SAVANNAH DISTRICT'S 2018 STANDARD OPERATING PROCEDURE FOR COMPENSATORY MITIGATION

April 27, 2018 (Version 1.0)

SAVANNAH DISTRICT'S 2018 STANDARD OPERATING PROCEDURE FOR COMPENSATORY MITIGATION

REVISION LOG

Date Edited	Editor	Version Edited	Section Edited	Changes/Updates

SAVANNAH DISTRICT'S 2018 STANDARD OPERATING PROCEDURE FOR COMPENSATORY MITIGATION

Table of Contents

SAVANNAH DISTRICT'S 2018 STANDARD OPERATING PROCEDURE FOR COMPENSATORY MITIGATION

1.0. PURPOSE

1.1. Introduction: This Standard Operating Procedure for Compensatory Mitigation (2018 SOP) contains instructions to aid applicants and mitigation sponsors in the calculation of credits associated with proposed impacts to and/or mitigation activities in waters of the U.S. as regulated under Section 404 of the Clean Water Act (CWA). The 2018 SOP is applicable in the geographic boundaries of the State of Georgia. In Georgia, Section 404 of the CWA is administered by the U.S. Army Corps of Engineers, Savannah District, Regulatory Program (Savannah District).

Specifically, this document provides a methodology for both quantifying the functional impairments (i.e., mitigation credits owed), and functional improvements (i.e., mitigation credits generated) to aquatic resources in accordance with the requirements set forth in the Compensatory Mitigation for Losses of Aquatic Resources; Final Rule (2008 Rule; 33 CFR Parts 325 and 332).

This document immediately supersedes the credit calculations outlined in Savannah District Standard Operating Procedure for Compensatory Mitigation - Wetlands, Open Waters, & Streams (2004 SOP), dated March 2004, for all complete applications (i.e., permits and mitigation plans[1]) received after the effective date of the public notice for the 2018 SOP. Mitigation requirements for permit applications determined to be complete prior to the effective date will be processed using the 2004 SOP, unless the applicant requests otherwise. Mitigation documents that pre-date the 2018 SOP are hereby formally rescinded, with the exception of those referenced in Section 4.0, below.

1.2. Goals: The goals for the 2018 SOP are to: 1) provide stakeholders with a consistent, repeatable, functionally-based mitigation credit assessment methodology for aquatic resources; and, 2) establish a transition to functionally-based credit types to facilitate in-kind replacement of aquatic resources. All documents supporting this SOP have been included as appendices, either in their existing form or to be released at a later date, in order to facilitate future updates, as needed.

2.0. BACKGROUND

2.1. 2004 Savannah District, Regulatory Division's Standard Operating Procedure for Compensatory Mitigation (SOP): The 2004 SOP was developed to provide a consistent methodology for assessing wetland, stream, and open water impacts and mitigation activities. While factors based on ecological function were considered in the development of both the impact and mitigation calculations within the 2004 SOP, overall, these factors generally comprised a very small percentage (less than 50

[1] For mitigation banking instrument proposals, the Public Notice soliciting comments on the project Prospectus will be utilized as the threshold for the determination of the applicability of the 2018 SOP.

percent) of the overall calculation of credits owed or generated. At the time it was developed, compensation ratios were not specified as an underlying goal of the 2004 SOP.

2.2. Coordination: In July 2017, the Savannah District published the initial public notice soliciting public comments on the proposed SOP. During the subsequent 90-day public comment period, the Savannah District received multiple comments from Federal and State resource agencies, environmental consultants, mitigation bank sponsors, and non-profit organizations. In addition, the Savannah District participated in a number of working sessions with interested stakeholders, both during and following the public comment period, to solicit more detailed input on the SOP proposal. In response to the receipt of the public comments and input received during stakeholder working sessions, Savannah District has made revisions, as appropriate, to the 2018 SOP.

3.0. APPLICABILITY

3.1. Resource and Geographic Scope: The 2018 SOP has been developed to assess the entire range of projects (both impacts and mitigation) that may occur in freshwater wetlands, streams, saltwater tidal wetlands, and open waters within the geographic boundaries of the Savannah District Regulatory Program.

3.2. Scalability: This SOP can be used for projects of all sizes. The development of the 2018 SOP focuses on functional characteristics of the above-mentioned aquatic resources, an approach which provides flexibility in the assessment of a wider range of projects. It also addresses both direct and indirect impacts for projects regardless of scale.

3.3. Project Type: The 2018 SOP is applicable to all regulated activities under Section 404 of the CWA, to include the assessment of adverse impacts and mitigation associated with permit applications, mitigation plans, and compliance and enforcement actions taken by the Savannah District[2].

4.0. REGULATIONS & DISTRICT GUIDELINES

4.1. 2008 Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (Rule): The Rule (Federal Register, Vol. 30, No. 70:19594-19705, April 10, 2008) emphasizes that the process of selecting a location for compensation sites should be informed by: an assessment of watershed needs and how specific wetland and/or stream restoration projects can best address those needs. It also identifies a

[2] The 2018 SOP may be used at the discretion of the U.S. Environmental Protection Agency for compliance and enforcement cases within the Savannah District in which they serve as the lead federal agency.

hierarchical preference for different compensatory mitigation options (i.e., mitigation banks, in-lieu-fee, and permittee responsible sites) to off-set adverse impacts. The Rule further requires measurable and enforceable ecological performance standards for all types of mitigation, so that project success can be evaluated, and regular monitoring is required to document the extent to which mitigation sites are achieving ecological performance standards. The Rule also specifies the components of a complete mitigation plan, and emphasizes the use of science-based assessment procedures (i.e., functional and/or conditional assessments) to evaluate the extent of potential aquatic resource impacts and mitigation measures (USEPA/USACE, 2008).

4.2. Savannah District's Guidelines to Evaluate Proposed Mitigation Bank Credit Purchases (Credit Purchase Guidelines): This document provides applicants with the appropriate procedure for evaluating and documenting the purchase of commercial mitigation bank credits when multiple banks and/or service areas must be considered in offsetting a permitted impact. The current Credit Purchase Guidelines are provided in Appendix 11.1. Where compensation is proposed from a mitigation bank or in-lieu-fee program, the Savannah District requires permit applicants to submit a completed Statement of Credit Availability Agreement. This procedure requires applicants to coordinate with the mitigation provider prior to submittal of the mitigation plan to ensure credit availability and accurate accounting. The Template Statement of Credit Availability Agreement is provided in Appendix 11.2.

4.3. Savannah District's Mitigation Service Areas: Guidelines regarding mitigation service areas for new mitigation banking projects will be provided at a future date. Appendix 11.3. is reserved for Mitigation Service Areas.

4.4. Savannah District's Mitigation Plan Guidelines: Guidelines regarding the development, design and implementation of mitigation plans will be provided at a future date. Appendix 11.4. is reserved for the Mitigation Plan Guidelines.

4.5. Savannah District's Monitoring Metrics and Performance Standards: Comprehensive guidelines regarding the development of mitigation performance monitoring plans and the criteria for the assessment of mitigation performance will be provided at a future date. Appendix 11.5. is reserved for Monitoring Metrics and Performance Standards.

4.6. Savannah District's Banking Instrument Template: A document outlining the required components of a complete mitigation banking instrument, will be provided at a future date. Appendix 11.6. is reserved for the Banking Instrument Template.

5.0. CREDITS

5.1. In-Kind Replacement: For the purposes of this 2018 SOP, the Savannah District has aligned mitigation credits with specific aquatic resource credit types in order to better replace the lost aquatic resource functions resulting from adverse impacts. In-kind replacement requires that mitigation resources have comparable functions and conditional characteristics as the resource being impacted. The list of credit types, below, will be utilized to achieve in-kind replacement. If in-kind replacement is unavailable at the time of permit issuance, the applicant will proposed and the Savannah District will determine, on a case-by-case basis, whether another resource credit type is appropriate for fulfilling the compensatory mitigation requirements for the aquatic resource impacts. “Grandfathered” credit types are addressed in Section 5.6 below.

5.2. Wetland Credit Types: The Hydrogeomorphic Approach, HGM, (Brinson, 1993, and Smith et al., 1995) is a methodology that helps wetland practitioners classify, group, and assess wetlands and their functional capacities. The goal of HGM is to consistently classify wetlands across diverse geomorphic landscapes and assess shared (i.e., HGM Class) functions of wetlands in comparison to a corresponding reference dataset. For the purposes of in-kind replacement of wetland resources, this 2018 SOP utilizes wetland credit classifications based on the HGM Classification, which focuses on the following three characteristics: 1) water source; 2) landscape position; and 3) hydro-dynamics. With the greatest weight given to water source, the following list of wetland credit classifications will be applied to impacts and compensation in the Savannah District: 1) Freshwater Tidal; 2) Saltwater Tidal; 3) Riverine and Lacustrine Fringe; 4) Slope; and 5) Depressional and Flats.

1) Freshwater Tidal Wetlands express a hydrologic regime and hydrodynamics regulated by the ebb and flow of the diurnal tides inland of the Georgia coastline. Specifically, these Freshwater Tidal Wetlands are located in the eleven coastal counties (Brantley, Bryan, Camden, Charlton, Chatham, Effingham, Glynn, Liberty, Long, McIntosh, and Wayne) and in a landscape position adjacent to rivers, streams/creeks, and ditches that are subject to the influence of the tide. Further, these resources exhibit very low substrate salinities as compared to Saltwater Tidal Wetlands, and are subsequently not dominated by salt-tolerant vegetation species typically associated with coastal marshlands.

2) Saltwater Tidal Wetlands express a hydrologic regime and hydrodynamics regulated by the ebb and flow of the diurnal tides along the Georgia coastline. Specifically, these Saltwater Tidal Wetlands are located in six of the eleven coastal counties (Bryan, Camden, Chatham, Glynn, Liberty, and McIntosh) and located in a landscape position adjacent to rivers, streams/creeks, ditches, and/or the Atlantic Ocean that are subject to the influence of the tide (i.e., lying within a tide-elevation range from 5.6 feet above mean tide level and below).

Further, these resources exhibit higher substrate salinities than Freshwater Tidal Wetlands and are typically dominated by one or more salt tolerant vegetative species (as codified in Official Code of Georgia Annotated 12-5-282).

3) Riverine and Lacustrine Fringe Wetlands are wetlands located in a landscape position directly adjacent to rivers and streams, or their impoundments, respectively. The hydrologic regime of Riverine Wetlands is dominated by the frequency and duration of overbank flooding events from the adjacent tributary system. However, not all wetlands located adjacent to rivers or streams are necessarily "Riverine" wetlands, as the hydroperiod of Slope Wetlands adjacent to small, headwater streams (i.e., 1st and 2nd order streams) is not dominated by the frequency and duration of overbank flood events. The hydrologic regime of Lacustrine Fringe Wetlands is regulated by the water level in the adjacent impoundment. The impoundment itself maintains elevated water table levels in fringe wetlands, and additional water sources may include periodic inundation by surface water as the impoundment itself expands or recedes due to variations in rainfall, tributary inflow, etc. The dominant hydrodynamics of Riverine Wetlands is uni-directional and horizontal, largely consistent with the valley gradient. By comparison, the dominant hydrodynamics of Lacustrine Fringe wetlands is also horizontal, but is bi-directional, as the water moves into and out of the wetland with the rise and fall of the lake levels, and under influence of wind generated lake seiches (i.e., standing wave).

4) Slope Wetlands are those wetlands typically located in a landscape position at the foot slope and toe slope of the valley. The hydrologic regime of Slope Wetlands is predominantly regulated by hill slope movement and discharge of groundwater, and is supplemented by direct precipitation. The dominant hydrodynamics of this wetland type is horizontally uni-directional, as water flows along a hydraulic gradient. For the purposes of assessing wetland adverse impacts, Slope Wetlands will include those wetlands at the head of small streams, including areas up-gradient of distinct channel formation through 2nd order stream reaches (Wilder et al., 2013). The determination of stream order will follow the Modified Strahler[3] Stream Order[4] value provided in the Watershed Report Tool for stream reaches identified in the USEPA Waters GeoViewer Application (please refer to the following website: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=ada349b90c26496ea52aab66a092593b).

[3] Refer to Strahler, A. N., 1952. Hypsometric (area-altitude) analysis of erosional topography. Bulletin Geological Society of America. 63: 1117-1142.

[4] Refer to McKay, L., Bondelid, T., Dewald, T., Johnston, J., Moore, R., and Rea, A., "NHDPlus Version 2: User Guide", 2012.

5) Depressional/Flat Wetlands are those wetlands located in a closed depression or on a flat landscape, respectively. The hydrologic regime of these wetlands is predominately dependent on precipitation inputs, but depressional wetlands may also have a secondary groundwater component. The dominant hydrodynamics of these wetlands are vertical, as water enters these wetlands through precipitation events and exits via groundwater recharge and evapotranspiration.

5.3. Stream Credit Types: Stream credit types are based on the association of flow regime and landscape position. The following list of stream credit types will be utilized in the assessment of both impacts and compensation within the Savannah District: 1) Intermittent and Ephemeral Streams[5]; 2) Perennial Streams (less than three (3) square mile watersheds); 3) Perennial Streams (greater than three (3) square mile watersheds).

1) Intermittent and Ephemeral Streams are those tributaries that are located in very small catchments (i.e., usually less than 100 acres in size). Intermittent streams exhibit base flow during a portion of the year under the range of normal climatic conditions[6], while ephemeral streams exhibit surface water flows during and shortly after storm events.

2) Perennial Streams (less than 3 square mile watersheds) are those tributaries located in small to medium-sized catchments that, under the range of normal climatic conditions, exhibit continuous base flow throughout the year.

3) Perennial Streams (greater than 3 square mile watersheds) are those tributaries located in medium to large catchments that, under the range of normal climatic conditions, exhibit continuous base flow throughout the year.

5.4. Open Waters, Ditches, and Canals: For aquatic resources whose only function is to move water from one point to another and that function is not adversely impacted, compensation is generally not required. However, the Open Waters, Ditches, and Canals Classification is provided to address authorized impacts that adversely affect functions performed by these aquatic resources. For the purposes of this 2018 SOP, impacts to Open Waters, Ditches, and Canals may be assessed as an impaired wetland and/or stream credit type on a case-by-case basis, in consultation with the Savannah District.

---

[5] The Savannah District does not currently consider the geomorphic restoration of ephemeral streams to be ecologically appropriate.

[6] The applicable WETS table and local precipitation record will be used to determine if a project site is under normal climatic conditions. Normal climatic conditions are defined as a range, 30 to 70 percent probability, of an amount of precipitation that could occur for each month of the year. The normal range is established through the statistical ranking of the precipitation record for 30 year period. At the discretion of the Savannah District, the Direct Antecedent Rainfall Evaluation Methodology (DAREM) may also be utilized to further assess the status of climatic conditions for a project site.

5.5. Out-Of-Kind Replacement: If in-kind replacement is unavailable at the time compensation is required, the Savannah District will determine if another resource credit type is appropriate. In these circumstances, applicants may be required to provide compensation at a higher ratio (1.25:1 ratio) than in-kind credit purchases (refer to 33 CFR 332.3(e) and (f)). However, stream credit types will not be approved for the compensation of wetland impacts, and wetlands credit types will not be approved for the compensation of stream impacts.

5.6. Grandfathered Credits: The Savannah District mitigation program has historically operated using two (2) generic credit types: stream credits and wetland credits. Since promulgation of the 2008 Rule, the Savannah District has recognized the need to diversify mitigation credit types based on aquatic resource classification to ensure compensatory mitigation is providing in-kind functional replacement. In the sections above, we define new mitigation credit types based on aquatic resource classifications to assist in no net loss of in-kind aquatic resources. However, there are large inventories of existing mitigation credits currently available for sale in the mitigation marketplace in Georgia. As a result, the Savannah District has developed the following guidelines regarding the applicability of these credits as compensation for aquatic resource impacts.

As of the effective date of this SOP, all existing, generic credits that have been authorized as part of an approved mitigation instrument (i.e., mitigation bank instruments and/or In-Lieu-Fee mitigation projects) will be considered "grandfathered credits". Any grandfathered credits proposed as compensatory mitigation will continue to provide valid, in-kind compensation (e.g., generic wetland credits for slope wetland impacts) and be sold in accordance with the terms and conditions associated with the approved mitigation instrument and any applicable instrument modifications.

The only exception to this grandfathered credit status will be for Saltwater and Freshwater Tidal Wetland credits in coastal areas (see Section 5.6.1 below). Once the required credits are calculated using the 2018 SOP, an equivalent number of grandfathered credits will be determined through the application of a conversion factor. The conversion factor has been set to eight (8) credits per acre for wetland adverse impacts, and twelve (12) credits per linear foot for stream adverse impacts. These conversion factors are based on the results of research on compensatory mitigation in Georgia conducted by the University of Georgia, River Basin Center[7] and the Savannah District's internal review of the adverse impact and restoration/enhancement mitigation factors in the Wetland and Open Waters Worksheets of the 2004 SOP.

[7] University of Georgia, River Basin Center. 2017. "No Net Loss In The U.S. Army Corps Savannah District,"

5.6.1. Grandfathered Credits in Coastal Areas: Grandfathered wetland credits servicing any portion of Georgia's eleven coastal counties (Brantley, Bryan, Camden, Charlton, Chatham, Effingham, Glynn, Liberty, Long, McIntosh, and Wayne) shall be considered out-of-kind for impacts to Saltwater and Freshwater Tidal Wetlands. Exceptions will be granted if Grandfathered Credits were generated from Saltwater Tidal Wetland or Freshwater Tidal Wetland areas that meet the respective resource definitions outlined in this 2018 SOP, or a provision in the approved banking instrument for a bank where Grandfathered Credits were generated, establishes intent to compensate for Saltwater or Freshwater Tidal Wetland impacts.

6.0. AQUATIC RESOURCE ASSESSMENTS FOR ADVERSE IMPACTS

6.1. Qualitative Resource Assessments for Adverse Impacts: The Savannah District has developed qualitative assessments to establish the existing qualitative functional capacity score of wetlands and streams proposed for all permitted impacts (including General and Standard Permits). For each of the following qualitative assessments, the Savannah District developed a dichotomous questionnaire (i.e., Yes/No) to categorize the function/condition of a wetland or stream. These responses are then converted into a categorical score (i.e., High, Moderate, Low) for each of the functions listed below. Each of the questions related to a function is equally weighted in the assessment, as is each of the functions. The following qualitative assessment methodologies will be utilized to establish the existing function/condition score:

6.1.1. Freshwater Wetland Qualitative Assessment: The framework of the wetland qualitative assessment is based on the functions outlined in "A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Forested Wetlands in Alluvial Valleys of the Coastal Plain of the Southeastern United States" (Wilder et al., 2013). Specifically, this qualitative assessment focuses on the following list of functions: 1) Water Storage; 2) Biogeochemical Transformation; 3) Maintain Wetland Vegetative Community; and, 4) Maintain Wetland Faunal Community. The total Freshwater Wetland Qualitative Functional Capacity Score is a result of the following basic composite functional attribute score combinations:

- "High" (H) function (e.g., H-H-H-H; H-H-H-M; H-H-H-L; H-H-M-M);
- "Moderate" (M) function (e.g., H-H-L-L; H-M-M-M; M-M-M-M; M-M-M-L; M-M-L-L);
- "Low" (L) function (e.g., H-L-L-L, M-L-L-L; L-L-L-L).

The Freshwater Wetland Qualitative Functional Capacity Score is then utilized in the Qualitative Worksheet for Wetland Adverse Impacts. See description below in Section 7.1.1 to determine the mitigation requirement for a given wetland impact. Refer to Appendix 11.7 for the Freshwater Wetland Qualitative Assessment Worksheets.

6.1.2. Saltwater Wetland Qualitative Assessment: The framework of the Saltwater Tidal Wetland Qualitative Assessment is based on the functions outlined in "A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing the Functions of Tidal Fringe Wetlands Along the Mississippi and Alabama Gulf Coast" (Shafer et al., 2007). Specifically, this qualitative assessment focuses on the following list of functions: 1) Wave Energy Attenuation; 2) Biogeochemical Cycling; 3) Nekton Habitat Utilization; 4) Marsh-Dependent Wildlife Habitat; and 5) Plant Community Structure and Composition. The total Saltwater Wetland Qualitative Functional Capacity Score is a result of the following basic composite functional attribute score combinations:

- "High" function (e.g., H-H-H-H-H; H-H-H-H-M; H-H-H-H-L; H-H-H-M-M);
- "Moderate" function (e.g., H-H-H-L-L; H-H-M-M-M; H-H-L-L-L; H-M-M-M-M; M-M-M-M-M; M-M-M-M-L; M-M-M-L-L);
- "Low" function (e.g., H-L-L-L-L, M-M-L-L-L; M-L-L-L-L; L-L-L-L-L).

The Saltwater Wetland Qualitative Functional Capacity Score is then utilized within the Qualitative Worksheet for Wetland Adverse Impacts. See equation below in Section 7.2.1 to determine the mitigation requirement for a given wetland impact. Refer to Appendix 11.8 for the Saltwater Wetland Qualitative Assessment Worksheet.

6.1.3. Stream Qualitative Assessment: The framework of the stream qualitative assessment is based upon the functions outlined by Fischenich (2006), "Functional Objectives for Stream Restoration" and Harman et al. (2012), "A Function-Based Framework for Stream Assessment and Restoration Projects". Specifically, this qualitative assessment focuses on the following list of functions: 1) Hydrology; 2) Hydraulics; 3) Geomorphology; 4) Physio-chemistry; and 5) Biology. The total Stream Qualitative Functional Capacity Score is a result of the following basic composite functional attribute score combinations:

- "High" function (e.g., H-H-H-H-H; H-H-H-H-M; H-H-H-H-L; H-H-H-M-M);
- "Moderate" function (e.g., H-H-H-L-L; H-H-M-M-M; H-H-L-L-L; H-M-M-M-M; M-M-M-M-M; M-M-M-M-L; M-M-M-L-L);
- "Low" function (e.g., H-L-L-L-L, M-M-L-L-L; M-L-L-L-L; L-L-L-L-L).

This Stream Qualitative Functional Capacity Score is then utilized within the Qualitative Worksheet for Stream Adverse Impacts. See description below in Section 7.2.2 to determine the mitigation requirement for a given stream impact. Refer to Appendix 11.9 for the Stream Qualitative Assessment Worksheets.

6.2. Quantitative Resource Assessments For Adverse Impacts: The District Engineer (DE), and/or his/her designee, may utilize quantitative functional assessments (e.g., Hydrogeomorphic Methodologies (HGM), Stream Quantification Tools (SQT), etc.) to determine the appropriate amount of compensatory mitigation for a given impact, at his/her discretion. If the use of a quantitative functional assessments is not initiated by the DE or their designee, then applicants will use a qualitative assessment (described above in Sections 6.1.1 through 6.1.3) to determine the type and amount of compensatory mitigation required for a project impact.

7.0. ADVERSE IMPACT CALCULATIONS

7.1. Adverse Impact Worksheet Definitions: Key terms applicable to the Wetland & Stream Qualitative and Quantitative Adverse Impacts worksheets are defined below. These worksheets are intended to support clear and consistent methodologies for impact credit calculations. Each worksheet has been developed with drop-down lists, text hover tips, and input validation rules to assist the user with the completion of the worksheets.

Clearing and Grubbing is defined as a mechanized land clearing practice in which natural vegetation (i.e., trees, shrubs/sapling, woody vines, and herbs), roots, and woody debris are removed from the wetland. This activity also includes the displacement of surface soil horizons within the wetland associated with the use of a root rake or similar device used to remove rooted vegetation.

Conversion of Kind is defined as converting tidal wetlands to non-tidal wetlands, or non-tidal wetlands to tidal wetlands, when the conversion is directly associated with a discharge of dredge and/or fill material (e.g., converting Saltwater Tidal Wetlands to freshwater wetlands by installing a tide gate).

Duration refers to the temporal loss of wetland/stream functions associated with length of time during which an impact (primary or secondary impact) persists. The categories for the duration factor are as follows: 1) **Permanent/Reoccurring**[8] is defined as persisting greater than or equal to one year (i.e., 365 days); 2) **Short-Term – Less than 1 Year** is defined as persisting less than one year (i.e., less than 365 days, but greater than 90 days); 3) **Temporary – Less than (or equal to) 90 days** is defined as persisting 90 days or less.

Hydrologic Alteration - Drain is defined as an impairment which results in the reduction of the hydro-period of a wetland, when associated with a discharge of dredge or fill material. This factor includes extensively changing the duration, degree, and/or frequency of the wetland's hydro-period.

Hydrologic Alteration - Impound is defined as the detention or retention of surface hydrology in a wetland and/or stream through the construction of a dam, weir, levee, or other man made structure or activity.

[8] The temporal assessment of reoccurring impacts is not limited to consecutive days.

Primary Adverse Impacts refers to the list of impact categories that are associated with the adverse modification of wetlands, streams, and/or open waters. Specifically, primary impacts are those impacts that are associated with discharge of dredged or fill material as regulated under Section 404 of the CWA. The list of Primary Adverse Impacts for Wetlands includes the following: 1) Discharge of Dredge Material; 2) Discharge of Fill; and, 3) Clearing and Grubbing. The list of Primary Adverse Impacts for Streams include the following: 1) Discharge of Fill; and 2) Primary Morphological Change.

Primary Morphological Alteration is defined as the hardening of the banks of the stream (either one or both), and/or the construction of perpendicular at-grade rock fords across the stream bed. Examples of hard engineering include placement of rip-rap, gabions, concrete structures, sheet-piles, or other hardening structures below the ordinary high water mark along the banks or bed of the stream. This does not include constructed riffles or instream structures incorporated as bed form and grade control features in natural channel restoration designs.

Secondary Adverse Impacts refers to the list of impact categories that are associated with the adverse modification of wetlands, streams, and/or open waters, which result from a discharge of dredged or fill material as regulated under Section 404 of the CWA. In accordance with the National Environmental Policy Act, the Savannah District will assess all reasonably foreseeable impacts to waters of the United States which fall within the Federal Scope of Analysis for a Section 404 Permit. The list of Secondary Adverse Impacts for Wetlands includes the following: 1) Hydrologic Alteration – Drain; 2) Hydrologic Alteration – Impound; 3) Conversion of Kind; and, 4) Vegetative Conversion. The list of Secondary Adverse Impacts for Streams includes the following: 1) Hydrologic Alteration - Impound; and 2) Secondary Morphological Alteration.

Secondary Morphological Alteration is defined as a reasonably foreseeable, functionally adverse change in the stream bed and/or banks as a result of an upstream or downstream primary adverse impact. Secondary morphological alterations may include changes in the stream bed and/or banks that result in losses of longitudinal habitat diversity (e.g., filling of pools, headcut migration through riffles), losses of the existing percentages of aquatic habitat (e.g., % of riffles and pools), loss of stream bank stability (e.g., increased Bank Erosion Hazard Index values), and loss of floodplain connectivity (e.g., increased Bank Height Ratio and/or decreased Entrenchment Ratio).

Stream Qualitative Functional Capacity Score (SQFC Score) refers to the existing, pre-impact stream function score, as determined using the Stream Qualitative Assessment Worksheet.

Stream Qualitative Functional Capacity Impact (SQFC Impact) refers to the product of the SQFC score and Type of Impact, as determined using the Qualitative Worksheet for Stream Adverse Impacts.

Total Stream Qualitative Functional Capacity Impact (Total SQFC Impact) refers to the product of the SQFC Impact and Duration, as determined using the Qualitative Worksheet for Stream Adverse Impacts.

Total Wetland Qualitative Functional Capacity Impact (Total WQFC Impact) refers to the product value of the Wetland Qualitative Function Capacity Impact and Duration, as determined using the Qualitative Worksheet for Wetland Adverse Impacts.

Type of Impact refers to the characterization of the impact. Specifically, the impact will be categorized as either a primary adverse impact or secondary adverse impact.

Vegetative Conversion is defined as associated clearing of the natural, forested vegetative community within a wetland, in conjunction with but outside of the limits of a discharge of dredge or fill material. This activity is limited to cutting vegetation at an elevation above the soil surface within wetlands, and does not include soil displacement (i.e., grubbing, and/or mechanized land clearing).

Wetland Qualitative Functional Capacity Score (WQFC Score) refers to the existing function score of a wetland prior to the impact, as determined using the Wetland Qualitative Assessment Worksheet.

Wetland Qualitative Functional Capacity Impact (WQFC Impact) refers to the product of the Wetland Qualitative Function Capacity Score and Type of Impact, as determined using the Qualitative Worksheet for Wetland Adverse Impacts.

7.2. Qualitative Worksheets for Adverse Impacts: The Qualitative Worksheets for Adverse Impacts utilize the following factors: 1) Type of Impact; and, 2) Duration of Impact. For each of these factors, the Savannah District developed a series of index values, on a 0.00 to 1.00 scale, to quantify the functional/conditional loss of the aquatic resources (please refer to Appendices 11.10 and 11.11 for the indices of wetland and stream adverse impacts). In order to determine mitigation credits required, the Qualitative Worksheets for Wetland and Stream Adverse Impacts (please refer to Appendices 11.12 and 11.13) are calculated as follows:

7.2.1. Equations for Qualitative Worksheet for Wetland Adverse Impacts:

a. Equation 1: (WQFC Score)(Type of Impact) = WQFC Impact

b. Equation 2: (WQFC Impact)(Duration) = Total WQFC Impact

c. Equation 3: (Total WQFC Impact)(Acres) = Total Wetland Credits Owed

7.2.2. Equations for Qualitative Worksheet for Stream Adverse Impacts:

a. Equation 1: (SQFC Score)(Type of Impact) = SCFC Impact

b. Equation 2: (SQFC Impact)(Duration of Impact) = Total SQFC Impact

c. Equation 3: (Total SQFC Impact)(Linear Feet) = Total Stream Credits Owed*

**If the impact is incurred to an intermittent/ephemeral stream, the Total Stream Credits Owed are prorated to 60 percent of the total as these stream types inconsistently support the physio-chemical and biological functions of the Harman et al. (2012) Stream Pyramid Framework.*

8.0. MITIGATION ACTION CALCULATIONS

8.1. Quantitative Mitigation Assessments: Quantitative mitigation assessment methodologies are required to establish baseline functions for wetland and/or stream resources associated with mitigation projects. Quantitative assessment methodologies will be utilized to establish both the existing and proposed functional scores for each of the following aquatic resource types:

8.1.1. Georgia Interim Freshwater Wetland Hydrogeomorphic Methodology (GA HGM): For the assessment of all freshwater wetland resources proposed for mitigation credit generation, mitigation sponsors will utilize the GA HGM to establish baseline conditions, estimate the proposed conditions, and verify that the proposed conditions have been achieved. The GA HGM was developed through the selection of function-based parameters as outlined in Wilder et al. (2013). All parameters were selected based upon their anticipated sensitivity to a measurable net lift of functions resulting from restoration/enhancement actions as documented during the monitoring period. In addition to the parameters selected from Wilder et al. (2013), a soil saturation threshold parameter was developed to assess wetland hydrologic functions. The list of parameters selected as part of the GA HGM has been provided in Table 1. As a guiding principle for this assessment methodology, wetland credit generation associated with restoration or enhancement actions will be based on a calculation of the proposed net functional lift from baseline, existing conditions. Refer to Appendices 11.14. and 11.15. for GA HGM Workbook and User Manual.

8.1.2. Georgia Interim Saltwater Wetland Hydrogeomorphic Methodology: This assessment methodology will be provided at a future date. Appendices 11.16. and 11.17. are reserved for the Georgia Interim Saltwater Wetland HGM Workbook and User Manual.

8.1.3. Georgia Interim Stream Quantification Tool (GA SQT): For the assessment of all stream resources proposed for mitigation credit generation, mitigation sponsors will utilize the GA SQT to establish baseline conditions, estimate the proposed conditions, and verify that the proposed conditions have been achieved. The GA SQT was developed through the selection of function-based parameters as outlined in the Tennessee Stream Quantification Tool (TDEC, 2017), North Carolina Stream Quantification Tool (Harman et al., 2017), and Wyoming Stream Quantification Tool (USACE, 2017). All parameters were selected based upon their anticipated sensitivity to a measurable net lift of functions resulting from restoration/enhancement actions as documented during the monitoring period. In addition to the parameters selected from Tennessee Stream Quantification Tool, a series of macro-invertebrate parameters was developed to assess stream biological functions. The list of parameters selected as part of the GA SQT has been provided in Table 2. As a guiding principle for this assessment methodology, stream credit generation associated with restoration or enhancement actions will be based on a calculation of the net functional lift from baseline conditions. Refer to Appendices 11.18 and 11.19 for the GA SQT Wookbook and User Manual.

Table 1. Selected Function-Based Parameters for the Interim GA HGM

Functional Category	Function-Based Parameters	Measurement Method
Hydrology /Water Storage	Soil Saturation	Water Table Measurements (measurements every 8 hours)
Maintain Vegetative Community	Wetland Vegetation Composition	Vegetative Plots
	Wetland Vegetation Structure	Vegetative Plots
Biogeochemical Transformation/Maintain Faunal Habitat	Large Woody Debris (LWD)	Pieces of LWD
Biogeochemical Transformation/Maintain Faunal Habitat	Upland Buffers	Buffer Width and % Perimeter

Table 2. Selected Function-Based Parameters for the Interim GA SQT

Functional Category	Function-Based Parameters	Measurement Method
Hydraulics	Floodplain Connectivity	Bank Height Ratio
		Entrenchment Ratio
Geomorphology	Riparian Vegetation	Left Buffer Width (ft.)
		Right Buffer Width (ft.)
	Bed Form Characterization	Pool Spacing Ratio
		Percent Riffle
		LWD Index
Biology	Macros	Proportion EPT Taxa Richness
		Proportion Clinger Taxa Richness
		Proportion Shredder Taxa Richness
		Proportion Burrower Taxa Richness

8.2. Preservation: If wetlands and/or streams are proposed for preservation, those resources must meet the preservation criteria outlined in the Rule. All proposed wetland and stream preservation must be supported with a Quantitative Mitigation Assessment to establish the existing functional capacity score. If the Savannah District determines the proposed preservation resource to be appropriate as mitigation, the mitigation credit for that resource will be limited to no more than 20 percent of the total potential functional capacity score.

9.0. SUPPORTING DOCUMENTATION

Each respective Adverse Impact and Mitigation Action worksheet must also be supported with the following information: 1) appropriate identification of the project location (vicinity and location maps); 2) a scaled figure defining the full extent of the subject aquatic resource impacts and/or mitigation activities on the project site; and 3) a copy of the completed assessment form, including the associated field assessments and raw data used to calculate the functional capacity (for both impacts and mitigation) of the aquatic resource. At the discretion of the Savannah District, additional documentation and/or site investigations associated with any wetland and/or stream adverse impact and/or mitigation assessment may be requested on a case-by-case basis.

10.0. LITERATURE REFERENCES

Brinson, M. M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4. US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Fischenich, J. C. 2006. Functional Objectives for Stream Restoration. Ecosystem Management and Restoration Research Program Report EMRRP-SR-52. U.S. Army Engineers Research and Development Center, Vicksburg, MS.

Harman, W., Starr, R., Carter, M., Tweedy, K., Suggs, K., and Miller, C. 2012. A Function-Based Framework for Stream Assessment and Restoration Projects. US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, D.C., EPA 843-K-12-006.

Harman, W.A. and C.J. Jones. 2017. North Carolina Stream Quantification Tool: Data Collection and Analysis Manual, NC SQT v3.0. Environmental Defense Fund, Raleigh, NC.

Hill, K., Skaggs, J.W., Jones, H., and Elkins, D. 2017. No Net Loss In The U.S. Army Corps Savannah District. University of Georgia, River Basin Center, Athens, GA.

Shafer, D. J., Roberts T. H., Peterson, M. S., and Schmid, K. 2007. A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing the Functions of Tidal Fringe Wetlands Along the Mississippi and Alabama Gulf Coast, ERDC/EL TR-07-2. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Smith, R. D., Ammann, A., Bartoldus, C., and Brinson, M. M. (1995). An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP-DE-9. U.S. Army Engineers, Waterways Experiment Station, Vicksburg, MS.

Strahler, A. N., 1952. Hypsometric (area-altitude) analysis of erosional topography. Bulletin Geological Society of America. 63: 1117-1142.

TDEC. 2017. Tennessee Stream Quantification Tool: Data Collection and Analysis Manual, TN SQT v1.0. Tennessee Department of Environment and Conservation, Nashville, TN.

Wilder, T. C., Rheinhardt, R. D. and Noble, C. V. 2013. A regional guidebook for applying the Hydrogeomorphic Approach to assessing wetland functions of forested wetlands in alluvial valleys of the coastal Plain of the southeastern United States. Technical Report ERDC/EL TR-13-1. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

U.S. Army Corps of Engineers. 2017. Wyoming Stream Quantification Tool (WSQT) User Manual and Spreadsheet. Beta Version.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. 2008. Wetlands Compensatory Mitigation Rule Factsheet.

Appendix 11.1. Guidelines to Evaluate Proposed Mitigation Bank Credit Purchases

SAVANNAH DISTRICT, US ARMY CORPS OF ENGINEERS, REGULATORY GUIDELINES TO EVALUATE PROPOSED MITIGATION BANK CREDIT PURCHASES IN THE STATE OF GEORGIA

Photo courtesy of:
Murphy B. Winn, retired
US Army Corps of Engineers

This document was prepared by the Regulatory Division, Savannah District, US Army Corps of Engineers, and coordinated with the US Environmental Protection Agency, US Fish and Wildlife Service, and Georgia Department of Natural Resources

SAVANNAH DISTRICT, US ARMY CORPS OF ENGINEERS, REGULATORY GUIDELINES TO EVALUATE PROPOSED MITIGATION BANK CREDIT PURCHASES IN THE STATE OF GEORGIA

I. SUBJECT

Guidance for selecting a mitigation bank that would adequately compensate for aquatic resource losses, as authorized in a Department of the Army (DA) permit in accordance with section 404 of the Clean Water Act (CWA) and/or sections 9 or 10 of the Rivers and Harbors Act (RHA) of 1899.

II. PURPOSE

The purpose of this document is two fold:

- It provides recommendations to aid permittee, their agent, and other interested parties when selecting credits at a previously approved US Army Corps of Engineers, Savannah District, Regulatory Division (herein after referenced as USACE) mitigation bank(s) to compensate for aquatic resource losses associated with an approved DA permit, as in accordance with the Final Mitigation Rule (hereinafter referred to as The Rule), dated April 10, 2008.

- It provides recommendations to aid USACE regulatory project manager/specialist (PM/S) when determining if proposed bank credits are available and appropriate to compensate for aquatic resource losses permitted in a DA permit.

III. APPLICABILITY

This document should be used as a reference when selecting a mitigation bank to compensate for USACE-approved aquatic resource losses in the State of Georgia.

The provisions provided herein have been developed to provide clarity for selecting a mitigation bank in the State of Georgia:

- Potential banks that have been submitted to the USACE after the effective date of this document shall be evaluated for availability and appropriateness in accordance with the 8-digit Hydrologic Unit Code (HUC) approach outlined herein.

- USACE-approved banks that have been signed by the Chief, Regulatory Division (or designated appointee) prior to the effective date of this document shall be evaluated for availability and appropriateness in accordance with the conditions presented in the Banking Instrument (BI)[1] and the approach outlined herein. Specific examples where a BI governs is as follows:

- o Where primary service areas have been established in the BI that differ from the boundaries posted at: http://www.sas.usace.army.mil/MBSA.htm, the boundaries presented in the BI shall be used for the analysis of that bank. Furthermore, where a Primary Service Area (PSA) contains more than one digit 8-digit HUC, the 8-digit HUC analysis discussed later in this document does not apply to a bank that was submitted prior to the effective date of this document. If the bank is included within the PSA of the impact area and the bank has appropriate credits available, credits may be purchased from the "grandfathered" bank to offset the permitted impacts.

- o Where aquatic resources are generally classified as a stream or wetland resource category, that category may be considered appropriate in the analysis for compensation of such resources, respectively.

The provisions provided herein have been developed to be in accordance with the requirements in The Rule, dated April 10, 2008 ((33 CFR Part 332) and (40 CFR Part 230)). Of particular importance is the recognition that the purpose of mitigation bank credits is to compensate for aquatic resource functions and services lost or impacted from an USACE authorized project.

The recommendations presented herein do not:

- Alter the regulations or circumstances under which compensatory mitigation may be required;

- Address in-lieu-fee or site specific mitigation requirements; or

- Alter provisions provided in the CWA or RHA.

[1]It is the responsibility of the applicant and potential banker to provide necessary information documenting deviations from the guidelines presented herein. Without proper documentation, banks may not be "grandfathered" under this clause.

IV. BANK AND CREDIT SOURCE SELECTION PROCESSES

1. Background

The Rule requires that a watershed approach be taken when using mitigation bank credits to fulfill compensatory mitigation requirements, and it requires the USACE to approve the bank selected as the source of such credits.

As stipulated in The Rule, a watershed approach to compensatory mitigation should take into account:

- Baseline Ecological Conditions, including, for example:
  - Historic and existing plant communities
  - Soil conditions
  - Aquatic resource delineations
  - Compensation credits[2]

- Landscape position
  - Distance between impact site and proposed mitigation bank
  - Type of aquatic resource at impact site and proposed mitigation bank
    - Stream order types/differences (e.g., ephemeral, intermittent and/or perennial)
    - Wetland type and relationship with other aquatic resources in area

- Aquatic resource functions
  - Impact site losses
  - Bank resource objectives and functions
  - Comparative site analysis: impact losses versus bank gains
    - Streams: chemical, biological, physical functions
    - Wetlands: ecological and physical functions

Where practicable, the suite of aquatic functions to be lost at the impact site should be compensated at the proposed mitigation bank(s).

To aid applicants in their selection of an appropriate credit source, a fact sheet has been solicited from all approved banks. Information includes, for example, primary/secondary service areas, HUCs, and habitat categories. It is recommended that this information be used to support the findings: does the proposed compensatory mitigation bank fulfill the compensation requirements of the DA permit in light of the watershed approach, in-kind replacement of lost functions and services, and proximity to the impacts? Fact sheets can be found at: http://www.sas.usace.army.mil/Banking.htm or information can be requested from the USACE Project Manager/Regulatory Specialist (PM/S).

---

[2]Compensation credits shall be generated using the Savannah District Mitigation SOP, as amended, unless otherwise approved by the USACE. Additionally, compensation credit calculations will need to be verified by the USACE.

The applicant must include the information necessary to verify that the proposed bank credits adequately compensate for aquatic resource functional losses based on a watershed analysis. The USACE role is to evaluate the proposed mitigation strategy for its appropriateness in compensating for lost aquatic resource functions, as authorized in the subject DA permit. If the choice of a particular mitigation bank does not adequately compensate for the aquatic resources to be lost, the PM/S will provide comments to the applicant, identifying the concerns and requesting additional information to support recommendation(s).

2. Procedural Steps

As noted in The Rule, the USACE must provide a final concurrence letter/e-mail transmission stating that the submitted proposal is an acceptable approach for compensating for impacts permitted in a specific DA authorization.

We recommend that the following analysis/recommendation be provided to the USACE when the permit application is submitted. Note that the permittee should not purchase bank credits until the USACE has provided concurrence with all recommendations. If not, the credits may not be applied for use.

The process is as follows:

a. PSA[3] Analysis:

(1) The applicant shall:

(a) Identify PSA and 8-digit HUC of proposed impact area.

(b) Identify functional resource losses and credits needed for compensation.[4]

(c) Identify names and locations of banks in PSA by 8-digit HUC. In matrix format, present approximate distances to impact area and credit types (wetland and/or stream) available for sale at each bank.

(d) Determine if appropriate (i.e., stream and/or wetland credits) credits exist in PSA, based on a watershed approach, and identify which bank(s) could fulfill compensatory mitigation requirements permitted in the DA authorization. The level of

[3] The US Geological Survey (USGS) has established 52 watersheds based on the 8-digit Hydrologic Unit Codes (HUC) within the state boundary of Georgia. In Georgia, these HUCs were reviewed by the IRT and used, in part, to establish standardized service areas. These service areas were developed to compensate lost aquatic functions associated with permitted impacts to waters to the US within a consistent geographical area where aquatic resources are similar in kind and function. The Savannah District issued a PN, dated March 2004, informing the public of the above service area procedures.

[4] See Footnote #2 above.

information and analysis needed to support a watershed approach shall be commensurate with the scope and scale of the proposed impacts requiring a DA permit, as well as the functional losses to result.

i. For impacts that are within the thresholds of a Nationwide Permit (NWP), any mitigation bank may be used for the replacement of credits providing the resource functional replacements are the same (i.e., freshwater for freshwater, estuarine for estuarine, and marine for marine) and the bank is located within the same PSA as is the proposed impacts. Examples are provided in the attached Supplement.

ii. For impacts exceeding the thresholds of a NWP, a watershed analysis shall be conducted to support final applicant recommendations. Preference shall be given first where similar resources (or habitats) occur in the same 8-digit HUC versus those occurring outside the HUC, but within the same PSA. Examples are provided in the attached Supplement. Note that bank credit recommendations shall be based on functional resource replacements as well as overall landscape position.

(e) Identify if credits from above analysis are available:

i. Verbal or written communication with the Point of Contact (POC) for each of the banks identified above via face to face or telephone communication. POC contact information is available at: http://www.sas.usace.army.mil/bankPOCs.xls.

ii. Document (date and time) when communication was completed and with whom you spoke (include telephone number).

iii. Ask bank's POC if type of credits required are available. If the needed credits are not available at the time of the communication, ask if there are credits expected to be available in the near future. (i.e., before work is to be initiated, as described in DA permit). Document responses.

(f) Provide final recommendations and supporting documentation on availability and appropriateness of bank credit proposal to USACE PM/S who is assigned to subject permit application.

(2) The USACE PM/S shall review and provide a final determination stating if submitted recommendations are appropriate. Notification may be in the form of a letter or an e-mail transmission.[5]

(a) If credits are determined not appropriate, the applicant must adequately address the USACE concerns, resubmit recommendations/supporting justification, and re-request USACE determination.

(b) If credits are determined appropriate, the applicant may purchase and secure said mitigation bank credits, if available.[6]

If it is determined that appropriate replacement credits are not available within the PSA of the permitted impact area, the scope of analysis may be expanded to include the Secondary Service Area (SSA). Note that it is the applicant's responsibility to investigate the availability and appropriateness of all bank credits within the applicable PSA before considering those available in a SSA.

b. 12-Digit HUC PSA Analysis (Optional):

(1) The applicant shall:

(a) Identify PSA, 8-digit HUC, and 12-digit HUC of proposed impact area.

(b) Identify functional resource losses and credits needed for compensation.[7]

(c) Identify names and locations of banks in PSA by 12-digit HUC. In matrix format, present approximate distances to

[5]For Individual Permits, the PM/S review period begins at the end of the 30-day Joint Public Notice Comment Period. If the PM/S has not acted (or requested additional information in writing/e-mail) on a mitigation proposal within 30-days of the close of the JPN comment period, the request should be forwarded to the Mitigation Liaison Specialist. If additional information has been requested and another 30-days has passed since the new information has been submitted to the Regulatory PM/S, the request should be forwarded to the Mitigation Liaison Specialist. If Mitigation Liaison Specialist has not acted on a request within 60-days of receipt of the request, the request should be forwarded to the Savannah District, Regulatory Chief.
[6]Recommend securing credits after the permit decision has been made. If credits are secured prior to a permit decision, securing of such credits will not influence permit decision.
[7]See Footnote #1 above.

impact area and credit types (wetland and/or stream) available for sale at each bank.

(d) Determine if appropriate (i.e., stream and/or wetland credits) credits exist in PSA, based on a watershed approach, and identify which bank(s) could fulfill compensatory mitigation requirements permitted in the DA authorization.

(e) Identify if credits from above analysis are available (see process step a(1)(e) above.

(f) Provide final recommendations and supporting documentation on availability and appropriateness of bank credit proposal to USACE PM/S who is assigned to subject permit application.

(2) The USACE PM/S shall review and provide a final determination stating if submitted recommendations are appropriate. Notification may be in the form of a letter or an e-mail transmission.[8]

(a) If credits are determined not appropriate, the applicant must adequately address the USACE concerns, resubmit recommendations/supporting justification, and re-request USACE determination.

(b) If credits are determined appropriate, the applicant may purchase and secure said mitigation bank credits, if available.[9]

As the Rule indicates that a Watershed Approach should be used to support the decision-making process and distance between the impact site and the proposed bank site is recognized as a factor in the overall equation, the USACE will reduce the credit needs by 10% when the applicant purchases credits deemed appropriate from the 12-digit impact HUC.

c. SSA Analysis: After the USACE concurs that appropriate replacement credits are not available within the PSA of the permitted impact area; the following steps <u>must</u> be completed to determine if potential credits exist in the SSA:

(1) This applicant shall:

(a) Provide documentation from above analysis demonstrating that credits are not available and/or appropriate to replace subject impacts from banks within PSA.

---

[8]See Footnote # 4 above
[9]See Footnote #5 above.

(b) Provide SSA analysis similar to that conducted above for a PSA (see Section 2.a.1).

(c) Provide final recommendations and supporting documentation on availability and appropriateness of bank credit proposal to USACE PM/S who is assigned to subject permit application.

(2) The USACE PM/S shall review and provide final determination stating if submitted recommendations are appropriate. Notification may be in the form of a letter or an e-mail transmission.[10]

(a) If credits are determined not appropriate, the applicant must adequately address the USACE concerns, resubmit recommendations/supporting justification and re-request USACE determination.

(b) If credits are determined appropriate, the applicant may purchase and secure said mitigation bank credits, if available.[11]

Note that if credits are available and determined appropriate in the PSA, those credits must be used before considering potential credits in a SSA. **It is the applicant's responsibility to investigate the availability of bank credits from the applicable service areas.** The SSA is restricted to use for projects where it has been clearly <u>demonstrated</u> that appropriate credits are not currently available and are not reasonably anticipated to be available in the near future in the PSA of the permitted impact area. Each USACE decision shall be based on a case-by-case review of the facts presented by the applicant when making the final determination. **Compensation at a mitigation bank for impacts at a site that is not within either the primary or secondary service area is not acceptable, unless approved by the entire IRT.**

3. Process Summary

The applicant must provide the information necessary for the USACE to verify that proposed bank credits adequately compensate for aquatic resource functional losses based on a watershed analysis, as authorized in a DA permit. In summary:

- Replacement credits should be obtained from a mitigation bank whose Primary Service Area (PSA) encompasses the impact area, if available and appropriate.
    - If appropriate credits are obtained from a bank whose PSA includes the impact area, and is also located within the 12-digit impact HUC in which the impact area is located, the USACE will reduce the overall credit need to mitigate for the impact by 10%.

[10] See Footnote #4 above.
[11] See Footnote #5 above.

- For banks that were not submitted to the USACE prior to the effective date of the guidance document, and if there are multiple 8-digit HUCs within the PSA, credits should be obtained from a mitigation bank within the 8-digit HUC in which the impact occurred, if available and appropriate. If appropriate credits are not available from a mitigation bank within the impact HUC, replacement credits may be obtained elsewhere in the approved PSA, if appropriate and available.

- For grandfathered banks, the analysis may be fulfilled by assessing those banks that have available and appropriate credits within the PSA, as approved in the signed Banking Instrument.

- If appropriate credits are not available in the PSA, replacement credits may be obtained from the Secondary Service Area (SSA).

- Compensation for impacts at a site that is not within either the PSA or SSA of an approved mitigation bank is not acceptable, unless approved by the Interagency Review Team.

If the choice of a particular mitigation bank does not adequately compensate for the aquatic resources to be lost, the PM/S will provide comments to the applicant, identifying the concerns and requesting additional information to support recommendation(s).

If for any reason a modification to the originally approved source or amount of the required mitigation credits is proposed, another credit source approval review will need to be requested by the applicant.

All pertinent documentation and analyses for a given determination shall be adequately reflected in the record and clearly demonstrate the basis for the findings. Although the level of documentation may vary among projects, each USACE decision shall be based on a case-by-case review of the facts presented by the applicant when making the final determination.

Prior to the purchase of credits, the USACE must provide a final concurrence letter/e-mail transmission stating that the submitted proposal is an acceptable approach for compensating for aquatic resource impacts permitted in a specific DA authorization.

If you have comments or questions concerning this document, please contact Justin Hammonds, Mitigation Liaison Specialist, of the Regulatory Division, at (770) 904-2365.

V. DURATION

This guidance is effective immediately and remains in effect unless revised or rescinded.

SUPPLEMENT TO EVALUATE PROPOSED MITIGATION BANK CREDIT PURCHASES IN THE STATE OF GEORGIA

Example 1.

Case Facts: As authorized in a Nationwide Permit (NWP) and in accordance with the Savannah District's Mitigation Standard Operating Procedures (SOP), the project (*USACE File Number*) would need to obtain 1.5 wetland credits and 50 stream credits. This project is located in the Upper Blue River Basin Primary Service Area (PSA) and in the 30267001 8-digit Hydrologic Unit Code (HUC). There are 5 banks located in the PSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	PSA; 30267001	- -	1.5	
Stream	PSA; 30267001	- -	50	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Alpha Mitigation Bank				
Stream	PSA; 30267001	4 miles	Yes	
Bravo Mitigation Bank				
Stream	PSA; 30267001	2 miles	Yes	X
Freshwater Wetland	PSA; 30267001	2 miles	Yes	X
Charlie Mitigation Bank				
Stream	PSA; 30267002	10 miles	Unknown	
Freshwater Wetland	PSA; 30267002	10 miles	Unknown	
Delta Mitigation Bank				
Freshwater Wetland	PSA; 30267002	15 miles	Unknown	
Echo Mitigation Bank				
Freshwater Wetland	PSA; 30267002	50 miles	Unknown	
Stream	PSA; 30267002	50 miles	Unknown	

Applicant Recommendations: Proposes to purchase all credits from the Bravo Mitigation Bank. Banker POC indicated on 30 Sep 09 that sufficient credits were available to cover project needs.

USACE Determination: Concur with Applicant proposal.

Example 2.

Case Facts: As authorized in a NWP and in accordance with the SOP, the project (*USACE File Number*) would need to obtain 1.4 marine wetland credits. This project is located in the Lower Purple River Basin PSA and in the 80200456 8-digit HUC. There are 2 banks located in the PSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Marine Wetland	PSA; 80200456	- -	1.4	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
X-Ray Mitigation Bank				
Freshwater Wetland	PSA; 30267005	4 miles	Yes	X
Holiday Mitigation Bank				
Estuarine Wetland	PSA; 30267005	20 miles	Yes	

Applicant Recommendations: Proposes to purchase all credits from the X-Ray Mitigation Bank. Banker POC indicated on 13 Sep 09 that sufficient credits were available to cover applicant needs. These credits are available and closest to the impact site.

USACE Determination: Do not concur with Applicant proposal. The applicant is not allowed to purchase freshwater or estuarine wetland credits to replace marine wetland impacts. Determination needs to consider resource category/functional changes and location considerations. In this case, mitigation may include use of permittee responsible compensation. The applicant will need to provide a revised analysis.

Example 3.

Case Facts: As authorized in a NWP and in accordance with the SOP, the project (*USACE File Number*) would need to obtain 7.5 wetland credits and 5000 stream credits. This project is located in the Blue River Basin PSA and in the 30267010 8-digit HUC. There are no banks located in the PSA. However, there are 4 banks located in the SSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	PSA; 30267010	- -	7.5	
Stream	PSA; 30267010	- -	5000	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Alpha Mitigation Bank				
Stream	SSA; 30267001	4 miles	Unknown	
Bravo Mitigation Bank				
Stream	SSA; 30267001	24 miles	Unknown	
Freshwater Wetland	SSA; 30267001	24 miles	Unknown	
Charlie Mitigation Bank				
Stream	SSA; 30267002	50 miles	Unknown	
Freshwater Wetland	SSA; 30267002	50 miles	Unknown	
Delta Mitigation Bank				
Freshwater Wetland	SSA; 30267002	15 miles	Unknown	

Applicant Recommendations: Proposes to purchase all credits from SSA bank(s), as there are no credits available in the PSA. Determination of credits would assess the following factors: availability and appropriateness (i.e., functional credits available at the different banks and location of the banks).

USACE Determination: Concur with Applicant proposal. In this case, it is appropriate to assess banks in the SSA.

Example 4.

Case Facts: As authorized in a NWP and in accordance with the SOP, the project (*USACE File Number*) would need to obtain 1.4 freshwater wetland credits. This project is located within the Blue River Basin (BRB) PSA and in the 33333333 8-digit HUC. There are no banks located in the PSA or SSA. However, there is 1 bank located in the adjacent PSA (i.e., Red River Basin (RRB). Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	BRB PSA; 33333333	- -	1.4	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Zulu Mitigation Bank				
Freshwater Wetland	RRB PSA; 22222222	14 miles	Yes	X

Applicant Recommendations: Proposes to purchase all credits from Zulu Mitigation Bank, as there are no credits available in the BRB PSA and/or SSA.

USACE Determination: Coordinate Applicant's proposal with the full IRT to determine appropriateness. If determined appropriate by the IRT, concur with Applicant proposal. If determined inappropriate by the IRT, do not concur with Applicant proposal. In the even that USACE/IRT does not concur, the applicant would not be allowed to purchase freshwater wetland credits in the adjacent PSA; rather, mitigation may include use of In-Lieu Fee or permittee responsible compensation. The applicant would need to provide a revised analysis.

Example 5.

Case Facts: As authorized in accordance with the SOP, the project (*USACE File Number*) would need to obtain 25 wetland credits. This project is located in the Upper Red River Basin PSA and in the 30267005 8-digit HUC. There are 2 banks located in the PSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	PSA; 30267005	- -	25	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Alpha Mitigation Bank				
Freshwater Wetland	PSA; 30267005	1 mile	Yes	
Stream	PSA 30267005	1 mile	Yes	
Bravo Mitigation Bank				
Stream	PSA; 30267006	15 miles	Yes	X
Freshwater Wetland	PSA; 30267006	15 miles	Yes	X
Note that Bravo Bank BI was submitted for USACE review in Dec 2005.				

Applicant Recommendations: Proposes to purchase all credits from the Bravo Mitigation Bank. Banker POC indicated on 30 Sep 09 that sufficient credits were available to cover applicant needs. POC indicated that original BI was submitted for review prior to the effective date of this document and that the PSA for this bank although larger than those identified on the USACE web page also services the Upper Red River Basin. POC also indicated that BI for this restoration effort would serve for all freshwater wetland impacts. Documentation demonstrating bank was proposed in Dec 2005 and credits are appropriate were provided to USACE.

USACE Determination: Concur with Applicant proposal.

Example 6.

Case Facts: Using the Savannah District's Mitigation SOP, the project (*USACE File Number*) would need to obtain 60 wetland credits. The project is located within the Middle Red River Basin PSA and in the 30200066 8-digit HUC. There are 2 banks located in the PSA. Additional resource information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	PSA; 30200066	- -	60	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Charlie Mitigation Bank				
Stream	PSA; 30200066	4 miles	Yes	X
Delta Mitigation Bank				
Freshwater Wetland	PSA; 30200065	10 miles	Yes	

Applicant Recommendations: Proposes to purchase all credits from the Charlie Mitigation Bank. Banker POC indicated on 05 Oct 09 that sufficient credits were available to cover applicant needs. These credits are of greatest value, because they are the least expensive to purchase and the nearest to the project impact site.

USACE Determination: Do not concur with Applicant proposal. The applicant is not allowed to purchase stream credits to replace freshwater wetland impacts. Determination needs to consider resource category/functional changes and location factors; cost is not a consideration in this analysis. It is likely that the Delta Mitigation Bank may be an appropriate bank, depending on the type of wetlands and functions existing at the bank site and those projected for loss at the development site. The applicant will need to provide a revised analysis.

Example 7:

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 250 freshwater wetland credits to replace proposed impacts to a cypress swamp. This project is located in the Black River Basin PSA and in the 30300221 8-digit HUC. There are 2 banks located in the PSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS						
Resource Category	**Type**	**Location**	**Landscape Position**	**Distance to Impact Site**	**Credits Needed**	
IMPACT SITE DATA						
Freshwater Wetland	Cypress swamp	PSA; 30300221	Adjacent to Stream	- -	250	
					Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA						
Echo Mitigation Bank						
Freshwater Wetland	Pine flatwoods	PSA; 30300221	Adjacent to Stream	4 miles	Yes	
Foxtrot Mitigation Bank						
Freshwater Wetland	Cypress swamp	PSA; 30300222	Adjacent to Stream	25 miles	Yes	X

Applicant Recommendations: Proposes to purchase all credits from the Foxtrot Mitigation Bank. Banker POC indicated on 15 Oct 09 that sufficient credits were available to cover applicant needs. In this case functional replacement of the cypress swamp with cypress swamp is considered more important than distance.

USACE Determination: Concur with Applicant proposal.

Example 8.

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 1,000 stream credits and 5 wetland credits. This project is located in the Middle Green River PSA and in the 30300331 8-digit HUC. There is 1 bank located in the PSA and 4 banks in the SSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS				
IMPACT SITE DATA				
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Credits Needed**	
Freshwater Wetland	PSA; 30300331	- -	5	
Stream	PSA; 30300331	- -	1000	
			Sufficient Credits Available	**Recommended for Use**
MITIGATION BANK DATA				
Golf Mitigation Bank				
Stream	PSA; 30300331	4 miles	Yes	
Freshwater Wetland	PSA; 30300331	4 miles	Yes	
Halo Mitigation Bank				
Stream	SSA; 30300332	2 miles	Yes	X
Freshwater Wetland	SSA; 30300332	2 miles	Yes	X
India Mitigation Bank				
Stream	SSA; 30300332	10 miles	Yes	
Freshwater Wetland	SSA; 30300332	10 miles	Yes	
Lima Mitigation Bank				
Freshwater Wetland	SSA; 30300332	15 miles	Yes	
Macke Mitigation Bank				
Freshwater Wetland	SSA; 30300332	20 miles	Yes	
Stream	SSA; 30300332	20 miles	Yes	

Applicant Recommendations: Proposes to purchase all credits from banks in the SSA. Banker POC indicated on 16 Oct 09 that sufficient credits were available to cover applicant needs. These credits are of greatest value, because they are the least expensive to purchase and are closest to the impact site.

USACE Determination: Do not concur with Applicant proposal. The applicant is not allowed to purchase credits in the SSA, until they demonstrate that credits available in the PSA are not appropriate and/or not available. Note that determination needs to consider resource category/functional changes and location considerations; cost is not a consideration in this analysis. The applicant will need to provide a revised analysis, discussing the availability and appropriateness of the credits available at the Golf Mitigation Bank.

Example 9.

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 1,000 stream credits and 35 wetland credits. This project is located in the Middle Purple River PSA and in the 33300022 8-digit HUC. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS					
IMPACT SITE DATA					
Resource Category	**Type**	**Location**	**Landscape Position**	**Distance to Impact Site**	**Credits Needed**
Freshwater Wetland	Bottomland Hardwood	PSA 33300022	Adjacent to Stream	- -	35
Stream	Intermittent	PSA 33300022	2nd Order	- -	1000
					Sufficient Credits Available
MITIGATION BANK DATA					
Romeo Mitigation Bank					
Stream	Intermittent	PSA 33300022	2nd Order	2 miles	No
Freshwater Wetland	Bottomland Hardwood	PSA 33300022	Adjacent to Stream	2 miles	No
Sierra Mitigation Bank					
Stream	Perennial	SSA 33300021	2nd Order	10 miles	Yes
Freshwater Wetland	Emergent	SSA 33300021	Adjacent to Stream	10 miles	Yes
Tango Mitigation Bank					
Freshwater Wetland	Bottomland Hardwood	SSA 33300021	Adjacent to Stream	20 miles	Yes
Stream	Intermittent	SSA 33300021	2nd Order	20 miles	Yes

Applicant Recommendations: Proposes to purchase all credits from the Tango Mitigation Bank. Romeo Banker POC indicated on 15 Sep 09 that sufficient credits were not available to cover applicant needs: there were no stream credits available and wetland credits may be available in 5 months. As all permits have been obtained and site construction may initiate once mitigation credits are secured, this site was dismissed. Sierra and Tango Banker POCs indicated on 17 Sep 09 that sufficient credits were available to cover applicant needs. In talking with the Tango Mitigation POC, POC indicated that wetland restoration efforts were similar to impacts to occur at project site.

USACE Determination: Concur with Applicant proposal.

Example 10.

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 3,000 stream credits and 150 wetland credits. This project is located in the Oso River PSA and in the 33300033 8-digit HUC. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS					
IMPACT SITE DATA					
Resource Category	**Type**	**Location**	**Landscape Position**	**Distance to Impact Site**	**Credits Needed**
Freshwater Wetland	Bottomland Hardwood	PSA 33300022	Adjacent to Stream	- -	150
Stream	Intermittent	PSA 33300022	2nd Order	- -	3000
					Sufficient Credits Available
MITIGATION BANK DATA					
Long Beach Mitigation Bank					
Stream	Intermittent	PSA 33300022	2nd Order	2 miles	1000
Freshwater Wetland	Bottomland Hardwood	PSA 33300022	Adjacent to Stream	2 miles	No
Vienna Mitigation Bank					
Stream	Intermittent	PSA 33300021	2nd Order	10 miles	500
Freshwater Wetland	Bottomland Hardwood	PSA 33300021	Adjacent to Stream	10 miles	100
Wilmington Mitigation Bank					
Freshwater Wetland	Emergent	SSA 33300020	Adjacent to Stream	20 miles	Yes
Stream	Intermittent	SSA 33300020	2nd Order	20 miles	Yes
Newport Mitigation Bank					
Freshwater Wetland	Bottomland Hardwood	PSA 33300021	Adjacent to Stream	30 miles	50
Marshfield Mitigation Bank					
Stream	Intermittent	PSA 33300021	2nd Order	25 miles	1500
Tybee Mitigation Bank					
Marine Wetland	Salt Marsh	SSA 33300020	Adjacent to River	100 miles	Yes
River	Perennial	SSA 33300020	4th Order	100 miles	Yes
Falls Church Mitigation Bank					
Stream	Intermittent	SSA 33300020	2nd Order	45 miles	150

Applicant Recommendations: Proposes to purchase the credits as follows:

- Long Beach: 1,000 stream credits
- Vienna:
  - 500 stream credits
  - 100 freshwater wetland credits
- Newport: 50 freshwater wetland credits
- Marshfield: 1,500 stream credits

Banker POCs indicated on 15 Sep 09 that sufficient credits were available to cover applicant needs.

USACE Determination: Concur with Applicant proposal.

Example 11.

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 100 stream credits. The project is located within the Middle Red River Basin PSA and in the 30200066 8-digit HUC. Project construction and operation is likely to affect listed fish habitat or passage. There are 2 banks located in the PSA and 1 in the SSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS					
IMPACT SITE DATA					
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Listed Species Impacts**	**Credits Needed**	
Stream	PSA; 30200066	- -	Yes	100	
			Bank Benefits Listed Species	**Sufficient Credits Available**	**Recommended for Use**
MITIGATION BANK DATA					
Charlie Mitigation Bank					
Stream	PSA; 30200066	4 miles	No	No	
Delta Mitigation Bank					
Freshwater Wetland	PSA; 30200065	10 miles	Yes	Yes	
Mensing Mitigation Bank					
Stream	SSA 30200067	20 miles	Yes	Yes	X

Applicant Recommendations: Proposes to purchase all credits from the Mensing Mitigation Bank. Banker POC indicated on 05 Oct 09 that sufficient credits were available to cover applicant needs. These credits would fulfill stream impact and Threatened and Endangered (T&E) species requirements.

USACE Determination: Concur with Applicant proposal. Projects that impact listed species habitat must mitigate for that loss at a bank that benefits listed species (unless the applicant proposes to purchase credits at an appropriate T&E conservation bank).

Example 12.

Case Facts: Using the SOP, the project (*USACE File Number*) would need to obtain 500 stream credits. The project is located within the Silver River Basin PSA and in the 30200333 8-digit HUC. Project construction and operation is likely to affect listed fish habitat or passage. There are 2 banks located in the PSA. Additional information and analyses are provided in the following matrix:

RESOURCE ANALYSIS					
IMPACT SITE DATA					
Resource Category	**Service Area; HUC**	**Distance to Impact Site**	**Listed Species Impacts**	**Credits Needed**	
Stream (Perennial)	PSA; 3020033	- -	Cherokee Darter Habitat	500	
			Bank Benefits Listed Species	**Sufficient Credits Available**	**Recommended for Use**
MITIGATION BANK DATA					
November Mitigation Bank					
Stream (Perennial)	PSA; 30200333	4 miles	No	Yes	
Oscar Mitigation Bank					
Stream (Perennial)	PSA; 30200333	20 miles	Yes	Yes	X

Applicant Recommendations: Proposes to purchase all credits from the Oscar Mitigation Bank. These credits would fulfill stream impact and T&E species requirements.

USACE Determination: Concur with Applicant proposal. Projects that impact listed species habitat must mitigate for that loss at a bank that benefits listed species (unless the applicant proposes to purchase credits at an appropriate T&E conservation bank).

Appendix 11.2. Template Statement of Credit Availability Agreement

STATEMENT OF CREDIT AVAILABILITY

APPLICATION INFORMATION

Permit Type: NWP
USACE Permit Number: SAS-2017-XXXX
Project Name: ABC Development
Applicant: XYZ Development Group, LLC
County: Gwinnett
Impacted HUC: 03130001

CREDIT NEED

Stream Credit Type: Intermittent/Ephemeral
Stream Credits Needed: 1,000.00
Wetland Credit Type: Riverine/Lacustrine Fringe
Wetland Credits Needed: 0.5

MITIGATION BANK NAMED

Bank Name: Acme Mitigation Bank
Bank Permit Number: SAS-2018-XXXXX
Primary Service Area HUC(s): 03130001
Secondary Service Area HUC(s): N/A
Stream Credit Type Utilized: Intermittent/Ephemeral
Stream Credits Utilized: 1,000.00
Wetland Credit Type Utilized: Riverine/Lacustrine Fringe
Wetland Credits Utilized: 0.5

The Bank Representative hereby authorizes the Applicant to name the mitigation bank listed above as a source of compensatory mitigation in its U.S. Army Corps of Engineers (Corps) permit application for the above referenced project. The credits listed from the mitigation bank are currently available for purchase and have been reserved by the Bank Representative for use by the Applicant. In order to finalize the credit purchase, the Bank Representative must submit an updated credit ledger showing the sale (debit) and any other required closing documentation to the Corps.

Bank Representative: XYZ Mitigation Co, LLC

By:____
Name:
Date:

As the Applicant, I understand that failure to purchase mitigation credits as required by the Corps may result in a suspension or revocation of the permit and/or civil or criminal enforcement actions by the Corps or the U.S. Environmental Protection Agency.

Applicant: XYZ Mitigation Co, LLC

By:____
Name:
Date:

Note 1: Potential mitigation credits that have not been released for sale will only be available for reservation at the discretion of the Corps.

Note 2: If the above agreement cannot be finalized by either party (Banker or Applicant), both parties will need to immediately coordinate with the Corps to ensure that an alternative compensatory mitigation plan is proposed to offset project impacts.

Note 3: If credits are being purchased from multiple mitigation banks, then a Statement of Credit Availability is required from each mitigation bank.

Appendix 11.3. Mitigation Service Areas
(In Development)

Appendix 11.4. Mitigation Plan Guidelines

(In Development)

Appendix 11.5. Monitoring Metrics and Performance Standards (In Development)

Appendix 11.6. Banking Instrument Template
(In Development)

Appendix 11.7. Freshwater Wetland Qualitative Assessment Worksheets

RIVERINE - LACUSTRINE FRINGE - FRESHWATER TIDAL WETLAND QUALITATIVE ASSESSMENT

Project Name:	
Impact Wetland Name:	
Wetland Type:	
WAA Center Coordinates:	
Date:	

Water Storage -1

Answer		**Questions**
Value		Are there above grade fills or structures obstructing hydrologic flows into or out of the wetland, or are there drainage structures, ditches, or man-made impoundments within 100 feet of the assessment area that are hydrologically affecting the wetland? (Y/N)
Value		Is the contributing drainage basin at least 50 percent forested? (Y/N)
FUNCTION SCORE	Index Value	

BioGeoChemical Cycling - 2

Answer		**Questions**
Value		Is there large woody debris (LWD) in the wetland? (Y/N)
Value		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
Value		Is the wetland hydrologically connected to the adjacent tributary at bankfull events? If the wetland is Lacustrine Fringe and is associated with a man-made impoundment, then the response to this assessment question should be "No". (Y/N)
FUNCTION SCORE	Index Value	

Maintain Characteristic Wetland Community - 3

Answer		**Questions**
		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
Value		Is there greater than 10 percent invasive cover (i.e., cumulative absolute cover across all strata)? (Y/N)
FUNCTION SCORE	Index Value	

Maintain Faunal Habitat - 4

Answer		**Questions**
		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
		Is there woody debris in the wetland? (Y/N)
		Is the contributing drainage basin at least 50 percent forested? (Y/N)
FUNCTION SCORE	Index Value	

WETLAND QUALITATIVE FUNCTIONAL CAPACITY SCORE	**Index Value**

Legend
Green Cell = User must manually input information.
Orange Cells = User must select the answer from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Dark Grey Cells = These cells do not require input. The corresponding value is populated from the user input to a previous question.

NON-RIVERINE WETLAND QUALITATIVE ASSESSMENT

Project Name:	
Impact Wetland Name:	
Wetland Type:	
WAA Center Coordinates:	
Date:	

Water Storage -1

Answer		Questions
Value		Are there above grade fills or structures obstructing hydrologic flows into or out of the wetland, or are there drainage structures, ditches, or man-made impoundments within 100 feet of the assessment area and within the catchment that are hydrologically affecting the wetland? (Y/N)
Value		Is the contributing drainage basin at least 50 percent forested? (Y/N)
FUNCTION SCORE	Index Value	

BioGeoChemical Cycling - 2

Answer		Questions
Value		Is there large woody debris (LWD) in the wetland? (Y/N)
Value		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
FUNCTION SCORE	Index Value	

Maintain Characteristic Wetland Community - 3

Answer		Questions
		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
Value		Is there greater than 10 percent invasive cover (i.e., cummulative absolute cover across all strata)? (Y/N)
FUNCTION SCORE	Index Value	

Maintain Faunal Habitat - 4

Answer		Questions
		Has the vegetative community been adversely altered within the last 20 years? (Y/N)
		Is there woody debris in the wetland? (Y/N)
		Is the contributing drainage basin at least 50 percent forested? (Y/N)
FUNCTION SCORE	Index Value	

WETLAND QUALITATIVE FUNCTIONAL CAPACITY SCORE	**Index Value**

Legend
Green Cell = User must manually input information.
Orange Cells = User must select the choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Dark Grey Cells = These cells do not require input. The corresponding value is populated from the user input to a previous question.

Appendix 11.8. Saltwater Wetland Qualitative Assessment Worksheet

SALTWATER TIDAL WETLAND QUALITATIVE ASSESSMENT

Project Name:	
Impact Wetland Name:	
Wetland Type:	
WAA Center Coordinates:	
Date:	

Wave Energy Attenuation – 1

Answer		**Questions**
Value		Is the Wetland Assessment Area (WAA) mean marsh width greater than 100 meters? (Y/N)
Value		Are one or more shorelines located adjacent to a tidal creek or river used by recreational or commercial boats? (Y/N)
Value		Is the WAA mean percent cover of emergent marsh vegetation greater than 70 percent? (Y/N)
FUNCTION SCORE	Index Value	

BioGeoChemical Cycling – 2

Answer		**Questions**
Value		Are there above grade fills or structures obstructing hydrologic flows into or out of the wetland, or are there drainage structures or ditches within 100 feet of the WAA that are hydrologically affecting the wetland? (Y/N)
Value		Is the WAA mean percent cover of emergent marsh vegetation greater than 70 percent? (Y/N)
Value		Is greater than 95 percent of the adjacent land use perimeter bounded by undeveloped naturally vegetated areas or open water? (Y/N)
FUNCTION SCORE	Index Value	

Nekton Habitat Utilization – 3

Answer		**Questions**
Value		Is the ratio of shoreline to wetlands greater than 100 meters per hectare? (Y/N)
Value		Are there above grade fills or structures obstructing hydrologic flows into or out of the wetland, or are there drainage structures or ditches within 100 feet of the WAA that are hydrologically affecting the wetland? (Y/N)
Value		Does the WAA have 5 or more of the following habitats located onsite or within 30 meters of the project boundary: (1) Low marsh (i.e. daily tidal flooding); (2) High marsh (i.e. irregular tidal flooding); (3) Intertidal creeks/channels (exposed at low tide); (4) Subtidal creeks/channels; (5) Ponds or depressions (temporary or permanent); (6) Shallow (less than 1 meter) sand or mudflats; (7) Submerged aquatic vegetation; and (8) Oyster reefs? (Y/N)
FUNCTION SCORE	Index Value	

Marsh Dependent Wildlife Habitat - 4

Answer		**Questions**
Value		Is the ratio of shoreline to wetlands greater than 100 meters per hectare? (Y/N)
Value		Is there woody debris in the wetland? (Y/N)
Value		Is at least 50 percent of the WAA dominated by tall, robust, native herbaceous vegetation and have at least 2 of the following habitat types: (1) Tall, robust herbaceous vegetation that is at least irregularly flooded (i.e., S. alterniflora, S. cynosuroides, J. roemerianus, Typha spp., Schoenoplectus spp.); (2) Short herbaceous vegetation that is infrequently flooded (i.e., S. patens, S. spartinae, Distichlis spicata, Borrichia frutescens, Batis maritima); (3) Intertidal creek banks and mudflats that are exposed at low tide; and, (4) Naturally vegetated upland (forested, shrub-scrub, or dense herbaceous) with a minimum width of 30 meters adjacent to the WAA perimeter? (Y/N)
Value		Is the WAA patch size (contiguous tidal fringe wetland within which the WAA is located) greater than 2 hectares? (Y/N)
Value		Is 50 percent of the wetland vegetation greater than 1 meter in height? (Y/N)
FUNCTION SCORE	Index Value	

Plant Community Structure and Composition – 5

Answer		**Questions**
Value		Is the wetlands mean percent cover of emergent marsh vegetation greater than 70 percent? (Y/N)
Value		Is the WAA invasive cover less than 5 percent? (Y/N)
Value		Is less than 1 percent vegetative cover of the WAA comprised of non-wetland species?□
Value		Is the WAA comprised of less than 5 percent woody cover? (Y/N)
FUNCTION SCORE	Index Value	

WETLAND QUALITATIVE FUNCTIONAL CAPACITY SCORE	**Index Value**

Legend
Green Cell = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Dark Grey Cells = These cells do not require input. The corresponding index value is populated from the user input to a previous question.

Appendix 11.9. Stream Qualitative Assessment Worksheets

PIEDMONT / RIDGE & VALLEY / BLUE RIDGE QUALITATIVE STREAM ASSESSMENT

Project Name:	
Impact Reach Name:	
Stream Type:	Stream Type
SAR Center Coordinates:	
Date:	

Hydrology - 1

Value		**Questions**
Value		The surface and groundwater hydrology of the assessment reach are free of upstream catchment impairments (e.g., diversions, stormwater management structures, wastewater facilities, agricultural ditches)? (Y/N)
Value		Is the contributing drainage basin of the assessment reach at least 50 percent forested? (Y/N)
FUNCTION SCORE	**Index Value**	

Hydraulics - 2

Value		**Questions**
Value		Is the assessment reach connected to it's floodplain at bankfull event? (Y/N)
Value		Are there headcuts in the assessment reach? (Y/N)
Value		Has the assessment reach been previously straightened? (Y/N)
FUNCTION SCORE	**Index Value**	

Geomorphology - 3

Value		**Questions**
Value		Does the assessment reach have bedform diversity (i.e., the presence of riffle/pool or step/pool complexes)? (Y/N)
Value		Is there high bank erosion present throughout the assessment reach? (Y/N)
Value		Is there large woody debris (LWD) in the assessment reach? (Y/N)
Value		Are riffles/runs in the assessment reach comprised of coarse material (i.e., gravel or larger)? (Y/N)
Value		Is there a woody riparian buffer (i.e., 25 feet in width) adjacent to both sides of the assessment reach? (Y/N)
FUNCTION SCORE	**Index Value**	

Chemistry - 4

Value		**Questions**
		Is the contributing drainage basin of the assessment reach at least 50 percent of the forested? (Y/N)
Value		Is the assessment reach designated as an impaired water on the most recent 303(D)/305(b) list?
FUNCTION SCORE	**Index Value**	

Biology - 5

Value		**Questions**
Value		Is there habitat diversity in the assessment reach (i.e., at least 3 of the following habitats: riffles, pools, steps, overhangs, leaf packs, woody debris)?
		Is the contributing drainage basin of the assessment reach at least 50 percent of the forested? (Y/N)
SUM	**Index Value**	

STREAM QUALITATIVE FUNCTIONAL CAPACITY SCORE	**Index Value**

Legend
Green Cell = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Dark Grey Cells = These cells do not require input. The corresponding index value is populated from the user input to a previous question.

COASTAL PLAIN QUALITATIVE STREAM ASSESSMENT

Project Name:	
Impact Reach Name:	
Stream Type:	Stream Type
SAR Center Coordinates:	
Date:	

Hydrology - 1

Value		Questions
Value		The surface and groundwater hydrology of the assessment reach are free of upstream catchment impairments (e.g., diversions, stormwater management structures, wastewater facilities, agricultural ditches)? (Y/N)
Value		Is the contributing drainage basin of the assessment reach at least 50 percent forested? (Y/N)
FUNCTION SCORE	**Index Value**	

Hydraulics - 2

Value		Questions
Value		Is the assessment reach connected to it's floodplain at bankfull event? (Y/N)
Value		Are there headcuts in the assessment reach? (Y/N)
Value		Has the assessment reach been previously straightened? (Y/N)
FUNCTION SCORE	**Index Value**	

Geomorphology - 3

Value		Questions
Value		Does the assessment reach have bedform diversity (i.e., the presence of riffle/pool or step/pool complexes)? (Y/N)
Value		Is there high bank erosion present throughout the assessment reach? (Y/N)
Value		Is there large woody debris (LWD) in the assessment reach? (Y/N)
Value		Is there a woody riparian buffer (i.e., 25 feet in width) adjacent to both sides of the assessment reach? (Y/N)
FUNCTION SCORE	**Index Value**	

Chemistry - 4

Value		Questions
		Is the contributing drainage basin of the assessment reach at least 50 percent of the forested? (Y/N)
Value		Is the assessment reach designated as an impaired water on the most recent 303(D)/305(b) list?
FUNCTION SCORE	**Index Value**	

Biology - 5

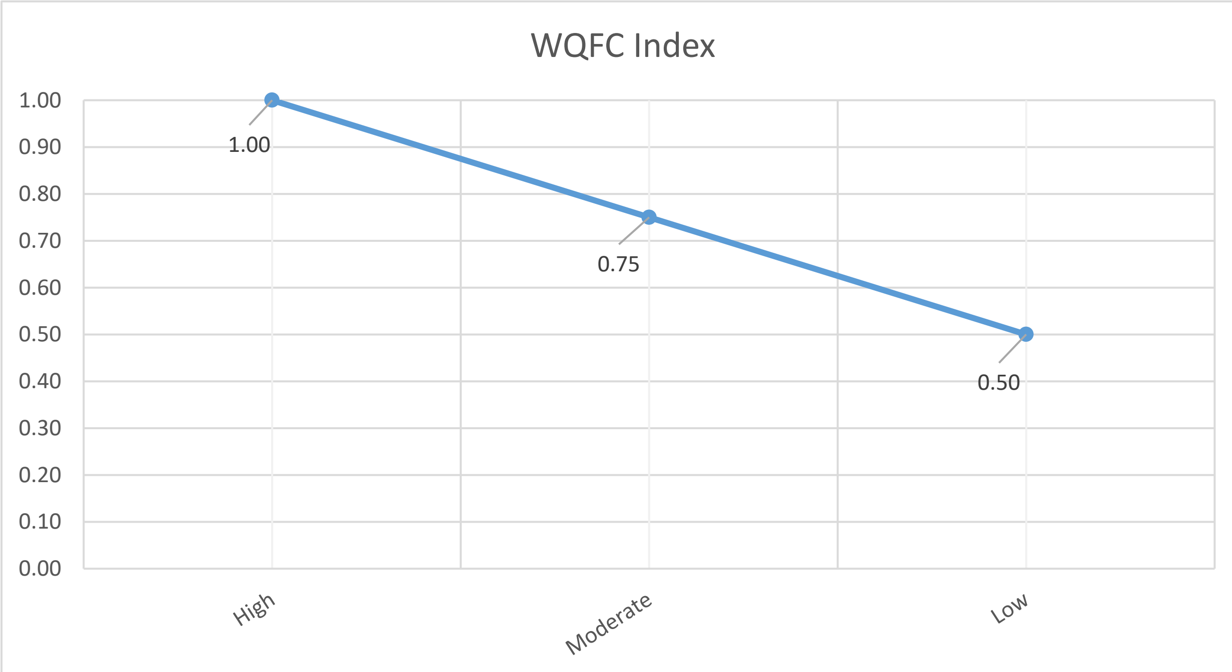
Value		Questions
Value		Is there habitat diversity in the assessment reach (i.e., at least 3 of the following: riffles, pools, steps, overhangs, leaf packs, woody debris)?
		Is the contributing drainage basin of the assessment reach at least 50 percent of the forested? (Y/N)
SUM	**Index Value**	

STREAM QUALITATIVE FUNCTIONAL CAPACITY SCORE	**Index Value**

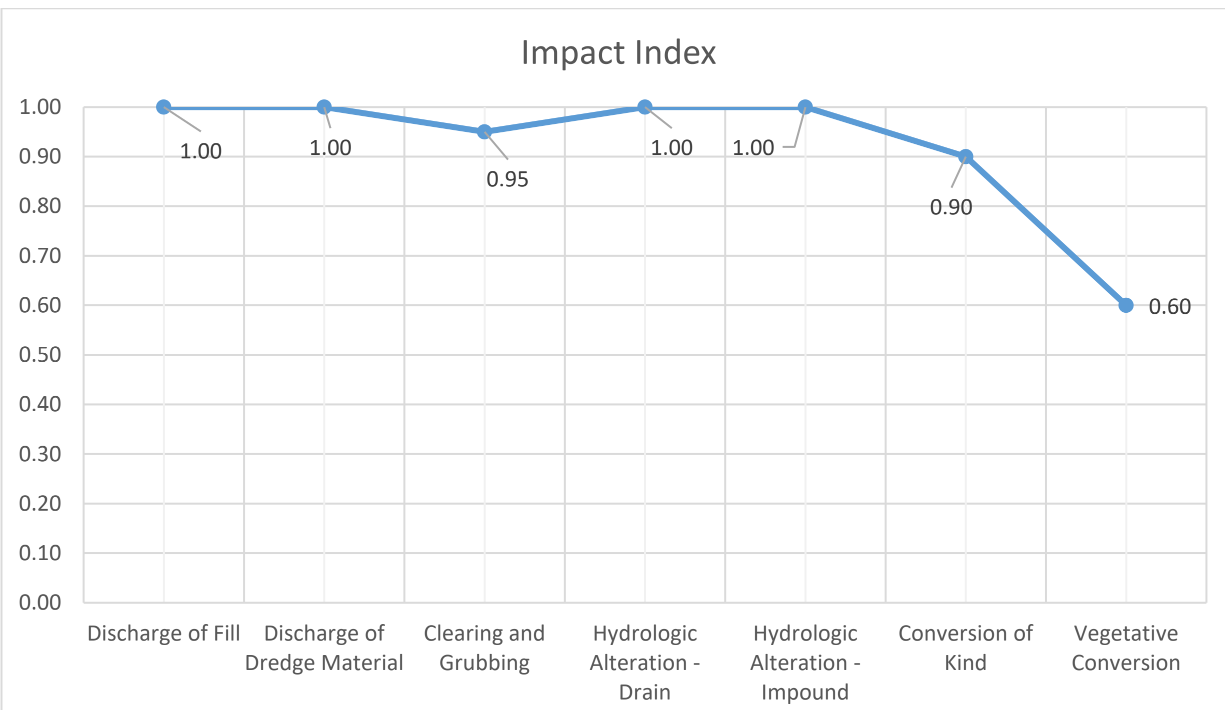
Legend
Green Cell = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Dark Grey Cells = These cells do not require input. The corresponding index value is populated from the user input to a previous question.

Appendix 11.10. Indices of the Worksheets for Wetland Adverse Impacts

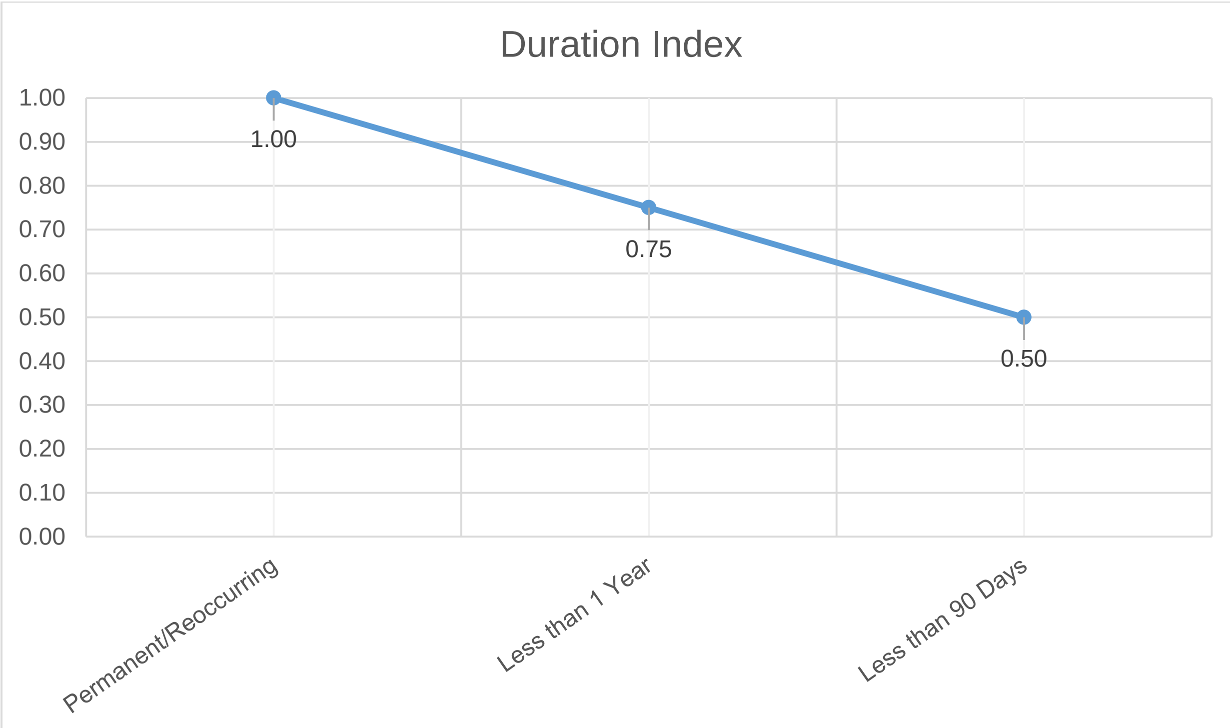
Index 1. Wetland Qualitative Functional Capacity (WQFC) Index



Index 2. Wetland Impact Index

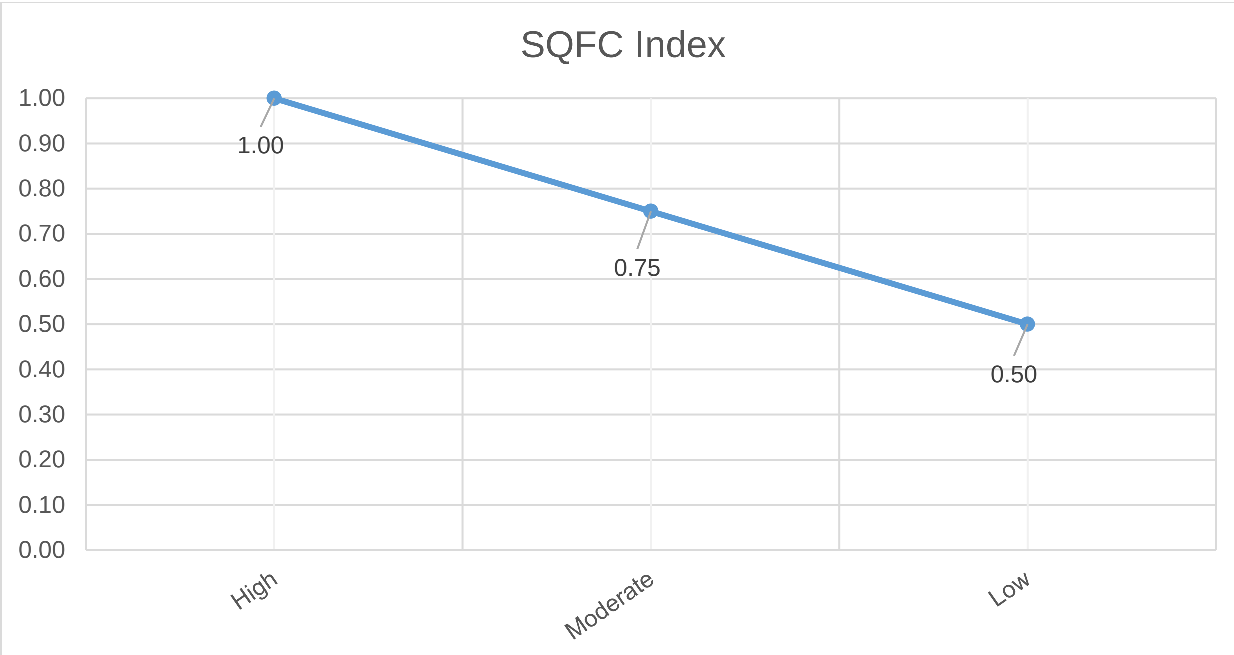


Index 3. Wetland Impact Duration Index

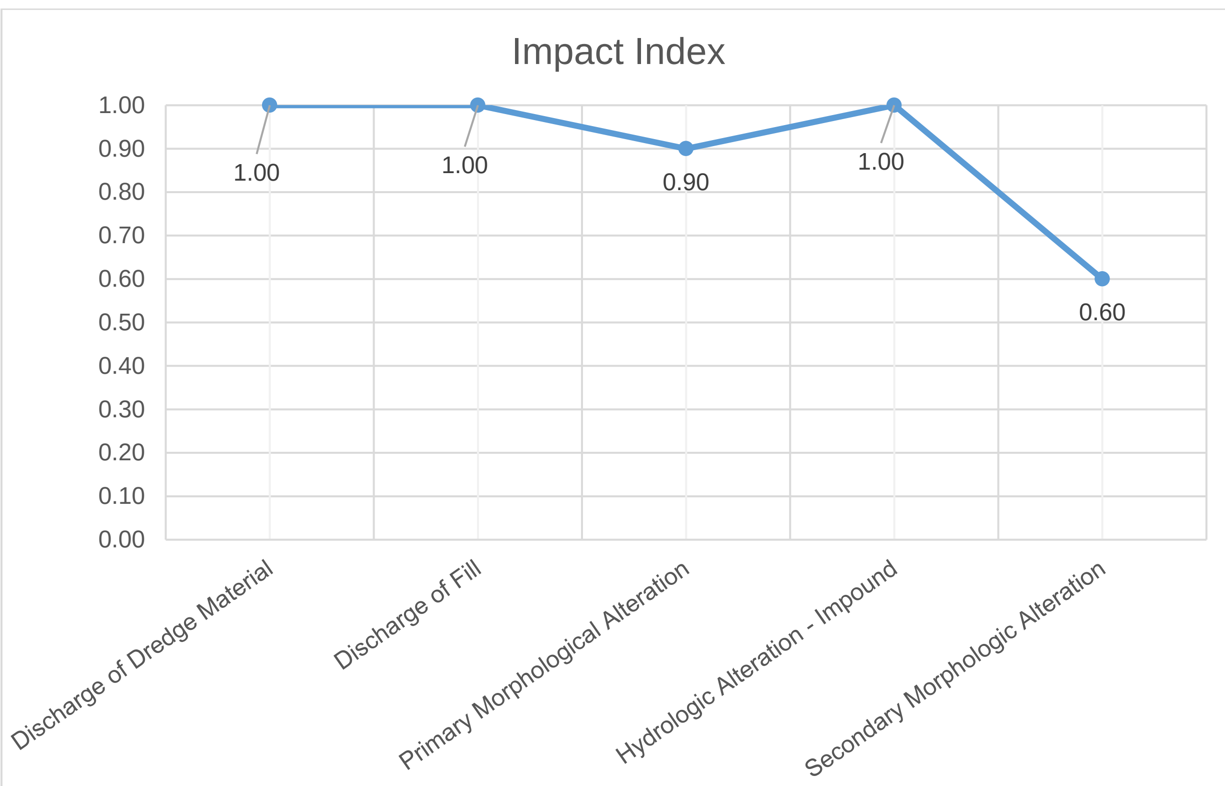


Appendix 11.11. Indices of the Worksheets for Stream Adverse Impacts

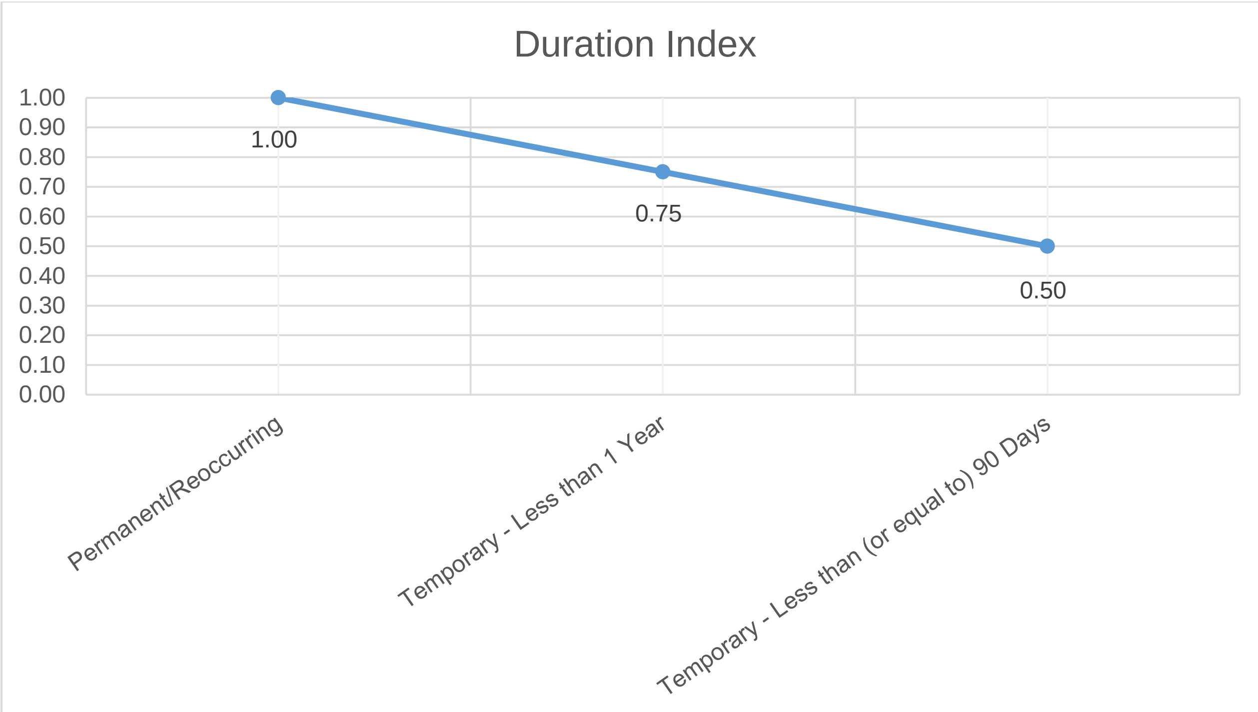
Index 1. Stream Qualitative Functional Capacity (SQFC) Index



Index 2. Stream Impact Index



Index 3. Stream Impact Duration Index



Appendix 11.12. Qualitative Worksheets for Wetland Adverse Impacts

Qualitative Worksheet Summary For Wetland Adverse Impacts						
Worksheet Number	**Name of Wetland**	**Wetland Type**	**Acres of Impact (ac.)**	**Impact Duration**	**2018 Credits**	**Grandfathered Credits**
1				Choose Duration	Credits Owed	Grandfathered Credits Owed
2				Choose Duration	Credits Owed	Grandfathered Credits Owed
3				Choose Duration	Credits Owed	Grandfathered Credits Owed
4				Choose Duration	Credits Owed	Grandfathered Credits Owed
5				Choose Duration	Credits Owed	Grandfathered Credits Owed
6				Choose Duration	Credits Owed	Grandfathered Credits Owed
7				Choose Duration	Credits Owed	Grandfathered Credits Owed
8				Choose Duration	Credits Owed	Grandfathered Credits Owed
9				Choose Duration	Credits Owed	Grandfathered Credits Owed
10				Choose Duration	Credits Owed	Grandfathered Credits Owed

Summary of Credits Owed			
Wetland Type	**Acres of Impact (ac.)**	**2018 Credits**	**Grandfathered Credits**
Freshwater Tidal Wetlands			
Saltwater Tidal Wetlands			
Riverine/Lacustrine Fringe Wetlands			
Slope Wetlands			
Depressional/Flat Wetlands			
Open Water			

Worksheet 1: Qualitative Worksheet for Wetland Adverse Impacts

Project Name:	
Impact Wetland Name:	
Acres of Impact (Acres):	
Wetland Type:	
Date:	

Impact Factors	**Index Description**	**Index Value**
1. Wetland Qualitative Functional Capacity Score (*WQFC*)	Choose WQFC	WQFC Index
2. Impact Category Description (*Impact Category*)	Choose Primary Impact	Impact Index
3. Product of WQFC and Impact (*WQFC Impact*) =		WQFC Impact
4. Duration of Impact (*Duration*)	Choose Duration	Duration Index
5. Product of WQFC Impact and Duration (*Total WQFC Impact*) =		Total WQFC Impact
6. Product of Total WQFC Impact and Acres (***Total 2018 Wetland Credits Owed***) =		**Credits Owed**
7. Conversion of Total 2018 Wetland Compensation to Grandfathered Credits (***Grandfathered Wetland Credits Owed***) =		**Grandfathered Credits Owed**

Legend
Green Cells = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.

Appendix 11.13. Qualitative Worksheets for Stream Adverse Impacts

Qualitative Worksheet Summary For Stream Adverse Impacts						
Worksheet Number	**Name of Stream**	**Stream Type**	**Length of Impact (L.F.)**	**Impact Duration**	**2018 Credits**	**Grandfathered Credits**
1				Choose Duration	Credits Owed	Grandfathered Credits Owed
2				Choose Duration	Credits Owed	Grandfathered Credits Owed
3				Choose Duration	Credits Owed	Grandfathered Credits Owed
4				Choose Duration	Credits Owed	Grandfathered Credits Owed
5				Choose Duration	Credits Owed	Grandfathered Credits Owed
6				Choose Duration	Credits Owed	Grandfathered Credits Owed
7				Choose Duration	Credits Owed	Grandfathered Credits Owed
8				Choose Duration	Credits Owed	Grandfathered Credits Owed
9				Choose Duration	Credits Owed	Grandfathered Credits Owed
10				Choose Duration	Credits Owed	Grandfathered Credits Owed

Summary of Credits Owed			
Stream Type	**Length of Impact (L.F.)**	**2018 Credits**	**Grandfathered Credits**
Zero and 1st Order Ephemeral Streams			
Zero, 1st, and 2nd Order Intermittent and Perennial Streams			
3rd Order Perennial Streams and larger			
Open Water			

Worksheet 1: Qualitative Worksheet for Stream Adverse Impacts

Project Name:	
Impact Reach Name:	
Linear Feet of Impact (*Feet*):	
Stream Type:	
Date:	

Impact Factors	**Index Description**	**Index Value**
1. Stream Qualitative Functional Capacity Score (*SQFC*)	Choose SQFC	SQFC Index
2. Type of Impact (*Impact*)	Choose Primary Adverse Impact	Impact Index
3. Product of SQFC and Impact (*SQFC Impact*) =		SQFC Impact
4. Duration of Impact (*Duration*)	Choose Duration	Duration Index
5. Product of SQFC Impact and Duration (*Total SQFC Impact*) =		Total SQFC Impact
6. Product of Total SQFC Impact and Linear Feet (***Total 2018 Stream Credits Owed***) =		**Credits Owed**
7. Conversion of Total 2018 Stream Compensation to Grandfathered Credits (***Grandfathered Stream Credits Owed***) =		**Grandfathered Credits Owed**

Legend
Green Cells = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.

Appendix 11.14 Georgia Interim Wetland Hydrogeomorphic Workbook

Existing Conditions Worksheet for Wetland Mitigation Actions

Project Information and Existing Conditions Summary

Project Name:	Acme Mitigation Bank
Mitigation Wetland Name:	Wetland A
Acres of Mitigation (*Acres*):	1.00
Wetland Type:	Riverine
WAA Center Coordinates:	x, y
County:	Appling
Date of Assessment:	April 27, 2018

Summary of Existing Wetland Function

Existing Condition - V_{HYDRO} Index Score	0.00
Existing Condition - V_{COMP} Index Score	0.00
Existing Condition - V_{STRUCT} Index Score	0.00
Existing Condition - V_{WD} Index Score	0.00
Existing Condition - V_{UP} Index Score	0.00
Existing Condition Functional Score	0.00

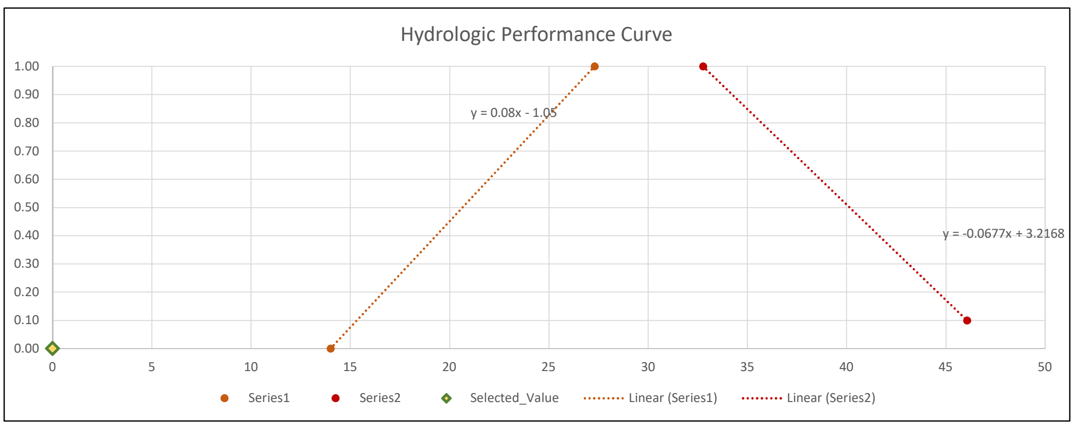
Saturation Threshold (V_{HYDRO}) Calculator

Physiographic Region:	Coastal_Plain
Confirmed Soil Series:	Allanton
Functioning Saturation Range:	10%-12%
Length of Growing Season - # days (WETS, 28 degrees F - 50%):	273

Functioning Saturation Range (in Consecutive Days)

		% Growing Season		Consecutive Days		Consecutive Days
Saturation Range (%, days):	**14 days**	5.1%	**10%**	27	**12%**	33

Choose Days of Saturation:



0.00 **V_{HYDRO} Index Score**

Wetland Vegetation Composition (V_{COMP}) Calculator

Choose Region: Coastal_Plain

Wetland Type: Riverine

Riverine Species List - Group 1 (Index Value - 1.00)	
☐ *Alnus serrulata*	☐ *Quercus phellos*
☐ *Carpinus caroliniana*	☐ *Sabal minor*
☐ *Carya aquatica*	☐ *Taxodium ascendens*
☐ *Cephalanthus occidentalis*	☐ *Taxodium distichum*
☐ *Chamaecyparis thyoides*	☐ *Ulmus americana*
☐ *Cliftonia monophylla*	☐
☐ *Cyrilla racemiflora*	☐
☐ *Decodon verticillatus*	☐
☐ *Eubotrys racemosa*	☐
☐ *Fraxinus caroliniana*	☐
☐ *Fraxinus pennsylvanica*	☐
☐ *Lyonia lucida*	☐
☐ *Magnolia virginiana*	☐
☐ *Nyssa aquatica*	☐
☐ *Nyssa biflora*	☐
☐ *Nyssa ogeche*	☐
☐ *Planera aquatica*	☐
☐ *Quercus laurifolia*	☐
☐ *Quercus michauxii*	☐
☐ *Quercus pagoda*	☐

0 Species in Group 1

Riverine Species List - Group 2 (Index Value - 0.66)
☐ *Acer negundo*
☐ *Acer rubrum*
☐ *Acer saccharinum*
☐ *Betula nigra*
☐ *Celtis laevigata*
☐ *Liquidambar styraciflua*
☐ *Platanus occidentalis*
☐ *Populus deltoides*
☐ *Quercus nigra*
☐ *Salix caroliniana*
☐ *Salix nigra*
☐ -
☐ -
☐ -
☐ -
☐ -
☐
☐
☐
☐

0 Species in Group 2

Riverine Species List - Group 3 (Index Value - 0.00)
☐ *Albizia julibrissin*
☐ *Alternanthera philoxeroides*
☐ *Cyperus iria*
☐ *Echinochloa crus-galli*
☐ *Imperata cylindrica*
☐ *Ligustrum japonicum*
☐ *Ligustrum sinense*
☐ *Lonicera japonica*
☐ *Lygodium japonicum*
☐ *Microstegium vimineum*
☐ *Panicum repens*
☐ *Pueraria montana*
☐ *Sorghum halepense*
☐ *Sorghum halepense*
☐ *Triadica sebifera*
☐ *Verbena brasiliensis*
☐
☐
☐
☐

0 Species in Group 3

Initial Quality Index

Adjusted Quality Index

0.00 **V_{COMP} Index Score**

Wetland Vegetation Structure (V_{STRUCT}) Calculator

Choose Uppermost Vegetative Stratum: Tree Stratum

Wetland Type: Riverine

List the dbh measurements of three largest canopy trees (at least 15cm):		
Tree 1 (cm at dbh):	15.00	0.00
Tree 2 (cm at dbh):	0.00	0.00
Tree 3 (cm at dbh):	0.00	0.00
		0.00
Average Tree dbh:	5.00	

0.00 **V_{STRUCT} Index Score**

Large Woody Debris (V_{LWD}) Calculator

Wetland Type: Riverine

Enter diameters (cm) of each fallen woody stem 7.6 cm (3 inches) or greater in diameter in each 50-foot transect. Leaning dead stems that intersect the sampling plane are sampled. Dead trees and shrubs still supported by their roots are not sampled. Rooted stumps are not sampled, but uprooted stumps are sampled. Down stems that are decomposed to the point where they no longer maintain their shape but spread out on the ground are not sampled.

Transect 1	Transect 2

☑ Check box if no logs were encountered within the transects.

0 Volume of non-living large woody stems (m3/ha)

0.00 **V_{LWD} Index Score**

Upland Buffer (V_{UP}) Calculator

Total Length of Wetland Perimeter: 1,000

Buffer Segment	Length of Segment (L.F.)	Width of Buffer (L.F.)	Segment Index Score	Weighted Segment Score
Buffer Segment 1				
Buffer Segment 2				
Buffer Segment 3				
Buffer Segment 4				
Buffer Segment 5				
Buffer Segment 6				
Buffer Segment 7				
Buffer Segment 8				
Buffer Segment 9				
Buffer Segment 10				
Total Length of Buffer Segments	0			

0.00 **V_{UP} Index Score**

Legend
Green Cells = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Yellow Cells = These automated cells summarize the functional index scores.

Proposed Conditions Worksheet for Wetland Mitigation Actions

Project Information and Proposed Conditions Summary

Project Name:	Acme Mitigation Bank
Mitigation Wetland Name:	Wetland A
Acres of Mitigation (*Acres*):	1.00
Wetland Type:	Riverine
Mitigation Potential:	Restoration
WAA Center Coordinates:	x, y
County:	Appling
Date of Wetland Credit Assessment:	April 27, 2018

Summary of Proposed Wetland Function

Proposed Condition - V_{HYDRO} Index Score	0.00
Proposed Condition - V_{COMP} Index Score	0.00
Proposed Condition - V_{STRUCT} Index Score	0.00
Proposed Condition - V_{WD} Index Score	0.00
Proposed Condition - V_{UP} Index Score	0.00
Proposed Condition Functional Score	0.00
Net Functional Lift (Δ)	0.00
Total Wetland Credits Generated	**0.00**

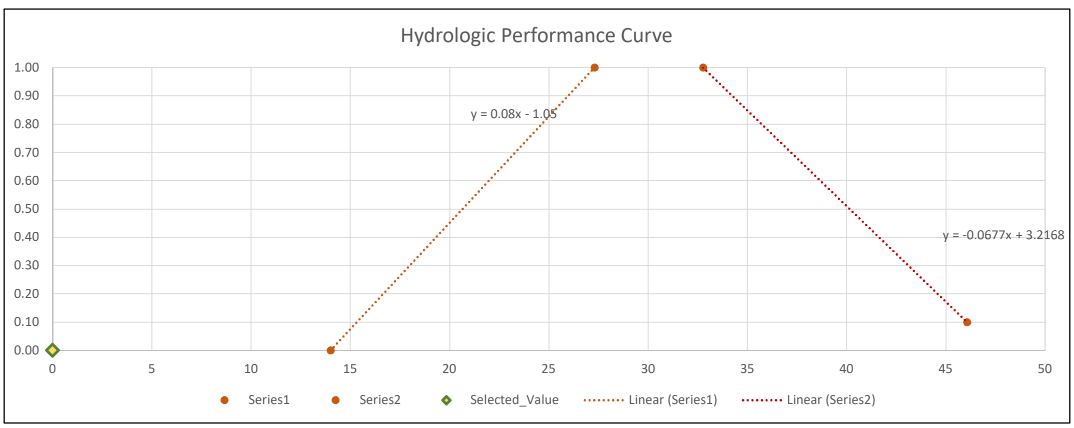
Saturation Threshold (V_{HYDRO}) Calculator

Physiographic Region:	Coastal_Plain
Confirmed Soil Series:	Allanton
Functioning Saturation Range:	10%-12%
Length of Growing Season - # days (WETS, 28 degrees F - 50%):	273

Functioning Saturation Range (in Consecutive Days)

		% Growing Season		Consecutive Days		Consecutive Days
Saturation Range (%, days):	**14 days**	5.1%	**10%**	27	**12%**	33

Choose Days of Saturation:



0.00	**V_{HYDRO} Index Score**

Wetland Vegetation Composition (V_{COMP}) Calculator

Choose Region: Coastal_Plain

Wetland Type: Riverine

Riverine Species List - Group 1 (Index Value - 1.00)	
☐ *Alnus serrulata*	☐ *Quercus phellos*
☐ *Carpinus caroliniana*	☐ *Sabal minor*
☐ *Carya aquatica*	☐ *Taxodium ascendens*
☐ *Cephalanthus occidentalis*	☐ *Taxodium distichum*
☐ *Chamaecyparis thyoides*	☐ *Ulmus americana*
☐ *Cliftonia monophylla*	☐
☐ *Cyrilla racemiflora*	☐
☐ *Decodon verticillatus*	☐
☐ *Eubotrys racemosa*	☐
☐ *Fraxinus caroliniana*	☐
☐ *Fraxinus pennsylvanica*	☐
☐ *Lyonia lucida*	☐
☐ *Magnolia virginiana*	☐
☐ *Nyssa aquatica*	☐
☐ *Nyssa biflora*	☐
☐ *Nyssa ogeche*	☐
☐ *Planera aquatica*	☐
☐ *Quercus laurifolia*	☐
☐ *Quercus michauxii*	☐
☐ *Quercus pagoda*	☐

0 Species in Group 1

Riverine Species List - Group 2 (Index Value - 0.66)
☐ *Acer negundo*
☐ *Acer rubrum*
☐ *Acer saccharinum*
☐ *Betula nigra*
☐ *Celtis laevigata*
☐ *Liquidambar styraciflua*
☐ *Platanus occidentalis*
☐ *Populus deltoides*
☐ *Quercus nigra*
☐ *Salix caroliniana*
☐ *Salix nigra*
☐ -
☐ -
☐ -
☐ -
☐ -
☐
☐
☐
☐

0 Species in Group 2

Riverine Species List - Group 3 (Index Value - 0.00)
☐ *Albizia julibrissin*
☐ *Alternanthera philoxeroides*
☐ *Cyperus iria*
☐ *Echinochloa crus-galli*
☐ *Imperata cylindrica*
☐ *Ligustrum japonicum*
☐ *Ligustrum sinense*
☐ *Lonicera japonica*
☐ *Lygodium japonicum*
☐ *Microstegium vimineum*
☐ *Panicum repens*
☐ *Pueraria montana*
☐ *Sorghum halepense*
☐ *Sorghum halepense*
☐ *Triadica sebifera*
☐ *Verbena brasiliensis*
☐
☐
☐
☐

0 Species in Group 3

Initial Quality Index

Adjusted Quality Index

0.00 **V_{COMP} Index Score**

Wetland Vegetation Structure (V_{STRUCT}) Calculator

Choose Uppermost Vegetative Stratum: Tree Stratum

Wetland Type: Riverine

List the dbh measurements of three largest canopy trees (at least 15cm):		
Tree 1 (cm at dbh):		100.00
Tree 2 (cm at dbh):		100.00
Tree 3 (cm at dbh):		100.00
		100.00
Average Tree dbh:	0.00	

0.00 **V_{STRUCT} Index Score**

Large Woody Debris (V_{LWD}) Calculator

Wetland Type: Riverine

Enter diameters (cm) of each fallen woody stem 7.6 cm (3 inches) or greater in diameter in each 50-foot transect. Leaning dead stems that intersect the sampling plane are sampled. Dead trees and shrubs still supported by their roots are not sampled. Rooted stumps are not sampled, but uprooted stumps are sampled. Down stems that are decomposed to the point where they no longer maintain their shape but spread out on the ground are not sampled.

Transect 1	Transect 2

☐ Check box if no logs were encountered within the transects.

Volume of non-living large woody stems (m3/ha):

0.00 **V_{LWD} Index Score**

Upland Buffer (V_{UP}) Calculator

Total Length of Wetland Perimeter:

Buffer Segment	Length of Segment (L.F.)	Width of Buffer (L.F.)	Segment Index Score	Weighted Segment Score
Buffer Segment 1				
Buffer Segment 2				
Buffer Segment 3				
Buffer Segment 4				
Buffer Segment 5				
Buffer Segment 6				
Buffer Segment 7				
Buffer Segment 8				
Buffer Segment 9				
Buffer Segment 10				
Total Length of Buffer Segments	0			

0.00 **V_{UP} Index Score**

Legend
Green Cells = User must manually input information.
Orange Cells = User must select the index choice from the drop-down list.
Grey Cells = The calculation of these cells is automated.
Yellow Cells = These automated cells summarize the functional index scores.

Appendix 11.15. Georgia Interim Freshwater Wetland Hydrogeomorphic Workbook - User Manual

U.S. Army Corps of Engineers, Savannah District

Georgia Interim Freshwater Wetland Hydrogeomorphic Workbook – User Manual

April 27, 2018

Contents

Glossary of Terms

Assessment Model – A model that defines the relationship between ecosystem and landscape scale variables and functional capacity of a wetland. The model is developed and calibrated using reference wetlands from a reference domain.

Continuous Saturation – A condition in which all easily drained voids (pores) between soil particles in the root zone (within 12 inches from the soil surface) are filled with water at conditions that are greater than atmospheric pressure for a consecutive period of days.

Credit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the accrual or attainment of aquatic functions at a compensatory mitigation site. The measure of aquatic functions is based on the resources restored, established, enhanced, or preserved (33 CFR 332.2; 40 CFR 230.922).

Creation – Creation (Establishment) means the manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site (33 CFR 332.2; 40 CFR 230.92).

Debit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the loss of aquatic functions at an impact or project site. The measure of aquatic functions is based on the resources impacted by the authorized activity (33 CFR 332.2; 40 CFR 230.92).

Diameter at Breast Height – Tree diameter measured at 1.4 meters (4.5 feet) above the ground on the uphill side of a tree.

Enhancement – Enhancement means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function (33 CFR 332.2; 40 CFR 230.92).

Existing Condition – The functional capacity of an associated function-based parameter or overall wetland area prior to mitigation actions, which is expressed as an index value between 0.00 and 1.00.

Function-Based Parameter – A structural measure or function (expressed as a rate) that both represents and supports the ecosystem functions expressed as functional statements for each functional category (e.g. hydrologic processes, maintain plant and animal communities, and biogeochemical processes). Each function-based parameter is quantified or estimated by measuring one or more assessment metrics in the field.

Functional Capacity – The degree to which an area of wetland performs a specific function (33 CFR 332.2; 40 CFR 230.92). Functional capacity is dictated by characteristics of the wetland and the surrounding landscape, and interaction between the two.

Functions – The physical, chemical, and biological processes that occur in ecosystems (33 CFR 332.2; 40 CFR 230.92).

Herbaceous stratum – The layer of vegetation consisting of all non-woody plants, regardless of height, and woody plants less than 1 meter (39 inches) tall.

Index Score – A value between 0.00 and 1.00 that expresses whether the associated function-based parameter, or overall wetland area is functioning, functioning-at- risk, or not functioning compared to a reference condition.

Invasive species –Non-native plants or animals that have been introduced, either intentionally or accidentally, into areas outside of their natural ranges and cause economic or environmental harm by outcompeting native species.

Large Woody Debris – Large Woody Debris is defined as downed and dead woody stems that are greater than 7.5 centimeters (3 inches) in diameter and a minimum of 1 meter in length that are no longer attached to living plants.

Net Functional Lift – The difference between the Proposed Condition and Existing Condition for a wetland mitigation area, which represents an increase in functional capacity. The change in functional capacity is expressed as an index value of between 0.00 and 1.00.

Performance Standard – Observable or measurable physical (including hydrological), chemical and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives (33 CFR 332.2; 40 CFR 230.92). The GA HGM uses performance standards that convert measured field data values to an index value of between 0.00 and 1.00.

Preservation – Preservation means the removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms (33 CFR 332.2; 40 CFR 230.92).

Proposed Condition – The functional capacity of an associated function-based parameter, or overall wetland area, following the implementation of a mitigation action and subsequent ecological and/or structural development, which is expressed as an index value of between 0.00 and 1.00.

Restoration – Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource (33 CFR 332.2; 40 CFR 230.92).

Reference Conditions – Conditions incorporating the whole range of variability exhibited by a regional class of aquatic resource as a result of both natural processes and anthropogenic disturbances (33 CFR 332.1; 40 CFR 230.92).

Reference Domain - All wetlands within a defined geographic area that belong to a single wetland type.

Reference Standard Condition – A wetland condition that is considered fully functioning for the parameter being assessed.

Shrub/Sapling Stratum – For the purposes of this user manual, the vegetation layer consisting of woody plants, excluding vines, greater than 1 meter (39 inches) in height, but less than 15 centimeters (6 inches) in diameter at breast height.

Soil Surface – The soil surface is the top of the mineral soil; or, for soils with an Organic (O) horizon, the soil surface is the top of the part of the O horizon that is at least slightly decomposed. Fresh leaf or needle fall that has not undergone observable decomposition is excluded from soil and should be described separately.

Tree Stratum – The vegetation layer consisting of woody plants, excluding vines, greater than 1 meter (39 inches) in height and greater than or equal to 15 centimeters (6 inches) in diameter at breast height.

Upland Buffer – Zone or area of uplands extending outwards from the wetland boundary that is comprised of natural vegetation. Upland buffer vegetation should typically include a mixed assemblage of trees, saplings, shrubs, vines, and ground cover vegetation. For the purposes of this model, the assessment of upland buffer will extend perpendicularly to a width of 100 linear feet from the wetland boundary.

Wetland Type – A hydrogeomorphic wetland class or combination of classes that can be identified based on landscape and ecosystem scale factors (e.g. riverine forested).

1. Purpose and Background

The purpose of this User Manual is to introduce the Georgia Interim Freshwater Wetland Hydrogeomorphic Workbook (GA HGM) and provide both background and instruction on its use to calculate functional lift and inform crediting for wetland mitigation projects undertaken in accordance with the Clean Water Act, Section 404 Regulatory program in the State of Georgia. This manual includes descriptions of how to collect and calculate field values for each assessment metric in the wetland condition assessments and describes how those field values are converted to index values in the GA HGM. Few measurements are unique to the GA HGM, and procedures are often detailed in other instruction manuals or available literature. Where appropriate, this document will reference other data collection manuals and make clear any differences in data collection or calculation methods as applied within the GA HGM. This manual will refer to wetland restoration in accordance with the definition used by the Final Mitigation Rule (33 CFR 332; 40 CFR 230):

> *Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource.*

This definition encompasses all activities aimed to improve wetland functions undertaken for compensatory mitigation or other purposes. Smith (1995) described ten (10) important wetland functions aggregated into three categories, including hydrologic processes, maintenance of plant and animal communities, and biogeochemical processes. This work informed the development of, “A regional guidebook for applying the Hydrogeomorphic Approach to assessing wetland functions of forested wetlands in alluvial valleys of the Coastal Plain of the southeastern United States” (Wilder et al., 2013), which collectively provide the structural underpinnings of the GA HGM. Portions of the GA HGM and user manual have been derived from Wilder (2013). Savannah District acknowledges the contributions of the authors of this guidebook to the development of the GA HGM. This User Manual and the GA HGM Worksheets assume the reader has a firm knowledge of both wetland processes and HGM (Smith, 1995; Wilder et al., 2013); therefore, it does not provide extensive definitions of related wetland terms such as hydrologic and biogeochemical processes.

Collection and analysis of the watershed-scale and wetland assessment area-scale data necessary to evaluate before proposing a wetland restoration project, or even selecting a potential wetland restoration site, is not limited to only the assessment metrics included in the GA HGM. The GA HGM incorporates only some of the necessary metrics that all wetland restoration projects will be expected to assess and document for the U.S. Army Corp of Engineers, Savannah District and the Georgia Interagency Review Team (IRT). Additional metrics required for wetland restoration projects are to be outlined in the Monitoring Metrics and Performance Standards

(Section 4.5) of the Savannah District's 2018 Standard Operating Procedure For Compensatory Mitigation. Thus, on its own, the GA HGM is not a method or protocol for designing a wetland restoration project.

The Georgia Interim Freshwater Wetland Hydrogeomorphic Workbook (GA HGM) – Microsoft Excel Workbook and this User Manual can be downloaded from the RIBITS website at:
https://ribits.usace.army.mil/ribits_apex/f?p=107:27:1866571602324::NO:RP:P27_BUTTON_KEY:10

The GA HGM and accompanying documents will be updated periodically as additional data are gathered and reference standards and metrics are refined.

2. Getting Started with the GA HGM

The assessment metrics and associated performance standards utilized in the GA HGM will not necessarily be the only field variables for which monitoring will be required, nor will they be the only field variables for which performance standards (success criteria) will be assigned.

The GA HGM uses three modified function-based parameters provided by Wilder et al. (2013), along with two additional function-based parameters that were developed by the Savannah District: Continuous Saturation[1], Wetland Vegetation Composition[2], Wetland Vegetation Structure[2], Large Woody Debris[2], and Upland Buffer[1]. All GA HGM function-based parameters and assessment metrics used to assess baseline conditions must also be used to assess post-construction conditions throughout the monitoring period. Note however, that while the maximum possible Net Functional Lift of the GA HGM (i.e. 1.00) is based upon all five function-based parameters, these parameters are not all equally weighted.

The Existing Conditions and Proposed Conditions Worksheets in the GA HGM Microsoft Excel workbook are the main spreadsheets of the GA HGM. Users enter field data describing the existing and proposed (or monitored) conditions of the mitigation wetland, and the worksheets quantify functional lift or loss. The worksheets contain six areas for data entry: Project Information and Existing (and Proposed) Conditions Summary, Continuous Saturation (V_{HYDRO}) Calculator, Wetland Vegetative Composition (V_{COMP}) Calculator, Wetland Vegetative Structure (V_{STRUCT}) Calculator, Large Woody Debris (V_{LWD}) and Upland Buffer (V_{UP}) Calculator. Cells that allow user input are shaded green and orange. All other cells are locked.

[1] These function-based parameters were develop by the Savannah District for use in mitigation assessment of freshwater wetlands throughout Georgia.
[2] These function-based parameters were originally provided by Wilder et al. (2013), and have been modified for use in mitigation assessment of freshwater wetlands throughout Georgia.

2.1 Project Information and Existing Conditions Summary

The Project Information and Existing Conditions Summary section of the Existing Condition Worksheet consists of general site information and other project-specific information necessary to determine which performance standards are applied in the GA HGM for calculating index values. Some fields in this section include drop-down menus (orange cells) from which the user will select the appropriate value, while others require information to be manually entered (green cells). The values selected or entered into these fields establish links between the worksheet and the applicable performance standards. It is therefore important for the user to input accurate site information. All of the values entered in the Project Information and Existing Conditions Summary are transferred to the Project Information and Proposed Conditions Summary of the Proposed Conditions Worksheet, with the exception of the Mitigation Potential and the Date of Wetland Credit Assessment fields, which require user input.

In addition to providing general site information and other project-specific information, this section also provides the Summary of Existing/Proposed Wetland Function. Further details regarding these summaries are provided in the Scoring Functional Lift section, below (Section 2.3).

2.2 Existing and Proposed Condition Worksheet Field Values

Once the Project Information and Existing/Proposed Conditions Summary section has been completed, the user can input data into the field value cells (i.e., green and orange cells, and checkboxes) of the function-based parameter calculators (e.g, Continuous Saturation (V_{HYDRO}) Calculator).

The Existing Condition Worksheet field values are derived from measurements collected in the field during baseline condition assessment of the project site before any mitigation work is undertaken. The Proposed Condition Worksheet field values are representative of estimated, but logical, field values informed by design studies/ calculations, reports, and best available science. Proposed condition field values are estimated during the development of the mitigation plan, but then measured in the field during the post-construction monitoring phase to validate the proposed condition field values and associated index values.

2.3 Scoring Functional Lift

Scoring occurs automatically as field values for each assessment metric are entered into the Existing Conditions or Proposed Conditions Worksheets. The functional parameter index score (yellow cell at the bottom of each calculator) will reflect an index value ranging from 0.00 to 1.00 for that parameter, based on the applicable performance curves. Parameter scores have been weighted to separately calculate both the Existing Condition Functional Score (ECFS) and the Proposed Condition Functional Score (PCFC).

The Existing Conditions and Proposed Conditions Worksheets summarize the scoring at the top of the sheet, next to the Project Information table in each respective worksheet. The summary tables for each of the respective worksheets are entitled “Summary of Existing Wetland Function” and “Summary of Proposed Wetland Function”.

The Summary of Existing Wetland Function table illustrates the index scores for each of the function-based parameters from the existing condition assessment along with a summarized Existing Condition Functional Score for the wetland. The Summary of Proposed Wetland Function table provides index scores for each of the function-based parameters from the proposed condition assessment along with a summarized Proposed Condition Functional Score, the Net Functional Lift (Δ) occurring within the wetland, and incorporates the area (Acres) of the wetland to calculate the Total Wetland Credits Generated. The change in functional condition of the project wetland is the difference between the PCFC and ECFS.

$$\Delta = (PCFS - ECFS) * Acres$$

If the Net Functional Lift value is a positive number, then functional lift is occurring within the wetland. A negative number represents a functional loss.

3. Assessment Metric Field Values

Data collection and analysis procedures for existing condition assessments and post-construction monitoring events should follow the procedures outlined in this section of the User Manual. During the project design and review period, the proposed condition assessment worksheet is filled out with data from the project design and best professional judgment of the anticipated project outcome. Subsequent to project construction, actual measured field values collected during each monitoring event are entered in the same worksheet.

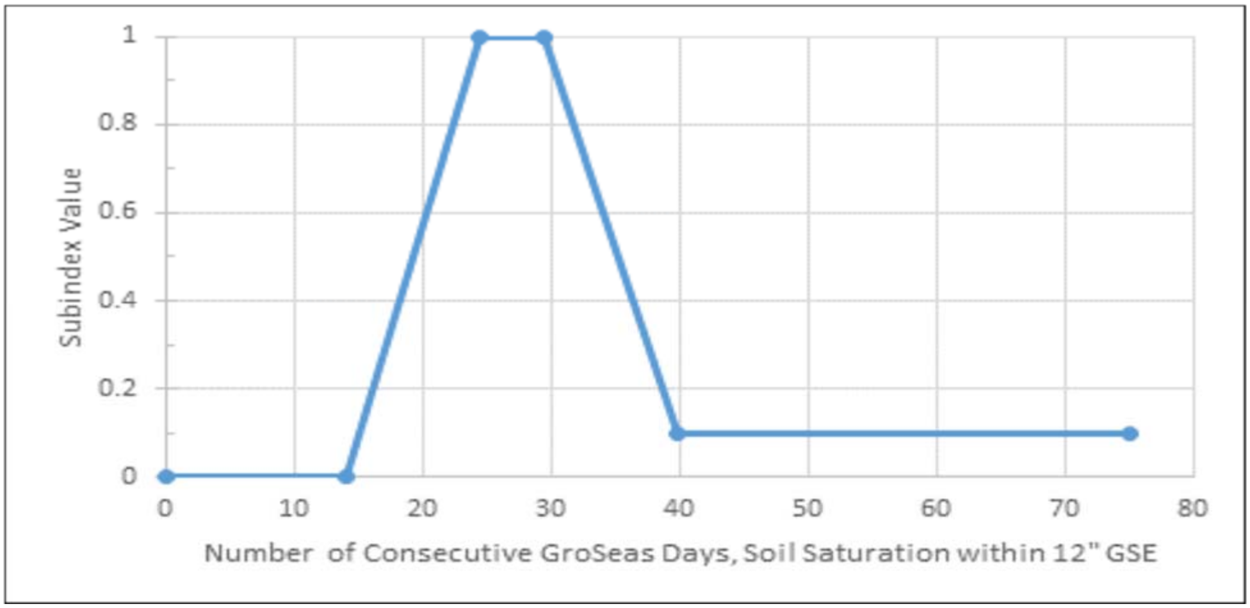
The field methods used to collect and/or calculate measured field values for each assessment metric are summarized below. No new field sampling protocols have been developed exclusively for the GA HGM, and most parameters will be familiar to practitioners and project sponsors.

3.1 Continuous Saturation (V_{HYDRO})

The GA HGM currently contains one function-based parameter to describe hydrologic processes (e.g., water storage) in wetlands: Continuous Saturation. One assessment metric is used to quantify continuous saturation: direct measurement of the shallow groundwater table via the installation of groundwater monitoring wells as outlined in the Technical Standard for Water-Table Monitoring of Potential Wetland Sites (US Army Corps of Engineers, 2005).

Target wetland soil saturation ranges (i.e. continuous percent of growing season) have been identified for each hydric soil series in Georgia based on soil drainage class, soil taxonomy, soil features described in the NRCS Official Soil Series Descriptions and the Water Features Tables associated with each mapped series (tables included within the HGM Workbook). The target soil saturation period for any given site will be based on the field-verified soil series, growing season length and the target soil saturation range for that verified soil series. Figure 1 illustrates how this information is utilized to inform wetland hydrologic performance standards.

Figure 1. Example performance curve for wetland hydrology based on a target soil saturation range.



The diagram in Figure 1 has been developed based upon a subindex graph, where the y-axis is a 0.00 to 1.00 index indicative of the degree to which the variable is performing as it should. In this case, the parameter is continuous saturation within 12 inches of the soil surface during the growing season.

In the example illustrated, our mitigation wetland is located in Coweta County, Georgia and has been field verified as Roanoke soil. Coweta County has a 243-day growing season, and Roanoke is a poorly drained thermic fluvaquentic endoaquept. The target saturation range for Roanoke soils is 10-12% of the growing season, thus the target saturation range on the site is 24.3 to 29.2 days.

If water table monitoring data indicate that the number of consecutive days for which soil saturation is within 12 inches of the surface is within the target saturation range, the index score is a 1.00. As duration move towards the drier side of the scale (i.e. to the left on the x-axis), the index value declines until saturation passes below the 14-day threshold, which is the technical standard for regulatory wetland hydrology. If continuous saturation is less than 14 days, the index value becomes zero.

Moving towards the wetter side of the scale (i.e. to the right on the x-axis), the index score declines until it plateaus at 0.10 on the number of days in excess of the target range that is equivalent to the number of days between the Corps' technical standard (14 days) and the minimum target saturation range. This upper index value does not drop to zero, because the site is a wetland, but it is a wetland with abnormally excessive hydrology. In the above illustrated example, 14 days is 10.3 days fewer than the lower end of the target saturation range (24.3 days – 14 days = 10.3 days). Therefore, the index score declines to 0.10 at 39.9 days of successive soil saturation within 12 inches of the surface (29.2 days + 10.3 days = 39.5 days). Index scores for durations less than or greater than the target saturation range are based on the slope of the rising and falling limb of the curve, respectively.

3.2 Wetland Vegetation Composition (V_{COMP})[3]

Wetland Vegetation Composition is the first of two function-based parameters describing the maintenance of plant and animal communities in the GA HGM.
The wetland vegetation composition parameter reflects the "floristic quality" of the community based on concepts in Andreas and Lichvar (1995) and Smith and Klimas (2002). The focus is on the plants that dominate the tallest stratum present. In reference standard freshwater wetlands in Georgia, the tallest stratum is composed of native canopy trees. In wetlands that have undergone recent and severe natural or anthropogenic disturbance, the tallest stratum may be dominated by herbaceous species or shrubs and tree saplings. Implicit in this approach is the assumption that the "quality" of the tallest layer is a reliable indicator of overall community composition, both current and future (i.e., native tree species dominating the shrub/sapling layer indicate appropriate future canopy composition). Most reference standard wetlands within the reference domain are relatively diverse with several dominant species present. Dominant species are determined using the "50/20 rule". Note that the tree stratum includes trees greater than 15 centimeters (6 inches.) diameter at breast height.

Dominant species are classified into three groups reflecting floristic quality. Group 1 consists of species that are typically dominants in undisturbed forested wetlands. Group 2 consists of other native plant species that are not typical dominants of mature, undisturbed forests, but are often dominant in wetlands that have been disturbed or altered or on newly deposited soil surfaces. Group 3 consists of nonnative (exotic) species or invasive species that are usually found on highly degraded sites.

[3] These sections have been adapted from Wilder (2013).

In reference standard wetlands in the coastal plain, dominant vegetation composition inventoried by Wilder at al. (2013) included species from Groups 1 and 2. The number of dominants was 4 or greater in the Slope and Riverine wetland types, while only two dominants were present in the reference standard Depressional wetlands in the coastal plain. As either composition or diversity deviates from those conditions, functional capacity is assumed to decline.

The procedure used to calculate an index score for V_{COMP} is described below and incorporates both diversity and quality of dominant species:

1. If total tree cover is greater than 20 percent, then V_{COMP} is determined for the tree stratum. If tree cover is less than 20 percent and shrub/sapling cover is greater than 20 percent, then V_{COMP} is determined for the shrub/sapling stratum. If tree cover and shrub/sapling cover are both less than 20 percent, then V_{COMP} is determined for the herbaceous stratum, even if the herbaceous stratum has less than 20 percent vegetation cover.

2. Use the "50/20 rule" to identify the dominant species in the appropriate vegetation stratum. For sites containing a tree stratum, be sure to consider all trees greater than 15 centimeters (6 inches) diameter at breast height.

3. In the GA HGM Worksheet, place a check beside each dominant species that appears in either Group 1 or 2 for the appropriate wetland type. If a dominant species is not listed, but is a species native to the reference domain, it can be added with IRT approval to Group 2 using the blanks provided. The GA HGM Workbook does not list herbaceous species. In addition, all dominant native, non-invasive herbaceous species may be assigned to Group 1 following IRT approval.

For exotic and invasive species in the reference domain (Group 3), check all species encountered in the sample plot without regard to dominance or stratum. Additional exotic and invasive species can be added using the blanks provided and should be treated as Group 3 species.

3.3 Wetland Vegetation Structure (V_{STRUCT})[3]

Wetland Vegetation Structure is the second of two function-based parameters describing the maintenance of plant and animal communities in the GA HGM. The GA HGM assessment model uses only one assessment metric to represent Wetland Vegetative Structure, which is based on the uppermost stratum of the wetland. The assessment metric for the tree stratum is the average diameter at breast height of the three largest trees in each 0.04-hectare (0.1-acre) plot, and summarized by stand. This variable is only measured if percent tree cover is 20 percent or greater. Canopy trees are defined as woody plants ≥15 centimeters (6 inches) diameter at breast height, excluding vines. Tree diameter is a common measure of dominance in forest ecology that expresses the relative age or maturity of a forest stand (Bonham, 1989; Spurr and Barnes, 1981; Tritton and Hornbeck, 1982; Whittaker, 1975; Whittaker et al., 1974). Tree basal area, measured as the cross-sectional area of tree stems at 1.4 meters (4.5 feet) above the ground per unit area (e.g., meters^2/hectare) is also a common measure of abundance and dominance in forest ecology that has been shown to be proportional to tree biomass (Bonham, 1989; Spurr and Barnes, 1981; Tritton and Hornbeck, 1982; Whittaker, 1975; Whittaker et al., 1974).

In Riverine reference wetlands in the coastal plain, Wilder et al. (2013) documented an average diameter at breast height of the three largest trees of each plot in a stand ranging from 0.0 centimeters on sites where all trees had been removed to 70 centimeters (27.6 inches) in mature forest stands. The mean diameter at breast height of the three largest trees of each plot at reference standard Slope wetlands in the coastal plain were greater than 35 centimeters (14 inches). A variable index of 1.00 is assigned at sites where the mean diameter at breast height is ≥35 centimeters. Tree size at the reference standard wetlands in the Riverine and Depressional wetland types were greater than 40 centimeters (15.7 inches). A variable index of 1.00 is assigned at sites where the mean diameter at breast height is ≥40 centimeters. The relationship between canopy tree diameter and functional capacity is assumed to be linear; thus, the index increases linearly from 0.10 to reference standard values. The final index score for the tree stratum is provided below (see Equation (1).

$$Tree\ Diameter\ Index\ Score = \left(\frac{Sum\ of\ Tree\ Diamter\ Index\ Values}{3}\right) \qquad \text{Equation (1)}$$

The shrub/sapling stratum is defined as the average percent cover of woody vegetation greater than one meter (39 inches) in height and less than ten (10) centimeters (four inches) diameter at breast height (e.g., shrubs, saplings, and understory trees). Shrubs contribute to the structure of the wetland plant community, particularly if trees are absent. They take up nutrients, produce biomass, and provide cover and breeding sites for wildlife. Shrubs may dominate the community in forested wetlands during early to mid-successional stages. The shrub/sapling stratum is only measured if tree canopy cover is less than 20 percent and sapling/shrub cover is greater than 20 percent. Wilder et al. (2013) found that shrub/sapling cover was highly variable in reference standard wetlands in the coastal plain, ranging from 4 to 91 percent. However, the shrub/sapling stratum is not used to evaluate wetlands that have a well-developed tree canopy. Instead, the shrub/sapling stratum is measured only in areas with less than 20 percent tree cover due to recent natural or anthropogenic disturbance. In this context, the shrub/sapling stratum reflects the amount of woody regeneration on the site that contributes immediately to carbon cycling and provides habitat for wildlife, and will eventually reproduce a mature forest canopy. Therefore, higher values of shrub/sapling cover are assumed to contribute more to these functions. Shrub/sapling cover on reference wetland sites with less than 20 percent tree cover ranged from 0 to 100 percent. Based on reference data, an index value of 1.00 is assigned when shrub/sapling cover is greater than 70 percent, but the final index score for a shrub/sapling stratum is the percent cover index value divided by three (see Equation (2) below).

$$Shrub \;\&\; Sapling\ Index\ Score = \left(\frac{Mean\ Shrub \;\&\; Sapling\ Percent\ Cover\ Index\ Value}{3}\right) \quad \text{Equation (2)}$$

The herbaceous stratum is defined as the average percent cover of herbaceous vegetation inside a 0.04-hectare plot. Herbaceous stratum vegetation is defined as all non-woody vegetation, regardless of height, and woody vegetation less than 1 meter (39 inches) in height. Herbaceous vegetation cover is indicative of the abundance and biomass of low vegetation in wetlands; these two characteristics affect the productivity and structure of these habitats. Herbaceous stratum vegetation only applies when canopy tree cover and shrub/sapling cover are each less than 20 percent.

On reference standard sites, Wilder et al. (2013) found that coverage of herbaceous-layer vegetation was highly variable, ranging from absent to 100 percent cover. The majority of the reference standard sites (+/- one standard deviation) were between 7 and 45 percent in the Riverine wetland type, and between 20 and 60 percent in the Slope wetland type. However, herbaceous vegetation cover is not used to evaluate wetlands that have a well-developed tree or shrub/sapling canopy. Instead, the herbaceous stratum is measured only in areas where tree and sapling/shrub cover are both less than 20 percent due to severe natural or anthropogenic disturbance. Even under these conditions, herbaceous vegetation contributes organic material to the wetland’s carbon cycle, provides benefits for wildlife, and helps produce conditions favorable to the regeneration of trees. Herbaceous vegetation cover on reference sites with less than 20 percent tree and sapling/shrub cover ranged from 20 to 100 percent. An index value of 1.00 is assigned when herbaceous vegetation cover is greater than 70 percent, but the final index score for a shrub/sapling stratum is the percent cover index value divided by five (see Equation (3) below).

$$Herbaceous\ Stratum\ Index\ Score = \left(\frac{Mean\ Herbaceous\ Percent\ Cover\ Index\ Value}{5}\right) \quad \text{Equation (3)}$$

See the corresponding measurement methodologies for each of the uppermost vegetative stratums below:

a. Tree Stratum Measurements: Mean diameter at breast height of 3 largest diameter trees in each 0.04-hectare (0.1-acre) plot. Use the following procedure to measure the tree stratum:

1. Measure this variable only if the total cover of trees greater than 15 centimeters (6 inches) diameter at breast height in the wetland is greater than 20 percent. If tree cover is less than 20 percent, the following steps may be skipped.

2. Measure the diameter at breast height (in centimeters) of only the 3 largest trees in the 0.04-hectare (0.1-acre) plot. (Record only the trees that are greater than 15 centimeters (6 inches) diameter at breast height in the plot, even if there is only 1 or 2 trees present).

3. Report the results for each tree in centimeters in the GA HGM Workbook.

b. Shrub/Sapling Stratum Measurements: Average percentage cover of shrubs and saplings. The shrub/sapling stratum is defined as woody vegetation greater than 1 meter (39 inches) in height and less than 15 centimeters (6 inches) diameter at breast height (e.g., shrubs, saplings, and understory trees). Use the following procedure to measure the shrub/sapling stratum:

1. Measure this variable only if total tree cover is less than 20 percent and cover of sapling/shrubs is greater than 20 percent.

2. Visually estimate the percentage cover of shrubs/saplings within each of the four 0.01-hectare (0.025-acre) subplots.

3. Report the shrub/sapling cover as percentages in the GA HGM Workbook.

c. Herbaceous Stratum Measurements: Average percentage cover of herbaceous vegetation is defined as all herbaceous vegetation, regardless of height, and woody vegetation less than 1 meter (39 inches) in height. Use the following procedure to measure herbaceous stratum:

1. Measure this variable only if tree and shrub/sapling cover are each less than 20 percent.

2. Visually estimate the percentage cover of herbaceous vegetation within each of the four 0.01-hectare (0.025-acre) subplots.

3. Report herbaceous vegetation cover as percentages in the GA HGM Workbook.

3.4 Large Woody Debris (V_{LWD})[3]

The GA HGM currently contains two function-based parameters to describe biogeochemical processes, the first of which is the assessment of Large Woody Debris. Large woody debris is defined as downed and dead woody stems that are greater than 7.5 centimeters (3 in) in diameter and a minimum of 1 meter in length that are no longer attached to living plants Dead wood is an important component of wildlife habitat and nutrient cycling of forests. Dead wood may be present in snags, small twigs, roots, stumps, and limbs or logs. Some important dead wood habitat features, such as snags, are low in density in a healthy forest. An adequate sample design necessary to accurately estimate low density features such as snags in a forest is often outside the scope of a rapid assessment. Large woody debris as defined here matches that of "coarse woody debris" in the Forest Inventory Analysis (FIA). Its volume may be estimated within a rapid assessment using methods based on those of the FIA (US Department of Agriculture, 2011; Waddell, 2002; Woodall and Monleon, 2008). Volume of large woody debris per hectare is used to quantify this parameter.

In reference wetlands across the Coastal Plain, Wilder et al. (2013) found the volume of woody debris ranged from 0 to 700 meters^3/hectare. The amount of woody debris in reference standard wetlands in the Coastal Plain varied by wetland type and were within the range of 20 to 60 meters^3/hectare. The decrease in the parameter index is based on the assumption that lower volumes of woody debris indicate an inadequate reservoir of nutrients (and a stand at an early stage of maturity) and the inability to maintain characteristic nutrient cycling over the long term. Above amounts characteristic of reference standard, the parameter index decreases linearly to 0.50. This is based on the assumption that increasingly higher volumes of woody debris indicate that high levels of nutrients are tied up in long-term storage and are unavailable for primary production in the short term. This situation can occur in instances of catastrophic wind damage, such as hurricanes or following logging operations. It can also occur if a hydrologic obstruction increases inundation depth or duration to the point that trees experience tip dieback or death. The procedure used to calculate an index value for V_{LWD} is described below:

1. Lay out two 50-foot (15.24-meter) transects perpendicular to each other, one bearing north and one bearing east, originating at the 0.04-hectare plot center point. (The transect bearings may also be established randomly. For the first transect, note the seconds on a watch and multiply by six. The product is the first transect's bearing. Add 90 degrees to the first transect bearing to obtain the second transect bearing. For example, if the seconds are 32, the bearing of the first transect is 182 (32 x 6) and the bearing of the second transect is 272 (182+90)).

2. Measure and record the diameter of nonliving stems[4] greater than or equal to 7.5 centimeters (3 inches) that intersect the plane above the entire length of the 50-foot transect. Record the diameters of individual stems (in centimeters) from each transect in the spaces provided on the V_{LWD} of the GA HGM Worksheet.

3.5 Upland Buffer (V_{UP})[5]

Upland Buffer is the second of two function-based parameters describing biogeochemical processes in the GA HGM. The functional importance of upland buffers in improving water quality of surface water and groundwater is well documented in the scientific literature. Upland buffers play an important role in improving water quality, as they trap and transform pollutants such has sediments, nutrients, pathogens, and pesticides (City of Boulder, 2007; Pearsell and Mulamoottil, 1996; Correll, 1996). Upland buffer vegetation also slows surface runoff, causing larger sediment particles and pollutants to drop out (City of Boulder, 2007; Lee et al., 2003; Correll, 1996). The filtering function of upland buffers is improved as both the density of vegetation and width of upland buffer increase. Further removal and/or transformation of pollutants can occur through groundwater filtration, uptake by vegetation, biogeochemical processes, and microbial processes in the shallow soil profile (City of Boulder, 2007; Lee et al., 2003; Correll, 1996; USEPA, 2005). Also, unsaturated buffer soils are more effective at reducing bacterial concentrations than saturated wetland soils (City of Boulder, 2007; Pearsell and Mulamoottil et al., 1996). Excessive levels of nitrate can be reduced as groundwater contacts roots of upland buffer vegetation and denitrifying microbes, which can reduce nuisance aquatic vegetation (City of Boulder, 2007; Lee et al., 2003). Mature vegetated upland buffers also mitigate the detrimental effects of runoff, which can transport pesticides, fertilizers, and other pollutants in surface waterbodies (City of Boulder, 2007; Miltner et al., 2004; Center for Watershed Protection, 1995; Meyer et al., 2005).

Assessment metrics for this parameter include the width of the upland buffer and the percent of the upland buffer protecting the wetland perimeter. Upland buffer will only be considered present if a restrictive covenant and conservation easement are recorded on the buffer itself. If the upland buffer is not protected by these real property protections, the upland buffer will be considered absent. The maximum upland buffer width is 100

---

[4] Log, or stem, diameter refers to the diameter at the point of intersection with the transect line. Leaning dead stems that intersect the sampling plane are sampled. Dead trees and shrubs still supported by their roots are not sampled. Rooted stumps are not sampled, but uprooted stumps are sampled. Downed stems that are decomposed to the point where they no longer maintain their shape but spread out on the ground are not sampled.

[5] The supporting documentation on the functional importance of upland buffers was adapted from "Wetland and Stream Buffers: A Review of the Science and Regulatory Approaches to Protection." (City of Boulder, 2007).

linear feet, measured perpendicular from the wetland boundary. If a section of upland buffer is 100 linear feet in width, an index value of 1.00 is assigned, while a section of upland buffer 25 linear feet in width would be assigned,an index value of 0.25. If the entire wetland is protected by 100 linear foot wide upland buffer, then an index score of 1.00 is realized. If there are different segments of buffer widths proposed, then the index score is weighted based upon the buffer width index value and the corresponding segment length (as a percentage of the total length of the wetland boundary).

4. References

Andreas, B. K., and R. W. Lichvar. 1995. *Floristic index for establishing assessment standards: A case study for northern Ohio*. Wetlands Research Program Technical Report WRP-DE-8. Vicksburg, MS: Waterways Experiment Station.

Bonham, C. D. 1989. *Measurements for terrestrial vegetation*. New York: Wiley-Interscience.

Center for Watershed Protection. 1995. Site Planning for Urban Stream Protection.

City of Boulder, Planning and Development Services. 2007. Wetland and Stream Buffers: A Review of the Science and Regulatory Approaches to Protection.

Correll, D. L. 1996. Buffer zones and water quality protection: general principles. In: Buffer Zones: Their Processes and Potential in Water Protection. The Proceedings of the International Conference on Buffer Zones, September 1996.

Lee, K. H., T. M. Isenhart, R. C. Schultz. 2003. Sediment and nutrient removal in an established multi-species riparian buffer. Journal of Soil and Water Conservation 58:1-7.

Meyer, Judy.L., Paul, Michael. and W. K. Taulbee. 2005. Stream ecosystem function in urbanizing landscapes. Journal of the North American Benthological Society 24(3) 602-612.

Miltner, R. J., D. White, and C. Yoder. 2004. The biotic integrity of streams in urban and suburbanizing landscapes. Landscape and Urban Planning 69:87-100.

Pearsell, W.G., and G. Mulamoottil. 1996. Toward the integration of wetland functional boundaries and suburban landscapes. Pages 139-152 in: Mulamoottil, G., B. G. Warner, and E. A. McBean (Eds.) Wetlands - environmental gradients, boundaries, and buffers. Lewis Publishers, Boca Raton, FL.

Smith, D. R., Ammann, A., Bartoldus, C., and Brinson, M. M. (1995). "An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices," Technical Report WRP-DE-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A307 121.

Smith, R. D., and C. V. Klimas. 2002. *A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of selected regional wetland subclasses, Yazoo Basin, Lower Mississippi River Alluvial Valley*. ERDC/EL TR-02-4. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Spurr, S. H., and B. V. Barnes. 1981. *Forest ecology*. New York: John Wiley and Sons.

Tritton, L. M., and J. W. Hornbeck. 1982. *Biomass equations for major tree species the northeast*. General Technical Report NE-69. Northeast Forest Experiment Station: U.S. Forest Service.

U.S. Army Corps of Engineers. (2005). “Technical Standard for Water-Table Monitoring of Potential Wetland Sites,” *WRAP Technical Notes Collection* (ERDC TNWRAP-05-2), U. S. Army Engineer Research and Development Center, Vicksburg, MS.

U.S. Department of Agriculture, U.S. Forest Service. 2011. *The forest inventory and analysis phase 3 indicators database 5.1: Description and users manual*. October, 2011. Department of Agriculture, U.S. Forest Service.

U.S. Environmental Protection Agency. 2005. Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations. EPA/600/R-05/118, October 2005.

Waddell, K. L. 2002. Sampling coarse woody debris for multiple attributes in extensive resource inventories. *Ecological Indicators* 1 (3):139-153.

Whittaker, R. H. 1975. *Communities and ecosystems*. New York: MacMillan Publishing Company.

Whittaker, R. H., F. H. Bormann, G. E. Likens, and T. G. Siccama. 1974. The Hubbard Brook ecosystem study: Forest biomass and production. *Ecological Monographs* 44 (2):233-254.

Woodall, C. W., and V. J. Monleon. 2008. *Sampling protocol, estimation, and analysis procedures for the down woody materials indicator of the FIA program*. Gen. Tech. Rep. NRS-22. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Wilder, T. C., Rheinhardt, R. D. and Noble, C. V. 2013. A regional guidebook for applying the Hydrogeomorphic Approach to assessing wetland functions of forested wetlands in alluvial valleys of the coastal Plain of the southeastern United States. Technical Report ERDC/EL TR-13-1. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Appendix 11.16. Georgia Interim Saltwater Wetland Hydrogeomorphic Workbook (In Development)

Appendix 11.17. Georgia Interim Saltwater Wetland Hydrogeomorphic Workbook - User Manual (In Development)

Appendix 11.18. Georgia Interim Stream Quantification Tool

Site Information and Performance Standard Stratification

Project Name:	
Reach ID:	
Mitigation Potential:	
Existing Stream Type:	
Proposed Stream Type:	
Region:	
County:	
Coordinates:	
Drainage Area (sqmi):	
Proposed Bed Material:	
Existing Stream Length (ft):	
Proposed Stream Length (ft):	
Stream Slope (%):	
Flow Type:	
Service Area:	
Stream Temperature:	
Date of Data Collection:	
Valley Type:	

Notes

1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY

Exisiting Condition Score (ECS)	
Proposed Condition Score (PCS)	
Change in Functional Condition (PCS - ECS)	
Percent Condition Change	
Existing Stream Length (ft)	0
Proposed Stream Length (ft)	0
Additional Stream Length (ft)	0
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS	
Functional Change (%)	
Total Number of Potential Stream Credits	

WARNING: Sufficient data are not provided.

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydraulics	Floodplain Connectivity		
Geomorphology	Riparian Vegetation		
	Bed Form Characterization		
Biology	Macros		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydraulics			
Geomorphology			
Biology			

EXISTING CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Assessment Metrics	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydraulics	Floodplain Connectivity	Bank Height Ratio							
		Entrenchment Ratio							
Geomorphology	Riparian Vegetation	Left Buffer Width (ft)							
		Right Buffer Width (ft)							
	Bed Form Characterization	Pool Spacing Ratio							
		Percent Riffle							
		LWD Index							
Biology	Macros	Proportion EPT Taxa Richness							
		Proportion Clinger Taxa Richness							
		Proportion Shredder Taxa Richness							
		Proportion Burrower Taxa Richness							

PROPOSED CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Assessment Metrics	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydraulics	Floodplain Connectivity	Bank Height Ratio							
		Entrenchment Ratio							
Geomorphology	Riparian Vegetation	Left Buffer Width (ft)							
		Right Buffer Width (ft)							
	Bed Form Characterization	Pool Spacing Ratio							
		Percent Riffle							
		LWD Index							
Biology	Macros	Proportion EPT Taxa Richness							
		Proportion Clinger Taxa Richness							
		Proportion Shredder Taxa Richness							
		Proportion Burrower Taxa Richness							

Appendix 11.19. Georgia Interim Stream Quantification Tool User Manual

U.S. Army Corps of Engineers, Savannah District

Georgia Interim Stream Quantification Tool – User Manual

Version 1.0 (dated April 27, 2018)

Contents

Glossary of Terms

Alluvial Valley – Valley formed by the deposition of sediment from fluvial processes.

Catchment – Portion of the project watershed that drains to the uppermost end of the project reach. The catchment is the total drainage area above the project reach.

Colluvial Valley – Valley formed by the deposition of sediment from hillslope erosion processes. Colluvial valleys are typically confined by terraces or hillslopes.

Condition Score – A value between 1.00 and 0.00 that expresses whether the associated parameter, functional category, or overall restoration reach is functioning, functioning-at- risk, or not functioning compared to a reference condition.

- ECS = Existing Condition Score
- PCS = Proposed Condition Score

Confined Alluvial Valley – Valley formed by the deposition of sediment from fluvial processes but confined between adjacent hillslopes. These valleys typically have noticeable slope changes in very short distances.

Credit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the accrual or attainment of aquatic functions at a compensatory mitigation site. The measure of aquatic functions is based on the resources restored, established, enhanced, or preserved (33 CFR 332.2; 40 CFR 230.922).

Debit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the loss of aquatic functions at an impact or project site. The measure of aquatic functions is based on the resources impacted by the authorized activity (33 CFR 332.2; 40 CFR 230.92).

Functional Capacity – The degree to which an area of aquatic resource performs a specific function (33 CFR 332.2; 40 CFR 230.92).

Functional Category – The levels of the stream functions pyramid: Hydrology, Hydraulics, Geomorphology, Physicochemical, and Biology. Each category is defined by a functional statement.

Functional Foot Score (FFS) – The product of a condition score and stream length.

- Existing FFS = Existing Functional Foot Score. Calculated by measuring the existing stream length and multiplying it by the Existing Condition Score (ECS).
- Proposed FFS = Proposed Functional Foot Score. Calculated by measuring the proposed stream length and multiplying it by the Proposed Condition Score (PCS).

Function-Based Parameter –A structural measure or function (expressed as a rate) that both represents and supports the ecosystem functions expressed as functional statements for each functional category.

Functions – The physical, chemical, and biological processes that occur in ecosystems (33 CFR 332.2; 40 CFR 230.92).

Performance Standard – Observable or measurable physical (including hydrological), chemical and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives (33 CFR 332.2; 40 CFR 230.92). The GA SQT uses performance standards that convert measured field data values (i.e. measurement methods) to an index value of between 0.0 and 1.0.

Reference Conditions – Conditions incorporating the whole range of variability exhibited by a regional class of aquatic resource as a result of both natural processes and anthropogenic disturbances (33 CFR 332.1; 40 CFR 230.92),

Reference Standard Condition – A stream condition that is considered fully functioning for the parameter being assessed.

Restoration - Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource (33 CFR 332.2; 40 CFR 230.92).

Riparian Buffer (a.k.a. stream buffer or buffer) – Zone or area extending outwards from top of bank on either side of the channel that is comprised of natural vegetation. In the Southeastern U.S., natural riparian buffer vegetation should typically include a mixed assemblage of trees, saplings, shrubs, vines and ground cover vegetation.

Stream Functions Pyramid Framework (SFPF) – The Stream Functions Pyramid is comprised of five functional categories (see above) stratified based on the premise that lower-level functions support higher-level functions and that they are all influenced by local geology and climate.

1. Purpose and Background

The purpose of this User Manual is to introduce the Georgia Interim Stream Quantification Tool (GA SQT) and provide both background and instruction on its use to calculate functional lift and inform crediting for stream mitigation projects undertaken in accordance with the Clean Water Act (CWA), Section 404 regulatory program in Georgia. This manual includes descriptions of how to collect and calculate field values for each assessment metric in the stream reach condition assessments and describes how those field values are converted to index values in the GA SQT. Few measurements are unique to the GA SQT, and procedures are often detailed in other instruction manuals or literature. Where appropriate, this document will reference other data collection manuals and make clear any differences in data collection or calculation methods needed for the GA SQT. This manual will refer to stream restoration in accordance with the definition used by the Final Mitigation Rule (33 CFR 332; 40 CFR 230):

> *Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource.*

This definition encompasses all activities aimed to improve stream functions undertaken for compensatory mitigation or other purposes. Fischenich (2006) described 15 key stream and riparian zone functions aggregated into five categories including system dynamics, hydrologic balance, sediment processes and character, biological support, and chemical processes and pathways. This work informed the development of the Stream Functions Pyramid Framework (SFPF; Harman et al., 2012) and the North Carolina SQT (Harman and Jones, 2017), which collectively provide the structural underpinnings of the GA SQT. The functional pyramid provides an organizational framework around which stream restoration practitioners and project reviewers can develop and identify clear goals, inform better site selection and focus on a suite of measurements for assessing applicable functions in an objective manner. This document and the Georgia Interim Stream Quantification Tool Worksheet assumes the reader has a firm knowledge of stream processes and the SFPF; therefore, it does not provide extensive definitions of terms such as bankfull, thalweg, riffle, etc.

Collection and analysis of the watershed-scale and stream reach-scale data necessary to evaluate before proposing a stream restoration project, or even selecting a potential stream restoration site, is not limited to only the assessment metrics and methods included in the GA SQT. The GA SQT incorporates only some of the necessary assessment metrics that all stream restoration projects will be expected to assess and document for the U.S. Army Corp of Engineers, Savannah District and the Georgia Interagency Review Team. Thus, the GA SQT is not a method or protocol for designing a stream restoration project.

The Georgia Stream Quantification Tool (GA SQT) – Microsoft Excel Workbook and this User Manual can be downloaded from the RIBITS website at: https://ribits.usace.army.mil/ribits_apex/f?p=107:27:3186893971619::NO:RP:P27_BUTTON_KEY:10

In addition, the above referenced RIBITS web site also includes a list of habits and trophic habits (i.e. functional feeding groups) per macroinvertebrate genus used in the assessment metrics for the Biology functional category (see Section 3.3). The GA SQT and accompanying documents will be updated periodically as additional data are gathered and reference standards and assessment metrics are refined.

2. Getting Started with the GA SQT

The GA SQT is used to inform mitigation credit allocations for stream mitigation projects undertaken pursuant to the CWA 404 regulatory program. The assessment metrics, measurement methods and associated performance standards utilized in the GA SQT will not necessarily be the only field variables for which monitoring will be required, nor will they be the only field variables for which performance standards (success criteria) will be assigned.

The GA SQT uses three functional categories from the SFPF: Hydraulics, Geomorphology and Biology. All GA SQT functional categories, parameters and assessment metrics used to assess baseline conditions must also be used to assess post-construction conditions throughout the monitoring period. Only the benthic macroinvertebrate parameter of the Biology functional category is optional. Note however, that the maximum possible Overall index score of the GA SQT (i.e. 1.0) is based upon all three functional categories weighted equally. Thus, by omitting the Biology category, the practitioner also caps the potential Overall scoring at 0.67, instead of 1.0.

The quantification tool worksheet in the GA SQT Microsoft Excel workbook is the main spreadsheet of the GA SQT. Users enter field data describing the existing and proposed (or monitored) conditions of the mitigation project stream reach, and the calculator quantifies functional lift or loss. The quantification tool worksheet contains three areas for data entry: Site Information and Performance Standard Stratification, Existing Condition Assessment field values, and Proposed Condition Assessment field values. Cells that allow user input are shaded grey. All other cells are locked.

2.1 Site Information and Performance Standard Stratification

The Site Information and Performance Standard Stratification section of the quantification tool worksheet consists of general site information and other project-specific information necessary to determine which performance standards are applied in the GA SQT for calculating index values. Some fields in this section include drop-down menus from which the user will select the appropriate value, while others require information to be manually entered. The values selected or entered into these fields establish links between the quantification tool worksheet and the applicable performance standards. It is therefore important for the user to input accurate site information.

2.2 Existing and Proposed Condition Assessment Field Values

Once the Site Information and Performance Standard Stratification section has been completed, the user can input data into the field value column of the Existing and Proposed Condition Assessment tables.

The Existing Condition Assessment field values are derived from measurements collected in the field during baseline condition assessment of the project site before any mitigation work is undertaken. The Proposed Condition Assessment field values are representative of estimated, but logical, field values informed by design studies/ calculations, reports, and best available science. Proposed condition field values are estimated during the development of the mitigation plan, but then measured in the field during the post-construction monitoring phase to validate the proposed condition index scores.

2.3 Scoring Functional Lift

Scoring occurs automatically as field values for each assessment metric are entered into the Existing Condition Assessment or Proposed Condition Assessment tables. A field value will reflect an index value ranging from 0.0 to 1.0 for that assessment metric, based on the performance curves provided in the Performance Standards worksheet. Assessment metric index values are averaged to calculate parameter scores on the quantification tool worksheet. Parameter scores within each functional category are equally weighted and averaged to calculate functional category scores. Similarly, category scores are equally weighted and averaged to calculate an overall condition score.

The quantification tool worksheet summarizes the scoring at the top of the sheet, next to and beneath the Site Information and Performance Standard Stratification table. There are three summary tables: Functional Change Summary, Function Based Parameters Summary and Functional Category Report Card.

The Functional Change Summary table provides the overall scores from the Existing Condition Assessment and Proposed Condition Assessment sections. This table illustrates the overall condition scores, functional change occurring at the project site, and incorporates the length of the project to calculate the overall Functional Foot Score (FF). The change in functional condition of the project stream is the difference between the proposed condition score (PCS) and the existing condition score (ECS). The table includes the existing and proposed stream lengths in order to calculate and communicate functional foot scores (FF). A functional foot is the product of a condition score and the stream length. Since the condition score must be 1.0 or less, the functional foot score is always less than or equal to the actual stream length.

$$Existing\ FF = ECS * Existing\ Stream\ Length$$

$$Proposed\ FF = PCS * Proposed\ Stream\ Length$$

The difference between the Proposed FF and the Existing FF is the amount of functional lift (or loss) resulting from the project related activities, and will inform the calculation of mitigation credits. The functional lift is also shown as the percent lift in functional feet for a project reach.

$$Functional\ Change = \frac{Proposed\ FF - Existing\ FF}{Existing\ FF} * 100$$

The Proposed FF – Existing FF score is also reported in the Mitigation Summary table. If this value is a positive number, then functional lift is occurring at the project site. A negative number represents a functional loss. To evaluate projects that consist of multiple reaches, the Proposed FF – Existing FF score for each reach is summed to create an overall project functional foot value.

3. Assessment Metric Field Values

The GA SQT includes Condition Assessments on the quantification tool worksheet, as well as the monitoring data worksheets. Data collection and analysis procedures for existing condition assessments and post-construction monitoring events should follow the procedures outlined in this section of the User Manual. During the project design and review period, the proposed condition assessment table is filled out with data from the project design and best professional judgement of the anticipated project outcome. Subsequent to project construction, actual measured field values collected during each monitoring event are entered in the monitoring data worksheets.

The field methods used to collect and/or calculate measured field values for each assessment metric are summarized below. No new field sampling protocols have been developed exclusively for the GA SQT, and most parameters will be familiar to practitioners and project sponsors. The only assessment metric with which practitioners may be unfamiliar is the large woody debris index. Additionally, the protocol for sampling and evaluating benthic macroinvertebrates is not the same as that utilized by the Georgia Environmental Protection Division as part of its monitoring and assessment program.

3.1 Hydraulics

The GA SQT currently contains one function-based parameter to describe the transport of water in the channel, on the floodplain, and through sediments: floodplain connectivity. Two assessment metrics are used to quantify floodplain connectivity: bank height ratio (BHR) and entrenchment ratio (ER). This parameter and both assessment metrics should be used for all projects. Note that the performance standards are stratified by Rosgen stream type to account for differences between streams in alluvial valleys relative to colluvial and v-shaped valleys. Both BHR and ER should be assessed for a stream length that is 20x the bankfull width or the entire reach length, using whichever is shorter (Harrelson et al., 1994). Note however that the minimum assessment reach length for the GA SQT is 100 meters.

3.1.1 Bank Height Ratio (BHR)

Bank height ratio (BHR) is a measure of channel incision and therefore representative of the likelihood for a stream to inundate its floodplain; the lower the ratio, the more frequently stormflow accesses the floodplain. The most common calculation for BHR is the low bank height divided by the maximum bankfull riffle depth (D_{max}). The low bank height is the lower of the left and right streambanks (measured at a riffle), indicating the minimum water depth necessary to inundate the floodplain:

$$BHR = Low\ Bank\ Height/D_{max} \qquad \text{Equation (1)}$$

To improve consistency, the GA SQT requires every riffle within the assessment reach to be measured. The BHR should be measured at the midpoint of the riffle, halfway between the head of the riffle and the head of the run or pool if there is not a run. Using this dataset, a weighted BHR is calculated using Equation (2) and illustrated in Table 2.

$$BHR_{weighted} = \Sigma^{n}_{i=1}(BHR_i * RL_i)/\Sigma^{n}_{i=1} RL_i \qquad \text{Equation (2)}$$

where, RL_i is the length of the riffle where BHR_i was measured.

Table 2. Example calculation of weighted bank height ratio (BHR).

Riffle ID	Length (RL)	BHR	BHR * RL
R1	25	1.0	25
R2	50	1.5	75
R3	5	1.1	5.5
R4	30	1.7	51
Total	**110 ft.**	**Total**	**156.5**
Weighted BHR = 156.5/110 = 1.4			

The reference conditions for the BHR measurement method follow the delineations for risk rating categories where very low and low risk banks are functioning; high, very high, and extreme risk banks are not functioning; and moderate risk banks are functioning-at-risk (Rosgen, 2014). For the GA SQT, BHR can be calculated for each riffle within the reach using either detailed or rapid field methods. While rapid field methods may be suitable for preliminary site assessments, detailed methods are expected to be used for more formal assessment of baseline conditions, design and compensatory monitoring.

Detailed Method:
For the GA SQT, the BHR is measured at riffle features from the longitudinal profile. Harrelson et al. (1994) provides field instructions for surveying a longitudinal profile, and examples of BHR calculations made at riffles along the longitudinal profile are provided in Rosgen (2014). This method is objective and reproducible, as it is measured directly from the surveyed longitudinal profile and easily verified in the office.

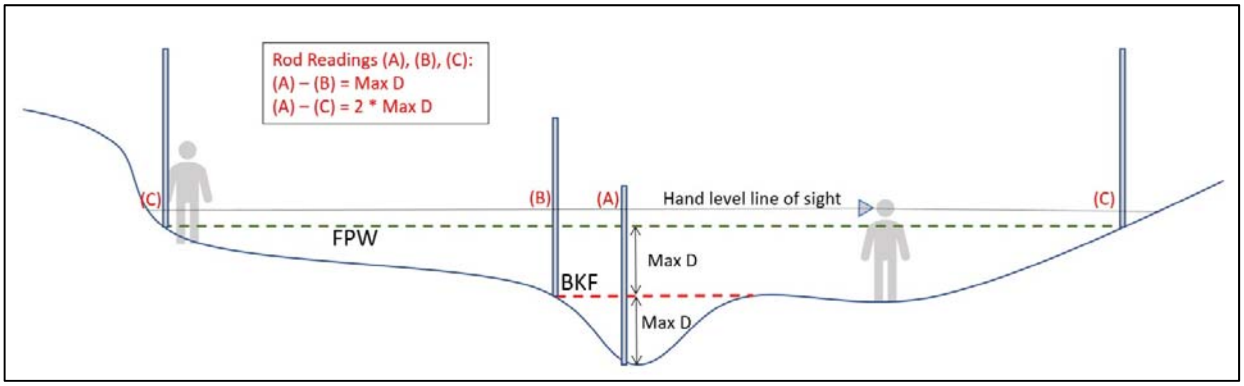
Rapid Method:
Rapid methods record measurements taken in the field using a stadia rod and a hand level and do not require a longitudinal profile survey. A line level can be used instead of a hand level for small streams.

1. Identify the middle of the riffle feature and the lower of the two streambanks.
2. Measure the difference in stadia rod readings from the thalweg to the top of the low streambank. This result is the Low Bank Height in Equation (1).
3. Measure the difference in stadia rod readings from the thalweg to the bankfull indicator, and enter this value in the denominator of Equation (1).
4. Measure the length of the riffle.
5. Repeat these measurements for every riffle to enter values into Equation (2).

3.1.2 Entrenchment Ratio (ER)

Entrenchment ratio (ER) is used to describe the vertical containment of a channel. It is a measure of approximately how far the 2-percent-annual-chance (50-year) discharge will laterally inundate the floodplain (Rosgen, 1996). ER is calculated by dividing the flood prone width by the bankfull width of a channel, measured at a riffle cross section (Equation (3)). The flood prone width (FPW on Figure 1) is measured as the cross section width at an elevation two times the bankfull max depth.

$$ER = Flood\ Prone\ Width/Bankfull\ Width \qquad \text{Equation (3)}$$



Source: TDEC (2017).

Figure 1. Surveying entrenchment ratio using rapid methods.

Unlike the BHR, the ER does not necessarily have to be measured at every riffle, if the valley width is fairly consistent. For valleys that have a variable width or for channels that have BHR's that range from 1.8 to 2.2, it is recommended that the ER be measured at each riffle and calculate a weighted ER using Equation (4) and illustrated in Table 3.

$$ER_{weighted} = \Sigma^{n}_{i=1}(ER_i * RL_i)/\Sigma^{n}_{i=1} RL_i \qquad \text{Equation (4)}$$

where, RL_i is the length of the riffle where ER_i was measured.

Table 3. Example calculation of weighted entrenchment ratio (ER).

Riffle ID	Length (RL)	ER	ER * RL
R1	25	1.2	30
R2	50	2.1	105
R3	5	1.6	8
R4	30	1.8	54
Total	**110 ft.**	**Total**	**197**
Weighted ER = 197/110 = 1.8			

There are two sets of reference conditions for ER, one for C and E type streams that are typically in alluvial valleys, and one for A and B type streams that typically occur in higher gradient systems with confined valleys. Note that the performance standard utilized in the GA SQT is based on the proposed stream type, not the existing stream type. For example, if the existing stream type is a Gc and the proposed stream type (which should be the appropriate stream type for the given valley morphology) is a C, the GA SQT will use performance standards for a C-type channel. The reference conditions for this assessment metric are based on the classification criteria for stream type with modifications based on best professional judgement. For the GA SQT, ER can be calculated using either detailed or rapid field methods. While rapid field methods may be suitable for preliminary site assessments, detailed methods are expected to be used for more formal assessment of baseline conditions, design and compensatory monitoring.

Detailed Method:
Measure ER at riffle features from surveyed cross sections. Harrelson et al. (1994) provides field instructions for surveying a cross section, and example ER calculations are provided in Rosgen (2014). This method is objective and reproducible, as it is measured directly from the surveyed cross sections and is easily verified in the office.

Rapid Method:
Rapid methods record measurements taken in the field using a stadia rod and a hand level and do not require surveyed cross sections. A line level can be used instead of a hand level for small streams. The rapid method measures the ER using bankfull and entrenchment widths measured from a riffle cross section.

1. Identify the middle of the riffle feature.
2. Measure the width between bankfull indicators on both banks and enter this value in the denominator of Equation (4).
3. Measure the difference in stadia rod readings from the thalweg to the bankfull indicator.
4. Locate and flag the point along the cross section in the floodplain where the difference in stadia rod readings between the thalweg and that point is twice that of the difference measured in the previous step.
5. Repeat step 4 on the other bank.
6. Measure the distance between the flags and enter this value as the numerator of Equation (3).
7. Measure the length of the riffle and repeat these measurements for every riffle to enter values into Equation (4), if needed.

3.2 Geomorphology

The GA SQT contains two function-based parameters to describe the transport of wood and sediment that creates diverse bed forms and maintains dynamic equilibrium: riparian vegetation and bed form characterization. One assessment metric is used to represent riparian vegetation, and three metrics are used to characterize bed forms.

3.2.1 Riparian Vegetation

Riparian vegetation is a critical component of a healthy stream ecosystem. While riparian vegetation is a life form and could be included in the Biology functional category, it also directly effects channel stability (geomorphology) and supports denitrification and other water quality functions. The assessment metric used in the GA SQT is solely the width of the vegetated riparian buffer on both the left and right sides of the channel. The width of the riparian buffer plays an important role in the capacity of the channel to adjust to long-term climatic trends and commensurate changes in sediment load and/or discharge. Therefore, riparian vegetation is placed within the Geomorphology functional category of the GA SQT.

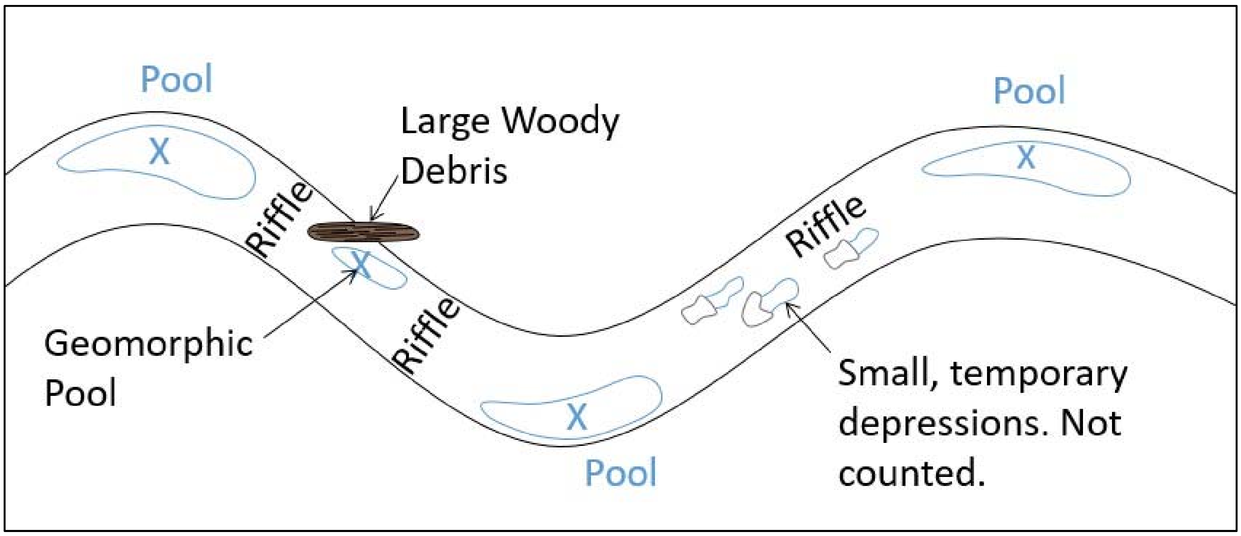
The riparian buffer width is measured horizontally from the top of the stream bank to the outer limit of the natural vegetative buffer or the proposed conservation easement boundary. Buffer width is measured perpendicular to the fall-line of the valley on the left and right sides of the channel. This measurement does not include the channel width itself. Measurements should be taken every 50-100 feet along the centerline of the channel (not the thalweg), and can be performed using recent ortho-imagery. However, remote sensing measurements must be verified with sufficient measurements collected in the field. An average buffer width is then calculated individually for the right and left side of the channel.

3.2.2 Bed Form Characterization

Bed forms include riffles, runs, pools and glides. Together, these bed features create important habitats for aquatic life and help dissipate the energy of flowing water. The location, stability, and depth of these bed features are symptomatic of sediment transport processes acting against the channel boundary conditions. Therefore, if the bed forms are representative of reference standards, it is assumed that the sediment transport processes are functioning normally and in equilibrium.

There are two assessment metrics for this parameter: pool spacing ratio and percent riffle. Both of these metrics should be assessed over a channel length that is at least 20x the bankfull width (two meander wavelengths for meandering streams is preferable) or the entire reach length, using whichever is shorter (Harrelson et al., 1994). Note however that the minimum assessment reach length for the GA SQT is 100 meters.

Pools are only measured if they are geomorphically significant and relatively permanent. In reference alluvial systems, these include pools located along the outside of meander bends and pools downstream of large, relatively stable flow obstructions such as steps formed by large trees, boulders or bedrock outcrops (Figure 2). Large pools providing energy dissipation are included, but small pools providing only habitat are not. For example, small, temporary depressions within riffles are not included as pools in the GA SQT. Pools should be noticeably deeper than riffle features, and the water surface slope of the pool should be lower than the riffle water surface slope at low flow.

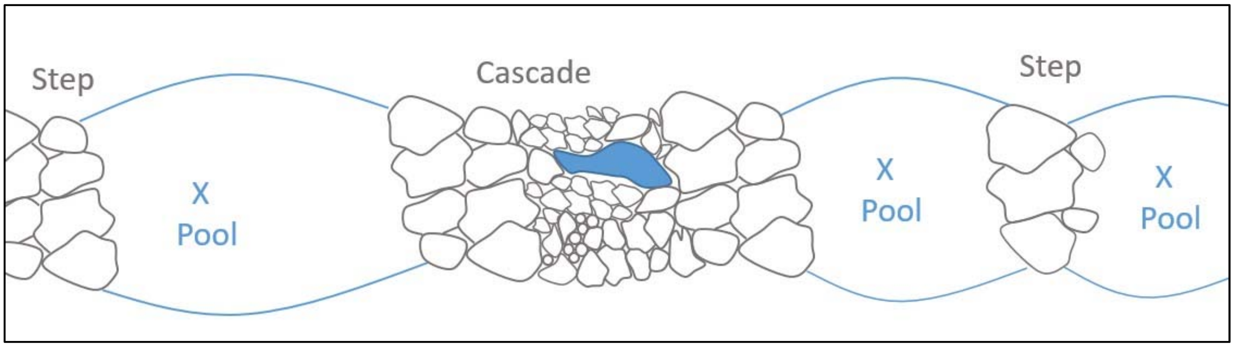


Source: TDEC (2017).

Figure 2. Pool spacing in alluvial valley streams (X marks the D_{max} location of pools counted for pool spacing).

Compound pools that are not separated by a riffle within the same meander bend are treated as a single pool. The deepest of such compound pools is used for measuring spacing. Compound bends with two pools separated by a riffle are treated as two pools. These scenarios are illustrated in Rosgen (2014).

Pools in colluvial or v-shaped valleys should only be included in measurements of pool spacing for the GA SQT if they are downstream of a step or riffle/cascade. Small, temporary pools within a riffle or cascade are not counted (Figure 3).



Source: TDEC (2017).

Figure 3. Pool spacing in colluvial and V-shaped valleys (X marks the D_{max} location of pools counted for pool spacing).

3.2.2.1 Pool Spacing Ratio

The pool spacing ratio is the calculation of the distance between successive geomorphically relevant pools divided by the bankfull riffle width (Equation (5)). The bankfull riffle width is measured from one stable riffle cross section rather than measured at each riffle. Dimensions from a stable riffle are used in this ratio in order to quantify the departure from a stable condition.

$$Pool\ Spacing\ Ratio = \frac{Distance\ between\ sequential\ pools}{Bankfull\ width} \qquad \text{Equation (5)}$$

The pool spacing ratio is calculated for each pair of sequential pools in the assessment reach. While the range of pool spacing ratios observed at a site should be assessed and reported, the field value entered in the GA SQT is the median value based on at least five pool spacing measurements. In a meandering stream, a moderate ratio is preferred over a very low or very high ratio. In other words, having too many pools or too many riffles can be detrimental to channel stability. In steeper gradient systems, the frequency of pools often increases with slope, and concerns about channel stability increase with higher pool spacing ratios. Reference conditions are stratified by stream type and channel slope.

Detailed Method:
For the detailed method, pool-to-pool spacing is measured from the longitudinal profile as the distance between the deepest points of two pools.

Rapid Method:
For the rapid assessment, a tape is laid along the stream centerline or bank and the stations for the deepest point of each pool within the assessment reach are recorded in the field and used to calculate the pool-to-pool spacing. A stable riffle is selected from within the sampling reach and the bankfull width of this stable riffle is measured with a

tape and recorded to calculate the pool-to-pool spacing ratio for each pair of pools using Equation (5).

3.2.2.2 Percent Riffle

The percent riffle is the total length of riffles within the assessment reach divided by the total assessment stream length. Riffle length is measured from the head (beginning) of the riffle downstream to the head of the pool. Run features are included with the riffle length. Calculating the percent of pool features is optional, and reference conditions for percent pool are not provided. However, if practitioners choose to calculate percent pool, the glide features should be included in the percent pool calculation. Performance standards are stratified by stream type.

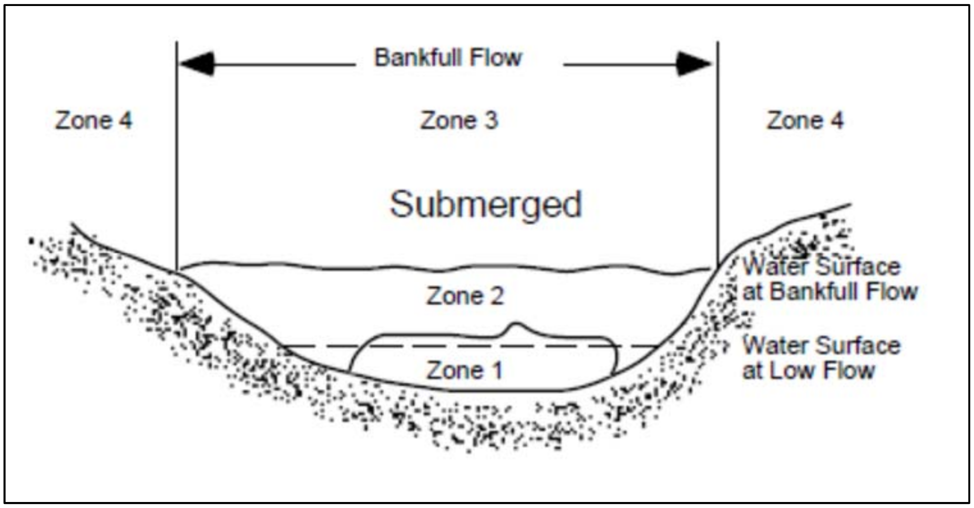
Detailed Method:
For the detailed assessment method, the percent riffle is measured from a longitudinal profile of the stream thalweg. Instructions for surveying a longitudinal profile are provided by Harrelson et al. (1994).

Rapid Method:
For the rapid assessment, a tape is laid along the stream centerline or bank and the stations at the beginning of each riffle and end of each run within the assessment reach is recorded in the field and used to calculate the individual riffle lengths.

3.2.2.3 Large Woody Debris

Large woody debris (LWD) is quantified in the GA SQT using the LWD Index (LWDI) developed by the U.S. Forest Service (Davis et al., 2001). LWD is defined as dead wood over 1 m in length and at least 10 cm in diameter at the largest end. The wood must be in or immediately adjacent to the active stream channel, but not solely resting atop the valley flat of an incised channel. Each of four zones or locations for the LWD contributes to the scoring of LWDI (Figure 4).

A sample reach of 100 m is required and must be within the same reach or sub-reach limits as the other geomorphology assessments. Additionally, the 100 m stream reach from which the LWDI is calculated should represent the 100 m segment of the larger assessment reach that will yield the highest LWDI score. The highest score, rather than an average score, is selected to reduce subjectivity in identifying an average condition.



Source: Davis et al. (2001), citing Robison and Beschta (1990).

Figure 4. Four stream locations or zones for inventorying large woody debris using the LWD Index (Davis et al., 2001).

The current reference conditions used in the GA SQT are based on data collected from 16 sites throughout the Piedmont and Mountain regions of North Carolina. A data collection effort is currently underway in Tennessee ecoregions (2017-2018), and that data may be utilized to update the GA SQT reference conditions until data from Georgia streams can be collected and assessed.

3.3 Biology

The GA SQT contains one function-based parameter to evaluate the biodiversity and ecological integrity of aquatic life: macroinvertebrate community structure. This function-based parameter and its associated reference conditions are applicable only to streams draining ≤ 3.0 square miles, and only in the Piedmont and Blue Ridge Level IV ecoregions (Ecoregions 45 and 66, respectively). Stream mitigation projects on streams draining greater than 3.0 square miles or streams lying outside of the above referenced Level IV ecoregions will be assessed for Biology on a case by case basis.

The GA SQT biological reference conditions are based on reference biological stream data from 183 sites in North Carolina that span the full range of biological conditions from poor to excellent. The collection, sorting, taxonomy and data reduction protocols for benthic macroinvertebrate sampling undertaken pursuant to the GA SQT must therefore be performed by a qualified biologist following the Qual 4 protocols outlined in the NC Department of Environmental Quality, Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates (NC DEQ, 2016), including the “pre-sampling site assessment” and the associated habitat assessment.

Four collections are made using the Qual 4 Method, and specific descriptions/ instructions for each collection are provided in Section 3.4 of NC DEQ (2016):

- one riffle-kick
- one sweep
- one leaf-pack
- visual

Care must be taken to note the ecoregion, drainage area and date of collection. Note that benthic macroinvertebrate sampling for the GA SQT should be undertaken between April 1 and June 30.

NC DEQ (2016) uses abundance classes instead of actual organism counts to represent organism abundance. For this reason, the GA SQT utilizes assessment metrics based on proportions of taxa richness rather than actual percentages of organisms present in the samples. Consequently, while all representative specimens in the entire macroinvertebrate sample (i.e. all four collections per sample station) must be picked for identification to obtain accurate taxa richness data, actual enumeration of all specimens per taxa is not required.

Each taxon must be identified and assigned to its respective habit and trophic habit following Poff et al. (2006) [see also Vieira et al. (2006)]. Then the proportion of total genus-level taxa richness comprised of organisms sharing each habit is computed. Based on analysis of eight potential assessment metrics assessed from the North Carolina data, the following selected traits are utilized in the GA SQT:

- Proportion Genus-level EPT[1] Richness
- Proportion Genus-level Clinger Richness
- Proportion Genus-level Shredder Richness
- Proportion Genus-level Burrower Richness

In order to develop the actual performance conditions, the proportion-based values from the North Carolina were standardized according to the percent-of-standard method (Barbour et al. 1999) using “ceilings” and “floors” to limit the influence of biological assemblages corresponding to values outside of the 95th percentile and 5th percentile. Standardization equations in Table 4, use the specific “ceiling” and “floor” values for each assessment metric in each Level IV ecoregion presented in Table 5. Users of the GA SQT must standardize their “raw” proportion-based values for the above referenced four assessment metrics, and enter the standardized values in the applicable Field Value columns of the Existing Condition Assessment and Proposed Condition Assessment tables of the GA SQT quantification tool worksheet.

[1] Taxa in the Ephemoptera, Plecoptera and Trichoptera orders (i.e. mayflies, stoneflies and caddisflies).

Table 4. Standardization equations for benthic macroinvertebrate measurement methods in the GA SQT.

Standardized Proportion Genus-level EPT Richness	$= \frac{(Prop\ EPT\ Rich - Floor)}{(Ceiling - Floor)}$	Equation (6)
Standardized Proportion Genus-level Clinger Richness	$= \frac{(Prop\ Clinger\ Rich - Floor)}{(Ceiling - Floor)} * 100$	Equation (7)
Standardized Proportion Genus-level Shredder Richness	$= \frac{(Prop\ Shredder\ Rich - Floor)}{(Ceiling - Floor)} * 100$	Equation (8)
Standardized Proportion Genus-level Burrower Richness	$= \frac{(Ceiling - \ Prop\ Burrower\ Rich)}{(Ceiling - Floor)} * 100$	Equation (9)

Table 5. Ceiling and floor values used to standardize raw proportion metrics according to Equations 6 through 9.

Metric		Piedmont	Blue Ridge
Proportion Genus-level EPT Richness	Ceiling	43.4	66.7
	Floor	9.7	16.4
Proportion Genus-level Clinger Richness	Ceiling	48.0	56.9
	Floor	24.0	20.0
Proportion Genus-level Shredder Richness	Ceiling	16.2	23.3
	Floor	3.3	7.7
Proportion Genus-level Burrower Richness	Ceiling	30.0	30.3
	Floor	14.6	8.2

If a standardized assessment metric value for any given sample is greater than 100 (i.e. a data value above the 95th percentile of the reference data), it must be corrected to equal 100. Similarly, if a standardized assessment metric value is less than 0 (i.e. a data value below the 5th percentile of the reference data), it must be corrected to equal 0.

4. References

Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stripling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Ed. EPA-841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Davis, J.C., G.W. Minshall, C.T. Robinson, and P. Landres. 2001. Monitoring Wilderness Stream Ecosystems. General Technical Report RMRS-GTR-70. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Fischenich, J.C. 2006. Functional Objectives for Stream Restoration. Vicksburg, M.S. U.S. Army Engineer Research and Development Center. EMRRP Technical Notes Collection, ERDC TN- EMRRP-SR-52.

Harman, W.A. and C.J. Jones. 2017. North Carolina Stream Quantification Tool: Spreadsheet User Manual, NC SQT v3.0. Environmental Defense Fund, Raleigh, NC.

Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. A Function-Based Framework for Stream Assessment and Restoration Projects. US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. General Technical Report RMRS-GTR-245. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

NC DEQ. 2016. Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates, Version 5.0. North Carolina Department of Environmental Quality, Division of Water Resources. Raleigh, North Carolina. February 2016. https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/biological-assessment-branch/dwr-benthos-data

Poff, N.L., J.D. Olden, N.K.M. Vieira, D.S. Finn, M.P. Simmons and B.C. Kondratieff. 2006. Functional trait niches of North American lotic insects: traits-based ecological applications in light of phylogenetic relationships. Journal of the North American Benthological Society 25(4): 730-755.

Robison, E.G., and R.L. Beschta. 1990. Characteristics of coarse woody debris for several coastal streams of southeast Alaska, USA. Canadian Journal of Fisheries and Aquatic Sciences 47: 1684-1693.

Rosgen, D.L. 1996. Applied River Morphology, Wildland Hydrology Books, Pagosa Springs, Colorado.

______. 2014. River Stability Field Guide, Second edition. Wildland Hydrology Books, Fort Collins, Colorado.

TDEC. 2017. Tennessee Stream Quantification Tool: Data Collection and Analysis Manual, TN SQT v1.0. Tennessee Department of Environment and Conservation, Nashville, TN.

Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C. Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available from http://pubs.water.usgs.gov/ds187