# Department of the Army
# Little Rock District, Corps of Engineers

## Little Rock District
## Stream Method

**March 21, 2008**

# COMPENSATORY STREAM MITIGATION

## A. GENERAL INFORMATION:

Compensatory stream mitigation involves the restoration, creation, enhancement, or for streams of national or state significance because of the resources they support, preservation of streams and their associated floodplains. The purpose is to compensate for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization have been achieved. Compensatory mitigation may be required for impacts to perennial, intermittent, and ephemeral streams and should be designed to restore, enhance, and maintain stream uses that are adversely impacted by authorized activities. Compensatory stream mitigation using this functional assessment method will be required for Standard Permits and Letters of Permission. Standard Permits specific to Section 10 activities, such as associated with dredging, will typically not require the use of this functional assessment method. The decision to use this method for General Permits, including Nationwide Permits, will be assessed on a case-by-case basis. In some cases, the evaluation of the permit application may reveal that the stream compensation measures are not practicable, constructible, or ecologically desirable.

Activities that constitute restoration/enhancement/preservation/creation include, but are not limited to: stream channel restoration; bank stabilization; in-stream habitat enhancement; impoundment removal; livestock exclusion devices; road crossing improvements; stream relocation; and natural buffer establishment.

Mitigation for streams will be implemented using this assessment method on a case-by-case basis. Mitigation will be evaluated using current regulatory guidance, this functional assessment method, and best professional judgment. Final compensatory mitigation requirements for Department of the Army permits will be commensurate with the type and amount of impact associated with the permitted activity. The Regulatory Project Manager will determine the impacts of a project and will assess mitigation requirements in linear feet or acreage, if linear feet is impractical.

Stream mitigation generally means the manipulation of the physical, chemical, and/or biological characteristics of a stream with the goal of repairing or replacing its natural functions.

### 1. Regulatory Authorities & Guidelines

**Section 10 of the Rivers and Harbors Act of 1899:** In accordance with Section 10 of the Rivers and Harbors Act of 1899, the Corps of Engineers is responsible for regulating all work in navigable waters of the United States.

**Section 404 of the Clean Water Act:** In accordance with Section 404 of the Clean Water Act as amended in 1977, the Corps of Engineers is responsible for regulating the discharge of dredged or fill material in waters of the United States, including wetlands. The purpose of the Clean Water Act is to restore and maintain the physical, chemical, and biological integrity of the nation's waters**.**

**Section 230.10 (d) of the Section 404 (b)(1) Guidelines** states 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." The Section 404 (b)(1) Guidelines require 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.

**Regulatory Guidance Letter (RGL) 02-02 -** Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This guidance requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. RGL 02-02 provides important guidance on compensatory mitigation including requiring increased use of functional assessment tools, improved performance standards, and a stronger emphasis on monitoring with the purpose of improving the success of compensatory mitigation projects.

**Regulatory Guidance Letter (RGL) 05-05 –** Ordinary High Water Mark Identification. This document provides guidance for identifying the ordinary high water mark. RGL 05-05 applies to jurisdictional determinations for non-tidal waters under Section 404 of the Clean Water Act and under Sections 9 and 10 of the Rivers and Harbors Act of 1899.

***Compensatory Mitigation, Little Rock District, Regulatory Office, US Army Corps of Engineers, Standard Operating Procedures*** – This document addresses Little Rock District procedures for mitigation activities including a comprehensive list of stream definitions and mitigation procedures. The Little Rock District SOP is subject to periodic review and modification. The SOP will be modified to include the Little Rock District Stream Functional Assessment Method.

**Regulatory Guidance Letter (RGL) 06-03** – Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Creation, Restoration, and/or Enhancement of Aquatic Resources. This guidance provides the Districts and regulated public guidance on minimum monitoring requirements for compensatory mitigation projects including the required content for monitoring reports.

## B. ADVERSE IMPACT FACTORS:

Streams are complex ecosystems with morphological characteristics that are dependent on appropriate geomorphic dimension, pattern, and profile as well as biological and chemical integrity. They are not simply stormwater conveyances. The following factors will determine the amount of mitigation credits required:

### 1. Stream Types:

**Ephemeral Streams** have flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streambeds are located above the water table

year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage.

**Intermittent Streams** have flowing water during certain times of the year, when ground water provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources.

**Perennial Streams** have flowing water year-round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support a diverse aquatic community of organisms year round and are typically the streams that support major fisheries.

**2. Priority Area:** Priority area is a factor used to determine the importance of the stream that would be impacted or used for mitigation. Priority areas are influenced by the quality of the aquatic habitat potentially subject to be impacted or used for mitigation. The priority area factor will influence the amount of stream credits generated. As new technology is available, a stream may increase to a higher category on a case-by-case basis. The priority areas are divided into three categories:

**Primary:** These streams provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these streams should be rigorously avoided or minimized. Compensation for impacts in these streams should emphasize replacement nearby and in the same immediate 8-digit hydrological unit code (HUC) watershed. Designated primary priority areas include:

Waters with listed Federal Endangered and Threatened species
National Wild and Scenic Rivers/Study Rivers
Outstanding National Resource Waters
Outstanding State Waters
Extraordinary Resource Waterbodies
Ecologically Sensitive Waters
State Natural and Scenic Waters
Approved greenway corridors

**Secondary:** Secondary priority areas include:

Waters on the 303(d) list that are impaired by sediments or nutrients
Designated Fish Spawning Habitat
Stream and river reaches within 0.5 mile upstream or downstream of primary priority reaches
Stream or river reaches within high growth areas that are not ranked as primary priority

systems

Adjacent to an approved mitigation bank or mitigation site

**Tertiary:** These areas include all other freshwater systems not ranked as primary or secondary priority.

**3. Existing Condition:** The state of the physical, chemical, and biological health of a stream at the time of an assessment, as compared to the least disturbed condition of similar streams in the ecoregion. This is a measure of the stability and functional state of a stream and the stability of the riparian buffer before project impacts.

**Fully functional** stream means that the physical geomorphology of the reach is stable and is representative of an appropriate stream hydrograph for the topographical setting. The biological community of a stream that is fully functional is diverse and unimpaired by excessive anthropogenic inputs. Streams with listed Federal species and streams identified as highly diverse could be considered fully functional.

For purposes of this methodology, a stream generally will be considered fully functional if it shows **no evidence of human-induced sedimentation** and meets three or more of the following criteria:

1. The stream is one that has not been channelized.
2. The stream reach has no more than one stream impact within 0.5 mile upstream or downstream of the proposed stream impact, including culverts, pipes, or other manmade modifications (less than 30 feet of impacted section).
3. The stream does not exhibit channel incision and headcutting. If necessary, this may be quantified through the determination of an appropriate entrenchment ratio and width/depth ratio at bankfull discharge relative to the unimpaired stream condition.
4. The stream has at least a minimum width riparian buffer (minimum of at least 25 feet on both sides of the stream) of deep-rooted native vegetation.

The Corps, at its discretion, may designate the largest streams within an 8-digit HUC as fully functional, regardless of whether they meet the criteria above, based on the streams recreational, commercial, or water supply values.

**Moderately Functional** stream means that the stability and resilience of the stream or river reach has been compromised, to a limited degree, through partial loss of one or more of the integrity functions (chemical, physical, biological). System recovery has a moderate probability of occurring naturally.

For purposes of this methodology, a stream generally will be considered somewhat impaired if the stream meets one or more of the following criteria:

1. The stream segment is considered somewhat impaired if the entrenchment ratio and width/depth ratio at bankfull discharge is inappropriate relative to the unimpaired stream conditions.

2. The stream shows that human-induced sedimentation and erosion is moderate.
3. The stream has a moderate riparian buffer of deep-rooted vegetation present (minimum of at least 10 feet on both sides of the stream).
4. The stream has no more than three stream impacts within 0.5 miles upstream of the proposed stream impact, including culverts, pipes, or other manmade modifications (with less than 100 feet of impacted section).

**Functionally Impaired** stream means that there is a very high loss of system stability and resilience characterized by loss of one or more integrity functions. Recovery is unlikely to occur naturally, and further damage is likely, unless restoration is undertaken.

For purposes of this methodology, a stream generally will be considered impaired if one or more of the following criteria is met.

1. The stream is considered impaired if the reach has been channelized.
2. The entrenchment ratio and width/depth ratio at bankfull discharge is inappropriate relative to the unimpaired stream condition.
3. The stream has extensive human-induced sedimentation.
4. The stream has little or no riparian buffer with deep-rooted vegetation on one or both sides of the stream.
5. The stream has banks that are extensively eroded or unstable.
6. The stream has five or greater stream impacts within 0.5 miles upstream of the proposed stream impact, including culverts, pipes, or other manmade modifications.

**4. <u>Duration</u>:** Duration is the amount of time adverse impacts are expected to last.

**Temporary** means impacts will occur within a period of less than 6 months and recovery of system integrity will follow cessation of the permitted activity.

**Recurrent** means repeated impacts of short duration (such as with in-channel 24-hour stormwater detention).

**Permanent** means project impacts will be permanent.

**5. <u>Activity</u>:**

**Armor** means to riprap, bulkhead, or use other rigid methods to contain stream channels.

**Below Grade (embedded) Culvert** means to route a stream through pipes, box culverts, or other enclosed structures (<= 100 LF of stream to be impacted per crossing). The *Little Rock District US Army Corps of Engineers, Regulatory Branch, Guidelines for Non-Bridged Stream Crossings* should be referenced. Culverts should be designed to allow fish and other aquatic organism passage and allow other natural stream processes to occur unimpeded.

**Clearing** means the removal of streambank vegetation or other activities associated with a regulated activity and that reduce or eliminate the quality and functions of vegetation within

the riparian habitat without disturbing the existing topography or soil.

**Detention** means to temporarily slow flows in a channel. Areas that are temporarily flooded due to detention structures must be designed to pass flows.

**Fill** means the permanent fill of a stream channel including the relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.

**Impound** means to convert a stream to a lentic state with a dam or other detention/control structure that is not designed to pass normal flows. Impacts to the stream channel where the structure is located is considered fill, as defined above.

**Morphologic change** means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

**Pipe** means to route a stream for more than 100 feet through pipes, box culverts, or other enclosed structures.

**Utility crossings** mean pipeline/utility line installation methods that require temporary disturbance of the streambed. **Bridge footings** requiring fill in waters of the United States are also considered in this activity factor.

**6. Linear Impact:** Linear impact means the length of stream, in feet, that will be impacted by a project, as authorized under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899, and for which mitigation will be required. This factor reflects the quantifiable cumulative impacts.

**C. MITIGATION CREDITS:** All proposed stream mitigation actions should include design criteria and explain why/how the project will benefit water quality and/or habitat. The Little Rock District Compensatory Mitigation Standard Operating Procedure Appendix A should be referenced in the development of a mitigation plan.

**Net Benefit**: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, creation, and preservation of the chemical, biological, and physical integrity of the Nation's waters. Five stream mitigation methods are covered under these guidelines – 1) stream channel restoration / stream enhancement, 2) stream relocation, 3) riparian creation, 4) riparian enhancement / restoration, and 5) stream channel / riparian preservation. ***The Corps will determine, on a case-by-case basis,*** the net benefit of mitigation actions.

**1. In-Stream Work**

- **Stream Channel Preservation** without any in-stream work/activity. This net benefit can only be used when the stream is either fully functional or moderately functional. Generally, this net benefit will be granted in combination with riparian preservation. The stream reach to be preserved must be at a minimum of 300 linear feet.

- **<u>Stream Channel Restoration / Stream Enhancement:</u>** All restored channels will generally be protected by a buffer of native vegetation. In addition, all stabilized stream banks should be protected by a buffer. This buffer will also generate riparian preservation, enhancement, restoration, or creation mitigation credit. Credit for removal of structures described below under the **Excellent** and **Good** restoration actions will be based on the documented length of reach that the structure impacts under current flow conditions. If the reach is not defined a reach will be considered 300 feet.

**Excellent stream channel restoration actions include:**

-Creating floodplains of appropriate dimensions adjacent to streams with inappropriately low width/depth ratios at bankfull discharge.

-Restoring appropriate bankfull discharge width, stream sinuosity, entrenchment ratio, and width/depth ratio in degraded streams to referenced morphologic patterns

-Removing dams and large weirs, pipes, culverts and other manmade in-stream structures with >50 linear feet of direct fill/impact, then restoring the stream channel to referenced, stable morphologic patterns (i.e. Replace culverts with span bridges).

-Development of a minimum flow release to improve downstream habitat and hydrology.

**Good stream channel restoration / stream enhancement actions include**

-Converting stream type by shaping upper slopes and stabilizing both bed and banks.

-Restoring streambank stability in highly eroded areas.

-Restoring in-stream channel features (i.e., riffle/run/pool/glide habitat) using methodology appropriate to stream type

-Culverting existing road crossings in existing floodplains and replacing inappropriately sized/designed culverts to allow more natural flood flows.

-Routing a stream around an existing impoundment by creating a morphologically stable and appropriate stream channel.

-Removing weirs, pipes, culverts and other manmade in-stream structures.

**Moderate stream channel restoration / stream enhancement actions include:**

-Stabilize stream channel in place

-Restoring streambank stability in moderately eroded areas

-Replacing inappropriately sized/designed culverts

-Constructing fish ladders or adding woody debris to create fish habitat

-Removing check dams, weirs, and other manmade in-stream structures with < 50 linear feet of direct fill/impact where these structures are contributing to bank erosion or scour or blocking stream processes and aquatic organism movements

- **Stream Relocation:** Movement/creation of a stream at a new location to allow an authorized project to be constructed in the stream's former location. In general, relocated streams must reflect the dimension, pattern, and profile indicated by a natural reference reach/condition in order to be adequate compensation for the authorized stream impact. Relocated streams will generally require vegetative protected buffers of sufficient width. This buffer will also generate riparian preservation, enhancement, restoration, or creation mitigation credit. Relocations resulting in a reduced channel length will generally require additional mitigation to replace stream functions. Relocated mitigation activities include, but are not limited to, open channel sections and in-stream features, including restoration of stream morphology.

**2. Riparian Buffer Creation, Enhancement, Restoration, and Preservation:**

- **Riparian Buffer Creation** means the manipulation of the physical, chemical, and/or biological characteristics present to develop a buffer on an upland where a buffer did not previously exist.

- **Riparian Buffer Restoration / Enhancement** means implementing rehabilitation practices within a stream riparian buffer zone to improve water quality and/or ecological function. Buffer enhancement may include increasing or improving upland and/or wetlands habitat within or adjacent to riverine systems. Restoration programs should strive to mimic the composition, density and structure of a reference reach habitat. For the purposes of these guidelines, an area will be considered as riparian buffer restoration if 51-100% of the area would require planting of vegetation to restore streambank stability and improve wildlife habitat. For the purposes of these guidelines, an area will be considered as riparian buffer enhancement if 10 to 50% of the area would require planting of vegetation to restore streambank stability and improve wildlife habitat.

- **Riparian Buffer Preservation** means the conservation, in its naturally occurring or present condition, of a riparian buffer to prevent its destruction, degradation, or alteration in any manner not authorized by the governing authority. For the purposes of these guidelines, an area will be considered as riparian buffer preservation if less than 10% of the area would require planting of vegetation to restore streambank stability and improve wildlife habitat.

**3. Riparian Buffer Restoration and Fencing in Livestock Pastures:** Means restoring vegetation and fencing livestock from pastures, where livestock grazing activities are impacting water quality and/or stream ecological function, thereby minimizing or avoiding streambank degradation, sedimentation, and water quality problems. Livestock exclusion is normally accomplished by fencing stream corridors and can include the construction of stream

crossings with controlled access and with stable and protected stream banks

Use a 1.2 multiplier with Table 1 to calculate mitigation credits generated for activities that demonstrate a benefit to the aquatic environment. For example, fencing livestock from a riparian buffer with no more than one livestock crossing planned per 1,000 linear feet of stream mitigation. The width of the livestock crossing will be deducted from the total length of the stream mitigation segment. Impacted riparian buffers will have to be restored or enhanced and may not be used for preservation purposes only, after cattle have been removed.

*** Requirements for Minimum Buffer Width: The minimum buffer width (MBW)** for which mitigation credit will be earned is 25 feet on one side of the stream, measured from the top of the streambank, perpendicular to the channel. Smaller buffer widths may be allowed on a case-by-case basis for small streams and consideration for a reduced buffer width will be based on issues related to construction constraints, land ownership, and land use activities (i.e. farming). If topography within a proposed stream buffer has more than a 2% slope, 2 additional feet of buffer are required for every additional percent of slope (e.g., minimum buffer width with a +10% slope is 41 feet). Buffer slope will be determined in 50-foot increments beginning at the stream bank. For the reach being buffered, degree of slope will be determined at 100-foot intervals and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

Table 1 below provides appropriate Net Benefit values for the riparian creation, restoration, enhancement, and preservation mitigation worksheet. Note that on this worksheet, buffers on each bank of a given reach, generates mitigation credit separately (Stream Side A and Stream Side B).

| | % Buffer that Needs Vegetation Planted | *Buffer Creation and Restoration Exotic Removal and (51-100%)Planting | Buffer Enhancement Exotic Removal and (10-50%)Planting | Buffer Preservation (<10%)Planting |
|---|---|---|---|---|
| Buffer Width (on one side of the stream) | 100 feet | 1.6 | 0.8 | 0.4 |
| | 75 feet | 1.2 | 0.6 | 0.3 |
| | 50 feet | 0.8 | 0.4 | 0.2 |
| | 25 feet (Minimum width)*** | 0.4 | 0.2 | 0.1 |

**Table 1. Riparian Buffer Creation, Restoration, Enhancement, and Preservation**

* A minimum of Level II Monitoring is required.
*** Smaller buffer widths may be allowed on a case-by-case basis for small streams and consideration for a reduced buffer width will be based on issues related to construction constraints, land ownership, and land use activities (i.e. farming).
Note: Use a 1.2 multiplier to calculate mitigation credits generated for activities that demonstrate a benefit to the aquatic environment.

**4. System Protection Credit:** Additional mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on both sides of a stream reach.

**5. Monitoring and Adaptive Management:**
Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include remedial actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period. Monitoring is a required component of all mitigation plans and should at a minimum, address all success criteria paragraphs.

Monitoring Level I will include only item 1 from Table 2.
Monitoring Level II will include at least two of the following items 1, 2, and 3 from Table 2 based on the project review.
Monitoring Level III will include items 1, 2 and 3 and may include item 4 from Table 2 based on the project review.

| **Mitigation Component (Item)** | **Success (Required on action)** | **Failure** | **Action** |
|---|---|---|---|
| **1. Photo Reference /Sample Site**<br>Longitudinal photos<br>Lateral photos | No substantial aggradation, degradation or bank erosion. | Substantial aggradation degradation or bank erosion. | When substantial aggradation, degradation or bank erosion occurs, remedial actions will be planned, approved, and implemented. |
| **2. Plant Survival**<br><br>Survival plots<br>Stake counts<br>Tree counts | > 75% Survival within the planted plots. These plots should mimic reference reach target habitat in species composition, density and structure. **Native vegetation regeneration may be in the percentage determination. | < 75% Survival within the planted plots. | Area with less than 75% coverage of target species will be re-seeded and/or fertilized; live stakes and bare rooted trees will be planted to achieve desired densities. |
| **3. Channel Stability**<br>Dimensions<br>Longitudinal profiles<br>Pebble count | Stable stream with pattern, profile and dimension of similar reference reach type. Minimal evidence of instability (down-cutting, deposition, bank erosion, increase in sands or finer substrate material). | Substantial evidence of instability. | When Substantial evidence of instability occurs, remedial actions will be planned, approved, and implemented. |

| | | | |
|---|---|---|---|
| **4. Biological Indicators** Invertebrate populations Fish populations | Population measurements remain the same or improve, and target species composition indicates a positive trend. | Population measurements and target species composition indicate a negative trend. | Reasons for failure will be evaluated and remedial action plans developed, approved, and implemented. |

**Table 2.* General criteria used to evaluate the success or failure of activities at mitigation sites and required remedial actions to be implemented should monitoring indicate failure of component.**

*Substantial or subjective determinations of success will be made by the mitigation sponsor and confirmed by the US Army Corps of Engineers.

**6. Control:** A **Conservation easement** is a legally binding recorded instrument approved by the Little Rock District to protect and preserve mitigation sites.

A **Deed restriction** is a provision in a deed limiting the use of the property and prohibiting certain uses. The Little Rock District approves mitigation areas and requires deed restrictions to protect and preserve mitigation sites. 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.

A **Restrictive covenant** is a legal document whereby an owner of real property imposes perpetual limitations or affirmative obligations on the real property.

**7. Credits:** No credits are generated for this factor if the mitigation action in a reach is primarily riparian buffer preservation (<10% of buffer area would require planting of vegetation; see Table 1).

**Non-Banks:**
***Schedule 1*:** All mitigation is completed before the impacts occur.
***Schedule 2*:** A majority of the mitigation is completed concurrent with the impacts
***Schedule 3*:** A majority of the mitigation will be completed after the impacts occur.

***Banks:*** Release of credits will be determined by the MBRT on a case-by-case basis.

**8. Temporal Lag:** A factor to compensate for temporal loss of stream functions, including buffers, due to a time lag in the ability of the enhanced, restored, or created mitigation area to fully replace functions lost at the impact site. Different systems will require different time to reach levels of functional capacity level with the impact site. Example: If a deep-rooted buffer, is impacted it may take over 20 years to replace all functions including structural habitat complexity. However, replacement of functions associated with a herbaceous buffer may take much less time.

**9. Mitigation Factor:**

Use a mitigation factor of **0.5** for all out-of-kind aquatic resource or buffer replacements and for mitigation located outside of the immediate 8-digit HUC watershed.

Out-of-kind replacements replace aquatic resources or buffers of a different physical and functional type. This is appropriate when it provides more environmental benefit and is more practical by providing more ecological or watershed benefit than in-kind.

Use a mitigation factor of **1.0** for all in-kind aquatic resource or buffer replacements or for mitigation located within the immediate 8-digit HUC watershed or for defined mitigation bank service areas.

In-kind replacements are stream losses or buffer losses, which are replaced by a stream/buffer that is established, restored, enhanced, or protected of the same physical and functional type. This is required when the impacted resource is locally important.

**D. DEFINITIONS:**

**Bankfull Stage** is the point at which water begins to overflow onto its floodplain. This may or may not be at the top of the stream bank on entrenched streams. Typically, the bankfull discharge recurrence interval is between one and two years. It is this discharge that is most effective at moving sediment, forming and removing bars, shaping meanders and generally doing work that results in the morphological characteristics of channels. Bankfull stage is not considered the Ordinary Highwater Mark (OHWM) by the Corps.

**Bankfull width** is the width of the stream channel at bankfull discharge, as measured in a riffle section.

**Channel Dimension** is the two-dimensional, cross sectional profile of a channel taken at selected points on a reach, usually taken at riffle locations. Variables that are commonly measured include width, depth, cross-sectional area, floodprone area and entrenchment ratio. These variables are usually measured relative to the bankfull stage.

**Channel Features:** Natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A **riffle** is a bed feature where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. **Pools** are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average channel depth. Step/pool sequences are found in high gradient streams. **Steps** are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.

**Channel Pattern** is the sinuosity or meander geometry of a stream. Variables commonly measured include sinuosity, meander wavelength, belt width, meander width ratio and radius of curvature.

**Channel Profile** is the longitudinal slope of a channel. Variables commonly measured include water surface slope, pool-to-pool spacing, pool slope and riffle slope.

**Channelized Stream** is a stream that has been degraded (straightened) by human activities. A channelized stream will generally have increased depth, increased width, and a steeper profile, be disconnected from its floodplain and have a decreased pattern or sinuosity.

**Entrenchment Ratio** is an index value that describes the degree of vertical containment of a river channel. It is calculated as the width of the flood-prone area divided by bankfull width.

**Flood-Prone Area** is the floodplain width measured at an elevation corresponding to twice the maximum bankfull depth. The area often correlates to an approximate 50-year flood or less.

**Mean Depth at Bankfull** is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

**Ordinary High Water Mark** (OHWM) is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding area.

**Reference Reach/Condition**: 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.

**Stable Stream:** A naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not degrade or aggrade. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Instability occurs when scouring causes the channel to incise (degrade) or when excessive deposition causes the channel bed to rise (aggrade). (Rosgen, 1996)

**Stream Enhancement** – Stream rehabilitation activities undertaken to improve water quality or ecological function of a fluvial system. Enhancement activities generally will include some activities that would be required for restoration. These activities may include in-stream or streambank activities, but in total fall short of restoring one or more of the geomorphic variables: dimension, pattern and profile. Any proposed stream enhancement activity must demonstrate long-term stability.

**Stream Preservation** - Protection of ecologically important streams, generally, in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation may include the protection of upland buffer areas adjacent to streams as necessary to ensure protection or enhancement of the overall stream. Generally, stream preservation should be in combination with restoration or enhancement activities. Under exceptional

circumstances, preservation may stand-alone where high value waters will be protected or ecologically important waters may be subject to developmental pressure.

**Stream Reach:** The length of a stream section containing a complete riffle and pool complex. If none noted, a suitable length is usually no less than 300 feet long.

**Stream Restoration or Rehabilitation** – The process of converting an unstable, altered, or degraded stream corridor, including adjacent riparian zone (buffers) and flood-prone areas, to its natural stable condition considering recent and future watershed conditions. This process should be based on a reference condition/reach for the valley type and includes restoring the appropriate geomorphic dimension (cross-section), pattern (sinuosity), and profile (channel slopes), as well as reestablishing the biological and chemical integrity, including transport of the water and sediment produced by the stream's watershed in order to achieve dynamic equilibrium.

**Stream Riparian Zone:** A riparian zone is the area of vegetated land along each side of a stream or river that includes, but is not limited to, the floodplain. The quality of this terrestrial or wetland habitat varies depending on width and vegetation growing there. As with vegetated buffer, functions of the riparian zone include reducing floodwater velocity, filtering pollutants such as sediment, providing wildlife cover and food, and shading the stream. The ability of the riparian zones to filter pollutants that move to the stream from higher elevations results in this area being referred to as the buffer zone. The riparian zone is measured landward from the OHWM on each side of a stream or river.

**Stream Stabilization** – The in-place stabilization of an eroding streambank. Stabilization techniques, which include primarily natural materials, like root wads and log crib structures, as well as sloping stream banks and revegetating the riparian zone may be considered for mitigation. When streambank stabilization is proposed for mitigation, the completed condition should be based on a reference condition or by methods appropriate to the stream reach.

**Width/Depth Ratio** is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

**APPENDIX A**

# Data Forms

## A-1: Adverse Impact Factors Worksheet

## A-2: In-Stream Work Worksheet

## A-3: Riparian Buffer Worksheet

**ADVERSE IMPACT**
**FACTORS FOR RIVERINE SYSTEMS WORKSHEET**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Stream Type Impacted | Ephemeral 0.1 | | | Intermittent 0.4 | | | Perennial 0.8 | | |
| Priority Area | Tertiary 0.1 | | | Secondary 0.4 | | | Primary 0.8 | | |
| Existing Condition | Functionally Impaired 0.1 | | | Moderately Functional 0.8 | | | Fully Functional 1.6 | | |
| Duration | Temporary 0.05 | | | Recurrent 0.1 | | | Permanent 0.3 | | |
| Activity | Clearing 0.05 | Utility Crossing/Bridge Footing 0.15 | Below Grade Culvert 0.3 | Armor 0.5 | Detention 0.75 | Morpho-logic Change 1.5 | Impound-ment (dam) 2.0 | Pipe >100' 2.2 | Fill 2.5 |
| Linear Impact | <100' 0 | 100'-200' 0.05 | 201-500' 0.1 | 501-1000' 0.2 | >1000 linear feet (LF) 0.1 reach 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1) | | | | |

| Factor | Dominant Impact Type 1 | Dominant Impact Type 2 | Dominant Impact Type 3 | Dominant Impact Type 4 | Dominant Impact Type 5 |
|---|---|---|---|---|---|
| Stream Type Impacted | | | | | |
| Priority Area | | | | | |
| Existing Condition | | | | | |
| Duration | | | | | |
| Activity | | | | | |
| Linear Impact | | | | | |
| Sum of Factors | M = | | | | |
| Linear Feet of Stream Impacted in Reach | LF= | | | | |
| M X LF | | | | | |

**Total Mitigation Credits Required = (M X LF) = _____**

**IN-STREAM WORK**
**STREAM CHANNEL / STREAM RESTORATION or ENHANCEMENT AND RELOCATION WORKSHEET**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stream Type | Ephemeral 0.05 | Intermittent 0.4 | Perennial Stream (OHWM Width) | | | | |
| | | | <15' 0.4 | 15'-30' 0.6 | 30'-50' 0.8 | >50' 1.0 | |
| Priority Area | Tertiary 0.05 | | Secondary 0.2 | | Primary 0.4 | | |
| Existing Condition | Not Applicable 0 | | Functionally Impaired 0.4 | | Moderately Impaired 0.05 | | |
| Net Benefit | Stream Relocation 0.1 | Stream Preservation | | Stream Channel Restoration / Stream Enhancement | | | |
| | | Moderately Functional 0.5 | Fully Functional 1.0 | Relocated Stream w/ In-Stream features 0.5 | Moderate 1.0 | Good 2.0 | Excellent 3.5 |
| Monitoring/ Contingency | Level I 0.05 | | | Level II 0.3 | Level III 0.5 | | |
| Control | No Covenant/Restrictive Covenant 0.1 | | | Conservation Easement/Deed Restriction 0.4 | | | |
| Credits | Schedule 1 0.3 | | | Schedule 2 0.1 | Schedule 3 0 | | |

| Factors | Net Benefit 1 | Net Benefit 2 | Net Benefit 3 | Net Benefit 4 | Net Benefit 5 | Net Benefit 6 |
|---|---|---|---|---|---|---|
| Stream Type | | | | | | |
| Priority Area | | | | | | |
| Existing Condition | | | | | | |
| Net Benefit | | | | | | |
| Monitoring/Contingency | | | | | | |
| Control | | | | | | |
| Credits | | | | | | |
| Sum Factors (M)= | | | | | | |
| Stream length in Reach (do not count each bank separately) (LF)= | | | | | | |
| Credits (C) = M X LF | | | | | | |
| Mitigation Factor Use (MF) = 0.5 or 1.0 | | | | | | |
| Total Credits Generated C X MF = | | | | | | |

**Total Channel Restoration/Relocation Credits Generated = _____**

## RIPARIAN BUFFER CREATION, ENHANCEMENT, RESTORATION AND PRESERVATION WORKSHEET

| | | | | |
|---|---|---|---|---|
| Stream Type | Ephemeral<br>0.05 | Intermittent<br>0.2 | Perennial<br>0.4 | |
| Priority Area | Tertiary<br>0.05 | Secondary<br>0.2 | Primary<br>0.4 | |
| Net Benefit (for each side of stream | Livestock (select values from Table 1 times 1.2 multiplier ) | Riparian Creation, Enhancement, Restoration, and Preservation Factors<br>(select values from Table 1)<br>(MBW = Minimum Buffer Width = 25' + 2' / 1% slope) | | |
| System Protection Credit | Condition : MBW restored or protected on both streambanks<br>To calculate:(Net Benefit Stream Side A + Net Benefit Stream Side B) / 2 | | | |
| Monitoring/ Contingency (for each side of stream) | Level I<br>0.05 | Level II<br>0.15 | Level III<br>0.25 | |
| Control | No Covenant / Restrictive Covenant<br>0.05 | | Conservation Easement / Deed Restriction<br>0.2 | |
| Credits (for each side of stream) | Schedule 1<br>0.15 | | Schedule 2<br>0.05 | Schedule 3<br>0 |
| Temporal Lag (Years) | Over 20<br>-0.3 | 10 to 20<br>-0.2 | 5 to 10<br>-0.1 | 0 to 5<br>0 |

| Factors | | Net Benefit 1 | Net Benefit 2 | Net Benefit 3 | Net Benefit 4 | Net Benefit 5 | Net Benefit 6 |
|---|---|---|---|---|---|---|---|
| Stream Type | | | | | | | |
| Priority Area | | | | | | | |
| Net Benefit | Stream Side A | | | | | | |
| | Stream Side B | | | | | | |
| System Protection Credit Condition Met (Buffer on both sides) | | | | | | | |
| Monitoring/ Contingency | Stream Side A | | | | | | |
| | Stream Side B | | | | | | |
| Control | | | | | | | |
| Credits (none for primarily riparian preservation) < 10% requires planting) | Stream Side A | | | | | | |
| | Stream Side B | | | | | | |
| Temporal Lag | | | | | | | |
| Sum Factors (M)= | | | | | | | |
| Linear Feet of Stream Buffer (LF)= (don't count each bank separately ) | | | | | | | |
| Credits ( C ) =M X LF | | | | | | | |
| Mitigation Factor Use (MF) = 0.5 or 1.0 | | | | | | | |
| Total Credits Generated C X MF = | | | | | | | |

**Total Riparian Restoration Credits Generated = _____**

# Appendix B
## B-1: References

References:

*Clean Water Act, Section 404*

*Compensatory Mitigation, Little Rock District, Regulatory Branch, US Army Corps of Engineers, Standard Operating Procedure*

*Department of the Army, Charleston District, Corps of Engineers, Standard Operating Procedure, Compensatory Mitigation*

*Department of the Army, Mobile District, Corps of Engineers, Standard Operation Procedure, Compensatory Stream Mitigation Guidelines*

*Department of the Army, Savannah District, Corps of Engineers, Standard Operating Procedure, Compensatory Mitigation, Wetlands, Openwater, & Streams*

*Department of the Army, Wilmington District, Corps of Engineers, Stream Mitigation Guidelines*

*Rivers and Harbors Act of 1899, Section 10*

*Rosgen, David L., Wildland Hydrology, March 2005*

*US Army Corps of Engineers, Regulatory Guidance Letters*