LOWER NORTH BRANCH PATAPSCO
Watershed Assessment

Lower North Branch Patapsco
Watershed (Baltimore City)

April 2019

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ACRONYMS / GLOSSARY

BMP – Best Management Practice (for controlling pollutant discharges)

DOT – Department of Transportation

DPW – Department of Public Works

ENR – Enhanced Nutrient Reduction

ESD-Environmental Site Design (aka Low Impact Development / LID), comprehensive strategy for maintaining predevelopment runoff characteristics by integrating site design, natural hydrology, and smaller controls to capture and treat runoff at the source.

EPA – Environmental Protection Agency

Impervious Surface-surfaces that prevent stormwater from infiltrating to below the ground, includes rooftops, pavement, and gravel.

MDE – Maryland Department of the Environment

MD DNR – Maryland Department of Natural Resources

MEP – Maximum Extent Practicable

MS4 – Municipal Separate Storm Sewer System

NPDES – National Pollutant Discharge Elimination System

Nutrients – Total phosphorus and total nitrogen

Planning – Department of Planning

TMDL – Total Maximum Daily Load, the maximum amount of a pollutant a water body can receive and still meet water quality standards; "pollution diet".

TN – Total Nitrogen

TP – Total Phosphorus

TSS – Total Suspended Solids

Watershed – an area of land that drains down slope to the lowest point, discharging to a river, river system or other body of water.

WIP – Watershed Implementation Plan; document that sets the way an agency will meet the regulatory requirements.

WLA – Waste Load Allocations

WQA – Water Quality Analysis, developed when supplemental data indicates the water body is meeting water quality standards for that substance

WS - Watershed

1   INTRODUCTION

The purpose of the Lower North Branch Patapsco (LNBP) Watershed Assessment report is to identify and rank watershed conditions according to physical feasibility, social and health factors, and equity, as well as identify best management practices (BMPs) for watershed restoration and Total Maximum Daily Load (TMDL) compliance to meet the requirements of the Baltimore City's Municipal Separate Storm Sewer System (MS4) permit and maximize co-benefits provided to communities within the watershed. Specifically, the report addresses the following:

- Provides an update on current water quality conditions;

- Summarizes the results of a visual watershed inspection;

- Identifies and ranks water quality problems; and

- Prioritizes structural and nonstructural water quality improvement projects

The Watershed Assessment is a planning document that identifies priority areas and water quality improvement strategies specific to each of the priority areas. The assessment will be used to inform the development of future Watershed Implementation Plans, which will include identification of specific projects. Pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater wasteload allocations (WLAs) for the LNBPs Watershed can be found in the current "Baltimore City MS4 Restoration and TMDL Watershed Implementation Plan (WIP)" (August 2015), as well as in the City's MS4 Annual Reports.

In addition to serving as a guide for developing future watershed implementation plans by the City, this Watershed Assessment can also serve as a framework and resource for non-profits, environmental groups, and city agencies in targeting projects and programs.

1.1   Watershed Assessment Report Organization

This report is organized into the following chapters:

Chapter 1 – Introduction. Explains the purpose of the report and the location and scope of the watershed assessment, along with the methods for the assessment.

Chapter 2 - Watershed Characterization.   Inventory of physical and social conditions, including 1) environmental factors related to water quality and physical conditions relevant for determining the feasibility of restoration activities, 2) social, economic, and health factors relevant for prioritization of work, and 3) regulatory and planning documents relevant for aligning restoration efforts with the work of other stakeholders operating within the watershed.

Chapter 3 – Water Quality Assessment. Identifies and ranks water quality problems. Includes a description of the TMDLs for the watershed as well as a prioritization of contributing factors to water quality problems.

Chapter 4 – Suitability Analysis and Prioritization. Outlines the proposed prioritization approach based on suitability for improving water quality and meeting TMDL WLAs, maximizing equity and potential co-benefits associated with restoration strategies, and prioritizing areas for potential projects, programs, and partnerships.

Chapter 5 – Stormwater Best Management Practices. Includes a description of various BMPs (Projects, Programs, and Partnerships) currently being employed by DPW, as well as BMP opportunities based on priority areas.

Chapter 6 – References and Data Sources. Contains citations and data sources used in mapping.

1.2 Watershed Delineation and Location

The LNBP watershed is one of five (5) 8-digit state defined watersheds within Baltimore City. The LNBP watershed includes portions of Baltimore City, Baltimore County, Anne Arundel County, Carroll County, and Howard County, and is included within the larger 6-digit Patapsco River Watershed. Water falling within this area drains to the Patapsco River and ultimately to the Chesapeake Bay (see Figure 1-2).

While the entire LNBP watershed is 116.4 square miles (74,496 acres), only the portion within Baltimore City (1.4 square miles or 890 acres) will be addressed in this report. Going forward, the LNBP will refer to the portion of the LNBP watershed within Baltimore City limits, unless otherwise specified.

There are no sub-watersheds within the LNBP in Baltimore City.

The 8-digit watershed boundary provided by MDE was reviewed in the context of existing topography and storm drainage systems, catchment areas, and outfalls within Baltimore City. The boundaries of the LNBP used were adjusted to reflect the existing drainage patterns. Changes are detailed in Figure 1-3.

Community Statistical Areas (CSAs)
Baltimore has various organizations that collect, compile, and analyze socio-economic, demographic, public health, and environmental data across the city. Neighborhoods often represent small geographic units with populations that are often too small to adequately protect privacy and/or provide a sample size sufficient to offer a representative perspective on neighborhood conditions.

In response to this challenge, the Baltimore Neighborhood Indicators Alliance (BNIA) identified 55 geographic areas, known as Community Statistical Areas (CSAs) (Figure 1-1) which combine clusters of similar Census Tracts that correspond to Baltimore's neighborhoods boundaries (Figure 1-4). Both BNIA and the Baltimore City Health Department collect and report publicly available data based on CSAs.
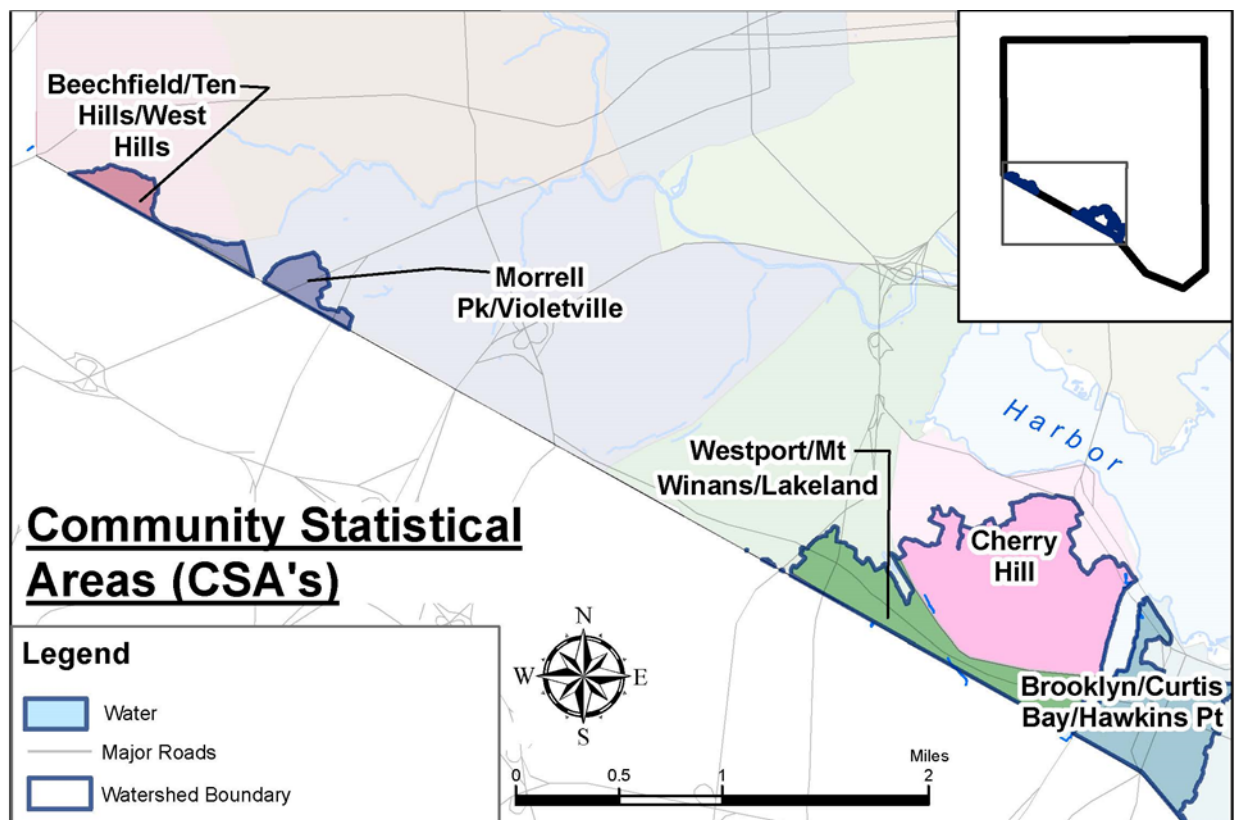
Figure 1-1 Community Statistical Areas within the LNBP

Lower North Branch Patapsco (LNBP) Watershed Boundary within Baltimore City

Carroll County

Baltimore County

Baltimore City

Howard County

Anne Arundel County

Lower North Branch Patapsco (Baltimore City)

Lower North Branch Patapsco

Legend

- LNBP Watershed Boundary
- LNBP Watershed in Baltimore City
- County Boundary
- Water

N W E S

Miles
0   0.75 1.5   3   4.5   6
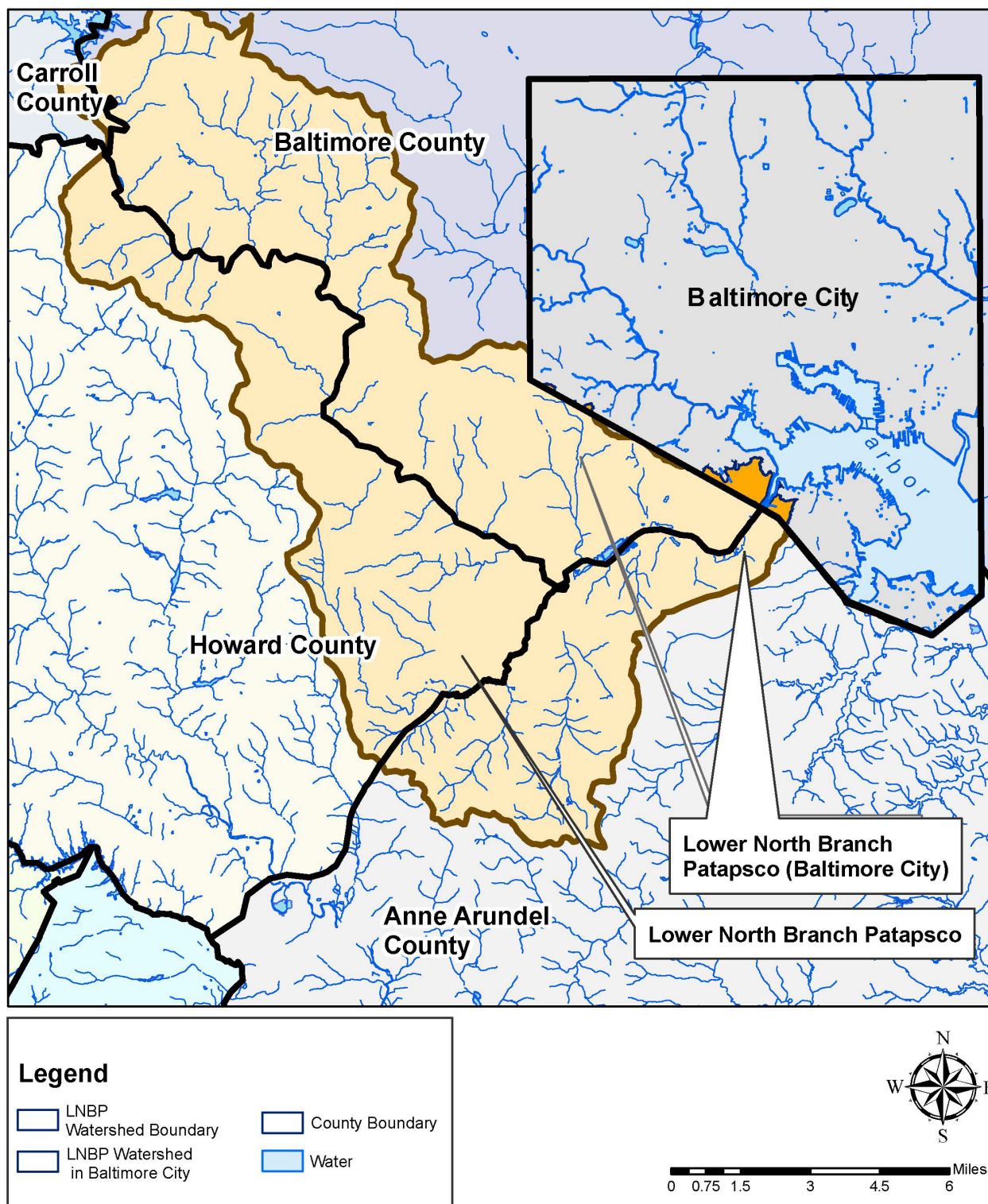
Figure 1-2: Lower North Branch Patapsco Watershed Context

Updated Lower North Branch Patapsco (LNBP) Boundary & Watershed Context

Jones Falls

Back River

Gwynns Falls

Baltimore Harbor

Harbor

Lower North Branch Patapsco (Baltimore City)

Legend

▮ No Change - LNBP	▭ Updated LNBP Boundary	
▮ Balt. Harbor to LNBP	▭ MDE 8 Digit Watershed Boundary	
▮ Gwynns Falls to LNBP	▮ Water	
▨ LNBP to Balt. Harbor		
▨ LNBP to Gwynns Falls		

N W E S

Miles
0   0.5   1   2   3   4
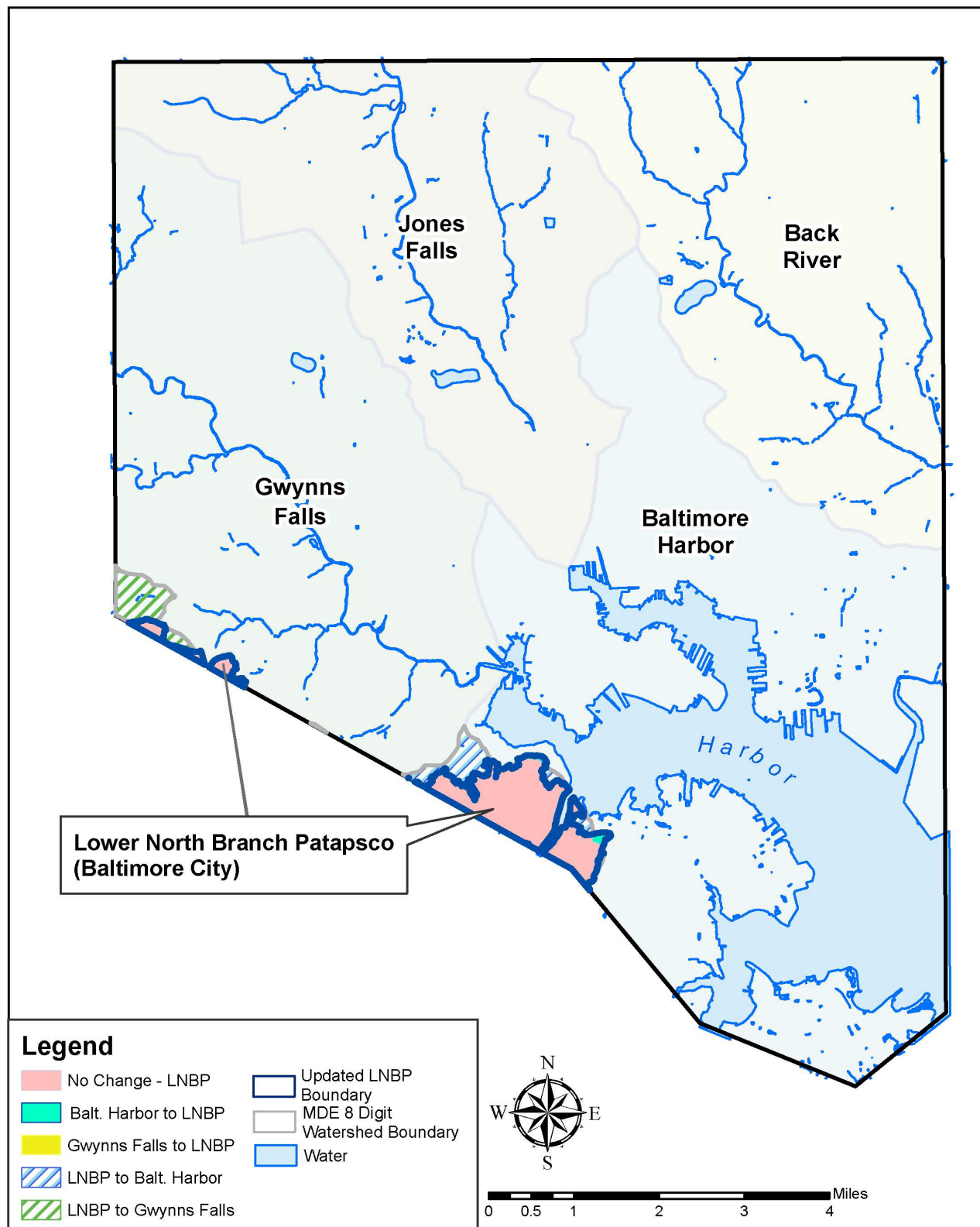
Figure 1-3 Updated Lower North Branch Patapsco Boundary and Watershed Context

Given the quality and quantity of data available on CSAs, this report uses CSAs as the primary geographic unit of analysis for illustrating the environmental, public health, and socio-economic contexts of various areas at the watershed. This report was completed at a watershed scale, but any project-scale planning efforts will consider the unique context of neighborhoods when planning outreach, engagement, and implementation.

Within the LNBP watershed, there are five CSAs (neighborhoods shown in parentheses). (Table 1-1)
1. Beechfield/Ten Hills/West Hills (Beechfield / Yale Heights)
2. Brooklyn/Curtis Bay/Hawkins Point (Brooklyn / Fairfield)
3. Cherry Hill (Cherry Hill)
4. Morrell Park/Violetville (Oaklee / Violetville / Yale Heights)
5. Westport/Mt. Winans/Lakeland (Lakeland)

Table 1-1 Summary of CSA Distribution within LNBP Watershed

CSA	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Acres	30.7	204.8	408.8	49.3	185.4
% of Watershed	3.4%	23.0%	45.9%	5.5%	20.8%
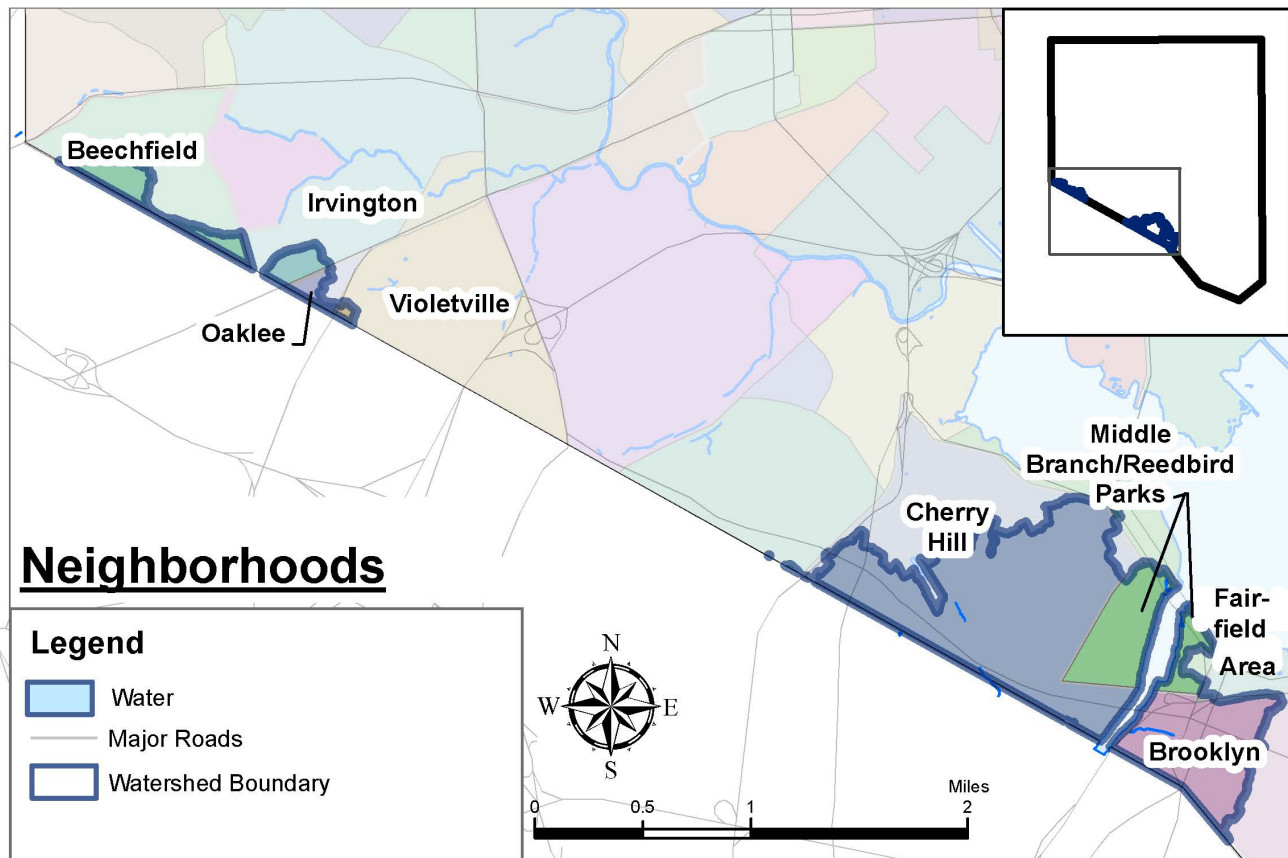
Figure 1-4 Neighborhoods within the LNBP

1.3   Assessment Approach

The LNBP watershed is a densely populated urban environment. Therefore, the relevance of human social behavior to water quality improvement efforts cannot be ignored. Watershed restoration activities used in Baltimore include a mix of constructed practices, programs, and partnerships that both directly treat and manage stormwater. The assessment also aims to cultivate public acceptance, support, and stewardship of watershed restoration efforts by leveraging these activities as a tool to improve the health and safety of communities within the watershed.

1.4   Defining the Scope of Best Management Practices [1]

Stormwater management includes many strategies known as Best Management Practices (BMPs) to mitigate the negative impact of development on watersheds. These BMPs aim to reduce the level of contamination in stormwater before it enters surface waters, and reduce the excess volume and rate of flow resulting from impervious surfaces.

Best Management Practices (BMPs) as defined within this document are inclusive of both modifications to the physical environment and operational strategies (structural and nonstructural, respectively). This includes the following types of practices:

1) **Projects:** Capital projects like stormwater ponds, environmental site design (ESD) (bio-swales, rain gardens, bioretention), impervious surface removal, and tree planting resulting in a definable asset. DPW will either be the lead for the installation of these projects and/or work in collaboration with other city agencies and the school system to provide capital funding.

2) **Programs:** DPW services and operations, including street and proactive inlet cleaning, inspections, and public outreach and education.

3) **Partnerships:** Partnerships can result in BMPs that are installed by the public, private and non-profit sectors, whether as a requirement for development, projects by environmental non-profits, or stormwater fee credits. Partnerships can also include public education, engagement, and initiatives that address co-benefits such as health and equity.

1.5   Method of Analysis

In order to identify and prioritize BMPs for watershed restoration, DPW performed an assessment of current watershed conditions to understand the physical and social context of the LNBP Watershed.

1.5.1   Watershed Characterization

Data was collected on the following factors within the watershed, which will be described along with their relationship to water quality (in Section 2 of this report) and suitability and prioritization analyses (in Section 4 of this report).

- Land Use
  - Zoning
  - Land Use
  - Property Ownership
- Regulatory Conditions
  - Projected Development Trends
  - Critical Area
  - NPDES Discharge Permits
- Assessment of Physical Conditions
  - Slope

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[1] A more detailed description of these BMPs can be found in Section 5.

- o Hydrologic Soil Classification
- o Stream/Shoreline Systems
- o Stream Riparian Buffers
- o Tidal Waters
- o Shoreline Riparian Buffers
- o Floodplain
- o Impervious Surfaces
- o Surface Temperature
- o Urban Tree Canopy Prioritization
- o Wet Utility Networks
  - ▪ Storm Drain System
  - ▪ Sanitary Sewer System)
  - ▪ Capital Improvement Projects
  - ▪ Sanitary Sewer Overflows (SSOs)
  - ▪ Dirty Streets and Alleys / Clogged Storm Drains
- Visual Watershed Inspection Results
- Socio-Economic Conditions
  - o Demographics
  - o Age Distribution
  - o Hardship Index
- Planning Initiatives / City-wide Initiatives
  - o Community Plans
  - o Small Watershed Action Plans and Harbor Plans
  - o Other Plans
  - o City Wide Initiatives

1.5.2 Water Quality Assessment
Data was collected on water quality impairments and TMDLs for the LNBP and for the Chesapeake Bay.

1.5.3 Suitability Analysis & Prioritization
In order to prioritize areas within the watershed for water quality improvement efforts, CSAs were analyzed and prioritized based on the following three (3) Prioritization Categories:

- Physical Feasibility
- Equity (social / economic/racial)
- Health Supportive Community

Each of the three Prioritization categories was defined by analyzing data based on several factors. These factors and the prioritization methodology are described in greater detail within Section 4 of this report.

Watershed opportunities and other stakeholder initiatives were also identified and mapped to determine areas where water quality improvement activities could meet the priorities of multiple stakeholders, and to identify where aligned interests and opportunities for partnership and coordination may be present.

1.5.4 Identification of Best Management Practices
Strategies were identified for implementing BMPs, developing new / enhancing existing programs, and conducting public outreach and education. These strategies represent various types of potential projects, programs, and partnerships that could be deployed within the watershed, based on the opportunities identified within this report (Section 5).

It is recognized that changes in weather patterns resulting from climate change will require adaptations in terms of the extent of the floodplain, facility design, and facility placement going forward. Additional considerations may become necessary as implementation plans are developed, and adaptations will be made as needed.

1.5.5   Recommendations

Each of the potential types of projects, programs, and partnerships identified was then linked to conditions that would indicate particular strategies that would be appropriate and beneficial. A list of partners that may be relevant for each effort was also identified. These recommendations will serve as a framework for identifying potential partnerships and collaborations for future implementation (Section 5.5).

2   WATERSHED CHARACTERIZATION

The following section includes an inventory of the physical and socio-economic conditions, and health related in the watershed, which will be used to determine where various stormwater BMPs are most appropriate. Recent infrastructure projects and planning initiatives in the watershed area are also noted to inform planning for future water quality improvement work.

2.1   Zoning / Land Use / Property Ownership

2.1.1   Zoning

Zoning is the process of dividing land in a municipality into zones (e.g. residential, industrial) in which certain land uses are permitted or prohibited. Zoning reflects what exists as land use, and an indication of what will be permitted for future development (Table 2-1).

Residential zoning occurs throughout the watershed (Figure 2-1), with the northwest corner comprised of a mix of detached residential, medium density residential, and multi-family, the central portion (Cherry Hill) a mix of public housing and medium density residential, and Brooklyn with high density residential. Commercial areas are located in Brooklyn along Hanover Street and Patapsco Avenue, along Patapsco Avenue in Lakeland, and the Cherry Hill Town Center. Industrial-zoned areas form the southern edge of the watershed along Patapsco Avenue and the CSX rail lines that wrap the edge of Cherry Hill.

Open space consists of parks along the edge of the LNBP (Reedbird and Middle Branch), as well as portions of two cemeteries in the northwest corner of the watershed – Loudon Park Cemetery and Baltimore National Cemetery.

In Table 2-1, the percentage of zoning type within the watershed is used to identify how different zoning types are distributed in order to target particular BMP opportunities. Table 2-2 indicates how each zoning type is distributed across the CSAs within the watershed.

Table 2-1 Zoning Type within the Watershed

Zoning Type	Area (Acres)	Percentage of Watershed Area
Commercial	81.3	9.1%
Hospital	2.0	0.2%
Industrial	209.8	23.6%
Open Space	126.7	14.2%
Residential Detached	73.0	8.2%
Residential Mixed Use	8.4	1.0%
Residential Rowhouse	388.3	43.6%

Table 2-2 indicates how zoning types are distributed across the CSAs. This shows, for instance, that while Brooklyn / Curtis Bay / Hawkins Point and Westport / Mt Winans / Lakeland may have a reasonably small percentage of their area within commercial use zones, they represent the largest opportunities for commercial outreach within the watershed. Similarly, there is a relatively small percentage of the LNBP watershed that represents areas with detached residential, which indicate areas where there are greater opportunities for residential private space BMP implementation and outreach. The bulk of these limited opportunities exist within Brooklyn / Curtis Bay / Hawkins Point and Beechfield / Ten Hills / West Hills.

Table 2-2 Zoning Type within CSAs in Watershed

CSA	Zoning Type	Area (Acres)	Percentage of CSA area	Percentage of the total area of each Zoning Type within the Watershed
Beechfield / Ten Hills / West Hills	Open Space	8.1	26.3 %	6.4 %
	Residential Detached	22.5	73.3 %	30.8 %
	Residential Rowhouse	0.1	0.4 %	0.0 %
Brooklyn / Curtis Bay / Hawkins Point	Commercial	48.9	23.9 %	60.1 %
	Industrial	33.2	16.2 %	15.8 %
	Open Space	35.1	17.2 %	27.7 %
	Residential Detached	30.3	14.8 %	41.4 %
	Residential Mixed Use	8.4	4.1 %	100.0 %
	Residential Rowhouse	48.8	23.8 %	12.6 %
Cherry Hill	Commercial	7.9	1.9 %	9.7 %
	Hospital	2.0	0.5 %	100.0 %
	Industrial	17.3	4.2 %	8.3 %
	Open Space	59.4	14.5 %	46.8 %
	Residential Rowhouse	322.2	78.8 %	83.0 %
Morrell Park / Violetville	Industrial	3.3	6.7 %	1.6 %
	Open Space	22.3	45.2 %	17.6 %
	Residential Detached	8.4	17.1 %	11.5 %
	Residential Rowhouse	15.2	31.0 %	7.3 %
Westport / Mt Winans / Lakeland	Commercial	23.4	12.6 %	18.5 %
	Industrial	154.8	83.5 %	73.8 %
	Residential Detached	7.2	3.9 %	9.9 %
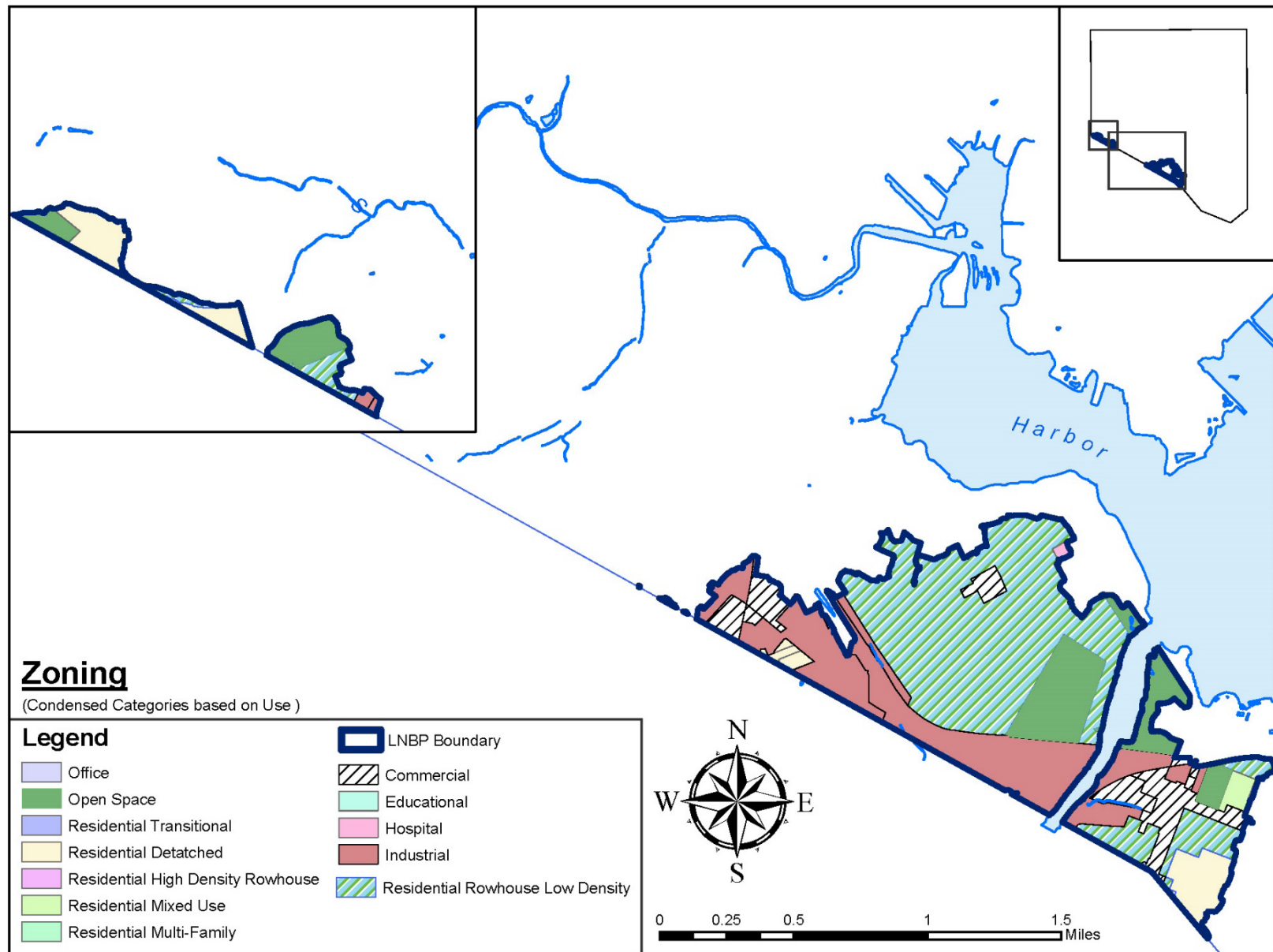
Figure 2-1 Zoning Type within Watershed

2.1.2   Land Use

Land use data was downloaded from the MD iMAP GIS portal. This dataset was compiled in 2010 to track how development has transformed land use generally over time at the state level. As such, the categorization differs from zoning, which represents the intended land use types established by the City going forward.

The predominant land use types within the LNBP watershed are high density residential, other developed land and Industrial land, and forest. Over 38% of the land area in the watershed is comprised of high density and medium density residential areas. Public housing represents the majority of the medium density housing in Cherry Hill. Residential areas present an opportunity for community involvement in restoration efforts, neighborhood pollutant source control, and environmental stewardship.

Commercial areas make up 9% of the total area, with the majority of commercial land use located in Brooklyn and along Patapsco Avenue in Lakeland. Institutional areas such as community centers, schools, churches, and medical facilities, comprise about 10% of the total area. Both of these land uses present opportunities to install ESD practices, plant trees, and promote environmental awareness education.

Table 2-3 Land Use Types

Land Use Type	Acres	Percentage of Watershed Area
Barren Land	12.8	1.4%
Commercial	75.2	8.5%
Forest	80.8	9.1%
Industrial	109.4	12.3%
Institutional	88.6	10.0%
Other Developed Land	146.5	16.5%
High Density Residential	288.2	32.4%
Medium Density Residential	51.4	5.8%
Transportation	35.9	4.0%
Water	1.2	0.1%
Wetland	9.1	1.0%

Land Use Land Cover

(State of Maryland)

Legend

Industrial	Watershed Boundary
Institutional	Medium Density Residential
Low Density Residential	Other Developed Lands
Barren Land	Transportation
Commercial	Water
Forest	Wetlands
High Density Residential	
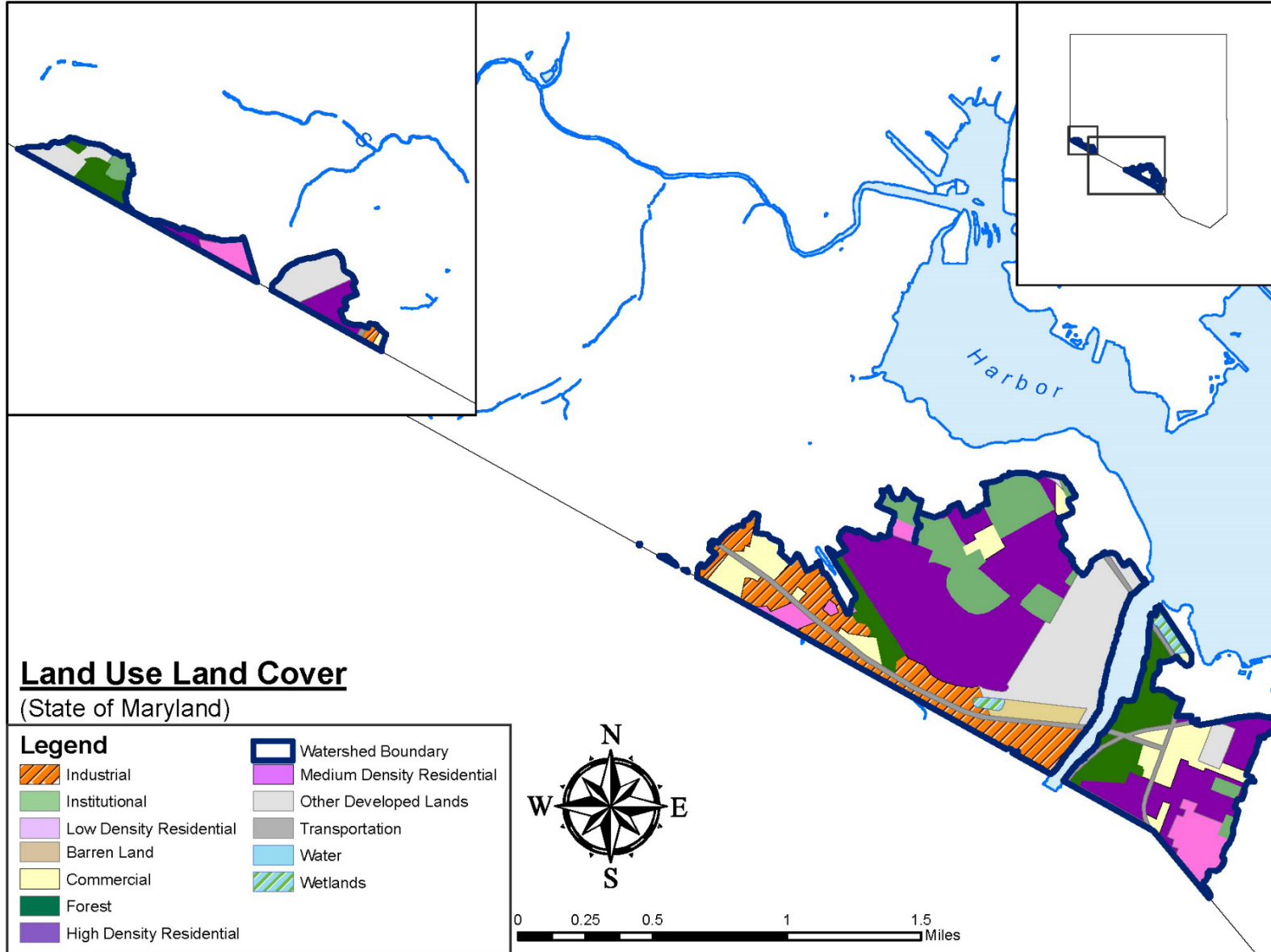
Figure 2-2 Land Use and Land Cover within Watershed

2.1.3 Property Ownership

Property ownership is a critical consideration for determining available space for restoration activities, potential partnerships necessary for implementation, and the barriers that may be encountered. Currently, it is the policy of DPW to only install stormwater management projects on publicly owned property, such as City owned land or within the right-of-way (ROW)[2]. Public land is limited, and often contains physical constraints or barriers such as utilities. For example, Reedbird Park is a closed landfill that limits the installation of facilities. Installing projects on federal, state, or private land would require additional tailored agreements, easements, or memorandums of understanding in order to protect investment of public funds. Programs, partnerships, and incentives may be more effective to allow for restoration activities on land owned by others, which can contain fewer utilities or other constraints. Railways corridors have been identified as particularly limiting for restoration projects based on prior experience, therefore parcels with above and below ground rail were identified. While railway corridors may not impact the entire parcel, the presence of railways indicates an additional stakeholder requiring coordination for activities on those parcels.

Baltimore City maintains a dataset which contains information on land parcels within the city limits and ownership information. This dataset was reviewed to identify parcels that were City-owned, State-owned, Federal-owned, or privately Privately-owned. The area of rights-of-ways (ROW) was estimated by designating identifying land area within the City limits that was not a parcel. For the rail crossings in the ROW, a 20 ft. buffer was assumed on either side of rail lines crossing the estimated right of way area to determine the area of ROW impacted by railways. This area was combined with the area of the parcels impacted by rail to determine the properties impacted by rail.

Results demonstrate that the percentage of the watershed that is City-owned land is approximately equivalent to the percentage of the watershed that is under private ownership. This indicates that there is substantial opportunity to consider programs to engage private land owners alongside City driven efforts for restoration and watershed management. Although about 17% of the watershed is within the ROW, the ROW serves a primary purpose of transportation and utilities, so land-intensive BMPs would be limited.

Table 2-4 Property Ownership

Type	AREA (ac)	Percentage of land area within Watershed
City Owned	177.2	19.9%
Federal Owned	138.9	15.6%
Private	321.3	36.1%
Right of Way (ROW)*	153.4	17.2%
Parcel/ROW w/Rail	47.7	5.4%
State Owned	22.8	2.6%
State Right of Way*	26.8	3.0%

*Area of Right of Ways and properties impacted by rail were estimated as described above

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[2] Stream restoration projects can be installed on private property utilizing a property easement.
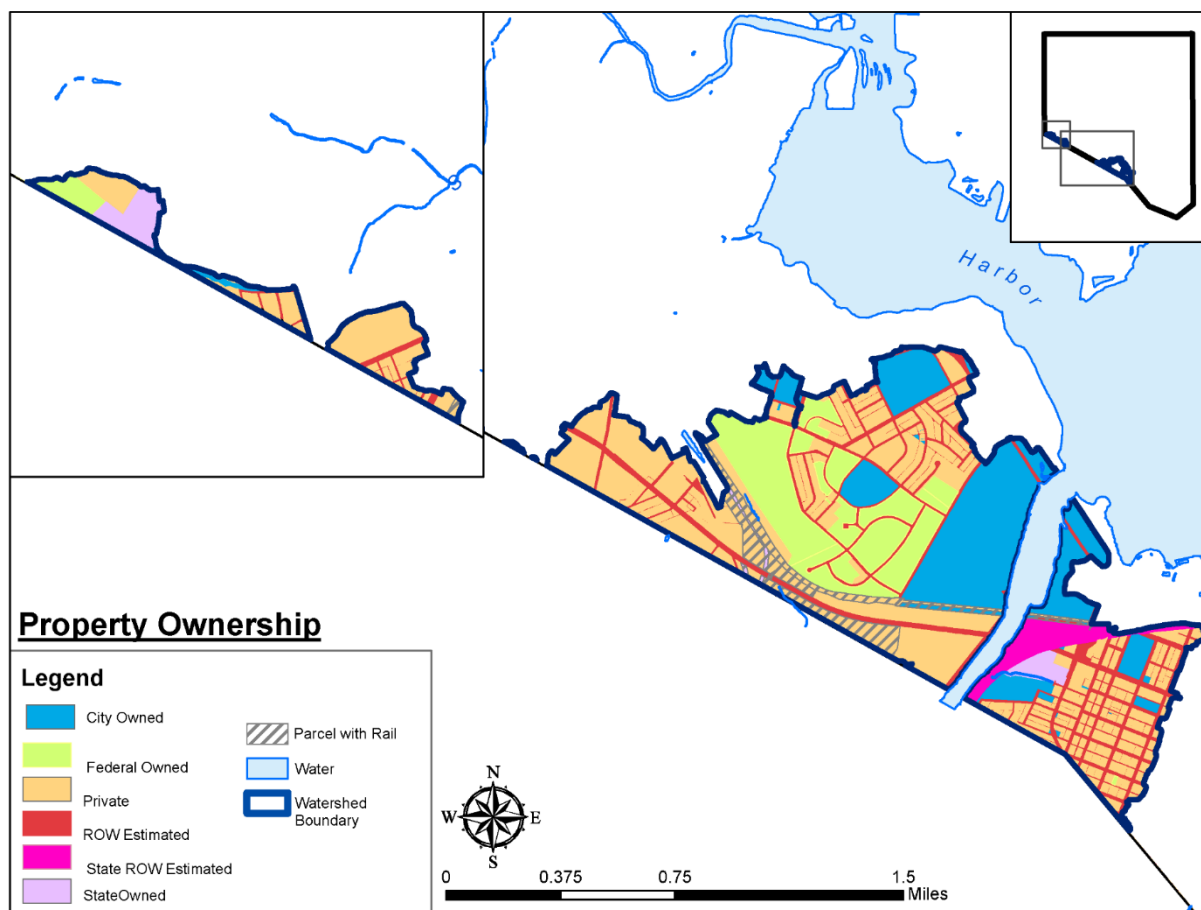
Figure 2-3 Property Ownership within the Watershed

2.1.4 Projected Development Trends

Estimating the geographic areas where private development is expected to occur can provide a forecast for the magnitude of watershed restoration activities carried out through private development as a result of existing stormwater management regulations. The Housing Department has identified several redevelopment initiatives and focus areas. None of these redevelopment focus areas currently exist in the LNBP, and therefore there are not specific areas where private development can be expected to contribute in a significant way towards restoration efforts.

2.2 Regulatory Conditions

2.2.1 NPDES Discharge Permits

Point source discharges of wastewater, stormwater, or water from industrial uses into waters of the United States are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit, which includes requirements to protect water quality. Large municipalities, like Baltimore, manage Municipal Separate Storm Sewer System (MS4) permits under the NPDES umbrella. Federal and state land owners, even within the city boundary, often have their own separate NPDES permits with separate requirements. Facilities that discharge industrial wastewater or conduct activities that can contribute a higher level of pollutants than typical may exist within the city boundaries, but often require separate industrial discharge permits with special requirements. This watershed assessment specifically aims to inform strategies to address water quality to satisfy the requirements of Baltimore City's MS4 permit. Therefore, it is important to identify properties within the city boundary that are regulated by separate permits, managed by others. (Figure 2-4).

Table 2-5 NPDES Regulated Stormwater Source Sectors

NPDES Sector	Area Ac	Percentage of WS
City MS4	684.3	76.9
Federal	138.9	15.6
Industrial	12.6	1.4
State	5.9	5.9
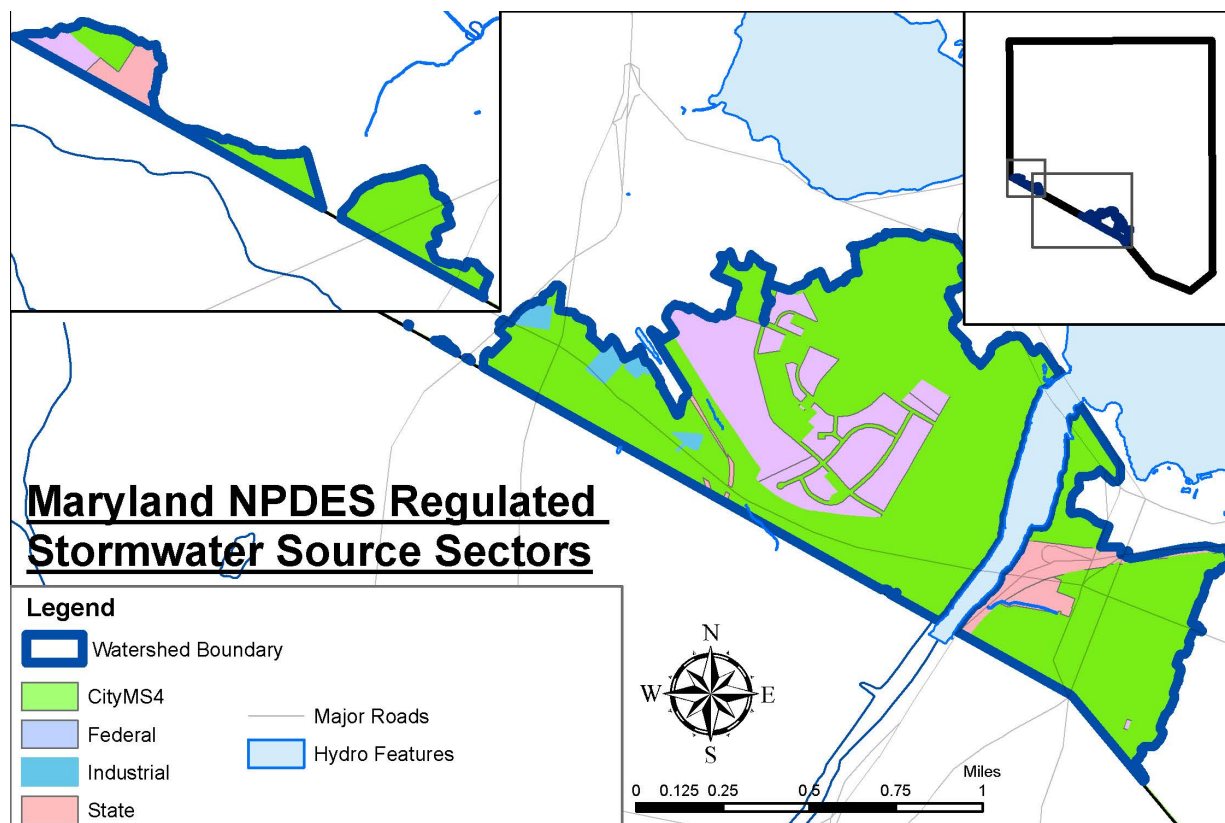
Figure 2-4 NPDES Regulated Stormwater Source Sectors within Watershed

2.2.2   Critical Area

The State of Maryland Chesapeake Bay Critical Area Law establishes the Chesapeake Bay Critical Area Commission (CAC) and requires that Baltimore City and other jurisdictions prepare and adopt a Critical Area Management Program (CAMP) to:

1.   Improve the water quality of the Bay by controlling pollution from stormwater runoff and;

2.   To conserve and protect wildlife habitat along the shoreline of the Bay

The City's CAMP establishes guidelines for development of properties within the 1,000-foot strip of land measured from the mean high tide line or the bulkhead. The Critical Area is also separated into additional sub-areas. Within the watershed, these sub-areas are Intensely Developed Areas (IDA) and Resource Conservation Areas (RCA). Two of the requirements for development projects in the Critical Area are for IDA projects to reduce phosphorus levels in storm water runoff by 10% and RCA projects to limit lot coverage (impervious surfaces) to 15-25% of the lot, depending on the size of the lot.

Critical Areas are primarily along the banks of the Lower North Branch of the Patapsco and two stream reaches

within Cherry Hill, Westport/Mt. Winans/Lakeland, and Brooklyn/Curtis Bay/Hawkins Point (Figure 2-5).
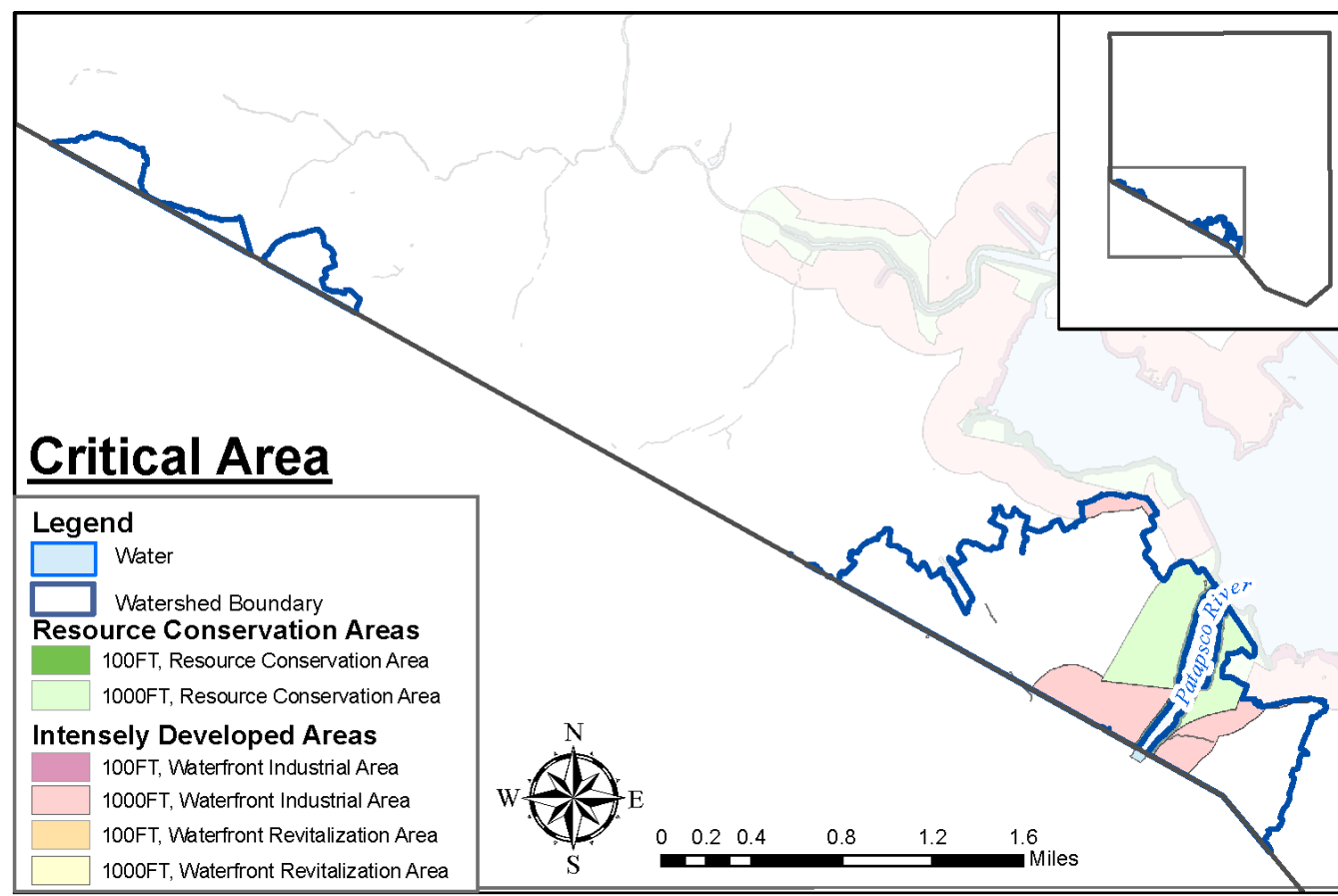
Figure 2-5 Critical Area

2.2.3 Streams, Riparian Areas, and Floodplains

The LNBP includes approximately 9,140 linear feet (LF) of streams and open channels. The primary stream is the North Branch of the Patapsco. In addition, there are four small unnamed open channels:

- BGE property west and south of Cherry Hill (1,650 LF and 1,400 LF). The unnamed channels on BGE property enter storm drain culverts and empty into the main stem of the stream from structured outfalls.

- Along the southern edge of Middle Branch Park (800 LF)

- State of Maryland Property adjacent to I-895 (1,100 LF).

The North Branch of the Patapsco is bordered primarily by two parks, Reedbird Park and Middle Branch Park, located north of the B&O Railroad and Patapsco Avenue. South of Patapsco Avenue the stream is bordered by industrial property owners (west shore) and I-895 (east shore). It is also characterized by broad slopes with a 100+ ft. wide riparian area, except for a wetland at the mouth of the Patapsco between Potee and Hanover Streets. The small unnamed tributaries are bordered by a combination of trees and open land. No assessments of the physical condition of these streams have been conducted.

In Baltimore, the "Floodplain" is defined as (1) a relatively flat or low land area adjoining a river, stream, or watercourse that is subject to partial or complete inundation, (2) an area subject to the unusual and rapid accumulation or runoff of surface waters from any source; or (3) an area subject to tidal surge or extreme tides. In Baltimore City, the regulated floodplain includes the 1% and 0.2% annual-chance flood areas, also known as the 100-year and 500-year floodplain (in GREEN towards the mouth of the LNBP's southern bank Figure 2-6).

According to the MDE Stormwater Design Manual, grading and construction for BMP practices is not recommended in the floodplain. In areas of regulated floodplain, alternative practices or specialized designs may be required. A small area of regulated 100-year floodplain exists near the mouth of the LNBP River in Cherry Hill and Brooklyn.
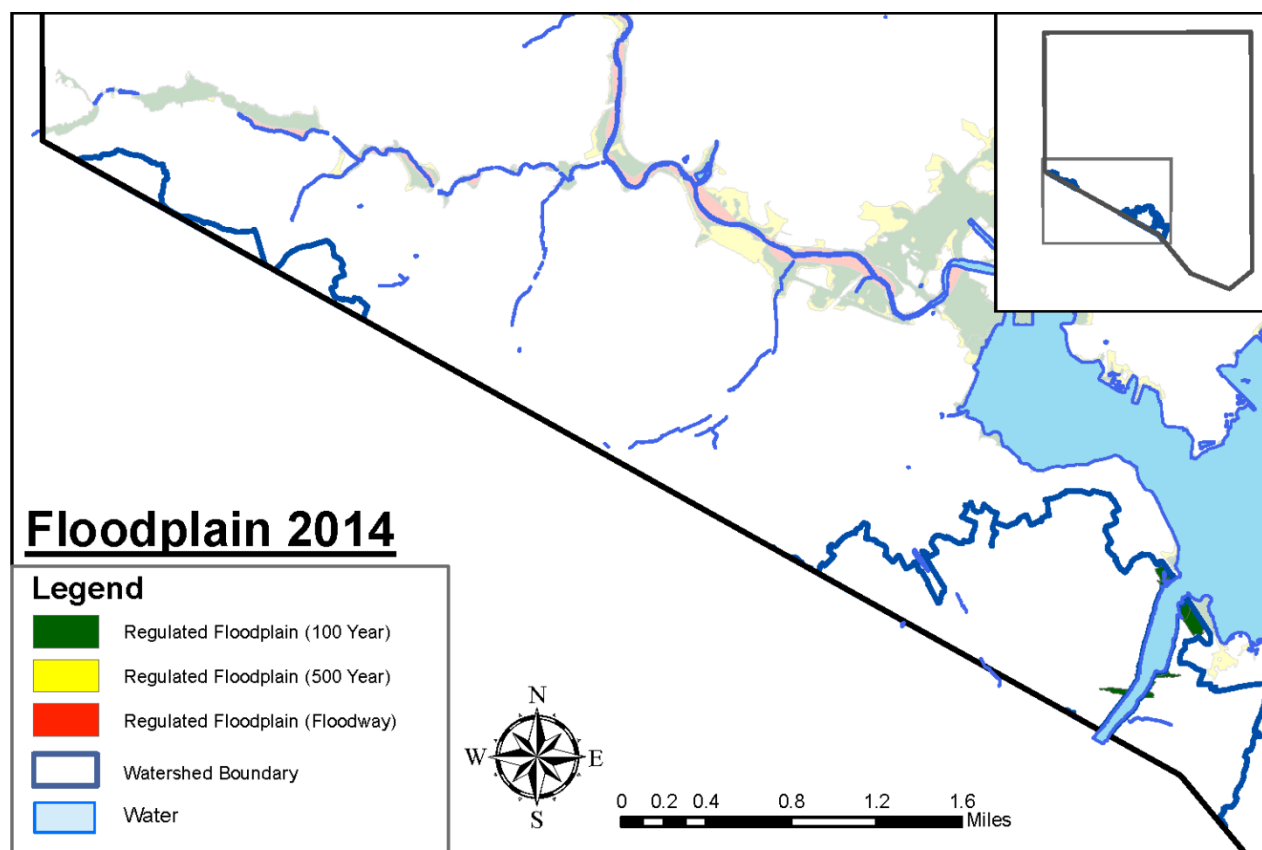
Figure 2-6 Floodplain within Watershed

2.3   Assessment of Physical Conditions

2.3.1   Slopes

While topography describes the shape of the land, slope describes steepness, which can affect the direction and magnitude of surface water flows, degree of soil erosion, and suitability for stormwater management. Slope data for the Lower North Branch Patapsco watershed is divided into the following four slope ranges:

- Gently sloping (0 to 5% slopes)
- Undulating, rolling (5 to 10% slopes)
- Strongly sloping (10 to 15% slopes)
- Moderately steep - steep (15%+)

Figure 2-7 and Table 2-6 provides a summary of the breakdown of percent slopes for the entire watershed. Because the optimal slope range for installing ESD practices like bioretention is 0-5%, with restrictions on some types of practices above 10 to 15%. The acreage and percent of these slopes was therefore calculated for slope ranges 0-5% and 5-10% for each CSA (see Table 2-7). Although 0-10% slopes are optimal for specific ESD practices,

this does not preclude other ESD practices, like regenerative conveyance systems, from being installed on steeper slopes or alternative practices such as tree planting or street sweeping from being deployed in those areas.

Cherry Hill has the most acreage that falls within this slope range within the watershed, followed by Westport/Mt. Winans/Lakeland and Brooklyn/Curtis Bay/Hawkins Point.
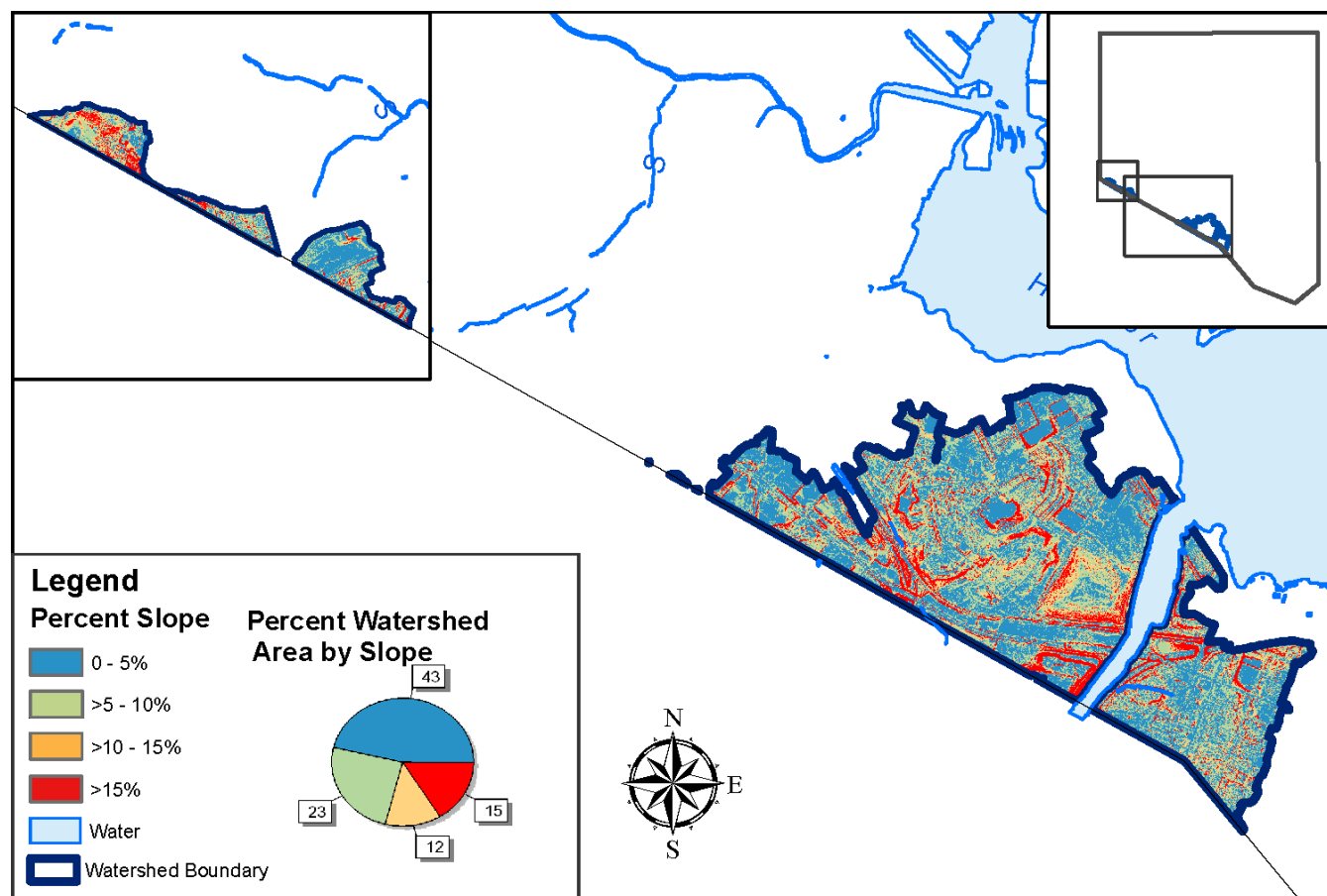
Figure 2-7 Slope Ranges within Watershed

Table 2-6 Slope Ranges within Watershed

Slope	0-5%	5-10%	10-15%	15%+
Acres	386.9	262.3	106.5	132.8
% of Watershed	43.5%	23.5%	12.0%	14.9%

Table 2-7 Slope Ranges in Watershed within CSAs

			Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Slopes 0-5%		Acres	6.4	85.3	175.8	25.6	89.6
		% of the CSA within the WS	20.9%	41.7%	43.0%	51.9%	48.3%
		% of the 0-5% Slopes within the WS	1.7%	22.1%	45.4%	6.6%	23.2%
Slopes >5-10%		Acres	10.4	65.0	124.8	14.6	44.3
		% of the CSA within the WS	34.0%	31.7%	30.5%	29.5%	23.9%
		% of the 0-5% Slopes within the WS	4.0%	24.8%	47.6%	5.5%	16.9%

2.3.2 Soils

Soils are an important consideration when evaluating hazards and opportunities related to improving stormwater quality and managing stormwater quantity. In particular, soil characteristics can determine the rate of infiltration, runoff, erosion that occurs as a result of a storm, and plant health. The Natural Resources Conservation Services (NRCS) classifies soils into four hydrologic soil groups (HSG) based on their runoff potential, which is estimated based on the infiltration rate (or the ability of a soil to absorb precipitation) of the soil when thoroughly wetted and not protected by vegetation. Soil composition, compaction, and infiltration rate are influenced by disturbances to the soil profile such as land development activities, and can be highly variable across small geographies, especially within urban areas.

The four hydrologic soil groups range from A to D, from highest infiltration rates to lowest, respectively. Brief descriptions of each hydrologic soil group are provided below. Further explanation can be found in the USDA/NRCS publication, *Urban Hydrology for Small Watersheds, 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.

- **Group B** soils include silt loam and loam types. They have a moderate infiltration rate when thoroughly wet. These soils mainly consist of somewhat deep to deep, moderately well to well drained soils with moderately fine texture to moderately coarse texture.

- **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.

- **Group D** soils include clay loam, silt clay loam, sandy clay, silty clay, or clay types. These soils have a very low infiltration rate and high runoff potential when thoroughly wet.

Soil groups A and B are preferred as they allow infiltration, which provides greater pollutant removal efficiency, assuming no shallow groundwater. However, as shown in Figure 2-8 and Table 2-8, 63% of the watershed is either hydrologic groups C, D, or unknown. These areas are unlikely to have good infiltration rates and therefore stormwater management practices such as bioretention facilities would require an underdrain and a viable connection to the storm drain system, increasing cost and decreasing pollutant removal efficiency.

Table 2-8 Hydrologic Soil Groups within Watershed

Soil Groups	Group A	Group B	Group C	Group D	Unknown
Acres	150.2	165.0	219.4	244.4	97.9
% of Watershed	16.9%	18.5%	24.7%	27.5%	11.0%
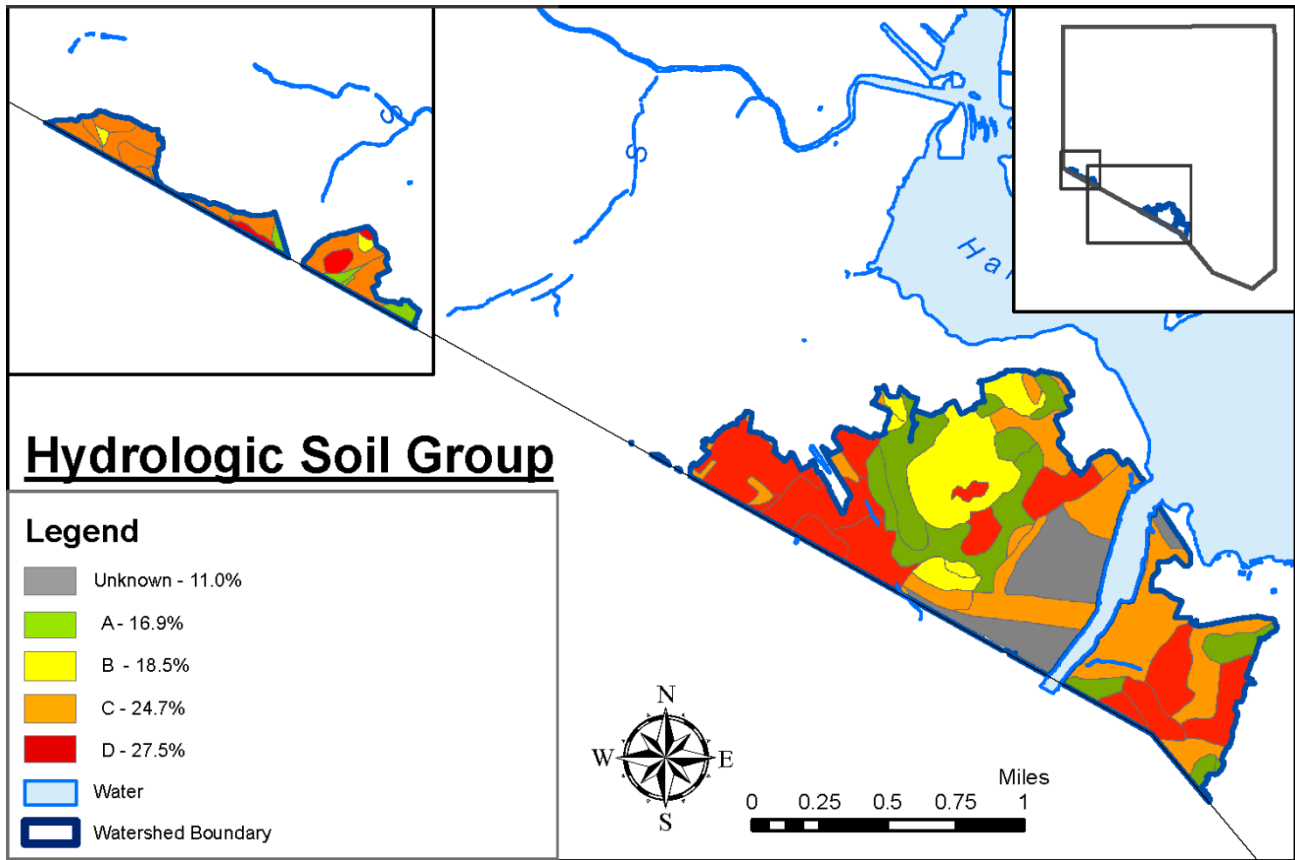
Figure 2-8 Hydrologic Soil Groups within Watershed

Table 2-9 shows that Cherry Hill has the greatest number of acres with A and B group soils. While Brooklyn/Curtis Bay/Hawkins Point has a similar acreage of A & B soils relative to Beechfield/Ten Hills/West Hills, there is a significant area of the CSA that has C and D soils and may be more challenging to install infiltration based ESD's. Westport/Mt. Winans/Lakeland is likely to be the most challenging place to find suitable locations to install infiltration-based practices. However, opportunities for non-infiltration-based practices, such as tree planting, rainwater harvesting, and street sweeping, remain viable in these areas.

Table 2-9 Hydrologic Soil Group by CSA (Acres)

Soil Group	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
A	0	26.8	114.2	7.6	0.5
B	29.5	0.1	102.9	30.2	0.2
C	1.2	98.7	78.4	1.8	39.0
D	0	69.1	56.6	9.0	108.7
Unknown	0	7.0	56.7	0	34.1

2.3.3 Impervious Surfaces

Impervious surface is a primary factor when determining pollutant rates and volume of stormwater runoff. Research has been conducted that link the degree of urbanization (typically measured by amount of impervious cover) with various watershed-based indicators of water quality, such as diversity and abundance of aquatic and terrestrial life. For the purpose of this watershed assessment, impervious surfaces include buildings, roads and sidewalks, parking lots, and other impermeable surfaces.

Table 2-10 includes Eligible MS4 Impervious, which is the impervious area not currently being treated[3] for each of the CSAs within the regulated MS4 area for Baltimore City. For the purposes of this report, "impervious" is used interchangeably with "eligible impervious" or "eligible MS4 impervious" unless otherwise noted.

All of the CSAs can be characterized as ultra-urban,[4] with Westport/Mt. Winans/Lakeland and Brooklyn/Curtis Bay/Hawkins Point having the highest percentage of impervious.

Table 2-10 Eligible MS4 Impervious by CSA within Watersheds

CSA	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Acres	0	69.3	87.0	11.0	84.3
% of CSA Area within Watershed	0.1%	33.8%	21.3%	22.3%	45.5%

The velocity of runoff generated from impervious surfaces increases with increasing slope. High velocity runoff can result in increased erosion and an increase in the amount of pollutants transported to storm drain systems and surface waters. Impervious surfaces with steep slopes above 5% can limit the suite of ESD practices available for restoration efforts, and can require additional design to mitigate the potential for erosion and bypass. Table 2-11 provides a summary of the percentage of eligible impervious surfaces that fall into each of the four slope categories. Figure 2-9 provides a visual representation of the distribution of eligible impervious by slope across the watershed.

The majority of eligible impervious in the watershed is 0-5% slope, indicating that management with typical ESD practices may be possible. For areas with higher slopes, alternative practices can be used for restoration.

Table 2-11 Eligible Impervious and Percent Slope

Slope %	0-5%	5-10%	10-15%	15%+
Acres	155.2	71.3	16.4	8.9
% of Eligible Impervious in Watershed	61.7%	28.3%	6.4%	3.5%

---

[3] Impervious surfaces within drainage areas spatially delineated in DPW GIS databases for stormwater management facilities installed post 2010 were assumed to be treated to the maximum extent practicable (MEP) and were removed from the Eligible Impervious totals. Not all drainage areas for stormwater management facilities installed post 2010 are spatially delineated in DPW GIS records. Eligible Impervious may include some areas already managed to the MEP, which would be determined during individual site investigations during future implementation efforts.

[4] Ultra-urban areas are characterized by high densities of paved surfaces or buildings that result in a high degree of imperviousness, characterized by buildings, parking facilities, urban streets, highways, and sidewalks.

Table 2-12 shows where within the watershed the eligible impervious with 0-5% AND >5-10% slopes can be found. The greatest percentage of eligible impervious with 0-5% AND >5-10% slopes are found in the Cherry Hill, Westport, and then Brooklyn CSAs, indicating areas where installation of ESD practices are likely to be more feasible and appropriate.

Table 2-12 Distribution of Eligible Impervious at 0-5% and >5 – 10% slope within CSAs in Watershed

	CSA	Beechfield / Ten Hills / West Hills	Brooklyn / Curtis Bay / Hawkins Point	Cherry Hill	Morrell Park / Violetville	Westport /Mt Winans / Lakeland
0-5 % Slope	**Acres**	0.02	39.4	54.5	5.7	55.6
	% of total Eligible Impervious with 0-5% Slope Watershed	0%	25.4%	35.1%	3.7%	35.8%
>5-10 % Slope	**Acres**	0.01	22.4	23.9	3.8	21.2
	% of total Eligible Impervious with 0-5% Slope Watershed	0%	31.4%	33.5%	6.0%	27.9%

Eligible MS4 Impervious by Slope

Legend

- ⬛ (green) Eligible Impervious at 0-5% Slope
- ⬛ (yellow) Eligible Impervious at >5-10% Slope
- ⬛ (orange) Eligible Impervious at >10-15% Slope
- ⬛ (pink) Eligible Impervious at >15% Slope
- ⬛ Watershed Boundary
- ⬛ Water
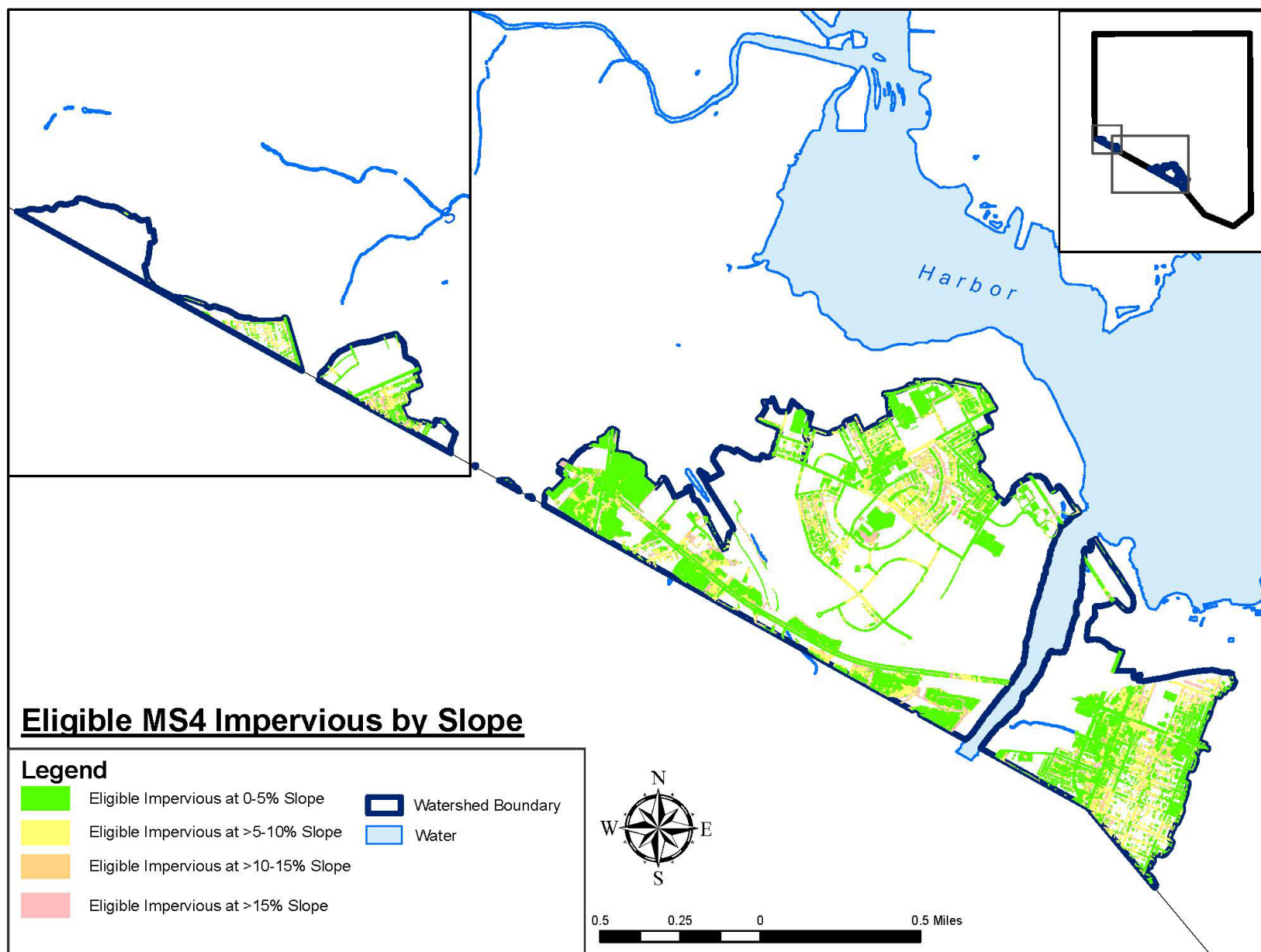
Figure 2-9 Eligible Impervious by Slope

Property ownership is critical to understanding the extent of the opportunity for DPW to install ESD facilities as part of the restoration strategy. Therefore, the distribution of eligible impervious by property ownership type was assessed (Table 2-13). The majority of eligible impervious in the LNBP Watershed is on private property, followed by within the public right-of-way. This highlights the importance of working with private property owners to support restoration efforts.

Table 2-13 Eligible Impervious by Property Ownership in Watershed

Type	AREA (ac) of Eligible Impervious	As % of Total Eligible Impervious
City Owned (non-ROW)	21.8	8.7%
Private	122.8	48.8%
City Right of Way (ROW)	93.5	37.2%
Parcel/ROW with Railroads	13.5	5.4%

Table 2-14 shows the distribution of impervious surfaces on various land ownership types across CSAs. The majority of impervious surfaces on City-owned property are contained within the Cherry Hill CSA (89.3%), but this represents only 7.7% of the eligible impervious within the watershed. Eligible impervious on private property is highest in Westport/Mt. Winans/Lakeland (41.9%), while eligible impervious in the right-of-way is evenly split between Cherry Hill (38.9%) and Brooklyn (35.3). The CSA of Westport /Mt Winans /Lakeland has the highest percentage of eligible impervious on property impacted by rail.

This demonstrates that the greatest potential for installing restoration projects on public land exists in the Cherry Hill and Brooklyn CSAs, and highlights the importance of programs and incentives aimed at private property owners.

Table 2-14 Distribution of Eligible Impervious under Various Property Ownership within CSA

CSA	Type	AREA (ac) of Eligible Impervious	As % of Eligible Impervious by Ownership Type	As % of Eligible Impervious in Ownership Type within WS
Beechfield / Ten Hills / West Hills	City Owned (non-ROW)	0.0	0.0%	0.0%
	Private	0.0	0.0%	0.0%
	City Right of Way (ROW)	0.0	0.0%	0.0%
	Parcel/ROW with Rail	0.0	0.0%	0.0%
Brooklyn / Curtis Bay / Hawkins Point	City Owned (non-ROW)	2.3	10.7%	0.9%
	Private	33.9	27.6%	13. 5%
	City Right of Way (ROW)	38.2	35.3%	13.1%
	Parcel/ROW with Rail	0.1	0.7%	0.0%

CSA	Type	AREA (ac) of Eligible Impervious	As % of Eligible Impervious by Ownership Type	As % of Eligible Impervious in Ownership Type within WS
Cherry Hill	City Owned (non-ROW)	19.5	89.3%	7.7%
	Private	31.1	25.3%	12.3%
	City Right of Way (ROW)	36.3	38.9%	14.4%
	Parcel/ROW with Rail	0.2	1.3%	0.1%
Morrell Park / Violetville	City Owned (non-ROW)	0.0	0.0%	0.0%
	Private	6.4	5.3%	2.6%
	City Right of Way (ROW)	4.5	4.9%	1.8%
	Parcel/ROW with Rail	0.0	0.0%	0.0%
Westport / Mt Winans / Lakeland	City Owned (non-ROW)	0	0.0%	0.0%
	Private	51.4	41.9%	20.4%
	City Right of Way (ROW)	19.6	21.0%	7.8%
	Parcel/ROW with Rail	13.3	98.0%	5.3%

2.3.4 Surface Temperature

Surface temperatures represent heat energy given off by the land, buildings, and other surfaces. Sometimes referred to as the heat island effect, impervious surfaces like roads, parking lots, and buildings absorb and retain heat from the sun. Elevated temperatures from urban heat islands, particularly during the summer, can affect a community's environment and quality of life, including an increased thermal loading, increase in the rate of NOx reactions driving the generation of air pollutants, impaired water quality, and compromised human health.

Figures 2-10 and 2-11 illustrate daytime and nighttime summer temperature readings. Impervious surfaces both radiate heat as well as hold heat. Thus, the highest temperatures for daytime temperatures are those CSAs with large amounts of impervious surfaces and lowest tree canopy and vegetation (which provide evapo-tranpirative cooling and shade), including Brooklyn/Curtis Bay/Hawkins Point, Cherry Hill, and Westport/Mt. Winans/Lakeland. Brooklyn has the highest nighttime temperatures, which is due to the acres of impervious surfaces that re-radiate heat at night, and lack of green spaces and trees.
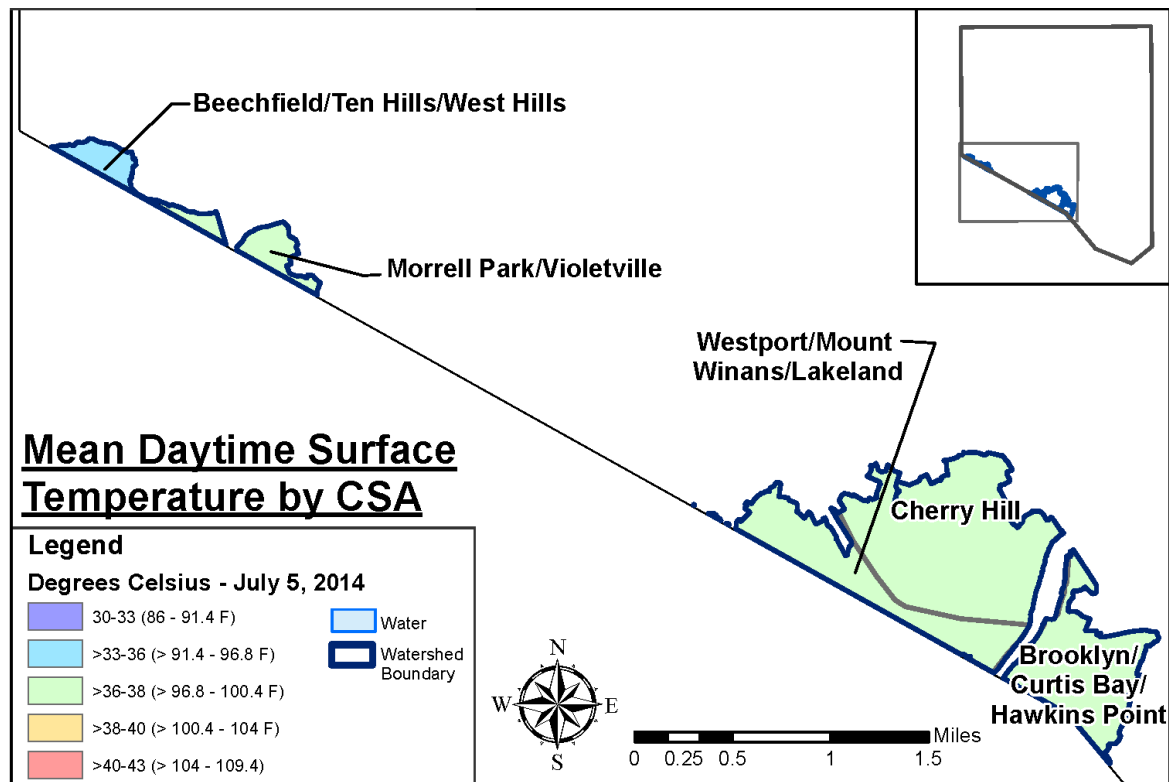
Figure 2-11 Daytime Summer Temperature by CSA
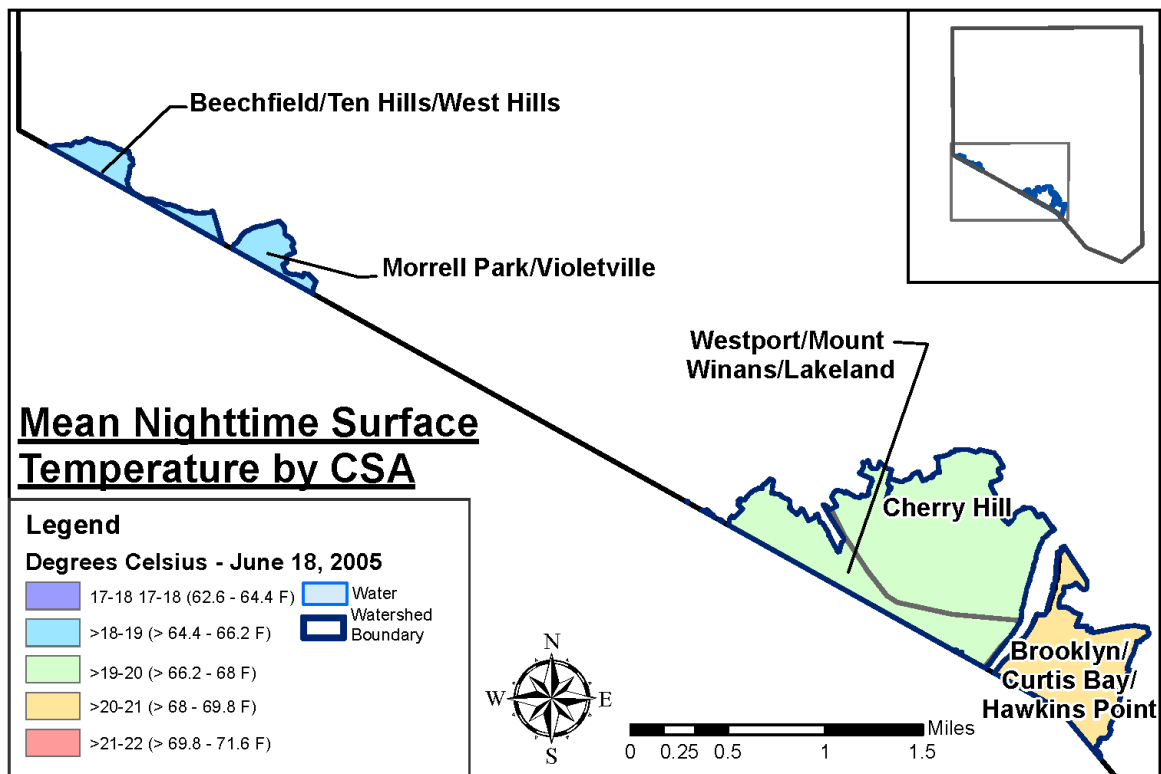
Figure 2-10 Nighttime Summer Temperature by CSAs

2.3.5   Urban Tree Canopy (UTC) Priority Planting Map

In 2012, Tree Baltimore (see Section 2.8), created a priority planting map to guide their work and that of their partners for tree planting. The priority map (Figure 2-12) considered multiple factors including heat island effect, existing tree canopy, and impervious areas. Lakeland is the highest priority for tree planting, followed by Brooklyn/Hawkins Point/Curtis Bay and Cherry Hill. The predominant priority zone of each CSA within the LNBP is summarized in Table 2-15.

Table 2-15 UTC Priority Planting Areas

CSA	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
UTC Priority	Low	Medium	Medium	Medium-Low	Medium-High

Figure 2-12 UTC Map
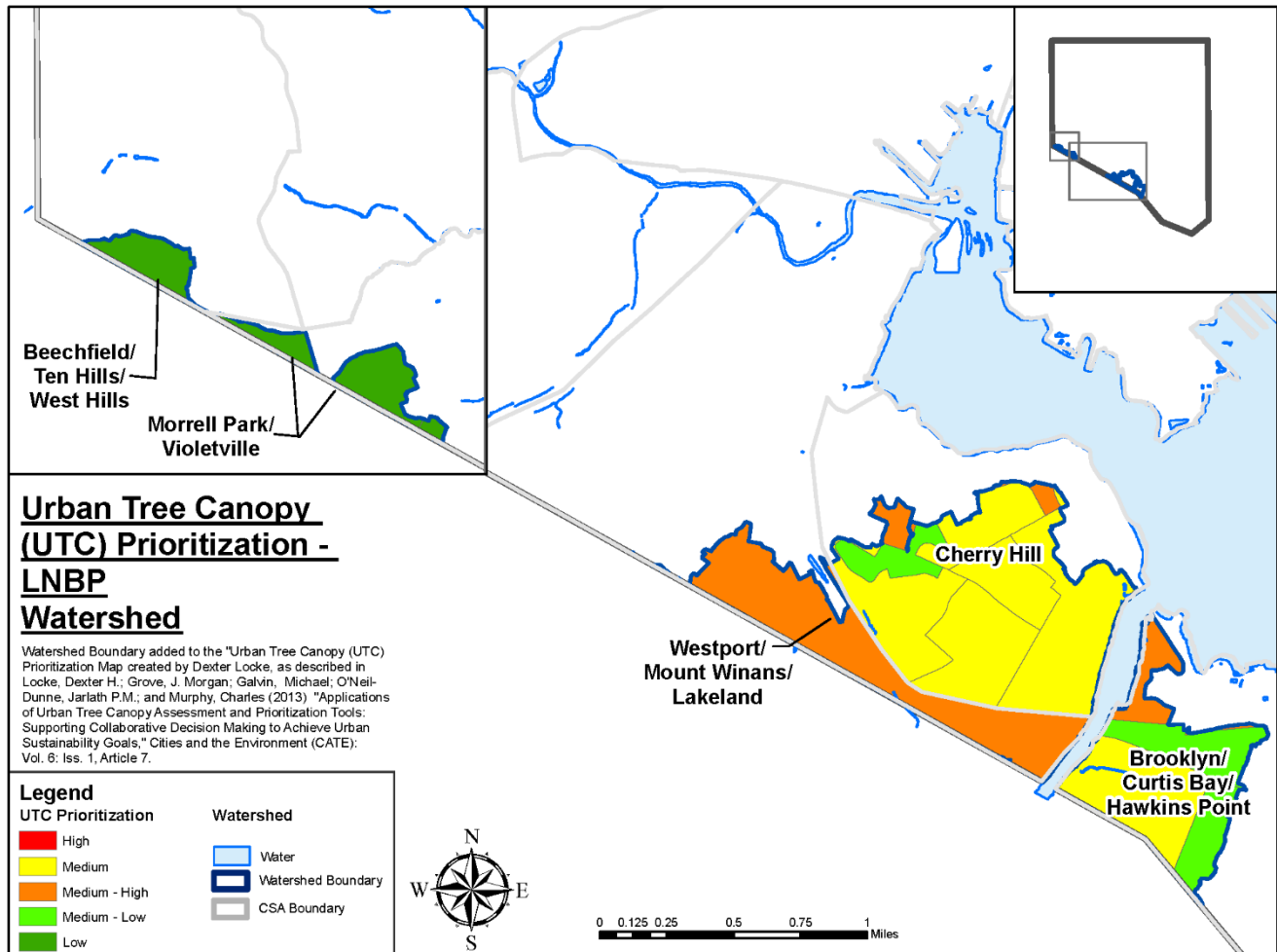
2.4 Wet Utilities (Storm Drain and Sanitary Sewer)

Baltimore City has separate utility systems for conveying stormwater and wastewater. While Baltimore City has three separate water utility systems[5] (stormwater, wastewater, and drinking water), for the purpose of the watershed assessment, only stormwater and wastewater infrastructure will be referenced, given the more direct relationship to the TMDL impairments. In addition to the statistics for these two systems, current and planned capital improvement program (CIP) projects are also noted, as well as sanitary sewer overflows (SSO).

2.4.1 Storm Drain System

Baltimore City has about 116 miles of streams, the primary ones being the Jones Falls, Herring Run, and Gwynn's Falls. However, this represents a fraction of what was originally a network of small streams and creeks that were piped and paved over as the city developed in the late 19th and early 20th centuries. Many of these streams were either entirely buried or significantly covered. Replacing the historic hydrology of the City is a massive network of storm drain infrastructure, primarily installed prior to 1950. In the LNBP this represents 16.5 miles of storm drain pipes. Additionally, there are 28 outfalls and 844 storm drain inlets within the watershed.

Approximately 50% of storm drain pipes (linear feet) in the LNBP watershed were installed prior to 1950, with the average age of stormwater drain pipes being 68 years. Storm drain pipes installed prior to 1950 are found primarily in Brooklyn, Morrell Park, and Oakley. These pipes are more likely to need repair.

2.4.2 Sanitary Sewer System

In the LNBP there are 22.3 miles of sanitary sewer pipes. Forty-five percent (45%) of these pipes were installed prior to 1950, with the average age being 67 years. Sanitary sewer pipes installed prior to 1950 are found primarily in Brooklyn, the north and west sides of Cherry Hill, Morrell Park, and Oakley. Similar to the storm drain pipes, these are more likely to need repair, which can result in ground water infiltrating into the sanitary sewer lines and causing SSOs.

2.4.3 Capital Improvement Program (CIP)

To guide the City in making necessary physical improvements, the City Charter requires the Planning Commission to annually recommend a six-year Capital Improvement Program (CIP) to the Board of Estimates. The Planning Department oversees the CIP and works with the various City agencies to prepare the six-year program.

There are three major CIP projects in the LNBP (Figure 2-13). ER4127 (RED) represents the MS4 projects that will be installed in the watershed (see Section 5.1.3). The second SC903 (BLUE) is a storm sewer replacement and relining project.

The final project, SDC7772 (Red Dot) is designed to address a flooding problem in Cherry Hill. For over a decade, the southern portion of the neighborhood along Spelman Road has experienced flooding problems during heavy rains. This area is a low point and drains approximately 90 acres of the Cherry Hill neighborhood. Flooding incidents have resulted in emergency evacuations of residents. DPW discovered most of the flooding problems were caused by water backing up from a crushed storm drain line at West Patapsco Avenue. DPW will replace and relocate the storm drain pipe as part of a capital investment project, estimated to cost approximately $6 million. This project is currently in the design phase.

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[5] Baltimore's utility pipe network extends into the surrounding counties.

WASTEWATER Projects

Project ID	Project Name	Phase
SC 903	Improvement of Patapsco Collection System	TO BE COMPLETE
SC 963	Improv. to SS in SW Baltimore City and Maidens Choice Pressure Sewer Assessment and Uplands Sewer Repl.	CONSTRUCTION

ENVIRONMENTAL Projects

Project ID	Project Name	Phase
ER 4127	Environmental Restoration Project 11	DESIGN
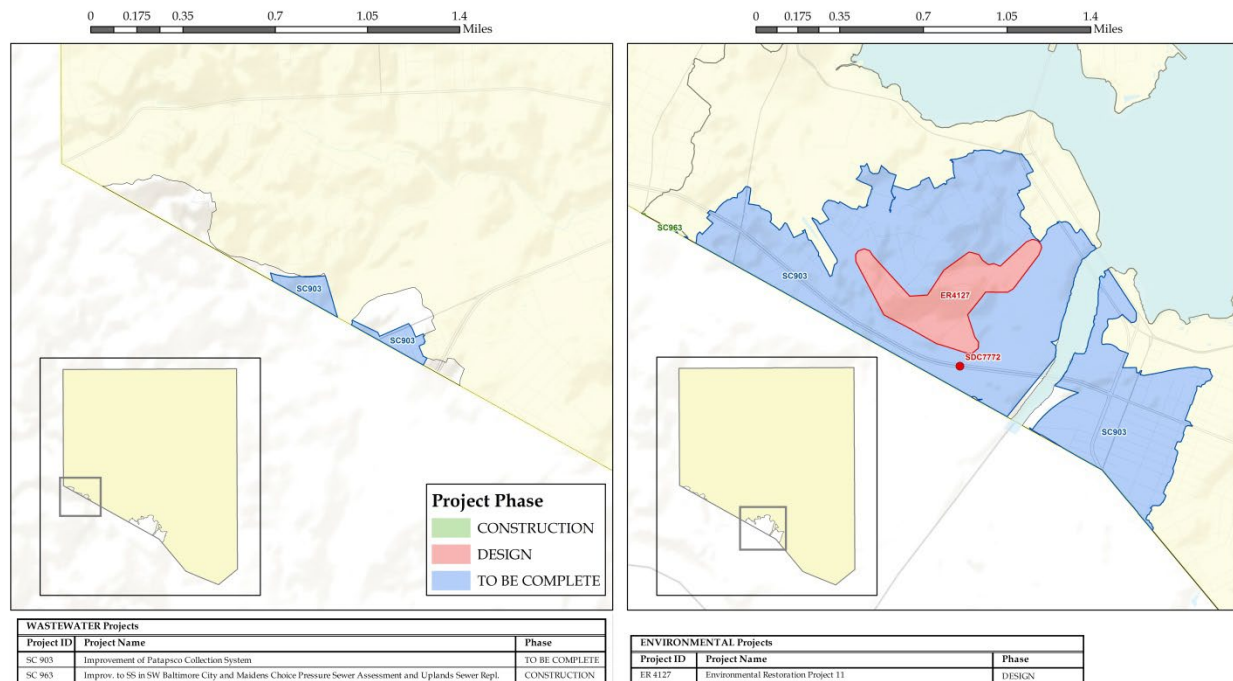
Figure 2-13 DPW CIP Projects

2.4.4   Sanitary Sewer Overflows (SSO)

Sewers can become clogged by tree roots, grease, or other items that should not be flushed down the drain (e.g., wipes, diapers, plastic products, paper towels, etc.), which can result in dry weather SSO's. Sewers can also develop cracks and breaks, which cause stormwater and groundwater to infiltrate the sewer system during wet weather, which can cause wet weather SSO's. Finally, sewers can fail due to deterioration, resulting in both dry and wet weather SSO's. These SSO's can cause sewers to overflow into waterways or even back up into basements. Capital projects, such as SC903, are intended to reduce the amount of groundwater that enters or infiltrates into sanitary sewers, which overwhelms the sanitary pipes and can cause wet weather overflows. These projects consist of performing repairs and installing pipe and manhole liners that seal joints and breaks where groundwater once entered the sanitary lines. Outreach to residents and businesses about proper disposal of waste and flushables are aimed at preventing dry weather SSO's. These types of projects are part of the City's Modified Consent Decree.

Figure 2-14 shows the location of SSOs in the LNBP. During 2017 there were nine dry weather SSOs and no wet weather SSOs. Dry weather SSOs are sanitary sewer overflows that is unrelated to precipitation related flows (including storm water and snow melt runoff). These types of overflows are typically caused by some type of blockage, often as a result of poor FOG practices (fats, oils, and grease), rags and other material improperly disposed of, and tree roots. These areas provide an opportunity for education and outreach regarding FOG and flushables.
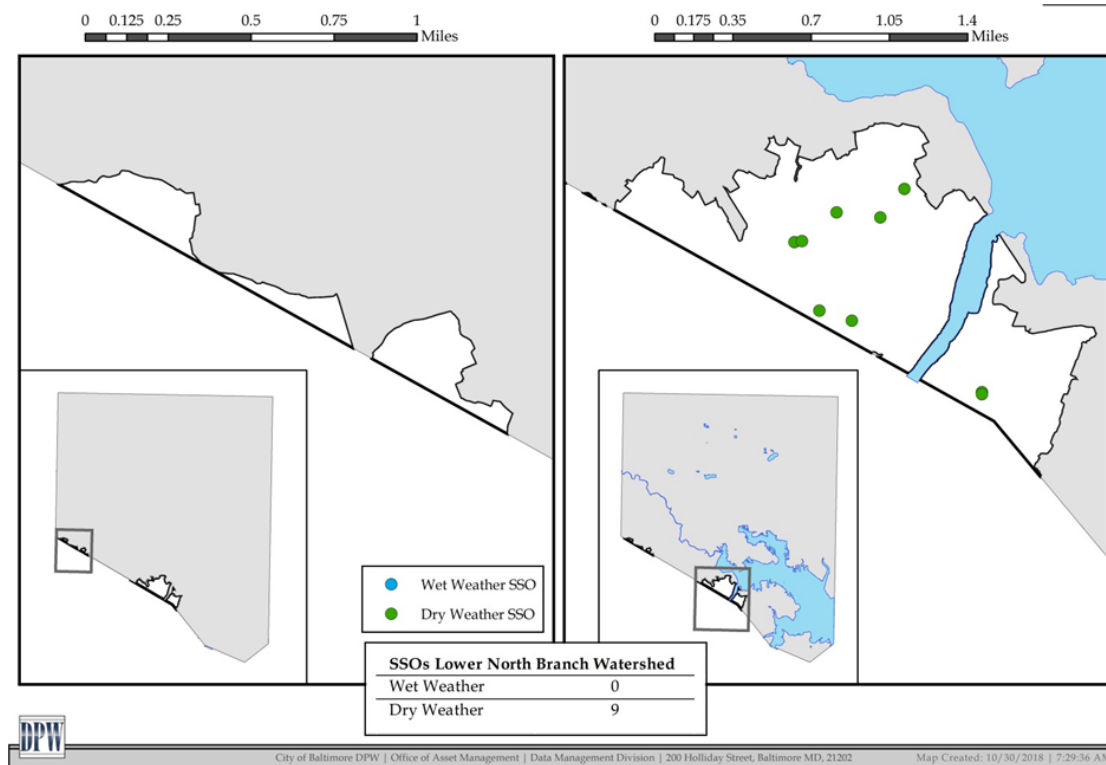
Figure 2-14 Dry and Wet Weather SSOs

2.5   Dirty Streets / Alleys and Clogged Storm Drains

Dirty streets and alleys not only diminish the quality of life of neighborhoods, they also make trash and associated pollutants accessible to stormwater runoff, which ultimately transports the debris and pollutants into storm drains before releasing them into waterways . The Dirty Streets and Alleys variable represents the rate of service requests for dirty streets and alleys through Baltimore's 311 system per 1,000 residents, and has been compiled by CSAs. Clogged storm drains represent the rate of service requests for addressing clogged storm drains made through Baltimore's 311 system per 1,000 residents, also compiled within CSA's. Both indicators represent reflect a combination of environmental condition and resident engagement, and can be used to target trash reduction and outreach programs, while recognizing that part of what is not captured in higher levels of reporting may reflect a greater problem or may reflect greater knowledge of the 311 program and trust the responsiveness of government to the problem using that system. Brooklyn has the highest rates of dirty streets/alleys as well as clogged storm drains, followed by Morrell Park / Violetville (Table 2-16 and Figures 2-15 and 2-16).

Table 2-16 Rate of Dirty Streets / Alleys and Clogged Storm Drains per 1,000 Residents

	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Dirty Streets/Alleys	10.9	71.1	8.0	43.2	43.8
Clogged Storm Drains	3.0	1.8	2.4	5.3	3.2

Figure 2-15 Clogged Storm Drains
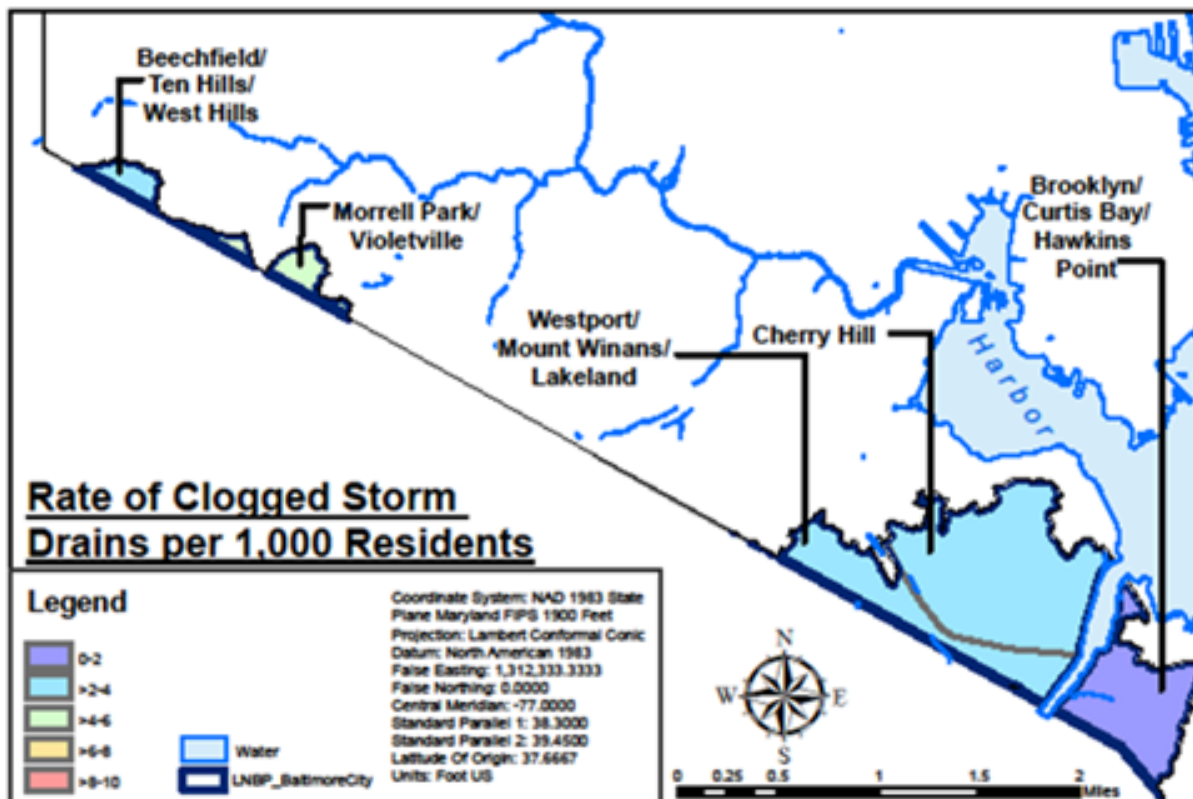
Figure 2-16 Dirty Streets / Alleys
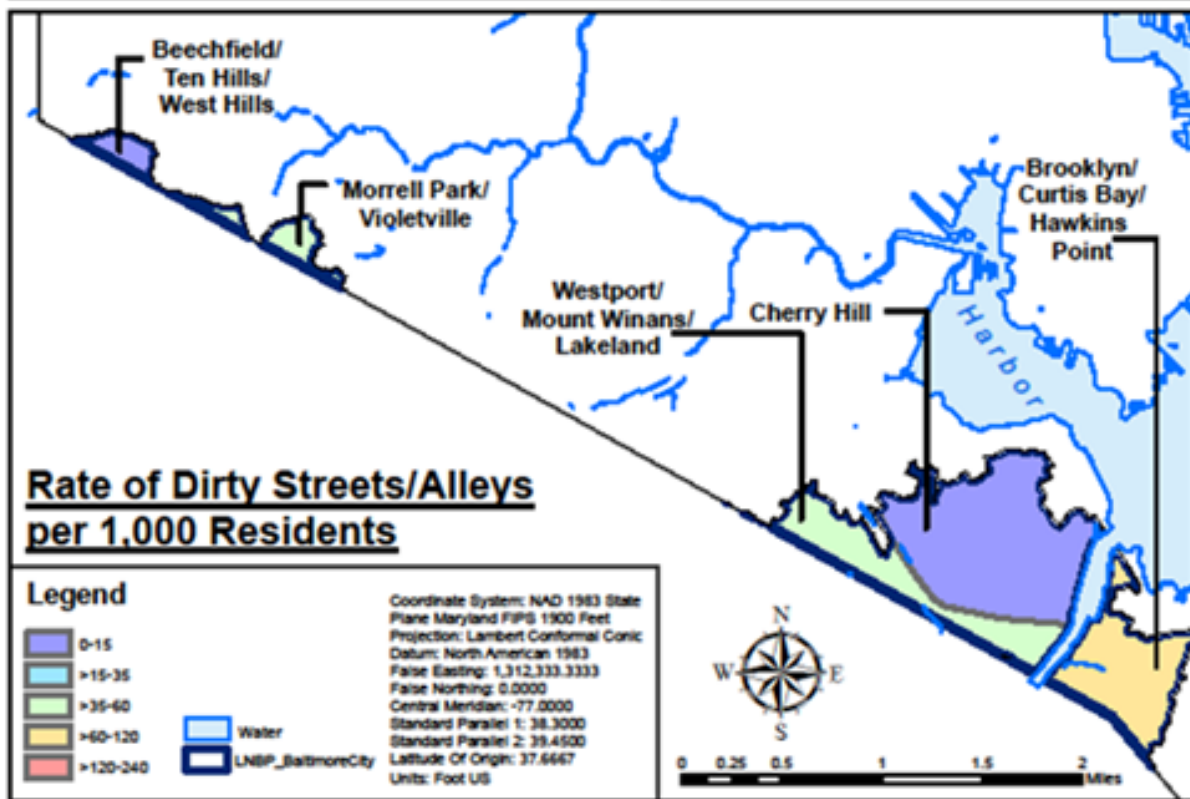
Figure 2-17 shows the location of customer service complaints (CSRs) between the years 2014-2018. Repeat CSRs are clustered in the commercial areas of Brooklyn and Spelman Avenue in Cherry Hill.

| CSA Boundary |

Clogged Storm Water Inlets Baltimore Harbor Watershed

Year	Count	Symbology
2014	9	·
2015	28	·
2016	24	·
2017	42	·
2018*	38	·

*Values as of November 15, 2018
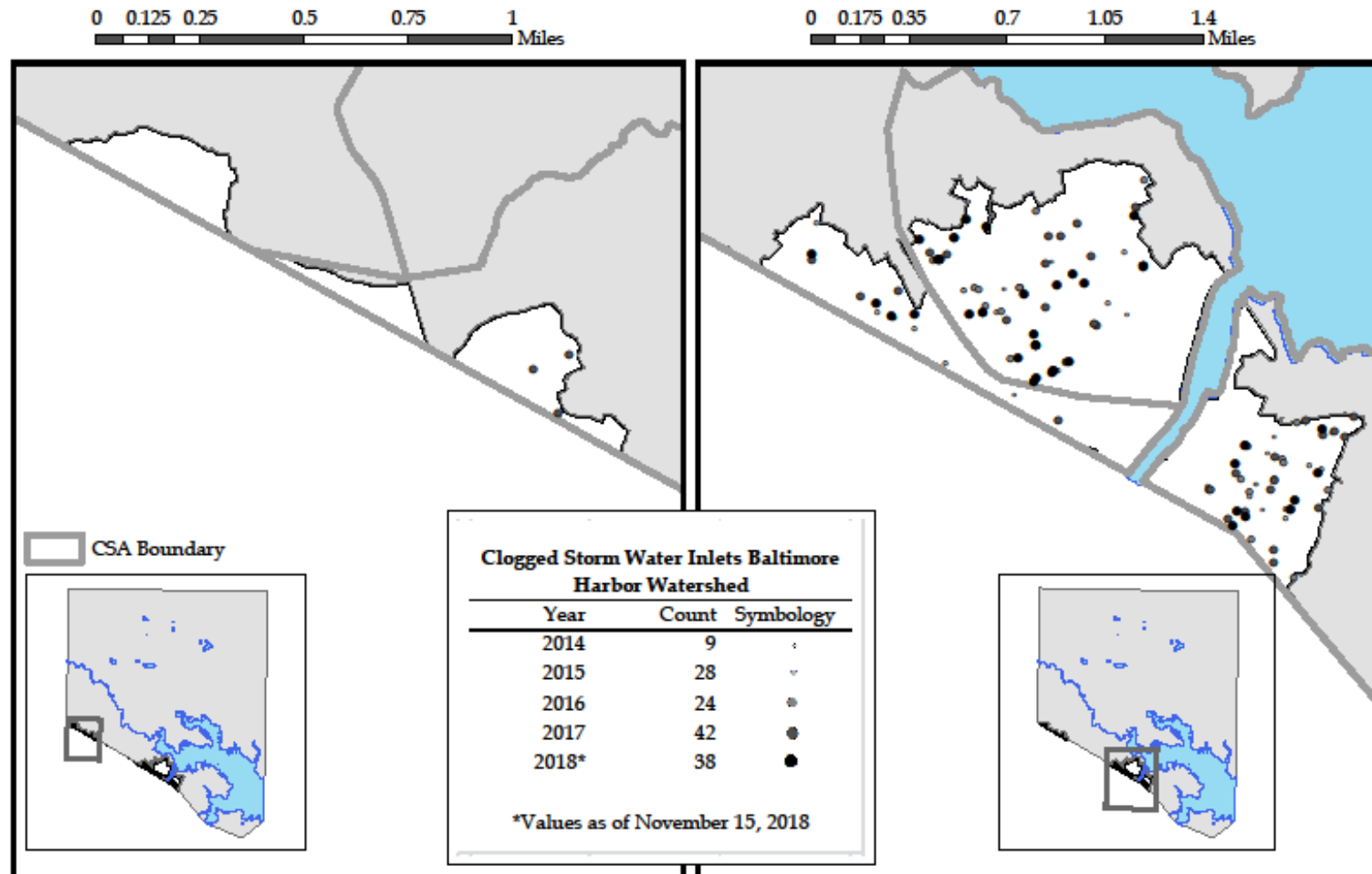
2.6   Visual Watershed Inspection

Upon completion of the desktop analysis, a visual inspection of the watershed was conducted in November 2018. The purpose was to field verify the desktop analysis and to refine the BMP recommendations made in Section 5.5. The visual inspection focused on:

Cherry Hill

- Non-public housing residential – housing type and right of way widths
- Cherry Hill Road commercial properties
- INSPIRE schools locations
- Patapsco Avenue (commercial area and street trees)

Brooklyn

- Density and distribution of street trees
- Baltimore Green Network community node (identified in the plan)
- Land use (Business district and adjoining residential streets)

2.7   Socio-Economic Conditions & Health Related Factors

Understanding the human component of a watershed is critical to help inform the types of BMPs that should be considered and also to identify geographic areas that should be prioritized in order to achieve maximum co-benefit. For instance, understanding the age distribution within neighborhoods can also start to inform the types of outreach and engagement activates that might be effective.

Additionally, Baltimore City has a near 20-year gap in life expectancy across neighborhoods. Addressing these disparities will likely require the intentional consideration of opportunities for health protection and promotion within decision making processes across multiple sectors, including land-use design and planning, beyond those traditionally associated with healthcare and public health systems.

For instance, the built environment is a known determinant of health outcomes, and socio-economic factors drive vulnerability to environmental and other risks to health. Modification of the built environment through installation of ESD, tree planting, and similar practices can mitigate hazardous environmental exposures (e.g. heat burden and air quality), or provide health supporting resources (e.g. access to nature). Programs and partnerships can also be developed that support community needs while addressing watershed concerns.

Therefore, data was also gathered on a wide variety of socio-economic and also human health related factors to inform this assessment. Table 2-17 is a summary of six (6) key factors. Additional factors were considered to inform the geographic prioritization of work, as discussed in detail within the Suitability Analysis Chapter 4. [6].

Table 2-17 Social / Economic Conditions by CSA

Social / Economic Conditions	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Age <18	25%	27%	37%	19%	29%
Age 65>	11%	6%	8%	19%	7%
% White	16%	48%	5%	74%	24%
Median Income	$52,623	$35,862	$22,659	$38,210	$41,368
Hardship Index	45	76	74	61	64
Life Expectancy	74.7	69.7	69.5	73.6	73.8

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[6] These factors are mapped as part of the Suitability Analysis prioritization.

Life Expectancy
This represents the average number of years a person living from birth to death in a set location could expect to live. Health outcomes, including life expectancy, are the result of a complex set of interwoven factors that extend beyond biological factors, behavior, and healthcare to include the modifiable socio-economic and environmental conditions that shape people's lives.

Age Distribution
This includes the percent of persons 5 to 17 years old, as well as the percentage of persons 65 years old and above (out of all persons living in an area). Age distribution is important because it can begin to inform age appropriate outreach formats and engagement strategies.

Percentage of White
This is defined by the total number of persons that identify themselves as being racially White (and ethnically non-Hispanic) out of the total number of persons living in an area. 'White' refers to a person having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicated their race(s) as 'White'. Percentage of white is used as an indicator of concentrations of populations not identifying as minority or people of color (i.e. African-American and Hispanic) and will inversely prioritized within the Equity prioritization analysis.

Median Income
The median household income is the middle value of the incomes earned in the prior year by households within an area. Income and earnings are inflation-adjusted for the last year of the 5-year period. The median value is used as opposed to the average so that both extremely high and extremely low prices do not distort the total amount of income earned by households in an area.

Hardship Index[7]
The Hardship Index is a composite score of socioeconomic hardship within a CSA, relative to other CSAs and to the City. The Hardship Index combines six indicators of public health significance: percentage of occupied housing units with more than one person per room; percentage of households living below the federal poverty level; percentage of persons aged 16 years or older in the labor force that are unemployed; percentage of persons aged 25 years or older without a high school diploma; percentage of the population under 18 or over 64 years of age (i.e., dependency); and per capita income. Areas with high hardship indices will be prioritized in the Equity prioritization analysis.

2.8 Planning Initiatives
In addition to understanding the water quality goals of the watershed, it is important to understand related community needs and goals that have been identified for the area. Since 2008, there have been several community plans within the LNBP watershed. These include:

Baltimore City MS4 Restoration and TMDL WIP
Baltimore's MS4 Permit was issued on December 27, 2013. As required by the permit, the City is required to develop a Watershed Implementation Plan (WIP). The WIP identifies strategies to meet the 20% impervious restoration requirement of the Permit as well as Total Maximum Daily Load (TMDL) waste load allocations for each receiving water body. The WIP listed specific projects and the City's ability to meet TMDLs, in particular pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs for the LNBP Watershed.

Baltimore Green Network Plan (2018)
The Baltimore Green Network Plan, led by the Department of Planning (DOP), is a collective vision for the City to strengthen communities by creating an interconnected network of greenspaces. The goal is to transform vacant properties into community assets such as recreation areas, parks, trails, public squares, and urban gardens and

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[7] Baltimore City Health Department 2017 Neighborhood Health Profile report

farms. Additionally, the plan includes recommendations for connecting the existing parks, water bodies, and natural areas through natural and community corridors. A portion of the network is located in Cherry Hill.

Cherry Hill Community Master Plan (2008).
The plan, led by the Department of Planning (DOP) and adopted by the Planning Commission in 2008, is an update of a previous plan for the neighborhood. Recommendations include the following categories: Economic Development, Physical Development, Transportation, Historic Preservation, Housing, Health, Public Safety, Education, Youth, and Civic Engagement.

Cherry Hill Vision Plan (2016).
The Cherry Hill Development Corporation (CHDC) worked with the Neighborhood Design Center (NDC) to create a community investment strategy to guide public and private investment. The plan parallels the investment under Baltimore City Schools' 21st Century Buildings Plan that includes Cherry Hill E/M School, Arundel E/M School, and Dr. Carter Godwin Woodson E/M School, as well as the Department of Planning's INSPIRE process.

Cherry Hill Deep Blue Plan (2017).
The Deep Blue Plan is a partnership between Blue Water Baltimore (BWB), the Neighborhood Design Center (NDC), the Baltimore City Department of Public Works (DPW), and the Cherry Hill community. The master plan identifies potential stormwater management projects on both public and private property.

Cherry Hill INSPIRE Schools Plan (2017).
INSPIRE, which stands for Investing in Neighborhoods and Schools to Promote Improvement, Revitalization, and Excellence, is led by the Department of Planning. The plan includes Arundel Elementary and Cherry Hill Elementary/Middle Schools, and focuses on the neighborhoods surrounding each, specifically the quarter-mile area around each school.

South Baltimore Gateway Master Plan (2015).
The Plan was developed for the twelve neighborhoods surrounding the Horseshoe Casino, and includes the LNBP watershed neighborhoods of Cherry Hill and Lakeland. The Plan provides guidance for investment of the Casino's Local Impact Grant funds. Included was the recommendation, "Adopt a 'Complete Streets' plan for each neighborhood". A Complete Streets study and implementation strategy was completed by the Department of Transportation (DOT) for Cherry Hill and Lakeland in 2016 and 2017.

Lakeland / Westport / Mount Winans Master Plan (2005).
Created by the DOP, the master plan focuses on land use, the housing market, commercial and industrial businesses, open space, and development opportunities in the area.

Middle Branch Waterfront (on-going)
Parks and People, Baltimore City Department of Recreation and Parks, South Baltimore Gateway Partnership and community stakeholders are currently conducting outreach and visioning related to a plan to create upgrades to Middle Branch Park aimed at connecting several multi-use trails running parallel to the Baltimore Harbor. Middle Branch Park is in the Direct Harbor Watershed but immediately adjacent to the LNBP, and so this multi-year planning effort should be considered due to its adjacency.

Community Benefits Plans – Healthcare Facilities (on-going)
Non-profit hospitals are required to complete Community Health Needs Assessments and make Community Benefits investments in order to keep their tax-exempt status. These needs assessments and targeted investments often contain data that can be useful to understanding community needs and priorities for outreach, and supporting the ability to recognize health related opportunities and co-benefits. There are two hospitals with Community Benefits areas located in the LNBP watershed, including Medstar Harbor Hospital and Saint Agnes Hospital.

South Baltimore Complete Streets Plan (2017)
The South Baltimore Complete Streets Plan includes a parking study and planned areas where multi-modal transit features can be implemented. This plan should be consulted to minimize conflicts with planned right of way modifications and minimize conflicts during construction or damage to facilities due to planned work following construction. The existing parking study also may serve as a resource when considering whether stormwater bump outs are feasible.

2.9   City-wide Initiatives

BMORE Beautiful
BMORE Beautiful is a City-led peer to peer beautification program that launched April 2017. The goal of the program is to change behaviors and attitudes towards the beautification of the City as well as encourage residents, businesses and organizations to become directly involved in activities and projects that will keep their neighborhoods clean. BMORE Beautiful works closely with neighborhoods across Baltimore on beatification projects and cleanliness challenges, as well as providing educational and outreach materials. Two BMORE Beautiful communities, Brooklyn and Cherry Hill, are located in the watershed.

TreeBaltimore
TreeBaltimore is a Mayoral initiative led by the Baltimore City of Recreation and Parks in partnership with non-profits like Blue Water Baltimore, the Parks & People Foundation, and Baltimore Tree Trust, as well as with community groups, schools, businesses, and other City agencies. TreeBaltimore strives to increase the urban tree canopy through the establishment, management and preservation of trees to reach the goal of 40% tree canopy cover by 2037. Information can be found at www.treebaltimore.org.

Workforce Development
Several non-profits offer some type of workforce development. Civic Work's Center for Green Careers offers a stormwater installation and maintenance program that connects applicants to private sector jobs. Others, like Baltimore Tree Trust, Blue Water Baltimore, and the Parks & People Foundation, hire and train people as part of construction crews and youth programs. While none of these initiatives are located within the LNBP watershed, they all draw participants from underserved neighborhoods like those found in the area. Additionally, DPW has the YH2O program, which trains young adults for water related jobs. Given current plans for installing stormwater management facilities within the watershed (Section 5.1.3) as well as those identified in this assessment, there is an opportunity to incorporate workforce development and local hiring into projects.

Green Schools Initiative
The Baltimore Green Schools Program is an Initiative of the Planning Department's Office of Sustainability and Baltimore City Public Schools and includes the Green, Healthy, Smart Challenge grant program, the Baltimore Energy Challenge grant program, promoting youth environmental leadership through paid internships, and engagement in green teams and in-school initiatives, and supporting professional development for teachers. As part of the State Maryland Environmental Literacy Standards and the Chesapeake Bay Agreement, all schools must include a Meaningful Watershed Educational Experience (MWEE) in elementary, middle, and high schools for students. Green schools present an opportunity to prioritize green stormwater infrastructure, since installation of these facilities can support environmental education within schools, especially those schools with active environmental leadership initiatives.

Social and Emotional Learning and Student Wholeness - Schools
In 2017, Baltimore City Schools partnered with the Collaborative for Academic, Social, and Emotional Learning (CASEL), and identified 20 pilot schools to receive intensive instruction in social and emotional learning. The focus areas established include Restorative Practices, Literacy, and Social Emotional Learning. The initiative will continue into the 2018-19 school year and, if deemed valuable, may continue in subsequent years. This supports one of the three pillars the City Schools' Blueprint for Success, Student Wholeness. There are opportunities to integrate education about water into the curriculum, since it is an integral part of the habitats of all species – human, animal,

and plants. Because habitat conditions affect the ability of natural communities to find food and shelter and carry on natural processes, it is necessary to evaluate the state of existing land, water, and biological elements that provide for their needs.

Public Health Initiatives
The approach taken by this WA includes the goal of maximizing the human relevant co-benefits associated with watershed restoration efforts, including a focus on contributing to health supportive communities and social equity. Therefore, it is the intent to explore how the siting of projects and development of programs and partnerships can support public health focused initiatives in the watershed. The LNBP includes St. Agnes Hospital Community Council and Medstar Harbor Hospital, which recently installed several ESD facilities in partnership with Blue Water Baltimore with the goal of providing access to nature on their hospital campus to support healing. Additionally, a multi-year grant was recently awarded to the Department of Recreation and Parks and the Office of Planning that focused on creating opportunities for access to nature to mitigate the health impacts of trauma; an initiative that is clearly aligned with strategies associated with watershed restoration.

3   WATER QUALITY ASSESSMENT

Water is an integral part of the habitats of all species – human, animal, and plants. Because habitat conditions affect the ability of natural communities to find food and shelter and carry on natural processes, it is necessary to evaluate the state of existing land, water, and biological elements that provide for their needs.

The Non-Tidal River waters of the MD 8-digit Patapsco LNB watershed are designated as Use I - Water Contact Recreation, and Protection of Non-tidal warm-water Aquatic Life, while the tidal waters are designated as Use II - Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting. Specific water quality criteria for designated uses can be found in COMAR Sec. 26.08.02.03-3.

3.1   Total Daily Maximum Loads (TMDLs)

The Clean Water Act (CWA) requires states, territories and authorized tribes to: develop water quality standards for all jurisdictional surface waters; monitor these surface waters; and identify and list impaired waters. More specifically, Section 305(b) of the CWA requires annual water quality assessments to determine the status of jurisdictional waters. Section 303(d) requires states to identify and periodically update a list of Water Quality Limited Segments (WQLS), or impaired waters that fail to meet applicable state water quality standards established for designated uses and biological integrity. The State of Maryland most recently compiled the results of these water quality assessments within the *2018 Integrated Report of Surface Water Quality in Maryland States*, which was approved by USEPA in April of 2019. Within the 2018 report, impairments that are estimated to require a TMDL within the next two years are identified. These impairments are listed within Table 3-2.

Based on these water quality assessments (WQA), states must also establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for waters on the 303(d) list, which generally target pollutants including sediment, metals, bacteria, nutrients, and pesticides, for USEPA approval. The USEPA defines a TMDL as the maximum amount of a pollutant that a water body can receive and still safely meet state water quality standards.

3.1.1   Chesapeake Bay Total Maximum Daily Load (TMDL)

The Chesapeake Bay TMDL, established by the US Environmental Protection Agency (EPA), set pollution limits for nitrogen, phosphorus, and sediment in the Chesapeake Bay Watershed. Pollutant load reduction goals are: 25 percent reduction in nitrogen, 24 percent reduction in phosphorus, and 20 percent reduction in sediment.

The City only has two primary source sectors: wastewater treatment plants and stormwater. The City owns and operates the two largest wastewater treatment plants in the State; both are in the process of implementing Enhanced Nutrient Reduction (ENR) technology upgrades. The ENR upgrades are part of the State's WIP to significantly reduce the nitrogen waste loads, and thus are partially funded by revenues from the state-managed Chesapeake Bay Restoration fund.

Pollutant loadings from stormwater are expected to be addressed within the state's timeline through the current 20% impervious area restoration goal of the MS4 permit and future Permit goals. Estimated reductions for nutrients and sediments associated with the 20% reduction are shown in Appendix E of the Baltimore City MS4 and TMDL WIP.

3.1.2   Local Baltimore City TMDLs

Table 3-1 lists the two (2) pollutants with TMDLs currently approved by the EPA for the LNBP Non-Tidal River. Additionally, the LNBP has six additional impairments, one of which is a structural impairment, where TMDL's have not yet been established. Table 3-2 lists these pollutants and other relevant water quality impairments and their sources.

Table 3-1 Local TMDLs for the LNBP Watershed

Impairment	Issue Date	Pollutant	MS4 Baseline Load	WLA	Units	Description	% Reduction
Sediments	2011	TSS	610.2	456.9	Tons/year	Annual Avg.	25.1%
Bacteria	2009	E.coli	5,193.00	3,902.00	Billion MPN/year	Annual Avg.	24.8%

http://wlat.mde.state.md.us/ByTmdl.aspx [1]

Table 3-2 Water Quality Impairments and Assessments Listings

Impairment	Applicable Segment	Status	Approval Date
Bacterial (Enterococcus)	Tidal subsegment of MD-PATMH: Middle Branch/Northwest Harbor	Impaired	TMDL not yet established
Total Suspended Solids (TSS) (replaces Biological listing 2016)	PATMH - Patapsco River Mesohaline (Note TSS is addressed by the Chesapeake Bay TMDL)	Impaired	TMDL not yet established
Metals in Sediment (Zinc)	Tidal subsegment of MD-PATMH: Middle Harbor & Inner Harbor/Northwest Branch	Impaired	WQA Complete 2005 - TMDL not yet established
Metals in Sediment (Lead)	Tidal subsegment MD-PATMH: Inner Harbor/Northwest Branch	Impaired	WQA Complete 2005 - TMDL not yet established
Chloride	Lower North Branch Patapsco	Impaired	TMDL need possible
Sulfate	Lower North Branch Patapsco	Impaired	TMDL need possible
PCB in Fish Tissue	Lower North Branch Patapsco	Currently under evaluation	N/A
Metals in Sediments (Chromium)	PATMH - Patapsco River Mesohaline	WQ Standards met – some insufficient data	WQA Complete 2014

Impairment	Applicable Segment	Status	Approval Date
Metals (Copper & Lead)	Lower North Branch Patapsco	WQ Standards met – some insufficient data	WQA Complete 2008
Metals (Arsenic, Cadmium, Chromium, Zinc, Selenium, Mercury, Nickel)	Lower North Branch Patapsco	WQ Standards met – some insufficient data	N/A
Habitat – Channelization	Lower North Branch Patapsco	Non-pollutant Impairment	N/A

Sediments *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
In the Baltimore City MS4 Restoration and TMDL WIP, DPW proposed a re-evaluation of the baseline load allocations contained within the TMDL document, in addition to an assessment of quantified benefits of suspended solids removal efficiencies for IDDE. For additional information, refer to Appendix F of the WIP (City of Baltimore, 2015).

Bacteria
Bacteria from human sources results from unpermitted discharges from the wastewater collection system. Much of this is not contributed by stormwater, as the City's routine surface water monitoring program has shown elevated bacteria levels during the dry weather periods due to failing sanitary sewer infrastructure, undocumented / unpermitted sanitary connections, consumer behavior, and poor pet waste management. The City is addressing these challenges separately, under a Modified Consent Decree. Additionally, a schedule for Bacteria TMDL compliance can be found in the Baltimore City MS4 Restoration and TMDL WIP (City of Baltimore, 2015).

Nutrients (Nitrogen and Phosphorus)
The LNBP was listed as impaired by nutrients (Nitrogen and Phosphorus) in 1996, and a TMDL was established. In 2008, the Integrated Report concluded that Phosphorus was the impairing substance (MDE, The 2008 Integrated Report of Surface Water Quality, 2008). The 2009 WQA of Eutrophication for the Lower North Branch Patapsco River Basin, approved by USEPA, indicated that the LNBP now meets water quality standards due to nutrients for both biological integrity and designated uses, and no TMDL for nutrients is necessary (MDE, 2009b). However, given that the LNBP flows into the Baltimore Harbor and the Chesapeake Bay both of which have TMDL's established for nutrients, the LNBP Watershed Assessment will also address these pollutants.

Sulfates *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
Sulfates have been identified as potentially contributing to impairments in the biological health of various organisms in the LNBP. Sulfates are present in roadway runoff, resulting from oils and de-icing products.

Chlorides *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
Chlorides have been identified as potentially contributing to impairments in the biological health of various organisms in the LNBP. Chlorides are present in roadway runoff, resulting de-icing products.

PCB's in Fish Tissue – TMDL Pending (2008)
The LNBP was added to the 303(d) list for PCB's in fish tissue in the EPA approved 2008 Integrated Report (MDE, 2008), however at the time of the preparation of this assessment, a TMDL has not yet been established. Exposure to high levels of PCB's through consumption of contaminated fish over time may result in reproductive or developmental harm. PCB's can accumulate in the body over time.

Compliance with the pending TMDL cannot be achieved using the same practices used for nutrient, sediment, and bacteria reduction. Disposal of PCB-contaminated sediment is the only method for pollutant reduction. The City

proposes to complete source targeting and decision of monitoring locations by 2020. Monitoring and load reduction is proposed to occur by 2040.

Local TMDLs for Metals
The Patapsco LNBP was ultimately delisted for heavy metals in 2005, except for Herbert Run (located in Baltimore County) which continued to be monitored for Cu and Pb due to inconclusive results (MDE, 2005) before being delisted in 2008 with the EPA approval of the 2008 Integrated Report (MDE, 2008).

Channelization *(this and other indicators collectively replace the biological listing – 2016 Integrated Report)*
Lack of riparian buffer & channelization are noted impairments to water quality that are structural, resulting from the existing intensely developed nature of the watershed. No TMDL has been developed since these are not related to pollutants.

Pollutant loadings from stormwater are expected to be addressed within the state's timeline through the current 20% impervious area restoration goal of the MS4 permit and future Permit goals. Estimated reductions for nutrients and sediments associated with the 20% reduction are shown in Appendix E of the Baltimore City MS4 and TMDL WIP.

Table 3-3 Water Quality Impairments & Contributing Factors

Impairment	Contributing Factors
Nutrients: Phosphorus Nitrogen	Untreated impervious surfaces Land Use (residential / large property owners: over-fertilization, improper disposal of grass clipping, leaf litter) Sanitary Sewer overflows (age / condition of pipes, clogged pipes (FOG / debris) Behavior (pet waste not disposed of properly / rats)
Sediments	Untreated impervious surfaces Degraded streams and culverts Steep slopes Bare soil (no vegetative cover) Development practices (Improperly maintained ESC practices)
Bacteria	Untreated Impervious surfaces Sanitary Sewer Overflows (age of pipes/improper disposal of fats/oil/grease (FOG)) Behavior (Pet waste not disposed of properly/Rats)
PCBs	Land Use (Legacy PCBs due to past industrial uses)
Metals	Untreated Impervious surfaces Land Use (industrial) Often bound to sediment (see contributing factors for sediment)
Trash[8]	Untreated Impervious surfaces (runoff) Behavior (Trash not disposed of properly) Land Use (Corner stores / fast food establishments)

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[8] While the City's Trash TMDL does not include the LNBP watershed as a contributing area, it is recognized that trash is a contributing factor to water quality and watershed health. Thus, trash reduction strategies will be included in this Watershed Assessment.

4   SUITABILITY ANALYSIS & PRIORITIZATION

4.1   Introduction

The regulatory purpose of this Watershed Assessment is to identify and prioritize strategies and areas for projects, programs and partnerships to improve water quality, as required by the MS4 permit.

Achieving the primary, regulatory goal of water quality improvement in a densely populated urban environment requires a full consideration of not just the physical conditions of the watershed, but also factors related to human behavior and the interface between human populations and the environment. This analysis, necessary to achieve the primary regulatory targets, creates a natural, aligned opportunity to leverage the activities required under the MS4 permit to address the additional (non-regulatory) goal of prioritizing locations and activities to better address equity and serve communities in Baltimore.

It is recognized that Baltimore City has a near 20-year gap in life expectancy across neighborhoods, with geographic disparities in environmental quality, socio-economic conditions, and health outcomes; all which can be affected by projects (which change the physical environment) and programs and partnerships (which interact with social and economic systems affecting communities). Addressing these disparities requires the incorporation of intentional consideration of opportunities to protect and promote health across multiple sectors outside of fields traditionally associated with healthcare or public health.

Through considering a broad range of factors not typically included in watershed assessments, this analysis aims to maximize the co-benefits of projects, programs, and partnerships implemented as part of MS4 permit compliance to reduce inequities for community members who live, work, and play within the watershed.

The following primary (regulatory) and secondary (non-regulatory) goals were established to guide the suitability analysis.

1. **Primary Goals (Driven by regulatory requirements)**
    a. Reduce pollutant loads for nitrogen, phosphorus, sediment, bacteria, trash, and metals.
        i. Identify areas where installed restoration projects are likely to be feasible and effective
        ii. Identify areas where opportunities exist to engage private land owners and businesses in restoration efforts
        iii. Identify tailored strategies and partnerships to ensure that public education and outreach efforts reach diverse community members across all neighborhoods

2. **Secondary Goals (Non-regulatory best practices identified locally)**
    a. Maximize the co-benefits associated with implementation of restoration efforts, in particular for vulnerable communities, including , including the following, associated with ESD practices:
        i. Heat island mitigation and decreased utility bills
        ii. Improve existing green spaces and accessible green spaces
        iii. Air quality enhancements
        iv. Pedestrian safety and comfort
        v. Support educational and workforce development initiatives
        vi. Foster community acceptance and stewardship
        vii. Align with existing community needs/goals
        viii. Mental and restorative health benefits
        ix. Maximize the direct beneficial environmental outcomes associated with implementation of restoration efforts, including:
            • Decrease flooding
            • Protect and restore shorelines, buffers, and natural areas
            • Increase tree canopy

b. Prioritize geographic locations where co-benefits can address the greatest need
c. Maximize efficiencies within implementation
d. Support aligned initiatives.

4.2 Methodology for Prioritization

The suitability analysis, first described in Section 1.6, was performed to identify areas where various projects and programs were most appropriate for achieving the primary and secondary goals, based on an assessment of physical watershed conditions, socio-economic factors, and health supportive neighborhood conditions.

The suitability analysis was developed based on the understanding that ESD projects provide a range of known co-benefits that are valuable in a highly developed, dense urban area like Baltimore, but also require a specific set of physical environmental conditions to be feasible. Where ESD projects may not be feasible, projects focused on alternative practices, programs, or partnerships may be appropriate, and can be developed with targeted goals in mind that may provide programmatic benefits to communities. The prioritization described below is used to identify areas that will be assessed first for feasible and appropriate projects, programs, and partnerships with the intent of prioritizing ESD practices where feasible.

Prioritization of CSA's was done City-wide, and included the following steps:

1. **Prioritization by Community Statistical Areas (CSAs):**
   a. Prioritization by CSA: A scoring process was developed to assess and prioritize CSAs based on:
      i. the feasibility for implementation of ESD projects based on the physical conditions within each CSA;
      ii. an assessment of socio-economic conditions within CSAs; and
      iii. an assessment of the health supportive conditions and health risks related to the built environment (inclusive of the physical environment and systems potentially impacted by the planning, design, and development of the physical environment) understood to be modifiable through implementation of projects, programs, and partnerships related to restoration activities.

2. **Identification of watershed resources and areas of opportunity:**
   a. Watershed Resources and Opportunities: Locations were identified where opportunities may exist to inform the development of programs and partnerships within the watershed.

3. **Identification of suitable Projects, Programs, and Partnerships by Priority area:** (Discussed in 5.2)
   a. Identification of Suitable locations for Projects and Programs: A list was compiled of the ideal conditions for various types of projects and programs identified. Once this list was compiled, areas where ideal conditions exist based on the suitability analysis were identified.

   b. Identification of potential partners: A list of potential partners that would be beneficial to engage based on the projects, programs, and locations identified was then generated.

4.2.1 Prioritization by Community Statistical Areas

Geographic areas within the watershed were first prioritized based on Community Statistical Areas (CSAs). To accomplish this, three main Prioritization Categories were identified as relevant for achieving the goals of this watershed assessment, defined by multiple embedded factors. Each CSA was ranked in terms of priority relative to others across the city within each Prioritization Category, based on the factors identified. Results from prioritization within the three Prioritization Categories were aggregated to arrive at an Overall Prioritization of CSA's, considering factors across all three Prioritization Categories.

The three (3) Prioritization Categories were defined as:
- Physical Feasibility for ESD practices
- Equity (socio-economic & racial)
- Health Supportive Community

4.2.1.1 Prioritization based on Physical Feasibility for ESD Practices

Physical feasibility factors were defined based on the conditions which would be ideal for implementation of ESD projects by DPW. Prioritizing CSAs based on physical feasibility is critical to ensuring that water quality goals can be met in a timely and cost-effective way. As a public utility implementing projects with public funds, identifying locations based on physical feasibility is necessary to ensure planned restoration work can provide the greatest possible benefit while minimizing the cost burden for the public.

Factors considered for Physical Feasibility of installing ESD practices included the following:

- o   Acres of Eligible Impervious in CSA
- o   Acres of 0-5% slopes in CSA
- o   Percent of Eligible Impervious available in CSA that is either within the City Rights of Way or on City Owned land
- o   Acres of Hydrologic Soil Groups A & B in CSA

Physical feasibility data was extracted for the area of each CSA using Arc GIS 10.3 mapping software. Cut points used to assign points for each factor were established based on quintiles derived from the results.

4.2.1.2   Prioritization based on Equity & Prioritization based on Health Supportive Community

Factors within the Equity and Health Supportive Community prioritization categories were identified based on their ability to assess some need that could be addressed by co-benefits associated with BMP's implemented as part of restoration activities, including ESD implementation.

Human health is broadly defined to include socio-economic factors affected through modification of the built environment, environmental exposures (heat, air quality), and access to health supportive resources (safe areas to exercise, access to nature and areas for stress mitigation, employment resources, etc.). This framework is based on the scope of factors considered to be health relevant within the field of public health, and is supported by the recently published Green Infrastructure & Health Guide (2018) prepared by the Oregon Health and Outdoors Initiative in partnership with the Green Infrastructure Leadership Exchange.

For equity, socio-economic factors were identified which could identify vulnerable populations where improvements to environmental quality could provide the greatest benefit. Areas with more residents that identify as other than white race were also prioritized, as these areas have experienced systemic disinvestment throughout Baltimore's history. For health supportive communities, factors known to be relevant to health for all communities were identified that could be modified through either installation of ESD projects, or implementation of restoration related programs, outreach and engagement.

Factors considered for the Equity Prioritization Category were as follows:

- o   Higher priority was assigned to CSAs with lower values for:
  - ▪   Percent White
  - ▪   Median Income
  - ▪   Life Expectancy
- o   Higher priority was assigned to CSAs with higher values for:
  - ▪   Hardship Index
  - ▪   Percent No HS Diploma
  - ▪   Households Poverty

Factors considered for the Health Supportive Communities[9] Prioritization Category were as follows:
- o   Percent of CSA covered by Not shaded Impervious surfaces
- o   Daytime Surface Temperature within CSAs

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[9] Health Equity is addressed by considering locations where vulnerable populations co-occur with health liabilities, and is captured in the overall prioritization.

- o Nighttime Surface Temperatures within CSAs
- o Percent that Walked to Work within CSAs
- o Percent Unemployed within CSAs
- o Percent without Access to a Vehicle within CSAs
- o Violent Crime Rate within CSAs
- o Percent Canopy within CSAs
- o Percent of CSA area covered by Parks and Greenspace

Cut points used to assign points for each factor were established based on natural breaks in the data considering all CSAs across Baltimore. Cut-points reviewed to ensure they were reasonable with regard to assessing relevant differences between CSAs and adjusted as necessary.

4.2.1.3   *Scoring and Overall Priority Designation*

Within each Prioritization Category, each CSA was assigned a score for each factor considered (1-5 points), based on its ranking relative to other CSAs across the city (5 points for higher priority, 1 point for lower priority). The scores for all factors were then summed to create a score for each CSA within each Prioritization Category.

Scores for each Prioritization Category were then divided into groups based on quintiles considering all CSA's across Baltimore City, and ranked. CSAs within each quintile were then assigned a Priority Designation (Priority 1 = High Priority; Priority 5 = Low Priority) within each Prioritization Category.

To arrive at an Overall Prioritization across the three Prioritization Categories, a composite score was created by assigning points to each Priority Designation within the three Prioritization Categories (5 points for priority 1 through 1 point for priority 5). This was necessary to avoid the artificial weighting of the importance of the Prioritization Categories based on the number of factors identified within each, which would have resulted from summing the raw scores**.** These points were then summed.

The resultant composite scores were divided into quintiles to determine the Overall Priority Designation for CSA (Priority 1 = High Priority; Priority 5 = Low Priority).

Table 4-1 Prioritization by CSA

| Category	Factor	Beechfield / Ten Hills / West Hills	Brooklyn / Curtis Bay / Hawkins Point	Cherry Hill	Morrell Park / Violetville	Westport / Mt. Winans / Lakeland
Equity SES	% White(Inv)	3	2	5	1	3
	% No HS Diploma or Equiv.	2	5	3	1	5
	Median Income	2	3	4	1	3
	HH Poverty	2	4	5	1	3
	Hardship Index	3	4	4	1	3
Equity Outcomes	Life Expectancy	2	5	5	1	4
Equity Score (Points Total)		14	23	26	6	21
Equity Priority Designation (1=High Priority)		**4**	**2**	**1**	**3**	**2**
Health- EnvEx	%Impervious Not Shaded	2	3	2	3	3
	Daytime Surface Temp	2	3	3	3	3
	Nightime Surface Temp	2	4	3	2	3
	%Walked	1	1	2	1	1
Health Resources	%Unemployment	3	4	4	3	4
	% No Vehicle	2	3	5	3	3
	Violent Crime	2	4	4	3	4
	% Canopy	1	4	3	3	3
	% Parks/Greenspace	2	4	3	3	3
Health Supportive Community Score		17	39	29	24	27
Health Supp. Comm. Priority Designation		**5**	**2**	**3**	**4**	**3**
Physical Feasibility	Ac Eligible Impervious	3	5	1	2	4
	Ac AB Soils	5	5	4	5	3
	Ac <5% Slope	3	5	3	3	4
	% of CSA E. Imperv. On Pub Land	3	1	5	5	3
Physical Feasibility Score		14	16	13	15	13
Physical Feasibility Priority Designation		**2**	**1**	**3**	**2**	**3**
Overall Priority		**4**	**1**	**2**	**3**	**2**
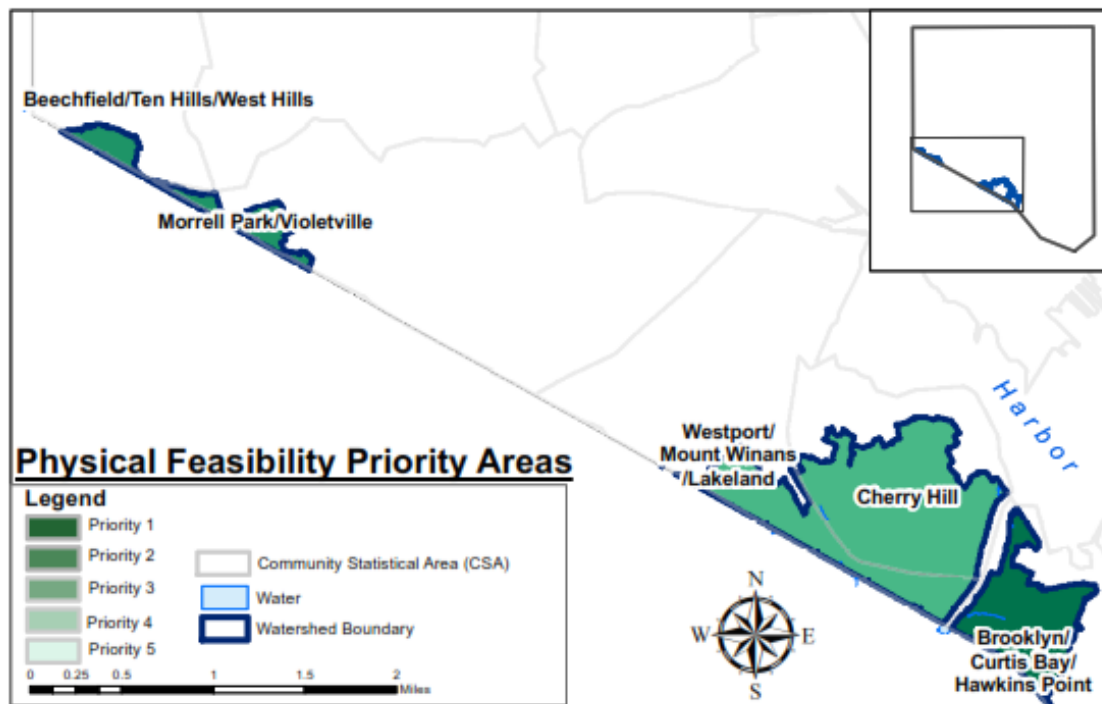
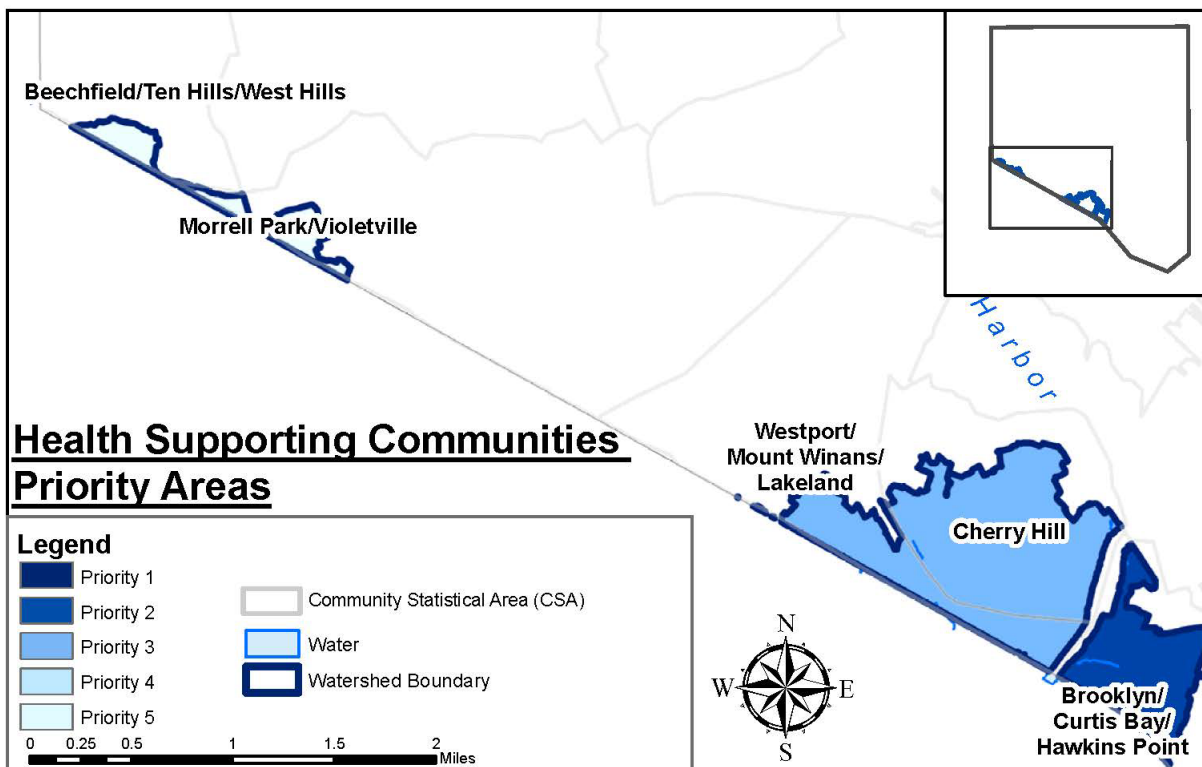*Figure 4-1 Priority Areas by Physical Feasibility*

Figure 4-2 Priority Areas by Health Supportive Communities
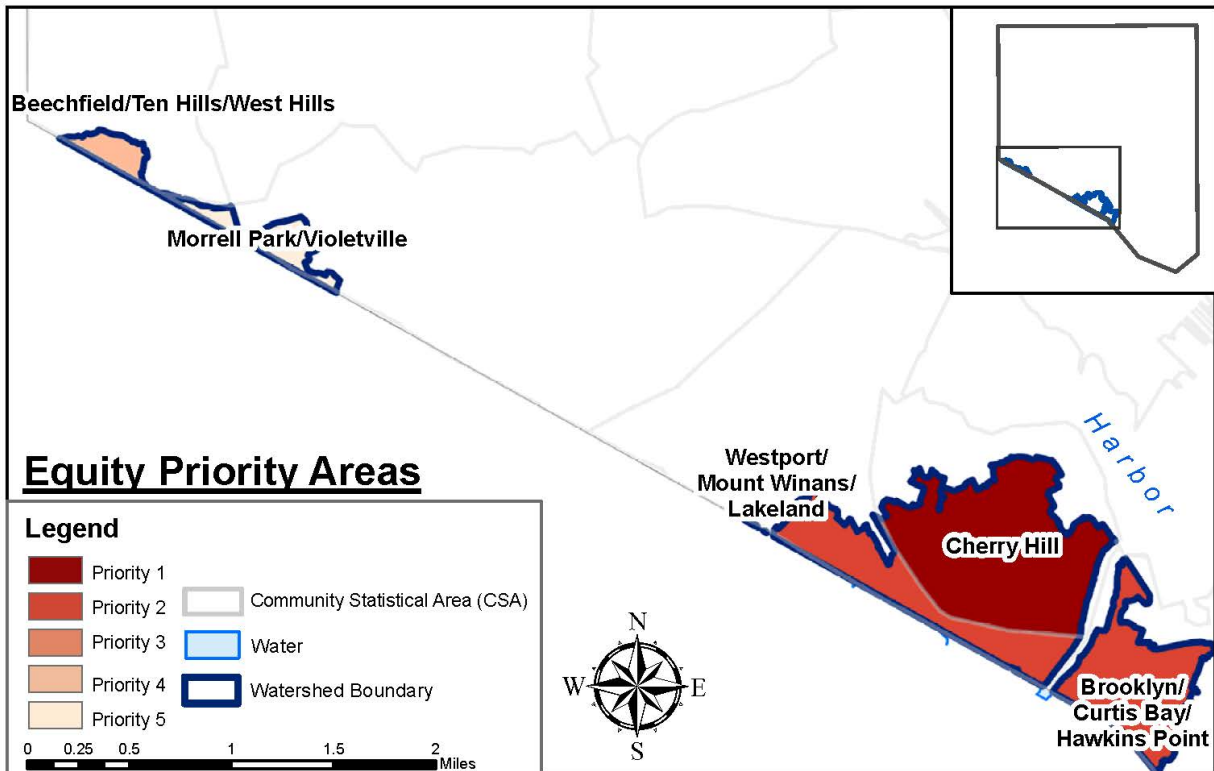
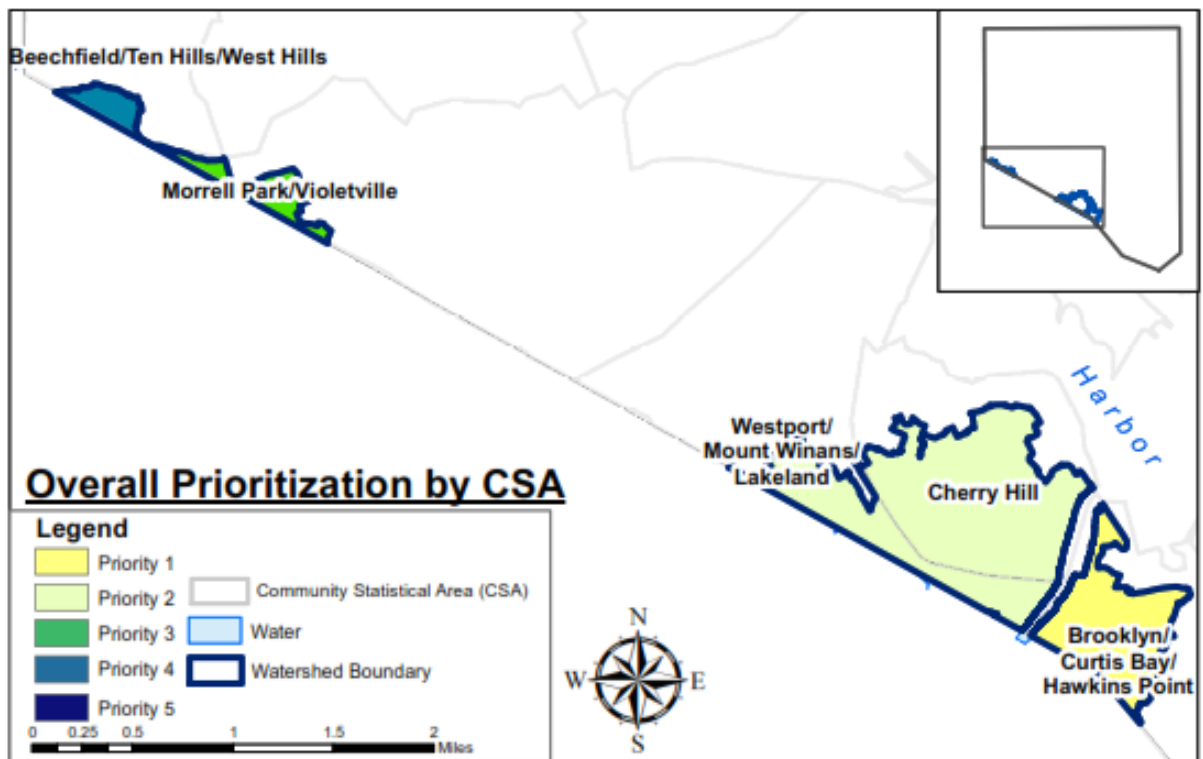*Figure 4-4 Prioritization by Socio-Economic and Racial Equity*

Figure 4-3 Prioritization Overall

4.2.2   Identification of Watershed Resources and Opportunities

Once the prioritization of CSAs was completed, geographic areas which represent potential opportunities for projects, programs, and partnerships were identified and mapped. For development of future implementation plans, opportunities will be identified within the highest priority CSAs first.

This mapping of watershed opportunities and resources serves to identify potential program and partnership opportunities that can be explored within these larger geographic areas. Table 4-2 identifies the types of resources that were mapped and the types of opportunities that area associated with the mapped resources.

Table 4-2 Watershed Resources / Opportunities

| Resource/Opportunity Identified	Significance of Data
o Department of Transportation planned pedestrian "bump-outs". o Existing and planned bicycle lanes	Areas to plan for outreach to Agencies Implementing Construction Projects in LNBP:
o Land Use – Commercial o Land Use – Residential by Density o Land Use – Institutional	Locations for Private Space Implementation Public Outreach and Programming
o Hospital Community Benefits and Service areas o Violence Reduction Initiative (VRI Zones) o ¼ Mile Buffers around schools o INSPIRE Schools o Intensive Learning Sites Schools o BMORE Beautiful Neighborhoods o Green Network Plan work areas o Percent who walked to work by CSA	Geographic Focus Areas of initiatives aligned with ESD co-benefits including physical activity/access to nature – Potential related Programs and Partnerships
o Unemployment by CSA o Percent without a High School (HS) diploma by CSA o Percent with a HS diploma and some college by CSA o Percent without Access to a Vehicle by CSA o Violent Crime Rate by CSA o Percent Under 18 by CSA	Potential Focus Areas for Workforce Development Programs and Partnerships
o ¼ Mile Buffer around Schools o BMORE Beautiful Neighborhoods	Potential Focus Areas for Stewardship, Engagement, Public Education, and Partnerships:
o Percent Under 18 by CSA o Percent Over 65 by CSA	Potential Consideration to Inform Development of Public Outreach and Engagement Strategies
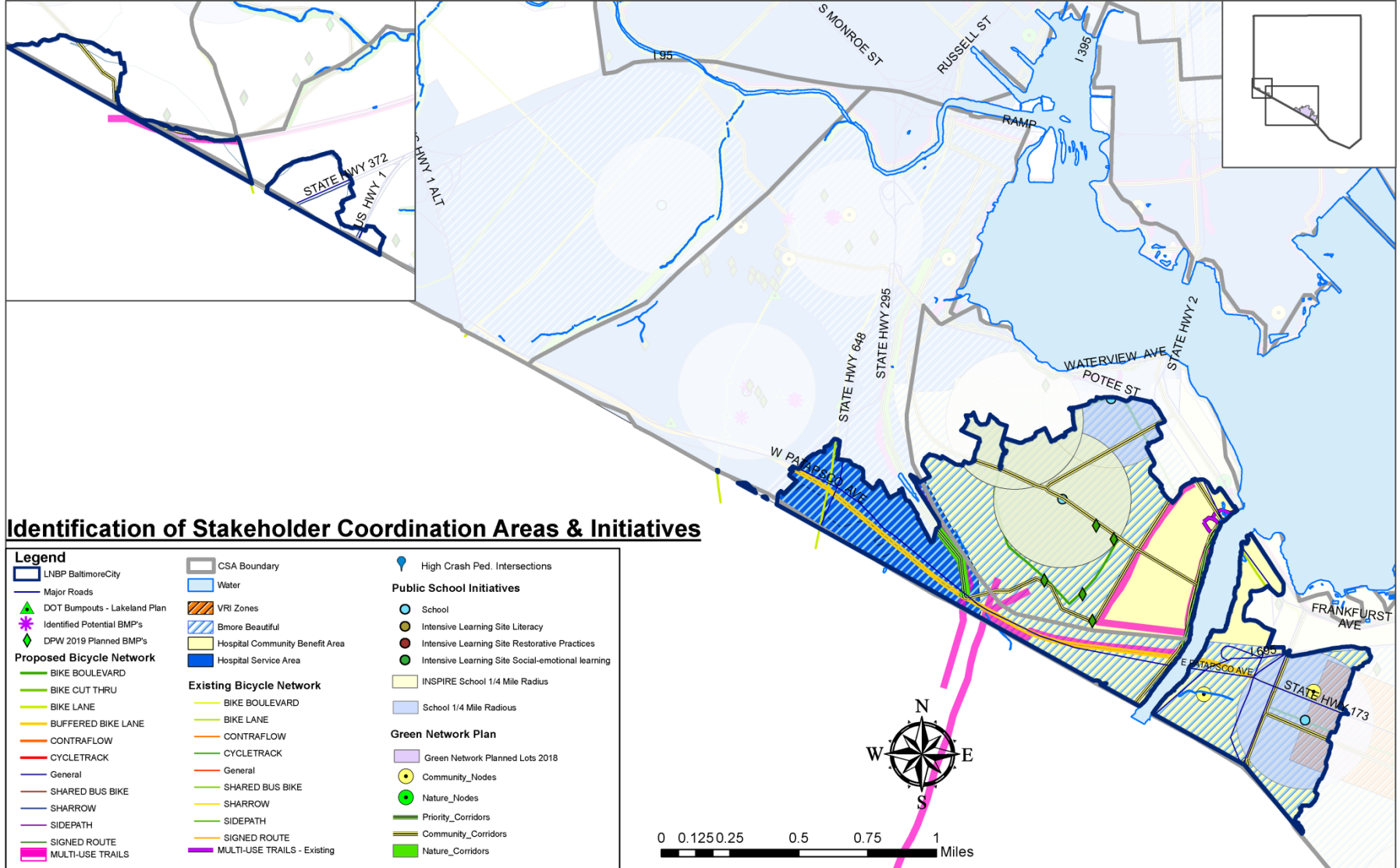
Figure 4-5 Stakeholder Coordination Areas and Initiatives

Table 4-3 contains a summary of the watershed resources and stakeholder coordination initiatives identified in Figure 4-5. Resources that represent discrete point locations were summarized using a number. Large zones or linear resources are indicated by an "X" when present. Land use and impervious area are indicated by a percentage of the CSA or acres as indicated. This table and the workforce and vehicle access information shown in Figures 4-6 and 4.7 were used to inform the opportunities identified in Section 5 of this report.

Table 4-3 Watershed Resources and Opportunities Summary (Portion within the Watershed)

Criteria	Beechfield / Ten Hills / West Hills	Brooklyn / Curtis Bay / Hawkins Point	Cherry Hill	Morrell Park / Violetville	Westport / Mount Winans / Lakeland
Green Network Community Corridor	X	X	X	X	X
Green Network Nature Corridor					X
Green Network Community Nodes		2			
School		1	5		
Inspire School			2		
1/4MILE RADIUS SCHOOL		1	5	1	
School ILS Restorative Practices			1		
School - Green Healthy Schools 2017/2018			1		
School GHG - TMDL Tangentially Related			1		
BMORE Beautiful		X	X		X
Hospital Community Benefits Focus Area		X	X		X
Planned 2018 DPW ESD			7		
Planned Bike Lane (more than sharrow/side path)		X	X		X
Planned multi-use trail	X		X	X	X
Commercial District		24%	2%		13%
Low Density Residential	74%	39%	78%	48%	4%
Institutional			1%		
Mixed Use		4%			
Industrial		16%	4%	7%	84%
Open Space	26%	17%	15%	45%	
Home Ownership >50%	77.3%			65.3%	
Home Ownership <50%		41.3%	47.5%		46.2%
Regulated Floodplain		X	X		
Elig. Imperv on Public Property (Ac)		2.3	19.5	0.01	
Elig. Imperv on Private Property (Ac)	0.03	33.8	31.1	6.4	51.4
Elig. Imperv on Right of Way (Est.) (Ac)		33.0	36.3	4.5	19.6

Unemployment Rate and % No High School Equivalency

Legend

% Un-employed
- 0-5%
- >5-10%
- >10-15%
- >15-20%
- >20%

% without High School Diploma or Equiv.
- 0-5%
- >5-15%
- >15-22%
- >22-25%
- >25%

Watershed Boundary
Water
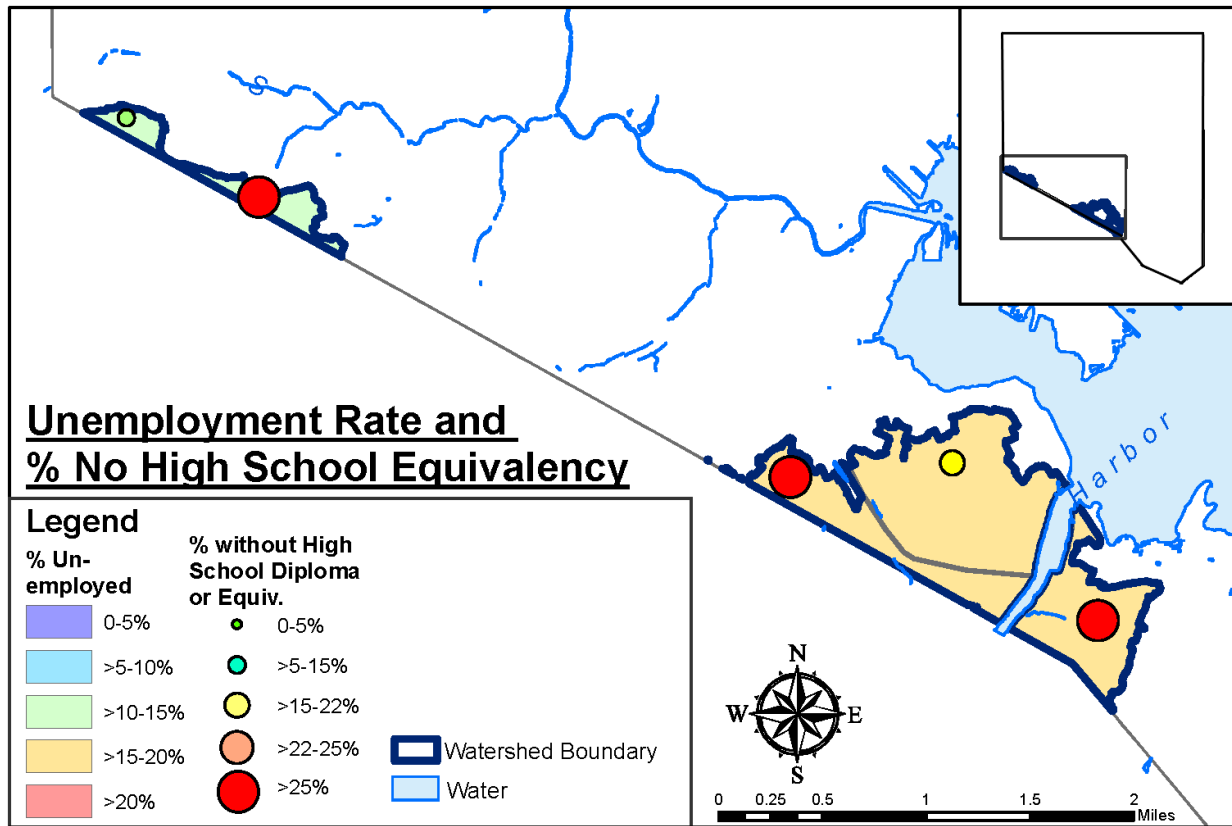
Figure 4-6 Unemployment Rate and High School Equivalency

Percent of Residents with no Access to a Vehicle

Beechfield/ Ten Hills/ West Hills

Morrell Park/Violetville

Westport/Mount Winans/Lakeland

Cherry Hill

Brooklyn/ Curtis Bay/ Hawkins Point

Legend
- 0-5%
- >5-10%
- >10-21%
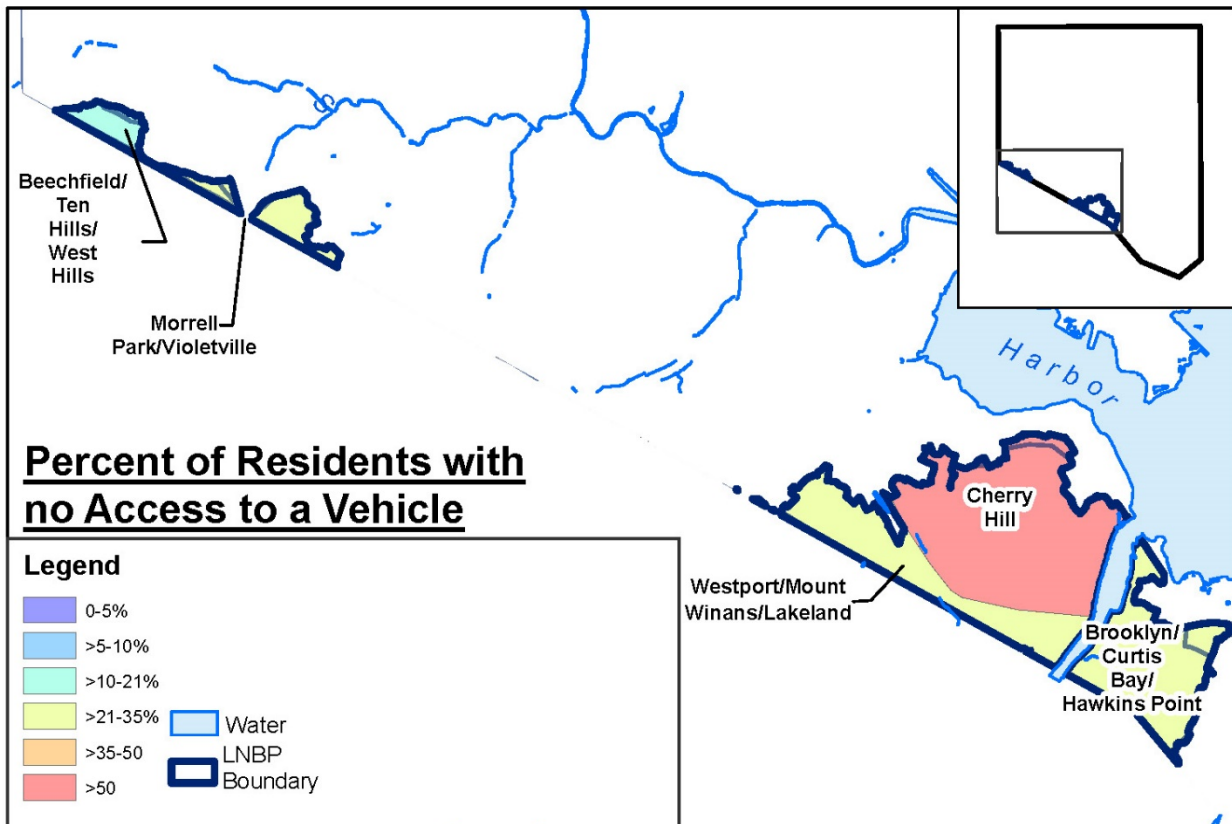- >21-35%
- >35-50%
- >50%

Water
LNBP Boundary

Figure 4-7 Residents with No Access to a Vehicle

5   STORMWATER BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) can be defined as the practice or combination of practices that are determined to be the most effective, practicable means of preventing or reducing the amount of pollution generated by point and nonpoint sources to a level compatible with water quality goals. In this assessment BMPs also include those practices that meet the Secondary Goals (co-benefits) identified in Section 2.7.

To best organize this diverse suite of practices, we have divided stormwater BMPs into three categories:

1. **Projects** – capital projects like stormwater ponds, ESD (bio-swales, rain gardens, bioretention), impervious surface removal, and reforestation resulting in a definable asset. DPW will either be the lead for the installation of these projects and/or work in collaboration with other city agencies and the school system to provide capital funding.

2. **Programs** – DPW services and operations, including street and inlet cleaning, inspections, and public outreach and education.

3. **Partnerships** – BMPs that are installed by the public, private and non-profit sectors, whether as a requirement for development, projects by environmental non-profits or stormwater fee credits. Partnerships can also include public education, engagement, and initiatives that address co-benefits such as health and equity.

5.1   Projects

In the context of the LNBP, projects consist of two types: Environmental Site Design (ESD) Practices and Alternative BMPs. While restoration projects can also include traditional BMPs like ponds or alternative BMPs like shoreline or stream restoration they are not included in this assessment because there are limited opportunities for these types of practices on City-owned property within the watershed. Specific locations for these practices will be explored further within the Watershed Implementation Plan (WIP).

5.1.1   Environmental Site Design (ESD)

ESD practices, also known as green stormwater infrastructure, are small stormwater facilities that typically treat 1/2 acre or less, including micro-bioretention, rain gardens, downspout disconnects, enhanced filters, permeable paving, and green roofs[10]. Given the small size of these practices, they fit well into Baltimore's urban environment of streets, parking lots, small parks, and school grounds. There are opportunities for incorporating ESD practices into complete and green street projects and on school grounds where they can be used for environmental education. Smaller practices like rain gardens and downspout disconnect are applicable on residential and institutional property. Unfortunately, ESD practices can be expensive to install, limited by existing conduits, utilities, and soil conditions, and conflict with right-of-way needs like on-street parking or community acceptance.

5.1.2   Alternative BMPs

Alternative BMPs, as outlined in MDE's "Accounting for Stormwater Waste Load Allocations and Impervious Acres Treated" guidance document, include impervious surface removal and greening, and reforestation. Impervious surface removal and greening projects have been undertaken at several schools and parks throughout Baltimore. There are opportunities for removing impervious surfaces and installing stormwater BMPs as part of the Baltimore City Public Schools' 10-Year Plan.

Reforestation and tree planting efforts are aligned with the City's TreeBaltimore Program. The Department of Recreation and Parks manages this program to meet the City's goal of 40 percent tree canopy cover. This effort in turn supports Baltimore's plans for increasing sustainability, improving surface water quality, and minimizing stormwater runoff. Locations will target TreeBaltimore's Priority Planting Areas (Section 2.3.5).

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[10] For additional information on ESD practices refer to the MDE Stormwater Design Manual, Chapter 5

5.1.3   Existing / Proposed Stormwater Management Facilities

Per Title 4, Subtitle 3, of the Environment Article of Annotated Code of Maryland, management of stormwater runoff is required to reduce erosion, sedimentation, pollution, and flooding (MDE, 2010). Increased importance of water quality and water resource protection has led to the development of the Maryland Stormwater Design Manual to provide BMP design standards that promote a general shift toward low-impact stormwater management practices that mimic natural hydrologic processes and achieve pre-development conditions. The latter is evident by the Maryland Stormwater Management Act of 2007 which requires that ESD be implemented to the maximum extent practicable (MEP) via nonstructural BMPs and/or other innovative design techniques.

Table 5-1 summarizes the number of various types of SWM facilities in each CSA. The SWM facilities are categorized by those constructed pre-2010, post 2010, and proposed (MS4 projects). Figure 5-1 shows the distribution of these SWM facilities within the planning area. The MS4 projects were identified through the 2014 MS4 WIP and consist of various micro-bioretention practices located in the ROW (Beechfield / Ten Hills / West Hills and Brooklyn) and bio-retention facilities on public housing property (Cherry Hill). Construction is scheduled to begin in 2019.

Table 5-1 Existing and Proposed BMPs

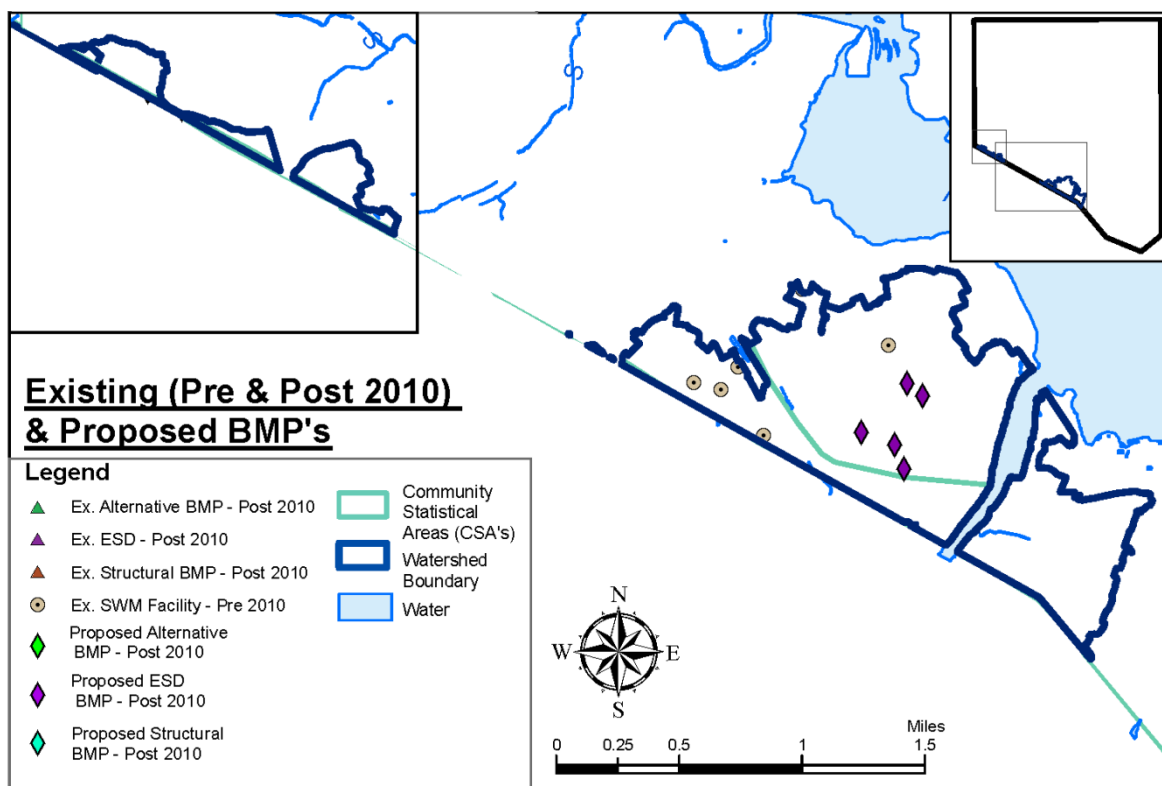| Facilities	Beechfield/Ten Hills/West Hills	Brooklyn/Curtis Bay/Hawkins Point	Cherry Hill	Morrell Park/Violetville	Westport/Mt. Winans/Lakeland
Pre 2010	0	0	1	0	4
Post 2010	0	0	0	0	0
Proposed DPW MS4	0	0	9	0	0

Figure 5-1 Existing and Proposed BMPs

One of the strategies of the City's MS4 WIP was to "identify more projects than are needed", recognizing that field conditions and property ownership might impact the feasibility of projects. Figure 5-2 illustrates MS4 WIP projects that were determined to be "Not Feasible" due to either a conflict (such as utilities) or they did not receive approval by the agency responsible for the property. Additionally, there were a number of projects that were listed in the WIP that were determined to be not cost-effective for DPW to construct in this Permit period (typically <0.2 IA treated) or where no feasibility study was conducted. These are listed as "Identified". These latter projects offer opportunities to revisit in the future, as well as be installed by an entity other than DPW.

Figure 5-2 Identified and Not Feasible BMPs
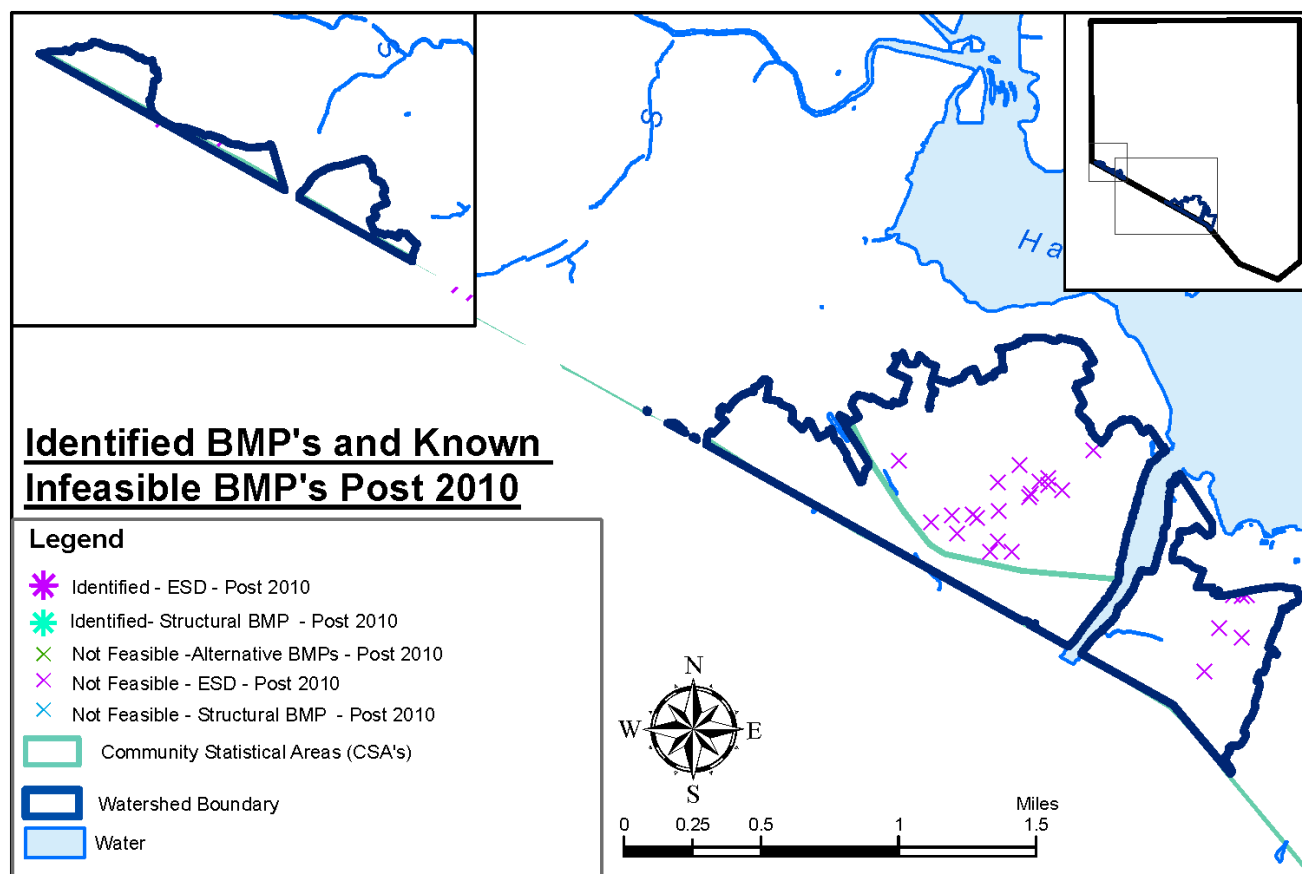
5.2 Programs

Programs represent those practices that are municipal services undertaken by the Department of Public Works as well as programs by others.

5.2.1 Street Sweeping

In April of 2014, DPW launched a citywide mechanical street sweeping program, covering neighborhoods which previously had no service or scattered, inefficient service. Instead of sweeping only the central areas of the City and some of our main commuter routes, all neighborhoods are now being reached using a fleet of 36 vehicles. Those additional neighborhoods are divided into a quadrant system; the LNBP is located in the Southwest Quadrant. The quadrant areas of the city are swept monthly. These routes do not have posted parking restrictions. Residents are asked to cooperate in the street sweeping effort by following the schedule when parking and move their cars on the designated sweeping days.

5.2.2 Trash Collection

In addition to the City's Municipal Can and Single Stream recycling programs, two additional collection programs have been initiated in the watershed. In June of 2018, fifteen new all-terrain litter vehicles (ATLVs) were added to DPW's street cleaning fleet. These collection vehicles will allow DPW to expand cleaning operations in nineteen business districts and traffic gateways business districts throughout Baltimore, including Patapsco and Hanover Streets in Brooklyn.

In September 2018, several "Smart Cans" were installed at the Cherry Hill Town Center. Smart Cans have numerous advantages over the simple round bins seen on many street corners. Their enclosed construction confines litter better, and helps keep rodents away. Additionally, the cans compact the trash to keep litter from overflowing. Sensors in the cans transmit data to let DPW's Bureau of Solid Waste know they are getting full, and supervisors can schedule pickups as they are needed. This first phase of the Smart Can rollout is a pilot that will be used to confirm the best ways to operate the program in other neighborhoods, business districts and, ultimately, bus stops.

5.2.3 Preventive cleaning of catch basins and debris collectors

In 2015, DPW initiated a proactive catch basin and debris collector cleaning program. Although there are no neighborhoods in the LNBP where the program was implemented, DPW will use 3-1-1 "hot spot" information to target problematic storm drains and catch basins and clean these on a regular schedule.

5.2.4 Illicit Discharge Detection and Elimination (IDDE) program[11]

DPW's Office of Compliance and Laboratories (OCAL) is responsible for monitoring the quality of the streams and Harbor in Baltimore City. It uses ammonia screening (AS) as a water quality monitoring program designed to rapidly identify potential pollutants with the intent to initiate pollution source tracking (PST).[12] There is one stream impact sampling (SIS) and ammonia screening location within the watershed, at Reedbird Avenue along the Patapsco.

5.2.5 Erosion and sediment control practices[13]

In 2013, Baltimore City adopted new legislation for erosion and sediment control (Baltimore City Code, Article 7). The legislation updated the City's erosion and sediment control law to provide clear guidance to developers and property owners and additional authority to enforce violations. Also, the City has a 3-1-1 Service Request category that allows citizens to report any erosion problems, whether construction sites, street work, or from private properties.

Figure 5-3: Stream Impact Sampling (Source: Van Sturtevant)

5.2.6 Public Education and Engagement [14]

DPW recognizes that meeting the City's MS4 and TMDL requirements cannot be done solely by government – residents, faith organizations, schools, and businesses each play a role. DPW provides various types of educational material at public events, community meetings, through social media, and on its website (https://publicworks.baltimorecity.gov/). Information ranges from how to properly dispose of household hazardous waste, reducing pesticide and herbicide use, installing stormwater Best Management Practices, recycling tip sheets, and various stormwater fee credit programs. Specifically, DPW's Community Liaison program provides information to communities within the area on DPW initiatives, attends community meetings, and serves

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[11] The Chesapeake Bay Program and MDE have not quantified the benefit in relation to impervious restoration at this time.

[12] The AS program is an alternative methodology to the prescribed sampling listed in the City's NPDES MS4 permit for Illicit Discharge Detection and Elimination (IDDE).

[13] See footnote 30.

[14] See footnote 30.

as a conduit for citizen complaints and concerns. While covering the breadth of DPW services, the Community Liaisons also work with DPW's Watershed Planning + Partnership Section and the Office of Engineering and Construction to schedule community meetings regarding MS4 and TMDL projects.

5.3 Partnerships

Improving both water quality and quality of life in the LNBP watershed will require a collaborative effort among multiple stakeholders, including city agencies, non-profit organizations, community partners, and the private sector. The following is a summary of key stakeholders, both City-wide and within the LNBP watershed, and the role that they play.

5.3.1 Baltimore City Government Stakeholders

Department of Public Works (DPW)
The Department of Public Works (DPW) is primarily responsible for the planning, implementing, maintaining, monitoring, and reporting of projects and programs related to meeting Bay and local TMDLs. Further descriptions of the DPW divisions are as follows:

Office of Compliance and Laboratories (OCAL)
The OCAL is responsible for planning, coordination, monitoring, and reporting for the MS4 permit including TMDL's. This includes maintenance of GIS information related to planned and completed stormwater management facilities, overseeing stormwater management and erosion and sediment control for all developments, surface water quality monitoring, Illicit discharge detection and elimination (IDDE) program, and hot spot investigations. OCAL develops Watershed Assessments and Watershed Implementation Plans for submittal to MDE and coordinates partnership development and community engagement activities.

Office of Engineering and Construction (OEC)
OEC is responsible for the implementation of the capital projects planned by OCAL, including the design and construction of stormwater management facilities and the coordination of Baltimore City and other utility capital improvement projects.

Office of Asset Management (OAM)
The OAM is responsible for inventory, condition assessment, and maintenance of all DPW assets, including ESD and structural practices, preventative maintenance of stormwater facilities and inlet cleaning. OAM also maintains GIS information related to the storm drain system.

Bureau of Water and Wastewater / Wastewater Facilities Division
The Bureau of Water and Wastewater / Wastewater Facilities Division is responsible for inspection and enforcement to ensure compliance with water quality discharge standards for NPDES industrial permits in Baltimore City. They provide operation of ENR upgrades at wastewater treatment plant, and manage the fats, oil, and grease (FOG) inspection and abatement program.

Bureau of Solid Waste
The Bureau of Solid waste is responsible for trash pick-up and disposal, mechanical street and alley sweeping, vacant land management, rat abatement, recycling pick-up, education and outreach, and the operation of solid waste facilities under NPDES industrial permit.

Community Liaison Program
Provides information to communities within the area on DPW initiatives, attends community meetings, and serves as a conduit for citizen complaints and concerns. See Section 5.2.6.

5.3.2 Other City Agencies

Various city agencies conduct work that intersects with watershed management and stewardship, and are important to engage during the planning, outreach and engagement, implementation, and assessment of

stormwater projects and programs. The following are some of the city agencies doing aligned work, and a description of how their work relates to watershed restoration.

Baltimore Development Corporation

The Baltimore Development Corporation (BDC) is a quasi-public entity that serves as the economic development agency for Baltimore City. Its mission is to retain and expand existing businesses, support cultural resources, and attract new opportunities that spur economic growth and help create jobs. BDC is a potential partner for incentive programs with businesses and commercial properties.

Department of Planning (includes the Office of Sustainability)

The Department of Planning (DOP) develops plans to guide redevelopment within Baltimore City. It includes the Office of Sustainability, Comprehensive Planning Land Use and Urban Design, and Research and Strategic Planning. They manage regulated sensitive environmental areas including the Critical Area Management Program and the Floodplain management program and disaster preparation related to climate change. They also oversee the Capital Improvement Program (CIP) and have developed long term development plans for Baltimore including the Green Network Plan and the Sustainability Plan.

The Department of Planning has recently taken steps to increase its focus on equity and equitable and meaningful community engagement related to planning for Baltimore's future development. Their focus on equity includes structural, procedural, transgenerational, and distributional equity[15]. This has included engaging residents across Baltimore in visioning sessions, which have resulted in plans that can be used to prioritize areas for implementation of ESD and other restoration efforts.

Baltimore City Public School System

The school system is responsible for facility planning, building renovations, and new construction (21st Century School Initiative). They coordinate with the Planning Department on the INSPIRE Schools program. Additionally, BCPSS works to lower its environmental impact through its daily operations, and with schools to meet the Maryland Environmental Literacy Standards by integrating the Next Generation Science Standards into curricula.

Department of General Services

The Department of General Services manages and maintains many City owned properties, including fire stations, police stations, and libraries. They are also responsible for the design and construction of new facilities and existing building renovations.

Health Department

The mission of the Health Department is to protect health, eliminate disparities, and ensure the well-being of every Baltimorean through education, advocacy, and direct service delivery. Many of the Health Department's programs and priority areas also align with co-benefits offered by stormwater management projects, including mosquito control/ponding water, outreach and partnerships around healthy environments, heat related illness, and office of youth violence.

Baltimore Department of Housing Community Development (DHCD)

DHCD is responsible for most of the city-owned vacant properties in Baltimore, and manages its acquisition and disposition through the Vacants to Value program. The department also works in partnership with the MD Department of Housing and Community Development and the Maryland Stadium Authority to demolish thousands of vacant buildings to serve as a catalyst for redevelopment and reinvestment.

Department of Recreation and Parks

Recreation and Parks is responsible for all public parks in Baltimore City. The Department also coordinates waterway recreation programs and education & outreach for nature and environmental initiatives. Additionally,

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[15] https://planning.baltimorecity.gov/equity-planning-committee#Defining%20Equity

the Forestry Division coordinates TreeBaltimore, a collaboration of city agencies, non-profit organizations, and community groups with the goal to increase the City's tree canopy.

Department of Transportation (DOT)
The department is responsible for the City's road ways, footways, and alley ways as well as transportation planning. This includes Complete Streets program and planning, the Bike Baltimore program, and coordination with MTA and public transit programs. . Opportunities may exist to collaborate on complete and green streets project and to coordinate work in the ROW.

Environmental Control Board (ECB)
Coordinates the Bmore Beautiful program in the Cherry Hill and Brooklyn neighborhoods, which engages residents as leaders of cleanup crews in their communities. Resident leaders coordinate and manage teams of residents who perform clean-up activities in their communities and are compensated for their work.

Mayor's Office of Employment Development (MOED)
The Mayor's Office of Employment Development (MOED) coordinates and directs workforce development initiatives responsive to the needs of Baltimore City employers and job seekers in order to enhance and promote the local economy. MOED is currently a partner with DPW on the YH2O internship program, and potentially a partner for other workforce development efforts. MOED operates a mobile workforce center that may be able to attend events, which is designed to connect residents with opportunities for employment, and also offers other workforce readiness services, which may include expungement.

5.3.3   Non-government Organizations (NGOs) - City Wide

Baltimore is fortunate to have a number of NGOs that have been active in addressing stormwater issues, providing education, advocacy, and project implementation.

Blue Water Baltimore
Blue Water Baltimore's (BWB) mission is to restore the quality of Baltimore's rivers, streams and harbor to foster a healthy environment, a strong economy, and thriving communities. BWB runs several programs, including the Water Audit program (installation of residential stormwater practices), Blue Water Congregations (faith-based communities), Baltimore Harbor Water Keeper, and Storm Drain Art program. BWB recently worked with the Cherry Hill community to create a Deep Blue Plan that identified opportunities for stormwater management projects on private property. BWB is also working with Medstar Harbor Hospital to install green stormwater infrastructure on the hospital property and educate staff about various green and sustainable practices.

Chesapeake Bay Foundation
Chesapeake Bay Foundation (CBF) is the largest independent conservation organization dedicated solely to saving the Bay. CBF's efforts include advocacy, restoration, education, and litigation. Related to watershed restoration within Baltimore City, CBF implements various watershed restoration projects, engages public leaders in policy and restoration, and also provides educational experiences to Baltimore City school students through hands-on field experiences, professional learning training to teachers who integrate investigative projects engaging students in their natural environment and adult education through restoration projects and raising public support for water quality issues in the Bay's waterways.

Chesapeake Bay Trust
Chesapeake Bay Trust (CBT) is a funding organization that supports various types of education, outreach, and restoration projects. DPW provides funding to CBT for its Outreach and Restoration grant program to support NGOs providing environmental education and installing stormwater management facilities in Baltimore. CBT also provides funding to schools that are implementing environmental education programs.

Civic Works / Baltimore Center for Sustainable Careers
Civic Works' mission is to strengthen Baltimore's communities through education, skills development, and community service. One of their programs is the Baltimore Center for Sustainable Careers. The Center is dedicated

to the creation of business and employment development initiatives that contribute to environmental sustainability and are open to all Baltimore job seekers. One of its workforce development programs provides ESD installation and maintenance training to underemployed residents within the watershed.

Interfaith Partners for the Chesapeake
Interfaith Partners for the Chesapeake (IPC) educates, supports, and inspires people and communities of faith to advocate for the waters of the Chesapeake through policies and practices that promote a healthier environment and healthier people. IPC provides outreach, educational information, and training, and works in partnership with Blue Water Baltimore to help congregations conduct water audits and develop stormwater management projects.

National Aquarium
National Aquarium is a nonprofit aquatic education and conservation organization whose mission is to inspire conservation of the world's aquatic treasures. The National Aquarium provides education, school programs, and community engagement. In particular, they have been working with the Brooklyn community on marine litter reduction programs. This includes providing educational material on water quality, organizing residents for community clean-ups, stenciling storm drains, and planning beautification projects.

Parks & People Foundation
The Parks & People Foundation (PPF) works to unite Baltimore by ensuring that everyone is connected to nature, their community and each other through vibrant parks and green spaces. They provide community greening grants, environmental education programming, and workforce development through Branches, a year-round green careers internship and summer jobs program for Baltimore City high school youth. PPF also installs stormwater management projects as part of its park restoration projects. PPF is leading the effort to create a master plan for the Middle Branch, which will include goals for environmental restoration and improved water quality.

Trash Free Maryland
Trash Free Maryland is a nonprofit organization focused on lasting change to prevent trash pollution. They bring together organizations, businesses, government agencies and decision makers, and individuals committed to reducing trash in Maryland's environment. Trash Free Maryland also works to prevent litter from happening in the first place by supporting various anti-litter policies and programs. Trash Free Maryland has been coordinating a "Trash Free Baltimore Coalition" whose goal is to coordinate and support efforts with social marketing, community clean-ups, and litter research.

5.3.4 NGOs - Watershed Specific

Baltimore Casino Local Development Council (BCLDC)
BCLDC is comprised of business owners, residents and community leaders, and major institutional representatives in the communities surrounding the Casino, including Cherry Hill. The Council has three primary roles consultation on the expenditures of the local impact funds, review of the Casino licensee's master plan for the development of the Casino, and consultation on transportation planning.

Catholic Charities
Catholic Charities is a non-profit that redeveloped and manages the Cherry Hill Town Center, which includes the Family Dollar and other retail shops, five different eateries, the Enoch Pratt Free Library, and the Cherry Hill Senior Center. Catholic Charities recently received a Chesapeake Bay Trust Watershed Assistance Grant to plan and design stormwater management projects for the Town Center.

Cherry Hill Development Corporation
The Cherry Hill Development Corporation (CHDC) is a non-profit organization located in Cherry Hill. The corporation is dedicated to promoting the general welfare and economic development of low and moderate-income residents of Cherry Hill. CHDC promotes new businesses in the area, encourage decent and affordable housing, and supports schools and other organizations tin the neighborhood.

Cherry Hill Homes Tenant Council

The Tenants Council is the governing body of residents for Cherry Hill Homes, a public housing development of the Housing Authority of Baltimore City.

Lakeland Coalition

The Coalition is a non-profit community association of homeowners, businesses, and residents in the Lakeland neighborhood.

Medstar Harbor Hospital

Medstar Harbor Hospital is located in the Direct Harbor Watershed, but its service area overlaps mostly with the LNBP. As a non-profit hospital, it conducts community health needs assessments and invests in community benefits initiatives. Understanding their goals and planned projects will be critical for aligning efforts in a way that supports community benefits.

5.4   Opportunities - General

Given the ultra-urban nature of Baltimore, a diverse and comprehensive approach for meeting the various TMDL requirements and watershed management goals is needed. These strategies are based on the watershed characterization mapping, the suitability analysis, and opportunity areas, and are not listed in order of priority. Since there isn't one strategy for all watershed restoration, it is important that the implementation of different strategies needs to occur in tandem with each other.

1. Implement ESD projects, such as bioretention and rain gardens, at schools and parks, as well as alternative BMPs like impervious surface removal and tree planting.

2. Implement bioretention projects and tree planting in the ROW to create "green streets".

3. Engage stakeholders in the planning process for public stormwater management projects.

4. Develop a neighborhood restoration program targeted at homeowners that includes downspout disconnection, tree planting, storm drain stenciling, and proper lawn care.

5. Engage non-profits, faith organizations, and businesses to implement stormwater retrofits, pollution prevention practices, and public outreach and engagement.

6. Support educational, community health, and workforce development initiatives.

7. Strengthen stakeholder connections to watershed restoration efforts (Watershed Connections) through exploring traditional and non-traditional programs and partnerships aimed at increasing awareness of and amplifying human health co-benefits resulting restoration activities.

8. Expand existing trash reduction programs and partnerships.

5.4.1   Projects/ Programs / Partnerships

Table 5-2 contains a list of suitable project types, programs, and partnerships for use within the LNBP watershed, the criteria for where these are considered most suitable, and the potential partnerships to be engaged. The plus signs (+) are positive criteria, while the negative sign (-) represent limitations.

Table 5-2 Criteria for identifying Projects / Programs / Partnerships

PROJECTS		
BMPs	**Criteria for priority locations**	**Partner**
Bioretention / Rain Gardens – General Conditions	+ Impervious surface / adjacent + A and B soils + Slopes <5% + Near a storm drain + Baltimore Green Network + Community Benefits areas	See Below
ESD practices - Right of Way (ROW)	+ Complete Streets plan + DOT CIP project + ¼ miles of School/an INSPIRE school - Bus stop - Fire hydrant	• DPW • DOT • Local community groups

PROJECTS		
BMPs	**Criteria for priority locations**	**Partner**
ESD practices - Schools	+ Existing Green Team + CASEL (Restorative Practices)	• DPW • BCPSS • Office of Sustainability • Planning • Environmental NGOs
BMPs	**Criteria for priority locations**	**Partner**
ESD practices - Parks / city-owned property	+ Adjacent to impervious surface + Near a storm drain - Active recreation field - Recent tree planting	• DPW • BCRP • Baltimore Housing • Planning / BOS • Parks & People Foundation • DGS
Alternative BMPs – General Conditions	+ Impervious surface + ¼ miles of INSPIRE school	See Below
Impervious removal	+ Impervious surface + Schools / parks	• DPW • BCPSS • BCRP • Baltimore Housing • Planning / BOS
Tree planting	+ UTC Priority Planting Map + Open tree pits + Available space (new pits)	• DPW • BCPSS • BCRP Forestry • TreeBaltimore
PROGRAMS		
SMART Cans	+ Commercial areas + Bus stops	• DPW • Main Street / business associations • MTA • LDC
Street Sweeping (expansion)	+ Clogged drain SRs + Dirty streets and alleys SRs	• DPW
Proactive Inlet Cleaning	+ Clogged storm drains	• DPW
IDDE	+ Monitoring locations + SR complaints	• DPW • Environmental NGOs

PARTNERSHIPS		
BMPs	**Criteria for priority locations**	**Partner**
Watershed Connections (Public Education, engagement, and programs aimed at strengthening stakeholder connections to watershed restoration efforts)	+ Hospital Community Benefits areas + Schools + Faith Organizations + Community-based groups with environmental focus + Areas focused on violence reduction + CASEL schools + Stewardship training programs (Civic Works Stormwater Stewards; Bmore Beautiful Block Captains; Green Stoop Challenge Participants, UMD Watershed Stewards, BOS Planning Academy/Sustainability Ambassadors, or similar)	• MedStar Hospital • BCPSS • Environmental NGOs Planning / BOS • MOED • National Aquarium • Health Department
Workforce Development	+ High unemployment	• MOED • BCGC • NGICP • Parks & People Foundation • Blue Water Baltimore • Civic Works
Anti-Litter Campaign	+ Commercial areas (concentration of take-out food establishments) + Dirty street / alley SRs + Clogged drain SRs	• Envir. Control Board • Trash Free Maryland • National Aquarium
Pet Waste Campaign	+ Dog Parks (formal and informal)	• Health Department • Envir. Control Board • Parks & People Foundation • Blue Water Baltimore

5.5   Opportunities by Priority Areas

5.5.1   Overall Priority Area 1: Brooklyn / Curtis Bay / Hawkins Point

The Brooklyn CSA scored priority 1 for physical feasibility of ESD projects and priority 2 for equity and health supportive communities. However the acreage of public property is limited. This means that alternative practices like street tree planting and residential, faith-based, and commercial programs are needed to incentivize private property owners.

Recommendations include:

- Explore Alternative BMPs like street tree planting.

- Explore opportunities for ESD retrofit at area schools.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and

watershed connections outreach and engagement within and around community nodes as identified in the Baltimore Green Network.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bump-out locations.

- Coordinate with schools on environmental education programs, in particular where ESD practices will be installed.

- Provide education and outreach to homeowners and renters, including litter prevention, proper disposal of oils and grease, pet waste, downspout disconnect, and rainwater harvesting, as well as watershed connections outreach and engagement.

- Promote homeowner incentive programs like rain barrels, tree planting, and community clean-ups.

- Explore outreach and incentive programs for commercial property owners.

- Connect Brooklyn with existing green stormwater infrastructure workforce development programs, like YH2O and the Baltimore Center for Sustainable Careers.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.2   Overall Priority Area 2: Cherry Hill

Cherry Hill was priority 1 for equity and 3 for health supportive community and physical feasibility. The Cherry Hill CSA offers good options for installing ESD practices, given the number of potential ESD locations identified in the area, the wide streets in the public housing area, local initiatives like BWB's Deep Blue and the South Baltimore Gateway Master Plan, and the location of two planned INSPIRE schools (Bridgeview School and Arundel Elementary School), the Bridgeview School which has an existing green team focused on recycling, and the Arundel Elementary School, which is participating in the CASEL restorative practices program. It is home to several very active community organizations, including the Cherry Hill Community Coalition, the Cherry Hill Development Corp, and the Youth Resiliency Institute, and is a Bmore Beautiful community, so has a history of engaging residents to care for public spaces.

Recommendations include:

- Explore the feasibility of potential ESD practices that have been identified in the MS4 WIP.

- Explore opportunities for ESD projects and tree planting in the ROW to create "green streets", including within ¼ mile buffers of INSPIRE schools aligning with the associated pedestrian safety and streetscape improvements.

- Explore opportunities for ESD installation and watershed connection programming at and around school areas, including the CASEL participating school focused on alternative practices.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around Green Network corridors.

- Coordinate with the Cherry Hill Community Coalition, the Cherry Hill Development Corp, and the Youth Resiliency Institute, Cherry Hill Tenants Association, and other community organizations regarding project location, outreach, and potential watershed connection programming.

- Coordinate with Recreation and Parks on ESD opportunities for the new Reedbird Recreation Center.

- Coordinate with DOT on identified complete streets, bicycle network and pedestrian safety/traffic calming work, and potential bump-out locations.

- Coordinate with schools on environmental education programs, in particular where ESD practices are installed and/or planned.

- Provide education and outreach to homeowners and renters, in particular on watershed health activities they can do on private property (i.e. litter prevention, pet waste, proper disposal of oils and grease, downspout disconnect, rainwater harvesting, lot greening etc.) and watershed connections outreach and engagement.

- Promote homeowner incentive programs like rain barrels, tree planting, and community clean-ups.

- Coordinate with non-profit partners to explore ESD opportunities on private property.

- Coordinate with BWB and other local stakeholders in implementing the Deep Blue Plan.

- Explore opportunities for innovative Watershed Connections programming to promote and increase awareness of health-related co-benefits of restoration activities within MedStar Hospital's Community Benefit Area.

- Connect Cherry Hill with existing green stormwater infrastructure workforce development programs, like YH2O and the Baltimore Center for Sustainable Careers.

- Explore workforce development / green jobs for maintenance of ESD practices installed in the area.

- Implement Phase 3 of the SMART Can program at local bus stops.

5.5.3 Overall Priority Area 2: Westport/Mt. Winans/Lakeland

Westport/Mt. Winans/Lakeland scored 2 in the equity prioritization analysis and 3 for health supportive communities and physical feasibility. The majority of the land use in this CSA is business and industry, with major transportation corridors like Patapsco Avenue and several rail lines. ESD projects that can be installed by DPW are limited, although there are opportunities to engage larger private property owners. Recommendations include:

- Explore ESD and tree planting opportunities along Patapsco Avenue.

- Coordinate with the Planning Department on opportunities for ESD, alternative practices, and watershed connections outreach and engagement within and around the community and nature corridors identified in the Baltimore Green Network.

- Explore opportunities to enhance the identified multi-use bike trail with ESD and alternative practices such as tree planting.

- Explore outreach and incentive programs for commercial property owners.

5.5.4 Overall Priority Area 3: Morrell Park / Violetville

Morrell Park / Violetville scored a 3 in the prioritization analysis for equity and a 3 for health supportive community and physical feasibility. The portion of this CSA within the LNBP is characterized by high homeownership and favorable opportunities within the ROW for ESD practices. Recommendations include:

- Explore ESD locations within the ROW.

- Provide education and outreach to homeowners, in particular on litter prevention, proper disposal of oil and grease, and pet waste.

- Promote homeowner incentive programs like rain barrels, tree planting, and community clean-ups.

5.5.5 Overall Priority Area 4: Beechfield/Ten Hills/West Hills

Beechfield/Ten Hills/West Hills scored a 4 in the equity prioritization analysis, a 5 in the health supportive communities prioritization analysis, and a 1 in the physical feasibility prioritization analysis. This CSA is primarily residential. Recommendations include:

- Explore opportunities to enhance the identified multi-use bike trail with ESD and alternative practices such as tree planting.

- Provide education and outreach to homeowners, and link this to incentive programs like rain barrels, tree planting, and community clean-ups.

- Promote homeowner incentive programs like rain barrels, tree planting, and community clean-ups.

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Data	Source
University of Maryland Midtown Primary Service Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/UMMCMidtown-CBR17.pdf
University of Maryland Midtown Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/UMMCMidtown-CBR17.pdf
Mercy Primary Service Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/Mercy-CBR17.pdf
Mercy Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/Mercy-CBR17.pdf
University of Maryland Primary Service Area	Created from zip codes identified in Community Benefits report a http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/UMMC-CBR17.pdf
University of Maryland Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/UMMC-CBR17.pdf
Bon Secours Primary Service Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/BonSecours-CBR17.pdf
Bon Secours Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/BonSecours-CBR17.pdf
Johns Hopkins Bayview Primary Service Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/JHBMC-CBR17.PDF
Johns Hopkins (Both) Community Benefits Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/JHH-CBR17.PDF
Johns Hopkins Primary Service Area	Created from zip codes identified in Community Benefits report at http://www.hscrc.state.md.us/Documents/HSCRC_Initiatives/CommunityBenefits/CBR-FY17/JHH-CBR17.PDF
Medstar Harbor Hospital Community Benefits Area	Created from zip codes identified in 2018 Community Benefits report at https://ct1.medstarhealth.org/content/uploads/sites/7/2018/06/MedStar_CHNA_Report_2018-FINAL.pdf?_ga=2.97635996.280585316.1543592446-2070020116.1535464969
Medstar Harbor Hospital Primary Service Area	Created from zip codes identified in 2018 Community Benefits report at https://ct1.medstarhealth.org/content/uploads/sites/7/2018/06/MedStar_CHNA_Report_2018-FINAL.pdf?_ga=2.97635996.280585316.1543592446-2070020116.1535464969
Medstar Harbor Hospital Community Benefits Service Area	Saint Agnes FY2018 Community Health Needs Assessment available online at https://www.stagnes.org/wp-content/uploads/2017/11/FY18-CHNA_FINAL-6-15-18.pdf

Daytime Summer Surface Temperature Baltimore	The daytime temp was from 7/5/14 and the nighttime was from 6/18/2005. Provided by Mehdi Heris & Austin Troy. Data collection methods described in detail in :
Nighttime Summer Surface Temp Baltimore	Heris, M., Bagstad, K., Troy, A., Middel, A., Rhodes, C., Matuszak, J., Piloting Urban Ecosystem Accounting for the U.S. *Ecosystem Services. Manuscript submitted for publication.*
Daytime Summer Surface Temperature Baltimore by 2010 CSA	Used Zonal Statistics to calculate the mean temperature within the 2010 CSA boundaries from the original rasters provided by Mehdi Heris & Austin Troy. Data collection methods described in detail in :
Nighttime Summer Surface Temp Baltimore by 2010 CSA	Heris, M., Bagstad, K., Troy, A., Middel, A., Rhodes, C., Matuszak, J., Piloting Urban Ecosystem Accounting for the U.S. *Ecosystem Services. Manuscript submitted for publication.*
2010 Neighborhood Boundaries	Downloaded from Open Data Baltimore https://data.baltimorecity.gov/Neighborhoods/Neighborhoods-Shape/ysi8-7icr
Zoning	Downloaded from Open Data Baltimore https://data.baltimorecity.gov/Geographic/Zoning-Shape/vvi4-ef6w
School Locations, CASEL Status, and Green Team Status of schools.	School location information provided by Baltimore City Public Schools on 12/10/2018, and joined to information on CASEL programming downloaded from the page https://www.baltimorecityschools.org/schools/school_list and additional information on and Green and Healthy School Grants provided by the Baltimore City Public Schools Green School Coordinator. List of INSPIRE schools was retrieved from https://baltimore21stcenturyschools.org/projects. All lists were downloaded in December 2018.
Floodplain	Downloaded from Open Data Baltimore Sept 2018 https://data.baltimorecity.gov/Geographic/Floodplain-Shape/pqt8-n8r7
Hydrography	Downloaded from Maryland GIS Data Catalog http://data.imap.maryland.gov/datasets/9ba87d5942744b3bb61c78dd22c76564_0
Critical Area	Downloaded from Open Data Baltimore Sept 2018 https://data.baltimorecity.gov/Geographic/Critical-Area-and-Resource-Conservation-Areas/m5av-ntyv
Locations of Hospitals	Downloaded from Open Baltimore Nov 2018. https://data.baltimorecity.gov/Health/Hospitals/g9ck-7zns "This data set shows the location of Baltimore City hospitals. The purpose of this data is to assist the City of Baltimore in identifying institutions that provides health care treatment by specialized staff and equipment. To assist the City's emergency organizations in identifying health institution during an emergency event. Cartographic, analysis, and planning." Multi-Purpose health centers are not included.
Railroads	Downloaded from Open Baltimore Nov 2018. https://data.baltimorecity.gov/Geographic/Railroad-Shape/buxu-32qi
BNIA Data Dictionary	Downloaded from https://bniajfi.org/indicators/all
2010 CSA Boundaries & BNIA Data	Downloaded from BNIA https://bniajfi.org/community/Baltimore%20City/

LNBP Watershed Boundary	Created by cross referencing the Watershed Boundaries available to download from MDE at (MDE - https://mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/8DigitWatershed.aspx) with the NPDES drainage areas created for DPW owned outfalls and topography based on aerial DEM raster data from
Major Roads	TigerLine Data
Water Features	TigerLine Data
Land Use/Land Cover	Name: County Land Use Land Cover 2010 Dataset provided by the State of Maryland, containing summary statistics from the state issued 1973, 2002, and 2010 land use/land cover datasets, created to provide a generalized view of how land has been developed and changed over time. Downloaded from the Maryland GIS Data Catalog <http://data.imap.maryland.gov/datasets/97717f333baf4e79abb7ab8098a99ee5_0>
Slope	LiDAR Elevation Dataset - Bare Earth DEM at 1m resolution - downloaded in 2008, compiled by Sanborn.
Soils (Hydrologic Group)	Originator: U.S. Department of Agriculture, Natural Resources Conservation Service Publication Date: July 15, 2006 Title: Digital General Soil Map of U.S. - City of Baltimore, Maryland - Downloaded from https://gdg.sc.egov.usda.gov/GDGOrder.aspx on 18-Sept-2018
Impervious Baseline 2015	Digitized and Photogrammetrically captured pavement edges based off of aerial photograph from 2011. Serves as the baseline for the DPW MS4 permit.
Eligible MS4 Impervious	Created by starting with the Impervious Baseline data, then removing impervious surfaces on federally or state owned property, industrial parcels that are not city-owned (owned by Mayor and City Council), and impervious surfaces within known drainage areas for stormwater management facilities installed after 2010 based on DPW records (as these have gone through review under the current stormwater management regulations and are assumed to be managed to the maximum extent practicable (MEP)).
Land parcels in Baltimore, by ownership type (NPDES Source Sector) with Industrial parcels noted and parcels with railways (at grade or below grade)	Property Ownership Database maintained by Baltimore City coded by ownership type with 2018 Industrial Permit holders (list provided by MDE) identified. Railways downloaded from Open Data Baltimore. https://data.baltimorecity.gov/Geographic/Railroad-Shape/buxu-32qi
Development Trends	Provided by the Department of Housing and Community Development - Baltimore City. Contains Neighborhood SubCabinet areas, (7 focus areas identified by Baltimore City for redevelopment. Planning process currently underway); Major Redevelopment areas (Not officially designated, but areas that have been identified where significant land changes are currently taking place); and Community Development Clusters (areas flagged for potential housing development, but with varying degrees of certainty and boundary integrity)
Green Network Pilot Sites	Created a shapefile of Green Network Pilot Project locations using a list provided by the Planning Department's Office of Sustainability, mapped to the Baltimore City Real

	Property Parcel Dataset (accessed October 2018) using the join function in Arc GIS based on Block Lot information.
Green Network Nodes/Corridors	Geodatabase Provided by the Department of Planning Office of Sustainability on Sept. 21, 2018
High Crash Pedestrian Intersections	List Provided by the Department of Transportation, and imported as points into ArcGIS.
BMORE Beautiful Neighborhoods	Created using the list of participating communities available at <https://mayor.baltimorecity.gov/BMORE_Beautiful> Accessed September 2018 and the Neighborhoods Shapefile downloaded from Open Data Baltimore September 2018 <https://data.baltimorecity.gov/Neighborhoods/Neighborhoods-Shape/ysi8-7icr>
Bicycle Master Plan	Map Package Provided by the Baltimore City Department of Transportation 2018
Existing Bicycle Facilities	Map Package Provided by the Baltimore City Department of Transportation 2018
Violence Reduction Initiative (VRI) Zones	Provided by the Baltimore City Office of Information & Technology (BCIT) - 2018
Storm & Sewer Infrastructure & 311 Call Density	Provided by DPW Office of Asset Management 2018
Proposed & Identified/Not Feasible Restoration Projects	Provided by DPW Office of Engineering and Construction 2018
% White % w/o High School Diploma/Equivalency Median Income % Households in Poverty % Walked to Work % Without Vehicle Access % Tree Canopy	BNIA Vital Signs 16 – Downloaded from https://bniajfi.org/community/Baltimore%20City/ See All Vital Signs Indicators for description of variables https://bniajfi.org/indicators/all
Hardship Index Life Expectancy % Parks & Greenspace	Baltimore City Health Department Vital Signs Reports (See reports for description of variables) https://health.baltimorecity.gov/neighborhoods/neighborhood-health-profile-reports
Percent Impervious (Not shaded)	Chesapeake Conservancy Conservation Innovation Center – High Resolution Land Cover data – Downloaded from : https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/