.02	2.47	247.3	75%	185.5	42.6	80%	34.1	43041	85%	36585
Wet Pond, No Concepts	24.73	8.74	382.0	20%	76.4	51.8	45%	23.3	52299	60%	31380
TOTAL	**316**	**92**	**4569**		**1865**	**656**		**385**	**662882**		**488342**

6.5 Impervious Surface Reduction (Model Tab T4)

Impervious cover removal would involve converting impervious surfaces to pervious surfaces; therefore, the loading rate would be reduced by a factor equal to the difference between impervious and pervious urban loading rates in the watershed pollutant loading analysis. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the area proposed for impervious cover removal, as shown in Tables 6-10 and 6-11.

Table 6-10. Existing impervious surface reduction projects in the Little Patuxent Watershed showing potential pollutant load reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Loading Rate (lbs/ac/yr)	Reduction in Loading Rate (lbs/ac/yr)	Impervious Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	15.62	9.93	5.69	27.57	157
TP	1.99	0.29	1.70	27.57	47
Sediment	2,014	286	1,727	27.57	47,632

Table 6-11. Proposed impervious surface reduction projects in the Little Patuxent Watershed showing potential pollutant load reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Loading Rate (lbs/ac/yr)	Reduction in Loading Rate (lbs/ac/yr)	Impervious Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	15.62	9.93	5.69	21.02	120
TP	1.99	0.29	1.70	21.02	36
Sediment	2,014	286	1,727	21.02	36,317

6.6 Urban Tree Plantings (Model Tab T6)

Open pervious areas with reforestation potential (forest buffers and urban tree plantings) were identified in the watershed. Pollutant reductions for pervious area reforestation are calculated based on land use conversion from pervious urban to forest. The equation used to estimate nutrient and sediment load reductions for pervious area reforestation is expressed as

Land Use Conversion load reduction = [pervious urban (lbs/ac/yr) - forest (lbs/ac/yr)]* Open Pervious Area (acres)

Pervious area reforestation would involve converting open pervious area to forest; therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant analysis (Tables 6-3 and 6-4) as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the open pervious area available for reforestation. A summary of pervious area reforestation reduction calculations and results are shown in Tables 6-12 through 6-14 for the watersheds, for all opportunities identified, including those with and without concept plans.

Table 6-12. Existing (post-2009) urban tree planting in the Little Patuxent Watershed potential pollutant load reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Open Pervious Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	9.93	3.49	6.44	7.0	45
TP	0.29	0.08	0.21	7.0	2
Sediment	286	194	92	7.0	646

Table 6-13. Urban tree planting in the Little Patuxent Watershed potential pollutant load reductions for sites without concept plans

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Open Pervious Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	9.93	3.49	6.44	7.5	48
TP	0.29	0.08	0.21	7.5	2
Sediment	286	194	92	7.5	686

Table 6-14. Proposed urban tree planting in the Little Patuxent Watershed potential pollutant load reductions for sites with concept plans

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Urban Tree Planting Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	9.93	3.49	6.44	88.6	570
TP	0.29	0.08	0.21	88.6	19
Sediment	286	194	92	88.6	8,123

6.7 Stream Restoration (Model Tab T7)

Nutrient and sediment reduction benefits were estimated for existing stream restoration sites from the County's BMP database and for the potential new stream restoration sites identified as part of the watershed assessments. Results are presented for all opportunities identified, including those with and without concept plans. Credits for stream restoration are based on the Chesapeake Bay Program's Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Schueler and Stack 2014). For general watershed planning, the Panel Report recommends using a factor of 0.075 pounds/linear foot of reach length (RL) for nitrogen, 0.068 pounds/linear foot for phosphorus, and 44.88 pounds/linear foot for sediment as the edge-of-stream loading reduction potential.

The equation used to estimate total nitrogen reductions for stream restoration is expressed as

0.075 (lbs/ft)*RL (ft)

The equation used to estimate total phosphorus load reductions for stream restoration is expressed as

0.068 (lbs/ft)*RL (ft)

The equation used to estimate sediment load reductions for stream restoration is expressed as

44.88 (lbs/ft)*RL (ft)

A summary of stream restoration reduction calculations and results for existing and proposed stream restoration projects are shown in Tables 6-15 through 6-18.

Table 6-15. Existing Stream Restoration practices in the Little Patuxent Watershed installed after 2009, showing estimated pollutant load reductions applicable to the Bay TMDL.

Pollutant	Reduction in Loading Rate (lbs/ft)	Stream Restoration Length (ft)	Estimated Load Reduction (lbs/yr)
TN	0.075	10,716	804
TP	0.068	10,716	729
Sediment	44.88	10,716	480,956

Table 6-16. Existing Stream Restoration practices in the Little Patuxent Watershed installed after 2004, showing potential pollutant load reductions applicable to the local sediment TMDL.

Pollutant	Reduction in Loading Rate (lbs/ft)	Potential Stream Restoration Length (ft)	Max Potential Load Reduction (lbs/yr)
TN	0.075	11,294	847
TP	0.068	11,294	768
Sediment	44.88	11,294	506,880

Table 6-17. Proposed Stream Restoration practices in the Little Patuxent Watershed, for sites with concept plans, showing potential pollutant load reductions applicable to the Bay and local TMDLs.

Pollutant	Reduction in Loading Rate (lbs/ft)	Potential Stream Restoration Length (ft)	Max Potential Load Reduction (lbs/yr)
TN	0.075	86,890	6,517
TP	0.068	86,890	5,909
Sediment	44.88	86,890	3,899,623

Table 6-18. Proposed Stream Restoration practices in the Little Patuxent Watershed, for sites without concept plans, showing potential pollutant load reductions applicable to the Bay and local TMDLs.

Pollutant	Reduction in Loading Rate (lbs/ft)	Potential Stream Restoration Length (ft)	Max Potential Load Reduction (lbs/yr)
TN	0.075	46,392	3,479
TP	0.068	46,392	3,155
Sediment	44.88	46,392	2,082,088

6.8 Regenerative Step Pool Storm Conveyance (Model Tab T10)

Regenerative Step Pool Storm Conveyance (SPSC) practices can be used for retrofitting unstable and degraded stormwater conveyance channels (MDE 2014c). The Anne Arundel County SPSC design guidelines (2012) define this practice as "open-channel conveyance structures that convert, through attenuation ponds and a sand seepage filter, surface storm flow to shallow groundwater flow." When these practices are used in ephemeral or dry channels as retrofits to capture the runoff from one inch of rainfall, the pollutant removal efficiencies from the most similar BMP type may be used. Because these practices apply to dry conveyance channels, they are located in small drainage areas (e.g., 10 acres). The SPSC performs very similar to a filtration practice, therefore, the pollutant removal efficiencies for micro-bioretention can be applied to the drainage area treated (values in Table 6 from MDE (2014c) were used for efficiencies assuming a 1" runoff treatment depth).

The equation used to estimate nutrient and sediment load reductions for SPSC practices is expressed as

[# (lbs/ac/yr)*DA (acres)]*RE (%)

The pollutant load received from the drainage area contributing to the SPSC is denoted by the first expression in brackets in the equation above. The pollutant loading rates shown, # lbs Total Nitrogen/ac/yr, # lbs Total Phosphorus/ac/yr, or # lbs Sediment/ac/yr, are the pervious and impervious urban rates used in the pollutant loading analysis (Tables 6-3 and 6-4) since this represents the source of runoff being treated. A summary of these load reduction calculations and results are shown in Tables 6-19 and 6-20.

Table 6-19. Proposed Regenerative Step Pool Conveyance projects with concept plans showing potential pollutant load reductions

Pollutant	Impervious Acre Equivalent	Impervious Urban Loading Rate (lbs/ac/yr)	Loads from DA (lbs/yr)	RE %	Max Potential Load Reduction (lbs/yr)
TN	28.35	15.62	442.8	57%	252.4
TP	28.35	1.99	56.4	66%	37.25
Sediment	28.35	2013.65	57,087	70%	39,961

Table 6-20. Potential pollutant load reductions for proposed Regenerative Step Pool Storm Conveyance projects without concept plans

Pollutant	Impervious Acre Equivalent	Impervious Urban Loading Rate (lbs/ac/yr)	Loads from DA (lbs/yr)	RE %	Max Potential Load Reduction (lbs/yr)
TN	32.58	15.62	508.9	57%	290.1
TP	32.58	1.99	64.9	66%	42.8
Sediment	32.58	2013.65	65,614	70%	45,930

6.9 Overall Pollutant Loading Reductions (Model Tab FinalSummary)

The sum of maximum potential pollutant load reductions calculated for individual BMPs represent the overall pollutant removal capacity for a maximum implementation scenario (i.e., 100% of the projects are implemented). Tables 6-21 and 6-22 present a summary of estimated pollutant load reductions for the maximum projected implementation of each BMP type, including how reductions were credited, pollutant removal efficiencies, potential load reductions, and units available for restoration. Also included are some additional credits for rain barrels, rooftop disconnects, and non-rooftop disconnects. These credits were calculated as part of the Countywide Implementation Strategy presented in a separate report (KCI 2015).

Results for the Bay TMDL indicate that the target load reduction for total phosphorus of 17.2% is easily met with a 54% load reduction if all potential projects are included; the sediment load reduction target is also met since the phosphorus target is met. If only new projects with concept plans are included, the total phosphorus goal is still exceeded with a 34% reduction. These goals are met primarily due to stream restoration and its associated reductions using the interim reduction rates. Actual phosphorus and sediment reduction could be different, depending on the actual design implemented for these projects. The total nitrogen target of 9.4% is not met, since there is only a 7.1% reduction achieved if all BMPs are implemented. An additional 2.4% reduction would be required to meet the target goal. If only new projects with concept plans are considered, there is a 4.5% reduction in total nitrogen. For the local sediment TMDL, the target goal of 48.1% is achieved with a total reduction achieved of 62% if all BMPs were implemented; if only projects with concept plans are implemented, the sediment goal is not achieved since only a 41% reduction is attained. As noted on individual concept plans, there are a number of constraints to project implementation. Other constraints may include citizen acceptance and permitting concerns.

The assumed implementation of potential restoration BMPs shows how they would approach or exceed the required percent reduction for nitrogen, phosphorus, and sediment loads needed to meet water quality standards for this watershed as specified by the local and Chesapeake Bay TMDLs. Additional reductions may also be achieved through restoration actions not included in this analysis such as street sweeping, erosion and sediment control, and public education and outreach efforts (e.g., watershed trash and recycling campaign, conservation landscaping, pet waste education). These types of actions are not included in the pollutant removal analysis

Table 6-21. Summary of potential pollutant load reductions for the Little Patuxent Watershed for existing and proposed stormwater management practices to meet the local sediment TMDL

BMP	How Credited	TN Efficiency	TP Efficiency	Sediment Efficiency	Max Potential TN Load Reduction	Max Potential TP Load Reduction	Max Potential Sediment Load Reduction	Units Available	
Existing SWM	Efficiency	varies	varies	varies	11,387	1,272	1,411,438	2,608	acres
Existing Stream Restoration	lbs per Ln Ft	0.075	0.068	44.88	847	768	506,880	11,294	ft
Existing Impervious Surface Reduction	LU Conversion	N/A	N/A	N/A	157	47	47,632	28	acres
Existing Tree Plantings	LU Conversion	N/A	N/A	N/A	45	2	646	7	acres
				Total	12,234	2,040	1,918,317		
				Total Existing Urban Load (lbs/yr)	282,269	17,259	14,629,477		
				Reduction Achieved	4.3%	11.8%	13.1%		
Impervious Surface Reduction	LU Change	N/A	N/A	N/A	120	36	36,317	21	acres
				Additional Reduction Achieved	0.04%	0.21%	0.25%		
SWM Conversion with concepts	Efficiency	varies	varies	varies	517	64	109,736	255	acres
				Additional Reduction Achieved	0.2%	0.4%	0.8%		
SWM Conversion without concepts	Efficiency	varies	varies	varies	2204	390	404685	1,066	acres
				Additional Reduction Achieved	0.8%	2.3%	2.8%		
Regenerative Step Pool Conveyance	Efficiency	57%	66%	70%	542	80	85891	61	acres
					0.2%	0.5%	0.6%		
Pervious Area Reforestation	LU Conversion	N/A	N/A	N/A	618	21	8,808	96	acres
				Additional Reduction Achieved	0.2%	0.1%	0.1%		
New Stream Restoration	lbs per Ln Ft	0.075	0.068	45	9,996	9,063	5,981,711	133,282	ft
				Additional Reduction Achieved	3.5%	52.5%	40.9%		
New BMPs	Efficiency	varies	varies	varies	1,865	385	488,342	408	acres
				Additional Reduction Achieved	0.7%	2.2%	3.3%		
Rain Barrels					7.17	0.97			
				Additional Reduction Achieved	0.003%	0.006%			
Rooftop Disconnects					81.74	98.08	147.12		
				Additional Reduction Achieved	0.029%	0.568%	0.001%		
Nonrooftop Disconnects					73.9	88.68	133.02		
				Additional Reduction Achieved	0.026%	0.514%	0.001%		
				TOTAL Reduction Achieved	10.0%	71.1%	61.8%		
		Total Potential Load Reduction			28,260	12,266	9,034,087		
		Reduction Target			N/A	N/A	48.1		

Table 6-22. Summary of potential pollutant load reductions for the Little Patuxent Watershed for existing and proposed stormwater management practices to meet the Bay TMDL

BMP	How Credited	TN Efficiency	TP Efficiency	Sediment Efficiency	Max Potential TN Load Reduction	Max Potential TP Load Reduction	Max Potential Sediment Load Reduction	Units Available	
Existing SWM	Efficiency	varies	varies	varies	3,516	243	624,692	1,073	acres
Existing Stream Restoration	lbs per Ln Ft	0.02	0.068	45	804	729	480,956	10,716	ft
Existing Impervious Surface Reduction	LU Conversion	N/A	N/A	N/A	157	47	47,632	28	acres
Existing Tree Plantings	LU Conversion	N/A	N/A	N/A	45	2	646	7	acres
				Total	4,320	972	1,105,649		
				Total Existing Urban Load (lbs/yr)	285,325	20,644	20,735,988		
				Reduction Achieved	1.5%	4.7%	5.3%		
Impervious Surface Reduction	Efficiency	N/A	N/A	N/A	120	36	36,317	21	acres
				Additional Reduction Achieved	0.04%	0.17%	0.18%		
SWM Conversion with concepts	Efficiency	varies	varies	varies	517	64	109,736	255	acres
				Additional Reduction Achieved	0.2%	0.3%	0.5%		
SWM Conversion without concepts	Efficiency	varies	varies	varies	2,204	390	404,685	1,066	acres
				Additional Reduction Achieved	0.8%	1.9%	2.0%		
Regenerative Step Pool Conveyance	Efficiency	57%	66%	70%	542	80	85,891	31	acres
				Additional Reduction Achieved	0.19%	0.39%	0.41%		
Pervious Area Reforestation	LU Conversion	N/A	N/A	N/A	618	21	8,808	96	acres
				Additional Reduction Achieved	0.22%	0.10%	0.04%		
New Stream Restoration	lbs per Ln Ft	0.075	0.068	45	9,996	9,063	5,981,711	133,282	ft
				Additional Reduction Achieved	3.5%	43.9%	28.8%		
New BMPs	Efficiency	varies	varies	varies	1,865	385	488,342	408	acres
				Additional Reduction Achieved	0.7%	1.9%	2.4%		
Rain Barrels					7.17	0.97			
					0.003%	0.005%			
Rooftop Disconnects					81.74	98.08	147.12		
					0.029%	0.475%	0.001%		
Nonrooftop Disconnects					73.9	88.68	133.02		
					0.026%	0.430%	0.001%		
				TOTAL Reduction Achieved	7.1%	54.2%	39.6%		
		Total Potential Load Reduction			20,345	11,199	8,221,418		
		Reduction Target			9.4%	17.2%	**		
		** met if TP target met							

because they require additional site-specific analyses, or reduction efficiencies are not well known and are difficult to estimate. These may be added as more information becomes available.

6.10 Proposed Implementation Timeframe

Howard County's MS4 permit requires that watershed assessments "specify pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs." To this end, an implementation timeline is presented in Tables 6-23 and 6-24 to assist the County in implementing recommended projects and tracking the program's progress toward WLA and MS4 goals.

Table 6-23. Pollutant load reduction benchmarks associated with TMDLs and impervious area restoration target, for Little Patuxent Watershed in Howard County

TMDL	Benchmarks: Pollutant Reduction	Benchmark timeframe
Chesapeake Bay TMDLs	9.4% reduction in TN from 2009 baseline	60% of reduction by 2017 100% of reduction by 2025
	17.2% reduction in TP from 2009 baseline	60% of reduction by 2017 100% of reduction by 2025
	X% reduction in TSS **	
Local Sediment TMDL	48.1% reduction in TSS from 2005 baseline	
	Impervious Area Restoration	
MS4 Permit	20% of impervious area restored, countywide	20% of impervious area restored, countywide by December 2019

** Bay sediment TMDL assumed met if TP target is met

Table 6-24. Proposed implementation timeline to meet TMDL pollutant reduction and MS4 permit deadlines, for the Little Patuxent Watershed

Action	Date Completed By	Milestone
MS4 Permit Issued	December 2014	
Completion of Little Patuxent Watershed Assessment	December 2015	
Completion of Countywide Restoration Plan (CIS)	December 2015	
Project design and implementation; annual tracking of progress toward TMDL targets	December 2016	
Continued project design and implementation; annual tracking	December 2017	Implement suite of projects and alternative BMPs providing 60% of the required TN and TP reductions in Little Patuxent Watershed, to meet Chesapeake Bay 2017 TMDL targets
Continued project design and implementation; annual tracking	December 2018	
Continued project design and implementation; annual tracking	December 2019	From December 2014 to December 2019, implement suite of projects and alternative BMPs providing 20% of impervious area restoration, countywide
New MS4 Permit	Estimated to be issued December 2019	
Continued project design and implementation; annual tracking	December 2020	
Continued project design and implementation; annual tracking	December 2021	
Continued project design and implementation; annual tracking	December 2022	
Continued project design and implementation; annual tracking	December 2023	
Continued project design and implementation; annual tracking	December 2024	From December 2019-December 2024, implement suite of projects and alternative BMPs providing impervious area restoration, countywide, to meet 2019 MS4 permit requirements (if applicable)
Continued project design and implementation; annual tracking	December 2025	Implement suite of projects and alternative BMPs providing 100% of the required TN and TP reductions in Little Patuxent Watershed, to meet Chesapeake Bay TMDL targets

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Appendices

A. Inventory of GIS Data Compiled for Howard County Watershed Assessments January 2015

Hydrologic Unit Boundaries:

Maryland 8-digit watershed names [MDE8NAME] and numbers [MDE8DIGT]
Maryland 12-digit watershed numbers [DNR12DIG]
Howard County's 15 watershed names [Subshed_Ho]
Centennial Lake, Wilde Lake, Lake Kittamaqundi [CA_shed]
66 catchments: G:\GIS-Data\Howard_County\Working\Howard_County\subwatersheds_HoCo_0508 _Countywide_and_Columbia_subshed_names.shp.
CIS watersheds: G:\GIS-Data\Howard_County\Working\Howard_County\CIS_PreAssessments\HoCo_CIS _watersheds.shp, contains a unique ID [CISshednum]
HUC14 characteristics: G:\GIS-Data\Howard_County\Working\Howard_County\subwatersheds_HoCo_0508 _Countywide_subshed_names.shp

Analysis data sets:

Data set	Date	Comment	Versar file information
Historic aerial photography	Various		
Current aerial photography	2011, March	Data in tiles; refer to grid files for 200 series	G:\GIS-Data\Howard_County\Archive_data\2013 _April \ftpDownload2011Aerials\2011\SID
Impervious areas	2014	Paved and unpaved, combined. Created in 2014, based off 2013 planimetric layers.	G:\GIS-Data\Howard_County\Working\Howard _County \Impervious_surface_2014planimetrics _HoCo_V0914_paved_unpaved1.shp
Land use	2010	Use MDP	G:\GIS-Data\Howard_County\Archive_data \LandUse _LandCover\2010_MDP_LULC
Property	2014	Received property data (with ownership) from the County	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Property_parks_open_space_zoning _easements\property.shp
Zoning	2014, assumed	Received data from the County	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Property_parks_open_space_zoning _easements\zoning_current_region.shp
Forest conservation areas	2014, assumed	Received data from the County	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Property_parks_open_space_zoning _easements\ForestConservationEasements.shp
Natural resource areas	2014, assumed	Received data from the County	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Property_parks_open_space_zoning _easements\NaturalResourceOpenSpace.shp
County parks	2014, assumed	Received data from the County	G:\GIS-Data\Howard_County\Archive_data \2014_December\Property_parks_open_space _zoning_easements\Parks_County.shp
Non-County open space	2014, assumed	Received data from the County	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Property_parks_open_space_zoning _easements\NonCountyOpenSpace.shp
Storm drain pipes	2014		G:\GIS-Data\Howard_County\Archive_data\2014 _September\BMPs_AnnualReport_fromCounty& McT\McT FTP Download_082014 \final_pipes_polyline.shp

Data set	Date	Comment	Versar file information
Storm drain inlets	2014		G:\GIS-Data\Howard_County\Archive_data \2014_September\BMPs_AnnualReport_fromCou nty&McT\McT FTP Download_082014 \final_inlet_cent_point.shp
Storm drain outlets	2014		G:\GIS-Data\Howard_County\Archive_data \2014_September\BMPs_AnnualReport_fromCou nty&McT\McT FTP Download_082014 \final_outlet_cent.shp
Public water system	2012		G:\GIS-Data\Howard_County\Archive_data \2012_February\Water_master\MasterWater.shp
Public sewer system	2012		G:\GIS-Data\Howard_County\Archive_data \2012_February\Sewer_master\MasterSewer.shp
Streams	2014, assumed	Stream and river centerlines	G:\GIS-Data\Howard_County\Archive_data \2014_December\Stream_centerlines_and_Waters hed_DAs_2009\Stream_Centerline
Forest cover	2014, assumed		G:GIS-Data\Howard_County\Archive_data \2014_November\Email_CSmith_112514\Tree_Li ne.shp
Drainage complaints (frequent flooding)	Unknown	Data records have only location	G:\GIS-Data\Howard_County\Archive_data \2014_December\Flooded_roads_download\Frequ entFlooders_font_point.shp
MS4 Boundary	2011		G:\GIS-Data\Howard_County\Archive_data \2011_June\VTownes_Versar_Ftp\HoCo_MS4_B oundary.shp
Soils	2002		G:\GIS-Data\Howard_County\Archive_data\Soils\ Soils_HowardCo_with_hydgrp_MDSP83ft.shp
Howard County biological monitoring program data	2014		G:\GIS-Data\Howard_County\Working \Howard_County\HowardCo_Stream_Survey_Cou ntywide_Master.mdb
MBSS IBI Scores	Thru 2014	Maryland DNR	
SCA data	2012	MainPatux has only severity ranking in point files; HowardCo_pointlist _master.shp has a concentration of points in Upper Little Patuxent sub-watershed	G:\GIS-Data\Howard_County\Archive_data \2012_March\Stream_Corridor_Assessment_data _sets\ - separate folders for watersheds plus Hammond Branch and Dorsey Run
Contour lines	2014, assumed	Two-foot and ten-foot intervals	G:\GIS-Data\Howard_County\Archive_data\2014 _December\Contours_download\Contours2011 .gdb
BMPs	2015	new data set from McCormick Taylor	G:\GIS-Data\Howard_County\Archive_data \2014_December\BMP_Cleanup_update _McCormick_Taylor\HoCo_BMP_CleanUp.mdb
Potential BMP restoration projects	2015	new data set from McCormick Taylor	G:\GIS-Data\Howard_County\Archive_data \2014_December\BMP_Cleanup_update _McCormick_Taylor\HoCo_BMP_CleanUp.mdb

Data set	Date	Comment	Versar file information
Stream restoration projects	2015	new data set from McCormick Taylor	G:\GIS-Data\Howard_County\Archive_data \2014_December\BMP_Cleanup_update _McCormick_Taylor\HoCo_BMP_CleanUp.mdb
READY Program projects	2015	new data set from McCormick Taylor	G:\GIS-Data\Howard_County\Archive_data \2014_December\BMP_Cleanup_update _McCormick_Taylor\HoCo_BMP_CleanUp.mdb
DNR Wetlands Inventory	2005	Maryland DNR website	
Green Infrastructure	2012	Howard's GI Plan (based on MD GI Plan)	
Tier II Streams and Catchments	2012	MDE website	
Howard County IDDE Geodatabases	2000, 2002-2014	Received from the County	
Road Centerlines		Received from the County	

Data from Previous Studies:

Upper Little Patuxent Watershed Management Plan (Howard County/KCI 2009)
Columbia Watershed Management Plan - Lake Elkhorn (Columbia Association/Versar 2009)
Centennial Lake and Wilde Lake in Little Patuxent (Howard Co./CWP 2005)
Downtown Columbia - Symphony Stream/Lake Kittamaqundi (General Growth Properties/Biohabitats 2008)
Howard County Dry Pond retrofit report (Versar 2013)
Howard County LID and Tree Planting report (Versar 2013)
Little Patuxent SCA 2001
Dorsey Run SCA 2003
Hammond Branch SCA 2003
Middle Patuxent SCA

B. Descriptions of BMP Types

Appendix B: Stormwater Treatment BMP Definitions

BMP definitions are taken from the Maryland Assessment and Scenario Tool (MAST) guidance as provided on mastonline.org and edited, with the exception of regenerative step pool conveyance (RSC) which is provided by Anne Arundel County (2012); green roofs, whose definition is taken from the MDE Stormwater Design Manual (2009); and outfall stabilization, described in the August 2014 MDE guidance entitled Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Names in "()" next to BMP types are the MAST BMP Short Name. Not all BMPs considered here have been recognized by MAST and therefore may not have an official MAST-designated Short Name.

Extended Detention Dry Pond (ExtDryPonds)

Dry extended detention (ED) basins are depressions created by excavation or berm construction that temporarily store stormwater runoff and release it slowly via surface flow to the receiving stream or stormsewer system, at a specified rate, and / or via groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.

Wet Ponds and Wetlands (WetPondWetland)

A wet pond and stormwater treatment wetland are water impoundment structures that intercept stormwater runoff then release it to the receiving stream or stormsewer system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal.

Bioretention

Bioretention/raingardens - A/B soils, no underdrain (BioRetNoUDAB)

An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These excavated, planted areas are installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components consisting of the engineered media, topsoil, mulch, and vegetation, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil which assumes that all water will infiltrate into the subsoils.

Bioretention/raingardens - A/B soils, underdrain (BioRetUDAB)

An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil, in order to more carefully control dewatering of the system.

Bioretention/raingardens - C/D soils, underdrain (BioRetUDCD)

An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP is in C or D soil and has an underdrain in order to more assure dewatering of the system in timely fashion in these poorly draining soils.

Appendix B: Stormwater Treatment BMP Definitions

Non-Bioretention Filtering Practices

Permeable Pavement w/ Sand, Veg. - A/B soils, no underdrain (PermPavSVNoUDAB)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils. This BMP has no underdrain, has sand as part of the filtration media to increase surface area and pollutant removal efficiency and/or vegetation in surface voids, and is in A or B soil.

Permeable Pavement w/ Sand, Veg. - A/B soils, underdrain (PermPavSVUDAB)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain to more carefully control dewatering of the system, which will preclude infiltration of some stormwater, has sand as part of the filtration media to increase surface area and pollutant removal efficiency and/or vegetation, and is in A or B soil.

Permeable Pavement w/ Sand, Veg. - C/D soils, underdrain (PermPavSVUDCD)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain to more carefully control dewatering of the system, which will preclude infiltration of some stormwater, has sand as part of the filtration media to increase surface area and pollutant removal efficiency and/or vegetation, and is in C or D soil.

Permeable Pavement w/o Sand, Veg. - A/B soils, no underdrain (PermPavNoSVNoUDAB)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain allowing for infiltration into subsoils, no sand or vegetation, and therefore lower pollutant removal rates than a system with sand and/or vegetation, and is in A or B soil.

Permeable Pavement w/o Sand, Veg. - A/B soils, underdrain (PermPavNoSVUDAB)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain to more carefully control dewatering of the system, which will preclude infiltration of some stormwater, no sand or vegetation and therefore lower pollutant removal rates than a system with sand and/or vegetation, and is in A or B soil.

Permeable Pavement w/o Sand, Veg. - C/D soils, underdrain (PermPavNoSVUDCD)

Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain to more carefully control dewatering of the system, which will preclude infiltration of some stormwater, no sand or vegetation and therefore lower pollutant removal rates than a system with sand and/or vegetation, and is in C or D soil.

Appendix B: Stormwater Treatment BMP Definitions

Urban Filtering Practices (Filter)

These are practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity (CEC) achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.

Urban Filter Strip Runoff Reduction (UrbFilterRR)

Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.4 design ratio of filter strip length to impervious flow length is recommended for runoff reduction urban filter strips. These filter strips allow for infiltration into subsoils and therefore significant pollutant removal compared to Urban Filter Strip Storm Water Treatment.

Urban Filter Strip Storm Water Treatment (UrbFilterST)

Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.2 design ratio of filter strip length to impervious flow length is recommended for stormwater treatment urban filter strips. These filter strips do not allow for infiltration of subsoils and therefore only allow for reductions in sediment load.

Regenerative Step Pool Storm Conveyance (SPSC)

Regenerative Step Pool Storm Conveyance (SPSC) practices developed by Anne Arundel County Department of Public Works, Bureau of Engineering, have been used for retrofitting unstable and degraded stormwater conveyance channels in steep conveyance circumstances. SPSC systems are open-channel conveyance structures that convert, through attenuation ponds and a sand seepage filter, surface storm flow to shallow groundwater flow. These systems safely convey, attenuate, and treat the quality of storm flow. These structures utilize a series of constructed shallow aquatic pools, riffle grade control, native vegetation, and an underlying sand/woodchip mix filter bed media. The physical characteristics of the SPSC channel are best characterized by the Rosgen A or B stream classification types, where "bedform occurs as a step/pool, cascading channel which often stores large amounts of sediment in the pools associated with debris dams" (Rosgen, 1996). The pretreatment, recharge, and water quality sizing criteria closely follow the State of Maryland's criteria for a typical stormwater filtering device. These structures feature surface / subsurface runoff storage seams and an energy dissipation design that is aimed at attenuating the flow to a desired level through energy and hydraulic power equivalency principles.

Green Roof

Green roofs are alternative surfaces that replace conventional construction materials and include a protective covering of planting media and vegetation. Also known as vegetated roofs, roof gardens, or eco-roofs, these may be used in place of traditional flat or pitched roofs to reduce impervious cover and more closely mimic natural hydrology. Green roofs produce less heat than conventional systems. Therefore, they may be used to help mitigate stormwater impacts and temperature increases caused by new development.

There are two basic green roof designs that are distinguished by media thickness and the plant varieties that are used. The more common or "extensive" green roof is a lightweight system where the media layer is between two and six inches thick. This limits plants to low-growing, hardy herbaceous varieties. An extensive green roof may be constructed off-site as a modular system with drainage layers, growing media, and plants installed in interlocking grids.

Conventional construction methods may also be used to install each component separately. "Intensive" green roofs have thicker soil layers (eight inches or greater) and are capable of supporting more diverse plant communities including trees and shrubs. A more robust structural loading capacity is needed to support the additional weight of the media and plants. Intensive green roofs are more complex and expensive to design, construct, and maintain, are less commonly used, and are therefore not covered in the Maryland Stormwater Design manual.

Vegetated Channels

Vegetated Open Channels - A/B soils, no underdrain (VegOpChanNoUDAB)

Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, and includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain, allowing for infiltration into subsoils; however, because the system is within A or B soil infiltration is better than in a similar channel in C or D soils and allows for higher pollutant removal rates.

Vegetated Open Channels - C/D soils, no underdrain (VegOpChanNoUDCD)

Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain, allowing for infiltration into subsoils; however, C or D soils have lower infiltration rates and therefore lower pollutant removal rates relative to vegetated open channels in A or B soils.

Bioswale (BioSwale)

With a bioswale the load is reduced because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function as a bioretention area and therefore has much higher pollutant removal rates compared to the vegetated open channels in A/B and C/D soils.

Infiltration Practices

An infiltration practice generally is a depression to form an infiltration basin where sediment is trapped and water infiltrates into the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil (A/B soils). They are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approved to build is issued. To receive credit over the longer term, jurisdictions must conduct yearly inspections to determine if the basin or trench is still infiltrating runoff.

Urban Infiltration Practices w/ Sand, Veg. - A/B soils, no underdrain (InfiltWithSV)

A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Sand provides additional surface area for more complete filtration and vegetation provides root system uptake and additional biological activity for more complete pollutant processing.

Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain (Infiltration)

A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Sand or vegetation are not included in these system.

Appendix B: Stormwater Treatment BMP Definitions

Impervious Surface Reduction (ImpSurRed)

Reducing impervious surfaces to promote infiltration and percolation of runoff storm water by removing pavement and providing vegetative cover for 95% of the area that was previously impervious surface. MDE 2014 guidance offers 0.75 impervious acre equivalent credit for every acre of impervious cover removed and replaced with vegetation.

Urban Stream Restoration (UrbStrmRest)

Stream restoration is a change to the stream corridor that improves the stream ecosystem by restoring the natural hydrology and landscape of a stream, and helps improve habitat and water quality conditions in degraded streams. Credit is provided in the form of 0.01 impervious reduction equivalents of 0.01 acre per linear foot of outfall stabilization.

Urban Tree Planting (UrbanTreePlant)

Urban tree planting is planting trees on urban pervious areas at a rate that would produce a forest-like condition over time. The intent of the planting is to eventually convert the urban area to forest. If the trees are planted as part of the urban landscape, with no intention to covert the area to forest, then this would not count as urban tree planting. Credit given is 0.38 impervious equivalent removed per acre planted with a survival rate of 100 trees/acre or greater and where at least 50% of trees have two-inch diameter or greater when measured at 4.5 ft. above ground level. (MDE 2014)

Urban Forest Buffers (ForestBufUrban)

An urban forest buffer is area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs, and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals.

Outfall stabilization

Outfall stabilization or repair of localized areas of erosion below a storm drain outfall will received a maximum credit is 2 acres per project as per MAST. Credit is provided in the form of 0.01 impervious reduction equivalents of 0.01 acre per linear foot of outfall stabilization. No direct pollutant reduction credits are appropriated.

CITATIONS

Anne Arundel County Government, Maryland. 2012. Design Guidelines for Step Pool Storm Conveyance (SPSC) Revision 5. Department of Public Works, Bureau of Engineering. Prepared by Hala Flores, P.E., Dennis McMonigle, and Keith Underwood. http://www.aacounty.org/DPW/Watershed /StepPoolStormConveyance.cfm

MAST 2015. Maryland Assessment and Scenario Tool. http://www.mastonline.org/

MDE 2009. Maryland Stormwater Design Manual 2000, Volumes I and II, 2009 Edition. Water Management Administration.

MDE 2014. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Guidance for National Pollutant Discharge Elimination System Stormwater Permits. August 2014.

Rosgen, D., 1996, Applied River Morphology, Wildland Hydrology.

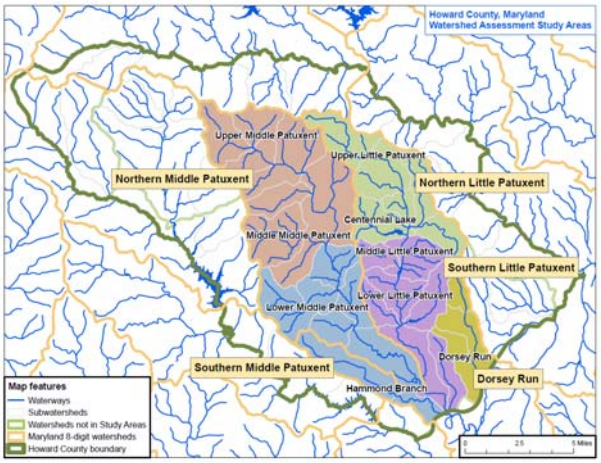
Appendix B: Stormwater Treatment BMP Definitions

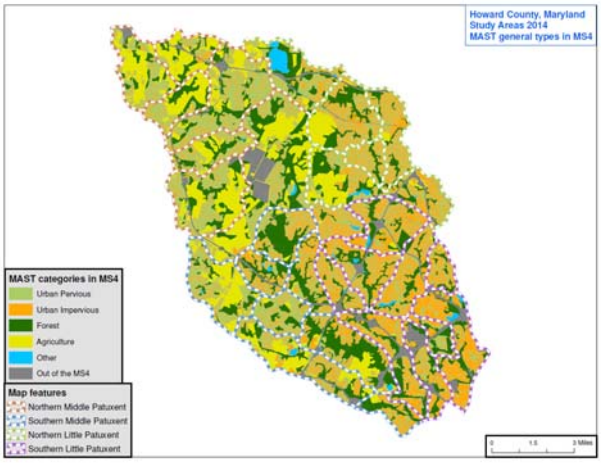
C. Field Protocols: Data Collection Guide

Field Protocols and Data Collection Guide

Howard County Watershed Assessments 2015

Middle and Little Patuxent River





Prepared for
Howard County Watershed Management Program
Howard County Department of Public Works
Bureau of Environmental Services
Stormwater Management Division

Prepared by
Versar, Inc.
Ecological Sciences and Applications
9200 Rumsey Road
Columbia, MD 21045

VERSAR

March 2015

Howard County Watershed Assessments in 2015

Study Areas and Consultant Assignments for Field Assessments

March 3, 2015 UPDATED

Watershed Assessment Study Area	Includes These Howard County Watersheds	Consultant for Field Assessments
Northern Middle Patuxent (NMP)	• Upper Middle Patuxent • Middle Middle Patuxent	McCormick Taylor
Southern Middle Patuxent (SMP)	• Lower Middle Patuxent • Hammond Branch	Biohabitats
Northern Little Patuxent (NLP)	• Upper Little Patuxent • Centennial Lake (part of Middle Little Patuxent)	KCI
Southern Little Patuxent (SLP)	• Middle Little Patuxent (except for Centennial Lake) • Lower Little Patuxent	Versar
Dorsey Run (DOR)	• Dorsey Run	McCormick Taylor

Note that Howard County Watersheds nest within Maryland 8-digit watersheds as follows:

02131106, Middle Patuxent River includes

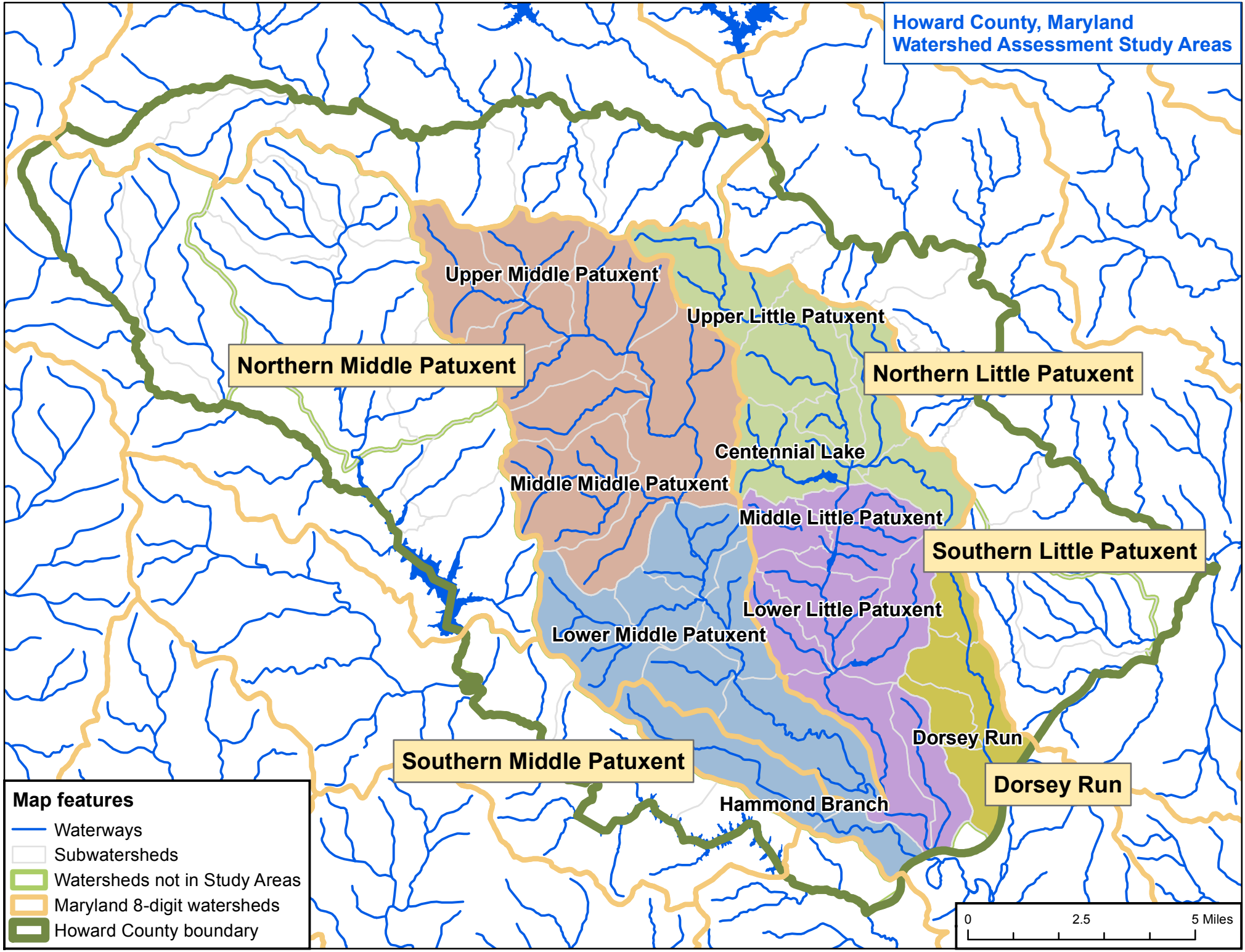
- Upper Middle Patuxent
- Middle Middle Patuxent
- Lower Middle Patuxent
- Hammond Branch

02131105, Little Patuxent River includes

- Upper Little Patuxent
- Middle Little Patuxent (includes Centennial Lake)
- Lower Little Patuxent
- Dorsey Run

Field sites identified in the desktop assessment will be properly labeled with site identifiers, before giving to the field teams. Site names will include the 3-letter Watershed Assessment Study Area identifier.

For data analysis, subwatershed designations may also be employed to aid in data organization. These subwatersheds correspond to the set of "66 Howard County subwatersheds" that nest within the 15 watersheds. Data will be managed so that all field data can be readily tied to the appropriate Study Area, 8-digit watershed, Howard County watershed, or subwatershed.


Howard County, Maryland
Watershed Assessment Study Areas
Upper Middle Patuxent
Upper Little Patuxent
Northern Middle Patuxent
Northern Little Patuxent
Centennial Lake
Middle Middle Patuxent
Middle Little Patuxent
Southern Little Patuxent
Lower Little Patuxent
Lower Middle Patuxent
Dorsey Run
Southern Middle Patuxent
Dorsey Run
Hammond Branch
Map features
Waterways
Subwatersheds
Watersheds not in Study Areas
Maryland 8-digit watersheds
Howard County boundary
0
2.5
5 Miles

Howard County Watershed Assessments Site Naming Conventions

March 3, 2015 UPDATED

Purpose: to name all field sites so they are readily recognizable by their location, site type, and unique identifier.

1. Standard site names

AAA-SS-Fxxx (Example NMP-SR-F101)

AAA = Study Area (which will also point us to which consultant team collected the data, should there be any questions)

- NMP = Northern Middle Patuxent
- SMP = Southern Middle Patuxent
- NLP = Northern Little Patuxent
- SLP = Southern Little Patuxent
- DOR = Dorsey Run

SS = Site type for the 5 types of opportunities

- BC = BMP Conversion (to upgrade existing stormwater BMP)
- NB = New BMP for currently untreated areas
- TP = Tree Planting
- OF = Outfall Stabilization
- SR = Stream Restoration

F = Field or desktop assessment

- F = Field assessment
- D = Desktop assessment (this applies to only a small number of sites that Versar and KCI will be evaluating based on past data)

xxx = 3-digit number that will be unique identifier within each type of opportunity (101, 102, etc.). These will be assigned as described in the following table. To avoid duplication, use the following guidance for any new site names added in the field:

Site numbering convention		
Consultant	Series starting with:	Study Area and Site Type (pre-assigned v. added in the field)
McCormick Taylor	101	NMP pre-assigned sites
	201	NMP sites added in the field
Biohabitats	301	SMP pre-assigned sites
	401	SMP sites added in the field
KCI	501	NLP pre-assigned sites
	651	NLP sites added in the field
Versar	701	SLP pre-assigned sites
	851	SLP sites added in the field
McCormick Taylor	901	DOR pre-assigned sites
	951	DOR sites added in the field

2. For specific types of data, there will be additional codes added:

AAA-SS-FxxxL (Example NMP-BC-F105A)

L = Letter for multiple recommendations/options (BMP conversion or new BMP Assessment) or reaches (Stream Restoration Assessment) within a site

- A = First recommendation/option or reach
- B = Second recommendation/option or reach
- C = Third recommendation/option or reach, etc.

2a. For BMP opportunities, there may be a need to keep track of multiple recommendations/options for the same site. Append A, B, C as needed to distinguish separate options.

- Example: NMP-BC-F105 has two options. Call them NMP-BC-F105A and NMP-BC-F105B

2b. For stream reaches, the first reach break along a reach will be named at the downstream end with the letter A. The upstream end will be named with the letter Z.

- Example: For stream reach NMP-SR-F101, the reach break at the downstream end will be called NMP-SR-F101A. A final reach break will be placed at the upstream end of the entire reach and be called NMP-SR-F101Z. No additional data is collected at F101Z.

If conditions vary within the reach, field crew should break the pre-selected stream restoration reach into two or more separate reaches if stream conditions warrant it.

- Example: if NMP-SR-F101 is broken into two reaches, the reach breaks at the bottom end of each will be named NMP-SR-F101A and NMP-SR-F101B. The reach break at the upstream end of Reach B will be marked NMP-SR-F101C, unless this is the final reach break, in which case it will be mark NMP-SR-F101Z.

2c. For stream assessment data, names will include additional digits as follows.

AAA-SS-FxxxL-TTyyy - For example at a stream restoration site (NMP-SR-F101A) with 3 erosion points, the erosion points would be recorded as NMP-SR-F101A-ES101, NMP-SR-F101A-ES102, NMP-SR-F101A-ES103]

TT = site type for specific stream data

- RE = Representative site - Habitat assessment
- ES = Erosion Site point
- CA = Channel Alteration point
- IB = Inadequate Buffer point
- EP = Exposed Pipe point
- UC = Unusual Condition or Comment
- PO = Pipe Outfall point
- XS = representative cross-section data

yyy = 3-digit number that will be unique identifier within each type of specific data (101, 102, etc.)

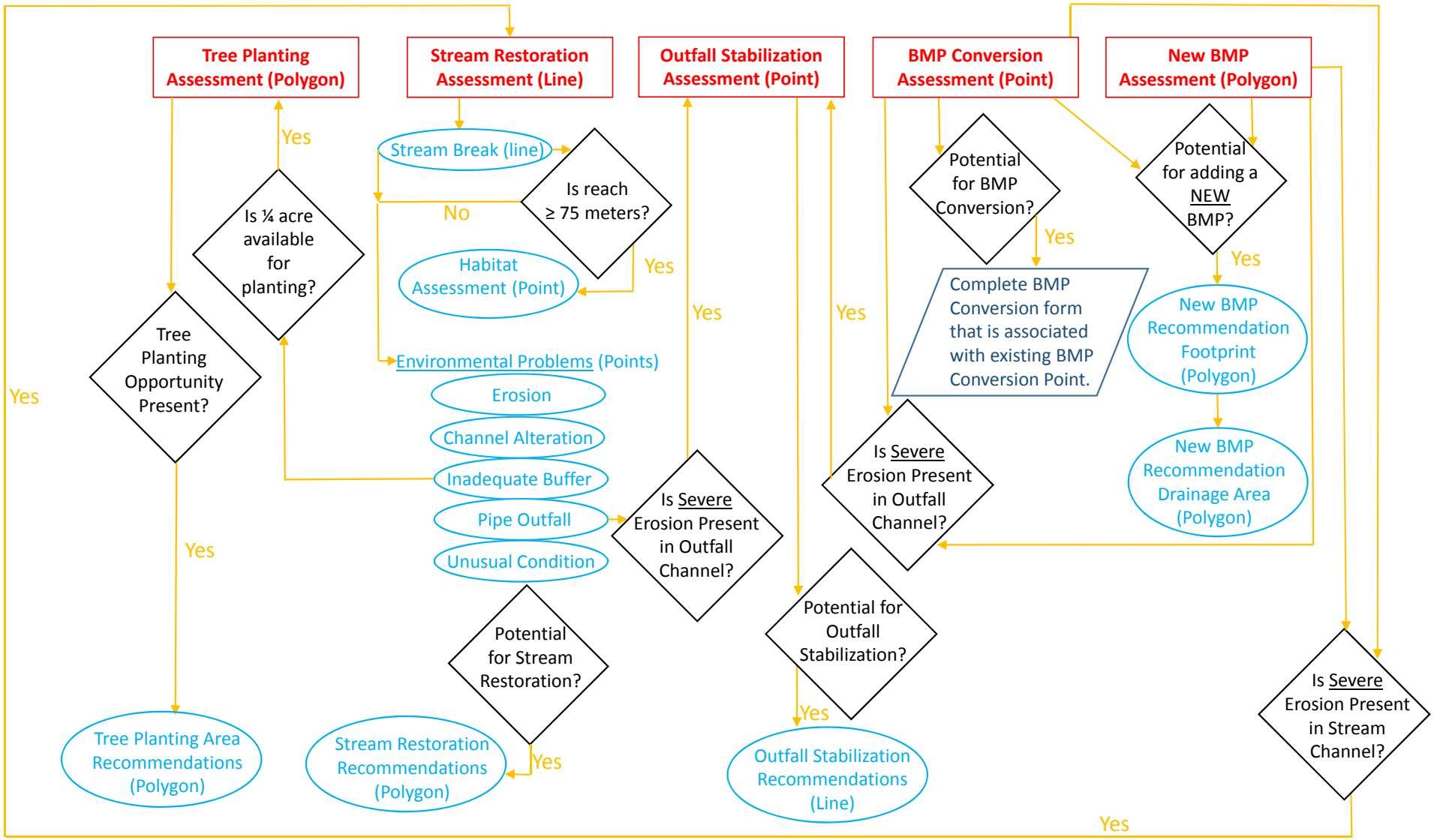
Special Notes For Field Teams

Site ID	STUDY AREA	CONTRACTOR	COMMENTS
SMP-BC-F311	Southern Middle Patuxent	Biohabitats	BMP near Engineering CIP area: U.S. Route 29 NB improvements
SMP-BC-F321	Southern Middle Patuxent	Biohabitats	On County Master List from Wilde Lake Study; listed as wet pond, but appears to be dry
SMP-NB-F303	Southern Middle Patuxent	Biohabitats	New BMP opportunities near Engineering CIP area: Hall Shop Road improvements (Site B
SMP-NB-F307	Southern Middle Patuxent	Biohabitats	New BMP opportunities near Engineering CIP area: Whiskey Bottom Road improvements
SMP-NB-F308	Southern Middle Patuxent	Biohabitats	New BMP opportunities near Engineering CIP area: Whiskey Bottom Road improvements
SMP-NB-F310	Southern Middle Patuxent	Biohabitats	New BMP opportunities near Engineering CIP area: Whiskey Bottom Road improvements
SMP-OF-F302	Southern Middle Patuxent	Biohabitats	Site is adjacent to Top Secret property; surveillance is possible for field operations
SMP-OF-F304	Southern Middle Patuxent	Biohabitats	Site is adjacent to Top Secret property; surveillance is possible for field operations
SMP-OF-F329	Southern Middle Patuxent	Biohabitats	Outfall near Engineering CIP area: Sanner Road improvements
SMP-OF-F332	Southern Middle Patuxent	Biohabitats	May be information available through MPEA
SMP-SR-F310	Southern Middle Patuxent	Biohabitats	Reach is near an Engineering CIP: Hall Shop Road at Simpson Road
SMP-SR-F320	Southern Middle Patuxent	Biohabitats	Split this section at the property line; retain downstream portion for field investigation
SMP-SR-F327	Southern Middle Patuxent	Biohabitats	On County Master List; citizen complaint of erosion; add note for field crew
SMP-SR-F328	Southern Middle Patuxent	Biohabitats	Reach crosses Engineering CIP: Stephens Road Bridge replacement
SMP-SR-F329	Southern Middle Patuxent	Biohabitats	BGE ROW - remove section that runs through ROW; retain remaining sections of the reach
SMP-SR-F351	Southern Middle Patuxent	Biohabitats	On County Master List; citizen complaint of bank erosion
SMP-SR-F354	Southern Middle Patuxent	Biohabitats	On County Master List; citizen complaint of bank erosion; private property
SMP-SR-F355	Southern Middle Patuxent	Biohabitats	On County Master List; citizen complaint of bank erosion; private property
SMP-SR-F356	Southern Middle Patuxent	Biohabitats	On County Master List; citizen complaint of bank erosion; private property
SMP-SR-F362	Southern Middle Patuxent	Biohabitats	On County Master List (Middle Patuxent WRAS); skip site if the property is a secure federal facility
SMP-TP-F301	Southern Middle Patuxent	Biohabitats	Parks review: Board of Ed. (contact before site visit)
SMP-TP-F303	Southern Middle Patuxent	Biohabitats	Parks review: No, MPEA: Mark R later confirms that Biohabitats can contact MPEA for guidance
SMP-TP-F304	Southern Middle Patuxent	Biohabitats	Parks review: No, MPEA; Mark R later confirms that Biohabitats can contact MPEA for guidance
SMP-TP-F305	Southern Middle Patuxent	Biohabitats	Biohabitats is studying MPEA; this may identify opportunities and refine field effort; Parks: No; Mark R later approve
NLP-BC-F502	Northern Little Patuxent	KCI	Believe BMP point is in the wrong location; may be Little Patuxent Study concept plan (FH1_04A); fill in form for ranking
NLP-NB-D557	Northern Little Patuxent	KCI	Good opportunity from Little Patuxent Study (FH1_04B or C); salt dome is out of MS4 - look for treatment opp
NLP-NB-D558	Northern Little Patuxent	KCI	Little Patuxent Study created a concept plan; fill out forms to conform to ranking standards
NLP-NB-D560	Northern Little Patuxent	KCI	Little Patuxent Study created a concept plan (PT1_04); fill out forms to conform to ranking standards
NLP-NB-D561	Northern Little Patuxent	KCI	Little Patuxent Study created a concept plan (PT1_03); fill out forms to conform to ranking standards
NLP-NB-D562	Northern Little Patuxent	KCI	Little Patuxent Study created a concept plan (LPX3_13); fill out forms to conform to ranking standards
NLP-NB-F503	Northern Little Patuxent	KCI	GIS Tech: Site appears to be under construction as a residential development; new homes have small BMPs
NLP-NB-F504	Northern Little Patuxent	KCI	GIS Tech: Site appears to be under construction as a residential development; new homes have small BMPs
NLP-NB-F542	Northern Little Patuxent	KCI	Home owner (3038 Southview Rd) would like drainage from the west edge of Southview to be re-routed into the County Open Space at the end of Southview
NLP-NB-F551	Northern Little Patuxent	KCI	GIS Tech: These parcels may already be treated by BMP along the entrance road; field crew could confirm
NLP-OF-F507	Northern Little Patuxent	KCI	The property owner is complaining about undermined trees and eroding banks; County wants it rated relative to others in the study
NLP-OF-F527	Northern Little Patuxent	KCI	Area could possibly use additional review for blown out area
NLP-SR-F507	Northern Little Patuxent	KCI	Reach crosses Engineering CIP: Marriottsville Road improvements
NLP-SR-F512	Northern Little Patuxent	KCI	Reach crosses Engineering CIP: Marriottsville Road improvements
NLP-SR-F515	Northern Little Patuxent	KCI	Reach is close to Engineering CIP: Marriottsville Road Bridge
NLP-SR-F517	Northern Little Patuxent	KCI	Reach is close to Engineering CIP: Marriottsville Road Bridge
NLP-SR-F519	Northern Little Patuxent	KCI	Reach crosses Alpha Ridge Park (Engineeriing CIP)
NLP-SR-F521	Northern Little Patuxent	KCI	Split segment at I-70; retain upstream section for field investigation
NLP-SR-F522	Northern Little Patuxent	KCI	Split segment at I-70; retain upstream section for field investigation
NLP-SR-F523	Northern Little Patuxent	KCI	Split the segment at the point; upstream is on ag-land (remove); retain downstream portion for field investigation
NLP-SR-F551	Northern Little Patuxent	KCI	Have field crew evaluate area on J. Schneider property for tree planting (perhaps purchase and plant)
NLP-SR-F558	Northern Little Patuxent	KCI	Remove sections downstream of Centennial Lane; retain upstream sections
NLP-SR-F559	Northern Little Patuxent	KCI	Remove sections downstream of Centennial Lane; retain upstream sections
NLP-SR-F560	Northern Little Patuxent	KCI	Split this section at the property line; retain downstream portion for field investigation
NLP-SR-F561	Northern Little Patuxent	KCI	Split this section at the property line; retain downstream portion for field investigation
NLP-SR-F562	Northern Little Patuxent	KCI	Split segment at I-70; retain upstream section for field investigation
NLP-SR-F571	Northern Little Patuxent	KCI	Retain southern extent of reach as a candidate for field investigation
NLP-SR-F573	Northern Little Patuxent	KCI	On County Master List; citizen complaint of bank erosion
NLP-SR-F591	Northern Little Patuxent	KCI	On County Master List; citizen complaint of bank erosion
NLP-SR-F593	Northern Little Patuxent	KCI	Project has been completed on the reach; split at Windflower Dr. and retain segment to the north for field investigation
NLP-SR-F601	Northern Little Patuxent	KCI	Split this reach at the point; southern section has a project; retain section to the north for field investigation
NLP-SR-F602	Northern Little Patuxent	KCI	Good opportunity from Little Patuxent Study (PT2_12)
NLP-TP-D517	Northern Little Patuxent	KCI	Little Pat. Study concept plan to enhance buffer (1752A (RHB)) - fill in form for ranking; Parks: FCA, supp. planting
NLP-TP-D518	Northern Little Patuxent	KCI	Little Pat. Study concept plan (BF_21) - fill in form for ranking; Parks: private property; Mark R confirms his approva
NLP-TP-D519	Northern Little Patuxent	KCI	Little Patuxent Study concept plan (BF_30) - fill in form for ranking; Parks: Yes

NLP-TP-D521	Northern Little Patuxent	KCI	Little Patuxent Study concept plan (BF_63) - fill in form for ranking
NLP-TP-D522	Northern Little Patuxent	KCI	Little Patuxent Study concept plan (BF_2) - fill in form for ranking; looks bare (2007 aerial) - good opportunit
NLP-TP-F514	Northern Little Patuxent	KCI	Parks review: Talk to DPW
DOR-BC-F922	Dorsey Run	McCormick Taylor	BMP near Engineering CIP area: Gateway at Robert Fulton intersection improvements
DOR-NB-F907	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F908	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F910	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F911	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F917	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F920	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F923	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Dorsey Run Road improvements
DOR-NB-F927	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
DOR-NB-F928	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
DOR-NB-F931	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
DOR-NB-F932	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
DOR-NB-F933	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
DOR-NB-F943	Dorsey Run	McCormick Taylor	New BMP opportunity near Engineering CIP areas: Gateway at Robert Fulton intersection improvements and Snowden River Pkwy improvement
DOR-OF-F912	Dorsey Run	McCormick Taylor	Outfall near Engineering CIP area: Dorsey Run Road improvements
DOR-OF-F921	Dorsey Run	McCormick Taylor	Outfall near Engineering CIP area: Dorsey Run Road improvements
DOR-OF-F923	Dorsey Run	McCormick Taylor	Good opportunity; on County Master Plan; citizen complaint of bank erosior
DOR-OF-F926	Dorsey Run	McCormick Taylor	Outfall near Engineering CIP area: Snowden River Pkwy improvements
DOR-SR-F904	Dorsey Run	McCormick Taylor	Reach crosses Engineering CIP: Dorsey Run Road improvements
DOR-SR-F912	Dorsey Run	McCormick Taylor	Reach crosses Engineering CIP: Snowden River Pkwy improvements
NMP-NB-F104	Northern Middle Patuxent	McCormick Taylor	Lagoon being considered for improvement; retrofitting up to BMP standard
NMP-SR-F120	Northern Middle Patuxent	McCormick Taylor	Split this section at I-70; retain downstream portion for field investigatior
NLP-BC-D543	Northern Little Patuxent	Versar	Concept plan from Little Patuxent Study; fill out form for ranking
SLP-BC-D782	Southern Little Patuxent	Versar	BMP near Engineering CIP area: Snowden River Pkwy widening
SLP-BC-F717	Southern Little Patuxent	Versar	BMP near Engineering CIP area: U.S. Route 29 NB improvements
SLP-BC-F734	Southern Little Patuxent	Versar	BMP near Engineering CIP area: Snowden River Pkwy widening
SLP-BC-F757	Southern Little Patuxent	Versar	BMP near Engineering CIP area: U.S. Route 29 NB improvements
SLP-NB-D777	Southern Little Patuxent	Versar	General note in County Master List to add bioretention; Versar confirms interest in revisiting site for opportunitie
SLP-NB-F701	Southern Little Patuxent	Versar	New BMP opportunity near and in Engineering CIP area: Cradlerock Channel improvements
SLP-NB-F716	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Guilford Road from U.S. Route 1 to Dorsey Rur
SLP-NB-F720	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Oakland Mills Road widening
SLP-NB-F734	Southern Little Patuxent	Versar	CA is redesigning a sand filter here, but the rest of it is still potential for new BMI
SLP-NB-F739	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Snowden River Pkwy improvements
SLP-NB-F740	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Snowden River/Brokenland Pkwy intersectior
SLP-NB-F744	Southern Little Patuxent	Versar	General note in County Master List to add bioretention; Versar confirms interest in revisiting site for opportunitie
SLP-NB-F755	Southern Little Patuxent	Versar	New BMP opportunities near Engineering CIP area: U.S. Route 29 NB improvements
SLP-NB-F756	Southern Little Patuxent	Versar	New BMP opportunities near Engineering CIP area: U.S. Route 29 NB improvements
SLP-NB-F765	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Oakland Mills Road widening
SLP-NB-F767	Southern Little Patuxent	Versar	New BMP opportunity near Engineering CIP area: Snowden River/Brokenland Pkwy intersectior
SLP-NB-F770	Southern Little Patuxent	Versar	New BMP opportunity is in an Engineering CIP area: Oakland Mills Road interchange
SLP-NB-F771	Southern Little Patuxent	Versar	New BMP opportunities near Engineering CIP area: U.S. Route 29 NB improvements
SLP-NB-F772	Southern Little Patuxent	Versar	New BMP opportunity near Engineeing CIP area: Cedar Lane ped improvements
SLP-OF-F717	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F718	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F719	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F720	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F721	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F722	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F723	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F724	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F725	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F726	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F727	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F728	Southern Little Patuxent	Versar	Outfalls throughout this reach should be inspected; new sheet pile weirs installed and CA is designing a repair for the most downstream devic
SLP-OF-F739	Southern Little Patuxent	Versar	Outfall near Engineering CIP areas: Guilford Road from U.S. Route 1 to Dorsey Rur
SLP-OF-F742	Southern Little Patuxent	Versar	Outfall near Engineering CIP areas: Guilford Road from U.S. Route 1 to Dorsey Rur
SLP-OF-F743	Southern Little Patuxent	Versar	Outfall near Engineering CIP areas: Guilford Road Ped/bike improvements and Mission Road sidewall

SLP-OF-F785	Southern Little Patuxent	Versar	Citizen concern area
SLP-OF-F787	Southern Little Patuxent	Versar	CA is designing an imbricated wall at the upstream end to protect a home foundatior
SLP-OF-F788	Southern Little Patuxent	Versar	CA is designing an imbricated wall at the upstream end to protect a home foundatior
SLP-OF-F789	Southern Little Patuxent	Versar	CA is designing an imbricated wall at the upstream end to protect a home foundatior
SLP-SR-F704	Southern Little Patuxent	Versar	CA is doing a stream restoration on the tributary that enters this reach from along Oakland Mills Roa
SLP-SR-F720	Southern Little Patuxent	Versar	EPA-installed sheet pile weirs (3) in the stream reach to Jackson Pond. CA will repair the most downstream wei
SLP-SR-F721	Southern Little Patuxent	Versar	EPA-installed sheet pile weirs (3) in the stream reach to Jackson Pond. CA will repair the most downstream wei
SLP-SR-F722	Southern Little Patuxent	Versar	EPA-installed sheet pile weirs (3) in the stream reach to Jackson Pond. CA will repair the most downstream wei
SLP-SR-F723	Southern Little Patuxent	Versar	EPA-installed sheet pile weirs (3) in the stream reach to Jackson Pond. CA will repair the most downstream wei
SLP-SR-F724	Southern Little Patuxent	Versar	Split segment at upstream pond; retain upstream segment for field investigatior
SLP-SR-F726	Southern Little Patuxent	Versar	Reach is near Engineering CIP: Oakland Mills Road widening
SLP-SR-F727	Southern Little Patuxent	Versar	Reach is near Engineering CIP: Oakland Mills Road widening
SLP-SR-F736	Southern Little Patuxent	Versar	On County Master List; citizen complaint
SLP-SR-F737	Southern Little Patuxent	Versar	Reach crosses Engineering CIP: U.S. 29 NB improvements
SLP-SR-F738	Southern Little Patuxent	Versar	On County Master List; citizen complaint of bank erosior
SLP-SR-F741	Southern Little Patuxent	Versar	On County Master List; citizen complaint of bank erosior
SLP-SR-F748	Southern Little Patuxent	Versar	On County Master List; citizen complaint of bank erosior
SLP-SR-F751	Southern Little Patuxent	Versar	CA is designing an imbricated wall at the upstream end to protect a home foundation; reach crosses Eng. CIP:US 29 impr
SLP-SR-F752	Southern Little Patuxent	Versar	On County Master List; citizen complaint of bank erosior
SLP-SR-F755	Southern Little Patuxent	Versar	Evaluate stream, including area upstream toward Thicket Lane
SLP-SR-F758	Southern Little Patuxent	Versar	EPA-installed sheet pile weirs (3) in the stream reach to Jackson Pond. CA will repair the most downstream wei
SLP-TP-F703	Southern Little Patuxent	Versar	Parks review: HCC, has forest conservation plan; GIS Tech: May ask HCC about more opportunities

Howard County Field Assessment Decision Flow Chart



Howard County Watershed Assessments
BMP Conversion Assessment – Data Collection Field Protocol
March 6, 2015

General Data Collection Instructions

- If any illicit discharges or other safety concerns (e.g., missing manhole cover) are observed in the field, notify the County as soon as possible by contacting Kelly Hargadin (khargadin@howardcountymd.gov, Office 410-313-0844 or Cell 720-979-1519). Provide location, information about the problem observed, and a photograph.
- Locate site on map layer for BMP Conversion Assessment **(*point*)** and fill in data for the fields below.

Fields - BMP Conversion Assessment *(Point)*

Overall

- Site ID (pre-assigned, unique number. Example: SLP-BC-F701)
- Field Crew [initials]
- Create a site name [This will be considered the common name for the site. Example: name of school, business, or nearest road.]
- Can site be evaluated? (if no, do not fill out other data)
  - Yes
  - No, landowner did not grant access
  - No, fence or other barrier
  - No, BMP does not exist at present
  - No, another reason
- Other reason site cannot be evaluated (describe)
- Can existing BMP be converted? [Answer this question after assessing the site and constraints. Use CONSTRAINTS SECTION BELOW to document constraints.]
  - Yes
  - No
- Notes: Reason BMP cannot be converted

General Site Description – Existing Conditions

- BMP Structure ID of existing pond [pre-filled from GIS data]
- BMP type from database [e.g., Dry Pond or Extended Detention Dry Pond]
- Owner Name [pre-filled from GIS data]
- BMP Address [pre-filled from GIS data]
- Drainage Area of Existing BMP (ac) [pre-filled from GIS data]
- Impervious Area of Existing BMP Drainage Area (ac) [pre-filled from GIS data]
- Study Area [pre-filled from GIS data]
- Contractor [pre-filled from GIS data]
- Comments [pre-filled from GIS data; information for field crew]
- Site Note [pre-filled from GIS data; information for field crew]
- Ownership [In most cases, this should be evident in GIS parcel layer.]
  - County School
  - County Parks
  - County – other

    - Private
    - Other
    - Unknown
- Notes, if ownership other
- Existing Pond Type (as YOU see it in field)
    - Dry Pond
    - Wet Pond
    - Other
- Describe type, if Other
- Is pond type same as listed in County database?
    - Yes/no
- Is repair needed?
    - Yes/No
- Other information describing existing pond condition (describe) [Such as need for maintenance, invasive vegetation removal, under construction, etc.]
- Existing Drainage area land use (predominant type)
    - Residential – single family homes <1 ac lots
    - Residential – single family homes > 1 ac lots
    - Townhouses
    - Multi-Family
    - Institutional
    - Industrial (not necessarily related to 02-SW or 12-SW permits)
    - Commercial
    - Transport-Related
    - Park
    - Undeveloped
    - Other
- Other information related to land use type within existing drainage area (describe) [This is a super-hotspot, lots of floatables or pet/goose waste, or other major issue.]

Downstream or Outfall Condition

Note: sites with < 200 feet of erosion below outfall will be considered *outfall channels*. Sites with >200-300 feet of erosion below outfall will be considered for stream restoration and evaluated for *downstream condition*.)

- Condition of outfall channel
    - 1-3: Minor erosion. Less than 1 foot of eroded banks. Healing may be present.
    - 4-6: Moderate erosion. Eroded banks are 1-2 feet in height. Erosion looks relatively recent.
    - 7-10: Severe Erosion. Eroded banks are greater than 2 feet in height. Erosion typically recent/active. (Fill out Outfall Stabilization Evaluation form)
- Reason Condition of outfall channel could not be inspected
    - Not applicable - discharges directly into MS4
    - Not applicable – discharges directly into large perennial stream
    - Could not inspect outfall [If behind fence etc.]
- Length of outfall channel erosion (ft.)

- Condition of stream channel [extending beyond 200 feet from discharge point]
    - 1-3: Minor erosion. 2-3 feet in eroded bank height, not causing significant stream degradation. Showing signs of healing.
    - 4-6: Moderate erosion. 3-5 feet in eroded bank height. Relatively recent/raw.
    - 7-10: Severe Erosion. 5 ft or greater eroded bank height. Erosion typically recent/active. Obvious instream degradation. If threatening utilities or structures rate 9-10. (Fill in Stream Restoration Assessment Form)
- Reason Condition of stream channel could not be inspected
    - Not applicable [make N/A the default]
    - Too far to warrant inspection
- Length of stream erosion (ft.)
- Notes: Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance

Candidate BMP Constraints

- Property for Sale or Lease?
    - Yes/No
- Are there many constraints to new BMP project?
    - None
    - Some
    - Many
- Type (check all that apply)
    - Slope
    - Utilities
    - Structures
    - Space insufficient
    - Significant impact to trees
    - Specimen tree removal
    - Property Ownership
    - Access
    - Proximity to neighboring properties
    - Other adjacent landowner issues
    - Safety
    - Aesthetics
    - Other
- Other information on BMP project constraints or conflicts (describe)
- Impact to Existing Trees
    - Minimal
    - Moderate
    - Significant
- Ease of access
    - Easy
    - Moderate
    - Difficult
- Conflicts with Existing Utilities – Sewer
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Water
    - Yes

    - No
    - Possible
- Conflicts with Existing Utilities – Gas
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Cable
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Electric
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Electric to Streetlights
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Overhead Wires
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Other
    - Yes
    - No
    - Possible
- Other information on conflicts with existing utilities (describe)

[Whatever additional details you can think of which are relevant to conflicts which cannot be answered by YES or NO]

Potential Permitting Factors

- Dam Safety Permits Necessary [make "not probable" the default] (height of the pond measured from the upstream toe to the top of dam is more than 20 feet)
    - Probable
    - Not probable
- Impacts to Wetlands [make "not probable" the default]
    - Probable
    - Not probable
- Impacts to a Stream [make "not probable" the default]
    - Probable
    - Not probable
- Floodplain Fill [make "not probable" the default] (Will new BMP cause changes to floodplain elevation?)
    - Probable
    - Not probable
- Impacts to Specimen Trees (≥30 inch DBH)
    - Probable
    - Not probable
- Number of Trees Impacted (number)
- Other permitting or impact factors (describe)

Soils

- Evidence of poor infiltration [clays, fines]

    - Yes/No/Unknown
- Evidence of shallow bedrock
    - Yes/No/Unknown
- Evidence of high water table [gleying, saturation]
    - Yes/No/Unknown
- Notes on soils

Other Project Types

- Is Site a Candidate for Other Restoration Projects?
    - No
    - Yes, BMP conversion
    - Yes, Tree planting
    - Yes, Stream restoration
    - Yes, Outfall stabilization
- Other Types of Projects Appropriate Here (describe)

Recommendations Summary

Proposed BMP Conversion Recommendations

- Proposed Treatment Option within pond boundary (check all that apply)
    - Extended Detention
    - Wet Pond
    - Created Wetland
    - Bioretention
    - Step Pool Conveyance
    - Filtering Practice other than Bioretention
    - Infiltration (not recommended for hotspots)
    - Swale (engineered)
    - Other
- If other type, describe proposed treatment option
- Will new BMP drainage area be the same as existing drainage area?
    - Yes/No
- If no, describe area to be treated by newly converted BMP
- Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance. Give a short narrative of BMP conversion to be done, as would be given on the first page of construction drawings.
- Notes on BMP conversion proposed. [Space for anything more that could not fit above.]
- Initial Feasibility and Construction Considerations (describe)

  Summarize some of the above criteria such as utility conflicts, neighborhood aesthetics consideration, treatment trains, technical complexity such as need for flow splitters etc.

- BMP Conversion Potential [This is a quick evaluation of "convertibility", not the pollutant removal efficiency gains anticipated.]
    - High
    - Medium
    - Low

- Optional: Sketch the proposed BMP conversion and attach sketch as photo. Sketch elements may include existing head available, surface area, minimum depth of treatment, conveyance, inlet, outlet, utility lines / other constraints, flow lines, property lines

Howard County Watershed Assessments
New BMP Assessment – Data Collection Field Protocol
March 6, 2015

General Data Collection Instructions

- If any illicit discharges or other safety concerns (e.g., missing manhole cover) are observed in the field, notify the County as soon as possible by contacting Kelly Hargadin (khargadin@howardcountymd.gov, Office 410-313-0844 or Cell 720-979-1519). Provide location, information about the problem observed, and a photograph.

- Locate site on map layer for New BMP Assessment **(*polygon*)** and fill in data for the fields below.

Fields – New BMP Assessment *(Polygon)*

Overall

- Site ID (pre-assigned, unique number. Example: SLP-NB-F701)
- Field Crew [initials]
- Create a site name [This will be considered the site's common name. Example: name of school, business, or nearest road.]
- Can site be evaluated? (if no, do not fill out other data)
    - Yes
    - No, landowner did not grant access
    - No, fence or other barrier
    - No, another reason
- Other reason site cannot be evaluated (describe)
- Is a new BMP retrofit possible on this site? Answer this question after assessing the site and constraints. Use CONSTRAINTS SECTION BELOW to document constraints.
    - Yes
    - No, too many constraints

General Site Description – Existing Conditions

- Owner Name [If known]
- BMP Address
- Study Area [pre-filled from GIS data]
- Contractor [pre-filled from GIS data]
- Comments [pre-filled from GIS data; information for field crew]
- Site Note [pre-filled from GIS data; information for field crew]
- Site Area - acres [prefilled from GIS]
- Ownership [In most cases, this should be evident in GIS parcel layer]
    - County School
    - County Parks
    - County – other
    - Private
    - Other
    - Unknown
- Notes, if ownership other
- Existing Land Use in Site Vicinity [predominant type]
    - Residential – single family homes <1 ac lots
    - Residential – single family homes > 1 ac lots
    - Townhouses
    - Multi-Family

    - Institutional
    - Industrial (not necessarily related to 02-SW or 12-SW permits)
    - Commercial
    - Transport-Related
    - Park
    - Undeveloped
    - Other
- Additional information about the land use type within existing drainage area (describe)
- Adjacent Land Use (check all that apply)
    - Residential
    - Commercial
    - Institutional
    - Industrial
    - Transport-Related
    - Park
    - Undeveloped
    - Other
- Other information on adjacent land use (describe)
- Is repair/replacement of an existing structure needed? [example: older pipe or parking lot in need of replacement]
    - Yes/No
- Other information describing existing conditions (describe) such as need for maintenance, invasive vegetation removal.

Downstream or Outfall Condition

Note that sites with < 200 feet of erosion below outfall will be considered *outfall channels*. Sites with >200-300 feet of erosion below outfall will be considered for stream restoration and evaluated for *downstream condition*.

- Condition of outfall channel
    - 1-3: Minor erosion. Less than 1 foot of eroded banks. Healing may be present.
    - 4-6: Moderate erosion. Eroded banks are 1-2 feet in height. Erosion looks relatively recent.
    - 7-10: Severe Erosion. Eroded banks are greater than 2 feet in height. Erosion typically recent/active. [Fill out Outfall Stabilization Assessment form]
- Reason Condition of outfall channel could not be inspected
    - Not applicable – discharges directly into MS4
    - Not applicable – discharges directly into large perennial stream
    - Could not inspect outfall [If behind fence etc.]
- Length of outfall channel erosion (ft.)
- Condition of stream channel [extending beyond 200 feet from discharge point]
    - 1-3: Minor erosion. 2-3 feet in eroded bank height, not causing significant stream degradation. Showing signs of healing.
    - 4-6: Moderate erosion. 3-5 feet in eroded bank height. Relatively recent/raw.
    - 7-10: Severe Erosion. 5 ft or greater eroded bank height. Erosion typically recent/active. Obvious instream degradation. If threatening utilities or structures rate 9-10. [Fill in Stream Restoration Assessment Form]
- Reason Condition of stream channel could not be inspected

    - Not applicable
    - Too far away, no access, to warrant inspection
- Length of stream erosion (ft.)
- Notes: Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance

Candidate BMP Constraints

- Property for Sale or Lease?
    - Yes/No
- Are there many constraints to new BMP project?
    - None
    - Some
    - Many
- Constraint Type [check all that apply]
    - Slope
    - Utilities
    - Structures
    - Space insufficient
    - Significant impact to trees
    - Specimen tree removal
    - Property Ownership
    - Access
    - Proximity to neighboring properties
    - Other adjacent landowner issues
    - Safety
    - Aesthetics
    - Other
- Other information on BMP project constraints or conflicts (describe)
- Impact to Existing Trees
    - Minimal
    - Moderate
    - Significant
- Ease of access
    - Easy
    - Moderate
    - Difficult
- Conflicts with Existing Utilities – Sewer
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Water
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Gas
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Cable
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Electric
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Electric to Streetlights

    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Overhead Wires
    - Yes
    - No
    - Possible
- Conflicts with Existing Utilities – Other
    - Yes
    - No
    - Possible

- Other information on conflicts with existing utilities (describe)

Potential Permitting Factors

- Dam Safety Permits Necessary [make "not probable" the default] (height of the pond measured from the upstream toe to the top of dam is more than 20 feet)
    - Probable
    - Not probable
- Impacts to Wetlands [make "not probable" the default]
    - Probable
    - Not probable
- Impacts to a Stream [make "not probable" the default]
    - Probable
    - Not probable
- Floodplain Fill [make "not probable" the default] (Will new BMP cause changes to floodplain elevation?)
    - Probable
    - Not probable
- Impacts to Specimen Trees [≥30 inch DBH]
    - Probable
    - Not probable
- Number of Trees Impacted (number)
- Other permitting or impact factors (describe)

Soils

- Evidence of poor infiltration [clays, fines]
    - Yes/No/Unknown
- Evidence of shallow bedrock
    - Yes/No/Unknown
- Evidence of high water table [gleying, saturation]
    - Yes/No/Unknown
- Notes on soils

Other Project Types

- Is Site a Candidate for Other Restoration Projects?
    - No
    - Yes, BMP conversion
    - Yes, Tree planting
    - Yes, Stream restoration
    - Yes, Outfall stabilization
- Other Types of Projects Appropriate Here (describe)

Recommendations: New BMP (Polygon) and Drainage Area (DA) (Polygon) [This will be 2 polygons – one for the project footprint, one for the DA.]

- Draw footprint of proposed project – on tablet in layer called "Sketch – Proposed New BMP Footprint"
- Draw proposed Drainage Area in layer called "Sketch – Proposed New BMP – Drainage Area"
- Comments
- Drainage Area Estimate [No need to enter - will be calculated with hand drawn polygon.]

NEW BMP Recommendation Summary – complete the form in the layer "New BMP Recommendation Footprint" (polygon)"

- Site ID (Example: NMP-NB-F101A)
- Proposed Treatment Option (check all that apply)
  - Extended Detention
  - Wet Pond
  - Created Wetland
  - Bioretention
  - Step Pool Conveyance
  - Filtering Practice other than Bioretention
  - Infiltration
  - Swale
  - Green roof
  - Impervious surface removal
  - Impervious pavement replacement
  - Other
- If other proposed treatment, describe type.
- Demonstration/Education value?
  - Yes/no
- Notes: Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance.

  Give a short narrative of BMP to be built, as would be given on the first page of construction drawings
- Initial Feasibility and Construction Considerations (describe)

  Summarize some of the above criteria such as utility conflicts, neighborhood aesthetics consideration, technical complexity such as need for flow splitters etc.
- Other notes on new BMP proposed: [Space for anything more that could not fit above.]
- New Stormwater BMP – Retrofit Potential [This is quick evaluation of retrofitability / feasibility of constructing this BMP - not a ranking of quality of the BMP to remove pollutants]
  - High
  - Medium
  - Low

- Optional: Sketch the proposed BMP and attach sketch as photo. Sketch elements may include existing head available, surface area, minimum depth of treatment, conveyance, inlet, outlet, utility lines / other constraints, flow lines, property lines.

NEW BMP Recommendation Drainage Area – complete the form in the layer "New BMP Recommendation Drainage Area" (Polygon)"

- Site ID (Example: NMP-NB-F101A)
- Comments

Howard County Watershed Assessments
Tree Planting Assessment – Data Collection Field Protocol
March 6, 2015

General Data Collection Instructions

- If any illicit discharges or other safety concerns (e.g., missing manhole cover) are observed in the field, notify the County as soon as possible by contacting Kelly Hargadin (khargadin@howardcountymd.gov, Office 410-313-0844 or Cell 720-979-1519). Provide location, information about the problem observed, and a photograph.
- Locate site on map layer for opportunity for Tree Planting Assessment **(*polygon*)** and fill in data for the fields below.

Fields – Tree Planting Assessment *(Polygon)*

Overall

- Site ID (pre-assigned, unique number. Example: SLP-TP-F701)
- Field Crew [Initials]
- Create a site name [This will be considered the common name of the site. Example: name of school, business, or nearest road.]
- Can site be evaluated? (if no, do not fill out other data)
  - Yes
  - No, landowner did not grant access
  - No, fence or other barrier
  - No, another reason
- Other reason site cannot be evaluated (describe)
- Is tree planting possible on this site? Answer this question after assessing the site and constraints. Use CONSTRAINTS SECTION BELOW to document constraints.
  - Yes
  - No, too many constraints
- Is tree planting opportunity at least 0.25 acres?
  - Yes/No

General Site Description

- Owner Name [prefilled from GIS]
- Owner Address [prefilled from GIS]
- Ownership [In most cases, this should be evident in GIS parcel layer.]
  - County School
  - County Parks
  - County – other
  - Private
  - Other
  - Unknown
- Notes, if ownership other
- Study Area [pre-filled from GIS data]
- Contractor [pre-filled from GIS data]
- Comments [pre-filled from GIS data; information for field crew]
- Site Note [pre-filled from GIS data; information for field crew]
- Parcel size: ____ acre(s) [prefilled - from GIS]
- Access to site (check all that apply)

    - Foot access
    - Vehicle access
    - Heavy equipment access
- Current Management
    - School District
    - Charter School
    - Park
    - Tot Lot
    - Public Right-of-way
    - Private Right-of-way
    - Vacant land
    - Other

Climate

- Sunlight exposure
    - Full sun (6 hours or more of direct sun per day)
    - Part sun or filtered light (<6 hours per day)
    - Shade (<3 hours of direct sun per day)
- Microclimate features: High wind exposure (Yes/No)
- Microclimate features: Re-reflected heat load (Yes/No)
- Microclimate features: Other (describe)

Topography

- Any slopes >15% present in proposed planting area? (Yes/No)
- If yes, estimate slope
- Any low-lying areas present in proposed planting area? (Yes/No)
- If yes, notes on low lying area

Vegetation

- Regional forest association or dominant species from reference site
- Current vegetative cover (estimate percent)
    - Mowed Turf _____% [1,2,3,4,5, 10, 15, 20, 25, 30 …100 by 5's]
    - Other Herbaceous _____% [as above]
    - Trees/Shrubs _____% [as above]
    - None (bare soil) _____% [as above]
- Note species to be preserved
- Are invasive species or noxious weeds present in proposed planting area? (Yes/No)
- % coverage by invasives in proposed planting area: _____
- List dominant types of invasive species in proposed planting area, if any _____
- Adjacent vegetative cover: is forest present? (Yes/No)
- If yes, note dominant forest species
- Are invasive species or noxious weeds present in adjacent vegetated area? (Yes/No)
- % coverage by invasives in adjacent area: _____
- List dominant types of invasive species in adjacent area, if any _____
- Is there heavy browsing by deer? (Yes/No)
- Is there beaver activity? (Yes/No)
- Evidence of previous tree planting? (Yes/No)
- Comment on success of previous tree planting, if evidence present
- Notes

Soils

- Soil texture
  - Clay
  - Loam
  - Sand
- Soil Compaction
  - None
  - Moderate
  - Severe
- Active or severe soil erosion? (Yes/No)
- Potential soil contamination? (Yes/No)
- Debris and rubble in soil? (Yes/No)
- Recent construction or other soil disturbance? (Yes/No)
- Other soil characteristics (describe)

Hydrology

- Site hydrology
  - Upland
  - Riparian
- Stormwater runoff to planting site – bypasses site in pipe? (Yes/No)
- Stormwater runoff to planting site – Upslope drainage area outfalls to site? (Yes/No)
- Note diameter of pipe outfall, if present (inches)
- Stormwater runoff to planting site – Open channel directs flow across or around site? (Yes/No)
- Stormwater runoff to planting site – Shallow concentrated flow (for example, evidence of rills, gullies, sediment deposits)? (Yes/No)
- Stormwater runoff to planting site – Sheetflow? (Yes/No)
- Contributing flow length (ft) [The distance over which runoff travels before entering planting area. For larger planting areas, distance runoff travels before leaving the planting area.]
- Contributing flow length, slope (%)
- Contributing flow length, cover type
  - Impervious
  - Pervious
- Floodplain connection (riparian areas only) – bank height (ft)
- If riparian planting is proposed on both sides of stream, explain/describe differences in hydrology or flow path.

Potential Planting Conflicts or Constraints

- Space Limitations
  - Overhead wires? (Yes/No)
  - Height of overhead wires, if present (ft)
  - Pavement? (Yes/No)
  - Structures? (Yes/No)
  - Signs? (Yes/No)
  - Height of signs, if present (ft)
  - Lighting? (Yes/No)
  - Height of lighting, if present (ft)
  - Underground Utilities? (Yes/No)

    - Note type of underground utilities present
    - Other space limitations (describe)
- Other limiting factors or constraints
    - Trash dumping/debris (Yes/No)
    - If trash present, note type, volume (estimated number pickup truck loads) and source if known.
    - Deer, beaver, or other animal impacts (Yes/No)
    - Site mowed regularly (Yes/No)
    - Wetland present (Yes/No)
    - Insect infestation or disease (Yes/No)
    - Access (Yes/No)
    - Ownership (Yes/No)
    - Heavy pedestrian traffic (Yes/No)
- Other limiting factors/constraints (describe)
- Notes

Planting and Maintenance Logistics

- Site Access
    - Delivery Access for planting materials present? (Yes/No)
    - Temporary storage areas for soils, mulch, etc. present? (Yes/No)
    - Heavy equipment access? (Yes/No)
    - Volunteer parking area available? (Yes/No)
    - Nearby facilities for volunteers? (Yes/No)
- Water source
    - Rainfall only? (Yes/No)
    - Stormwater runoff? (Yes/No)
    - Hose hook-up nearby? (Yes/No)
    - Irrigation system in place? (Yes/No)
    - Overbank flow from river or stream? (Yes/No)
    - Fire hydrant nearby? (Yes/No)
- Other water source (describe)
- Estimated distance to nearest water source (ft)

TREE PLANTING RECOMMENDATIONS

Tree Planting Recommendation Summary – complete the form in the layer "Tree Planting Area Recommendations" [polygon]

Sketch footprint of proposed tree planting area – on tablet, outline area(s) to be planted

- Site ID (Example: SLP-TP-F701A)
- Site Preparation Required
    - High (e.g., clearing of dumpsite)
    - Medium (e.g., extensive clearing of invasives)
    - Low
    - None
- Type of site prep needed (describe)
- Potential Demonstration/Education Project? (Is site public/highly visited v. remote location?)
    - Yes/No/Maybe

- Notes: _____
- Tree Planting Areas - Restoration Potential [This is quick, overall evaluation of feasibility of tree planting at this site.]

    - High
    - Medium
    - Low

- Comments

- Optional: Sketch the proposed tree planting area and attach sketch as photo. Sketch elements may include:
    - Property boundary and features such as roads, streams, and adjacent land use/cover
    - Boundary and approximate dimensions of proposed planting area
    - Variations in sun exposure, microclimate, and topography within planting area
    - Current vegetative cover, location of trees to be preserved, and invasive species
    - Flow paths to planting area and contributing flow length
    - Above or below ground space limitations (e.g., utilities, structures)
    - Other limited factors such as trash dumping, pedestrian paths
    - Water source and access points
    - Scale bar and north arrow.

Howard County Watershed Assessments

Stream Restoration Assessment – Data Collection Field Protocol

March 6, 2015

General Data Collection Instructions

- All reaches are assessed while walking upstream
- If there is a significant change in biological, physical or geomorphic conditions within a reach, then the field team has the ability to draw a Stream Reach Break Line to designate separate reaches.
- Each reach, including new reaches designated in the field, must have a habitat assessment point if reach is at least 75 meters long.
- If a portion of a reach cannot be assessed due to access or safety issues, then place a Reach Break Line at the point in the reach where the team can no longer walk upstream. Place a new Reach Break Line when the reach is assessable again.
- Right and left bank are determined while facing downstream.
- A minimum of two photos must be taken at each feature (point, line or polygon). First photo is taken looking upstream (or upslope in the case of outfalls), second photo is taken while looking downstream. Additional photos may be taken at the discretion of the field team.
- If any illicit discharges or other safety concerns (e.g., missing manhole cover) are observed in the field, notify the County as soon as possible by contacting Kelly Hargadin (khargadin@howardcountymd.gov, Office 410-313-0844 or Cell 720-979-1519). Provide location, information about the problem observed, and a photograph.

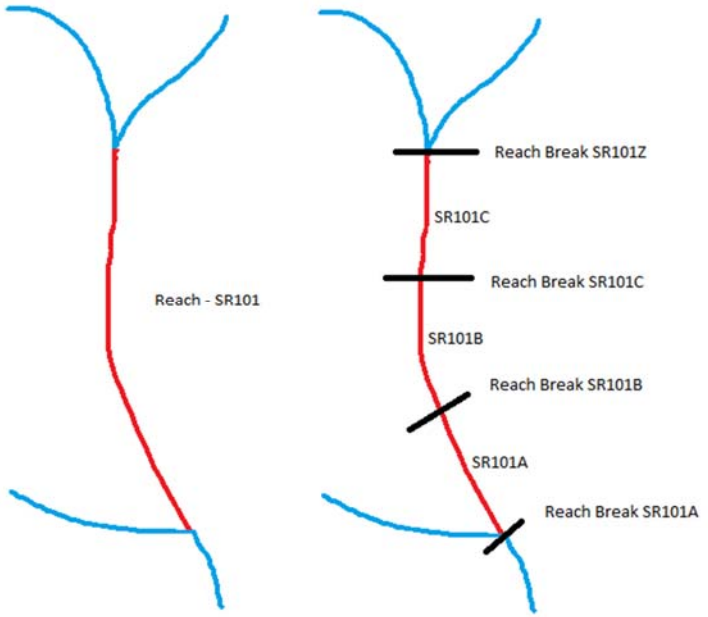
Stream Restoration Assessment Data Layers

Stream Restoration Assessment (line) – No editing; base layer with Site IDs. Check here for comments that may contain special notes for field crews.

Stream Reach Break Data *(line)*

Data Collection Instructions

Add a Stream Reach Break line at the beginning of a new stream reach assessment for either a pre-selected reach or a new reach within a pre-selected reach. This line signifies the downstream end of a new section of stream that is assessed. Each line will be perpendicular to and crossing the stream reach. Break line may be at or slightly below the downstream end of the stream reach. The last reach break will be labelled with Z to signify the upstream end of the study reach; do not fill in any other data for the "Z" reach.



Fill out all fields prior to assessing reach, except for the final field, Stream Restoration Opportunities Present, which you will complete after the assessment.

Fields

- Site ID of Stream Reach [fill in ID from the Stream Reach base layer, in which the number will be pre-assigned (e.g., NMP-SR-F101); add A for the first reach break. Add B, C, D, etc. for each additional break. Assign Z to the break at the end of reach.]
- Field Crew [Initials]
- Can site be evaluated? (if no, do not fill out other data)
    - Yes
    - No, landowner did not grant access
    - No, fence or other barrier
    - No, another reason
- Notes
- Create a site name [This wil be considered the common name for the site. Example: name of school, business, or nearest road.]
- Is this an end of reach? (if Yes, do not answer further questions)
    - Yes
    - No
- Past Weather (24 hours) – yes/no for all
    - Clear
    - Cloudy
    - Trace of Rain
    - Rain
    - Snow
    - Extreme Cold [consistently < 32 degrees F]
    - Extreme Hot ([consistently > 80 degrees F])

    - Other
- Current Weather
    - Same Options as above
- Stream Type – check one
    - Perennial
    - Intermittent
    - Ephemeral
    - Unknown
    - If stream type is unknown, explain
- Notes
- Stream Restoration Opportunities Present (Filled out after walking reach) [Note if opportunities present, then also fill in Stream Restoration Recommendations form.]
    - None
    - One
    - Several

Rapid Biology/Habitat Assessment Data *(Point)*

Data Collection Instructions

At least one Habitat Assessment point needs to be placed within each stream reach. If a reach is >1000 ft long, place a Stream Reach Break and collect another Habitat Assessment Point.

The assessment is conducted within a representative 75-meter reach. It is at the discretion of the field crew to choose a representative location for the 75-m reach assessment.

See example RBP data form for habitat parameter scoring guidance. For each RBP parameter, scale runs from 1 (worst condition) to 10 or 20 (best condition).

Fields

- Site ID (e.g. NMP-SR-F101A-RE101) [Fill in, using Stream Reach ID and adding RE###, RE for Representative Site]
- Stream Bed Particle Size (note percentage, estimate to the nearest 5%)
    - Clay
    - Silt
    - Sand
    - Gravel
    - Cobble
    - Boulder
    - Bedrock
    - Concrete
- Epifaunal Substrate/Available Cover (0-20 score)
- Embeddedness (0-20)
- Velocity/Depth Regime (0-20)
- Sediment Deposition (0-20)
- Channel Flow Status (0-20)
- Channel Alteration (0-20)
- Frequency of Riffles (or bends) (0-20)
- Bank Stability (Right) (0-10)
- Bank Stability (Left) (0-10)
- Vegetative Protection (Right) (0-10)
- Vegetative Protection (Left) (0-10)
- Riparian Vegetative Zone Width (Right) (0-10)
- Riparian Vegetative Zone Width (Left) (0-10)
- Percent Shading (estimate to nearest 10%, assuming leaf-on)
- Trash Rating (0-20)
- Notes

Erosion Site (*Point, placed at downstream end of erosion)*

Data Collection Instructions

Document all stream bank erosion that has an eroded surface of at least 2 feet high and 10 feet long. Shorter instances of erosion can be documented if the erosion is threatening a utility, property, or structure. Erosion points are placed at the downstream end of erosion. A new erosion point is placed on the map if the average height of erosion changes by more than 2-3 feet, or any of the erosion point parameters have a significant change. See BEHI diagram for guidance on collecting the applicable parameters. If there is erosion on both banks, record BEHI parameters for whichever bank is more extreme. If there are multiple areas of erosion that are vastly different in degree of erosion hazard, additional erosion points may be added if needed.

A gully associated with an outfall channel will be recorded as an erosion point. If the actual outfall is located, that will also be recorded, as a pipe outfall.

Fields

- Site ID (e.g. NMP-SR-F101A-ES101) [Fill in using Stream Reach ID and adding ES###, ES for Erosion Site]
- Type of Erosion (check all that apply)
    - Headcutting
    - Downcutting
    - Widening
    - Other
- Right Bank Length of Erosion (ft) - extending upstream of point, estimate or measure to the nearest 10 ft the length along bank
- Left Bank Length of Erosion (ft) - extending upstream of point, estimate or measure to the nearest 10 ft the length along bank
- Height of Erosion on Right Bank (ft) – to nearest 0.1 ft
- Height of Erosion on Left Bank (ft) – to nearest 0.1 ft
- Right Bank Total Height (ft) – to nearest 0.1 ft, measure from thalweg to top of bank
- Left Bank Total Height (ft) – to nearest 0.1 ft, measure from thalweg to top of bank
- Bankfull Depth (ft) – to nearest 0.1 ft, measure from thalweg to bankfull
- Note bankfull indicators
- Predominant Bank Material
    - Clay
    - Silt
    - Sand
    - Gravel
    - Cobble
    - Boulder
    - Bedrock
- Bank angle as degrees, Bank Erosion Potential category
    - 0 – 20 degrees, Very Low
    - 21 – 60 degrees, Low
    - 61 – 80 degrees, Moderate
    - 81 – 90 degrees, High
    - 90 – 119 degrees, Very High
    - >119 degrees, Extreme

- Root Density as percentage, Bank Erosion Potential category
  - 80 - 100% Very Low
  - 55 - 79% Low
  - 30 - 54% Moderate
  - 15 - 29% High
  - 5 – 14% Very High
  - <5% Extreme
- Root Depth as proportion of bank height, Bank Erosion Potential category
  - 0.90 – 1.0 Very Low
  - 0.50 – 0.89 Low
  - 0.30 - 0.49 Moderate
  - 0.15 – 0.29 High
  - 0.05 - 0.14 Very High
  - <0.05 Extreme
- Surface protection as percentage, Bank Erosion Potential category
  - 80 - 100% Very Low
  - 55 - 79% Low
  - 30 - 54% Moderate
  - 15 - 29% High
  - 10 – 14% Very High
  - <10% Extreme
- Near Bank Stress Rating [narrative category]
  - Very Low
  - Low
  - Moderate
  - High
  - Very High
  - Extreme
- Soil Stratification
  - None/Low
  - Medium
  - High
- Headcut height, ft, to the nearest 0.5 ft [if applicable]
- Headcut angle, degrees [if applicable]
  - 0 – 30 degrees
  - 31 - 60 degrees
  - 61 – 90 degrees
- Headcut length, ft [bottom to top; if applicable]
- Overall Erosion Severity Rating (1-10)
  - 1-3: Minor erosion. 2-3 feet in eroded bank height, not causing significant stream degradation. Showing signs of healing.
  - 4-6: Moderate erosion. 3-5 feet in eroded bank height. Relatively recent/raw.
  - 7-10: Severe Erosion. 5 ft or greater eroded bank height. Erosion typically recent/active. Obvious instream degradation. If threatening utilities or structures rate 9-10.
- Notes

Channel Alteration Site *(Point, placed at downstream end of channel alteration)*

Data Collection Instructions

Document instances of the channel bed, bank, or nearby floodplain being altered by placing a Channel Alteration point at the downstream extent of the alteration and completing the electronic form. Only document instances where the alteration is detrimental to the stream (e.g. concrete-lined channel) or needs to be fixed (e.g. failing bank stabilization project). Do not document stable utility line protection or successful stream restoration projects. Channel Alteration points are placed at the downstream end of erosion.

Fields

- Site ID (e.g. NMP-SR-F101A-CA101) [Fill in using Stream Reach ID and adding CA###, CA for Channel Alteration]
- Type
    - Concrete
    - Riprap
    - Gabion Basket
    - Earthen Channel
    - Channelization/Straightening
    - Other
- Alteration Length (ft) (extending upstream of point, estimate or measure to the nearest 10 ft)
- Alteration Width (ft) (Bed only)
- Alteration Location
    - Bed
    - Bank
    - Bed and Bank
    - Floodplain
- Signification vegetation in channel?
    - Yes, No, Unknown
- Signification Aggradation
    - Yes, No, Unknown
- Significant Degradation
    - Yes, No, Unknown
- Associated with a Road Crossing
    - Yes, No, Unknown
- Alteration Severity (1-10)
    - 1-3: Alteration is detrimental to the health of the stream, but alteration is relatively short and is not causing any current channel instability.
    - 4-6: Alteration is causing noticeable channel instability (e.g. channel starting to erode around riprap placed on bank or channelized stream banks slumping in stream) and should be corrected.
    - 7-10: Alteration is relatively long, causing significant channel instability/loss of habitat and should be corrected as soon as possible.
- Notes

Inadequate Buffer Site *(Point, placed at downstream end of inadequate buffer)*

Data Collection Instructions

Document non-natural areas with a minimum length along the stream (parallel to the channel) of 100 feet. A buffer will be considered adequate if it is tree-covered within 75 ft of the stream.

A more detailed assessment of the area can be completed with the Tree Planting Area form (polygon feature) if adequate space is available for planting (at least 0.25 acre).

Inadequate buffer points are placed at the downstream end of the inadequate buffer.

Fields

- Site ID (e.g. NMP-SR-F101A-IB101) [Fill in using Stream Reach ID and adding IB###, IB for Inadequate Buffer]
- Inadequate buffer length – Right (ft)
- Inadequate buffer length – Left (ft)
- Existing Buffer width – Right (ft) (to 150 ft maximum)
- Existing Buffer width – Left (ft) (to 150 ft maximum)
- Opportunity for tree planting project? (yes/no) – If Yes, fill out Tree Planting assessment form
- Notes

Pipe Outfall Site *(Point)*

Data Collection Instructions

Document all outfall pipes or channels that can be seen from the stream by placing an outfall point on the map. If the outfall is a pipe then place the point at the opening of the pipe, if the outfall is a channel then place the point at the termination of the formal conveyance (i.e. do not place point at end of erosional gully, this will be documented within the field form).

Use this form to record unmapped outfalls and problematic outfalls observed while conducting stream assessment. This is not intended to be a comprehensive inventory of outfalls.

Fields

- Site ID (e.g. NMP-SR-F101A-PO101) [Fill in using Stream Reach ID and adding PO###, PO for Pipe Outfall]
- Mapped outfall number, if available [from GIS]
- Type of Outfall
    - Stormwater BMP Outfall
    - Stormwater Outfall, no BMP
    - BMP Overflow Channel / Spillway
    - Agricultural Drainage Pipe
    - Roof Drains (only record if there are major problems to address)
    - Sewage Plant
    - Unknown
    - Other
- Enclosed Pipe or Open Channel (choose one)
- Material
    - Earth Channel
    - Concrete Channel
    - Concrete Pipe
    - Smooth Metal Pipe
    - Corrugated Metal Pipe
    - Smooth Plastic Pipe
    - Corrugated Plastic Pipe
    - Unknown
    - Other
- Pipe Diameter [inside – inches]
- Lcoation in relation to stream channel (choose one)
    - Right side
    - Left side
    - In-line with stream
- Evidence of dry weather flow (e.g. staining, excessive vegetation, oil sheen, etc.)?
    - Yes, No
- Is there a suspected illicit discharge that needs to be addressed?
    - Yes, No – If yes, notify Howard County
- Trash Rating (0-20)
- Evidence of Erosion below outfall?
    - Yes, No - If yes, erosion is observed, fill out Outfall Stabilization Assessment form [point feature].
- Notes

Unusual Condition/Other *(Point)*

Data Collection Instructions

Document any unusual conditions found during the stream assessments. These may not necessarily be good indicators for targeting restoration sites, but these conditions may be leading to (or indicative of) instream degradation and are worth documenting for the County's use if the condition is severe. Place a new point on the map where the unusual condition is found.

Fields

- Site ID (e.g. NMP-SR-F101A-UC101) [Fill in using Stream Reach ID and adding UC###, UC for Unusual Condition]
- Near-stream construction with poor ESC (yes/no)
- Suspected illicit discharge (yes/no)
- Illegal Dumping (yes/no)
- Exposed Pipe (yes/no)
- Unusual Water Color (yes/no)
- Unusual Water Clarity (yes/no)
- Unusual Water Odor (yes/no)
- Excessive Algae (yes/no)
- Excessive Bacteria Indicators (yes/no)
- Severe Fish Blockage/Barrier (yes/no)
- Other (describe) (yes/no)
- Notes

Stream Restoration Recommendations *(Polygon)*

Data Collection Instructions

Use this feature to indicate the location and extent of one or many potential stream restoration projects within the assessed reach. Draw a polygon that includes the extent of stream length to be restored, including side tributaries if they are to be included in project.

Also, document the potential of adding one or many restoration projects in the Stream Reach Break line shapefile.

Fields

- Site ID (e.g., NMP-SR-F101A)
- Instream Restoration Potential
    - High
    - Medium
    - Low
- Restoration Length (ft) [will be calculated later in GIS]
- Are there many constraints to restoration project?
    - None
    - Some
    - Many
- Stream Restoration Project Constraints - Type
    - Utility
    - Roadway
    - Buildings
    - Other Structure
    - Ownership
    - Access
    - Significant Impact to Trees
    - Specimen Tree Removal
    - Wetland Impacts
    - Other
- Approximate length of project affected by constraint (ft)
- Impact to Existing Trees
    - Minimal
    - Moderate
    - Significant
- Ease of access
    - Easy
    - Moderate
    - Difficult
- Potential Demonstration/Educational Value? (yes/no)
- Notes

Howard County Watershed Assessments
Outfall Stabilization Assessment (Point) – Data Collection Field Protocol
March 6, 2015

General Data Collection Instructions

- If any illicit discharges or other safety concerns (e.g., missing manhole cover) are observed in the field, notify the County as soon as possible by contacting Kelly Hargadin (khargadin@howardcountymd.gov, Office 410-313-0844 or Cell 720-979-1519). Provide location, information about the problem observed, and a photograph.

- Edit an existing (preselected) outfall stabilization point OR add a new outfall stabilization point. If adding a new point and the outfall is a pipe then place the point at the opening of the pipe. If the outfall is a channel then place the point at the termination of the formal conveyance (i.e. do not place point at end of erosional gully, this will be documented within the field form).

Fields – Outfall Stabilization Assessment (*Point)*

- Site ID (prefilled) (example: NMP-OF-F101). If site was a Pipe Outfall Site in Stream Restoration reach, use that outfall point site ID (example: SR-F101-PO103).
- Field Crew [Initials]
- Create a site name [This will be considered the common name of the site. Example: name of school, business, or nearest road.]
- Study Area [pre-filled from GIS data]
- Contractor [pre-filled from GIS data]
- Comments [pre-filled from GIS data; information for field crew]
- Site Note [pre-filled from GIS data; information for field crew]
- Can site be evaluated? (if no, do not fill out other data)
    - Yes
    - No, landowner did not grant access
    - No, fence or other barrier
    - No, another reason
- Notes
- Past Weather (24 hours) – yes/no for all
    - Clear
    - Cloudy
    - Trace of Rain
    - Rain
    - Snow
    - Extreme Cold (consistently < 32 degrees F)
    - Extreme Hot (consistently > 80 degrees F)
    - Other
- Current Weather
    - Same Options as above
- Outfall Pipe Height (inches)
- Outfall Pipe Width (inches)
- Outfall Pipe Shape
    - Round
    - Rectangular
- Outfall Type
    - Pipe
    - Headwall
- Is repair needed?
    - Yes/No

- Is sediment removal needed?
  - Yes/No
- Is there baseflow?
  - Yes/No
- Outfall Material
  - Earth Channel
  - Concrete Channel
  - Concrete Pipe
  - Smooth Metal Pipe
  - Corrugated Metal Pipe
  - Smooth Plastic Pipe
  - Corrugated Plastic Pipe
  - Unknown
  - Other
- Trash Rating (0-20)
- Evidence of Erosion below outfall?
  - Yes, No
- Location of Erosion
  - Outfall Channel (yes/no)
  - Main Stream Channel (yes/no)
- Length of outfall channel erosion (ft)
- Length of stream channel erosion that is attributable to the outfall (ft)
- Distance from outfall to Stream Channel (ft)
- Height of pipe above stream bed (ft)
- Severity of outfall channel Erosion/degradation (1-10)
  - 1-3: Minor erosion. Less than 1 foot of eroded banks. Healing may be present.
  - 4-6: Moderate erosion. Eroded banks are 1-2 feet in height. Erosion looks relatively recent.
  - 7-10: Severe Erosion. Eroded banks are greater than 2 feet in height. Erosion is typically recent/active.
- Does this site have potential for outfall stabilization?
  - Yes (if yes, go to Outfall Stabilization Recommendation, add line, and fill out form)
  - No
- Does this site have potential for stream restoration?
  - Yes (if yes, go to Stream Restoration Assessment, beginning with Stream Reach Break Data and fill out forms, including Erosion Site form)
  - No
- Notes

Outfall Stabilization Recommendation *(Line)*

Data Collection Instructions

Add line to map and fill out the form below if "Yes" was answered for "potential for outfall stabilization". Draw line to indicate proposed location and length of outfall stabilization project. Note: portions of Outfall Stabilization projects that extend beyond 200-300 feet will be categorized as stream restoration projects.

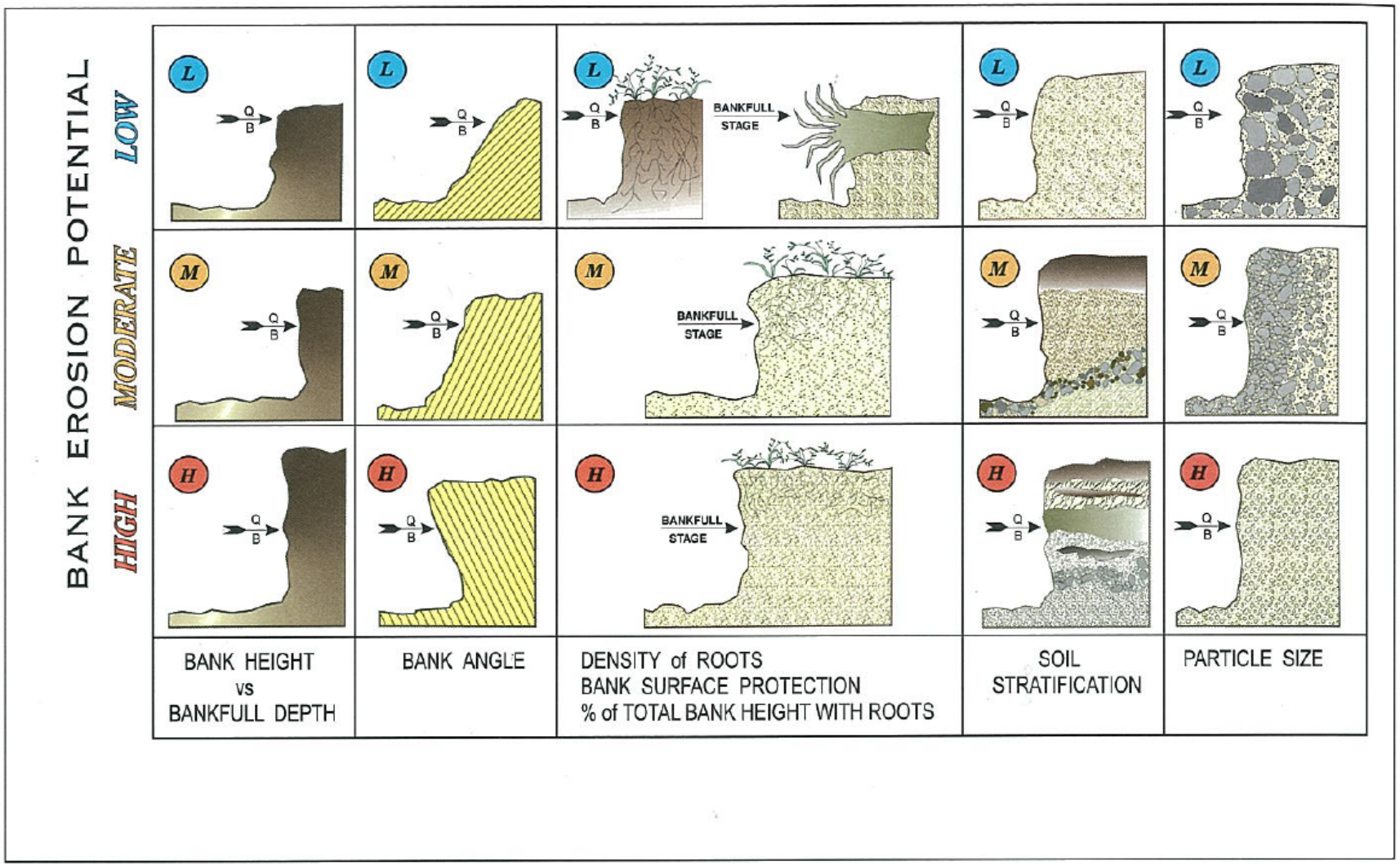
Fields

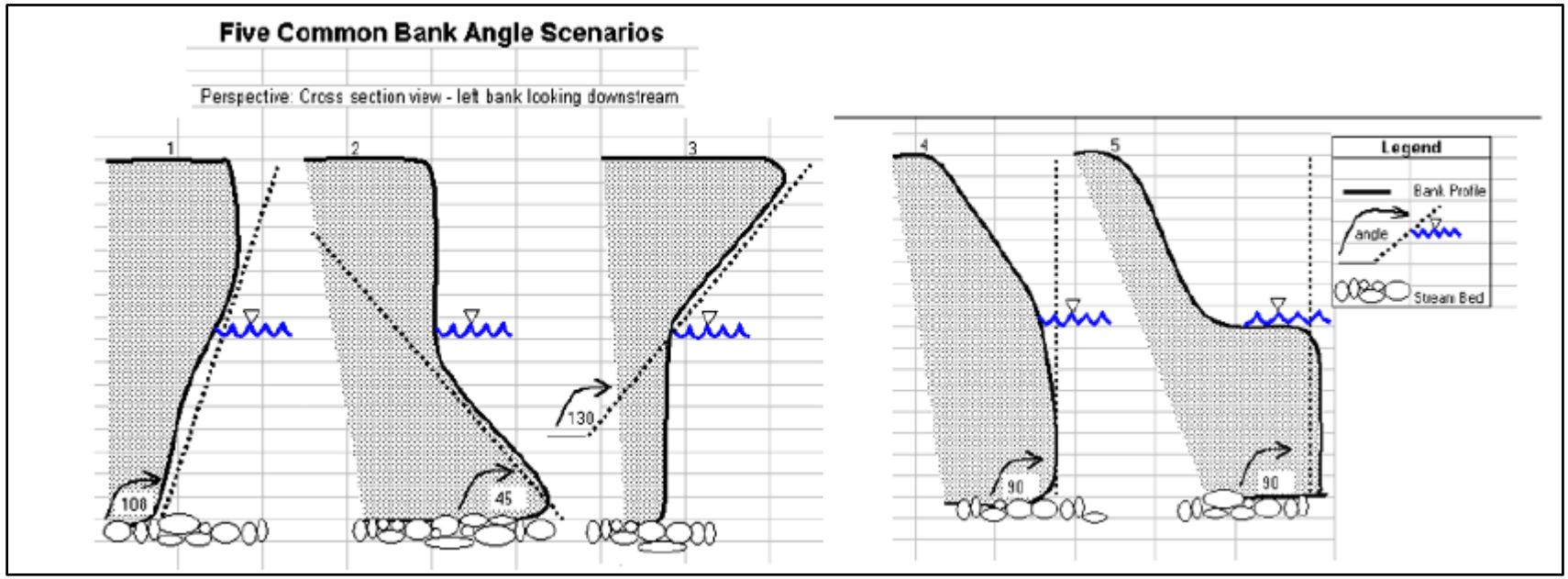
- Site ID (e.g. NMP-OF-F101) (match Outfall Stabilization Assessment Site ID)
- Overall Outfall Stabilization Potential
  - High
  - Medium
  - Low
- Type of Outfall Stabilization Project
  - Rip Rap
  - Drop Structure
  - Regenerative Stormwater Conveyance
  - Other
- Describe Other type of stabilization
- Proposed project length (ft) (estimate to nearest 10 ft)
- Are there many constraints to an outfall stabilization project?
  - None
  - Some
  - Many
- Outfall Stabilization Project Constraints - Type
  - Utility
  - Roadway
  - Buildings
  - Other Structure
  - Ownership
  - Access
  - Draining a hotspot
  - Significant impact to trees
  - Specimen tree removal
  - Wetland Impacts
  - Other
- Approximate length of project affected by constraint (ft)
- Impact to Existing Trees
  - Minimal
  - Moderate
  - Significant
- Ease of access
  - Easy
  - Moderate
  - Difficult
- Potential Demonstration/Educational Value? (yes/no)
- Notes

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Parameters to be evaluated broader than sampling reach	Habitat Parameter	Condition Category			
		Optimal	**Suboptimal**	**Marginal**	**Poor**
	7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
	9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
	SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Habitat Parameter	Optimal 16-20	Sub-Optimal 11-15	Marginal 6-10	Poor 0-5
Trash Rating	Little or no human refuse visible from stream channel or riparian zone	Refuse present in minor amounts	Refuse present in moderate amounts	Refuse abundant and unsightly


BANK EROSION POTENTIAL
LOW
MODERATE
HIGH
L
M
H
Q
B
BANKFULL
STAGE
BANK HEIGHT
vs
BANKFULL DEPTH
BANK ANGLE
DENSITY of ROOTS
BANK SURFACE PROTECTION
% of TOTAL BANK HEIGHT WITH ROOTS
SOIL
STRATIFICATION
PARTICLE SIZE

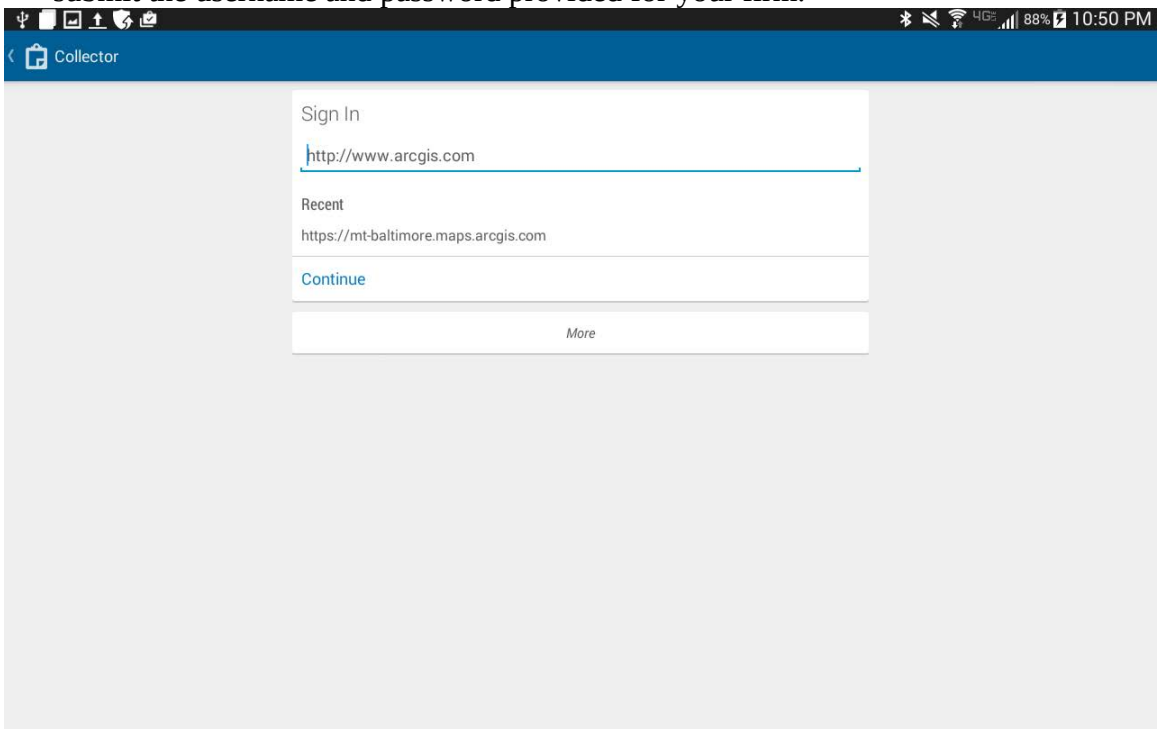

Five Common Bank Angle Scenarios
Perspective: Cross section view - left bank looking downstream
1
2
3
4
5
100
45
130
90
90
Legend
Bank Profile
angle
Stream Bed

D. Electronic Data Collection Protocols

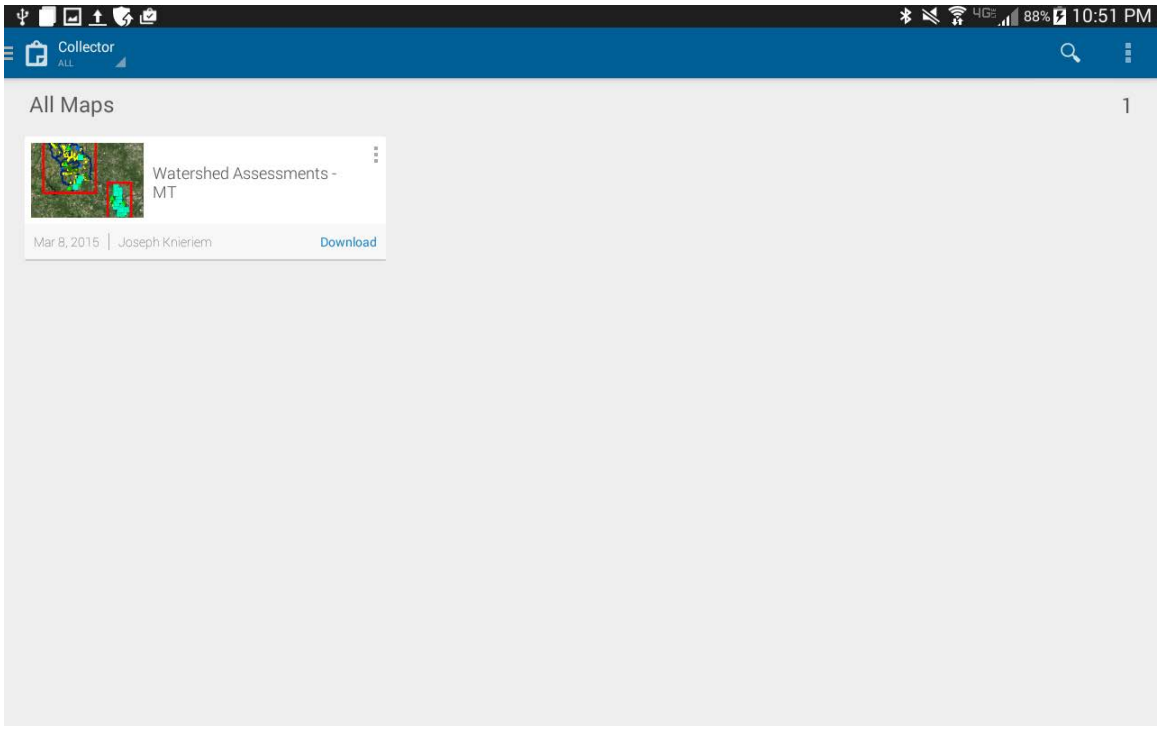
Howard County Watershed Assessments
March 9, 2015

Arc Collector Field Data Collection Instructions

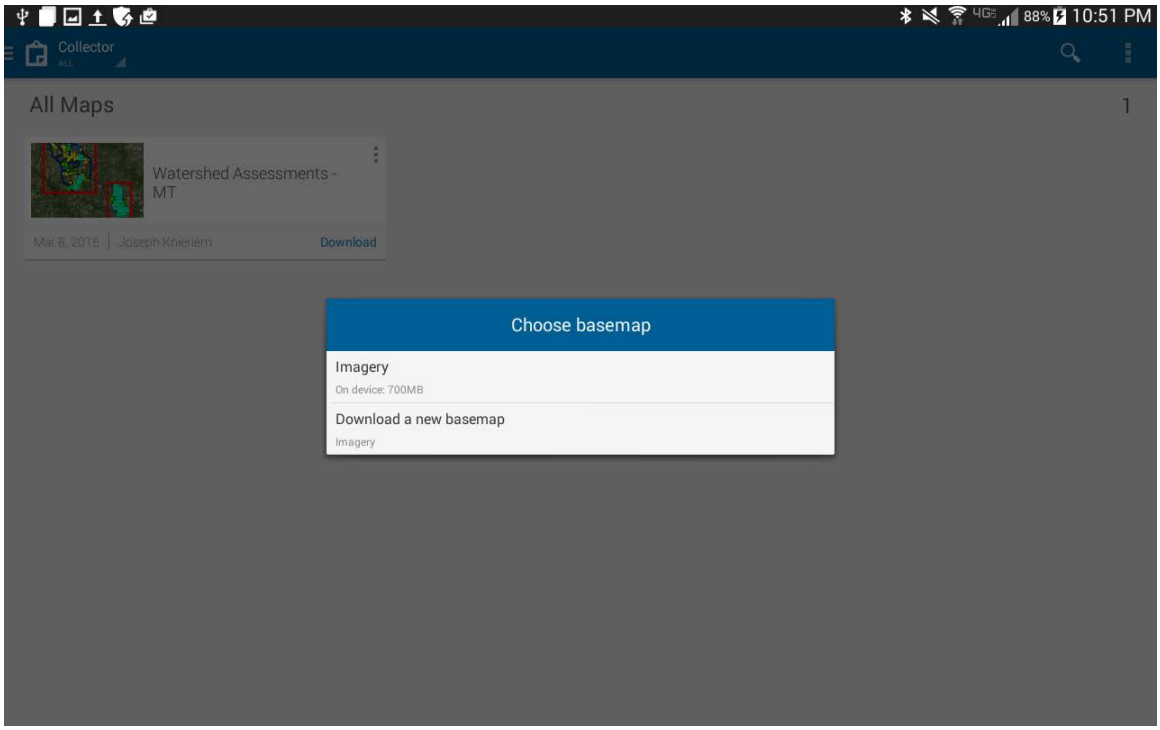
1. **Logging into ArcGIS Online with the tablet.**
   Open the Arc Collector app and create a new account. Type in the URL https://mt-baltimore.maps.arcgis.com and click continue. On the next screen, submit the username and password provided for your firm.



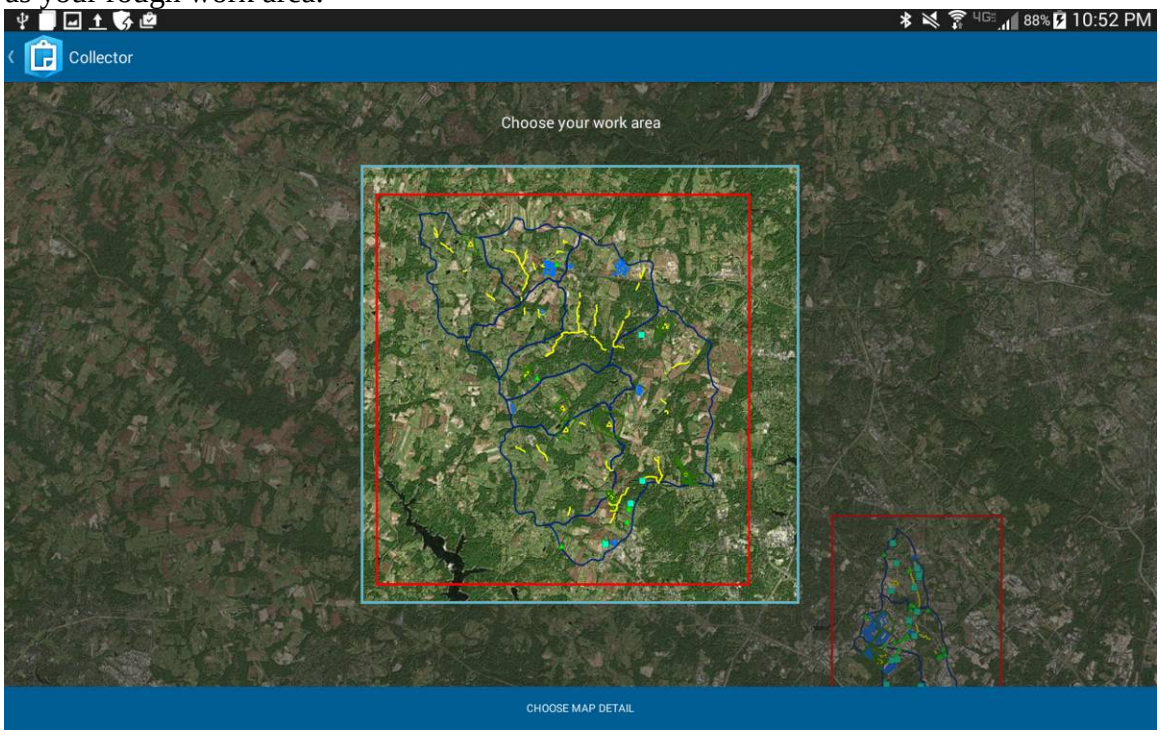
2. **Downloading data to the device for offline use.**
   a. When you sign into Collector, you will see one map available for your firm. To use the map in offline mode, click the "Download" button at the bottom right



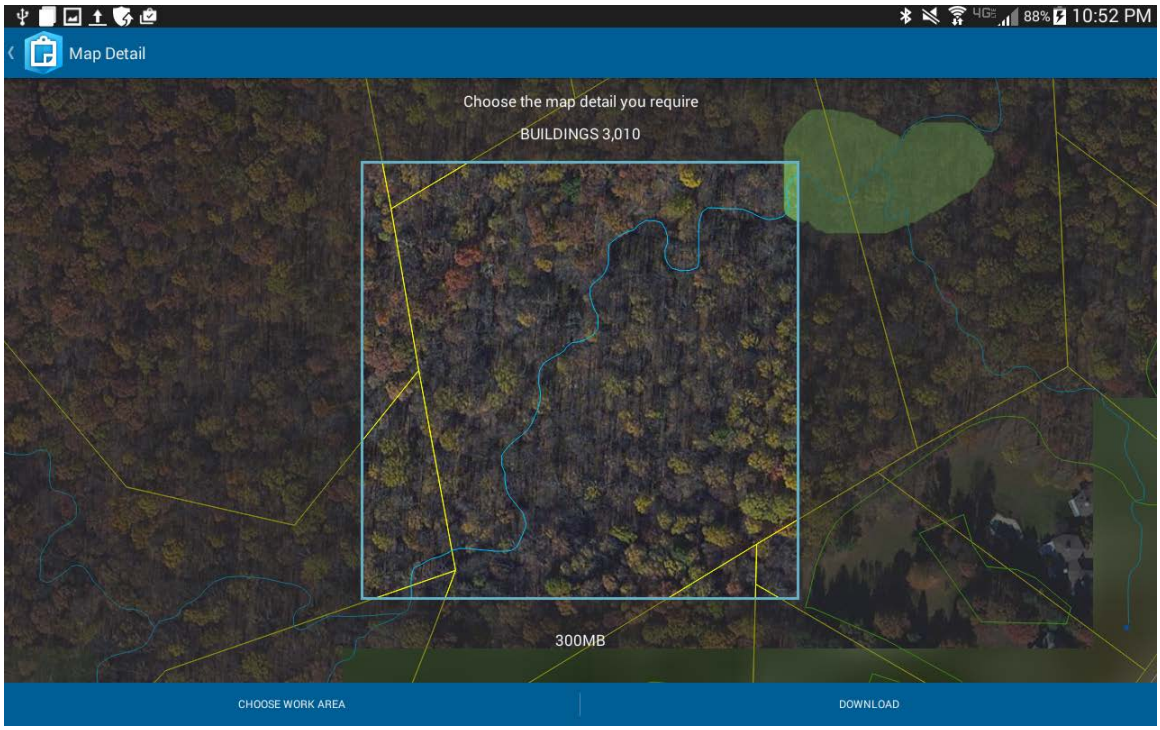
b. If you're downloading the map for the first time, you will be asked to download a new basemap. If you have downloaded a basemap previously, you may opt to reuse a previously downloaded basemap. In the screenshot below, the "Imagery" layer represents a basemap already stored on the device.



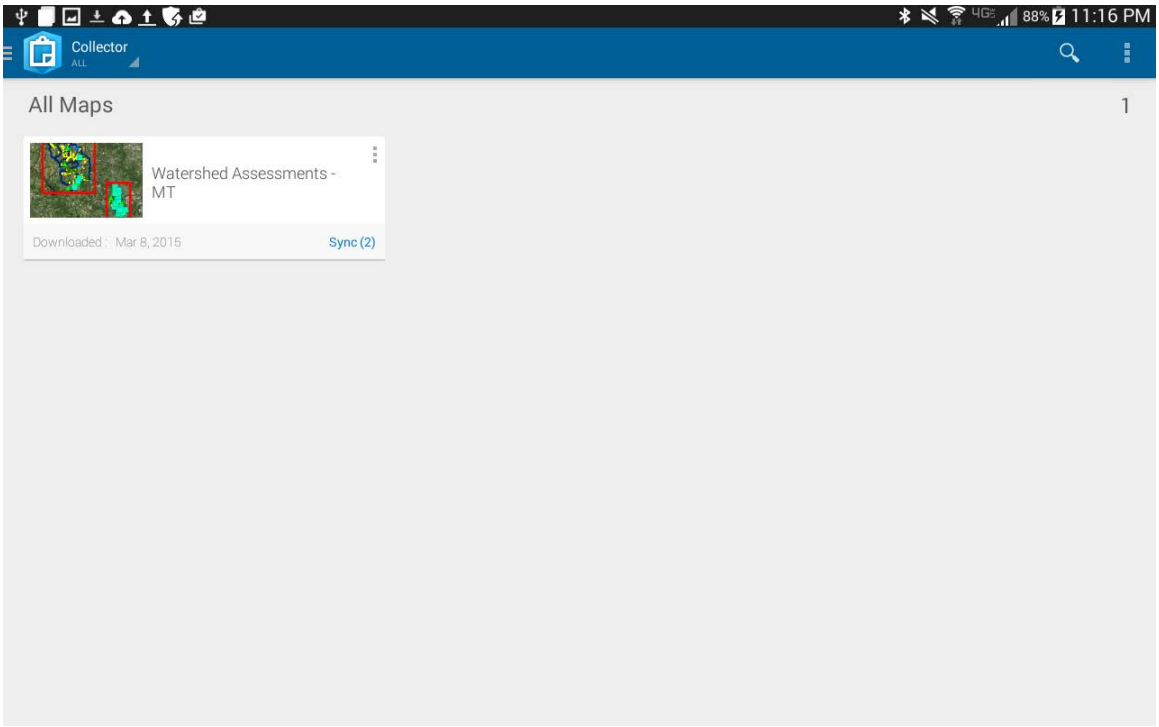
c. To download data to your device, you must specify the "work area" for which you wish to download data. Once data is downloaded to the device, if you venture outside of your work area, you won't have any data available. In each web map, there is a large red box representing the extent of all your available data. It is recommended that you use this box as your rough work area.



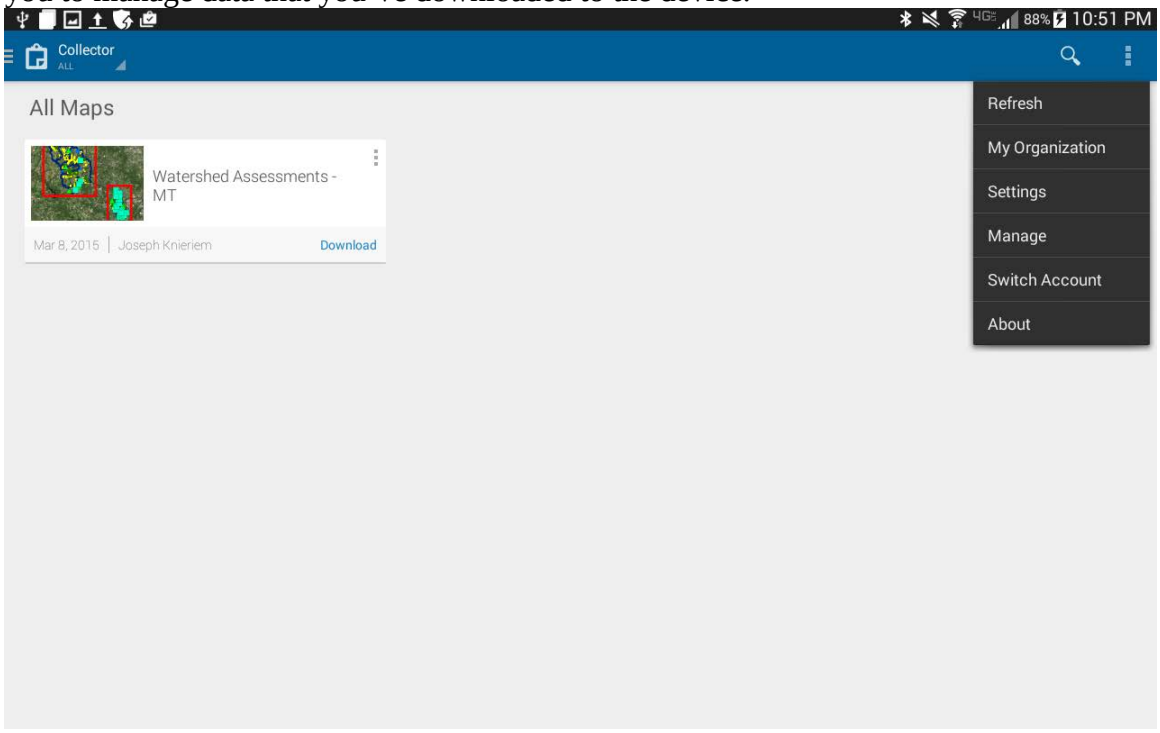
d. Once you select your work area, if you are downloading a base map, you will be asked to choose the level of detail for the base map. This level of detail affects how far you will be able to zoom in on the aerial before it gets blurry in offline mode. It is recommended that you zoom in to at least 3600 scale (1" = 300'). The more detail you want, the larger the download will be. It is recommended that you download a high resolution aerial for your study area just once and then reuse it each time.



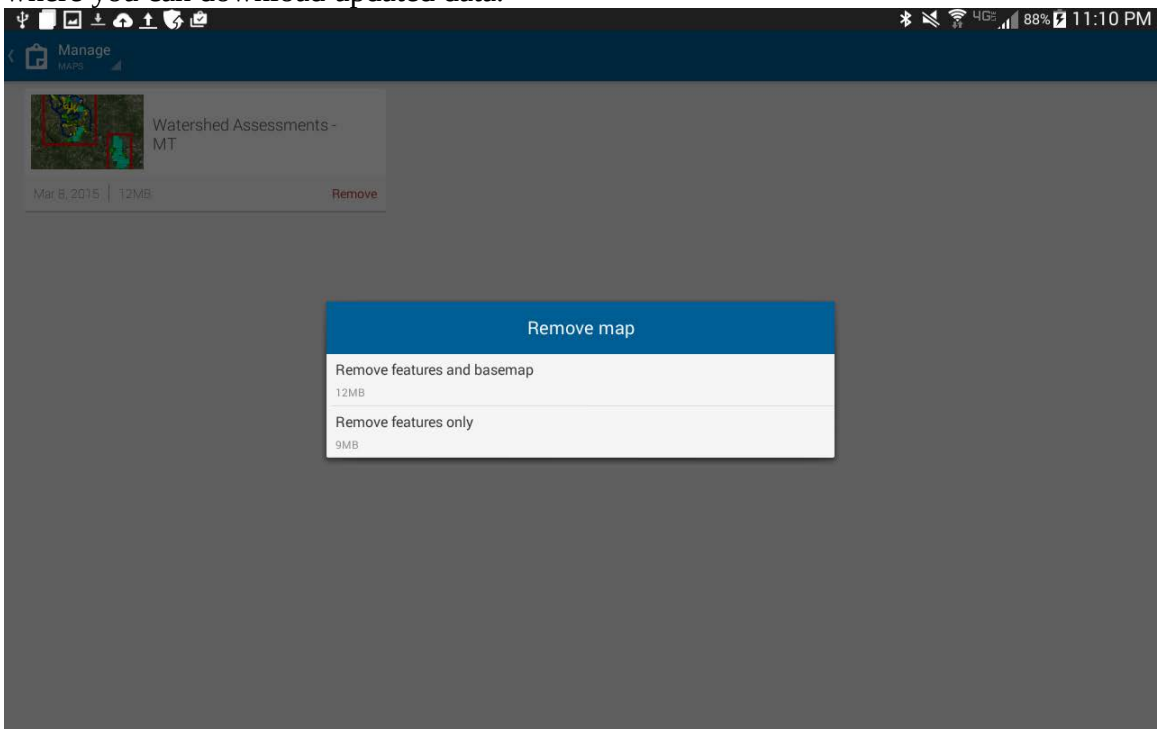
3. **Syncing Collected data**
   Once you have finished collecting data for the day, if you back out to the main map screen of the Collector app, you will see a sync button at the bottom right with a number in parenthesis indicating the number of edits you made in offline mode. Pressing the sync button will upload all of your changes to the master database on the server. This requires an internet connection. Once your data has been synced back to the master database, it is recommended that you check the web map to ensure that the data was synced properly.



4. **Managing device data**
   a. Once your data has been synced, you can remove it from the device so that you can download the latest available dataset for the next day's work. Clicking the 3 dots button at the top right of the main screen brings up a menu. Clicking the Manage option takes you to a screen which allows you to manage data that you've downloaded to the device.



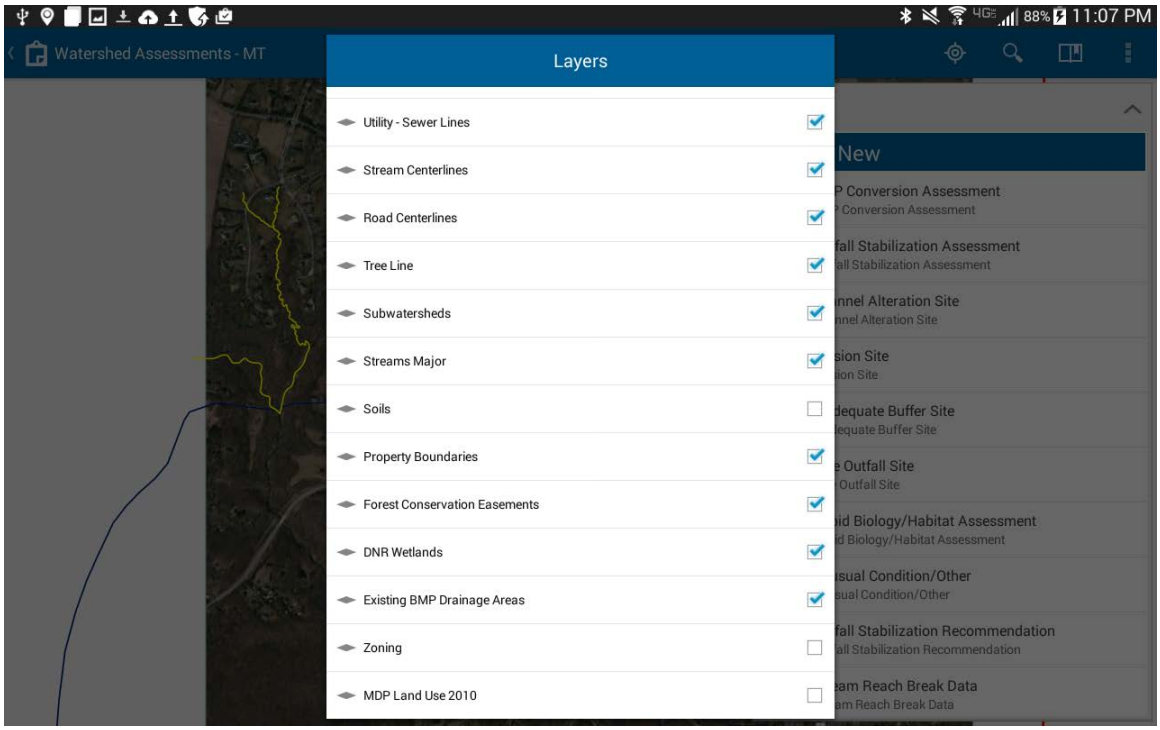
b. The maps shown on this Manage screen represent data you have downloaded to your device. Before you can download updated data to your device, you must first remove any data you currently have stored on the device. To do that, click the "Remove" button at the bottom right. A dialog box like the one below will pop up and ask if you wish to remove only the features or feature and basemap. It is recommended that you choose "remove features only". This will reduce the amount of data you have to download each time. Once your data has been removed, you may hit the back arrow at the top left to take you back to the main map page, where you can download updated data.



5. Working within the map

a. Toggling layers on and off

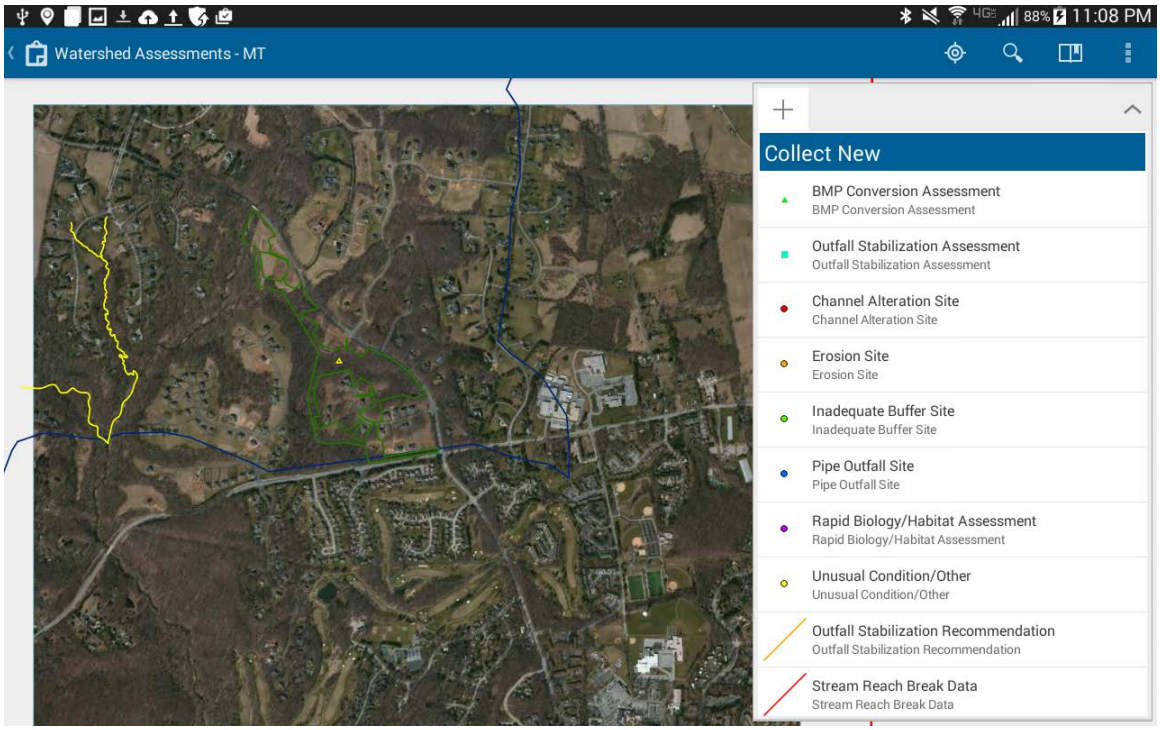
To toggle layers on and off, click the 3 dots at the top right and click the "Layers" option. This brings up a list of all layers available in the current map. Checking or unchecking a layer will make it visible or hidden respectively.



b. Collecting New Features (used for collecting data for Stream Reach Break Data, stream features such as Erosion Points and Inadequate Buffer, and all types of Recommendations)

On the right side of your screen you will see a list of available features that you can collect. Only layers that are visible will be shown in this list, so by hiding layers, you can trim down the number of options you see here. Clicking one of the feature types will collect a new feature of that type.

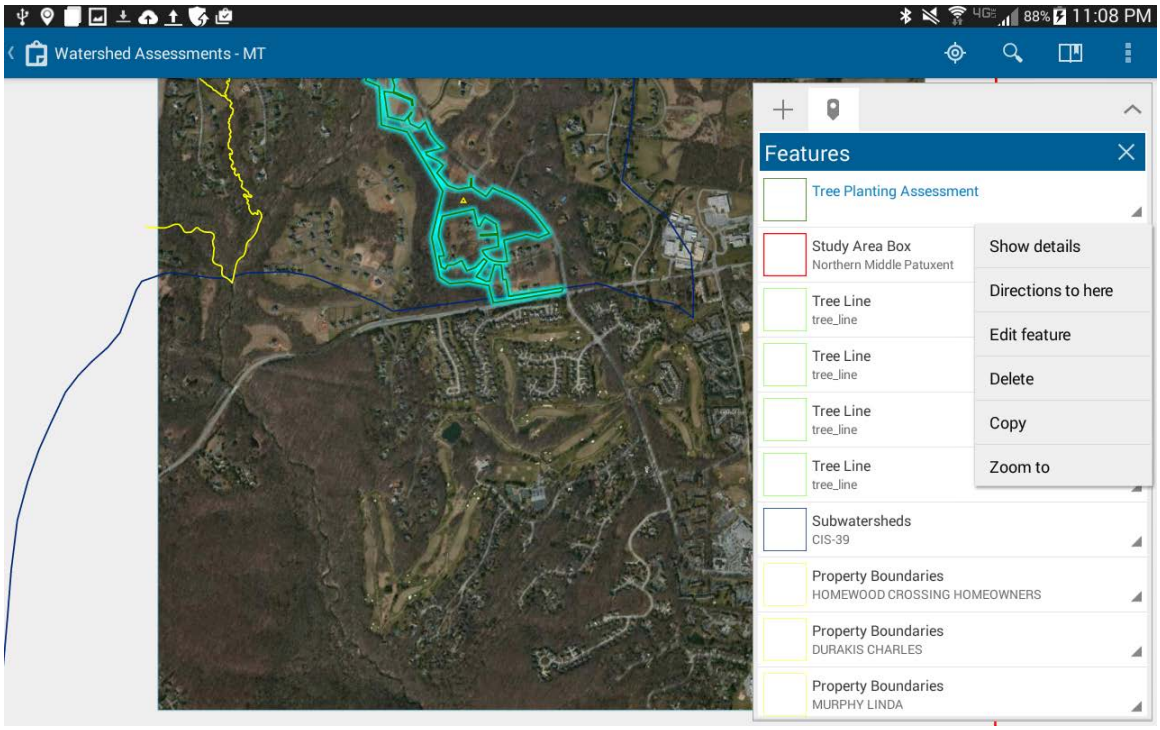
Warning: *When collecting new features, touching the map accidentally will move the location of the feature you are collecting to wherever you touched. You can hit the undo button (U shaped arrow) at the top right to undo any accidental movement of features.*



c. **Updating existing features** (used for collecting data for BMP Conversion Assessments, New BMP Assessments, Tree Planting Assessments, and Outfall Stabilization Assessments)
Clicking on the map will select all features near where your finger touched the map. It brings up a new tab on the right panel with a marker symbol at the top. You may click the gray triangle at the bottom right of a feature and click the "Edit Feature" option to enter edit mode on that feature.

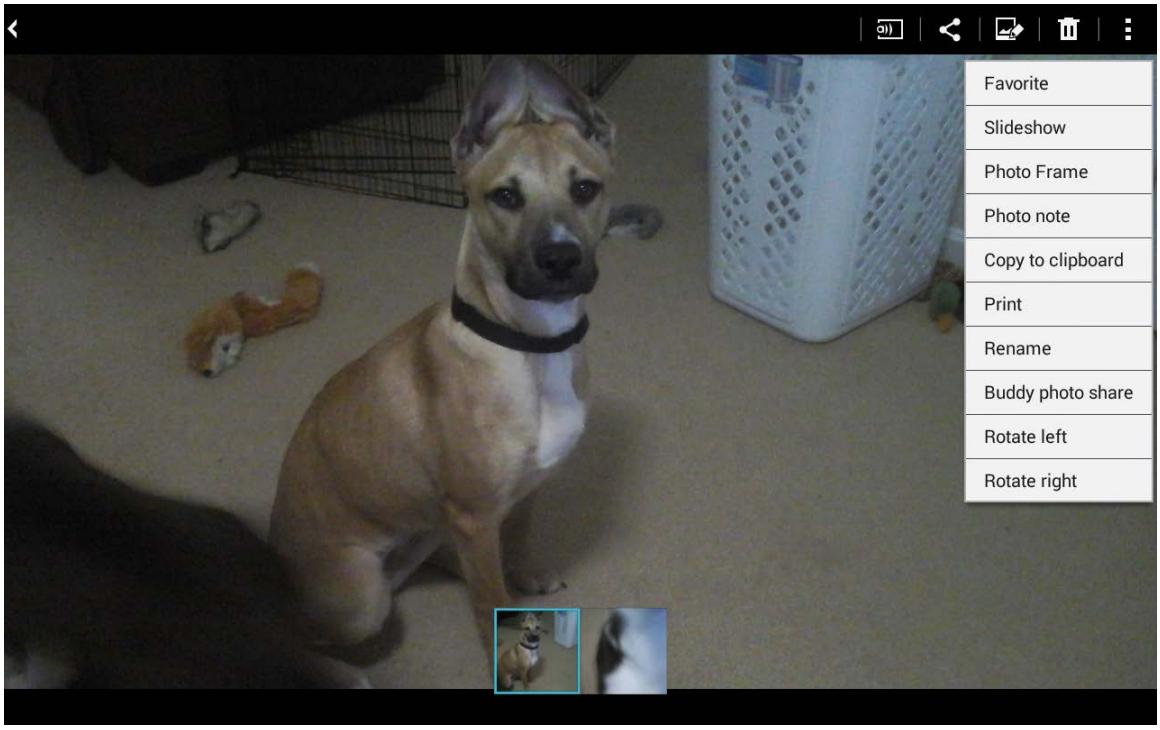
Warning: *When collecting new features, touching the map accidentally will move the location of the feature you are updating to wherever you touched. You can hit the undo button (U shaped arrow) at the top right to undo any accidental movement of features.*

The location of existing features should not be updated in the field. *If an existing feature is at the incorrect location, it is recommended that you collect a new feature of the same type, give it the same ID, and note in the comments that the location should be updated. Your assessment should still be performed on the existing feature.*

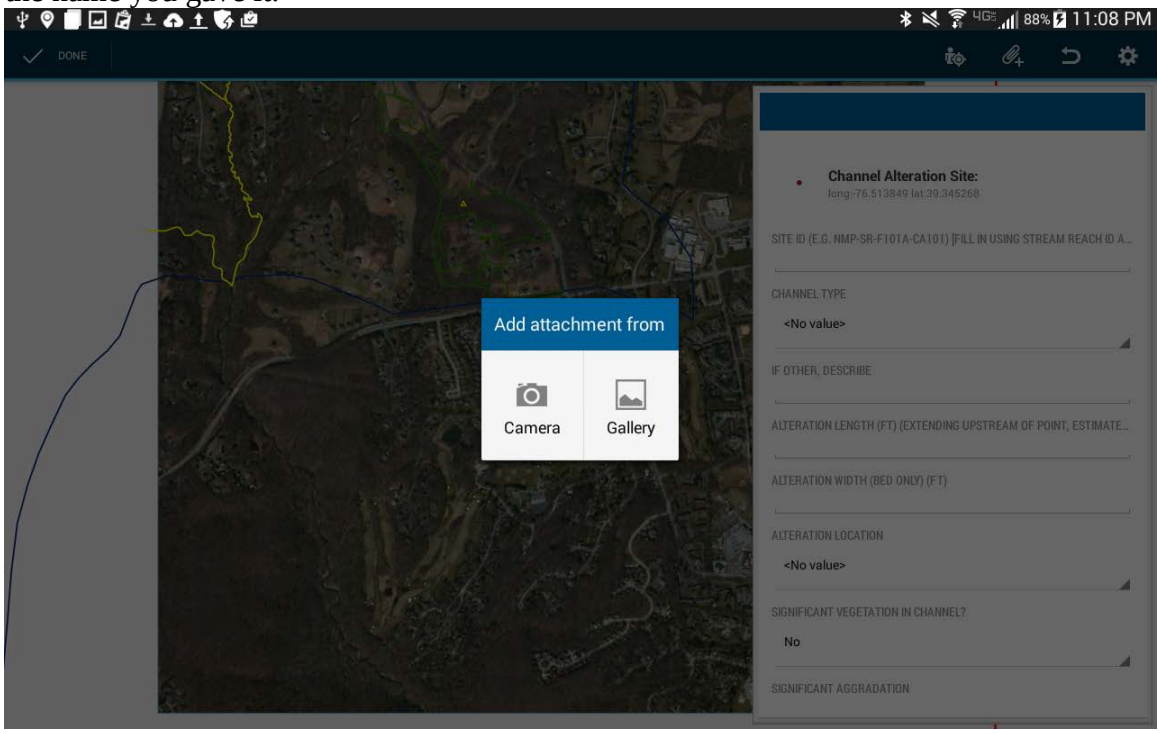


d. Renaming Photos

Renaming photos is a two part process. Specific instructions vary from device to device, so your device may differ slightly from the screenshots shown below. First, you must take the photo using the camera app on your device. This saves the photo to the device. Next, you must navigate to the photo using the Gallery app on your device. Opening the photo in this way should allow you the option to rename the photo. In the screenshot below, the 3 dot symbol at the top right brings up a menu that has a "Rename" option. We recommend naming with site name and description, e.g., "SLP-OF-F701 downstream".

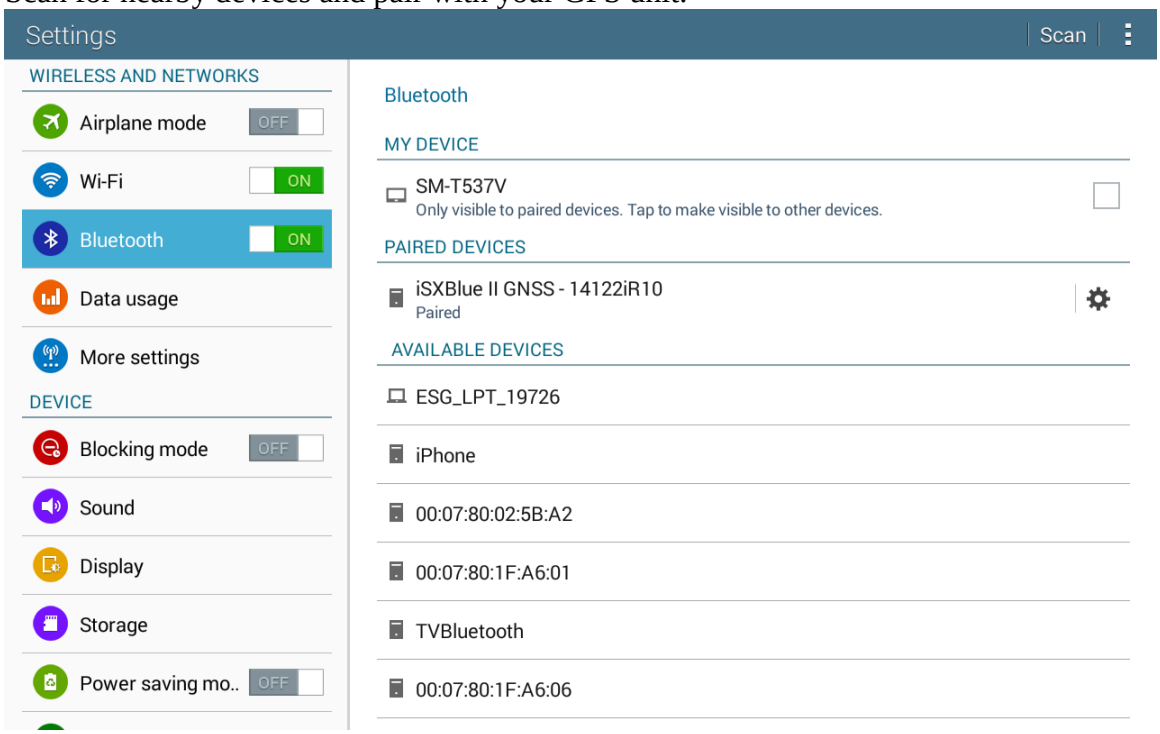


Once the photo is taken and renamed, return to the Collector app and click the paper clip button at the top right. Choose the "Gallery" option and navigate to the photo you just renamed. This will attach the photo with the name you gave it.



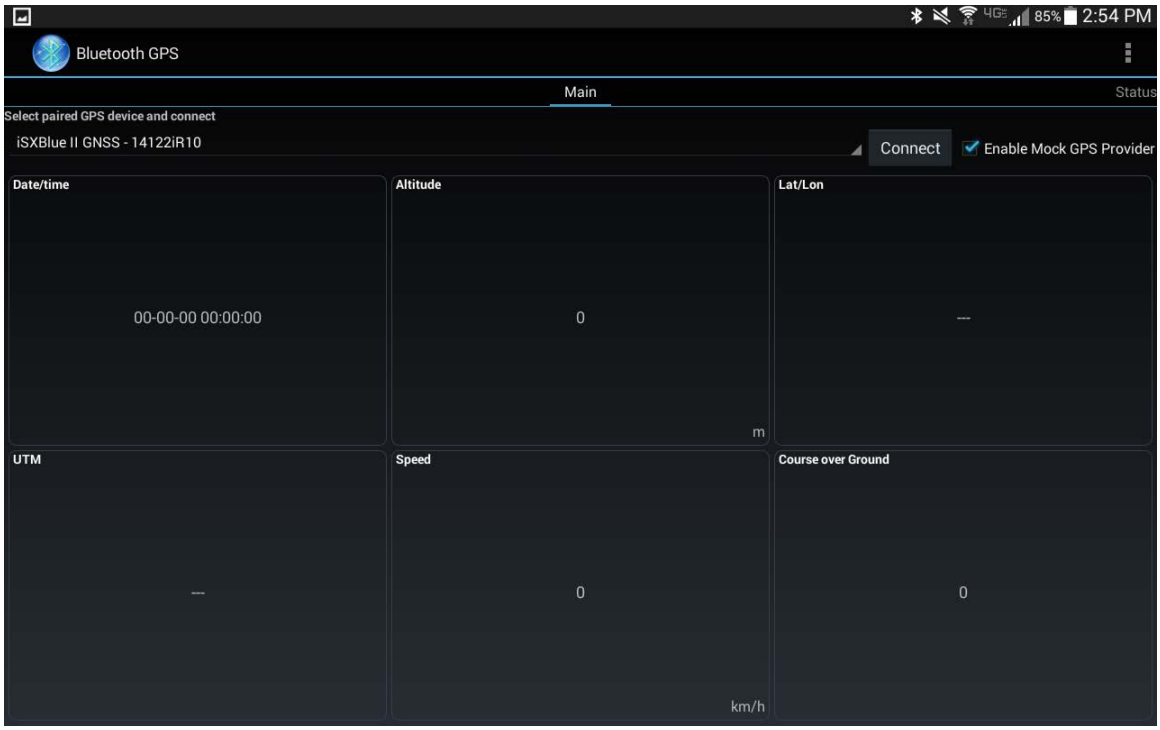
Alternatively, if you aren't concerned with the name of the photo, you can take the photo directly through the Collector app by selecting the "Camera" option from the screenshot above. Photos captured in this manner won't be able to be renamed.

6. **Connecting GPS Device to an Android Tablet** (Note that these instructions may vary slightly depending on your tablet and GPS)
   a. **Install the Bluetooth GPS App**
   b. **Pair your Bluetooth enabled GPS to your tablet.**
   On your Android device, open your settings and click the Bluetooth tab. Scan for nearby devices and pair with your GPS unit.



   c. **Using the Bluetooth GPS app**
   Once your device is successfully paired, open the Bluetooth GPS app. At the top left, you will see a dropdown to select the paired device. Select your GPS device. Ensure that "Enable Mock GPS Provider" is checked, then click the "Connect" button. If successful and your GPS is getting a signal, the Datetime, Altitude, and Lat/Long boxes will populate with actual values.

   To test that your GPS device is indeed overwriting the internal GPS of the tablet, you can lay your GPS down and walk away from it with the tablet. If your position on the map remains stationary, then the pairing is successful. If your position updates as you walk, that means the device is still pulling from the internal GPS.



Contact Info:
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Field Coordinator: Mark Voli
Firm: Versar
E-Mail: mvoli@versar.com
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Cell Phone (if urgent): 610-517-0985

E. Landowner Notification Letter

HOWARD COUNTY DEPARTMENT OF PUBLIC WORKS
6751 Columbia Gateway Drive, Suite 514 ■ Columbia Maryland 21046 ■ 410-313-6444

Mark DeLuca, P.E., Deputy Director
Chief, Bureau of Environmental Services
mdeluca@howardcountymd.gov

FAX 410-313-6490
TDD 410-313-2323

February 25, 2015

Re: Little Patuxent River and Middle Patuxent River Watershed Study

Dear Occupant:

The Howard County Department of Public Works will soon be undertaking a comprehensive watershed assessment within the Middle Patuxent River and the Little Patuxent River watersheds. The watershed assessment is being performed to create an inventory of the natural resources as well as existing problems (erosion, trash, lack of wooded stream buffers, etc.) within these watersheds. Another result of the assessment will be a list of potential projects that can be done to protect and restore these resources, address the problems, and ultimately improve water quality in our streams and water bodies.

The County welcomes participation in development of the study from watershed residents, businesses, and organizations. Public workshops will be planned after the initial field work has been completed to present the results from the assessment and to discuss proposed restoration projects suggested by the study. Exact workshop dates will be advertised when the dates are finalized.

Field crews of two or three County employees or consultants will conduct their assessments on public property to the extent possible but there may be a need for them to be on private property briefly to access certain sites. You may see a crew briefly in your neighborhood. The field crews will be there only to assess existing conditions through visual observations, taking photos, and preparing sketches. Field crews will use extreme care when on private property.

The County anticipates that the majority of the field assessment work will occur during the March to May 2015 time frame with the possibility of a quick second visit to verify field information later in summer 2015.

If you have any specific questions or concerns or would like additional information regarding the watershed assessment, please contact the County by emailing khargadin@howardcountymd.gov or calling 410-313-6444.

F. Field Reports from Consultant Field Teams

Howard County Watershed Assessments

Northern Little Patuxent Watershed

June 2015

KCI Technologies, Inc.
936 Ridgebrook Road
Sparks, MD 21152

CONTENTS

TABLES

FIGURES

1 Introduction

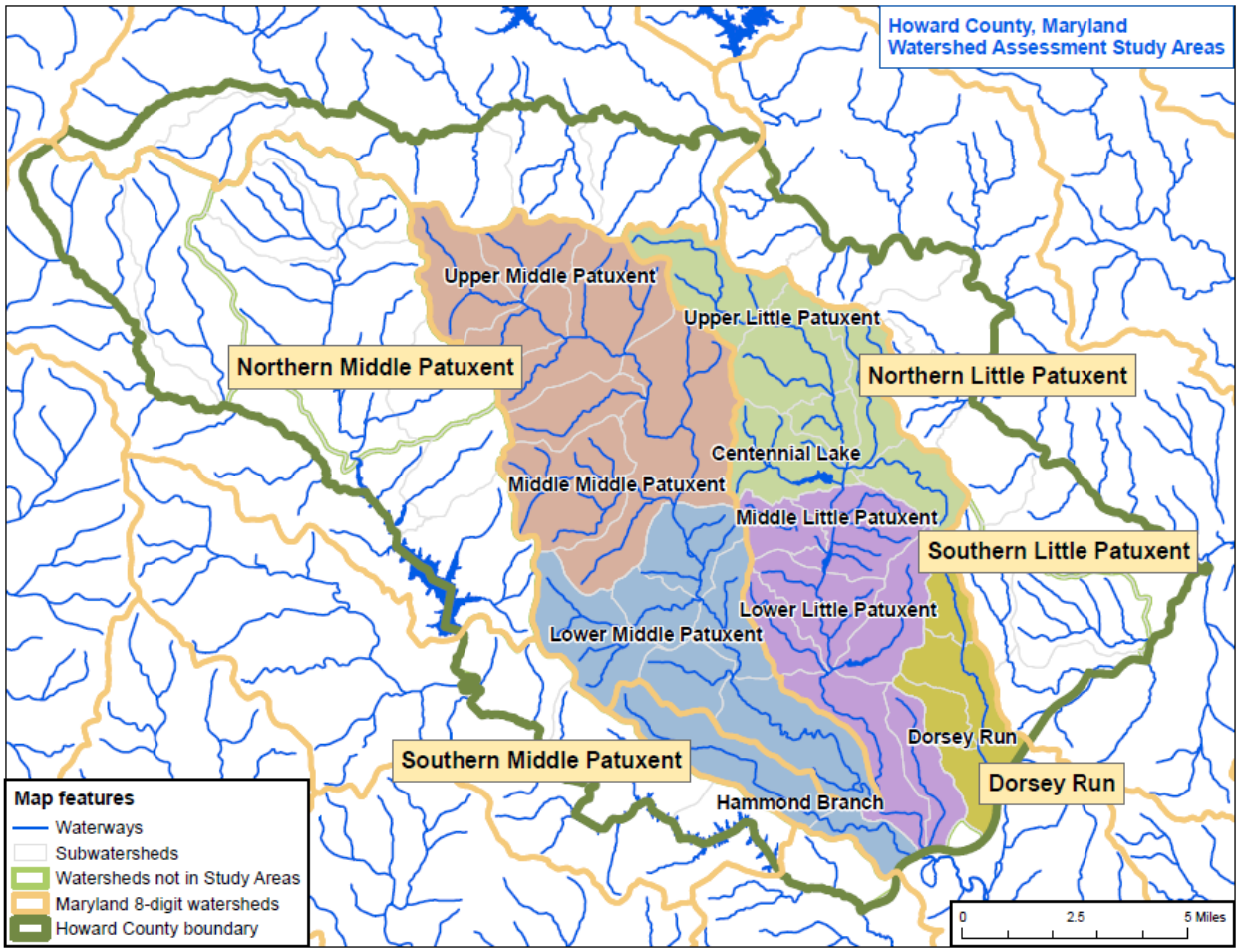
KCI Technologies, Inc. (KCI) completed detailed field and desktop watershed assessments in the Northern Little Patuxent (NLP) watershed in the Spring of 2015 in support of Howard County's efforts to complete Countywide watershed assessments in 2015 and 2016. For the purposes of this study, the NLP watershed includes the Upper Little Patuxent and Centennial Lake watersheds (Figure 1).

The assessments are designed to meet the County's National Pollutant Discharge Elimination System (NPDES) permit conditions under section III.E.1.a which requires the County to complete detailed watershed assessments for the entire County by the end of the current permit term (December 2019).

The goal of the project is to identify feasible and meaningful restoration and retrofit projects that when implemented, provide progress towards meeting the County's local and Chesapeake Bay Total Maximum Daily Load (TMDL) goals and progress toward impervious surface treatment targets. In addition to the Bay TMDL targets there are currently final approved TMDLs and Stormwater Waste Load Allocations (SW-WLA) for the Little Patuxent River for sediment for Centennial Lake for sediment and phosphorus.

Assessment and recommendation will be evaluated and sites selected and prioritized for further study, design and implementation. Results of the initial assessments are included below.

Figure 1. Watershed Assessment Study Areas



2 Field Assessment Results

The following sub-sections describe the results of the assessments in terms of the total number of sites per category completed with detail on the numbers assigned, those assigned sites completed, and any additional sites that were added and assessed through the course of the field effort. Results are summarized in Table 1.

Table 1. Number of Field Assessments Completed

Consultant Firm	**KCI Technologies, Inc.**			
Study Area	**Northern Little Patuxent**			
Type	**# Sites (or Stream Miles) Assigned (from Table A)**	**# Pre-Assigned Sites (or Stream Miles) that Were Completed**	**# Additional Sites (or Stream Miles), Added in the Field and Completed**	**Total # Sites (or Stream Miles) Completed**
BMP conversion	11	11	1	12
New BMP	52	51	0	51
Stream Restoration	24 miles	23 miles	0.6 miles	23.6 miles
Tree Planting	16	15	5	20
Outfall stabilization	37	37	18	55

2.1 BMP Conversion Field Assessments

A total of 11 BMP conversion field assessments were assigned. Site access permissions were obtained for all sites and each was evaluated in the field. An additional conversion site was added in the field because one of the New BMP assessment sites (NLP-NB-F512) was found to be located at an existing stormwater management pond, which was not listed in the original geodatabase; therefore a conversion site (NLP-BC-F651) was added. The site was located at an industrial facility and after checking into the property's office, the property owner provided the design plans for this pond dating back to 1986. Twelve total BMP conversion assessment sites were completed. A breakdown of the number of field assessment sites assigned and completed can be found in Table 1.

2.2 New BMP Field Assessments

A total of 52 new BMP field assessments were assigned. As described above, site NLP-NB-F512 was found to be an existing facility; therefore it was treated as a conversion site, and not assessed as a new BMP site. No additional sites were added in the field. In total, 51 new BMP field assessment sites were completed. A breakdown of the number of field assessment sites assigned and completed can be found in Table 1.

2.3 Stream Restoration Assessment

A total of 24 miles of stream were assigned for evaluation. All pre-assigned sites were able to be assessed with the exception of sites located within one property where access was denied by the property owner. This site included reaches F538, F539, F541, F542, and F545; for a total of 1 mile of stream. In addition, a total of 0.6 mile of stream was added in the field. Those areas that were added include pre-assigned reaches that were extended to capture continued erosion that existed beyond the

assigned reach; as well as, degraded tributaries that drain to a pre-assigned reach. In total, 23.6 miles of stream were evaluated during the field efforts.

Two points, F596b-UC101 and F588b-UC101, were found that contained questionable potential illicit discharges. These observations were discussed with KCI's illicit discharge specialist and did not seem to warrant an emergency or immediate response; however the County may want to add these sites to their regular rotation of illicit discharge checks.

Another unusual condition point (F527a-UC101) was noted where several large trees within close proximity to the channel appeared to have been recently cut down in an area that is noted as a Forest Conservation Area. The cut material was left onsite in the riparian buffer. It was unclear if this was done by the adjacent homeowners.

In general, erosion was typically found to be segmented throughout a reach, with the eroded bank alternating as the channel meanders. In these cases, the erosion was typically found to be very similar throughout and therefore, one erosion point was used to identify the total reach of observed erosion. The total length of erosion noted per bank is provided based on an estimate of actual erosion and excluding the areas that did not contain erosion. The total eroded reach length was then noted in the "Notes" section of the form.

2.4 Tree Planting Field Assessments

A total of 16 tree planting field assessments were assigned. Of these, site access permission was not obtained at only one site (NLP-TP-F515, Covenant Park), and as a result this site was not assessed in the field. An additional five sites were added in the field. Three of these sites, NLP-TP-F652, NLP-TP-F653, and NLP-TP-F654, were added and assessed during the stream restoration streamwalks effort. The other two sites, NLP-TP-F651 and NLP-TP-F655, were created at assigned tree planting assessment sites to assess a distinct portion of the assigned study area that was recommended for tree planting. Twenty total tree planting assessment sites were completed. A breakdown of the number of field assessment sites assigned and completed can be found in Table 1.

2.5 Outfall Stabilization Field Assessments

A total of 37 outfall stabilization sites were assigned for evaluation. Of those, 33 sites were able to be assessed in the field. Those sites that were not assessed were a result of the field crew being unable to locate the outfalls in the field. In these cases, the areas at and around the mapped location of the outfall was traversed; however, no sign of the outfall was observed. A total of 18 sites were added during the assessment and are linked to Pipe Outfall points that were assessed as part of the stream restoration assessments, with the exception of one site that was observed during a BMP assessment. In total, 55 outfall stabilization assessments were performed.

3 Field Recommendations Results

The following sub-sections describe the recommendations made as a result of the field assessments in terms of the total number of recommendations per category and a breakdown of the general restoration/retrofit potential within each category. Results are summarized in Table 2.

Table 2. Number of Site Recommendations Completed for Field Sites Assessed

Consultant Firm	**KCI Technologies, Inc.**			
Study Area	**Northern Little Patuxent**			
		Field Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion	10	4	6	0
New BMP	50	15	29	6
Stream Restoration	50	16	24	10
Tree Planting	17	10	6	1
Outfall stabilization	28	13	10	5

3.1 BMP Conversion Recommendations

Two sites, NLP-BC-F504, and NLP-BC-F505, were the only sites not recommended for conversion. These were listed as dry ponds in the geodatabase, but were stormdrain inlets. Based on the site conditions, there were no recommendations for these sites.

Ten sites with existing dry ponds can be converted to wet ponds to provide water quality volume treatment for their contributing drainage area. Two sites were recommended to be converted to bioretention practices as alternatives, and one site was recommended to be converted to an infiltration practice as an alternative. Four out of the ten sites were considered to have high conversion potential. A breakdown of the number of field assessment of retrofit potential can be found in Table 2. The existing site soils should be investigated to determine the best conversion options for next design phase.

3.2 New BMP Recommendations

Twenty-one sites were not recommended with any new BMP practices. The most common reason new BMPs were not recommended was a lack of open space or residential property issues within the study area. Many commercial sites were found to have large impervious areas draining directly into existing stormwater drainage systems with little or no open space available.

Thirty-one sites were considered feasible for new BMP practices. Each site was recommended with one or multiple new BMP practice types. A total of fifty new BMP footprints were recommended. The most common recommendations were wet pond and bioretention practices for these sites. Further investigations regarding soils, water balance analysis, and contributing drainage areas are needed to determine the best retrofit options for the next design phase. Of these sites, 15 were found to have a high retrofit potential, 29 sites have medium potential, and six sites have low potential (Table 2).

3.3 Stream Restoration Recommendations

Stream restoration recommendations were created for 50 sites. Of these, 16 sites were rated as having high restoration potential, 24 as medium potential, and 10 as low potential. In most cases, each stream restoration recommendation site includes multiple stream reaches. These areas were lumped together to better represent a complete and practical restoration project where similar conditions exist, the general restoration approach would be similar, and it would be cost effective to prepare design plans and mobilize construction for the entire site.

All areas that showed some restoration potential that could result in a feasible project were included in the restoration recommendations. Overall, many of the sites assessed contained only moderate erosion, but in these areas, the conditions typically existed over a long distance. As a result, many of the restoration recommendations include sites that may not appear severely degraded or be considered a high priority, but due to the consistent conditions over a long distance, are expected to result in a feasible project that will yield significant restoration credit.

3.4 Tree Planting Recommendations

A total of 17 tree planting recommendation sites were created at the field assessment sites (Table 2). Of these, 10 sites were evaluated to have a high restoration potential, 6 sites had medium potential, and 1 site had low potential. Sites with high restoration potential were generally open, mowed fields with minimal site preparation required. Sites with medium or low restoration potential generally had more site preparation required, included mowing and invasive removal, or beaver activity within the area that would reduce the survival potential of planted trees.

The most common reason planting was not recommended was lack of suitable planting area space (generally enough space for more than approximately 10 trees) within the study area. Many sites included stormwater management facilities which left little room for planting due to the facility structures and embankments. Several sites were already forested.

Many tree planting assessment sites had distinct areas of the site that would yield different assessment results (for example: sunlight exposure, vegetative cover, invasive cover), however if no planting was recommended at the site, the site was assessed as a whole and existing conditions were averaged. If planting areas were recommended, typically only the planting area conditions were assessed, however if multiple planting areas were recommended within one large study area, the conditions were averaged for the assessment. A description of the areas assessed (entire site, planting areas only, etc.) at each site is included in the Notes field.

The tree planting assessments were conducted in late March and early April, therefore invasive species and percent cover may be artificially lower and results may have been different had the site been assessed during the growing season.

3.5 Outfall Stabilization Recommendations

A total of 28 outfall stabilization recommendation sites were created during the field assessments. Of these, 13 sites were rated as having high restoration potential, 10 as medium potential, and 5 as low potential. In general, the outfall stabilization recommendations included stabilization of a degraded outfall channel located immediately downstream of the outfall. Of the 28 recommendations, eight included drop structures, five are rip-rap stabilization, six are RSC projects, and nine are projects involving riffle-pool design and bank stabilization.

4 Desktop Assessment Results

KCI was asked to prepare assessments and generate recommendations for BMP and tree planting sites that were visited previously during preparation of the Upper Little Patuxent (ULP) Watershed Management Plan, prepared by KCI in 2009. Data from site visits, photos, and concept plans were used to complete the assessments. The following sub-sections describe the results of the desktop assessments in terms of the total number of sites per category completed with detail on the numbers assigned, those assigned sites completed, and any additional sites that were added and assessed through the course of the desktop effort. Results are summarized in Table 3.

Table 3. Number of Desktop Assessments Completed

Consultant Firm	**KCI Technologies, Inc.**		
Study Area	**Northern Little Patuxent**		
Type	**# Sites (or Stream Miles) Assigned (from Table B)**	**# Sites (or Stream Miles) for Which Desktop Assessment Was Completed**	**For These Sites, Number of Concept Plans Previously Prepared**
BMP conversion	12	12	2
New BMP	5	4	4
Stream Restoration	0 miles	0 miles	0
Tree Planting	5	4	0
Outfall stabilization	0	0	0

4.1 BMP Conversion Desktop Assessments

A total of 12 BMP conversion desktop assessments were assigned. Of these, two sites had concept plans prepared previously for the ULP management plan; therefore the concept was used for the assessment. Ten sites did not have concept plans and were evaluated based on previous field notes and photos. Twelve total BMP conversion assessment sites were completed. A breakdown of the number of desktop assessment sites assigned and completed can be found in Table 3.

4.2 New BMP Desktop Assessments

A total of five new BMP desktop assessments were assigned. Of these, one site NLP-NB-D561, is the same site as NLP-BC-D525, and has been considered a BMP conversion desktop analysis site because of the existing facility located at the site; therefore four new BMP desktop assessment sites were completed. All four sites had a concept plans previously prepared during the ULP management plan development. A breakdown of the number of field assessment sites assigned and completed can be found in Table 3.

4.3 Tree Planting Desktop Assessments

A total of five tree planting desktop assessment sites were assigned. Very little information required in the planting assessment could be obtained through the desktop investigation; therefore four of the five sites were visited during the field assessments. One site could not be field evaluated due to lack of landowner permission to access the site. A breakdown of the number of field assessment sites assigned and completed can be found in Table 3.

5 Desktop Recommendations Results

The following sub-sections describe the recommendations made as a result of the desktop assessments in terms of the total number of recommendations per category and a breakdown of the restoration/retrofit potential within each category. Results are summarized in Table 4.

Table 4. Number of Site Recommendations Completed for Desktop Sites Assessed

Consultant Firm	**KCI Technologies, Inc.**			
Study Area	**Northern Little Patuxent**			
		Desktop Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion	12	3	7	2
New BMP	4	3	1	0
Stream Restoration	0	0	0	0
Tree Planting	6	3	3	0
Outfall stabilization	0	0	0	0

5.1 BMP Conversion Recommendations

Eleven sites with existing dry ponds are proposed to be converted to wet ponds to provide water quality volume treatment for the contributing drainage areas. Two sites were recommended to be converted to wetlands as an alternative, and one site was recommended to be converted to a bioretention practice as an alternative. One site with an existing dry pond was proposed to for conversion to bioretention practice. Three out of twelve sites were considered to have high conversion potential. A breakdown of the number of desktop assessment sites and retrofit potential can be found in Table 4. The existing site soils and water balance analysis should be investigated to decide the best conversion options for the next design phase.

5.2 New BMP Recommendations

All four sites were recommended with new BMP practices. Wet pond and bioretention practices were recommended for these sites. Further investigations of soils and contributing drainage areas are recommended to decide the best retrofit option for the next design phase. Of these sites, three were found to have a high retrofit potential and one site had medium potential (Table 4).

5.3 Tree Planting Recommendations

Planting was found to be possible at three of the five desktop sites assigned. Multiple planting areas were created for NLP-TP-D519 and NLP-TP-D521 and resulted in the creation of six total planting recommendation sites. At the third site, NLP-TP-D522, a smaller portion of the site was recommended for planting and separate field assessment and planting recommendation forms were filled out for this portion of the site (NLP-TP-F655A), therefore the recommendation site is linked to a field assessment site rather than the original desktop site ID. Of these sites, 3 were found to have a high restoration potential and 3 sites had medium potential (Table 4).

Field Data Summary

Howard County Watershed Assessments 2015

Southern Little Patuxent River Watershed




Prepared for
Howard County Watershed Management Program
Howard County Department of Public Works
Bureau of Environmental Services
Stormwater Management Division

Prepared by
Versar, Inc.
Ecological Sciences and Applications
9200 Rumsey Road
Columbia, MD 21045

VERSAR

June 2015

Southern Little Patuxent Field Summary
June 22, 2015

1. Number of field assessments completed

Table 1. Number of field assessments completed				
Consultant Firm Name	**Versar**			
Study Area Name*	**Southern Little Patuxent**			
Type	**# Sites (or Stream Miles) Assigned (from Table A below)**	**# Pre-Assigned Sites (or Stream Miles) that Were Completed**	**# Additional Sites (or Stream Miles), Added in the Field and Completed**	**Total # Sites (or Stream Miles) Completed**
BMP conversion	73	69	2	71
New BMP	76	72	1	73
Stream Restoration	15 miles	13.7 miles	1.2 miles	14.9 miles
Tree Planting	4	4	6	10
Outfall stabilization	95	82	14	96

2. If there were sites that could not be assessed in the field, please summarize primary reasons.

BMP Conversion Assessments: All sites were visited, but 4 BMPs either could not be found or did not exist. A total of 8 sites did not have potential for conversion due to either already being state of the art facilities, having safety issues, or are back-up type flood control without the correct elevations to treat the first flush. One site was evaluated during a past study and was thus completed as a desktop assessment.

New BMP Assessments: Four sites (SLP-NB-F708, SLP-NB-F714, SLP-NB-F763, and SLP-NB-F775) that were only rooftops were merged with adjacent parking surfaces to create a single site. The number of pre-selected sites assessed were thus reduced by 4 to 72. Some sites or portions of sites appeared to be in error. For example, Oakland Mills High School (SLP-NB-F759) had a portion of an impervious surface on a parking lot subtracted out but there appeared to be no reason for including a patch nearby as they were both in the same drainage area.

Stream Restoration Assessments: One pre-assigned stream reach (SLP-SR-F728) that totaled 1.23 miles in length was not assessed because it is located on FCC property. Versar confirmed with the County that this reach was to be left out of the assessment pool.

Tree Planting Assessments: All pre-assigned sites were assessed, and several additional sites were assessed.

Outfall Stabilization Assessments: All of the 95 pre-assigned sites were visited, but 9 sites were duplicates (either the duplicate point was marking the same outfall twice, or the duplicate

point was marking the downstream extent of the erosion surveyed during a previous SCA study), two sites could not be located (SLP-OF-F705 and SLP-OF-F788), one site was marking infrastructure that was not an outfall (SLP-OF-F755), and one site was marking a potentially submerged pond infall (SLP-OF-F712).

3. Other comments about data or assumptions made.

BMP Conversion Assessments: Two additional dry ponds were assessed due to their close proximity to a pre-assigned pond.

New BMP Assessments: One additional site was assessed due to its close proximity to a pre-assigned pond. The site consists of a large overflow parking lot that appears to get very little use and was thus recommended for impervious surface removal. The one Desktop New BMP Assessment Site that was assigned to Versar was evaluated in the field.

Stream Restoration Assessments: One additional stream reach located next to a Tree Planting Assessment site was fully assessed, and two additional stream reaches adjacent to BMP Conversion sites were photodocumented and added as Stream Restoration Recommendation sites due to the severity and longevity of erosion. The total length of stream assessed also includes outfall stabilization recommendations that extended beyond 200 feet.

Tree Planting Assessments: Six additional tree planting sites were found, three of which were discovered while conducting Stream Restoration Assessments, and the remaining three were discovered while conducting BMP Conversion Assessments.

Outfall Stabilization Assessments: A total of 14 additional outfalls were assessed during the study. 9 of these were added during Stream Restoration Assessments, 3 were added during New BMP Assessments, and two were added during BMP Conversion Assessments.

4. Number of site recommendation forms completed for field sites assessed

Table 2. Number of site recommendation forms completed for field sites assessed				
Consultant Firm Name	**Versar**			
Study Area Name*	**Southern Little Patuxent**			
		Field Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion recommendations	62	38	23	1
New BMP recommendations	144	91	50	3
Stream Restoration recommendations	37 (23,920 ft)	22 (14,950 ft)	14 (8,920 ft)	1 (50 ft)
Tree Planting recommendations	21	17	2	2
Outfall stabilization recommendations	44 (4,005 ft)	22 (2,210 ft)	19 (1,630 ft)	3 (165 ft)

5. General comments about the types of recommendations made.

BMP Conversion Recommendations: The following BMP conversion types are recommended: 33 Wet Pond, 27 Non-Bioretention Filtering Practice, 23 Created Wetland, 12 Bioretention, 7 Infiltration, 7 Extended Detention, 4 Swale, and 1 Step Pool Conveyance. The total number of recommended conversions exceeds the number of assessed BMPs because multiple BMP conversion options are feasible at several sites.

New BMP Recommendations: The following new BMP types are recommended: 59 Bioretention, 48 Non-bioretention filtering practices, 24 Underground Storage, 23 Impervious Pavement Replacement, 12 Impervious Surface Removal, 3 Green Roof, 2 Infiltration, 1 Swale, 1 Wet Pond, and 1 Buffer Enhancement. The total number of recommended BMP facilities exceeds the number of assessed sites because multiple BMP opportunities are feasible at several sites.

Stream Restoration Recommendations: In general, stream reaches recommended for restoration contained either one (or multiple) instance(s) of severe bank erosion, or consistent minor to moderate bank erosion along with unsuitable instream habitat and threatened infrastructure (e.g. exposed utility pipes, power line poles located in the stream channel, etc.). In addition, several concrete channels were recommended for removal.

Tree Planting Recommendations: Tree Planting recommendations that are rated High or Medium typically target riparian areas and areas of existing forest that can be expanded. A few

areas of open pervious land were also recommended for planting, but were rated lower due to the smaller potential for biological uplift at these sites.

Outfall Stabilization Recommendations: The following Outfall Stabilization types are recommended: 32 Regenerative Stormwater Conveyance, 7 Rip Rap, and 5 Drop Structure.

6. List of sites reported to Howard County because of suspected illicit discharges, safety concerns, or other reasons for County followup.

A sudsy discharge was observed while conducting an Outfall Stabilization Assessment for the outfall (SLP-OF-F708) associated with BMP HO101950 on 5/8/15. Field personnel inspected the BMP's drainage area, but could not identify a definitive source for the sudsy discharge. The County was notified of the issue immediately, and photos of the outfall were sent to County personnel at the end of the field day.

Field personnel discovered an unusual amount of water flowing over a stream bank in the vicinity of Rommel Drive and Gerwig Lane while conducting a Stream Restoration Assessment for SLP-SR-F732 on 5/13/15. The flow was followed up to a point where water was bubbling out of the ground approximately 100 feet east of the stream and 100 feet west of Rommel Drive. The County was notified of the issue immediately, and eventually discovered that a problem with a potable water line was the source of the bubbling water.

Outdoor washing of vehicles was observed at an auto care business located at 7248 Cradlerock Way, Columbia, MD while field personnel were conducting a BMP Conversion Assessment on 5/14/15. The County was notified of the issue immediately.

A sediment-laden discharge was discovered while conducting an Outfall Stabilization Assessment along Green Mountain Circle (SLP-OF-F766) on 5/19/15. The source of the discharge was discovered to be a pile of dirt associated with construction occurring along Twin Rivers Road, between Green Mountain Circle and Lynx Lane. The silt fence that was in place was compromised and allowing sediment to spill into the road and wash into a storm drain. The County was notified of the issue immediately.

Field personnel discovered a homeless camp within an outfall channel while conducting an Outfall Stabilization Assessment (SLP-OF-F716) behind 6560 Dobbin Rd. Columbia, MD on 5/19/15. The County was notified of the discovery the following morning.

7. Other comments/explanations related to data collected.

Ten of the 63 assigned desktop analysis sites were not previously visited by Versar, and thus full desktop assessments could not be performed.

8. Number of desktop assessments completed

Table 3. Number of desktop assessments completed			
Consultant Firm Name	**Versar**		
Study Area Name	**Southern Little Patuxent**		
Type	**# Sites (or Stream Miles) Assigned – see Table B below**	**Total # Sites (or Stream Miles) For Which Desktop Assessment was Completed**	**For These Sites, Number of Concept Plans Previously Prepared**
BMP conversion	63	53	25
New BMP	1	1*	0
Stream Restoration	NA miles	NA miles	NA miles
Tree Planting	NA	NA	NA
Outfall stabilization	NA	NA	NA
*evaluated in the field.			

9. Number of site recommendation forms completed for desktop assessment sites

Table 4. Number of site recommendation forms completed for desktop assessment sites				
Consultant Firm Name	**Versar**			
Study Area Name	**Southern Little Patuxent**			
		Desktop Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion recommendations	50	39	9	2
New BMP recommendations	NA	NA	NA	NA
Stream Restoration recommendations	NA	NA	NA	NA
Tree Planting recommendations	NA	NA	NA	NA
Outfall stabilization recommendations	NA	NA	NA	NA

Attachment. Numbers of field and desktop sites assigned.

Table A. Estimates of field effort for identifying opportunities, total and by watershed study area - based on site selection (REVISED 25FEB2015)

		Watershed Study Area				
	Total for Five Watershed Study Areas	Northern Middle Patuxent	Southern Middle Patuxent	Northern Little Patuxent	Southern Little Patuxent	Dorsey Run
	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)
Convert existing BMPs (# BMP facilities)	160	12	21	11	73	43
Opportunities for new BMPs for untreated impervious areas (# sites)	207	7	29	52	76	43
Potential stream restoration (# stream miles)	78	17	18	24	15	4
Potential tree planting sites (# sites)	46	10	11	16	4	5
Outfall stabilization (# outfalls)	202	4	36	37	95	30
Total (counting 1 stream mile = 1 site)	693	50	115	140	263	125

Table B. Assigned "desktop/office visit" sites for Versar and KCI - data sheets to be filled out for sites assessed in previous studies, without field visit (or with only minimal field check).

	Total for Five Study Areas	Northern Middle Patuxent	Southern Middle Patuxent	Northern Little Patuxent	Southern Little Patuxent	Dorsey Run
Total "desktop/office visit" sites - Versar	64	5	15	10	30	4
Total "desktop/office visit" sites - KCI	22			22		

Howard County Watershed Assessments
Field Summary Report

Northern Middle Patuxent and Dorsey Run Watersheds

June 1, 2015

Prepared for:

Howard County Government

Stormwater Management Division

Bureau of Environmental Services

6751 Columbia Gateway Drive, Suite 514

Columbia, Maryland 21046-3143

Prepared by:

McCORMICK TAYLOR

509 South Exeter Street, 4th Floor
Baltimore, Maryland 21202

1.

Table 1.1 Number of field assessments completed				
Consultant Firm Name	**McCormick Taylor**			
Study Area Name*	**Northern Middle Patuxent**			
Type	**# Sites (or Stream Miles) Assigned (from Table A below)**	**# Pre-Assigned Sites (or Stream Miles) that Were Completed**	**# Additional Sites (or Stream Miles), Added in the Field and Completed**	**Total # Sites (or Stream Miles) Completed**
BMP conversion	12	12	0	12
New BMP	7	7	0	7
Stream Restoration	16.8 miles	15.9 miles	0 miles	15.9 miles
Tree Planting	10	10	18	28
Outfall stabilization	4	4	0	4

Table 1.2 Number of field assessments completed				
Consultant Firm Name	**McCormick Taylor**			
Study Area Name*	**Dorsey Run**			
Type	**# Sites (or Stream Miles) Assigned (from Table A below)**	**# Pre-Assigned Sites (or Stream Miles) that Were Completed**	**# Additional Sites (or Stream Miles), Added in the Field and Completed**	**Total # Sites (or Stream Miles) Completed**
BMP conversion	43	43	0	43
New BMP	43	42	0	42
Stream Restoration	4.3 miles	3.9 miles	0.4 miles	4.3 miles
Tree Planting	5	5	3	8
Outfall stabilization	30	26	3	29

2. If there were sites that could not be assessed in the field, please summarize primary reasons.

<u>BMP Sites:</u>

- One site could not be assessed in the field due to denied access to the property by the landowner.

<u>Stream Restoration Sites:</u>

- Portions of 19 stream restoration sites could not be evaluated in the field.
- Primary reasons assessments could not be made include:
    - Access not granted by the landowner.
    - Site was not associated with a stream, but with a wetland system or pond.

- Livestock (bull or electric fences) present on site.
- One stream site was not assessed as it was noted to be a citizen erosion complaint, but no erosion was found and the downstream portion was a wetland system. In this case the adjacent unmarked stream, which appeared to have been the intended target of the citizen erosion complaint, was assessed instead.

Tree Planting Sites:

- All sites were evaluated.

Outfall Stabilization Sites:

- 4 sites were not assessed.
- Primary reasons assessments could not be made include access not granted by the landowner, fencing, and/or no outfall in vicinity of point.

3. Other comments about data or assumptions made.

BMP Sites:

The following information should be noted for BMP Sites:

- Facilities that did not exist:
  - DOR-BC-F902 (Grass space behind Montgomery Irrigation facility)
  - DOR-BC-F923 (Parking lot on site of Bowles Fluidics)
- Facility already under design for conversion:
  - DOR-BC-F933 (CSX property)
- Facilities that were moved:
  - NMP-BC-F104 to 12056 Broad Meadow Lane, Clarksville, MD (was at facility on 12106 Dusk View Ct where NMP-BC-F105 is located)
  - NMP-BC-F108 to 12975 Livestock Rd, Sykesville, MD (was on side of I-70 where existing BMP point is still located)
- Sites with new facilities/already treated:
  - DOR-NB-F909 recently reconstructed entire site. Two Bioretention facilities, underground storage, stormceptors found.
  - DOR-NB-F935 several existing facilities are on site but drainage areas may not be represented. Several underground facilities/stormceptors located in parking lots.
  - DOR-NB-F922 and DOR-NB-F918 entire site drains to recently reconstructed facility (pond is in database as existing facility, drainage area is just incorrect)

Tree Planting Sites:

- 3 capped landfill sites were assessed from the gated fence line.

Outfall Stabilization Sites:

- Outfall stabilization points at 11 sites were moved from a pond riser or inlet structure to a nearby outfall. Additionally, 2 pond inlets were assessed at the original outfall stabilization assessment location before adding 2 site assessments at outfalls from that pond. In 3 cases, the pond outfall could either not be found or accessed due to landowner constraints; instead the pond structures were assessed.

4.

Table 2.1 Number of site recommendation forms completed for field sites assessed				
Consultant Firm Name	**McCormick Taylor**			
Study Area Name*	**Northern Middle Patuxent**			
		Field Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion recommendations	12	4	5	3
New BMP recommendations	6	0	1	5
Stream Restoration recommendations	79	14	48	17
Tree Planting recommendations	38	15	15	8
Outfall stabilization recommendations	2	0	1	1

Table 2.2 Number of site recommendation forms completed for field sites assessed				
Consultant Firm Name	**McCormick Taylor**			
Study Area Name*	**Dorsey Run**			
		Field Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion recommendations	40	21	13	6
New BMP recommendations	170	21	74	75
Stream Restoration recommendations	24	13	7	4
Tree Planting recommendations	13	2	2	9
Outfall stabilization recommendations	10	2	7	1

5. General comments about the types of recommendations made.

BMP Sites:

- Recommended conversions include wet ponds, wetlands, bioretention facilities, sand filters, and rain gardens. These facilities were recommended based on the land use in the area, existing conditions (soil, standing water, vegetation, etc.), and depth of outfall, riser, or inlet structure.
- Recommended new BMP sites include wet ponds, wetlands, bioretention facilities, sand filters, tree box filters, swales, pavement removal, underground sand filters, and rain gardens. New BMP sites were recommended based on available space with a reasonable drainage area, existing utilities (avoiding significant visible conflicts), storm drain location, and existing land use.
- A number of sites in both the BMP conversions and new BMP sites have high potential based on the need for repair, the feasibility of construction and access, minimal conflicts, size of impervious drainage area, and land use in vicinity.

Stream Restoration Sites:

- Stream restoration is generally recommended in reaches with active erosion, threatened infrastructure, and limited habitat.
- Overall, 14 stream reaches in the Northern Middle Patuxent watershed and 13 stream reaches in the Dorsey Run watershed have high stream restoration potential. Of these high priority reaches, those with the most potential are listed below:
    - DOR-SR-F906 is a heavily incised and actively eroding channel which is currently threatening private property as the stream continues to erode and meander.
    - DOR-SR-F909, DOR-SR-F910, and DOR-SR-F911 are experiencing moderate to severe erosion, an abundance of depositional areas, and pools filled with fine sediment (primarily silt) indicating large sediment loads upstream. There may be good restoration potential north of Tamar Drive as well.
    - DOR-SR-F912 has moderate to severe erosion throughout include degradation and lateral migration. Restoration could include outfall stabilization and BMPs in several locations and the length may be extended further downstream.
    - NMP-SR-F133, NMP-SR-F136, and NMP-SR-F145 have severe bank erosion, numerous tree falls, lack of riparian vegetation, and moderate bar deposition. Access may be relatively easy.
    - NMP-SR-F135 has moderate to severe erosion including headcuts and is highly sinuous.
    - NMP-SR-F152 is experiencing severe active erosion along the left bank. Homeowners mow to top of bank, but expressed interest in the County planting a stream buffer.
    - NMP-SR-F168 and NMP-SR-F-169 are the mainstem of the Northern Middle Patuxent and a large tributary to the mainstem, both experiencing severe erosion throughout. This is likely a more expensive restoration opportunity than lower-order streams.

Tree Planting Sites:

- Tree planting recommendations were ranked high when located in cleared areas within or adjacent to existing Howard County Forest Conservation Easements and some sites that are located in areas adjacent to highly erosive stream segments. Cleared areas containing recent tree plantings that exhibited low species survivability were specifically recommended for replacement plantings.

Outfall Stabilization Sites:

- Outfall stabilization recommendation types include riprap, outfall and apron replacement, and regenerative stormwater conveyance.
- Overall, only 2 outfalls located in the Dorsey Run watershed have high outfall stabilization potential. One is in need of structure replacement and riprap, while the other is not recommended at the outfall itself, but a regenerative stormwater conveyance upstream of the inlet.

6. List of sites reported to Howard County because of suspected illicit discharges, safety concerns, or other reasons for County followup.

- Homeless campsite found at DOR-SR-F901, near the intersection of I-95 and MD-175.
- Recommend county coordination with the Columbia Association stream assessments. A field crew ran into a U.S. Fish and Wildlife employee working for the Columbia Association at DOR-SF-F912. The Columbia Association assessment appears to be similar to the Howard County assessment.
- Homeless camp located in the woods on north side of Holiday Inn parking lot at MD 175 and US 1 and small wooded area bordered by Holiday Inn, Exxon Station, Burger King, and La Quinta Inn and Suites.

7. Other comments/explanations related to data collected.

- May be helpful to understand site selection process. Some selected stream sites appeared to completely stable with no problems while other streams not selected appeared to have more problems or showed some form of impairment. Due to schedule constraints and property owner permissions, these additional stream sites were not assessed. Some segments were very short with difficult access and it was challenging to understand how the site could be considered for a restoration project.
- Consider performing stream assessments on entire drainage network within local drainage areas or subwatershed areas.
- Consider simplifying database entries and/or incorporating automated data population for some fields that are populated multiple times for a given site (e.g. weather). Utilities, particularly for new BMP sites, are another example where data on utilities could include one entry for the type of utilities that conflict or possibly conflict with BMP opportunity.

Biohabitats

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Baltimore, MD 21211
410.554.0156
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MEMORANDUM

Date: June 4, 2015

To: Nancy Roth, Versar
Kelly Hargadin, Howard County, Storm Water Management Division

From: Biohabitats, Inc.
Stormwater Maintenance & Consulting

RE: **Howard County Watershed Assessments in 2015**

Subject: **Southern Middle Patuxent Field Summary Report**

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1. Number of Field Assessments Completed

Table 1. Number of field assessments completed				
Consultant Firm Name	**Biohabitats and Stormwater Maintenance and Consulting**			
Study Area Name	**Southern Middle Patuxent**			
Type	**# Sites (or Stream Miles) Assigned (from Table A below)**	**# Pre-Assigned Sites (or Stream Miles) that Were Completed**	**# Additional Sites (or Stream Miles), Added in the Field and Completed**	**Total # Sites (or Stream Miles) Completed**
BMP conversion	21	21	1	22
New BMP	29	28	0	28
Stream Restoration	18.42 miles	18.37 miles	0 miles	18.37 miles
Tree Planting	11	7	7	14
Outfall stabilization	36	36	8	44

2. Primary Reasons that Sites Could Not be Assessed

Stream Restoration

- SMP-SR-F312 (0.05 miles) was visited but not assessed. Construction of a bottomless arch culvert crossing and associated stabilization work was in progress at the time of the assessment.

Tree Planting

- SMP-TP-303, 304, & 305 in the Middle Patuxent Environmental Area (MPEA) were not assessed. MPEA is actively managing these sites as meadow or old field for American woodcock habitat.
- SMP-TP-310 has already been planted with the exception of utility and SWM easements.

Outfall Stabilization

- SMP-OF-F311 is a duplicate site; no outfall was found. (Assessed SMP-OF-F314)
- SMP-OF-F315 is a duplicate site; no outfall was found. (Assessed SMP-OF-F314)
- SMP-OF-F320, no outfall to assess.
- SMP-OF-F316, no outfall to assess.

New BMP Opportunities

- SMP-NB-F322 was not assessed as access was denied at the gate.

3. Other Comments about Data or Assumptions Made

Stream Restoration

- The assessed reaches along the mainstem of the Middle Patuxent (SMP-SR-F306, F307, F308, F352, F353, F359, and F361) exhibit a channel form characteristic of a post agricultural age alluvial stream channel. These channels have historically accreted 4-6 feet of fine sediments across the valley bottom and have subsequently incised through that sediment as the supply of sediment from the watershed reduced with better land use practices. The contemporary channels typically exhibit raw 4-6' high banks and a high fine sediment load. For these reasons, restoration opportunities were not identified for the individual reaches assessed; however a focused phased restoration of the mainstem of the Middle Patuxent may be feasible and yield significant nutrient and sediment load reductions.
- In cases where the bank erosion was similar in character and flip flopped from left bank to right bank the length of erosion on left and right banks summed for the respective banks and a total length of erosion was included in the notes. This total length of erosion may be less than the sum of erosion on left and right banks if overlap occurred.
- An additional 12 Stream Restoration Assessment reaches totaling approximately 1.35 miles were added in post-processing to account for outfall restoration opportunities that exceeded the 200 LF threshold or outfall reaches that flowed to a significantly degraded receiving stream. Reach assessments were not completed for these reaches, but Stream Restoration Opportunity polygons were placed to delineate the opportunities.

Tree Planting

- Private property sites, we assumed that property owner was okay with planting.
- Watering was assessed as onsite sources available or access for a truck.
- Additional sites added in the field were identified during the stream restoration assessment. The tree planting assessment polygon for the additional sites did not always match property boundaries like the assigned sites. Since the additional sites were identified during the stream restoration assessment, the tree planting assessment polygons for additional sites could cross several properties and/or only include portions of properties adjacent to a stream.
- Regional forest association was based on USDA Forest Service Potential Natural Vegetation Groups, version 2000, available at http://www.firelab.org/sites/default/files/images/downloads/pnv2000.pdf.
- No optional sketches of the tree planting areas were completed.

Outfall Stabilization

- It was assumed that 'distance from outfall to stream channel' was the vertical distance from the invert of the outfall pipe to the immediate receiving channel (outfall channel).
- 'SMP-OF-F313' is the outfall for a newly constructed underground sand filter.

New BMP Opportunities

- 'River Hill Rain Garden' is an existing BMP, not a new recommendation, but was created as a recommended footprint to bring to County's attention
- Base maps were outdated and did not reflect active construction sites, new buildings, new BMPs, and/or had incorrect drainage areas, etc. It was assumed that a newly developed site or active construction site meets current stormwater standards for water quality. See below for summary.

Site ID	**Active or New Construction not reflected in GIS**
SMP-NB-307	Southern portion of facility drains to an existing detention structure
SMP-NB-F310	Site drains to an existing wet pond and bioretention facility
SMP-NB-F315	Site is treated; drains to an existing wet pond.
SMP-NB-F316	Site drains to newly constructed wet pond.
SMP-NB-F317	Site has an approved redevelopment plan with approved BMPs
SMP-NB-F318	Site is treated; drains to an existing wet pond.
SMP-NB-F319	Site is treated; drains to newly constructed wet pond (same as F326).
SMP-NB-F321	Site is under active development.
SMP-NB-F326	Site is treated; drains to newly constructed wet pond (same as F319).
SMP-OF-F313	Newly constructed underground sand filter and outfall.

BMP Conversions

- Four sites assessed have insufficient capacity and do not offer retrofit opportunities (SMP-BC-F305; SMP-BC-F313; SMP-BC-F317; SMP-BC-F321)

4. Number of Recommendations Made At Field Sites

Table 2. Number of site recommendation forms completed for field sites assessed				
Consultant Firm Name	**Stormwater Maintenance and Consulting**			
Study Area Name	**Southern Middle Patuxent**			
		Field Assessment of Restoration/Retrofit Potential (# Sites)		
Type	**# Recommendations**	**High**	**Medium**	**Low**
BMP conversion recommendations	21	4	7	10*
New BMP recommendations	55	8	31	16
Stream Restoration recommendations	91	28	45	18
Tree Planting recommendations	20	13	7	0
Outfall stabilization recommendations	18	8	9	1

5. General Comments about the Types of Recommendations Made

Stream Restoration

- Over 9 miles of stream restoration opportunities were identified by the field crews. The average project length was approximately 1000 LF. These opportunities varied widely from livestock fencing and straight forward gully or bank repairs to significant restoration projects along the higher order stream reaches. Field crews generally thought that tree impacts could be minimized and only 4 sites (F328, F329, F335, and F363) totaling about 0.5 miles of opportunities would result in significant tree impacts. The overall access ratings were moderate to easy, with only 12 sites (approximately 1.2 miles) rating in the significant range.
- Twelve additional stream restoration opportunities totaling over 1 mile were associated with the outfall and BMP assessments. The average length of these opportunities was approximately 500 LF and the restoration potential generally scored medium with some constraints and moderate tree impacts.

Tree Planting

- Of the sites that were rated high restoration potential, five (SMP-TP-F308, F307, F402, F403, and F406) appeared to be the best opportunities. Sites F308 and F307 were at churches, so some coordination of the planned use of these spaces will be necessary.

Outfall Stabilization

- Ten of the eighteen outfall stabilization recommendations were proposed as Regenerative Stormwater Conveyance. Twelve of the assessed outfalls were candidates for stream restoration and accounted for with stream restoration recommendation polygons.

New BMP Opportunities

- New BMP Recommendations were typically filtering practices or bioretention (39). If space was very limited green roofs were recommended but prioritized as low (4). Some site recommendations require parking spot elimination.

BMP Conversions

- BMP Conversion recommendations were typically sand filter or bioretention for existing dry pond conditions. If soils appear hydric with wetland vegetation, recommended to convert to wet pond or wetland.

6. List of Sites Reported To Howard County Because Of Suspected Illicit Discharges, Safety Concerns, or Other Reasons for County Follow-Up

- County was notified of a turbidity issue in Hammond Branch on April 17, 2015. Before and after photos showing a rapid increase in turbidity was sent to the County. These were taken at Hammond Parkway between 3:45pm (before pictures) and 3:55pm (after pictures). This information was forward to Construction Inspection, which visited the site and found that the increase in turbidity was due to construction and sediment control measures installed per the grading permit.
- County was notified of a sinkhole directly above the outfall barrel of a pond while assessing 'SMP-BC-F317'. County was previously aware of this issue and working with the property owner.
- County was notified that a pond near assessment 'SMP-NB-F316' had missing manhole lids on the outlet control structure (2).
- County was notified of piping along with severe corrosion of an outfall barrel at a pond on River Hill High School property. Issue was found while assessing 'SMP-NB-F328'. County and school was previously aware of the issue.
- County was notified of illicit discharge at the Joseph Square Shopping Center 5467 Harpers Farm Road, Columbia, MD 21044 while assessing 'SMP-BC-310'. The message was forwarded to Angela M. who handles illicit discharges for the county.

7. Other Comments/Explanations Related to Data Collected

Overall

- Unless a unique opportunity was presented, photos were not generally attached to Stream Restoration Opportunities, New BMP Recommendations, and Outfall Stabilization Recommendations because they are attached to the relevant assessment features.

Stream Restoration

- During QA/QC, it was determined that three site assessment forms (SMP-SR-F322B-ES002, SMP-SR-F330C-ES007, and SMP-SR-F303B-PO001) do not have photos in the geodatabase submitted on June 4, 2015. These sites will be revisited and photos will be uploaded to the web map or forward via email for upload within the next week.
- SMP-SR-F347-UC001 – This point was recorded to document potential erosion within a stream channel adjacent to an assessed reach (SMP-SR-F347). The assessed reach exhibited no signs of erosion, so we were not sure if it may have been mapped incorrectly.
- SMP-SR-F326A-ES001 – The channel was braided in this section and only the cutoff channel was mapped for assessment. The mapped channel was stable; however, the channel to the east exhibited significant channel erosion as documented by this point.

Outfall Stabilization

- Some outfall stabilization assessment sites require local repair or stabilization, but did not warrant a full outfall stabilization recommendation as the receiving channel appears stable. These include:

Site ID	**Name**	**Local Repair required**
SMP-OF-F310	Trotter Ridge	minor roadside rills
SMP-OF-F302	River Wood Dr	corroded, barrel, associated with SR-F362
SMP-OF-F307	New Hope Church	right side of Gabion, New Church
SMP-OF-F328	Rosemont HOA	Local Stabilization (headwall, channel ok)
SMP-OF-F326	Palace Hall	downstream end of apron
SMP-OF-F331	Linden Chapel	Budget for Pipe Repair
SMP-OF-F327	Palace Hall	right side of gabion, recent development
SMP-OF-F312	9549 Washington Blvd	headwall undermined

New BMP Opportunities

- Some sites appear to be industrial sites and may be subject to NPDES 12SW General Permit: SMP-NB-F304 and SMP-NB-F305 both (12070 and 12024 Hall Shop Road respectively); SMP-NB-F310 Nestle Factory, SMP-NB-F323 (9549 Washington Blvd). The auto salvage yard, SMP-NB-F305, likely has illicit discharges during runoff events.

Attachment: Numbers of Field and Desktop Sites Assigned

Table A. Estimates of field effort for identifying opportunities, total and by watershed study area - based on site selection (REVISED 25FEB2015)						
		Watershed Study Area				
	Total for Five Watershed Study Areas	Northern Middle Patuxent	Southern Middle Patuxent	Northern Little Patuxent	Southern Little Patuxent	Dorsey Run
	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)	# sites (or miles)
Convert existing BMPs (# BMP facilities)	160	12	21	11	73	43
Opportunities for new BMPs for untreated impervious areas (# sites)	207	7	29	52	76	43
Potential stream restoration (# stream miles)	78	17	18	24	15	4
Potential tree planting sites (# sites)	46	10	11	16	4	5
Outfall stabilization (# outfalls)	202	4	36	37	95	30
Total (counting 1 stream mile = 1 site)	693	50	115	140	263	125

G. Table Listing Individual Retrofit and Restoration Opportunities, with Scores and Rankings

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SMP-TP-F311	Tree Planting	Biohabitats	7.6	8	6	10	8	32	Yes
NLP-BC-D528	BMP Conversion	Versar	22.1	10	3	10	8	31	
SR-43	Stream	Biohabitats	13.6	10	3	8	10	31	Yes
DOR-BC-D947	BMP Conversion	Versar	7.3	8	6	8	8	30	
NLP-SR-F552A	Stream	KCI	12.8	10	3	8	8	29	Yes
NLP-SR-F557A	Stream	KCI	17.9	10	3	8	8	29	Yes
SLP-BC-D798	BMP Conversion	Versar	10.5	10	10	5	4	29	Yes
SLP-BC-D802	BMP Conversion	Versar	14.8	10	3	10	6	29	Yes
SR-29	Stream	Biohabitats	16.1	10	3	8	8	29	Yes
SR-34	Stream	Biohabitats	13.9	10	3	8	8	29	Yes
SR-35	Stream	Biohabitats	27.7	10	3	8	8	29	Yes
SR-36	Stream	Biohabitats	27.5	10	3	8	8	29	Yes
SR-37	Stream	Biohabitats	17.5	10	3	8	8	29	Yes
SR-38	Stream	Biohabitats	16.7	10	3	8	8	29	Yes
SR-45	Stream	KCI	29.9	10	3	8	8	29	Yes
SR-47	Stream	KCI	30.5	10	3	8	8	29	Yes
DOR-NB-F912A	BMP New Footprint	McCormick Taylor	5.3	8	6	8	6	28	Yes
NLP-OF-F662	Outfall	KCI	2.0	4	6	10	8	28	Yes
NLP-TP-F511	Tree Planting	KCI	0.4	2	6	10	10	28	Yes
NLP-TP-F655	Tree Planting	KCI	1.7	4	6	10	8	28	Yes

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-NB-F712A	BMP New Footprint	Versar	3.1	6	6	8	8	28	Yes
SLP-NB-F739B	BMP New Footprint	Versar	5.5	8	6	8	6	28	Yes
SLP-OF-F792	Outfall	Versar	1.6	4	6	10	8	28	Yes
SLP-OF-F852	Outfall	Versar	2.0	4	6	10	8	28	Yes
SLP-TP-F703	Tree Planting	Versar	2.0	4	6	10	8	28	Yes
SMP-OF-F324	Outfall	Biohabitats	1.4	4	6	10	8	28	Yes
SMP-TP-F307	Tree Planting	Biohabitats	2.5	4	6	10	8	28	Yes
SMP-TP-F309	Tree Planting	Biohabitats	4.2	6	6	10	6	28	Yes
SMP-TP-F405	Tree Planting	Biohabitats	0.4	2	6	10	10	28	Yes
SMP-BC-D332	BMP Conversion	Versar	10.3	10	6	8	4	28	Yes
DOR-BC-F942	BMP Conversion	McCormick Taylor	6.8	8	3	10	6	27	Yes
NLP-BC-D512	BMP Conversion	Versar	16.1	10	3	10	4	27	
NLP-SR-F504A	Stream	KCI	26.6	10	3	8	6	27	Yes
NLP-SR-F509A	Stream	KCI	22.5	10	3	8	6	27	Yes
NLP-SR-F520B	Stream	KCI	23.0	10	3	8	6	27	Yes
NLP-SR-F551A	Stream	KCI	26.5	10	3	8	6	27	Yes
NLP-SR-F555A	Stream	KCI	11.9	10	3	8	6	27	Yes

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-SR-F555B	Stream	KCI	17.9	10	3	8	6	27	Yes
NLP-SR-F571A	Stream	KCI	10.7	10	3	8	6	27	Yes
NLP-SR-F583A	Stream	KCI	19.9	10	3	8	6	27	Yes
NLP-SR-F587D	Stream	KCI	19.8	10	3	8	6	27	Yes
NLP-SR-F590A	Stream	KCI	17.6	10	3	8	6	27	Yes
NLP-SR-F599A	Stream	KCI	22.0	10	3	8	6	27	Yes
SLP-BC-D774	BMP Conversion	Versar	10.7	10	3	10	4	27	Yes
SLP-BC-D780	BMP Conversion	Versar	6.8	8	3	10	6	27	Yes
SLP-BC-D792	BMP Conversion	Versar	9.7	8	3	10	6	27	Yes
SLP-BC-F701	BMP Conversion	Versar	4.4	6	3	10	8	27	Yes
SLP-BC-F772	BMP Conversion	Versar	1.8	4	10	5	8	27	Yes
SLP-SR-F735	Stream	Versar	20.1	10	3	8	6	27	Yes
SLP-SR-F737A	Stream	Versar	8.5	8	3	8	8	27	Yes
SLP-SR-F740A	Stream	Versar	10.5	10	3	8	6	27	Yes
SLP-SR-F753I	Stream	Versar	15.3	10	3	8	6	27	Yes
SLP-SR-F754	Stream	Versar	10.0	8	3	8	8	27	Yes
SLP-SR-F852	Stream	Versar	13.4	10	3	8	6	27	Yes
SLP-SR-F853	Stream	Versar	10.3	10	3	8	6	27	Yes

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SMP-NB-F325	Stream	Biohabitats	6.1	8	3	8	8	27	Yes
SMP-SR-F324	Stream	Biohabitats	10.5	10	3	8	6	27	Yes
SR-30	Stream	Biohabitats	22.2	10	3	8	6	27	Yes
SR-31	Stream	Biohabitats	29.0	10	3	8	6	27	Yes
SR-32	Stream	Biohabitats	18.1	10	3	8	6	27	Yes
SR-33	Stream	Biohabitats	27.9	10	3	8	6	27	Yes
SR-46	Stream	KCI	44.5	10	3	8	6	27	Yes
SR-48	Stream	KCI	15.2	10	3	8	6	27	Yes
SR-49	Stream	KCI	12.6	10	3	8	6	27	Yes
SR-50	Stream	KCI	16.8	10	3	8	6	27	Yes
SR-51	Stream	KCI	26.8	10	3	8	6	27	Yes
SR-52	Stream	McCormick Taylor	11.4	10	3	8	6	27	Yes
SR-53	Stream	McCormick Taylor	18.9	10	3	8	6	27	Yes
SR-54	Stream	McCormick Taylor	23.5	10	3	8	6	27	Yes
SR-55	Stream	McCormick Taylor	13.9	10	3	8	6	27	Yes
SR-59	Stream	McCormick Taylor	28.8	10	3	8	6	27	Yes
DOR-BC-F943	BMP Conversion	McCormick Taylor	5.0	6	6	8	6	26	Yes
DOR-SR-F904C	Tree Planting	McCormick Taylor	0.1	2	6	10	8	26	Yes
DOR-TP-F901B	Tree Planting	McCormick Taylor	3.5	6	6	10	4	26	Yes
DOR-TP-F905G	Tree Planting	McCormick Taylor	1.9	4	6	10	6	26	Yes

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-BC-D521	BMP Conversion	Versar	1.2	4	6	8	8	26	
NLP-BC-D540	BMP Conversion	Versar	2.2	4	6	8	8	26	
NLP-OF-F508	Outfall	KCI	0.9	2	6	10	8	26	Yes
NLP-OF-F516	Outfall	KCI	1.2	4	6	10	6	26	Yes
NLP-OF-F536	Outfall	KCI	1.1	4	6	10	6	26	Yes
NLP-OF-F654	Outfall	KCI	2.0	4	6	10	6	26	Yes
NLP-OF-F661	Outfall	KCI	2.0	4	6	10	6	26	Yes
NLP-TP-D519	Tree Planting	KCI	1.6	4	6	10	6	26	Yes
NLP-TP-F514	Tree Planting	KCI	2.1	4	6	10	6	26	Yes
NLP-TP-F653	Tree Planting	KCI	1.7	4	6	10	6	26	Yes
NLP-TP-F654	Tree Planting	KCI	1.2	4	6	10	6	26	Yes
SLP-BC-D794	BMP Conversion	Versar	7.9	8	6	8	4	26	
SLP-BC-F728	BMP Conversion	Versar	8.0	8	6	8	4	26	Yes
SLP-BC-F734	BMP Conversion	Versar	3.8	6	6	8	6	26	Yes
SLP-BC-F758	BMP Conversion	Versar	1.6	4	6	8	8	26	Yes
SLP-NB-F711A	BMP New Footprint	Versar	3.2	6	6	8	6	26	Yes
SLP-NB-F712C	BMP New Footprint	Versar	2.6	4	6	8	8	26	Yes
SLP-NB-F715B	BMP New Footprint	Versar	3.2	6	6	8	6	26	Yes

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-NB-F722D	BMP New Footprint	Versar	2.2	4	6	8	8	26	Yes
SLP-NB-F731A	BMP New Footprint	Versar	3.2	6	6	8	6	26	Yes
SLP-NB-F740A	BMP New Footprint	Versar	4.8	6	6	8	6	26	Yes
SLP-OF-F706	Outfall	Versar	1.6	4	6	10	6	26	Yes
SLP-OF-F710	Outfall	Versar	1.7	4	6	10	6	26	Yes
SLP-OF-F711	Outfall	Versar	2.0	4	6	10	6	26	Yes
SLP-OF-F740	Outfall	Versar	1.3	4	6	10	6	26	Yes
SLP-OF-F753	Outfall	Versar	1.6	4	6	10	6	26	Yes
SLP-OF-F754	Outfall	Versar	0.9	2	6	10	8	26	Yes
SLP-OF-F773	Outfall	Versar	0.2	2	6	10	8	26	Yes
SLP-OF-F851	Outfall	Versar	0.3	2	6	10	8	26	Yes
SLP-OF-F855	Outfall	Versar	0.6	2	6	10	8	26	Yes
SLP-OF-F859	Outfall	Versar	1.6	4	6	10	6	26	Yes
SLP-TP-F701	Tree Planting	Versar	0.7	2	6	10	8	26	Yes
SLP-TP-F704	Tree Planting	Versar	0.5	2	6	10	8	26	Yes
SLP-TP-F851	Tree Planting	Versar	0.4	2	6	10	8	26	Yes
SLP-TP-F852	Tree Planting	Versar	0.3	2	6	10	8	26	Yes
SMP-BC-D323	BMP Conversion	Versar	2.3	4	6	8	8	26	
SMP-BC-D333	BMP Conversion	Versar	3.4	6	10	2	8	26	Yes
SMP-BC-D335	BMP Conversion	Versar	2.9	4	6	8	8	26	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SMP-BC-F314	BMP Conversion	Biohabitats	3.6	6	6	8	6	26	Yes
SMP-OF-F317	Outfall	Biohabitats	2.0	4	6	10	6	26	Yes
SMP-TP-F406	Tree Planting	Biohabitats	1.5	4	6	10	6	26	Yes
DOR-BC-D944	BMP Conversion	Versar	4.9	6	3	10	6	25	
DOR-BC-F915	BMP Conversion	McCormick Taylor	1.7	4	10	5	6	25	
DOR-BC-F917	BMP Conversion	McCormick Taylor	4.9	6	10	5	4	25	
NLP-BC-D513	BMP Conversion	Versar	3.3	6	3	10	6	25	
NLP-SR-F525A	Stream	KCI	20.3	10	3	8	4	25	
NLP-SR-F533A	Stream	KCI	25.7	10	3	8	4	25	
NLP-SR-F537A	Stream	KCI	5.9	8	3	8	6	25	
NLP-SR-F574A	Stream	KCI	10.0	8	3	8	6	25	
NLP-SR-F580C	Stream	KCI	14.9	10	3	8	4	25	
NLP-SR-F586A	Stream	KCI	42.9	10	3	8	4	25	
NLP-SR-F588A	Stream	KCI	12.1	10	3	8	4	25	
NLP-SR-F593	Stream	KCI	17.1	10	3	8	4	25	
NLP-SR-F596A	Stream	KCI	5.8	8	3	8	6	25	
NLP-SR-F596C	Stream	KCI	5.0	8	3	8	6	25	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-SR-F601A	Stream	KCI	18.1	10	3	8	4	25	
SLP-BC-D778	BMP Conversion	Versar	6.3	8	3	10	4	25	
SLP-BC-D804	BMP Conversion	Versar	4.2	6	3	10	6	25	
SLP-BC-F711	BMP Conversion	Versar	0.8	2	10	5	8	25	
SLP-BC-F725	BMP Conversion	Versar	2.3	4	10	5	6	25	
SLP-BC-F754	BMP Conversion	Versar	0.6	2	10	5	8	25	
SLP-BC-F765	BMP Conversion	Versar	1.1	4	10	5	6	25	
SLP-SR-F741	Stream	Versar	12.5	10	3	8	4	25	
SLP-SR-F755D	Stream	Versar	3.5	6	3	8	8	25	
SLP-SR-F857	Stream	Versar	5.7	8	3	8	6	25	
SLP-SR-F858	Stream	Versar	8.7	8	3	8	6	25	
SLP-SR-F859	Stream	Versar	6.3	8	3	8	6	25	
SLP-SR-F860	Stream	Versar	5.4	8	3	8	6	25	
SMP-OF-F323	Stream	Biohabitats	8.9	8	3	8	6	25	
SMP-SR-F325A	Stream	Biohabitats	8.4	8	3	8	6	25	
SR-56	Stream	Versar	43.3	10	3	8	4	25	
SR-57	Stream	McCormick Taylor	14.4	10	3	8	4	25	
SR-58	Stream	McCormick Taylor	27.2	10	3	8	4	25	
DOR-BC-F931	BMP Conversion	McCormick Taylor	4.4	6	6	8	4	24	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
DOR-OF-F902	Outfall	McCormick Taylor	2.0	4	6	10	4	24	
DOR-OF-F926	Outfall	McCormick Taylor	1.7	4	6	10	4	24	
DOR-OF-F927	Outfall	McCormick Taylor	1.8	4	6	10	4	24	
DOR-OF-F928	Outfall	McCormick Taylor	2.0	4	6	10	4	24	
DOR-OF-F930	Outfall	McCormick Taylor	1.1	4	6	10	4	24	
NLP-BC-D531	BMP Conversion	Versar	3.2	6	6	8	4	24	
NLP-OF-F517	Outfall	KCI	0.6	2	6	10	6	24	
NLP-OF-F521	Outfall	KCI	1.1	4	6	10	4	24	
NLP-TP-D521	Tree Planting	KCI	1.2	4	6	10	4	24	
NLP-TP-F505	Tree Planting	KCI	0.1	2	6	10	6	24	
SLP-BC-D781	BMP Conversion	Versar	2.7	4	6	8	6	24	
SLP-BC-D783	BMP Conversion	Versar	2.9	4	6	8	6	24	
SLP-BC-D796	BMP Conversion	Versar	3.6	6	6	8	4	24	
SLP-BC-D803	BMP Conversion	Versar	2.6	4	6	8	6	24	
SLP-BC-F703	BMP Conversion	Versar	2.1	4	6	8	6	24	
SLP-BC-F730	BMP Conversion	Versar	2.8	4	6	8	6	24	
SLP-BC-F735	BMP Conversion	Versar	2.4	4	6	8	6	24	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-BC-F741	BMP Conversion	Versar	1.8	4	6	8	6	24	
SLP-BC-F749	BMP Conversion	Versar	1.6	4	6	8	6	24	
SLP-BC-F757	BMP Conversion	Versar	2.0	4	6	8	6	24	
SLP-BC-F759	BMP Conversion	Versar	1.7	4	6	8	6	24	
SLP-BC-F766	BMP Conversion	Versar	3.0	4	6	8	6	24	
SLP-NB-F703B	BMP New Footprint	Versar	2.6	4	6	8	6	24	
SLP-NB-F707A	BMP New Footprint	Versar	3.4	6	6	8	4	24	
SLP-NB-F713A	BMP New Footprint	Versar	2.8	4	6	8	6	24	
SLP-NB-F718A	BMP New Footprint	Versar	2.9	4	6	8	6	24	
SLP-NB-F728A	BMP New Footprint	Versar	3.9	6	6	8	4	24	
SLP-NB-F733A	BMP New Footprint	Versar	3.0	4	6	8	6	24	
SLP-NB-F761C	BMP New Footprint	Versar	2.7	4	6	8	6	24	
SLP-NB-F762B	BMP New Footprint	Versar	3.8	6	6	8	4	24	
SLP-NB-F762C	BMP New Footprint	Versar	2.0	4	6	8	6	24	
SLP-OF-F704	Outfall	Versar	1.0	2	6	10	6	24	
SLP-OF-F713	Outfall	Versar	1.2	4	6	10	4	24	
SLP-OF-F716	Outfall	Versar	0.6	2	6	10	6	24	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-OF-F736	Outfall	Versar	0.5	2	6	10	6	24	
SLP-OF-F737	Outfall	Versar	0.4	2	6	10	6	24	
SLP-OF-F744	Outfall	Versar	1.2	4	6	10	4	24	
SLP-OF-F748	Outfall	Versar	0.7	2	6	10	6	24	
SLP-OF-F750	Outfall	Versar	1.2	4	0	10	10	24	
SLP-OF-F765	Outfall	Versar	1.6	4	6	10	4	24	
SLP-OF-F770	Outfall	Versar	1.3	4	6	10	4	24	
SLP-OF-F772	Outfall	Versar	0.7	2	6	10	6	24	
SLP-OF-F775	Outfall	Versar	0.7	2	6	10	6	24	
SLP-OF-F781	Outfall	Versar	2.0	4	6	10	4	24	
SLP-OF-F789	Outfall	Versar	0.6	2	6	10	6	24	
SLP-OF-F794	Outfall	Versar	2.0	4	6	10	4	24	
SLP-OF-F858	Outfall	Versar	1.5	4	6	10	4	24	
SLP-SR-F713B-IB101A	Tree Planting	Versar	0.5	2	6	10	6	24	
SLP-SR-F750B-IB101	Tree Planting	Versar	0.2	2	6	10	6	24	
SLP-TP-F702	Tree Planting	Versar	0.3	2	6	10	6	24	
SLP-TP-F854	Tree Planting	Versar	0.1	2	6	10	6	24	
SMP-NB-F323B	BMP New Footprint	Biohabitats	3.2	6	6	8	4	24	
SMP-NB-F323D	BMP New Footprint	Biohabitats	2.4	4	6	8	6	24	
SMP-OF-F321	Outfall	Biohabitats	0.8	2	6	10	6	24	
DOR-NB-F920B	BMP New Footprint	McCormick Taylor	2.0	4	10	5	4	23	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
DOR-SR-F951	Stream	McCormick Taylor	6.4	8	3	8	4	23	
NLP-SR-F511B	Stream	KCI	8.0	8	3	8	4	23	
NLP-SR-F530B	Stream	KCI	5.9	8	3	8	4	23	
NLP-SR-F600B	Stream	KCI	13.2	10	3	8	2	23	
SLP-BC-D784	BMP Conversion	Versar	2.6	4	3	10	6	23	
SLP-BC-D797	BMP Conversion	Versar	2.8	4	3	10	6	23	
SLP-BC-D805	BMP Conversion	Versar	1.8	4	10	5	4	23	
SLP-BC-F722	BMP Conversion	Versar	0.5	2	10	5	6	23	
SLP-SR-F712B	Stream	Versar	3.2	6	3	8	6	23	
SLP-SR-F717A	Stream	Versar	6.0	8	3	8	4	23	
SLP-SR-F718A	Stream	Versar	3.2	6	3	8	6	23	
SLP-SR-F719B	Stream	Versar	6.3	8	3	8	4	23	
SLP-SR-F723C	Stream	Versar	4.9	6	3	8	6	23	
SLP-SR-F730	Stream	Versar	5.6	8	3	8	4	23	
SLP-SR-F732B	Stream	Versar	5.7	8	3	8	4	23	
SLP-SR-F747C	Stream	Versar	3.9	6	3	8	6	23	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-SR-F750A	Stream	Versar	5.7	8	3	8	4	23	
SLP-SR-F751E	Stream	Versar	4.6	6	3	8	6	23	
SLP-SR-F751G	Stream	Versar	1.1	4	3	8	8	23	
SLP-SR-F752E	Stream	Versar	5.1	8	3	8	4	23	
SLP-SR-F854	Stream	Versar	6.0	8	3	8	4	23	
SMP-BC-F301	BMP Conversion	Biohabitats	0.4	2	10	5	6	23	
SMP-NB-F309	Stream	Biohabitats	7.5	8	3	8	4	23	
DOR-BC-F927	BMP Conversion	McCormick Taylor	3.0	6	10	2	4	22	
DOR-NB-F907B	BMP New Footprint	McCormick Taylor	4.1	6	10	2	4	22	
DOR-NB-F910B	BMP New Footprint	McCormick Taylor	2.3	4	6	8	4	22	
DOR-NB-F914A	BMP New Footprint	McCormick Taylor	2.5	4	6	8	4	22	
DOR-NB-F916	BMP New Footprint	McCormick Taylor	3.4	6	10	2	4	22	
DOR-OF-F924	Outfall	McCormick Taylor	1.0	4	6	10	2	22	
NLP-BC-F508	BMP Conversion	KCI	0.9	2	6	8	6	22	
NLP-OF-F664	Outfall	KCI	0.8	2	6	10	4	22	
SLP-BC-D785	BMP Conversion	Versar	2.9	4	6	8	4	22	
SLP-BC-F723	BMP Conversion	Versar	0.7	2	6	8	6	22	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-BC-F724	BMP Conversion	Versar	0.4	2	6	8	6	22	
SLP-BC-F726	BMP Conversion	Versar	1.2	4	6	8	4	22	
SLP-BC-F733	BMP Conversion	Versar	0.4	2	6	8	6	22	
SLP-BC-F742	BMP Conversion	Versar	1.4	4	10	2	6	22	
SLP-BC-F743	BMP Conversion	Versar	0.6	2	6	8	6	22	
SLP-BC-F745	BMP Conversion	Versar	1.0	2	6	8	6	22	
SLP-BC-F750	BMP Conversion	Versar	1.1	4	6	8	4	22	
SLP-NB-F710A	BMP New Footprint	Versar	2.2	4	6	8	4	22	
SLP-NB-F753A	BMP New Footprint	Versar	2.3	4	6	8	4	22	
SLP-OF-F749	Outfall	Versar	0.3	2	0	10	10	22	
SLP-OF-F759	Outfall	Versar	0.8	2	6	10	4	22	
SLP-OF-F761	Outfall	Versar	1.0	2	6	10	4	22	
SLP-OF-F779	Outfall	Versar	0.8	2	6	10	4	22	
SLP-OF-F853	Outfall	Versar	0.5	2	6	10	4	22	
SLP-OF-F856	Outfall	Versar	0.4	2	0	10	10	22	
SLP-OF-F857	Outfall	Versar	0.5	2	6	10	4	22	
SLP-OF-F864	Outfall	Versar	1.4	4	0	10	8	22	
SLP-TP-F853	Tree Planting	Versar	0.4	2	6	10	4	22	
SMP-BC-F315	BMP Conversion	Biohabitats	0.3	2	6	8	6	22	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
DOR-BC-F903	BMP Conversion	McCormick Taylor	1.5	4	3	10	4	21	
DOR-BC-F904	BMP Conversion	McCormick Taylor	0.7	2	3	10	6	21	
DOR-BC-F926	BMP Conversion	McCormick Taylor	0.1	2	10	5	4	21	
DOR-BC-F936	BMP Conversion	McCormick Taylor	14.9	10	3	2	6	21	
DOR-SR-F953	Stream	McCormick Taylor	4.3	6	3	8	4	21	
NLP-BC-F506	BMP Conversion	KCI	0.2	2	10	5	4	21	
NLP-SR-F521B	Stream	KCI	2.8	4	3	8	6	21	
NLP-SR-F532A	Stream	KCI	3.6	6	3	8	4	21	
NLP-SR-F562A	Stream	KCI	3.9	6	3	8	4	21	
SLP-BC-D788	BMP Conversion	Versar	1.5	4	3	10	4	21	
SLP-BC-F739	BMP Conversion	Versar	0.7	2	10	5	4	21	
SLP-BC-F740	BMP Conversion	Versar	0.5	2	10	5	4	21	
SLP-BC-F767	BMP Conversion	Versar	7.6	8	3	2	8	21	
SLP-SR-F711A	Stream	Versar	1.9	4	3	8	6	21	
SLP-SR-F720	Stream	Versar	3.2	6	3	8	4	21	
SLP-SR-F739A	Stream	Versar	0.6	2	3	8	8	21	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-SR-F851A	Stream	Versar	2.7	4	3	8	6	21	
SLP-SR-F855	Stream	Versar	2.3	4	3	8	6	21	
SLP-SR-F856	Stream	Versar	3.4	6	3	8	4	21	
SLP-SR-F861	Stream	Versar	2.2	4	3	8	6	21	
DOR-BC-F909	BMP Conversion	McCormick Taylor	0.5	2	6	8	4	20	
DOR-BC-F934	BMP Conversion	McCormick Taylor	0.3	2	6	8	4	20	
DOR-BC-F935	BMP Conversion	McCormick Taylor	0.3	2	6	8	4	20	
DOR-BC-F939	BMP Conversion	McCormick Taylor	2.9	4	10	2	4	20	
DOR-BC-F940	BMP Conversion	McCormick Taylor	3.0	4	10	2	4	20	
DOR-BC-F941	BMP Conversion	McCormick Taylor	1.6	4	10	2	4	20	
DOR-NB-F905B	BMP New Footprint	McCormick Taylor	2.1	4	10	2	4	20	
DOR-NB-F907A	BMP New Footprint	McCormick Taylor	2.1	4	10	2	4	20	
DOR-OF-F915	Outfall	McCormick Taylor	0.1	2	0	10	8	20	
NLP-BC-D538	BMP Conversion	Versar	3.0	6	3	5	6	20	
NLP-OF-F501	Outfall	KCI	2.0	4	0	10	6	20	
NLP-OF-F507	Outfall	KCI	1.2	4	0	10	6	20	
NLP-OF-F523	Outfall	KCI	2.0	4	0	10	6	20	
NLP-OF-F525	Outfall	KCI	2.0	4	0	10	6	20	
NLP-OF-F527	Outfall	KCI	2.0	4	0	10	6	20	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-OF-F528	Outfall	KCI	0.6	2	0	10	8	20	
NLP-OF-F653	Outfall	KCI	1.9	4	0	10	6	20	
NLP-OF-F665	Outfall	KCI	1.6	4	0	10	6	20	
NLP-OF-F667	Outfall	KCI	1.5	4	0	10	6	20	
NLP-OF-F670	Outfall	KCI	1.1	4	0	10	6	20	
SLP-BC-F709	BMP Conversion	Versar	0.9	2	6	8	4	20	
SLP-BC-F714	BMP Conversion	Versar	0.4	2	10	2	6	20	
SLP-BC-F719	BMP Conversion	Versar	0.8	2	6	8	4	20	
SLP-BC-F746	BMP Conversion	Versar	0.7	2	6	8	4	20	
SLP-BC-F760	BMP Conversion	Versar	0.2	2	6	8	4	20	
SLP-BC-F761	BMP Conversion	Versar	0.7	2	6	8	4	20	
SLP-OF-F701	Outfall	Versar	0.3	2	0	10	8	20	
SLP-OF-F734	Outfall	Versar	0.2	2	0	10	8	20	
SLP-OF-F768	Outfall	Versar	0.8	2	0	10	8	20	
SLP-OF-F862	Outfall	Versar	1.5	4	0	10	6	20	
SMP-BC-F316	BMP Conversion	Biohabitats	0.6	2	6	8	4	20	
SMP-OF-F314	Outfall	Biohabitats	0.8	2	0	10	8	20	
DOR-BC-D946	BMP Conversion	Versar	8.8	8	3	2	6	19	
DOR-BC-F918	BMP Conversion	McCormick Taylor	6.7	8	3	2	6	19	
DOR-BC-F922	BMP Conversion	McCormick Taylor	13.0	10	3	2	4	19	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
DOR-BC-F930	BMP Conversion	McCormick Taylor	11.0	10	3	2	4	19	
DOR-NB-F920C	BMP New Footprint	McCormick Taylor	12.0	10	3	2	4	19	
NLP-BC-D539	BMP Conversion	KCI	9.8	8	3	2	6	19	
NLP-SR-F507B	Stream	KCI	2.6	4	3	8	4	19	
SLP-BC-F712	BMP Conversion	Versar	4.9	6	3	2	8	19	
SLP-BC-F744	BMP Conversion	Versar	0.4	2	3	10	4	19	
SLP-BC-F747	BMP Conversion	Versar	0.4	2	3	10	4	19	
SLP-BC-F755	BMP Conversion	Versar	4.9	6	3	2	8	19	
SLP-BC-F852	BMP Conversion	Versar	8.3	8	3	2	6	19	
SLP-SR-F746A	Stream	Versar	0.8	2	3	8	6	19	
SLP-SR-F758	Stream	Versar	0.9	2	3	8	6	19	
SMP-BC-F309	BMP Conversion	Biohabitats	1.0	2	3	10	4	19	
SMP-SR-F326	Stream	Biohabitats	2.3	4	3	8	4	19	
DOR-BC-F908	BMP Conversion	McCormick Taylor	0.1	2	6	8	2	18	
DOR-BC-F912	BMP Conversion	McCormick Taylor	0.3	2	10	2	4	18	
DOR-BC-F925	BMP Conversion	McCormick Taylor	1.6	4	6	2	6	18	
DOR-NB-F920A	BMP New Footprint	McCormick Taylor	3.6	6	3	5	4	18	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
DOR-NB-F921A	BMP New Footprint	McCormick Taylor	3.4	6	6	2	4	18	
DOR-OF-F916	Outfall	McCormick Taylor	0.1	2	0	10	6	18	
NLP-OF-F506	Outfall	KCI	2.0	4	0	10	4	18	
NLP-OF-F514	Outfall	KCI	2.0	4	0	10	4	18	
NLP-OF-F537	Outfall	KCI	0.8	2	0	10	6	18	
NLP-OF-F655	Outfall	KCI	0.5	2	0	10	6	18	
NLP-OF-F658	Outfall	KCI	0.3	2	0	10	6	18	
SLP-BC-F715	BMP Conversion	Versar	0.4	2	3	5	8	18	
SLP-BC-F721	BMP Conversion	Versar	0.6	2	10	2	4	18	
SLP-BC-F771	BMP Conversion	Versar	1.2	4	3	5	6	18	
SLP-OF-F783	Outfall	Versar	1.1	4	0	10	4	18	
SLP-OF-F854	Outfall	Versar	0.5	2	0	10	6	18	
SLP-OF-F863	Outfall	Versar	1.1	4	0	10	4	18	
DOR-BC-F921	BMP Conversion	McCormick Taylor	3.7	6	3	2	6	17	
DOR-BC-F924	BMP Conversion	McCormick Taylor	5.9	8	3	2	4	17	
DOR-BC-F928	BMP Conversion	McCormick Taylor	6.1	8	3	2	4	17	
DOR-BC-F932	BMP Conversion	McCormick Taylor	3.7	6	3	2	6	17	
DOR-BC-F937	BMP Conversion	McCormick Taylor	6.1	8	3	2	4	17	
NLP-BC-D527	BMP Conversion	KCI	4.7	6	3	2	6	17	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-BC-F502	BMP Conversion	KCI	3.0	6	3	2	6	17	
NLP-BC-F651	BMP Conversion	KCI	4.0	6	3	2	6	17	
NLP-SR-F528A	Stream	KCI	2.1	4	3	8	2	17	
SLP-BC-D782	BMP Conversion	Versar	4.1	6	3	2	6	17	
SLP-BC-F764	BMP Conversion	Versar	5.0	6	3	2	6	17	
DOR-BC-D945	BMP Conversion	Versar	0.0	2	3	5	6	16	
DOR-BC-F906	BMP Conversion	McCormick Taylor	0.6	2	3	5	6	16	
DOR-BC-F913	BMP Conversion	McCormick Taylor	1.0	2	3	5	6	16	
DOR-NB-F929A	BMP New Footprint	McCormick Taylor	2.2	4	3	5	4	16	
DOR-OF-F907	Outfall	McCormick Taylor	0.2	2	0	10	4	16	
DOR-OF-F911	Outfall	McCormick Taylor	0.8	2	0	10	4	16	
NLP-BC-D517	BMP Conversion	KCI	1.1	4	3	5	4	16	
NLP-OF-F522	Outfall	KCI	0.4	2	0	10	4	16	
NLP-OF-F656	Outfall	KCI	1.0	4	0	10	2	16	
NLP-OF-F660	Outfall	KCI	0.2	2	0	10	4	16	
SLP-NB-F764A	BMP New Footprint	Versar	2.5	4	3	5	4	16	
SLP-NB-F765A	BMP New Footprint	Versar	2.2	4	3	5	4	16	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-OF-F752	Outfall	Versar	0.2	2	0	10	4	16	
DOR-BC-F905	BMP Conversion	McCormick Taylor	1.8	4	3	2	6	15	
DOR-BC-F911	BMP Conversion	McCormick Taylor	1.8	4	3	2	6	15	
DOR-BC-F914	BMP Conversion	McCormick Taylor	1.0	4	3	2	6	15	
DOR-BC-F916	BMP Conversion	McCormick Taylor	4.7	6	3	2	4	15	
DOR-BC-F919	BMP Conversion	McCormick Taylor	4.1	6	3	2	4	15	
DOR-BC-F929	BMP Conversion	McCormick Taylor	3.4	6	3	2	4	15	
DOR-BC-F938	BMP Conversion	McCormick Taylor	3.4	6	3	2	4	15	
DOR-NB-F911B	BMP New Footprint	McCormick Taylor	2.3	4	3	2	6	15	
NLP-BC-D515	BMP Conversion	KCI	1.5	4	3	2	6	15	
NLP-BC-D516	BMP Conversion	KCI	1.3	4	3	2	6	15	
NLP-BC-D525	BMP Conversion	KCI	3.2	6	3	2	4	15	
NLP-BC-D532	BMP Conversion	KCI	2.4	4	3	2	6	15	
NLP-BC-F503	BMP Conversion	KCI	1.8	4	3	2	6	15	
NLP-BC-F507	BMP Conversion	KCI	2.0	4	3	2	6	15	
NLP-BC-F509	BMP Conversion	KCI	2.8	4	3	2	6	15	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
NLP-BC-F511	BMP Conversion	KCI	0.8	2	3	2	8	15	
SLP-BC-F705	BMP Conversion	Versar	1.5	4	3	2	6	15	
SLP-BC-F731	BMP Conversion	Versar	0.5	2	3	2	8	15	
SLP-BC-F748	BMP Conversion	Versar	3.4	6	3	2	4	15	
SLP-BC-F770	BMP Conversion	Versar	4.9	6	3	2	4	15	
SMP-BC-D322	BMP Conversion	Versar	1.7	4	3	2	6	15	
SLP-BC-F708	BMP Conversion	Versar	0.1	2	3	5	4	14	
SLP-BC-F751	BMP Conversion	Versar	0.3	2	3	5	4	14	
SLP-BC-F773	BMP Conversion	Versar	0.4	2	3	5	4	14	
DOR-BC-F907	BMP Conversion	McCormick Taylor	2.9	4	3	2	4	13	
DOR-NB-F938A	BMP New Footprint	McCormick Taylor	4.3	6	3	2	2	13	
NLP-BC-D523	BMP Conversion	KCI	1.9	4	3	2	4	13	
NLP-BC-D526	BMP Conversion	KCI	2.0	4	3	2	4	13	
NLP-BC-D529	BMP Conversion	KCI	1.4	4	3	2	4	13	
NLP-BC-D533	BMP Conversion	KCI	1.3	4	3	2	4	13	
NLP-BC-F501	BMP Conversion	KCI	1.1	4	3	2	4	13	

Rankings and Scores for Little Patuxent Watershed Project Recommendations

Site ID	Type	Contractor	Acres of Impervious Treated	Acres of Impervious Treated Score	Pollutant Load Reduction Score	Cost Per Acre Score	Biological uplift - Programmatic Benefit - Feasibility Proportional Score	Total Score Combined Metrics	Concept 2015
SLP-BC-F716	BMP Conversion	Versar	0.8	2	3	2	6	13	
SLP-BC-F718	BMP Conversion	Versar	1.3	4	3	2	4	13	
SLP-BC-F737	BMP Conversion	Versar	1.2	4	3	2	4	13	
SLP-BC-F753	BMP Conversion	Versar	0.8	2	3	2	6	13	
SLP-BC-F762	BMP Conversion	Versar	1.2	4	3	2	4	13	
SLP-BC-F768	BMP Conversion	Versar	1.4	4	3	2	4	13	
SLP-BC-F851	BMP Conversion	Versar	2.2	4	3	2	4	13	
DOR-BC-F901	BMP Conversion	McCormick Taylor	2.6	4	3	2	2	11	
NLP-BC-F510	BMP Conversion	KCI	0.8	2	3	2	4	11	
SLP-BC-D776	BMP Conversion	Versar	0.3	2	3	2	4	11	
SLP-BC-F752	BMP Conversion	Versar	0.4	2	3	2	4	11	

H. Individual Concept Plans for Top-Ranked Opportunities

List of Concept Plans in Little Patuxent River Watershed

Site ID	Site Name	Project Type
DOR-BC-F942	Iron Mountain	BMP Conversion
DOR-BC-F943	Gatewood Drive	BMP Conversion
DOR-NB-F912a	Capitol Express	New BMP
DOR-SR-F904c	Dorsey Run Road	Tree Planting
DOR-TP-F901b	Pepsi Delivery	Tree Planting
DOR-TP-F905g	Lee Deforest Drive	Tree Planting
NLP-OF-F508	Lilac Lane	Outfall Stabilization
NLP-OF-F516	Rumsey Road	Outfall Stabilization
NLP-OF-F536	Soccer Association of Columbia	Outfall Stabilization
NLP-OF-F654	Waverly Woods	Outfall Stabilization
NLP-OF-F661	Little Brick House Court	Outfall Stabilization
NLP-OF-F662	Waterloo Road	Outfall Stabilization
NLP-SR-F504a	Turf Valley (a)	Stream Restoration
NLP-SR-F509a	Turf Valley (b)	Stream Restoration
NLP-SR-F520b	Turf Valley (c)	Stream Restoration
NLP-SR-F551a	Enchanted Forest 3	Stream Restoration
NLP-SR-F552a	Boones Lane (a)	Stream Restoration
NLP-SR-F555a	Enchanted Forest (a)	Stream Restoration
NLP-SR-F555b	Enchanted Forest (b)	Stream Restoration
NLP-SR-F557a	Boones Lane (b)	Stream Restoration
NLP-SR-F571a	Red Hill Branch at Santa Fe Court	Stream Restoration
NLP-SR-F583a	Tributaries to Plumtree Branch, North	Stream Restoration
NLP-SR-F587d	Lutheran Village North	Stream Restoration
NLP-SR-F590a	Turf Valley (d)	Stream Restoration
NLP-SR-F599a	Plumtree Branch	Stream Restoration
NLP-TP-D519	Forest Hill	Tree Planting
NLP-TP-F511	Breconshire	Tree Planting
NLP-TP-F514	Thomas B. Dorsey Building	Tree Planting
NLP-TP-F653	Turf Valley (e)	Tree Planting
NLP-TP-F654	Bethany Lane	Tree Planting
NLP-TP-F655	David W Force Park	Tree Planting
SLP-BC-D774	End of Durham Road East	BMP Conversion - Previous Study
SLP-BC-D780	Tree Swallow Court	BMP Conversion - Previous Study
SLP-BC-D792	Dobbin Road Commercial Business Center	BMP Conversion - Previous Study
SLP-BC-D798	Golden Coin Court	BMP Conversion - Previous Study
SLP-BC-D802	Old Annapolis Road	BMP Conversion - Previous Study
SLP-BC-F701	Wesleigh and Seneca Drive	BMP Conversion
SLP-BC-F728	Columbia Medical Campus	BMP Conversion
SLP-BC-F734	9265 Berger Road Business Complex	BMP Conversion
SLP-BC-F758	Elliott & Franz Inc. Heavy Equipment Rentals	BMP Conversion
SLP-BC-F772	Thrift Store Dry Pond	BMP Conversion
SLP-NB-F711a	Maine: Paper and Food Service, Inc. - Truck Parking Lot	New BMP
SLP-NB-F711b	Maine: Paper and Food Service, Inc. - Employee Parking Lot	New BMP
SLP-NB-F712a	Coastal Sunbelt Produce - Employee Parking Lot	New BMP
SLP-NB-F712c	Coastal Sunbelt Produce - Truck Parking Lot	New BMP

Site ID	Site Name	Project Type
SLP-NB-F715b	JFC International, Inc.	New BMP
SLP-NB-F722d	Weis Market	New BMP
SLP-NB-F731a	Rivers Technology Park	New BMP
SLP-NB-F739b	Lincoln Technology Institute	New BMP
SLP-NB-F740a	Nielsen Company Parking Lot	New BMP
SLP-OF-F706	8928 McGaw Court	Outfall Stabilization
SLP-OF-F710	South of Phelps Luck and Tamar Drives Intersection	Outfall Stabilization
SLP-OF-F711	Cradlerock Way and Homespun Drive	Outfall Stabilization
SLP-OF-F740	Cheshire Court	Outfall Stabilization
SLP-OF-F753	9053 Guilford Road	Outfall Stabilization
SLP-OF-F754	9790 Patuxent Woods Drive	Outfall Stabilization
SLP-OF-F773	Lightning View Road	Outfall Stabilization
SLP-OF-F792	7363-7351 Hickory Log Circle	Outfall Stabilization
SLP-OF-F851	5377 Racegate Run	Outfall Stabilization
SLP-OF-F852	Wolf River Lane and Lightning View Road	Outfall Stabilization
SLP-OF-F855	6029 Majors Lane	Outfall Stabilization
SLP-OF-F859	Lake Circle West	Outfall Stabilization
SLP-SR-F735	Wilde Lake Headwaters Stream Restoration	Stream Restoration
SLP-SR-F737A	Oakland Mills	Stream Restoration
SLP-SR-F740a	Lightning View Road	Stream Restoration
SLP-SR-F753I	North Laurel Industrial Park	Stream Restoration
SLP-SR-F754	Lake Elkhorn Receiving Channel	Stream Restoration
SLP-SR-F852	Oakland Ridge Industrial Park	Stream Restoration
SLP-SR-F853	Hopewell Park	Stream Restoration
SLP-TP-F701	Forest Ridge Elementary School	Tree Planting
SLP-TP-F703	Howard Community College	Tree Planting
SLP-TP-F704	Sand Chain Road	Tree Planting
SLP-TP-F851	Marsh Hawk Way	Tree Planting
SLP-TP-F852	Crossroads Business Park	Tree Planting
SMP-BC-D332	Jaclyn Court	BMP Conversion - Previous Study
SMP-BC-D333	Crest Drive at Route 216	BMP Conversion - Previous Study
SMP-BC-F314	9525 Chaton Road	BMP Conversion
SMP-NB-F325	BGE Substation	Stream Restoration
SMP-OF-F317	End of Queens Guard Court	Outfall Stabilization
SMP-OF-F324	End of Elsie's Way	Outfall Stabilization
SMP-SR-F324	BGE ROW Washington Boulevard	Stream Restoration
SMP-TP-F307	Temple Isaiah	Tree Planting
SMP-TP-F309	Eternal Rings Road	Tree Planting
SMP-TP-F311	Northern Lakes	Tree Planting
SMP-TP-F405	Hammond Branch at Hammond Drive	Tree Planting
SMP-TP-F406	Hammond Branch at Maple Lawn	Tree Planting
SR-29	Emerson Community Association	Stream Restoration
SR-30	Sterling Drive	Stream Restoration
SR-31	BGE ROW Stephens Road	Stream Restoration
SR-32	Bowling Brook Farms	Stream Restoration
SR-33	Hammond Branch (a)	Stream Restoration
SR-34	Hammond Branch (b)	Stream Restoration
SR-35	Maple Lawn Farms	Stream Restoration
SR-36	Hammond Branch (c)	Stream Restoration

Site ID	Site Name	Project Type
SR-37	Hammond Branch (d) - Reservoir High School	Stream Restoration
SR-38	Hammond Branch (e) - The Home Farm LLC	Stream Restoration
SR-43	Ashleigh Knolls Homeowners Association	Stream Restoration
SR-45	Boones Lane Tributary and Little Patuxent River	Stream Restoration
SR-46	Boones Lane, Tributaries and Little Patuxent River	Stream Restoration
SR-47	Font Hill, Tributary to Little Patuxent River	Stream Restoration
SR-48	Font Hill, Tributary to Little Patuxent River, Upstream Centennial Lake	Stream Restoration
SR-49	Dunloggin Middle School	Stream Restoration
SR-50	Lutheran Village South, tributary to Plumtree Branch	Stream Restoration
SR-51	North Chatham Road	Stream Restoration
SR-52	Gray Sea Way	Stream Restoration
SR-53	Broken Wing Court	Stream Restoration
SR-54	Distant Rock Path	Stream Restoration
SR-55	Summer Cloud Way	Stream Restoration
SR-59	Jessup Correctional	Stream Restoration

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F942
Site Name: Iron Mountain

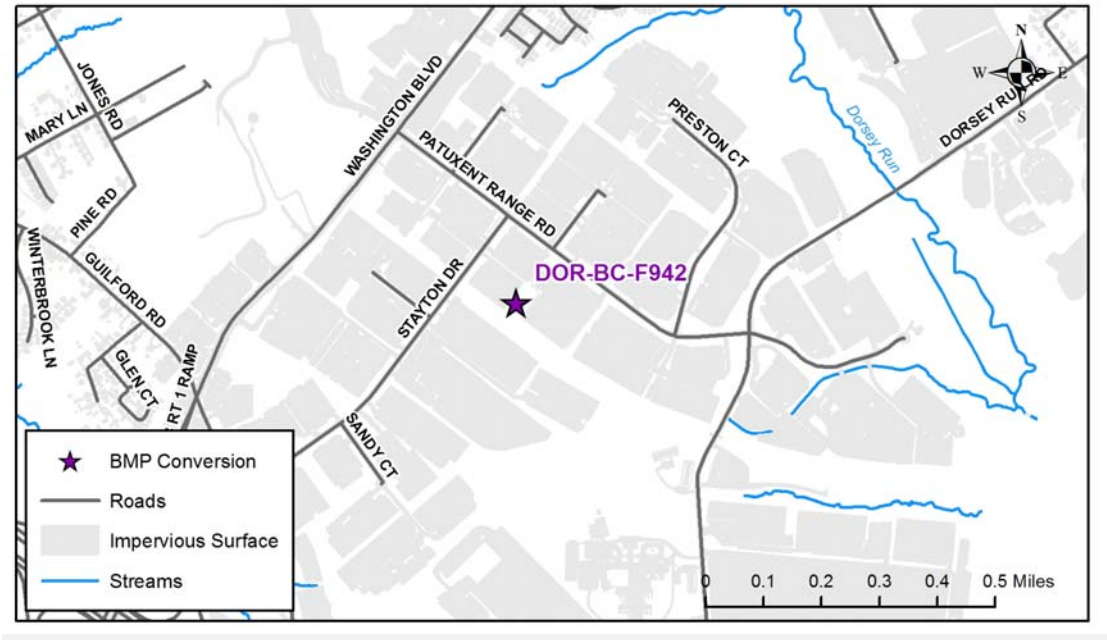
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed BMP Type: Shallow Marsh
Ownership: Private- Commercial/Industrial
Single Owner

BMP Structure ID: HO105455
Existing BMP Type: Dry Pond

Existing Conditions:

The site consists of a large warehouse and office building with loading docks and a parking lot. Currently, 8.99 ac. of runoff from the parking lot and rooftop discharges into an extended detention dry pond on the western side of the property. Based on a field visit and the as-built plan set, there is one 30 in. HDPE inflow at elevation 248.00, one 15 in. HDPE inflow, and one small riprap swale inflow. A 30 in. RCP inflow pipe was abandoned with new construction in 2000. There are riprap channels at the inflows and 15-20 trees in the pond and on the side slopes; the embankment is approximately 8 ft. high. The storm drain manhole on the north side of the pond which diverts the large inflow pipe is failing and a sinkhole is forming. The riser structure has an HDPE low flow pipe, a weir in the front, and an open top with an inlet grate. The structure has been patched and the principal spillway is a 21 in. CMP that flows to a manhole north of the CSX railroad. The ultimate outfall of the pond is on the southern side of the CSX railroad tracks. A second manhole just south of the embankment and north of the CSX railroad tracks which receives the barrel from the riser is also failing.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F942
Site Name: Iron Mountain

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Looking south toward the facility from the asphalt access path. Failing manhole at bottom right of photo.

Looking north toward the facility from the embankment.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F942
Site Name: Iron Mountain

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints for this project include the property ownership, available surface area, and proximity to CSX railroad. The pond is on private property and the outfall is on CSX property. There is no room to expand the current pond footprint. No utilities were observed in the pond vicinity during the initial site assessment.

Concept Description:

A shallow marsh is proposed within the existing footprint of the dry pond. The permanent pool elevation will be 248.00 with a 2 ft. deep forebay to provide the required 2,476 cf. of pretreatment. The small HDPE inflow near the riser will be stabilized with riprap. Excluding the forebay, the facility will provide approximately 13,900 cf. of wet storage in the permanent pool with 65% of the ponded surface area 18 in. or less, as per the Maryland Department of the Environment Design Manual (2000). A bottom elevation of 243.00 is proposed in a pool near the riser. With approximately 1.25 ft. of extended detention volume, the entire WQv (23,913 cf.) is treated. If a maintenance bench is required, the treatment potential of the facility will be significantly reduced. The failing manholes are to be replaced and sinkholes stabilized. The riser and barrel will be replaced and designed for maximum treatment while providing sufficient freeboard in the pond. A clay core will be required at the barrel and a clay liner is proposed along the length of the embankment under the facility to maintain the permanent pool. The current outfall on the south side of the CSX railroad is a CMP with a concrete pad. There is erosion around the concrete pad where it meets the side slope of the downstream channel. This outfall could be improved and stabilized as part of this conversion if the property owner gives consent. Access to the pond will be along the existing 12 ft. wide asphalt path from the parking lot on the north side of the building.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	8.99
Impervious Area within Drainage (ac.):	6.82
Impervious Area Treated (ac.):	6.82
Impervious Area Treated Credit (ac.):	6.9

Water Quality Volume	
WQVolume Target (cft.):	23,913
Max Treated (cft.):	25,101
Percent Treated:	105%
Rainfall Depth Treated (in.):	1.05

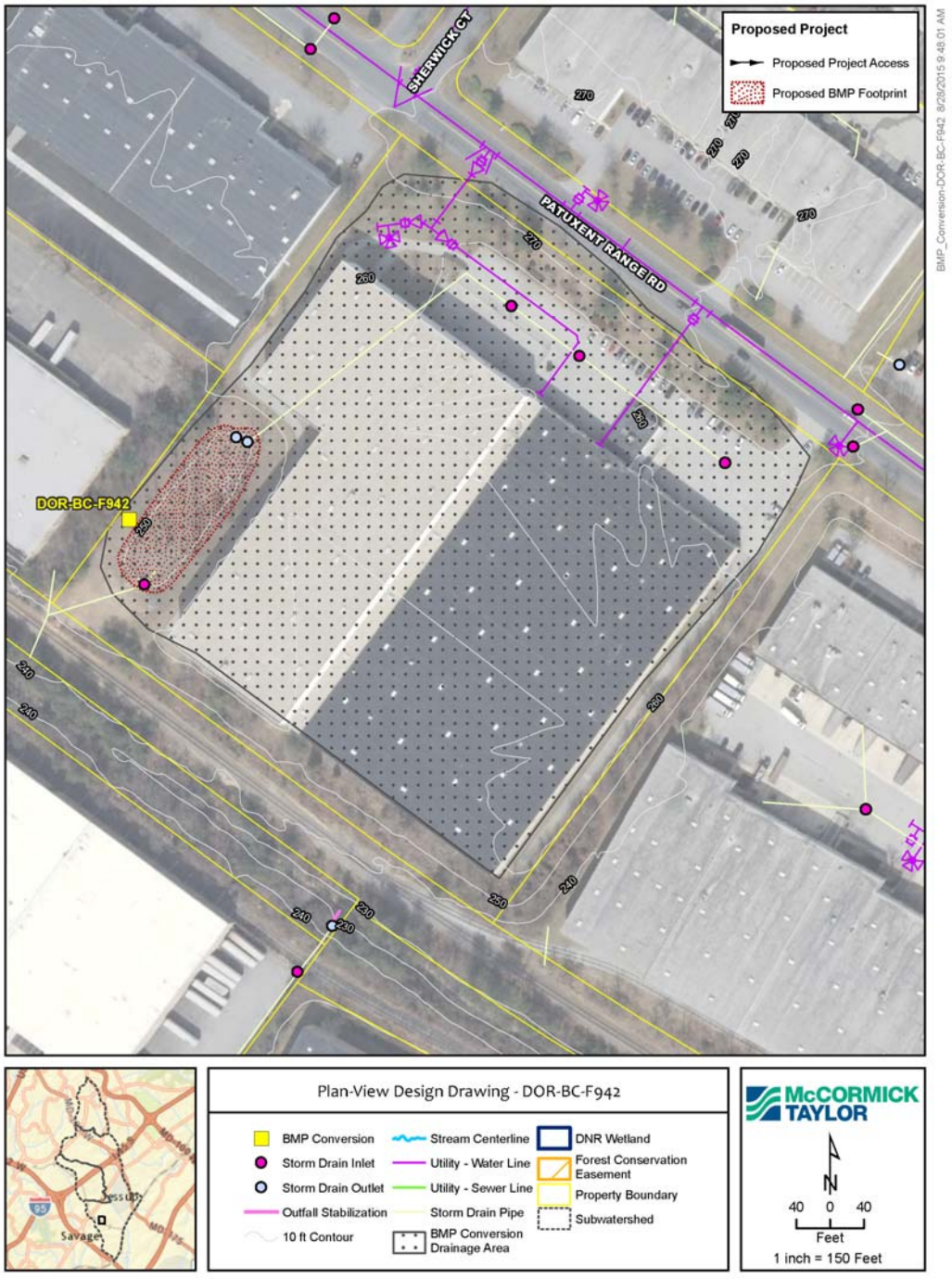
Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$177,294.00
30% Contingency:	$53,188.20
Estimated Total Cost	$350,482.20
Cost per Impervious Credit Acre:	$50,794.52

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F942
Site Name: Iron Mountain

Contractor: McCormick Taylor
Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F943
Site Name: Gatewood Drive

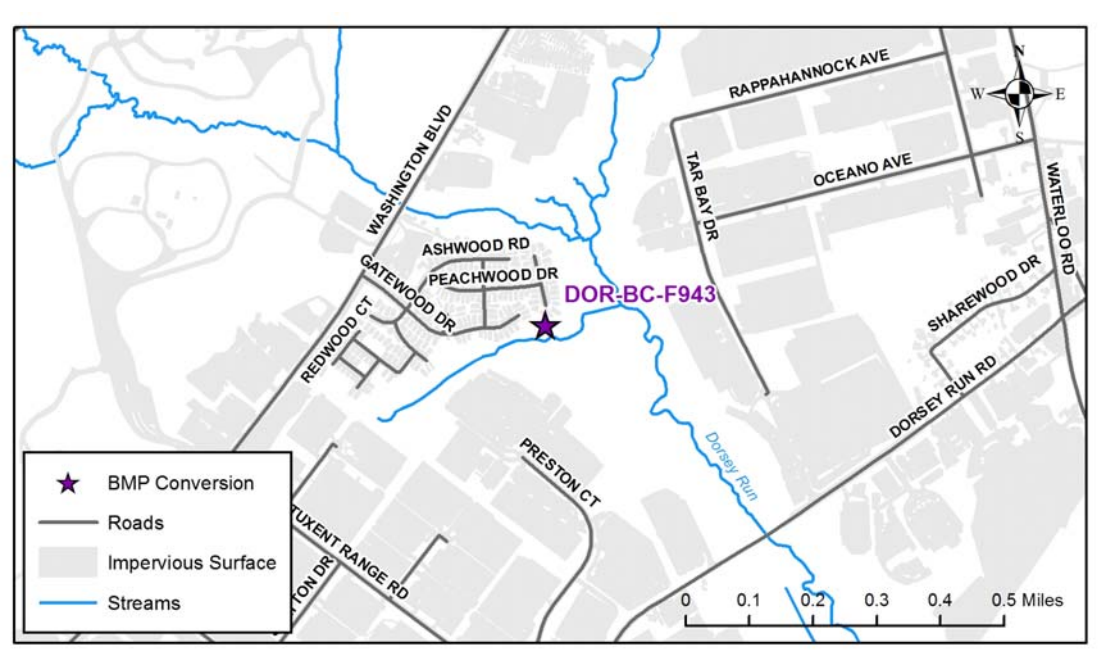
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed BMP Type: Sand Filter
Ownership: Private- Residential
Multiple Owners

BMP Structure ID: HO100795
Existing BMP Type: Extended Detention

Existing Conditions:

The existing extended detention dry pond receives runoff from a high density residential neighborhood. There are two CMP inflows from the neighborhood storm drain network that appear to have inverts above the current pond bottom. Minor ponding was observed during the field assessment and sewer and electric were observed along the top of the pond. The existing riser structure is a concrete structure with a brick bottom, a low flow orifice, and multiple weirs. It has been repaired or modified as there is evidence of concrete patching or grout at the weirs. The barrel is a 42 in. RCP and the embankment is approximately 6 ft. high. The immediate outfall of the pond is stable, but there is erosion at the downstream end of the outfall channel where it meets the stream. At this location, the stream banks are eroding and there is an abrupt drop in elevation of approximately one to two ft. from the outfall channel to the stream.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F943
Site Name: Gatewood Drive

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Looking east toward the facility and riser from near Gatewood Drive.

Looking west toward the riser structure and 24” CMP inflow from the pond embankment.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F943
Site Name: Gatewood Drive

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints for this project include the property ownership, available surface area, and utilities. The pond is on private property in close proximity to a number of homes and the existing footprint does not allow the entire WQv to be treated. The elevation between the pond bottom and outfall is minimal and a facility with an underdrain is not feasible unless the outfall is lowered and the outfall channel is graded to tie into the stream. Grading the outfall channel will require a large number of trees to be removed. Sewer and electric run along the northern edge of the pond and should not affect the facility, but their exact locations and elevations will need to be verified.

Concept Description:

The proposed facility is a sand filter with forebays at each of the inflows, a new riser structure and spillway through the embankment, and an approximately 6,400 sf. sand filter area. The forebays will be sized appropriately for the contributing area to each inflow, providing a total of 0.11 ac-ft. of storage. With 2 ft. of media, the sand filter area provides 0.12 ac-ft. of subsurface treatment and an additional 0.16 ac-ft. of storage to be treated in 1 ft. of temporary ponding. The sand filter has potential to treat approximately 0.28 ac-ft. or 66% of the required WQv. The riser structure will be replaced to lower the principal spillway and allow underdrain connections from the sand filter. Weirs will be sized for 1 ft. of ponding in addition to the larger rainfall events. The outfall channel will also require significant grading to lower the elevation of the channel and improve the confluence with the stream. A clay liner is proposed over the entire embankment. Access to the pond is from Gatewood Drive but will disrupt the parking lot use and the homeowners' yards.

Nearby Opportunities:

DOR-OF-F923, DOR-SR-F907

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	11.09	WQVolume Target (cft.):	18,315
Impervious Area within Drainage (ac.):	4.99	Max Treated (cft.):	12,053
Impervious Area Treated (ac.):	4.99	Percent Treated:	66%
Impervious Area Treated Credit (ac.):	3.28	Rainfall Depth Treated (in.):	0.66

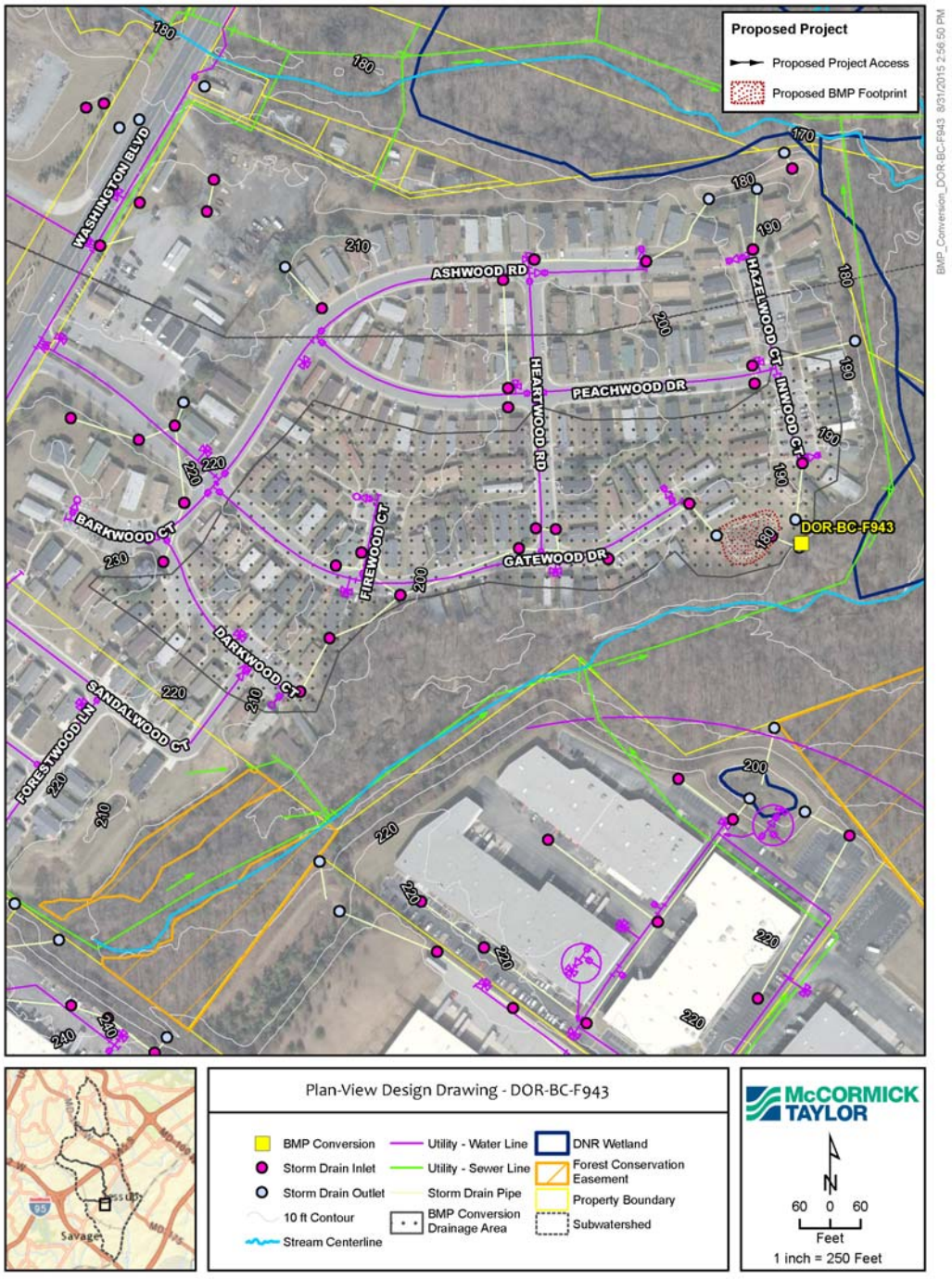
Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$188,409.52
30% Contingency:	$56,522.86
Estimated Total Cost	$364,932.38
Cost per Impervious Credit Acre:	$111,259.87

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: DOR-BC-F943
Site Name: Gatewood Drive

Contractor: McCormick Taylor
Watershed: Little Patuxent River



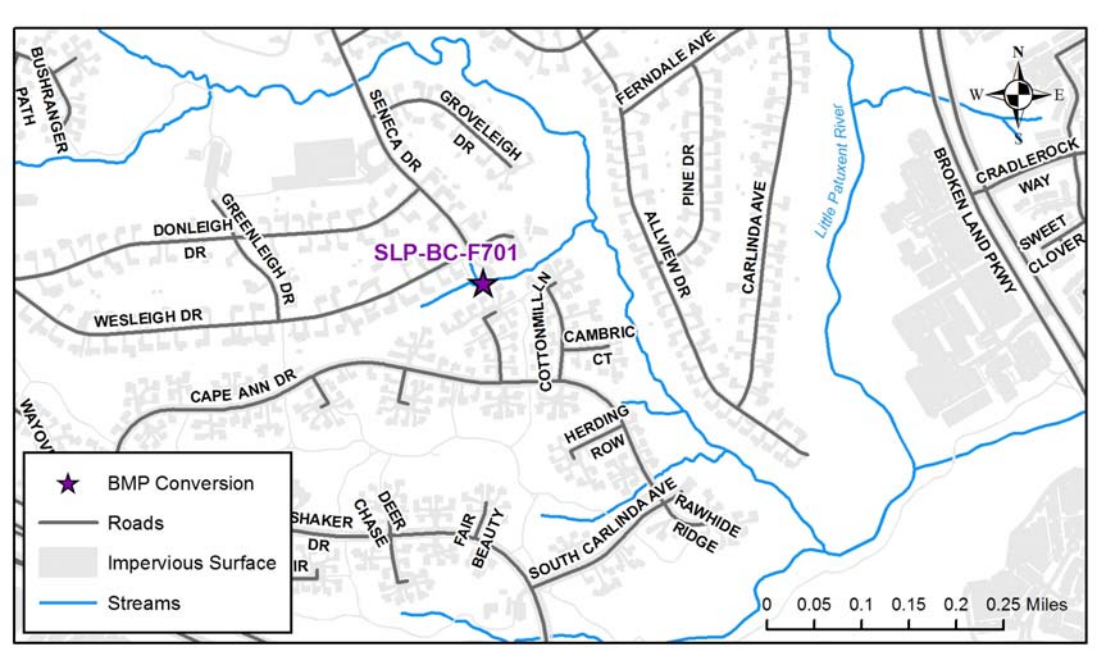
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F701
Site Name: Wesleigh and Seneca Drive
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Submerged Gravel Wetlands
Ownership: Private- Residential
Single Owner
BMP Structure ID: HO100148
Existing BMP Type: Dry Pond

Existing Conditions:

A small amount of water flows from the north inlet (30 in. RCP), through wetland vegetation to the south outfall (18 in. RCP) of the existing facility at the time of the field investigation. There is a pedestrian trail along the west and south side of the facility. The south end of the facility has an outfall with headwall and paved emergency spillway, which discharges east onto private property. In addition to the principal outfall there is an asphalt emergency spillway at this facility. An unconnected stormwater system is located at the south end of the facility which bypasses this facility.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F701
Site Name: Wesleigh and Seneca Drive
Contractor: Versar
Watershed: Little Patuxent River

Standing on outlet headwall looking upstream.

Standing at south end looking downstream.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F701
Site Name: Wesleigh and Seneca Drive
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The approval of the adjacent landowners and possible HOA. The facility is possibly in the Waters of the United States (WUS) and a wetland.

Concept Description:

Either a submerged gravel wetland (SGW) or a wet pond can be constructed within the facility. The SGW will require a new outlet weir to be constructed upstream of the existing outlet. The site currently has an access route from Wesleigh Drive into the bottom of the basin.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	14.59
Impervious Area within Drainage (ac.):	3.91
Impervious Area Treated (ac.):	3.91
Impervious Area Treated Credit (ac.):	3.91

Water Quality Volume	
WQVolume Target (cft.):	15,422
Max Treated (cft.):	16,964
Percent Treated:	110%
Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$63,938.62

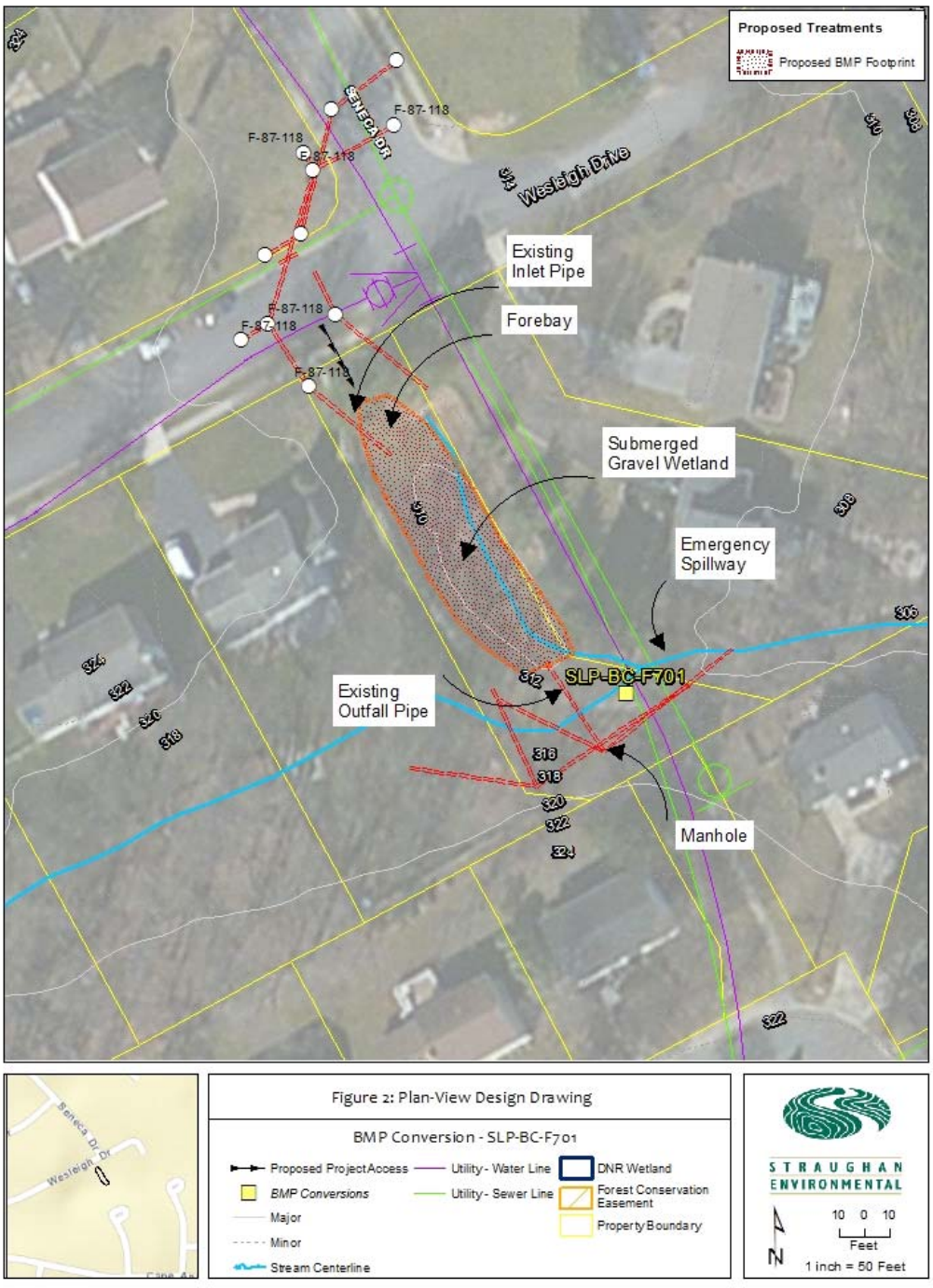
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F701

Site Name: Wesleigh and Seneca Drive

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F728
Site Name: Columbia Medical Campus

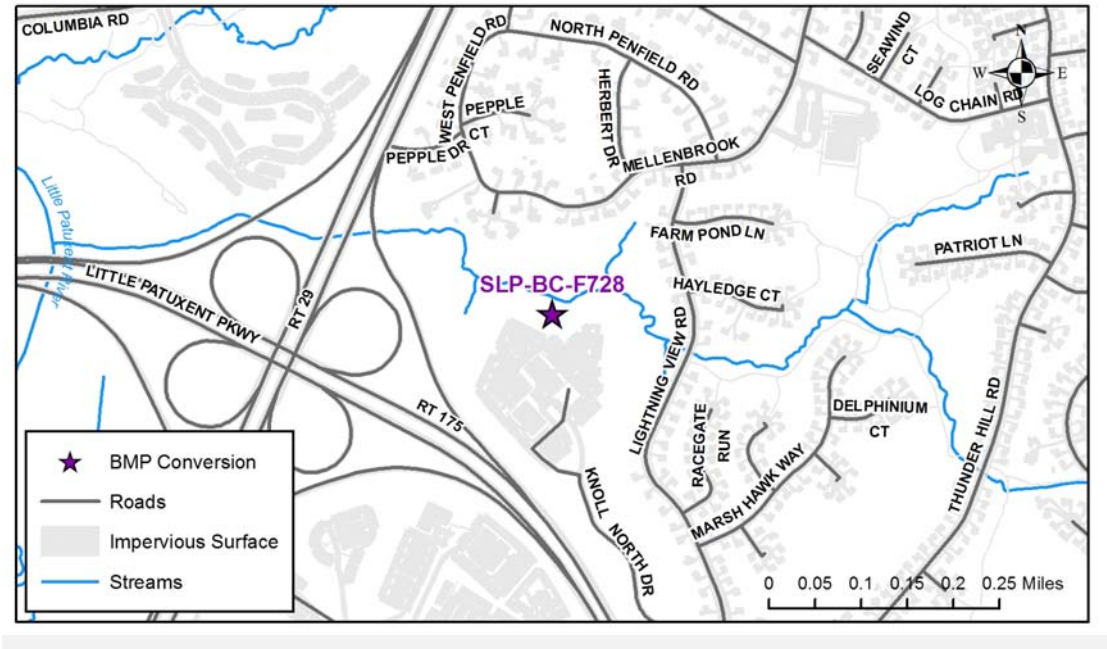
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Submerged Gravel Wetlands
Ownership: Private- Commercial/Industrial
Single Owner

BMP Structure ID: HO101106
Existing BMP Type: Extended Detention

Existing Conditions:

This facility is currently a dry extended detention facility with three surface inflows and two subsurface inflows. The surface inflows are in the east, west and center south sides of the facility. The two subsurface inflows come into the bottom center of the facility at a Type K inlet with a metal orifice plate that controls the discharge out, which is functioning as a low flow device. This junction box connects to concrete riser set in an embankment along the north side of the facility. The outfall from the facility is through a 36 in. CMP into a tributary. In walking the entire site, it appears all of the surrounding parking lots and main building drain into this facility. There appears to be an area along the northwest side that, if not for the fiber optic line, could be converted into a new second stormwater management facility. The source for one of the subsurface inlets could not be located, but it may coming from the main building. During the site visit, water was flowing through the subsurface system.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F728
Site Name: Columbia Medical Campus
Contractor: Versar
Watershed: Little Patuxent River

View south from embankment behind riser.

Facility looking west from embankment.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F728
Site Name: Columbia Medical Campus
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

No known constraints.

Concept Description:

This facility can be converted into a submerged gravel wetland. As part of this conversion, the existing "low-flow" device may need to be altered.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	12.31
Impervious Area within Drainage (ac.):	7.96
Impervious Area Treated (ac.):	7.96
Impervious Area Treated Credit (ac.):	7.96

Water Quality Volume	
WQVolume Target (cft.):	28,239
Max Treated (cft.):	31,063
Percent Treated:	110%
Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$159,630.00
30% Contingency:	$47,889.00
Estimated Total Cost	$327,519.00
Cost per Impervious Credit Acre:	$41,145.60

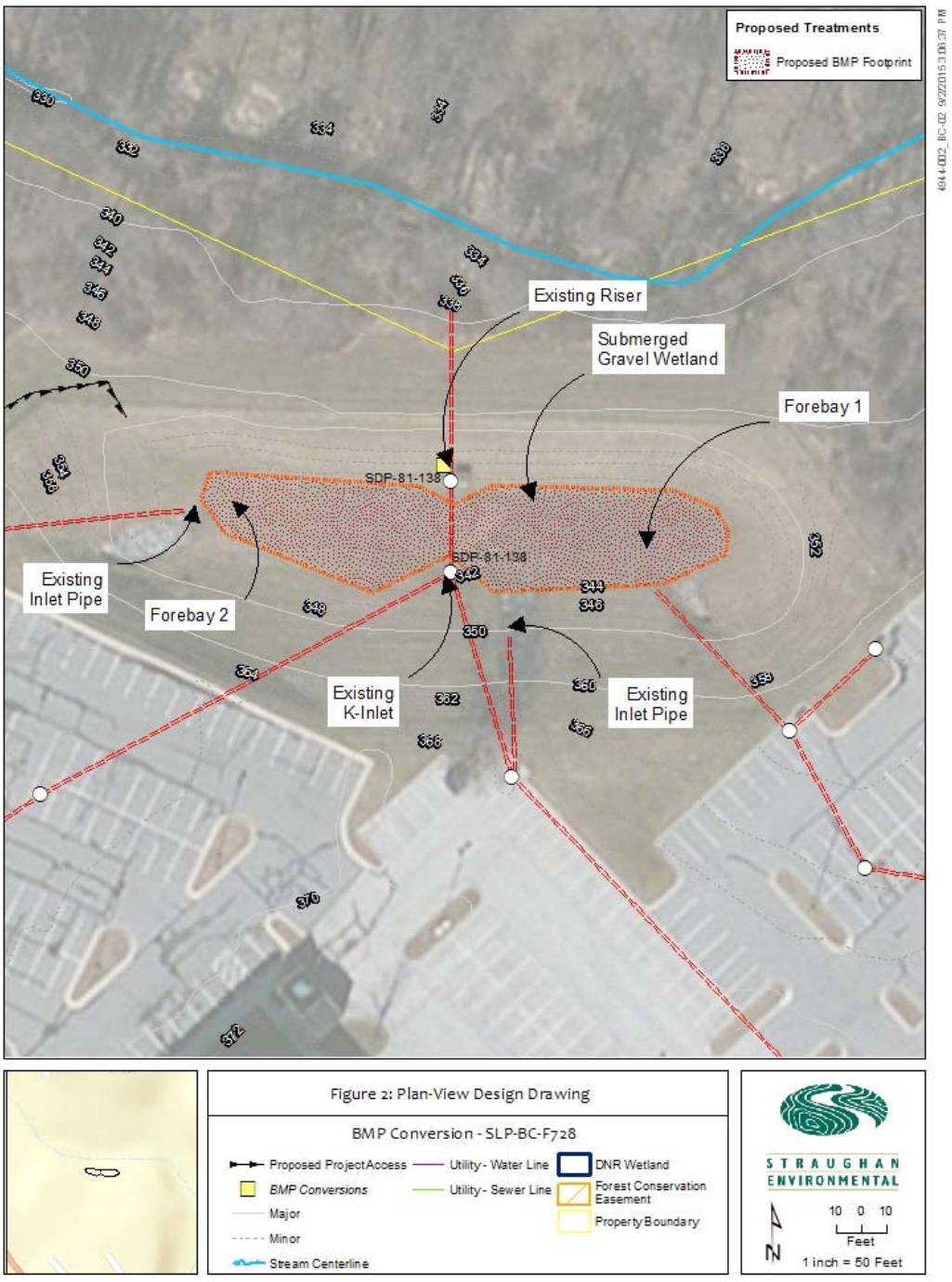
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F728

Site Name: Columbia Medical Campus

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F734
Site Name: 9265 Berger Road Business Complex

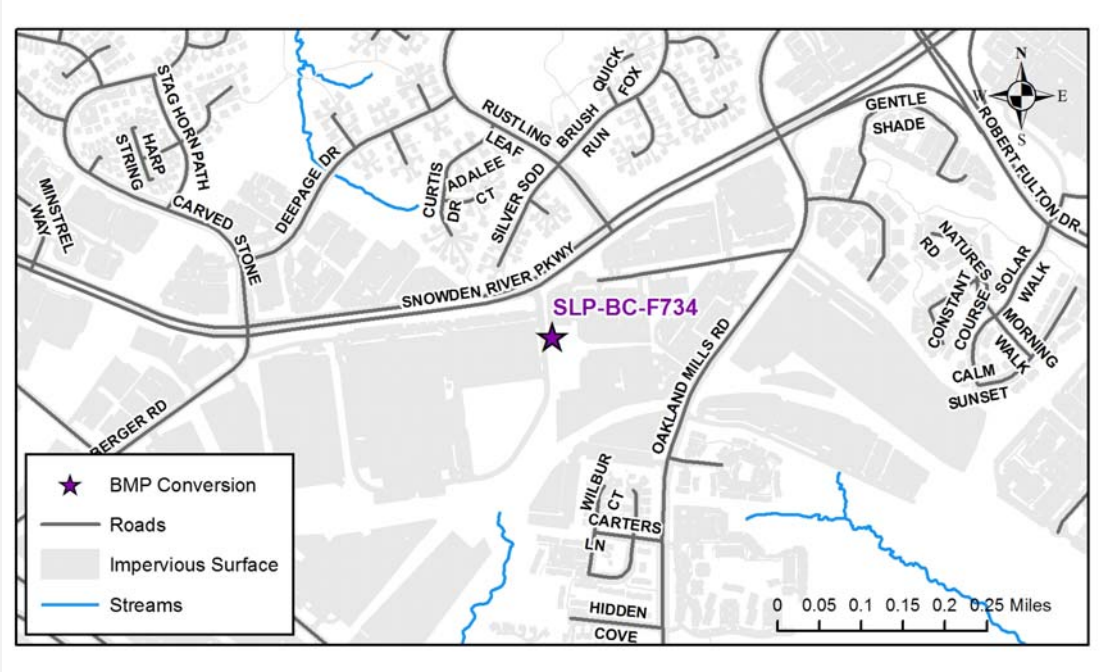
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Extended Detention Structure, Wet
Ownership: Private- Commercial/Industrial
Multiple Owners

BMP Structure ID: HO101392
Existing BMP Type: Dry Pond

Existing Conditions:

Discharges into roadway. A total of five buildings and much of the surrounding impervious parking area drain into this facility. Three of the five buildings are currently occupied by auto repair businesses, the forth building is currently vacant, and the fifth building is self-storage. The four buildings east of the self-storage facility are connected to a stormwater system that runs along the south and east side of the site property. The existing facility has three inflows (two in the northeast corner and one in the southeast corner) and a single 36 in. CMP riser outfall in the southwest corner. The outfall discharges into a double at-grade inlet in the northwest corner of the adjacent property. The existing riser and embankments are in good condition. The roof for the self-storage building is collected into a stormwater pipe along the north side of the facility before entering through one of the northeast inlets.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F734
Site Name: 9265 Berger Road Business Complex
Contractor: Versar
Watershed: Little Patuxent River

East side of BMP looking north.

Over principal spillway looking northeast.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F734
Site Name: 9265 Berger Road Business Complex
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The site may be declared a "hotspot" due to automotive repair shops at this location.

Concept Description:

Convert the existing dry extended detention facility into a wet extended detention pond with a liner and install two oil interceptors (one for each storm drain system). Construction of an access road into the facility is not possible without reducing pond storage capacity.

It is also recommended that a direct connection be made between the outfall and the double inlet in the adjacent property. Plans were not readily regarding the construction of the embankment available while developing this concept, and it may need to be upgraded.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	4.72
Impervious Area within Drainage (ac.):	3.77
Impervious Area Treated (ac.):	3.77
Impervious Area Treated Credit (ac.):	3.77

Water Quality Volume	
WQVolume Target (cft.):	13,173
Max Treated (cft.):	14,491
Percent Treated:	110%
Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$66,313.00

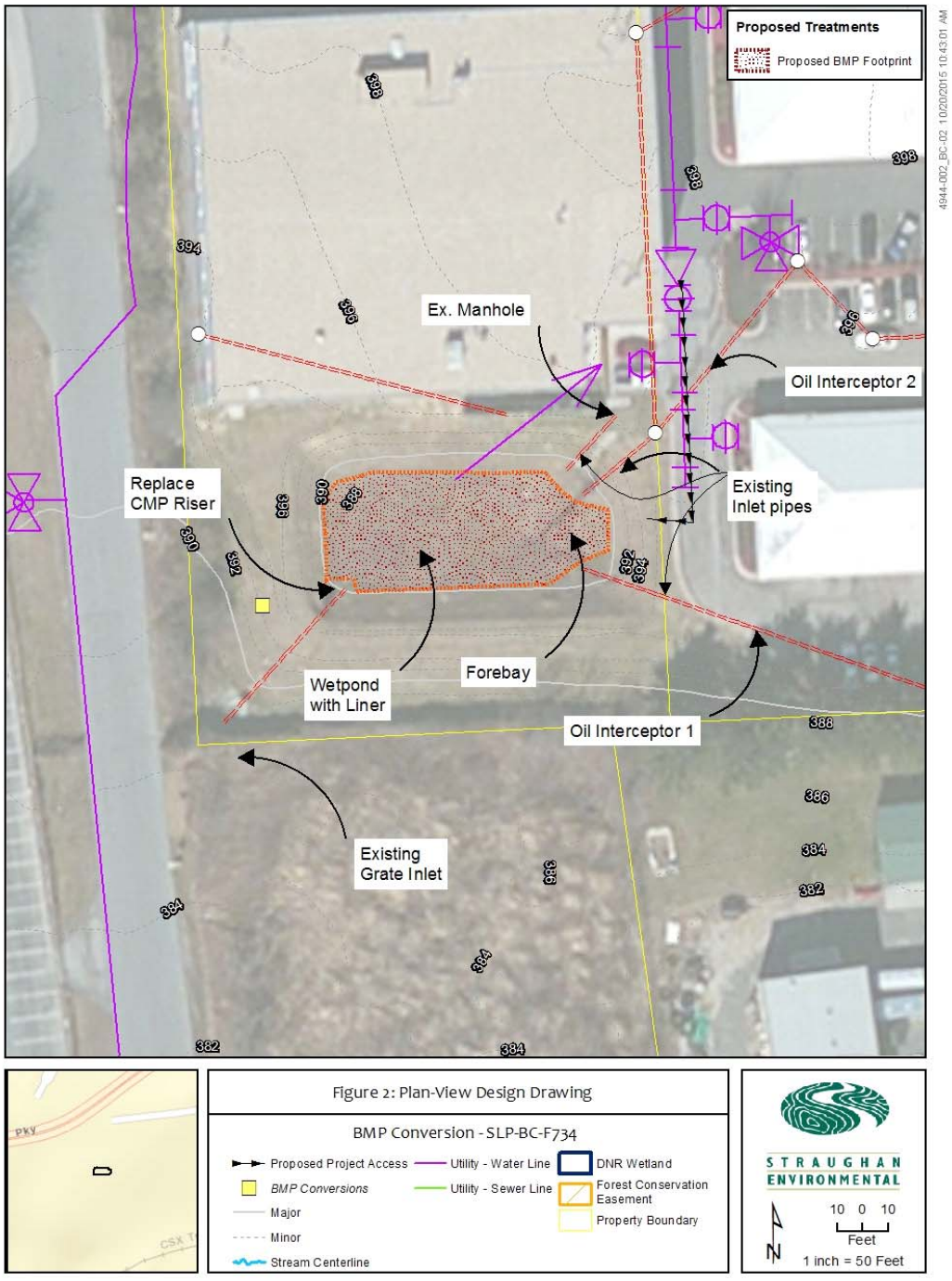
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F734

Site Name: 9265 Berger Road Business Complex

Contractor: Versar

Watershed: Little Patuxent River



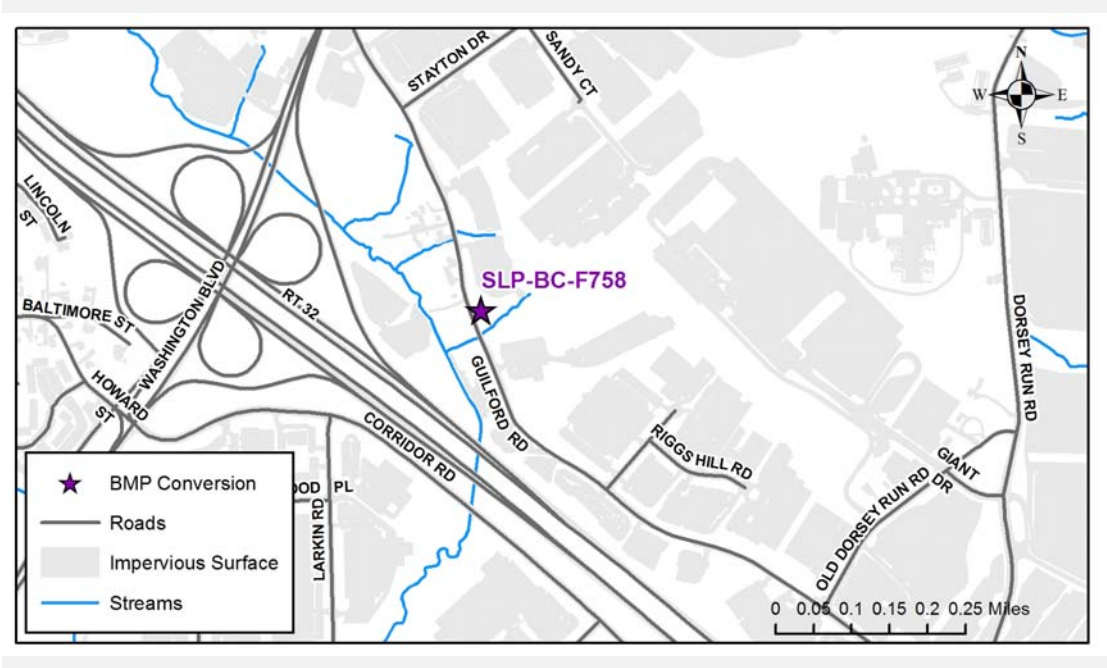
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F758
Site Name: Elliott & Franz Inc. Heavy Equipment Rentals
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Retention Pond (Wet Pond)
Ownership: Private- Commercial/Industrial
Single Owner
BMP Structure ID: HO102072
Existing BMP Type: Dry Pond

Existing Conditions:

The basin has a single inflow receiving sediment containing asphalt material from the adjacent industrial parking lot. The facility bottom is about one quarter covered with sediment from the inlet. The facility's embankments are mowed, free of woody vegetation and in good condition. The pond bottom is free of wetland vegetation, indicating the facility may infiltrate. The outlet structure is a composite of concrete and brick but is intact with no signs of breaks or cracks. The discharge from the facility spills directly onto the downstream roadway. The nearest downstream collection point is a double (at-grade) inlet about 200 ft. downstream



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F758
Site Name: Elliott & Franz Inc. Heavy Equipment Rentals
Contractor: Versar
Watershed: Little Patuxent River

The erosion of the inflow swale.

The facility bottom and outlet riser from the access.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F758
Site Name: Elliott & Franz Inc. Heavy Equipment Rentals
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Downstream of the facility are a road, overhead power lines, and a cemetery. Upstream is a private industrial parking lot which has a building containing two repair bays for large construction equipment. Water balance calculations will be needed to prove that facility soils can support a wet pond and that the downstream channel is Use I or II.

Concept Description:

A wet pond with liner is proposed if downstream channel is Use I or II or submerged gravel wetland (SGW) is proposed if the stream is Use III or IV. The inflow channel needs to be stabilized with riprap, and a new forebay constructed. The forebay is strongly recommended due to the large amount of sediment and bituminous materials from the upstream property. The forebay needs to be accessible for regular maintenance.

It is also recommended that a swale be constructed downstream of the outfall pipe that will convey discharge to the double (at-grade) inlets and minimize water ponding on the street.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	2.52	WQVolume Target (cft.):	5,097
Impervious Area within Drainage (ac.):	1.418	Max Treated (cft.):	5,606
Impervious Area Treated (ac.):	1.42	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	1.42	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$176,056.34

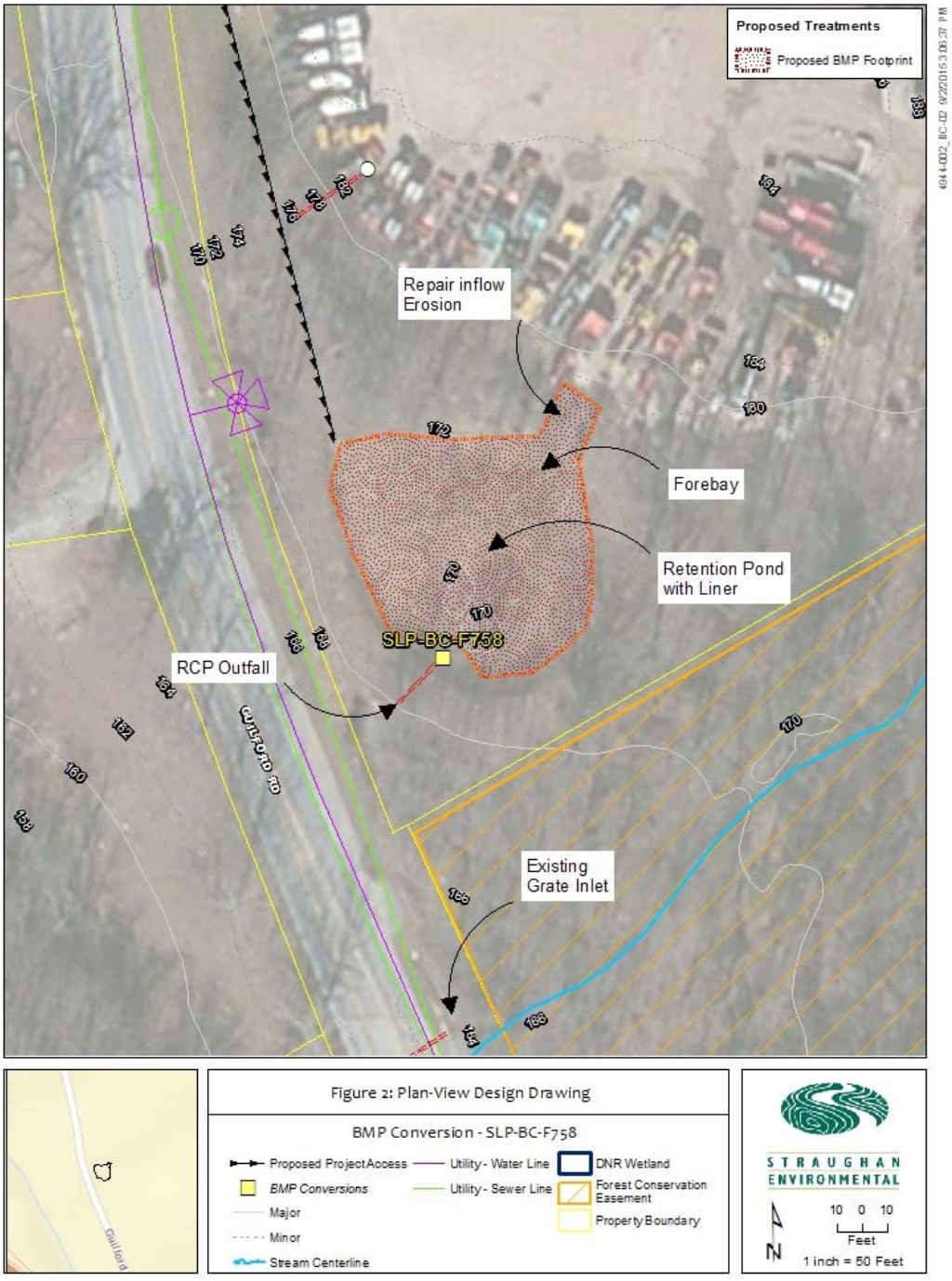
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F758

Site Name: Elliott & Franz Inc. Heavy Equipment Rentals

Contractor: Versar

Watershed: Little Patuxent River



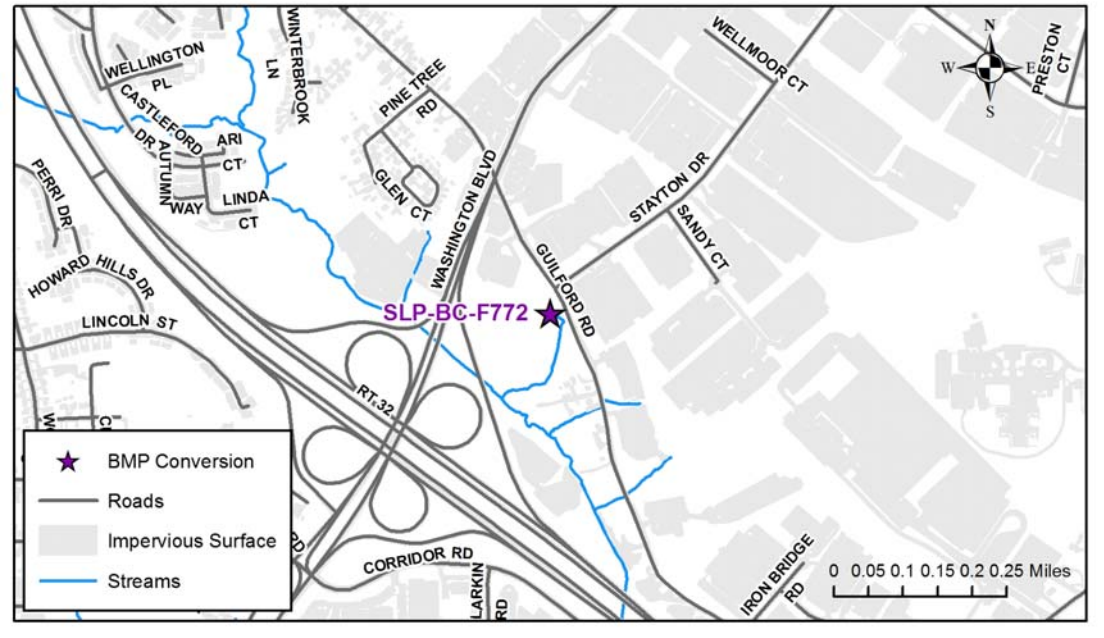
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F772
Site Name: Thrift Store Dry Pond
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Submerged Gravel Wetlands
Ownership: Private- Commercial/Industrial
Single Owner
BMP Structure ID: HO101856
Existing BMP Type: Extended Detention

Existing Conditions:

Existing facility lacks proper access. The existing inflow is a storm drain pipe with a concrete end section. The inflow is surrounded by a large amount of trash and tall reeds. At the time of site visit, no standing water was found at the inlet or in the tall reeds. The bottom of the pond is extremely dry with areas of cracking soil. Except for around the inflow the vegetation in the pond is low (30 in. or less). At the concrete riser structure (6 ft. by 7 ft.) a riprap depression was found, indicating the possibility of a low flow inlet pipe, but the pipe could not be found. The concrete riser is in good condition with no cracks, and the four trash racks are free of rust. The reinforced concrete outfall pipe appears to be in good condition. The outfall riprap channel is also in good condition. The facility has an earth embankment with non-woody vegetation on the inside and 1 in. to 4 in. diameter woody vegetation on the outside. No emergency spillway was found and the embankment inspection was limited due to thick vegetative cover.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F772
Site Name: Thrift Store Dry Pond
Contractor: Versar
Watershed: Little Patuxent River

Standing on manhole upstream of inlet looking over the facility (outlet riser left of photo area).

Inlet with trash and tall reeds.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F772
Site Name: Thrift Store Dry Pond
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Construction of access road will require cutting into the existing roadside 2:1 slope.

Concept Description:

A submerged gravel wetland (SGW) is proposed as the stream is Use IV. A forebay is recommended, as well as an access road to the inflow.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	5.527
Impervious Area within Drainage (ac.):	1.9
Impervious Area Treated (ac.):	1.9
Impervious Area Treated Credit (ac.):	1.9

Water Quality Volume	
WQVolume Target (cft.):	7,211
Max Treated (cft.):	7,932
Percent Treated:	110%
Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$131,578.95

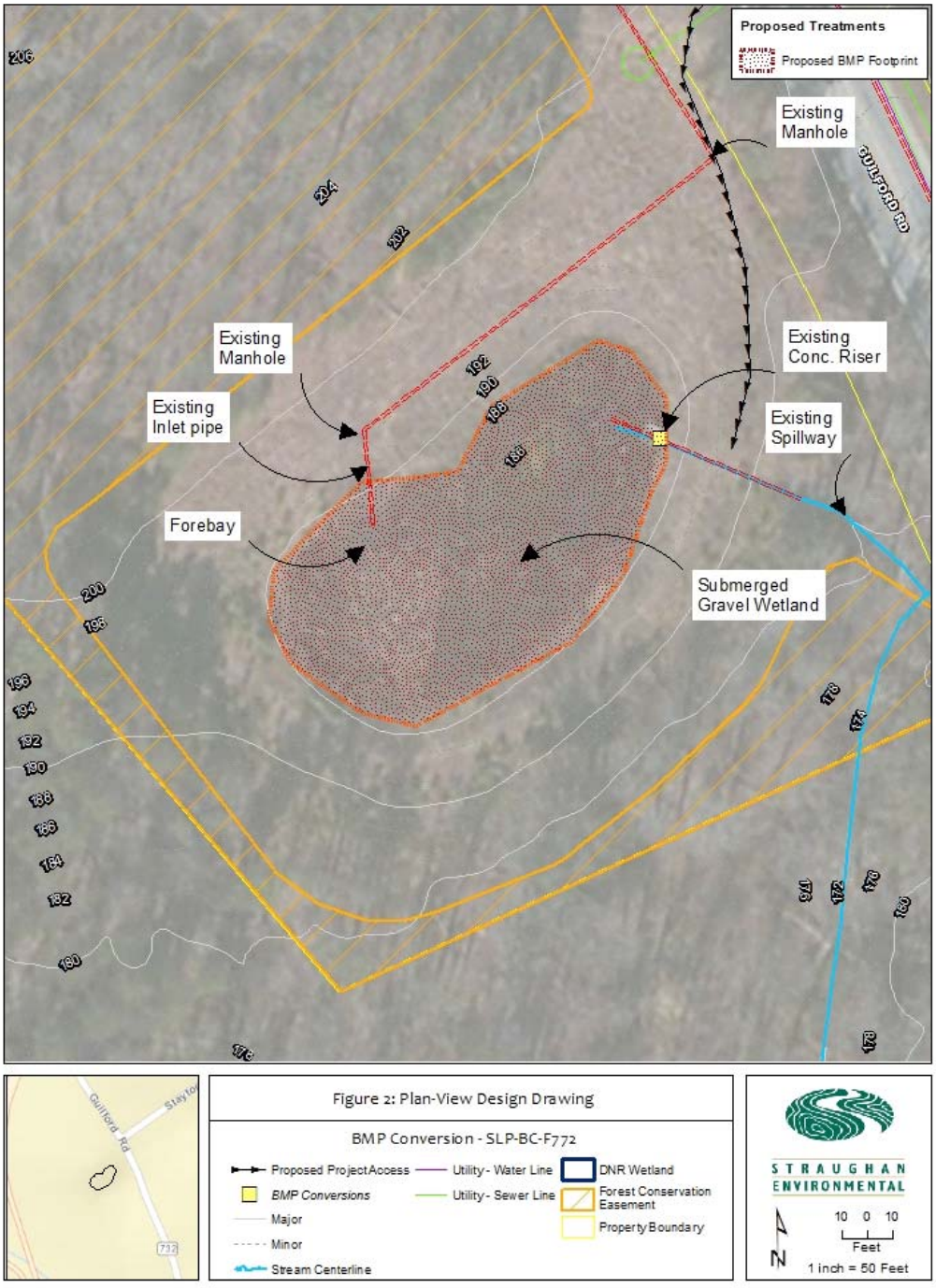
Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SLP-BC-F772

Site Name: Thrift Store Dry Pond

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SMP-BC-F314
Site Name: 9525 Chaton Road

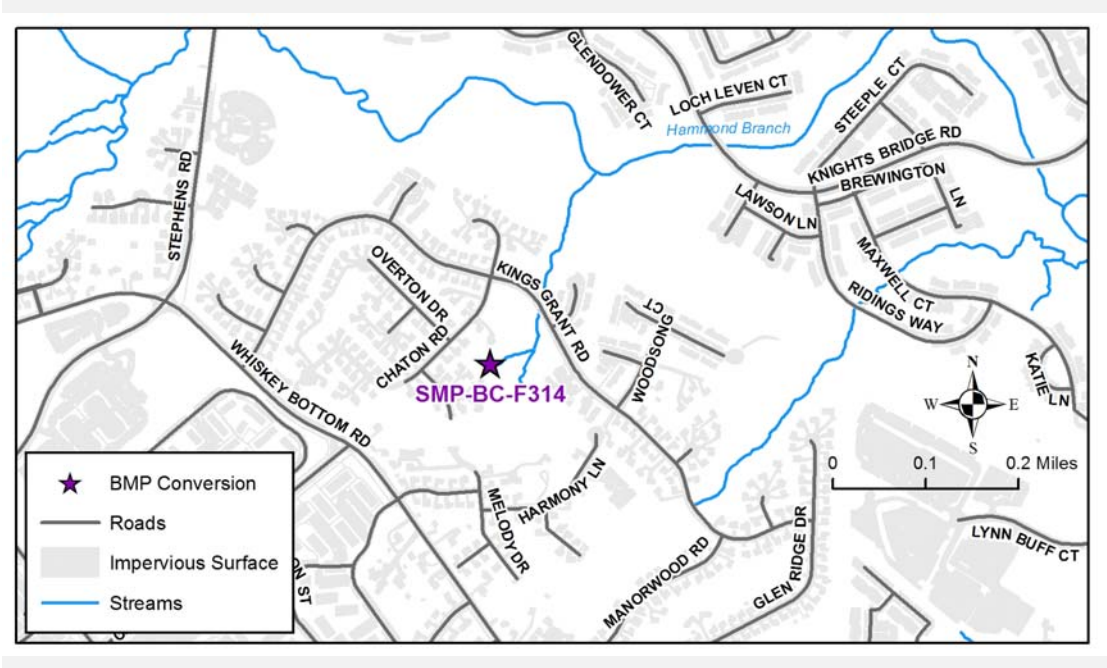
Contractor: Biohabitats
Watershed: Little Patuxent River

Proposed BMP Type: Sand Filter
Ownership: Private- Residential
Single Owner

BMP Structure ID: HO100434
Existing BMP Type: Extended Detention

Existing Conditions:

The current pond is a dry pond with one storm drain infall and manages a 8.35 ac. drainage area containing 43% impervious surfaces from a residential development. The infall discharges to a forebay in the pond and low flows discharge through a perforated pipe surrounded by stone. The pond was observed to have some aquatic vegetation, likely due to the low flow configuration. The outfall barrel is a 36 in. reinforced concrete pipe (RCP) and outfalls into a wooded area near a wetland area which is owned by Columbia Association. A 12 ft. maintenance access surrounds the pond. The pond is located on the Kings Woods HOA property.



Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SMP-BC-F314
Site Name: 9525 Chaton Road

Contractor: Biohabitats
Watershed: Little Patuxent River

Pond basin overview.

Riser overview.

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SMP-BC-F314
Site Name: 9525 Chaton Road

Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

The only place to discharge the emergency spillway on original ground would be toward lot 255; all other locations for the emergency spillway would be located on fill material. The groundwater level needs to be investigated for feasibility for a sand filter. Work would require permission from the HOA.

Concept Description:

The existing dry pond could be converted to a dry pond with sand filter by lowering the pond basin by 2 ft. and by lowering the outfall by 4 ft. The upstream embankment is currently at a 3:1 slope and would be excavated to a 2:1 to increase the storage capacity of the pond. A forebay would be constructed at the facility infall using the existing excavated material. The existing stormwater pond currently has 2 ft. of freeboard without an emergency spillway. The sand filter would require 3 ft. of depth to treat 1 in. of runoff. The remaining 1 ft. of depth could be met by raising the water level in the facility by reducing the freeboard from 2 ft. to 1 ft. and constructing an emergency spillway. An alternative plan would be to convert the pond to an extended detention pond with micropool or a pocket pond by removing the western 12 ft. maintenance access.

Nearby Opportunities:

Assess stream channel near the intersection of Kings Grant Rd and Earl Le

Proposed Project Credit	
Drainage Area (ac.):	8.35
Impervious Area within Drainage (ac.):	3.58
Impervious Area Treated (ac.):	3.58
Impervious Area Treated Credit (ac.):	3.58

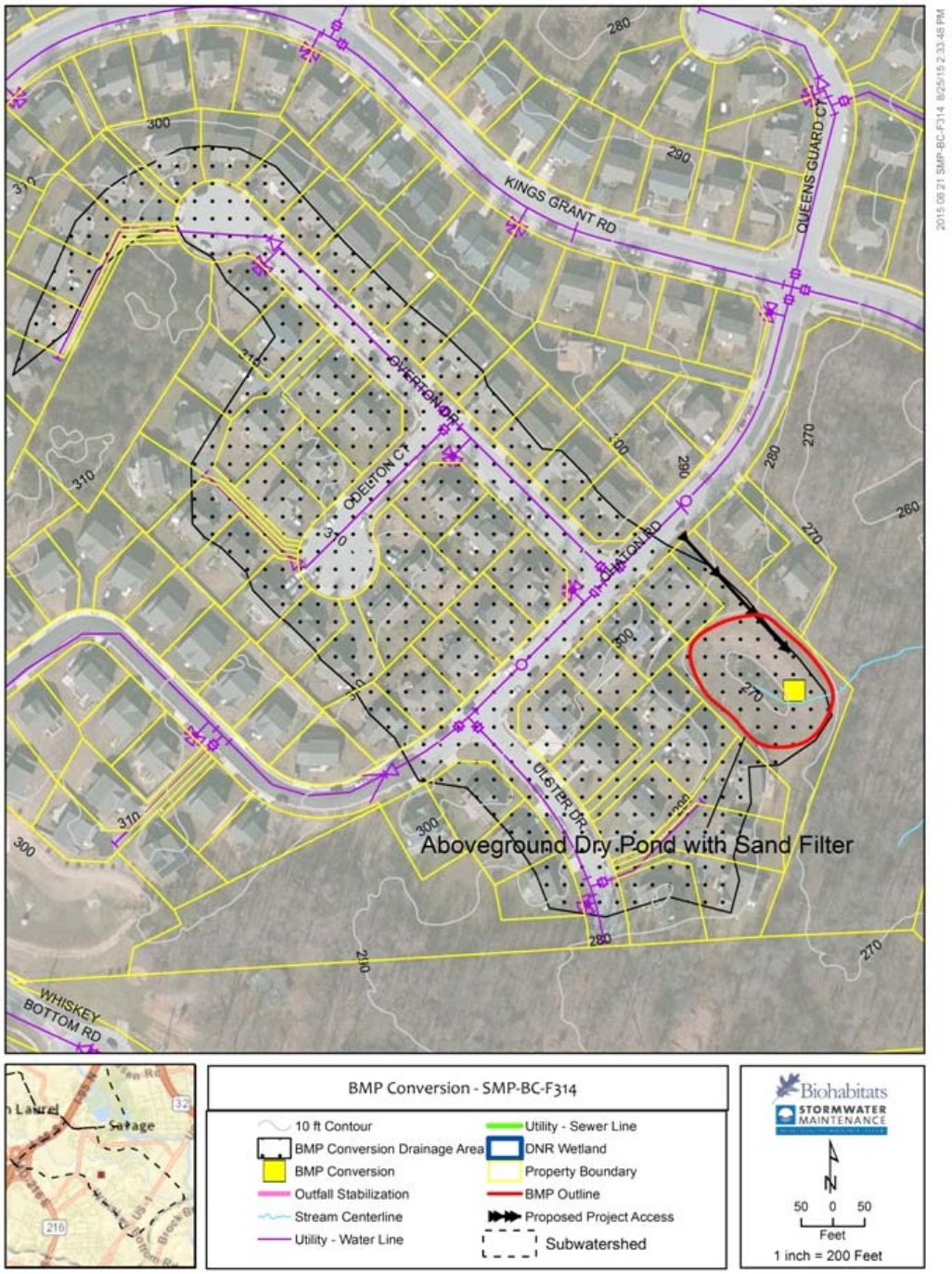
Water Quality Volume	
WQVolume Target (cft.):	13,211
Max Treated (cft.):	13,211
Percent Treated:	100%
Rainfall Depth Treated (in.):	1

Costs	
Estimated Design Cost:	$220,000.00
Estimated Construction Cost:	$355,330.00
30% Contingency:	$106,599.00
Estimated Total Cost	$681,929.00
Cost per Impervious Credit Acre:	$190,482.96

Howard County Watershed Assessment Concept Plan: BMP Conversion

Site ID: SMP-BC-F314
Site Name: 9525 Chaton Road

Contractor: Biohabitats
Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: New BMP

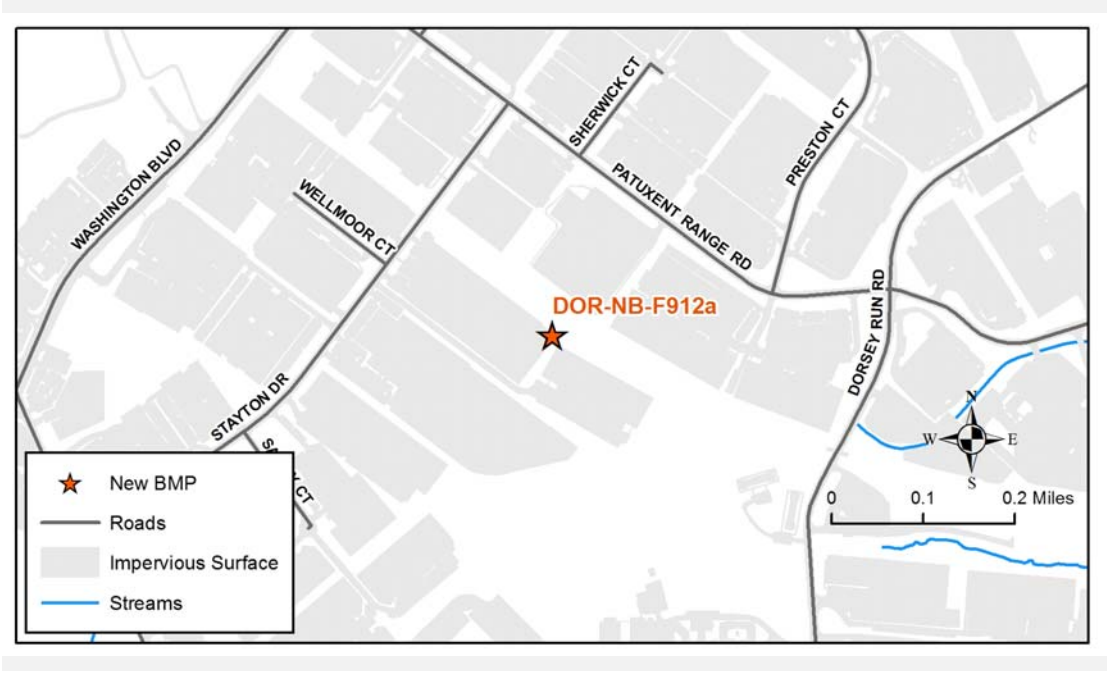
Site ID: DOR-NB-F912a
Site Name: Capitol Express

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed BMP Type: Underground Filter
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The site consists of a large warehouse building with loading docks and a parking lot. An existing 42 in. storm drain network along the southeast side of the parking lot carries stormwater runoff from the parking lot to an outfall and swale along the CSX Railroad tracks. The inlet in the northeastern corner of the property is approximately 12 ft. deep and no other utilities were visible during the initial assessment. The inlet is partially clogged and does not function as designed. Rooftop runoff discharges directly into the stream adjacent to the railroad via a series of PVC pipes.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: DOR-NB-F912a
Site Name: Capitol Express

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Looking east toward the existing clogged inlet to be used as the facility outfall.

Looking south toward the parking lot area to be used for the underground sand filter.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: DOR-NB-F912a
Site Name: Capitol Express

Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints for this project include the property ownership and land use. It is on private property and the site has frequent truck traffic. The project may require the temporary closure of some loading docks as the proposed facility is in the parking lot. The proposed outfall may also be a constraint since the rooftop runoff does not currently enter the storm drain network at the inlet on the northeast corner of the property. No utilities were observed during the initial site assessment.

Concept Description:

An underground sand filter (USF) is proposed to treat 2.00 ac. of rooftop runoff from the warehouse. The PVC roof drains within the 2.00 ac. drainage area would be connected and routed to a flow splitter which will divert the WQv to the USF on the eastern side of the lot near the existing storm drain inlet. The existing storm drain is to be utilized as the outfall for the flow splitter bypass and the facility overflow connection. A hydraulic analysis will be required on the flow splitter, bypass, and overflow storm drain network to ensure there is capacity for larger storms. The USF would have 1,733 cf. of pretreatment in a sedimentation chamber with a surface area of approximately 578 sf. The sand filter area is 960 sf. with 2 ft. of media. An additional 4 ft. of temporary ponding over the entire facility area (1,538 sf.) is also considered to treat 100% of the WQv.

The total size of the USF would be approximately 30 ft. wide and 55 ft. long (interior dimensions) to treat the entire WQv from the 2.00 ac. drainage area. This area includes the three chambers for sedimentation, treatment, and overflow as typical per the Maryland Department of Environment Design Manual (2000). The remaining 2.5 ac. of the warehouse roof could be diverted to a second underground treatment facility if desired for additional cost. To reduce the facility footprint and cost, a smaller sand filter can be installed to treat a smaller portion of the roof or a portion of the WQv. The outfall was also assessed during the watershed study and could be considered for stabilization along with this project as the concrete apron is cracked and failing. Access to the proposed site location would be through the parking lot.

Nearby Opportunities:

DOR-OF-F907

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	2	WQVolume Target (cft.):	6,897
Impervious Area within Drainage (ac.):	2	Max Treated (cft.):	6,897
Impervious Area Treated (ac.):	2	Percent Treated:	100%
Impervious Area Treated Credit (ac.):	2	Rainfall Depth Treated (in.):	1

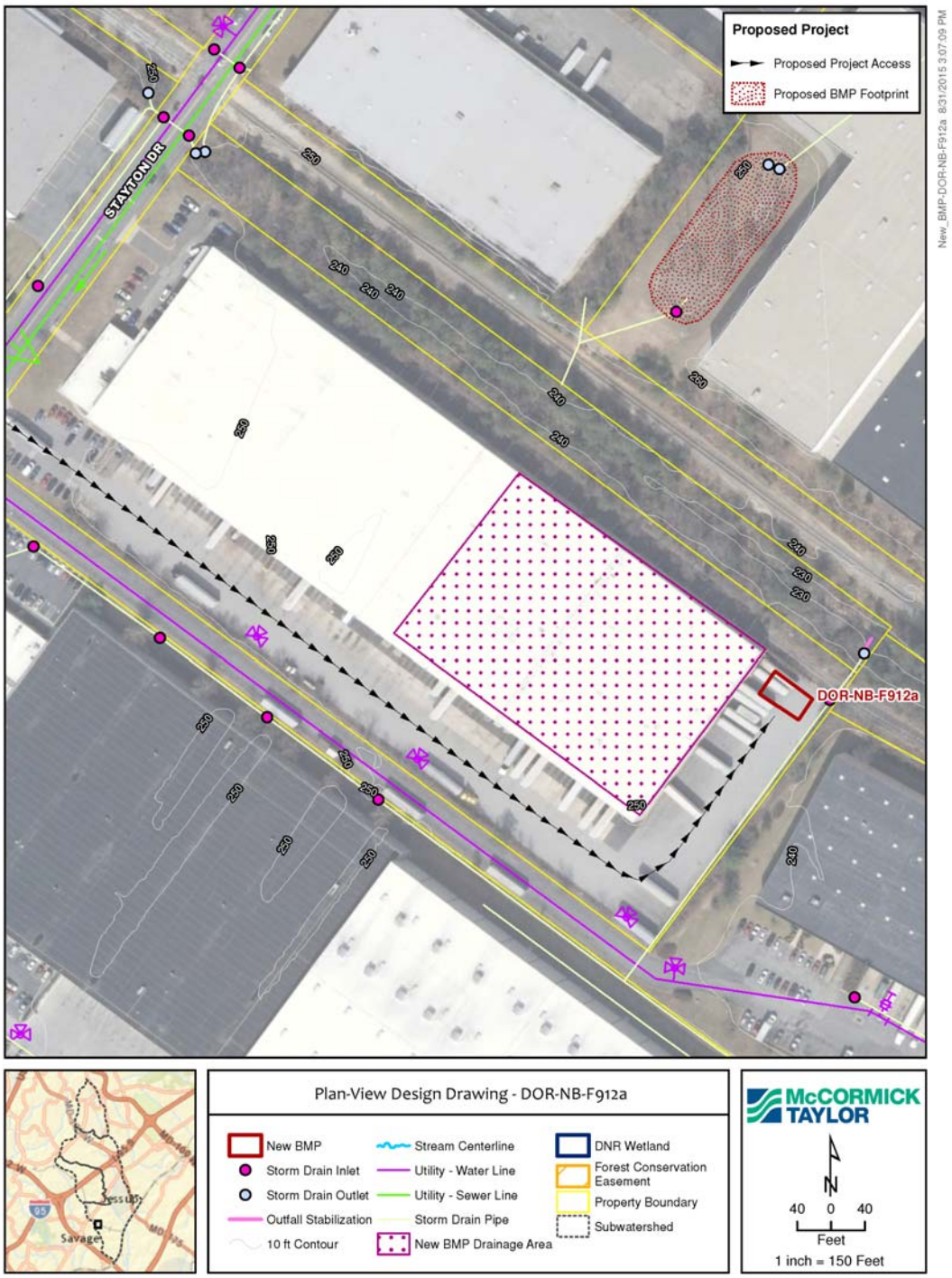
Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$142,601.56
30% Contingency:	$42,780.47
Estimated Total Cost	$305,382.03
Cost per Impervious Credit Acre:	$152,691.01

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: DOR-NB-F912a
Site Name: Capitol Express

Contractor: McCormick Taylor
Watershed: Little Patuxent River



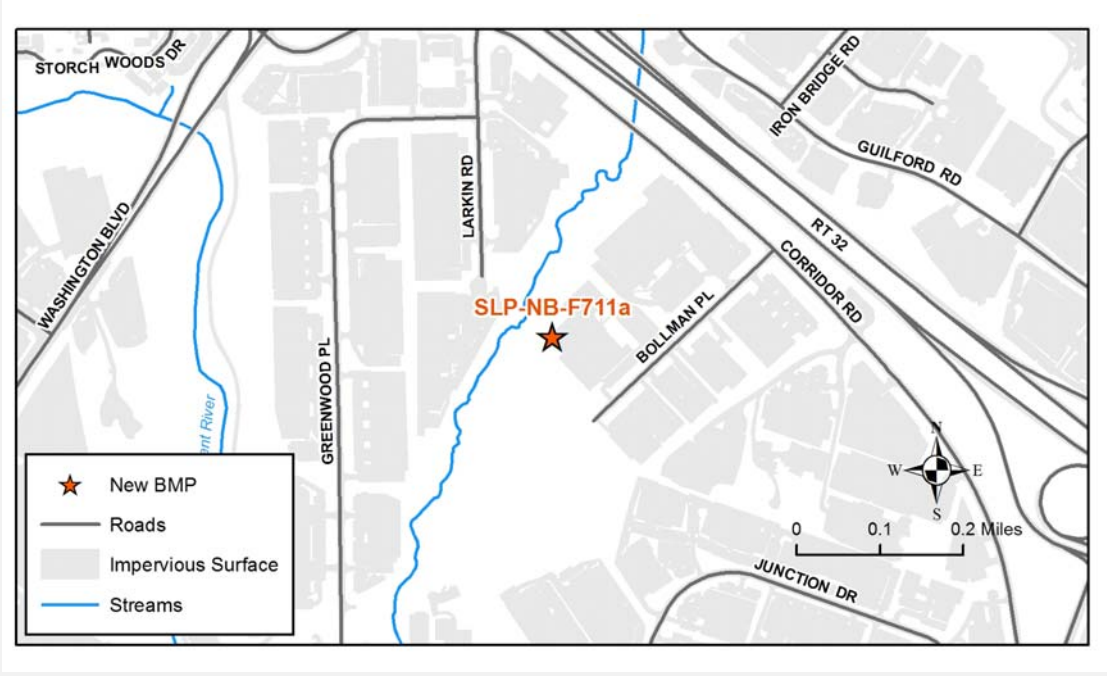
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711a
Site Name: Maine: Paper and Food Service, Inc. - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Retention Pond (Wet Pond)
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The site is dominated by parking for passenger cars (north and east sides) and semi-trucks (west side), and the warehouse. The runoff from the roof appears to collect to a pipe system within the warehouse and discharges into a ravine along the south side of the property. The only other possible roof discharge is into the stormwater pipe under the western parking lot. Runoff from the east parking lot discharges into the north lot. The north lot runoff discharges into the west parking lot through a stormwater pipe. The west lot runoff enters an at-grade inlet located in the center of the west lot south end. The final point of discharge for the site is into a brick junction box (Type K) located east of the railroad tracks and south of the perimeter fence. There are two inlet pipes at this junction box. The east pipe origin is unknown. It appears the outfall of this junction box is through a concrete pipe under the railroad track.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711a
Site Name: Maine: Paper and Food Service, Inc. - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Southwest corner of warehouse (possible site for new BMP facility).

Brick junction box downstream of site.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711a
Site Name: Maine: Paper and Food Service, Inc. - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Project will require coordination with CSX Railroad and the depth of the existing stormwater system will need to be determined.

Concept Description:

Construct a retention pond (aka wet pond) adjacent to the existing outbuilding between the parking lot to be treated and the CSX spur line. A new storm drain system and modification of the parking lot may be needed to direct runoff into the facility.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	1.61	WQVolume Target (cft.):	3,984
Impervious Area within Drainage (ac.):	1.13	Max Treated (cft.):	4,382
Impervious Area Treated (ac.):	1.13	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	1.13	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$221,238.94

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711a

Site Name: Maine: Paper and Food Service, Inc. - Truck Parking Lot

Contractor: Versar

Watershed: Little Patuxent River

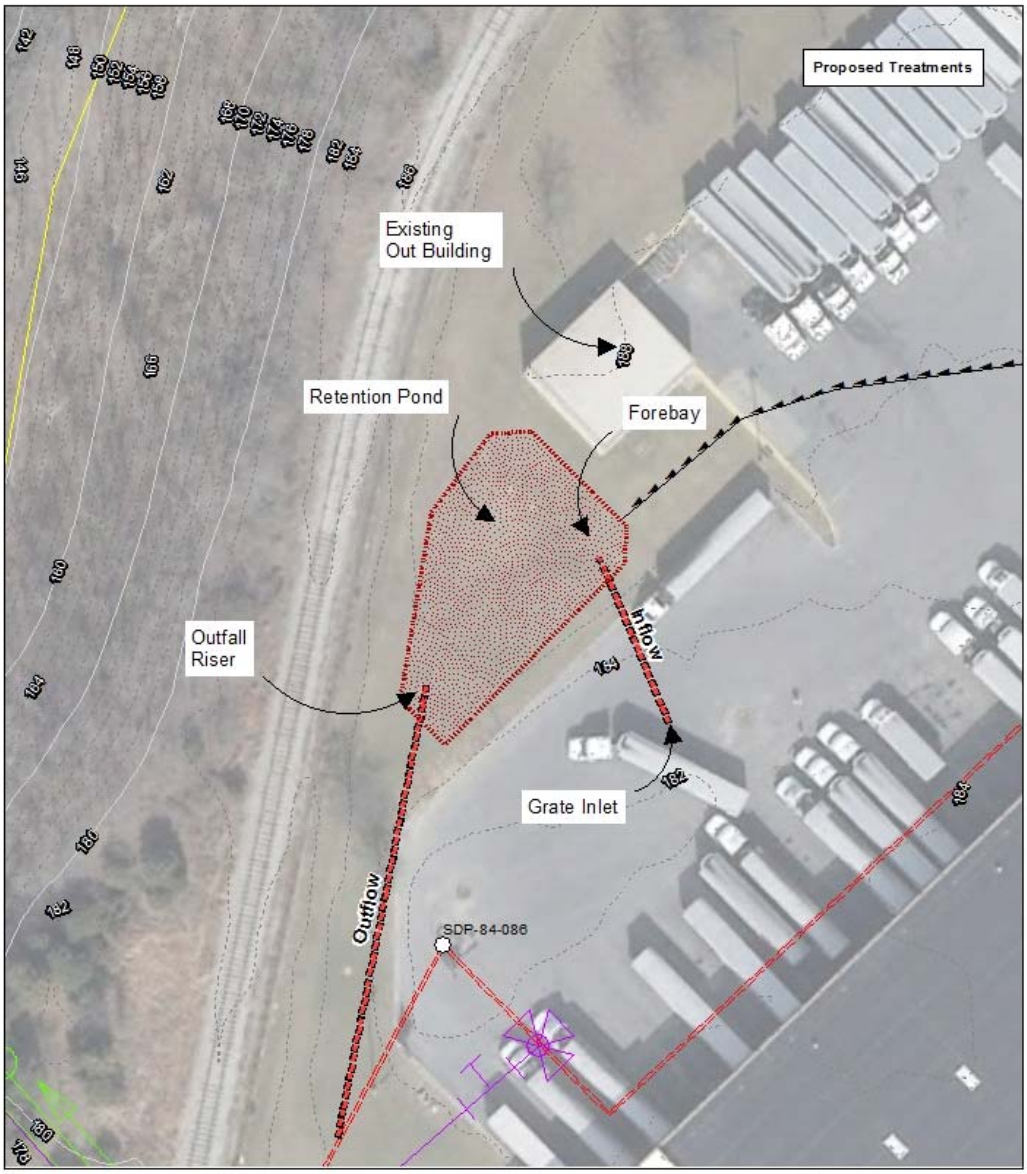


Figure 2: Plan-View Design Drawing

NEW BMP - SLP-NB-F711a

Proposed Project Access
Major
Major_Approx
Minor
Minor_Approx
Stream Centerline
Utility - Water Line
Utility - Sewer Line
Utility-Stormdrain
Utility_Prop. Stormdrain
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711b

Site Name: Maine: Paper and Food Service, Inc. - Employee Parking Lot

Contractor: Versar

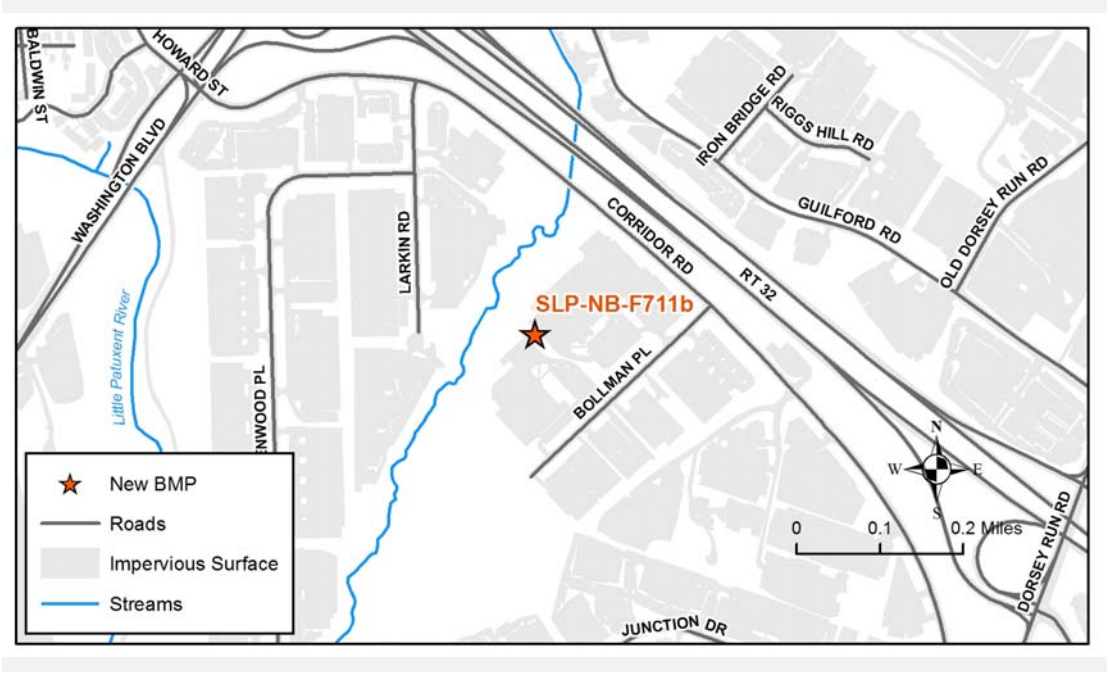
Watershed: Little Patuxent River

Proposed BMP Type: Bioretention

Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

This site is located between SLP-NB-F711a and SLP-NB-F712a. The site is mostly parking lot with a single storm drain system. Treatment in this area will be limited to the parking lot (no buildings).



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711b

Site Name: Maine: Paper and Food Service, Inc. - Employee Parking Lot

Contractor: Versar

Watershed: Little Patuxent River

Google Maps aerial image centered on proposed treatment option location.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711b
Site Name: Maine: Paper and Food Service, Inc. - Employee Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The depth of the existing storm drain system in this site area is unknown. This information will determine if a bioretention facility can be properly graded.

Concept Description:

Maintaining the existing storm drain system, a bioretention facility is proposed at the west end of the drainage area. Downstream of the westernmost curb/grate inlet a new manhole will be constructed and a pipe installed to convey the runoff into the east end of the new bioretention facility. At the west end of the bioretention facility runoff will pass through the underdrain and a K-Type inlet into the existing large diameter storm drain pipe along the north side of the bioretention facility.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	3.68	WQVolume Target (cft.):	6,483
Impervious Area within Drainage (ac.):	1.78	Max Treated (cft.):	7,131
Impervious Area Treated (ac.):	1.78	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	1.78	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120.000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost	$250,000.00
Cost per Impervious Credit Acre:	$140,449.44

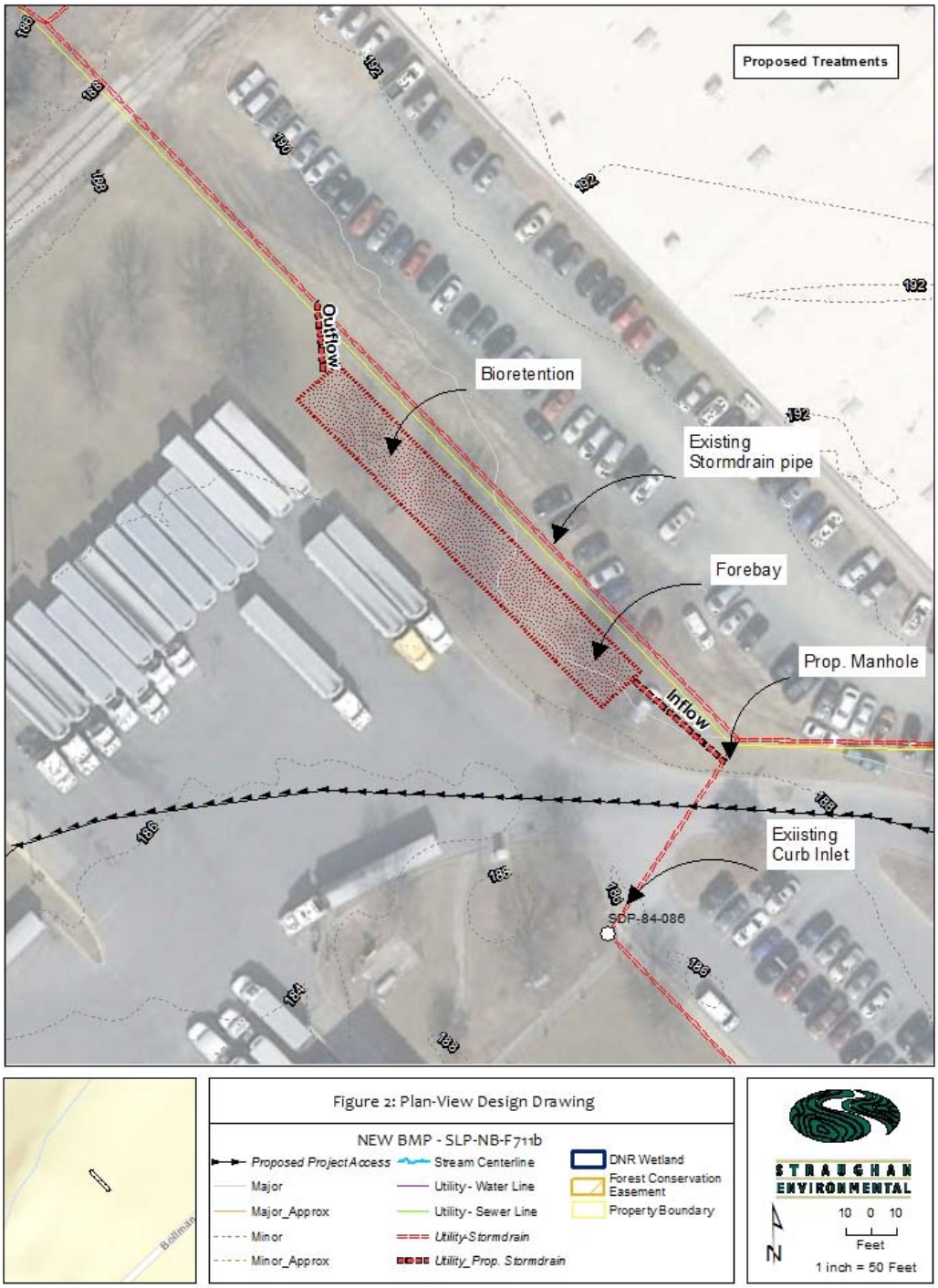
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F711b

Site Name: Maine: Paper and Food Service, Inc. - Employee Parking Lot

Contractor: Versar

Watershed: Little Patuxent River



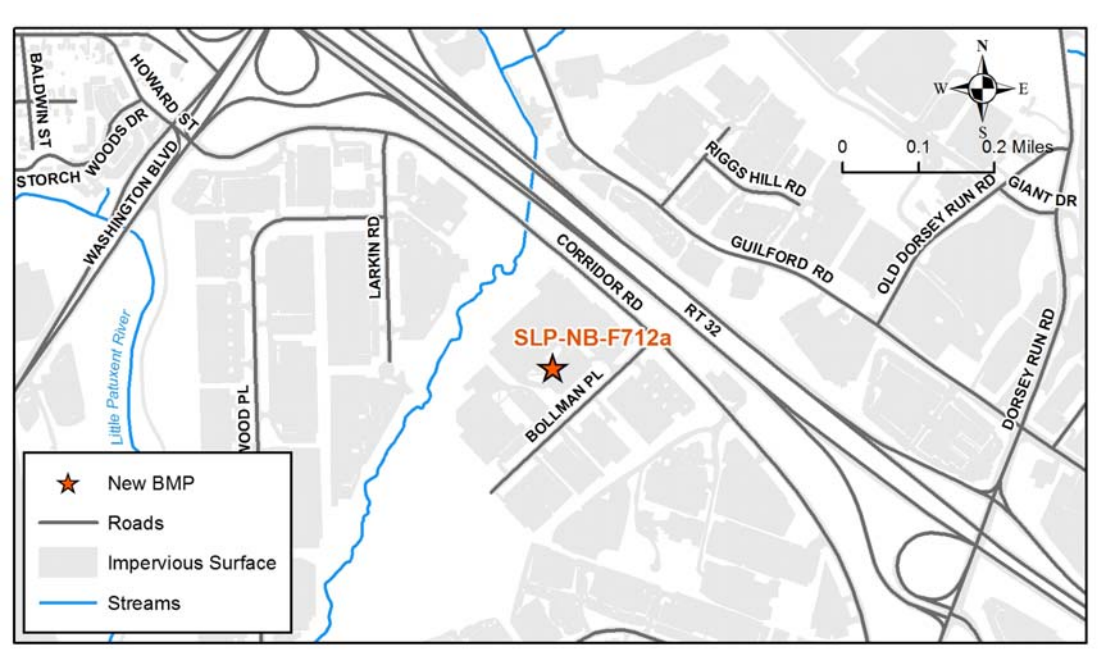
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712a
Site Name: Coastal Sunbelt Produce - Employee Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Retention Pond (Wet Pond)
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

Site is an industrial food processing facility with heavy truck traffic and a large amount of employee parking. The employee parking has been expanded along the south side of the warehouse with a gravel parking laid down over existing turf and curb. The existing stormwater system in the east parking lot has at-grade inlets with brick boxes. This system discharges south into a manhole where it then is conveyed west to the outlet point at the river.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712a
Site Name: Coastal Sunbelt Produce - Employee Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

The stormwater system grates (3) in the east parking lot.

Sidewalk along west side of east parking lot (in direction of stormwater discharge).

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712a
Site Name: Coastal Sunbelt Produce - Employee Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Water line along west side of east parking lot. Electric lines for parking lights. Possible electric lines for warehouse refrigerator unit. Temporary loss of some parking during construction. Will need to notify CSX Railroad for work within 100 ft. of tracks.

Concept Description:

Construct a retention pond (wet pond) in the southeast corner of the property. This will require redirecting the stormwater in the west corner of the parking lot through a new pipe into the wet pond. A baffle will be needed to prevent short-circuit of flow to the wet pond outfall. The wet pond outfall will be near the inflow pipe, and connect the existing storm drain system to the southwest. This location will allow treatment of all impervious area within the east parking area with minimal impact to utilities.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	8.96	WQVolume Target (cft.):	22,110
Impervious Area within Drainage (ac.):	6.27	Max Treated (cft.):	24,321
Impervious Area Treated (ac.):	6.27	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	6.27	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$152,314.00
30% Contingency:	$45,694.20
Estimated Total Cost	$318,008.20
Cost per Impervious Credit Acre:	$50,719.01

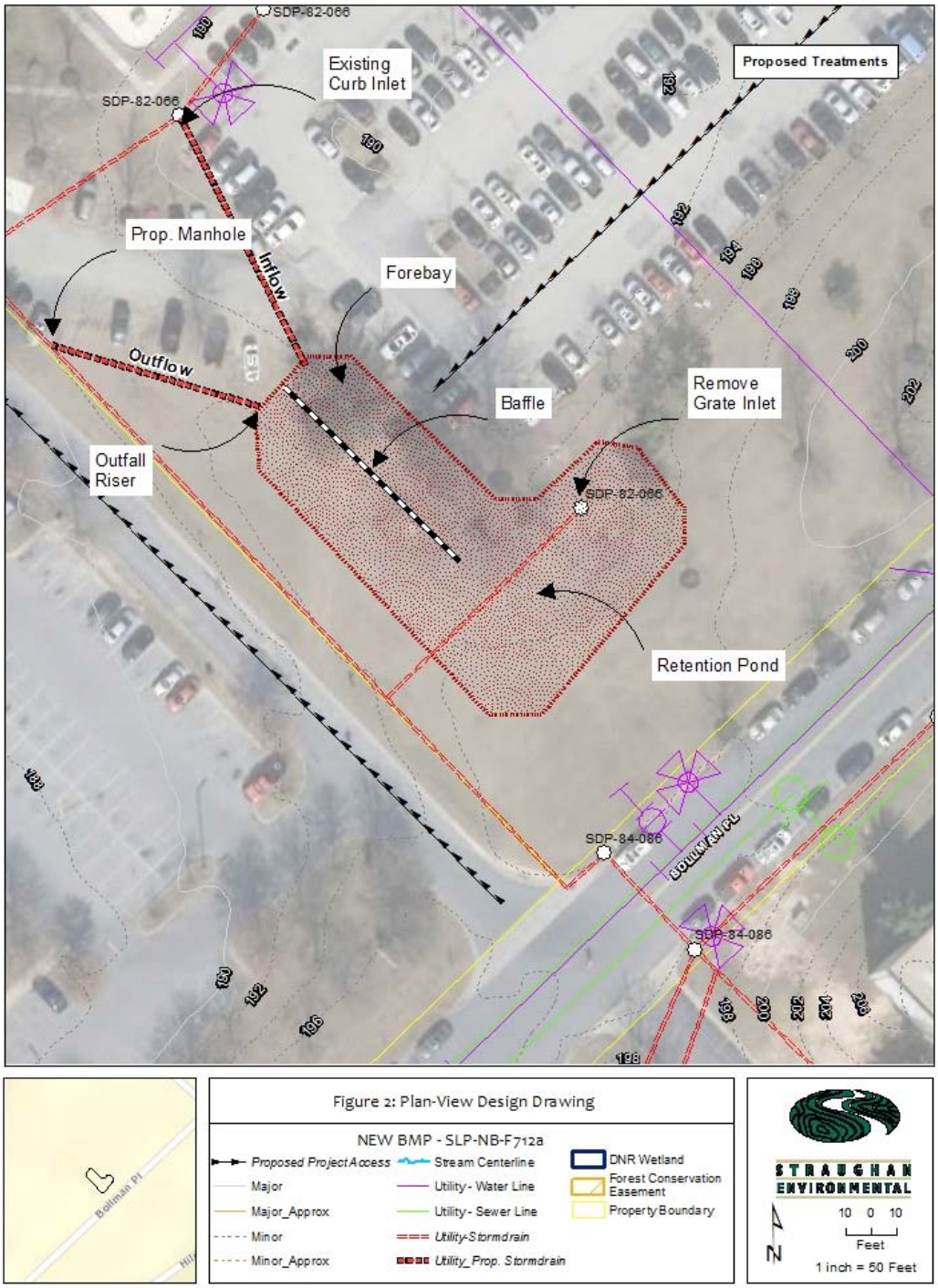
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712a

Site Name: Coastal Sunbelt Produce - Employee Parking Lot

Contractor: Versar

Watershed: Little Patuxent River



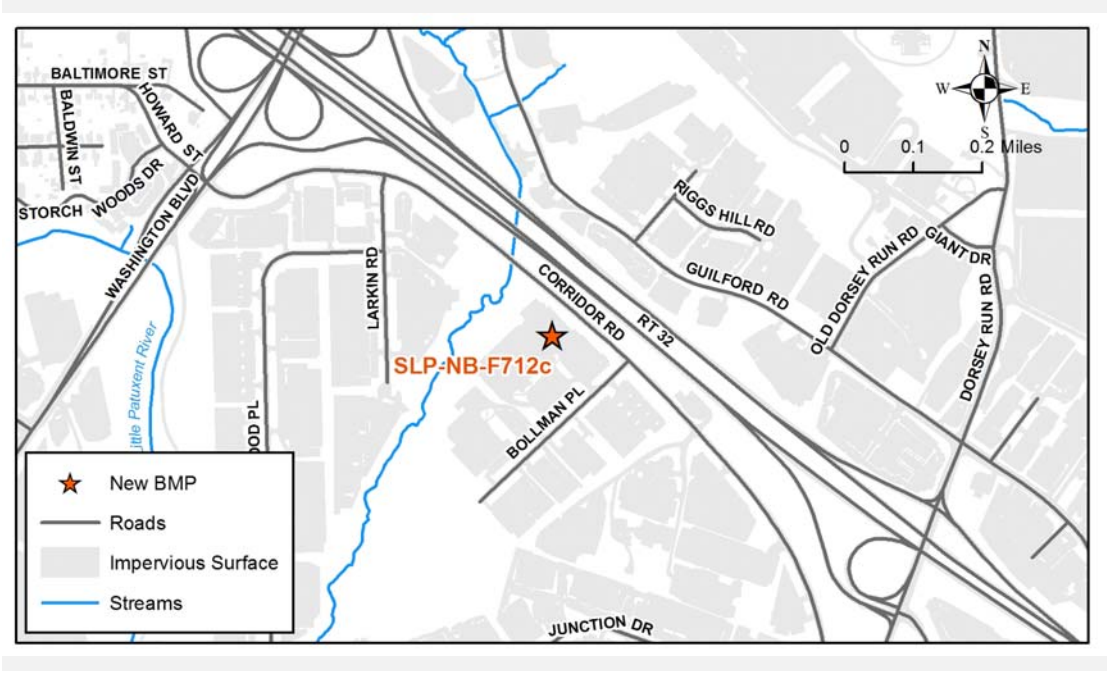
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712c
Site Name: Coastal Sunbelt Produce - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Bioretention
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The north parking lot (trucks only) has a stormwater system which conveys runoff west into a manhole before discharging south between a railroad spur and steep river bank. The outfall pipe connects to the same outfall point at the river for the East parking lot (SLP-NB-F712a). The outfall pipe has a large concrete box about 50 ft. upstream of a river. This outfall pipe is about 6 ft. in diameter. In the north parking lot is a third stormwater system that collects runoff from the loading dock area into an interceptor. It is believed the interceptor outlets to the stormwater system in the north parking lot.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712c
Site Name: Coastal Sunbelt Produce - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Standing on west end of north lot looking east. First of two at-grade inlets in foreground.

Independent stormwater system for docking bays evident by concrete sloping back to slotted drain along docking bays.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712c
Site Name: Coastal Sunbelt Produce - Truck Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Depth of existing storm drain pipe is unknown and may affect ability to design of a bioretention facility. Heavy truck traffic and truck storage area. A sewer manhole found west side of north lot with unknown pipe directions (may connect to warehouse). Loss of a few parking spaces during construction may occur. Will need to notify CSX Railroad for work within 100 ft. of tracks.

Concept Description:

The recommended location for the bioretention facility is the pervious area west of the railroad spur. The advantage here is no disturbance to parking and system will not need to accommodate H-20 Loads. The disadvantage is proximity to railroad spur, and 20 ft. tall bank.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	3.17	WQVolume Target (cft.):	9,886
Impervious Area within Drainage (ac.):	2.85	Max Treated (cft.):	10,875
Impervious Area Treated (ac.):	2.85	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	2.85	Rainfall Depth Treated (in.):	1.1

Costs	
Estimated Design Cost:	$120.000.00
Estimated Construction Cost:	$173,515.00
30% Contingency:	$52,054.50
Estimated Total Cost	$345,569.50
Cost per Impervious Credit Acre:	$121,252.46

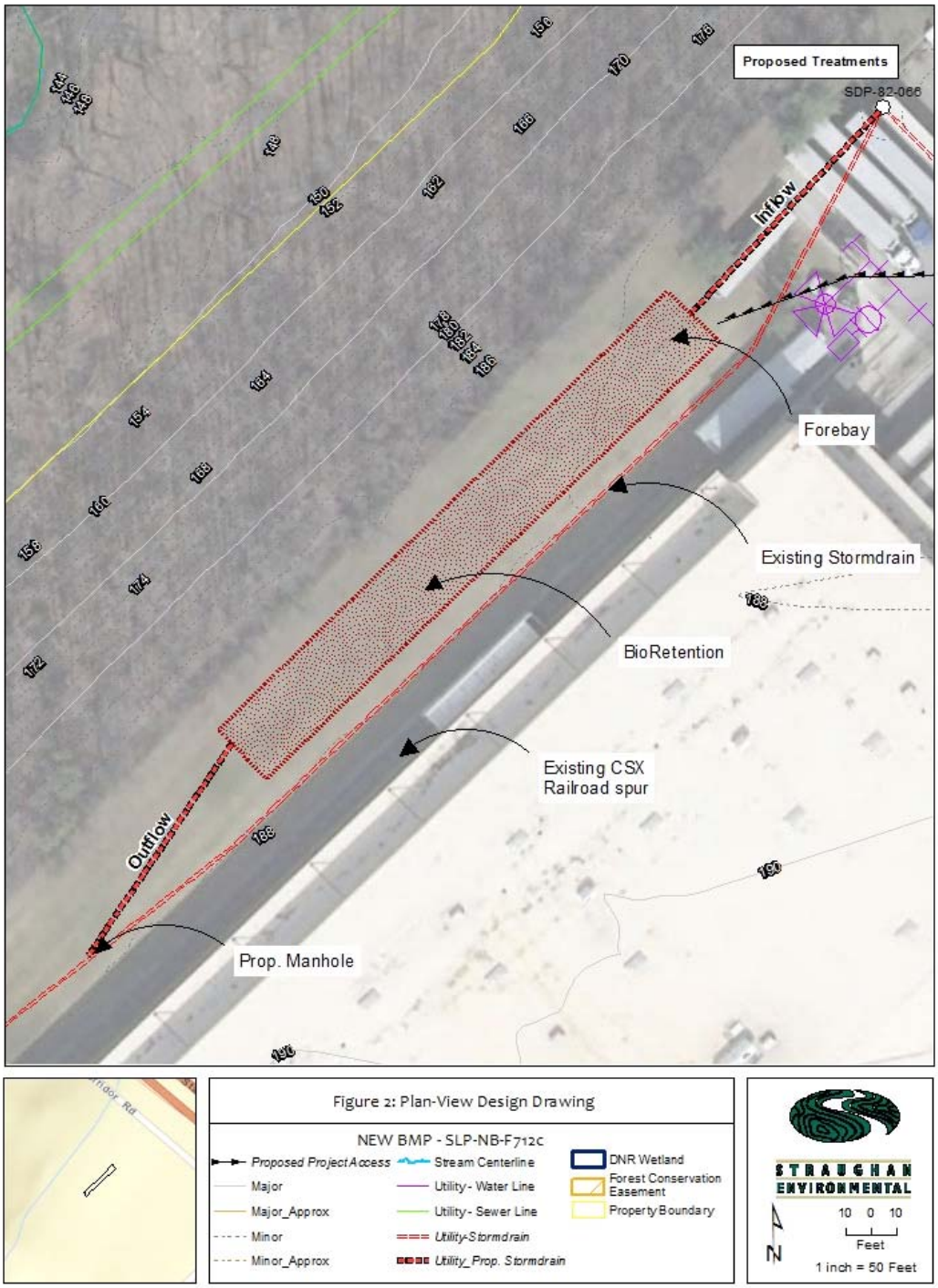
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F712c

Site Name: Coastal Sunbelt Produce - Truck Parking Lot

Contractor: Versar

Watershed: Little Patuxent River



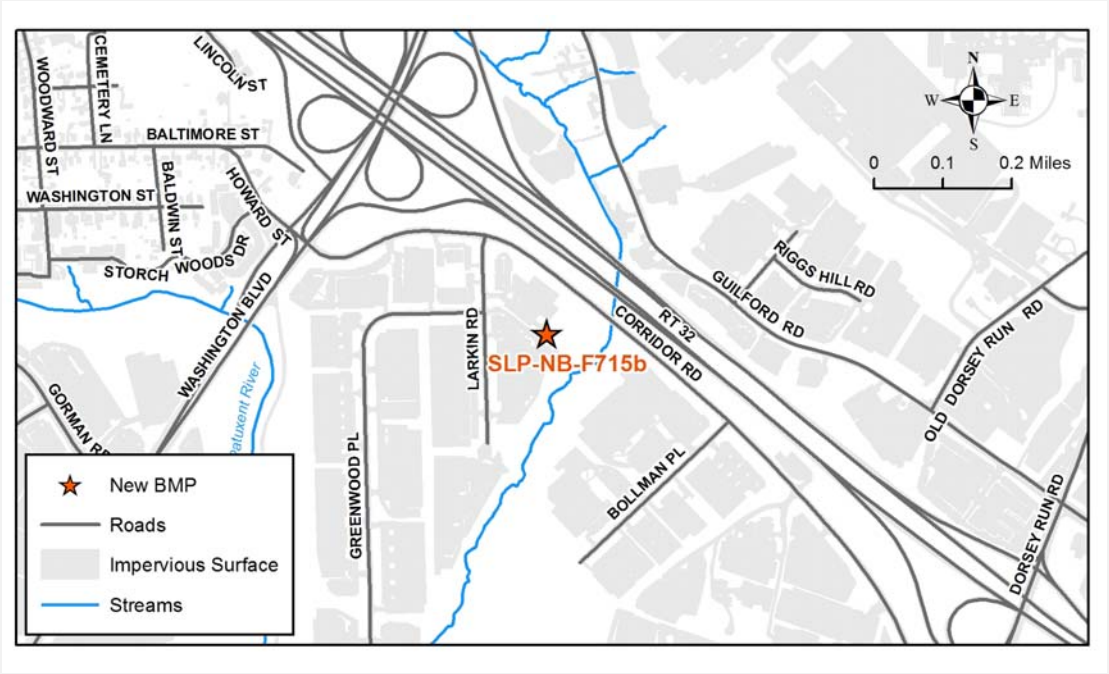
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F715b
Site Name: JFC International, Inc.
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Retention Pond (Wet Pond)
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

Stormwater on site all drains to the southeast corner of the property, where it is conveyed across a wooded area to a tributary of Little Patuxent River. There is a parking lot located on the east side of the building. There is also a steep (2:1) bank along the south side of the property. No downspouts on the building could be found, indicating that the rooftop runoff drains into the stormwater system.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F715b
Site Name: JFC International, Inc.

Contractor: Versar
Watershed: Little Patuxent River

Grate inlet looking into area for proposed extended detention wet pond.

Area behind grate in above photo.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F715b
Site Name: JFC International, Inc.
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The proposed stormwater management facility must keep a safe distance (20 to 30 ft.) from the bank along the south side of the property.

Concept Description:

Build a wet pond in the wooded area (mostly pear trees) located east of the manhole (not found) downstream of the curb/grate inlet. Use the existing storm drain pipe for both inflow to and outflow from the new facility.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	4.55	WQVolume Target (cft.):	11,280
Impervious Area within Drainage (ac.):	3.2	Max Treated (cft.):	12,408
Impervious Area Treated (ac.):	3.2	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	3.2	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$104,063.00
30% Contingency:	$31,218.90
Estimated Total Cost	$255,281.90
Cost per Impervious Credit Acre:	$79,775.59

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F715b

Site Name: JFC International, Inc.

Contractor: Versar

Watershed: Little Patuxent River

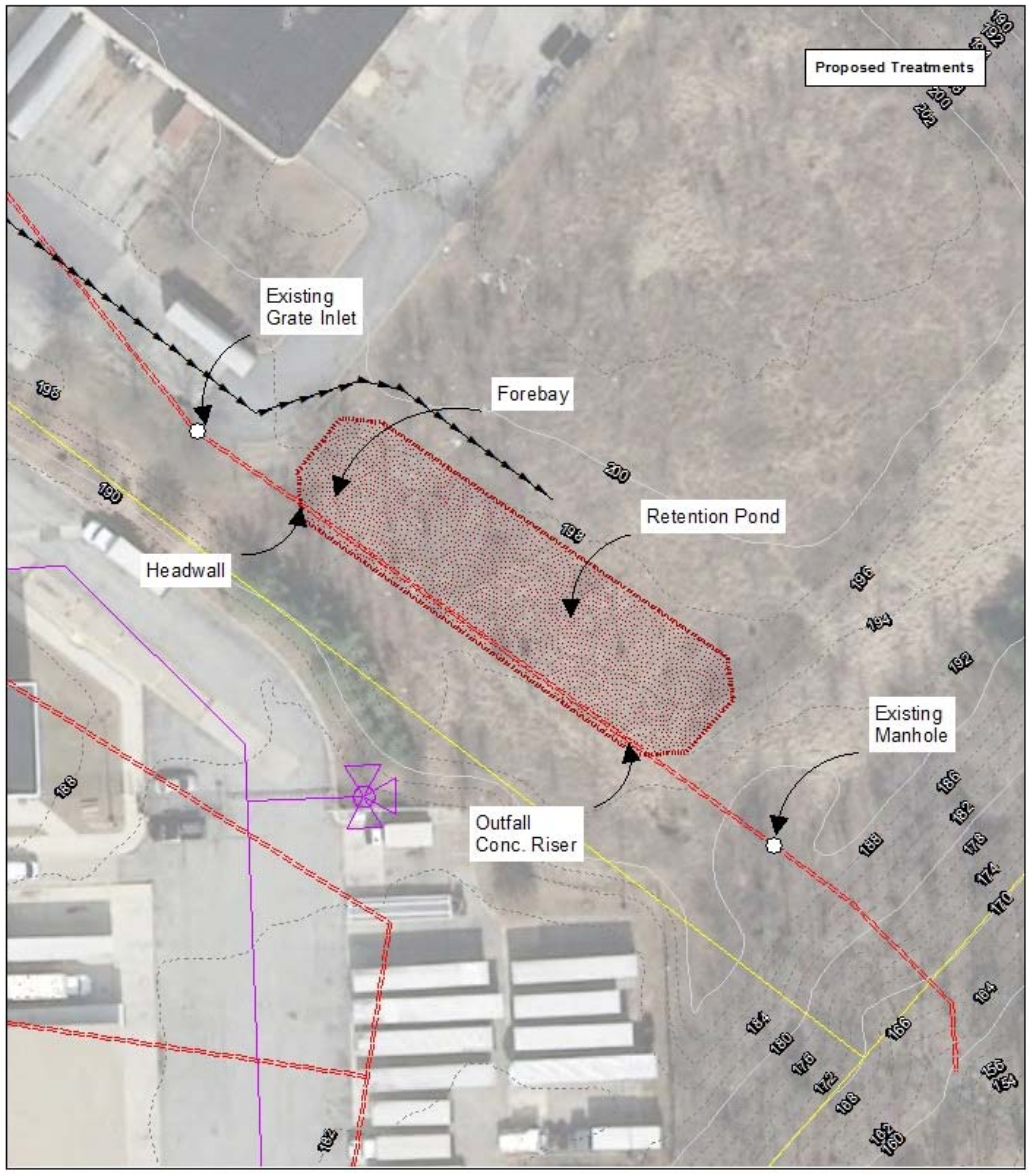


Figure 2: Plan-View Design Drawing

NEW BMP - SLP-NB-F715b

- Proposed Project Access
- Major
- Major_Approx
- Minor
- Minor_Approx
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility-Stormdrain
- Utility_Prop. Stormdrain
- DNR Wetland
- Forest Conservation Easement
- Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10

Feet

1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: **SLP-NB-F722d**

Site Name: **Weis Market**

Contractor: Versar

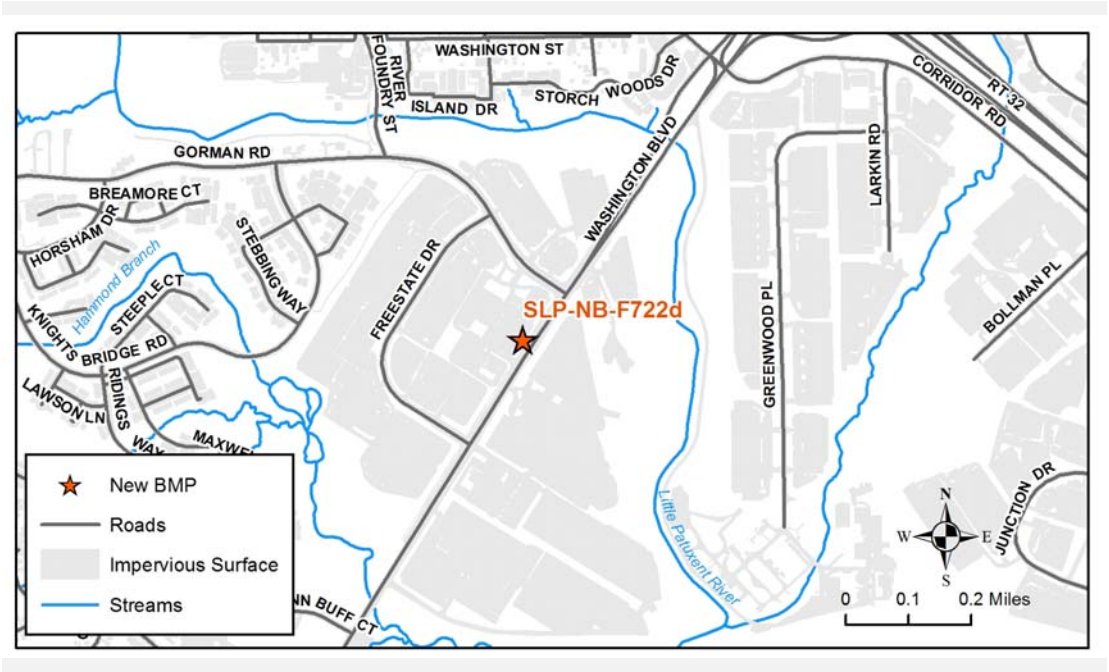
Watershed: Little Patuxent River

Proposed BMP Type: Perimeter (Sand) Filter

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

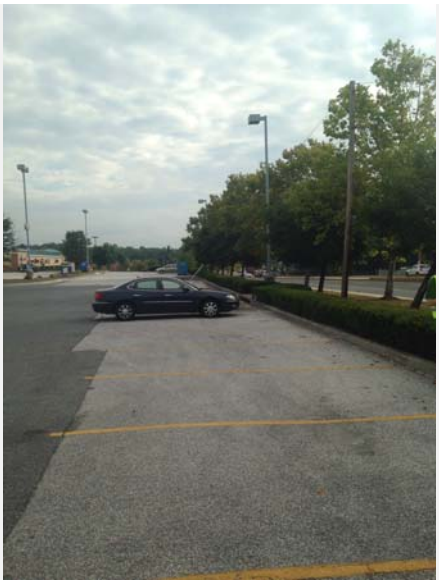
There is a single flow path in the south portion of the parking lot which conveys runoff towards an existing gas station before entering a curb/grate opening in the southeast corner of the parking lot. Along Route 1, adjacent to the parking lot, is a fiber optic line and overhead utilities. The parking lot serving the multi-unit commercial building north of the main parking lot drains to the north. It appears the roof of Weis Market drains into a storm drain system at the back of the building.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F722d
Site Name: Weis Market

Contractor: Versar
Watershed: Little Patuxent River



Proposed treatment option area for perimeter sand filter.

Existing principal inlet structure.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F722d
Site Name: Weis Market
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

An existing gas station in the southeast corner of the parking lot. Maintaining the existing storm drain system under the proposed perimeter sand filter. A utility pole/guy wire will need to be relocated or removed.

Concept Description:

Construct a perimeter sand filter (underground) along the southeast side of the parking lot. The standard underground perimeter sand filter will need to be modified so that the sand filter is in front of (under parking spaces) and the grates will be against the concrete curb. It will also need to avoid conflict with the existing storm drain system. Perthe Maryland Department of Environment Stormwater Manual (2000) Section 4.1, Table 4.1 filtration systems such as underground sand filters are acceptable in hotspots, such as gas stations, so long as there is no exfiltration. Since the underground sand filter is contained no discharge will result in percolation or absorption into the surrounding soil.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	2.56	WQVolume Target (cft.):	7,946
Impervious Area within Drainage (ac.):	2.29	Max Treated (cft.):	8,741
Impervious Area Treated (ac.):	2.29	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	2.29	Rainfall Depth Treated (in.):	1.1

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$145,955.00
30% Contingency:	$43,786.50
Estimated Total Cost	$309,741.50
Cost per Impervious Credit Acre:	$135,258.30

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: **SLP-NB-F722d**

Site Name: **Weis Market**

Contractor: Versar

Watershed: Little Patuxent River

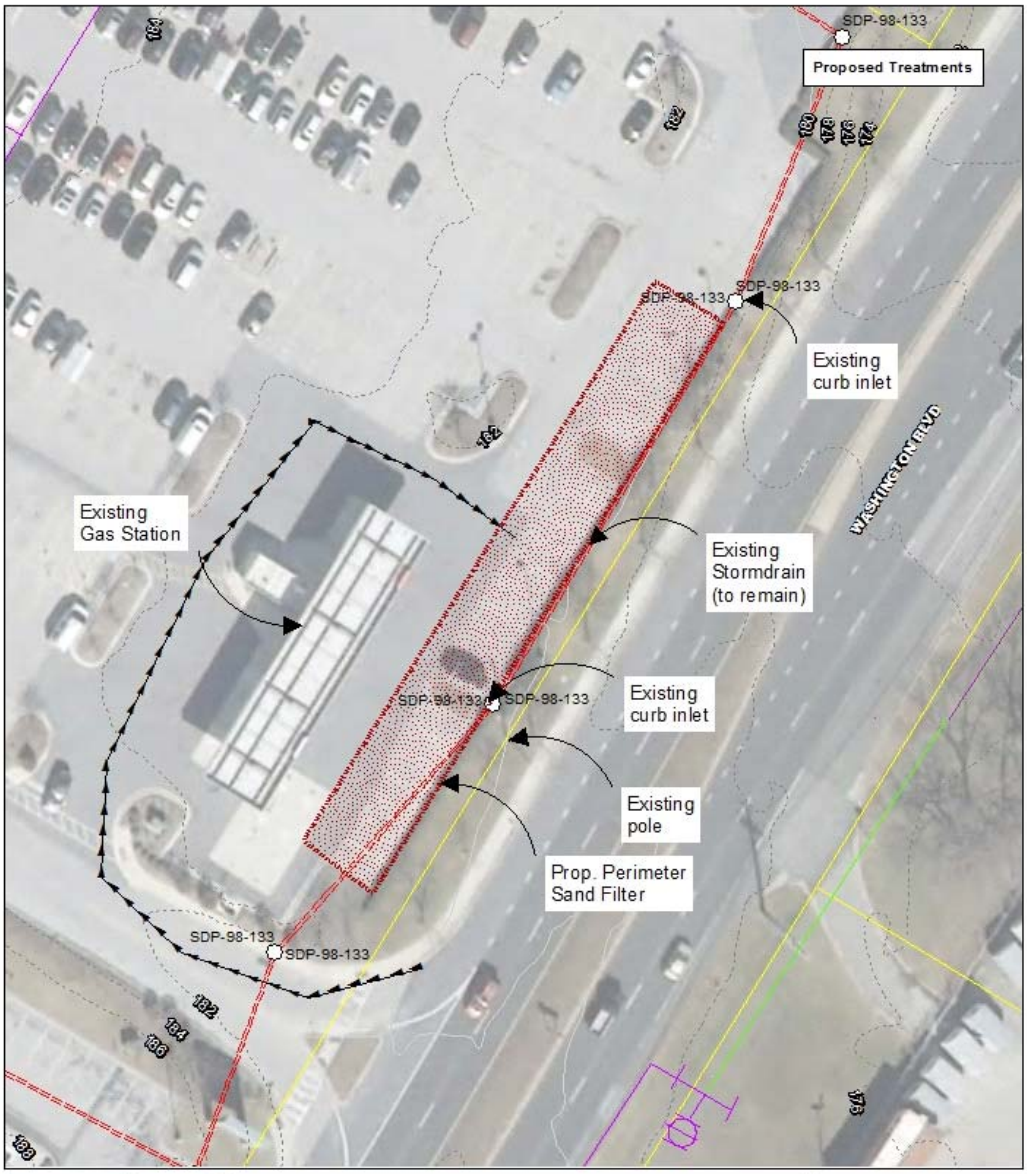


Figure 2: Plan-View Design Drawing

NEW BMP - SLP-NB-F722d

Proposed Project Access	Stream Centerline	DNR Wetland
Major	Utility - Water Line	Forest Conservation Easement
Major_Approx	Utility - Sewer Line	Property Boundary
Minor	Utility-Stormdrain	
Minor_Approx	Utility_Prop. Stormdrain	

STRAUGHAN ENVIRONMENTAL

10 0 10

Feet

1 inch = 50 Feet

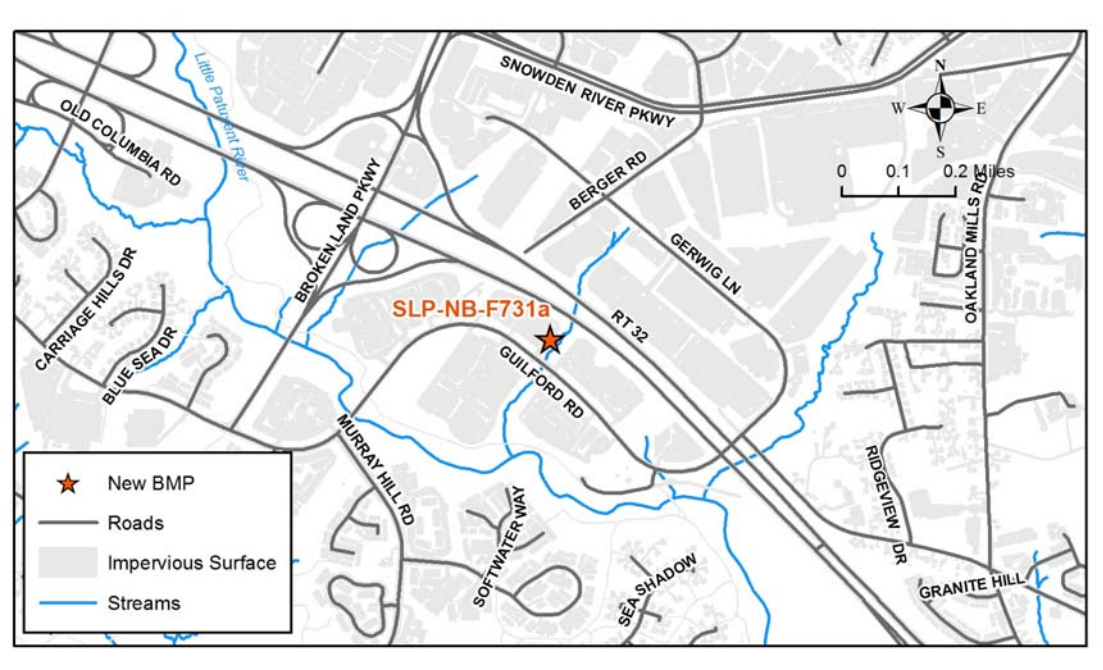
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F731a
Site Name: Rivers Technology Park
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Perimeter (Sand) Filter
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The runoff from this site flows from the northwest parking area and building into two independent sub-areas (north and south) toward a tributary along the southeast side of the site. All three buildings for this site have rain spouts that discharge directly into the parking lot. The existing inlet structures at the southeast side of the building discharge directly into the adjacent tributary.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F731a
Site Name: Rivers Technology Park

Contractor: Versar
Watershed: Little Patuxent River

Proposed treatment option area for underground filtration.

Proposed treatment area for BMP pond facility.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F731a
Site Name: Rivers Technology Park
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The main constraints to this opportunity are the potential lack of elevation difference needed to discharge the filtration underdrains and possible high groundwater.

Concept Description:

Construct an underground perimeter sand filter to treat the southeast portion of the existing impervious area. Due to possible high groundwater and lack of elevation drop it is unlikely the impervious area along the northeast side of the property can be treated without substantial regrading of the parking lot (east end). As part of the proposed improvements the existing southeast grate inlet would be removed and some regrading of the parking spaces may be needed.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	1.43	WQVolume Target (cft.):	4,409
Impervious Area within Drainage (ac.):	1.27	Max Treated (cft.):	4,849
Impervious Area Treated (ac.):	1.27	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	1.27	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$120.000.00
Estimated Construction Cost:	$159,770.00
30% Contingency:	$47,931.00
Estimated Total Cost	$327,701.00
Cost per Impervious Credit Acre:	$258,032.28

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F731a

Site Name: Rivers Technology Park

Contractor: Versar

Watershed: Little Patuxent River

Howard County Watershed Assessment Concept Plan: New BMP

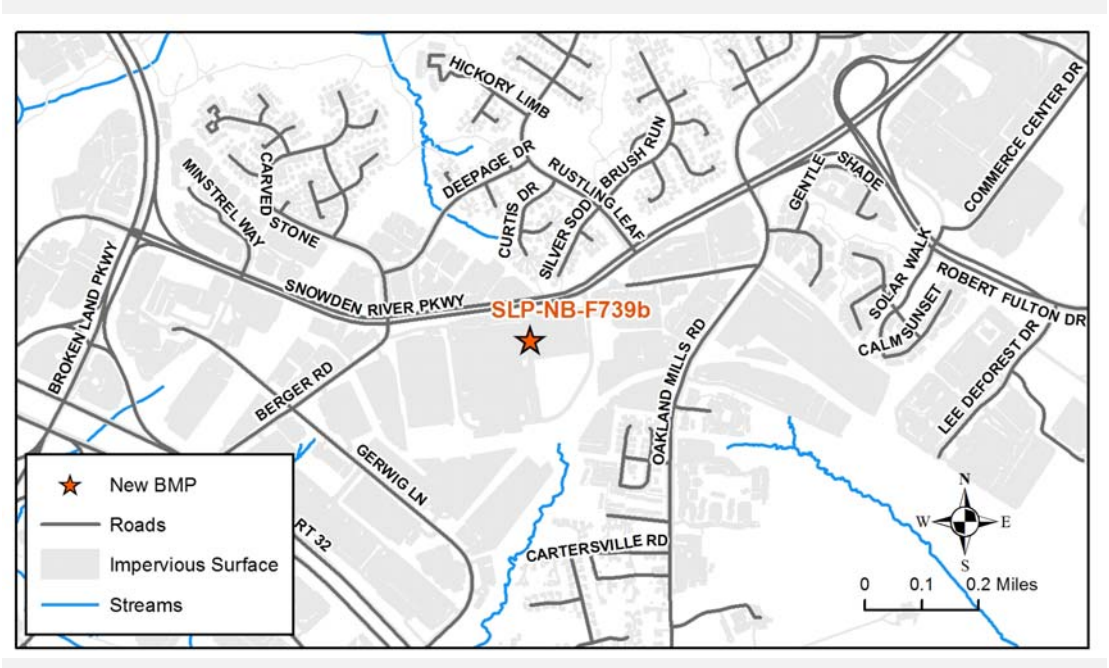
Site ID: SLP-NB-F739b
Site Name: Lincoln Technology Institute

Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Underground Filter
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

There are two sub-drainage areas for this property. The primary drainage area discharges through a large-diameter storm drain pipe system to the southeast corner of the property. The one important landmark for this larger drainage area is an existing cylinder tower on the east side of the building. The parking area north and east of this tower is served by two catch basins (6 sf. or less) with at-grade grates. The portion of the building north of the tower drains into the same catch basins. It will need to be determined if all of the main building roof runoff drains to the east or if only the east half of the building does. A secondary drainage area is the strip of parking along the north side of the property. This drainage area lacks an adequate discharge point resulting in regular flooding (per facility manager comments).



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F739b
Site Name: Lincoln Technology Institute

Contractor: Versar
Watershed: Little Patuxent River

Proposed treatment option for underground filtration.

Aerial image from Google Maps of new development southeast of the main building.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F739b
Site Name: Lincoln Technology Institute
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Unknown depth and size of existing storm drain. Research is needed to determine if the new stormwater management facility, downstream of the proposed filtration system, provides adequate WQv treatment for the proper drainage area. Possible parking impacts during construction.

Concept Description:

An underground filtration system is recommended for this sub-drainage area. The filtration system will be located northeast of the tower and west of the existing large diameter stormwater pipe. The discharge from the filtration system will be directed downstream back into the main stormwater pipe. This system should be able to treat all of the east parking lot and the northeast quarter of the main building.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	7.88	WQVolume Target (cft.):	25,704
Impervious Area within Drainage (ac.):	7.43	Max Treated (cft.):	28,274
Impervious Area Treated (ac.):	7.43	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	7.43	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$320.000.00
Estimated Construction Cost:	$748,475.00
30% Contingency:	$224,542.50
Estimated Total Cost	$1,293,017.50
Cost per Impervious Credit Acre:	$174,026.58

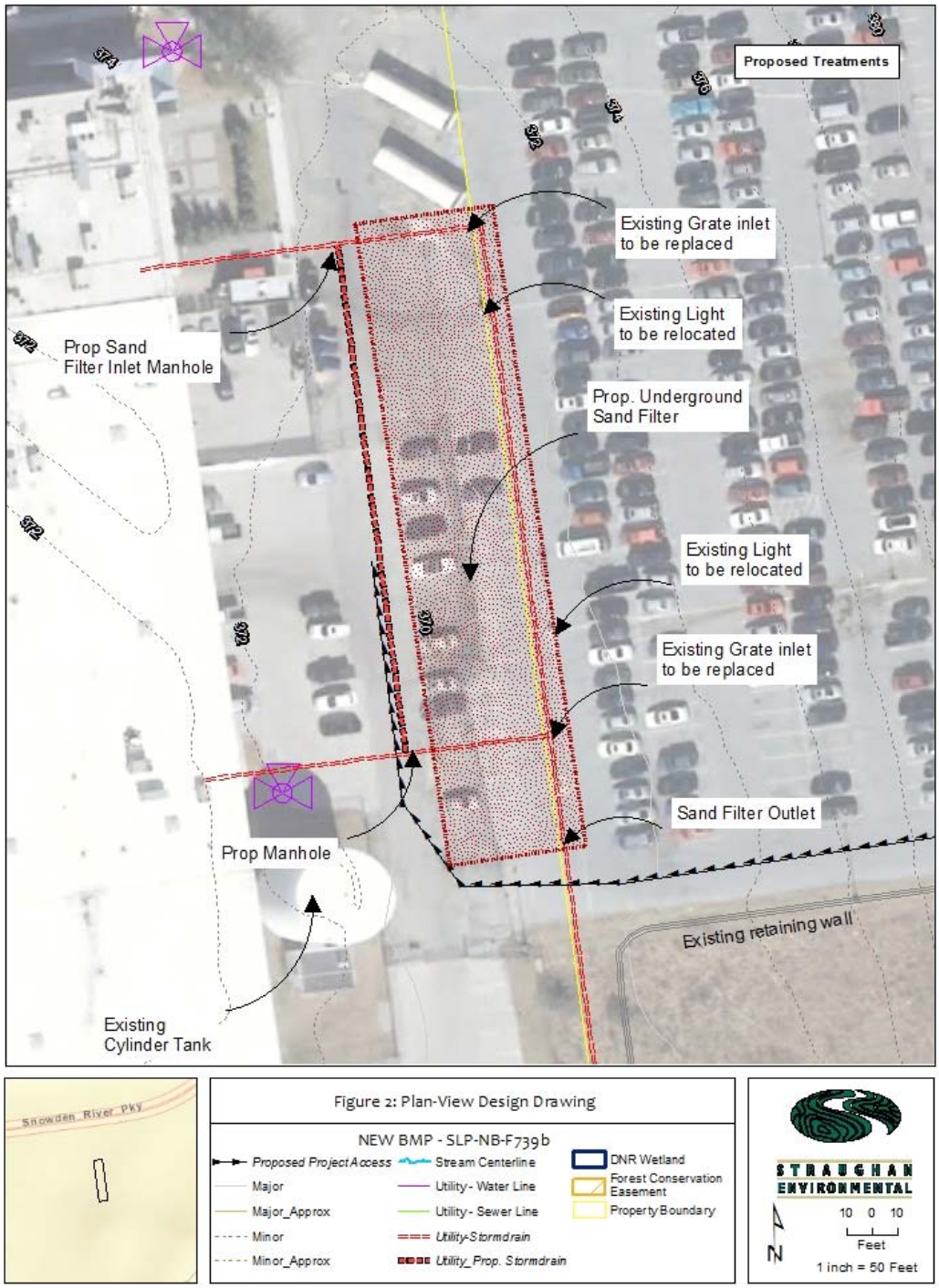
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F739b

Site Name: Lincoln Technology Institute

Contractor: Versar

Watershed: Little Patuxent River



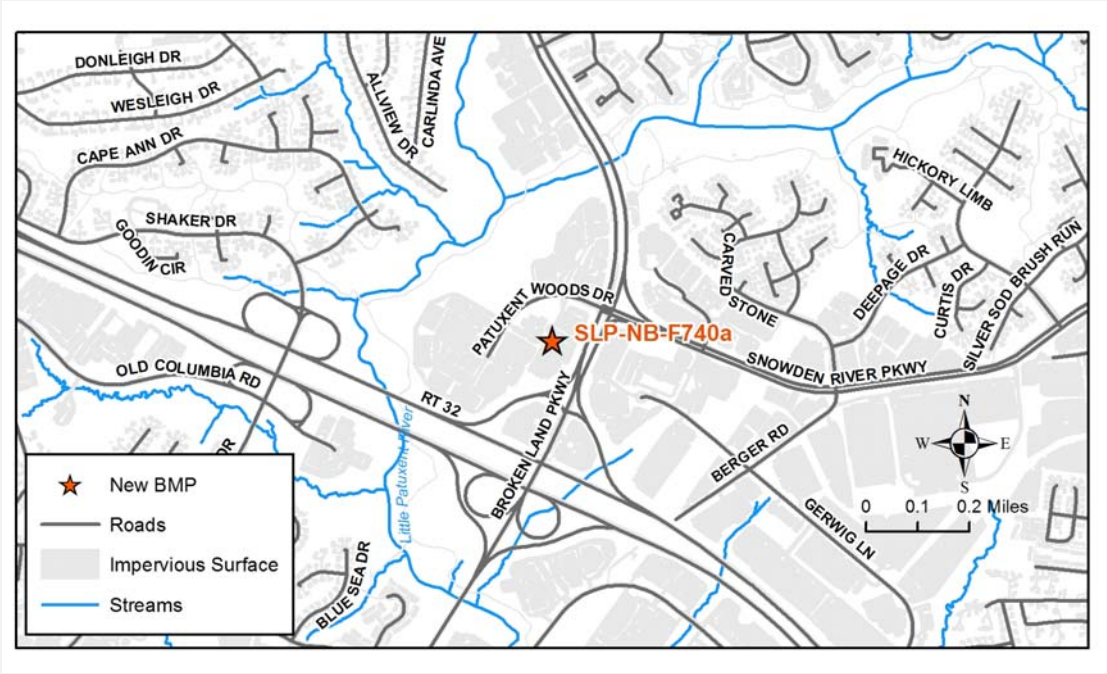
Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F740a
Site Name: Nielsen Company Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Retention Pond (Wet Pond)
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

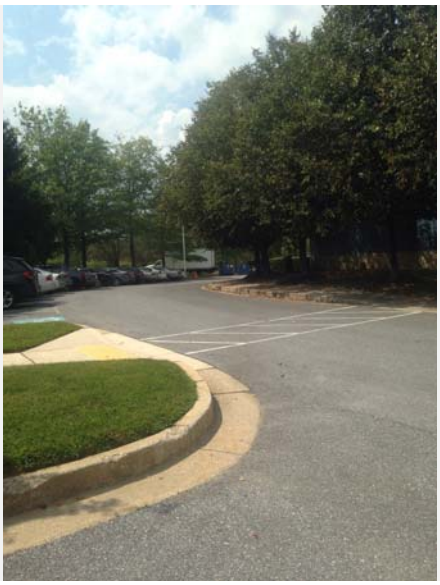
Between main building and Broken Land Parkway is a large parking area that is broken into two sub-drainage areas (north and south areas). The south area stormwater system is located in the western portion of the parking lot and conveys water from the southwest corner of the parking lot north to a junction manhole. The north area stormwater system is located in the western portion of the parking lot and conveys water from the northwest corner south to a junction manhole. The junction manhole is located in the driveway (southeast corner of main building). The discharge from this junction manhole is conveyed west to Patuxent Woods Drive in a 48 in. RCP. Plans indicate the rooftop runoff enters the storm drain system near Patuxent Woods Drive.



Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F740a
Site Name: Nielsen Company Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Standing on junction manhole looking south.



Standing on junction manhole looking west.

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F740a
Site Name: Nielsen Company Parking Lot
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The only restrictions to this concept are existing inverts and crossing the existing 8 in. PVC sanitary sewer serving the main building.

Concept Description:

Construct a single retention pond (wet pond) northeast of the main building in the east portion of the lawn. A new storm drain system will be constructed starting downstream of the existing junction manhole and continue to the existing driveway northeast toward the new facility. The outfall for the new facility will be on the northwest side and consist of a new storm drain system across the lawn to Patuxent Woods Drive. From here the new storm drain system will connect into the existing system.

Nearby Opportunities:

None recommended

Proposed Project Credit		Water Quality Volume	
Drainage Area (ac.):	10.29	WQVolume Target (cft.):	19,019
Impervious Area within Drainage (ac.):	5.25	Max Treated (cft.):	20,921
Impervious Area Treated (ac.):	5.25	Percent Treated:	110%
Impervious Area Treated Credit (ac.):	5.25	Rainfall Depth Treated (in.):	1.1

Costs

Estimated Design Cost:	$220.000.00
Estimated Construction Cost:	$212,150.00
30% Contingency:	$63,645.00
Estimated Total Cost	$495,795.00
Cost per Impervious Credit Acre:	$94,437.14

Howard County Watershed Assessment Concept Plan: New BMP

Site ID: SLP-NB-F740a

Site Name: Nielsen Company Parking Lot

Contractor: Versar

Watershed: Little Patuxent River

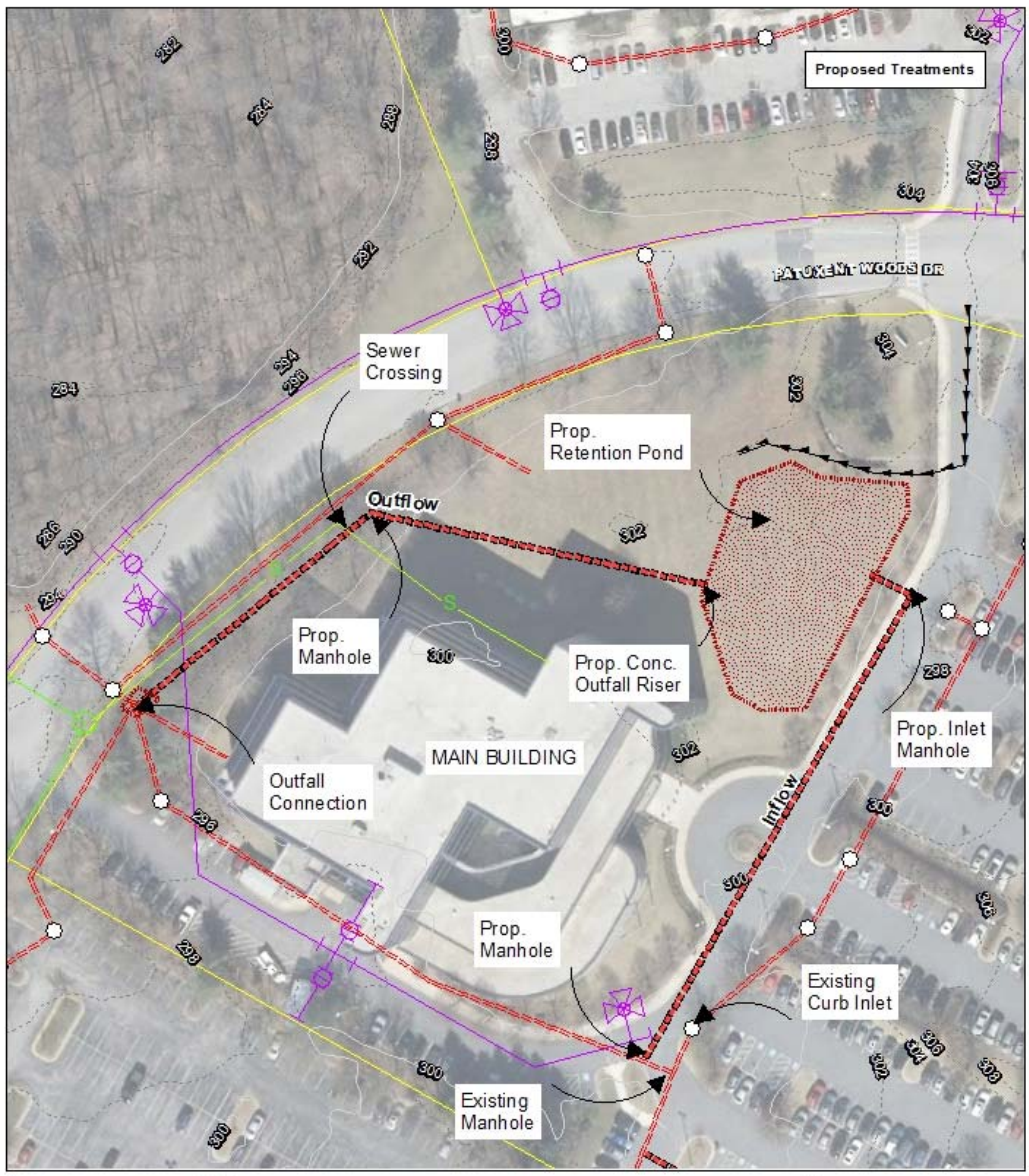


Figure 2: Plan-View Design Drawing

NEW BMP - SLP-NB-F740a

- Proposed Project Access
- Major
- Major_Approx
- Minor
- Minor_Approx
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility-Stormdrain
- Utility_Prop. Stormdrain
- DNR Wetland
- Forest Conservation Easement
- Property Boundary

STRAUGHAN ENVIRONMENTAL

20 0 20

Feet

1 inch = 83 Feet

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F504a
Site Name: Turf Valley (a)
Contractor: KCI
Watershed: Little Patuxent River

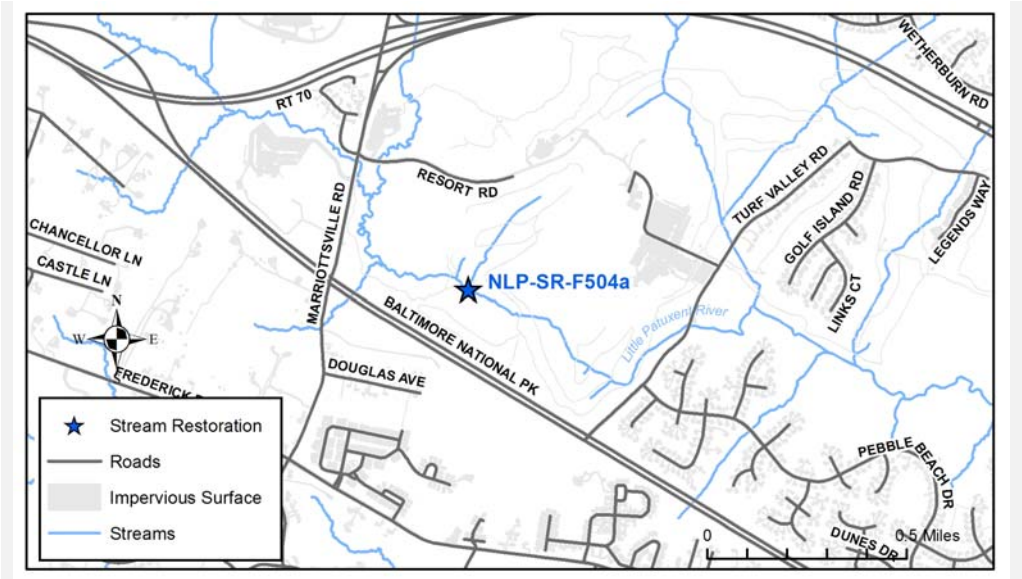
Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

The site is a reach of the Little Patuxent River located primarily within the Turf Valley Golf Course. The reach is characterized by 3 ft. high banks that are 15 to 30 ft. in width at the top of bank. Banks are a silty material that is easily erodible due to the low root depths and lack of surface protection. Portions of the channel are located within forested sections while others are in open areas of the golf course which contain mowed turf. The stream banks are more severely eroded in the open areas that are lacking sufficient vegetation to stabilize the banks. A reach located between two forested sections of channel contains recent tree plantings.

The channel is moderately embedded with fines and the bed material is composed of mostly sand, gravel and cobble. Large amounts of sand deposition were observed in the channel. There is a moderate presence of available and good quality epifaunal substrate habitat and coverage. Two velocity/depth regimes are apparent and baseflow occupies the full channel width, reaching both banks. Riffle spacing is characterized as being approximately seven to 15 channel widths. Minor channel alterations were observed, including golf cart trail crossings.

The majority of the riparian buffer width is less than 20 ft. on both the right and left banks as the majority of stream runs through Turf Valley Golf Course, and the quality of the riparian vegetation is low, at approximately 30% cover. However, the upper portion and a section in the middle of the stream reach have a forested buffer.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F504a
Site Name: Turf Valley (a)
Contractor: KCI
Watershed: Little Patuxent River

Left bank erosion with vertical banks, poor root depth and a silty material.

Facing downstream with moderate erosion and falling trees.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F504a
Site Name: Turf Valley (a)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The reach runs through two private properties, the Mangione Enterprises Turf Valley property and the Turf Valley Property Owners Association. A significant amount of the reach runs through the Turf Valley Golf Course playing surface, requiring special consideration to the design and construction access. Significant coordination with Turf Valley will be needed to accomplish the project. A sewer line also parallels the channel on the right bank, approximately 8 to 65 ft. from the channel with two crossings along the reach. Given the close proximity of the reach to the golf course field of play, access and timing of construction coordination may be difficult to acquire as to not interfere with normal play.

Concept Description:

The proposed stream restoration includes widening the floodplain at the existing bankfull elevation in some areas, and other areas being stabilized in place. Stabilization will be applied to areas that are located in the golf course field of play where vegetative plantings will likely be restricted and as a result, stone bank treatments will likely be necessary to stabilize the banks. The areas of this reach containing a riparian buffer will receive a floodplain widening approach. In these areas bioengineering techniques such as coir logs and vegetative stabilization can be used to stabilize the banks. A sanitary sewer line parallels the stream channel and crosses the channel in two locations and a water line crosses the channel. Consideration will be given in the proposed design to protect the existing infrastructure. Existing bed materials are likely salvageable, but larger cobble and boulder material will be necessary to provide better riffle habitat and bank stabilization.

A planting plan will be developed for the landscape zones throughout the site that will allow for the establishment of native plant species and does not interfere with golf course field of play.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,662	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	26.6	Estimated Construction Cost:	$1,198,350.00
Cost per Impervious Credit Acre:	$69,791.70	30% Contingency:	$359,505.00
		Estimated Total Cost:	$1,857,855.00

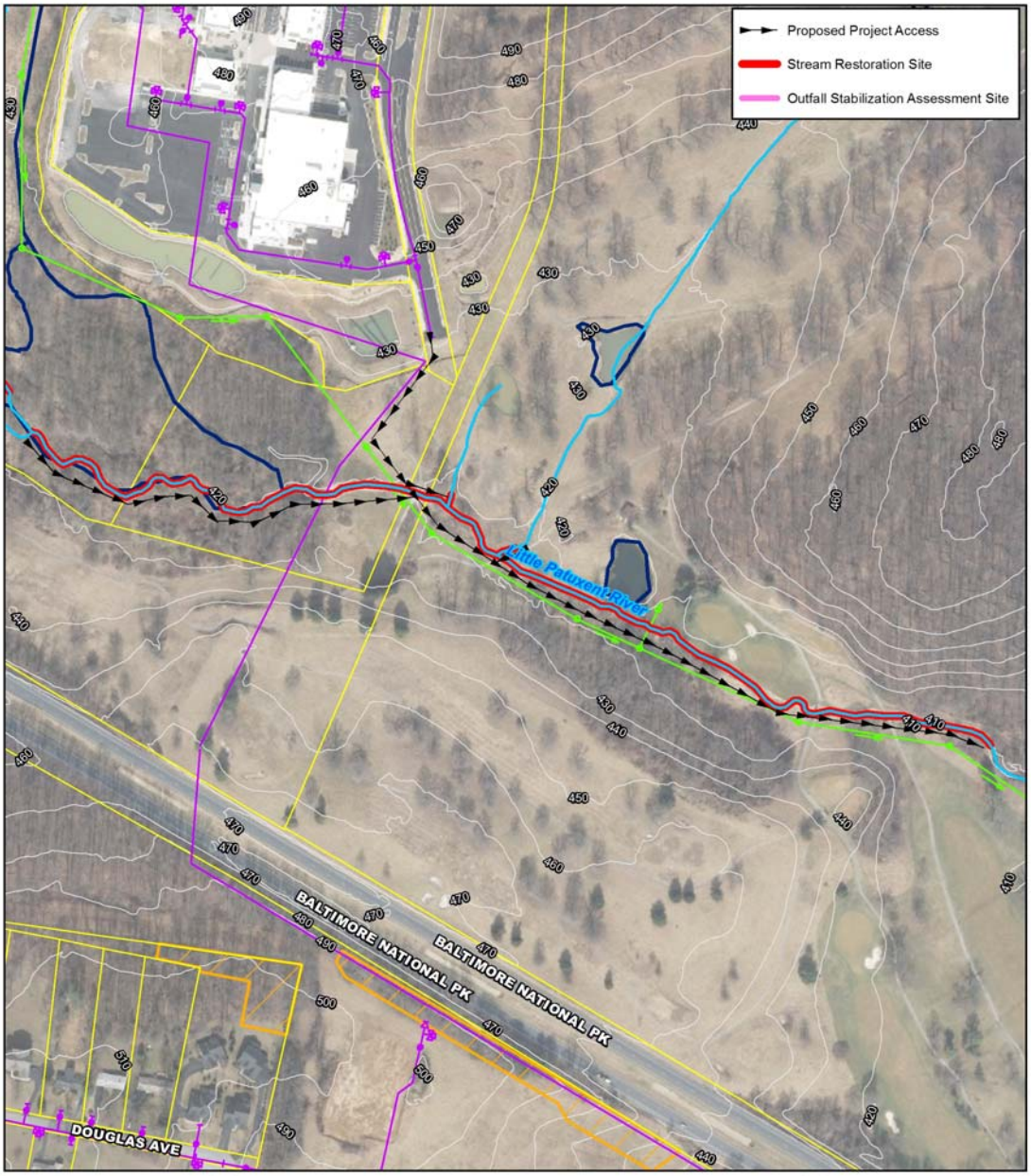
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F504a

Site Name: Turf Valley (a)

Contractor: KCI

Watershed: Little Patuxent River



Plan-View Design Drawing
Stream Restoration - NLP-SR-F504a

- Pipe Outfall
- Pipe Outfall Assessment Site
- 10 ft Contour
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility - Storm Drain
- Tree Planting
- DNR Wetland
- Forest Conservation Easement
- Subwatershed
- Property Boundary

KCI TECHNOLOGIES

N

90 0 90

Feet

1 inch = 325 Feet

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F509a
Site Name: Turf Valley (b)
Contractor: KCI
Watershed: Little Patuxent River

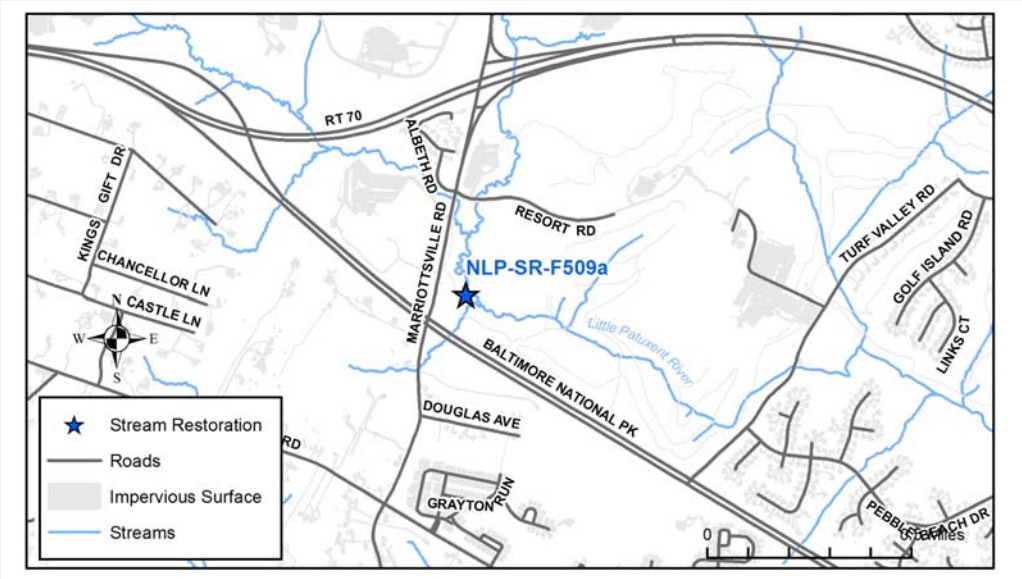
Ownership: Private- Mixed Use
Single Owner

Existing Conditions:

The site is located on a reach of the Little Patuxent River situated between Marriottsville Road to the west and shopping center development to the east. The reach is part of an abandoned golf course at Turf Valley. The reach has approximately 4 to 5 ft. high banks that are 10 to 15 ft. in width at the top of bank. Banks are a silty material that is easily erodible due to the low root depths, low surface protection and vertical angles. The reach contains a high sinuosity and compressed meander geometry.

The channel appears to be in the process of widening/aggrading in the lower portions of the reach with undercut banks and deposition in the channel bed; and downcutting/widening in the upper portions of the reach with higher banks towards the upstream extent of the site. The channel is moderately embedded with fines and the bed material is composed of mostly sand and gravel with some silt and cobble. Moderate bar formation and deposition is observed in the channel. The presence of high quality epifaunal substrate and habitat coverage is marginal, with all three velocity/depth regimes present and baseflow occupying approximately 75% of the width of the channel. Riffle spacing is characterized as being approximately 7-15 channel widths.

The riparian buffer width is narrow at 20 to 40 ft. on both the right and left bank and the quality of the riparian vegetation ranging from low to moderate, currently providing approximately 10 to 60% cover. The sparse vegetation is further contributing to the accelerated erosion as there is little to no root density available to stabilize the banks. A paved trail exists along the right overbank area, approximately 50 to 100 ft. from the top of bank. This trail leads to a stormwater management facility.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F509a
Site Name: Turf Valley (b)
Contractor: KCI
Watershed: Little Patuxent River

Facing right bank, erosion with poor root depth and stream has poor epifaunal habitat availability.

Vertical banks with falling trees. Stream has moderate deposition of silt and sand.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F509a
Site Name: Turf Valley (b)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The restoration reach is located exclusively on private property so property coordination will be necessary to perform the proposed project. Access will be achievable from Marriottsville Road or Resort Drive. Impacts to the existing forest will be low to moderate due to the existing sparse riparian buffer.

Concept Description:

The proposed stream restoration includes a design throughout this site where a secondary floodplain can be graded at a new, lower elevation. Channel realignment is necessary throughout the restoration reach to soften compressed meander geometry. Proposed bank protection will include bioengineering techniques such as coir logs, alternating roughness protection, and vegetative stabilization; however, stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

The site has potential for educational outreach, as it is across the street from Chapelgate Christian Academy.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,251	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	22.5	Estimated Construction Cost:	$1,012,950.00
Cost per Impervious Credit Acre:	$71,827.41	30% Contingency:	$303,885.00
		Estimated Total Cost:	$1,616,835.00

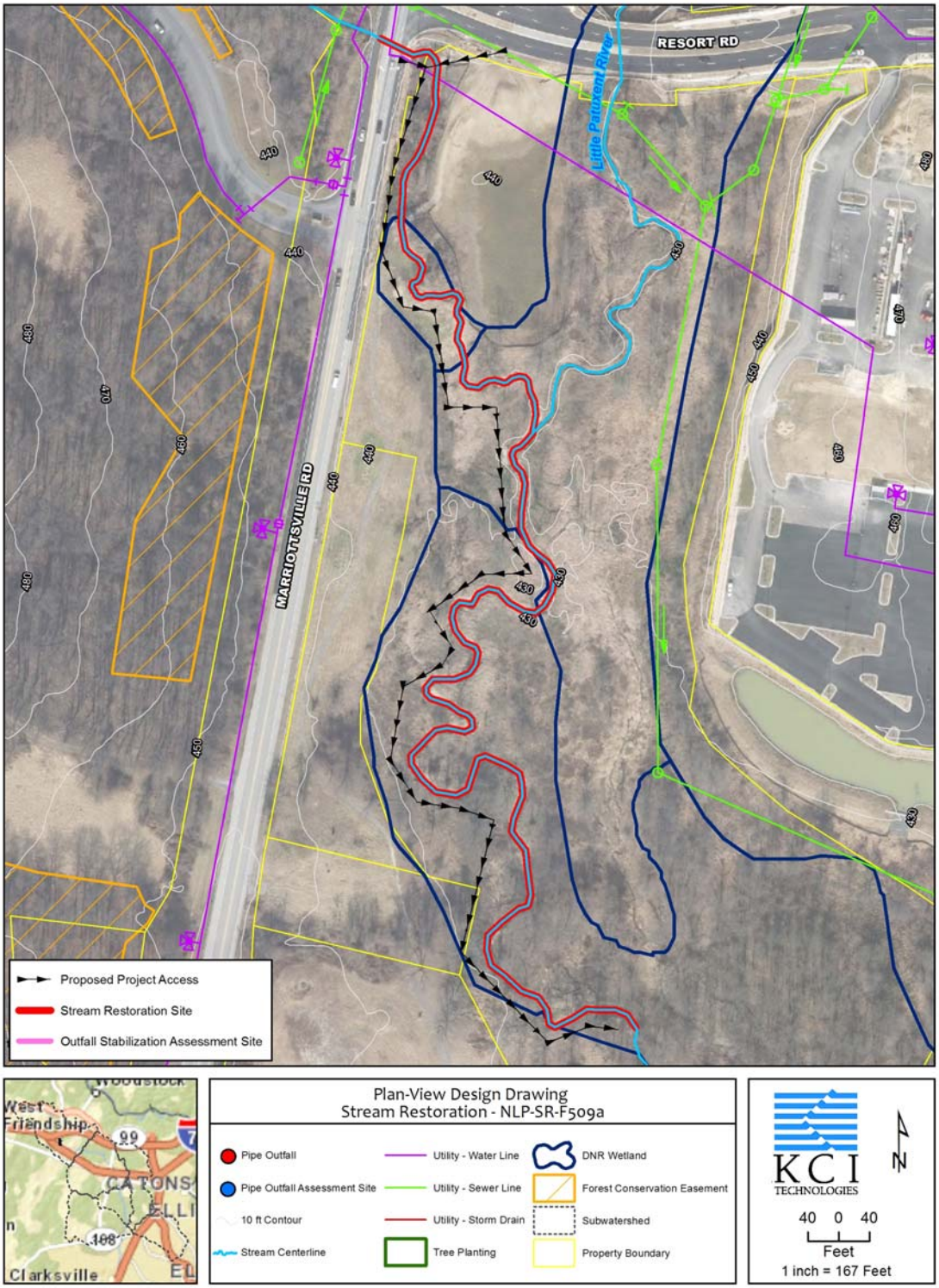
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F509a

Site Name: Turf Valley (b)

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

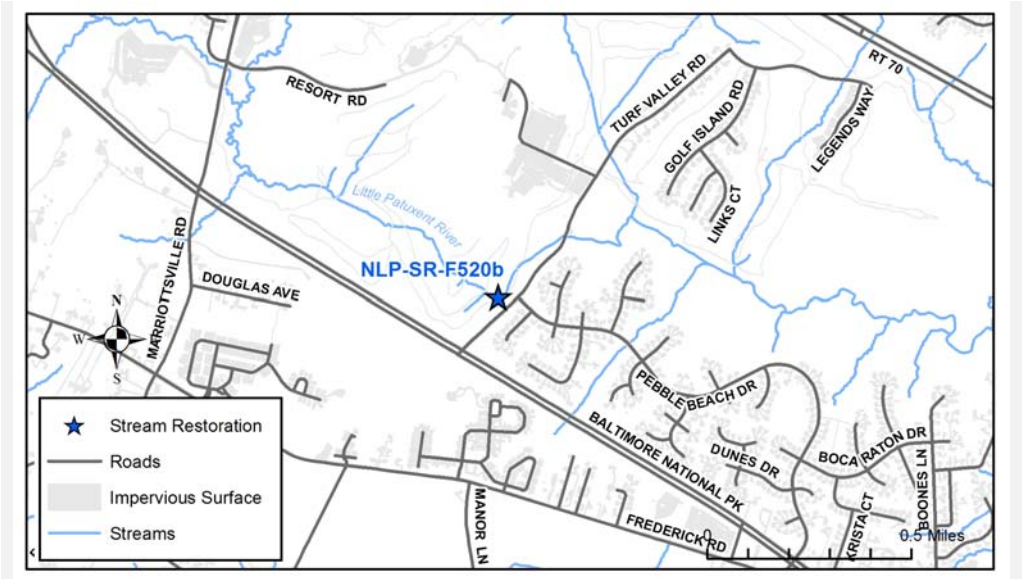
Site ID: NLP-SR-F520b
Site Name: Turf Valley (c)
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Single Owner

Existing Conditions:

The site includes a reach of the Little Patuxent River located on the Turf Valley Golf Course. The reach has approximately 3 ft. high banks that are 15 to 25 ft. in width at the top of bank. Banks are a silty material that is easily erodible due to the low root depths and little surface protection due to a lack of vegetation along the banks. Near bank stresses are found to be low due to benches and low banks present throughout the site that appear to be bankfull indicators of 2.5 ft. in height above the bed. While benches are observed in some areas, localized areas of undercut banks are observed.

The channel appears to be widening with the presence of eroding and undercut banks. The channel is also moderately to highly embedded with fines and the bed material is composed of mostly silt, sand and gravel with some amounts of cobble. Very little amounts of sand deposition are observed in the channel. There is a marginal presence of available and good quality epifaunal substrate habitat and coverage. Two velocity/depth regimes are apparent and baseflow is occupying the channel width to both banks. Riffle spacing is characterized as being approximately 7 to 15 channel widths. The reach is located within an active play area of the Turf Valley Golf course and therefore contains a lack of riparian buffer and includes mowed turf reaching the top of bank. Minor channel alterations were observed for golf cart path crossings. A sanitary sewer line runs parallel to the restoration reach and crosses the channel in two locations.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F520b
Site Name: Turf Valley (c)
Contractor: KCI
Watershed: Little Patuxent River

Erosion on left bank with poor root depth.

Facing upstream, poor root density and no cover.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F520b
Site Name: Turf Valley (c)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The restoration reach is located exclusively on private property where access would need to be given by owner. The entire reach runs through the Turf Valley Golf Course playing surface, requiring special consideration to the design and construction access. A sewer line crosses the reach twice, switching from right bank to left bank and back to the right. There are also four golf cart crossings over the reach which could present issues during construction and will need to be given consideration in the restoration design. Given the close proximity of the reach to the golf course field of play, access and timing of construction will be difficult to acquire as to not interfere with normal play.

Concept Description:

The proposed stream restoration includes a design where a limited bench will be established at the current bankfull elevation and where the channel will mainly be stabilized in place. Bank protection is expected to be composed primarily of stone protection and other harder bank treatments as it is expected that plantings will be limited due to the location of the channel within the active play area of the golf course; however, bioengineering techniques such as coir logs and vegetative stabilization can be used in isolated areas which are not in the golf course field of play. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat and bed stabilization. Grade control structures may be necessary at the sanitary sewer crossings depending on the elevation of the pipes in relation to the stream channel invert.

A limited planting plan will be developed and will be dependent on plants that are approved for use within the golf course that will not interfere with the active play areas.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,299	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	23	Estimated Construction Cost:	$1,035,000.00
Cost per Impervious Credit Acre:	$71,574.60	30% Contingency:	$310,500.00
		Estimated Total Cost:	$1,645,500.00

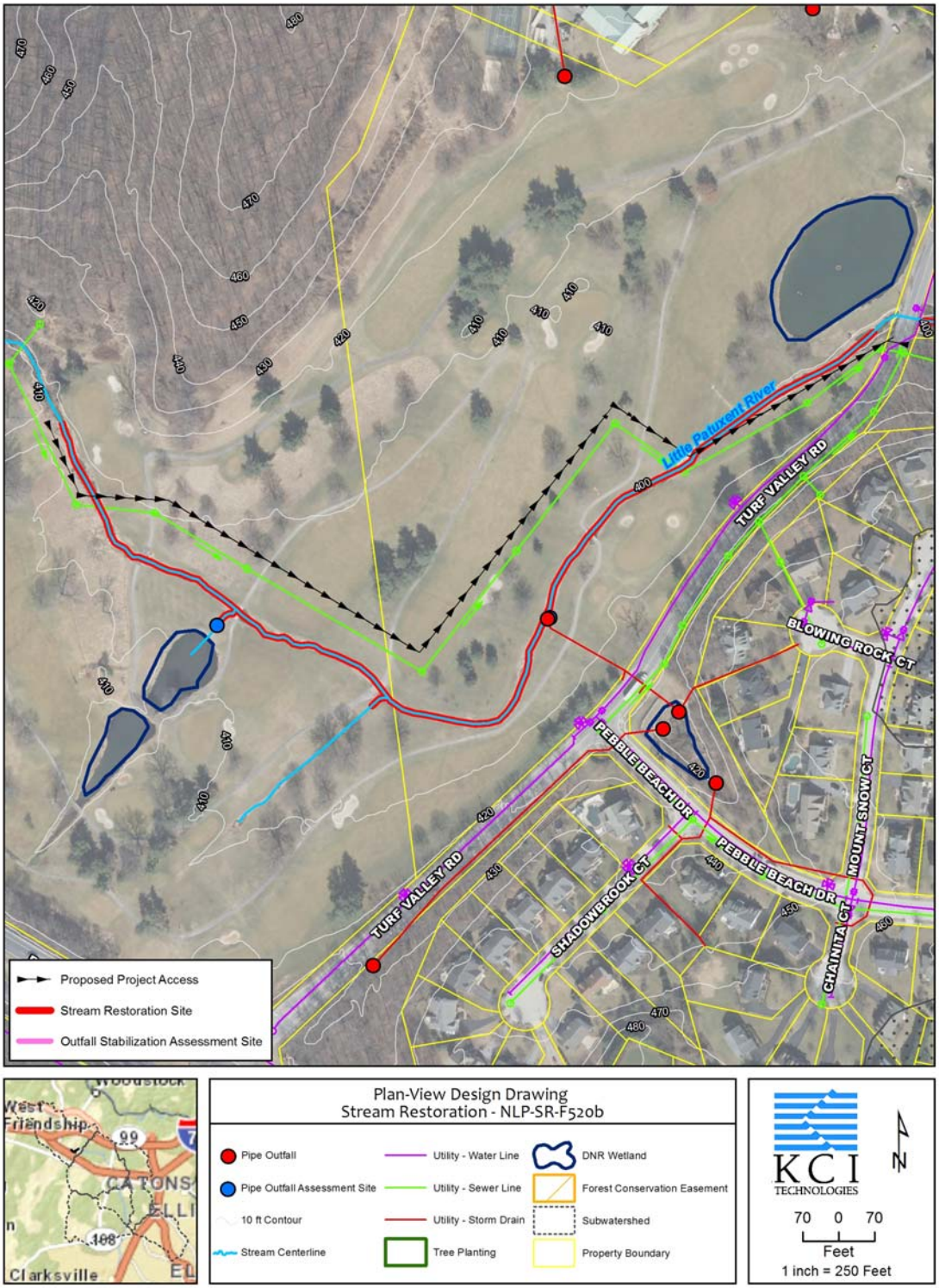
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F520b

Site Name: Turf Valley (c)

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F551a
Site Name: Enchanted Forest 3
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Residential
Multiple Owners

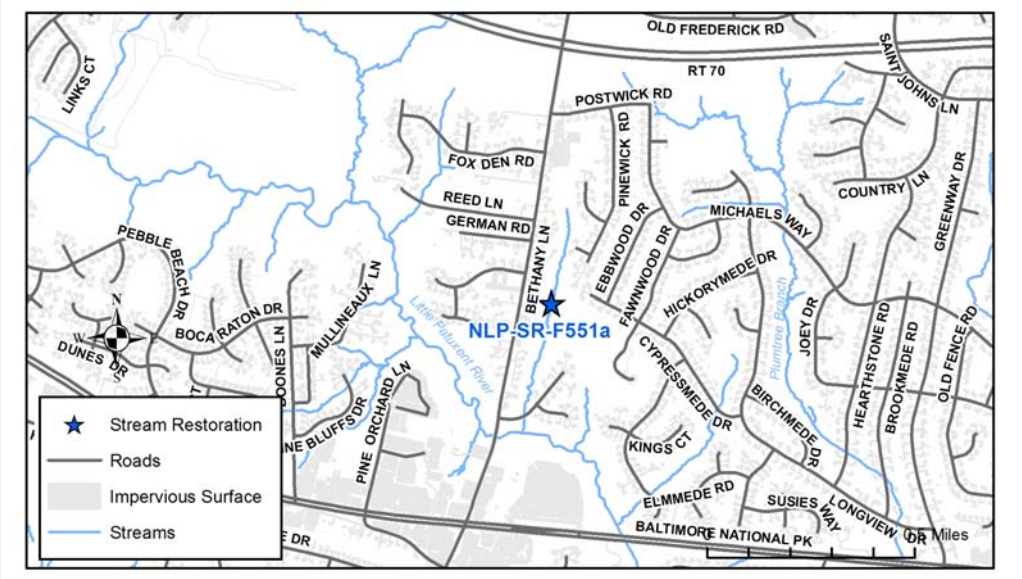
Existing Conditions:

The site is an unnamed tributary that flows to the Little Patuxent River. The banks are approximately 2 to 5 ft. high with a silty material that is easily erodible due to the vertical banks, low to very low root depths and surface protection. Some localized more stable segments are present exhibiting a lower bank slope and stabilizing vegetation. Near bank stresses were found to be moderate to very high with bankfull indicators at 2 to 2.5 ft. above the bed. Banks are undercut in many areas with fallen and falling trees. A stormwater management pond is located at the upstream extent of the site.

The bed material is composed of mostly silt, sand and gravel with some cobbles. Moderate bar formation was observed and the channel is moderately embedded with fines. The presence of available and good quality epifaunal substrate habitat and coverage is marginal to suboptimal. Two to three velocity/depth regimes are apparent and baseflow occupies 75% to 100% of the channel width at the bottom of both banks. Riffle spacing is variable and in moderate condition, with the spacing characterized as being approximately 7 to 15 channel widths.

A sanitary sewer line runs parallel to the channel along the right bank (facing downstream) with three crossings existing throughout the restoration reach. In multiple areas, the channel has eroded towards and is now located within close proximity to the sanitary sewer line and manholes. Few channel alterations were observed and are associated with the sanitary sewer crossings.

The riparian buffer width varies between less than 20 ft. and greater than 60 ft. on both banks, but the quality of the riparian vegetation is moderate to good, at approximately 60 to 80% cover. The bank erosion is more severe in the areas that are lacking a riparian buffer.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F551a
Site Name: Enchanted Forest 3
Contractor: KCI
Watershed: Little Patuxent River

Facing upstream, moderate silt and sand deposition.

Right bank erosion with vertical bank angle, no surface protection and silty bank material.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F551a
Site Name: Enchanted Forest 3
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The majority of the reach is on private property, with the downstream-most 550 lf. being located on Howard County Parks and Recreations property. As a result, property coordination will be necessary to complete the project. A sanitary sewer easement runs parallel to the stream channel along the right bank. While this easement can be used for access, it will not negate the need for property owner coordination. Wetlands were noted on site, requiring special consideration to the design, permitting and construction access. While the easement running parallel to the channel could provide access; the location of the wetlands may determine construction access. Although the design would attempt to limit tree impacts, a moderate impact to trees would likely result during construction of the reach; however, sections of the channel contain little to no riparian buffer and could benefit from the additional plantings that would result from the project.

Concept Description:

The proposed stream restoration includes a design throughout the site where a narrow floodplain could be developed at the current bankfull elevation, and where the stream could be stabilized in place. This design approach will be necessary due to the close proximity of the channel to the sanitary sewer line and since the channel is located within private property. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization; however, stabilizing the channel in place may result in the need for stone protection and other harder bank treatments in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,647	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	26.5	Estimated Construction Cost:	$1,191,150.00
Cost per Impervious Credit Acre:	$69,833.59	30% Contingency:	$357,345.00
		Estimated Total Cost:	$1,848,495.00

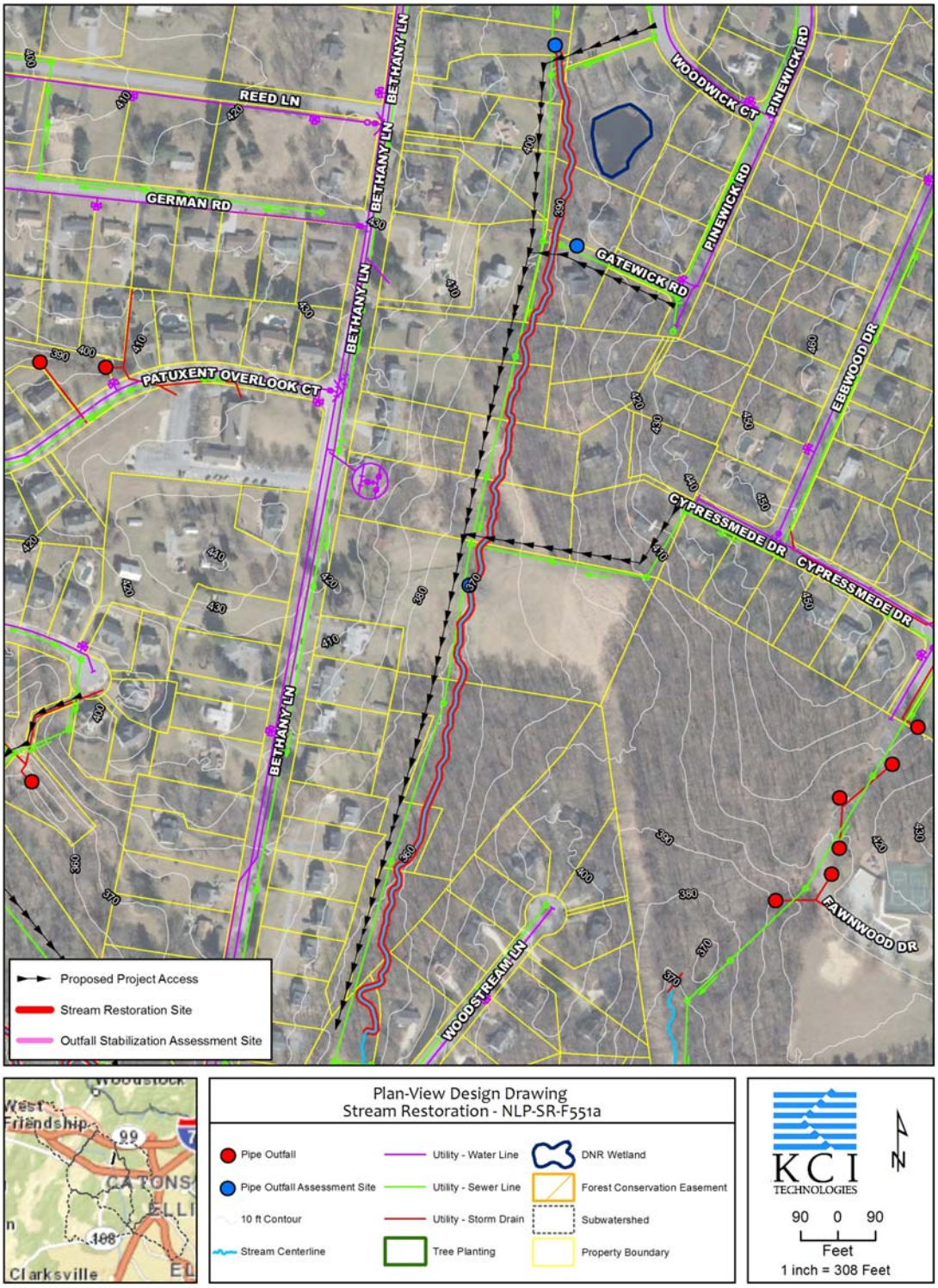
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F551a

Site Name: Enchanted Forest 3

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F552a
Site Name: Boones Lane (a)
Contractor: KCI
Watershed: Little Patuxent River

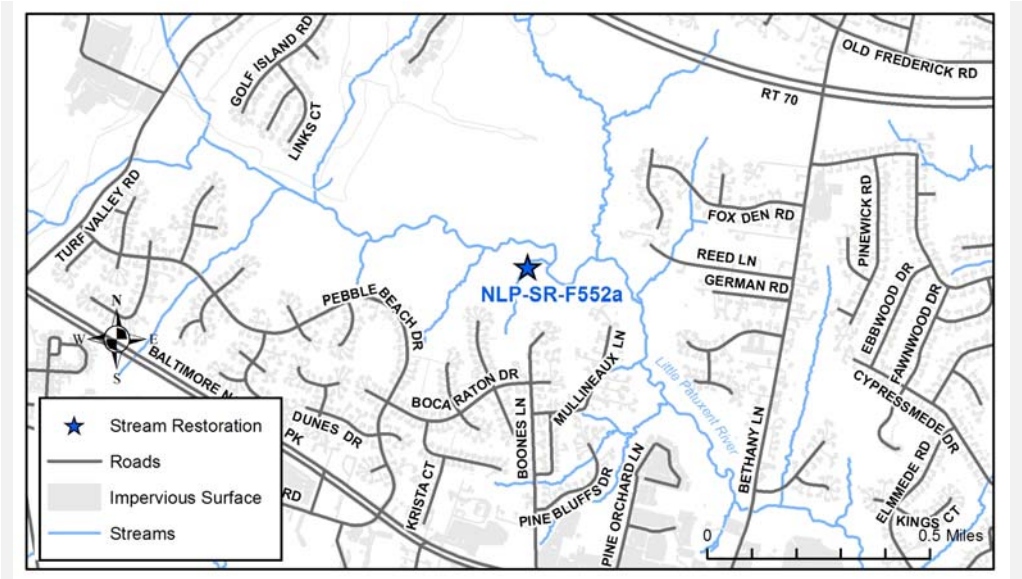
Ownership: County Owned
Single Owner

Existing Conditions:

The site is an unnamed tributary to the Northern Little Patuxent that begins from a storm drain outfall at Boca Raton Drive, between Boones Lane and Congressional Court. The reach has 4.5 to 6.5 ft. high banks with a high silt composition, vertical bank angles, very shallow root depths, and minimal surface protection, making them highly susceptible to erosion. Banks are undercut with recently fallen trees. As a result of continued erosion, this channel has incised at 4.5 to 6.5 times its bankfull depth, and near bank stresses are high to extreme with a bankfull height of 1 ft.

The channel is widening and headcutting, with benches present throughout the site at 1 ft. in height above the bed. The bed material is composed of mostly sand, gravel and cobble, and some deposition was observed in the channel. Deposition was noted mostly in the form of benches as well as accumulation of fines at the downstream extent of this channel. The presence of available and good quality epifaunal substrate habitat and coverage is suboptimal in quality, and only two velocity/depth regimes were apparent through the reach. Riffle spacing is in good condition, with the spacing characterized as being approximately nine channel widths

The riparian buffer width is approximately 100 ft. on both banks and the quality of the riparian vegetation is good with 70% cover.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F552a
Site Name: Boones Lane (a)
Contractor: KCI
Watershed: Little Patuxent River

Erosion on right bank with vertical bank angle and poor root depth.

Vertical banks.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F552a
Site Name: Boones Lane (a)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The reach is within several Howard County Parks and Recreations property boundaries, providing good property access. Construction access may be possible from Congressional Ct. Parks property joins Congressional Ct at the upstream end of the site. A sewer line crosses the channel at the upstream extent of the site, then runs parallel to the channel on the left bank, which poses some minor constraint to the design. Although the design would attempt to limit tree impacts, a significant impact to trees would likely result during construction due to the existing wide riparian buffer. However, access along the maintained sewer easement, when available, will limit tree impacts. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where the bed elevation may be raised to utilize the existing floodplain in some areas of Parks property, but a new floodplain may be graded at a new, lower elevation where private property encroaches onto the floodplain. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,276	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	12.8	Estimated Construction Cost:	$574,650.00
Cost per Impervious Credit Acre:	$82,056.82	30% Contingency:	$172,395.00
		Estimated Total Cost:	$1,047,045.00

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F552a

Site Name: Boones Lane (a)

Contractor: KCI

Watershed: Little Patuxent River

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555a
Site Name: Enchanted Forest (a)
Contractor: KCI
Watershed: Little Patuxent River

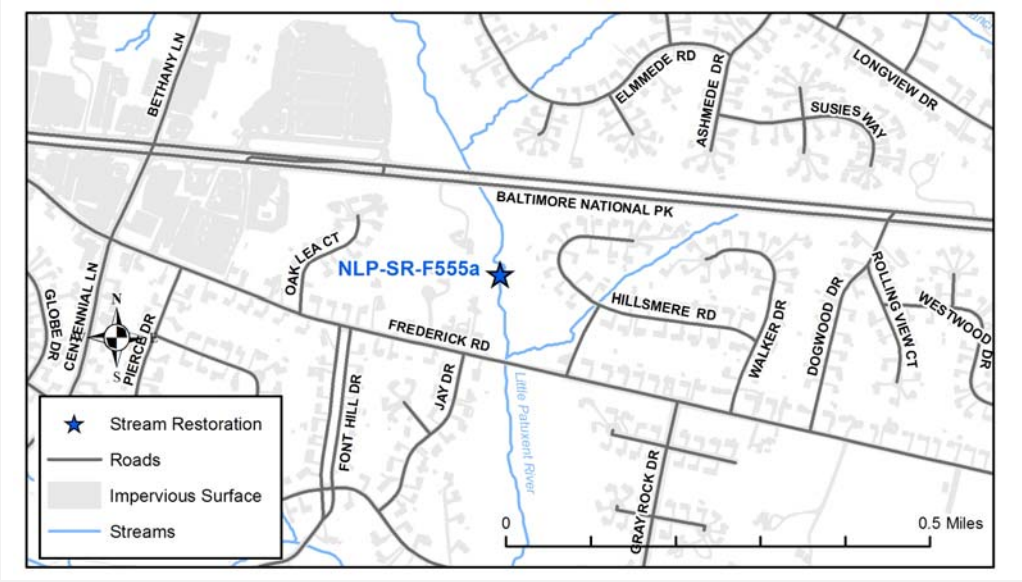
Ownership: County Park
Multiple Owners

Existing Conditions:

The site is on a reach of the Little Patuxent River that has approximately 6 ft. high banks that are 25 to 35 ft. wide at the top of bank. Banks are silty and easily erodible due to the low to moderate root depths and low to moderate surface protection. The banks are vertical with undercut trees. Bar deposition was noted to a height of 1 to 1.5 ft. Multiple fallen trees were noted, particularly near the compressed meanders at the center of the reach.

The channel is highly embedded with fines. Bed material is composed of mostly sand and gravel with some silt, and moderate bar formation was observed in the channel. The presence of available and good quality epifaunal substrate habitat and coverage is very good, and all four velocity/depth regimes are present with baseflow reaching both banks. Riffle spacing was characterized as being approximately 5-7 channel widths. No channel alterations were observed.

The riparian buffer width is greater than 60 ft. on the right bank and approximately 60 ft. on the left, but the quality of the riparian vegetation is moderate, at approximately 70% cover. An abundance of wavy leaf basketgrass and Japanese stiltgrass, both invasive species, was observed throughout the site.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555a
Site Name: Enchanted Forest (a)
Contractor: KCI
Watershed: Little Patuxent River

Eroding and undercut banks; fallen trees; poor quality riparian zone along right bank.

Abundant sand deposition as bars.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555a
Site Name: Enchanted Forest (a)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

This reach runs along the western edge a Howard County Parks property with short segments of the channel crossing onto two private residential properties. These same two properties run the length of the reach and are in close proximity to the right bank, throughout. A significant area of wetlands runs parallel to the left bank of the channel for most of the reach, requiring special consideration to the design and construction access and for project permitting. There is a sewer easement running parallel to the right bank that could provide access; however, the proximity of private property to the channel limits the design for floodplain access, as it could cause an increase to the floodplain elevation on private property. Given the abundance of County park property to the east, the left bank presents potential for realigning the channel away from the private properties and allowing for greater floodplain access. Further evaluation of the wetland extents and permitting constraints would be necessary for the next phase of the design strategy for this reach.

Concept Description:

The proposed stream restoration includes a natural channel design throughout this site, where a new floodplain can be graded at a secondary, lower elevation. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,194	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	11.9	Estimated Construction Cost:	$537,300.00
Cost per Impervious Credit Acre:	$83,625.63	30% Contingency:	$161,190.00
		Estimated Total Cost:	$998,490.00

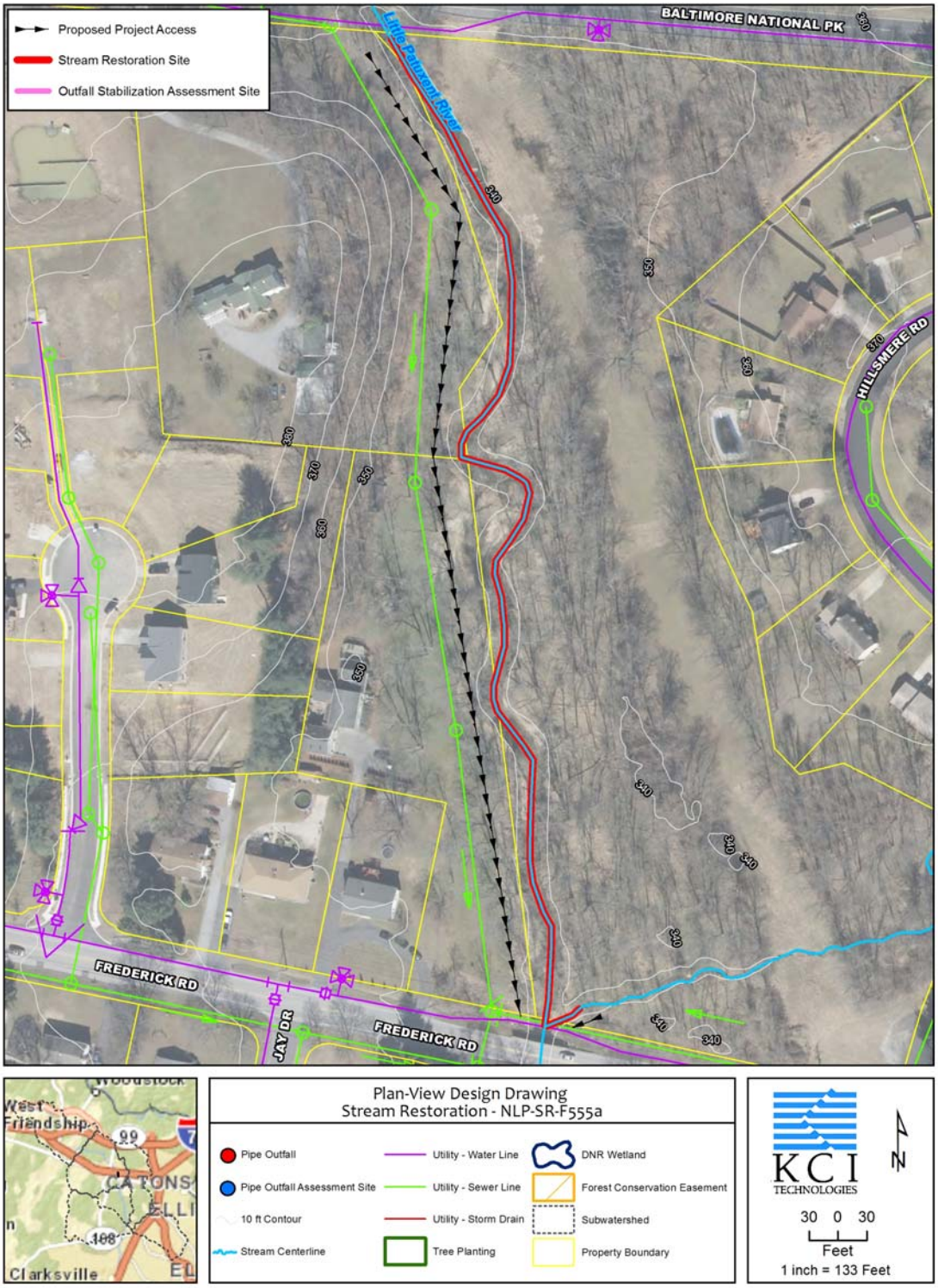
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555a

Site Name: Enchanted Forest (a)

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

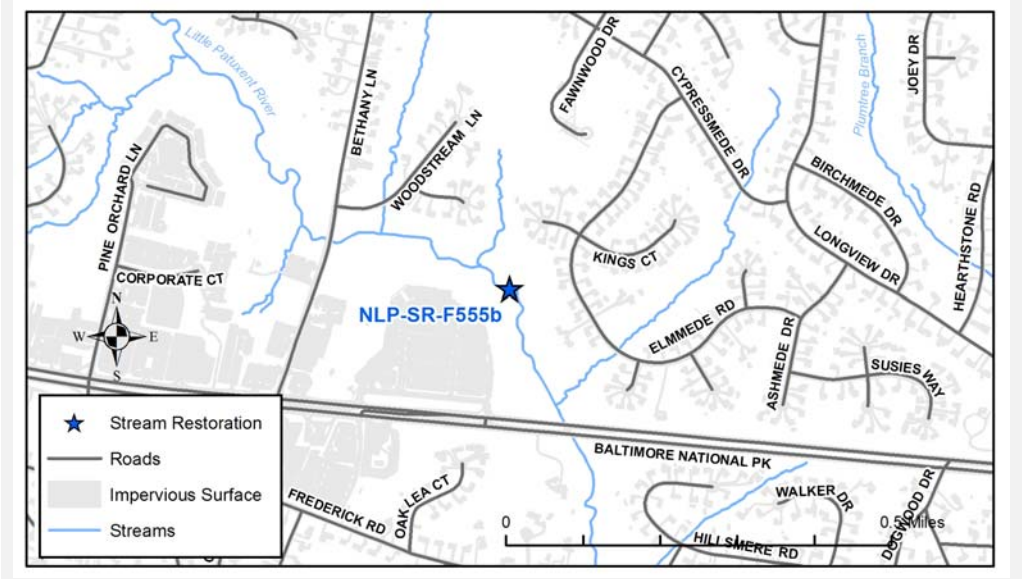
Site ID: NLP-SR-F555b
Site Name: Enchanted Forest (b)
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Park
Multiple Owners

Existing Conditions:

The site is a reach of the Little Patuxent River located just upstream of Route 40, between the Enchanted Forest Shopping Center to the west and Elmmede Road to the east. The channel contains approximately 5.5 ft. high banks with silty material that is easily erodible due to the vertical banks, moderate root depths and moderate surface protection. Near bank stresses were found to be high due to the bankfull indicator at 2.5 ft. above the bed. An eroded tributary enters the channel at the downstream end of the site. This tributary has approximately 120 lf. of erosion. A stormwater management pond is located at the upstream extent of this site, which appears to be the start of the erosion. The pond may require further evaluation.

A sanitary sewer line runs parallel to the channel along the left bank (facing downstream) in the upper portions and then along the right bank in the lower portion after crossing the channel. In a few areas, the banks have eroded to a degree that they within close proximity to the sanitary sewer line. The channel is highly embedded with fines. The bed material is composed of mostly sand and silt with some cobbles, and moderate bar formation is observed in the channel. The presence of available and good quality epifaunal substrate habitat and coverage is very good. Three velocity/depth regimes are apparent and baseflow occupies the channel width to both banks. Riffle spacing is variable and in moderate condition, with the spacing characterized as being approximately seven to 25 channel widths. No channel alterations were observed. The riparian buffer width is greater than 60 ft. on both banks, but the quality of the riparian vegetation moderate to poor, at approximately 50 to 60% cover.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555b
Site Name: Enchanted Forest (b)
Contractor: KCI
Watershed: Little Patuxent River

Vertical, eroding banks with undercut trees and debris jams; sand deposition as bars; wide buffer along the left bank.

Vertical, eroding banks with some bench establishment; undercut trees.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555b
Site Name: Enchanted Forest (b)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The majority of this reach is within Howard County Parks and Recreations property, with upstream-most third of the site divided between Parks and Recreations property and the Enchanted Forest property. A sewer line runs parallel to the channel just to the west with two crossings identified through available mapping. A maintained easement also runs parallel to the channel, approximately 100 ft. from the left bank, seen in aerial imagery. Wetlands were noted on site, requiring special consideration to the design, permitting and construction access. The parallel easements could provide access; however, the location of the wetlands may determine construction access. Although the design would attempt to limit tree impacts, a moderate impact to trees would likely result during construction due to the existing wide riparian buffer. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations, and riparian cover is described as moderate.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a new floodplain can be graded at a secondary, lower elevation, or where a bench can be established at the current bankfull elevation. Some minor channel realignment may be proposed to shift the channel away from the parallel sanitary sewer line in areas that are currently within close proximity. A portion of the tributary is also proposed for design to stabilize the eroding banks, prevent further downcutting along the tributary, and provide a stable tie-in with the mainstem at the confluence.

Proposed bank protection will include bioengineering techniques such as alternating roughness protection, branch layering, coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations, especially in areas that are in close proximity to the parallel sanitary sewer line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat. Grade control structures will be used as necessary to stabilize the sanitary sewer crossing, depending on the elevation of the pipe in relation to the stream invert. A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,786	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	17.9	Estimated Construction Cost:	$803,700.00
Cost per Impervious Credit Acre:	$75,297.31	30% Contingency:	$241,110.00
		Estimated Total Cost:	$1,344,810.00

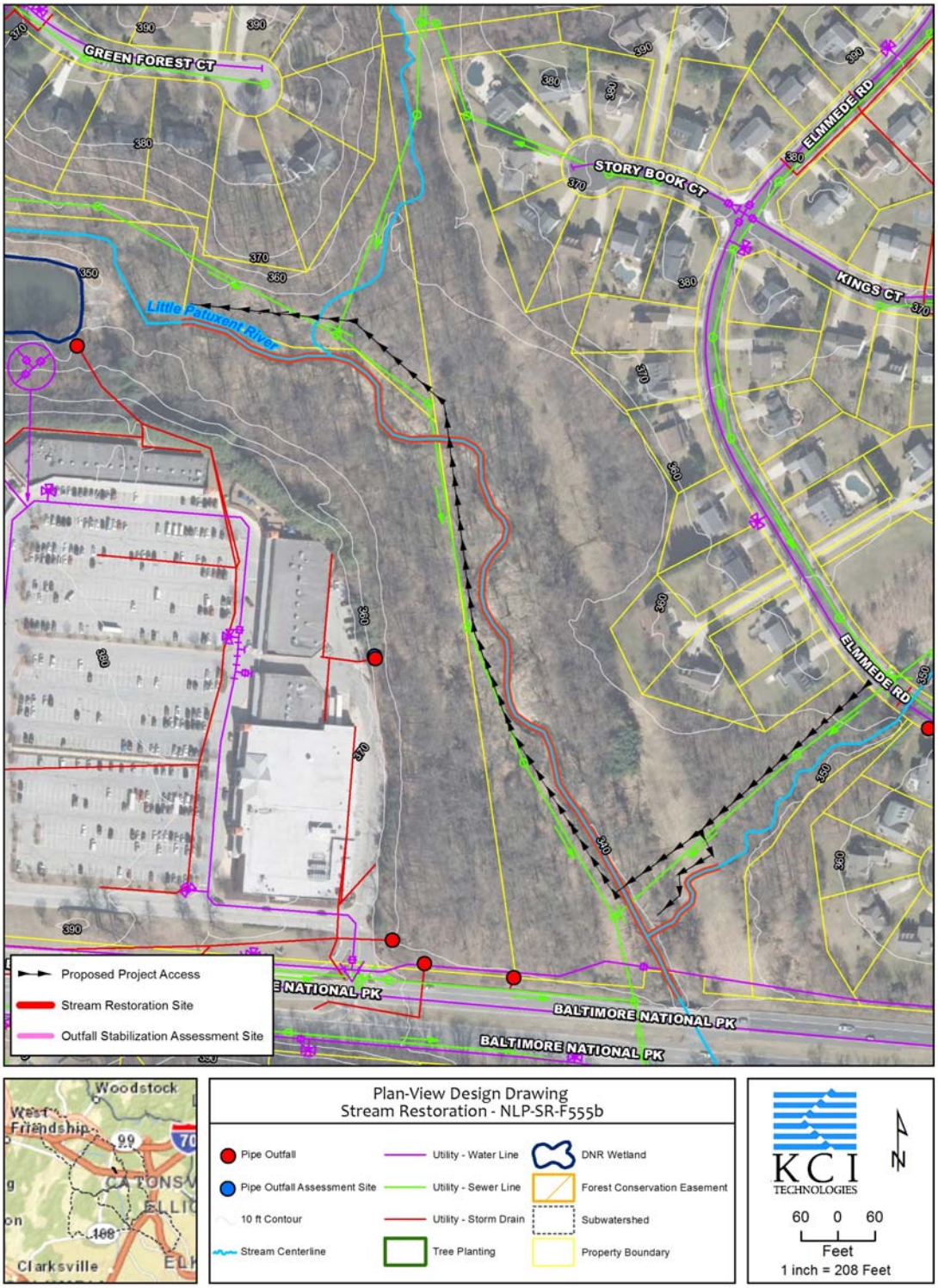
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F555b

Site Name: Enchanted Forest (b)

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F557a
Site Name: Boones Lane (b)
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

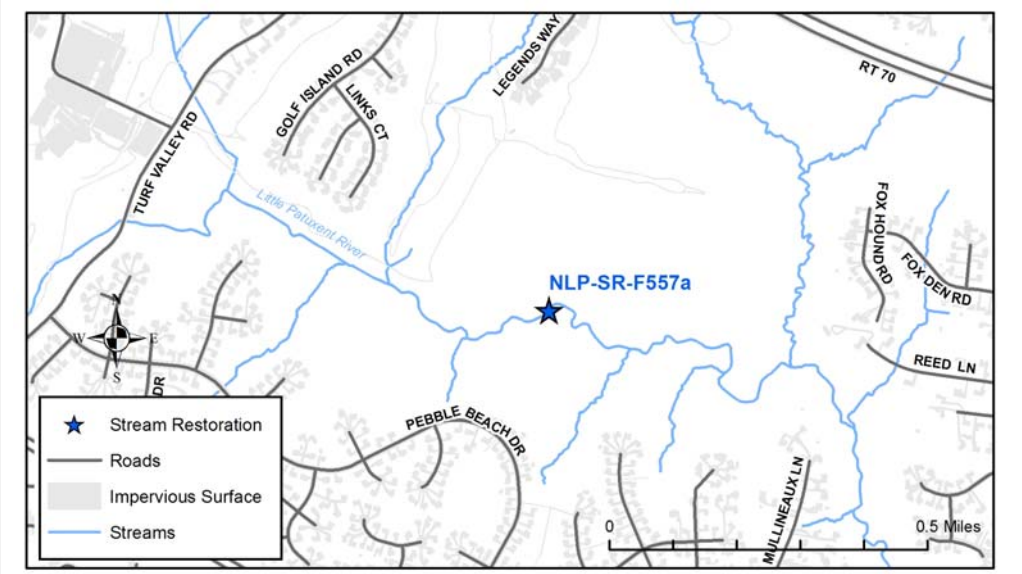
Existing Conditions:

The site is a reach located along the Little Patuxent River, just downstream of David W Force Park. The reach has 5.5 ft. high banks that are comprised mainly of silt and are easily erodible due to the vertical banks, moderate root depths, and moderate surface protection. Near bank stresses were found to be moderate to high with benches present throughout the site that appear to be bankfull indicators at 3 ft. in height above the bed. Banks are undercut with near fallen and falling trees. In addition, a large amount of debris was noted along the overbanks and within the channel bed throughout the reach as a result of fallen trees that are being transported by storm flows.

The channel appears to be in the process of widening and aggrading. The channel is low to moderately embedded with fines. Bed material is composed of mostly sand, gravel and cobble, and moderate amounts of deposition were observed in the channel. The presence of available and good quality epifaunal substrate habitat and coverage is suboptimal. Four velocity/depth regimes are apparent and baseflow occupies the entire channel width from bank to bank. Riffle spacing is in good condition, with the spacing characterized as being approximately five to seven channel widths.

A sanitary sewer line runs parallel to the channel along the left bank (facing downstream) and crosses the channel in one location along the restoration reach. In a few locations the channel has migrated towards the sanitary sewer line and appears to be in close proximity to the line and manholes. In addition, a water line crossing exists in the upper portion of the restoration reach. Minor channel alterations were observed in this channel and are associated with utility crossings.

The riparian buffer width is approximately 330 ft. on both the right and left banks, but the quality of riparian vegetation is moderate with 60% cover.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F557a
Site Name: Boones Lane (b)
Contractor: KCI
Watershed: Little Patuxent River

Erosion on right bank, vertical banks with poor root depth.

Undercut banks with falling trees and poor root depth.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F557a
Site Name: Boones Lane (b)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

This reach is located within various Howard County Parks and Recreation properties, allowing for minimal coordination necessary to gain access; however, the site is located within a wide forested buffer that will require a long access path to the channel, which will impact the adjacent forest. Construction access may be possible from Pebble Beach Dr. or Pinehurst Ct. Although there are no property owner constraints, the access route from Pebble Beach Dr. to the restoration reach is 650 ft. and will require significant impacts to trees. The access route from Pinehurst Ct is along a sewer easement, but is 1,300 ft. from the reach and will require a stream crossing at an unnamed tributary to the Little Patuxent River that is not included in the current extents of restoration. The sewer line that runs parallel to the channel on the left bank with a stream crossing at the downstream end of the site, poses some minor constraint to the design. Although the design would attempt to limit tree impacts, a significant impact to trees would likely result during construction due to the existing wide riparian buffer in most areas; however, the forest was noted as being somewhat sparse in areas and the trees are not overly healthy.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a secondary floodplain can be graded at a new, lower elevation. Proposed bank protection will include bioengineering such as alternating roughness protection, live branch layering, and vegetative stabilization; however, stone protection and other harder bank treatments may be necessary in a few isolated locations, particularly to stabilize the parallel sanitary sewer and water line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,795	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	18	Estimated Construction Cost:	$807,750.00
Cost per Impervious Credit Acre:	$75,171.21	30% Contingency:	$242,325.00
		Estimated Total Cost:	$1,350,075.00

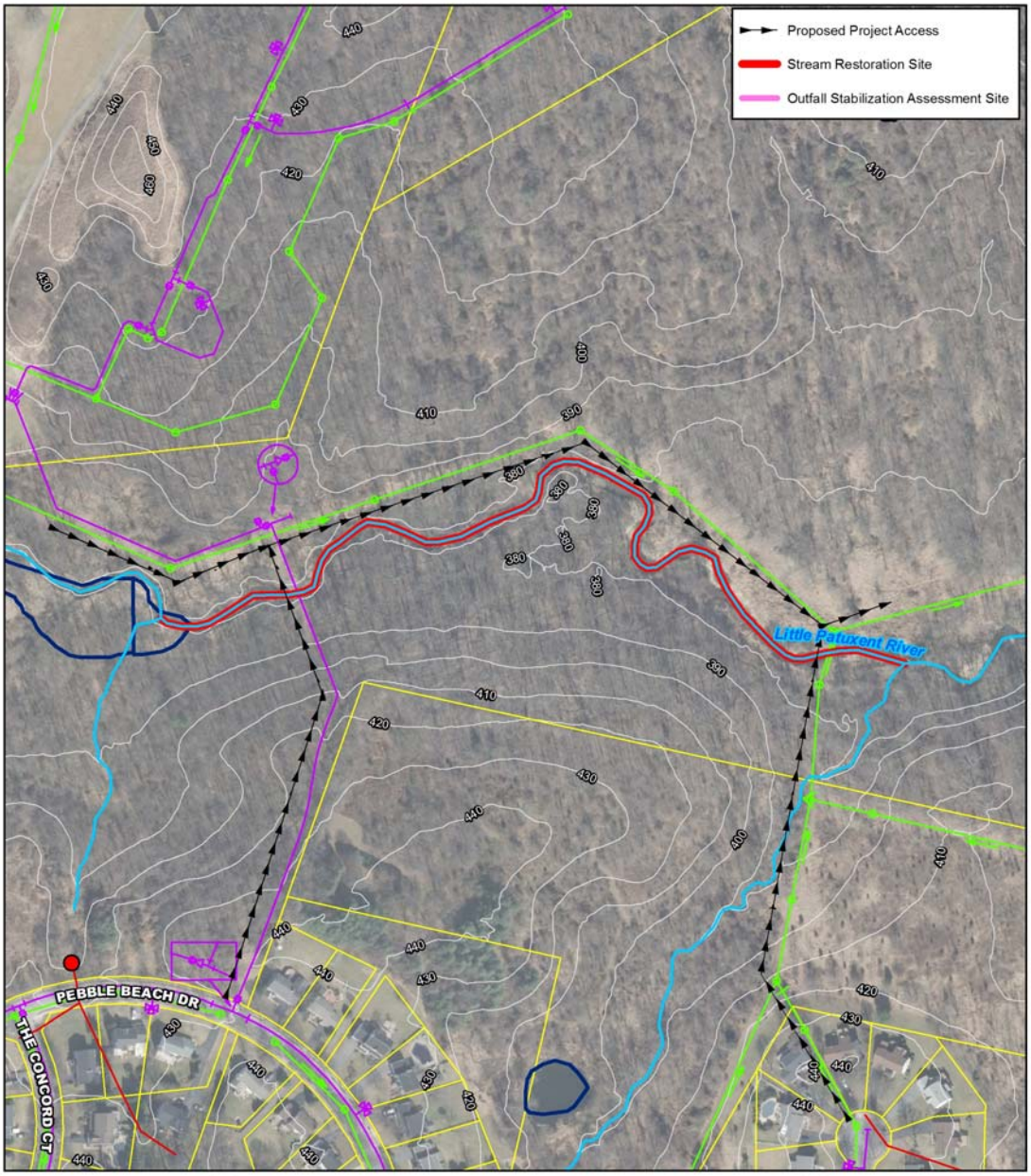
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F557a

Site Name: Boones Lane (b)

Contractor: KCI

Watershed: Little Patuxent River



Plan-View Design Drawing
Stream Restoration - NLP-SR-F557a

- Pipe Outfall
- Pipe Outfall Assessment Site
- 10 ft Contour
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility - Storm Drain
- Tree Planting
- DNR Wetland
- Forest Conservation Easement
- Subwatershed
- Property Boundary

KCI TECHNOLOGIES

N

75 0 75

Feet

1 inch = 258 Feet

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F571a
Site Name: Red Hill Branch at Santa Fe Court
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

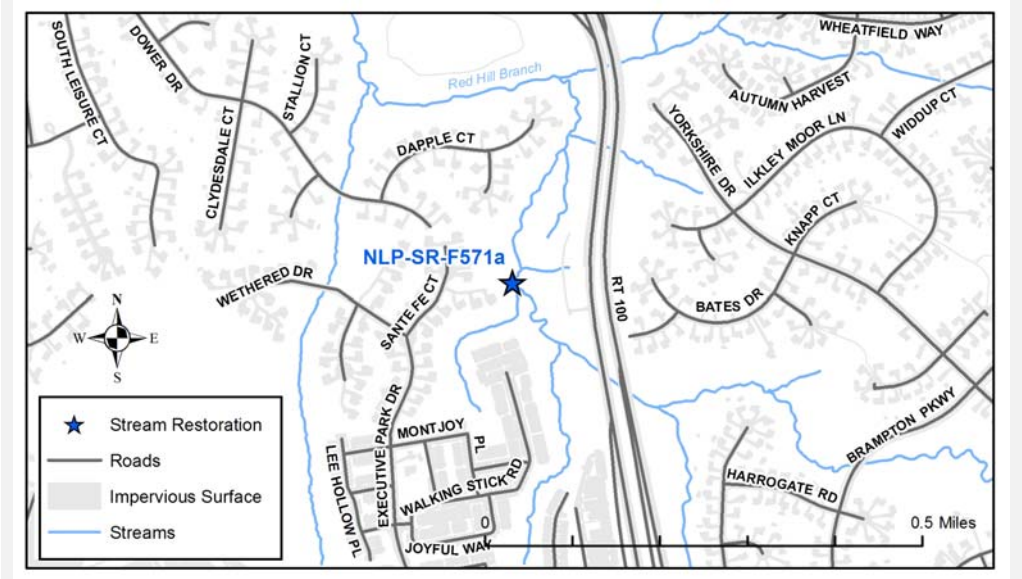
Existing Conditions:

The site is located on Red Hill Branch between MD 100 to the east and Sante Fe Court to the west. The reach has 4 to 8 ft. high banks with silty to clay material that is easily erodible due to the vertical banks, shallow root depths and very little surface protection. Near bank stresses were found to be moderate to very high due to the change in bank heights. Possible bankfull indicators ranged from the presence of inner berms at 1.5 and 2 ft. above the bed at the upstream extent of the site, the low bank at 3.5 ft. above the bed at the middle section of the reach, and the presence of benches at 3 ft. above the bed in the downstream extent of the site.

A stormwater management pond drains to the middle of the site. The pond outfall channel is severely backwatered, and is functioning more like a continuation of the pond; therefore, its banks are in good condition. The pond is adjacent to MD 100, and includes access from MD 100 that may be useful for this site.

The channel is moderately embedded with fines. The bed material is composed of mostly gravel, sand, and silt with some cobbles, and moderate bar formation is observed in the channel. The presence of available and good quality epifaunal substrate habitat and coverage is moderate. Three velocity/depth regimes are apparent and baseflow occupies approximately 75% of the channel width at the bottom of the banks. Riffle spacing is variable and in moderate condition, with the spacing characterized as being approximately 15 channel widths. No channel alterations were observed.

The potential riparian buffer width is great than 60 ft. on both banks; however, the sewer easement along the left bank interrupts the potential for a completely uninterrupted forested buffer. Despite the open space and available land, the quality of forest cover is poor, and poor survival was noted for a recent tree planting project adjacent to the channel.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F571a

Site Name: Red Hill Branch at Santa Fe Court

Contractor: KCI

Watershed: Little Patuxent River

Vertical banks and undercut trees; abundant woody debris; bar deposition.

Raw and undercut banks with poor riparian vegetation.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F571a
Site Name: Red Hill Branch at Santa Fe Court
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

This reach is within various Howard County properties, making property access feasible. Construction access may be possible using the sewer easement from Santa Fe Court or from MD 100, though this will require coordination with MD SHA . A sewer line runs parallel to the channel with a stream crossing at the upstream end of the site, which poses some constraint to the design. Although the design would attempt to limit tree impacts, a moderate impact to trees would likely result during construction due to the existing wide riparian buffer. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations. The largest constraint to the success of this project is the beaver activity.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a secondary floodplain can be graded at a new, lower elevation. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat. A few areas were noted during the assessment that did not appear eroded, including approximately 500 lf. downstream of the confluence with the pond. Such areas may require bank grading and plantings only. Further, the more severely eroded conditions of this channel occur at the downstream extents of the site and beyond. Further evaluation is recommended downstream of this site in order to better assess the project limits.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species. Additional plantings may also be feasible surrounding this site as a tree planting site; however, beaver activity was noted, and a failed tree planting site adjacent to the channel was observed. Beaver activity could also be detrimental to success of this stream restoration project as well, as vegetative stabilization measures are key to the success of a stream restoration project.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,067	Estimated Design Cost:	$200,000.00
Impervious Area Treated Credit (ac.):	10.7	Estimated Construction Cost:	$480,150.00
Cost per Impervious Credit Acre:	$77,244.14	30% Contingency:	$144,045.00
		Estimated Total Cost:	$824,195.00

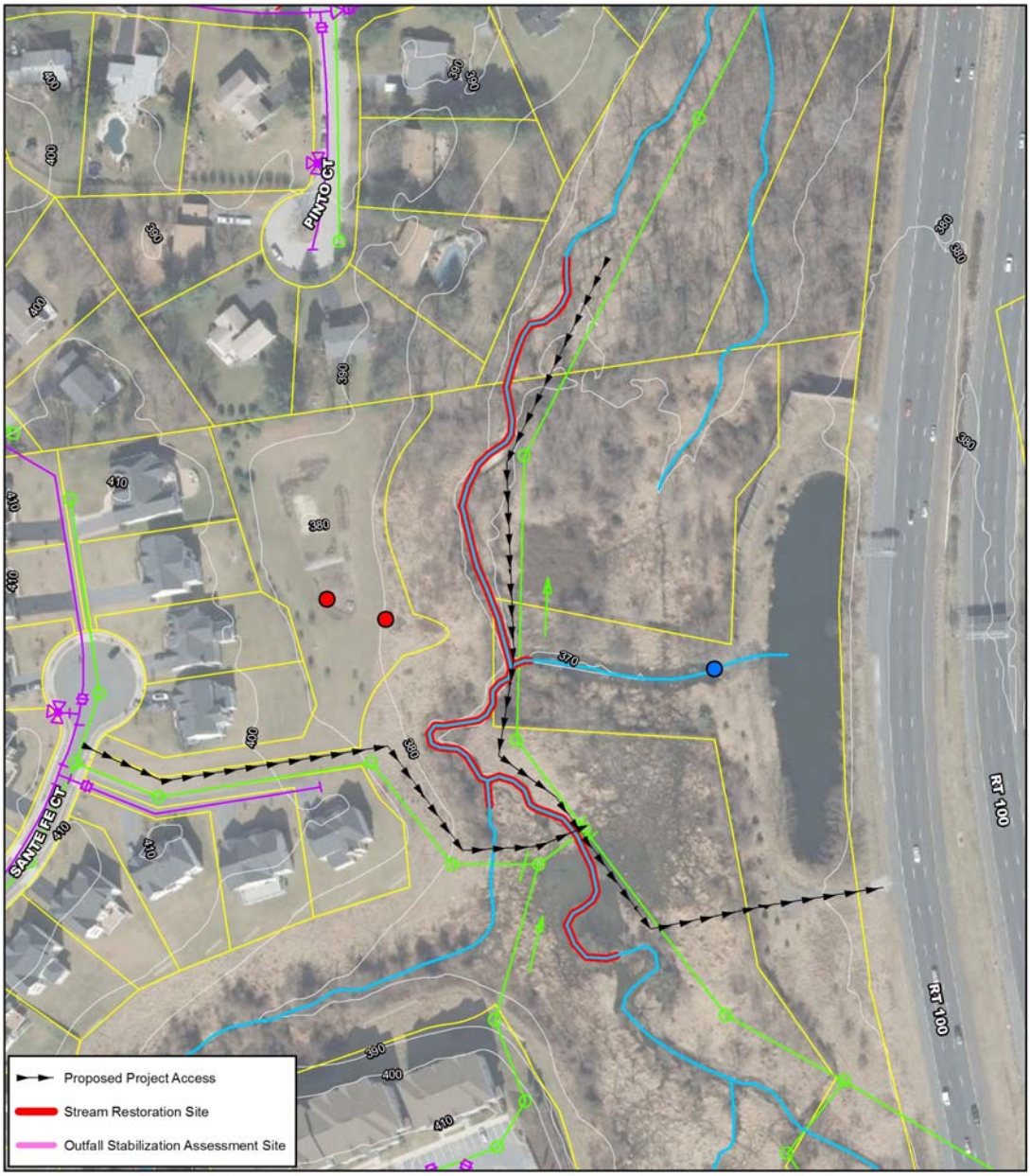
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F571a

Site Name: Red Hill Branch at Santa Fe Court

Contractor: KCI

Watershed: Little Patuxent River



Plan-View Design Drawing
Stream Restoration - NLP-SR-F571a

- Pipe Outfall
- Pipe Outfall Assessment Site
- 10 ft Contour
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility - Storm Drain
- Tree Planting
- DNR Wetland
- Forest Conservation Easement
- Subwatershed
- Property Boundary

KCI TECHNOLOGIES

N

40 0 40

Feet

1 inch = 150 Feet

Howard County Watershed Assessment Concept Plan: Stream Restoration

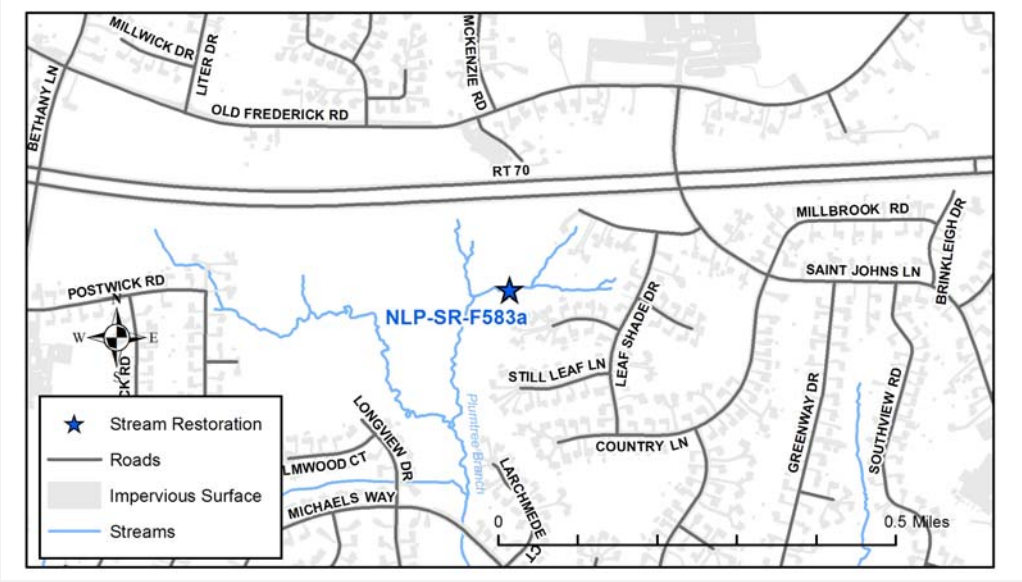
Site ID: NLP-SR-F583a
Site Name: Tributaries to Plumtree Branch, North
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Residential
Multiple Owners

Existing Conditions:

The site is located on several unnamed tributaries to Plumtree Branch. The reach includes branching of several tributaries that contribute flow to a mainstem segment. The bank heights range from 4 to 10 ft., with silt and clay material that is easily erodible due to their vertical bank angles, shallow root depths and poor surface protection. These tributaries are incised, when comparing their bank heights to the bankfull indicator (2 ft.). Thus, near bank stresses are very high. Erosion is recent and active, with sections of slumping banks and destabilized bank material, causing large amounts of deposition within the channel.

The bed material is composed of mostly sand and silt, but some gravel and cobbles were found in the riffles. As a result of the fine bed and bank material, the channel is highly embedded. The presence of available and good quality epifaunal substrate habitat and coverage is suboptimal due to the abundance of woody debris and leaf packs; however, the stability of habitat is uncertain due to the active erosion. Flow regimes are limited to two velocity/depth regimes, and riffle spacing is variable, ranging from seven to 20 channel widths. The riparian buffer width is greater than 60 ft. on both banks, with approximately 70% vegetative cover. No channel alterations were observed.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F583a
Site Name: Tributaries to Plumtree Branch, North
Contractor: KCI
Watershed: Little Patuxent River

Vertical and eroding banks, severe erosion.

Undercut banks, some deposition.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F583a
Site Name: Tributaries to Plumtree Branch, North
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The majority of the reach is within private property. The area, however, is landlocked, and is not likely to be developed. Access from Leaf Shade Dr. can be achieved through a Howard County Parks and Recreations property near the upstream end of the site, or from a number of sewer easements along private property to the left bank of the channel. The sewer line runs parallel to the channel with three crossings through the stream that will require special considerations during design and construction.

Although the design would attempt to limit tree impacts, a moderate impact to trees would likely result during construction due to the existing wide riparian buffer. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations and riparian cover was described as moderate and sparse due to the sewer easement along the channel.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a secondary floodplain can be graded at a new, lower elevation. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable for the pools, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,987	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	19.9	Estimated Construction Cost:	$894,600.00
Cost per Impervious Credit Acre:	$73,627.58	30% Contingency:	$268,380.00
		Estimated Total Cost:	$1,462,980.00

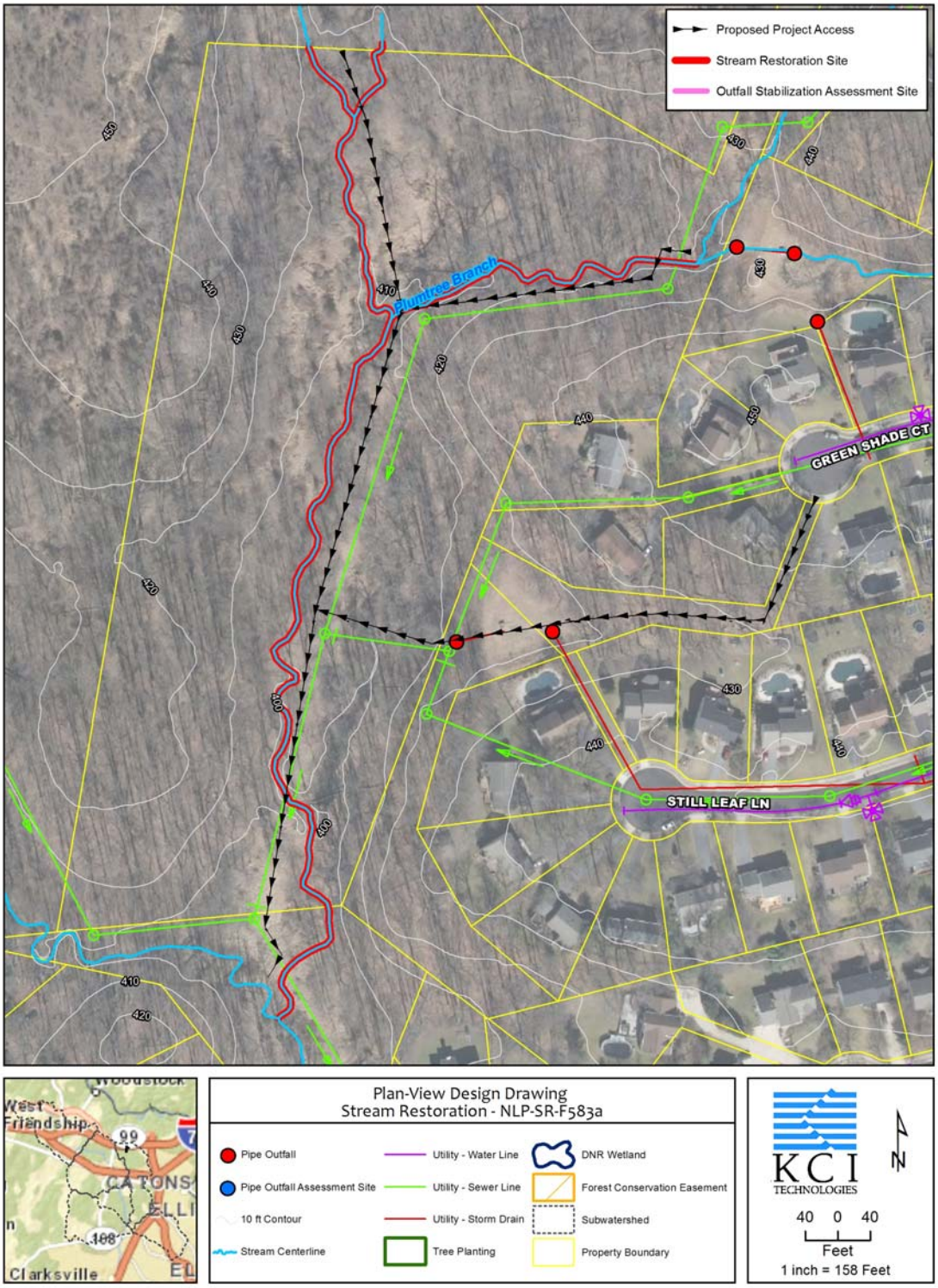
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F583a

Site Name: Tributaries to Plumtree Branch, North

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

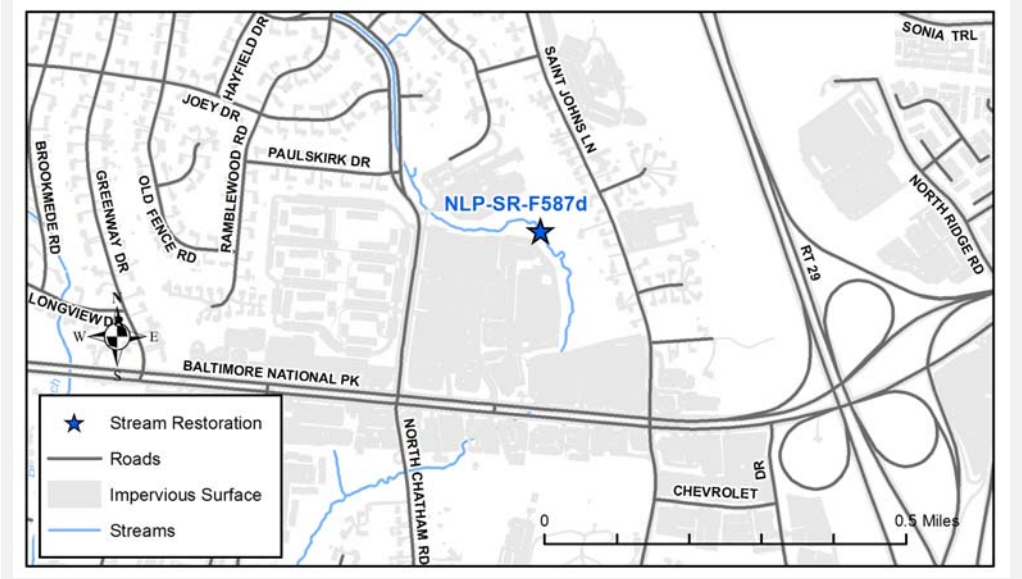
Site ID: NLP-SR-F587d
Site Name: Lutheran Village North
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

This site runs behind the parking lot for the Chatham Station Shopping Center, with its embankment greater than 25 ft. above the channel. The right bank of the channel is pinned close to this embankment, with boulders encroaching upon the channel banks. The left bank contains a wide, flat floodplain with a riparian buffer width greater than 60 ft. Banks are 3 to 6 ft. in height, and approximately 15 to 20 ft. wide. Erosion is present throughout the reach due to the silt-clay bank composition, steep bank angles, and shallow root depth, and minimal surface protection. Some bar deposition was noted as sandy lateral and point bars up to 1 ft. in height. An inner berm at 2 ft. in height above the bed was observed as the bankfull height. Thus, near bank stresses are moderate, based on the mean bankfull depth to near-bank maximum depth ratio.

The channel is highly embedded with fines and contains very poor quality epifaunal substrate and cover. Geomorphic variability is also limited, based on the number of velocity/depth regimes (2) and riffle spacing (15-25 channel widths). Nonetheless, an abundance of fish was noted throughout the site, compared to other sites.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F587d
Site Name: Lutheran Village North
Contractor: KCI
Watershed: Little Patuxent River

Undercut and eroding banks with no surface protection and shallow root depth; deposition as bar deposits.

Incised and eroding outfall channel.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F587d
Site Name: Lutheran Village North
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The channel runs through multiple private commercial and residential properties, including the Chatham Mall Company, and a large parcel owned by the Church of the Resurrection and two large parcels owned by the Roman Catholic Archbishop of Baltimore through which access will need to be coordinated. Construction access may be feasible from the northwest corner of the Chatham Shopping Center parking lot, where shopping center activity is minimal or behind St. John's Plaza. Access from the Church of the Resurrection may also be possible, if coordination agreements can be made, particularly with regard to time of the school day.

The embankment to the Chatham Station Shopping Center is very steep and is composed of very large boulders down to the channel. This embankment and its boulders present significant constraints to the design, as moving the boulders would be intensive and costly. It is recommended that the horizontal alignment of this channel be pulled away from the embankment to limit grading along the right bank to fill areas, which will also provide some flood relief along this bank.

The existence of wetlands will require special considerations to the design. Tree removals will also be required; however tree cover is sparse.

Concept Description:

The proposed stream restoration includes a natural channel design throughout this site, where a secondary floodplain can be graded at a new, lower elevation. Bank protection is expected to be composed primarily of bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species. Several areas were noted as having potential for further planting beyond the LOD, including an area in the rear of the adjacent Church of the Resurrection parking lot, and another area of open space towards the downstream end and on the left bank of the channel.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,980	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	19.8	Estimated Construction Cost:	$891,450.00
Cost per Impervious Credit Acre:	$73,681.06	30% Contingency:	$267,435.00
		Estimated Total Cost:	$1,458,885.00

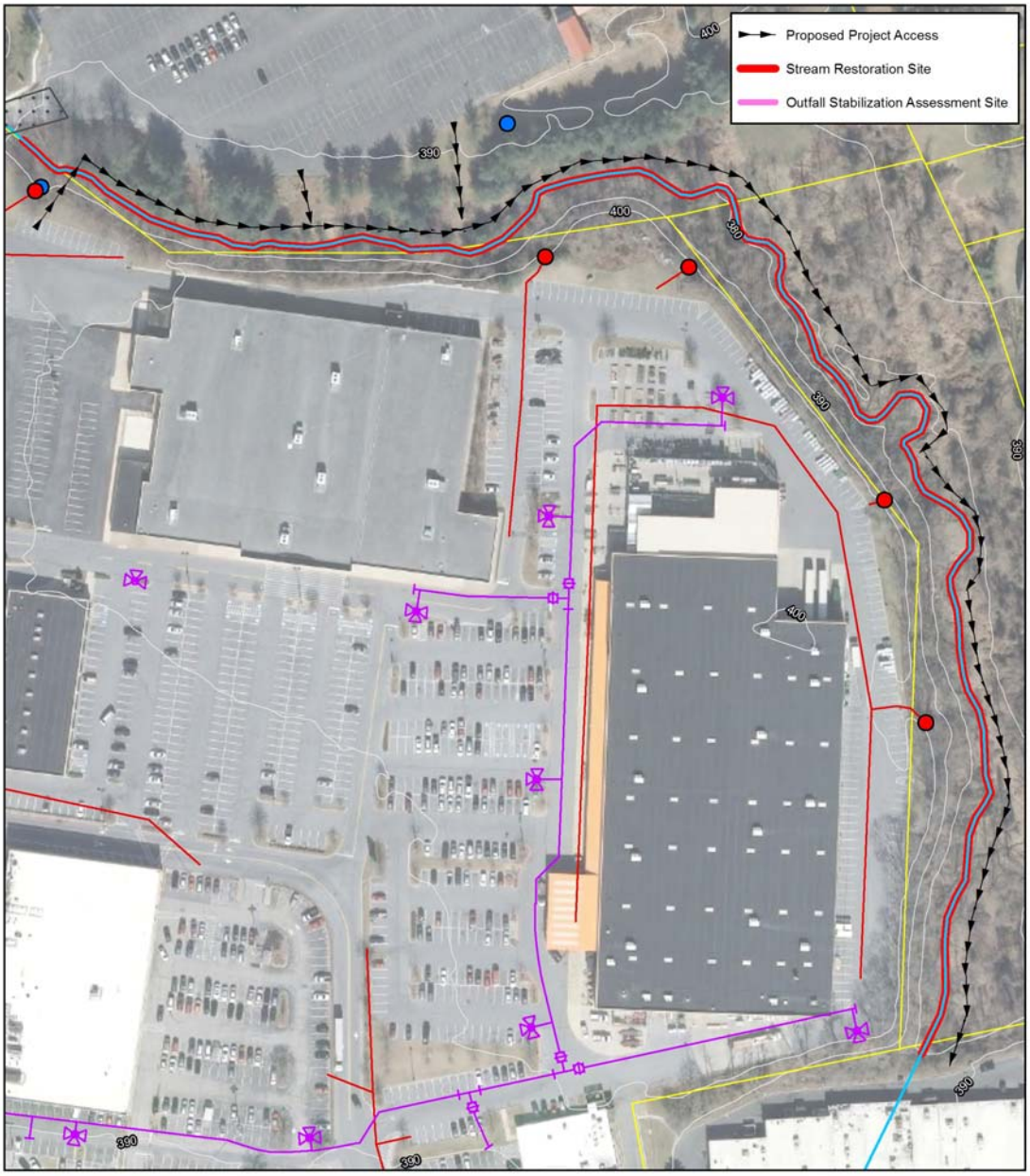
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F587d

Site Name: Lutheran Village North

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F590a
Site Name: Turf Valley (d)
Contractor: KCI
Watershed: Little Patuxent River

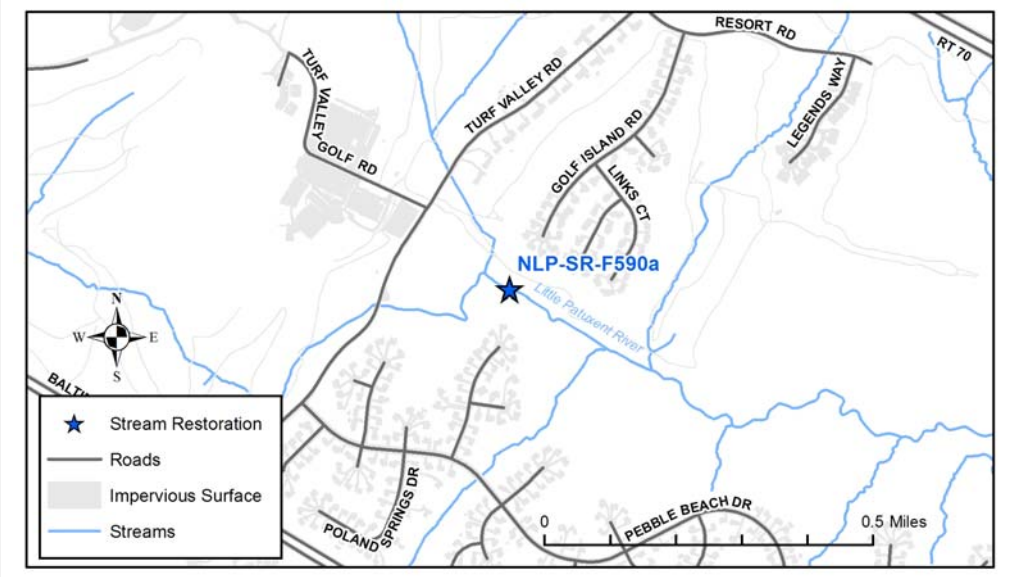
Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

The restoration reach is located on the Little Patuxent River. It has approximately 3 to 6 ft. high vertical banks comprised of easily erodible silty material; however, the banks contain areas of moderate to high root depths and high surface protection. Bank heights are lower, around 3 ft., in the upper portions of the restoration reach to the confluence with an unnamed tributary. Downstream of the confluence the bank height increases, reaching up to 6 ft. in height. Overall, the restoration reach has approximately 1,800 linear ft. of moderately eroded banks.

The reach has a low level of embeddedness and the bed material is composed of mostly sand, gravel, cobble and boulders with some silt. The presence of available and good quality epifaunal substrate habitat and coverage is suboptimal to optimal. Three velocity/depth regimes are apparent and baseflow occupies more than 75% of the width between both banks. Riffle spacing is characterized as being approximately 5 to 15 channel widths. Minimal channel alterations were observed and are associated with a sanitary sewer crossing. The sanitary sewer line also runs parallel to the restoration reach.

The riparian buffer width is greater than 60 ft. on both banks until after the confluence at the middle of the reach where the left bank changes to less than 20 ft. because the reach runs along the Turf Valley Golf Course. The quality of the riparian vegetation is good, at approximately 90% cover.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F590a
Site Name: Turf Valley (d)
Contractor: KCI
Watershed: Little Patuxent River

Facing downstream, vertical left banks with moderate root depth.

Facing upstream, erosion on left bank with poor root depth. Good epifaunal habitat availability.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F590a
Site Name: Turf Valley (d)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

Half of the restoration area is within Howard County Parks and Recreations property while the other half is on Mangione Enterprises Turf Valley property, so property owner coordination will be necessary to complete the project. A sewer line runs parallel to the channel with a crossing at the midpoint of the reach. A maintained easement also runs parallel to the channel in the lower half of the site.

The easements running parallel to the channel could provide access; however, the location of the wetlands may determine construction access. Although the design would attempt to limit tree impacts, a significant impact to trees would likely result during construction due to the existing wide riparian buffer. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a secondary floodplain can be graded at a new, lower elevation, and where a limited bench can be established at the current bankfull elevation. As the reach runs along the border of Howard County Parks property and Mangione Enterprises Turf Valley property, there is potential to realign portions of the reach so it is solely on Howard County Parks property and better floodplain access would be available. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,762	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	17.6	Estimated Construction Cost:	$793,350.00
Cost per Impervious Credit Acre:	$75,559.31	30% Contingency:	$238,005.00
		Estimated Total Cost:	$1,331,355.00

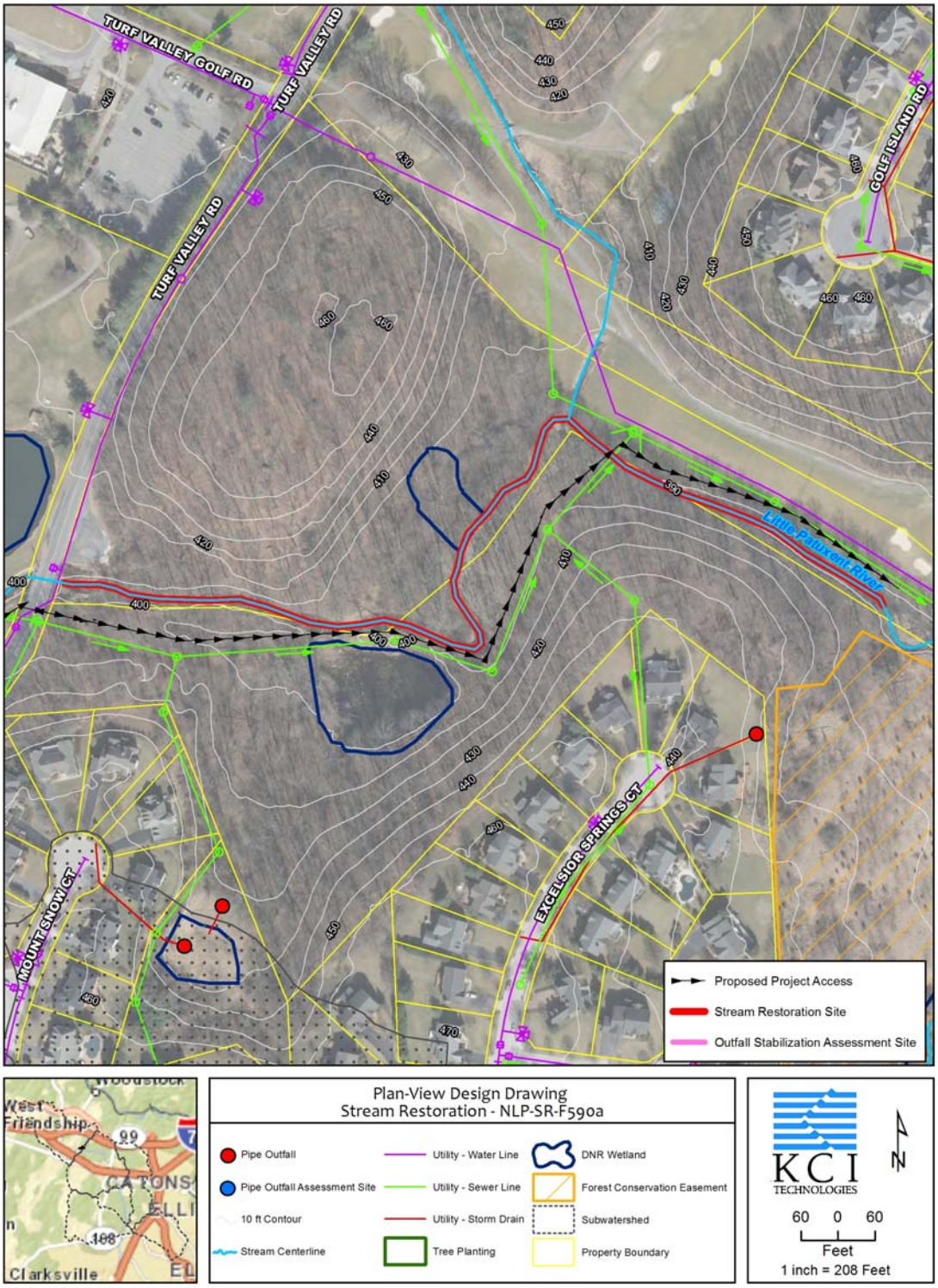
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F590a

Site Name: Turf Valley (d)

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

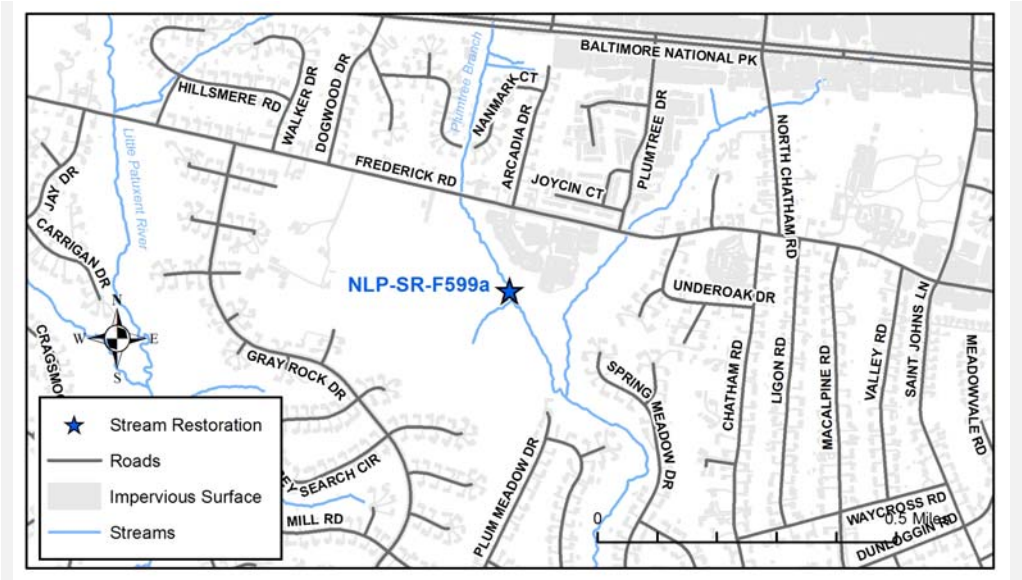
Site ID: NLP-SR-F599a
Site Name: Plumtree Branch
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

The project site is a segment of Plumtree Branch bounded to the north by Frederick Road and ending at the confluence with the unnamed tributary from proposed project SR-50. A sewer line runs parallel to the channel along the right bank, with two contributing lines that cross the channel from the left bank; the easement contains abundant grasses and few trees. Reach 1 is approximately 560 lf. and starts at the upstream end of the project site. Banks are generally 5 ft. in height along the right bank and 3 ft. on the left bank. The top of bank width is approximately 15 ft., and bed material is sand and silt with some cobbles present in the riffles. A few benches along the right bank have formed out of slumped bank material, with a stabilized height above the bed at 2 ft. The reach is characterized by vertical and eroding banks and localized erosion on outer meander bends of the left bank. A very large debris jam was noted. Reach 2 is approximately 1,070 lf., and has shorter stretches of less severe erosion than Reach 1. The riparian floodplain has a few more trees and shrubs that provide better rooting depth for bank protection. The reach ends at a new bridge under construction. Reach 3 is approximately 575 lf. in length, with 4 to 5 ft. high banks. Banks are 15 to 20 ft. wide, vertical, and raw with very low root depth.

A very large construction operation is under way on the right bank, and construction has recently been completed at the library and senior center along the left bank of this project site. The right bank was formerly abandoned agricultural land with abundant unmowed grasses and some trees and shrubs. Because of the recent construction surrounding this site, it is doubtful that the effects of the change in land use have impacted the channel at this time. However, with the existing channel erosion and recent environmental disturbances, this site is a prime candidate for stream restoration. A channel design that addresses the new stormwater inputs prior to significant degradation would be in good timing to mitigate future erosion. With the recent community and environmental disturbance surrounding construction, an immediate restoration strategy might lessen the total time to recovery, as opposed to disrupting newly established vegetation and other riparian and aquatic life. The project may also provide a good educational opportunity due to its proximity to several community facilities and could be visible from Frederick Road.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F599a
Site Name: Plumtree Branch
Contractor: KCI
Watershed: Little Patuxent River

Vertical banks and sand deposition, very fine bed material.

Bench establishment at approximately 2 ft. in height.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F599a
Site Name: Plumtree Branch
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

Ownership through the study area includes four large parcels: the right bank is owned predominantly by Lutheran Village, and the left bank is split between Howard County and the Miller Land Company. The final parcel of land is owned by Howard County, and includes approximately 340 lf. along both banks.

A sewer line runs parallel to the channel along the right bank, with two contributing lines that cross the channel from the left bank. The maintained sewer easement contains abundant grasses and few trees. Although this may be a constraint in some areas, it also provides good access for construction.

A few specimen trees were noted along the channel that appears to be in good condition, and some wetlands may be present along the left bank at the lower extent of the project reach.

Concept Description:

The proposed stream restoration includes a natural channel design throughout this site, where a new secondary floodplain can be graded at a lower elevation. The width of the proposed secondary floodplain will be determined by distance to private property, wetlands, and specimen trees. Bank protection is expected to be composed primarily of bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations, particularly in close proximity to the sewer line. Some existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

Riffle Grade Controls are also proposed at the sewer crossings to provide vertical control of the channel bed to protect the sanitary sewer. A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

NLP-SR-50, NLP-SR-F586a (not selected for concept phase)

Proposed Project Credit		Costs	
Length Restored (ft):	2,204	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	22.0	Estimated Construction Cost:	$992,250.00
Cost per Impervious Credit Acre:	$72,138.16	30% Contingency:	$297,675.00
		Estimated Total Cost:	$1,589,925.00

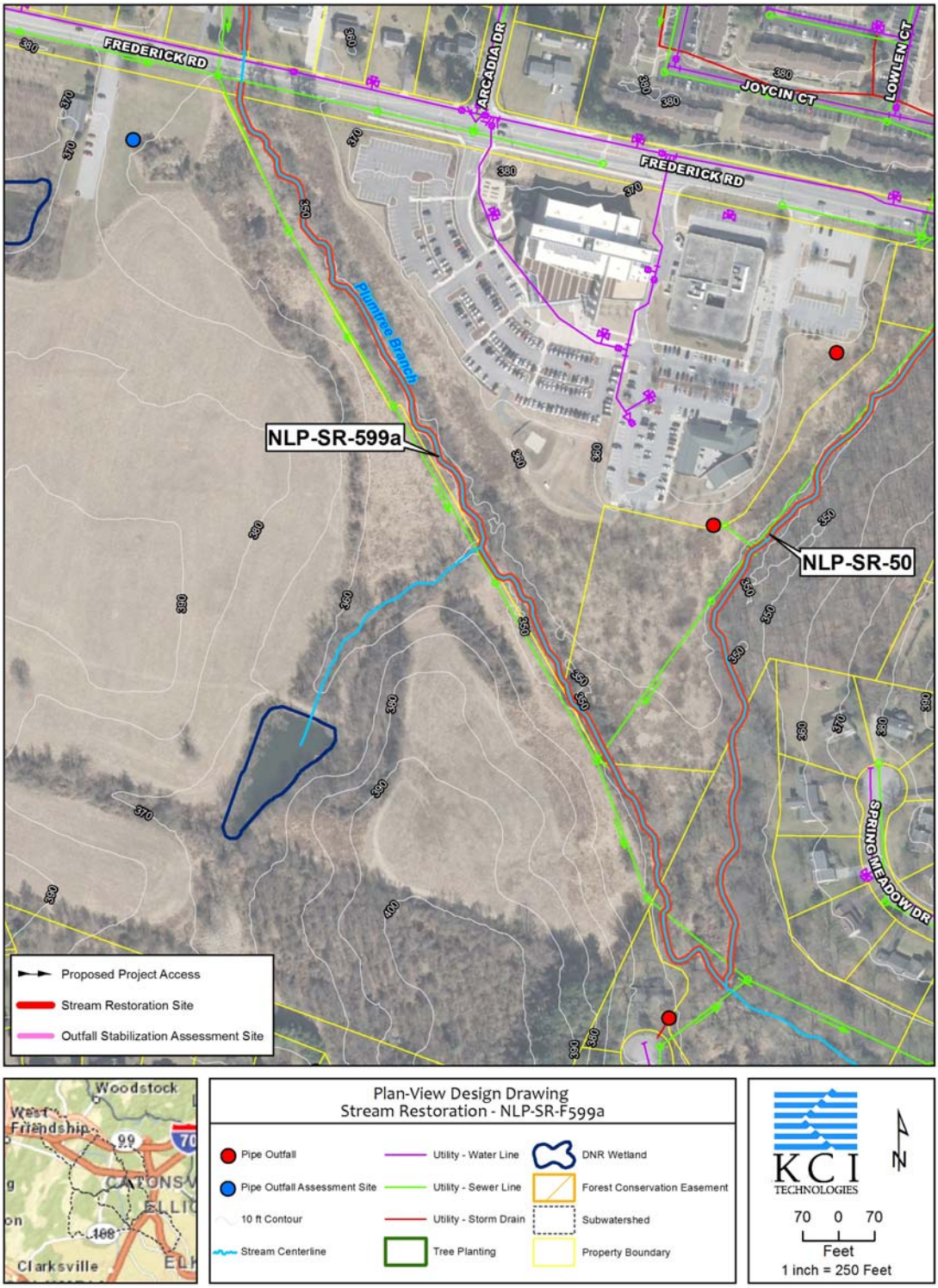
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: NLP-SR-F599a

Site Name: Plumtree Branch

Contractor: KCI

Watershed: Little Patuxent River



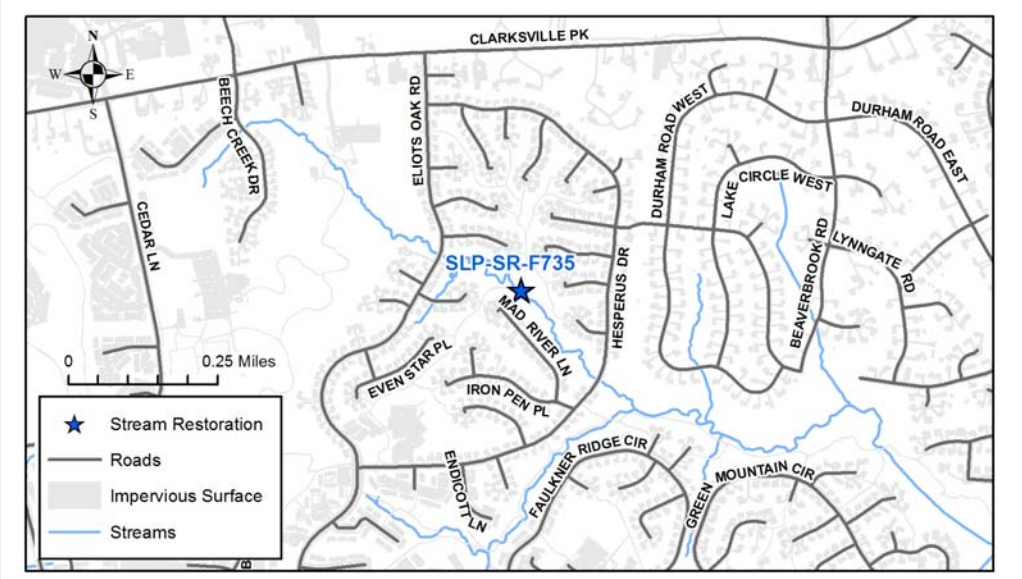
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F735
Site Name: Wilde Lake Headwaters Stream Restoration
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Columbia Association
Single Owner

Existing Conditions:

The stream corridor recommended for restoration is fully contained within Columbia Association property, though several private residential houses and yards are within 100 ft. of the stream channel. Three outfalls discharge directly into the stream reach. Erosion is present along 70-80% of the stream reach, but only 10-20% of the existing erosion is severe. Several large point bars are present within the reach. The assessments of habitat conditions conducted within the reach yielded a Partially Supporting rating.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F735

Site Name: Wilde Lake Headwaters Stream Restoration

Contractor: Versar

Watershed: Little Patuxent River

Cut bank erosion occurring along the left bank. Photo taken approximately 250 ft. upstream of Hesperus Drive. Bank height is approximately 4 ft.

Cut bank erosion occurring along the right bank. Photo taken approximately 650 ft. upstream of Hesperus Drive from the top of a large point bar. Bank height is approximately 5 ft.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F735
Site Name: Wilde Lake Headwaters Stream Restoration
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Two sewer line crossings exist within the proposed restoration reach. One crossing is located approximately 800 ft. upstream of Hesperus Drive, and one crossing is located 450 ft. downstream of Eliot Oaks Road. Mature trees exist along both sides of the stream for the entire length of the proposed project, with several that have recently fallen into the stream channel. Two wetland areas were noted within the reach, one near the very downstream extent, and another near the upstream extent.

Concept Description:

The proposed restoration will stabilize eroding banks and reconnect the stream channel with the floodplain. Any floodplain reconnection work will have to be mindful of the Columbia Association trails that are often adjacent to the channel, and wetland areas that are present along the floodplain. The large point bars that dominate the inside of meander bends should be addressed as well. It is also recommended that a drop structure replaces the outfall (SLP-OF-F854) located on the right side of the channel, close to the middle of the reach. Approximately 30 ft. of riprap should also be installed along the associated outfall channel. The cost of the outfall stabilization is not included in the total cost for this site. The site can be accessed from Columbia Association trails located on either side of the proposed restoration reach.

Nearby Opportunities:

SLP-OF-F854

Proposed Project Credit		Costs	
Length Restored (ft):	2,008	Estimated Design Cost:	$320,000.00
Impervious Area Treated Credit (ac.):	20.1	Estimated Construction Cost:	$903,676.50
Cost per Impervious Credit Acre:	$74,441.21	30% Contingency:	$271,102.95
		Estimated Total Cost:	$1,494,779.45

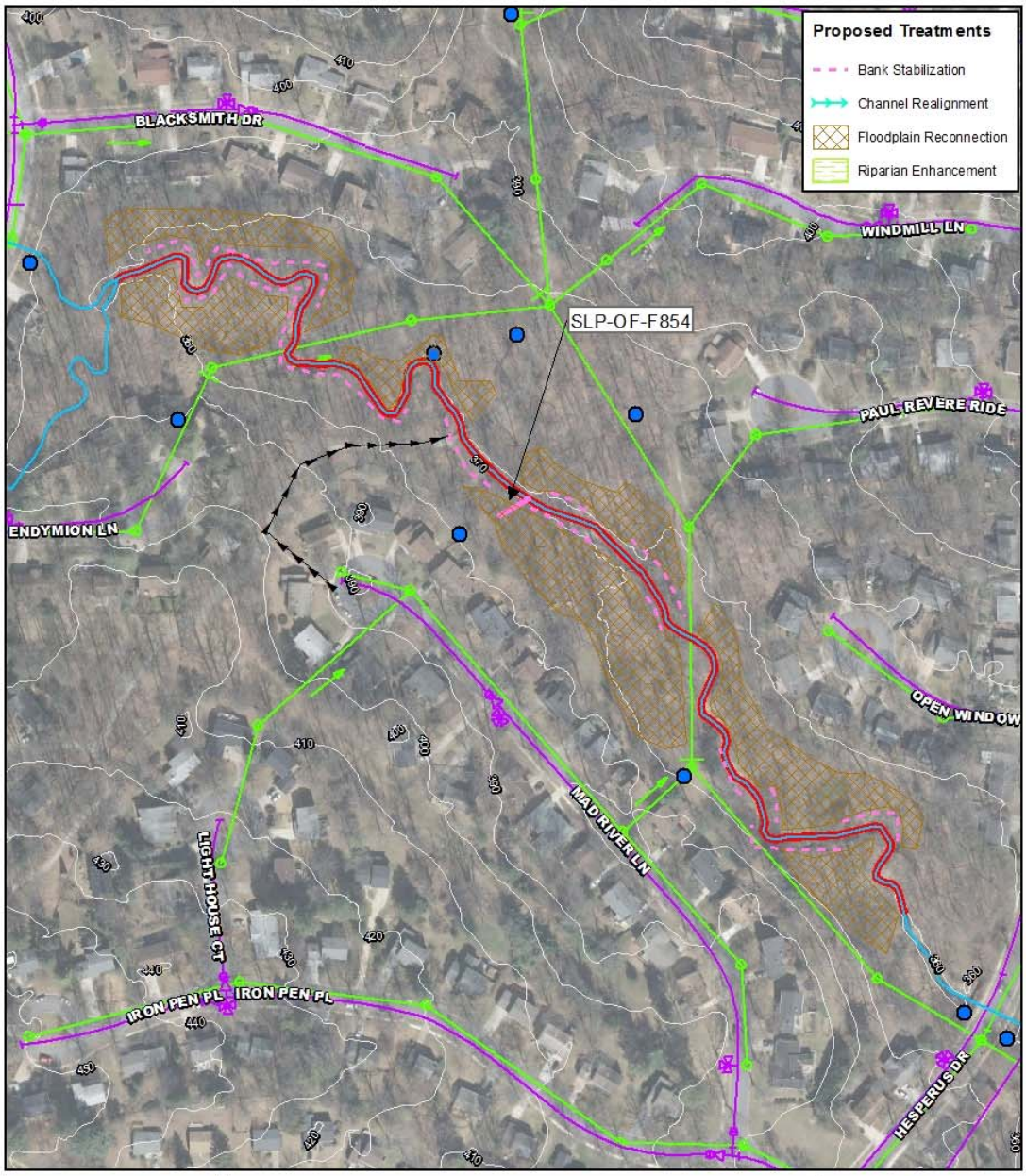
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F735

Site Name: Wilde Lake Headwaters Stream Restoration

Contractor: Versar

Watershed: Little Patuxent River



Plan-View Design Drawing

Stream Restoration - SLP-SR-F735

Proposed Project Access
Stream Restoration Site
Pipe Outfall Site
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
New BMP
DNR Wetland
Forest Conservation Easement

VERSAR

N

50 0 50

Feet

1 inch = 200 Feet

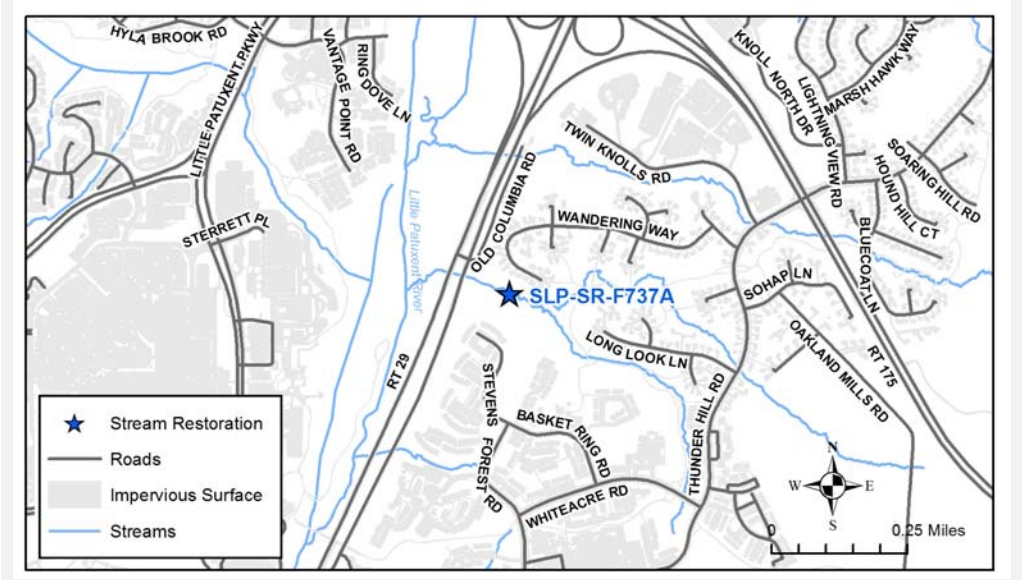
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F737A
Site Name: Oakland Mills
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Columbia Association
Multiple Owners

Existing Conditions:

Nearly the entire stream corridor recommended for restoration is contained within Columbia Association property, with approximately 50 lf. being located within State Highway Administration Right of Way for Route 29. One stabilized outfall discharges directly into the stream reach and appears to have been installed within the past few years. A few patches of minor to moderate erosion exist in the downstream portion of the reach, and severe erosion exists in the upstream portion of the reach. Large and raw stream banks in the upstream portion of the reach appear to be the result of an old dam that once blocked the stream channel; remnants of this dam still remain in the channel. An exposed utility pipe was observed in the upper most portion of the reach. The assessment of habitat conditions conducted within the reach yielded a Non-supporting rating.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F737A
Site Name: Oakland Mills
Contractor: Versar
Watershed: Little Patuxent River

An approximately 7 ft. high sediment deposit located along the left bank. Sediment appears to have accumulated behind an old dam. Dam remnants can be found approximately 500 ft. upstream of Route 29.

Erosion occurring along the left bank of the stream. Photo taken approximately 800 ft. upstream of Route 24. Bank height is approximately 5 ft.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F737A
Site Name: Oakland Mills
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

One mapped sewer line crosses the restoration reach approximately 75 ft. upstream of Route 29. Another utility line was noted in the upper most section of the restoration reach, but this crossing does not appear in the County's GIS mapping. Forested land exists on the left side of the stream channel and extends approximately 300-350 ft. to the south. Any construction activities occurring on the left side of the channel will result in a disturbance to trees.

Concept Description:

The focus of the proposed restoration will be reconnecting the stream channel with the floodplain. The lack of residential encroachment and the sparsity of trees along the right side of the channel should be conducive for a floodplain reconnection project. The proposed project should also address the exposed utility pipe that was observed in the upstream portion of the restoration reach, and should include an option to plant trees in the floodplain. Best access to the proposed restoration site is to follow the Columbia Association trail from end of Wandering Way into woods located along northern side of stream.

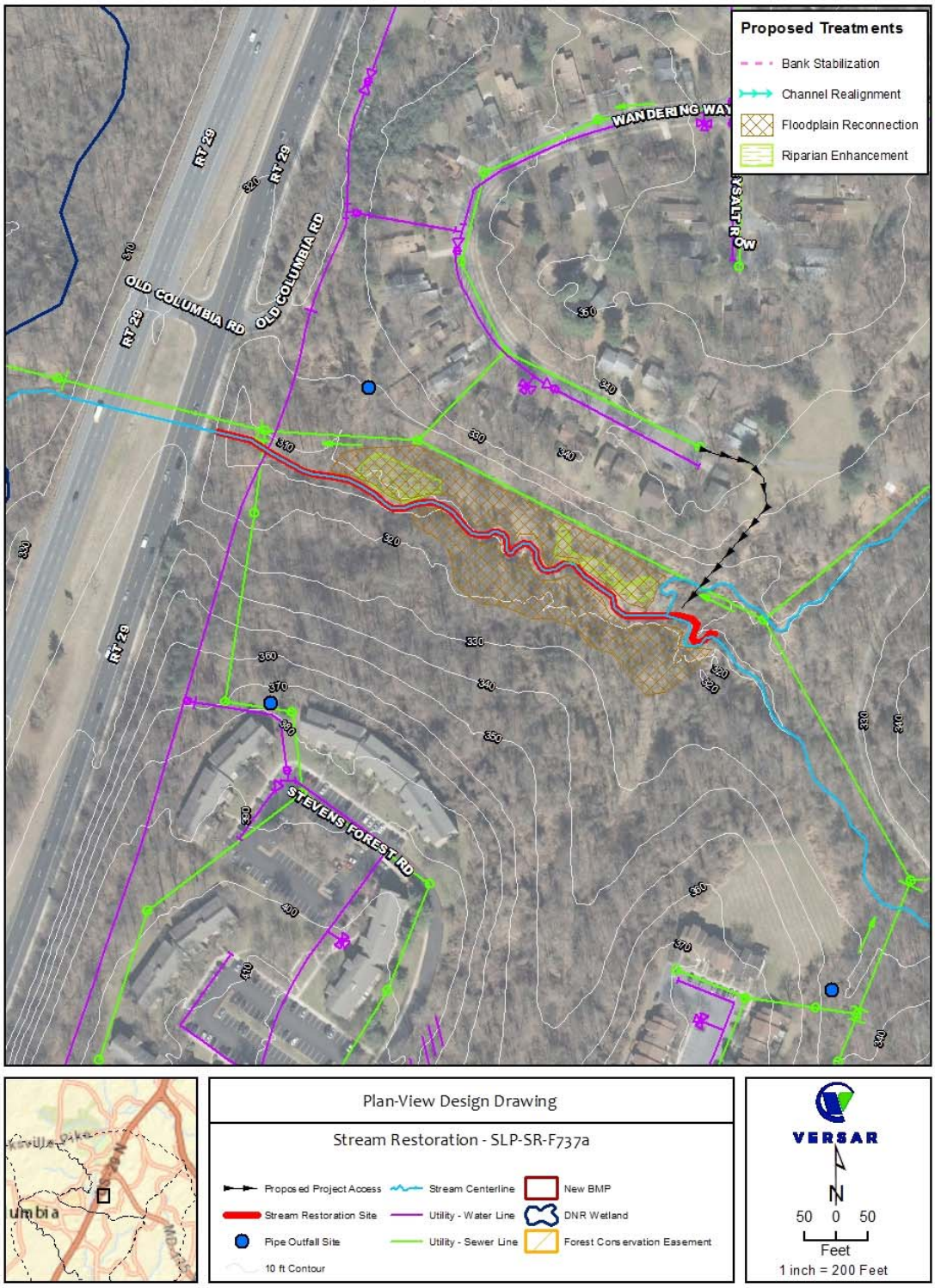
Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	973	Estimated Design Cost:	$220,000.00
Impervious Area Treated Credit (ac.):	9.73	Estimated Construction Cost:	$437,778.00
Cost per Impervious Credit Acre:	$81,100.86	30% Contingency:	$131,333.40
		Estimated Total Cost:	$789,111.40

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F737A
Site Name: Oakland Mills
Contractor: Versar
Watershed: Little Patuxent River



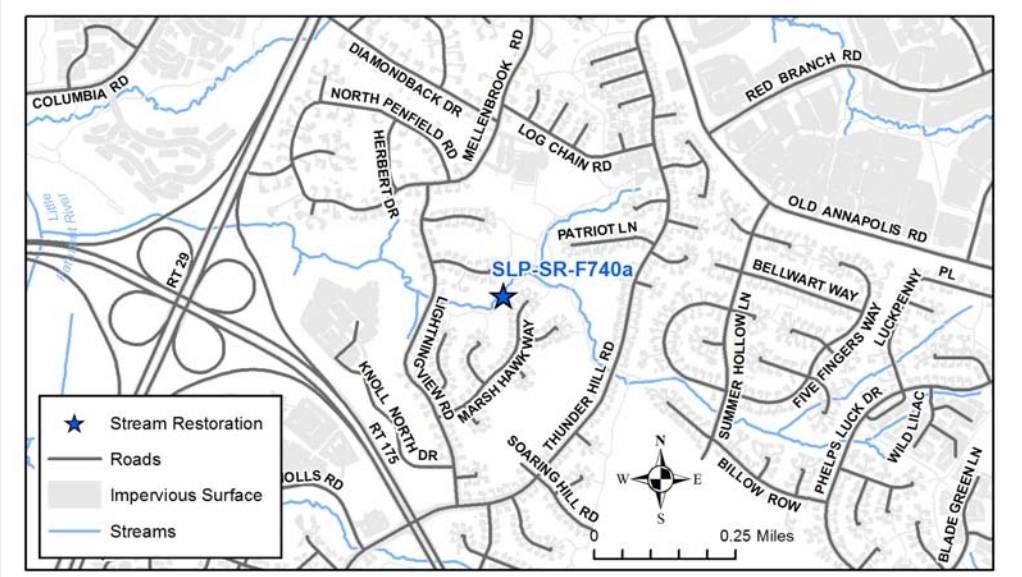
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F740a
Site Name: Lightning View Road
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Columbia Association
Multiple Owners

Existing Conditions:

The stream corridor recommended for restoration is fully contained within Columbia Association property on the left side of the stream, but several private residential properties abut the channel on the right side. Four outfalls discharge into the stream reach, two of which have been recommended for stabilization and are having separate concept plans developed. Moving upstream from Lightning View Road, the first 600 ft. of the proposed restoration reach exhibits nearly continuous erosion, with smaller patches of erosion existing in the upper portions of the reach. The upstream extent of the reach is marked by a step pool outfall channel that drains a large wet pond. The assessment of habitat conditions conducted within the reach yielded a Non-supporting rating.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F740a
Site Name: Lightning View Road
Contractor: Versar
Watershed: Little Patuxent River

Erosion occurring along the left bank. Private residential yards with no trees are nearly abutting the stream in this section of the reach. Bank height is approximately 4.5 ft.

Erosion occurring along the right bank. Mowing is occurring along the bank in a private residential yard abutting the stream. Bank height is approximately 4.5 ft.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F740a
Site Name: Lightning View Road
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Two mapped sewer lines cross the proposed restoration reach, one of which is approximately 150 ft. upstream of Lightning View Road, and the other is approximately 750 ft. upstream of the same road. Although a well established forest is not present, several small to medium sized trees will need to be removed during construction.

Concept Description:

The proposed restoration will stabilize eroding banks and prevent the further loss of private property. While floodplain reconnection would help alleviate erosive flows and reduce sediment and nutrient loads, it may not be feasible due to the proximity of the residential yards on the right side of the channel, and the Columbia Association trail on the left side of the channel. Details for the two outfall stabilization projects that are contained within the restoration reach can be found on the factsheets for SLP-OF-F851 and SLP-OF-F852. The total cost estimate for the stream restoration work does not include the two stabilization projects. The site can be accessed from either the Columbia Association trail that crosses Lightning View Road or the Columbia Association trail that originates at the end of Marsh Hawk Way.

Nearby Opportunities:

SLP-OF-F851, SLP-OF-F852

Proposed Project Credit		Costs	
Length Restored (ft):	1,048	Estimated Design Cost:	$220,000.00
Impervious Area Treated Credit (ac.):	10.5	Estimated Construction Cost:	$471,447.00
Cost per Impervious Credit Acre:	$79,473.39	30% Contingency:	$141,434.10
		Estimated Total Cost:	$832,881.10

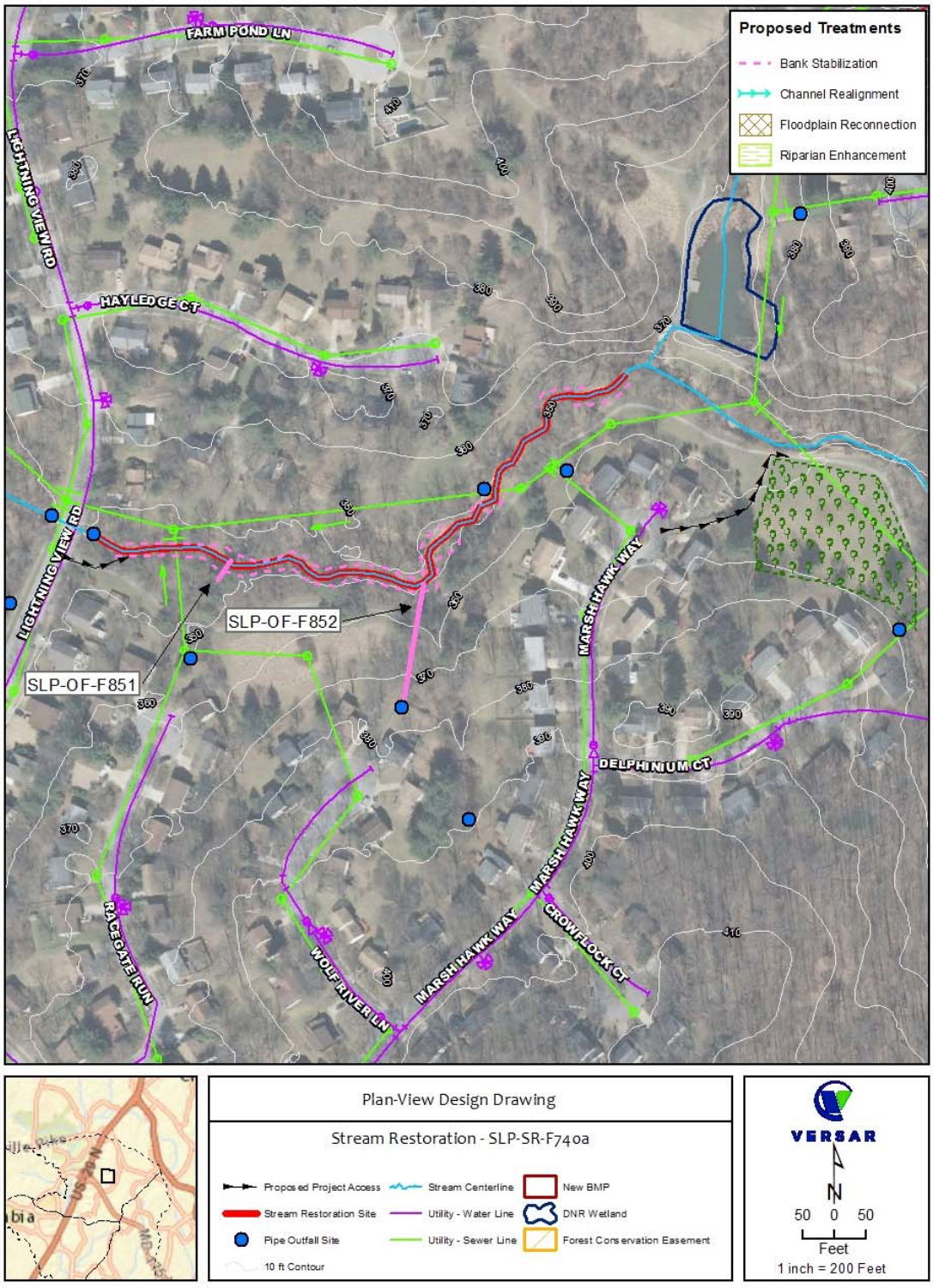
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F740a

Site Name: Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River



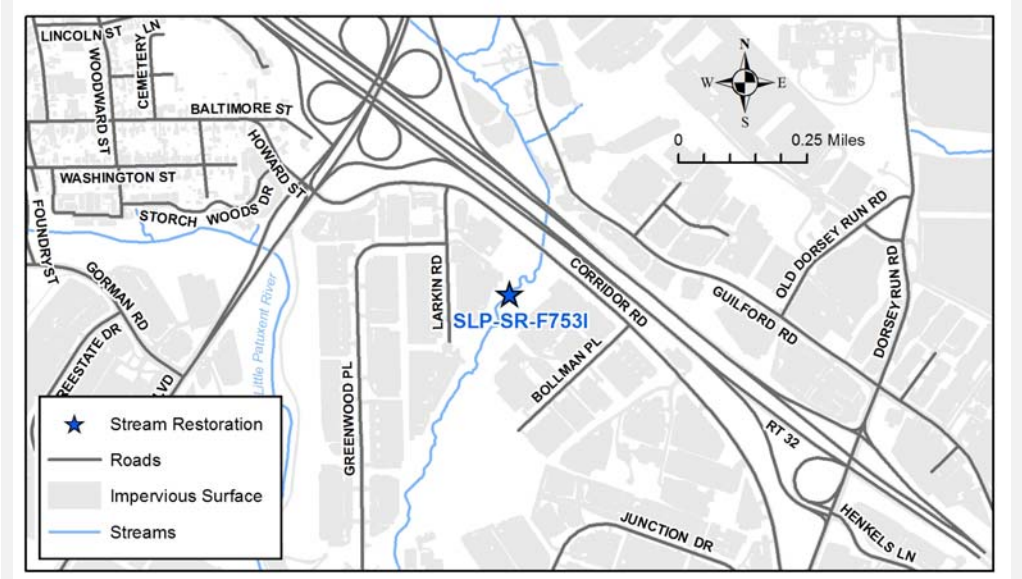
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F753I
Site Name: North Laurel Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

Existing Conditions:

The stream corridor recommended for restoration is fully contained within Howard County property, with the exception of the portion that abuts Route 32, which is considered State Highway Administration Right of Way. A proposed outfall stabilization site is located just downstream of the proposed stream restoration reach, and is partially contained on private commercial property. Three outfalls discharge directly into the stream reach. Moderate to severe erosion exists throughout approximately 50% of the reach. Large point bars can be found throughout most of the reach. The assessment of habitat conditions conducted within the reach yielded a Non-supporting rating.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F753I
Site Name: North Laurel Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Erosion occurring along the right stream bank. A large gravel bar is present on the left side of the stream.

Erosion occurring along the right stream bank. Bank height is approximately 6.5 ft. A large cobble bar is present on the left side of the stream.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F753I
Site Name: North Laurel Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

A sewer main crosses the channel at one location, and runs along side the channel throughout most of the proposed restoration reach. Mature trees are present through the entire reach, and will almost certainly be impacted by construction activities.

Concept Description:

The focus of the proposed restoration will be stabilizing eroding banks and restoring a natural flow regime to prevent the future formation of large point bars throughout the reach. Little to no residential or commercial encroachment is present on either side of the channel, which is conducive for floodplain reconnection; however, several mature trees exist on both sides of the channel, which may lead to a difficult permitting process. The outfall recommended for stabilization (SLP-OF-F736) has a 6 ft. drop between the mouth of the outfall and the receiving outfall channel bed. A step pool conveyance should be constructed if enough space is available, otherwise a drop structure should be used to reconnect the outfall pipe with the channel bed. The total cost estimate does not include the outfall stabilization option. The easiest access to the proposed restoration project is from Corridor Road.

Nearby Opportunities:

SLP-OF-F736

Proposed Project Credit		Costs	
Length Restored (ft):	1,534	Estimated Design Cost:	$320,000.00
Impervious Area Treated Credit (ac.):	15.3	Estimated Construction Cost:	$690,160.50
Cost per Impervious Credit Acre:	$79,348.67	30% Contingency:	$207,048.15
		Estimated Total Cost:	$1,217,208.65

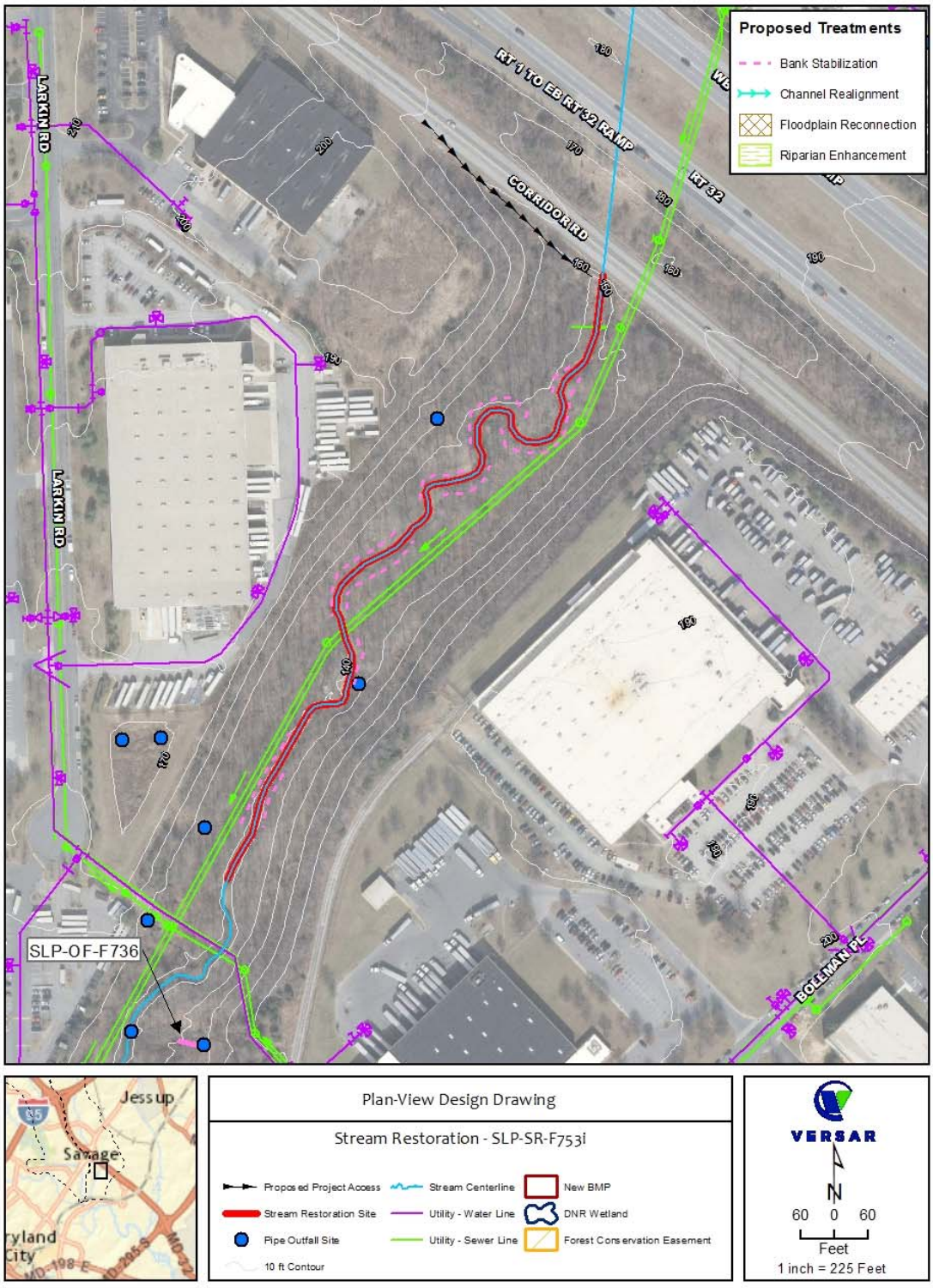
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F753I

Site Name: North Laurel Industrial Park

Contractor: Versar

Watershed: Little Patuxent River



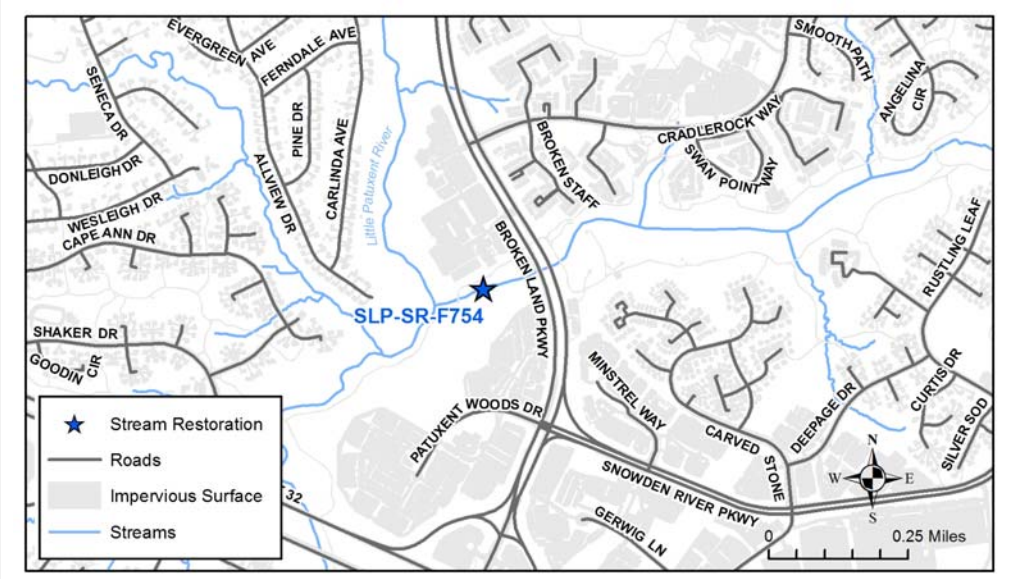
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F754
Site Name: Lake Elkhorn Receiving Channel
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Columbia Association
Single Owner

Existing Conditions:

The stream corridor recommended for restoration is fully contained within Columbia Association property and is located just downstream of Lake Elkhorn; between Broken Land Parkway and the mainstem of the Little Patuxent River. No observed outfalls discharge directly into the reach. Stream bank erosion is present throughout approximately 60% of the reach, with the majority of that erosion being categorized as severe. The majority of the stream banks are 4-6 ft. high and exhibit a high amount of stratigraphy. The assessments of habitat conditions conducted within the reach yielded a Partially Supporting rating.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F754

Site Name: Lake Elkhorn Receiving Channel

Contractor: Versar

Watershed: Little Patuxent River

Erosion occurring along the left stream bank. Bank height is approximately 5.5 ft. Photo taken near the stream's confluence with the main stem of the Little Patuxent River.

Erosion occurring along the right stream bank. Bank height is approximately 5 ft. Photo taken approximately 250 ft. upstream of the stream's confluence with the main stem of the Little Patuxent River.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F754
Site Name: Lake Elkhorn Receiving Channel
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

A sewer line crosses the channel in one location , and runs along side the channel for approximately 80% of the reach. Moderate sized trees run along the entire length of the proposed restoration reach, and will likely be disturbed by any stream bank or floodplain construction activities.

Concept Description:

The focus of the proposed restoration will be reconnecting the incised stream channel with the floodplain. Localized stabilization of the banks is possible, but not preferred due to the consistent nature of severe erosion and channel incision. The lack of residential and commercial encroachment on either side of the channel should be conducive for a floodplain reconnection project; however, many small to moderate sized trees would need to be removed during construction. The site can be accessed from a Columbia Association trail that originates at a parking lot that is adjacent to Broken Land Parkway.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	997	Estimated Design Cost:	$220,000.00
Impervious Area Treated Credit (ac.):	9.97	Estimated Construction Cost:	$448,524.00
Cost per Impervious Credit Acre:	$80,549.77	30% Contingency:	$134,557.20
		Estimated Total Cost:	$803,081.20

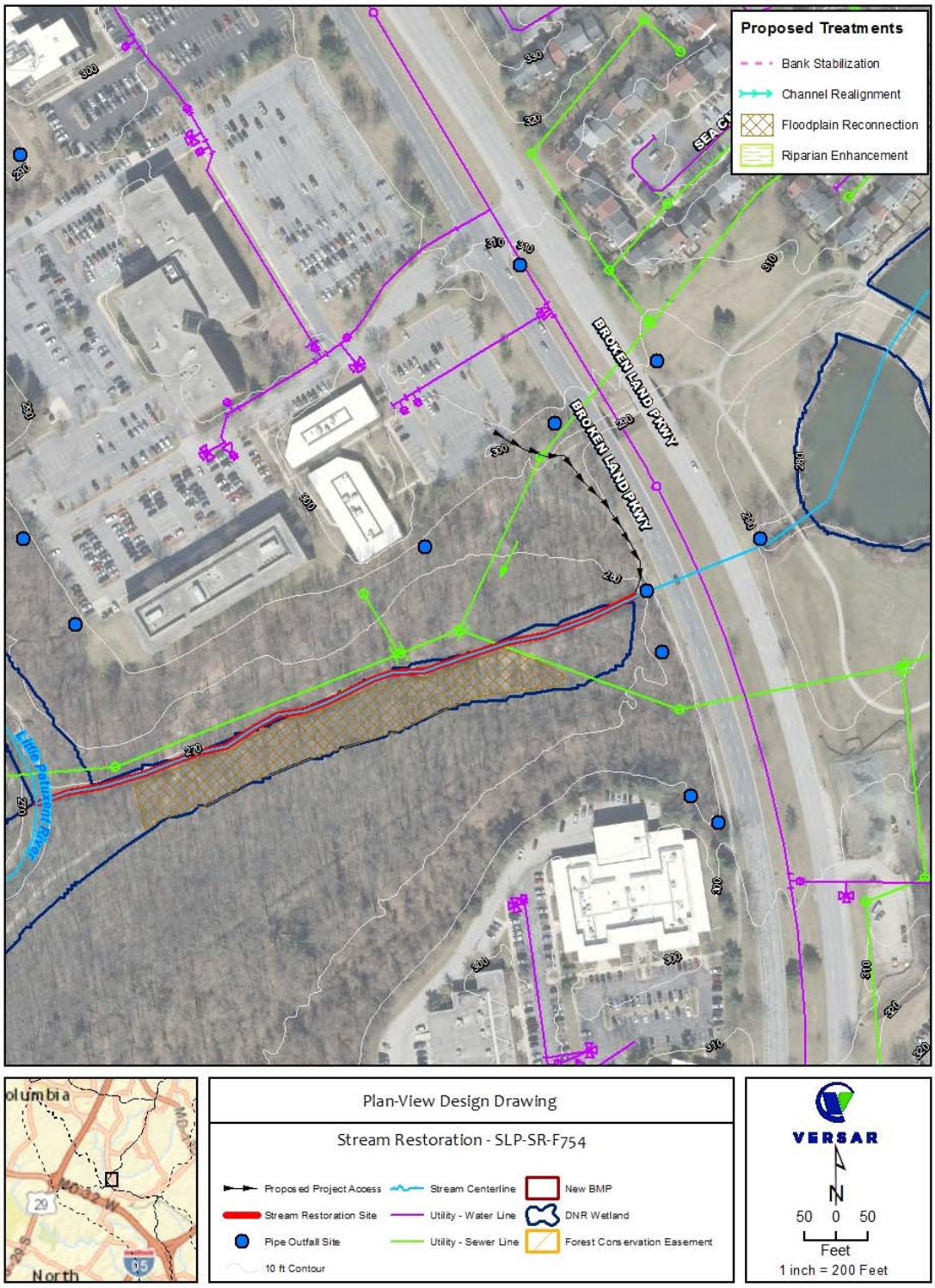
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F754

Site Name: Lake Elkhorn Receiving Channel

Contractor: Versar

Watershed: Little Patuxent River



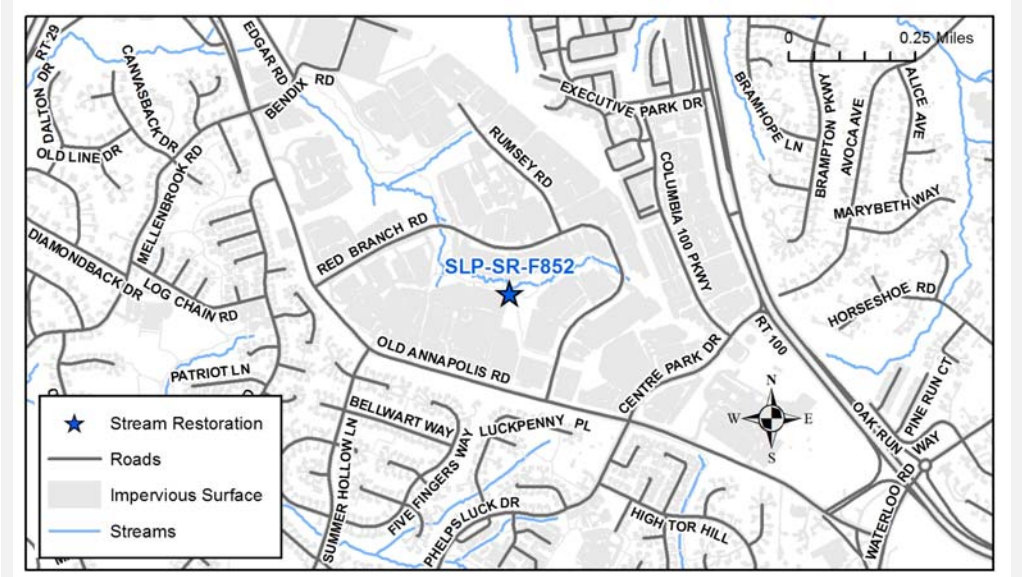
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F852
Site Name: Oakland Ridge Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The stream reach recommended for restoration is fully contained within Howard Research and Development property, and is located in a small wooded corridor between Oakland Ridge business parks. Two distinct sections of stream are present within the targeted reach, one of which is an incised intermittent channel that drains to a perennial channel, which is the second section. One outfall discharges directly within the intermittent portion of the stream reach. Nearly the entire length of the restoration reach contains eroded banks, and the mainstem has appeared to widen to the point of no longer being able to transport a large portion of the sediment load, as evidenced by the large amount of in-channel deposition.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F852
Site Name: Oakland Ridge Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Erosion occurring along both banks of the mainstem. Photo was taken looking upstream.

Erosion occurring along both banks of the incised tributary channel. Photo was taken looking upstream.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F852
Site Name: Oakland Ridge Industrial Park
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

One sewer line crossing exists along the tributary channel approximately 100 ft. upstream of the confluence with the mainstem. There are several other locations along the channels where a sewer line comes within 20 ft. of the channel, but does not cross. Several small to moderate size trees will need to be removed for construction. The valley slope along the tributary channel will make heavy machinery access difficult.

Concept Description:

The proposed restoration will stabilize the eroding stream banks and restore the channel's natural flow regime in order to prevent future instream sedimentation along the mainstem. Work along the tributary channel will focus on restoring the bed to its original elevation and preventing future incision by installing step pools or similar structures that provide grade control. There is an option to conduct a small outfall stabilization project (SLP-OF-F775) for a dry pond outfall located just downstream of the mainstem restoration work. The outfall stabilization work for SLP-OF-F775 is not included in the total cost estimate. The restoration site can be accessed from Columbia Association trails that originate in parking lots located on either side of the site, and a Columbia Association trail that can be accessed directly from Red Branch Road.

Nearby Opportunities:

SLP-OF-F775

Proposed Project Credit		Costs	
Length Restored (ft):	1,342	Estimated Design Cost:	$320,000.00
Impervious Area Treated Credit (ac.):	13.4	Estimated Construction Cost:	$603,769.50
Cost per Impervious Credit Acre:	$82,332.37	30% Contingency:	$181,130.85
		Estimated Total Cost:	$1,104,900.35

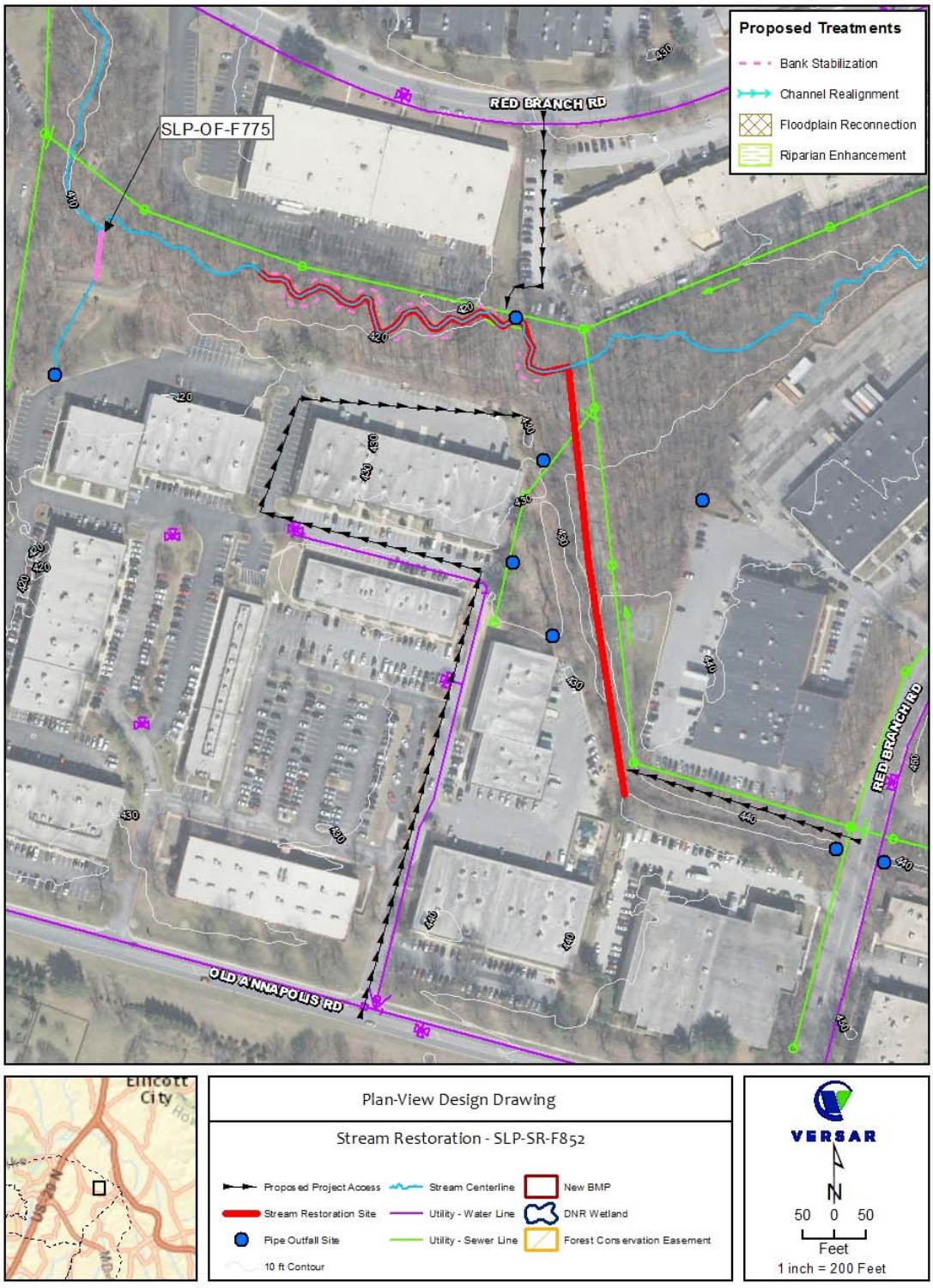
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F852

Site Name: Oakland Ridge Industrial Park

Contractor: Versar

Watershed: Little Patuxent River



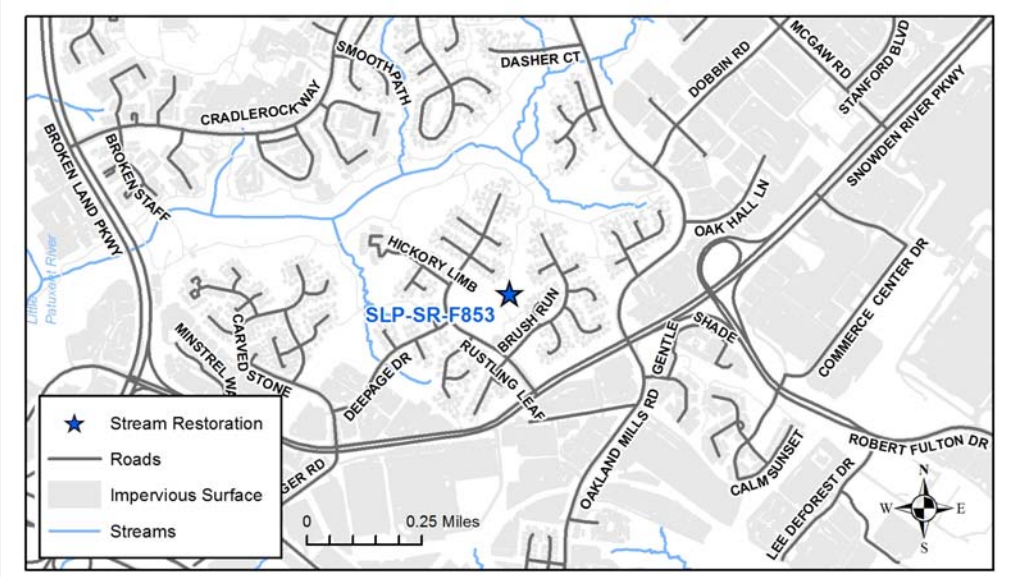
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F853
Site Name: Hopewell Park
Contractor: Versar
Watershed: Little Patuxent River

Ownership: Columbia Association
Single Owner

Existing Conditions:

The stream corridor recommended for restoration is fully contained within Columbia Association property, though several private residential houses and yards are within 50 ft. of the stream channel in the upstream portion of the stream reach. The reach begins at an outfall located downstream of Brush Run. This outfall's concrete apron is cracked and falling apart. The stream contains a moderate amount of erosion as it flows from the outfall, through a wooded area, and through a small park with a playground. There are a series of headcuts just downstream of the playground, and the stream bank erosion becomes severe in several locations downstream of these headcuts. Three outfalls discharge directly into the channel within the proposed restoration reach.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F853
Site Name: Hopewell Park
Contractor: Versar
Watershed: Little Patuxent River

Erosion occurring along both stream banks. Photo was taken looking downstream and approximately 100 ft. downstream of Brush Run. Bank height is approximately 3.5 ft.

Erosion occurring along the left bank. Photo was taken close to the downstream extent of the proposed restoration reach. Bank height is approximately 4.5 ft.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F853
Site Name: Hopewell Park
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

One sewer line crossing is located approximately 600 ft. downstream of Brush Run. Several rows of trees buffer the stream channel for most of the proposed restoration reach, some of which are mature trees, and any construction activities occurring outside of the channel will impact these trees. A Columbia Association trail located along the left side of the stream will limit the amount and type of earth work that can be undertaken.

Concept Description:

The proposed project will focus on stabilizing eroding banks throughout the reach, especially those closest to Brush Run, and those below the series of headcuts found just downstream of the playground. Floodplain reconnection is needed below the headcuts, and may be feasible along the right side of the stream channel, where the loss of trees seems to be the only issue, but not the left side where a Columbia Association trail and a sewer line may be too costly to relocate. The failing outfall apron at the upstream extent of the reach should be removed. Multiple access routes may be used for this project, but the removal of the outfall apron will likely need to be accessed from Brush Run, while other portions of the project can be accessed from Columbia Association trails, as sketched on the map.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,221	Estimated Design Cost:	$320,000.00
Impervious Area Treated Credit (ac.):	12.2	Estimated Construction Cost:	$550,243.00
Cost per Impervious Credit Acre:	$84,792.46	30% Contingency:	$165,072.90
		Estimated Total Cost:	$1,035,315.90

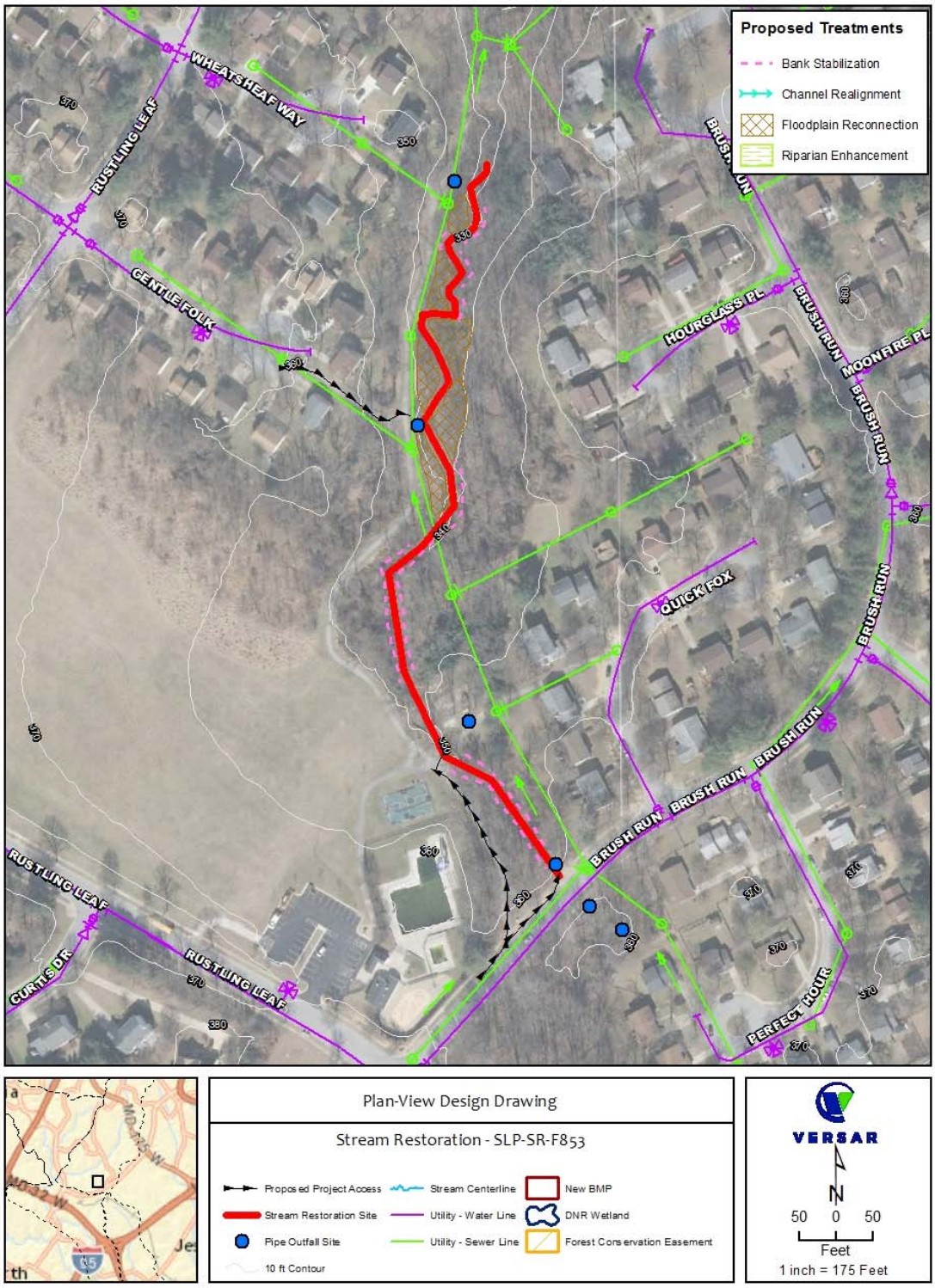
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SLP-SR-F853

Site Name: Hopewell Park

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

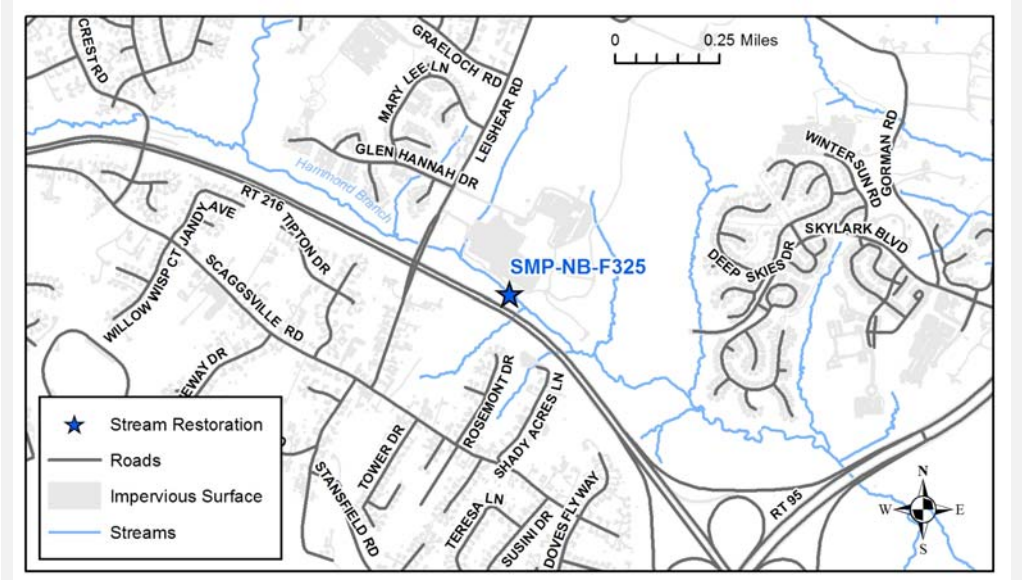
Site ID: SMP-NB-F325
Site Name: BGE Substation
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The stream is located on BGE property at the corner of Route 216 and Leishear Road in Laurel, MD. The stream flows adjacent to a large BGE substation and has transmission poles that run along the left bank (looking downstream) and another utility line that crosses the stream at the upstream end. The utility line that crosses the stream is a relatively low hanging line that could be a hazard during construction. When assessed, invasive species and other vegetation had overgrown and covered most of the banks making it difficult to identify erosion points. Originally, the proposed stream restoration length was 613 ft.; however, after the field assessment was completed, the proposed stream restoration length was extended an additional 179 ft. downstream. The new proposed stream length to be restored is 792 ft. A road culvert was spotted during the field assessment that was allowing a small stream to pass under Route 216 and discharge into the stream. The small stream could not be assessed due to overgrowth of vegetation surrounding the pipe outfall and discharge channel; however, the small stream appears to be an incised channel and should be restored along with the assessed stream.

The instream habitat within the discharge channel scored in the marginal range. The epifaunal substrates consists of 20-40% stable habitat with some embeddedness (25-50%) making these substrates less available for colonization. The velocity/depth regime of the channel is consistently marginal with only two velocities present. Sediment deposition in the form of bar features is not a concern; however, the overall sediment supply did influence the embeddedness score especially within pools where more sediment was found. The channel flow status is suboptimal with water filling over 75% of the channel and some riffle substrate exposed. The left stream bank is more unstable and raw compared to the right bank; however, it was difficult to determine how unstable these banks were because of extreme vegetation overgrowth. Vegetative protection along the stream bank is high with 70-90% of the surface covered by vegetation and invasive species. Shading along the discharge channel is extremely poor (0%) due to the stream being located at a BGE substation.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-NB-F325
Site Name: BGE Substation
Contractor: Biohabitats
Watershed: Little Patuxent River

Facing downstream, an old concrete channel along the right bank that is causing bank erosion.

Facing upstream, recent bank failure and surrounding overgrown vegetation.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-NB-F325
Site Name: BGE Substation
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

The site is located on BGE property and is next to a large BGE substation, which could create a hazardous work environment. An unknown utility line crosses the stream and transmission poles are located adjacent to the stream. A sewer line also runs adjacent to the stream. The BGE access road could be used as an access road for the stream. The use of woody vegetation would be limited due to the BGE lines above.

Concept Description:

Before pursuing this project, the County will coordinate with the State Highway Administration (SHA) to determine if there is additional work to be performed in relation to the SHA stream mitigation project in this area. The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This may be accomplished by grading banks back to a stable angle and stabilizing them with boulder and integrated native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however some minor realignment may be necessary where the stream approaches transmission poles. A floodplain bench could be integrated into the proposed channel restoration work to optimize as much floodplain reconnection as possible. Because the stream is located on BGE property and under electrical lines, no trees can be planted along the stream banks; however, establishing riparian buffer will increase shading, reduce stream temperature and provide needed litter inputs and woody debris. This channel restoration has the potential to reduce sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from the BGE access road that is adjacent to the stream. There are no nearby project recommendations for concurrent implementation.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	792	Estimated Design Cost:	$200,000.00
Impervious Area Treated Credit (ac.):	7.92	Estimated Construction Cost:	$356,400.00
Cost per Impervious Credit Acre:	$83,752.53	30% Contingency:	$106,920.00
		Estimated Total Cost:	$663,320.00

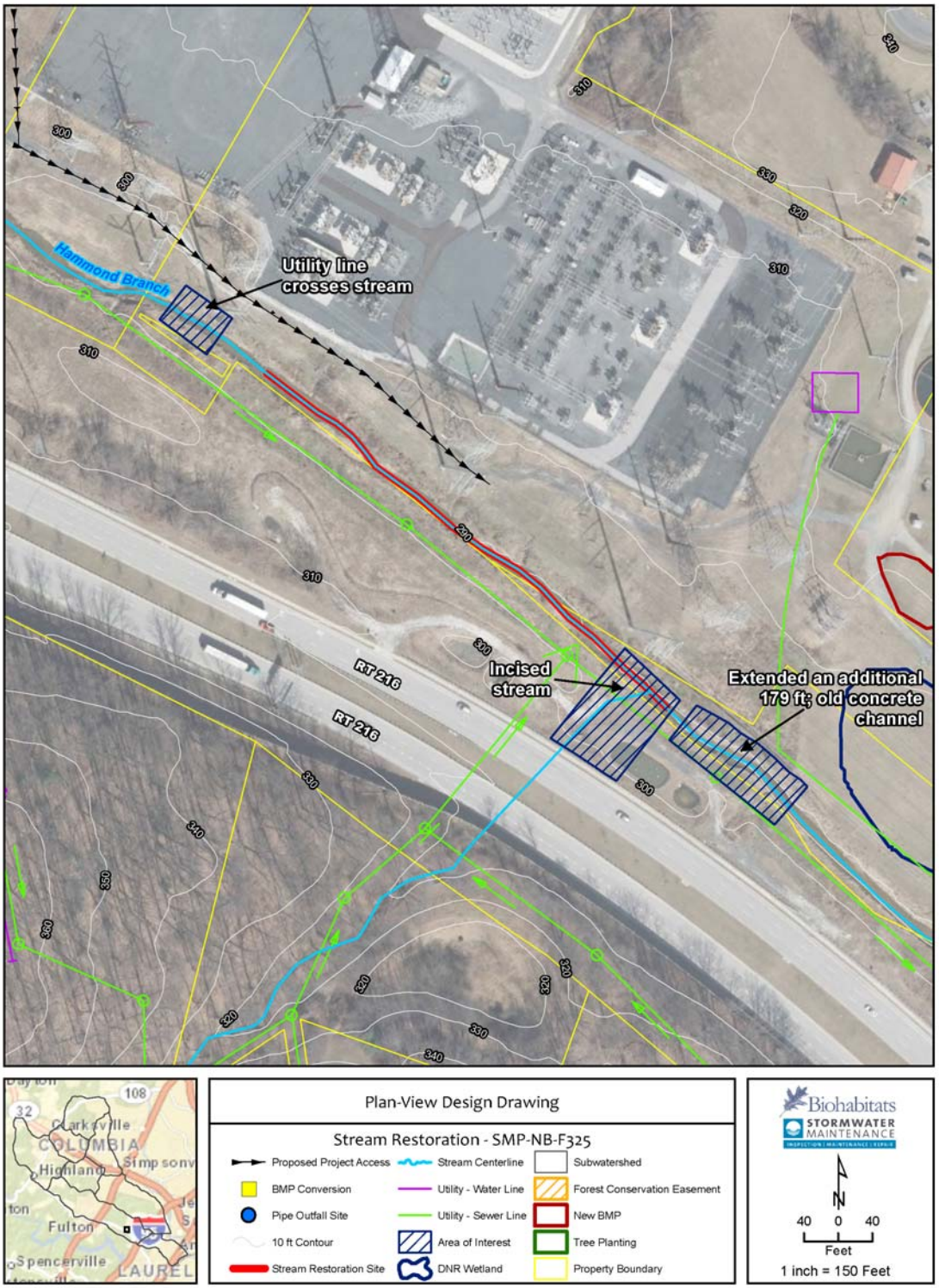
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-NB-F325

Site Name: BGE Substation

Contractor: Biohabitats

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

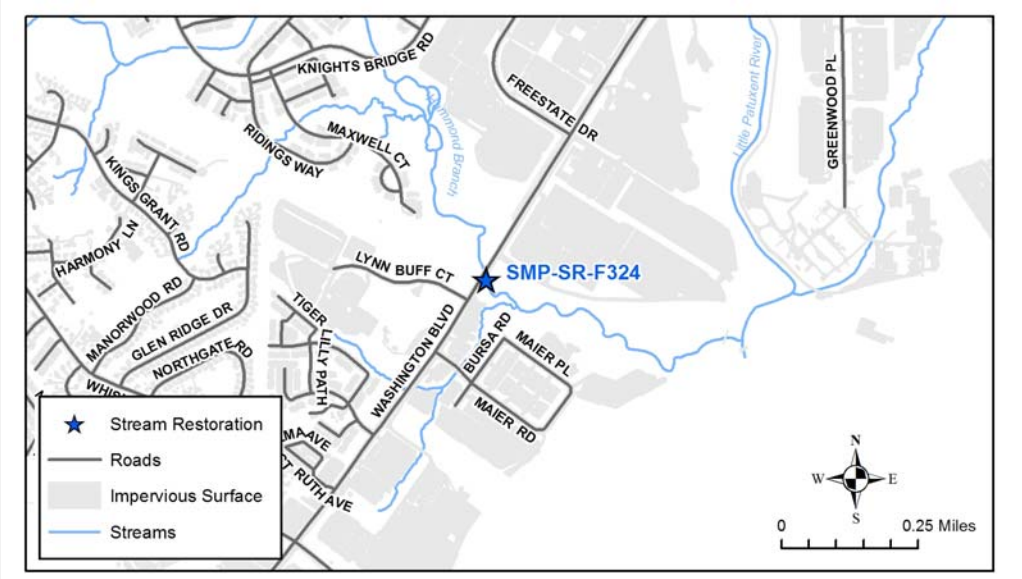
Site ID: SMP-SR-F324
Site Name: BGE ROW Washington Boulevard
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The existing channel is located within a forested area until it reaches a BGE Right-of-Way (ROW) that runs perpendicular to Washington Boulevard and east of Lynn Buff Court in Laurel, MD. The channel within the forest is stable, with one problem area in which the stream creates a tight bend into a valley wall that shows signs of recent slumping and fallen trees. More severe erosion is occurring within the BGE ROW and downstream of the assessed reach. The BGE ROW has an inadequate buffer along the channel on both banks, which is affecting stream bank erosion. The channel is meandering throughout the BGE ROW and is impeding on transmission poles. Recent bank failure was observed during the stream assessment and an abandoned utility pipe was exposed on the right bank (looking downstream). The existing channel currently exhibits moderate erosion with 3-5 ft. eroding banks with recent bank erosion and deposition evident; however, severe erosion of 5 ft. or greater eroding banks was also found throughout the stream due to very tight bends.

The instream habitat within the existing channel scored in the suboptimal range overall with the existing channel being worse within the BGE ROW. The epifaunal substrates consists of 40-70% stable habitat well suited for full colonization and adequate habitat with relatively low embeddedness (25-50%) making these substrates fairly desirable for colonization. The velocity/depth regime of the channel is suboptimal with all velocities present minus fast-deep. Some new sediment deposition throughout the channel is evident based on recent bank failure which is creating some new bar formations, but is not affecting the bottom of the channel; therefore, the overall sediment supply did influence the embeddedness score. The channel flow status is suboptimal with water filling more than 75% of the channel and less than 25% of the riffle substrate exposed. Both stream banks are moderately stable and have 70% vegetative protection along both banks. Shading along the existing channel is poor (10%) within the BGE ROW, but is better (70%) within the forest area.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-SR-F324
Site Name: BGE ROW Washington Boulevard
Contractor: Biohabitats
Watershed: Little Patuxent River

Facing downstream from the assessed channel. Downstream channel was not assessed, but should be considered as part of the stream restoration.

Facing downstream, existing channel where a deep pool has formed and recent bank failure has exposed pipes and geotextile fabric.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-SR-F324
Site Name: BGE ROW Washington Boulevard
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Stream is located on BGE Company's property and coordination with them will need to occur in order to access the stream. Utility poles and electric lines are a constraint for this site. Proposed access is via an access road already in place. Both water and sewer lines cross the stream more than once. A major road (Washington Blvd) crosses the stream. Revegetation of the site will need to be coordinated with BGE.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, to pull flow off of the valley wall and away from the BGE transmission poles, realignment of tight meanders would be proposed. In addition, establishing the maximum riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel over time to maintain the habitat complexity and quality. Because this channel runs through a BGE ROW, no large tree plantings should be associated with this project. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from the BGE ROW access road that runs parallel to the existing stream. There are no nearby project recommendations for concurrent implementation for this site.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,047	Estimated Design Cost:	$200,000.00
Impervious Area Treated Credit (ac.):	10.5	Estimated Construction Cost:	$471,150.00
Cost per Impervious Credit Acre:	$77,602.20	30% Contingency:	$141,345.00
		Estimated Total Cost:	$812,495.00

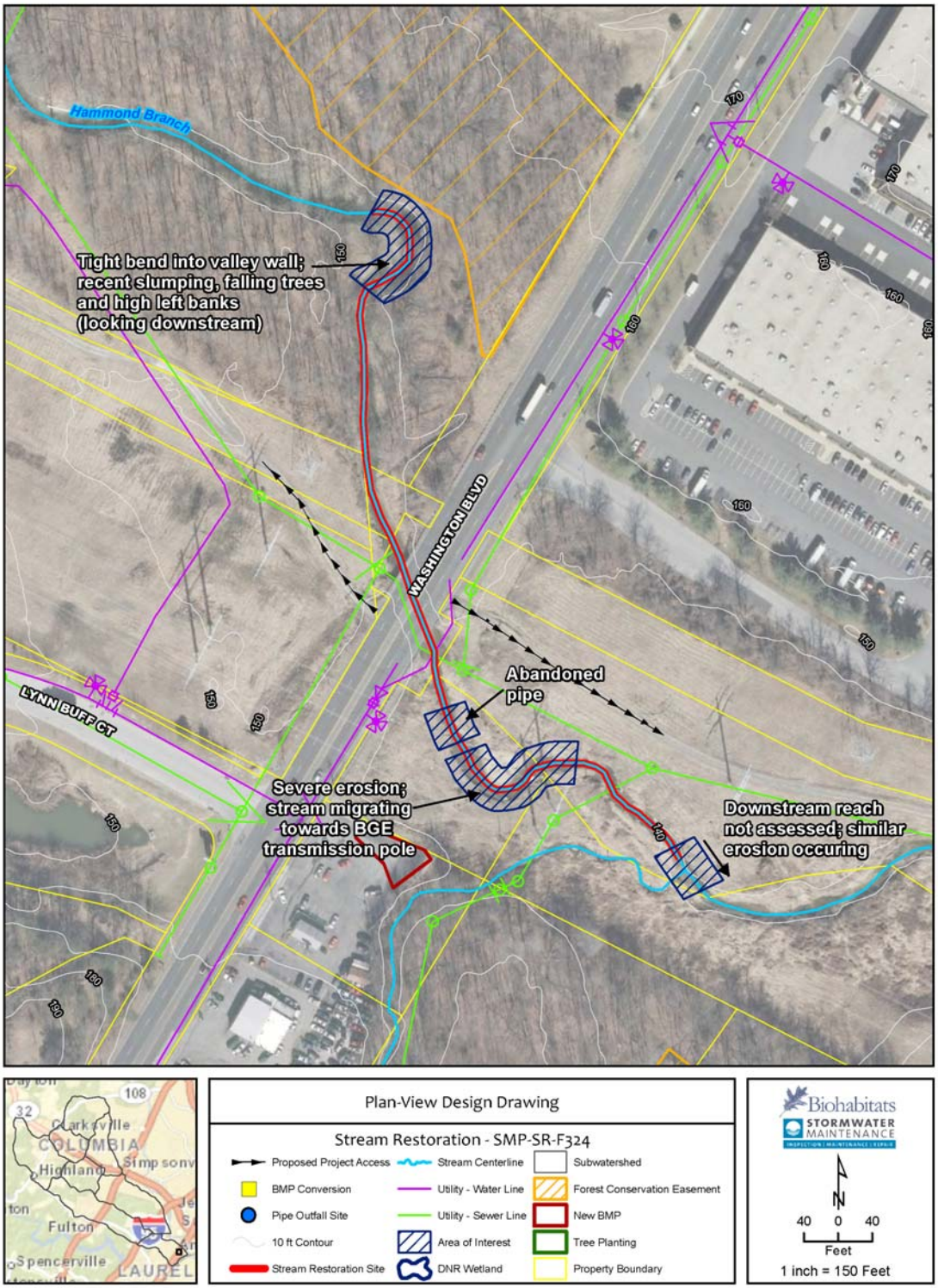
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SMP-SR-F324

Site Name: BGE ROW Washington Boulevard

Contractor: Biohabitats

Watershed: Little Patuxent River



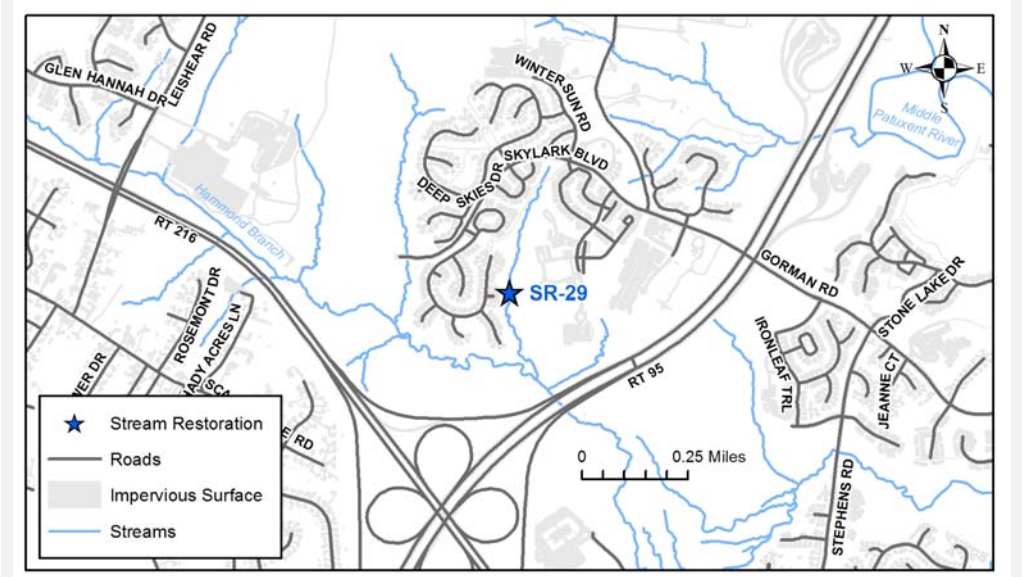
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-29
Site Name: Emerson Community Association
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Residential
Single Owner

Existing Conditions:

This site consists of three stream assessments including: SMP-SR-F330B, SMP-SR-F330C, and SMP-SR-F330E. These stream segments are located along one stream which is created from an upstream extended detention wet pond located within the Emerson Community Association. The stream runs through an approximately 7 ac. forest conservation easement called Emerson (F-05-049). The system has had multiple headcuts move upstream, which has created a stream channel that is no longer connected with the surrounding floodplain. Currently the headcuts are located just downstream of a walking path and together are over 6 ft. in height. The entire system is entrenched with severe eroding banks. More pipe outfalls are encountered as the stream moves downstream. The stream is becoming incised due to these extremely high eroded banks. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates consists of 20-40% stable habitat not well suited for full colonization with substrate frequently disturbed and/or removed, causing the embeddedness throughout the stream to vary. The velocity/depth regime of the channel is marginal with only one to two velocities present throughout the stream. Sediment deposition throughout the channel is evident with moderate deposition occurring creating bar formations and some sediment deposition within the stream bed. The channel flow status is marginal with water filling only 50% of the channel and most of the riffle substrate exposed. Both stream banks are moderately unstable with 60% of the stream banks having little cover and erosional scars. The stream has 70% vegetative protection along both banks. Shading along the existing channel is poor (10%) within the BGE ROW, but is better (70%) within the forest area.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-29

Site Name: Emerson Community Association

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream, extremely high and raw banks with fallen trees creating debris jams.

Facing upstream, variable bank heights with no bank protection and more fallen trees.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-29
Site Name: Emerson Community Association
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Sewer line easement runs adjacent to the stream and could act as an access road to the stream. Because this stream is located within a forest conservation easement, tree impacts need to be reduced as much as possible. Stream surrounded by private properties.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by raising the stream invert to connect the channel to the existing floodplain, grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at the tight meander bends. In addition, establishing the maximum riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel over time to maintain the habitat complexity and quality. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Skylark Boulevard near the existing stormwater pond or from Ebb Tide Lane and use the sewer line easement to access the stream. There are no project recommendations that could be implemented concurrently with this site.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,605	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	16.1	Estimated Construction Cost:	$722,700.00
Cost per Impervious Credit Acre:	$77,228.04	30% Contingency:	$216,810.00
		Estimated Total Cost:	$1,239,510.00

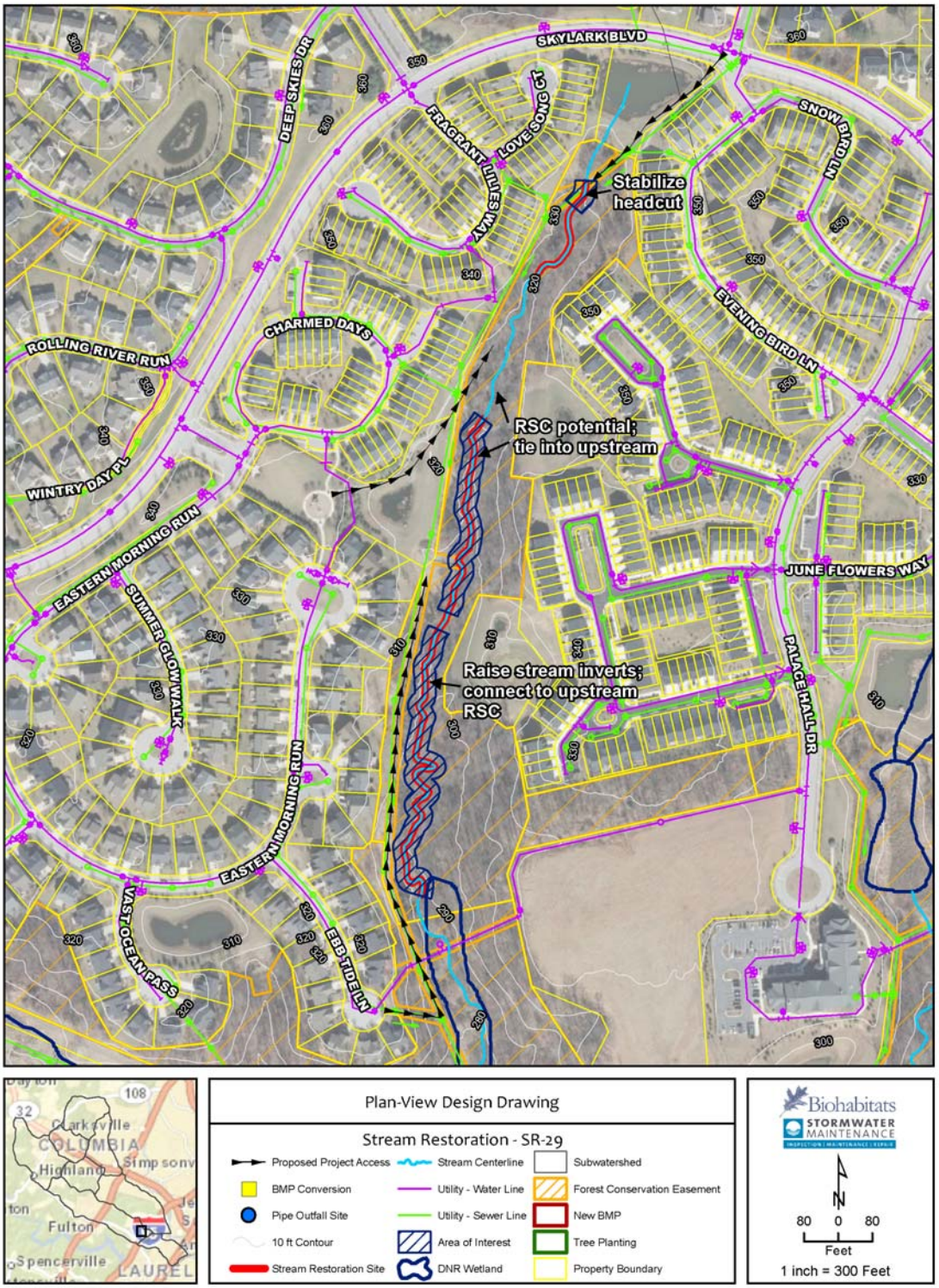
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-29

Site Name: Emerson Community Association

Contractor: Biohabitats

Watershed: Little Patuxent River



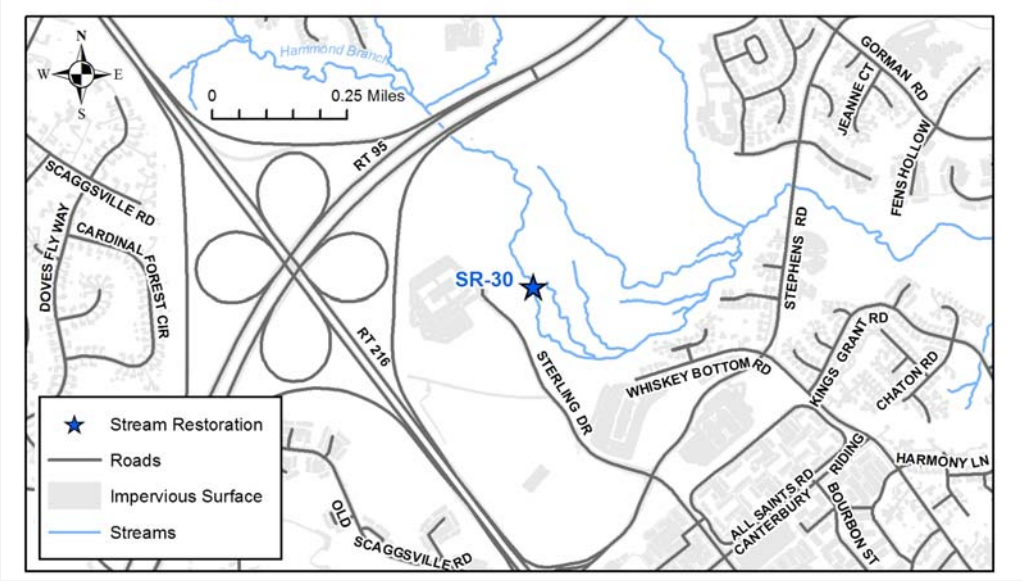
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-30
Site Name: Sterling Drive
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

Existing Conditions:

This site consists of two stream assessments including: SMP-SR-F329A and SMP-SR-F329B. These two assessed areas are part of Hammond Branch. The site is located along Sterling Drive near Whiskey Bottom Road and Promise Court in Laurel, MD. The site is located on Howard County property. The stream is located within a Department of Natural Resources Wetland Class PF01A and within a Forest Conservation Easement named Emerson (F-08-082). The stream is eroded heavily on both banks with bank height averaging 3-5 ft. Upstream of the assessed stream, the stream runs through a BGE ROW. The stream near the BGE ROW has higher eroding banks of greater than 5 ft. and extremely raw banks with little vegetative bank protection. As the stream moves downstream, both banks are continually raw with no root protection, but eroded bank height decreases. The stream has a high velocity, which is increasing the rate of erosion. The stream is meandering and creating tight bends throughout while widening at the same time; therefore, trees are falling into the stream causing major debris jams and large pools to form. Wetland species growing right up to stream bank edge, but are not providing enough vegetative protection. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates consists of 40-50% stable habitat well suited for full colonization with substrate frequently disturbed and/or removed, causing the embeddedness throughout the stream to be high with 50-75% of stream particles being covered by sediment. The velocity/depth regime of the channel is marginal with only two velocities present throughout the stream. Sediment deposition throughout the channel is evident with moderate deposition occurring creating bar formations and some sediment deposition within the stream bed. The channel flow status is marginal with water filling only 50-75% of the channel and some of the riffle substrate exposed. Both stream banks are moderately unstable with 60% of the stream banks having little cover and erosional scars. Despite being within a Department of Natural Resources wetland and forest conservation easement, vegetative protection along both banks is poor with less than 50% of the stream bank surface being covered by vegetation. Shading along the stream is better within the forested area at about 60% coverage; however, upstream near the BGE ROW less shading occurs.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-30
Site Name: Sterling Drive
Contractor: Biohabitats
Watershed: Little Patuxent River

Facing downstream, high and bare stream banks, large sand bar and downed trees. Photo taken near the end of the assessed stream by the BGE ROW.

Facing downstream, lower bare stream banks with wetland species growing right to the edge. Photo captures a tree fallen into the stream creating a debris jam, which occurs frequently throughout the length of the stream.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-30
Site Name: Sterling Drive
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Healthy wetlands and trees surround the stream; therefore, impact to these systems would be the biggest constraint. Another constraint is access. The property is surrounded by a fence and there are no easements located near the stream; therefore, more trees may be impacted trying to access the site.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by raising the stream invert, grading banks back to a stable angle, and stabilizing them with native vegetation to hold soil in place. Private properties might have a higher risk of flooding with raising the stream invert. A floodplain bench could be added within the stream instead of raising the stream invert to reduce potential flooding issues downstream. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. Trees have recently fallen into the stream and should be reused for structures and/or bank protection. By raising the stream invert, floodplain reconnection will occur and support the surrounding wetlands. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at the tight meander bends. In addition, establishing the maximum riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel overtime to maintain the habitat complexity and quality. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Whiskey Bottom Road which currently is a dead end. The site could also be accessed along Sterling Drive, but a fence does surround the property from the woods where the stream is located. SMP-SR-F325 was a stream assessment completed that was not selected for a project recommendation, but should be considered because the site is just downstream of SR-30 and is eroding into private property. SR-31 and SR-32 should also be considered for concurrent implementation with SR-30.

Nearby Opportunities:

SMP-SR-F325A, SR-31, SR-32

Proposed Project Credit		Costs	
Length Restored (ft):	2,221	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	22.2	Estimated Construction Cost:	$999,450.00
Cost per Impervious Credit Acre:	$72,007.43	30% Contingency:	$299,835.00
		Estimated Total Cost:	$1,599,285.00

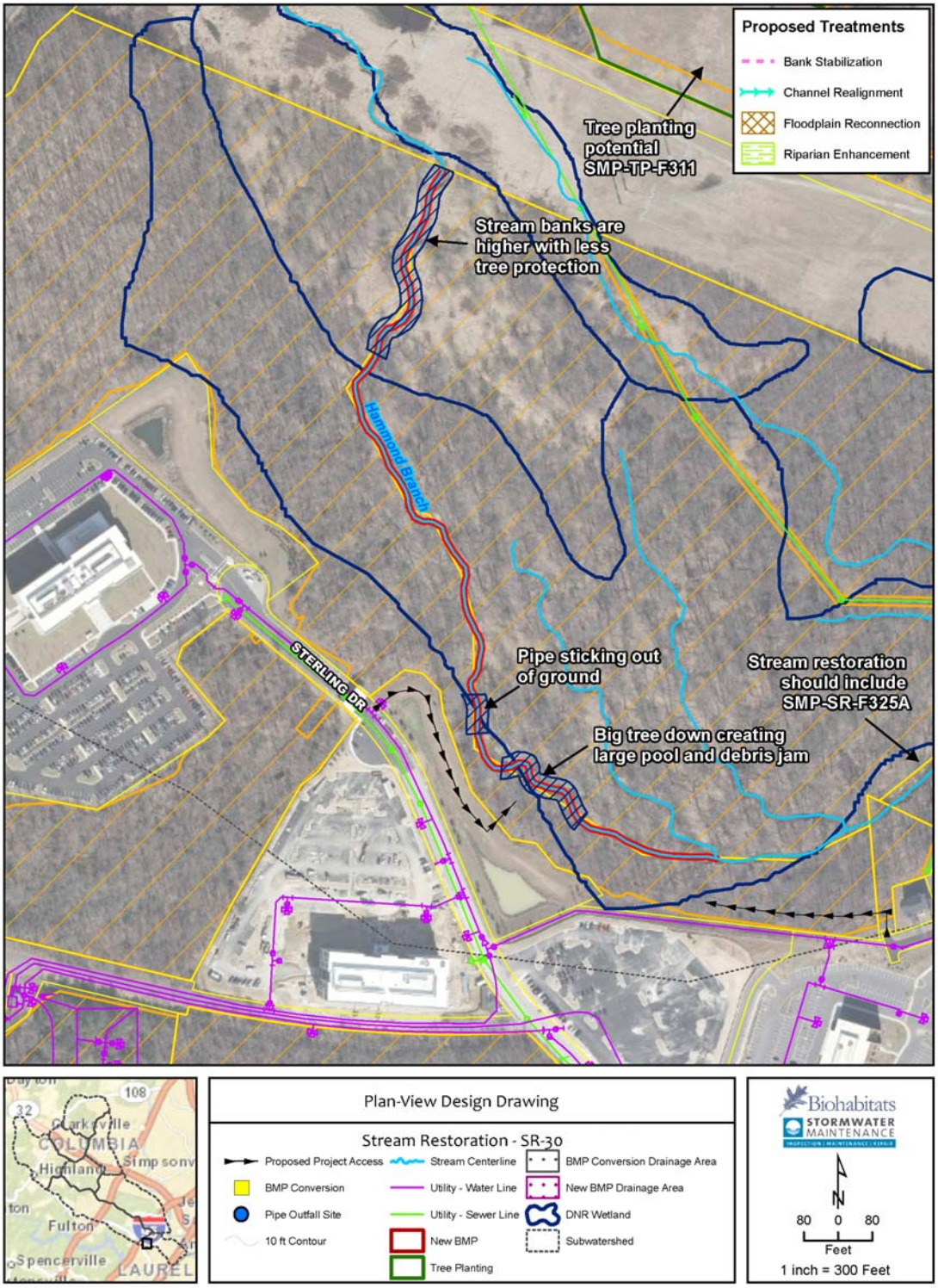
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-30

Site Name: Sterling Drive

Contractor: Biohabitats

Watershed: Little Patuxent River



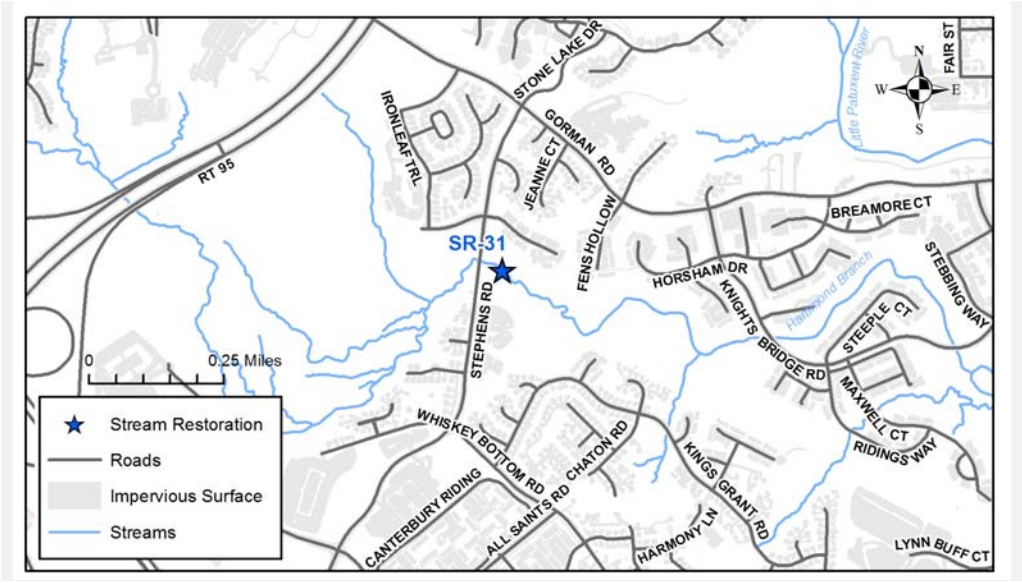
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-31
Site Name: BGE ROW Stephens Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

This site consists of four separate stream assessments including: SMP-SR-F328A, SMP-SR-F328B, SMP-SR-F328C, and SMP-SR-F328D. These four sites are all part of Hammond Branch, just downstream of I-95. Downstream of the site, Hammond Branch flows through private properties and county owned properties. These properties include private residential, private commercial (Baltimore Gas and Energy Company), and county owned (Howard County Rec and Parks). Stream has multiple tight bends and is currently meandering and approaching some BGE transmission poles. In areas where these tight bends occur, large pools are forming and the stream banks are very raw. Both banks have relatively patchy erosion with some vegetative protection, but recent bank failure is evident along the stream bank. Most of the stream is located within a BGE ROW where there are no trees providing bank stabilization and shade. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates upstream is worse than downstream consisting of only of 20-40% stable habitat well suited for full colonization with substrate frequently disturbed and/or removed, causing the embeddedness throughout the stream to be high with greater than 75% of stream particles being covered by sediment. As the stream moves downstream, epifaunal substrate and embeddedness becomes better. The velocity/depth regime of the channel is marginal with only two velocities present throughout the stream. Sediment deposition throughout the channel is evident with moderate deposition occurring creating bar formations and increased sediment deposition within the stream bed at the upstream end of the channel. The channel flow status is suboptimal with water filling only 75% of the channel and some of the riffle substrate exposed. Both stream banks are moderately unstable with 30-60% of the stream banks having little cover and erosional scars. Vegetative protection along both banks is poor with 50% of the stream bank surface being covered by vegetation. Because the majority of the stream is within a BGE ROW, there is no shade along the stream.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-31
Site Name: BGE ROW Stephens Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Looking downstream at recent bank failure along the left bank.

Looking upstream at a tight bend in the stream creating a deep pool with high banks with little to no cover.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-31
Site Name: BGE ROW Stephens Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Coordination with multiple owners, including private residential, private commercial, and county owned properties will be a constraint. Access is easy with most of the stream being located within a BGE ROW; therefore, an access road is already there that could be used to access the stream. No trees or wetlands will be impacted due to the lack of these surrounding the stream.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The pipe outfall should be cut back and the bank should be graded around the pipe to provide a stable outfall into the stream. The proposed channel restoration work would occur predominately on the existing channel alignment; however, to pull flow away from the BGE transmission poles, realignment of tight meanders or hydraulic controls such as rock vanes would be proposed. In addition, establishing the maximum riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel over time to maintain the habitat complexity and quality. Because this channel runs through a BGE ROW, no large tree plantings should be associated with this project. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from the BGE ROW access road that runs parallel to the existing stream. SR-30 is a nearby project recommendation that could be implemented concurrently with SR-31.

Nearby Opportunities:

SR-30, SR-32

Proposed Project Credit		Costs	
Length Restored (ft):	2,904	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	29.0	Estimated Construction Cost:	$1,307,250.00
Cost per Impervious Credit Acre:	$68,850.72	30% Contingency:	$392,175.00
		Estimated Total Cost:	$1,999,425.00

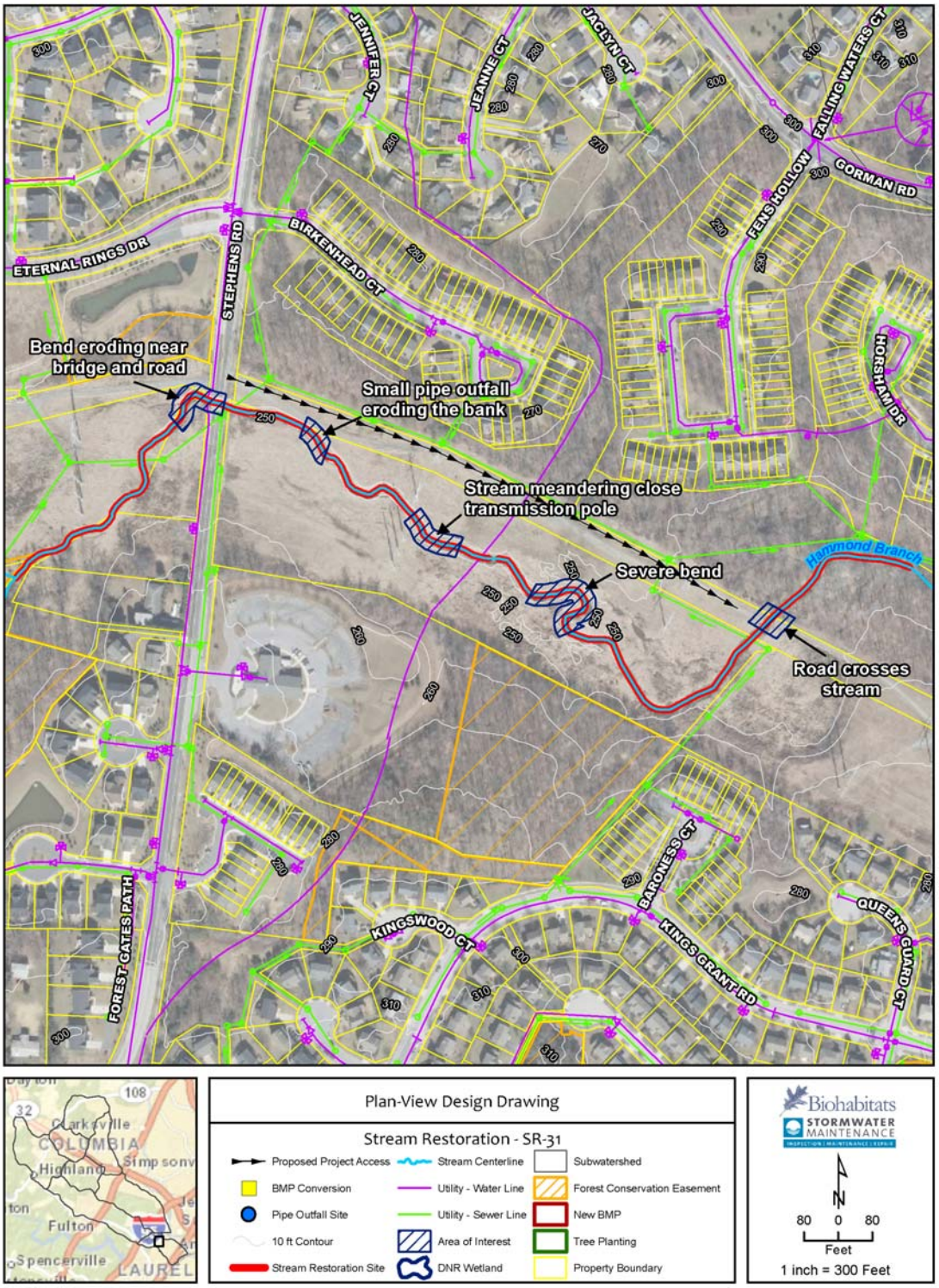
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-31

Site Name: BGE ROW Stephens Road

Contractor: Biohabitats

Watershed: Little Patuxent River



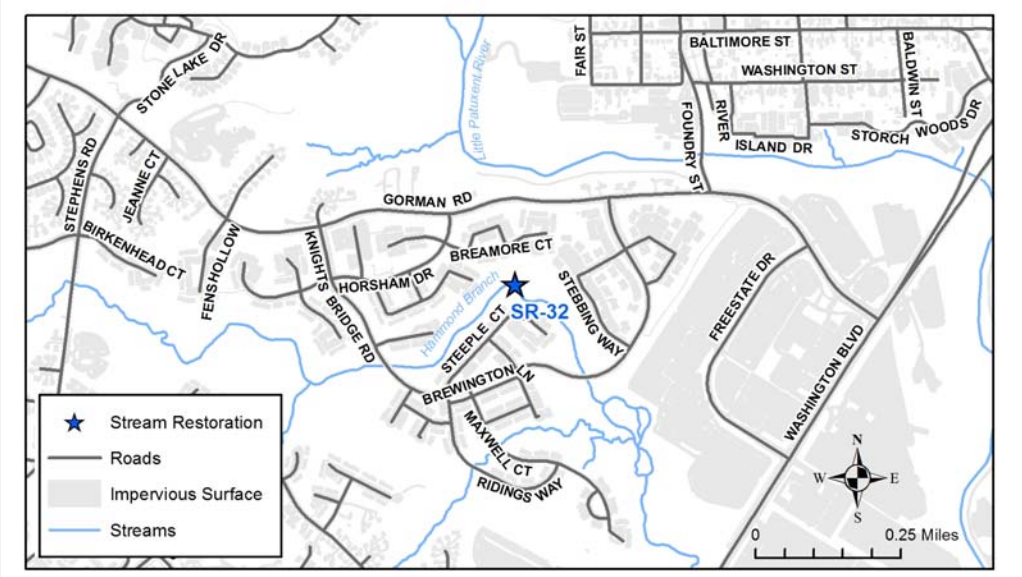
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-32
Site Name: Bowling Brook Farms
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

Existing Conditions:

This site involves two stream assessments including: SMP-SR-F327B and SMP-SR-F327C. These two site assessments are part of Hammond Branch and are downstream of project SR-31. The stream within this project area is near a condominium complex called Bowling Brook Farms; however, the stream is located within Howard County property. The stream is meandering closer to the condos and beginning to cut into private property. There are several pipe outfalls along the stream that discharge into the stream. One pipe outfall did not have a stabilized outfall with exposed geotextile and moved riprap was found downstream of the outfall. The pipe outfall could be restored with the stream with a RSC safely discharging the water into the stream. The average stream bank height is around 3 ft.; however, in problem areas, most of the stream banks are greater than 5 ft. with an eroded bank of 5 ft. or greater. Areas where the stream banks are greater than 5 ft., the length of erosion is typically between 100-200 ft. long and mostly on the right bank which is closest to the condos. One problem area that poses a concern is located on site SMP-SR-F327C, where major erosion is occurring close to the property. A large middle channel bar has formed in the stream at this site creating two smaller streams to form. During flooding, it is evident that storm flows are cutting into the existing hillside and removing more and more of the bank. The instream habitat within the existing channel scored in the marginal to suboptimal range overall. The epifaunal substrate is consisting of 40-70% stable habitat well suited for full colonization with some new fall substrate not ready for colonization yet. Embeddedness throughout the stream is low with only 25-50% of the stream particles being covered and/or surrounded by sediment. The velocity/depth regime of the channel is suboptimal with three of the four velocities present throughout the stream. Sediment deposition throughout the channel is evident with some deposition occurring creating bar formations and affecting the stream bed. The channel flow status is marginal with water filling only 50-75% of the channel and some of the riffle substrate exposed. The right stream bank is moderately unstable with 30-60% of the stream bank having little cover and erosional scars at the upstream end of the stream, but as the stream flows downstream both banks become more stable with only 5-30% of the bank showing signs of active erosion. Vegetative protection along both banks is suboptimal with 70% of the stream bank surface being covered by vegetation. The shading within this area is optimal with 70% of the stream being shaded.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-32

Site Name: Bowling Brook Farms

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream, erosion occurring on the right bank (looking downstream) with homes and properties close to the stream.

Facing downstream at the right bank.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-32
Site Name: Bowling Brook Farms
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

The stream runs through county owned property; however, there are a lot of private properties near the stream. A sewer line runs along the stream which could pose problems with the restoration. Access would need to be from the sewer line easement or from Knights Bridge Road near the upstream end of the stream by the bridge.

Concept Description:

The objective for this project is to reduce bank erosion and improve sediment transport capacity in problem areas while preserving and enhancing the instream habitat for aquatic organisms. This will be accomplished by grading banks back to a stable angle and stabilizing them with native vegetation and/or boulders to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at the tight meander bends. An RSC outfall stabilization could help repair the outfall that is currently missing riprap and has exposed geotextile fabric. In addition, enhancing the existing riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel overtime to maintain the habitat complexity and quality. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from the sewer line easement that runs adjacent to the stream. Entrance to the sewer line easement is on Steeple Court near the cul-de-sac. The site could also be accessed from Knight Bridge Road at the upstream end of the stream to avoid private property. SR-30 and SR-31 are two project recommendations that are upstream from SR-32 that should be considered for concurrent implementation.

Nearby Opportunities:

SR-30, SR-31

Proposed Project Credit		Costs	
Length Restored (ft):	1,811	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	18.1	Estimated Construction Cost:	$814,950.00
Cost per Impervious Credit Acre:	$75,065.43	30% Contingency:	$244,485.00
		Estimated Total Cost:	$1,359,435.00

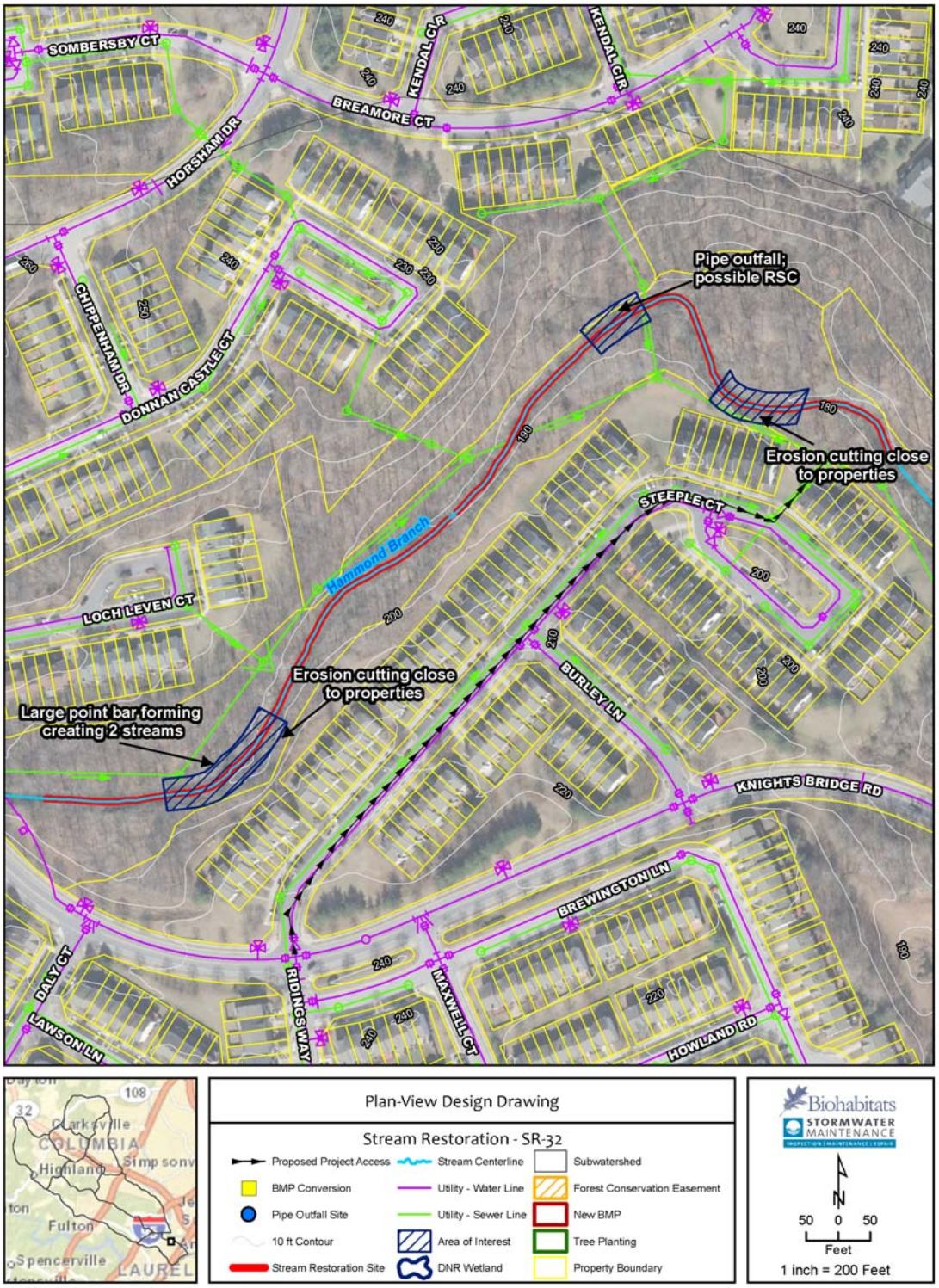
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-32

Site Name: Bowling Brook Farms

Contractor: Biohabitats

Watershed: Little Patuxent River



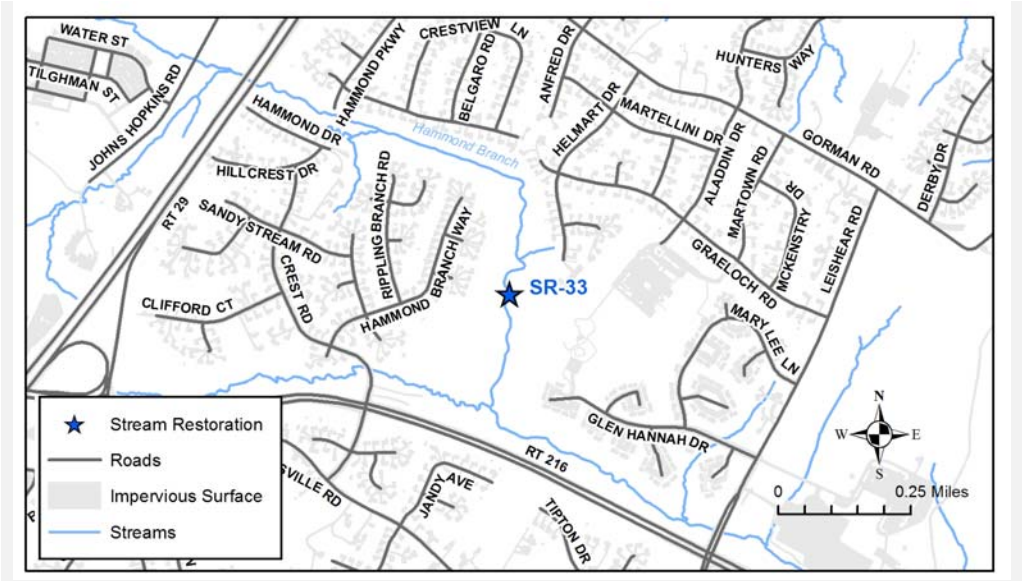
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-33
Site Name: Hammond Branch (a)
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Park
Single Owner

Existing Conditions:

This project site consists of four separate stream assessment sites including: SMP-SR-F332A, SMP-SR-F332B, SMP-SR-F341A, AND SMP-SR-F341B. All four stream assessment sites are part of Hammond Branch near Hammond Branch Way where the stream takes a 90 degree turn going south towards MD-216. The project site is located on Howard County Department of Recreation and Parks property. As the stream flows downstream, it transitions from a relatively straight channel to a more meandering channel with tight bends. The stream is wide with point bars forming within the channel and along the banks. Several fallen trees are present within the stream causing debris jams, deep pools, and impacting stream bank erosion. Severely eroding banks (5 ft. or greater) were encountered throughout the stream. The instream habitat within the existing channel scored in the suboptimal range overall. The epifaunal substrates consists of greater than 70% stable habitat favorable for epifaunal colonization with a mix of unstable and stable substrate. Embeddedness throughout the stream becomes worse as the stream moves downstream, with 50-75% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is optimal with typically all velocities present throughout the stream. Sediment deposition throughout the channel is evident with moderate deposition occurring creating bar formations and some sediment deposition within the stream bed. The channel flow status is suboptimal with water filling on average 75% of the available channel and some of the riffle substrate exposed. Both stream banks are moderately unstable with 50% of the stream banks having little cover and increased erosion during floods. Vegetative protection along both banks is also poor, with only 50-70% of the stream bank surface being covered by vegetation. Shading along the existing channel is marginal (40%), but more shade (80%) is encountered as the stream moves downstream.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-33

Site Name: Hammond Branch (a)

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream, evident bank erosion on the left bank (looking downstream).

Facing downstream at a tight bend in the stream, a deep pool forming with little to no protection on the left bank (looking downstream).

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-33
Site Name: Hammond Branch (a)
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Sewer line easements could be used to access the stream, but access could impact vernal pools that are currently found along the easement and floodplain. Because this stream is located within a heavily forested area, moderate impacts to trees are expected. There are several places along the stream where the sewer line crosses.

Concept Description:

Hammond Branch is over-wide throughout this reach. The stream has become entrenched and disconnected from its surrounding floodplain. The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. The recommended approach for stream restoration in this reach is to raise the invert as much as possible using the existing alignment and creating a new base flow channel. This would involve adding woody debris, cobble riffles, pools, and other habitat nature-like structures to the stream bed. This approach would meet the objectives of improving water quality, reducing sediment loading to the downstream system, and improve instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however some minor realignment may be necessary at tight meander bends. Because Hammond Elementary and Middle School are adjacent, this site has potential to be integrated into the school curriculum. The site can be accessed via Helmart Drive through Howard County Recreation and Parks property. There are seven other project recommendations for concurrent implementation including two tree plantings sites and five stream restoration sites. These seven projects include: SR-34, SR-35, SR-36, SR-37, SR-38, SMP-TP-F405A, and SMP-TP-406.

Nearby Opportunities:

SR-34, SR-35, SR-36, SR-37, SR-38, SMP-TP-F405A, SMP-TP-406

Proposed Project Credit		Costs	
Length Restored (ft):	2,790	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	27.9	Estimated Construction Cost:	$1,255,950.00
Cost per Impervious Credit Acre:	$69,273.66	30% Contingency:	$376,785.00
		Estimated Total Cost:	$1,932,735.00

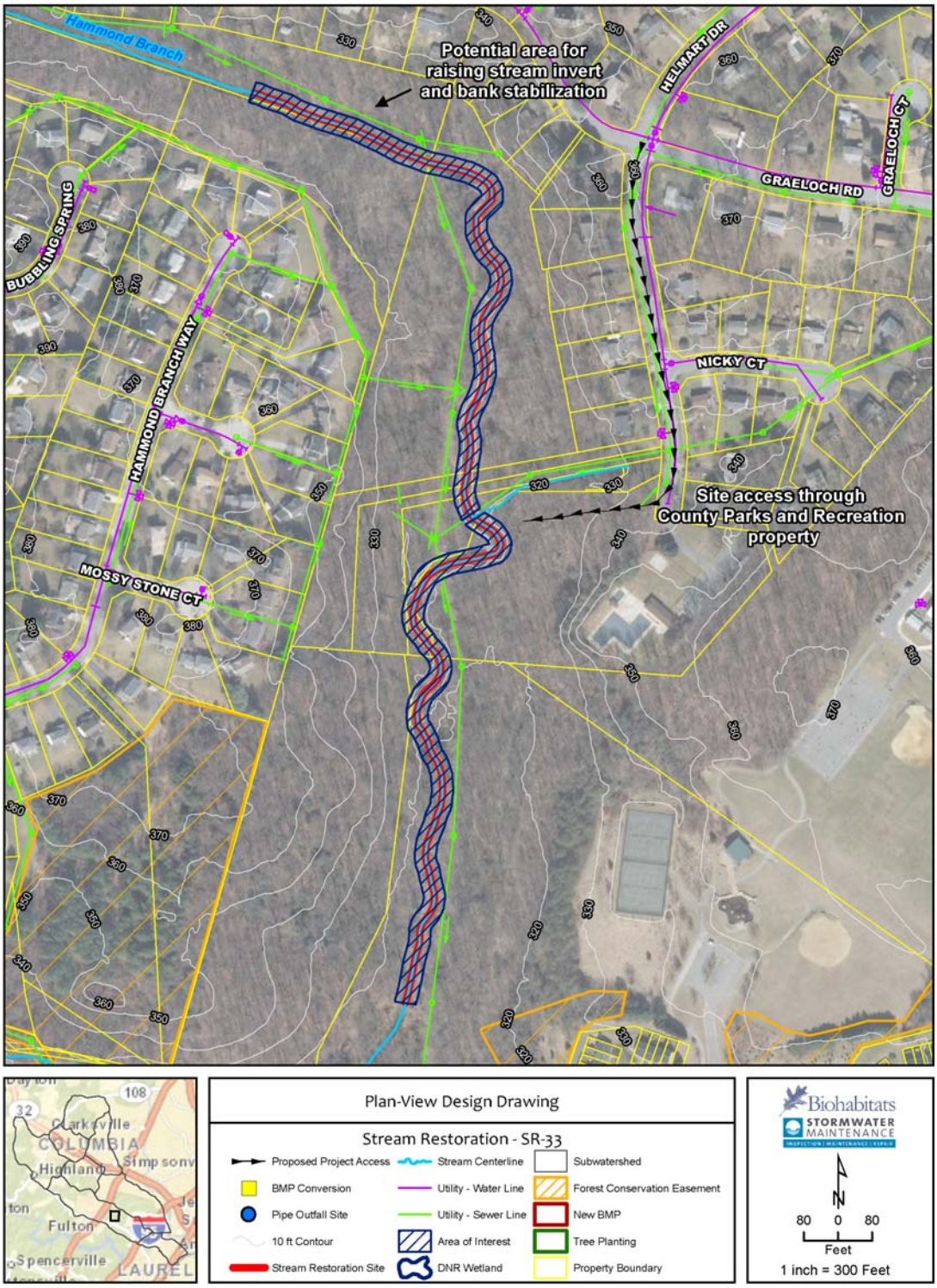
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-33

Site Name: Hammond Branch (a)

Contractor: Biohabitats

Watershed: Little Patuxent River



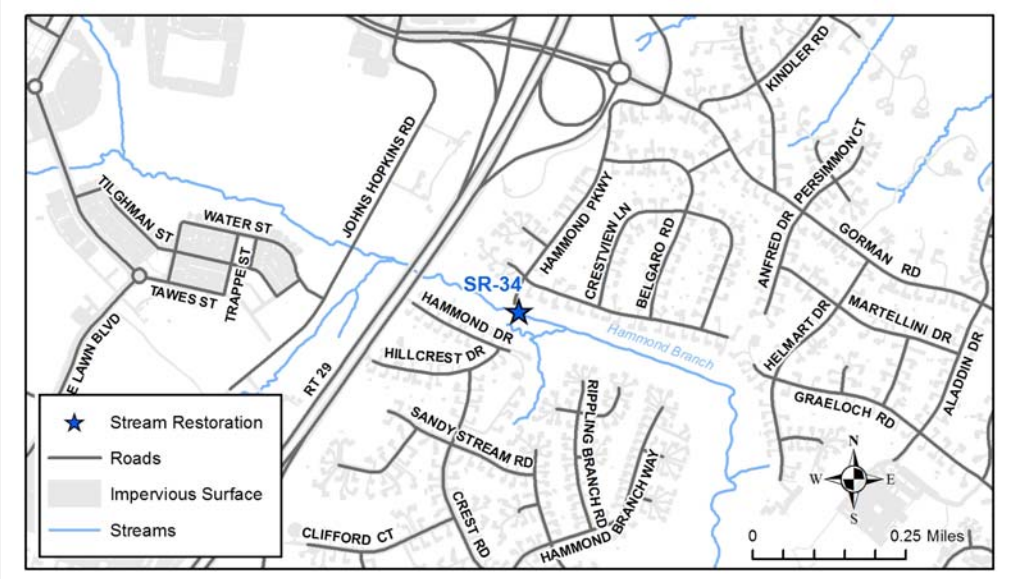
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-34
Site Name: Hammond Branch (b)
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

This project site, located on Hammond Branch, consists of two stream assessment sites: SMP-SR-F335A and SMP-SR-F335B. Multiple owners are involved in this section of Hammond Branch, including private property owners and the State of Maryland. Private property and homes surround the stream on both sides of the stream with homeowners mentioning frequent flooding occurring. Relatively moderate bank erosion was observed, with eroded bank heights averaging from 3-5 ft. high. Two locations along the stream showed eroded bank heights of greater than 5 ft. Residential lawns run directly to the stream, providing a poor riparian vegetative buffer. Concrete rubble was found along a portion of the project site; it was presumably placed there to act as bank protection. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates consists of 20-40% stable habitat favorable for epifaunal colonization with less than desirable habitat and frequently disturbed substrate increasing the embeddedness throughout the stream, with 50% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is suboptimal with typically three of four velocities present throughout the stream. More sediment deposition occurs within the upstream portion of this assessed part of Hammond Branch where moderate deposition occurring creating bar formations and some sediment deposition within the stream bed. The channel flow status is suboptimal with water filling on average 75% of the available channel and some of the riffle substrate exposed. Both stream banks are moderately unstable with 40% of the stream banks having some cover and increased erosion during floods. The right bank (looking downstream) is more unstable than the left bank. Vegetative protection along both banks is suboptimal with some areas being disturbed. There is little to no riparian vegetation along the right and left banks (looking downstream) due to encroachment on private properties. Shading along the existing channel is marginal (40%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-34

Site Name: Hammond Branch (b)

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream, concrete rubble presumably acting as bank protection.

Facing the left bank, an eroded bank height greater than 5 ft. with no protective vegetative cover.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-34
Site Name: Hammond Branch (b)
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Access to the stream can be from Hammond Parkway and/or along the existing sewer line easement. There are several locations along the stream where either a water line and/or sewer line crosses the stream. Impacts to trees would be moderate, but mainly due to access.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. As homes are located within the floodplain, the stream invert cannot be raised without potentially creating more flooding within this area. A multistage channel should be created and the riparian buffer on the left bank enhanced. This will be accomplished by grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at the tight meander bends. In addition, establishing the maximum riparian buffer and improving tree understory will provide shading to reduce the stream temperature and needed litter inputs and woody debris. This channel restoration has the potential to reduce sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Hammond Parkway. There are seven other project recommendations that can be concurrently implemented with this project including two tree planting sites and five stream restoration sites. These seven projects include: SR-33, SR-35, SR-36, SR-37, SR-38, SMP-TP-F405A, and SMP-TP-F406.

Nearby Opportunities:

SR-33, SR-35, SR-36, SR-37, SR-38, SMP-TP-F405A, SMP-TP-F406

Proposed Project Credit		Costs	
Length Restored (ft):	1,387	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	13.9	Estimated Construction Cost:	$624,600.00
Cost per Impervious Credit Acre:	$80,171.59	30% Contingency:	$187,380.00
		Estimated Total Cost:	$1,111,980.00

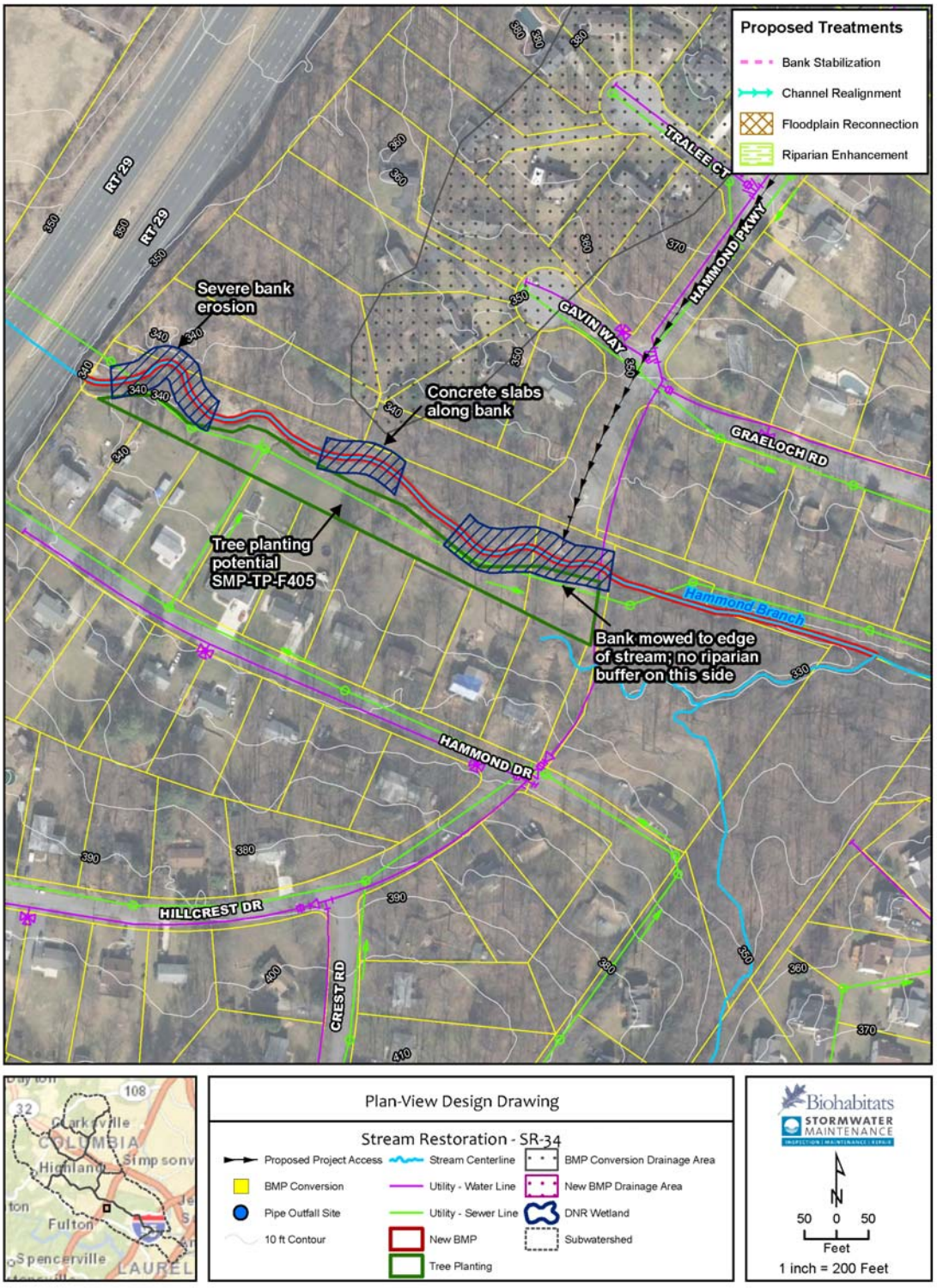
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-34

Site Name: Hammond Branch (b)

Contractor: Biohabitats

Watershed: Little Patuxent River



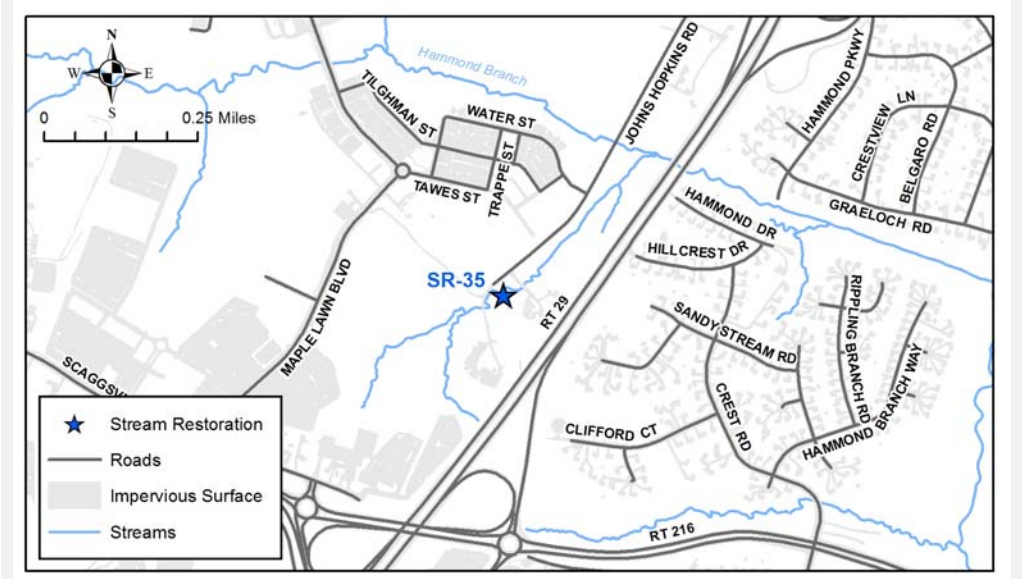
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-35
Site Name: Maple Lawn Farms
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

Existing Conditions:

This project site involves four different stream assessment sites: SMP-SR-F333B, SMP-SR-F333C, SMP-SR-F334A, and SMP-SR-F334B. The stream flows through multiple privately and publicly owned properties as well as a forest conservation easement named Maple Lawn Farms. The system had multiple headcuts moving upstream, creating a stream channel that is no longer connected to the surrounding floodplain. The headcuts are currently located in the upstream most reach. Most of the existing system is entrenched within the reaches indicated for restoration. Erosion throughout the stream shows varying eroded bank heights ranging from 3 to greater than 5 ft. The channel has been altered throughout the stream reach, presumably to stabilize the bank; however, the channel alteration has caused more erosion to occur downstream of the "fixed" area. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates consists of 20-40% stable habitat favorable for epifaunal colonization with less than desirable habitat and frequently disturbed substrate increasing the embeddedness throughout the stream, with 50% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is marginal with typically one or two velocities present throughout the stream. Less sediment deposition occurs within the assessed site where some deposition occurs throughout the stream creating bar formations and some sediment deposition. The channel flow status is optimal at the upstream end of the stream with water filling on average 75% of the available channel; however, as the stream moves downstream, the channel flow status becomes marginal with the channel only filling 50% of the available channel and more riffle substrate is exposed. Upstream bank stability is moderately stable, while as the stream moves downstream, stream banks on both the left and right side of the stream become unstable with 60% of the stream banks having some cover and increased erosion during floods. Vegetative protection upstream is great with 70-90% of the stream bank surface covered, while the downstream portion of the stream has little to no vegetative protection. Shading along the existing channel is suboptimal (60%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-35

Site Name: Maple Lawn Farms

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream, a recent bank failure along the right bank (looking downstream), leaving the bank raw with little to no vegetative protection.

Facing upstream, little protective cover on the right bank (looking downstream).

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-35
Site Name: Maple Lawn Farms
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Two sewer lines run along the stream before they converge into one sewer line after crossing the stream. No water lines cross the stream. Tree impacts are to be expected because of the location of the stream, but should be avoided to the extent possible during construction. The stream runs through a BGE ROW; therefore, overhead lines need to be avoided. The stream can be accessed using John Hopkins Road and using the existing sewer line easement.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by raising the stream invert to connect the channel to the existing floodplain, grading banks back to a stable angle, and stabilizing the banks with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however some minor realignment may be necessary at tight meander bends. A berm along John Hopkins Road should be removed to allow greater floodplain access during larger flows. In addition, maximizing the riparian buffer will increase shading, reduce the stream temperature and provide needed litter inputs and woody debris. This channel restoration has the potential to reduce sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Johns Hopkins Road. Seven other project recommendations can be implemented concurrently with this project including two tree planting sites and five other stream restoration sites. These seven other projects include: SR-33, SR-34, SR-36, SR-37, SR-38, SMP-TP-F405A, and SMP-TP-F406.

Nearby Opportunities:

SR-33, SR-34, SR-36, SR-37, SR-38, SMP-TP-F405A, SMP-TP-F406

Proposed Project Credit		Costs	
Length Restored (ft):	2,773	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	27.7	Estimated Construction Cost:	$1,247,850.00
Cost per Impervious Credit Acre:	$69,318.61	30% Contingency:	$374,355.00
		Estimated Total Cost:	$1,922,205.00

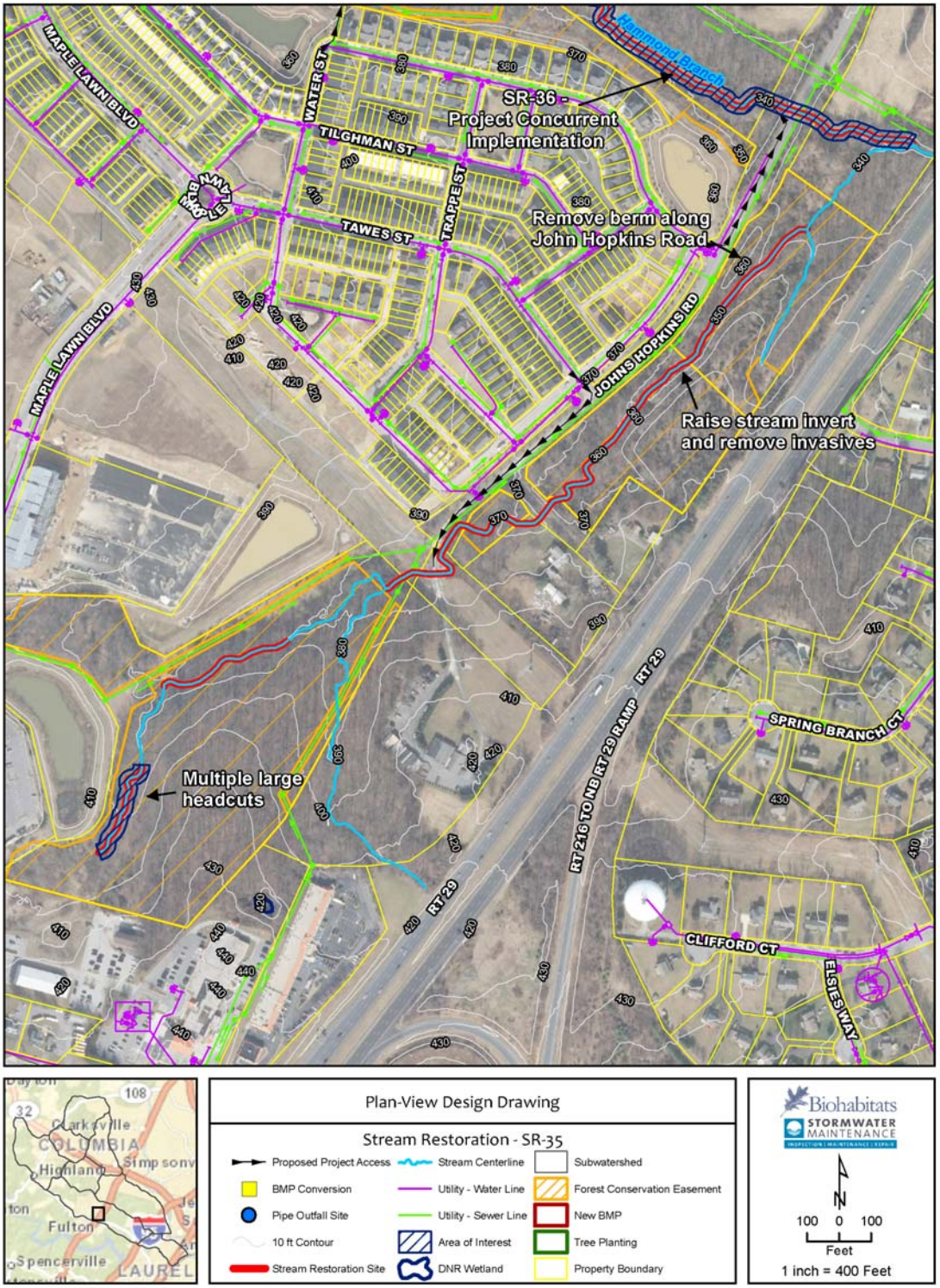
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-35

Site Name: Maple Lawn Farms

Contractor: Biohabitats

Watershed: Little Patuxent River



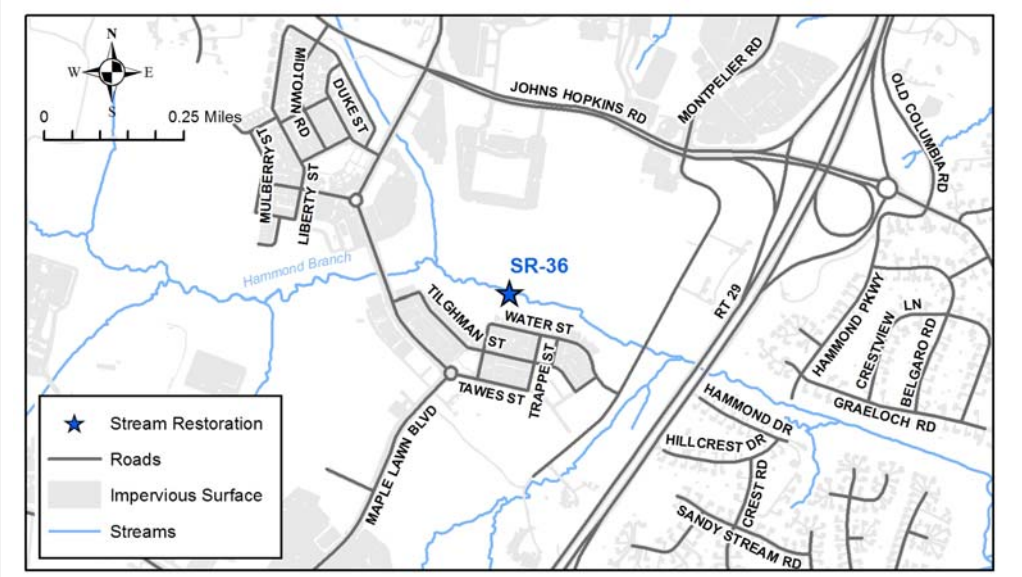
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-36
Site Name: Hammond Branch (c)
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

Existing Conditions:

This project site involves three stream assessment sites: SMP-SR-F337A, SMP-SR-F337B, and SMP-SR-F337C. The project site is on Hammond Branch and is upstream of project site SR-35. The stream runs parallel to Water Street and crosses Johns Hopkins Road as it flows downstream toward Route 29. Portions of the stream corridor are located within the Maple Lawn Farms Forest Conservation Easement. A large development with town homes is located along the right side of the stream. There are two wet ponds also near the stream that capture stormwater from the surrounding neighborhood. The outfalls from these wet ponds drain to the stream, and are starting to headcut back up the flow path from the stream banks. Severe bank erosion of 5 ft. or greater is occurring along the stream on both the left and right banks with the right bank being more severe due to the adjacent neighborhood. Point and mid-channel bars and debris jams were found throughout the stream that were hindering the health and flow of the stream. Instream habitat within the existing channel scored in the suboptimal range overall. The epifaunal substrates consists of 20-40% stable habitat favorable for epifaunal colonization with less than desirable habitat and frequently disturbed substrate affecting the embeddedness throughout the stream, with 25-50% of gravel, cobble, and boulder particles surrounded by fine sediment. Both stream banks are unstable with 30-60% of the stream banks having some cover and increased erosion during floods. Vegetative protection upstream is worse with only 50-70% of the stream bank surface covered; however, as moving downstream, vegetative protection increases with an average of 90% of the stream bank surface covered. Shading along the existing channel is suboptimal (70%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-36
Site Name: Hammond Branch (c)
Contractor: Biohabitats
Watershed: Little Patuxent River

Facing upstream, a tight bend with a raw left bank (looking downstream), a deep pool and a large mid channel bar forming upstream of the tight bend.

Facing downstream, a large debris jam and bank erosion occurring on both the left and right banks.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-36
Site Name: Hammond Branch (c)
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

The site can be accessed from Johns Hopkins Road. There is also a sewer line easement that runs along the stream that could be used as access to avoid major tree impacts. The stream is located within a forest easement; therefore, more tree impacts are expected within the area.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. If possible, the stream invert will be raised to increase floodplain access. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at tight meander bends. In addition, establishing the maximum riparian buffer by improving the existing forest understory to increase shading, reduce stream temperature, and provide needed litter inputs and woody debris to the channel overtime to maintain the habitat complexity and quality. All invasive species should be removed and an invasive management program should be applied to this site. This channel restoration has the potential to reduce the sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Johns Hopkins Road and by a sewer line easement that runs adjacent to the stream. There are six nearby project recommendations that could be implemented concurrently with this project, including five stream restoration sites and one tree planting site. These nearby projects include: SR-33, SR-34, SR-35, SR-37, SR-38, and SMP-TP-F405A.

Nearby Opportunities:

SR-33, SR-34, SR-35, SR-37, SR-38, SMP-TP-F405A, SMP-TP-F406

Proposed Project Credit		Costs	
Length Restored (ft):	2,748	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	27.5	Estimated Construction Cost:	$1,237,050.00
Cost per Impervious Credit Acre:	$69,438.32	30% Contingency:	$371,115.00
		Estimated Total Cost:	$1,908,165.00

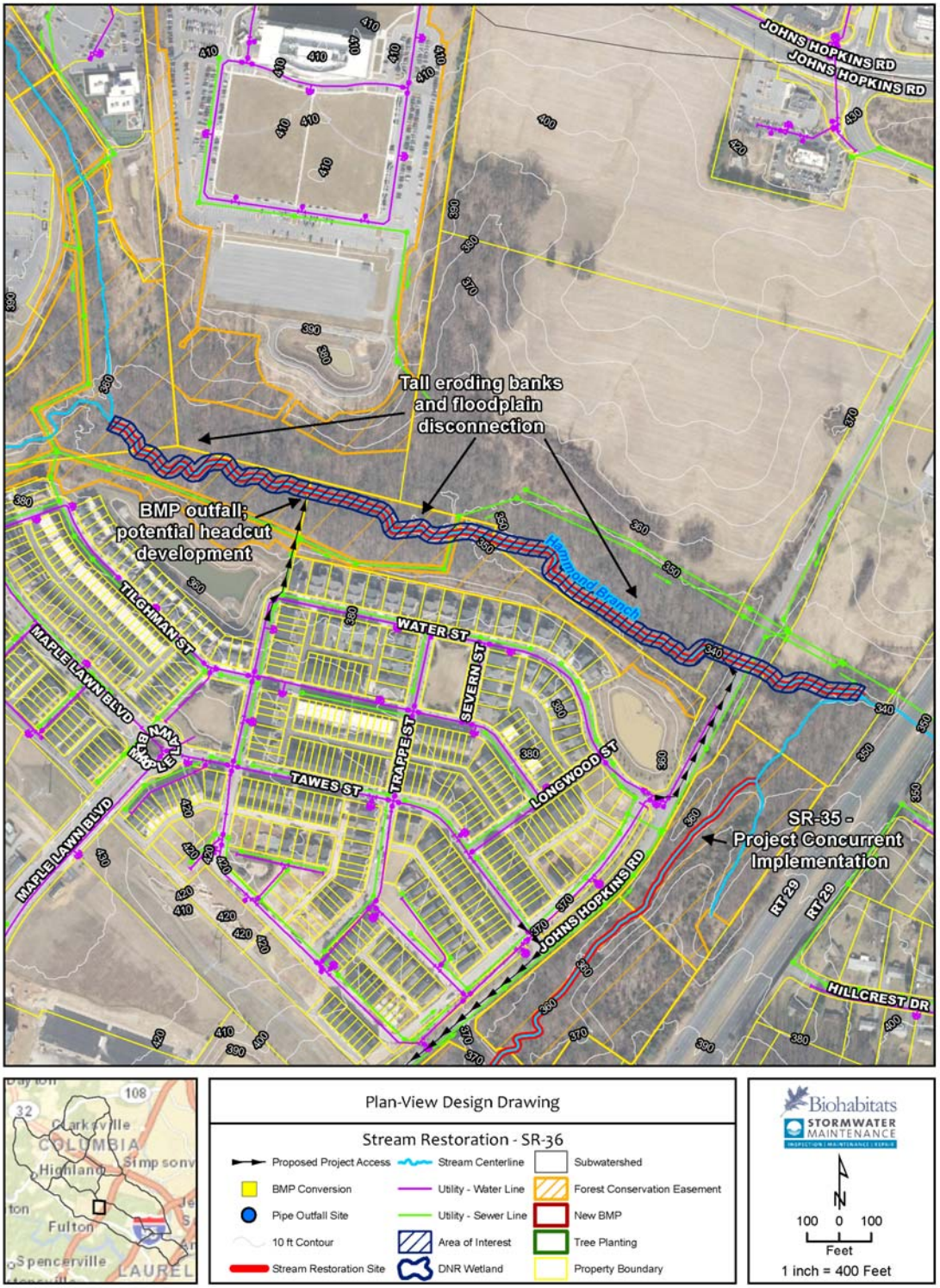
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-36

Site Name: Hammond Branch (c)

Contractor: Biohabitats

Watershed: Little Patuxent River



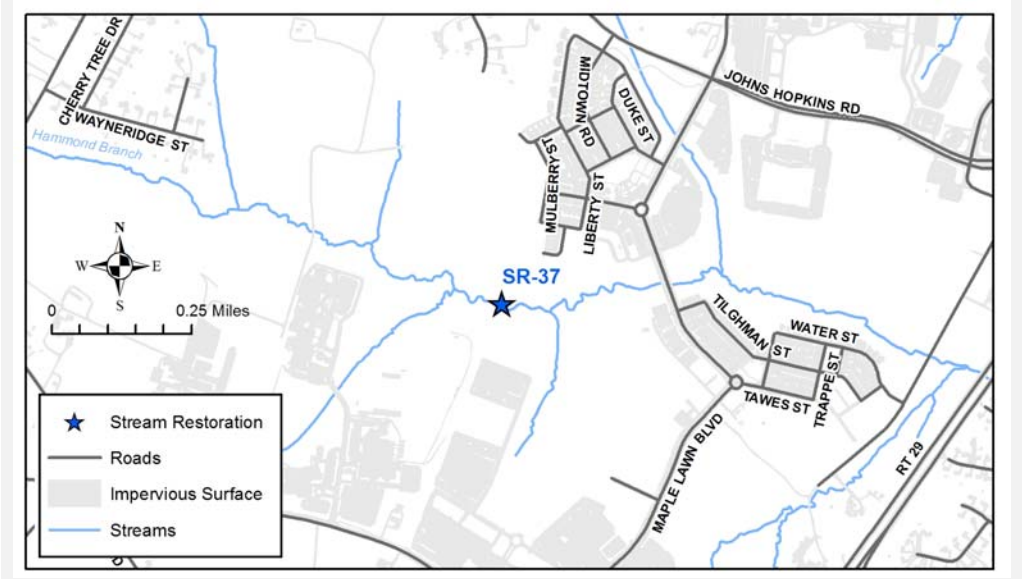
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-37
Site Name: Hammond Branch (d) - Reservoir High School
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

This project site includes two stream assessment sites: SMP-SR-F336A and SMP-SR-F338A. SMP-SR-F338A is upstream of SMP-SR-F336A on Hammond Branch. A BGE ROW runs the length of the site, with very little overhead cover and shade. SMP-SR-338A is located near Cedar Lane School and Lime Kiln Middle School, while SMP-SR-F336A is near Reservoir High School. The stream has moderate erosion occurring along both the left and right banks ranging from 3 to 5 ft. in bank height for most of the length. The upstream reach (SMP-SR-F338A) has a long section of eroding bank over 9 ft. in height, the right bank has very high eroding banks cutting into the hillslope near the school. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrate upstream is poor with less than 20% stable habitat; however, as the stream moves downstream the epifaunal substrate becomes better and consists of 40-70% stable habitat favorable for epifaunal colonization with desirable habitat and some disturbed substrate not ready for colonization yet. Embeddedness throughout the stream is higher at the upstream end and continues to decrease as the stream moves downstream with an average of 25-50% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is suboptimal with three velocities present throughout the stream. Severe sediment deposition occurs within the upstream portion of the stream with 50% of the bottom affected and bar formations are occurring along the stream banks. As the stream moves downstream, only 30% of the bottom is affected by sediment deposition. The channel flow status is suboptimal throughout the stream with water filling on average 75% of the available channel and some riffle substrate exposed. Bank stability is moderately unstable on both the left and right side of the stream with 30-60% of the stream banks having some cover and increased erosion during floods. Vegetative protection along the left and right bank is marginal with an average of 70% of the stream bank surface covered. Shading along the existing channel is poor (10%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-37

Site Name: Hammond Branch (d) - Reservoir High School

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing downstream, an average 4 ft. recently eroded bank.

Facing downstream, very high eroded banks cutting into the hillslope near the school.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-37
Site Name: Hammond Branch (d) - Reservoir High School
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Both site assessments are mainly within a BGE ROW and are in close proximity to multiple schools. There are electrical power lines overhead and transmission poles along the stream that can make the site hazardous during construction. A sewer line does cross the stream and runs along a small portion of the stream. Very minimal tree impacts are anticipated due to a lack of overhead cover.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. To improve instream habitat, either the stream invert can be raised or a new floodplain can be graded to reduce bank erosion and promote floodplain reconnection. In addition, grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place will help reduce bank erosion. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary where the stream is cutting into the hillslope. Maximizing riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris. This channel restoration has the potential to reduce the sediment supply, improve habitat, provide opportunities for nutrient uptake, and serve as an outdoor learning laboratory for the surrounding schools. The site can be accessed from the BGE access road and/or the nearby school. There are seven other nearby project recommendations that should be concurrently implemented with this site including five stream restoration sites and two tree planting site. These nearby projects include: SR-33, SR-34, SR-35, SR-36, SR-38, SMP-TP-F405A, and SMP-TP-F406. The outfalls from the area being developed on the reach between here and SR-38 should be modified so that the flow passes to the stream through a channel, not sheet flow so as to limit future headcutting up to the outfall.

Nearby Opportunities:

SR-33, SR-34, SR-35, SR-36, SR-38, SMP-TP-F405A, SMP-TP-F406

Proposed Project Credit		Costs	
Length Restored (ft):	1,749	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	17.5	Estimated Construction Cost:	$787,500.00
Cost per Impervious Credit Acre:	$75,686.11	30% Contingency:	$236,250.00
		Estimated Total Cost:	$1,323,750.00

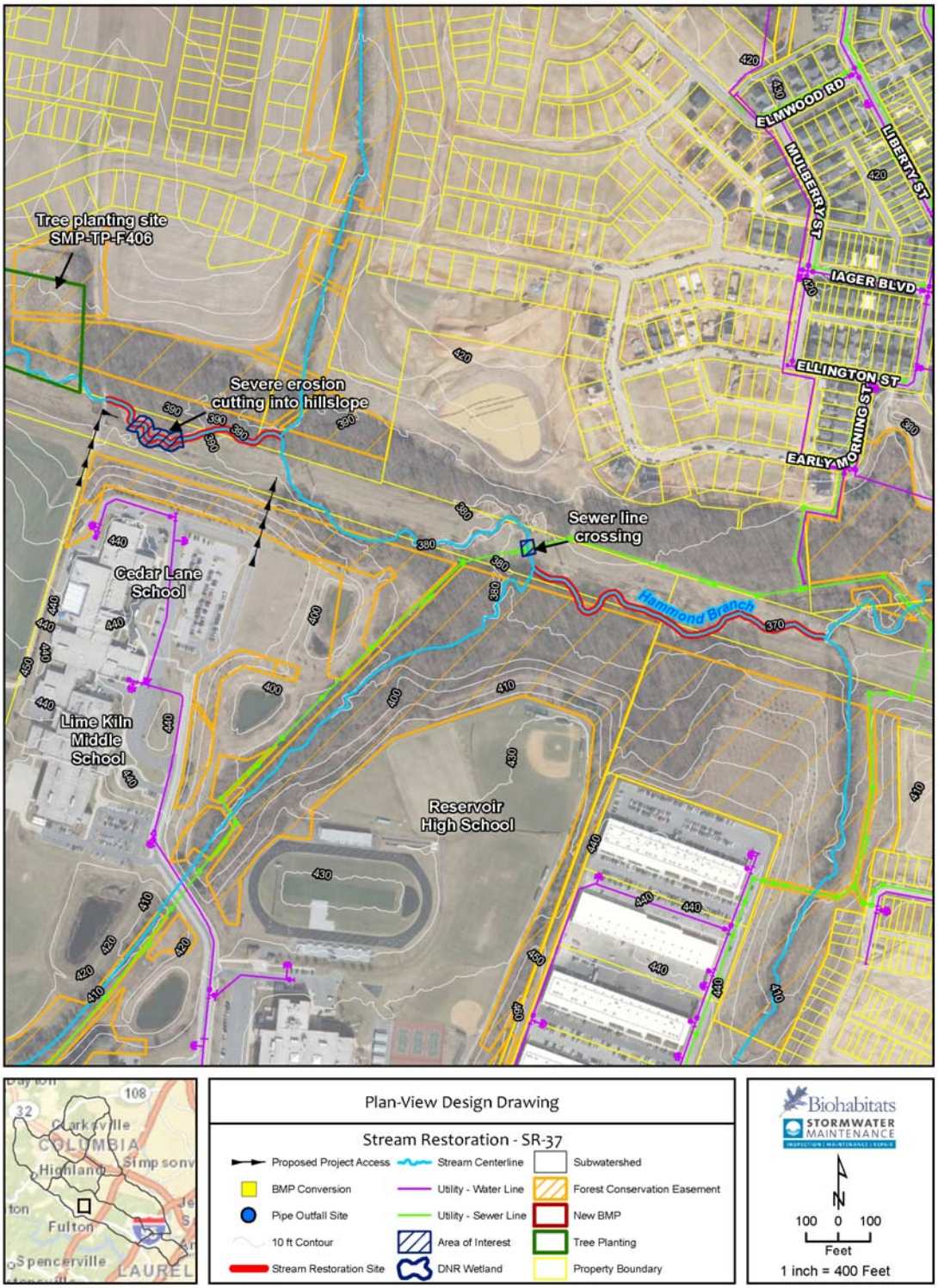
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-37

Site Name: Hammond Branch (d) - Reservoir High School

Contractor: Biohabitats

Watershed: Little Patuxent River



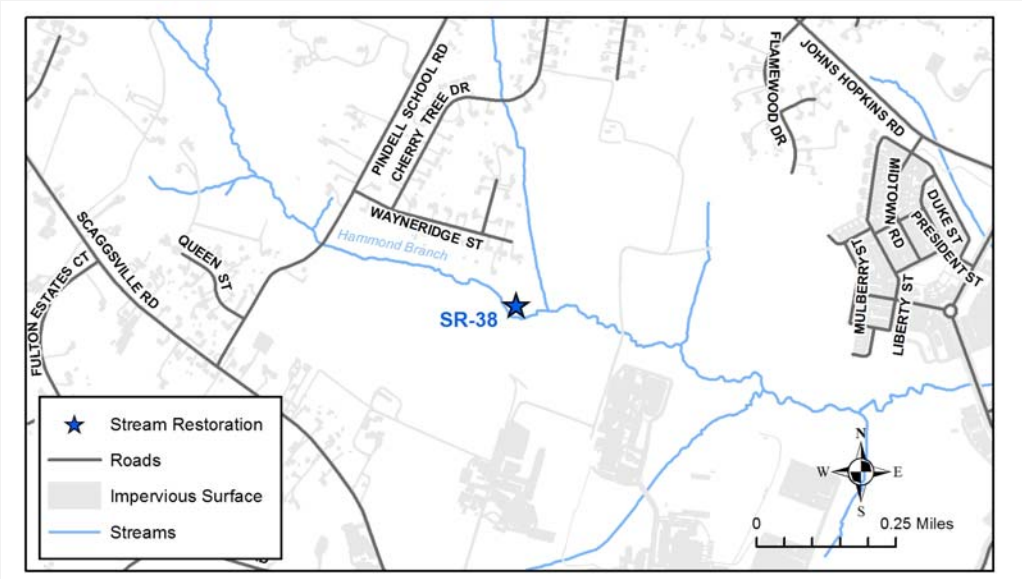
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-38
Site Name: Hammond Branch (e) - The Home Farm LLC
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

Existing Conditions:

This project site involves two stream assessment sites: SMP-SR-F339A and SMP-SR-F339B. The project site is on Hammond Branch and is located upstream of SR-37. The stream flows through three separate properties, including county owned, private-commercial (BGE ROW), and private-residential (The Home Farm LLC). Most of the project site is located on county land. The stream has moderate erosion occurring along both the left and right banks, ranging from 3 to 5 ft. in eroded bank height. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrate upstream is suboptimal with 40-70% stable habitat; however, as moving downstream the epifaunal substrate becomes worse and consists of less than 20% stable habitat favorable for epifaunal colonization with undesirable habitat and unstable substrate. Embeddedness throughout the stream is lower at the upstream end and continues to increase as the stream moves downstream with an average of 50% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is optimal with two velocities present throughout the stream. Severe sediment deposition occurs within the downstream portion of the stream with more than 50% of the bottom affected and bar formations are occurring along the stream banks. As the stream moves upstream, only 30% of the bottom is affected by sediment deposition. The channel flow status is suboptimal throughout the stream with water filling on average 75% of the available channel and some riffle substrate exposed. Bank stability is moderately stable on both the left and right side of the stream with 30% of the stream banks having some cover and increased erosion during floods. Vegetative protection along the left and right bank is marginal with an average of 70% of the stream bank surface covered. Shading along the existing channel is poor (10%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-38
Site Name: Hammond Branch (e) - The Home Farm LLC
Contractor: Biohabitats
Watershed: Little Patuxent River

Facing upstream at the right bank.

Facing upstream at the right bank showing average bank erosion for the site.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-38
Site Name: Hammond Branch (e) - The Home Farm LLC
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

This portion of Hammond Branch is located on three separate properties including county owned property, private property for commercial use (BGE), and private property for residential and commercial use (The Home Farm LLC). No utilities were observed in the area except for BGE lines over the stream. Transmission poles are along the stream and could create a hazardous work site during construction. The site can be accessed through the BGE ROW.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. To improve instream habitat, the stream invert can be raised, reducing bank erosion and promoting floodplain reconnection. Removing failing fences, grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place will also help reduce bank erosion. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary. In areas where power lines are not a constraint, tree planting and establishing the maximum riparian buffer will increase shading, reduce stream temperature and provide needed litter inputs and woody debris. This channel restoration has the potential to reduce sediment supply, improve habitat, and provide opportunities for nutrient uptake. The site can be accessed from the BGE access road. There are six nearby project recommendations that could be concurrently implemented with this project, including five stream restoration sites and one tree planting site. These nearby projects include: SR-33, SR-34, SR-35, SR-36, SR-37, and SMP-TP-F405A. The outfalls from the area being developed on the reach between this project site and SR-37 should be modified so that the flow passes to the stream through a channel, not as sheet flow so as to limit future headcutting up to the outfall.

Nearby Opportunities:

SR-33, SR-34, SR-35, SR-36, SR-37, SMP-TP-F405A, SMP-TP-F406

Proposed Project Credit		Costs	
Length Restored (ft):	1,671	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	16.7	Estimated Construction Cost:	$752,400.00
Cost per Impervious Credit Acre:	$76,488.33	30% Contingency:	$225,720.00
		Estimated Total Cost:	$1,278,120.00

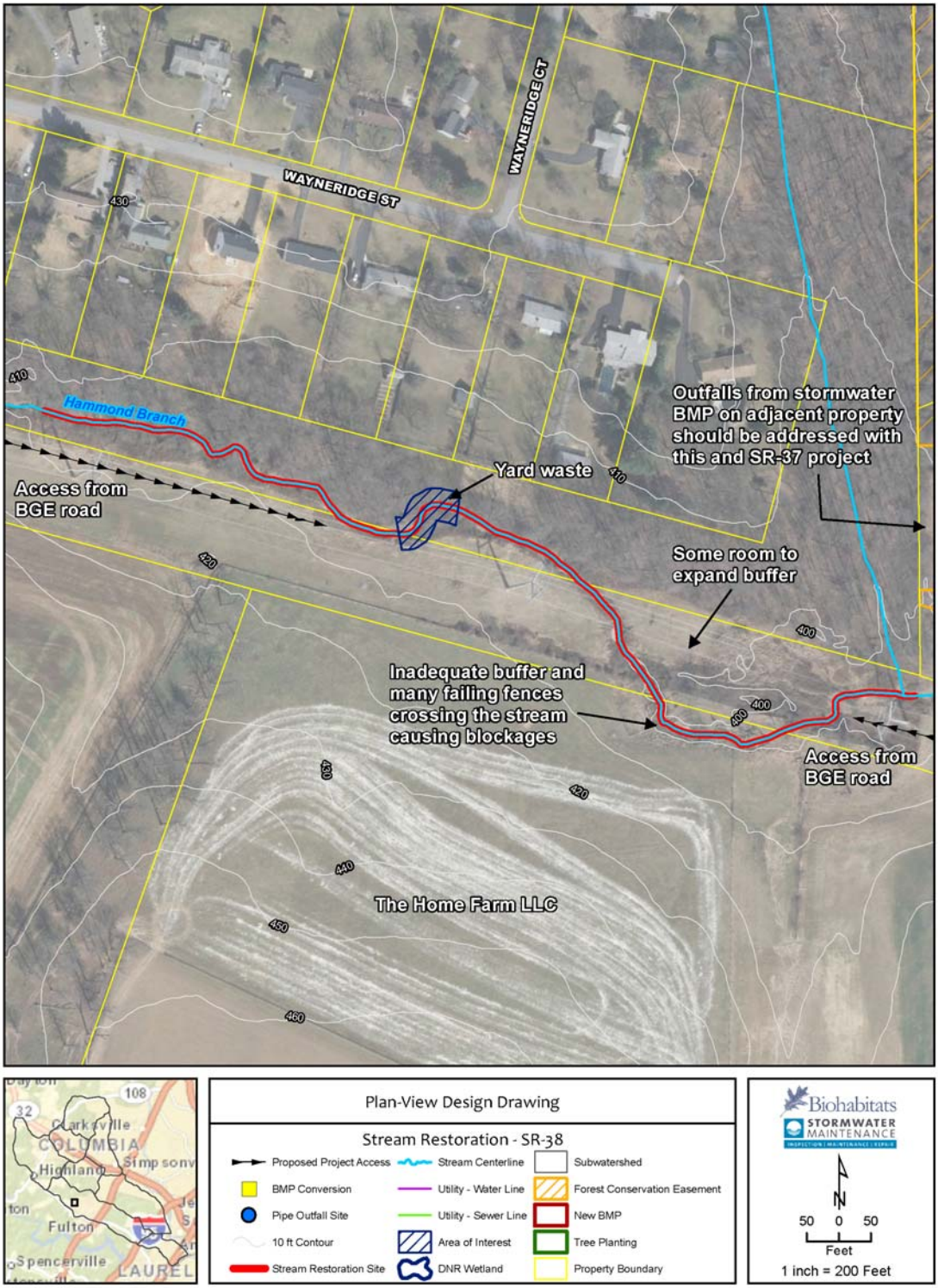
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-38

Site Name: Hammond Branch (e) - The Home Farm LLC

Contractor: Biohabitats

Watershed: Little Patuxent River



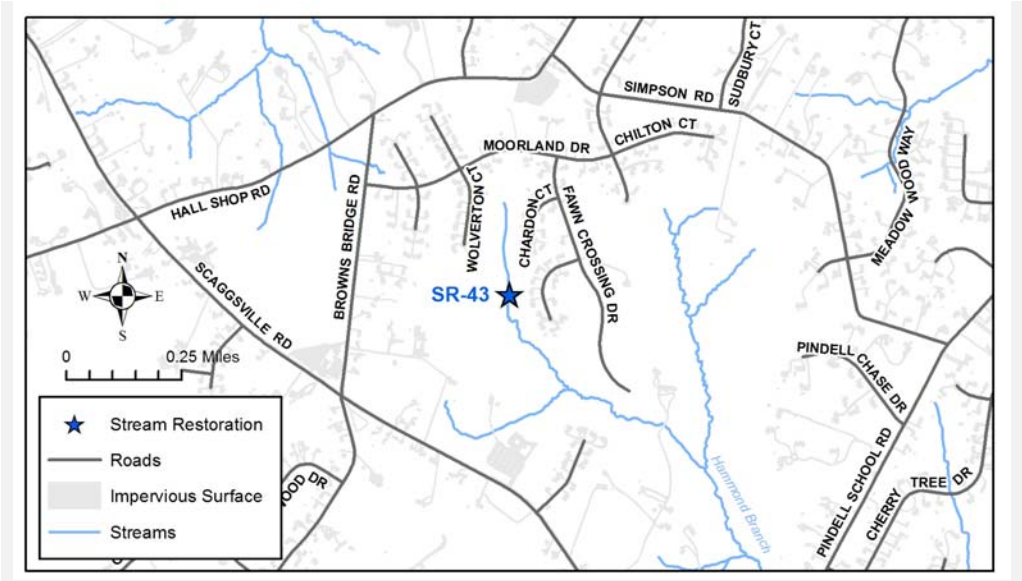
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-43
Site Name: Ashleigh Knolls Homeowners Association
Contractor: Biohabitats
Watershed: Little Patuxent River

Ownership: Private- Residential
Single Owner

Existing Conditions:

This project site involves two stream assessment sites: SMP-SR-F340B and SMP-SR-F340C. The stream is located on a wooded parcel that is privately owned by Ashleigh Knolls Homeowners Association. The stream runs adjacent to Wolverton Court in Clarksville, MD, is located within a Department of Natural Resources Wetland, Class PFO1A and is adjacent to the VanNoy Property Forest Conservation Easement. SMP-SR-F340C has minor erosion with two to three eroding banks throughout; however, as the stream moves downstream from SMP-SR-F340C to SMP-SR-F340B there is a 4 ft. head cut. After this head cut, more moderate erosion occurs with an average eroding bank height between 3 and 5 ft. There are several tight meanders throughout the stream causing raw and undercut banks to occur on both the left and right banks. The instream habitat within the existing channel scored in the marginal range overall. The epifaunal substrates consists of more than 70% stable habitat favorable for epifaunal colonization with desirable habitat and little disturbed substrate. Embeddedness throughout the stream is marginal with an average of 50-75% of gravel, cobble, and boulder particles surrounded by fine sediment. The velocity/depth regime of the channel is suboptimal with three to four velocities present throughout the stream. Heavy sediment deposition occurs within the stream where over 50% of the bottom affected and bar formations are occurring along the stream banks. The channel flow status is suboptimal at the upstream end of the stream with water filling on average 75% of the available channel. Bank stability is moderately unstable on both the left and right side of the stream with 60% of the stream banks having little cover and increased erosion during floods. Vegetative protection along the left and right bank is marginal with an average of 50-70% of the stream bank surface covered. Shading along the existing channel is optimal (90%).



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-43

Site Name: Ashleigh Knolls Homeowners Association

Contractor: Biohabitats

Watershed: Little Patuxent River

Facing upstream showing 4 ft. a headcut causing more extensive erosion downstream.

Facing upstream showing a high, raw eroded left bank (looking downstream).

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-43
Site Name: Ashleigh Knolls Homeowners Association
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Tree and wetland impacts due to the location are a major constraint to this project. The stream can be accessed from Moorland Drive between Wolverton Court and Fawn Crossing Drive. There were no observed utilities near this stream.

Concept Description:

The objective for this project is to reduce bank erosion and improve instream habitat for aquatic organisms. This will be accomplished by raising the stream invert to reconnect the stream with its floodplain as well as grading banks back to a stable angle and stabilizing them with native vegetation to hold soil in place. Adding woody debris, cobble riffles, pools, and other nature-like habitat structures will reinforce the stream bed and banks, improve the flow diversity and structural complexity of the stream bed, and uplift the instream habitat. The proposed channel restoration work would occur predominately on the existing channel alignment; however, some minor realignment may be necessary at tight meander bends. Maximizing the riparian buffer will increase the shading to reduce the stream temperature and provide needed litter inputs and woody debris to the channel. An invasive species management plan should be developed for the area. This channel restoration has the potential to reduce sediment supply, improve habitat and provide opportunities for nutrient uptake. The site can be accessed from Moorland Drive between Wolverton Court and Fawn Crossing Drive. There will be some tree impacts in order to access the stream. SMP-TP-F307A is an adjacent project recommendation that can be concurrently implemented with this project.

Nearby Opportunities:

SMP-TP-F307

Proposed Project Credit		Costs	
Length Restored (ft):	1,364	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	13.6	Estimated Construction Cost:	$613,800.00
Cost per Impervious Credit Acre:	$80,494.13	30% Contingency:	$184,140.00
		Estimated Total Cost:	$1,097,940.00

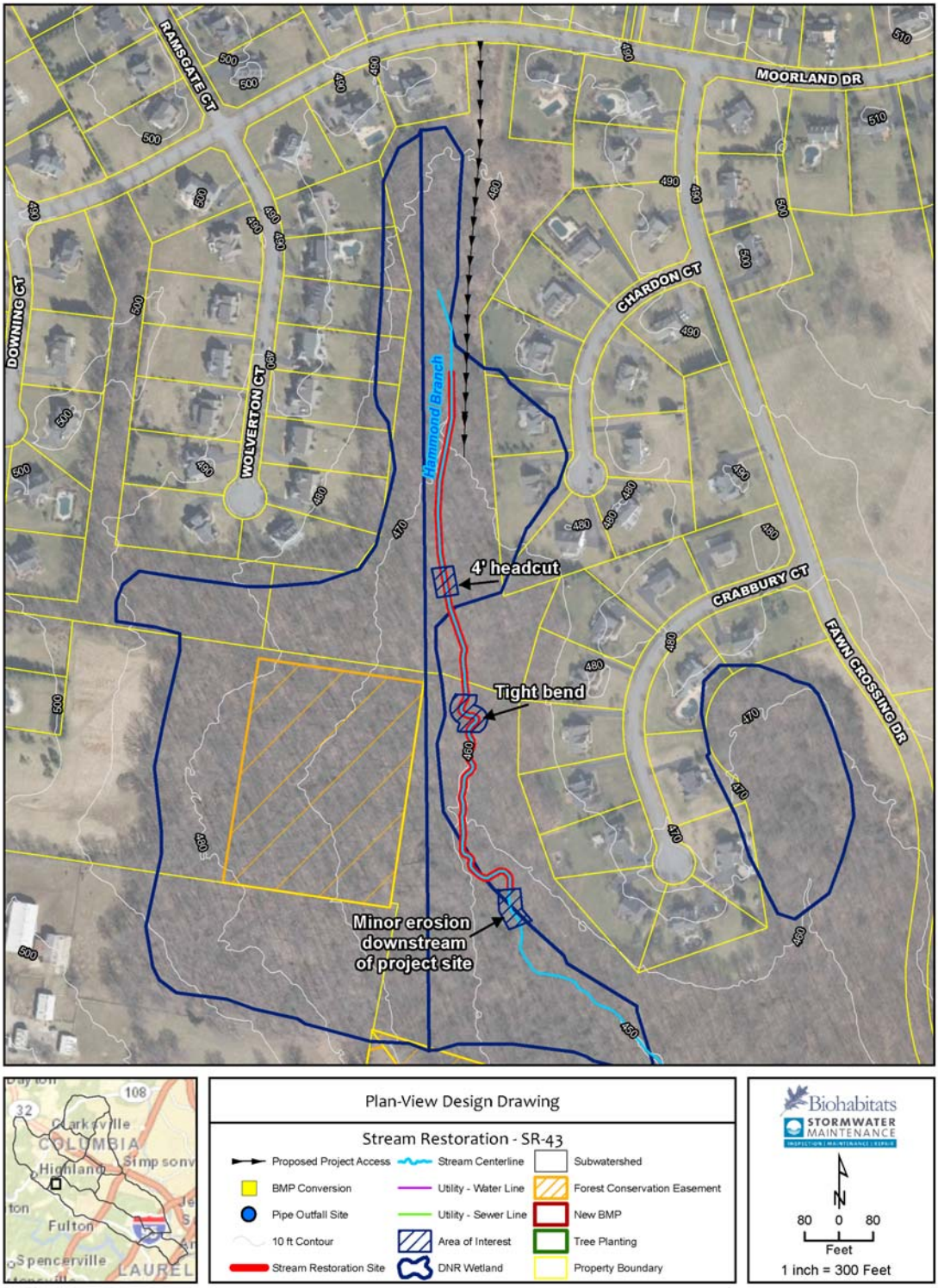
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-43

Site Name: Ashleigh Knolls Homeowners Association

Contractor: Biohabitats

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-45
Site Name: Boones Lane Tributary and Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

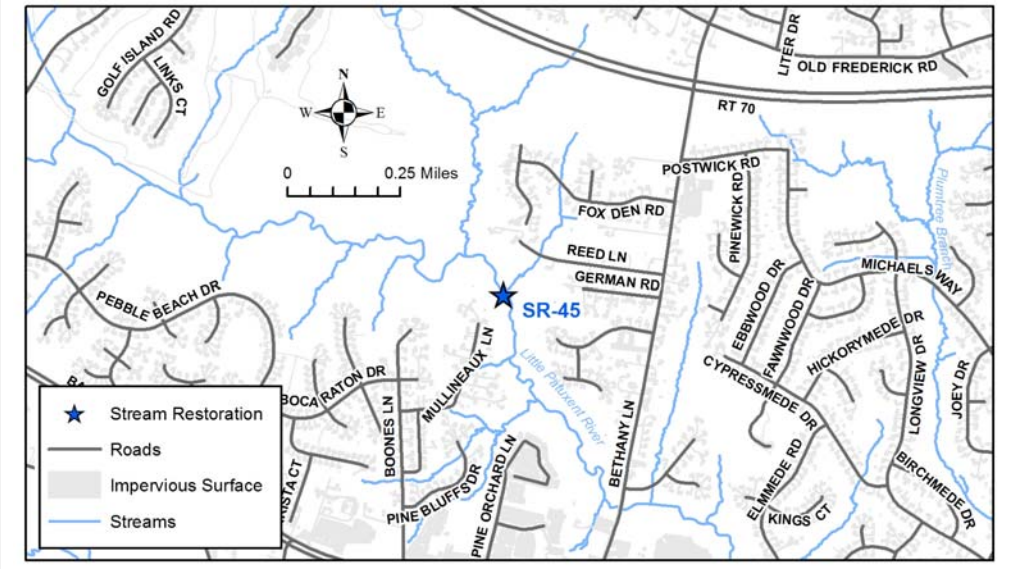
Existing Conditions:

The site consists of two reaches, Reach 1 consisting of approximately 1,000 lf. of an unnamed tributary to the Little Patuxent River and Reach 2 consisting of approximately 1,800 lf. of the Little Patuxent River. The confluence of Reach 1 occurs at the start of Reach 2, which is also at the downstream end of a stable bedrock reach of the Little Patuxent. The site also includes approximately 200 lf. of an unnamed tributary to the Little Patuxent River.

Reach 1 has approximately 4 ft. high banks that are a silty material that is easily erodible due to the vertical banks, moderate root depths, and moderate surface protection. Near bank stresses were found to be very high due to the bankfull indicator at 1.5 ft. above the bed. The reach has approximately 500 ft. of moderately eroded and undercut banks. Reach 1 is moderately embedded with fines, the bed material is composed of mostly silt sand and gravel with some cobbles, and moderate deposition was observed in the channel. Riffle spacing is characterized as being approximately five to seven channel widths. No channel alterations were observed.

Reach 2 has approximately 5 to 6 ft. high banks which are a silty material that is easily erodible due to the vertical banks, low to moderate root depths, and moderate surface protection. Near bank stresses were found to be high to very high due to the bankfull indicator at 1 to 2.5 ft. above the bed. This reach has approximately 900 ft. of severely eroded and undercut banks. Reach 2 is moderately embedded with fines, the bed material is composed of mostly silt, sand and gravel with some cobbles, and moderate to high bar formation is observed in the channel. Riffle spacing is characterized as being approximately five to seven channel widths.

The riparian buffer width for Reach 1 and Reach 2 is greater than 60 ft. on both banks and the quality of the riparian vegetation is good, at approximately 90% cover. A sanitary sewer line runs parallel and crosses both Reaches 1 and 2. In some localized areas the stream banks have eroded to a degree that they are within close proximity to the sanitary sewer line and manholes.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-45

Site Name: Boones Lane Tributary and Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River

Erosion facing left bank.

Erosion on left bank, vertical bank with moderate root depth. Moderate epifaunal habitat availability.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-45
Site Name: Boones Lane Tributary and Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The entire project site is located within Howard County Parks and Recreations property. A sewer line runs parallel to both reaches with a number of crossings throughout. A maintained easement associated with the parallel sewer exists and could potentially be used for access. Wetlands were noted on site, requiring special consideration to the design, permitting and construction access.

The easements running parallel to the channel could provide access; however, the location of the wetlands may determine construction access. In addition, due to the wide riparian buffer, a long access path will likely be necessary to reach the channel, causing a significant impact to trees. The use of the maintained easement should help to reduce the impact to the trees.

Concept Description:

The proposed stream restoration includes a natural channel design throughout this site, where a new floodplain can be graded at a new, lower elevation. This approach will be applied to both reaches. Some minor channel realignment may be proposed to shift the channel away from the parallel sanitary sewer line. Proposed bank protection will include bioengineering techniques such as alternating roughness protection, branch layering, and other vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations, especially in areas that are in close proximity to the parallel sanitary sewer line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat. Grade control structures will be used as necessary to stabilize the sanitary sewer crossings.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,992	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	29.9	Estimated Construction Cost:	$1,346,400.00
Cost per Impervious Credit Acre:	$68,526.74	30% Contingency:	$403,920.00
		Estimated Total Cost:	$2,050,320.00

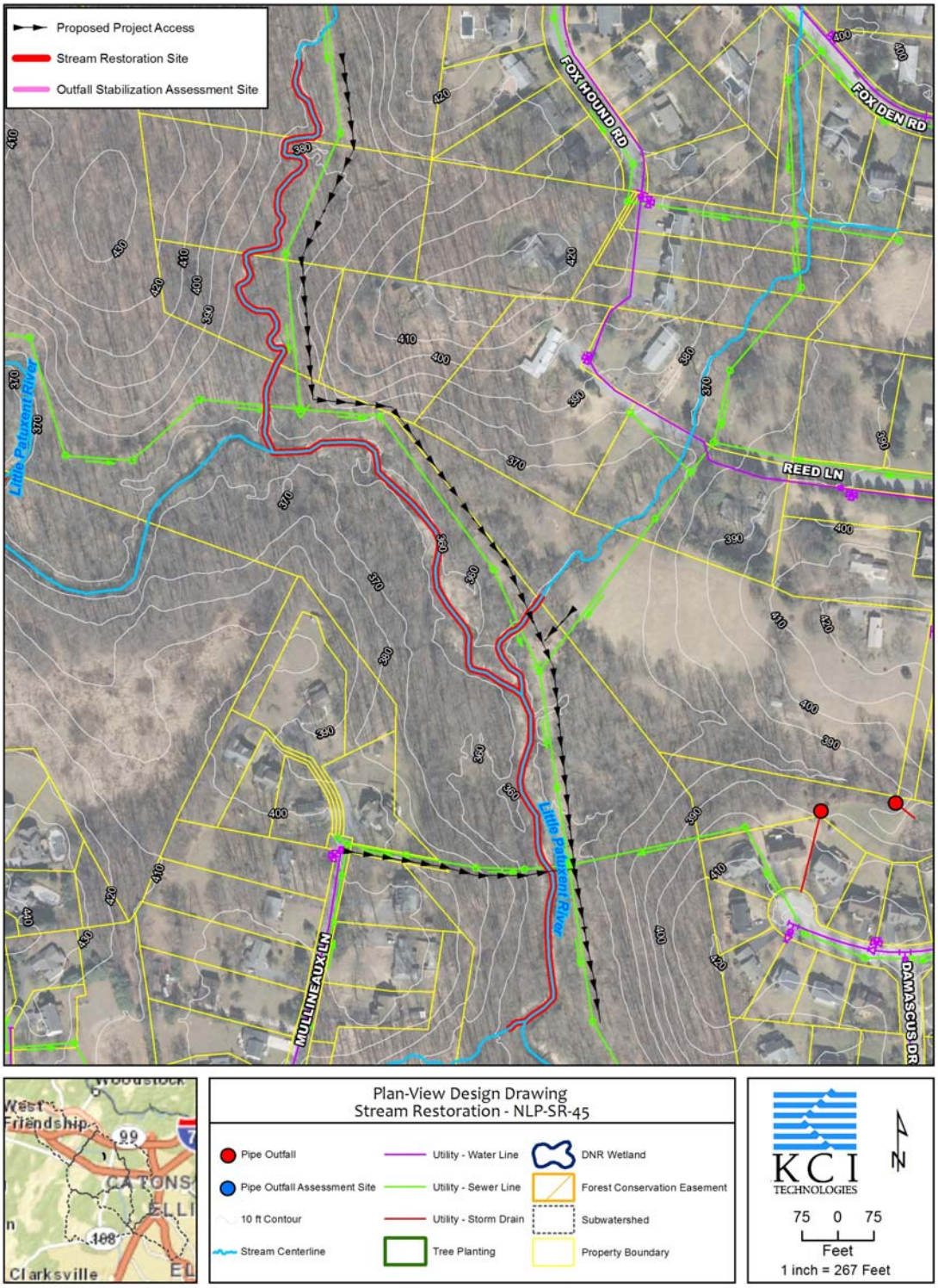
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-45

Site Name: Boones Lane Tributary and Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

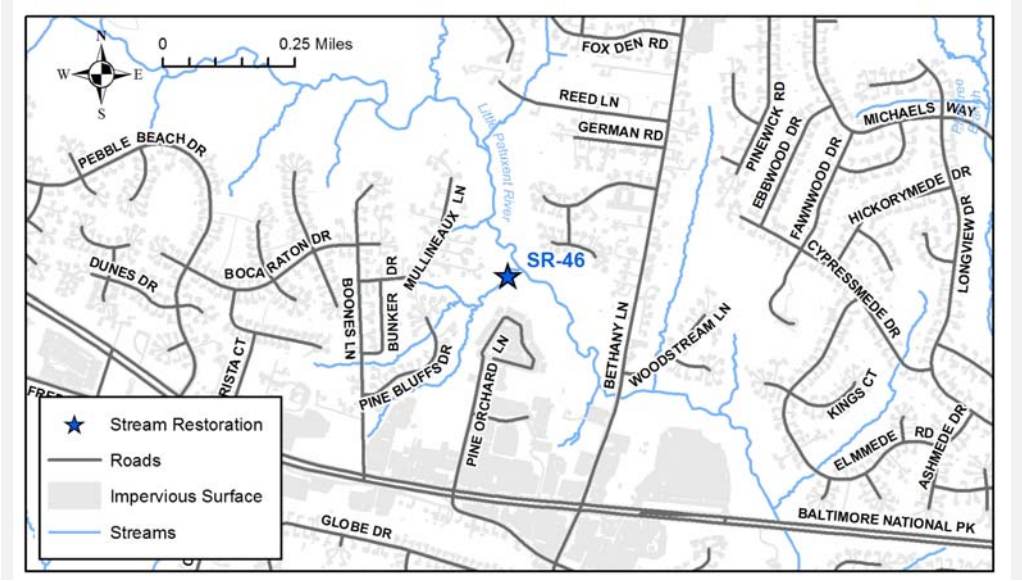
Site ID: SR-46
Site Name: Boones Lane, Tributaries and Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

Existing Conditions:

The restoration site consists of three reaches. Reach 1 includes a network of three small, unnamed tributaries to the Little Patuxent River, where Reach 2 begins. Reach 2 is located on the Little Patuxent River and continues to the confluence with the unnamed tributary located between Corporate Ct and Bethany Ln. The lower portion of this unnamed tributary is Reach 3. Reach 1 contains three tributaries and reach has approximately 2,400 lf. of moderately eroded banks that are approximately 3 to 5 ft. high. Eroded segments tend to alternate from one bank to the other and overall the length of erosion is occurring equally on each bank. Banks are comprised of silt material that is easily erodible due to the vertical bank angle, moderate root depths, and moderate surface protection. The presence of bankfull indicators at 1 to 2 ft. above the bed suggests that the near bank stresses are very high. The riparian buffer width for Reach 1 is approximately 125 ft. on both banks until the furthermost upstream portions where the buffer decreases to 50 ft. on both banks and the quality of the riparian vegetation is good, at approximately 90% cover.

Reach 2, located on the Little Patuxent River, is a much larger channel with approximately 4.5 to 5 ft. high banks which are silty and vertical. Root depths and surface protection are moderate to high, providing greater protection than other areas. However, the channel is incised with moderate near bank stresses, as determined by bankfull indicators at 3 ft. above the bed. This reach has approximately 1,800 lf. of eroded banks. The riparian buffer width for Reach 2 is approximately 300 ft. on both banks and the quality of the riparian vegetation is good, at approximately 70 to 80% cover. This site may have good potential for biological uplift as it is not currently in a severely degraded state. Reach 3 is a small, unnamed tributary to the Little Patuxent that has approximately 225 lf. of erosion upstream of its confluence with the Little Patuxent. The erosion begins at the corner of a commercial parking lot on Bethany Lane. The banks are approximately 4 ft. high and easily erodible due to their silty composition and vertical angle. The channel is highly incised with high near bank stress. The riparian buffer width for Reach 3 is approximately 40 ft. on both banks and the quality of the riparian vegetation is good, at approximately 80% cover.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-46

Site Name: Boones Lane, Tributaries and Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River

Erosion on left bank, vertical bank with poor root depth. Poor epifaunal habitat availability.

Reach 1, erosion on right bank.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-46
Site Name: Boones Lane, Tributaries and Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

A majority of the restoration area is within Howard County Parks and Recreations property; however, surrounding property at the most upstream portions or Reach 1 and 3 is private. A sewer line runs parallel to the channel with two crossings through the stream. Wetlands and specimen trees were also noted on site. The sewer crossing, wetlands, and specimen trees will require special consideration to the design and construction access.

The easements running parallel to the channel could provide access; however, the location of the wetlands may determine construction access. Although the design would attempt to limit tree impacts, a significant impact to trees would likely result during construction, due to the existing wide riparian buffer.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a new secondary floodplain can be graded at a lower elevation. The width of the proposed secondary floodplain will be determined by distance to private property, wetlands, and specimen trees. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Riffle grade controls may be necessary at sewer crossings. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	4,451	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	44.5	Estimated Construction Cost:	$2,003,400.00
Cost per Impervious Credit Acre:	$65,253.20	30% Contingency:	$601,020.00
		Estimated Total Cost:	$2,904,420.00

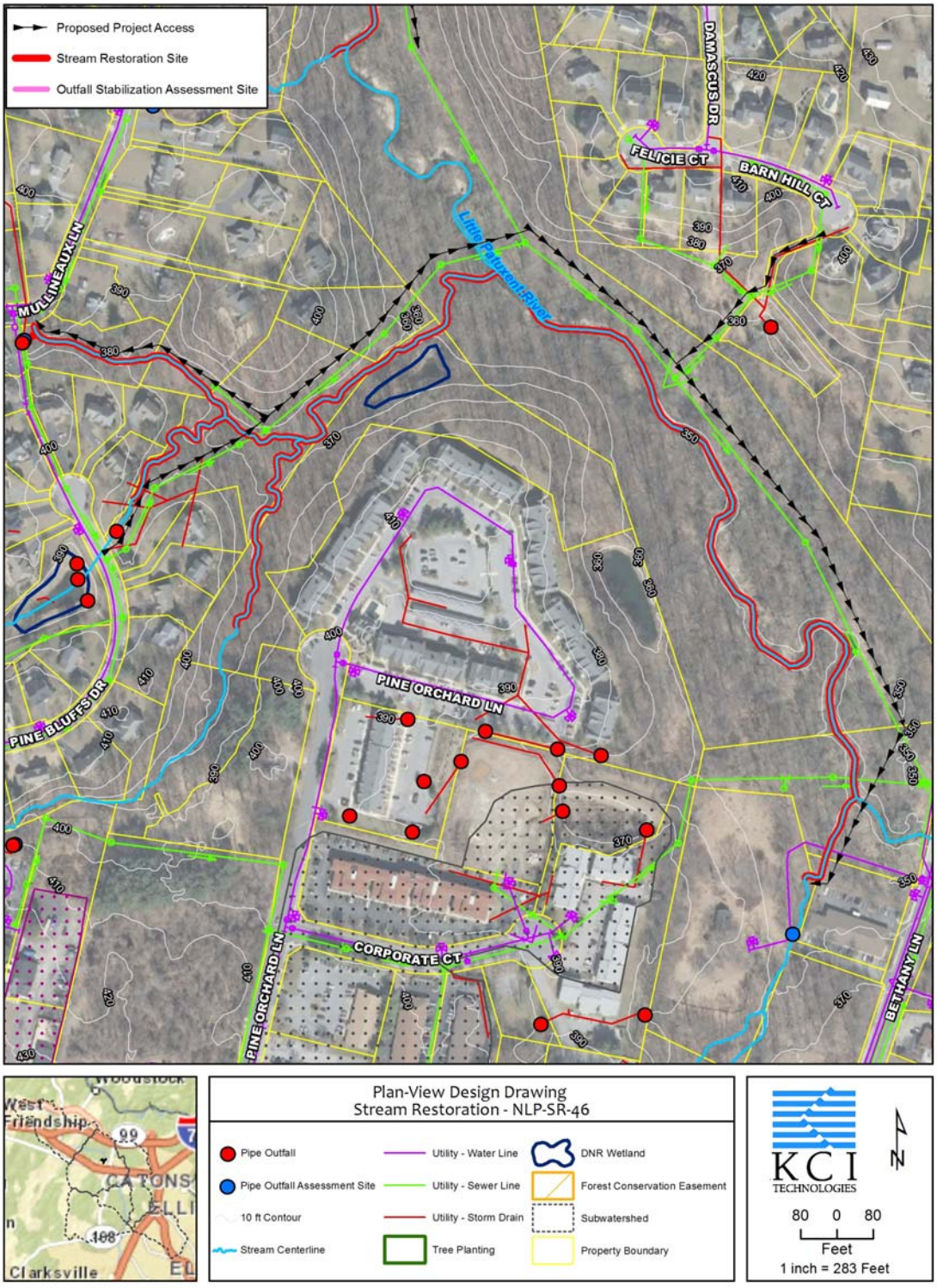
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-46

Site Name: Boones Lane, Tributaries and Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-47
Site Name: Font Hill, Tributary to Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

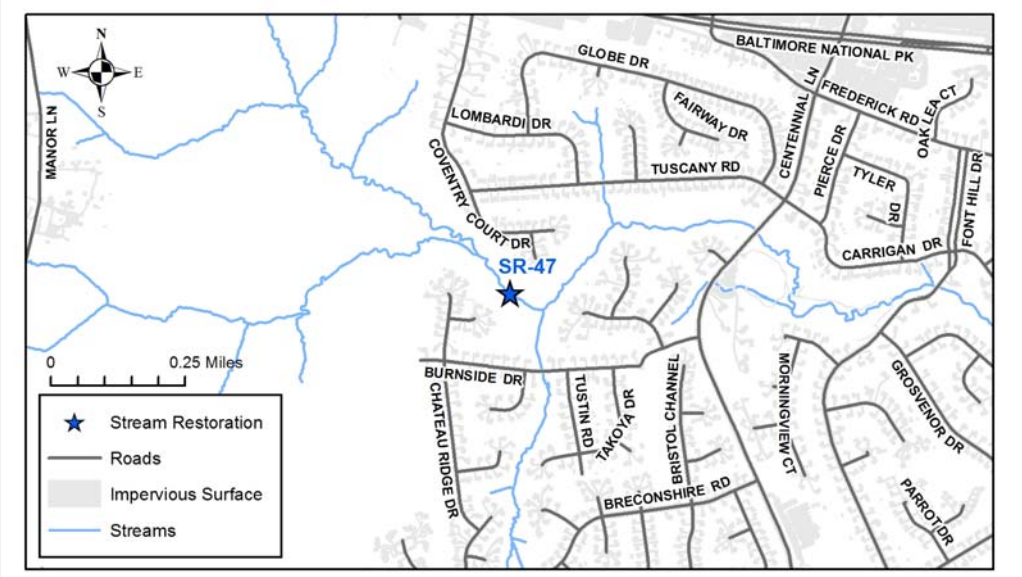
Ownership: County Owned
Single Owner

Existing Conditions:

The site contains three reaches on unnamed tributaries upstream of the confluence with the Little Patuxent River. The mainstem, termed the Font Hill Tributary to the Little Patuxent, contains approximately 1,530 lf. of channel. The first tributary enters the mainstem approximately 1,000 lf. downstream of the start of the mainstem restoration reach and includes approximately 870 lf. of channel. The second tributary enters the mainstem at the downstream most extent of the mainstem restoration reach and includes approximately 370 lf. of stream.

The mainstem reach has 3 to 4.5 ft. high banks with a silt material that is easily erodible due to the vertical banks, shallow to moderate root depths and very little surface protection. Near bank stresses were found to range from low to high with benches present throughout the site that appear to be bankfull indicators at 2 to 3 ft. in height above the bed. Banks are undercut with fallen and falling trees. The channel appears to be widening with higher bank heights progressing downstream. The channel is moderately embedded with fines. Riffle spacing is ideal, with the spacing characterized as being approximately five to seven channel widths. The riparian buffer width along the mainstem is substantial on both the right and left bank, with greater than 60 ft. of forest cover.

The upstream most tributary contains similar conditions as the mainstem, with bank heights ranging from 3 to 4.5 ft. The banks are vertical, exposed and undercut in many areas. The riparian buffer is wide in this area; however, the adjacent forest is sparse in the lower extents of the tributary. In this area, the bank erosion is more severe as the presence of roots needed to help stabilize the bank is limited. The downstream most tributary contains banks that are 2.5 to 3.5 ft. in height that are vertical and contain bank erosion. This tributary contains a wide riparian buffer, with greater than 60 ft. of forest cover. A sanitary sewer line runs parallel with the mainstem and its tributaries and contains a crossing on each reach. While no exposures were noted during the assessments, there are a few areas where the channel has eroded towards and is located within close proximity to the sanitary sewer line.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-47

Site Name: Font Hill, Tributary to Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River

Reach 2, erosion on right bank. Undercut tree and point bar formation.

Reach 1, facing downstream.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-47
Site Name: Font Hill, Tributary to Little Patuxent River
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

This reach is located within various Howard County open space properties, making property access easy from Coventry Court Drive and Burnside Drive. The sewer line runs parallel to the channel on the right bank with six stream crossings throughout the proposed restoration area, which may pose some minor constraint to the design. Although the design would attempt to limit tree impacts, a moderate impact to trees would likely result during construction due to the existing wide riparian buffer in most areas. However, access along the sewer easement when available will limit tree impacts in some locations. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a secondary floodplain can be graded at a new, lower elevation, or a bench can be established at the current bankfull elevation. Minor channel realignment may be proposed in a few areas to shift the channel away from the sanitary sewer line where the channel is currently in close proximity. Bank protection is expected to be composed primarily of bioengineering techniques such as coir logs, alternating roughness protection, and vegetative stabilization; however, stone protection and other harder bank treatments may be necessary in a few isolated locations, mainly to stabilize the parallel sanitary sewer line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat. In addition, grade control structures may be necessary to stabilize the channel bed at the sanitary sewer crossings, depending on the depth of the structures.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	3,054	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	30.5	Estimated Construction Cost:	$1,374,750.00
Cost per Impervious Credit Acre:	$68,342.34	30% Contingency:	$412,425.00
		Estimated Total Cost:	$2,087,175.00

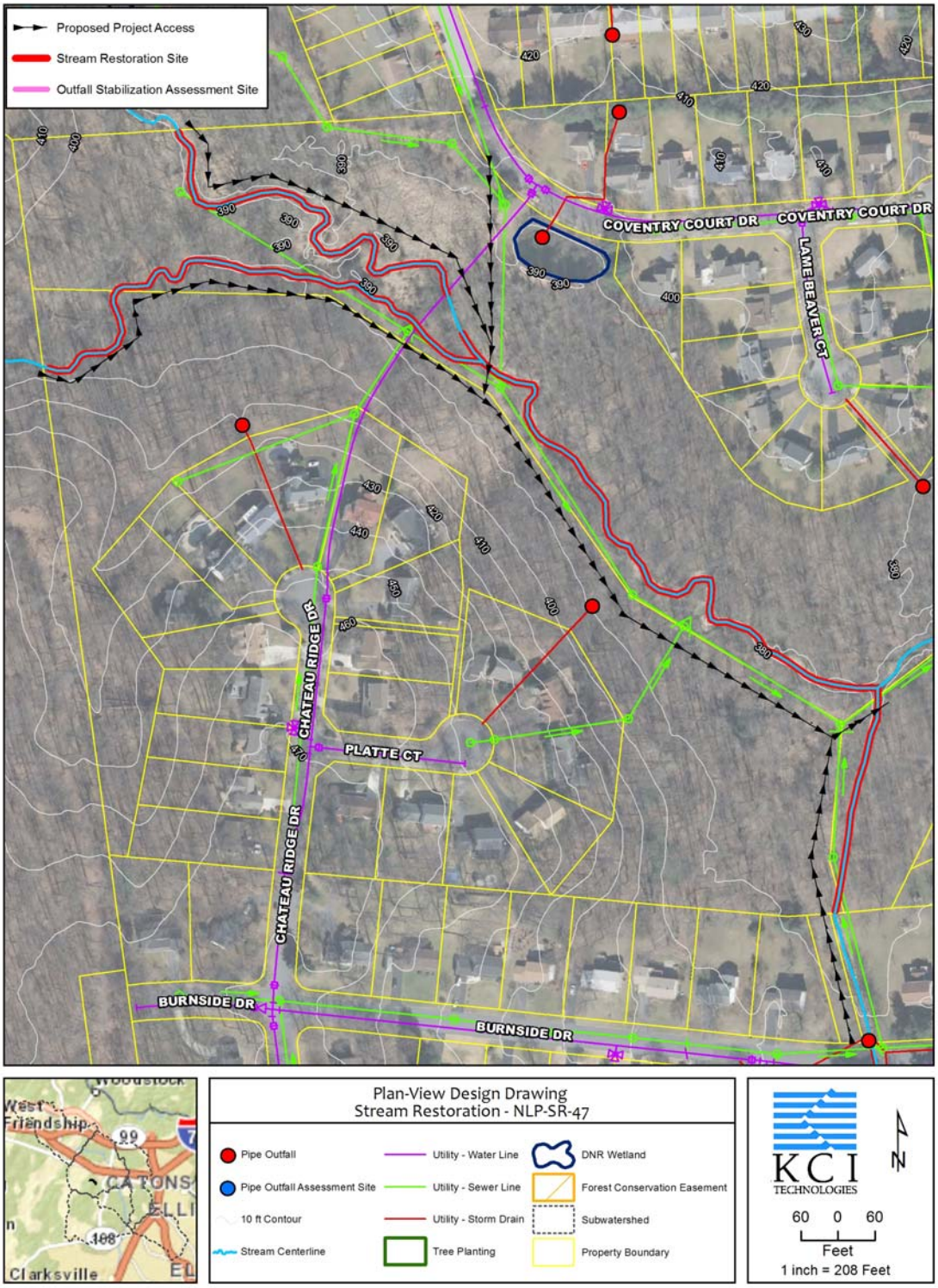
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-47

Site Name: Font Hill, Tributary to Little Patuxent River

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-48

Site Name: Font Hill, Tributary to Little Patuxent River, Upstream Centennial Lake

Contractor: KCI

Watershed: Little Patuxent River

Ownership: County Owned
Single Owner

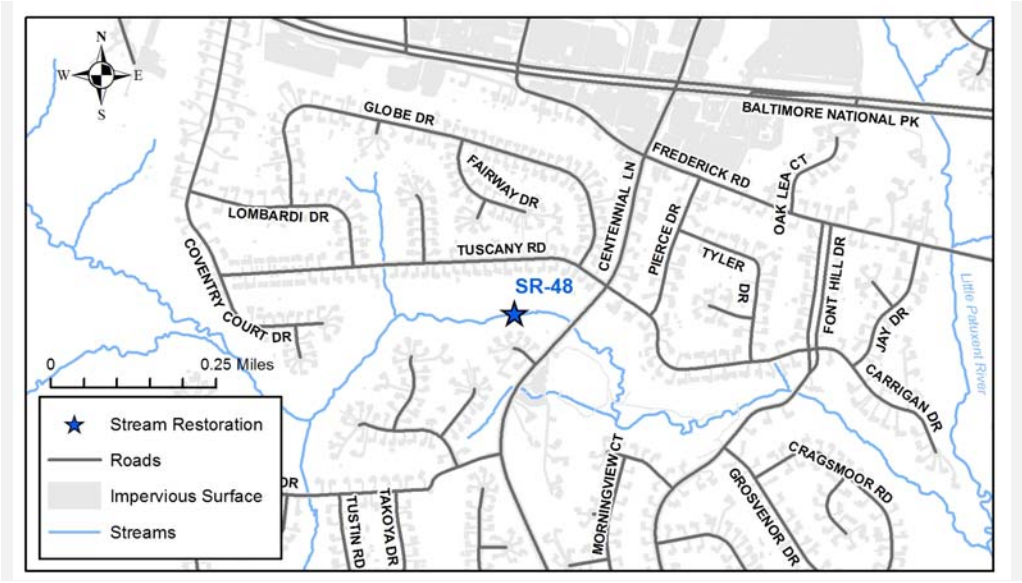
Existing Conditions:

Restoration potential at this site is segmented into three reaches. Two reaches are located along the Mainstem, with 200 lf. separating the two. A third reach is located on an outfall channel to this Mainstem. The third reach is a much smaller channel and contains approximately 160 lf. of eroded channel. The Mainstem is an unnamed tributary to the Little Patuxent River, termed the Font Hill Tributary to the Little Patuxent, located upstream of Centennial Lane and Font Hill Park. The banks are 4.5 ft. high, with bankfull indicators at 2.5 ft. above the bed. These banks are composed of silt and appear easily erodible due to vertical bank angles, shallow root depths, and very little surface protection. The channel is incised, as determined by the near-bank height to mean bankfull depth, indicating that near bank stresses are high. Banks are severely undercut with fallen and falling trees as the channel is in the process of widening.

Bed materials are composed of mostly sand, gravel and cobble, with some silt. The habitat assessment indicates that this channel may be partially supporting of aquatic habitat: epifaunal substrate habitat and coverage is optimal quality, a variety of flow regimes were apparent, and riffle spacing was in good condition.

The riparian buffer is very wide on the left bank, with greater than 60 ft. of forest cover; however, the maintained sewer easement along the right bank interrupts the forested buffer.

The outfall channel has approximately 170 lf. of eroded banks. The channel originates from Tuscany Rd with no apparent stormwater management currently in place, and has eroded banks of 2 ft. Minor erosion was observed during the field visit.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-48

Site Name: Font Hill, Tributary to Little Patuxent River, Upstream Centennial Lake

Contractor: KCI

Watershed: Little Patuxent River

Reach 2 facing downstream, vertical banks with moderate root depth.

Reach 1 facing downstream, vertical banks and minor bar formation.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-48
Site Name: Font Hill, Tributary to Little Patuxent River, Upstream Centennial Lake
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The reach is within several Howard County Parks and Recreations properties, making property access feasible. Construction access may be possible along Centennial Lane or through sewer easements from Tuscany Rd, Char Lil Ct, and Shirley Meadow Ct. A sanitary sewer line runs parallel to the channel on the right bank with a stream crossing at the upstream and downstream ends of the site. Wetlands were also noted within the site and would need special considerations during design and permitting. Although the design would attempt to limit tree impacts, a significant impact to trees would likely result during construction due to the existing wide riparian buffer in most areas. However, access along the sewer easement when available may limit tree impacts.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a new floodplain can be graded at a secondary, lower elevation. Bank protection is expected to be composed primarily of bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,515	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	15.2	Estimated Construction Cost:	$682,200.00
Cost per Impervious Credit Acre:	$78,340.59	30% Contingency:	$204,660.00
		Estimated Total Cost:	$1,186,860.00

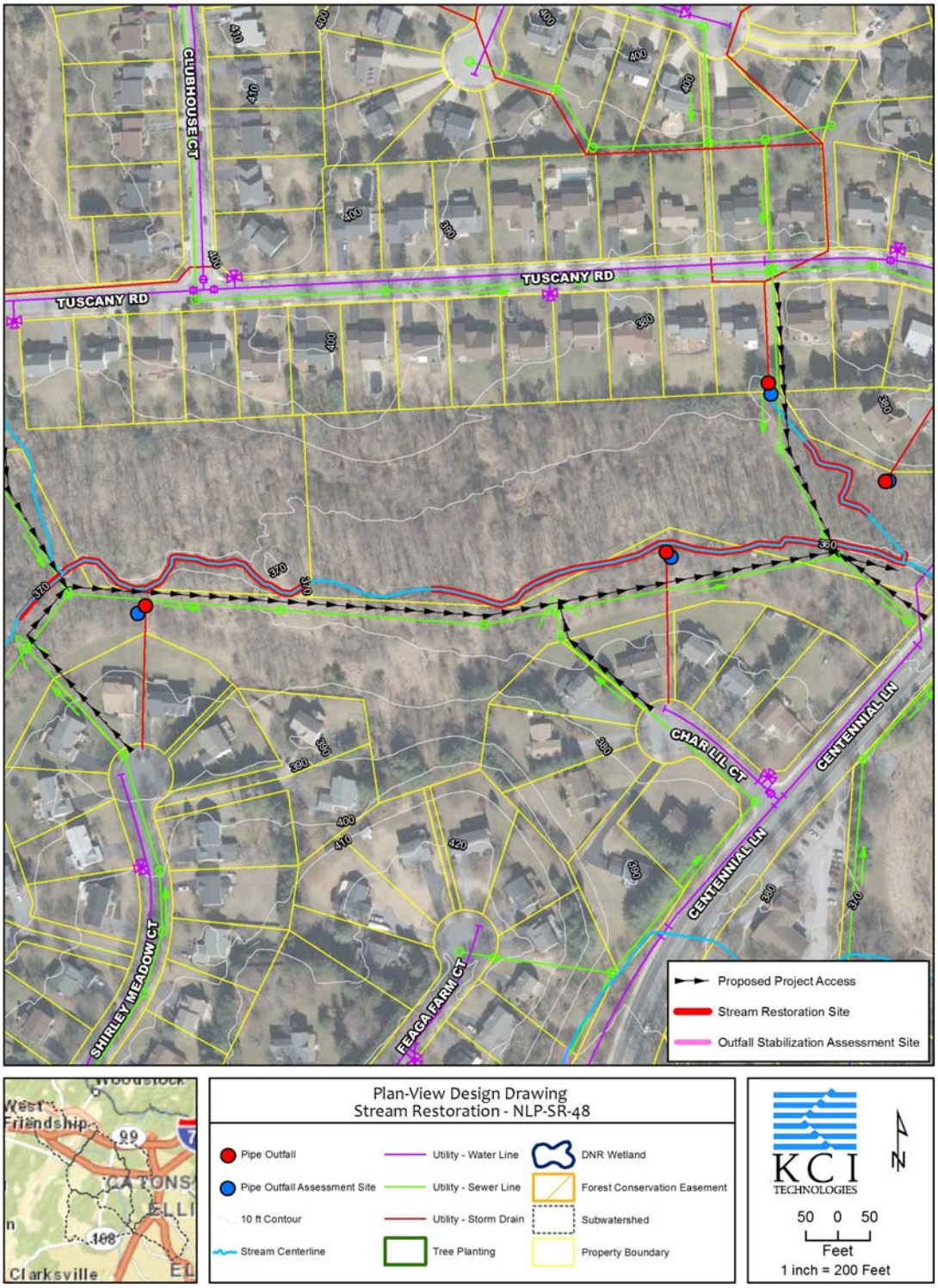
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-48

Site Name: Font Hill, Tributary to Little Patuxent River, Upstream Centennial Lake

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-49
Site Name: Dunloggin Middle School
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Park
Multiple Owners

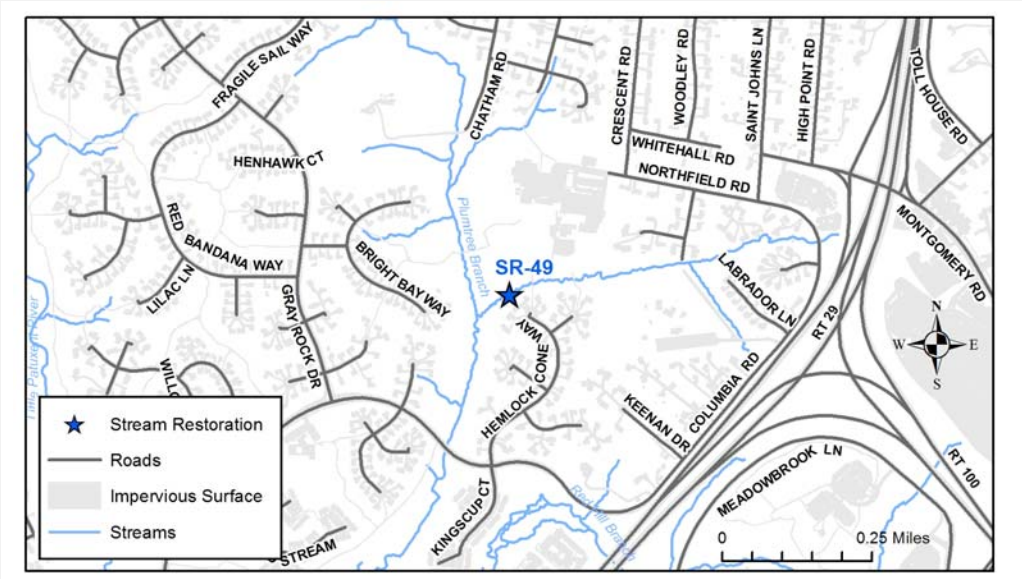
Existing Conditions:

The site is on an unnamed tributary near the confluence with Plumtree Branch. The reach has 2.5 to 4 ft. high banks with silty to clay material that is easily erodible due to the vertical banks, shallow root depths and very little surface protection. Near bank stresses were found to be moderate due to benches present throughout the site that appear to be bankfull indicators at 2 ft. in height above the bed. Banks are undercut with fallen and falling trees.

The channel is incising and widening, with higher banks towards the upstream extent of the site. A footbridge crosses the channel for access from Hemlock Cone Way to Dunloggin Middle School. The channel widening has caused the riprap beneath the footbridge to become destabilized.

The channel is extremely embedded with fines. Bed material is composed of mostly gravel, sand, and silt, and some deposition was observed in the channel. The presence of available and good quality epifaunal substrate habitat and coverage is moderate. Two velocity/depth regimes are apparent and baseflow occupies approximately 75% of the channel width at the bottom of the banks. Riffle spacing is in good condition, with the spacing characterized as being approximately seven channel widths.

The riparian buffer width is good on the right bank, with greater than 60 ft. of forest cover; however, a sewer easement along the left bank interrupts the potential for a forest buffer, and private property extends toward this easement.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-49
Site Name: Dunloggin Middle School
Contractor: KCI
Watershed: Little Patuxent River

Eroding and undercut banks with falling trees.

Failing riprap under footbridge.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-49
Site Name: Dunloggin Middle School
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

This reach is within various Howard County Park and Board of Education properties, making property access feasible. Construction access may be possible through the Dunloggin Middle School parking lot. A sewer line runs parallel to the channel on the left bank with a stream crossing at the downstream end of the site, which poses some minor constraint to the design. Wetlands were also noted within the site and would need special considerations during design and permitting. Although the design would attempt to limit tree impacts, a moderate to high impact to trees would likely result during construction due to the existing wide riparian buffer. However, access along the sewer easement will limit tree impacts. A full tree evaluation has not been conducted, but no specimen trees were noted during initial investigations.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where a new floodplain can be graded at a secondary, lower elevation. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

This site has potential for educational outreach, as it is adjacent to Northfield Elementary and Dunloggin Middle Schools.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	1,261	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	12.6	Estimated Construction Cost:	$567,900.00
Cost per Impervious Credit Acre:	$82,337.03	30% Contingency:	$170,370.00
		Estimated Total Cost:	$1,038,270.00

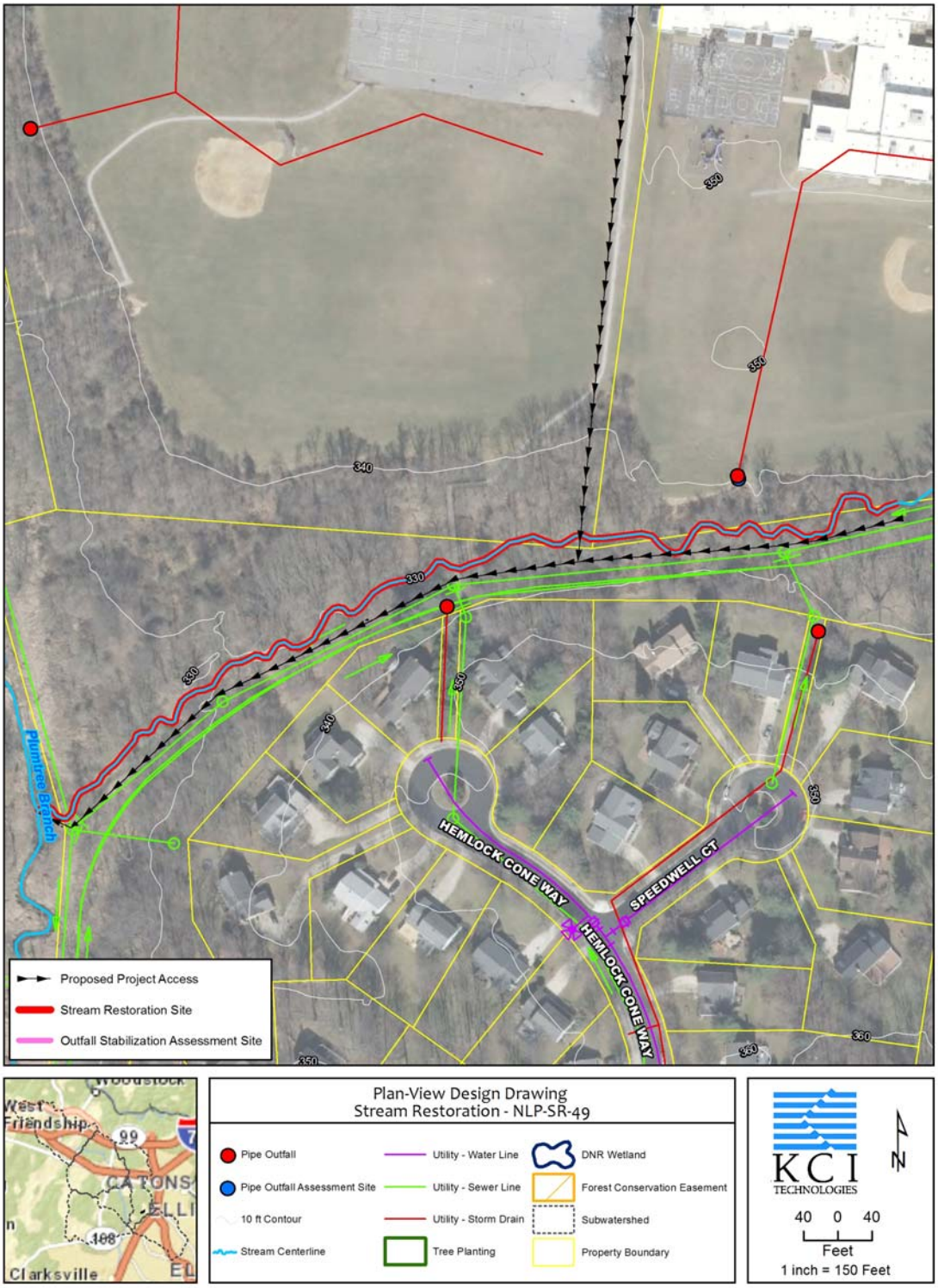
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-49

Site Name: Dunloggin Middle School

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

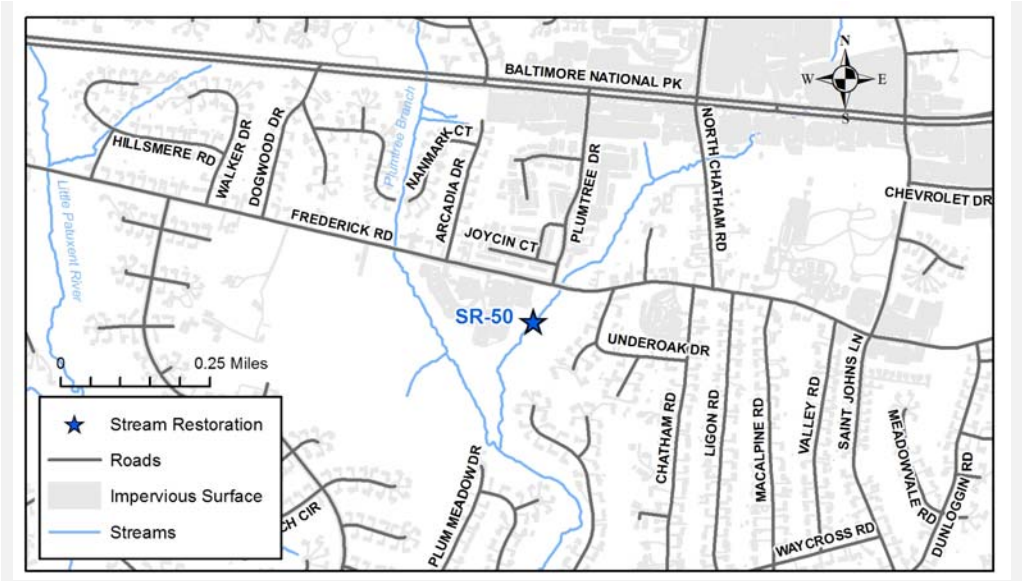
Site ID: SR-50
Site Name: Lutheran Village South, tributary to Plumtree Branch
Contractor: KCI
Watershed: Little Patuxent River

Ownership: County Owned
Multiple Owners

Existing Conditions:

The project site is bounded to the north by Frederick Road and ends at the confluence with Plumtree Branch. Reach 1 is comprised of the first 1050 lf. of channel from the upstream end at Frederick Road, which includes approximately 190 lf. of channel within the Howard County Public Works property, and continues through approximately 860 lf. of channel through abandoned agricultural land currently owned by the Miller Land Company. Banks are generally 4 to 5 ft. in height and approximately 15 ft. wide at the top of bank. Reach 1 is characterized by vertical and raw clay-silt banks and highly mobile sand-cobble substrate with good riparian buffer along the left bank and a maintained sewer easement along the right bank. The sewer line crosses the channel in several locations, through which the banks are protected by concreted gabion stones. Erosion around this protection has occurred, as these segments are narrowed and appear to be constricting flow. Eroding banks include undercut trees, compressed meanders, and debris jams. A wetland begins along the left bank at the lower half of this reach and continues through the first half of Reach 2.

Reach 2 is approximately 650 lf. and is located within Howard County property. Banks are lower and wider in this reach (generally 3 ft. high and 20 ft. in width across the top of bank). Substrate continues to be highly mobile through this reach. This reach contains more sand deposition and bar formation than Reach 1, with bar heights generally being 1 ft. high. Fresh sand deposits were also noted on top of the banks, as this reach has better floodplain access. Nonetheless, bankfull appears to be located at a height closer to 1.5 to 2-ft. in height, making this channel slightly incised. The bottom of this restoration reach end at the confluence with Plumtree Branch; however, the eroding banks continue on the Mainstem of Plumtree Branch.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-50

Site Name: Lutheran Village South, tributary to Plumtree Branch

Contractor: KCI

Watershed: Little Patuxent River

Eroded banks, good riffle material.

Close proximity to sewer line.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-50
Site Name: Lutheran Village South, tributary to Plumtree Branch
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The maintained sewer easement provides good access through this site, while access can also be gained to the site from Frederick Road and/or one of the parking lots adjacent to the Senior Center. The channel runs through three properties, two of which are owned by Howard County, and the third may have potential to be acquired, as it is landlocked and undeveloped. The existence of wetlands and specimen trees will require special considerations to the design, but given the width of the buffer, and the fact that this is not a mature forest, alternative alignments may be feasible in order to pull the channel away from the sewer line, and minimize wetland disturbance.

Concept Description:

The proposed stream restoration includes a natural channel design throughout this site, where a new, secondary floodplain can be graded at a lower elevation. The width of the proposed secondary floodplain will be determined by distance to wetlands, and specimen trees. Bank protection is expected to be composed primarily of bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations, particularly in close proximity to the sewer line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat. Riffle Grade Controls are also proposed at the sewer crossings to provide vertical control of the channel bed to protect the sanitary sewer. A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species. This project site may also provide opportunity for community education given its proximity to the library and senior center.

Nearby Opportunities:

NLP-SR-F599

Proposed Project Credit		Costs	
Length Restored (ft):	1,678	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	16.8	Estimated Construction Cost:	$755,550.00
Cost per Impervious Credit Acre:	$76,413.29	30% Contingency:	$226,665.00
		Estimated Total Cost:	$1,282,215.00

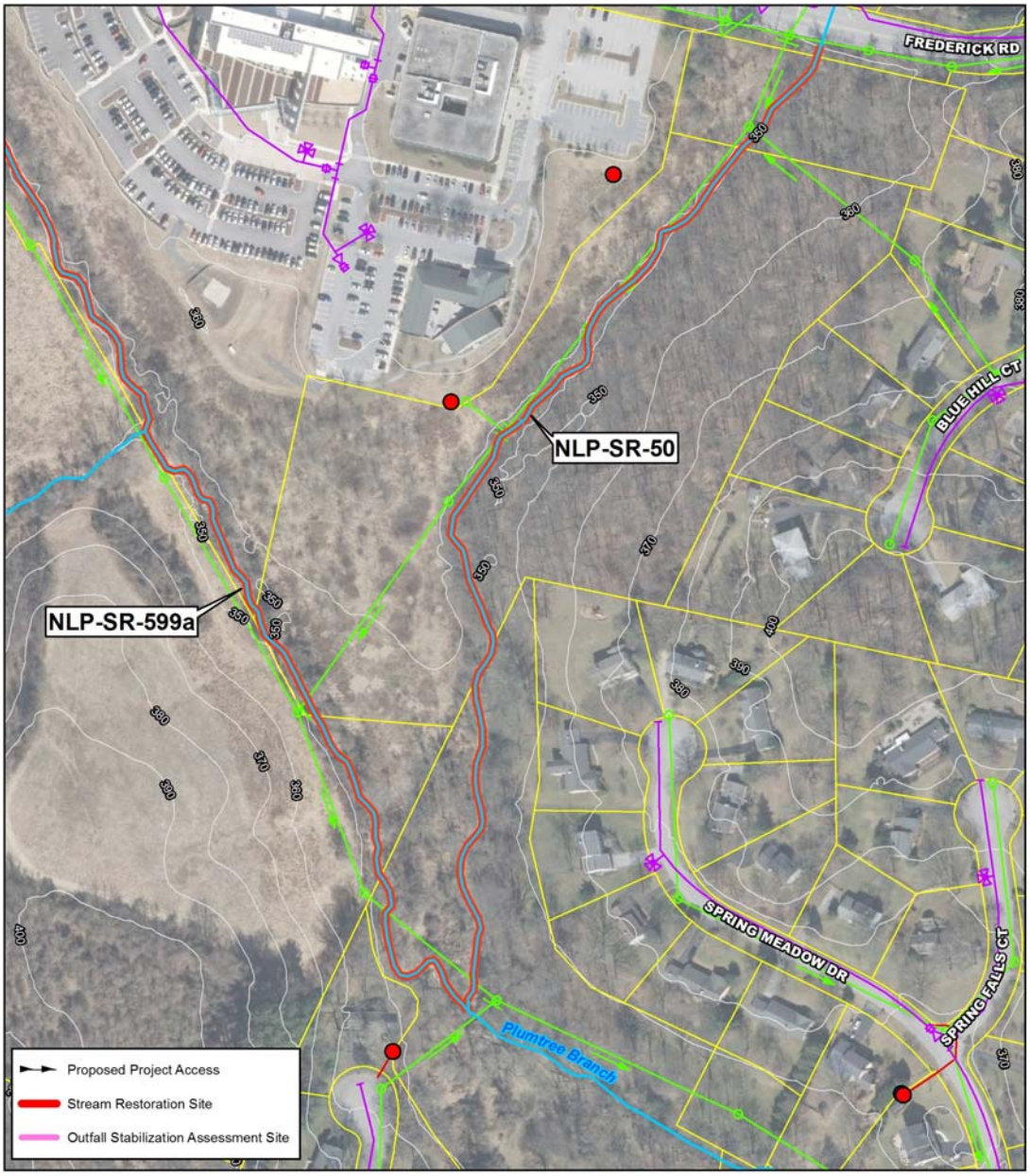
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-50

Site Name: Lutheran Village South, tributary to Plumtree Branch

Contractor: KCI

Watershed: Little Patuxent River



Plan-View Design Drawing
Stream Restoration - NLP-SR-50

- Pipe Outfall
- Pipe Outfall Assessment Site
- 10 ft Contour
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility - Storm Drain
- Tree Planting
- DNR Wetland
- Forest Conservation Easement
- Subwatershed
- Property Boundary

KCI TECHNOLOGIES

N

60 0 60

Feet

1 inch = 208 Feet

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-51
Site Name: North Chatham Road
Contractor: KCI
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

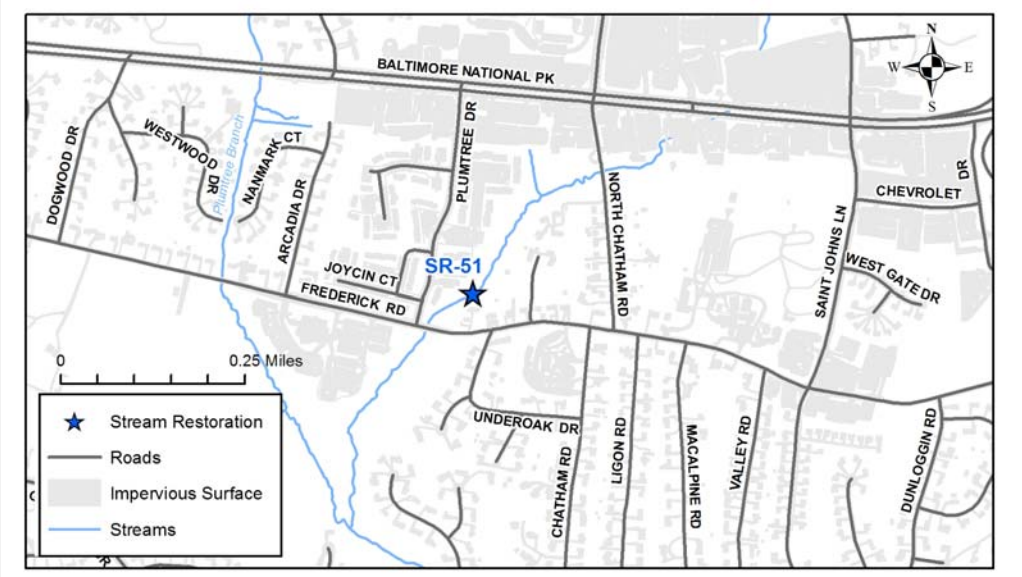
Existing Conditions:

The site is composed of three reaches on a tributary to Plumtree Branch between Route 40 and Frederick Road. Reach 1 is comprised of the first 470 lf. of channel from the outfall of the pipe under Route 40 to North Chatham Road. Banks are generally 3 to 4 ft. in height and less than 15 ft. wide at the top of bank. The reach is characterized by vertical and raw silty banks with good riparian buffer along the left bank and a sewer easement along the right bank. Erosion is segmented into two areas within the reach, each approximately 150 lf. in length, with a short section of banks (approx. 80 lf.) in good condition between the eroded segments and another prior to the road crossing at North Chatham Road. A wetland begins along the left bank at the lower half of the reach and continues through the first half of Reach 2.

Reach 2 is approximately 550 lf. and runs from the crossing at North Chatham Rd to the confluence with the outfall channel on the right bank. Banks are generally highest (4 to 5 ft.) and most undercut in this reach, despite having the widest and most heavily treed riparian buffer. The bed substrate contains mostly sand with gravels and cobbles in the riffles.

The outfall channel is approximately 350 lf. The channel is located on the right bank of the Mainstem tributary and is extremely incised with up to 6 ft. high banks. Trees are heavily undercut, and banks are vertical with very shallow root depths and little to no surface protection.

Reach 3 is approximately 1,310 lf. The reach begins at the confluence with the outfall channel and ends at Frederick Road. Banks are generally 3.5 ft. in height and 15 to 20 ft. in width at the top of bank. The reach is backed by the Plum Tree Apartments on the right bank, with a sewer easement in close proximity to the channel. The area is mowed and maintained with a narrow forest buffer adjacent to the channel on the right bank. The left bank has a well vegetated forest buffer.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-51
Site Name: North Chatham Road
Contractor: KCI
Watershed: Little Patuxent River

Tributary is very incised with vertical silty banks with shallow root depth and no surface protection.

Mainstem has steep silty banks with moderate root depth and very little surface protection. Sand deposition as lateral and central bars 0.5 to 1 ft. in height.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-51
Site Name: North Chatham Road
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The sewer easement provides good access through this site, particularly in Reach 3, where it is partially mowed. Potential access can be acquired through the Plum Tree Apartments parking lot and from the U-turn area on North Chatham Road. The channel runs through multiple commercial and residential properties, including two HOA properties, through which access will need to be coordinated. The existence of wetlands will require special considerations to the design and permitting. Tree removals will also be required, particularly for the upper reaches (Reaches 1, 2, and the outfall channel), but many of those are in poor health.

Concept Description:

The proposed stream restoration includes a natural channel design throughout the site, where the floodplain is widened at the existing bed elevation. Proposed bank protection will include bioengineering techniques such as coir logs and vegetative stabilization, but stone protection and other harder bank treatments may be necessary in a few isolated locations, particularly in close proximity to the sewer line. Existing bed materials are likely salvageable, but larger cobble material will be necessary to provide better riffle habitat.

Riffle Grade Controls are also proposed at the sewer crossings in Reach 2 to provide vertical control of the channel bed to protect the sanitary sewer. A comprehensive planting plan will be developed for the various landscape zones throughout the site that will allow for the establishment of native plant species.

This project site may also provide passive opportunity for community education given the higher density residential property that would be impacted. However, since this community is comprised of few landowners, community involvement may be limited to casual observation of the project without targeted community outreach efforts.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,680	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	26.8	Estimated Construction Cost:	$1,206,000.00
Cost per Impervious Credit Acre:	$69,694.03	30% Contingency:	$361,800.00
		Estimated Total Cost:	$1,867,800.00

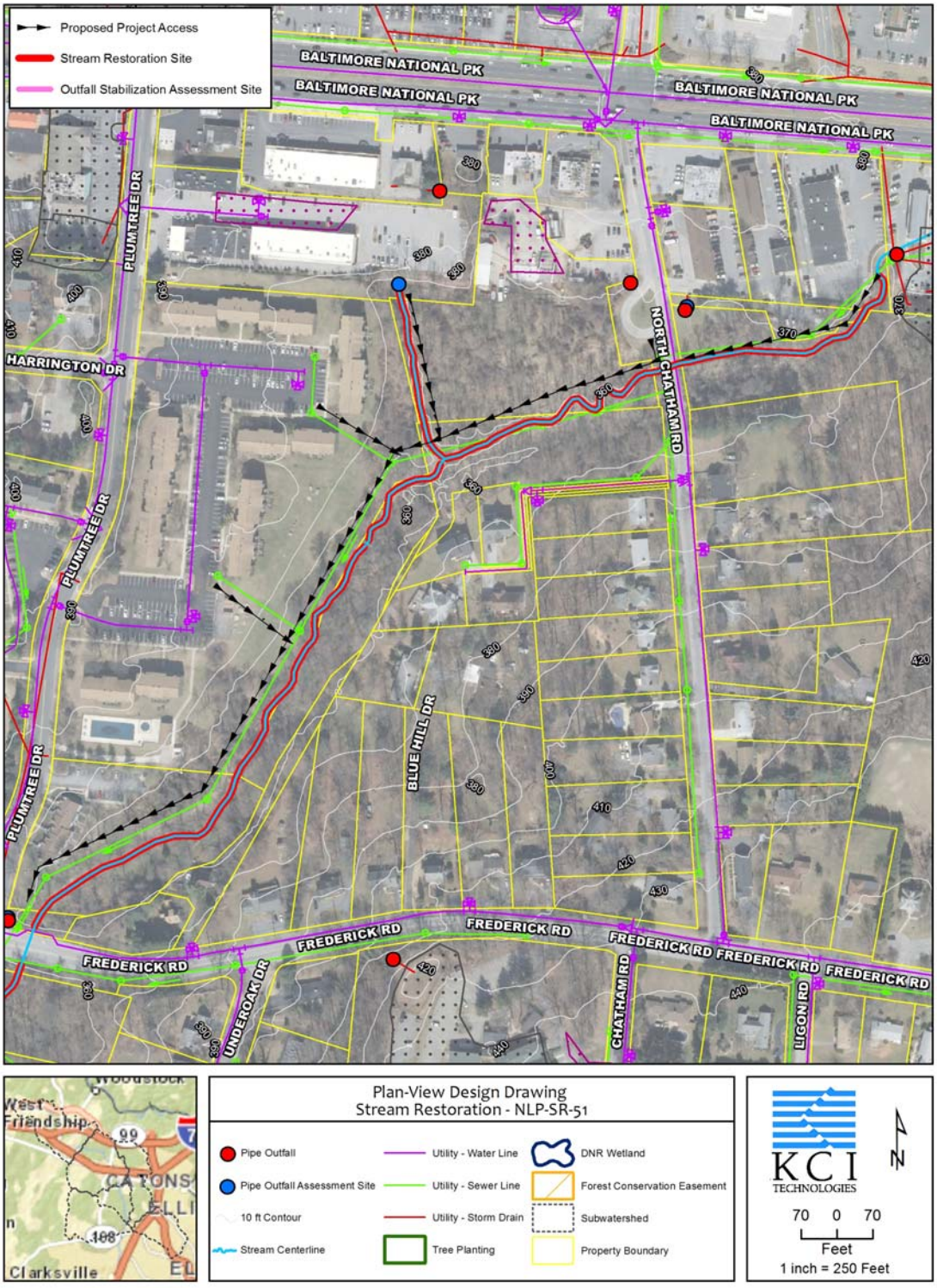
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-51

Site Name: North Chatham Road

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-52
Site Name: Gray Sea Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

SR-52 consists of two stream assessment reaches (DOR-SR-F908A and DOR-SR-F912A) associated with an unnamed tributary of Dorsey Run. Land use surrounding the project site is primarily commercial and residential land with adjacent riparian forest. The stream is located within one commercial property and one parcel owned by the Columbia Association. The stream restoration site begins at three outfalls of a stormwater pond facility that is associated with commercial properties off of Dobbin Road. The upstream extent of the project (DOR-SR-F908A) begins as an ephemeral channel that changes to a perennial stream near the confluence area at the upstream end of the project site. The stream channels are experiencing channel degradation by downcutting of the channel bed and by bank erosion throughout the entire project site. A majority of the stream banks are nearly vertical, lack surface protection or vegetation, and have heights ranging between 2 to 5 ft. There are two significant headcuts located at the upstream end of the tributaries that appear to be actively migrating upstream and associated with flow draining from the pond facility outfalls. There is another headcut associated with drainage from the pipe outfall of the dry pond facility located on the south side of the channel just west of Snowden River Parkway. Another 2.5 ft. headcut located on the downstream reach just east of Snowden River Parkway is causing additional channel instability. There are two storm drain outlets located at the toe of slope on the east side of Snowden River Parkway on each side of the channel that are creating some minor erosion.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-52
Site Name: Gray Sea Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

SR-52 facing upstream at erosion along the ephemeral reach.

SR-52 facing upstream at bank erosion adjacent to the community trail.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-52
Site Name: Gray Sea Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints with the project include existing sanitary sewer utilities, potential impacts to trees and forested areas and disruption of pedestrian traffic along the community trail.

Concept Description:

The proposed stream restoration project includes approximately 1,547 lf. of stream restoration to an unnamed tributary of Dorsey Run. The stream restoration primarily includes bank stabilization measures and opportunities to improve floodplain connection throughout the entire extent of the project site. Channel stabilization and BMP opportunities could also include treatments to five existing headcut identified along the project. Two of the headcuts are located on the mainstem of the channel. The other three headcuts are associated with drainage coming from pipe outfalls that will continue to erode and increase sediment loads to the stream system. Proposed access to the site includes maintained sewer line utility easements and the community trail located between Gray Sea Way and April Brook Circle. The project has potential to provide education value due to an existing community trail along the downstream extent of the site. The project would include additional stream assessment and design phases to determine specific channel treatments and construction sequence.

Nearby Opportunities:

DOR-SR-F912a-PO102; DOR-SR-F912a-PO101

Proposed Project Credit		Costs	
Length Restored (ft):	1,547	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	15.5	Estimated Construction Cost:	$696,150.00
Cost per Impervious Credit Acre:	$77,892.37	30% Contingency:	$208,845.00
		Estimated Total Cost:	$1,204,995.00

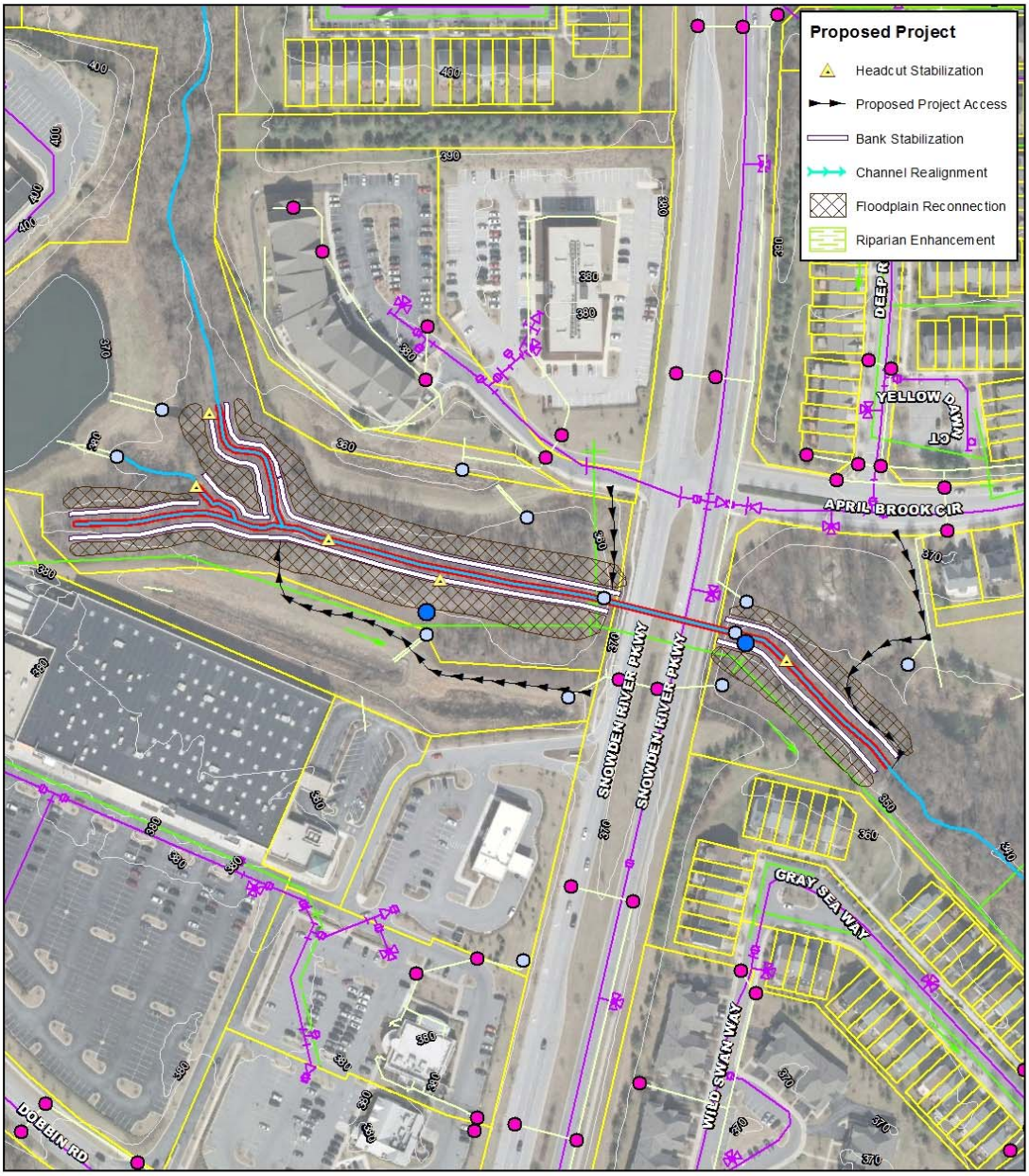
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-52

Site Name: Gray Sea Way

Contractor: McCormick Taylor

Watershed: Little Patuxent River



Plan-View Design Drawing - SR-52

Stream Restoration Site	Stream Centerline	BMP Conversion Drainage Area
BMP Conversion	Utility - Water Line	New BMP Drainage Area
Pipe Outfall Site	Utility - Sewer Line	DNR Wetland
Storm Drain Inlet	Storm Drain Pipe	Forest Conservation Easement
Storm Drain Outlet	New BMP	Subwatershed
10 ft Contour	Tree Planting	

McCORMICK TAYLOR

N

50 0 50

Feet

1 inch = 200 Feet

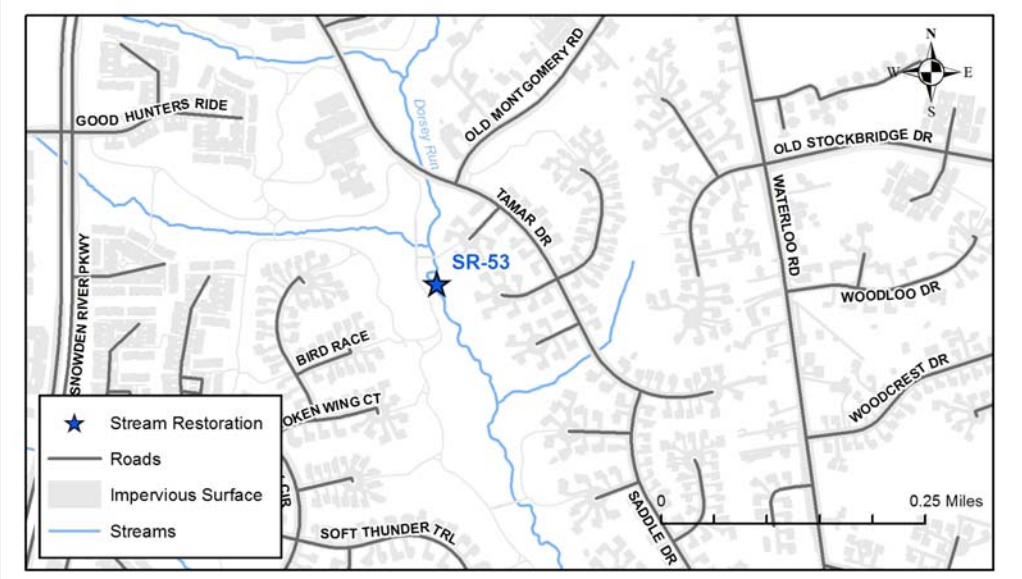
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-53
Site Name: Broken Wing Court
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

SR-53 consists of four stream assessment reaches (DOR-SR-F910A, DOR-SR-F910B, DOR-SR-F911A, DOR-SR-F911B) associated with Dorsey Run. Land use surrounding the project site is primarily forested and residential land that is mainly owned by the Columbia Association. The stream restoration site begins 460 lf. north of the culvert at Tamar Drive, northwest of the intersection of Tamar Drive and Old Montgomery Road, and extends downstream (south) approximately 1,903 lf. In general, the stream has a predominantly sand/silt channel substrate with bank heights ranging from 2-7 ft. The upstream reaches of the project (DOR-SR-F911A, DOR-SR-F911B) have some areas of channel degradation caused by downcutting of the channel bed and bank erosion. Two significant knickpoints are located at the upstream end of the project and associated with debris jams. The channel is predominately composed of silt/sand/gravel material with bank heights ranging between 2.5 to 7 ft. that are nearly vertical, lack surface protection or vegetation. The channel does have floodplain access along the upstream reaches. As the project site continues downstream of the crossing with Tamar Drive (DOR-SR-F910A and DOR-SR-F910B), the stream banks are eroding and causing widening of the channel. A majority of the eroded banks are nearly vertical with heights between 5 to 6 ft., lack surface protection or vegetation, and are comprised of a large percentage of silt and clay. An extensive wetland system is located on the right bank floodplain. One of the wetland outlets in this area has started to degrade and could be stabilized with the project to maintain the hydrology of the wetlands.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-53
Site Name: Broken Wing Court
Contractor: McCormick Taylor
Watershed: Little Patuxent River

SR-53 facing upstream at moderate bank erosion.

SR-53 facing upstream at a 4 ft. tall headcut.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-53
Site Name: Broken Wing Court
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints with the project include access, existing sanitary sewer utilities, potential impacts to trees and forested areas and disruption of pedestrian traffic along the community trail.

Concept Description:

The proposed stream restoration project consists of four reaches associated with approximately 1,903 lf. of Dorsey Run. The project primarily includes bank stabilization, one area for potential floodplain reconnection, one channel realignment, and grade control structures to address existing headcuts and stabilize the channel bed. Headcut stabilization is proposed in the reaches upstream of Tamar Drive. Some areas of the upstream reaches could include some bank stabilization. However, this segment of the project may benefit by just including supplemental tree plantings on the right floodplain and installation of woody vegetation or live stakes along portions of the stream banks. Bank stabilization is primarily proposed along reaches downstream of Tamar Drive. Channel realignment is proposed along the tight meander bend just downstream of the existing pipe outfall site. The realignment will focus on correcting tight planform geometry and providing some floodplain relief. The stream restoration project could include closer investigation of smaller drainage channels with stabilization measures or BMP's. Stabilization on one of the wetland drainage outlets located on the right floodplain is proposed and could be included with the bank stabilization treatments. Proposed access to the site includes several access points along existing community trails and sanitary sewer right of ways. The project would likely include some impacts to existing trees and forested areas in order to access the channel. The project has potential to provide education value due to an existing community trail along the downstream reaches of the site. The project would include additional stream assessment and design phases to determine specific channel treatments and construction sequence.

Nearby Opportunities:

SR-54; SR-55; DOR-BC-F915

Proposed Project Credit		Costs	
Length Restored (ft):	1,903	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	19.0	Estimated Construction Cost:	$856,350.00
Cost per Impervious Credit Acre:	$74,264.58	30% Contingency:	$256,905.00
		Estimated Total Cost:	$1,413,255.00

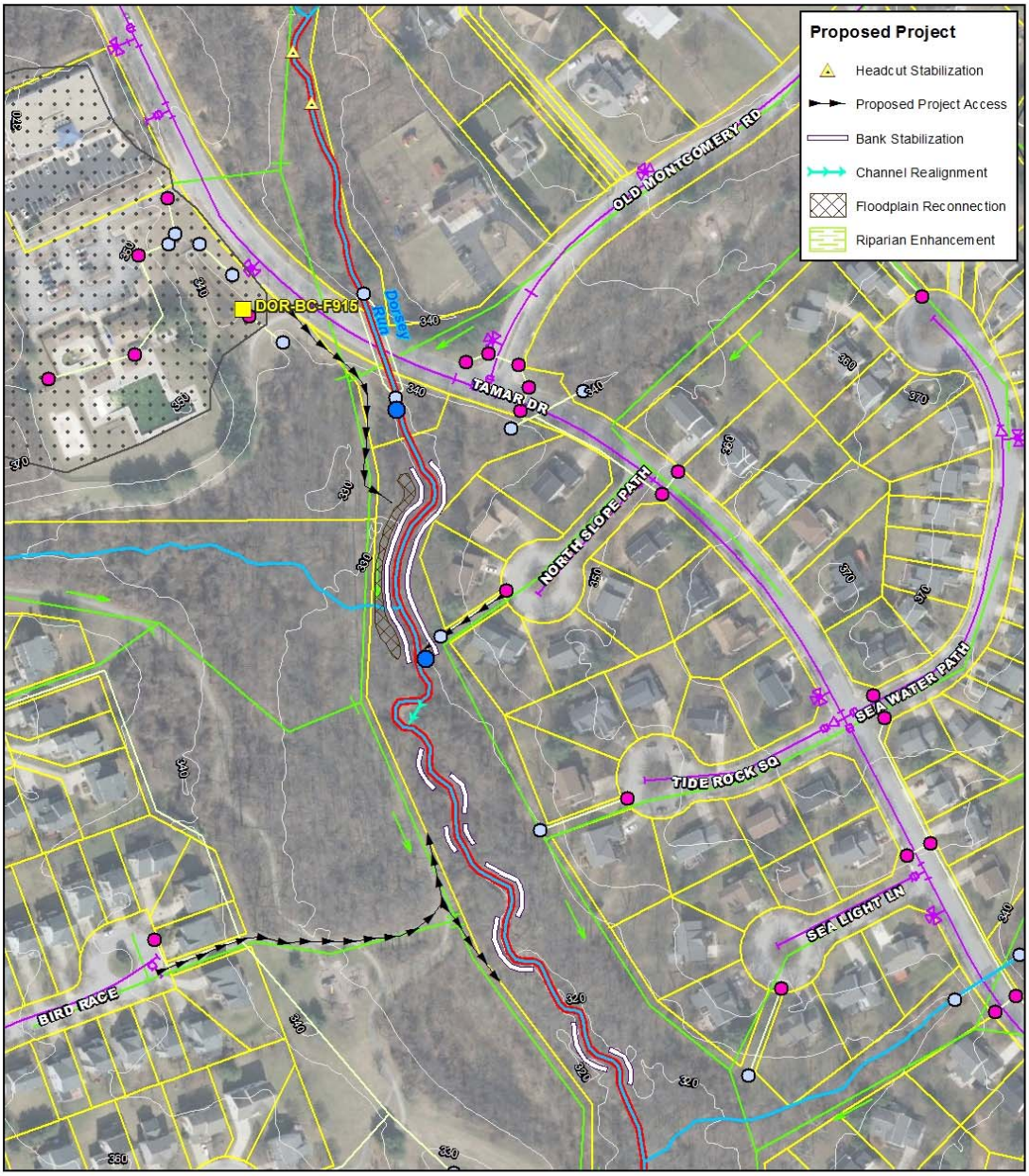
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-53

Site Name: Broken Wing Court

Contractor: McCormick Taylor

Watershed: Little Patuxent River



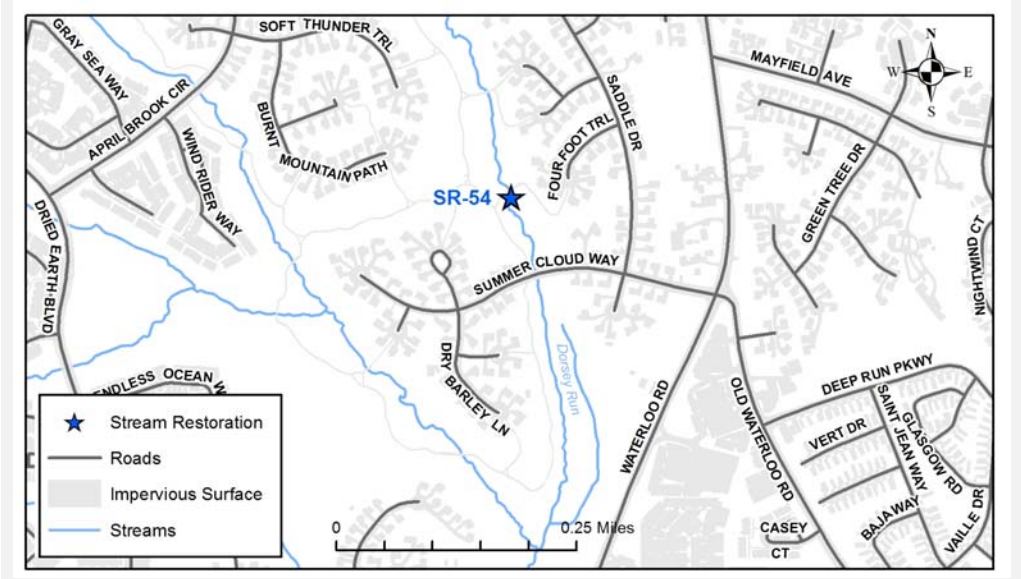
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-54
Site Name: Distant Rock Path
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

SR-54 consists of four stream assessment reaches (DOR-SR-F909C, DOR-SR-F909D, DOR-SR-909E, DOR-SR-F909F) associated with Dorsey Run. Land use surrounding the project site is primarily residential and forested land that is mainly owned by the Columbia Association. The stream restoration site begins 20 lf. north of the culvert at Summer Cloud Way, approximately 500 ft. west of the intersection of Summer Cloud Way and Saddler Drive, and extends upstream (north) about 2,356 lf. The majority of the channel contains a significant amount of depositional features and pools that are filled with fine sediments, which indicate large sediment loads from upstream sources. The upstream reaches of the project (DOR-SR-F909E and DOR-SR-F909F) generally has a sand/silt channel substrate with bank heights ranging from 3 to 4.5 ft. Several areas of the channel are associated with bank erosion that is causing lateral migration and widening of the channel. Many areas of the eroded banks are nearly vertical, lack surface protection or vegetation, and are comprised primarily of silt and clay material. The downstream reaches of the project (DOR-SR-F909C and DOR-SR-F909D) generally have a cobble/gravel/sand substrate with bank heights ranging from 2.5 to 5 ft. These reaches also have multiple areas of bank erosion. However, overall bank erosion throughout the entire site is sporadic and not as severe compared to some of the other stream restoration sites identified in the study areas. There are two exposed pipes within the channel bed. One pipe is located at the downstream extent of reach DOR-SR-F909E, but is not shown from existing utility data mapping. The other exposed pipe is located within reach DOR-SR-F909D which coincides with existing GIS utility data designated as either a water line or a storm drain pipe.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-54
Site Name: Distant Rock Path
Contractor: McCormick Taylor
Watershed: Little Patuxent River

SR-54 facing downstream at severe bank erosion.

SR-54 facing upstream at a 3 ft. tall headcut.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-54
Site Name: Distant Rock Path
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints with the project include access, existing sanitary sewer utilities, potential impacts to trees and forested areas and disruption of pedestrian traffic along the community trail.

Concept Description:

The proposed stream restoration project consists of four reaches associated with approximately 2,356 lf. of Dorsey Run. The project mainly includes bank stabilization treatments located primarily on the outside of meander bends. There is one opportunity for a minor channel realignment to correct tight planform geometry and provide relief for high energy storm flows. The channel realignment is proposed along a tight meander bend located just downstream from the pedestrian bridge that crosses the channel in the vicinity of Young Buck Circle. The stream restoration could also include protection of the two existing utility pipes that are exposed in the channel with a grade control structure such as a constructed riffle. The project could potentially include a tree planting area east of the channel in the vicinity of Dry Stone Gate and Young Buck Circle. This area is currently mowed and maintained with turf grass. Proposed access to the site includes several access points along existing community trails and sanitary sewer right of ways. The project would likely include some impacts to existing trees and forested areas in order to access the channel. The project has potential to provide education value due to an existing community trail along the downstream reaches of the site. The project would include additional stream assessment and design phases to determine specific channel treatments and construction sequence.

Nearby Opportunities:

SR-53 and SR-55

Proposed Project Credit		Costs	
Length Restored (ft):	2,356	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	23.6	Estimated Construction Cost:	$1,060,200.00
Cost per Impervious Credit Acre:	$71,233.45	30% Contingency:	$318,060.00
		Estimated Total Cost:	$1,678,260.00

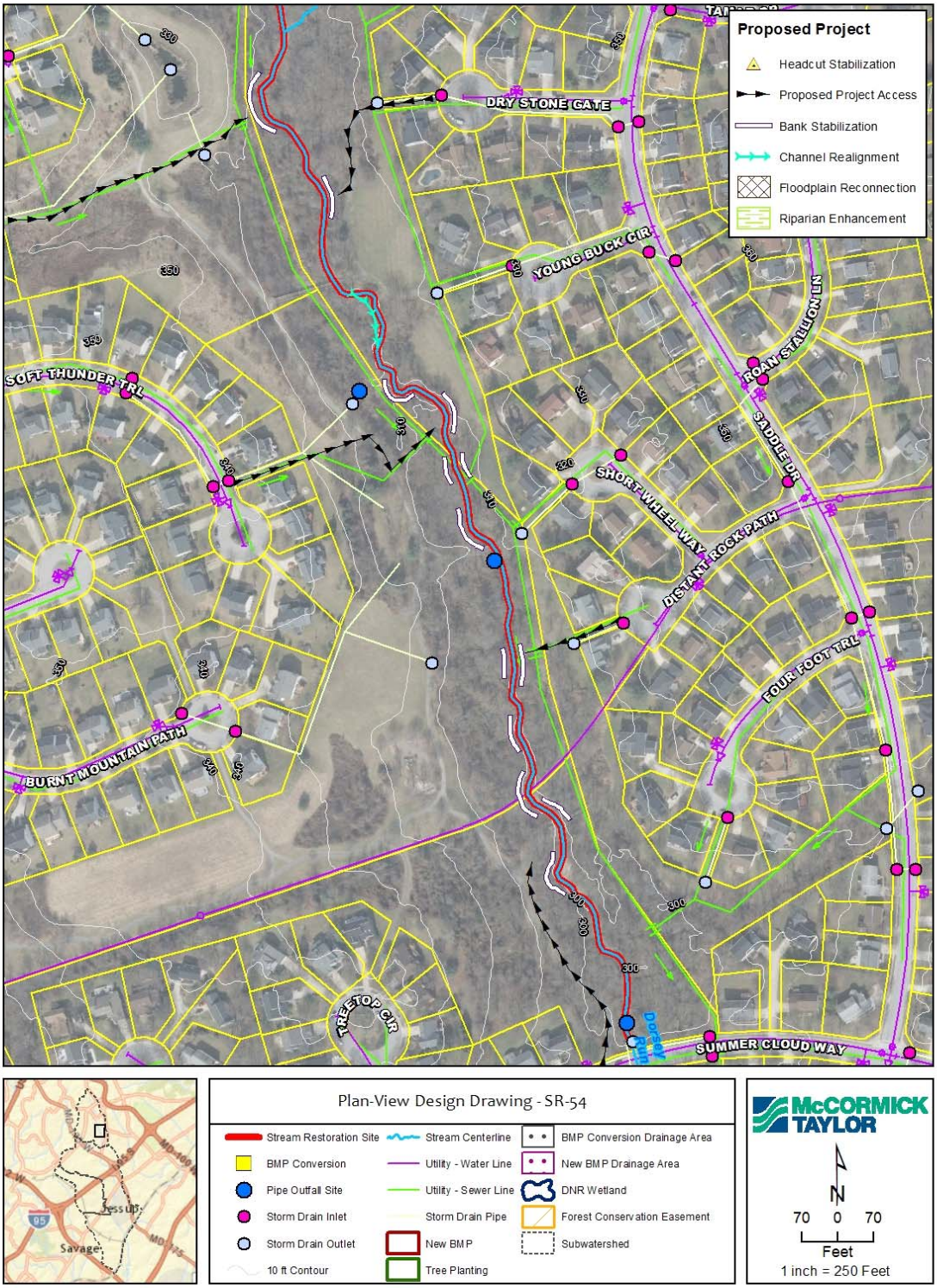
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-54

Site Name: Distant Rock Path

Contractor: McCormick Taylor

Watershed: Little Patuxent River



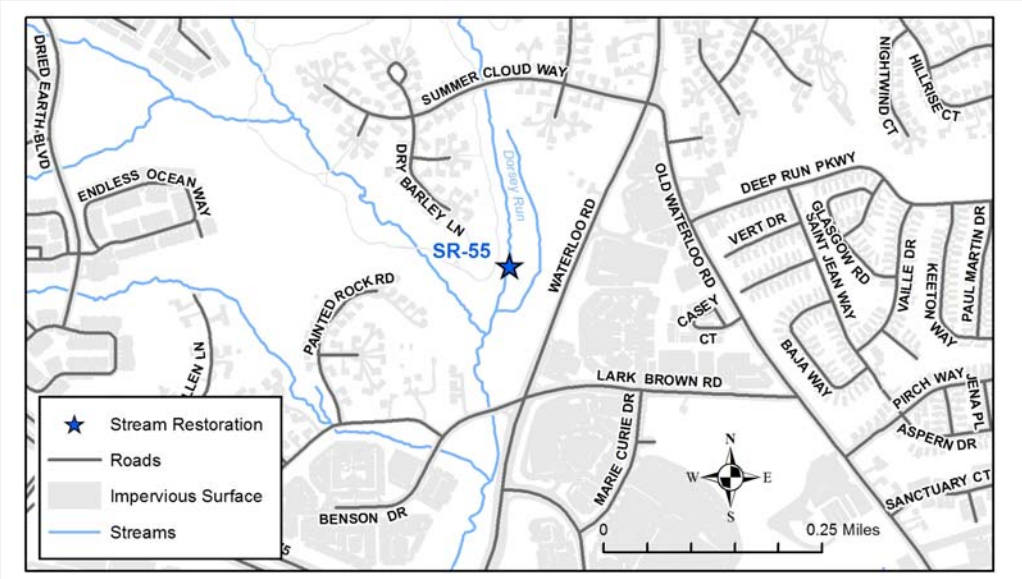
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-55
Site Name: Summer Cloud Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Ownership: Columbia Association
Single Owner

Existing Conditions:

SR-55 consists of two stream assessment reaches (DOR-SR-F909A and DOR-SR-F909B) associated with Dorsey Run and another unnamed tributary of Dorsey Run that was added to the project site. Land use surrounding the project site is forested and residential land, with the entire project being owned by the Columbia Association. The stream restoration site begins approximately 40 lf. south of the culvert at Summer Cloud Way, approximately 500 ft. west of the intersection of Summer Cloud Way and Saddler Drive, and extends downstream about 1,986 lf. The channel has several areas of bank erosion with bank heights ranging from 2.5 to 5 ft. The stream bed is predominantly composed of gravel/sand/silt substrate and many of the pool features are filled with fine sand and silt sediments. Approximately 750 lf. of Dorsey Run are currently eroding, causing lateral migration and widening of the channel. A large portion of the eroded banks are nearly vertical, lack surface protection or vegetation, and are comprised of larger percentages of silt and clay. A debris jam downstream of the first sewer line crossing was noted during the initial assessment in Spring 2015, which has now caused a majority of the channel flow to avulse onto the left floodplain. The segment of stream downstream of the debris jam has filled with sediment and the cross section area is significantly smaller with a very low baseflow. Flow from the channel avulsion area is spread on the left floodplain and providing hydrology to existing wetland areas. Below these wetland areas flow becomes concentrated and is draining to an area of the unnamed tributary of Dorsey Run just upstream of a sanitary sewer crossing. There is a significant headcut associated with concentrated flow draining from the floodplain wetlands to the tributary. The unnamed tributary of Dorsey Run is severely incised and characterized with vertical eroding banks that are composed of silt and clay material and lack vegetation.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-55
Site Name: Summer Cloud Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

SR-55 facing upstream at riprap channel alteration and 3.5 ft. tall headcut.

SR-55 facing upstream at severe bank erosion.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-55
Site Name: Summer Cloud Way
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints with the project include access, existing sanitary sewer utilities, potential impacts to trees and forested areas and disruption of pedestrian traffic along the community trail.

Concept Description:

The proposed stream restoration project consists of approximately 1,400 lf. of Dorsey Run and approximately 550 lf. of the unnamed tributary of Dorsey Run downstream of Summer Cloud Way. The project mainly includes bank stabilization treatments along areas of the upstream reach of Dorsey Run and at the downstream extent of the lower reach of Dorsey Run. No work is proposed at this time along approximately 500 lf. of Dorsey Run that corresponds with the segment of stream below the channel avulsion area. Bank stabilization is also proposed along a majority of stream channel associated with the unnamed tributary of Dorsey Run, which may be able to be extended farther upstream. The stream restoration would include stabilization of the headcut that has formed on the right bank of the unnamed tributary where flow has concentrated from drainage of the existing wetlands located between the two stream systems. Proposed access to the site is proposed off of Summer Cloud Way along the existing community trail and some areas of the sanitary sewer right of ways. The project would likely include some impacts to existing trees and forested areas in order to access the channel. The project has potential to provide education value due to an existing community trail along the downstream reaches of the site. The project would include additional stream assessment and design phases to determine specific channel treatments and construction sequence.

Nearby Opportunities:

SR-53 and SR-54

Proposed Project Credit		Costs	
Length Restored (ft):	1,986	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	19.9	Estimated Construction Cost:	$893,700.00
Cost per Impervious Credit Acre:	$73,605.74	30% Contingency:	$268,110.00
		Estimated Total Cost:	$1,461,810.00

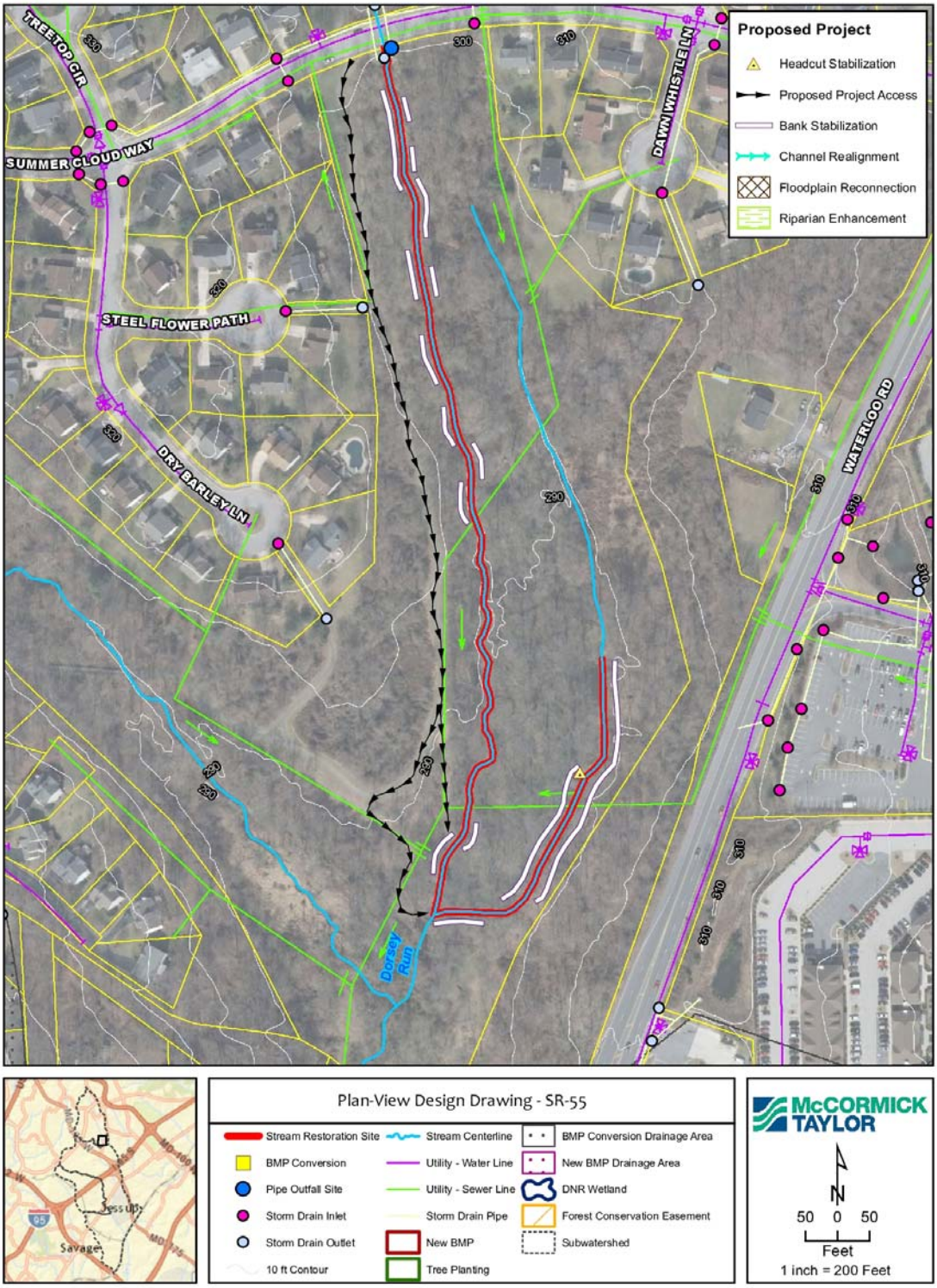
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-55

Site Name: Summer Cloud Way

Contractor: McCormick Taylor

Watershed: Little Patuxent River



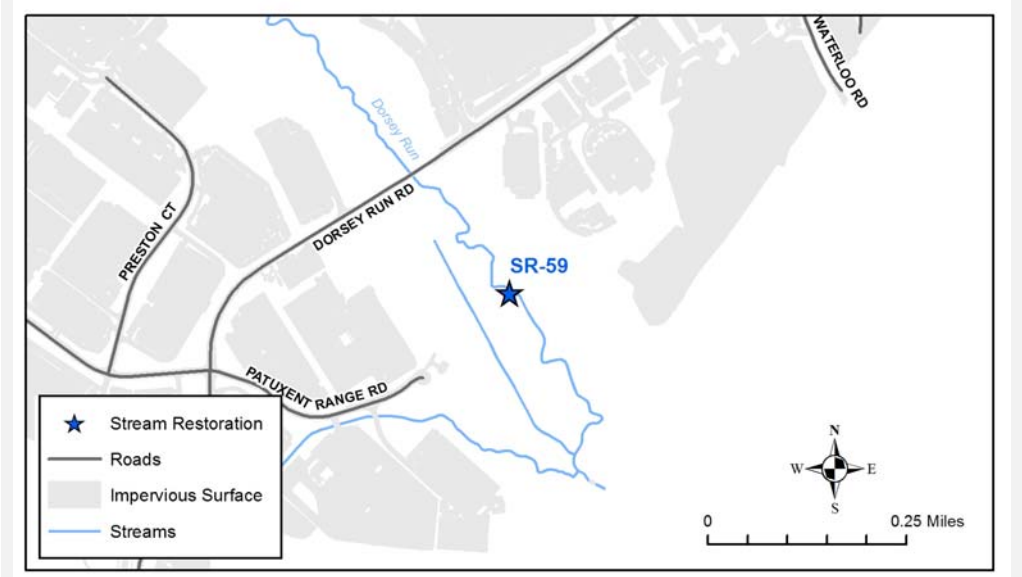
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-59
Site Name: Jessup Correctional
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Ownership: Private- Mixed Use
Single Owner

Existing Conditions:

SR-59 consists of four stream assessment reaches (DOR-SR-F904A, DOR-SR-F904B, DOR-SR-F904C, DOR-SR-F904D) associated with Dorsey Run. Land use surrounding the project site is mostly forested, with a CSX railroad located along the east side of the stream. The entire project site property is owned by the Maryland State Department of Public Safety and Correctional Services. The project begins approximately 400 lf. downstream of the culvert at Dorsey Run Road and extends about 2,572 lf. downstream (south). In general, the stream has a predominantly gravel/sand/silt substrate with bank heights ranging from 4-6 ft. Approximately 1,500 lf. of the stream banks are currently eroding primarily causing lateral migration and widening of the channel. A majority of the eroding banks are nearly vertical with bank heights between 5 to 6 ft., lack surface protection and/or vegetation, and are comprised mainly of silt and loamy soil material. Two areas of the left bank are eroding into the CSX railroad track and threatening stability of the railroad. An existing concrete weir is located south of a proposed tree planting area (DOR-SR-F904C) and is approximately 40 ft. wide, extending 70 ft. from upstream to downstream. The weir has a significant amount of accumulated sediment and debris on the upstream side and also acts as a fish blockage. The site is also associated with beaver activity and evidence of old beaver dams. Forested and emergent wetlands are located primarily on the right side (west) of the channel in several areas of the project site. The site is also associated with an SHA project that was completed in 2013. The SHA project included stream and wetland restoration on the west side of Dorsey Run that mainly focused on treatments to the unnamed tributary located on the west side of the property.



Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-59
Site Name: Jessup Correctional
Contractor: McCormick Taylor
Watershed: Little Patuxent River

SR-59 facing upstream at failing dam structure.

SR-59 facing downstream at severe bank erosion.

Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-59
Site Name: Jessup Correctional
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints with the site include existing sewer utilities, CSX railroad tracks, and potential impacts to trees, forested areas and wetlands.

Concept Description:

The proposed stream restoration project consists of approximately 2,572 lf. of Dorsey Run immediately upstream of the Howard County boundary with Anne Arundel County. The project mainly includes bank stabilization treatments along several areas of Dorsey Run. The majority of the proposed bank stabilization areas are associated with outside meander bends that are actively eroding and lack protection. The existing concrete weir could be considered for removal with the project, but this would greatly increase project costs. The concrete weir is slowly deteriorating and failure of the structure would be associated with significant channel degradation and release of sediment. Currently, the weir and old beaver dams that are located within the channel are highly influential on the amount of sediment deposition and floodplain connectivity characterizing the stream system. There are extensive floodplain wetlands located along the entirety of the project and receive large amounts of sediment deposits during storm events. The proposed project may need to include outfall stabilization associated with one of the bank stabilization areas located toward the downstream extent of the project. Trash and debris removal is also recommended for the project site. Proposed access to the site includes an existing sanitary sewer easement that was also utilized for the previous SHA project. The haul road is still relatively clear of vegetation. Coordination with SHA should be conducted to determine if there are any existing protective easements or covenants associated with the property. The project would include additional stream assessment and design phases to determine specific channel treatments and construction sequence.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	2,572	Estimated Design Cost:	$300,000.00
Impervious Area Treated Credit (ac.):	25.7	Estimated Construction Cost:	$1,157,400.00
Cost per Impervious Credit Acre:	$70,164.07	30% Contingency:	$347,220.00
		Estimated Total Cost:	$1,804,620.00

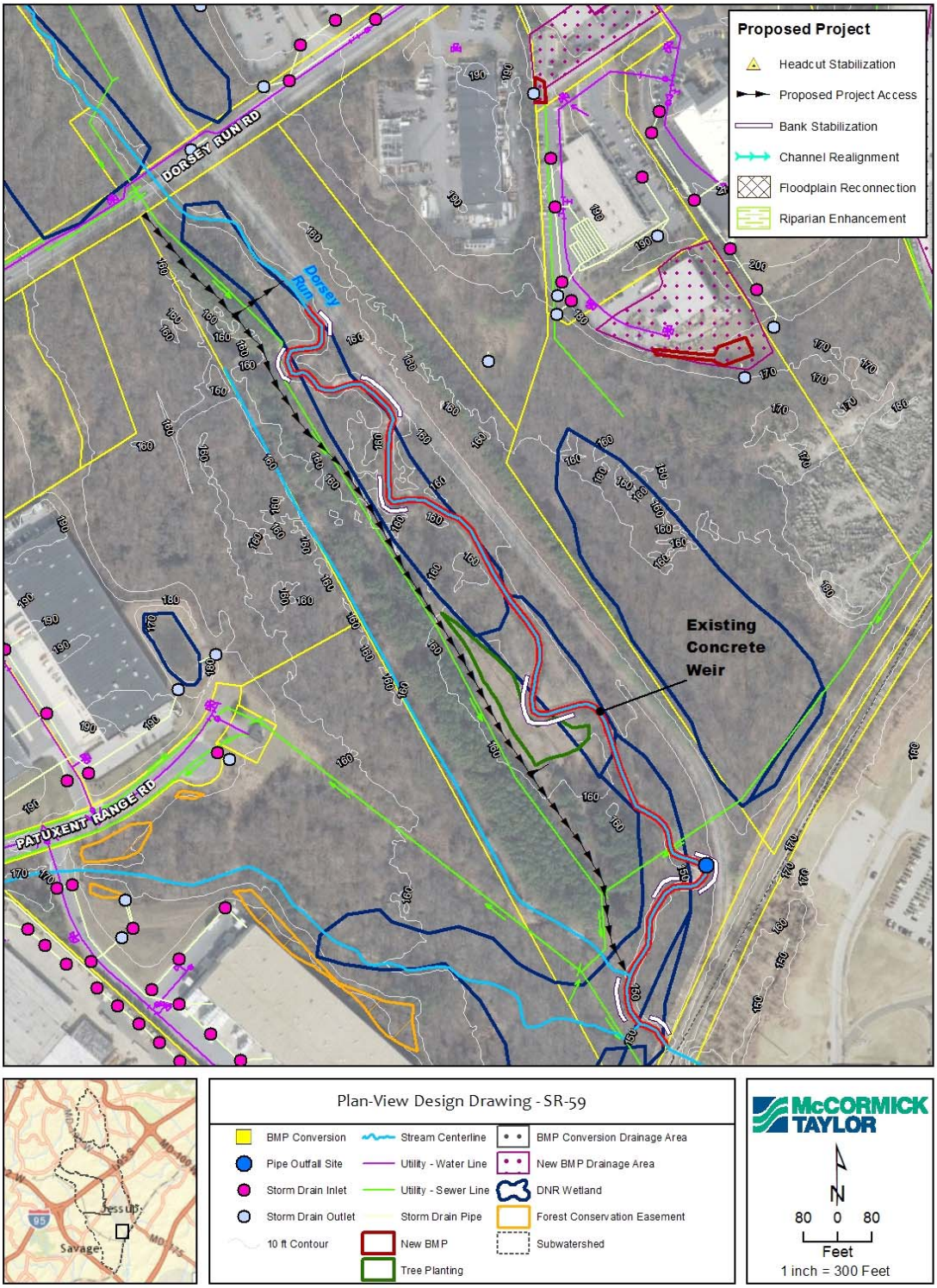
Howard County Watershed Assessment Concept Plan: Stream Restoration

Site ID: SR-59

Site Name: Jessup Correctional

Contractor: McCormick Taylor

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

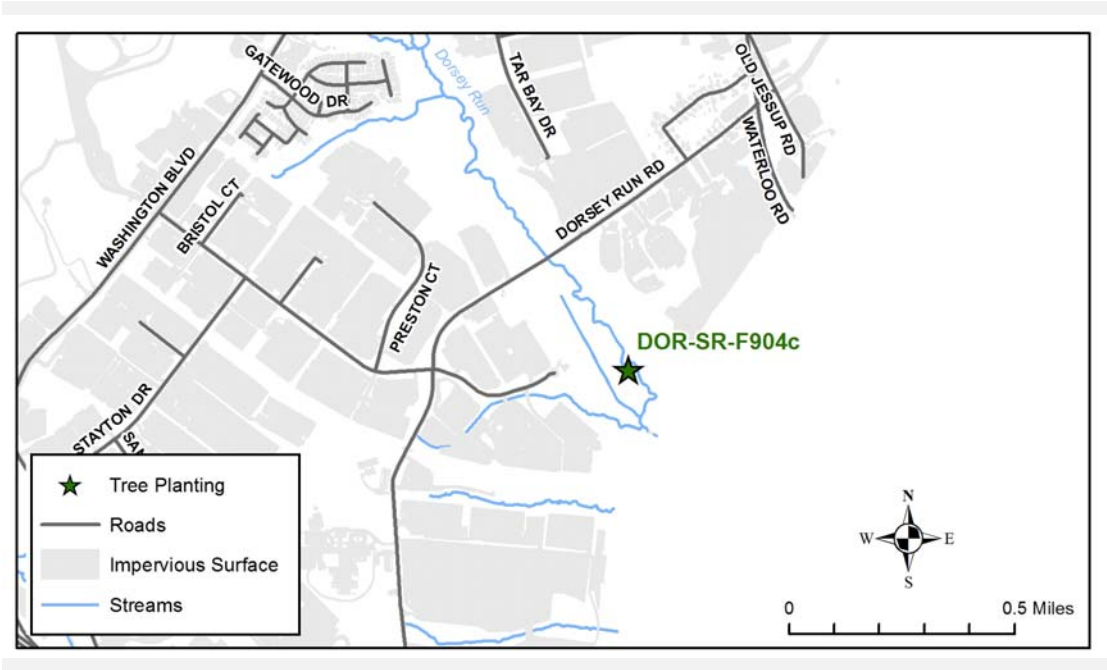
Site ID: DOR-SR-F904c
Site Name: Dorsey Run Road
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: State
Single Owner

Existing Conditions:

The proposed tree planting site is located approximately 1,200 ft. southeast of the crossing of Dorsey Run Road and Dorsey Run in Jessup, MD. The property associated with the planting area is state owned by the Department of Public Safety and Correctional Services. The project site is within the riparian buffer zone of SR-59. A majority of the proposed planting area receives full sunlight except on the fringes with adjacent forested areas. About 60% of the site is comprised of herbaceous cover, with 10% trees and shrubs and 30% bare soil. Dominant tree species observed in adjacent areas of the site include box elder (Acer negundo), black walnut (Juglans nigra), and American sycamore (Platanus occidentalis). No invasive species are present within the planting area; however 25% invasive species coverage of Japanese honeysuckle (Lonicera japonica) is located in the adjacent area.

Soils within the project are primarily loam and are moderately compacted. Water sources other than rainfall include overbank flow from SR-59 and runoff from the surrounding land use, with a pervious contributing flow length of 50 ft. along a 5% slope. The site has some floodplain connection with SR-59, which has bank heights between 4-6 ft. There are multiple animal impacts to the site including heavy deer browse and beaver activity. The site is associated with an SHA project that focused on restoration treatment to the unnamed tributary to Dorsey Run on the west side of the property. The haul road utilized for the project is still accessible and is associated with some soil disturbance, compaction, and the presence of mulch. Recent tree plantings are located within the planting area; however, none of them were successful. Wetlands are located within adjacent areas of the planting site. The proposed planting area is also within a green infrastructure hub.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-SR-F904c
Site Name: Dorsey Run Road
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed tree planting site DOR-SR-F904c facing northwest.

Proposed tree planting site DOR-SR-F904c facing west at adjacent streambank erosion.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-SR-F904c
Site Name: Dorsey Run Road
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints within the project include animal impacts, ownership, and possible wetland impacts. The planting area may require further coordination with SHA to determine if additional constraints or protective easements exist on the property.

Concept Description:

Approximately 0.57 ac. of riparian buffer will be planted with suitable tree species. Recent tree plantings are located within the planting area, but none appear to be surviving. It is recommended that American sycamore (Platanus occidentalis) be included as a suitable tree species since it is typically more resistant to deer browse. Selection of other suitable tree species will be determined in a planting plan if the project is selected for planting.

Access to the site is generally easy with foot and vehicle traffic able to enter through the sewer line easement off of Dorsey Run Road, which was previously utilized as a haul road for the SHA project. Space for temporary storage and onsite material delivery is available adjacent to the planting site.

Nearby Opportunities:

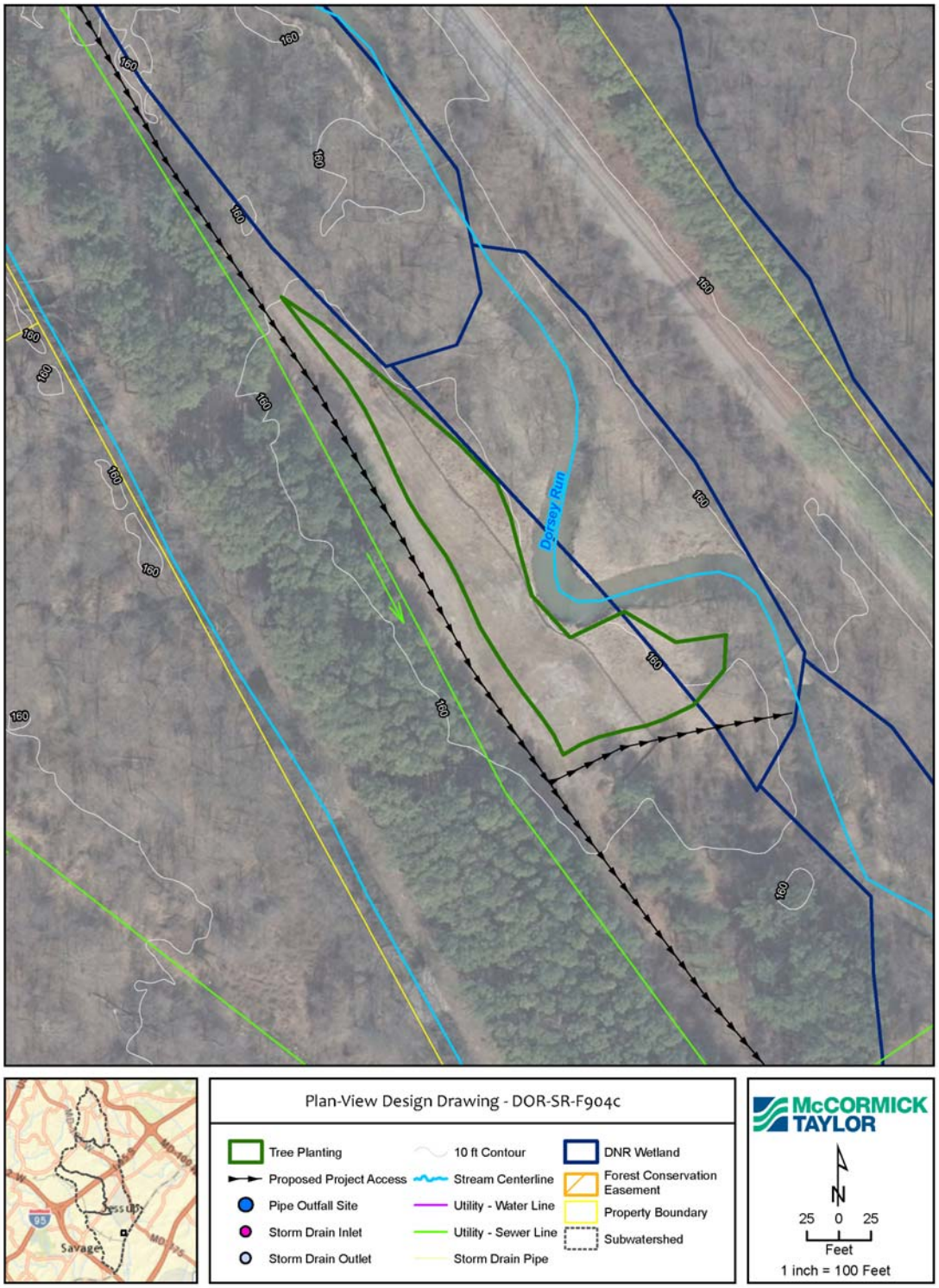
SR-59

Proposed Project Credit	
Planting Acres:	0.6
Impervious Area Treated Credit (ac.):	0.22
Cost per Impervious Credit Acre:	$153,236.36

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$18,240.00
30% Contingency:	$5,472.00
Estimated Total Cost:	$33,712.00

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-SR-F904c
Site Name: Dorsey Run Road
Contractor: McCormick Taylor
Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

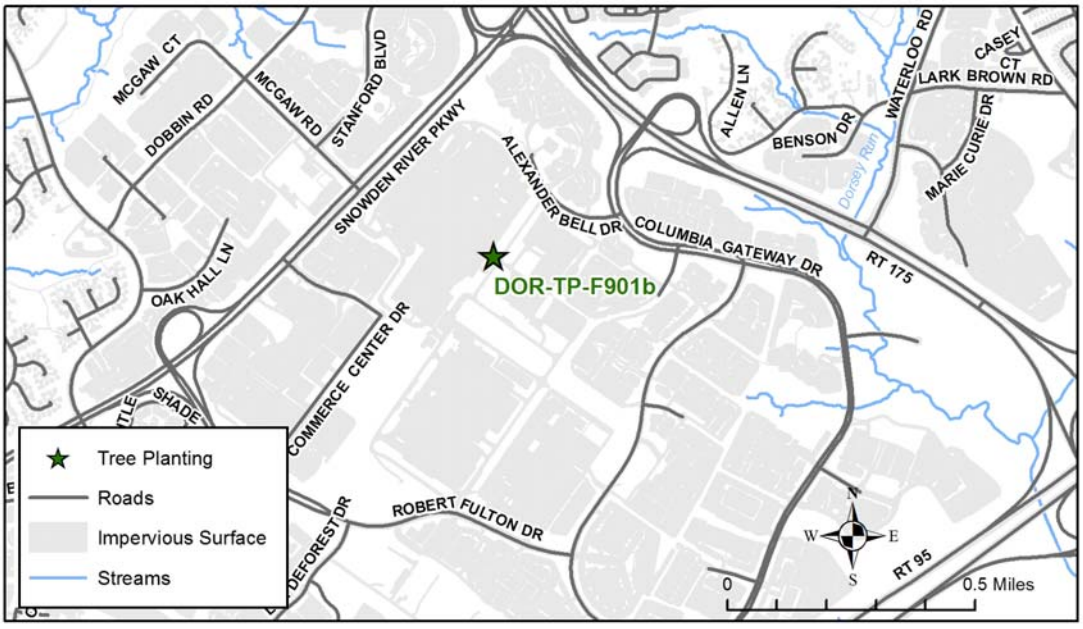
Site ID: DOR-TP-F901b
Site Name: Pepsi Delivery
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The proposed tree planting project consists of five planting assessments (DOR-TP-F901b, DOR-TP-F901c, DOR-TP-F901d, DOR-TP-F901e, and DOR-TP-F901g) located within an industrial/commercial property southeast of the intersection of Snowden River Parkway and McGaw Road. The property associated with the tree planting area is privately owned by Gateway A 74 & A 76 LLC. The project site is generally made up of multiple regularly mowed median strips which are within highly impervious areas that receive full sun. Planting areas within the site are comprised of 80-95% mowed turf, 1-10% trees and shrubs, and 3-10% bare soil.

Dominant tree species observed within some planting areas and in adjacent forested areas include red maple (Acer rubrum), sweet-gum (Liquidambar styraciflua), eastern white pine (Pinus strobus), and American sycamore (Platanus occidentalis). Invasive species cover 5% of the western planting area (DOR-TP-F901g) and include multiflora rose (Rosa multiflora), wine raspberry (Rubus phoenicolasius), and Japanese honeysuckle (Lonicera japonica). Soils within the project site are primarily loam and are moderately compacted. Water sources other than rainfall include runoff from adjacent land use, with both pervious and impervious flow lengths ranging from 15 to 50 ft. along a slope of 2 to 30%. Greater than 15% slopes can be found within the western planting area, the large middle planting area (DOR-TP-F901c), and the southeastern planting area (DOR-TP-F901b). There is no evidence of animal impacts.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F901b
Site Name: Pepsi Delivery
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed tree planting site DOR-TP-F901b facing east at the southernmost southeastern parcel.

Proposed tree planting site DOR-TP-F901b facing northeast at the large middle parcel.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F901b
Site Name: Pepsi Delivery
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints within the project include ownership and regular mowing of planting areas. The small middle and northeastern planting areas also have 30 ft. high light posts along the edge of pavement that may limit the extent or type of tree species selected for planting. Based on available GIS data, it does not appear that the proposed planting areas include underground utilities but this will require verification.

Concept Description:

Approximately 7.27 ac. of industrial/commercial property will be planted with suitable tree species. No previous plantings have occurred on this property. Selection of suitable tree species will be determined in planting plans if the project is selected for planting.

Access to the site is generally easy, with foot and vehicle traffic able to enter the industrial property by adjacent roadways. Temporary storage for material is possible using existing parking lots and planting areas on the property. Heavy equipment traffic and onsite material delivery is available to all planting areas.

Nearby Opportunities:

DOR-NB-925, DOR-NB-926, DOR-NB-927, DOR-NB-F928, DOR-NB-F929, DOR-NB-F931, and DOR-NB-F943.

Proposed Project Credit	
Planting Acres:	7.3
Impervious Area Treated Credit (ac.):	2.76
Cost per Impervious Credit Acre:	$113,200.00

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$232,640.00
30% Contingency:	$69,792.00
Estimated Total Cost:	$312,432.00

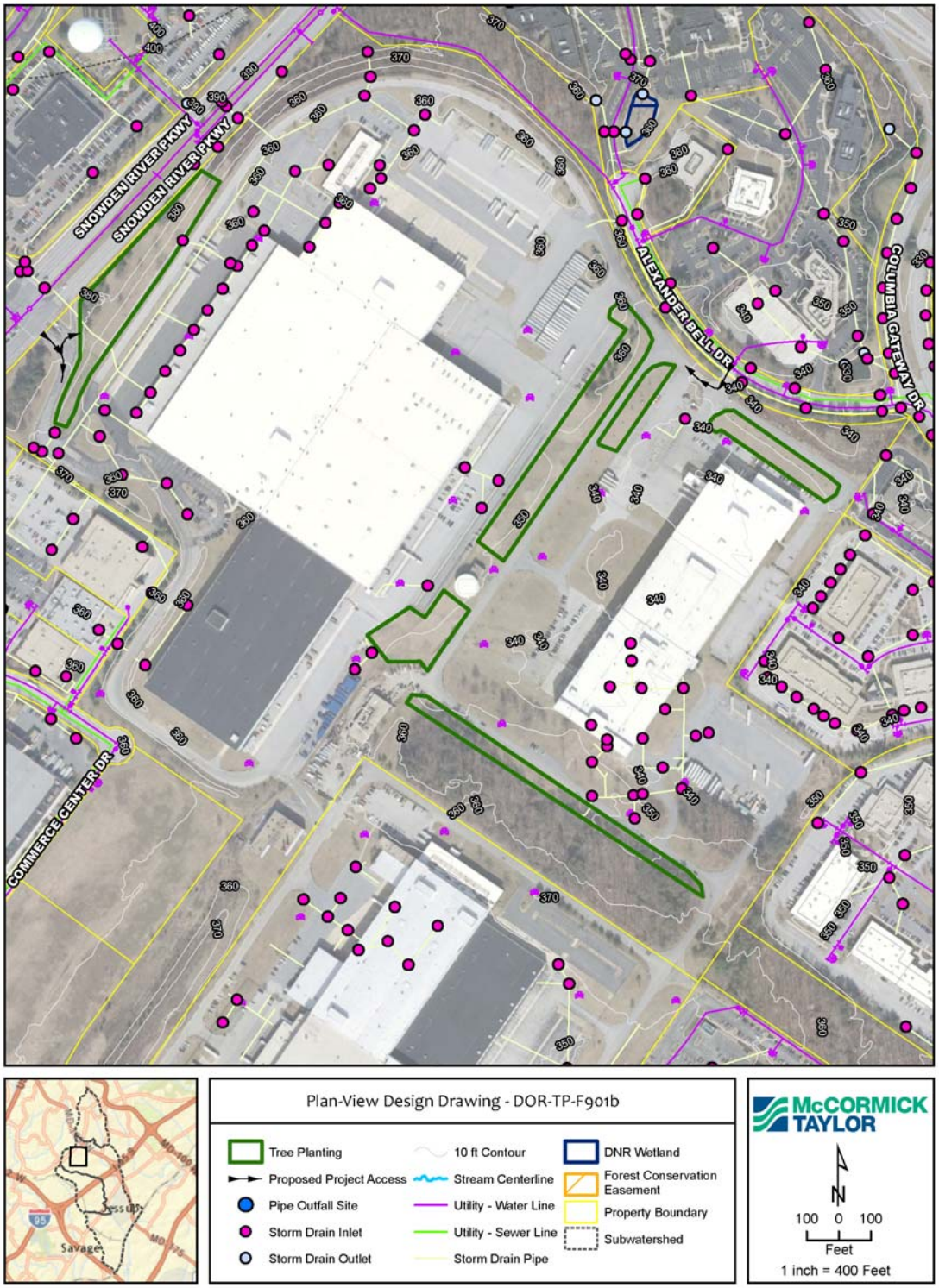
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F901b

Site Name: Pepsi Delivery

Contractor: McCormick Taylor

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

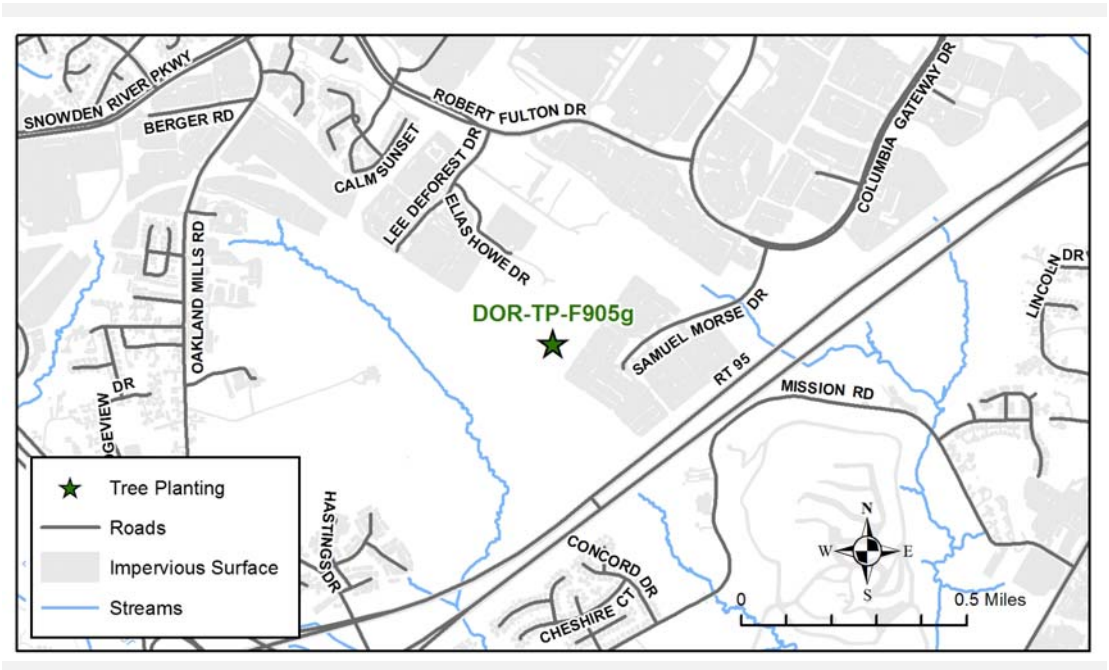
Site ID: DOR-TP-F905g
Site Name: Lee Deforest Drive
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

The proposed tree planting project is a combination of five planting areas (DOR-TP-F905d, DOR-TP-F905e, DOR-TP-F905g, and DOR-TP-F905h) located south of the intersection of Robert Fulton Drive and Lee Deforest Drive in Columbia, MD. The property associated with the site is privately owned by two commercial titleholders. The project is generally made up of multiple upland areas adjacent to a commercial business park that receive full sun. Planting areas within the site are generally comprised of 90-95% herbaceous cover, 3-5% trees and shrubs, and 2-5% bare soil.

Dominant tree species observed in some planting areas and in adjacent forested areas include red maple (Acer rubrum), Virginia pine (Pinus virginiana), and tulip poplar (Liriodendron tulipifera). The majority of the planting areas have no invasive species present; however, Bradford pear (Pyrus calleryana) covers approximately 5% of the northwestern (DOR-TP-F905f) and southwestern (DOR-TP-F905d) planting areas. Soils within the project are primarily loam and are moderately compacted. Water sources other than rainfall include runoff from surrounding drainage areas, with a pervious flow length ranging from 5 to 50 ft. along a 10 to 30% slope. Greater than 15% slopes can be found within the southwestern planting area. There is no evidence of animal impacts or previous tree plantings.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F905g
Site Name: Lee Deforest Drive
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Proposed tree planting site DOR-TP-F905g facing northwest at the southwestern parcel.

Proposed tree planting site DOR-TP-F905g facing north at the northwestern parcel.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F905g
Site Name: Lee Deforest Drive
Contractor: McCormick Taylor
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints within the project include ownership, regular mowing in areas adjacent to the commercial park, and a potential wetland in the southwestern planting area.

Concept Description:

Approximately 4.74 ac. of commercial property will be planted with suitable tree species. No recent tree plantings have occurred within the project site. Selection of suitable tree species will be determined in a planting plan if the project is selected for planting.

Access to the site is generally easy, with foot, vehicle, and heavy equipment traffic able to enter the commercial property by roadways adjacent to the project parcels. The two eastern areas adjacent to the landfill would need to be accessed by entering the fence surrounding the capped landfill. Space for temporary storage and onsite material delivery is available.

Nearby Opportunities:

DOR-NB-F902, DOR-NB-F903, DOR-NB-F941, and DOR-NB-F942.

Proposed Project Credit	
Planting Acres:	4.7
Impervious Area Treated Credit (ac.):	1.8
Cost per Impervious Credit Acre:	$115,102.22

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$151,680.00
30% Contingency:	$45,504.00
Estimated Total Cost:	$207,184.00

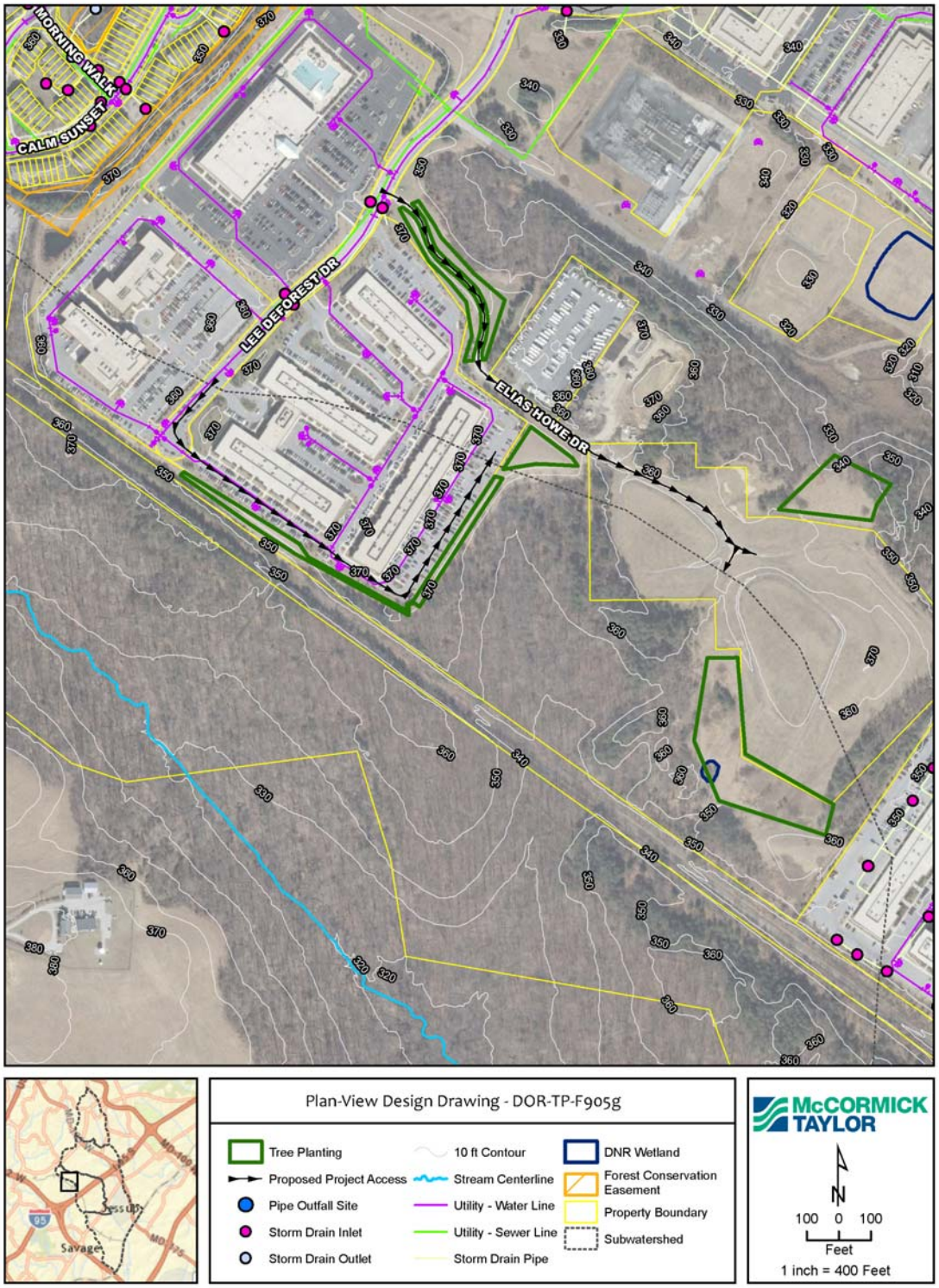
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: DOR-TP-F905g

Site Name: Lee Deforest Drive

Contractor: McCormick Taylor

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-D519

Site Name: Forest Hill

Contractor: KCI

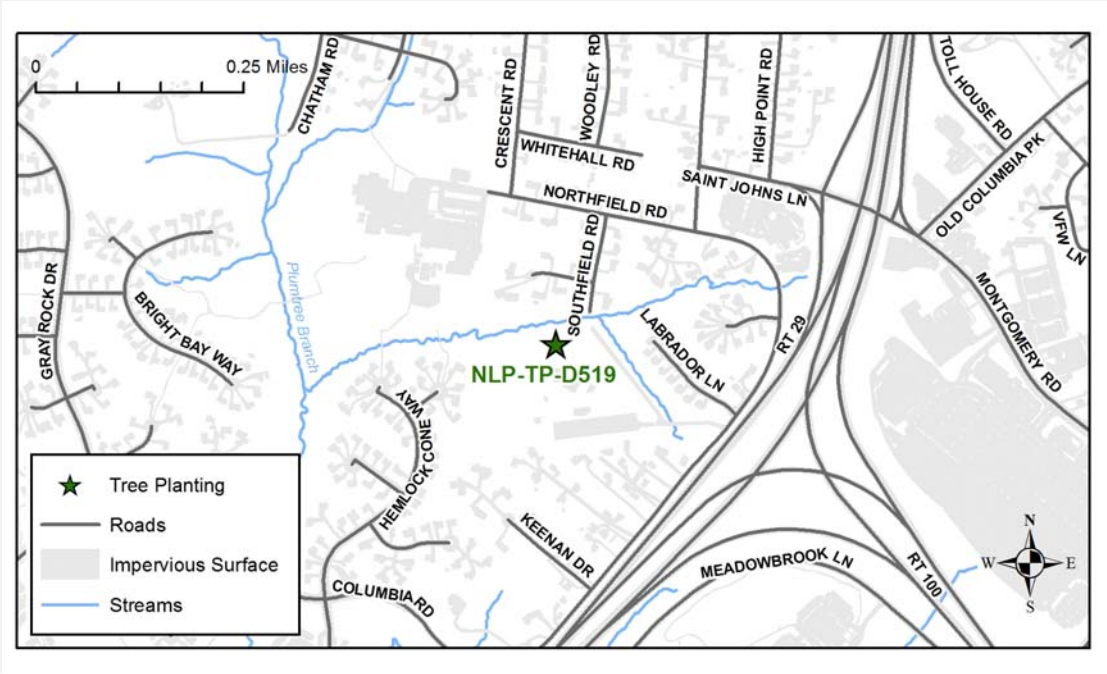
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The Forest Hill tree planting site consists of two separate areas around the perimeter of the Forest Hill Swim & Tennis Club property. Both areas are currently mowed grass and maintained by Forest Hill Swim & Tennis Club. The planting will occur around the existing large Norway spruce and white pine trees on the property. Majority of the site receives full sun.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-D519
Site Name: Forest Hill
Contractor: KCI
Watershed: Little Patuxent River

View of open grass and existing trees facing west at southern portion of planting area.

View of open field facing west at northern portion of planting area.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-D519
Site Name: Forest Hill
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The open, mowed areas recommended for tree planting may be used by swim club members for various activities. The County will need to coordinate with Forest Hill Swim & Tennis Club for access. No utilities have been found to conflict with the planting of this site.

Concept Description:

Tree planting is proposed on 4.32 ac. This planting will extend the existing riparian buffer by approximately 150 ft. Very little site preparation will be required. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. Water access is close to the planting areas, however permission to use the water will need to be obtained from the Swim Club. The site can be accessed from the entrance to the Swim Club at the southern side of the property or from the gate at the northeastern side of the property.

Nearby Opportunities:

NLP-NB-D560, NLP-SR-F527

Proposed Project Credit	
Planting Acres:	4.3
Impervious Area Treated Credit (ac.):	1.64
Cost per Impervious Credit Acre:	$115,678.05

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$138,240.00
30% Contingency:	$41,472.00
Estimated Total Cost:	$189,712.00

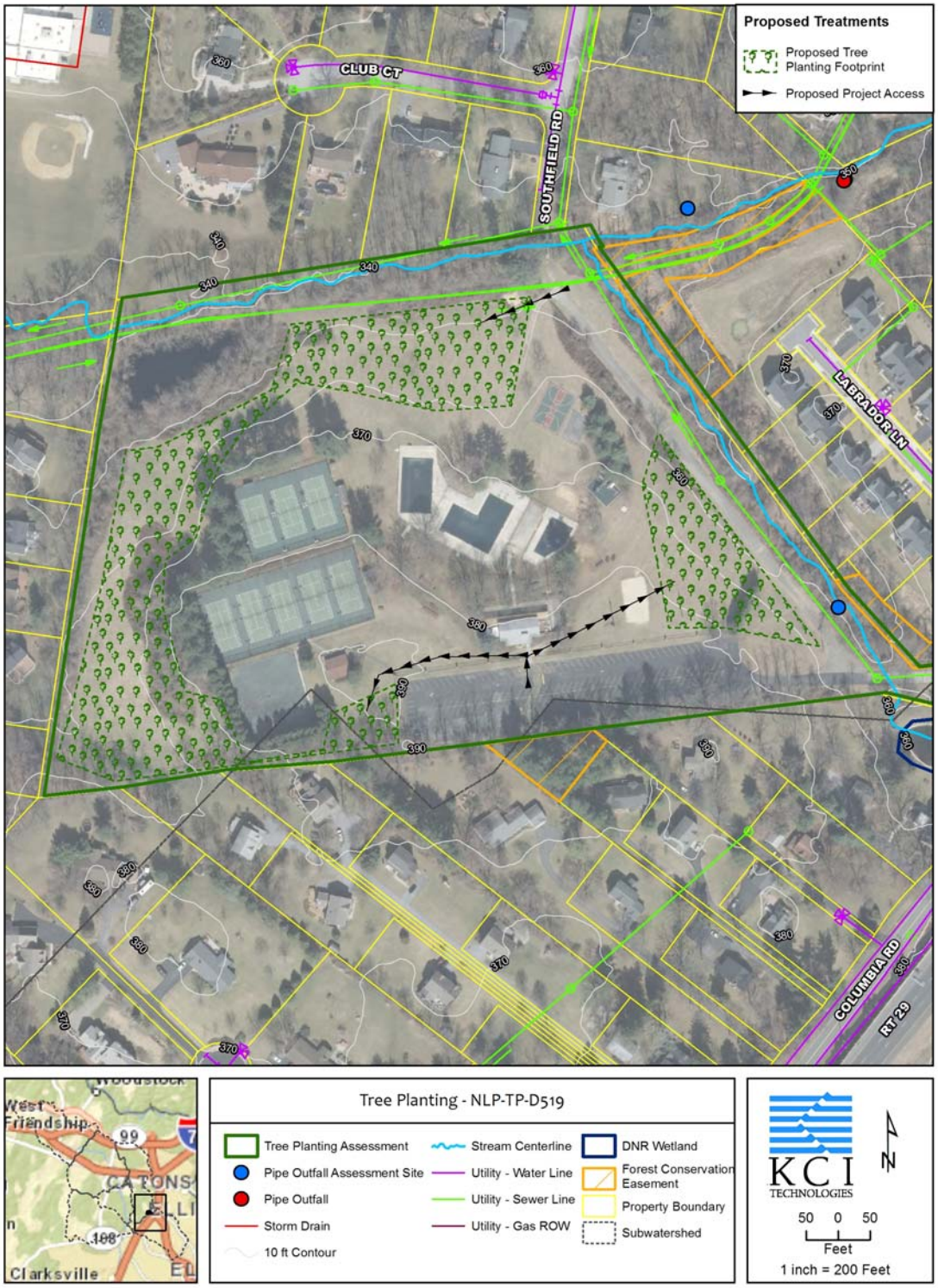
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-D519

Site Name: Forest Hill

Contractor: KCI

Watershed: Little Patuxent River



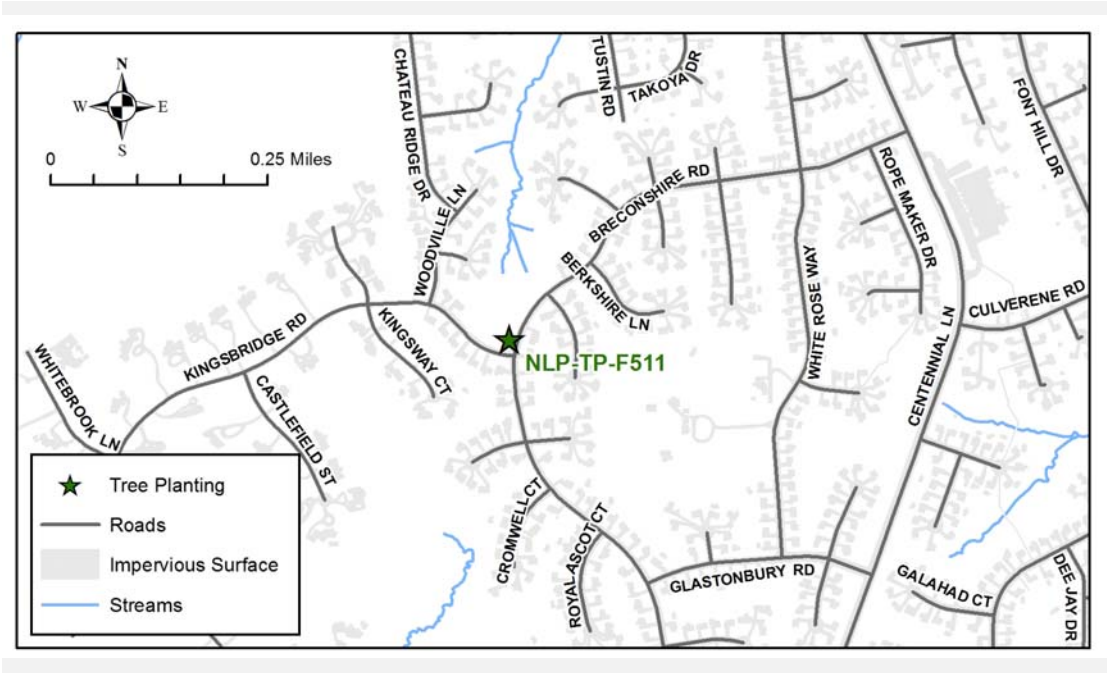
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F511
Site Name: Breconshire
Contractor: KCI
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: County Owned
Single Owner

Existing Conditions:

The Breconshire tree planting site consists of one planting area surrounding the stormwater management pond north of the intersection of Breconshire and Kingsbridge Roads. The planting areas are currently mowed and receive full sun. The planting should occur around the existing sycamore trees along Kingsbridge and Breconshire Roads without disturbing the existing trees. Majority of the site receives full sun.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F511

Site Name: Breconshire

Contractor: KCI

Watershed: Little Patuxent River

Site overview of open grass, existing sycamore trees, and stormwater management pond facing northwest from southern extent of planting area.

Site overview of open grass and existing sycamore trees facing northeast from southern extent of planting area.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F511
Site Name: Breconshire
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

Three storm drains connect road inlets to the pond inflow pipes and cross the proposed planting area. Trees should not be planted within a 20 ft. buffer over these storm drain pipes. No other utilities have been found to conflict with the planting of this site. Neighborhood use of the open space may be a constraint. Additionally, care must be taken when planting near the intersection of Kingsbridge and Breconshire Roads to avoid obstructing the view of drivers.

Concept Description:

Tree planting is proposed on 1.00 ac. surrounding the stormwater management pond on the southeastern and southwestern sides of the pond. The plantings will extend from the road to the edge of the water of the ponds. The ponds are excavated ponds, therefore no planting on the pond embankments on the northern side of the ponds should occur. Very little site preparation will be required. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. A fire hydrant on Breconshire Road may be used as a water source. The site can easily be accessed directly from Kingsbridge and Breconshire Roads.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	1
Impervious Area Treated Credit (ac.):	0.38
Cost per Impervious Credit Acre:	$135,789.47

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$32,000.00
30% Contingency:	$9,600.00
Estimated Total Cost:	$51,600.00

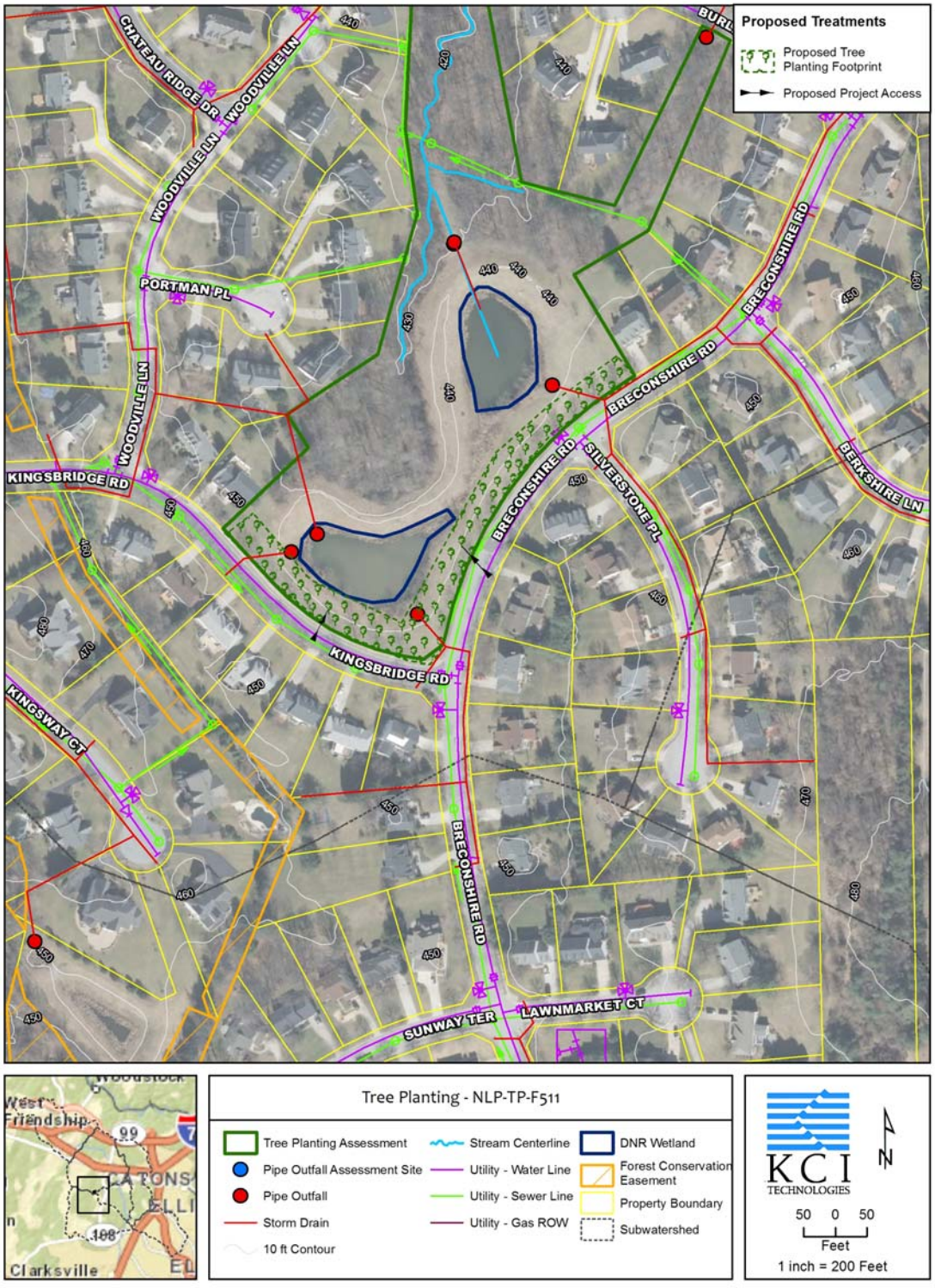
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F511

Site Name: Breconshire

Contractor: KCI

Watershed: Little Patuxent River



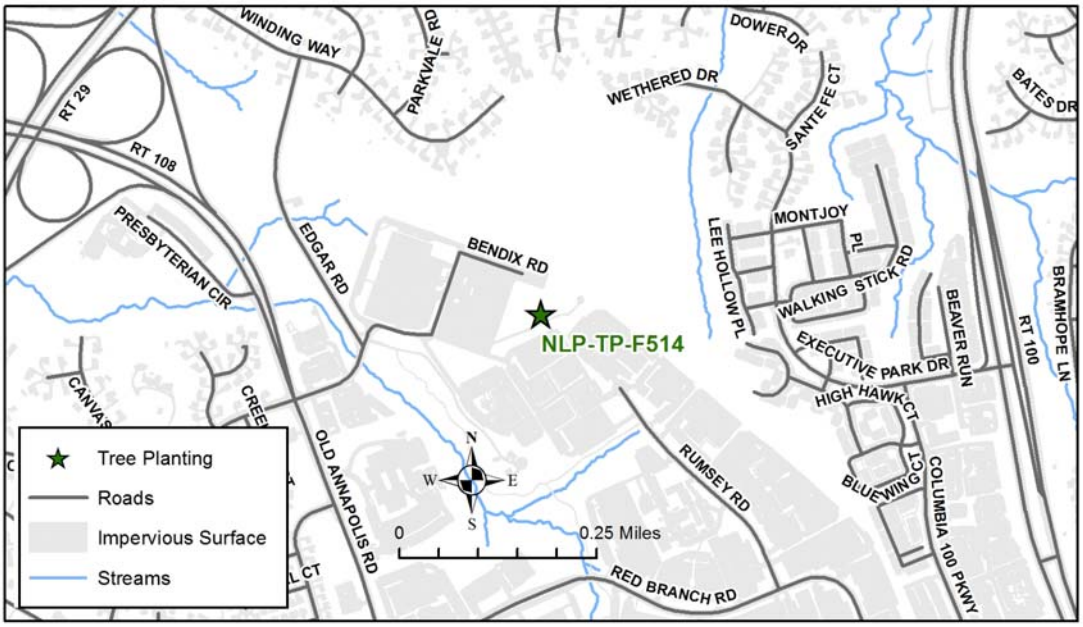
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F514
Site Name: Thomas B. Dorsey Building
Contractor: KCI
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: County Owned
Single Owner

Existing Conditions:

The Thomas B. Dorsey Building tree planting site consists of two areas. The southern portion of the site is currently an open mowed field. The northern portion of the site is an overgrown field with a stand of small Bradford pear trees. Other invasive species found include mile-a-minute and autumn olive. A stormwater management pond is present near the parking lot at the northern side of the site and the embankments of this pond should not be planted. Majority of the site receives full sun. Some areas appear to be used for storage.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F514

Site Name: Thomas B. Dorsey Building

Contractor: KCI

Watershed: Little Patuxent River

Site overview facing southwest at southern portion of planting area.

Site overview and view of Bradford pear tree stand facing east at northern portion of planting area.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F514
Site Name: Thomas B. Dorsey Building
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

A moderate amount of site preparation will be required and includes the removal of the Bradford pear trees and mowing of the site. The stormwater management pond basin should not be planted. A water line bisects the southern portion of the site; however, this would not likely greatly reduce the quantity of trees planted.

Concept Description:

Invasive species removal and tree planting is proposed on 5.58 ac. The stand of Bradford pear trees should be removed and the entire site will require mowing in preparation for the tree planting. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. Water will need to be transported to the site. The site can easily be accessed from the Thomas B. Dorsey building parking lot on Bendix Rd.

Nearby Opportunities:

NLP-NB-F548

Proposed Project Credit	
Planting Acres:	5.6
Impervious Area Treated Credit (ac.):	2.12
Cost per Impervious Credit Acre:	$114,211.32

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$178,560.00
30% Contingency:	$53,568.00
Estimated Total Cost:	$242,128.00

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F514

Site Name: Thomas B. Dorsey Building

Contractor: KCI

Watershed: Little Patuxent River

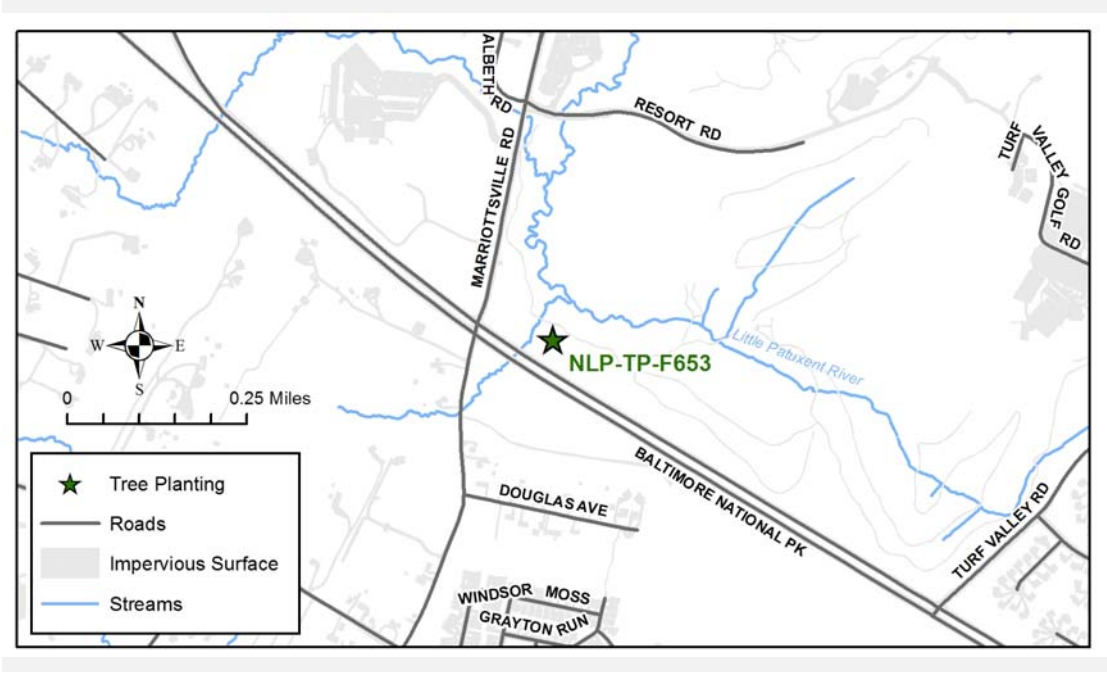
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F653
Site Name: Turf Valley (e)
Contractor: KCI
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The Turf Valley tree planting site consists of one planting area on the Turf Valley property northeast of the intersection of Marriottsville Road and Baltimore National Pike. A stream bisects the planting area. The planting area is currently mowed and receives full sun. Multiflora rose was found throughout the planting area.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F653
Site Name: Turf Valley (e)
Contractor: KCI
Watershed: Little Patuxent River

Site overview of open field facing west from middle of planting area.

Site overview of open field facing east from middle of planting area.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F653
Site Name: Turf Valley (e)
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

No utilities have been found to conflict with the planting of this site. Site access directly from Marriottsville Road may be a constraint due to terrain and existing trees. Plans for future development of the property will need to be discussed with the owner prior to moving forward with this project.

Concept Description:

Invasive species removal and tree planting is proposed on 4.55 ac. The possibility for additional planting area exists east of the proposed tree planting area; however, this area needs to be investigated. A water line and gas right of way are known to be within the possible additional acreage to the east. The existing multiflora rose should be removed and the entire site will require mowing in preparation for the tree planting. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. Water will need to be transported to the site. The site may be able to be accessed from Marriottsville Road.

Nearby Opportunities:

NLP-SR-F504A, NLP-SR-F509A

Proposed Project Credit	
Planting Acres:	4.6
Impervious Area Treated Credit (ac.):	1.73
Cost per Impervious Credit Acre:	$115,190.75

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$145,600.00
30% Contingency:	$43,680.00
Estimated Total Cost:	$199,280.00

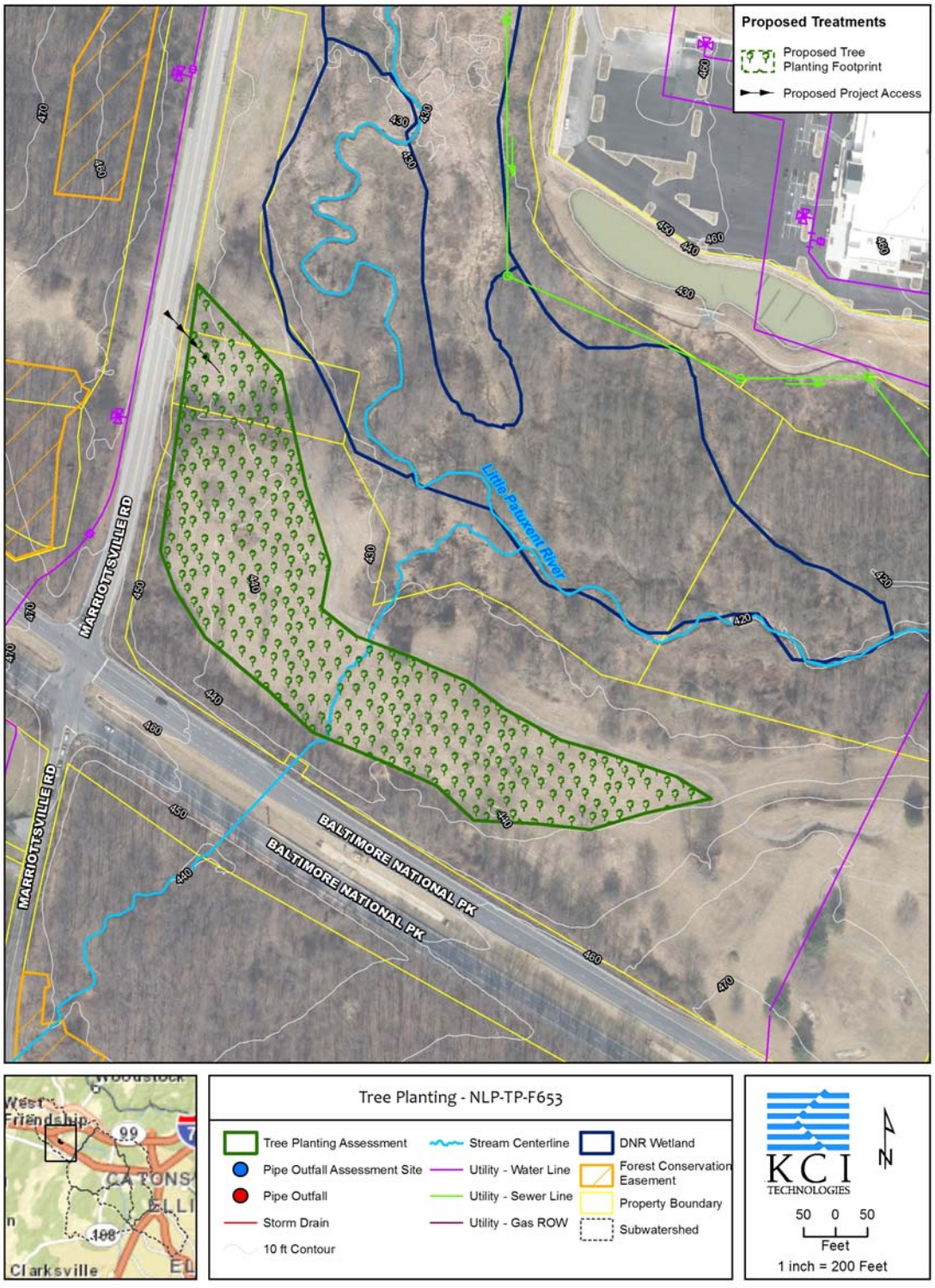
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F653

Site Name: Turf Valley (e)

Contractor: KCI

Watershed: Little Patuxent River



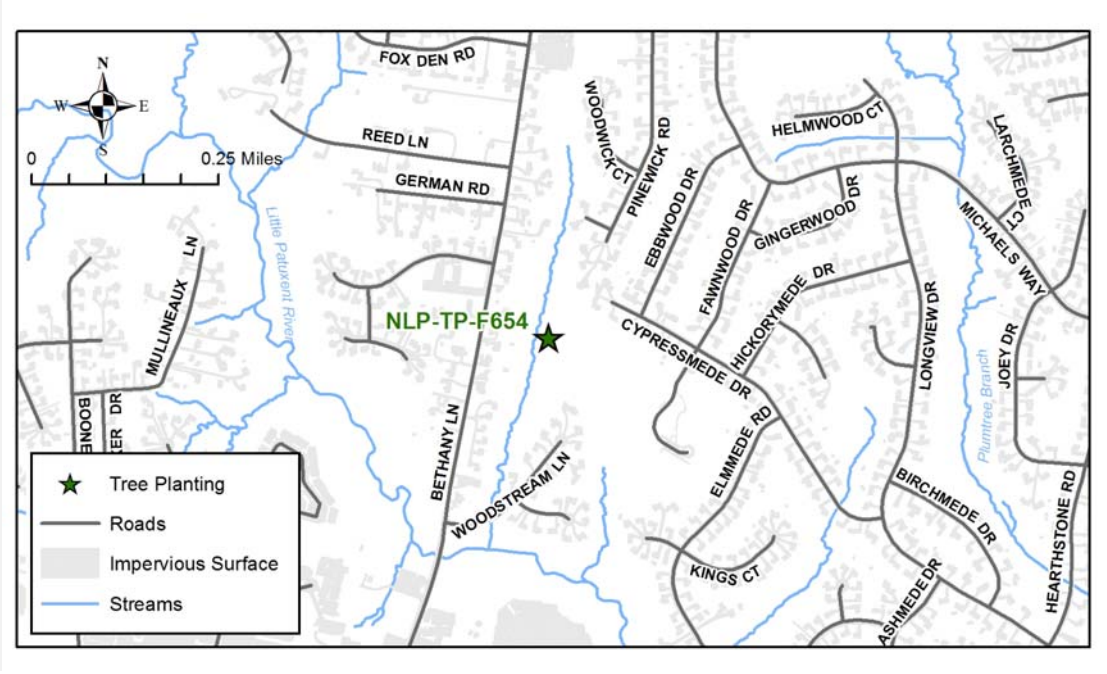
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F654
Site Name: Bethany Lane
Contractor: KCI
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Residential
Single Owner

Existing Conditions:

The Bethany Lane tree planting site consists of one planting area on a residential property on Bethany Lane. A stream bisects the planting area. A fenced pasture is on the western side of the stream and may be used by the homeowner. The planting area is currently mowed and receives full sun.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F654
Site Name: Bethany Lane
Contractor: KCI
Watershed: Little Patuxent River

View of proposed planting area within open field facing east from middle of planting area at stream.

View of proposed planting area within open field/pasture facing west from middle of planting area at stream.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F654
Site Name: Bethany Lane
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

Utility constraints include gas and sewer pipelines that bisect the planting area; however, these would not likely greatly reduce the quantity of trees planted. There is an outfall pipe on the western side of the stream in the center of the site. The storm drain infrastructure to this pipe will need to be investigated and if a storm drain pipe runs through the proposed planting area, a 20 ft. buffer should be placed over the storm drain pipe. Homeowner agreement will be required to plant this site. The fenced pasture may not be an option for planting. Access from the residential property at 3071 Bethany Lane may be limited by existing fences or buildings.

Concept Description:

Tree planting is proposed on 3.24 ac. Very little site preparation will be required. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. Water will need to be transported to the site. The site will need to be accessed from the residential property at 3071 Bethany Lane.

Nearby Opportunities:

NLP-SR-F551A

Proposed Project Credit	
Planting Acres:	3.2
Impervious Area Treated Credit (ac.):	1.23
Cost per Impervious Credit Acre:	$117,710.57

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$103,680.00
30% Contingency:	$31,104.00
Estimated Total Cost:	$144,784.00

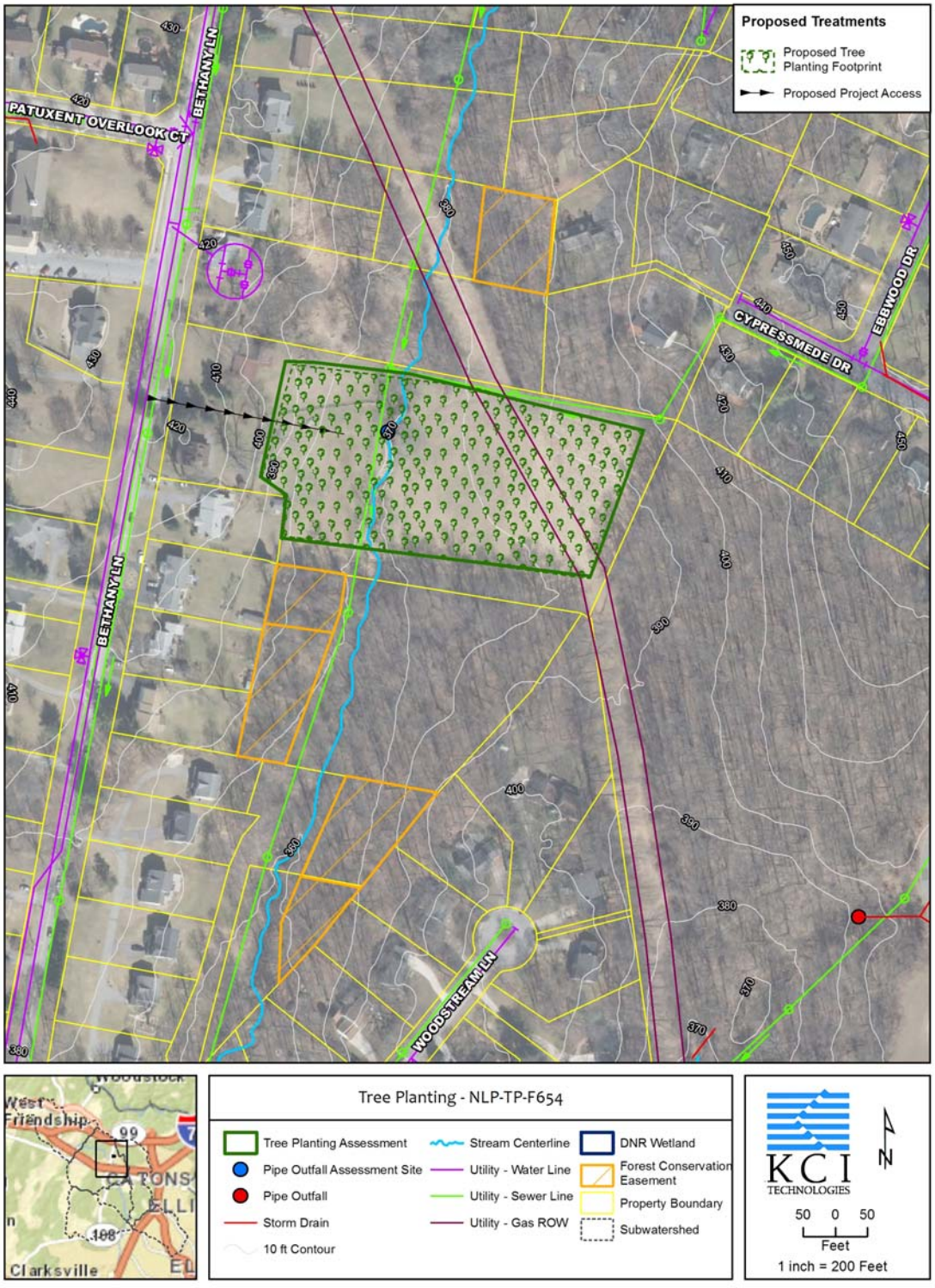
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F654

Site Name: Bethany Lane

Contractor: KCI

Watershed: Little Patuxent River



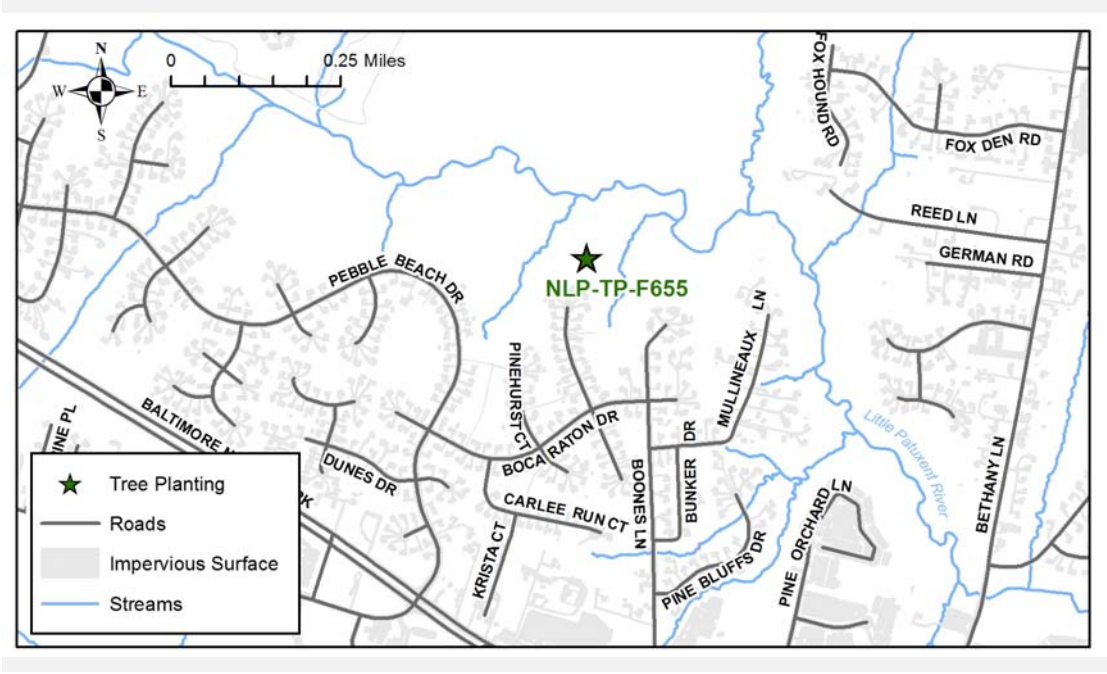
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F655
Site Name: David W Force Park
Contractor: KCI
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: County Owned
Single Owner

Existing Conditions:

The David W Force Park tree planting site consists of one planting area behind residential properties on the northern side of Congressional Court. The site is an overgrown field with scattered honey locust trees. Majority of the site receives full sun.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F655
Site Name: David W Force Park
Contractor: KCI
Watershed: Little Patuxent River

View of widespread invasive species facing north from middle of planting area.

View of existing trees and invasive species facing east from middle of planting area.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F655
Site Name: David W Force Park
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

A moderate amount of site preparation will be required and includes the removal of the honey locust trees and mowing of the site. No utilities have been found to conflict with the planting of this site.

Concept Description:

Invasive species removal and tree planting is proposed on 4.47 ac. This planting will extend the existing narrow riparian buffers of two tributaries to the Little Patuxent River. The existing honey locust trees should be removed and the entire site will require mowing in preparation for the tree planting. A variety of native trees should be planted. Tree shelters should be installed to protect the trees from deer damage. Tree maintenance and inspections should be performed yearly, and should include the removal of invasive species and repair of tree shelters and stakes. Water will need to be transported to the site. The site can be accessed from a walking path off Congressional Court.

Nearby Opportunities:

NLP-NB-D558, NLP-SR-F522A

Proposed Project Credit	
Planting Acres:	4.5
Impervious Area Treated Credit (ac.):	1.7
Cost per Impervious Credit Acre:	$115,265.88

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$143,040.00
30% Contingency:	$42,912.00
Estimated Total Cost:	$195,952.00

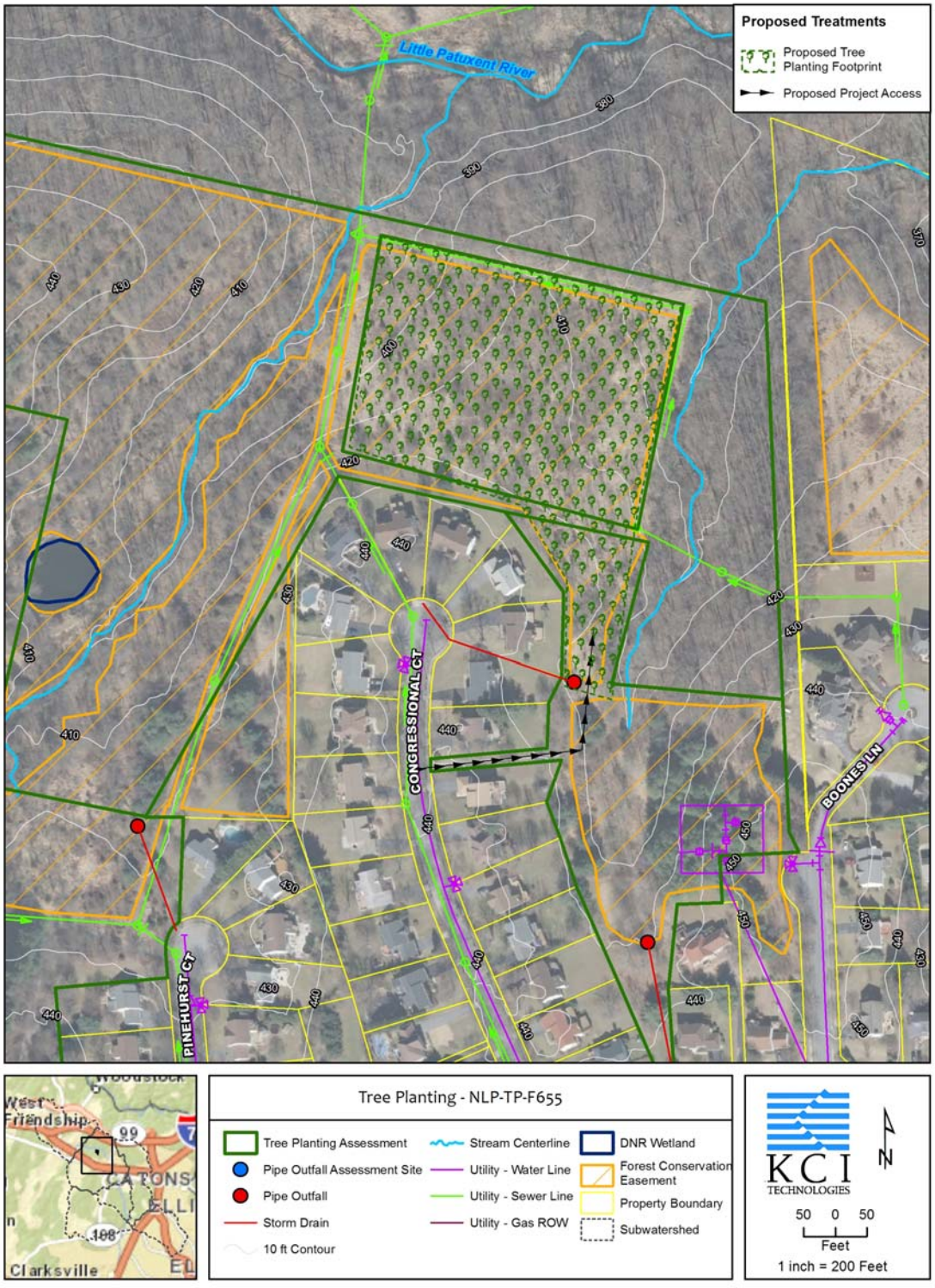
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: NLP-TP-F655

Site Name: David W Force Park

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F701

Site Name: Forest Ridge Elementary School

Contractor: Versar

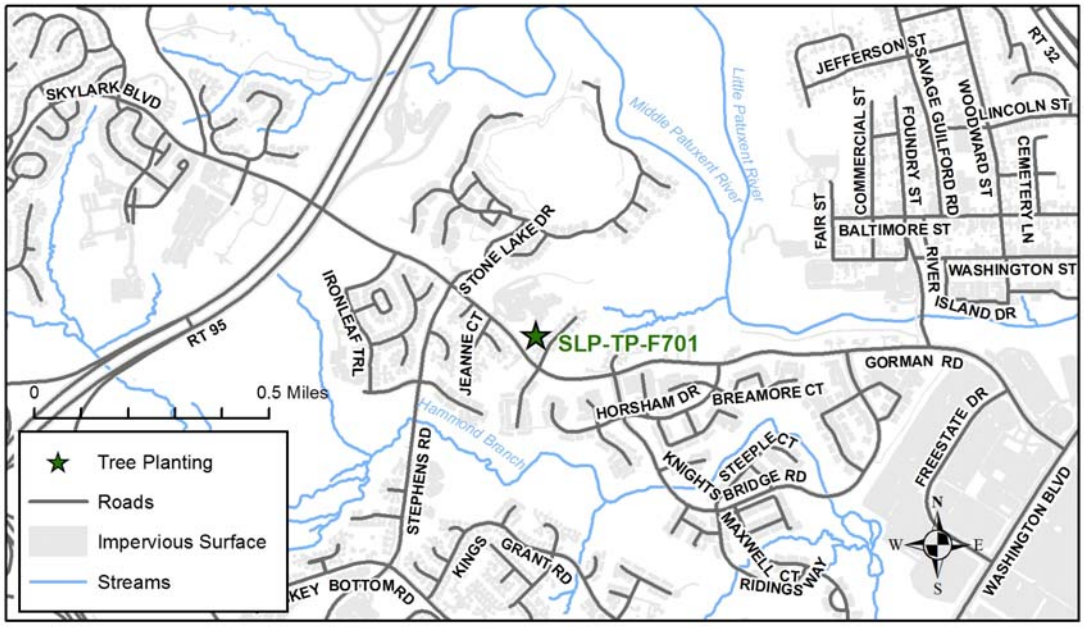
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: Board of Education
Single Owner

Existing Conditions:

Howard County public school with a small existing wetland BMP stormwater pond on its southwest side, and baseball/playing fields on its north side.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F701
Site Name: Forest Ridge Elementary School
Contractor: Versar
Watershed: Little Patuxent River

View looking southeast along Gorman Road, at the edge of the existing wetland BMP.

View looking northeast along the northeastern boundary of the site, at the narrow tree planting parcel.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F701
Site Name: Forest Ridge Elementary School
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Plans for tree planting at the school need to be vetted with Howard County Schools, for safety issues, other potential intended land uses, etc.

Concept Description:

The concept here would be to plant trees along the southern and eastern sides of the existing wetland BMP, and then extending to the north along the eastern boundary of the school. The trees could be planted with very little, if any, site preparation. Access to the planting parcel is good, and no utilities appeared to be within the planting areas. Although somewhat compacted in some areas, the site soils appeared to be suitable for tree planting. Another potential tree planting parcel exists along the eastern edge of the ball fields on the northeastern side of the school.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	1.9
Impervious Area Treated Credit (ac.):	0.73
Cost per Impervious Credit Acre:	$122,542.47

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$61,120.00
30% Contingency:	$18,336.00
Estimated Total Cost:	$89,456.00

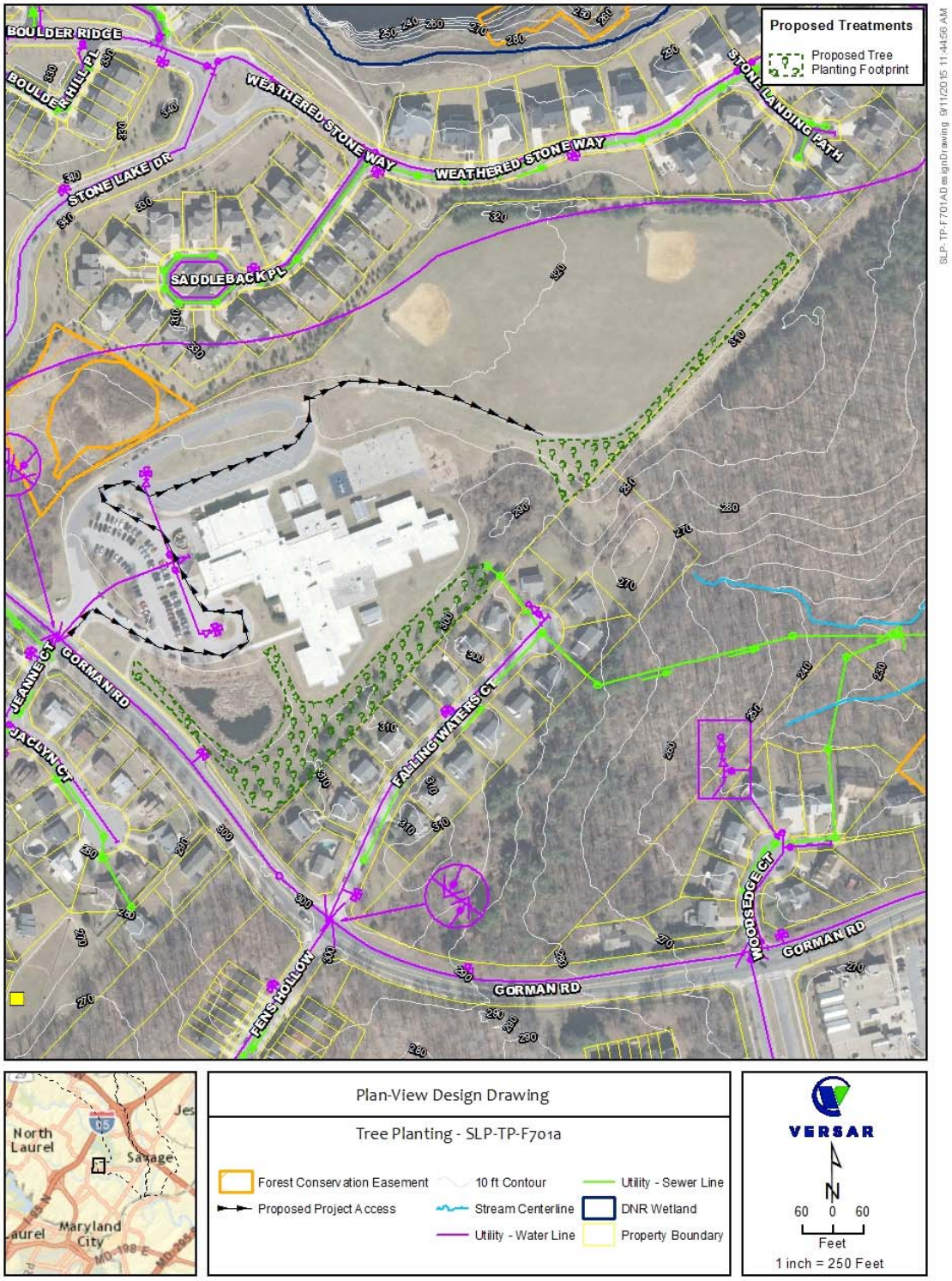
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F701

Site Name: Forest Ridge Elementary School

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F703

Site Name: Howard Community College

Contractor: Versar

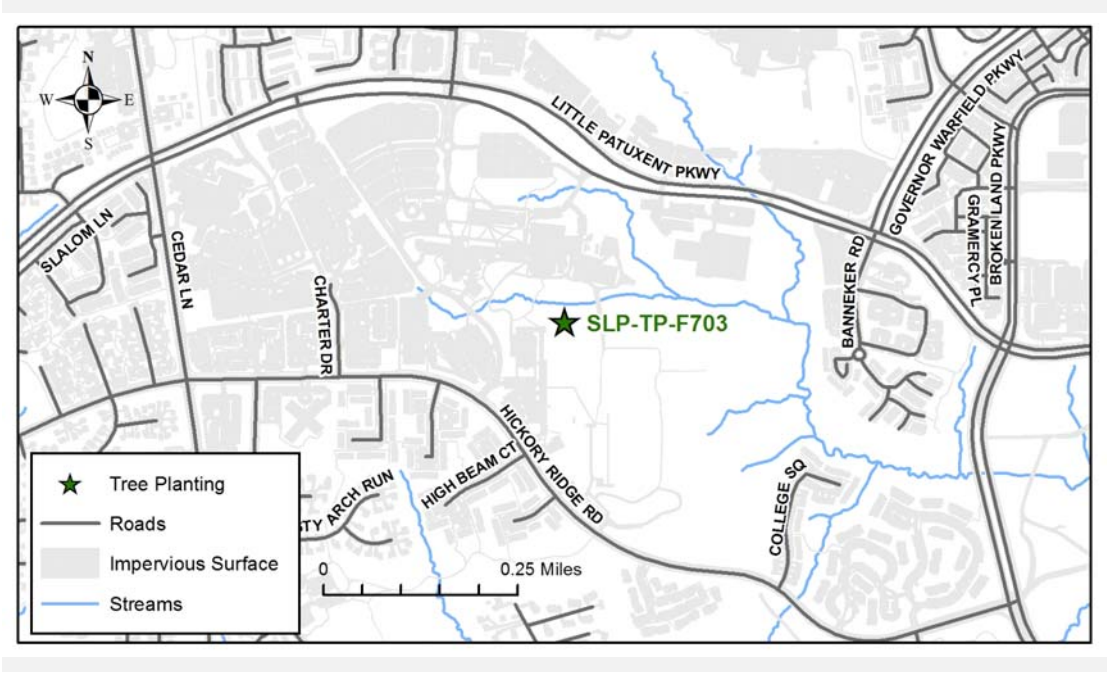
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: Howard Community College
Single Owner

Existing Conditions:

Community college on a large property with three tree planting parcels on its north side, and another tree planting parcel on its south side. The existing wooded parcels are somewhat degraded, and contain large numbers of non-native invasive plant species.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F703
Site Name: Howard Community College
Contractor: Versar
Watershed: Little Patuxent River

View looking northeast into existing wooded area along stream in northern part of the site.

View looking northwest into existing wooded area along stream in northern part of the site.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F703
Site Name: Howard Community College
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Plans for tree planting at the college need to be vetted with Howard Community College, for safety issues, other potential intended land uses, etc. Some steep slopes exist along the existing wetland BMP; these should not be planted with trees. A sewer line passes through a portion of the northern proposed tree planting areas.

Concept Description:

The concept here would be to plant trees along the periphery of the existing wetland BMP, and then along the edges of two degraded wooded areas to its east. The third tree planting parcel exists to the immediate south of the track. The trees could be planted with very little, if any, site preparation. Access to the planting parcel is good. Although somewhat compacted in some areas, the site soils appeared to be suitable for tree planting. Some invasive species removal may be prudent in all three planting parcels.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	5.2
Impervious Area Treated Credit (ac.):	1.96
Cost per Impervious Credit Acre:	$114,408.16

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$164,800.00
30% Contingency:	$49,440.00
Estimated Total Cost:	$224,240.00

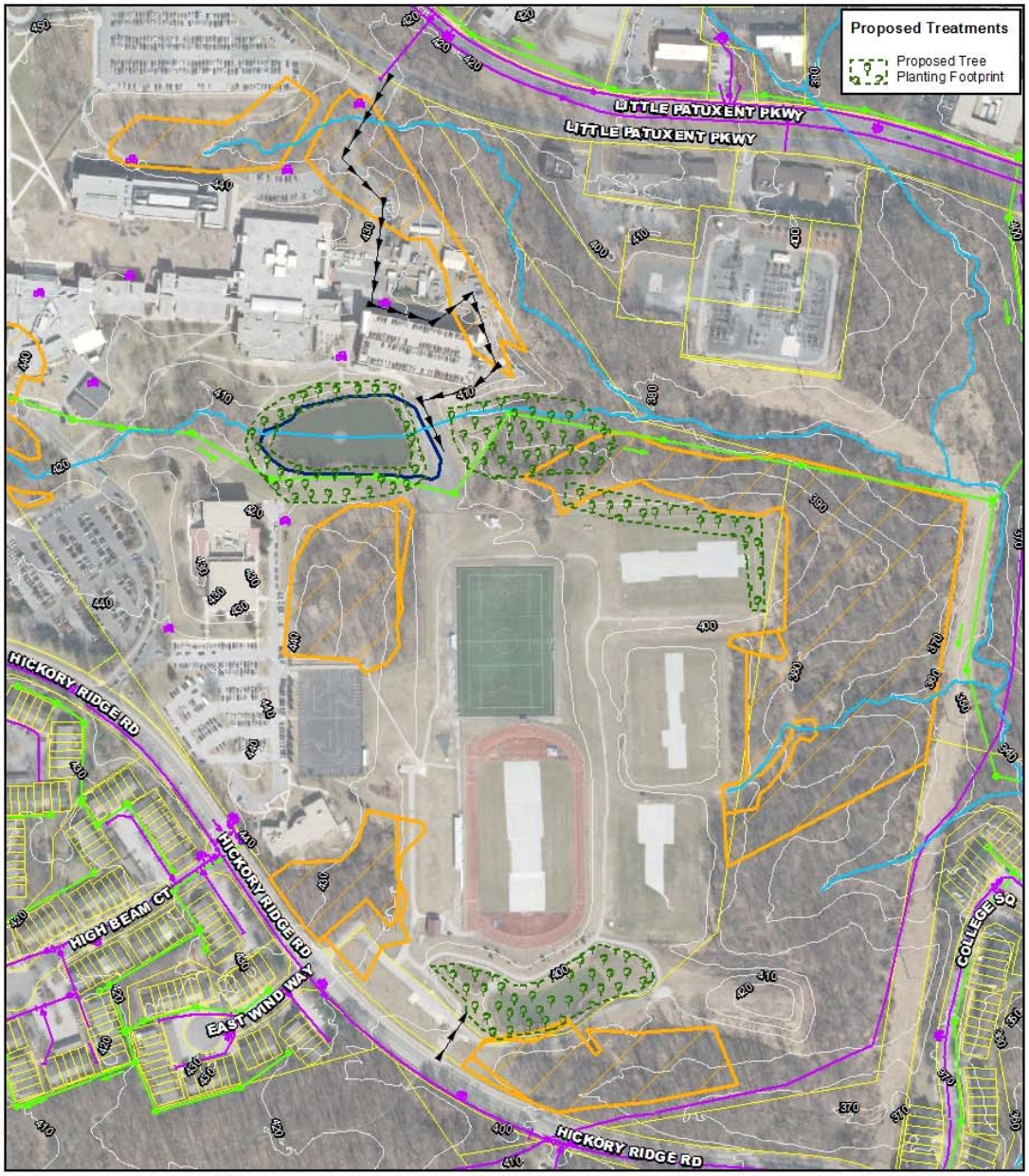
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F703

Site Name: Howard Community College

Contractor: Versar

Watershed: Little Patuxent River



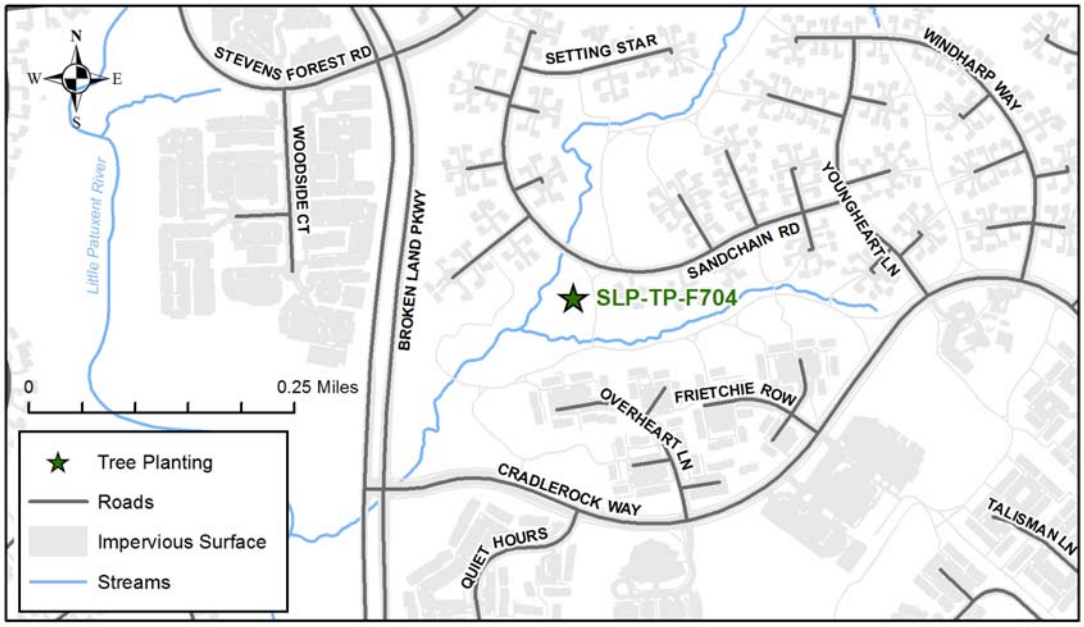
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F704
Site Name: Sand Chain Road
Contractor: Versar
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Columbia Association
Single Owner

Existing Conditions:

Two open, maintained lawn areas along the Columbia Association paths. Parts of the northern parcel likely contains nontidal wetlands.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F704
Site Name: Sand Chain Road
Contractor: Versar
Watershed: Little Patuxent River

View looking southwest through southern-most tree planting parcel. Note broad, rather flat conditions over most of this site.

View looking north through northern-most planting parcel, toward Sandchain Road. Area with small trees along left site of photo likely contains nontidal wetlands.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F704
Site Name: Sand Chain Road
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Plans for tree planting at this site need to be vetted with the Columbia Association, for access issues, other potential intended land uses, etc.

Concept Description:

The concept here would be to plant a mix of native trees in two lawn areas along the Columbia Association path that are currently regularly mowed. The trees could be planted with very little, if any, site preparation. Access to the planting parcel is good, and no utilities appeared to be within the planting areas. Although somewhat compacted in some areas, the site soils appeared to be suitable for tree planting.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	1.4
Impervious Area Treated Credit (ac.):	0.54
Cost per Impervious Credit Acre:	$128,681.48

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$45,760.00
30% Contingency:	$13,728.00
Estimated Total Cost:	$69,488.00

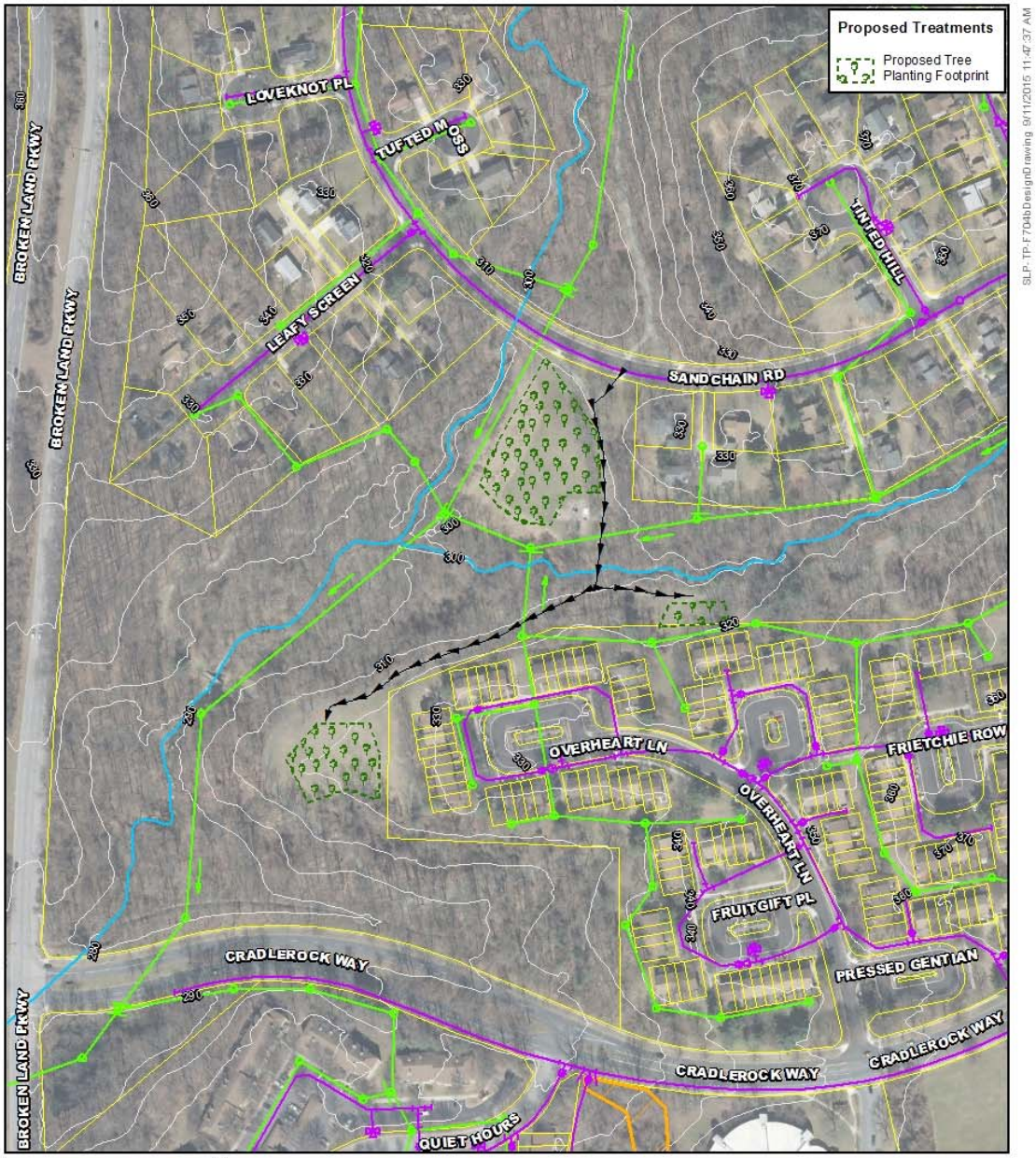
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F704

Site Name: Sand Chain Road

Contractor: Versar

Watershed: Little Patuxent River



Plan-View Design Drawing

Tree Planting - SLP-TP-F704b

Forest Conservation Easement
Proposed Project Access
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Property Boundary

VERSAR

N

60 0 60

Feet

1 inch = 250 Feet

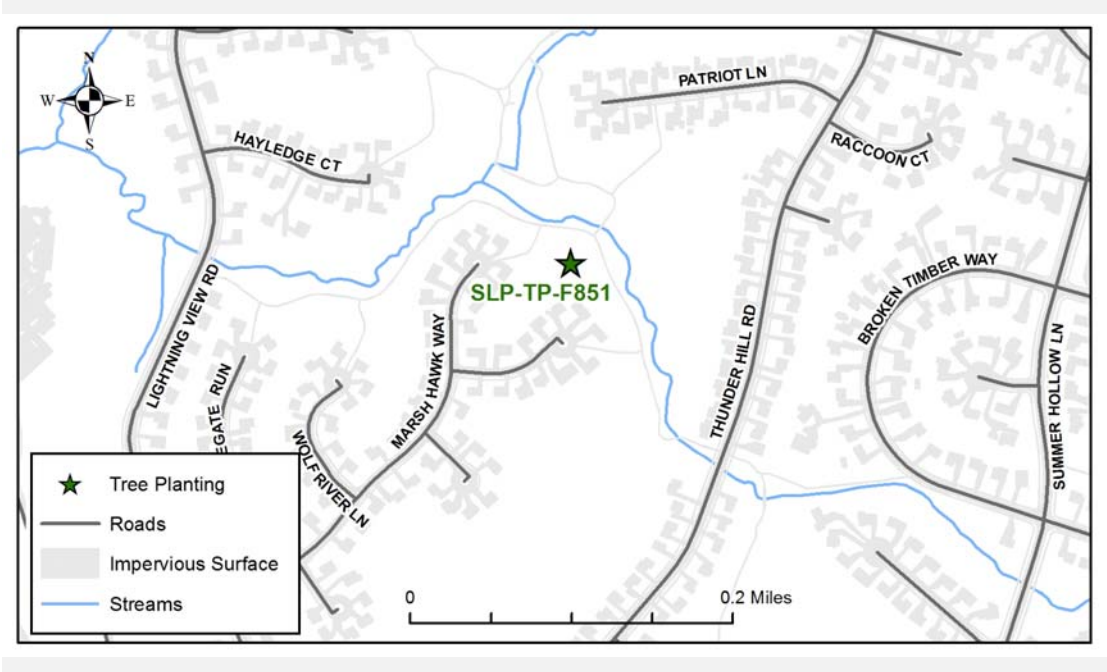
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F851
Site Name: Marsh Hawk Way
Contractor: Versar
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Columbia Association
Single Owner

Existing Conditions:

One open, maintained lawn area along the Columbia Association path at Marsh Hawk Way. The northern-most part of the parcel likely contains nontidal wetlands.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F851

Site Name: Marsh Hawk Way

Contractor: Versar

Watershed: Little Patuxent River

View looking northeast through tree planting parcel. Note broad, rather flat open conditions over most of this site.

View looking south near the southern edge of the tree planting parcel. Note the proximity to the Columbia Association path and the existing houses.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F851
Site Name: Marsh Hawk Way
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Plans for tree planting at this site need to be vetted with the Columbia Association, for access issues, other potential intended land uses, etc. A sewer line passes through the northeastern portion of the proposed planting area.

Concept Description:

The concept here would be to plant a mix of native trees in a large open lawn area along the Columbia Association path that is currently regularly mowed. The trees could be planted with very little, if any, site preparation. Access to the planting parcel is good. Although somewhat compacted in some areas, the site soils appeared to be suitable for tree planting.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	1
Impervious Area Treated Credit (ac.):	0.36
Cost per Impervious Credit Acre:	$137,555.56

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$30,400.00
30% Contingency:	$9,120.00
Estimated Total Cost:	$49,520.00

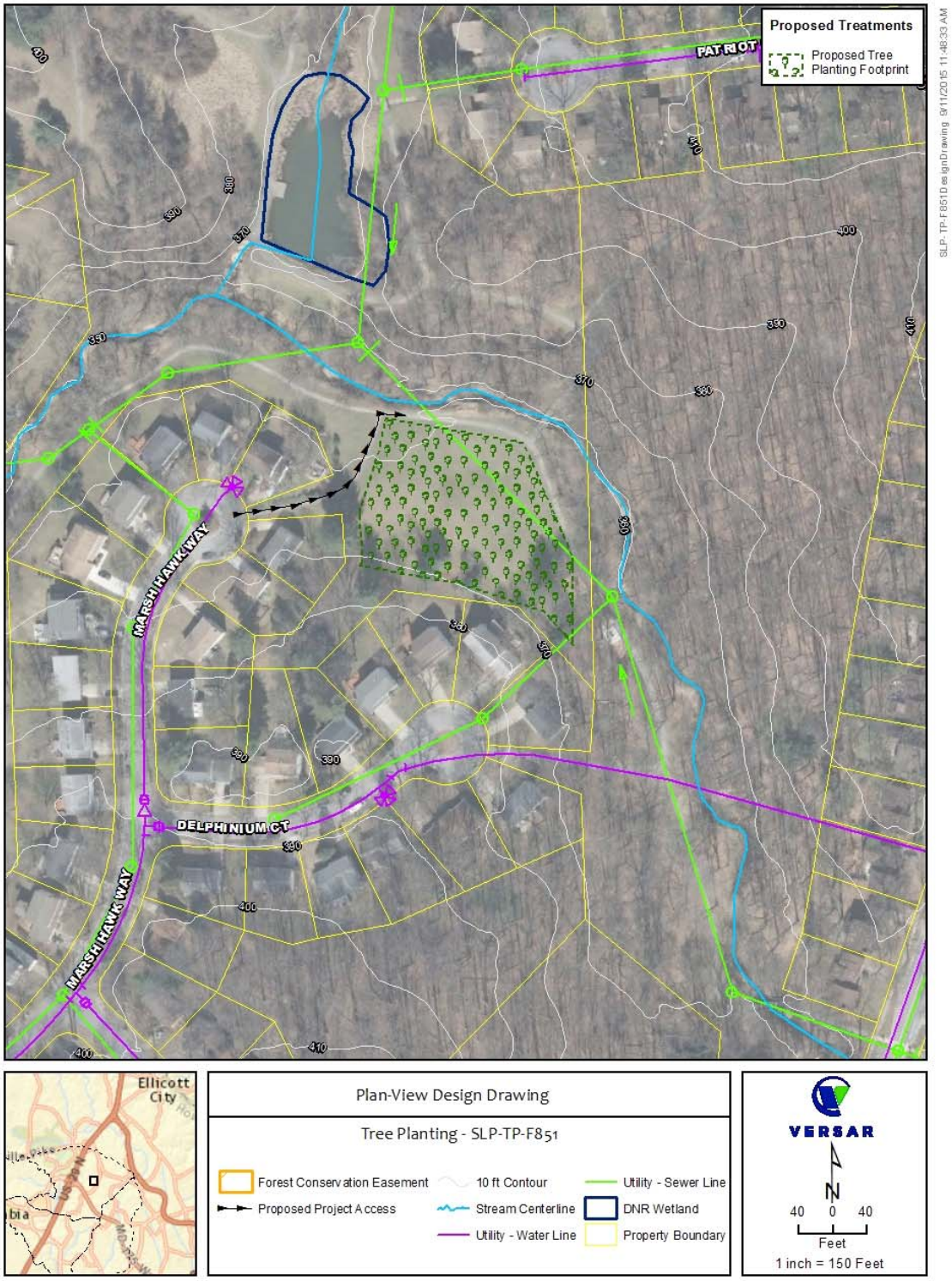
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F851

Site Name: Marsh Hawk Way

Contractor: Versar

Watershed: Little Patuxent River



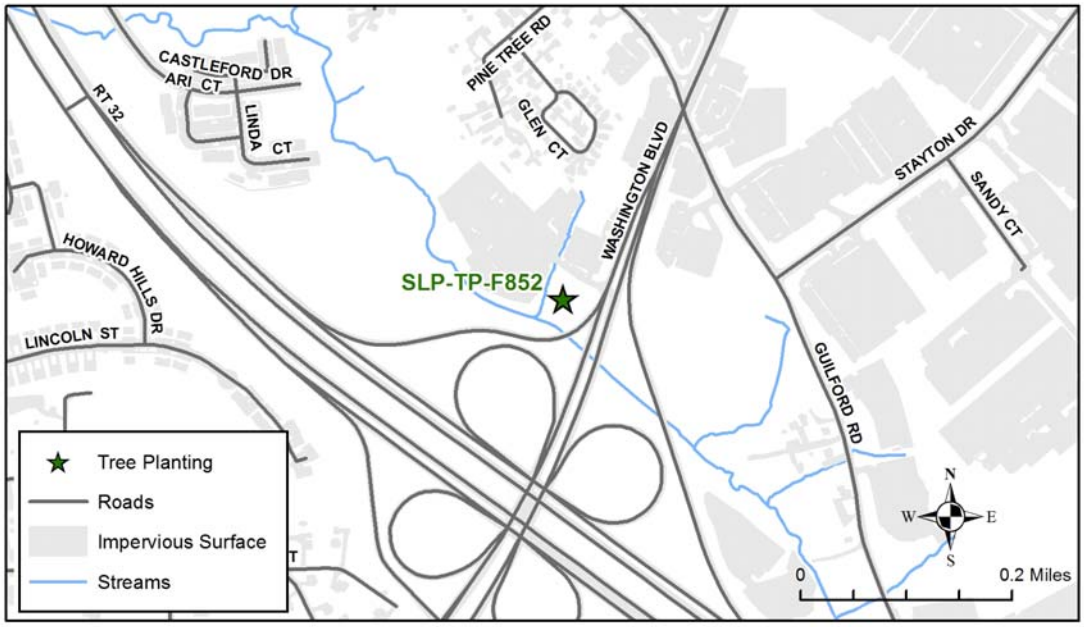
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F852
Site Name: Crossroads Business Park
Contractor: Versar
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

One large open, regularly maintained lawn area on an industrial parcel, next to Route 1. Some recently planted tree saplings are located adjacent to the site and are associated with an existing stream restoration project.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F852
Site Name: Crossroads Business Park
Contractor: Versar
Watershed: Little Patuxent River

View looking west through the tree planting parcel, at some of the existing buildings just off site.

View looking east through the tree planting parcel, toward Route 1, just off site.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SLP-TP-F852
Site Name: Crossroads Business Park
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Plans for tree planting at this site need to be vetted with the private land owner, for access issues, other potential intended land uses, etc. A sewer line passes through the western and southern portions of the proposed tree planting area.

Concept Description:

The concept here would be to plant a mix of native trees on a large open lawn area in this open site that is currently regularly mowed. The trees could be planted with very little, if any, site preparation. Access to the planting parcel is good. Although somewhat compacted in some areas, the site soils appeared to be suitable for tree planting.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	0.7
Impervious Area Treated Credit (ac.):	0.26
Cost per Impervious Credit Acre:	$145,661.54

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$21,440.00
30% Contingency:	$6,432.00
Estimated Total Cost:	$37,872.00

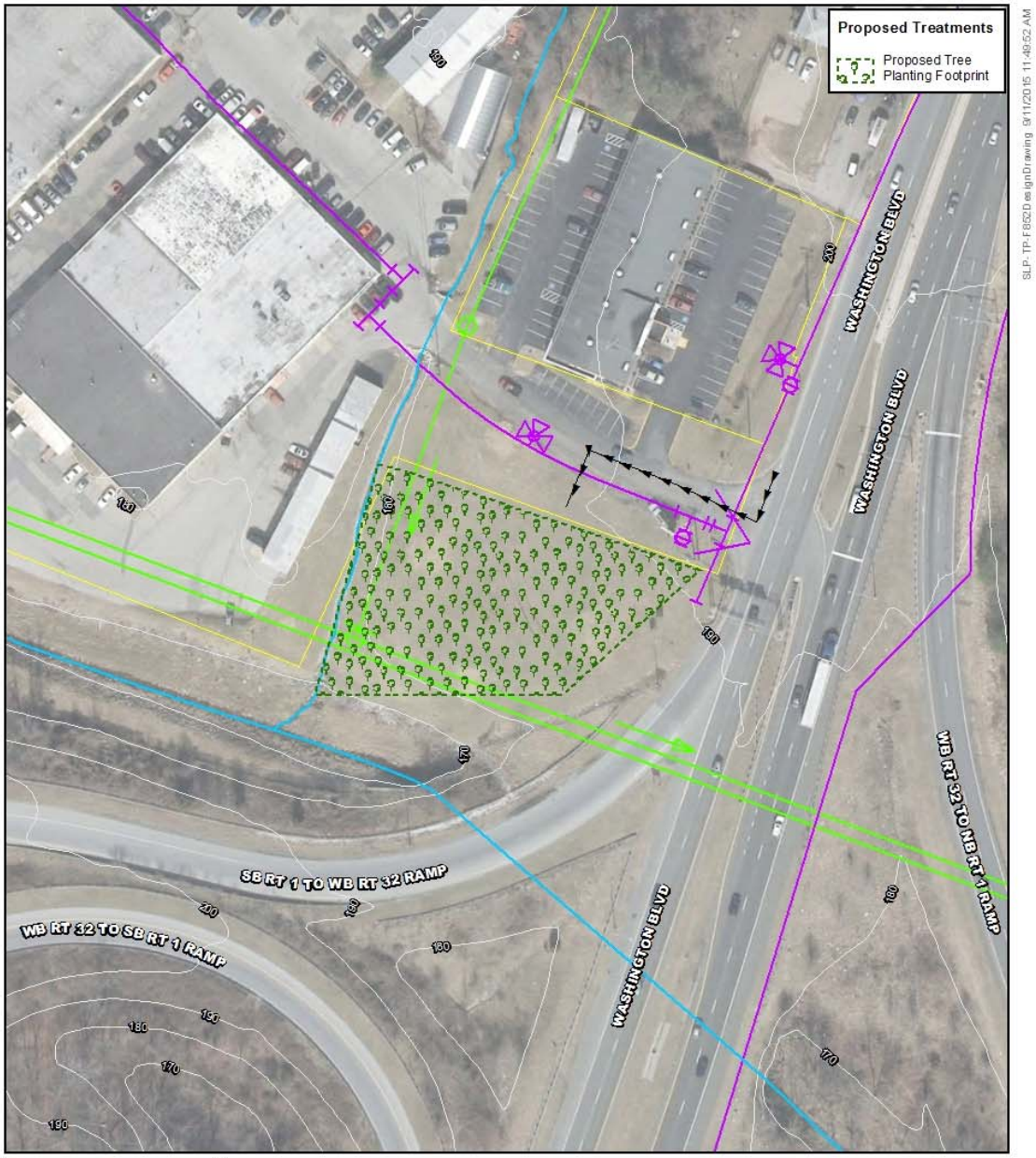
Howard County Watershed Assessment Concept Plan: Tree Planting

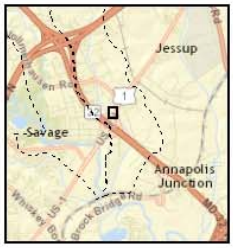
Site ID: SLP-TP-F852

Site Name: Crossroads Business Park

Contractor: Versar

Watershed: Little Patuxent River





Plan-View Design Drawing

Tree Planting - SLP-TP-F852

Forest Conservation Easement
Proposed Project Access
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Property Boundary

VERSAR

N

25 0 25

Feet

1 inch = 100 Feet

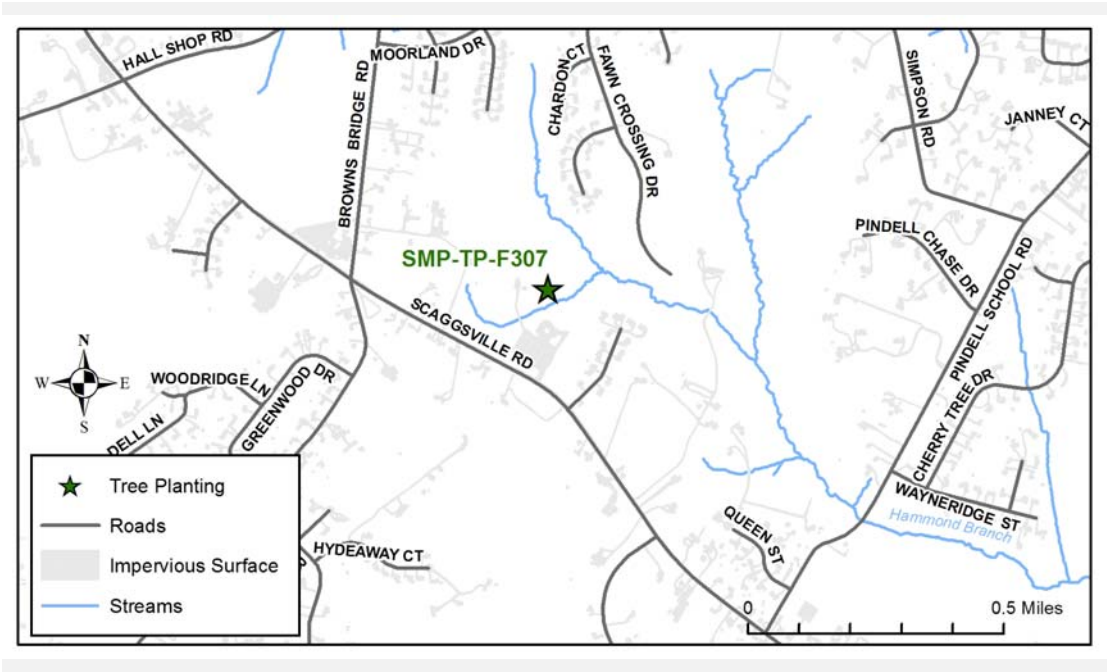
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F307
Site Name: Temple Isaiah
Contractor: Biohabitats
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Mixed Use
Single Owner

Existing Conditions:

The site is the Temple Isaiah. Approximately a third of the property is occupied by the church, a house, and parking lots while the remainder of the property is open space and forest. The current vegetation cover is 50% trees, 25% turf, and 25% other herbaceous plants. Existing forest conservation easements are also present on the site. There is also evidence of recent tree plantings in the northern-most portion of the site. Forest consisting of southern red oak (Quercus falcata), white oak (Quercus alba), and maples (Acer sp.) is adjacent to the site to the north and east. Multiflora rose (Rosa multiflora) is also present in the adjacent forest covering roughly 5%. The site is located in an upland landscape with non-compacted and loamy textured soil. The regional forest association, which indicates the climax or dominant species for an area, is Appalachian Oak.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F307
Site Name: Temple Isaiah
Contractor: Biohabitats
Watershed: Little Patuxent River

Western portion of tree planting area wrapping around the main parking lot and building looking north.

Eastern portion of tree planting area wrapping around the main parking lot and building looking south towards Scaggsville Road.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F307
Site Name: Temple Isaiah
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints at the site include current mowing practices and wildlife (i.e. deer). In addition, space for proposed planting areas at the site is limited by existing forest conservation easements and other previous tree plantings.

Concept Description:

The proposed project consists of two tree planting areas totaling 6.57 ac. One 2.91 ac. planting area is located on the southern portion of the site wrapping around three sides of a large parking lot and around the side of the main temple facility. This area is currently maintained as mowed turf. A second 3.66 ac. planting area is located on the northern portion of the site surrounding a house associated with the temple. The second planting areas is currently maintained as mowed turf with a few groupings of trees.

The proposed planting areas receive full sun. There is also no evidence at the proposed tree planting areas of erosion, contamination or debris. While some stormwater from the parking lot bypasses the southern planting area site via piping, there is sheet flow to the southern planting area from the adjacent parking lot. No stormwater runoff was observed to be directed toward the northern tree planting area.

The site provides access for delivery, temporary storage, as well as foot, vehicle, and heavy equipment traffic. The project has possible educational potential due to its location on a temple property.

Potential water sources for the proposed tree planting project include rainfall, stormwater runoff, nearby hose hook up, and tanker water delivery. Medium site preparation would be required, primarily consisting of invasives removal of multiflora rose which covers approximately 5% of the planting areas.

The concept proposes planting a mix of native tree species saplings. Deer are active in the area; therefore, newly planted trees would need to be protected from potential wildlife impacts using appropriate fencing, tree protectors, repellents, etc. The existing trees within the planting areas could be preserved as long as trees are healthy and not an invasive species. A few existing trees noted for preservation surrounding the house included pin oak (Quercus palustris), white pine (Pinus strobus), cedar (Cedrus sp.) and hickory (Carya sp.).

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	6.6
Impervious Area Treated Credit (ac.):	2.5
Cost per Impervious Credit Acre:	$113,324.80

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$210,240.00
30% Contingency:	$63,072.00
Estimated Total Cost:	$283,312.00

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F307

Site Name: Temple Isaiah

Contractor: Biohabitats

Watershed: Little Patuxent River

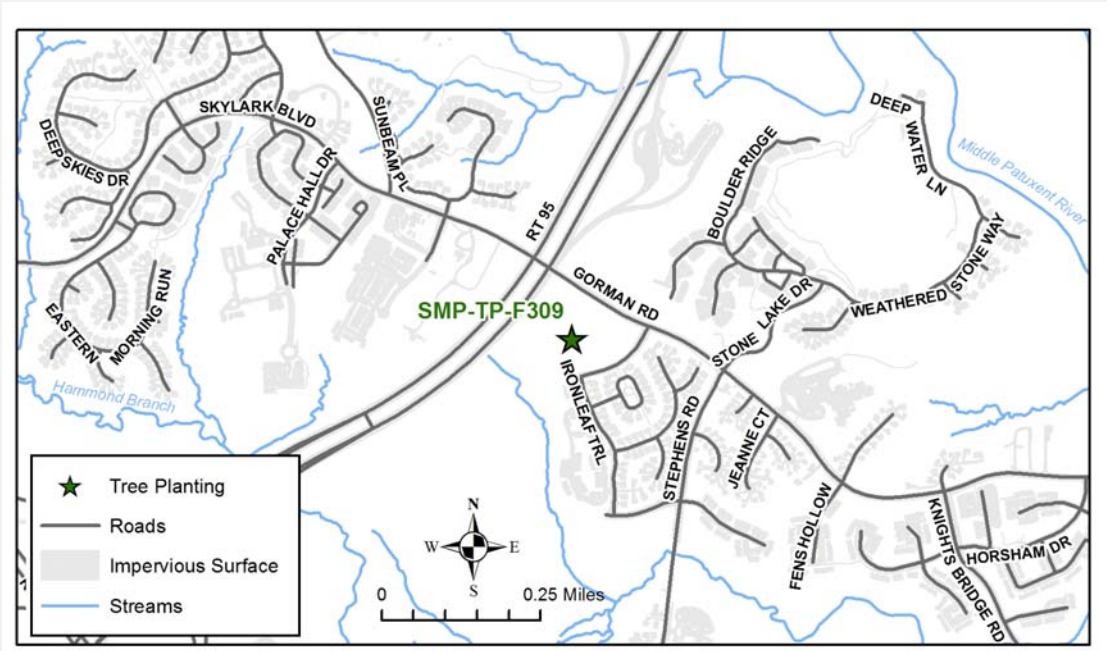
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F309
Site Name: Eternal Rings Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Project Type: Tree Planting
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The site is a privately owned vacant lot. At the time of assessment a sign for leasing commercial space was present. The current vegetative cover is 20% trees and 80% other herbaceous plants. Existing forest conservation easements are present at the site. Forest consisting of red maple (Acer rubrum) is adjacent to the site to the west and southwest. The adjacent forest is 75% covered with invasive species including mile-a-minute (Persicaria perfoliata), Japanese honeysuckle (Lonicera japonica), multiflora rose (Rosa multiflora), and Japanese stiltgrass (Microstegium vimineum). The site is located in an upland landscape with non-compacted and loamy textured soil. The regional forest association, which indicates the climax or dominant species for an area, is Appalachian Oak.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F309
Site Name: Eternal Rings Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Tree planting area adjacent to Eternal Rings Road looking northeast. Eternal Rings Road is on the right.

Tree planting area looking north towards Gorman Road.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F309
Site Name: Eternal Rings Road
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints at the site include current mowing practices and wildlife (i.e. deer). In addition, the site is a privately owned, commercial vacant land that could have plans for development.

Concept Description:

The proposed project consists of one tree planting area that is 11.1 ac. The planting area is currently a vacant lot that is mowed periodically.

The proposed planting area receives full sun and high wind exposure is present. There are no steep slopes (greater the 15%) or low lying areas within the planting area. There is also no evidence of erosion, contamination or debris within the proposed planting area. Stormwater runoff is directed across the planting area via an open channel or drainage swale located in the southern portion of the site.

The site provides access for delivery, temporary storage, as well as foot, vehicle, and heavy equipment traffic. The project has possible educational potential due to its location near the entrance of and adjacent to a residential community.

Potential water sources for the proposed tree planting project include rainfall, nearby hydrant hook up, and tanker water delivery. No site preparation would be required because the tree planting area is periodically mowed with no invasives present.

The concept proposes planting a mix of native tree species saplings. Deer are active in the area; therefore, newly planted trees would need to be protected from potential wildlife impacts using appropriate fencing, tree protectors, repellents, etc.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	11
Impervious Area Treated Credit (ac.):	4.22
Cost per Impervious Credit Acre:	$111,890.05

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$355,520.00
30% Contingency:	$106,656.00
Estimated Total Cost:	$472,176.00

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F309

Site Name: Eternal Rings Road

Contractor: Biohabitats

Watershed: Little Patuxent River

Howard County Watershed Assessment Concept Plan: Tree Planting

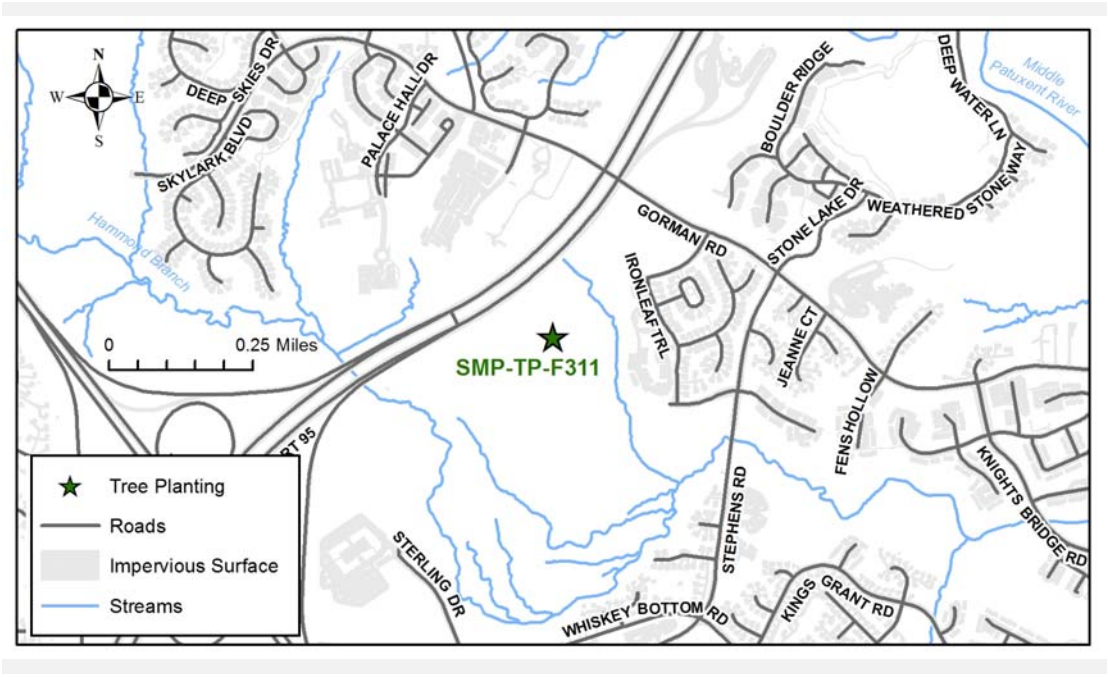
Site ID: SMP-TP-F311
Site Name: Northern Lakes
Contractor: Biohabitats
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The site is a privately owned vacant lot. The current vegetative type is 25% trees and 75% other herbaceous plants. Forest consisting of red maple (Acer rubrum), black walnut (Juglans nigra), and tulip poplar (Liriodendron tulipifera) is adjacent to the site. The adjacent forest is 75% covered with invasive species including Japanese honeysuckle (Lonicera japonica) and Japanese stilt grass (Microstegium vimineum). The site is located in an upland landscape with non-compacted and loamy textured soil. The regional forest association, which indicates the climax or dominant species for an area, is Appalachian Oak.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F311
Site Name: Northern Lakes
Contractor: Biohabitats
Watershed: Little Patuxent River

Northern tree planting area looking east towards Northern Lakes Lane.

Southern tree planting area looking south toward power lines.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F311
Site Name: Northern Lakes
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints at the site include current mowing practices and wildlife (i.e. deer). In addition, the property is privately owned with limited access due to existing utilities and distance from a main road.

Concept Description:

The proposed project consists of two tree planting areas totaling 20.12 ac. One 16.27 ac. planting area is located on the northern portion of the site and another 3.85 ac. planting areas is located on the southern portion of the site. The two areas are mostly separated by existing forest. The proposed planting areas appear to be periodically mowed. Existing forest conservation areas are also present along various portions of the proposed planting areas. The proposed project includes tree planting in portions of existing forest conservation areas that are not currently planted.

The proposed planting area receives full sun and a high wind exposure is present. There are no steep slopes (greater the 15%) or low lying areas. There is no evidence at the site of erosion, contamination, or debris within the planting area. Stormwater is directed to the planting areas through shallow concentrated overland flow such as rills.

A BGE electric transmission line and right-of-way borders the southern planting area and could provide access to the planting site. The BGE right of way can be accessed 0.4 miles east of the site at Stephens Road. This access would allow for delivery, temporary storage, as well as vehicle and heavy equipment traffic. Foot traffic would be limited due to the distance from Stephens Road to the site. The project doesn't have educational potential due to its more remote location. Alternate site access from Northern Lakes Lane would require crossing a stream and from I-95 would likely require a traffic control plan.

Potential water sources for the proposed tree planting project is limited to rainfall and tanker water delivery. No site preparation would be required because tree planting areas are periodically mowed with no invasives present.

The concept proposes planting a mix of native tree species saplings. Deer are active in the area; therefore, newly planted trees would need to be protected from potential wildlife impacts using appropriate fencing, tree protectors, repellents, etc. Existing trees within the planting areas could be preserved as long as trees are healthy and not an invasive species.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Planting Acres:	20
Impervious Area Treated Credit (ac.):	7.65
Cost per Impervious Credit Acre:	$110,717.91

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$643,840.00
30% Contingency:	$193,152.00
Estimated Total Cost:	$846,992.00

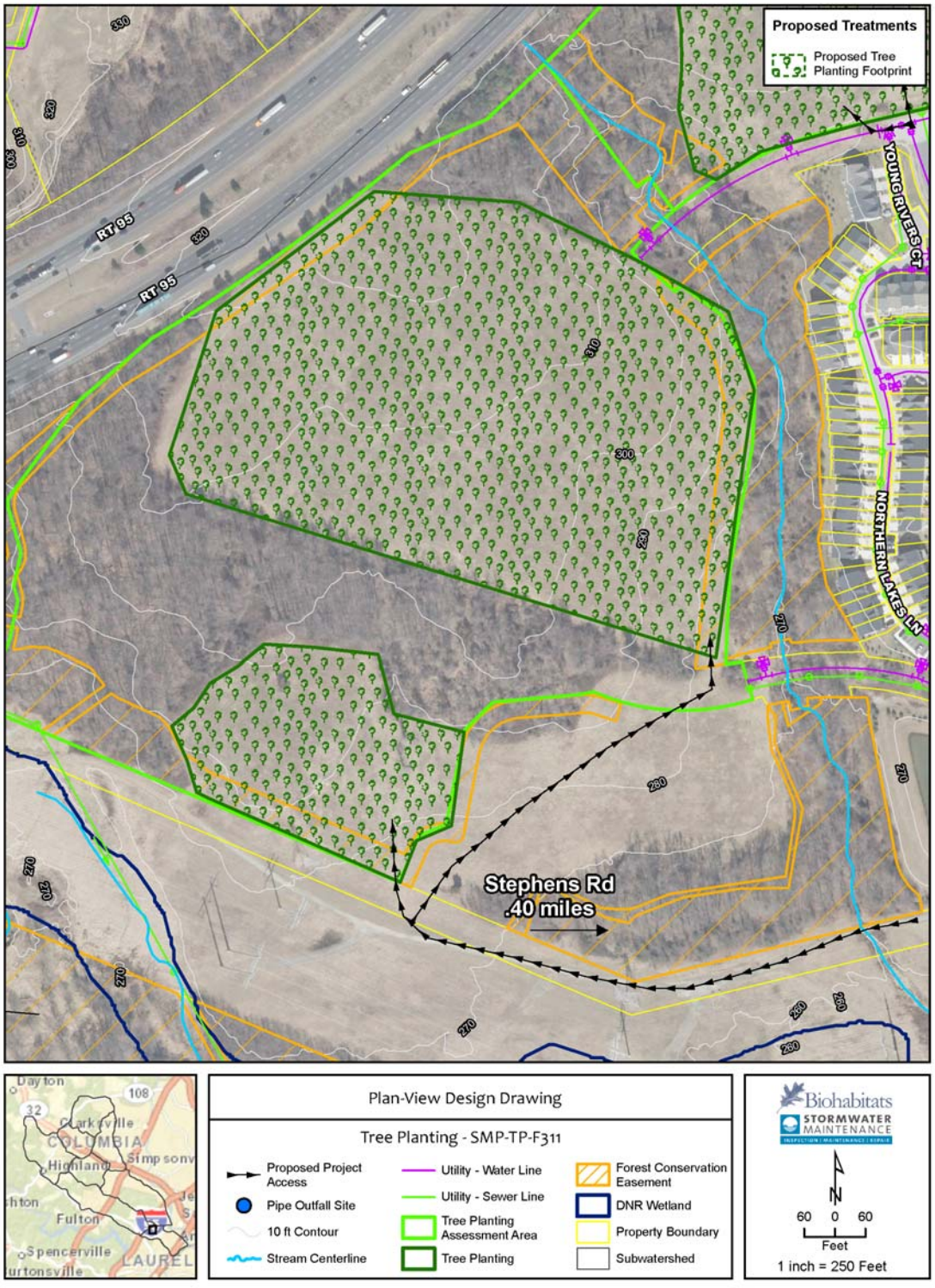
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F311

Site Name: Northern Lakes

Contractor: Biohabitats

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F405

Site Name: Hammond Branch at Hammond Drive

Contractor: Biohabitats

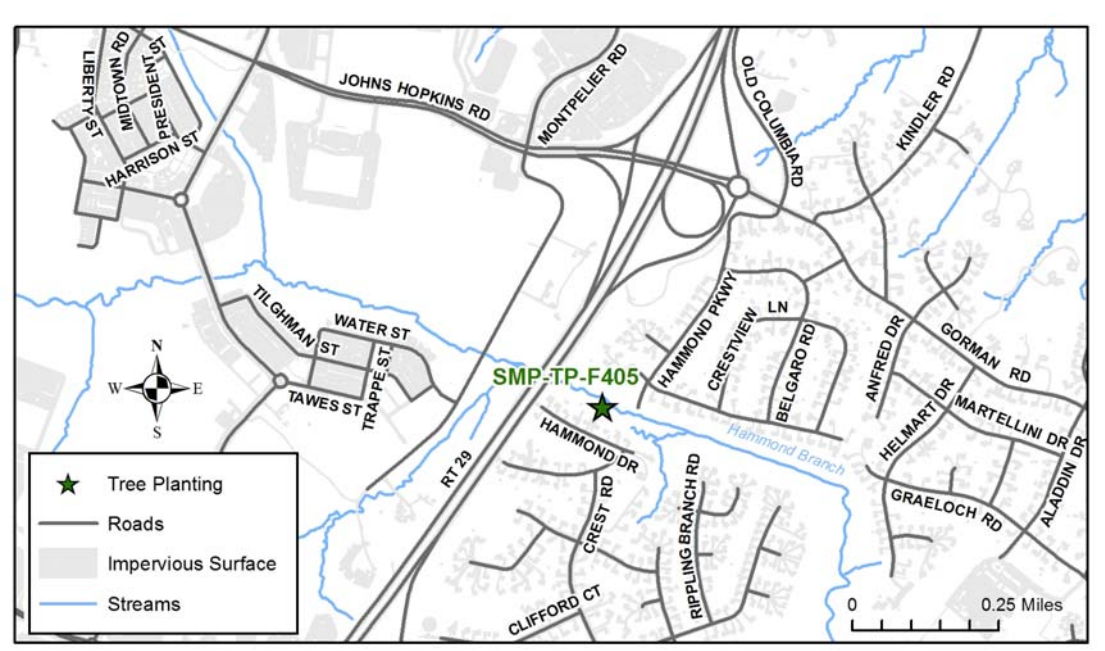
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: County Owned
Single Owner

Existing Conditions:

The site is a county owned right-of-way adjacent to Hammond Branch. Portions of the site are being managed by adjacent homeowners while the remaining portion of the site is an unmaintained riparian buffer. The current vegetative cover is 60% trees, 30% other herbaceous plants, and 10% turf. Forest consisting of red maple (Acer rubrum), tulip poplar (Liriodendron tulipifera), sycamore (Platanus occidentalis), and silver maple (Acer saccharinum) is present adjacent to the site. The adjacent forest is roughly 45% covered with invasive species including multiflora rose (Rosa multiflora), Japanese honeysuckle (Lonicera japonica), English ivy (Hedera helix), and garlic mustard (Alliaria petiolata). The site is located within the riparian buffer of Hammond Branch with non-compacted and loamy textured soil. The average bank height along the stream is currently 4 ft. with limited floodplain connection. The regional forest association, which indicates the climax or dominant species for an area, is Appalachian Oak.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F405

Site Name: Hammond Branch at Hammond Drive

Contractor: Biohabitats

Watershed: Little Patuxent River

Tree planting area bounded by Hammond Branch on the left with residences to the right looking southeast.

Tree planting area looking northwest with residences to the left and Hammond Branch to the right.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F405
Site Name: Hammond Branch at Hammond Drive
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints at the site include encroachment from adjacent homeowners, wildlife (i.e. deer), underground utilities such as sanitary sewer and fiber optics and access only available via private property.

Concept Description:

The proposed project consists of one tree planting area that is 1.07 ac. The planting area is confined within the riparian buffer between Hammond Branch and the adjacent residential properties. A restoration project is recommended for the segment of Hammond Branch flowing through the site, and concurrent implementation of the tree planting and stream restoration projects should be explored. The proposed planting project would also serve to enhance the riparian buffer of the stream.

The site receives partial sun due to existing tree cover. There are low lying areas consisting of floodplain depressions throughout the planting area. There is no evidence at the planting area of erosion, contamination, or debris. Approximately 30% of the planting area is covered with invasive species including multiflora rose (Rosa multiflora), English ivy (Hedera helix), garlic mustard (Alliaria petiolata), and Japanese honeysuckle (Lonicera japonica). Stormwater runoff from the upslope drainage area is directed to the planting area via a 14 in. outfall pipe. In addition, the site also receives stormwater runoff via sheet flow over the pervious, turf surfaces as a result of sloping topography within the planting area.

The site provides access for delivery, temporary storage, as well as foot and vehicle traffic. However, heavy equipment access is not possible and all access would require crossing private residential properties. The project has minimal educational potential due to the site being adjacent to private properties, thus limiting exposure and access to the public. Potential water sources for the proposed tree planting project are limited to rainfall. Some site preparation would be required including minor invasives removal. The concept proposes planting a mix of native tree species saplings. Deer are active in the area; therefore, newly planted trees would need to be protected from potential wildlife impacts using appropriate fencing, tree protectors, repellents, etc. The existing trees within the planting area could be preserved as long as trees are healthy and not an invasive species.

Nearby Opportunities:

SMP-SR-F335

Proposed Project Credit		Costs	
Planting Acres:	1.1	Estimated Design Cost:	$10,000.00
Impervious Area Treated Credit (ac.):	0.41	Estimated Construction Cost:	$34,240.00
		30% Contingency:	$10,272.00
Cost per Impervious Credit Acre:	$132,956.10	Estimated Total Cost:	$54,512.00

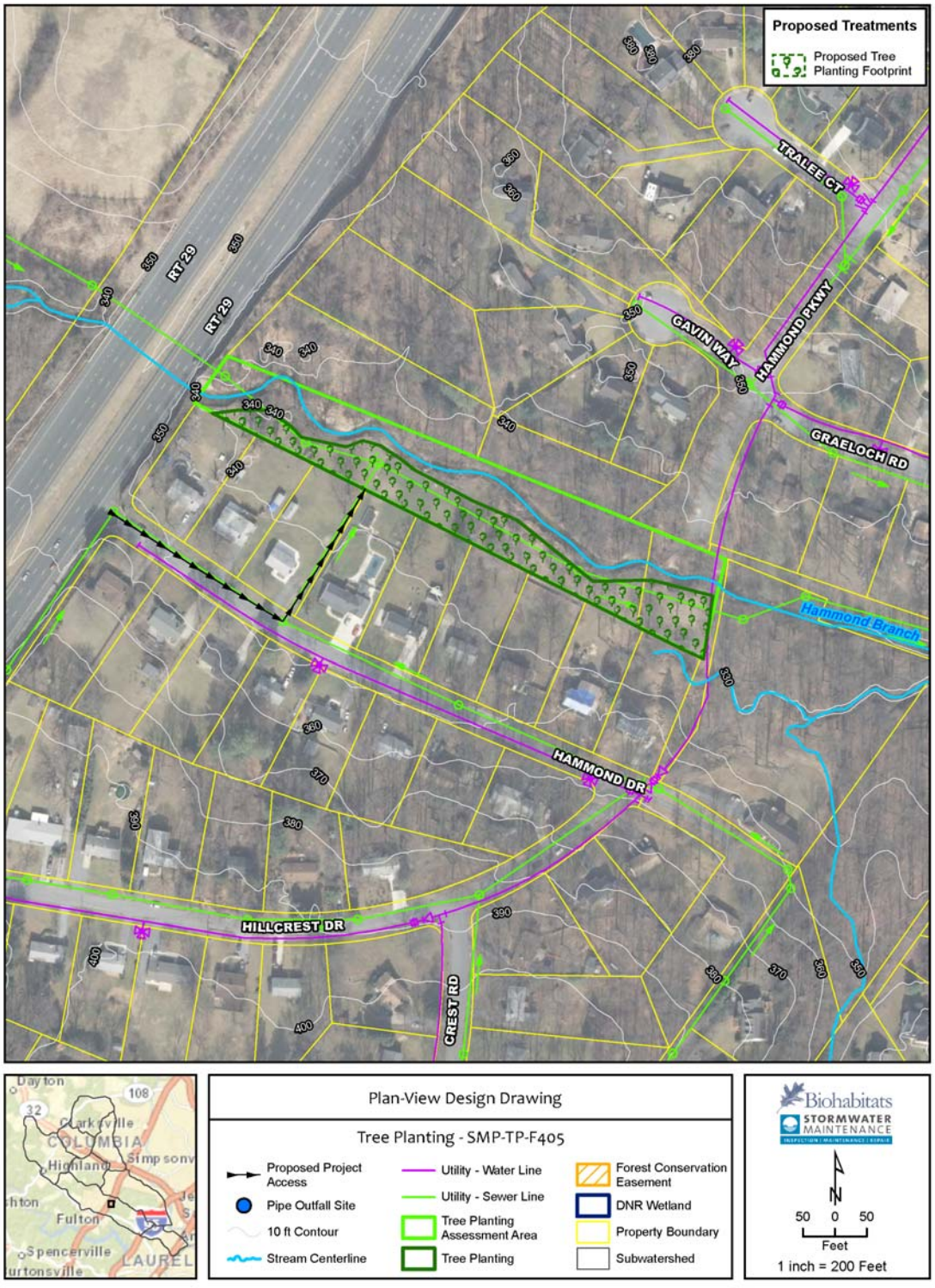
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F405

Site Name: Hammond Branch at Hammond Drive

Contractor: Biohabitats

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F406

Site Name: Hammond Branch at Maple Lawn

Contractor: Biohabitats

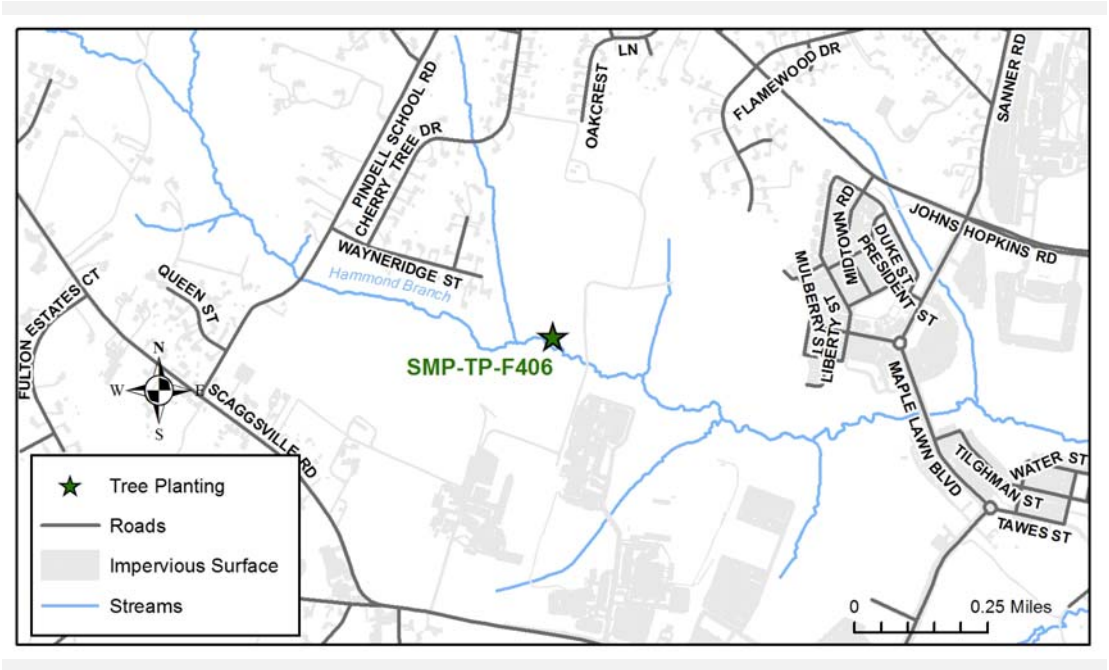
Watershed: Little Patuxent River

Project Type: Tree Planting

Ownership: Private- Residential
Single Owner

Existing Conditions:

The site is a vacant area located between Hammond Branch and a stormwater management pond. While there is no Maryland State Department of Assessments and Taxation (SDAT) account ID associated with the parcel, the parcel appears to be contained within a larger tract of land owned by Maple Lawn Farms, Inc. The current vegetative cover is 90% other herbaceous plants and 5% trees, and 5% bare ground. Forest consisting of tulip poplar (Liriodendron tulipifera) and red maple (Acer rubrum) is present adjacent to the site. The adjacent forest is roughly 10% covered with the invasive species including multiflora rose (Rosa multiflora). The site is located within the riparian buffer of Hammond Branch with moderately compacted and loamy textured soil. The average bank height along the stream is currently 2 ft. with frequent floodplain connection. The regional forest association, which indicates the climax or dominant species for an area, is Appalachian Oak.



Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F406

Site Name: Hammond Branch at Maple Lawn

Contractor: Biohabitats

Watershed: Little Patuxent River

Tree planting area looking east. Riprap lined outfall from stormwater pond to the left visible in foreground.

Tree planting area looking east adjacent to Hammonds Branch. Power lines visible to the right.

Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F406
Site Name: Hammond Branch at Maple Lawn
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Constraints at the site include 100 ft. overhead wires, wildlife (i.e. deer), presence of wetlands, and close proximity of a stormwater management pond with a silt fence. Private ownership of the site could also result in a constraint.

Concept Description:

The proposed project consists of one tree planting area that is 3.84 ac. The planting area encompasses Hammond Branch and is confined to the north by a stormwater management pond. The proposed planting area does not appear to be maintained. Existing forest conservation areas, associated with the nearby Maple Lawn residential development, are present covering portions of the proposed planting areas. The proposed project includes planting trees in portions of existing forest conservation areas that are not currently planted. A restoration project is recommended for Hammond Branch within the vicinity of the planting area, and concurrent implementation of the tree planting and stream restoration projects should be explored. The proposed planting project would also serve to enhance the riparian buffer of the stream.

The planting area receives full sun and low lying areas consisting of floodplain depressions are present. There is no evidence of erosion, contamination, or debris within the proposed planting area. However, there is recent and on-going construction nearby which appears to be associated with residential development. Approximately 5% of the planting area is covered with invasive species including multiflora rose (Rosa multiflora). Stormwater runoff from a stormwater management pond is directed to the planting area via a 36 in. outfall pipe. In addition, the site also receives stormwater runoff via sheet flow over pervious, herbaceous surfaces as a result of sloping topography within the planting area. The site provides access for delivery, temporary storage, as well as foot, vehicle, and heavy equipment traffic. The project has minimal educational potential due to the site being adjacent to a residential development, thus limiting exposure and access to the public. Potential water sources for the proposed tree planting project include rainfall, stormwater runoff, overbank flows during storm events from the adjacent stream and tanker water delivery. Minimal site preparation would be required including minor invasives removal. The concept proposes planting a mix of native tree species saplings. Deer are active in the area; therefore, newly planted trees would need to be protected from potential wildlife impacts using appropriate fencing, tree protectors, repellents, etc. The existing trees within the planting area could be preserved as long as trees are healthy and not an invasive species.

Nearby Opportunities:

SMP-SR-F338

Proposed Project Credit	
Planting Acres:	3.8
Impervious Area Treated Credit (ac.):	1.46
Cost per Impervious Credit Acre:	$116,263.01

Costs	
Estimated Design Cost:	$10,000.00
Estimated Construction Cost:	$122,880.00
30% Contingency:	$36,864.00
Estimated Total Cost:	$169,744.00

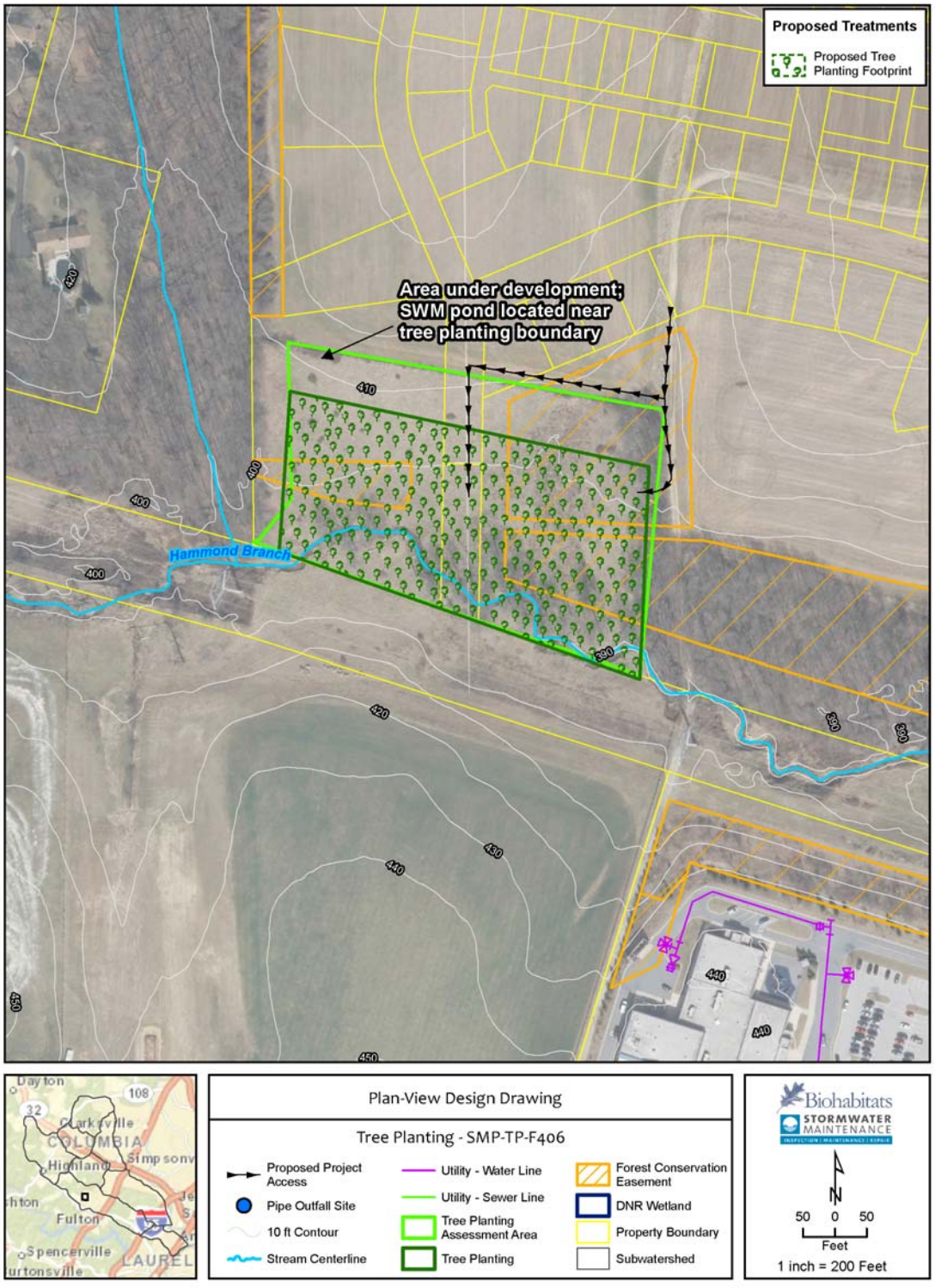
Howard County Watershed Assessment Concept Plan: Tree Planting

Site ID: SMP-TP-F406

Site Name: Hammond Branch at Maple Lawn

Contractor: Biohabitats

Watershed: Little Patuxent River



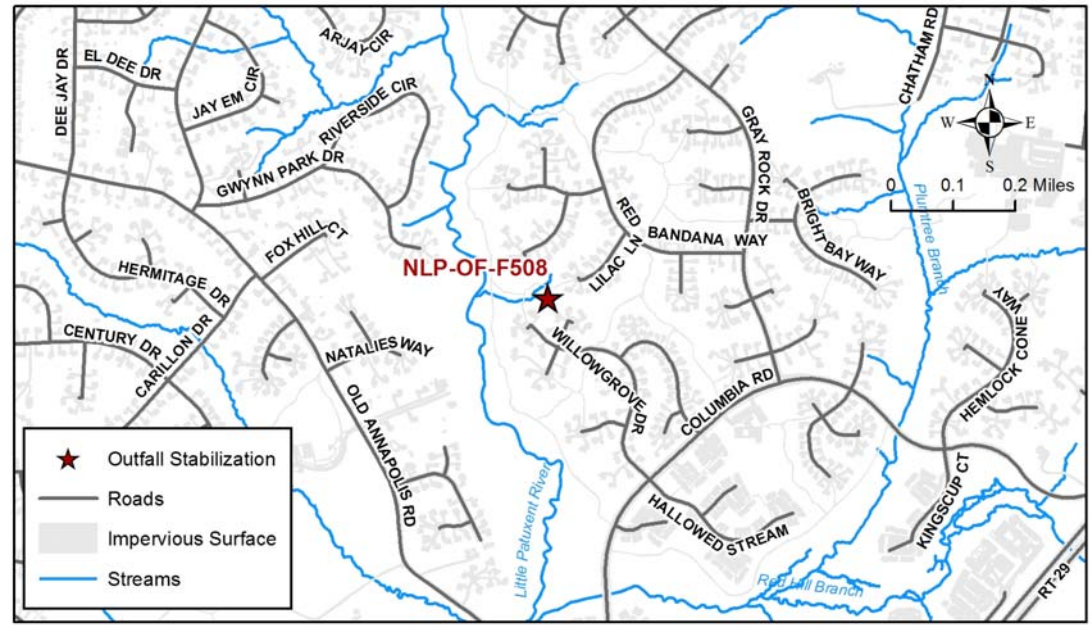
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F508
Site Name: Lilac Ln
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Step Pool Storm Conveyance
Ownership: Columbia Association
Single Owner

Existing Conditions:

The proposed outfall stabilization begins at a stormwater outfall from Lilac Lane with no existing stormwater treatment. The reach is situated south of the walking trail. The reach is approximately 650 lf. from the outfall to the confluence with the Little Patuxent River. Several headcuts, up to 3 ft. in height, were observed immediately downstream of the outfall, with failing riprap displaced along the channel. Banks are approximately 6.5 ft. high and are composed of very fine silty material that is easily erodible. Approximately 20 lf. along the left bank is severely eroded downstream of the headcuts. Near bank stress appears to be moderate; however, no bankfull indicators occur along the channel. This outfall is located within Columbia Association property, where the sewer easement and walking trail may provide good access.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F508
Site Name: Lilac Ln
Contractor: KCI
Watershed: Little Patuxent River

Facing upstream towards outfall, displaced riprap and eroded banks.

Facing upstream towards headcuts and debris jams.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F508
Site Name: Lilac Ln
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:
There is one utility pipe present across the outfall channel. The proposed construction should avoid impacting it. There are specimen tree impacts anticipated.

Concept Description:
A Step Pool Storm Conveyance (SPSC) is proposed for this reach due to the steep elevation gradient over a short distance of approximately 100 ft. The proposed SPSC begins at the outfall and continues for approximately 100 ft. downstream. The SPSC includes four riffle weirs with 30 ft. width and 8 ft. length, and four pools with 30 ft. width, 3 ft. depth, and 17 ft. length. The SPSC will treat more than 1 in. of rainfall and safely convey the 100 yr. flow. However, because of the diminishing credit returns on treatment over 1 in. of rainfall, it may be feasible to cut costs by reworking the SPSC design to bring the rainfall depth treated closer to the targeted 1 in. depth.

Nearby Opportunities:
None recommended

Proposed Project Credit	
Drainage Area (ac.):	15.11
Impervious Area within Drainage (ac.):	2.78
Impervious Area Treated (ac.):	3.89
Impervious Area Treated Credit (ac.):	3.89

Water Quality Volume	
WQVolume Target (cf.):	11,825
Max Treated (cf.):	43,838
Percent Treated:	370%
Rainfall Depth Treated (in.):	2.6

Costs

Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30 % Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00
Cost per Impervious Credit Acre:	$59,125.96

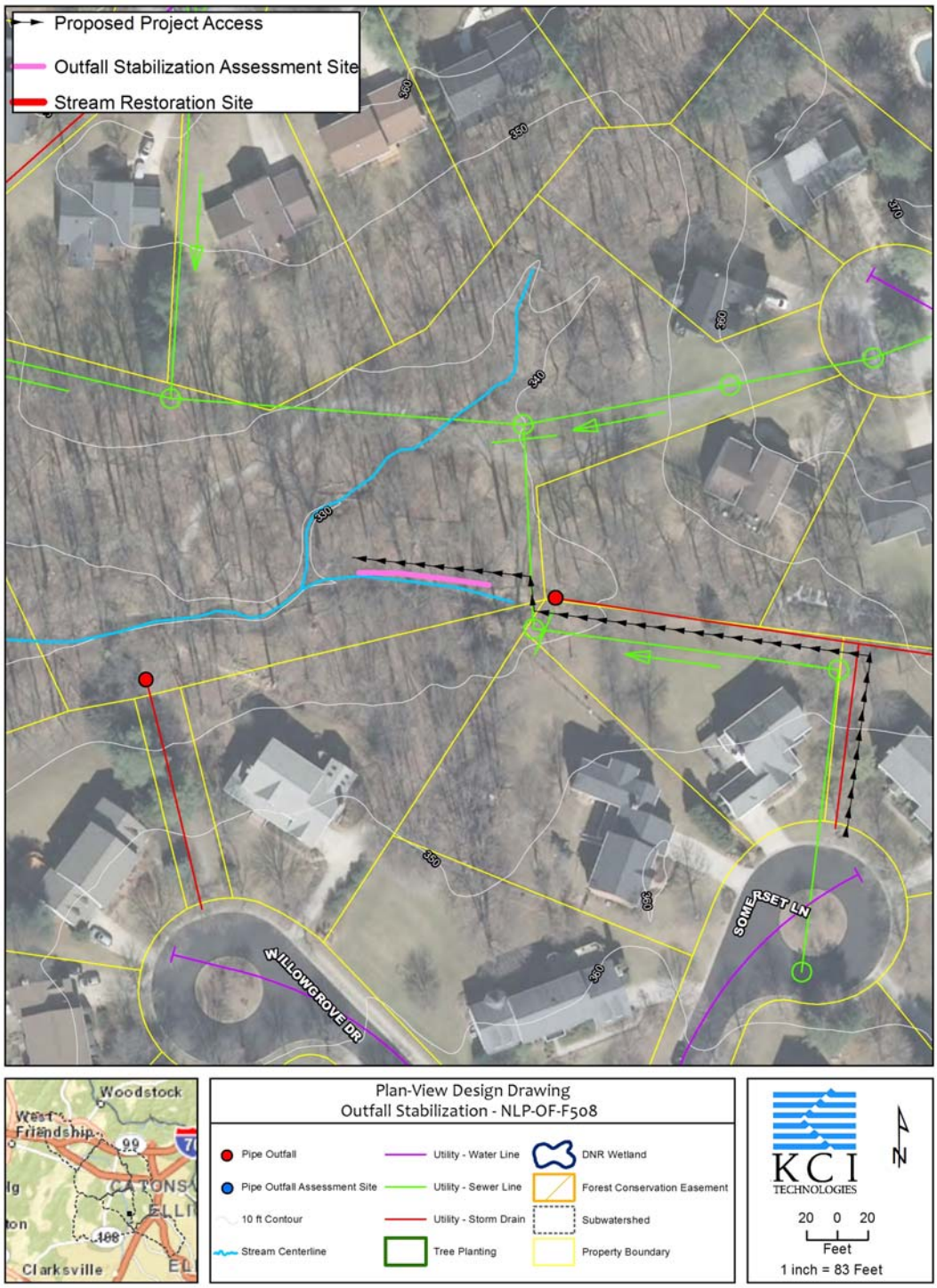
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F508

Site Name: Lilac Ln

Contractor: KCI

Watershed: Little Patuxent River



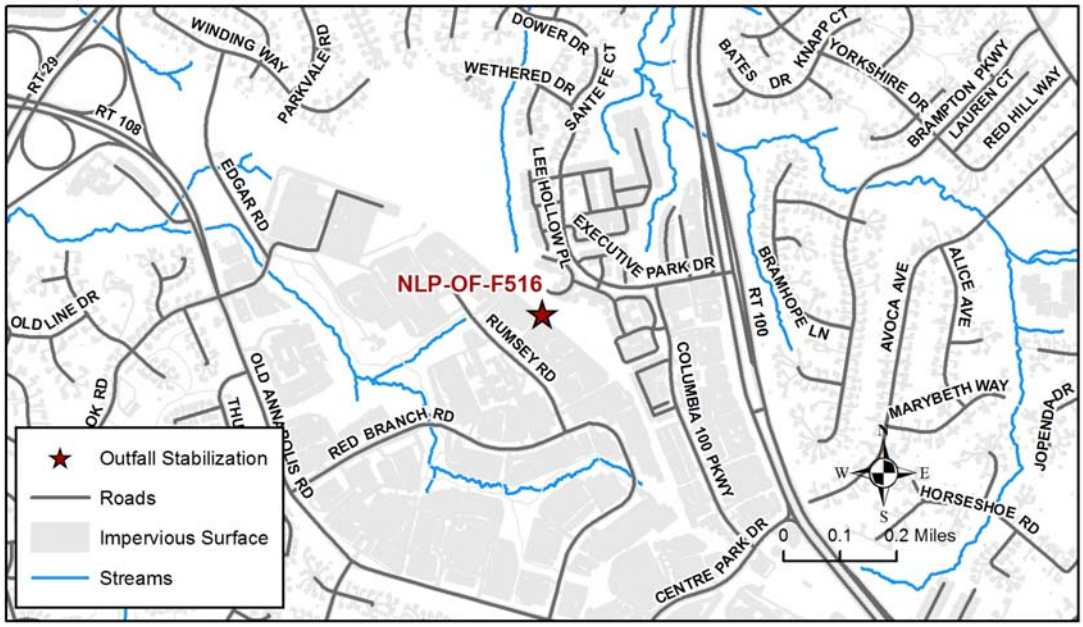
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F516
Site Name: Rumsey Rd
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Step Pool Storm Conveyance
Ownership: Private- Commercial/Industrial
Single Owner

Existing Conditions:

The proposed restoration reach begins at an outfall that drains multiple commercial buildings and parking lots on Rumsey Road to the southwest and residential use on Teal Wing Court to the northeast. The outfall conveys water into an unnamed tributary that leads to Red Hill Branch. This reach has several headcuts of 1 ft., 2 ft., and 5 ft. in height. There is also another significant headcut 100 ft. downstream near the next outfall. This next outfall pipe appears to be in good condition, but has moderate sediment deposition. Both outfalls are proposed to be stabilized at the same time during construction.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F516
Site Name: Rumsey Rd
Contractor: KCI
Watershed: Little Patuxent River

Facing upstream towards large headcut.

Facing upstream towards second outfall pipe with sediment deposition.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F516
Site Name: Rumsey Rd
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:
The reach runs through multiple private commercial properties therefore good property owner coordination and approval will be needed; however both outfalls are situated close to parking areas with minimal disturbance to trees and utilities.

Concept Description:
A Step Pool Storm Conveyance (SPSC) is proposed for this reach due to the steep elevation gradient over 120 ft. The proposed SPSC begins at the outfall and continues approximately 150 ft. downstream. The SPSC includes five riffle weirs with 20 ft. width and 8 ft. length, five pools with 20 ft. width, 3 ft. depth, and 16 ft. length, and a cascade structure with 20 ft. width, 30 ft. length and 0.5 ft. depth. The SPSC will treat more than 1 in. of rainfall and safely convey the 100 yr. flow. However, because of the diminishing credit returns on treatment over 1 in. of rainfall, it may be feasible to cut costs by reworking the SPSC design to bring the rainfall depth treated closer to the targeted 1 in. depth.

Nearby Opportunities:
None recommended

Proposed Project Credit

Drainage Area (ac.):	5.08
Impervious Area within Drainage (ac.):	3.8
Impervious Area Treated (ac.):	5.32
Impervious Area Treated Credit (ac.):	5.32

Water Quality Volume

WQVolume Target (cf.):	13,337
Max Treated (cf.):	43,838
Percent Treated:	330%
Rainfall Depth Treated (in.):	2.6

Costs

Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30 % Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00
Cost per Impervious Credit Acre:	$43,233.08

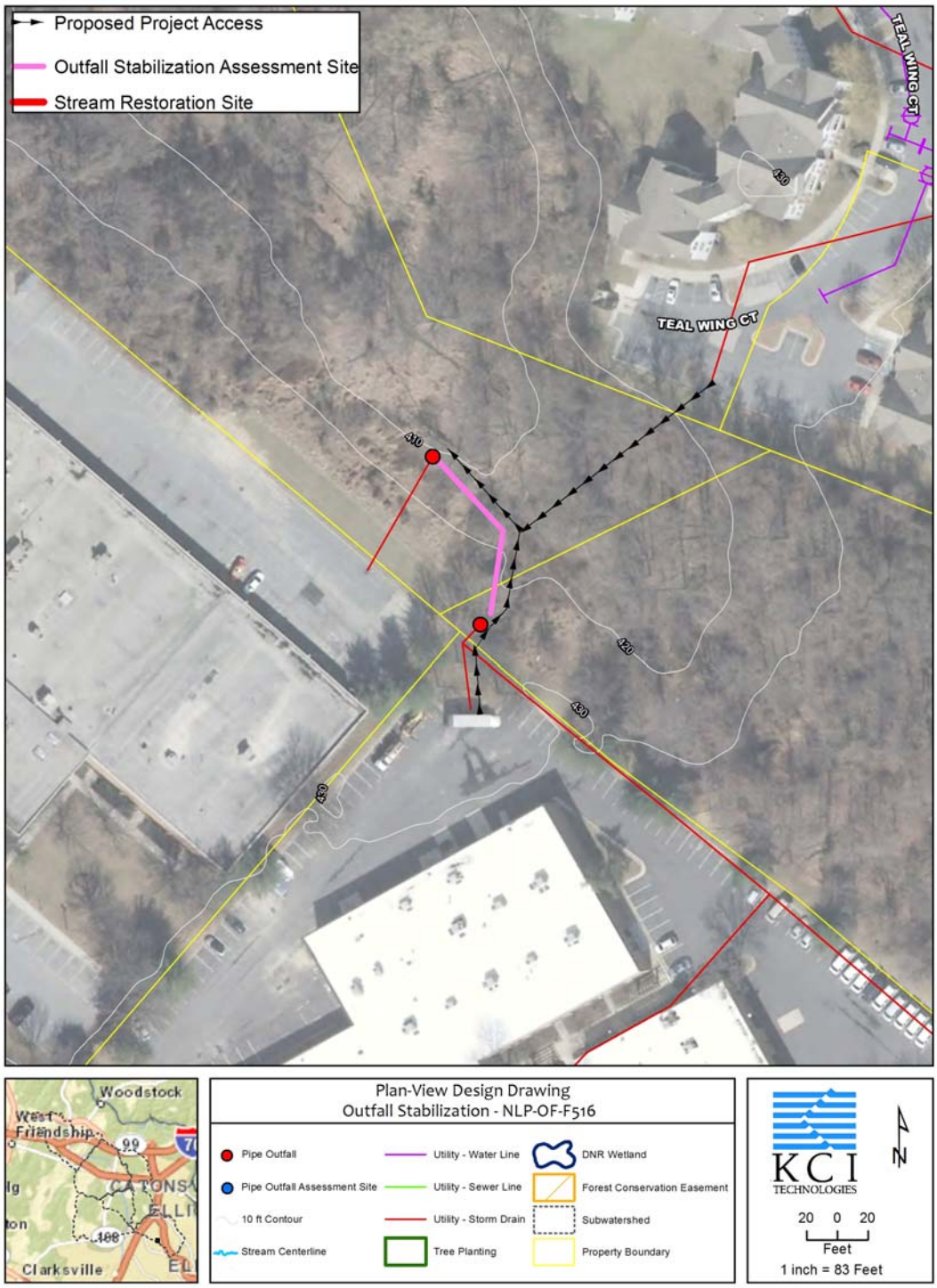
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F516

Site Name: Rumsey Rd

Contractor: KCI

Watershed: Little Patuxent River



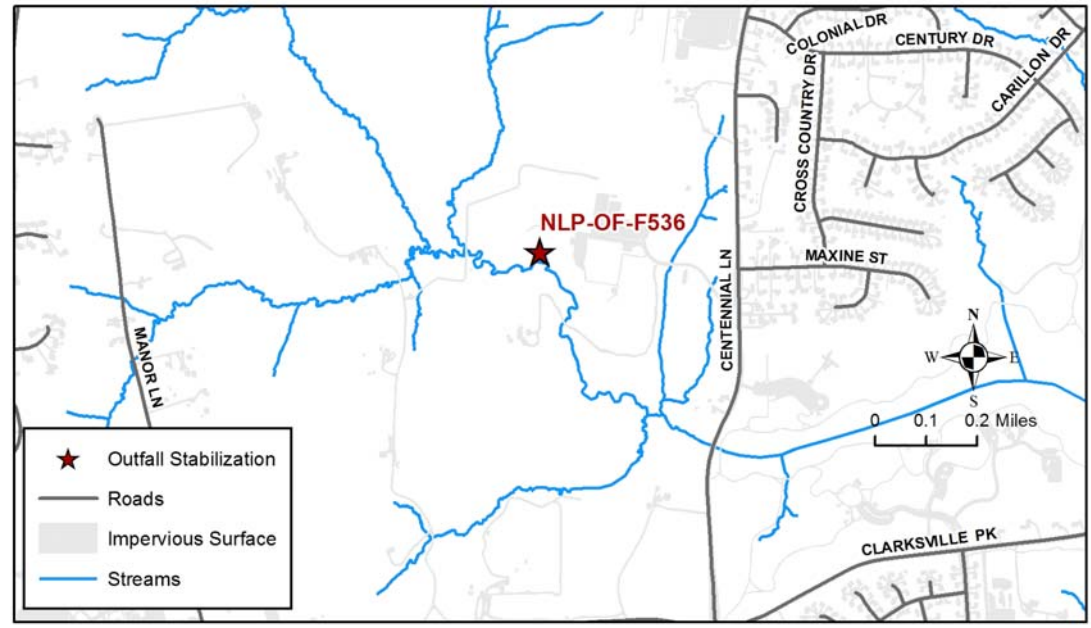
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F536
Site Name: Soccer Association of Columbia
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Step Pool Storm Conveyance
Ownership: Private- Commercial/Industrial
Multiple Owners

Existing Conditions:

The proposed outfall stabilization site originates at an outfall from a stormwater management pond that collects water from the Soccer Association of Columbia property located to the west of Centennial Lane. The site is located in the woods along the southern edge of the Soccer Association property. The outfall channel conveys water to an unnamed tributary that leads to Centennial Lake.
The proposed restoration reach is approximately 100 lf. from the outfall to the confluence with the unnamed tributary. This channel is narrow and severely incised due to headcuts that have migrated towards the outfall. The banks are vertical and raw, with minimal surface protection, exposing the highly erodible silt soil to confined stormwater flows with little protection.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F536

Site Name: Soccer Association of Columbia

Contractor: KCI

Watershed: Little Patuxent River

Facing upstream towards outfall.

Facing downstream , above headcuts.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F536
Site Name: Soccer Association of Columbia
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:
At the outfall, a steep embankment around the stormwater management pond may make access difficult for heavy machinery. The reach flows onto a private commercial property, making property owner coordination and approval an important aspect of the project success.

Concept Description:
A Step Pool Storm Conveyance (SPSC) is proposed for this reach due to the steep elevation gradient over a short distance of 111 ft. The proposed SPSC will begin at the outfall and continue approximately 130 ft. downstream. The SPSC includes four riffle weirs with 20 ft. width and 8 ft. length, four pools with 20 ft. width, 3 ft. depth, and 16 ft. length, and a cascade structure with 20 ft. width, 34 ft. length and 0.8 ft. depth. The SPSC will treat more than 1 in. of rainfall and safely convey the 100 yr. flow. There is an existing wet pond upstream of this outfall. The wet pond should already provide some water quality treatment. However, because of the diminishing credit returns on treatment over 1 in. of rainfall, it may be feasible to cut costs by reworking the SPSC design to bring the rainfall depth treated closer to the targeted 1 in. depth. This outfall stabilization project may be reclassified as a stream restoration project if the length of channel restored exceeds 200 lf.

Nearby Opportunities:
None recommended

Proposed Project Credit

Drainage Area (ac.):	24.96
Impervious Area within Drainage (ac.):	2.88
Impervious Area Treated (ac.):	4.03
Impervious Area Treated Credit (ac.):	4.03

Water Quality Volume

WQVolume Target (cf.):	13,939
Max Treated (cf.):	37,993
Percent Treated:	270%
Rainfall Depth Treated (in.):	2.6

Costs

Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30 % Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00
Cost per Impervious Credit Acre:	$57,071.96

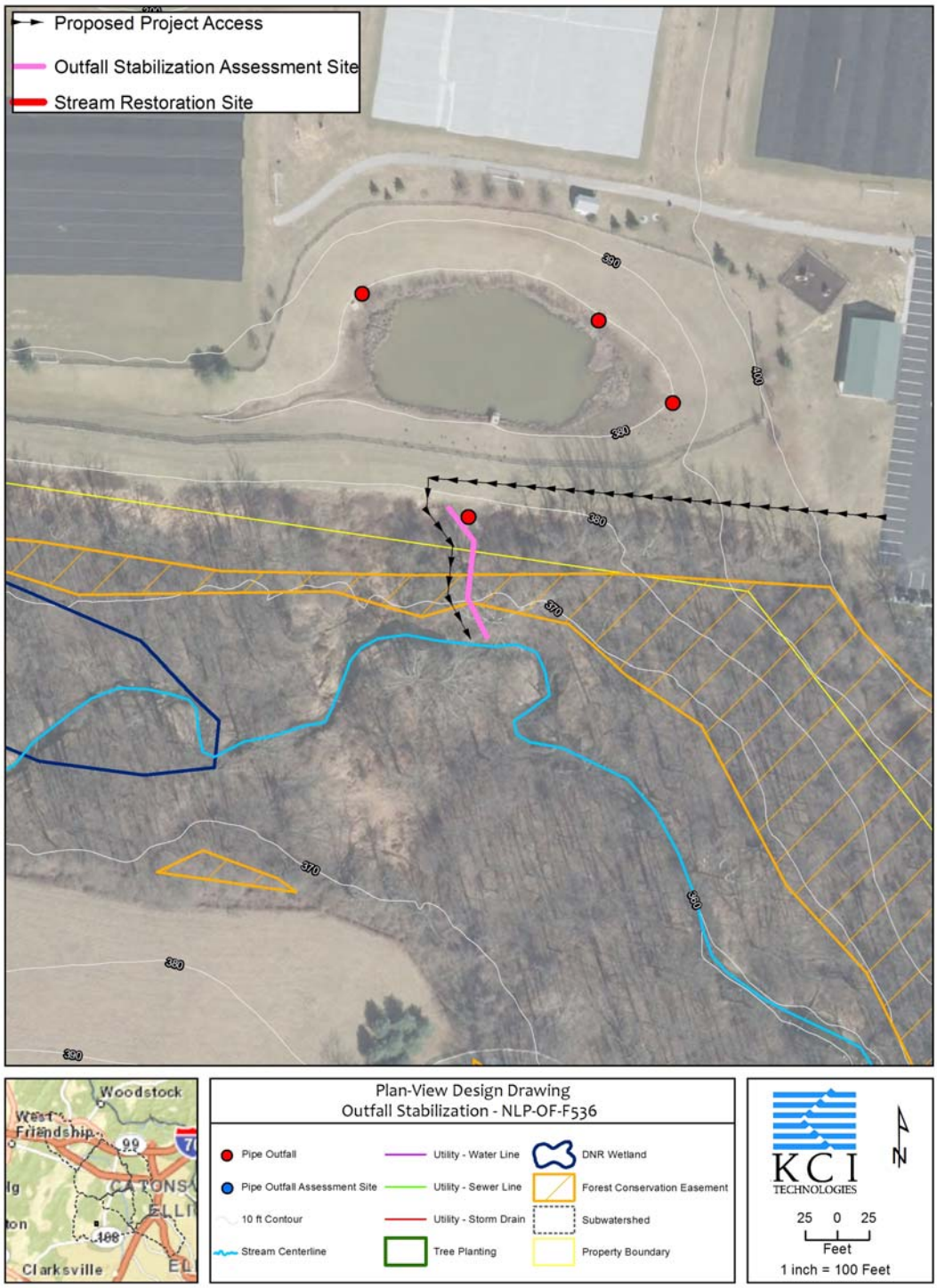
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F536

Site Name: Soccer Association of Columbia

Contractor: KCI

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

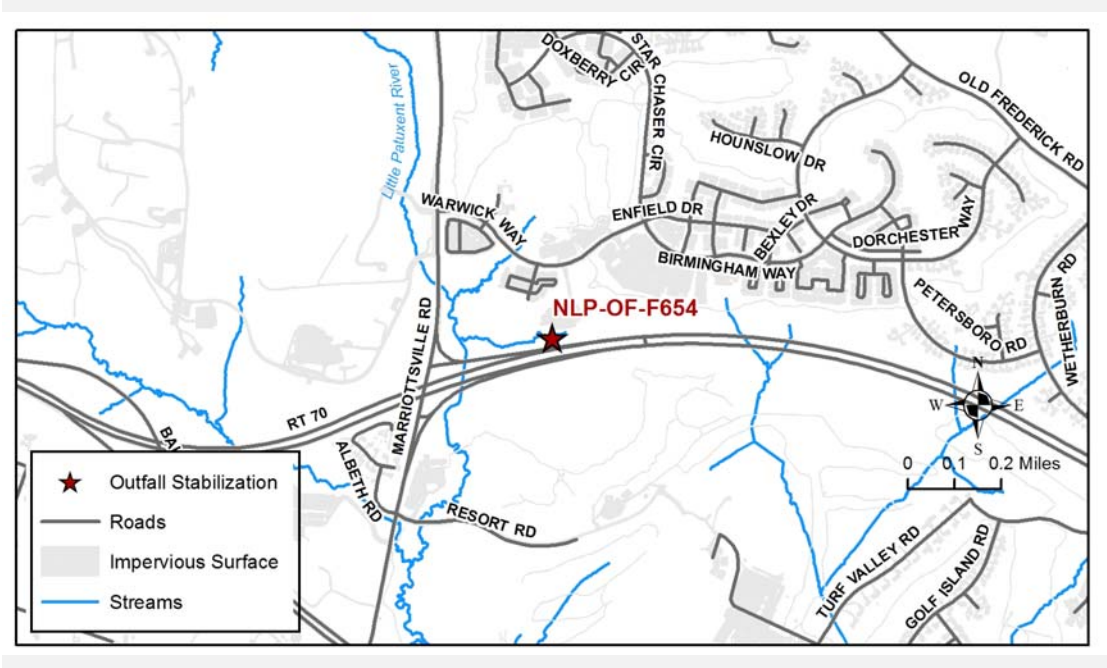
Site ID: NLP-OF-F654
Site Name: Waverly Woods
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riffle-Pool Channel
Ownership: Private- Residential Single Owner

Existing Conditions:

The outfall stabilization and restoration reach begins downstream of an outfall from I-70 that contributes flows to an unnamed tributary to the Little Patuxent River. The storm drain outlets onto a concrete channel that conveys flow to the edge of the property line demarcated by a fence. Approximately 1.5 ft. has eroded at the downstream edge of the concrete, with erosion continuing approximately 275 lf. downstream. Erosion is greatest along the outer meander bends.

The reach is located within a narrow, undeveloped parcel of Waverly Woods which separates I-70 from the Waverly Woods Condominiums. The site is wholly contained within an existing County Forest Conservation Easement. This segment of channel is highly sinuous with very steep bank angles, shallow root depths, and minimal surface protection. Banks are currently 3 ft. in height with high near bank stresses, as determined by the bankfull depth (1.5 ft.).



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F654
Site Name: Waverly Woods
Contractor: KCI
Watershed: Little Patuxent River

Facing upstream towards the outfall, severe erosion at the bottom of the concrete channel.

Facing downstream from outfall, bank erosion along outer meander bends.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F654
Site Name: Waverly Woods
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

A water line runs parallel to the channel, crossing twice within a very tight meander bend. The elevation of the water line may require some design considerations. Construction entrance access might be feasible from the Waverly Woods parking lot from Warwick Way.

Concept Description:

The restoration approach for this segment of channel includes a full cross section design and realignment to the planform. The goal of this approach is to reduce bed and bank stress by creating a stable channel cross section, adding bank protection, and reducing stress caused by the highly sinuous planform. Bank treatments might include bioengineering treatments, such as coir fiber rolls, alternating roughness, as well as planting of trees, shrubs, and live stakes. The stream restoration cost per linear foot was used for this outfall stabilization project due to the restoration approach being closer to a stream restoration concept than to a typical outfall stabilization, despite its shorter length. This outfall stabilization project may be reclassified as a stream restoration project if the length of channel restored exceeds 200 lf.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	272
Impervious Area Treated Credit (ac.):	2.72
Cost Per Impervious Credit Acre:	$95,264.71

Costs	
Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$122,400.00
30% Contingency:	$36,720.00
Estimated Total Cost:	$259,120.00

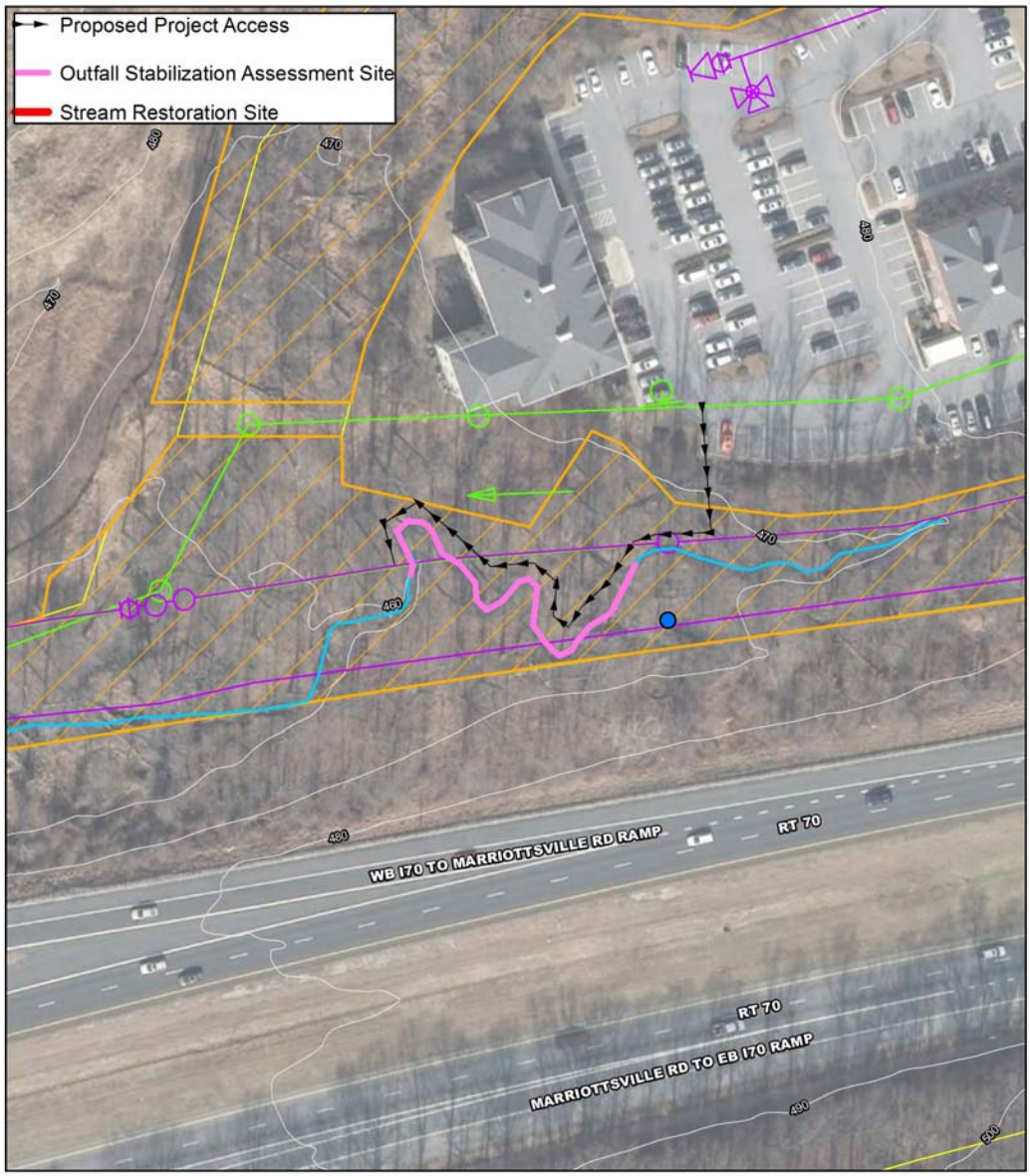
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F654

Site Name: Waverly Woods

Contractor: KCI

Watershed: Little Patuxent River



Plan-View Design Drawing
Outfall Stabilization - NLP-OF-F654

- Pipe Outfall
- Pipe Outfall Assessment Site
- 10 ft Contour
- Stream Centerline
- Utility - Water Line
- Utility - Sewer Line
- Utility - Storm Drain
- Tree Planting
- DNR Wetland
- Forest Conservation Easement
- Subwatershed
- Property Boundary

KCI TECHNOLOGIES

20 0 20
Feet
1 inch = 83 Feet

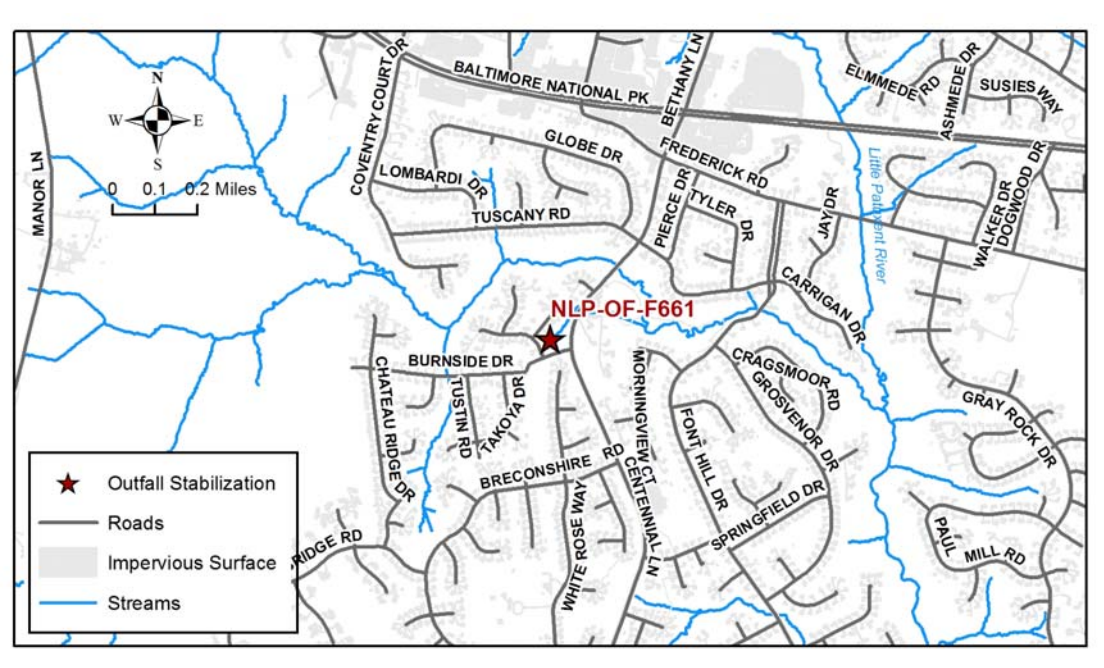
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F661
Site Name: Little Brick House Ct.
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riffle-Pool Channel
Ownership: Private- Residential
Multiple Owners

Existing Conditions:

The proposed outfall stabilization site is located on a channel running along the back of private property lots along Feaga Farm Ct and parallel to Centennial Lane. A sewer line runs parallel to the channel, with two crossings in the proposed reach. The channel is incised following several headcuts that begin approximately 100 lf. downstream of the outfall. A series of headcuts have produced a 3-4 ft. elevation drop within the channel over a 20 lf. distance. Banks are approximately 3 ft. high with shallow root depths, steep bank angles, and minimal surface protection. The bankfull depth is approximately 1.5 ft. high, as determined by the low bank height immediately upstream of the headcuts.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F661
Site Name: Little Brick House Ct.
Contractor: KCI
Watershed: Little Patuxent River

Facing upstream at headcut.

Facing downstream, erosion along outer bends.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F661
Site Name: Little Brick House Ct.
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:

The channel is located on three private properties through which a sewer also runs parallel. Construction access can be obtained through the sewer and storm drain easements on Little Brick House Ct and/or from the sewer easement from Feaga Farm Ct.

Concept Description:

Although considered an outfall stabilization project, this restoration site contains enough length that a riffle-pool sequence similar to the standard approach for a stream restoration project is proposed. The restoration approach for this segment of channel includes full cross section design to achieve riffle-pool morphology. The goal of this approach is to reduce bed and bank stress by creating a stable channel cross section, then adding bank protection to resist the bank stresses that occur. Bank treatments might include bioengineering treatments, such as coir fiber rolls, and alternating roughness. Tree, shrub, and live stake planting is proposed throughout the site; however, tree planting will be restricted to areas outside of the sewer easement. The stream restoration cost per linear foot was used for this outfall stabilization project due to the restoration approach being more similar to a stream restoration concept, despite its shorter length. This outfall stabilization project may be reclassified as a stream restoration project if the length of channel restored exceeds 200 lf.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	209
Impervious Area Treated Credit (ac.):	2.09
Cost Per Impervious Credit Acre:	$110,047.85

Costs	
Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00

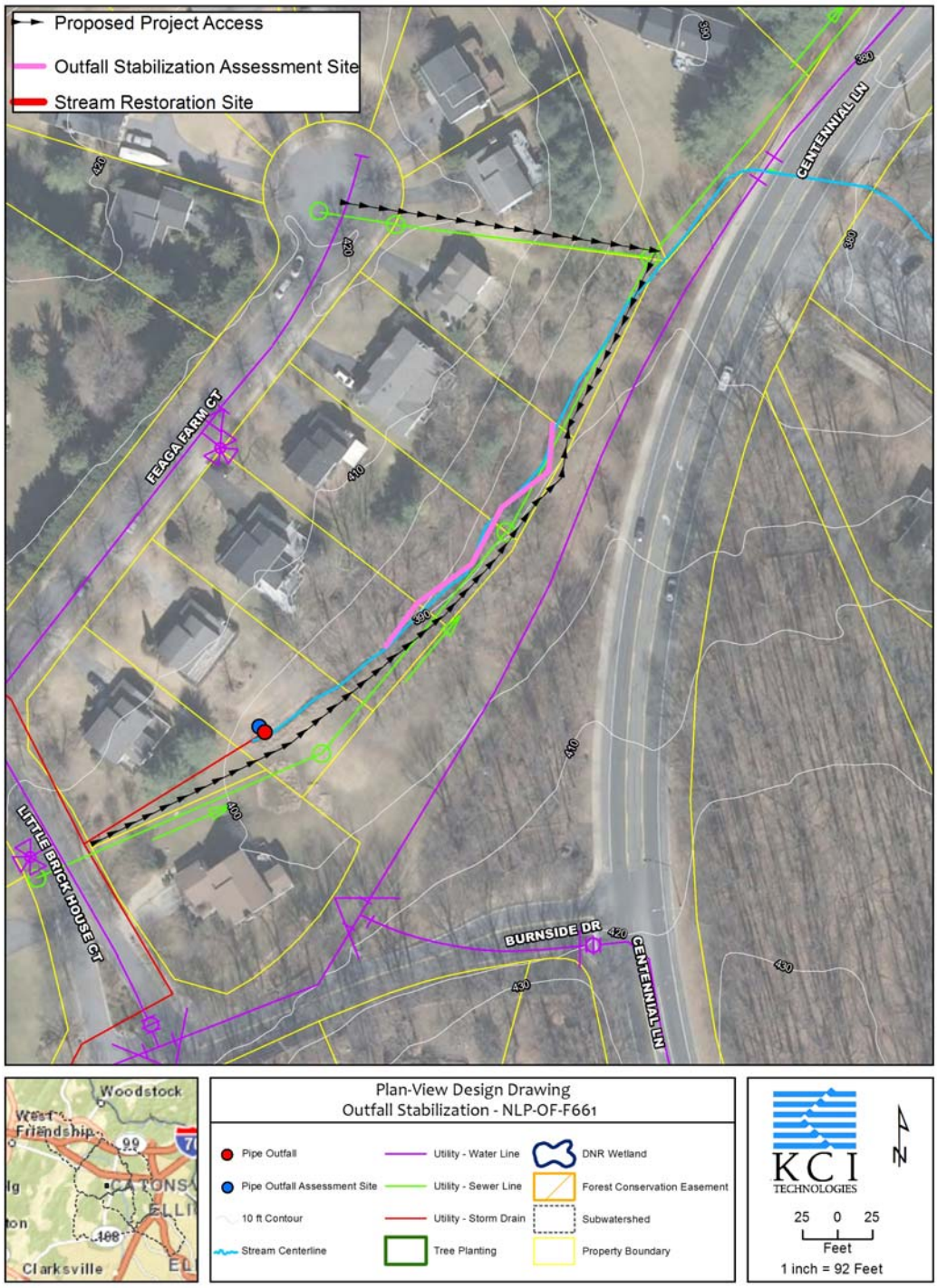
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F661

Site Name: Little Brick House Ct.

Contractor: KCI

Watershed: Little Patuxent River



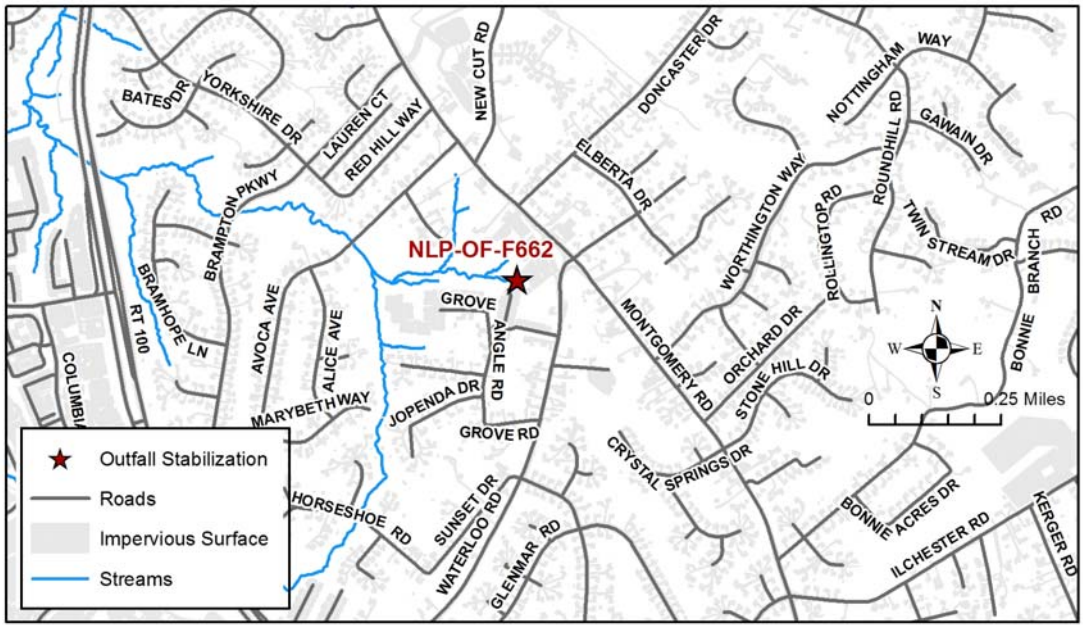
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F662
Site Name: Waterloo Rd
Contractor: KCI
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Step Pool Storm Conveyance
Ownership: Private- Mixed Use
Multiple Owners

Existing Conditions:

The outfall stabilization site originates from an outfall that drains multiple parking lots and restaurants at the corner of Montgomery Rd and Waterloo Rd. The outfall pipe is in a rusted condition, and trash below the embankment from the parking lots is abundant. The total length of erosion is approximately 200 lf., through which trees and limbs have fallen. Bank erosion heights were observed on the right and left banks at a height of 5.5 and 10 ft. respectively. The banks are a silty material that is easily erodible due to its composition, the vertical bank angle, moderate root depths and moderate surface protection. Near bank stresses were found to be very high due to the large bank heights and severe incision. No bankfull indicators were observed. A severe erosion rating is given to this outfall reach as the height of erosion is greater than 5 ft.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F662
Site Name: Waterloo Rd
Contractor: KCI
Watershed: Little Patuxent River

Facing downstream: channel erosion and debris.

Facing upstream: steep bed slope, fallen trees, and eroded banks.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F662
Site Name: Waterloo Rd
Contractor: KCI
Watershed: Little Patuxent River

Constraints/Utilities:
No utility impacts are anticipated. Minimal impacts to the trees. The valley slope is very steep, making access more difficult. The sewer easement from Evening Sky Court appears to be the most feasible point of access due to the embankment of the outfall pipe.

Concept Description:
A Step Pool Storm Conveyance (SPSC) is proposed for this reach due to the steep elevation gradient over a relatively short distance of 200 ft. The proposed SPSC begins at the outfall and continues approximately 266 ft. downstream. The SPSC includes seven riffle weirs with 30 ft. width and 8 ft. length, seven pools with 30 ft. width, 3 ft. depth, and 22 ft. length, and a cascade with 30 ft. width following by three pools with 30 ft. length. The proposed design will treat more than 1 in. of rainfall and safely convey the 100 yr. flow. However, because of the diminishing credit returns on treatment over 1 in. of rainfall, it may be feasible to cut costs by reworking the SPSC design to bring the rainfall depth treated closer to the targeted 1 in. depth.

Nearby Opportunities:
None recommended

Proposed Project Credit

Drainage Area (ac.):	16.36
Impervious Area within Drainage (ac.):	5.65
Impervious Area Treated (ac.):	7.91
Impervious Area Treated Credit (ac.):	7.91

Water Quality Volume

WQVolume Target (cf.):	21,428
Max Treated (cf.):	105,210
Percent Treated:	490%
Rainfall Depth Treated (in.):	2.6

Costs

Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30 % Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00
Cost per Impervious Credit Acre:	$29,077.12

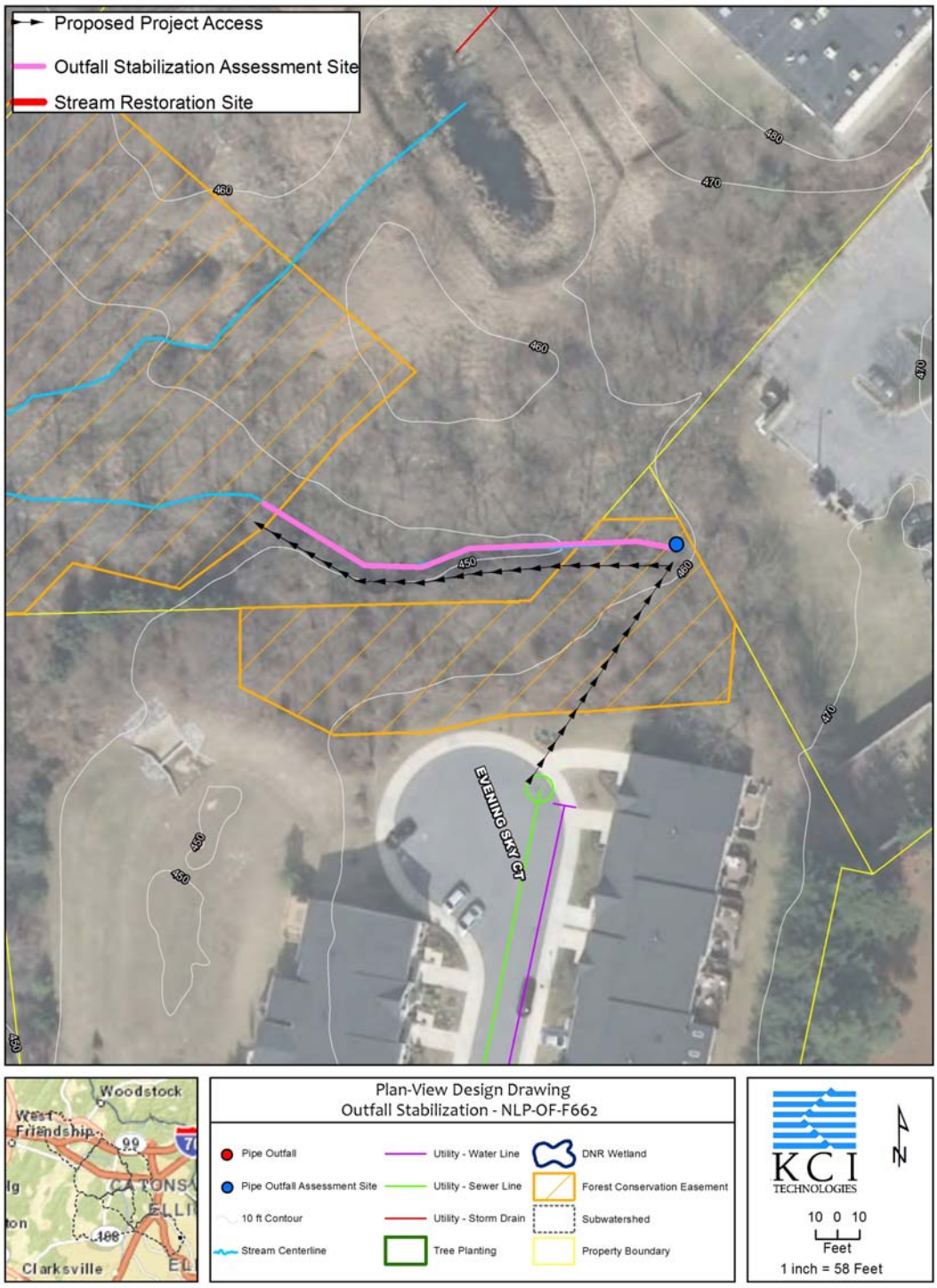
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: NLP-OF-F662

Site Name: Waterloo Rd

Contractor: KCI

Watershed: Little Patuxent River



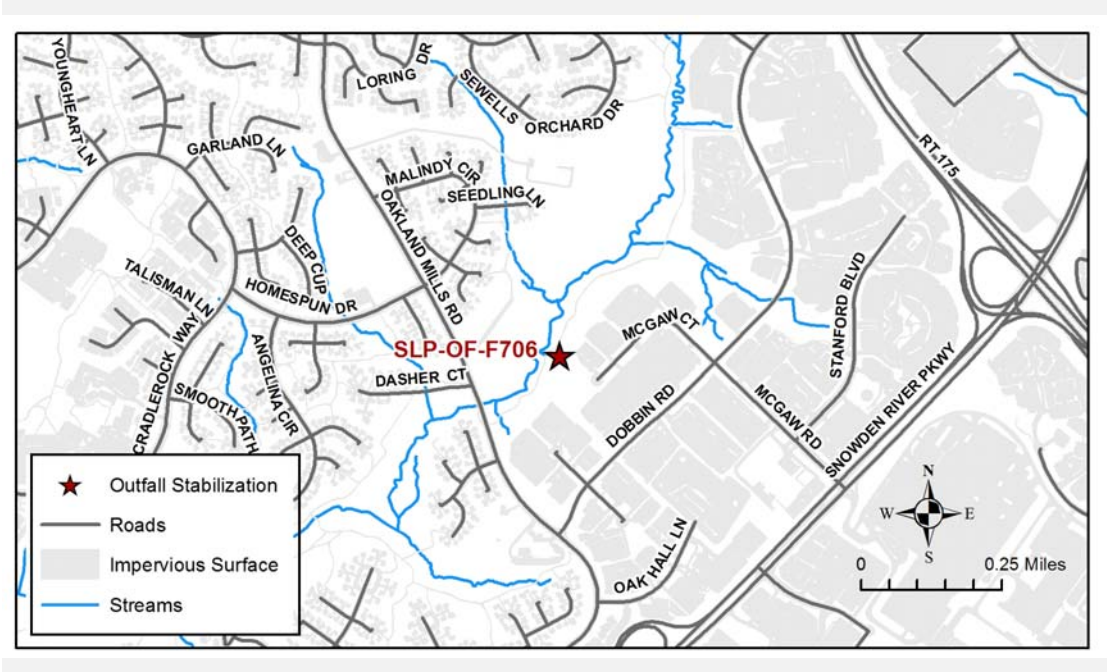
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F706
Site Name: 8928 McGaw Court
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Columbia Association
Single Owner

Existing Conditions:

SLP-OF-F706 is located behind 8928 McGaw Court, approximately 365 ft. northwest from the end of McGaw Court. The surrounding development that drains into the outfall is designated as Industrial under 2010 Maryland Department of Planning Land Use/Land Cover. The outfall is a concrete endwall with 30 ft. long rock apron made up of boulders and large riprap. A 2.5 ft. cascade is located about 10 ft. from the endwall. Geotextile fabric has been exposed from under the riprap. Below the rock, an approximately 3 ft. 8 in. deep gully has formed into a hard clay layer. The outfall goes under the Patuxent Branch Trail (a paved, mixed-use path) in a 48 in. corrugated metal pipe about 140 ft. downstream of the endwall. The outfall enters an unnamed tributary of the Little Patuxent River another 55 ft. below the trail.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F706
Site Name: 8928 McGaw Court
Contractor: Versar
Watershed: Little Patuxent River

At outfall pipe looking downstream.

Area of erosion upstream of Patuxent Branch Trail.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F706
Site Name: 8928 McGaw Court
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The primary constraint is the trees along the outfall. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots. Also, the cascade is split by a paved, mixed-use trail with a sanitary sewer underneath.

Two private stormwater management ponds are upstream of outfall SLP-OF-F706. One is located on the property of 6656 Dobbin Road Investors LLC, at 6656 Dobbin Road, Columbia, Maryland. The other is owned by Arcus Data Security Inc. at 8928 McGaw Court, Columbia, Maryland.

Concept Description:
A 140 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-706 because the channel is too steep (average slope is 10%) and the length does not allow enough pools for full credit using a step pool storm conveyance credit.

The outfall can be accessed either from the Patuxent Branch Trail, or from the end of McGaw Court. Access from McGaw Court requires creating a 380 ft. long access road through the forest. Both accesses are on land owned by the Columbia Association.

Nearby Opportunities:
None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	140	**Estimated Design Cost:**	$120,000.00
Impervious Area Treated Credit (ac.):	1.4	**Estimated Construction Cost:**	$100,000.00
		30% Contingency:	$30,000.00
Cost Per Impervious Credit Acre:	$178,571.43	**Estimated Total Cost:**	$250,000.00

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F706

Site Name: 8928 McGaw Court

Contractor: Versar

Watershed: Little Patuxent River

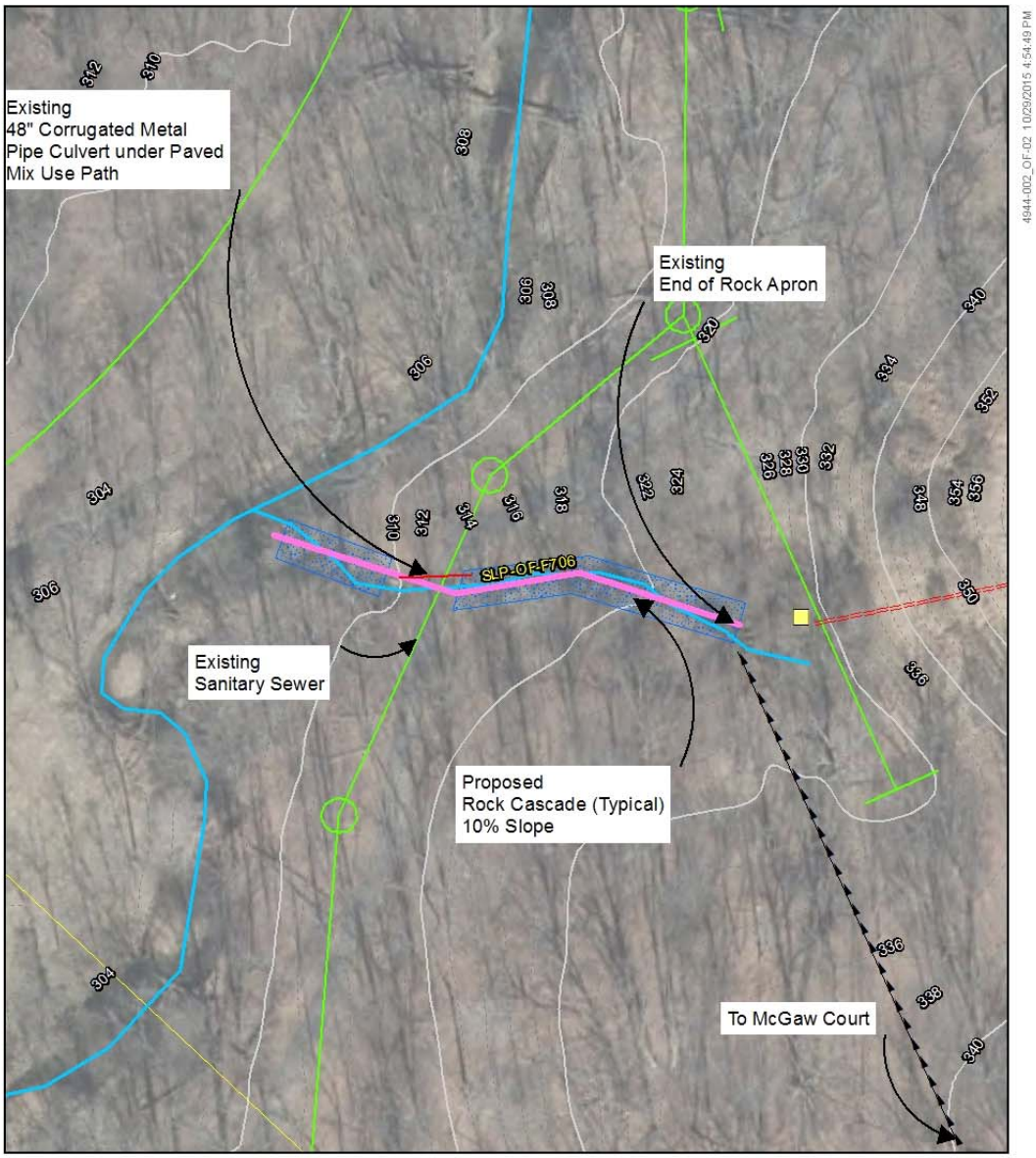


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F706

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F710

Site Name: South of Phelps Luck and Tamar Drives Intersection

Contractor: Versar

Watershed: Little Patuxent River

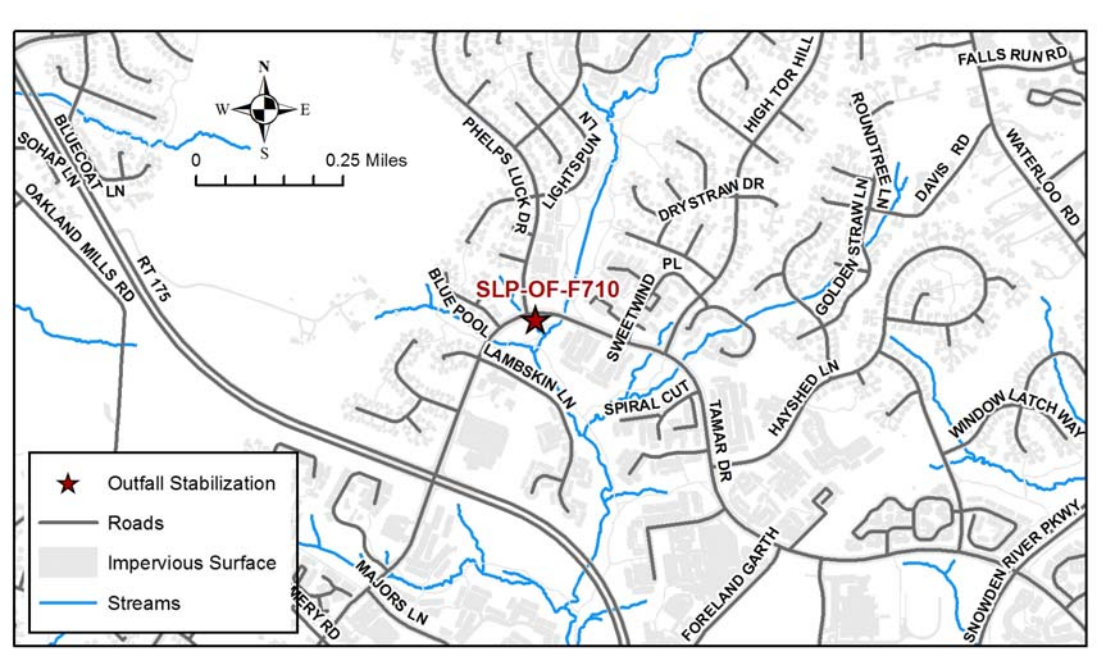
Proposed BMP Type: Outfall Stabilization

Stabilization Type: Riprap

Ownership: Columbia Association
Single Owner

Existing Conditions:

SLP-OF-F710 is located south of the intersection of Phelps Luck and Tamar Drives. The surrounding development that drains into the outfall is designated as Medium and High Density Residential under 2010 Maryland Department of Planning Land Use/Land Cover. The outfall has a concrete endwall with a 42 in. reinforced concrete pipe. The pipe discharges to a 15 ft. long trapezoidal concrete apron, and 1 ft.-10 in. drop off the end into a naturally eroded plunge pool. Downstream of the plunge is a 3 ft.-7 in. deep natural channel with vertical side slopes flowing for 160 ft. to an unnamed to a tributary of the Little Patuxent River. A paved, mixed-use trail crosses the channel via a wooden bridge about 100 ft. downstream of the concrete apron.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F710

Site Name: South of Phelps Luck and Tamar Drives Intersection

Contractor: Versar

Watershed: Little Patuxent River

At outfall pipe looking downstream.

Eroded area downstream of outfall pipe.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F710

Site Name: South of Phelps Luck and Tamar Drives Intersection

Contractor: Versar

Watershed: Little Patuxent River

Constraints/Utilities:

The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

An upstream pond is located on land owned by the Howard County Department of Recreation.

Concept Description:

A 168 ft. rock cascade outfall stabilization is recommended for SLP-OF-710 although this outfall has a slope of less than 5%. The primary reason for choosing this option is because it offers greater impervious credit treatment than the step pool storm conveyance. The outfall can be accessed directly from Tamar Drive, across land owned by the Columbia Association.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	168
Impervious Area Treated Credit (ac.):	1.68
Cost Per Impervious Credit Acre:	$148,809.52

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

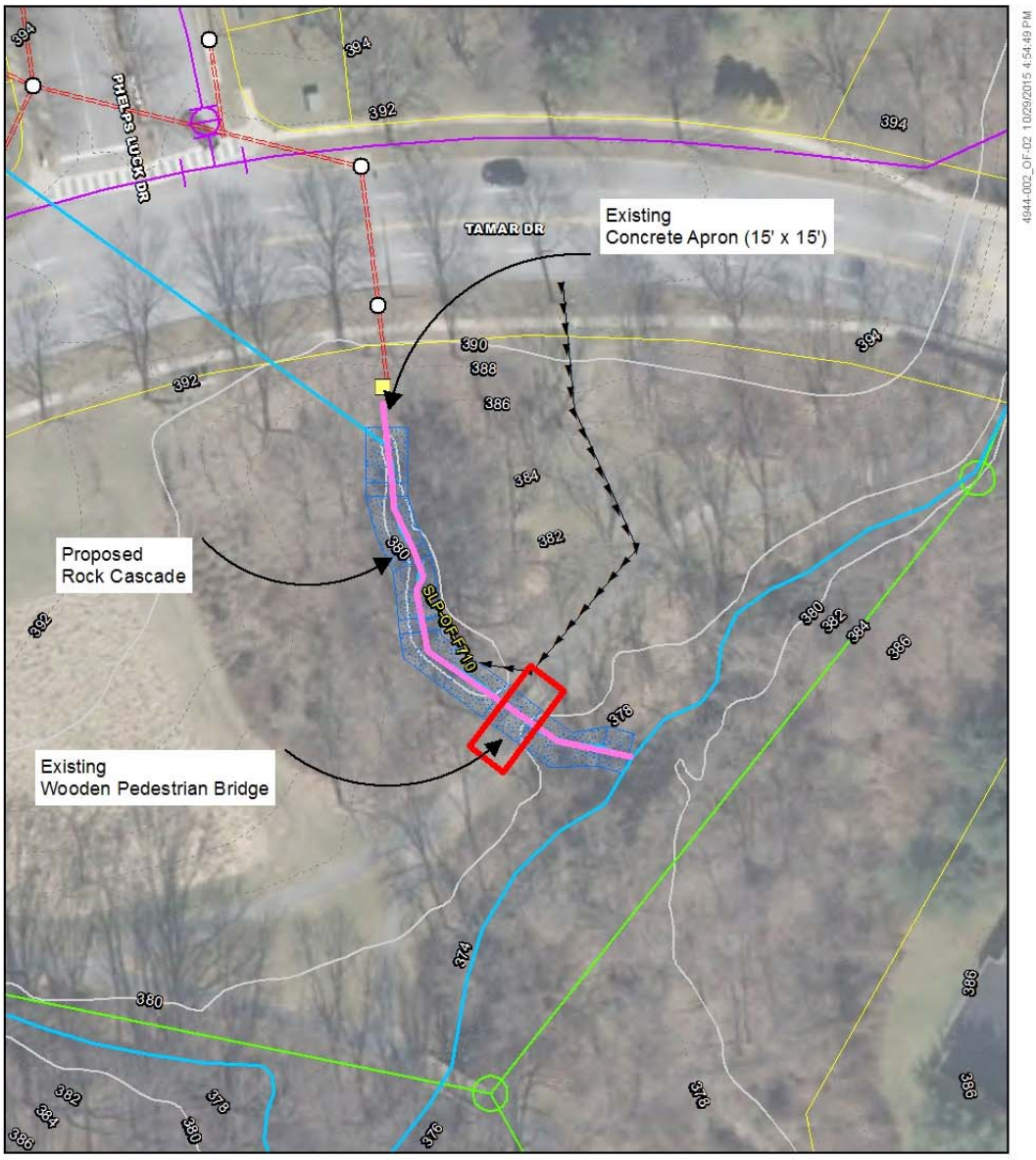
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F710

Site Name: South of Phelps Luck and Tamar Drives Intersection

Contractor: Versar

Watershed: Little Patuxent River



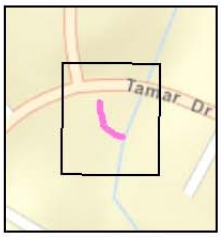


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F710

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F711

Site Name: Cradlerock Way and Homespun Drive

Contractor: Versar

Watershed: Little Patuxent River

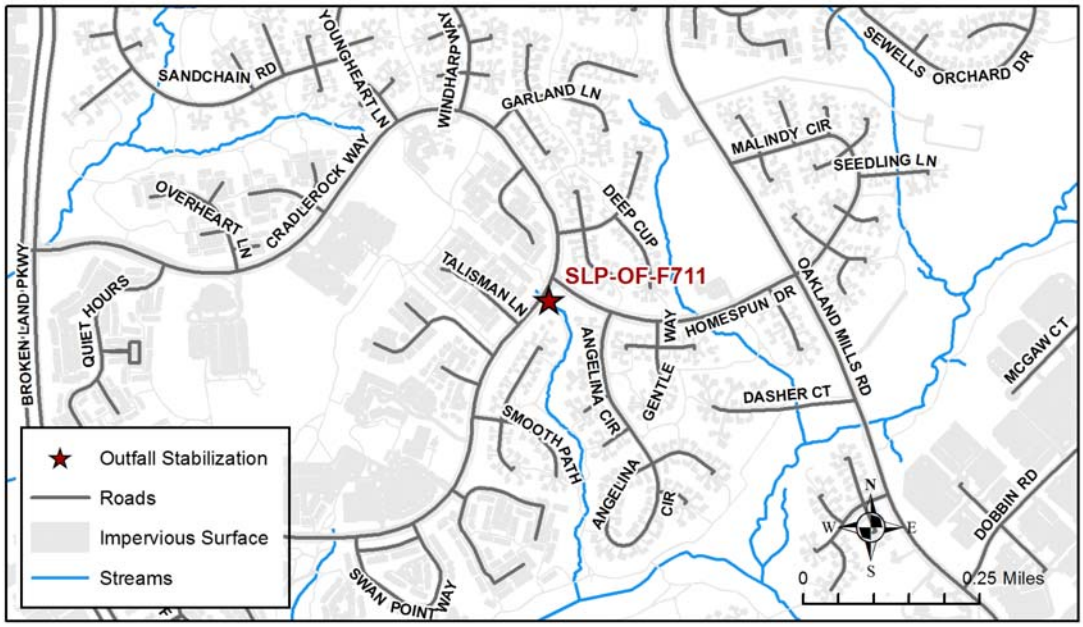
Proposed BMP Type: Outfall Stabilization

Stabilization Type: Step Pool Storm Conveyance.

Ownership: Columbia Association
Single Owner

Existing Conditions:

SLP-OF-F711 is located 130 ft. south of the traffic circle at Homespun Drive and Cradlerock Way. Lake Elkhorn is downstream of the outfall and the surrounding development that drains into the outfall is designated as Medium and High Density Residential under 2010 Maryland Department of Planning Land Use/Land Cover. The outfall has a concrete endwall with 4 ft. and 3 ft. diameter reinforced concrete pipes. Below the outfall is 29 ft. of riprap. Erosion has exposed a hard clay layer downstream of the riprap. The channel continues in a series of long pools interrupted by two sections of riprap. A third section riprap starts about 300 ft. from the outfall, the limit of this study. The stream continues in a similar fashion downstream.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F711

Site Name: Cradlerock Way and Homespun Drive

Contractor: Versar

Watershed: Little Patuxent River

Downstream of outfall looking upstream.

Eroded area in channel downstream of outfall pipe.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F711

Site Name: Cradlerock Way and Homespun Drive

Contractor: Versar

Watershed: Little Patuxent River

Constraints/Utilities:

The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:

A 226 ft. long step pool storm conveyance with eight pool and riffle segments is recommended for SLP-OF-F711. A paved trail follows the channel for the entire length, providing site access. A paved trail follows the channel for the entire length, providing site access. This outfall stabilization project may be reclassified as a stream restoration project if the length of channel restored exceeds 200 lf.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Drainage Area (ac.):	41.92
Impervious Area within Drainage (ac.):	14.41
Impervious Area Treated (ac.):	14.4
Impervious Area Treated Credit (ac.):	7.2

Water Quality Volume	
WQVolume Target (cf.):	54,798
Max Treated (cf.):	43,815
Percent Treated:	46%
Rainfall Depth Treated (in.):	0.46

Costs

Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$106,160.00
30 % Contingency:	$31,848.00
Estimated Total Cost:	$258,008.00
Cost per Impervious Credit Acre:	$35,834.44

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F711

Site Name: Cradlerock Way and Homespun Drive

Contractor: Versar

Watershed: Little Patuxent River

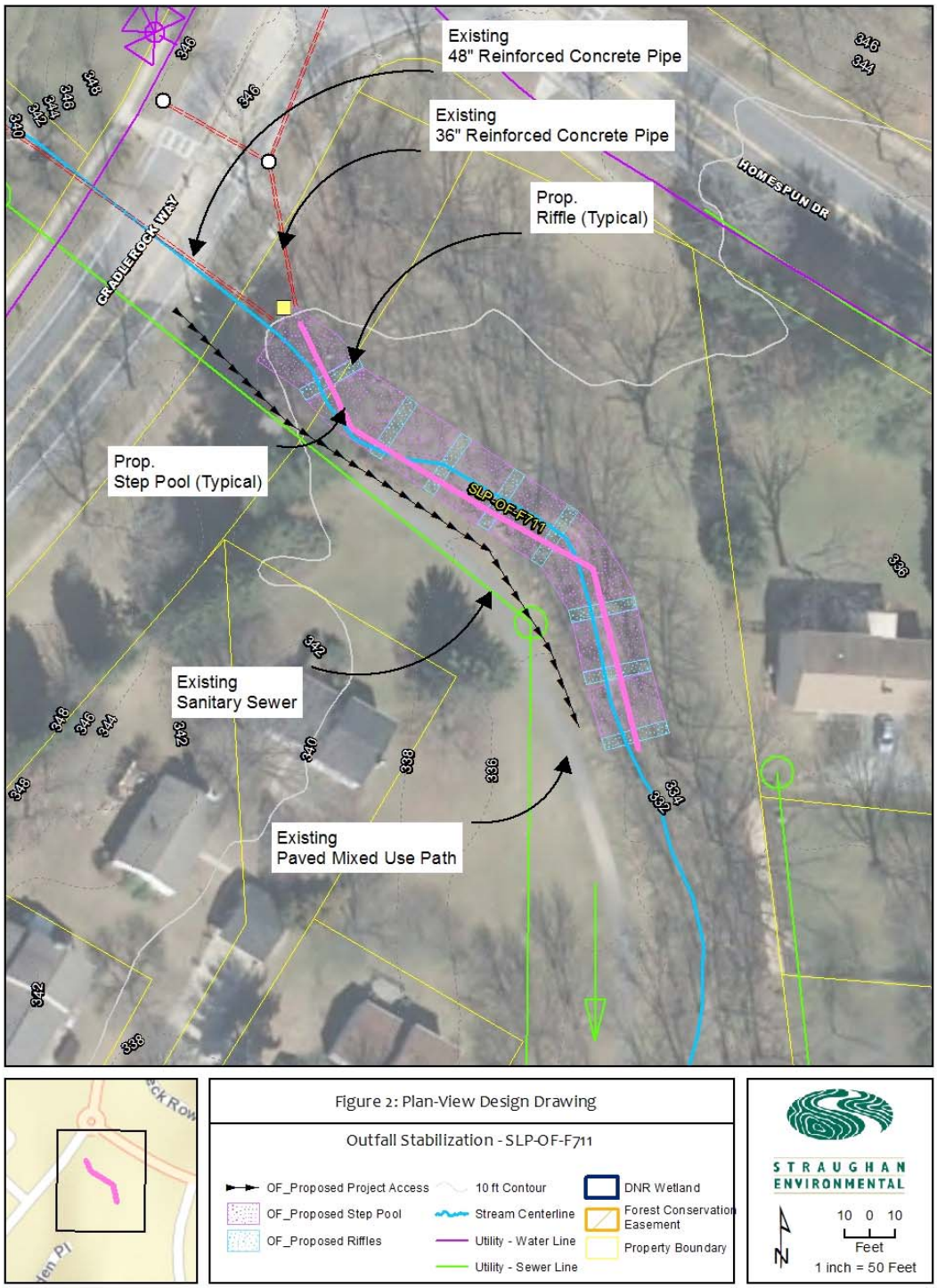


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F711

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

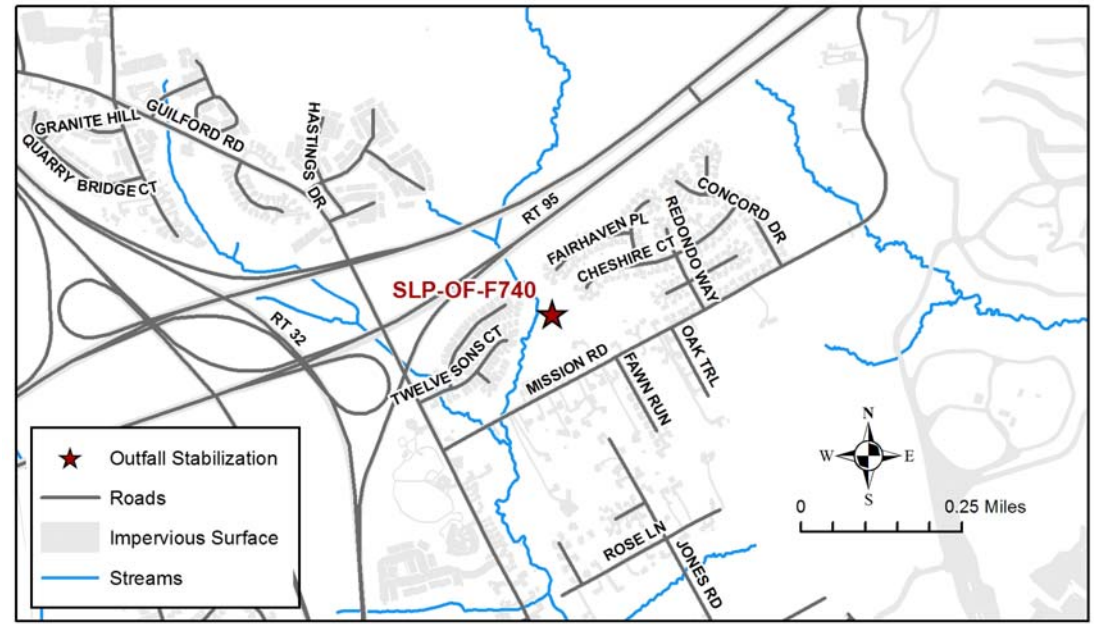
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F740
Site Name: Cheshire Court
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Private- Residential
Multiple Owners

Existing Conditions:

The targeted outfall is located on the property line between the Heritage Woods Homeowner's Association and the Signal Hill Neighborhood Homeowner's Association. The dry pond that the outfall drains is located on Heritage Woods HOA property, while the outfall channel is located on Signal Hill Neighborhood HOA property. The corrugated metal 30 in. diameter outfall that drains the dry pond has a rusted-out, flared end apron. The outfall channel is fairly stable, except along one meander bend where minor to moderate erosion exists. The receiving stream appears to be very stable and providing good instream habitat. It was also observed that the dry pond's low flow orifice was clogged with debris.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F740
Site Name: Cheshire Court
Contractor: Versar
Watershed: Little Patuxent River

A 30 in. diameter corrugated metal outfall pipe with a rusted-out flared metal apron. The outfall drains a dry pond.

Minor to moderate erosion occurring around a meander bend in the outfall channel.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F740
Site Name: Cheshire Court
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The proposed project will require coordination with two separate Homeowner's Associations and will likely result in the removal of a few moderate sized trees.

Concept Description:
The proposed stabilization project will focus on replacing the rusting metal pipe and apron with a new concrete pipe, and using some riprap and minor grading to stabilize the eroding outfall channel banks. Debris should also be removed from the dry pond's low flow orifice. The site can be accessed from the end of Cheshire Court.

Nearby Opportunities:
None recommended

Proposed Project Credit	
Length Restored (ft):	127
Impervious Area Treated Credit (ac.):	1.27
Cost Per Impervious Credit Acre:	$181,102.36

Costs	
Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00

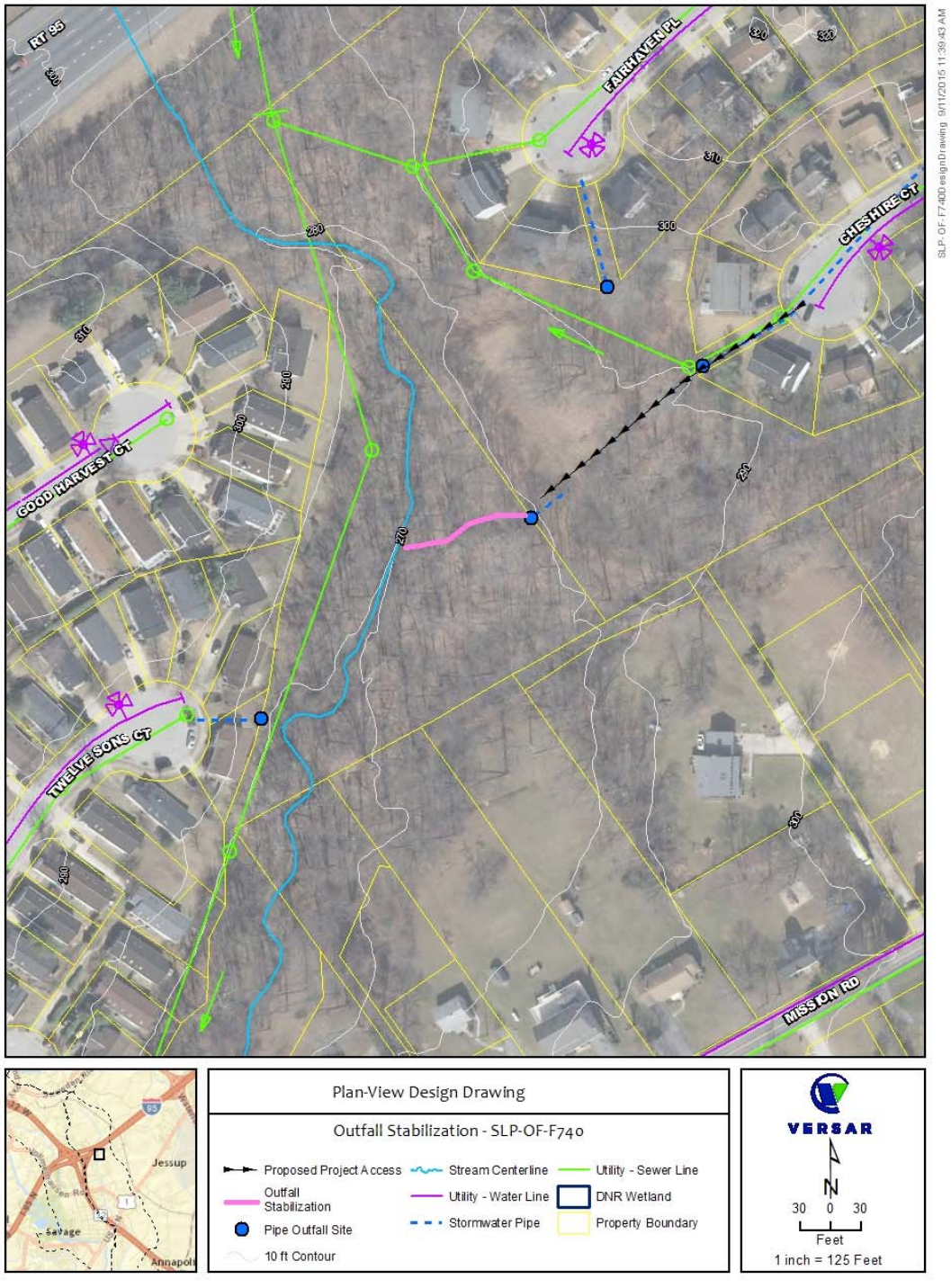
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F740

Site Name: Cheshire Court

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

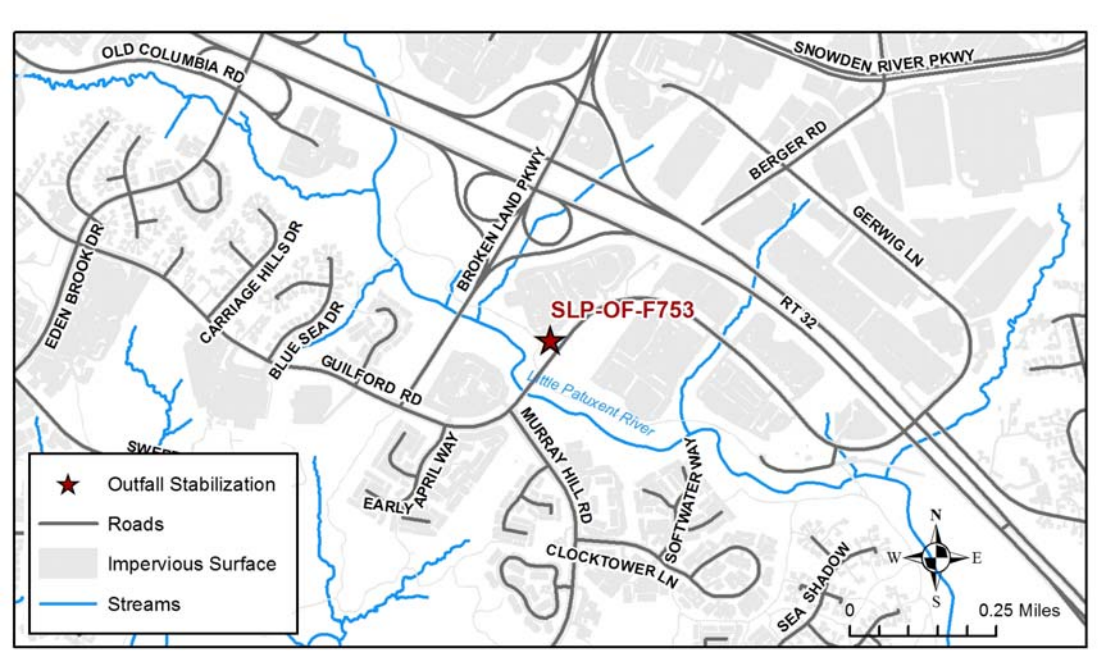
Site ID: SLP-OF-F753
Site Name: 9053 Guilford Road
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Columbia Association
Multiple Owners

Existing Conditions:

The outfall is a concrete endwall with a 27 ft. long riprap apron. In front of the endwall a 13 ft. long, 1.5 ft. deep pool has been formed by the water piling the riprap farther downstream. At the end of the riprap apron, a tree root is holding up a 4 ft. high headcut. The head cut is covered in geotextile, and riprap is present at both the top and the bottom.

Below the headcut at the outfall is an approximately 100 ft. long channel that is incised. About 80 ft. downstream of the headcut, an unknown 6 in. diameter corrugated metal pipe discharges into the channel. At the end of the incised channel the banks slope down, and the channel spreads out on a flat area covered in deposited sediment. The flow meanders through a wetland area, and enters the Little Patuxent River through a 42 in. diameter corrugated plastic pipe under the Patuxent Branch Trail.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F753
Site Name: 9053 Guilford Road
Contractor: Versar
Watershed: Little Patuxent River

Downstream of the outfall pipe, in background of photo where erosion starts.

In the eroded area looking downstream at second outfall pipe.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F753
Site Name: 9053 Guilford Road
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:
A 142 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-753 because the slope is too steep (average slope is 7%)and the length does not allow enough pools for a step pool storm conveyance. The outfall can be accessed from the driveway to 9053 Guilford Road down a 3:1 grassed slope. The bottom of the outfall can also be reached from the Patuxent Branch Trail, however access from here may impact a potential wetland between the trail and outfall.

Nearby Opportunities:
None recommended

Proposed Project Credit	
Length Restored (ft):	142
Impervious Area Treated Credit (ac.):	1.42
Cost Per Impervious Credit Acre:	$176,056.34

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

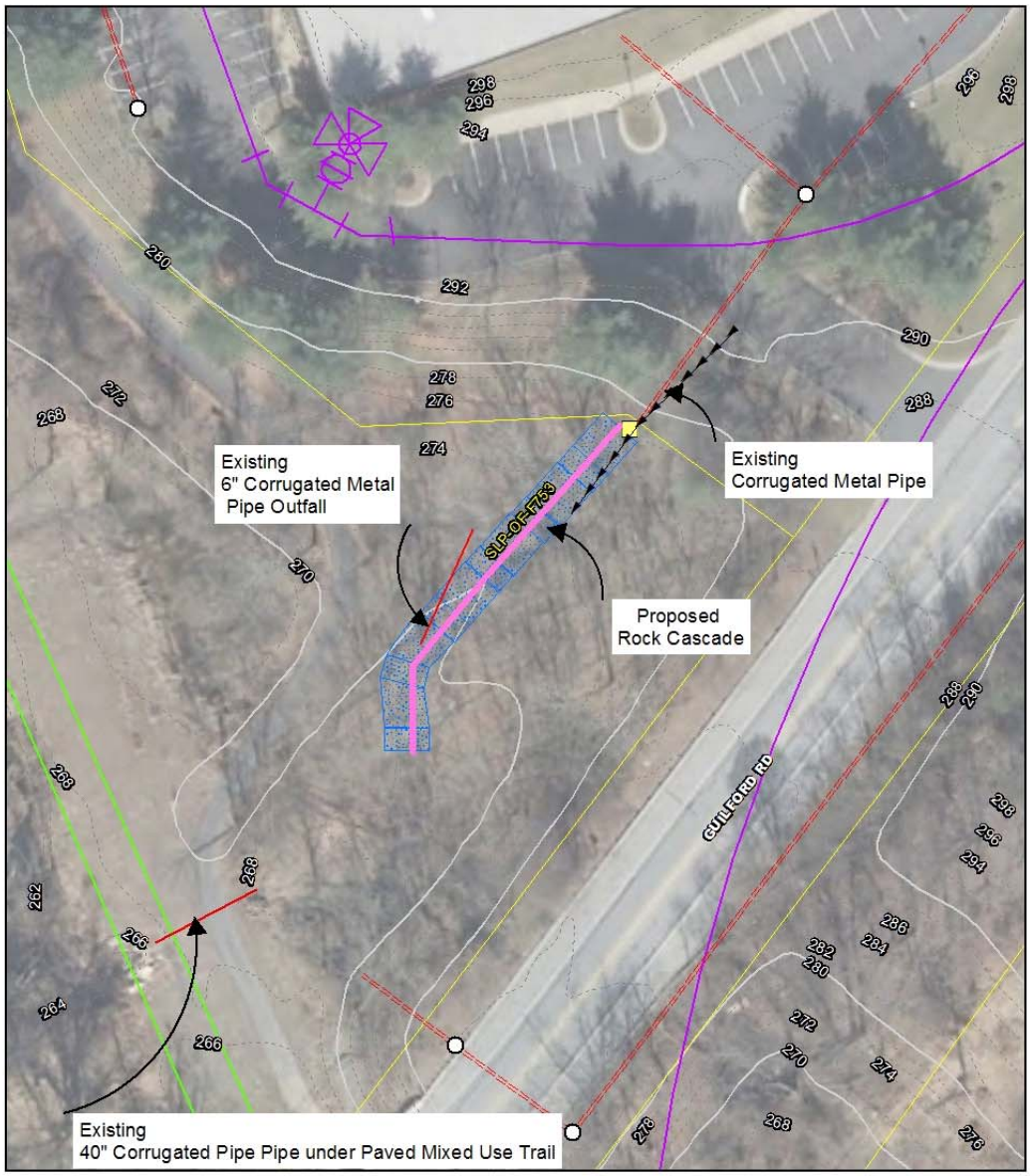
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F753

Site Name: 9053 Guilford Road

Contractor: Versar

Watershed: Little Patuxent River



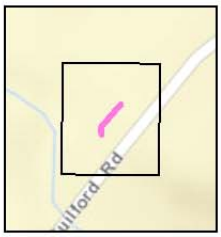


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F753

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

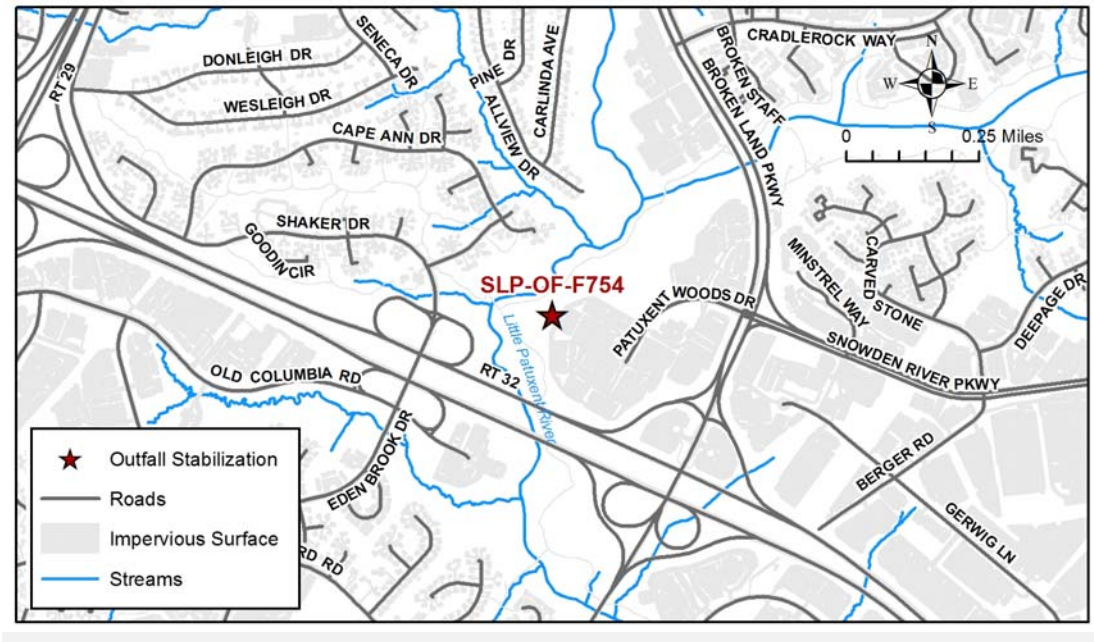
Site ID: SLP-OF-F754
Site Name: 9790 Patuxent Woods Drive
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Columbia Association
Multiple Owners

Existing Conditions:

SLP-OF-F754 is on land owned by Columbia Association but is adjacent to a private commercial property. The outfall is located within Department of Natural Resources and National Wetlands Inventory palustrine wetland boundaries, while the surrounding development is designated as Commercial, Industrial and Medium Density Residential under the 2010 Maryland Department of Planning Land Use/Land Cover.

The outfall is a concrete end section with an apron of crushed stone. The stones are about 3 in. in diameter and are being moved downslope by parking lot runoff. Discharge from the pipe formed a 1.5 ft. deep and 7 ft. long plunge pool in the rocks beneath the end section. The crushed stone is 23 ft. wide. An island of brush is located in the center of the rocks about 26 ft. from the end section. The channel is braided downstream of the island. The rock ends 76 ft. from the endwall, and the channel splits again. Here the outfall channel has a sandy bottom and shallower slope. The channel joins a dry sandy channel 137 ft. from the end section and follows a sewer right of way south to the Little Patuxent River.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F754
Site Name: 9790 Patuxent Woods Drive
Contractor: Versar
Watershed: Little Patuxent River

At outfall pipe, upstream end of outfall.

Standing midway along channel looking downstream at area of sediment deposit.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F754
Site Name: 9790 Patuxent Woods Drive
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:
A 100 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-754 because the slope is too steep (average slope is 11%) and the length does not allow enough pools for a step pool storm conveyance design. The outfall is located directly behind 9790 Patuxent Woods Dr. The end section and top of the outfall is best reached from the commercial property's private parking lot. The bottom of the outfall can also be reached from the sewer right of way however, anew access road will need to be constructed

Nearby Opportunities:
None recommended

Proposed Project Credit	
Length Restored (ft):	100
Impervious Area Treated Credit (ac.):	1
Cost Per Impervious Credit Acre:	$250,000.00

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F754

Site Name: 9790 Patuxent Woods Drive

Contractor: Versar

Watershed: Little Patuxent River

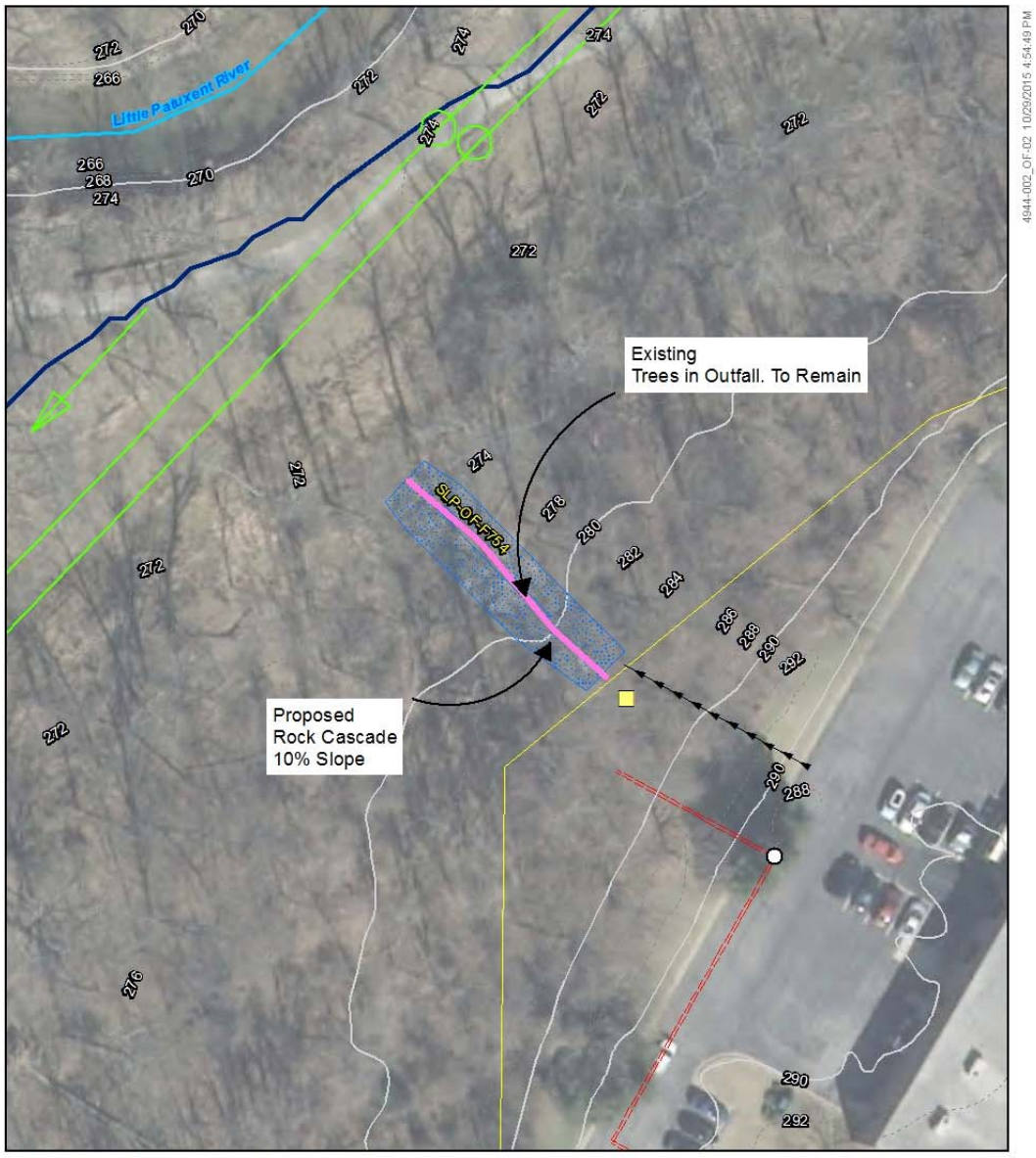


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F754

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F773

Site Name: Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River

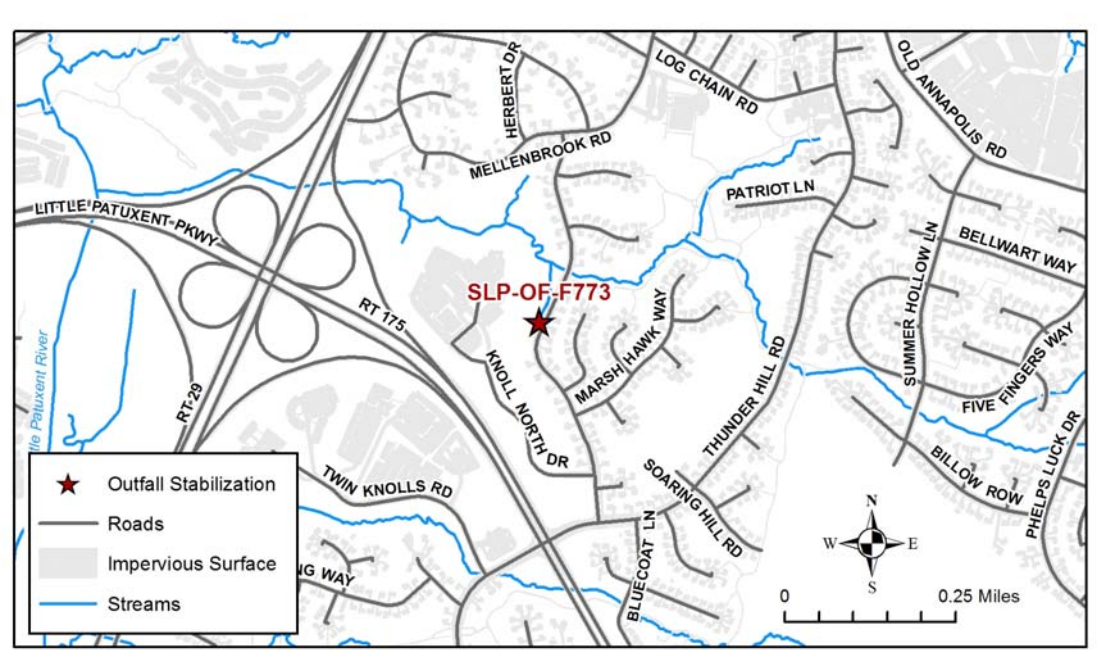
Proposed BMP Type: Outfall Stabilization

Stabilization Type: Riprap

Ownership: Columbia Association
Single Owner

Existing Conditions:

The area recommended for stabilization is fully contained within Columbia Association property, though it abuts the road right-of-way associated with Lightning View Road. The targeted outfall discharges flow onto a failing 20-25 ft. long concrete channel that is located in an intermittent stream.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F773

Site Name: Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River

Failing concrete channel downstream of 36 in. outfall. Photo taken looking downstream.

Failing concrete channel downstream of 36 in. outfall. Photo taken looking upstream shows that the stream is starting to cut around the left side of the concrete channel.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F773
Site Name: Lightning View Road
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
Some minor clearing of brush and small trees may be needed to access the channel.

Concept Description:
The proposed project will result in the removal of the failing concrete channel and the stabilization of the stream banks using riprap. The site can be accessed from Lightning View Road.

Nearby Opportunities:
None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	25	**Estimated Design Cost:**	$100,000.00
Impervious Area Treated Credit (ac.):	0.25	**Estimated Construction Cost:**	$100,000.00
Cost Per Impervious Credit Acre:	$920,000.00	**30% Contingency:**	$30,000.00
		Estimated Total Cost:	$230,000.00

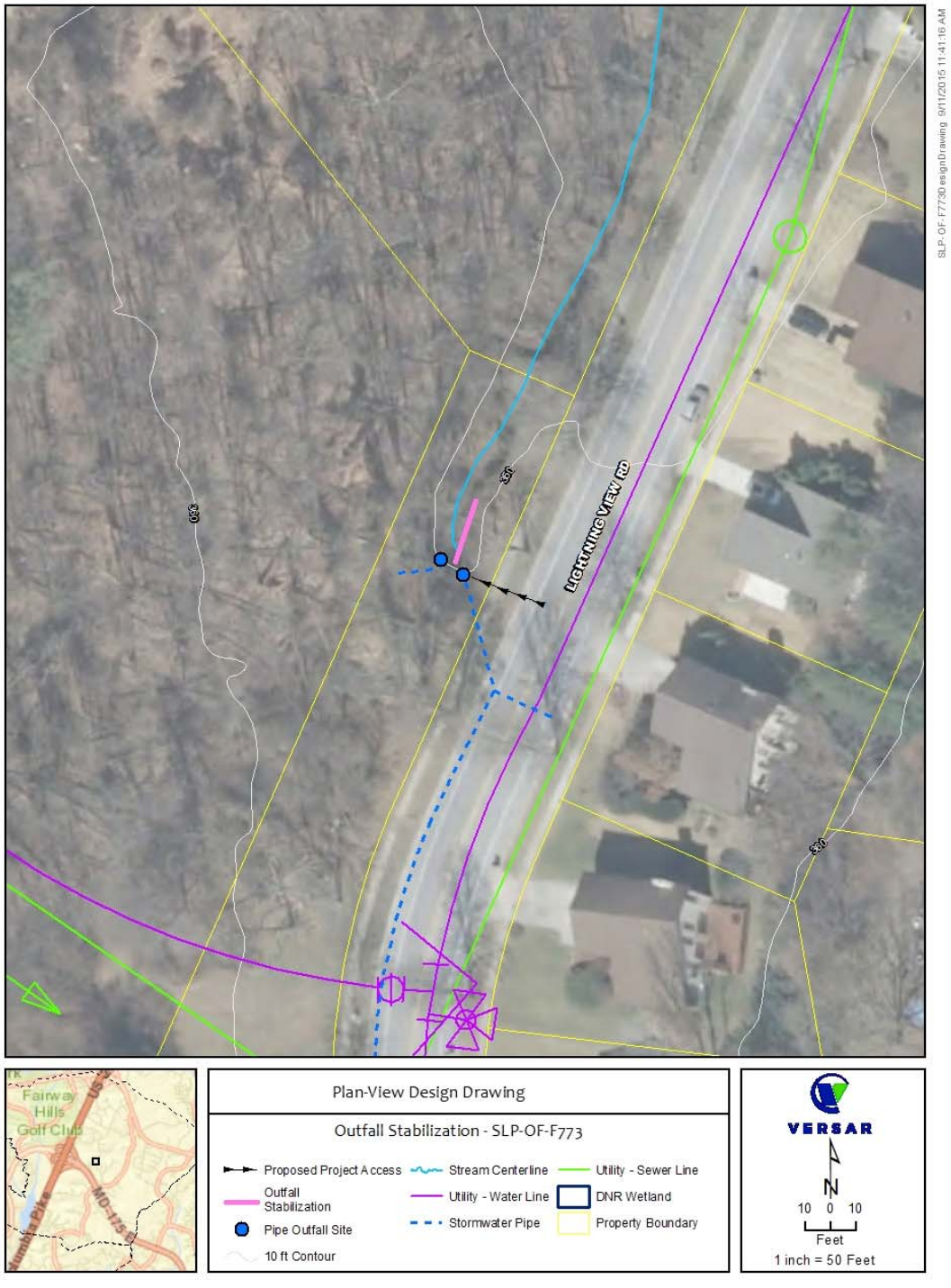
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F773

Site Name: Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F792

Site Name: 7363-7351 Hickory Log Circle

Contractor: Versar

Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization

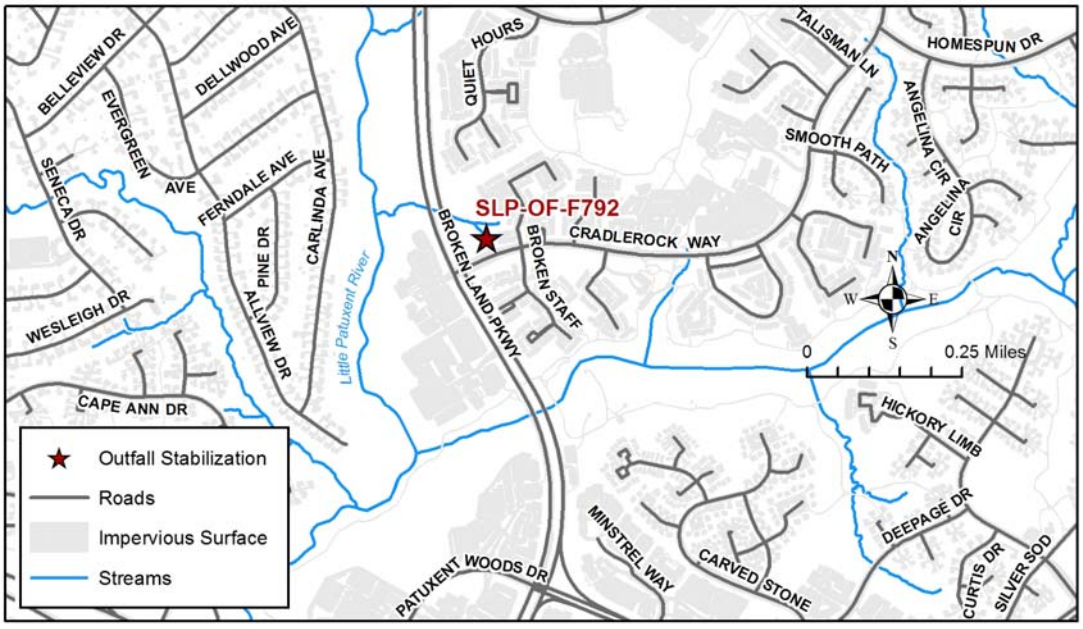
Stabilization Type: Riprap

Ownership: Columbia Association
Single Owner

Existing Conditions:

The outfall is located within Maryland Department of Natural Resources and National Wetlands Inventory palustrine wetland boundaries. The surrounding development is designated as Commercial and High Density Residential under the 2010 Maryland Department of Planning Land Use/Land Cover.

The outfall starts at a 3 ft. diameter corrugated metal pipe with a concrete endwall. Water cascades off the endwall into a plunge pool created by erosion. The plunge pool contains the remains of a concrete apron that erosion undermined and destroyed. The outfall is 16.5 ft. wide with 8 to 10 ft. high banks. About 171 ft. from the pipe, the outfall's left bank (looking upstream) is a peninsula between the outfall and a larger channel. The peninsula is about 10 ft. high and less than a foot at its narrowest, with vertical slopes on both sides. The peninsula continues for 34 ft. to the confluence of the outfall and the larger channel.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F792

Site Name: 7363-7351 Hickory Log Circle

Contractor: Versar

Watershed: Little Patuxent River

Looking at outfall pipe from top of bank.

Standing on bank downstream of outfall pipe in eroded area.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F792
Site Name: 7363-7351 Hickory Log Circle
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:
A 166 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-792 although this outfall has a slope < 5%. The primary reason for choosing this option is that it would receive more impervious treatment credit than a step pool storm conveyance. The outfall can be accessed from the parking area for townhouses, 7363-7351 Hickory Log Circle. The outfall is approximately 95 ft. northwest of the parking area.

Nearby Opportunities:
None recommended

Proposed Project Credit	
Length Restored (ft):	166
Impervious Area Treated Credit (ac.):	1.66
Cost Per Impervious Credit Acre:	$150,602.41

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

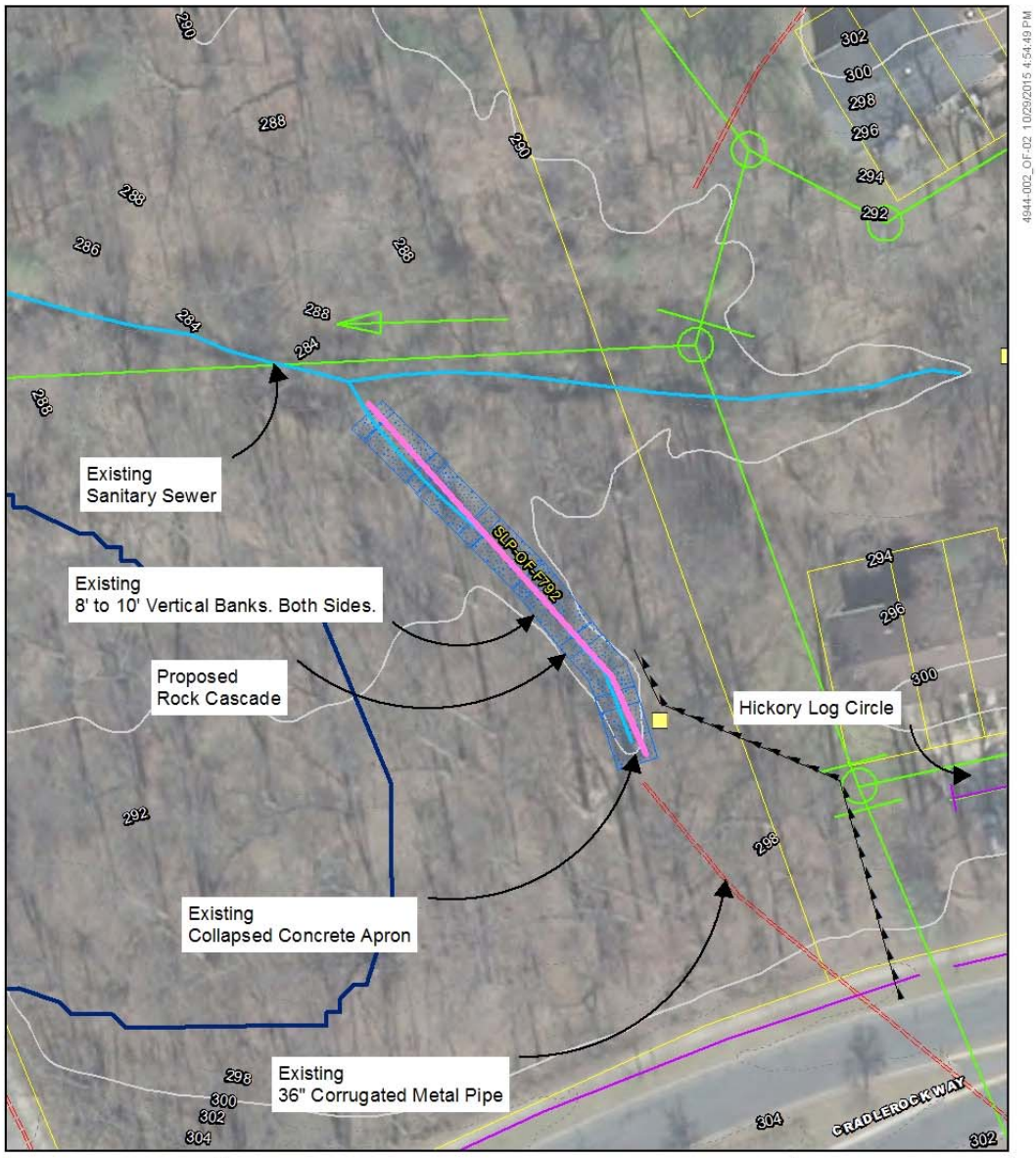
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F792

Site Name: 7363-7351 Hickory Log Circle

Contractor: Versar

Watershed: Little Patuxent River



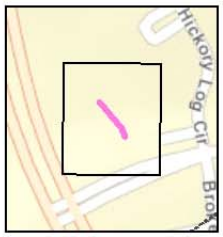


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F792

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

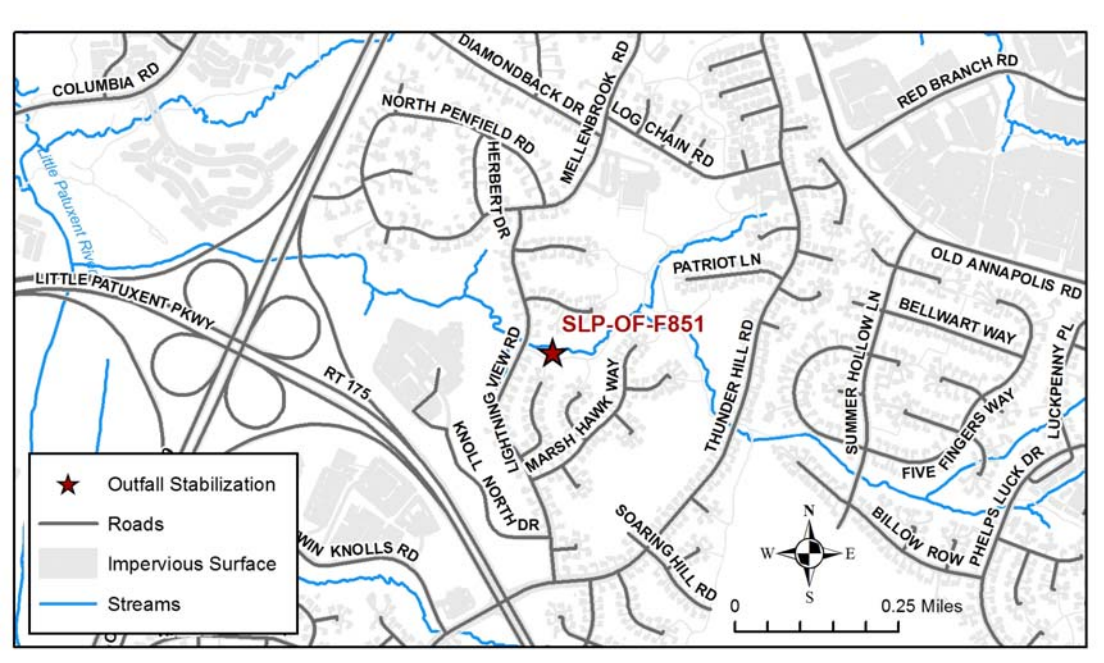
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F851
Site Name: 5377 Racegate Run
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Columbia Association
Single Owner

Existing Conditions:

SLP-OF-F851 is at the end of Racegate Run and the surrounding development that drains into the outfall is designated as Medium Density Residential under 2010 Maryland Department of Planning Land Use/Land Cover. The outfall starts at a concrete endwall which is completely submerged in a 19 in. deep pool. The pool is formed because the outfall channel downstream is higher than the pipe invert. The pool is 6 ft. wide and 12 ft. long. Several frogs were at the pool, indicating it may regularly remain wet between storms. Drainage travels through a shallow brushy channel downstream of the outfall. A paved, mixed-use path crosses the outfall via a wooden bridge 50 ft. from the pipe. The outfall continues for another 50 ft. downstream of the bridge in a similar shallow channel to a large box elder tree growing in the center of the channel. The box elder is holding back an eroding headcut. The channel enters a more formed channel behind the box elder, and then cuts its way to the stream, which has 5 ft.-10 in. banks.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F851
Site Name: 5377 Racegate Run
Contractor: Versar
Watershed: Little Patuxent River

The eroded segment of the outfall looking downstream from the box elder.

The 20 in. diameter box elder at the top of the eroded section, looking upstream.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F851
Site Name: 5377 Racegate Run
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:

A 53 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-851 although this outfall has a slope of less than 5%. The primary reason for choosing this option is that it will provide more impervious treatment credit than a step pool storm conveyance. The outfall can be reached either from the end of Racegate Run, or from Lightning View Road. Both access paths are owned by the Columbia Association.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	53
Impervious Area Treated Credit (ac.):	0.53
Cost Per Impervious Credit Acre:	$471,698.11

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

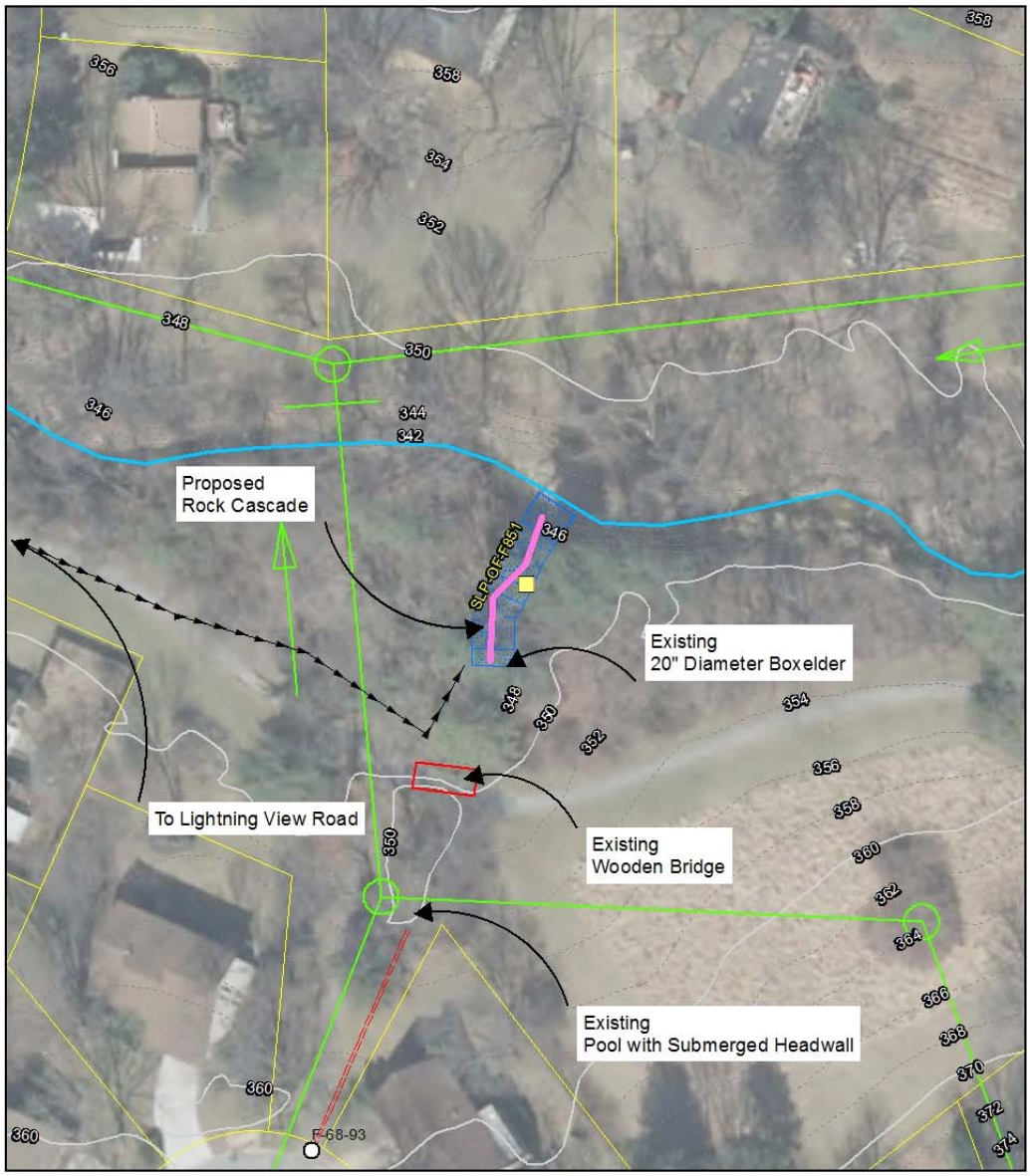
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F851

Site Name: 5377 Racegate Run

Contractor: Versar

Watershed: Little Patuxent River



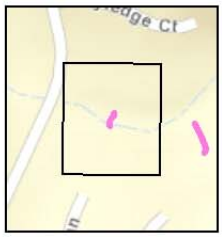


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F851

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F852

Site Name: Wolf River Lane and Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization

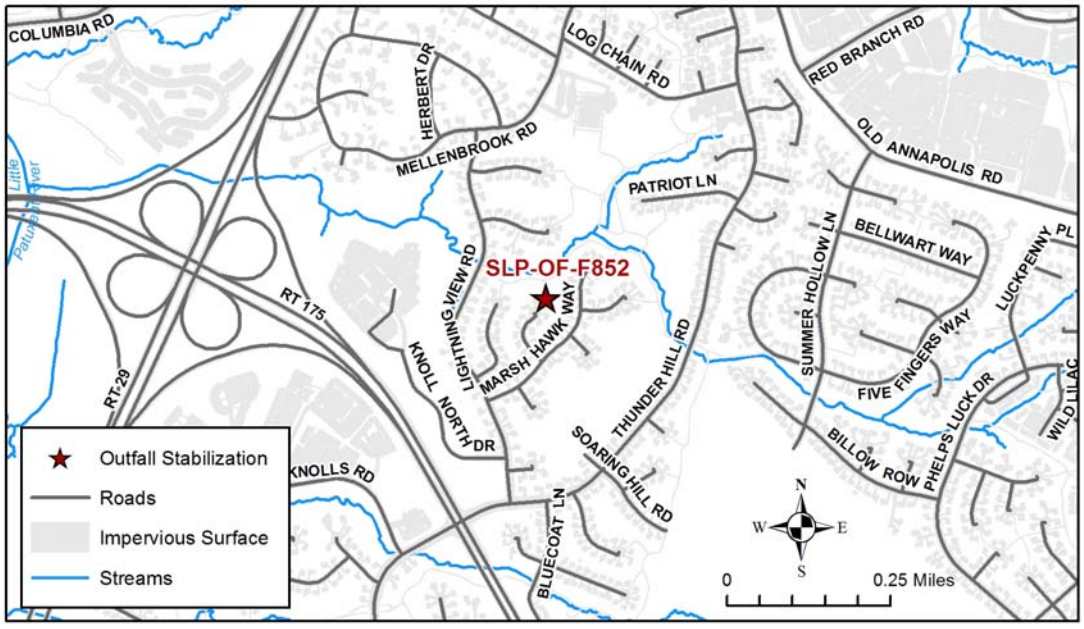
Stabilization Type: Riprap

Ownership: Columbia Association
Single Owner

Existing Conditions:

SLP-OF-F852 is at the end of Wolf River Lane and the surrounding development that drains to the outfall is designated as Medium Density Residential under 2010 Maryland Department of Planning Land Use/Land Cover. SLP-OF-F852 starts at a concrete endwall with a 18 in. reinforced concrete pipe. A concrete apron whose bottom has been eroded out is downstream of the pipe. A pool formed in the apron. Flow runs out of the pool along a shallow channel that is filled with debris, including leaves, riprap, and dumped yard waste. Several large trees grow directly adjacent to the channel, including a mulberry, box elders, ashes, and honey locusts.

SLP-OF-F852 joins with another outfall channel about 100 ft. downstream of the pipe. The other outfall begins at a pipe outlet 266 ft. upstream of the confluence. An unknown corrugated metal pipe discharges into the other outfall channel about 40 ft. upstream from the confluence. The corrugated pipe shows severe erosion around it. Long sections of the corrugated pipe (2 to 10 ft. long), including a metal end section, have disconnected from the pipe and washed farther down the outfall channels. Downstream of the confluence the outfall has 6 to 7 ft. high banks. SLP-OF-F852 has a series of headcuts and cascades upstream of the confluence to match its invert. The combined outfalls pass underneath a wooden bridge on a paved, mixed-use trail about 76 ft. downstream of the confluence. A headcut and heavy erosion is occurring at the bridge, and the banks are almost vertical. The outfalls continue in a steep narrow gully to the stream, which also has 7 ft. vertical banks.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F852

Site Name: Wolf River Lane and Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River

Standing on bridge for pedestrian trail looking at area of channel erosion.

Standing downstream of pedestrian bridge looking at eroded area.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F852

Site Name: Wolf River Lane and Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River

Constraints/Utilities:

The primary constraint is the trees along the outfall. The tree roots are helping reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.

Concept Description:

A 179 ft. long, rock cascade outfall stabilization is recommended for SLP-OF-852, although this outfall has a slope of less than 5%. The primary reason for choosing this option is that it will provide more impervious treatment credit than a step pool storm conveyance. The outfall can be reached either from the end of Wolf River Lane, or from Lightning View Road. Both access paths are owned by the Columbia Association.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	179
Impervious Area Treated Credit (ac.):	1.79
Cost Per Impervious Credit Acre:	$139,664.80

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

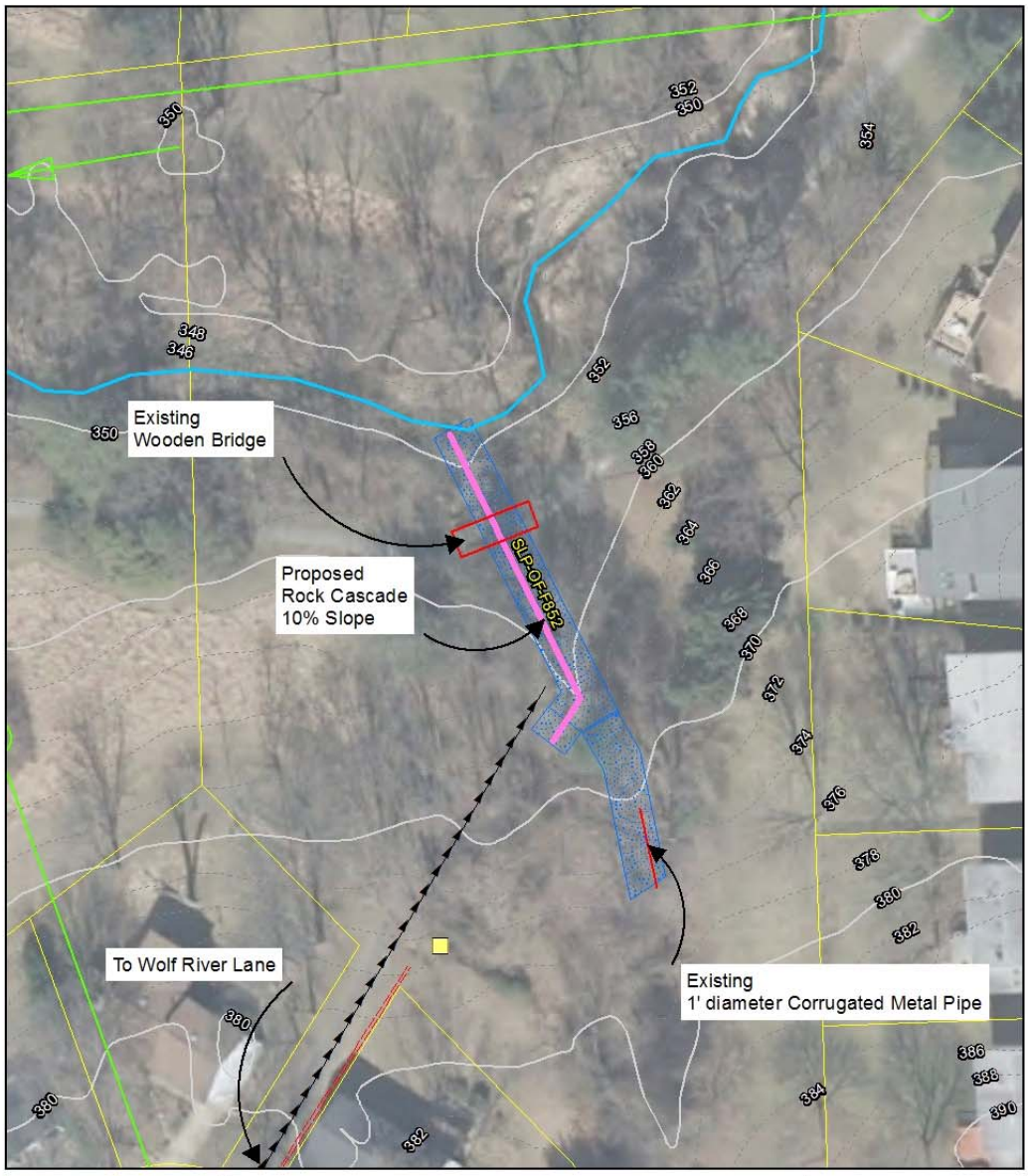
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F852

Site Name: Wolf River Lane and Lightning View Road

Contractor: Versar

Watershed: Little Patuxent River



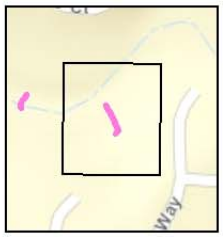


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F852

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

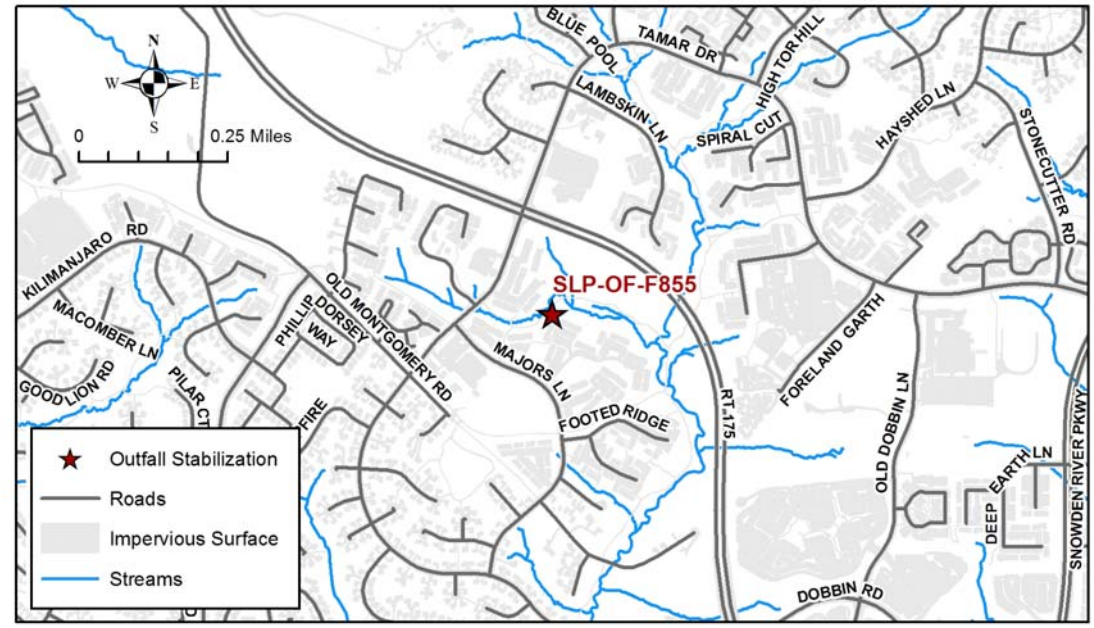
Site ID: SLP-OF-F855
Site Name: 6029 Majors Lane
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Columbia Association
Multiple Owners

Existing Conditions:

SLP-OF-F855 is on land owned by a private gardens style apartment complex. The outfall is behind 6029 Majors Lane. The surrounding development that drains into the outfall is designated as Institutional, Medium and High Density Residential under 2010 Maryland Department of Planning Land Use/Land Cover.

The outfall has a trapezoidal concrete apron with energy dissipaters installed. Downstream of the apron a cascade of debris, chunks of concrete, tree limbs, and trash, and a head cut cause the outfall to fall 5 ft. into a deep gully. Several large trees adjacent to the outfall are supporting the cascade and headcut. A paved, mixed-use trail crosses the gully on wooden bridge downstream of the headcut. The outfall enters a stream about 35 ft. downstream of the bridge.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F855
Site Name: 6029 Majors Lane
Contractor: Versar
Watershed: Little Patuxent River

Standing on apron at outfall pipe looking downstream at drop and bridge for pedestrian trail.

Standing under pedestrian bridge looking downstream at eroded bank.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F855
Site Name: 6029 Majors Lane
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:
The primary constraint is the trees along the outfall. The tree roots are helping hold reduce the erosion, and removing them to construct the rock cascade may destabilize the slope. Great care should be taken in planning and constructing the outfall stabilization to minimize the impact on the tree roots.
Access and some of the work may require coordination with the apartment complex to gain access to their land.

Concept Description:
A 64 ft. long, rock cascade outfall stabilization is recommended, because the existing outfall is too steep (average slope is 10%) for step pools. The outfall can be reached from the apartment complex, across private land. The SLP-OF-855 can also be reached via the mixed-use path from Tamar Drive, owned by the Columbia Association; however, a new stream crossing will need to be constructed for construction vehicles.

Nearby Opportunities:
None recommended

Proposed Project Credit	
Length Restored (ft):	64
Impervious Area Treated Credit (ac.):	0.64
Cost Per Impervious Credit Acre:	$390,625.00

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F855

Site Name: 6029 Majors Lane

Contractor: Versar

Watershed: Little Patuxent River

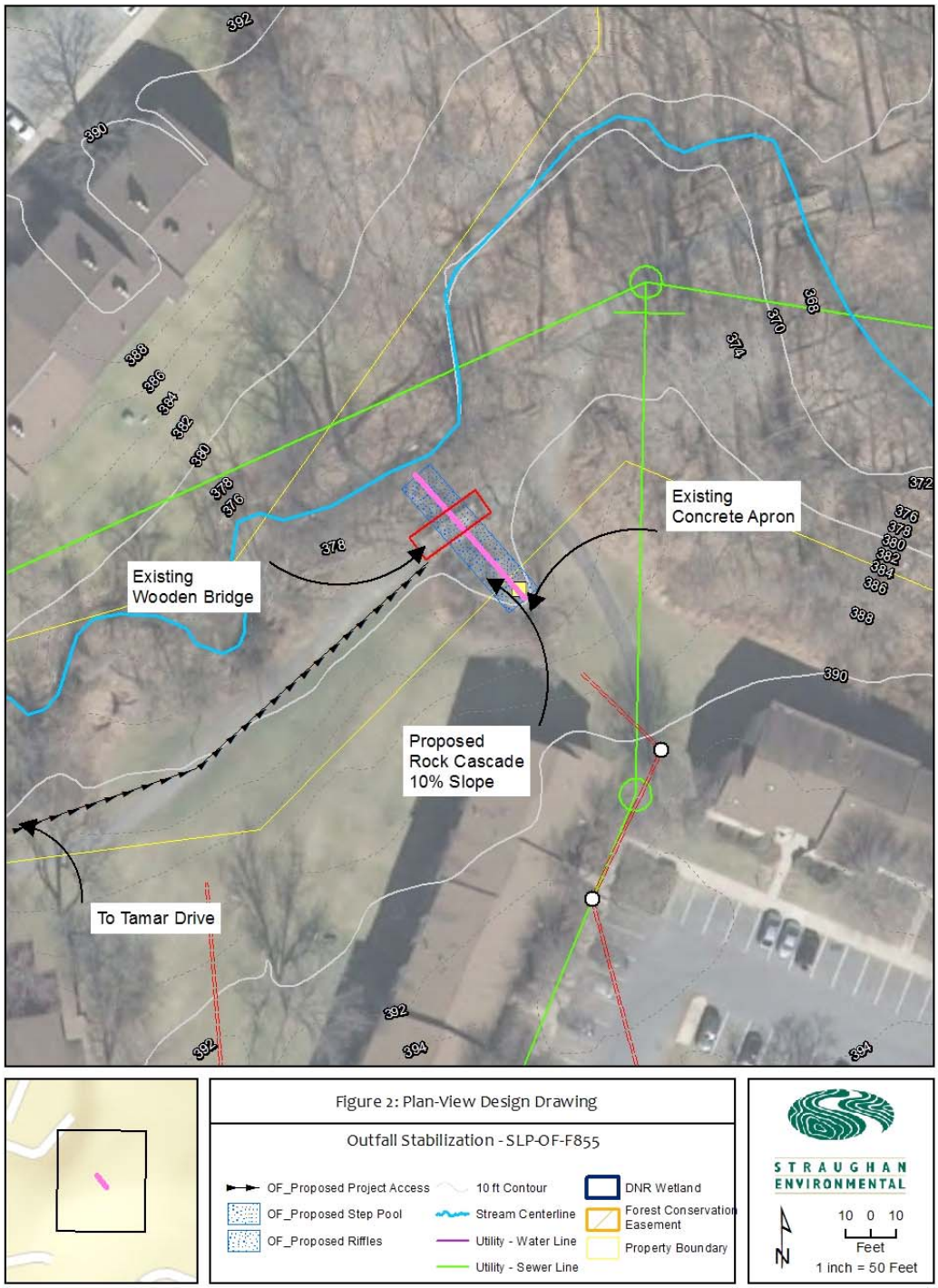


Figure 2: Plan-View Design Drawing

Outfall Stabilization - SLP-OF-F855

OF_Proposed Project Access
OF_Proposed Step Pool
OF_Proposed Riffles
10 ft Contour
Stream Centerline
Utility - Water Line
Utility - Sewer Line
DNR Wetland
Forest Conservation Easement
Property Boundary

STRAUGHAN ENVIRONMENTAL

10 0 10
Feet
1 inch = 50 Feet

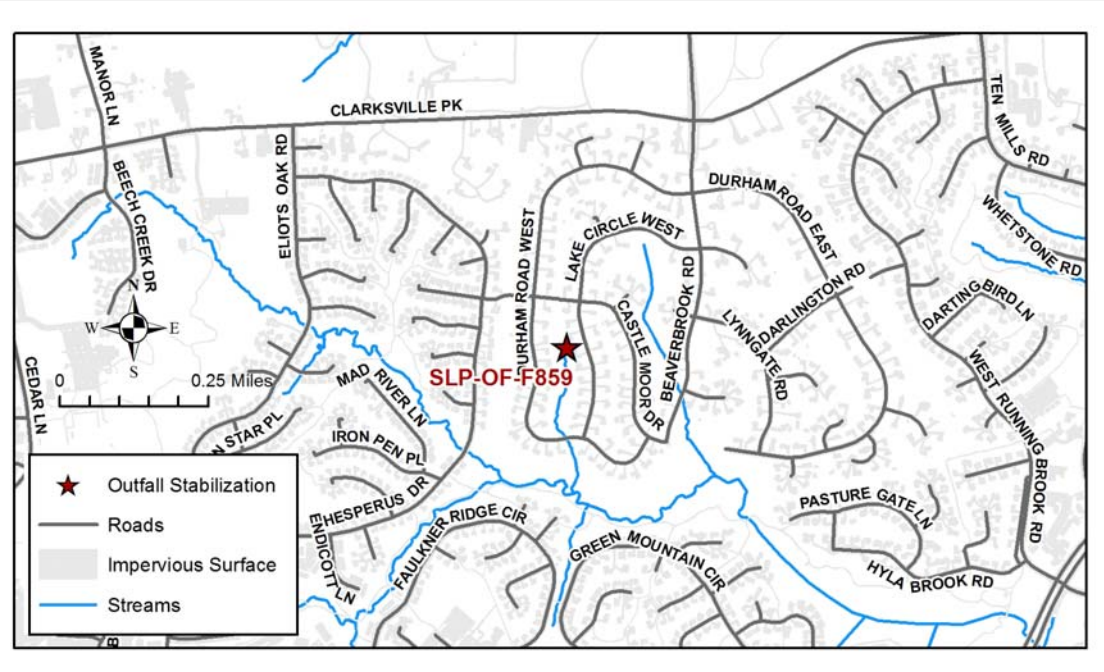
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F859
Site Name: Lake Circle West
Contractor: Versar
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Riprap
Ownership: Private- Residential
Multiple Owners

Existing Conditions:

The area recommended for stabilization is located on an intermittent channel that runs between several private residential yards. Two outfalls discharge into the proposed stabilization reach, one unmapped 30 in. diameter outfall along the right bank that appears to be newly installed, and one 15 in. diameter outfall along the left bank that is currently 2.5 ft. above the stream bed and in danger of collapsing. Stream bank erosion begins between the two outfalls and extends several hundred feet downstream.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F859

Site Name: Lake Circle West

Contractor: Versar

Watershed: Little Patuxent River

A 15 in. diameter concrete outfall headwall that is in need of replacement. The outfall currently sits 2.5 ft. above the bottom of the stream bed.

Erosion occurring along the right stream bank. Photo taken just downstream of failing outfall headwall.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F859
Site Name: Lake Circle West
Contractor: Versar
Watershed: Little Patuxent River

Constraints/Utilities:

Any work conducted on the proposed stabilization project will need to be coordinated with the owners of the adjacent residential properties. The need to access the site with heavy machinery may result in the removal of a few trees on residential properties.

Concept Description:

The proposed stabilization project will replace the failing concrete outfall headwall with a drop structure that discharges runoff closer to the current height of the stream bed. The project will also stabilize eroding banks along the receiving channel with riprap and minor grading. The site can be accessed by crossing through residential properties from either of the two roadways that it sits between.

Nearby Opportunities:

None recommended

Proposed Project Credit	
Length Restored (ft):	164
Impervious Area Treated Credit (ac.):	1.64
Cost Per Impervious Credit Acre:	$140,243.90

Costs	
Estimated Design Cost:	$100,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$230,000.00

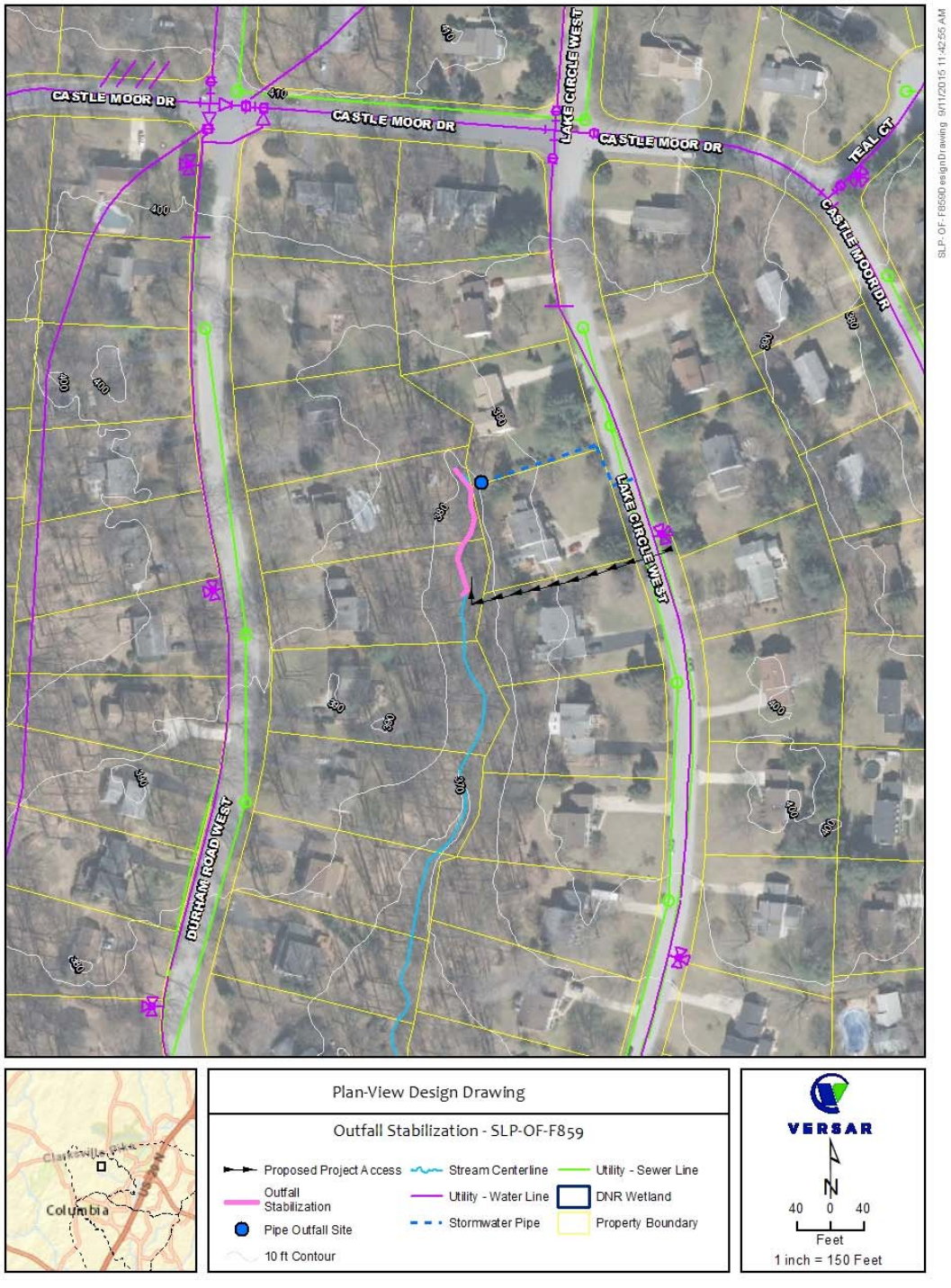
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SLP-OF-F859

Site Name: Lake Circle West

Contractor: Versar

Watershed: Little Patuxent River



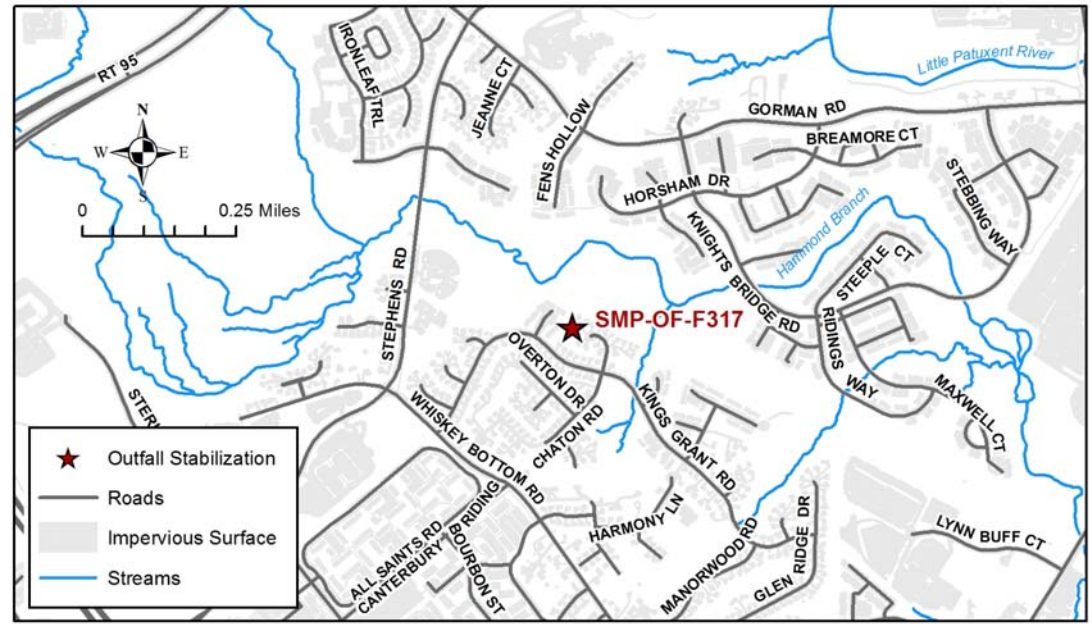
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F317
Site Name: End of Queens Guard Ct
Contractor: Biohabitats
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Natural Channel Design
Ownership: County Owned
Single Owner

Existing Conditions:

Examination of available plans and GIS, determines that the existing drainage area is approximately 15.6 ac. of which 3.5 are impervious (22%). Land use within the drainage area is primarily commercial development. The 36 in. CMP outfall discharges from an existing wet pond. A 211 lf. outfall channel runs through a wooded section from the end of Queens Guard Ct. down to a wetland/meadow within the BGE high voltage power line corridor . The channel is unstable with active headcuts and areas of erosion and deposition. There are many trees along the channel ranging from 6 to 20 in. diameter at breast height (DBH).



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F317

Site Name: End of Queens Guard Ct

Contractor: Biohabitats

Watershed: Little Patuxent River

Downstream view of upper portion.

Downstream view of lower portion.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F317
Site Name: End of Queens Guard Ct
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:

Tree impacts (more significant in the upper portion of the channel): between 10 and 15 trees that are 6 to 12 in. diameter at breast height (DBH) and appromiately four trees that are 15 to 20 in. DBH. Access through the powerline corridor is a good alternative depending on length of haul route and ownership agreement.

Concept Description:

The proposed Step Pool Storm Conveyance (SPSC) sized to convey the 10 year discharge would require a riffle cross section of approximately 8 ft. wide by 0.8 ft. deep with 6 in. cobble. With a 5 to 6% slope, this option appears to meet the filter bed area requirements (per Maryland Department of Environment) and provide full WQv treatment. Access is proposed off Queen Guards Ct and work would be entirely within the County property. The alternative access would be to use the existing BGE utility access path to the downstream end of the outfall channel. To reduce tree loss, an alternative design approach would be to use step pools or natural channel design sized for the 1 to 2 year discharge. This option would result in a total of 2 impervious ac. treated (rather than 3.5) based on the current credit guidance. This outfall stabilization project may be reclassified as a stream restoration project if the length of channel restored exceeds 200 lf.

Nearby Opportunities:

None recommended

Proposed Project Credit		Costs	
Length Restored (ft):	211	**Estimated Design Cost:**	$100,000.00
Impervious Area Treated Credit (ac.):	2	**Estimated Construction Cost:**	$100,000.00
Cost Per Impervious Credit Acre:	$115,000.00	**30% Contingency:**	$30,000.00
		Estimated Total Cost:	$230,000.00

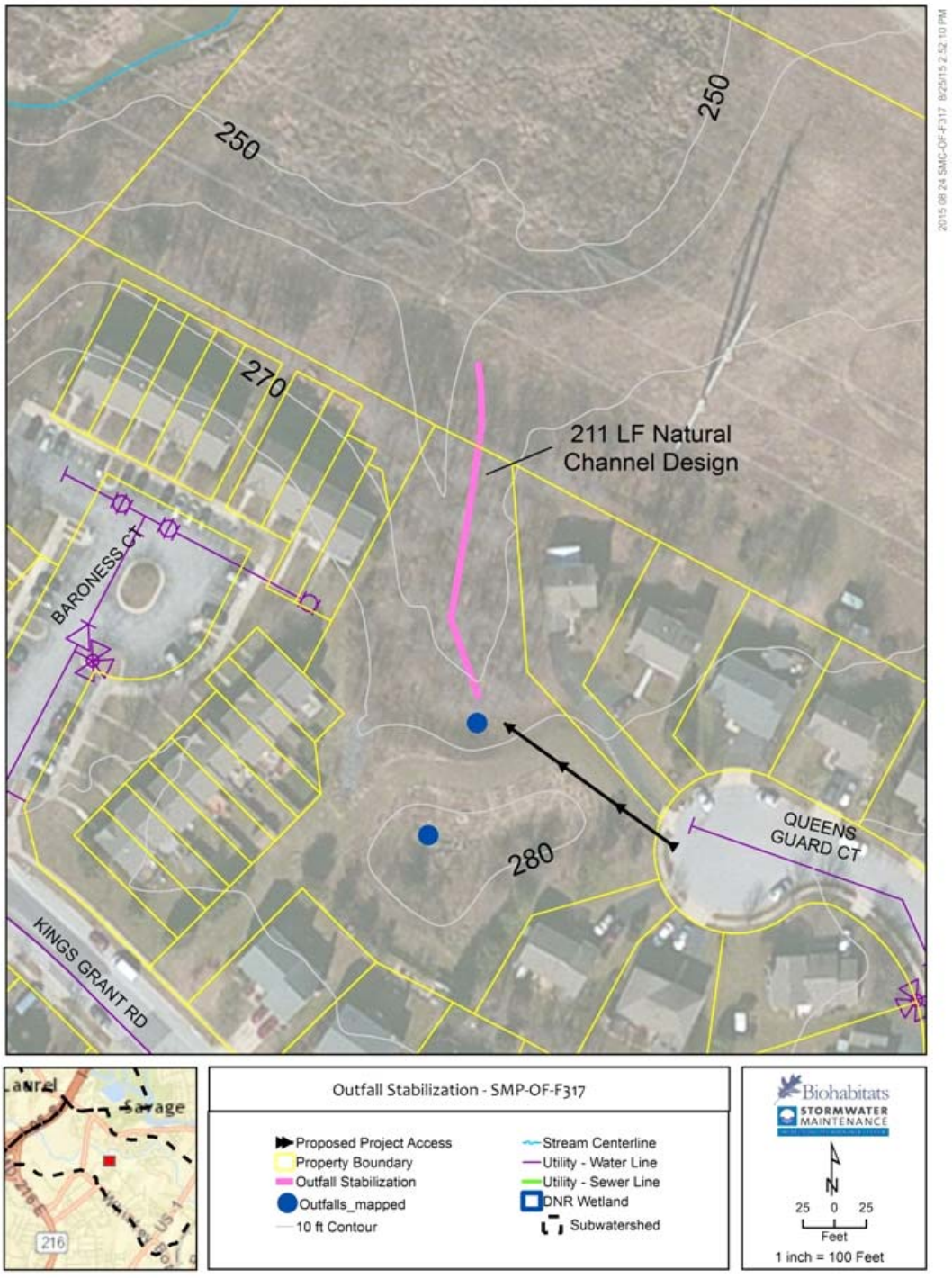
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F317

Site Name: End of Queens Guard Ct

Contractor: Biohabitats

Watershed: Little Patuxent River



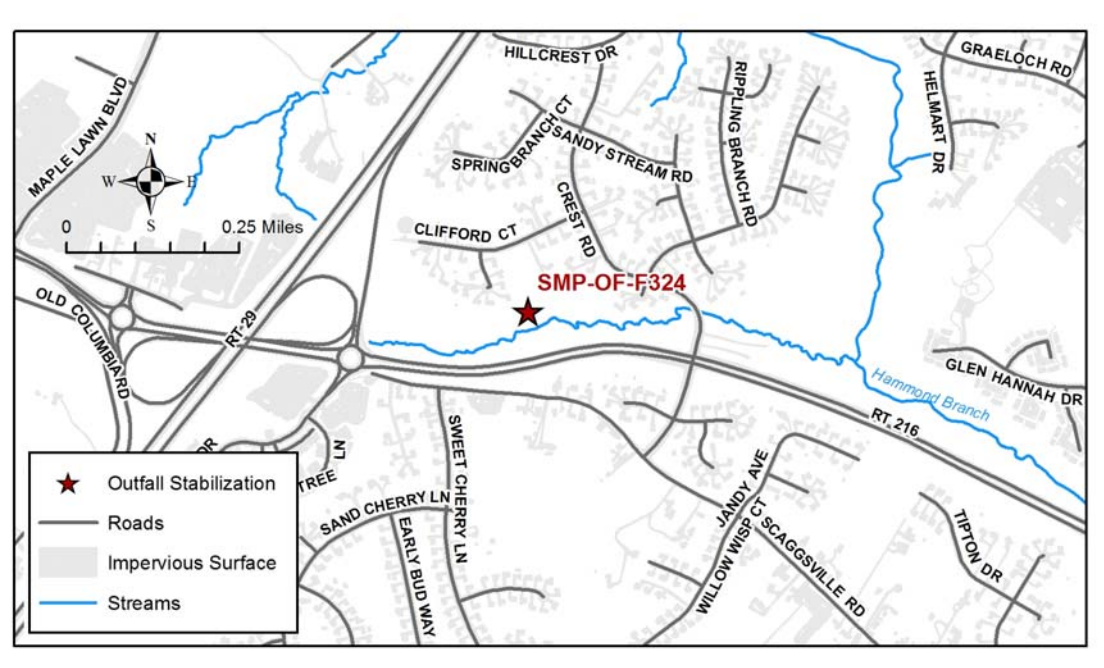
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F324
Site Name: End of Elsie's Way
Contractor: Biohabitats
Watershed: Little Patuxent River

Proposed BMP Type: Outfall Stabilization
Stabilization Type: Rock Step Pools & Grade Control
Ownership: County Owned
Multiple Owners

Existing Conditions:

The existing drainage area is 34.3 ac. of which 3.4 are impervious (9.8%), primarily single family residential land use. The dry pond appears to be holding water and discharges via a 30 in. concrete pipe/endwall down a 50 lf. steep eroding outfall channel where it enters a wetland area and the confluence with the mainstem another 90 lf. downstream. The downstream wetland area has small active headcuts. Pond and outfall are on County property with the downstream end potentially on PEPCO property. Gullies/rills observed along the steep slopes along the outside of the pond embankment and around the sewer manhole on the mainstem near the confluence.



Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F324

Site Name: End of Elsie's Way

Contractor: Biohabitats

Watershed: Little Patuxent River

Downstream view from outfall showing eroded unstable channel.

Upstream view of eroded channel.

Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F324
Site Name: End of Elsie's Way
Contractor: Biohabitats
Watershed: Little Patuxent River

Constraints/Utilities:
Sanitary sewer line adjacent to channel. Soils appear highly erosive. There may be wetlands downstream requiring additional permits. Potential coordination with PEPCO landowner.

Concept Description:
The proposed design is a rock/boulder step pool stabilization down the steep portion (50 lf.) followed by stabilization using grade control placed to address headcuts (90 lf.). Equipment access would be through County property, or off of Clifford Court through the PEPCO high voltage power line easement. The dry pond could be assessed for BMP conversion potential. In addition, stabilization is required around the pond and mainstem near the confluence, including the significant sink hole associated with the sewer line (not included in cost estimate).

Nearby Opportunities:
SMP-BC-F401 (pond conversion); Repair sinkhole on mainstem at confluence near sewer crossing.

Proposed Project Credit	
Length Restored (ft):	140
Impervious Area Treated Credit (ac.):	1.4
Cost Per Impervious Credit Acre:	$178,571.43

Costs	
Estimated Design Cost:	$120,000.00
Estimated Construction Cost:	$100,000.00
30% Contingency:	$30,000.00
Estimated Total Cost:	$250,000.00

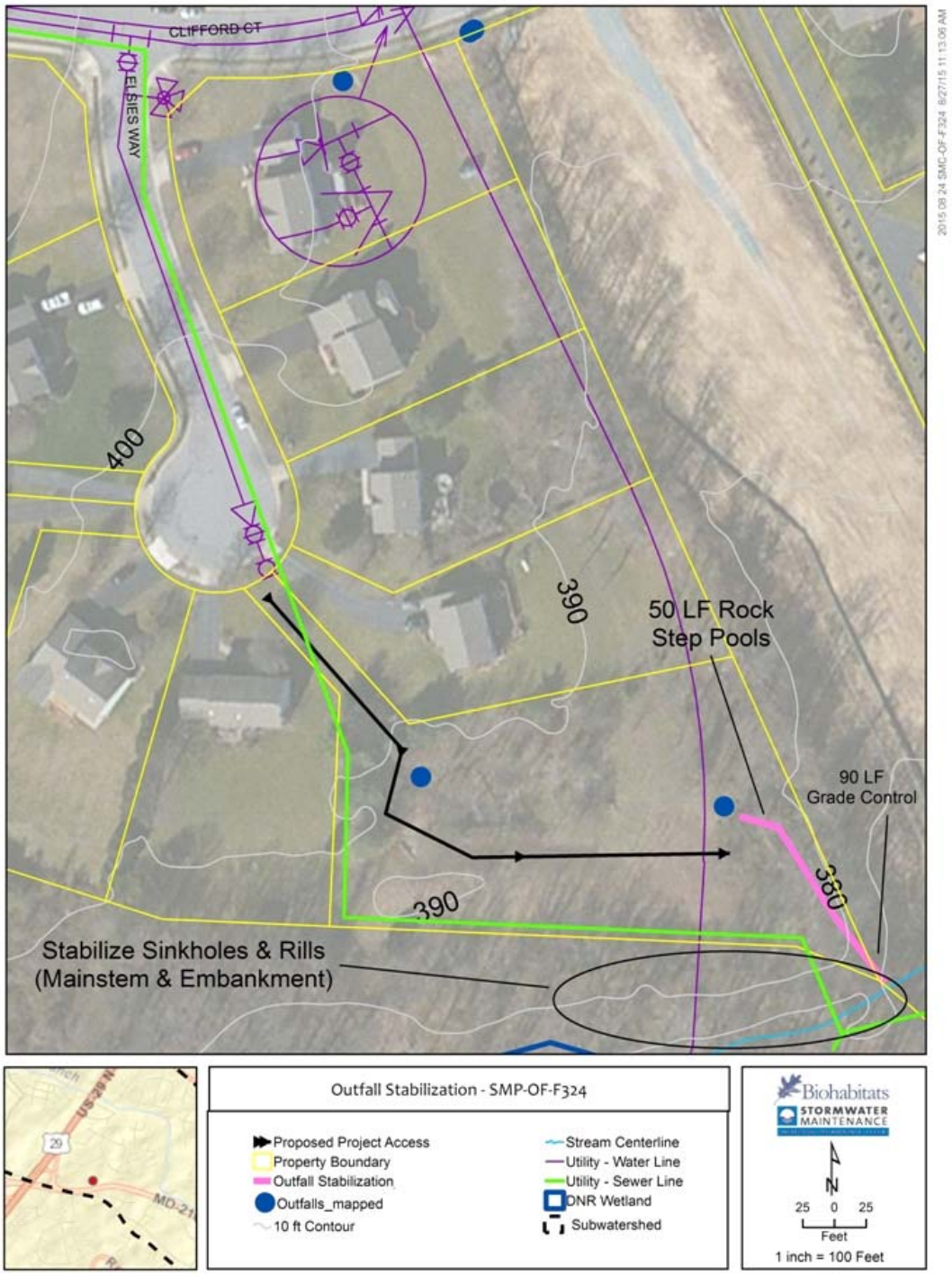
Howard County Watershed Assessment Concept Plan: Outfall Stabilization

Site ID: SMP-OF-F324

Site Name: End of Elsie's Way

Contractor: Biohabitats

Watershed: Little Patuxent River



Project Overview: Dead End of Durham Road East (SLP-BC-D774)

Project Type:	Convert dry pond to an extended detention shallow wetland with micropools and forebays
Total Cost:	$347,175 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – "Durham Road East – Section 2, Area 1"; 5th Election District Subdivision – Beaverbrook Address – 5304 Durham Road East Access – End of Durham Road East at T-Turn around ADC Map 15-F03 MS Link 100078
Land Use:	Residential
Ownership:	HOA
Maintenance Responsibility:	Public
Drainage Area:	53.11 acres
Impervious Area:	10.31 acres (19.41%)
Surface Soils:	0.2% Co: Codorus and Hatboro silt loams, 0-3% slopes 62.7% GfB: Gladstone-Urban land complex, 0-8% slopes 14.9% GfC: Gladstone-Urban land complex, 8-15% slopes 22.2% GuB: Glenville-Urban land-Udorthents complex, 0-8% slopes Classification: Hydrologic Soil Group, Type B Hydrologic Soil Group, Type C

Existing Conditions

The dry pond is owned by the homeowners association for the surrounding community. Drainage is collected from Durham Road East, Woodman Court, Lynngate Road, Beavertrail Court, and Flattail Court via a main stormdrain system and discharged into the pond via two outfalls. The two outfalls discharge southern and northern ends of the pond where stormwater runoff is conveyed directly into the dry pond. A 48" RCCP pipe conveys the stormwater under Durham Road East after passing the riser structure where the stormwater is ultimately discharged into the nearby stream.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a shallow wetland. The forebays, pilot channels and micropool will be designed to retain existing vegetation to the maximum extent possible. The existing riser will be relocated and modified based on the required micropool and stormwater quantity criteria. A stable outfall will also be provided downstream of the adjusted principal spillway. A more detailed analysis may show that this design could provide channel protection[1].

An extended detention shallow wetland was chosen because the drainage area is sufficient, there is adequate head, and retaining existing vegetation was desirable. Channel protection and flood control can likely be incorporated into this type of retrofit. Shallow wetlands have high community acceptance, provide high habitat quality, are relatively easy to maintain, and are not a safety concern.

The extended detention shallow wetland layout will be similar to Figure G in Appendix B, but it will contain two forebays.

Design Parameter	**Value**
Drainage Area (Ac)	53.11
Percent Impervious (I)	19.41
Volumetric runoff coefficient (R_v)	0.225
Soil specific recharge factor (S)	0.23
Water quality volume (WQ_v) (ft^3)	43,322.24
Recharge Volume (Re_v) (ft^3)	10,002.94
Pretreatment Volume (25% WQ_v) (ft^3)	10,830.56

[1] Channel Protection Volume calculations were not performed as part of this conceptual design analysis.

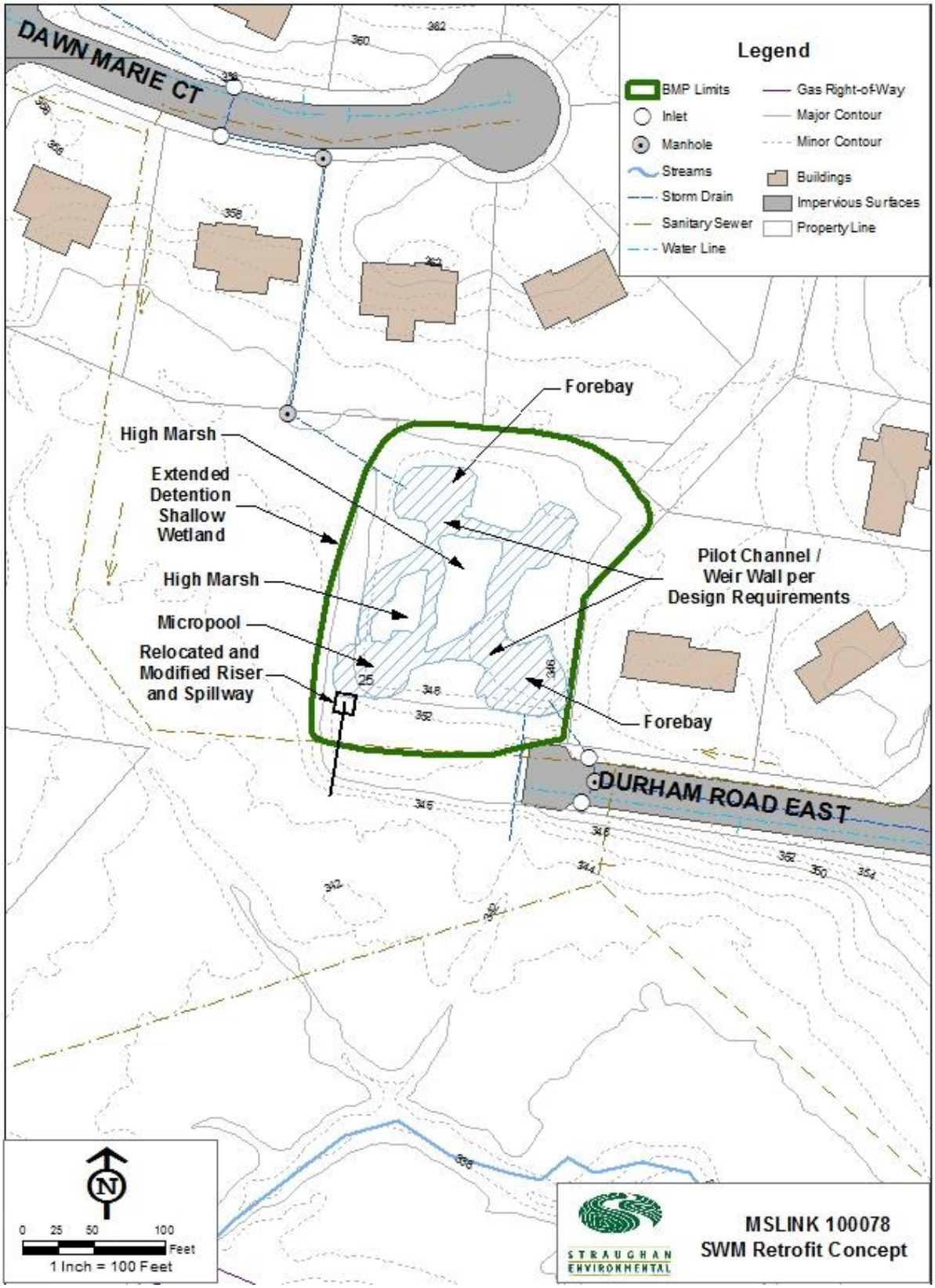


Figure 1. Concept Design Plan View at dead end of Durham Road East, SLP-BC-D774

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
WETLANDS / MICROPOOLS				
Excavate and Remove (incl. transportation)	2000	cy	$40.00	$80,000.00
Earthwork/Grading	1050	cy	$16.00	$16,800.00
Remove Wall	130	lf	$50.00	$6,500.00
Overflow Structure	1	ea	$16,000.00	$16,000.00
48" Storm Sewer	70	lf	$185.00	$12,950.00
Stabilized Outfall (Rip-rap)	50	SY	$250.00	$12,500.00
Planting	0.7	Ac	$12,000.00	$8,400.00
TOTAL CONSTRUCTION COSTS				**$171,150.00**
ENGINEERING MANAGEMENT				
Engineering / Permitting / Construction Mgmt				$200,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$51,345.00
TOTAL PROJECT COSTS				**$442,495.00**

Constructability

Design & Construction:

Access: End of Durham Road East at T-Turn around

Utilities:

Other impacts:

Existing Condition Photograph

Figure 2. SWM pond at dead end of Durham Road East, SLP-BC-D774

Calculations

PROJECT: Howard County Retrofit
LOCATION: 5304 Durham Road East
DEVELOPER:

DATE: 1/21/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$

= **0.9945** **acre-feet**

= **43322.24** **cubic-feet**

where:

P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover

Impervious Cover = **10.31** acres
Total Site Area = **53.11** acres
% Impervious Cover = **19.41%**

therefore, Rv = **0.225**

COMPUTE RECHARGE VOLUME (Re_v):

$(Rev) = \frac{[(S)(R_v)(A)]}{12}$

= **0.2296** **acre-feet**

= **10002.94** **cubic-feet**

where:

S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.225**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
41.22	B	0.26	10.72
11.89	C	0.13	1.55
	D	0.07	0.00
53.11		**Computed Average S =**	**0.23**

Project Overview: Tree Swallow Court (SLP-BC-D780)

Project Type:	Flood control dry pond to extended detention with micropool and forebay
Total Cost:	$250,000 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – "Cedar Acres – Section 1"; 5th Election District Subdivision – Cedar Acres Address – 6047 Tree Swallow Court Access – Between 6047 and 6068 Tree Swallow Court or from Cedar Lane just north of intersection with Hill Top Lane ADC Map 15-C08 MS Link 156992
Land Use:	Residential
Drainage Area:	20.54 acres
Ownership:	HOA
Maintenance Responsibility:	Public
Impervious Area:	6.45 acres (31.40%)
Surface Soils:	100% GfB: Gladstone-Urban land complex, 0-8% slopes Classification: Hydrologic Soil Group, Type B

Existing Conditions

This facility is designed as a dry pond to provide stormwater management associated with the Cedar Acres subdivision development and is owned by this homeowners association. Runoff is conveyed via two main storm drain systems that discharge at two locations into the pond. The facility appears to be an excavated pond with landscaped trees planted on the two sides of pond facing the apartments. Concrete low flow channels direct runoff from the storm drain outfalls to the riser structure near Cedar Lane. The existing 36" RCP principal spillway of the pond connects to an existing 30" RCP storm drain system that immediately crosses under Cedar Lane. Water quality treatment is not currently being provided in this facility.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a "Micropool" Extended Detention Pond. The forebay, pilot channel, and Micropool (3 to 4 feet deep) will be designed to retain adjacent vegetation to the maximum extent possible. The pond bottom is to be excavated to increase capacity and the existing outfall structure modified to store the required management volumes. A more detailed analysis may show that this design could provide channel protection while satisfying freeboard requirements[1]. The 36" RCP principal spillway of the pond connects to an existing 30" RCP storm drain system that immediately crosses under Cedar Lane. A detailed hydraulic gradient analysis of this downstream storm drain is necessary to determine the effects on peak discharge capacity and on water surface elevations in the pond.

An extended detention pond with micropool was chosen because the drainage area to the facility is greater than 10 acres and the available dry storage capacity that can be reallocated to meet the current regulations to the maximum extent practicable.

The micropool extended detention pond layout will be similar to Figure A in Appendix B.

Design Parameter	**Value**
Drainage Area (Ac)	20.54
Percent Impervious (I)	31.40
Volumetric runoff coefficient (R_v)	0.333
Soil specific recharge factor (S)	0.26
Water quality volume (WQ_v) (ft^3)	24,800.16
Recharge Volume (Re_v) (ft^3)	6,448.04
Pretreatment Volume (25% WQ_v) (ft^3)	6,200.04

[1] Channel Protection Volume calculations were not performed as part of this conceptual design analysis.

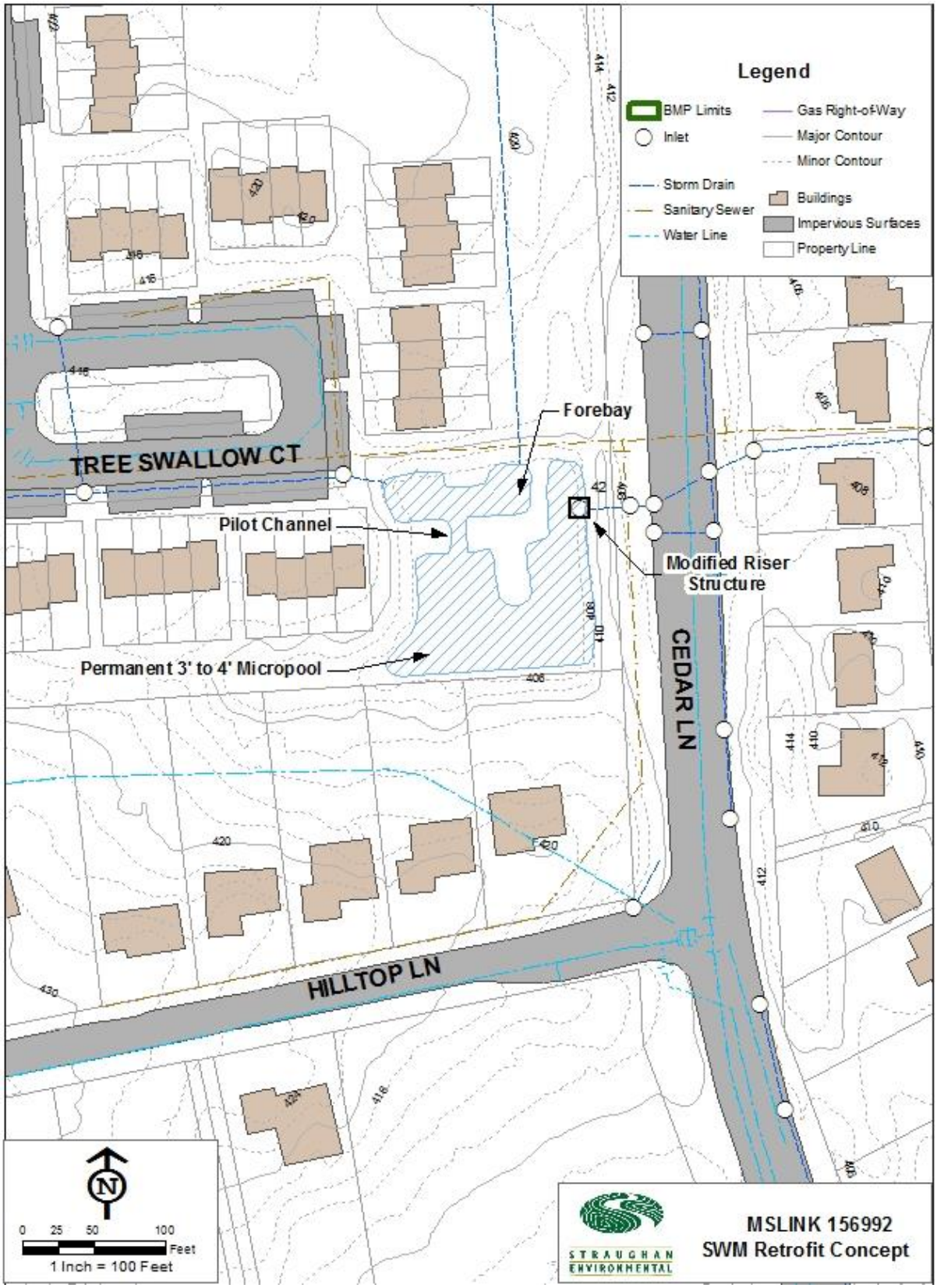


Figure 1. Concept Design Plan View at 6047 Tree Swallow Court, SLP-BC-D780

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
EXTENDED DETENTION WITH FOREBAY				
Excavate and Remove (incl. transportation)	1150	cy	$40.00	$46,000.00
Modify Overflow Structure	1	LS	$5,000.00	$5,000.00
Plants (Seeding, Trees, Shrubs, etc.)	1	LS	$10,000.00	$10,000.00
TOTAL CONSTRUCTION COSTS				**$79,000.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Mgmt.				$100,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$23,700.00
TOTAL PROJECT COSTS				**$222,700.00**

Constructability

Design & Construction:

Access: Between 6047 and 6068 Tree Swallow Court, or from Cedar Lane just north of intersection with Hilltop Lane.

Utilities: Howard County GIS suggests that there is a sewer main immediately north of the facility that crosses a storm drain system draining into the pond and a sewer main immediately east of the facility that crosses the principal spillway.

Other Impacts:

Existing Condition Photograph

Figure 2. SWM pond at 6047 Tree Swallow Court, SLP-BC-D780

Calculations

PROJECT: Howard County Retrofit
LOCATION: 6047 Tree Swallow Court
DEVELOPER:

DATE: 1/21/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$$

= **0.5693** **acre-feet**
= **24800.16** **cubic-feet**

where:
P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover
Impervious Cover = **6.45** acres
Total Site Area = **20.54** acres
% Impervious Cover = **31.40%**
therefore, Rv = **0.333**

COMPUTE RECHARGE VOLUME (Re_v):

$$(Rev) = \frac{[(S)(R_v)(A)]}{12}$$

= **0.1480** **acre-feet**
= **6448.04** **cubic-feet**

where:
S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.333**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
20.54	B	0.26	5.34
	C	0.13	0.00
	D	0.07	0.00
20.54		**Computed Average S =**	**0.26**

Project Overview: 6480 Dobbin Road, Dobbin Road Commercial Business Center (SLP-BC-D792)

Project Type:	Convert dry pond to extended detention pond with micropool and forebay
Total Cost:	$271,359 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – "Commercial Business Center– Section 1, Area 1"; 6th Election District Subdivision – Dobbin Road Commercial Business Center Address - 6480 Dobbin Road Access – 6480 Dobbin Road from south side parking lot ADC Map 16-C10 MS Link 1732
Land Use:	Commercial
Ownership:	Private
Maintenance Responsibility:	Private
Drainage Area:	14.77 acres
Impervious Area:	9.35 acres (63.30%)
Surface Soils:	92.7% UuB: Urban land-Udorthents complex, 0-8% slopes 5.2% UcD: Urban land-Udorthents complex, 8-25% slopes 2.1% WcB: Watchung silt loam, 3-8% slopes Classification: Hydrologic Soil Group, Type D

Existing Conditions

The facility is privately owned and is believed to be owned by the Columbia Business Center C/O Greenfield Partners LLC Association. Drainage is collected from the Dobbin Road Commercial Business Center via a main stormdrain system and discharges directly in front of the riser structure. The majority of the stormwater runoff is short circuiting due to the outfall's proximity to the existing riser structure, where it discharges directly into the nearby steam.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a "Micropool" Extended Detention Pond. The forebay, pilot channel, and micropool will be designed to retain existing vegetation to the maximum extent possible. A flow splitter is to be installed to allow the stormwater pipe to discharge to the forebay and micropool. An apron will be installed where the stormdrain discharges to the micropool. The existing riser will be moved to the east side of the pond based on the required micropool and stormwater quantity requirements. A stable outfall also will be provided downstream of the adjusted principal spillway. A more detailed analysis may show that this design could provide channel protection[1].

An extended detention pond with micropool with a forebay was chosen because an anti-clogging device will be installed (since the drainage area is less than 10 acres), adequate head is available, and since space is limited a micropool ED requires a relatively small footprint. The limited footprint available for water quality control limits us to treatment of 2/3rd of the WQv or 22,129.32 ft^3.

The micropool extended detention pond layout will be similar to Figure A in Appendix B.

Design Parameter	**Value**
Drainage Area (Ac)	14.77
Percent Impervious (I)	63.30
Volumetric runoff coefficient (R_v)	0.620
Soil specific recharge factor (S)	0.07
Water quality volume (WQ_v) (ft^3)	33,227.21
Expected maximum WQv treatment (ft^3)	*22,129.32*
Recharge Volume (Re_v) (ft^3)	2,325.90
Pretreatment Volume (25% WQ_v) (ft^3)	8,306.81

[1] Channel Protection Volume calculations were not performed as part of this conceptual design analysis.

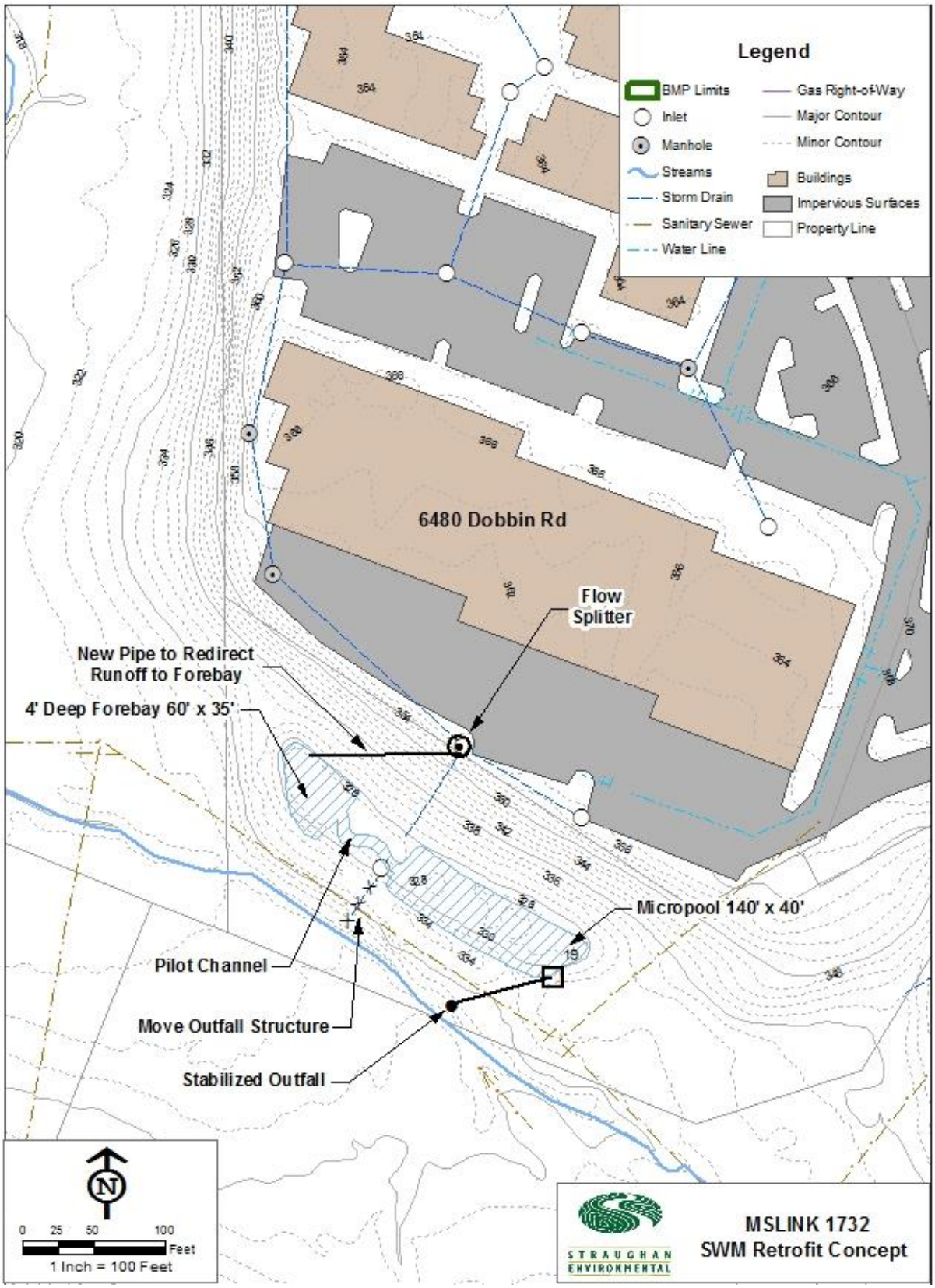


Figure 1. Concept Design Plan View 6480 Dobbin Road, Dobbin Road Commercial Business Center, SLP-BC-D792

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
EXTENDED DETENTION/MICROPOOL WITH FOREBAY				
Excavate and Remove (incl. transportation)	1025	cy	$40.00	$41,000.00
Modify MH with Flow splitter	1	LS	$5,000.00	$5,000.00
Remove 36" Storm Sewer	50	lf	$35.00	$1,750.00
Overflow Structure	1	LS	$16,000.00	$16,000.00
24" Storm Sewer	100	lf	$96.00	$9,600.00
36" Storm Sewer	70	lf	$144.00	$10,080.00
Stabilization of Outfall (Rip-rap)	20	sy	$250.00	$5,000.00
Plants (Seeding, Trees, Shrubs, etc.)	1	LS	$10,000.00	$10,000.00
TOTAL CONSTRUCTION COSTS				**$116,430.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Management				$200,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$34,929.00
TOTAL PROJECT COSTS				**$371,359.00**

Constructability

Design & Construction:	None
Access:	6480 Dobbin Road from south side parking lot
Utilities:	A sewer line appears to exist along the southern and eastern sides of the pond and should be considered during final design
Other Impacts:	Possible wetland impacts. Wetland delineation may be required.

Existing Condition Photograph

Figure 2. SWM pond at 6480 Dobbin Road, Dobbin Road Commercial Business Center, short circuiting dewatering structure, SLP-BC-D792

Calculations

PROJECT: Howard County Retrofit
LOCATION: 6480 Dobbin Road
DEVELOPER:

DATE: 1/21/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$

= **0.7628** **acre-feet**
= **33227.21** **cubic-feet**

where:
P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover
Impervious Cover = **9.35** acres
Total Site Area = **14.77** acres
% Impervious Cover = **63.30%**
therefore, Rv = **0.620**

COMPUTE RECHARGE VOLUME (Re_v):

$(Rev) = \frac{[(S)(R_v)(A)]}{12}$

= **0.0534** **acre-feet**
= **2325.90** **cubic-feet**

where:
S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.620**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
	B	0.26	0.00
	C	0.13	0.00
14.77	D	0.07	1.03
14.77		**Computed Average S =**	**0.07**

Project Overview: Golden Coin Court (SLP-BC-D798)

Project Type:	Flood control dry pond conversion to extended detention pond with micropool
Total Cost:	$250,000 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – "Oakland Mills Road – Section 1, Area 3"; 6th Election District Subdivision – Marbella Address – 6527 Golden Coin Court Access – Between 6256 & 6257 Golden Coin Court ADC Map 16-A08 MS Link 2331
Land Use:	Residential
Ownership:	HOA
Maintenance Responsibility:	Public
Drainage Area:	31.71 acres
Impervious Area:	9.92 acres (31.28%)
Surface Soils:	87.1% GhB: Glenelg-Urban land complex, 0-8% slopes 12.9% GuB: Glenville-Urban land-Udorthents complex, 0-8% slopes Classification: Hydrologic Soil Group, Type B Hydrologic Soil Group, Type C

Existing Conditions

This facility is designed as a dry pond to provide storm water management associated with the Marbella subdivision development. Drainage from roadways and residential development along Light Point Place, Golden Coin Court, and Fairwell Road discharges via a stormdrain system which outfalls on the south side of the facility onto a riprap apron. Two drainage channels also enter on the west and east sides of the facility. An underground storage reservoir is present beneath the facility. The dry pond discharges via a riser into a 21" BCCMP that connects to the existing stormdrain system. No water quality improvement is being provided by the pond.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a "Micropool" Extended Detention Pond. The pond bottom is to be excavated to increase capacity, and the existing outfall structure is to be modified based on the required micropool storage and stormwater management quantities. Due to right-of-way constraints, a forebay or safety bench will not be feasible and the permanent pool depth will be limited to four feet. Therefore, only a portion of the required water quality volume will be provided. The pond will continue to discharge into an existing stormdrain system. A more detailed analysis may show that this design could provide channel protection[1].

An extended detention pond with micropool was chosen because the drainage area is greater than 10 acres, adequate head is available, and since space is limited a micropool ED requires a relatively small footprint. We anticipate being able to treat 1/3rd or 12,708.61 ft^3 of the WQv.

The micropool extended detention pond layout will be similar to Figure A in Appendix B, but without a forebay.

Design Parameter	**Value**
Drainage Area (Ac)	31.71
Percent Impervious (I)	31.28
Volumetric runoff coefficient (R_v)	0.332
Soil specific recharge factor (S)	0.24
Water quality volume (WQ_v) (ft^3)	38,164.01
Expected maximum WQv treatment (ft^3)	*12,708.61*
Recharge Volume (Re_v) (ft^3)	9,282.72
Pretreatment Volume (25% WQ_v) (ft^3)	9,541.01

[1] Channel Protection Volume calculations were not performed as part of this conceptual design analysis.

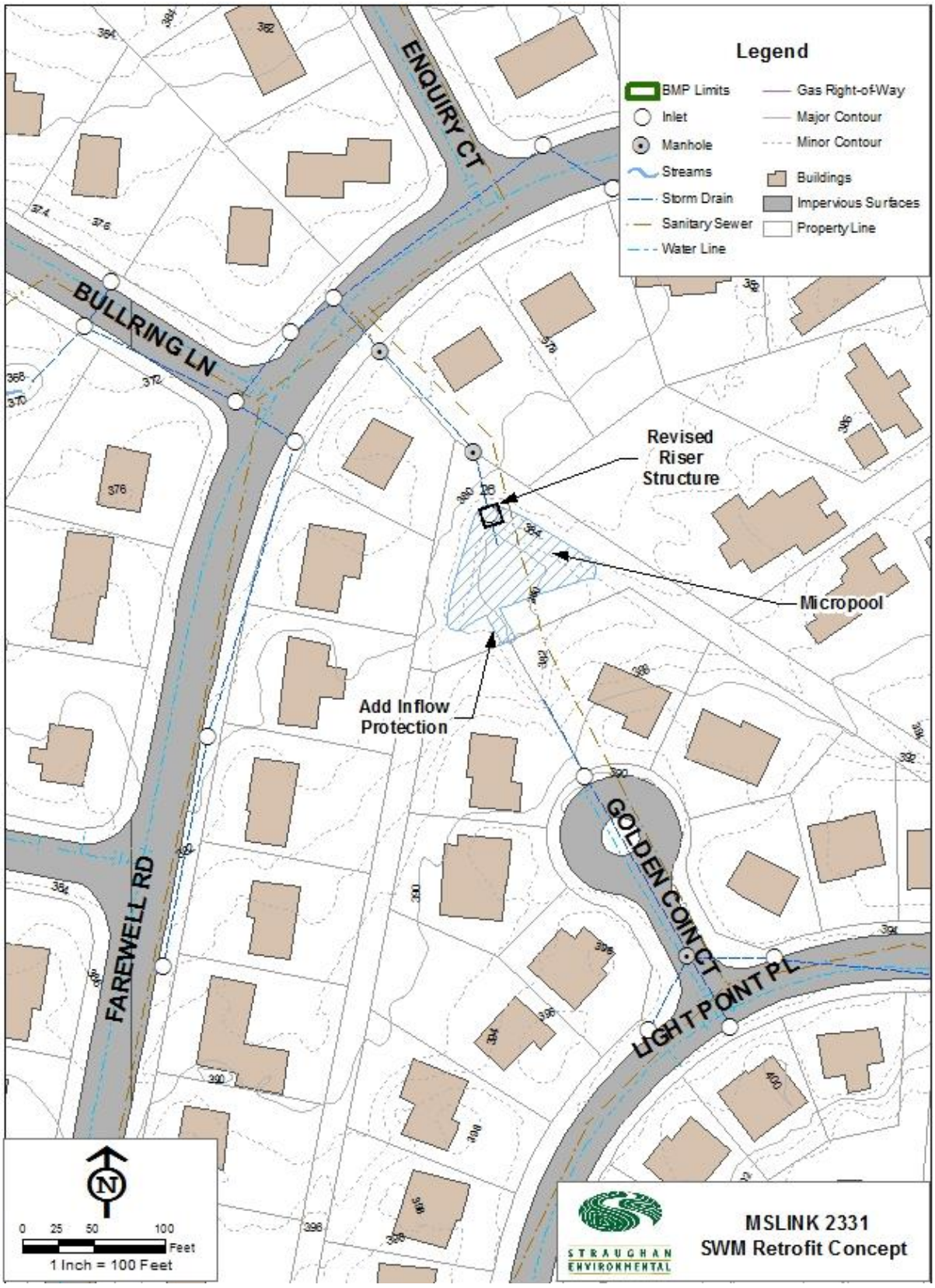


Figure 1. Concept Design Plan View at 6527 Golden Coin Court, SLP-BC-D798

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
EXTENDED DETENTION				
Excavate and Remove (incl. transportation)	475	cy	$40.00	$19,000.00
Channel Protection	80	sy	$35.00	$2,800.00
Modify Overflow structure	1	ea	$5,000.00	$5,000.00
PLANTING				
Plants (Seeding, Trees, Shrubs, etc.)	1	LS	$10,000.00	$10,000.00
TOTAL CONSTRUCTION COSTS				**$54,800.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Mgmt.				$100,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$16,440.00
TOTAL PROJECT COSTS				**$191,240.00**

Constructability

Design & Construction:

Access:	Between 6256 & 6257 Golden Coin Court.
Utilities:	Howard County GIS indicates that a sewer line crosses under the pond. Depending on the depth of the sewer line, the position of the micropool may need to be modified.
Other Impacts:	Some existing trees will be impacted. Aesthetics need to be considered carefully given prominence of existing pond.

Existing Condition Photograph

Figure 2. SWM pond at 6527 Golden Coin Court, SLP-BC-D798

Calculations

PROJECT: Howard County Retrofit
LOCATION: 6257 Golden Coin Court
DEVELOPER:

DATE: 1/21/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$

= **0.8761** **acre-feet**

= **38164.01** **cubic-feet**

where:

P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover

Impervious Cover = **9.92** acres
Total Site Area = **31.71** acres
% Impervious Cover = **31.28%**

therefore, Rv = **0.332**

COMPUTE RECHARGE VOLUME (Re_v):

$(Rev) = \frac{[(S)(R_v)(A)]}{12}$

= **0.2131** **acre-feet**

= **9282.72** **cubic-feet**

where:

S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.332**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
27.62	B	0.26	7.18
4.09	C	0.13	0.53
	D	0.07	0.00
31.71		**Computed Average S =**	**0.24**

Project Overview: Old Annapolis Road (SLP-BC-D802)

Project Type:	Flood control dry pond to extended detention pond with micropool and forebay
Total Cost:	$262,480 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – "Oakland Ridge / Manekin" Subdivision – Oakland Ridge / Manekin Address – 9030 Old Annapolis Road Access – Behind 8970 Old Annapolis Road (Rear Northwest Corner of Property) ADC Map 16-C04 MS Link 188
Land Use:	Commercial
Ownership:	Private
Maintenance Responsibility:	Private
Drainage Area:	20.45 acres
Impervious Area:	14.50 acres (70.90%)
Surface Soils:	< 0.1% BaA: Bale silt loam, 0-3% slopes 100.0% UtD: Urban land-Udorthents complex, 0-15% slopes Classification: Hydrologic Soil Group, Type D

Existing Conditions

The facility is privately owned and is believed to be owned by the surrounding commercial development. Drainage is collected from the buildings parking lots from this development via two stormdrain systems, both of which discharge on the south end of the pond. Surface runoff from the adjacent parking lot also drains directly into the pond. The pond discharges into a headwater stream via a riser structure. As-builts are not available for this pond, so the specific outfall details are not known.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a "Micropool" extended detention pond. The forebay, pilot channel, and micropool will be designed to retain existing perimeter vegetation to the maximum extent possible. The existing outfall structure will be modified based on the micropool and stormwater quantity requirements. A more detailed analysis may show that this design could provide channel protection[1].

An extended detention pond with micropool was chosen because the drainage area is greater than 10 acres, and because little space is available, and a micropool ED requires a relatively small footprint. Due to size constraints of the existing stormwater detention pond, the actual treatable WQv is estimated to be approximately 2/3rds of the required WQv (51,082.18 ft^3), or about 34,020.73 ft^3.

The micropool extended detention pond layout will be similar to Figure A in Appendix B.

Design Parameter	**Value**
Drainage Area (Ac)	20.45
Percent Impervious (I)	70.90
Volumetric runoff coefficient (R_v)	0.688
Soil specific recharge factor (S)	0.07
Water quality volume (WQ_v) (ft^3)	51,083.18
Expected maximum WQv treatment	*34,020.73*
Recharge Volume (Re_v) (ft^3)	3,575.82
Pretreatment Volume (25% WQ_v) (ft^3)	12,770.79

[1] Channel Protection Volume calculations were not performed as part of this conceptual design analysis.

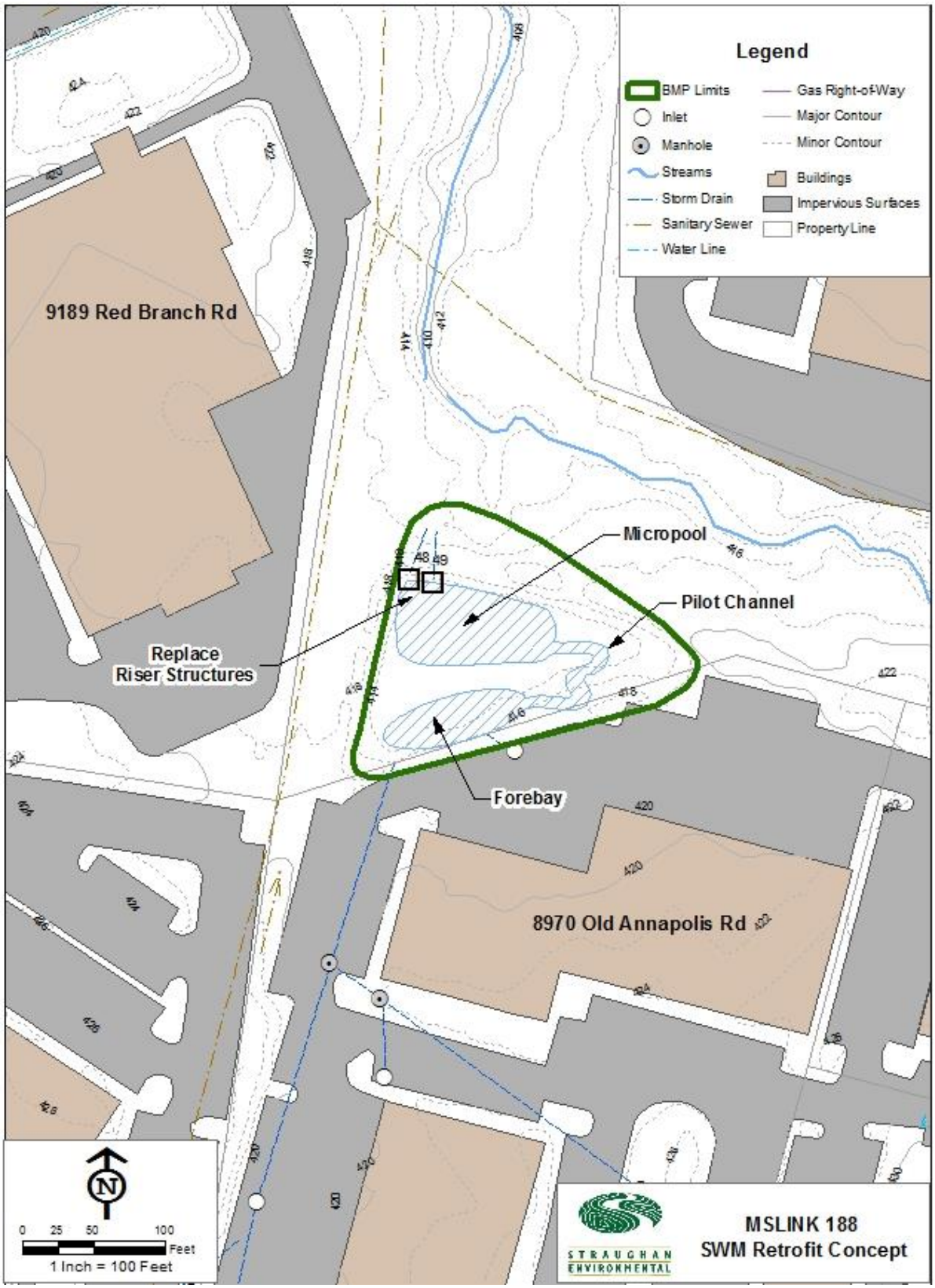


Figure 1. Concept Design Plan View for 8970 Old Annapolis Road, SLP-BC-D802

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
EXTENDED WET DETENTION & FOREBAY				
Excavate and Remove (incl. transportation)	1200	cy	$40.00	$48,000.00
Grading/Earthwork	100	cy	$16.00	$1,600.00
Overflow Structure	2	ea	$16,000.00	$32,000.00
Plants (Seeding, Trees, Shrubs, etc.)	1	LS	$10,000.00	$10,000.00
TOTAL CONSTRUCTION COSTS				**$109,600.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Mgmt.				$100,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$32,880.00
TOTAL PROJECT COSTS				**$262,480.00**

Constructability

Design & Construction:

Access: Behind 8970 Old Annapolis Road (Rear Northwest Corner of Property)

Utilities:

Other Impacts: Some trees will need to be removed

Existing Condition Photograph

Figure 2. SWM pond at 8970 Old Annapolis Road, SLP-BC-D802

Calculations

PROJECT: Howard County Retrofit
LOCATION: 9030 Old Annapolis Road
DEVELOPER:

DATE: 1/30/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$

= **1.1727** **acre-feet**

= **51083.18** **cubic-feet**

where:

P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover

Impervious Cover = **14.50** acres
Total Site Area = **20.45** acres
% Impervious Cover = **70.90%**

therefore, Rv = **0.688**

COMPUTE RECHARGE VOLUME (Re_v):

$(Rev) = \frac{[(S)(R_v)(A)]}{12}$

= **0.0821** **acre-feet**

= **3575.82** **cubic-feet**

where:

S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.688**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
	B	0.26	0.00
	C	0.13	0.00
20.45	D	0.07	1.43
20.45		**Computed Average S =**	**0.07**

Project Overview: Jaclyn Court (SMP-BC-D332)

Project Type:	Convert dry pond to shallow wetland
Total Cost:	$251,300 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title - Robinson's Promise. 6th Election District Subdivision – Robinson's Promise Address – 9518 Jaclyn Court Access – From Fens Hollow Court and through woods into pond ADC Map 19-K08 MS Link 76
Land Use:	Residential
Ownership:	HOA
Maintenance Responsibility:	Public
Drainage Area:	27.64 acres
Impervious Area:	9.89 acres (35.78%)
Surface Soils:	3.5% Fa: Fallsington sandy loam, 0-2% slopes 3.9% LeC: Legore silt loam, 8-15% slopes 0.4% SaC: Sassafras loam, 5-10% slopes 91.2% UcB: Udorthents, Highway, 0-5% slopes 0.4% UcD: Udorthents, Highway, 5-15% slopes 0.6% UsB: Urban land-Sassafras-Beltsville complex, 0-5% slopes Classification: Hydrologic Soil Group, Type B Hydrologic Soil Group, Type D

Existing Conditions

The dry pond is owned by the homeowners association for the surrounding community. Drainage is collected from Gorman Road, Jeanne Court, Jaclyn Court, and Jennifer Court via a main storm drain system and discharged into two concrete pilot channels located at the north and west ends of the pond. The two channels converge at the southern end of the pond where stormwater runoff is conveyed to a mowed dry stormwater management pond basin and ultimately discharged into the nearby steam via a riser structure.

Conceptual Design

The proposed retrofit concept is to improve water quality performance by converting the existing dry pond to a Shallow Wetland. The forebays, pilot channels and micropool will be designed to retain existing vegetation to the maximum extent possible. The existing riser will be modified based on the required micropool and storm water quantity management storages including channel protection. A stable outfall will also be provided downstream of the adjusted principal spillway. If additional channel protection is desired, the embankment can be shifted to the southwest to increase the size of the micropool.

A shallow wetland was chosen because the drainage area is sufficient, because there is adequate head, and because retaining existing vegetation was desirable. Shallow wetlands have high community acceptance, provide high habitat quality, are relatively easy to maintain, and are not a safety concern.

The shallow wetland layout will be similar to Figure G in Appendix B, with two forebays instead of one.

Design Parameter	**Value**
Drainage Area (Ac)	27.64
Percent Impervious (I)	35.78
Volumetric runoff coefficient (R_v)	0.372
Soil specific recharge factor (S)	0.08
Water quality volume (WQ_v) (ft^3)	37,327.29
Recharge Volume (Re_v) (ft^3)	2,915.69
Pretreatment Volume (25% WQ_v) (ft^3)	9,331.82

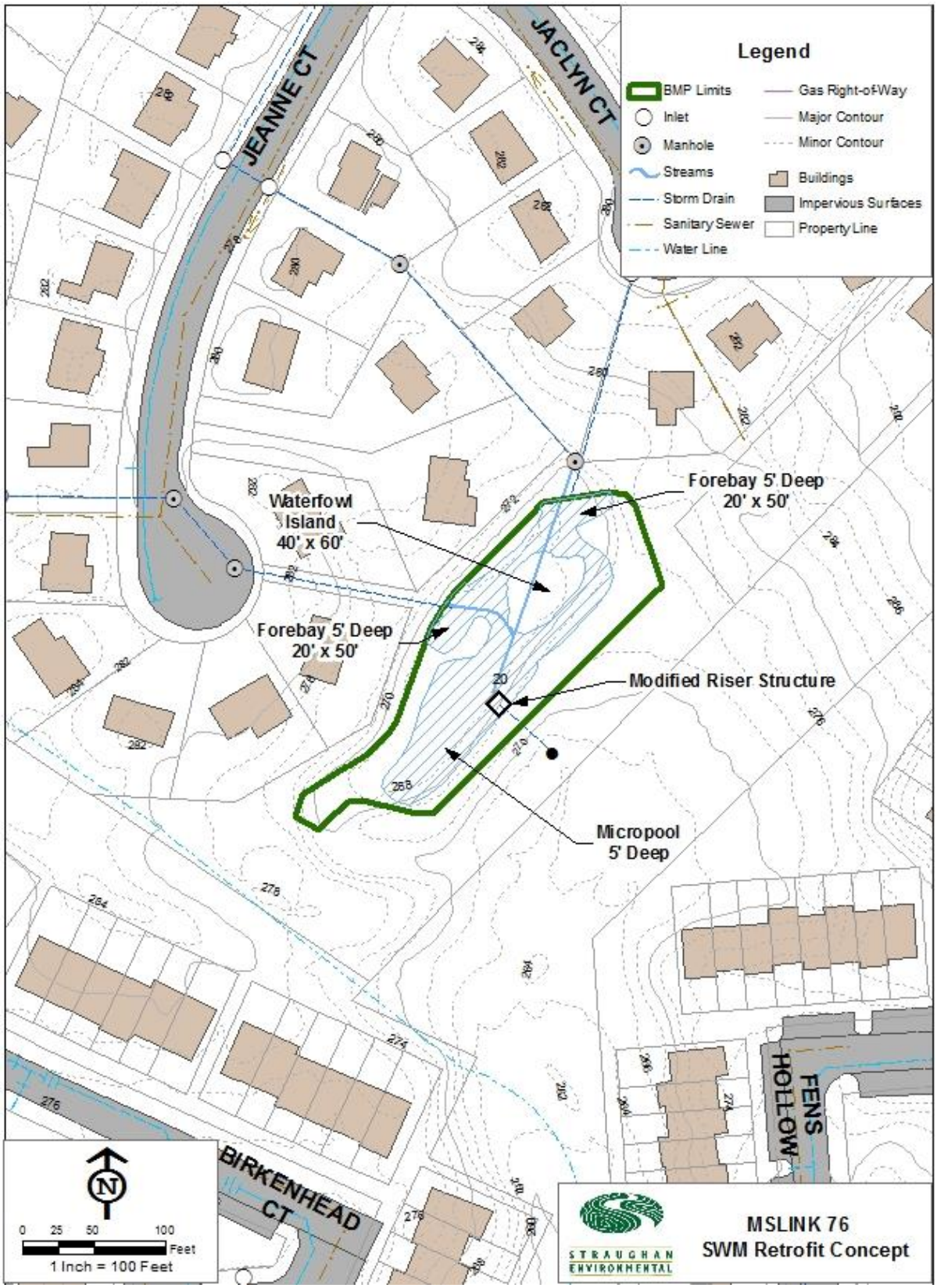


Figure 1. Concept Design Plan View at 9518 Jaclyn Court, access via Fens Hollow Court and through woods, SMP-BC-D332

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
WETLANDS / MICROPOOLS				
Earthwork/Grading	750	cy	$16.00	$12,000.00
Excavate and Remove Soil (Inc. transportation)	1400	cy	$40.00	$56,000.00
Modify Riser	1	ea	$5,000.00	$5,000.00
Planting	0.6	Ac	$10,000.00	$10,000.00
TOTAL CONSTRUCTION COSTS				**$101,000.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Mgmt.				$200,000.00
Geotech / Soil Borings				$20,000.00
Contingency (30% of Total Construction)				$18,640.00
TOTAL PROJECT COSTS				**$339,640.00**

Constructability

Design & Construction:

Access: Fens Hollow Court and through woods into pond. Formal easement is between 9514 and 9518 Jaclyn Court. Access via fenced areas will need to be negotiated as easement has been fenced off.

Utilities:

Other Impacts:

Existing Condition Photograph

Figure 2. SWM pond at 9518 Jaclyn Court, access via Fens Hollow Court, SMP-BC-D332

Calculations

PROJECT: Howard County Retrofit
LOCATION: 9518 Jaclyn Court
DEVELOPER:

DATE: 1/21/2013
COMPUTED BY: ANB
CHECKED BY: EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$

= **0.8569** **acre-feet**

= **37327.29** **cubic-feet**

where:

P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover
Impervious Cover = **9.89** acres
Total Site Area = **27.64** acres
% Impervious Cover = **35.78%**

therefore, Rv = **0.372**

COMPUTE RECHARGE VOLUME (Re_v):

$(Rev) = \frac{[(S)(R_v)(A)]}{12}$

= **0.0669** **acre-feet**

= **2915.69** **cubic-feet**

where:

S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.372**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
	A	0.38	0.00
1.18	B	0.26	0.31
	C	0.13	0.00
26.46	D	0.07	1.85
27.64		**Computed Average S =**	**0.08**

Project Overview: Crest Drive and Route 216 (SMP-BC-D333)

Project Type:	Dry pond to be retrofit with one filtration dry-swale with check dams and one wet-swale with check dams and storage forebay
Total Cost:	$250,000 (updated according to 2015 Cost Estimation spreadsheet)
Location/Address:	Title – Hammond Hills Roadway, Storm Drain, & Storm Water Management 6th Election District Subdivision – Hammond Hills Address – 8303 Honeyhill Road Access – SHA right of way/Easement at Crest Drive, behind sound wall. No access from Honey Hill Road ADC Map – 19-C06 MS Link 157009
Land Use:	Single family residential subdivision
Ownership:	Public
Maintenance Responsibility:	Public
Drainage Area:	12.60 acres
Impervious Area:	3.16 acres (25.08%)
Surface Soils:	27% GgC: Glenelg loam, 8-15% slopes 49% GhB: Glenelg-Urban land complex, 0-8% slopes 23% GuB: Glenville-Urban land-Udorthents complex, 0-8% slopes 1% MaC: Manor loam, 8-15% slopes Classification: Hydrologic Soil Group, Type B Hydrologic Soil Group, Type C

Existing Conditions

This facility is designed as a dry pond to provide storm water management associated with the Hammond Hills Subdivision. Most of the development runoff is from Honeyhill Road. The street runoff is collected into a storm drain system and discharges into the pond via an 18" RCCP pipe. The rest of the drainage area discharges to the pond via a rip rap channel located on the east side of the pond, and another rip rap channel located on the west side of the pond. These three inlets lead directly to the riser at the north side of the pond. A 48" RCP spillway discharges to an existing swale before entering a nearby stream. No water quality improvement is being provided by the pond.

Conceptual Design

The proposed concept design is to remove both riprap-lined channels and replace them with a dry swale with check dams along lots 15 and 16 and a wet swale with check dams outside lots 10 and 11 within the 20' drainage and utility easements. A pretreatment forebay is also proposed to stabilize the pipe inflow and provide a measure of water quality for the pipe's drainage area.

Swales upstream of the facility were chosen since there was limited space available for pond expansion and the existing swale locations were within easily accessible easements. Swales typically have low maintenance and high community acceptance. The type of swale was estimated based on existing site conditions.

The dry and wet swale will be similar to Figures K and L, respectively, in Appendix B, with check dams to provide required WQv.

Design Parameter	**Value**
Drainage Area (Ac)	12.60
Percent Impervious (I)	25.08
Volumetric runoff coefficient (R_v)	0.276
Soil specific recharge factor (S)	0.23
Water quality volume (WQ_v) (ft^3)	12,610.62
Recharge Volume (Re_v) (ft^3)	2,923.56
Pretreatment Volume (25% WQ_v) ($ft^{3)}$	3,152.66
Filter soil depth, sand (d_f) (ft)	2
Coefficient of permeability (k) (ft/day)	3.5
Avg. Ponding depth (h_f) (ft)	1
Drain time (t_f) (day)	2

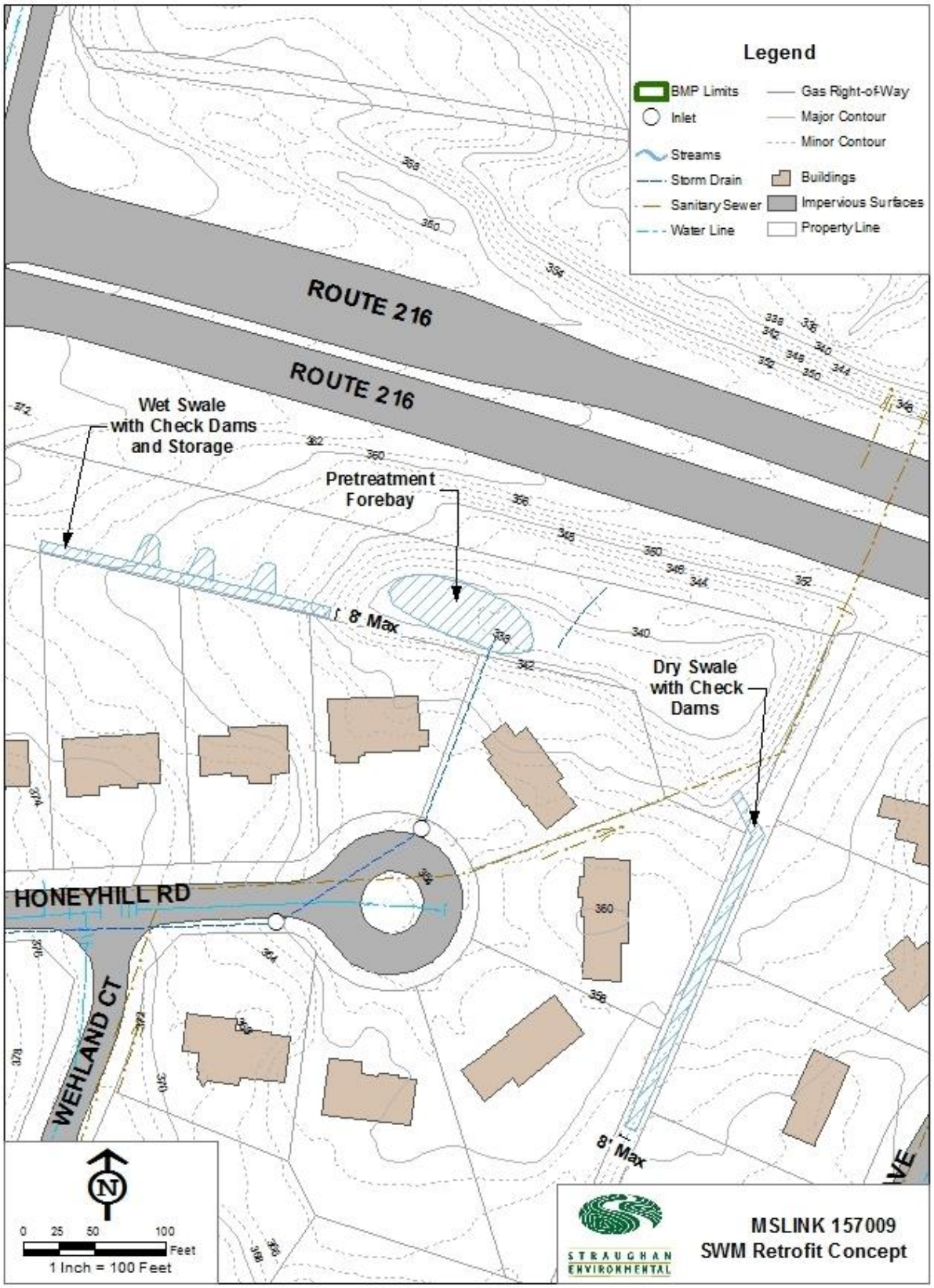


Figure 1. Concept Design Plan View for Crest Drive and Route 216, SMP-BC-D333

Cost Estimate

Item Description	Quantity/Units		Unit Cost	Subtotal Cost
SITE PREP				
Mobilization/Demobilization	1	LS	$10,000.00	$10,000.00
Erosion and Sediment Control	1	LS	$8,000.00	$8,000.00
Plants (Seeding, Wetland plantings, etc.)	1	LS	$10,000.00	$10,000.00
DRY SWALE				
Excavate and Remove (incl. transportation)	460	cy	$40.00	$18,400.00
4" Perforated underdrain	250	lf	$16.00	$4,000.00
Crushed Stone Fill	20	cy	$65.00	$1,300.00
Sand Fill	80	cy	$115.00	$9,200.00
Check dams	5	ea	$250.00	$1,250.00
WET SWALE				
Excavate and Remove (incl. transportation)	120	cy	$40.00	$4,800.00
Check dams	4	ea	$250.00	$1,000.00
TOTAL CONSTRUCTION COSTS				**$67,950.00**
ENGINEERING AND MANAGEMENT				
Engineering / Permitting / Construction Mgmt.				$100,000.00
Geotech / Soil Boring				$20,000.00
Contingency (30% of Total Construction)				$12,220.00
TOTAL PROJECT COSTS				**$200,170.00**

Constructability

Design & Construction:

Access: 216 and Crest Drive behind sound wall. No access from Honey Hill Road

Utilities: A sewer line is present between the swale and the facility along the southeast side of the facility.

Other Impacts:

Existing Condition Photograph

Figure 2. SWM pond at Crest Drive and Route 216, SMP-BC-D333

Calculations

PROJECT:	Howard County Retrofit	DATE:	12/31/2012
LOCATION:	8303 Honeyhill Road	COMPUTED BY:	ANB
DEVELOPER:		CHECKED BY:	EHF

UNIFIED SIZING CRITERIA

COMPUTE WATER QUALITY VOLUME (WQ_v):

$$(WQv) = \frac{[(1.0)(R_v)(A)]}{12}$$

where:

P = 1" Rainfall Depth (Eastern Zone)
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I)
where I is % Impervious Cover

= **0.2895** **acre-feet**
= **12610.62** **cubic-feet**

Impervious Cover = **3.16** acres
Total Site Area = **12.60** acres
% Impervious Cover = **25.08%**

therefore, Rv = **0.276**

COMPUTE RECHARGE VOLUME (Re_v):

$$(Rev) = \frac{[(S)(R_v)(A)]}{12}$$

where:

S = Soil Specific Recharge Factor
A = Total Site Area (acres)
Rv = Volumetric Runoff Coefficient
= 0.05 + 0.009 (I) [as calculated above]
= **0.276**

= **0.0671** **acre-feet**
= **2923.56** **cubic-feet**

COMPUTE SOIL RECHARGE FACTOR (S):

Acres	Hydrologic Soil Group	Soil Specific Recharge Factor (S)	A*S
0	A	0.38	0.00
9.87	B	0.26	2.57
2.73	C	0.13	0.35
0	D	0.07	0.00
12.60		**Computed Average S =**	**0.23**

I. Pollutant Load Reduction Calculations for Individual BMP Projects

Table I-1. Stormwater Management Facility (SWM) conversions proposed for the Little Patuxent Watershed and potential pollutant load reductions, for individual sites

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SMP-BC-D333	02131105,DryPonds to BioSwale,Concept	3.47	9.13	144.8	65%	94.1	9.6	65%	6.2	9,594.2	70%	6,716.0
SLP-BC-D780	02131105,DryPonds to ExtDryPonds,Concept	6.87	13.68	243.0	15%	36.5	17.7	10%	1.8	17,744.0	50%	8,872.0
SLP-BC-D802	02131105,DryPonds to ExtDryPonds,Concept	14.87	5.58	287.7	15%	43.1	31.2	10%	3.1	31,540.8	50%	15,770.4
SLP-BC-D792	02131105,DryPonds to ExtDryPonds,Concept	9.72	5.05	201.9	15%	30.3	20.8	10%	2.1	21,013.9	50%	10,506.9
SLP-BC-D798	02131105,DryPonds to ExtDryPonds,Concept	10.61	21.10	375.2	15%	56.3	27.3	10%	2.7	27,400.0	50%	13,700.0
SLP-BC-F701	02131105,DryPonds to WetPondWetland ,Concept	4.48	15.48	223.7	15%	33.6	13.4	35%	4.7	13,455.9	50%	6,727.9
SLP-BC-F758	02131105,DryPonds to WetPondWetland ,Concept	1.59	1.43	39.0	15%	5.9	3.6	35%	1.3	3,609.5	50%	1,804.7
SLP-BC-F734	02131105,DryPonds to WetPondWetland ,Concept	3.72	1.18	69.8	15%	10.5	7.7	35%	2.7	7,822.5	50%	3,911.2
DOR-BC-F942	02131105,DryPonds to WetPondWetland ,Concept	6.97	2.02	128.9	15%	19.3	14.5	35%	5.1	14,616.1	50%	7,308.0
SMP-BC-D332	02131105,DryPonds to WetPondWetland ,Concept	10.90	16.74	336.4	15%	50.5	26.6	35%	9.3	26,736.0	50%	13,368.0
SLP-BC-D774	02131105,DryPonds to WetPondWetland ,Concept	10.76	42.35	588.5	15%	88.3	33.8	35%	11.8	33,788.2	50%	16,894.1
SMP-BC-F314	02131105,ExtDryPonds to Filter,Concept	3.60	4.75	103.4	20%	20.7	8.6	40%	3.4	8,608.4	20%	1,721.7
DOR-BC-F943	02131105,ExtDryPonds to Filter,Concept	5.21	5.88	139.8	20%	28.0	12.1	40%	4.8	12,173.8	20%	2,434.8
SLP-BC-F772	02131105,ExtDryPonds to WetPondWetland ,Concept	1.81	3.68	64.8	0%	0.0	4.7	25%	1.2	4,695.9	0%	0.0
SLP-BC-F728	02131105,ExtDryPonds to WetPondWetland ,Concept	7.95	4.36	167.4	0%	0.0	17.1	25%	4.3	17,254.0	0%	0.0
DOR-BC-F917	02131105,DryPonds to BioRetUDAB,No Concept	4.97	2.26	100.0	65%	65.0	10.5	65%	6.9	10,646.4	70%	7,452.5
SLP-BC-F773	02131105,DryPonds to BioRetUDCD,No Concept	0.37	0.22	8.0	20%	1.6	0.8	35%	0.3	816.3	45%	367.3
SLP-BC-F708	02131105,DryPonds to BioRetUDCD,No Concept	0.13	0.16	3.6	20%	0.7	0.3	35%	0.1	307.7	45%	138.4
SLP-BC-F715	02131105,DryPonds to BioRetUDCD,No Concept	0.37	1.80	23.6	20%	4.7	1.3	35%	0.4	1,252.5	45%	563.6
SLP-BC-F751	02131105,DryPonds to BioRetUDCD,No Concept	0.35	0.18	7.2	20%	1.4	0.7	35%	0.3	746.6	45%	336.0
DOR-BC-F913	02131105,DryPonds to BioRetUDCD,No Concept	0.95	0.49	19.7	20%	3.9	2.0	35%	0.7	2,053.3	45%	924.0

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
DOR-BC-F906	02131105,DryPonds to BioRetUDCD,No Concept	0.64	1.64	26.2	20%	5.2	1.7	35%	0.6	1,755.1	45%	789.8
DOR-BC-D945	02131105,DryPonds to BioRetUDCD,No Concept	0.15	1.16	13.9	20%	2.8	0.6	35%	0.2	635.7	45%	286.1
NLP-BC-D517	02131105,DryPonds to BioRetUDCD,No Concept	1.16	2.54	43.3	20%	8.7	3.0	35%	1.1	3,061.8	45%	1,377.8
SLP-BC-F742	02131105,DryPonds to BioSwale,No Concept	1.42	0.95	31.7	65%	20.6	3.1	65%	2.0	3,135.1	70%	2,194.5
DOR-BC-F941	02131105,DryPonds to BioSwale,No Concept	1.58	1.57	40.2	65%	26.1	3.6	65%	2.3	3,628.1	70%	2,539.6
DOR-BC-F927	02131105,DryPonds to BioSwale,No Concept	3.04	1.10	58.5	65%	38.0	6.4	65%	4.1	6,442.6	70%	4,509.8
DOR-BC-F912	02131105,DryPonds to BioSwale,No Concept	0.29	0.31	7.6	65%	4.9	0.7	65%	0.4	671.5	70%	470.0
SLP-BC-D784	02131105,DryPonds to ExtDryPonds,No Concept	2.66	1.39	55.3	15%	8.3	5.7	10%	0.6	5,748.3	50%	2,874.1
SLP-BC-D788	02131105,DryPonds to ExtDryPonds,No Concept	1.55	1.85	42.7	15%	6.4	3.6	10%	0.4	3,661.4	50%	1,830.7
DOR-BC-D944	02131105,DryPonds to ExtDryPonds,No Concept	4.94	9.82	174.6	15%	26.2	12.7	10%	1.3	12,763.0	50%	6,381.5
NLP-BC-D513	02131105,DryPonds to ExtDryPonds,No Concept	3.30	15.96	210.0	15%	31.5	11.2	10%	1.1	11,215.2	50%	5,607.6
SLP-BC-D778	02131105,DryPonds to ExtDryPonds,No Concept	6.35	9.93	197.8	15%	29.7	15.5	10%	1.6	15,633.8	50%	7,816.9
SLP-BC-F760	02131105,DryPonds to Filter,No Concept	0.18	1.09	13.7	35%	4.8	0.7	50%	0.3	675.4	70%	472.8
SLP-BC-F743	02131105,DryPonds to Filter,No Concept	0.56	0.93	18.0	35%	6.3	1.4	50%	0.7	1,394.1	70%	975.9
SLP-BC-F749	02131105,DryPonds to Filter,No Concept	1.59	0.40	28.8	35%	10.1	3.3	50%	1.6	3,315.2	70%	2,320.6
SLP-BC-F750	02131105,DryPonds to Filter,No Concept	1.06	0.52	21.7	35%	7.6	2.3	50%	1.1	2,289.2	70%	1,602.4
SLP-BC-F759	02131105,DryPonds to Filter,No Concept	1.74	1.67	43.7	35%	15.3	4.0	50%	2.0	3,981.7	70%	2,787.2
SLP-BC-F730	02131105,DryPonds to Filter,No Concept	2.82	2.04	64.3	35%	22.5	6.2	50%	3.1	6,261.2	70%	4,382.8
SLP-BC-F761	02131105,DryPonds to Filter,No Concept	0.68	1.17	22.2	35%	7.8	1.7	50%	0.8	1,702.1	70%	1,191.4
SLP-BC-F741	02131105,DryPonds to Filter,No Concept	1.83	1.32	41.8	35%	14.6	4.0	50%	2.0	4,071.4	70%	2,850.0
SLP-BC-F719	02131105,DryPonds to Filter,No Concept	0.80	0.70	19.4	35%	6.8	1.8	50%	0.9	1,808.4	70%	1,265.8
SLP-BC-F726	02131105,DryPonds to Filter,No Concept	1.21	0.46	23.4	35%	8.2	2.5	50%	1.3	2,565.8	70%	1,796.1
SLP-BC-F709	02131105,DryPonds to Filter,No Concept	0.89	0.87	22.6	35%	7.9	2.0	50%	1.0	2,050.1	70%	1,435.1
SLP-BC-F732	02131105,DryPonds to Filter,No Concept	6.99	1.92	128.3	35%	44.9	14.5	50%	7.2	14,631.9	70%	10,242.4
SLP-BC-F733	02131105,DryPonds to Filter,No Concept	0.40	0.63	12.6	35%	4.4	1.0	50%	0.5	993.8	70%	695.6
SLP-BC-F757	02131105,DryPonds to Filter,No Concept	1.96	5.34	83.6	35%	29.3	5.5	50%	2.7	5,477.6	70%	3,834.3
SLP-BC-F703	02131105,DryPonds to Filter,No Concept	2.19	3.84	72.2	35%	25.3	5.5	50%	2.7	5,497.6	70%	3,848.3

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
NLP-BC-F508	02131105,DryPonds to Filter,No Concept	0.93	1.08	25.3	35%	8.9	2.2	50%	1.1	2,187.4	70%	1,531.2
DOR-BC-F931	02131105,DryPonds to Filter,No Concept	4.43	0.52	74.3	35%	26.0	9.0	50%	4.5	9,062.3	70%	6,343.6
DOR-BC-F909	02131105,DryPonds to Filter,No Concept	1.03	1.05	26.5	35%	9.3	2.3	50%	1.2	2,366.8	70%	1,656.8
DOR-BC-F934	02131105,DryPonds to Filter,No Concept	0.28	0.20	6.4	35%	2.2	0.6	50%	0.3	622.4	70%	435.7
DOR-BC-F935	02131105,DryPonds to Filter,No Concept	0.33	0.26	7.7	35%	2.7	0.7	50%	0.4	735.3	70%	514.7
SLP-BC-D781	02131105,DryPonds to Filter,No Concept	2.75	0.96	52.4	35%	18.4	5.8	50%	2.9	5,808.8	70%	4,066.2
NLP-BC-D521	02131105,DryPonds to Filter,No Concept	1.20	4.01	58.6	35%	20.5	3.6	50%	1.8	3,566.3	70%	2,496.4
SLP-BC-D783	02131105,DryPonds to Filter,No Concept	2.89	1.08	55.9	35%	19.6	6.1	50%	3.0	6,134.9	70%	4,294.4
SMP-BC-D323	02131105,DryPonds to Filter,No Concept	2.30	4.85	84.0	35%	29.4	6.0	50%	3.0	6,013.4	70%	4,209.4
SLP-BC-D785	02131105,DryPonds to Filter,No Concept	2.87	1.06	55.3	35%	19.3	6.0	50%	3.0	6,073.9	70%	4,251.7
DOR-BC-D947	02131105,DryPonds to Filter,No Concept	7.35	4.22	156.6	35%	54.8	15.9	50%	7.9	16,001.8	70%	11,201.3
SLP-BC-D794	02131105,DryPonds to Filter,No Concept	7.94	3.73	161.1	35%	56.4	16.9	50%	8.5	17,063.5	70%	11,944.4
NLP-BC-D531	02131105,DryPonds to Filter,No Concept	3.19	9.25	141.6	35%	49.6	9.0	50%	4.5	9,068.1	70%	6,347.7
SLP-BC-D803	02131105,DryPonds to Filter,No Concept	2.57	6.03	99.9	35%	35.0	6.9	50%	3.4	6,891.5	70%	4,824.0
SLP-BC-F739	02131105,DryPonds to Infiltration,No Concept	0.69	1.25	23.3	75%	17.5	1.7	75%	1.3	1,757.2	85%	1,493.6
SLP-BC-F754	02131105,DryPonds to Infiltration,No Concept	0.64	0.63	16.3	75%	12.2	1.5	75%	1.1	1,475.9	85%	1,254.5
SLP-BC-F740	02131105,DryPonds to Infiltration,No Concept	0.46	0.23	9.4	75%	7.0	1.0	75%	0.7	986.4	85%	838.4
SLP-BC-F765	02131105,DryPonds to Infiltration,No Concept	1.05	1.56	31.9	75%	23.9	2.5	75%	1.9	2,559.8	85%	2,175.9
SLP-BC-F711	02131105,DryPonds to Infiltration,No Concept	0.91	1.45	28.6	75%	21.5	2.2	75%	1.7	2,253.4	85%	1,915.4
NLP-BC-F506	02131105,DryPonds to Infiltration,No Concept	0.20	0.63	9.4	75%	7.0	0.6	75%	0.4	581.4	85%	494.2
DOR-BC-F926	02131105,DryPonds to Infiltration,No Concept	0.07	0.56	6.6	75%	5.0	0.3	75%	0.2	300.4	85%	255.3
SLP-BC-D805	02131105,DryPonds to Infiltration,No Concept	1.80	8.83	115.8	75%	86.8	6.2	75%	4.6	6,150.3	85%	5,227.8
SLP-BC-F764	02131105,DryPonds to WetPondWetland ,No Concept	5.00	2.01	98.1	15%	14.7	10.5	35%	3.7	10,648.5	50%	5,324.3
SLP-BC-F748	02131105,DryPonds to WetPondWetland ,No Concept	3.42	1.24	65.7	15%	9.9	7.2	35%	2.5	7,242.2	50%	3,621.1
SLP-BC-F762	02131105,DryPonds to WetPondWetland ,No Concept	1.21	0.70	25.9	15%	3.9	2.6	35%	0.9	2,644.8	50%	1,322.4
SLP-BC-F710	02131105,DryPonds to WetPondWetland ,No Concept	3.93	15.08	211.1	15%	31.7	12.2	35%	4.3	12,227.2	50%	6,113.6
SLP-BC-F770	02131105,DryPonds to WetPondWetland ,No Concept	4.98	1.14	89.1	15%	13.4	10.2	35%	3.6	10,353.9	50%	5,177.0

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SLP-BC-F767	02131105,DryPonds to WetPondWetland ,No Concept	7.59	1.74	135.8	15%	20.4	15.6	35%	5.5	15,786.5	50%	7,893.2
SLP-BC-F752	02131105,DryPonds to WetPondWetland ,No Concept	0.43	0.45	11.2	15%	1.7	1.0	35%	0.3	1,002.9	50%	501.5
SLP-BC-F712	02131105,DryPonds to WetPondWetland ,No Concept	4.92	9.41	170.2	15%	25.5	12.5	35%	4.4	12,595.8	50%	6,297.9
SLP-BC-F731	02131105,DryPonds to WetPondWetland ,No Concept	0.51	0.73	15.2	15%	2.3	1.2	35%	0.4	1,234.1	50%	617.0
SLP-BC-F705	02131105,DryPonds to WetPondWetland ,No Concept	1.52	2.11	44.7	15%	6.7	3.6	35%	1.3	3,667.8	50%	1,833.9
SLP-BC-F851	02131105,DryPonds to WetPondWetland ,No Concept	2.22	0.90	43.6	15%	6.5	4.7	35%	1.6	4,723.4	50%	2,361.7
SMP-BC-F309	02131105,DryPonds to WetPondWetland ,No Concept	0.99	0.19	17.3	15%	2.6	2.0	35%	0.7	2,044.1	50%	1,022.0
NLP-BC-F511	02131105,DryPonds to WetPondWetland ,No Concept	0.80	1.20	24.3	15%	3.6	1.9	35%	0.7	1,947.8	50%	973.9
NLP-BC-F507	02131105,DryPonds to WetPondWetland ,No Concept	1.99	0.49	36.0	15%	5.4	4.1	35%	1.4	4,152.9	50%	2,076.5
NLP-BC-F651	02131105,DryPonds to WetPondWetland ,No Concept	4.01	4.23	104.7	15%	15.7	9.2	35%	3.2	9,296.0	50%	4,648.0
DOR-BC-F910	02131105,DryPonds to WetPondWetland ,No Concept	1.33	0.48	25.5	15%	3.8	2.8	35%	1.0	2,810.8	50%	1,405.4
DOR-BC-F930	02131105,DryPonds to WetPondWetland ,No Concept	11.10	3.95	212.5	15%	31.9	23.3	35%	8.1	23,483.1	50%	11,741.5
DOR-BC-F911	02131105,DryPonds to WetPondWetland ,No Concept	1.79	1.13	39.1	15%	5.9	3.9	35%	1.4	3,926.3	50%	1,963.1
DOR-BC-F918	02131105,DryPonds to WetPondWetland ,No Concept	6.70	3.69	141.2	15%	21.2	14.4	35%	5.0	14,544.1	50%	7,272.0
DOR-BC-F914	02131105,DryPonds to WetPondWetland ,No Concept	1.04	0.42	20.4	15%	3.1	2.2	35%	0.8	2,219.3	50%	1,109.7
DOR-BC-F921	02131105,DryPonds to WetPondWetland ,No Concept	3.73	2.14	79.5	15%	11.9	8.1	35%	2.8	8,130.5	50%	4,065.3
DOR-BC-F937	02131105,DryPonds to WetPondWetland ,No Concept	6.15	2.24	118.3	15%	17.7	12.9	35%	4.5	13,023.6	50%	6,511.8
DOR-BC-F928	02131105,DryPonds to WetPondWetland ,No Concept	6.08	1.51	109.9	15%	16.5	12.5	35%	4.4	12,670.7	50%	6,335.4
DOR-BC-F929	02131105,DryPonds to WetPondWetland ,No Concept	3.40	0.91	62.1	15%	9.3	7.0	35%	2.5	7,105.0	50%	3,552.5
DOR-BC-F932	02131105,DryPonds to WetPondWetland ,No Concept	3.70	3.13	88.8	15%	13.3	8.3	35%	2.9	8,340.7	50%	4,170.4
DOR-BC-F904	02131105,DryPonds to WetPondWetland ,No Concept	0.62	0.42	13.8	15%	2.1	1.4	35%	0.5	1,365.7	50%	682.9

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
DOR-BC-F903	02131105,DryPonds to WetPondWetland ,No Concept	1.55	3.92	63.1	15%	9.5	4.2	35%	1.5	4,234.6	50%	2,117.3
DOR-BC-F907	02131105,DryPonds to WetPondWetland ,No Concept	3.01	7.02	116.6	15%	17.5	8.0	35%	2.8	8,059.8	50%	4,029.9
DOR-BC-F905	02131105,DryPonds to WetPondWetland ,No Concept	1.80	3.75	65.3	15%	9.8	4.7	35%	1.6	4,690.9	50%	2,345.5
DOR-BC-D946	02131105,DryPonds to WetPondWetland ,No Concept	8.83	4.38	181.4	15%	27.2	18.9	35%	6.6	19,028.5	50%	9,514.2
SLP-BC-D795	02131105,DryPonds to WetPondWetland ,No Concept	13.59	20.19	412.6	15%	61.9	32.9	35%	11.5	33,134.6	50%	16,567.3
SMP-BC-D322	02131105,DryPonds to WetPondWetland ,No Concept	1.69	6.30	89.0	15%	13.4	5.2	35%	1.8	5,215.8	50%	2,607.9
NLP-BC-D512	02131105,DryPonds to WetPondWetland ,No Concept	16.23	47.27	722.8	15%	108.4	46.1	35%	16.1	46,216.0	50%	23,108.0
NLP-BC-D528	02131105,DryPonds to WetPondWetland ,No Concept	23.66	61.11	976.1	15%	146.4	64.9	35%	22.7	65,127.7	50%	32,563.8
NLP-BC-D524	02131105,DryPonds to WetPondWetland ,No Concept	9.79	4.30	195.6	15%	29.3	20.7	35%	7.3	20,949.8	50%	10,474.9
SLP-BC-D804	02131105,DryPonds to WetPondWetland ,No Concept	4.40	9.01	158.1	15%	23.7	11.4	35%	4.0	11,436.8	50%	5,718.4
NLP-BC-D526	02131105,DryPonds to WetPondWetland ,No Concept	1.97	0.84	39.2	15%	5.9	4.2	35%	1.5	4,216.5	50%	2,108.2
NLP-BC-D527	02131105,DryPonds to WetPondWetland ,No Concept	4.97	16.70	243.4	15%	36.5	14.8	35%	5.2	14,793.0	50%	7,396.5
NLP-BC-D532	02131105,DryPonds to WetPondWetland ,No Concept	2.40	9.76	134.4	15%	20.2	7.6	35%	2.7	7,626.6	50%	3,813.3
NLP-BC-D525	02131105,DryPonds to WetPondWetland ,No Concept	3.32	5.37	105.1	15%	15.8	8.2	35%	2.9	8,211.7	50%	4,105.8
DOR-BC-F915	02131105,ExtDryPonds to BioRetUDAB,No Concept	1.69	4.26	68.7	50%	34.3	4.6	55%	2.5	4,619.7	20%	923.9
SLP-BC-F771	02131105,ExtDryPonds to BioRetUDCD,No Concept	1.17	2.15	39.6	5%	2.0	3.0	25%	0.7	2,967.4	-5%	-148.4
NLP-BC-D538	02131105,ExtDryPonds to BioRetUDCD,No Concept	3.06	4.59	93.3	5%	4.7	7.4	25%	1.9	7,470.3	-5%	-373.5
SLP-BC-F747	02131105,ExtDryPonds to BioRetUDCD,No Concept	0.39	0.68	12.9	5%	0.6	1.0	25%	0.2	983.6	-5%	-49.2
SLP-BC-F744	02131105,ExtDryPonds to BioRetUDCD,No Concept	0.40	0.20	8.2	5%	0.4	0.9	25%	0.2	862.0	-5%	-43.1
SLP-BC-D797	02131105,ExtDryPonds to BioRetUDCD,No Concept	2.75	6.84	110.9	5%	5.5	7.5	25%	1.9	7,501.4	-5%	-375.1
SLP-BC-F721	02131105,ExtDryPonds to BioSwale,No Concept	0.56	0.49	13.7	50%	6.8	1.3	55%	0.7	1,274.7	20%	254.9

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SLP-BC-F714	02131105,ExtDryPonds to BioSwale,No Concept	0.37	0.21	8.0	50%	4.0	0.8	55%	0.4	814.4	20%	162.9
DOR-BC-F940	02131105,ExtDryPonds to BioSwale,No Concept	2.97	0.96	55.8	50%	27.9	6.2	55%	3.4	6,246.4	20%	1,249.3
DOR-BC-F939	02131105,ExtDryPonds to BioSwale,No Concept	2.95	0.73	53.3	50%	26.6	6.1	55%	3.3	6,142.5	20%	1,228.5
SLP-BC-F745	02131105,ExtDryPonds to Filter,No Concept	0.98	0.39	19.2	20%	3.8	2.1	40%	0.8	2,091.6	20%	418.3
SLP-BC-F746	02131105,ExtDryPonds to Filter,No Concept	0.70	0.12	12.2	20%	2.4	1.4	40%	0.6	1,448.1	20%	289.6
SLP-BC-F766	02131105,ExtDryPonds to Filter,No Concept	2.97	3.39	80.1	20%	16.0	6.9	40%	2.8	6,954.8	20%	1,391.0
SLP-BC-F735	02131105,ExtDryPonds to Filter,No Concept	2.37	0.57	42.7	20%	8.5	4.9	40%	2.0	4,939.4	20%	987.9
SLP-BC-F723	02131105,ExtDryPonds to Filter,No Concept	0.68	0.41	14.6	20%	2.9	1.5	40%	0.6	1,480.0	20%	296.0
SLP-BC-F724	02131105,ExtDryPonds to Filter,No Concept	0.42	0.79	14.3	20%	2.9	1.1	40%	0.4	1,064.7	20%	212.9
SMP-BC-F316	02131105,ExtDryPonds to Filter,No Concept	0.61	0.29	12.5	20%	2.5	1.3	40%	0.5	1,318.0	20%	263.6
SMP-BC-F315	02131105,ExtDryPonds to Filter,No Concept	0.33	2.12	26.2	20%	5.2	1.3	40%	0.5	1,274.3	20%	254.9
DOR-BC-F908	02131105,ExtDryPonds to Filter,No Concept	0.13	0.43	6.3	20%	1.3	0.4	40%	0.2	383.9	20%	76.8
SMP-BC-D335	02131105,ExtDryPonds to Filter,No Concept	2.94	13.94	184.3	20%	36.9	9.9	40%	4.0	9,905.0	20%	1,981.0
NLP-BC-D540	02131105,ExtDryPonds to Filter,No Concept	2.22	5.11	85.5	20%	17.1	5.9	40%	2.4	5,942.0	20%	1,188.4
SLP-BC-D796	02131105,ExtDryPonds to Filter,No Concept	3.68	6.88	125.8	20%	25.2	9.3	40%	3.7	9,386.1	20%	1,877.2
SLP-BC-F725	02131105,ExtDryPonds to Infiltration,No Concept	2.36	6.45	100.8	60%	60.5	6.6	65%	4.3	6,587.7	35%	2,305.7
SLP-BC-F722	02131105,ExtDryPonds to Infiltration,No Concept	0.55	0.23	10.9	60%	6.5	1.2	65%	0.8	1,172.0	35%	410.2
SMP-BC-F301	02131105,ExtDryPonds to Infiltration,No Concept	0.41	1.54	21.7	60%	13.0	1.3	65%	0.8	1,265.9	35%	443.1
DOR-BC-F925	02131105,ExtDryPonds to SW to the MEP - SPSC,No Concept	1.66	4.37	69.3	37%	25.6	4.6	46%	2.1	4,589.7	10%	459.0
SLP-BC-F716	02131105,ExtDryPonds to WetPondWetland ,No Concept	0.84	0.80	21.1	0%	0.0	1.9	25%	0.5	1,927.2	0%	0.0
SLP-BC-F768	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.43	1.20	34.3	0%	0.0	3.2	25%	0.8	3,221.1	0%	0.0
SLP-BC-F718	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.34	0.74	28.2	0%	0.0	2.9	25%	0.7	2,901.0	0%	0.0
SLP-BC-F737	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.20	0.91	27.7	0%	0.0	2.6	25%	0.7	2,670.5	0%	0.0
SLP-BC-F753	02131105,ExtDryPonds to WetPondWetland ,No Concept	0.84	0.30	16.0	0%	0.0	1.8	25%	0.4	1,767.8	0%	0.0
SLP-BC-F755	02131105,ExtDryPonds to WetPondWetland ,No Concept	4.93	1.80	95.0	0%	0.0	10.3	25%	2.6	10,452.6	0%	0.0

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SLP-BC-F713	02131105,ExtDryPonds to WetPondWetland ,No Concept	31.65	22.77	720.4	0%	0.0	69.7	25%	17.4	70,252.7	0%	0.0
SLP-BC-F852	02131105,ExtDryPonds to WetPondWetland ,No Concept	8.28	4.53	174.2	0%	0.0	17.8	25%	4.4	17,962.7	0%	0.0
NLP-BC-F503	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.81	2.72	55.2	0%	0.0	4.4	25%	1.1	4,418.5	0%	0.0
NLP-BC-F509	02131105,ExtDryPonds to WetPondWetland ,No Concept	2.78	1.78	61.1	0%	0.0	6.1	25%	1.5	6,104.9	0%	0.0
NLP-BC-F510	02131105,ExtDryPonds to WetPondWetland ,No Concept	0.84	0.92	22.3	0%	0.0	1.9	25%	0.5	1,951.8	0%	0.0
NLP-BC-F501	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.14	4.96	67.1	0%	0.0	3.7	25%	0.9	3,716.8	0%	0.0
NLP-BC-F502	02131105,ExtDryPonds to WetPondWetland ,No Concept	3.03	2.03	67.5	0%	0.0	6.6	25%	1.7	6,688.7	0%	0.0
DOR-BC-F938	02131105,ExtDryPonds to WetPondWetland ,No Concept	3.36	2.13	73.6	0%	0.0	7.3	25%	1.8	7,383.3	0%	0.0
DOR-BC-F920	02131105,ExtDryPonds to WetPondWetland ,No Concept	9.92	4.71	201.6	0%	0.0	21.1	25%	5.3	21,318.3	0%	0.0
DOR-BC-F916	02131105,ExtDryPonds to WetPondWetland ,No Concept	4.71	1.80	91.4	0%	0.0	9.9	25%	2.5	9,995.7	0%	0.0
DOR-BC-F936	02131105,ExtDryPonds to WetPondWetland ,No Concept	14.91	3.78	270.4	0%	0.0	30.8	25%	7.7	31,106.5	0%	0.0
DOR-BC-F901	02131105,ExtDryPonds to WetPondWetland ,No Concept	2.62	0.73	48.2	0%	0.0	5.4	25%	1.4	5,484.1	0%	0.0
DOR-BC-F922	02131105,ExtDryPonds to WetPondWetland ,No Concept	13.35	3.89	247.0	0%	0.0	27.7	25%	6.9	27,984.9	0%	0.0
DOR-BC-F924	02131105,ExtDryPonds to WetPondWetland ,No Concept	5.92	3.14	123.7	0%	0.0	12.7	25%	3.2	12,820.5	0%	0.0
DOR-BC-F919	02131105,ExtDryPonds to WetPondWetland ,No Concept	4.09	1.97	83.4	0%	0.0	8.7	25%	2.2	8,795.9	0%	0.0
SLP-BC-D782	02131105,ExtDryPonds to WetPondWetland ,No Concept	4.10	2.20	85.9	0%	0.0	8.8	25%	2.2	8,891.3	0%	0.0
SLP-BC-D776	02131105,ExtDryPonds to WetPondWetland ,No Concept	0.33	2.48	29.8	0%	0.0	1.4	25%	0.3	1,378.1	0%	0.0
NLP-BC-D516	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.35	6.04	81.0	0%	0.0	4.4	25%	1.1	4,439.6	0%	0.0
NLP-BC-D529	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.36	4.24	63.3	0%	0.0	3.9	25%	1.0	3,944.6	0%	0.0
NLP-BC-D518	02131105,ExtDryPonds to WetPondWetland ,No Concept	3.35	6.06	112.6	0%	0.0	8.4	25%	2.1	8,486.1	0%	0.0
NLP-BC-D515	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.55	4.76	71.5	0%	0.0	4.5	25%	1.1	4,487.0	0%	0.0

Site ID	SWM Facility Conversion Type and Priority	Imper-vious DA (acres)	Pervious DA (acres)	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
NLP-BC-D523	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.88	3.60	65.0	0%	0.0	4.8	25%	1.2	4,813.2	0%	0.0
NLP-BC-D539	02131105,ExtDryPonds to WetPondWetland ,No Concept	9.99	31.84	472.1	0%	0.0	29.2	25%	7.3	29,225.3	0%	0.0
NLP-BC-D533	02131105,ExtDryPonds to WetPondWetland ,No Concept	1.33	2.68	47.4	0%	0.0	3.4	25%	0.9	3,448.9	0%	0.0
	TOTAL	577	743			2,721			454			514,420

Table I-2. Proposed Stormwater Management (SWM) facilities for the Little Patuxent Watershed showing potential pollutant load reduction for individual sites

Site ID	SWM Facility Type and Priority	IMP DA (acres)	PERVIOUS DA (acres	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SLP-NB-F711b	02131105,BioRetUDCD,Concept	1.78	1.90	47.3	25%	11.8	4.1	45%	1.8	4128	55%	2270
SLP-NB-F712c	02131105,BioRetUDCD,Concept	2.85	0.32	33.3	25%	8.3	5.8	45%	2.6	5830	55%	3207
SLP-NB-F731a	02131105,Filter,Concept	1.27	0.16	15.1	40%	6.0	2.6	60%	1.5	2603	80%	2082
SLP-NB-F739b	02131105,Filter,Concept	7.43	0.45	80.8	40%	32.3	14.9	60%	9.0	15090	80%	12072
SLP-NB-F722d	02131105,Filter,Concept	2.29	0.27	27.0	40%	10.8	4.6	60%	2.8	4689	80%	3751
DOR-NB-F912a	02131105,Filter,Concept	2.00	0.00	19.9	40%	7.9	4.0	60%	2.4	4027	80%	3222
SLP-NB-F740a	02131105,WetPondWetland ,Concept	5.25	5.04	130.8	20%	26.2	11.9	45%	5.4	12014	60%	7208
SLP-NB-F715b	02131105,WetPondWetland ,Concept	3.20	1.35	52.9	20%	10.6	6.8	45%	3.0	6830	60%	4098
SLP-NB-F711a	02131105,WetPondWetland ,Concept	1.13	0.48	18.7	20%	3.7	2.4	45%	1.1	2413	60%	1448
SLP-NB-F712a	02131105,WetPondWetland ,Concept	6.27	2.69	104.3	20%	20.9	13.3	45%	6.0	13395	60%	8037
SLP-NB-F754a	02131105,BioRetUDAB,No Concept	1.01	0.19	12.9	70%	9.1	2.1	75%	1.5	2085	80%	1668
SLP-NB-F770a	02131105,BioRetUDAB,No Concept	0.05	1.92	30.4	70%	21.3	0.7	75%	0.5	649	80%	519
SLP-NB-F770b	02131105,BioRetUDAB,No Concept	0.04	0.95	15.2	70%	10.6	0.4	75%	0.3	357	80%	285
NLP-NB-F502B	02131105,BioRetUDAB,No Concept	0.40	0.15	6.3	70%	4.4	0.8	75%	0.6	846	80%	677
NLP-NB-F521	02131105,BioRetUDAB,No Concept	1.40	0.37	19.7	70%	13.8	2.9	75%	2.2	2920	80%	2336
DOR-NB-F910a	02131105,BioRetUDAB,No Concept	1.02	0.57	19.0	70%	13.3	2.2	75%	1.6	2215	80%	1772
DOR-NB-F919a	02131105,BioRetUDAB,No Concept	1.46	0.16	17.0	70%	11.9	2.9	75%	2.2	2980	80%	2384
SLP-NB-F753b	02131105,BioRetUDCD,No Concept	0.29	0.03	3.3	25%	0.8	0.6	45%	0.3	594	55%	327
SLP-NB-F751a	02131105,BioRetUDCD,No Concept	0.27	0.02	3.0	25%	0.8	0.6	45%	0.2	558	55%	307
SLP-NB-F750a	02131105,BioRetUDCD,No Concept	0.24	0.01	2.6	25%	0.6	0.5	45%	0.2	492	55%	270
SLP-NB-F750b	02131105,BioRetUDCD,No Concept	0.21	0.17	4.8	25%	1.2	0.5	45%	0.2	473	55%	260
SLP-NB-F749b	02131105,BioRetUDCD,No Concept	0.49	0.03	5.3	25%	1.3	1.0	45%	0.4	993	55%	546
SLP-NB-F745b	02131105,BioRetUDCD,No Concept	0.29	0.24	6.5	25%	1.6	0.6	45%	0.3	648	55%	357
SLP-NB-F742c	02131105,BioRetUDCD,No Concept	0.06	0.02	0.9	25%	0.2	0.1	45%	0.1	133	55%	73
SLP-NB-F743a	02131105,BioRetUDCD,No Concept	0.70	0.44	13.9	25%	3.5	1.5	45%	0.7	1542	55%	848

Site ID	SWM Facility Type and Priority	IMP DA (acres)	PERVIOUS DA (acres	Total Nitrogen			Total Phosphorus			Sediment		
				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
SLP-NB-F771a	02131105,BioRetUDCD,No Concept	0.72	0.48	14.6	25%	3.6	1.6	45%	0.7	1590	55%	874
SLP-NB-F773a	02131105,BioRetUDCD,No Concept	0.66	0.04	7.1	25%	1.8	1.3	45%	0.6	1338	55%	736
SLP-NB-F773b	02131105,BioRetUDCD,No Concept	0.18	0.02	2.0	25%	0.5	0.4	45%	0.2	359	55%	197
SLP-NB-F773c	02131105,BioRetUDCD,No Concept	0.12	0.02	1.6	25%	0.4	0.3	45%	0.1	253	55%	139
SLP-NB-F757b	02131105,BioRetUDCD,No Concept	0.12	0.04	1.8	25%	0.5	0.3	45%	0.1	252	55%	139
SLP-NB-F767c	02131105,BioRetUDCD,No Concept	0.53	0.39	11.4	25%	2.9	1.2	45%	0.5	1186	55%	652
SLP-NB-F768a	02131105,BioRetUDCD,No Concept	0.93	0.27	13.4	25%	3.3	1.9	45%	0.9	1946	55%	1070
SLP-NB-F737c	02131105,BioRetUDCD,No Concept	0.72	0.33	12.3	25%	3.1	1.5	45%	0.7	1543	55%	848
SLP-NB-F766a	02131105,BioRetUDCD,No Concept	1.11	0.01	11.1	25%	2.8	2.2	45%	1.0	2232	55%	1227
SLP-NB-F720a	02131105,BioRetUDCD,No Concept	0.16	0.01	1.7	25%	0.4	0.3	45%	0.1	319	55%	176
SLP-NB-F720c	02131105,BioRetUDCD,No Concept	0.69	0.23	10.5	25%	2.6	1.4	45%	0.6	1459	55%	802
SLP-NB-F759a	02131105,BioRetUDCD,No Concept	1.94	0.48	26.7	25%	6.7	4.0	45%	1.8	4036	55%	2220
SLP-NB-F758a	02131105,BioRetUDCD,No Concept	0.94	0.20	12.4	25%	3.1	1.9	45%	0.9	1940	55%	1067
SLP-NB-F759b	02131105,BioRetUDCD,No Concept	0.61	0.28	10.5	25%	2.6	1.3	45%	0.6	1315	55%	723
SLP-NB-F755a	02131105,BioRetUDCD,No Concept	0.46	0.20	7.8	25%	1.9	1.0	45%	0.4	993	55%	546
SLP-NB-F701a	02131105,BioRetUDCD,No Concept	1.94	0.56	28.0	25%	7.0	4.0	45%	1.8	4067	55%	2237
SLP-NB-F729a	02131105,BioRetUDCD,No Concept	1.40	0.39	20.0	25%	5.0	2.9	45%	1.3	2925	55%	1609
SLP-NB-F765a	02131105,BioRetUDCD,No Concept	2.17	0.95	36.4	25%	9.1	4.6	45%	2.1	4636	55%	2550
SLP-NB-F739c	02131105,BioRetUDCD,No Concept	0.92	0.43	15.8	25%	4.0	2.0	45%	0.9	1975	55%	1086
SLP-NB-F764a	02131105,BioRetUDCD,No Concept	2.53	0.37	30.9	25%	7.7	5.1	45%	2.3	5201	55%	2861
SLP-NB-F726a	02131105,BioRetUDCD,No Concept	0.64	0.19	9.3	25%	2.3	1.3	45%	0.6	1347	55%	741
SLP-NB-F724b	02131105,BioRetUDCD,No Concept	0.45	0.30	9.2	25%	2.3	1.0	45%	0.4	984	55%	541
SLP-NB-F722c	02131105,BioRetUDCD,No Concept	0.15	0.11	3.2	25%	0.8	0.3	45%	0.1	336	55%	185
SLP-NB-F722b	02131105,BioRetUDCD,No Concept	0.79	0.07	8.9	25%	2.2	1.6	45%	0.7	1609	55%	885
SLP-NB-F723a	02131105,BioRetUDCD,No Concept	1.51	0.30	19.6	25%	4.9	3.1	45%	1.4	3132	55%	1722
SLP-NB-F713b	02131105,BioRetUDCD,No Concept	1.48	0.68	25.3	25%	6.3	3.1	45%	1.4	3174	55%	1746
NLP-NB-F541A	02131105,BioRetUDCD,No Concept	0.25	0.06	3.3	25%	0.8	0.5	45%	0.2	510	55%	280
NLP-NB-F541B	02131105,BioRetUDCD,No Concept	0.25	0.02	2.8	25%	0.7	0.5	45%	0.2	519	55%	285

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NLP-NB-F541C	02131105,BioRetUDCD,No Concept	0.16	0.02	1.9	25%	0.5	0.3	45%	0.1	323	55%	178
NLP-NB-F537A	02131105,BioRetUDCD,No Concept	0.20	0.00	2.0	25%	0.5	0.4	45%	0.2	396	55%	218
NLP-NB-F537B	02131105,BioRetUDCD,No Concept	0.18	0.00	1.8	25%	0.5	0.4	45%	0.2	372	55%	205
NLP-NB-F537C	02131105,BioRetUDCD,No Concept	0.20	0.00	1.9	25%	0.5	0.4	45%	0.2	394	55%	216
NLP-NB-F537D	02131105,BioRetUDCD,No Concept	0.18	0.02	2.0	25%	0.5	0.4	45%	0.2	366	55%	201
NLP-NB-F539A	02131105,BioRetUDCD,No Concept	0.11	0.00	1.1	25%	0.3	0.2	45%	0.1	220	55%	121
NLP-NB-F539B	02131105,BioRetUDCD,No Concept	0.11	0.00	1.1	25%	0.3	0.2	45%	0.1	217	55%	119
NLP-NB-F539E	02131105,BioRetUDCD,No Concept	0.31	0.01	3.1	25%	0.8	0.6	45%	0.3	617	55%	340
DOR-NB-F943s	02131105,BioRetUDCD,No Concept	0.05	0.26	4.6	25%	1.1	0.2	45%	0.1	180	55%	99
DOR-NB-F943t	02131105,BioRetUDCD,No Concept	0.10	0.15	3.3	25%	0.8	0.2	45%	0.1	243	55%	134
SLP-NB-F721a	02131105,BioRetUDCD,No Concept	0.46	0.67	15.1	25%	3.8	1.1	45%	0.5	1124	55%	618
SLP-NB-F760b	02131105,BioRetUDCD,No Concept	0.26	0.39	8.6	25%	2.2	0.6	45%	0.3	637	55%	350
SLP-NB-F761a	02131105,BioRetUDCD,No Concept	0.82	0.17	10.8	25%	2.7	1.7	45%	0.8	1700	55%	935
SLP-NB-F761b	02131105,BioRetUDCD,No Concept	1.18	0.45	18.7	25%	4.7	2.5	45%	1.1	2513	55%	1382
SLP-NB-F762a	02131105,BioRetUDCD,No Concept	0.56	0.04	6.2	25%	1.5	1.1	45%	0.5	1135	55%	625
SLP-NB-F725a	02131105,BioRetUDCD,No Concept	1.17	0.67	22.1	25%	5.5	2.5	45%	1.1	2539	55%	1397
SLP-NB-F712b	02131105,BioRetUDCD,No Concept	0.46	0.32	9.6	25%	2.4	1.0	45%	0.5	1014	55%	557
SLP-NB-F744a	02131105,BioRetUDCD,No Concept	0.22	0.05	2.9	25%	0.7	0.4	45%	0.2	452	55%	249
SLP-NB-F774a	02131105,BioRetUDCD,No Concept	0.12	0.86	14.7	25%	3.7	0.5	45%	0.2	498	55%	274
SLP-NB-F744b	02131105,BioRetUDCD,No Concept	0.35	0.18	6.2	25%	1.6	0.7	45%	0.3	749	55%	412
SLP-NB-F744d	02131105,BioRetUDCD,No Concept	0.43	0.97	19.3	25%	4.8	1.1	45%	0.5	1134	55%	624
SLP-NB-F774c	02131105,BioRetUDCD,No Concept	0.22	0.10	3.8	25%	0.9	0.5	45%	0.2	479	55%	264
SLP-NB-F774b	02131105,BioRetUDCD,No Concept	0.23	0.07	3.3	25%	0.8	0.5	45%	0.2	474	55%	260
SLP-NB-F746b	02131105,BioRetUDCD,No Concept	0.48	0.30	9.5	25%	2.4	1.0	45%	0.5	1049	55%	577
SLP-NB-F746a	02131105,BioRetUDCD,No Concept	0.09	0.16	3.4	25%	0.8	0.2	45%	0.1	223	55%	123
SLP-NB-F750d	02131105,BioRetUDCD,No Concept	0.84	0.23	12.0	25%	3.0	1.7	45%	0.8	1761	55%	969
NLP-NB-F549	02131105,BioRetUDCD,No Concept	0.34	0.02	3.8	25%	1.0	0.7	45%	0.3	701	55%	385
DOR-NB-F915c	02131105,BioRetUDCD,No Concept	0.85	0.03	9.0	25%	2.2	1.7	45%	0.8	1728	55%	951

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DOR-NB-F913c	02131105,BioRetUDCD,No Concept	0.53	0.00	5.2	25%	1.3	1.0	45%	0.5	1058	55%	582
DOR-NB-F903b	02131105,BioRetUDCD,No Concept	0.29	0.04	3.6	25%	0.9	0.6	45%	0.3	604	55%	332
DOR-NB-F903a	02131105,BioRetUDCD,No Concept	0.37	0.06	4.7	25%	1.2	0.8	45%	0.3	766	55%	421
DOR-NB-F941h	02131105,BioRetUDCD,No Concept	0.12	0.02	1.5	25%	0.4	0.2	45%	0.1	248	55%	136
DOR-NB-F943c	02131105,BioRetUDCD,No Concept	0.29	0.27	7.1	25%	1.8	0.7	45%	0.3	662	55%	364
DOR-NB-F943l	02131105,BioRetUDCD,No Concept	0.66	0.28	11.0	25%	2.8	1.4	45%	0.6	1411	55%	776
DOR-NB-F943v	02131105,BioRetUDCD,No Concept	0.88	0.72	19.9	25%	5.0	2.0	45%	0.9	1971	55%	1084
DOR-NB-F943x	02131105,BioRetUDCD,No Concept	0.52	0.69	16.0	25%	4.0	1.2	45%	0.6	1243	55%	684
dor-nb-f932h	02131105,BioRetUDCD,No Concept	0.43	0.02	4.6	25%	1.2	0.9	45%	0.4	879	55%	483
DOR-NB-F931k	02131105,BioRetUDCD,No Concept	0.08	0.01	1.0	25%	0.3	0.2	45%	0.1	169	55%	93
DOR-NB-F929a	02131105,BioRetUDCD,No Concept	2.17	0.01	21.6	25%	5.4	4.3	45%	1.9	4362	55%	2399
DOR-NB-F925g	02131105,BioRetUDCD,No Concept	0.20	0.01	2.2	25%	0.5	0.4	45%	0.2	403	55%	222
DOR-NB-F920a	02131105,BioRetUDCD,No Concept	3.55	0.17	37.8	25%	9.5	7.1	45%	3.2	7200	55%	3960
SLP-NB-F754b	02131105,BioSwale,No Concept	0.14	0.01	1.4	70%	1.0	0.3	75%	0.2	276	80%	221
NLP-NB-F508	02131105,BioSwale,No Concept	0.74	0.10	8.9	70%	6.2	1.5	75%	1.1	1510	80%	1208
NLP-NB-F525	02131105,BioSwale,No Concept	0.04	0.01	0.7	70%	0.5	0.1	75%	0.1	90	80%	72
SMP-NB-F325	02131105,BioSwale,No Concept	0.74	1.00	22.9	70%	16.0	1.8	75%	1.3	1777	80%	1422
NLP-NB-F522A	02131105,BioSwale,No Concept	0.83	0.12	10.2	70%	7.1	1.7	75%	1.3	1702	80%	1362
NLP-NB-F522B	02131105,BioSwale,No Concept	0.20	0.06	3.0	70%	2.1	0.4	75%	0.3	420	80%	336
NLP-NB-F542	02131105,BioSwale,No Concept	0.83	1.17	26.5	70%	18.6	2.0	75%	1.5	1997	80%	1598
NLP-NB-F550A	02131105,BioSwale,No Concept	0.38	0.57	12.7	70%	8.9	0.9	75%	0.7	925	80%	740
NLP-NB-F550B	02131105,BioSwale,No Concept	0.20	0.42	8.5	70%	6.0	0.5	75%	0.4	514	80%	411
NLP-NB-F548A	02131105,BioSwale,No Concept	0.02	0.08	1.5	70%	1.0	0.1	75%	0.1	71	80%	57
NLP-NB-F548B	02131105,BioSwale,No Concept	0.10	0.00	1.1	70%	0.7	0.2	75%	0.2	209	80%	167
NLP-NB-F505	02131105,BioSwale,No Concept	0.23	0.37	8.1	70%	5.7	0.6	75%	0.4	577	80%	461
NLP-NB-D557	02131105,BioSwale,No Concept	0.33	0.33	8.4	70%	5.9	0.8	75%	0.6	759	80%	607
DOR-NB-F916	02131105,BioSwale,No Concept	3.38	0.12	35.5	70%	24.9	6.8	75%	5.1	6851	80%	5481
DOR-NB-F902a	02131105,BioSwale,No Concept	0.08	0.18	3.6	70%	2.5	0.2	75%	0.2	204	80%	163

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DOR-NB-F902b	02131105,BioSwale,No Concept	0.12	0.54	9.6	70%	6.7	0.4	75%	0.3	404	80%	323
DOR-NB-F902c	02131105,BioSwale,No Concept	0.05	0.25	4.5	70%	3.1	0.2	75%	0.1	175	80%	140
DOR-NB-F902d	02131105,BioSwale,No Concept	0.75	0.56	16.2	70%	11.3	1.7	75%	1.2	1668	80%	1334
DOR-NB-F943a	02131105,BioSwale,No Concept	0.25	0.66	12.9	70%	9.0	0.7	75%	0.5	702	80%	561
DOR-NB-F943r	02131105,BioSwale,No Concept	0.17	0.76	13.5	70%	9.5	0.6	75%	0.4	554	80%	443
DOR-NB-F943w	02131105,BioSwale,No Concept	0.58	1.54	29.8	70%	20.8	1.6	75%	1.2	1612	80%	1289
DOR-NB-F943y	02131105,BioSwale,No Concept	0.37	0.46	10.8	70%	7.6	0.9	75%	0.6	871	80%	697
DOR-NB-F943z	02131105,BioSwale,No Concept	0.19	0.53	10.2	70%	7.2	0.5	75%	0.4	536	80%	429
DOR-NB-F934a	02131105,BioSwale,No Concept	0.11	0.58	10.1	70%	7.0	0.4	75%	0.3	377	80%	301
DOR-NB-F905a	02131105,BioSwale,No Concept	0.84	0.06	9.2	70%	6.5	1.7	75%	1.3	1707	80%	1366
DOR-NB-F905b	02131105,BioSwale,No Concept	2.13	0.08	22.4	70%	15.7	4.3	75%	3.2	4306	80%	3445
DOR-NB-F919b	02131105,BioSwale,No Concept	0.89	0.44	15.7	70%	11.0	1.9	75%	1.4	1910	80%	1528
DOR-NB-F917c	02131105,BioSwale,No Concept	0.30	0.32	8.0	70%	5.6	0.7	75%	0.5	692	80%	554
DOR-NB-F920d	02131105,BioSwale,No Concept	1.12	0.54	19.7	70%	13.8	2.4	75%	1.8	2416	80%	1933
DOR-NB-F907a	02131105,BioSwale,No Concept	2.15	0.31	26.1	70%	18.3	4.4	75%	3.3	4409	80%	3527
DOR-NB-F907b	02131105,BioSwale,No Concept	4.14	0.43	47.9	70%	33.5	8.4	75%	6.3	8463	80%	6770
SLP-NB-F757a	02131105,DryPonds,No Concept	0.73	0.27	11.4	5%	0.6	1.5	10%	0.2	1538	10%	154
SLP-NB-F737a	02131105,DryPonds,No Concept	0.43	0.07	5.4	5%	0.3	0.9	10%	0.1	877	10%	88
SLP-NB-F753a	02131105,Filter,No Concept	2.30	0.08	24.0	40%	9.6	4.6	60%	2.8	4647	80%	3718
SLP-NB-F747a	02131105,Filter,No Concept	0.92	0.13	11.3	40%	4.5	1.9	60%	1.1	1898	80%	1518
SLP-NB-F750c	02131105,Filter,No Concept	1.02	0.20	13.3	40%	5.3	2.1	60%	1.3	2121	80%	1696
SLP-NB-F752a	02131105,Filter,No Concept	0.72	0.05	8.0	40%	3.2	1.5	60%	0.9	1473	80%	1179
SLP-NB-F749a	02131105,Filter,No Concept	0.92	0.09	10.5	40%	4.2	1.9	60%	1.1	1876	80%	1501
SLP-NB-F745a	02131105,Filter,No Concept	0.49	0.33	10.1	40%	4.0	1.1	60%	0.6	1090	80%	872
SLP-NB-F742a	02131105,Filter,No Concept	1.29	0.41	19.2	40%	7.7	2.7	60%	1.6	2710	80%	2168
SLP-NB-F769b	02131105,Filter,No Concept	0.26	0.13	4.7	40%	1.9	0.6	60%	0.3	556	80%	445
SLP-NB-F754c	02131105,Filter,No Concept	0.54	0.46	12.5	40%	5.0	1.2	60%	0.7	1224	80%	979
SLP-NB-F767a	02131105,Filter,No Concept	1.67	0.45	23.6	40%	9.4	3.5	60%	2.1	3497	80%	2797

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SLP-NB-F741a	02131105,Filter,No Concept	0.92	0.18	12.0	40%	4.8	1.9	60%	1.1	1905	80%	1524
SLP-NB-F741b	02131105,Filter,No Concept	1.23	0.35	17.7	40%	7.1	2.6	60%	1.5	2580	80%	2064
SLP-NB-F732a	02131105,Filter,No Concept	1.06	0.38	16.5	40%	6.6	2.2	60%	1.3	2242	80%	1794
SLP-NB-F702a	02131105,Filter,No Concept	0.86	0.32	13.5	40%	5.4	1.8	60%	1.1	1818	80%	1454
SLP-NB-F705a	02131105,Filter,No Concept	0.61	0.04	6.6	40%	2.6	1.2	60%	0.7	1237	80%	990
SLP-NB-F704a	02131105,Filter,No Concept	1.15	0.10	13.0	40%	5.2	2.3	60%	1.4	2340	80%	1872
SLP-NB-F703a	02131105,Filter,No Concept	1.85	0.07	19.4	40%	7.7	3.7	60%	2.2	3736	80%	2989
SLP-NB-F703b	02131105,Filter,No Concept	2.57	0.00	25.5	40%	10.2	5.1	60%	3.1	5173	80%	4139
SLP-NB-F705b	02131105,Filter,No Concept	0.17	0.00	1.8	40%	0.7	0.3	60%	0.2	344	80%	275
SLP-NB-F766c	02131105,Filter,No Concept	0.97	0.00	9.7	40%	3.9	1.9	60%	1.2	1958	80%	1567
SLP-NB-F720b	02131105,Filter,No Concept	0.67	0.00	6.7	40%	2.7	1.3	60%	0.8	1343	80%	1074
SLP-NB-F738a	02131105,Filter,No Concept	1.12	0.08	12.3	40%	4.9	2.3	60%	1.4	2278	80%	1822
SLP-NB-F733a	02131105,Filter,No Concept	2.98	0.15	32.0	40%	12.8	6.0	60%	3.6	6048	80%	4839
SLP-NB-F735a	02131105,Filter,No Concept	1.03	0.06	11.2	40%	4.5	2.1	60%	1.2	2093	80%	1675
SLP-NB-F734b	02131105,Filter,No Concept	1.45	0.05	15.3	40%	6.1	2.9	60%	1.7	2940	80%	2352
SLP-NB-F728a	02131105,Filter,No Concept	3.86	2.03	70.0	40%	28.0	8.3	60%	5.0	8353	80%	6683
SLP-NB-F718a	02131105,Filter,No Concept	2.87	0.64	38.5	40%	15.4	5.9	60%	3.5	5966	80%	4773
SLP-NB-F718b	02131105,Filter,No Concept	1.23	0.20	15.3	40%	6.1	2.5	60%	1.5	2530	80%	2024
SLP-NB-F713a	02131105,Filter,No Concept	2.80	1.12	45.4	40%	18.2	5.9	60%	3.5	5965	80%	4772
SLP-NB-F707a	02131105,Filter,No Concept	3.42	0.56	42.7	40%	17.1	7.0	60%	4.2	7041	80%	5633
SLP-NB-F736a	02131105,Filter,No Concept	1.65	0.56	25.1	40%	10.1	3.4	60%	2.1	3484	80%	2787
NLP-NB-F540A	02131105,Filter,No Concept	0.19	0.09	3.3	40%	1.3	0.4	60%	0.2	416	80%	333
NLP-NB-F540B	02131105,Filter,No Concept	0.69	0.88	20.5	40%	8.2	1.6	60%	1.0	1639	80%	1311
NLP-NB-F540C	02131105,Filter,No Concept	0.14	0.10	2.9	40%	1.1	0.3	60%	0.2	301	80%	241
NLP-NB-F530	02131105,Filter,No Concept	0.25	0.02	2.8	40%	1.1	0.5	60%	0.3	518	80%	414
NLP-NB-F526	02131105,Filter,No Concept	0.30	0.01	3.1	40%	1.3	0.6	60%	0.4	614	80%	491
NLP-NB-F523	02131105,Filter,No Concept	0.09	0.02	1.2	40%	0.5	0.2	60%	0.1	188	80%	151
DOR-NB-F943i	02131105,Filter,No Concept	0.35	0.05	4.3	40%	1.7	0.7	60%	0.4	722	80%	578

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				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
DOR-NB-F943p	02131105,Filter,No Concept	0.58	0.00	5.7	40%	2.3	1.1	60%	0.7	1160	80%	928
DOR-NB-F943o	02131105,Filter,No Concept	0.58	0.01	5.8	40%	2.3	1.1	60%	0.7	1163	80%	930
DOR-NB-F943u	02131105,Filter,No Concept	0.61	0.01	6.2	40%	2.5	1.2	60%	0.7	1235	80%	988
DOR-NB-F943cc	02131105,Filter,No Concept	0.22	0.33	7.4	40%	3.0	0.5	60%	0.3	539	80%	431
DOR-NB-F943e	02131105,Filter,No Concept	0.48	0.05	5.5	40%	2.2	1.0	60%	0.6	972	80%	777
SLP-NB-F710a	02131105,Filter,No Concept	2.17	0.63	31.3	40%	12.5	4.5	60%	2.7	4545	80%	3636
SLP-NB-F761c	02131105,Filter,No Concept	2.66	0.37	32.2	40%	12.9	5.4	60%	3.2	5466	80%	4373
SLP-NB-F762b	02131105,Filter,No Concept	3.80	0.37	43.5	40%	17.4	7.7	60%	4.6	7762	80%	6210
SLP-NB-F762c	02131105,Filter,No Concept	2.04	0.21	23.5	40%	9.4	4.1	60%	2.5	4172	80%	3337
SLP-NB-F717a	02131105,Filter,No Concept	0.76	0.13	9.5	40%	3.8	1.5	60%	0.9	1562	80%	1249
SLP-NB-F717b	02131105,Filter,No Concept	0.77	0.37	13.5	40%	5.4	1.7	60%	1.0	1667	80%	1334
SLP-NB-F716a	02131105,Filter,No Concept	0.67	0.59	15.9	40%	6.3	1.5	60%	0.9	1511	80%	1209
SLP-NB-F719a	02131105,Filter,No Concept	1.63	0.18	19.0	40%	7.6	3.3	60%	2.0	3329	80%	2663
SLP-NB-F748b	02131105,Filter,No Concept	0.12	0.01	1.3	40%	0.5	0.2	60%	0.1	241	80%	193
SMP-NB-F308A	02131105,Filter,No Concept	1.24	0.25	16.2	40%	6.5	2.5	60%	1.5	2572	80%	2057
SMP-NB-F323D	02131105,Filter,No Concept	2.42	0.01	24.2	40%	9.7	4.8	60%	2.9	4884	80%	3907
SMP-NB-F323B	02131105,Filter,No Concept	3.19	1.25	51.3	40%	20.5	6.7	60%	4.0	6786	80%	5429
SMP-NB-F323C	02131105,Filter,No Concept	1.19	0.11	13.5	40%	5.4	2.4	60%	1.4	2432	80%	1946
SMP-NB-F323A	02131105,Filter,No Concept	4.13	0.59	50.2	40%	20.1	8.4	60%	5.0	8485	80%	6788
SMP-NB-F314C	02131105,Filter,No Concept	0.56	0.03	6.1	40%	2.4	1.1	60%	0.7	1129	80%	904
SMP-NB-F314B	02131105,Filter,No Concept	0.30	0.35	8.5	40%	3.4	0.7	60%	0.4	704	80%	563
SMP-NB-F314A	02131105,Filter,No Concept	1.54	1.17	33.5	40%	13.4	3.4	60%	2.0	3433	80%	2747
SMP-NB-F314D	02131105,Filter,No Concept	1.28	0.73	24.1	40%	9.6	2.8	60%	1.7	2791	80%	2233
SMP-NB-F309A	02131105,Filter,No Concept	0.23	0.00	2.3	40%	0.9	0.5	60%	0.3	460	80%	368
SMP-NB-F313C	02131105,Filter,No Concept	1.08	0.42	17.3	40%	6.9	2.3	60%	1.4	2299	80%	1839
SMP-NB-F313D	02131105,Filter,No Concept	1.25	0.16	14.9	40%	6.0	2.5	60%	1.5	2568	80%	2055
SMP-NB-F313B	02131105,Filter,No Concept	0.57	0.10	7.2	40%	2.9	1.2	60%	0.7	1167	80%	934
SMP-NB-F313A	02131105,Filter,No Concept	0.15	0.21	4.7	40%	1.9	0.4	60%	0.2	354	80%	283

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SMP-NB-F312	02131105,Filter,No Concept	1.03	0.02	10.5	40%	4.2	2.0	60%	1.2	2073	80%	1659
SMP-NB-F311B	02131105,Filter,No Concept	1.42	0.39	20.2	40%	8.1	2.9	60%	1.8	2978	80%	2382
SMP-NB-F311A	02131105,Filter,No Concept	0.62	0.00	6.2	40%	2.5	1.2	60%	0.7	1258	80%	1006
SMP-NB-F324A	02131105,Filter,No Concept	0.22	0.08	3.4	40%	1.4	0.5	60%	0.3	458	80%	366
SMP-NB-F324D	02131105,Filter,No Concept	0.00	0.10	1.7	40%	0.7	0.0	60%	0.0	36	80%	28
NLP-NB-F507	02131105,Filter,No Concept	0.14	0.01	1.6	40%	0.6	0.3	60%	0.2	282	80%	226
NLP-NB-F502A	02131105,Filter,No Concept	0.31	0.06	4.0	40%	1.6	0.6	60%	0.4	633	80%	507
NLP-NB-F522C	02131105,Filter,No Concept	0.50	0.04	5.5	40%	2.2	1.0	60%	0.6	1009	80%	807
NLP-NB-F509	02131105,Filter,No Concept	0.22	0.02	2.4	40%	1.0	0.4	60%	0.3	444	80%	356
NLP-NB-F524	02131105,Filter,No Concept	0.13	0.11	3.0	40%	1.2	0.3	60%	0.2	296	80%	237
NLP-NB-D560	02131105,Filter,No Concept	1.26	0.24	16.4	40%	6.5	2.6	60%	1.6	2612	80%	2090
NLP-NB-F534	02131105,Filter,No Concept	0.58	0.01	5.9	40%	2.4	1.2	60%	0.7	1165	80%	932
DOR-NB-F939b	02131105,Filter,No Concept	0.17	0.03	2.0	40%	0.8	0.3	60%	0.2	342	80%	273
DOR-NB-F939c	02131105,Filter,No Concept	0.13	0.01	1.4	40%	0.6	0.3	60%	0.2	263	80%	211
DOR-NB-F939d	02131105,Filter,No Concept	0.21	0.01	2.3	40%	0.9	0.4	60%	0.3	429	80%	343
DOR-NB-F939e	02131105,Filter,No Concept	0.17	0.02	1.9	40%	0.8	0.3	60%	0.2	338	80%	270
DOR-NB-F939a	02131105,Filter,No Concept	0.17	0.01	1.9	40%	0.8	0.3	60%	0.2	346	80%	277
DOR-NB-F939f	02131105,Filter,No Concept	0.15	0.02	1.7	40%	0.7	0.3	60%	0.2	300	80%	240
DOR-NB-F915a	02131105,Filter,No Concept	1.09	0.04	11.5	40%	4.6	2.2	60%	1.3	2200	80%	1760
DOR-NB-F915b	02131105,Filter,No Concept	0.22	0.04	2.8	40%	1.1	0.4	60%	0.3	448	80%	358
DOR-NB-F913a	02131105,Filter,No Concept	0.18	0.06	2.8	40%	1.1	0.4	60%	0.2	388	80%	310
DOR-NB-F915d	02131105,Filter,No Concept	0.22	0.01	2.3	40%	0.9	0.4	60%	0.3	454	80%	363
DOR-NB-F915e	02131105,Filter,No Concept	1.29	0.02	13.2	40%	5.3	2.6	60%	1.5	2610	80%	2088
DOR-NB-F915g	02131105,Filter,No Concept	0.77	0.07	8.7	40%	3.5	1.5	60%	0.9	1562	80%	1250
DOR-NB-F915h	02131105,Filter,No Concept	0.73	0.07	8.3	40%	3.3	1.5	60%	0.9	1483	80%	1186
DOR-NB-F913b	02131105,Filter,No Concept	0.33	0.13	5.3	40%	2.1	0.7	60%	0.4	706	80%	565
DOR-NB-F914a	02131105,Filter,No Concept	2.51	0.08	26.2	40%	10.5	5.0	60%	3.0	5078	80%	4062
DOR-NB-F903d	02131105,Filter,No Concept	0.57	0.06	6.6	40%	2.7	1.2	60%	0.7	1164	80%	931

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DOR-NB-F903e	02131105,Filter,No Concept	0.51	0.06	6.0	40%	2.4	1.0	60%	0.6	1048	80%	838
DOR-NB-F903f	02131105,Filter,No Concept	0.10	0.05	1.7	40%	0.7	0.2	60%	0.1	206	80%	164
DOR-NB-F903g	02131105,Filter,No Concept	0.07	0.05	1.5	40%	0.6	0.2	60%	0.1	158	80%	126
DOR-NB-F903h	02131105,Filter,No Concept	0.55	0.05	6.2	40%	2.5	1.1	60%	0.7	1119	80%	895
DOR-NB-F903i	02131105,Filter,No Concept	0.74	0.10	8.9	40%	3.6	1.5	60%	0.9	1526	80%	1220
DOR-NB-F903k	02131105,Filter,No Concept	0.37	0.04	4.4	40%	1.7	0.8	60%	0.5	759	80%	607
DOR-NB-F942b	02131105,Filter,No Concept	0.09	0.02	1.2	40%	0.5	0.2	60%	0.1	186	80%	149
DOR-NB-F942c	02131105,Filter,No Concept	0.09	0.02	1.2	40%	0.5	0.2	60%	0.1	196	80%	157
DOR-NB-F942d	02131105,Filter,No Concept	0.18	0.01	2.0	40%	0.8	0.4	60%	0.2	368	80%	295
DOR-NB-F942e	02131105,Filter,No Concept	0.18	0.02	2.2	40%	0.9	0.4	60%	0.2	374	80%	299
DOR-NB-F942a	02131105,Filter,No Concept	0.19	0.08	3.1	40%	1.2	0.4	60%	0.2	402	80%	322
DOR-NB-F942g	02131105,Filter,No Concept	0.36	0.10	5.2	40%	2.1	0.8	60%	0.5	762	80%	610
DOR-NB-F941a	02131105,Filter,No Concept	0.22	0.01	2.4	40%	1.0	0.4	60%	0.3	445	80%	356
DOR-NB-F941d	02131105,Filter,No Concept	0.19	0.03	2.3	40%	0.9	0.4	60%	0.2	386	80%	309
DOR-NB-F941e	02131105,Filter,No Concept	0.22	0.04	2.8	40%	1.1	0.5	60%	0.3	457	80%	365
DOR-NB-F941f	02131105,Filter,No Concept	0.20	0.03	2.4	40%	1.0	0.4	60%	0.2	408	80%	326
DOR-NB-F925b	02131105,Filter,No Concept	0.71	0.03	7.5	40%	3.0	1.4	60%	0.9	1446	80%	1157
DOR-NB-F925c	02131105,Filter,No Concept	0.91	0.15	11.3	40%	4.5	1.8	60%	1.1	1865	80%	1492
DOR-NB-F925d	02131105,Filter,No Concept	0.44	0.04	4.9	40%	2.0	0.9	60%	0.5	889	80%	711
DOR-NB-F925e	02131105,Filter,No Concept	0.69	0.03	7.4	40%	3.0	1.4	60%	0.8	1407	80%	1126
DOR-NB-F925f	02131105,Filter,No Concept	1.36	0.18	16.3	40%	6.5	2.8	60%	1.7	2784	80%	2227
DOR-NB-F941i	02131105,Filter,No Concept	0.46	0.08	5.8	40%	2.3	0.9	60%	0.6	951	80%	761
DOR-NB-F903c	02131105,Filter,No Concept	0.54	0.08	6.7	40%	2.7	1.1	60%	0.7	1116	80%	893
DOR-NB-F903j	02131105,Filter,No Concept	0.48	0.11	6.5	40%	2.6	1.0	60%	0.6	1004	80%	804
DOR-NB-F903l	02131105,Filter,No Concept	0.57	0.09	7.0	40%	2.8	1.2	60%	0.7	1169	80%	935
DOR-NB-F903m	02131105,Filter,No Concept	0.67	0.12	8.4	40%	3.4	1.4	60%	0.8	1374	80%	1099
DOR-NB-F903n	02131105,Filter,No Concept	0.12	0.05	2.0	40%	0.8	0.3	60%	0.2	253	80%	203
DOR-NB-F903o	02131105,Filter,No Concept	0.04	0.02	0.7	40%	0.3	0.1	60%	0.1	87	80%	70

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DOR-NB-F942f	02131105,Filter,No Concept	0.13	0.04	1.8	40%	0.7	0.3	60%	0.2	267	80%	213
DOR-NB-F941b	02131105,Filter,No Concept	0.24	0.02	2.7	40%	1.1	0.5	60%	0.3	481	80%	385
DOR-NB-F941c	02131105,Filter,No Concept	0.20	0.02	2.3	40%	0.9	0.4	60%	0.2	407	80%	325
DOR-NB-F941g	02131105,Filter,No Concept	0.13	0.07	2.3	40%	0.9	0.3	60%	0.2	273	80%	219
DOR-NB-F941j	02131105,Filter,No Concept	0.43	0.08	5.5	40%	2.2	0.9	60%	0.5	897	80%	718
DOR-NB-F943b	02131105,Filter,No Concept	0.29	0.10	4.4	40%	1.8	0.6	60%	0.4	613	80%	490
DOR-NB-F943d	02131105,Filter,No Concept	0.32	0.00	3.1	40%	1.3	0.6	60%	0.4	637	80%	510
DOR-NB-F943f	02131105,Filter,No Concept	0.26	0.00	2.6	40%	1.0	0.5	60%	0.3	522	80%	417
DOR-NB-F943g	02131105,Filter,No Concept	0.33	0.00	3.3	40%	1.3	0.7	60%	0.4	673	80%	538
DOR-NB-F943h	02131105,Filter,No Concept	0.29	0.00	2.9	40%	1.1	0.6	60%	0.3	579	80%	464
DOR-NB-F943j	02131105,Filter,No Concept	0.38	0.03	4.3	40%	1.7	0.8	60%	0.5	779	80%	623
DOR-NB-F943k	02131105,Filter,No Concept	0.53	0.04	5.8	40%	2.3	1.1	60%	0.6	1073	80%	858
DOR-NB-F943m	02131105,Filter,No Concept	0.62	0.20	9.2	40%	3.7	1.3	60%	0.8	1301	80%	1041
DOR-NB-F943n	02131105,Filter,No Concept	0.83	0.24	12.0	40%	4.8	1.7	60%	1.0	1744	80%	1395
DOR-NB-F943q	02131105,Filter,No Concept	1.19	0.01	12.0	40%	4.8	2.4	60%	1.4	2402	80%	1921
DOR-NB-F943aa	02131105,Filter,No Concept	1.05	0.02	10.7	40%	4.3	2.1	60%	1.3	2115	80%	1692
DOR-NB-F943bb	02131105,Filter,No Concept	0.71	0.01	7.2	40%	2.9	1.4	60%	0.8	1428	80%	1143
dor-nb-f932a	02131105,Filter,No Concept	0.80	0.15	10.3	40%	4.1	1.6	60%	1.0	1648	80%	1318
dor-nb-f932b	02131105,Filter,No Concept	1.07	0.08	11.9	40%	4.8	2.2	60%	1.3	2182	80%	1746
dor-nb-f932c	02131105,Filter,No Concept	0.17	0.06	2.6	40%	1.0	0.4	60%	0.2	355	80%	284
dor-nb-f932e	02131105,Filter,No Concept	0.46	0.10	6.1	40%	2.5	0.9	60%	0.6	953	80%	762
dor-nb-f932f	02131105,Filter,No Concept	0.25	0.01	2.6	40%	1.0	0.5	60%	0.3	497	80%	397
dor-nb-f932g	02131105,Filter,No Concept	0.06	0.01	0.8	40%	0.3	0.1	60%	0.1	132	80%	106
DOR-NB-F927a	02131105,Filter,No Concept	0.24	0.06	3.3	40%	1.3	0.5	60%	0.3	494	80%	395
DOR-NB-F931a	02131105,Filter,No Concept	0.61	0.07	7.2	40%	2.9	1.2	60%	0.7	1250	80%	1000
DOR-NB-F931b	02131105,Filter,No Concept	1.31	0.08	14.3	40%	5.7	2.6	60%	1.6	2667	80%	2133
DOR-NB-F931c	02131105,Filter,No Concept	1.25	0.07	13.5	40%	5.4	2.5	60%	1.5	2529	80%	2023
DOR-NB-F931d	02131105,Filter,No Concept	0.88	0.04	9.4	40%	3.7	1.8	60%	1.1	1777	80%	1422

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				Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)	Load from DA (lbs/yr)	RE	Max Potential Load Reduction (lbs/yr)
DOR-NB-F931e	02131105,Filter,No Concept	0.72	0.03	7.6	40%	3.1	1.4	60%	0.9	1450	80%	1160
DOR-NB-F931f	02131105,Filter,No Concept	1.12	0.07	12.3	40%	4.9	2.3	60%	1.4	2281	80%	1824
DOR-NB-F931g	02131105,Filter,No Concept	0.67	0.06	7.6	40%	3.0	1.4	60%	0.8	1366	80%	1093
DOR-NB-F931h	02131105,Filter,No Concept	1.37	0.08	14.8	40%	5.9	2.7	60%	1.6	2777	80%	2221
DOR-NB-F931i	02131105,Filter,No Concept	1.37	0.13	15.6	40%	6.2	2.8	60%	1.7	2786	80%	2229
DOR-NB-F931j	02131105,Filter,No Concept	0.54	0.22	8.8	40%	3.5	1.1	60%	0.7	1143	80%	914
DOR-NB-F931l	02131105,Filter,No Concept	0.20	0.03	2.4	40%	1.0	0.4	60%	0.2	409	80%	327
DOR-NB-F931m	02131105,Filter,No Concept	0.11	0.01	1.2	40%	0.5	0.2	60%	0.1	215	80%	172
DOR-NB-F929b	02131105,Filter,No Concept	0.27	0.01	2.7	40%	1.1	0.5	60%	0.3	539	80%	431
DOR-NB-F925a	02131105,Filter,No Concept	0.73	0.07	8.3	40%	3.3	1.5	60%	0.9	1486	80%	1189
DOR-NB-F925i	02131105,Filter,No Concept	0.33	0.07	4.4	40%	1.8	0.7	60%	0.4	683	80%	546
DOR-NB-F925j	02131105,Filter,No Concept	0.70	0.08	8.3	40%	3.3	1.4	60%	0.9	1440	80%	1152
DOR-NB-F925k	02131105,Filter,No Concept	1.45	0.08	15.7	40%	6.3	2.9	60%	1.7	2949	80%	2359
DOR-NB-F926a	02131105,Filter,No Concept	1.03	0.14	12.4	40%	5.0	2.1	60%	1.3	2120	80%	1696
DOR-NB-F926b	02131105,Filter,No Concept	1.20	0.07	13.0	40%	5.2	2.4	60%	1.4	2434	80%	1948
DOR-NB-F926c	02131105,Filter,No Concept	1.21	0.07	13.1	40%	5.3	2.4	60%	1.5	2449	80%	1959
DOR-NB-F926d	02131105,Filter,No Concept	0.58	0.03	6.1	40%	2.5	1.2	60%	0.7	1172	80%	938
DOR-NB-F924b	02131105,Filter,No Concept	0.18	0.04	2.4	40%	1.0	0.4	60%	0.2	371	80%	297
DOR-NB-F930a	02131105,Filter,No Concept	0.59	0.06	6.8	40%	2.7	1.2	60%	0.7	1202	80%	961
DOR-NB-F930b	02131105,Filter,No Concept	0.28	0.09	4.2	40%	1.7	0.6	60%	0.4	592	80%	474
DOR-NB-F930c	02131105,Filter,No Concept	0.44	0.15	6.7	40%	2.7	0.9	60%	0.6	931	80%	745
DOR-NB-F930d	02131105,Filter,No Concept	0.64	0.41	12.9	40%	5.1	1.4	60%	0.8	1414	80%	1131
DOR-NB-F930e	02131105,Filter,No Concept	0.03	0.01	0.4	40%	0.2	0.1	60%	0.0	53	80%	42
DOR-NB-F901a	02131105,Filter,No Concept	1.07	0.12	12.5	40%	5.0	2.2	60%	1.3	2180	80%	1744
DOR-NB-F901b	02131105,Filter,No Concept	0.88	0.11	10.5	40%	4.2	1.8	60%	1.1	1796	80%	1437
DOR-NB-F901c	02131105,Filter,No Concept	0.84	0.09	9.7	40%	3.9	1.7	60%	1.0	1712	80%	1369
DOR-NB-F901d	02131105,Filter,No Concept	0.82	0.08	9.4	40%	3.8	1.7	60%	1.0	1676	80%	1341
DOR-NB-F901e	02131105,Filter,No Concept	0.07	0.01	0.9	40%	0.3	0.1	60%	0.1	138	80%	110

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DOR-NB-F901f	02131105,Filter,No Concept	0.44	0.13	6.5	40%	2.6	0.9	60%	0.6	926	80%	741
DOR-NB-F901g	02131105,Filter,No Concept	0.59	0.10	7.4	40%	3.0	1.2	60%	0.7	1213	80%	971
DOR-NB-F901h	02131105,Filter,No Concept	0.51	0.07	6.2	40%	2.5	1.0	60%	0.6	1046	80%	837
DOR-NB-F901i	02131105,Filter,No Concept	0.11	0.05	1.9	40%	0.8	0.2	60%	0.1	243	80%	195
DOR-NB-F901j	02131105,Filter,No Concept	0.64	0.11	8.1	40%	3.2	1.3	60%	0.8	1326	80%	1060
DOR-NB-F901k	02131105,Filter,No Concept	0.52	0.08	6.5	40%	2.6	1.1	60%	0.6	1078	80%	862
DOR-NB-F901l	02131105,Filter,No Concept	0.82	0.08	9.5	40%	3.8	1.7	60%	1.0	1679	80%	1343
DOR-NB-F901m	02131105,Filter,No Concept	0.40	0.02	4.3	40%	1.7	0.8	60%	0.5	816	80%	653
DOR-NB-F904a	02131105,Filter,No Concept	0.28	0.64	12.8	40%	5.1	0.7	60%	0.4	746	80%	597
DOR-NB-F904b	02131105,Filter,No Concept	0.07	1.09	17.7	40%	7.1	0.5	60%	0.3	459	80%	367
DOR-NB-F910b	02131105,Filter,No Concept	2.31	0.10	24.4	40%	9.8	4.6	60%	2.8	4673	80%	3739
DOR-NB-F910c	02131105,Filter,No Concept	0.71	0.73	18.4	40%	7.4	1.6	60%	1.0	1639	80%	1311
DOR-NB-F917b	02131105,Filter,No Concept	0.56	0.23	9.2	40%	3.7	1.2	60%	0.7	1197	80%	957
dor-nb-f932d	02131105,Filter,No Concept	0.28	0.01	2.9	40%	1.2	0.6	60%	0.3	573	80%	458
SLP-NB-F768b	02131105,Infiltration,No Concept	1.69	0.13	18.8	80%	15.1	3.4	85%	2.9	3439	95%	3268
SLP-NB-F772a	02131105,Infiltration,No Concept	1.53	0.65	25.3	80%	20.3	3.2	85%	2.7	3263	95%	3100
SLP-NB-F756a	02131105,Infiltration,No Concept	1.15	0.27	15.6	80%	12.5	2.4	85%	2.0	2394	95%	2274
NLP-NB-F513	02131105,Infiltration,No Concept	0.97	1.35	30.7	80%	24.6	2.3	85%	2.0	2334	95%	2218
NLP-NB-F544	02131105,Infiltration,No Concept	0.11	0.04	1.7	80%	1.4	0.2	85%	0.2	225	95%	214
dor-nb-f933a	02131105,Infiltration,No Concept	0.00	0.06	1.0	80%	0.8	0.0	85%	0.0	18	95%	17
dor-nb-f933b	02131105,Infiltration,No Concept	0.12	0.10	2.7	80%	2.1	0.3	85%	0.2	266	95%	253
DOR-NB-F920b	02131105,Infiltration,No Concept	2.02	0.16	22.6	80%	18.1	4.1	85%	3.5	4120	95%	3914
DOR-NB-F917a	02131105,Infiltration,No Concept	0.72	0.80	19.7	80%	15.8	1.7	85%	1.4	1680	95%	1596
SLP-NB-F776b	02131105,PermPavNoSVNoUD,No Concept	0.41	0.25	7.9	75%	5.9	0.9	80%	0.7	902	85%	766
SLP-NB-F748a	02131105,PermPavNoSVNoUD,No Concept	0.90	0.07	10.0	75%	7.5	1.8	80%	1.4	1824	85%	1551
SLP-NB-F752b	02131105,PermPavNoSVNoUD,No Concept	0.35	0.05	4.3	75%	3.2	0.7	80%	0.6	711	85%	605
SLP-NB-F742b	02131105,PermPavNoSVNoUD,No Concept	0.13	0.03	1.7	75%	1.3	0.3	80%	0.2	271	85%	230
SLP-NB-F743b	02131105,PermPavNoSVNoUD,No Concept	0.24	0.03	2.8	75%	2.1	0.5	80%	0.4	485	85%	413

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SLP-NB-F769a	02131105,PermPavNoSVNoUD,No Concept	0.24	0.01	2.5	75%	1.9	0.5	80%	0.4	484	85%	412
SLP-NB-F757c	02131105,PermPavNoSVNoUD,No Concept	0.48	0.07	5.8	75%	4.4	1.0	80%	0.8	985	85%	837
SLP-NB-F737b	02131105,PermPavNoSVNoUD,No Concept	0.49	0.12	6.8	75%	5.1	1.0	80%	0.8	1025	85%	871
SLP-NB-F741c	02131105,PermPavNoSVNoUD,No Concept	0.30	0.00	3.1	75%	2.3	0.6	80%	0.5	605	85%	514
SLP-NB-F727a	02131105,PermPavNoSVNoUD,No Concept	1.66	0.39	22.6	75%	17.0	3.4	80%	2.7	3459	85%	2940
SLP-NB-F730a	02131105,PermPavNoSVNoUD,No Concept	2.04	0.44	27.1	75%	20.4	4.2	80%	3.4	4234	85%	3599
SLP-NB-F706a	02131105,PermPavNoSVNoUD,No Concept	1.89	0.10	20.4	75%	15.3	3.8	80%	3.0	3831	85%	3256
SLP-NB-F701b	02131105,PermPavNoSVNoUD,No Concept	0.31	0.03	3.5	75%	2.6	0.6	80%	0.5	624	85%	531
SLP-NB-F739a	02131105,PermPavNoSVNoUD,No Concept	3.56	0.02	35.6	75%	26.7	7.1	80%	5.7	7173	85%	6097
SLP-NB-F715c	02131105,PermPavNoSVNoUD,No Concept	0.57	0.07	6.8	75%	5.1	1.2	80%	0.9	1176	85%	999
SLP-NB-F726b	02131105,PermPavNoSVNoUD,No Concept	0.30	0.02	3.3	75%	2.4	0.6	80%	0.5	602	85%	511
SLP-NB-F724c	02131105,PermPavNoSVNoUD,No Concept	0.33	0.04	3.9	75%	2.9	0.7	80%	0.5	684	85%	581
SLP-NB-F722a	02131105,PermPavNoSVNoUD,No Concept	1.23	0.10	13.8	75%	10.3	2.5	80%	2.0	2507	85%	2131
SLP-NB-F760a	02131105,PermPavNoSVNoUD,No Concept	0.49	0.03	5.3	75%	4.0	1.0	80%	0.8	993	85%	844
SLP-NB-F762d	02131105,PermPavNoSVNoUD,No Concept	1.18	0.10	13.2	75%	9.9	2.4	80%	1.9	2400	85%	2040
SLP-NB-F712d	02131105,PermPavNoSVNoUD,No Concept	1.29	0.06	13.7	75%	10.3	2.6	80%	2.1	2612	85%	2220
SLP-NB-F744c	02131105,PermPavNoSVNoUD,No Concept	1.24	0.26	16.4	75%	12.3	2.5	80%	2.0	2575	85%	2189
NLP-NB-F547A	02131105,PermPavNoSVNoUD,No Concept	0.39	0.09	5.3	75%	4.0	0.8	80%	0.6	814	85%	692
NLP-NB-F547B	02131105,PermPavNoSVNoUD,No Concept	1.01	0.11	11.7	75%	8.8	2.0	80%	1.6	2066	85%	1756
NLP-NB-D558	02131105,WetPondWetland ,No Concept	1.56	6.03	109.6	20%	21.9	4.9	45%	2.2	4862	60%	2917
DOR-NB-F938a	02131105,WetPondWetland ,No Concept	4.25	0.12	44.0	20%	8.8	8.5	45%	3.8	8599	60%	5159
DOR-NB-F911a	02131105,WetPondWetland ,No Concept	1.81	1.02	34.0	20%	6.8	3.9	45%	1.8	3934	60%	2361
DOR-NB-F911b	02131105,WetPondWetland ,No Concept	2.25	0.88	36.1	20%	7.2	4.7	45%	2.1	4787	60%	2872
DOR-NB-F928a	02131105,WetPondWetland ,No Concept	1.96	0.60	28.7	20%	5.7	4.1	45%	1.8	4108	60%	2465
DOR-NB-F925h	02131105,WetPondWetland ,No Concept	0.13	0.02	1.7	20%	0.3	0.3	45%	0.1	275	60%	165

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DOR-NB-F924a	02131105,WetPondWetland ,No Concept	0.74	0.06	8.3	20%	1.7	1.5	45%	0.7	1509	60%	905
DOR-NB-F920c	02131105,WetPondWetland ,No Concept	12	0	119.6	20%	23.9	24.0	45%	10.8	24226	60%	14536
	Total	316.2	91.6	4568.6		1865.2	656.1		385.1	662882		488342