D-5. Urban Stream Restoration

General Information

New stream restoration techniques have been pioneered in the Chesapeake Bay watershed to restore urban streams. Approaches to stream restoration include natural channel design, regenerative stream channel and legacy sediment removal. Stream restoration projects require state and federal permits and thus extensive regulatory review. Projects often take multiple years from concept to construction, involving high costs and extensive effort from multiple stakeholders at the community, state and federal level. Note: This BMP reference sheet is targeted for the Developed sector. See Sheets A-9: Stream Restoration (Ag) and N-1: Urban and Non-Urban Stream Restoration if interested in agricultural or general sectors, though the information is almost entirely the same.

Figure D-5-1. Stream restoration projects can improve the health of aquatic resources and can be one of the more cost-effective practices to reduce nutrient and sediment loads in urban watersheds. A stream in a residential area prior to restoration (top) that has an eroded stream bank and channel can be restored so that natural processes reduce the erosive energy of the stream flow during storm events. Small step pools and reconnecting the stream channel to the floodplain are two methods for restoring natural processes to a stream. The bottom picture is of the same stream three years after restoration. Photos: Arlington County (VA), Department of Environmental Services (https://projects.arlingtonva.us/projects/donaldson-run-stream-restoration-tributary-b/)

CBP Definition(s)

Natural Channel Design (NCD) applies the principles of stream geomorphology to maintain a state of dynamic equilibrium among water, sediment, and vegetation that creates a stable channel.

Legacy Sediment Removal (LSR) seeks to remove legacy sediments from the stream and its floodplain and thereby restore the natural potential of aquatic resources including a combination of streams, floodplains, and wetlands.

Regenerative Stream Channel (RSC, aka Regenerative Stormwater Conveyance) uses in-stream weirs in perennial streams to increase the interaction with the floodplain during smaller storm events. These projects may also include sand seepage wetlands and other habitats to increase the stream's connection with its floodplain. Only wet channel RSC practices are eligible as stream restoration projects. Dry channel RSC projects are considered a runoff reduction retrofit practice (see Sheet D-2: Stormwater Retrofits).

Stream Restoration refers to any NCD, RSC, LSR or other restoration project that meets the qualifying conditions for credits, including environmental limitations and stream functional improvements.

Specifications or Key Qualifying Conditions

There are further protocol-specific qualifying criteria detailed in other resources listed under Additional Information below. All projects must meet the following criteria to be eligible for credit:

- Reach restored must be greater than 100ft in length.

- Reach restored must be actively enlarging or degrading.
- Reach restored MAY NOT be tidally influenced.
- The project MAY NOT be primarily designed to protect public infrastructure. Bank armoring and rip rap are not eligible for stream restoration credit.
- Restoration plan must utilize a comprehensive approach to stream restoration design, addressing long-term stability of the channel, banks, and floodplain.
- Must comply with all state and federal permitting requirements, including 404 and 401 permits.

Stream restoration is a carefully designed intervention to improve the hydrologic, hydraulic, geomorphic, water quality, and biological condition of degraded urban streams, and must not be implemented for the sole purpose of nutrient or sediment reduction. Restoration projects should be developed through a functional assessment process, such as the stream functions pyramid (Harman et al., 2012) or functional equivalent.

Nitrogen, Phosphorus and Sediment Reductions

There are three general protocols to define the pollutant load reductions from stream restoration practices. There is also a default rate for historic projects and new projects that cannot conform to the recommended reporting requirements.

- Protocol 1. Credit for prevented sediment during storm flow
- Protocol 2. Credit for in-stream nitrogen processing during base flow
- Protocol 3. Credit for reconnection to the floodplain

For details on how to use the protocols consult the resources listed under Additional Information.

Table D-5-1. Summary of stream restoration protocols for nitrogen, phosphorus and sediment reductions

Protocol	TN (lbs/ linear ft/ year)	TP (lbs/ linear ft/ year)	TSS (lbs/ linear ft/ year)
Protocol 1. Prevented sediment	Site-specific	Site-specific	Site-specific
Protocol 2. In-stream nitrogen processing	Site-specific	N/A	N/A
Protocol 3. Floodplain reconnection	Site-specific	Site-specific	Site-specific
Default for existing/non-conforming projects*	0.075	0.068	248**

*The existing/non-conforming rates were adjusted following a test drive period. These adjustments are explained in Appendix G of the expert panel report.
**Because small stream loads are explicitly modeled in the Phase 6 tools, no sediment delivery factors are needed to reduce the default edge-of-field rate of 248 lbs of TSS/linear ft/year published by the panel.

Specific Reporting and Modeling Information

Applicable Land Use Types (or other load sources) Treated by the BMP:

- Stream Bed and Bank

The practice can only be applied to the "Stream Bed and Bank" load source, but it is recommended to distinguish the BMP based on its sector using the appropriate secondary BMP designation of either "Urban Stream Restoration" or "Non-Urban Stream Restoration."

Brief Description of BMP Simulation in the Model

All stream restoration practices are *Load Reduction BMPs,* which means they are modeled as a simple removal of pounds of nitrogen, phosphorus and/or sediment from the edge-of-stream load. To calculate the pounds

reduced for each protocol, follow the methods and examples described in the panel report and other resources listed under Additional Information. The protocols are additive. So, a project that reduces 100 lbs TN under Protocol 1, 25 lbs TN under Protocol 2, and 30 lbs TN under Protocol 3 has a net reduction of 155 lbs TN. As another example, pretend the project design is unknown for a project planned to restore 1,000 linear feet of a degraded stream. Using the default rate for that project yields reductions of 7.5 lbs TN, 6.8 lbs TP and 24,800 lbs TSS, which would be removed from the edge-of-stream load in the Watershed Model. Load reduction BMPs such as stream restoration cannot remove more pounds of nitrogen, phosphorus or sediment than are available in a watershed, however. So, the Watershed Model does enforce maximum reductions that are described in Section 6.5.4.1 of the Watershed Model documentation.

Annual or Cumulative? Cumulative (5-year credit duration for urban stream restoration)

Can this practice be combined with other BMPs? Yes.

Key Elements for State BMP Reporting through NEIEN

- *BMP Name:*
  - Urban Stream Restoration Protocol
  - Urban Stream Restoration
- *Measurement unit(s): Length restored (feet); Protocol 1 TN (lbs); Protocol 1 TP (lbs); Protocol 1 TSS (lbs); Protocol 2 TN (lbs); Protocol 3 TN (lbs); Protocol 3 TP (Lbs); Protocol 3 TSS (lbs)*
- *Load Source:* Stream Bed and Bank.
- *Geographic location:* Approved NEIEN geographies: County; County (CBW only); Hydrologic Unit Code (HUC12, HUC10, HUC8, HUC6, HUC4); State (CBW only)
- *Date of implementation:* Year the project was completed.

Table D-5-2. Synonymous BMP names for Watershed Model, NEIEN and other sources

CBP or Expert Panel term	NEIEN BMP name	Other common practice names
Stream Restoration (Urban)	Urban Stream Restoration Protocol*	natural channel design, legacy sediment removal, regenerative stream channel or regenerative stormwater conveyance (wet channel only)
Stream Restoration (Urban)	Urban Stream Restoration**	
* Uses protocols 1-3 summarized in Table D-5-1. Requires unit of feet in addition to the pounds reduced for each respective protocol. ** For use when specific project design is not known. Requires unit of feet.		

Additional Information

Expert panel report:
Berg, J., Burch, J., Cappuccitti, D., Filoso, S., Fraley-McNeal, L., Goerman, D., Hardman, N., Kaushal, S., Medina, D., Meyers, M., Kerr, B., Stewart, S., Sullivan, B., R. Walter & J. Winters. 2013. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Prepared by T. Schueler, Chesapeake Stormwater Network, and B. Stack, Center for Watershed Protection. Test-drive revisions approved by the WQGIT September 8, 2014.
https://www.chesapeakebay.net/documents/Stream_Panel_Report_Final_08282014_Appendices_A_G.pdf

Chesapeake Stormwater Network, Good Recipes for the Bay Pollution Diet: U-4: Urban Stream Restoration. Available at: http://chesapeakestormwater.net/bay-stormwater/fact-sheets/

Chesapeake Stormwater Network. BMP Resources, Urban Stream Restoration: http://chesapeakestormwater.net/bmp-resources/urban-stream-restoration/

Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs & C. Miller. 2012. A function-based framework for developing stream assessments, restoration goals, performance standards and standard operating procedures. U.S. Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds. Washington, D.C. EPA 843-K-12-006. https://www.epa.gov/sites/production/files/2015-08/documents/a_function_based_framework_for_stream_assessment_3.pdf

Version and History Statement

This info sheet was first published on August 10, 2018 and reflects the BMP definitions and reductions approved by the WQGIT in May 2013, with test-drive revisions approved in September 2014.

All BMP effectiveness estimates are subject to potential future reviews according to the availability of new scientific information and CBP partnership needs, as defined in the BMP Review Protocol.