IN-STREAM RESTORATION

AUTHORS

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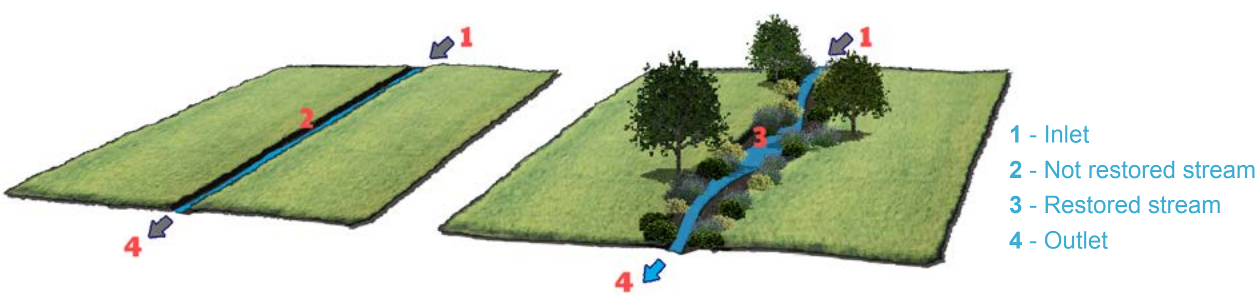

Description

Stream restoration generally refers to approaches that improve stream health by returning stream banks to a more natural shape and restoring natural functions that have been lost or impaired over time. This often involves a combination of different practices, such as stabilizing stream channels and eroding banks, removing concrete conduits, filling incised channels to raise the stream bed, removing legacy sediments, planting trees and shrubs in a buffer along the stream, and reconnecting the natural floodplain of a stream to the channel.

There are still uncertainties on the magnitude and range of nutrient removal. Therefore, stream restoration should complement watershed-based management strategies for reducing nitrogen and phosphorus sources to streams such as source control, improved agricultural methods, and green infrastructure for stormwater management.

Advantages

- Low energy usage possible (feeding by gravity)
- Robust against load fluctuations
- Reduces sediment load by stabilizing banks
- Reduces P as it is attached to sediment and reduces bacteria by enhancing light penetration of the water column
- Restorations reconnect disconnected floodplains and provide flood control
- Restorations also improve dissolved oxygen by reestablishing riffle pool sequences by use of in-stream structures and modifying stream geometry

Disadvantages

- Use of techniques are not in widespread use, and there are a limited number of companies with the expertise to design and construct natural stream restoration projects
- The positive impacts of stream restoration may not be immediately apparent and noticeable changes may take years

Co-benefits

High	Biodiversity (fauna)	Biodiversity (flora)	Flood mitigation	Aesthetic value	Recreation
Medium	Carbon sequestration	Food source			
Low	Biomass production				

Notes:

The primary goals of stream restoration are bank stabilization, upgrading aging infrastructure, and repairing property damage.

Increased costs should be balanced with the benefits to the natural and human communities within the corridor, and beyond. The decrease in sedimentation and other pollutants in the stream will result in lower costs of drinking water treatment. By adding aesthetic and recreational value, an increase in tourism can affect the economy of the entire region by creating jobs and bringing in revenue from out of state. Decreased pollution, coupled with increased economic benefit can reach beyond the corridor and have a long-term impact.

Compatibilities with Other NBSs

Coupling of treatment wetlands and/or ponds in parallel to the stream. Sedimentation ponds in the riparian zone may be installed.

Case Studies

In publication

- Stream restoration in Baltimore, Maryland, USA

Operation and Maintenance

Regular

- Planting trees, grass and other plant species in the riparian zone

Extraordinary

- Artificially created meanders

Troubleshooting

- Manual removal of sediments

Literature

Hunt, P. G., Stone, K. C., Humerik, F. J., Matheny, T. A., Johnson, M. H. (1999). Stream wetland mitigation of nitrogen contamination in a USA coastal plain stream. Journal of Environmental Quality 28(1), 249-256.

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NBS Technical Details

Type of influent

- Secondary treated wastewater
- Combined sewer overflow discharge water
- River diluted wastewater

Treatment efficiency

• TN	20 - 27 %
• NH_4-N	10 - 26 %
• TP	8 %

Requirements

- Size of the stream restoration surface area, hydrological connectivity, and hydraulic residence time are key drivers affecting nutrient retention across the wider watershed including from urban areas (see Newcomer-Johnson et al., (2016) for more details)

Design criteria

- Increased hydraulic residence time and the volume of water interacting with reactive biofilms and sediments will improve nutrient retention (noting that nitrogen and phosphorus removal can be highly variable). Thus, all four dimensions of a stream network or urban watershed continuum need to be considered in design: lateral, longitudinal, vertical, and temporal (see Newcomer-Johnson et al., (2016) for more details)
- The cost of natural stream restoration may be high due to construction costs.
- Stream restoration practices for stormwater management that create connectivity between the stream and the riparian zone can increase rates of in situ denitrification in stream banks. Consequently, mass nitrate-N removal may be substantial at the riparian-zone–stream interface (see Kaushal et al., (2008) for more details)
- Inclusion of macrophytes in stream and river restoration designs can potentially support retention of both nitrogen and phosphorus. This is because roots can oxygenate soil for coupled nitrification-denitrification and phosphorous immobilization (see Newcomer-Johnson et al., (2016) for more details)

NBS Technical Details

Commonly implemented configurations

- In-stream restoration can be used alone introducing some restoration actions however parallel ponds and treatment wetlands can be installed to improve pollutants removal
- Sedimentation ponds can be put in place prior to the instream system

Climatic conditions

- In-stream restoration can be applied under all kinds of climatic conditions: tropical, dry, temperate and continental. Fauna and flora are adapted to their indigenous climate