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MARYLAND

I-495 & I-270 Managed Lanes Study

FINAL AVOIDANCE, MINIMIZATION, AND IMPACTS REPORT

July 2022

U.S. Department of Transportation
Federal Highway Administration

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 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 four-year 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, have prepared 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 MLS study limits and to enhance existing and planned multimodal mobility and connectivity. The MLS study limits (**Figure 1**) include a 48-mile long and approximately 600-foot-wide roadway corridor, or corridor study boundary, spanning two states, three counties, and 15 Maryland 12-digit watersheds.

The 48-mile Study limits remain unchanged for the Preferred Alternative: I-495 from south of the George Washington Memorial Parkway in Fairfax County, Virginia, to west of MD 5 and along I-270 from I-495 to north of I-370, including the east and west I-270 spurs in Montgomery and Prince George's Counties, Maryland. The Preferred Alternative, Alternative 9 - Phase 1 South (shown in **dark blue** in **Figure 1**), includes build improvements within the limits of Phase 1 South only totaling approximately 15 miles of proposed improvements. There is no action, or no improvements included at this time on I-495 east of the I-270 east spur to MD 5 (shown in **light blue** in **Figure 1**). The Preferred Alternative also includes 67 offsite compensatory stormwater quality treatment LODs necessary to achieve the project's stormwater quality treatment requirements, as included in the Compensatory Stormwater Mitigation Plan (FEIS, Appendix D).

Figure 1. I-495 & I-270 MLS Study Corridors – Preferred Alternative

Efforts have been made throughout the preliminary design process during the MLS planning stage to avoid and minimize impacts to wetlands, their buffers, waterways, and the Federal Emergency Management Agency (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 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 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 the Preferred Alternative. The AMR then describes specific areas where additional agency coordination will be required prior to clearing or impact and provides an impact narrative, which includes the justification for unavoidable impacts, some of 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, wetland buffer, waterway, and floodplain features. Impacts were avoided and minimized to the greatest extent practicable at a planning level design for all Draft EIS (DEIS) Build Alternatives and a concept level design for the Preferred Alternative through collaboration between the MLS Team and regulatory and resource agencies.

2 AVOIDANCE & MINIMIZATION APPROACH

The MLS Team worked closely with regulatory and resource agencies to limit impact to wetlands, wetland buffers, waterways, and floodplains to the greatest extent practicable during preliminary design, while assuring there was enough room for construction of the roadway and the required ancillary roadway systems, such as drainage culverts. The MLS team worked with regulatory and resource agencies for over 4 years to review potentially impacted natural resources and explore avoidance and minimization possibilities.

Avoidance and minimization was conducted corridor-wide using a five-stage standardized process to avoid and minimize impacts to all wetlands and waterways throughout the corridor by adding retaining walls, where necessary, to limit roadway impacts and by altering the preliminary stormwater management (SWM) design. This five-step process established the SDEIS LOD and set the design limits for the FEIS and developer. The preliminary design for the Preferred Alternative is within these design limits. Targeted avoidance and minimization of the Potomac River and Plummers Island, Thomas Branch, and other major stream crossings within Phase I South was closely investigated and the LOD and preliminary design were refined to avoid impacts to these resources to the greatest extent practicable during this stage of design. Individual resource avoidance and minimization was conducted throughout the preliminary design stage, taking into consideration resource agency requests for specific avoidance and minimization; adjusting new sound wall locations to limit impact to resources; and limiting the LOD only to those areas required for roadway expansion and constructability.

The MLS Team made a concerted effort to avoid and minimize impacts throughout the planning process and 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. Following the Record of Decision (ROD), the developer will be required to continue avoidance and minimization throughout final design and construction and document that the final design has fewer impacts to the Preferred Alternative or submit a permit modification.

2.1 Corridor-Wide Avoidance and Minimization Applied to all Build Alternatives

A LOD was established for each DEIS 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).

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:

- Step 1 - an open section with a full-width (8-foot) bioswale for SWM;
- Step 2 - an open section with a reduced-width (2-4-foot) bioswale for SWM;
- Step 3 - an open section with no surface SWM (drainage ditch only);
- Step 4 - a closed section with concrete barrier; and
- 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) and displayed in **Appendix A** 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. This five-step process established the SDEIS LOD and set the design limits for the FEIS and developer.

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, such as around augmented culverts, 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, culvert augmentation, SWM, bridge construction/widenings, staging, stockpiling, access, outfall stabilization, noise walls, retaining walls, and construction equipment areas.

Corridor-wide 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 SWM facility locations;
- Relocations of preliminary managed lane access locations; and
- Revisions of proposed SWM facility locations.

2.2 Targeted Areas of Avoidance and Minimization

U.S. Army Corps of Engineers (USACE), Maryland Department of the Environment (MDE), U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency (EPA), Maryland Department of Natural Resources (MDNR), Maryland National Capital Park and Planning Commission (M-NCPPC), and National Park Service (NPS) 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:

- The Potomac River crossing, including Plummers Island – Need to replace and widen the American Legion Bridge (ALB) over the river and tie-in to existing roadways on either side, and
- Thomas Branch – Potential need to culvert portions of the stream.

2.2.1 Potomac River, Plummers Island, and the American Legion Bridge

The existing ALB structures, linking the Virginia and Maryland portions of I-495 over the Potomac River, were constructed in the early 1960s and must be replaced by 2030 due to age and condition. Replacing these bridge structures as part of the MLS would eliminate the need for a follow-up bridge replacement project for which the state does not have funding allocated. MDOT SHA carefully considered various potential roadway alignments as well as various types of potential bridge structures to inform the LOD in this area to accommodate roadway widening and bridge replacement across the Potomac River while limiting impact to NPS property and resources.

The Preferred Alternative includes numerous LOD modifications since the DEIS, one of the most significant of which is in the vicinity of the ALB to address comments and concerns received from the NPS regarding impacts to NPS lands and resources.

Multiple alignments were considered when determining the LOD for the replacement of the ALB. Off-alignment bridge options were considered but were not retained for further study in the DEIS, since they were not practicable. Tunnel and full-span suspension on-alignment alternatives were also considered but were not retained for further study in the DEIS, because they would not allow for connection with the Clara Barton Parkway or George Washington Memorial Parkway and would be cost prohibitive. Alignment options that were investigated further include: an entirely offset alignment to either the east or west; a minimally offset alignment to either the east or west; and widening the structure on the existing alignment.

The ALB alignment determination required assessing impacts to wetlands, streams, forests, rare plant species, cultural resources, and adjacent properties such as the Naval Surface Warfare Center at Carderock in Maryland and a residential community along the Virginia shoreline of the Potomac River. Other factors considered when evaluating the proposed alignments included maintenance of traffic, constructability, construction access, and roadway engineering issues such as re-aligning the interchanges that lead to the ALB.

Building the replacement ALB on an entirely offset alignment to the east of the existing structure while traffic remains in its current configuration would result in unacceptable impacts to Plummers Island, an important biological and cultural resource within the Chesapeake and Ohio National Historical Park, and impacts the two other NPS parks in the vicinity of the ALB. This approach would not be feasible on the west side of the existing ALB either, due to unacceptable impacts to the Naval Surface Warfare Center Carderock Division property located on the north side of the Potomac River, to a residential community

on the south side of the Potomac River and to two NPS parks (Clara Barton Parkway and Chesapeake and Ohio Canal National Historical Park).

A less impactful approach would be to construct a new structure on a minimally offset alignment, while placing traffic partly on the existing structure and partly on a new structure during construction. The minimally offset alignment to the east would still impact Plummers Island and NPS property more than would be acceptable and this alignment is not feasible. The minimally offset alignment to the west would avoid impacts to Plummers Island but would impact more NPS property and would require displacement of a residential property on the Virginia shoreline of the Potomac River. This "west shift" alignment was considered post-DEIS and is discussed further in **Section 2.2.1.A**.

Widening on the existing alignment would impact Plummers Island to some extent but would avoid impacts to the residential property on the Virginia side of the ALB and would impact less NPS property than the "west shift" alignment option. This "on-center" widening alignment, or base option, was considered post-DEIS and is discussed further in **Section 2.2.1.A**.

See **Figure 2** through **Figure 4** for a visualization of the base option and the west shift. A comparison of impacts for the base option, west shift, and on-center widening included in the Preferred Alternative LOD are displayed in **Table 2-1** below.

Table 1. Comparison of Impacts for ALB Alignment Options

Resource (unit)	DEIS LOD Conventional Construction (June 2020)			Centerline ALB Alignment (Base Option) March 4, 2021			West Shift ALB Alignment March 4, 2021			FEIS MDOT SHA RPA[3] March 21st, 2022		
	Perm	**Temp**	**Total**	**Perm**	**Temp**	**Total**	**Perm**	**Temp**	**Total**	**Perm**	**Temp**	**Total**
NPS Park Properties[1]												
Total NPS Properties Around ALB[2] (acres)	**4.88**	**11.30**	**16.18**	**5.26**	**4.51**	**9.77**	**5.88**	**5.23**	**11.11**	**0.90**	**8.76**	**9.66**
Chesapeake and Ohio Canal National Historical Park (acres)	4.88	7.69	12.57	5.09	4.25	9.34	5.88	4.93	10.81	0.87	8.46	9.33
Clara Barton Parkway (acres)	0	0.19	0.19	0	0.19	0.19	0	0.19	0.19	0.00	0.19	0.19
George Washington Memorial Parkway (acres)	0	3.42	3.42	0.17	0.07	0.24	0	0.11	0.11	0.03	0.11	0.14
Individual Trees within Park Boundaries												
Live Tree Impacts (#/DBH)	1,108 / 14,033	N/A	1,108 / 14,033	805 / 10,032	N/A	806 / 10,032	878 / 11.136	N/A	878 / 11,136	803 / 9,994	N/A	803 / 9,994
Standing Dead Tree Impacts (#/DBH)	190 / 2,202	N/A	190 / 2,202	116 / 1,335	N/A	116 / 1,335	129 / 1,608	N/A	129 / 1,608	118 / 1,363	N/A	118 / 1,363
Natural Resources within the Potomac River Gorge												
NR Waters (acres)	8.81	N/A	8.81	4.56	3.68	8.24	4.46	3.66	8.12	0.92	7.33	8.25
NR Waters (linear feet)	3,830	N/A	3,830	1,985	1,110	3,095	2,142	821	2,963	1,075	2,188	3,263
NR Wetlands (acres)	0.78	N/A	0.78	0.36	0.33	0.69	0.73	0.49	1.22	0.16	0.40	0.56
Plummers Island Area (acres)	0.28	1.69	1.97	0.28	0	0.28	0.00	0.04	0.04	0.004	0.26	0.26
Forest Canopy (acres)	17.74	N/A	17.74	6.72	4.56	11.28	6.56	6.06	12.62	4.85	6.93	11.78
FEMA 100 Year Flood (acres)	22.22	N/A	22.22	11.31	7.52	18.83	11.11	8.64	19.75	3.64	7.25	10.89
FIDS (ac)	7.01	N/A	7.01	3.29	1.01	4.30	1.27	2.71	3.98	1.70	2.46	4.16
FIDS - DNR (ac)	8.79	N/A	8.79	1.75	3.94	5.69	2.21	5.21	7.42	0.94	4.77	5.71
RTEs (# species impacted)	7 (4 poly / 3 point)			6 (4 poly / 2 point)			5 (4 poly / 1 point)			6 (4 poly / 2 point)		

Notes:
1. These impact calculations are based on the NPS GIS Park Boundaries received via email from NPS personnel on 4/29/2021 (Tammy Stidham).
2. Impacts to properties excludes the areas within existing transportation easements; portions removed in GIS using spatial overlay before the impacts were calculated.
3. MDOT SHA RPA includes the Centerline ALB Alignment from March 4, 2021 with additional refinements to the design and constructability assumptions.

Figure 2. Roadway Comparison Base and West Shift Options

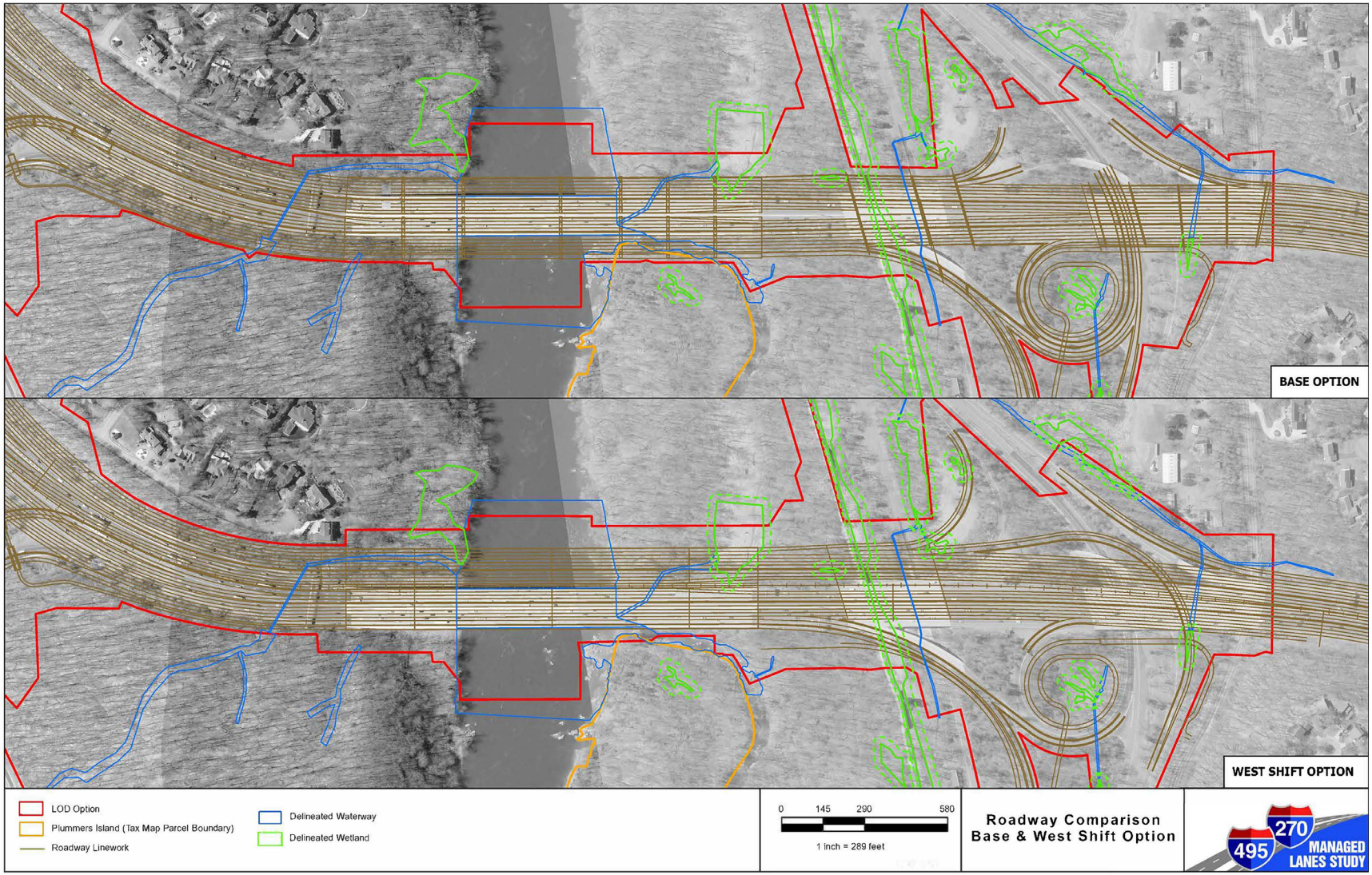


Figure 3. LOD Comparison Base and West Shift Options

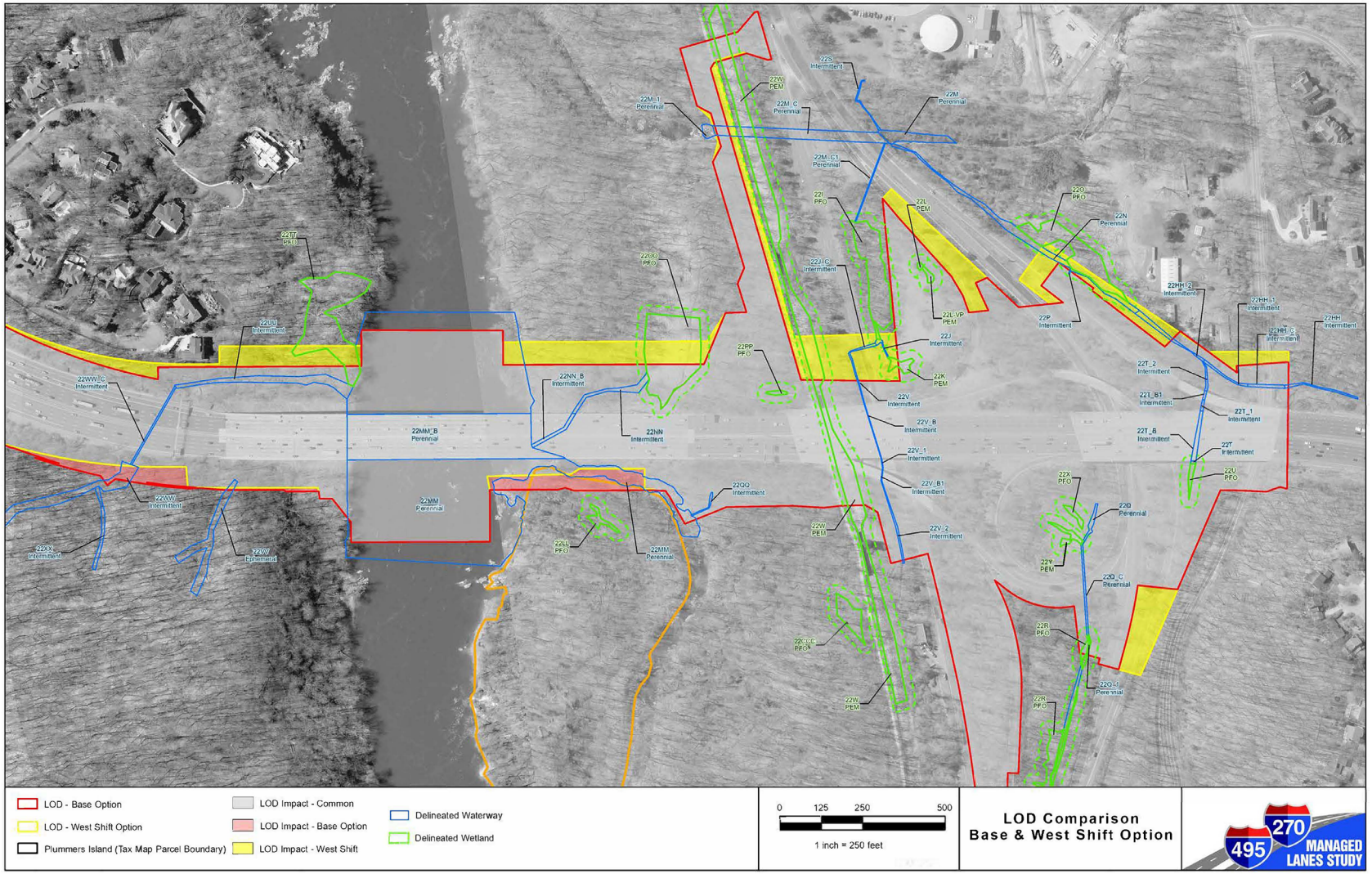
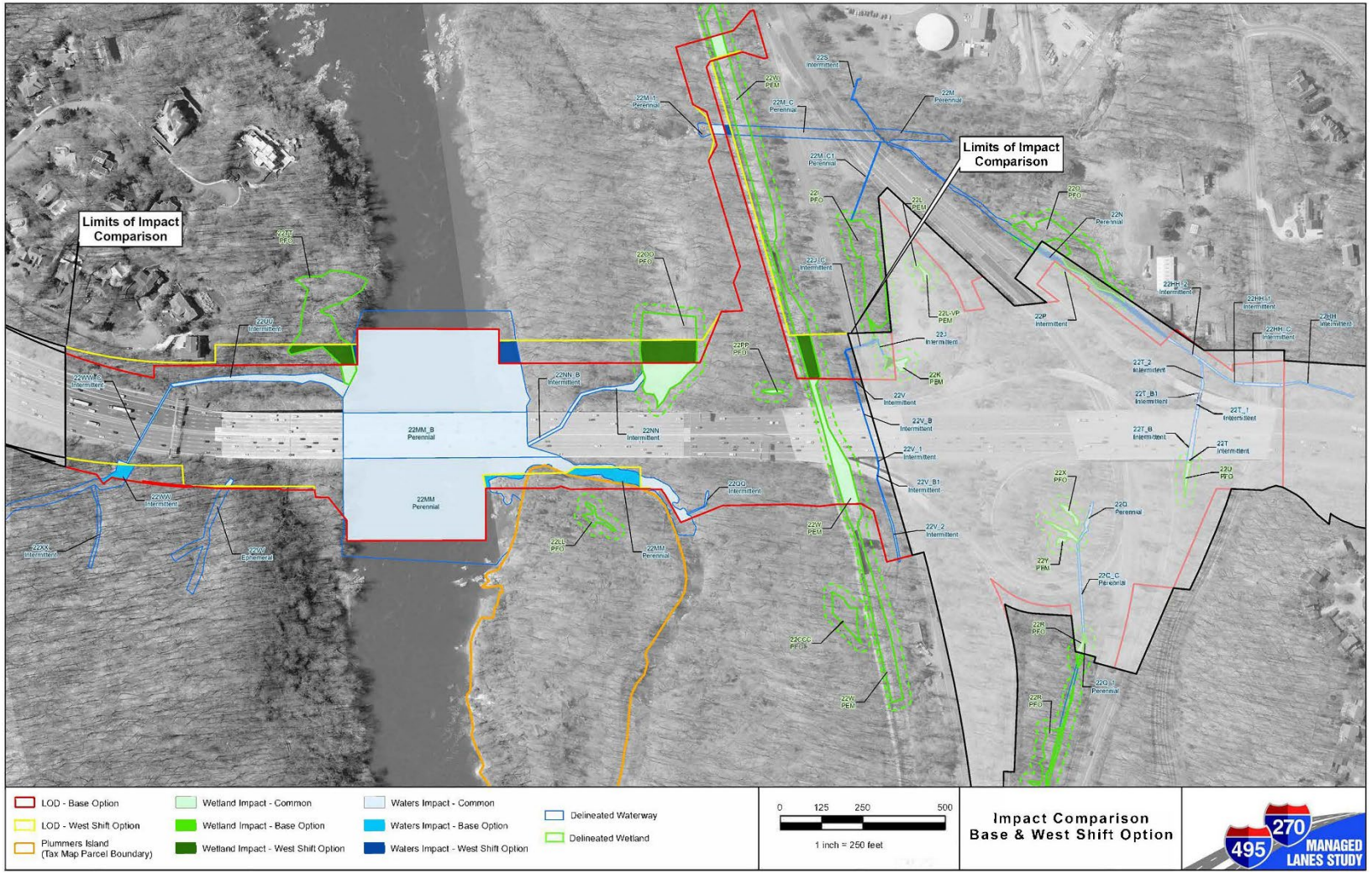


Figure 4. Impact Comparison Base and West Shift Option



2.2.1.A. Alternative Bridge Design Options

Alternative bridge design options were considered to inform the LOD in the vicinity of the ALB, to determine the extent to which the LOD could be minimized to limit impacts to NPS land and natural and cultural resources, while still providing enough space to accommodate bridge construction and maintenance.

a. Avoidance

Long-span Bridge:

The only avoidance option identified was replacement of the ALB with a long-span bridge. In order to avoid natural resources at the bridge location, permanent piers would need to be constructed completely beyond the limits of the resources. This would require a pier north of the Washington Aqueduct on the Maryland side and at, or south, of the existing south abutment in Virginia. The resulting clear span is at least 3,250 feet. A suspension bridge is the only feasible bridge type to span this distance and a bridge this long would be the 35th longest suspension bridge in the world, or the 5th longest in the U.S. Additional back-span dimensions for anchorage would be at least another 800-feet on each end for a total bridge length between cable anchorages of 4,850 feet. This length does not include a likely need for approach spans on either end to transition from the highway on grade to the suspended roadway. The total bridge length needed would make the interchanges at Clara Barton Parkway and George Washington Memorial Parkway inaccessible. Replacing the ALB with a suspension bridge would not be practicable, since it would eliminate the interchanges with the parkways in Maryland and Virginia; would be cost-prohibitive; and would drastically alter the viewshed of the surrounding natural area.

b. Minimization

i. DEIS Minimization Options

Reconstruct Bridge without Widening:

One minimization option identified was reconstructing the ALB without widening. The existing bridge out-to-out width is approximately 138-feet and carries five lanes of traffic in each direction. To maintain 10 lanes of traffic during construction with minimal offsets to temporary barriers requires 119-feet of bridge width. Therefore, a maximum of 19-feet of the existing bridge is available for demolition and reconstruction in the first phase. This means that only one lane at a time could be reconstructed and shifted onto the new bridge. A minimum of nine phases of traffic control would be required to fully replace the bridge. This assumes that all the deck joints between phases are structurally feasible; the existing piers are stable in a partially loaded and/or demolished condition; and the new superstructure configuration could be made compatible with the temporary lane placement. The resulting superstructure would be inefficient, because uniform girder spacing would not be feasible while accommodating the required construction phasing. In addition, in the middle three phases of demolition and construction, work would have to occur between active lanes of traffic. In the same phases, traffic in the same direction would be divided with a construction zone in between the travel lanes. No work zone for construction vehicles and equipment would be available on the bridge, because all bridge deck that is in place, either existing or proposed, would be required to carry traffic. This approach to construction is very unsafe for motorists and construction staff. There would be no emergency pull off lanes for five lanes of traffic in each direction. Construction work would occur between and over open lanes of traffic. The duration of construction, number of traffic shifts, and inefficient structure configuration would result in a highly

undesirable and expensive approach to construction. This option is not practicable due to extreme safety issues, construction inefficiencies and challenges, and prohibitive cost and duration.

Double-Deck Existing Bridge:

A double-deck bridge was considered in hopes of reducing the extent of the construction footprint and minimizing impacts to NPS property and natural resources. The out-to-out superstructure width of one direction of travel in the proposed condition would be approximately 124-feet. Since this is less than existing superstructure width, constructing a second deck over the existing bridge superstructure would provide sufficient width for the proposed lane configuration. Previous analysis of the existing substructure units indicate that the piers are currently loaded to the point that there is no additional capacity. The additional dead load from the second deck and the live load from the vehicles could not be accommodated by the existing substructure. In order to support the second deck, new substructure units independent from the existing, would need to be constructed. These would consist of new pier caps spanning across the entire width of the existing bridge to newly constructed column elements supported on large, deep foundations located outside the existing bridge. To minimize the impact of the foundation elements, they would likely consist of large diameter drilled shafts. The associated pier cap would span a minimum of 155-feet, resulting in a significant concrete beam that would greatly increase the vertical profile of the top deck in order to provide sufficient vehicular under clearance to the lower deck. The approach roadway modifications necessary to transition from side-by-side to stacked roadways would extend well beyond the interchanges on each end of the bridge.

Proposed Double-Deck Bridge:

Building on the discussion above, it is clear that the out-to-out superstructure width of a completely new double-deck bridge would be 124-feet. To support both decks, the substructure would need to be wider than the superstructure. Again, assuming large, drilled shaft foundations and columns, the out-to-out of the entire bridge would be approximately 144-feet, which is wider than the existing bridge. Some minor additional impacts to the resources would be likely. To build an entirely new bridge, the construction phasing would ideally require the new bridge to be built off of the existing bridge alignment. This would allow conventional maintenance of traffic on the existing bridge while the new double-deck structure is completed. The approach roadway modifications required for the option to double-deck the existing bridge remain with this option. Construction of either double-deck bridge option is not practicable, since it would require a new substructure so far beyond the width of the existing structure that it would not reduce the construction footprint or minimize impacts to natural resources from a conventional construction method but would be far more expensive than a conventionally constructed bridge.

Top-Down Construction:

Utilizing top-down construction techniques for the proposed bridge structure means that all construction equipment and access would be provided from the completed bridge deck. The contractor would begin construction at an abutment and the first pier working from the approach roadway behind the abutment. Next the superstructure would be constructed on the first span. All construction operations would then move onto the completed first span in order to construct the next pier and next span of superstructure. Construction would proceed in this manner along the entire length of the bridge until the full structure is complete. Two separate crews working from opposite ends of the bridge could each begin at opposite abutments and meet in the middle of the bridge. This technique would result in relatively short spans between pier locations due to limited equipment reach and capacity. The total footprint of pier elements

would be much larger than the footprint of a bridge with conventional span lengths. In addition, utilizing top-down construction does not address any of the issues with traffic phasing and work zones discussed in previous options. While this type of construction would still require a construction access road to remove materials and would be relatively more expensive to construct than the conventional method, it was determined to be a viable option.

ii. Strike Team Minimization Options

MDOT SHA and Federal Highway Administration met with the NPS to discuss the LOD presented in the MLS DEIS on December 8, 2020. The NPS requested that MDOT SHA re-assess the LOD in the vicinity of the ALB to limit impacts to NPS land and its natural resources. MDOT SHA convened an 'ALB Strike Team' composed of national and local experts on bridge design, natural resources, and cultural resources who were charged with the following mission:

To develop and evaluate alternatives for the replacement of the ALB to avoid impacts, to the greatest extent practicable, and reduce overall acreage impacts to the Chesapeake and Ohio Canal National Historical Park and George Washington Memorial Parkway units of the NPS.

The ALB Strike Team conducted its intensive investigation in January 2021 to explore alternative design solutions, project phasing solutions, site access solutions, and the potential use of specialty construction techniques to limit the LOD. The ALB Strike Team presented its results to the NPS on February 8, 2021.

MDOT SHA established the Base LOD as the "Base Option," which includes a conventionally constructed bridge structure built in two phases on the existing bridge centerline with the assumption of temporary construction access over the Potomac River via trestles and causeways. This Base Option included minor LOD reductions from the DEIS LOD to minimize impacts to Plummers Island. The Base Option also started with construction access in all four quadrants and was minimized to remove the construction access in the southwest, southeast, and northeast quadrants, which significantly reduced impacts to NPS property.

The ALB Strike Team first reviewed the avoidance and minimization options developed by MDOT SHA to date, as described above, and the Strike Team agreed that these options were not practicable, except perhaps the top-down construction option, which they investigated in further detail. The Strike Team then reviewed the viability of the Base Option and confirmed that this on-center alignment with a conventional construction approach was a viable option. The ALB Strike Team also considered a "west shift" of the LOD to entirely avoid impacts to Plummers Island and determined that a conventional construction approach with a west shift was also a viable option.

The ALB Strike Team then considered other bridge construction approaches to determine if any of them could limit the LOD further than the Base Option could. The Strike Team conducted detailed investigation on a top-down segmental construction approach; a top-down cable stayed approach; and a slide-in place bridge construction approach.

<u>Top-Down Construction</u>

The first type of construction method assessed by the Strike Team was the top-down approach. The Strike Team investigated whether the existing bridge could be used as a work platform as part of the top-down construction method, but determined it could not, since the northbound and southbound lanes are at very different elevations, making it impossible to shift traffic across the bridge during construction. This

also means that the existing bridge cannot be used for construction and material deliveries, except during light traffic periods that would allow a lane closure. Top-down construction approaches investigated included: gantry, pre-cast segmental, cast-in-place segmental, and cable stayed. The Strike Team determined that the gantry method was not viable, because the ALB would require either spread footing foundations on rock or drilled piers, both of which would require ground access to the foundation locations for construction. Pre-cast segmental construction would also not be viable, because segments for the ALB would be too large and heavy to transport to the site.

Cast-In-Place Segmental

A cast-in-place segmental construction method was determined to be viable. A cast-in-place segmental bridge option would fit within the Base LOD, with impacts similar to the Base Option. The cost of this option is likely competitive with the Base Option and would likely be faster to construct.

Cable Stayed

The next top-down option reviewed by the Strike Team was the Cable Stayed Option, which would use a top-down cantilever method of construction. The primary advantage of this method is that it requires the fewest number of foundations of all options considered, minimizing the permanent ground displacement area. This option would also reduce the shade and shadow areas under the bridge, which is known to affect anadromous fish species. The cable stayed option would require a 200-foot tower and cables and would have a significant effect on the overall viewshed. This is the most expensive construction method considered.

Slide-In Place

A third type of bridge construction considered by the Strike Team for the ALB is the Slide-In Place Option. This option would construct the entire new superstructure on falsework situated west of the existing bridge and then slide it in place over a weekend. This option was found to be the most impactful strike team option and therefore not viable.

The Strike Team also reviewed constructability and construction access options and those are summarized in **Section 2.2.1.B** below.

2.2.1.B. Constructability Considerations

Construction equipment and personnel must be able to work below the bridge structures at river level to construct proposed piers and demolish the existing structure. Given the steep slopes on both shorelines of the Potomac River, limited access opportunities, and characteristics of the Potomac River channel, a site access plan is needed that requires additional LOD beyond the limits of the existing and proposed structures.

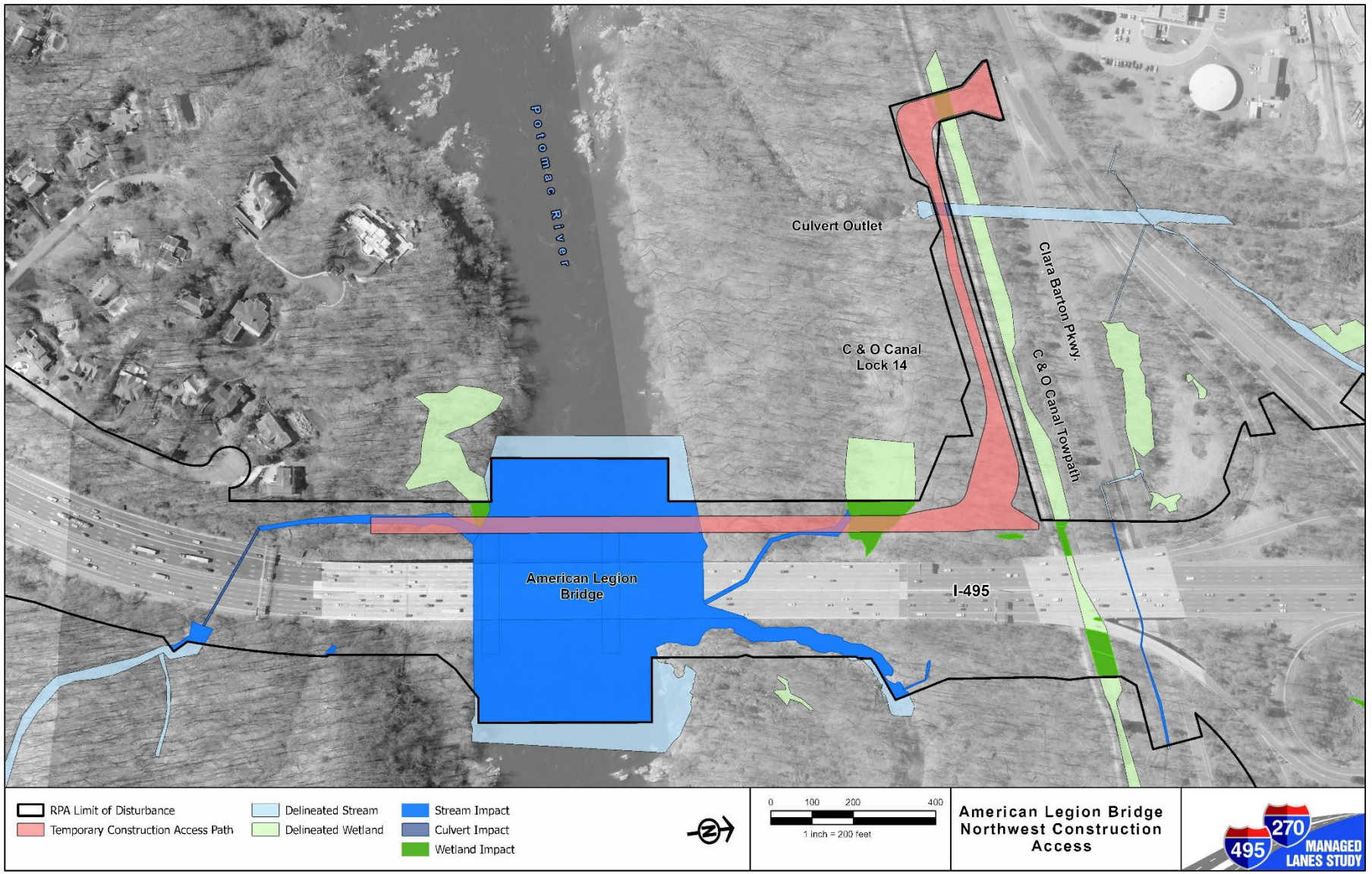
After field analysis and known information review, MDOT SHA and the ALB Strike Team determined that access to the site at river level can be consolidated to the north side of the river along Clara Barton Parkway, eliminating the construction access from the other three quadrants around the bridge and significantly reducing impacts to NPS land. This would be achieved by constructing a temporary construction access road entrance off of Clara Barton Parkway in the northwest quadrant and installing a temporary bridge over the Chesapeake and Ohio Canal and a temporary haul road paralleling the towpath. Construction traffic could then turn south parallel to the existing structure and follow existing right-of-

way to the area below the existing/proposed bridge. It is important to note that pedestrian traffic on the Chesapeake and Ohio Canal towpath must be maintained throughout construction. A barrier between the haul road and the towpath would need to be constructed to ensure public safety. The site access plan on the north side of the ALB would require an approximate travel way width of 40 feet beyond the extent of the proposed bridge to supply enough area for crane booms, pump trucks, man lifts, and other equipment needed to reach the proposed bridge deck from river level.

Access to the site at river level from the south side is more difficult. The existing residential neighborhood in the bridge's southwest quadrant constricts this area for site access. It is proposed that access to the south side of the river be via means of a temporary river causeway and temporary bridge, such as floating bridges and barges. River flooding would also need to be considered in the design of this temporary structure, which would require a contingency plan should water levels rise and would require the temporary structures be built to withstand the 100-year flood and barges and other equipment be removed prior to flood events.

The proposed construction access is shown in **Figure 5**. Storage of construction equipment, vehicles, and materials could be accommodated within the temporary LOD indicated in the Final EIS (FEIS).

Figure 5. Proposed Construction Access for American Legion Bridge



2.2.1.C. Avoided and Minimized LOD in the Vicinity of the American Legion Bridge

MDOT SHA determined the LOD options for the ALB based on the results of the ALB Strike Team investigations. The bridge construction types with the smallest LOD footprint were the Base Option and the Cast-In-Place Segmental Option, both with a similar LOD requirement. Both construction types could be built with an on-center alignment or a west-shift alignment. MDOT SHA compared the NPS land impacts and those of the natural and cultural resources surrounding the ALB and determined that the on-center alignment would impact the least amount of total NPS Land; would not require re-configuration of the Clara Barton Parkway interchange; and would not require residential displacement, as the west shift alignment would. For these reasons, the on-center alignment with the reduced LOD required by the Base Option or Cast-In-Place Segmental bridge types was incorporated into the Preferred Alternative LOD.

2.2.2 Thomas Branch

The Thomas Branch mainstem, features 21C and 23A, is located in the Cabin John Creek MD 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 Thomas Branch mainstem was assessed and delineated from River Road (MD 190) to just North of Democracy Boulevard (**JPA Impact Plates 6 through 10**). Thomas Branch is a highly-restricted stream system confined by concrete trapezoidal channels; bedrock; sheet pile noise walls; 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.

A preliminary geomorphic analysis was performed by MDOT SHA in July 2018, and the analysis concluded that the reach is highly constrained and restricted, and where not restricted, bank erosion and woody debris are moderately present. The results of this analysis and other field observations from the delineation and stream assessment were presented in an avoidance and minimization meeting with MDOT SHA, USACE, and MDE on May 13, 2019. Thomas Branch historically flowed down the center of the stream valley, but was relocated to either side of I-495 when the roadway was constructed in the 1960s. 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 is highly-degraded and has a limited functional value due to prior impacts, previous realignment, stream blockages, and a constrained channel environment. Although no recent fish data were available for Thomas Branch, Montgomery County Department of Environmental Protection (MCDEP) conducted fish sampling in 1996 and 2003. They documented blacknose dace, common carp, creek chub, and goldfish in 1996 and blacknose dace and creek chub in 2003.

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 within the Impact Narrative, Section 3.3, of this report.

Generally, Thomas Branch will be culverted for most of its length within the corridor study boundary due to its proximity to the roadway but will be maintained as an open channel wherever practicable.

2.2.3 Other Major Stream Crossings

Major stream crossings were examined to determine the potential for impact reduction. Stream crossings within the Preferred Alternative LOD 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." The mainstem of Thomas Branch and the Potomac River required extensive investigation and are documented in the previous sections, while the remaining major stream crossings are discussed in this section. 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 by crossing.

2.2.3.A. Rock Run

Rock Run, feature 22M, flows south under the Clara Barton Parkway, Chesapeake and Ohio Canal, and the Chesapeake and Ohio Canal Towpath west of I-495. Rock Run flows through a two-cell 10-foot-by-10-foot Reinforced Concrete (RC) box culvert located at Station 114+00 Left (LT) (**JPA Impact Plate 3**). 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 Preferred Alternative LOD near Rock Run includes areas necessary to allow access to construct the ALB over the Potomac River.

2.2.3.B. Booze Creek

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 Right (RT) (**JPA Impact Plate 5**). 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 Preferred Alternative LOD near Booze Creek includes construction access areas.

2.2.3.C. Cabin John Creek – River Road

Cabin John Creek – River Road, 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 198+00 RT and LT (**JPA Impact Plate 5 & 6**). 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 Preferred Alternative LOD near Cabin John Creek includes area to remove

existing structures and construct the new bridges. MDOT SHA commits to maintaining or improving aquatic life passage in Cabin John within the project limits.

2.2.3.D. Cabin John Creek – Montrose Road

Cabin John Creek – Montrose Road, 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 13 & 14**). 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 at the Montrose Road structure. 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 Preferred Alternative LOD includes areas near Cabin John Creek at Montrose Road for maintenance of traffic and at I-270 for culvert augmentation.

2.2.3.E. Muddy Branch

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 culvert located at Station 3328+00 RT and LT (**JPA Impact Plate 21**). 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 will not 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 Preferred Alternative LOD near Muddy Branch includes area necessary to allow for roadway resurfacing.

2.2.3.F. Watts Branch

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 18**). Watts Branch then flows through a 25-foot-by-8-foot RC box culvert under West Montgomery Avenue at Station 3484 LT. 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, or overflow pipes, will likely be required to be installed to maintain headwater depths. Since the culverted portions of the waterway (27A_C and 27A_C1) are proposed for augmentation, the areas downstream of the culverts have been designated as Limits of Restoration and Limits of Stabilization areas, which will require USACE and MDE review and approval of final stabilization/restoration design prior to any clearing or construction.

2.2.3.G. Old Farm Creek

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 11**). 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 Preferred Alternative LOD near Old Farm Creek includes areas necessary to allow for culvert augmentation. MDOT SHA commits to maintaining or improving aquatic life passage in Old Farm Creek within the project limits.

2.3 Individual Resource Avoidance and Minimization

The MLS Team evaluated agency recommendations for avoidance and minimization and implemented them wherever practicable during preliminary stages of design. Resource impacts associated with proposed noise walls were evaluated to determine if they could be limited by altering the placement of the structures. Proposed noise wall locations were refined to limit impacts to wetlands and waterways as much as possible and the results of this process are included in **Section 2.3.1**. Vernal pool wetlands provide important habitat for various species of wildlife, including amphibians and invertebrates and are a protection priority for MDE. The MLS Team identified vernal pools within the Preferred Alternative in coordination with MDE and worked to eliminate these areas from the LOD, as detailed in **Section 2.3.2**. All natural resource impacts were scrutinized within the Preferred Alternative LOD to ensure that there was significant justification for including them either for roadway expansion, constructability, drainage, or culvert augmentation. **Section 2.3.3** details the individual wetland, wetland buffer, and waterway impacts that were avoided and minimized during this process.

2.3.1 Noise Wall Barriers

Noise wall barriers are necessary for the abatement of traffic noise impact to noise-sensitive areas, as discussed in **Section 5.9 of the FEIS.** Several existing noise walls will be impacted, and new noise barriers are proposed within the Preferred Alternative LOD.

Two specific noise wall configurations were revised to minimize the impact to waterway features. At Station 312+00 RT and Station 342+00 RT, the noise wall barriers were brought in closer to the roadway so that the barriers could cross waterway features 21B and 20B, respectively, at a location that would already be impacted by roadway widening instead of further downstream.

2.3.2 Vernal Pools

Potential vernal pools were identified during field delineation of wetlands and verified during agency field reviews with the regulatory agencies. Two vernal pools were identified within the Phase I South portion of the Preferred Alternative: 22L_VP and 22LL_VP. Both vernal pool wetlands are located in close proximity to the ALB, and the LOD was revised to avoid impact to these wetlands.

2.3.3 Northern Long-Eared Bat

The northern long-eared bat (NLEB) is a federally threatened species in Maryland and Virginia that requires Endangered Species Act Section 7 consultation with USFWS if tree clearing for transportation projects would be greater than 15 acres, as is the case for the MLS. MDOT SHA coordinated with USFWS during the development of the LOD to exclude forested areas greater than 300 feet from the existing roadway to protect potential NLEB habitat. A total of 11 discreet areas were excluded from the LOD including areas within NPS land near the ALB and M-NCPPC land near Cabin John Creek.

2.3.4 Other Avoidance and Minimization

Based on agency comments, field reviews, and careful review of impacts and their justifications as the design progressed, the MLS Team requested revisions to the LOD to reduce or avoid impacts to specific features. **Table 2-2** includes a list of wetland, wetland buffer, and waterway feature impacts that were avoided or minimized throughout preliminary design.

Table 2. Individual Features Avoided or Minimized

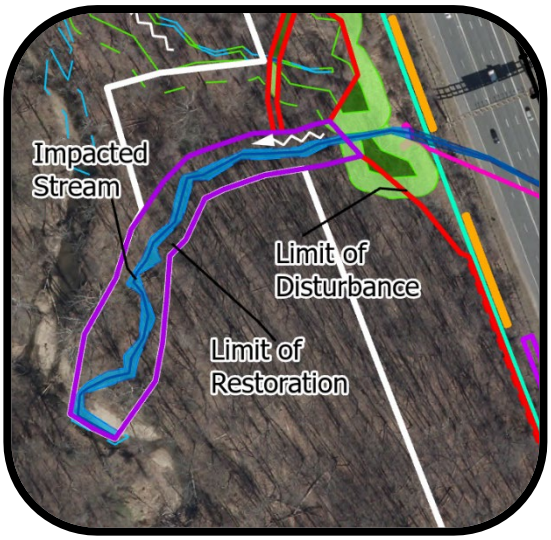
Feature ID	Classification and Type	Avoided or Minimized	Agency Requested
19J_2	Perennial Waterway	Avoided	No
20F_C	Perennial Waterway	Avoided	No
21B	Perennial Waterway	Minimized	No
21Q	Palustrine Forested (PFO) Wetland	Minimized	Yes
22JJ	PFO Wetland	Avoided	Yes
22L, 22L_VP	Palustrine Emergent (PEM) Wetland (Vernal Pool)	Avoided	Yes
22LL_VP	PEM Wetland (Vernal Pool)	Avoided	Yes
22K	PEM Wetland	Minimized	Yes
22I	PFO Wetland	Avoided	Yes
22O	PFO Wetland	Minimized	Yes
23E	Intermittent Waterway	Avoided	No
23EE	PFO Wetland	Avoided	Yes
23F	PEM Wetland	Minimized	Yes
23H	Ephemeral Waterway	Avoided	No
23HH	PFO Wetland	Avoided	Yes
23G, 23G_1, 23G_C	Perennial Waterways	Avoided	No
23GG	PFO Wetland	Minimized	Yes
23K_1	Perennial Waterway	Minimized	No
23R, 23R_1, 23R_2	Intermittent Waterways	Avoided	No
23PP	Intermittent Waterway	Avoided	No
23Q, 23Q_2	Perennial Waterways	Avoided	No
23NN	Perennial Waterway	Avoided	No
23QQ	Ephemeral Waterway	Avoided	No
23RR	Intermittent Waterway	Avoided	No
23S	Intermittent Waterway	Avoided	No
23SS	Ephemeral Waterway	Avoided	No
23T	Ephemeral Waterway	Avoided	No
23UU	Intermittent Waterway	Avoided	No
23WW	PFO Wetland	Avoided	No
24M	PEM Wetland	Avoided	No
24N	PFO Wetland	Minimized	No
25A_1	Perennial Waterway	Avoided	Yes
26G	Ephemeral Waterway	Avoided	No
26G_1	Intermittent Waterway	Avoided	Yes
26H	PEM Wetland	Minimized	Yes

Feature ID	Classification and Type	Avoided or Minimized	Agency Requested
27F	PFO Wetland	Minimized	Yes
29B, 29B_1	Perennial Waterway	Avoided	No
29C	Intermittent Waterway	Avoided	Yes
29E, 29E_1	Perennial Waterways	Avoided	Yes
29F	Perennial Waterway	Avoided	No
29G	PEM Wetland	Avoided	Yes
29H	Intermittent Waterway	Avoided	Yes
29J	PEM Wetland	Avoided	Yes
29L	PFO Wetland	Avoided	No
29M	PFO Wetland	Avoided	No
29N	PFO Wetland	Avoided	No
29P	Intermittent Waterway	Avoided	No

2.3.5 Required Future Avoidance and Minimization

Areas of stream restoration, stream stabilization, and improvements to SWM facilities require some impact to natural resource features. However, the MLS Team determined that these impacts should be differentiated from the LOD to ensure that impacts to natural resources are avoided and minimized to the maximum extent practicable by requiring additional design detail prior to clearing or resource impact for construction in these limits. These Limits of Restoration (LOR), Limits of Stabilization (LOS), and Limits of Improvement to Stormwater Capacity (LOI) areas require special consideration of impacts and require further coordination with agencies before any construction activity including clearing can take place.

2.3.5.A. Limits of Restoration (LOR)



On-site stream restoration activities will impact some streams and the wetlands adjacent to those streams. Impacts to these environmentally sensitive areas are often associated with culvert augmentation. These impacts typically result from excavation and/or fill associated with stream restoration treatments that may include, but are not limited to: rock toe protection, log vanes, cross vanes, and boulder step pools. At this preliminary stage of design, the details of the restoration have not been completed and the estimated limits are conservative. To ensure environmentally sensitive design and to prevent unnecessary tree clearing or impacts, these stream restoration areas have been excluded from the LOD and included in LOR linework on the JPA impact plates. In LOR areas, USACE and MDE approval of final restoration design is required prior to conducting any clearing or construction and will be focused on achieving ecological uplift with channel restoration.

2.3.5.B. Limits of Stabilization (LOS)

On-site stream stabilization activities will impact some short segments of stream and wetlands adjacent to these streams. Impacts to these environmentally sensitive areas are often associated with culvert augmentation. These impacts typically result from excavation and/or fill associated with stream stabilization treatments that may include, but are not limited to, scour pools and bank armoring. At this preliminary stage of design, the details of the stabilization have not been completed and the estimated limits are conservative. To ensure environmentally sensitive design and to prevent unnecessary clearing or impacts, these stream stabilization areas have been excluded from the LOD and included in the LOS linework on the JPA impact plates. In LOS areas, USACE and MDE approval of final stabilization design is required prior to conducting any clearing or construction. Work in these areas may include stabilizing a bank or repairing a small erosion area, but not full pattern and profile type restoration.

2.3.5.C. Limits of Improvements to Stormwater Capacity (LOI)

In some locations, streams and wetlands will be impacted by modifications to stormwater treatment facilities. In some cases, these modifications are necessary to increase storage capacity upstream of culverts and in other cases, modification may be needed to increase on-site stormwater quality or quantity treatment. Final stormwater design and culvert analysis cannot be completed at this stage of design and the estimated limits are conservative. To prevent unnecessary clearing and impacts, these improved stormwater and storage areas have been excluded from the LOD and included in LOI linework on the JPA impact plates. In LOI areas, USACE and MDE approval of stormwater treatment modifications is required prior to conducting any clearing or construction.

2.4 Avoidance and Minimization Summary

As evidenced in the above sections, all wetlands, their buffers, waterways, and floodplains were avoided and minimized to the maximum extent practicable **at this stage of the project**.

3 UNAVOIDABLE IMPACTS

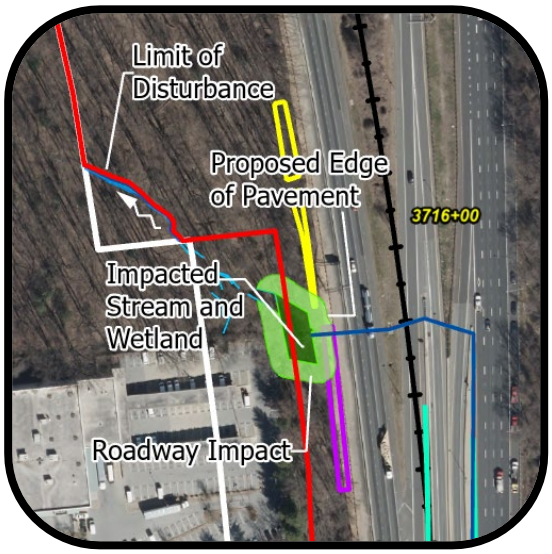
Despite the avoidance and minimization measures discussed previously, many impacts to wetlands, their buffers, waterways, and floodplains were unavoidable. Unavoidable impacts result primarily from fill and structures used to support the widened roadway; new interchanges; direct access ramps; and construction access areas needed to complete construction. Channel relocation, SWM outfalls, and wetland hydrology loss also cause unavoidable impacts. **Section 3.1** discusses these distinct sources of impact. **Section 3.2** discusses how SWM relates to and, in some cases, causes impact. One unique unavoidable impact type results from the need to augment culverts and increase culvert capacity to prevent flood risk and these impacts are discussed in **Section 3.3.** The LOD has been set to accommodate improvements related to aquatic life passage, which is discussed in **Section 3.4**. Finally, the rationale for each type of unavoidable impact was evaluated and is detailed for each impacted feature in the Impact Narrative, included in **Section 3.5**.

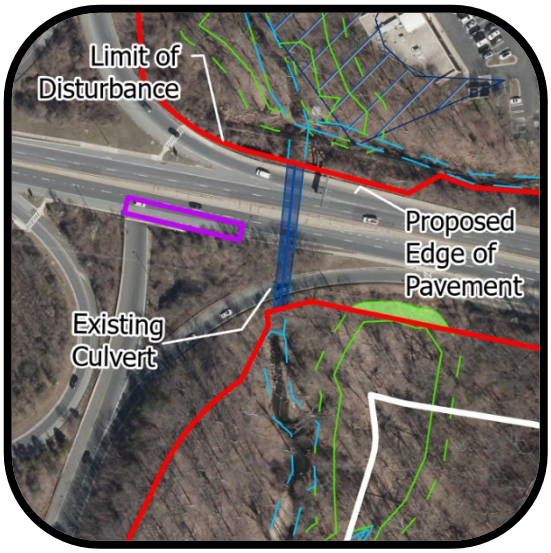
3.1 Impact Types

A total of 15 distinct impact categories have been identified to help describe the most common design elements that would affect natural resources. The name of each impact category was selected to represent the main cause of impacts in the category; however, some ancillary elements may be included in these categories. The general description of each category is presented below. Specific feature impacts are included by station and resource following the general impact category descriptions in the Impact Narrative, **Section 3.5**.

3.1.1 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.





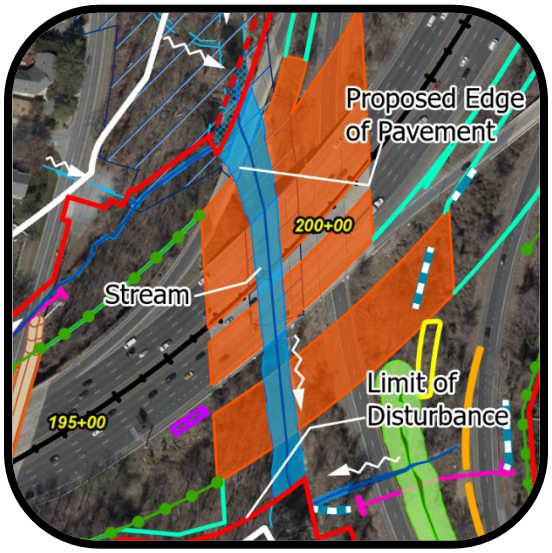
3.1.2 Existing Culvert

Channels classified as flowing within existing culverts or pipes inside the Preferred Alternative LOD 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.

3.1.3 Existing Bridge

Jurisdictional features beneath existing bridges inside the Preferred Alternative LOD 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. It is assumed that features flowing beneath bridges will maintain their existing function.



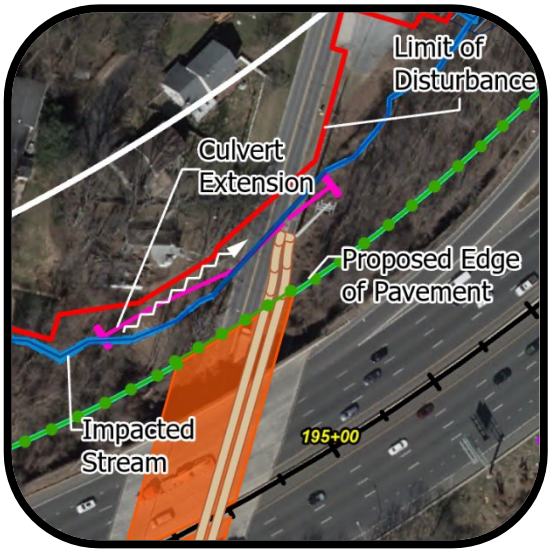
3.1.4 New/Expanded Bridge

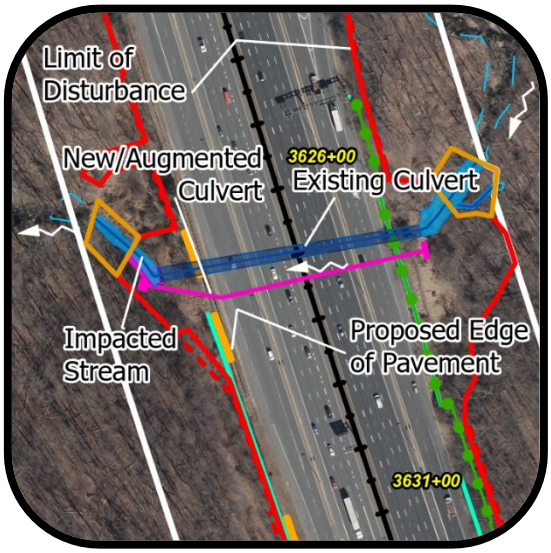
Jurisdictional features or portions of features that would be located under proposed new or expanded bridges are considered impacted. These impacts occur most commonly in direct access interchange and ramp additions. Since features below new or expanded bridges are within the proposed road edge, new or expanded bridge impacts are considered a subset of roadway impacts.

3.1.5 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. Some impacts may be the result of tying the culvert flow back into the waterway.

If a feature is located behind or next to the headwall of a culvert extension, then the feature is considered impacted by roadway. If a feature is only located directly in front of the culvert extension, then the feature is considered impacted only by the culvert extension.





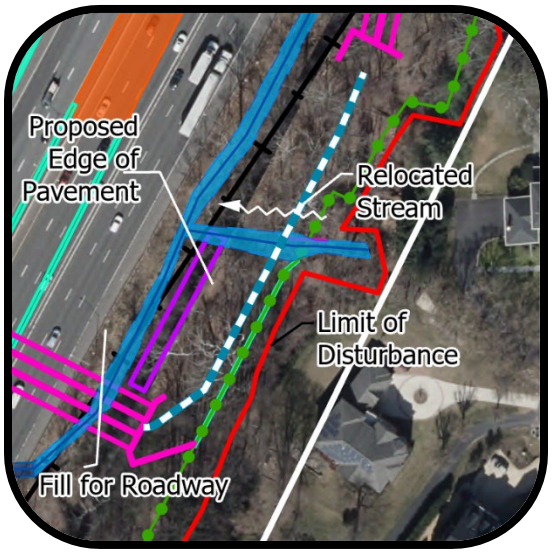
3.1.6 New/Augmented Culvert

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 2.2.3 Other Major Stream Crossings**.

If a feature is located behind or next to the headwall of a new/augmented culvert, then the feature is considered impacted by roadway. 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.

3.1.7 Relocated Channel

Relocated channel impacts are impacts to other wetland or waterway features resulting from the relocation of a channel.

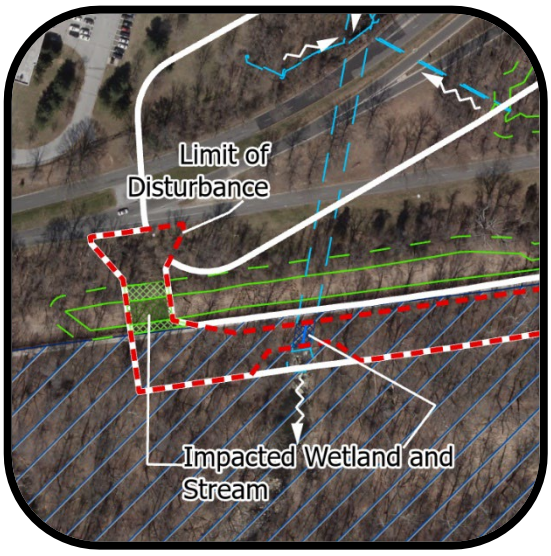


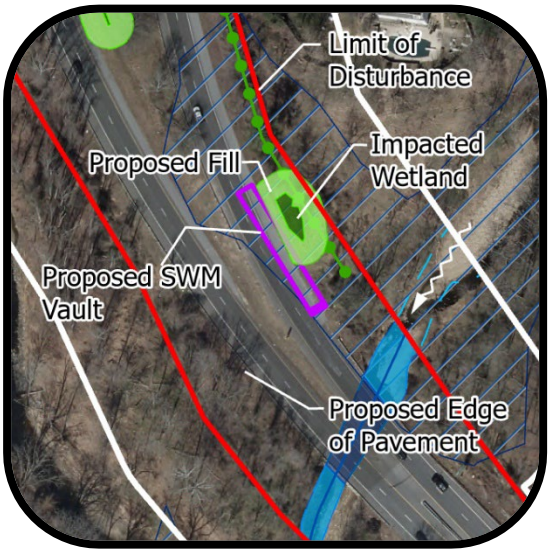
3.1.8 Stormwater Outfalls

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.

3.1.9 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.





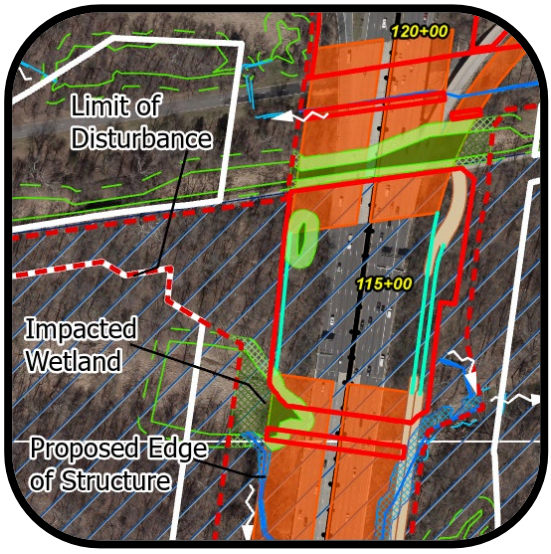
3.1.10 Hydrology Loss

Wetlands that were located partially within or near the temporary or permanent 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 were impacted by hydrology loss, roadway drainage and SWM changes 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 drainage and SWM alterations, 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 the open section roadway drainage providing most of the hydrology to the wetland would be captured, treated in SWM vault, and discharged directly into a stream channel, 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.

3.1.11 Shading

The ALB will be replaced and widened and the bridge over Clara Barton Parkway will also be widened. Portions of wetland and waterway features adjacent to the existing bridges that had not been previously shaded will be shaded by the new bridge structures. Shading will likely affect the extent and type of vegetative cover as well as the temperature of these resources, which would change their habitat quality. MDE will consider the newly shaded portions of features as impacted with mitigation required, while USACE will not consider newly shaded features as impacted.



3.1.12 Temporary Impacts

Temporary and permanent LODs have been defined for the Preferred Alternative. Temporary disturbance areas are those areas that are short-term and related to the construction of the Preferred Alternative that will not require MDOT SHA to purchase land for long-term maintenance. Short-term, construction related work includes construction staging, material and equipment storage, construction easements, and other areas needed to support the construction, but not part of the long-term improvements. However, some impacts to wetlands and waterways within the temporary LOD may be considered permanent.

Temporary impacts to wetlands and waterways are those that can be restored to pre-existing conditions (i.e. no major loss of vegetation and no loss of function and value). If construction would result in a change of classification or a loss of function, then the impact to the wetland or waterway would be considered permanent.

3.2 Impacts Related to Stormwater Management

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. This section presents the wetlands and waterways features that would be fully impacted by the roadway and replaced with SWM features; features that would experience hydrology loss from the roadway construction and be replaced with SWM facilities; features coordinated with the regulatory agencies that could be impacted by SWM facilities if sufficient justification were provided; and a list of remaining wetlands and waterways within the Preferred Alternative LOD that shall not be impacted by SWM facilities, as determined through extensive coordination with MDE and USACE.

3.2.1 Features Fully Impacted by the Roadway or Experiencing Hydrology Loss and Replaced with SWM Facilities

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.

The following wetlands will experience hydrology loss due to roadway construction, therefore SWM facilities are proposed on or near them. PEM wetland 22E (**JPA Impact Plate 4**) receives most of its hydrology from roadway drainage and will experience hydrology loss because of roadway widening, therefore a stormwater pond and stormwater swale are proposed adjacent to the proposed road edge. PFO wetland 23CC (**JPA Impact Plate 10**) receives most of its hydrology from untreated open section roadway drainage and will experience hydrology loss because new closed section drainage and SWM vaults will treat SWM and discharge directly to 23V_C, therefore a stormwater pond and a stormwater vault are proposed directly adjacent to the existing wetland's location.

The features that will be fully impacted by the proposed roadway footprint or would lose all hydrology and are proposed to be replaced with SWM facilities are presented in **Table 3-1**.

Table 3. Permanently Impacted Features Proposed for Replacement with SWM Facilities

Feature ID	Impact Plate	Classification	Impact	Replacement SWM Facility
21D_1	6	Intermittent	Roadway widening	Pond
22A	6	Intermittent	Roadway widening	Pond
22E	4	PEM	Hydrology loss	Swale, Pond
22F, 22G, 22H	5	PEM, PFO, Intermittent	Roadway ramp construction and culvert replacement	Pond
23CC	10	PFO	Hydrology loss	Adjacent swale

3.2.2 Features Coordinated with the Regulatory Agencies that Could Be Impacted by SWM Facilities with Sufficient Justification

In certain locations, the regulatory agencies determined that SWM facilities may impact natural resource features if sufficient justification was provided for the impact. The following justifications for impacting the features were determined through several office and field meetings to consider the feature's current functions.

Waterway 22H_1 and Wetlands 22F & 22G – Station 198+50 RT (JPA Impact Plate 5)

Waterway 22H_1 is an intermittent ditch that drains PEM wetland 22F and PFO wetland 22G. These features will be impacted by ramp construction and the replacement of a culvert (currently waterway 22H_C) to span the proposed ramps. A stormwater pond is proposed north of wetland 22G to capture runoff that is currently captured by these features. Waterway 22H_1 and wetlands 22F and 22G are degraded in function, therefore the construction of a functioning SWM pond would benefit the overall water quality of the area.

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

Waterway 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. Waterway 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 23GG – Station 3685+00 RT (Impact Plate 11)

Wetland 23GG will be partially impacted by the replacement of an impacted existing SWM facility. The existing stormwater facility treats the adjacent Montgomery County school bus facility and roadway widening and associated drainage improvements will partially impact the facility, thus the facility will require improvements as part of this project.

3.2.3 Features that Shall Not Be Impacted by SWM Facilities

The wetland and waterway features listed below shall not be impacted by SWM facilities. These features are fully or partially within the Preferred Alternative LOD but not fully impacted by roadway elements to

the point of elimination; not impacted by hydrology loss to the point of being a full take; and were not previously coordinated with the regulatory agencies for SWM impact. In most cases, these features are within the Preferred Alternative LOD because of necessary nearby modifications to existing structures such as culverts, bridges, or outfalls. Features within the LOR, LOS, or LOI should also be considered as part of this list if not specifically included below.

Wetlands

- 21P PFO
- 21T PFO
- 22OO PFO
- 22R PFO
- 22TT PFO
- 22U PFO
- 22W PEM
- 22X PFO
- 22Y PEM
- 23W PEM
- 26E PEM
- 27G PSS
- 27F PFO

Waterways

- 22SS Perennial
- 22ZZ Perennial
- 22UU Intermittent
- 22HH_2 Intermittent
- 22Q_1 Perennial
- 23A_1 Perennial
- 23DD Intermittent
- 23K Perennial
- 23C Intermittent
- 25H Perennial
- 29K Intermittent
- 29D_D Intermittent
- 29A_2 Perennial

3.3 Impacts Related to Augmented/Auxiliary Culverts

One element that contributes to the LOD required for many streams 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. Augmentation to provide additional hydraulic capacity at these crossings is necessary to: 1) avoid potential highway overtopping during the 100-year return interval flood, and thus to meet MDOT SHA's design criteria, 2) mitigate for increases in 100-year water surface elevations that result from culvert extension required for roadway widening, or 3) eliminate a culvert from classification as a dam per MDE policy Memo No. 2 criteria. Culvert classification as a dam should ideally be avoided as it would require that additional work be performed at the upstream and downstream ends of the culvert to comply with MDE Dam Safety regulations (e.g. slip line the pipe or add filter diaphragm).

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.

Based on the initial planning level analysis and review, culvert augmentation was proposed at 39 culvert sites across Phase I South. Further desktop and field investigations were completed on behalf of MDOT SHA, as described below, and the proposed culvert augmentation and/or replacement locations were revised to 33 sites.

Investigations, including some site visits and initial hydrologic and hydraulic computations, were conducted to set the LOD at each augmentation site. The LOD was expanded in these areas to accommodate this work including any erosion and sediment control, maintenance of streamflow, and channel stabilization downstream of the augmentation. The process developed to set the LOD attempts to balance the planning level nature of this project and the limited data availability with the need to provide a conservative yet realistically sufficient LOD limit.

Site visits were conducted on behalf of MDOT SHA at all proposed culvert augmentation sites in Phase I South to assess existing site conditions and potential LOD requirements related to existing conditions and proposed crossing modification. A desktop review of each location was conducted to prepare for each site visit. An assessment form, included for reference in **Appendix B**, was developed to use in this study. Data obtained in the desktop review, such as details of the existing and proposed culvert geometry, drainage area parameters, and estimate of the potential capacity increase via augmentation, were compiled in the assessment form. Additional site-specific information, such as upstream and downstream channel conditions including any bank erosion, channel head cutting, or other instability; notation of any unusual site circumstances including any potentially impacted built infrastructure; and a photo documentation log, were added to the assessment form during the field investigations. Based on the field findings, the investigation team recommended LOD requirements for each augmentation site. A summary document for each culvert augmentation site provides information about the location and the basis of the LOD recommendations. These individual site summaries are presented in **Appendix B**.

Results of MDOT SHA's preliminary analysis were used to set the LOD around the auxiliary culverts and results were shared with the Phase Developer. The Phase Developer then conducted a preliminary hydrologic analysis for all 104 culvert locations within Phase 1 South and identified 38 locations where culvert augmentation, extension, modification, or replacement is expected. The Phase Developer reviewed the LOD and requested LOD expansions in any areas that required additional area for construction. The culvert augmentation locations determined by the Phase Developer and the resulting LOD is reflected in the JPA Impact Plates and the FEIS.

The Phase Developer will conduct detailed hydrologic and hydraulic analysis as part of the final design to determine where augmentation or modification is required at each of the 104 culvert locations. The detailed study will utilize additional data, including roadway and stream topographic survey, to thoroughly analyze each culvert crossing location. The detailed study will also assess the hydraulic impacts associated with augmentation to confirm that the proposed design meets all regulatory requirements. Based on the results of the detailed hydrologic and hydraulic analysis, culvert modification locations may change in the final design.

3.3.1 Structure Modification/Replacement Methodology

MDOT reviewed structure inspection reports and noted condition for all structures within the Preferred Alternative LOD, including bridges, ramps, box culverts, noise walls, and drainage structures. MDOT SHA will require the Phase Developer to replace or rehabilitate all existing structures for the Phase I South portion of mainline I-495 & I-270 and associated ramps, except for existing culverts and noise walls demonstrated to be in a state of good repair or where replacement of specific bridges has been deferred to later in the anticipated 50-year term of the P3 agreement as agreed to by MDOT SHA. If replacement is deferred, replacement requirements and permitting will be deferred until such time as the replacement is undertaken. If not deferred, structures must be replaced or rehabilitated within the initial design and construction term, which is anticipated to be approximately 5 years. Existing culverts and noise walls within the mainline and all existing structures outside of the mainline, but within the Preferred Alternative LOD, must meet the residual life requirements as outlined in the Technical Requirements and a minimum 25-year residual life at hand back requirement at the conclusion of the P3 term. Some structures outside of the mainline and associated ramps were determined not to need replacement based on existing inspection records. It is incumbent upon the Phase Developer to do the necessary inspections and evaluations to determine the ability to incorporate existing structures that are not required to be replaced into the ultimate project. If the Phase Developer determines that an existing structure cannot meet these requirements, that structure must be rehabilitated or replaced as part of the project.

3.4 Aquatic Life Passage

Another element influencing the LOD at major stream crossings is the need to promote aquatic life passage. Code of Maryland Regulations (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)))."

All proposed culverts that will be greater than 150 feet in length are included in **Appendix C**. Only two existing culverts that are currently less than 150 feet in length, waterways 22C_C and 22H_C, are proposed for replacement with culverts that will increase their length beyond 150-feet. Waterway 22C_C (unnamed tributary to Cabin John Creek) is proposed for replacement to accommodate ramp reconfiguration. The proposed culvert system will be over 150 feet long when combined into a single culvert along with nearby features 22A_C, 22B, 22C, and 22D. This intermittent channel and culvert system originates as highway drainage and the proposed culvert does not connect to any upstream habitat. Because this system does not connect to upstream habitat, aquatic passage is not likely to be adversely affected. Waterway 22H_C (unnamed tributary to Cabin John Creek) is proposed for replacement to accommodate roadway reconfiguration along Cabin John Parkway. The culvert is currently less than 150-feet long and will be over 200 feet long after its replacement. The source of water flowing into waterway 22H_C is a pipe draining runoff from a residential neighborhood, therefore there is no upstream aquatic habitat.

Most of the culverts within the project area are longer than 300-feet in their existing condition and have limited potential for aquatic life passage. MDOT SHA coordinated with USFWS, MDNR, and NMFS to determine a list of priority crossings within the project area for aquatic life passage. The agencies provided feedback based on the USFWS Nature's Network Imperiled Species Habitat Layer, MDNR's Bionet, and streams within the project area that provide anadromous fish habitat. The resulting list of streams within the project area that have been identified as aquatic life passage and anadromous fish habitat priorities

includes: the Potomac River, Cabin John Creek, Old Farm Creek, and Watts Branch. MDOT SHA coordinated with the resource agencies to include many commitments related to aquatic life passage in the FEIS. One of these is that MDOT SHA commits to maintaining or improving aquatic life passage in Cabin John Creek, Watts Branch, and Old Farm Creek within the Preferred Alternative LOD and will consider the recommendations outlined in the *Recommendations for Aquatic Organism Passage at Maryland Road-Stream Crossings* for new and replacement culverts. Please see FEIS Chapter 7 for a full list of commitments.

3.5 Impact Narrative

Wetland, wetland buffer, waterway, and floodplain impacts are unavoidable for the Preferred Alternative. The reason and rationale for each impact is described below by location and resource to add clarity to the impact plates. The descriptions include both temporary and permanent impacts. The impacted systems are described according to order of appearance on the Impact Plates and by station along the Phase I South portion of the corridor study boundary and impacts are generally discussed from upstream to downstream within impacted systems.

3.5.1 Mainline Impact Plate 1

Project NEXT, a separate project from the I-495 and I-270 MLS, will impact the resources shown within the LOD on Impact Plate 1 before the MLS begins construction.

3.5.2 Mainline Impact Plate 2

3.5.2.A. Station 95+50 to 97+50 LT & RT; Waterways 22WW, 22WW_C

Intermittent waterway 22WW_C is an existing culvert that requires replacement and headwall modification at the inlet end for a proposed new shared use path and retaining wall. Waterway 22WW_C will require outfall extension and modification to accommodate the widened roadway and associated retaining wall and noise wall. Intermittent waterways 22WW and 22UU will be permanently impacted by the 22WW_C culvert replacement and extension. A portion of the impact to waterway 22WW will be temporary in order to tie in the replaced inlet to 22WW_C.

3.5.2.B. Station 97+50 to 114+00 LT & RT

a. Waterways 22UU, 22VV; Wetland 22TT

Intermittent waterway 22UU will be permanently impacted by roadway widening, access for ALB pier construction, the extension of 22WW_C, and accommodation of the Potomac Heritage trail. PFO wetland 22TT and part of ephemeral waterway 22VV will be temporarily impacted by construction access necessary to construct the ALB. Waterway 22VV will also be permanently impacted by roadway widening, structure modification, and the proposed shared use path.

b. Waterways 22MM and 22MM_B

Perennial waterways 22MM and 22MM_B are the Potomac River, also a Traditionally Navigable Waterway. Waterways 22MM and 22MM_B will be permanently impacted by the construction of bridge piers supporting the ALB and will be temporarily impacted by access necessary to construct the ALB. Permanent impacts to the Potomac River were calculated based on the square foot (SF) increase in pier

footprint. The existing ALB piers total 945 SF and the proposed bridge piers total 2,214 SF resulting in an net permanent impact of 1,296 SF. All other impacts to the Potomac River are temporary for construction access. One of the existing in-water piers of the ALB will be eliminated and the proposed piers near Plummers Island will be drilled shaft piers, which will minimize impact to Plummers Island. Construction access impacts include temporary trestle and causeway construction, as well as potential barge operation in the mainstem of the Potomac River, and temporary bridging of the oxbow channel around Plummers Island, also 22MM, on the east side of the ALB.

c. Waterways 22NN, 22NN_B; Wetland 22OO

Intermittent waterways 22NN, 22NN_B, and part of PFO wetland 22OO and its buffer will be temporarily impacted by construction access necessary for the replacement of the ALB. Part of PFO wetland 22OO and its buffer and part of 22NN_B will also be permanently impacted by a bridge pier supporting the ALB, abutment fill, and shading from the widened ALB.

d. Waterways 22QQ, 22MM

Intermittent waterway 22QQ and a portion of 22MM, the oxbow channel of the Potomac River around Plummers Island, will be temporarily impacted by outfall stabilization to repair erosion in 22QQ. 22MM, the oxbow channel of the Potomac River around Plummers Island, will also be temporarily impacted for construction of the widened ALB, and no bridge piers or hardened structures will be placed within the oxbow.

3.5.3 Mainline Impact Plate 3

3.5.3.A. Station 114+50 to 116+00 LT; Waterway 22M_C; Wetlands 22W, 22PP

Part of PEM wetland 22W, its buffer, and perennial waterway 22M_C will be temporarily impacted by the ALB construction access road, which permits direct access to northbound and southbound I-495 for incoming and outgoing vehicles with minimal travel on the Clara Barton Parkway. PFO wetland 22PP and its buffer will be permanently impacted by grading associated with the widened roadway, retaining wall construction, and bridge abutment.

3.5.3.B. Station 116+50 to 119+50 LT & RT; Waterways 22V, 22V_B, 22V_B1, 22V_1, 22V_2; Wetlands 22W and 22K

Intermittent waterways 22V_B1 and 22V_1will be permanently impacted by bridge piers for I-495 over Clara Barton Parkway and the Chesapeake and Ohio Canal. These features and 22V, 22V_2, and 22V_B will be temporally impacted by access to construct this bridge. Part of PEM wetland 22W and its buffer will be permanently impacted by shading from the widened bridge carrying I-495 over Clara Barton Parkway and the Chesapeake and Ohio Canal and temporarily impacted by access to construct this bridge. PEM wetland buffer 22K will also be temporarily impacted by impacted by construction access for this bridge.

3.5.3.C. Station 123+50 to 126+50 RT; Waterways 22Q, 22Q_C; Wetlands 22X and 22Y

Perennial waterways 22Q and 22Q_C; PFO wetland 22X and its buffer; and PEM wetland 22Y and its buffer will be permanently impacted by the eastbound Clara Barton to northbound I-495 roadway ramp widening, retaining wall construction, and the construction of a nearby SWM pond and its outfall.

3.5.3.D. Station 124+50 to 125+50 LT; Waterway 22P and Wetland Buffer 22O

Portions of intermittent waterway 22P and PFO wetland buffer 22O will be permanently impacted by construction access necessary for roadway widening.

3.5.3.E. Station 127+25 to 133+50 RT & LT

a. Waterways 22HH, 22HH_C, 22HH_1

Intermittent waterway 22HH will be permanently impacted by construction access to build a noise wall and proposed retaining wall to support roadway widening. A portion of 22HH will be relocated to realign the channel outside of the retaining wall. Intermittent waterway 22HH_C, an existing culvert, will be permanently and temporarily impacted by roadway widening and construction of the I-495 Bridge over MacArthur Boulevard and Clara Barton Parkway. Intermittent waterway 22HH_1 will be permanently impacted by roadway widening and bridge construction.

b. Waterways 22T, 22T_B, 22T_1, 22T_B1, 22T_2, 22HH_2; Wetland 22U

PFO wetland 22U and its buffer and intermittent waterways 22T, 22T_B, 22T_1, 22T_B1, and 22T_2 will be permanently impacted by roadway, ramp, and structure widening over Clara Barton Parkway and MacArthur Blvd. Intermittent waterway 22HH_2 will be permanently impacted by roadway and structure widening, proposed retaining wall construction, and the stabilization of tie-ins to 22HH_1 and 22T_2.

3.5.4 Mainline Impact Plate 4

3.5.4.A. Station 151+00 LT; Wetland 22E

PEM wetland 22E and its buffer will be permanently impacted by fill necessary to support the widened roadway. Since the wetland and buffer will be eliminated by roadway fill, a proposed SWM swale has been proposed in the new roadway fill.

3.5.4.B. Station 176+00 to 177+00 RT; Waterway 22FF

Ephemeral waterway 22FF will be permanently impacted by grading associated with the construction of a SWM facility. Since the waterway is currently functioning as a SWM pathway and does not connect to other jurisdictional features, the feature will be modified to function as a proper SWM pond with a functioning channel.

3.5.5 Mainline Impact Plate 5

3.5.5.A. Station 191+00 to 206+00 LT; Waterways 22AA_1, 22AA_2, 22AA_3, 22AA_B, 22AA_B1, 22BB, 22CC, 22CC_C, 22CC_1, 22DD, 22EE

Ephemeral waterways 22BB, 22CC, 22EE, 22CC_C, 22CC_1 and intermittent waterways 22DD_C and 22DD comprise a drainage network draining I-495 and an adjacent neighborhood. This drainage network is characterized by eroded channels, undersized culverts, and undermined concrete channel. Roadway widening and drainage/stormwater improvements will result in permanent impacts to these features. The hydrology forming portions of 22CC and 22EE will be captured in a SWM facility, while 22BB will be relocated to accommodate the new SWM facility and carry stormwater from the new facility to a new longer culvert replacing 22CC_C. A portion of the impact to 22CC will be temporary due to construction

access. The longer culvert will help alleviate drainage concerns of the Gibson Grove AME Zion Church. A restored channel will carry flow from this culvert, accounting for the permanent impacts to 22CC_1 and 22DD, by replacing the undermined and eroding concrete lined channel with a stable armored channel. Cabin John Creek (features 22AA_1, 22AA_2, 22AA_3, 22AA_B, 22AA_B1) will be permanently impacted by roadway and ramp bridge replacements and necessary streambank stabilization and scour protection measures. A portion of water 22AA_1 will be temporarily impacted by construction access to remove a ramp bridge over Cabin John Creek.

3.5.5.B. Station 197+00 to 200+00 RT

a. Waterways 22H, 22H_1, 22H_C, 22KK; Wetlands 22F and 22G

Intermittent waterways 22H, 22H_1, and 22H_C will be replaced with a new 48-inch culvert to accommodate Cabin John Parkway ramp reconfiguration. PEM wetland 22F and its buffer, and PFO wetland 22G and its buffer will be permanently impacted by fill from the ramp reconfiguration. Perennial channel 22KK will be permanently impacted as it is relocated to accept flow from the new 48-inch culvert.

b. Wetland 22GG

PEM wetland 22GG and its buffer will be permanently impacted by roadway fill and construction access for the reconfigured Cabin John Parkway Ramps and will lose hydrology due to these impacts. Since wetland 22GG and its buffer will be eliminated by construction impacts, a SWM vault and a SWM swale are proposed in this location.

c. Waterways 22Z, 22Z_C, 22Z_1

Perennial waterways 22Z, 22Z_C, and 22Z_1, Booze Creek, will be permanently impacted by the reconfiguration of the Cabin John Parkway Ramps.

3.5.6 Mainline Impact Plate 6

3.5.6.A. Station 218+50 to 233+00 LT; Waterways 22A, 22A_C, 22B, 22C, 22C_C, 22D, 22AA

Intermittent waterways 22A, 22B, 22C and intermittent culverts 22A_C and 22C_C will be permanently impacted by roadway widening and ramp reconfiguration. All of these features will be removed and replaced with a new culvert system. A stormwater pond will be constructed at the beginning of this system to treat roadway runoff. Intermittent waterway 22D will be permanently impacted by construction access and outfall stabilization associated with the new roadway drainage and SWM. Perennial waterway 22AA (Cabin John Creek) will be permanently impacted by the stabilization of the tie-in to waterway 22D

3.5.6.B. Station 224+50 RT to 245+50 RT and 223+00 to 247+00 LT

a. Waterways 21D, 21D_C, 21D_1, 21D_C1

Intermittent waterway 21D will be permanently impacted by roadway ramp construction and a SWM pond will be constructed upstream of its previous location. Intermittent waterways 21D_C and 21D_1 will be permanently impacted by roadway widening fill and SWM pond construction. Intermittent culvert 21D_C1 will be permanently impacted by roadway ramp shifts, and SWM swale construction. The existing intermittent channel complex, consisting of culverts and drainage ditches in this interchange, will be replaced with a stormwater treatment complex consisting of two treatment ponds connected by culverts directly to the Thomas Branch Culvert.

b. Waterways 21F, 21F_C

Intermittent culvert 21F_C, an existing 30-inch reinforced concrete pipe (RCP), will be replaced and extended to accommodate roadway widening. Intermittent waterway 21F will be permanently impacted by roadway widening fill, noise wall construction, retaining wall construction, and upstream stabilization for the augmentation of 21F_C that is included in a LOR.

c. Waterways 21C_1, 21C_C1, 21G

Perennial waterway 21C_1 (Thomas Branch) will be permanently impacted by roadway widening fill, retaining wall construction and stream stabilization associated with the downstream culvert augmentation. Waterway 21C_1 will be relocated in an open channel adjacent to the retaining wall. Perennial culvert 21C_C1, an existing 12-foot-by-9-foot reinforced concrete box culvert (RCB) carrying Thomas Branch under I-495, will be extended to accommodate roadway widening and augmented with three 12-foot by 10-foot RCBs. Intermittent waterway 21G will be permanently impacted by the upstream headwall structure for the augmented 21C_C1 culvert.

d. Waterways 21C_2, 21C_C2, 22AA

Perennial waterway 21C_2 (Thomas Branch) will be replaced with a pair of 16-foot-by-12-foot RCBs, permanently impacting its entire length depicted on this plate to accommodate roadway widening and a ramp to River Road. Perennial waterway 21C_C2, an existing 12-foot-by-9-foot RCB, will be augmented with three new 108-inch RCPs on the west side of the existing RCB. The existing culvert will be shortened to permit the construction of a plunge pool between the end of the culverts at Cabin John Creek (22AA). Perennial waterway 22AA (Cabin John Creek) will be permanently impacted by the downstream outfall and stabilization for augmented culvert 21C_C2 and temporarily impacted by construction access.

3.5.7 Mainline Impact Plate 7

3.5.7.A. Station 249+50 to 261+00 RT and 261+00 to 279+00 LT

a. Waterways 21L_D, 21L_C, 21L_D1

To accommodate roadway widening, perennial waterway 21L_C, an existing 78-inch structural plate pipe (SPP) culvert, will be extended and augmented with an additional 60-inch RCP and will outfall into Thomas Branch in a plunge pool at the downstream end of a pair of box culverts. Perennial waterway 21L_D, a ditch, will be permanently impacted by roadway widening and relocated to flow into the extended 21L_C culvert. Perennial waterway 21L_D1, a ditch, will be permanently impacted and replaced by the extended 21L_C culvert.

b. Waterways, 21C, 21M

Perennial waterway 21C (Thomas Branch) will be permanently impacted by roadway widening. 21C will be placed into a pair 14.5-foot-by-11.5-foot RCBs near Station 278+00, will be relocated adjacent to the widened roadway retaining wall from Station 278+00 downstream to Station 266+00, and placed into a pair of 12-foot-by-10-foot RCBs from Station 266+00 to the junction with feature 21C_C. Intermittent waterway 21M, a ditch between a neighborhood drainage pipe and Thomas Branch, will be eliminated and the neighborhood drainage will be piped directly into culverted Thomas Branch at the upstream end of 21C_C.

c. Waterways 21C_C, 21C_1

Perennial waterway 21C_C, an existing 12-foot-by-9-foot RCB, will be extended to accommodate roadway widening and augmented with a pair of flanking 12-foot-by-10-foot RCBs. This structure will convey Thomas Branch flow under I-495, and then turn to convey flow to the south, parallel to the I-495 inner loop and permanently impacting a portion of perennial waterway 21C_1. The remainder of 21C_1 will be permanently impacted downstream by roadway widening, retaining wall construction, and noise wall construction, and will be relocated adjacent to the roadway retaining wall.

d. Waterway 21H; Wetlands 21P, 21T, 21Q

PFO wetland 21P and its buffer, part of PFO wetland 21T and its buffer, part of PFO wetland buffer 21Q, and ephemeral waterway 21H will be permanently impacted by relocation of Thomas Branch necessary to accommodate the widened roadway.

3.5.8 Mainline Impact Plate 8

3.5.8.A. Station 297+50 to 309+50 RT; Waterways 21B, 21U, 21B_C, 21J

Perennial waterway 21B will be permanently impacted by roadway widening fill, ramp construction, and noise wall construction. At the upstream end of 21B on this plate, the waterway within the LOD will be restored prior to flowing into a culvert. From Station 312+00 to Station 303+00 the waterway will be placed in a pair of 10-foot-by-4-foot RCBs under the roadway. 21B will be relocated and partially confined between two retaining walls from the end of the RCBs to Station 298+50 where it enters three 11-foot-by-5-foot RCBs crossing under I-495, which will replace 21B_C. These three RCBs will enter directly into culverted Thomas Branch at a junction box eliminating 21J, which connects flow from 21B_C to Thomas Branch in its existing condition. Perennial waterway 21U will be permanently impacted by the widened roadway, the relocated 21B, and noise wall construction. 21U will be piped under the proposed noise wall at the upstream end of a retaining wall and will flow into relocated 21B.

3.5.8.B. Station 279+50 to 297+00 LT; Waterway 21C, 21K, 21V

Perennial waterway 21C, Thomas Branch, will be permanently impacted by roadway widening and will be placed in a culvert running under the roadway for its entire length depicted on this plate. Thomas Branch could not be relocated as an open channel in this section because of the proximity of adjacent properties and the local topography. Upstream of the tie-in with 21B_C, Thomas Branch will flow in a pair of 16-foot-by-7-foot RCBs. Downstream of the tie-in with 21B_C, the stream will flow in a pair of 16-foot-by-10-foot RCBs. Intermittent waterway 21V will be permanently impacted by roadway widening and most of the channel will be replaced with a pipe flowing into Thomas Branch. Part of waterway 21V will remain open outside of the LOD, and 21V will be temporarily impacted by the tie-in to the open channel portion. A retaining wall is located is this section to reduce impact to properties and to 21V. Intermittent waterway 21K, a short channel carrying flow from a culvert under I-495 to Thomas Branch, will be eliminated and replaced by the proposed Thomas Branch culvert.

3.5.9 Mainline Impact Plate 9

3.5.9.A. Station 3747+00 to 3760+50 LT & RT

a. Waterways 23A_C1, 23A_2, 23A_C2, 23A_3

Perennial waterways 23A_C1, 23A_2, 23A_C2 and 23A_3 carry Thomas Branch from the east side of the west I-270 spur to the west side of the spur diagonally through the Democracy Boulevard interchange. Roadway widening and resultant interchange improvements will permanently impact these features and force the abandonment of the original channel alignment. In the proposed condition, Thomas Branch will flow along the east side of the west I-270 spur through the interchange and will cross the spur near Station 3759+00. This new alignment results in shorter culverted sections of Thomas Branch. On this plate, Thomas Branch will flow in a relocated channel inside the Democracy Boulevard to northbound I-270 ramp and then under this ramp through three 84-inch RCPs. The stream will then flow through a short, relocated channel and under the northbound I-270 to Democracy Boulevard ramp in three 84-inch RCPs, where it joins with the flow from 23D. The combined flow is described in **Section c** below.

b. Waterways 23AA, 23AA_C, 23AA_1, 23AA_C1; Wetlands 23L, 23BB

The perennial channel and PEM wetland system consisting of perennial culverts 23AA_C and 23AA_C1; perennial waterway 23AA and 23AA_1; and PEM wetlands 23L and 23BB and their buffers will be permanently impacted by roadway widening and Democracy Boulevard interchange reconfiguration. The stream system will be combined with relocated Thomas Branch and will follow the flow path described in **Section a** above. The PEM wetland systems and their buffers will be filled to accommodate the widened roadway and relocated Thomas Branch.

c. Waterways 23D, 23D_C

Intermittent waterway 23D will be permanently impacted and merged with relocated Thomas Branch at the end of the proposed Thomas Branch culvert under the northbound I-270 to Democracy Boulevard ramp. The merged streams will flow south in a relocated channel along the northbound I-270 to Democracy Boulevard ramp; through a pair of 12-foot-by-8-foot RCBs; then through another relocated channel; and finally into three 11-foot-by-7-foot RCBs the cross perpendicularly under the west I-270 spur, permanently impacting and replacing 23D_C.

3.5.9.B. Station 3760+50 to 3779+00 RT

a. Waterway 23A_3 and Wetland 23MM

Perennial waterway 23A_3 (Thomas Branch) will flow in a relocated channel south along the west side of the west I-270 spur until the channel naturally flows away from the edge of the west I-270 spur. As 23A_3 flows away from the spur, the channel will be permanently impacted by stream stabilization within the Limits of Stabilization shown on the plate. Part of PFO wetland 23MM and its buffer will be permanently impacted by stream stabilization within the limits of stabilization shown on the plate. Waterway 23A_3 flows outside of the LOD between Station 3766+00 and 3775+00 RT.

b. Waterways 21C and 21I

Perennial waterway 21C (Thomas Branch) is a continuation of 23A_3 where it reenters the LOD at Station 3775+00 RT. Waterway 21C will be permanently impacted by roadway widening and will flow in a relocated channel along the west edge of the west I-270 spur adjacent to a retaining wall until it enters a proposed pair of 16-foot-by-7-foot RCBs and continues onto Plate 8. Perennial waterway 21I, a short

stream segment flowing from a pipe under the west I-270 spur into Thomas Branch, will be eliminated by roadway widening, and the pipe will discharge directly into relocated Thomas Branch.

3.5.10 Mainline Impact Plate 10

3.5.10.A. Station 3714+00 to 3722+50 LT & RT; Waterways 23V, 23V_C; Wetland 23CC

Intermittent waterway 23V and 23V_C will be permanently impacted by roadway widening, and part of 23V will be placed into a pipe. PFO wetland 23CC developed at the downstream end of culvert 23V_C. Wetland 23CC and its buffer will be permanently impacted by roadway fill within the LOD and will lose its remaining hydrology due to roadway drainage. Wetland 23CC and its buffer are considered a total take, therefore SWM features are proposed in place of the wetland.

3.5.10.B. Station 3741+00 to 3748+00 LT & RT

a. Waterways 23A, 23A_C, 23A_1, 23A_C1; Wetland 23W

Perennial waterways 23A, 23A_1, and culverts 23A_C and 23A_C1 comprise the headwaters of Thomas Branch within the LOD. 23A and 23A_C will be permanently impacted by construction access and tie-in to the downstream stream restoration during construction. Feature 23A_1 will be permanently impacted by stream restoration within the limits of restoration shown on the plate and will also be partially filled due to roadway widening. As described in **Section 3.6.9.A**, Thomas Branch is relocated to the east side of the west I-270 spur and 23A_1 flows into a pair of 8-foot-by-8-foot RCBs under Democracy Boulevard, which replace the function of permanently impacted culvert 23A_C1. Part of PEM wetland 23W and its buffer will be will permanently and temporarily impacted by roadway widening fill and stream restoration. A retaining wall will be installed adjacent to wetland 23W to minimize the fill impacts to the wetland and the wetland buffer.

3.5.11 Mainline Impact Plate 11

3.5.11.A. Station 3683+00 LT & RT; Waterways 24A, 24A_C, 24A_1; Wetland 24W, 24X

Perennial waterway 24A, 24A_1, and culvert 24A_C (Old Farm Creek), flows as open channel and through an existing 20-foot-by-10-foot box culvert under I-270. These features are proposed for stream stabilization within the limits shown on the plate and will be permanently impacted by construction access and scour protection on either side of I-270. Impacts to Old Farm Creek may be required to ensure fish passage remains the same or is improved in this location. Portions of PEM wetland buffer 24W and PEM wetland 24X and its buffer will be permanently impacted by stream stabilization.

3.5.11.B. Station 3683+00 to 3702+50 RT

a. Waterways 23DD, 23K, 23K_1, 23K_C1, 23K_D, 23K_C; Wetlands 23F, 23X

All features along the west side of I-270 in this area will be permanently impacted by fill or drainage outfall improvements associated with the roadway widening of I-270. Intermittent waterway feature 23DD and perennial waterway 23K will be permanently impacted by fill despite the inclusion of a retaining wall adjacent to the SWM pond. Part of PEM wetland buffer 23F near Station 3679+00 will be permanently impacted by the construction of SWM features at the end of roadway drainage pipes. Portions of PEM wetland 23F, its buffer, and perennial channel 23K_1 will be permanently impacted by roadway drainage outfall improvements near Station 3695+00 and by channel relocation necessary to accommodate

roadway widening and retaining wall construction near Station 3692+50. Culvert 23K_C1 will be permanently and temporarily impacted by construction access and maintenance of stream flow. Perennial ditch 23K_D will be permanently impacted by roadway widening. This ditch will be relocated for a short distance near Station 3691+50 and then placed in a 6-foot-by-12-foot RCB that will carry flow along I-270, under Tuckerman Lane and will discharge into Old Farm Creek. A portion pf 23K_D will be temporarily impacted by construction access necessary for the culvert construction and channel relocation. Culvert 23K_C will be permanently impacted, removed, and replaced with a 6-foot-by-12-foot RCB. PEM wetland 23X and its buffer will be eliminated by roadway widening.

b. Wetland 23GG

The eastern portion of PFO wetland 23GG and its buffer will be permanently impacted by the restoration of a county-owned SWM pond located at the northeast corner of the bus depot, which is being impacted by roadway widening. The buffer of feature 23GG will be permanently impacted for proposed maintenance of traffic control purposes along Tuckerman Lane. Design options for proposed fill impacts to a portion of 23GG by the stormwater facility were discussed with MDE and USACE in the field and, of the options discussed, the selected option was deemed reasonable by both agencies, since the existing wetland is currently acting as a stormwater facility.

3.5.11.C. Station 4711 +00 LT; Waterway 23M

Ephemeral channel 23M will be permanently impacted by maintenance of traffic and construction access.

3.5.12 Mainline Impact Plate 12

3.5.12.A. Station 3661+60 R; Waterway 24C

Intermittent waterway 24C flows southwest from a non-jurisdictional drainage pipe under I-270 and will be permanently impacted by roadway widening, retaining wall construction, and SWM outfall stabilization.

3.5.13 Mainline Impact Plate 13

3.5.13.A. Station 3625+50 to 3627+50 LT & RT; Waterways 24K, 24F_2, 24F_C2, 24F_3

Perennial culvert 24F_C2, an existing 16-foot-by-8-foot concrete box culvert, will be augmented with an additional parallel 48-inch RCP and extended. Intermittent channel 24K and perennial channel 24F_2 will be permanently impacted by stream stabilization associated with the culvert 24F_C2 augmentation within the limits shown on the plate. Perennial waterway 24F_3 will be permanently impacted by the extension of the existing box culvert, the culvert 24F_C2 augmentation, and the stream stabilization associated with culvert augmentation within the limits shown on the plate.

3.5.13.B. Station 3638+75 RT; Wetland 24N

A stormwater pond is proposed on the southbound side of I-270. Part of PFO wetland 24N and its buffer will be permanently impacted by the outfall from this new facility. The buffer of wetland 24N will be permanently impacted by stormwater pond construction and construction access for retaining wall and roadway widening.

3.5.13.C. Station 3639+25 to 3646+00 LT & RT; Waterways 24V, 24V_C, 24D; Wetlands 24N, 24Q

Intermittent culvert 24V_C, an existing 60-inch RCP, will be augmented with an additional 60-inch RCP to accommodate flow and extension to accommodate proposed noise and retaining walls on the east side of I-270 adjacent to the widened roadway. Intermittent waterway 24V will be permanently impacted by the culvert extension and augmentation for 24V_C. Perennial waterway 24D will be permanently impacted by repairing the existing failing outfall from 24V_C, construction of a pedestrian bridge to ensure safe trail connection across waterway 24D, and for stream restoration associated with culvert augmentation within the limits shown on the plate. PFO wetland 24Q has formed where non-jurisdictional drainage flowing north along I-270 encounters a surface trail and enters 24D. This wetland and its buffer will be permanently impacted by the 24D outfall repair, pedestrian bridge construction, and by grading of a stable non-jurisdictional swale to convey flow into 24D. Wetland 24Q and its buffer will lose hydrology due to the drainage improvements and this wetland and its buffer are considered a total take. Part of PFO wetland 24N and its buffer will be permanently impacted by the outfall repair, pedestrian bridge construction, and stream restoration. The trail and crossing are shown in FEIS Appendix E, Environmental Resource Mapping, Map 23.

3.5.14 Mainline Impact Plate 14

3.5.14.A. Station 3614+00 to 3617+00 LT; Waterways 24F_C1, 24S; Wetland 24R

Perennial culvert 24F_C1, ephemeral waterway 24S, and part of PFO wetland buffer 24R will be permanently impacted by roadway widening and construction access.

3.5.15 Mainline Impact Plate 15

3.5.15.A. Station 3581+00 to 3582+50 LT; Waterway 25F

Ephemeral waterway 25F will be permanently impacted by construction staging, storage, and access.

3.5.15.B. Station 3571+50 RT

Part of PEM wetland buffer 25M will be permanently and temporarily impacted by roadway re-configuration on Wootton Parkway.

3.5.16 Mainline Impact Plate 16

3.5.16.A. Station 3537+50 LT; Wetland 26H

Part of PEM wetland 26H and its buffer will be permanently impacted by roadway widening fill.

3.5.16.B. Station 3559+75 to 3567+75 RT; Waterways 25E, 25H_1, 25H_C; Wetland 25K

Perennial waterway 25H_C, an existing 60-inch RCP that flows under I-270, requires augmentation with an additional 48-inch RCP and extension. Control structure modifications are required for the flow from perennial waterways 25E and 25H_1 and the surrounding PEM wetland 25K and its buffer into culvert 25H_C. All of these features will also be permanently impacted by widening of I-270, and these features will be potentially permanently impacted by stormwater improvements within the limits shown on the

plate. These features are shown as permanent impacts for this JPA, but these areas will require additional design detail and avoidance and minimization effort prior to any disturbance.

3.5.16.C. Station 3561+25 to 3564+00 LT; Waterways 25H, 25H_C, 25N; Wetland 25D, 25P

Perennial waterway 25H and part of PFO wetland 25D and its buffer will be permanently impacted by the extension and augmentation of the existing culvert 25H_C and by stream restoration within the limits shown on the plate. Intermittent waterway 25N and part of PFO wetland 25P and its buffer will be permanently impacted by the stream restoration of 25H within the limits shown on the plate.

3.5.17 Mainline Impact Plate 17

3.5.17.A. Station 3507+00 to 3510+50 LT & RT; Waterways 26B, 26B_C, 26B_1, 26B_C1; Wetland 26A

Intermittent culvert 26B_C, an existing 48-inch RCP, will be augmented with a 72-inch RCP. Intermittent waterway 26B and PFO wetland 26A and its buffer will be permanently impacted by access for noise wall construction and maintenance of stream flow to permit augmentation of 26B_C. Waterway 26B and wetland 26A and its buffer will also be permanently impacted by grading for a headwater pool within the limits of improvement shown on the plate. Intermittent waterway 26B_1 will be permanently impacted by outfall stabilization from augmented culvert 26B_C. Intermittent culvert 26B_C1 will be permanently impacted by the 26B_C outfall stabilization and maintenance of stream flow.

3.5.17.B. Station 3521+50 to 3534+00 LT & RT; Waterways 26L, 26J, 26K, 26C, 26C_C, 26C_1, 26C_C1; Wetlands 26F, 26D, 26E

Intermittent waterways 26L, 26C, 26J, 26K, and most of PEM wetland 26F and its buffer are included in a "limits of improved SWM" area and shown as permanently impacted within the limits shown on the plate to allow for increased upstream storage to avoid culvert augmentation in this area. Closer to I-270, waterway 26C and wetland 26F and its buffer will be permanently impacted by control structure modification and roadway widening fill. Intermittent culvert 26C_C will be permanently impacted by roadway widening, proposed noise wall construction, proposed swale construction, and outfall stabilization. Intermittent waterways 26C_1 and 26C_C1 and PEM wetland 26D and its buffer will be permanently impacted by outfall stabilization downstream of culvert 26C_C. Part of wetland 26E and its buffer will be permanently impacted by outfall stabilization downstream of culvert 26C_C, and by roadway widening fill. A portion of 26E and its buffer will be temporarily impacted by access to construct the widened roadway and noise wall.

3.5.18 Mainline Impact Plate 18

3.5.18.A. Station 3475+50 to 3480+00 LT; Waterways 27A, 27B, 27C, 27D, 27A_C; Wetlands 27E and 27F

Perennial waterway 27A and 27A_C, Watts Branch, flows under I-270 in a 25-foot-by-8-foot RCB. This RCB will be augmented with a 96-inch RCP. Upstream stabilization and modified headwall construction associated with this augmentation will result in permanent impacts to perennial waterway 27A; intermittent waterways 27B and 27D; ephemeral channel 27C; part of PFO wetland 27F and its buffer; and

part of PFO wetland buffer 27E. Perennial culvert 27A_C will be permanently impacted by construction access and maintenance of stream flow.

3.5.18.B. Station 3480+00 to 3486+50 RT; Waterways 27A_1, 27N, 27H, 27A_C1, 27A_2, 27K, 27A_C2, 27A_3, 27P; Wetlands 27G,27Q, and 27S

Perennial waterway 27A_1 will be permanently impacted by outfall stabilization immediately downstream of augmented culvert 27A_C. Further downstream, 27A_1; intermittent waterways 27N and 27H; and PSS wetland 27G and its buffer will be permanently impacted by stream restoration within the limits shown on the plate. 27A_1 flows into 27A_C1, a 25-foot-by-8-foot RCB, which will be augmented with a 96-inch RCP. 27A_C1 will be permanently impacted by construction access and maintenance of stream flow associated with this augmentation. Perennial waterway 27A_2 and ephemeral waterway 27K will be permanently impacted by outfall stabilization downstream of augmented culvert 27A_C1. Perennial culvert 27A_C2; perennial waterways 27A_3 and 27P; and PEM wetland 27Q and its buffer will be permanently impacted by construction access, maintenance of stream flow and outfall stabilization within the limits of stabilization shown on the plate. A portion of PEM wetland buffer 27S will be permanently impacted by outfall stabilization.

3.5.19 Mainline Impact Plate 19

3.5.19.A. Station 3399+50 to 3401+00 LT; Wetland 27M

PFO wetland 27M and its buffer will be permanently impacted by roadway fill, construction access, and staging and stockpiling.

3.5.19.B. Station 3404+00 to 3407+00 LT & RT; Waterways 27L and 27L_C

Intermittent storm drain 27L_C will be partially replaced at its inlet, and partially replaced and extended at its outlet. Intermittent waterway 27L will be permanently impacted by the culvert modification of 27L_C and roadway widening.

3.5.20 Mainline Impact Plate 20

3.5.20.A. Station 3336+00 to 3343+00 RT; Waterways 29A_C, 29A, 29A_C1, 29A_1, 28B, 29A_C2

Perennial culvert 29A_C will be permanently impacted by construction access and maintenance of stream flow. Perennial waterway 29A will be permanently impacted by excavation of a headwater pool to store storm flows and avoid augmentation of downstream culverts. Perennial culvert 29A_C1 will be permanently impacted by construction access and maintenance of stream flow. Perennial waterway 29A_1 will be permanently impacted by outfall stabilization between culverts 29A_C1 and 29A_C2. Intermittent waterway 28B, which carries roadway drainage into 29A_1, will be permanently impacted by the construction of a SWM pond, which will treat roadway stormwater and provide increased water quality to Muddy Branch. Perennial culvert 29A_C2 will be permanently impacted by construction access and maintenance of streamflow.

3.5.20.B. Station 3339+50 to 3346+00 LT; Waterway 29K

Intermittent waterway 29K, a short channel between two pipes, will be permanently impacted by stabilization of the channel between the pipes.

3.5.21 Mainline Impact Plate 21

3.5.21.A. Station 3328+00 to 3330+50 LT & RT; Waterways 29B_C

Perennial waterway 29B_C will be permanently impacted by construction access for roadway construction.

3.5.21.B. Station 3332+75 to 3336+00 RT; Waterway 29A_2

Perennial waterway 29A_2 will be permanently impacted by outfall stabilization and by stream stabilization within the limits shown on the plate.

3.5.21.C. Station 3335+25 to 3337+00 LT; Waterway 29D_D

Intermittent waterway 29D_D will be permanently impacted by drainage outfall stabilization.

3.5.22 Mainline Impact Plate 22

3.5.22.A. Station 4717+00 to 4730+00 LT & RT

a. Waterways 23U_1, 23U_C, 23U

Perennial waterway 23U_C, an existing 60-inch SPP culvert, is proposed for augmentation with a 42-inch RCP and extension. Perennial waterway 23U_1 will be permanently impacted by the extension of 23U_C to accommodate roadway widening and construction of a SWM pond. Perennial waterway 23U will be permanently impacted by the extension of 23U_C to accommodate roadway widening and by outfall stabilization at the downstream end of the augmented culvert within the limits of stabilization shown on the plate.

b. Waterways 23N_D, 23N_C, 23N, 23N_1; Wetland 23LL

Intermittent waterway 23N_C, an existing 60-inch RCP culvert, will be augmented with a 24-inch RCP. Intermittent waterways 23N_D and 23N will be permanently impacted by drainage stabilization and inlet/outfall modification upstream and downstream of culvert 23N_C. 23N, perennial waterway 23N_1, and part of PEM wetland 23LL and its buffer will be permanently impacted by outfall stabilization for the augmentation 23U_C within the limits of stabilization shown on the plate.

3.5.23 Mainline Impact Plate 23

3.5.23.A. Station 4768+50 to 4770+00 LT & RT; Waterways 23R_C

Intermittent waterway 23R_C will be permanently impacted by construction access for roadway widening.

3.5.24 Mainline Impact Plate 24

3.5.24.A. Station 4782+00 to 4783+25 LT & RT; Waterways 23Q_C

Perennial waterway 23Q_C, an existing culvert, will be permanently impacted by construction access for roadway widening, retaining wall construction, and noise wall construction.

3.5.25 Mainline Impact Plate 25

3.5.25.A. Station 316+00 to 327+50; Waterways 20D, 20C, 20C_C, 20D_C, 21B

Greentree Road and its related structure over I-495 will be modified. Perennial waterways 20D and 20C will be permanently impacted by construction access to facilitate Greentree Road modifications. Intermittent culvert 20C_C will be permanently impacted by construction access for roadway widening, and perennial culvert 20D_C will be permanently impacted by construction access for Greentree Road modifications. Perennial waterway 21B will be permanently impacted by outfall stabilization at the downstream end of culvert 20D_C and by channel relocation necessary to accommodate roadway widening within the limits of restoration shown on the plate.

3.5.25.B. Station 333+25 RT

Intermittent waterway 20E will be permanently impacted by proposed SWM swale construction and proposed noise wall construction.

3.5.25.C. Station 343+00 RT

Intermittent waterway 20B will be permanently impacted by proposed SWM swale and vault construction and proposed noise wall construction.

4 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. For over 4 years, a multidisciplinary team of roadway, structural, and stormwater engineers, construction specialists, environmental planners, and environmental scientists collaborated with regulatory and resource agencies to avoid and minimize impacts to wetlands, their buffers, waterways, and floodplains while maintaining adequate construction area for the proposed MLS.

Despite the concerted effort to avoid and minimize impacts to these natural resources to the greatest extent practicable at this stage of design, the MLS would still result in unavoidable impacts, given the extremely confined roadway corridor that would be affected. Nontidal wetlands and waterway mitigation for these impacts is discussed in the *Final Compensatory Wetlands and Waterways Mitigation Plan*, which is included in the JPA package. Further avoidance and minimization in coordination with agencies and landowners will continue in later stages of design.

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ACRONYMS

ALB – American Legion Bridge

AMR – Avoidance, Minimization, and Impacts Report

COMAR – Code of Maryland Regulations

EIS – Environmental Impact Statement; DEIS = Draft EIS; FEIS = Final EIS

EPA – Environmental Protection Agency

FEMA – Federal Emergency Management Agency

FHWA – Federal Highway Administration

JPA – Joint Permit Application

LOD – Limits of Disturbance

LOI – Limits of Improvement to Stormwater Capacity

LOR – Limits of Restoration

LOS – Limits of Stabilization

LT – left

MCDEP – Montgomery County Department of Environmental Protection

MDE – Maryland Department of the Environment

MDOT SHA – Maryland Department of Transportation State Highway Administration

MDNR – Maryland Department of Natural Resources

MLS – I-495 & I-270 Managed Lanes Study

M-NCPPC – Maryland National Capitol Park and Planning Commission

NEPA – National Environmental Policy Act

NHD – National Hydrography Dataset

NLEB – Northern Long-Eared Bat

NPS – National Park Service

PEM – palustrine emergent

PFO – palustrine forested

RC – reinforced concrete

RCB – reinforced concrete box culvert

RCP – reinforced concrete pipe

ROD – Record of Decision

ROW – right-of-way

RT – right

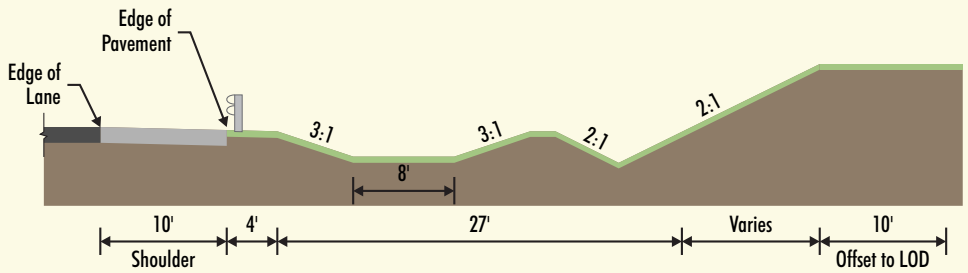
SPP – structural plate pipe

SWM – stormwater management

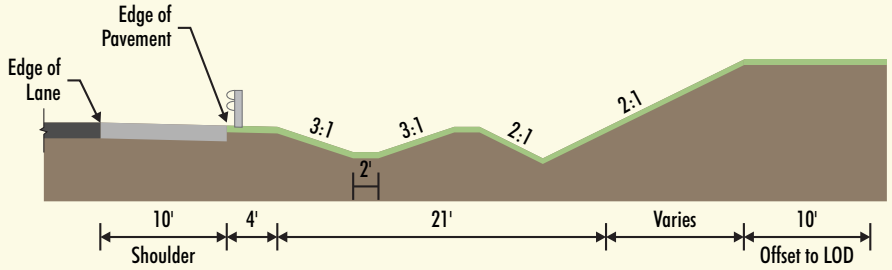
USACE – United States Army Corps of Engineers

USFWS – United States Fish and Wildlife Service

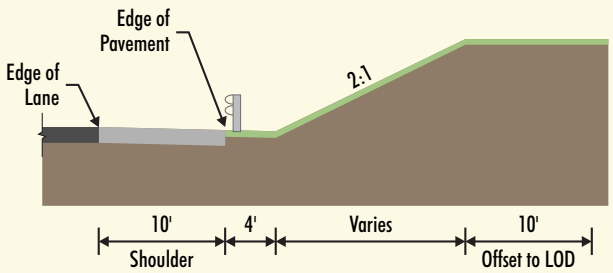
APPENDIX A: ROADSIDE LOD MODIFICATION STEPS



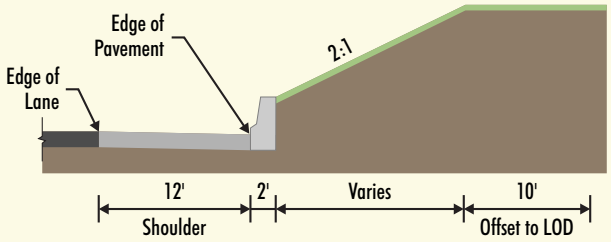
Step 1: Open Section with Full Stormwater Management



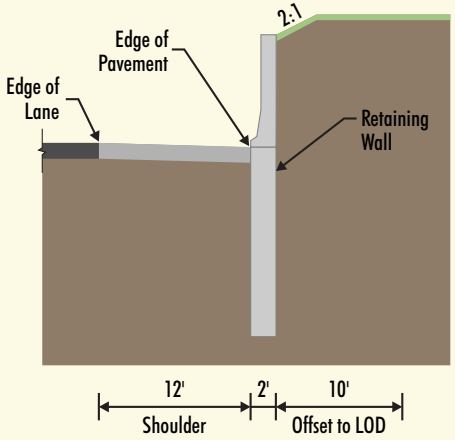
Step 2: Open Section with Reduced Stormwater Management



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

MANAGED LANES STUDY 495 270

I-495 & I-270 Managed Lanes Study

Roadside LOD Modification Steps

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

January 2020

Draft, Pre-Decisional

APPENDIX B: CULVERT AUGMENTATION ASSESSMENT RESULTS

LOD Requirements at Culvert Augmentation Sites

Culvert augmentation, or the addition of culvert pipes, is proposed at certain existing cross culvert locations. Augmentation to provide additional hydraulic capacity at these crossings is necessary in order to avoid potential highway overtopping during the 100-year return interval flood, and thus to meet MDOT SHA's design criteria, or to mitigate for increases in 100-year water surface elevations that result from culvert extension required for roadway widening. Initial hydrologic and hydraulic analysis was performed for each culvert to assess which culverts may require augmentation. The initial hydrologic analysis utilized the Maryland Fixed Region Regression Equations and ultimate development land use conditions to compute the estimated 100-year peak discharge. The FHWA HY-8 model was used to conduct the hydraulic analysis to identify the potential augmentation locations. Based on the initial planning level analysis and review, culvert augmentation was proposed at 123 culvert sites. Further desktop and field investigations were completed, as described following, which revised the identified location list to a total of 104 sites where augmentation and/or replacement of the existing cross culvert will be required.

Detailed hydrologic and hydraulic analysis will be completed during the MLS design phase to confirm that augmentation is required at each of the 104 locations identified during the NEPA phase. The detailed study will utilize additional data, including roadway and stream topographic survey, to more thoroughly analyze each culvert crossing location. The detailed study will also assess the hydraulic impacts associated with augmentation to confirm that the proposed design meets all regulatory requirements. It is likely that during this next phase of the project, it will be determined that augmentation is not needed at some previously identified locations or is needed as other additional locations.

Investigations, including some site visits and additional hydrologic and hydraulic computations, were conducted to set the limit of disturbance (LOD) at each augmentation site. The process developed to set the LOD attempts to balance the planning level nature of this project and the limited data availability with the need to provide a conservative yet realistically sufficient LOD limit. The process included two stages. Desktop review and site visits were conducted for all proposed augmentation locations in Phase 1. The finding of the effort completed for the Phase 1

locations were used to develop parameters that were then applied to set the LOD at the MLS future phases augmentation locations.

For all proposed culvert augmentation sites in Phase 1, site visits were conducted to assess the existing site condition, as well as the potential LOD requirements related to this existing condition and the proposed crossing modification. To prepare for the site visit, a desktop review of each location was conducted. An assessment form, included for reference in this appendix, was developed to use in this study. Data obtained in the desktop review, such as details of the existing and proposed culvert geometry, drainage area parameters, and estimate of the potential capacity increase via augmentation, were compiled in the assessment form. Additional site-specific information, such as upstream and downstream channel conditions including any bank erosion, channel head cutting, or other instability; notation of any unusual site circumstances including any potentially impacted built infrastructure; and a photo documentation log were added to the assessment form during the field investigations. Based on the field findings, the investigation team recommended LOD requirements for each augmentation site. A summary document for each culvert augmentation site provides summary information about each location and the basis of the LOD recommendations. These individual site summaries are presented in this appendix.

Assessment Team:	Date: Weather Condition: Significant Rainfall (>0.2") in Previous 24 HR:
Culvert ID:	

Desktop Data

Ex. Culvert Size/Material/Length/Inv.: Pr. Culvert Size/Material/Length/Inv.:	Drainage Area (ac): Percent Impervious (or Urbanized): Discharge Basis: (Regression Eqn./TR55) Reason for Augmentation: 1. Ex. HW Increase > 0.1': Y/N 2. Overtopping Elevation (Pr. Cond.): Y/N MD 378 Risk Level: Upstream Invert + 2D =

Storm Event	Peak Discharge (cfs)	Ex. HW El. (HY-8)	Discharge at Ex. HW El. w/ Aux Pipe (cfs per HY-8)	Percent Change	Pr. HW El. at Storm Event Peak Discharge
2-year	28	309.39	74	+164%	308.97
10-year	92	312.91	174	+90%	310.59
100-year	173	318.22	270	+56%	312.96

Geometry:

Upstream Length of Culvert Extension:

Relative Change in Upstream Invert:

Downstream Length of Culvert Extension:

Relative Change in Downstream Invert:

Slope of Downstream Channel:

1. At Pr. Culvert Outlet (Segment No. 1):____% for _____ L.F. downstream
2. Downstream Segment No. 2:_____% for _____ L.F. downstream
3. Downstream Segment No. 3:_____% for _____ L.F. downstream

Approx. Size of Plunge Pool based on Detail D-4-2:

Length of Downstream Channel in the LOD (currently proposed):

Upstream Field Data
Downstream Channel Slope; Bed Material; Bank Height; Bank Slope; Vegetative Condition of Banks/Floodplain; Existing Degradation; Location of Representative X-Sections; Number and Location of Homogenous Reach Segments; Location of Hard Point Controls, Water Marking on Culvert/Headwalls

Downstream Field Data
Downstream Channel Slope, Bed Material; Bank Height; Bank Slope; Vegetative Condition of Banks/Floodplain; Existing Degradation; Location of Representative X-Sections; Number and Location of Homogenous Reach Segments; Location of Hard Point Controls, Water Marking on Culvert/Headwalls

PhotoLog

Photo No.	Description
Photo Naming Convention: Culvert ID_Date_Number (i.e. 431_20201202_01)	

Field Recommendations
Downstream LOD: Description of Additional Area Needed Upstream LOD: Description of Additional Area Needed Auxiliary Culvert Current Location Acceptable: Y/N, if N, provide explanation based on site constraints
Office Analysis (Post Field if Needed, Prior if wanted)
Cut representative x-sections; evaluate shears and velocities

Note: Teams to provide CAD version of LOD recommendations

Questions/considerations for LOD determination:

1. Is the downstream channel stable?
2. Is the downstream channel stable under proposed conditions? I.e. where the channel is both stable and a minimal flow increase is anticipated, use a "tie-in" approach:
    a. If a drop is necessary just to make tie-in, assume plunge pool or step-pool (1-ft max per drop) can be implemented.
    b. Where AOP considerations are present, riffle/pool approach may be necessary and require more detailed assessment of a reference reach; however, 2.5% riffles or rock ramps are probably necessary to tie-in the proposed culvert outlet into the stream channel.
3. Does the channel become stable downstream?
    a. Do geometric or hydraulic changes or characteristics exist (e.g. floodplain connection) that would minimize increases to the three main criteria (100-yr WSE; 2- and 10-year velocity and shear stress increases)?
    b. Does a hydrologic flow change condition existing wherein the peak flow increase due to culvert augmentation would be diluted?
    c. Either of the above may be suitable for determining termination points, even if instability continues downstream.
4. If the channel is unstable due to existing conditions (i.e. if it is unstable upstream and downstream), proposed peak flow increases or the overall instability in the watershed for which the roadway culverts do not contributes, what are the closest, most stable in-stream features beyond which it is not reasonable to expand the LOD?
5. What is the proximity of property lines? Due to the sensitivity of property owner notification, it is recommended to expand LODs onto close-proximity property lines.
6. After field investigation, consider if the culvert augmentation is needed:
    a. Re-evaluated using more detailed routing techniques (HydroCAD)?
    b. Reconsidered (i.e. augmented culvert downsizing) to minimize impacts due to augmentation.
    c. Consider upstream attenuation

Feature ID #21D, 21D_C, 21D_1, and 21D_C1, Sta 225+15 (JPA Impact Plate #6), I-495 over Unnamed Tributary to Thomas Branch, Structure #002 and #006

Existing Site Description

The structures that convey the unnamed tributary to Thomas Branch are a 36" RCP transitioning to 42" RCP (Culvert ID 002) under I-495 just north of River Road and a 42" RCP (Culvert ID 006) under a ramp from River Road to I-495. Culvert ID 002 receives runoff from a drainage ditch/culvert and storm drain system in the gore area upstream. The concrete channel upstream of Culvert ID 002 is stable but does have displaced slab sections and other portions filled with sediment. Culvert ID 006 receives runoff from Culvert ID 002 and curb cuts in the gore area. The concrete channel between Culvert ID 002 and Culvert ID 006 is stable but does have displaced slab sections and other portions filled with sediment. Culvert ID 006 discharges directly into Thomas Branch. Thomas Branch in this portion is a wide concrete lined channel with grade control structures and is stable.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 48" RCP is proposed for Culvert ID 002. Due to the roadway widening along I-495, Culvert ID 002 is proposed to be extended on both the upstream and downstream ends. Based on the current roadway configuration, an open channel from Culvert ID 002 down to Thomas Branch and removal/abandonment of Culvert ID 006 is proposed. Thomas Branch in this area is to be relocated due to upstream and downstream roadway and channel changes.

LOD Description and Justification

The LOD extends approximately 450 feet upstream of the Culvert ID 002 entrance, which will provide adequate space for grading tie-in for the new culvert augmentation and extension, stream diversion during construction, and potential grading if additional upstream storage is desirable. The downstream LOD extends to the confluence with Thomas Branch, which will provide adequate space for grading tie-in for the new culvert augmentation and extension, stream diversion during construction, and for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The LOD is also adequate to provide for access during construction. The entirety of the Thomas Branch channel is included in the LOD due to the proposed channel relocation requirements.

Upstream of feature ID #29K, Sta 3343+00 LT (JPA Impact Plate #20), I-370 over Unnamed Tributary to Muddy Branch, Structure #123

Existing Site Description

The structure that conveys the unnamed tributary to Muddy Branch under 1-370 is a 48" RCP. Culvert ID 123 receives drainage from a drainage ditch and two (2) storm drain systems upstream. There is a control structure at the upstream end of Culvert ID 123, with a low flow opening and an inlet grate opening for larger flow events. A secondary culvert is located under Industrial Drive approximately 120 feet downstream (north) of Culvert ID 123. The upstream and downstream areas are submerged due to a beaver dam located just upstream of the Culvert ID 123 control structure and another located just upstream of the culvert under Industrial Drive.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of two (2) 48" RCP is proposed for Culvert ID 123. Since the roadway widening along I-370 is along the inside shoulder there are no proposed extensions to this culvert. The two (2) beaver dams should also be removed as they currently impact the functionality of the drainage system in this area.

LOD Description and Justification

The upstream LOD extends to the limits of the MDOT SHA Right-of-Way (ROW) to provide adequate space for grading tie-in for the new culvert augmentation, stream diversion during construction, and potential grading if additional upstream storage is desirable. The downstream LOD extends to Industrial Drive to provide adequate space for grading tie-in for the new culvert augmentation, stream diversion during construction, potential grading for additional storage between Culvert ID 123 and the Industrial Drive culvert, and channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity at the crossing. The LOD on the downstream end also provides space for access during construction.

Feature ID #27A_C1, Sta 3484+00 (JPA Impact Plate #18), MD-28 over Watts Branch, Structure #338

Existing Site Description

The structure that conveys Watts Branch under MD-28 (Montgomery Avenue) is a 25' by 8' box culvert. Approximately 550 ft upstream of the MD-28 crossing, Watts Branch passes under I-270. The I-270 structure is also a 25' x 8' box culvert. Immediately downstream of I-270, the channel appears stable. Towards MD 28, the channel becomes less stable with bank erosion and head cuts present. During the site visit, significant debris jams were noted, and a beaver dam was present approximately 100 ft upstream of the MD 28 culvert headwall. The current channel, which bends to the right upstream of MD 28, is poorly aligned for conveyance through the existing structure and significant bank erosion is present immediately upstream. Approximately 100 ft downstream of the MD-28 crossing, Watts Branch passes under Watts Branch Parkway. The Watts Branch Parkway structure is a 3-cell box culvert (2 cells 11' x 8' and 1 cell 13' x 8'). At the time of the site visit, the far-right cell of this structure was significantly blocked with sediment.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 96" RCP in the right overbank is proposed. A similar augmentation strategy is proposed for the upstream I-270 crossing (Feature ID #27A_C). Based on the preliminary hydrology and hydraulics computations, the crossing embankment was assignment a low risk of being classified as a dam per MDE Dam Safety Policy Memorandum #2.

LOD Description and Justification

The upstream LOD was set to include the full reach between the I-270 and MD-28 crossings. This will allow for stabilization of the existing unstable channel and for construction of any channel stability measures required to mitigate for the potential increased shear stress and velocity that may result from increased downstream discharges. This will also allow for channel re-alignment to improve conveyance through the MD-28 crossing. The proposed pipe augmentation will be located in the right overbank, which should improve flow conditions through the Watts Branch Parkway structure and reduce sediment deposition in the far-right cell. The downstream LOD was set approximately 150-ft downstream of the Watts Branch Parkway crossing in order to provide space for the removal of existing sediment in the structure as well as construction of any necessary downstream stabilization measures.

Feature ID # 23A_C2, Sta 3751+00 (JPA Impact Plate #9), Democracy Blvd to southbound I-270 west Spur over Thomas Branch, Structure #356

Existing Site Description

The existing 96" Structure Plate Pipe (SPP) conveys Thomas Branch stream flow under the Democracy Blvd ramp to southbound I-270 west Spur from northeast to southwest. At the outfall, Thomas Branch flows south along the I-495 outer loop.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics assessment indicate roadway overflow at 10-year storm event, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of removing the existing culvert and replacing it with a dual 8'x8' concrete box culvert system which will carry Thomas Branch stream flow from Democracy Boulevard STA 3747+50 south to STA 3760+50. At this downstream end of the dual box culvert Thomas Branch joins with the downstream discharge of existing culvert crossing 150137X01.

LOD Description and Justification

The upstream LOD includes the full interchange area, thus providing the necessary area for culvert removal and replacement. The downstream LOD extends west and south, in order to provide sufficient space for estimated grading limits associated with the proposed removal of Culvert 356 and replacement with the concrete box culvert which will convey Thomas Branch to the south.

Feature ID # 23A_C, Sta 3741+75 (JPA Impact Plate #10), Ramp from Democracy Blvd to I-270 over Thomas Branch, Structure #357

Existing Site Description

The existing 84" Structure Plate Pipe (SPP) built in 1964 conveys Thomas Branch flow under the ramp (from Democracy Blvd to northbound I-270 west spur) from east to west and outfalls to downstream open channel within SHA ROW. Thomas Branch drainage is from an upstream in-line BMP pond which outfalls upstream of the existing 84" SPP culvert #357.

The upstream headwater pool of culvert #357 is confined between roadway embankment and the upstream BMP embankment at Marriott International property. The existing endwall of the upstream BMP outfall is facing towards the headwall of culvert #357. Inflow channels come from both the northwest side and southeast side, with a confluence at the riprap apron between the BMP endwall and culvert headwall. The downstream outfall of culvert has bedrock outcropping on the north side.

Eroded banks were observed during field investigation along the downstream Thomas Branch segment to Culvert #150137X01. Channel bottom is armored naturally with boulder and bedrock. Lateral erosion is apparent throughout the stream section.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics analysis indicate roadway overtopping during the 50-year storm, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. The addition of a new 84" RCP along the south side of the existing 84" SPP is proposed for structure augmentation.

LOD Description and Justification

LOD is provided to the north side of the culvert for construction/maintenance access down to the upstream headwall. Initial placement of the proposed augmentation pipe was on the north side of culvert. However, this was modified to be the south side based on field investigations which suggest the inflow channel coming from southeast side is flatter with fewer environmental impact than the northwest side. Also, on the downstream end there is bedrock outcrop that may limit ability to place augmentation culvert on the north side. The LOD limit includes the stream channel between the two culverts (#357 and #150137X01) for proposed stream bank stabilization. This section of stream channel is within SHA right of way. The LOD also includes an existing graded access from the ramp towards the stream channel, to be used as construction access for the stream channel work.

Feature ID #20C, 20D, 20D_C, and 21B, Sta 323+50 RT (JPA Impact Plate #25), Greentree Road over Unnamed Tributary to Thomas Branch, Structure #425

Existing Site Description

The structure that conveys the unnamed tributary to Thomas Branch is a 54" RCP under Greentree Road. Culvert ID 425 receives runoff from a drainage ditch, open channel, and two (2) roadway storm drain systems upstream. The roadway elevations along I-495 are lower than the elevation of Greentree Road at the crossing, therefore overtopping occurs along I-495. The upstream and downstream channel is confined between I-495 and its soundwall to the north and residential properties to the south. The residential properties are set approximately 20 feet above the stream bed and there is no concern of adverse impacts. The upstream channel at the entrance of the culvert is stable. There are signs of erosion in the upstream drainage ditch and open channel. One of the roadway storm drain outfalls is partially submerged. The downstream channel is stable with bedrock observed along the channel bed and banks.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of two (2) 72" RCPs is proposed for Culvert ID 425. Since the roadway along Greentree Road is shifting approximately 50 feet to the east in the proposed condition, an approximately 45-foot culvert extension along the upstream end is proposed for Culvert 425.

LOD Description and Justification

The LOD upstream extends south of I-495 by approximately 150 feet and east of Greentree Road by approximately 90 feet which will provide adequate space for grading tie-in for the new culvert augmentation and extension. The proposed LOD also allows space for stream diversion during construction and potential grading if additional upstream storage is desirable.

The downstream LOD extends south of I-495 by approximately 90 feet which will provide adequate space for grading tie-in for the new culvert augmentation. The channel downstream of the crossing is completely included in the LOD, down to the next stream crossing, which is Culvert 426. This LOD area will allow for any necessary stream diversion during construction, and for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The LOD is also adequate to provide for access during construction from either I-495 or Greentree Road.

Feature ID #22A, 22A_C, 22C, 22C_C, and 22D, Sta 220+00 LT (JPA Impact Plate #6), I-495/River Road ramps over Unnamed Tributary to Cabin John Creek, Structure #427 and #428

Existing Site Description

The structures that convey the unnamed tributary to Cabin John Creek are a 42" RCP (Culvert ID 427) under a ramp from I-495 to River Road and a 42" RCP (Culvert ID 428) under an assumed old roadbed. Culvert ID 427 receives drainage from a cross culvert under I-495 and curb cuts in the gore area upstream. The concrete ditch upstream of Culvert ID 427 is stable with some sediment throughout. Culvert ID 428 receives runoff from Culvert ID 427, drainage ditches, and two (2) roadway storm drain systems. The earthen/riprap channel between Culvert ID 427 and Culvert ID 428 is stable. The steep concrete ditch downstream of Culvert ID 428 is unstable with the concrete ditch being undermined and numerous displaced concrete sections throughout. The concrete ditch outfalls directly into Cabin John Creek where there is a significant headcut. There is a wetland delineated just north of the outfall for Culvert ID 428.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Due to the ramp reconfiguration in this area, Culvert ID 427 and Culvert ID 428 will become a single culvert system. Structure augmentation with the addition of a 48" RCP transitioning to a 60" RCP is proposed for Culvert ID 427 and Culvert ID 428. Also, due to the ramp reconfiguration, both culverts will be extended on both the upstream and downstream ends. The unstable steep concrete ditch downstream of Culvert ID 428 requires stabilization regardless of the other proposed drainage changes.

LOD Description and Justification

The LOD extends through the gore area upstream of the Culvert ID 427 entrance, which will provide adequate space for grading tie-in for the new culvert augmentation and extension, stream diversion during construction, and potential grading if additional upstream storage is desirable. The downstream LOD extends to the confluence with Cabin John Creek, which will provide adequate space for grading tie-in for the new culvert augmentation and extension, stream diversion during construction, and for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. Additional LOD is provided just north of the steep concrete ditch outfall to Cabin John Creek to provide for access during construction and additional flexibility in a potential drainage design.

Feature ID #23K_C, Sta 3684+25 (JPA Impact Plate #11), Tuckerman Lane over Unnamed Tributary to Old Farm Creek, Structure #431

Existing Site Description

The structure that conveys the unnamed tributary to Old Farm Creek under Tuckerman Lane is an 84" SPP. The culvert outlets to Old Farm Creek just downstream of the I-270 crossing. The 84" SPP shares a downstream headwall with the 20-ft x 10-ft box culvert that convey Old Farm Creek under I-270. Flow enters the 84" SPP on the upstream (south) side of Tuckerman Lane via a drainage ditch that runs parallel to I-270. Upstream of the crossing, the drainage ditch continues parallel to I-270 for approximately 700 ft. Further upstream the flow is conveyed via a pipe under a retaining wall and embankment which spurs from the I-270 SB lanes. The channel was not investigated in the field beyond this retaining wall due to access constraints, but a GIS aerial review shows an open channel continuing some distance upstream along I-270. Just upstream of the crossing at Tuckerman Lane, there is an existing "smart" stormwater management pond (i.e., the pond includes an Opti computerized control system). The pond is located on Montgomery County, Board of Education property.

Reason for Augmentation and Potential Proposed Condition

Due to the lane expansion and retaining wall construction, Structure 431 must be relocated. The concept includes relocation of the culvert to the west. The proposed replacement structure consists of 2 each 106" x 68" elliptical pipes. The current upstream channel parallel to I-270 will also need to be relocated. The channel can be shifted west, away from the roadway embankment. Near the existing pond the channel shift will conflict with the existing pond spillway. In proposed condition this conflict can be solved by extending the piped section of the channel or by modifying the existing pond to relocate the emergency spillway.

LOD Description and Justification

The LOD upstream of the crossing extends around the existing pond in order to allow for options to realign the crossing, the drainage channel upstream of the crossing, and to mitigate for impacts to the pond emergency spillway including potential pond grading redesign. The LOD downstream of the crossing allows space to realign the culvert crossing and for the tie-in grading required to route flows to a new location further downstream in Old Farm Creek. The downstream LOD coincides with the LOD needed for Structure 150080001 (Feature ID #24A_C).

Feature ID #21F_C, Sta 0245+25 (JPA Impact Plate #6), I-495 over Unnamed Tributary to Thomas Branch, Structure #602

Existing Site Description

An existing 30" RCP conveys the Unnamed Tributary to Thomas Branch under I-495 from west to east. The upstream channel is unstable and incised. There is an exposed sanitary sewer pipe located approximately 200-ft upstream of the culvert. Downstream of the I-495 crossing, the culvert immediately outfalls to Thomas Branch, which flows south parallel to the I-495 roadway for approximately 500-ft, then flows under I-495 via Culvert 150257X01. There are roadway inlets connected to the culvert #602 to capture pavement drainage. Field investigation indicates the most downstream culvert segment is 36" RCP.

Reason for Augmentation and Potential Proposed Conditions

The existing culvert outfalls to Thomas Branch east of I-495. The tailwater condition and thus conveyance capacity of the culvert is impacted by the Thomas Branch water surface elevation. Initial hydrology and hydraulics analysis indicate roadway overtopping during the 10-year storm, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria.

In the proposed design, the downstream segment of Thomas Branch will be realigned to accommodate the proposed widened roadway. The existing 30" RCP will be extended to the new outfall location. The addition of a new 48" RCP along the north size of existing culvert is proposed for structure augmentation.

LOD Description and Justification

The LOD extends approximately 300-feet upstream of Culvert 602 to allow for space to stabilize the highly incised, unstable ephemeral/intermittent channel which in existing condition has poor tie-in to the culvert. The LOD limit includes the exposed sanitary sewer pipe upstream of the culvert in order to allow for channel stabilization. Downstream of Culvert 602 the LOD extents eastward to allow for the culvert augmentation and extension, as well as to include the required area for construction of the proposed Thomas Branch relocation.

Feature ID #22CC, 22CC_C, Sta 195+00 LT (JPA Impact Plate #5), Seven Locks Road over Unnamed Tributary to Thomas Branch, Structure #641

Existing Site Description

Structure #641 is a 30" CMP and conveys an unnamed tributary to Thomas Branch under Seven Locks Road. The culvert receives runoff from an earthen channel fed by two (2) MDOT SHA outfalls. The roadway elevations along I-495 are significantly higher than those along Seven Locks Road therefore overtopping occurs along/over Seven Locks Road. The upstream and downstream channel is confined between I-495 to the south and residential properties (upstream) and MNCPPC (downstream) to the north. Just upstream of the existing culvert is an historic church property and downstream of the culvert is an existing parking lot adjacent to the stream channel. The upstream channel between the two (2) MDOT SHA outfalls and the culvert entrance is unstable and has been documented by MDOT SHA through drainage complaints and by the OP3 team. The outfall of Culvert ID 641 is submerged and there is sedimentation directly downstream creating a negative slope. The downstream channel is stable but does show signs of erosion and sedimentation through the earthen channel portion and displaced concrete sections through the concrete lined portion. There is also a significant headcut at the confluence with Cabin John Creek.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 25-year flood, which results in the need for augmentation to meet the MDOT SHA 25-year design storm criteria. Structure augmentation with the addition of a 30" RCP is proposed for Culvert ID 641. All proposed roadway work is limited to I-495 and no widening of Seven Locks Road is proposed. There are no proposed extensions along Culvert ID 641.

LOD Description and Justification

The upstream LOD fully encompasses the upstream channel extend to the two (2) MDOT SHA outfalls in order to provide adequate space for stream stabilization, grading tie-in for the new culvert augmentation, and stream diversion during construction. The downstream LOD extends to the confluence with Cabin John Creek to provide adequate space for the new culvert augmentation, stream diversion during construction, and drainage design to account for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The downstream LOD also allows for access though the existing parking area during construction.

Feature ID #27L_C, Sta 3405+50 (JPA Impact Plate #19), I-270 over Unnamed Tributary to Watts Branch, Structure #703

Existing Site Description

The structure that conveys the unnamed tributary to Watts Branch under I-270 is a multi-segment 48" RCP. At the downstream (west) side of I-270, the 48" pipe terminates in a concrete structure. A 54" RCP then conveys flow out of the structure to a ditch that runs parallel to I-270 for approximately 260-ft. At the end of the ditch flow enters the County storm drain system via a 60" pipe. The entrance headwall of the 60" pipe is also the exit headwall of an I-270 cross culvert (18" RCP). Flow from the 18" pipe, in addition to sheet flow from adjacent paved surface (parking lot) enters the 60" pipe along with flow from culvert 703. On the upstream side of the I-270 crossing there is an existing stormwater management pond. The outflow from this pond is conveyed via a small channel that is approximately 40-ft long to the 48" RCP which conveys flow under I-270. The existing pond outflow is the primary inflow to culvert 703, other than sheet flow from the adjacent paved area (parking lot).

Reason for Augmentation and Potential Proposed Conditions

The simplified planning level hydrology and hydraulics indicates roadway overtopping during the 100-year flood. Initially, augmentation with an additional 48" RCP was proposed to ensure that the crossing meets the MDOT SHA 100-yr design flood criteria. However, given the potential impacts related to any increase in downstream discharge associated with conveyance improvement at the crossing, consideration was given to the potential to expand the volume controlled upstream to ensure no roadway overtopping, rather than provide a pipe augmentation to reduce headwater elevations.

LOD Description and Justification

Due to the existing downstream infrastructure, any discharge increase is constrained by the capacity of the existing storm drain system. If the existing system does not have capacity to convey the increased downstream peak flow, storm drain system improvement (pipe size increase) would be required for over 2,400-ft of existing storm drain pipe (i.e., the length of the system to the tributary to Watts Branch stream outfall). Therefore, the LOD upstream of the crossing was increased to fully include the existing stormwater facility and adjacent open space which would be needed for expansion of this existing facility. This will allow for storage and attenuation on the upstream side of I-270 in order to ensure the roadway is not flooded in the 100-year flood.

Feature ID #29B, 29B_C, and 29B_1, 3328+50 (JPA Impact Plate #21), I-270 over Unnamed Tributary to Muddy Branch and I-270 over Muddy Branch, Structure #705 and #150278X01

Existing Site Description

The structure that conveys the unnamed tributary to Muddy Branch is a 48" RCP (Culvert ID 705). The structure that conveys Muddy Branch under I-270 is a 120" concrete lined CMP (Culvert ID 150278X01). Culvert ID 705, according to record drawings, receives runoff via a blind connection from an upstream storm drain system; the system could not be field verified. Culvert ID 150278X01 receives drainage from numerous upstream culverts, storm drain systems and open channel flow. Near the culvert there is an MDOT SHA eroded drainage ditch with exposed geotextile and RCP culvert outfall from the adjacent park area. Culvert IDs 705 and 150278X01 share the same endwall and outfall to an earthen channel within Malcolm King Park. The upstream portion of Muddy Branch is an earthen channel with the downstream portion being heavily armored with riprap. There is one location approximately 220 feet upstream of the headwall where a deep pool has formed due to fallen trees within the channel. The downstream portion of Muddy Branch is incised, with large, imbricated rock along some portion of the bank. The direct outfall is heavily armored with riprap and some has washed downstream. Bedrock was observed in the channel in several locations. An unnamed tributary to Muddy Branch outfalls into Muddy Branch approximately 630 feet downstream.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping for both structures during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 48" RCP is proposed for Culvert ID 705 and a 72" RCP is proposed for Culvert ID 150278X1. Since there is no roadway widening in this area there are no proposed extensions.

LOD Description and Justification

The upstream LOD extends approximately 280 feet upstream along Muddy Branch to provide adequate space for grading tie-in for the proposed augmentation of Culvert 150278X01, stream diversion during construction, and potential grading if additional upstream storage is desirable. In addition, the upstream LOD extends to fully encompass the unstable MDOT SHA drainage ditch for remediation efforts.

The downstream LOD extends approximately 480 feet downstream to provide adequate space for the new culvert augmentation, stream diversion during construction, and drainage design to account for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the increase in conveyance capacity. The downstream LOD does not extend past the confluence with the secondary stream, in order to limit impacts to this feature. The provided LOD will also provide space for access during construction.

Feature ID #24F_C2, Sta 3627+00 (JPA Impact Plate #13), I-270 over Cabin John Creek, Structure #150017X01

Existing Site Description

The structure that conveys Cabin John Creek under I-270 is a 16-ft by 8-ft box culvert. The existing box culvert includes vertical and horizontal bends. The middle straight section was initially constructed in 1954 and extended both upstream and downstream in 1987. Upstream and downstream of the crossing, Cabin John Creek appears to be in stable condition. There is a small tributary that joins Cabin John Creek approximately 70 ft upstream of the culvert headwall. This tributary shows signs of instability, including headcuts, incising/downcutting, and some eroding banks. Approximately 2,500-ft downstream of I-270, a small tributary joins with Cabin John Creek. This tributary (Feature ID #24D) is also conveyed under I-270. The channel and floodplain area, both upstream and downstream of the I-270 crossing, is within MNCPPC property boundaries.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood thus requiring culvert augmentation to meet the MDOT SHA 100-year design storm criteria. Preliminary analysis also indicates that if upstream storage is considered the roadway overtopping may be reduced or removed. However, this will need to be verified in detailed analysis due to the complex hydraulics of the existing pipe system. Structure augmentation with the addition of a 96” RCP in the right overbank is proposed. There is the potential that sewer pipe re-alignment will also be required in order to construct the pipe augmentation.

LOD Description and Justification

The LOD extends approximately 130 ft upstream of the crossing. This will allow for space to tie-in grading associated with the potential new 96” pipe. The upstream LOD was also set to allow space for construction of stabilization measures at the location where the small tributary joins the main channel and space for stabilization measures at a drainage channel in the right floodplain near the culvert endwall. The LOD extends approximately 130 ft downstream of the crossing at the location of an existing riffle feature. This will allow for space to tie-in grading associate with the potential new pipe and space for construction of any stability protection measures that are found to be needed.

Feature ID # 21C_C2, Sta 0225+50 (JPA Impact Plate #6), MD190 (River Road) over Thomas Branch, Structure #150076X01

Existing Site Description

An existing 12' x 9' Reinforced Concrete Box Culvert (RCB), built in 1961, conveys Thomas Branch under MD 190 (River Road) from north to south. The culvert outfalls to Cabin John Creek, which flows south along the I-495 outer loop. Much of the east stream bank of Cabin John Creek downstream of the culvert has a sloped concrete revetment. The approach and entrance to the box culvert is heavily armored with large boulders and concrete trapezoidal channel with four integrated 3- to 4-ft concrete steps.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics assessment indicate roadway overtopping during the 25-year storm event, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of three new 108" RCPs on the west side of the existing culvert to convey Thomas Branch south under MD190 (River Road) to the confluence with Cabin John Creek.

LOD Description and Justification

The LOD upstream of the crossing includes the full Thomas Branch channel up to and including the next proposed section of relocation. This will provide the necessary area for construction of the proposed augmentation structures and any necessary associated grading, as well as construction access. The LOD downstream of the crossing extends past the confluence with Cabin John Creek, which will allow space for tie-in grading, as well as for construction of any channel stabilization or protection measures that may be required due to the proposed increase in conveyance capacity.

Feature ID #26C_C, Sta 3523+25 (JPA Impact Plate #17), I-270 over Fallsmead Stream (Tributary to Watts Branch), Structure #150107X01

Existing Site Description

The structure that conveys Fallsmead Stream (aka Tributary to Watts Branch) under I-270 consists of a 78" SPP constructed in 1954, which was extended in 1986, and a 60" RCP constructed in 1986. Upstream of I-270, the pipes connect to a concrete control structure, which manages outflows from a regional stormwater management facility located in the Rose Hill Stream Valley Park. There is a joint use agreement between MDOT SHA and City of Rockville from 1992 for the facility. Per criteria in the MDE Dam Safety Policy Memorandum #2, the embankment at this crossing is classified as a dam in the existing condition. Approximately 40 ft downstream of the I-270 crossing, Fallsmead Stream crosses under Watts Branch Parkway via an 84" CMP culvert. Between the two crossings, there is a residential property in the left overbank area close to the Watts Branch Parkway low (overtopping) point. Downstream of Watts Branch Parkway there are signs of channel instabilities (eroded banks, fallen trees). Approximately 2000 ft downstream, there is a confluence with a similarly size stream, which also crosses under I-270 approximately 1,300 ft north of this site (see Feature ID #26B_C). Approximately 300 ft downstream of the confluence, there is a multi-pipe structure to carry an access road over the stream.

Reason for Augmentation and Potential Proposed Conditions

The simplified planning level hydrology and hydraulics indicates minor roadway overtopping during the 100-year flood (0.15-ft) requiring culvert augmentation. The roadway overtopping was not found to occur in the simplified analysis which considered the upstream storage. Initially, augmentation with a 72" RCP was proposed for the structure to ensure that the crossing meets the MDOT SHA 100-yr design flood criteria. However, given that in the existing condition the upstream area is an inline regional stormwater management facility, consideration was given to the potential to expand the volume controlled upstream to ensure no roadway overtopping, rather than provide a pipe augmentation.

LOD Description and Justification

The LOD was developed assuming the preferable option at this site would be to add storage upstream of the crossing, **if the detailed H&H analysis conducted during the design phase confirms that the roadway is overtopped in the 100-year flood**. If the 100-yr overtopping were to be addressed via pipe augmentation, up to 2,500 ft of downstream stream reach would need to be included in the LOD, in order to mitigate for any downstream discharge increase and the resultant velocity and shear stress increases. It is also likely that a pipe augmentation at Watts Branch Parkway would also be required to mitigate for any increase in downstream peak flow which would likely result in increased flood overtopping (water surface elevation) at Watts Branch Parkway.

To mitigate for the noted risk at this site, the proposed LOD upstream of the I-270 crossing extends into the adjacent park property (area currently used as the regional stormwater management facility). The LOD encompasses the low area upstream of the existing control structure, which could potentially be modified to provide additional upstream storage and peak attenuation. The proposed LOD downstream of the I-270 crossing includes just a minimal bumpout downstream of the culvert headwall to allow for any outfall stabilization that may be required based on the upstream modifications.

Feature ID #23A_C1, Sta 3744+50 (JPA Impact Plate #10), I-270 west spur and Democracy Blvd over Thomas Branch, Structure #150135X01

Existing Site Description

The existing 96" Structure Plate Pipe (SPP) (Culvert 150135X01) built in 1964 conveys Thomas Branch flow under the I-270 west spur from east to west and under Democracy Boulevard from north to south. The culvert outfalls to an open channel section of Thomas Branch, which flows south along the west side of the I-270 west spur.

Upstream of Culvert 150135X01, Thomas Branch flows under an on ramp from Democracy Blvd to the northbound lanes of the I-270 west spur, through Culvert 357, and discharges into an approximately 400-feet open stream channel section before entering Culvert 150135X01. Downstream of Culvert 150135X01, stream flow continues for approximately 240 feet as open channel flow before entering Culvert 356. Culvert 356 conveys flow under another ramp from Democracy Blvd to the southbound lanes of the I-270 west spur.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 10-year storm, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of a new 13' x 8' Concrete Box Culvert along the north side of existing 96" SPP. At the existing outlet of Culvert 150135X01, the culvert is proposed to discharge to a new flow junction structure and continue downstream in a proposed dual 8' x 8' concrete box culvert system running parallel to southbound side of I-270 west spur.

LOD Description and Justification

The LOD upstream of the crossing includes the Thomas Branch channel upstream to Culvert 357. The LOD will provide space for the grading tie-in required due to the augmentation, and for grading related to a wetland seep swale relocation required due to the widening of I-495 roadway. Inclusion of the stream channel in the upstream LOD limit will also allow for proposed channel stabilization between the two culverts (see additional information in the Culvert 357 statement). The LOD downstream of the crossing includes the full Thomas Branch channel in order to provide the space required for the augmentation, the proposed junction structure, and the proposed channel realignments.

Feature ID # 23D_C, Sta 3759+00 (JPA Impact Plate #9), I-270 west spur over Unnamed Tributary to Thomas Branch, Structure #150137X01

Existing Site Description

The existing 11’ 10” x 7’ 7” Structural Plate Pipe Arch (SPPA) culvert, built in 1964, conveys upstream drainage under I-270 from east to west and outfalls to Thomas Branch along the southbound I-270 west spur. The culvert downstream headwall was modified, and the culvert bottom was concrete lined in 2001. The channel immediately downstream of the crossing is incised and unstable. Further downstream, bedrock and a stable riffle section were observed during the site investigation.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics assessment indicate roadway overflow along the edge of pavement occurred during the 50-year storm, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria.

The proposed design includes structure augmentation with a new 7’ x 7’ concrete box structure to convey the drainage perpendicular to the roadway from east of I-270 west spur to the northwest. Due to the I-270 west spur roadway widening and limited ROW, a reach of Thomas Branch upstream of the existing crossing is proposed to be relocated within a dual 8’ x 8’ concrete box culvert. The existing culvert #150137X01 will continue to outfall to an open channel section of Thomas Branch. The proposed augmentation culvert will connect directly to the east barrel of the proposed dual 8’x8’ concrete box culvert. This tie-in is approximately 225 feet north (upstream) of the existing Culvert 150137X01 outfall. The alignment of the augmentation pipe is based on coordination with other disciplines to reduce construction times and impacts to traffic during construction.

LOD Description and Justification

The LOD upstream of the crossing includes approximately 800-ft of channel length, which will allow space for any required grading associated with the proposed augmentation as well as proposed channel modifications due to the roadway widening. The LOD downstream of the crossing includes approximately 600-ft of channel length, as well as area to the northwest of 1-270 where the proposed dual 8’ x 8’ concrete box culvert is located. The downstream LOD will allow for stabilization of the existing downstream unstable channel and for construction of any channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity.

Upstream of feature ID #21K, Sta 0292+75 (JPA Impact Plate #8), I-495 over Unnamed Tributary to Thomas Branch, Structure #150139X01

Existing Site Description

An existing 54" RCP (Structure #150139X01), which is located just south of the Bradley Blvd overpass, conveys upstream drainage under I-495 from southeast to northwest. The 54" RCP outfalls to Thomas Branch, which flows south parallel to I-495. A concrete channel between the Bradley Blvd embankment and a residential property conveys runoff to the upstream headwall of Culvert 150139X01. The existing 54" RCP is shallowed at the entrance and there is limited headwater pool storage due to the nearby Bradley Blvd overpass embankment and residential area grading.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overflowing during the 10-year storm, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of a new 7.5' x 3.5' concrete box structure to convey the drainage from southeast of I-495 to northwest. The upstream existing headwall is to be extended to accommodate the proposed augmentation structure. Downstream of the crossing, in order to accommodate the proposed roadway expansion, the proposed design includes a dual 12' x 10' concrete box culvert system to carry Thomas Branch. The existing 54" RCP and the proposed augmentation structure will directly connect to this proposed Thomas Branch culvert system.

LOD Description and Justification

The upstream LOD includes approximately 200-ft of the existing channel, which will accommodate the concrete ditch grading tie-in. The downstream LOD includes the existing Thomas Branch channel and space to construct the new proposed dual 12' x 10' culvert. This LOD allows space for the proposed connection of structure #150139X01 to the new Thomas Branch culvert.

Feature ID #21L_C, Sta 0278+25 (JPA Impact Plate #7), I-495 over Unnamed Tributary to Thomas Branch, Structure #150140X01

Existing Site Description

An existing 78" Structural Plate Pipe (SPP) culvert, built in 1965, conveys upstream drainage under I-495 from east to west and outfalls to Thomas Branch, which flows south along I-495 outer loop. The culvert bottom was concrete lined in 2013. An existing noise wall was constructed on top of the 78" SPP along the I-495 roadway. A concrete lined channel conveys nearby residential drainage to the upstream headwall of Culvert 150140X01.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics analysis provided mixed results related to the potential for 100-yr flood roadway overtopping at this crossing. Given the uncertainty in the analysis at this planning level stage of the project development, the augmentation was assumed to be necessary unless detailed analysis shows otherwise. Augmentation is proposed via a 78" RCP, which is to be located to the north of the existing structure.

In the proposed design, due to the I-495 roadway widening and limited ROW along the Thomas Branch corridor, some of Thomas Branch, including the section downstream of the 150140X01 crossing, is proposed to be contained within a structure. The outlet of the existing 78" SPP and the proposed augmentation will directly connect to the proposed dual 12' x 10' concrete box structure, which is proposed to replace the Thomas Branch open channel.

LOD Description and Justification

The LOD upstream of the crossing includes approximately 75-ft of channel, which will provide space for any necessary tie-in grading associated with the proposed structure augmentation. The LOD downstream of the crossing includes the existing Thomas Branch channel and space to construct the new proposed dual 12' x 10' culvert. This LOD allows space for the proposed connection of structure #150140X01 to the new Thomas Branch culvert.

Feature ID # 21C_C, Sta 0261+50 (JPA Impact Plate #7), I-495 over Thomas Branch, Structure #150141X01

Existing Site Description

An existing single 12' x 9' reinforced concrete box culvert (RCB), built in 1961, conveys Thomas Branch stream flow under I-495 from northwest to southeast. Downstream of the crossing, Thomas Branch flows south along I-495.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics assessment indicate roadway overtopping during the 10-year storm event, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of a new dual 12' x 9' RBC structure at the north side of existing culvert headwall. This structure will convey flow perpendicular under I-495, then turns to convey flow parallel south along the I-495 inner loop. The proposed dual 12' x 9' RBC will connect to a proposed extension of the existing Culvert 150141X01 at a proposed junction structure.

Due to the I-495 roadway widening and limited ROW along the Thomas Branch corridor, some channel sections are proposed to be conveyed within a structure. Approximately 7800 feet of Thomas Branch open channel upstream of Culvert #150141X01 is proposed to be conveyed within a dual 12' x 10' concrete box culvert. The upstream and downstream existing headwall of structure 150141X01 will be changed to junction boxes which connect the existing culvert 150141X01 and the proposed augmentation dual concrete box culverts. Downstream of the proposed junction box, Thomas Branch is conveyed approximately 127 feet to outfall to an open channel segment which continues to flow south along the I-495 inner loop.

LOD Description and Justification

Upstream and downstream of the crossing, the Thomas Branch channel is completely within the LOD. This will allow space for the proposed channel modifications, culvert augmentation, junction structures, and outlet stabilization at the downstream outfall to open channel.

Feature ID #23U_C, Sta 4719+00 (JPA Impact Plate #22), I-270 East Spur over Unnamed Tributary to Old Farm Creek, Structure #150149X01

Existing Site Description

The structure that conveys the unnamed tributary is a 60" SPP. Culvert ID 150149X01 receives runoff from two (2) roadway drainage ditches and an offsite stormdrain in an area confined by a private property (owned by Lockheed Martin) and the I-270 east spur. The drainage ditches upstream of Culvert ID 150149X01 are eroded, while the stormdrain outfall appears stable. The upstream outfall discharges approximately 20 feet upstream from Culvert ID 150149X01 and then flow enters the stable rock outfall before entering the culvert. The stream conveyed by Culvert ID 150149X01 discharges to an unnamed tributary of Old Farm Creek approximately 30 feet downstream of the culvert outfall. The drainage areas of the unnamed tributary conveyed by Culvert ID 150149X01 and the unnamed tributary to Old Farm Creek are approximately equivalent in size. The outfall channel shows some signs of bank erosion and the channel bed is armored with large riprap in some portions.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of two (2) 60" RCPs are proposed for Culvert ID 150149X01. Due to the minimal roadway widening and/or shifting there are no proposed extensions.

LOD Description and Justification

The upstream LOD extends to the private drive along the Lockheed Martin property to provide adequate space for grading tie-in for the new culvert augmentation, stream diversion during construction, and potential grading if additional upstream storage is desirable. The downstream LOD extends approximately 215 feet downstream to the confluence with the Unnamed Tributary to Old Farm Creek. The downstream LOD should provide adequate space for the new culvert augmentation, stream diversion during construction, and drainage design to account for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The LOD also extends upstream along the unnamed tributary to Old Farm Creek to provide adequate space to account for backwater impacts, grading tie-ins, and stream diversion during construction. The LOD on the downstream will allow for access during construction.

Feature ID #28B, 29A_C2, and 29A_2, Sta 3338+00 RT (JPA Impact Plate #20 & 21), I-370 over Unnamed Tributary to Muddy Branch, Structure #150226X01

Existing Site Description

The structure that conveys the unnamed tributary to Muddy Branch are two (2) 72" RCPs. Culvert ID 150226X01 receives runoff from Culvert ID 150225X01 and a concrete ditch fed by Culvert ID 095. The upstream channel area appears stable. Culvert ID 150226X01 discharges to an unnamed tributary of Muddy Branch, which joins with Muddy Branch approximately 870 feet downstream of the culvert outfall. The outfall channel shows some signs of bank erosion. The channel bed is armored with large riprap in some portions, there is bedrock observed in other portions of the channel, and there is a large riprap scour hole directly downstream of the outfall. A secondary MDOT SHA outfall is located just east of the outfall of Culvert ID 150226X01. The downstream channel is confined for approximately 280 feet until the right overbank (looking downstream) flattens out to become a broad floodplain.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. The overtopping location in the gore area is located to the southeast of the entrance of Culvert ID 150226X01. Structure augmentation with the addition of two (2) 72" RCPs are proposed for Culvert ID 150226X01 to avoid flooding the ramp between I-370 and I-270 to the southeast. Due to the roadway configuration in this area, there are no proposed extensions.

LOD Description and Justification

The upstream LOD extends to the edge of the roadway ramp between I-270 and I-370 to provide adequate space for grading tie-in for the new culvert augmentation, stream diversion during construction, and potential grading if additional upstream storage is desirable. The downstream LOD extends approximately 290 feet downstream to provide adequate space for the new culvert augmentation, stream diversion during construction, and drainage design to account for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The LOD on the downstream end will allow for access during construction.

Feature ID #22H, 22F, 22G, 22H_C, and 22KK, Sta 199+00 RT (JPA Impact Plate #5), Cabin John Parkway over Unnamed Tributary to Cabin John Creek, Structure #150237X01 and #434

Existing Site Description

The structures that convey the unnamed tributary to Cabin John Creek are two (2) 48" RCPs (Culvert ID 150237X01 and Culvert ID 434) in series under interchange ramps to/from Cabin John Parkway and I-495. Culvert ID 150237X01 receives runoff from a drainage ditch confined by Cabin John Parkway and residential properties. The drainage ditch upstream of Culvert ID 150237X01 is stable but does have a significant amount of riprap and sediment in the downstream concrete lined portion. Culvert ID 434 receives runoff from Culvert ID 150237X01 and two (2) drainage ditches in the gore area. The concrete channel between Culvert ID 150237X01 and Culvert ID 434 is stable but is filled with debris and sediment in some sections. The gore area is saturated and has been identified as a wetland. Culvert ID 434 discharges directly into Cabin John Creek approximately 60 feet downstream of its outfall. The small portion of outfall channel is stable.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Based on the current proposed roadway configuration, an open channel is proposed in place Culvert 150237X01, which is proposed to be removed. A 60" RCP is proposed to augment flow for Culvert ID 434. Due to the roadway reconfiguration along Cabin John Parkway, Culvert ID 434 is proposed to be extended upstream and downstream of the proposed roadway extents.

LOD Description and Justification

The LOD extends approximately 210 feet upstream of the Culvert ID 434 entrance which will provide adequate space for grading tie-in for the new culvert augmentation and extension of Culvert 434. The LOD will allow work area for the realignment and extension of the existing drainage ditch upstream of the removed Culvert 150237X01. The LOD as proposed provides adequate space for stream diversion during construction and grading if additional upstream storage is desirable. The downstream LOD extends to the confluence with Cabin John Creek, which will provide adequate space for grading tie-in for the new culvert augmentation, stream diversion during construction, and for channel stability measures required to mitigate for the potential increased shear stresses and velocities that may result from the proposed increase in conveyance capacity. The LOD is also adequate to provide for access during construction.

Upstream of feature ID # 21I, Sta 3778+50 (JPA Impact Plate #9), I-270 over Unnamed Tributary to Thomas Branch, Structure #150239X01

Existing Site Description

An existing 36" RCP conveys upstream drainage under I-495 from northeast to southwest and outfalls to Thomas Branch along I-495. An inlet structure was added to the middle of the culvert in 1994 (identified as I-12). A storm drain system, receiving I-495 roadway pavement drainage, was connected to inlet I-12 via a 36" RCP from north.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicates roadway flooding during the 50-year storm, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. The existing 36" culvert does not have the capacity to convey both the drainage from east of I-495, as well as the roadway pavement run-off captured by the drainage system from the north.

The proposed design includes abandoning the upstream segment of 36" RCP from the headwall to inlet I-12. The downstream segment of 36" RCP, from inlet I-12 to the culvert outfall, is to remain in order to convey the current storm drain system flow. The structure augmentation consists of a new 6' x 3' reinforced concrete box (RCB) structure on the south side of existing culvert to convey the drainage from east of I-495 to west. The new structure will outfall to a Thomas Branch existing open channel segment.

LOD Description and Justification

The area upstream of the existing culvert is identified as potential location for a stormwater management best management practice (SWM BMP) to provide water quality treatment for impervious area within SHA right of way. A ditch is proposed to convey off-site drainage around the proposed SWM BMP and discharge to the structure 150239X01 upstream headwall. The upstream LOD will provide space to accommodate the SWM BMP and the ditch grading tie-in. Based on the current proposed roadway configuration, there is no downstream extension of the existing culvert. The downstream LOD extends past the confluence with Thomas Branch in order to allow sufficient area for the proposed culvert augment and headwall.

Feature ID # 21C_C1, Sta 0237+50 (JPA Impact Plate #6), I-495 over Thomas Branch, Structure #150257X01

Existing Site Description

An existing single 12' x 9' Reinforced Concrete Box Culvert (RCB), built in 1964, conveys Thomas Branch stream flow under I-495 from northeast to southwest. Downstream of the crossing, Thomas Branch flows south along the I-495 outer loop. A concrete trapezoidal channel with a single integrated concrete step is upstream of the box culvert. Thomas Branch is confined by the I-495 roadbed to the west and high ground to the east as the stream parallels I-495 for the entire assessment reach upstream of the culvert. A sheet pile wall comprises much of the western stream bank with noise wall and associated foundation above.

Reason for Augmentation and Potential Proposed Conditions

The initial hydrology and hydraulics assessment indicate roadway overflow at 10-year storm event, which results in the need for culvert augmentation to meet the MDOT SHA 100-year design storm criteria. In the proposed design, the structure augmentation consists of installing four (4) new 120" RCPs on the south side of existing culvert to convey the Thomas Branch stream flow under I-495. At the downstream end of the crossing, Thomas Branch will continue within a dual RCB structure for approximately 700 feet.

LOD Description and Justification

The LOD upstream of the crossing extends approximately 100-feet east from the existing culvert 150257X01 headwall. The LOD will accommodate the proposed alignment of Thomas Branch and the expanded headwall/retaining wall structure based on the current proposed roadway configuration. Downstream of the crossing, the LOD is proposed to be offset approximately 115-feet from the proposed edge of road, based on the current proposed roadway configuration. The proposed LOD area will accommodate the proposed culvert junction structure installation and dual RCB structure extending downstream.

Feature ID #26B_C, Sta 3509+75 (JPA Impact Plate #17), I-270 over Unnamed Tributary to Fallsmead Stream (Tributary to Watts Branch), Structure #150271X01

Existing Site Description

The structure that conveys Unnamed Tributary to Fallsmead Stream (aka Tributary to Watts Branch) under I-270 consists of a 72" SPP constructed in 1954, which was extended in 1986, and a 48" RCP constructed in 1986. Upstream of I-270, an existing off-line stormwater management pond in the left floodplain manages runoff from adjacent development (pond property owner listed as Mayor & Council of Rockville). The channel upstream of the crossing is through private property (Rockville Nursing Home, Inc.) and appears to be migrating towards the building on this property. The area between the channel and stormwater pond was delineated as wetland. Approximately 70 ft downstream of the I-270 crossing, the Unnamed Tributary crosses under Watts Branch Parkway via a 78" SPP culvert. Downstream of Watts Branch Parkway there are signs of channel instabilities (eroded banks, fallen trees). Immediately downstream of the Parkway crossing, the channel appears to be migrating towards the properties in the right floodplain. FEMA mapping indicates that the homes on these properties are outside the 100-year floodplain. Approximately 1,800 ft downstream, there is a confluence with a similarly size stream, which also crosses under I-270 approximately 1,300 ft south of this site. Approximately 300 ft downstream of the stream confluence, there is a multi-pipe structure to carry an access road over the stream.

Potential Proposed Conditions

The simplified planning level hydrology and hydraulics indicates roadway overtopping during the 100-year flood requiring culvert augmentation. The roadway overtopping was not found to occur in the simplified analysis which considered the upstream storage. Initially, augmentation with a 72" RCP was proposed for the structure to ensure that the crossing meets the MDOT SHA 100-yr design flood criteria. However, given the potential impacts related to any increase in downstream discharge associated with conveyance improvement at the crossing, consideration was given to the potential to expand the volume controlled upstream to ensure no roadway overtopping, rather than provide a pipe augmentation to reduce headwater elevations.

LOD Description and Justification

The LOD was developed assuming the preferable option at this site would be to add storage upstream of the crossing, **if the detailed H&H analysis conducted during the design phase confirms that the roadway is overtopped in the 100-year flood**. If the 100-yr overtopping were to be addressed via pipe augmentation, up to 2,300 ft of downstream stream reach would need to be included in the LOD, in order to mitigate for any downstream discharge increase and the resultant velocity and shear stress increases. It is also likely that a pipe augmentation at Watts Branch Parkway would also be required to mitigate for any increase in downstream peak flow which would likely result in increased flood overtopping (water surface elevation) at Watts Branch Parkway.

To mitigate for the noted risk at this site, the proposed LOD upstream of the I-270 crossing was extended to provide space for additional storage volume and peak attenuation. The upstream LOD was increased to encompass the existing pond (left floodplain), the existing channel (right floodplain), and the open (undeveloped) area between the channel and pond. The proposed LOD downstream of the I-

270 crossing includes just a minimal bumpout downstream of the culvert headwall to allow for any outfall stabilization that may be required based on the upstream modifications.

Feature ID #24V_C, Sta 3641+50 (JPA Impact Plate #13), I-270 over Tributary to Cabin John Creek, Structure #150419X01

Existing Site Description

A 60" RCP conveys the tributary to Cabin John Creek under I-270. The area upstream of I-270 is not stable in existing conditions. There is an existing 48" RCP and 24" RCP that outfall to a small channel, which conveys flow to the 60" RCP. The approximately 50-ft channel is partially lined with concrete, which is broken and undermined. Two eroded side channels conveying roadway runoff also contribute flow to the 60" RCP. The channel immediately downstream of the I-270 crossing has been protected with rock and appears to be stable for approximately 30 ft. Downstream from this location until the confluence with Cabin John Creek the channel is degraded, with headcuts and severely eroded banks.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. The roadway overtopping was not found to occur in the simplified analysis when the upstream storage and routing was considered. Given the uncertainty in the analysis, the augmentation was assumed to be necessary unless detailed analysis shows otherwise. Structure augmentation with the addition of two each 60" RCP on each side of the existing pipe is proposed.

LOD Description and Justification

The LOD extends approximately 150-ft upstream of the crossing, which should provide space for grading tie-in for the new culvert augmentation, as well as space to repair the existing damaged pipe outfall and erosion issues. The downstream LOD was set to include the full reach down to the confluence with Cabin John Creek. This lengthy LOD will be needed to repair and stabilize the existing degraded channel. The channel improvements will also mitigate for any velocity and shear stress increases associated with the potential increased downstream peak discharge related to the capacity increase at the crossing. This channel stabilization effort will be entirely on MNCPPC property.

Feature ID #25H_C, Sta 3561+00 (JPA Impact Plate #16), I-270 over Unnamed Tributary to Cabin John Creek, Structure #150420X01

Existing Site Description

The structure that conveys the unnamed tributary to Cabin John Creek under I-270 is a 60" RCP. Upstream of I-270, the pipe connects to the outlet control structure of an existing stormwater management wet pond. The existing pond is located on Montgomery County property, between the Montgomery County Detention Facility and the I-270 roadway. On the downstream side of the crossing, the 60" RCP discharges to a small channel. Approximately 200-ft downstream of the outfall, the small channel joins with another unnamed tributary to Cabin John Creek. The small channel and tributary flow through a currently undeveloped, open area. The property is privately owned (Owner listed as Tower-Dawson, LLC) and zoned as commercial.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 60" RCP is proposed. The initial analysis did not consider the storage and attenuation provided by the upstream existing stormwater facility. This detailed analysis will need to be conducted during the design phase prior to any modification of the pond outlet structure, including the pipe augmentation.

LOD Description and Justification

The LOD upstream of the crossing includes the area around the pipe and upstream control structure in order to allow for augmentation and outlet structure modification. The LOD downstream of the crossing includes the small outlet channel down to the confluence with the other unnamed tributary to Cabin John Creek. This will allow for tie-in grading associated with the pipe augmentation and for the construction of channel stability measures as need to mitigate for any velocity and shear stress increases that result from the increase to downstream discharge.

Feature ID #27A_C, Sta 3479+25 (JPA Impact Plate #18), I-270 over Watts Branch, Structure #150064001

Existing Site Description

The structure that conveys Watts Branch under I-270 is a 25' by 8' box culvert. Approximately 250 ft upstream of the I-270 crossing, Watts Branch passes under Nelson Street via a 31' by 8' box culvert. Upstream of the Nelson Street culvert, there is evidence of stream restoration work. The channel upstream of the Nelson Street and I-270 crossings appears to be stable. Approximately 550 ft downstream of the I-270 crossing, Watts Branch passes under MD 28. The MD 28 structure is also a 25' x 8' box culvert. Immediately downstream of I-270, the channel appears stable. Towards MD 28, the channel becomes less stable with bank erosion and head cuts present. During the site visit, significant debris jams were noted.

Potential Proposed Conditions

Initial hydrology and hydraulics indicate roadway overtopping during the 100-year flood, which results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 96" RCP in the right overbank is proposed. A similar augmentation strategy is proposed for the downstream MD 28 crossing (Feature ID #27A_C1).

LOD Description and Justification

The LOD extends approximately 150-ft upstream of the crossing, which should provide space for grading tie-in for the new culvert augmentation, as well as space for stream diversion during construction. The upstream LOD limit is just upstream of a confluence with a small tributary (drainage ditch), which is in the right overbank area and thus minimally impacted by grading that will be needed for the proposed pipe augmentation. The downstream LOD was set to include the full reach between the I-270 and MD-28 crossings. This will allow for stabilization of the existing unstable channel and for construction of any channel stability measures required to mitigate for the potential increased shear stress and velocity that may result from increased downstream discharges. This LOD will also provide space for channel alignment that is needed for the MD 28 culvert (see additional discussion included with Feature ID #27A_C1 site summary).

Feature ID #24A_C, Sta 3683+00 (JPA Impact Plate #11), I-270 over Old Farm Creek, Structure #150080001

Existing Site Description

The structure that conveys Old Farm Creek under I-270 is a 20-ft x 10-ft box culvert. The channel upstream of the crossing was identified as stable, with evidence of stream restoration work observed during a site visit. Downstream of the crossing, some signs of instability (eroded banks and undercut trees along stream banks) were noted. An 84" SPP (Feature ID #23K_C, Structure 431) outlets to Old Farm Creek on the downstream side of I-270. This culvert carries flow under Tuckerman Lane and shares a downstream headwall with the box culvert. Old Farm Creek is within MNCPPC property on both the upstream and downstream side of the crossing. Approximately 2,500-ft downstream of the crossing, Old Farm Creek joins with Cabin John Creek. In the project area Old Farm Creek runs parallel to Tuckerman Lane, which also crosses under I-270 near the Old Farm Creek crossing.

Reason for Augmentation and Potential Proposed Conditions

Initial hydrology and hydraulics indicate that 100-year flood water surface elevations exceed the elevation of Tuckerman Lane. Based on topography, flow exits the stream channel and left floodplain upstream of the I-270 crossing. Flood waters flow down Tuckerman Lane, eventually rejoining the main channel flow path prior to the confluence. This results in the need for augmentation to meet the MDOT SHA 100-year design storm criteria. Structure augmentation with the addition of a 96" RCP in the left overbank is proposed. In existing conditions, the outfall of the 84" SPP is located in the left overbank area. This pipe will be relocated in the proposed condition due to the lane expansion and retaining wall construction.

LOD Description and Justification

The LOD upstream of the crossing extends to a constructed riffle approximately 300-ft upstream of the headwall that was identified during a field visit. This will allow space for construction access and grading tie-ins related to the proposed culvert augmentation. Significant trees were noted in the overbank area. These trees will be within the LOD and will need to be protected during construction. The downstream LOD limit was set approximately 300-ft downstream of culvert outlet. During a field visit, an area of bedrock was noted in the channel at this location. The proposed LOD area will provide space for tie-in grading in the left floodplain for the added 96" RCP and space for grading related to the potential realignment of the 84" SPP (Culvert 431). The LOD was set to the minimum width it is assumed will be needed, to minimize left floodplain impacts on MNCPPC property.

APPENDIX C: Existing and Proposed Culverts Greater than 150-Feet

Existing or Proposed Culverts Greater than 150 Feet

Feature ID	Augment Status	Existing Length (ft)	Proposed Length (ft)	Notes	Station
21D_C	Proposed Augmentation	316.0	725.8	Adjacent relocation and extension	225+00
27A_C1	Proposed Augmentation	151.1	158	Augmented and extended	3484+00
23A_C2	AR - Abandoned and Replaced	235.7	Removed	Removed and relocated west of spur under Democracy Boulevard ramps.	3751+00
23A_C	Not augmented	215.8	No change		3741+75
22Q_C	Not augmented	276.1	No change		125+00
20D_C	Not augmented	179.1	No change		323+50
22A_C	AR - Abandoned and Replaced	151.0	370.1	Adjacent relocation and extension; Combining several features and culverts - 22B, 22C, 22D, 22A_C, 22C_C	220+50
22C_C	AR - Abandoned and Replaced	90.8	Replaced	Adjacent relocation and extension; Combining several features and culverts - 22B, 22C, 22D, 22A_C, 22C_C	218+50
22Z_C	Not augmented	98.9	No change		197+00
23K_C	Proposed Augmentation	177.7	843	Incorporated most of 24K_D	3684+25
24F_C1	Not augmented	271.5	No change		3616+50
22H_C	AR - Abandoned and Replaced	91.8	222	Adjacent replacement and extension; Extended length >150	198+00
21F_C	AR - Abandoned and Replaced	257.3	298.3	Replaced and extended	245+25
27L_C	Removed and Replaced (US); Removed, Replaced, Extended (DS)	404.4	No change	Removed and replaced/extended	3405+50
22M_C	Not augmented	512.820229	No change		117+00
27A_C	Proposed Augmentation	324.1	No change	Augmented and same length	3479+25
24A_C	Not augmented	319.8	No change		3683+00
23N_C	Proposed Augmentation	582.3	No change	Augmented and same length	4727+50
24F_C2	Proposed Augmentation	389.1	424.6	Augmented and extended	3627+00
21C_C2	Proposed Augmentation	327.4	273.9	Augmented	225+50
26C_C	Not augmented	359.3	No change		3523+25
23A_C1	Abandoned and Replaced	406.3	Removed	Removed and moved under Democracy Blvd (>326 ft)	3744+50
23D_C	Abandoned and Replaced	254.6	Removed	Removed and new culvert will be located north of 23D_C	3759+00
21B_C	Abandoned and Replaced	260.5	323.2	Adjacent replacement	297+00
21L_C	Proposed Augmentation	269.7	307.1	Augmented and extended	278+25
21C_C	Proposed Augmentation	252.0	301.3	Augmented; Includes extension onto WUS 21C and 21C_1	261+50
23U_C	Proposed Augmentation	316.4	345.3	Augmented and extended	4719+00
23Q_C	Not augmented	249.9	No change		4783+00
29A_C1	Not augmented	223.4	No change	Nearby SWM facility installation	3341+00
29A_C2	Not augmented	463.8	No change	Nearby SWM facility installation	3338+00
21C_C1	Proposed Augmentation	320.1	377.7	Augmented and extended	237+50
26B_C	Removed and Replaced	305.3	No change	Removed and replaced	3509+75
29B_C	Not augmented	442.5	No change		3328+50
24V_C	Proposed Augmentation	417.6	454.2	Augmented and extended	3641+50
25H_C	Proposed Augmentation	419.9	493.9	Augmented and extended	3561+00
20C_C	Not augmented	168.7	No change	Adjacent storm drain proposed	324+00
22AAA_C	Not augmented	490.1	No change		74+50
22WW_C	Not augmented	272.0	323	Extended	97+00
23AA_C1	Not augmented	219.8	Removed	Being eliminated and flow combined with 23AA, relocated to channels and culverts on east side of I-270 W Spur.	3753+00
23R_C	Not augmented	214.3	No change		4769+25
23V_C	Extended	776.1	No change	Storm drain showing; not noted in culvert layer	3722+50
26C_C1	Not augmented	207.6	No change		3523+25