Draft Stream Mitigation Guidelines for the State of Tennessee

The department is working with the U.S. Army Corps of Engineers to revise the Tennessee Stream Mitigation Guidelines originally published in 2004. The guidelines would be used in determining the type and quantity of mitigation for permitted stream impacts in both the state Aquatic Resource Alteration Permit and federal §404 regulatory programs. A significant part of the revision is the inclusion of a rapid functional assessment of the stream being impacted as well as the stream where mitigation would occur. Since the proposed approach is untested, we especially invite comments and evaluation concerning the Stream Mitigation Assessment Sheet including factors and weighting used to derive mitigation quantities. The draft for review and comment follows. Comments or inquiries can be directed to Ben Brown at benjamin.brown@tn.gov or 615-532-0645.

DRAFT

STREAM MITIGATION GUIDELINES FOR THE STATE OF TENNESSEE

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
NATURAL RESOURCES SECTION

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Section #1 Introduction

Purpose

The U.S. Army Corps of Engineers (Corps) and Tennessee Division of Water Pollution Control (TDEC) require compensatory mitigation for certain permitted impacts to Tennessee's streams. Compensatory mitigation is required for offsetting unavoidable adverse impacts which remain when all appropriate and practicable avoidance and minimization has been achieved. Compensatory mitigation may be accomplished through the replacement, restoration, and enhancement of aquatic resources utilizing fluvial geomorphological principles, natural channel designs, bioengineering techniques, and other appropriate methods, and potentially through preservation of existing aquatic resources.

The intent of this document is to provide permit applicants, consultants, and others with guidance on preparing compensatory mitigation and monitoring plans for unavoidable impacts to the aquatic environment. It replaces the July 1, 2004 *Stream Mitigation Guidelines for the State of Tennessee.* This document includes reference to federal and state regulations and policies, and discusses activities requiring compensatory mitigation, mitigation activities to compensate for impacts, and monitoring requirements. It also provides definitions of terms pertinent to or utilized within this document as related to stream mitigation. These guidelines do not replace state or federal law or regulations on the subject of mitigation. Any conflict must be resolved in favor of law and rules. The State of Tennessee's rules on mitigation are found in the Rules of the Tennessee Water Quality Control Board Chapter 1200-4-7 and 1200-4-3-.06. The applicable federal rules are found in Department of the Army (DA), Corps of Engineers 33 CFR Parts 325 and 332-Compensatory Mitigation for Losses of Aquatic Resources.

This method is not certified for use in Corps Civil Works ecosystem restoration and mitigation projects. In May 2005, the Corps established a Model Certification process known as the Planning Models Improvement Program (PMIP) to review, improve, and validate analytical tools and models for Corps Civil Works business programs [Engineering Circular (EC) 1105-2-407]. The EC requires use of certified models for all planning activities and tasks the Ecosystem Restoration Planning Center of Expertise (ECO-PCX) to evaluate the technical soundness of models used in ecosystem restoration and mitigation projects. The Tennessee Stream Mitigation Guidelines is not encumbered by the EC and will undergo separate evaluation by ECO-PCX should Corps Civil Works Planning have an interest in using this methodology.

Please note that TDEC and the Corps' regulatory programs operate under different authorities; activities that require permits and mitigation from one agency may not require permits or mitigation from the other. Questions about specific permitting and mitigation requirements should be directed to the appropriate agency.

This guidance is not a rule and therefore applicants may submit mitigation plans based on other approaches. If, for example a different approach is used, the scientific basis for the approach must be explained in the document and it will be evaluated by the appropriate permitting agency(ies). This guidance is not intended to provide all the details for collecting data, analyzing data, or writing mitigation plans since many of the information needs are site and project specific. **In some cases, the evaluation of the permit application may reveal the proposed stream compensation measures are not practical, constructible, or ecologically desirable, therefore, all determinations involving projects requiring stream mitigation will be made on a case-by-case basis at the discretion of the reviewing agencies.**

Statutory and Regulatory Authorities

Section 10 of the Rivers and Harbors Act of 1899*: Section 10 of the Rivers and Harbors Act* prohibits construction, excavation or filling activities in Navigable Waters *of* the United States without a permit from the Corps.

Section 404 of the Clean Water Act*:* In accordance with *Section 404 of the Clean Water Act* (CWA), the Corps has the responsibility to administer a permit program regulating discharges of dredged or fill material in Waters of the United States including wetlands. The purpose of the CWA is to restore and maintain the physical, chemical, and biological integrity of the nation's waters. Frequently, the permits issued under Section 404 and Section 10 require compensatory mitigation for the unavoidable aquatic resource losses, including stream resources.

Section 404(b)(1) Guidelines*: Section 404(b)(1) of the CWA* authorizes EPA to issue "guidelines" to be followed by the Corps in issuing §404 permits. The "guidelines" have been promulgated as rules that are found at 40 CFR, Part 230. Section 230.10(d) states in part that "...no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem."

EPA/Army Mitigation Memorandum of Agreement (MOA), February 6, 1990: The MOA interprets Section 230.10 (d) of the Guidelines to require the use of mitigation in order to be in compliance with this section of the Guidelines. As clarified in the MOA, compliance with the Section 404 (b)(1) Guidelines requires application of a sequence of mitigation -- avoidance, minimization, and compensation. In other words, mitigation consists of the set of modifications necessary to avoid adverse impacts altogether, minimize the adverse impacts that are unavoidable, and compensate for the unavoidable adverse impacts. Compensatory mitigation is required for unavoidable adverse impacts, which remain after all appropriate and practicable avoidance and minimization has been achieved. The Guidelines identify a number of "Special Aquatic Sites," including riffle pool complexes, which require a higher level of regulatory review and protection. This stream guidance document addresses only compensatory mitigation and should only be used after adequate avoidance and minimization of impacts associated with the proposed project has occurred.

Compensatory Mitigation Rule, March 31, 2008 The regulations establish performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects for activities authorized by Department of the Army permits. This rule improves the planning, implementation and management of compensatory mitigation projects by emphasizing a watershed approach in selecting compensatory mitigation project locations, requiring measurable, enforceable ecological performance standards and regular monitoring for all types of

compensation and specifying the components of a complete compensatory mitigation plan, including assurances of long-term protection of compensation sites, financial assurances, and identification of the parties responsible for specific project tasks.

§**401 Water Quality Certification**: Section 401 of *The Federal Clean Water Act* (33 U.S.C. 1341), requires any applicant for a Federal license or permit involving any discharge into Waters of the US (including, but not limited to, a Section 404 Permit) to provide the Corps with a certification from the state in which the discharge originates or will originate that a given project will not violate state water quality standards. In Tennessee, the state Aquatic Resource Alteration Permit typically serves as the §401 Certification.

The Tennessee Water Quality Control Act of 1977: Requires permits for the alteration of the physical, chemical, biological, bacteriological, or radiological properties of waters of the state. Permitted alterations cannot result in a condition of pollution or a violation of water quality standards.

Section 26a of the Tennessee Valley Authority Act: Prohibits the erection or maintenance of any "dam, appurtenant works, or other obstruction, affecting navigation, flood control or public lands or reservations...across, along, or in" the Tennessee River or any of its tributaries until plans for its construction, operation, and maintenance have been submitted and approved by the Board of Directors of the Tennessee Valley Authority.

The Fish and Wildlife Coordination Act (FWCA) of 1958: requires federal agencies, including the Corps, to coordinate its projects and regulatory programs with the U.S. Fish and Wildlife Service, and the state fish and wildlife agency.

Endangered Species Act (ESA): Conserves threatened and endangered species and ecosystems on which those species depend. One of the Acts provisions requires the Corps to consult with the U.S. Fish and Wildlife Service to ensure the regulated activities are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of designated critical habitats.

Important Definitions

Bankfull Discharge: channel forming flow; flow that is most effective at transporting sediment, forming or removing bars, forming or changing bends and meanders, working towards average morphological characteristics of channels (Dunne and Leopold 1978). Bankfull flow is the point at which flooding may begin to escape the stream channel and enter the floodplain. Bankfull flows occur with sufficient regularity and force to establish and maintain a stream's morphology.

Bioengineering techniques: techniques that incorporate the use of vegetation and engineering structures to increase bank stabilization and slope stability.

Buffer: an upland, wetland, and/or riparian area that protects and/or enhances aquatic resource functions associated with wetlands, rivers, streams, lakes, marine, and estuarine systems from disturbances associated with adjacent land uses.

Channel Morphology: The study of the channel pattern and the channel geometry at several points along a river channel, including the network of tributaries within the drainage basin

Compensatory Mitigation: refers to the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of streams for the purpose of offsetting unavoidable adverse impacts that remain after all appropriate and practicable avoidance and minimization has been achieved.

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.

Dam: barrier built across a watercourse to impound or divert water. A barrier that obstructs, directs, retards, collects, confines, or stores the flow of water. A structure built to hold back a flow of water.

***Degradation**: alteration of the properties of waters by the addition of pollutants or removal of habitat.

Dynamic Equilibrium: a condition in which a stream and its floodplain maintain their natural dimension pattern and profile over time, neither aggrading nor degrading (eroding).

Enhancement: the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s).

Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): the manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in the gain in aquatic resource area and functions.

Fill: material placed in waters of the U.S. where the material has the effect of either replacing any portion of a water of the U.S. with dry land or changing the bottom elevation of any portion of water

Functions: the physical, chemical, and biological processes that occur in ecosystems.

Hydrologic Unit Code (HUC): a standardized classification system developed by United States Geological Service to define watershed boundaries.

Impoundment: a body of water formed by impounding

Interagency Review Team (IRT): an interagency group of federal, tribal, state, and/or local regulatory and resource agency representatives that reviews documentation for, and advises the district engineer (DE) on, the establishment and management of a mitigation bank or an in-lieu fee (ILF) program.

Natural Channel Design: a methodology that addresses the entire stream system based on principles of fluvial geomorphology to achieve a channel configuration that is in dynamic equilibrium, neither aggrading nor degrading.

Parameter: A directly measurable biological, chemical, radiological, bacteriological, or physical property of water. Some criteria are expressed in terms of a single parameter; others, such as habitat, nutrients, and biological integrity are not directly measurable, but are derived from measurements of parameters.

Performance Standards: observable or measurable physical (including hydrological), chemical and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives.

Preservation: 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. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic function to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Resource: includes both the physical elements of the environment, such as streams, uplands, wetlands, and non-wetland riparian buffers, as well as life forms such as plants, fish, and mammals that live within the environment.

Restoration: 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. Also, see definitions for re-establishment and rehabilitation above.

Reference Reach: A stable stream reach generally located in the same physiographic ecoregion, climatic region, and valley type as the project that serves as the blueprint for the dimension, pattern, and profile of the channel to be restored.

Reference Conditions: parameter-specific set of data from regional reference sites that establish a statistical range of values for particular variables or stream metrics at least-impacted streams.

***Unavailable Conditions Waters**: 1200-4-3-.06 (2) where water quality is at, or fails to meet, the criterion for one or more parameters.

Watershed: a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

Watershed approach: an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs. A landscape perspective is used to identify the types and locations of compensatory mitigation projects that will benefit the watershed and offset losses of aquatic resource functions and services caused by activities authorized by DA and/or TDEC permits.

The watershed approach may involve consideration of landscape scale, historic and potential aquatic resource conditions, past and projected aquatic resource impacts in the watershed, and terrestrial connections between aquatic resources when determining compensatory mitigation requirements.

Watershed plan: a plan developed by federal, tribal, state, and/or local government agencies or appropriate non-governmental organizations, in consultation with relevant stakeholders, for the specific goal of aquatic resource restoration, establishment, enhancement, and preservation. A watershed plan addresses aquatic resource conditions in the watershed, multiple stakeholder interests, and land uses. Watershed plan may also indentify priority sites for aquatic resource restoration and protection.

**Denotes state specific definition*

Section #2 Project Planning and Compensatory Mitigation Options

Watershed Approach to Mitigation

The goal of a watershed approach is to maintain and improve the quality and quantity of aquatic resources in a watershed through strategic selection of mitigation sites. This approach to mitigation considers the importance of landscape position, maintenance of terrestrial resources, and mitigation projects that contribute to the overall ecological function of aquatic resources within the watershed. It considers how the compensatory mitigation projects will provide the desired aquatic resource functions and function over time in a changing landscape. Considerations include:

- Habitat requirements of important species
- Habitat loss or conversion trends
- Identifying sources of watershed impairment, including identification of degraded aquatic resources
- Current development trends
- Requirements of other regulatory and non-regulatory programs that affect the watershed, such as storm water management or habitat conservation programs
- Identification of immediate and long-term aquatic resource needs within the watershed that can be met through permittee responsible mitigation, mitigation banks, or in-lieu fee (ILF) programs
- Identification and prioritization of aquatic resource restoration, establishment, enhancement activities, and preservation of existing aquatic resources that are particularly important for maintaining or improving ecological functions of the watershed
- Identification and prioritization of resource needs should be as specific as possible to facilitate determination of mitigation requirements

In some watersheds, point and nonpoint sources of pollutant loads have direct and predictable relationships to water body impairment. In many cases, however, the connection between load sources and impairment is less obvious, and physical habitat variation may play an important role in the nature and occurrence of impairment. A spatial analysis of the specific nature and

causes of impairments throughout the watershed is usually not feasible during the watershed inventory. Initial identification can, however, make use of available information, including databases and extant studies on physical habitat degradation and associated impairment of beneficial uses, such as §303(d) lists, §305(b) reports, §319 reports.

Exceptional Tennessee Waters, Outstanding National Resource Waters & Unavailable Conditions Waters

In some situations specific state rules require that any necessary compensatory mitigation be conducted "in-system", which is generally considered to be within the same 12-digit Hydrologic Unit Code (HUC). Mitigation projects within the same 12-digit HUC will be considered in-system. However, for other situations, a determination of what constitutes in-system mitigation will be made by the permitting agencies on a case-specific basis, and will take into consideration relevant factors including, but not limited to, proximity and distance in stream miles between the site where the impact occurs and the mitigation site.

Physical alterations resulting in degradation may not be permitted on some streams. For instance, in surface waters designated by the Water Quality Control Board as Outstanding National Resource Waters, no degradation is permitted. Likewise, state water quality standards may require that mitigation be conducted in-system where stream segments that have been assessed as unavailable conditions waters (impaired for one or more uses) are protected from additional alterations or discharges that may worsen the cause of impairment. Furthermore, degradation is not permitted in Exceptional Tennessee Waters except as provided in Chapter 1200-4-3.06(3) of the Rules of the Water Quality Control Board.

Exceptional Tennessee Waters: 1200-4-3-.06(4)(a) are waters that are in any one of the following categories:

- Waters within state or national parks, wildlife refuges, forests, wilderness areas, or natural areas;
- State Scenic Rivers or Federal Wild and Scenic Rivers;
- Federally-designated critical habitat or other waters with documented non-experimental populations of state or federally-listed threatened or endangered aquatic or semi-aquatic plants, or aquatic animals;
- Waters within areas designated as Lands Unsuitable for Mining pursuant to the federal Surface Mining Control and Reclamation Act where such designation is based in whole or in part on impacts to water resource values;
- Waters with naturally reproducing trout;
- Waters with exceptional biological diversity as evidenced by a score of 40 or 42 on the Tennessee Macroinvertebrate Index (or a score of 28 or 30 in subecoregion 73a) using

protocols found in TDEC's 2006 Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, provided that the sample is considered representative of overall stream conditions; or

- Other waters with outstanding ecological or recreational value as determined by the department. When application of this provision is a result of a request for a permit, such preliminary determination is to be made within 30 days of receipt of a complete permit application.

Outstanding National Resource Waters (ONRW): 1200-4-3-.06 (5) high quality waters that have been designated by rule, such as certain waters in national or state parks, wildlife refuges, and waters of exceptional recreational or ecological value. The currently designated ONRWs are:

- Little River Portion within Great Smoky Mountains National Park.
- Abrams Creek Portion within Great Smoky Mountains National Park.
- West Prong Little Pigeon River Portion within Great Smoky Mountains National Park upstream of Gatlinburg.
- Little Pigeon River from the headwaters within Great Smoky
- Mountains National Park downstream to the confluence of Mill Branch.
- Big South Fork Cumberland River Portion within Big South Fork National River and Recreation Area.
- Reelfoot Lake Tennessee portion of the lake and its associated wetlands.

Mitigation Options

Where appropriate and practicable, compensatory mitigation decisions should be made from a watershed perspective in which the type and location of compensatory mitigation follows from an analytically-based watershed assessment to assure that the proposed compensation furthers watershed goals. This assessment may take the form of a watershed plan, which typically involves an intensive regional planning effort involving many stakeholders. It may also be a less formal watershed approach involving the analysis of available data concerning regional environmental issues, efforts to inventory historic trends in aquatic resource condition, and the prioritization of aquatic resource restoration opportunities.

Both regulatory agencies have mitigation preferences, but also recognize that departure from this preference can be environmentally preferable where replacement wetlands, streams, and other aquatic resources are designed and situated to address specific regional environmental issues, and to bring the maximum ecological benefit to the watershed.

Stream Mitigation Banks

A mitigation bank is a site, or suite of sites, where resources such as streams are restored, established, enhanced, and/or preserved for the purpose of providing compensatory mitigation

for impacts authorized by 404/401 permits. In general, a mitigation bank sells compensatory mitigation credits to permittees whose obligation to provide compensatory mitigation is then transferred to the mitigation bank sponsor.

In-Lieu Fee Programs

In-lieu fee programs involve the restoration, establishment, enhancement, and/or preservation of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation requirements for 404/401 permits. Similar to a mitigation bank, an ILF program sells compensatory mitigation credits to permittees whose obligation to provide compensatory mitigation is then transferred to the in-lieu program sponsor.

Permittee-responsible Mitigation

A permittee may be required to provide compensatory mitigation through an aquatic resource restoration, establishment, enhancement, and/or preservation activity. This compensatory mitigation may be provided at or adjacent to the impact site (i.e., on-site mitigation) or at another location, preferably within the same watershed as the permitted impact (i.e., off-site mitigation). The permittee retains responsibility for the implementation and success of the mitigation project.

Mitigation Plan Review

Mitigation plans are intended to fully illustrate the measures proposed to create, restore, enhance, or preserve a stream. Please keep in mind that the level of detail provided under each section should be commensurate with the scale of the project. The following twelve components must be included in the final mitigation plan:

1. **Objectives**: A description of the resource type(s) and amount(s) that will be provided, the method of compensation (restoration, establishment, preservation, etc.), and how the anticipated functions of the mitigation project will address watershed needs.

2. **Site selection**: A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the mitigation project site.

3. **Site protection instrument**: A description of the legal arrangements and instrument, including site ownership, that will be used to ensure the long-term protection of the mitigation project site.

4. **Baseline information:** a description of the ecological characteristics of the proposed mitigation site, in the case of an application for a 404/401 permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the location of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other characteristics appropriate to the type of resource proposed as compensation. The baseline information should include a delineation of waters of the United States/State on the proposed mitigation site. A prospective permittee planning to secure credits from an approved mitigation bank or ILF program only needs to provide baseline information about the impact site.

5. **Determination of Credits:** a description of the number of credits to be provided including a brief explanation of the rationale for this determination.
    - For permittee responsible mitigation, this should include an explanation of how the mitigation project will provide the required compensation for unavoidable impacts to aquatic resources as a result of the permitted activity.
    - For permittees intending to secure credits from an approved mitigation bank or ILF program, it should include the number and resource type of credits to be secured and how these were determined.

6. **Mitigation work plan:** detailed written specifications and work descriptions for the mitigation project, including: geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water; methods for establishing the desired plant community; plans to control invasive plant species; proposed grading plan; soil management; and erosion control measures. For stream mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross-sections), watershed size, design discharge, and riparian buffer plantings.

7. **Maintenance Plan:** a description and schedule of the maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

8. **Performance standards**: ecologically-based standards that will be used to determine whether the mitigation project is achieving its objectives.

9. **Monitoring requirements**: a description of parameters monitored to determine whether the mitigation project is on track to meeting performance standards and if adaptive management is needed. A schedule for monitoring and reporting monitoring results must be included.

10. **Long-term management plan**: a description of how the mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

11. **Adaptive management plan**: a management strategy to address unforeseen changes in site conditions or other components of the mitigation project, including the party or parties responsible for implementing adaptive management measures.

12. **Financial assurances**: a description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the mitigation project will be successfully completed, in accordance with its performance standards.

Other information: additional information may be required as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

Pre-Application Meetings

A pre-application meeting/consultation is one or more meetings between permitting agency and an applicant and/or his agent/consultant. Applicants are encouraged to schedule a pre-application meeting with the resource and regulatory agencies to identify initial concerns and expedite permit reviews. A pre-application would preferably occur early enough in the process to allow for agencies' input that could reduce the expenditure of funds on a project requiring permitting and mitigation.

Section #3 Debits

Evaluation of Debits and Credits

This document uses the Adverse Impact Factors table and Stream Mitigation Factors table located in the appendix to evaluate mitigation proposals. The tables compare impacts to aquatic resources (debits) and the improvements to aquatic resources (credits) of the mitigation site.

Adverse Impact Factors

Adverse impact factors are variables or conditions that are used to characterize stream impacts from a proposed project. They include special designations of the stream in question, its size and condition, and the type of impacts proposed. Adverse impact factors are used in the Adverse Impact Factors Table and Adverse Impact Worksheet contained in the appendix to calculate debits generated and mitigation credits required for a proposed impact.

Stream Mitigation Assessment

This assessment tool is used to evaluate a stream prior to any impact. The scores compiled from the stream assessments are used to assess mitigation debits and credits. Streams are evaluated by scoring several variables in the following categories: water quality, geomorphology, riparian buffer, and available aquatic habitat. Each variable is scored between one through five and a weighted average is calculated for each category. Complete the assessment sheet found in the appendix.

Priority Designation

Priority designation is a factor used to determine the importance of the stream that would be impacted. The priority designation of a stream reflects the importance of either preventing degradation from additional permitted impacts, or of encouraging measures that will improve water quality and habitat. The priority designation of a stream will influence the amount of stream credits generated. The priority status areas are as follows:

High Priority

These streams and associated tributaries provide very important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape, social, economic or human values. Impacts to these streams should be rigorously avoided or minimized. Compensation for impacts in these streams should emphasize replacement in the same 12-digit hydrological unit code (HUC 12) watershed. The primary stream priority category includes:

National Wild and Scenic Rivers/Study Rivers;

Outstanding National Resource Waters;
Exceptional Tennessee Waters;
TDEC Stream Reference Reach Sites;
Waters listed for habitat in most current Tennessee Section 303(d) Impaired Waters List ;
Waters with listed Federal or State Endangered and Threatened aquatic species; and*
Waters identified as important fish spawning habitat or native mussel habitat.*

***** *These areas are determined in coordination with the USFWS and the TWRA.*

Standard Priority
Streams in the standard priority category include all other streams not ranked as high priority.

Total Project Cumulative Impacts
This is a scaling factor used in the Adverse Impact Table (located in the appendix) to address the scope of impacts. Cumulative impact refers to the total linear feet impacted by the project within the same stream reach or HUC 12 watershed.

Example: A 100 foot pipe and 25 feet of riprap upstream and 25 feet downstream of the structure would total 150 feet for Total Project Cumulative Impact.

Using the previous example, Impact 1 would be a "Pipe" at 100 feet, while Impact 2 would be "Armor" for 50 feet.

Impact Activity

Impact activity is the type of impact proposed that will diminish the functional parameter of the stream. Weight is assigned to the various impact factors in the Adverse Impact Factors Table (located in the appendix) commensurate with their effect on streams' integrity parameters. Below are a few examples of stream impact activities. Please note that these activities may or may not require compensatory mitigation from both the Corps and/or TDEC.

Stream Elimination

- Culverts (includes transition channels, end walls, aprons, or riprap);
- Elimination of streams by fill;
- Modifications resulting in a loss of stream length;
- Cumulative impacts from multiple culverts;
- Concrete lined channels (bottom and/or sides); or
- Stream relocations resulting in a loss of stream length.
- Placement of riprap in the bottom and/or both sides of the stream channel.

Dams and Impoundments

- The segment of stream beneath the footprint of a dam is considered fill;
- Pool zone is also a habitat conversion and resource loss;
- Dams and impoundments that change the downstream flow regime, water temperature, water chemistry, and/or species composition are also subject to compensatory mitigation.

Stream Relocations

- Stream relocations with an oversized channel designed to convey flood flows;
- Stream relocations requiring armored bottom and/or banks (synthetic liners, riprap; these activities may be considered elimination);
- Stream relocations that do not include a minimum 50 foot riparian buffer with appropriate woody vegetation (site restrictions may be required).

* *stream relocation proposals which will likely eliminate or reduce hydrology may not be authorized*

Channel Modifications

- Inappropriate channel modifications such as deepening, straightening, or widening;
- The removal of in-stream vegetation, other than cutting, or unconsolidated sediments for flood control or other purposes that results in a degradation of the resource;
- Other channel modifications that deviate from or degrade the proper pattern, profile, dimension, and/or in-stream habitat (riffles, pools, structure, etc.).

Cumulative Impacts

Effects which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions within the same stream and/or watershed.

Section #4 Compensation Crediting

Mitigation Activities

The amount of credit generated by a mitigation project depends on the ecological lift that should result from a mitigation project. Credit for stream mitigation will only be awarded when the proposed mitigation activities properly address the sources of stream impairment and will result in long-term improvement of habitat and/or water quality. Stream restoration projects that lengthen stream channels in ways inconsistent with natural channel design principles will not be approved for mitigation credit.

Factors Affecting Mitigation Credit

Where practicable, an appropriate assessment method or other suitable metric must be used to assess and describe the aquatic resource types that will be restored, established, enhance and/or preserved by the project. The number of credits must reflect the difference between pre- and post- compensatory mitigation project site conditions, as determined by a functional or condition assessment or other suitable metric.

Described below are several factors that influence the amount of credit assigned to a mitigation project. Varying weight is assigned to the described subcategories of each factor as laid out in the Stream Mitigation Factors Table.

Stream Mitigation Assessment

See description of "Stream Mitigation Assessment" in previous section.

Stream Protection Priority

See description of "Stream Protection Priority" in previous section.

Site Protection Mechanism

Long-term protection refers to measures taken through use of a real estate instrument to sustain and preserve the compensatory mitigation project after performance standards are met and monitoring requirements have been fulfilled. A long-term management plan should include a

description of the long-term management needs, annual cost estimates for these needs, and identify the funding mechanism that will be used to meet those needs.

Types of Long-Term Protection Instruments:

Non-Third Party

1. *Deed restriction* means a provision in a deed limiting the use of the property and prohibiting activities on the property that are inconsistent with the goals of the mitigation. If the applicant can demonstrate that the mitigation activity will occur within a right-of-way easement and if the easement will offer protection and preservation of the site, such as associated with highway projects, the credit will be considered the same as that for deed restriction of the mitigation site. In this circumstance, administrative provisions must be made by the entity responsible for the mitigation site to maintain awareness of the restrictions.

2. *Restrictive covenant* / *land use restriction* means a legal document whereby an owner of real property imposes limitations or affirmative obligations on the real property to restrict activities on the property that are inconsistent with the goals of the mitigation.

Third Party

3. *Conservation easement* means a legally binding recorded easement approved by the division to protect and preserve mitigation sites by giving protection and enforcement rights to a qualified, experienced, third party.

4. *Fee Title* a transfer of complete ownership to a qualified, experienced, non-profit conservation organization or government agency. Non-profit organization means an entity qualifying under section 501(c)(3) of the rules of the Internal Revenue Code.

Activities Generally Prohibited within Stream Mitigation Easements: Any of the above types of long-term protection shall have language prohibiting the following:

- Any change in, disturbance, alteration or impairment of the restored and natural features of the property, or any deliberate introduction of non-native plants or animals.
- Except as specifically authorized, construction or placement of any building, mobile home, road, trail, path, asphalt or concrete pavement, antenna, utility pole, or any other temporary or permanent structure or facility on the property.
- Agricultural, grazing, silviculture or horticulture use of property.
- Destruction, cutting, mowing, or harming any native vegetation on the easement property.
- Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, hazardous substances, toxic hazardous waste, or any placement of any underground or aboveground storage tanks on the property.
- Filling, excavation, dredging, mining or drilling, diking, removal of topsoil, sand, gravel, rock, peat, minerals or other materials, and any change in the topography of the land.

- Pollution, alteration, depletion or extraction of surface, natural watercourses or subsurface water. Any activity detrimental to water purity, or that would alter physical, chemical, or biological characteristics.
- Off road vehicle use; if there is potential for destructive or recreational off-road vehicle access at the site the mitigation plan shall include a strategy to minimize impacts. Plans should illustrate locations of any necessary barriers placed at access points to the mitigation sites to prevent vehicles from damaging the sites.

Mitigation Watershed Location

Credits are awarded for mitigation projects that occur within or closer to same watershed as the impact site (*Does not apply to mitigation banks, in-lieu fees, or preservation*).

Temporal Lag

Takes into account the time required (measured in years) for a mitigation area to fully replace the riparian vegetation size and age class lost at the impact site. The riparian buffer targeted for restoration, establishment or enhancement at the mitigation site will require different lengths of time to reach a commensurate level of maturity than existed at the impact site.

Mitigation Construction Timing

Schedule A:	All mitigation except monitoring is approved and implemented prior to impacts
Schedule B:	At least 75% of mitigation is completed prior to impact (The other 25% of mitigation would be competed post impact)
Schedule C:	Less than 75% of mitigation is completed prior to impacts

Common Mitigation Approaches

Vegetated Riparian Buffer

A riparian buffer should be a part of every compensatory mitigation proposal where the mitigation stream does not have an established, appropriately vegetated riparian buffer, except in certain circumstances, such as urban areas, where a full riparian buffer may not be feasible. Restoration and/or enhancement of a vegetated riparian buffer must adhere to the following conditions in order to qualify as compensatory stream mitigation:

- The Corps and TDEC may authorize the use of riparian buffer and/or upland credits if it is determined that these areas are essential to sustaining aquatic resource functions in the watershed and are the most appropriate compensation of the authorized impacts.

- The compensatory mitigation site should provide a sustainable habitat for establishment of native vegetation, which may require control of exotic invasive plants.
- Stream banks must be planted with native Tennessee vegetation that represents both woody (trees and shrubs) and herbaceous species. An extensive list of native plants has been established by the Southeast Exotic Pest Plant Council. The proposed species should already colonize the surrounding area or the reference site.
- Vegetation must be planted at a rate sufficient to establish effective riparian cover beginning at bankfull elevation, extending on each side of the stream. Density of plantings will depend on the re-vegetation technique to be used and existing site conditions.
- No species may comprise more than 20% of the total planted trees.
- Planted seedlings/trees must be guaranteed at a 75% survivorship for the duration of the required monitoring period.
- Where livestock are present, riparian buffers must be physically protected from livestock. A fence must be erected and maintained at all times where livestock is present and necessary managed stream crossings and livestock watering facilities should be installed.

  Note: *Streams which are recognizably unstable, entrenched, or otherwise disconnected from their floodplains, and which require extensive stream bed and/or bank restoration are not considered good candidate streams for solely producing riparian buffer credit. If various buffer widths are proposed, a weighted average buffer width should be calculated.*

Natural Channel Design

Stream mitigation projects often involve a natural channel design approach, which consists of returning a severely degraded, disturbed, or altered stream, including adjacent riparian buffer and flood-prone area, to a natural stable condition based on reference conditions or other appropriate standards.

Natural channel design is a geomorphologic approach to stream restoration based on an understanding of the valley type, general watershed conditions, dimension, pattern, profile, hydrology and sediment transport of natural, stable channels (reference condition) and applying this understanding to the reconstruction of an unstable channel. Successful natural stream channel designs achieve sediment transport, habitat enhancement, and bank and channel stabilization. The degree to which a project attains these goals depends on the project's specific objectives. Ultimately, a stream considered stable or "in equilibrium" will carry the sediment load supplied by the watershed without changing its dimension, pattern, or profile, and without aggrading or degrading.

- Restoring stream channel to its former location or restoring sinuosity, channel dimensions (width/depth ratio), and bankfull width of a degraded steam reach to appropriate design based on reference reach or other appropriate standards
- Building a new, stable stream channel at higher elevation and connecting it to its natural floodplain. This does not include the relocation of a stream channel to accommodate a project in the stream's former location
- Reconnecting abandoned side channels or meanders that were artificially cutoff, blocked, or filled where functionally appropriate (more typical of western Tennessee)

**Most such projects require the practice of engineering and therefore Tennessee law requires the plans to be stamped by engineer licensed in Tennessee; we strongly recommend that qualified personnel are on site daily during construction to oversee mitigation related construction activities.*

Livestock Exclusion

Livestock exclusion fencing may be credited as compensatory mitigation only when the presence of the livestock has resulted in extensive impacts to the stream, stream banks, and/or riparian buffer. Streams that have been extensively impacted commonly exhibit sloughing banks, sparse riparian canopy, and excessive sedimentation resulting in embedded substrate. Severely impacted streams may also require bank stabilization and/or riparian plantings to receive mitigation credit. Livestock exclusion involves removing or excluding livestock from the stream and riparian buffer using fencing. The stream and riparian buffer must be protected from future livestock impacts utilizing appropriate long-term protection measures.

Mitigation credit for livestock exclusion does not apply to sites where land use is converted due to land development. For example, construction of a subdivision on land formerly grazed by cattle does not generate compensatory mitigation credit for livestock exclusion. Additionally, mitigation credit is not awarded where livestock fencing projects are federally funded through landowner incentive programs. Except for projects undertaken by federal agencies, or where federal funding is specifically authorized to provide compensatory mitigation, federally-funded aquatic resource restoration or conservation projects undertaken for purposes other than compensatory mitigation, such as the Wetlands Reserve Program, Conservation Reserve Program, and Partners for Wildlife Program activities, cannot be used for the purpose of generating compensatory mitigation credits.

Dam and Culvert Removal

Dam and culvert removal is another acceptable form of stream mitigation. Dams and culverts adversely affect and fragment stream systems by altering the movement of aquatic organisms, water, sediment, organic matter, and nutrients; thereby, creating physical alterations in both

tailwaters and downstream riparian buffers and biological effects both upstream and downstream of the dam. Dam or culvert removal, if done properly, can improve natural stream functions. However, without sufficient evaluation, dam or culvert removal may result in bed and bank instability, upstream migration of headcuts, and increased sediment loads. If the evaluation indicates that such impacts are likely, the project will require natural channel design in conjunction with the removal in order to minimize those impacts and the time for the stream to reach a state of dynamic equilibrium.

Bank Stabilization

Streams with severely degraded stream banks may serve as compensatory mitigation projects. Severely degraded stream banks are actively eroding and typically have little or no woody riparian vegetation. Bank stabilization should incorporate bioengineering techniques to slow erosive near-bank velocities and protect easily erodible soils. Examples of bioengineering techniques may include the use of rock vanes, rock weirs, log deflectors, and cedar tree revetments. Bioengineering projects may also include bank re-sloping and riparian zone restoration. Paving the bank with riprap will not be awarded mitigation credit. Any bank stabilization project must consider the overall condition of the stream reach. If the stream lacks appropriate pattern, profile, and dimension the project may not be approved since localized repairs in an unstable system will not likely succeed long term.

Other Mitigation Activities

The division, in consultation with other resource and regulatory agencies will determine the net benefit of mitigation actions that do not involve direct manipulation of a stream and/or its riparian buffers. These include, but are not limited to, actions such as retrofitting storm water detention facilities; restoration of stream flow where flow has been captured by sewer lines, construction of off-channel storm water detention facilities in areas where runoff is accelerating stream bank erosion and other watershed protection practices. Any proposal for mitigation credit must be in addition to existing regulatory requirements such as existing local storm water requirements.

Preservation

Preservation of a threatened, unique, or ecologically significant aquatic resource may serve as compensatory mitigation, provided that it is a component of a replacement or restoration project. At least 50% of the stream mitigation credits required for an authorized project must be generated from mitigation activities that result in a net gain in aquatic function. As with all compensatory mitigation, preservation projects require long-term protection that restricts alterations to the watercourse and land use within the riparian buffer; however, preservation does not receive any “net benefit” credit. Where land use restrictions are required to protect other mitigation treatments, those restrictions do not qualify for additional mitigation credit.

Preservation may be used to provide compensatory mitigation for 404/401 permits when all of the following criteria are met:

1. The resources to be preserved provide important physical, chemical, or biological functions for the watershed;
2. The resources to be preserved contribute significantly to the ecological sustainability of the watershed.
3. Preservation is determined by the permitting agencies to be appropriate and practicable;
4. The resources are under threat of destruction or adverse modifications; and
5. The preserved site will be permanently protected through an appropriate real estate or other legal instrument (e.g., easement, title transfer to state resource agency or land trust).

Section #5 Post-Construction Monitoring and Maintenance

Monitoring

The goal of monitoring is to evaluate the success of the overall mitigation project and address any problems with the project in the early stages of development by performing appropriate corrections and to evaluate the success of the overall mitigation project with regard to its performance standards. Common monitoring requirements include: narrative project description, photos, riparian vegetation survey, as built survey, aquatic species survey, channel morphology survey.

Annual monitoring and reporting to the permitting agencies is appropriate for most compensatory mitigation projects. Certain compensatory mitigation projects may require more frequent monitoring and reporting during the early stages of development to allow project managers to quickly address any problems or concerns. If significant problems arise, annual monitoring will start over once necessary corrective measures have been implemented and the project begins to develop in accordance with the approved performance standards, the site is stable, and major additional work is not required.

In cases where monitoring is required for longer than five years, monitoring may be conducted on a less than annual timeframe (such as every other year), though yearly monitoring is recommended until the project becomes established as a successful mitigation project. On-site conditions, the complexity of the approved mitigation plan, and unforeseen circumstances will ultimately determine whether the monitoring period should be extended beyond the specified monitoring time frame for a particular project.

Annual monitoring reports must be submitted by October 31st of each year unless otherwise agreed. Projects requiring biannual (twice a year) monitoring will have an additional report due April 30th.

Prior to approval of compensatory mitigation proposals the applicant should identify the party responsible for monitoring and maintenance.

As-Built Plans

Within 30 days following completion of mitigation projects, as-built plans should be submitted to demonstrate that the site was constructed in accordance with the approved mitigation plans; mitigation projects requiring engineering design must submit certified plans (stamped by engineer licensed in Tennessee). Any major modifications to approved mitigation plans should be discussed with appropriate regulatory agencies before taking place. All modifications to approved mitigation plans should be documented in as-built surveys to inform the permitting agencies of any alterations to the approved mitigation plan.

Narrative Description/Photos

The narrative should include a description of the physical condition of the mitigation stream including a description and photos of bank stability, in-stream habitat, substrate, under-cutting of structures, stability of in-stream structures, and riparian buffer. When substantial aggradation, degradation, or bank erosion occurs, remedial actions will be planned, approved, and implemented.

Riparian Vegetation Survey

Surveys of flora should be made when buffers are being enhanced and when bioengineering techniques are being used for bank stabilization. Vegetation monitoring, which will be required for most riparian restoration and bioengineered bank stabilization projects, includes measurement of vegetation diversity, survival, and growth. Areas of less than 75% coverage will be re-seeded, and bare-root, live stakes will be planted to achieve the desired densities.

Aquatic Species Survey

Pre- and post- project biological surveys are useful tools in determining the success of a restoration project and may be required for some projects. Surveys of stream fauna such as fish and macro-invertebrates should be used on larger projects that target, either directly or indirectly, in-stream habitat restoration.

Channel Morphology Survey

Channel morphology surveys are required on projects that involve significant reshaping of the stream channel. The types of measurements and monitoring that may be required include, but are not limited to flow characteristics, channel cross-sections, longitudinal profiles, substrate and sediment characteristics, other morphological characteristics (dimension, pattern, and profile), channel stability (vertical and lateral), and presence of large woody debris. It is important that selected monitoring parameters are sensitive enough to document change and can be measured. When evidence of significant instability occurs, remedial actions must be planned, approved, and implemented.

Adaptive Management

Mitigation projects should be designed so that ongoing stream channel maintenance will not be required. If a good design is implemented properly, annual channel maintenance should not be required to achieve overall project success. However, because most mitigation projects will require some level of post construction management, an adaptive management plan is required for all mitigation proposals. Adaptive management might include minor touch ups after a high flow event, replacement of planted vegetation, or repair to cattle exclusion fencing.

Completion of Compensatory Mitigation Requirements

The applicant should notify the agencies in writing when the monitoring period is complete. Following receipt of the final report, the agencies will contact the applicant (or agent) as soon as possible to schedule a site visit to confirm the completion of the compensatory mitigation site. The compensatory mitigation will not be considered complete without an on-site inspection by regulatory staff and written confirmation that the site is functioning as proposed.

Additional Resources

Compensatory Mitigation for Losses of Aquatic Resources; Final Rule 4/10/08; 33 CFR Parts 325 and 332 ("Mitigation Rule") http://www.usace.army.mil/CECW/Pages/final_cmr.aspx

Doll, B.A., G.L. Grabow, K.R. Hall, J. Halley, W.A. Harman, G.D. Jennings and D.E. Wise, 2003. Stream Restoration: A Natural Channel Design Handbook. NC Stream Restoration Institute, NC State University. 128 pp.

EPA's Compensatory Mitigation Website:
http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm

Fischenich, Craig. 2006. Functional Objectives for Stream Restoration. Technical Rep. No. ERDC TNEMRRP SR-52, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Harman, W.A. and Star, R. R. 2008. Natural Channel Design Review Checklist. Baker Engineering NY, Inc. and U.S. Fish and Wildlife Service
http://www.fws.gov/chesapeakebay/pdf/Final%20NCD%20Review%20Checklist%20Document%201-23-08.pdf

Harrelson, C. C.; Rawlins, C. L.; Potyondy, J. P. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

NRCS National Engineering Handbook Part 654: Stream Restoration Design
http://policy.nrcs.usda.gov/viewerFS.aspx?id=3491

Regulatory Guidance Letter 08-03: Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources
http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl08_03.pdf

Schiff, R., J.G. MacBroom, and J. Armstrong Bonin, 2006, River Restoration and Fluvial Geomorphology White Paper. NHDES-R-WD-06-27. Prepared by Milone & MacBroom, Inc. for the New Hampshire Department of Environmental Services and the New Hampshire Department of Transportation, Concord, N.H.

Skidmore, P. B., C. R. Thorne, B. Cluer, G. R. Pess, J. Castro, T. J. Beechie, and C.C. Shea. 2010. Science base and tools for evaluating stream engineering, management, and restoration proposals. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC.

Soar, P. J., and Thorne, C. R. ~2001. ''Channel restoration design for meandering rivers.'' *Rep. No. ERDC/CHL CR-01-1*, U.S. Army Engineer Research and Development Center, Vicksburg, Miss.

Tennessee Exotic Pest Plant Council http://www.tneppc.org/

Appendix A: Worksheets

Adverse Impact Factors Table

Existing Water Quality	Sum scores for water quality category to determine a weighted average. Example: Algal Growth Score 3, Watershed Condition Score 2 3 + 2 = 5 (total score) / 2 (total categories) = 0.5						
Existing Geomorphology	Sum scores for geomorphology category to determine a weighted average.						
Existing Riparian Buffer	Sum scores for riparian buffer category to determine a weighted average.						
Existing Aquatic Habitat	Sum scores for aquatic habitat category to determine a weighted average.						
Protection Priority	Standard Priority 0.3				High Priority 0.6		
Cumulative Impact	.002 X total linear feet of stream impacted for project						
Impact Activity	Rip Rap One Bank 0.6	Stream Relocation 1.0	Rip Rap Lined Channel 1.4	Bottomless Culvert 1.8	Impoundment / Tail water 2.0	Pipe 2.2	Fill 2.5

Adverse Impact Worksheet

Impact Factors	Impact 1	Impact 2	Impact 3	Impact 4	Impact 5	Impact 6
Existing Water Quality						
Existing Geomorphology						
Existing Riparian Buffer						
Existing Aquatic Habitat						
Protection Priority						
Cumulative Impact						
Impact Activity						
Sum of Factors (S)						
Linear Feet of Stream Impact (LF)						
S x LF						

Stream Mitigation Factors Table

Water Quality	Use mitigation score - existing condition score = _____change in value			
Geomorphology	Use mitigation score - existing condition score = _____ change in value			
Riparian Buffer	Use mitigation score - existing condition score = _____ change in value			
Aquatic Habitat	Use mitigation score - existing condition score = _____ change in value			
Protection Priority	Standard 0.3		High 0.6	
Site Control Mechanism	Non-Third Party 0.1		Third Party 0.4	
Mitigation Watershed	Outside HUC 8 of impact site 0	Within same HUC 8 as impact site 0.1	Within same HUC 10 as impact site 0.2	Within same HUC 12 as impact site 0.3
Mitigation Construction Timing	Schedule C 0	Schedule B 0.1	Schedule A 0.3	
Temporal Lag (Years)	Over 20 -0.3	10 to 20 -0.2	5 to 10 -0.1	0 to 5 0

Stream Mitigation Worksheet

Mitigation Factor	Mitigation 1	Mitigation 2	Mitigation 3	Mitigation 4	Mitigation 5	Mitigation 6
Water Quality (*change in value*)						
Geomorphology (*change in value*)						
Riparian Buffer (*change in value*)						
Aquatic Habitat (*change in value*)						
Protection Priority						
Site Control Mechanism						
Mitigation Watershed						
Mitigation Construction Timing						
Temporal Lag (Years)						
Sum of Factors (S)						
Stream length (LF)						
Credits (C) = S x LF						

Total Credits Generated_____

Appendix B: Tennessee Stream Mitigation Assessment Sheet

Number	Existing Condition Score (1-5 or N/A)	Post mitigation Score (1-5 or N/A)	Indicator	Scoring Definitions and Directions Scores of 5 indicate the parameter is close to a reference reach (least impacted waters within an eco-region) or what would be expected to be found in a healthy ecosystem. Scores of 1 indicate the parameter not functioning properly. Use N/A if the indicator is not relevant or appropriate for this particular reach.
Water Quality				
1			**Algal Growth**	1) > 50% of stream bottom covered by filamentous algae 2) 25-50% of stream bottom covered by filamentous algae 3) 10-25% of stream bottom covered by filamentous algae 4) 1- 10% of stream bottom covered by filamentous algae 5) No filamentous algae on stream bottom
2			**Watershed Condition**	Determine a weighted average based on land use coverage (*Read Instructions for this Category*). For example if 50% of the watershed is completely forested, 30% is good condition pasture, and 20% is impervious. [(50 X 1) + (30 X .3) + (20 X 0)] / 100 = .59 X 5 = 2.95
Geomorphology				
3			**Bank Height Ratio**	1) > 1.8 Bank Height Ratio 2) 1.5 - 1.8 3) 1.3 - 1.5 4) 1.1 - 1.3 5) > 1.1
4			**Bank Erosion Hazard Index (BEHI)**	1) 50 – 46 Dominant BEHI Score 2) 40 – 45 3) 39.5 – 30 4) 29.5 – 20 5) < 20
5			**Physical Channel Alteration**	1) > 75% of the stream reach has been channelized, etc. (*Read Instructions for this Category*) 2) 51 – 75% Bridge, culverts, shoring or artificial structures have slight affect on natural flow patterns in reach. 3) 26- 50% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined 4) 5-25% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined 5) < 5% recent channelization, gravel dredging, rock removal are near absent
Riparian Buffer				
6			**Vegetated Riparian Buffer Width**	1) < 10 Average riparian buffer width (feet) 2) 10 - 19 3) 20 - 39 4) 40 - 59 5) ≥ 60

7			**Riparian Buffer Diversity**	1) ≥ 3 genera of woody vegetation 2) 4 - 6 genera of woody vegetation 3) 7 - 8 genera of woody vegetation 4) 9 - 10 genera of woody vegetation 5) ≥ 11 genera of woody vegetation
8			**Canopy Tree Size**	1) < 3 Average DBH of Canopy Trees (inches) 2) 3 - 5.9 3) 6 - 9.9 4) 10 - 12.9 5) ≥ 13
9			**Percent Canopy Cover**	1) < 20% 2) 21-40% 3) 41-60% 4) 61-80% 5) > 81%
10			**Floodplain Encroachment**	1) Floodplain not functioning, due to levees, numerous floodplain developments 2) Significant floodplain encroachment (i.e. fill material, land development, or manmade structures), significant effect of floodplain function 3) Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function 4) Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not affecting floodplain function 5) No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures
Aquatic Habitat				
11			**Sediment Deposition**	1) >75% of the bottom substrate is affected by sediment deposition 2) 50 - 75% of the bottom substrate is affected by sediment deposition 3) 25 - 50% of the bottom substrate is affected by sediment deposition 4) Sediment deposition affects 5 – 25% of the bottom substrate. 5) Small amount of sediment in pools or slow areas. < 5% of bottom area affected.
12			**Available Aquatic Habitat**	1) There are no natural, stable, productive habitats within the reach. 2) Less than 20% stable habitat regardless of number of habitats. Lack of habitat is obvious. Substrate unstable or lacking. 3) Natural stable habitat covers 20 - 40% of stream reach **or** only 1 or 2 productive habitats are available in sufficient quantity to support a population. If coverage nears 40% and three or more productive habitats are present go to suboptimal. 4) Natural, **s**table habitat covers 40 – 80% of stream reach. Three or more productive habitats present. If near 80% and more than three habitats are available go to optimal. 5) Over 80% of the stream reach has natural, stable habitat available for colonization by macroinvertebrates and/or fish. Four or more productive habitats are present. Deadfall, leaf litter, snags etc. are not new-fall but show evidence of decay. If less than four habitats are present drop to Suboptimal.
13			**Embeddedness of Riffles**	1) > 75% of gravel, cobble, and boulders are surrounded by fine sediment 2) 50 - 75% of gravel, cobble, and boulders are surrounded by fine sediment 3) 25 - 50% of gravel, cobble, and boulders are surrounded by fine sediment 4) 5 - 25% of gravel, cobble, and boulders are surrounded by fine sediment 5) < 5% of gravel, cobble, and boulders are surrounded by fine sediment

1. Algal Growth

Streams having slow flow waters, warm temperatures, and highly elevated nutrient concentrations can develop nuisance growth of algae. Beyond the appearance, odor, and taste problems normally associated with nuisance algal growth, various instream problems can also result. For example, dense growths of filamentous algae in streams can block access to microhabitat features important for the growth and survival of many small or young aquatic species. Further, few aquatic species can use filamentous algae for food. The rapid and abundant growth of filamentous algae tend to competitively reduce the abundance of other algal forms that potentially provide favorable food sources for various aquatic species. Thus, nuisance algal growth tends to reduce available food supplies and, therefore, growth potential for many aquatic species.

Most importantly, both the high metabolic demands by the dense algal growths and the decay of the many dead algal filaments can drive down oxygen concentrations (especially at night-time) in the affected surface water. Often these demands can lead to depletion of dissolved oxygen concentrations. In turn, this can lead to severe stress or death of many species, loss of aquatic populations, and substantial shifts and simplification of aquatic communities. Generally, these changes also reduce the potential remaining assimilative capacities of receiving waters for other pollutants and reduce the resistance of the remaining stream community to other potential pollutant stressors. Additional concerns related to low dissolved oxygen concentrations are discussed in the next subsection.

2. Watershed Condition

This variable is defined as the surface runoff potential from the watershed or catchment outside the riparian/buffer zone into headwater streams. Variable scores are based upon the weighted average of the combination of percent land cover and land-use classifications. To calculate the score for this variable, the percentage of the watershed in each of the land-use categories (forested, residential, industrial, etc.) must be calculated or estimated. This requires the use of internet resources, landscape images, and/or GIS, along with field reconnaissance and verification. The score is based on the weighted average of the runoff scores associated with the various land uses identified in the watershed catchment outside the riparian/buffer zone.

Use topographic maps, GIS data, or other sources to delineate the catchment or watershed above the lowest point of the assessment reach and percentage of each land-use category in the watershed. Do not include areas from which water is being diverted away from the assessment reach: include any adjacent catchment area from which water is being imported into the watershed.

Determine a weighted average (by area) of land-use categories for the catchment. Use table below to determine the score.

Land use	Runoff score
Open space (pasture, lawns, parks, golf courses, cemeteries):	
Poor condition (grass cover <50%)	0.1
Fair condition (grass cover 50% to 75%)	0.2
Good condition (grass cover >75%)	0.3
Impervious areas (parking lots, roofs, driveways, etc)	0
Gravel	0
Urban districts:	
Industrial, commercial and business (≥70% cover)	0
Residential districts by average lot size:	
1/8 acre or less (town houses and apartments) (65% cover)	0
1/4 acre to 1/3 acre (38% to 30% cover)	0.1
1/2 acre to 1 acre (25% to 20% cover)	0.2
2 acres (12% cover)	0.3
Newly graded areas (bare soil, no vegetation or pavement)	0
Forest and shrub/sapling:	
Forest and native range (<50% ground cover)	0.5
Forest and native range (50% to 75% ground cover)	0.7
Forest and native range (>75% ground cover)	1.0

3. Bank Height Ratio

This variable is a field measurement that determines the degree of channel incision. It is calculated by dividing the maximum bankfull depth into the height of the lowest bank. Streams with high bank height ratios generally contribute disproportionate amount of sediment from streambanks and the bed of the channel due to high shear stress.

(Lowest Bank Height) / (Max Bankfull Depth)

4. Bank Erosion Hazard Index

The Bank Erosion Hazard Index (BEHI) is a method for assessing stream bank erosion potential. It assigns point values to several aspects of bank condition and provides an overall score that can be used to inventory stream bank condition over large areas and prioritize restoration efforts.

BEHI assessments will based on the method published by Rosgen 2001

(http://www.wildlandhydrology.com/assets/Streambank_erosion_paper.pdf) to characterize stream bank conditions into numerical indices of bank erosion potential.

5. Channel Alteration

Determine how much, if at all, the stream reach has been altered by man-made activities (not beavers). Channel alteration is present when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams, culverts or bridges are present; when dredging or gravel/rock removal is evident, when snags/deadfall is removed, off-road vehicle activity has altered the bottom contours/compressed riffles; if loss of hydrology has occurred and when other such artificial changes have occurred. Bridges, dams or other man-made structures upstream or downstream of the assessed reach should be considered if they affect flow patterns in the targeted reach.

1. Over 75% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined (culverts included). Impoundment, bridge or other artificial structure has a high level of impact on normal stream flow and/or channel pattern, stream lacks hydrology from previous alteration.

2. Between 51-75% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined (culverts included).

3. Between 26-50% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined (culverts included). Bridge, culverts, shoring or artificial structures have slight affect on natural flow patterns in reach. (Includes structures upstream or downstream as well as within reach).

4. Between 5-25% of the stream reach has been channelized, stabilized with artificial shoring, or concrete lined (culverts included). Artificial structures may be present outside of the reach but are not affecting the flow patterns, habitat or stream contours within reach.

5. Channelization, gravel dredging, rock removal (past or present) absent or minimal, less than 5%. Stream has natural meander pattern. Shoring structures including riprap are absent. Artificial structures are not present in stream reach. Bridges, culverts, dams or other structures upstream or downstream are not affecting the stream reach.

6. Riparian Buffer Width

Estimate the width of natural vegetation from the top of the stream bank out through the riparian zone (approximately 60 feet). Disturbance to the riparian zone occurs when there are roads,

parking lots, fields, row crops, lawns, parks, bare soil, buildings, logging, campgrounds, golf courses or other human activity.

Condition category is determined by estimating the width of the riparian zone from the top of the stream bank, outward.

The average riparian forest buffer width shall be calculated based upon the entire length of streambank that is located within or along the boundaries of the project site. When calculating the buffer length the natural streambank shall be followed.

7. Riparian Buffer Diversity

Areas of known size are needed for this variable, thus plots (30-ft. radius or equivalent) should be placed in representative areas of each assessment area. The evaluator should count the number of woody genera represented in each 30-ft. radius plot. The average number of genera from the plot(s) sampled is used to determine the score for this variable.

8. Canopy Tree Size

This parameter measures canopy trees which are greater than 3 inches diameter at breast height (DBH, approximately 4.5 feet above ground) that are canopy trees, not overtopped by a larger individual. DBH should be measured using a girthing (or diameter) tape or calipers.

9. Percent Canopy Cover

This variable is the average percent cover of canopy over the stream channel. Stream canopy cover is determined using a visual estimate.

If no trees or saplings are present within the riparian/buffer zone or stream channel, then the variable would not be used, and the following steps can be skipped.

Using a densitometer, spherical crown densiometer, or equivalent device designed for estimating percent canopy cover, estimate the amount of light obscured by tree branches and leaves. Follow all manufacturers' instructions. This is done while standing in the stream channel within the assessment reach. Only the contribution from leaves, branches, and other canopy constituents should be included in the measurement. Do not include shadows from surrounding hills, or manmade structures when estimating percent canopy cover.

Estimate the percentage of the canopy above that is obscured by tree branches and leaves. This number is the estimate of canopy cover. Estimating percent canopy cover can be difficult in winter when there are no leaves on the trees. However, with practice a reasonable estimate can be made by visualizing the trees with leaves. If necessary, revisit the site when the trees have

leaves. Cover percentages from multiple samples can be combined and averaged to determine the score for this variable.

10. Floodplain Land Use

This variable is an indication of alteration to the floodplain. Floodplains allow water to be released slowly into the river system and also give time for sediment to settle out of floodwaters, thereby keeping it out of water bodies. Development in the floodplain increases stream velocities which can destroy habitats and cause greater erosion including the loss of topsoil often creating a need for increased fertilizer use.

11. Sediment Deposition

This parameter is designed to measure the changes that have occurred to the stream bottom and flow patterns as a result of the deposition of small particles (gravel, sand, silt). It differs from embeddedness which is designed to measure loss of niche space.

Select condition category by estimating the percent of the stream bottom that is affected by sediment deposition. Areas of deposition occur in pools, bends, natural or man-made constrictions and other areas of slower flow. Deposition is also observable through the formation of islands, point bars (areas of increased deposition at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals. Only areas of new, un-vegetated deposition on bars and islands should be considered when scoring.

Rank within each category is determined by the areas most affected by sediment deposition. Sediment in pools or slow areas will score higher than sediment on point bars and islands.

12. Available Aquatic Habitat

When assessing this parameter, look at various types of natural structures available to macroinvertebrates and/or fish throughout the entire reach. Look for habitat that provides refugia, feeding, spawning or nursery functions. Do not count “newly fallen trees, leaf litter that is not decaying or unstable habitats that will be washed out. Also do not include artificial habitat such as fish attractors, tires, appliances, rip-rap, etc.

To assign a condition category, first look at how much of the stream reach is covered by natural, stable, productive habitat. The numeric score (rank) within the condition category is assigned based on the variety and quality of habitat.

Variations in habitat that provide niches for different faunal types should be considered as different habitat types. For example, cobble in flowing water and cobble in pools count as two types of habitat.

Habitat that is not of sufficient quantity to support faunal populations, does not show evidence of colonization (such as newly fallen leaves), is not productive (such as seamless bedrock) or is likely to wash out should not be included. Artificial or man-made structures such as rip-rap are also not included since the goal is to evaluate natural habitat.

13. Embeddedness of Riffles

Estimate the percent that rocks are covered or sunken into the silt, sand, or mud of the stream bottom. Ideally, observations should be done in cobble riffle areas. Ideally, riffles should have multiple layers of cobble loosely lying on each other providing niches for macroinvertebrates and fish between and under the rocks. Gravel riffles or cobble/gravel runs may be substituted if necessary. However, make sure riffles are not absent due to sedimentation (in which case the parameter should score 1).

In moderate to high gradient streams that naturally do not have cobble riffles (i.e. extremely high gradient boulder streams or some moderate gradient bedrock streams) the parameter would score lower due to lack of niche space even if embeddedness is not high.).

Two factors should be evaluated for this parameter.

To determine the condition category, estimate the amount to which the rock is surrounded by fine sediment. Fine sediments are silt, clay, sand, sludge etc. Discoloration on the bottom and sides of rocks is a good way to determine the percent of embeddedness. However, take care that additional cobble layers are not buried in sediment and are not visible.

To select the score within the category, examine the amount of niche space that is provided by layering of cobble (ideal). There should be lots of sediment free spaces between and under rocks for macroinvertebrates and small fish to live. If the stream type is not a cobble-riffle, other examples of riffle or run niches affected by embeddedness include the bottom area of round boulders where it curves into the substrate or the spaces between gravel in a bedrock fissure. In moderate gradient bedrock streams without gravel (for example those with bedrock shelves) examine loose rocks or slabs in areas of relatively fast flow. These are less productive and should be scored lower in the selected condition category.