STREAM MITIGATION PERFORMANCE STANDARDS IN MARYLAND
(USACE BALTIMORE DISTRICT)
January 8, 2024

This document is separated into five sections:

I. Background

II. General Requirements for Stream Mitigation Monitoring

III. Performance Standards and Monitoring Requirements for Stream Channels

IV. Performance Standards and Monitoring Requirements for Stream Buffers

V. Performance Standards for Fish Passage projects (Dams and Culvert Removals)

The sections listed above are associated with tables ("Stream Mitigation Performance Standard Tables") that are to be completed by an applicant during the monitoring period and provided with monitoring reports. Note that a separate table is required for each stream reach or buffer area, and which table is required depends on the mitigation activity (restoration/enhancement, preservation, vegetative only) and resource type (channels vs buffers). It is unlikely that a project would require all five tables listed below. However, each stream reach and each buffer area credited requires its own table where performance is tracked over the monitoring period.

List of Stream Mitigation Performance Standard Tables (provided separately as Microsoft excel workbook):

Table 1: Performance Standards for Restoration/Enhancement of Stream Channels-2015 FBRSA

Table 2: Performance Standards for Preservation of Stream Channels-2015 FBRSA

Table 3: Performance Standards for Restoration/Enhancement of Stream Buffers

Table 4: Performance Standards for Preservation of Stream Buffers

Table 5: Performance Standards for Vegetative Enhancement of Stream Buffers (No Earthwork)

Table 6: Barrier Removal (Fish Passage)

Table 7: Performance Standards for Restoration/Enhancement of Stream Channels-2024 FBRSA

Table 8: Performance Standards for Preservation of Stream Channels-2024 FBRSA

A separate Stream Mitigation Performance Standard Table will be needed to track each stream reach or stream buffer area that was credited. This will be only one table from the workbook. The specific resources that require assessment during the monitoring period can be found in the Mitigation Plan as the independent reaches and credited stream buffer areas identified in the Maryland Stream Mitigation Framework output from Appendix A.1. ***IMPORTANT* The main stream assessment for stream channels in Maryland is the Function Based Rapid Stream Assessment. It was updated in 2024, and there are two versions: 2015 Function Based Rapid Stream Assessment (FBRSA) and 2024 FBRSA. It is important that applicants continue to use the same assessment that was conducted for baseline (preconstruction). Performance Standards tables for stream channel work and preservation under the 2015 FBRSA are found in Tables 1 & 2, while the performance standards tables for stream channel work under the 2024 FBRSA can be found in Tables 7 & 8.**

These performance standards rely heavily on the Maryland Stream Mitigation Framework Version 1 Final (MSMF V.1 Final). MSMF V.1. Final includes a user manual and several appendices and it is located at: https://www.nab.usace.army.mil/Missions/Regulatory/Mitigation/.

Four documents may be needed to complete monitoring reports from MSMF V.1. Final:

i. Appendix A1. MSMF Version 1 Calculator

ii. Appendix B EPA RBP Forms and Parameters (for ephemeral channels)

iii. Appendix C3 Monitoring-Function Based Rapid Stream Assessment (for stream channels)

iv. Appendix D3 Monitoring-Stream Buffer Quality Assessment (for stream buffers)

Please note that most projects will only use some combination of Appendix A1, C3 and D3, and use of Appendix B will be rare. Monitoring submittals requiring these appendices will vary by year. Some years will only involve visual monitoring, where these appendices would not be needed. More details can be found in Tables 1 through 5.

I. Background

Performance standards for stream mitigation exist to ensure mitigation efforts meet the goals and objectives outlined in the approved mitigation plan or instrument (“Mitigation Plan”, 33 CFR 332.5). Monitoring is required to demonstrate a site is trending towards

success and is on target to meet the goals and objectives outlined in the Mitigation Plan. It is critical that all Mitigation Plans are developed with appropriate and attainable goals and objectives. Success or failure of a mitigation site is documented through the use of performance standards, which are defined in the mitigation rule as “observable or measurable physical (including hydrological), chemical, and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives.” Following establishment of a stream mitigation site or bank, performance is tracked through subsequent monitoring years (typically over ten years). Stream mitigation work must be self-sustaining once performance standards are met (33 CFR 332.7(b)), and the performance standards are in place to help ensure sustainability of the functions and conditions provided.

Mitigation banks, in-lieu fee mitigation, and permittee-responsible mitigation that seek CWA Section 404 stream credits must conform to the following interim-based and final performance standards unless otherwise determined by Army Corps of Engineers Baltimore District (USACE) and the Maryland Department of the Environment (MDE). For mitigation banks and in-lieu fee projects, coordination with the Maryland Interagency Review Team (IRT) may also be needed. Stream channel and buffer monitoring timeframes, monitoring reports, and monitoring report measurements must be consistent with the requirements in this document.

These performance standards and monitoring protocols are intended to provide a predictable and consistent approach to monitoring mitigation sites and to demonstrate that a site is trending towards meeting overall goals and objectives of the mitigation plan. All final performance standards, including any deviation in these standard performance standards, must be approved by the USACE and MDE prior to implementing the mitigation site. Alternative performance standards and monitoring protocols may be considered by the IRT when site-specific objectives critical to the establishment of the desired aquatic resource would not be met through use of the following general performance standards and monitoring protocols. If any of the performance standards or monitoring protocols listed below are not proposed for use or alternative standards or protocols are proposed for any given project, the rationale based on scientific literature, reference data, or data from prior professional experiences must be explained in the mitigation banking instrument or mitigation plan. If alternate performance standards or monitoring protocol are proposed, the Bank Sponsor, Permittee, or Authorized Person (Sponsor) of the Site must clearly specify through track changes the proposed differences as part of their Performance Standards and Monitoring Protocol submitted with the mitigation proposal for review and approval. These alternate standards cannot just be shown on the design plans. **If these alternate standards are not clearly stated in the Performance Standards and Monitoring sections of a mitigation instrument, the below standards shall apply.** The USACE and MDE retain approval authority for any performance standards proposed that are different from those contained in this document.

This document applies to monitoring of stream mitigation including work in stream channels, stream buffers, and fish passage throughout the monitoring period. Wetlands

performance standards are provided separately from this document and described in the document “Ecological Performance Standards and Monitoring Protocol for Nontidal Wetland Mitigation Sites in Maryland.” *Note: For projects proposing bundled credits (e.g., overlapping stream buffer and wetland), the overlapping area must meet the performance standards for both credit types (wetlands and stream buffers). Credit bunding is a rare approach to mitigation banking and does not apply to most mitigation proposals.*

*Note: Wetland Replacement: If wetland was present in the limit of disturbance (or adjacent) prior to construction, there must be at least as much wetland area present at the end of the monitoring period, based on a wetland delineation, that meet the wetland performance standards. *If loss of wetland acreage or function occurs, wetland mitigation may be required. The Agencies may consider relocation of wetlands within the site if the acreage and functions are replaced.*

II. General Requirements for Stream Mitigation Monitoring

For all credited stream reaches and stream buffer areas, the following general requirements will apply for each monitoring year as outlined in the Stream Mitigation Performance Standard Tables excel document. Please note that performance standards outlined throughout this document are written to apply directly to stream and buffer restoration/enhancement. Stream channel and stream buffer preservation monitoring will entail a smaller subset of the requirements listed herein and are reflected in performance standard Tables 2 and 4. Further, stream buffer work that solely consists of vegetative management (plantings and invasive species management) have their own set of performance standards (Table 5).

General standards are provided in this section (Section II) and more specific requirements are provided in Section III (for stream channels) and Section IV (for stream buffers).

A. The Sponsor must provide all required documentation, including monitoring reports, construction completion reports, and as-built surveys to the USACE and MDE (in the case of Permittee-Responsible Mitigation) or the USACE and MDE, in consultation with the IRT (in the case of mitigation banks) (Agencies). The Agencies will use observations during site visits and monitoring reports to evaluate attainment of performance standards and performance-based milestones and in determining whether part of or the entire site is successful or whether corrective actions are warranted. Presenting averages or means of plot data across a site is not satisfactory to demonstrate success. All the following standards and milestones will be used to assess project success.

B. Project Goals: The mitigation project must meet the intended goals and objectives in the Mitigation Plan. This means that observed values (particularly in the later years of post-construction monitoring) should be in reasonable proximity to the originally Proposed Conditions identified in the stream channel assessment: FBRSA and the

Stream Buffer Quality Assessment (SBQA). The Sponsor must include the intended goals, objectives, and associated measurable attributes in their Mitigation Plan.

C. Monitoring Reports: Monitoring reports should be concise and effectively provide the information necessary to assess the status of the site. Reports should provide a bulleted list restating the goals and objectives of the project. If different for specific reaches or buffer areas, these should be split out. Reports should include project coordinates (latitude and longitude) and a resource map showing any identifiable landmarks of the site, including information to locate the site perimeter(s), and easement boundary. Reports should provide information necessary to illustrate site conditions and whether the site is meeting its objectives and performance standards. Monitoring reports must be submitted consistent with the current monitoring report format, using the Mitigation Monitoring Report Form (Attachment 2). Monitoring reports must be submitted electronically to the Agencies by December 31 of each monitoring year. For mitigation banks, the Sponsor must concurrently upload a copy of the monitoring report to the Regulatory In-lieu Fee and Bank Information Tracking Systems ('RIBITS') for access by the IRT. Monitoring reports must be submitted for years 1, 2, 3, 5, 7, and 10 ('Monitoring Years') following completion of construction and planting of the mitigation site or phase thereof. *While survey data is not required in Year 1, a monitoring report that includes photos and results of a visual inspection must be submitted to the Agencies in Year 1 to document success or concerns related to the stream restoration/enhancement project. Failure to submit monitoring reports will result in non-compliance of permit conditions and delay of approval of any remaining credits and formal release from future monitoring requirements until reports are submitted and approved by the Agencies. The following information must be included in monitoring reports (as applicable by year):

1. Site map showing satellite imagery, and all stream reaches and stream buffer areas of the mitigation site. This should include points of interest including monumented cross-section locations, vegetative sample plot locations, and areas that are being watched for potential remediation.

2. Photographs demonstrating the condition of each stream reach and stream buffer area.

3. Stream Mitigation Performance Standard Tables tracking progress of mitigation sites over the monitoring period, including preconstruction data, as-built data, and data for specific monitoring years (Tables 1-5 below).

4. FCAMs for monitoring years (FCAMS- for stream quality and stream buffer quality are only required in some monitoring years). See the Stream Mitigation Performance Standard Tables for more details. (*Note: An FCAM is a "functional or conditional assessment methodology.")*

5. For stream restoration work: Monumented cross-section graphs overlaying all previous monitoring years, including the as-built cross-section.

6. List of areas being watched and areas requiring remedial action, employing the adaptive management plan of the Mitigation Plan.

D. Monitoring Time of Year Requirements: After Year 1, monitoring of physical stream conditions (e.g., longitudinal profiles, cross-sections, channel width and depth, photographs) may be conducted outside of the growing season. Monitoring vegetation within the stream buffer must be conducted inside of the growing season (May 1-Sept 30) for forested areas and June 15-Sept 30 for emergent areas). The monitoring period begins the year construction is complete and the mitigation planting occurs, unless planting occurs after April 15, in which case the monitoring period will not begin until the following year. Stream water quality (i.e., temperature, DO) monitoring (if applicable) will occur continuously, year-round using data loggers. For stream biological monitoring, it is recommended that the sampling event occur consistently within the index period as required by the Maryland Biological Stream Survey; between March 1 and April 30 for benthos sampling and between June 1 and September 30 for fish sampling. If preconstruction monitoring is not possible in this window, post construction biological monitoring must occur in the same time period as preconstruction monitoring, unless the Agencies approve an alternate schedule.

E. Monitoring Pre and Post Construction Conditions: Monitoring protocol must include detailed information about the pre- and post-construction stream and riparian buffer condition. This is tracked in the Stream Mitigation Performance Standard Tables. Existing vs proposed assessment values provided in the Mitigation Plan must be entered into the table. Specific functional and conditional assessments needed for stream channels and stream buffers differ, and more details are provided in Sections III and IV of this document regarding assessments for each resource type. Monitoring reports must include all information to support this assessment, including field data sheets, field measurements, and associated photos. Pre-, proposed, and post-construction methods reported and used to demonstrate existing and proposed conditions must use the same parameters and measurement methods to determine success.

F. Visual Inspections: Visual inspection will be conducted throughout the compensatory mitigation site during each monitoring event by traversing the entire mitigation site to identify and document areas of stream instability, low stem density or poor plant vigor, non-native or invasive species, beaver activity, herbivory, encroachment, indicators of livestock access, erosion, or other areas of concern. A brief narrative of the results of the visual assessments must be included in each monitoring report. Visual monitoring is intended to identify potential problems and allow them to be tracked and addressed, when necessary. Any areas of concern must be annotated on a plan view of the site with GPS coordinates, photographs, and a written narrative describing the features and issues of concern. Once a feature of concern has been identified that same feature will be reassessed on all subsequent visual assessments. Depending on the nature of the concern, field measurements may be warranted to track conditions as they improve or decline over time. Photographs should be taken from the same location each year to document the current condition of the area of concern. In general, repairs will be

required when stream stability issues are identified that continue to worsen, pose a threat to other portions of the stream (e.g., vertical instability/headcuts, etc.) or adjacent resources (e.g., wetlands), or are symptomatic of more serious issues with the design and/or construction of the project. If problems continue to persist, repairs may be discontinued, and mitigation credits will be adjusted accordingly. Aerial photographs are encouraged as they may be useful in describing the overall site conditions.

G. Stream Mitigation Credits (Functional Feet): Stream credits will be determined using the Maryland Stream Mitigation Framework Version 1 (MSMF V.1. Final). The actual number of functional foot credits awarded will be based on post-construction monitoring and results of the stream assessment, stream buffer assessment and other applicable factors for each stream reach and buffer assessment area respectively.

1. At the final monitoring year, generally Year 10, the final credit amount will be based on the final monitoring values (FCAM score). While the stream credits cannot be increased based on a higher FCAM score, if the total FCAM score is less than the total proposed FCAM value in the Mitigation Plan, stream credit will be reduced.

H. Requirements in the Event of Substantial Variation from Approved Design: If the project is constructed with substantial variations from the approved design, particularly in grading and structure elevations, a hydraulic model must be run applying the red-line as-built plan for the flows (2, 10, 50, 100), clearly showing shear stresses at various points in the floodplain and channel. If shear stresses of the revised model exceed stability thresholds for the floodplain or instream grade control, repairs will likely be required. Any repairs of this type would be required within one year after identification of the problem. The Agencies may also require additional site-specific performance standards based on the variation from the approved design and/or additional monitoring to assure achievement of the mitigation project goals. Depending on the outcome of the re-evaluation, mitigation credits may be adjusted.

I. As specified in the Mitigation Plan, additional monitoring may be required to verify/document attainment of additional site-specific performance standards based on goals of the mitigation project.

Note: This document describes the performance standards for stream mitigation proposals. In rare instances, alternate performance standards may be proposed and approved by the Agencies as part of the Mitigation Plan but must be justified based on the proposed construction methods, project design, reference conditions, and unique project goals.

III. Performance Standards and Monitoring Requirements for Stream Channels

This section provides stream performance standards for perennial and intermittent streams. Separate standards for ephemeral streams are also provided within this section.

A. Requirements for Stream Channel Restoration/Enhancement: Performance standards for stream channel restoration/enhancement may be found in Table 1 and are outlined below:

1. Photograph site conditions annually along the entire stream mitigation project. Each stream reach must be photographed and photographs must occur at 300-foot intervals along the stream channel, at points demonstrating project success, and at locations of instability. Photos should also be taken at representative locations within each stream reach and in areas of interest or concern. Photos should be taken at the same station each year, with the exception of any new findings. Any supplemental drone footage must clearly show the entire mitigation project width (i.e., stream, buffer, and approximately 50 additional feet on each bank).

2. Stream Length: Stream reach lengths, measured along the centerline of the stream, must be verified, and documented in linear feet for each monitoring period. Reach lengths must be measured using a combination of field investigation/geomorphic assessments as well as through drone video and static photographs. If drone footage is the primary method to assess stream length, it must be digitized and georeferenced. Stream lengths observed during each monitoring period must be compared with those proposed in the MSMF V.1. Final Appendix A.1 of the Mitigation Plan for each reach. These should be classified into stream flow before and after construction (perennial, intermittent, and ephemeral). In all monitoring report years, stream length must be the same or longer than proposed stream length. Any reduction in stream length may result in a reduction in stream credits.

3. Stream Quality: Stream reach quality parameters will be assessed and documented each monitoring year as outlined in Table 1 below and following the methods established in the MSMF V.1. Final, including re-assessing the FBRSA using Appendix C3 of MSMF V.1. Final. Individual quality parameters will be assessed for each reach and compared with those presented in the Proposed Conditions. These can be viewed in Table 1 below. *Important: be sure to use the same assessment that was used for baseline conditions. For example, if baseline conditions were documents using the 2015 Function Based Rapid Stream Assessment, use the monitoring sheet and associated performance standards table 1 (0r 2 if preservation). If the 2024 Function Based Rapid Stream Assessment Was used, this will be tracked with the matching Monitoring sheet and performance standards table 7 (or 8 if preservation).

(a) Stream Quality Threshold: The FCAM FBRSA values must not be:

(i) More than 10 percent lower than the initial Proposed Conditions total value.

(ii) More than 20 percent lower than the initial Proposed Conditions for any individual metrics determined by Agencies to be important for meeting project goals. *These metrics will be identified and approved as part of the Mitigation Plan.

(b) Stream crediting for multi-thread channel: Consistent with the MSMF V.1. Final Manual, any credits derived from second or third channels in multi-thread systems must be perennial, at least one foot wide and with pools at least half a foot deep to qualify for credits. Any second or third channels that do not meet these requirements will not receive stream channel credit. However, they may be eligible for stream buffer credit or wetland credit if they meet those respective requirements. Consistent with MSMF V.1. Final Manual, stream quality scores for multi-threaded systems include assessment of all stream threads in a single assessment, so the stream quality scores will be the same for the primary, second, and third channels. In rare instances where a second or third channel is a long distance from the primary channel of a valley, it may be assessed separately.

4. Stream Stability: Evaluate stream stability by performing monumented valley-wide cross-sections to document channel shape and thalweg and elevations at riffle crests (or top of grade control). These cross sections should also document changes in the floodplain. Cross-sections must be monumented using metal survey stakes, and locations must be noted on the as-built report. A minimum of one cross-section for every 300 linear feet of stream work is required. In general, two cross-sections must be installed near the downstream limits of the project, two near the upstream limits of the project, and at least one cross-section must be installed on each tributary where construction has occurred. Further, a monumented cross-section must occur upstream of any abrupt elevation changes exceeding 1 foot (if they occur), and the remaining cross-sections must be distributed evenly throughout the remainder of the project area. Note: extend cross-sections perpendicular to each channel location (riffle crest, structure crest, etc.); extend the entire 100-year floodplain where possible. In some locations where the stream runs perpendicular to the valley, a shorter cross-section is generally recommended. In those instances, at minimum the full flood-prone width should be captured in the cross-section. Cross-sections must be shown in a graphical display which overlays previous cross-sections per location in each monitoring report. Incision of the channel thalweg or erosion of the floodplain may require corrective actions or additional monitoring. Monumented cross-section location must be provided in site mapping and include specific coordinates shown in decimal degrees (a separate table is recommended for coordinates).

5. Stream and Floodplain Stability: The stream and floodplain must be stable and functioning as proposed. Documentation of stream condition/functional improvements occurring due to the mitigation project must include the following:

(a) Stream flow classification (perennial, intermittent, and ephemeral) is the same or greater than proposed in the Mitigation Plan.

(b) Based on modeling data, shear stresses of flows up to and including the 100-year flow event should not exceed the stability thresholds of floodplain materials or riffle framework material. *The framework material are the largest material or structures that hold the grade control together. Sediment transport may occur for smaller non-

framework materials. This item will typically be assessed at the final design phase and on any subsequent design changes which may affect the hydraulic model.

(c) Riffle crest and/or structure thalwegs must be stable as documented using data from monumented cross sections. *The conditions below are based on a stream with 0-10 square mile drainage area. Different thresholds may be assessed for larger drainage areas. If any of the conditions below are not met, remediation will likely be required after confirmation from an Agency field visit.

(i) For streams with slopes from 0-4.9%, riffle crest and structure thalwegs are not degraded more than 1-foot in comparison to the as-built report.

(ii) For streams with slopes exceeding 5%, no substantial vertical degradation may occur which threatens a reach or multiple reaches.

(d) Erosion in the floodplain is non-existent, or minor (e.g., not progressing, not threatening the overall project goals). *Localized lateral erosion that is not problematic to the larger project as determined by the Agencies may not require remediation.

6. Stream Crediting: In years required, indicate the estimated functional foot value of the stream reach as of that given year by running Tab 3 of MSMF V.1. Final Appendix A1 Calculation Workbook. Indicate the functional foot value for the reach.

7. Identify any necessary corrective measures and provide notes on a copy of a project planset or detailed map to include stream stationing.

8. Provide any additional monitoring required in the Mitigation Plan.

B. Requirements for Stream Channel Preservation (*See Table 2*): Performance standards and monitoring requirements for Stream Channel Preservation are outlined in Table 2 of the “Stream Mitigation Performance Standard Tables” document. Standards for stream channel preservation are a subset of those in Section III.A above. The following requirements from Section III.A. apply to stream channel preservation and are reflected in Table 2: III.A.1, III.A.3, III.A.6, III.A.7, and III.A.8.

C. Requirements for Stream Restoration/Enhancement in Ephemeral Channels: Mitigation work in ephemeral channels is limited in MSMF V.1. to necessary tie-in points that allow for a more stable, successful perennial/intermittent stream mitigation project. This is limited to providing stable elevation transitions with ongoing work and addressing any major sediment supply concerns. Performance standards for this type of ephemeral channel mitigation work is therefore more limited in scope.

1. No specific Stream Mitigation Performance Standard Table is required for work in ephemeral channels.

2. The following performance standards and monitoring are required and are a subset of items in Section III.A. They include Sections III.A.1, III A.4, III.A.6, III.A.7, and III.A.8.

3. Stream Quality: Stream quality must be monitored using The EPA Rapid Bioassessment Protocol Habitat Assessment Forms. These may be found in MSMF V.1. Final Appendix B. The same EPA Rapid Bioassessment Protocol Habitat Assessment Form from Appendix B used in the pre-construction assessment must be used to assess ephemeral stream quality in monitoring years listed below. Stream quality for each monitoring year must be provided in addition to values from preconstruction and as-built phases.

4. Items 2 and 3 above are required in monitoring years: As-built, Year 2, 5, and Year 10.

IV. Performance Standards and Monitoring Requirements for Stream Buffers
These performance standards apply to credited stream buffer areas ('CSBAs'). CSBAs are defined in detail in MSMF V.1. Final Appendix D2. Agencies may also require that these performance standards must be met for areas proposed to be cleared as part of construction access. Please note that post-construction monitoring for the SBQA must occur in the same season as the preconstruction monitoring that informed the Existing Conditions score. One SBQA and Stream Mitigation Performance Standard Table must be completed for each CSBA assessed. The Stream Mitigation Performance Standard Table will track progress of a CSBA throughout the monitoring period.

Requirements vary by monitoring year, and Table 3 (Restoration), Table 4 (Preservation), and Table 5 (Vegetative Enhancement-no earthwork) below will indicate which years a specific monitoring item is required.

A. Performance Standards for Stream Buffer Restoration/Enhancement (See Table 3): Identify credited stream buffer areas and establish sample vegetative plot locations within these CSBAs (See MSMF V.1. Appendix D2 and D3). These must be shown on a map.

1. Measuring Buffer Area: Credited stream buffer areas should be verified and documented in acres for each monitoring year as required in Table 3. Buffer areas will be measured using a combination of field investigations and drone video/static photographs. *This section includes monitoring required to verify that both the SBQA metrics and the additional stream buffer performance standards are being met.

2. Buffer Quality: The stream buffer quality assessment must be re-evaluated each monitoring year identified in Table 3 below using the SBQA (MSMF V.1. Final Appendix D3) to compare to the stream buffer Proposed Conditions in each CSBA. In restored/enhanced areas, commonly the stream buffer quality score will improve over subsequent monitoring years. In Years 1 through 4, progress will be monitored regarding potential for achieving proposed stream quality values for Year 10. If major

problems are identified by the Agencies which bring into question the likelihood of achieving projected values as listed in the Mitigation Plan, interim credit releases may be reduced.

(a) Photograph site conditions annually for each stream buffer area at locations demonstrating project success, locations of instability, representative locations, and areas of interest or concern. Any drone footage must clearly show the entire mitigation project width.

(b) Using the tables in Appendix D3 of the MSMF V.1. Final, estimate the actual and relative percent cover by plant species across all strata for each plot. Summarize the data by plot, area and overall site.

(c) Using Appendix D3 of the MSMF V.1. Final, provide the score for each assessment parameter in the Stream Buffer Quality Assessment section in Table 3 as required by the specific monitoring year.

(i) In all monitoring reports from Year 5 through Year 10, each individual stream buffer metric within the SBQA must not be less than 1 point lower than that metric in the stream buffer Proposed Condition of the Mitigation Plan, for the metrics plant species richness, canopy cover, strata, life forms, and age of plant community.

3. Stream Credits in Stream Buffers: In the years specified in Table 3 below, provide the estimated functional foot value for each CSBA by rerunning Tab 4 of MSMF V.1. Final Appendix A1 (Stream Calculation Workbook).

4. Bulk Density: For areas within the Limit of Disturbance, the subsoil must have a bulk-density of less than 85 lbs/cubic foot (1.35 g/cc) for loamy and finer textured soils and less than 107 lbs/cubic foot (1.70 g/cc) in sands (prior to adding topsoil or organic matter).

5. Topsoil: For areas where significant grading occurred or topsoil has been removed, the entire stream buffer outside of bank full must have a depth of at least six inches topsoil, or other depth as approved in the Mitigation Plan. Imported topsoil must be a loam, sandy loam, clay loam, silt loam, silty clay loam, sandy clay loam, or loamy sand, unless previously approved by the Agencies. Imported topsoil must contain less than 5 percent by volume of cinders, stones, slag, coarse fragments, gravel, sticks, roots, trash, or other materials larger than 1½ inches in diameter. **This performance standard will be waived or modified for restoration projects where the topsoil remains intact, e.g., projects that are mainly plugging ditches/redirecting hydrology, vegetative plantings, grading only to add microtopography, or legacy sediment removal when the excavation goes to the depth of the buried high-carbon hydric soil surface.*

6. Microtopography: Microtopography is an important consideration in floodplain design. It improves floodplain roughness, hydraulic diversity, and habitat diversity. The Agencies generally require at least 20% of the floodplain to consist of microtopographic

features (i.e., microtopographic variations between 3 and 6 inches from design elevation and downed wood). The exact amount required will be dependent upon the Mitigation Plan. If no standard is specified in the Mitigation Plan, the site must have at least 20% microtopography spread evenly throughout the site. This may include course woody debris (i.e., logs at least six inches in diameter and six feet long, brush piles, root wads, overturned stumps) in addition to microtopography of the ground surface.

7. Requirements for Forested Buffers:

(a) Tree/Shrub Richness: Establish a minimum of three species of native trees and two species of native shrubs with no more than 50% relative cover of tree/shrub species being one species, over the entire site. Loblolly pine cannot be more than 25% relative cover. **"Relative cover of tree/shrub species" is defined as the cover of a particular species as a percentage of total tree/shrub cover. Thus, relative cover of tree/shrub species will always total 100%, even when total absolute tree/shrub cover is quite low.*

(b) Tree/Shrub Density: For forested buffers, native plant density of at least 435 living trees/shrubs per acre with a minimum height of 10 inches must be achieved by the end of the first year of monitoring and maintained each monitoring year thereafter through the end of the monitoring period. **If different tree/shrub sizes are planted, the Sponsor may request and the Agencies may approve, alternate tree density requirements as part of the Mitigation Plan. The Agencies may consider alternate performance standards for areas that are too wet to meet this requirement.*

(c) Tree Height and Canopy Cover: For forested buffers, average tree height of tallest five native trees within each sample plot must be at least three feet in height at Year 3 and at least five feet in height at Year 5 and each monitoring year thereafter. Canopy cover of native trees must be at least 30% by the end of the monitoring period. **The Agencies may consider alternate performance standards for areas that are too wet to meet this requirement.*

(d) Establish sample vegetative plot locations within stream buffer areas. These should be shown on a map. Estimate the actual and relative percent cover by plant species across all strata for each plot. Include this information in a table. For each species listed in the table, include native/non-native/invasive status. Summarize the data by plot, area and overall site.

(e) Measure the height of the tallest five trees within each sample plot in each monitoring year. Measure canopy cover of native trees and shrubs.

(f) Supplemental plantings must be present for at least two growing seasons before counting toward meeting performance standards for monitoring year five and seven. Supplemental plantings that cover more than 20% of a site, use small stock, or are conducted during the 7-year or later monitoring years are more likely to require additional monitoring.

8. Non-Native and Invasive Species: The goal of any mitigation site is to have no non-native or invasive species. However, if non-native or invasive species are present, no more than 10% of relative plant cover over the entire site must be made up by non-native or invasive species, with no individual colony greater than or equal to 5% of relative plant cover. No more than 5% of relative plant cover over the entire site must be made up of *Phragmites australis, Persicaria perfoliata, Pueraria montana, or Lythrum salicaria.* The presence, location, and percent cover of invasive and/or non-native species must be noted on the mitigation plan. Invasive species are identified on the 2010 National Park Service/United States Fish and Wildlife Service document Plant Invaders of Mid Atlantic Natural Areas and the Maryland Invasive Species Council Invasive Species of Concern in Maryland. Native status will be based on the Natural Resources Conservation Service Plants Database. Phalaris arundinacea will be considered as invasive by the Agencies and Typha spp. may be considered as invasive. If the Sponsor determines they are unable to meet the performance standards and the Agencies recommend alternate standards, the Sponsor may provide justification for alternate standards based on the likelihood of successfully controlling those species. The documentation for these alternate standards must be reviewed and approved by the Agencies prior to implementation. In this approach, consideration should be given to the adverse effects of the species presence and of continuous treatment with herbicide. Non-chemical treatments are favored over chemical treatments in Maryland. For example, alternate standards may be proposed for invasive and/or non-native species that are not easily controlled without extensive and chronic herbicide use, and when their relative plant cover value will not adversely affect ecological functions related to community properties or hinder long-term success of the project (e.g., tree survival, plant diversity, etc. In addition, the Sponsor must demonstrate that they are following the Adaptive Management Plan approved as part of their Mitigation Plan. If the Agencies allow different requirements, while the project may not be considered a failure, reduction in credit will likely occur.

(a) American Common Reed, Phragmites australis subsp. americanus, while uncommon, is not considered to be an invasive plant.

(b) Useful Links:

i. https://www.invasive.org/alien/pubs/midatlantic/midatlantic.pdf.

ii. http://mdinvasives.org/species-of-concern/.

iii. https://plants.sc.egov.usda.gov/.

9. Identify any necessary corrective measures and provide notes on a copy of a project planset or detailed map.

10. Provide any additional monitoring as required by the mitigation plan.

11. Unique applications: Bundling Stream Buffer and Non-tidal Wetland Credits

(a) Where overlapping or “bundled” credits occur for stream buffers and wetlands, the more rigorous monitoring conditions would apply. Vegetative monitoring procedures would follow that for wetlands, but the Stream Buffer Quality Assessment must still be completed for each monitoring year.

B. Performance Standards for Stream Buffer Preservation: (See Table 4 of “Stream Mitigation Performance Standards Tables”). The performance standards of Stream Buffer Preservation are a subset of the performance standards for Stream Buffer Restoration/Enhancement seen in Section IV above.

C. Performance Standards for Stream Buffer Vegetative Enhancement (no earthwork): (See Table 5 of “Stream Mitigation Performance Standards Tables”). The performance standards of Stream Buffer Vegetative Enhancement are a subset of the performance standards for Stream Buffer Restoration/Enhancement seen in Section IV above. This is specific to vegetative enhancement activities in buffers where no earthwork is proposed.

V. Fish Passage Performance Standards and Monitoring Requirements

NAB (Corps-Baltimore District) typically requires 10 years of monitoring for stream mitigation projects to ensure performance standards are being met. 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 but will generally follow the requirements below. Please note that some performance standards/monitoring requirements below do not apply to all projects, as they have specific application. Those are called out below.

Physical Monitoring: The intent of geomorphic and physical monitoring is to ensure that a barrier removal project does not result in adverse impacts to a waterway (including wetlands) or infrastructure. In some situations, substantial watershed changes may have occurred since barrier installation (often decades ago). If hydraulic modeling or calculations suggest removal may result in substantial adverse impacts to a waterway or infrastructure, remedies must be identified (such as grade-control structures or grading). Geomorphic change is anticipated following a barrier removal, and adjustments back to the historic stream dimension, pattern, and profile are anticipated. However, where substantial watershed changes have occurred over the decades since installation (development, head-cutting, infrastructure buildup), engineering may be needed.

A. Dam Removals:

1. Infrastructure Photos:

(a) Monitoring Requirement: Photo document infrastructure (bridges, utility corridors, roads, etc.) within the hydraulic influence of the barrier.

(b) Performance Standard: No evidence that infrastructure has been compromised.

2. Visual Inspection/Photos:

(a) Monitoring Requirement: Photograph annually, location of former barrier, location of former impoundment, first riffle/structure upstream of barrier hydraulic influence, downstream of barrier, and any wetlands that occur within 3,000 linear feet downstream of the former impoundment. Provide an aerial image (drone etc.) of the former impoundment area, former barrier location, areas within 3,000 linear feet downstream of the barrier. Aerial image should be taken from no more than 300 feet above the stream/river.

(b) Performance Standard: No substantial impairments to wetlands or waterways detected from photographs. Work area appears to be stabilizing during monitoring period.

3. Functional Foot Value: Using Appendix F1 of MSMF, estimate the functional foot value of the barrier removal project during specified years.

4. Sediment Analysis: Report on the grain size composition and any contaminants in impoundment sediment.

5. Actively Removed Sediment: This element applies only to where credit is sought for Active Sediment Removal (Section D of Appendix F1 FP Calculator).

(a) Report the quantity of sediment removed in cubic yards during construction (demolition) of the dam and its impoundment with the As-built report.

6. Downstream Wetland Delineation (Passive Sediment Removal Only)

(a) Monitoring Requirements: Where passive sediment release occurs, photograph and re-delineate wetlands within 3,000 linear feet downstream of the former impoundment. This distance may vary by project scope and sediment volume discharged.

(b) Performance Standard: Loss of wetlands due to sediment fill do not exceed 10,000 sq. ft. Note: MDE may require mitigation for impacts less than 10,000 sq. ft.

7. Riffle Crest Cross-Section:

(a) Monitoring Requirement: To verify vertical stability, a monumented riffle cross section station must occur on the first riffle upstream of the hydraulic influence of the

dam. This is an area some distance above the impoundment. Hydraulic modeling will help inform the appropriate location.

(b) Performance Standard: Riffle crest may not degrade more than 2 ft from the pre-construction condition.

8. Biological Monitoring:

The performance standards for “general assemblage” crediting and “target species” differs. For the “general assemblage,” biological monitoring is required, but the performance standard and crediting is achieved through providing access (no barriers >1ft in UFN). For “target species,” performance standards and credits are tied specifically to the upstream limit where the species was detected during the monitoring period. In some instances, where a target species had already occurred above the impoundment, a mark/recapture study may be needed using a surrogate species (suckers, etc). A surrogate species may be used to avoid impacts to a sensitive target species or where the target species is difficult to track in the field.

(a) General Assemblage verified UFN:

(i) Monitoring requirements: Verify that no barriers taller than 1ft occur within the Upstream functional network during pre-construction. Conduct biological sampling (eDNA or fish-in-hand) throughout the UFN to document assemblage composition changes following barrier removal.

(ii)Performance standards: No barriers above 1ft occur in UFN. Biological monitoring reports submitted as required. A higher tolerance may be allowed on higher gradient streams such as some brook trout streams. Note: in some instances where Diadromous species are concerned, barriers lower than 1 ft may also be evaluated.

(b) Fish Sampling throughout UFN: Fish sampling (eDNA or fish-in-hand monitoring) must occur throughout the UFN at selected accessible locations during specified monitoring years. eDNA meta barcoding should be used for eDNA efforts for the general assemblage where eDNA is used. Maryland Biological Stream Survey standards must be used for fish-in-hand monitoring if it is the method used.

(c) Target Species Verified UFN (only applied where credit is sought for target species)

(i) Monitoring requirements: Conduct biological sampling (eDNA or fish-in-hand) throughout the UFN to document assemblage composition changes following barrier removal.

(ii) Performance Standards: Target species found at upper limit of projected UFN during monitoring period.

(iii) Final Credits are determined using the maximum extent of each target species observed during the monitoring period.

B. Culvert Removals: For culvert removals, only items V.1, V.2, V.3, V.7, V.8.a, and V.8.c are applicable from the list above for dams.

C. Considerations for Biological Monitoring: For anadromous species, applicants will need to include a documented list of anadromous species below the barrier and those above the barrier (or former barrier) for each monitoring year. The FPWG conferred with regional fisheries experts and academic researchers over the course of developing the Fish Passage Credit Calculator tool, many eDNA assays are available or are under development for detecting the presence or absence of a target anadromous species in a waterbody in the Chesapeake Bay. For species where an eDNA assay does not currently exist, the applicant may elect to develop it for use on their mitigation proposal. eDNA monitoring is preferred to fish-in-hand surveys or PIT tagging to minimize impacts and mortality of target species populations, many of which are currently at historic population lows. This may also be the most cost-effective monitoring approach for the purposes of performance evaluation.

In the case of barriers where there is documented presence of a target species upstream of the proposed barrier, eDNA should be used to determine the extent of upstream habitat the species is utilizing. This extent would be included in the Calculator as “verified” UFN. eDNA monitoring should be continued after the barrier removal. For resident species of concern, eDNA assays are not as readily available. Surveys, including mark-recapture (e.g., PIT tag) surveys, could be utilized for some species. In cases where the impact of surveys may be of concern on target species (e.g., RTE species)), a proxy species with comparable swimming abilities may be used to determine the extent of resident fish upstream of a barrier removal. In some cases, passage of resident species could be reasonably assumed and monitoring would not be required. In these cases, regional fisheries biologists would need to confirm the assumption.