US Army Corps of Engineers—Galveston District

Stream Condition Assessment 2013

US Army Corps of Engineers

Galveston District

Regulatory Branch

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Level 1 - Stream Condition Assessment for All Ephemeral and Intermittent Streams and for Impacts Less Than 500 Linear Feet to Intermittent Streams with Perennial Pools, Perennial Streams and Wadeable Rivers

1.0 Introduction

Regulated impacts are proposed to various types and qualities of streams. Therefore, it is important to assess the functional condition of the stream being impacted and use this condition as a baseline when evaluating the proposed impacts and determining the appropriate mitigation. The Level 1 assessment is designed to assess the functional condition of ephemeral and intermittent streams. In addition, Level 1 may be used to assess the functional condition of intermittent streams with perennial pools, perennial streams, and wadeable rivers when the proposed impact less than 500 linear feet. Level 1 is not designed to assess the functional condition of large navigable rivers or rivers with tidal influence. This assessment process does not alter the circumstances under which compensatory mitigation is required or the definitions of “waters of the United States” or “navigable waters of the United States.”

This qualitative assessment is designed to evaluate relative potential of a stream to support and maintain a diverse community of organisms by visually assessing hydrogeomorphic and fluvial geomorphic characteristics such as active floodplain, width/depth ratios, bed elevation and floodplain storage and release. The visual parameters sampled under Level 1 include: 1) Visual Channel Assessment; 2) Desktop Riparian Buffer Assessment; 3) Desktop Aquatic Use Assessment; and 4) Visual Channel Alteration Assessment.

1.0.1 Stream Assessment Transect

The fundamental units for evaluating stream condition are the stream assessment transects (Transect). Application of the Transect is an important step in the assessment process and may affect the score. To simplify the process of establishing Transects, a fixed length Transect of 350 feet will be placed within set intervals commensurate with the project. The following guidelines will be applied for the placement and number of Transects to assure accuracy and precision of the assessment:

Projects proposing impacts to less than 500 linear feet of ephemeral, intermittent or perennial streams will be assessed using three, 350-linear-foot Transects placed no less than 125 feet apart and no greater than 200 feet apart.

Projects proposing impacts to 500 linear feet or greater to an ephemeral and/or intermittent stream will add one 350-linear-foot Transect for each additional 500 feet of impact. Transects must be placed no less than 125 feet apart and no greater than 200 feet apart.

Projects proposing impacts to intermittent streams with perennial pools, perennial streams, and wadeable rivers with proposed impacts of 500-linear feet or greater shall use the Level 2 Stream Condition Assessment Procedure.

1.1 Visual Channel Condition Parameter

Under most circumstances, channels respond to disturbances or changes in flow regime in a sequential, predictable manner. The way a stream responds to changes by degrading to a lower elevation and eventually re-stabilizing at that lower elevation is the basic premise behind the stream channel evolutionary process. The differing stages of this process can be directly correlated with the current state of stream stability. The purpose of evaluating channel condition is to determine the current condition of the channel cross-section, as it relates to this evolutionary process, and to make a correlation to the current state of stream stability. These evolutionary processes apply to the majority of stream systems since the majority of stream systems are degrading, aggrading, healing, or stable.

For a Level 1 Stream Condition Assessment, channel condition will be determined by visually assessing certain geomorphological indicators. These indicators include: channel incision; access to original or recently created floodplains; channel widening; channel depositional features; rooting depth compared to streambed elevation; streambank vegetative protection; and streambank erosion. Each of the categories describes a particular combination of the state of these geomorphological indicators which generally correspond to a stream channel stability condition at some stage in the evolution process.

1.1.1 Visual Channel Condition Variable

The Visual Channel Condition Variable assesses the channel condition by visually inspecting the cross-section of the stream along the Transect. The channel condition of each transect is categorized using the following five stream conditions: optimal; sub-optimal; marginal; poor; and severe. A score is given for each **Channel Condition Value (CV)**; however, there may be cases where the stream lies between the descriptions. In these cases, a score between those provided may be used. Scores for this category range from 1 for the most severe condition to 5 for the most optimal condition. The stream evaluator needs to identify the current channel condition by visually assessing the channel's geometry, the channel's stability and the channel's ability to connect to the active floodplain and document the basis for the findings; including providing photos, drawings or verbal description.

Channel Geometry:

The evaluator visually assesses the channel profile by assessing the degree of incision and/or widening. Channel incision is a common response of alluvial channels that have excess amounts of flow energy or stream power relative to the sediment load. This change in flow regime results in the stream eroding the streambed, causing steep, easily eroded banks. If the cohesiveness of the bank material is very low, such as loose sand, the channel will erode the banks and have a wide cross-section compare to its depth. This instability presents itself as an over-widened channel.

Channel Stability:

The evaluator assesses channel stability by looking for visual indicators of stability or instability. In a stable stream, the pattern of erosion and deposition occurs in an orderly and predictable fashion. One of the most common depositional features of stable streams in this region is the creation of point bars. A point bar is a crescent-shaped depositional feature located on the inside of a stream bend or meander. Point bars are composed of well-sorted sediment with a very gentle slope at an elevation below bankfull and very close to the baseflow water level. Since point bars are low-lying, they are often overtaken by streamflow and can accumulate driftwood and other debris during times of high water levels. Another common feature of a stable stream is a bankfull bench. A bankfull bench is a flat or shallowly sloped area above bankfull that slows high velocity flows during flows above bankfull. The bank of a stable stream will also be well vegetated with either herbaceous or woody species or may have a natural rock surface. These banks are stabilized by these surfaces, thereby reducing or preventing erosion. Finally, an indication of a stable stream may simply be an absence of indicators of an unstable stream channel.

Indicators of an unstable stream channel include depositional features such as mid-channel bars, transverse bars, and transient sediments, as well as erosion features such as erosion scars, denuded banks, and threaded channels. Mid-channel bars and transverse bars are landforms in a stream channel that begin to form when the discharge rate is low and the stream is forced to take the route of less resistance by flowing in locations of lowest elevation. Over time, the stream begins to erode the outer edges of the bar, causing it to remain at a higher elevation than the surrounding areas. The water level decreases even more as the river laterally erodes the less cohesive bank material, resulting in a widening of the river and a further exposure of the bar. As the discharge rate increases, material may deposit about the bar since it is an area in the stream of low velocity due to its higher elevation than the surrounding areas.

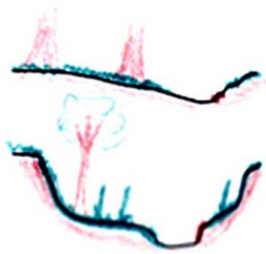
Active Floodplain Connection:

Active floodplain is the land between the active channel at the bankfull elevation and the terraces that are flooded by stream water on a periodic basis. Natural channels at or immediately below surrounding floodplain elevations will be connected to the active floodplain. Channels that are deeply incised or channelized will be below the elevation of the floodplain and will no longer be able to flood the floodplain during normal high-water events.

1.1.2 Identifying Visual Channel Condition Variable

Each transect is assessed for the condition of the channel by using the five categories described below.

Optimal-Score 5



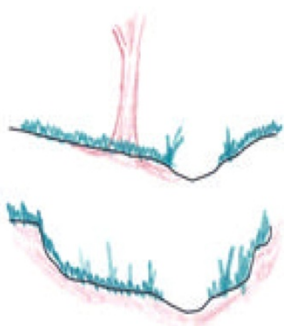
Channel Geometry: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2.

Channel Stability: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom.

Floodplain Connection: The channel has access to the active floodplain or has fully developed wide bankfull benches.

Additional Information: In addition, no bulkheading or riprap may be present along the Transect for an **Optimal** score, regardless of channel profile.

Suboptimal-Score 4



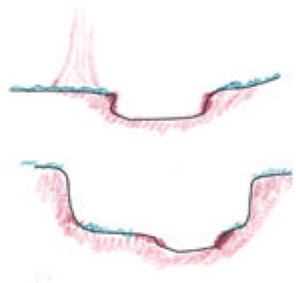
Channel Geometry: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2.

Channel Stability: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom.

Active Floodplain: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach.

Additional Information: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as **Suboptimal** if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.

Marginal-Score 3



Channel Geometry: These channels are often incised or their course has been widened, but to a lesser degree than the **Severe** and **Poor** channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8.

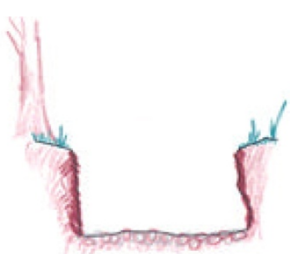
Channel Stability: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom.

However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas.

Active Floodplain: Marginal streams have no connection to the active floodplain.

Additional Information: In addition, a stream channel is visually characterized as **Marginal** if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.

Poor-Score 2



Channel Geometry: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4.

Channel Stability: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent.

Active Floodplain: **Poor** streams are not connected to the active floodplain.

Additional Information: In addition, a stream channel is visually characterized as **Poor** if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.

Severe-Score 1

Channel Geometry: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is less than 1.2. Channel Stability: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score.

Active Floodplain: **Severe** streams are not connected to the active floodplain.

Additional Information: In addition, a stream channel is visually characterized as **Severe** if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.

1.2 Riparian Buffer Parameter

A Riparian buffer is defined as the zone of vegetation adjacent to streams, rivers, creeks or bayous. These vegetated zones are important in intercepting and controlling nutrients entering into the system. As such, it is considered a best management practice to include a riparian buffer in a compensatory mitigation plan as well as being an important consideration in the review of proposed impacts to the stream. Buffer width is positively related to nutrient removal effectiveness by influencing retention through plant sequestration or removal through microbial denitrification. This parameter is not intended to be a detailed vegetative cover survey, but instead, is a qualitative evaluation of the cover types that make up the riparian buffer. For the purpose of this assessment, the buffer is measured from the verified ordinary high water mark of the stream. The **Buffer Value (BV)** for this parameter is determined by evaluating the percentage of each cover type occupying the riparian buffer area for 100 feet on each side of the ordinary high water mark of the stream channel within the Transect. The left bank (LB) and right bank (RB) are determined by facing downstream.

The ideal riparian buffer would be 100% coverage of the assessment area by the native woody vegetation community with no additional land use. If the buffer is a mixed land use (example: 33% forested, 33% cropland, and 34% pavement), it is possible that the buffer could contain multiple condition categories. In that case, each condition category present within the buffer is scored and weighted by the percent it occupies within the buffer. An estimate of the percent area that each cover type occupies may be made from visual estimates made on-the-ground or by measuring each different area to obtain its dimensions. Multiple intrusions of roads, houses, developments, etc., into the 100-foot zone may require more detailed measurements to determine percentages. The observed cover types should be categorized and scored accordingly, based upon the parameter category description.

1.2.1 Riparian Buffer Condition Variable

The Transect is assessed for the condition of the Riparian Buffer to calculate the Riparian Buffer Variable (BV) using the five categories described below.

Optimal-Score 5

Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.

Suboptimal:

High Suboptimal-Score 4.5: Native woody community species represent greater than 60% coverage *with no* wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage *with* wetlands present and no maintenance or grazing within the buffer.

Low Suboptimal-Score 4: Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.

Marginal-Score 3

Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.

Poor-Score 2

The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition**.**

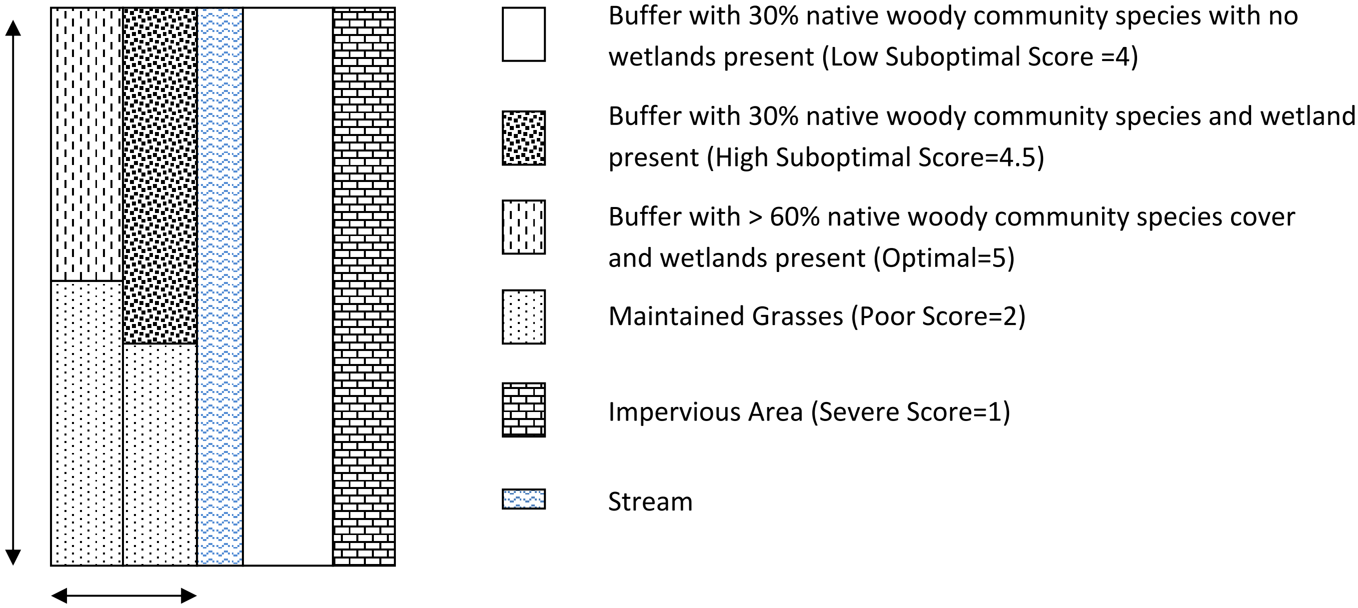
Severe-Score 1

The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.

1.2.2 Identifying Riparian Buffer Condition

When a buffer is simply one vegetation community, determining the appropriate buffer condition variable is simple. However, often times the buffer in the Transect is a mixed community. Since a single variable is required for the calculations, an example of how to calculate a multiple condition buffer is included to explain the method.

EXAMPLE 1: Calculating Multiple Condition Riparian Buffer



<u>Right Buffer</u>

The buffer located on the right bank is comprised of:

1. A 60-foot by 1000-foot (or 60%) Low Suboptimal Score (or 4) area.
2. A 40-foot by 1000-foot (or 40%) Severe Score (or 1) area.

Therefore, the equation to calculate the Right Buffer is:

$$(0.60 * 4) + (0.40 * 1) = 2.8$$

<u>Left Buffer</u>

The buffer located on the left bank is comprised of:

1. A 50-foot by 500-foot (or 25%) Optimal Score (or 5) area.
2. A 50-foot by 750-foot (or 37.5%) High Suboptimal (or 4.5) area.
3. One 50-foot by 500-foot and one 50-foot by 250-foot (or a total of 37.5%) of Poor Score (or 2) area.

Therefore, the equation to calculate the Left Buffer is:

$$(0.25 * 5) + (0.375 * 4.5) + (0.375 * 2) = 3.68$$

The final variable for BV is calculated by averaging the two buffer scores.

$$(2.8 + 3.68)/2 = 3.24$$

1.3 Desktop Aquatic Use Parameter

The Texas Commission on Environmental Quality (TCEQ) and its cooperators, in compliance with 305(b) and 303(d) of the Clean Water Act, evaluate and monitor the state's surface waters and assess the health of surface waters of the state by comparing the data to the water quality standards. These standards are defined in the *Texas Surface Water Quality Standard (TSWQS).* Water quality standards are composed of designated uses and their associated criteria for instream conditions necessary to support those uses. Evaluation of state waters is conducted biennially and published as the *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d).* The purpose of this report is to provide resource managers with a tool for making informed decisions. In developing this report, TCEQ considers all existing and readily available water quality related data and information. Data has been collected in the previous 7 years and is required to have been consistently sampled using scientifically rigorous water quality sampling methods. The TCEQ assess water quality based on the purposes designated for a water body, such as aquatic life use, providing water that is safe for swimming or other recreational purposes. The criteria may be expressed in terms of desirable conditions, or as numeric limits on certain pollutants. Specific criteria tested may include; water temperature, pH, chloride, sulfate, dissolved oxygen (DO), total dissolved solids (TDS) as well as fish and macroinvertebrate communities. Many stream segments have multiple parameters measured and examined in combination. Based on the TCEQ's assessment, each stream segment's Aquatic Life Use is designated into one of five categories. These categories indicate the suitability of stream segment to support an environment for fish and other aquatic life.

1.3.2 Aquatic Use Variable

The Transect is assessed based on the aquatic life use category score assigned to the stream segment by the TCEQ. Each classified segment in the TSWQS is assigned an aquatic life use, based on physical, chemical, and biological characteristics of the water body. The five aquatic life use categories are: *exceptional; high; intermediate; limited; and minimal* (no significant) *aquatic life use*. For streams not classified in the TSWQS, the aquatic life use is presumed based on the stream flow type. The Transect's Aquatic Use Variable (UV**)** is assessed based on the following five categories.

Optimal-Score 5

Aquatic Life Score of *Exceptional*.

Suboptimal-Score 4

Aquatic Life Score of *High*. Perennial streams that have not been assessed are also assumed to have an Aquatic Life Score of *High*.

Marginal-Score 3

Aquatic Life Score of *Intermediate.*

Poor-Score 2

Aquatic Life Score of *Limited*. Intermittent Streams with Perennial Pools that have not been assessed are also assumed to have an Aquatic Life Score of *Limited*.

Severe-Score 1

Aquatic Life Score of *Minimal*. Intermittent and ephemeral streams that have not been assessed are also assumed to have an Aquatic Life Score of *Minimal*.

1.4 Visual Channel Alteration Parameter

This parameter considers direct impacts to the stream channel from anthropogenic sources. The Transect may or may not have been altered throughout its entire length. Examples of channel alterations evaluated in this parameter that may disrupt the natural conditions of the stream include, but are not limited to, the following:

- Straightening of channel or other channelization
- Stream crossings (bridges and bottomless culverts)
- Riprap, articulated matting, concrete aprons, gabions, or concrete blocks along streambank or in streambed
- Manmade embankments on streambanks, including spoil piles
- Constrictions to stream channel or immediate flood prone area such as any culverts, levees, weirs, and impoundments
- Livestock impacted channels (i.e., hoof treads, livestock in stream, *etc*.)

It is important to note that this parameter evaluates the physical alteration, separate from the impact the alteration is having on the assessment reach. Any impact to the assessment reach resulting from the alteration (i.e. scouring, head cuts, vertical banks, etc.) is accounted for in the Visual Channel Condition Parameter. Any revegetation or natural re-stabilization of the channel is also accounted for in the Visual Channel Condition Parameter. For example, consider two Transects, each with similar bridges: the first reach shows no adverse effects to the stream channel or banks; the second shows significant scouring. The alteration is the bridge, not the effects of the bridge; therefore it is the length of bridge relative to the length of the assessment reach that is evaluated. The presence of a structure does not necessarily result in a reduced score. For instance, a bridge that completely spans the floodplain would not be considered an alteration. Also, the stream evaluator is cautioned not to make assumptions about past alterations. For example, incision can be mistaken for channelization. While the both result in an unstable width/depth ratio, only channelization would be accounted for in this parameter.

1.4.1 Channel Alteration Categories

The Transect is assessed for the extent of anthropogenic channel alterations to determine the appropriate Visual Channel Alteration Variable (AV) using the following four Categories. The evaluator selects the category most representative of the assessment Transect.

Optimal-Score 5:

Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.

Suboptimal-Score 4:
Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.

Marginal-Score 3:
Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.

Poor-Score 2:
Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.

Severe-Score 1:
Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.

1.5 Calculations

1.5.1 Assessing Transect Condition Index:
The first step is to assess the Condition Index (CI) for each Transect sampled. Each Transect is sampled for the following variables:

- Channel Condition Variable (CV) = Score 1-5
- Riparian Buffer Variable (BV) (see Example 1)= Score =1-5
- Aquatic Use Variable (UV)= 1-5
- Channel Alteration Variable (AV)= 1-5

The CI is calculated using an arithmetic mean, or average score. The CI shall be calculated for each Transect sample. The calculation for determining CI is:

$$CI = (CV+BV+UV+AV) \div 4$$

1.5.2 Assessing Reach Condition Index

Similar to the CI for each Transect, an arithmetic mean is used to calculate the Reach Condition Index (RCI). A single RCI is calculated for each stream segment, or reach, proposed for impact. The calculation for determining RCI is:

$$\mathrm{RCI}=\left(\sum_{\mathrm{n}=1}^{\mathrm{Y}} \mathrm{CIn}\right) \div Y$$

RCI = Reach Condition Index

CI = Condition Index for each Transect

Y= Number of Transects

Level 2 Stream Condition Assessment for Impacts Greater than 500 Linear Feet to Intermittent Streams with Perennial Pools, Perennial Streams and Wadeable Rivers

2.1 Under Development

Evaluating Avoidance, Minimization, Stream Restoration Projects and Compensatory Mitigation Plans

3.1 Introduction

When evaluating a permit under Section 404, the district engineer must conclude that the proposed discharge complies with the requirement (40 CFR part 230) that the permit applicant has taken all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the United States. Similarly, projects whose purpose is stream restoration or re-habilitation must also demonstrate their end result will heighten, intensify, or improve specific stream function(s) or return natural/historic functions. Through several development phases of the Stream SOP, the Galveston District has developed a process for demonstrating how proposed impacts to stream functions have been avoided or minimized. In addition, the Galveston District has established a qualitative method for evaluating a stream's condition, based on its stability, to track if the proposed project will result in a net gain in aquatic resource function.

3.2 Avoidance and Minimization

Stream stability is morphologically defined as the ability of the stream to maintain, overtime, its dimension, pattern and profile in such a manner that is aggrading or degrading and is able to effectively transport the flows and sediment delivered to it by its watershed. The Corps must make a determination that the potential impact to streams, which have been identified in 33 CFR 332 as a difficult to replace resource, have been avoided altering this stability to the maximum extent practicable; remaining unavoidable impacts to stability will then be mitigated to the extent appropriate and practicable by requiring steps to minimize impacts to stability, and, finally, compensate for aquatic resource values lost by. The Level 1 stream condition assessment may be used to demonstrate avoidance and minimization similarly to how the Galveston District uses their wetland functional assessments.

3.2.1 Avoidance

Many projects located in streams do not result in the loss of area of the water of the U.S. but rather result in a reduction of its function by reducing stream stability. In accordance with the 404(b)(1) Guidelines, the applicant must demonstrate the proposed project has been designed to avoid adverse impacts to stream function to the greatest extent practicable. For the purposes of assessing streams, a project that will not affect the streams stability is considered to have avoided impacts to stream function. Demonstration of this avoidance starts with using Level 1 to assess the current condition of the stream's functions to establish a baseline for comparison. Once this baseline has been established, and verified by the Corps, the investigator may then assess the post-project impacts using the Level 1 Condition Assessment. This assessment shall include project plans that clearly demonstrate the proposed project's post-construction plan and profile of the stream as well as planting schedules for the riparian buffer, if appropriate. While project design components may be included to improve avoidance of loss of stream functions, best management practices required to offset temporary impacts resulting from construction may not be included as avoidance. Assessment of avoidance using the

Level 1 assessment will focus on stream channel condition and anthropogenic modification as well as buffer and in-stream habitat loss. However it may be appropriate to demonstrate further avoidance using quantitative measures not included in the Level 1 assessment. Other methods demonstrating avoidance will be assessed on a case-by-case basis. It is recommended, although not required, that the applicant provide an avoidance analysis for inclusion in a public notice.

3.2.2 Minimization

Once the Corps has concluded that the potential impacts to stream function have been avoided to the maximum extent practicable, the remaining unavoidable impacts shall be minimized to the extent appropriate and practicable. For the purpose of assessing streams, a project that will affect stream stability but has incorporated design features that will maintain stability after normalization is considered to have minimized impacts. Similar to demonstrating avoidance, the Level 1 condition assessment is used to establish a baseline condition of stream function. Once a baseline has been established, appropriate and practicable steps to minimize the adverse impacts through project modifications and permit conditions may also be assessed using the Level 1 assessment. Subpart H of the 404(b)(1) Guidelines describes several (but not all) means of minimizing impacts of an activity. It is recommended that on-site and off-site alternatives described in the Guidelines be assessed using the Level 1 assessment. It is recommended, although not required, that the applicant provide an avoidance analysis for inclusion in a public notice.

3.3 Stream Restoration & Re-establishment

Restoration projects evaluated by the Corps must have the goal of returning natural/historic functions to a former or degraded aquatic resource. This is often construed as returning a stream to a pristine or to pre- disturbance condition. However, many of the systems along the Texas coastal plains have had their sediment and flow regime, as well as many other variables, significantly altered in the watershed, making the return of a stream to a pristine condition not possible.

There are two factors to evaluate on a proposed stream restoration project; 1) the current condition of the stream's functions and 2) the proposed restoration method. The first factor allows the evaluator to assess the stream condition so as to conclude if any proposed work is warranted. Stream restoration projects may be proposed for a variety of reasons, but the underlying purpose and need for the project must be restoration for consideration under this section.

3.3.1 Assess Current Stream Condition for Restoration and Re-establishment.

Demonstrating a stream's need for restoration is important; we should not assume a stream has impaired function based on a visual inspection that lacks the understanding of fluvial or hydrogeomorphology of the stream segment. The first step in demonstrating the streams condition starts with using Level 1 to establish a baseline for comparison. Once this baseline has been established, and verified by the Corps, the investigator may then assess the post-project improvement using the Level 1 Condition Assessment. This assessment shall include project plans that clearly demonstrate the proposed project's restoration plan and profile of the stream as well as planting schedules for the riparian buffer.

3.3.2 Assessing Restoration & Re-establishment Projects

Property owners and local and state agencies restore streams for many reasons, like repairing damage from bridge and dam construction or runoff from farms, subdivisions and parking lots or historic flood management practices. The damage is visible in reduced water quality, damage to habitats, declines in fish, reduced recreational and aesthetic value and other problems. However, these groups often design projects without fully understanding the waterways they want to restore and without paying enough attention to what happens to the chemical, physical and biological function of the stream after a project is finished. Therefore, restoration projects should focus project designs, using natural channel stream design, on creating landforms and water flows that streams can maintain naturally that focus on the restoration of the chemical, physical and biological functions.

Hydrologist Dr. Dave Rosgen, of Wildland Hydrology, developed natural channel stream design restoration priorities which evaluators shall use to help them identify and address deficiencies in stream functions and track improvements through restoration projects. These priorities are based on the project's ability to reconnect the stream to the floodplain. Many historic projects resulted in the straightening of stream channels and disconnecting it from the floodplain. These activities resulted in increases in the force of floods because they resulted in an increase in the slope of the channel and the velocity of the water. Sediment is not dispersed on the floodplain but stays in the water, further increasing its erosive force and damaging fish habitat. The periodic cycling of nutrients from floodplain vegetation to stream channel is lost. The productive backwaters that are refuge and nursery to young fish and other aquatic life are gone. The connections between groundwater and surface water are altered or severed locally. Focusing restoration and re-establishment projects on reconnecting a stream to a natural channel design that includes a floodplain can produce benefits that include: reducing flooding downstream; reducing sediment load; raising the water table; lowering water temperature; and enhancing in-stream habitat for fish and wildlife.

Floodplains are defined as the lateral components of alluvial river systems and are not synonymous with flood hazards mapped by FEMA. Healthy floodplains are critical for healthy streams. Because a floodplain is only flooded when a stream overflows its banks, it is easy to forget the important work a healthy floodplain does for a stream. Floodplains are viewed as critical for maintaining river productivity, biotic diversity, and for providing many chemical, physical and biological services of direct benefit to humans. By definition, floodplains are transitional environments between terrestrial and aquatic ecosystems and hydrology is a key factor in determining the type and functional nature of floodplains.

3.3.2.1 Restoration and Re-Establishment Priorities

Rosgen's first priority for restoration involves the re-establishment of a stable C or E channel type on the original floodplain by constructing a new channel or using a relic channel if available. This is a complex restoration project that results in improvements to the chemical, physical and biologic functions of the stream system as well as an increase in aquatic area, as required in a re-establishment project. Relocation of the stream and construction of a vegetated buffer assures the proper dimension, pattern, and profile characteristics will be established for a stable stream. Stream restoration projects involving relocation of a historic channel into a new channel shall not be used for a stream channelization or relocation project purpose.

Rosgen's second priority for restoration involves creating a stable C or E channel type and re-establishment of a new floodplain at the existing channel level or higher but not at the original level. Although the stream channel is not relocated in this type of restoration project, the new channel shall be designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. Assuring the stream is re-established may be difficult when the project site is laterally contained by limitations on the belt width. Common examples of limitations are utilities, infrastructure, and other floodplain encroachments. If the appropriate sinuosity cannot be established, the stream will not be considered restored.

Rosgen's third priority is the modification to existing channels and floodplains at the current elevation to create a stable B or Bc stream type. While natural channel design recognizes this as a restoration priority, Corps regulatory definitions provide limited availability to incorporate this design into restoration and re-establishment projects. The best use of this restoration priority is in stream projects that have historic and contemporary purposes associated with flood management. These sites present difficulties in reestablishing a sinuous pattern because they are laterally contained or have limitations in available belt width. This is often caused by utilities, infrastructure, and other floodplain encroachments. Such physical constraints often favor the creation of step/pool bed morphology with less sinuosity (associated with Priority 3) over riffle/pool bed morphology with greater sinuosity (associated with Priorities 1 & 2).

Regardless of the level of priority the restoration project has or what channel type will be produced, the channel restoration must involve establishing proper dimension, pattern, and profile.

Information the evaluator shall consider includes, but is not limited to: 1) available belt width; 2) the slope of the proposed stream; and 3) the dimension, pattern, and profile of the restored stream.

The difference between projects that are credited as R-establishment and projects that are credited as Enhancement is whether or not changes are necessary to address the current channel's dimension, pattern, and profile, as described for each of the Priorities, to produce a stable channel. All three geomorphic variables are required to be addressed, with noted pattern limitations for Priority 3, in order to be considered stream restoration or to be credited with stream re-habilitation. Enhancement credit is given in all other situations when only two geomorphic variables are addressed to produce a stable channel.

3.3.2.2 Restoration and Re-Establishment Project Plans

Stream restoration and re-establishment projects shall establish clear goals and objectives based on a geomorphic and hydraulic analysis of the current stream condition so that the appropriate functional improvement, or lift, can be identified. This analysis will identify the cause of the stability issues which will lead to designs that focus on solving problems rather than just addressing the streams dimension, pattern and profile.

To provide a predictable and easily reviewable restoration or re-establishment plan, the *Natural Channel Design Review Checklist* published by the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office and U.S Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds should be used. The Checklist provides guidance on important considerations when designing and reviewing a natural channel stream design for restoration and re-establishment projects. By providing the information described in the checklist in your project plan, including a completed checklist identifying the location of these items in the plan, the reviewer will be able to streamline the review and evaluation process of a proposed project.

3.4 Assessing Enhancement Projects

The purpose of this mitigation type is to provide compensation for small projects and/or to improve the chemical, physical and/or biological function of streams that do not qualify for restoration or re-establishment. Given the numerous man-made alterations to streams, there are plenty of opportunities to enhance streams that are not full degraded in our District. In addition, a project requiring a small mitigation plan to offset minor loss in function may be best suited for stream enhancement project rather than stream re-establishment projects. To provide a predictable and easily reviewable enhancement plan, the *Natural Channel Design Review Checklist* may be an invaluable tool. However, the amount of detail and planning for an enhancement project shall be commensurate with the project. At a minimum, a baseline condition of the stream should be assessed as well as a demonstration of the functional lift resulting from the proposed mitigation plan.

Impact Assessment

4.0 Impact Factor

Permitted impacts result in a variety of impairments to a stream's ability to transport water, transport sediment, support and maintain a community of organisms and provide a safe water supply. Impacts affect streams by altering bankfull depth, slope, velocity, flow resistance, sediment size, sediment load, and bankfull discharge.

Different types of impacts should be assessed based on the extent to which they are expected to impair the stream. A stream condition assessment shall be completed to determine the current stream function conditions. A theoretical stream condition assessment will also be conducted based on the proposed project plans. The difference between these, or Delta, will be used to calculate the functional loss resulting from the project. The difference will be referred to as the Reach Condition Index Delta, or dRCI. Impacts shall be characterized into one of five classifications based on the dRCI. The five categories are: 1) Severe; 2) Major; 3) Moderate; 4) Minor; and 5) Negligible. Each Impact Classification has a corresponding **Impact Factor (IF)**; the more severe the impact, the higher the **IF**. If multiple impacts occur within the stream reach, the district engineer will determine, on a case-by-case basis, the most applicable **IF**.

4.1 Impact Classification

Severe-IF Score 5

The proposed project will eliminate a stream, or result in a loss function equivalent to a 4-point change in Reach Condition Index.

Major-IF Score 4

The proposed project will result in a loss of function equivalent to a 3-point change in Reach Condition Index.

Moderate-IF Score 3

The proposed project will result in a loss of function equivalent to a 2-point change in Reach Condition Index.

Minor –IF Score 2

The proposed project will result in a loss of function equivalent to or less than a 1-point change in Reach Condition Index.

Temporary- If Score 1

Impacts are temporary and the site will be returned to pre-construction contours and elevations with no permanent loss of aquatic function.

4.2 Calculating Debits

$$Reach\ Condition\ Index\ Delta\ x\ Impact\ Factor\ x\ Linear\ Feet\ of\ Impact = Debits$$

Determination of Compensation

5.0 Determination of Compensation Requirements (Credits)

This section describes the methods and alternatives for fulfilling the **Compensation Requirement (CR),** representing the total stream compensation required for the project, and explain the process. Using this process ensures that crediting compensation projects, evaluating, and approving stream compensation banks and in-lieu fee fund projects through the Interagency Review Team are all credited in the same manner. This process does not include a method for crediting out-of-kind compensation between streams and wetlands; these activities may serve to fulfill the **CR** in certain situations, but will be evaluated on a case-by-case basis.

The process categorizes compensation methods for various levels of stream enhancement and restoration as well as riparian buffer preservation activities. The compensation may be further refined by applying appropriate Adjustment Factors (AF) to the credits obtained through the various activities.

The following provides details on compensation practices and guidelines for using the calculating compensation. This method is applicable to streams assessed under Level 1, 2 and 3 Stream Condition Assessment procedures.

5.1 Re-Establishment Credits (3 credits per linear foot)

Re-establishment means the manipulation of the physical, chemical, and biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. Re-establishment shall result in a net gain in aquatic resource. Re-establishment activities include the process of converting an unstable, altered, or degraded stream corridor, including flood-prone areas, to a natural stable condition considering recent and future watershed conditions. The re-establishment process shall target the restoration standards set forth in the *Restoration and Re-Establishment Priorities* section of Chapter 3 or may be based on pre-approved reference sites. This process supports the re-establishment of the stream's biological, chemical and physical integrity, including transport of the water and sediment produced by its watershed in order to achieve dynamic equilibrium. Re-establishment activities may include: 1) the re-establishment of a channel on the original floodplain, using a relic channel or constructing a new channel; 2) re-establishment of a floodplain at the existing level or higher but not at the original level; or 3) re-establishment of a channel with a flood prone area, but without an active floodplain.

5.1.1 Re-establishment Restrictions

The difference between projects that are credited as re-establishment and projects that are credited as rehabilitation or enhancement is whether or not changes are necessary to address the current channel's dimension, pattern, and profile to produce a stable channel.

All three geomorphic characteristics (i.e., pattern, profile, and dimension) are required to be addressed, as well as a net gain in aquatic area, for a stream to receive re-establishment credit. Rehabilitation or enhancement credit is given in all other situations when only two geomorphic variables are addressed to produce a stable channel or there is no net gain of aquatic resource area. Additional restrictions include:

1. No rehabilitation and/or enhancement activities can be coupled with re-establishment on the same linear foot of stream channel. Credit is limited to three credits per linear foot of in-channel and buffer work for the mandatory first 100-foot of buffer work. Additional Credit for additional buffer between 100-200 feet is calculated pursuant to Section 5.2.2.
2. Re-establishment mitigation credits cannot be generated for stream channel or streambank restoration if the mitigation segment is within 500 feet of a dam or a channelized/piped stream reach.
3. No artificial hydrology allowed.
4. Water rights should be established.

5.2 Rehabilitation or Enhancement Credits

Rehabilitation means the manipulation of the chemical, physical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource.

Similarly enhancement means the manipulation of the physical, chemical, or biological characteristics of a site to heighten, intensify, or improve a specific aquatic resource function(s). Neither rehabilitation nor enhancement will result in a gain in aquatic resource area. For this reason, rehabilitation and enhancement credits are determined the same way. Stream rehabilitation and enhancement activities may include physical alterations to the channel that do not constitute re-establishment but that directly augment channel stability, water quality, and stream ecology in accordance with a reference condition, where appropriate. In order for a site to be considered for rehabilitation, pre-approved reference sites must be utilized to establish the natural/historic function goals. However, enhancement process shall simply target the Optimal and Suboptimal standards set forth in the Conditional Assessment Procedure. Rehabilitation or enhancement activities may include in-stream and/or streambank activities, but in total improve only one or two of the chemical, physical or biological functions of a stream.

5.2.1 Rehabilitation or Enhancement of Physical Functions (1 credit per linear foot).

Rehabilitation or enhancement of physical function is primarily achieved through the manipulation of following geomorphic variables – dimension, pattern, and profile. Activities included, but not limited to, in rehabilitation or enhancement category: 1) In-stream structures constructed of natural materials that provide channel stability (cross vanes, j hooks, etc); 2) Bankfull bench creation; 3) Laying Back Banks; and 4) Bioremediation Techniques. Structures constructed by non-natural materials, such as concrete or metal, may be considered on a case-by-case basis and shall only be approved when no natural alternative is feasible. These compensation activities shall directly improve the stability of the streambank or streambed.

5.2.1.1 Typical Streambank and Streambed Improvements

The following are typical examples of streambank and streambed improvements. However, these representatives are not the only improvements that may be considered during development of re-habilitation or enhancement projects.

In-stream Structures: This activity includes natural structures that are specifically designed and result in grade control and/or bank stabilization. Accepted structures include, but are not limited to, cross-vanes, j-hook vanes, native material revetments, W-rock weirs, rock vortex weirs, log-vanes, constructed riffles, and step-pools. These structures may be created out of appropriate sized rock or logs, boulders or cobbles based on the size of the stream and the flow regime. Structures not listed will be considered on case-by-case basis. Normally, a pool should be constructed in combination with these structures; however, if one is determined not to be required, it will not alter the credit provided.

Bankfull Bench Creation: This activity involves the creation of a bankfull bench along the streambanks. This activity may result in less than the proper entrenchment ratio but does result in a stable channel. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where bankfull benches are proposed. The bankfull bench shall be sufficient to handle discharge rates associated with a bankfull event for that stream. Normally, a bankfull bench should be constructed on both streambanks; however, if one it is determined to not be required, it will not alter the credit provided.

Lay Back Bank: This activity involves the manual manipulation of the bank slope but does not create a bankfull bench or floodplain. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where laying back the banks is proposed. Normally, both banks should be layed back; however, if one is determined to not be required, it will not alter the credit provided.

Bioremediation Techniques This activity primarily relates to the use of coir logs or similar materials for bank stabilization. Techniques and materials in this category include, but are not limited to: live fascines; branch packing; brush mattresses; coir logs; and natural fiber rolls. More than one of these materials or techniques may be warranted over the same stream length. In this case, no additional credit will be applied for that length. In other words, the compensation plan should include all bioremediation techniques required over a particular length. Techniques and materials other than those listed will be considered on a case-by-case basis for approval.

Streambank Planting: This activity includes the installation of plants other than seed, along the immediate streambank area for the purpose of streambank stabilization. Seed is a required construction BMP with no lift given. This activity includes: live stakes; dormant post/stakes; branch layering; and/or the installation of native plants at or below the ordinary high water mark. Species selected shall be adapted to fluctuations of water levels and have flexible branches that will in most cases bend over without damaging banks. This activity will not be considered on stable streambanks.

5.2.2 Rehabilitation or enhancement of Chemical Functions

Riparian Buffer Zones (Buffer) improve water quality in different ways depending upon the pathway of delivery of water to the Buffer. Groundwater passing through the Buffer may be cleansed of nitrate and acidity due to a combination of denitrification, biostorage, and changes in soil composition. Overland storm flows entering laterally from the uplands may be cleansed of suspended particulates, with adhering nutrients, inorganic toxins, and pesticides, as well as some dissolved nutrients and toxins. Sometimes these overland flows will also infiltrate within the Buffer and become a part of the groundwater, thus also obtaining the benefits associated with groundwaters in the Buffer. During stream flooding events, waters flooding out into the Buffer may also be cleansed of sediments, nutrients and toxic materials as a result of particulate trapping and the binding of materials on the leaf litter and soils within the Buffer.

This category includes establishment or enhancement of riparian buffer zones and requires appropriate monitoring and site protection in perpetuity. With some exception, livestock shall not access riparian buffers within compensatory mitigation or restoration sites. Livestock exclusion is normally accomplished by fencing stream corridors and may include the construction of stream crossings with controlled access and with stable and protected streambanks. No more than one livestock crossing is allowed per 1,000 linear feet of stream mitigation or restoration. The width of the livestock crossing and any length of affected stream downstream will be deducted from the total length of the stream mitigation segment. After cattle have been removed, impacted riparian buffers must be restored or enhanced and may not be used for preservation purposes only. Additional activities restricted from the riparian buffer include:

1. Timber harvesting.
2. Any off-road vehicles.
3. Horses.
4. Any other activity that may affect the water quality and/or aquatic habitat.

The Riparian Buffer Credit category includes the following four activities: 1) Buffer Re-Establishment; 2) Heavy Buffer Planting; 3) Light Buffer Planting; and 4) Preservation Only.

The minimum buffer width for which mitigation credit will be earned is100 feet on both sides of the stream as measured from the top of the ordinary high water mark, perpendicular to the channel. Buffer areas should be developed as a belt width that allows the stream to naturally migrate within the belt. However, the stream may not extend any closer than 25 feet from the outer edge of the buffer.

Up to an additional 100 feet of buffer may be included for credit; however, buffer in excess of 100 feet will be credit at a prorated amount. Narrower buffer widths may be approved on a case-by-case basis and will also be prorated. Target species in the first 100 feet are limited to native woody species. Target species in the outer 100-200 feet may be planted with non-woody, native coastal prairie species if the project is located in the coastal prairie.

5.2.2.1 Riparian Buffer Calculations

Buffer Re-Establishment (0.5 per linear foot for the inner 100 feet/0.5 per linear foot for the outer 100-200 feet)

Credit for this activity is given when impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions are removed and the buffer area is replanted with target species and a heavy buffer planting rate. Annual abatement to ensure invasive species eradication for the duration of the monitoring period and the success of the target species shall be required. Invasive species are those included in the Texas Invasive Plant and Pest Council database. For a current, comprehensive list of species, visit http://www.texasinvasives.org/invasives_database/index.php.

Heavy Buffer Planting (0.5 per linear foot for the inner 100 feet/0.25 per linear foot for the outer 100-200 feet)

Credit for this activity is given when the buffer area requires extensive planting (e.g. 400 stems per acre or more) and may include balled and burlapped specimens and/or containerized specimens. Annual abatement to ensure invasive species eradication for the duration of the monitoring period and the success of the target species shall be required. Invasive species are those included in the Texas Invasive Plant and Pest Council database. For a current, comprehensive list of species, visit http://www.texasinvasives.org/invasives_database/index.php.

Light Buffer Planting (0.25 per linear foot for the inner 100 feet/0.25 per linear foot for the outer 100-200 feet)

Credit for this activity is given when the buffer area requires only light or supplemental planting. This activity would involve planting at less than ideal densities (example: less than 400 stems per acre), either because vegetation is already present, a seed source is present, or the project does not otherwise warrant it. Annual abatement to ensure invasive species eradication for the duration of the monitoring period and the success of the target species shall be required. Invasive species are those included in the Texas Invasive Plant and Pest Council database. For a current, comprehensive list of species, visit http://www.texasinvasives.org/invasives_database/index.php.

Preservation Only (No Work Proposed)

Credit for this activity is given when no work to a riparian buffer area is proposed but that area will be placed under perpetual protection through an appropriate real estate instrument. Riparian buffer preservation must meet the requirements contained in 33 CFR Part 332.3(h) on preservation. Credit is given based on the quality of the stream buffer preserved. A High Quality streams is defined as a stream with an RCI score of 4 or higher. A Low Quality streams is defined as a stream with an RCI from 3-3.9. Preservation will not be allowed for streams that score below an RCI of 3. When preservation of high-quality buffer is conducted on streams where stream re-establishment, rehabilitation or enhancement activities are proposed, the credit for Low Quality streams is applied since the compensation proposal has not yet resulted in an improvement. Calculation of buffer preservation scores is as follows:

- High Quality streams receive 0.1 credits per linear feet for the inner 100 feet.
- Low Quality streams receive 0.05 credits per linear foot for the inner 100 feet.
- For the outer 100-200 feet of buffer, all streams receive 0.05 credits per linear foot.

5.2.2.2 Riparian Buffer Restrictions:

- Buffer proposals for less than 100 feet in width or greater than 200 feet in width, on either side of the stream, must be approved on a case -by-case basis.
- No area of buffer can be credited under more than one Riparian Buffer category.

5.3.3 Rehabilitation or Enhancement of Biological Functions (0.5 Credit per Linear Foot)

Aquatic species, such as fish and macroinvertebrates require sufficient habitat for their survival and prosperity. Many streams in our region lack natural habitat as a result of many situations, including stream channelization, poor agricultural practices, inadequate stormwater management, and disturbance to the riparian zones bordering the stream. The placement of artificial habitat structures can often enhance stream reaches that lack naturally occurring habitat features. The more diverse this habitat is, the greater potential it has to support a healthy, self-sustaining population. Habitat functions may be credited based on either the construction of habitat structures that provide habitat for aquatic species (fish boards, root wads, etc) and/or streambank planting.

5.3.3.1 Typical Habitat Improvements

Habitat Structures: This activity includes structures designed specifically for habitat creation. Although, In-stream structures typically provide habitat, they are constructed for channel stability and will not receive credit for Habitat Structures. Habitat Structures do not typically contribute to channel stability; however bank stability is required for successful habitat structures. Accepted structures include, but are not limited to, submerged shelters, fish boards or bank cover, floating log structures, root wads, and half-log cover. Riffle and pool complexes and over hanging vegetation do not qualify for credit in this activity.   Technical design of in-stream structures should mimic natural structures found in a reference stream.

Streambank Planting: This activity includes the installation of plants other than seed, seed is a required construction BMP with no lift given, along the immediate streambank area. While this is primarily done for streambank stabilization, stable streams banks that have been denuded may use this technique for habitat improvements. This activity includes: live stakes; dormant post stakes; branch layering; and/or the installation of native plants at are below the ordinary high water mark that are adapted to fluctuations of water levels and have flexible branches that will in most cases bend over without damaging banks.

5.4 Credit Adjustment Factors

Adjustment Factors **(AF)** are used to account for exceptional or site specific circumstances associated with the compensation site. These circumstances may provide ecological benefits or detriments that must be accounted for when determining credits. The Adjustment Factors are applied only when ecological and/or water quality function is affected by the action.

Each AF activity is scored within a prescribed range. The range is to account for variation in activities and conditions that warrant **AF** credit. Examples are given for each of the ranges. The agency representative shall make this determination on a case-by-case basis and use best professional judgment.

5.4.1 Credit Adjustments

Riparian Buffers with Wetlands (0.25 per linear foot of buffer with wetland)
Increased compensation will be offered for riparian buffers where medium to high quality wetlands, as determined by an approved functional assessment, are created, enhanced or restored.   Wetlands included in this adjustment factor shall not be utilized for compensatory mitigation to offset the authorized impacts to wetlands.   A credit may be given at a rate of 0.25 credits per linear foot of buffer with a medium to high quality wetland.

Riparian Buffers Under 100 feet (-0.25 per linear foot of buffer under 100 feet)
In rare cases, stream mitigation will be authorized in areas where land use prohibits the minimum buffer of 100 feet.   Sites where buffers will not be the minimum 100 feet from the middle of the stream will have an adjustment factor of -0.25 credits per linear foot of buffer under 100-feet. The following factors are considered when determining if the reduced buffer will be authorized: 1) quality of remaining buffer (e.g. wetlands present), and 2) the water quality and/or streambank stability benefits of the stream restoration/enhancement activities.

Livestock Exclusion (-0.5 per linear foot of buffer subject to grazing)
Sites where livestock will be excluded will have no additional credit awarded for this management technique.   Sites where livestock will not be excluded will have an adjustment factor of -0.5 credits per linear foot of buffer subject to grazing and must have

an approved management plan. The following factors are considered when determining an approved grazing regime and monitoring protocol for a management plan: 1) the number and type of livestock, and 2) the water quality and streambank stability impacts.

Terminology

For the purpose of assessing the aquatic functions of streams, the following definitions may assist the investigator in understanding:

Active floodplain: The land between the active channel at the bankfull elevation and the terraces that are flooded by stream water on a periodic basis. This is not synonymous with the FEMA flood zone designation.

Aggradation: The rising of a streambed due to sediment deposition.

Alluvial and/orAlluvium: Clay, silt, sand, gravel, or similar detrital material deposited by running water.

Avoidance: In the context of a stream, a project that will not affect stream stability.

Back water pools: A pool type formed by an eddy along channel margins downstream from obstructions such as bars, rootwads, or boulders, or resulting from backflooding upstream from an obstructional blockage. Backwater pools are sometimes separated from the channel by sand or gravel bars.

Bankfull: The water level, or stage, at which a stream, river or lake is at the top of its banks and any further rise would result in water moving into the flood plain. It may be identified by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Bankfull bench: A flat or shallowly sloped area above bankfull that slows high velocity flows during flows above bankfull.

Bankfull Depth: The average depth measured at Bankfull Discharge.

Bankfull Discharge: The dominant channel forming flow with a recurrence interval seldom outside the 1 to 2 year range.

Bankfull Width: Channel width at Bankfull Discharge.

Base flow: During most of the year, stream flow is composed of both groundwater discharge and land surface runoff. When groundwater provides the entire flow of a stream, baseflow conditions are said to exist.

Branch packing: Technique in which alternate layers of compacted backfill and live branches are used to restore voids, slumps, and holes in streambanks.

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 Length: Curvilinear distance measurement along the center of the channel.

Channel Slope: Change in elevation divided by the length of channel along a channel distance of 20-30 riffle/pool sequences or 2 meander lengths. valley slope/sinuosity.

Condition: The relative ability of an aquatic resource to support and maintain a community of organisms having a species composition, diversity, and functional organization comparable to reference aquatic resources in the region.

Coir logs: Tightly bound cylinders of coir fibers (Coconut Fiber) held together by coir fiber netting made from coir twine. They are generally available in 10 to 20 foot lengths and are 12 to 20 inches in diameter. They are excellent to use as a toe protection in areas of low velocity water flow. After installation, the coir fiber logs become saturated with water and vegetation can be planted directly on the logs.

Coarse substrates: Naturally occurring gravel (0.079 inches in smallest dimension) or larger particle sizes.

Cross vanes: Rock structures built below the water level to control the direction of flow within a stream. Various types of in-stream rock structures are used. One or more structures can be used to direct a stream's energy toward the center of the channel and relieve pressure on an eroding streambank.

Deep pools: Areas characterized by a smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75-100% deeper than prevailing stream depth).

Degradation: The lowering of the streambed by scour and erosion.

Dense macrophyte beds: Beds of native emergent or submerged aquatic vegetation thick enough to provide invertebrate attachment and fish cover.

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.

Entrenchment Ratio: The channel width at two times the Bankfull Depth divided by the channel width at Bankfull Width of Floodprone Area / Width Bankfull

Ephemeral stream: A stream with 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 rainfall is the primary source of water for stream flow.

Fascines: A rough bundle of brushwood used for strengthening an earthen structure, or making a path across uneven or wet terrain. Typical uses are protecting the banks of streams from erosion, covering marshy ground and so on.

FEMA Flood Zone Designations: Flood zones are geographic areas that the FEMA has defined according to varying levels of flood risk.

Flats: Areas with still, unbroken surface, but a shallow, uniform bottom that are filled with aquatic vegetation.

Floodplain: A relatively flat alluvial feature adjacent to the stream channel that is formed during the present climate and receives flood flows.

Flood-Prone Area: A relatively flat lowland that borders a Stream and is covered by its waters at flood stage of twice the maximum Bankfull Depth.

Flood-Prone Width: The Stream width at a discharge level defined as twice the maximum Bankfull Depth.

In-kind: a resource of a similar structural and functional type to the impacted resource.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

J hooks: An upstream directed, gently sloping structure composed of natural materials. The structure can include a combination of boulders, logs and root wads and is located on the outside of stream bends where strong downwelling and upwelling currents, high boundary stress, and high velocity gradients generate high stress in the near-bank region. The structure is designed to reduce bank erosion by reducing near-bank slope, velocity, velocity gradient, stream power and shear stress.

Knickpoint (See **Nickpoint**)

Logs/large woody debris: Fallen trees or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish.

Low Flow: Groundwater fed flow

Live fascines: Long bundles of live woody vegetation buried in a streambank in shallow trenches placed parallel to the flow of the stream (Figure 1). The plant bundles sprout and develop a root mass that will hold the soil in place and protect the streambank from erosion.

Lunker structure: An artificial structure constructed along the bank of a stream designed to mimic undercut banks and provide habitat for fish species. These structures are generally found in high gradient streams.

Meander: Curves deviating from a linear course. Components of Meander geometry include length, amplitude, and belt width.

Meander Width Ratio: Meander Belt Width divided by the Bankfull Width.

Mid channel: Landforms in a stream channel that begin to form when the discharge is low and the stream is forced to take the route of less resistance by flowing in locations of lowest elevation.

Minimization: In the context of streams, a project that will affect stream stability but includes design features that will maintain stability after normalization.

Nickpoint (Knickpoint): A term in geomorphology to describe a location in a river or channel where there is a sharp change in channel slope, such as a waterfall or lake, resulting from differential rates of erosion above and below the knickpoint.

Off-site: an area that is neither located on the same parcel of land as the impact site, nor on a parcel of land contiguous to the parcel containing the impact site.

On-site: an area located on the same parcel of land as the impact site, or on a parcel of land contiguous to the impact site.

Out-of-kind: means a resource of a different structural and functional type from the impacted resource.

Overhanging vegetation: Trees, shrubs, vines, or perennial herbaceous vegetation that hang immediately over the stream surface, providing shade and cover.

Perennial Stream: A stream that has 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 rainfall is a supplemental source of water for stream flow.

Plunge pools: Plunge pools are formed where waterfalls over a boulder or log. The falling water scours out the streambed.

Point Bar: A point bar is a crescent-shaped depositional feature located on the inside of a stream bend or meander. Point bars are composed of well sorted sediment with a very gentle slope at an elevation below bankfull and very close to the baseflow water level.

Pool: Is a stretch of a river or stream in which the water depth is above average and the water velocity is quite below average.

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 functions 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.

Riffle: A short, relatively shallow and coarse-bedded length of stream over which the stream flows at lower velocity and higher turbulence than it normally does in comparison to a pool. As a result of the lower velocity and heightened turbulence, small ripples are frequently found.

Riparian buffer: The zone of vegetation adjacent to streams, rivers, creeks or bayous, generally forested, that plays a key role in increasing water quality in associated streams.

Rock weirs or rock vortex weirs: A structure designed to serve as grade control and create a diversity of flow velocities, while still maintaining the bed load sediment transport regime of the stream. The weir points upstream with the legs angling downstream at anywhere from a 15 to 30 degree angle relative to the streambank. The legs are carried up the streambank to just above the bankfull elevation. The key component of the rock vortex weir is that the weir stones do not touch each other.

Root wads: Commonly refers to the trunk of a tree with the roots attached, and the soil or dirt removed so that the roots are exposed. Individual rootwads are placed in series and utilized to protect streambanks along meander bends. A revetment can consist of just one or two rootwads or up to 20 or more on larger streams and rivers.

Run: A somewhat smoothly flowing segment of the stream.

Sinuosity: Ratio of Channel Length to Valley Length or ratio of Valley Slope to Channel Slope.

Streambed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the streambed, but outside of the ordinary high water marks, are not considered part of the streambed.

Step pools: Consist of a series of structures designed to dissipate energy in steep gradient sections of a stream. They are often used where a large nick point has formed and is migrating headward or where a channel has degraded below a culvert or outfall. They are made of large rock in alternating short steep drops and longer low or reverse grade sections. There are various configurations and arrangements of rock that can be utilized. The requirement is that whatever the design configuration chosen it must be stable at all flows, the rock must be large enough to be essentially immobile, and the drops should be low enough to allow aquatic life to migrate upstream.

Stream Assessment Reach: A fixed-length segment of the stream being sampled.

Terrace: An abandoned Floodplain, due to river incision or downcutting, etc.

Thalweg: Longitudinal outline/trace/survey of a deepest part of riverbed from source to mouth (upstream/downstream). Line of steepest descent along the Stream.

Thick rootwads: Dense mats of roots (generally from trees) at or beneath the water surface forming structure for invertebrate attachment and fish cover.

Transverse Bars: A slightly submerged sand bar extending perpendicular to the shoreline.

Undercut banks: Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets used by fish for hiding and protection.

Wadeable Rivers: A river is considered wadeable if it may be sampled in accordance with the procedure without a boat.

Valley: A depression on the earth surface drained by, and whose form is changed by, water under the attractive force of gravity, between two adjacent uplands.

Valley Length: Horizontal distance measured in the Thalweg of two cross sections in a linear depression between two adjacent uplands.

Valley Slope: Slope of a Valley for a given Reach where Valley and Reach intersect for some longer distance (several Meanders or step pools).