PLEASE NOTE: **The following document is in draft and subject to change. While the information contained herein may be used for planning purposes, final plans should be coordinated with the Corps of Engineers, the NC Division of Water Quality and/or the Ecosystem Enhancement Program as appropriate.**

INFORMATION REGARDING STREAM RESTORATION
With Emphasis on the Coastal Plain

Prepared By:

US Army Corps of Engineers,
Wilmington District, Regulatory Division
And
North Carolina Department of Environment and Natural Resources,
Division of Water Quality

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This document is intended to provide general information to compensatory mitigation providers for use when planning or evaluating potential stream mitigation projects; particularly in the coastal plain (defined as the Middle Atlantic Coastal Plain Ecoregion as shown on Griffith, et. al. 2002) of North Carolina. The term "stream" as used in this document, means that the flow of water is contained in a natural channel or bed with identifiable banks and, in its unaltered state on the coastal plain, usually has adjacent wetlands. This document is meant to complement the April 2003, Stream Mitigation Guidelines, prepared by the Corps of Engineers Wilmington District, Environmental Protection Agency, the North Carolina Division of Water Quality and the North Carolina Wildlife Resources Commission (US Army Corps of Engineers, 2003).

INTRODUCTION

The decision whether to purse any potential mitigation site should hinge on what can reasonably be accomplished considering current site conditions, and site constraints. Mechanically returning a site to a historic condition may not be possible or in some cases even preferable. The primary consideration must be what functions need to be returned or improved upon. Designers must then examine to what degree they can control those factors contributing to the loss or degradation of those identified functions. Together, these considerations should indicate whether a project is viable and ultimately determine the goals of the project.

Site Selection Considerations

The primary consideration in site selection for stream restoration efforts should be whether the site historically supported a stream. Placing a stream or wetland in a landscape position in which it does not naturally occur is considered "Creation" and brings with it many potential factors of failure. In some instances, manmade channels constructed in areas where no historic stream existed, have intercepted surface and/or ground water sufficient to develop intermittent or perennial flow and exhibit functions commonly associated with natural streams. While true stream restoration or enhancement activities may not be appropriate in these systems, there may be opportunities to meet watershed goals through application of best management practices (BMP). BMP projects will be considered on an individual basis. Therefore, we will not make effort to expand on the discussion in this document.

It is sometimes difficult to determine if a site historically supported a stream. This is particularly true in areas of the outer coastal plain that have been historically channelized or ditched. Direct evidence such as construction or maintenance records or photographs is the most acceptable method of documenting historical conditions. USDA Soil Surveys and USGS topographical maps are also often reliable indicators. However, it should be noted that, especially on the lower coastal plain, manmade ditches and canals are also sometimes identified as perennial and intermittent streams on these maps. Comparison to less altered systems in similar landscape positions may also be helpful.

There are many acceptable indicators which may be used in the absence of specific evidence. Streams exist primarily as a function of slope and watershed area. Local topographic signatures exhibiting both latitudinal and longitudinal slope can indicate historic presence of waterways. Tools such as visual observation, onsite surveys or LIDAR imaging can aid in determining presence and degree of slope. Designers should also document the presence of sufficient watershed area. Recent studies indicate that a drainage basin of 50 to 100 acres in size is generally sufficient to support the development of stream features in the coastal plain depending on the hydrogeomorphology of the site. Consideration should be given to both historic watershed and present watershed. It is possible that a system historically had sufficient hydrologic input to exhibit flowing water but due to recent land-use/drainage practices, this input has been removed.

Soils data can also be helpful in determining whether a stream or watercourse existed on the site. Project designers should look at local, site specific soil information as well as NRCS County Soil Surveys. The presence of soils classified as entisols or inceptisols would indicate historical flow. Linear features exhibiting higher organic content than surrounding soils or vertical layers of higher organic content may indicate historic presence of water. Likewise, variation in soil texture may indicate past sorting of sediment by a channel.

Project Design Considerations

Designers must consider what overall functional lift can be accomplished given current conditions and what type of project can be accomplished given current land use practices. If a stream historically relied on a watershed which has been significantly altered to the point that a new hydrologic regime is now present, restoration of the historic feature may no longer be appropriate. Likewise, if the stream has been channelized historically and now possesses a mature wooded buffer and does not have significant stability/erosion problems; restoring pattern and profile at the expense of the existing buffer may not result in any real gain in aquatic function. This is particularly true where existing wetlands are associated with these channels. Substantial channel work may not only lead to direct damage for equipment and materials access but may also result in drainage of portions of the wetland area.

When evaluating a site, designers must identify what natural functions have been removed or diminished. Restoration efforts should be focused on returning those functions to a stable state closer to that of the original system. Selecting a reference system to use as a target may be useful. The stated goals of the project should reflect the proposed functional lift. Success criteria should then be established which will adequately demonstrate that goals have been accomplished and function has been returned. In the absence of true data collection and analysis it is acceptable to infer level of function based on physical condition. It is critical however, to choose the appropriate physical indicators.

In the Mountain and Piedmont regions, streams that have experienced some clearing, channelization and/or damage to the riparian buffer are most often targeted as potential stream restoration sites. The decreased sinuosity and eroding banks typically observed in these systems are good indicators that the system is experiencing increased direct sediment input and unnatural sediment transport leading to degradation of water quality and habitat. In these situations, stream restoration efforts most often focus on restoring pattern, stabilizing banks and introducing structure. It is widely accepted that restoring the pre-impact pattern dimension and profile to these system and replacing structure will result in a more stable system with improved water quality and better habitat. In these systems, measuring physical properties of pattern, dimension and profile is typically appropriate for estimating function.

Another important consideration in project design is the degree of control over the immediate site and over the watershed as a whole. The success and longevity of any stream project is largely dependent on both present and future land uses within the watershed. The quality and quantity of water entering a site can have a significant bearing on the overall success of the site. Designers should make every attempt to control these inputs. For example, if there are local storm water inputs, designers should incorporate treatment of these storm water inputs into their design where possible.

Designers should not only consider present and planned development within the watershed but must also consider the possibility of hydrologic trespass and/or hydrologic bypass, particularly in the coastal plain. Project designers will often face legal ramifications if the project causes the impoundment of water on adjacent sites. If sites are located within established drainage districts, project designers must also be aware of the possibility that water passing through the site may be diverted to other waterways if the project affects overall drainage within the district. Designers may wish to contact the local Natural Resources Conservation Service office and/or the Board of Drainage Commissioners to explore this issue further.

COASTAL PLAIN STREAM MITIGATION

In the Coastal Plain, the concept that simply restoring channel pattern, dimension and profile will result in a net gain in function, does not necessarily hold true. It has been our experience that existing channels, even when heavily manipulated, are often stable and direct sediment input is typically not a major concern. In these coastal plain systems one of the more likely physical links to decrease in function is the lack of or disconnection from riparian wetlands and/or floodplain buffers. Riparian wetlands often play an integral role in coastal plain stream function and designers should consider incorporating wetlands into stream designs whenever possible. Where designers can adequately document, through achievement of appropriate success criteria, reconnection with an effective floodplain, it is possible to achieve restoration credit with little or no channel engineering. On a case-by-case basis, we will also consider allowing restoration credit without the restoration of pattern, dimension and profile; provided designers can document that lost key functions are being restored.

In deciding whether a coastal plain site is appropriate for mitigation, designers should consider comparing the site to a nearby reference area with similar landscape conditions. This will give some indication of what type of system the site may support and potentially aid in the development of project goals. For the purposes of this document, we have separated coastal stream systems into three broad categories:

1. **Riparian Headwater Systems –** These systems are, for purpose of this guidance, those systems that either do not appear or appear as first order streams[1] on the appropriate county soil survey as published by the Natural Resources Conservation Service or its predecessor, the Soil Conservation Service and/or USGS Topographic Map. These systems typically have small watersheds draining into defined valleys with little longitudinal slope. Relatively unaltered riparian headwater systems will usually possess a braided, diffuse surface flow pattern across a narrow floodplain of riparian, wooded wetlands.

[1] A first order stream is that portion of a waterway from its identified point of origin downstream to the first intersection with another waterway.

2. **Low energy streams –** These systems may appear as first or higher order streams on Soil Surveys or USGS maps. In a relatively unaltered state, these systems may have either intermittent or perennial flow and exhibit true bed and bank and indicators of an ordinary high water mark. In headwater settings, these systems are typically formed when a relatively large watershed drains into a well-defined topographic feature with little to moderate slope. They are usually associated with specific soil series (Table 1). Lower on the Coastal Plain, these systems may be affected by lunar or wind tides causing bidirectional flow.

3. **High energy streams -** These systems are typically found in areas with a relatively high slope. They tend to behave similar to piedmont type streams.

Riparian Headwater Systems

Many lower coastal plain riparian headwater systems have been converted to intense agricultural or silvicultural use, making it difficult to determine whether a true intermittent or perennial stream was historically present. Depending on the degree and success of the drainage system, some ditches may have intercepted sufficient surface and/or ground water so as to possess intermittent or perennial flow and exhibit functions commonly associated with natural streams. These ditches are often considered jurisdictional waters of the United States and, in some cases, are classified as "streams" for permitting purposes.

Mitigation project designers exploring projects in this setting must first document that a riparian system historically existed on the landscape. Areas exhibiting non-hydric soils or non-alluvial hydric soils are typically not suitable sites for riparian headwater establishment. Likewise, sites with little or no topographical relief would not likely exhibit flowing water features.

Designers should then consider local topography and watershed condition to determine whether the system historically supported an intermittent or perennial stream. Typically, sites with watersheds less than 100 acres would not support a stream with defined bed and bank. These sites may contain a valley with some longitudinal slope but it is likely that historic flow was not concentrated in a channel feature. If a channel feature is present it is likely man-made and typically does not appear on the county Soil Survey. In this situation, restoration of a riparian headwater type system may be more appropriate than channel construction. According to data being assembled by NCDWQ (Periann Russell, DWQ, personal communication) watersheds less than 25 acres in size, will not likely support a riparian headwater system.

Restoration of these riparian headwater systems could still be accomplished to provide both stream and wetland mitigation credit without physically constructing a distinctive stream channel. This type of mitigation would typically be appropriate for offsetting impacts to those systems that either do not appear or appear as first order streams on

USGS maps or Soil surveys but would not necessarily be acceptable for mitigating impacts to higher order systems. The limit of stream and riparian wetland mitigation credit will be decided on a case-by-case basis and will typically depend on the width and extent of a clearly visible valley in the landscape. A 50-foot buffer is typically required for stream mitigation projects in the coastal plain. Therefore, stream credit may only be awarded where the discernible valley is a minimum of 100 feet wide. Areas outside this 100 foot corridor but within the valley feature may be used as riparian wetland mitigation. Mitigation outside of and/or above the riparian boundary could be considered non-riparian wetland mitigation assuming restoration of wetland hydrology, hydric soils and appropriate wetland plants. The limits of the riparian area may be defined using appropriate and identifiable topographical or soils boundaries. In-field confirmation of the presence and limits of the valley may be needed in order to determine the extent of riparian wetland and stream mitigation. Local topographic information, site-specific soil mapping and information on flood frequency and duration are often helpful tools in identifying these valleys in the outer coastal plain.

Success criteria for these systems should include vegetation establishment similar to the restoration of a bottomland riparian (wetland) community. Additional considerations for success criteria should include documenting an adequate flooding regime and presence of at least periodic flow. Identification and examination of a local reference area may be helpful in establishing the appropriate target hydrograph. Flooding regime may be documented by continuous or semi-continuous monitoring wells, periodic staff gauge measurement, and/or visual observation. Potential methods of flow documentation are strategically placed flow meters, recording movement of wrack materials and/or periodic dye testing. Monitoring changes in faunal species and distribution patterns to document a shift from a terrestrial to an emergent aquatic community may also be appropriate.

Low Energy Stream

These are typically existing streams with intermittent or perennial flow. In the coastal plain, these systems have often been channelized historically and many are being actively maintained for drainage purposes. The channelization work alone does not typically result in the destabilization of these systems therefore, simply returning pattern and profile will not usually result in a lift in aquatic function. Designers should strongly consider whether substantial amounts of engineering and construction are actually necessary.

The loss or reduction in function is more typically due to a lack of access to a flood plain or significant alteration within the riparian zone. Designers should concentrate more on connecting these systems to an adequate and functioning floodplain and less on restoring historic morphology. In-Stream structures that serve to effectively raise the bottom elevation of a stream channel so as to increase the frequency and duration of over-bank flooding and/or to restore adjacent wetlands may be appropriate but should be scrutinized on a case-by-case basis. Designers must ensure that such structures do not cause other adverse impacts such as restricting the passage of important aquatic organisms for feeding and reproduction. If used, in-stream structures should be designed so that long term maintenance is not required and so that, over time, the stream channel will accumulate sediment to the level of the grade control that was installed. Restoration of riparian wetlands and treatment of existing stormwater input is strongly encouraged as a part of any stream restoration project in this setting.

Often these streams may have been historically channelized but due to abandoned maintenance they have developed a semi-mature vegetated riparian areas. Since stability is often not an issue, these systems can begin to function as well as unchannelized systems. In these cases, substantial work within these systems resulting in damage to the existing resources will seldom result in any substantial lift in aquatic function. This is particularly true when existing wetlands will be impacted. Therefore, designers are encouraged to avoid such projects. These systems may however have benefit if approached as enhancement or preservation activities. The North Carolina Division of Water Quality is currently working on guidance regarding the disturbance of riparian zones for stream restoration projects (Appendix 1).

Generally, credit for this type of project would be calculated based on actual channel length. As with riparian headwater systems, the riparian area may be defined by identifying and documenting appropriate soils or topographic boundaries. Documentation of restoration could be tied to lifting key functions rather than returning or installing pattern dimension and profile. Success criteria could be based on documenting the return of the system to the floodplain as measured by increased occurrence of overbank flooding and/or return of wetland conditions within the floodplain where appropriate.

High Energy streams

Traditional stream mitigation methods using natural channel design to predict and restore pattern, dimension and profile are typically appropriate in systems indicated as second and higher order streams. Generally, credit for this type project would be calculated based on the actual length of the channel restored or enhanced. The restoration of wetlands adjacent to the restored channel should be given strong consideration.

This document is intended as a general guide. The preparers realize there may be exceptions to the above information. Natural channel design may, for instance, be appropriate when a zero or first order stream is located in a soil series that traditionally supports streams (Table 1) and sufficient watershed area is available. The converse is also true in that there may be larger watersheds where stream mitigation as described for zero to first order streams may be more appropriate. It is also likely that large mitigation sites may have both zero/first order streams and higher order streams as well as wetland complexes thereby requiring multiple mitigation design techniques. Designers are strongly encouraged, in all cases, to use reference sites with similar watershed size and topographic conditions to determine the type of restoration that is appropriate for the site Planning documents must adequately support the mitigation work proposed.

The guidance found in this document is subject to change if and when additional information becomes available. The most current version of this document as well as information on its applicability will be posted on the websites of both the Corps of Engineers (http://www.saw.usace.army.mil/wetlands/notices.html) and Division of Water Quality (http://h2o.enr.state.nc.us/ncwetlands/rd_pub_not.html).

Citations

Griffith, G.E., et al. 2002. Ecoregions of North and South Carolina. Reston, VA. United States Geological Survey.

US Army Corps of Engineers, et al. 2003. Stream Mitigation Guidelines. Wilmington, NC

DWQ. 2006. Stream Origin Assessment: South Creek, NC (PCS Phosphate Company). Available at http://h2o.enr.state.nc.us/ncwetlands/documents/pcsdocfinal.pdf

Table 1[2]

Soils series in the coastal plain of NC which typically can contain streams

Soil Series Name	Beaufort	Bertie	New Hanover	Craven
Altavista	X			X
Augusta	X			
Autryville				X
Bibb		X		
Chewacla		X		
Craven		X		X
Currituck	X			
Doravan	X	X	X	X
Exum				X
Goldsboro				X
Johnston			X	
Lafitte				X
Masontown				X
Muckalee	X			
Norfolk		X		X
Onslow				X
Seabrook				X
State				X
Suffolk				X
Tidal Marsh			X	
Wahee	X	X		
Wasda	X			
Wehadkee		X		
Winton	X	X		

[2] These features normally occur on soils that typically contain streams. This table lists examples of some of these soil series for several coastal plain counties and is intended to serve as a general guide for this determination.

Appendix 1: Disturbance of Riparian Zones for Stream Restoration

The demand for stream restoration for mitigation of federal and state permitting requirements is increasing in response to continued development in North Carolina. The growing number of restoration projects has facilitated the need for additional guidelines in making restoration decisions. The following guidance is associated with existing riparian zones and buffers adjacent to potential restoration sites. It is expected that this policy will eventually be incorporated into the updated version of the joint state-federal stream mitigation guidelines in North Carolina (US Army Corps of Engineers, et al 2003).

General Guidance: Where an established and functioning riparian zone* consisting of native trees and shrubs exists at a potential restoration site, the riparian zone and the protection it provides to stream function and aquatic life will take precedence in restoration considerations. Given the existence of an established riparian zone (most common in rural settings), stream restoration that disturbs the riparian zone should be avoided.

Exceptions include but not limited by:

- Conditions (e.g. urban settings) where stream incision processes (degradation) are dominant and threaten most of the existing buffer, and where sufficient space exists for stream restoration.

- Rural settings where stream incision processes are dominant and portions of established riparian zones can be maintained on one or both sides of newly constructed channel.

All exceptions must be fully justified and documented upon submission for 401 certification and 404 permitting. Exceptions will be reviewed and approved by DENR Division of Water Quality and the US Corps of Engineers through the 404 permit process.

*Established and functioning riparian zone consists of at least two species of abundant (greater than 100 stems per acre) native overstory trees with a minimum of 5" DBH and understory woody shrubs and herbaceous vegetation that functions to filter sediment and nutrients, to provide shade and to supply small and large woody debris and leaf litter to the stream. The width requirement of the functioning riparian zone is based on the quality and quantity of native vegetation specific to a stream, that is, if a width of 1 or 2 large trees is providing an ecological benefit to the stream, then that width is the 'established and functioning' riparian zone. It may be necessary to evaluate select riparian zones on a site by site basis as needed.