Urban Subwatershed Restoration Manual Series

1

An Integrated Framework to Restore Small Urban Watersheds

Version 2.0

February 2005

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Foreword

Manual 1: An Integrated Approach to Restore Small Urban Watersheds

Manual 2: Methods to Develop Restoration Plans for Small Urban Watersheds

Manual 4: Urban Stream Repair Practices

Manual 6: Discharge Prevention Practices

Manual 5: Riparian Management Practices

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Chapter 4: Range of Available Subwatershed Restoration Practices

Chapter 1: Organizing to R

Table 1: Selion4i0Tc 06 Tw 1541d037 0031 0T

Public Demand for Better Local Environment

1.3 Many Different Goals Guide Urban Watershed Restoration

Growth in Urban Watershed Organizations

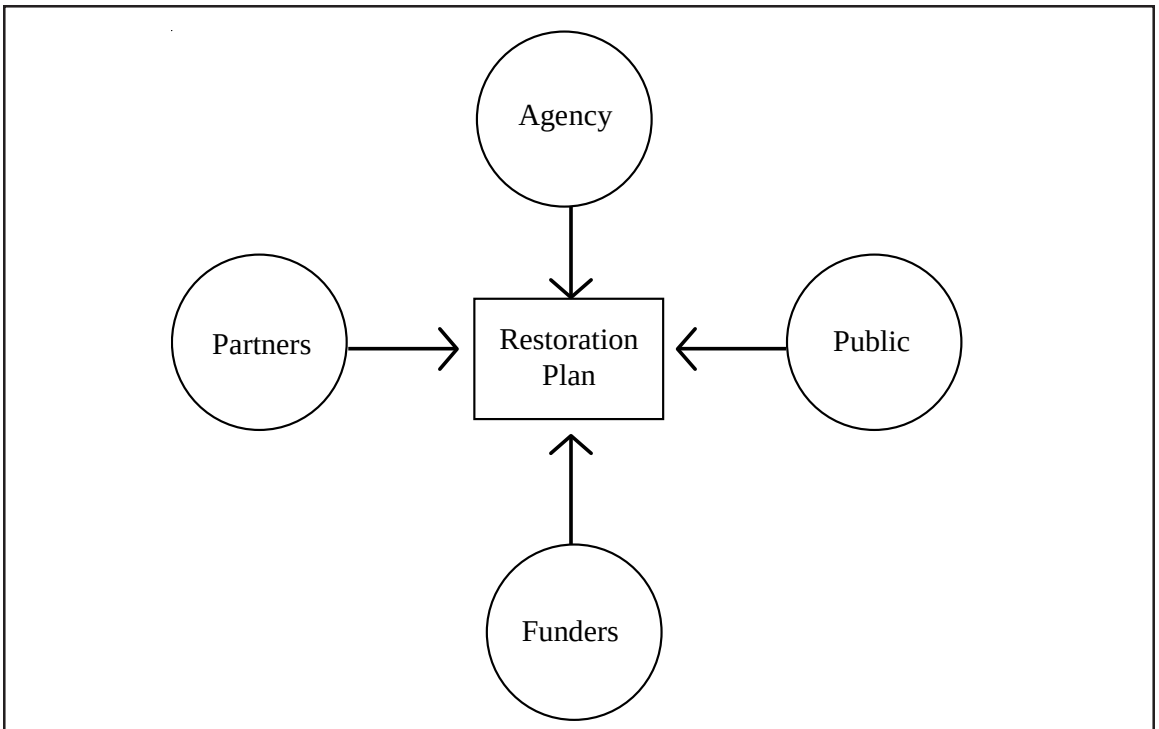


Figure 3: Four Types of Stakeholders Involved in Watershed Restoration Plans

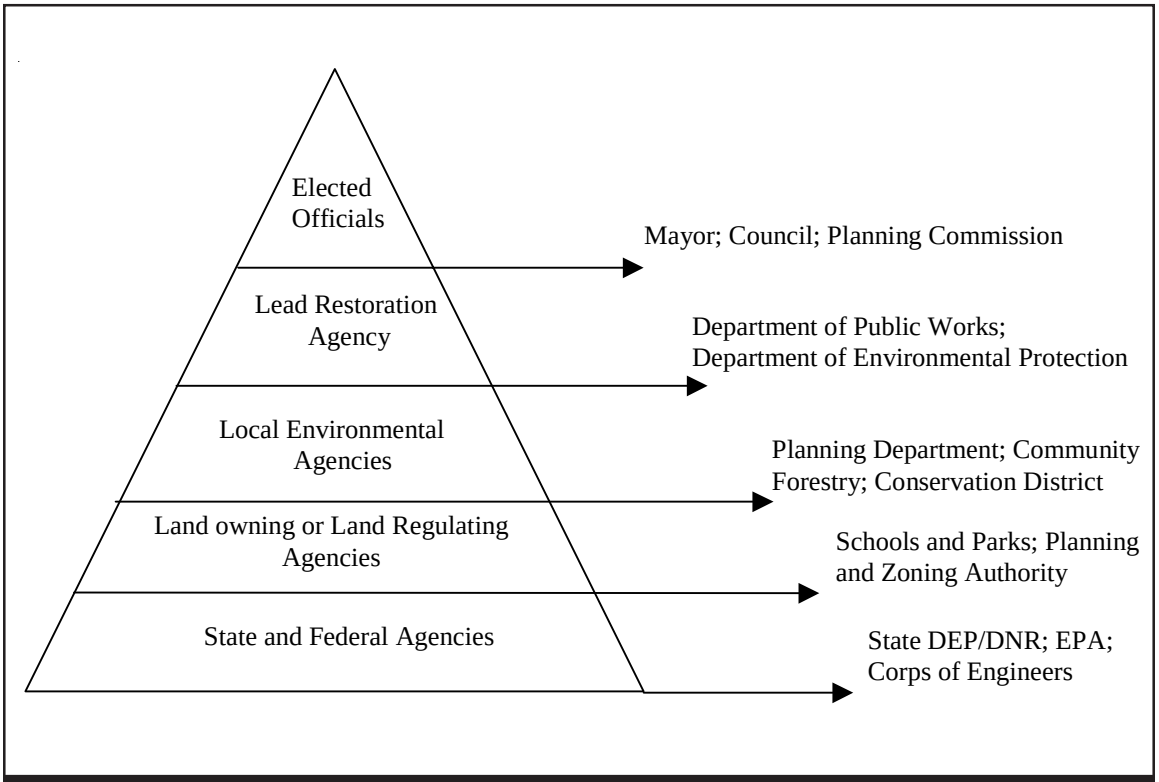


Figure 4: The Agency Stakeholder Pyramid
Dozens of local, state and even federal agency stakeholders need to be involved to coordinate effective local restoration planning.

The Public

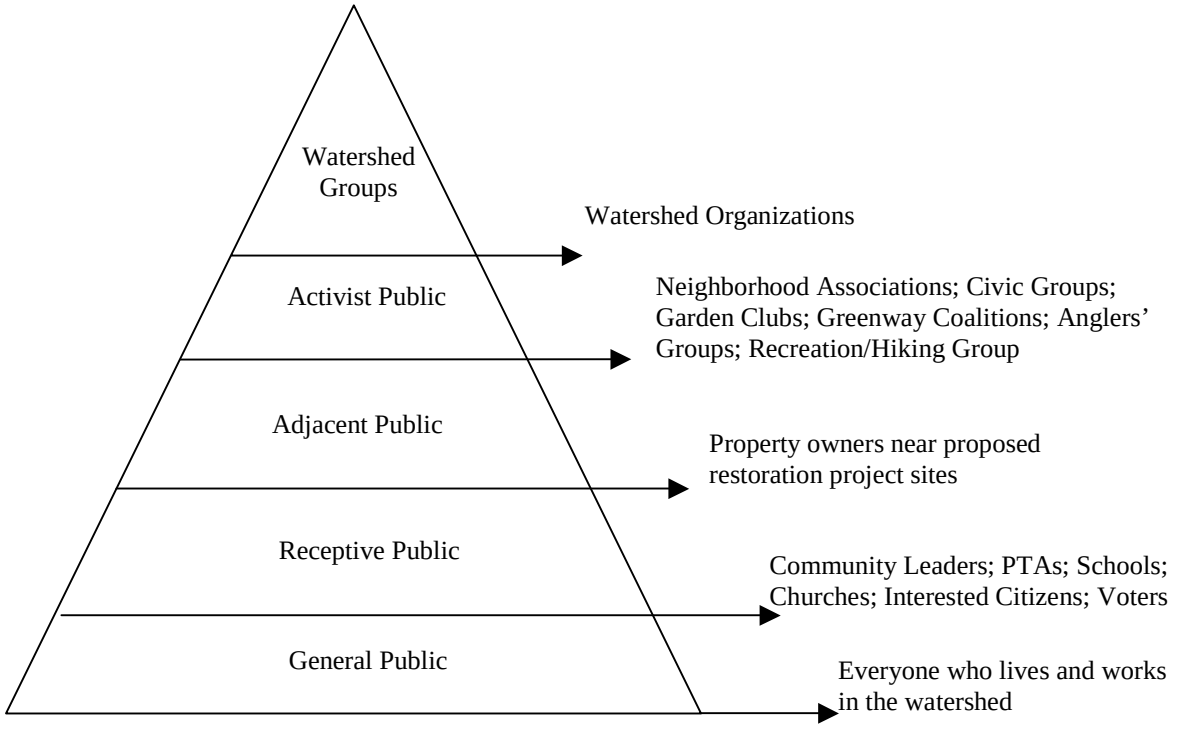


Figure 5: The Public Stakeholder Pyramid

Public stakeholders are not monolithic, but can be stratified on the basis of their awareness, stewardship activities, and interest in participating in the local watershed restoration process.

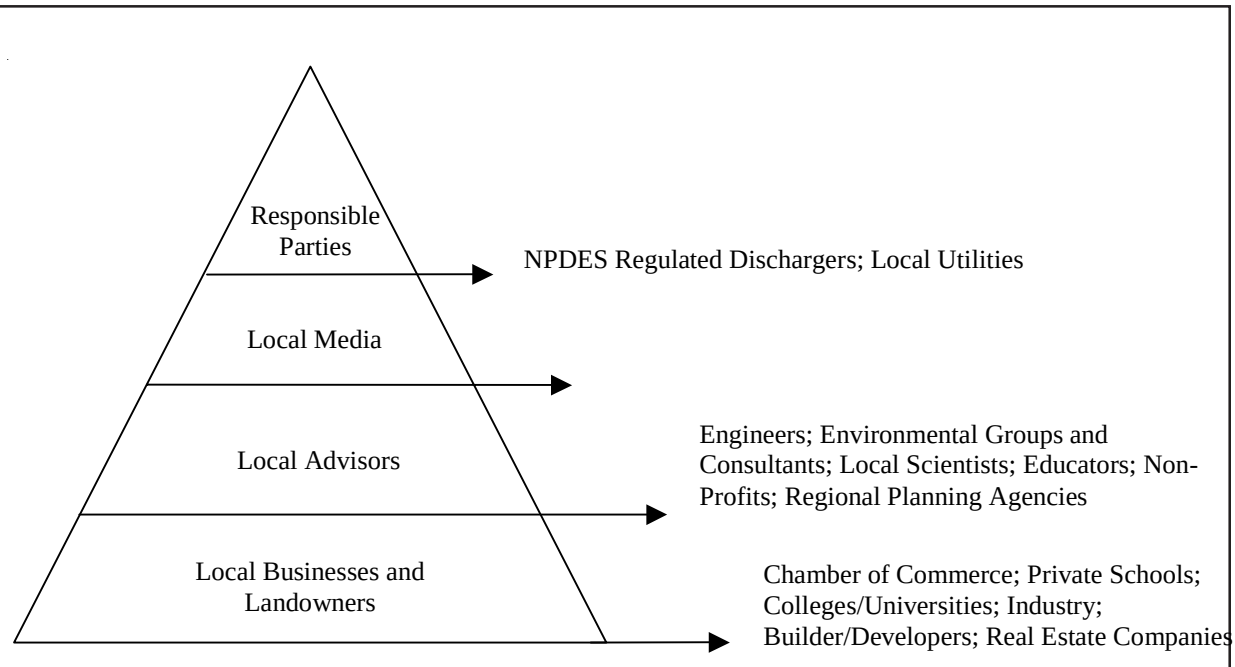
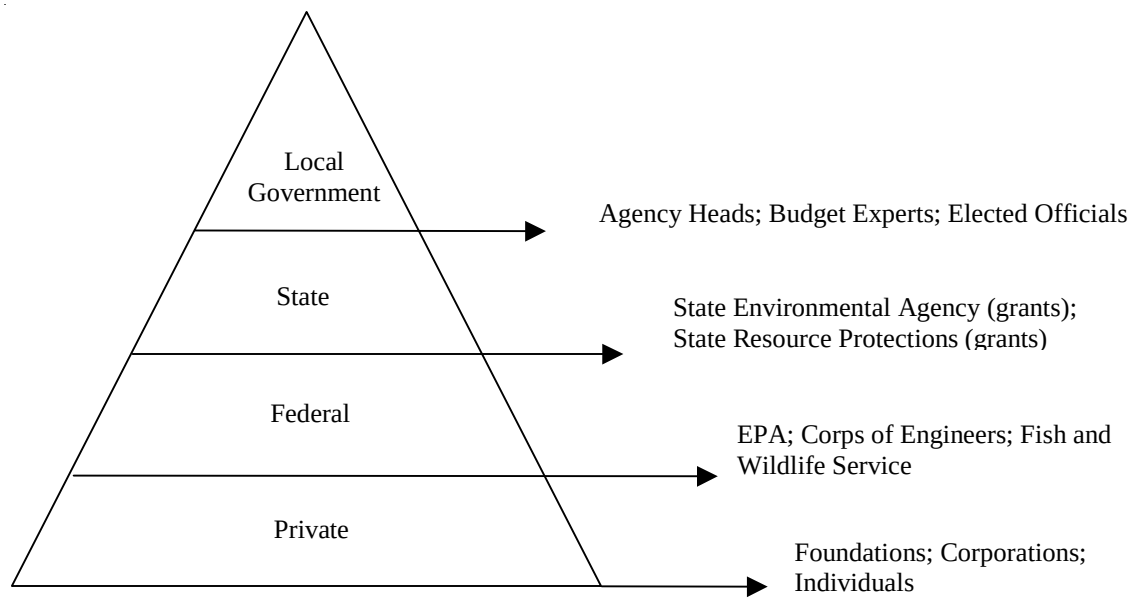


Figure 6: The Partner Stakeholder Pyramid

Many different partners comprise this diverse stakeholder group asked to perform many roles in watershed restoration, including implementing pollution controls, spreading the restoration message, providing expertise, and integrating restoration goals into their normal operations.

Funders


Local Government
Agency Heads; Budget Experts; Elected Officials
State
State Environmental Agency (grants);
State Resource Protections (grants)
Federal
EPA; Corps of Engineers; Fish and Wildlife Service
Private
Foundations; Corporations; Individuals

1.5 Organizing Stakeholders Into Action

2.4 Fragmentation of Natural Area Remnants

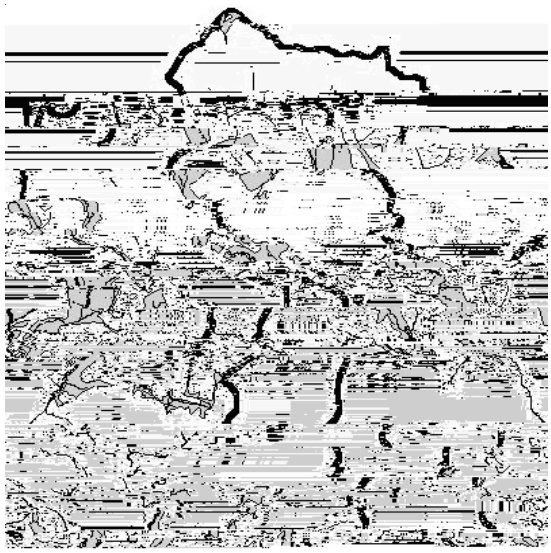
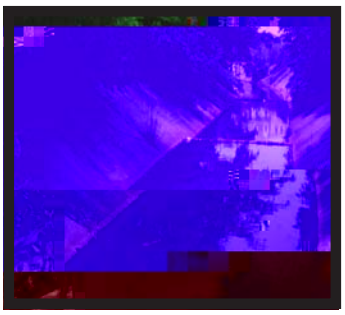


Figure 9: Distribution of Natural Area Remnants in a Non-Supporting Subwatershed
Although Watts Branch (Rockville, MD) has nearly 30% IC, it still contains significant forest and wetland fragments in its subwatershed, many of which are found in close proximity to the stream corridor.



2.5 Interruption of the Stream Corridor

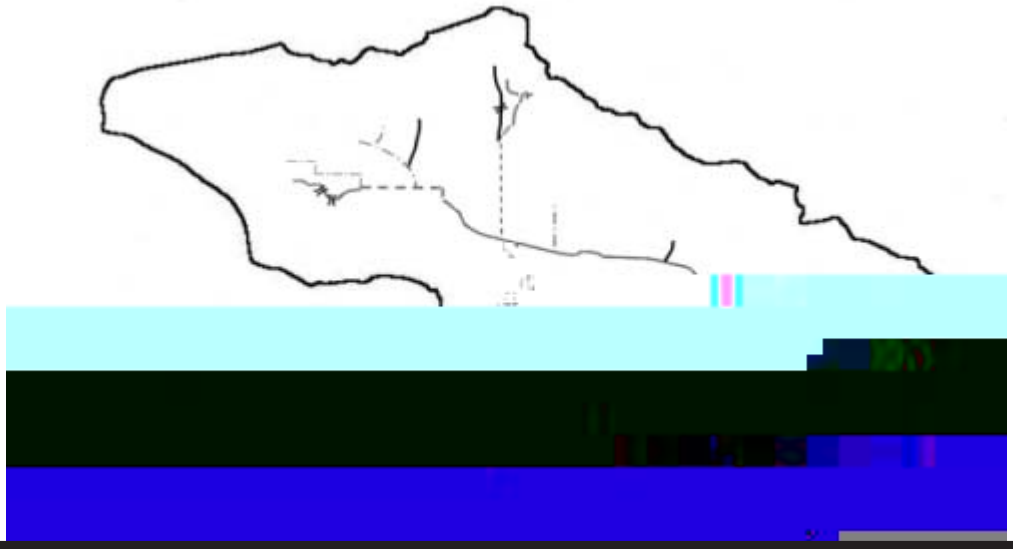
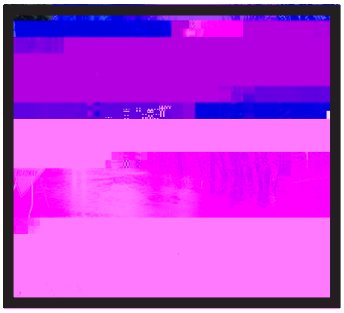


Figure 10: Stream Interruption in a Non-Supporting Subwatershed
This stream network of this Baltimore (MD) subwatershed has been extensively interrupted by road crossings, extended culverts, channelization and other engineering "improvements" over many decades. Most first order streams are not shown on the map because they have been enclosed by storm drains. Stream interruption is an important factor in determining fish passage, channel erosion, and aquatic habitat suitability.



2.6 Encroachment and Expansion in the Flood Plain

Chapter 3: Impacts of Urbanization on Streams

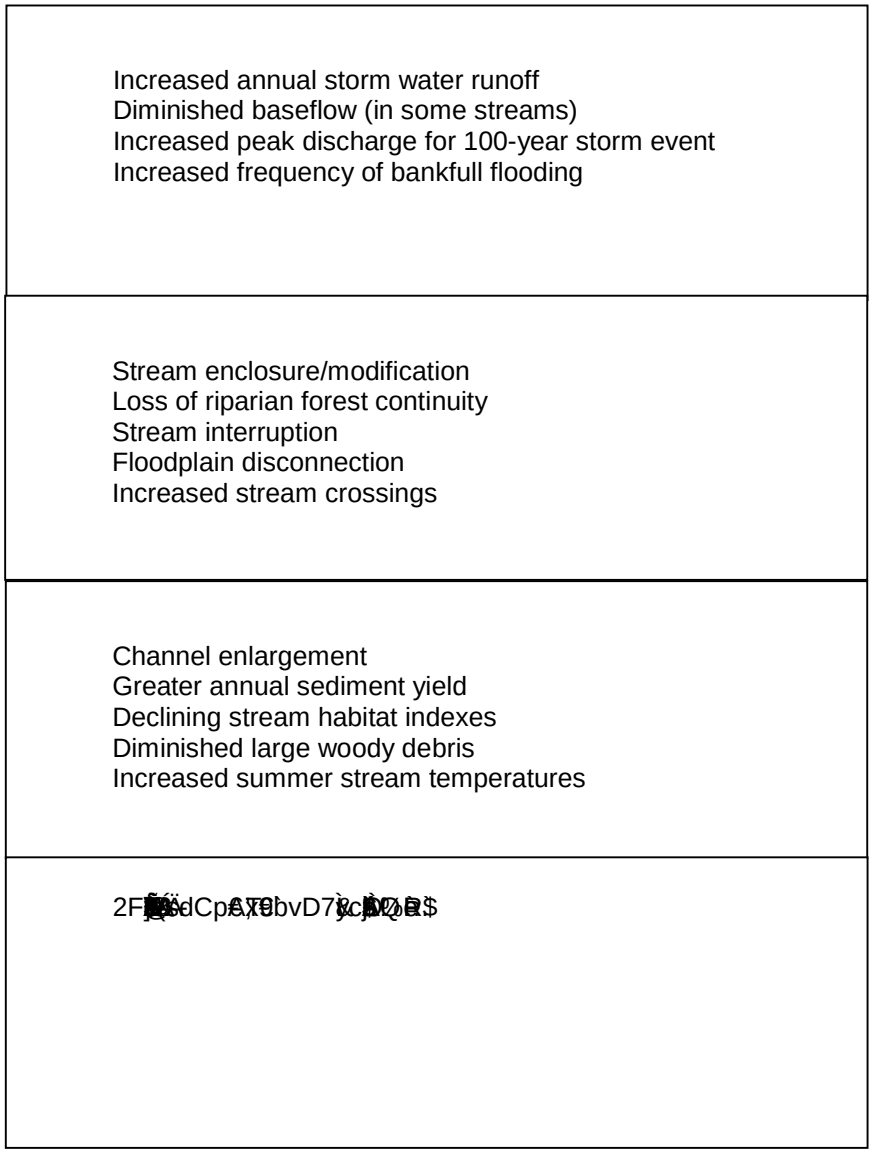
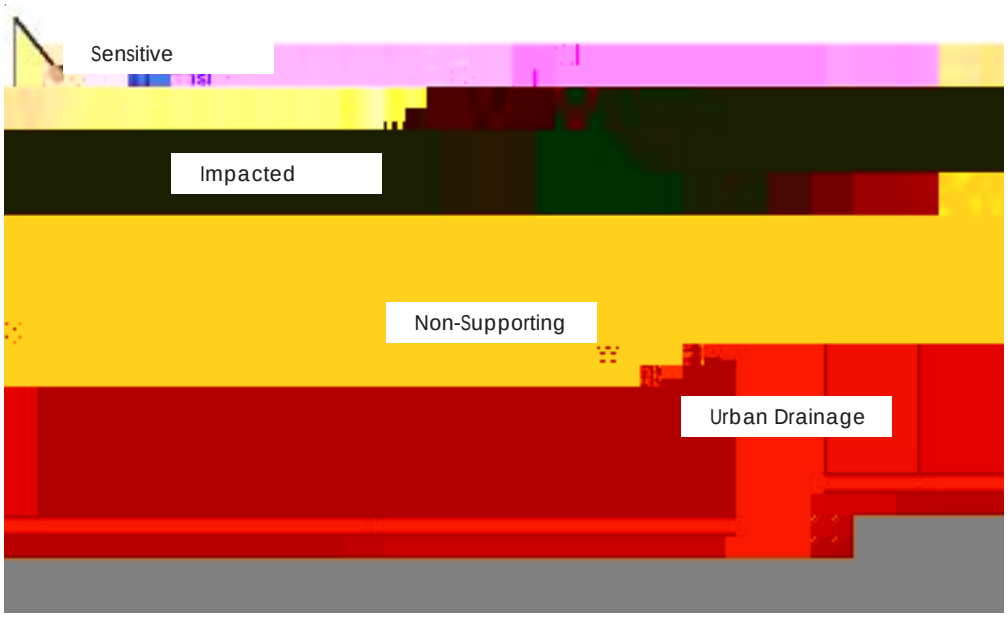


Figure 11: Five Groups of Stream Impacts Associated with Urban Subwatersheds

3.1 Changes to Stream Hydrology



3.2 Physical Alteration of the

3.3 Degradation of Stream Habitat

3.4 Decline in W

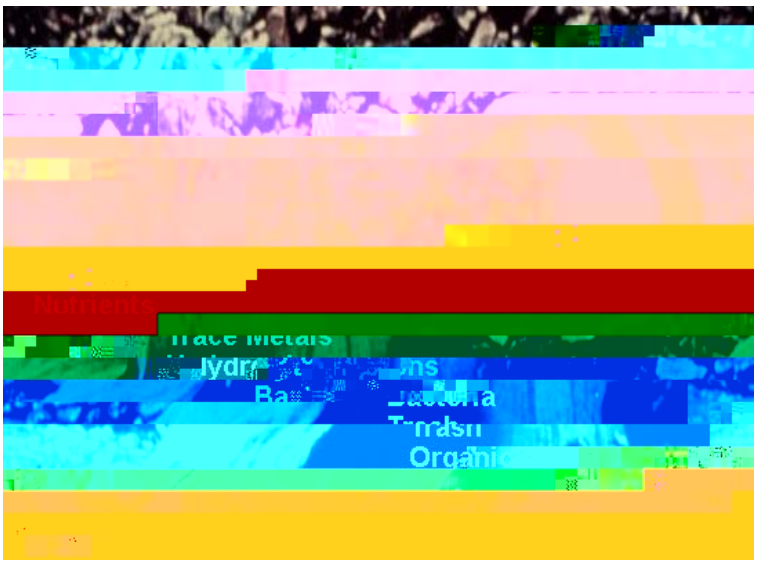


Table 5: Water Quality Predictions According to the ICM			
Water Quality Indicator	**ICM Stream Classification**		
	Impacted	**Non-Supporting**	**Urban Drainage**
Annual Nutrient Load [a]	1 to 2 times higher than rural background	2 to 4 times higher than rural background	4 to 6 times higher than rural background
Violations of Bacteria Standards [b]	Frequent violations during wet weather	Continuous violations during wet weather; Episodic violations during dry weather	Continuous violations during wet weather, frequent violations during dry weather
Aquatic Life Toxicity [c]	Acute toxicity rare	Moderate potential for acute toxicity during some storms and spills	High potential for acute toxicity during dry and wet weather
Contaminated Sediments	Sediments enriched but not contaminated	Sediment contamination likely, potential risk of bioaccumulation	Contamination should be presumed
Fish Advisories [d]	Rare	Potential risk of bioaccumulation	Should be presumed

Bacterial Contamination

Aquatic Life Toxicity


ICM Stream Classification

4.2 Stream Repair Practices

On-site Residential Retrofits

Stream Cleanups

Figure 19: Example of a Storage Retrofit Pond
The top photo shows an old flood detention pond that was converted into a shallow marsh pond system to remove pollutants and protect downstream banks (bottom photo). This storage retrofit, known as Rolling Stone, was constructed in the late 1980s and treats about 75 acres of upstream drainage.

Parks or Greenways

Active Reforestation

Upstream
Retrofit:
Wet Extended
Detention Pond

Figure 21: Example of Comprehensive Stream Restoration Approach
The diagram shows the combination of stream restoration techniques employed to restore Wheaton

Natural Regeneration

Riparian Wetland Restoration

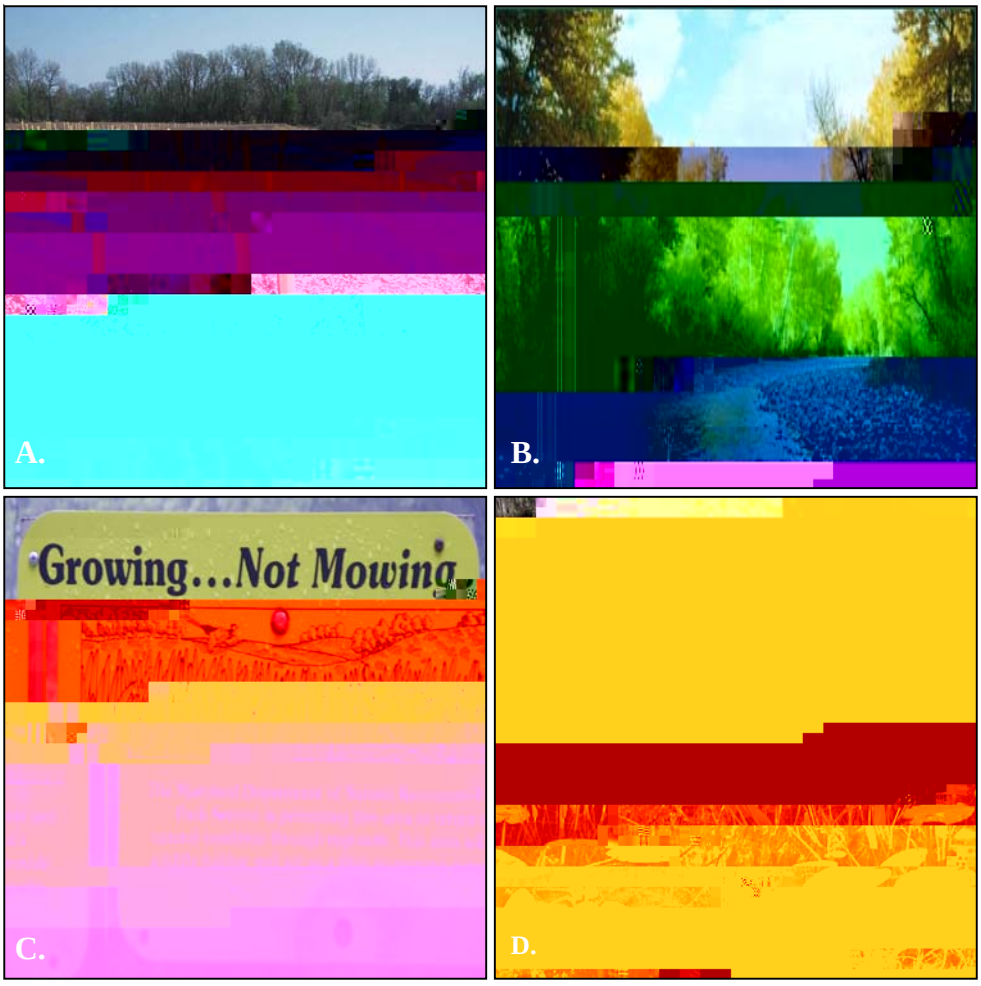


Figure 22: Four Strategies to Establish Vegetation in the Riparian Area
The strategy to establish riparian vegetation depends on the condition of the stream corridor, its ownership and intended management use. Strategies include active reforestation (Panel A), more limited park/greenway plantings (Panel B), natural regeneration (Panel C) and restoration of riparian wetlands/forests (Panel D).

4.4 Discharge Prevention

Management of Natural Area Remnants

Residential Stewardship

4.6 Pollution Source Control Practices

Figure 23: Pollution Source Control Opportunities in Residential Neighborhoods
Nearly two dozen pollution source control opportunities can exist within a residential neighborhood. They can be systematically evaluated by looking at lawns and yard practices, rooftop connections, the

Figure 24: Investigating Potential Storm Water Hotspots
Storm water hotspots are sites that produce higher levels of storm water pollution and/or a greater risks of spills, leaks and discharges, and are created by vehicles, outdoor storage, waste management, plant maintenance, grounds care and other site operations and practices.

4.7 Municipal Practices and Programs

Stewardship of Public Land

Restoration Practice	Subwatershed Impervious Cover			
	10 to 25%	25 to 40%	40 to 60%	60 to 100%
Storm Water Retrofit Practices				
Storage Retrofit				

Figure 25: General Feasibility of Retrofit Practices at Different Levels of Subwatershed IC

This chart provides general guidance on the subwatershed conditions where the restoration techniques can be most widely applied. Actual restoration potential should always be assessed in the field, but the ability to widely implement some restoration techniques is often limited in the most intensely developed subwatersheds, due to lack of available land in the

Subwatershed Restoration Goals	Percent Subwatershed Impervious Cover			
	10 to 25	25 to 40	40 to 60	60 to 100
Water Quality				
Reduce pollutants of concern	¸	¸	¸	¾
Prevent illegal discharges/spills	¾	¸	¸	¾
Meet water quality standards	¸	¾	1	Î
Reduce sediment contamination	¸	¸	¾	Î
Allow water contact recreation	¸	¸	¾	Î

Restoration Goals for Urban Drainage Subwatersheds

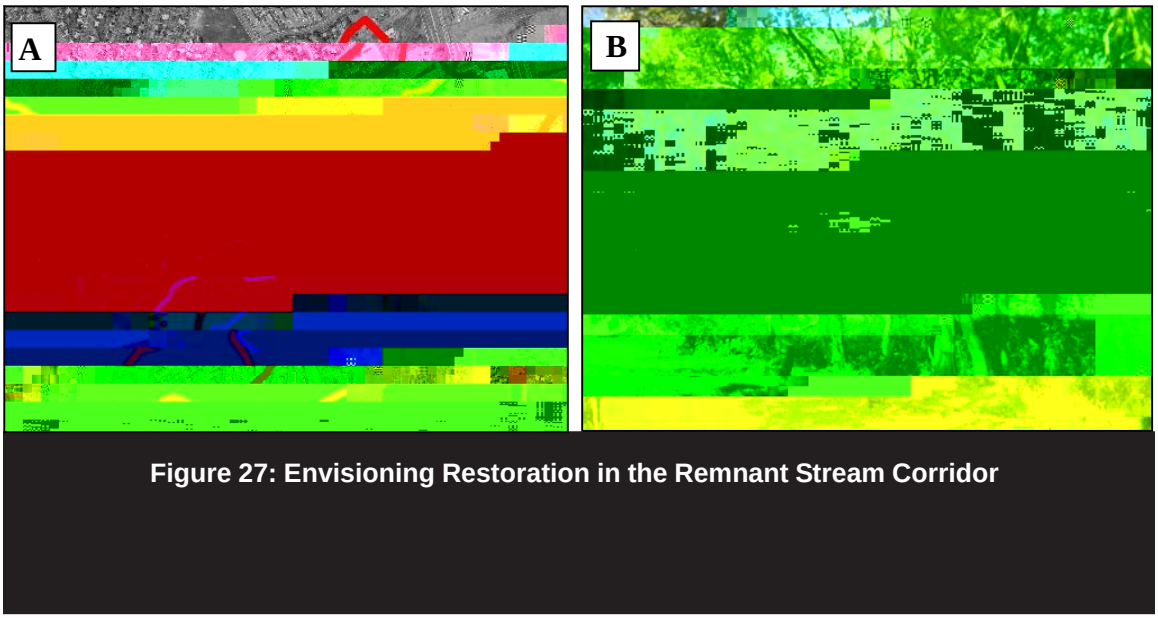


Figure 27: Envisioning Restoration in the Remnant Stream Corridor

5.2 Existing Storm Water Infrastructure

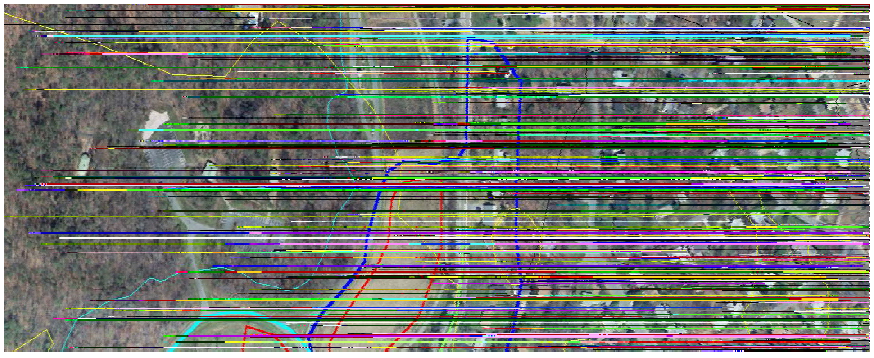


Figure 29: Envisioning Restoration on Open Municipal Lands
Portions of open municipal land are often good candidates for locating restoration practices, particularly along the property margins. Parks, schools and ballfields (shown in photo) are always worth evaluating in any subwatershed.

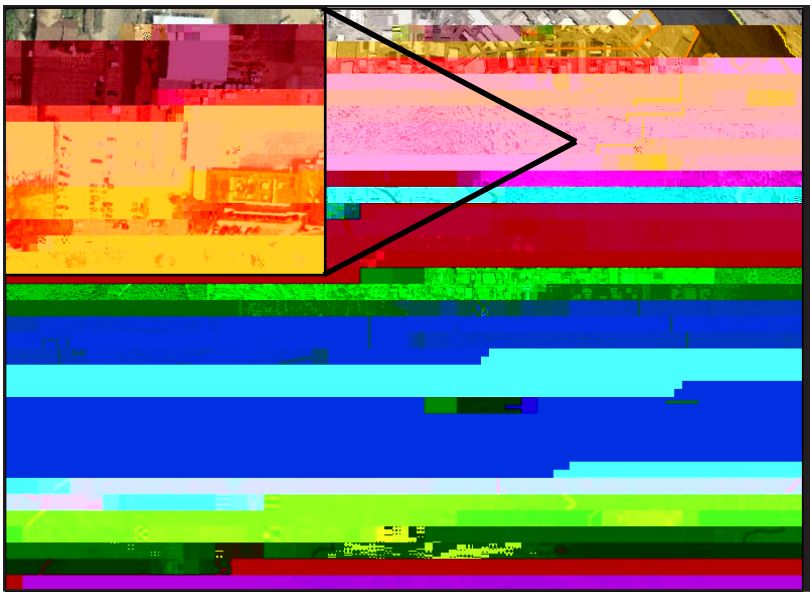


Figure 33: Envisioning Restoration for Storm Water Hotspots
Storm water hotspots are very hard to find, given their small size and uneven distribution in most urban subwatersheds. Field investigations are almost always needed to confirm locations of severe hotspots, although analysis of business or permit databases can be used to narrow the search.

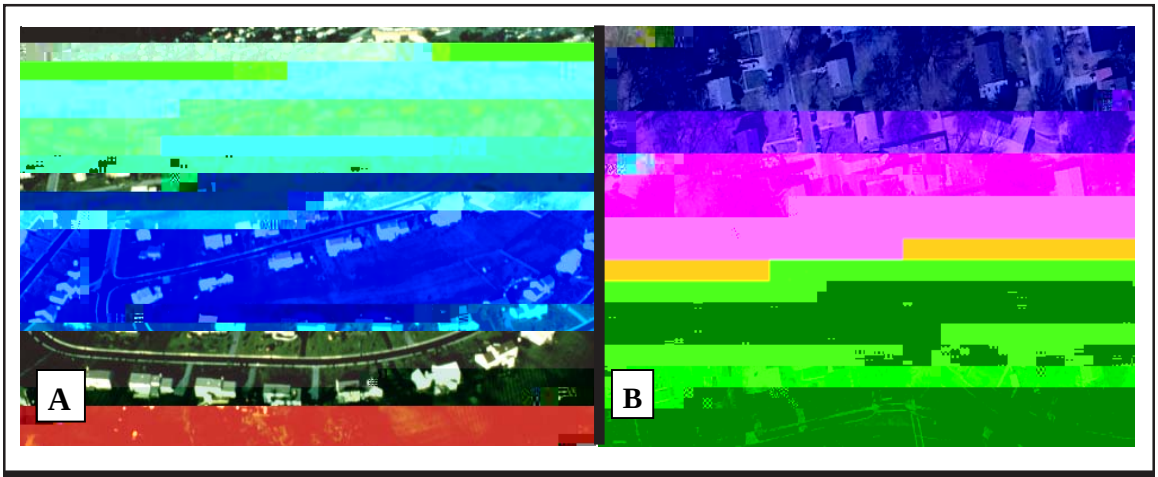
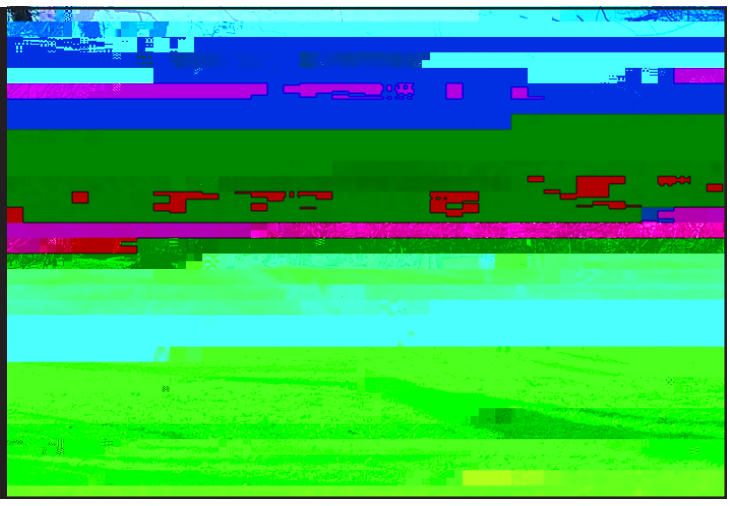


Figure 34: Envisioning Restoration in Residential Neighborhoods
Each residential neighborhood has its own distinctive character, based on its age, lot size, vegetative cover and housekeeping. These characteristics greatly influence opportunities for residential source control, which is evident when a large lot suburban neighborhood (Panel A) is compared to small lot urban neighborhood (Panel B).

Figure 35: Envisioning Restoration on Large Parcels of Institutional Land
Institutions such as this college campus, may have unused land on their property that may be suitable for locating subwatershed restoration practices.



5.10 The Sewer System

5.11 Streets and Storm Drain Inlets

5.12 Summary

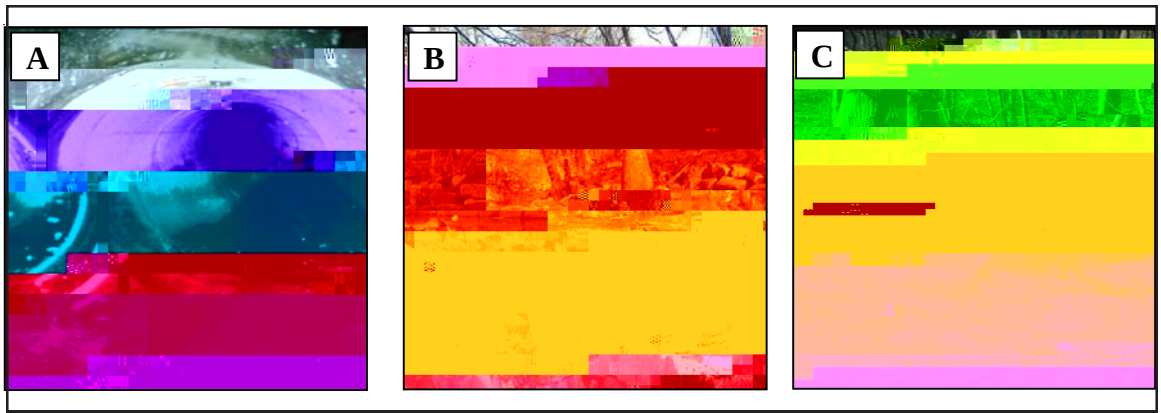


Figure 36: Envisioning Restoration in the Sewer System
While the sewer system is mostly underground (Panel A), manholes (Panel B) and sewer crossings near the stream corridor (Panel C) should always be investigated to check for potential sewage leaks and discharges.

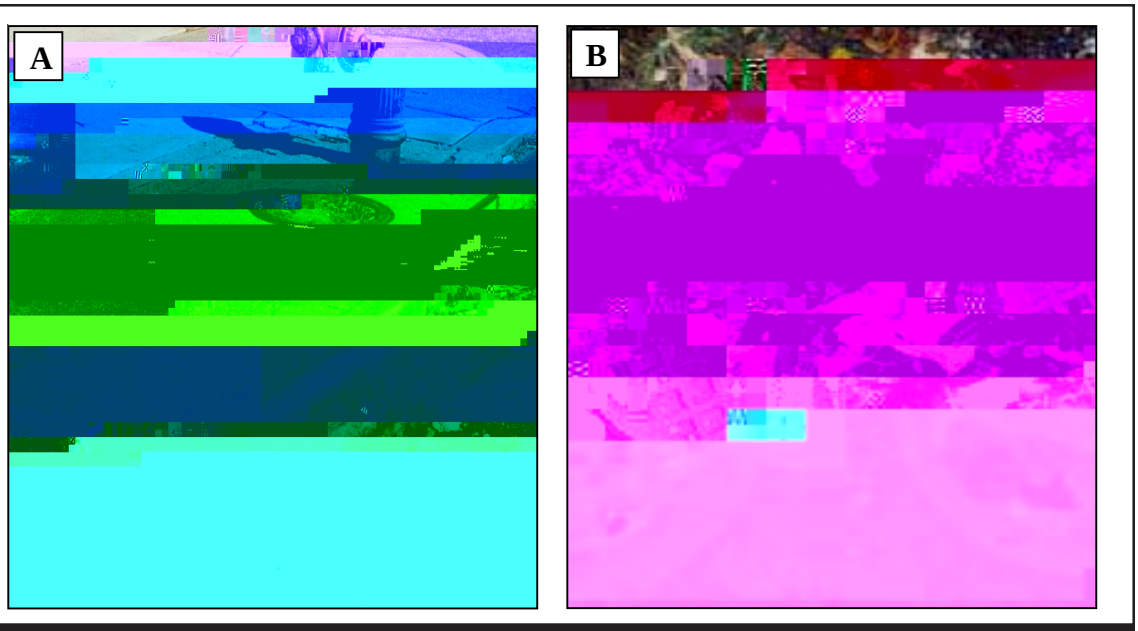


Figure 37: Envisioning Restoration on Streets and Storm Drain Inlets
Pollutants and trash can accumulate on street surfaces and curbs (Panel A) or within storm drain catch basins and sumps (Panel B). Street sweeping and catch basin cleanouts may be the last chance to remove these pollutants in highly urban subwatersheds with few other restoration options.

Chapter 6: A Framework for Small
W

Figure 39: Detailed Steps and Tasks Involved in the Restoration Planning Process

Each step in the planning process usually has its own associated desktop analysis, field

Step 3: Evaluate Restoration Potential

Step 4: Conduct Detailed Restoration Assessment

Step 6: Determine Whether Subwatershed Plan Meets Watershed Goals

Step 7: Implement Plan

Step 8: Measure Improvements Over Time

Summary

3. Bankfull Flooding Frequency

C: Derivation of ICM Predictions for Physical Alteration of the Urban Stream Corridor

4. Stream Enclosure/Modification

5. Riparian Forest Continuity

8. Sediment Supply to Stream

9. Typical Stream Habitat Score

10. Presence of Large Woody Debris

13. Exceedance of Bacteria Standards

16. Trash and Debris

17. Other Storm Water Pollutants

20. F *Deriv0/G2 gsp.a f12 0 Ş and UDs F*

22. Riparian Plant Diversity

Appendix B: Organization of Restoration Technique Profile Sheets for the Manual Series

Manual 3: Storm Water Retrofit Practices

Storage Retrofit Techniques

On-site Non-Residential Retrofit Techniques

On-site Residential Retrofit Techniques

Manual 4: Stream Repair Practices

Stream Cleanup Techniques

Stream Repair Techniques

Manual 9: Municipal Practices and Programs

Techniques for Streets and Storm Drains

Best Practices for New Construction

Inspection and Enforcement

References