**Compensatory Stream Mitigation**
**Definitions of Factors**

**Net benefit** is an evaluation of the proposed mitigation action's ability to restore and sustain the chemical, biological, and physical integrity of the Nation's waters. Six stream restoration methods are covered under this SOP – stream channel restoration/relocation, removal of culverts/dams or other instream structures that block flow or fish movement, streambank repair, riparian restoration, riparian habitat improvement, and riparian preservation. The USACE will determine, on a case-by-case basis, the net benefit for actions that do not involve direct manipulation of a length of stream and/or its riparian buffers, such as returning natural flows to relict channels dewatered by drainage canals, retrofitting stormwater detention facilities, construction of off-channel stormwater detention facilities in areas where runoff is accelerating streambank erosion, measures to reduce septic tank leakage, paving of dirt roads, contaminant reduction, stormwater surcharge reduction and other watershed protection practices. (Note: Off-channel stormwater detention facilities should not be placed in jurisdictional wetlands, forested floodplains, or riparian buffer zones.) Stream mitigation within 100' of a culvert, dam, or other man-made impact to waters of the United States generally will generate only minimal restoration or preservation credit due to impacts associated with these structures.

- **Stream Channel Restoration and Relocation**: **Stream Channel Restoration** refers to actions to convert an incised, unstable stream channel to a natural stable condition, considering recent and future watershed conditions. Stream channel restoration will be appropriate for streams described below under Existing Conditions as Fully Impaired, and with Corps' discretion, on streams described under Existing Conditions as Somewhat Impaired. Restoration or relocation of a stream that is considered Fully Functional will not be considered for mitigation credit.
- **Stream Relocation** means to move an existing stream channel and reconstruct it, in a new location to allow an authorized project to be constructed in the stream's former location. Only Priority 1 restoration is acceptable for stream relocation projects. Note: Fill of the original channel for a stream relocation is considered an impact and shall be included in calculations for required mitigation credit (Worksheet 1).

  Design of a restored or relocated channel should be based on a reference reach and include restoration of appropriate pattern, profile, and dimension, as well as transport of water and sediment produced by the stream's upstream watershed. This SOP provides for four levels of stream restoration or relocation:
  - **Priority 1 Restoration/Relocation** involves excavation of a stable Rosgen Class C or E stream channel, on previous floodplain, to replace an entrenched Rosgen Class G or F stream channel.
  - **Priority 2 Restoration** involves establishment of a stable Rosgen Class C or E stream channel and floodplain, at the current or higher (but not original) channel elevation, to replace an entrenched Rosgen Class G or F stream channel.
  - **Priority 3 Restoration** involves converting to a new stream type without an active floodplain but containing a floodprone area (example, Rosgen Class G to B stream, or Rosgen Class F to Bc).
  - **Priority 4 Restoration** involves stabilization of an incised stream channel in place using instream structures and bioengineering. Typical instream structures for bank stability include crossvanes, J-hook vanes, other rock vanes, single and double wing deflectors, and root wads that divert the thalwag from the streambank and/or absorb water energy. Bioengineering techniques include fascines, branch packing, brush mattresses, live cribwalls, tree revetments, or coir fiber logs, supplemented with use of erosion control matting and live staking for long term stability.

All proposed stream channel restoration/relocation mitigation plans shall include:
**(1)** geomorphic data describing the existing stream, the reference reach upon which design criteria are based, and the proposed stream design (Table 2).
**(2)** a conceptual design showing proposed stream pattern in the landscape; a final design showing proposed pattern, profile, and dimension should be provided the Corps and other reviewing agencies before construction;
**(3)** a minimum 25-foot riparian buffer on both banks along the length of the project. Additional mitigation credit may be generated if buffers on one or both banks meet or exceed minimum buffer width, as defined in this SOP.

- **Streambank repair** is the stabilization of localized lateral streambank erosion using bioengineering techniques such as fascines, branch packing, brush mattresses, live cribwalls, tree revetments, or coir fiber logs, supplemented with use of erosion control matting and live staking for long term stability. Streambank stabilization alone does not constitute Priority 4 Stream Channel Restoration. Credit for installation of streambank stabilization measures to stabilize localized lateral erosion will be based on 3X the length of the appropriate size structure (e.g., 600' for a 200' tree revetment).

- **Structure removal** refers to removal of existing pipes, culverts, dams, wiers, and other manmade structures that alter a stream's geomorphology or flows. A series of crossvanes or other appropriate grade control structures may be needed to reconstruct the channel profile and avoid a headcut if channel elevation above the location where the structure is to be removed is greater than channel elevation below the structure. Where dams are proposed to be removed, it generally is best to remove the dam to the level of sediment behind the dam and then to construct a series of crossvanes to develop a stable slope. To prevent disruption of fish movements, elevation drop from one crossvane to the next shall be no more than 0.5' (i.e., at least 4 crossvanes will be needed to develop a stable slope when channel elevation above and below a culvert to be removed drops 1.5'). The proposed structural removal will be assigned a credit factor of from 4.0 to 8.0, depending on the ecological lift associated with the specific action. The credit factor selected for a specific structural removal must be supported by information necessary to document ecological lift. Selection of an appropriate credit factor is at the sole discretion of the USACE. Credit for removal of manmade structures will be based on total length of stream impacted directly or indirectly by the structure (i.e., dam fill plus length of impounded stream; culvert fill plus upstream and downstream areas where aggradation/degradation can be attributed to the culvert).

- **Riparian Restoration, Preservation, and Habitat Improvement:** Riparian restoration, preservation, or habitat improvement, will not be allowed on Fully Impaired streams, as described in Existing Condition below.
  - **Riparian restoration** is the reestablishment of well-established stands of deep-rooted native vegetation (trees, shrubs, and herbaceous species) in areas adjacent to riverine systems.
  - **Riparian preservation** is the conservation of already well-vegetated buffers adjacent to riverine systems. Riparian buffer preservation may account for no more than 50% of the credits generated by a mitigation bank or required to mitigate for a single and complete project. If the mitigation plan for a single and complete project combines riparian buffer preservation with purchase of bank credits, non-bank buffer preservation may account for no more than 50% of the required credits.
  - **Riparian habitat improvement** is implementation of activities to improve the biological function of an existing buffer. Riparian habitat improvement may include planting of understory species, planting of desirable canopy trees, and/or timber stand improvement. Riparian habitat improvement is applicable only in buffers that already support well-established stands of deep-rooted native vegetation; activities proposed for riparian habitat improvement must be approved by the USACE.

**Table 1. Riparian Buffer Mitigation Activities**

| | | 71-100% of the Proposed Buffer will be Planted (Extensive Restoration) | 41-70% of the Proposed Buffer will be Planted (Substantial Restoration) | 10-40% of the Proposed Buffer will be Planted (Moderate Restoration) | Riparian Habitat Improvement | The buffer does not Require Planting (Preservation) |
|---|---|---|---|---|---|---|
| Minimum Buffer Width on One Side of Stream) (MBW = 50' + 2'/% slope) | 4X MBW | 2.0 | 1.6 | 0.8 | 0.4 | 0.3 |
| | 3X MBW | 1.5 | 1.2 | 0.6 | 0.3 | 0.2 |
| | 2X MBW | 1.0 | 0.8 | 0.4 | 0.2 | 0.1 |
| | 1X MBW | 0.3 | 0.2 | 0.1 | 0 | 0 |

**Control** means the entity empowered or responsible for enforcing the mitigation requirements.

**Compensatory Stream Mitigation**
**Definitions of Factors**

**Dominant Impact**:

- **Fill** means permanent fill of a stream channel due to construction of dams or wiers, relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.
- **Pipe** means to route a stream for 100' or more through pipes, box culverts, or other enclosed structures.
- **Morphologic change** means to channelize, dredge, construct an armored ford, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.
- **Impound** means to convert a stream to a lentic state with a dam or other retention/control structure that is not designed to pass normal flows below bankfull stage. Impact to the stream channel where the structure is located is considered fill, as defined above.
- **Stream Crossing** means to route a stream through pipes, culverts, or other structures where less than 100' of stream will be impacted per crossing.
- **Detention** means to temporarily slow flows ($\leq$ 72 hours) in a channel when bankfull is reached. Areas that are temporarily flooded due to detention structures must be designed to pass flows below bankfull stage.
- **Bank armor** means to riprap, bulkhead, or use other rigid methods to contain stream channels.
- **Utility crossing** means pipeline/utility line installation methods that require disturbance of the streambed.
- **Shading and clearing** means activities, such as bridging or streambank vegetation clearing, that reduce or eliminate the quality and functions of vegetation within riparian habitat without disturbing the existing topography or soil. Although these impacts may not be directly regulated, mitigation for these impacts may be required if the impact occurs as a result of, or in association with, an activity requiring a permit.

**Duration**: Duration is the amount of time the adverse impacts to a stream reach are expected to last.

- **Temporary** means impacts will occur within a period of less than 1 year and recovery of system integrity will follow cessation of the permitted activity.
- **Recurrent** means repeated impacts of short duration (such as with on-channel 24-hour stormwater detention).
- **Permanent** means project impacts will occur for more than one year. This will also be used in cases where the impact will occur during spawning or growth periods for Federal and State protected species.

**Existing Condition**: The functional state of a stream reach before any project impacts or mitigation actions occur.

- **Fully Functional** means that the physical geomorphology of the reach is stable and the biological community likely is diverse. For the purposes of this SOP, a stream generally will be considered fully functional if it meets one or more of the following five criteria:

1. the reach is not entrenched (entrenchment ratio >2.2, excluding Rosgen Class A and B streams).
2. the reach supports aquatic species listed as endangered, threatened, or rare by the U.S. Fish and Wildlife Service (USFWS) or Georgia Department of Natural Resources (GADNR) (refer to USFWS Georgia Field Office or GADNR web page),
3. the stream is a State designated primary trout stream (refer to GADNR web site),
4. the reach supports a diverse biological community (IBI Category classification of Good or Excellent, based on standardized IBI methodology).
5. the stream is a GADNR Stream Team reference reach (refer to GADNR Fisheries).

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 these streams' recreational, commercial, and water supply values.

- **Somewhat Impaired** means that stability and resilience of the stream or river reach has been compromised, to a limited degree, but the system has a moderate probability of recovering naturally. For purposes of this SOP, a stream is considered somewhat impaired if none of the five criteria listed above for a fully functional stream are met but the stream meets one of the following four criteria:

1. the stream reach is moderately entrenched (entrenchment ratio of 1.4-2.2, excluding Rosgen Class A and B streams)
2. the channel is dominated by sand, gravel, cobble, boulders, or bedrock, rather than silt and clay

3. bank erosion, excluding undercut banks often found in stable streams at bends, is localized
4. the stream reach supports a moderately diverse biological community (IBI Category classification of Fair).

- **Fully Impaired** means that there is a high loss of system stability and resilience. Recovery is unlikely to occur naturally without further bank erosion and/or aggradation, unless restoration is undertaken. For purposes of this SOP, a stream is considered fully impaired if none of the nine criteria listed above for fully functional or somewhat impaired streams is met. Common indicators of a fully impaired reach include a high entrenchment ratio (<1.4, excluding Rosgen Class A streams, which are naturally entrenched); low sinuosity (<1.2, excluding Rosgen Class A streams, which are naturally relatively straight); low biodiversity (IBI or IWB Category classification of Poor or Very Poor); extensive human-induced sedimentation; extensive bank erosion on both sides of riffle reaches; significant erosion of point bars or deposition of mid-channel bars within the reach; and/or extensive culverting, piping, or impoundment within the reach.

**Geomorphic Definitions**:

- **Bankfull Discharge** is the flow that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels (Dunne and Leopold 1978). The bankfull stage is the point at which water begins to overflow onto a floodplain (may not coincide with the top of the visible bank in entrenched streams). On average, bankfull discharge occurs approximately every 1.5 years
- **Dimension** refers to the stream's width, depth, and cross-sectional area at bankfull.
- **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.
- **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.
- **Pattern**: Stream pattern describes the shape of a stream as seen from above, and includes factors such as sinuosity, meander length, radius of curvature, and beltwidth.
- **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 water and the sediment load supplied by the watershed.
- **Profile**: The profile of a stream refers to its longitudinal slope, including factors such as water surface slope, pool-to-pool spacing, and pool and riffle slopes.

**Minimum Buffer Width**: The **minimum buffer width** (MBW) for which mitigation credit will be earned is 50 feet on one side of the stream, measured from the top of the stream bank perpendicular to the channel. 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 70'). Buffer slope will be determined in 50'-increments beginning at the stream bank. No additional buffer width will be required for negative slopes. For the reach being buffered, degree of slope will be determined at 100' 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.

**Mitigation Timing**: No credits are generated for this factor if the proposed mitigation in a reach is primarily riparian buffer preservation or Riparian Habitat Improvement.

- **Non-Banks**: ***Schedule 1***: All mitigation is completed before the impacts occur.
  ***Schedule 2***: The mitigation is completed concurrent with the impacts.
  ***Schedule 3***: The mitigation will be completed after the impacts occur.
- **Banks:** Use Schedule 2 (Note: release of credits will be based on a release schedule).

**Monitoring and Contingencies**: 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 shall include contingency 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. Mitigation Banks are required to develop an *Excellent M and C Plan*.

- **Minimum Level Restoration M&C**:
  -- **Riparian preservation/Riparian Habitat Improvement**: Collection of basic information on vegetation in the buffer and stability of the banks being buffered, following protocols provided by the Corps, unless another protocol is approved in advance. Information shall be collected on the following two factors at 0-, 3-, and 5-years after the mitigation is approved:
    a. an evaluation of bank stability throughout the reach .
    b. species composition, average species height and average species diameter at breast height (dbh) of woody vegetation within the buffer.
  -- **Riparian restoration**: Collection of basic information on vegetation in the buffer and stability of the banks being buffered. Information shall be collected on the following three factors before planting and annually for 5 years after planting (remediation and continued monitoring will be required if success criteria are not met after 5 years).
    a. an evaluation of bank stability throughout the reach.
    b. species composition, average species height and average species dbh of woody vegetation within the buffer.
    c. survival and growth (height and dbh or other biomass measure) of planted vegetation.
  -- **Stream channel restoration, streambank stabilization and stream relocation**: Collection of baseline data on stream stability and water quality in streams before and after mitigation is implemented. Information shall be collected on the following four factors before mitigation activities are implemented and at 1-, 3-, and 5-years after mitigation activities are implemented (remediation and continued monitoring will be required if success criteria are not met after 5 years):
    a. an evaluation of bank stability throughout the reach.
    b. longitudinal and cross-sectional profiles of the restored, relocated, or stabilized reach.
    c. mean depth, width, entrenchment ratio, maximum depth at bankfull, bank height ratio, substrate characteristics, and other geomorphic data, as indicated on Table 2.
    d. surveying fish populations in the restored reach.
- **Moderate Level Restoration M&C Plans:**
  -- **Riparian preservation/Riparian Habitat Improvement:** Conducting all features under Minimum M&C, plus surveying bird, mammal, reptile, and amphibian life in the buffer and fish populations in the buffered reach at 0-, 3-, and 5-years after the mitigation is approved.
  -- **Riparian restoration**: Conducting all features under Minimum M&C, plus surveying bird, mammal, reptile, and amphibian life in the buffer and fish populations in the buffered reach at 0-, 3-, and 5-years after planting.
  -- **Stream channel restoration/streambank stabilization and stream relocation**: Conducting all features under Minimum M&C, plus surveying freshwater mussels and snails, crawfish, and other macroinvertebrates in the restored channel before mitigation activities are implemented and at 1-, 2-, and 5-years after mitigation activities are implemented.
- **Substantial Level Restoration M&C**: Conducting all features listed under Moderate M&C, plus simultaneous collection of these data in a suitable reference site. Substantial M&C Credit cannot be generated for Riparian Buffer Preservation or Habitat Improvement.
- **Excellent Level Restoration M&C**: Conducting all features listed under Substantial M&C at Year 7. <u>For all banks, excellent level of M&C is required and an annual status report must be submitted until all credits are sold</u>. Substantial M&C Credit cannot be generated for Riparian Buffer Preservation or Habitat Improvement.

**Compensatory Stream Mitigation**
**Definitions of Factors**

- **Priority Area**:
- **Primary Priority**:
  -- Reaches with species listed as endangered, threatened, or candidate by FWS or GADNR
  -- Primary trout streams
  -- Streams identified by the GADNR Stream Team as having an excellent or good IBI score
  -- Waters adjacent to other Corps' approved mitigation sites/banks or other protected lands
  -- National Estuarine Research Reserves
  -- Reaches in approved greenway corridors
  -- Wild and Scenic Rivers
  -- Outstanding Resource Waters
  -- Essential Fish Habitat
- **Secondary Priority**:
  -- Waters with species listed as Species of concern by FWS or rare/uncommon by GADNR
  -- Secondary trout streams
  -- State Heritage Trust Preserves
  -- Anadromous fish spawning habitat
  -- Designated shellfish grounds
- **Tertiary Priority**:
  -- All other areas

**Scaling Factor**: The Scaling Factor is based on the cumulative length of stream, in feet, that will be affected by a given dominant impact.

**Simon's Channel Evolution Stages:**

| | |
|---|---|
| Stage I | Stable stream connected to floodplain |
| Stage II | Disturbance |
| Stage III | Degradation; stream begins to entrench |
| Stage IV | Continued degradation and widening; significant bank erosion on both banks |
| Stage V | Stream continues to widen and form a floodplain; aggradation of sediment to form point bars |
| Stage VI | Quasi-stable stream with new, but lower, floodplain |

**System Credit:** Bonus mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on both sides of a stream reach and legal protection of a fully buffered stream channel. Condition 1 must be met to receive System Protection Credit for Condition 2.

**Table 2. Geormorphic measurements for stream restoration and relocation projects.**

| | Current Condition | Reference Reach Measurements | | | Designed Stream |
|---|---|---|---|---|---|
| | | Mean | High | Low | |
| Drainage Area (square miles) | | | | | |
| Stream Type (Rosgen) | | | | | |
| $W_{bkf}$ (Bankfull width in feet) | | | | | |
| $D_{bkf}$ (Bankfull mean depth in feet) | | | | | |
| $W_{fpa}$ (Width of floodprone area) | | | | | |
| $A_{bkf}$ (Xsect. Area) = $W_{bkf}$ X $D_{bkf}$ | | | | | |
| $W_{bkf}$ /$D_{bkf}$ ratio | | | | | |
| $W_{fpa}$/$W_{bkf}$ (Entrenchment ratio) | | | | | |
| $D_{max}$ (Max. depth at bankfull) | | | | | |
| $D_{maxtob}$ (Max depth at top of bank) | | | | | |
| $D_{max}$/Dbkf (Max depth ratio) | | | | | |
| $D_{maxtob}$/$D_{max}$ (Bank ht ratio) | | | | | |
| Lm (Meander length in feet) | | | | | |
| Rc (Radius of Curvature in feet) | | | | | |
| $W_{blt}$ (Belt width in feet) | | | | | |
| K (Sinuosity) | | | | | |
| Lm/$W_{bkf}$ (Meander length ratio) | | | | | |
| Rc/$W_{bkf}$ (Radius of Curve ratio) | | | | | |
| $W_{blt}$/$W_{bkf}$ (Meander width ratio) | | | | | |
| $S_{val}$ (Valley slope) | | | | | |
| $S_{chan}$ (Channel slope) | | | | | |
| $S_{rif}$ (Riffle slope) | | | | | |
| $S_{pool}$ (Pool slope) | | | | | |
| $S_{run}$ (Run slope) | | | | | |
| $S_{glide}$ (Glide slope) | | | | | |
| $S_{rif}$/$S_{chan}$ (Riffle slope ratio) | | | | | |
| $S_{pool}$/$S_{chan}$ (Pool slope ratio) | | | | | |
| $S_{run}$/$S_{chan}$ (Run slope ratio) | | | | | |
| $S_{glide}$/$S_{chan}$ (Glide slope ratio) | | | | | |
| $D_{maxpool}$ (Max Pool depth in feet) | | | | | |
| $W_{pool}$ (Width of pool in feet) | | | | | |
| $L_{pool}$ (Length of pool in feet) | | | | | |
| Lps (Pool-pool spacing in feet) | | | | | |
| $A_{pool}$ (Pool area) = $W_{pool}$ X $L_{poo}$ | | | | | |
| $D_{maxpool}$/$D_{bkf}$ (Max pool depth ratio) | | | | | |
| $A_{pool}$/$A_{bkf}$ (Pool area ratio) | | | | | |
| $W_{pool}$/$W_{bkf}$ (Pool width ratio) | | | | | |
| $L_{pool}$/$L_{bkf}$ (Pool length ratio) | | | | | |
| Lps/$W_{bkf}$ (Pool-pool spacing ratio) | | | | | |
| D16 (mm) | | | | | |
| D35 (mm) | | | | | |
| D50 (mm) | | | | | |
| D84 (mm) | | | | | |
| D95 (mm) | | | | | |