MSMF V.1. Appendix F2

Fish Passage for Mitigation

Beta Tool Instructions

March 2025

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I. SUMMARY:

The Fish Passage for Mitigation Beta Tool (Fish Passage Tool or FPBT) is a process to estimate compensatory mitigation stream crediting (functional feet) for fish barrier removal projects in Maryland. It includes a calculator and this instructional document. It uses the same credit unit (functional foot) as other stream mitigation options (restoration, preservation, buffer enhancement, etc.) available through the Maryland Stream Mitigation Framework (MSMF).

The FPBT is a component of the Maryland Stream Mitigation Framework and is included as "MSMF V.1. Final Appendix F. Fish Passage." The Maryland Stream Mitigation Framework is a process established primarily for United States Army Corps of Engineers (USACE) Baltimore District (NAB) regulators in Maryland to estimate stream credits/debits for permit actions under CWA Section 404. The Fish Passage Tool establishes an additional option to provide compensatory mitigation for stream impacts through removal of barriers to aquatic life movement. The MSMF V.1. Final Calculators for Stream Channels or Stream Buffers (MSMF V.1. Final Appendix A1) may be used in combination with the Fish Passage Calculator (MSMF V.1. Appendix F) where the restoration work is recommended AND permanent protection is provided for the restoration work. Note: this tool may also be used by the Maryland Department of the Environment (MDE) to evaluate impacts and mitigation related to waters of the state.

The purpose of the Fish Passage Tool is to: 1) to encourage strategic fish passage projects as a form of compensatory mitigation for impacts under CWA Section 404; 2) to create a credit accounting system which rewards proposals based on the ecological benefits of the proposed projects. The Fish Passage Tool does not incentivize projects which do not provide substantial ecological benefits or where detriments outweigh benefits; and 3) to align with the Maryland Stream Mitigation Framework (MSMF) by using functional feet as the unit of credit, allowing for combination with other forms of mitigation such as stream preservation and restoration work. 4) Improve public safety through the removal of obsolete dangerous structures 5) Increase the availability of mitigation credits for CWA Section 404 permit applicants. 6) Support fish populations critical to the commercial and recreational fishing industries.

This Beta version of the Fish Passage Tool provides two calculation methods (two tabs): 1) Calculation Dams, and 2) Calculation Culverts for dam removal and culvert removal respectively. These two calculation methods are nearly identical aside from minor differences in calculation parameters. Crediting is not provided for fish ladders or other proposals which do not include complete remedy of a fish passage barrier. Complete passage at baseflow (at a minimum common flow events) must occur as a result of the mitigation activity to be considered for crediting in the Fish Passage Tool. For dam removals, the dam must be removed, and any replacement structures must be passible by fishes of that waterway. In general, this means remaining or constructed grade control structures with drops not exceeding 1 ft and riffle slopes not exceeding 10%, however this range will vary based on geographic region, reference geomorphology, and the needs of local aquatic fauna. For culvert removals, the culvert must be removed and replaced with a bridge, bottomless arch culvert, or removed without replacement to be eligible to use this credit determination tool.

This Fish Passage Tool development has been a collaborative process to define elements of credit determination with an inner-agency Fish Passage Work Group (FPWG) made up of the following members: Jim Thompson, Maryland department of Natural Resources (MD DNR); Jonathan Watson National Oceanic and Atmospheric Administration (NOAA); Mary Andrews, NOAA; Ray Li, United States Fish and Wildlife Services (USFWS); Lindsey Nolan, NOAA; Nick Ozburn, USACE; and Meg Fullam, USACE. We also thank Kim Isenhour, USACE-North Atlantic Division, for detailed review to help refine this Beta Tool. The FPBT utilizes previously developed regional tools, most notably the Chesapeake Bay Fish Passage Prioritization Fresh Water Network (FWN) Tool https://www.maps.tnc.org/chesfpp/#/explore, which is a collaboration between resource agencies, the Nature Conservancy, and other stakeholders of the Chesapeake Bay Region to identify opportunities for aquatic connectivity through in-stream barrier removals. The FWN prioritizes barriers across the Chesapeake Bay based on a variety of metrics and weighted multipliers to ecologically prioritize barriers for removal that would best benefit diadromous, resident, and/or brook trout species.

Per the 2008 Mitigation Rule, “in-kind” mitigation is preferable to “out-of-kind” mitigation because it is more likely to compensate for the functions and services lost at the impact site. For purposes of the fish passage for mitigation beta tool, in-stream impacts to diadromous species waters should not be mitigated by barrier removals benefiting only resident species (“out-of-kind” mitigation).

RGL 18-01 includes provisions to promote credit generation for improved use of habitat by threatened and endangered species and/or the reestablishment of passage for diadromous fish species. These benefits have also been incorporated into the baseline credit and is also captured in the “target species” section. This approach is much more predictable and avoids numerous constraints such as the difficulty with identifying suitable habitat, property access limitations, and inability to identify and monitor all suitable habitats for species usage, as well as the variable distance between obstructions. If the project includes benefits to specific species listed under Section 7 of the Endangered Species Act, sponsors are encouraged to pursue conservation banking options with the USFWS.

Additionally, RGL 18-01 promotes the removal of non-impounding structures that obstruct the passage of aquatic life, such as culverts, to be considered on a case-by-case basis where there are unique aquatic resource considerations, and a culvert tool was established to award credits in such instances.

Disclaimer: *Please note that while this beta tool considers mitigation scenarios through stream barrier removal, exceptional circumstances may arise requiring adjustments to the tool output by a Corps Project Manager. While a permit applicant may use the Fish Passage for Mitigation beta tool to forecast mitigation credits for aquatic species* *passage, a Corps Project Manager will ultimately use the calculator to determine the functional foot gains by the activity, and upon coordination with resource agencies the project manager may adjust credits awarded for a given mitigation proposal. Information gained during use of the Beta version of the Fish Passage Calculator will help inform development of Version 1. This FPBT may be rescinded, revoked, or revised by the Corps Baltimore District.*

Questions on application of the FPBT may be directed to Meg Fullam at meghan.e.fullam@usace.army.mil or Nick Ozburn at nicholas.r.ozburn@usace.army.mil.

II. BACKGROUND:

A. Ecological Benefits of Stream Barrier Removal:

In-stream barriers fundamentally alter aquatic ecosystems, disrupting the natural flow of water, transforming biological and physical characteristics, and fragmenting continuity and connectivity of rivers. Dams alter the timing, duration, and magnitude of river discharge and can have a profound impact on sediment transport and the hydraulic conditions and substrates native fauna rely on to complete life history cycles (Poff & Allan 1997, Freeman et al. 2003). Many dams are approaching the end of their lifespan and have significantly deteriorated, been abandoned, or no longer fulfill intended use. Economic as well as energy needs have shifted, and ecological research has advanced to elevate issues of water quality, aquatic species, and tribal claims along rivers impounded by dams (Headwaters Economics, 2016). Careful removal of obsolete dams and culverts can present direct ecological and societal benefits, including removal of public safety hazards.

By physically blocking a river, storing excess runoff, and/or releasing water according to human needs, dams and in-stream barriers alter natural flow regimes (Poff & Allan 1997). Physical obstruction of dams can result in major alterations to riverine hydraulics and seciment transport, affecting both riverine systems and coastal waters. Damming rivers alters species richness and composition due to changes in hydrological regimes, water quality, and disruption of longitudinal flow (Freeman et al. 2003). Seasonal flow variability and peak flows may be considerably reduced, resulting on overall declining water level fluctuations (Leyer, 2005) depending on a dam's storage capacity and operational regime. The configuration of multiple dams in a watershed can amplify this effect on the hydrology, sediment transport, and resulting ecological systems of a river. Lateral exchanges of sediment, nutrients, and organisms between aquatic and terrestrial areas are limited by fewer overbank floods in a dammed river. The hydrological changes of natural flood pulses are often removed from floodplains downstream and result in permanently inundated floodplains upstream (Junk et al., 1989),

Creation of a reservoir turns impounded sections of river into slow-moving, lake-like habitat and alters species composition of the river. Lake-adapted (lentic) species may flourish while riverine (lotic) species might become more susceptible to predation and displacement. In the Snake River in Oregon, the creation of lake-like habitat had resulted in an increase in salmonid predator densities (Bendarek, 2001).

Dams reduce water velocity of the river, causing reduction in capacity to transport sediment, often resulting in aggradation of the streambed upstream of the dam. Finer particles can fill the impoundment, limiting water storage, and fill in valuable spawning substrates. Retention of sediment upstream of a dam often result in altered sediment transport downstream and alteration of downstream habitat features (Bednarek, 2001). When a dam is removed, fine sediment is mobilized and redistributed, exposing gravel, cobble, and boulders in the formerly impounded area. In addition, the alteration of the timing, duration, and magnitude of flow events by dams may adversely affect native fish fauna (Poff & Allan 1997, Freeman et al. 2001). The adverse effect of disrupted sediment transport may be somewhat muted for barriers in Maryland waterways, as most are “run-of-river” dams that do transport sediment once the impoundment reaches storage capacity.

The higher water temperatures in a dam impoundment can often present stressful conditions associated with elevated temperature and diminished dissolved oxygen conditions (Abbott et al. 2022). This habitat modification alone prevents or hinder both upstream and downstream fish migrations, with particularly deleterious effects for migratory fishes. The presence and operation of dams has been identified as a top threat to anadromous species in the mid-Atlantic and northeast (Greene et al. 2009; German et al. 2022), as there are more than 14,000 dams from Virginia to Maine. Dams disrupt migratory aquatic movement during the adult spawning migration, in-river movements, adult out-migration, and juvenile out-migration (Brown et al. 2013; Hare et al., 2021; Zydlewski et al. 2023).

In addition to dams, many stream crossings are culvert installations historically designed to convey a desired storm flow with little or no consideration for fish passage or stream channel habitat loss. The implementation of these structures has resulted in perched outlet conditions and unsuitable velocity and flow conditions through the barrel of the culvert (Clay, 1995), including for Atlantic coast migratory fishes (Alcott et al., 2021). Many culvert installations consist of corrugated metal pipes, box culverts, and natural bottom arches, and there’s been a growing recognition that road-stream crossings should not only be aligned for road alignment and grade but also for allowing unhindered fish passage (Votapka, 1991).Barrier removal and redesign of full-blockage road-stream crossings provides an opportunity to expand available habitat to restricted species, and reconnect severed fish populations, benefiting both population size and genetic health of native fish populations.

B. Site Selection:

Site selection is one of the 12 fundamental components of a mitigation plan per the Mitigation Rule § 332.3(d). Strategic site selection is essential to long term sustainability, maximizing ecological benefits, minimizing risks, and improving credit yields.

The FPBT prioritizes high ranking barriers that provide the largest gains in upstream access to aquatic fauna. In selecting sites for barrier removal projects, these locations should be researched first to determine if they are feasible projects. Barriers are ranked using the Freshwater Network Tool (FNT) https://www.maps.tnc.org/chesfpp/#/explore. The FNT is a barrier prioritization tool including a map and background information on barriers. It was established by the Nature Conservancy and resource agency partners to prioritize barrier removals presenting the greatest potential benefit to aquatic species.

1. Dam Removals:

When exploring dam removal projects in the FNT, select the appropriate model (Diadromous or Resident), for Geography, select “Maryland,”, and for Barrier Type, select “Dams Only.” Dams are prioritized with a rank from 1-20 where ranks of 1-3 are very highly prioritized dams for removal. The “Diadromous” model should only be used on the first barrier above tidal water. Dam removal projects can present several challenges such as sediment management, vertical stability, conservation of freshwater mussels, invasive species, future development, utility corridors, historic resources, and real property considerations. Project proponents are encouraged to reach out to regulators and resource agencies regarding proposals when a barrier is identified for removal.

2. Culvert Removals:

When exploring dam removal projects in the FNT, select the appropriate model (Diadromous or Resident), for Geography, select “Maryland,”, and for Barrier Type, select “Culverts Only.” Culvert barriers are prioritized with a rank from 1-20 where ranks of 1-3 are very highly prioritized dams for removal. The “Diadromous” model should only be used on the first barrier above tidal water. Culvert removal projects can present several challenges such as vertical stability, finding suitable replacement crossings, long term management of crossings, potential for road widenings, utilities, future development, sediment management, invasive species, historic, and real property considerations. Project proponents are encouraged to reach out to regulators and resource agencies regarding proposals when a barrier is identified for removal.

C. Potential for Adverse Impacts:

For some barrier removals, adverse impacts such as loss of wetlands, and sediment releases may occur. During barrier removal planning, care must be taken to avoid substantial adverse impacts to the environment, however minor impacts resulting during dam removal may be unavoidable. Per Regulatory Guidance Letter (RGL) 18-01 released on September 25, 2018, wetlands developed near impoundments that have resulted from man-made impairments of streams should generally not result in mitigation requirements. However, the Corps may require compensatory mitigation for wetland losses for “Wetlands of Special State Concern” (MDE Nontidal Wetlands of Special State Concern) or wetlands which existed prior to dam/barrier construction. MDE may also require mitigation for permanent wetland loss. The Maryland Interagency Review Team (IRT) will evaluate impacts to wetlands, stream channel quality and stability, as well as impacts from downstream sediment/nutrient transport and potential impacts to sensitive species (e.g., mussels) and habitats on case-by-case basis. In some cases, measures such as incremental removal, slow release of sediments, or complete sediment removal may be required depending on contamination factors and considerations such as eutrophication of the Chesapeake Bay and actions adverse to the intent of the Chesapeake Bay Total Maximum Daily Load Executive Order.

D. Helpful Resources:

The Freshwater Network, Chesapeake Bay Fish Passage Prioritization (For examining potential barrier removal projects in Maryland): https://www.maps.tnc.org/chesfpp/.

Design considerations for culvert replacement: https://www.fhwa.dot.gov/engineering/hydraulics/culverthyd/aquatic.cfm. See document: Aquatic Org Passage at Highway Crossings: An Implementation Guide. (USDT 2024).

United States Geological Survey (USGS) Stream Stats (For Determining Drainage Area of a Stream/River): https://www.usgs.gov/streamstats.

Watershed Resources Registry (For GIS Data and mapping): https://watershedresourcesregistry.org/map/?config=stateConfigs/maryland.json.

Dam Removal Analysis Guidelines for Sediment (US DOI 2017).

Maryland Credit Release Schedules (In RIBITS, Filter by State: “Maryland” Folder “Bank & In-Lieu Fee (ILF) Establishment): https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10.

Maryland Stream Mitigation Performance Standards and Monitoring Requirements (In RIBITS, Filter by State: “Maryland” Folder “Bank & ILF Establishment): https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10 or https://www.nab.usace.army.mil/Missions/Regulatory/Mitigation/ under the “Maryland Stream Mitigation Framework” heading.

The Maryland Stream Mitigation Framework: https://www.nab.usace.army.mil/Missions/Regulatory/Mitigation/.

The Freshwater Network, Northeast Regional Fish Passage Prioritization (Provides barrier prioritizations where not covered by the Chesapeake Bay Model): https://maps.freshwaternetwork.org/northeast/.

Southeast Aquatic Resource Partnership, Aquatic Barrier Inventory & Prioritization Tool (For aquatic barriers outside of Maryland): https://aquaticbarriers.org/.

Fish Passage Training Portal and Checklists: https://units.fisheries.org/fishpassagejointcommittee/resources/fishpassagetrainingportal/.

III. FISH PASSAGE CALCULATOR INSTRUCTIONS:

A. Preapplication Coordination:

This FPBT may be used to estimate stream mitigation credits for Mitigation Banks, Permittee Responsible Mitigation (PRM), or ILF mitigation when acceptable to the Corps permit application reviewer. Consultation in the preapplication phase is strongly recommended for agency perspectives regarding ecological benefits, risks, and effects to fisheries, wildlife populations, historic and tribal resources.

The Corps and MDE, with advisement from resource agencies, will determine whether the barrier removal is suitable for mitigation and whether sediment removal is recommended or required. For agencies to make this determination, information regarding the volume, composition (grain size), and potential contamination of impoundment sediments will be needed. The applicant must consult with MD DNR at email environmentalreview.dnr@maryland.gov regarding whether the agency recommends barrier removal. In some rare instances, a barrier may be in important blockage for exotic or invasive species, preventing upstream colonization, or sensitive mussels may occur downstream of the dam, requiring relocation. Prospective applicants are also encouraged to contact Maryland Department of the Environment: Dam Safety. A wetland delineation may also be required where sediment releases resulting from a barrier removal may adversely affect downstream wetlands. See “Draft Prospectus Information Checklist” and “Required Information for a Complete Prospectus” located on RIBITS in “Bank and ILF Establishment” at: https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10. This checklist is also helpful when drafting a conceptual plan for PRM.

For mitigation bank or ILF proposals: A draft prospectus would be presented to the Corps and MDE at an IRT meeting for consideration as a mitigation proposal; a site visit with the IRT is recommended at the draft prospectus phase.

For PRM mitigation proposals: The pre-application coordination would take place prior to the submittal of a joint permit application for a PRM proposal to offset proposed impacts. After submittal of the joint permit application, agency coordination would take place during the Maryland Joint Evaluation coordination process, including similar review by resource agencies as outlined in the mitigation bank process. A conceptual mitigation plan is required for agency review.

B. Detailed Description of Calculator Parameters and Steps:

In the MSMF FPBT, the user will first select the Calculation Tab that applies to the subject project. Tab 1) Calculation Dams or Tab 2) Calculation Culverts.

The steps for credit calculation follow the sequence: Section A. Background Information, Section E. Known Fish and Mussel Species in Waterway, Section B. Waterway Barrier Assessment, Section C. Expanded River Access and Section D. Active Sediment Management. Both Tab 1 & Tab 2 follow the same sequence and generally the same fields, however the minor differences are described in the detailed steps below. Tab 3 Species & Multipliers is a reference sheet for filling out Section C of either Tab 1 or Tab 2. *Note: user data is entered in cells with WHITE background. Colored cells are pre-set for calculations or headings. While there are two separate calculation tabs (dams vs culverts), we include only one instruction set below, and we note the few areas below where the calculation parameters differ. Should multiple barriers be selected for removal, the user may create a duplicate calculation tab by right clicking the relevant tab title at the bottom of the sheet and selecting to create a copy. The user may then rename those tabs with the barrier name.*

<u>Credit Calculation Steps:</u>

<u>Overview:</u> Within the FPBT there are two calculation tabs: Calculation Dams (for dam removals) and Calculation Culverts (for culvert removals). These tabs are nearly identical. Within each of these calculators, there are three ways to generate credits. 1) General Assemblage credits provide a number of credits based on assumed fish passage if criteria are met for the upstream watershed (for example no other upstream barriers in the network over 1 foot in height) 2) Target Species credits for species of concern in Maryland. Target species credits are performance based where the species (or a surrogate) must be tracked to the extent they colonize upstream habitats 3) Active Sediment Removal credits: for removal of accumulated impoundment sediments when recommended by the Corps/MDE and resource agencies.

Calculation Equations (auto-generated):

For Dams: Increase in upstream access upstream functional network (UFN) x Functional Network Multiplier x Barrier Tier Adjustment X Barrier Height Adjustment X Drainage Area Adjustment X Mitigation Ratio = Functional Feet of Stream Credits.

For Culverts: Increase in upstream access UFN x Functional Network Multiplier X Barrier Severity Adjustment X Barrier Height Adjustment X Drainage Area Adjustment X Mitigation Ratio = Functional Feet of Stream Credits.

For Active Sediment Removal: 70 CY removed = 1 Functional Foot.

<u>The instructions below will walk through the steps of the FPBT from top to bottom, including background on the metrics/multipliers listed in the above equations.</u>

1. Identify the Barrier.

The user may explore barriers, their features, and prioritization through the Chesapeake Bay FWN tool: https://maps.freshwaternetwork.org/chesapeake/.

Please note, the barrier tier (priority) and UFN affect crediting values substantially. Identifying a high priority barrier is essential to generating the highest amount of credits. These factors are identified in the Chesapeake Bay FWN tool.

a. Alternatively, for waterways outside of the Chesapeake Bay, the Northeast Regional Tool will generally be used for prioritization https://maps.freshwaternetwork.org/northeast/.

b. Note: *SARP (Southeast Aquatic Resources Partnership) is developing prioritization models across the US by pulling data from all known sources. The SARP tool for Maryland may be used in areas outside of the Chesapeake Bay https://aquaticbarriers.org/priority/combined_barriers/ when it is completed. The SARP prioritization tool is planned for completion in 2026.* The link above may be helpful to those focused on adapting this FPBT to other regions or Corps Districts.

2. Identify the Applicable Barrier Removal Tab (Tab 1_Calculation Dams or Tab 2_Calculation Culverts).

3. Complete Section A: Background Information.

The applicant should identify the barrier and input general information in the appropriate cells. The project summary should include the type of barrier(s) proposed for removal, other barriers in the watershed (with mapping), whether physical restoration work is proposed or involved, and details regarding the sediment composition and any sediment management. (Note: not all barrier removals require active sediment management, See Section E. Active Sediment Management).

Note: *Projects involving restoration of stream or river geomorphology, and habitat may also be eligible for CWA Section 404 crediting through the MSMF Calculator Appendix A.1.). If stream credits for physical restoration are also sought in addition to fish passage credits, this should be indicated in the project summary. Keep in mind, mitigation credits for stream channel restoration in MSMF Appendix A.1. (i.e. credits beyond benefits of fish passage determined in the FPBT) require site protection. General stabilization and vegetation of the work area is required regardless of the crediting method used upon construction/demo completion.*

A. Backround Information				
Project Name	Example Culvert	Sponsor	Example Sponsor	Functional Feet
Waterway	Ches Bay Trib 1	Principal Contact	Example Contact	
Barrier Name		County	Harford	
		Lat (Decimal Degrees)	39.44555	503
		Long (Decimal Degrees)	-76.77777	
Project Summary				

Figure 1. Section A Background Information and credit total in Functional Feet from the MSMF FPBT.

4. Determine Type of Barrier for Removal. In the Freshwater Network Tool https://maps.freshwaternetwork.org/chesapeake/.

Under "Filter Results" Select from either "Dams Only" or "Culverts Only" depending on whether a dam or culvert is proposed for removal.

5. Select Geography: Select "Maryland"

B. WATERWAY BARRIER ASSESSMENT							
Model	Barrier Tier	Barrier Tier Adjustment	Barrier Height (feet)	Barrier Height Adjustment	Physiography	Drainage Area (sqmi)	Drainage Area Adjustment
Diadromous	1	1	4	1	Piedmont	55.0	1.94

Figure 2. Section B Waterway Barrier Assessment from the MSMF FPBT.

6. Complete Section B: Waterway Barrier Assessment

a. Identify the Species Scenario/Model: Barriers affect fish species differently due to varying life history strategies across taxa. Diadromous fishes which depend on both freshwater and saltwater environments are affected by barriers differently than resident freshwater fishes. The FWN tool provides simple models grouping diadromous species and freshwater resident species separately. A user may elect to identify barriers for Resident fishes, Diadromous fishes, or Brook Trout under the "Model" field. The user will select the most applicable species model when running the calculator. Only select the Diadromous model if the barrier is the first barrier above tidal waters. In the FPBT, Select the same model in the "Model" Field in cell A17 of the calculation tab (Figure 4).

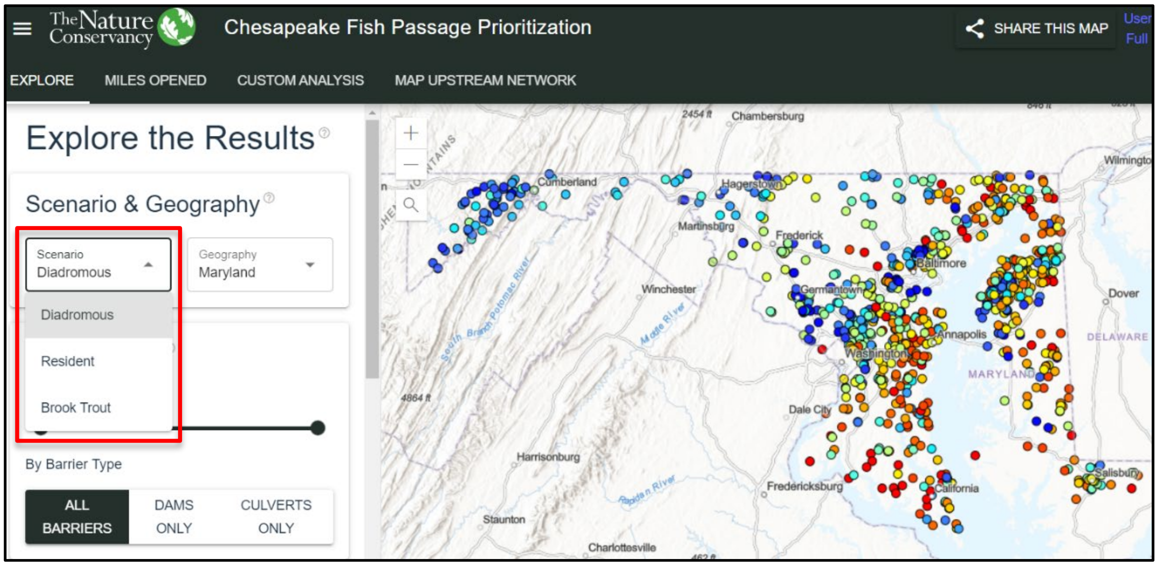


Figure 3. FWN tool model scenario dropdown for barrier removals benefiting diadromous, resident, or brook trout species (outlined in red).

B. WATERWAY BARRIER ASSESSMENT							
Model	Barrier Tier	Barrier Tier Adjustment	Barrier Height (feet)	Barrier Height Adjustment	Physiography	Drainage Area (sqmi)	Drainage Area Adjustment
Diadromous	1	1	4	1	Piedmont	161.0	2.45

Figure 4. Model input in cell A17 of the Fish Passage calculation tab should be the same as the FWN tool (outlined in red).

b. Identify the Barrier Tier: The barrier tier is the Barrier rank or prioritization value. A tier of 1 is the highest priority, while a tier of 20 would be very low priority. The FWN provides a prioritized dam score based on Scenario & Geography; the scenario refers to species that most benefit from a barrier removal (see Section 3(a) above), and geography refers the barriers ranked across the entire Chesapeake Bay or within individual Bay states. Sixty-four (64) metrics were incorporated into the FWN tool to rank dams across the bay based on diadromous, resident, and brook trout species scenarios. Datasets include river hydrography, land cover and impervious surface, road cover, rare, threatened, and endangered (RTE) species, etc. and weighted depending on their importance. For example, the highest priority dams for diadromous scenarios are located in areas with a high proportion of natural land cover (low impervious) and with long stretches of access to downstream and upstream habitat. In the selected barrier type and species model (i.e. “Dams” and “Diadromous”) zoom in on the barrier of interest. Once you click on the barrier of interest it will display the ranked tiers for all species models (Figure 3). Barrier tiers are ranked based on the benefits of removal to diadromous, resident, or brook trout species, so ensure the correct species model is selected.

i. If the barrier is not within the Chesapeake Bay watershed, the user should instead use the prioritization tool for the Northeastern United States. https://aquaticbarriers.org/priority/ or another barrier prioritization method approved by the Corps. The SARP prioritization layers will be available in 2025 and may be used if acceptable the Corps/MDE and resource agencies.

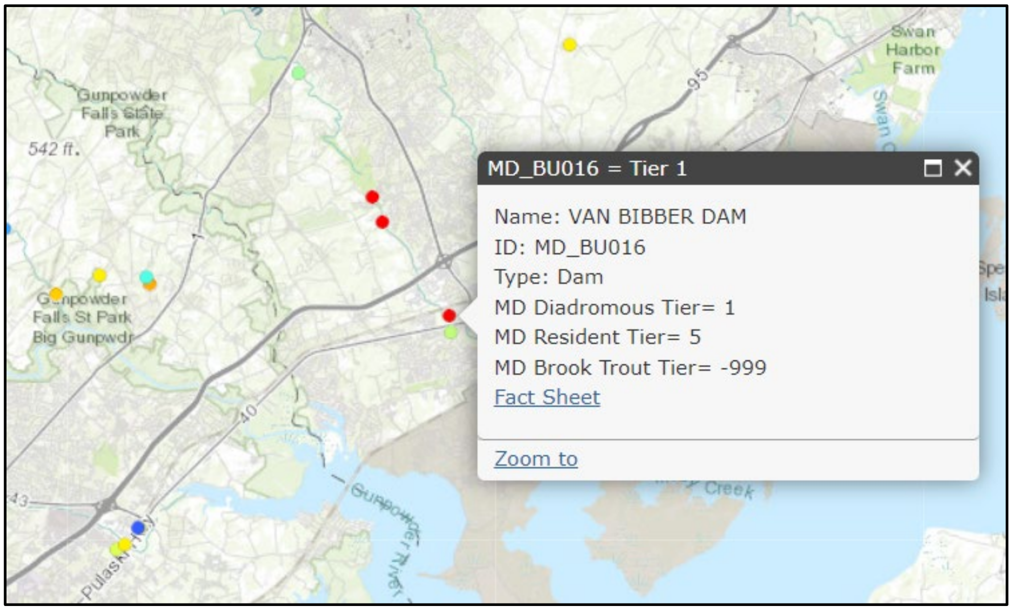


Figure 5. Maryland Diadromous Dam Tier ranking of 1 for Van Bibber dam.

ii. Where a barrier severity has not been established, the user is advised to select the value of “20,” unless otherwise directed by the Corps/IRT.

c. Determine Barrier Height (**for Dam Calculations only**):

i. Dam height (barrier crest to low-flow water elevation below) is a consideration added to address barriers that are full vs partial blockages to fish passage. The beta tool calculator provides a multiplier of 1 for any barrier over 4 feet in height (i.e., any barrier taller than 4 feet is a complete blockage for most species during most flow events). Barriers that are 3.9 feet to 1.5 feet receive downward adjustments, as they are assumed generally passable during some flow events each year. No credit is typically given for dams of heights less than 1.5 ft. For a project to be eligible, the Corps/MDE must concur the structure is a barrier of concern. In the barrier height adjustment, we must keep in mind that barrier heights have different effects in high gradient mountain streams than low gradient coastal plain streams. We received comments that some barriers as low as 1 foot on low-gradient rivers of the coastal plain can be barriers to fish passage, and likewise a 2 foot step pool in a high gradient mountain stream may be similar to natural conditions. Such instances will be considered in the beta tool on a project-specific basis and the calculator further refined in FPBT Version 1.

ii. Enter only the barrier height. The barrier height adjustment is an automatic calculation in the excel tab and is accurate to tenths of feet.

iii. Field verify the dam height and measure the distance between the dam crest thalweg and the water surface below the dam during typical flow for an accurate input. An estimated dam height is provided in the FWN Fact Sheet for the identified barrier (Figure 7).

B. WATERWAY BARRIER ASSESSMENT								
Model	Barrier Tier	Barrier Tier Adjustment	Barrier Height (feet)	Barrier Height Adjustment	Physiography	Drainage Area (sqmi)	Drainage Area Adjustment	Mitigation Ratio for Dams (4:1)
Diadromous	1	1	4	1	Piedmont	75.0	5.39	0.25

Figure 6. Barrier height fields for dam scenarios highlighted in cells A20 and A21 in the fish passage beta calculator tool.

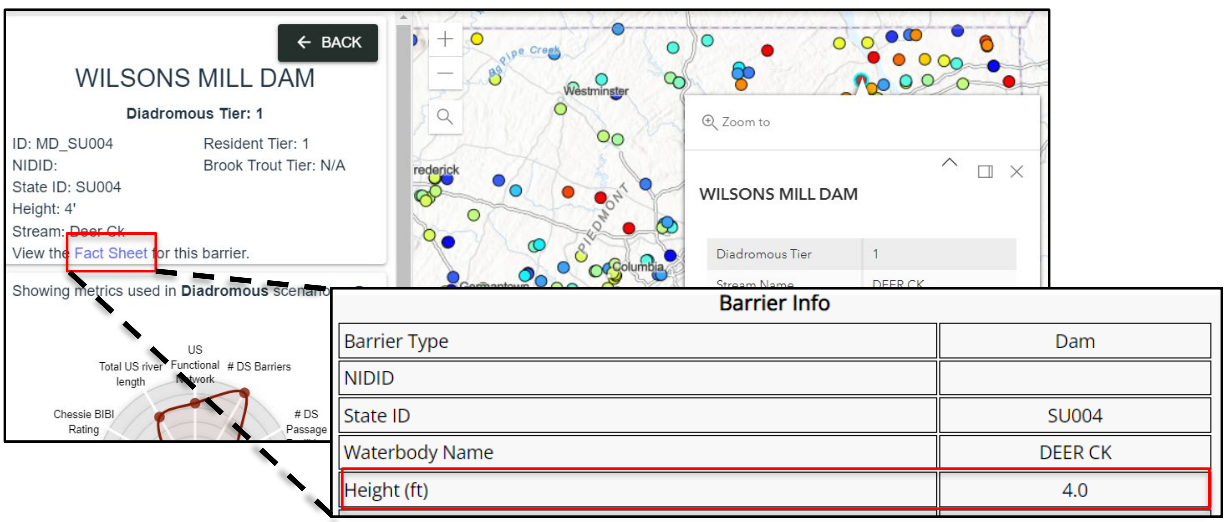


Figure 7. Using the Fact Sheet to identify dam height in the FWN tool.

d. Barrier Severity (**for Culvert Calculations only**): In the Freshwater Network Tool, Culvert Prioritization, click on the barrier factsheet and/or select "view NAACC factsheet.' At the top of the screen next to "AOP Coarse Screen" it will say "No AOP" or full blockage, "Partial AOP" or partial blockage, or "Complete AOP"-no blockage.

i. Road stream crossings (i.e. culverts) can function as dams to inhibit aquatic organism passage. Culverts in Maryland have been surveyed using the North Atlantic Aquatic Connectivity Collaborative (NAACC) scoring algorithm. The increase in the number of field-surveyed road stream crossings using the NAACC protocol has enabled the incorporation of road-stream crossings as prioritized barriers in the FWN tool.

ii. In the FWN Tool, Culvert Prioritization, click on the barrier and select “view NAACC page for this culvert”. At the top of the screen there is an Aquatic Organism Passage (AOP) Coarse Screen, next to which it will say: “No AOP” (indicating a full blockage); “Partial AOP” (partial blockage), or “Complete AOP” (no blockage). See Figure 8.

iii. Select the Appropriate Barrier Severity from the dropdown in the Fish Passage Calculator.

iv. Complete blockages receive a multiplier of 1 and partial blockages receive a multiplier of 0.5. This corresponds to full credit or a 50% reduction in credit respectively.

v. If no assessment has been completed, the user will need to assess and decide on the barrier severity in the field. Be sure to take photos and general measurements of the structure.

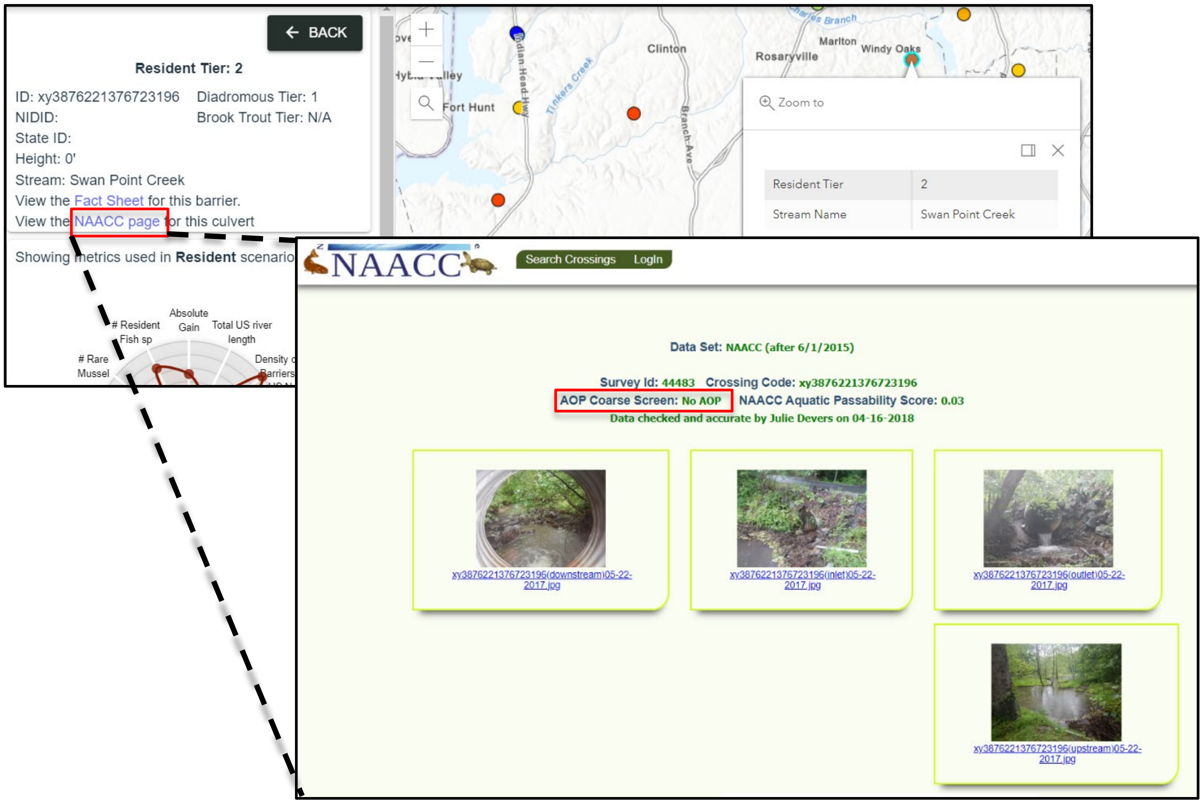


Figure 8. Using the NAACC page in the FWN to identify severity of AOP for culverts. Note that the barrier above has a rating of "No AOP." This means no aquatic organism passage or the barrier is a full blockage.

B. WATERWAY BARRIER ASSESSMENT									
Model	Barrier Tier	Barrier Tier Adjustment	Blockage Severity	Blockage Severity Adjustment	Physiography	Drainage Area (sqmi)	Drainage Area Adjustment	Mitigation Ratio for Culverts (2.5:1)	
Diadromous	4	0.9	Full	1	Coastal Plain	3.5	1.61	0.40	

Figure 9. Blockage severity fields for culvert scenarios highlighted in cells A20 and A21 in the fish passage beta calculator tool.

Barrier Height and Barrier Severity metric Discussion: The FPWG chose to use simplified estimates of full vs partial fish passage based on barrier height and barrier severity. The alternative involved complex analysis of hydraulics of various scenarios that was too complex for this crediting tool.

e. Physiography: Identifying the physiographic region is an important component of the bankfull regional curves used in the calculation of the drainage area adjustment. Applicants will choose from the dropdown of three physiographic regions depending on the location of the proposed barrier removal: coastal plain, piedmont, or mountain.

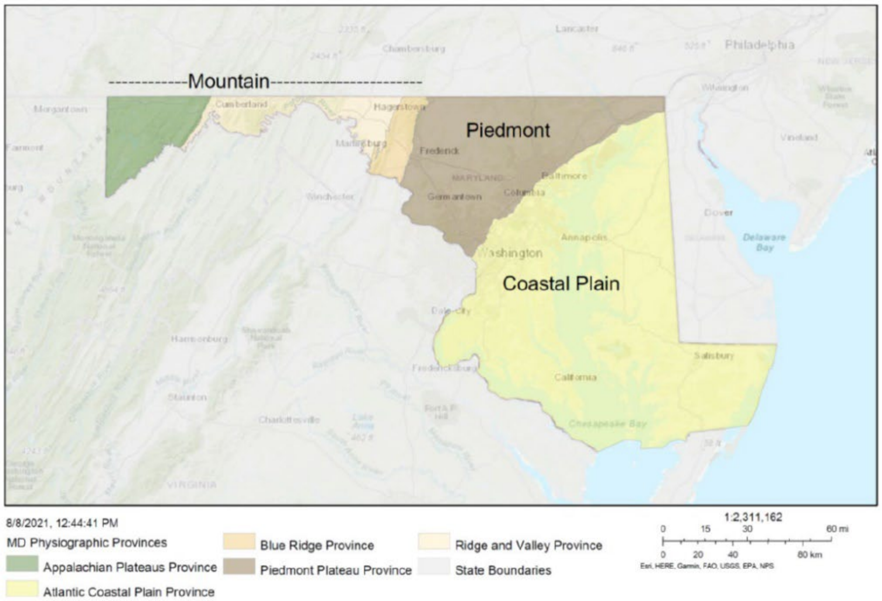


Figure 10. General physiographic regions of Maryland.

f. Drainage Area: A drainage area adjustment is included as a multiplier to better address the size of the watershed and stream using the bankfull regional curves with an upper limit of 100 square miles for the dam's calculation and 50 square miles for culverts. Drainage area was identified as an important consideration in determining credits for barrier removals of different scales due to increasing regulated area (Ordinary High-Water Mark) as drainage area increases. The bankfull regional curves for Maryland produced by USFWS-Annapolis Field Office were used comparing drainage area to bankfull width for scaling (Krstolic, J.L., and Chaplin, J.J., 2007). These curves provide projected regulated area and habitat area based on drainage area, which is applied in the tool. The selected benchmark drainage area is 1 square mile for the purposes of the Maryland Stream Mitigation Framework and Fish Passage Calculator. Use USGS Stream Stats at https://www.usgs.gov/streamstats to determine the drainage area at the barrier. Alternatives may be used where USGS stream stats does not have data on a given stream/river. Where drainage areas are not available in USGS stream stats, and estimate may be used by measuring the watershed in ArcGIS. *Note: USGS stream stats sometimes produces errors where drainage areas cross state lines. In rare instances, the user may need to apply a different method to determining drainage area such as using GIS to measure the area contained in the watershed above a barrier.*

g. Mitigation Ratio: A mitigation ratio is applied to fish passage mitigation to adjust for this being an out-of-kind type of mitigation. For dams, the mitigation ratio is set to 4:1 (0.25) and culverts 2.5:1 (0.4). Culvert removals have a lower mitigation ratio as they tend to be waterbodies closer in size to those typically impacted in Maryland. These values are preset in the calculation tabs.

7. Complete Section E: Known Fish and Mussel Species in Waterway

a. Identify the source population area. This should be a broad area where aquatic species may travel from to reach the project area.

b. Using data collected by the user and historic data from MD DNR. (For example, see the Maryland Stream Health Mapper Tool at: https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=30ee9336f8d54e4ebf971c3a1a7576ed) and other sources (such as the freshwater network tool, linked above) over the past 20 years, list the known fish and mussel species in the waterway (downstream of the barrier that may realistically migrate above it after removal). If other barriers occur below the subject barrier, do not consider species below the downstream barrier.

E. Known Fish and Mussel Species in Waterway		
Common Name	Scientific Name	Classification
Alewife	*Alosa pseudoharengus*	Anadramous
Blueback Herring	*Alosa aestivalis*	Anadramous
American Shad	*Alosa sapidissima*	Anadramous
Hickory Shad	*Alosa mediocris*	Anadramous
American Eel	*Anguilla rostrata*	General Resident/Eels
Resident fish sp		General Resident/Eels
Mussel sp		General Resident/Eels
		NA

Figure 11. Example list of known fish and mussel species in the waterway from Section E.

8. Complete Section C: Expanded River Access.

This section assesses the expansion of river/stream access to fishes. The fish passage beta calculator tool currently provides two types of crediting for species: general assemblage species credit and targeted species credit; monitoring requirements differ (see Section VI. Monitoring Requirement for more detail).

a. General Assemblage Species Credits: The categories for general assemblage species credit follow the model used in the FWN tool: projects that benefit diadromous species use the “General Diadromous and Resident” assemblage, and projects that benefit resident species use the “General Resident” assemblage (Figure 12). (Note: for projects using the brook trout model in the FWN tool, the General Resident species assemblage would be used). The Fish Passage Work Group has identified diadromous fish passage as a priority and the FPBT aims to incentivize projects that would provide ecological uplift, restore large upstream functional networks and habitat connectivity for projects benefiting anadromous/diadromous species. Therefore, identified barriers that rank as high priority in the FWN tool under the “Diadromous” scenarios receive a higher multiplier than identified barriers for the “Resident” scenarios.

Model	Barrier Tier	Barrier Tier Adjustment	Barrier Height (feet)	Barrier Height Adjustment	Physiography	Drainage Area (sqmi)	Drainage Area Adjustment	Mitigation Ratio for Dams (4:1)
Diadromous	1	1	4	1	Piedmont	75.0	5.39	0.25

C. Expanded River Access

General Assemblages	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
General Diadromous and Resident	79,200	150,000	1.25%	2525
Target Species	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
Alewife	79,200	64,000	0.20%	172
American shad	79,201	264,000	0.30%	1066
Blueback Herring	79,202	64,000	0.20%	172
Hickory shad	79,203	64,000	0.20%	172
List of Fish and Mussels			0.00%	0

General Resident
General Diadromous and Resident

Figure 12. Dropdown for General Species Assemblages in the fish passage beta calculator tool.

i. Select the General Assemblage model, either “General Diadromous and Resident” or “General Resident” based on the model used from the FWN tool. **Only the first barrier upstream of tidal waters may be classified as “General Diadromous and Resident.”**

ii. Identify the UFN using the FWN tool Fact Sheet (Figure 13). The FWN tool summarizes the functional network that would be reconnected through the removal of an in-stream barrier.

iii. Determine the Verified UFN: The FPBT uses the UFN as identified in the FWN tool as an input, and the mitigation sponsor/applicant must verify the extent of the UFN for any undetected barriers, as well as consult fisheries biologists for anticipated available upstream habitat using a combination of satellite imagery, LiDAR, topographic mapping, and field identification. The verified UFN removes any other obstacles blocking portions of the projected UFN provided by the FWN Tool.

1. For dams: the maximum value awarded in the fish passage beta calculator for UFN is 50 miles of stream or t264,000 linear feet.

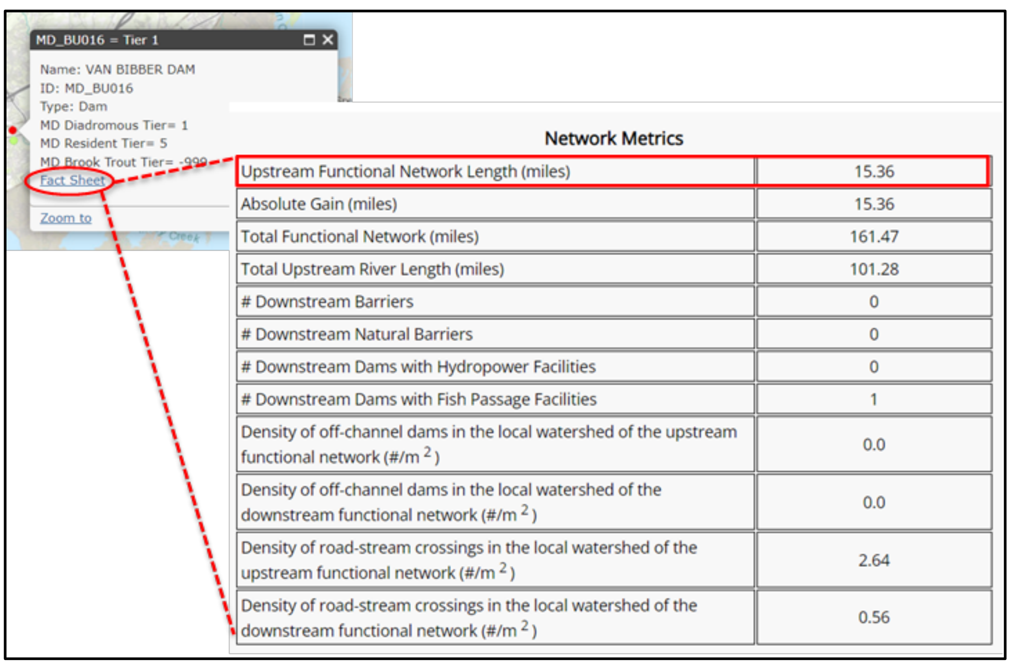
2. For culverts: the maximum value awarded for UFN is 20 miles of stream or 105,600 linear feet.

iii. The Functional Network Multiplier will be automatically applied depending on the chosen General Assemblage (General Resident or General Diadromous and Resident).

1. For Both Tab 1: Calculation Dams and Tab 2: Calculation Culverts: The General Resident Multiplier is 1% per linear foot of increased access. The General Diadromous and Resident Multiplier is 1.25% to incentivize projects benefiting diadromous species.

2. These multipliers were set after extensive coordination between the Corps and resource agencies to ensure appropriate incentives for species and assemblages of interest. The general species multipliers require only that waterways are assumed to be accessible through the verified UFN. This typically would mean that no barriers occur in the UFN beyond 1 ft structures (measuring from structure crest to water surface below). This assumption may be interpreted differently across physiographic regions and stream/river slopes. While higher drops may be tolerable to fauna in the higher gradient or mountain regions, structures of a 0.5-1 ft could present partial blockages to Diadromous species of the lower gradient streams of the coastal plain. This interpretation will occur on a project-by-project basis.

iv. Functional Foot Value: The credit value output is in functional feet for the barrier removal and the benefited fish assemblage specified.



Network Metrics

Upstream Functional Network Length (miles)	15.36
Absolute Gain (miles)	15.36
Total Functional Network (miles)	161.47
Total Upstream River Length (miles)	101.28
# Downstream Barriers	0
# Downstream Natural Barriers	0
# Downstream Dams with Hydropower Facilities	0
# Downstream Dams with Fish Passage Facilities	1
Density of off-channel dams in the local watershed of the upstream functional network (#/m ^{2})	0.0
Density of off-channel dams in the local watershed of the downstream functional network (#/m ^{2})	0.0
Density of road-stream crossings in the local watershed of the upstream functional network (#/m ^{2})	2.64
Density of road-stream crossings in the local watershed of the downstream functional network (#/m ^{2})	0.56

Figure 13. UFN identified using the FWN tool Fact Sheet.

C. Expanded River Access				
General Assemblages	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
General Diadromous and Resident	150,000	79,200	1.25%	1333
Target Species	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
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Blueback Herring	79,202	64,000	0.20%	172
Hickory shad	79,203	64,000	0.20%	172
			0.10%	0

Figure 14. General Assemblage credit inputs outlined in red: the FWN projected UFN and verified UFN are input by the user; the functional network multiplier determines the credit output in functional feet in cell I21.

b. Target Species Credits**:** In addition to the blanket multiplier, mitigation sponsors may seek additional credits for barrier removals benefiting target species identified by the FPWG. These included federally listed, federally petitioned, and some state-listed and State Wildlife Action Plan species of concern. The multipliers associated with each species were determined based on their listed status and/or status as a target anadromous species, listed on Tab 3: Species and Multipliers in the beta fish passage calculator tool (Figure 15). This tab lists the Designated State/Federal Listing Status to identify species that are federally listed (LE); Federally Threatened (LT); Federally Petitioned (FP); State Endangered (SE); State Threatened (ST); and State In Need of Conservation (SI). Any species that is listed as LE, LT, or FP receive the highest relative species multiplier. Target anadromous species receive the second-highest species multiplier. American shad has been identified as a high-priority target species by NOAA and fisheries biologists and therefore has been designated the highest relative species multiplier. For purposes of the beta version of the calculator, American eels (Anguilla rostrata) have been lumped with general resident species, as they are habitat generalists and very mobile. Benefits to RTE mussel species should also be a consideration of barrier removal site selection. Tab 3 Species and Multipliers list target species eligible for additional credit and associated multipliers.

In addition to sensitive species, the target species crediting section also considers aquatic invasive species. In the FPBT, only Northern Snakehead is listed. A barrier removal benefiting Northern Snakehead receives a multiplier of -0.3% and is effective through the entire verified UFN.

The Target Species process is similar to the General Assemblage process, the main differences are:

i. Verified UFN would be verified for species post-construction (or demolition) of the barrier. The species receiving credit, or an appropriate surrogate species, must be monitored via eDNA or “fish-in-hand” sampling.

1. For diadromous species, a “presence/absence” survey within the UFN to document presence of the species receiving credit.

2. For resident species, UFN verification would be based on barriers upstream and species tracking. Some assumptions would be made by agencies and best professional judgement regarding a realistic gain of upstream habitat for cases where the target species already occurs upstream.

ii. The Functional Network Multiplier for individual species is applied to the approximate UFN for each species and output in functional foot value (Figure 16).

iii. The total functional foot value for each additional species is added to the General Assemblage credit output in functional feet and reflected in the total functional foot credit at the top of the calculator in cell J6.

Species	Designated State/Federal Listing Sta	Multiplier	eDNA Assay Availabl	Classification
List of Fish and Mussels				
Alewife		0.20%		Migratory
American Brook Lamprey	ST	0.10%		Resident
American shad		0.30%		Migratory
Banded sunfish		0.10%		Resident
Blueback Herring		0.20%		Migratory
Brook trout		0.30%		Resident
Checkered sculpin		0.10%		Resident
Chesapeake Logperch	ST; FP	0.30%		Resident
Comely shiner		0.10%		Resident
Glassy Darter		0.10%		Resident
Hickory shad		0.20%		Migratory
Ironcolor Shiner		0.10%		Resident
Pearl Dace		0.10%		Resident
Stripeback Darter	SE	0.10%		Resident
Swamp darter	SI	0.10%		Resident
Yellow Perch (from tidal only)		0.10%		Semi-Migratory
Alewife floater		0.10%		Resident
Atlantic Spike	SI	0.10%		Resident
Brook Floater	SE; FP	0.10%		Resident
Creeper	SI	0.10%		Resident
Dwarf Wedge Mussel	LE	0.30%		Resident
Eastern lampmussel		0.10%		Resident
Eastern pondmussel		0.10%		Resident
Green Floater	SE; FP	0.10%		Resident
Northern lance		0.10%		Resident
Triangle Floater	SE	0.10%		Resident
Yellow lampmussel		0.10%		Resident
Yellow lance	LT	0.30%		Resident
Northern Snakehead	Exotic Invasive	-0.30%		

Designated State/Federal Listing	
Federally Endangered (LE)	Taxa listed as Endagered under the federal Endangered Species Act (ESA); in danger of extinction throughout all or a significant porition of its range
Federally Threatened (LT)	Taxa listed as Threatened under the federal ESA; likley to become endangered within the foreseeable future throughout all or a significant portion of its range
Federally Petitioned (FP)	Taxa under request to list as Endangered or Threatened under the federal ESA
State Endangered (SE)	A species whose continued existence as a viable component of Maryland's fauna is determined to be in jeopardy
State Threatened (ST)	A species that appears likely, within the foreseeable future, to become endangered in Maryland
State In Need of Conservation (SI)	An animal species whose population is limited or declining in Maryland such that it may become threatened in the foreseeable future if current trends or conditions

Figure 15. Tab 3 Species and Multipliers listing target species eligible for additional credit and associated multipliers.

C. Expanded River Access				
General Assemblages	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
General Diadromous and Resident	150,000	79,200	1.25%	1333
Target Species	Upstream Functional Network (UFN) Linear Feet	UFN (Verified) Linear Feet	Functional Network Multiplier	Functional Foot Value
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Blueback Herring	79,202	64,000	0.20%	172
Hickory shad	79,203	64,000	0.20%	172

Figure 16. Target Species listed for additional credit outlined in purple.

9. Complete Section D: Active Sediment Management (if recommended) Sediment removal and management will be a consideration for some proposed dam removal projects. Sediment removal may be necessary to prevent adverse impacts resulting from release of excessive accumulated sediment and may provide benefits to receiving waters. The FPBT awards mitigation credits for active sediment removal only when recommended by the Corps, MDE and resource agencies. See Step 14 for additional information. Additional information on dam removal analysis guidelines for sediment testing can be found in US DOI_2017.

Where active sediment management is required, credits may be awarded. 1 functional foot of credit is awarded for every 70 cubic yards of sediment removed. The Corps in coordination with regulatory and resource agencies will determine if credits may be awarded for active sediment management.

a. A maximum of 2,857 functional feet may be awarded for active sediment management.

b. Section D is only to be used where impoundment sediment is removed as part of a fish barrier removal project, where the removal of sediments is recommended by the Corps and regulatory/resource agencies. Crediting is limited to excavation of sediment that would have been released passively and to establish stable slopes in the vicinity of the former impounded area, but not for additional excavation for broader work or wetland establishment, etc.

D. ACTIVE SEDIMENT MANAGMEMENT***	
Removed*	Value**
75,000	1071

*capped at 200,000 CY

** 1 functional foot/70 CY removed

*** Sediment removal only credited when recommended by resource agencies

Figure 17. Example input for Section D. Active Sediment Management.

IV. MITIGATION PLAN ELEMENTS

Mitigation plan elements are outlined in 33 CFR 332.4 (C). Developing mitigation plans for fish passage projects will differ from that of typical stream mitigation in a few ways. Most elements will remain the same. This section describes the differences in what is required in mitigation plans in relation to what is required for typical stream mitigation projects (stream channel restoration projects). Where fish passage credits are sought in combination with credits for stream or buffer restoration, both requirements apply.

Mitigation Plan Elements:

1. Objectives: The objectives of a fish passage project will differ from that of a typical stream restoration project. It is important to detail objectives specific to the general fish assemblage and any target species.

2. Site Selection: This section will describe use and parameters of the Freshwater Network Tool, which prioritizes barriers based on ecological benefits. It should also consider potential challenges for a site like those mentioned in section II. B. above.

3. Site protection instrument: Where credits sought are limited to fish passage, a site protection instrument is generally not required Where credits are also sought for stream channel or stream buffer mitigation, a site protection instrument will generally be required. Topics to discuss on long term site protection are still relevant regardless of whether a conservation easement is required. For example: development trends are important for culvert removals as plans for road widening or road capacity increases may require a structure replacement. Where credits are awarded for culvert removal, future structures must also be passable.

4. Baseline information: This section should describe the barrier and its history in detail. It should include information regarding the source population (or fish assemblage downstream) listed in Section E of the FPBT. It should also describe the volume, grain size distribution, and any potential contaminants in the impoundment sediments.

5. Determination of Credits: Using the MSMF Appendix F: FPBT. Where combined with stream channel or stream buffer mitigation, this will also include Appendix A 1: MSMF V.1. Final Calculator. Credit release schedule will follow that of the general release schedule for streams outlined in the document "Maryland Credit Release schedule for Nontidal Wetlands" located on RIBITS under "Bank & ILF Establishment." https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10. In RIBITS, filter by state "Maryland" and see folder "Bank & ILF Establishment."

6. Mitigation Work Plan: The Mitigation Work plan will differ from that of a typical stream restoration project. It should consider barrier removal, sediment removal (if required), erosion and sediment control measures, utility and transportation corridors, measures regarding impoundment bank slopes, tree planting, and river grade measures (if applicable). This should include measures to ensure the relative stability of impounded tributaries in addition to the mainstem waterbody itself. It is essential that the work area is restored to stable slopes and revegetated to address stability and public safety concerns. Where fords are used on smaller streams, they must be designed to maintain aquatic life passage. Fords should be designed with a low sag in the middle to provide sufficient water depths for aquatic organism passage during normal and low flow events. The structure should have an upstream and downstream sill to hold elevation and retain substrate material in place. If the underlying bed material is not bedrock or boulder/cobble, the ford should be designed to incorporate similar reinforcing material that will support the finer substrate throughout the perpetual use of the crossing.

7. Maintenance Plan: The Maintenance Plan will be fundamentally different than a typical stream restoration project where barrier removal is proposed on its own for fish passage credits. The maintenance plan must include maintaining riparian vegetation, maintaining vertical stability of the mainstem and tributaries and stable cross-section slopes, maintaining any ford crossings, and may require management of aquatic invasive species among other items. For culvert removals, this will require a plan to ensure any future crossings are passible for aquatic life.

8. Performance Standards: Performance standards will follow the performance standards outlined below, the "Maryland Stream Mitigation Performance Standards and Monitoring Requirements," and other requirements as determined by the Corps and MDE reviewers. For stand-alone barrier removals, standards focus on general stability, riparian vegetation, biological monitoring reports, and public safety. Where credits are sought for stream restoration work, the performance standards for stream restoration will apply.

9. Monitoring Requirements: Monitoring requirements will follow those outlined in the "Stream Mitigation Performance Standards in Maryland, and other requirements as determined by the Corps and MDE reviewers. While the "general assemblage credit" requires submittal of fish assemblage monitoring reports, the "target species credit" requires monitoring of the target species or a surrogate species. Stream monitoring requirements will be informed by the "Stream performance standards in Maryland"

document located on RIBITS under “Bank & ILF Establishment.” https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10.

10. Long Term Management Plan: The Long-Term Management Plan will differ from that of typical stream channel mitigation projects. In general, attention should be paid to vertical stability, aquatic invasive species, buffer vegetation management, stable slopes, and public safety.

11. Adaptive Management Plans: Must consider potential adverse effects of dam removal (downstream wetland filling, threats to infrastructure, threats to upstream river grade, public safety concerns, etc.).

12. Financial Assurances: These may differ from that of a typical stream channel restoration project.

13. Other information: Other information may differ from that of a typical stream channel restoration project.

V. MONITORING REQUIREMENTS AND PERFORMANCE STANDARDS

Monitoring Requirements and Performance Standards are broadly described below. Please note that permit application reviewers may require additional monitoring. See document “stream mitigation performance standards” for more specific information on required monitoring and monitoring reports for barrier removal projects. The “Maryland Stream Mitigation Performance Standards and Monitoring Requirements” documents are located on RIBITS under “Bank & ILF Establishment.” https://ribits.ops.usace.army.mil/ords/f?p=107:27:6456857690559::NO::P27_BUTTON_KEY:10.

At the RIBITS link above, Filter by state “Maryland” and see folder “Bank & ILF Establishment.” Specifically, Section V (and Table 6-Dams and 7-Culverts in the excel workbook) addresses performance standards and monitoring requirements for fish passage projects.

NAB typically requires 10 years of monitoring for stream mitigation projects to ensure performance standards are being met. In the case of the Fish Passage for Mitigation Beta Tool monitoring will be required to ensure the ecological uplift from barrier removal as well as monitoring for the listed target anadromous species and species of concern receiving additional credit. Monitoring for barrier removals will require some case-by-case considerations.

VI. OTHER TOPICS:

A. Stacked Barrier Scenarios

A consideration that was brought to the attention of the FPWG was that of scenarios where there are “stacked dams” (i.e. Bloede, Simkins, and Daniels along the Patapsco River) where the application of the Upstream Functional Network could generate skewed functional foot credit values based on the order in which barriers are removed. There are few instances where stacked dams would be a consideration in the state of Maryland, and it would be discussed on a project-specific level by the IRT, but the beta tool outlines an approach to stacked dam scenarios.

When barriers are to be removed during different times or by different permit applicants:

For non-tidal stacked dam scenarios, if the distance between dams is less than 20 miles, NAB would require that the downstream dam must come out first, to avoid double-counting of upstream functional miles (Figure 18). Each barrier to be removed would have its own credit calculation sheet (“1_Calculation Dams”, etc).

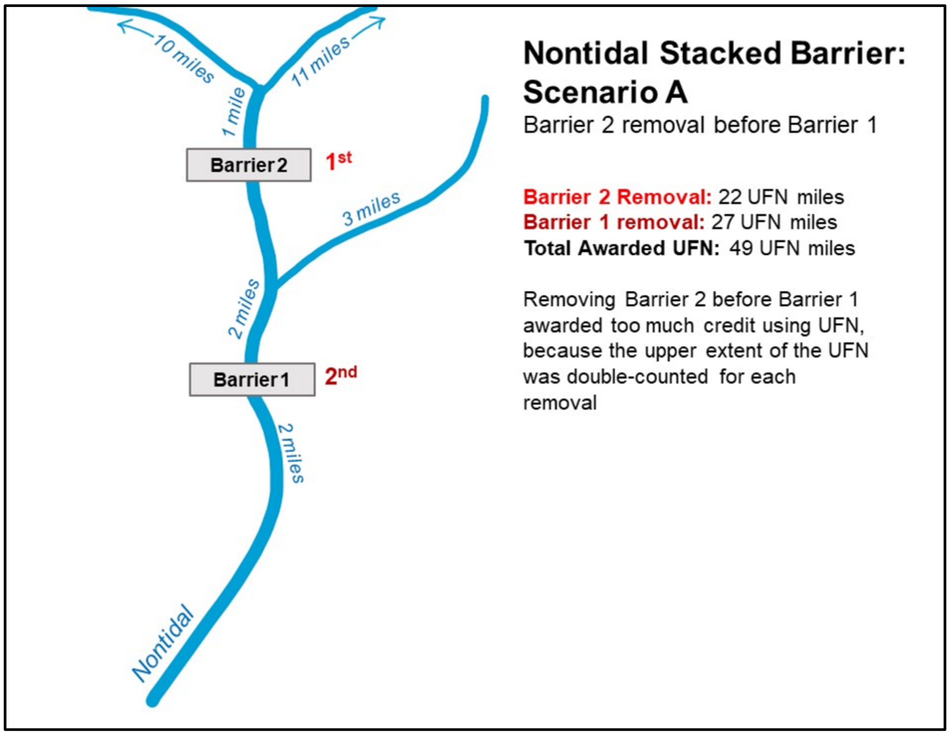
For tidal stacked dam scenarios, if the upstream dam (Barrier 2) comes out first, it would only receive credit for benefits to resident species, since there is a full blockage downstream (Barrier 1) to the tidal reach (Figure 19). Based on the weighting of the dam tiers in the FWN tool and multipliers in the FPBT, it incentivizes consideration of removal of Barrier 1 prior to Barrier 2 to benefit target anadromous species. If the downstream Barrier 1 comes out after Barrier 2, applicants could only receive credit for General Resident and Anadromous Species up to the former location of Barrier 2 (i.e. those miles would be frozen, even if the FWN tool changes).

When barriers are to be removed by the same permit applicant and roughly at the same time:

In cases where multiple barriers are proposed for removal simultaneously, an alternative approach could be used to determine credit. Crediting values will be based on the downstream most barrier with the UFN extending above the series of barriers to be removed in one calculation tab. Consideration may be given to the status of other barriers to be removed in terms of “Barrier Tier” rankings, “Blockage Severity,” and “Barrier Height.”

B. Barriers with UFN Crossing State Lines

In cases where a barrier is proposed for removal in Maryland and the opened upstream miles cross state lines (such as Pennsylvania or West Virginia), the mitigation sponsor/applicant is still eligible to count the credits in another state if it can be safely assumed that species would utilize the opened habitat across state lines. This was discussed and confirmed with the Maryland IRT in early 2022. Note: MDE will evaluate these projects on a case-by-case basis to determine if the out-of-state credits would be considered as mitigation for waters of the state. Such instances would need to be evaluated on a project-specific basis with consideration to access and monitoring requirements. Where the watershed and UFN crosses state lines, carefully examine the drainage area calculation from USGS stream stats. Sometimes errors are found in measuring drainage areas crossing state lines using that tool.



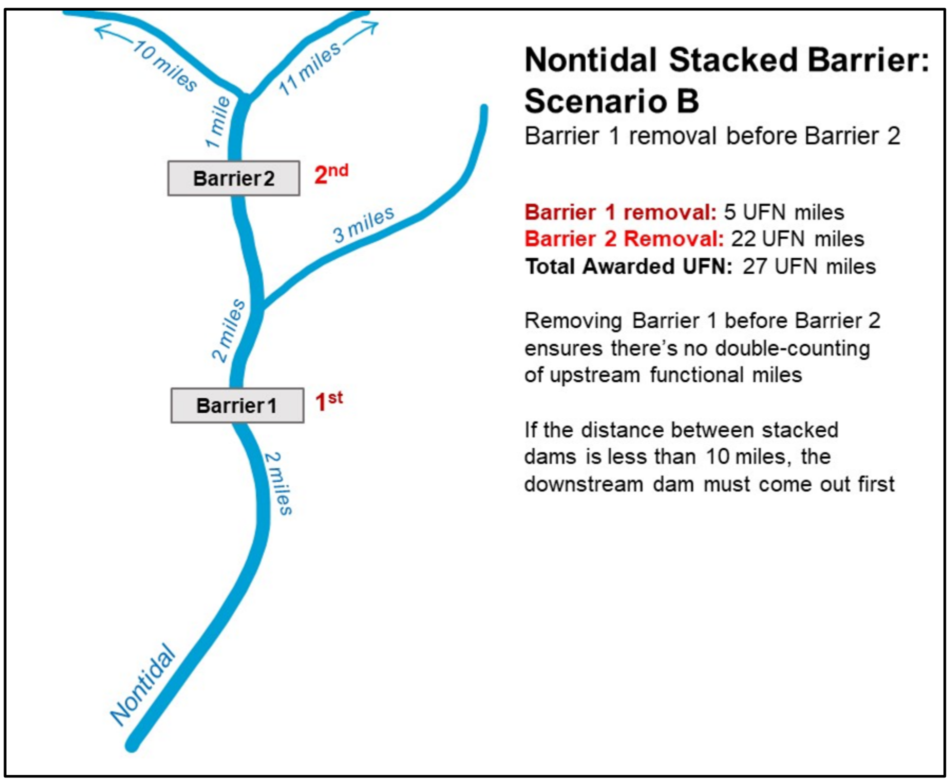
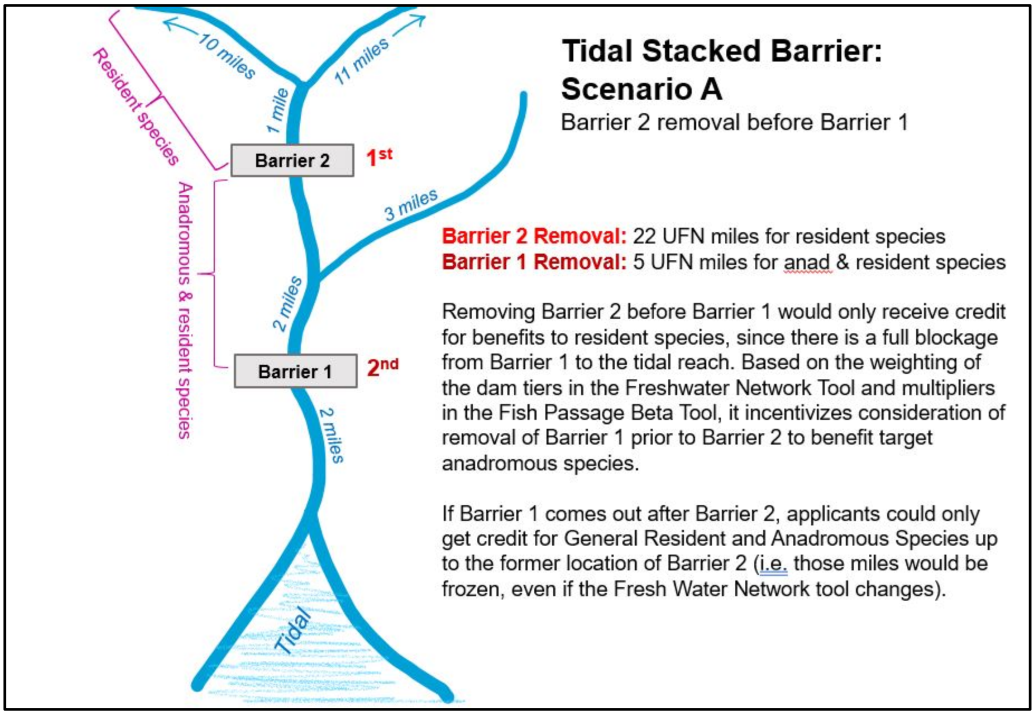


Figure 18. Nontidal stacked barrier scenarios A & B.



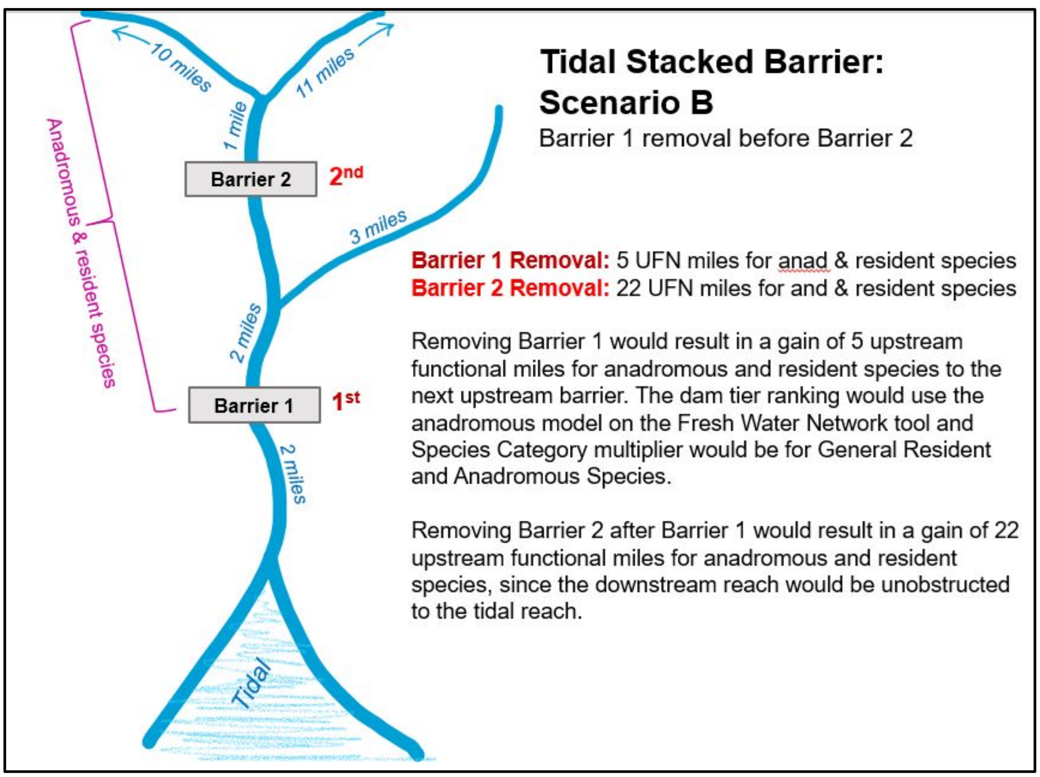


Figure 19. Tidal stacked barrier scenarios A & B.

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DEFINITIONS

Absolute Gain: A metric of the FWN, Connectivity Improvement Category; the minimum of the two functional networks (upstream functional network and downstream functional network) of a barrier. For example, if the upstream functional network was 10 miles and the downstream functional network was 5 miles, the Absolute Gain would be 5 miles.

Barrier Height: Difference in elevation between the thalweg elevation of the barrier and the water surface below the barrier (measured during baseflow).

Barrier Tier: The Freshwater Network Tools barrier prioritization rank.

Barrier Severity: In the Freshwater Network Tool this is a determination whether the blockage is full, partial, or not a blockage. It is expresses as “Full AOP” or no blockage, “Partial AOP” or partial blockage, and “No AOP” or complete blockage. This field is only used in the culvert calculation.

Functional Network: Summed length of the upstream and downstream functional networks of a barrier. The functional network is defined by those sections of river that a fish could theoretically access from any other point within that functional network; its terminal ends are barriers, headwaters, and/or the river mouth.

Upstream Functional Network: A metric of the FWN, Connectivity Improvement Category; the length of functional network upstream of a barrier.

Downstream Functional Network: A metric of the FWN, the length of the functional network downstream of a barrier.

Functional Foot: The mitigation credit unit in the Maryland Stream Mitigation Framework. A functional foot is equivalent to a linear foot of stream with a 1 square mile drainage area with a quality of 100%. Different activities and adjustment factors affect the total number of functional feet awarded for a mitigation activity or an impact (*Stream quality, drainage area, activity type, etc*).

eDNA monitoring: Organismal DNA that originates from cellular material shed by organisms (via skin, excrement, etc.) into aquatic environments that can be sampled and monitored via the development of species-specific assays.

Target Species: Anadromous aquatic species identified by the FPWG and the MD DNR *List of Rare, Threatened, and Endangered Animals of Maryland* that are the most in need of conservation efforts.

Drainage Area: Defined as the land area where precipitation falls off into creeks, streams, rivers, lakes, and reservoirs. It is expressed in square miles in the credit calculator.

Diadromous Species: Fish species that migrate between saltwater and freshwater as part of their life cycle.

Resident Species: Fish species that complete all stages their life cycle within freshwater and frequently within a local area.

Anadromous Species: Fish species that spend most of their adult lives in saltwater but return to freshwater to spawn.

Stacked Barrier: A fish passage barrier which occurs within 20 river miles of another fish passage barrier. For stacked barriers, the sequence of removal is important to crediting and is outlined above in Additional Discussion: Stacked Dam Scenarios.

IRT: The Interagency Review Team for Clean Water Act Section 404 Mitigation. It is comprised of several state and federal agencies in Maryland who review, recommendations, and processes regarding mitigation banking.

RTE: For the purposes of the Fish Passage Tool, RTE are rare, threatened, or endangered species.