Appendix F – Utilizing Streambank Stabilization in Water Quality Trading

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Introduction

WDNR offers watershed-based alternatives for meeting requirements associated with effluent limits in WPDES permits. These programs include Adaptive Management (AM), Water Quality Trading (WQT) and the statewide Multi-discharger Variance (MDV). This document details the necessary steps for quantifying pollutant reductions achieved from streambank stabilization projects implemented for the above programs. While the steps and examples are specific to WQT projects, similar methods should be used for AM and MDV projects.

Section 283.84(1m)(a), Wis. Stats. requires trades to result in water quality improvement. For WDNR to assert that this requirement has been met, pollutant reductions must be properly quantified, assigned a trade ratio, and be accompanied by supporting documentation.

Streambank erosion has long been identified as having negative impacts to water quality. The U.S. Environmental Protection Agency lists excessive sediments as a leading problem in our nation's rivers and streams. Unnatural quantities of sediment entering streams can degrade aquatic habitat and alter physical and chemical characteristics of the water. Nutrients associated with soil particles enter the stream and become available to aquatic plants and algae, ultimately contributing to eutrophication of local and downstream waters.

Erosion of streambanks is a naturally occurring process for many waterways, but human impacts can exacerbate erosion. Removal of vegetation, foot or vehicle traffic, and channel modifications can contribute to erosion. Hydrologic alteration of a stream's watershed (such as tiling or paving) can also result in streambank erosion. When planning a streambank stabilization project, treatments should aim to correct the cause of erosion. Stabilization projects that do not address the cause of erosion are generally less sustainable and have a higher risk of failure.

Considerations for Project Selection

When planning streambank stabilization projects for credit generation, the following factors should be considered early in the process:

- <u>Existing Information</u>: Have erosion issues already been identified in your area? Consider contacting your County Land and Water Conservation Department (LCD). Other organizations or documents such as watershed plans may have already identified erosion and offer resources or partnership for certain projects.

- <u>Magnitude of pollutant offset</u>: For compliance-driven projects, the number of credits required may guide the scope of the project.

- <u>General location of the project</u>, relative to the pollutant discharge: Project eligibility, as well as trade ratio, is influenced by location. The most effective locations for pollutant offsets are generally located upstream from the permitted discharge within the same HUC 12 watershed.

- Land access: Landowner support may dictate what areas can be considered. In addition to granting access for preliminary surveying and eventual implementation, the landowner should be willing to enter into a binding agreement to inspect and maintain the practice and/or allow 3rd party inspections and maintenance.

Numerous techniques exist for stabilizing eroding streambanks. A common approach is to regrade a steep bank to a more gradual slope, thereby providing stability and dispersing the energy of high flows. However, regrading alone will leave soil particles exposed and vulnerable to erosion. Additional practices should be implemented to avoid erosion of the disturbed area:

- Immediate seeding with a native seed mix suitable to the conditions of the site
- Plantings of native riparian vegetation
- Use of erosion breaks and or structures such as coir (coconut fiber) logs
- Erosion matting or webbing
- Surface hardening, such as rock rip rap

The use of surface hardening can be detrimental to a stream. Hardened streambanks may channel the energy of high flows to downstream banks, exacerbating erosion there. Unnatural quantities of rock in riparian areas may impede vegetation growth and decrease the aesthetic and habitat values of a stream corridor. Projects that employ excessive hardening may need to be modified prior to approval. The criteria outlined in Natural Resource Conservation Service (NRCS) Code 580: Streambank and Shoreline Protection should be adhered to.

Measuring the Baseline

By implementing a project that stabilizes an eroding streambank, soil particles that would have entered the waterway now remain on land. A series of measurements and calculations can quantify the mass of pollutants kept out of the waterway. Values are often reported in pounds per year. These reductions equate to pollutant credits, generated annually for the life of the practice.

Several key steps are needed to properly quantify pollutant reductions:

- Delineation of erosion areas
- Measurement of individual erosion sites (length, height, recession rate)
- Soil sampling and lab analysis
- Calculations, using the above information

Identifying Erosion Areas

Erosion sites are most commonly identified by a lack of vegetation. This condition indicates that erosion is likely occurring. However, streambanks lacking vegetation may not be eroding, or may be eroding very slowly. Other observations can help verify the presence of erosion.

Other symptoms of erosion include:

- Banks with steep or vertical slopes, often with loose soil
- Overhanging vegetation or recently fallen trees
- Deformations in the shape of the bank, relative to other banks
- Soil fracture lines, slumping, or sliding
- Exposed plant roots
- Buried cultural features are now exposed (fence posts, footings, foundations, etc.)

A comprehensive erosion survey will provide the baseline data needed to plan a project. Walking a section of stream and completing a standardized streambank erosion survey form can provide a structured approach. Beyond site-specific measurements (discussed next), data collected should include: a unique site ID, centerpoint GPS coordinates, bank designation (right or left, facing downstream), apparent cause of erosion, and vegetative condition on and above the bank.

Site Delineation

On certain streams, erosion may be concentrated in localized "pockets", with stable bank conditions found between sites. Other streams may exhibit a continual stretch of eroding bank. A degree of variability along an eroding bank is expected, which should be addressed by averaging all measurements for a site. However, large scale averaging across a highly variable bank does not properly quantify the site's baseline. When deciding where to "split or lump", consider bank height, recession rate, soil texture, and cause of erosion. If any of these observations substantially change, it is best to split the bank into two or more individual sites, with specific measurements for each site. Photographs of the site should be taken. Photographic coverage of the entire site should be included in the project plan to support measurements and calculations.

Measuring Bank Height and Length

Basic measurements required for quantifying pollutant reductions include bank height and length. As discussed previously, reasonable averaging across a site can occur, but large-scale averaging should be avoided, as it does not properly quantify pollutant reductions. The height of a bank should include the entire eroding slope. Length measurements are dictated by the linear distance downstream where erosion is shown. Detailed survey measurements may satisfy documentation requirements in lieu of photographs.

Bank Height:

Bank Length:

Measuring Lateral Recession Rate

Lateral recession rate, or depth of bank loss, has a large influence on the amount of soil estimated to be entering the stream from a given site. Lateral recession rate is most commonly measured in feet per year, and ranges from 0 ft/year (no erosion occurring) to 1+ ft/year (very severe erosion). This value should be a long-term average, since high-water events will intermittently cause greater amounts of erosion, with less erosion occurring during low flows. Various methods exist for measuring recession rate. These involve taking a baseline reading with survey equipment at two points in time and calculating bank surface differences between before and after surveys. Bank pins or stakes (multiple, arranged to represent the entire bank) may also be used as a benchmark for comparison of current and future conditions.

If it is not feasible to measure lateral recession rate, it may be estimated through other observations. Vegetative indicators are moderately useful. A lack of vegetation does not guarantee that erosion is occurring, so additional methods should be used to quantify recession rate. The following points should be observed and compared to the NRCS erosion severity chart below.

- Exposed Roots
- Physical deformation of the bank surface including gullies, rills, or slumping

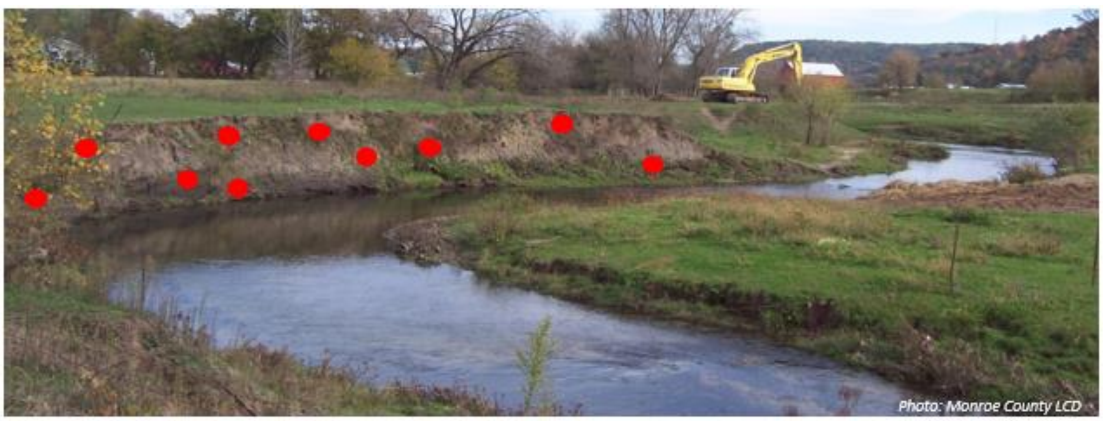
- Bank grade steeper than what is sustainable
- Channel shape indicates active cutting

Lateral Recession Rate (ft/yr)	Category	Description
0.01-0.05	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
0.06-0.2	Moderate	Bank is predominantly bare with some rills and vegetative overhang. Some exposed tree roots but no slumps or slips.
0.3-0.5	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross section becomes U-shaped as opposed to V-shaped.
0.5+	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross section is U-shaped and stream course may be meandering.

Soil Sampling Protocol

By measuring length, width, and lateral recession rate of an erosion site, the amount of soil entering a stream can be determined. Once the phosphorus concentration of the soil is known, the amount of phosphorus entering a stream can be calculated.

Composite soil samples must be taken to represent an average phosphorus concentration for each site. Sub-samples should be taken from each soil horizon, ensuring that variability in soil texture is captured, then combined into one composite sample per site. Mix, bag, and transport samples in accordance with lab procedures. Samples must be analyzed for total phosphorus. This is also known as total leachable P or P_2O_5. The Bray-1 soil or other soil phosphorus tests are inappropriate for this purpose and will underestimate total phosphorus contributions resulting from erosion. Samples should be analyzed at a certified laboratory.



A simple, mass-based equation is used to calculate phosphorus reductions from streambank stabilization:

$$\text{P Yield (lbs./year)} = L\ x\ H\ x\ R\ x\ bD\ x\ \%P$$

Where:
L = Bank Length (ft)

H = Bank Height (ft)

R = Lateral Recession Rate (ft/year)

bD= Soil Bulk Density (lbs./ft^3)

%P = Total Phosphorus Concentration (%)

NRCS Erosion Tool

The Natural Resources Conservation Service (NRCS) has created a spreadsheet that estimates soil loss at an erosion site using all components of the phosphorus yield equation, with the exception of soil total phosphorus (%). Standardized soil bulk densities are pre-programmed into the spreadsheet, and are applied once a site soil texture is selected. The NRCS spreadsheet can be found here: https://dnr.wi.gov/topic/surfacewater/documents/ModelingTools/gully-ephemeral_-streambank_-irrig_ditch_erosion.xlsm

NRCS Streambank and Irrigation Ditch Erosion Estimator (Direct Volume Method) — Clear Form

Farmer / Cooperator Name: Farmer John | Evaluated By: DNR

Tract Number: 1 | Evaluation Date: July 20, 2020

Field Number	Eroding Strmbnk Reach #; or Ditch Side/Bottom	Eroding Bank or Ditch Length (Feet)	Eroding Bank Height; or Ditch Bottom Width* (Feet)	Area of Eroding Strmbank or Ditch (FT^2)	Lateral or Ditch Bottom Recession Rate (Estimated) (FT / Year)	Estimated Volume (FT^3) Eroded Annually	Soil Texture	Approximate Pounds of Soil per FT^3	Estimated Soil Loss (Tons/Year)
N/A	Site 1A	50.0	2.0	100	0.05	5.0	Organic	22	0.1
	Site 1B	85.0	2.5	213	0.10	21.3	Loamy Sand	100	1.1
	Site 1C	20.0	5.0	100	0.50	50.0	Fine Sandy Loam	100	2.5
				Total Estimated Annual Streambank or Ditch Erosion Soil Loss (Tons):					3.6

Once soil loss is calculated in the spreadsheet, it can be multiplied by soil total phosphorus (%) results from the lab. This final result represents the pounds per year of phosphorus reduction. Reductions are subject to trade ratios and TMDL credit threshold when calculating credits generated.

Habitat Adjustment to the Uncertainty Factor

Many of Wisconsin's waters are impaired due to a combination of chemical, biological, and aquatic habitat impairments. In many cases, habitat restoration may be necessary for the listed surface water to achieve its full designated use. Therefore, streambank stabilization projects that include habitat restoration features may qualify for an aquatic habitat adjustment to the uncertainty factor (reduced from 3 to 2).

- To qualify, the stream in which the habitat is placed must be impaired for the traded pollutant.

- The habitat feature(s) must help alleviate the impacts of the traded pollutant.
- The habitat features(s) must provide substantial gains in aquatic habitat, appropriate for the stream in which they are installed.
- Follow criteria outlined in NRCS 395 Technical Standard

A chapter 30 waterways permit may be needed to conduct in-stream work.

Refer to Waterway Protection - Fish and Wildlife Habitat Structures for more information. It is recommended that this permitting process be initiated as soon as possible. Habitat structure types must fall under the stream habitat general permit or an individual permit to be eligible for the habitat adjustment.

Two options exist for demonstrating proposed features are appropriate and substantial:

- Consult with your regional WDNR fisheries biologist when planning habitat projects. The biologist may provide recommendations on appropriate habitat types and quantities. Your county LCD or other professional experienced with stream habitat work may facilitate this conversation.
- Submit habitat installment details as part of the water quality trade plan. This includes proposed structure types, quantities, and locations relative to bank stabilization sites. This should be accompanied by a completed stream assessment outlined in NRCS 395 Technical Standard. Elements 12 and 13 of the Stream Visual Assessment Protocol Version 2 will be suitable for qualified projects.

Operation and Maintenance (O & M) Plans

As a component of the trade plan, an O&M plan should be developed to outline necessary actions that ensure adequate performance and long life of the practice. An O&M plan should be developed for each set of similar features. The plan should be consistent with NRCS code 580.

Consider the following content for O&M plans:

- Define who is responsible for implementing the O&M plan
- The practice(s) should be inspected at set intervals, and after every flood event
- Remove debris that are channeling flow towards the banks, threatening damage
- Establish and maintain vegetative cover, control invasive species as needed
- Repair any damage or further erosion and revegetate as soon as possible. Define a timeline for responding to damages.

Waterways Permit and Written Agreements

- A Chapter 30 Waterways permit may be required for streambank stabilization projects. Refer to Waterway Protection – Stream Bank Erosion Control for more information. This permitting process should be started as soon as possible to ensure permits are in place prior to the desired project start date.

- Pursuant to s. 283.84 (1) Wis. Stats., a trade agreement is required between two parties engaging in a water quality trade. A common approach is to establish the agreement between the land owner and permittee, with the O&M plan requirements included in the agreement as a responsibility of the landowner. If the permittee directly implements measures on its own land, then the agreement will be between the WDNR and permittee. Refer to WQT Guidance (section 3.6) for general agreement information.
- Streambank stabilization has the potential to be a component of many WQT, AM, or MDV plans. Permittees and consultants are encouraged to seek site-specific advice by contacting WDNR when considering this option.