Restoration of Urban Streams:
Practical Evaluation of Options for 319(h) Funded Projects

Fred Kelly
Resource Conservationist
USDA-NRCS

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Introduction

As population grows, and development spreads, the impacts on our water resources become critical. Ground water supplies are depleted for human use and polluted by nitrates, pathogens, and pesticides. In areas that have been impacted by development, surface water resources often are subjected to extreme risks from stormwater runoff. The change of land cover from woods and fields to one dominated by impervious pavement, rooftops, and turfgrass leads to runoff of greater volume, velocity, and pollutant load. Surface water supplies are depleted for human use and polluted from runoff containing nutrients, sediment, pesticides, pathogens, road salts, hydrocarbons, metals, organic matter, elevated temperatures, and other constituents. In other words, the urban stream is dramatically impacted by man's activities.

Urban streams can be an asset to a community. However, flooding, channelization, erosion, and pollution often pose significant threats to the stream corridor and adjacent areas. Too often, urban streams become receiving points for a myriad of wastes and become an environmental risk.

Problems with these streams often arise from changes in the natural stream corridor characteristics brought about by urbanization. Historically, structures such as concrete channels were typically constructed to stabilize streambanks and protect properties.

Consequently, recent years have seen a swing toward stream corridor *restoration* projects to try and mitigate some of the degradation that has occurred. There are a number of obvious advantages to returning a stream closer to its natural state: cooler water temperatures, improved quality of incoming runoff, improved riparian habitat, stable streambanks, restoration of riffle-pool sequences enhancing fish and other aquatic habitats, and improved aesthetics. This improvement can be reflected economically in improved property values in areas near the stream corridor, and additional recreational activities made possible by the improvement.

A prominent vehicle to get urban stream restoration started is the DWM 319(h) grants program. Through this program, enough money is made available on a competitive basis to get 'action now' water quality restoration work underway. These funded projects can be considered a 'seed' to lead to other work in other portions of the given stream. When viewed as such, it becomes more crucial to fund the best planned projects*. In this context, what does* 'best' *mean?*

Simply put, it means projects that are conceived and submitted with the proper amount of background research done. This 'homework' done by the applicant should indicate that the proposal should be successful in terms of reference condition chosen, restoration measures chosen, maintenance program chosen, and monitoring program chosen.

The restoration proposal should be evaluated using some type of accepted methodology. This summary presents a number of evaluation guidelines for urban stream restoration proposals as it applies to the 319-h funding program.

Improvement of water quality, of course, is the overarching aim of the 319 program. Generally, the submission of a proposal will focus on stream restoration that will improve water quality using one of four approaches:

1. Improve the quality of stormwater entering the stream
2. Maximize the quality of the urban stream riparian corridor
3. Stabilize the urban stream banks
4. Improve habitat within the urban stream

Along with the restoration plan, critical data for any proposal are the <u>costs</u> to be incurred with the planning and implementation of the measures. These must be within reasonable limits for the type of restoration work planned.

In a perfect world, a restoration proposal would include all four factors. These four, when combined into a single restoration strategy, provide a sum that is far greater than the individual parts. By implementing actions that improve the inflow quality, riparian corridor, streambanks, *and* in-stream environment, the urban stream can become a valuable resource to the local community and an environmental success story. However, it should be understood that a well conceived proposal that addresses just one of these facets can still be an effective restoration measure - it all depends on the condition of the stream and the *targeted reference condition.*

The reference should be a portion of the same stream or one nearby in the same ecoregion that represents what the impaired reach once was. Some ecoregion reference stations have been established by the Division of Watershed Management that may be utilized as reference stations; however, other reference stations may be utilized which are representative of the stream being restored.

Additional information regarding Ecoregion Reference Stations can be obtained from the at the Bureau of Freshwater and Biological Monitoring website: www.state.nj.us/dep/watershedmgt or at (609) 292-0427.

The restoration measures should be planned with an eye toward the corridor, bank, and channel conditions of the reference reach. The reference condition should be described as part of the restoration proposal. This description should include the reference stream name, ecoregion, and reach location. Documentation of the reference riparian corridor, streambank, and channel conditions also help the proposal evaluation process.

1. Improving the Inflow Stormwater Quality

The first and most important factor to consider when evaluating an urban stream restoration strategy is the very nature of the stormwater that is reaching the stream. Where is the storm runoff coming from? What are the likely pollutants in the runoff? What methods are available to reduce the pollutant load to the stream? These questions must be answered before planning work in the urban stream corridor itself. Guidance on pollutant characteristics of urban stormwater and appropriate Best Management Practices (BMPs) can be found in detail within the New Jersey manual, Best Management Practices for Control of Nonpoint Source Pollution from Stormwater. Principles and practices found within the proposal should be consistent with those in the manual.

2. Maximizing Riparian Corridor Quality

A well vegetated, healthy riparian corridor provides a number of beneficial functions to the urban stream. Some important ones are:

1. Reduces watershed imperviousness by imposing development limits adjacent to the stream.
2. Reduces flood impacts.
3. Filters pollutants from runoff flowing overland to the stream.
4. Provides wildlife habitat.
5. Protects stream bank from erosion.
6. Reduces stream warming.
7. Protects associated wetland ecosystems.
8. Provides large woody debris to the stream ecosystem.
9. Maintains infiltration of rainfall and contributes to stream baseflow.

How can one determine the relative quality of a riparian corridor? There are several factors that act as environmental indicators:

1. Width of the corridor
2. Plant community in the corridor
3. Soil stability in the corridor

Water quality indicators in the stream, including clarity, temperature, substrate makeup, and macroinvertebrate community, all are impacted positively by a healthy riparian corridor. However, often these in-stream conditions usually are more profoundly impacted by what's going on in the upstream watershed.

There are a number of sources of information that can be helpful when evaluating and restoring riparian corridor health. Portions of these are attached.

The USDA Natural Resources Conservation Service Stream Visual Assessment Protocol (SVAP) should be used to evaluate present stream corridor conditions. This protocol is easily used by consultants or citizen watershed groups with a modicum of training. It is attached to this summary. Others useful are:

1. USDA-NRCS Field Office Technical Guide. Standard 391, Riparian Forest Buffer; and Standard 393, Filter Strip.
2. The Federal Interagency Stream Restoration Working Group. Stream Corridor Restoration: Principles, Processes, and Practices
3. Illinois Dept. of Natural Resources. Field Manual of Urban Stream Restoration
4. Riley, Ann L. Restoring Streams in Cities
5. North Jersey RC&D. Riparian Buffer Evaluation Guide.

3. Ensuring Stability of the Streambanks

A stable, non-eroding streambank is indicated by a gradual sloping back from the waters edge, and vegetation or rock providing a protective layer over the soil. Little or no exposed bare soil is visible. An unstable streambank is often characterized by steeper slopes, often to the point of being vertical or overhanging. There may be exposed roots of trees and shrubs, and sections of exposed subsoil. (Tables 1 and 2) When left untreated, streambank erosion is a significant source of sediment to the stream environment, and a taker of valuable streamside property.

Many stream corridor restoration measures contain streambank stabilization as a central theme, usually employing a variety of bioengineering practices to accomplish this objective. Here, a critical consideration comes into play: *is the proposal for vegetating a bare, eroding bank, or is it for removal of undesirable species such as ailanthus and replacement with natives?* This latter concept must be evaluated to a higher resolution

than a simple stabilization measure. When considering removal of undesirables, the overriding concern is that the bank may already be stable, being adequately protected by the undesirable vegetation. Removal of this vegetation may create a serious erosion problem. Consequently, stream hydrology must be examined to ensure that the replacement vegetation and temporary stabilization measures will be adequate to keep the streambank stable.
Determinations of the following factors should be made to ensure that the proposed streambank stabilization measures will be successful:

1. Stream order
2. Channel and bank composition
3. Height and angle of eroded bank
4. Establish severity of erosion
5. Typical low flow water elevation
6. Typical high flow elevation
7. Bankfull velocity
8. Thalweg location (deepest part of channel)
9. Sunlight percentage reaching the streambank during the growing season

This information can be obtained from US Geological Service (USGS) streamflow gauging data, local records and in-field measurements.

The best sources of information to consult when performing this phase of evaluation are:

Standards for Soil Erosion and Sediment Control in New Jersey, 2000 Edition. Standard for Soil Bioengineering. (Attached to this summary)

USDA, NRCS Engineering Field Manual, Chapter 16. Streambank and Shoreline Stabilization. (portions attached)

Table 1: General Streambank Erosion Evaluation

Erosion Problem	Characteristics	Possible Solutions
General bank scour	Widespread erosion of streambank, extensive stretches of exposed soil	Bioengineering practices
Toe erosion and upper bank failure	Vertical or overhanging eroded streambanks, often on outside of a bend. Undercutting prevalent because of unstable toe	Bioengineering practices combined with rock toe stabilization
Local streambank scour	Isolated sections of unstable streambanks within otherwise stable reaches.	Bioengineering practices
Overbank runoff	Surface runoff coming from lawns, streets, parking lots, etc creating gully-like scars in the streambank	Surface runoff control: Diversions, drop structures Bioengineering practices

Reference: Guidelines for Streambank Restoration (adapted from Sotir, 1993)

Table 2. Guidance for Determining Degree of Erosion

Degree of Erosion	Characteristics
Stable to Mild	Little or no evidence of erosion: if eroding banks are present, they are small in extent (linear extent less than average bank height) and rates are modest (less than 0.5 foot per year); greater erosion may be tolerated at bends if it causes no associated problems.
Moderate	Extent of problem or rate of erosion exceeds criteria for stable, but is less than severe.
Severe	Erosion covers larger area of bank (linear extent greater than three times average bank height) and is occurring at a rate in excess of one foot per year or a rate that is unacceptable for safety, environmental, or economic reasons.

Reference: Guidelines for Streambank Restoration (Sotir, 1993)

4. Improving Quality of the In-Stream Habitat

Once the health of the riparian corridor and streambanks have been assured, attention can be turned to improving the quality of in-stream habitat. There are a great number of habitat improvement measures that can be economically installed using natural materials and volunteer labor. <u>However, be advised that practically all would require a permit from the NJDEP.</u>

Usually, habitat improvement consists of using large native rock, boulder or timber structures in a variety of configurations to alter the flow regime of a location within the channel of a perennial watercourse. The intent is often to create pools, riffles, and feeding or resting areas.

The best sources of information relating to habitat improvement are:

USDA Forest Service. <u>Stream Habitat Improvement Handbook</u>
Pennsylvania Fish and Boat Commission. <u>Fish Habitat Improvement for Trout Streams</u>
Government of Quebec, Canada. <u>Guidelines for the Improvement and Restoration of Fish Habitat in Small Streams</u>

Remember that all planned measures must be in compliance with New Jersey DEP, Division of Floodplain Management, Division of Fish and Game, and other possible regulations. Consult with the Land Use Regulation Program if there are any questions relating to a stream restoration measure.

Reasonable Costs for Restoration

All of the aforementioned notwithstanding, a proposal must have a reasonable price tag for the work to be undertaken. Stream restoration projects can vary widely in the planning and implementation, based on a number of variables: difficulty of design, locality, size and scope, materials chosen, etc. Consequently, it can be difficult to find comparative data to assess the reasonability of a proposal.

Nonetheless, following is data taken from the 1999 USDA-NRCS Cost Table for use with farm programs. These costs should be reasonable, having been derived from contractors, suppliers, and professional judgement. A 319 proposal's installation costs should be within 20% of the costs cited here.

Table 3. Average Costs per Unit for Stream Restoration Work

Practice	Component	Units	Unit average cost
Filter Strip	Site prep and seeding	Acre	$475.00
Riparian Forest Buffer	Site preparation	Acre	$75.00
	Tree planting	Acre	$800.00
	Tree shelters	Each	$3.00
	Seeding	Acre	$400.00
Fish Habitat Improvement	Stream boulder placement	Each	$50.00
	Log/wood frames	Linear foot	$3.00
	Rock riprap	Cubic yard	$50.00
Streambank Stabilization	Brush mattressing	Linear foot	$6.00
	Plant cuttings	Each	$0.50
	Fiber rolls	Linear foot	$12.00
	Live stakes	Each	$2.00
	Erosion control blanket	Square yard	$2.00
	Herbaceous plants	Each	$2.00