495 270 MANAGED LANES STUDY

APPENDIX L

NATURAL RESOURCES TECHNICAL REPORT

MAY 2020

U.S. Department of Transportation

Federal Highway Administration

and

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1

1 INTRODUCTION

1.1 Overview

The Federal Highway Administration (FHWA), as the Lead Federal Agency, and the Maryland Department of Transportation State Highway Administration (MDOT SHA), as the Local Project Sponsor, are preparing an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) for the I-495 & I-270 Managed Lanes Study (Study). The Study is evaluating potential transportation improvements to portions of the I-495 and I-270 corridors in Montgomery and Prince George's County, Maryland (MD), and Fairfax County, Virginia (VA).

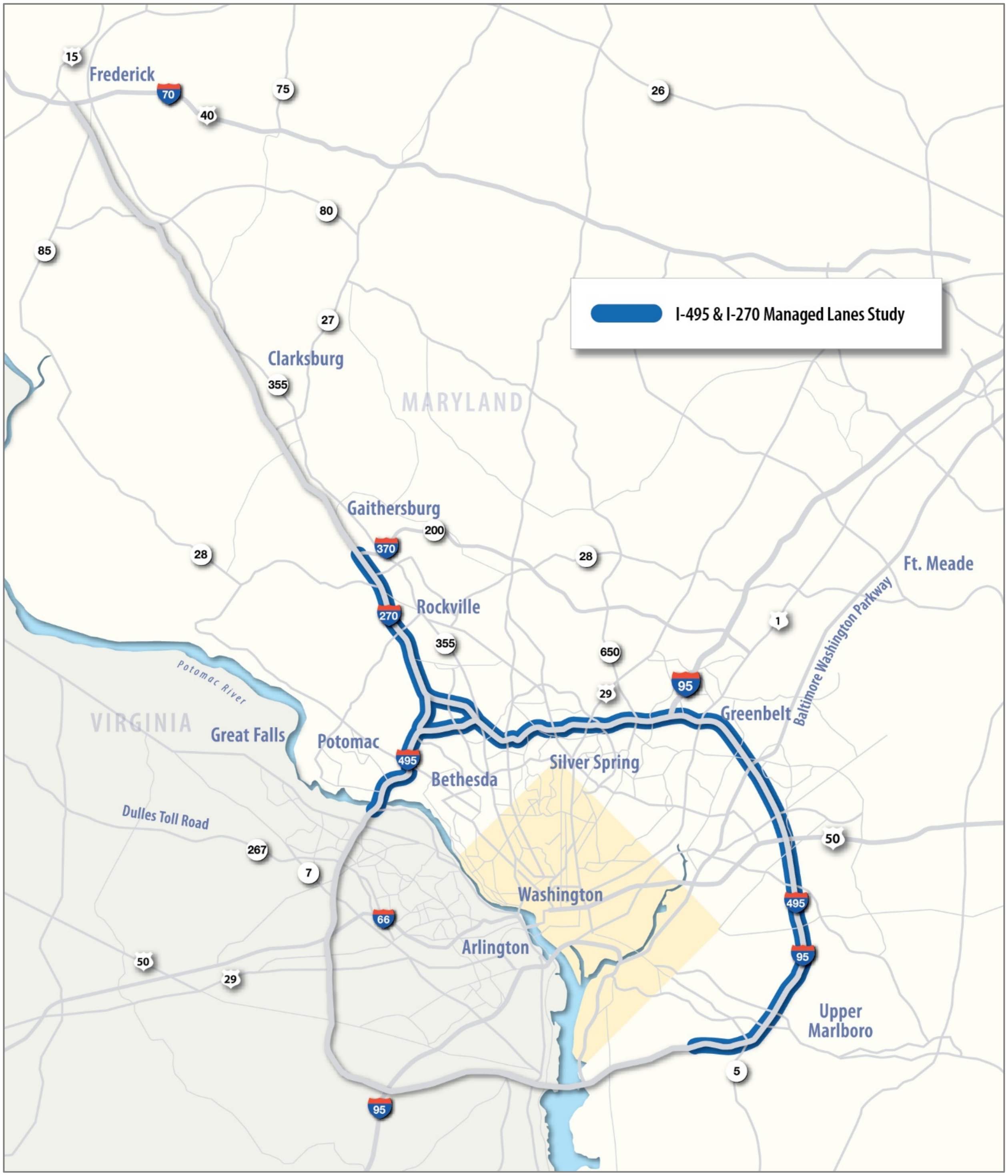
This EIS is being prepared in accordance with FHWA and Council on Environmental Quality (CEQ) regulations implementing NEPA and provisions of the Fixing America's Surface Transportation (FAST) Act. The content of the EIS also conforms to CEQ guidelines, which provide direction regarding implementation of the procedural provisions of NEPA, and the FHWA's Guidance for *Preparing and Processing Environmental and Section 4(f) Documents* (Technical Advisory T6640.8A, October 1987).

The purpose of the Natural Resources Technical Report (NRTR) is to present the existing conditions and an assessment of potential direct impacts of the Screened Alternatives to natural resources and, it is being prepared to support and inform the EIS. The report begins with a description of the study corridors, followed by a summary of the Purpose and Need, and a description of the alternatives evaluated.

1.2 Study Corridors

I-495 and I-270 in Maryland are the two most heavily traveled freeways in the National Capital Region, each with Average Annual Daily Traffic (AADT) volume up to 260,000 vehicles per day in 2018 (MDOT SHA, 2019). I-495 is the only circumferential route in the region that provides interregional connections to many radial routes in the region, such as I-270, United States (US) 29 (Colesville Road), I-95, the Baltimore-Washington Parkway, US 50 (John Hanson Highway), and MD 5 (Branch Avenue). I-270 is the only freeway link between I-495 and the fast-growing northwest suburbs in northern Montgomery County and the suburban area in Frederick County. In addition to heavy commuter traffic demand, I-495 provides connectivity along the East Coast, as it merges with I-95 in Maryland for 25 miles around the east side of Washington, District of Columbia (DC) providing connectivity along the East Coast (**Figure 1-1**).

Figure 1-1: Study Corridors



1.3 Study Purpose and Need

The purpose of the Study is to develop a travel demand management solution(s) that addresses congestion and improves trip reliability on I-495 and I-270 within the Study limits and enhances existing and planned multimodal mobility and connectivity. The Study will address the following needs:

- **Accommodate Existing Traffic and Long-Term Traffic Growth** - High travel demand from commuter, business, and recreational trips results in severe congestion from 7 to 10 hours per day on the Study corridors; which is expected to deteriorate further by the planning horizon year of 2040. Additional roadway capacity is needed to address existing and future travel demand and congestion, reduce travel times, and allow travelers to use the facilities efficiently.

- **Enhance Trip Reliability -** Congestion on I-495 and I-270 results in unpredictable travel times. Travelers and freight commodities place a high value on reaching their destinations in a timely and safe manner, and in recent years, the study corridors have become so unreliable that uncertain travel times are experienced daily. More dependable travel times are needed to ensure trip reliability.

- **Provide Additional Roadway Travel Choices -** Travelers on I-495 and I-270 do not have enough roadway options for efficient travel during extensive periods of congestion. Additional roadway management options are needed to improve travel choices, while retaining the general-purpose lanes.

- **Accommodate Homeland Security** - The National Capital Region is considered the main hub of government, military, and community installations related to homeland security. These agencies and installations rely on quick, unobstructed roadway access during a homeland security threat. Additional capacity would assist in accommodating a population evacuation and improving emergency response access should an event related to homeland security occur.

- **Improve Movement of Goods and Services** - I-495 and I-270 are major regional transportation networks that support the movement of passenger and freight travel within the National Capital Region. Existing congestion along both corridors increases the cost of doing business due to longer travel times and unreliable trips. The effects of this congestion on the movement of goods and services is a detriment to the health of the local, regional, and national economy. Efficient and reliable highway movement is necessary to accommodate passenger and freight travel, moving goods and services through the region.

Additional roadway capacity and improvements to enhance reliability must be financially viable. MDOT's traditional funding sources would be unable to effectively finance, construct, operate, and maintain improvements of this magnitude. Revenue sources that provide adequate funding, such as pricing options, are needed to achieve congestion relief and address existing high travel demand.

Given the highly constrained area surrounding the interstates in the Study corridors, MDOT SHA recognizes the need to plan and design this project in an environmentally responsible manner. MDOT SHA will strive to avoid and minimize community, natural, cultural, and other environmental impacts, and mitigate for any unavoidable impacts at an equal or greater value. MDOT SHA will work with our Federal, State, and Local resource agency partners in a streamlined, collaborative, and cooperative way to meet all regulatory requirements to ensure the protection of environmental resources to the maximum extent practicable. Any Screened Alternatives will offset unavoidable impacts, while prioritizing and coordinating comprehensive mitigation measures in or near the study area which are meaningful to the environment and the community.

1.4 Alternatives Evaluated

Seven alternatives are being evaluated and compared in the technical reports supporting the EIS. These Screened Alternatives include Alternatives 1, 5, 8, 9, 10, 13B, and 13C and are illustrated in the typical sections shown in Figure 1-2.

The following terms are used in the description of the alternatives.

- **General Purpose (GP) Lanes** are lanes on a freeway or expressway that are open to all motor vehicles.[1]
- **Managed Lanes** are highway facilities, or a set of lanes, where operational strategies are proactively implemented and managed in response to changing conditions.[2]
- **High-Occupancy Toll (HOT) Lanes** are High-Occupancy Vehicle (HOV) facilities that allow lower-occupancy vehicles, such as solo drivers, to use the facilities in return for toll payments, which could vary by time of day and level of congestion.[1]
- **Express Toll Lanes (ETL)** are dedicated managed lanes within highway rights-of-way that motorists may use by paying a variably priced toll.[3]
- **High-Occupancy Vehicle (HOV) Lanes** are any preferential lane designated for exclusive use by vehicles with two or more occupants for all or part of a day, including a designated lane on a freeway, other highway or a street, or independent roadway on a separate right-of-way (ROW).[4]
- **Reversible Lanes** are facilities in which the direction of traffic flow can be changed at different times of the day to match peak direction of travel, typically inbound in the morning and outbound in the afternoon.[1]

A. Alternative 1: No Build

The No Build Alternative, often called the base case, includes all projects in the 2040 financially Constrained Long-Range Plan (CLRP) for the National Capital Region adopted by the Metropolitan Washington Council of Governments (MWCOG) - Transportation Planning Board (TPB). This includes other projects impacting the facilities that are subject to this Study. Specifically, the CLRP reflects the Purple Line which is currently under construction (Spring 2019), and the extension of the I-495 Express Lanes in Virginia from north of the Dulles Toll Road interchange to the American Legion Bridge (ALB) (Virginia's 495 Express Lanes Northern Extension [NEXT] Project). Alternative 1 also includes the I-270 Innovative

[1] *National Cooperative Highway Research Program, Research Report 835, Guidelines for Implementing Managed Lanes*. Transportation Research Board. 2016

[2] https://ops.fhwa.dot.gov/publications/managelanes_primer/index.htm

[3] https://www.fhwa.dot.gov/ipd/tolling_and_pricing/defined/demand_mgmt_tool.aspx

[4] https://ops.fhwa.dot.gov/freewaymgmt/hovguidance/glossary.htm

Congestion Management (ICM) Contracts, which are providing a series of construction projects to improve mobility and safety at key points along I-270 targeted to reduce congestion at key bottlenecks along the corridor. All improvements are being implemented within the existing roadway ROW and are anticipated to be completed in 2021. While these improvements will improve mobility and safety, they will not address the long-term roadway capacity needs for the I-270 corridor. Routine maintenance and safety improvements along I-495 and I-270 are included in the No Build Alternative, but it does not include new capacity improvements to I-495 and I-270. Consistent with NEPA requirements, Alternative 1 will be carried forward for further evaluation to serve as a base case for comparing the other alternatives.

B. Alternative 5: 1-Lane, High-Occupancy Toll Managed Lane Network

This alternative consists of adding one HOT managed lane in each direction on I-495 and converting the one existing HOV lane in each direction to a HOT managed lane on I-270. Buses would be permitted to use the managed lanes.

C. Alternative 8: 2-Lane, Express Toll Lane Managed Lanes Network on I-495 and 1-Lane Express Toll Lane and 1-Lane HOV Managed Lane Network on I-270

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane in each direction on I-270, and adding one ETL managed lane in each direction on I-270. Buses would be permitted to use the managed lanes.

D. Alternative 9: 2-Lane, High-Occupancy Toll Managed Lanes Network

This alternative consists of adding two HOT managed lanes in each direction on I-495, converting the one existing HOV lane in each direction on I-270 to a HOT managed lane, and adding one HOT managed lane in each direction on I-270, resulting in a two-lane, managed lane network on both highways. Buses would be permitted to use the managed lanes.

E. Alternative 10: 2-Lane, Express Toll Lane Managed Lanes Network and 1-Lane HOV Managed Lane Network on I-270 Only

This alternative consists of adding two ETL managed lanes in each direction on I-495, retaining one existing HOV lane per direction on I-270, and adding two ETL managed lanes in each direction on I-270. Buses would be permitted to use the managed lanes.

F. Alternative 13B: 2-Lane, High-Occupancy Toll Managed Lanes Network on I-495 and HOT Managed Reversible Lanes Network on I-270

This alternative consists of adding two HOT managed lanes in each direction on I-495 and converting the existing HOV lanes in both directions to two HOT managed, reversible lanes on I-270. Buses would be permitted to use the managed lanes.

G. Alternative 13C: 2-Lane, ETL Managed Lanes Network on I-495 and ETL Managed, Reversible Lanes Network and 1-Lane HOV Managed Lane Network on I-270

This alternative consists of adding two ETL managed lanes in each direction on I-495 and retaining the existing HOV lanes in both directions and adding two ETL managed, reversible lanes on I-270. Alternative 13C would maintain the existing roadway network on I-270 with HOV lanes to allow for HOV travel while adding two managed, reversible lanes. Buses would be permitted to use the managed lanes.

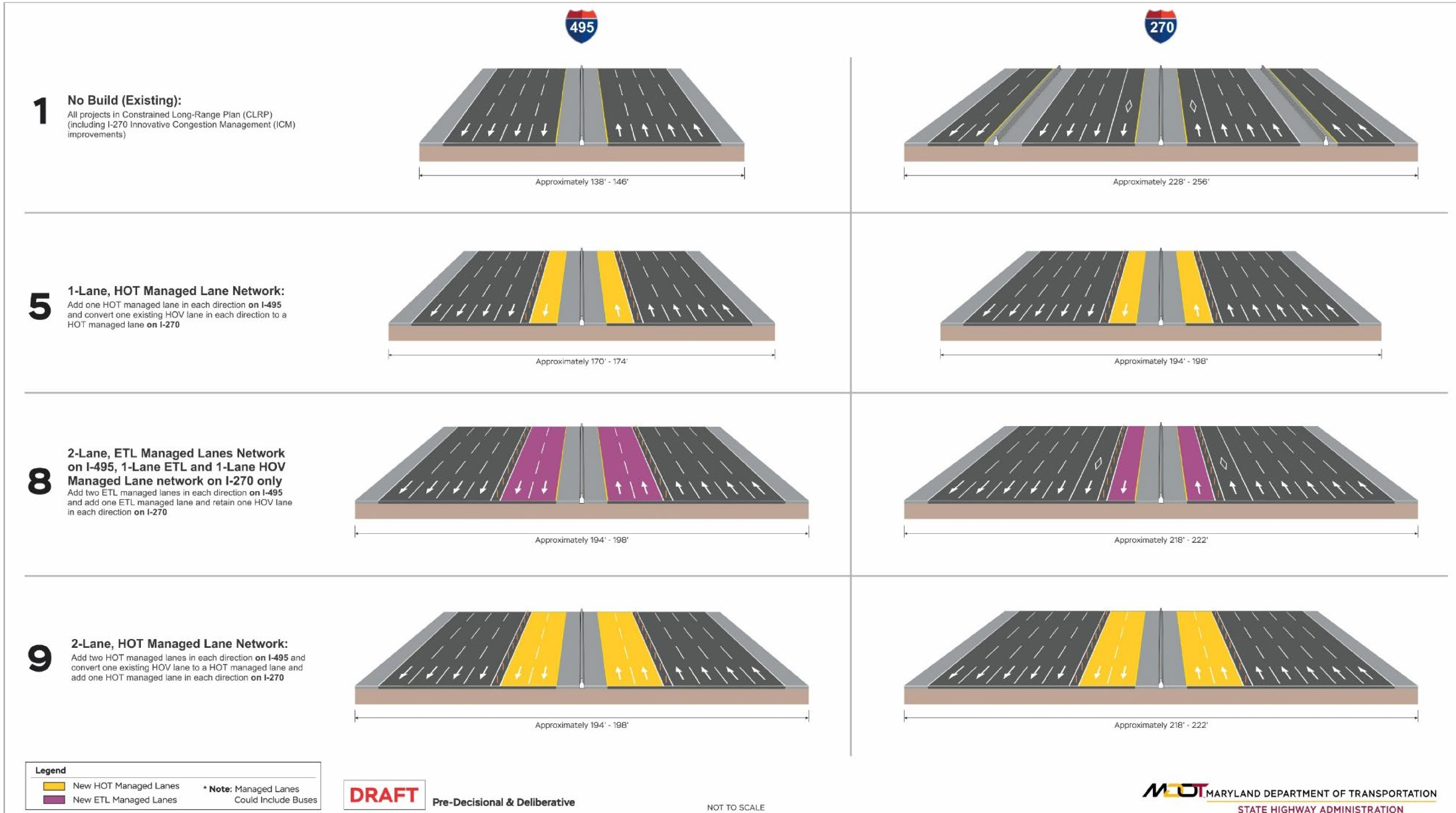
H. Consideration of Alternative 9M

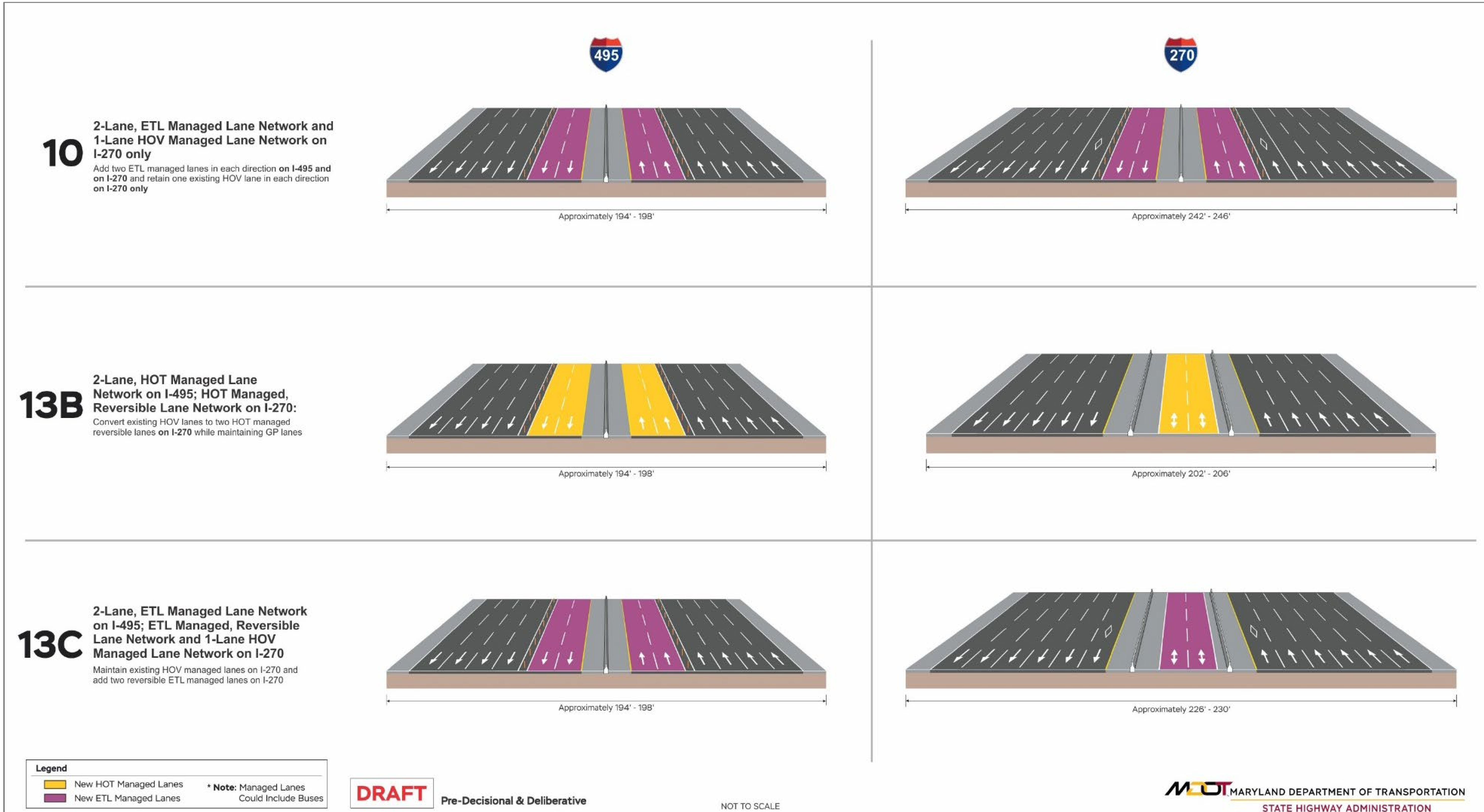
The analysis for the Screened Alternatives summarized above was completed in Spring of 2019 and reflects information available to MDOT SHA at that time. As the Study progressed through the NEPA process, the project team obtained comments as a result of cooperating agency coordination. As a result of this continued effort, MDOT SHA and FHWA have evaluated an additional alternative for the Study known as Alternative 9M. Alternative 9M is considered a blend of two Screened Alternatives, Alternative 5 (one-lane HOT) and Alternative 9 (two-lane HOT).

Alternative 9M has the same LOD as Alternative 9 along I-495 from south of the George Washington Memorial Parkway in Virginia to the I-270 West Spur and from the I-95 interchange to west of MD 5 as well as along I-270 from I-495 to I-370. Alternative 9M has the same LOD as Alternative 5 along I-495 from I-270 West Spur to the I-95 interchange. Alternative 9M includes the same build elements as the other Screened Alternatives including direct access locations and interchange improvements.

Because Alternative 9M is a blend of Alternatives 9 and 5, the environmental impacts associated with Alternative 9M are covered in this Technical Report. Specific impacts associated with Alternative 9M have been quantified and are shown in the DEIS for comparison with the other Build Alternatives. Any differences in the quantity or intensity of impacts between Alternative 9M and other alternatives are noted either in tables or text in the DEIS.

Figure 1-2: Typical Sections of Alternatives Considered




495
270
10
2-Lane, ETL Managed Lane Network and 1-Lane HOV Managed Lane Network on I-270 only
Add two ETL managed lanes in each direction on I-495 and on I-270 and retain one existing HOV lane in each direction on I-270 only
Approximately 194' - 198'
Approximately 242' - 246'
13B
2-Lane, HOT Managed Lane Network on I-495; HOT Managed, Reversible Lane Network on I-270:
Convert existing HOV lanes to two HOT managed reversible lanes on I-270 while maintaining GP lanes
Approximately 194' - 198'
Approximately 202' - 206'
13C
2-Lane, ETL Managed Lane Network on I-495; ETL Managed, Reversible Lane Network and 1-Lane HOV Managed Lane Network on I-270
Maintain existing HOV managed lanes on I-270 and add two reversible ETL managed lanes on I-270
Approximately 194' - 198'
Approximately 226' - 230'
Legend
New HOT Managed Lanes
New ETL Managed Lanes
* Note: Managed Lanes Could Include Buses
DRAFT
Pre-Decisional & Deliberative
NOT TO SCALE
MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

2

2 EXISTING CONDITIONS AND ENVIRONMENTAL EFFECTS

The NRTR Existing Conditions and Environmental Effects section details the existing environmental features within the I-495 & I-270 Managed Lanes Study corridors; the potential environmental effects to these resources resulting from the Screened Alternatives; and the avoidance and minimization strategies used during the planning phase of this study. All alternatives except for the No Build Alternative are referred to as the Screened Alternatives throughout this report. The field delineation and investigation of environmental features was conducted within the I-495 & I-270 Managed Lanes Study corridor study boundary, a 48-mile long and approximately 600-foot wide roadway corridor spanning two states, three counties, and 15 MDNR 12-digit watersheds, plus part of Fairfax County, Virginia. An overview map depicting the extent of the corridor study boundary is included in **Section 1.2, Figure 1-1: Study Corridors**. Impact tables included in **Appendix A** compare the quantifiable natural resource impacts of the Screened Alternatives.

2.1 Topography, Geology, and Soils

2.1.1 Regulatory Context and Methods

Environmental scientists conducted a desktop review of publicly available topography, geology, and soils data within the corridor study boundary on behalf of MDOT SHA. Geological and soils data within the corridor study boundary were sourced from the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) website and Web Soil Survey, elevations were determined using US Geological Survey (USGS) geospatial data, and agricultural land was identified using Maryland's Environmental Resources and Land Information Network (MERLIN).

The Farmland Protection Policy Act (FPPA) 7 U.S.C. 4201 et seq, implementing regulations 7 CFR Part 658, of the Agriculture and Food Act of 1981, as amended aims to minimize the conversion of important food and fiber producing farmland into non-agricultural land by federal programs (USDA, 1981). Coordination of an FPPA review by NRCS must be completed at the Alternatives Retained for Detailed Study (ARDS) level if a project has the potential to convert prime, statewide, unique, or locally important farmland to non-farm use. Prime Farmland Soils, Soils of Statewide Importance, and unique farmland soils within the corridor study boundary were identified using desktop review. FFPA does not apply to most of the corridor study boundary because there is only a very small area that is not a census-designated urban area, which is excluded from FFPA regulation. If required, NRCS review establishes a farmland conversion impact rating score using a land evaluation and site assessment (LESA) system (Form AD-1006) to identify potential impacts to important agricultural land within federally funded or assisted project sites. Consideration of alternative sites is suggested if the score and potential adverse impacts on farmland exceed the recommended allowable level (USDA, 1981).

2.1.2 Existing Conditions

A. Topography and Geology

The corridor study boundary includes the Piedmont Plateau and Atlantic Coastal Plain Physiographic Provinces. The provinces are separated by the Atlantic Seaboard Fall Line, a geomorphologic break between an upland region of relatively hard, crystalline basement rock and a coastal plain of softer sedimentary rock, which roughly matches the boundary between Montgomery and Prince George's Counties. The Atlantic Seaboard Fall Line is both a geologic and topographic boundary, marking the boundary between two distinct areas of geologic origin and of relative elevation: the low-lying Coastal Plain and the hilly and mountainous Piedmont. The elevation within the corridor study boundary ranges from 38 to 516 feet above mean sea level (**Appendix B**). The lowest elevations occur as I-495 approaches the Woodrow Wilson Bridge in Virginia along the Potomac River on the eastern side of the corridor study boundary. The areas of highest elevation occur near the terminus of the corridor study boundary at the convergence of I-270 and I-370 along Shady Grove Road in Montgomery County.

The Piedmont Plateau Physiographic Province has broadly undulating to rolling topography underlain by metamorphic rock, with low knobs, ridges, and valleys. The corridor study boundary includes three Physiographic Districts within the Piedmont Plateau Physiographic Province: the Perry Hall Upland District, Hampstead Upland District, and Middle Potomac Gorge District (Reger & Cleaves, 2008). The Perry Hall Upland District marks the transition between the Piedmont and Atlantic Coastal Plain. Hilltops in this district are capped by Cretaceous gravels and sediments that thicken to the southeast, and rivers flow across the region in steep-walled valleys incised into crystalline rock. The Hampstead Upland District consists of rolling to hilly uplands interrupted by steep-walled gorges. This district has distinctive ridges, hills, barrens, and valleys, and its streams include short segments of narrow, steep-sided valleys. The Middle Potomac Gorge District is where the Potomac River flows through a steep sided gorge. Bedrock islands are common in this district, while rapids and falls occur downstream, including the Great Falls of the Potomac River (USDA NRCS, 2018).

The Atlantic Coastal Plain Physiographic Province is characterized by flat to moderately rolling upland and an even flatter lowland, composed of unconsolidated sediments including gravel, sand, and silt. The corridor study boundary includes four Physiographic Districts within the Atlantic Coastal Plain Physiographic Province: the Glen Burnie Rolling Upland District, Crownsville Upland District, Prince Frederick Knobby Upland District, and Waldorf Upland Plain District (Reger & Cleaves, 2008). The Glen Burnie Rolling Upland District is an undulating upland with slopes typically less than eight degrees. This district contains the pronounced Anacostia Valley, which cuts into the upland surface of Southern Maryland and contains deposits of Quaternary sand, gravel, silt, and clay with Tertiary terraces adjacent to the river. The Crownsville Upland District is an undulating upland, similar in appearance to, but somewhat more dissected than the Glen Burnie Rolling Upland District. The Prince Frederick Knobby Upland District is a moderately to well-dissected upland with numerous small hills, occupying the area between the Patuxent River and Chesapeake Bay watersheds. The Waldorf Upland Plain District is a relatively flat upland surface in Southern Maryland comprised of alluvial plains and fluvial-estuarine terraces. Stream incision in this district creates steep-sided valleys, and much of the upland soils contain a fragipan (Reger & Cleaves, 2008).

B. Soils

a. Soil Types

A soil map unit is a collection of areas on a soil map defined by their dominant taxonomic components, which can include a combination of soil type and miscellaneous, non-soil areas (e.g. rock outcrop) (USDA NRCS, 2018). The USDA-NRCS Web Soil Survey (2018) identified 151 soil map units within the corridor study boundary, as summarized in **Appendix C** and depicted in the Natural Resources Inventory Maps in **Appendix B.**

b. Soil Hydrologic Groups

The USDA NRCS classifies soils into "hydrologic soil groups" based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration that is expected to occur when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The four hydrologic soil groups are defined in **Table 2.1-1.** If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter refers to drained areas and the second refers to undrained areas. The majority of soils in the corridor study boundary are in Hydrologic Groups B and C, with slow to moderate infiltration rates. Soils with slower infiltration rates have higher runoff potential during rain events (USDA NRCS, 2018).

Table 2.1-1: Soils Hydrologic Group Descriptions

Group	Description
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Source: NRCS Web Soil Survey

c. Hydric Soils

The National Technical Committee for Hydric Soils (NTCHS) defines hydric soils as soils that are saturated or inundated long enough during the growing season to become anaerobic in their upper layer and support the growth and reproduction of hydrophytic vegetation (59 FR 16835, proposed July 13, 1994). The hydric soil ratings shown in the soils tables in **Appendix C** indicate the percentage of the soil map units that meet the NRCS criteria for hydric soils. Map units are composed of one or more components or soil types, with each rated as hydric or not hydric soil. Each map unit is rated based on its respective components and the percentage of each component within the map unit. The five rating groups are separated as hydric (100 percent hydric components), predominantly hydric (66 to 99 percent hydric components), partially hydric (33 to 65 percent hydric components), predominantly non-hydric (1 to 32 percent hydric components), and non-hydric (less than one percent hydric components) (USDA NRCS, 2018).

Within the corridor study boundary, three soil units are classified as hydric (covering approximately 1 percent of the area within the corridor study boundary), five soil units are classified as predominantly hydric (covering approximately 3 percent of the area within the corridor study boundary), five soil units are classified as partially hydric (covering approximately 2 percent of the area within the corridor study boundary), 33 soil units are classified as predominantly non-hydric, and 105 soil units are classified as non-hydric (predominantly non-hydric and non-hydric soil units covering the remaining 94 percent of the area within the corridor study boundary).

d. Highly Erodible Soils

Highly erodible soils are potentially more prone to erosion from wind, rain, and disturbance (USDA NRCS, 2010). The Code of Maryland Regulations (COMAR) defines "highly erodible soils" as soils with a slope greater than 15 percent, or those soils with a soil erodibility factor (K factor) greater than 0.35 and with slopes greater than 5 percent (COMAR 26.17.01). Based on this definition, 54 soil units within the corridor study boundary are highly erodible. Highly erodible soils are located throughout the corridor study boundary, with higher concentrations along I-270, and I-495 west of New Hampshire Avenue.

e. Prime Farmland, Soils of Statewide Importance, and Unique Farmland Soils

USDA NRCS classifies farmland soils as Prime Farmland Soils, Soils of Statewide Importance (also referred to as farmland of statewide importance), or Unique Farmland Soils by identifying the location and extent of soils that are best suited to growing human food, animal feed, fiber, forage, and oilseed crops. Prime Farmland Soils have the best quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to widely acceptable farming methods. In general, Prime Farmland Soils have an adequate and dependable water supply from precipitation or irrigation, favorable temperature and growing seasons, acceptable pH, adequate salt and sodium content, and few or no rocks. These soils are permeable to water and air, are not excessively erodible or saturated for long periods, and do not frequently flood (43 FR Ch 675.5, 1978).

Unique Farmland Soils are soils other than Prime Farmland Soils that have the best combination of physical and chemical characteristics to produce a specific high value food or fiber crop like citrus, tree nuts, olives, cranberries, fruits, or vegetables. Unique Farmland Soils have a combination of soil quality, growing season, temperature, humidity, air drainage, elevation, and other factors like nearness to market that favor the specific crop (USDA, 1981).

Soils of Statewide Importance are soils, in addition to prime and unique farmland soils, that are of statewide importance to produce human food, animal feed, fiber, forage, and oilseed crops as designated by the appropriate state agency. Soils of Statewide Importance are typically nearly Prime Farmland soils that produce high crop yields when managed properly (43 FR Ch 675.5, 1978).

Twenty-eight soils within the corridor study boundary were identified by USDA NRCS (2018) as Prime Farmland Soils, 21 soils were identified as Soils of Statewide Importance, and no soils were identified as Unique Farmland Soils. Two soils were identified as having the potential to be Prime Farmland, one if drained (FaaA) and one if irrigated (HgB).

2.1.3 Environmental Effects

A. Topography and Geology

The No Build Alternative would have no impact on topography and geology within the corridor study boundary. Topography within Screened Alternative construction areas would be altered by surficial excavation and grading, thereby changing the relative ground elevation, but this work is not anticipated to have a substantial effect on underlying sediments. Possible impacts to geologic formations and rock structures include impacts from construction activities, such as cutting and filling.

B. Soils

The No Build Alternative would have no impact on soils within the corridor study boundary. The primary impact to soils from the Screened Alternatives would be soil removal or alterations to the soil profile and structure due to construction activities. Additional potential impacts could include leaching of chemicals into the soil from general construction or accidental spills, soil erosion, and soil compaction associated with the use of heavy equipment. Erosion of topsoil may result in the loss of soil nutrients and nutrient holding capacity, as well as a reduction of organic material in the soil. The loss of organic-rich topsoil reduces the soil's natural ability to provide nutrients to plants and regulate water flow, making the soil more susceptible to pests, disease, and compaction. Soil compaction reduces infiltration rates and can cause rapid surface water runoff or ponding, resulting in shifts in vegetation from wet to dry or dry to wet. Soil compaction can also damage roots, leading to plant mortality. Erosion from construction sites can lead to the transport of excess nutrients and sediments downstream, but this will be minimized to the greatest extent possible by state required erosion and sediment control measures (USDA NRCS, 2000).

a. Hydric Soils and Highly Erodible Soils

Impacts to soils from the Screened Alternatives are presented in **Table 2.1-2**[5]. Alternative 5 would result in the lowest hydric soil impact of 20.0 acres and Alternative 10 would result in the highest hydric soil impact of 20.8 acres. Note that hydric soil acreage identified in this section are as defined in the NRCS Web Soil Survey and do not reflect the hydric soils identified as jurisdictional wetlands in accordance with the Clean Water Act.

Table 2.1-2 Impact to Soils by Type in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Farmland of Statewide Importance	0	1.9	1.9	1.9	1.9	1.9	1.9
Prime Farmland	0	2.1	2.1	2.1	2.1	2.1	2.1
Hydric	0	20.0	20.4	20.4	20.8	20.3	20.6
Predominantly Hydric	0	80.4	82.2	82.2	82.8	82.0	82.4
Partially Hydric	0	24.2	25.3	25.3	25.3	25.3	25.3
Predominantly Non-Hydric	0	711.0	733.1	733.1	742.4	728.2	735.6
Non-Hydric	0	2,508.3	2,556.9	2,556.9	2,566.7	2,552.8	2,561.7

[5] For reference, impact tables presented in the report are also included in Appendix A.

Alternative 5 would result in the lowest highly erodible soil impact of 1,158.7 acres and Alternative 10 would result in the highest hydric soil impact of 1,206.9 acres. Impacts to highly erodible soils are summarized in **Table 2.1-3**.

Table 2.1-3 Impacts to Steep Slopes and Highly Erodible Soils in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Steep Slopes > 5, K Factor > 0.35	0	350.5	362.1	362.1	369.0	359.1	364.5
Steep Slopes 15	0	808.2	831.4	831.4	837.9	827.9	796.4
Total Impacts to Highly Erodible Soils	**0**	**1,158.7**	**1,193.5**	**1,193.5**	**1,206.9**	**1,187.0**	**1,160.9**

b. Prime Farmland, Soils of Statewide Importance, and Unique Farmland Soils

A farmland assessment will be conducted at the ARDS level to refine the potential for impacts to Prime Farmland Soils and Soils of Statewide Importance. There are no Unique Farmland Soils within the corridor study boundary. Farmland soils occur throughout the corridor study boundary; however, many areas within the corridor study boundary that were once mapped as Prime Farmland Soils or Soils of Statewide Importance were developed or converted to impervious surface and no longer qualify as these soil types under the FPPA, Section 523.10.B(2). Consequently, lands identified as "urbanized area" (UA) on Census Bureau maps were removed from the calculation of farmland soil impacts to assess the potential for impacts to these resources. Impacts to Prime Farmland Soils and Farmland of Statewide Importance are in **Table 2.1-2**. All Screened Alternatives would result in 1.9 acres of impacts to Farmland of Statewide Importance. Impacts to Prime Farmland do not differ between Screened Alternatives, with total impact of 2.1 for all Screened Alternatives.

As noted in the *I-495 & I-270 Managed Lanes Study Cumulative Effects Analysis (CEA) Technical Report*, the corridor study boundary is not within the Maryland Agricultural Land Preservation Program, the Maryland Agricultural Easement Program, the Maryland Environmental Trust (MET), the Maryland Rural Legacy Program, or the Montgomery County Agricultural Reserve, (MCATLAS, 2018 and Montgomery County Rustic Roads Advisory Committee, 2015). See the CEA Technical Report for further information.

2.1.4 Avoidance, Minimization, and Mitigation

Detailed geotechnical studies would be performed before construction to identify subsurface issues that may impact project construction or the surrounding environment. MDOT SHA would mitigate any negative effects, such as unstable soils or high-water table, through engineering design. Negative impacts to the surrounding environment, such as sedimentation, would be mitigated through implementation and strict adherence to erosion and sediment control plans.

Construction in the corridor study boundary requires consideration of hydric and highly erodible soils, as well as steep slopes. Maryland Department of the Environment (MDE) will review wetlands adjacent to steep slopes and highly erodible soils on a case-by-case basis to determine where expanded nontidal wetland buffers would apply. Measures to protect soils from erosion would be implemented based on approved Erosion and Sediment Control Plans (E&S Plans) prepared in accordance with the "Maryland Standards and Specifications for Soil Erosion and Sediment Control" (MDE, 2011) and the Virginia Erosion and Sediment Control Law (VDEQ, 2014) in accordance with the Virginia Erosion and Sediment Control

Handbook (VDEQ, 1992) and the VDOT Drainage Manual (VDOT, 2017). The E&S Plans would be prepared during final design and include erosion and sediment control devices to avoid or minimize the impacts of soil erosion such as: sediment traps, silt fencing, sedimentation basins, interception channels, and seeding and mulching. Drainage patterns would be preserved to the extent practicable during future design which would maintain hydric soils where possible.

Additional water quality protection measures are required for highway construction projects in Maryland to prevent soil erosion and subsequent sediment influx into nearby waterways. Construction contractors are designated as co-permittees on the National Pollutant Discharge Elimination System (NPDES) permit to ensure compliance. This permit is issued under Maryland's General Permit for construction activities and is implemented with a regular inspection program for construction site sediment control devices that includes penalties for inadequate maintenance. To ensure compliance, onsite evaluations by a certified erosion and sediment control inspector would occur throughout the duration of construction.

Fairfax County, VA requires any projects with land-disturbing activities exceeding 2,500 square feet (SF) to prepare an erosion and sediment control plan (Fairfax County, 2018g). The County must approve each plan before any land-disturbing activities begin, and each project is subject to inspections throughout the duration of land-disturbing activities to prevent erosion and sediment control violations.

2.2 Air Quality

2.2.1 Regulatory Context and Methods

For purposes of NEPA, general guidance for project-level air quality analyses is provided in the FHWA 1987 Technical Advisory 6640.8A, *Guidance for Preparing and Processing Environmental and Section 4(f) Documents*[6]. That guidance focuses on carbon monoxide. FHWA provides separate guidance for mobile source air toxics (MSATs)[7].

The Air Quality Study is currently included in the National Capital Region Transportation Planning Board (NCRTPB) FY 2019 – 2024 Transportation Improvement Program (TIP) [TIP ID 6432 and Agency ID AW0731 (planning activities)] and the NCRTPB Visualize 2045 Long-Range Plan (CEID 1182, CEID 3281, and Appendix B page 56). The Air Quality Study is also included in the Air Quality Conformity Analysis that accompanies the Visualize 2045 Plan. Prior to the Record of Decision being signed, the selected alternative will be included in the TIP and Long-Range Plan, along with a Transportation Conformity Determination.

Pollutants that have established National Air Quality Standards (NAAQS) are referred to as criteria pollutants. The criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and lead (Pb). In addition to the criteria pollutants for which there are NAAQS, EPA also regulates MSATs. The nine priority MSATs are benzene, 1,3-butadiene, formaldehyde, acrolein, acetaldehyde, diesel particulate matter, ethylbenzene, naphthalene, and polycyclic organic matter. Greenhouse gases (GHGs) are another pollutant monitored by EPA. The primary GHGs in the Earth's atmosphere are carbon dioxide (CO_2), methane (CH_4), nitrous Oxide (N_2O), and fluorinated gases.

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[6] *https://www.environment.fhwa.dot.gov/projdev/impTA6640.asp*

[7] *FHWA, "INFORMATION: Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents", October 18, 2016. See: http://www.fhwa.dot.gov/environment/air_quality/air_toxics/*

For the air quality analysis, the Air Quality Study conducted a carbon monoxide, MSAT and GHG emissions analysis. The methodology and results are presented in the *Air Quality Technical Report.* The results are summarized here.

2.2.2 Existing Conditions

The CO dispersion modeling results demonstrate that the worst-case interchanges and intersections for each Screened Alternative and No Build alternative, using very conservative assumptions, would not cause or contribute to a violation of the CO NAAQS within the air quality study corridors.

Under each of the Screened Alternatives, there may be slightly higher or lower MSAT emissions in the design year relative to the No Build Alternative due to increased vehicle miles traveled (VMT) or increased vehicle speeds. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, lower MSAT levels are expected in the future due to cleaner engine standards coupled with fleet turnover. The magnitude of the EPA-projected reductions is so great that, even after accounting for VMT growth, MSAT emissions in the air quality study area would be significantly lower in the future than they are today, regardless of the Alternative selected.

The average travel speeds across I-495 and I-270 within the air quality study area would range from 36 mph to 41 mph under the Screened Alternatives compared to 25 mph under the 2040 No Build Alternative. GHG emissions rates decrease with speed over the range of average speeds encountered in this corridor, although they do increase at very high speeds. Reduction of road grade also reduces energy consumption and GHG emissions. The proposed road widening under the Screened Alternatives would generally match existing road grades. EPA estimates that each one percent decrease in grade reduces energy consumption and GHG emission by seven percent although the effect is not linear[8].

2.2.3 Environmental Effects

Under the No Build and Screened Alternatives conditions, VMT in the region is expected to increase between 2015 and 2040. Nationally, the Energy Information Administration (EIA) estimates that VMT will increase by approximately 38 percent between 2012 and 2040. While VMT is expected to increase under the Screened Alternatives, the increase is still at or below the projected national rate. A major factor in mitigating this increase in VMT and associated GHG emissions is more stringent fuel economy standards. EIA projects that vehicle energy efficiency, thus GHG emissions, on a per-mile basis, will improve by 28 percent between 2012 and 2040.

2.2.4 Avoidance, Minimization, and Mitigation

By reducing congestion and increasing speeds, vehicle travel duration and the associated amount of fuel combustion and associated emissions will decrease, minimizing the impacts of GHGs. Regional accessibility will be increased through providing additional lanes so that motorists can more easily pass slow-moving vehicles. Thus, the study area would see a net reduction in GHG emissions under any of the Screened Alternatives, even though VMT increases relative to the No Build Alternative and 2015 levels.

[8] EPA MOVES2010b model

2.3 Waters of the US and Waters of the State, Including Wetlands

Only nontidal wetlands and waterways are located within the corridor study boundary; therefore, this section will only reference non-tidal wetlands and waterways regulations.

2.3.1 Regulatory Context and Methods

A. Regulations

Wetlands and waterways are protected by several federal and state regulations. Jurisdictional Waters of the US, including wetlands, are jointly defined by the Environmental Protection Agency (EPA) and the US Army Corps of Engineers (USACE) in 40 CFR 230.3(s) and 33 CFR 328.3. Effective June 22, 2020, the regulatory definitions for Jurisdictional Waters of the US will be set forth in 33 CFR 328.3 and 40 CFR 120.2. Executive Order 11990 of the Federal Register (FR), entitled *Protection of Wetlands*, was enacted to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands; to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative; and "each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds: (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use" (42 FR 26961, E.O. 11990, May 1977). Unavoidable impacts caused by the discharge of dredge or fill material into Waters of the US, including wetlands, within the I-495 & I-270 Managed Lanes Study corridor study boundary are federally regulated under Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). Section 10 will only apply to the Potomac River for the I-495 & I-270 Managed Lanes Study.

Wetlands and their buffers are also protected by the State of Maryland Environment Article Title 5, Subtitles 5 and 9 of the Maryland Annotated Code. Pursuant to the Maryland Code, the MDE has promulgated stringent regulations to protect wetlands (COMAR, Title 26). Buffers are defined in the COMAR 26.23.01.01 as a regulated area, 25 feet in width, surrounding a nontidal wetland, measured from the outer edge of the nontidal wetland. According to COMAR 26.23.01.04, nontidal wetland buffers shall be expanded to 100 feet for nontidal wetlands of special State concern, nontidal wetlands with adjacent areas containing steep slopes or highly erodible soils (soils with an erodibility factor greater than 0.35), and outstanding national resource waters. Wetlands of special State concern are examples of Maryland's most valuable wetlands resources and are designated for special protection under COMAR 26.23.06. These wetlands have high ecological or educational value and may provide specialized habitat for rare plant or animal species. Waterways regulated by the State are defined in COMAR 26.17.04.02 as Waters of the State and include the 100-year floodplain. Impacts to waterways, 100-year floodplains, nontidal wetlands, 25-foot nontidal wetland buffers, or 100-foot expanded buffers require a Maryland Nontidal Wetlands and Waterways Permit. Additionally, a Section 401 Water Quality Certificate from MDE is required for any impacts to waterways or wetlands requiring a USACE Section 404 permit.

In Virginia, the Virginia Department of Environmental Quality (VDEQ) is the authority that provides the Section 401 certification through its Virginia Water Protection Permit (VWPP) Program (9 VAC 25-210), which gets its statutory authority from the Code of Virginia (VAC 62.1-44.15). State law requires that a VWPP be obtained before disturbing a stream by clearing, filling, excavating, draining, or ditching (VDEQ, 2018). Work in non-tidal streams with drainage areas greater than five square miles also require a permit from the Virginia Marine Resources Commission (VMRC) under the authority of the Code of Virginia (VAC 28.2-1204).

Section 404 of the CWA provides regulatory authority to the USACE to issue or deny permits for the discharge of dredged or fill material into Waters of the US and a Section 404 permit is required for impacts. Authorization under a Section 404 Permit, a MDE Nontidal Wetlands and Waterways Permit, and a VWPP are required prior to any construction. Section 10 of the Rivers and Harbors Act provides regulatory authority to the US Coast Guard (USCG) for the permitting of bridges over navigable rivers and the USACE for the permitting of piers, abutments, and associated impacts. In a letter dated September 19, 2019, included in **Appendix N**, the USCG stated that the ALB reconstruction over the Potomac River would not require a bridge permit. However, the USACE would permit the ALB piers and abutments within the Potomac River under Section 10.

B. Methodology

Prior to beginning the field investigation, environmental scientists conducted a desktop review of mapped waterways and nontidal wetlands in the corridor study boundary on behalf of MDOT SHA using existing National Wetlands Inventory (NWI) and Maryland Department of Natural Resources (MDNR) Wetlands and Waters Geographic Information System (GIS) data. No similar statewide wetland and stream GIS layer exists for Virginia. The results of the desktop investigation are included in **Appendix B**.

The I-495 & I-270 Managed Lanes Study corridor study boundary, a 48-mile long and approximately 600-foot wide roadway corridor, was split into 29 field sub-segments (See **Appendix D, Overview Map**) for the purposes of the wetlands and waterways field investigation, and field sub-segment numbers were incorporated into the naming convention of features within each sub-segment. Field sub-segment breaks were established at major road crossings to provide clear physical boundaries and to limit the number of features that may occupy more than one segment.

A two-tier approach was applied to fieldwork within the corridor study boundary since properties adjacent to the ROW were not fully accessible when delineation efforts began. Before delineation efforts began, MDOT SHA notified property owners of non-invasive fieldwork (i.e., involving no soil disturbance). When field teams identified potential wetland areas based on the non-invasive field visit, letters were then sent to the respective properties to request invasive access. Tier one fieldwork consisted of full delineation of wetlands and waterways features within the MDOT SHA ROW, and non-invasive access to properties adjacent to the ROW. Non-invasive access allows access for stream delineation, flagging, photography, characterization of vegetation, and surface hydrology, but not digging soil pits for soil characterization or groundwater hydrology. In areas outside of the MDOT SHA ROW, field crews delineated waterway features and conducted planning level investigation of wetlands, including conservative estimations of potential wetland boundaries based on surface hydrology and vegetation. Tier two fieldwork consisted of soils investigations to finalize delineations of the potential wetland areas identified during tier one fieldwork on public and private properties where the property owners granted MDOT SHA access to perform invasive investigations.

Environmental scientists delineated most wetlands and waterways within the corridor study boundary on behalf of MDOT SHA and VDOT from March 2018 through January 2019, with delineation ongoing for properties that have not yet permitted access. Much of the MDOT SHA ROW within the corridor study boundary was previously delineated as part of the Prince George's and Montgomery County Integrated Roadside Vegetation Management (IRVM) and ICM projects. All previously delineated features were field reviewed, and delineations were revised as needed for the purposes of the I-495 & I-270 Managed Lanes Study. No previous delineations were referenced for the Virginia portion of the corridor study boundary. Environmental scientists completed data sheets for features delineated in areas that were not previously delineated by the IRVM or ICM projects, previously delineated features without data sheets, and previously delineated features that changed classification (e.g., palustrine emergent [PEM] wetland to palustrine forested [PFO] wetland or intermittent to perennial stream) since the previous delineation. All features were photographed and given a unique identifier containing the number of its associated field sub-segment. Data obtained from the field reconnaissance was collected with an iPad and boundary points were located using global positioning systems (GPS).

Wetlands features were delineated in accordance with the following:

- USACE Wetlands Delineation Manual, Y-87-I (Environmental Laboratory, 1987);
- USACE 2012 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0 (USACE, 2012); and
- USACE 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (USACE, 2010).

These manuals employ a three-parameter approach to wetland identification, including (1) hydrology, (2) hydrophytic vegetation, and (3) hydric soils. All three parameters must be present for an area to be considered a jurisdictional wetland under Section 404 of the CWA. Routine wetland determination methods with onsite inspection were used to determine the presence of wetlands in the corridor study boundary. Wetlands including dying ash trees were characterized as PFO wetlands, as requested by MDE and USACE. Wetlands and waterways located on National Park Service (NPS) park land were identified by Cowardin classification including the system, subsystem, class, subclass, and any applicable modifiers (Cowardin, 1979).

Wetland scientists completed a functions and values assessment for all delineated wetlands using the USACE New England Method as presented in The Highway Methodology Workbook Supplement – Wetland Functions and Values; A Descriptive Approach (USACE, 1999). Along with the best professional judgment of an experienced wetland scientist, this method uses the presence of certain physical characteristics broadly understood to indicate the presence of related functions. The functions and values assessed include:

- Groundwater Recharge/Discharge,
- Floodflow Alteration,
- Fish and Shellfish Habitat,
- Sediment/Toxicant Retention,
- Nutrient Removal,
- Production Export,
- Sediment/Shoreline Stabilization,
- Wildlife Habitat,
- Recreation,
- Educational/Scientific value,
- Uniqueness/Heritage,
- Visual quality/Aesthetics, and
- Endangered Species Habitat.

Waterways features were delineated using the limits defined in 33 Code of Federal Regulations (CFR) § 328. The boundaries of nontidal waterways features were set at the ordinary high water (OHW) mark and include but are not limited to: in-line stormwater management (SWM) ponds, palustrine open water (POW or ponds), stream systems (waterways), and some disturbed areas. The OHW mark was determined in the field using physical characteristics established by the fluctuations of water (e.g., change in plant community, changes in the soil character, shelving) in accordance with USACE Regulatory Guidance Letter No. 05-05. Prior to August 16, 2018, CWA jurisdiction of delineated features was determined in accordance with the June 5, 2007 joint guidance issued by EPA and USACE following the US Supreme Court's decision in the Rapanos case; and the January 19, 2001 joint guidance issued by EPA and USACE following US Supreme Court's decision in SWANCC. After August 16, 2018, jurisdiction of new delineated features was determined in accordance with the CWR, and previously delineated feature data was supplemented to determine likely jurisdiction under the new jurisdictional definitions of Waters of the US outlined by the rule.

The MDE regulation of nontidal wetlands, nontidal wetland buffers, and waterways is based on the COMAR Title 26 Subtitle 17, Water Management; COMAR Title 26 Subtitle 23, Nontidal Wetlands; and field review of delineated features. Unlike USACE, MDE does not regulate ephemeral channels, however it does regulate isolated wetlands and certain intermittent features that may not be considered jurisdictional by USACE. USACE and MDE jurisdictional results for each delineated feature are represented in **Appendix E.** VDEQ determines jurisdiction based on the Code of Virginia, Virginia Administrative Code (VAC) 62.1-44.15 and VMRC based on the Code of Virginia VAC 28.2-1204. Virginia state permits will be acquired by the end of the NEPA process.

Between July 2018 and December 2019, representatives from the USACE, MDE, and EPA conducted field review of numerous wetland and waterways features delineated within the corridor study boundary. The goal of the meetings was to review representative delineated wetlands and waterways to gain general concurrence on the delineation in support of a preliminary jurisdictional determination (JD), as well as an Approved JD for roadside ditches and drainage features that may not be considered jurisdictional by USACE but may be considered jurisdictional by MDE.

Unavoidable impacts to regulated wetlands and waterways within the corridor study boundary in Maryland are subject to a Section 404 permit from the USACE, as well as a Maryland Nontidal Wetlands and Waterways Permit, and Section 401 Water Quality Certificate. USACE Baltimore District will be the lead district for permitting impacts to Waters of the US within both the Virginia and Maryland portions of the corridor study boundary. The Potomac River is considered a navigable water of the US under Section 10 of the Rivers and Harbors Act. Typically, the designation of a waterway under Section 10 would require a bridge permit to be issued by the USCG, but in a letter dated September 19, 2019, the USCG stated that a bridge permit would not be required under Section 10 for the ALB. USACE will regulate the Potomac River under Section 10 regarding the piers and abutments for the ALB reconstruction. In Virginia, VDEQ is the authority that provides the Section 401 certification through its VWPP Program (9VAC25-210). Work in non-tidal streams with drainage areas greater than five square miles also require a permit from the VMRC under the authority of the Code of Virginia (VAC 28.2-1204).

2.3.2 Existing Conditions

A total of 407 nontidal wetlands and 1,075 stream segments were delineated within the corridor study boundary, as presented in the I-495 & I-270 Managed Lanes Study Wetland Delineation Memo. Only one TNW, the Potomac River, was identified within the corridor study boundary. All other perennial waters are classified as tributaries of the Potomac or Patuxent Rivers. Long stream channels were segmented due to changes in classification, splitting by culverted sections, or other refinement needs during data processing. Therefore, the number of individual channel segments is greater than the features presented in field documents, such as photos and datasheets. No wetlands of special state concern or outstanding national resource waters are within the corridor study boundary. The total features delineated and totals of the delineated features by classification are provided in **Table 2.3-1**. A detailed summary of surface water resources, including stream systems, is included in **Section 2.4**.

Table 2.3-1: Total Delineated Features

Features	Totals
Wetlands	**407**
Palustrine Emergent (PEM)	117
Palustrine Forested (PFO)	269
Palustrine Scrub-Shrub (PSS)	21
Waterways	**1,075**
Ephemeral	140
Intermittent	464
Perennial	458
Palustrine Open Water (POW)	13

The delineated waters features are summarized in **Appendix E** and maps of each feature's location and boundaries within the corridor study boundary are provided in **Appendix F**. Feature boundaries identified in the mapping as located on properties where access is pending or denied are based on visual observations only. Routine Wetland Determination Data Forms, Waters Datasheets, and Wetland Functions and Values Evaluation Forms completed for each delineated feature are included in **Appendix G**, and photographs of each feature are included in **Appendix H**.

NPS wetlands identified according to Cowardin classification on NPS park land include: 3 PEM, 9 PFO, 1 PSS, 4 riverine lower perennial, 2 riverine upper perennial, and 22 riverine intermittent wetlands. Impacts to and full Cowardin classification of these features are summarized in **Appendix I**.

Wetlands in the corridor study boundary provide one or more ecological functions such as:

- Groundwater Recharge/Discharge,
- Floodflow Alteration,
- Fish and Shellfish Habitat,
- Sediment/Toxicant Retention,
- Nutrient Removal,
- Production Export,
- Sediment/Shoreline Stabilization,
- Wildlife Habitat,
- Recreation,
- Educational/Scientific value,
- Uniqueness/Heritage,
- Visual quality/Aesthetics,
- Endangered Species Habitat, and
- Relative Value in Urban Landscape

The quantity and degree of wetland functions varies based on location, vegetation type, hydroperiod, and level of disturbance. Principal functions for each wetland are listed in **Appendix J**.

2.3.3 Environmental Effects

The No Build Alternative would not result in additional changes to the natural environment or effects to wetlands and waterways other than those already proposed by the projects in the 2040 CLRP. Direct impacts to wetlands and waterways associated with construction of the Screened Alternatives would include roadway impacts (i.e., widening, grading, etc.), bridge expansions or rehabilitations, culvert extensions or augmentations, relocation of impacted channels, SWM facility outfalls, and construction-related access.

Indirect impacts to wetlands and waterways from the Screened Alternatives could result from roadway runoff, sedimentation, and changes to hydrology. A detailed assessment of indirect hydrologic effects would occur once final amounts of cut and fill are determined in the final phase of engineering design.

All direct and indirect impacts would lead to a decrease in available wetland and waterway habitat within the project area and ultimately a decrease in plant and animal species inhabiting these areas. Impacts to wetland functions may include losses of groundwater recharge/discharge, fish and shellfish habitat, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, sediment/shoreline stabilization, wildlife habitat, recreation, educational/scientific value, uniqueness/heritage, visual quality/aesthetics, wildlife habitat, endangered species habitat, and capacity for floodflow alteration.

Alternatives 10 and 13C would have the highest wetland impacts, totaling 16.5 acres, and Alternative 5 would have the lowest impacts, totaling 15.4 acres. Alternative 10 would also have the highest waterways impacts, totaling 156,984 linear feet (LF), while Alternative 5 would have the lowest impacts to waterways, totaling 153,702 LF. The impacts presented are jurisdictional to USACE and/or MDE and feature-specific impacts are presented in **Appendix A** by jurisdiction.

Potential direct impacts to nontidal wetlands, their buffers, and waterways from the Screened Alternatives are detailed in **Appendix A.** During the NEPA preliminary design phase, all impacts are considered permanent. Temporary impacts will be determined at a later stage of design. Refer to the Screened Alternatives summary in **Section 1.4** for a description of the Screened Alternatives. **Table 2.3-2** to **Table 2.3-8**[5] summarize the potential direct impacts to wetlands and waterways by classification in total, by county, by federal HUC8, or USGS designated hydrologic unit code (HUC), and MDNR 12-digit watersheds. MDNR 12-digit watersheds that would be least impacted include Little Paint Branch, Bald Hill Branch, Beaverdam Creek, and Muddy Branch, each with less than 1,500 LF of potential impact. MDNR 12-digit watersheds that would incur the most impact would be Cabin John Creek, Northeast Branch of the Anacostia River (Northeast Branch), Upper Henson Creek, and Upper Southwest Branch of the Western Branch of the Patuxent River (Upper Southwest Branch), each with more than 17,000 LF of potential impact.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Table 2.3-2: Summary of Impacts to Wetlands and Waterways by Classification

Type	Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Wetlands	PEM	0	0	3.7	162,549	3.9	167,750	3.9	167,750	4.0	173,615	3.8	167,589	4.0	172,983
	PFO	0	0	10.7	464,917	11.4	497,307	11.4	497,307	11.5	499,176	11.4	496,280	11.4	498,158
	PSS	0	0	1.0	45,524	1.1	46,802	1.1	46,802	1.1	46,802	1.1	46,802	1.1	46,802
	Grand Total	**0**	**0**	**15.4**	**672,990**	**16.3**	**711,859**	**16.3**	**711,859**	**16.5**	**719,593**	**16.3**	**710,671**	**16.5**	**717,943**
Waterways		**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
	Ephemeral	0	0	10,829	46,016	11,167	47,293	11,167	47,293	11,199	47,556	11,167	47,293	11,196	47,539
	Intermittent	0	0	64,252	368,373	65,354	373,447	65,354	373,447	65,580	375,839	65,287	372,841	65,445	374,323
	Perennial	0	0	78,621	1,401,275	79,401	1,424,712	79,401	1,424,712	80,205	1,432,736	79,368	1,424,335	79,991	1,429,246
	POW	0	0	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134
	Grand Total	**0**	**0**	**153,702**	**1,879,798**	**155,922**	**1,909,586**	**155,922**	**1,909,586**	**156,984**	**1,920,265**	**155,822**	**1,908,603**	**156,632**	**1,915,242**

Table 2.3-3: Summary of Impacts to Wetland Buffers by Classification

Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
PEM	0	0	14.6	634,381	15.0	651,682	15.0	651,682	15.3	665,922	14.9	649,804	15.3	664,976
PFO	0	0	32.8	1,429,874	34.3	1,495,037	34.3	1,495,037	34.5	1,501,615	34.3	1,494,032	34.4	1,496,893
PSS	0	0	3.7	162,795	3.8	166,124	3.8	166,124	3.8	166,124	3.8	166,124	3.8	166,124
Grand Total	**0**	**0**	**51.1**	**2,227,050**	**53.1**	**2,312,843**	**53.1**	**2,312,843**	**53.6**	**2,333,661**	**53.0**	**2,309,960**	**53.4**	**2,327,993**

NOTES: 1. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

Table 2.3-4: Summary of Impacts to Wetlands and Waterways by Classification within Virginia and Maryland Counties

Type	Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Wetlands	**Fairfax**	**0**	**0**	**0.0**	**2,021**	**0.0**	**2,021**	**0.0**	**2,021**	**0.0**	**2,021**	**0.0**	**2,021**	**0.0**	**2,021**
	PFO	0	0	0.0	2,021	0.0	2,021	0.0	2,021	0.0	2,021	0.0	2,021	0.0	2,021
	Montgomery	**0**	**0**	**1.9**	**81,736**	**2.3**	**99,073**	**2.3**	**99,073**	**2.5**	**106,807**	**2.2**	**97,885**	**2.4**	**105,157**
	PEM	0	0	1.0	41,574	1.0	43,768	1.0	43,768	1.1	49,633	1.0	43,607	1.1	49,001
	PFO	0	0	0.9	39,803	1.3	54,692	1.3	54,692	1.3	56,561	1.2	53,665	1.3	55,543
	PSS	0	0	0.0	359	0.0	613	0.0	613	0.0	613	0.0	613	0.0	613
	Prince George's	**0**	**0**	**13.5**	**589,233**	**14.0**	**610,765**	**14.0**	**610,765**	**14.0**	**610,765**	**14.0**	**610,765**	**14.0**	**610,765**
	PEM	0	0	2.8	120,975	2.8	123,982	2.8	123,982	2.8	123,982	2.8	123,982	2.8	123,982
	PFO	0	0	9.7	423,093	10.1	440,594	10.1	440,594	10.1	440,594	10.1	440,594	10.1	440,594
	PSS	0	0	1.0	45,165	1.1	46,189	1.1	46,189	1.1	46,189	1.1	46,189	1.1	46,189
	Grand Total	**0**	**0**	**15.4**	**672,990**	**16.3**	**711,859**	**16.3**	**711,859**	**16.5**	**719,593**	**16.3**	**710,671**	**16.5**	**717,943**
Waterways		**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
	Fairfax	**0**	**0**	**3,349**	**43,879**	**3,349**	**43,879**	**3,349**	**43,879**	**3,349**	**43,879**	**3,349**	**43,879**	**3,349**	**43,879**
	Ephemeral	0	0	371	7,102	371	7,102	371	7,102	371	7,102	371	7,102	371	7,102
	Intermittent	0	0	879	14,544	879	14,544	879	14,544	879	14,544	879	14,544	879	14,544
	Perennial	0	0	2,099	22,233	2,099	22,233	2,099	22,233	2,099	22,233	2,099	22,233	2,099	22,233
	Montgomery	**0**	**0**	**58,708**	**1,071,029**	**59,752**	**1,094,028**	**59,752**	**1,094,028**	**60,814**	**1,104,707**	**59,652**	**1,093,045**	**60,462**	**1,099,684**
	Ephemeral	0	0	2,373	13,471	2,534	14,144	2,534	14,144	2,566	14,407	2,534	14,144	2,563	14,390
	Intermittent	0	0	19,335	124,899	19,796	127,302	19,796	127,302	20,022	129,694	19,729	126,696	19,887	128,178
	Perennial	0	0	37,000	932,659	37,422	952,582	37,422	952,582	38,226	960,606	37,389	952,205	38,012	957,116
	POW	0	0	-	-	-	-	-	-	-	-	-	-	-	-
	Prince George's	**0**	**0**	**91,645**	**764,890**	**92,821**	**771,679**	**92,821**	**771,679**	**92,821**	**771,679**	**92,821**	**771,679**	**92,821**	**771,679**
	Ephemeral	0	0	8,085	25,443	8,262	26,047	8,262	26,047	8,262	26,047	8,262	26,047	8,262	26,047
	Intermittent	0	0	44,038	228,930	44,679	231,601	44,679	231,601	44,679	231,601	44,679	231,601	44,679	231,601
	Perennial	0	0	39,522	446,383	39,880	449,897	39,880	449,897	39,880	449,897	39,880	449,897	39,880	449,897
	POW	0	0	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134
	Grand Total	**0**	**0**	**153,702**	**1,879,798**	**155,922**	**1,909,586**	**155,922**	**1,909,586**	**156,984**	**1,920,265**	**155,822**	**1,908,603**	**156,632**	**1,915,242**

NOTES:
1. A "-" symbol indicates that no impacts to the resource occurs within that category.
2. If a classification does not appear under the wetlands or waters category, no features with that classification were identified within that watershed. (e.g. No PSS wetlands were identified in the Rock Creek watershed within the corridor study boundary.)
3. "NA" was used for POW LF because these features are not assessed in LF.
4. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

Table 2.3-5: Summary of Impacts to Wetland Buffers by Maryland Counties and Classification

County	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Montgomery	**0**	**0**	**7.7**	**335,311**	**8.5**	**371,024**	**8.5**	**371,024**	**9.0**	**391,842**	**8.5**	**368,141**	**8.9**	**386,174**
PEM	0	0	3.1	135,250	3.3	145,824	3.3	145,824	3.7	160,064	3.3	143,946	3.7	159,118
PFO	0	0	4.5	193,991	5.0	216,524	5.0	216,524	5.1	223,102	4.9	215,519	5.0	218,380
PSS	0	0	0.1	6,070	0.2	8,676	0.2	8,676	0.2	8,676	0.2	8,676	0.2	8,676
Prince George's	**0**	**0**	**43.4**	**1,891,739**	**44.6**	**1,941,819**	**44.6**	**1,941,819**	**44.6**	**1,941,819**	**44.6**	**1,941,819**	**44.6**	**1,941,819**
PEM	0	0	11.5	499,131	11.6	505,858	11.6	505,858	11.6	505,858	11.6	505,858	11.6	505,858
PFO	0	0	28.4	1,235,883	29.4	1,278,513	29.4	1,278,513	29.4	1,278,513	29.4	1,278,513	29.4	1,278,513
PSS	0	0	3.6	156,725	3.6	157,448	3.6	157,448	3.6	157,448	3.6	157,448	3.6	157,448
Grand Total	**0**	**0**	**51.1**	**2,227,050**	**53.1**	**2,312,843**	**53.1**	**2,312,843**	**53.6**	**2,333,661**	**53.0**	**2,309,960**	**53.4**	**2,327,993**

NOTES:
1. A "-" symbol indicates that no impacts to the resource occurs within that category.
2. If a classification does not appear under the wetlands or waters category, no features with that classification were identified within that watershed. (e.g. No PSS wetlands were identified in the Rock Creek watershed within the corridor study boundary.)
3. "NA" was used for POW LF because these features are not assessed in LF.
4. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

Table 2.3-6: Summary of Impacts to Wetlands and Waterways by Classification within USGS HUC8 Watersheds

Type	Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
	Middle Potomac-Anacostia-Occoquan	**0**	**0**	**9.6**	**416,559**	**10.1**	**439,821**	**10.1**	**439,821**	**10.1**	**439,821**	**10.1**	**439,821**	**10.1**	**439,821**
	PEM	0	0	2.0	86,813	2.0	89,079	2.0	89,079	2.0	89,079	2.0	89,079	2.0	89,079
	PFO	0	0	7.2	313,267	7.6	332,985	7.6	332,985	7.6	332,985	7.6	332,985	7.6	332,985
	PSS	0	0	0.4	16,479	0.4	17,757	0.4	17,757	0.4	17,757	0.4	17,757	0.4	17,757
	Middle Potomac-Catoctin	**0**	**0**	**1.5**	**64,587**	**1.6**	**70,477**	**1.6**	**70,477**	**1.8**	**78,211**	**1.6**	**69,289**	**1.8**	**76,561**
	PEM	0	0	0.8	36,723	0.9	38,917	0.9	38,917	1.0	44,782	0.9	38,756	1.0	44,150
Wetlands	PFO	0	0	0.6	27,862	0.7	31,558	0.7	31,558	0.8	33,427	0.7	30,531	0.7	32,409
	PSS	0	0	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2
	Patuxent	**0**	**0**	**4.4**	**191,844**	**4.6**	**201,561**	**4.6**	**201,561**	**4.6**	**201,561**	**4.6**	**201,561**	**4.6**	**201,561**
	PEM	0	0	0.9	39,013	0.9	39,754	0.9	39,754	0.9	39,754	0.9	39,754	0.9	39,754
	PFO	0	0	2.8	123,788	3.0	132,764	3.0	132,764	3.0	132,764	3.0	132,764	3.0	132,764
	PSS	0	0	0.7	29,043	0.7	29,043	0.7	29,043	0.7	29,043	0.7	29,043	0.7	29,043
	Grand Total	**0**	**0**	**15.4**	**672,990**	**16.3**	**711,859**	**16.3**	**711,859**	**16.5**	**719,593**	**16.3**	**710,671**	**16.5**	**717,943**
		LF	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
	Middle Potomac-Anacostia-Occoquan	**0**	**0**	**94,816**	**844,827**	**96,273**	**857,249**	**96,273**	**857,249**	**96,554**	**861,689**	**96,260**	**857,060**	**96,349**	**858,389**
	Ephemeral	0	0	7,101	25,843	7,273	26,345	7,273	26,345	7,273	26,345	7,273	26,345	7,273	26,345
	Intermittent	0	0	44,865	245,058	45,623	248,316	45,623	248,316	45,633	248,407	45,623	248,316	45,623	248,316
	Perennial	0	0	42,850	539,639	43,377	548,301	43,377	548,301	43,648	552,650	43,364	548,112	43,453	549,441
	POW	0	0	0	34,287	0	34,287	0	34,287	0	34,287	0	34,287	0	34,287
	Middle Potomac-Catoctin	**0**	**0**	**36,472**	**852,579**	**36,916**	**868,099**	**36,916**	**868,099**	**37,697**	**874,338**	**36,829**	**867,305**	**37,550**	**872,615**
	Ephemeral	0	0	1,192	12,313	1,321	12,861	1,321	12,861	1,353	13,124	1,321	12,861	1,350	13,107
Waterways	Intermittent	0	0	9,988	81,765	10,125	82,684	10,125	82,684	10,341	84,985	10,058	82,078	10,216	83,560
	Perennial	0	0	25,292	758,501	25,470	772,554	25,470	772,554	26,003	776,229	25,450	772,366	25,984	775,948
	Patuxent	**0**	**0**	**22,414**	**182,392**	**22,733**	**184,238**	**22,733**	**184,238**	**22,733**	**184,238**	**22,733**	**184,238**	**22,733**	**184,238**
	Ephemeral	0	0	2,536	7,860	2,573	8,087	2,573	8,087	2,573	8,087	2,573	8,087	2,573	8,087
	Intermittent	0	0	9,399	41,550	9,606	42,447	9,606	42,447	9,606	42,447	9,606	42,447	9,606	42,447
	Perennial	0	0	10,479	103,135	10,554	103,857	10,554	103,857	10,554	103,857	10,554	103,857	10,554	103,857
	POW	0	0	NA	29,847	NA	29,847	NA	29,847	NA	29,847	NA	29,847	NA	29,847
	Grand Total	**0**	**0**	**153,702**	**1,879,798**	**155,922**	**1,909,586**	**155,922**	**1,909,586**	**156,984**	**1,920,265**	**155,822**	**1,908,603**	**156,632**	**1,915,242**

NOTES:

1. A "-" symbol indicates that no impacts to the resource occurs within that category.
2. If a classification does not appear under the wetlands or waters category, no features with that classification were identified within that watershed. (e.g. No PSS wetlands were identified in the Rock Creek watershed within the corridor study boundary.)
3. "NA" was used for POW LF because these features are not assessed in LF.
4. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

Table 2.3-7: Summary of Impacts to Wetland Buffers by Classification and USGS HUC8 Watersheds

Watershed	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Middle Potomac-Anacostia-Occoquan	**0**	**0**	**30.0**	**1,305,994**	**31.0**	**1,348,956**	**31.0**	**1,348,956**	**31.0**	**1,348,956**	**31.0**	**1,348,956**	**31.0**	**1,348,956**
PEM	0	0	8.4	365,072	8.5	369,300	8.5	369,300	8.5	369,300	8.5	369,300	8.5	369,300
PFO	0	0	20.2	879,029	21.0	914,434	21.0	914,434	21.0	914,434	21.0	914,434	21.0	914,434
PSS	0	0	1.4	61,893	1.5	65,222	1.5	65,222	1.5	65,222	1.5	65,222	1.5	65,222
Middle Potomac-Catoctin	**0**	**0**	**5.2**	**224,985**	**5.5**	**239,546**	**5.5**	**239,546**	**6.0**	**260,364**	**5.4**	**236,663**	**5.8**	**254,696**
PEM	0	0	2.7	117,308	2.9	127,461	2.9	127,461	3.3	141,701	2.9	125,583	3.2	140,755
PFO	0	0	2.4	106,205	2.5	110,613	2.5	110,613	2.7	117,191	2.5	109,608	2.6	112,469
PSS	0	0	0.0	1,472	0.0	1,472	0.0	1,472	0.0	1,472	0.0	1,472	0.0	1,472
Patuxent	**0**	**0**	**16.0**	**696,071**	**16.6**	**724,341**	**16.6**	**724,341**	**16.6**	**724,341**	**16.6**	**724,341**	**16.6**	**724,341**
PEM	0	0	3.5	152,001	3.6	154,921	3.6	154,921	3.6	154,921	3.6	154,921	3.6	154,921
PFO	0	0	10.2	444,640	10.8	469,990	10.8	469,990	10.8	469,990	10.8	469,990	10.8	469,990
PSS	0	0	2.3	99,430	2.3	99,430	2.3	99,430	2.3	99,430	2.3	99,430	2.3	99,430
Grand Total	**0**	**0**	**51.1**	**2,227,050**	**53.1**	**2,312,843**	**53.1**	**2,312,843**	**53.6**	**2,333,661**	**53.0**	**2,309,960**	**53.4**	**2,327,993**

NOTES:
1. A "-" symbol indicates that no impacts to the resource occurs within that category.
2. If a classification does not appear under the wetlands or waters category, no features with that classification were identified within that watershed. (e.g. No PSS wetlands were identified in the Rock Creek watershed within the corridor study boundary.)
3. "NA" was used for POW LF because these features are not assessed in LF.
4. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

Table 2.3-8: Summary of Impacts to Wetlands and Waters by Classification within MDNR 12-Digit Watersheds

MDNR Watershed and Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF
Potomac River/Rock Run														
Wetlands	**0**	**0**	**0.8**	**34,059**	**0.9**	**37,097**	**0.9**	**37,097**	**0.9**	**37,097**	**0.9**	**37,097**	**0.9**	**37,097**
PEM	0	0	0.4	18,495	0.4	19,556	0.4	19,556	0.4	19,556	0.4	19,556	0.4	19,556
PFO	0	0	0.4	15,564	0.4	17,541	0.4	17,541	0.4	17,541	0.4	17,541	0.4	17,541
Waterways	**0**	**0**	**3,619**	**358,997**	**3,667**	**371,658**	**3,667**	**371,658**	**3,667**	**371,658**	**3,667**	**371,658**	**3,667**	**371,658**
Ephemeral	0	0	107	307	107	307	107	307	107	307	107	307	107	307
Perennial	0	0	1,697	345,830	1,733	358,452	1,733	358,452	1,733	358,452	1,733	358,452	1,733	358,452
Intermittent	0	0	1,815	12,860	1,827	12,899	1,827	12,899	1,827	12,899	1,827	12,899	1,827	12,899
Cabin John Creek														
Wetlands	**0**	**0**	**0.3**	**11,884**	**0.3**	**13,860**	**0.3**	**13,860**	**0.5**	**20,583**	**0.3**	**12,749**	**0.4**	**19,093**
PEM	0	0	0.2	7,474	0.2	8,003	0.2	8,003	0.3	13,868	0.2	7,842	0.3	13,236
PFO	0	0	0.1	4,410	0.1	5,857	0.1	5,857	0.2	6,715	0.1	4,907	0.1	5,857
Waterways	**0**	**0**	**25,490**	**383,645**	**25,851**	**386,150**	**25,851**	**386,150**	**26,472**	**390,495**	**25,780**	**385,581**	**26,361**	**389,213**
Ephemeral	0	0	531	3,699	660	4,247	660	4,247	675	4,419	660	4,247	675	4,419
Perennial	0	0	19,691	346,309	19,833	347,740	19,833	347,740	20,345	350,818	19,813	347,552	20,328	350,631
Intermittent	0	0	5,268	33,637	5,358	34,163	5,358	34,163	5,452	35,258	5,307	33,782	5,358	34,163
Rock Creek														
Wetlands	**0**	**0**	**0.4**	**15,567**	**0.6**	**25,360**	**0.6**	**25,360**	**0.6**	**25,360**	**0.6**	**25,360**	**0.6**	**25,360**
PEM	0	0	0.1	3,175	0.1	3,175	0.1	3,175	0.1	3,175	0.1	3,175	0.1	3,175
PFO	0	0	0.3	12,392	0.5	22,185	0.5	22,185	0.5	22,185	0.5	22,185	0.5	22,185
Waterways	**0**	**0**	**16,045**	**185,114**	**16,308**	**188,956**	**16,308**	**188,956**	**16,589**	**193,396**	**16,295**	**188,767**	**16,384**	**190,096**
Ephemeral	0	0	998	4,209	1,010	4,232	1,010	4,232	1,010	4,232	1,010	4,232	1,010	4,232
Perennial	0	0	10,355	151,741	10,501	155,026	10,501	155,026	10,772	159,375	10,488	154,837	10,577	156,166
Intermittent	0	0	4,692	29,164	4,797	29,698	4,797	29,698	4,807	29,789	4,797	29,698	4,797	29,698
Sligo Creek														
Wetlands	**0**	**0**	**0.1**	**3,603**	**0.1**	**5,257**	**0.1**	**5,257**	**0.1**	**5,257**	**0.1**	**5,257**	**0.1**	**5,257**
PEM	0	0	0.0	1,676	0.0	1,676	0.0	1,676	0.0	1,676	0.0	1,676	0.0	1,676
PFO	0	0	0.0	1,570	0.1	2,970	0.1	2,970	0.1	2,970	0.1	2,970	0.1	2,970
PSS	0	0	0.0	357	0.0	611	0.0	611	0.0	611	0.0	611	0.0	611
Waterways	**0**	**0**	**2,539**	**19,276**	**2,733**	**20,598**	**2,733**	**20,598**	**2,733**	**20,598**	**2,733**	**20,598**	**2,733**	**20,598**
Ephemeral	0	0	0	0	8	30	8	30	8	30	8	30	8	30
Perennial	0	0	630	5,911	674	6,800	674	6,800	674	6,800	674	6,800	674	6,800
Intermittent	0	0	1,909	13,365	2,051	13,768	2,051	13,768	2,051	13,768	2,051	13,768	2,051	13,768

MDNR Watershed and Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF
Northwest Branch														
Waterways	**0**	**0**	**9,183**	**65,635**	**9,326**	**67,950**	**9,326**	**67,950**	**9,326**	**67,950**	**9,326**	**67,950**	**9,326**	**67,950**
Ephemeral	0	0	554	4,051	566	4,123	566	4,123	566	4,123	566	4,123	566	4,123
Perennial	0	0	2,822	38,739	2,876	40,435	2,876	40,435	2,876	40,435	2,876	40,435	2,876	40,435
Intermittent	0	0	5,807	22,845	5,884	23,392	5,884	23,392	5,884	23,392	5,884	23,392	5,884	23,392
POW	0	0	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-
Paint Branch														
Wetlands	**0**	**0**	**2.0**	**88,221**	**2.0**	**88,221**	**2.0**	**88,221**	**2.0**	**88,221**	**2.0**	**88,221**	**2.0**	**88,221**
PEM	0	0	0.3	14,011	0.3	14,011	0.3	14,011	0.3	14,011	0.3	14,011	0.3	14,011
PFO	0	0	1.7	74,210	1.7	74,210	1.7	74,210	1.7	74,210	1.7	74,210	1.7	74,210
Waterways	**0**	**0**	**13,969**	**166,599**	**13,969**	**166,599**	**13,969**	**166,599**	**13,969**	**166,599**	**13,969**	**166,599**	**13,969**	**166,599**
Ephemeral	0	0	661	1,868	661	1,868	661	1,868	661	1,868	661	1,868	661	1,868
Perennial	0	0	8,235	121,627	8,235	121,627	8,235	121,627	8,235	121,627	8,235	121,627	8,235	121,627
Intermittent	0	0	5,073	27,523	5,073	27,523	5,073	27,523	5,073	27,523	5,073	27,523	5,073	27,523
POW	0	0	NA	15,581	NA	15,581	NA	15,581	NA	15,581	NA	15,581	NA	15,581
Little Paint Branch														
Wetlands	**0**	**0**	**0.3**	**14,348**	**0.4**	**17,012**	**0.4**	**17,012**	**0.4**	**17,012**	**0.4**	**17,012**	**0.4**	**17,012**
PEM	0	0	-	-	-	-	-	-	-	-	-	-	-	-
PFO	0	0	0.3	14,348	0.4	17,012	0.4	17,012	0.4	17,012	0.4	17,012	0.4	17,012
Waterways	**0**	**0**	**901**	**16,817**	**901**	**16,817**	**901**	**16,817**	**901**	**16,817**	**901**	**16,817**	**901**	**16,817**
Perennial	0	0	454	15,149	454	15,149	454	15,149	454	15,149	454	15,149	454	15,149
Intermittent	0	0	447	1,668	447	1,668	447	1,668	447	1,668	447	1,668	447	1,668
Northeast Branch														
Wetlands	**0**	**0**	**2.9**	**126,693**	**3.0**	**131,721**	**3.0**	**131,721**	**3.0**	**131,721**	**3.0**	**131,721**	**3.0**	**131,721**
PEM	0	0	0.5	22,744	0.5	23,615	0.5	23,615	0.5	23,615	0.5	23,615	0.5	23,615
PFO	0	0	2.1	93,217	2.2	97,273	2.2	97,273	2.2	97,273	2.2	97,273	2.2	97,273
PSS	0	0	0.2	10,732	0.2	10,833	0.2	10,833	0.2	10,833	0.2	10,833	0.2	10,833
Waterways	**0**	**0**	**22,174**	**176,596**	**22,686**	**179,857**	**22,686**	**179,857**	**22,686**	**179,857**	**22,686**	**179,857**	**22,686**	**179,857**
Ephemeral	0	0	1,476	3,888	1,515	3,974	1,515	3,974	1,515	3,974	1,515	3,974	1,515	3,974
Perennial	0	0	8,682	97,768	8,923	100,213	8,923	100,213	8,923	100,213	8,923	100,213	8,923	100,213
Intermittent	0	0	12,016	74,940	12,248	75,670	12,248	75,670	12,248	75,670	12,248	75,670	12,248	75,670
POW	0	0	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-
Bald Hill Branch														
Wetlands	**0**	**0**	**0.1**	**2,784**	**0.1**	**2,784**	**0.1**	**2,784**	**0.1**	**2,784**	**0.1**	**2,784**	**0.1**	**2,784**
PEM	0	0	0.0	1,877	0.0	1,877	0.0	1,877	0.0	1,877	0.0	1,877	0.0	1,877
PFO	0	0	0.0	892	0.0	892	0.0	892	0.0	892	0.0	892	0.0	892
PSS	0	0	0.0	15	0.0	15	0.0	15	0.0	15	0.0	15	0.0	15

MDNR Watershed and Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF
Waterways	**0**	**0**	**967**	**5,164**	**967**	**5,164**	**967**	**5,164**	**967**	**5,164**	**967**	**5,164**	**967**	**5,164**
Ephemeral	0	0	469	1,152	469	1,152	469	1,152	469	1,152	469	1,152	469	1,152
Intermittent	0	0	498	4,012	498	4,012	498	4,012	498	4,012	498	4,012	498	4,012
Upper Beaverdam Creek														
Wetlands	**0**	**0**	**0.5**	**23,661**	**0.6**	**24,058**	**0.6**	**24,058**	**0.6**	**24,058**	**0.6**	**24,058**	**0.6**	**24,058**
PEM	0	0	0.2	9,297	0.2	9,307	0.2	9,307	0.2	9,307	0.2	9,307	0.2	9,307
PFO	0	0	0.3	12,539	0.3	12,926	0.3	12,926	0.3	12,926	0.3	12,926	0.3	12,926
PSS	0	0	0.0	1,825	0.0	1,825	0.0	1,825	0.0	1,825	0.0	1,825	0.0	1,825
Waterways	**0**	**0**	**10,988**	**82,023**	**11,040**	**82,315**	**11,040**	**82,315**	**11,040**	**82,315**	**11,040**	**82,315**	**11,040**	**82,315**
Ephemeral	0	0	198	476	198	476	198	476	198	476	198	476	198	476
Perennial	0	0	4,334	28,635	4,363	28,864	4,363	28,864	4,363	28,864	4,363	28,864	4,363	28,864
Intermittent	0	0	6,456	34,206	6,479	34,269	6,479	34,269	6,479	34,269	6,479	34,269	6,479	34,269
POW	-	-	NA	18,706	NA	18,706	NA	18,706	NA	18,706	NA	18,706	NA	18,706
Upper Southwest Branch														
Wetlands	**0**	**0**	**3.7**	**161,381**	**3.9**	**171,059**	**3.9**	**171,059**	**3.9**	**171,059**	**3.9**	**171,059**	**3.9**	**171,059**
PEM	0	0	0.8	35,427	0.8	36,168	0.8	36,168	0.8	36,168	0.8	36,168	0.8	36,168
PFO	0	0	2.7	115,516	2.9	124,453	2.9	124,453	2.9	124,453	2.9	124,453	2.9	124,453
PSS	0	0	0.24	10,438	0.24	10,438	0.24	10,438	0.24	10,438	0.24	10,438	0.24	10,438
Waterways	**0**	**0**	**18,061**	**155,121**	**18,368**	**156,865**	**18,368**	**156,865**	**18,368**	**156,865**	**18,368**	**156,865**	**18,368**	**156,865**
Ephemeral	0	0	2,176	4,802	2,201	4,927	2,201	4,927	2,201	4,927	2,201	4,927	2,201	4,927
Perennial	0	0	9,173	91,538	9,248	92,260	9,248	92,260	9,248	92,260	9,248	92,260	9,248	92,260
Intermittent	0	0	6,712	28,934	6,919	29,831	6,919	29,831	6,919	29,831	6,919	29,831	6,919	29,831
POW	0	0	NA	29,847	NA	29,847	NA	29,847	NA	29,847	NA	29,847	NA	29,847
Lower Southwest Branch														
Wetlands	**0**	**0**	**0.6**	**27,679**	**0.6**	**27,718**	**0.6**	**27,718**	**0.6**	**27,718**	**0.6**	**27,718**	**0.6**	**27,718**
PEM	0	0	0.0	1,709	0.0	1,709	0.0	1,709	0.0	1,709	0.0	1,709	0.0	1,709
PFO	0	0	0.2	7,380	0.2	7,419	0.2	7,419	0.2	7,419	0.2	7,419	0.2	7,419
PSS	0	0	0.4	18,590	0.4	18,590	0.4	18,590	0.4	18,590	0.4	18,590	0.4	18,590
Waterways	**0**	**0**	**2,276**	**18,321**	**2,288**	**18,423**	**2,288**	**18,423**	**2,288**	**18,423**	**2,288**	**18,423**	**2,288**	**18,423**
Ephemeral	0	0	280	2,755	292	2,857	292	2,857	292	2,857	292	2,857	292	2,857
Perennial	0	0	1,306	11,597	1,306	11,597	1,306	11,597	1,306	11,597	1,306	11,597	1,306	11,597
Intermittent	0	0	690	3,969	690	3,969	690	3,969	690	3,969	690	3,969	690	3,969
POW	0	0	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-
Watts Branch														
Wetlands	**0**	**0**	**0.4**	**16,623**	**0.4**	**17,499**	**0.4**	**17,499**	**0.4**	**18,510**	**0.4**	**17,422**	**0.4**	**18,350**
PEM	0	0	0.2	10,754	0.3	11,358	0.3	11,358	0.3	11,358	0.3	11,358	0.3	11,358
PFO	0	0	0.1	5,867	0.1	6,139	0.1	6,139	0.2	7,150	0.1	6,062	0.2	6,990
PSS	0	0	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2

MDNR Watershed and Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF	AC/LF	SF
Waterways	**0**	**0**	**2,698**	**40,937**	**2,733**	**41,291**	**2,733**	**41,291**	**2,893**	**43,185**	**2,717**	**41,066**	**2,857**	**42,744**
Ephemeral	0	0	183	1,205	183	1,205	183	1,205	200	1,296	183	1,205	197	1,279
Perennial	0	0	718	21,091	718	21,091	718	21,091	739	21,688	718	21,091	737	21,594
Intermittent	0	0	1,797	18,641	1,832	18,995	1,832	18,995	1,954	20,201	1,816	18,770	1,923	19,871
Muddy Branch														
Wetlands	**0**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PEM	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Waterways	**0**	**0**	**1,316**	**25,121**	**1,316**	**25,121**	**1,316**	**25,121**	**1,316**	**25,121**	**1,316**	**25,121**	**1,316**	**25,121**
Perennial	0	0	1,087	23,038	1,087	23,038	1,087	23,038	1,087	23,038	1,087	23,038	1,087	23,038
Intermittent	0	0	229	2,083	229	2,083	229	2,083	229	2,083	229	2,083	229	2,083
Beaverdam Creek														
Waterways	**0**	**0**	**11**	**67**	**11**	**67**	**11**	**67**	**11**	**67**	**11**	**67**	**11**	**67**
Intermittent	0	0	11	67	11	67	11	67	11	67	11	67	11	67
Henson Creek														
Wetlands	**0**	**0**	**3.3**	**144,466**	**3.4**	**148,192**	**3.4**	**148,192**	**3.4**	**148,192**	**3.4**	**148,192**	**3.4**	**148,192**
PEM	0	0	0.8	35,910	0.9	37,295	0.9	37,295	0.9	37,295	0.9	37,295	0.9	37,295
PFO	0	0	2.4	104,991	2.4	106,409	2.4	106,409	2.4	106,409	2.4	106,409	2.4	106,409
PSS	0	0	0.1	3,565	0.1	4,488	0.1	4,488	0.1	4,488	0.1	4,488	0.1	4,488
Waterways	**0**	**0**	**20,116**	**136,486**	**20,409**	**137,876**	**20,409**	**137,876**	**20,409**	**137,876**	**20,409**	**137,876**	**20,409**	**137,876**
Ephemeral	0	0	2,825	10,502	2,926	10,793	2,926	10,793	2,926	10,793	2,926	10,793	2,926	10,793
Perennial	0	0	7,338	80,069	7,351	80,187	7,351	80,187	7,351	80,187	7,351	80,187	7,351	80,187
Intermittent	0	0	9,953	45,915	10,132	46,896	10,132	46,896	10,132	46,896	10,132	46,896	10,132	46,896
POW	0	0	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-

NOTES:

1. Wetlands are presented in acres and square feet, waterways are presented in linear feet and square feet.
2. A "-" symbol indicates that no impacts to the resource occurs within that category. A "-" symbol is also used for POW LF because these features are not assessed in LF.
3. If a classification does not appear under the wetlands or waters category, no features with that classification were identified within that watershed. (e.g. No PSS wetlands were identified in the Rock Creek watershed within the corridor study boundary.)
4. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

2.3.4 Avoidance, Minimization, and Mitigation

A. Avoidance and Minimization

Wetland and stream impacts are unavoidable if a Screened Alternative is selected and constructed for the I-495 & I-270 Managed Lanes Study. The corridor study boundary is characterized by an extensive network of streams and wetlands that are located adjacent to and flow beneath the existing roadway, resulting in unavoidable impacts to these resources with roadway modification and/or widening. However, efforts to avoid and minimize impacts have occurred throughout the planning process and would continue during more detailed phases of project design.

Avoidance and minimization efforts to reduce impacts to Waters of the US, including wetlands, involve a two-tiered approach. The first tier occurs during the planning stage of the study, where every reasonable effort has been made to avoid wetlands and waterways to the maximum extent practicable. This effort continues as MDOT SHA works with regulatory agencies and resource managers to identify sensitive aquatic resources and determine further avoidance and minimization possibilities. Agency recommendations for avoidance and minimization will be evaluated and implemented wherever practicable. Permit conditions requiring avoidance of features would be included in the Nontidal Wetlands and Waterways Permit issued by MDE, and Department of the Army authorization issued by USACE under Section 404. Efforts to avoid and minimize direct impacts to stream channels and wetlands to date have included alignment shifts, alteration of SWM swales, addition of retaining walls, and revision of preliminary SWM locations to avoid streams and wetlands. MDOT SHA is committed to continuing efforts to maximize avoidance and minimization where practicable.

The second tier of avoidance and minimization will occur at the public-private partnership (P3) design/build stage, with advancement of the design and further refinements to the limits of disturbance (LOD). The P3 concessionaire will be incentivized to reduce impacts to wetlands and streams wherever practicable.

B. Screened Alternatives and Avoidance and Minimization Steps

A LOD was established for each Screened Alternative. A LOD is the proposed boundary within which all construction, construction access, materials storage, grading, clearing, landscaping, drainage, stormwater management, and related activities would occur. The LODs for the Screened Alternatives were determined from the proposed roadway typical sections, interchange configuration, and roadside design elements. Software models produced cut and fill lines that represent the location at which the proposed slope intersects with existing ground or the back of a retaining wall, which were offset by 10 feet to create the LOD.

The design for on-site SWM, including ponds and large facilities along the roadside and within interchanges, was developed to a concept level of detail and was included within the LOD. Existing streams that would be impacted by roadside grading were relocated within the proposed LODs where possible. Full SWM design will be completed in later stages of the project.

Improvements needed to accomplish profile adjustments and roadway shifts for roads that cross over I-495 and I-270 due to mainline widening were designed at a preliminary level. The LOD incorporates the modifications along these crossroads. It was assumed that any required noise barriers along I-495 and I-

270 would be located within the LOD. A 30-foot offset to the proposed LOD was established beyond the edge of I-495 and I-270 mainline bridges over water and roadways to accommodate reconstruction.

The utility team identified major utility relocations. A preliminary assessment of potential impacts and necessary utility relocations was conducted and an offset of between 10 feet and 50 feet to the proposed LOD was established beyond the cut and fill lines for these potential utility relocations.

The proposed LOD was compared to existing ROW and adjusted according to the following conditions. Where the distance between the cut and fill lines and the existing ROW was greater than 10 feet, the LOD was set at the existing ROW line. Adjacent land use was considered in the development of the LOD.

There are various regulated and sensitive resources adjacent to the roadway along I-495 and I-270, such as natural resources including streams and wetlands; historic communities; and national and local parks. Private business and residential properties were also considered during the development of the LOD and efforts were taken to avoid displacement of these properties, where possible. During the development of the engineering layouts and LOD for the Screened Alternatives, a process was used to limit or avoid impacts to environmental features to the maximum extent practicable. This included the application of five progressively narrower roadside typical sections to minimize or avoid impacts to these environmental and community resources. Wetlands and waterways were considered impacted if the cut or fill line physically intersected or overlapped the resource boundary. Note that the typical section figures apply to both cut and fill sections although only cut sections are shown.

The five roadside typical sections are described below. These include an open section with a full-width bioswale for SWM, an open section with a reduced-width bioswale for SWM, an open section with no surface SWM, a closed section with concrete barrier, and a closed section with retaining wall. The roadside typical sections were applied to the Screened Alternatives using a step-by-step process, from widest to narrowest to the greatest extent necessary, based on the existing roadside conditions and land use constraints.

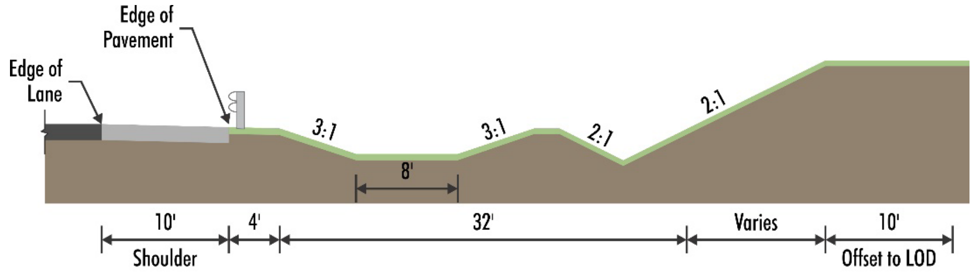
The LOD used to quantify environmental impacts served as the proposed ROW line where it is located outside of the existing ROW line. All roadside design values meet MDOT SHA and American Association of State Highway and Transportation Officials (AASHTO) design standards. Existing roadways were widened into the median wherever possible to minimize impacts.

These engineering modifications were applied to demonstrate that environmental impacts can be minimized or avoided. Final decisions on minimization or avoidance methods will be made as MDOT SHA advances the engineering design, after coordination with the regulatory agencies.

a. Step 1: Open Section with Full Stormwater Management

The widest roadside typical section with surface stormwater management is an open section without curb and gutter that allows stormwater to sheet flow off the road into a drainage ditch. The typical section would include W-beam guardrail at the edge of pavement; an 8-foot wide flat bottom Environmental Site Design (ESD) swale with 3-to-1 side slopes; a V-ditch with 2-to-1 side slopes that ties to existing ground; and a 10-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This typical section was used as the starting typical section since it provided the greatest flexibility for roadside grading and linear stormwater management.

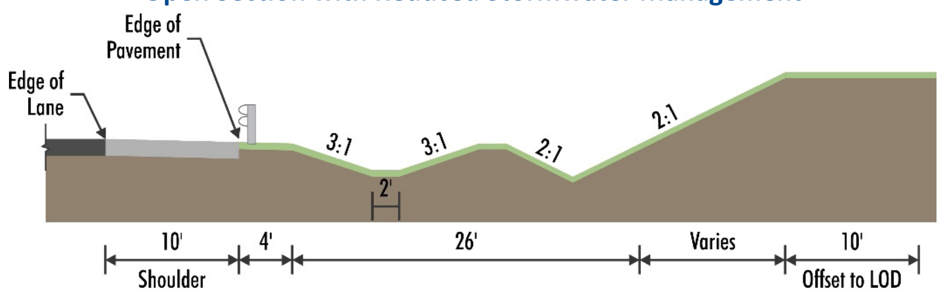
Open Section with Full Stormwater Management



b. Step 2: Open Section with Reduced Stormwater Management

A second roadside typical section with surface stormwater management is an open section that would include W-beam guardrail at the edge of pavement; a 2-foot wide flat bottom ESD swale, the minimum allowable by MDE with 3-to-1 side slopes; a V-ditch with 2-to-1 side slopes that ties to existing ground; and a 10-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This would maintain linear stormwater management, but at a reduced water storage capacity compared to Step 1.

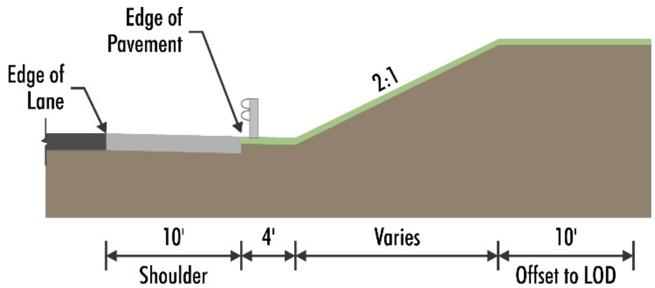
Open Section with Reduced Stormwater Management



c. Step 3: Open Section with No Stormwater Management

This roadside typical section is an open section with no surface stormwater management facilities and would include W-beam guardrail at the edge of pavement; a 2-to-1 slope to tie to existing ground; and a 10-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. This section would maintain an open section for drainage conveyance without linear stormwater management. Stormwater quantity management and treatment would be provided via ponds and underground vaults.

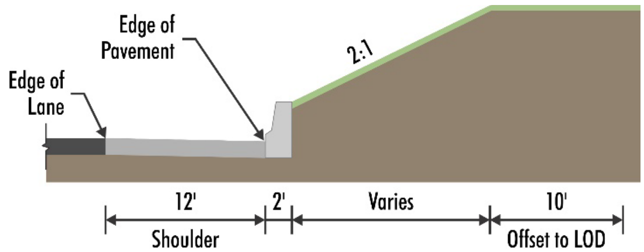
Open Section with No Stormwater Management



d. Step 4: Closed Section with Concrete Barrier

This closed roadside typical section would include a single-face concrete barrier at the edge of pavement with no linear surface stormwater management facilities; a 2-to-1 slope behind the barrier to tie to existing ground; and a 10-foot offset to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. The paved outside shoulder would be 12 feet wide to provide a 2-foot offset to the barrier. Stormwater quantity management and treatment would be provided via ponds and underground vaults.

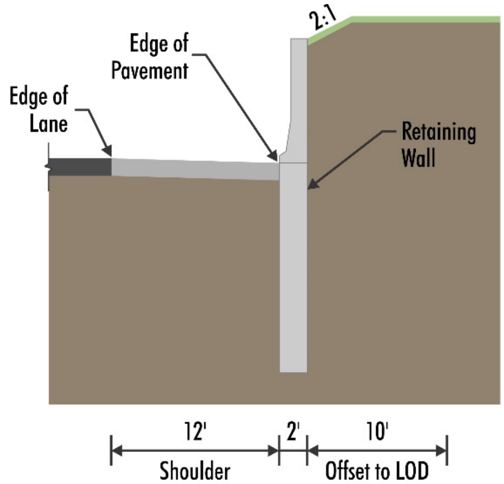
Closed Section with Concrete Barrier



e. Step 5: Closed Section with Retaining Wall

This closed roadside typical section would include a retaining wall at the edge of pavement with no surface stormwater management facilities; and a 10-foot offset from the back of the wall to the LOD to accommodate erosion and sediment control, noise barrier construction, and construction easements. The paved outside shoulder would be 12 feet wide to provide a 2-foot offset to the retaining wall. Stormwater quantity management and treatment would be provided via ponds and underground vaults. This step would be the narrowest typical section.

Closed Section with Retaining Wall



f. Avoidance and Minimization of Wetlands and Waters Features

I-495 & I-270 Managed Lanes Study Natural Resources Team field leads qualitatively assessed and described all delineated wetland and waters features based on the feature's function and value and the best professional judgement of the field lead who delineated the feature. Wetland functions and values considered in this assessment are explained in the USACE Highway Methodology Workbook and included on the Function and Value datasheet that field teams filled out for each wetland and include consideration of the following wetland parameters:

- Groundwater Recharge/Discharge
- Floodflow Alteration
- Fish and Shellfish Habitat
- Sediment/Toxicant Retention
- Nutrient Removal
- Production Export
- Sediment/Shoreline Stabilization
- Wildlife Habitat
- Recreation
- Education/Scientific Value
- Uniqueness/Heritage
- Visual Quality/Aesthetics
- Endangered Species Habitat
- Relative Value in Urban Landscape

For streams, parameters such as bank erosion/stability/incision, connectivity, level of alteration, substrate, vegetation cover of banks/riparian buffer, fish and wildlife habitat, relative value in the urban landscape, and recreational value were considered in determining a qualitative function and value.

In areas where regulated wetlands and waterways, private properties, and other regulated resources including parkland were impacted by the widest roadside typical section (Step 1), the second widest roadside typical section (Step 2) was applied to modify and narrow the LOD to the maximum extent practicable. This process continued by applying the increasingly narrower roadside typical sections (Steps 3, 4, and 5) consecutively, as necessary to avoid or minimize impacts to the adjacent resource to the maximum extent practicable. If a private property was still considered to be a displacement after application of the LOD minimization process, it was assumed that the entire parcel is impacted and was encompassed in the LOD. At natural resource locations, the LOD was set based on the ten-foot offset from the cut and fill lines. At other regulated resource locations including park land, the LOD was set based on the ten-foot offset from the cut and fill lines or was set at the resource boundary if the distance between the cut/fill line and the resource boundary is greater than 10 feet.

The quality assessment of wetlands and waterways is discussed in more detail in the I-495 & I-270 Managed Lanes Study Avoidance, Minimization, and Impacts Report (AMR).

C. Mitigation

As part of the permitting process, a detailed Draft Compensatory Mitigation Plan (CMP), including final mitigation design, will be developed and require approval by the USACE and MDE prior to permit issuance. All mitigation measures employed to compensate for unavoidable project impacts to Waters of the US or Waters of the State would follow the federal Compensatory Mitigation Rule (33 CFR Parts 325 and 40 CFR Part 230), and other state compensatory mitigation guidelines, as well as other recommendations from federal and state resource agencies. When practicable measures have been taken to avoid and minimize impacts to aquatic resources, mitigation may be required in the form of establishment/creation, enhancement, or preservation to replace the loss of wetland, stream, and/or other aquatic resource functions. Mitigation options under both the federal Compensatory Mitigation Rule and state mitigation guidelines would follow a watershed approach.

Compensatory mitigation focuses on the replacement of the functions provided by an aquatic resource or wetland, in addition to the acreage affected. The decision to replace function, acreage, or both may be adjusted at the discretion of the USACE or MDE, in addition to the mitigation ratios. Traditionally, mitigation requirements under Section 404 are determined by the ratio of wetland acres replaced to wetland acres lost. Emergent nontidal wetlands are typically mitigated on a 1:1 replacement basis, while forested and scrub-shrub nontidal wetlands are mitigated on a 2:1 basis. The agencies also target compensatory stream mitigation projects for the replacement of aquatic resource functions and services. In addition to stream channel improvements, mitigation measures for waterway impacts consider the size, stream order, and location of the stream to determine appropriate stream mitigation. Other mitigation measures, such as removal of fish blockages, riparian buffer enhancements, and water quality improvements may also be used at the agencies' discretion.

Stream impacts include culverts conveying water under the existing roadway, elements of the roadside drainage network, and streams immediately adjacent to the roadway. Roadside drainage networks and streams impacts would be replaced in kind when possible with replacement of roadside drainage features and relocated channels designed to maintain or enhance the functions and values of the impacted features. Existing culverts are considered impacts but would not require mitigation because they would remain in place or would be replaced with new culverts of the same function and value. When functions and values are not mitigated by the new feature or when design constraints prohibit optimal relocated channel design, regulatory agencies will require off-site mitigation. The compensatory mitigation package for all impacts will be designed to fulfill the mitigation requirements, as well as meet the resource protection goals of the regulations.

The mitigation site search is occurring in two phases: a traditional site search on public lands and a solicitation for full delivery stream and wetland mitigation on private lands. The traditional site search is occurring in two stages. Stage I consists of a desktop review of multiple resources, including MDOT SHA Environmental Program Division's (EPD) Master Site Selection geodatabase, which also incorporates sites identified in the Watershed Resources Registry (WRR). All sites within the database were evaluated in accordance with the draft 2015 MDOT SHA Site Selection Process Document. Additional documents, such as pertinent watershed studies and reports were reviewed to identify potential wetland sites and stream reaches suitable for restoration within the targeted watersheds. All identified sites were then evaluated in Stage II through a windshield survey, which was conducted for sites visible from public roadways to confirm current land use and preliminary site suitability. Some wetland and stream sites were found to be unsuitable and dropped from further consideration. For sites deemed viable following the windshield survey, on-site investigations were completed. Property owners were identified for each site and notified via certified mailing to request property access for site investigations.

During the on-site investigations, all potential wetland mitigation sites were scored and ranked using the following criteria: soils, hydrology, vegetation, land use, 100-year floodplain, habitat value, geomorphic position, ease of access, estimated cut to hydrology, and presence of utilities. The soils criteria place an emphasis on those sites that are mapped as hydric soils, with higher scores related to percent cover of the hydric unit on site. Vegetation criteria place an emphasis on sites dominated by herbaceous species and manipulated/maintained vegetative landscapes, such as crops, pastures, fallow fields, and lawns. Forested sites were considered less desirable because of the need for tree clearing. Habitat value is established through review of GIS data to determine if the site is contiguous to a riparian corridor or a forest greater than 100 acres. Sites that are connected to habitat corridors score higher for this category. Sites at low elevation – or characterized by concave topography – and those for which the estimated excavation required to connect to hydrology would be minimal are given the highest scores. Additionally, potential sites with no utilities within the creation area that have existing vehicular access are given the highest scores. A score of 10 represents the highest or best possible score under each criterion. Hence, the higher the total score, the more suitable the site is for wetland restoration or creation.

Stream mitigation sites were scored and ranked during the on-site investigations using the following criteria: bank erosion, channel incision, existing floodplain access, opportunity for floodplain development, opportunity for ecological lift, vegetation (including riparian forest), land use, drainage area, ease of access and presence of utilities. The estimated bank erosion, channel incision, and existing floodplain access criteria prioritize sites with unstable channels that have little to no floodplain access. Sites with extensive bank erosion, a higher degree of channel incision, and limited floodplain access receive higher scores. Sites with greater opportunities for floodplain development and ecological lift that can be realistically achieved are given higher scores. Opportunities for ecological lift that are considered include sediment reduction, temperature regulation, floodplain connectivity, aquatic life passage, habitat for fish and/or benthic macro invertebrates, and water chemistry. Vegetation and land use criteria prioritize sites dominated by herbaceous species and manipulated/maintained vegetative landscapes, such as crops, pastures, fallow fields, and lawns. Sites with existing riparian forest received lower scores because of the potential impact to these forests. Drainage area is estimated through review of GIS data to determine the square miles of drainage to the site. Sites with a smaller drainage area are more feasible to restore and thus receive higher scores. Additionally, potential sites with no utilities within the restoration area that have existing vehicular access are given the highest scores. A score of 10 is the highest or best possible score for each criterion. Hence, sites with the highest total scores have the greatest potential for stream restoration.

The solicitation process for full delivery stream and wetland mitigation is designed to leverage the growing natural resource credit market by requesting full delivery of mitigation credits from private industry providers under a permittee-provided mitigation framework. MDOT SHA issued the request to provide mitigation credits on private property and required Phase I Mitigation Plans along with other supporting documents as the response to the Request for Proposals (RFP). The best full delivery sites along with the highest ranked traditional sites were evaluated and compared to the overall mitigation need to develop a Draft CMP sufficient to compensate for the project's unavoidable impacts and to allow for some sites to be reduced in size or drop out during site development. Upon resource agency approval of the Draft CMP, site development, including baseline investigations, agency reviews, and site design will proceed on both traditional and full delivery mitigation sites. A detailed Draft CMP Report was developed and will be submitted in support of the permit application which will include Phase II mitigation plans for each site along with further detail about the mitigation process and its results. Detailed information regarding avoidance and minimization for the I-495 & I-270 Managed Lanes Study can be found in the I-495 & I-270 Managed Lanes Study AMR.

2.4 Watersheds and Surface Water Quality

2.4.1 Regulatory Context and Methods

A. Surface Waters and Watershed Characteristics

Surface waters include rivers, streams, and open water features such as ponds and lakes. Streams are generally defined as water flowing in a channel with defined bed and bank and an ordinary high water mark. Section 401 and Section 402 of the Federal CWA (33 U.S.C. 1341 and 1342) regulate water quality and the introduction of contaminants to waterbodies. The MDE and VDEQ are the regulatory agencies responsible for ensuring adherence to water quality standards in Maryland and Virginia, respectively. In general, the National Pollutant Discharge Elimination System (NPDES) stormwater program requires permits for discharge from construction activities that disturb one or more acres, and discharges from smaller sites that are part of a larger common plan of development. Individual permits for erosion and sediment control approval will be submitted and approved as contract packages are developed.

Under the COMAR: Title 26 Department of the Environment, Subtitle 08 Water Pollution, Chapter 02 Water Quality (26.08.02), the State of Maryland has adopted water quality standards to enhance and protect water resources and serve the purposes of the Federal CWA. Similarly, all of Virginia's surface waters are classified by VDEQ according to designated uses promulgated in Virginia's water quality standards (9 VAC 25-260). The water quality standards serve this purpose by designating uses to the waters of the state and setting criteria by which these uses are protected. Water quality in Maryland and Virginia shall be protected and maintained for these "Designated Uses." Coordination with the MDNR Environmental Review Program (ERP) (2018) and online research through the MDE and VDEQ websites was conducted to determine designated uses and regulations for the waters crossed by the corridor study boundary.

MDE has also designated certain surface waters of the state as Tier II (High Quality) waters, based on monitoring data that documented water quality conditions that exceeded the minimum standard necessary to meet designated uses. In accordance with federal antidegradation regulations (40 CFR 131.12), these waters are afforded additional antidegradation protections to ensure that these high-quality waters are maintained (COMAR 26.08.02.04-1). Impacts to Tier II waters are reviewed by MDE for certain state permits and approvals (including Wetlands and Waterways permits and authorizations), with the purpose of preventing degradation to high quality waters as a result of permitted activities. The review process would identify impacts associated with the selected Screened Alternative, and then determine if there are opportunities to avoid these impacts, as well as potentially requiring additional minimization measures to further protect water quality.

Included in this review is an evaluation of the assimilative capacity of the Tier II waters. Assimilative capacity is defined as the difference between the Tier II water quality of the stream segment at the time it was designated as Tier II and the overall state-wide Tier II water quality listing threshold. Impacts to Tier II waters determined to have no remaining assimilative capacity will trigger additional steps and permit requirements, such as additional Best Management Practices (BMPs) or mitigation, during the review process.

In compliance with CWA Sections 303(d), 305(b), and 314 and the Safe Drinking Water Act (SDWA), states develop a prioritized list of waterbodies that currently do not meet water quality standards. The 303(d) prioritized list includes those waterbodies and watersheds that exhibit levels of impairment requiring further investigation or restoration. MDE and VDEQ use monitoring data to compare stream conditions to water quality standards and determine which streams should be listed. Parameters monitored include: temperature, dissolved oxygen (DO), pH, fecal coliform, Escherichia coli (E. coli), enterococci, total phosphorus, chlorophyll a, benthic macroinvertebrates, as well as metals and toxics in the water column, sediments, and fish tissues. The waterbodies on this list may be subject to a total maximum daily load (TMDL) of these constituents under Section 303(d) of the CWA. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Waterbodies can also be listed under Category 5 on the 303(d) list for impairment, which indicates that the waterbody is impaired, does not meet the water quality standard, and that a TMDL is required.

Information on surface water resources and water quality within the corridor study boundary was primarily gathered from available published sources through background research, online sources, and agency coordination. This review involved consultation with various state and local agencies including MDOT SHA, MDE, MDNR's Maryland Biological Stream Survey (MBSS), Montgomery County Department of Environmental Protection (MCDEP), Prince George's County Department of the Environment (PGDoE), VDEQ, and Fairfax County Department of Public Works and Environmental Services (FCDPWES). These agencies and monitoring groups use a broad range of data to assess overall watershed health and condition, including data on chemical water quality, fish and benthic macroinvertebrate communities, aquatic habitat, land use characteristics, riparian buffer conditions, and impervious surface coverage. Data collected on aquatic habitat conditions and fish and benthic macroinvertebrate communities are often used to summarize existing water quality conditions based on an overall narrative rating (e.g., Very Poor, Poor, Fair, Good, etc.), using established methodologies. These methodologies and rating criteria are detailed in **Section 2.9, Aquatic Biota**.

B. Scenic and Wild Rivers

The federal Wild and Scenic Rivers system was created to protect "rivers of the nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." The system is administered by four lead federal agencies—the Bureau of Land Management (BLM), NPS, US Forest Service (USFS) and US Fish and Wildlife Service (USFWS). "Rivers included in the National System at the request of a governor and designated by the Secretary of the Interior (under Section 2(a)(ii) of the Act) are administered by their respective state(s), with the NPS or another of the three lead agencies making determinations under Section 7 of the Act" (IWSRCC, 2018).

The Maryland Scenic and Wild Rivers Act of 1968 established the Maryland Scenic and Wild Rivers System to preserve and protect the natural values and enhance the water quality of rivers, or segments of rivers, which possess outstanding scenic, geologic, ecologic, historic, recreational, agricultural, fish, wildlife, cultural, and other similar resource values (MDNR, 2011). A Scenic River is a "free-flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshland, or swampland with a minimum of development for at least two miles of the river length." A Wild River is a "free-flowing river whose shoreline and related land are undeveloped, inaccessible except by trail, or predominantly primitive in a natural state for at least four miles of the river length" (Md. Code Ann., Nat. Res. § 8-402). The Scenic and Wild Rivers Act mandates the preservation and protection of natural values associated with rivers designated as Scenic and/or Wild. Each unit of state and local government, in recognizing the intent of the Act and the Scenic and Wild Rivers Program, is required to take whatever action is necessary to protect and enhance the qualities of a designated river. Potential effects to scenic and wild rivers are reviewed and coordinated by the MDNR in collaboration with the relevant Scenic and Wild River Advisory Board.

The Virginia Scenic Rivers Act of 1970 established the Virginia Scenic Rivers Program with the intent to identify, designate, and help protect rivers and streams that "possess superior natural and scenic beauty, fish and wildlife, and historic, recreational, geologic, cultural, and other assets." River segments are evaluated based on 13 criteria, including water quality, corridor development, recreational access, historic features, natural features, visual appeal, quality of fisheries, and the presence of unique habitats or species. If a waterway qualifies for designation, the Virginia Department of Conservation and Recreation (VDCR) prepares a report including supporting comments by local governments and state agencies. For the designation to take effect, it must be passed by the General Assembly and receive final approval by the governor.

Environmental scientists accessed online information on behalf of MDOT SHA from the National Wild and Scenic River System website, the VDCR Scenic Rivers Program website, and the MDNR Scenic and Wild Rivers Program to determine if any federally designated Wild and Scenic Rivers or state-designated Scenic and Wild Rivers were located within the I-495 & I-270 Managed Lanes Study corridor study boundary (IWSRCC, 2018; MDNR, 2018a; VDCR, 2018). These results are summarized in **Section 2.4.2.B, Scenic and Wild Rivers**.

C. Surface Water Quality

For the purposes of this document, discussions of water chemistry include both in-situ multi-probe sampling and chemical grab sampling. In-situ data are defined as data collected with field measurement techniques such as water quality meters, while chemical grab sampling is defined as sampling where water samples were collected in the field and transported to a laboratory for detailed analysis.

For Maryland waterways, existing in-situ and chemical water grab sample quality data were gathered from MBSS, MCDEP, PGDoE, MDE, and various other organizations through the National Water Quality Monitoring Council (NWQMC) database. MCDEP and PGDoE developed widespread monitoring networks throughout the corridor study boundary that yielded information on the existing conditions in

Montgomery and Prince George's Counties. Primary data sources from the NWQMC database include: Chesapeake Bay Program, MDE, MDNR, NPS, USGS, and Friends of Sligo Creek. In general, water quality data collected within 1 mile of the corridor study boundary were considered most relevant to characterize existing conditions and are summarized in this report.

In Maryland, MDE established acceptable standards for several parameters under each designated stream use classification. The Use Class designation for streams within the Maryland portion of the corridor study boundary are shown in **Table 2.4-1** below. All Maryland streams within the corridor study boundary are classified as nontidal.

Table 2.4-1: Maryland COMAR Stream Designated Use Classifications

Use Class	Description	Applicable Watersheds
I	Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life	All waters within or in the vicinity of the corridor study boundary, with the exception of those mentioned below.
I-P	Water Contact Recreation, Protection of Nontidal Warmwater Aquatic Life, and Public Water Supply	All waters within the Potomac River/Rock Run watershed, Cabin John Creek watershed, Watts Branch watershed, and Muddy Branch watershed.
III	Nontidal Cold Water	All waters draining to Paint Branch and its tributaries north/upstream of I-495.
IV	Recreational Trout Waters	All waters in the Northwest Branch watershed upstream of MD 410.

Source: Maryland COMAR

The Maryland standards for the use classes of streams are listed in COMAR 26.08.02.01-.03–Water Quality and are shown in **Table 2.4-2.** Each parameter measured by in-situ sampling and regulated by the State of Maryland can have an impact on the aquatic communities of streams. In general, data on pH, DO, conductivity, temperature, and turbidity data are collected during in-situ sampling, often as part of biological sampling efforts by state and county monitoring groups.

Table 2.4-2: Maryland COMAR Stream Use Water Quality Criteria

Parameter	Use I and I-P	Use III	Use IV
Temperature	Maximum of 90°F (32°C) or ambient temperature, whichever is greater	Maximum of 68°F (20°C) or ambient temperature, whichever is greater	Maximum of 75°F (23.9°C) or ambient temperature, whichever is greater
pH	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5
Dissolved Oxygen	Minimum of 5 mg/L	Minimum of 5 mg/L	Minimum of 5 mg/L
Turbidity	Maximum of 150 Nephelometric Turbidity Units (NTU) and maximum monthly average of 50 NTU	Maximum of 150 NTU and maximum monthly average of 50 NTU	Maximum of 150 NTU and maximum monthly average of 50 NTU
Fecal Coliform	Exceeds log mean of 200 per 100 ml, based on a minimum of not less than five samples taken over a 30-day period.	Exceeds log mean of 200 per 100 ml, based on a minimum of not less than five samples taken over a 30-day period.	Exceeds log mean of 200 per 100 ml, based on a minimum of not less than five samples taken over a 30-day period.

Source: Maryland COMAR

Some of the sampled parameters have associated Maryland state and federal standards for the protection of aquatic life. EPA established aggregate reference condition values, based on ecoregions, for total nitrogen and total phosphorus (EPA, 2000). These reference condition values were developed to be used by state agencies as guidelines for developing criteria and have no standalone regulatory importance. Ranges for other parameters indicative of anthropogenic stress were determined for the state by MBSS. These benchmarks developed by MBSS are only used as a management guideline and do not carry the same weight as the regulatory standards set by the state and federal governments. These parameters include ammonia, nitrate, nitrite, phosphorus, and sulfate. These benchmark levels, as well as the state and federal standards and recommendations, are found in **Table 2.4-3**.

Excess levels of these metals and nutrients have negative effects on fish and macroinvertebrate communities. According to the EPA, acute effects are those that show up in zero to seven days, while chronic effects can take years or lifetimes to be seen. Each of the following parameters was determined to have negative effects by the EPA "Gold Book" of water quality criteria (EPA, 1986).

Table 2.4-3: Maryland Criteria and Federal Water Quality Recommendations

Parameter Tested	Maryland		EPA Recommendations	
	Acute	Chronic	Acute	Chronic
Ammonia (mg/L)	>0.03*		None	
Alkalinity (mg/L)	None		None	20
Chromium (mg/L)	0.570	0.074	0.570	0.074
Chloride (mg/L)	None		860	230
Copper (mg/L)	0.013	0.009	0.013	0.009
Lead (mg/L)	0.065	0.0025	0.065	0.0025
Nickel (mg/L)	0.470	0.052	0.470	0.052
Selenium (mg/L)	0.020	0.005	None	0.005
Silver (mg/L)	0.0032	None	0.0032	None
Zinc (mg/L)	0.120	0.120	0.120	0.120
Biochemical Oxygen Demand (mg/L)	None		8.41	
Total Suspended Solids (mg/L)	None		None	
Nitrate Nitrogen (mg/L)	>1*		0.89	
Nitrite Nitrogen (mg/L)	>0.0025*		0.01	
Nitrogen (Total) (mg/L)	>1.5*		0.69	
Phosphorus (Total) (mg/L)	>0.025*		0.037	
Orthophosphate (mg/L)	>0.008*		None	
Fecal Coliform (mpn/100ml)	200		None	

* Threshold level used by MBSS as an indication of anthropogenic stress.

Source: Maryland COMAR regulation 26.08.02.03-2, EPA Ambient Water Quality Criteria Recommendations, 2000, and MBSS 2000-2004 Volume II Ecological Assessment of Streams Sampled in 2001.

For Virginia waterways, existing in-situ and chemical grab sample water quality data were gathered from VDEQ and FCDPWES, as well as from the USGS through the NWQMC database. VDEQ and FCDPWES maintain widespread monitoring networks within the Virginia portion of the corridor study boundary that yielded information on the existing conditions in Fairfax County. In general, water quality data collected within 1 mile of the corridor study boundary were considered most relevant to characterize existing conditions and are summarized in this report.

All waters in Virginia are designated for recreational uses; the propagation and growth of a balanced, indigenous population of aquatic life, wildlife; and the production of edible and marketable natural resources. VDEQ established acceptable standards for ambient water quality parameters for seven different classifications of waters (e.g., tidal waters, nontidal waters, natural trout streams) to determine whether a waterbody is attaining the aquatic life use, and these standards are listed in the VAC 9VAC25-260-50–Numerical criteria for dissolved oxygen, pH, and maximum temperature. All Virginia streams within the corridor study boundary fall under the nontidal waters classification. The standards for the Virginia nontidal waters in the corridor study boundary are shown in **Table 2.4-4**. In addition to aquatic life protections, Virginia also designated the nontidal waters within the corridor study boundary for the protection of public water supply.

Table 2.4-4: Virginia Stream Class Water Quality Criteria

Class of Waters	Description	Dissolved Oxygen (mg/L)		pH (SU)	Maximum Temperature (C°)
		Min.	Daily Av.		
III	Nontidal Waters	4.0	5.0	6.0-9.0	32

Source: Virginia Administrative Code

Some of the sampled parameters have associated Virginia state and federal standards for the protection of aquatic life. As described above, EPA established aggregate reference condition values, based on ecoregions, for nutrient parameters (EPA, 2000). These reference condition values were developed to be used by state agencies as guidelines for developing criteria and have no standalone regulatory applicability. VDEQ has also established threshold values for other water quality parameters for use as benchmarks in selecting reference sites, which are considered to be least-degraded within the state (VDEQ, 2006). These benchmarks used by VDEQ do not carry the same weight as the regulatory standards set by the state and federal governments but are useful for characterizing relative impairment. These parameters include conductivity, nitrogen, and phosphorus. The benchmark levels, as well as the state and federal standards and recommendations, are found in **Table 2.4-5.**

Table 2.4-5: Virginia Criteria and Federal Water Quality Recommendations

Parameter Tested	Virginia	EPA Recommendations
Ammonia (mg/L; varies based on pH)	1.32 – 48.8	None
Conductivity (µS/cm)	250*	None
Nitrate Nitrogen (mg/L)	None	0.89
Nitrite Nitrogen (mg/L)	None	0.01
Nitrogen (Total) (mg/L)	1.5*	0.69
Phosphorus (Total) (mg/L)	0.05*	0.037
Orthophosphate (mg/L)	None	None
E. coli (cfu/100mL; monthly geometric mean)	126	None

* Threshold level used by VDEQ as a cutoff for reference, or least-degraded, stream conditions.

Source: 9VAC25-260 Water Quality Standards, EPA Ambient Water Quality Criteria Recommendations, 2000, and VDEQ 2006 Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index.

2.4.2 Existing Conditions

A. Surface Waters and Watershed Characteristics

Within Virginia, the entirety of the corridor study boundary crosses the Potomac River drainage basin in Fairfax County. More specifically, the corridor study boundary crosses the Middle Potomac watersheds, comprised of the Bull Neck Run, Scotts Run, Dead Run, Turkey Run, and Pimmit Run subwatersheds (FCDPWES, 2008). For the purposes of this document, only streams within the Fairfax County Middle Potomac watersheds that cross the corridor study boundary are discussed. These subwatersheds include the Scotts Run and Dead Run watersheds. Characteristics of the Fairfax County Middle Potomac watersheds are detailed below and summarized in **Table 2.4-6**.

Table 2.4-6: Virginia Watershed Characteristics Summary

Watershed	Drainage Area (Square Miles)	Class	303(d) Impairments Listings	
			Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
Fairfax County Middle Potomac Watersheds	9[1]	III	None	Unknown pollutants in Dead Run (based benthic IBIs)

[1]Drainage area for the Scotts Run and Dead Run subwatersheds

Within Maryland, the majority of the corridor study boundary crosses the Potomac River drainage basin, with the eastern-most portion of the corridor study boundary, between approximately US 50 and MD 4, crossing the Patuxent River drainage basin. Within the Potomac River drainage basin, the corridor study boundary crosses the state-designated Washington Metropolitan watershed (MDE 6-digit watershed), encompassing the Potomac River-Montgomery County, Cabin John Creek, Rock Creek, Anacostia River, Potomac River Upper Tidal, and Oxon Creek subbasins (MDE 8-digit watersheds). Within the state-designated Patuxent River watershed (MDE 6-digit watershed), the corridor study boundary crosses the Western Branch subbasin (MDE 8-digit watershed).

Each subbasin that crosses the corridor study boundary in Maryland contains numerous smaller watersheds (MDNR 12-digit). For the purposes of this document, only streams with watersheds that cross the corridor study boundary are discussed. These watersheds include Potomac River/Rock Run, Cabin John Creek, Rock Creek, Sligo Creek, Northwest Branch of the Anacostia River (Northwest Branch), Paint Branch, Little Paint Branch, Northeast Branch, Bald Hill Branch, Upper Beaverdam Creek, Upper Southwest Branch, Lower Southwest Branch of the Western Branch of the Patuxent River (Lower Southwest Branch), Upper Henson Creek, Watts Branch, and Muddy Branch. Characteristics of Maryland watersheds are detailed below and summarized in **Table 2.4-7**. Watershed locations are shown in **Appendix K**.

The only delineated tributaries within the corridor study boundary which also drain to Tier II waters were identified in the Bald Hill Branch and Beaverdam Creek – Northeast Branch watersheds. The Piscataway Creek 12-digit watershed does not intersect the corridor study boundary. A small portion of the Piscataway Creek Tier II watershed intersects the corridor study boundary. This is due to discrepancies between the 12-digit and Tier II geospatial datasets. However, no wetlands or waterways features were identified in the corridor study boundary within the limits of the Piscataway Tier II watershed.

Table 2.4-7: Watershed Characteristics Summary

MDE Watershed			Drainage Area (Square Miles)	Designated Use	303(d) Impairments Listings	
6-digit Name	8-digit Name	12-digit Name (Number)[1]			Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
Potomac River – Washington Metropolitan	Potomac River – Montgomery County	Potomac River/Rock Run (021402020845)	15	I-P	Total suspended solids	Chlorides and sulfates in first through fourth order streams; pH[2] and polychlorinated biphenyls in fish tissue in the Potomac River mainstem
	Cabin John Creek	Cabin John Creek (021402070841)	26	I-P	Total suspended solids; Escherichia coli	Chlorides; sulfates
	Rock Creek	Rock Creek (021402060836)	18	I	Total suspended solids; phosphorus; Enterococcus	None
	Anacostia River	Sligo Creek (021402050821)	11	I	Biochemical oxygen demand; Enterococcus; nitrogen; polychlorinated biphenyls; phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams
		Northwest Branch (021402050818)	25	I[3]; IV	Biochemical oxygen demand; Enterococcus; nitrogen; polychlorinated biphenyls (Northwest Branch mainstem only); phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams; heptachlor epoxide in the Northwest Branch mainstem
		Paint Branch (021402050826)	18	I; III	Biochemical oxygen demand; Enterococcus; nitrogen; polychlorinated biphenyls (Paint Branch mainstem only); phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams
		Little Paint Branch (021402050825)	11	I	Biochemical oxygen demand; Enterococcus; nitrogen; phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams
		Northeast Branch (021402050822)	22	I	Biochemical oxygen demand; Enterococcus; nitrogen; polychlorinated biphenyls (Northeast Branch and Paint Branch mainstems only); phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams
Patuxent River	Western Branch	Bald Hill Branch (021311030928)	6	I	None	Unknown pollutants in first through fourth order streams (based on fish and benthic IBIs)
Potomac River – Washington Metropolitan	Potomac River – Montgomery County	Upper Beaverdam Creek (021402050816)	8	I	Biochemical oxygen demand; Enterococcus; nitrogen; phosphorus; total suspended solids; trash	Chlorides and sulfates in first through fourth order streams
Patuxent River	Western Branch	Upper Southwest Branch (021311030924)	11	I	None	Unknown pollutants in first through fourth order streams (based on fish and benthic IBIs)
		Lower Southwest Branch (021311030922)	5	I	None	Unknown pollutants in first through fourth order streams (based on fish and benthic IBIs)
Potomac River – Washington Metropolitan	Potomac River Upper Tidal	Upper Henson Creek (021402010797)	12	I	None	Unknown pollutants in first through fourth order streams (based on fish and benthic IBIs)
	Potomac River – Montgomery County	Watts Branch (021402020846)	22	I	Total suspended solids	Chlorides and sulfates in first through fourth order streams
		Muddy Branch (021402020848)	20	I-P; III-P	Total suspended solids	Chlorides and sulfates in first through fourth order streams

[1] 12-digit watersheds listed by their location relative to the corridor study boundary from west to east along I-495 and south to north along I-270.
[2] The Category 5 impairment listing for high pH is based on data collected well upstream of the 12-digit Potomac River/Rock Run watershed.
[3] The only portion of the 12-digit Northwest Branch watershed that contains Use I waters is located well downstream of the study corridors, near the border of Maryland and Washington, DC.
Sources: MDE, 2018a; MDE, 2018b

a. Fairfax County Middle Potomac Watersheds

The Fairfax County Middle Potomac watersheds drain approximately 26 square miles in Fairfax County, Virginia and are comprised of the Bull Neck Run, Scotts Run, Dead Run, Turkey Run, and Pimmit Run subwatersheds (FCDPWES, 2008). The Scotts Run and Dead Run subwatersheds are crossed by the corridor study boundary. Within Virginia, the majority of the corridor study boundary crosses the Scotts Run subwatershed, which drains the I-495 corridor from Leesburg Pike to the Potomac River. A small section of the corridor study boundary, just north of Georgetown Pike, crosses the Dead Run subwatershed to the east. Characteristics of these two Fairfax County Middle Potomac watersheds are summarized in **Table 2.4-6**.

The Scotts Run subwatershed drains approximately 6 square miles, with its headwaters beginning slightly outside of the corridor study boundary in Tysons Corner (FCDPWES, 2008). Flowing northeast, the Scotts Run mainstem parallels I-495 and gradually turns north to intersect Georgetown Pike, eventually joining the Potomac River on the western side of Scott's Run Nature Preserve. The subwatershed is 25 percent impervious, and 9 percent of the land use is vacant/undeveloped (USGS, 2019). Dominant land uses include residential, open space/parks/recreational areas, road ROWs, and commercial. The 2008 Fairfax County Middle Potomac Watersheds Management Plan describes the majority of the in-stream habitat quality in the Scotts Run subwatershed as Fair. Scotts Run was also noted as having inadequate riparian buffers that are less than 100 feet wide or with non-native, non-diversified, or insufficient vegetation. Several unnamed tributaries drain directly into the Potomac River between the Scotts Run mainstem and I-495. These tributaries drain approximately 1 square mile within the Scotts Run Nature Preserve, bound by Georgetown Pike to the south and I-495 to the east. For these unnamed Potomac River direct tributaries, the land use is 46 percent open space/parks/recreational areas, with other dominant land uses including residential, commercial, and vacant/undeveloped (FCDPWES, 2008).

The Dead Run subwatershed drains an area of approximately 3 square miles, entirely to the east of the I-495 corridor (FCDPWES, 2008). The headwaters begin just upstream of McLean Central Park, north of the intersection of Dolley Madison Boulevard and Old Dominion Drive. The Dead Run mainstem flows north, intersecting Georgetown Pike and George Washington Memorial Parkway and joining the Potomac River to the east of I-495. The Dead Run subwatershed is 25 percent impervious and 3 percent vacant/undeveloped. Dominant land uses include open space/parks/recreational areas, residential, commercial, and road right-of-way. The 2008 Fairfax County Middle Potomac Watersheds Management Plan describes the majority of the habitat quality in the Dead Run subwatershed as Fair, while having inadequate riparian buffers that are less than 100 feet wide or with non-native, non-diversified, or insufficient vegetation.

Within the vicinity of the corridor study boundary, all streams in the Fairfax County Middle Potomac watersheds are designated as Class III waters (nontidal waters). In addition to aquatic life protections, Virginia has also designated the waters within the vicinity of the corridor study boundary for the protection of public water supply. There are no completed TMDLs for the Fairfax County Middle Potomac watersheds within the vicinity of the corridor study boundary, but Dead Run has a Category 5 impairment listing for aquatic life based on benthic macroinvertebrate bioassessments (VDEQ, 2016).

b. Potomac River/Rock Run

The Potomac River/Rock Run watershed (MDE 12-digit: 021402020845), hereafter referred to as Rock Run, is located within the Piedmont Plateau physiographic province, within and extending south of Potomac, Maryland. The Rock Run watershed crosses the northwestern portion of the corridor study boundary extending from the Potomac River to just east of Seven Locks Road. The MDE 12-digit watershed drains an area of 15 square miles, entirely within Montgomery County (MDE, 2018b). Within the vicinity of the corridor study boundary, Rock Run and several unnamed tributaries drain into the Chesapeake and Ohio (C&O) Canal or directly into the Potomac River near the head of tide.

Near the headwaters of the Rock Run watershed is a major commercial area, Potomac Village, and the rest of the watershed is dominated by low-density, large-lot residential development and steep, wooded stream valleys (M-NCPPC, 2002). Impervious surfaces, primarily roads and rooftops, comprise approximately 11 percent of the Rock Run watershed, and are mostly located along the Potomac River south of Great Falls, Maryland, and within the Avenel Farm in Potomac, Maryland (MCDEP, 2011). The watershed is 38 percent forested with much of the contiguous forest cover located within public parks or along waterways (MCDEP, 2011; M-NCPPC, 2002). As of 2011, at least 60 percent of the Rock Run watershed had a minimum riparian buffer of 100 feet; however, only a small portion is protected by park land (MCDEP, 2011; M-NCPPC, 2002).

Aquatic habitat within the Rock Run watershed is generally Good due to forested stream valleys and relatively recent development (MCDEP, 2011). Despite generally Good habitat, a 2011 MCDEP report indicated that fish and benthic macroinvertebrate communities were generally Fair or Poor (MCDEP, 2011). While the Rock Run watershed is predominantly residential land use, historic land uses were associated with gold-mining practices. Legacy sediments from this historic land use and runoff from recent development have resulted in impaired stream conditions (MCDEP, 2011).

All Rock Run watershed streams in the vicinity of the corridor study boundary are classified as Use I-P (water contact recreation, protection of aquatic life, and public water supply). As part of the greater Potomac River-Montgomery County watershed, the Rock Run watershed currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams and for polychlorinated biphenyls in fish tissue in the Potomac River mainstem. Upstream of the 12-digit Rock Run watershed, the Potomac River Montgomery County watershed also has a Category 5 listing for high pH on the Potomac River mainstem (MDE, 2018a).

c. Cabin John Creek

The Cabin John Creek watershed (MDE 12-digit: 021402070841) runs parallel to the corridor study boundary, with its headwaters beginning just south of MD 28 and continuing until it joins the Potomac River at the intersection of Cabin John Parkway and Clara Barton Parkway. The MDE 12-digit Cabin John Creek watershed drains approximately 26 square miles, entirely within Montgomery County (MDE, 2018b). Of the major tributaries to Cabin John Creek, Bogley Branch, Old Farm Creek, Thomas Branch, and Booze Creek flow within the vicinity of the corridor study boundary.

Because of its proximity to the corridor study boundary, land use within the Cabin John Creek watershed has been subject to urban development and is comprised of approximately 21 percent impervious surfaces. Over 70 percent of the land cover is residential, followed by 13 percent municipal/institutional, and seven percent roadway (MCDEP, 2012a). Due to the presence of Montgomery County's stream valley park system, some riparian zone protection exists throughout the watershed, but only five percent of the land cover is considered forest (MCDEP, 2012a).

The mainstem of Thomas Branch was assessed and delineated from River Road to just North of Democracy Boulevard. The entire headwaters of the stream is contained in a stormwater pond located just outside of the corridor study boundary, northeast of the Democracy Boulevard and I-270 interchange. Thomas Branch is a highly-restricted stream system confined by concrete trapezoidal channels; bedrock; sheet pile soundwalls; high, steep valley walls; and residential development. I-495 was constructed in the center of the narrow, steep-sided Thomas Branch stream valley and a large portion of the stream was relocated to build the current alignment of I-495. The majority of Thomas Branch is characterized by a high level of bank erosion where the banks are not armored; a shallow, wide channel incised in some areas with sheer 15-foot banks; bedrock blockages to aquatic life passage; little instream habitat; low head dams; concrete trapezoidal channels, integrated concrete weirs, and riprap; and sheet pile walls abutting the stream or at the top of its banks.

Inorganic pollutants are present in roughly 95 percent of the Cabin John Creek stream miles and have led to the degradation of the watershed's biological communities (MDE, 2012a). With respect to stream resources, around 83 percent of the stream miles in the Cabin John Creek watershed were assessed as Fair, and the remaining 17 percent were assessed as Poor (MCDEP, 2012a). All Poor stream resource conditions were found in the Booze Creek and Thomas Branch subwatersheds, in the vicinity of the corridor study boundary. Other anthropogenic influences, such as channelization and flow/sediment impacts, have led to degraded water quality and current TMDL impairments. Over half of the degraded stream miles in the Cabin John Creek watershed are channelized (MDE, 2012a).

All streams within the Cabin John Creek watershed are classified as Use I-P waters (MDE, 2012a). Cabin John Creek currently has TMDLs for total suspended solids and Escherichia coli concentrations, and Category 5 impairment listings for chlorides and sulfates (MDE, 2018a).

d. Rock Creek

The greater MDE 8-digit Rock Creek watershed (MDE 8-digit: 02140206) begins in Laytonsville, Maryland and flows approximately 21 miles through the Piedmont Plateau physiographic province before entering Washington, DC and eventually joining the Potomac River. The MDE 12-digit Rock Creek watershed (MDE 12-digit: 021402060836) is located entirely within Montgomery County and has a drainage area of 18 square miles (MDE, 2018b). It crosses the central portion of the corridor study boundary, approximately bound by MD 187 to the west and MD 97 to the east.

Impervious surfaces, including primarily rooftops, paved roads, and parking lots, comprise approximately 21 percent of the greater Rock Creek watershed within Maryland (MDE, 2012c; MCDEP, 2012c). The Maryland portion of the watershed is heavily developed, with 75 percent urban land use and 16 percent forested cover (MDE, 2012c). The greatest development densities occur in the lower portions of the watershed in southern Montgomery County, within and adjacent to the corridor study boundary. Within the vicinity of the corridor study boundary, the majority of the forested area exists as a riparian corridor around waterways, within protected county stream valley parks.

In 2012, 53 percent of Rock Creek was rated as having Fair overall stream conditions, based on assessments of physical and biological parameters (MCDEP, 2012c). The least degraded portion of the greater Rock Creek watershed is upstream of MD 28, where development densities are lower and stream conditions range from Fair to Good (MCDEP, 2012c). Downstream of MD 28, where the study corridors are located, the watershed is highly developed, densely populated, and stream quality is more degraded, with stream conditions ranging from Fair to Poor (MCDEP, 2012c). Many of the developed areas in the southern portion of the watershed lack stormwater BMPs, leading to unmitigated flows that have negatively impacted Rock Creek and its tributaries. Other anthropogenic influences including dams and old sanitary sewer pipes have created barriers to aquatic life passage and prevent Rock Creek from fully functioning in a natural state (DDOE, 2010; MDNR, 2016).

The mainstem of Rock Creek, totaling approximately 14,000 LF within the corridor study boundary, was visually assessed and delineated within the corridor study boundary from Jones Mills Road to Grosvenor Lane. Rock Creek is a highly mobile perennial stream system with a wide floodplain and a deeply incised channel with eroding clay banks of 1:1 and 2:1 slopes. The delineated portion of Rock Creek is twenty to forty feet wide; 0.5 to 6-feet deep; with moderate to severe bank erosion; and silts, cobbles, sands, gravels, muck, and concrete substrates. The stream has a man-altered channel shape in some areas and a natural channel shape in others. 1963 USDA Farm Service Agency aerial imagery indicates that Rock Creek historically flowed adjacent to much of the current alignment of I-495 but flowed over two areas of what is now roadway. These two segments of the stream were re-located when the interstate was built. The portion of Rock Creek that flows within the study corridors is located within Maryland-National Capital Park and Planning Commission (M-NCPPC) parkland, with many park amenities located in its forested floodplain. Rock Creek often erodes below the root line of trees on its banks, causing the trees to fall and resulting in rapid bank erosion and downstream debris jams. In several areas, large boulders and rock have been placed to prevent lateral migration of the stream towards the interstate; the stream has been armored to reinforce banks at sewer crossings; and matting and rock have been placed to stabilize the channel and protect Beach Drive.

In the vicinity of the corridor study boundary, all streams within the Rock Creek watershed are classified as Use I waters (water contact recreation and protection of nontidal warmwater aquatic life). The Rock Creek watershed currently has TMDLs for phosphorus, Enterococcus, total suspended solids, and no Category 5 impairment listings (MDE, 2018a).

e. Sligo Creek

The Sligo Creek watershed (MDE 12-digit: 021402050821) crosses the central portion of the corridor study boundary between MD 192 to the west and MD 193 to the east. Sligo Creek begins in the Piedmont Plateau physiographic province and ends in the Atlantic Coastal Plain physiographic province where the mainstem joins the Northwest Branch, west of Hyattsville, Maryland. The MDE 12-digit Sligo Creek watershed has a drainage area of 11 square miles (MDE, 2018b), spanning Montgomery County, Prince George's County, and Washington, DC. Approximately 75 percent of the watershed area falls within Montgomery County (Galli et al., 2010).

Ninety percent of the Sligo Creek watershed is developed, with the majority of land cover consisting of medium and high-density residential land uses. Only 19 percent of the watershed is forested (Galli et al., 2010). Due to this high level of development, impervious surfaces comprise approximately 34 percent of the watershed, and only approximately 21 percent of these impervious surfaces have SWM controls using BMPs, most of which are located within the upper portion of the Sligo Creek watershed (Galli et al., 2010). Poor water quality and degraded stream conditions documented by various agencies within the Sligo Creek watershed are likely due to inadequate SWM controls, non-point source pollution from impervious runoff, nutrient loading, and stream channel erosion (Galli et al., 2010). In addition, only approximately 35 percent of the 22 stream miles have a riparian buffer, defined as a buffer that is at least 300 feet wide (Galli et al., 2010). Immediately upstream of the corridor study boundary, however, the mainstem of Sligo Creek is largely forested within Sligo Creek Stream Valley Park. Despite having relatively degraded conditions overall, improvements relative to historic stream conditions have been documented in the last decade in upper Sligo Creek where restoration efforts have successfully improved aquatic habitat and fish communities (Galli et al., 2010; EPA, 2012).

All streams within the Sligo Creek watershed are classified as Use I waters. As part of the Anacostia River watershed, Sligo Creek currently has TMDLs for biochemical oxygen demand, Enterococcus, nitrogen, polychlorinated biphenyls, phosphorus, total suspended solids, and trash, and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

f. Northwest Branch

The Northwest Branch watershed (MDE 12-digit: 021402050818) crosses the central portion of the corridor study boundary, between MD 516 to the west and MD 650 to the east. Within Maryland, approximately 80 percent of its drainage area is in Montgomery County, while the remaining 20 percent is in Prince George's County (MDE, 2006). The Northwest Branch watershed begins near Sandy Spring and continues south until the confluence with Northeast Branch near Bladensburg. The MDE 12-digit Northwest Branch watershed drains approximately 25 square miles, which includes a small component drainage area in Washington, DC (MDE, 2018b).

According to 2006 National Land Cover Data, land use in the Northwest Branch watershed is 64 percent urban, 24 percent forest, and 6 percent agricultural (MDE, 2011). On average, approximately 19 percent of the greater Northwest Branch watershed is comprised of impervious surfaces (Galli et al., 2010). Within the vicinity of the corridor study boundary, however, the mainstem of the Northwest Branch flows through the Northwest Branch Stream Valley Park and is largely forested.

The entire Northwest Branch watershed upstream of MD 410 (East-West Highway) is designated as Use IV recreational trout waters. In the Northwest Branch mainstem, the MDNR typically releases roughly 5,000 brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) in March and April, resulting in a popular put-and-take trout fishery (MDNR, 2018b). At the very downstream extent of the 12-digit watershed, well downstream of the corridor study boundary, a small portion of the watershed contains Use I waters.

The 2008 MDE Integrated Report lists the Anacostia River watershed, including Northwest Branch, under Category 5 as impaired for biological community impacts. Approximately 95 percent of stream miles in the Anacostia River watershed are estimated to have fish and and/or benthic communities rated in the Very Poor to Poor range (MDE, 2012b). In general, less degraded biological conditions are found in the northern portions of the watershed, well upstream of the corridor study boundary. Chemical and physical stressors caused by urban development, which increases in density lower in the watershed, have led to degraded habitats for aquatic organisms, especially in downstream portions of the watershed (Miller et al., 2013).

As part of the Anacostia River watershed, Northwest Branch currently has TMDLs for Enterococcus, phosphorus, total suspended solids, trash, nitrogen, and biochemical oxygen demand and polychlorinated biphenyls in the Northwest Branch mainstem. The Northwest Branch watershed also has Category 5 impairment listings for heptachlor epoxide in the mainstem, and chlorides and sulfates in first through fourth order streams (MDE, 2018a).

g. Paint Branch

The Paint Branch watershed (MDE 12-digit: 021402050826) is located just east of Northwest Branch and crosses the central portion of the corridor study boundary, between MD 212 and Cherry Hill Road. Paint Branch originates near Cloverly, Maryland, flowing south to join Indian Creek just south of College Park to form the Northeast Branch of the Anacostia River. The MDE 12-digit Paint Branch watershed drains approximately 18 square miles (MDE, 2018b), and the greater Paint Branch watershed, including the MDE 12-digit watershed and downstream to the confluence with Indian Creek, is approximately 17 percent impervious (Galli et al., 2010). Montgomery County contains 72 percent of the greater Paint Branch watershed, with the remaining 28 percent falling in Prince George's County. Dominant land uses within the greater Paint Branch watershed include 42 percent residential, 26 percent forested, 12 percent agricultural, 10 percent institutional, and 5 percent parkland (EoPB, 2012).

The Paint Branch watershed is one of the least densely developed watersheds in the Anacostia drainage (Galli et al., 2010). Roughly half of Paint Branch has forested parkland that provides a substantial riparian buffer, predominantly in the upper two-thirds of the watershed where additional protections from development in the stream's headwaters have been instituted in the form of the Upper Paint Branch Special Protection Area (MCDEP, 1999). The headwaters of Paint Branch are renowned for supporting the only self-sustaining brown trout population in the Washington Metro area (MCDEP, 1999), and aquatic communities in the upper watershed are relatively un-impacted. The majority of stream miles of Paint Branch have adequate riparian buffers; however, sections of the Paint Branch watershed downstream of I-495 suffer from moderate to severe erosion, and riparian buffers in the lower portion of the watershed are generally only 35 to 50 feet wide (Galli et al., 2010). The Paint Branch Subwatershed Action Plan (Galli et al., 2010), indicates that the lower and middle reaches of the Paint Branch watershed within Montgomery County have aquatic biotic communities ranging from Poor to Good. Sampling results in Prince George's County within and downstream of the corridor study boundary indicated impaired stream conditions in the lower portions of the watershed, with a 62 percent increase in degradation over approximately ten years (M-NCPPC, 2015). Within the greater Paint Branch watershed, aquatic life passage has been impacted by road crossings and exposed utility lines due to erosion. As of 2009, approximately 35 fish blockages were present within the greater Paint Branch watershed; however, numerous efforts to improve aquatic connectivity within the watershed have been undertaken and continue to be implemented (Galli et al., 2010).

The mainstem of Paint Branch meanders through the I-95 interchange with I-495 and is box culverted under the interstate. Paint Branch is approximately thirty feet wide and has good instream habitat diversity, including shallow riffles, deep pools, and fast, relatively deep runs. There is instream cover for fish including woody debris and large rock within the stream channel. Bank stability is variable, but relatively good with a forested riparian zone.

Paint Branch is classified as Use III waters (nontidal cold water) upstream of I-495 and Use I waters downstream of I-495. As part of the Anacostia River watershed, the Paint Branch watershed currently has TMDLs for Enterococcus, phosphorus, total suspended solids, trash, nitrogen, and biochemical oxygen demand. In addition, the Paint Branch mainstem has a TMDL for polychlorinated biphenyls. The Paint Branch watershed also has Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

h. Little Paint Branch

The Little Paint Branch watershed (MDE 12-digit: 021402050825) is located within the upper section of the Anacostia River watershed, originating near MD 198. The watershed crosses the central portion of the corridor study boundary and is bound approximately by Cherry Hill Road to the west and US 1 to the east. The Little Paint Branch watershed begins in the Piedmont Plateau physiographic province and ends in the Atlantic Coastal Plain physiographic province where it joins Paint Branch to the west of Beltsville, Maryland. The MDE 12-digit Little Paint Branch watershed has a drainage area of 11 square miles and is nearly equally divided between Montgomery and Prince George's Counties (MCDEP, 1997; Galli et al., 2010; MDE, 2018b).

Dominant land uses within the Little Paint Branch watershed include approximately 37 percent residential, 31 percent forest cover, 20 percent impervious, and 11 percent agricultural (primarily the USDA Beltsville Agricultural Research Center (BARC); Galli et al., 2010). Development covers approximately half of the watershed, and the least developed areas occur upstream of the corridor study boundary, above Greencastle Road and along the Montgomery/Prince George's County border in the Little Paint Branch Stream Valley Park (Galli et al., 2010). There is an adequate (greater than 300 feet wide) forest buffer along 48 percent of the stream miles (Galli et al., 2010), with the largest areas of forest found predominantly in the upper half of the watershed (MCDEP, 1997; Galli et al., 2010).

The 2009 Little Paint Branch Subwatershed Action Plan indicates that upper portions of the Little Paint Branch generally remain in Good condition; however, conditions decline rapidly downstream within the vicinity of the corridor study boundary, as many portions of the watershed were developed before stormwater control was required. Physical barriers to diadromous fishes exist throughout Little Paint Branch and its tributaries (Galli et al., 2010).

All tributaries within the Little Paint Branch watershed are classified as Use I waters. As part of the Anacostia River watershed, Little Paint Branch currently has TMDLs for biological oxygen demand, Enterococcus, nitrogen, phosphorus, total suspended solids, and trash, and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

i. Northeast Branch

The MDE 12-digit Northeast Branch watershed (MDE 12-digit: 021402050822) is located in Prince George's County within the northeastern section of the Anacostia River watershed and has a drainage area of approximately 22 square miles (MDE, 2018b). This watershed is part of the greater Northeast Branch watershed and is made up of the Indian Creek drainage, as well as Still Creek, Brier Ditch and the

Northeast Branch mainstem. The greater Northeast Branch watershed has a drainage area of 75 square miles and also includes Paint Branch, Little Paint Branch, and Beaverdam Creek, which are located to the west and south of the Northeast Branch 12-digit watershed discussed in this section. Paint Branch, Little Paint Branch, and Beaverdam Creek are discussed separately in **Section 2.4.2.A**. The MDE 12-digit Northeast Branch watershed begins at the confluence of Paint Branch and Little Paint Branch to the northwest and the confluence of Indian Creek and Beaverdam Creek to the north and crosses the central portion of the corridor study boundary, bound by US 1 to the west and MD 450 to the southeast. Downstream, Paint Branch and Indian Creek combine to form the Northeast Branch, and flow continues through the confluence with Brier Ditch until the mainstem joins the Northwest Branch, forming the Anacostia River (**Appendix K**).

The Indian Creek subwatershed drains approximately 15.1 square miles, which includes the portion within the Northeast Branch 12-digit watershed and the Indian Creek 12-digit watershed upstream (MDE 12-digit: 021402050824) (Galli et al., 2010). The watershed is fairly developed (approximately 70 percent urbanized), with dominant land uses including medium-density single-family residential, industrial, and agricultural areas (Galli et al., 2010). The watershed is approximately 31 percent forested with approximately 30 percent of streams having a riparian buffer that is at least 300 feet wide (Galli et al., 2010). Impervious surfaces including roads, parking lots, and roofs, comprise approximately 22 percent of the Indian Creek watershed, and of this impervious area, only 23 percent is controlled by BMPs (Galli et al., 2010). The 2009 Indian Creek Subwatershed Action Plan summarized the watershed as generally having Poor water quality and physical habitat conditions, with only the lower mainstem containing areas with Good aquatic habitat (Galli et al., 2010). Benthic macroinvertebrate communities are generally degraded; however, fish communities are less degraded, likely due to less-degraded upstream conditions (Galli et al., 2010).

Upstream of the Northeast Branch 12-digit watershed, Indian Creek splits to form Indian Creek and Beaverdam Creek – Northeast Branch. The Beaverdam Creek – Northeast Branch watershed (MDE 12-digit: 021402050823) was designated as Tier II (High Quality) waters in 2007, based on baseline data collected by MBSS in 1997. Beaverdam Creek – Northeast Branch is currently listed as having assimilative capacity. As discussed in **Section 2.4.1, Regulatory Context and Methods**, Tier II waters are afforded additional antidegradation protections to ensure that these high-quality waters are maintained when permits for wetlands and waterways impacts are issued. The majority of Beaverdam Creek – Northeast Branch and its adjacent floodplain is also a Wetland of Special State Concern. A small portion of the corridor study boundary intersects the outskirts of this Tier II watershed.

The Still Creek subwatershed drains approximately 3.8 square miles and is located entirely within the Northeast Branch 12-digit watershed (Galli et al., 2010). The Still Creek watershed is approximately 66 percent urbanized and dominant land uses include parkland, medium density single family residential, and high-density single-family residential areas (Galli et al., 2010). Despite considerable urbanization, the Still Creek watershed remains approximately 51 percent forested and 70 percent of streams have a riparian buffer that is at least 300 feet wide (Galli et al., 2010). Impervious surfaces comprise approximately 19 percent of the watershed, with BMPs controlling approximately 18 percent (Galli et al., 2010). The 2009 Still Creek Subwatershed Action Plan classified the watershed as generally having degraded water quality and aquatic habitat conditions (Galli et al., 2010).

The Brier Ditch subwatershed drains approximately 4.1 square miles and is also located entirely within the Northeast Branch 12-digit watershed (Galli et al., 2010). The watershed is 66 percent urbanized and dominant land uses include medium-density single-family residential, parkland, and high-density single-family residential areas (USGS, 2018; Galli et al., 2010). The Brier Ditch watershed is roughly 29 percent forested and about 13 percent of streams have a riparian buffer that is at least 300 feet wide (Galli et al., 2010). Impervious surfaces account for approximately 29 percent of the watershed, with less than one percent controlled by BMPs (Galli et al., 2010). The 2009 Brier Ditch Subwatershed Action Plan reported water quality conditions throughout the watershed, including fish and benthic macroinvertebrate communities, as generally degraded (Galli et al., 2010).

The Lower Northeast Branch mainstem subwatershed drains approximately 7.2 square miles and is located within the Northeast Branch 12-digit watershed, downstream of Still Creek and Brier Ditch (Galli et al., 2010). The watershed is highly developed with urban land uses, including residential and commercial uses, comprising approximately 95 percent of the watershed (Galli et al., 2010). The Lower Northeast Branch mainstem watershed is approximately 23 percent forested and roughly 13 percent of streams have an adequate riparian buffer (Galli et al., 2010). Impervious surfaces comprise approximately 37 percent of the watershed, with 5 percent controlled by BMPs (Galli et al., 2010). The 2009 Northeast Branch Subwatershed Action Plan characterizes water quality throughout the Lower Northeast Branch mainstem watershed as Poor with substantially degraded habitats from historic conditions (Galli et al., 2010). Benthic macroinvertebrate conditions are also generally degraded throughout the watershed, while fish communities are degraded in upstream tributaries and less degraded within the mainstem (Galli et al., 2010).

All 12-digit Northeast Branch watershed streams within the vicinity of the corridor study boundary are classified as Use I waters. As part of the Anacostia River watershed, Northeast Branch currently has TMDLs for biological oxygen demand, Enterococcus, nitrogen, phosphorus, total suspended solids, and trash, as well as for polychlorinated biphenyls in the mainstem. Northeast Branch also has Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

j. Bald Hill Branch

The Bald Hill Branch watershed (MDE 12-digit: 021311030928) drains approximately 6 square miles within the Atlantic Coastal Plain physiographic province of Prince George’s County (MDE, 2018b). The majority of Bald Hill Branch falls to the east of the corridor study boundary, but the western edge of the watershed drains areas bordering I-495, between MD 202 and MD 450. The mainstem of Bald Hill Branch flows from north to south, generally parallel to I-495, eventually joining the Western Branch of the Patuxent River near Mitchellville, Maryland.

With an average imperviousness of 22 percent, Bald Hill Branch is the most highly developed Western Branch subwatershed and has the second highest percentage of impervious area of Western Branch subwatersheds (MDNR, 2003). Land uses within the watershed include approximately 77 percent developed land, 20 percent forest, and three percent agriculture (MDNR, 2003).

While fish blockages are not prevalent in Bald Hill Branch, physical barriers to migratory fishes exist downstream on the mainstem of Western Branch (MDNR, 2003). Approximately 72 percent of the greater Bald Hill Branch stream miles are degraded, based on modeling using Indices of Biotic Integrity (IBIs) and aquatic habitat data (M-NCPPC, 2017). However, the mainstem of Bald Hill Branch was designated as Tier II (High Quality) waters in 2007, based on baseline data collected by MBSS in 1997. At the time of the listing, Bald Hill Branch was also identified as having no assimilative capacity due to more current sampling showing degradation relative to the initial 1997 listing data. As discussed in **Section 2.4.1, Regulatory Context and Methods**, these waters are afforded additional antidegradation protections to ensure that these high-quality waters are maintained when permits for wetlands and waterways impacts are issued.

All streams within the Bald Hill Branch watershed are classified as Use I waters. As part of the Western Branch watershed, Bald Hill Branch currently has no completed TMDLs, but has a Category 5 impairment listing for unknown pollutants in first through fourth order streams, based on fish and benthic IBIs (MDE, 2018a).

k. Upper Beaverdam Creek

The Upper Beaverdam Creek watershed (MDE 12-digit: 021402050816) has a drainage area of 8 square miles and crosses the central portion of the corridor study boundary, bound generally by MD 450 to the north and MD 202 to the south (MDE, 2018b). The upstream portion of the Upper Beaverdam Creek watershed near I-495 is comprised of two main, free-flowing waterbodies: Beaverdam Creek and Cattail Branch. Below the confluence of these two tributaries, Beaverdam Creek flows into the Anacostia River in Washington, DC, roughly a quarter of a mile downriver from the Maryland state line.

The Upper Beaverdam Creek watershed is located entirely within Prince George's County. The greater Beaverdam Creek watershed is a heavily populated urban landscape with an average imperviousness of 32 percent (Galli et al., 2010). Dominant land uses within the greater Beaverdam Creek watershed include 41 percent residential, 24 percent industrial and transportation, seven percent commercial (Galli et al., 2010), and 25 percent forested (Galli et al., 2010). Approximately 20 percent of the 27 miles of stream in the greater Beaverdam Creek watershed has a riparian buffer that is at least 300 feet wide (Galli et al., 2010).

Like many developed watersheds, aging wastewater infrastructure, impervious surface runoff, and legacy pollutants contribute to degraded stream water quality. Physical barriers to migratory fishes exist throughout Beaverdam Creek and its tributaries, and many of the remaining streams have been channelized or piped underground. As of 2009, approximately 33 percent of the daylighted streams exhibit moderate to severe channel erosion and overall stream conditions are generally Poor, based on monitoring of habitat and aquatic communities (Galli et al., 2010).

All streams within the Upper Beaverdam Creek watershed are classified as Use I waters. As part of the Anacostia River watershed, Upper Beaverdam Creek currently has TMDLs for biological oxygen demand, Enterococcus, nitrogen, phosphorus, total suspended solids, and trash, and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

l. Upper Southwest Branch

The Upper Southwest Branch watershed (MDE 12-digit: 021311030924) has a drainage area of 11 square miles (MDE, 2018b) and is located within the mid-western section of the Western Branch watershed. The watershed crosses the southeastern portion of the corridor study boundary, bound approximately by MD 202 to the north and MD 214 to the south. The Upper Southwest Branch watershed is located within the Atlantic Coastal Plain physiographic province of Prince George's County and includes Ritchie Branch, along with other unnamed tributaries. Southwest Branch joins the Western Branch east of Largo, Maryland, before flowing into the Patuxent River mainstem in Upper Marlboro, Maryland.

The Upper Southwest Branch watershed is one of the most developed watersheds contributing to the Western Branch drainage, with impervious surfaces comprising approximately 25 percent of the watershed (MDNR, 2003). Nearly 30 percent of the Upper Southwest Branch watershed is forested, and the majority of forested areas are located upstream of the corridor study boundary in the central and western portions of the watershed (PGDoE, 2004; MDNR, 2003). However, the City of District Heights is also located in the western portion of the watershed, contributing to substantial development in the headwaters.

The Upper Southwest Branch watershed is heavily urbanized, and based on a 2003 report, aquatic conditions and biotic communities were generally degraded within the greater Southwest Branch watershed (PGDoE, 2004; MDNR, 2003). The Upper Southwest Branch received the worst overall condition score out of all Western Branch subwatersheds, resulting in its designation as a priority restoration watershed (PGDoE, 2004). The northern portion of the Upper Southwest Branch watershed near MD 214 has the least degraded biological conditions and a fish community rating of Good (MDNR, 2003). Since 2004, aquatic habitat and biological conditions within the greater Southwest Branch watershed have improved and the extent of biologically degraded stream miles have decreased by nearly half (PGDoE, 2014b). Multiple fish blockages that limit fish movement still exist within the Upper Southwest Branch watershed, including blockages within District Heights and at the confluence of Southwest Branch and Western Branch.

All streams within the Upper Southwest Branch watershed are classified as Use I waters. As part of the Western Branch watershed, the Upper Southwest Branch watershed currently has no completed TMDLs but has a Category 5 impairment listing for unknown pollutants in first through fourth order streams, based on fish and benthic IBIs (MDE, 2018a).

m. Lower Southwest Branch

The Lower Southwest Branch watershed (MDE 12-digit: 021311030922) has a drainage area of 5 square miles and is situated within the mid-western section of the Western Branch watershed, downstream of the Upper Southwest Branch watershed (MDE, 2018b). Crossing the southeastern portion of the corridor study boundary, the Lower Southwest Branch watershed is bound approximately by MD 214 to the north and Ritchie Marlboro Road to the south. Southwest Branch is located within the Atlantic Coastal Plain physiographic province of Prince George's County.

The Lower Southwest Branch watershed is moderately developed (PGDoE, 2004). Impervious surfaces comprise approximately 14 percent of the watershed, which is considerably less than the Upper Southwest Branch watershed, but still among the most impervious watersheds in Western Branch (MDNR, 2003). Land uses include urban, forested, and agricultural, with the most highly developed areas located upstream of White House Road (MDNR, 2003). The Lower Southwest Branch watershed is approximately 35 percent forested, with forested areas primarily concentrated along the stream valleys (MDNR, 2003).

Overall, the aquatic resources of the Lower Southwest Branch watershed are in Poor condition and biological communities are degraded. Aquatic habitat and biological conditions within the greater Southwest Branch watershed have improved considerably since 2004, but some fish blockages remain (PGDoE, 2014b).

All streams within the Lower Southwest Branch watershed are classified as Use I waters. As part of the Western Branch watershed, the Lower Southwest Branch watershed currently has no completed TMDLs but has a Category 5 impairment listing for unknown pollutants in first through fourth order streams, based on fish and benthic IBIs (MDE, 2018a).

n. Upper Henson Creek

The Upper Henson Creek watershed (MDE 12-digit: 021402010797) is located just southeast of Washington, DC, originating near MD 4, and has a drainage area of 12 square miles (MDE, 2018b). The watershed crosses the southern portion of the corridor study boundary, bound approximately by MD 4 to the north and Temple Hill Road to the south. The greater Henson Creek watershed is located within the Atlantic Coastal Plain physiographic province, joining Hunters Mill Branch to form Broad Creek to the northwest of Friendly, Maryland. The MDE 12-digit Upper Henson Creek watershed is comprised of the Henson Creek mainstem and numerous unnamed tributaries.

Impervious surfaces comprise approximately 29 percent of the Henson Creek-Upper watershed (USGS, 2018) with the largest single source of imperviousness being Joint Base Andrews (PGDoE, 2014a). The watershed is highly developed, consisting of 84 percent urban area and 19 percent forested area, with the least developed areas of the watershed occurring along the unnamed tributary between MD 337 and MD 5 (USGS, 2018). Within the vicinity of the corridor study boundary, the mainstem of Henson Creek is largely forested within the Henson Creek Stream Valley Park. Based on the 2014 Watershed Existing Condition Report for the Potomac River Watershed, dominant land uses within the Upper Henson Creek watershed include residential, forest, and commercial/industrial (PGDoE, 2014a). Stream sampling conducted by the county and state indicated that approximately 60 to 70 percent of the greater Henson Creek watershed has degraded conditions (PGDoE, 2014a).

All nontidal streams within the Upper Henson Creek watershed are classified as Use I waters. As part of the Potomac River Upper Tidal watershed, Henson Creek currently has no TMDLs, but has a Category 5 impairment listing for unknown pollutants in first through fourth order streams, based on fish and benthic IBIs (MDE, 2018a).

o. Watts Branch

The Watts Branch watershed (MDE 12-digit: 021402020846) has a drainage area of 22 square miles and begins east of I-270 in the City of Rockville, Maryland, continuing southwest until it crosses under MD 190 and flows into the Potomac River, south of Travilah, Maryland (MDE, 2018b). The Watts Branch headwaters cross the corridor study boundary, with all major tributaries joining the mainstem well downstream of the corridor study boundary. Watts Branch is located entirely within the Piedmont Plateau physiographic province in Montgomery County.

According to 2011 National Land Cover Data, urban development comprises 64 percent of land use in the Watts Branch watershed, with 15 percent impervious surface and 23 percent forested cover (USGS, 2018). Within the City of Rockville, land use is 79 percent residential and commercial/industrial development, and 19 percent open space, which includes forest, water, and farmland. Rockville's impervious surfaces comprise over 40 percent of the Watts Branch watershed, and within City of Rockville limits, 16.6 stream miles of Watts Branch have highly eroded banks, widened stream channels, piped/straightened channels, and/or little riparian buffer (City of Rockville, 2015). Overall, the Watts Branch headwaters are highly developed and have been impacted by runoff from impervious areas, leading to over-widened channels with little floodplain connectivity (MCDEP, 2012b).

The lower portions of the watershed, downstream of the corridor study boundary, are dominated by lower density residential land use and still support more diverse aquatic communities (MCDEP, 2012b). Piney Branch, a major tributary to Watts Branch downstream of the corridor study boundary, was designated as a Special Protection Area by the MCDEP in 1995 and is largely forested (MCDEP, 2012b).

All streams within the Watts Branch watershed are classified as Use I-P waters. Watts Branch currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

p. Muddy Branch

The Muddy Branch watershed (MDE 12-digit: 021402020848) originates upstream of MD 355 in Gaithersburg, Maryland, and flows southwest to the Potomac River within Blockhouse Point Conservation Park. The watershed crosses the northwest portion of the corridor study boundary, bound by MD 124 to the north and Shady Grove Road to the south, and falls entirely within the Piedmont Plateau physiographic province. The Muddy Branch watershed has a drainage area of approximately 20 square miles (MDE, 2018b).

The Muddy Branch watershed is approximately 67 percent developed and 21 percent forested (USGS, 2018). Impervious surfaces comprise approximately 18 percent of the overall watershed (USGS, 2018). The upper watershed, in the vicinity of the corridor study boundary, falls within the City of Gaithersburg, where development is highly concentrated, while the lower portions of the watershed are considerably less developed. Within the City of Gaithersburg, Muddy Branch is comprised of 37 percent impervious surfaces (URS, 2014). Within the vicinity of the corridor study boundary, the mainstem of Muddy Branch is primarily forested as it flows through Morris Park and Malcolm King Park adjacent to the corridor. The lower portions of the Muddy Branch mainstem are largely forested due to a series of stream valley parks downstream of the corridor study boundary. In 2012, Good water quality conditions were observed in the lower Muddy Branch watershed, while Fair water quality conditions were observed in the upper Muddy Branch watershed (MCDEP, 2012b; URS, 2014).

All Muddy Branch watershed streams in the vicinity of the corridor study boundary are classified as Use I-P waters. One unnamed tributary in the lower portion of Muddy Branch, well downstream of the corridor study boundary is classified as Use III-P waters (nontidal coldwater and public water supply). Muddy Branch currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

B. Scenic and Wild Rivers

Based on review of available information on the National Wild and Scenic River System website, there are no federally designated Wild and Scenic Rivers in Maryland or Virginia (IWSRCC, 2018). However, the Potomac River in Montgomery County, the Anacostia River, and the Patuxent River, "including their tributaries," are state-designated as Scenic under the Maryland Scenic and Wild Rivers Program (MDNR, 2018a; Md. Code Ann., Nat. Res. § 8-402). Most streams within the I-495 & I-270 Managed Lanes Study corridor study boundary are regulated under the Maryland Scenic and Wild Rivers Act, as they drain to one of the rivers or river segments mentioned above. Streams in the Rock Creek and Henson Creek watersheds are not regulated under the Maryland Scenic and Wild Rivers Act, as these watersheds enter the Potomac River downstream of the designated river segments. No waterways within the Virginia portion of the corridor study boundary are state-designated as Scenic Rivers (VDCR, 2018).

C. Surface Water Quality

Existing conditions for surface water quality are discussed by watershed, as defined in **Section 2.4.2.A**, above. For both in-situ and chemical grab sample parameters, state and federal standards and recommendations, as well as benchmark levels used to indicate anthropogenic stress, are presented in **Section 2.4.2.C**.

a. Fairfax County Middle Potomac Watersheds

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Fairfax County Middle Potomac watersheds were available for Dead Run from NWQMC (**Table 2.4-8**). At the single monitoring site located just north of Whann Avenue, individual chemical grab sample parameter values varied across sampling events. Ammonia values were generally low and did not exceed Virginia state standards. Although E. coli levels were reported in different units than the Virginia state criterion, E. coli levels within Dead Run were well below state standards based on the magnitude of reported values. All nutrient parameters were also variable among sampling events, but values frequently exceeded the state and federal benchmarks used to indicate anthropogenic stress.

In-situ water quality data were available for the Fairfax County Middle Potomac watersheds from FCDPWES. In-situ data were available for the Scotts Run mainstem, Unnamed Tributary 1 to Scotts Run, Unnamed Tributary 2 to Scotts Run, the Dead Run mainstem, and Unnamed Tributary 1 to Dead Run. Unnamed Tributary 1 and Unnamed Tributary 2 to Scotts Run both enter the Scotts Run mainstem downstream of I-495. Unnamed Tributary 1 to Dead Run joins the Dead Run mainstem to the east of I-495, at the southern end of Turkey Run Park. With the exception of pH, all in-situ water quality parameters met Virginia standards for Class III waters (**Table 2.4-9**). One pH value, collected in the spring on Unnamed Tributary 2 to Scotts Run, had a pH value of 5.8, which is slightly below the Virginia minimum threshold. For the Scotts Run and Dead Run mainstems, conductivity values exceeded the benchmark used by VDEQ to categorize streams as least-degraded.

Table 2.4-8: Summary of Chemical Grab Sample Water Quality Data for the Fairfax County Middle Potomac Watersheds

Waterway	Dead Run
Source Data	NWQMC
Year[1]	2008 – 2019
Number of Sampling Sites	1
Ammonia (mg/L)	0.016 – 0.255
E. coli (MPN/100 mL)	0.393 – 2.500
Nitrate Nitrogen (mg/L)	0 – 3.7
Nitrite Nitrogen (mg/L)	0.35 – 6.70
Nitrogen (Total) (mg/L)	0 – 6.3
Orthophosphate (mg/L)	0.004 – 9.000
Phosphorus (Total) (mg/L)	0 – 2,350

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-9: Summary of In-situ Water Quality Data for the Fairfax County Middle Potomac Watersheds

Waterway	Scotts Run	Unnamed Tributary 1 to Scotts Run	Unnamed Tributary 2 to Scotts Run	Dead Run	Unnamed Tributary 1 to Dead Run
Source Data	FCDPWES	FCDPWES	FCDPWES	FCDPWES	FCDPWES
Year[1]	2012-2014	2009	2014	2010-2015	2008
Number of Sampling Sites	3	1	1	4	1
DO (mg/L)	8.1-13.1	11.5	10.3	6.2-14.0	12.1
pH	6.8-9.0	--	5.8	6.8-7.4	8.0
Conductivity (µS/cm)	331-650	168	96	178-456	212
Water Temp. (°C)	12.0-23.3	9.0	11.3	6.7-22.4	9.0

[1]Sampling may not have been conducted during all years within year ranges.

b. Potomac River/Rock Run

No recent chemical grab sample data were available for the Potomac River/Rock Run watershed within the vicinity of the I-495 & I-270 Managed Lanes Study corridor study boundary; however, MCDEP collected in-situ water quality data along Rock Run, upstream of the corridor study boundary. With the exception of pH, all in-situ water quality parameters met COMAR criteria for Use I-P streams (**Table 2.4-10**). One pH value of 9.0, collected in spring, exceeded the COMAR criterion of 8.5.

Table 2.4-10: Summary of In-situ Water Quality Data for the Rock Run Watershed

Waterway	Rock Run
Source Data	MCDEP
Year[1]	2010-2014
Number of Sampling Sites	1
DO (mg/L)	7.1 – 13.5
pH (SU)	7.2 – 9.0
Conductivity (µS/cm)	211 – 308
Water Temp. (°C)	14.0 – 24.5

[1]Sampling may not have been conducted during all years within year ranges.

c. Cabin John Creek

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Cabin John Creek watershed were available for Booze Creek, Cabin John Creek, Ken Branch, Thomas Branch, and Unnamed Tributary 1 to Snakeden Branch from MBSS and NWQMC (**Table 2.4-11**). Ammonia concentration was only assessed along Cabin John Branch and Ken Branch, and all concentrations fell below the threshold of 0.03 mg/L used by MBSS to indicate anthropogenic stress. Alkalinity levels were only monitored along Cabin John Creek, with all values exceeding the chronic exposure criterion of 20 mg/L recommended by EPA for freshwater aquatic life. Conductivity and chloride levels were highly variable across all waterways and generally fluctuated between sampling events. While no state or federal ambient surface water quality criteria exist for conductivity, most sampled waterways exceeded EPA's recommended aquatic life criterion for chronic chloride exposure. Booze Creek, Cabin John Creek, and Thomas Branch also exceeded criteria for acute chloride exposure. High conductivity and chloride levels in the spring are often associated with deicing procedures, as runoff from roadways can transport deicing compounds into nearby waterbodies. Two recent pH readings along Booze Creek fell below the minimum COMAR criterion of 6.5 SU for Use I-P streams. Alternatively, one recent pH reading within Unnamed Tributary 1 to Snakeden Branch exceeded the maximum COMAR criterion.

Turbidity measurements were also variable among sites and sampling events. Although the COMAR monthly average turbidity criterion of 50 Nephelometric Turbidity Units (NTU) was frequently exceeded within the watershed, the instantaneous turbidity criterion of 150 NTU was only exceeded at Cabin John Creek. Nutrient compounds (those containing nitrogen and phosphorus) across the watershed generally exceeded thresholds used by state and federal agencies to indicate anthropogenic stress. All other chemical water quality parameters, including all heavy metals, met state and federal criteria.

Within the Cabin John Creek watershed, in-situ water quality data are available for Booze Creek, Cabin John Creek, Ken Branch, Old Farm Creek, Thomas Branch, Unnamed Tributary 1 to Cabin John Creek, and Unnamed Tributary 1 to Old Farm Creek (**Table 2.4-12**). Several pH readings at Cabin John Creek exceeded COMAR criterion for Use I-P streams and one recent reading in Old Farm Creek fell below COMAR criterion. All other in-situ water quality parameters within the Cabin John Creek watershed met COMAR criteria. During several sampling events, conductivity levels along the Cabin John Creek mainstem and Unnamed Tributary 1 to Cabin John Creek were notably elevated. Conductivity levels as low as 247 and

469 µS/cm, have been documented to correlate with impaired benthic macroinvertebrate and fish communities in Maryland, respectively (Morgan et al., 2007).

Table 2.4-11: Summary of Chemical Grab Sample Water Quality Data for the Cabin John Creek Watershed

Waterway	Booze Creek	Cabin John Creek		Ken Branch		Thomas Branch	Unnamed Tributary 1 to Snakeden Branch
Source Data	NWQMC	NWQMC	MBSS	NWQMC	MBSS	NWQMC	NWQMC
Year[1]	2008 – 2016	2007 – 2017	2008 – 2017	2008 – 2016	2008	2008 – 2016	2016
Number of Sampling Sites	2	8	3	2	1	2	1
Ammonia (mg/L)	--	--	0.006 – 0.009	--	0.009	--	--
Alkalinity (mg/L)	--	22 – 96	--	--	--	--	--
Biochemical Oxygen Demand (mg/L)	--	0.1 – 8.2	--	--	--	--	--
Chloride (mg/L)	28 – 3,333	16 – 4,558	105 – 161	29 – 752	50	65 – 2,503	149 – 203
Conductivity (µS/cm)	287 – 11,200	124 – 13,473	516 – 720.5	227 – 3,084	337	283 – 12,890	275 – 2,952
Copper (µg/L)	--	--	3.8	--	--	--	--
DO (mg/L)	5.3 – 15.2	6.7 – 16.4	--	7.6 – 15.1	--	7.9 – 15.9	12.3 – 14.6
Nitrate Nitrogen (mg/L)	--	--	0.79 – 1.41	--	1.14	--	--
Nitrite Nitrogen (mg/L)	--	--	0.0029 – 0.0115	--	0.0022	--	--
Nitrogen (Total) (mg/L)	--	0.49 – 2.36	0.95 – 1.67	--	1.22	--	--
Orthophosphate (mg/L)	--	--	0.001 – 0.005	--	0.002	--	--
pH	5.1 – 8.4	6.5 – 8.7	7.3 – 8.1	7.2 – 8.4	7.6	6.5 – 8.4	7.6 – 8.7
Phosphorus (Total) (mg/L)	--	--	0.007 – 0.019	--	0.008	--	--
Total Suspended Solids (mg/L)	--	0 – 932	--	--	--	--	--
Turbidity (NTU)	0 – 89	0 – 1,185	--	0 – 83	--	0 – 88	0 – 25
Zinc (µg/L)	--	--	17.0	--	--	--	--

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-12: Summary of In-situ Water Quality Data for the Cabin John Creek Watershed

Waterway	Booze Creek	Cabin John Creek			Ken Branch	Old Farm Creek	Snakeden Branch	Unnamed Tributary 1 to Cabin John Creek	Unnamed Tributary 1 to Old Farm Creek
Source Data	MCDEP	MCDEP	MBSS	NWQMC	MBSS	MCDEP	MCDEP	NWQMC	MCDEP
Year[1]	2008	2008 – 2014	2008	2008 – 2017	2008	2008 – 2014	2008 – 2014	2015	2015 – 2017
Number of Sampling Sites	1	4	3	8	1	1	1	1	1
DO (mg/L)	6.9 – 11.5	6.1 – 16.8	9.9 – 11.7	7.8 – 15.2	8.8	8.5 – 11.5	9.9 – 12.1	12.3	6.9 – 9.5
pH	7.6 – 8.4	6.5 – 8.8	7.4 – 7.5	7.0 – 8.7	7.3	6.4 – 7.7	7.4 – 7.6	7.7 – 8.0	7.4 – 7.5
Conductivity (µS/cm)	530 – 563	202 – 649	402 – 403	79 – 3,752	289	224 – 631	354 – 444	873 – 1,984	605 – 830
Water Temp. (°C)	14.7 – 19.9	11.5 – 23.5	21.9 – 24.5	--	22.7	12.4 – 20.1	12.6 – 13.1	--	10.0 – 14.5
Turbidity (NTU)	--	--	1.6 – 1.8	--	1.5	--	--	--	--

[1]Sampling may not have been conducted during all years within year ranges.

d. Rock Creek

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Rock Creek watershed are available from MBSS. Chemical grab sample data were only collected at Kensington Branch, with all nutrient parameters except ammonia exceeding state and federal thresholds used to indicate anthropogenic stress (**Table 2.4-13**). Chloride concentration was relatively low compared to other streams within the vicinity of the corridor study boundary; however, measured DO fell below the COMAR criterion of 5 mg/L.

In-situ water quality data were also collected by MBSS and MCDEP along Alta Vista Tributary, Capital View Tributary, Coquelin Run, Kensington Branch, Luxmanor Branch, and Rock Creek (**Table 2.4-14**). All in-situ water quality parameters met COMAR criteria except for one DO reading at Luxmanor Branch. Several conductivity measurements were notably elevated throughout the watershed, especially at Kensington Branch.

Table 2.4-13: Summary of Chemical Grab Sample Water Quality Data for the Rock Creek Watershed

Waterway	Kensington Branch
Source Data	MBSS
Year[1]	2009
Number of Sampling Sites	1
Ammonia (mg/L)	0.011
Chloride (mg/L)	145
Conductivity (µS/cm)	745
DO (mg/L)	2.3
Nitrate Nitrogen (mg/L)	1.73
Nitrite Nitrogen (mg/L)	0.0123
Nitrogen (Total) (mg/L)	1.85
Orthophosphate (mg/L)	0.010
pH	7.1
Phosphorus (Total) (mg/L)	0.031

Table 2.4-14: Summary of In-situ Water Quality Data for the Rock Creek Watershed

Waterway	Alta Vista Tributary	Capital View Tributary	Coquelin Run	Kensington Branch		Luxmanor Branch	Rock Creek
Source Data	MCDEP	MCDEP	MCDEP	MCDEP	MBSS	MCDEP	MCDEP
Year[1]	2011 – 2013	2017	2012 – 2017	2008 – 2017	2009	2008 – 2017	2008 – 2017
Number of Sampling Sites	2	1	2	1	1	4	2
DO (mg/L)	4.6 – 12.7	9.5	7.7 – 14.9	5.9 – 12.0	5.5	3.6 – 8.3	4.6 – 12.7
pH	6.7 – 8.0	6.9	7.3 – 8.4	6.9 – 7.6	6.6	6.8 – 7.6	6.7 – 8.0
Conductivity (µS/cm)	375 – 761	817	327 – 882	370 – 1,284	654	279 – 654	159 – 761
Water Temp. (°C)	6.4 – 24.1	14.2	15.0 – 19.2	14.0 – 22.5	19.3	15.0 – 26.0	6.4 – 24.7

[1]Sampling may not have been conducted during all years within year ranges.

e. Sligo Creek

No recent chemical grab sample data were available for the Sligo Creek watershed within the vicinity of the corridor study boundary; however, in-situ water quality data were available from MCDEP and NWQMC. MCDEP collected in-situ water quality data along Sligo Creek mainstem and Unnamed Tributary 1 to Sligo Creek, which joins the mainstem just downstream of I-495. All water quality parameters met COMAR criteria for Use I streams for both waterways (**Table 2.4-2**). Along the mainstem, water quality parameters were similar at monitoring sites located upstream and downstream of I-495, except for conductivity, which was slightly elevated downstream of the corridor study boundary. NWQMC collected in-situ water quality data for Wheaton Branch, a tributary that enters Sligo Creek just upstream of I-495. All in-situ water quality parameters met COMAR criteria for Use I streams except for several DO readings (**Table 2.4-15**). Wheaton Branch is urban and largely channelized with a limited riparian buffer just upstream of the confluence with Sligo Creek. Therefore, direct effects of runoff would likely affect water quality. Although no state or federal criteria exist, extremely high conductivity levels were documented within Wheaton Branch.

Table 2.4-15: Summary of In-situ Water Quality Data for the Sligo Creek Watershed

Waterway	Sligo Creek	Unnamed Tributary 1 to Sligo Creek	Wheaton Branch
Source Data	MCDEP	MCDEP	NWQMC
Year[1]	2009 – 2016	2009	2007 – 2010
Number of Sampling Sites	3	1	1
DO (mg/L)	5.7 – 14.0	--	4.1 – 12.5
pH	6.8 – 8.1	6.7	7.1 – 7.8
Conductivity (µS/cm)	204 – 595	474	73 – 15,410
Water Temp. (°C)	11.4 – 23.3	16.5	--

[1]Sampling may not have been conducted during all years within year ranges.

f. Northwest Branch

No recent chemical grab sample data were available for the Northwest Branch watershed within the vicinity of the corridor study boundary; however, in-situ water quality data were available from MCDEP and PGDoE. MCDEP collected in-situ data along Lockridge Drive Tributary, upstream of I-495, and Northwest Branch mainstem, both upstream and downstream of I-495. Both streams met all COMAR criteria for Use IV streams, except for temperature and pH along the downstream portion of Northwest Branch mainstem (**Table 2.4-16**). One summer water temperature slightly exceeded the COMAR criterion of 23.9 °C and one spring pH reading fell below the COMAR criterion. PGDoE collected in-situ water quality data along Unnamed Tributary 1 to Northwest Branch, downstream of I-495 with drainage beginning near the interstate. Four temperature readings exceeded COMAR criterion. All other in-situ parameters met COMAR criteria for Use IV streams (**Table 2.4-2**).

Table 2.4-16: Summary of In-situ Water Quality Data for the Northwest Branch Watershed

Waterway	Lockridge Drive Tributary	Northwest Branch	Unnamed Tributary 1 to Northwest Branch
Source Data	MCDEP	MCDEP	PGDoE
Year[1]	2007 – 2009	2007 – 2016	2010
Number of Sampling Sites	1	2	1
DO (mg/L)	9.6 – 13.0	8.3 – 14.8	5.3 – 10.0
pH	7.2 – 8.1	6.2 – 7.9	7.0 – 7.2
Conductivity (µS/cm)	470 – 686	186 – 598	441 – 456
Water Temp. (°C)	10.4 – 10.5	7.1 – 24.5	15.9 – 28.2

[1]Sampling may not have been conducted during all years within year ranges.

g. Paint Branch

Recent chemical grab sample data were available for the Paint Branch watershed through the NWQMC database. Chemical grab sample data were available for Paint Branch mainstem, both upstream and downstream of I-495, and Unnamed Tributary 1 to Paint Branch, which is located downstream of the corridor study boundary and enters the mainstem south of the Paint Branch Golf Course (**Table 2.4-17**). A limited suite of parameters was monitored at Unnamed Tributary 1 to Paint Branch. Alkalinity levels exceeded the chronic impairment criterion issued by EPA for freshwater aquatic life, and all other monitored parameters met state and federal water quality criteria. Along the Paint Branch mainstem, conductivity and chloride levels were highly variable, but have generally increased over time. While no state or federal criterion exist for conductivity, chloride concentrations exceeded the EPA recommended criteria in recent years, likely due to roadway deicing activities in the watershed. In recent years, five fecal coliform measurements have exceeded the COMAR criterion of 200 mpn/100mL on Paint Branch upstream of I-495. COMAR criteria for instantaneous turbidity readings and monthly average turbidity were both exceeded along the mainstem, indicating the potential for Paint Branch to transport large amounts of sediment. Although variable, all nutrient compounds collected along Paint Branch generally exceeded the state and federal thresholds used to indicate anthropogenic stress. All other chemical water quality parameters met state and federal criteria.

MDOT SHA and PGDoE collected in-situ water quality data for Paint Branch, Unnamed Tributary 1 to Paint Branch, and Unnamed Tributary 2 to Paint Branch (**Table 2.4-18**). Several pH readings along Paint Branch fell below the COMAR criterion. Upstream of I-495, where Paint Branch is designated as Use III, several summer temperature readings exceeded the COMAR temperature criterion for Use III streams of 20 °C. All other in-situ water quality parameters within the Paint Branch watershed met COMAR criteria. Along Unnamed Tributary 2 to Paint Branch, conductivity levels were notably elevated.

Table 2.4-17: Summary of Chemical Grab Sample Water Quality Data for the Paint Branch Watershed

Waterway	Paint Branch	Unnamed Tributary 1 to Paint Branch
Source Data	NWQMC	NWQMC
Year[1]	2008 – 2016	2012
Number of Sampling Sites	2	1
Alkalinity (mg/L)	--	32
Chloride (mg/L)	9 – 1,280	13
Conductivity (µS/cm)	16 – 3,910	--
DO (mg/L)	6.8 – 14.3	--
Fecal Coliform (mpn/100mL)	20 – 8,000	--
Nitrate Nitrogen (mg/L)	0.15 – 1.80	--
Nitrite Nitrogen (mg/L)	0.0010 – 0.850	--
Orthophosphate (mg/L)	0.004 – 0.048	--
pH	6.6 – 8.0	--
Phosphorus (Total) (mg/L)	0.006 – 0.850	--
Selenium (µg/L)	--	0.1
Total Suspended Solids (mg/L)	1 – 2,020	--
Turbidity (NTU)	0 – 2,240	--

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-18: Summary of In-situ Water Quality Data for the Paint Branch Watershed

Waterway	Paint Branch		Unnamed Tributary 1 to Paint Branch	Unnamed Tributary 2 to Paint Branch
Source Data	MDOT SHA	PGDoE	PGDoE	PGDoE
Year[1]	2012 – 2018	2010 – 2015	2010	2015
Number of Sampling Sites	2	4	1	2
DO (mg/L)	7.1 – 13.7	5.2 – 11.9	9.4 – 9.7	10.1 – 11.0
pH	7.1 – 8.2	6.2 – 7.6	6.5 – 6.9	6.5 – 6.9
Conductivity (µS/cm)	246 – 777	231 – 667	103 – 206	1,140 – 1,550
Water Temp. (°C)	8.6 – 24.3	10.4 – 26.6	14.5 – 24.5	6.2 – 8.9
Turbidity (NTU)	0.5 – 22.8	--	--	--

[1]Sampling may not have been conducted during all years within year ranges.

h. Little Paint Branch

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Little Paint Brach watershed were available through the NWQMC database. Chemical grab sample data were available for Little Paint Branch mainstem, both upstream and downstream of I-495 (**Table 2.4-19**). Compared to other developed watersheds within the vicinity of the corridor study boundary, chloride concentrations were relatively low at Little Paint Branch, falling well below EPA's recommended aquatic life criterion. One DO reading fell below the COMAR criterion, and turbidity was documented above the COMAR criterion for monthly average. Based on the low DO reading, conditions at the time of sampling were nearly anoxic.

MDOT SHA and PGDoE collected in-situ water quality data along the mainstem of Little Paint Branch (**Table 2.4-20**). Several pH readings along Little Paint Branch exceeded the COMAR criterion maximum for Use I streams, and several conductivity measurements were notably elevated despite no indication of high chloride levels from chemical water quality sampling efforts. Although chloride concentration can influence conductivity in developed systems, many other factors also affect conductivity.

Table 2.4-19: Summary of Chemical Grab Sample Water Quality Data for the Little Paint Branch Watershed

Waterway	Little Paint Branch
Source Data	NWQMC
Year[1]	2008 – 2013
Number of Sampling Sites	2
Biochemical Oxygen Demand (mg/L)	2.0 – 8.7
Chloride (mg/L)	52 – 83
Conductivity (µS/cm)	143 – 591
DO (mg/L)	0.1 – 14.3
pH	6.7 – 8.2
Total Suspended Solids (mg/L)	5.0 – 8.5
Turbidity (NTU)	0 – 121

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-20: Summary of In-situ Water Quality Data for the Little Paint Branch Watershed

Waterway	Little Paint Branch	
Source Data	PGDoE	MDOT SHA
Year[1]	2010 – 2015	2012 – 2018
Number of Sampling Sites	3	1
DO (mg/L)	11.4 – 13.5	7.4 – 14.3
pH	7.8 – 8.6	7.0 – 9.00
Conductivity (µS/cm)	386 – 1,280	353 – 979
Water Temp. (°C)	12.7 – 29.1	10.5 – 22.8
Turbidity (NTU)	--	0.9 – 6.5

[1]Sampling may not have been conducted during all years within year ranges.

i. Northeast Branch

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Northeast Branch watershed were available from MBSS and NWQMC. Within the watershed, chemical grab sample data were only available for Still Creek, located well downstream of the corridor study boundary and just upstream of the confluence with Northeast Branch (**Table 2.4-21**). Relative to other watersheds in the vicinity of the corridor study boundary, chloride concentrations were low at Still Creek, falling well below recommended values by EPA. However, based on NWQMC data, conductivity reached high levels that exceeded 1,000 µS/cm. One DO reading fell below the COMAR criteria, and nitrite was the only nutrient parameters that exceeded the state threshold used to indicate anthropogenic stress.

In-situ water quality data were collected by MBSS and PGDoE along Brier Ditch, Indian Creek, Still Creek, and Walker's Brook (**Table 2.4-22**). At Still Creek, one DO reading fell below the COMAR criterion, several pH readings fell below the minimum COMAR criterion, and conductivity levels were variable but relatively high. Water quality parameters for all other waterways met COMAR criteria.

Table 2.4-21: Summary of Chemical Grab Sample Water Quality Data for the Northeast Branch Watershed

Waterway	Still Creek	
Source Data	MBSS	NWQMC
Year[1]	2008	2007 – 2016
Number of Sampling Sites	1	1
Ammonia (mg/L)	0.019	--
Chloride (mg/L)	104	--
Conductivity (µS/cm)	468	42 – 4,763
DO (mg/L)	--	3.6 – 14.7
Nitrate Nitrogen (mg/L)	0.19	--
Nitrite Nitrogen (mg/L)	0.0046	--
Nitrogen (Total) (mg/L)	0.46	--
Orthophosphate (mg/L)	0.001	--
pH	7.3	6.8 – 8.3
Phosphorus (Total) (mg/L)	0.013	--

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-22: Summary of In-situ Water Quality Data for the Northeast Branch Watershed

Waterway	Brier Ditch	Indian Creek	Still Creek		Walker's Brook
Source Data	PGDoE	PGDoE	MBSS	PGDoE	PGDoE
Year[1]	2015	2010	2008	2010 – 2015	2016
Number of Sampling Sites	1	1	1	2	1
DO (mg/L)	12.8	7.5 – 10.6	4.7	7.3 – 10.4	7.4
pH	7.5	7.0 – 7.1	6.9	6.3 – 7.3	6.8
Conductivity (µS/cm)	551	249 – 273	239	219 – 920	299
Water Temp. (°C)	6.6	12.9 – 27.2	22.6	6.6 – 23.8	14.5
Turbidity (NTU)	--	--	8.2	--	--

[1]Sampling may not have been conducted during all years within year ranges.

j. Bald Hill Branch

Within the vicinity of corridor study boundary, recent chemical grab sample data were available for the Bald Hill Branch mainstem through the NWQMC database (**Table 2.4-23**). Chloride concentration was variable, with some measurements exceeding the chronic exposure criterion and nearly exceeding the acute exposure criterion recommended by EPA, likely resulting in the documented elevated conductivity levels. DO and pH values fell below COMAR criteria for Use I streams on several occasions, and turbidity measurements exceeded COMAR criteria for monthly average, but not for instantaneous turbidity. In-situ water quality data were also collected by PGDoE along the mainstem of Bald Hill Branch (**Table 2.4-24**). Several in-situ DO readings fell below COMAR criterion for Use I streams and conductivity measurements were notably elevated.

Table 2.4-23: Summary of Chemical Grab Sample Water Quality Data for the Bald Hill Branch Watershed

Waterway	Bald Hill Branch
Source Data	NWQMC
Year[1]	2007 – 2011
Number of Sampling Sites	1
Chloride (mg/L)	40 – 853
Conductivity (µS/cm)	236 – 3,000
DO (mg/L)	4.3 – 12.8
pH	6.4 – 7.7
Total Suspended Solids (mg/L)	4 – 46
Turbidity (NTU)	3 – 91

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-24: Summary of In-situ Water Quality Data for the Bald Hill Branch Watershed

Waterway	Bald Hill Branch
Source Data	PGDoE
Year[1]	2010 – 2015
Number of Sampling Sites	2
DO (mg/L)	4.6 – 9.7
pH	6.5 – 7.2
Conductivity (µS/cm)	285 – 1,770
Water Temp. (°C)	4.6 – 25.4

[1]Sampling may not have been conducted during all years within year ranges.

k. Upper Beaverdam Creek

No recent chemical grab sample data were available for the Upper Beaverdam Creek watershed within the vicinity of the corridor study boundary; however, PGDoE and the Maryland Transit Authority (MTA) collected in-situ water quality data within the watershed. In-situ water quality data were collected by PGDoE along the mainstem of Beaverdam Creek, downstream of I-495. Except for one pH value that fell slightly below the COMAR criterion, all in-situ water quality parameters met COMAR criteria for Use I streams (**Table 2.4-25**). In-situ water quality data were collected by MTA along Cattail Branch, downstream of I-495, and all parameters met COMAR criteria (**Table 2.4-2**). Conductivity values were notably high for both Beaverdam Creek and Cattail Branch, which is likely due to effects of development upstream, such as the use of deicing compounds.

Table 2.4-25: Summary of In-situ Water Quality Data for the Upper Beaverdam Creek Watershed

Waterway	Beaverdam Creek	Cattail Branch
Source Data	PGDoE	MTA
Year[1]	2013 – 2017	2014 – 2016
Number of Sampling Sites	3	4
DO (mg/L)	7.2 – 9.8	6.9 – 12.8
pH	6.4 – 7.2	6.8 – 7.7
Conductivity (µS/cm)	878 – 1,000	484 – 1,381
Water Temp. (°C)	6.3 – 17.7	3.1 – 21.7
Turbidity (NTU)	--	10.5 – 23.5

[1]Sampling may not have been conducted during all years within year ranges.

I. Upper Southwest Branch

Within the vicinity of the corridor study boundary, recent chemical grab sample data for the Upper Southwest Branch watershed were available from MBSS and the NWQMC. Within the watershed, chemical grab sample data were available for Southwest Branch mainstem and Unnamed Tributary 1 to Southwest Branch, which enters the mainstem at I-495 (**Table 2.4-26**). Chloride concentration was variable along Southwest Branch, with a few values exceeding the acute exposure value of 860 mg/L recommended by EPA. Chloride levels were well below this threshold at Unnamed Tributary 1 to Southwest Branch. Although variable as well, one pH measurement fell below the COMAR criteria and the upper range of measured turbidity exceeded COMAR instantaneous turbidity criteria at Southwest Branch. Similar to other Patuxent River drainages within the vicinity of the corridor study boundary, nutrient parameters for Unnamed Tributary 1 to Southwest Branch generally fell below or only slightly exceeded thresholds set by MBSS to indicate anthropogenic stress.

Extensive in-situ water quality data were also available from MBSS and PGDoE for the Upper Southwest Branch watershed. In-situ water quality data were available for Ritchie Branch, Southwest Branch, Unnamed Tributary 1 to Southwest Branch, and Unnamed Tributary 2 to Southwest Branch (**Table 2.4-27**). At Unnamed Tributary 1 to Southwest Branch, DO readings collected by both MBSS and PGDoE fell below the COMAR criterion. One pH reading fell just below COMAR criterion for both Southwest Branch and Unnamed Tributary 2 to Southwest Branch. Based on in-situ data, conductivity levels were relatively low compared to other watersheds within the vicinity of the corridor study boundary; however, elevated conductivity levels were documented from chemical water quality sampling along the mainstem of Southwest Branch. All other in-situ water quality parameters met COMAR criteria.

Table 2.4-26: Summary of Chemical Water Quality Data for the Upper Southwest Branch Watershed

Waterway	Southwest Branch	Unnamed Tributary 1 to Southwest Branch
Source Data	NWQMC	MBSS
Year[1]	2007 – 2011	2008
Number of Sampling Sites	1	1
Ammonia (mg/L)	--	0.0482
Chloride (mg/L)	656 – 1,187	113
Conductivity (µS/cm)	303 – 4,120	684
DO (mg/L)	5.1 – 12.9	--
Nitrate Nitrogen (mg/L)	--	0.029
Nitrite Nitrogen (mg/L)	--	0.0056
Nitrogen (Total) (mg/L)	--	0.32
Orthophosphate (mg/L)	--	0.001
pH	6.4 – 7.7	7.5
Phosphorus (Total) (mg/L)	--	0.054
Total Suspended Solids (mg/L)	2 – 19	--
Turbidity (NTU)	0 – 201	--

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-27: Summary of In-situ Water Quality Data for the Upper Southwest Branch Watershed

Waterway	Ritchie Branch	Southwest Branch	Unnamed Tributary 1 to Southwest Branch		Unnamed Tributary 2 to Southwest Branch
Source Data	PGDoE	PGDoE	MBSS	PGDoE	PGDoE
Year[1]	2017	2013 – 2017	2008	2017	2013
Number of Sampling Sites	3	2	1	1	1
DO (mg/L)	10.1 – 11.9	11.6 – 11.7	3.4	3.7	7.9
pH	6.6 – 7.4	6.3 – 7.5	6.9	7.0	6.3
Conductivity (µS/cm)	568 – 624	549 – 602	216	502	474
Water Temp. (°C)	8.5 – 11.8	4.3 – 4.8	24.3	16.6	9.6
Turbidity (NTU)	--	--	7.8	--	--

[1]Sampling may not have been conducted during all years within year ranges.

m. Lower Southwest Branch

No recent chemical grab sample data were available for the Lower Southwest Branch watershed within the vicinity of the corridor study boundary; however, PGDoE collected in-situ water quality data along two unnamed tributaries that originate near I-495 and flow to the east (**Table 2.4-28**). Except for pH, all in-situ water quality parameters met COMAR criteria for Use I streams. Conductivity was notably high for Unnamed Tributary 3 to Southwest Branch, possibly due to the use of deicing compounds upstream, as both tributaries drain largely impervious areas.

Table 2.4-28: Summary of In-situ Water Quality Data for the Lower Southwest Branch Watershed

Waterway	Unnamed Tributary 3 to Southwest Branch	Unnamed Tributary 4 to Southwest Branch
Source Data	PGDoE	PGDoE
Year	2017	2013
Number of Sampling Sites	1	3
DO (mg/L)	12.5	9.5 – 11.7
pH	6.9	6.8 – 7.2
Conductivity (µS/cm)	1,120	360 – 598
Water Temp. (°C)	5.2	7.8 – 11.3

n. Upper Henson Creek

Within the vicinity of the corridor study boundary, recent chemical grab sample data for Henson Creek and three unnamed tributaries in the Upper Henson Creek watershed were available from MBSS and NWQMC (**Table 2.4-29**). Alkalinity data were only available for Unnamed Tributary 4 to Henson Creek, with the only value slightly exceeding the recommended EPA criterion. Similar to other Patuxent River drainages within the vicinity of the corridor study boundary, chloride concentrations were relatively low across all waterways, with all values meeting EPA guidelines. However, conductivity levels were elevated along the mainstem of Henson Creek. One pH reading at Unnamed Tributary 4 to Henson Creek exceeded the COMAR criterion maximum. Along the Henson Creek mainstem, some nutrient parameters exceeded state and federal thresholds used to indicate anthropogenic stress. Nutrient parameter values were much lower for all other sampled tributaries within the watershed, generally falling below the same thresholds.

MBSS and PGDoE collected in-situ water quality data for Henson Creek and four unnamed tributaries within the Upper Henson Creek watershed (**Table 2.4-30**). Several pH readings fell below the COMAR criterion for Henson Creek, Unnamed Tributary 3 to Henson Creek, and Unnamed Tributary 4 to Henson Creek. All other water quality parameters met state criteria.

Table 2.4-29: Summary of Chemical Grab Sample Water Quality Data for the Upper Henson Creek Watershed

Waterway	Henson Creek		Unnamed Tributary 2 to Henson Creek	Unnamed Tributary 3 to Henson Creek	Unnamed Tributary 4 to Henson Creek	
Source Data	MBSS	NWQMC	MBSS	MBSS	MBSS	NWQMC
Year[1]	2007 – 2015	2007 – 2009	2007	2009	2009	2011
Number of Sampling Sites	3	2	1	1	1	1
Alkalinity (mg/L)	--	--	--	--	--	30.4
Ammonia (mg/L)	0.006 – 0.080	--	0.006	0.011	0.012	--
Chloride (mg/L)	111 – 199	42 – 305	55	62	150	86
Conductivity (µS/cm)	494 – 865	164 – 3,620	329	316	659	422
DO (mg/L)	--	5.4 – 14.8	--	--	--	7.8
Nitrate Nitrogen (mg/L)	0.54 – 0.75	--	1.10	0.60	0.30	--
Nitrite Nitrogen (mg/L)	0.0054 – 0.0074	--	0.0057	0.0019	0.0036	--
Nitrogen (Total) (mg/L)	0.74 – 0.94	--	1.31	0.71	0.45	--
Orthophosphate (mg/L)	0.001 – 0.003	--	0.004	0.004	0.008	--
pH	7.0 – 7.8	6.7 – 8.7	7.6	7.1	8.6	7.2
Phosphorus (Total) (mg/L)	0.011 – 0.019	--	0.025	0.023	0.023	--
Selenium (µg/L)	--	--	--	--	--	0.2
Total Suspended Solids (mg/L)	3 – 6	--	--	--	--	--
Turbidity (NTU)	1 – 35	--	--	--	--	0

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.4-30: Summary of In-situ Water Quality Data for the Upper Henson Watershed

Waterway	Henson Creek		Unnamed Tributary 1 to Henson Creek	Unnamed Tributary 2 to Henson Creek	Unnamed Tributary 3 to Henson Creek	Unnamed Tributary 4 to Henson Creek	
Source Data	MBSS	PGDoE	PGDoE	MBSS	MBSS	MBSS	PGDoE
Year[1]	2007 – 2015	2013 – 2016	2013 – 2016	2007	2009	2009	2013 – 2016
Number of Sampling Sites	3	5	2	1	1	1	3
DO (mg/L)	6.7 – 7.9	9.0 – 11.8	11.6 – 11.8	7.8	8.9	8.7	11.1 – 12.3
pH	7.2	6.1 – 6.8	6.7	7.3	6.5	6.9	6.2 – 7.2
Conductivity (µS/cm)	342 – 421	452 – 678	616 – 682	295	235	321	524 – 920
Water Temp. (°C)	20.9 – 22.4	6.5 – 12.5	6.7 – 7.7	20.6	18.4	21.0	5.7 – 6.6
Turbidity (NTU)	4.3 – 7.1	--	--	8.7	2.0	2.5	--

[1]Sampling may not have been conducted during all years within year ranges.

o. Watts Branch

No recent chemical grab sample data were available for the Watts Branch watershed within the vicinity of the corridor study boundary; however, in-situ water quality data were collected by MCDEP along Watts Branch, downstream of I-495. All water quality parameters met COMAR criteria for Use I-P streams (**Table 2.4-31**).

Table 2.4-31: Summary of In-situ Water Quality Data for the Watts Branch Watershed

Waterway	Watts Branch
Source Data	MCDEP
Year[1]	2007 – 2014
Number of Sampling Sites	2
DO (mg/L)	6.8 – 14.1
pH	6.8 – 7.7
Conductivity (µS/cm)	395 – 790
Water Temp. (°C)	11.6 – 24.2

[1]Sampling may not have been conducted during all years within year ranges.

p. Muddy Branch

No recent chemical grab sample data were available for the Muddy Branch watershed within the vicinity of the corridor study boundary; however, in-situ water quality data were collected by MCDEP along Muddy Branch and Decoverly Tributary, downstream of I-495. All water quality parameters met COMAR criteria for Use I-P streams. Although no state or federal criteria exist, conductivity was somewhat elevated at Muddy Branch, approaching 1,000 µS/cm (**Table 2.4-32**).

Table 2.4-32: Summary of In-situ Water Quality Data for the Muddy Branch Watershed

Waterway	Decoverly Tributary	Muddy Branch
Source Data	MCDEP	MCDEP
Year[1]	2007	2007 – 2014
Number of Sampling Sites	1	2
DO (mg/L)	6.9 – 7.1	6.5 – 11.9
pH	6.6 – 7.4	6.7 – 7.7
Conductivity (µS/cm)	477 – 497	440 – 996
Water Temp. (°C)	17.0 – 22.2	9.1 – 23.7

[1]Sampling may not have been conducted during all years within year ranges.

2.4.3 Environmental Effects

A. Surface Waters and Watershed Characteristics

There would be no effect on surface waters and watershed characteristics from the No Build Alternative. However, all Screened Alternatives would affect surface waters and watershed characteristics in the corridor study boundary due to direct and indirect impacts to ephemeral, intermittent, and perennial stream channels. Impacts to jurisdictional surface waters are discussed in **Section 2.3.3** and the impacts to jurisdictional surface waters by MDNR 12-digit watershed are included in **Table 2.3-8**. Watersheds would also be impacted by increasing impervious surface area. SWM controls will be included in the final design to reduce velocity of runoff flow and negative impact to water quality. **Section 2.4.3.C** includes more information regarding environmental effects to water quality. Additional information regarding SWM assumptions are discussed in **Section 2.7.3 of the DEIS**. Note that although the corridor study boundary intersects the Piscataway Creek Tier II watershed, no features were identified and therefore no impacts would occur within this watershed.

B. Scenic and Wild Rivers

Based on review of available information on the National Wild and Scenic River System website, there are no federally-designated Wild and Scenic Rivers in Maryland or Virginia (IWSRCC, 2018). No waterways within the Virginia portion of the corridor study boundary are state-designated as Scenic Rivers (VDCR, 2018). There would be no effect on the Maryland designated Scenic and Wild Rivers from the No Build Alternative. The Screened Alternatives do have the potential to affect the Potomac River in Montgomery County, the Anacostia River, the Patuxent River, and their tributaries which are designated as Scenic under the Maryland Scenic and Wild Rivers Program (MDNR, 2018a). It is anticipated that most aesthetic impacts would be temporary, during construction activities. However, replacement or major modification of the ALB and Northwest Branch bridges could have a longer-term aesthetic effect on the designated rivers, and would therefore be designed to protect the scenic value of the resource. MDNR will assist the project team with coordination for Maryland Scenic Rivers. ALB reconstruction design and impacts will be a part of this coordination.

C. Surface Water Quality

There would be no effect on surface water quality from the No Build Alternative. However, all Screened Alternatives have the potential to affect surface water quality in the project area due to direct and indirect impacts to ephemeral, intermittent, and perennial stream channels and increases in impervious surface in their watersheds.

Impacts during construction include physical disturbances or alterations, accidental spills, and sediment releases. These impacts can affect aquatic life through the potential to contaminate waterways in the vicinity of the corridor study boundary. Direct stream channel impacts associated with each Screened Alternative are compared and quantified in **Section 2.3.3**. The potential negative water quality results of these impacts are discussed below.

During construction, large areas of exposed soil can be severely eroded by wind and rain when the vegetation and naturally occurring soil stabilizers are removed. Erosion of these exposed soils can considerably increase the sediment load to receiving waters (Barrett et al., 1993). These increased sediment loads can destroy or damage fish spawning areas and macroinvertebrate habitat. An accidental sediment release in a stream can clog the respiratory organs of fish, macroinvertebrates, and the other members of their food web (Berry et al., 2003). Additional suspended sediment loads have also been shown to cause stream warming by reflecting radiant energy (CWP, 2003).

An additional impact associated with the initial construction phase of roadway improvements is the removal of trees and possibly other riparian buffer vegetation. The removal of riparian vegetation greatly reduces the buffering of nutrients and other materials and allows unfiltered water to enter a stream channel directly (Trombulak and Frissell, 2001). Tree removal during the construction process can reduce the amount of shade provided to a stream and thereby raise the water temperature of that stream. In addition to tree removal, stormwater discharges also have the potential to increase surface water temperatures in nearby waterways. The effect of the temperature change depends on stream size, existing temperature regime, the volume and temperature of stream baseflow, and the degree of shading. Thermal effects from decreased shading and stormwater discharge are of particular concern for Use III and IV stream networks, such as Paint Branch and Northwest Branch, as they support aquatic biota less tolerant of warmwater conditions.

Impacts associated with the use of the road after construction are mainly based on the potential for contamination of surface waters by runoff and from new impervious roadway surfaces. The most common heavy metal contaminants are lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron. Most of these contaminants are related to gasoline additives and regular highway maintenance. Other sources of metals include mobilization by excavation, vehicle wear, combustion of petroleum products, historical fuel additives, and catalytic-converter emissions. Generally, heavy metals from highways found in streams are not at concentrations high enough to cause acute toxicity (CWP, 2003).

Deicing compounds that are used during the winter for highway safety maintenance also pose a threat to water quality. Sodium chloride is the most common deicing compound, but it can also be blended with calcium chloride or magnesium chloride. Urea and ethylene glycol are also sometimes used to deice. MDOT SHA most commonly uses rock salt (sodium chloride), a salt brine, and magnesium chloride. Chlorides from these salts can cause acute and chronic toxicity in fish, macroinvertebrates, and plants. The effect of chlorides in streams is dependent on the amount that is applied and the dilution of the receiving waters. Runoff containing road salts, among other things, can cause elevated conductivity in streams, especially during the spring.

Organic pollutants, including dioxins and PCBs, have been found in higher concentrations along roadways. Sources of these compounds include runoff derived from exhaust, fuel, lubricants, and asphalt (Buckler and Granato, 1999). These organic pollutants are known to accumulate in concentrations that can cause mortality and affect growth and reproduction in aquatic organisms (Lopes and Dionne, 1998).

Sediments are also a primary pollution concern associated with an increase in impervious areas. All Screened Alternatives would add the most impervious surface to the Cabin John Creek, Northeast Branch, and Upper Beaverdam MDNR 12-digit watersheds, with between 45.7 and 111.7 acres added. The least additional impervious surface would be added to Potomac River/Rock Run, Beaverdam Creek, Little Paint Branch, Watts Branch, and Bald Hill Branch watersheds, with between less than 0.1 and 13.8 acres added. The only Tier II watershed that would experience an increase in impervious surface is the Beaverdam Creek – Northeast Branch watershed, with an increase of less than 0.1 acres. See **Section 2.3.4** for a discussion of jurisdictional surface water impacts and **Table 2.4-33** below for additional impervious surface by Screened Alternative. Additional impervious surface includes all new impervious surface outside of the existing roadway footprint. Water quality would be protected by implementing strict erosion and sediment control plans with BMPs appropriate to protect water quality during construction activities. Post-construction SWM and compliance with TMDLs will be accounted for in the stormwater design and water quality monitoring to comply with required permits.

Table 2.4-33: Additional Impervious Surfaces by Watershed

Watershed Name	MDNR 12-Digit Watershed	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Potomac River/Rock Run	021402020845	0	0	9.1	396,479	13.8	599,986	13.8	599,986	13.8	599,986	13.8	599,986	13.8	599,986
Cabin John Creek	021402070841	0	0	64.1	2,791,915	90.4	3,937,384	90.4	3,937,384	111.7	4,865,280	80.6	3,510,516	96.4	4,199,977
Rock Creek	021402060836	0	0	43.7	1,904,069	56.5	2,460,759	56.5	2,460,759	62.9	2,739,693	54.5	2,375,644	58.4	2,542,005
Sligo Creek	021402050821	0	0	17.7	770,111	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885
Northwest Branch	021402050818	0	0	16.6	722,856	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664
Paint Branch	021402050826	0	0	24.7	1,077,300	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058
Little Paint Branch	021402050825	0	0	8.4	364,474	10.1	439,088	10.1	439,088	10.1	439,088	10.1	439,088	10.1	439,088
Northeast Branch	021402050822	0	0	64.8	2,823,465	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473
Upper Beaverdam Creek	021402050816	0	0	45.7	1,992,463	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977
Upper Southwest Branch	021311030924	0	0	22.2	967,846	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606
Lower Southwest Branch	021311030922	0	0	15.0	653,087	18.4	800,512	18.4	800,512	18.4	800,512	18.4	800,512	18.4	800,512
Upper Henson Creek	021402010797	0	0	35.3	1,539,708	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481
Muddy Branch	021402020848	0	0	13.4	582,659	14.5	632,307	14.5	632,307	19.1	830,422	14.9	650,486	18.3	796,919
Watts Branch	021402020846	0	0	1.1	47,398	2.9	127,328	2.9	127,328	7.6	331,873	2.4	102,407	5.4	233,242
Bald Hill Branch	021311030928	0	0	0.9	38,634	1.0	42,208	1.0	42,208	1.0	42,208	1.0	42,208	1.0	42,208
Beaverdam Creek	021402050823	0	0	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007
Virginia: Nichols Run - Potomac River	N/A	0	0	12.9	562,791	14.5	631,590	14.5	631,590	14.5	631,590	14.5	631,590	14.5	631,590

Note: Part of the additional impervious surface area is in the Potomac River HUC8 Watershed in Virginia and is not associated with an MDNR 12-digit Watershed.

2.4.4 Avoidance, Minimization and Mitigation

A. Surface Waters and Watershed Characteristics

Impacts to surface waters would be unavoidable if a Screened Alternative is selected. However, continual efforts to avoid and minimize impacts have occurred throughout the planning process and would continue as the I-495 & I-270 Managed Lanes Study moves forward to more detailed stages of design. MDOT SHA would work with regulatory agencies and resource managers to identify sensitive aquatic resources and determine further avoidance and minimization possibilities. Agency recommendations would be evaluated and implemented wherever practicable. Efforts to avoid and minimize direct impacts to stream channels to date have included alignment shifts, alteration of roadside ditch design, addition of retaining walls, and revision of preliminary SWM locations to avoid streams. MDOT SHA is committed to continuing efforts to maximize avoidance and minimization where practicable.

Avoidance and minimization efforts to reduce impacts to surface waters, including wetlands, involve a two-tiered approach. The first tier has occurred during the planning stage where every reasonable effort has been made to avoid wetlands and waterways to the maximum extent practicable. The second tier of avoidance and minimization will occur at the P3 design/build stage, with advancement of the design and further refinements to the LOD. The P3 concessionaire will be incentivized to reduce impacts to wetlands and streams wherever practicable.

Any unavoidable impacts would be regulated under state and federal wetlands and waterways permits that would be issued for the project. Detailed information regarding avoidance and minimization of direct impacts to waterways for the I-495 & I-270 Managed Lanes Study can be found in **Section 2.3.4** and is further detailed in the AMR. In addition, detailed information regarding avoidance and minimization with respect to surface water quality can be found in **Section 2.4.4.C.**

B. Scenic and Wild Rivers

Maryland Scenic Rivers and/or their tributaries within the corridor study boundary include the Northwest and Northeast Branch of the Anacostia River; the Upper and Lower Southwest Branch of the Western Branch of the Patuxent River; and the Potomac River and its tributaries. Impacts to all Scenic Rivers have been avoided and minimized to the maximum extent practicable during preliminary design. Coordination with MDNR and the Scenic and Wild River Advisory Board and efforts to reduce impacts further will continue throughout future project design phases. Specifically, new or modified bridges over the Potomac River and Northwest Branch will be designed in coordination with these entities to ensure that the scenic and wild values of the designated rivers would not be negatively affected. Typically, protection of tributaries to state-designated Scenic Rivers is achieved through application of BMPs and avoidance and minimization measures to reduce impacts to water quality that are already being applied to waterways within the corridor study boundary. Detailed information regarding avoidance and minimization for impacts to wetlands and waterways within the I-495 & I-270 Managed Lanes Study can be found in **Section 2.3.4** and is further detailed in the AMR.

C. Surface Water Quality

There would be no effect to surface waters from the No Build Alternative. If a Screened Alternative is selected, the I-495 & I-270 Managed Lanes Study would require a Section 401 water quality certification from MDE indicating that anticipated discharges from the I-495 & I-270 Managed Lanes Study will comply with federally-mandated water quality standards. In support of the water quality certification requirements, avoidance and minimization measures would be further evaluated through each phase of the I-495 & I-270 Managed Lanes Study. Minimization efforts for potential water quality impacts that could result from road crossings may include the proper maintenance of flood-prone flows through proposed structures using flood relief culverts to avoid increased scour and sedimentation. Most of the stream systems within the corridor study boundary currently have floodplain access; this should be retained as much as possible to preserve benefits such as velocity dissipation, storage, and sedimentation/stabilization. Other efforts should consider retaining or adding riparian buffers, as well as aquatic life passage through structures.

Erosion and sediment control, as well as SWM techniques, are the most important minimization efforts in relation to chemical water quality. Impacts to chemical water quality would be minimized through strict adherence to erosion and sediment control procedures and MDE storm water management regulations. In 2012, MDE revised erosion and sediment control regulations in adherence with the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control (MDE, 2014). These revisions include the establishment of a grading unit criteria, along with stricter stabilization requirements to more thoroughly protect water quality.

Potential organic (e.g., PCBs and dioxins) and heavy metal pollutants are generally sediment-bound or behave like sediment with respect to runoff and transport. Current research is limited; however, settling and filtering urban BMP removal mechanisms have been shown to achieve reductions of 50 to 90 percent with respect to toxic contaminants (Schueler and Youngk, 2015). Therefore, SWM techniques aimed at reducing erosion and sediment transport would also reduce the transport of toxic contaminants into downstream waterways.

SWM would be developed in compliance with all applicable MDE regulations and guidance and designed in accordance with MDE's 2000 Maryland Stormwater Design Manual (MDE, 2009) and MDE's SWM Act of 2007. The 2007 SWM Act requires establishing a comprehensive approach to SWM through the implementation of Environmental Site Design (ESD) to the maximum extent practicable, and only using structural practices where absolutely necessary. The SWM Design Manual requires small-scale SWM practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics. Micro-scale practices, such as water quality swales, would be used to capture and treat runoff closer to the source, as well as increase recharge by infiltrating some or all of the storage volume. The practicability of diverting bridge scupper drainage into SWM areas would be investigated as part of the future planning process, on a structure-by-structure basis. Structural SWM techniques such as underground vaults are proposed to attenuate water flow from stormwater runoff. Due to the importance of protecting water quality in the study area, MDOT SHA has undertaken initial analysis of SWM needs for the project in preliminary planning rather than in later phases of the project.

This early analysis ensures that the feasibility of providing effective SWM on all alternatives has been considered throughout the planning process and allows for identification of ROW needs for the most effective SWM solutions, and avoidance of additional natural resource impacts from SWM to the maximum extent practicable. Water quantity treatment would be met onsite or through waiver requests in specific areas. The project would attempt to meet water quality treatment requirements onsite, where practicable. Where this is not practicable, water quality requirements would be met offsite in accordance with MDE regulations. Other measures may also be considered in particularly sensitive watersheds after further coordination with resource agencies, such as redundant erosion and sediment control measures in especially sensitive watersheds and/or providing on-site environmental monitors during construction to provide extra assurance that erosion and sediment control measures are fully implemented and functioning as designed.

2.5 Groundwater and Hydrology

2.5.1 Regulatory Context and Methods

In 1974, Congress passed the SDWA to regulate the public drinking water supply (EPA, 2004). The SDWA Amendments of 1986 require each state to develop Wellhead Protection Programs to assess, delineate, and map source protection areas for their public drinking water sources, and determine potential risks to those sources (42 U.S.C. 300h-7). Wellhead Protection specifically manages the land surface around a well where activities might affect water quality (MDE, 2018). Source water protection is not specifically mandated by the SDWA, though it does mandate source water assessments, as described below. This allows for flexibility in the delineation and development of source water protection areas to fit the needs of the state (42 U.S.C. 300j-13). States, tribes, and communities are encouraged to use SDWA guidance to protect their public water sources from pollution of major concern and to pass local regulations (EPA, 2004). The EPA approved Maryland's Wellhead Protection Program in June of 1991, and Maryland's Source Water Assessment Program in November of 1999. The EPA approved Virginia's Source Water Assessment Program in October 1999, and their Wellhead Protection Program in 2005 (VDH, 1999; VDEQ, 2005). Both Virginia's and Maryland's program provides technical assistance, information, and funding to local governments to aid in water supply protection. The SDWA does not regulate private wells serving fewer than 25 individuals (EPA, 2004).

The EPA, as authorized by Section 1424(e) of the SDWA, is responsible for the Sole Source Aquifer (SSA) Program, which allows the EPA to designate an aquifer as a sole source of drinking water and establish a review area for any federally-funded projects that fall within the area (42 U.S.C. 300h-6). SSAs are defined as providing at least 50 percent of the drinking water for its service area, and where that service area has no reasonably available alternative drinking water sources. No SSAs cross the corridor study boundary.

Data on wells and groundwater conditions within the corridor study boundary were gathered from online sources from the USGS, Maryland Geological Survey (MGS), Virginia Department of Health (VDH), and the EPA. Groundwater well data were gathered from the USGS National Water Information System (USGS, 2017).

2.5.2 Existing Conditions

The hydrogeology of the I-495 & I-270 Managed Lanes Study corridor study boundary is largely defined by the geology of the area. According to USGS and MGS, two main aquifers split the corridor study boundary almost evenly in half. The western half of the corridor study boundary is underlain by the crystalline-rock and undifferentiated sedimentary-rock aquifer, one of the three primary aquifers of the Piedmont and Blue Ridge Physiographic Province. The eastern half of the corridor study boundary is underlain by the North Atlantic Coastal Plain aquifer, which is comprised of 16 local aquifers and 14 confining units that vary in their extent depending on the location within the North Atlantic Coastal Plain aquifer. The Atlantic Seaboard Fall Line is an area of the Coastal Plain Physiographic Province that is underlain by a wedge of unconsolidated sediments including gravel, sand, silt, and clay, which overlaps the consolidated rocks of the eastern Piedmont along an irregular line of contact (MGS, 2018). The Atlantic Seaboard Fall Line, or Fall Zone, transects the corridor study boundary near and generally parallel to the

I-95 corridor, but the exact outcrop locations of the coastal aquifers along the Atlantic Seaboard Fall Line vary in width and depth depending on where coastal sediments and consolidated rocks come together. These aquifer outcroppings along the Atlantic Seaboard Fall Line serve as groundwater recharge areas for these coastal aquifers and are therefore susceptible to groundwater contamination (WMA, 2013).

Most of the Piedmont and Blue Ridge Physiographic Province is underlain by dense impermeable bedrock that yields water from secondary porosity and permeability provided by fractures. Recharge is highly variable in these aquifers because it is determined by local precipitation and runoff, which are influenced by topographic relief, roadway infrastructure, land use, and the infiltration rates of the available land surface (USGS, 1997). The crystalline-rock and undifferentiated sedimentary-rock aquifers are composed of mainly crystalline metamorphic and igneous rocks. An unconsolidated, permeable material called regolith overlies these aquifers. The regolith consists of saprolite, colluvium, alluvium, and soil. The hydraulic properties of the regolith vary greatly due to its variation in thickness, composition, and grain size. The recharge and discharge process occurs in these aquifers through instream areas where precipitation enters the regolith and then moves laterally through the material, discharging into nearby streams. However, some water moves downward through the regolith until it reaches bedrock, where it enters fractures in crystalline rocks. Base flow ranges from 33 to 67 percent of stream flow in the Maryland drainage basins underlain by crystalline rocks, which is consistent with flow ranges in other states with crystalline rock basins (USGS, 1997). The majority of these aquifers are unconfined, allowing contaminants to enter the aquifers. Common contaminants include nitrate from fertilizers and chloride from road salts. Because water relies on fractures for movement, availability for groundwater usage is limited and well rates are usually only a few gallons per minute. Wells are often drilled deep and left open to allow water to infiltrate from fractures along the drill hole (MGS, 2013).

As mentioned above, the crystalline-rock and undifferentiated sedimentary-rock aquifers consist primarily of metamorphic and igneous rocks, but also include small areas of sedimentary rocks, principally conglomerate, sandstone, and shale. These rocks consist mostly of silica and silicate minerals that are not readily dissolved. Dissolved-solids concentrations in water from these aquifers average about 120 milligrams per liter. The water is soft; hardness averages about 63 milligrams per liter. The median hydrogen ion concentration, which is measured in pH units, is 6.7, meaning the water is slightly acidic. The median iron concentration is 0.1 milligram per liter, but concentrations as large as 25 milligrams per liter have been reported. Typical groundwater is comprised of dissolved calcium bicarbonate and magnesium bicarbonate ions (USGS, 1997).

The North Atlantic Coastal Plain aquifer extends beneath the eastern half of the corridor study boundary and consists of six regional aquifers (USGS, 1997). Of the six regional aquifers, three are represented within three wells in the vicinity of the corridor study boundary, including the Castle Hayne-Aquia aquifer, the Severn-Magothy aquifer, and the Potomac aquifer (Andreasen et al., 2013; USGS, 1997). These regional aquifers are further delineated within the State of Maryland, which recognizes 16 local aquifers and aquifer systems and 14 confining units in the Coastal Plain (**Table 2.5-1**).

Table 2.5-1: Regional and Local Aquifer and Aquifer Systems within the North Atlantic Coastal Plain Portion of the Corridor Study Boundary

Regional Aquifer	Local Aquifer/Aquifer System
Castle Hayne-Aquia	Surficial Upland Aquifer
	Calvert Aquifer System
Severn-Magothy	Aquia Aquifer
	Magothy Aquifer
Potomac	Upper Patapsco Aquifer System
	Lower Patapsco Aquifer System
	Patuxent Aquifer

Source: USGS, 1997; Andreasen et al., 2013.

Aquifers and aquifer systems are distinguished by their geology, with aquifers being more homogeneous and aquifer systems being more heterogeneous in terms of composition and continuity of the formation(s). Seven local aquifers and aquifer systems were observed across the aforementioned three wells within the vicinity of the corridor study boundary, including the Surficial Upland aquifer, the Calvert aquifer system, the Aquia aquifer, the Magothy aquifer, the Upper Patapsco aquifer system, the Lower Patapsco aquifer system, and the Patuxent aquifer. In a given well, the observed count of aquifers and aquifer systems ranged from two to four. Aquifers could occur at different depths depending on well location, highlighting the vertical spatial variability of the North Atlantic Coastal Plain aquifer. As such, additional Coastal Plain aquifers and aquifer systems may occur beneath the corridor study boundary (Andreasen et al., 2013).

Unconsolidated sediments underlie the North Atlantic Coastal Plain, ranging from fine clays to sands and coarse gravel. The layers comprised of sands and gravel serve as groundwater yielding aquifers, while silts and clays impede water flow to form the confining units between the aquifers. Sediment depth ranges from very shallow (tens of feet) to very deep (7,200 feet) moving east from the Atlantic Seaboard Fall Line to the Atlantic Coast (Andreasen et al., 2013). All local aquifers within and around the corridor study boundary are artesian aquifers, except the Surficial Upland aquifer which is a water-table aquifer. The Surficial Upland aquifer is used in a limited capacity for commercial and farming operations within Prince George's, Charles, and St. Mary's Counties. The Calvert aquifer system is a similarly minor aquifer on the western shore of Maryland, used for limited domestic and farm use. The Aquia, Magothy, Upper and Lower Patapsco, and Patuxent aquifers and aquifers systems serve as water sources on the western shore, although specific withdrawals vary by county (Andreasen et al., 2013). Yields can range from less than 10 gallons/minute to 2,000 gallons/minute in larger public and industrial wells. Coastal Plain wells, which are typically screened, are drilled to a specific aquifer and range in depth from tens of feet to several hundred feet for domestic use and up to 2,000 feet for industrial use (MGS, 2014). Recharge of these aquifers occurs where the aquifers outcrop near the land surface, usually near the Atlantic Seaboard Fall Line and therefore near the corridor study boundary. Deeper aquifers require the infiltration of water through confining units to recharge, which can lead to slow recovery of groundwater that is removed for human use (USGS, 1997).

The Coastal Plain confining units between each aquifer or aquifer system assist in keeping contaminants out of the confined aquifers; however, water-table aquifers are unconfined and at risk of contamination from a variety of sources including runoff, road salts, chemical spills, fertilizers and pesticides, and leaking underground storage tanks. While confined aquifers in the Coastal Plain have generally good water quality, additional sources of contamination can occur naturally from the geology, including elevated iron, manganese, arsenic, radionuclides, and salt water intrusion (MGS, 2014). Other areas that are susceptible to groundwater contamination within the Coastal Plain are those with karst geology, which allow for easier movement of water both laterally and downward into subsequent aquifers. The USGS has mapped karst in the lower portion of the corridor study boundary in Prince George's County, characterized as unconsolidated to poorly consolidated calcareous and carbonate rocks which are at risk of producing shallow sinkholes and are high-permeability conduits that allow increased infiltration (Weary and Doctor, 2014).

The North Atlantic Coastal Plain aquifers vary in their chemical composition (which dictates water chemistry and water quality), but trend from calcium and magnesium bicarbonate, to sodium bicarbonate, to sodium chloride as the aquifer moves from the Atlantic Seaboard Fall Line to the Atlantic Coast. As such, dissolved solids concentrations increase in the same geographic trend from west to east. As part of infiltration, ion-exchange reactions erode the sediments that make up the aquifers and the confining units, further influencing the chemical composition of water within an aquifer (USGS, 1997). Neighboring wells drilled to different depths, and therefore into different aquifers, can have variable water chemistry. As mentioned above, the shallower the aquifer, the more susceptible to groundwater contamination from human activities. This is especially true of the Surficial Aquifer, as it is a water-table aquifer.

Groundwater contaminants can come from a variety of sources, but the type of contaminant is often tied to the pollution source. Common highway runoff contaminants that impact both surface and groundwater are listed in **Table 2.5-2** (Kobringer and Geinopolos, 1984; Barrett et al., 1995). The EPA's National Primary Drinking Water Standards regulate the allowable amounts of these listed compounds within drinking water due to concerns over human and environmental health (EPA, 2009). The Secondary Drinking Water Standards recommend acceptable levels of compounds that can cause cosmetic effects or aesthetic effects to drinking water, such as poor taste or smell (EPA, 2009). This designation is listed in the table where applicable, as well as the origin of these pollutants within the scope of highway activities.

USGS groundwater well data were reviewed to establish water quality trends within the vicinity of the corridor study boundary. Six USGS groundwater wells with recent water quality data were identified: three within the Piedmont and Blue Ridge crystalline-rock and unconsolidated sedimentary-rock aquifer and three within the North Atlantic Coastal Plain aquifer. The specific well information is presented in **Table 2.5-3 .**

Table 2.5-2: Common Highway Runoff Contaminants

Contaminant	Primary Source on Roadways	Primary or Secondary Pollutant*	EPA Maximum Contaminant Limit (MCL)*	Units
Arsenic	Fossil fuel combustion	Primary	10	ug/L
Cadmium	Exhaust, tire wear	Primary	5	ug/L
Chromium	Wear of engine parts, brake lining wear	Primary	100	ug/L
Lead	Exhaust, tire wear, fossil fuels	Primary	15	ug/L
Nitrate (measured as Nitrogen)	Roadside fertilizer	Primary	10,000	ug/L
Nitrite (measured as Nitrogen)	Roadside fertilizer	Primary	1,000	ug/L
Turbidity	Sediment runoff, pavement wear, highway maintenance	Primary	1	NTU
Copper	Vehicle fluids and fuel	Primary/Secondary	1,300/1,000	ug/L
Total Dissolved Solids	Includes salts from roadway deicing.	Secondary	500,000	ug/L
Iron	Auto body rust, metal roadway components (bridges, guardrails, etc.), wear of engine parts	Secondary	300	ug/L
Manganese	Wear of engine parts	Secondary	50	ug/L
Zinc	Tire wear, motor oils	Secondary	5,000	ug/L
Sulfate	Pavement, fuel, deicing salts	Secondary	250,000	ug/L
Nickel	Fossil fuels, metal plating, brake wear, asphalt paving	N/A	N/A	
Ammonia	Roadside fertilizer	N/A	N/A	
Phosphorus	Roadside fertilizer	N/A	N/A	
*N/A = No EPA Primary or Secondary Drinking Water Standard, but still a known constituent of highway runoff with potential environmental effects.				

Source: Kobringer and Geinopolos,1984; Barrett et al., 1995; EPA, 2009.

Table 2.5-3 : USGS Groundwater Wells Representing Aquifers that Underlie the Corridor Study Boundary

USGS Code	Well Name	Latitude	Longitude	National Aquifer	Local Aquifer
385130076465501	PG De 21	38°51'31.8"	76°46'53.8"	Northern Atlantic Coastal Plain	Magothy Formation
384715076522001	PG Ed 50	38°47'16"	76°52'18"	Northern Atlantic Coastal Plain	Magothy Formation
385327076544801	WE Cc 3	38°53'27.0"	76°54'48.5"	Northern Atlantic Coastal Plain	Potomac Group
390533077125201	MO De 52	39°05'33.18"	77°12'52.32"	Piedmont and Blue Ridge crystalline-rock	Upper Pelitic Schist of Wissahickon Formation
385929077020901	WW Ac 8	38°59'29.3"	77°02'08.6"	Piedmont and Blue Ridge crystalline-rock	NR*
385644077061101	WW Ba 28	38°56'44"	77°06'11"	Piedmont and Blue Ridge crystalline-rock	Sykesville Formation
*Not reported					

Source: USGS, 2017.

Recent groundwater quality data was reviewed within these six wells to provide a snapshot of existing conditions, within their respective watersheds, of the pollutants listed in **Table 2.5-2**. As shown in **Table 2.5-4**, chemical constituents vary across all wells, both between the two physiographic regions, and between the different aquifers (USGS, 2017). At the time of sampling, two of the Northern Atlantic Coastal Plain wells showed turbidity at levels above the Primary Drinking Water EPA Standards. For Secondary Drinking Water Standards, two of the three Piedmont wells showed higher total dissolved solids. These elevated values, for both turbidity and total dissolved solids, could indicate impacts from current road salting operations, the existing geology, or a combination of both geologic components and human activities in the surrounding area. Levels of iron and manganese, both naturally occurring within the surrounding geology of these aquifers, were elevated slightly above the Secondary Drinking Water pollutant levels. Iron was elevated in one Northern Atlantic Coastal Plain well, and manganese was elevated in two of the three Northern Atlantic Coastal Plain wells and in two of the three Piedmont wells.

Table 2.5-4: Groundwater Quality Data for Selected Pollutants

Well Name	PG De 21	PG Ed 50	WE Cc 3	MO De 52	WW Ac 8	WW Ba 28
pH	6.8	7.9	6.0	7.2	5.0	7.2
Arsenic (ug/L)	0.07	<0.05	0.15	0.53	0.37	1.6
Cadmium (ug/L)	<0.030	<0.030	0.204	<0.030	0.573	0.030
Chromium (ug/L)	<0.50	<0.50	0.92	1.7	0.65	<0.50
Lead (ug/L)	0.303	0.260	<0.040	<0.040	0.046	0.020
Nitrate (ug/L as N)	<40	<40	3,150	2,010	7,060	14
Nitrite (ug/L as N)	<1	<1	<1	<1	<1	<1
Turbidity (NTU)	4.0	<1.0	1.6	0.8	NR*	0.3
Total Dissolved Solids (ug/L)	173,000	153,000	409,000	**590,000**	**741,000**	266,000
Copper (ug/L)	<0.20	1.3	<0.80	<0.80	<0.80	<0.20
Iron (ug/L)	**8,750**	66.4	<4.0	<4.0	<4.0	31.8
Manganese (ug/L)	**208**	**8.06**	**74**	2.84	**152**	**470**
Zinc (ug/L)	**770**	**15.8**	**16.6**	<2.0	3.4	8.2
Sulfate (mg/L)	7.19	6.79	51.1	32.6	53.5	41,200
Nickel (ug/L)	<0.20	<0.20	8.7	34.9	2.6	3.6
Ammonia (ug/L as N)	40.00	100.00	<10	<10	<10	10
Ortho-phosphate (ug/L as P)	91	24	<3	140	28	17

Bold values indicate a concentration higher than the established water quality standards (Table 2.5-2: Common Highway Runoff Contaminants).
Source: USGS, 2016

As discussed above, the aquifers beneath the corridor study boundary are used for groundwater withdrawals. MDE has documented numerous groundwater wells within Montgomery and Prince George's Counties, although the majority of these fall in locations far from the corridor study boundary where homes still use well water (MDE, 2015). MDE does not release the exact locations of groundwater wells for landowner privacy and security, therefore the exact location of most wells within the corridor study boundary cannot be determined. In Maryland, the entire corridor study boundary falls within the service area of the Washington Suburban Sanitary Commission (WSSC), which receives its water from the Potomac River and the Patuxent River. WSSC provides all drinking water within the corridor study boundary. Similarly, in Virginia, the Fairfax County Water Authority serves the areas immediately surrounding the corridor study boundary and receives its water from the Potomac River via the Washington Aqueduct (Fairfax Water, 2018). Less than 20 percent of the population in Fairfax County is served by private wells (VDH, 2019). Groundwater wells within the corridor study boundary that are still in use are generally for commercial and industrial usage, and not used as drinking water.

2.5.3 Environmental Effects

There would be no direct effect on groundwater quality from the No Build Alternative. All the Screened Alternatives have the potential to affect groundwater and hydrology in the project area, mainly due to highway runoff impacts from stormwater infiltration. Groundwater can be contaminated by roadway runoff including substances such as gasoline, oil, and road salts that can seep into the soil and enter the groundwater flow. Soil composition affects how readily contaminants may reach groundwater sources. For example, contaminants are more likely to reach groundwater in sandy soils, which allow more infiltration, than clay soils, which have low infiltration rates. The entire corridor study boundary falls within the service area of the WSSC in Maryland and Fairfax County Water Authority in Virginia, which receive their drinking water supply from the Potomac River and/or the Patuxent River. Groundwater wells within the corridor study boundary that are still in use are generally for commercial and industrial usage, and not for drinking water. Consequently, drinking water impacts are not anticipated. Groundwater impacts are highly geographically variable, based on local soil types, slope variability, impervious area, and widespread construction throughout the region. Therefore groundwater impacts are difficult to quantify and attribute to one source.

2.5.4 Avoidance, Minimization and Mitigation

During construction activities of any of the Screened Alternatives, erosion and sediment control plans with the most appropriate BMPs would be in place to mitigate potential impacts to groundwater and hydrology by capturing sediment and pollutants before they are released to the surrounding environment. As described in **Section 2.4.4.C**, ESD SWM would be developed to maintain current infiltration rates to the greatest extent practicable. This will ensure that recharge of the local water table and shallow aquifers is maintained, to preserve local groundwater quantities. The use of the latest SWM BMPs in Screened Alternative design, including wet ponds and bioswales that filter pollutants through vegetation and soil mediums, would also help to reduce the potential for contamination of shallow groundwater resources, while promoting infiltration.

2.6 Floodplains

Floodplains provide numerous natural and beneficial functions including: flood moderation; water impurity and sediment filtration; groundwater recharge; habitat for fish, terrestrial wildlife, and plants; outdoor recreation space; and open space for agriculture, aquaculture, and forestry (USDOT, 1979). Floodplains naturally and economically help to maintain water quality and reduce flood property damage by providing floodwater storage and decreasing water flow velocity and sedimentation. Floodplains also provide protected environments for plants to grow and for fish and other wildlife to breed and forage. In addition to the advantage of flood damage reduction, humans also benefit from floodplains through the agricultural and recreational space they provide (FEMA, 2018).

2.6.1 Regulatory Context and Methods

Executive Order 11988, US Department of Transportation (USDOT) Order 5650.2, and the National Flood Insurance Act of 1968 govern the construction and fill of floodplains to ensure proper consideration to the avoidance, minimization, and mitigation of floodplain development and associated adverse effects. In addition to enforcing floodplain regulations, the National Flood Insurance Act and its National Flood Insurance Program (NFIP) provide affordable flood insurance to property owners (FEMA, 2018).

Floodplains are governed by local Flood Insurance Programs and supervised by Federal Emergency Management Agency (FEMA) (FEMA, 2015). MDE houses Maryland's Coordinating Office for the NFIP and is responsible for coordination of all state floodplain programs in Maryland under the Maryland Model Floodplain Management Ordinance (MDE, 2014). Impacts to 100-year floodplain must be included in the Joint federal/State Permit Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland and coordinated through MDE's Water Management Administration – Regulatory Services Coordination Office and the USACE. Regulatory authority for floodplain impacts includes Section 404 of the CWA; Environment Article Title 5, Subtitle 5-501 through 5-514; and COMAR 26.17.04 (Waterway and 100-year Flood Plain) (MDOT, 2015). Work within floodplains on NPS lands must adhere to NPS Floodplain Management DO 77-2 unless exempted. Floodplain approvals will be obtained by the appropriate jurisdiction.

The VDCR floodplain management program and Virginia Department of Transportation (VDOT) construction specifications for roadways also address roadway construction within floodplains. Sections 107 and 303 of VDOT's Road and Bridge Specifications require the use of SWM practices to address issues such as post-development storm flows and downstream channel capacity (VDOT, 2018). These standards require that SWM be designed to reduce stormwater flows to preconstruction conditions for up to a ten-year storm event. As part of these regulations, the capture and treatment of the first half-inch of runoff in a storm event is required, and all SWM facilities must be maintained in perpetuity.

Fairfax County Floodplain Regulations are more stringent than the federal minimum requirements of the NFIP. Activities within their floodplains may require written approval from the Fairfax County Department of Public Works and Environmental Services, or a Special Exception approval issued by the Board of Supervisors (Fairfax County, 2018c).

Floodplains within the corridor study boundary were identified using Maryland iMap and the FEMA Effective Floodplain GIS layer. Acreage of the 100-year floodplains within the LOD for the Screened Alternatives were calculated using GIS. No floodplain fieldwork was conducted.

Section 14 of the Rivers and Harbors Act of 1899, as amended and codified in 33 US Code (USC) 408 (Section 408) regulates alteration of USACE civil work's projects, such as dams, levees, or flood channels. The I-495 & I-270 Managed Lane Study coordinated with USACE to determine applicability of Section 408 to the proposed study. The Section 408 review process typically includes review of engineering, environmental, legal, and safety issues associated with the requested alteration(s). USACE Engineering Circular No. 1165-2-220 issued on September 10, 2018 provides procedural guidance for processing Section 408 requests.

2.6.2 Existing Conditions

The Montgomery County portion of the corridor study boundary crosses the FEMA 100-year floodplains of several large streams, including: Muddy Branch, Watts Branch, an unnamed tributary to Watts Branch, Cabin John Creek, Booze Creek, an unnamed tributary to Old Farm Creek, Thomas Branch, the Potomac River, Rock Run, Rock Creek, Sligo Creek, and the Northwest Branch of the Anacostia River. The Prince George's County portion of the corridor study boundary crosses the FEMA 100-year floodplains of: Paint Branch, Little Paint Branch, Indian Creek, an unnamed tributary to Paint Branch, Beaverdam Creek, Bald Hill Branch, the Southwest Branch of the Western Branch of the Patuxent River, Ritchie Branch, and

Henson Creek. The Fairfax County portion of the corridor study boundary crosses the FEMA 100-year floodplains of: the Potomac River, Dead Run, Scott Run, unnamed tributaries to Scott Run, and Bradley Branch. The corridor study boundary overlaps the FEMA 100-year floodplains of these stream systems to varying degrees. **Table 2.6-1** lists each stream and the location where its associated floodplain crosses or enters the corridor study boundary, and all FEMA 100-year floodplains within the corridor study boundary are depicted on the Natural Resources Inventory Maps in **Appendix B**.

USACE identified one Section 408 resource near the corridor study boundary, the Washington Aqueduct, located adjacent to Clara Barton Parkway near the Potomac River.

Table 2.6-1: Waterways and Associated Floodplains within the Corridor Study Boundary

Name of Associated Waterway	Location Where Floodplain Crosses Corridor Study Boundary
Muddy Branch	Crosses I-270, north of I-370 interchange and enters SE of I-270/Muddy Branch Road intersection
Watts Branch	Crosses I-270, NW of W Montgomery Ave interchange
Unnamed Tributary to Watts Branch	Small area between I-270 and Watts Branch Pkwy near Fallswood Ct
Cabin John Creek	Enters NE portion of I-270/Montrose Rd interchange, enters south of the I-495/Cabin John Parkway, crosses the I-495/Cabin John Parkway interchange, enters southwest of I-495/River Road interchange
Booze Creek	Southwest of the I-495/Cabin John Parkway
Unnamed Tributary to Old Farm Creek	Small area between I-270 and Windermere Court
Thomas Branch	Follows Thomas Branch from I-270 Spur S at Democracy Blvd (starting at NE corner of interchange), south along I-495 to the River Road interchange where it meets Cabin John Creek
Potomac River	At the Maryland/Virginia border
Rock Run	Northwest of I-495/Clara Barton Parkway interchange
Rock Creek	Along 495 from I-270 to Jones Mill Road
Sligo Creek	Crosses I-495 at Sligo Creek Pkwy
Northwest Branch Anacostia River	Crosses I-495 at Northwest Branch Stream Valley Park
Paint Branch	Crosses I-495/I-95 interchange
Little Paint Branch	Crosses I-495 west of the I-495/Baltimore Ave interchange
Indian Creek	Crosses I-495 east of the Greenbelt metro station
Unnamed Tributary to Paint Branch	Crosses 295 in Greenbelt Park (south of I-95/I-295 interchange) and I-495 at Kepner Ct and Lake Park Dr. Enters southeast portion of I-495/I-295 interchange.
Beaverdam Creek	Crosses MD 50 west of the MD 50/I-495 interchange
Bald Hill Branch	Crosses MD 50 east of the MD 50/I-495 interchange
Southwest Branch Western Branch Patuxent River	Crosses through southern portion of MD 214/I-495 interchange
Ritchie Branch	Crosses I-495 near Kaverton Road
Henson Creek	Crosses I-495 at Suitland Pkwy and again at west of Branch Avenue

2.6.3 Environmental Effects

Development and fill in the floodplain alters flooding dynamics by reducing flood storage capacity and/or increasing the velocity of flood flows. These changes may result in infrastructure damage due to increased instances of flooding and more extreme amounts of runoff. Between 8 and 10 million US homes are located in floodplains. Flooding causes more than $6 billion in property damage and kills approximately 150 people annually (FEMA, 2018).

The No Build Alternative would not affect the 100-year floodplain within the corridor study boundary. The 100-year floodplain impacts presented in **Table 2.6-2**[5] represent the estimated footprint of fill areas associated with construction of the Screened Alternatives. Actual analysis of potential project related changes to hydraulic function and elevation of floodplains would be determined using hydraulic and hydrologic floodplain modeling as part of the engineering process for each structure in later phases of design. In general, construction of roadway improvements across drainageways and in floodplains may lead to increases in floodplain elevation and size, which would be addressed by adjusting stormwater structures to accommodate increased flood volumes to eliminate property damage or impacts to other natural resources. Portions of the I-495 roadway are already significant encroachments according to 23 CFR §650.105(q). The proposed expansion of the roadway would increase the size of existing significant encroachment areas, but would not propose significant encroachment in new areas.

Table 2.6-2: Impacts to FEMA 100-Year Floodplain in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
FEMA 100-Year Floodplain	0.0	114.3	119.5	119.5	120.0	119.5	119.9

One Section 408 resource was identified by USACE near the corridor study boundary, the Washington Aqueduct, adjacent to the Clara Barton Parkway near the Potomac River. This feature would not be impacted by any of the Screened Alternatives.

2.6.4 Avoidance, Minimization, and Mitigation

FEMA 100-year floodplain impacts were avoided and minimized to the greatest extent practicable while also minimizing increases to flooding levels. Impacts to large vegetated floodplains such as Rock Creek were avoided and minimized to maintain hydrologic function as well as wildlife habitat. A detailed hydrologic and hydraulic (H&H) study would be prepared during final design to identify the existing storm discharge and floodplain extent. All construction occurring within the FEMA designated floodplains must comply with FEMA-approved local floodplain construction requirements. These requirements consider structural evaluations, fill levels, and grading elevations. SWM would be provided and all hydraulic structures would be designed to accommodate flood volumes without causing substantial impact. Culverts and bridges would be designed to limit the increase of the regulatory flood elevation to protect structures from flooding risks, and the use of standard hydraulic design techniques for all waterway openings would be used where feasible to maintain current flow regimes, limit upstream flooding, and preserve existing downstream flow rates (COMAR 26.17.04). The use of state-of-the-art erosion and

[5] For reference, impact tables presented in the report are also included in Appendix A.

sediment control techniques and SWM controls would also minimize the risks or impacts to beneficial floodplain values due to encroachments.

If H&H studies find that the flood elevation would change, floodplain storage mitigation will be implemented, if required. SHA will submit project plans to MDE for approval of structural evaluations, fill volumes, proposed grading evaluations, structural flood-proofing, and flood protection measures in compliance with FEMA requirements, USDOT Order 5650.2, "Floodplain Management and Protection," and Executive Order 11988. Improvements at existing culverts are required to maintain existing 100-year high water elevations. At new culverts, 100-year high water elevation is required to be contained within either right-of-way or permanent easement. Culvert improvements and new culvert design would ensure that flood risk to adjacent properties is not increased, a requirement of COMAR 26.17.04.11.

23 CFR § 650.115(a) will be consulted when determining design standards for flood control measures. The requirement set forth in 23 CFR § 650.111 will be complied with at later stages of design to complete location hydraulic studies for floodplain encroachment areas. Any significant encroachments associated with the Preferred Alternative will include a finding by FHWA in the FEIS that the proposed significant encroachment is the only practicable alternative. This finding will be supported by the three elements of 23 CFR § 650.113(a).

2.7 Vegetation and Terrestrial Habitat

2.7.1 Regulatory Context and Methods

Terrestrial habitats identified within the corridor study boundary include: forests, urban and maintained areas, agricultural lands, open fields, and barren lands. While some wetlands have adjacent terrestrial zones, they are considered a separate and distinct habitat type for the purposes of this document and are discussed in **Section 2.3**.

Forest is the most common terrestrial habitat within the corridor study boundary. COMAR (2016) defines a forest as, "a biological community dominated by trees and other woody plants covering a land area of 10,000 SF or larger. It includes areas that have at least 100 trees per acre with at least 50 percent of those having a two-inch or greater diameter at breast height (DBH), and forest areas that have been cut but not cleared (08.19.03.01, Article 2.17)." State funded highway construction projects that involve cutting and clearing of forests are regulated under Maryland Reforestation Law, a regulation created to protect Maryland forests and mitigate for the loss of forest cover. Forest impacts must be replaced on an acre-for-acre or one-to-one basis on public lands, within two years or three growing seasons of project completion (MDNR, 2013).

Virginia Department of Forestry (VDOF) regulates the use of state forests. No state forests exist within the Virginia portion of the corridor study boundary. The only forest resources within the corridor study boundary in Virginia are on NPS property and Scott's Run Nature Preserve. Park Use Permits require coordination and application with the Fairfax County Park Authority for construction within parkland. Any impact to forests on NPS lands must be coordinated directly with the NPS.

Forest conservation easements are often required as a condition of development to preserve forested land in perpetuity and to mitigate impacts to forests at the state and county level. Montgomery County Category I easements protect existing and future forested areas from being cleared for construction, paving, or grading. Montgomery County Category II easements prohibit construction activities but are also designed to protect large specimen trees in non-forested areas (M-NCPPC, 2016). In Prince George's County, Tree Conservation Plans (TCPs) Type I and Type II are used to conserve forests during land development and in perpetuity after completion of construction activities. Deeds of Conservation Easements are also administered at the state level through the MDNR MET (MET, 2016). Existing county and state forest conservation easement locations within the corridor study boundary were determined using data provided by Prince George's County and Montgomery County. No Virginia Outdoors Foundation (VOF) open space easements or Agricultural/Forestal Districts are located within the study area.

Individual forest stand data was not able to be collected in the field for the Study due to the extent of the study area. However, GIS forest cover data from the Chesapeake Conservancy Conservation Innovation Center's High Resolution Land Cover Data for tree canopy cover and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014) were used to identify forest coverage within the corridor study boundary. Data from the 2006 MDOT SHA Draft Capital Beltway Study Natural Environmental Technical Report (NETR) and the 2017 MDOT SHA I-270 ICM Project provide vegetation cover type information that remains applicable within the Maryland portions of the corridor study boundary. Land cover types were identified according to the Anderson Land Use Classification System (Anderson et al., 1976). Forests were classified by cover types in the 2006 and 2017 studies in accordance with "Forest Cover Types of the United States and Canada" (Eyre, 1980) and associations in accordance with the "Vegetation Map of Maryland" (Brush et al., 1976). The aerial extent of vegetation cover within the corridor study boundary was identified using GIS data obtained from the Chesapeake Conservancy Conservation Innovation Center's High Resolution Land Cover Data for tree canopy cover and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014).

2.7.2 Existing Conditions

The following land cover types were identified within the corridor study boundary: residential; commercial and services; industrial; transportation, communication, and utilities; industrial and commercial complexes; mixed urban or built-up land; cropland and pasture; orchards, groves, vineyards, nurseries, and ornamental horticultural areas; strip mines, quarries, and gravel pits; open fields/meadows/grasslands, scrub/shrub lands, and deciduous, evergreen, and mixed forests. Wetlands and streams, while classified under the Anderson hierarchy, are discussed in **Section 2.3**. Descriptions of land cover included below were adapted from the Draft Capital Beltway Study NETR (MDOT SHA, 2006) and the I-270 ICM Program field investigation. Although the Draft Capital Beltway Study NETR information was collected in 2006, the land cover are still generally the same based on windshield survey and aerial review; therefore, the data collected for this purpose remains valid.

A. Urban/Built-up and Maintained Areas

Urban or built-up land covers most of the corridor study boundary, including dense clusters of old and new residential, commercial, and industrial land cover types on formerly forested areas. Vegetation in these areas is dominated by tulip poplar (*Liriodendron tulipifera)* forest, landscaped areas and lawns, and ornamental and non-native shrubs and trees. Consequently, most wildlife within the corridor study boundary are adapted to human-modified environments, especially where development occurred near existing forest or where wildlife has been displaced. Many wildlife species can be found in older residential developments with mature landscape plantings, a variety of fruit or seed producing vegetation, established forest corridors, or food in feeders. See **Section 2.8 Terrestrial Wildlife** for more detail.

B. Agricultural Land, Open Fields, Meadow, and Grassland

Anderson et al. (1976) defines agricultural land as areas that are tilled for crops or mowed or grazed so few woody species can establish. Agricultural land is situated within two areas of the Prince George's County portion of the corridor study boundary according to MERLIN (MDNR, 2010). The first area is the BARC adjacent to the inner loop and outer loop of I-495 near the I-95 interchange and Cherry Hill Road overpass. The second area is located west of the Greenbelt Rail Yard and CSX Railroad line underpass at I-495. Both areas of agricultural land are fallow or hay fields surrounded by urban or built-up lands. No agricultural land was identified within the corridor study boundary in Montgomery County.

The corridor study boundary also includes meadow habitats and open fields. Anderson et al. (1976) defines the old field/meadow cover type as abandoned land that has a large portion of shrubs, a few trees, and an extensive herbaceous layer containing a mix of grasses and other plants. The majority of meadow habitat within the corridor study boundary consists of meadow "edge" habitats, which occur in strips along roadways, trails, and fields and were historically mowed (MDNR, 2017). MDOT SHA commonly uses seed mixes that promote pollinator species on roadsides and edges and will continue this practice within the corridor study boundary.

C. Barren Land

Barren land within the corridor study boundary is composed entirely of quarries and gravel pits. Active and recently abandoned sand and gravel mines occur in Montgomery County at the I-495/MD 190 interchange and in Prince George's County south of Ritchie Marlboro Road. Soil in these areas has been excavated to varying depths, and vegetation typically consists of pioneer herbaceous species and early successional forest dominated by Virginia pine (*Pinus virginiana*).

D. Forested Areas

Forested land within the corridor study boundary occurs predominantly as small strips along roadsides and interchanges, stream valleys, and steep slopes, with larger tracts occurring on undeveloped park lands. Individual forest stands in Montgomery County are typically smaller and more fragmented than those found in Prince George's County, most likely due to a higher level of development adjacent to I-495 and I-270 in Montgomery County (MDOT SHA, 2006). Development along I-495 in Prince George's County is more clustered, allowing for larger, less disturbed forested tracts. The only forest resources within the corridor study boundary in Virginia are on NPS property and Scott's Run Nature Preserve.

Large tracts of contiguous forest are necessary to support Forest Interior Dwelling Species (FIDS) and Green Infrastructure (GI) habitats. FIDS habitats are specifically discussed in **Section 2.8** and GI habitats are discussed in **Section 2.11.**

Forest associations commonly found in central Maryland and northern Virginia and their general descriptions are provided below.

a. Red Maple Association

The Red Maple Association grows in a wide variety of locations over an extensive range in the Eastern US and is comprised mostly of red maple (*Acer rubrum*). There has been an increased presence of red maple in forest stands in the Mid-Atlantic, most likely due to changes in forest composition resulting from clearcutting, removal of other more desirable trees for lumber, and the decline of American elm (*Ulmus americana*) due to Dutch elm disease. Due to the adaptable nature of red maple, this association can be found on sites ranging from extremely wet to dry. The Red Maple Association is generally considered an early to mid-successional forest type.

The Red Maple Association occurs throughout the corridor study boundary and is more abundant in Prince George's County (MDOT SHA, 2006). The Montgomery County-Prince George's County line roughly matches the Atlantic Seaboard Fall Line, which separates the Piedmont and Atlantic Coastal Plain Physiographic Provinces. The high occurrence of the red maple forest cover type in Prince George's County is most likely due to the County's lower elevation and location within the wetter moisture regime of the Atlantic Coastal Plain. Associated species include sycamore (*Platanus occidentalis*), tulip poplar, silver maple (*Acer saccharinum*), box elder (*Acer negundo*), black cherry (*Prunus serotina*), ash (*Fraxinus sp*.), slippery elm (*Ulmus rubra*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), black locust (*Robinia pseudoacacia*), spicebush (*Lindera benzoin*), flowering dogwood (*Cornus florida*), southern arrowwood (*Viburnum dentatum*), and poison ivy (*Toxicodendron radicans*).

b. Tulip Poplar Association

The Tulip Poplar Association is typically found in the Eastern US at lower elevations and can occur in large, uninterrupted stands. Soils in this association tend to be moderately deep to deep, moist, well-drained, and medium to fine in texture, and are derived primarily from sandstones or shales.

The Tulip Poplar Association comprises the majority of the mid to late-successional forest stands within the I-495 portion of the corridor study boundary. This association is the most common in Montgomery County most likely due to the County's location within the drier moisture regime of the Piedmont Physiographic province (MDOT SHA, 2006). Associated species most commonly include: red maple, sycamore, American beech (*Fagus grandifolia*), oaks (*Quercus sp.*), hickory (Carya sp.), black locust, sassafras (*Sassafras albidum*), spicebush, flowering dogwood, southern arrowwood, American hornbeam (*Carpinus caroliniana*), viburnum (*Viburnum sp.*), American holly (*Ilex opaca*), greenbrier (*Smilax rotundifolia*), blackberry (*Rubus sp*.), poison ivy, Virginia creeper (*Parthenocissus quinquefolia*), wintercreeper (*Euonymus fortunei*), Christmas fern (*Polystichum acrostichoides*), and scattered false solomon's seal (*Maianthemum racemosum*).

c. Black Locust Association

The Black Locust Association is a pioneer forest type that is found extensively throughout the Eastern US, most often in highly-disturbed areas such as mines and recently cleared areas. Common associate species are extremely variable due to the early successional nature of this forest type, and could include: red maple, box elder, silver maple, black cherry, ash, American elm , staghorn sumac (*Rhus typhina*), winged sumac (*Rhus copallinum*), Eastern red-cedar (*Juniperus virginiana*), black walnut (*Juglans nigra*), sassafras, blackberry, Virginia creeper, and grapevine (*Vitis sp*.).

d. White Oak-Black Oak-Northern Red Oak Association

The White Oak-Black Oak-Northern Red Oak Association occurs over a wide range of areas within the I-495 portion of the corridor study boundary, with dominant canopy species including white oak (*Quercus alba*), black oak (*Quercus velutina*), and red oak (*Quercus rubra*) (MDOT SHA, 2006). This forest association occurs on glaciated and non-glaciated soils, and most of the stands are mid-successional. White oak is present over the greatest range of sites from moist to dry, northern red oak is more common on moist lower and middle slopes, and black oak is more common on drier, upper slopes. Northern red oak is the most common species in the association, followed by white oak, and then black oak. Other common associate species include: hickory, tulip poplar, American beech, black gum, American hornbeam, and Christmas fern.

e. Northern Red Oak Association

The Northern Red Oak Association occurs infrequently in the northeastern US and is most common on sites with intermediate moisture regimes. Several Northern Red Oak Associations occur along I-495 within the Montgomery County portion of the corridor study boundary (MDOT SHA, 2006). Common associate species include: tulip poplar, red maple, American beech, white oak, green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), southern red oak (*Quercus falcata*), and flowering dogwood.

f. Sycamore-Green Ash-Box Elder-Silver Maple Association

The Sycamore-Green Ash-Box Elder-Silver Maple Association is typically found in wetter areas and common associate species include sassafras, elm (*Ulmus sp*.), ash, white oak, box elder, black cherry, American hornbeam, spicebush, Virginia creeper, poison ivy, and grapevine. Ash trees are one of the most common landscaping and native forest trees in Maryland, however the emerald ash borer (EAB) (*Agrilus planipennis*), an invasive beetle species native to Asia, has killed millions of ash trees in the central and northeastern US resulting in millions of dollars of losses to municipalities, property owners, nurseries, and other forest-related industries. EAB larvae tunnel into and feed on ash trees, stopping nutrient and water movement, which kills large trees within three years after infestation (University of Maryland, 2018). The species composition of the Sycamore-Green Ash-Box Elder-Silver Maple Association forests within Maryland will continue to evolve as the EAB infestation results in mortality of ash trees statewide.

g. River Birch-Sycamore Association

The River Birch-Sycamore Association is typically found along rivers and streams in eastern North America and includes dominant species of river birch (*Betula nigra*) and sycamore. The association typically appears in the earlier stages of floodplain establishment and is most well-suited to generally moist, periodically drained alluvial areas. Common associate species include box elder, red maple, tulip poplar, black walnut, elm, sweet gum, cottonwood (*Populus deltoides*), black cherry, white oak, overcup oak (*Quercus lyrata*), spicebush, American hornbeam, American holly, sassafras, southern arrowwood, and poison ivy.

h. White Oak Association

The White Oak Association is found on dry to moderately wet sites, occasionally occurring on poorly-drained bottomland soils with high clay content. White oak is a common species within several parts of the corridor study boundary, but the White Oak Association is not very common. Commonly associated species include: northern red oak, tulip poplar, hickory, and flowering dogwood.

i. Cottonwood Association

The Cottonwood Association is commonly found along rivers and streams and quickly establishes in areas with bare, moist soils. This forest type is typically classified as early successional, as it establishes very quickly within the floodplain following disturbance. Associate species include sycamore, box elder, and black locust.

j. Pioneer/Invasive Areas

Forested areas dominated by the non-native species tree of heaven (*Ailanthus altissima*) and occurring in highly-disturbed areas were grouped as Pioneer/Invasive. Associate species include black walnut, Eastern red-cedar, staghorn sumac, multiflora rose, Japanese knotweed (*Polygonum cuspidatum*), porcelain berry, oriental bittersweet, Japanese honeysuckle, poison ivy, and Callery (Bradford) pear.

k. Chestnut Oak Association

Chestnut Oak Association forests are typically found on dry, upland sites with steep, rocky slopes and outcrops with thin soils. Common associate species include hickory, white ash, and flowering dogwood

l. Tulip Poplar-White Oak-Northern Red Oak Association

The Tulip Poplar-White Oak-Northern Red Oak Association is commonly observed at higher elevations in the eastern US and can be found on drier sites in the Piedmont Plateau. Common associate species include hickory and Christmas fern.

m. Virginia Pine Association

The Virginia Pine Association is most often identified as early-successional, as it tends to be relatively short-lived. Virginia pine is tolerant of poor site conditions and typically invades old fields or disturbed areas. Common associate species include various oak species, Eastern red-cedar, sassafras, greenbrier, blackberry, and poison ivy.

E. Invasive and Exotic Species

Invasive and exotic plants thrive in vegetative edge and fragmented forest environments, competing with and often displacing native plant species. This results in a reduction in diversity of native plant and animal species and overall health of the ecological community (Swearingen et al., 2002). The corridor study boundary contains miles of linear vegetative edges along the roadway, as well as extensive forest fragments within highway interchanges. **Table 2.7-1** lists the most common invasive species identified within these areas during the IRVM program.

MDOT SHA began management of invasive species within the I-495 ROW in May 2016 as part of the IRVM program. This vegetation management included cutting, removal, and chemical control of invasive tree, shrub, and herbaceous species along I-495 in Montgomery County, from south of the C&O Canal to the Prince George’s County line.

Table 2.7-1: Common Invasive Species within the Corridor Study Boundary

Common Name	Scientific Name	Stratum	Ecological Threat
Norway maple	*Acer platanoides*	Tree	Norway maple spreads rapidly by seed, and shades out native trees and shrubs.
Tree-of-Heaven	*Ailanthus altissima*	Tree	Tree of heaven invades urban areas, where it can cause damage to man-made structures, and natural habitats, where it displaces native plants and

Common Name	Scientific Name	Stratum	Ecological Threat
			produces toxins, which prevent nearby plants from establishing and/or surviving.
Silktree	*Albizia julibrissin*	Tree	Tolerant of a wide variety of conditions, silktree is prolific and displaces native trees and shrubs.
Princesstree	*Paulownia tomentosa*	Tree	Princesstree is highly adaptable and can be found in a wide variety of habitats, where it displaces native vegetation.
Callery (Bradford) Pear	*Pyrus calleryana* Dcne.	Tree	Callery pear forms dense thickets that push out other plants including native species that can't tolerate the deep shade or compete with pear for water, soil, and space. It produces copious amounts of seeds that are readily dispersed by animals, grows rapidly in disturbed areas, and lacks natural controls like insects and disease.
Privet	*Ligustrum sp.*	Shrub	Privets form dense thickets, thereby outcompeting and eventually excluding native vegetation.
Morrow's honeysuckle; Twinsisters; other bush honeysuckles	*Lonicera morrowi and Lonicera tatarica; other Lonicera species*	Shrub	Bush honeysuckles compete with and eventually displace native shrubs, thereby altering the natural habitat. These shrubs also outcompete native shrubs for pollinators and seed-dispersing animals, such as birds.
Multiflora rose	*Rosa multiflora*	Shrub	Multiflora rose can invade a wide range of habitats, and displaces native shrubs and herbs, possibly decreasing nesting areas for native birds.
Amur peppervine	*Ampelopsis brevipedunculata*	Vine	Spreading vine, which invades disturbed and open areas, threatens native vegetation by shading out herbs, trees, and shrubs.
Asian bittersweet	*Celastrus orbiculatus*	Vine	Spreading vine, which is tolerant of a wide range of conditions and threatens native vegetation by shading out herbs, trees, and shrubs, or girdling native trees and shrubs or uprooting them due to added weight.
Winter creeper	*Euonymus fortunei*	Vine	Spreading evergreen vine, which is tolerant of a wide range of conditions and threatens native vegetation by shading out herbs, trees, and shrubs; especially common in forest openings.
English ivy	*Hedera helix*	Vine	Evergreen spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, or girdling native trees and shrubs or uprooting them due to added weight.
Japanese honeysuckle	*Lonicera japonica*	Vine	Evergreen spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, or girdling young trees and shrubs.

Common Name	Scientific Name	Stratum	Ecological Threat
Asiatic tearthumb	*Persicaria perfoliata*	Vine	Spreading vine, which invades disturbed and open areas threatens native vegetation by shading out herbs, trees, and shrubs.
Kudzu	*Pueraria montana var. lobata*	Vine	Spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, and possibly girdling native trees and shrubs or uprooting them due to added weight. Kudzu can grow up to one foot per day.
Garlic-mustard	*Alliaria petiolata*	Herb	Extremely shade tolerant, garlic mustard invades forested areas and shades out native wildflowers, eventually displacing them.
Bamboo	*Bambusa, Phyllostachys, and Pseudosasa species*	Herb	Bamboo is widely planted by humans as a landscape plant, but if not controlled, forms dense, spreading thickets, which will displace native vegetation.
Japanese stilt grass	*Microstegium vimineum*	Herb	Japanese stiltgrass is tolerant of a wide range of conditions, and invades both full sun and shaded areas, eventually shading out native vegetation.
Common reed	*Phragmites australis*	Herb	Grass species, which invades wet areas, such as marshes, drainage areas, and riverbanks. Forms expansive monocultures, which threaten biodiversity in these areas.
Japanese knotweed	*Polygonum cuspidatum*	Herb	Knotweed is tolerant of a wide range of conditions, but is most commonly found on stream and riverbanks, where it spreads quickly, outcompeting native vegetation.

F. Reforestation Areas

MDOT SHA planted thousands of trees within the corridor study boundary under the Chesapeake Bay TMDL Tree Program and the Intercounty Connector (ICC) Project Mitigation Program, with the goal of establishing new forested areas to mitigate for stormwater runoff and project construction impacts. The EPA developed the Chesapeake Bay TMDL to establish the maximum amount of nitrogen, phosphorus, and sediment that the Chesapeake Bay can receive and still meet water quality standards as required by the Federal CWA. MDOT SHA is required to meet the reductions in the Bay TMDL as a condition of its NPDES Municipal Separate Storm Sewer System (MS4) Permit 11-DP-3313 issued on October 9, 2015. The MS4 permit requires MDOT SHA to treat or offset pollutants from stormwater runoff from 20 percent of MDOT SHA's untreated impervious surfaces using BMPs approved by the MDE by October 8, 2020.

Tree planting in state road rights-of-way or state-owned properties is one of the most cost-effective and widely implemented MDOT SHA strategies for meeting the MS4 permit requirements, and TMDL tree planting sites are located in interchanges throughout the corridor study boundary, with the majority of sites located in Prince George's County.

The ICC is an 18.8-mile-long six-lane toll highway that connects Gaithersburg in Montgomery County to Laurel in Prince George's County. In accordance with Maryland Reforestation Law, reforestation areas were established within the MDOT rights-of-way along I-495 and I-270 to mitigate for forest impacts associated with ICC construction. Two reforestation sites (REF-6D1 and REF-6F) are located in the Montgomery County portion of the corridor study boundary in the eastern clover leaf of the I-270/Shady Grove Road interchange and the northern clover leaf of the I-495/Connecticut Avenue interchange.

No reforestation areas were identified by VDOT within the Virginia portion of the corridor study boundary.

G. Forest Conservation Easements

Sixteen Montgomery County forest conservation easements and three Prince George's County Type 2 TCPs fall within the corridor study boundary, according to MD iMap data. These protected forest areas are described in **Table 2.7-2** below with location and category information. There are no state held forest conservation easements within the corridor study boundary according to available GIS data from MD DNR. No Virginia Department of Forestry open space easements or Agricultural/Forestal Districts are located within the corridor study boundary.

Table 2.7-2: Forest Conservation Easements Within the Corridor Study Boundary

County	Property	Category[1]	Location
Montgomery	M-NCPPC	I	Northwest of the I-495/New Hampshire Ave interchange
	M-NCPPC	I	South of I-495, west of Seminary Road
	M-NCPPC	I	Southeast of the I-495/Old Georgetown Road interchange
	M-NCPPC	I	Southwest of the I-495/Old Georgetown Road interchange
	M-NCPPC	I	South of I-495, west of Fernwood Road
	M-NCPPC	I	East of I-495, north of Bradley Boulevard
	M-NCPPC	I	West of I-495, north of Cindy Lane
	M-NCPPC	I	West of I-495, north of Lonesome Pine Road
	M-NCPPC	I	West of I-495, north of Old Seven Locks Road
	M-NCPPC	I	Northwest of the I-495/River Road interchange
	M-NCPPC	I	Northeast of the I-495/River Road interchange
	M-NCPPC	I	South of I-495, east of Osage Lane
	M-NCPPC	I	North of I-495, west of Persimmon Tree Road
	M-NCPPC	I	East of I-270, south of Tuckerman Lane
	M-NCPPC	I	Southwest of the I-270/Montrose Road interchange
	Gaithersburg	I	Northeast of the I-270/I-370 interchange
Prince George's	Inglewood Business Park	Type 2 TCP	Southeast of the I-495/Landover Road interchange
	Steeplechase Business Park	Type 2 TCP	Northwest of the I-495/Ritchie Marlboro Road interchange
	Wesson Drive WC Bank	Type 2 TCP	North of I-495, west of Suitland Road

[1] Montgomery County Category I easements protect existing and future forested areas from being cleared for construction, paving, or grading. Montgomery County Category II easements protect large specimen trees in non-forested areas. Prince George's County Type 1 and Type 2 TCPs conserve lands during land development and in perpetuity after completion of construction activities.

Other forest conservation easements exist within close proximity to the corridor study boundary, and any changes to the corridor study boundary could impact forest conservation easements not listed here.

2.7.3 Environmental Effects

Forested areas naturally filter ground water, reduce runoff from impervious surfaces, contribute to lower stream temperatures, supply necessary habitat for wildlife, sequester carbon, and contribute to air filtration and cooling (M-NCPPC, 1992). Construction of any of the Screened Alternatives for the I-495 & I-270 Managed Lanes Study would involve the physical removal and disturbance of vegetated areas, including forests, within the LOD due to clearing and grading of land needed for construction of highway travel lanes; highway interchanges, ramps, and service roads; construction of noise barriers; and construction of required SWM BMPs. Fewer impacts from the Screened Alternatives would occur to non-forested areas, such as managed lawns, landscaped areas, and cropland or pastures within interchanges, along the roadside, and within adjacent parcels to the existing roadway rights-of-way.

Larger forested areas within the corridor study boundary are found on parkland and within stream valleys, with smaller areas of mostly disturbed vegetation occurring in residential and commercial areas. Total forest canopy and conservation easement impacts from each of the Screened Alternatives are shown in **Table 2.7-3**[5] below. The No Build Alternative would result in no direct effects to terrestrial habitats, including forests and conservation easements. Forest canopy impacts would range from 1,434 to 1,515 acres. Impacts to Forest Conservation Act easements, including state and county-owned easements, would range from 17.2 to 20.8 acres.

Table 2.7-3: Impacts to Forests in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Forest Canopy[1]	0.0	1,434	1,497	1,497	1,515	1,489	1,503
Forest Conservation Act Easements	0.0	17.2	19.3	19.3	20.8	18.8	19.7

[1]Tree cover removed where wetlands overlapped.

Direct forest and tree impacts would include tree removal, critical root zone (CRZ) disturbance, tree canopy/limb damage, soil compaction, changes in soil moisture regimes due to grading operations and other construction-related activities, and sunscald and windthrow of individual trees growing along the newly exposed edges of retained forested areas. Indirect impacts to vegetated areas could result from increased roadway runoff, sedimentation, and the introduction of non-native plant species within disturbed areas. These indirect impacts could lead to terrestrial habitat degradation within the corridor study boundary, and ultimately a decrease in plant and animal species that inhabit these areas.

Impacts to contiguous forest areas, such as FIDS habitat, increase habitat fragmentation and edge to interior ratio, which has the potential to negatively impact wildlife species that rely on these forested corridors as habitat. Many wildlife species in the Washington D.C. metropolitan region rely on forested corridors to move safely within an otherwise urbanized environment. Impacts to potential FIDS habitat would be due to widening of the existing highway, resulting in slightly contracted forest interiors required by FIDS species, but would not result in new edge habitat as would occur from bisecting the FIDS habitat. A few contiguous forested areas within the study corridors would be bisected, such as those along the GWMP, which would result in increased edge habitat. Increased edge habitat supports species common to developed areas such as deer and red-tailed hawks, but impacts populations that rely on mature forests such as barred owls and scarlet tanagers, thereby reducing biodiversity. Increased deer habitat within an urbanized setting promotes unhealthy population growth and can pose a roadway hazard by increasing deer-related automobile accidents. Increased edge to interior ratio in forests also results in increased introduction of invasive plant species, resulting in lower plant biodiversity and fewer native plant species that support native wildlife.

The No Build Alternative would have no impact on Reforestation Sites. The Screened Alternatives would impact 4.6 acres of ICC Reforestation Sites and a maximum of 60.7 acres of TMDL reforestation sites. Impacts to the TMDL and ICC reforestation sites are summarized in **Table 2.7-4** below.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Table 2.7-4: Impacts to TMDL and ICC Reforestation Sites in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
TMDL Reforestation Sites	0	60.6	60.7	60.7	60.7	60.7	60.7
ICC Reforestation Sites	0	4.6	4.6	4.6	4.6	4.6	4.6

2.7.4 Avoidance, Minimization, and Mitigation

Avoidance and minimization efforts to reduce forest impacts will involve a two-tiered approach. The first level will occur during the planning stage where every reasonable effort will be made to minimize disturbance to or removal of forest and trees by minimizing the LODs of the Screened Alternatives. The second level of additional avoidance and minimization will occur at the Public-Private Partnership (P3) design/build stage, with advancement of the design and further refinements to the LOD. Cost reduction related to tree removal and replacement provide incentive to refine the LOD and reduce impacts to resources, but due to the fixed nature of the highway corridor, opportunities for avoidance and minimization of impacts to roadside forest and tree resources are limited.

Unavoidable impacts to forest from the I-495 & I-270 Managed Lanes Study will be regulated by MDNR under Maryland Reforestation Law. When appropriate minimization efforts have been considered and one acre or more of forest clearing is required, acre for acre replacement of forested areas must occur according to a mitigation hierarchy. First, MDOT SHA would be required to replant available public land within the same county and/or watershed. Once those public land planting opportunities are exhausted, MDOT SHA would purchase credits in a forest mitigation bank or demonstrate that no other forest conservation banks are available in the affected watershed or county. Typically, the final mitigation option would be to pay into the MDNR Reforestation Fund at a rate of 10 cents per square foot of impact (MDNR, 2013). Coordination with MDNR is ongoing to determine acceptable forest mitigation for potential impacts of the I-495 & I-270 Managed Lanes Study.

One-to-one tree replacement is required to mitigate impacts to Reforestation Law planting sites, such as ICC Reforestation Areas, while impacts to TMDL tree planting sites will require replacement of the water quality benefits provided by the site. If most feasible to replace the impact to a TMDL site with tree plantings, the area impacted must be replaced acre-for-acre and reported back to MDNR and the MDOT SHA Office of Environmental Design's Water Programs Division. Impacts to county-held forest conservation easements that can be mitigated on the same parcel would require one-to-one tree replacement, while impacts that cannot be mitigated on the same parcel would require two-to-one tree replacement according to Forest Conservation Law and direction by M-NCPPC. Reforestation would adhere to any additional mitigation requirements of the affected county (the submittal of a Forest Conservation Plan (FCP) amendment, additional planting, easement plat revisions, fee-in-lieu payment, etc.). FCP amendment submittals, approvals, and easement mitigation requirements would be coordinated with the M-NCPPC forest conservation reviewer for Montgomery and/or Prince George's County during final project design.

The only forest resources within the corridor study boundary in Virginia are NPS property and Scott's Run Nature Preserve. Mitigation for any impacts to these forests would require specific coordination with NPS and VDCR. No Virginia Department of Forestry open space easements or Agricultural/Forested Districts are located within the corridor study boundary.

2.8 Terrestrial Wildlife

2.8.1 Regulatory Context and Methods

Terrestrial wildlife in the I-495 & I-270 Managed Lanes Study corridor study boundary are protected under several state and federal provisions. The protection of all migratory birds is governed by the Migratory Bird Treaty Act (16 U.S.C. 703-712), under which it is illegal to "take, kill, possess, transport, or import migratory birds or any part, nest, or egg of any such bird" unless authorized by a valid permit (16 U.S.C. 703). A list of migratory birds protected by the Migratory Bird Treaty Act (MBTA) is included in 50 CFR 10.13, and includes most species within Maryland and Virginia. However, on December 22, 2017, the Solicitor of the Department of the Interior issued Solicitor's Memorandum M-37050 that declares that only activities deliberately intended to kill or take migratory birds may be the subject of regulation or enforcement under the MBTA.

Although the bald eagle (*Haliaeetus leucocephalus*) is no longer a listed species under the Endangered Species Act (ESA), it is still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). The Bald and Golden Eagle Protection Act prohibits the take, possession, sale, purchase, barter, transport, export, or import of any bald or golden eagle (alive or dead), including any part (such as feathers), nest, or egg without a valid permit issued by the Secretary of the Interior (50 CFR 22.3). According to Opinion M-37050, a "take" refers to actions specifically aimed to capture or kill a migratory bird, its nest, or eggs and not an incidental effect of another lawful activity. The Act prohibits disturbing any bald or golden eagle, including agitating or bothering "to a degree that causes, or is likely to cause, based on scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." MDOT SHA's position is that the MLS is not an activity that deliberately intends to kill or take migratory birds.

In an e-mail from USFWS dated May 13, 2020, the USFWS stated that bald eagle nest surveys were annually conducted by MDNR, but the last comprehensive efforts ended in 2004. Recently, the Maryland Bird Conservation Partnership established a Bald Eagle Nest Monitoring Program with the support of volunteers to monitor nests and collect information. These data are entered into an electronic database and used by the USFWS Chesapeake Bay Field Office to make determinations on project impacts that may impact eagle nests.

In the same e-mail correspondence, the USFWS stated that peregrine falcons began nesting at the American Legion Bridge in 2007 (USFWS, 2007). When MDOT SHA initiated a contract for bridge painting and maintenance it became apparent that the falcon nesting attempts would fail. In response, MDOT SHA formed a partnership with the USFWS and MDNR to protect and promote more favorable conditions for nesting falcons on the Bridge. Through this partnership, MDOT SHA constructed and installed a nest box platform to ensure long term protection for nesting falcons on the bridge. The e-mail correspondence documenting both the bald eagle and peregrine falcon information is located in **Appendix N**.

The conservation of terrestrial wildlife is managed in both Maryland and Virginia through the implementation of state wildlife action plans (SWAP). The SWAP was initiated by the USFWS in 2005 to have states track wildlife species to determine those species of greatest conservation need (SGCN). The states participating in the SWAP program were then eligible to receive funding through the state and

Tribal Wildlife Grants program to assist with the conservation of at-risk species before they become threatened or endangered. The SWAP program must be updated every 10 years, and Maryland and Virginia each updated their initial SWAP in 2015 (MDNR, 2016; VDGIF, 2015). These documents identify each state's SGCN and identify conservation goals to keep these species from becoming threatened or endangered.

The NPS manages the Potomac Gorge Conservation Area, a 15-mile long riparian corridor along the Potomac River running downstream from Great Falls. This biologically diverse area that crosses the corridor study boundary contains at least 30 distinct natural vegetation communities that support numerous rare plant and animal species (The Nature Conservancy 2005). State and federally listed plant species within the Potomac Gorge are addressed in **Section 2.10**. Targeted animal surveys have also been conducted within the Potomac Gorge by the NPS, with the primary focus being on invertebrate species. Many of these surveys have documented first state records or species new to science.

In Maryland, Colonial Water Bird Nesting Areas and FIDS are regulated as protected resources within the Chesapeake Bay Critical Area (Critical Area) (COMAR 27.01.09.04). Additionally, the MDNR and USFWS track these species to ensure their populations remain viable and do not become threatened or endangered. Examples of colonial water birds include herons, egrets, and terns. FIDS require larger forest patches to successfully maintain viable populations. FIDS habitat typically includes contiguous forest of at least 50 acres with at least 10 acres of forest interior habitat or riparian forests at least 50 acres in size with a width of at least 300 feet (Jones et al., 2000). Forest interior habitat is defined as forest at least 300 feet from the nearest forest edge (Jones et al., 2000). Regulated FIDS habitat includes documented FIDS breeding areas within existing riparian forests that are at least 300 feet in width and that occur adjacent to streams, wetlands, or the Chesapeake Bay shoreline, and other forest areas used for breeding by FIDS (Jones et al., 2000). There are no designated Critical Areas within the I-495 & I-270 Managed Lanes Study corridor study boundary, and FIDS are not specifically regulated outside of the Critical Area; however, MDNR encourages avoidance of impacts to FIDS habitat throughout the state, including those associated with transportation improvements.

Several types of amphibians are obligate vernal pool species, meaning that they must use temporary pools during a portion of their life stage. The presence of vernal pool amphibian species discussed in **Section 2.8.2** is based upon the availability of vernal pool habitat within the corridor study boundary, as observed and mapped during fieldwork for the I-495 & I-270 Managed Lanes Study, and information gathered from Cunningham and Nazdrowicz (2018). In Maryland, vernal pools may or may not be regulated by the USACE under Section 404, depending upon their position within the landscape, duration of inundation, and connection or lack thereof to Waters of the US. Because vernal pools are necessarily ephemeral in nature, they may not hold water long enough to create hydric soil conditions. However, the MDE regulates most naturally occurring vernal pools in Maryland regardless of whether they are isolated or maintain hydric soils.

Data on wildlife habitat and documented wildlife species within the I-495 & I-270 Managed Lanes Study corridor study boundary were collected through analysis of aerial imagery of vegetative cover, incidental observations of wildlife species and related habitat made during various natural resource field investigations (e.g., wetland delineations), and data provided by the resource agencies. Information on the potential presence of colonial nesting waterbirds is provided by MDNR and the USFWS during the rare, threatened, and endangered species review process described in **Section 2.10**.

The MDNR FIDS habitat GIS layer, available via the MERLIN database, includes 2006 land cover data that is no-longer accurate, in some cases depicting FIDS habitat crossing roads. For the purposes of this study, the MDNR FIDS habitat layer represents historic FIDS habitat. To more accurately document the extent of the current FIDS habitat within the corridor study boundary, environmental scientists, on behalf of MDOT SHA, used the MDNR FIDS data as a baseline and refined the data through an analysis of current GIS forest cover data from the Chesapeake Conservancy Conservation Innovation Center's High Resolution Land Cover Data for tree canopy cover and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014). Those forest patches that met the definition of FIDS habitat, as defined by Jones, et al., 2000, were considered FIDS habitat for the purposes of this study. Total acreage of historic FIDS habitat within the corridor study boundary was calculated to be approximately 220 acres based on the 2006 data and total acreage of current FIDS habitat within the corridor study boundary is approximately 120 acres.

2.8.2 Existing Conditions

Terrestrial wildlife expected within the corridor study boundary reflect the availability of various natural and man-modified habitats across a wide swath of the western Coastal Plain and eastern Piedmont physiographic provinces. Because of the mostly built environment adjacent to the existing highway corridors, natural habitats along the corridors are comprised of a mix of scattered small, remnant patches of forest and disturbed old fields. Man-modified open agricultural land occurs within the BARC. Larger patches of forest habitat exist primarily where larger streams cross the corridor study boundary, particularly within stream valley parks in Montgomery and Prince George's Counties in Maryland and on NPS property in Maryland and Virginia along the Potomac River. These forested stream corridors occur on the I-495 portion of the corridor study boundary at crossings of the Potomac River, Cabin John Branch, Rock Creek, Sligo Creek, Northwest Branch, Paint Branch, Little Paint Branch, Indian Creek, Southwest Branch, and Henson Creek. There is also a larger forested habitat on the southwest side of I-495 adjacent to the Baltimore Washington Parkway associated with Greenbelt Park. In the I-270 portion of the corridor study boundary, these larger forested areas occur along Muddy Branch, Watts Branch, and Cabin John Creek. Many of these large forest tracts and forested stream corridors are also recognized by MDNR as GI hubs or corridors, which are important habitats for wildlife. GI is discussed in more detail in **Section 2.11**.

As noted in **Section 2.7, Vegetation and Terrestrial Habitat**, the smaller remnant forest patches and old fields within the corridor study boundary are primarily disturbed and contain numerous invasive vines, shrubs, and trees. These disturbed remnant forests and old fields surrounded by development provide habitat for edge adapted and disturbance tolerant wildlife species. The open fields on BARC property also provide habitat for edge-adapted species and some grassland species. More disturbance tolerant species observed within the corridor study boundary include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), groundhog (*Marmota monax*), gray squirrel (*Sciurus carolinensis*), mourning dove (*Zenaida macroura*), American crow (*Corvus brachyrhynchos*), blue jay (*Cyanocitta cristata*), Carolina wren (*Thryothorus ludovicianus*), northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), common grackle (*Quiscalus quiscula*), house sparrow (*Passer domesticus*), common gartersnake (*Thamnophis sirtalis sirtalis*), eastern ratsnake (*Pantherophis alleghaniensis*), and ring-necked snake (*Diadophis punctatus*). Where temporary and permanent water sources are also available within these habitats, the corridor study boundary may also support various amphibians, including eastern red-backed salamander (*Plethodon cinereus*), American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), green frog (*Lithobates clamitans*), and American bullfrog (*Lithobates catesbeianus*). **Appendix L** provides a table of mammals, birds, reptiles, and amphibians observed within the corridor study boundary during fieldwork conducted in 2018.

In an e-mail dated May 13, 2020, USFWS stated that a recent search of the Maryland Bird Conservation Partnership by USFWS determined that no bald eagle nests are noted within the I-495 & I-270 Managed Lanes Study corridor study boundary. The closest nests were noted in Prince George's County near the I-495/Woodrow Wilson Memorial Bridge and at the Washington DC-Maryland border, over eight miles away. A peregrine falcon pair has been successfully using a nest box installed on the ALB for 12 consecutive years (USFWS, 2019). The e-mail correspondence regarding bald eagle and peregrine falcon presence and recommendations is located in **Appendix N**.

The above referenced NPS Potomac Gorge surveys noted numerous Virginia state first records or newly described species for various species of beetles (Steury et al. 2018, Steury 2018, Steury 2017, Steury and MacCrae 2014, Steury and Messer 2014, Cavey et al. 2013, Evans and Steury 2012, Steury et al. 2012), moths (Steury et al. 2007), caddisflies (Flint 2011), and land snails and slugs (Steury and Pearce 2014). These species are included in **Appendix M**.

Only six SGCN were observed within the mostly disturbed I-495 & I-270 Managed Lanes Study corridor study boundary, including eastern box turtle (*Terrapene carolina*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), American kestrel (*Falco sparverius*), chimney swift (*Chaetura pelagica*), and magnolia warbler (*Setophaga magnolia*) (See the list of observed wildlife during the I-495 & I-270 Managed Lanes Study in **Appendix L**). However, both the great egret and magnolia warbler are migrants that do not breed within the corridor study boundary. The great blue heron typically nests in colonies within large, somewhat remote beaver marshes with clumps of dead trees; however, no active great blue heron rookeries were observed during the study fieldwork and no colonial nesting waterbird rookeries were documented by the MDNR and USFWS. Suitable habitat exists for the remaining SGCN.

Less disturbed and larger contiguous forests can provide habitat for FIDS, and MDNR recognizes 25 species of FIDS in Maryland. The greater I-495 & I-270 Managed Lanes Study corridor study boundary contains some FIDS habitat and smaller areas of forest interior, particularly along the Potomac River, Cabin John Branch, Rock Creek, Northwest Branch, Paint Branch along I-95 north of I-495, Indian Creek, Southwest Branch, Henson Creek, and within Greenbelt Park. Areas of FIDS habitat are depicted in **Appendix B, Natural Resources Inventory Maps**. Two FIDS were observed during the study, including red-shouldered hawk and pileated woodpecker.

Vernal pool amphibians are another specialized group of wildlife potentially occurring within the corridor study boundary. Vernal pools are temporary pools that typically retain water only during winter and spring and are dry by mid-summer. Vernal pools do not support fish, allowing specialized frog and salamander species to exploit a predator-free breeding and early life stage environment. Species that rely completely on vernal pools for reproduction that could occur within the corridor study boundary include marbled salamanders (*Ambystoma opacum*), spotted salamanders, (*Ambystoma maculatum*) and wood frogs (*Lythobates sylvaticus*). Vernal pool habitat exists within the corridor study boundary as natural or man-modified shallow depressions that appear to hold water only for a temporary period of time. The Rock Creek floodplain had the most mapped potential vernal pools within the corridor study boundary. No obligate vernal pool species were incidentally observed during the study.

2.8.3 Environmental Effects

There would be no study-related effects on wildlife from the No Build Alternative. There would be some wildlife impacts from construction of a Screened Alternative, as each alternative would involve widening along the same alignment as the existing highway. Therefore, clearing of forest fragments and encroachments on larger forest resources would result in displacements of some edge adapted species, but would not result in substantial loss of wildlife habitat. Typically, forests along the corridor study boundary are early- to mid-successional (MDOT SHA, 2006) and many areas would regain functionality due to replanting requirements. The Screened Alternatives could potentially contribute contaminants to remaining wildlife habitat through pollutant runoff. The use of erosion and sediment control BMPs will help to minimize pollutant runoff into surrounding wildlife habitat. Disturbances during construction could also provide opportunities for invasive plant species colonization. Care should be taken to stabilize disturbed soils with native vegetation, and to treat areas of significant invasive species establishment.

Bald eagles are not expected to be negatively affected by the Build Alternatives, because no bald eagle nests have been identified within the study corridor boundary. Since bald eagle populations are expanding, it is possible that additional nesting pairs may utilize areas near highways in the future. MDOT SHA will consult with the USFWS when construction begins to confirm the presence/absence of bald eagle nests in the vicinity of the I-495 and I-270 Managed Lanes Study. The improvements to the ALB will likely disturb the resident peregrine falcon nest. USFWS expects disruption of the falcons for one or more nesting seasons due to long term construction activities.

The greatest potential project-related wildlife impacts would occur from Alternative 10, which has the greatest forest impacts. Most of these impacts would be to smaller, upland forest stands resulting in reductions in available edge habitat, rather than complete elimination of habitat. Therefore, some less motile wildlife could be killed during construction and other more motile species will be shifted away from the new construction, potentially into already occupied territories requiring further movement into unoccupied suitable habitat if available. It is also possible that these wildlife movements would be onto existing roadways resulting in potential mortality from vehicle strikes, posing threats to both wildlife and drivers. This effect would be most apparent within the smallest forest stands where remaining habitat may be too small to support populations.

There would be impacts to potential FIDS habitat within the corridor study boundary from the various Screened Alternatives. Alternative 5 has slightly less impact than Alternatives 8, 9, 10, 13A, and 13C, as summarized in **Table 2.8-1**. Impacts to potential FIDS habitat would be due to widening of existing highway, resulting in slightly contracted forest interiors required by FIDS species, but would not result in new edge habitat as would occur from bisecting the FIDS habitat.

Table 2.8-1: Impacts to Potential FIDS Habitat in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Potential FIDS Habitat	0	25.2	27.7	27.7	27.7	27.7	27.7

2.8.4 Avoidance, Minimization, and Mitigation

Some level of impact to terrestrial wildlife would be unavoidable if a Screened Alternative is selected, primarily due to the associated reduction in the availability of vegetated habitat. Impacts to wildlife are anticipated to be minimal since the project will improve an existing roadway corridor primarily populated by edge and disturbance acclimated species.

As stated in **Section 2.8.3**, MDOT SHA will consult with the USFWS when construction begins to confirm the presence/absence of bald eagle nests in the vicinity of the I-495 and I-270 Managed Lanes Study. To minimize potential impacts to the currently nesting peregrine falcons, USFWS recommends that MDOT SHA remove the existing peregrine falcon nest box on the ALB just prior to the nesting season when construction is scheduled to begin. Once construction activities are nearly complete near the former nest site, USFWS recommends that the nest box is reinstalled. MDOT SHA will follow the USFWS recommended protection measures for the peregrine falcons nesting on the ALB.

Impacts to potential FIDS habitat would result from slightly contracted forest interiors. Efforts to avoid and minimize forest impacts are discussed in **Section 2.7, Vegetation and Terrestrial Habitat**. To minimize vehicle collisions with large animals, MDOT SHA would also investigate options such as fencing and landscaping. In addition, the use of erosion and sediment control best management practices would help to minimize pollutant runoff into surrounding wildlife habitat.

2.9 Aquatic Biota

2.9.1 Regulatory Context and Methods

Fish and shellfish species are protected through Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and MDNR Fishery Management Plans. Existing data on aquatic biota within the I-495 & I-270 Managed Lanes Study corridor study boundary were gathered from MCDEP, PGDoE, MBSS, MDOT SHA, FCDPWES, Virginia Department of Game and Inland Fisheries (VDGIF), and VDEQ, all of which conduct periodic monitoring of stream habitat, benthic macroinvertebrates, and/or fish within the vicinity of the corridor study boundary as part of long-term water quality monitoring efforts. The presence, abundance, and diversity of aquatic biota, along with physical and in-situ chemical characteristics of the stream, are used by all agencies to assess overall stream conditions and develop watershed management strategies for each watershed. As required by the CWA (Sections 305b and 303d), MDE and VDEQ use biological monitoring data in their determination of impaired waterbodies within Maryland and Virginia, respectively. According to MDE methodologies, Maryland watersheds are assessed using a multi-step process to categorize impaired waters for the Integrated Report (MDE, 2014). A site is considered failing if Index of Biotic Integrity (IBI) scores do not meet the minimum allowable limit (MAL) of 2.5 for fish IBIs and 2.65 for benthic IBIs. Failing IBI scores are then compared to scores from reference watersheds and the watershed is categorized as impaired (Category 5) if the scores are significantly different. According to VDEQ methodologies, Virginia streams are considered biologically impaired (Category 5) based on benthic macroinvertebrate data if the Virginia Stream Condition Index (VSCI) score falls below 60 or if the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) score falls below 40 (VDEQ, 2018).

For the purposes of this study, only data collected within the 10-year period from 2007-2017 and generally falling within 1 mile of the study corridors were considered representative of existing conditions in the corridor study boundary. Substantial existing data on aquatic communities within the corridor study boundary were obtained from 43 PGDoE sites, 36 MCDEP sites, 13 MBSS sites, 10 FCDPWES sites, four MTA sites, three MDOT SHA sites, and one VDEQ site within the corridor study boundary's watersheds. The locations of the monitoring stations are shown in **Appendix K** and data from these stations are summarized below and provided in detail in **Appendix M**. Summary data are organized by watershed, as described in **Section 2.4.1.A,** and then presented per waterway as the range of values observed over the 10-year data review period provided.

As discussed in **Section 2.10,** MDOT SHA requested information from MDNR ERP and MDNR Wildlife and Heritage Service (WHS) regarding the presence of sensitive species and other natural resources within the corridor study boundary. MDNR ERP provided feedback in a response letter dated January 10, 2019 that included a list of fish species likely to occur within the waterbodies crossed by the corridor study boundary. The majority of the species noted by MDNR were also documented in the data obtained from MBSS and county agencies within the 2007 to 2017 timeframe and one-mile radius described above. However, some additional species were also noted in the MDNR letter, and it is likely that these additional species were documented outside of the physical and temporal boundaries used to collect existing data on aquatic biota for this document. These additional species are noted in the discussions below, and the full lists provided by MDNR can be found in **Appendix N**.

Methods for collection and analysis of existing data on aquatic habitat, macroinvertebrates, and fish often vary between agencies. Specific methods of collection and analysis are available from each contributing agency. Differences that affect interpretation and comparison of results between agencies are also broadly discussed to facilitate understanding of relative findings.

A. Aquatic Habitat

Several aquatic habitat scoring and narrative ranking processes are used by the agencies from which data were collected. MCDEP, FCDPWES, and VDEQ use the EPA Rapid Bioassessment Protocol (RBP) for aquatic habitat scoring, which rates the quality of velocity-depth regime, epifaunal substrate, embeddedness, sediment deposition, frequency of riffles, channel alteration, channel flow status, bank vegetative protection, bank stability, and riparian vegetative zones for high gradient streams. The narrative ranking criteria utilized by MCDEP, FCDPWES, and VDEQ based on RBP aquatic habitat scoring are shown in **Table 2.9-1**.

Table 2.9-1: EPA Rapid Bioassessment Protocol Aquatic Habitat Ranking Criteria

Score	Narrative
166 – 200	Excellent
154 – 165	Excellent/Good
113 – 153	Good
101 – 112	Good/Fair
60 – 100	Fair
54 – 59	Fair/Poor
0 – 53	Poor

Source: Van Ness et al., 1997; Stribling et al., 1999

PGDoE also uses the EPA's RBP, but with ranking criteria developed specifically for streams within Prince George's County, shown below in **Table 2.9-2**.

Table 2.9-2: PGDoE Aquatic Habitat Ranking Criteria

Score	Narrative
151 +	Comparable
126 – 151	Supporting
100 – 125	Partially Supporting
< 100	Non-supporting

Source: PGDER, 1995

The aquatic habitat assessment used by MBSS is based on the EPA RBP aquatic habitat assessment methodology and modified for use in Maryland streams. This protocol assigns a value and weight to each of eight parameters for Piedmont streams and six parameters for Coastal Plain systems. The following parameters are used for Piedmont systems: instream habitat, epifaunal substrate, embeddedness, number of rootwads and woody debris, remoteness, shading, bank stability, and riffle/run quality. The following parameters are used for Coastal Plain systems: instream habitat, epifaunal substrate, remoteness, shading, bank stability, and number of rootwads and woody debris. For each physiographic province, the parameter scores are combined into a physical habitat index (PHI), set on a scale of 0 to 100, and a narrative ranking is assigned, as shown in **Table 2.9-3**. In addition to using a modified version of EPA's RPB methods, PGDoE also uses MBSS methods for aquatic habitat assessments. MBSS methods were also used by MDOT SHA and MTA.

Table 2.9-3: MBSS Aquatic Habitat Ranking Criteria

Score	Narrative
81 – 100	Minimally Degraded
66 – 80	Partially Degraded
51 – 65	Degraded
0 – 50	Severely Degraded

Source: Paul et al., 2002

B. Benthic Macroinvertebrates

For Virginia streams, VDEQ and FCDPWES use different biotic indices for assessing the health of benthic macroinvertebrate communities. VDEQ uses the VSCI for non-coastal streams. The VSCI uses eight core metrics to compare biological conditions of a stream to reference (best available) conditions to identify impaired waterbodies (Burton et al., 2003). FCDPWES has developed their own benthic IBI that compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in the least-impaired streams (FCDPWES, 2006). For the Piedmont physiographic province, the FCDPWES benthic IBI is based on state-wide reference streams and five community metrics found to characterize macroinvertebrate community health. VDEQ and FCDPWES benthic IBI scores are not directly comparable due to differences in benthic IBI metrics and overall scoring. **Table 2.9-4** and **Table 2.9-5** summarize how VDEQ and FCDPWES rank each benthic IBI score and how each of the scores and rankings relates to reference conditions.

Table 2.9-4: VDEQ VSCI Scores and Rankings

Score	Narrative Ranking
73 – 100	Excellent
60 – 72	Good
59 – 43	Stress
0 – 42	Severe Stress

Source: Burton et al., 2003

Table 2.9-5: FCDPWES Benthic IBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
80 – 100	Excellent	Equivalent to reference conditions; high biodiversity and balanced community
60 – 80	Good	Slightly degraded site with intolerant species decreasing in numbers
40 – 60	Fair	Marked decrease in intolerant species; shift to an unbalanced community
20 – 40	Poor	Intolerant species rare or absent, decreased diversity
0 – 20	Very Poor	Degraded site dominated by a small number of tolerant species

Source: FCDPWES, 2006

For Maryland streams, MBSS and MCDEP methods were used for conducting benthic macroinvertebrate assessments within the corridor study boundary. MBSS and MCDEP each developed their own benthic IBI that compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in the least-impaired streams. For the Piedmont and Coastal Plain physiographic provinces, the MBSS benthic IBI is based on state-wide reference streams and uses six and seven community metrics found to characterize macroinvertebrate community health, respectively. PGDoE follows the MBSS methods of sampling and analysis, so PGDoE and MBSS data are directly comparable. In addition, all data collected by MDOT SHA and MTA were developed following MBSS methods. The MCDEP benthic IBI was developed using reference streams from within Montgomery County and from other Piedmont streams in neighboring counties. This method uses the scoring of eight metrics tailored specifically to conditions within local Piedmont streams. MCDEP and MBSS benthic IBI scores were not comparable due to differences in benthic IBI metrics and lab protocols. **Table 2.9-6** and **Table 2.9-7** summarize how MBSS and MCDEP rank each benthic IBI score and how each of these scores and rankings relates to reference conditions.

Table 2.9-6: MBSS Benthic IBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10^{th} percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10^{th} percentile of reference site values.

Source: Stribling et al., 1998

Table 2.9-7: MCDEP BIBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
> 35	Excellent	IBI scores within the upper 50 percent of reference site conditions are assigned to this highest attainable IBI class.
26 – 34	Good	Decreased number of sensitive species, decreased number of specialized feeding groups with some intolerant species present.
17 – 25	Fair	Intolerant and sensitive species are largely absent; unbalanced feeding group structure.
< 17	Poor	Top carnivores and many expected species are absent or rare; general feeders and tolerant species dominate.

Source: Roth et al., 2000; Van Ness, 1997

For Virginia streams, FCDPWES has developed their own Fish Index of Biotic Integrity (fish IBI). The fish IBI developed by FCDPWES uses seven community metrics to assess the health of fish communities, relative to Virginia's Piedmont streams (FCDPWES, 2006). **Table 2.9-8** summarizes how FCDPWES ranks each fish IBI score and how each of these scores and rankings relates to least-impaired, or reference, conditions.

Table 2.9-8: FCDPWES Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking
> 29	Excellent
23 – 28	Good
18 – 22	Good
13 – 17	Poor
< 13	Very Poor

Source: FCDPWES, 2006

C. Fish

MBSS and MCDEP methods were used in Maryland to conduct fish assessments within the corridor study boundary. MBSS and MCDEP have each developed a fish IBI that compares the fish community within a given stream to reference fish communities in the least-impaired streams. Both methods for assessing fish communities are based on the same principles of measuring a community using a suite of comparative metrics, but are considerably different in most other ways. These fish IBIs are calculated by assigning a score to each metric result based on their comparison to the distribution of values at a reference site. All of the metric scores are averaged and assigned a narrative value that varies between agencies. For the Piedmont and Coastal Plain physiographic provinces, the MBSS fish IBI is based on state-wide reference streams and uses six community metrics found to characterize fish community health in Maryland's streams (Stranko et al., 2007; Roth et al., 2000; Southerland et al., 2005). Different individual fish IBI metrics were used for Piedmont and Coastal Plain systems within the corridor study boundary. MDOT SHA, MTA, and PGDoE follow the MBSS methods of sampling and analysis, making them all directly comparable. The MCDEP fish IBI uses nine different metrics and narrative rankings based on dominant soil type and stream order. Since MBSS and MCDEP use different narrative rankings and fish IBI metrics, the resulting scores and rankings are not directly comparable. Additionally, MCDEP reports fish IBI scores to the nearest tenth, while MBSS reports scores to the hundredths decimal place. **Table 2.9-9** and **Table 2.9-10** summarize how MBSS and MCDEP rank each fish IBI score and how these scores and rankings relate to reference conditions.

Table 2.9-9: MBSS Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

Source: Roth et al., 2000

Table 2.9-10: MCDEP Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking	Characteristics
>4.5	Excellent	IBI scores within the upper 50 percent of reference site conditions are assigned to this highest attainable IBI class.
3.4 – 4.5	Good	Decreased number of sensitive species, decreased number of specialized feeding groups with some intolerant species present.
2.3 – 3.3	Fair	Intolerant and sensitive species are largely absent; unbalanced feeding group structure.
< 2.2	Poor	Top carnivores and many expected species are absent or rare; general feeders and tolerant species dominate.

Source: Roth et al., 1998; Van Ness, 1997

In addition to summarizing biological survey data, the Chesapeake Fish Passage Prioritization (CFPP) database was also reviewed for all watersheds in the vicinity of the corridor study boundary. The CFPP project is a collaboration led by The Nature Conservancy (TNC) and is comprised of fish blockage data for the greater Chesapeake Bay watershed (Martin, 2019). This database includes historic blockages that have not been recently confirmed, as well as partial blockages and blockages with aquatic life passage facilities. Despite these limitations of the database, it provides context for the current status of fish movement and blockages within each watershed.

2.9.2 Existing Conditions

A. Fairfax County Middle Potomac Watersheds

a. Aquatic Habitat

FCDPWES assessed aquatic habitat at four sites within the Scotts Run subwatershed from 2009 through 2014. Habitat assessments were conducted at two sites on the mainstem and at two sites located on unnamed tributaries to Scotts Run. Both tributaries enter the mainstem of Scotts Run downstream of I-495. Aquatic habitat along the Scotts Run mainstem, both upstream and downstream of I-495, was rated as Fair. Aquatic habitat along both of the unnamed tributaries was rated as Good/Fair (**Table 2.9-11**).

Aquatic habitat conditions were assessed by FCDPWES at four sites throughout the Dead Run subwatershed from 2008 through 2015, three of which were on the mainstem and one of which was on an unnamed tributary. Unnamed Tributary 1 to Dead Run joins the mainstem at the southern end of Turkey Run Park. For the Dead Run mainstem and Unnamed Tributary 1 to Dead Run, aquatic habitat conditions were rated as Fair by FCDPWES. VDEQ also assessed aquatic habitat at one site on the Dead Run mainstem in 2009, located well downstream near George Washington Memorial Parkway. Aquatic habitat was rated as Good for the Dead Run mainstem, based on data collected by VDEQ (**Table 2.9-11**). Overall, habitat conditions were generally minimally to moderately degraded for the Fairfax County Middle Potomac watersheds.

Table 2.9-11: Range of Aquatic Habitat Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	63 – 99	Fair
Unnamed Tributary 1 to Scotts Run	FCDPWES	2009	108	Good/Fair
Unnamed Tributary 2 to Scotts Run	FCDPWES	2014	110	Good/Fair
Dead Run	FCDPWES	2008 – 2015	81 – 100	Fair
	VDEQ	2009	118 – 123	Good
Unnamed Tributary 1 to Dead Run	FCDPWES	2008	91	Fair

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

A summary of benthic macroinvertebrate sampling results for the Fairfax County Middle Potomac watersheds is presented in **Table 2.9-12**. According to existing data collected by FCDPWES in the Scotts Run subwatershed, benthic macroinvertebrate community conditions vary by watershed. The benthic IBI scores on the mainstem of Scotts Run ranged from Very Poor to Poor, indicating a substantially degraded benthic macroinvertebrate community. Unnamed Tributary 1 to Scotts Run had a rating of Poor for the benthic macroinvertebrate community, while the benthic macroinvertebrate community was rated as Good along Unnamed Tributary 2 to Scotts Run.

The Dead Run subwatershed was sampled between 2008 and 2018 by FCDPWES and VDEQ. Overall, the benthic community within the Dead Run subwatershed was severely degraded. Based on FCDPWES sampling, the benthic macroinvertebrate community along the Dead Run mainstem was rated as Very Poor to Poor. VDEQ VSCI scores indicated that the benthic macroinvertebrate community in the mainstem of Dead Run ranged from Severe Stress to Stress, also indicating severe stream degradation. The benthic macroinvertebrate community in Unnamed Tributary 1 to Dead Run was sampled in 2008 by FCDPWES with benthic IBI scores falling in the Poor range, similar to the mainstem.

Table 2.9-12: Range of Benthic IBI and VSCI Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	18.1 – 23.3	Very Poor – Poor
Unnamed Tributary 1 to Scotts Run	FCDPWES	2009	23.3	Poor
Unnamed Tributary 2 to Scotts Run	FCDPWES	2014	66.0	Good
Dead Run	FCDPWES	2008 – 2018	12.5 – 39.7	Very Poor – Poor
	VDEQ	2009	22.06 – 45.90	Severe Stress – Stress
Unnamed Tributary 1 to Dead Run	FCDPWES	2008	31.5	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Eight fish species were recently documented by FCDPWES in the Fairfax County Middle Potomac watersheds, fewer than any other watershed within the corridor study boundary in recent years **(Appendix O).** No intolerant or sensitive species were documented, and the only diadromous species observed was American eel, which was found in Dead Run. American eel is a catadromous fish species that lives the majority of its life in freshwater and migrates to the sea to spawn. Of the diadromous fish species, American eel is among the most successful at navigating fish blockages. According to the CFPP database, there are no fish blockages located within the Fairfax County Middle Potomac watersheds; however, Little Falls Dam is located downstream on the Potomac River mainstem and may limit movement of diadromous fish upstream (Martin, 2019). Results from sampling conducted by FCDPWES indicate that the fish communities in both the Scotts Run and Dead Run subwatersheds were severely degraded, with fish IBI scores falling in the Very Poor category (**Table 2.9-13**).

Table 2.9-13: Range of Fish IBI Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	--	Very Poor
Dead Run	FCDPWES	2013 – 2015	--	Very Poor

[1]Sampling may not have been conducted during all years within year ranges.

B. Potomac River/Rock Run Watershed

a. Aquatic Habitat

MCDEP assessed aquatic habitat conditions at one site along the Rock Run mainstem, which enters the Potomac River just upstream of the ALB and west of the corridor study boundary. Results from assessments in 2010 and 2014 indicate that the waterway is generally minimally to moderately degraded, as aquatic habitat was rated as Good (**Table 2.9-14**).

Table 2.9-14: Range of Aquatic Habitat Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	118 – 141	Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

A summary of benthic macroinvertebrate sampling results for the Potomac River/Rock Run watershed is presented in **Table 2.9-15**. The Rock Run mainstem was sampled by MCDEP between 2010 and 2014. The benthic macroinvertebrate community along the Rock Run mainstem was rated as Poor to Fair, indicating moderate to substantial degradation. No recent benthic macroinvertebrate data were readily available for the Potomac River mainstem within the vicinity of the corridor study boundary.

MDNR ERP documented several mussel species in the Potomac River and C&O Canal within the vicinity of the corridor study boundary, including eastern elliptio (*Elliptio complanata*), Atlantic spike (*Elliptio producta)*, *Lampsilis* sp., and paper pondshell (*Utterbackia imbecillis)*.

Table 2.9-15: Range of Benthic IBI Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	16 – 22	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

In recent years, 11 different species have been documented along the Rock Run mainstem in the vicinity of the corridor study boundary (**Table 2.9-16**). All of these species are found throughout Maryland and the adjacent watersheds in the corridor study boundary. No intolerant or sensitive species or diadromous fish species were documented. According to the CFPP database, there are three fish blockages located within the Rock Run watershed (Martin, 2019). One gamefish species, largemouth bass, was collected in the corridor study boundary since 2007. All species documented in the Rock Run mainstem in recent years are widespread and capable of persisting in degraded conditions.

A summary of fish species documented during sampling in the Potomac River/Rock Run watershed by MCDEP from 2010 to 2014, is presented in **Appendix O**. The fish community along the Rock Run mainstem was rated as Fair to Good, indicating moderate degradation.

No recent fish data were readily available for the Potomac River mainstem, within the vicinity of the corridor study boundary. However, the fish communities surrounding Plummers Island, located within the watershed immediately downstream of I-495, have been studied extensively (Starnes et al., 2011). Additional fish species that have not been recently documented along the Rock Run mainstem (**Appendix O**), but are likely to occur along the Potomac River and C&O Canal mainstem are presented in **Table 2.9-17.** For the purposes of this report, these species were considered likely to occur within the Potomac River and C&O Canal and not documented within the corridor study boundary, as the exact locations of species occurrences are unknown.

Along the Potomac River and C&O Canal, 49 additional species that haven't been recently documented in Rock Run were reported. Of those species, eight are intolerant of degraded conditions. Black crappie, largemouth bass, muskellunge, smallmouth bass, striped bass, walleye, white perch, and yellow perch are all sought after gamefish species that are likely to occur in the Potomac River and C&O Canal. Blue catfish and northern snakehead are also likely to occur, both of which are invasive species that are often sought after by recreational fishermen. As noted in **Table 2.9-17**, nine diadromous or semi-diadromous fish species are likely to occur along the Potomac River and C&O Canal, despite the presence of Little Falls Dam downstream along the mainstem. Diadromous fish species spend portions of their life cycle in both fresh and salt water, typically migrating from one to the other to spawn.

Table 2.9-16: Range of Fish IBI Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	3.2 – 3.7	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

Table 2.9-17: Additional Fish Species Likely to Occur within the Potomac River and C&O Canal

Species[1]	Species[1]	Species[1]	Species[1]
Alewife[2]	Channel catfish	Margined madtom	Spotfin shiner
American eel[2]	Creek chubsucker	Muskellunge	Spottail shiner
American shad[2]	Eastern silvery minnow	Northern hogsucker	Striped bass[2]
Banded killifish	Eastern mosquitofish	Northern snakehead	Swallowtail shiner
Black crappie	Gizzard shad[2]	Pumpkinseed	Walleye
Blue catfish	Golden redhorse	Quillback	White catfish
Blueback herring[2]	Golden shiner	Redbreast sunfish	White crappie
Bluntnose minnow	Goldfish	River chub	White perch[2]
Bowfin	Greenside darter	Rock bass	Yellow bullhead
Brown bullhead	Hickory shad[2]	Shield darter	Yellow perch[2]
Central stoneroller	Inland silverside	Shorthead redhorse	
Comely shiner	Longear sunfish	Silverjaw minnow	
Common carp	Longnose gar	Smallmouth bass	

[1]Species list only includes those not documented along Rock Run.
[2]indicates that species is considered diadromous or semi-diadromous.
Source: Starnes et al., 2011

C. Cabin John Creek Watershed

a. Aquatic Habitat

Aquatic habitat assessments were conducted by MCDEP and MBSS throughout the Cabin John Creek watershed from 2008 to 2017. Aquatic habitat conditions in the watershed vary by location (**Table 2.9-18**); however, most waterways exhibit moderate aquatic habitat degradation. The Cabin John Creek mainstem crosses the corridor study boundary along I-270 just south of Montrose Road, and along I-495 at Cabin John Parkway. Along the Cabin John Creek mainstem, MCDEP aquatic habitat assessments indicated Fair to Good aquatic conditions and MBSS aquatic habitat assessments indicated Degraded to Partially Degraded aquatic habitat conditions.

Aquatic habitat was also assessed by MCDEP at Snakeden Branch and Old Farm Creek, two tributaries located near where the Cabin John Creek mainstem crosses I-270. Snakeden Branch lies to the west of I-270, and aquatic habitat ratings ranged from Fair to Good/Fair. Old Farm Creek is primarily east of I-270 but crosses the corridor study boundary to join the mainstem within Cabin John Regional Park. Aquatic habitat assessments were conducted downstream of the crossing, and conditions were rated as Fair to Good. Aquatic habitat conditions were also assessed by MCDEP along Unnamed Tributary 1 to Old Farm Creek, located upstream of the corridor study boundary, and aquatic habitat along the tributary was generally in Fair condition.

Ken Branch joins the Cabin John Creek mainstem along the midsection of the Cabin John Creek watershed and drains an area to the west of the corridor study boundary. Aquatic habitat conditions along Ken Branch were rated as Degraded by MBSS in 2008. Another tributary, Booze Creek, joins the mainstem of Cabin John Creek just downstream of the I-495 crossing, and aquatic habitat conditions were rated as Fair to Good/Fair by MCDEP.

Table 2.9-18: Range of Aquatic Habitat Scores for the Cabin John Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Booze Creek	MCDEP	2008	96 – 107	Fair – Good/Fair
Cabin John Creek	MCDEP	2008 – 2014	94 – 147	Fair – Good
	MBSS	2008	60.74 – 79.56	Degraded – Partially Degraded
Ken Branch	MBSS	2008	60.19	Degraded
Old Farm Creek	MCDEP	2008 – 2014	93 – 137	Fair – Good
Snakeden Branch	MCDEP	2008 – 2014	95 – 106	Fair – Good/Fair
Unnamed Tributary 1 to Old Farm Creek	MCDEP	2015	79	Fair

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in the Cabin John Creek watershed are summarized in **Table 2.9-19**. Overall, benthic macroinvertebrate community health was variable in the Cabin John watershed, with narrative benthic IBI scores indicating moderate to substantial degradation. MCDEP rated benthic macroinvertebrate communities in the Old Farm Creek and Snakeden Branch tributaries as Poor to Fair, while Ken Branch was rated as Very Poor by MBSS. Benthic macroinvertebrate community health was variable along the Cabin John Creek mainstem, ranging from Poor to Fair overall, as rated by MCDEP. The uppermost portion of the Cabin John Creek mainstem, above I-270, was sampled at various locations by both MCDEP and MBSS and received ratings of Poor and Very Poor, respectively. The benthic macroinvertebrate community in the portion of the Cabin John Creek mainstem that runs parallel to and just west of the I-270 corridor between Montrose Road and River Road was rated as Very Poor by MBSS and Poor by MCDEP. MCDEP sampling in the downstream portion of the Cabin John Creek mainstem resulted in benthic macroinvertebrate community ratings of Poor to Fair.

Table 2.9-19: Range of Benthic IBI Scores for the Cabin John Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Cabin John Creek	MCDEP	2008 – 2014	12 – 18	Poor – Fair
	MBSS	2008 – 2017	1.00 – 1.33	Very Poor
Ken Branch	MBSS	2008	1.00	Very Poor
Old Farm Creek	MCDEP	2008 – 2014	10 – 20	Poor – Fair
Snakeden Branch	MCDEP	2008 – 2014	8 – 22	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

The Cabin John Creek watershed contains 33 recently documented fish species, more than any other watershed in the corridor study boundary more recently (**Appendix O**). Black crappie and river chub were recently documented in the Cabin John Creek watershed within the vicinity of the corridor study boundary. Black crappie are a sought-after gamefish species and river chub are intolerant of degraded conditions and require coarse riffle habitat for spawning. Six additional intolerant fish species were recently documented in the Cabin John Creek watershed: central stoneroller, common shiner, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. These species are generally considered indicative of good stream health and minimally degraded water quality. Fathead minnow and goldfish were documented in the Cabin John Creek and Rock Creek watersheds only. Both species are non-native to Maryland and are thought to have been introduced through the bait and pet trades, respectively (MDNR, 2018). Sea lamprey are anadromous, inhabiting streams and rivers when young, migrating to the sea or a large lake to mature, and returning to streams and rivers to spawn. According to the CFPP database, there is one fish blockage located within the Cabin John Creek watershed, as well as Little Falls Dam located downstream on the Potomac River mainstem (Martin, 2019). In addition to black crappie, largemouth bass and smallmouth bass were the only other gamefish species documented in Cabin John Creek in the corridor study boundary since 2007.

Results of fish sampling in the Cabin John Creek watershed are summarized in **Table 2.9-20**. Overall, fish communities within the Cabin John Creek watershed are moderately degraded. MCDEP and MBSS sampled several sites along the Cabin John Creek mainstem where fish communities were rated as Fair to Good by MCDEP and Fair by MBSS. MBSS sampling along Ken Branch also resulted in a fish community health rating of Fair. Along Old Farm Creek, the fish community was similar, with MCDEP fish IBIs ranging from Fair to Good. Fish community health was more degraded in Booze Creek and Unnamed Tributary 1 to Old Farm Creek, where communities were rated as Poor by MCDEP.

Table 2.9-20: Range of Fish IBI Scores for the Cabin John Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Booze Creek	MCDEP	2008	1.4	Poor
Cabin John Creek	MCDEP	2008 – 2014	3.0 – 4.1	Fair – Good
	MBSS	2008 – 2017	3.33 – 3.67	Fair
Ken Branch	MBSS	2008	3.00	Fair
Old Farm Creek	MCDEP	2008 – 2014	3.0 – 3.4	Fair – Good
Unnamed Tributary 1 to Old Farm Creek	MCDEP	2015	1.7	Poor

[1]Sampling may not have been conducted during all years within year ranges.

D. Rock Creek Watershed

a. Aquatic Habitat

Aquatic habitat conditions in the Rock Creek watershed vary slightly by subwatershed, but are generally considered moderately degraded in the vicinity of the I-495 & I-270 Managed Lanes Study corridor study boundary (**Table 2.9-21**). MCDEP data exist for two sites along the mainstem of Rock Creek just upstream of the corridor study boundary, and aquatic habitat conditions ranged from Fair to Good at both sites.

Recent aquatic habitat condition data also exist for four tributaries within the corridor study boundary that join the Rock Creek mainstem at or near the I-495 & I-270 corridors. Luxmanor Branch enters the mainstem near the I-495 & I-270 split, Kensington Heights Branch and Capital View Tributary enter the mainstem farther downstream along I-495, and Alta Vista Tributary joins the mainstem directly at I-495. MCDEP rated aquatic habitat conditions within Luxmanor Branch and Capital View Tributary as Fair, and along Alta Vista Tributary as Fair to Good. MCDEP rated aquatic habitat conditions in Kensington Heights Branch as Fair to Good over multiple years; however, one assessment by MDNR documented Degraded conditions.

Stoneybrook Tributary joins the mainstem of Rock Creek upstream of the corridor study boundary, and MCDEP rated aquatic habitat conditions along the tributary as Fair to Good. Coquelin Run joins Rock Creek downstream of the corridor study boundary, and existing data for Coquelin Run suggest aquatic habitat conditions were similar to the mainstem at the time of MCDEP's assessments, with aquatic habitat conditions ranked as Fair to Good/Fair.

Table 2.9-21: Range of Aquatic Habitat Scores for the Rock Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2011 – 2013	65 – 123	Fair – Good
Capital View Tributary	MCDEP	2017	99	Fair
Coquelin Run	MCDEP	2012 – 2017	91 – 105	Fair – Good/Fair
Kensington Heights Branch	MBSS	2009	59.23	Degraded
	MCDEP	2008 – 2017	93 – 119	Fair – Good
Luxmanor Branch	MCDEP	2008 – 2017	95 – 110	Fair
Rock Creek	MCDEP	2008 – 2017	91 – 121	Fair – Good
Stoneybrook Tributary	MCDEP	2014	89 – 117	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in the Rock Creek watershed are summarized in **Table 2.9-22**. In general, benthic macroinvertebrate communities throughout the watershed are moderately to substantially degraded. MCDEP sampled two sites along the Rock Creek mainstem, both of which were located upstream of the corridor study boundary, and benthic macroinvertebrate community health was rated as Poor to Fair at both sites. One site along the Rock Creek mainstem, located just downstream of Knowles Avenue, had ratings that ranged from Poor to Fair. The other site along the Rock Creek mainstem, located in the portion that runs parallel to the corridor study boundary, was rated as Poor.

Benthic macroinvertebrate community health was similar across three of the four tributaries that enter the mainstem of Rock Creek at or near the corridor study boundary. MCDEP benthic IBI ratings were Poor in the Alta Vista Tributary, Capital View Tributary, and Luxmanor Tributary. Kensington Heights Branch was sampled by both MCDEP and MBSS and the benthic macroinvertebrate communities were rated as Poor to Fair and Very Poor, respectively.

MCDEP rated benthic macroinvertebrate communities as Poor in Stoneybrook Tributary, which joins Rock Creek upstream of the corridor study boundary, and Poor to Fair in Coquelin Run, which is entirely downstream of the corridor study boundary.

Table 2.9-22: Range of Benthic IBI Scores for the Rock Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2012 – 2013	8 – 12	Poor
Capital View Tributary	MCDEP	2017	14	Poor
Coquelin Run	MCDEP	2012 – 2017	14-18	Poor – Fair
Kensington Heights Branch	MBSS	2009	1.0	Very Poor
	MCDEP	2008 – 2017	14-18	Poor – Fair
Luxmanor Branch	MCDEP	2008 – 2017	8 – 12	Poor
Rock Creek	MCDEP	2008 – 2017	14 – 18	Poor – Fair
Stoneybrook Tributary	MCDEP	2014	10 – 12	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Twenty-four different fish species were recently documented within the Rock Creek watershed in the vicinity of the corridor study boundary (**Appendix O**). All species documented within the Rock Creek watershed are also found within other watersheds along the corridor study boundary. Fathead minnow and goldfish, both non-native species thought to have been introduced through the bait and pet trades, were only documented in the Rock Creek and Cabin John Creek watersheds (MDNR, 2018). Six species of fish that are considered intolerant of degraded conditions have been documented in nearby areas of Rock Creek in recent years, including fallfish, northern hogsucker, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. American eel and sea lamprey were the only diadromous species documented, and no gamefish species have been documented in recent years. According to the CFPP database, there are no fish blockages located in the Rock Creek 12-digit watershed; however, there is one blockage located downstream along the Rock Creek mainstem in Washington DC that likely hinders fish movement (Martin, 2019).

Results of fish sampling in the Rock Creek watershed are summarized in **Table 2.9-23**. Fish community health was notably better in the mainstem than in most tributaries near the corridor study boundary. Based on MCDEP data collected from sites upstream of the corridor study boundary, fish communities along the mainstem of Rock Creek were rated as Good.

The fish communities within Alta Vista Tributary and Luxmanor Branch were substantially degraded, as they were consistently rated as Poor by MCDEP. Along Kensington Heights Branch, the fish communities were rated as Poor and Very Poor by MCDEP and MBSS, respectively.

Upstream of the corridor study boundary, MCDEP rated Stoneybrook Tributary fish communities as Poor to Fair, and the community in Coquelin Run, well downstream of the corridor study boundary, was rated as Fair.

Table 2.9-23: Range of Fish IBI Scores for the Rock Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2012 – 2013	1.0 – 1.4	Poor
Coquelin Run	MCDEP	2017	2.8	Fair
Kensington Heights Branch	MBSS	2009	1.33	Very Poor
	MCDEP	2008 – 2012	1.9	Poor
Luxmanor Branch	MCDEP	2008 – 2017	1.4 – 1.7	Poor
Rock Creek	MCDEP	2008 – 2017	3.4 – 4.1	Good
Stoneybrook Tributary	MCDEP	2014	1.9 – 2.3	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

E. Sligo Creek Watershed

a. Aquatic Habitat

MCDEP aquatic habitat assessments conducted within the vicinity of the corridor study boundary indicate that aquatic habitat conditions in the Sligo Creek watershed are moderately degraded (**Table 2.9-24**). Upstream of the corridor study boundary, aquatic habitat conditions were somewhat variable. Aquatic habitat at one site located approximately 1 mile upstream was rated as Fair to Good/Fair, whereas conditions immediately upstream of I-495 were rated as Good. Conditions were similar downstream of the corridor study boundary, where aquatic habitat was also rated as Fair to Good/Fair. An aquatic habitat assessment was conducted along Unnamed Tributary 1 to Sligo Creek located just downstream of I-495, indicating that aquatic habitat conditions were similar to the mainstem, with scores falling in the Good/Fair range.

Table 2.9-24: Range of Aquatic Habitat Scores for the Sligo Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Sligo Creek	MCDEP	2009 – 2016	92 – 120	Fair – Good/Fair
Unnamed Tributary 1 to Sligo Creek	MCDEP	2009	108	Good/Fair

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Overall, existing data from sampling in the Sligo Creek watershed indicates that the benthic macroinvertebrate community is substantially degraded (**Table 2.9-25)**. MCDEP sampled several sites along the Sligo Creek mainstem, both upstream and downstream of the corridor study boundary, all of which were rated as Poor in all years sampled. Unnamed Tributary 1 to Sligo Creek, located just downstream of I-495, was also sampled and received a Poor benthic macroinvertebrate community rating.

Table 2.9-25: Range of Benthic IBI Scores for the Sligo Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Sligo Creek	MCDEP	2009 – 2016	10 – 20	Poor
Unnamed Tributary 1 to Sligo Creek	MCDEP	2009	8	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Eleven different fish species were recently documented in the Sligo Creek watershed within the vicinity of the corridor study boundary, as shown in **Appendix O**. Despite the relatively low species diversity, eleven species is a marked improvement over the much lower diversity documented in past decades (EPA, 2012). All eleven fish species are widely distributed throughout the corridor study boundary and are generally tolerant of degraded conditions. No intolerant or sensitive species were recently documented by MCDEP in the corridor study boundary. American eel was the only diadromous fish species captured during recent sampling, as numerous fish blockages exist downstream. According to the CFPP database, there are seven fish blockages located in the 12-digit Sligo Creek watershed, as well as several downstream, that likely hinder fish movement (Martin, 2019).

Results of fish sampling in the Sligo Creek watershed are summarized in **Table 2.9-26**. Overall, fish communities throughout the Sligo Creek watershed are largely degraded, ranging from Poor to Fair based on MCDEP data from sites immediately upstream and downstream of the corridor study boundary.

Table 2.9-26: Range of Fish IBI Scores for the Sligo Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Sligo Creek	MCDEP	2009 – 2016	1.2 – 2.8	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

F. Northwest Branch Watershed

a. Aquatic Habitat

According to existing data collected in the Northwest Branch watershed, aquatic habitat conditions vary by subwatershed, and range from minimally to substantially degraded (**Table 2.9-27**). Along the mainstem, MCDEP assessed aquatic habitat at one site upstream and one site downstream of I-495. Conditions were slightly better upstream of I-495, with aquatic habitat scores falling in the Good to Excellent/Good range upstream and the Good/Fair to Good range downstream.

In addition to the Northwest Branch mainstem, aquatic habitat data also exist for two tributaries in the corridor study boundary: Lockridge Drive Tributary and Unnamed Tributary 1 to Northwest Branch. Conditions in the Lockridge Drive Tributary, which is located well upstream of the corridor study boundary but within 1 mile of the corridor study boundary, were rated as Good during both MCDEP assessment years. The other tributary, Unnamed Tributary 1 to Northwest Branch, is located just downstream of I-495 and to the east of the mainstem. Data collected by PGDoE ranked conditions in this waterway as Non-supporting to Partially Supporting.

Table 2.9-27: Range of Aquatic Habitat Scores for the Northwest Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Lockridge Drive Tributary	MCDEP	2007 – 2009	136 – 147	Good
Northwest Branch	MCDEP	2007 – 2016	103 – 165	Good/Fair – Excellent/Good
Unnamed Tributary 1 to Northwest Branch	PGDoE – RBP	2010	80 – 105	Non-supporting – Partially Supporting

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Existing benthic macroinvertebrate data for the Northwest Branch watershed are summarized in **Table 2.9-28**. In general, benthic macroinvertebrate communities in this watershed are moderately to substantially degraded, with benthic IBIs scoring in the low to median range throughout the watershed. MCDEP assigned Poor ratings to the benthic macroinvertebrate communities in the Lockridge Drive Tributary, the most upstream portion of the Northwest Branch watershed within the corridor study boundary. The benthic macroinvertebrate communities at the two locations MCDEP sampled on the mainstem of the Northwest Branch were rated as Poor upstream of I-495 and Poor to Fair downstream of I-495. PGDoE rated the benthic communities in Unnamed Tributary 1 to Northwest Branch as Poor.

Based on coordination with MDNR ERP, the acuminate crayfish (*Cambarus acuminatus*) is found upstream and downstream of the corridor study boundary in the Northwest Branch watershed. Acuminate crayfish is a state species in Greatest Conservation Need, indicating that populations are at risk or declining in Maryland.

Table 2.9-28: Range of Benthic IBI Scores For the Northwest Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Lockridge Drive Tributary	MCDEP	2007 – 2009	10 – 12	Poor
Northwest Branch	MCDEP	2007 – 2016	12 – 22	Poor – Fair
Unnamed Tributary 1 to Northwest Branch	PGDoE	2010	2.14	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

With 30 different species, the Northwest Branch watershed contains the second highest number of fish species recently documented in a watershed in the immediate vicinity of the corridor study boundary (**Appendix O**). Although they are found throughout Maryland, banded killifish and margined madtom were only documented in the Northwest Branch watershed in the vicinity of the corridor study boundary. More notably, eight species that are considered intolerant to degraded conditions were documented within this portion of the Northwest Branch watershed, including central stoneroller, common shiner, margined madtom, northern hogsucker, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. These species are generally considered indicative of good stream health and minimally degraded water quality. American eel and sea lamprey were the only diadromous species documented in recent years. According to the CFPP database, there are six fish blockages located in the 12-digit Northwest Branch watershed that likely hinder fish movement (Martin, 2019). Largemouth bass and smallmouth bass were the only gamefish species documented in Northwest Branch within the corridor study boundary since 2007; however, brown trout and rainbow trout were documented in the past and are known to populate nearby portions of the Northwest Branch watershed. MDNR stocks the Northwest Branch watershed with over 5,000 trout annually in March and April to maintain a popular put-and-take fishery. Stocking locations exist on the Northwest Branch mainstem both upstream and downstream of the corridor study boundary and stocked trout may be transient throughout the project area.

Results of fish sampling in the Northwest Branch watershed are summarized in **Table 2.9-29**. MCDEP sampled at sites up and downstream of the corridor study boundary, indicating that fish communities along the Northwest Branch mainstem are variable, but minimally to moderately degraded on average. Within the corridor study boundary, mainstem fish IBI scores ranged from Fair to Good, and community conditions were generally similar up and downstream.

Table 2.9-29: Range of Fish IBI Scores for the Northwest Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Northwest Branch	MCDEP	2009	2.8 – 4.3	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

G. Paint Branch Watershed

a. Aquatic Habitat

PGDoE and MDOT SHA data suggest variable aquatic habitat conditions throughout the Paint Branch watershed (**Table 2.9-30**). Existing data along the Paint Branch mainstem indicate moderate aquatic habitat degradation in the vicinity of the corridor study boundary. PGDoE IBIs rated aquatic habitat along the mainstem as Non-supporting to Supporting, and PGDoE PHI scores from the same sampling events rated aquatic habitat as Degraded. In general, aquatic habitat conditions at PGDoE monitoring sites were less degraded upstream of I-495 than downstream. Downstream of I-495, MDOT SHA conducted aquatic habitat assessments associated with stream restoration monitoring, indicating that aquatic habitat conditions ranged from Severely Degraded to Partially Degraded, but have improved in recent years. One monitoring site along the Paint Branch mainstem fell just downstream of the confluence with Little Paint Branch, within the Northeast Branch MDE 12-digit watershed. For the purposes of this document, those data were included as part of the Paint Branch MDE 12-digit watershed.

Aquatic habitat conditions were also assessed along two unnamed tributaries in the Paint Branch watershed within the vicinity of the corridor study boundary. Unnamed Tributary 1 to Paint Branch is located entirely downstream of I-495, and PGDoE ranked aquatic habitat conditions in this tributary as Non-supporting to Partially Supporting. Unnamed Tributary 2 to Paint Branch abuts I-495, and PGDoE RBP scores ranked aquatic habitat conditions in this tributary as Non-supporting to Supporting. PGDoE PHI scores at the same sites rated aquatic habitat as Severely Degraded to Partially Degraded.

Table 2.9-30: Range of Aquatic Habitat Scores for the Paint Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Paint Branch	PGDoE – RBP	2010 – 2015	85 – 140	Non-supporting – Supporting
	PGDoE – PHI	2015	54.37	Degraded
	MDOT SHA	2012 – 2018	48.12 – 67.89	Severely Degraded – Partially Degraded
Unnamed Tributary 1 to Paint Branch	PGDoE – RBP	2010	71 – 103	Non-supporting – Partially Supporting
Unnamed Tributary 2 to Paint Branch	PGDoE – RBP	2015	70 – 142	Non-supporting – Supporting
	PGDoE – PHI	2015	43.87 – 78.99	Severely Degraded – Partially Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in Paint Branch are summarized in **Table 2.9-31**. Degradation varies by waterway, but most sites sampled show moderate to substantial degradation. The portion of the Paint Branch mainstem upstream of I-495 had a benthic macroinvertebrate community rating of Poor, and the portion of the Paint Branch mainstem downstream of I-495 had a benthic macroinvertebrate community rating of Very Poor to Fair. PGDoE rated the benthic macroinvertebrate communities in Unnamed Tributary 1 to Paint Branch as Very Poor, with one site receiving a benthic IBI score of zero. PGDoE rated the benthic macroinvertebrate community of Unnamed Tributary 2 to Paint Branch as Poor. Based on coordination with MDNR ERP, the acuminate crayfish, a state species in Greatest Conservation Need, is also found within the Paint Branch watershed.

Table 2.9-31: Summary of Benthic IBI Scores for the Paint Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Paint Branch	PGDoE	2010 – 2015	1.57 – 3.86	Very Poor – Fair
	MDOT SHA	2012 – 2018	1.57 – 3.00	Very Poor – Fair
Unnamed Tributary 1 to Paint Branch	PGDoE	2010	2.71	Poor
Unnamed Tributary 2 to Paint Branch	PGDoE	2015	0 – 1.29	Very Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

With 29 different species, the Paint Branch watershed contains the third highest number of fish species recently documented in a watershed in the immediate vicinity of the corridor study boundary (**Appendix O**). Although they are found throughout Maryland's Coastal Plain, eastern mudminnow was only documented in the Paint Branch watershed in the vicinity of the corridor study boundary. In addition, Blue

Ridge sculpin was only recently documented in one other watershed within the vicinity of I-495. Blue Ridge sculpin are an intolerant species often indicative of good water quality. Eight additional intolerant fish species were recently documented in the watershed, including common shiner, fallfish, margined madtom, northern hogsucker, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. American eel and sea lamprey were the only diadromous species documented in recent years. According to the CFPP database, there are eight fish blockages in the Paint Branch watershed, as well as one downstream along the Northeast Branch mainstem, that likely inhibit fish movement (Martin, 2019). Largemouth bass was the only gamefish species documented in Paint Branch within the corridor study boundary since 2007; however, smallmouth bass and brown trout are also known to inhabit the Paint Branch watershed. Upstream of I-495, Paint Branch is classified as Use III waters (nontidal cold water), and the headwaters are renowned for supporting the only self-sustaining brown trout population in the Washington Metro area (MCDEP, 1999). The brown trout population generally inhabits the reaches above Fairland Road, well upstream of the corridor study boundary. Based on coordination with MDNR, brown trout populations were documented within the vicinity of the corridor study boundary during sampling events between 1990 and 1994.

Results of fish sampling in the Paint Branch watershed are summarized in **Table 2.9-32**. MDOT SHA sampled two sites along the Paint Branch mainstem, well downstream of the corridor study boundary, near the confluence with Little Paint Branch. MDOT SHA rated fish communities along the lower Paint Branch mainstem as Good, indicating that the fish community is generally comparable to reference streams that are considered minimally impacted.

Table 2.9-32: Range of Fish IBI Scores for the Paint Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Paint Branch	MDOT SHA	2012 – 2018	4.00 – 4.33	Good

[1]Sampling may not have been conducted during all years within year ranges.

H. Little Paint Branch Watershed

a. Aquatic Habitat

Existing data collected by PGDoE indicate moderately degraded aquatic habitat conditions within the Little Paint Branch watershed (**Table 2.9-33**). Available Little Paint Branch aquatic habitat data exist for one site upstream of the I-495 and Baltimore Avenue interchange, and three sites downstream of I-495, just above the confluence with Paint Branch. Aquatic habitat conditions along the Little Paint Branch mainstem ranged from Partially Supporting to Supporting based on RBP scores and fell in the Degraded to Minimally Degraded range based on PHI scores. PGDoE and MDOT SHA data indicate that aquatic habitat conditions upstream of I-495 were more degraded than conditions closer to the confluence with Paint Branch downstream.

Table 2.9-33: Range of Aquatic Habitat Scores for the Little Paint Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Little Paint Branch	PGDoE – RBP	2010 – 2015	112 – 137	Partially Supporting – Supporting
	PGDoE – PHI	2010 – 2015	59.55	Degraded
	MDOT SHA	2012 – 2018	64.84 – 85.87	Degraded – Minimally Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in Little Paint Branch are summarized in **Table 2.9-34**. Overall, PGDoE and MDOT SHA data indicate that benthic macroinvertebrate communities in this watershed are moderately degraded. Benthic macroinvertebrate community health ranged from Poor to Fair along the Little Paint Branch mainstem. The most upstream site sampled had a benthic macroinvertebrate community rating of Fair, while sites sampled downstream of I-495 were slightly more degraded, ranging from Poor to Fair. Based on coordination with MDNR WHS, the acuminate crayfish, a state species in Greatest Conservation Need, is found within the Little Paint Branch watershed.

Table 2.9-34: Range of Benthic IBI Scores for the Little Paint Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Little Paint Branch	PGDoE	2010 – 2015	2.43 - 3.57	Poor – Fair
	MDOT SHA	2012 – 2018	2.43 – 3.00	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

With 26 different species, the Little Paint Branch watershed contains a relatively high number of fish species for a watershed in the immediate vicinity of the corridor study boundary (**Appendix O**). Yellow perch is the only gamefish species that has been documented in Little Paint Branch in the vicinity of I-495 in recent years, and was found downstream of the corridor study boundary, near the confluence with Paint Branch. Yellow perch is considered a semi-anadromous species in Maryland, as they live in fresh or brackish rivers and spawn in smaller, freshwater tributaries. Little Paint Branch is the only watershed where yellow perch were recently documented in the vicinity of the corridor study boundary. The largemouth bass was also identified by MDNR ERP as a gamefish species known to occur in the Little Paint Branch watershed. American eel and sea lamprey, both diadromous species, have also been documented in the Little Paint Branch watershed in recent years. According to the CFPP database, there are four fish blockages in the Paint Branch watershed, as well as one downstream along the Northeast Branch mainstem, that likely inhibit fish movement (Martin, 2019). Seven intolerant fish species have been documented within the vicinity of I-495, including common shiner, fallfish, margined madtom, northern hogsucker, satinfin shiner, sea lamprey, and spottail shiner. These species are generally considered indicative of good stream health and minimally degraded water quality. Based on coordination with

MDNR WHS, American brook lamprey (*Lethenteron appendix*), a state threatened species, has also been documented in Little Paint Branch.

Results of fish sampling in the Little Paint Branch watershed are summarized in **Table 2.9-35**. MDOT SHA sampled one site along the lower mainstem of Little Paint Branch over multiple years, well downstream of the corridor study boundary. The fish community at this site was rated as Good in all sampling years. The proximity of this site to the confluence with Paint Branch likely positively influences the species richness and diversity observed in recent years.

Table 2.9-35: Range of Fish IBI Scores for the Little Paint Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Little Paint Branch	MDOT SHA	2012 – 2018	4.33	Good

[1]Sampling may not have been conducted during all years within year ranges.

I. Northeast Branch Watershed

a. Aquatic Habitat

Aquatic habitat conditions in the Northeast Branch watershed vary widely by waterway (**Table 2.9-36**). Aquatic habitat conditions along the Indian Creek mainstem are among the least degraded in the watershed. PGDoE RBP scores ranked aquatic habitat conditions along the Indian Creek mainstem upstream of I-495 as Supporting. Upstream of the corridor study boundary, Beaverdam Creek – Northeast Branch drains into Indian Creek at MD 201. Beaverdam Creek – Northeast Branch is a Tier II watershed and the majority of Beaverdam Creek – Northeast Branch and its adjacent floodplain is also a Wetland of Special State Concern. Downstream of I-495, aquatic habitat along Walker's Brook, a tributary to Indian Creek, was ranked by PGDoE as Non-supporting and Partially Degraded based on RBP and PHI scores, respectively.

Existing data collected along Brier Ditch indicate that aquatic habitat conditions are moderately to substantially degraded. I-495 crosses Brier Ditch and data exist for a PGDoE monitoring site just upstream of the interstate. Aquatic habitat at this site ranks as Non-supporting and Degraded based on RBP and PHI scores, respectively.

Aquatic habitat data collected by PGDoE and MBSS from Still Creek, a tributary to Northeast Branch that is crossed by I-495 and flows through Greenbelt Park, indicate that aquatic habitat conditions are Non-supporting to Partially Supporting based on RBP scores, and Severely Degraded to Degraded based on PHI scores. Aquatic habitat conditions in the downstream portions of Still Creek, closer to Northeast Branch, are more degraded due to the presence of concrete-lined portions of the stream.

Table 2.9-36: Range of Aquatic Habitat Scores for the Northeast Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Brier Ditch	PGDoE – RBP	2015	86	Non-supporting
	PGDoE – PHI	2015	61.4	Degraded
Indian Creek	PGDoE – RBP	2010	131 – 151	Supporting
Still Creek	PGDoE – RBP	2010 – 2015	98 – 121	Non-supporting – Partially Supporting
	PGDoE – PHI	2015	54.64	Degraded
	MBSS	2008	34.71	Severely Degraded
Walker's Brook	PGDoE – RBP	2016	93	Non-supporting
	PGDoE – PHI	2015	72.25	Partially Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Data from benthic macroinvertebrate sampling in the Northeast Branch Watershed are summarized in **Table 2.9-37**. Benthic macroinvertebrate communities in the Northeast Branch watershed are moderately degraded within the vicinity of I-495. PGDoE sampled Indian Creek upstream of I-495 and the Walker's Brook tributary to Indian Creek downstream of I-495, and the benthic macroinvertebrate communities in both locations were rated as Fair. PGDoE rated Brier Ditch benthic macroinvertebrate communities as Fair just upstream of I-495, and PGDoE and MBSS rated Still Creek benthic macroinvertebrate communities as Poor.

Based on coordination with MDNR WHS, state rare Laura's clubtail (*Stylurus laurae*) and state threatened Selys' sundragon (*Helocordulia selysii*) dragonfly species have been documented upstream of the corridor study boundary in the downstream portion of Beaverdam Creek, which flows into Indian Creek. Both species have an aquatic larval stage that is susceptible to changes in water quality.

Table 2.9-37: Range of Benthic IBI Scores for the Northeast Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Brier Ditch	PGDoE	2015	3.29	Fair
Indian Creek	PGDoE	2010	3.57 – 3.86	Fair
Still Creek	PGDoE	2010 – 2015	2.43 – 2.71	Poor
	MBSS	2008	2.71	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

The only recent fish data available for the Northeast Branch watershed, within the vicinity of I-495, were collected by MBSS in 2008 along Still Creek. In 2008, only six different fish species were documented in Still Creek, including one diadromous fish species, American eel, and no gamefish species. Two of the fish species, spotfin shiner and spottail shiner, are considered intolerant of degraded conditions. According to the CFPP database, there are three fish blockages in the Northeast Branch watershed that likely inhibit fish movement (Martin, 2019). Results of fish sampling in the Northeast Branch watershed are summarized in **Table 2.9-38**. The fish community along Still Creek was rated as Poor in all sampling years.

In addition to recent data along Still Creek, MDNR ERP documented 28 different fish species in the Indian Creek, Brier Ditch, Beaverdam Creek, and Cattail Branch watersheds, including largemouth bass, a gamefish species.

Table 2.9-38: Range of Fish IBI Scores for the Northeast Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year		
Still Creek	MBSS	2008	2.00	Poor

J. Bald Hill Branch Watershed

a. Aquatic Habitat

Based on previous assessments, aquatic habitat conditions in the Bald Hill Branch watershed are substantially degraded in the vicinity of I-495 (**Table 2.9-39**). Bald Hill Branch flows parallel to I-495, nearing the corridor study boundary at the US 50 interchange. Existing data from PGDoE indicate that aquatic habitat rankings ranged from Non-supporting to Partially Supporting based on RBP aquatic habitat scores. Additional data collected by PGDoE using PHI scores indicate that aquatic habitat conditions scored in the Severely Degraded range. Despite degraded conditions near the corridor study boundary, Bald Hill Branch is a Tier II watershed.

Table 2.9-39: Range of Aquatic Habitat Scores for the Bald Hill Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Bald Hill Branch	PGDoE – RBP	2010 – 2015	88 – 114	Non-supporting – Partially Supporting
	PGDoE – PHI	2015	45.74	Severely Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Benthic macroinvertebrate data for the Bald Hill Branch watershed is summarized in **Table 2.9-40**. Bald Hill Branch runs parallel to and east of the corridor study boundary and was sampled by PGDoE. The benthic macroinvertebrate communities ranged in health from Very Poor to Fair, with better conditions observed downstream of US 50, near the confluence with Lottsford Branch.

Table 2.9-40: Range of Benthic IBI Scores for the Bald Hill Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Bald Hill Branch	PGDoE	2010 – 2015	1.57 – 3.00	Very Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

No recent data on fish communities within the vicinity of the corridor study boundary were available for the Bald Hill Branch watershed. Data from further downstream, near the confluence with Lottsford Branch, indicate that the fish community is in Good condition (MDNR, 2003). MDNR ERP documented 27 different fish species in the Bald Hill Branch watershed. This includes the diadromous species American eel, gizzard shad, and sea lamprey, as well as four gamefish species: black crappie, chain pickerel (*Esox niger*), largemouth bass, and yellow perch. Based on coordination with MDNR WHS, the state threatened American brook lamprey and glassy darter (*Etheostoma vitreum*), as well as the state endangered stripeback darter (*Percina notogramma*), have been documented downstream in Western Branch. According to the CFPP database, there is one fish blockage in the Bald Hill Branch watershed that may hinder fish movement (Martin, 2019).

K. Upper Beaverdam Creek Watershed

a. Aquatic Habitat

Existing data from PGDoE and MTA within the vicinity of the corridor study boundary indicate that aquatic habitat conditions in the Upper Beaverdam Creek watershed are substantially degraded (**Table 2.9-41**). Along the Beaverdam Creek mainstem, aquatic habitat scores all fell in the low range for both scoring methods used by PGDoE. Aquatic habitat ranked as Non-supporting to Partially Supporting based on RBP scores and Degraded based on PHI scores. At Cattail Branch, a major tributary entering Beaverdam Creek near the intersection of Good Hope Road and Kenilworth Avenue, aquatic habitat conditions ranged from Severely Degraded to Partially Degraded. All sites along Beaverdam Creek and Cattail Branch are located downstream of the corridor study boundary, as the headwaters for both streams begin near the interstate.

Table 2.9-41: Range of Aquatic Habitat Scores for the Upper Beaverdam Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Beaverdam Creek	PGDoE – RBP	2013 – 2017	97 – 111	Non-supporting – Partially Supporting
	PGDoE – PHI	2017	54.45	Degraded
Cattail Branch	MTA	2014 – 2015	37.57 – 69.41	Severely Degraded – Partially Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Existing data from benthic macroinvertebrate sampling in the Upper Beaverdam Creek watershed is summarized in **Table 2.9-42**. Overall, data collected by PGDoE and MTA at sites located downstream of the corridor study boundary indicate that benthic macroinvertebrate communities in this watershed are moderately to substantially degraded. PGDoE rated benthic macroinvertebrate community health as Poor to Fair at three locations along the Beaverdam Creek mainstem. PGDoE and MTA rated benthic macroinvertebrate community health in Cattail Branch as Very Poor to Poor.

Table 2.9-42: Range of Benthic IBI Scores for the Upper Beaverdam Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Beaverdam Creek	PGDoE	2013 – 2017	2.43 – 3.00	Poor – Fair
Cattail Branch	MTA	2015	1.86 – 2.43	Very Poor – Poor
	PGDoE	2017	2.71	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

In recent years, 18 different fish species have been documented in the Upper Beaverdam Creek watershed within the vicinity of the corridor study boundary, all but two of which have also been recently documented in several other watersheds in the corridor study boundary (**Appendix O**). Although commonly found further east within the Coastal Plain physiographic province, Creek chubsucker and mummichog were only documented in two other watersheds within the corridor study boundary. Only one species, satinfin shiner, is considered intolerant to degraded conditions. American eel was the only diadromous fish species and largemouth bass was the only gamefish species to have been recently documented in the Upper Beaverdam Creek watershed. According to the CFPP database, there is one fish blockage in the Upper Beaverdam Creek watershed that may inhibit fish movement (Martin, 2019).

Fish community health along Cattail Branch was variable, with fish IBI scores generally decreasing from upstream to downstream (**Table 2.9-43**). MTA monitored the fish community downstream of Landover Road, with community health ranging from Very Poor to Fair. In addition to Cattail Branch, fish community data from well downstream of the corridor study boundary indicate that the fish community is also largely degraded along Beaverdam Creek (Galli et al., 2010).

Table 2.9-43: Range of Fish IBI Scores for the Upper Beaverdam Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year		
Cattail Branch	MTA	2014 – 2015	1.33 – 3.33	Very Poor – Fair

L. Upper Southwest Branch Watershed

a. Aquatic Habitat

Based on previous assessments conducted in the Upper Southwest Branch watershed, aquatic habitat conditions vary by waterway from moderately to substantially degraded (**Table 2.9-44**). The Upper Southwest Branch watershed begins at I-495 and several sites were sampled along the mainstem, just upstream of the corridor study boundary. Based on data collected by PGDoE, aquatic habitat conditions along the Southwest Branch mainstem were Non-supporting to Partially Supporting based on RBP scores, and Partially Degraded based on PHI scores. Upstream of the Southwest Branch mainstem, Ritchie Branch crosses the corridor study boundary before eventually flowing into Southwest Branch. PGDoE aquatic habitat assessments conducted along Ritchie Branch resulted in rankings ranging from Non-supporting to Partially Supporting based on RBP scores and Severely Degraded to Partially Degraded based on PHI scores. Aquatic habitat conditions upstream of I-495 were notably more degraded than downstream.

Aquatic habitat assessments were also conducted along two unnamed tributaries to Southwest Branch. Unnamed Tributary 1 to Southwest Branch drains an area upstream of I-495 and enters Southwest Branch just upstream of the corridor study boundary. PGDoE indicated that aquatic habitat conditions in this tributary were Partially Supporting based on RPB score and Severely Degraded based on PHI score, suggesting moderately degraded aquatic habitat conditions. Additional data collected by MBSS further upstream indicated that aquatic habitat conditions were Degraded. Unnamed Tributary 2 to Southwest Branch flows parallel to I-495 and enters the mainstem just downstream of the corridor study boundary. Based on PGDoE assessments, aquatic habitat conditions in Unnamed Tributary 2 to Southwest Branch were Partially Supporting.

Table 2.9-44: Range of Aquatic Habitat Scores for the Upper Southwest Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year		
Ritchie Branch	PGDoE – RBP	2017	77 – 123	Non-supporting – Partially Supporting
	PGDoE – PHI	2017	40.39 – 72.17	Severely Degraded – Partially Degraded
Southwest Branch	PGDoE – RBP	2017	96 – 102	Non-supporting – Partially Supporting
	PGDoE – PHI	2017	66.74	Partially Degraded
Unnamed Tributary 1 to Southwest Branch	PGDoE – RBP	2017	105	Partially Supporting
	PGDoE – PHI	2017	48.90	Severely Degraded
	MBSS	2008	54.71	Degraded
Unnamed Tributary 2 Southwest Branch	PGDoE – RBP	2013	118	Partially Supporting

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in the Upper Southwest Branch watershed are summarized in **Table 2.9-45**. Overall, waterways in the Upper Southwest Branch watershed had substantially degraded benthic macroinvertebrate communities. Based on data collected by MBSS and PGDoE, benthic macroinvertebrate communities were rated as Poor for Ritchie Branch, Southwest Branch, and Unnamed Tributary 1 to Southwest Branch. PGDoE rated the benthic community in Unnamed Tributary 2 to Southwest Branch, which runs parallel to I-495, as Very Poor.

Table 2.9-45: Range of Benthic IBI Scores for the Upper Southwest Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Ritchie Branch	PGDoE	2017	2.14 – 2.71	Poor
Southwest Branch	PGDoE	2013 – 2017	2.14 – 2.43	Poor
Unnamed Tributary 1 to Southwest Branch	PGDoE	2017	2.14	Poor
	MBSS	2008	2.43	Poor
Unnamed Tributary 2 to Southwest Branch	PGDoE	2013 – 2017	1.86	Very Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

For the Upper Southwest Branch watershed, fish sampling was only conducted within the vicinity of the corridor study boundary at Unnamed Tributary 1 to Southwest Branch. Based on available data in the watershed, 11 different fish species were recently documented by MBSS (**Appendix O**). All 11 species are widely distributed in Maryland and are found throughout many watersheds in the corridor study boundary. Only one species considered intolerant to degraded conditions, fallfish, was recently documented in the watershed. No gamefish or diadromous fish species were recently documented. According to the CFPP database, there is one fish blockage in the Upper Southwest Branch watershed that may inhibit fish movement (Martin, 2019). MBSS rated the fish community along the tributary as Fair, indicating that it is moderately degraded (**Table 2.9-46**). According to fish sampling conducted by MBSS in 1997, the fish community was in Good condition in the vicinity of the I-495 and MD 214 interchange (MDNR, 2003).

Table 2.9-46: Range of Fish IBI Scores for the Upper Southwest Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year		
Unnamed Tributary 1 to Southwest Branch	MBSS	2008	3.33	Fair

M. Lower Southwest Branch Watershed

a. Aquatic Habitat

The condition of aquatic habitat in the Lower Southwest Branch watershed varies by waterway; however, streams generally show moderate to substantial aquatic habitat degradation (**Table 2.9-47**). Recent data exist for two major unnamed tributaries that drain directly into Southwest Branch. Unnamed Tributary 3 to Southwest Branch begins at I-495, near the Ritchie Marlboro Road interchange. PGDoE rated aquatic habitat conditions along Unnamed Tributary 3 to Southwest Branch as Non-supporting based on RBP score and Degraded based on PHI score. Unnamed Tributary 4 to Southwest Branch begins downstream of the corridor study boundary and flows roughly parallel to Tributary 3. PGDoE RBP scores rated aquatic habitat conditions along Unnamed Tributary 4 to Southwest Branch as Partially Supporting.

Table 2.9-47: Range of Aquatic Habitat Scores for the Lower Southwest Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Unnamed Tributary 3 to Southwest Branch	PGDoE – RBP	2017	84	Non-supporting
	PGDoE – PHI	2017	57.01	Degraded
Unnamed Tributary 4 to Southwest Branch	PGDoE – RBP	2013	120 – 128	Partially Supporting

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Benthic macroinvertebrate sampling for the Lower Southwest Branch watershed is summarized in **Table 2.9-48**. PGDoE rated the benthic macroinvertebrate community in Unnamed Tributary 3 to Southwest

Branch as Poor, and the benthic macroinvertebrate community in Unnamed Tributary 4 to Southwest Branch as Poor to Fair.

Table 2.9-48: Range of Benthic IBI Scores for the Lower Southwest Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year		
Unnamed Tributary 3 to Southwest Branch	PGDoE	2017	2.14	Poor
Unnamed Tributary 4 to Southwest Branch	PGDoE	2013	2.43 – 3.29	Poor – Fair

c. Fish

No recent data on fish communities within the vicinity of the corridor study boundary were available for the Lower Southwest Branch watershed. According to the CFPP database, there are no fish blockages in the Upper Beaverdam Creek watershed (Martin, 2019). For a summary of existing data for the Upper Southwest Branch watershed, located immediately upstream, refer to **Section 2.9.2.K.**

N. Upper Henson Creek Watershed

a. Aquatic Habitat

Aquatic habitat conditions in the Upper Henson Creek watershed are summarized in **Table 2.9-49**. Existing aquatic habitat condition data along Henson Creek mainstem are variable, but indicate moderate aquatic habitat degradation overall. Henson Creek mainstem crosses I-495 twice and sites along Henson Creek were sampled by both PGDoE and MBSS. Aquatic habitat conditions ranged from Partially Supporting to Supporting based on RBP scores and Severely Degraded to Partially Degraded based on PHI scores.

Aquatic habitat data exist for two unnamed tributaries that originate near the corridor study boundary. Unnamed Tributary 1 to Henson Creek begins at I-495 and flows north, joining the mainstem near MD 218. Existing data for Unnamed Tributary 1 to Henson Creek indicate that aquatic habitat conditions vary from moderate to substantial degradation. Based on PGDoE data, aquatic habitat conditions were rated as Non-supporting to Partially Supporting based on RBP scores and Partially Degraded based on PHI scores. Unnamed Tributary 4 to Henson Creek flows parallel to I-495 and begins just upstream of MD 5. Existing data for Unnamed Tributary 4 to Henson Creek indicate that aquatic habitat conditions also vary from moderate to substantial degradation. According to data collected by MBSS and PGDoE, aquatic habitat conditions ranged from Non-supporting to Partially Supporting based on RBP scores and Degraded to Partially Degraded based on PHI scores.

Unnamed Tributary 2 to Henson Creek and Unnamed Tributary 3 to Henson Creek both drain areas outside of the corridor study boundary and join the mainstem just upstream of MD 5. Data collected by MBSS indicate that aquatic habitat conditions in both tributaries are moderately to substantially degraded. MBSS data rated aquatic habitat conditions in both Unnamed Tributary 2 and Unnamed Tributary 3 to Henson Creek as Degraded.

Table 2.9-49: Range of Aquatic Habitat Scores for the Upper Henson Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Henson Creek	PGDoE – RBP	2013 – 2016	104 – 128	Partially Supporting – Supporting
	PGDoE – PHI	2016	47.95 – 55.36	Severely Degraded – Degraded
	MBSS	2013 – 2016	61.02 – 79.88	Degraded – Partially Degraded
Unnamed Tributary 1 to Henson Creek	PGDoE – RBP	2013 – 2016	80 – 110	Non-supporting – Partially Supporting
	PGDoE – PHI	2016	69.20	Partially Degraded
Unnamed Tributary 2 to Henson Creek	MBSS	2007	65.16	Degraded
Unnamed Tributary 3 to Henson Creek	MBSS	2009	64.65	Degraded
Unnamed Tributary 4 to Henson Creek	PGDoE – RBP	2013 – 2016	88 – 114	Non-supporting – Partially Supporting
	PGDoE – PHI	2013 – 2016	57.54	Degraded
	MBSS	2009	69.78	Partially Degraded

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling conducted by PGDoE and MBSS in the Upper Henson Creek watershed are summarized in **Table 2.9-50**. Overall, benthic macroinvertebrate communities throughout the watershed are moderately degraded. The benthic macroinvertebrate communities along the Henson Creek mainstem were rated as Poor by PGDoE and Very Poor to Fair by MBSS. PGDoE rated benthic macroinvertebrate communities in Unnamed Tributary 1 to Henson Creek, Unnamed Tributary 2 to Henson Creek, and Unnamed Tributary 3 to Henson Creek as Poor. Unnamed Tributary 5 to Henson Creek, located downstream of I-495 and sampled by MBSS and PGDoE, had benthic macroinvertebrate community ratings that ranged from Poor to Fair.

Table 2.9-50: Range of Benthic IBI Scores for the Upper Henson Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Henson Creek	PGDoE	2013 – 2016	2.14 – 2.71	Poor
	MBSS	2007 – 2015	1.57 – 3.00	Very Poor – Fair
Unnamed Tributary 1 to Henson Creek	PGDoE	2013 – 2016	2.71	Poor
Unnamed Tributary 2 to Henson Creek	MBSS	2007	2.43	Poor
Unnamed Tributary 3 to Henson Creek	MBSS	2009	2.14	Poor
Unnamed Tributary 4 to Henson Creek	PGDoE	2009	2.43 – 3.00	Poor – Fair
	MBSS	2013 – 2016	3.00	Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

In recent years, 20 different fish species were documented in the Upper Henson Creek watershed within the vicinity of the corridor study boundary (**Appendix O**). All but two of these species were also recently documented in several other watersheds in the corridor study boundary. Although commonly found farther east within the Coastal Plain physiographic province, creek chubsucker and mummichog were only documented in two other watersheds within the corridor study boundary. Only four of the fish species documented in the watershed are considered intolerant of degraded conditions, including central stoneroller, satinfin shiner, spotfin shiner, and spottail shiner. American eel was the only documented diadromous fish species and no gamefish species were recently documented in the Henson Creek watershed. According to the CFPP database, there is one fish blockage in the Upper Henson Creek watershed that may inhibit fish movement (Martin, 2019).

Within the Henson Creek watershed, the health of the fish community is variable across waterways (**Table 2.9-51**). The health of the fish community was relatively less degraded along the two larger waterbodies in the vicinity of I-495, the Henson Creek mainstem and Unnamed Tributary 4 to Henson Creek. Based on data collected by MBSS, the fish communities were rated as Fair to Good and Good along Henson Creek and Unnamed Tributary 4 to Henson Creek, respectively. In 2007 and 2009, MBSS rated the fish communities at Unnamed Tributary 2 to Henson Creek and Unnamed Tributary 3 to Henson Creek as Poor and Very Poor, respectively.

Table 2.9-51: Range of Fish IBI Scores for the Upper Henson Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Henson Creek	MBSS	2007 – 2015	3.33 – 4.67	Fair – Good
Unnamed Tributary 2 to Henson Creek	MBSS	2007	2.33	Poor
Unnamed Tributary 3 to Henson Creek	MBSS	2009	1.33	Very Poor
Unnamed Tributary 4 to Henson Creek	MBSS	2009	4.00	Good

[1]Sampling may not have been conducted during all years within year ranges.

O. Watts Branch Watershed

a. Aquatic Habitat

Data collected at two sites along the mainstem of Watts Branch and downstream of I-270 in the Watts Branch watershed indicate moderate aquatic habitat degradation (**Table 2.9-52**). Existing data collected by MCDEP ranked aquatic habitat conditions as Fair to Good along the Watts Branch mainstem. In general, aquatic habitat conditions were slightly better at the site located farther upstream and closer to I-270.

Table 2.9-52: Range of Aquatic Habitat Scores for the Watts Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	87 – 131	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results from benthic macroinvertebrate sampling conducted by MCDEP within the corridor study boundary are summarized in **Table 2.9-53**. Benthic macroinvertebrate community health indicated moderate degradation within Watts Branch downstream of I-270 where benthic macroinvertebrate community health was rated as Fair.

Table 2.9-53: Range of Benthic IBI Scores for the Watts Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	14 – 22	Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Twenty-five different fish species occupy the Watts Branch watershed within the vicinity of the corridor study boundary (**Appendix O**). Apart from Blue Ridge sculpin and greenside darter, which have only been recently documented in one other watershed within the corridor study boundary, all other fish species documented in Watts Branch are found throughout the corridor study boundary and in other Central Maryland streams. The blue Ridge sculpin is an intolerant species often indicative of good water quality. Two additional intolerant fish species were documented in Watts Branch: central stoneroller and common shiner. American eel was the only diadromous species and largemouth bass was the only gamefish species documented in the vicinity of the corridor study boundary in recent years. Historically, smallmouth bass have also been documented throughout the watershed (MCDEP, 2003). According to the CFPP database, there is one fish blockage in the Watts Branch watershed, as well as the Little Falls Dam located downstream on the Potomac River mainstem, that may inhibit fish movement (Martin, 2019).

Results from fish sampling conducted by MCDEP within the corridor study boundary are summarized in **Table 2.9-54**. Fish community health indicated moderate degradation within the Watts Branch; however, fish ratings were slightly better than benthic macroinvertebrate ratings. Based on data collected, fish community health ranged from Fair to Good. On average, fish community health was slightly better at the site located farther upstream and closer to I-270, which is consistent with the better aquatic habitat conditions documented at that location.

Table 2.9-54: Range of Fish IBI Scores for the Watts Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	2.6 – 3.9	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

P. Muddy Branch Watershed

a. Aquatic Habitat

Aquatic habitat assessments conducted by MCDEP in the Muddy Branch watershed show moderately degraded conditions within the vicinity of the I-270 corridor study boundary (**Table 2.9-55**). Data for the Muddy Branch mainstem indicate slightly variable conditions, with ratings ranging from Fair to Good. Along the mainstem, aquatic habitat conditions were slightly less degraded upstream of I-270 (Good) than at the monitoring site well downstream of the corridor study boundary (Fair to Good/Fair). An aquatic habitat assessment was also conducted along one tributary to Muddy Branch, Decoverly Tributary, which is located downstream of I-270. MCDEP rated aquatic habitat conditions in Decoverly Tributary as Good.

Table 2.9-55: Range of Aquatic Habitat Scores for the Muddy Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	117 – 132	Good
Muddy Branch	MCDEP	2007 – 2014	96 – 120	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in Muddy Branch are summarized in **Table 2.9-56**. Overall, benthic macroinvertebrate communities in this watershed indicate moderate degradation. MCDEP sampled two locations along the Muddy Branch mainstem in recent years, one upstream and one downstream of I-495. Benthic macroinvertebrate communities were similar at both sites and were rated as Poor to Fair. Decoverly Tributary located downstream of I-495, had a benthic macroinvertebrate community health rating of Fair.

Table 2.9-56: Range of Benthic IBI Scores for the Muddy Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	18	Fair
Muddy Branch	MCDEP	2007 – 2014	16 – 18	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Nineteen different fish species were recently documented in the Muddy Branch watershed within the vicinity of the corridor study boundary, all of which are also found in neighboring watersheds (**Appendix O**). Central stoneroller was the only intolerant fish species documented in Muddy Branch. No diadromous species were documented and only one gamefish species, largemouth bass, was documented within Muddy Branch in recent years. Aside from central stoneroller, all species observed in the Muddy Branch watershed are generally widely distributed and capable of persisting in degraded stream conditions. According to the CFPP database, there are eight fish blockages in the Muddy Branch watershed, as well as the Little Falls Dam located downstream on the Potomac River mainstem, that likely inhibit fish movement (Martin, 2019).

Results of fish sampling in the Muddy Branch watershed are summarized in **Table 2.9-57**. Recent data collected by MCDEP in the vicinity of the corridor study boundary indicate that fish communities in the Muddy Branch watershed appear to be moderately to minimally degraded. Communities in the Muddy Branch mainstem ranged from Fair to Good, based on sampling at one site well downstream of the corridor study boundary. Sampling at the MCDEP site located approximately one mile downstream of the corridor study boundary along Decoverly Tributary indicated that fish communities were in Good condition.

Table 2.9-57: Range of Fish IBI Scores for the Muddy Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	4.1	Good
Muddy Branch	MCDEP	2007 – 2014	3.0 – 3.4	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

2.9.3 Environmental Effects

There would be no effect on aquatic biota from the No Build Alternative. However, all Screened Alternatives have the potential to affect aquatic biota in the corridor study boundary due to direct and indirect impacts to perennial and intermittent stream channels. Stream channel impacts associated with the Screened Alternatives range from 153,702 to 156,984 LF and wetland impacts range from 15.4 to 16.5 acres. Impacts are provided in more detail in **Section 2.3.3** and in **Table 2.9-58** and **Table 2.9-59**[5] below. The greatest stream channel impacts associated with the Screened Alternatives are associated with Alternative 10, which impacts 156,984 LF of streams. Impacts to aquatic biota could range from mortality of aquatic organisms during construction of culvert extensions and loss of natural habitat from the placement of culvert pipes and other in-stream structures, to more gradual changes in stream conditions. Impacts to aquatic biota, including species of freshwater mussels, are possible from the replacement of bridges and their in-water piers. Replacement of the American Legion Bridge crossing the Potomac River will require extensive in-stream work and all required precautions will be taken to avoid and minimize impacts to the steam and its aquatic biota.

Most culverts within the corridor study boundary are being extended or augmented rather than replaced since the project would improve an existing roadway. Although this reduces the overall length of potential impacts to waterways, if existing culverts do not meet current aquatic life passage standards and are being extended rather than replaced, then opportunities for improving aquatic life passage are limited. The possibility of retrofitting some culverts with a natural stream bottom will be evaluated in later phases of the study.

No Essential Fish Habitat (EFH) was identified within the study corridors, therefore the MSFCMA does not apply to this project. MDOT SHA requested information from the MDNR ERP regarding the presence of protected aquatic species within the corridor study boundary. MDNR ERP provided feedback in a response letter dated January 10, 2019 that included a list of fish species likely to occur within the waterbodies crossed by I-495 and I-270 and time of year restrictions for instream work to minimize impact to these species. A copy of this letter is included in **Appendix N** and the I-495 & I-270 Managed Lanes Study will comply with all time of year restrictions for construction activities within stream channels to protect fish species that are included in this correspondence.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Table 2.9-58: Summary of Impacts to Wetlands and Waterways by Classification

Type	Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Wetlands	PEM	0	0	3.7	162,549	3.9	167,750	3.9	167,750	4.0	173,615	3.8	167,589	4.0	172,983
	PFO	0	0	10.7	464,917	11.4	497,307	11.4	497,307	11.5	499,176	11.4	496,280	11.4	498,158
	PSS	0	0	1.0	45,524	1.1	46,802	1.1	46,802	1.1	46,802	1.1	46,802	1.1	46,802
	Grand Total	**0**	**0**	**15.4**	**672,990**	**16.3**	**711,859**	**16.3**	**711,859**	**16.5**	**719,593**	**16.3**	**710,671**	**16.5**	**717,943**
Waterways		**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
	Ephemeral	0	0	10,829	46,016	11,167	47,293	11,167	47,293	11,199	47,556	11,167	47,293	11,196	47,539
	Intermittent	0	0	64,252	368,373	65,354	373,447	65,354	373,447	65,580	375,839	65,287	372,841	65,445	374,323
	Perennial	0	0	78,621	1,401,275	79,401	1,424,712	79,401	1,424,712	80,205	1,432,736	79,368	1,424,335	79,991	1,429,246
	POW	0	0	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134	NA	64,134
	Grand Total	**0**	**0**	**153,702**	**1,879,798**	**155,922**	**1,909,586**	**155,922**	**1,909,586**	**156,984**	**1,920,265**	**155,822**	**1,908,603**	**156,632**	**1,915,242**

Table 2.9-59: Summary of Impacts to Wetland Buffers by Classification

Classification	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
PEM	0	0	14.6	634,381	15.0	651,682	15.0	651,682	15.3	665,922	14.9	649,804	15.3	664,976
PFO	0	0	32.8	1,429,874	34.3	1,495,037	34.3	1,495,037	34.5	1,501,615	34.3	1,494,032	34.4	1,496,893
PSS	0	0	3.7	162,795	3.8	166,124	3.8	166,124	3.8	166,124	3.8	166,124	3.8	166,124
Grand Total	**0**	**0**	**51.1**	**2,227,050**	**53.1**	**2,312,843**	**53.1**	**2,312,843**	**53.6**	**2,333,661**	**53.0**	**2,309,960**	**53.4**	**2,327,993**

1. "NA" was used for POW LF because these features are not assessed in LF.

2. Zero impacts occur in alternative 1, therefore all values are denoted as "0."

During construction of culvert extensions or stream relocations, the stream channel is excavated and any organisms living within the stream channel would be displaced or crushed by construction equipment. The primary impact from these activities would be to benthic organisms, such as macroinvertebrates, that are relatively stationary. However, fish mortality is also a possibility as they can be trapped in pools during dewatering of the channel. Even if a natural stream bottom is reestablished within the culvert or relocated channel, the habitat is unlikely to immediately support the same fish or macroinvertebrate community present before construction. Relocated channels would require a period of reestablishment before the same fish or macroinvertebrate communities could recolonize the channel. In the majority of the impacted streams, the area of channel disturbance for the culvert extension is relatively small in comparison to the remaining habitat available, making the overall habitat and mortality impact minor. In addition to displacement and habitat alteration, decreased aquatic organism passage could result from the extension of culverts. As detailed in **Section 2.9.2**, fish blockages are prevalent in many of the watersheds within the vicinity of the corridor study boundary and any additional restrictions to passage at culverts could further hinder aquatic organism movement and migration.

Although the immediate impacts from stream crossings have the potential to cause negative impacts to aquatic biota, some potential long-term negative effects are related to the change in land-cover associated with the Screened Alternatives and the potential for increases in impervious surfaces. The Screened Alternatives would require clearing of forested land, with impacts ranging from 1,434 to 1,515 acres (**Section 2.7.3, Environmental Effects, Vegetation and Terrestrial Habitat**). Forest impacts would include clearing forested land in stream valleys that currently provides important ecological services including: shading streams; reducing the quantity and increasing the quality of stormwater runoff; providing food and habitat sources from leaf detritus and coarse woody debris; and anchoring stream banks and floodplains with tree and shrub roots. Loss of detrital inputs and other impacts from forest clearing can have far reaching effects, including diminishing critical food sources in downstream waters. Tree removal during the construction process can also reduce the amount of shade provided to a stream and thereby raise the water temperature of that stream. In addition to tree removal, stormwater discharges also have the potential to increase surface water temperatures in nearby waterways. The effect of the temperature change depends on stream size, existing temperature regime, the volume and temperature of stream baseflow, and the degree of shading. Thermal effects from decreased shading and increased warm stormwater discharge are of particular concern for Use III and IV stream networks, such as Paint Branch and Northwest Branch, as they support aquatic biota less tolerant of warmwater conditions. Some of this clearing would be a temporary impact related to construction of the road improvements. In these cases, disturbed areas would be revegetated and eventually would again provide shade to the stream. Other temporary impacts to aquatic biota related to construction include the potential for unintentional sediment discharges that degrade aquatic habitat and impair aquatic communities as described in **Section 2.4.3.A, Environmental Effects, Surface Water Quality**.

The conversion of open-space and forested areas to impervious surfaces has the potential to have a wide range of impacts on study area streams and their inhabitants. The scientific literature generally shows that aquatic insect and freshwater fish diversity decline in watersheds at 10 to 15 percent impervious cover, with sensitive elements of the communities being affected at even lower impervious levels (CWP 2003). Often, impacts from imperviousness are most apparent in the macroinvertebrate community. Macroinvertebrates are relatively immobile and are quickly affected by habitat impacts such as bank erosion, sedimentation, and channel bed instability. While fish are more mobile than macroinvertebrates and can sometimes avoid short-term water quality or flow impacts, long-term changes in flow regime and habitat from imperviousness have been documented across the country. Sensitive fish that require clean and stable stream substrates for feeding and spawning are typically lost at approximately the 10 percent imperviousness threshold, while broader overall declines in the community are documented in the 10 to 15 percent impervious range (CWP, 2003). As discussed in **Section 2.4.2.A**, imperviousness of the greater watersheds within the corridor study boundary ranges from 14 to 37 percent, with the majority of the watersheds over 20 percent impervious, well above the 10 to 15 percent imperviousness range.

All of the Screened Alternatives would result in a net increase in impervious surfaces, ranging from a total of 396 to 554 additional acres across all watersheds. For most watersheds, the individual increase in imperviousness associated with this study is minimal compared to the size of the watershed, or the amount of existing imperviousness. Excluding the Upper Beaverdam Creek MDE 12-digit watershed, additional impervious surface area would equate to less than one percent of the total watershed area under all of the Screened Alternatives. Alternatives 8, 9, 10, 13B, and 13C would all result in a one percent increase in impervious surfaces within Upper Beaverdam Creek.

The greatest increase in impervious surfaces associated with the Screened Alternatives is associated with Alternative 10, which would result in a net increase in impervious surfaces of approximately 554 acres. Under the remaining Screened Alternatives, the increase in impervious surfaces would range from approximately 396 acres for Alternative 5 to 531 acres for Alternative 13C. For Piscataway Creek, one of the Tier II (High Quality) waters crossed by the corridor study boundary, there would be no net increase in impervious surfaces associated with any of the Screened Alternatives. In the Tier II Beaverdam Creek – Northeast Branch watershed, the Screened Alternatives would result in an increase of impervious surface by less than 0.1 acres. In the Tier II Bald Hill Branch watershed, the Screened Alternatives would result in an increase of impervious surface by 0.9 to 1.0 acres. The additional impervious acreage added for each Screened Alternative is summarized in **Table 2.9-60**[5] below. Through the use of erosion and sediment control measures, SWM, and other BMPs, MDOT SHA will mitigate impacts from any additional impervious area from the proposed project to the greatest extent practicable to avoid further declines in the quality of aquatic habitat and communities.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Table 2.9-60: Additional Impervious Surfaces by Watershed

Watershed Name	MDNR 12-Digit Watershed	ALT 1		ALT 5		ALT 8		ALT 9		ALT 10		ALT 13B		ALT 13C	
		AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF
Potomac River/Rock Run	021402020845	0	0	9.1	396,479	13.8	599,986	13.8	599,986	13.8	599,986	13.8	599,986	13.8	599,986
Cabin John Creek	021402070841	0	0	64.1	2,791,915	90.4	3,937,384	90.4	3,937,384	111.7	4,865,280	80.6	3,510,516	96.4	4,199,977
Rock Creek	021402060836	0	0	43.7	1,904,069	56.5	2,460,759	56.5	2,460,759	62.9	2,739,693	54.5	2,375,644	58.4	2,542,005
Sligo Creek	021402050821	0	0	17.7	770,111	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885	24.5	1,066,885
Northwest Branch	021402050818	0	0	16.6	722,856	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664	23.7	1,030,664
Paint Branch	021402050826	0	0	24.7	1,077,300	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058	29.2	1,270,058
Little Paint Branch	021402050825	0	0	8.4	364,474	10.1	439,088	10.1	439,088	10.1	439,088	10.1	439,088	10.1	439,088
Northeast Branch	021402050822	0	0	64.8	2,823,465	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473	86.3	3,758,473
Upper Beaverdam Creek	021402050816	0	0	45.7	1,992,463	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977	51.0	2,219,977
Upper Southwest Branch	021311030924	0	0	22.2	967,846	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606	33.1	1,443,606
Lower Southwest Branch	021311030922	0	0	15.0	653,087	18.4	800,512	18.4	800,512	18.4	800,512	18.4	800,512	18.4	800,512
Upper Henson Creek	021402010797	0	0	35.3	1,539,708	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481	47.0	2,045,481
Muddy Branch	021402020848	0	0	13.4	582,659	14.5	632,307	14.5	632,307	19.1	830,422	14.9	650,486	18.3	796,919
Watts Branch	021402020846	0	0	1.1	47,398	2.9	127,328	2.9	127,328	7.6	331,873	2.4	102,407	5.4	233,242
Bald Hill Branch	021311030928	0	0	0.9	38,634	1.0	42,208	1.0	42,208	1.0	42,208	1.0	42,208	1.0	42,208
Beaverdam Creek	021402050823	0	0	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007	0.0	2,007
Virginia: Nichols Run - Potomac River	N/A	0	0	12.9	562,791	14.5	631,590	14.5	631,590	14.5	631,590	14.5	631,590	14.5	631,590

Note: Part of the additional impervious surface area is in the Potomac River HUC8 Watershed in Virginia and is not associated with an MDNR 12-digit Watershed.

2.9.4 Avoidance, Minimization, and Mitigation

Aquatic biota would be affected to some degree by the I-495 & I-270 Managed Lanes Study if a Screened Alternative is selected. Efforts have been made throughout the planning process to avoid and minimize potential direct impacts to stream channels and these efforts would continue as the project design is refined. Avoidance and minimization efforts to date have included alignment shifts, reductions to roadside ditch widths to minimize the overall width of improvements, bridging waterways when feasible, and addition of retaining walls where practicable. During the development of the engineering layouts and LOD for the Screened Alternatives, a process was used to limit or avoid impacts to sensitive environmental features. This included the application of five progressively narrower roadside typical sections, as described in **Section 2.3.4**, to minimize or avoid impacts to these environmental and community resources. MDOT SHA would work closely with regulatory agencies and resource managers to identify sensitive aquatic resources and determine further potential avoidance and minimization as design is refined. Agency recommendations would be evaluated based on engineering and cost effectiveness and implemented wherever possible.

Bridges and natural bottom culverts would be used wherever possible to maintain natural stream substrate in areas where new or replaced culverts are necessary. However, opportunities for using natural bottom culverts may be limited because most existing culverts would be extended or augmented rather than replaced. Channel morphology would be evaluated, and culvert extensions designed to maintain aquatic life passage by avoiding downstream scour and channel degradation. Preliminary designs do not include culvert replacements but do include augmentations resulting from installing new pipes adjacent to existing culverts to provide additional area for flow. In addition to the augmentations, 117 culverts would be extended that are greater than 36 inches in diameter and drain an area of greater than 25 acres. Ongoing coordination is being conducted with MDNR to identify culverts within the corridor study boundary that are of concern for aquatic organism passage. Although aquatic organism passage may be currently limited within the vicinity of the corridor study boundary, additional impacts to aquatic organism passage will be minimized or avoided, where practicable.

Unavoidable direct impacts to stream channels would be mitigated in accordance with state and federal regulations through restoration projects aimed at replacing lost aquatic resource functions and services; for example, by improving water quality and providing high quality habitat for aquatic biota. Mitigation for stream channel impacts is discussed in **Section 2.3.4** and is covered in detail in the Compensatory Mitigation Report. Unavoidable impacts to forest from the I-495 & I-270 Managed Lanes Study will be regulated by MDNR under Maryland Reforestation Law and will adhere to all applicable local reforestation requirements. Mitigation for forests is discussed in more detail in **Section 2.7.4** and would be further coordinated in later stages of design.

All in-stream work would comply with the stream closure period for the designated use class of the stream, including that for culvert extensions, and any potential waiver requests would require agency approval(s). In-stream work is prohibited in Use I streams from March 1 through June 15, Use III streams from October 1 through April 30, and Use IV streams from March 1 through May 31, to protect aquatic species. In addition, in areas where yellow perch have been documented (Bald Hill Branch and Western Branch of the Patuxent River), no in-stream work is permitted in Use I waters from February 15 through June 15.

Potential water quality impacts from construction would be minimized through strict adherence to mandated erosion and sediment control and SWM requirements. State-of-the-art erosion and sediment control techniques would be implemented in compliance with MDE regulations. SWM BMPs would be developed in compliance with all applicable MDE regulations and guidance to provide channel protection, protect water quality, and maintain baseflow, which would minimize the negative effects of the roadway improvements on aquatic biota. In particularly sensitive areas, other impact minimization activities may be considered and could include more specialized SWM options; redundant erosion and sediment control measures; monitoring of aquatic biota above and below sensitive stream crossings before and after construction to quantify any inadvertent impacts that occur at the crossing; fish relocation from dewatered work areas during construction to reduce fish mortality and use of a qualified environmental monitor on-site to enhance erosion and sediment control compliance.

2.10 Rare, Threatened, and Endangered Species

2.10.1 Regulatory Context and Methods

Section 7 of the ESA of 1973 (16 U.S.C. Sections 1531-1544) requires all federal agencies to use their authorities to conserve endangered and threatened species in consultation with the USFWS and/or National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). Section 7(a)(2) (16 U.S.C. § 1536) establishes substantive requirements for federal agencies to insure, in consultation with the USFWS, any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify designated critical habitat. The Section 7 implementing regulations (50 CFR Part 402) specify how federal agencies must fulfill their Section 7(a)(2) consultation requirements. Section 9 of the ESA (16 U.S.C. § 1538) prohibits any action that causes a “take” of species listed as endangered or threatened. “Take” is further defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt any of these. The USFWS administers the ESA for all terrestrial and nontidal freshwater species, while the NMFS administers the ESA for marine and anadromous species or critical habitat. While there are no tidal areas within the corridor study boundary, NMFS also regulates effects to other trust resources such as anadromous fish species, estuaries, and EFH. The Fish and Wildlife Coordination Act (FWCA) requires consultation with the NMFS to address impacts to fish and aquatic resources under their jurisdiction. The MSFCMA requires consultation to address effects to fish and EFH identified under the MSFCMA. These resources are discussed in **Section 2.9, Aquatic Biota**.

The Maryland Nongame Endangered Species Conservation Act (Md. Code Ann., Nat. Res. § 10-2A-01 through 09) regulates activities that impact plants and wildlife, including their habitats, listed on the Maryland Threatened and Endangered Species list. Protections under the Act are for species listed as Endangered, Threatened, or In Need of Conservation (animals only). Endangered species are those whose continued existence in Maryland is in jeopardy. Threatened species are those that are likely, in the foreseeable future, to become endangered in Maryland. Species with a status of In Need of Conservation are animals whose population is limited or declining in Maryland such that it may become threatened in the foreseeable future if current trends or conditions persist. Any federal, state, local, or private constructing agency is required to cooperate and consult with MDNR regarding: the presence of listed species within a project area, field verification of habitat and/or populations of listed species, and avoidance and minimization efforts, as appropriate.

The Virginia Department of Agriculture and Consumer Services (VDACS), VDGIF, and VDCR cooperate in the protection of Virginia’s state and federally listed threatened and endangered species. Threatened and endangered wildlife species are protected under the Virginia ESA of 1972 (Chapter 5 Wildlife and Fish Laws; Va. Code Ann., § 29.1¬563 through 570). Virginia’s threatened and endangered plant and insect species are protected under the Endangered Plant and Insect Species Act of 1979 (Chapter 10 Endangered Plant and Insect Species of the Virginia Code; Va. Code Ann., § 3.2¬1000 through 1011). In addition, a cooperative agreement with the USFWS, signed in 1976, recognizes VDGIF as the designated state agency with regulatory and management authority over federally-listed animal species and provides for federal/state cooperation regarding the protection and management of those species. VDACS holds authority to enforce regulations pertaining to plants and insects. However, as per a memorandum of agreement between VDCR and VDACS, VDCR represents VDACS in comments regarding potential impacts to state-listed threatened and endangered plant and insect species.

The Information for Planning and Consultation (IPaC) tool was used to assess the potential presence of federally listed species under the jurisdiction of the USFWS. This online resource allows an assessment of potential listed species within an estimated action area. The IPaC official species list for both the Virginia and Chesapeake Bay Ecological Services field offices of the USFWS were originally accessed on July 11, 2018. Follow-up IPaC coordination occurred on October 24, 2019. The NMFS was contacted by email on July 16, 2018 regarding the potential presence of EFH or federally listed tidal aquatic threatened or endangered species.

The Maryland Trilogy Application was completed to assess the potential for the presence of Maryland state listed terrestrial or aquatic RTE species within the I-495 & I-270 Managed Lanes Study corridor study boundary. This online application solicits state listed RTE species review from the MDNR WHS and MDNR ERP. In addition, mapped MDNR Sensitive Species Project Review Areas (SSPRA) were reviewed in Maryland to determine areas supporting or providing habitat buffers for RTE species within the corridor study boundary. SSPRAs are mapped to include both sensitive species habitat and a buffer to allow potential activities anywhere within or near the SSPRA to be flagged for more detailed review by MDNR to determine if a sensitive species could potentially be affected. For Virginia state listed RTE species, the VDCR was contacted for information on the potential presence of RTE plant and insect species within the corridor study boundary. Response letters, online reviews, and other correspondence from the state and federal agencies responsible for rare, threatened, and endangered (RTE) species are included in **Appendix N**.

2.10.2 Existing Conditions

A. Northern Long-eared Bat and Indiana Bat

The USFWS Virginia field office 2018 official species list indicated the potential presence of the northern long-eared bat (*Myotis septentrionalis*) (NLEB) and the yellow lance (*Elliptio lanceolata*), both federally listed threatened species. The yellow lance appears to be presumed extirpated in the study area, as explained by USFWS in the *Species Status Assessment Report for the Yellow Lance (Elliptio lanceolata)* and the Final Rule (USFWS, 2018a and 2018b). No federally listed species were noted in the Chesapeake Bay field office official species list. However, in early 2019, during coordination meetings with MDOT SHA, USFWS voiced concerns about potential impacts from the I-495 and I-270 Managed Lanes Study in Maryland and Virginia to the NLEB and Indiana bat (*Myotis sodalis*) (IB), a federally-listed endangered species due to positive detection of these species by Virginia Tech in areas surrounding the corridor study boundary in their 2017, 2018, and 2019 spring/summer surveys. This concern was raised as a result of research being conducted on NPS lands in the Metropolitan Washington DC area by Virginia Tech (NPS

Publication Pending). As a result of this new information, the USFWS met with MDOT SHA and FHWA on March 25, 2019 to further discuss project coordination efforts regarding the NLEB and IB.

Both listed bat species are found throughout the eastern and north-central US, hibernating in mines and caves during winter and spending the summer in wooded areas (USFWS, 2016; USFWS, 2018c). NLEB is typically a short distance migrant, with the distance from winter hibernacula in caves and mines to summer roosts being typically less than 50 miles (USFWS, 2016), while IB are known to migrate hundreds of kilometers from their hibernacula (USFWS, 2007). No winter hibernacula exist within the corridor study boundary for either species, but summer roosting and maternity habitat can include any patch of typically upland forest or loose clusters of trees that have individual live or dead trees with loose bark, crevices, cavities, or hollows. The NLEB will also use barns and sheds in areas where suitable roost trees do not occur (USFWS, 2016). Upland forest habitat that could serve as summer roost habitat for NLEB or IB occurs throughout the corridor study boundary in Virginia and Maryland.

On July 18, 2019, the USFWS submitted a letter to the MDOT SHA providing comments on the IPaC Section 7 coordination for the two federally listed bat species. The USFWS letter specifies two potential ESA consultation pathways that can be used when transportation projects may affect the NLEB or IB. These include 1) the Programmatic Biological Opinion (BO) for Transportation Projects in the Range of the Indiana Bat and Northern Long-eared Bat, currently dated February 2018 due to revisions, and 2) the Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions, dated January 5, 2016. Either of these two Biological Opinions could be used to help facilitate ESA Section 7(a)(2) compliance for the I-495 & I-270 Managed Lanes Study.

According to the July 18, 2019 USFWS letter to MDOT SHA, the project would not qualify under the Programmatic BO for Transportation Projects referenced above because the project proposes to clear more than 20 acres of suitable habitat within any given five-mile section of roadway. The letter states that the project would qualify under the Programmatic BO on Final 4(d) Rule for the NLEB even though forest clearing may affect NLEB. However, the following conservation measures in the Final 4(d) Rule must be followed: Incidental take from tree removal is prohibited if it: (1) occurs within a 0.25 mile (0.4 kilometer) radius of known NLEB hibernacula; or (2) cuts or destroys known occupied maternity roost trees, or any other trees within a 150-foot (45-meter) radius from the known maternity tree during the pup season (June 1 through July 31). Based on the data collected by researchers at Virginia Tech over the previous three summers, the USFWS recommended that MDOT SHA conduct surveys to determine if IB are utilizing summer habitat within the corridor study boundary. These studies, which would qualify as Conservation Measures under the Final 4(d) Rule for the NLEB, would include mist-netting, radio-tracking, visual bridge surveys, and emergence bridge surveys. These studies, which include visual bridge surveys and emergence bridge surveys, would qualify as “conservation measures” under Section 7(a)(I) of the ESA for the NLEB and are recommended for the IB to let the USFWS know if conservation measures need to be implemented to avoid adverse effects to the IB.

A follow-up meeting between the MDOT SHA, FHWA, and USFWS was held on July 26, 2019 to further discuss potential bat survey activities and to finalize an acceptable survey approach. It was determined that insufficient time was available to conduct trapping surveys within the acceptable window of May 15 to August 15, 2019. However, it was decided that bat surveys of bridges, both visual and emergence, adjacent to suitable forest habitat could be conducted prior to the August 15, 2019 deadline. Suitable forest habitat includes areas of contiguous forest meeting the definition of FIDS[9] habitat, in proximity to a water resource, or adjacent to areas where NLEB and IB were detected by the Virginia Tech researchers. A preliminary list of bridges to be surveyed was presented to the USFWS for approval at the July 26, 2019 meeting. After the meeting, the USFWS revised the list to include a few additional bridges. The USFWS also accepted the proposed approach to conduct bat emergence surveys at the ALB and the bridge over Northwest Branch, two bridges that would be difficult to visually survey because of either their expanse over open water (ALB) or height (Northwest Branch Bridge).

Between August 5 and 12, 2019, 14 bridge structures and associated ramp bridges within the corridor study boundary were assessed for the presence of roosting bats or their suitability to support roosting bats. While suitable bat roosting habitat features were present on most bridges, most did not combine all necessary habitat variables. Bat guano was found beneath the ALB on the Maryland side of the Potomac River, the McArthur Boulevard/Clara Barton Parkway Westbound bridge, and the bridge over Seven Locks Road. Based on the results of the visual assessment, there was no evidence of use of the bridges by the NLEB or IB. However, five big brown bats, not state or federally listed, were found day-roosting singly within gaps between pier caps of the bridge over the McArthur Boulevard/Clara Barton Parkway Westbound bridge. All five roosting bats were in locations with a vertical clearance of at least 10 feet with forested habitat adjacent to the bridge. All had small amounts of guano on the ground beneath them suggesting that these were not extensively used roosts. Bat emergence surveys were conducted at the ALB on August 12, 2019 and at the Northwest Branch Bridge on August 13, 2019. Small and larger bats were observed flying beneath or near each bridge, but no bats were definitively confirmed exiting the bridge structures.

Based on suitable conditions for bridge roosting reported in the literature and evidence of roosting bats from this study, corridor study boundary bridges that support or could support roosting bats include the ALB, Clara Barton Parkway Eastbound bridge (not surveyed due to construction, but with conditions similar to the McArthur Boulevard/Clara Barton Parkway Westbound bridge), McArthur Boulevard/Clara Barton Parkway Westbound bridge, Seven Locks Road bridge, and Northwest Branch bridge. Details of the bridge visual and bridge emergence surveys can be found within the *Bridge Survey Report for the Northern Long-eared Bat (Myotis septentrionalis) and Indiana Bat (Myotis sodalis)* in **Appendix P**.

The IPaC reviews for the USFWS Virginia and Chesapeake Bay field offices were rerun on October 24, 2019. Both field offices listed only the NLEB as potentially occurring within the corridor study boundary. The yellow lance, which was reported in the 2018 official species list, appears to be presumed extirpated in the area near the corridor study boundary, as explained by USFWS in a 2018 Final Rule regarding the species. To apply "conservation measures" under Section 7(a)(I) of the ESA for the NLEB, MDOT SHA proposed informational mist netting and presence/absence acoustic surveys and radio tracking in areas with positive acoustic identification of rare, threatened, and endangered bat species during the survey window of May 15 through August 15, 2020. The USFWS concurred with the study team's survey approach on March 11, 2020. USFWS subsequently asked that mist netting and radio telemetry surveys be removed

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9 FIDS habitat is described as forests at least 50 acres in size with 10 or more acres of forest interior habitat (i.e., forest greater than 300 feet from the nearest forest edge) or riparian forests at least 50 acres in size with an average total width of at least 300 feet.

from the study plan due to concerns of transmission of COVID-19 to bats. Coordination with the USFWS and researchers from Virginia Tech regarding these studies is ongoing.

B. Fisheries

A response was received on August 9, 2018 from NMFS stating the corridor study boundary lies outside the limits of potential direct or indirect effects to federally listed or proposed threatened or endangered species under the jurisdiction of NMFS. Therefore, further consultation with NMFS under Section 7 of the ESA is not needed unless the study changes substantially or new information becomes available.

C. SSPRAs

MDNR has mapped five SSPRAs that intersect with the corridor study boundary, however, as mentioned previously these mapped areas include both sensitive species habitat and a buffer to allow potential activities within the SSPRA to be flagged for more detailed review by MDNR to determine if a sensitive species could potentially be affected. Presence of an SSPRA within the corridor study boundary or LOD does not necessarily mean an impact would occur. **Table 2.10-1** displays the total acreage of SSPRA located within the corridor study boundary per alternative.

Table 2.10-1: SSPRA Acreage within the Corridor Study Boundary

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Total SSPRA in Acres	0	151.7	155.0	155.0	155.0	155.0	155.0

D. State-listed Species

MDNR issued a response letter to MDOT SHA's request for review dated July 17, 2018 that documented areas of concern with regards to potential study-related impacts to RTE plant species. No state-listed wildlife species were identified as RTE within the corridor study boundary. Follow-up coordination with MDNR resulted in a revised response letter dated September 11, 2018 with additional comments and more detailed descriptions of the potentially affected RTE plant species. A meeting was then held with MDNR on September 14, 2018 to further discuss the potential RTE occurrences within the corridor study boundary. MDNR indicated which RTE plant species should be surveyed in the field if suitable habitat exists within the corridor study boundary. MDOT SHA agreed to conduct state listed RTE plant habitat assessments to determine the presence of suitable habitat and subsequent targeted species surveys to look for RTE plant species within areas determined to have suitable habitat.

Prior to conducting the RTE habitat assessments, available habitat and population occurrence information on each RTE plant species of concern were gathered from published botanical references and records from the MDNR herbarium. Areas identified within the corridor study boundary as having potential for RTE species were then investigated in the field to verify and document the presence of suitable habitat for the given species. Areas determined to contain suitable habitat were delineated and mapped, and photographs were taken to document suitable habitat areas. Where suitable RTE plant species habitat was found during the habitat assessments, targeted species surveys were completed to confirm whether any RTE plant species occur within the corridor study boundary. Targeted species surveys are species specific field surveys within suitable habitat and at appropriate seasons of occurrence to determine presence or absence of the species within the corridor study boundary. Because the areas the MDNR recommended for RTE plant surveys occur on NPS property near the Potomac River, permission to access NPS lands first had to be obtained. Permission was granted in July 2019, and the RTE plant survey was then carried out within the corridor study boundary (**Appendix R**).

Summer 2019 surveys were conducted by walking transects through the area of appropriate habitat during the most likely times of occurrence (e.g., flowering or seeding). Transects were walked to cover all areas of suitable habitat within the study boundary. If a targeted RTE plant species were to be found, all individuals of the population would be counted or an estimate made of the number of individuals for large populations. Additionally, the population would be surveyed; detailed notes would be taken on the condition of the population as well as other plant species growing with the RTE species; potential threats would be noted; and photographs would be taken of the population and individual plants as appropriate.

The targeted RTE species include the species shown in **Table 2.10-2**, located within riparian areas on NPS lands along the Potomac River in the western portion of the corridor study boundary.

Table 2.10-2: RTE Plant Species in Riparian Areas of the Potomac River Within the Corridor Study Boundary, as Indicated by MDNR

Scientific Name	Common Name	Status
Rumex latissimus	Tall dock	Endangered
Paspalum fluitans	Horse-tail paspalum	Endangered
Matelea obliqua	Climbing milkweed	Endangered
Baptisia australis	Blue wild indigo	Threatened
Coreopsis tripteris	Tall tickseed	Endangered
Phacelia covellei	Buttercup scorpionweed	Endangered

All of the listed species are known to occur on scour bars of the Potomac River or within the adjacent floodplain, and MDNR recommended habitat surveys of the area where the Potomac River crosses the corridor study boundary to determine whether suitable habitat exists for the listed species Small areas of suitable RTE habitat were found within upland terrace forest and on scour bars/riverside outcrop barrens. Much of the forested upland terrace areas within the proposed limits of disturbance had dense invasive species cover within the understory, vine, and groundcover layers. Dominant species included bush honeysuckle (*Lonicera* spp.), Asian bittersweet (*Celastrus orbiculatus*), Japanese stilt grass (*Microstegium vimineum*), and ground ivy (*Glechoma hederacea*). The scour bar areas occurred beneath the ALB and intermittently downstream to the extent of the corridor study boundary. Areas beneath the bridge appeared to be frequently flooded and may not have been able to support herbaceous vegetation growth, as much of the area was bare mud. Riverside outcrop barrens occurred on boulders at the edge of the river, but these areas had very little soil. Vegetation present in this area included sapling American sycamore (*Platanus occidentalis*) and sticky goldenrod (*Solidago racemosa*). None of the targeted RTE plant species were found during the surveys. One of the targeted species, buttercup scorpionweed (*Phacelia covellei*), is an early spring blooming herbaceous plant that would not have been present at the time of the surveys. Follow up surveys for this and any other targeted species identified by the state or federal resource agencies will be conducted during the appropriate season in 2020.

MDNR also identified the following areas of known RTE occurrence near the corridor study boundary:

- Within a powerline ROW north of Sellman Road, east of I-95, and between the I-495 split and Powder Mill Road is an occurrence of the state-threatened sundial lupine (*Lupinus perennis*) within upland meadow habitat, and the state-endangered long's rush (*Juncus longii*) within seepage wetland habitat.
- The state-endangered long's rush, the state threatened long-stalk greenbrier (*Smilax pseudochina*), and the state-rare pink milkwort (*Polygala incarnata*) occur within wetlands associated with Little Paint Branch east of I-95 just south of Powder Mill Road where the corridor study boundary crosses the Little Paint Branch near Cherry Hill.
- There are records of the state-threatened American brook lamprey (*Lethenteron appendix*) and the acuminate crayfish (*Cambarus acuminatus*), a species designated as In Need of Conservation, where the project route crosses Little Paint Branch in the area of Cherry Hill.
- The floodplain of a tributary of Indian Creek near the Greenbelt Metro Station supports a population of state-endangered trailing stitchwort (*Stellaria alsine*).
- Two dragonfly species, the state-rare Laura's clubtail (*Stylurus laurae*) and state-threatened Selys' sundragon (*Helocordulia selysii*) occur where Beaverdam Creek crosses Indian Creek northeast of the corridor study boundary.
- The state-rare switch cane (*Arundinaria tecta*), state-threatened glassy darter (*Etheostoma vitreum*) and American brook lamprey, and the state-endangered stripeback darter (*Percina notogramma*) occur within Western Branch downstream of Bald Hill Branch east of the corridor study boundary.

Most of the RTE species at these additional sites are aquatic flora or fauna for which MDNR did not recommend habitat surveys. MDNR instead emphasized the need for stringent erosion and sediment control during work in these areas. For the Sellman Road and Little Paint Branch south of Powder Mill Road RTE sites, MDNR suggested habitat surveys be conducted only if the corridor study boundary would overlap these areas. At present, the corridor study boundary does not encroach on these areas. While specific surveys for these RTE species was not recommended, coordination with MDNR is ongoing for all listed RTE species potentially affected by the project.

A response letter was issued by the VDCR Division of Natural Heritage on May 3, 2018 that presented a table of natural heritage resources, including the habitat of rare, threatened, or endangered plant and animal species, within a two-mile radius of the corridor study boundary. Follow up coordination with the VDCR resulted in a revised response letter dated July 31, 2019 that provided a list of natural heritage resources within their database that occur within the narrower corridor study boundary. The VDGIF online Fish and Wildlife Information Service was accessed on March 19, 2019 to identify species of conservation concern within a three-mile radius of the corridor study boundary. This list includes all federal and state-listed threatened and endangered animal species.

The July 31, 2019 response letter from VDCR indicated that the corridor study boundary overlaps the Potomac Gorge Conservation Site. According to VDCR, conservation sites are tools for representing key areas of the landscape that warrant further review for possible conservation action because of the natural heritage resources and habitat they support. Conservation sites are like SSPRAs tracked by the MDNR in Maryland and discussed above. The Potomac Gorge Conservation Site has been given a biodiversity significance rank of B1, which represents a site of outstanding significance. The list of the natural heritage resources known to occur within the Potomac Gorge Conservation site includes several state listed rare plant and invertebrate fauna. While not protected under state or federal laws, these species are tracked by the state because they are vulnerable to becoming state threatened or endangered. Additionally, the NPS has identified state and globally rare plants and invertebrates from national park property within the Potomac Gorge on both sides of the Potomac River through numerous distributional surveys over the past ten to twenty years. Some of these areas lie adjacent to the corridor study boundary. **Table 2.10-3** includes a list of these state listed rare plant and invertebrate species documented by VDCR or the NPS.

Table 2.10-3: Virginia and Maryland State Listed Species From the Potomac Gorge Known or Potentially Occurring[3] (VDCR/NPS/MDNR) Within the Corridor Study Boundary

Scientific Name	Common Name	Organism	Global Rank[2]	State Rank/Status[3]
Stygobromus phreaticu	Northern Virginia Well Amphipod	Amphipod	G1	S1
Stygobromus pizzinii[1]	Pizzini's Amphipod	Amphipod	G3G4	S1S2
Fontigens bottimer	Appalachian Springsnail	Snail	G2	S1S2
Hydropsyche brunneipenni	Caddisfly	Caddisfly	G3G4	S1S3
Cordulegaster erronea	Tiger Spiketail	Dragonfly	G4	S3
Gomphus fraternus	Midland Clubtail	Dragonfly	G5	S2
Acronicta radcliffei	Radcliffe's Dagger Moth	Moth	G5	S2S4
Acronicta spinigera	Nondescript Dagger Moth	Moth	G4	S1S3
Sphinx frankii	Frank's Sphinx	Moth	G4G5	S2S3
Arabis patens	Spreading Rock Cress	Vascular Plant	G3	S1
Baptisia australis	Blue Wild Indigo	Vascular Plant	G5T5	S2
Boechera dentata	Short's Rock Cress	Vascular Plant	G5	S1
Cirsium altissimum[1]	Tall Thistle	Vascular Plant	G5	S1
Clematis viorna	Vase-vine Leatherflower	Vascular Plant	G3	S3
Coreopsis tripteris	Tall Tickseed	Vascular Plant	G5T5	S1
Cuscuta polygonorum[1]	Smartweed Dodder	Vascular Plant	G5	S1
Echinocystis lobata[1]	Wild Cucumber	Vascular Plant	G5	SH
Erigenia bulbosa	Harbinger-of-Spring	Vascular Plant	G5	S1
Eryngium yuccifolium var. *yuccifolium*[1]	Northern Rattlesnake-Master	Vascular Plant	G5T5	S2
Galactia volubilis	Downy Milkpea	Vascular Plant	G5	S3
Helianthus occidentalis	McDowell's Sunflower	Vascular Plant	G5	S1/T
Hibiscus laevis	Halberd-leaf Rosemallow	Vascular Plant	G5	S3
Hybanthus concolor	Green Violet	Vascular Plant	G5	S3
Lipocarpha micrantha	Small-flower Halfchaff Sedge	Vascular Plant	G5	S2
Maianthemum stellatum	Starry Solomon's-Plume	Vascular Plant	G5	S2
Monarda clinopodia	Basil Beebalm	Vascular Plant	G5	S3S4
Orthilia secunda[1]	One-sided Shinleaf	Vascular Plant	G5	SH
Phacelia covillei	Covilli's Phacelia	Vascular Plant	G3	S1
Phaseolus polystachios	Wild Kidney Bean	Vascular Plant	G5	S3
Polygala polygama	Racemed Milkwort	Vascular Plant	G5	S1/T
Sida hermaphrodita	Virginia Sida	Vascular Plant	G3	S1
Silene nivea	Snowy Campion	Vascular Plant	G4?	S1

[1]Historically occurred within the Potomac Gorge Conservation Site crossed by the project.
[2]G1 = Highly Globally Rare, G2 = Globally Rare, G3 = Very Rare and Local or Range Restricted, G4 = Apparently Secure Globally, G5 = Demonstrably Secure Globally, GNR = Not Yet Ranked, G? = Species has not yet been Ranked
[3]Rank: S1 = Highly State Rare, S2 = State Rare, S3 = Watch List, S4 = Apparently Secure; Status: E = Endangered, T = Threatened
Sources: VDCR July 31, 2019 letter, Steury et al. 2007, NPS Coordination

The above referenced NPS Potomac Gorge park surveys also noted numerous Virginia state first records for various species of beetles (Steury et al. 2018, Steury 2018, Steury 2017, Steury and MacCrae 2014, Steury and Messer 2014, Cavey et al. 2013, Evans and Steury 2012, Steury et al. 2012), moths (Steury et al. 2007), caddisflies (Flint 2011), and land snails and slugs (Steury and Pearce 2014). VDCR also indicated the potential presence of other *Stygobromus* amphipod species within the corridor study boundary. A discussion of these newly documented invertebrate species is included in **Section 2.8 Terrestrial Wildlife** since they do not yet have designated state or federal rare, threatened, or endangered species ranks or statuses. VDCR and the NPS recommended conducting plant surveys to document whether any of the listed species are presently located within the corridor study boundary. Coordination with VDCR and NPS will continue and targeted plant species surveys within the corridor study boundary are planned for 2020.

2.10.3 Environmental Effects

The presence of federal or state listed species has not been confirmed within the corridor study boundary. The USFWS IPaC indicates that the NLEB may occur within the corridor study boundary. Additionally, the NPS has identified rare state listed plant and invertebrate species that occur on NPS lands within the Potomac River Gorge. Coordination is ongoing with the USFWS, VDGIF, VDCR, and NPS to determine whether any potential effects could occur to any of these species from any of the Screened Alternatives.

Within the Maryland portion of the corridor study boundary, the NLEB and IB may occur within suitable forested habitat. Neither species was confirmed within the corridor study boundary during visual bridge and emergence surveys in 2019. However, temporary day roosting by big brown bats on the bridge over McArthur Boulevard/Clara Barton Parkway Westbound and evidence of guano beneath the ALB and bridge over Seven Locks Road, suggest that bats do occasionally roost on suitable I-495 bridges. As noted above, based on the small amount of guano observed beneath the day roosting big brown bats and guano found on other bridges, none of the I-495 bridges appeared to serve as maternity roosting habitat, but were likely used as temporary day or night roosting sites. Therefore, potential impacts to bridge roosting bats would be minimal and would likely cause a shift to other suitable roosting sites near the bridges rather than resulting in an impact to the bats.

To determine potential impacts to suitable forested habitat for the NLEB and IB, further studies will be undertaken within the corridor study boundary during the 2020 active season (May 15 through August 15). Acoustic surveys are proposed to be conducted to better determine the potential presence of these federally listed bat species within the corridor study boundary. Mist net and radio telemetry surveys were proposed within the corridor study boundary for the 2020 survey season, however the USFWS has asked that mist netting not be conducted due to concerns of transmission of COVID-19 to bats. Ultimately, the results of this effort will assist MDOT SHA with an effects determination process and allow for targeted avoidance, minimization, and mitigation efforts to ensure that no take of either species would occur. Further discussion of potential impacts to NLEB and IB will occur following the 2020 survey efforts.

The MDNR identified several state-listed threatened or endangered plant species that may occur within scour bars or the adjacent floodplain of the Potomac River. A habitat assessment and targeted species survey was completed on federal lands within the C&O Canal National Historical Park in late June and early July 2019 to determine whether suitable habitat for the state listed plant species exists. Marginally suitable habitat was found for climbing milkweed (*Matelea obliqua*) and buttercup scorpionweed within less disturbed understory of upland terrace forest habitat and on scour bar/riverside outcrop barren habitat along the Potomac River for the remaining species. The targeted species survey did not identify any of the listed species, though surveys for the buttercup scorpionweed will need to be conducted during the suitable flowering period for this species in the spring of 2020. Based on the results of the targeted

RTE species survey conducted in 2019, the Screened Alternatives for the proposed I-495 & I-270 Managed Lanes Study would not be anticipated to impact five of the six DNR WHS listed plant species of concern within the Potomac River corridor. However, further surveys will be conducted in this area and within the Potomac Gorge in Virginia in the spring and summer of 2020 to determine whether buttercup scorpionweed and other state listed or rare plants occur within the corridor study boundary. If found, an evaluation will be made of the potential impacts of the project on these species.

MDNR indicated in an email on February 28, 2020, included in **Appendix N**, that MDNR no longer tracks bald eagle nests and that although this species is no longer listed by the state, it is protected under the federal Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). MDNR generally defers to the National Bald Eagle Management Guidelines. MDOT SHA has coordinated and will continue to coordinate with USFWS concerning bald eagles, in addition to peregrine falcons, as discussed in **Section 2.8**.

2.10.4 Avoidance, Minimization, and Mitigation

As stated above, based on currently available information, including targeted RTE plant species surveys during summer 2019, there are no anticipated effects to RTE species from any of the proposed I-495 & I-270 Managed Lanes Study Screened Alternatives. However, acoustic surveys for federally listed bats are proposed during spring and summer 2020 to determine the presence/probable absence of these species within the I-495 & I-270 Managed Lanes Study LODs. MDOT SHA will continue to coordinate with USFWS regarding federally listed bat species before, during, and after the bat surveys are completed. USFWS confirmed in a meeting with MDOT SHA on April 30, 2020, that if high frequency calls from NLEB and/or IB are identified within the MLS LODs, each positive acoustic detection location will receive a 3-mile buffer for NLEB and a 5-mile buffer for IB, within which there will be a tree clearing time-of-year restriction from May 1 to July 31. Additional bridge surveys for bats will also be conducted in the 2020 survey season.

If either the NLEB or IB are found roosting on bridges within the corridor study boundary, minimization efforts could include a time of year restriction on the start of construction on these bridges. This would ensure that bats would not be present when the construction work began. Most species of bats, and particularly NLEB and IB, would be expected to be absent from the corridor study boundary from mid to late October through March. Bats returning to the area the following season would likely seek other suitable roosting sites to avoid an active work zone on the bridge. In the unlikely event of a construction delay or stoppage lasting longer than 2 months, bridges under construction would be re-surveyed for bat utilization prior to resuming construction. All bridges where guano was found occur in areas with large stands of suitable forest habitat for bats that extend well outside the limits of project disturbance and could be and are likely used for alternate roosting. USFWS indicated in the April 30, 2020 meeting that full compliance with the time-of-year restrictions would conclude informal Section 7 consultation.

For state listed plant species, additional surveys will be conducted in the spring and summer of 2020 for the buttercup scorpionweed and other rare and listed species to determine whether project related impacts could occur to these species if present. As noted, coordination with the regulatory agencies is ongoing and will occur during later phases of the project to ensure that the project will not affect any potentially occurring federally or state listed RTE species. If more detailed surveys or later coordination indicate that affects could occur, those effects will be avoided, minimized, and mitigated to the extent practicable and in accordance with state and federal regulations.

2.11 Unique and Sensitive Areas

2.11.1 Regulatory Context and Methods

Unique and Sensitive Areas are ecological resources designated by state and local municipalities that do not fall within the regulations of other environmental resources such as waterways or forests. Maryland's 2001 GreenPrint Program was established to protect Maryland's most ecologically valuable natural lands and watersheds, which were designated as "Targeted Ecological Areas" (TEAs). TEAs have been identified by MDNR as conservation priorities for natural resource protection and receive the majority of Maryland's Program Open Space funds. These areas provide natural resource-based economies to Maryland citizens including clean water and air, flood protection, recreational and commercial fishing, wood products, forestry, and ecotourism. TEAs were identified by maps of Maryland's most ecologically important forests, wetlands, meadows, streams, and other natural systems using over 30 years of collected data. TEAs were created based on rankings of Green Infrastructure (GI); RTE species; aquatic habitat and biota; water quality; coastal ecosystem; and climate change adaptation. Developed lands were excluded from the TEA layer since developed lands are not preferred for stateside Program Open Space funding (MDNR, 2013).

GI areas were identified by the Maryland Greenways Commission and MDNR's Green Infrastructure Assessment (GIA), which considered land cover, wetlands, sensitive species, roads, streams, terrestrial and aquatic conditions, floodplains, soils, and developmental pressure to identify a network of "hubs" and "corridors" containing the most ecologically critical undeveloped lands remaining in Maryland (The Conservation Fund, 2016). "Hubs" are contiguous forest blocks and wetland complexes of at least 250 acres, rare or sensitive species habitats, biologically important rivers and streams, and existing conservation lands managed for their natural values. "Corridors" are linear stretches of land, at least 1,100 feet wide that follow the best ecological or most natural routes for animals, seeds, water, and other important resources to move between hubs. Areas of disconnect between the hubs and corridors are called "gaps" (Weber, et al., 2006).

Montgomery County has designated certain watersheds as Special Protection Areas (SPAs) due to the presence of high-quality water resources and related natural features that could be jeopardized by development activities without additional water quality protection measures. SPAs provide protection beyond standard environmental laws and regulations for land use and development, calling for stringent water resource protection measures in new and expanded development projects. Regulations in SPAs require developers to: support stream monitoring; adhere to stormwater BMPs; conduct water quality inventory and monitoring; establish performance goals to protect critical natural resources and minimize impacts; and maintain a close working relationship with Montgomery County Department of Permitting Services (MCDPS), MCDEP, and the M-NCPPC throughout the regulatory process (MCDEP, 2018). Environmental Overlay Zones were established within the limits of SPAs to impose additional land use regulations and impervious surface limits on the underlying areas (Montgomery Planning, 2012; Blackwell, 1989).

Locations of TEAs, GI hubs and corridors, SPAs, and Environmental Overlay Zones within the corridor study boundary were determined using desktop review. Background information and geospatial data for TEAs and GI areas were obtained from MDNR and Maryland iMap (State of Maryland, 2018). Background information and geospatial data for SPAs and Environmental Overlay Zones in the corridor study boundary were obtained from Montgomery County Atlas (MCAtlas) (See **Appendix Q**) (Montgomery Planning, 2018).

The Virginia Department of Conservation and Recreation (VDCR) Natural Heritage (DNH) Program conserves Virginia's natural resources through programs such as biological inventories, natural community inventory and classification, and the creation of Natural Area Preserves throughout the state (VDCR, 2018e). In addition, VDCR-DNH identifies Conservation Sites, which represent key areas of the landscape worthy of protection and stewardship action, because of the natural heritage resources and habitat they support (VDCR, 2018d). Conservation Sites are given a biodiversity significance ranking based on the rarity, quality, and number of element occurrences they contain on a scale of B1-B5, with B1 being the most significant.

2.11.2 Existing Conditions

A. Targeted Ecological Areas and Green Infrastructure

As shown in **Appendix Q**, ten GI corridors and eight GI hubs overlap with the corridor study boundary. The GI corridors are associated with Muddy Branch, Watts Branch, Cabin John Creek, Rock Creek, Sligo Creek, Paint Branch, Little Paint Branch, and an unnamed tributary to Paint Branch. The GI hubs are associated with Cabin John Creek, Potomac River, Rock Creek, the Northwest Branch of the Anacostia River, Indian Creek, an unnamed tributary to Paint Branch, the Southwest Branch of the Western Branch of the Patuxent River, and Henson Creek.

In addition to the GI areas mentioned above, TEAs overlap with the corridor study boundary between Cabin John Creek and the Potomac River in Montgomery County, a small area along Little Paint Branch, and along Bald Hill Branch east of the I-495/MD 50 interchange in Prince George's County.

B. Special Protection Area (SPA) and Environmental Overlay Zones

There are no SPAs or Environmental Overlay Zones within the corridor study boundary, but the Piney Branch SPA is located approximately 4,000 feet southwest of the I-270/Shady Grove Road interchange.

C. Natural Area Preserves and Conservation Sites

There are no VDCR-DNH Natural Area Preserves within the corridor study boundary or within Fairfax County, Virginia. There are two VDCR Conservation Sites within a five-mile radius of the corridor study boundary according to the VDCR initial project review: the Potomac River Yellow Falls SCU and the Potomac Gorge. The Potomac River Yellow Falls SCU is the stretch of Bullneck Run between Old Dominion Drive and the Potomac River. VDCR ranks this area as a B3 High Significance stream. This stream is approximately 0.8 miles from the corridor study boundary in Virginia. The Potomac Gorge is located in the entrenched valley of the Potomac River that generally extends between Great Falls and DC, along the Fall Line between the Piedmont Plateau and the Atlantic Coastal Plain. The landscape of the Potomac Gorge fosters great species diversity and includes Great Falls on the Potomac River, high rocky bluffs, forested river terraces, and grassy meadows.

2.11.3 Environmental Effects

The No Build Alternative would have no impact on GI hubs and corridors, TEAs, or SPAs. Impacts associated with each Screened Alternative are summarized in **Table 2.11-1**[5] below. Each Screened Alternative would impact 77.1 acres of TEAs, except for Alternative 5, which would result in 74.7 acres of TEA impact. GI hubs would be impacted from between 41.8 acres from Alternative 5 to 46.2 acres from Alternative 10. GI corridors would be impacted similarly by all alternatives as well, with the lowest impact of 278.8 acres from Alternative 5 and the highest impact of 287.5 acres from Alternative 10. SPAs and VDCR Natural Area Preserves and Conservation Sites would not be impacted by the Screened Alternatives.

Table 2.11-1: Impacts to Unique and Sensitive Areas in Acres

	ALT 1	ALT 5	ALT 8	ALT 9	ALT 10	ALT 13B	ALT 13C
Targeted Ecological Areas	0	74.7	77.1	77.1	77.1	77.1	77.1
Green Infrastructure Hubs	0	41.8	45.0	45.0	46.2	43.8	44.4
Green Infrastructure Corridors	0	278.8	286.1	286.1	287.5	285.8	287.1
Special Protection Areas	0	-	-	-	-	-	-
Total Impacts to Unique and Sensitive Areas	**0**	**395.3**	**408.2**	**408.2**	**410.8**	**406.7**	**408.6**

Note: A "-" indicates that SPAs do not occur within the corridor study boundary.

The I-495 & I-270 Managed Lanes Study would increase the man-made footprint within the TEAs and GI areas, but the GI hubs and corridors will remain intact. However, road widening would create larger gaps in GI corridors, further fragmenting the GI network. New manmade structures and roadways impact contiguous forest blocks and wetland complexes in TEAs and GI areas, which are often habitats for rare and sensitive species, and contain biologically important rivers, streams, and other natural resources. While the majority of impacts associated with construction of the Screened Alternatives are linear and along existing roadways, the Screened Alternatives would impact TEAs and GI hubs and corridors, which would potentially threaten important habitat and ecosystems (MDNR, 2018).

2.11.4 Avoidance, Minimization, and Mitigation

Avoidance and minimization efforts to reduce impacts to GI and TEAs involve a two-tiered approach. The first level will occur during the planning stage where every reasonable effort will be made to avoid wetlands and waterways as well as parklands to the greatest extent practicable. Many GI, TEA, and wildlife corridors overlap with wetlands, waterways, and park land. The second level of avoidance and minimization will occur at the P3 design/build stage, with advancement of the design and further refinements to the LOD. Reducing construction cost by limiting vegetation removal, the need for endangered species assessment, and forest and wetland mitigation provide incentive to refine the LOD and reduce impacts to resources. However, opportunities for avoidance and minimization of impacts to roadside resources are limited due to the fixed nature of the highway corridor.

[5] For reference, impact tables presented in the report are also included in Appendix A.

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Section 2.2 Air Quality

TBD

Section 2.3 Waters of the US, Including Wetlands

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List of Acronyms

AADT – Average Annual Daily Traffic

AASHTO – American Association of State Highway and Transportation Officials

ALT* – Alternative
*Only abbreviated in tables.

ARDS – Alternatives Retained for Detailed Study

BARC – Beltsville Agricultural Research Center

BLM – Bureau of Land Management

BMP(s) – Best Management Practice(s)

C&O – Chesapeake and Ohio

CEA – Cumulative Effects Analysis

CEQ – Council on Environmental Quality

CFR – Code of Federal Regulations

CLRP – Constrained Long-Range Plan

CMP – Compensatory Mitigation Package

COMAR – Code of Maryland Regulations

Critical Area – Chesapeake Bay Critical Area

CRWR – Center for Research in Water Resources

CRZ – Critical Root Zone

CWA – Clean Water Act

CWP – Center for Watershed Protection

CWR – Clean Water Rule

DBH – Diameter at Breast Height

DC – District of Columbia

DDOE – District Department of the Environment Watershed Protection Division

DEIS – Draft Environmental Impact Statement

DO – Dissolved Oxygen

EAB – Emerald ash borer

EFH – Essential Fish Habitat

EIS – Environmental Impact Statement

EoPB – Eyes of Paint Branch

EPA – Environmental Protection Agency

EPD – Environmental Program Division

ERP – Environmental Review Program

ESA – Endangered Species Act

ESD – Environmental Site Design

ETL – Express Toll Lanes

FAST – Fixing America's Surface Transportation

FCDPWES – Fairfax County Department of Public Works and Environmental Services

FCP – Forest Conservation Plan

FEMA – Federal Emergency Management Agency

FHWA – Federal Highway Administration

FIDS – Forest Interior Dwelling Bird Species

FPPA – Farmland Protection Policy Act

FR – Federal Register

FWCA – Fish and Wildlife Coordination Act

GI – Green Infrastructure

GIA – Green Infrastructure Assessment

GIO – Geographic Information Office

GIS – Geographic Information System

GP – General Purpose

GPS – Global Positioning System

HOT – High-Occupancy Toll

HOV – High-Occupancy Vehicle

IBI – Index of Biotic Integrity

ICC – Intercounty Connector

ICM – Innovative Congestion Management

IPaC – Information for Planning and Consultation

IRVM – Integrated Roadside Vegetation Management

ISW – Interstate Waters

IWSRCC – Interagency Wild and Scenic River Coordinating Council

JD – Jurisdictional Determination

LESA – Land Evaluation and Site Assessment

LF – Linear Feet

LOD – Limits of Disturbance

MAL – Minimum Allowable Limit

MBSS – Maryland Biological Stream Survey

MCAtlas – Montgomery County Atlas

MCDEP – Montgomery County Department of Environmental Protection

MCDPS – Montgomery County Department of Permitting Services

MCL – Maximum Contaminant Limit

MD – Maryland

MDE – Maryland Department of the Environment

MDNR – Maryland Department of Natural Resources

MDOT SHA – Maryland Department of Transportation State Highway Administration

MERLIN – Maryland's Environmental Resources and Land Information Network

MET – Maryland Environmental Trust

MGS – Maryland Geological Survey

M-NCPPC – Maryland National Capital Park and Planning Commission

MS4 – Municipal Separate Storm Sewer System

MSFCMA – Magnuson-Stevens Fishery Conservation and Management Act

MTA – Maryland Transit Authority

MWCOG – Metropolitan Washington Council of Governments

NCEI – National Centers for Environmental Information

NEPA – National Environmental Policy Act

NFIP – National Flood Insurance Program

NLEB – Northern Long-Eared Bat

NMFS – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollutant Discharge Elimination System

NPS – National Park Service

NRCS – Natural Resources Conservation Service

NRTR – Natural Resources Technical Report

NTCHS – National Technical Committee for Hydric Soils

NTU – Nephelometric Turbidity Units

NWI – National Wetlands Inventory

NWQMC – National Water Quality Monitoring Council

OHW – Ordinary High Water

P3 – Public-Private Partnership

PEM – Palustrine Emergent

PFO – Palustrine Forested

PGDER – Prince George's County Department of Environmental Resources

PGDoE – Prince George's County Department of the Environment

PHI – Physical Habitat Index

POW – Palustrine Open Water

PSS – Palustrine Scrub-Shrub

RBP – Rapid Bioassessment Protocol

RFP – Request for Proposals

ROW – Right-of-Way

RTE – Rare, Threatened, and Endangered

SDWA – Safe Drinking Water Act

SF – Square Feet

SGCN – Species of Greatest Conservation Need

SPA(s) – Special Protection Area(s)

SSPRA – Sensitive Species Project Review Area

SWANCC – Solid Waste Agency of Northern Cook County

SWAP – State Wildlife Action Plans

SWM – Stormwater Management

TCP – Tree Conservation Plan

TEAs – Targeted Ecological Areas

TMDL – Total Maximum Daily Load

TNW – Traditionally Navigable Waters

TPB – Transportation Planning Board

TS – Territorial Seas

UA – Urbanized Area

URS – United Research Services

US – United States

USACE – United States Army Corps of Engineers

USC – United States Code

USDA – United States Department of Agriculture

USDOT – United States Department of Transportation

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

VA – Virginia

VAC – Virginia Administrative Code

VCPMI - Virginia Coastal Plain Macroinvertebrate Index

VDACS – Virginia Department of Agriculture and Consumer Services

VDCR – Virginia Department of Conservation and Recreation

VDEQ – Virginia Department of Environmental Quality

VDGIF – Virginia Department of Game and Inland Fisheries

VDH – Virginia Department of Health

VDOF – Virginia Department of Forestry

VDOT – Virginia Department of Transportation

VMRC – Virginia Marine Resources Commission

VOF – Virginia Outdoors Foundation

VSCI - Virginia Stream Condition Index

VWPP – Virginia Water Protection Permit

WHS – Wildlife and Heritage Service

WIP – Watershed Implementation Plan

WMA – Water Management Administration

WRR – Water Resources Registry

WSSC – Washington Suburban Sanitary Commission

Glossary

Anadromous – Fish that spend most of their adult lives at sea but return to fresh water to spawn. (National Conservation Training Center - https://nctc.fws.gov/pubs5/web_link/text/int_fish.htm)

Aquifer – An underground layer of water-bearing rock. Water-bearing rocks are permeable, meaning that they have openings that liquids and gases can pass through. (National Geographic - https://www.nationalgeographic.org/encyclopedia/aquifer/)

- Artesian aquifer – Water is pushed to the surface as a result of pressure between rock formations (USGS - https://water.usgs.gov/edu/qa-home-artesian.html)
- Unconfined (water-table) aquifer – Water is near the land surface and movement is controlled by the water table, therefore subject to rise and fall of the water table (USGS - https://www.usgs.gov/faqs/what-difference-between-a-confined-and-unconfined-water-table-aquifer?qt-news_science_products=0#qt-news_science_products)

Benthic - Occurring at the bottom of a body of water. (EPA - https://www.epa.gov/national-aquatic-resource-surveys/indicators-benthic-macroinvertebrates)

Catadromous – Fish that spend most of their adult lives in fresh water but return to salt water to spawn (NOAA Fisheries - https://www.nefsc.noaa.gov/faq/faq-archive/fishfaq1a.html)

Corridor Study Boundary – The project area which includes a 48-mile long and approximately 600-foot wide roadway corridor around I-495 and I-270 spanning two states, three counties, and 15 MDNR 12-digit watersheds. (NRTR)

Diadromous - A general category describing fish that spend portions of their life cycles partially in fresh water and partially in salt water. (National Conservation Training Center - https://nctc.fws.gov/pubs5/web_link/text/int_fish.htm)

Palustrine emergent wetland (PEM) – A nontidal wetland characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. (USFWS - https://www.fws.gov/wetlands/documents/classwet/emergent.htm)

Ephemeral Streams that flow only after precipitation. Runoff from rainfall is the primary source of water for these streams. Like seasonal streams, they can be found anywhere but are most prevalent in arid areas. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Exotic species – A species not native to the continent on which it is now found (USDA NRCS- https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/technical/ecoscience/invasive/?cid=nrcs142p2_011124)

Forest – A biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or greater. Forest includes (1) areas that have at least 100 trees per acre with at least 50% of those having a two-inch or greater diameter at 4.5 ft above the ground and larger, and (2) forest areas that have been cut but not cleared. Forest does not include orchards (Maryland State Forest Conservation Technical Manual - https://mdstatedocs.slrc.info/digital/collection/mdgov/id/11130/)

Forest Stand – A contiguous group of trees sufficiently uniform in species composition, arrangement of age classes, and condition to be a distinguishable, homogeneous unit. (Maryland State Forest Conservation Technical Manual - https://mdstatedocs.slrc.info/digital/collection/mdgov/id/11130/)

Palustrine forested wetland (PFO) – A nontidal wetland characterized by woody vegetation that is 6 m tall or taller. (USFWS - https://www.fws.gov/wetlands/documents/classwet/forested.htm)

Geology – Referring to physical features of the earth's surface including rock and soil formations. (Geology.com - https://geology.com/articles/what-is-geology.shtml)

Hydrologic Unit Code (HUC) – A number ranging from 2 to 8 digits nationally that classifies an area into regions, sub-regions, accounting units, and cataloging units which identify the movement of water into successively smaller geographic areas. The term can be used interchangeably with "watershed." (USGS - https://water.usgs.gov/GIS/huc.html)

Intermittent – Streams that flow seasonally and often have connectivity to groundwater. Runoff from rainfall or other precipitation supplements the flow of seasonal stream. During dry periods, seasonal streams may not have flowing surface water. Larger seasonal streams are more common in dry areas. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Interstate waters (ISW) - A water body that flow across, or form a part of, a State's boundaries. (Congressional Research Service - https://fas.org/sgp/crs/misc/R44585.pdf)

Invasive species – Any living organism that is not native to an ecosystem and causes harm to the ecosystem, community, or health of the area where they are introduced. These species usually reproduce quickly and outcompete native species. They are not necessarily from different countries or continents. (National Wildlife Federation - https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Invasive-Species)

Karst – An area of land comprised of limestone (soft rock) that is prone to erosion when exposed to water and can result in steep, rocky cliffs or sinkholes. (National Geographic - https://www.nationalgeographic.org/encyclopedia/karst/)

Macroinvertebrate – Small aquatic animals and the larval stage of insects which are visible without the aid of a microscope and lack a backbone. Commonly described as "benthics." (EPA - https://www.epa.gov/national-aquatic-resource-surveys/indicators-benthic-macroinvertebrates)

Non-native/Introduced species – A species introduced intentionally or accidentally by human intervention to an area/region where it was previously not found. Not all non-native species are invasive or exotic. (USDA NRCS - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/technical/ecoscience/invasive/?cid=nrcs142p2_011124)

Nontidal – Not influenced by tide, most commonly used to describe wetlands along rivers, streams, isolated depressions, or other low-lying areas where groundwater intercepts the soil surface. These areas can be inundated seasonally and can consist of a variety of vegetation types from grasses to forest, and in some cases may lack vegetation. (EPA - https://www.epa.gov/wetlands/what-wetland)

Palustrine open water (POW) – Nontidal system that is permanently flooded and largely lacks rooted vegetation above the water's surface. (USFWS - https://www.fws.gov/wetlands/documents/classwet/)

Palustrine - All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 %. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5 %. (USFWS - https://www.fws.gov/wetlands/documents/classwet/palustri.htm)

Perennial – Streams that typically have water flowing in them year-round. Most of the water comes from smaller upstream waters or groundwater while runoff from rainfall or other precipitation is supplemental. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Scrub-shrub wetland – (Palustrine) A wetland dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. (USFWS - https://www.fws.gov/wetlands/documents/classwet/scrbshrb.htm)

Territorial seas (TS) - The area of the sea immediately adjacent to the shores of a state and subject to the territorial jurisdiction of that state. (Britannica - https://www.britannica.com/topic/territorial-waters)

Tidal – Influenced by tide, most commonly used to describe wetlands along coast lines and usually a mix of salt and freshwater. Vegetation may be absent, as in sand or mud flats, but many areas consist of grasses, shrubs, and some tree species that have adapted to the influence of salt water. (EPA - https://www.epa.gov/wetlands/what-wetland)

Topography - The configuration of a surface including its relief and the position of its natural and man-made features (Merriam-Webster Dictionary - https://www.merriam-webster.com/dictionary/topography)

Traditionally navigable waters (TNW) - A water body that is subject to the ebb and flow of the tide, and/or the water body is presently used, or has been used in the past, or may be susceptible for use to transport interstate or foreign commerce. (United States Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook - https://www.epa.gov/sites/production/files/2017-05/documents/app_d_traditional_navigable_waters.pdf)

Watershed - An area of land that drains water, sediment and dissolved materials to a common receiving body or outlet. The term is not restricted to surface water runoff and includes interactions with subsurface water. Watersheds vary from the largest river basins to just acres or less in size. (EPA Watershed Academy Web - https://www.epa.gov/hwp/basic-information-and-answers-frequent-questions)