US Army Corps of Engineers
Nashville District

CELRN SOP #2022-02

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SUBJECT: Standard Operating Procedure (SOP) - Assessing Impoundments using the Tennessee Stream Quantification Tool

1. BACKGROUND

This document provides procedures for assessing the existing and proposed condition of stream impoundments using the Tennessee Stream Quantification Tool (TN SQT). While regulatory agencies recognize that the TN SQT was not specifically designed for use in impounded streams, the tool can be adapted to provide an evaluation of impoundment (lentic) ecosystem functions by scoring the function-based parameters and metrics which have been impaired by impoundment. This document outlines procedures for how the current version of the TN SQT should be used for assessing the existing and proposed condition of impoundments. These procedures apply to proposed restoration projects involving culvert and dam removals and proposed impact projects, which include impoundment construction.

For the purposes of these procedures, the U.S. Army Corps of Engineers, Nashville District, and the Tennessee Interagency Review Team have established four categories of impoundments:

- Category I: run-of-the-river impoundments, which are more linear in nature and often associated with low head dams. The term “low-head dam” is defined as a dam built across a stream to pass flows from upstream, over all, or nearly all, of the width of the dam crest on a continual and uncontrolled basis; however, during a drought, there may not be water flowing over the dam crest. In general, a low-head dam does not have a separate spillway or spillway gates, but it may have an uncontrolled spillway. The dam crest is the top of the dam from left abutment to right abutment, and if present, an uncontrolled spillway. A low-head dam provides little true storage function.
- Category II: storage impoundments of jurisdictional waters (which include storage or flood control reservoirs and smaller ‘farm pond’ type impoundments).
- Category III: impoundments or obstructions of jurisdictional waters created by culverts, pipes, and similar man-made structures. These types of impoundments generally restrict or impede the passage of normal or high flows; however, the primary purpose of the structure is generally not to impound water or manage high flows. The reach of pooled water is often minimal in size.
- Category IV: impoundments in uplands. These are features that do not impound waters of the United States.

The procedures described in this document apply to Category I-III impoundments only.

2. METHODOLOGY OVERVIEW

The procedures for assessing the Existing Condition Score (ECS) of impoundments using the TN SQT should be applied to reaches that are directly impacted by the physical impoundment structure, as well as the upstream reach of waters that has been impounded (pooled). In most cases there are two reaches directly affected, one for the direct footprint of the impoundment structure or fill, and one for the impounded waters area (pool) upstream of the impoundment structure. These procedures do not apply to impoundments constructed in upland areas.

If the proposed restoration approach will also occur downstream of the impoundment structure, or upstream of the impounded (pooled) waters, the TN SQT should be used as described in the user manual, with additional guidance on reach segmentation found in this guidance. Under the procedures described within this SOP, users are instructed to enter the number of linear feet where required in the TN SQT workbook or the TN SQT debit tool. While it can be argued that impoundments totally eliminate stream functional feet, impounded streams still retain some (albeit impaired) physical, biological, and chemical functions of a stream (Poff et al., 1997; Poff and Hart, 2002; Thomason at al., 2005). Finally, users should evaluate the measured parameters at base pool conditions and during conditions of good water clarity.

3. METHODOLOGY FOR ASSESSING DEBITS ASSOCIATED WITH NEW IMPOUNDMENTS

The following summarizes impact tiers for use in the TN SQT debit tool for the permitted construction of new Category I – III impoundments. See TDEC (2019) for a full description of the TN SQT Impact Severity Tiers:

- The proposed physical dam footprint (structure) would be considered a Tier 6 impact.
- The proposed impounded (pooled) portion of the stream above the impoundment would generally be considered a Tier 4 or Tier 5 impact, depending on the proposed conditions at the site, and as determined on a case-by-case basis by the agencies, utilizing the guidance provided within TDEC (2019). The length would be defined as described in the section below.
- The stream reach below the impoundment may be considered based on the proposed conditions at the site, and as determined on a case-by-case basis by the agencies, utilizing the guidance provided within TDEC (2019).

4. METHODOLOGY FOR ASSESSING THE EXISTING LENGTH OF THE IMPOUNDMENT

The linear extent of the impoundment effect area is defined by the centerline upstream of an impoundment that typically pools water. The length of the primary impoundment is assessed as a horizontal line extending from the center of the impoundment structure through the center of the impounded pool, upstream to the point where the top of the dam crest elevation, or water surface elevation at the dam crest, intersects the existing stream's water surface elevation. For culverts, the impounded reach begins at the inlet of the culvert/s and extends upstream to where free-flowing conditions are observed. This distance will be recorded as the 'Existing Stream Length' in the quantification tab for the respective reach in a TN SQT workbook.

5. METHODOLOGY FOR ASSESSING FUNCTIONS UTILIZING THE TN SQT

I. Stream Reach Below the Impoundment Structure

Impoundments of streams also result in downstream effects; however, few studies exist that look at various fixed intervals below dams to determine downstream effects. While every project is unique, the following guidance should be used if the user desires to assess the TN SQT below an impoundment structure.

If a project has a fixed downstream project limit (such as a conservation easement boundary or other project boundary), all applicable guidance for assessing the Existing and Proposed Condition Scores in the TN SQT should be followed to the project limit. If the length of the downstream reach has no fixed or pre-determined project boundary, then the downstream reach is defined as section of the stream outside of the direct dam footprint downstream to the first tributary that enters the impounded stream or 500 feet (Tiemann et al., 2004; Thomson et al., 2005), whichever distance is smaller.

II. Reach Containing the Impoundment Structure

For the reach that contains the physical impoundment structure or fill (such as a dam or culvert), all existing condition field values are entered to yield an index value of zero for all Category I - III impoundments; the Existing Condition Score will equal zero. The respective existing stream length of the structure or fill, and proposed restoration stream length for that reach should be entered.

III. Impounded Reach Upstream from the Impoundment Structure

The procedures below are for the impounded reach (pooled waters) upstream of the impoundment structure. Many of the ECS metrics will be assumed following the procedures outlined below. As per guidance from the TN SQT manuals, all parameters through Level III (Hydrology, Hydraulics, and Geomorphology) of the stream pyramid as a minimum must be entered. While some measurement methods will follow the instructions in the TN SQT user manual, exceptions are noted below.

HYDROLOGY FUNCTIONAL CATEGORY

- Catchment Hydrology Function-Based Parameter

    · Watershed Land Use Runoff Score: For Category I-III impoundments, enter field values following guidance in the TN SQT manual.

- Reach Runoff Function-Based Parameter

    · Stormwater Infiltration: For Category I-III impoundments, enter field values following guidance in the TN SQT Rapid Data Collection Methods manual. The stormwater infiltration measurement method is likely to be functioning for the impoundment if the stormwater runoff from small events is detained and infiltration exceeds outflow. By

including this metric for structure removal projects, BMPs that treat runoff source areas are encouraged in the design process.

HYDRAULICS FUNCTIONAL CATEGORY

- Floodplain Connectivity Function-Based Parameter

  - This parameter should rate as "not functioning" since it generally takes a very large flow event for the water to enter the impoundment's floodplain. The guidance below applies to Category I - III impoundments. The overall floodplain connectivity ECS should equal zero.
  - Bank Height Ratio: enter a value of 1.8 for the bank height ratio field value; while this is not necessarily the actual value, this will yield an index value of zero.
  - Entrenchment Ratio: enter a value of zero for the entrenchment ratio field value, which will yield an index value of zero.

GEOMORPHOLOGY FUNCTIONAL CATEGORY

- Large Woody Debris (LWD) Function-Based Parameter

  - Users are instructed to use a piece count instead of the Large Woody Debris Index.
  - Large Woody Debris - Category I and Category III impoundments: visually assess the number of pieces of LWD above and below the water surface. Use the field method that gives you the best estimate (i.e., wading, boat, or line of sight) to determine the number of pieces of LWD in the reach. Attempts should be made to assess this parameter during base flow or low flow conditions.
  - Large Woody Debris - Category II impoundments: A value of zero should be entered into the TN SQT workbook for this parameter, yielding an index value of zero.

- Lateral Migration Function-Based Parameter

  Impounded waterbodies do not typically support natural lateral stream migration processes. With this being the case, the user is instructed to enter zeros for the ECS for all lateral migration measurement methods for Category I - III impoundments.

- Riparian Vegetation Function-Based Parameter

  Riparian vegetation may be altered in several ways. Large impoundments may totally inundate the previous riparian area, fully converting riparian vegetation into impounded water. Run-of-river impoundments may have only a minor impact on riparian vegetation. Therefore, the existing condition field index values will vary depending on the nature of the site.

  - For Category II impoundments, users should enter values of zero for all riparian vegetation function-based parameters, yielding index values of zero for all parameters.
  - For Category I & III Impoundments users should utilize the procedures described in the TN SQT user manual to assess all riparian vegetation function-based parameters. With these types of impoundments, the existing and proposed streambank will remain

approximately in the same location. The buffer width parameter is measured from the edge of the streambank proceeding outward. In situations where water is entirely impounded for 50 feet from the centerline of the impoundment, relevant parameters (excluding buffer width) would be simply scored a zero.

- Bed Material Characterization Function-Based Parameter

  · Size Class Pebble Count Analyzer: Users are instructed to not use this measurement method for determining existing or proposed TN SQT condition scores in Category I – Category III impoundments.

- Bed Form Diversity Function-Based Parameter

  The following procedures apply to Category I – Category III Impoundments.

  · Pool Spacing Ratio: entry should yield an index value of 0.0.
  · Pool Depth Ratio: enter 0 to yield an index value of 0.0.
  · Percent Riffle: enter 0 to yield an index value of 0.0.
  · Aggradation Ratio: assessment of this parameter is not applicable for use with evaluation of impoundments. Users are instructed to not use this measurement method in determining existing or proposed TN SQT condition scores.

- Plan Form Function-Based Parameter

  · Sinuosity: Geomorphological processes associated with lateral migration, such as lateral channel incision and aggradation, are largely arrested in impounded systems. As such, the user is instructed to enter a value of zero for the sinuosity measurement method for Category I - III impoundments, yielding an index value of zero.

PHYSIOCHEMICAL AND BIOLOGY FUNCTIONAL CATEGORIES

While benthic macroinvertebrates and fishes will likely be present in the impounded reach of Category I & II impoundments, species compositions will not reflect a true representation of lotic system assemblages. As such, for all Category I and Category II impoundments, a zero would be entered for all physiochemical and biology measurement methods to determine the Existing Condition Score. For Category III impoundments, utilize procedures described in the TN SQT manuals, unless otherwise determined on a case-by-case basis by the agencies. Measuring the physiochemical and biology functional categories are considered optional in the TN SQT. However, if users choose to include physiochemical or biology measurement methods in the ECS for scoring the impounded reach, they would also be required to also provide a Proposed Condition Score (PCS) for the chosen measurement method.

IV. Assessing Upstream Indirect Effects Area

The indirect effects area would be outside of the primary impoundment pool footprint, where the impoundment may affect sediment transport, natural stream flows, etc. upstream from the impounded pool. If assessment of this upstream area is desired by the user, please coordinate with the regulatory agencies to establish a TN SQT reach within the suspected indirect effects zone, as well as an upstream reach that is outside of the influence of the downstream impoundment.

6. APPLICABILITY

- This SOP applies to all impoundment assessments submitted after the effective date of this SOP, within the Nashville District area of responsibility. This SOP does not apply to applications pending prior to the effective date of this SOP.

7. EXPIRATION

- This SOP, including subsequent revisions, will be in effect until revoked.
- Questions should be directed to the Technical Services Branch Chief.

Literature Cited:

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Tiemann, J.S., and D.P. Gillette. 2004. Effects of lowhead dams on riffle-dwelling fishes and macroinvertebrates in a midwestern river. Transactions of the American Fisheries Society 133: 705-717.