United States Department of Agriculture

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD

CHANNEL BED STABILIZATION

Code 584

(Ft.)

INITIAL REVIEW – Comments and Responses

Drafted technical standard text (as sent for Initial Review) is in black and blue fonts. National minimum requirements are in black font; Wisconsin specific criteria is denoted with blue font.

Comments are in red, preceded by comment number (**C#**). To find a specific comment number, search for that number using "Ctrl + F" (Windows) or "Command + F" (Mac).

Responses to comments are in green italics.

Changes to standard text are in tracked changes.

DEFINITION

Measure(s) used to stabilize the bed or bottom of a channel.

PURPOSE

This practice may support one or more of the following:

- Maintain or alter channel bed elevation or gradient
- Modify sediment transport or deposition
- Manage surface water and groundwater levels in floodplains, riparian areas, and wetlands

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to the beds of existing or newly constructed alluvial or threshold channels undergoing damaging aggradation or degradation that cannot be feasibly controlled by clearing or snagging, establishment of vegetative protection, installation of bank protection, or installation of upstream water control measures.

This practice also applies to channels where the removal of barriers to aquatic organism passage would result in destabilization of the channel bed.

Refer to Open Channel (Code 582), Additional Criteria for Stream Restoration, when this practice is used in combination with other practices for stream restoration.

C7: What is the intent of this standard? It references Open Channel which states it is often used in combination with 580, 584, and 395…so can this practice stand alone or be used in conjunction with other practices besides those previously mentioned? More clearly defining the definition, purpose, and conditions where this practice applies would be helpful. In general, this standard does not appear to offer much beyond the 580 or 582 standard and if this can stand alone it offers much less guidance on what is required or acceptable under this practice.

RESPONSE: This is a stand-alone standard that can also be used in a stream restoration context. It can be used to stabilize a headcut moving upstream. It can also be used re-distribute channel grade over a long distance. For example, if a high stream crossing (ford) is removed, this practice can be used to re-distribute the overfall over multiple riffle-pool-run sequences. Likewise, this practice could be used to raise a downcut channel so that it becomes better connected to a floodplain.

C9: Is this already covered in Code 395? If yes, then simply refer to that document too. If this is intended to supplement CPS 395, why not move it into that document?

RESPONSE: Cross channel weir structures, such as those installed for the purpose of fish habitat under CPS 395, do overlap with this standard unless they would substantially affect the channel gradient and bankfull channel.

CRITERIA

Design and install measures according to a site-specific plan in accordance with all local, State, Tribal, and Federal laws and regulations. Apply measures that are compatible with improvements planned or being carried out by others.

C10: Integrate the interdisciplinary team requirement from Code 395 here – either add the same words or refer to Code 395 for requirements.

RESPONSE: This standard does not need to apply to natural streams and therefore is not appropriate to have the interdisciplinary team requirement. When the standard is applied to natural streams it refers to the additional criteria for stream restoration in CPS 582 which requires a thorough assessment of the stream.

C11: Since the Code 395 assessments are more comprehensive, consider making 395 the starting point for all assessments, for all types of mitigations, since the likelihood of habitat impact assessment is very high with 580, 582 and here.

RESPONSE: This standard does not need to apply to natural streams and therefore is not appropriate to have the interdisciplinary team requirement. When the standard is applied to natural streams it refers to the additional criteria for stream restoration in CPS 582 which requires a thorough assessment of the stream.

Evaluate effects of channel work on existing structures such as culverts, bridges, buried cables, pipelines, and irrigation flumes to determine impact on their intended functions. Analyze the quantity and character of sediments entering the channel reach under consideration on the basis of both present and projected conditions caused by changes in land use or land treatment and upstream improvements or structural measures. Select measures that are compatible with the bank or shoreline materials, water chemistry, channel hydraulics, and slope characteristics, both above and below the waterline.

Conduct a site assessment to identify the causes of bed instability and the potential effects of a channel bed stabilization structure. At minimum, incorporate the following information into the design report:

C4: As a non-engineer I don't have a good understanding of what bed instability is or how to measure it. A common practice on streams managed for trout is to narrow the stream channel with usually results in increased water velocities and transport of fine bed materials often associated with streams with high width / depth ratio; presumably this type of bed movement is desirable. Also during storm events, much of the streambed is set in motion and the fine bed materials are picked-up and transported downstream resulting in an increase in the amount of coarse substrate and interstitial space which usually results in a shift towards greater invertebrate diversity and biomass which is usually a good thing.

RESPONSE: Agreed. This standard does not seek to directly affect this natural process. This standard could be used in a scenario where the stream is showing significant down cutting and becoming incised. That in turn could lead to bank instability.

C5: As a non-practitioner I have no idea what these structures are what range of types or liner extent (if any) are considered. Not that it necessarily needs to be clarified just that non-practitioners presumably will not know what is being addressed.

RESPONSE: These types of structures are not common in Wisconsin. They can be used in any situation where a channel is down cutting and that is potentially causing bank instability.

- Cause of channel bed instability such as advancing head cuts, replacement of culverts to a lower elevation, sudden watershed changes that may increase channel flows, or extreme flood events, etc.

C1: I would add "etc". I don't think you want to limit yourself on this.

RESPONSE: Text added.

- Downstream hydraulic controls or restrictions that may generate backwater and affect the performance of a channel bed stabilization structure, e.g. culvert crossings, bridges, stream crossings, etc.
- Upstream pipe outlets, culvert crossings, or other hydraulic structures that could be impacted by the installation of a channel bed stabilization structure.
- Elevation of baseflow, bankfull discharge (i.e. channel-forming discharge or ordinary high water mark), and highest active floodplain bench.
- Description of channel evolutionary stage in natural streams, i.e. down-cutting, widening, aggrading, or stable. Refer to NRCS NEH Part 654.0305(c).
- ~~Evaluation of bank instability and lateral migration rates of the channel.~~

C2: I think you need something more with this statement as it is too broad. Consider "Evaluation and determination of the cause of bank instability and lateral migration rates of the channel." Or "Evaluation and determination of the cause of bank instability and the affect the proposed practices will have on it". What I am after is you need to make the designer think on a broader scope on why and if the bank is unstable and if I install this type of practice what is the effect on the system. We need to be better planners and that's what I am trying to get at.

RESPONSE: This bullet is removed to avoid confusion. The cause of the bank instability is addressed in the first bullet point in this section. Additionally, the "site assessment" section is not the appropriate section to consider the potential effects of what will be installed. If this practice is installed on a natural stream the standard will refer the designer to the Additional Criteria for Stream Restoration section of Open Channel (Code 582), which should address the concerns raised about effects on the broader system.

Design measures to—

- Withstand flow duration, depth of inundation, buoyancy, uplift, scour, angle of attack, stream velocity, and higher-flow conditions, based on acceptable risk.
- Maintain sufficient depth to provide adequate outlets for subsurface drains, tributary streams, ditches, or other channels.
- Maintain the appropriate sediment transport regime in order to avoid detrimental erosion or sedimentation upstream and downstream.
- Anticipate ice action, debris impact, and fluctuating water levels.
- Avoid adverse effects on endangered, threatened, proposed, and candidate species and their habitats.
- Avoid adverse effects on archaeological, historical, structural, and traditional cultural properties.
- Minimize safety hazards to boaters, swimmers, or people using the channel.

Measures must not—

- Impair the floodway or floodplain functions.
- Cause detrimental changes in water surface elevations when water surface elevations are a concern.
- Impede the upstream or downstream passage of aquatic organisms, unless the objective is to restrict invasive species access.

Refer to NRCS NEH 654, TS-14G, for grade stabilization techniques, including rock sills and artificial riffles.

Evaluate stability of the structure for all flows up to the 100-year flood. Estimate stream flows using the USGS Flood Frequency Characteristics of Wisconsin Streams or hydrologic models such as NRCS WinTR-20, WinTR-55, or USACOE HEC-HMS.

Evaluate ~~Model~~ water surface profiles with a model such as USACE HEC-RAS software for the full range of channel flows with and without the channel bed stabilization structure.

C3: What were the alternatives to using this [HEC-RAS] program? Which ones were considered? This software and the data needed to run it may be a limiting factor to local field offices to meet the requirement of this standard. Why does this standard require this level of software? What about smaller projects, would this still be a requirement? To accomplish this sentence, we are going to have to provide significant training to the technical support agencies to accomplish this. Is this type of support feasible from the NRCS even for non-farm bill programs? I don't dispute the need for modeling water surface profiles but I think this will make this standard difficult to meet if we have do it in all cases.

RESPONSE: The forced change in the channel bed grade is the reason for the need to understand what the new water surface profile will be. HEC-RAS is a well-established hydrologic model that is often used for determining water surface profiles in streams for a range of flows. The software is free and in the public domain. It is agreed that this requirement will limit when and where this practice can be installed. It is not anticipated that this practice will be installed very often and therefore will not likely have a large impact on our technical support people. Both NRCS and DATCP has staff that are capable of utilizing HEC-RAS software. Text added to allow for other modeling programs.

C8: Suggest adding alternate to HEC-RAS: "Model water surface profiles with USACE HEC-RAS software*….or similar software that will show water surface changes before and after.***"**

RESPONSE: Similar language was added to this paragraph.

Evaluate the backwater effect on the bankfull elevation, base flood elevation, vegetation, channel crossings, pipe/ditch outlets, and other in-stream structures. Evaluate the effect of the structure on sediment transport (sediment competency) during bankfull flow.

Refer to NRCS NEH Part 654, TS-14B, to estimate scour depth immediately below the structure to ensure adequate keyway depth. Use a minimum keyway depth into the channel bed of 3 feet, or 1 foot below the calculated depth of scour, whichever is greater.

Key the structure at least 8 feet into the channel banks to prevent flanking caused by channel erosion or lateral migration. Increase the keyway length based on the anticipated channel migration over the design life, or design streambank protection to ensure stable banks.

Evaluate the potential for stream channel avulsions which could change the effect of the bed stabilization structure.

C6: Lateral channel migration could be anticipated to accelerate immediately upstream of the structure with even minimal sediment deposition or aggrading above the structure. Some hard armoring of the upstream banks to some extent may be a consideration to reduce accelerated lateral movement and facilitate excess deposition at bankfull stage.

RESPONSE: The design procedures for channel bed stabilizations structures contained in NRCS NEH 654, TS-14G, for grade stabilization techniques address this concern. The 8-foot requirement to key the structure into the bank is intended to be relatively inexpensive insurance to prevent an expensive structure from being destroyed. Language added to include evaluation.

Evaluate the potential for soil piping or sand boils immediately downstream of the structure due to differential head pressure. Soil piping of streambed material can undermine the structure. Refer to NRCS NEH-11, Lane's Weighted Creep Method (page 4-14), or NRCS SM Note -5, Flow Net Construction and Use, or seepage analysis software to evaluate foundation pressures under the structure.

Dispose of spoil material from clearing, grubbing, and channel excavation in a manner that will not interfere with the function of the channel. Protect all disturbed areas around measures from erosion. Select vegetation or other measures that are best suited for the anticipated site conditions.

Clear the channel to remove stumps, fallen trees, debris, and sediment bars only when they are causing, or could cause, detrimental bank erosion, structural failure, or reduction of channel capacity that results in above-average overflows on adjacent floodplains. Retain or replace habitat-forming elements that provide cover, food, pools, and water turbulence to the extent possible.

CONSIDERATIONS

Assess channel stabilization needs in sufficient detail to identify the causes contributing to instability (e.g., watershed alterations resulting in significant modifications of discharge or sediment production). Due to the complexity of such an assessment, consider using an interdisciplinary team and watershed modeling.

When designing protective measures—

- Conduct area-wide planning efforts for proper design, function, and management of protective measures if the design reach involves multiple stakeholders.
- Consider the changes that may occur in the watershed hydrology and sedimentation over the design life of the measure.
- Use woody material removed during construction in the overall practice design.
- Maintain or improve the habitat value for fish and wildlife, which includes providing cover, lowering or moderating water temperature, and improving water quality.
- Improve habitat for threatened, endangered, and other species of concern, where applicable.

- Maximize adjacent wetland functions and values and minimize adverse effects to existing wetland functions and values.
- Protect side channel inlets and outlets from erosion or sedimentation.

Plan for the type of human use and social and safety aspects when designing protective measures. Use construction materials, grading practices, vegetation, and other site-development elements that enhance aesthetics, recreational use, and maintain or complement existing landscape uses such as pedestrian paths, climate controls, and buffers. Avoid excessive disturbance and compaction of the site during installation.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for specific channel reaches and field sites that describe the requirements for applying the practice to achieve its intended purpose(s). At the minimum the plan will include:

- Topographic map
- Drainage area
- Velocities
- Plan view showing the location, spacing, and overall dimensions.
- Profile view along the improved channel that extends at least 150 feet downstream of the structure. Include the thalweg, top of high bank, bankfull elevation, vertical extent (top and bottom) of each structure.
- Structural detail drawings to describe components and construction requirements.
- Construction and material specifications, e.g. rock gradations.
- Work limits, including ingress and egress for construction equipment, restricted areas within the work limits, e.g. wetlands.
- Borrow and spoil areas.
- Pollution control, e.g. staged construction, floating silt curtains, silt fences, erosion control wattles or logs.
- Requirements for vegetative establishment and mulching.

OPERATION AND MAINTENANCE

Prepare an Operation and Maintenance plan that provides specific instructions for operating and maintaining the system to ensure it functions properly. Provide for periodic inspections and promptly repair or replacement of damaged components.

REFERENCES

USDA, NRCS, Conservation Engineering Division, National Engineering Handbook, Part 653, Stream Corridor Restoration.

USDA, NRCS, Conservation Engineering Division, National Engineering Handbook Part 654, Stream Restoration Design.

USDA, NRCS, Stream Restoration Planning and Design, Fluvial System Stabilization and Restoration Field Guide.

USDA NRCS. 2016. User Guide. Windows Technical Release 55 (WinTR-55) Version 1.00.10. Watershed Hydrology. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2016. User Guide. Windows Technical Release 20 (WinTR-20) Version 3.20.0. Project Formulation Hydrology. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2008. National Engineering Handbook (Title 210), Section 11, Drop Spillways. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2008. National Engineering Handbook (Title 210), Soil Mechanics Note 5, Flow Net Construction and Use. Washington, D.C. https://directives.sc.egov.usda.gov/

USACE. 2020. Hydrologic Engineering Center, Hydrologic Modeling System (HEC-HMS) Software, Version 4.7.1. https://www.hec.usace.army.mil/software/hec-hms/downloads.aspx

USACE. 2020. Hydrologic Engineering Center, River Analysis System (HEC-RAS) Software, Version 6.0. https://www.hec.usace.army.mil/software/hec-ras/documentation.aspx

USGS. 2003. Water-Resources Investigations Report 2003-4250. Flood-Frequency Characteristics of Wisconsin Streams.