APPENDIX M

AVOIDANCE, MINIMIZATION, AND IMPACTS REPORT

APRIL 15, 2020

U.S. Department of Transportation
Federal Highway Administration

and

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

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1 INTRODUCTION

The I-495 & I-270 Managed Lanes Study (MLS) Avoidance, Minimization, and Impacts Report (AMR) describes the process of avoiding and minimizing impacts to wetlands, their buffers, waterways, and Federal Emergency Management Agency (FEMA) 100-year floodplains to the greatest extent practicable and presents justifications for impacts that were unavoidable. A multi-disciplinary team, hereafter referred to as the MLS Team, including roadway engineers, stormwater engineers, structural engineers, construction engineers, environmental planners, and environmental scientists, reviewed the entire corridor over a 16-month period to identify avoidance and minimization opportunities and coordinate reduction of the Limits of Disturbance (LODs) with the regulatory and resource agencies.

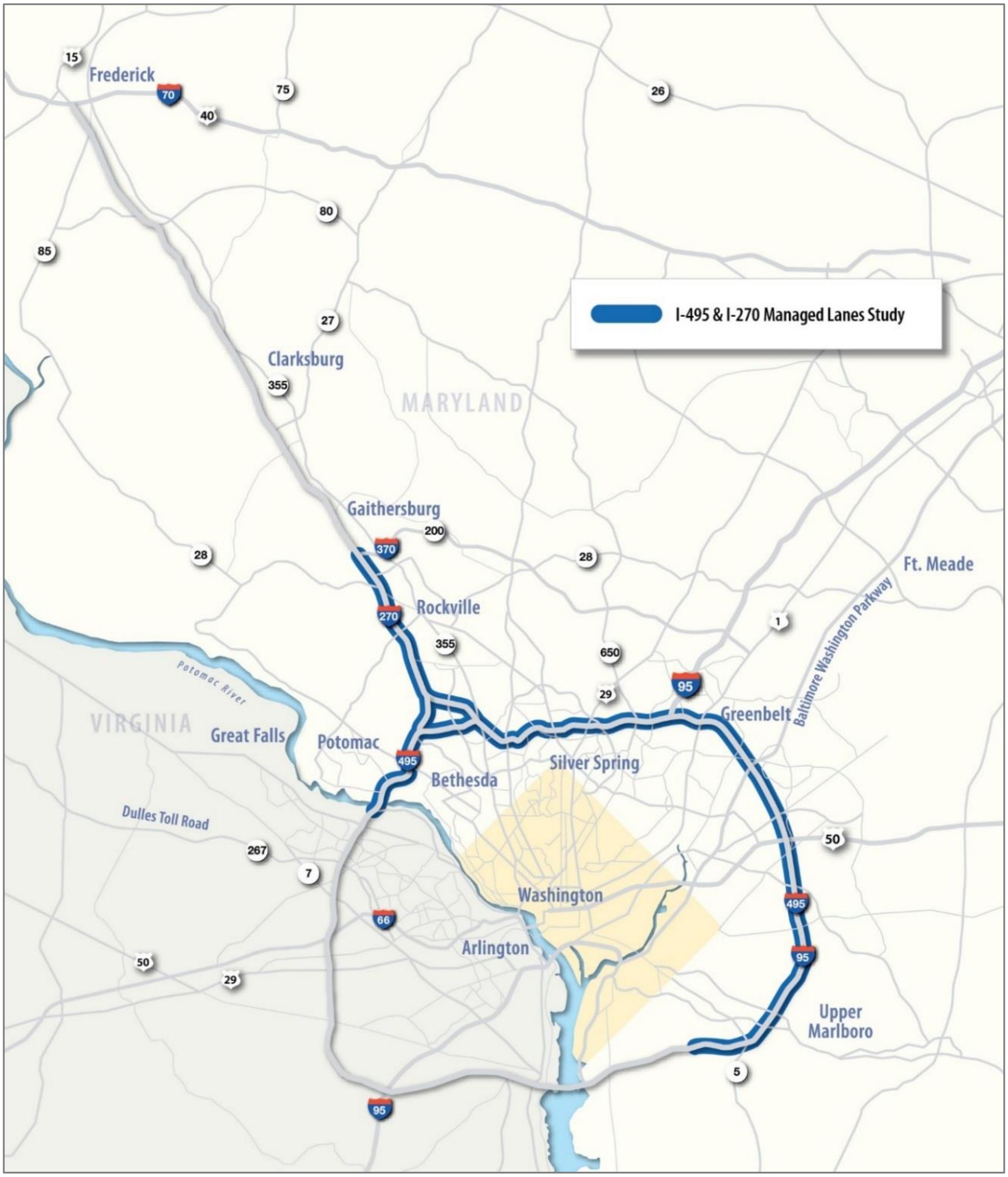
The Federal Highway Administration (FHWA), as the lead Federal agency, and the Maryland Department of Transportation State Highway Administration (MDOT SHA), as the project sponsor, are preparing an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) for the MLS. The purpose of the MLS is to develop a travel demand management solution(s) that addresses traffic congestion and improves trip reliability on I-495 and I-270 within the study limits and to enhance existing and planned multimodal mobility and connectivity. The study limits (**Figure 1-1**: **Study Corridors**) include a 48-mile long and approximately 600-foot wide roadway corridor spanning two states, three counties, and 15 Maryland 12-digit watersheds.

Efforts have been made throughout the MLS planning process to avoid and minimize impacts to wetlands, their buffers, waterways, and the FEMA 100-year floodplain to the greatest extent practicable while maintaining a corridor wide enough to support a constructible project. Avoidance and minimization of impacts to these resources is an integral part of the permitting process and is required by state and federal regulations. The AMR is submitted with the MLS Joint Permit Application (JPA) in accordance with the NEPA of 1969, Executive Order (EO) 11990, May 24, 1977 (42 FR 26961), which states that 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.

The AMR summarizes the study alignment and the Build Alternatives; explains how the Build Alternative LODs were established based on a corridor-wide stepwise process of avoidance and minimization of impacts; and describes the targeted avoidance and minimization of impacts to resources in specific areas of the study corridor. The AMR then presents impact reductions resulting from the avoidance and minimization process and provides justifications for unavoidable impacts, which may not be immediately apparent from a review of the JPA Impact Plates, such as the construction access areas. The JPA Impact

Plates and Tables present all unavoidable impacts to wetland and waterways features. Impacts were avoided and minimized to the greatest extent practicable at a planning level design for all DEIS Build Alternatives through collaboration between the MLS Team and regulatory and resource agencies.

Figure 1-1: Study Corridors



1.1 Regulatory Context

The Maryland Department of the Environment (MDE) regulates the alteration of floodplains, wetlands, their buffers, and waterways under the Maryland Nontidal Wetlands Protection Act and Section 401 of the Clean Water Act (CWA); the Virginia Department of Environmental Quality (VDEQ) regulates wetlands and waterways under the Code of Virginia; and the U.S. Army Corps of Engineers (USACE) regulates Waters of the U.S. under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. For more information about the individual permits required by these agencies, please see the *Natural Resources Technical Report* (NRTR) (**DEIS Appendix L, Section 2.3**).

President Trump issued EO 13807, Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects on August 15, 2017, requiring Federal agencies to conduct environmental reviews and determine authorization decisions for “major infrastructure projects” as One Federal Decision (OFD). EO 13807 sets a government-wide goal of reducing the average time for each agency to complete these required environmental reviews and authorization decisions to two years, measured from the date of publication of a notice of intent to prepare an Environmental Impact Statement (FHWA, 2019). The MLS is a major infrastructure project under EO 13807.

Under the OFD Federal Agency Memorandum of Understanding (MOU) for Major Infrastructure Projects, signed in 2018, the wetlands and waterways permit application and authorization process must be completed concurrently with the NEPA process, requiring permitting decisions to be made based on preliminary design. The OFD MOU requires a paradigm shift by both the project designers and environmental regulators: EO 13807 mandates that preliminary project design incorporate more avoidance and minimization techniques and that the permitting process move forward with less design specificity than would have been done prior to the issuance of the OFD MOU.

1.2 The Build Alternatives

The MLS Team established an initial LOD for each DEIS Build Alternative by implementing general design assumptions, refining each LOD by applying a corridor-wide avoidance and minimization process, and then targeting location-specific avoidance and minimization. The team defined the LOD of each Build Alternative to avoid and minimize impacts to adjacent resources to the maximum extent practicable **at this stage of the project** while maintaining a constructible area for roadway modifications. The MLS team commits to pursuing additional avoidance and minimization on the Recommended Preferred Alternative (RPA), including identifying temporary versus permanent impacts in the FEIS. Following the Record of Decision (ROD), as the design advances, further avoidance and minimization will be considered, and the developer will be required to document that the design has equal or fewer impacts to the RPA.

The MLS Team analyzed the Build Alternatives for cost, impacts to resources, functionality, and constructability. Build Alternatives 8, 9, 10, 13B, and 13C consist of adding two managed lanes, either High-Occupancy Toll (HOT) Lanes or Express Toll Lanes (ETLs), in each direction on I-495. Alternative 9M would be a similar configuration except that only one additional managed lane would be added in each direction between the I-270 spur and the I-95 interchange. Build Alternatives 8 and 9 have the same roadway footprint on I-270, but Build Alternative 8 would consist of one ETL managed lane and retain the one existing High-Occupancy Vehicle (HOV) lane in each direction, while Build Alternative 9 would convert the HOV lane to a HOT managed lane and add a HOT managed lane in each direction. Build Alternative

9M would be the same as Alternative 9 for all areas except between the I-270 West Spur and the I-95 interchange, where only one additional HOT managed lane would be added in each direction. Build Alternative 10 maintains the one existing HOV lane and adds two ETL managed lanes in each direction on I-270. Build Alternative 13B would convert the existing HOV lane to two reversible HOT managed lanes on I-270, and the HOT managed lanes would be separated from the general purpose lanes by concrete barriers. Build Alternative 13C would be identical to 13B except that the HOT managed lanes are ETL managed lanes and the HOV lane would be retained in both directions, which slightly widens the proposed roadway footprint. For further details on the Build Alternatives please see the MLS *Draft Environmental Impact Statement* (DEIS) and the *Alternatives Technical Report* (**DEIS Appendix B, Section 6**).

2

2 WETLANDS AND WATERWAYS

The natural resource team delineated a total of 407 nontidal wetlands and 1,061 stream segments within the corridor study boundary. The NRTR (**DEIS Appendix L, Section 2.3**) and MLS *Wetland Delineation Memorandum* dated April 15, 2020 include specific information regarding these features. Natural resource team field leads conducted a function and value assessment of delineated features based on parameters outlined in the *USACE Highway Methodology Workbook Supplement* (USACE, 1999) and best professional judgement. Function and Value datasheets were completed for each wetland and included in the NRTR, Appendix G (**DEIS Appendix L**). The team assessed wetland function and value based on the following 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

The team completed waterways datasheets for each stream segment delineated in the field and prepared a qualitative function and value assessment considering parameters such as bank erosion, stability, and incision; hydrologic connectivity; level of alteration; channel substrate; vegetation cover of banks and riparian buffer; fish and wildlife habitat; relative value in an urban landscape; and recreational value. USACE, MDE, U.S. Fish and Wildlife Service (USFWS), and Maryland Department of Natural Resource (MDNR) reviewed this function and value assessment and provided comments. The MLS Team revised portions of the function and value assessment based on the agencies' input. The function and value assessments were helpful in prioritizing the conservation of resources in areas where impacts were unavoidable and minimization choices between resources were necessary due to the confined nature of the study corridor.

3

3 MINIMIZATION APPROACH

Wetland, wetland buffer, waterway, and FEMA 100-year floodplain impacts are unavoidable for all Build Alternatives of the MLS. 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, thus any roadway modification and/or widening will result in unavoidable impacts to these resources. However, the MLS team made a concerted effort to avoid and minimize impacts throughout the planning process and will continue to do so during later phases of project design.

The MLS Team worked with regulatory and resource agencies during field and office meetings over a 16-month period to review impacted natural resources and explore avoidance and minimization possibilities. The team evaluated agency recommendations and implemented these wherever practicable. Design revisions to avoid and minimize direct impacts to natural resources to date include the following:

- Elimination of the collector-distributor system on I-270;
- Preliminary alignment shift designs;
- Alterations to preliminary roadside ditch and grading designs;
- Additions to preliminary retaining wall designs to minimize the roadway footprint;
- Revisions to preliminary ramp designs, construction access areas, and preliminary stormwater management (SWM) facility locations; and
- Relocations of preliminary managed lane access locations.

This report focuses on these planning stage avoidance and minimization efforts. The Public Private Partnership authorized by the Maryland Board of Public Works for the MLS will continue to implement avoidance and minimization during the design-build stage of the project as the design advances and the LOD is refined.

3.1 Study Alignment and Alternatives

The MLS Team initially identified 15 Preliminary Alternatives that had been developed in previous studies and planning documents while taking into account input from federal, state, and local regulatory agencies and the public during the NEPA scoping process. The team then screened the 15 Preliminary Alternatives by applying screening criteria related to the MLS Purpose and Need to each alternative, making a general, qualitative assessment of these criteria using readily available information. The team only dropped a Preliminary Alternative from further consideration if the readily available information demonstrated that the alternative clearly did not meet the MLS Purpose and Need. The team developed a list of Screened

Alternatives consisting of those alternatives that either met the screening criteria or required additional analysis to determine the alternative's ability to meet the MLS Purpose and Need. For additional documentation of this screening process, please see the *Alternatives Technical Report* (**DEIS Appendix B, Section 6**).

A comment period followed the development of the Screened Alternatives. During the comment period on the Preliminary Alternatives, agency representatives questioned whether elevated alignment options were being considered to limit the widening of I-495 and I-270. The team responded that vertical options were being considered as a means and methods for adding roadway capacity on I-495 and I-270 but were not being considered as separate, standalone alternatives. MDOT SHA does not permit construction overtop of active traffic lanes. This restriction would require the construction of temporary traffic lanes outside of the existing roadway for maintenance of traffic during construction. In addition, an elevated alignment option would need to include access to the elevated roadway and would need to consider interchange reconfigurations and noise and visual impacts resulting from an elevated roadway. For these reasons, elevated alignment options were not included in any of the alternatives.

Upon completion of the comment period, the MLS team performed additional preliminary engineering along with additional traffic, financial, and environmental analyses to determine whether each of the Screened Alternatives was reasonable and to identify which alternatives would be carried forward as Alternatives Retained for Detailed Study (ARDS).

Based on additional financial analysis and the deficiencies in addressing the existing traffic and long-term traffic growth and trip reliability, Alternative 5 was determined not to be a reasonable alternative, as it does not meet the MLS Purpose and Need and is not financially viable. However, Alternative 5 is included in the DEIS for comparison of impacts at the request of some of the Cooperating Agencies. The No Build Alternative (Alternative 1) does not meet the Study's Purpose and Need but was retained for comparison with the other alternatives in technical reports. **DEIS Chapter 2** summarizes the results of alternatives screening process and the rationales for the identification of the ARDS. The *Alternatives Technical Report* (**DEIS Appendix B, Section 6**) documents these results in more detail.

Following public workshops and agency meetings, a few Cooperating Agencies and Participating Agencies requested that MDOT SHA evaluate an additional alternative through the NEPA process. Titled the Maryland (MD) 200 Diversion Alternative, this alternative would preclude the construction of Priced Managed Lanes (PMLs) between the I-495 interchange with I-270 near the MD 355 interchange and the I-495 interchange with I-95, resulting in reduced impacts to regulated resources and fewer residential displacements. In lieu of these PMLs, it would be assumed that travelers would use MD 200, an existing price managed toll road, also known as the Intercounty Connector, that roughly parallels I-495 from east of I-270 to I-95 a few miles north of I-495. However, the MD 200 Diversion Alternative would not address the MLS Purpose and Need of accommodating long-term traffic growth, enhancing trip reliability, or improving the movement of goods and services. The *Alternatives Technical Report* (**DEIS Appendix B, Section 6.4.2**) includes a summary of the MD 200 Diversion Alternative analysis. **DEIS Chapter 6** presents the summary comparison of traffic improvements, financial viability, and environmental impacts between the Build Alternatives. The MD 200 Diversion Alternative was not carried forward as a DEIS Build Alternative.

MDOT SHA and FHWA evaluated an additional alternative for the Study called Alternative 9 Modified (Alternative 9M) in response to public and agency comments. Alternative 9M consists of a blend of Alternatives 5 and 9 on the top side of I-495 resulting in one HOT managed lane in each direction on I-495 between I-270 and I-95. Alternative 9 Modified has the following lane design elements:

- Two HOT managed lanes added in each direction on I-495 between the study limits south of the George Washington Memorial Parkway and the I-270 West Spur, including the American Legion Bridge. (Similar to Alternative 9).
- Conversion of the one existing HOV lane in each direction to a HOT managed lane on I-270 and the West Spur, and the addition of one HOT managed lane in each direction on I-270, resulting in a two-lane managed lanes network. (Similar to Alternative 9).
- One HOT managed lane in each direction on I-495 between the I-270 West Spur and I-95. (Similar to Alternative 5).
- Two HOT managed lanes added in each direction on I-495 between I-95 and the study limits west of MD 5. (Similar to Alternative 9).

The ARDS that were carried forward, Alternatives 8, 9, 10, 13B, and 13C, and the additional Alternative 9M, discussed above, are referred to as the Build Alternatives in this report.

3.2 Corridor-Wide Avoidance and Minimization

3.2.1 Limits of Disturbance

A LOD was established for each Build Alternative by implementing the following general design assumptions:

- the LOD was established 10 feet beyond the standard roadway typical section cut or fill limits;
- 10 or 14 feet beyond the exterior face of retaining walls; or
- at the existing state or county right-of-way (ROW) line when the aforementioned dimensions fell within these existing ROW lines.

A typical roadway section includes the added travel lanes, full-width median and outside shoulder, 8-foot flat bottom SWM bioswales or drainage channels, and slope grading to meet existing grade. The LOD at intersections and interchanges was set at the existing ROW except where the improvements outside of ROW or additional construction access was needed. The methods used to incorporate design features are detailed in the *Alternatives Technical Report* (**DEIS Appendix B, Section 5**).

The MLS team determined the resource impacts for a “worst-case” 2-Lane Alternative in July 2018, and these quantities represent the impacts before avoidance and minimization techniques were applied. This worst-case LOD was used as the reference point from which avoidance and minimization techniques were developed. The total impacts of all Build Alternatives were calculated in January 2020, and these quantities represent the impacts of each alternative after the application of avoidance and minimization techniques, including corridor-wide avoidance and minimization and targeted areas of avoidance and minimization. These values are presented for comparison in **Section 4**.

A step-wise process was applied corridor-wide to avoid or limit impacts to natural resource features, which included the application of five progressively narrower roadside typical sections from widest to narrowest until impacts were avoided or Step 5 was reached.

The five roadside typical sections include:

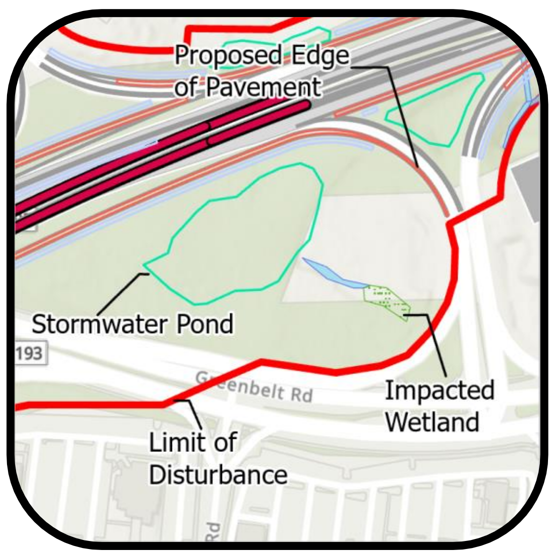
1. Step 1 - an open section with a full-width (8-foot) bioswale for SWM;
2. Step 2 - an open section with a reduced-width (2-4-foot) bioswale for SWM;
3. Step 3 - an open section with no surface SWM (drainage ditch only);
4. Step 4 - a closed section with concrete barrier; and
5. Step 5 - a closed section with retaining wall.

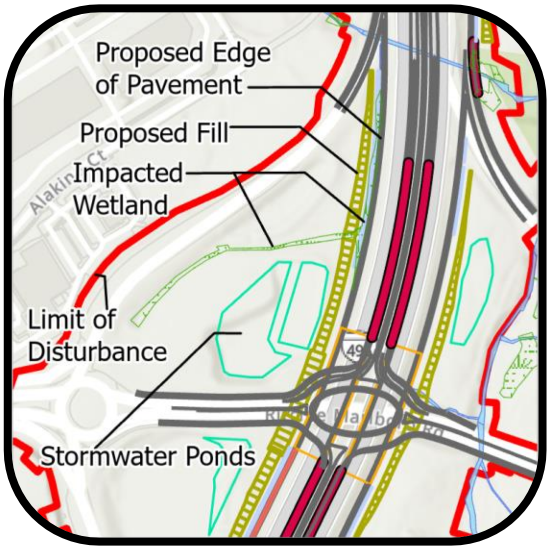
The five roadside typical sections are described further in the *Alternatives Technical Report* (**DEIS Appendix B, Section 5.2.3**), NRTR (**DEIS Appendix L, Section 2.3.4**), and displayed in **Appendix B** of this report. Avoidance and minimization steps were applied in interchanges where possible. Natural resources were avoided and minimized along the outer edge of interchanges using the same 5-step process as along the roadway. Additionally, the roadway team refined design and eliminated portions of the LOD within interchanges when feasible to limit impacts to natural resources.

When the MLS team reviewed the corridor for avoidance and minimization opportunities, they recognized the need for a balance between avoidance and minimization of impacts and providing adequate space to construct roadway improvements. The LOD was expanded in areas where construction activities would likely require additional space and was reduced in areas adjacent to wetlands and waterways where practicable. Construction elements other than roadway widening that were considered in determining the extent of the LODs included: culvert or drainage outfalls, stormwater management, bridge construction/widenings, staging, stockpiling, access, outfall stabilization, and construction equipment areas.

The Build Alternative LODs have not been fully refined in some locations at this stage of design, because there is not yet enough information about construction requirements to advance the minimization effort.

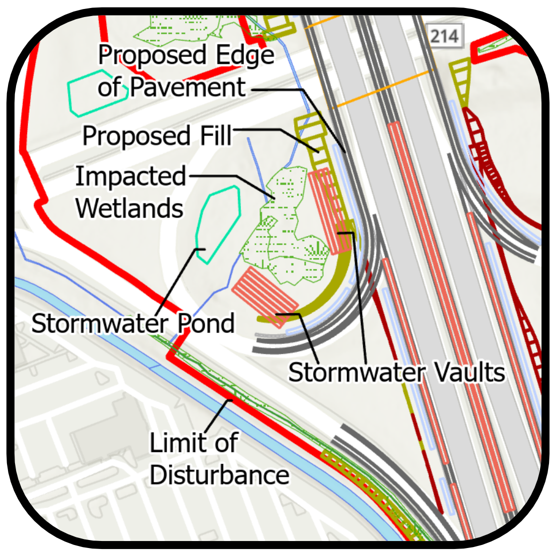
One example is where stormwater management ponds are being proposed. Proposed stormwater management pond locations are not shown on the impact plates since their design and proposed locations are preliminary. In all but the unique cases discussed later in this report, proposed stormwater ponds will not permanently impact jurisdictional features. However, construction of stormwater ponds may result in temporary impacts or temporary impacts could be avoided as design is advanced. Wetland 10GG on Impact Plate 31A and shown as an 'Impacted Wetland' in the adjacent figure, demonstrates a stormwater pond construction access impact to a feature that can likely be avoided in future design.

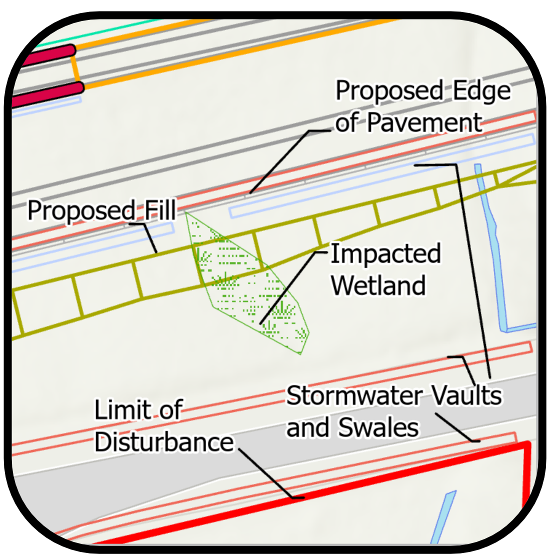




In other instances, construction elements such as roadway fill and stormwater management ponds are not shown on the impact plates making it impossible to differentiate between impacts that will ultimately be identified as temporary versus permanent impacts. In these cases, to be conservative, the entire resource is within the LOD. Wetland 5E on Impact Plate 46A, shown as the 'Impacted Wetland' in the adjacent figure, is an example of such a location.

Another example is where further LOD refinement once a RPA is identified could entirely avoid impacts to resources or at least make them temporary. Wetlands 5AA and 5Z on Impact Plate 43A, shown as 'Impacted Wetlands' in the adjacent figure, is an example of a location where a doughnut hole in the LOD in an interchange was not included at this stage of design, but avoidance could be included as design advances.





Another type of situation that is not apparent on the impact plates, but causes impacts to resources, is that fill slopes may extend from the edge of the proposed roadway to significantly impact resources. Wetland 12AA on Impact Plate 22A, shown as the 'Impacted Wetland' in the adjacent figure, demonstrates a roadway impact that is not obvious based on information that can be shown on a permit plate.

3.2.2 Stormwater Management Assumptions

Impacts to natural resources features resulting from SWM facility placement were avoided and minimized to the maximum extent practicable while still meeting SWM requirements. Some unavoidable impacts are associated with SWM pond facility outfalls to natural resource features and expansion of existing SWM facilities. Office and field coordination meetings were held with USACE, MDE, MDNR, and USFWS to appropriately balance the need for stormwater treatment and impacts to natural resources.

The regulatory agencies agreed that proposed SWM pond facilities could outfall to, i.e. partially impact, natural resources and that existing SWM facilities could be expanded. The locations at which a stormwater outfall will impact a feature are listed in Table 3 of **Appendix A** of this report. The MDE and USACE Impact Tables indicate when stormwater outfall (SO) is the only potential impact to a feature, e.g. 6QQ, or when it is one of several impact types to potentially impact a feature, e.g. feature 23Q_1. Impacts associated with stormwater outfalls will largely be determined to be temporary in the FEIS. If natural resource features would be fully impacted by the proposed roadway footprint, then the regulatory agencies agreed that SWM facilities could be proposed in those locations. Features were considered fully impacted by the roadway design if the widening and roadside elements overlapped the features to such an extent that the feature would experience a total loss of function as a result of the impact.

In certain locations, the regulatory agencies determined that SWM facilities may impact natural resource features if sufficient justification was provided for the impact. A total of eight proposed SWM pond facilities impact wetland and waterway features. The justifications for replacing these features with SWM pond facilities were determined through several office and field meetings to consider the features' current functions and are presented below.

Waters 22FF – Station 177+00 RT (JPA Impact Plate 4)

Waters 22FF is an ephemeral erosional feature that drains uplands and does not link to other features within the corridor study boundary. It originates on the roadside, receives sheet flow from a culvert under the roadway, and drains into a residential development outside of the study area. The feature has a degraded function and exhibits moderate erosion. Waters 22FF would provide more benefit to the surrounding landscape if converted to a SWM facility, which would be capable of slowing down and improving the water quality of the sheet flow intercepted from the nearby culvert.

Wetland 14F – Station 730+00 LT (JPA Impact Plate 17)

Wetland 14F is a PEM wetland entirely contained within the LOD in all Build Alternatives. The wetland would be fully impacted for roadway widening and construction access purposes. Additionally, the wetland is isolated, less than 275 square feet in size, and currently has a degraded function. Creating a SWM facility in this location would improve water quality in this area by capturing and treating roadway runoff.

Waters 13S and 13T – Station 845+50 to 847+00 LT & RT (JPA Impact Plate 20)

Waters 13S is an intermittent channel and 13T is an intermittent ditch located in a manmade depression within interchange ramps. The features are completely within the LOD in all Build Alternatives and would be impacted by roadway construction and construction access. Since the waterway features are in a low landscape position that receives inputs from multiple culverts, they are already functioning as catchments for stormwater runoff. The channels are in poor condition, as seen during the July 18, 2019 agency field review meeting, and creating a SWM facility in this location would improve the overall hydrologic function of this area.

Wetland 9D – Station 1288+00 to 1289+00 LT (JPA Impact Plate 34)

Wetland 9D is a PFO located entirely within the LOD of all Build Alternatives in an exit ramp loop. The feature currently acts as a stormwater catchment and would be at least partially impacted by roadway fill and the construction of a culvert extension. Wetland 9D is currently degraded in quality, and if it were impacted during construction, would continue to be degraded. A SWM facility at this location would improve water quality in the nearby area by providing an adequate catchment for runoff.

Waters 8D, 8E_C, and 8E_D – Station 1338+50 1339+50 LT (JPA Impact Plate 36)

Waters 8D is an existing SWM facility that is proposed for expansion, and Waters 8E_C and 8E_D are adjacent intermittent ditches that would be impacted by roadway construction and the augmentation of an existing culvert. All three waterway features are located within interchange ramps and are connected to culverts capturing roadway runoff and would be impacted by all the Build Alternatives. Improving the existing SWM facility would improve the area's ability to filter roadway runoff before the water drains outside of the roadway footprint.

Waters 7Q_3 – Station 1351+00 to 1352+00 RT (JPA Impact Plate 36)

Waters 7Q_3 is a perennial ditch approximately 167 feet long located within interchange ramps in between two culverts. The feature is entirely within the LOD of all Build Alternatives, currently acts as a stormwater catchment, and its function is degraded by erosion, absence of vegetation, and poor water quality entering the feature. The area would be improved by constructing a SWM facility, because runoff would be treated before flowing outside of the roadway footprint.

Waters 6MM – Station 1539+00 to 1539+50 LT (JPA Impact Plate 43)

Waters 6MM is an ephemeral channel located within an interchange on-ramp. The feature is entirely within the LOD of all Build Alternatives and flows into waterway 6G, an unnamed tributary to the Upper Southwest Branch of the Western Branch of the Patuxent River (Upper Southwest Branch). Waters 6MM is degraded in function and would be partially impacted by a proposed SWM facility. Waters 6MM would benefit from this SWM facility because the channel would be repurposed as the inlet and outlet of the SWM facility. This would improve water quality input to the unnamed tributary.

Waters 5Y – Station 1549+00 to 1550+00 LT (JPA Impact Plate 44)

Waters 5Y is an ephemeral channel located entirely within the LOD of all Build Alternatives that would be partially impacted by a SWM facility. The feature is currently degraded and acts as a catchment for existing roadway runoff, between a wetland and a stormwater outfall. Similar to Waters 6MM, Waters 5YY would act as the inlet and outlet of the proposed SWM facility and benefit from the facility construction because of the improvement of outlet water quality.

3.3 Targeted Areas of Avoidance and Minimization

USACE, MDE, USFWS, MDNR, and Maryland National Capital Park and Planning Commission (M-NCPPC) requested a series of avoidance and minimization coordination meetings to focus on areas of particular concern within the corridor study boundary to ensure that avoidance and minimization measures were applied to the maximum extent practicable while still meeting the MLS purpose and need. Avoidance and minimization of the following resources is discussed in detail due to their close proximity to the roadway and the more specific reasons listed below:

- Rock Creek – Potential need to relocate portions of the stream;
- Thomas Branch – Potential need to culvert portions of the stream;
- Paint Branch – Potential need to bridge portions of the stream;
- The Northwest Branch of the Anacostia River (Northwest Branch) crossing – Need to replace bridge structures over the stream;
- The Potomac River crossing – Need to replace the American Legion Bridge (ALB) over the river; and
- Tributary of the Southwest Branch of the Western Branch of the Patuxent River (Southwest Branch) – Potential need to relocate portions of the stream and impact a large wetland complex.

3.3.1 Rock Creek

The Rock Creek mainstem, feature 19K, and its forested floodplain provide habitat for wildlife that is scarce in an otherwise urbanized area; are valued by the surrounding communities for recreation, parkland, and aesthetics; and provide greater functional benefits than many nearby waterway systems. The greater MDE 8-digit Rock Creek watershed (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 corridor study boundary falls within the Rock Creek MDE 12-digit watershed (021402060836), which is located entirely within Montgomery County and has a drainage area of 18 square miles (MDE, 2018). The Rock Creek watershed is located in the central portion of the corridor study boundary, roughly bound by MD 187 to the west and MD 97 to the east and is particularly degraded downstream of MD 28. Near 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 watershed is discussed in greater detail in the NRTR (**DEIS Appendix L, Section 2.4).**

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.

The portion of Rock Creek that flows within the study corridor is located within M-NCPPC parkland, with many park amenities located in its forested floodplain. MDE, USACE, MDNR, and USFWS consider Rock Creek a valuable resource and worked with the MLS Team to determine targeted avoidance and minimization options for Rock Creek and resources within its floodplain. As of June 2019, all Build Alternative LODs impacted approximately 3,700 LF of Rock Creek along two sections as follows:

1) the upstream section of Rock Creek, located along Beach Drive west of Cedar Lane, and
2) the downstream section of Rock Creek, located along Beach Drive between Jones Mill Road and Kensington Parkway.

Several coordination meetings were conducted to review the design options for the upstream and downstream sections to avoid and minimize natural resources impacts, while maintaining a constructible project. Based on agency comments and constructability needs, three options were considered for both sections of the stream:

Option 1: symmetrical on-center widening of the roadway and no stream relocation,

Option 2: symmetrical widening of the roadway and relocation of the stream (with a reduced amount of surface water elevation increase), or

Option 3: asymmetrical off-center widening of the roadway to maintain the current edge of pavement adjacent to the stream (avoid riparian area).

In the upstream section of Rock Creek, from approximate Station 483+00 to 493+00 (**JPA Impact Plate 11**), Option 1 was considered infeasible by two independent constructability analysis teams, determining that the stream diversion necessary to create a dry work area would not be effective and would result in inefficient and costly construction methods while still impacting the stream. Option 2 was not preferred due to significant environmental and parks impacts as a result of the stream relocation, including extensive impacts to both Rock Creek and the adjacent M-NCPPC-owned playground and trail. Option 3, which shifts the I-495 widening to the south and maintains the existing edge of pavement along the I-495 outer loop, would result in fewer wetland and stream impacts than Options 1 or 2 at this location. Option 3 would still result in some impacts to Rock Creek due to the stream diversion needed to construct an auxiliary pipe adjacent to the existing culvert west of the I-495 bridge over Cedar Lane to accommodate potential increases to surface water elevation and/or flooding risk. It was assumed that installation of the auxiliary pipe would be done using trenchless technologies that require sending and receiving pits at the upstream and downstream ends of the pipe. Due to the shifting of traffic and roadway to the inner loop, setup of the construction equipment to install the auxiliary pipe could be located within the existing shoulder and one existing lane of traffic. This would result in a smaller work area within the stream channel of Rock Creek. There is a sanitary sewer line that could be impacted by the trenchless technology pit located on the inner loop of the beltway, but it was determined that the relocation of this line would not impact any additional wetland or stream features. The team determined that by moving the roadway widening to the inner loop, no wetland impacts would be incurred on the inner loop side; however, there may be impacts to a tributary of Rock Creek during construction. Option 3 is included in the LOD of all Build Alternatives for this section because of the reduced impacts to wetlands, waterways, and park-owned land as well as construction feasibility.

In the downstream section of Rock Creek, from approximate Station 565+00 to 588+00 (**JPA Impact Plate 13**), the same three avoidance and minimization options were considered as were for the upstream section. The LOD was set at the top-of-bank of Rock Creek under Option 1, which would result in avoidance of impacts to the stream channel with a constrained work area. This option would require the use of a temporary barrier at the top of the stream bank during construction, e.g. Jersey barriers wrapped in plastic. Option 2 was not evaluated for the downstream section because Option 1 would avoid impacting Rock Creek, therefore consideration of relocation of Rock Creek was not necessary. Option 3 would result in greater wetland impacts overall in this section, increased and new impacts to private properties, and a significantly higher construction cost due to asymmetrical roadway widening along this bifurcated roadway segment. Since Option 1 resulted in avoidance of Rock Creek impacts, resulted in fewer wetland and private property impacts, and has a feasible method of construction at a reasonable cost, Option 1 is proposed for this section in all Build Alternative LODs.

In addition to analyzing the three options to reduce resource impacts, engineering revisions conducted as part of the avoidance and minimization process resulted in a narrowed roadway footprint along the downstream section of Rock Creek and included: revising the initial design for a two-lane exit ramp from the I-495 outer loop to MD 185 to a single lane exit ramp to match existing conditions; adding a retaining wall along the I-495 outer loop from approximately Station 492+00 to 588+00; and shifting proposed at-grade slip ramps to/from the managed lanes closer to the MD 185 interchange.

These selected design options and engineering revisions were implemented in the January 2020 LODs and result in decreased linear foot impacts to the Rock Creek mainstem. In addition, impacts to parkland and wetlands were reduced, as displayed in **Table 3-1.** Note that impacts to Rock Creek tributaries increased rather than decreased because of additional culvert or outfall augmentations and maintenance needs.

Table 3-1: Rock Creek Park Preliminary Environmental Impacts Comparison

Resource	June 2019[1] 2-Lane Alternative LOD	January 2020[2] Alternative 8, 9, 10, 13B, and 13C LODs	January 2020 Alternative 9M LOD
Parkland[3] (acres)	14.5 acres	3.7 acres	2.7 acres
Wetlands (acres)	1.1 acres	0.6 acres	0.35 acres
Rock Creek (linear feet)	3,717 linear feet	430 linear feet	414 linear feet
Tributaries (linear feet)	8,697 linear feet	9,683 linear feet	9,574 linear feet

Notes: 1 - June 2019 LOD and impacts was an update from the May Build Alternatives Paper to the Agencies and to the Public at the Spring 2019 Workshops. The June 2019 LOD represents an interim step in LOD development before targeted avoidance and minimization efforts began.
2 - January 2020 LOD reflects avoidance and minimization efforts in coordination with the agencies in July through December 2019 and additional tributary outfall repair impacts.
3 - Parkland impacts reflect the preliminary totals to Rock Creek Stream Valley Park, Units 2 and 3 (the only units adjacent to the study corridor).

3.3.2 Thomas Branch

The Thomas Branch mainstem, features 21C and 23A, is located in the Cabin John Creek MDE 12-digit watershed (021402070841), which 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 Cabin John Creek watershed drains approximately 26 square miles, entirely within Montgomery County (MDE, 2018). Of the major tributaries to Cabin John Creek, Bogley Branch, Old Farm Creek, Thomas Branch, and Booze Creek intersect the corridor study boundary. All streams within the Cabin John Creek watershed are classified as Use I-P waters (MDE, 2012). The Cabin John Creek watershed is discussed in detail in the NRTR (**DEIS Appendix L, Section 2.4**).

The Thomas Branch mainstem was assessed and delineated from River Road (MD 190) to just North of Democracy Boulevard (**JPA Impact Plates 5 through 8 and 59**). The entire headwaters of the stream are contained in a stormwater pond located just outside of the corridor study boundary, northeast of the I-270 west spur interchange at Democracy Boulevard. 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 fish 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. Thomas Branch has a limited functional value due to prior impacts, previous realignment, and a constrained channel environment.

Thomas Branch flows south from Democracy Boulevard, along the west side of the I-270 west spur and then along I-495 to River Road where it enters Cabin John Creek. Due to its proximity to the existing roadway and the surrounding steeply sloped topography, significant impacts to Thomas Branch could not be avoided or minimized, as relocation is not an option. Each impacted section of Thomas Branch is discussed as it flows south through the project area.

In the vicinity of Democracy Boulevard, Thomas Branch flows south under I-270 and Democracy Boulevard in a 96-inch structural plate pipe (SPP) at approximate Station 3745+00 (**JPA Impact Plate 59**), continues as open channel immediately west of I-270, and then flows south under the entrance ramp from Democracy Boulevard to southbound I-270 (**JPA Impact Plate 59**). The culvert ends near Station 3760+00. Thomas Branch continues south as an open channel immediately west of I-270 for approximately 150 feet before heading west and out of the LOD. In this section of Thomas Branch, the existing culverts must be extended to accommodate relocation of the interchange ramps and mainline widening. Some open channel sections of Thomas Branch must be placed in culvert due to the proximity of the channel to the roadway.

Thomas Branch reenters the LOD near Station 3775+00 LT (**JPA Impact Plate 8**) and flows south along the west side of the I-270 spur and along the outer loop of I-495 for approximately 5,300 feet. In this section, to accommodate widening for additional lanes, a significant portion of Thomas Branch would be placed in culvert. Thomas Branch would remain an open channel for 1,200 feet along the I-270 Spur, then it would be placed in culvert for approximately 2,600 feet from approximately Station 307+00 to Station 278+00 (**JPA Impact Plates 6 & 7**) along I-495 before it could be daylighted for another 1,500 feet. Near Station 269+00, Thomas Branch enters a culvert for approximately 216 feet to account for a tight LOD and steep slopes. Around Station 263+00 (**JPA Impact Plate 6**), Thomas Branch flows under I-495 in a 12-foot-by-9-foot reinforced concrete (RC) box culvert. The existing culvert would be extended and an auxiliary culvert would need to be installed due to the widened roadway. Thomas Branch continues south along the east side of I-495 for 2,100 feet. The first 162 feet would be placed into a culvert at Station 260+00 and the remaining length would be a daylighted channel, relocated due to the adjacent roadway widening.

Around Station 239+00 (**JPA Impact Plate 5**), Thomas Branch flows under I-495 in a 12-foot-by-9-foot RC box culvert. The existing culvert would be extended and an auxiliary culvert would need to be installed due to the roadway widening. On the west side of I-495, Thomas Branch continues to flow south as an open channel for 700 feet before turning west and leaving the LOD. Approximately 400 feet of this open channel section would be placed in a box culvert to accommodate roadway widening. Thomas Branch reenters the LOD to flow south under River Road at Station 224+00 LT (**JPA Impact Plate 5**) in a 12-foot-by-9-foot RC box culvert. This culvert would not need to be extended, but an auxiliary culvert would need to be installed to accommodate potential increases to surface water elevation and/or flooding risk under the proposed roadway improvements.

The impacts for the mainstem of Thomas Branch are shown in **Table 3-2** below.

Table 3-2: Impact to Thomas Branch in Linear Feet

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 Alternative 8, 9, 9M, and 13B LODs	January 2020 Alternative 10 and 13C LODs
21C	5,588	5,539	5,547
21C_1	2,140	2,133	2,133
21C_2	722	896	896
21C_C	252	252	252
21C_C1	322	321	321
21C_C2	313	328	328
23A	23	44	44
23A_1	453	148	148
23A_2	199	200	200
23A_3	1,568	1,130	1,220
23A_C	216	216	216
23A_C1	406	407	407
23A_C2	240	236	236
Total	**12,442**	**11,850**	**11,948**

3.3.3 Paint Branch

The Paint Branch MDE 12-digit watershed (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 (**JPA Impact Plates 23 and 24**). The Paint Branch mainstem, feature 12II, 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 Paint Branch MDE 12-digit watershed drains approximately 18 square miles (MDE, 2018), and the greater Paint Branch MDE 8-digit 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 located in Prince George's County. The Paint Branch MDE 12-digit watershed is discussed in greater detail in the NRTR (**DEIS Appendix L, Section 2.4**).

The Paint Branch mainstem crosses the corridor study boundary at the I-495/I-95 interchange and provides significant function and value within the corridor study boundary. MDE, USACE, MDNR, and USFWS consider Paint Branch a valuable resource and worked with the study team to determine targeted avoidance and minimization options for Paint Branch and resources within its floodplain. Paint Branch is approximately 30 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. The mainstem of Paint Branch meanders south through the I-95 interchange with I-495 and flows through several box culverts and under several bridges. Addition of managed lane ramps and reconfiguration of the existing ramps at the I-95 interchange would occur under all Build Alternatives.

Four new ramp improvements are proposed within the I-95/I-495 interchange as part of the design concept. To avoid impacts to the Paint Branch mainstem and its associated wetlands, several areas within the I-95 and I-495 interchange were excluded from the LOD. Where the Paint Branch mainstem could not be avoided, impacts will be minimized by constructing bridges at all new crossings of Paint Branch and prohibiting new piers within the banks of Paint Branch. The impacts to the Paint Branch mainstem are shown in **Table 3-3** below.

Table 3-3: Impact to Paint Branch Mainstem in Linear Feet

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
12II	364	131
12II_1	387	-
12II_2	351	-
12II_3	413	-
12II_4	1,068	464
12II_5	287	286
12II_6	151	6
12II_7	32	-
12II_8	-	-
12II_B	45	-
12II_B1	44	-
12II_B2	31	-
12II_B3	45	46
12II_C	241	174
12II_C1	97	79
12II_C2	120	90
12II_C3	154	159
Total	**3,828**	**1,435**

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

3.3.4 Northwest Branch Crossing

The Northwest Branch MDE 12-digit watershed (021402050818) is located in the central portion of the corridor study boundary, between MD 193 to the west and MD 650 to the east (**JPA Impact Plate 19**). 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 Northwest Branch watershed drains approximately 25 square miles, which includes a small component drainage area in Washington, DC (MDE, 2018). The entire Northwest Branch watershed upstream of MD 410 (East-West Highway) is designated as Use IV recreational trout waters. The Northwest Branch watershed is discussed in more detail in the NRTR (**DEIS Appendix L, Section 2.4**).

The Northwest Branch mainstem, feature 13P, is located deep within a steep stream valley and flows south under a pair of bridges carrying I-495 approximately 140 feet above the stream channel elevation. Northwest Branch provides significant function and value in this area of the MLS. The existing I-495 bridges over Northwest Branch are dual, multi-span deck truss bridges that would be replaced with new wider structures along the same alignment and at the same elevation. Remaining on the existing alignment limits impacts to mature forest, and parkland both north and south of the existing structure and alternative alignments were not considered due to the obvious increase in impacts to natural resources and potential impacts to communities and private property. The proposed replacement bridges are anticipated to be three span multi-girder bridges, with tall multi-column piers, approximately 120 to 130 feet tall that would be founded beneath the Northwest Branch stream invert. The center span of the bridges would completely span Northwest Branch and the impact of the slightly wider bridge structures on Northwest Branch would be negligible due to the height of the structures over the stream; however, potential impacts related to demolition of the existing structures and construction of the new structures could be significant and are the focus of the avoidance and minimization efforts in this area. The impacts to the Northwest Branch crossing are shown in **Table 3-4** below. Note that impacts were calculated within the LOD between Station 794+00 to 802+00. Impacts increased rather than decreased because preliminary analysis of the area determined that a larger area would be needed to feasibly demolish the old bridge and construct the new bridge.

Table 3-4: Impact to Northwest Branch Crossing

Resource	July 2018 2-Lane Alternative LOD	January 2020 Alternative 8, 9, 9M, 10, 13B, and 13C LODs	January 2020 Alternative 9M LOD
Northwest Branch (linear feet)	318	483	469
Tributaries (linear feet)	774	794	741
Parkland (acres)	3.34	7	6.83

Removal and deconstruction of these two multi-span deck truss bridges while maintaining traffic would be challenging. Demolition of one structure using explosives would not be possible due to traffic on the adjacent span and the resulting impacts to Northwest Branch and surrounding parkland. Thus, the bridges must be deconstructed, and since the deck truss cannot be safely deconstructed in place without significant temporary shoring towers and additional impacts, each span of each structure must be lowered to the ground and disassembled. This process would require cranes located in the stream valley on either side of Northwest Branch and temporary construction access over Northwest Branch. Another construction challenge is the ability to access the work area in the stream valley with bridge embankment slopes approaching 1:1 and steep valley slopes. Construction access into the stream valley, across Northwest Branch, and out of the stream valley would require switchbacks down to Northwest Branch, an anchored temporary bridge installed over Northwest Branch, and switchbacks up the opposite valley slope. Optimal construction access would include this type of access on both the north and south sides of I-495. However, to minimize impacts to Northwest Branch, tributaries to Northwest Branch, and Northwest Branch Stream Valley Park, access would be limited to the south side of I-495. This side of I-495 was selected because access would have fewer impacts to tributaries of Northwest Branch. The temporary bridge over Northwest Branch would need to be about 45-foot-wide-by-105-foot long at an elevation of about 140 feet (bottom of temporary structure). The LOD near Northwest Branch is the minimum area required to deconstruct the existing bridges and construct the new bridges, minimizing impacts to natural resources.

3.3.5 Potomac River Crossing

The Potomac River/Rock Run MDE 12-digit watershed (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, including Chesapeake and Ohio (C&O) NPS land. The Rock Run watershed drains an area of 15 square miles, entirely within Montgomery County (MDE, 2018). Within the vicinity of the MLS corridor study boundary, Rock Run and several unnamed tributaries drain into the C&O Canal or directly into the Potomac River near the head of tide. 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). The Rock Run Watershed is discussed in more detail in the NRTR (**DEIS Appendix L, Section 2.4**).

The Potomac River mainstem, feature 22MM, provides significant function and value within the MLS corridor. MDE, USACE, MDNR, and USFWS consider the Potomac River a valuable resource and worked with the study team to determine targeted avoidance and minimization options for the Potomac River and resources within its floodplain.

The ALB carries I-495 over the Potomac River between Maryland and Virginia approximately 100 feet above the water surface (**JPA Impact Plate 2**). This structure would be replaced as part of the MLS and replacement was assumed for all Build Alternatives. The existing ALB would be replaced with dual structures carrying each direction of traffic. Each structure would carry four general purpose lanes, a general purpose auxiliary lane, two managed lanes, and a managed auxiliary lane. The general purpose auxiliary lanes are required to provide access to and from the Clara Barton Parkway and the George Washington Memorial Parkway. The managed auxiliary lanes are required to provide direct access for the managed lanes to and from the George Washington Memorial Parkway. There is no managed lanes direct access proposed at the Clara Barton Parkway. The inner loop structure would also carry a shared-use path connecting the C&O Canal and George Washington Memorial Parkway National Park Service properties in Virginia and Maryland.

The existing ALB alignment is highly constrained by the 4(f) resources, high-quality natural resources, and a residential community immediately adjacent to both sides of the structure and approach roadways. Constraining 4(f) resources include George Washington Memorial Parkway, C&O Canal National Historic Park, and Clara Barton Parkway. Shifting the ALB off-alignment would result in increased impacts to 4(f) resources and would also impact larger portions of the high-quality resources surrounding the current alignment. A bedrock outcrop on the Potomac River shoreline in Maryland and a large hill on the Potomac River shoreline in Virginia provide barriers to shifting the alignment to the south without extensive grading. A residential community immediately north of the alignment in Virginia and the Naval Surface Warfare Center Carderock Division prevent shifting the alignment to the north. As a result of the constraints adjacent to the alignment and coordination with 4(f) properties, the proposed ALB would remain generally on-alignment and would be widened to accommodate additional travel lanes. The impact of the wider bridge structures on the Potomac River, tributaries to the Potomac River, and associated wetlands would be minimal due to the heights of these structures over these features; however, impacts associated with construction access for these new structures would be significant and were the focus of avoidance and minimization in this area.

Construction access for this bridge is particularly challenging because of the bridge's height; the steep grades on each river bank; the bridge's location within sensitive parkland; the amount of material required to be removed from the existing structures and brought in to build the new structures; and the bridge location over the Potomac River. Access from the Maryland side of the bridge would be from Clara Barton Parkway (**JPA Impact Plate 3**) using temporary crossings over the C&O Canal and access roads south of the towpath, including bump-outs to accommodate turning radii of construction vehicles, and switchbacks to lessen the steep grades. Access from the Virginia side of the bridge would be from the south side of I-495 and would require switchbacks to lessen the steep grades. The proposed access locations were selected by NPS from three potential options. The proposed access would minimize fill placement and tree clearing required to safely move construction equipment and materials to the edge of the river. Access roads would need to accommodate two-way construction traffic and crane staging areas would need to accommodate 500- to 600-ton cranes as well as room for construction vehicles to pass. Construction access needs limit the amount of avoidance and minimization that could be implemented at this location. The proposed bridge replacement would require special permit conditions indicating precise existing structural removal requirements and construction methods to reduce impacts to the Potomac River.

To provide bridge construction access, a trestle structure would be built along with a causeway outside of the proposed structures in each of the four quadrants of the bridge to allow for the use of equipment and cranes to construct the new structures while maintaining travel lanes on the existing structures. The trestles would be supported on driven piles, and the causeways would have pipes for flood relief. Finger trestles and causeways would project from the main trestles and causeways toward the centers of the structures to provide pier construction access. Upon completion of the proposed structure outside of the existing structures, travel lanes would be switched to the outside, the existing structure would be demolished, and the interior portions of the proposed structure would be constructed.

It is anticipated that the replacement span lengths would be similar to the existing span lengths of approximately 165 feet for the northern approach spans; 210 feet, 280 feet, and 210 feet for the main spans; and 100 feet for the southern approach spans. The span lengths could be adjusted based on the selected design. The design would likely maximize the span lengths to minimize the number of piers necessary, but would still need to work within the geometric constraints for the access. The complete replacement of the ALB would likely take four to five years.

For removal of the existing bridge, demolition shields would be installed beneath the superstructures to minimize the amount of material dropping into the Potomac River. Partial saw cuts of the bridge deck slabs would likely be made to minimize both the amount of slurry produced and the amount of material falling on the shields. Parapet and deck slab pieces would be hauled off using the undemolished portions of the existing structure. Girder sections would be lowered by cranes to the trestle and causeway level. Since these pieces would be too large to transport for removal directly by a truck, flexi-float barges would be needed as an intermediary staging point. During construction, these barges could be used for tying rebar and setting the forms for the replacement bridge piers. Proposed barge placement requires additional areas of the Potomac River to be included in all Build Alternative LODs.

The intermittent channel currently flowing from a wetland west of the ALB to the east under the ALB, feature 22NN, would require relocation. However, the auxiliary channel of the Potomac River that flows around Plummers Island, near the northeast quadrant of the bridge, cannot be feasibly relocated. The existing channel flow adjacent to the bridge would be maintained with a temporary pipe placed within fill for the construction causeway located over the channel. Causeway fill would be retained along the Potomac River bank with gabion walls. This construction approach provides construction access, allows flow during construction, and ensures fill retention during flood events. The channel could then be restored upon completion of bridge construction in this area. The minimized impacts to wetlands, their buffers, and waterways within the National Park Service C&O Canal Parkland (**JPA Impact Plates 1-2**), surrounding the Potomac River, are included in

Table 3-5 below. The impact calculation includes features within the LOD on NPS property in MD and VA. Impacts increased in January 2020 LODs because additional area would be needed for access by flexi-float barges and existing culverts were added to the tributary impacts.

Table 3-5: Impact to Potomac River Crossing

Resource	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
Potomac River (LF)	869	1,163
Tributaries (LF)	1,144	1,688
Wetlands (AC)	1.33	0.69
Wetland Buffers (AC)	1.30	1.00

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

3.3.6 Tributary to Southwest Branch

Southwest Branch refers to the Southwest Branch of the Western Branch of the Patuxent River and joins the Western Branch of the Patuxent east of Largo, Maryland, before flowing into the Patuxent River mainstem in Upper Marlboro, Maryland. The Upper Southwest Branch MDE 12-digit watershed (021311030924) has a drainage area of 11 square miles (MDE, 2018) and is located within the mid-western section of the MDE 8-digit Western Branch (Patuxent River) watershed. The Upper Southwest Branch watershed is located within the southeastern portion of the corridor study boundary, approximately spanning the area south of MD 202 to north of MD 214 (**JPA Impact Plates 41 through 44**). The Upper Southwest Branch watershed is heavily urbanized, but the northern portion of the Upper Southwest Branch watershed near MD 214 has the least degraded habitat relative to other areas of the watershed. The northern portion of the watershed is within the corridor study boundary. Further information about the overall watershed is included in the NRTR (**DEIS Appendix L, Section 2.4**).

An unnamed tributary to the Southwest Branch mainstem, feature 6G, runs along the east side of I-495 from the MD 202 interchange to its convergence with the Southwest Branch mainstem south of MD 214. The unnamed tributary is relatively well-connected to its floodplain and associated wetlands north of Arena Drive, but relatively incised and disconnected from adjacent wetlands south of Arena Drive. The unnamed tributary and associated wetlands north of Arena Drive are adjacent to the existing roadway embankment, and the wetlands provide significant function and value to the surrounding area.

Avoidance and minimization efforts in the Southwest Branch area focused on the unnamed tributary to Southwest Branch and associated wetlands because of the importance of this area to its watershed and concerns regarding the initially proposed impacts by the July 2018 LODs to both the channel and its wetland complex. The MLS Team reviewed the design options in the vicinity of the tributary to Southwest Branch north of Arena Drive to limit impact to the stream channel and its associated wetland complex.

The MLS Team considered multiple design elements when determining avoidance and minimization techniques, including: retaining wall construction; the presence of an 84-inch water main along the west side of I-495; the potential relocation of the unnamed tributary and its proximity to the 84-inch water main; reconfiguration of the roadway travel lanes; and managed lane direct access ramp locations. The design that informed the July 2018 LOD included direct access ramps to and from the managed lanes at the MD 202 interchange, resulting in a wide roadway footprint, and included construction of a retaining wall along the outside edge of the shoulder along the I-495 outer loop. Even with the addition of a retaining wall in this location, the roadway impacts resulting from the July 2018 LOD would require relocation of the channel into the adjacent wetland, impacting valuable natural resources and potentially impacting an 84-inch water main.

The potential modifications to narrow the roadway footprint evaluated by the MLS team included: elimination of the managed lane direct access ramps at MD 202 to/from the south; asymmetrical roadway widening toward the I-495 inner loop; elimination of the collector-distributor (C-D) system along this portion of I-495, resulting in removal of a four-foot striped buffer; and reconfiguration of the exit ramp from the I-495 outer loop to MD 202 to a loop ramp in the northeast quadrant, thus allowing for elimination of the auxiliary lane along the I-495 outer loop between the Arena Drive and MD 202 interchanges. A combination of these design modifications was adopted to narrow the roadway footprint of the Build Alternatives, including: shifting the proposed roadway alignment 11 feet west of the existing alignment, resulting in less widening along the channel; eliminating the direct access ramps to/from the south at the MD 202 interchange and relocating the ramps to the I-495 interchange at MD 214; and maintaining construction of the retaining wall along the widened I-495 outer loop. The design modifications to eliminate the C-D system or reconfigure the exit ramp were not selected as feasible engineering solutions because the preliminary traffic analysis results indicated that maintenance of these access elements is preferred for traffic operations. The offset to the LOD behind the proposed retaining wall along the I-495 outer loop includes 20 feet for a dry work area, as determined by the constructability team, and 15 feet for diversion of the tributary channel during construction. While this effort did not result in total avoidance of impacts, the amount of impacts to the tributary to Southwest Branch and its associated wetlands north of Arena Drive are reduced compared to the July 2018 LOD.

The impacts associated with the tributary to Southwest Branch, its associated wetland complex, and the Southwest Branch mainstem, feature 5S, are shown in **Table 3-6** below. Note that impacts to the Southwest Branch mainstem increased rather than decreased because a review of the preliminary design determined that additional construction access space, including dewatering for a dry work area, would be necessary behind the retaining walls in this area.

Table 3-6: Impacts Associated with Southwest Branch

Resource	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
Southwest Branch Mainstem	344	390
Tributary to SW Branch	6,105	4,556
Wetlands[2] (AC)	3.21	1.42
Wetlands North of Arena Dr (AC)	2.59	0.75
Wetland Buffers (AC)	6.14	4.43

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

2 - This represents the impact to wetlands within the LOD adjacent to the tributary to SW Branch and mainstem SW Branch from south of MD 202 to just south of MD 214.

3.3.7 Other Major Stream Crossings

Major stream crossings were examined to determine the potential for impact reduction. Stream crossings within the MLS Build Alternative LODs that were shown as blue line streams on the USGS National Hydrography Dataset (NHD) layer and had a drainage area greater than 1.5 square miles were included in this report as "major stream crossings." Some of these crossings required extensive investigation and are documented in the previous sections, while the remaining major stream crossings are discussed below. Proposed construction activities and impacts at these stream crossings vary widely, ranging from existing culverts that do not require modification to full bridge replacements. Likewise, the opportunity for impact reduction varies significantly.

A. Augmented/Auxiliary Culverts

One element that contributes to the LOD required for major stream crossings is the potential need for capacity augmentation/auxiliary culverts to accommodate potential increases in surface water elevation and reduce flood risk. Culverts were evaluated throughout the study corridor to determine flood risk potential and auxiliary culverts, additional culvert pipes running alongside the existing culverts, are proposed in those areas where flood risk potential was identified.

MDE regulates surface water elevation increases for construction projects that would result in increased risk of flooding to adjacent properties, prohibiting such changes unless the areas at risk of flooding are purchased, placed in designated flood easement, or addressed by other means acceptable to MDE (COMAR 26.17.04.11 B(6)). A preliminary analysis was conducted within the MLS corridor of all hydraulic structures and culverts with a diameter greater than three feet or those less than three feet that appeared as if they may create hydraulic trespass on properties not owned by MDOT SHA.

Each culvert was evaluated using HY-8 software to determine the capacity at the existing crossing and the likelihood of overtopping the roadway in the 100-year proposed conditions storm. Culverts were also analyzed for potential headwater increases above the 0.1-foot maximum allowable increase from existing to proposed conditions that result in hydraulic trespass to properties that MDOT SHA does not own. Where either of these two potential risks were present, estimated overtopping in the 100-year proposed condition or potential headwater increases above the 0.1-foot maximum allowable increase, an auxiliary culvert was added to the proposed design.

Augmented culverts have been proposed in areas where the proposed pavement width is narrower than existing pavement. This may be counterintuitive, but these culverts either do not convey the 100-year storm flow without overtopping or do not meet current MD 378 regulations. Even if these culverts would not require construction of an auxiliary culvert to prevent overtopping, additional work may need to be performed at the upstream and downstream ends of the culvert to comply with MD 378 regulations (e.g. slip line the pipe or add filter diaphragm), requiring LOD bump outs. Additional LOD may also be required for erosion and sediment control and maintenance of streamflow.

B. Aquatic Life Passage

Another element influencing the LOD at major stream crossings is the need to ensure aquatic life passage. Aquatic life passage priority in Maryland is focused on large streams with large drainage areas and culverts with a length of 150-feet or less. COMAR states that "the length of culverts shall be limited to a maximum of 150 feet unless it can be demonstrated through an environmental study that any adverse impacts will be adequately mitigated (COMAR 26.17.04.06 (B(3))." These aquatic life passage priorities are based on the fact that culvert lengths greater than 150-feet are not likely to be crossed by many aquatic species, since longer culverts require fish to maintain speed for extended periods of time and many species are dissuaded by the darkness created by very long culverts (Bates et al., 2003, Robison et al., 1999, and Weaver et al., 1976).

Currently, most of the culverts within the project area are longer than 300-feet and have limited potential for aquatic life passage, however, aquatic life passage will be ensured at appropriate crossings. To identify aquatic life passage needs, the MLS Team is conducting a preliminary assessment of aquatic life passage priority areas. The Team is starting with the Chesapeake Fish Passage Prioritization web tool to identify priority locations and is including culverts less than 150-feet long and culverts greater than 150-feet long that carry larger streams with large drainage areas. The smallest drainage area associated with culverts in this analysis is 132 acres. Aquatic life passage design elements, at appropriate locations, will be incorporated into the RPA as design is advanced.

C. Additional Stream Crossings

Rock Run, feature 22M, flows south under the Clara Barton Parkway, C&O Canal, and the C&O Canal Towpath west of I-495. Rock Run flows through a two-span 10-foot-by-10-foot RC box culvert located at Station 114+00 LT (**JPA Impact Plate 2**). This structure is not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required. Since the Rock Run culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible at this feature location. The LODs for all Build Alternatives near Rock Run include areas necessary to allow access to construct the ALB over the Potomac River. The impact to Rock Run is shown in **Table 3-7** below. Note that impacts to this feature increased rather than decreased because it was determined that additional area would be needed for ALB construction and an additional segment of 22M was delineated after July 2018.

Table 3-7: Impact to Rock Run

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
22M	27 LF	95 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Booze Creek, feature 22Z, flows south under Cabin John Parkway south of the I-495 and Cabin John Parkway interchange. The existing structure over Booze Creek flows through a three-cell 14-foot-by-9-foot RC box culvert located at Station 196+00 to 201+00 RT (**JPA Impact Plate 4**). This structure is not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required in this location. Since the Booze Creek culvert is not proposed for replacement or extension, no targeted avoidance or minimization is possible in this location. The LODs for all Build Alternatives near Booze Creek include construction access areas. The impact to Booze Creek is shown in **Table 3-8** below. Note that impacts to this feature increased rather than decreased because construction access needs were assessed after the July 2018 LOD was established and the needs around feature 22Z were not included in the July 2018 2-Lane Alternative LOD.

Table 3-8: Impact to Booze Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
22Z	0 LF	150 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Cabin John Creek, feature 22AA, flows south under the ramp from Cabin John Parkway to southbound I-495, and under I-495, between Seven Locks Road and Cabin John Parkway. The existing ramp structure is a four-span steel beam bridge, and the structure carrying I-495 is a five-span steel beam bridge, both located near Station 199+00 (**JPA Impact Plate 4**). Reconfiguration of the I-495 and Cabin John Parkway interchange would require removal of these existing structures. Reconfigured I-495 and ramp crossings of Cabin John Creek would be on new bridge structures. Bridge design specifics, including under-clearance to the waterway, pier location, and span distance over the waterway would be determined during final design. Since bridge design details are unknown, additional avoidance and minimization other than what has been included in the preliminary design is not possible in this location at this time. The LOD for all Build Alternatives near Cabin John Creek includes area to remove existing structures and construct the new bridges. The impact to Cabin John Creek is shown in **Table 3-9** below.

Table 3-9: Impact to Cabin John Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
22AA	1,151 LF	630 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Sligo Creek, feature 15D, flows south under I-495 just west of Sligo Creek Parkway. Sligo Creek flows through a two-cell 14-foot-by-8-foot RC box culvert located at Station 685+00 RT and LT (**JPA Impact Plate 16**). This structure is not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required in this location. Since the Sligo Creek culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LOD for all Build Alternatives near Sligo Creek includes construction access areas. The impact to Sligo Creek is shown in **Table 3-10** below.

Table 3-10: Impact to Sligo Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 Alternative 8, 9, 10, 13B, and 13C LODs	January 2020 Alternative 9M LOD
15D	549 LF	307 LF	278 LF

Little Paint Branch, feature 12OO, flows south under I-495 west of the US-1 interchange. The existing Little Paint Branch structure is a four-cell 14-foot-by-10-foot RC box culvert located at Station 976+00 RT and LT (**JPA Impact Plate 25**). This structure is not proposed for replacement as part of the MLS but would require extension to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation may be required to maintain headwater depths. Since retaining walls have been proposed to limit impacts along Little Paint Branch and adjacent wetlands, no targeted avoidance or minimization is possible in this location (i.e., the 5th step of the corridor-wide avoidance and minimization steps are proposed in this location). The LOD for all Build Alternatives near Little Paint Branch includes the expanded culvert and area necessary to allow augmentation. The impact to Little Paint Branch is shown in **Table 3-11** below. Note that impacts to this feature increased rather than decreased because it was determined that a culvert extension would be required to accommodate the roadway widening in this area.

Table 3-11: Impact to Little Paint Branch

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
12OO	379 LF	425 LF

1 - Alternatives 8, 9, 9M 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Indian Creek, feature 11L, flows southwest under I-495 northwest of Cherrywood Lane. Indian Creek flows through a four-cell 17-foot-by-12-foot RC box culvert under the outer loop of I-495 and then through a four-cell 17-foot-by-12-foot RC box culvert under the inner loop of I-495 at Station 1071+00 (**JPA Impact Plate 27**). This structure is not proposed for replacement as part of the MLS, but would require extension to accommodate roadway widening and direct access ramps. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required. A retaining wall has been proposed to limit impacts to wetlands northeast of I-495, but impacts cannot be avoided further while accommodating the managed lane direct access ramps and widening for managed lanes in the median of I-495. The LODs for all Build Alternatives near Indian Creek include the expanded culvert and area necessary for augmentation. The impact to Indian Creek is shown in

Table 3-12 below.

Table 3-12: Impact to Indian Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
11L	491 LF	464 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

An unnamed tributary to Northeast Branch, feature 10TT, flows west under I-295 south of the intersection of I-295 and I-495 (**JPA Impact Plate 30**) at Station 1172+50 RT. The structure is not proposed for replacement as part of the MLS and would not require extension to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required in this location. Since the unnamed tributary to Northeast Branch culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LOD for all Build Alternatives near the unnamed tributary to Northeast Branch includes minor road widening of southbound Baltimore Washington Parkway. The impact to the unnamed tributary to Northeast Branch is shown in **Table 3-13** below.

Table 3-13: Impact to unnamed tributary to Northeast Branch

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
10TT	72 LF	67 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Henson Creek, feature 1VV, flows south under I-495 west of Branch Avenue (MD 5). Henson Creek flows through a three-cell 15-foot by 10-foot RC box culvert located at Station 1973+50 to 1974+00 RT and LT (**JPA Impact Plate 57**). This structure is not proposed for replacement as part of the MLS and would not require extension to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required in this location. Since the Henson Creek culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LOD for all Build Alternatives near Henson Creek includes construction access and channel relocation areas. The impact to Henson Creek is shown in **Table 3-14** below.

Table 3-14: Impact to Henson Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
1VV	424 LF	385 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Cabin John Creek, feature 24F, flows south under Montrose Road just east of the I-270 and Montrose Road interchange through a single cell 16-foot by 8-foot box culvert from Station 3615+00 to 3617+50 LT, and then flows west under I-270 through a single cell 16-foot by 8-foot box culvert at Station 3627+00 (**JPA Impact Plate 65**). The Montrose Road structure is not proposed for replacement as part of the MLS and would not require extension to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation would not be required in this location. The I-270 structure is not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation may be required to maintain headwater depths. Since the Cabin John Creek culverts are not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LOD for all Build Alternatives near Cabin John Creek at Montrose Road includes area for maintenance of traffic and the LODs for all Build Alternatives near Cabin John Creek at I-270 include area necessary to allow for culvert augmentation. The impact to Cabin John Creek is shown in **Table 3-15** below. Note that impacts to this feature increased rather than decreased because it was determined that a culvert augmentation would be required to accommodate likely increased flood flow in this area.

Table 3-15: Impact to Cabin John Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
24F	657 LF	1,149 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Muddy Branch, feature 29B, flows west under I-270 just north of the I-370 interchange. The existing Muddy Branch structure is a 120-inch corrugated metal pipe (CMP) culvert located at Station 3328+00 RT and LT (**JPA Impact Plate 71**). This structure is not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation may be required to maintain headwater depths. Since the Muddy Branch culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LOD for all Build Alternatives near Muddy Branch includes area necessary to allow for culvert augmentation. The impact to Muddy Branch is shown in **Table 3-16** below. Note that impacts to this feature increased rather than decreased because it was determined that a culvert augmentation would be required to accommodate likely increased flood flow in this area.

Table 3-16: Impact to Muddy Branch

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
29B	335 LF	553 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

Watts Branch, feature 27A, flows southwest under I-270 and under West Montgomery Avenue (MD 28) on the north side of the I-270 and West Montgomery Avenue interchange. Watts Branch flows through a 25-foot-by-8-foot RC box culvert under I-270 at Station 3479+00 RT and LT (**JPA Impact Plate 69**). Watts Branch flows through a 25-foot-by-8-foot RC box culvert under West Montgomery Avenue. These structures are not proposed for replacement as part of the MLS and would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation may be required to maintain headwater depths. Since the Watts Branch culverts are not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LODs for all Build Alternatives near Watts Branch include areas necessary to allow for augmentation. The impact to Watts Branch is shown in **Table 3-17** below.

Table 3-17: Impact to Watts Branch

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 Alternative 8, 9, 10, and 13B LODs	January 2020 Alternative 9M LOD	January 2020 Alternative 13C LOD
27A	1,348 LF	718 LF	739 LF	737 LF

Old Farm Creek, feature 24A, flows west under I-270 on the north side of I-270 over Tuckerman Lane. Old Farm Creek flows through a 20-foot-by-10-foot RC box culvert under I-270 at Station 3683+00 (**JPA Impact Plate 63**). This culvert would not need to be extended to accommodate roadway widening. Preliminary hydrology and hydraulic estimates indicate that capacity augmentation may be required to maintain headwater depths. Since the Old Farm Creek culvert is not proposed for extension or replacement, no targeted avoidance or minimization is possible in this location. The LODs for all Build Alternatives near Old Farm Creek include areas necessary to allow for culvert augmentation. The impact to Old Farm Creek is shown in **Table 3-18** below.

Table 3-18: Impact to Old Farm Creek

Segment (Feature ID)	July 2018 2-Lane Alternative LOD	January 2020 All Alternative LODs[1]
24A	755 LF	446 LF

1 - Alternatives 8, 9, 9M, 10, 13B, and 13C LODs result in the same impacts to this area of the MLS.

4

4 IMPACTS

All wetlands, their buffers, waterways, and FEMA 100-year floodplains were avoided and minimized to the greatest extent practicable **at this stage of the project**, resulting in a significant reduction of impacts. The MLS team computed the impact quantities for a 2-Lane Build Alternative in July 2018, and these quantities represent the impacts before avoidance and minimization techniques were applied. The total impacts of all Build Alternatives were calculated in January 2020, and these quantities represent the impacts after the application of avoidance and minimization techniques, including corridor-wide and targeted avoidance and minimization (**Table 4-1**). Note that impacts reported in the AMR are sum totals of all feature impacts regardless of jurisdiction (i.e., USACE and MDE jurisdictional wetlands and waterways are reported as a composite quantity). For totals of impacts by agency jurisdiction, please see the JPA Impact Tables.

Table 4-1: Comparison of 2-Lane "Worst Case" Alternative Pre-Avoidance and Minimization (A&M) to All Build Alternatives Post-A&M Impacts

Resources	Pre-A&M Impacts	Post-A&M Impacts				
	July 2018 2-Lane Alternative	Alternatives 8 & 9	Alternative 9M	Alternative 10	Alternative 13B	Alternative 13C
Waterways (LF)	168,534	152,708	152,015	153,744	152,623	153,392
Wetlands (AC)	38.10	16.34	16.08	16.52	16.31	16.48
Wetland Buffer (AC)	69.05	53.14	52.65	53.62	53.07	53.49
FEMA Floodplain (AC)	143.44	119.53	116.51	120.00	119.51	119.93

Despite the avoidance and minimization measures discussed previously, many impacts to wetlands, their buffers, waterways, and the FEMA 100-year floodplain were unavoidable. The rationales for each type of unavoidable impact were evaluated and are reported for each impacted feature by category in the JPA Impact Tables. The categories are general types of impacts that occur throughout the MLS corridor for all Build Alternatives and are used to present justifications of specific impacts.

4.1 Unavoidable Impacts

Unavoidable impacts result primarily from fill and structures used to support the widened roadway, new interchanges, and direct access ramps along with the construction access areas needed to complete construction. Channel relocation, SWM outfalls, and wetland hydrology loss also cause unavoidable impacts. One unique unavoidable impact results from the need to augment culverts and increase culvert capacity to prevent flood risk.

While most unavoidable impacts and the associated cause are apparent on the impact plates, tables and the DEIS resource mapping, some unavoidable impacts require additional explanation. Stormwater outfalls; wetlands experiencing hydrology loss; and unavoidable construction access areas are explained in tables in **Appendix A** by feature name. These and all other impacted features are included in the JPA Impact Tables with the applicable impact codes. Please see the *Draft Compensatory Mitigation Plan* (**DEIS Appendix N**) for details regarding the wetlands and waterway mitigation proposed to account for these unavoidable impacts.

4.2 Impact Types

Impacts were split into ten categories for reporting purposes. These categories were determined based on the most common design elements that would affect natural resources. The name of the impact category was selected to represent the main cause of impacts in the category; however, some ancillary elements may be included in these categories. If all impacts to a feature can be attributed to one impact code, then only that impact code is associated with that feature. If other impact types increase the area that a feature is impacted, then multiple codes are associated with the feature. For example, the culvert extension category requires construction access to properly construct the extension and headwall, but this is assumed to be part of the culvert extension category, and the construction access code would not be included for the impacted feature. The general description of each category is presented below.

4.2.1 Roadway

Roadway impacts include any impact resulting directly from the roadway widening such as grading, cut/fill, and standard offsets (i.e. 10-foot offset from the limit of cut/fill and 10- to 14-foot offset from the back of retaining walls to allow for access and erosion and sediment control measures). Roadway impacts were determined by design elements such as additional travel lanes, new direct access interchanges, and modified interchanges.

Features impacted by the roadway were assigned the code "RW." If all impacts to a feature were contained within the proposed roadway edge, cut/fill, and/or standard offsets, then that feature was only assigned the "RW" code. If the LOD was expanded or impacts were increased because of an impact type in addition to roadway, then the feature was assigned additional codes.

4.2.2 Existing Culvert

Channels classified as flowing within existing culverts or pipes inside the Build Alternative LODs are considered impacted. Existing culverts are located beneath roadways, so this impact type is considered a subset of roadway impacts. All existing culverts are assumed to be replaced in-kind or to remain in place unless augmentation of the culvert is apparent.

Since existing culverts are assumed to remain in place, it is also assumed that these segments of channels will maintain their existing function. All channels that flow within existing culverts were assigned the code "EC." These features were not assigned any additional impact codes, and the code was only applied to waterway features with the channel type classification "Culvert."

4.2.3 Existing Bridge

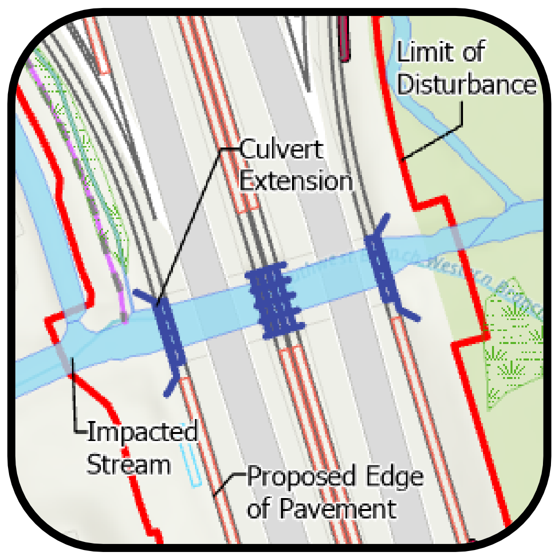
Jurisdictional features underneath existing bridges inside the Build Alternative LODs are considered impacted. Existing bridges are within the existing roadway footprint, so this impact type is considered a subset of roadway impacts. Existing bridges are assumed to remain in place unless the expansion or replacement of a bridge is apparent.

Features underneath existing bridges were assigned the code "EB." Channel features that are located under bridges were not assigned any other impact codes and instead were separated from the original feature and renamed with "_B" as a descriptor, e.g. 23K_B. Wetland features may have multiple codes in addition to "EB" if they are located under bridges. Since existing bridges are assumed to remain in place, it is assumed that the features categorized as impacted by "EB" will maintain their existing function.

4.2.4 New/Expanded Bridge

Jurisdictional features or portions of features that would be located under proposed new or expanded bridges are considered impacted. These impacts occur most commonly in direct access interchange and ramp additions. Since features below new or expanded bridges are within the proposed road edge, new or expanded bridge impacts are considered a subset of roadway impacts. Features underneath of new/expanded portions of bridges were assigned the code "NB," but may have multiple impact codes.

4.2.5 Culvert Extension

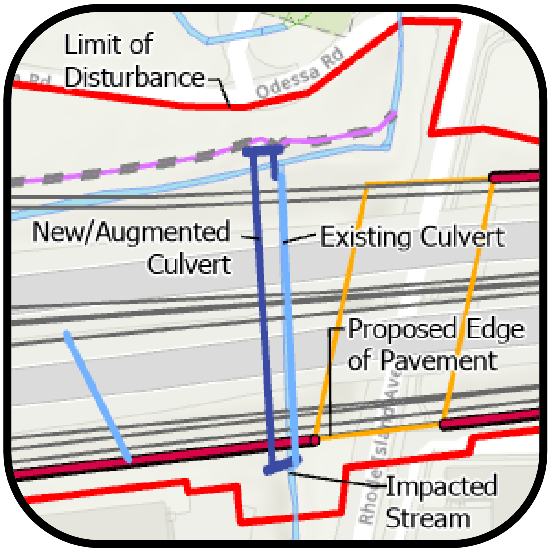


Some existing culverts would need to be extended according to the preliminary design and any access to wetlands or waters due to these extensions is considered a culvert extension impact.

Features directly impacted by or within the access area of culvert extensions were assigned the code "CE." If a feature is located behind or next to the headwall of a culvert extension, then the feature is considered impacted by roadway (RW). If a feature is only located directly in front of the culvert extension, then the feature is considered impacted only by the culvert extension (CE). If the feature is both behind and in front of the culvert extension headwall, then both codes were assigned to the feature. Features impacted by culvert extensions may be assigned multiple codes if other impact types increase the area of impact, e.g. the feature is also impacted by a new culvert or relocated channel.

4.2.6 New/Augmented Culvert

New and augmented culvert impacts include any impact resulting directly from the construction of new culverts or new culverts installed alongside an existing culvert (augmented). These impacts do not include culvert extensions or existing culverts. New headwalls associated with new or augmented culverts are considered part of the construction of a new or augmented culvert, not a culvert extension. For more information regarding augmented/auxiliary culverts, please see **Section 3.3.7A** Other Major Stream Crossings.

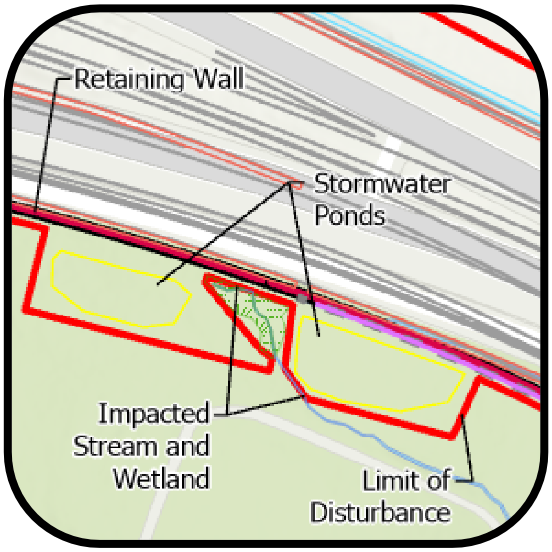


Natural resources features impacted by new/augmented culvert construction were assigned the code "NC." If a feature is located behind or next to the headwall of a new/augmented culvert, then the feature is considered impacted by roadway (RW). If the feature is only located directly in front of the new/augmented culvert, then the feature is considered impacted only by the new/augmented culvert (NC). If the feature is both behind and in front of the new/augmented culvert headwall, then both codes were assigned to the feature. Features impacted by new/augmented culverts may be assigned multiple codes if other impact types increase the area of impact, e.g. the feature is also impacted by a culvert extension or relocated channel.

4.2.7 Relocated Channel

Relocated channel impacts are impacts to other wetland or waterway features resulting from the relocation of a channel. Features were considered impacted by a relocated channel only if the LOD or impact area was increased specifically for channel relocation.

Features impacted by relocated channels were assigned the code "RC." Note that relocated channels will sometimes be assigned the "RC" code if they are partially relocated and the impact to the part of the channel to remain is due to the need to relocate the other portion of the channel.



4.2.8 Stormwater Outfalls

Some proposed SWM pond facility outfall locations are proposed along the edge of natural resource features. A feature was considered impacted by a proposed SWM facility outfall if the LOD or impact area was only increased for the SWM facility. If a feature did not appear to have a proposed SWM facility outfalling to it, but the LOD or impact area around the feature appeared to be increased specifically for the SWM facility, the feature was considered impacted by "construction access," discussed below. Features impacted by proposed stormwater facility outfalls were assigned the code "SO." All features impacted by stormwater outfalls are included in **Appendix A Table 2**.

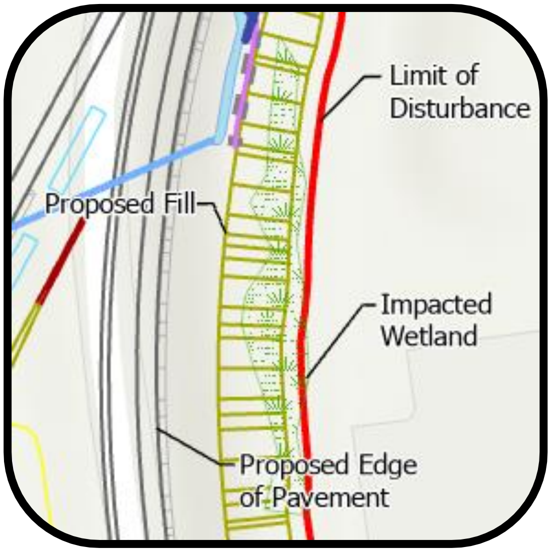
4.2.9 Construction Access

Construction access impacts include any unavoidable impact outside of the standard offset areas resulting from access needed for outfall stabilization, fly-over ramp construction, bridge construction, and general constructability areas.

Features impacted by construction access were assigned the code "CA." If a feature was assigned this code, it indicates that the impact area or LOD near at least a portion of the feature was only increased for construction access needs. All features potentially impacted by construction access along with brief explanations of construction access need are included in **Appendix A Table 1**.

4.2.10 Hydrology Loss

Wetlands that were located partially within the Build Alternative LODs were evaluated for their likelihood of being totally impacted by a loss of hydrology source(s) on a case-by-case basis. Wetlands were considered totally impacted if hydrology loss would occur to such an extent that the USACE definition of wetland hydrology would likely not exist after construction. To determine whether wetlands that are partially within the LOD were impacted by hydrology loss, other impacts influencing the wetland were considered in conjunction with contour lines and the approximate drainage area contributing to the wetland. If it was estimated that over half of the hydrology to the wetland is proposed to be removed by MLS impacts, then the wetland was considered fully impacted. For example, if the drainage area was relatively localized, fill is proposed to most of the wetland, and most flow is proposed to be directed away from the wetland by a stormwater vault, the wetland would be considered fully impacted.



Many wetlands completely encompassed by the LODs will experience hydrology losses; however, since wetlands entirely within the LODs are assumed to be fully impacted, it was not necessary to determine whether they would incur a hydrology loss. Wetland features partially within the LODs that were considered likely to experience hydrology loss were assigned the code "HL."

5

5 CONCLUSION

The avoidance and minimization process for the MLS began with an analysis of the roadway alignment, which determined that overall shifts of the roadway would not result in fewer impacts and would not be practicable. The roadway design, therefore, remained on the existing alignment overall with local shifts proposed to avoid impacting particularly sensitive or recreationally valuable areas. A five-step process for avoiding and minimizing wetlands and waterways was developed and applied corridor-wide, then avoidance and minimization was refined in targeted areas of particular concern. This 16-month long process included the collaboration of a multidisciplinary team of roadway, structural, and stormwater engineers, construction specialists, environmental planners, and environmental scientists with regulatory and resource agencies to avoid and minimize impacts to wetlands, their buffers, waterways, and the FEMA 100-year floodplain to the greatest extent practicable while maintaining adequate construction area for the proposed MLS.

Despite the concerted effort to limit impacts as much as possible to these natural resources, the MLS would still result in unavoidable impacts, given the extremely confined roadway corridor that would be affected. Mitigation for these impacts is discussed in the *Draft Compensatory Mitigation Plan* (**DEIS Appendix N**). Further avoidance and minimization in coordination with agencies and landowners will continue in later stages of design.

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APPENDIX A: IMPACT JUSTIFICATION TABLES

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
68+00 RT	22ZZ	1	Interchange MOT
72+50 LT	22SS	1	Interchange MOT
75+00 LT	22AAA	1	Interchange MOT
96+00 RT (ALB)	22WW	2	Access to ALB replacement, access to crane staging area, and outfall stabilization
97+50 to 99+50 (ALB)	22UU, 22VV	2	Access to ALB replacement; crane staging on eastern side
103+00 LT (ALB)	22TT	2	Access to ALB replacement
103+00 to 108+00	22MM	2	Access for ALB construction
109+50 to 114+00 (ALB)	22LL, 22NN, 22QQ	2	Access to ALB replacement, access to C&O towpath, reconstruction of trails, and channel relocation
112+50 to 113+50	22M_1	2	Access for ALB construction
117+00 to 118+00	22W	2, 3	Bridge and fly-over ramp replacement
118+00 to 119+00	22V, 22V_2	2	Fly-over ramp and bridge reconstruction
120+50 LT	22L	2	SWM facility construction
123+50 to 125+00 RT	22Y	3	Interchange MOT, SWM facility construction, and outfall stabilization
124+00 to 125+00 RT	22Q_1, 22R, 22X	3	Interchange MOT, SWM facility outfall, and outfall stabilization
124+50 to 125+00 LT	22P	3	Outfall stabilization
128+00 to 129+00	22U	3	Access to Clara Barton Parkway bridge replacement
128+00 to 130+00 LT	22HH_1, 22HH_2, 22T_2	3	Fly-over ramp construction, ramp construction, and channel replacement
177+00 RT	22FF	4	SWM facility construction
194+00 to 195+00 LT	22CC	4	Outfall stabilization
197+00 to 198+00 RT (S on Cabin John Pkwy)	22Z, 22Z_1	4	Ramp construction
197+00 to 201+00	22AA_1, 22AA_2, 22AA_3	4	Fly-over ramp construction
197+50 to 199+50 RT	22G, 22GG, 22KK	4	Fly-over ramp and ramp construction
198+50 RT	22F	4	Ramp and new culvert construction
218+50 to 219+50 LT	22B, 22D	5	Ramp construction, safe construction operations, nearby SWM construction, and outfall stabilization
219+00 and 224+00 LT	22AA	5	Outfall stabilization and bridge construction
226+00 to 229+00 LT	21C_2, 21D_1	5	Outfall stabilization, interchange MOT, ramp construction, and partial channel replacement
248+00 to 261+00 RT	21C_1	6	Channel realignment and culvert installation
309+00 to 319+00 RT	21B	8	Outfall stabilization, channel replacement, and nearby SWM facility construction with outfall connection
332+00 to 332+50 RT	20E	8	Outfall stabilization and SWM swale construction
342+00 RT	20B	8	Safe construction operations and outfall stabilization
450+00 to 453+00 LT	19A	10	Bridge and nearby SWM facility construction

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
463+00 LT	19R, 19R_1, 19S, 19Y	10	Access for utility repair
469+00 RT	19W	10	Retaining wall construction
471+50	19T_1	10	Outfall stabilization
483+00 LT	19K_2	11	Outfall stabilization
500+00 to 501+50 LT	18M	11	Retaining wall construction
526+50 RT	18B	12	Outfall stabilization
533+00 to 534+00 LT	18F	12	Retaining wall construction
536+50 LT and RT	18G, 18G_D	12	Outfall stabilization
537+50 LT	19K_6	12	Outfall stabilization
543+50 to 544+00 LT	17B	12	Outfall stabilization
545+50 to 548+50 LT	17A, 17GG	12	Interchange MOT
557+50 to 558+50 LT	17Y, 17X	13	Outfall stabilization
565+50 RT and LT	17DD	13	Outfall stabilization
566+00 to 568+00 RT	17CC	13	Retaining wall construction, outfall stabilization, and augmented culvert construction
572+50 to 575+00 RT	17AA	13	Safe construction operations
581+00 LT	17R	13	Retaining wall construction
582+00 to 586+00 LT	17S	13	Retaining wall construction
583+50 to 586+00 RT	17V	13	Retaining wall construction and safe construction operations
588+00 to 588+50	19K_7, 19K_8	13	Bridge expansion
588+50 to 592+00 RT	16A_1, 16A_2	13	Bridge construction
589+00 LT	17F	13	Augmentation of bridge over Rock Creek
592+00 to 603+00 RT	16A_1	14	Outfall stabilizations and retaining wall construction
599+50 LT	16D	14	Outfall stabilization and access to culvert
604+00 LT	16A	14	Outfall stabilization
607+00 to 607+50 RT	16L	14	Retaining wall construction
610+00 RT	16J, 16J_1	14	Outfall maintenance and new bridge construction
610+00 to 611+00 RT	16G, 16G_1	14	Bridge construction and realignment of roadway
618+00 to 619+00 RT	16G, 16G_D1	14	Outfall stabilization and retaining wall construction
626+50 to 627+00 RT	16F	14	Retaining wall and nearby SWM facility construction
662+50 LT	15B	15	Nearby SWM facility construction
684+00 RT	15D_1	16	Augmentation of bridge over Sligo Creek
685+00 to 686+00 LT	15C, 15E	16	Outfall stabilization
685+50 LT	15D	16	Augmentation of bridge over Sligo Creek
730+00 LT	14F	17	Nearby SWM facility and ramp construction
757+00 RT	14A_1	17	Outfall stabilization and nearby SWM facility construction
786+00 to 787+00 LT	13F, 13H	18	Outfall stabilization and channel replacement
792+00 to 800+00 LT and RT	13G, 13I, 13I_1, 13K, 13L, 13P, 13P_1	18, 19	Northwest Branch bridge replacement access and outfall stabilization

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
794+00 to 794+50 LT	13E	19	Retaining wall and augmented bridge construction
821+50 RT	13O	19	Nearby SWM facility construction and safe construction operations
835+00 to 846+00 LT	13M, 13M_D	20	Interchange MOT, nearby SWM facility construction, and channel replacement
844+00 LT	13S_1	20	Outfall stabilization
845+50 to 847+50 LT	13S	20	Outfall stabilization and nearby SWM facility construction
849+00 to 850+00 LT	13R	20	Nearby SWM facility construction
859+00 to 861+50 RT	13B	21	Ramp construction
859+50 to 864+50 LT	13Q	21	Retaining wall and augmented culvert construction access and safe construction operations
896+00 LT	12HHHH	22	Nearby SWM facility construction
897+50 to 899+00 (Median of 495)	12DD	22	Retaining wall construction
905+00 LT	12KKK, 12LLL	22	Nearby SWM facility construction, facility would outfall to these features, and outfall stabilization
905+00 to 908+50 RT (S on 95)	12O	22	Ramp construction
905+50 to 909+00 RT (S on 95)	12GGG, 12H, 12HHH, 12JJJ, 12O_1, 12P	22	Outfall stabilization
907+00 to 909+00 LT (Ramp to 495)	12MMM, 12NNN	22	Outfall stabilization
907+00 to 909+00 RT (Ramp to 495)	12Q	22	Outfall stabilization and interchange MOT
909+00 to 912+50 (Median of 495/95 interchange)	12BB	22	Nearby ramp, swale, and new culvert construction
912+50 RT	12K_1	22	Outfall stabilization
913+50 to 915+00 RT (S near Park and Ride)	12A, 12B	22	Interchange MOT
916+00 RT (S on 95)	12C	22	Nearby SWM facility construction
917+50 (Median 495/95 interchange)	12Z	22	SWM swale construction and interchange MOT
919+50 to 924+00 LT (Median 495/95 interchange)	12S, 12T, 12T_D, 12U	23	Interchange MOT, nearby SWM facility construction, and ramp construction
923+50 to 927+00 LT (N along I-95)	12XX, 12XX_1	24	Outfall stabilization
924+00 RT	12CCC, 12H_2	22, 23	Outfall and channel stabilization
925+00 to 933+50 RT	12H_3, 12H_4, 12H_5	23	Outfall stabilization, interchange MOT, and ramp construction
927+00 to 932+00 RT	12DDD, 12EEE, 12FFF	23	Interchange MOT
928+50 to 931+00 (Median 495/95 interchange)	12Y_D	23	Culvert construction and nearby SWM facility construction
929+00 LT (N on 95)	12ZZZ	24	Fly-over ramp construction

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
931+00 to 935+50 LT (N on 95)	12WW, 12WW_1, 12WW_2	24	Outfall stabilization, partial channel replacement, and interchange MOT
931+00 to 936+00	12II, 12II_4	23, 24	Interchange MOT, ramp construction, and bridge construction
931+50 LT	12YY	23	Nearby SWM swale construction and interchange MOT
932+00 to 939+50 LT (N on 95)	12YYY, 12YYY_1	24	Nearby SWM facility construction, facility outfalls to these features, and interchange MOT
932+50 LT (N on 95)	12VVV	24	Ramp construction and interchange MOT
933+00 RT (Median 495/95 interchange)	12FF	23	Interchange MOT
933+00 to 935+00 (Median 495/95 interchange)	12FF	23	Ramp construction and interchange MOT
936+00 to 937+50 LT (N on I-95)	12WWW, 12WWW_1	24	Outfall stabilization, nearby SWM facility and swale construction
938+00 LT (Median 495/95 interchange)	12II_5, 12II_6	23	Bridge and ramp construction
938+00 to 941+50 LT	12PPP, 12QQQ, 12OOO	23	Outfall maintenance and interchange MOT
945+50 LT (Median of 495/95 interchange)	12FFFF	23	Fly-over ramp, swale, and retaining wall construction
946+00 LT	12RRR	23	Outfall stabilization
972+00 to 976+00 LT	12SS	25	Culvert augmentation access and safe construction operations
1015+00 LT	11R_1	26	Nearby SWM facility construction
1034+50 to 1035+50 RT	11GG	26	Nearby SWM facility construction and facility outfalls to this feature
1096+00 to 1104+00 LT	11E_D	28	Partial channel replacement and interchange MOT
1103+00 to 1104+00 LT	11C	28	Ramp construction, nearby SWM facility construction, and interchange MOT
1108+50 LT	11E	28	Outfall stabilization and interchange MOT
1109+50 LT	10Q	28	Interchange MOT
1110+00 to 1112+00 LT	10R	28	Outfall stabilization, nearby SWM facility construction, and interchange MOT
1111+00 to 1113+00 LT	10S	28	Nearby SWM facility construction and partial channel replacement
1114+00 to 1116+50 LT	10BB	28	Nearby SWM facility construction
1114+50 to 1115+00 LT	10AA	28	Outfall stabilization, nearby SWM facility construction, and interchange MOT
1118+00 to 1119+00 RT	10W	28	Interchange MOT
1134+50 RT	10X	29	Nearby SWM swale construction and relocated channel construction
1139+00 to 1140+00	10N_1	29	Temporary channel disturbance and channel replacement
1145+50 to 1147+50 LT	10M	29	Channel relocation and tie-in
1148+50 to 1149+00 LT	10L	29	Ramp construction and interchange MOT

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
1159+00 to 1161+00 LT (N on 295)	10PP, 10PP_1	31	Ramp construction
1161+00 RT (S on 295)	10A	30	Interchange MOT
1161+50 to 1162+50 LT (N on 295)	10KK, 10MM_1	31	Nearby SWM swale construction and interchange MOT
1162+00 LT (N on 295)	10GG	31	Nearby SWM facility construction
1162+00 to 1164+00 RT	10F, 10F_1, 10F_2	29	Outfall stabilization, interchange MOT, and ramp construction
1163+00 to 1166+00 RT	10C, 10C_1, 10I	29	Outfall stabilization, ramp construction, and interchange MOT
1163+50 to 1165+00 RT	10B, 10B_1	29	Outfall stabilization, nearby SWM facility construction, and interchange MOT
1167+00 RT (S along 295)	10AAA	30	Safe construction operations
1224+50 to 1227+50 LT	9CC, 9VV	33	Safe construction operations
1243+50 to 1244+50 LT	9JJ, 9LL	33	Partial channel replacement and partial channel tie-in
1247+00 LT	9KK	33	SWM facility outfalls to this feature and safe construction operations
1286+00 LT	8R_D1	34	Interchange MOT
1287+00 to 1292+00 RT	9R	34	Outfall stabilization and interchange MOT
1288+00 to 1289+00 LT	9D	34	Nearby SWM facility construction
1289+00 to 1289+50 LT	8T, 8U	34	Interchange MOT
1289+00 to 1291+00 RT	9A, 9B, 9C	34	Outfall stabilization and nearby SWM facility construction
1292+00 to 1293+00 LT	8S	34	Outfall stabilization and interchange MOT
1334+00 RT (W on 50)	8Z	37	Ramp construction
1336+50 to 1339+00 LT	8D	36	Nearby SWM facility construction and interchange MOT
1337+00 LT	8I	36	Outfall stabilization and interchange MOT
1337+50 RT	8W, 8Y	37	Outfall stabilization and interchange MOT
1337+50 to 1338+00 LT	8H	36	Nearby SWM swale construction and outfall stabilization
1339+00 LT	8E_D, 8G	36	Interchange and nearby SWM facility construction; channel tie-in (8G)
1339+50 RT (W on 50)	7PP	37	Interchange MOT
1351+00 RT	7Q_3	36	Interchange and SWM facility construction
1352+50 LT	8JJ	38	Nearby SWM facility construction
1355 LT	8KK	38	Interchange MOT and roadway tie-in
1355+00 to 1356+50 RT	7P	36	Ramp and retaining wall construction
1356+50 LT	7NN	38	Interchange MOT and roadway tie-in
1357+00 LT (E on 50)	7LL, 7MM, 7RR	38	Interchange MOT for Route 50 reconstruction
1393+00 to 1393+50 LT	7O	39	Channel replacement, channel tie-in, and nearby SWM facility construction
1424+00 LT	7T	40	Relocated channel tie-in
1424+00 LT	7Z	40	Nearby SWM facility construction and relocated channel construction
1431+50 LT	7G	40	Access for stream relocation and outfall stabilization

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
1443+50 to 1447+50 RT	7B	40	Interchange MOT
1447+00 to 1448+00 LT	7M	40	Interchange MOT and SWM facility construction
1451+00 and 1456+00 LT	6G, 6OO	41	Outfall stabilization
1454+50 to 1457+00 LT	6VV, 6WW, 6XX, 6YY, 6ZZ	41	Outfall stabilization and interchange MOT
1457+50 LT	6EEE	41	Interchange MOT
1457+50 to 1460+50 LT	6DDD	41	Outfall stabilization
1460+00 to 1461+00 RT	6ZZZ	41	Channel relocation access
1462+50 LT	6TT	41	Outfall stabilization
1462+50 to 1463+00 LT	6OO	41	Outfall stabilization
1466+50 to 1469+00 LT	6OO	41	Retaining wall construction and new culvert construction
1467+00 to 1476+00 LT	6G_1	41	Retaining wall construction
1471+00 to 1478+00 LT	6Y	41	Retaining wall construction
1478+00 RT	6UUU, 6VVV	41	Channel tie-in
1479+00 to 1480+00 LT	6YYY	41	Channel relocation and culvert augmentation access
1486+00 to 1493+50 LT	6U	42	SWM facility and swale construction; interchange MOT
1491+00 to 1493+50 LT	6G_2	42	Channel tie-in and replacement, interchange MOT
1497+50 to 1502+00 LT	6G_3	43	Ramp construction, outfall stabilization, and channel relocation
1525+50 LT	6Q	43	Access for new culvert/culvert extension and relocated channel construction
1536+50 to 1538+00 RT	6CCC	43	Ramp construction
1539+00 to 1539+50 LT	6MM	43	SWM facility construction
1543+50 RT	6QQQ	43	Safe construction operations
1543+50 to 1545+00 RT	6GGG, 6HHH	43	Outfall stabilization and safe construction operations
1546+00 to 1551+00 RT	5AA, 5BB, 5Q, 5R, 5Z, 6GGG_1	43, 44	Interchange MOT and SWM facility outfall
1548+50 to 1552+50 LT	5QQ, 5QQ_2, 5RR, 5TT, 5UU, 5Y, 6G_6	43, 44	Outfall stabilization, interchange MOT, and SWM facility outfalls to 5Y
1550+00 to 1552+00 LT	6G_6	44	Outfall stabilization and interchange MOT
1550+00 to 1557+50 RT	5Q, 5R	44	Outfall stabilization and safe construction operations
1553+50 to 1556+00 LT	6G_6	44	Outfall stabilization
1555+00 LT	5MM	44	Retaining wall construction and channel replacement
1555+50 LT	5SS	44	Outfall stabilization and retaining wall construction
1563+00 LT	5KK, 5II	44	Outfall stabilization
1570+00 to 1570+50 LT	5JJ	44	Retaining wall construction
1620+50 to 1621+50 LT	5F_1, 5J, 5K	46	Outfall stabilization and channel replacement
1621+00 to 1631+50 RT	5E	46	Nearby SWM facility construction and interchange MOT

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
1623+00 to 1624+00 LT	4Z_3	46	Outfall stabilization and SWM facility outfalls
1649+50 LT	4Y, 4Y_D	46	Outfall stabilization
1703+50 to 1708+50 LT	4N, 4O, 4QQ, 4RR	48	Outfall stabilization and channel relocation
1714+00 to 1716+00 LT	4R, 4YYYY	48	Channel replacement and realignment
1714+00 to 1716+00 RT	4PPPP	48	Augmented culvert and retaining wall construction
1724+50 to 1724+50 LT	4L, 4M	49	Outfall stabilization
1733+00 RT	4GGGG, 4ZZZ	49	Outfall stabilization
1752+50 to 1754+00 RT	4WWW	50	Outfall stabilization and interchange MOT
1754+00 to 1755+00 LT	4H, 4I	50	Outfall stabilization, nearby SWM facility construction, and interchange MOT
1755+00 RT	4XXX, 4YYY	50	Relocated channel construction (4YYY) and interchange MOT (4XXX)
1756+50 to 1760+00 LT	3JJ	50	Outfall stabilization and nearby SWM swale construction
1758+00 to 1761+00 RT	3LL_1	50	Outfall stabilization and nearby SWM facility construction
1761+00 to 1764+50 LT	3HH	50	Ramp and nearby SWM swale construction
1763+00 to 1764+50 RT	3RR	50	Outfall stabilization and interchange MOT
1764+50 RT	3PP	50	Interchange MOT, ramp augmentation, and SWM facility outfall
1764+50 to 1766+00 RT	3OO	50	SWM facility and ramp construction
1789+00 to 1790+00 RT	3U	51	Safe construction operations and outfall stabilization
1789+50 to 1791+00 LT	3Q	51	Retaining wall and nearby SWM facility construction
1790+00 to 1793+00 RT	3S, 3T	51	Outfall and channel stabilization
1793+00 RT	3SS	51	Channel replacement access
1795+50 to 1797+00 RT	3X	51	Bridge structure expansion
1801+00 to 1804+00 LT	3F, 3HHH	51	New culvert/culvert extension construction access
1816+00 RT	3UU	52	Interchange MOT
1823+00 to 1823+50 RT	3DD	52	Retaining wall construction
1853+00 LT	2TT	53	Interchange MOT
1860+00 to 1866+00 RT	2P	53	Retaining wall construction and augmented culvert construction
1865+00 to 1866+00 LT	2SS	53	Access for culvert extension construction
1869+00 LT	2B	53	Channel tie-in and safe construction operations
1872+00 LT	2I	53	Outfall stabilization
1915+00 to 1916+00 LT	2NN	54	SWM facility and retaining wall construction
1916+00 LT	2X_1	54	Outfall stabilization, channel replacement, and nearby SWM facility construction with outfall connection
1921+50 LT	2YY	55	Interchange MOT
1924+00 to 1930+00 LT (S on Branch Ave)	1O, 1Q_1	55	Access for relocated channel, new culvert, and ramp construction
1925+00 to 1929+00	2C, 2Y, 2Y_1	55	Partial channel replacement, ramp construction, and fly-over ramp construction

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
1931+00 LT	1QQ	55	Access for channel relocation
1932+00 to 1939+50 LT	1R_1	55	Channel replacement and outfall stabilization
1940+50 to 1945+50 LT	1R	55	Outfall stabilization and ramp construction
1947+50 to 1950+50 LT	1T	55	Outfall stabilization and safe construction operations
1948+00 RT	1A, 1BB	55	Outfall stabilization
1956+00 to 1958+00 RT	1SS	57	Safe construction operations and swale construction
1969+00 RT	1TT	57	Safe construction operations, swale construction, and outfall stabilization
1973+00 RT	1UU	57	Outfall stabilization
1973+50 to 1975+00 LT	1VV_1, 1YY	57	Safe construction operations, swale construction, and outfall stabilization
1973+50 to 1975+50 RT	1VV, 1XX	57	Safe construction operations, swale construction, and outfall stabilization
1976+50 to 1977+00 RT and 1976+50 LT	1DDD, 1WW	57	Outfall stabilization
1977+00 to 1981+50 RT	1C	57	Culvert augmentation and channel relocation access
1989+50 to 1990+50 RT	1D_1	58	Outfall stabilization and safe construction operations
1990+50 RT	1E	58	Channel tie-in access
1994+50 to 1996 RT	1G, 1H, 1I	58	Access to outfall stabilization, nearby SWM facility construction, and culvert construction
3336+00 LT	29D_D	71	Outfall stabilization and SWM facility outfalls to this feature
3400+00 to 3401+00 LT	27M	70	Nearby SWM facility and swale construction
3476+50 to 3477+50 LT	27D	69	Channel relocation
3483+00 RT	27G	69	Interchange MOT
3509+00 LT	26A	68	Culvert augmentation and channel replacement
3529+00 to 3533+50 LT	26G_1	68	Nearby SWM facility construction and safe construction operations
3537+50 LT	26H	68	Interchange MOT
3560+50 to 3562+00 LT	25D	67	Retaining wall construction
3581+00 to 3582+50 LT	25F	66	Outfall and channel stabilization
3596+00 to 3597+50 LT	25G	66	Outfall stabilization and nearby SWM facility construction
3615+00 LT	25A_1	65	Interchange MOT
3618+00 LT	24S, 24R	65	Outfall stabilization
3684+50 RT	23GG	63	Outfall and culvert access
3692+50 to 3695+00 RT	23F, 23K_1	63	Retaining wall construction
3700+00 to 3702+00 RT	23K	63	Partial channel replacement
3716+50 RT	23E	62	Safe construction operations
3716+50 to 3717+50 RT	23CC	62	Outfall stabilization
3741+50 LT	23A	59	Outfall stabilization
3743+00 to 3744+50 LT	23W, 23A_1	59	Retaining wall construction, interchange MOT and outfall stabilization

Table 1. Features Impacted by Construction Access

Station	Feature ID	Impact Plate	Construction Access Justification
3762+50 to 3763+50 RT	23A_3	59	Partial channel replacement and tie-in
3780+00 to 3784+00 RT	21C	7, 8	Crane staging area for bridges to be constructed to the south
4718+00 to 4719+50 and 4724+00 LT	23N	62	Outfall stabilization and nearby SWM facility construction with outfall connection
4730+00 RT	23N_D	62	Outfall stabilization
4770+00 to 4771+00 RT	23R	61	Outfall stabilization
4775+00 to 4777+00 RT	23Q	61	Outfall stabilization, partial channel replacement, and nearby SWM facility construction

Notes:

1. The above table lists all features impacted by construction access (CA). The notes below indicate CA impact differences between alternatives.
2. 23K, 23Q, 25H_1, and 27D are not impacted by CA design elements in Alternatives 8 and 9 .
3. 20B, 23K, 23Q, 23R, 24C, and 27D are not impacted by CA design elements in Alternative 9M.
4. 23Q, 23R, and 27D are not impacted by CA design elements in Alternative 13B.
5. 23E, 24C, 25H_1, and 27C are not impacted in Alternatives 8 and 9.
6. 15C, 15E, 17F, 23E, 24C, and 27C are not impacted in Alternative 9M.
7. 23E and 24C are not impacted in Alternative 13C.
8. 17AA, 17V, and 19W are not impacted by CA design elements except within Alternative 9M.

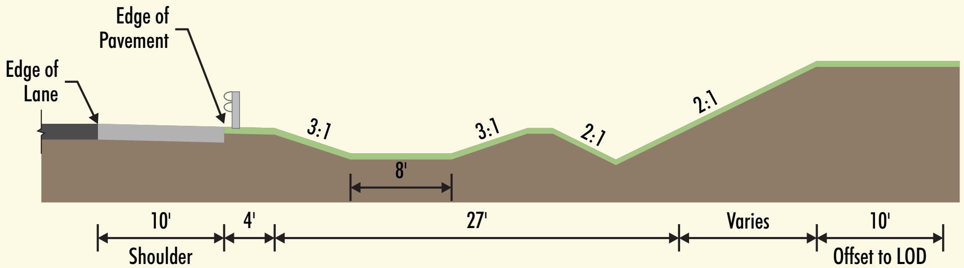
Table 2. Features Impacted by Stormwater Management Facility Outfalls

Station	Feature ID	Impact Plate	Description of Impact
119+50 to 120+00 LT	22K	2	SWM facility outfalls to this feature
309+00 to 319+00 RT	21B	8	SWM facility outfalls to feature, retaining wall construction, and roadway
440+50 to 443+00 RT	19F_2	9	SWM facility outfalls to this feature; outfall must be located to the south of facility because of slope
932+00 to 939+50 LT (N on 95)	12YYY_1	24	Nearby SWM facility construction, facility outfalls to these features, and interchange MOT
964 to 965+50 RT	12PP, 12QQ	25	SWM facility outfalls to these features
1034+50 to 1035+50 RT	11GG	26	SWM facility construction and facility outfalls to this feature
1160+50 LT (E on 295)	10MM	31	SWM facility outfalls to this feature
1162+00 (NE on 295)	10FF	31	SWM facility outfalls to these features and interchange MOT
1227+50 RT	9BB	33	SWM facility outfalls to this feature
1247+00 LT	9KK	33	SWM facility outfalls to this feature
1283+50 to 1284+50 RT	8R	34	SWM facility outfalls to this feature
1351+50 LT (intersection of 50 and 704, NW quadrant)	8HH	38	SWM facility outfalls to this feature
1515+00 LT	6C	42	SWM facility outfalls to this feature
1528+00 to 1534+50 LT	6G_3	43	SWM facilities outfall to this feature
1543+00 to 1544+00 LT	6QQ, 6RR	43	SWM facility outfalls to this feature
1548+50 to 1550+00 LT	5Y	43, 44	Outfall stabilization, interchange MOT, and SWM facility outfalls to 5Y
1626+00 to 1630+00 LT	4Z_2	46	SWM facility outfalls to this feature
1667+00 to 1668+00 LT	4WW	47	SWM facility outfalls to this feature
1788+50 LT	3TT	51	SWM facility outfalls to this feature
1896+00 to 1899+00 LT	2LL, 2XX	54	SWM facility outfalls to this feature
1916+00 LT	2X_1	54	Outfall stabilization, channel replacement, and nearby SWM facility construction with outfall connection
3564+00 RT	25K	67	SWM facility outfalls to this feature
3596+50 to 3597+00 LT	25L	66	SWM facility outfalls to this feature
3639+50 RT	24D, 24N	64	SWM facility outfalls to these feature
4718+00 to 4719+50 and 4724+00 LT	23N	62	Outfall stabilization and nearby SWM facility construction with outfall connection

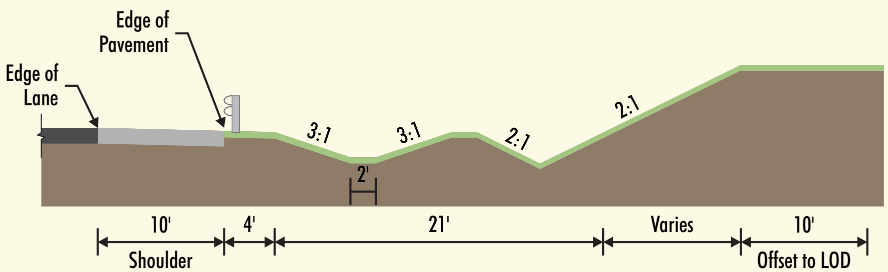
Table 3. Wetlands Likely to Experience Hydrology Loss

Station	Feature ID	Impact Plate	Justification
971+50 to 976+00 LT	12SS	25	Diversion of water by SWM vault
1062+00 to 1067+50 LT	11Z	27	Diversion of water by SWM facility and SWM vault
1145+00 to 1147+50 LT	10M	29	Diversion of water by SWM swale and SWM vault
1184+00 LT	9PP	32	Diversion of water by SWM vault
1355+00 to 1357+00 RT	7P	36	Diversion of water by SWM vault
1506+00 to 1506+50 LT	6E	42	Diversion of water by SWM swale and SWM vault
1507+00 to 1508+50 LT	6I	42	Diversion of water by SWM swale and SWM vault
1508+50 to 1509+50 LT	6K	42	Diversion of water by SWM swale and SWM vault
1536+50 to 1540+00 RT	6CCC	43	Diversion of water by SWM swale
1692+00 to 1693+00 RT	4KKKK	48	Diversion of water by SWM swale and SWM vault
1693+50 LT	4VV	48	Diversion of water by SWM facility
1720+00 to 1721+50 LT	4MM	49	Diversion of water by SWM swale
1732+00 to 1733+00 RT	4ZZZ	49	Diversion of water by SWM swale and SWM vault
1742+00 to 1743+50 RT	4CCCC	49	Diversion of water by SWM vault
1745+00 to 1747+00 LT	4HH	49	Proposed construction will eliminate ponding conditions
1790+00 to 1794+00 RT	3T	51	Diversion of water by SWM vault
1867+00 to 1870+00 LT	2B	53	Significant roadway impacts and SWM swale water diversion
1870+50 to 1877+00 RT	2S	53	Diversion of water by SWM swale and SWM vault
1995+50 to 1996+50 RT	1I	58	Diversion of water by SWM swale and SWM vault
3522+50 to 3524+00 RT	26E	68	Diversion of water by SWM swale

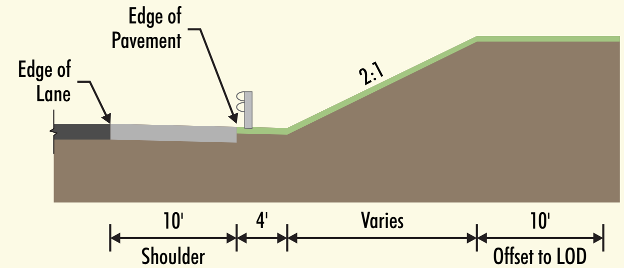
APPENDIX B: ROADSIDE LOD MODIFICATION STEPS



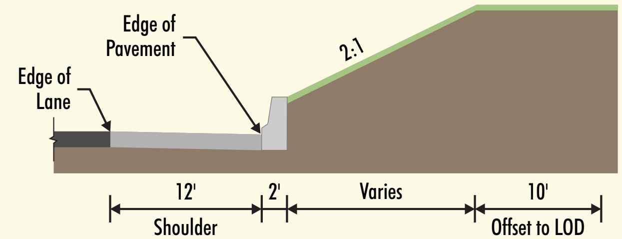
Step 1: Open Section with Full Stormwater Management



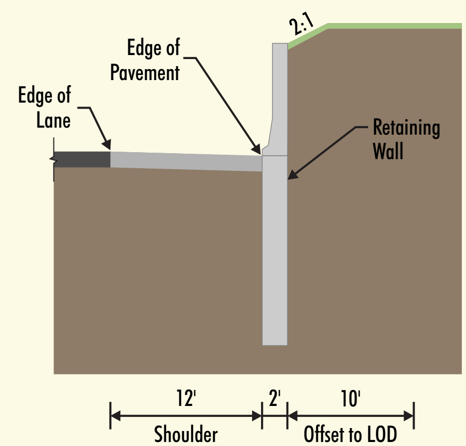
Step 2: Open Section with Reduced Stormwater Management



Step 3: Open Section with No Stormwater Management



Step 4: Closed Section with Concrete Barrier



Step 5: Closed Section with Retaining Wall

Not to scale

Note:

1. Offset to LOD includes erosion and sediment control and noise barrier construction

I-495 & I-270 Managed Lanes Study

Roadside LOD Modification Steps

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

April 2020