Developing and Implementing a Stream Watch Program

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Preface

Developing and Implementing a Stream Watch Program was created by the Center for Watershed Protection (CWP) in cooperation with Jones Falls Watershed Association (JFWA) and Baltimore County Department of Environmental Protection and Resource Management (DEPRM). The intended audience is a local watershed group implementing a Stream Watch Program in its watershed.

The main goal of the Stream Watch Program is to develop citizen stewardship of streams within Baltimore County watersheds by providing ample opportunities for citizen involvement in stream assessment and restoration activities. The central idea behind the Stream Watch Program is that a watershed organization, working with citizen volunteers, will track the health of County streams and identify potential restoration and protection projects. The watershed association will be responsible for collecting stream data collected and reported by volunteers, and for continuously updating the Stream Watch Program database.

The purpose of this document is to provide educational materials on the impacts of humans on streams, to provide lessons learned from other Stream Watch Programs, and to provide a process for a watershed group to implement a Stream Watch Program.

This document was first developed as a draft based on extensive research and detailed surveys of six of Adopt-a-Stream programs from around the country. The JFWA initiated the Stream Watch Pilot Program in July 2003, focusing on the Jones Falls watershed. JFWA served as the principal director and implementation agency of the pilot program and provides periodic updates to DEPRM and CWP.

During the pilot program, JFWA was responsible for the recruitment and training of volunteers, the collection of stream data, organizing and implementing annual monitoring programs, reporting updates to DEPRM and updating the Stream Watch database. Although the program was County funded, the pilot program included surveys and adoption sites throughout the entire watershed, including portions in Baltimore City.

Developing and Implementing a Stream Watch Program was revised based on lessons learned during the pilot program, feedback from Stream Watch volunteers, and experience gained by the JFWA staff over the course of the pilot program.

Instructions for Using the Stream Watch Program Document

There are three sections in the Stream Watch Program document. The first two sections describe necessary background information for the document, and the remaining section describes the steps involved in implementing a program. The purpose of each of the sections and the steps are as follows:

Section 1. Introduction Outlines the goals of the Stream Watch Program and provides tips gleaned from other programs across the County.

Section 2. Streams 101 Provides necessary background information on the impacts of humans on streams that may be useful in answering questions posed by the public when training volunteers

Section 3. Implementing a Stream Watch Program Describes the steps involved in implementing a Stream Watch Program, including stream adoption options, volunteer management, data tracking, measuring program success, and budgeting program costs.

Appendix A. Stream Watch Visual Survey Provides an introduction to the Visual Survey, a review of important elements of the Visual Survey field form, and the Visual Survey field form.

Appendix B. Stream Watch Site Conditions Survey Provides an introduction to the Site Conditions Survey, a review of important elements of the Site Condition forms, and the Site Conditions Survey forms.

Appendix C. Data Interpretation: Water Quality and Macroinvertebrate Sampling Provides an overview of interpreting water quality and macroinvertebrate sampling results.

Appendix D. Stream Watch Program Database (under separate cover) A Microsoft Access database created to track all volunteer and stream data collected under the Stream Watch program.

Appendix E. Stream Watch Program Flyer The flyer used during the pilot program.

Appendix F. Stream Watch Training Presentation The presentation used to train volunteers during the pilot program.

Appendix G. Stream Watch STREAM CLEANER Pilot Program Volunteer Orientation Packet Orientation materials distributed to volunteers that participated as STREAM CLEANERS in the pilot program.

Appendix H. Stream Watch STREAM WALKER Pilot Program Volunteer Orientation Packet Orientation materials distributed to volunteers that participated as STREAM WALKERS in the pilot program.

Appendix I. Stream Watch STREAM WATCHER Pilot Program Volunteer Orientation Packet Orientation materials distributed to volunteers that participated as STREAM WATCHERS in the pilot program.

Appendix J. Jones Falls Watershed Stream Watch Program Evaluation Form Stream Watch Program evaluation form used during the pilot program.

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Section 1. Introduction

1.1 Goals of the Stream Watch Program

The Stream Watch Program will develop citizen stewardship within Baltimore County watersheds by providing ample opportunities for citizen involvement in stream assessment and restoration activities. The goals guiding the development of this program include the following:

- Expand watershed stewardship throughout the County
- Build the technical and organizational capacity of the watershed organizations in the County
- Build the memberships of the watershed organizations in the County
- Identify priority stream and public health concerns to be addressed by the County
- Identify potential stream protection and restoration projects to be implemented by the watershed organizations
- Identify potential stream protection and restoration projects to be implemented by the County
- Collect data on the health of County streams
- Actively involve County residents and watershed stakeholders in stream health data collection and goal setting

1.2 Lesson Learned from other Stream Watch Programs

In an effort to improve our recommendations and guidance for the Stream Watch Program in Baltimore County, the Center for Watershed Protection (CWP) researched existing Stream Watch Programs nationwide. CWP found approximately 13 programs and, after briefly researching each, narrowed these down to eight. CWP conducted detailed surveys of six of these programs, via telephone or email, to understand each program in detail and to assess their successes, failures and lessons learned. The survey explored topics such as the program's background, information on volunteer recruitment and retention, and the lessons learned by each community.

Each community found some aspects of its program were successful and some were not so successful. Some of the communities are in the process of using the information and feedback they have gained themselves, to fine tune their own programs.

While each community measured its program's overall success differently, volunteer retention and number of volunteers were commonly used. Other measures of success included: use of data to influence change, number of reports written, number of bags of trash collected, and amount of good data collected. In general, the program managers surveyed indicated that they felt the programs have been successful. One notable aspect of all programs that has been successful is the large turnout of volunteers at training workshops and monitoring events. It was noted that people were interested in volunteering because they felt they were contributing to improving water quality in their rivers and streams. These events also provided opportunities to meet like-minded people and were free, family-oriented events for all ages. Some lessons for success cited by the interviewees are summarized in Table 1.1.

Aspects of each program that were unsuccessful were more variable than the successes, although limited funding was mentioned more than once during the survey. The challenges cited by the interviewees are summarized in Table 1.1, as well as what they would do differently next time.

Table 1.1: Summary of Stream Watch Programs - Lessons Learned
Most successful part of program: • Having the data used in advocacy for the river • Ability to attract people and keep them interested • Family oriented, free workshops with opportunities for all age groups • Large turnouts for monitoring • Dedicated volunteers who see the program as a priority • Continual community interest, commitment of people involved
Program challenges: • Successfully changing data collection methods or program objectives • Maintaining a up-to-date database of volunteers • Acquiring continual funding • Getting data results out to the public • Having enough people power to motivate volunteers • Follow-up with volunteers
What to do differently: • Have both a general and technical advisory group • Do more on-the-ground projects • Conduct state-wide training • Hire more staff for data collection • Get more professionals in lab • Acquire more short and long-term funding • Continually monitor volunteer satisfaction

Based on feedback from the surveys on lessons learned, CWP has developed a list of elements for success for possible incorporation into the Baltimore County Stream Watch Program. These include:

- Conduct outreach to educate potential volunteers about water quality issues and get them interested in volunteering
- Use volunteer recruitment methods such as newsletters, newspaper ads, websites, flyers and word-of-mouth
- Make the monitoring events fun and family oriented
- Regularly recruit new volunteers
- Conduct regular training sessions with workshops and hands-on training for new volunteers and to re-train existing volunteers
- Provide incentives or rewards for volunteers such as class credits, awards and community recognition

- Solicit long-term funding in order to hire staff for data collection and analysis and to run the program
- Conduct County-wide training sessions to ensure standardization in monitoring
- Select previously tested monitoring methods and develop a plan for quality control
- Continually monitor volunteer satisfaction through surveys or other methods and incorporate results into program
- When problems are identified, seek funding for restoration projects to implement with the volunteers
- Hire technical staff to assist with data collection
- Start a website or newsletter to get results out to the public
- Address potential liability issues with insurance or waiver forms

Section 2. Streams 101

2.1 Why Small Streams are Important

Depending on where we live, we cross quite a few brooks, creeks, runs, branches, ditches or channels as we drive to work each day. Each stream we cross is part of a massive network of perhaps three million streams that flow into our rivers, and ultimately, to the sea. Each stream has its own watershed – the watershed consists of all of the land area that drains to the stream. These small watersheds play a critical role in sustaining our environment. Simply put, the health of each stream is fundamentally influenced by how we manage the land in its small watershed. Moreover, the health of downstream rivers, lakes and estuaries is also inextricably linked to this network of small watersheds that feed into them.

Streams and their accompanying watersheds get relatively little attention compared to the larger rivers, lakes and estuaries to which they drain. However, small streams are the single most important habitat for both terrestrial and aquatic wildlife in any landscape. Not only do streams provide the waters that sustain life, but they also create a critical wildlife corridor that links downstream habitats with upland ones. The stream corridor, with its rich floodplains, wetlands and forests, is also the home of many unique plant and animal species. The stream itself supports a diverse aquatic community, and performs the unheralded but vital ecological role of processing carbon, sediments, and nutrients upon which downstream ecosystems depend.

Small streams are fun, whether we directly experience them in a canoe, kayak, inner tube or raft, swim or fish in them, or hike along their shady banks. The natural beauty of running water is a refreshing tonic in our lives, whether we seek recreation, an encounter with wildlife, or simple solitude. Small streams are an important element of our local geography, and confer a strong sense of place to a community. Indeed, much of our local history has been written in or around small streams, whether it is the site of a pioneer settlement, the layout of a road, an old mill, or a disastrous flood. We tend to take small streams for granted, but they are deeply rooted in our culture and help shape our relationship to the land.

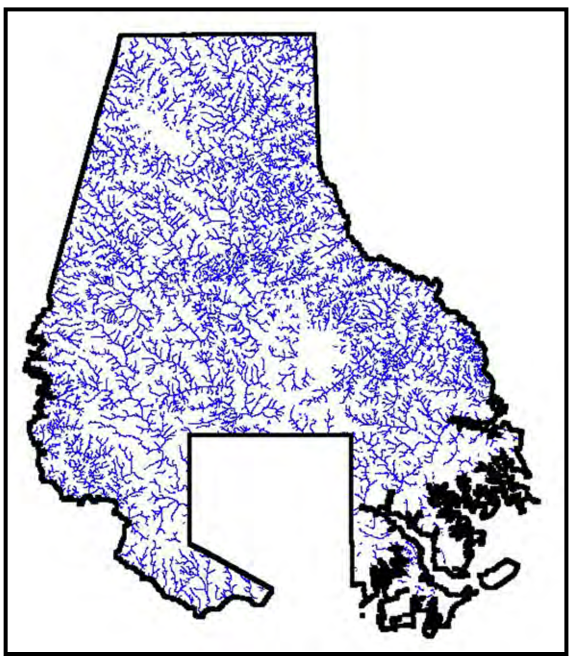


Figure 2.1: Stream Network in Baltimore County

Each watershed contains a network of small stream channels that are known as headwater streams. While each headwater stream is short and narrow, they collectively represent a majority of the drainage network of any watershed management unit. Figure 2.1 illustrates the significance of the headwater stream network in Baltimore County. What happens in the local landscape is directly translated to headwater streams, and major receiving waters are affected in turn.

The impacts of urbanization can be broken into four main categories:

1. Hydrology (the flow of water through the ecosystem)
2. Geomorphology (the shape & composition of streams)
3. Water Quality
4. Habitat for Aquatic & Terrestrial Life

2.2 How We Impact Streams

Stream quality begins to degrade when the natural condition of land is altered within a watershed. The natural condition is altered by the physical changes we make to the watershed landscape and by the introduction of our individual behaviors to the watershed.

Changes in Hydrology

The quality of watersheds begins to change when forests are converted to farms, and then declines very rapidly when the watershed is converted to urban land uses, largely due to the transformation of the surface of the watershed. Rooftops, parking lots, roads, buildings, and other impervious surfaces cover the land in the watershed (Figure 2.2), which can then no longer absorb and store rainfall.

Water balance is the concept that the same amount of water that goes into the system must come out. Once it rains, the water can follow only one of the following four paths:

- Rain soaks through the soil into the groundwater supply (infiltration)
- Rain is absorbed and trapped by vegetation, soil and groundcover (absorption)
- Rain is used by plants and evaporated from surfaces (evapotranspiration)
- Rain is turned into runoff

Before development, much of the rainfall is intercepted and used by the tree canopy and vegetation (Figure 2.3). A significant portion also soaks into the ground and recharges the groundwater, which in turn, recharges stream flow during dry summer months. This leaves a small percentage of the rainfall that runs off the surface of the ground.

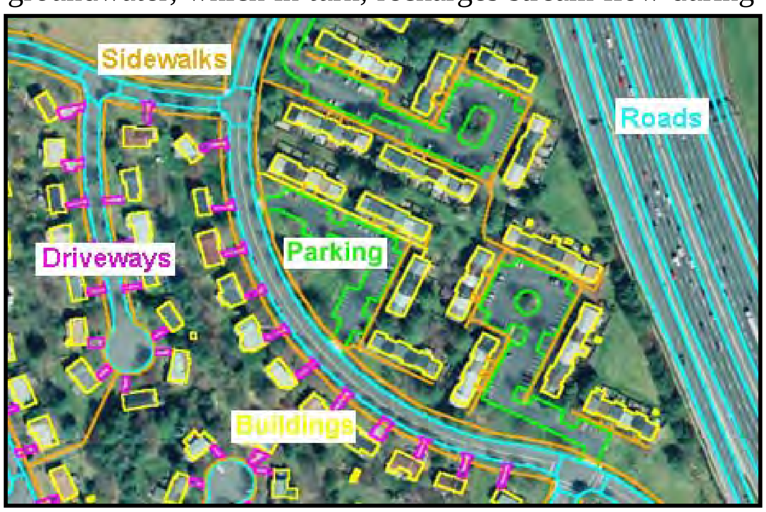


Figure 2.2: Components of Impervious Cover in the Urban Landscape

When we develop land, however, much of the vegetation is replaced with lawns and with impervious surfaces, such as our houses, driveways, and roads. This means that there is less canopy interception and evapotranspiration since the amount of vegetation is reduced. Also, since the surface of land has been covered with

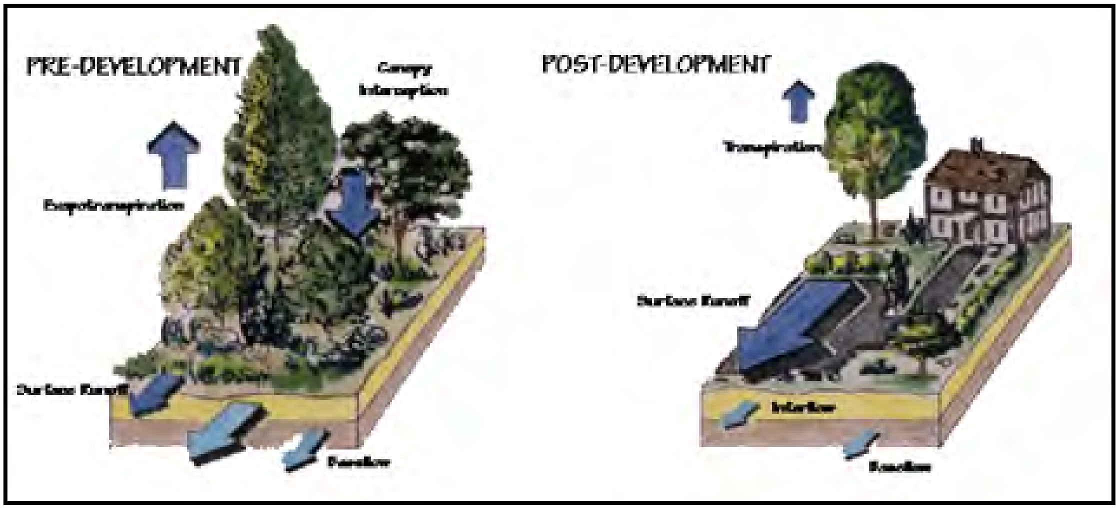


Figure 2.3: The Pre- and Post-Development Water Balance

impermeable surfaces, the rainfall cannot infiltrate into the ground to recharge groundwater. This means that more rainfall is running off the surface of the land (Figure 2.3).

Curbs and gutters, storm drain pipes, catch basins and other drainage systems quickly deliver the runoff from impervious surfaces through pipes to the stream. This means that more stormwater runoff is getting to the stream much faster than it would have prior to development (Figure 2.4).

There are many hydrological impacts of increased runoff on streams. A few of the changes to stream flow include:

- More frequent flooding - for example, instead of having flood events one time a year, it could happen three times
- Increased flood peaks- flood peaks refers to the height the flood waters reach; in some situations the flood peak may more than double due to an increased amount of runoff
- Lower baseflow - during dry periods there is less water in the stream. This can happen because there is less input from groundwater supplies because all rainfall was converted to runoff.

Figure 2.4: Rainwater Runs Off of Impervious Surfaces, Enters the Storm Drain System, and is Directed to Streams

In watersheds with less than 5% impervious cover, streams are typically stable and pristine, provide a variety of habitats, maintain a diverse aquatic population and have good tree canopy coverage.

While this stream at 8-10% impervious cover is still relatively stable, signs of stream erosion are more apparent, and there is some loss of good habitat.

The surrounding area of this stream is approximately 20% impervious cover. Stream erosion is much worse than in the previous slide due to an absence of vegetation to hold together bank structure. The amount of erosion has been so great that the outfall that once rested on the stream bottom is now two feet above the water and sticking six feet out from the bank.

This stream has a surrounding area of approximately 30% impervious cover. The channel is deeply cut down, there is little to no bank vegetation to prevent erosion, and there is little habitat structure.

Above 65% impervious cover, the stream geomorphology is typically completely destroyed by channelization. Concrete channels and pipes provide little to no habitat and support little to no aquatic life.

Figure 2.5: Changes in Geomorphology as Impervious Cover Increases

Changes in Geomorphology

Hydrology, or the flow of water, largely dictates the shape of stream channels. As we develop, more runoff reaches stream channels at a much faster rate than before development. This causes more stream channel erosion. Figure 2.5 illustrates how impervious cover and the resultant changes in hydrology can alter the geomorphology of a stream channel.

Table 2.1: Key Individual Behaviors that Potentially Influence Watersheds
Lawn Fertilization
Pesticide Application
Dog Walking
Car Washing
Fluid Changing
Septic System Maintenance
Leaf Disposal/Composting
Disposal of Household Hazard Wastes
Hosing and Power-washing
Landscaping Practices
De-icing
Watering/Irrigation
Sidewalk/Driveway Sweeping
Maintenance of Common Stormwater Facilities and Conservation Areas

Changes in Water Quality

The impervious surfaces in our watersheds also accumulate pollutants deposited from the atmosphere, leaked from vehicles, or derived from other sources. During storms, accumulated pollutants are quickly washed off and rapidly delivered to out streams.

At the same time, the cumulative impacts of our individual behaviors in the watersheds in which we live and work can have a serious negative effect on water quality. These behaviors (Table 2.1), often driven by our desire for a nice green lawn, a shiny car, a pest-free yard, and a clean driveway, means that each of us is personally responsible for contributing some of the pollutants that run off of our lawns, streets and parking lots (Figure 2.6).

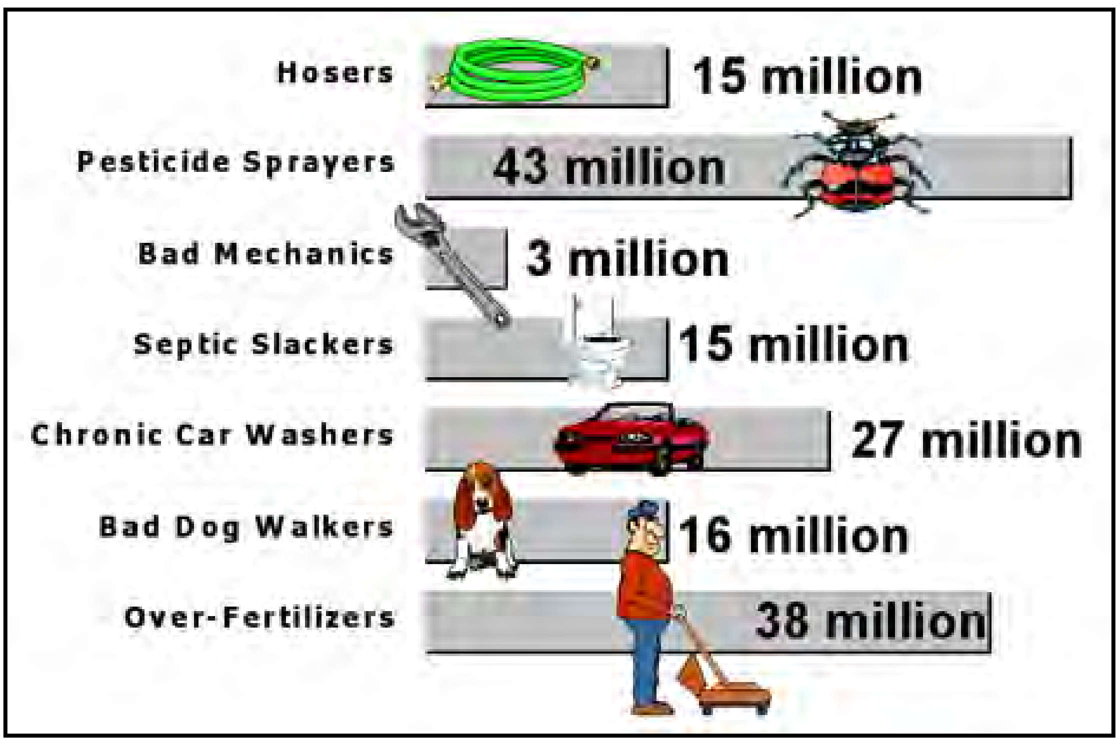


Figure 2.6: Conservative Estimates of US Polluters

As stormwater runs off of lawns and impervious surfaces, it picks up many pollutants. Common pollutants in stormwater include:

- Bacteria and pathogens
- Sediment
- Heavy metals from our cars
- Nutrients from our lawn fertilizers
- Pesticides
- Oil and grease

Figure 2.7: Sediment Plume (Source: Atlantic States Legal Foundation

Sediment plumes (relatively concentrated masses of sediments spreading in the environment) can clog waterways, prevent sunlight from reaching aquatic plants, smother valuable habitat, and cause physical damage to aquatic animals (Figure 2.7). Pesticides, polycyclic-aromatic hydrocarbons (PAHs), oil and grease can have toxic effects on plants and animals.

Figure 2.8: Fish Kill (Source: Roger Bannerman)

Increased nutrient levels can cause algal blooms, which can lead to eutrophication and ultimately fish kills. Eutrophication is the process of over-enrichment of water bodies by nutrients. This is typified by the presence of algal blooms. When the algae die and decompose, they consume oxygen in the water, reducing the level of dissolved oxygen in the water and leading to fish kills (Figure 2.8).

Metals accumulate in aquatic organisms, like fish, harming the organism as well as influencing related activities such as fishing, harvesting of shellfish.

In addition to an increase in pollutant runoff, the temperature also increases with impervious cover. As the runoff crosses over hot pavement or other impervious surfaces it increases the runoff temperature. In addition, in areas with high impervious cover there are fewer trees and vegetation to help block direct sunlight from reaching the stream. An increase in stream temperature can alter natural chemical reactions, negatively effect reproductive processes and limit habitat for temperature sensitive species.

Changes in Habitat for Aquatic & Terrestrial Life

The negative effects of land development is also greatly seen in the degradation of in-stream and shoreline habitat. In an enlarged urban stream, habitat structure is lost and flows become shallower, slow moving and indistinct. Sedimentation, which occurs when soil particles suspended in stormwater and stream flow settle in streambeds, can smother valuable habitat.


Figure 2.9: Loss of Stream Buffer

When flows become more shallow and slow moving, the riffle-pool structure of streams is lost. A pool is a region of deeper, slow-moving water with fine bottom materials. A riffle is a length of stream where water flows over and around rocks disturbing the water surface. Riffles often support diverse biological communities due to their habitat niches and increased oxygen levels created by the water disturbance.

Buffers, which provide valuable shoreline habitat and pollutant protection to streams, are also frequently removed during development (Figure 2.9). Buffers provide stream shading and inputs of tree litter and woody debris to streams. Large woody debris is important in a stream because it provides habitat structure.

Fish barriers are often created by urban infrastructure including culverts, dams, and piping. These can all prevent the natural migration of fish.

The combined impacts from changes in hydrology, geomorphology, water quality, and habitat structure adversely affect the population of waterfowl, macroinvertebrates (or bugs that live in streams), amphibians and fish that make the stream and its corridor their home.

Section 3. Implementing a Stream Watch Program

3.1 Identifying Streams for Adoptions

This section describes the process of stream section and monitoring site identification.

Stream Section Identification

All walkable streams in the watershed are open for adoption (even those that extend beyond County boundaries). Considering that there are over 2,100 miles of streams in Baltimore County, watershed groups will need to clearly define the streams in their program and divide these streams into smaller, more manageable units for volunteers to adopt. Before volunteers can get their feet wet, the watershed group must spend some time mapping their watershed.

A preliminary mapping exercise should be performed using a Geographic Information System (GIS) to delineate adoption sections. Aerial photos, watershed and subwatershed boundaries, hydrology, and roads are the primary data layers you will need; land use and parcel data may also be useful. Having a street map handy will also prove useful in determining the names of streets that can provide access to the stream. Mapping data for watershed organizations will be provided by DEPRM. DEPRM has delineated most of the subwatersheds in the County and has assigned numeric designations to each. If, however, a watershed has not been delineated into smaller subwatershed units (10 square miles or less), then delineate the subwatersheds using topography and hydrology layers (assistance is available from DEPRM if necessary). After the subwatersheds have been delineated, submit the new map to DEPRM to review. Techniques for delineating subwatersheds can be found on the web: http://www.stormwatercenter.net/Slideshows/delineating_boundaries_files/frame.htm.

Delineating Adoption Sections

Within each subwatershed, the stream network should then be divided into smaller sections appropriate for adoption. While in-house mapping may not translate into perfection on the ground, spending time upfront defining sections will make the adoption, tracking, and data collection process more seamless. As general guidance, adoption sections can be delineated based on the following criteria:

- Approximately ¼ mile in length
- Include at least one easy stream access point (from a road or open area)
- Located between major road crossings or major land use changes (include culvert with downstream section - however, continuously tell to volunteers that they should not enter any culverts)
- Use major confluences as breaks between sections
- Include only 1 stream per section
- Access is permitted along entire reach (private property, fences, etc)

Figure 3.1 provides examples of stream section delineation based on some of the delineation criteria discussed above. Inevitably, not all adoptive sections will meet these criteria—which

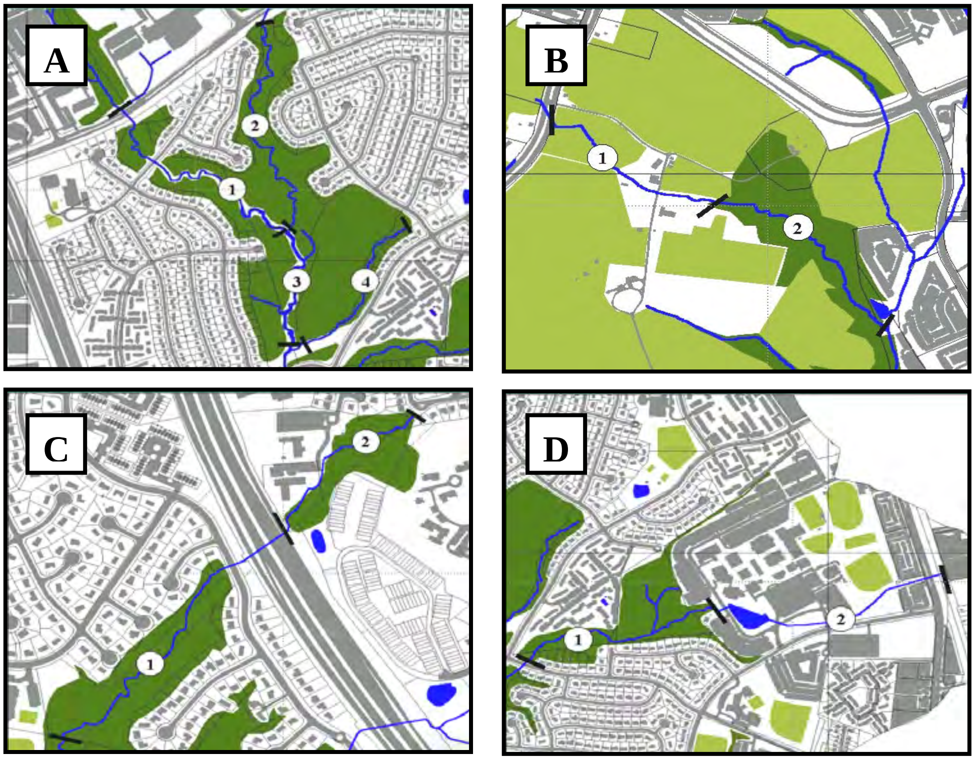


Figure 3.1: Various physical factors will control how individual adoption sections are defined. (A) Sections based on the confluence of stream tributaries. (B) A long tributary split into ¼ mile sections. (C) Based on a major road crossing; include the culvert in the downstream reach. (D) Based on significant changes in land use.

is okay. Stream network, land use, and road patterns unique to each subwatershed will affect how easily segment delineation can be completed and how uniform adoptive segments will be across the subwatershed. Once in the field, you may find that streams may be underground or that access is not available due to private property, debris jams, or other physical conditions not seen during the mapping process. Modifications to stream segments can be made in GIS as needed.

Naming Stream Segments

Once adoption sections have been identified, each section should be given a unique ID. Numerous systems exist for stream system labeling, and program organizers should check with the County or the Maryland Department of Natural Resources (MD DNR) prior to establishing a naming system because a naming system may already exist. In conventional techniques such as the Strahler system, names are based on stream order, where first order streams are headwater streams with no tributaries. When two first order streams join, a second order stream is formed. Where two second order streams join, a third order stream is formed, and so on. When a stream of lower order joins a stream of higher order the stream order does not increase. Starting at the bottom of each subwatershed and moving in a clockwise direction, each first order stream reach is numbered starting with the number 101 and continuing clockwise (i.e., 102, 103, etc.) until all first order reaches are numbered. The process is repeated for each second order reach (i.e., 201, 202, etc.) and each third order reach (i.e., 301, 302, etc.), until all stream reaches in each subwatershed are assigned a three digit identifying number, as shown in Figure 3.2.

The first section on a first order stream in Towson Run, for example, may be something like this:

Stream Name-Reach Number-Section Number
(Towson Run-101-1)

While this system works well at the reach level, it may be overly complex for the Stream Watch Program. We recommend using a simpler naming system based on the name of major streams followed by a single identifying number or letter. For example:

Stream Name- Section ID
(Towson Run-A)

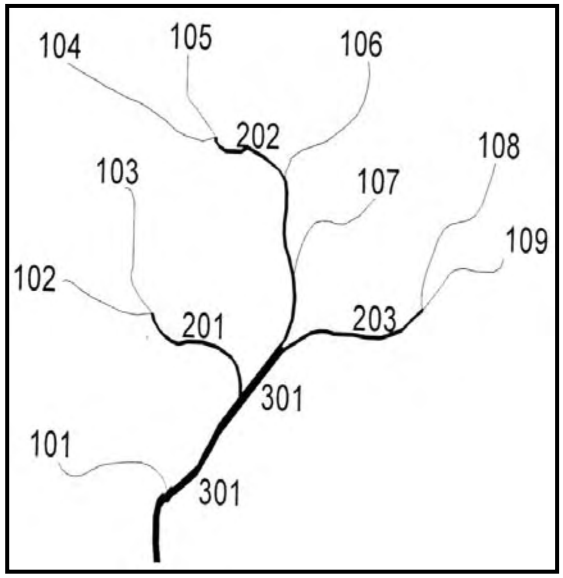


Figure 3.2: Strahler's Stream Nomenclature

Using this simpler ID will lend itself to less cluttered maps and potentially less confusion among volunteers. Program coordinators may choose to utilize a more detailed naming convention in their internal database (i.e., including stream order).

Generating Adoption Maps

Once all sections have been identified, a watershed Stream Watch map can be generated. This map should show watershed boundaries, roads, structures, streams, and labeled adoption sections. Major roads, neighborhoods, landmarks and adoption sections should also be labeled. This map can be printed in brochure format and distributed throughout the watershed (program details on one side, map on the other). Stream Watch maps should also be posted on the watershed organization and County website. Volunteers can choose which section(s) they would like to adopt from looking at the maps.

Case Study: Adoption Section Delineation

Towson Run is a 2.9 square mile subwatershed in the Jones Falls Watershed. Baltimore County data shows 13.6 miles of blue line streams, however, some of the reaches appear to be piped. Using the delineation criteria as a guide for breaking the stream network into adoption sections, the stream was divided into 26 sections by hand in about 10 minutes. Next, a GIS layer was created that identifies these sections (Figure 3.3). In this example, sections were identified using letters and color coded by stream order. Stream order, surrounding land use, and street names for the nearest roadway were entered into the data table (Table 3.1). Linking stream section data to GIS allows the user to easily revise section delineation, quantify miles adopted, and generate maps useful in recruiting program volunteers.

You will notice that not all segments meet the delineation criteria. Some of the sections are longer than ¼ mile, some contain additional drainage, and some are questionable as to whether they are actually surface streams. This is okay. It is likely that volunteers or program managers will make modifications to the stream segment selections as they go out in the field. The most useful section delineation criteria were section length, confluences, and road crossings. Land use and accessibility considerations were often factors leading to sections in excess of ¼ mile rule (see sections V and A).

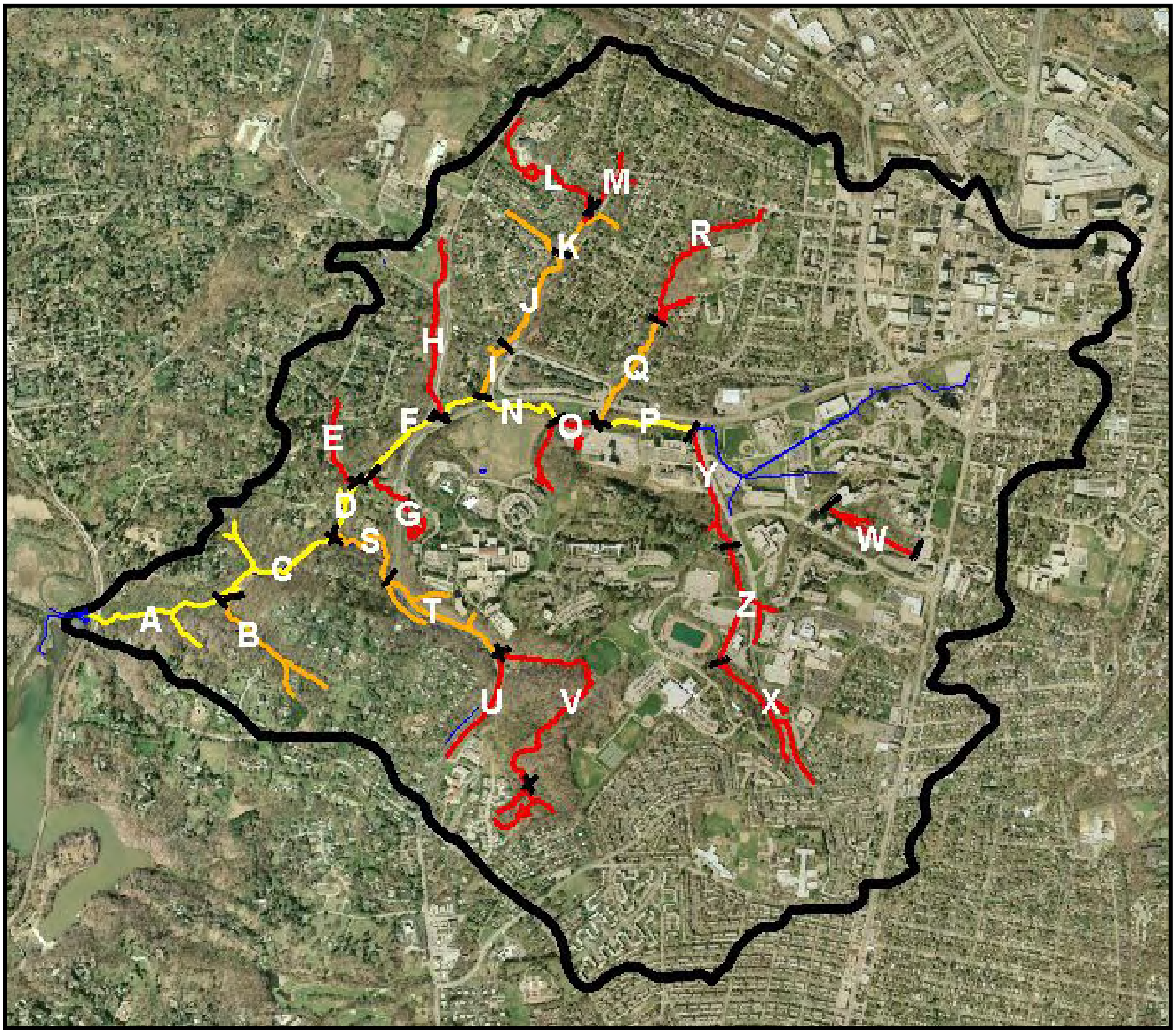


Figure 3.3: Towson Run Adoption Segments

Table 3.1: Data Table for Towson Run Adoption Sections				
Id	Order	Length (miles)	Land Use	Nearest Road
A	Main Stem	0.45	Low Density Residential; Forest; Water	Charles Way
B	Second Order	0.42	Low Density Residential; Forest	Montrose Ave
C	Main Stem	0.52	Low Density Residential; Forest	Malvern Ave
D	Main Stem	0.22	Low Density Residential	Malvern Ave
E	First Order	0.22	Low Density Residential	Charles Street
F	Main Stem	0.21	Low Density Residential; Open Urban Land	Charles Street
G	First Order	0.30	Low Density Residential	N. Charles Street
H	First Order	0.43	Low Density Residential	Malvern Ave
I	Second Order	0.17	High Density Residential	Boyce Ave
J	Second Order	0.26	Medium Density Residential	Chesapeake Ave
K	Second Order	0.38	Medium Density Residential	Charles Street Ave
L	First Order	0.43	Medium Density Residential; Institutional	Chestnut Ave
M	First Order	0.26	Medium Density Residential	Charles Street Ave
N	Main Stem	0.37	Open Urban Land; Medium Density Residential; Forest	Towsontown Blvd
O	First Order	0.42	Institutional; Forest; Open Urban Land	Towsontown Blvd
P	Main Stem	0.33	Institutional	Towsontown Blvd
Q	Second Order	0.28	Institutional; High Density Residential; Medium Density Residential	Chesapeake Ave
R	First Order	0.56	Institutional; Medium Density Residential	Allegheny Ave
S	Second Order	0.26	Medium Density Residential; Forest	Charles Street
T	Second Order	0.61	Medium Density Residential; Forest	Charles Street
U	First Order	0.28	Open Urban Land; Institutional; Forest	Charles Street
V	First Order	1.04	Open Urban Land; Medium Density Residential; Forest	Bellona Ave
W	First Order	0.30	Institutional	York Rd & St. Joseph Hospital
X	First Order	0.57	High Density Residential; Medium Density Residential; Institutional	Osler Drive & Stevenson Lane
Y	First Order	0.34	Institutional	Osler Drive
Z	First Order	0.42	Commercial, Institutional	Osler Drive

Monitoring Station Locations

Program staff will also need to establish sentinel stations for both synoptic ("snapshot") water quality and macroinvertebrate sampling. These stations will be the locations for repetitive, long term monitoring efforts by the watershed group and its Stream Watch volunteers. You may choose to sample water quality more often and at a greater number of locations than aquatic insect sampling, however the general recommendation is to overlap these efforts and have at least one site per subwatershed. Two or three stations should also be established below major confluences on the mainstem of the watershed. Coordination with DEPRM, MD DNR and other jurisdictions such as the Baltimore City Department of Public Works on the locations for the sampling sites is important for consistency and to avoid duplicative efforts. General considerations for locating sampling stations may include:

- Existing County, state, or academic sampling stations
- Above the most downstream road crossing in each subwatershed
- Below major confluences
- Below catchments draining single land uses
- Above and below areas of concern or discharges (when below discharges, make sure the station is far enough downstream to allow for mixing)

3.2 Stream Adoption Options

There are five levels of adoption under the Stream Watch Program. Each level varies in the type of activities volunteers will complete in their adoption section(s). Table 3.2 describes the various components of each adoption level and summarizes the cumulative time commitment required by volunteers. Estimated time commitments associated with the individual activities are broken down in Table 3.3.

Table 3.2: Description and Time Commitment for Each Level of Adoption

Action Level	Description	Protocol	Time Commitment*
STREAM CLEANER	Pick up trash and debris	Trash Collection Report	• 1 hr training on safety and collection procedures • Section should be visited 4 times a year ➢ 2 hrs/section visit for trash removal (quarterly) • **Total 9 hrs/year**
STREAM WALKER	Identify major in-stream and riparian problems	Visual Survey	• 2 hr training on safety, trash collection procedures, and performing Visual Survey • Section should be visited 4 times a year (twice for trash removal, twice for trash removal and Visual Survey). ➢ 2 hrs/section visit for trash removal (quarterly) ➢ 1 hr/section visit for Visual Survey (biannual) • **Total 12 hrs/year**
STREAM WATCHER	Assess major in-stream and riparian problems	Visual Survey and Site Conditions Survey	• 3 hr training on safety, trash collection, and performing Visual and Site Conditions Survey • Section should be visited 4 times a year (twice for trash removal, twice for trash removal and Visual and Site Conditions Survey) ➢ 2 hrs/section visit for trash removal (quarterly) ➢ 2 hr/section visit for initial Visual and Site Conditions Survey (once) ➢ 1 hr/section visit for follow-up Visual and Site Conditions Survey (biannual) • **Total 13 - 14 hrs/year**
Stream Monitor-BUG COLLECTOR	Collecting aquatic insects at fixed stations	Stream Waders or similar	• 4 hr training on Stream Waders or similar protocol and trash collection • Section should be visited 1 time a year (once for bug sample and trash removal) ➢ 2 hrs/section visit for trash removal (annual) ➢ 1 hr/section for bug sample (annual) • **Minimum 7 hrs/year depending on number of sampling stations**
Stream Monitor-SNAPSHOT SAMPLER	Collecting water samples at fixed stations	Grab sample	• 1.5 hr training on sampling protocol and trash collection • Station should be visited 1 time a year ➢ 0.5 hrs/section for sample collection ➢ 2 hrs/section visit for trash removal (optional) ➢ 1 hr/section visit for Visual Survey (optional) • **Minimum 2 - 5 hrs/year depending on number of stations and sampling frequency**

* All volunteers should walk their section at least 4 times a year regardless of adoption level. Time spent will depend on the amount of trash, # of people, and level of impact. Time estimates provided are for the first year. Note that while # of field visits remains constant over time, the time spent will decline significantly after first cleanup or assessment activity.

Table 3.3: Time Estimates for Each Activity*		
Action Performed	**Training**	**Field**
Trash removal	1 hr	2 hr/visit
Visual Survey	2 hr	1 hr/visit
Visual Survey and Site Conditions Survey	3 hr	2 hr/initial visit 1 hr/follow-up
Bug Sampling	4 hr	1 hr/station
Water Quality Sampling	0.5 hr	30 min/sample
* Actual field times will vary based on section length, quality of conditions, number of volunteers, and number of times task has been performed previously.		

Table 3.4 shows hypothetical volunteer schedules for various levels of adoption.

Table 3.4: Hypothetical Volunteer Schedules

Action Level	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
CLEANER		T			T			T			T			T			T			T			T	
WALKER		T	ts		T,A			T			T,A			T			T,fA			T			T,fA	
WATCHER		T	ts		T,A			T			T,A			T			T,fA			T			T,fA	
Monitor-SNAPSHOT SAMPLER		ts	A,T			A,T			A,T			A,T			A,T			A,T			A,T			A,T
Monitor-BUG COLLECTOR		ts	A,T												A,T									

T = Trash Cleanup; ts = Training Session; A = Assessment or Sampling; fA = Follow-Up Assessment

Volunteers should register with the watershed organization by providing name(s) of adopters, address, level of action, and stream section(s) of interest. They must commit to attend training sessions and perform field collection protocols.

The watershed group has various coordination and organizational responsibilities for each adoption level. Table 3.5 summarizes supplies the watershed association must provide volunteers and Table 3.6 summarizes the tasks the watershed association must complete for each level of adoption.

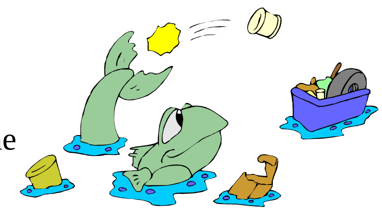
Table 3.5: Supplies for each Adoption Level[1]	
STREAM CLEANER	
• Heavy duty trash bags • Gloves (pick up sticks optional) • Waders (optional) • First aid kit	• Trash Collection Report postcards • Informational letter that describes the program and has contact information for the watershed association
STREAM WALKER	
• Visual Survey forms (always take an extra copy) • Trash Collection Report postcards • Informational letter that describes the program and has contact information for the watershed association • Survey guide with emergency contact information	• Heavy duty trash bags • Gloves • Waders (optional) • Tape measure[2] • First aid kit • Cell phone (optional) • Camera (optional)[2]
STREAM WATCHER	
• Visual Survey and Site Conditions Survey forms (always take extra copies) • Trash Collection Report postcards • Survey guide with emergency contact information • Informational letter that describes the program and has contact information for the watershed association	• Heavy duty trash bags • Gloves • Waders (optional) • GPS unit[2] • Camera[2] • Tape measure[2] • First aid kit • Cell phone (optional)
Stream Monitor-BUG COLLECTOR	
• Collection Forms • Collection guide with emergency contact information • Waders (optional) • D-net • Sample container	• One screened backed bucket, one regular bucket • Forceps • Ethyl alcohol • Permanent markers, pencil
Stream Monitor-SNAPSHOT SAMPLER	
• Sample bottles • Cooler with ice • Permanent markers • Zip lock bags • Latex gloves • Collection forms and Visual Survey forms (always take an extra copy) • Informational letter that describes the program and has contact information for the watershed association	• Sampling protocol and Visual Survey guide with emergency contact information • Heavy duty trash bags • Gloves • Waders (optional) • Tape measure[2] • First aid kit • Cell phone (optional) • Camera (optional)[2]

1. Each adoption level should include waders and first aid kit among supplies. Also, all volunteers should be provided with emergency and coordination contact information.
2. GPS units, cameras, tape measures, and other field equipment may be kept in a central resource library and loaned to the Stream Watch volunteers on an as-needed basis.

Table 3.6: Summary of Watershed Organization Responsibilities for each Adoption Level[1]
STREAM CLEANER
• Compile list of contact numbers for reporting hazardous materials, trash pickup, and coordinating with watershed organization. • Plan, schedule, and conduct training events. • Print and distribute self addressed, stamped return postcards that volunteers will return after each stream visit (Figure 3.4). • Develop a plan for compiling and reporting trash collection data. • Coordinate larger track pickup events. • Follow up reporting of hazardous materials. • Develop a plan to track volunteer participation over time. • Provide educational materials on backyard stream management.
STREAM WALKER
• Compile a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies. • Plan, schedule, and conduct training events. • Print and distribute the STREAM WALKER Visual Survey forms. • Develop a plan for compiling and reporting collection data. • Perform quality control on Visual Survey data (comparison of first two collections). • Develop a "restoration triage" system – a method for reporting information collection to Baltimore County and for prioritizing potential restoration projects. • Devise a system to transfer updated data to County. • Provide copies of completed Visual Survey forms to volunteers so they can perform follow-up surveys. • Develop a plan to track volunteer participation over time. • Provide educational materials on backyard stream management.
STREAM WATCHER
• Compile a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies. • Create mini orthophoto maps for adoption sections (note – this may not be a realistic goal for watershed organizations with small staffs with little GIS expertise). • Print and distribute the assessment forms. • Plan, schedule, and conduct training events. • Develop a system for distributing GPS units and cameras • Perform quality control on assessment data (comparison of first two collections). • Develop a plan for compiling and reporting collection data • Develop a "restoration triage" system – a method for reporting information collection to Baltimore County and for prioritizing potential restoration projects. • Devise a system to transfer updated data to County • Provide copies of completed assessment forms to volunteers so they can perform follow-up surveys • Begin restoration opportunity identification and implementation • Develop a plan to track volunteer participation over time. • Provide educational materials on backyard stream management.

Table 3.6: Summary of Watershed Organization Responsibilities for each Adoption Level[1] (cont.)
Stream Monitor-BUG COLLECTOR
• Coordinate with MD DNR or DEPRM on volunteer training and sampling protocol by December of the year prior to sampling • Plan the sampling between March 1st and April 30th • Determine appropriate sites for sampling with DEPRM and MD DNR • Coordinate these sites with the water quality sampling locations • Physically mark sampling sites; use a GPS to establish sampling locations • Ensure permission to sample sites on private property • Establish a protocol for labeling and preserving samples • Distribute equipment to and collect samples from volunteers • Deliver samples to MD DNR or to DEPRM for analysis • Report trends • Develop a plan to track volunteer participation over time. • Distribute backyard stream management educational materials
Stream Monitor-SNAPSHOT SAMPLER
• Compiling a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies. • Planning, scheduling, and conducting training events. • Coordinating with DEPRM on locations of the sampling sites. • Creating maps with specific locations of the sampling sites. • Physically marking sampling sites in the field, GPS coordinates of the sampling sites. • Obtaining sample bottles from laboratory conducting analysis. • Figuring out how volunteers can pick up clean bottles (possibly pre-labeled) and small coolers with ice, and then how they can drop samples off. • Developing flash cards as written reminders of sampling protocol. • Printing and distributing the Sample Collection forms and the Visual Survey forms and/or Trash Collection Report postcards. • Coordinating with a lab for delivery and analysis of appropriate parameters. • Ensure permission to sample sites on private property. • Completing chain of custody forms for the samples collected. • Reporting trends. • Developing a plan to track volunteer participation over time. • Providing educational materials on backyard stream management.
1. Processing data collected and tracking volunteer participation occur at all adoption levels

Level 1: Stream Cleaner



Description

This is the most basic level of adoption and requires the STREAM CLEANER to remove trash from adopted section(s) on a quarterly basis. In areas with extensive trash or large pieces, the STREAM CLEANER may need to coordinate with the watershed group or friends and neighbors to organize a trash removal work event. Hazardous materials, chemical drums, or illegal dumping activity should be reported to the proper local authorities.

Protocol for Watershed Group

In addition to purchasing and distributing supplies, the watershed group will need to:

- Compile list of contact numbers for reporting hazardous materials, trash pickup, and coordinating with watershed organization.
- Plan, schedule, and conduct training events.
- Print and distribute self addressed, stamped return postcards that volunteers will return after each stream visit (Figure 3.4).
- Develop a plan for compiling and reporting trash collection data.
- Coordinate larger track pickup events.
- Follow up reporting of hazardous materials.
- Develop a plan to track volunteer participation over time.
- Provide educational materials on backyard stream management.

Protocol for Volunteers

While no formal protocol is required for in-stream and riparian/floodplain area cleanup, the following guidelines should be followed:

- Scout the area to see how much trash is there and where it is located. If you have a lot of trash, you may need to get additional help for your section. Inform your watershed organization and coordinate a large or small-scale stream cleanup workday. You may be able to hold your clean up in conjunction with broader clean up efforts or utilize local school groups, scouts, or other civic organizations. If you have large or hazardous material, you will have to contact the local authorities.
- If you have deep or fast flowing section, you may want to encourage kids to work in safer stream sections.
- Think about where to deposit bags of trash prior to collection. Depending on how much trash you collect you can either put the bags out for collection on your regular trash day or you may need to call and schedule a pickup from County maintenance crews. Proper contact information will be provided by the local watershed organization.
- Decide ahead of time if you are going to recycle portions of trash collected.
- At sites with extensive trash, you may want to take before and after pictures to document your work.
- If hazardous materials or chemical drums present, report immediately to proper local authorities. Contact information will be provided.

- Once trash collection is complete, you will need to complete and return a self-addressed, stamped postcard to send to the watershed organization (Figure 3.4).
- If source(s) of trash are obvious or recurring, note on Trash Collection Report postcard so it can be addressed.

Supplies

Supplies needed will be provided by the local watershed organization upon request and include:

- Heavy duty trash bags
- Gloves (pick up sticks optional)
- Waders (optional)
- First aid kit
- Trash Collection Report postcards
- Informational letter that describes the program and has contact information for the watershed association

Volunteer Time Commitment

In order to be a STREAM CLEANER, you should be willing to visit your stream section a minimum of four times a year. Plan to participate in a 1-hour training session on safety, pick-up scheduling, and trash collection and reporting procedures. Sections should be cleaned once every season. Volunteers should spend about 2 hours for each cleanup depending on amount of trash and number of people helping.

PLACE
23¢
STAMP
HERE

Jones Falls Watershed Association
Stream Watch
3503 N. Charles Street
Baltimore, MD 21218

Name/Group:______________________ **Adopted Stream:**______________________

Date:______________ **# of Volunteers:**____________ **Time Spent:**________hrs

 # Bags Collected:__________ **Trash Bag Size:**________ **% Recycled:**____%

Type of Trash: (circle all that apply) Plastic Construction Appliances Yard Waste Automotive Metal Tires Paper/Wrappers Other:____________________

Trash Source: (circle all that apply) Unknown Flooding Illegal Dumping Local Outfall Other:____

Trash Location: (circle all that apply) In Stream Riparian **If Riparian:** Left Bank Right Bank (facing downstream)

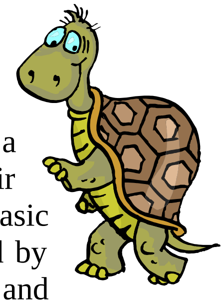
Emergency Reported: No / Yes

If yes, why: Outfall failure Leaking sewer Hazardous material

Comments/Requests:

Figure 3.4: Trash Collection Report Postcard

Level 2: Stream Walker



Description

In addition to performing the duties of the STREAM CLEANER, a STREAM WALKER will also complete a short Visual Survey of their adoptive section(s). This simple assessment is designed to collect basic information on existing in-stream and riparian conditions and will be used by the watershed group and Baltimore County to identify major concerns and assess habitat. Additionally, STREAM WALKERS should take responsibility for reporting any maintenance issues, utility leaks and illicit discharges observed to the proper local authorities.

Protocol for Watershed Group

In addition to purchasing and distributing supplies, the watershed group will need to:

- Compile a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies.
- Plan, schedule, and conduct training events.
- Print and distribute the Visual Survey forms.
- Develop a plan for compiling and reporting collection data.
- Perform quality control on Visual Survey data (comparison of first two collections).
- Develop a "restoration triage" system – a method for reporting information collection to Baltimore County and for prioritizing potential restoration projects.
- Devise a system to transfer updated data to County.
- Provide copies of completed Visual Survey forms to volunteers so they can perform follow-up surveys.
- Develop a plan to track volunteer participation over time.
- Provide educational materials on backyard stream management.

Protocol for Volunteers

The protocol for the STREAM WALKER is more detailed than that of the STREAM CLEANER and is based on accurate completion of the Visual Survey form. Questions on this form are based on the EPA's Rapid Bioassessment Protocol Habitat Assessment (RBP), Georgia Adopt a Stream Visual Survey, and CWP's Unified Stream Assessment (USA). This form and a detailed description are located in Appendix A.

For the first year, the Visual Survey form should be completed twice for quality assurance purposes. After that, a quick visual check to record any changes in condition should be performed during your biannual visit. Depending upon how frequently you visit your stream section, you may want to complete the survey during one of your trash collection days (or, at least four times per year). Basic steps to completing the survey are outlined as follows:

- Before getting wet, you should review the questions on the Visual Survey form.
- If possible, you should walk the entire section looking for the visual clues the survey form will prompt you for PRIOR to actually completing the survey. We recommend your first visit to the stream section be a reconnaissance/trash clean up visit, and the

next time you come out, perform the actual assessment.

- Remember, the Visual Survey is supposed to record the average conditions of your adoption section, so it is important to get the full picture before completing the form. We encourage you to walk the whole section first (one person in the stream, one person in the riparian area). Try walking downstream first, taking mental notes, and then complete the form as you return upstream.
- If you have more than one section, remember to complete one form per section. If in your section, you observe two very different conditions, then it may be worth splitting your section into two. Go ahead and complete a second form and submit your recommendation to the watershed organization.
- You will want to draw the locations of pipe outfalls, sewer crossings, impacted buffers, severely eroded banks, and other physical features observed on your reach map. Photos of major features may also be taken.
- You should immediately report major problems such as sewer overflows and hazardous materials to the proper local authorities. Non-emergency concerns, such as bank erosion, trash, outfall failures, or buffer planting opportunities should be reported to the watershed organization.
- Mail the completed form to your watershed group.

Once you have completed the first two Visual Surveys (YEAR 1), you will only need to report changes to these conditions or impairments in need of immediate care. If, during a visit, you find that it is not necessary to report any changes to the Visual Survey, complete and return a Trash Collection Report postcard (Figure 3.4) instead.

Supplies

Supplies will be provided by the watershed organization. Basic supplies include:

- Visual Survey forms (always take an extra copy)
- Trash Collection Report postcards
- Informational letter that describes the program and has contact information for the watershed association
- Survey guide with emergency contact information
- Heavy duty trash bags
- Gloves
- Waders (optional)
- Tape measure
- First aid kit
- Cell phone (optional)
- Camera (optional)

Time Commitment

In order to be a STREAM WALKER you should be willing to visit your stream section a minimum of four times a year. Plan to participate in a 2-hour training session on safety, trash collection procedures, and performing and reporting the Visual Survey. Sections should be cleared of trash once every season and the Visual Survey should be performed twice a year. We recommend combining tasks during two trips to your sections. Volunteers should expect to spend about 2 hours on trash cleanup and 1 hour on the Visual Survey, depending on amount of trash and number of people helping.

After completing the survey twice, you are only required to report observed changes to these conditions (i.e., removal of buffer, collapsed outfall, evidence of sewer overflow, etc.).

Level 3: Stream Watcher

Description

In addition to fulfilling the requirements of both the STREAM CLEANER and STREAM WALKER, the STREAM WATCHER collects specific information on impairments and potential restoration opportunities observed within their adoptive section. Locations are marked using a GPS unit and data sheets. The watershed group and Baltimore County will use this data to generate mapping information, and to identify "at risk" stream reaches and potential restoration opportunities. Additionally, STREAM WATCHERS should take responsibility for reporting any maintenance issues, utility leaks and illicit discharges observed to the proper local authorities.

Protocol for Watershed Group

In addition to purchasing supplies, the watershed group will need to:

- Compile a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies.
- Create mini orthophoto maps for adoption sections (*note – this may not be a realistic goal for watershed organizations with small staffs with little GIS expertise*).
- Print and distribute the assessment forms.
- Plan, schedule, and conduct training events.
- Develop a system for distributing GPS units and cameras
- Perform quality control on assessment data (comparison of first two collections).
- Develop a plan for compiling and reporting collection data
- Develop a "restoration triage" system – a method for reporting information collection to Baltimore County and for prioritizing potential restoration projects.
- Devise a system to transfer updated data to County
- Provide copies of completed assessment forms to volunteers so they can perform follow-up surveys
- Begin restoration opportunity identification and implementation
- Develop a plan to track volunteer participation over time.
- Provide educational materials on backyard stream management.

Protocol for Volunteers

The protocol for the STREAM WATCHER includes performing a Visual Survey (same as that of the STREAM WALKER) and a Site Conditions Survey, whereby additional attention is paid to individual stream impairments. The Stream Watch protocol is based on a modified version of CWP's Unified Stream Assessment (USA), the MD DNR Stream Corridor Assessment Method and the EPA Rapid Bioassessment.

The protocol is designed to collect the minimum amount of data necessary to characterize stream corridor habitat and identify restoration opportunities. The Site Conditions Survey was designed with the intention that trained watershed groups could perform the fieldwork. The Site Conditions Survey has separate forms for each of the various types of impairments you might encounter. These include:

- Stormwater outfalls (OT)
- Severe streambank erosion (ER)
- Impacted buffers (IB)
- Sewer leaks and other utility related impacts (UT)
- Trash and debris (TR)
- Structured stream crossings (SC)
- Channel modifications (CM)
- Other unusual features (MISC)

Figure 3.5 shows some of the typical impacts you might see in urban stream corridors. Field forms and a description of the Site Conditions Survey are located in Appendix B. For a more detailed description of the USA refer to Kitchell and Schueler, 2004.

Volunteers for each adoptive section should complete the Visual Survey twice, but need not complete the Site Conditions Survey more than once. However, a quick visual follow up survey will be performed to record any changes in condition during your next visit. Depending upon how frequently you visit your stream section, you may want to complete the survey during one of your trash collection days. Basic steps to completing the Visual Survey and Site Conditions Survey are outlined as follows:

- Before getting wet, you should thoroughly review the field sheets and how to operate the GPS unit.
- If possible, walk the entire section looking for the visual clues the survey form will ask you about PRIOR to actually completing the survey. We recommend your first visit to the stream section be a reconnaissance/trash clean up visit, and the next time you come out, perform the actual assessment.
- Remember, the STREAM WATCHER protocol has two components: a Visual Survey of your section and a Site Conditions Survey of individual stream impairments. The Visual Survey is supposed to record the average conditions of your adoption section, so it is important to get the full picture before completing the form. We encourage you to walk the whole section first (one person in the stream, one person in the riparian area). Try walking downstream first, taking mental notes, and then complete the form as you return upstream.
- If you have more than one section, remember to complete one Visual Survey form per section. If in your section, you observe two very different conditions, then it may be worth splitting your section in two. Go ahead and complete a second form and submit your recommendation to the watershed organization.
- While you will have to complete the Visual Survey, you may or may not need to complete the Site Conditions Survey forms depending on the condition of your section. For example, if you have no outfalls in your section, then you will not need to complete an outfall condition form. If you do have impaired sites within your section, then complete the appropriate form.
- At individual impact sites, a GPS reading should be recorded and a photo should be taken. Be sure to properly label your picture number and record the camera ID.
- You should immediately report major problems such as sewer overflows and hazardous materials to the proper local authorities. Non-emergency concerns, such as

bank erosion, trash, outfall failures, or buffer planting opportunities should be reported to the watershed organization.
- Return completed forms to your watershed group when you return the camera and GPS unit. The watershed group will provide you with a copy for your records. This copy will be important so you can track changes in your stream section over time.

After you have completed the Visual Survey and Site Conditions Survey for your adoption section(s), you will want to perform the assessment again in six months for quality control purposes. At that time, you only need to fill out the Visual Survey form. Individual Site Condition forms do not need to be resubmitted unless their information has substantially changed (i.e. the sewer pipe is now leaking…). From this point on, you will only need to report changes to these conditions or impairments in need of immediate care. If you find that it is not necessary to report any changes to the Visual Survey or Site Conditions Survey, complete and return a Trash Collection Report postcard (Figure 3.4) instead.

Supplies

Supplies will be provided by the watershed organization. Basic supplies include:

- Visual Survey and Site Conditions Survey forms (always take extra copies)
- Trash Collection Report postcards
- Survey guide with emergency contact information
- Informational letter that describes the program and has contact information for the watershed association
- Heavy duty trash bags
- Gloves
- Waders (optional)
- GPS unit
- Camera
- Tape measure
- First aid kit
- Cell phone (optional)

Time Commitment

In order to be a STREAM WATCHER you should be willing to visit your stream section a minimum of 4 times a year. Plan to participate in a 3-hour training session on safety, trash collection procedures, and performing and reporting the Visual Survey and Site Conditions Survey. Sections should be cleared of trash once every season and the Visual Survey should be performed twice a year. We recommend combining tasks during two trips to your sections. Volunteers should expect to spend about 2 hours on trash cleanup and 2 hours on the Visual and Site Conditions Surveys (first time only), depending on amount of trash and number of people helping. The second time you complete the Visual Survey and Site Conditions Survey, it should only take about 1 hour.

After completing the Visual Survey and Site Conditions Survey twice, you are only required to report observed changes to these conditions (i.e., removal of forested buffer, collapsed outfall, evidence of sewer overflow, etc).

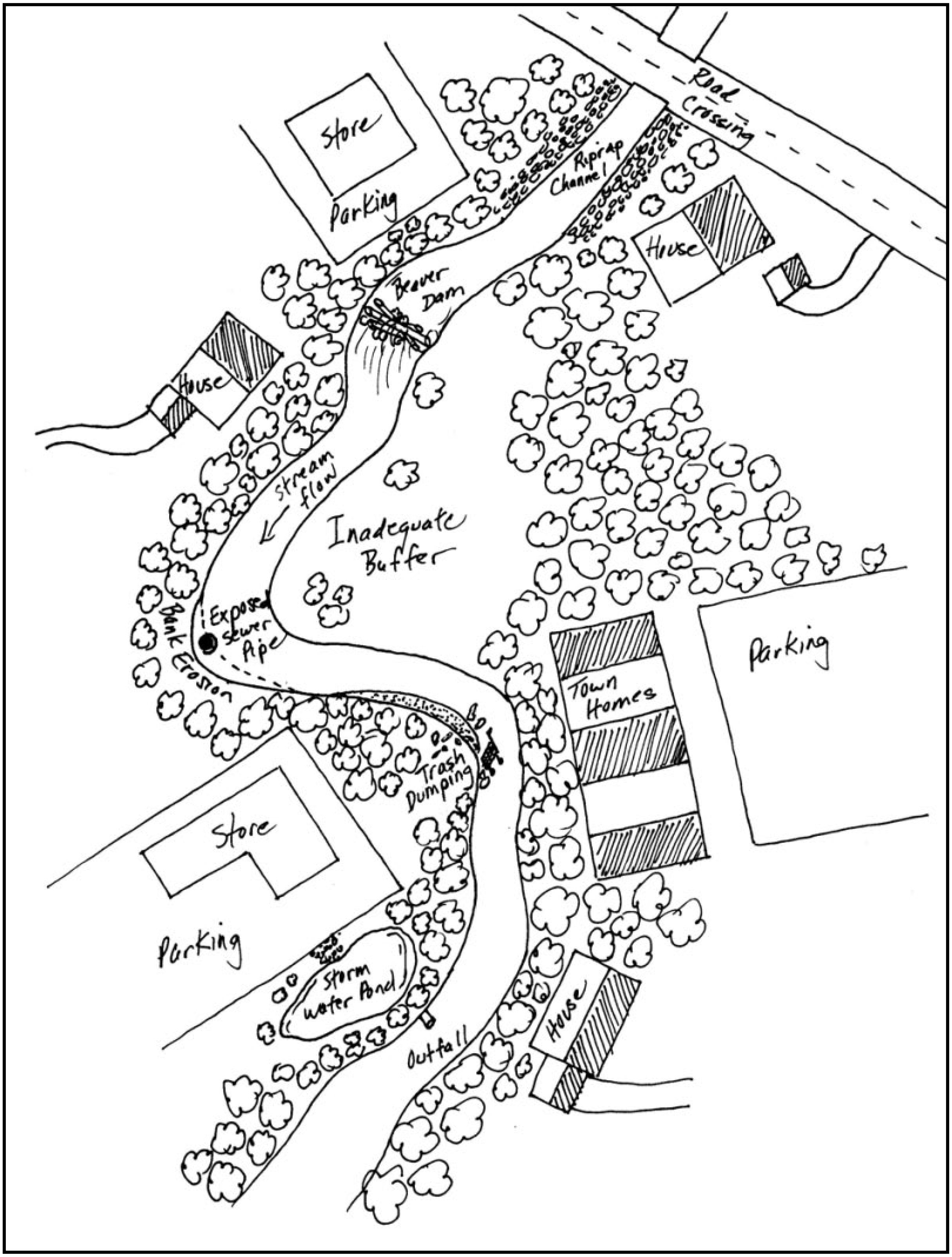
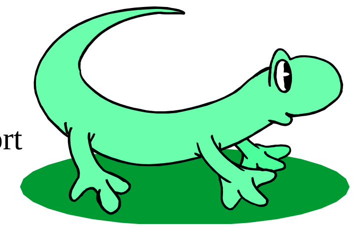


Figure 3.5: Typical Impacts Assessed During the Visual Survey and Site Conditions Survey

Level 4: Stream Monitor – Snapshot Sampler



Description

Snapshot or "synoptic" monitoring consists of a coordinated effort where water quality samples are collected throughout the watershed over several hours once (or twice) a year. The results represent a "snapshot" in time of the water quality conditions in the watershed. Snapshot monitoring activities may serve as an invaluable education tool when involving residents and volunteers in monitoring the health of their local streams. In addition, the data can be used to better understand watershed conditions and to help identify areas that may be a source of water quality problems.

At a minimum, one sample should be collected in each of the subwatersheds and on the mainstem. Synoptic surveys can also be used on a subwatershed basis to help track down pollutant sources in an area with a known problem. Sampling sites should also overlap with biological and physical monitoring sites to improve resolution gained with sampling multiple parameters (i.e., water quality, habitat, and macroinvertebrates).

There are a number of water quality parameters that may be of interest to watershed groups leading Stream Watch programs. Parameters sampled will ultimately depend on the interest of the watershed group, its volunteers and the County. A list of recommended parameters is listed in Table 3.7, all of which are listed in Burton and Pitt, 2002 as important water quality parameters in aquatic ecosystems. In subwatersheds with a large proportion of industrial or commercial land uses, water quality or sediment samples for parameters such as metals and petroleum compounds could be considered (Burton and Pitt, 2002).

Table 3.7: Recommended Parameters for Synoptic Surveys

Parameter	Reason	Recommended Analysis
Total Kjeldhal Nitrogen (TKN)		Lab
Nitrite & Nitrate		Lab
Phosphorus (Total P)	Eutrophication causing nutrient (tends to move attached to sediment)	Lab
Ammonia (NH4)	Form of nitrogen (can be toxic) that can be an indicator of sewage contamination	Lab
E. coli	Bacteria species that can cause illness in humans	Lab
Temperature	Important parameter to both fish and macroinvertebrates (trout and stoneflies are especially sensitive to temperature) (ID of summer high temperatures can be helpful in determining source areas of thermal impacts – temperature reading should be made in the afternoon in close time proximity for consistency or in-situ *probes may be used)	Field Thermometer
* In-situ probes may be available to borrow through County or State resource agencies		

Table 3.8: Optional Parameters for Synoptic Sampling	
Parameter	**Recommended Analysis**
Dissolved Oxygen	Probe
pH	Probe
Conductivity	Probe

Appendix C provides some guidance on interpreting water quality monitoring results.

In addition to sampling, the SNAPSHOT SAMPLERS should also complete a Visual Survey of their section.

Protocol for Watershed Group

The role of the watershed group is to have all the preparations in place for the volunteers to perform the sampling. In addition to providing supplies, the watershed group is responsible for:

- Compiling a list of contact numbers for reporting hazardous materials, sewer overflows, or other emergencies.
- Planning, scheduling, and conducting training events.
- Coordinating with DEPRM on locations of the sampling sites.
- Creating maps with specific locations of the sampling sites.
- Physically marking sampling sites in the field, GPS coordinates of the sampling sites.
- Obtaining sample bottles from laboratory conducting analysis.
- Figuring out how volunteers can pick up clean bottles (possibly pre-labeled) and small coolers with ice, and then how they can drop samples off.
- Developing flash cards as written reminders of sampling protocol.
- Printing and distributing the Sample Collection forms and the Visual Survey forms.
- Coordinating with a lab for delivery and analysis of appropriate parameters.
- Ensure permission to sample sites on private property.
- Completing chain of custody forms for the samples collected.
- Reporting trends.
- Developing a plan to track volunteer participation over time.
- Providing educational materials on backyard stream management.

Protocol for Volunteers

The SNAPSHOT SAMPLER is responsible for sampling 5-10 sites once or twice a year. SNAPSHOT SAMPLERs may be able to monitor a few sites more frequently (monthly or bimonthly) if the watershed group has that ability and equipment. Duplicate samples may be required, and ideally, a lab should analyze the samples collected in order to ensure consistency and scientific credibility. At a minimum 5-10% of the samples collected should be analyzed by a lab for quality assurance.

The SNAPSHOT SAMPLER protocol may be varied, in coordination with DEPRM, depending on the interests of the watershed group and the volunteers. For instance, the Jones

Falls Snapshot occurs once a year in July at 23 pre-selected sites throughout the watershed. Volunteers may choose to sample sites in addition to these 23 sites. All sampling occurs on the same morning and all samples are analyzed by EnviroChem Laboratories. Volunteers help collect samples and also conduct a Visual Survey of their selected stream.

Sampling should be performed during baseflow conditions defined as three consecutive days without significant rainfall (less than 0.5 in cumulative). Data from BWI Airport is available at http://www.erh.noaa.gov/er/lwx/climate.htm. Two types of samples will be collected:

1. Water quality samples should be collected in 500ml Nalgene bottles. Sample bottles and caps should be rinsed three times with water in the middle of the stream and then filled just below the shoulder of the bottle. Samples can be collected by wading the stream or by dropping a bucket on a rope and rinsing the bucket three times before collecting the sample.
2. Bacteria sample bottles should be pre-sealed and therefore not rinsed – after filling the bottle to the top line it should be placed in a zip lock bag.

A few simple rules should be followed when sampling and handling samples.

- Exercise caution to ensure that you do not disturb the area upstream of where you are sampling – stand downstream of where you are sampling.
- Latex gloves should be worn when collecting samples.
- All samples should be placed on ice in a cooler and delivered to the watershed group coordinator the same day.
- Each sample bottle should be clearly marked using a permanent marker with the station ID, date, and initials of individuals who performed the collection.
- Along with each sample, basic physical information such as the date, time, team members and weather conditions should be recorded (in pencil) on a sampling collection form (Figure 3.6).
- The completed collection form should be placed inside the Ziploc bag with the sample and returned to the watershed organization.
- Collect the sample BEFORE completing the Visual Survey or picking up trash.

COLLECTION FORM *(check one)* ☐ **Water Quality** ☐ **Macroinvertebrate**
(to be included with each sample)

Watershed Group Name: Jones Falls Watershed Association

Station ID: ________ -- ________ -- ________ **Date:** ____/____/____

Stream Monitor Name(s): ____________________

Time: ______:______ am/pm **Photo Documentation:** ☐ yes ☐ no

Rain in Last 24 Hours:
☐ heavy rain ☐ steady rain
☐ intermittent rain ☐ none

Present Conditions:
☐ heavy rain ☐ steady rain ☐ intermittent rain
☐ overcast ☐ partly cloudy ☐ clear/sunny

Figure 3.6: Example Sample Collection Form

Station ID number: The station IDs will be set prior to the sampling days by DEPRM and the watershed organization hosting the Stream Watch Program.

Stream Monitor Name(s): Please list all individuals who assisted in collecting the sample and completing the forms. If there are too many to list, list several, beginning with the section registrant and all QA/QC-certified individuals, and please include the total number of investigators.

Date and Time: The date and time is important for proper tracking of results.

Photo documentation: Check yes or no. Photo documentation is important to provide visual locator of sampling station. Photos of each step of the sampling procedure can also be useful for educational and outreach purposes.

Rain and Current Conditions: Please describe rain patterns over the previous 24 hours and indicate current conditions.

Supplies

Estimated supply costs are summarized in Table 3.9. Supplies will be made available by the watershed organization. Volunteers will need:

- Sample bottles
- Cooler with ice
- Permanent markers
- Zip lock bags
- Latex gloves
- Collection forms and Visual Survey forms (always take an extra copy)
- Informational letter that describes the program and has contact information for the watershed association
- Sampling protocol and Visual Survey guide with emergency contact information
- Heavy duty trash bags
- Gloves
- Waders (optional)
- Tape measure
- First aid kit
- Cell phone (optional)
- Camera (optional)

Table 3.9: Cost Estimates for Monitoring Supplies

Supplies	Cost Estimate
Sample bottles – 500 ml Nalgene (125)	$170 (may be available from the lab)
Bacteria sample bottles	Generally available from the lab as part of the sample cost
Labeling tape, permanent markers, Ziploc bags	$40
Small cooler	$75 (for 5)
Total	$285

Time Commitment

For the SNAPSHOT SAMPLER, the time commitment for water quality sampling will vary depending on how the watershed organization schedules training and sampling activities. Volunteers should expect to spend 1.5 hours in training on safety, trash collection procedures, and water quality sampling protocol. Plan on spending at least 2 hours at each station cleaning trash and an additional 30 minutes collecting your sample.

Level 5: Stream Monitor – Bug Collector

Description

Macroinvertebrate monitoring consists of sampling for benthic insects that live at least part of their life in streams. They are used as an indicator of stream health (Barbour, 1999). Monitoring for macroinvertebrates involves the use of a D-net to sample habitats of stream insects including riffles, submerged vegetation, snags and undercut banks (Figure 3.7).

Protocol

Watershed groups may link the macroinvertebrate monitoring program to the Stream Waders Program administered by the MD DNR (Boward, 2002). Alternatively, groups may coordinate with DEPRM to conduct this activity. Volunteers will receive training and will collect samples. Samples will be analyzed by either DNR or DEPRM. Volunteers interested in learning or refining their macroinvertebrate ID skills may collect duplicate samples and lab space may be available for analysis at DEPRM.

If linking this program to the Stream Waders program, coordination with MD DNR should occur by December of year prior to sampling. More detailed information on the Stream Waders program is available at: http://www.dnr.state.md.us/streams/mbss/mbss_volun.html.

When working with the Stream Waders Program, a smaller number of sites will be sampled each year (less than 15) and then every third year or so sample a greater number of sites to fit in with the Stream Waders sampling regime. Results will subsequently be posted on http://mddnr.chesapeakebay.net/mbss/streamwaders.cfm.

The watershed group will need to:

- Coordinate with MD DNR or DEPRM on volunteer training and sampling protocol by December of the year prior to sampling.
- Plan the sampling between March 1st and April 30th.
- Determine appropriate sites for sampling with DEPRM and MD DNR.
- Coordinate these sites with the water quality sampling locations.
- Physically mark sampling sites; use a GPS to establish sampling locations.
- Ensure permission to sample sites on private property.
- Establish a protocol for labeling and preserving samples.

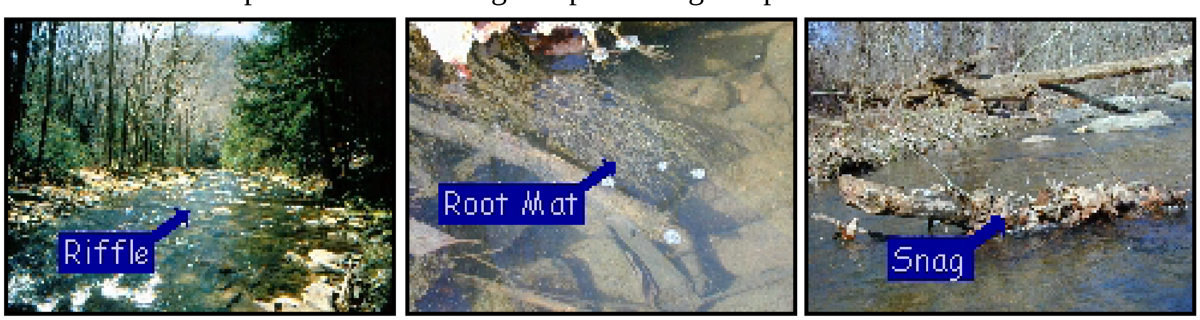


Figure 3.7: Some of the Habitats to be Sampled (MD DNR, 2003)

- Distribute equipment to and collect samples from volunteers.
- Deliver samples to MD DNR or to DEPRM for analysis
- Report trends
- Develop a plan to track volunteer participation over time.
- Distribute backyard stream management educational materials

Volunteers will need to:

- Attend a training seminar. When coordinating with the Stream Waders program, volunteers should attend a seminar led by MD DNR in February of the sampling year (at least one person from each team needs to have attended the Stream Waders training by MD DNR in February).
- Collect samples according to the established protocol .
- Return samples to the watershed group (with attached Collection Form, see Figure 3.6).

Appendix C provides some guidance on interpreting macroinvertebrate sampling results.

Supplies

Table 3.10 summarizes the costs for the various supplies needed for sampling aquatic insects. Equipment for volunteers will be made available through the watershed organization. Volunteers will need:

- Collection forms
- Collection guide with emergency contact information
- Waders (optional)
- D-net
- Sample container
- One screened backed bucket, one regular bucket
- Forceps
- Ethyl alcohol
- Permanent markers, pencil

Table 3.10: Supplies for a Benthic Macroinvertebrate Biological Monitoring Program

Item	Quantity	Total Cost	Source
D-nets	3	$120	Ward’s Natural Science, 2003
Ethyl alcohol	20 Liters	$85	Fisher Scientific, 2003
Containers 16 oz with screw lids	24	$85	Fisher Scientific, 2003
Waders	6	$240	Cabela’s, 2003
Screened wash bucket	3	$300	Ben Meadows, 2003
Forceps – Wide Point	5	$25	Ben Meadows, 2003
Total		$855	
Assumptions include: 3 teams, 3 years, 8 sites per year (Ethyl alcohol and containers would be the only repeating costs)			

Time Commitment

For the BUG COLLECTOR, the time commitment for aquatic insect sampling will vary depending on how the watershed organization schedules training and sampling activities. Volunteers should expect to spend up to 4 hours in training on safety, trash collection procedures, and macroinvertebrate sampling protocol. Plan on spending at least 2 hours at each station cleaning trash and an additional hour collecting your bug sample.

3.3 Volunteer Management

Volunteer Recruitment and Retention

Volunteer recruitment is the process of identifying groups and individuals who are likely to be interested in your volunteer opportunities and asking them to participate.

According to a 2001 survey, 44% of American adults volunteer, and of these, 66% volunteer monthly or more often (Independent Sector, 2001). The same survey found that 71% of adults reported that they volunteered simply because they were asked to (Independent Sector, 2001). This is good news for stream watch programs because seeking out a substantial volunteer base may seem like a daunting task.

Three basic steps to recruiting volunteers for your Stream Watch program are described below:

Step 1: Design your recruitment strategy
Step 2: Develop your outreach materials
Step 3: Recruit volunteers

Step 1: Design Your Recruitment Strategy

Developing a recruitment strategy involves identifying the target audience and the recruitment techniques and outreach materials that will be used. Recruitment methods may include: placing calls to specific groups to solicit volunteers, sending information to a targeted list of potential volunteers, distributing flyers door-to-door, making a presentation at a homeowners association meeting, posting an announcement in a newspaper, newsletter or on a website, making a public service announcement or handing out brochures at a neighborhood event.

Since the Stream Watch program allows for the participation of volunteers that have no prior experience, a broad-based outreach should be a part of your strategy. However, targeted outreach that focuses efforts on neighborhoods, institutions and organizations within your watershed is also a good place to start. You likely have members and volunteers who are already interested in or are participating in another aspect of you organization. Schools, universities, neighborhood associations, libraries, local businesses and churches may all be sources for volunteers. Universities may also be prime sources for volunteers since they often encourage students to volunteer and may have active environmental clubs. Neighborhood associations can be targeted based on their proximity to streams. Many neighborhood associations have regular meetings and may be pleased to offer members with a speaker for their meetings. Local scout troops and schools may also provide volunteers. There are also a number of organizations that serve as clearinghouses for volunteers. and it is always a good idea to post your project with these organizations.

Begin by making phone calls to key organizations to determine the appropriate contact. Be prepared to propose several alternative ways that the organization might be able to help. Are there locations where a flyer might be posted? Is permission required prior to posting? Are there environmental clubs or service clubs that might be interested in the Stream Watch program? Is there a newsletter that might include an announcement? Is there a scheduled meeting that could allow you a time to make an announcement? Do they have an email list that they could use to broadcast your volunteer opportunities? You may also want to consider distributing fliers door to door particularly if there are homes adjacent to a particular stream segment that you are interested in.

While targeted recruitment activities are likely to provide the most results, a broad-based approach can also be an effective recruitment tool. Several websites are available for you to register your volunteer opportunities and the local clearinghouse for volunteers may also provide you with interested volunteers. In the Baltimore area, Volunteer Central is the clearinghouse for volunteers and posts opportunities:

Volunteer Central
175 West Ostend Street, Suite 100
Baltimore, MD 21230
410.366.6030 or info@volunteercentral.net

You may also want to try out some of the national volunteer posting sites listed below.

- www.volunteermatch.org
- www.servenet.org
- www.planetvolunteer.com
- www.singlevolunteers.org

Other broad-based methods include issuing media releases and public service announcements to local print and broadcast media. Local newspapers, weeklies and publications available for free at your supermarket may have columns that feature volunteer opportunities.

You may also be interested in participating in local community festivals and special events. These festivals attract local residents and often provide economical opportunities for non-profit or community interest groups to participate. One-on-one communication with interested residents and an opportunity to provide the prospect with written material worked well with the Stream Watch pilot program. Search the internet or talk with your area's Chamber of Commerce or Office of Promotions to learn about festivals in your target area. Keep in mind that this outreach is staff intensive. Coordinating the event, ensuring that your materials are set up appropriately, and that your display is manned with knowledgeable staff are issues to keep in mind.

Step 2: Develop Your Outreach Materials

Outreach materials include flyers, brochures, presentations and other methods of communication. These materials are used to let potential volunteers know what volunteer opportunities are available, what will be expected of the volunteers, and to communicate the benefits of the Stream Watch program. The recruitment strategy you choose will determine what outreach materials will need to be developed. This manual provides many of the materials needed to define the volunteer positions available in a Stream Watch program. You will need to customize these documents and make them your own to ensure that you have addressed local issues and provided information that may be unique to your organization, program and watershed. Some general guidance is provided below on developing flyers, brochures, job descriptions, presentations and public service announcements for volunteer recruitment.

Flyers – Keep the information simple. You may want an eye-catching graphic or phrase to dominate the page. Be sure to include a short description of the program. Provide complete contact information with a name, address, phone number and web site where more information is available.

Brochures – A volunteer brochure is another successful tool that describes the volunteer opportunities available and the commitment required. This publication is usually more detailed than the flyer, but not as detailed as a job description for the position.

Job descriptions – A job description for each level of stream adoption enables you to describe in detail the requirements and expectations of the volunteer position. Clearly communicating the details of the volunteer opportunity allows potential volunteers to assess whether they are willing to tackle the task. It also allows you to define your expectations. Be sure to include the record keeping, reporting, and training that is expected for each task.

Presentations – A presentation should address the purpose of the Stream Watch program and the benefits of being a volunteer, as well as describe the volunteer opportunities available and commitment required. Presentations should be short (15-20 minutes) and include graphics to illustrate the points being made. Remember to allow time for questions when making a presentation and bring other outreach materials for potential volunteers to take home. With each presentation, remember to close with a request for volunteers. Emphasize the need for volunteers and the value that they offer.

Public Service Announcements – The Texas Commission on Volunteerism and Community Service (2003) recommends the format displayed in the box for developing a public service announcement. By writing out a suggested script in advance, radio stations can better assess whether they are interested in airing your message and can edit from a baseline of information as needed.

Example Public Service Announcement Format:

[Motivational appeal/goal] by [task] for [persons or goal] for [time required] in/at [general location]. [Reward]. Training provided. [Any requirements/qualifications]. For more information call [recruiter's name] at [organization/program] at [phone number].

Resulting Public Service Announcement:

Do you want to help protect the environment? Jones Falls Watershed Association is looking for individuals ready "to get their feet wet" for our adopt-a-stream program. We need your eyes on the stream in your neighborhood for 2 hours per month! Training provided. To learn more about this exciting opportunity, call JFWA at 410-261-3515.

Other materials you may wish to develop at this time include: waiver forms, scripted responses to calls and volunteer evaluation forms. These materials are not directly used to recruit volunteers but may be used in the volunteer management process.

Waivers – A release form is another communication tool that allows the volunteer to understand potential hazards of the position and accept responsibility for the job.

Scripted Responses - You may want to script out a response to calls from potential volunteers. This step will better ensure that their first contact with your organization is a positive one. Determine how you will respond to calls from volunteers and what the procedure is for dealing with new recruits so you will never have to ask a volunteer to call back at another time.

Volunteer Evaluation Forms - You may also want to establish a means for volunteers to assess the Stream Watch program and provide feedback on training, reporting forms, and procedures. A simple evaluation form should suffice for this purpose.

Step 3: Recruit Volunteers

The final step is to actually use your recruitment strategy and outreach materials to attract volunteers. This is when you actually make the phone calls, distribute the flyers, post announcements, give presentations or otherwise get the message out to the public that volunteer STREAM WATCHERS are needed.

Program Incentives and Recognition

Individuals choose to volunteer for many reasons. They may be interested in the outdoors or have a specific concern about their neighborhood stream. They may be seeking an opportunity to meet new people or learn more about the environment. Other reasons for volunteering may be to:

- Improve the quality of life in the community
- Have fun
- Take the first steps of environmental activism
- Acquire new skills
- Fulfill the service requirement of a club, school, church
- Complete community restitution requirements
- Make new friends and network
- Contribute to a cause that is important to them

No matter what the motivation, incentives and recognition may be needed to retain these volunteers.

Incentives are benefits that entice individuals to participate in an activity, while recognition involves thanking and acknowledging volunteers for past participation. It is easier to retain an existing volunteer than to recruit a new one. Therefore it is worthwhile to spend some time thinking through the incentives your organization can provide and opportunities to thank and recognize your volunteers. Many of the activities that serve as incentives for volunteers can also serve to recognize and thank volunteers.

Most volunteers claim that the recognition programs are not the reason they continue to volunteer. However, volunteers do want to be appreciated. There are many, many opportunities for citizens to volunteer and many other activities that require their time. It is important then, that volunteers feel appreciated, that their contribution is meaningful, and that the organization is making a positive impact on the community. With these goals in mind, it is not necessary to use expensive options to encourage, thank and recognize your volunteers. Some suggestions might include:

- Saying, writing or emailing a sincere thank you
- T-shirts
- Certificates
- Awards
- Gifts of photos of the watershed
- Volunteer of the month/year
- Most hours of service
- Number of years of service
- Outstanding service
- Gift Certificates to restaurants
- Drawings for prizes
- Recognition at regularly scheduled events
- A recognition event, dinner, lunch, or other gathering

Incentives and recognitions can be tied to a regular activity, such as recognition of a volunteer of the year, or may be earned, such as a gift certificate awarded after a certain number of hours of service. Events and gatherings can also be fun social events that add to a sense of camaraderie among the volunteer teams. Keep in mind that when an event is intended to thank volunteers, it should be organized by the staff. In other words, do not ask the volunteers to plan and organize their own recognition. If your staff is limited, it may be appropriate to ask individuals who are working on an event committee to plan a recognition activity for stream watch volunteers, but then be sure to develop a separate plan to recognize the volunteers on the event committee.

While any one of these incentives and recognition activities may have a place in your volunteer program, be sure to tailor your plans to your audience. If your volunteer base seems to be comprised of many college students, you might consider different recognition activities than you would for a program that primarily targets young families or neighboring residents.

Additional Incentives for Consideration

It is interesting to note that volunteers do not report that incentives and recognition motivate their volunteerism. Therefore it is helpful to examine elements of your program and volunteerism itself that serve to motivate their efforts. Volunteers may be interested in a higher level of training, access to lectures in related topics, and in opportunities to become more involved in shaping the program or taking on a greater leadership role in the program. Often volunteers see added responsibility as recognition for a job well done. Seeking their input in the program can also be a way to recognize the importance of the role they play and capitalize on their familiarity with the way the protocols are implemented in the field. Think through your options and opportunities. Often there may be an event planned outside your program that might serve as an incentive or recognition opportunity. If you are already planning a dinner, you might want to consider reserving a certain number of free tickets to individuals who have been volunteering for a certain length of time. If an organization is planning a seminar in a topic related to streams, you might consider asking whether some key volunteers would like to attend.

Regardless of the particular set of incentives and recognition activities you choose, try to customize them to your audience and request feedback from the volunteers.

Incentives for Stream Watch Volunteers

To get you started on your program, we have suggested some volunteer recognition incentive ideas for the Stream Watch program (Table 3.11). Your program may differ based on budget and your experience and feedback from your volunteers. Regardless of the particular set of incentives and recognition activities you choose, try to customize them to your audience and request feedback from the volunteers regarding your activities.

Each level of adoption for the Stream Watch program varies in the level of commitment required. The number of hours of commitment is an excellent criteria for establishing volunteer incentives. The STREAM WATCHER requires the "highest" level of commitment; therefore, this level needs the most incentives and recognition. Awards should also be outlined for individuals who commit to more than one stream watch level of adoption.

All Stream Watch volunteers should attend training sessions. The training will provide them with additional information in case they notice something in the field or have questions. This may also present an opportunity to increase their commitment to a higher level. STREAM CLEANERS can choose to skip the outside training segment when participants review assessment forms.

Table 3.11: Stream Watch Program Volunteer Incentives

Volunteer Level (s)	Incentive/Recognition
I. STREAM CLEANER	• Web listing/newsletter recognition • Certificate • Bumper Sticker • Thank you letter
II. STREAM WALKER	• Level I incentives • T-shirt
III. STREAM WATCHER	• Level I and II Incentive
IV. Monitor – SNAPSHOT SAMPLER	• Level I incentives
V. Monitor – BUG COLLECTOR	• Level I incentives
Additional Awards for Multiple Levels of Adoption: • Special Certificate (for all volunteers adopting at 2 or more levels) • Additional Mention in Annual Report (I or II and IV or V; I or II and IV and V) • Rain Gauge Gift (III and IV and/or V) • Volunteer Award (III and IV and V)	

3.4 Using the Tracking Database

The Stream Watch Tracking Database is a Microsoft Access database that will allow the user to track volunteer activity and stream conditions. The database is provided on the CD in Appendix D of this document. Data that can be tracked includes:

- Volunteer contact information
- Stream reach data
- Data returned by STREAM CLEANERS on Trash Collection report postcards
- Data returned by STREAM WALKERS or STREAM WATCHERS on Visual Survey forms
- Data returned by STREAM WATCHERS on Site Conditions Survey forms
- Stream Monitor – Snapshot Survey activities
- Stream Monitor – BUG COLLECTOR activities

When the database is opened a “switchboard” form appears (Figure 3.8) that gives the user several options. When using the database, the first set of data that should be entered is the Stream Reach information. This may be done at the time of adoption, or ahead of time if the user has identified specific reaches that may be adopted. The user assigns a unique identification code to each reach, per the naming convention described in Section 3.1 of this report. Additional pertinent information about the reach may be entered at this time, or added later as additional information on the reach is gathered.

When entering data into the other forms, the reach ID may be selected from a pull-down menu. The list of reaches supplied in the pull-down menus is supplied by the data entered on the Stream Reach Tracking form. As each reach is adopted, the user should enter the volunteer’s contact information. Data entry on the other forms is an on-going activity as volunteers conduct various monitoring activities.

Figure 3.8: Stream Watch Database "Switchboard" Form

Stream Reach Tracking

The Stream Reach Tracking form (Figure 3.9) allows the user to enter basic information about stream reaches that have been adopted as well as stream reaches up for adoption. Information that may be entered includes:

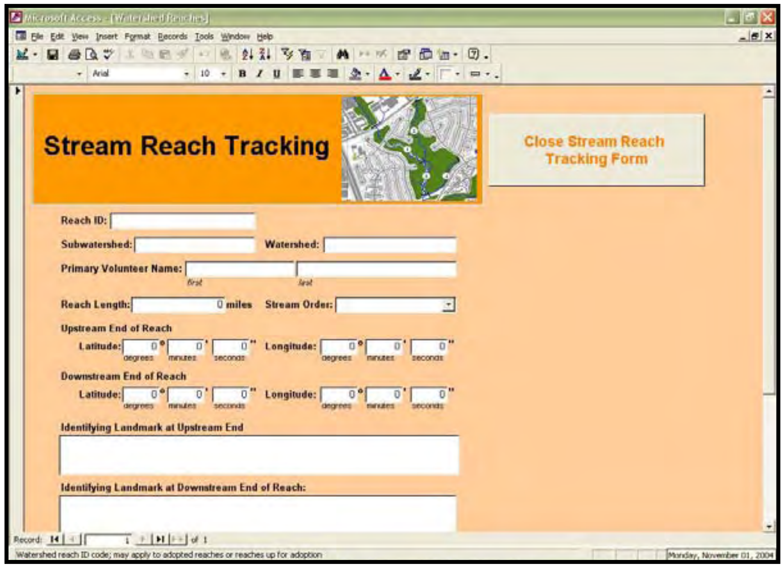


Figure 3.9: Stream Reach Tracking Form

- Reach ID: A unique identification code assigned to each reach by the user, per the naming convention described in Section 3.1 of this report.
- Subwatershed: The subwatershed the reach is located in (e.g., Towson Run Subwatershed).
- Watershed: The watershed the reach is located in (e.g., Jones Falls Watershed)
- Reach Length: The length of the reach in miles.
- Stream Order: The stream order of the reach (main stem, first order, second order, third order, fourth order, fifth order).
- Upstream End of Reach Latitude and Longitude: The latitude and longitude of the upstream end of the reach.
- Downstream End of Reach Latitude and Longitude: The latitude and longitude of the downstream end of the reach.
- Identifying Landmark at Upstream End of Reach: When latitude and longitude are not available, or in addition to, an identifying landmark at the upstream end of the reach, such as a road crossing or building.
- Identifying Landmark at Downstream End of Reach: When latitude and longitude are not available, or in addition to, an identifying landmark at the downstream end of the reach, such as a road crossing or building.
- Land Use: Land use adjacent to the reach.
- Nearest Road: Closest road to the reach.
- Reach Adoption Status: Whether or not the reach has been adopted and the level of adoption (STREAM CLEANER, STREAM WALKER, STREAM WATCHER, Stream Biological Monitor, Stream Water Quality Monitor).
- Volunteer Contact Information: Names of the person that has adopted the reach, or a primary contact if a group has adopted the reach.

Data entered into the Stream Reach Tracking form is saved in a “Watershed Reaches” table. As the pilot program is implemented, the data fields tracked in this table will be expanded to include additional information deemed necessary.

Volunteer Tracking

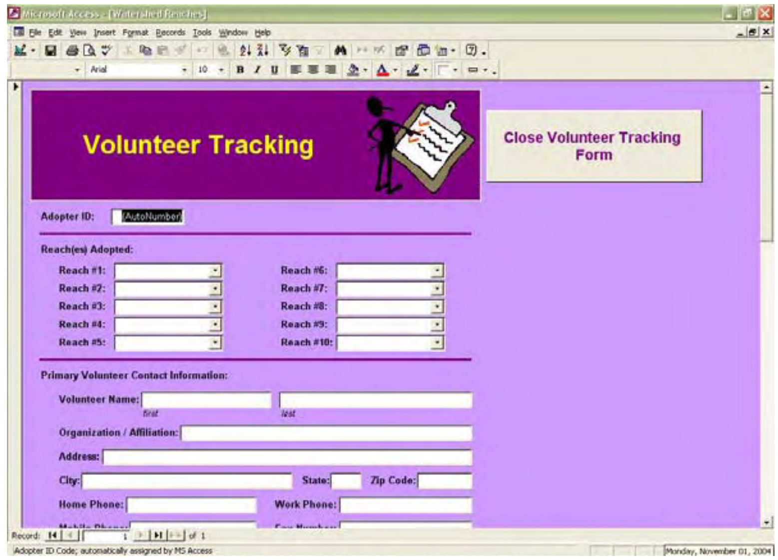


Figure 3.10: Volunteer Tracking Form

The Volunteer Tracking form (Figure 3.10) allows the user to enter contact information on the program volunteers and to identify the reach or reaches identified by each volunteer or group of volunteers.

- Adopter ID: Adopter ID Code; automatically assigned by Microsoft Access.
- Reach Adopted: Select up to 10 reaches adopted by the volunteer from a pull-down menu of Reach IDs.
- Volunteer Name: Names of up to four people that have adopted the reach, or a primary contact if a group has adopted the reach.
- Organization / Affiliation: Organization adopter is affiliated with (i.e., school, university, business, etc.)
- Address, Phone Number(s), Email: Contact information for the Adopter; if adopted by group, identify primary contact person
- Emergency Contact: Emergency contact information

Trash Collection Tracking

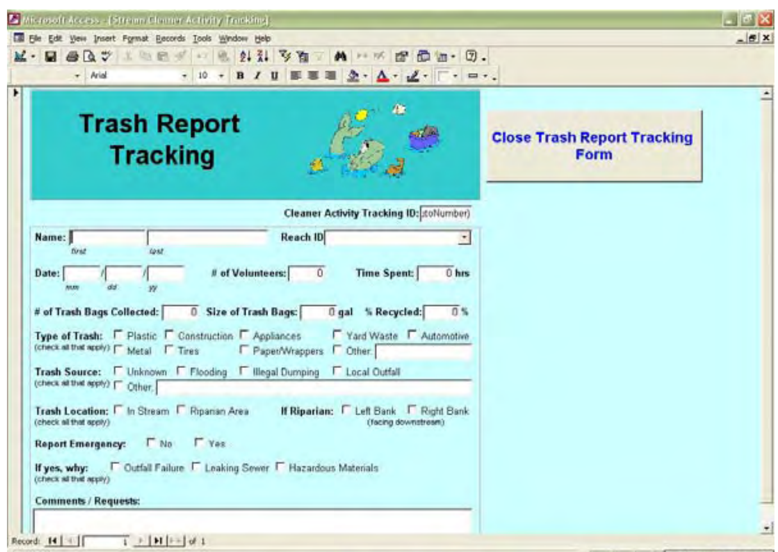


Figure 3.11: Trash Report Tracking Form

The Trash Report Tracking Form (Figure 3.11) allows the user to enter data submitted by volunteers on the Trash Collection Report postcards.

Visual Survey Tracking

The Visual Survey Tracking Form (Figure 3.12) allows the user to enter data submitted by STREAM WALKERS or STREAM WATCHERS on the Visual Survey form.

Site Condition Survey Tracking

The Site Conditions Survey forms allow the user to enter data submitted by Stream Watchers on any of the eight Site Conditions forms (Figure 3.13).

Stream Monitor – BUG COLLECTOR Activity Tracking

The user may enter information (Figure 3.14) presented in the Sample Collection Form (Figure 3.6).

Stream Monitor – Snapshot Survey Activity Tracking

The user may enter information (Figure 3.15) presented in the Sample Collection Form (Figure 3.6).

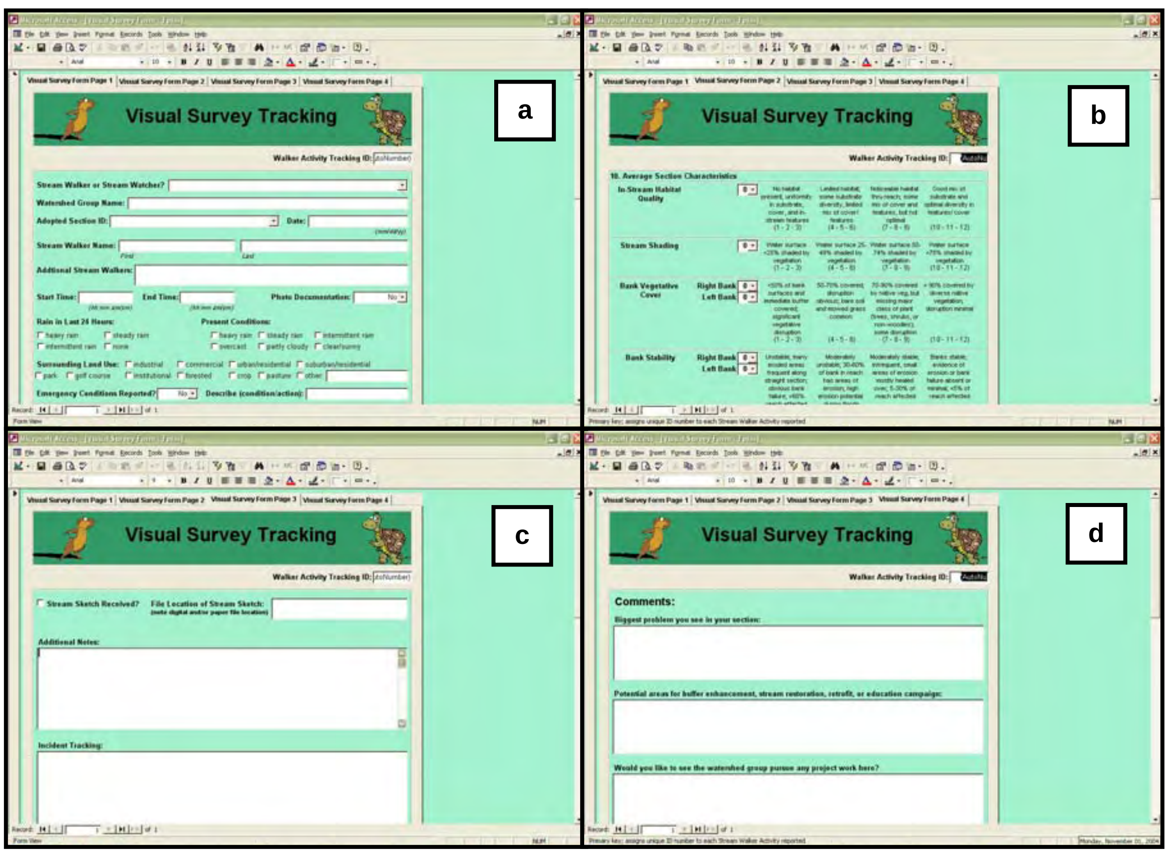


Figure 3.12: Visual Survey Tracking Form Page 1 (a), Page 2 (b), Page 3 (c), and Page 4 (d)

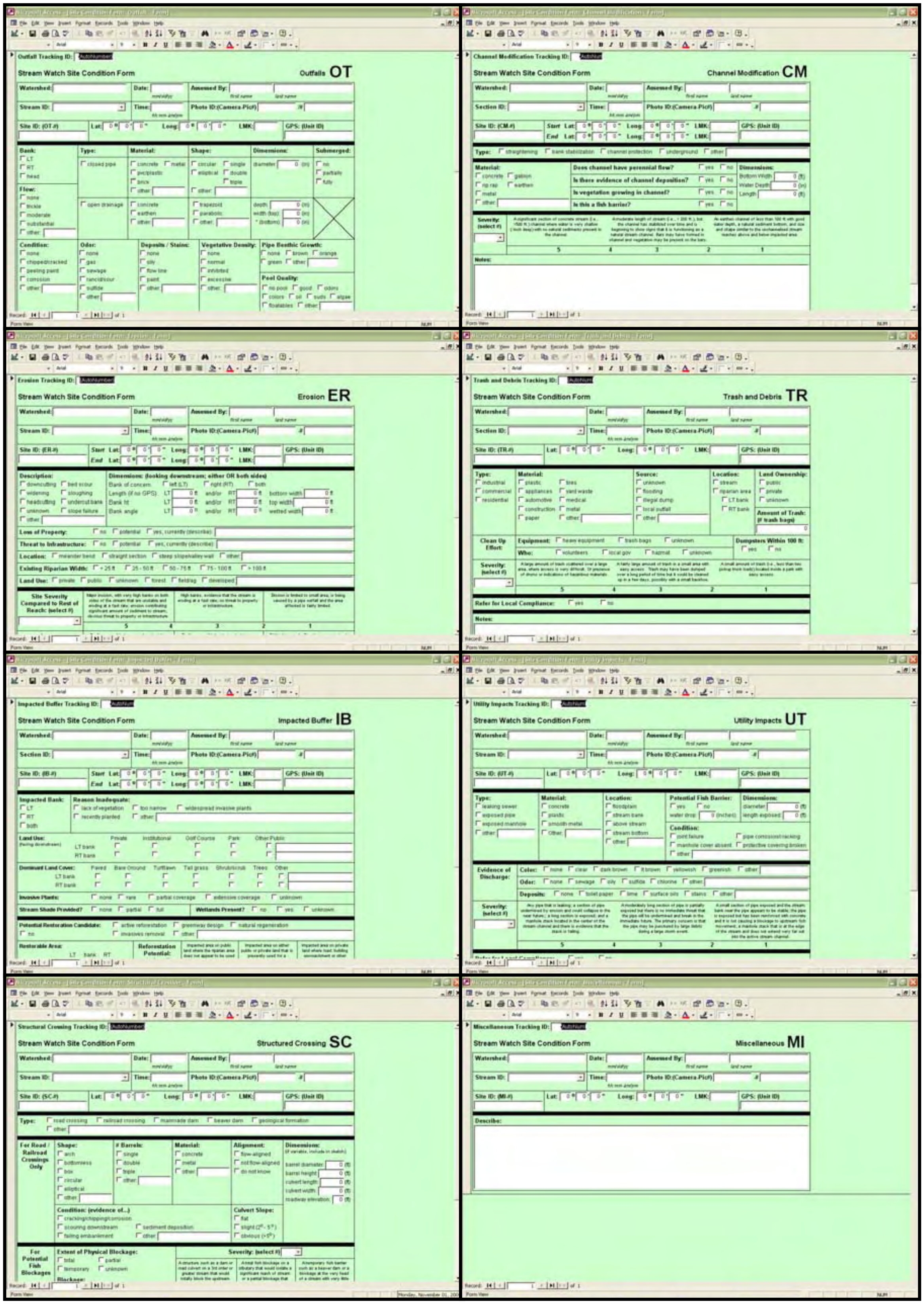


Figure 3.13: Site Conditions Survey Tracking Forms

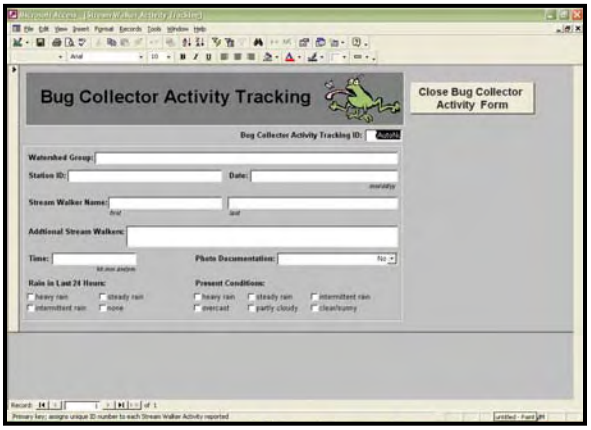


Figure 3.14: Bug Collector Activity Tracking Form

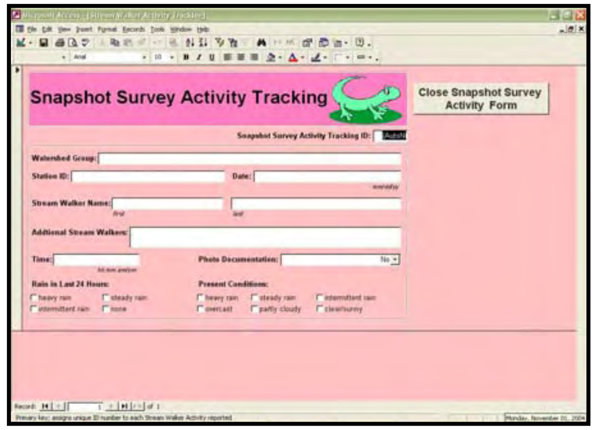


Figure 3.15: Snapshot Survey Activity Tracking Form

3.5 Reporting Problems and Data to Baltimore County

Volunteers involved in the stream watch program will be reporting data directly to the watershed group. Be sure to know who and how often you will be able to enter in the data into your system. It is often most efficient to schedule a weekly or monthly time period for entering the data. Keep in mind, however, that all the data will need to be reviewed at least briefly to see if there are any issues that might need to be reported to the responsible agency more immediately.

In Baltimore City

Issues and concerns discovered on stream reaches in Baltimore City should be reported to the Department of Public Works. If the issues are urgent, it is recommended that the report be called in to 311. The volunteer or staff person should be sure to:

- Record the time and date of the incident,
- Ask for a tracking number for the complaint and
- Request the name of the individual taking the report.

If the issue is less urgent, water quality issues should be reported to (410) 396-7032 and sewer leak issues should be reported to (410) 396-1460.

In Baltimore County

TO BE FILLED IN BY DEPRM

Data Reporting

General data reporting to report the results of the stream survey information should be submitted annually or bi-annually to Baltimore County DEPRM. The Stream Watch coordinating staff should summarize the survey results and note areas of particular concern within the watershed in a cover letter accompanying the data. This will enable DEPRM to hear about particular concerns of both the coordinating agency and issues that citizens may be noting in their reports.

3.6 Measurements of Program Success

Evaluation of the Stream Watch program is essential in determining the success of the program. Evaluating the success of your program will enable you to make decisions to improve the program and modify procedures to improve its success. There are a number of measurable parameters that can help you evaluate the success of the program and track improvements from year to year. Volunteer participation and stream miles monitored may be the best indicator of the success of a Stream Watch program because they are easy to track and the most important components of the program.

Information on volunteer participation is relatively simple to collect. The number of active participants for each level, the number of returning participants, the number of volunteers who attend training, and the number of new volunteers per year are all measures that can indicate the success of your recruitment and retention efforts.

To gain additional insight about the program, ask your volunteers to complete an evaluation of their experience. This will allow you to identify opportunities to modify your training program or other elements of the program to better address these issues. You may also consider providing volunteers with a pre- and post-monitoring or training questionnaire that briefly identifies their level of understanding of watershed issues. This questionnaire may help substantiate how the program helps to elevate the participants' understanding and appreciation for watershed and water quality issues. Though it is easy to place an evaluation form in the hands of your volunteers, it is not always as simple to have the form completed and returned. You may want to consider some incentives for returning the forms. Some efforts that have worked for other organizations include entering names in drawings for dinner or movie tickets.

The number of stream miles adopted also provides an indication of the level of program success. This measurement allows you to compare the average length of stream reaches adopted to the target adopted stream reach length in your watershed.

Other statistics worth collecting include:

- The number of issues reported, whether they were resolved, the length of time required to resolve the issues
- The number of restoration activities completed or planned based on the monitoring data
- The number of trash bags collected
- Water quality improvement noted from monitoring

Tracking, recording, and reporting these measurements of success help guide future efforts, support your program and provide incentives for participation from volunteers. Quantitative measures of program success are difficult to argue with and can also be used to promote the program to funders or justify expenses to the Board.

3.7 Estimated Program Costs

Implementation of a successful Stream Watch Program requires dedicated staff, continual volunteer outreach and communication, regularly offered training sessions, and cooperation with County staff.

The program is more likely to be successful and sustainable with an organization that has dedicated staff or volunteers willing to commit to servicing the program. Potential and active volunteers like to be able to call in their questions, stop by to drop off or pick up equipment, and talk to someone familiar with the program. Therefore, the budget and finance information provided is based on implementation by a small non-profit or watershed group with staff and office rather than an organization with only volunteer support.

This section provides guidance on developing a budget for a Stream Watch program. Two budgets are presented – an estimated annual, on-going budget, and a start-up budget for the first year of the program.

The budgets below are specific in order to attempt to identify some of the expenses that may incur with the program. Every organization will have different needs and may have existing resources that can be shifted into supporting some of these categories. There may be other items that are not included in this budget that would be entirely reasonable for implementation of the program.

Estimated Annual Budget

The estimated annual budget for a Stream Watch Program (Table 3.12) was developed based on the experience of the pilot program.

Different organizations may discover that their needs for field equipment vary. The list above is based on the experience of the pilot program. It may also be that software or computer upgrades are needed depending on the resources of the program.

Start-Up Budget for the First Year of the Program

The expenses in Table 3.12 represent the annual budget for a continuing program. In addition to these expenses there are likely to be a number of start up costs and considerations in the amount of staff time required. Launching a new program may warrant a number of one-time expenses that would significantly alter the budget for the first year of the program (Table 3.13).

<u>Staff</u>

Staffing levels required are likely to be higher in the first year. Initiating any new program often experiences a learning curve. The two areas that seem likely to require additional hours are in mapping and becoming familiar with the extensive stream system.

Volunteers are asked to identify the stream segment that they are interested in adopting and to identify it on a map and if possible use the GPS units to record the segment more accurately. The adopted segments are entered in ArcView and maps are generated to allow volunteers to understand how their stream segment relates to the subwatershed and watershed. Setting up the system, acquiring the map layers necessary (particularly if the watershed area encompasses more than one political jurisdiction, and gaining proficiency in manipulating the data in ArcView is very time consuming. This may be reduced if a staff person is familiar with GIS, but even with experience in the computer system building the necessary maps is a time consuming project. Additional funds may also be needed in getting staff training in GIS.

The issue of familiarity may also consume additional staff time. The program cannot be managed from the desk and training. Volunteers have issues on their streams that require a staff visit. They may not be able to explain their question adequately, have access issues or note particular questions they have on their stream segment that is best resolved with a staff visit. The implementing organization needs to be prepared to accommodate the volunteer's request and assist in getting GPS readings and helping with other aspects of the program when the volunteer is seeking specific assistance.

Equipment

Start up expenses for equipment and annual expenses as well will depend on the resources of the individual organization. The program utilized PowerPoint to develop the training program. To deliver the training a laptop, projector, and screen may need to be acquired. Organizations may also need to purchase new office computers or upgrade existing equipment in order to accommodate the ArcView and the database required for the program. JFWA loaned GPS units, digital cameras, D-nets, waders and other equipment for use in the field and the start up needs may vary dependent on the organization, the size of the watershed and the number of volunteers involved in the program.

Supplies

Though equipment and staffing are likely to be the two largest expenses for start up fees, the general supply of gloves, trash bags and other supply items may also be larger upfront than they will be on an annual basis.

Estimates for some of these expenses are displayed in Table 3.13.

Table 3.12: Stream Watch Program Annual Costs		
Expense Item	**Description**	**Cost**
Salary		
Salary (@ $17 per hour)	520 hours	$ 8,840
Fringe Benefits	30%	$ 2,652
Salary Subtotal		$ 11,492
Printing	Brochures, fliers, volunteer packets, postcards, signs, schedules	$ 2,000
Postage and Mail Supplies		$ 150
Travel	35 miles/month	$ 65
Field Equipment		
GPS Units	2 units	$ 1,000
Batteries	GPS units, camera, etc.	$ 100
Digital Camera Memory Disk	1 replacement/spare	$ 100
Thermometers	10 units	$ 100
Volunteer T-shirts	75 shirts – printed	$ 750
Trash Bags	12 boxes of 100 heavy duty	$ 150
Gloves	6 dozen	$ 58
First Aid Kits	5 complete kits with case	$ 125
Waders	4 pairs	$ 240
Miscellaneous	Tape measures, etc.	$ 150
Field Equipment Subtotal		$ 2,773
SnapShot Chemical Testing	20 sites @ approximately $95.00/site	$ 2,000
Volunteer Events and Recognition	Picnic, trainings, awards	$ 550
Subtotal of Direct Costs		$ 19,130
Indirect Rate	15% of direct costs	$ 2,870
TOTAL		**$ 22,000**

Table 3.13: Stream Watch Program for Year 1		
Expense Item	**Description**	**Cost**
Start-Up Costs		
Salary		
Salary @ $17/hour	150 hours	$ 2,550
Fringe Benefits	30% of salary	$ 765
Salary Subtotal		$ 3,315
Travel	15 miles/month	$ 65
Equipment		
Lap top	1 unit	$ 1,500
Projector	1 unit	$ 2,500
Workstation	Computer, monitor, keyboard, etc.	$ 1,500
ArcGIS 9.0	1 single use license	$ 1,500
Digital Camera	1 unit	$ 500
Equipment Subtotal		$ 7,500
Subtotal of Direct Costs		$ 10,880
Indirect Rate	15% of direct costs	$ 1,632
Total Start-Up Costs		**$ 12,512**
Annual Program Management Costs		
Total Annual Costs	See Table 3.12	**$ 22,000**
TOTAL COSTS FOR YEAR 1		**$ 34,512**

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Appendix A
Stream Watch Visual Survey

Appendix A.
Stream Watch Visual Survey

The Stream Watch Visual Survey is based on assessment parameters from the EPA's Rapid Bioassessment Protocol Habitat Assessment, Georgia Adopt a Stream Visual Survey, and the Center for Watershed Protection's Unified Stream Assessment (USA). This simple assessment is designed to collect basic information on existing in-stream and riparian conditions and will be used by the watershed group and Baltimore County to identify major concerns and assess habitat.

This appendix directs the volunteer on completing the Visual Survey form. The Stream Watch Visual Survey is composed of four basic parts:

- *General collection information*: section location and ID, volunteer names, date, weather conditions, and emergency response
- *Visual assessment*: ten questions on a range of in-stream and riparian characteristics
- *Section Sketch*: plan view of adoptive section showing any structures or features of interest
- *Comments*: Restoration recommendations, section highlights, requests for watershed group action

This appendix provides an introduction to the Visual Survey, a review of important elements of the Visual Survey field form, and the Visual Survey field form.

General Collection Information

Watershed Group Name. This should be filled in by the watershed group hosting the Stream Watch Program.

Adopted Section ID. You should have registered for your stream section site(s). When you do this, the Watershed Organization hosting the Stream Watch Program will tell you your pre-assigned section ID. This section ID allows the County to identify the exact location of your section and track data you collect.

Stream Walker Name(s). List all individuals who assisted in performing the survey. If there are too many to list, list several, beginning with the section registrant and all trained individuals. Please indicate the total number of investigators.

Date and Time. Document the date and how long it took you to complete the survey. Vegetation and stream flow will vary depending on the time of year. This information is important for the watershed group to properly track your effort and interpret the results.

Photo documentation. Circle yes or no. You are not required to take photos of features in your section, however, photo documentation can be a valuable tool in describing conditions and in documenting changes. Photos can also be useful for educational and outreach purposes.

Rain and Current Conditions. Please describe rain patterns over the previous 24 hours and indicate current conditions. The weather conditions can dramatically affect the results of your Visual Survey. For example, heavy or sometimes even light rain can result in altered stream flow conditions (reduction or increase in riffle numbers), clearing or deposition of organic debris, appearance of unusual odors, oils, or foam, and changes in water clarity.

Surrounding Land Use. Check the box describing the predominant land use surrounding your reach. You may check more than one box if uses differ on either side of the stream. Institutional land use includes schools, cemeteries, hospitals, etc.

Emergency Conditions Reported. Circle yes or no and describe what condition or follow-up action you reported to the County or watershed organization.

Visual Assessment

Descriptions of many of these parameters were taken from the Georgia Adopt a Stream Visual Survey (2002) guidance document.

1. Water Flow. Note the average conditions of flow for your adoptive section.

2. Water Odor. Note whether you detect any odors (including those not listed on the form) that are associated with the water in the surrounding area.

3. Water Clarity. Based upon visual observation, note the general clarity of the water column throughout your adoptive section (be sure to observe area prior to disturbance). Clear indicates high clarity and lack of color. Stained generally refers to clear but reddish or brownish color often associated with tannic acids (think iced tea). Turbidity is defined as a cloudy condition in water due to the suspension of silt or fine particles of organic matter. It affects light penetration and the productivity of algae and aquatic plants. The settling of solids alters the nature of the substrate, possibly resulting in habitat destruction. Lack of water clarity or the presence of color may be caused by algae, suspended solids, dyes, or chemical discharges.

4. Aquatic Plants in Stream. Here you are looking for the amount of algae or vascular aquatic plants present in the stream. Excessive nutrient loading often results in blooms of aquatic plants. Please note the relative presence of attached (rooted) or floating plants. A stream should have a light coating of algae on the rocks and other submerged material, visible only when standing within a few feet of the rock. The presence of stringy or clumps of floating algae is not typical in a healthy stream.

5. Wildlife in or Around Stream. Make note of the wildlife you see or evidence you observe (see browse, beaver activity) both in the stream and in the floodplain.

6. Natural Organic Material in Stream. This assessment measures availability of physical habitat for aquatic organisms, including fish and macroinvertebrates. The potential for the maintenance of a healthy fish community and its ability to recover from disturbance is dependent on the variety and abundance of suitable habitat and cover available. Look for logs, fallen trees, or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish. Thick root mats from trees and shrubs at or beneath the water surface also provides ideal habitat for aquatic animals. Also, please note the presence of major log and debris jams created during storm events. Sometimes, these may block flows and cause backup of floodwaters and/or bank erosion.

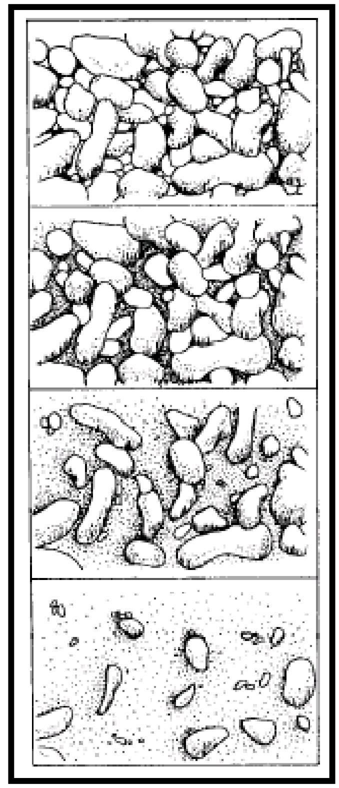


Figure A.1: Increasing Embeddedness (Top to Bottom)

7. Embeddedness (in the riffle). Riffles are areas, often downstream of a pool, where the water is breaking over rocks or other debris causing surface agitation. Riffles are critical for maintaining high species diversity and abundance of insects for most streams, and are vital spawning and feeding grounds for some fish species. Embeddedness measures the degree to which gravel and cobble substrate are surrounded by fine sediment (Figure A.1). It relates directly to the suitability of the stream substrate as habitat for macroinvertebrates, fish spawning, and egg incubation. This assessment should be used only in riffle areas and in streams where this is a natural feature. The measure is the depth to which objects are buried by sediment. This assessment is made by picking up pieces of gravel or cobble with your fingertips at the fine sediment layer. Pull the rock out of the streambed and estimate what percentage of it was buried. Some streams have been so smothered by fine sediment that the original stream bottom is not visible. Test for complete burial of a streambed by probing with a sturdy stick or rebar. Do not use your bare hands, as there may be broken glass or other dangerous objects hidden by the sediment *(Description, figure, and definition provided by Georgia Adopt a Stream Visual Survey; taken from USDA NRCS Stream Visual Assessment Protocol National Water and Technical Center Technical Note 99-1).*

8. Average Channel Dimensions. Once you have a feel for your adoptive section, find a location that represents the average channel shape and measure bank heights (from top of water) to bottom and top of channel width, and the wetted width. Figure A.2 shows where these measurements should be taken. **Side of stream is determined by facing downstream.**

9. Impacts. While you may not be an expert of stream ecology, you should be able to note any major structural or habitat impacts to your adoptive section. Noting the lack of forested buffers, severe bank erosion (loss of property, high banks, active erosion), concrete channels, or leaking sewer lines is important. Major emergencies should be reported to the proper local authorities. Less critical impacts should be checked on this form and communicated to the watershed group. The location of these impacts should be drawn on your stream sketch.

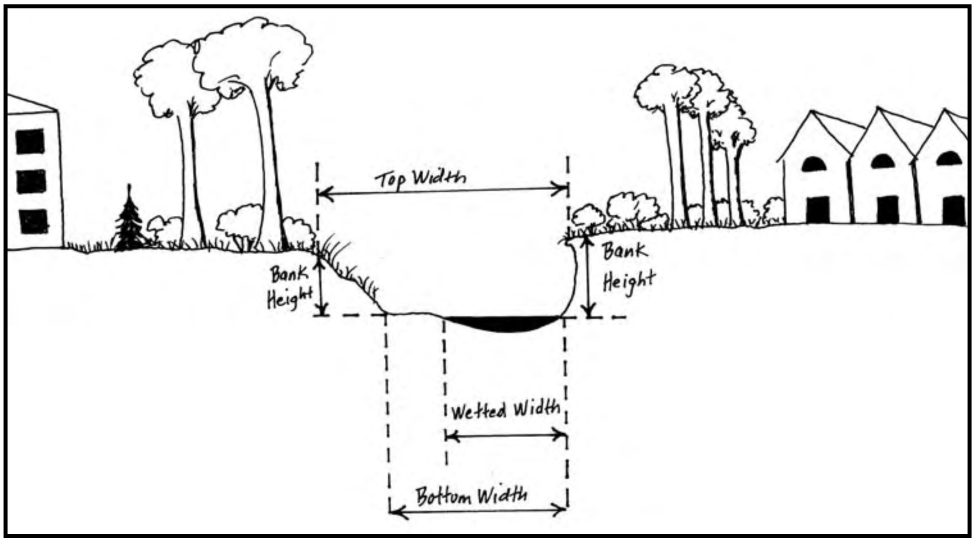


Figure A.2: Cross Section of Stream Showing Where to Measure Channel Dimensions

10. Average Section Characteristics. The remaining questions in this survey are mostly drawn from the EPA's Rapid Bioassessment Protocol Habitat Assessment. Listed are eight parameters that are easy to quickly assess and can be characterized as optimal, suboptimal, marginal, or poor conditions. Detailed descriptions of these parameters are provided below.

10a. In-Stream Habitat Quality. Includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refuge, feeding, or sites for spawning and nursery functions of aquatic macrofauna. Also takes into account mixture of pools, riffles, and runs. A wide variety and/or abundance of submerged structures in the stream provide macroinvertebrates and fish with a large number of niches, thus increasing habitat diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Riffles and runs are critical for maintaining a variety and abundance of insects in most high-gradient streams and serving as spawning and feeding refuge for certain fish. The extent and quality of the riffle is an important factor in the support of a healthy biological condition in high-gradient streams. Riffles and runs offer a diversity of habitat through variety of particle size, and, in many small high-gradient streams, will provide the most stable habitat. Snags and submerged logs are among the most productive habitat structure for macroinvertebrate colonization and fish refuge however, “new fall” will not yet be suitable for colonization.

10b. Stream Shading. Vegetative cover of the water’s surface (trees and shrubs overhanging the stream, not algae covering the surface of it!) reduces the amount of direct sunlight and also provides organic matter for the stream’s food chain. Estimate the % of water surface throughout your adoptive sections covered by shade during the summer (full leafage).

10c. Bank Vegetative Cover. Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of in-stream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap. Each bank is evaluated separately.

10d. Bank Stability. The process of erosion and sedimentation is natural. However, the rate of erosion is accelerated by human disturbances either to the hydrology of the stream or to the stream buffer (riparian zone). Check all descriptions that apply to the left and right banks of your stream. A stable bank will have vegetation. Banks can lose vegetation due to large amounts of water rushing through the stream channel during storm events or because someone has removed the vegetation, e.g. as a result of development and construction within the riparian zone. Natural banks have gentle slopes. Undercutting of stream banks is natural, though excessive undercutting may lead to stream bank failure. Streams that have a lot of erosion may have steep, U shaped banks. Another sign of rapid erosion is tree and plant roots that are exposed along the stream bank.

This parameter measures whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately.

10e. Channel Stability/Floodplain Connection. Streams and their floodplains work together in a natural setting. Non-impacted streams are designed to overflow when flood flows reach the point of being big enough and fast enough to erode or scour the stream channel. The act of overflowing the stream banks into the floodplain effectively dissipates the erosive flow by spreading the water out across a wider area. Once streams become impacted (through urbanization or other manmade alterations), they often become separated from their floodplain by downcutting or through structural revetments. Once a stream begins to erode downward, the banks get taller and erosive storm flows are trapped in the channel. This parameter is asking you to evaluate the possibility of flows escaping the channel. If banks are low and there is evidence of flooding in the floodplain, chances are that connectivity exists.

10f. Vegetative Buffer Width. Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of the riparian zone.

Conversely, the presence of "old field" (i.e., a previously developed field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. Each bank is evaluated separately. Consider evaluating buffer widths based on your community's required buffer widths (i.e., 25 feet, 50 feet, 100 feet).

10g. Floodplain Vegetation. This parameter refers to the dominant type of vegetation you see in the riparian corridor (on both sides of the stream).

10h. Floodplain Encroachment. Encroachment differs from vegetative buffer width because it is looking primarily at structural impacts from the perspective of floodplain functioning rather than vegetative width.

Section Sketch

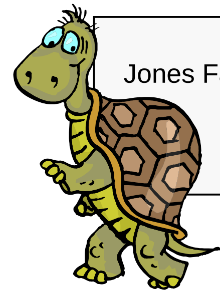
Take a few minutes to draw the major features of your adoption section. You don't need to be an artist! And you don't need to have every detail to scale. You simply need to be able to draw the stream and its immediate surroundings so someone else could envision the major features of your section. Note the physical features of the stream reach, such as riffles, pools, runs, streambanks (bare or eroded), changes to stream shape (rip-rap, gabions, cemented banks), vegetation, stream flow obstructions (dams, pipes, culverts), outfalls, tributaries, landscape features, paths, bridges, and roads. Include comments such as changes or potential problems, e.g. spills, new construction, type of discharging pipes, etc. See sample sketch.

Comments

Please include any comments you have regarding your adoption section. Your comments will be reviewed by the watershed association and should include a detailed description of any conditions or features of unique value or of concern, any potential restoration projects you may notice, or any information on surrounding land uses or stakeholders you think would be of value to the watershed group. Also, if you had problems completing the survey, please write that down.

Stream Watch
Visual Survey Form

Stream Walker / Stream Watcher (circle one)



Return to:
Jones Falls Watershed Association
Stream Watch
3501-3N. Charles St
Baltimore, MD 21218

Watershed Group Name:____

Adopted Section ID:_______________________________________ **Date:**_____________________

Stream Walker Name(s):____

Start Time:__________am/pm **End Time:**__________am/pm **Photo Documentation?** yes / no

Rain in Last 24 Hours:
☐ heavy rain ☐ steady rain
☐ intermittent rain ☐ none

Present Conditions:
☐ heavy rain ☐ steady rain ☐ intermittent rain
☐ overcast ☐ partly cloudy ☐ clear/sunny

Surrounding Land Use: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Residential
☐ Park ☐ Golf course ☐ Institutional ☐ Forested ☐ Crop ☐ Pasture ☐ Other:________________

Emergency Conditions Reported? yes / no **Describe (condition/action):**

Answer the following questions:

1. **Water Flow** (present conditions)	☐ dry/no flow/pooling ☐ flooding over banks	☐ flowing, channel width partially filled ☐ flowing, complete width of channel filled
2. **Water Odor**	☐none ☐ sewage ☐ sulfide ☐ chemical ☐gas ☐ rancid/sour ☐ other:____________	
3. **Water Clarity** (check all that apply)	☐ clear ☐ stained (clear water that is naturally colored) ☐ opaque (milky) ☐ slightly turbid (suspended matter in water) ☐ turbid ☐other (chemicals, dyes, etc.):_________	
4. **Aquatic Plants in Stream**	Attached plants: ☐ none ☐ occasional ☐ plentiful Free-floating plants: ☐ none ☐ occasional ☐ plentiful	
5. **Wildlife in or Around Stream**	Evidence of: ☐ fish ☐ amphibians ☐ waterfowl ☐ reptiles ☐ beaver ☐ deer ☐ mussels ☐ snails ☐ other:____________________________	
6. **Natural Organic Material in Stream**	Logs or large woody debris: ☐none ☐ occasional ☐ plentiful Leaves, twigs, root mats, etc.: ☐none ☐ occasional ☐ plentiful Log jams: ☐none ☐ few ☐ many	
7. **Embeddedness** (in the riffle)	☐ not applicable ☐ somewhat/not embedded (0 - 25%) ☐ mostly embedded (75%) ☐ don't know ☐ halfway embedded (50%) ☐ completely embedded (100%)	
8. **Average Channel Dimensions** (facing downstream)	Rt Bank Height:_______(ft) Bottom width:_____(ft) Wetted Width:_____(ft) Lt Bank Height:_______(ft) Top width:________(ft)	
9. **Impacts**	☐ no visible impacts ☐ impacted buffer ☐ severe erosion ☐ utility impact ☐outfall ☐trash/debris ☐ channel modification ☐ road crossing ☐ other:	

10. Average Section Characteristics (circle #) (bank determination by facing downstream)

Condition	Poor	Marginal	Suboptimal	Optimal
In-Stream Habitat Quality	No habitat present; uniformity in substrate, cover, & in-stream features	Limited habitat; some substrate diversity, limited mix of cover/ features	Noticeable habitat thru reach; some mix of cover and features, but not optimal	Good mix of substrate and optimal diversity in features/ cover
	1 2 3	4 5 6	7 8 9	10 11 12
Stream Shading	Water surface <25% shaded by vegetation	Water surface 25-49% shaded by vegetation	Water surface 50-74% shaded by vegetation	Water surface >75% shaded by vegetation
	1 2 3	4 5 6	7 8 9	10 11 12
Bank Vegetative Cover	<50% of bank surface and immediate buffer covered; significant vegetative disruption	50-70% covered; disruption obvious; bare soil and mowed grass common	70-90% covered by native veg, but missing major class of plant (trees, shrubs, or non-woodies); some disruption	> 90% covered by diverse native vegetation; disruption minimal
Right Bank	1 2 3	4 5 6	7 8 9	10 11 12
Left Bank	1 2 3	4 5 6	7 8 9	10 11 12
Bank Stability	Unstable; many eroded areas frequent along straight section; obvious bank failure; >60% reach affected	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% of reach affected	Banks stable; evidence of erosion or bank failure absent or minimal; <5% of reach affected
Right Bank	1 2 3	4 5 6	7 8 9	10 11 12
Left Bank	1 2 3	4 5 6	7 8 9	10 11 12
Channel Stability / Floodplain Connectivity	Stream deeply entrenched; high flows (> than bankfull) not able to enter floodplain	Entrenchment evident; flows rarely escape to floodplain	Some scouring or sediment buildup; moderately active floodplain	Natural channel conditions; high flows enter floodplain often
	1 2 3	4 5 6	7 8 9	10 11 12
Vegetative Buffer Width	Width of riparian zone <18 feet; little or no riparian vegetation due to human activities (i.e., parking lots, roads, lawns, etc)	18-36 feet; human activities have impacted zone a great deal	36-54 feet; human activities have impacted zone only minimally	>54 feet; human activities have not impacted zone
Right Bank	1 2 3	4 5 6	7 8 9	10 11 12
Left Bank	1 2 3	4 5 6	7 8 9	10 11 12
Floodplain Vegetation	Predominant floodplain vegetation type is turf or crop land	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is mature forest
Right Bank	1 2 3	4 5 6	7 8 9	10 11 12
Left Bank	1 2 3	4 5 6	7 8 9	10 11 12
Floodplain Encroachment	Significant encroachment in the form of fill material, development, or manmade structures; significant effect on floodplain function	Moderate encroachment; some effect on floodplain function	Minor encroachment, but not effecting floodplain function	Not evident
Right Bank	1 2 3	4 5 6	7 8 9	10 11 12
Left Bank	1 2 3	4 5 6	7 8 9	10 11 12

Total Score: _____ / 156

Sketch your stream segment:

Note the physical features of the stream reach, such as riffles, pools, runs, streambanks (bare or eroded), changes to stream shape (rip-rap, gabions, cemented banks), vegetation, stream flow obstructions (dams, pipes, culverts), outfalls, tributaries, landscape features, paths, bridges, and roads. Include comments such as changes or potential problems, e.g. spills, new construction, type of discharging pipes, etc. Please indicate which direction the stream is flowing and sketch the stream area as if from an aerial view (not a cross section).

Comments:

Please include any comments you have regarding your adopted section. Your comments will be reviewed by the watershed association and should include a detailed description of any conditions or features of unique value or of concern, any potential restoration projects you may notice, or any information on surrounding land uses or stakeholders you think would be of value to the watershed group. Also, if you had problems completing the survey, please write that down.

Biggest problem you see in your section:

Potential areas for buffer enhancement, stream restoration, retrofit, or educational campaign:

Would you like to see the watershed group pursue any project work here?

General comments:

Appendix B
Stream Watch Site Conditions Survey

Appendix B.
Stream Watch Site Conditions Survey

The protocol for the STREAM WATCHER includes performing a Stream Watch Visual Survey (same as that of the STREAM WALKER) and a Stream Watch Site Conditions Survey, whereby additional attention is paid to individual stream impairments. Locations are marked using a GPS unit and data sheets. The watershed group and Baltimore County will use this data to generate mapping information, and to identify "at risk" stream reaches and potential restoration opportunities. Additionally, STREAM WATCHERS should take responsibility for reporting any maintenance issues, utility leaks and illicit discharges observed to the proper local authorities.

The Stream Watch protocol is a modified version of CWP's Unified Stream Assessment (USA), which integrates qualitative and quantitative parameters based on a number of stream survey and habitat assessment protocols. The MD DNR Stream Corridor Assessment Method and the EPA Rapid Bioassessment Protocol Habitat Assessment were the primary models.

Modifications to the USA for the Stream Watch Program were based on the following:

- The USA was intended for a few staff to cover an entire subwatershed; stream watch volunteers will only be doing one or two adoption sections.
- To increase amount of coverage, the reach level assessment is designed to be used at both the STREAM WATCHER and STREAM WALKER levels.
- The volunteer protocol was simplified and does not include equipment, staffing, reach assignment, and data usage protocols.

The STREAM WATCHER protocol uses two types of field forms:

- *Visual Survey*—collects information on average reach conditions using the same Visual Survey described in the STREAM WALKER protocol (see Appendix A for details).
- *Site Condition Form*—collects detailed information on individual impacts or impairments. There is an individual form for eight typical types of impacts you may expect to find.

This appendix provides an introduction to the STREAM WATCHER protocol, a review of important elements of the Site Condition Forms, and the Site Condition Forms.

Description

The STREAM WATCHER protocol is a comprehensive stream walk protocol for evaluating the physical riparian and floodplain conditions in small urban watersheds. It is based on the USA, which was developed by CWP as one of two preliminary field assessment techniques for small urban watersheds. The protocol integrates qualitative and quantitative components of various stream survey and habitat assessment methods[1]. For a detailed description of the USA refer to Kitchell and Schueler, 2004.

This continuous stream walk method is designed to evaluate riparian corridor conditions that may not be detectable given existing surveys, monitoring data, or aerial photographs (Figure B.1). This method is designed for volunteers with minimal training to get their "feet wet" by walking the stream corridor, reporting on existing in-stream and floodplain conditions, and identifying opportunities for trash cleanup, stream restoration, and buffer enhancement. Volunteers will also identify locations of suspect discharges and infrastructure repair and maintenance needs.

Figure B.1: The STREAM WATCHER protocol is designed to assess overall conditions and potential restoration opportunities in small urban streams. Information is collected on condition of outfalls, riparian buffers, and other impacts as shown here.

What Are The Major Components Of The STREAM WATCHER Protocol?

This protocol is composed of both a site and a reach assessment completed simultaneously during the stream walk. The first assessment is a detailed inventory of impacted stream and floodplain sites identified along a survey reach. The second part is a subjective assessment of overall reach quality based on the average characteristics observed. While the site survey provides a running list of potential restoration sites, the reach assessment puts those sites in context of overall reach and subwatershed conditions, which helps to prioritize potential sites for further restoration assessments. Combined, these two components provide the basis for stream condition mapping and an abbreviated list of the potential restoration candidates.

[1] Specific assessment parameters were taken from the Maryland Stream Corridor Assessment, US Environmental Protection Agency Rapid Bioassessment Protocol for Habitat, Metropolitan Washington Council of Governments Rapid Stream Assessment Technique, and Aquatic Resource Restoration Co. Stream Reach Prioritization.

- *Site Condition* forms are impact-specific and are used to record necessary data at each impacted site to eventually determine potential restorability. There are eight different *Site Condition* forms (more detail on these conditions provided later):

    1. Outfalls (OT)—*all stormwater and other discharge pipes*
    2. Severe erosion (ER)—*bank sloughing, active widening or incision*
    3. Impacted buffer (IB)—*lack of natural vegetation, width*
    4. Utility impacts (UT)—*leaking sewer, exposed pipes susceptible to damage*
    5. Structured crossing (SC)—*culverts, dams, natural features, etc*
    6. Channel modification (CM)—*straightening, channelization, dredging, etc*
    7. Trash and debris (TR)—*trash and illegal dumping*
    8. Miscellaneous (MI)—*unusual features or conditions*

- *Reach Visual Survey* form contains a series of questions to gauge overall section conditions and help rank reach restoration priorities. For the purposes of Baltimore County's Stream Watch Program, the STREAM WALKER Visual Survey will be used for the reach assessment (see Appendix A for details). This form should be completed for every survey reach and should reference all recorded *Site Condition* IDs on the stream sketch or diagram.

Is Training Important?

Before the assessment, it is important to train all volunteers on the protocol and proper form completion. You will want to make sure all team members are using the same terminology and have a general sense of what a best and a worst-case scenario site look like (Figure B.2). As part of the training, we suggest walking the least impacted reach in your watershed AND a highly degraded reach together and completing the field sheets as a group.

When Should This Be Done?

The protocol can be performed at any time during the year, though vegetation, water levels, and temperature should be considered during assessment planning. Leafed-out vegetation may hinder visibility of outfalls, trash, and eroded banks, while at the same time making stream access and floodplain walking difficult. This may not be an issue in highly urban or less vegetated settings. Dry conditions are optimal for problem outfall identification, so it is important to conduct the survey when there have been a few days without rain. Additionally, exposure to hot, humid, or freezing weather conditions may not be ideal for field crews.

Figure B.2: Be familiar with the least impacted conditions expected prior to completing the survey. Low, undercut banks represent the ideal situation; however, in highly urban systems you may not see this.

What Kind of Impacts Am I Looking For?

While there are many different kinds of streams and floodplains, there are a set of common problems consistently found in small urban watersheds. The field forms focus on seven major conditions: outfalls, severe erosion, impacted buffers, structured crossings, utility impacts, trash and debris, and channel modifications. Other unique features or impacted conditions not captured within these categories can be recorded separately. Table B.1 summarizes the criteria for recording information on each type of impact. Broad descriptions of the eight site conditions are discussed below and organized into four parts:

About the Impact. Provides an overview of the types of impacts you are looking for.

Introduction to the Form. Introduces the kinds of questions you should be asking yourself at each location to determine if the site should be recorded and what is the overall restoration potential of the site. Specific assessment parameters are also listed and should be reviewed in conjunction with *Site Condition* field sheets.

What Do I Assess? Provides criteria for determining when an impact site should trigger completion of a *Site Condition* form.

Field Assessment Tips. Lists some field tips for more effective assessment.

Table B.1: Site Condition Evaluation Criteria and Assessment Parameters			
Condition	**Recommended Criteria for Recording**	**Information Collected** ***(In addition to photo and GPS)***	**Restoration Assessment**
Outfalls	All outfalls of at least 6" diameter. You may want to include smaller diameter discharges in highly urban settings. Outfalls are defined as discharge pipes or channels for controlled or uncontrolled stormwater, WWT, or other point source discharges. Bridges and culverts are not included.	Basic descriptive information on type, source, and condition and whether outfall is a candidate for stormwater retrofit. If flowing, then additional information on flow conditions should be recorded and potentially reported to appropriate authorities.	Stormwater retrofit & Discharge prevention
Severe Erosion	Slope failures, bank sloughing, head cuts, and incision or widening only in areas noticeably worse than the average erosive condition of the survey reach. In urban settings, typical bank erosion may be considered severe when infrastructure is threatened or significant property loss evident.	Location of eroded site (meander or straight section), threat to property or infrastructure, accessibility; and basic bank measurements (height, angle, and bottom and top widths). **Note**: Average bank stability is recorded at the reach level.	Stream restoration
Impacted Buffer	All stream reaches greater than 100 ft in length and lacking at least a 25 ft wide, naturally-vegetated riparian buffer on one or both stream banks.	Diversity and density of existing vegetation, floodplain conditions, adjacent land use and land cover, extent of impacted buffer	Riparian reforestation
Utility Impacts	All leaking or exposed sewer, water, or other utility pipelines in the riparian corridor causing water quality, aquatic habitat, or channel stability problems. This can include manhole stacks. Exposed pipes along the stream bottom, in the bank, or above the stream susceptible to damage due to lack of maintenance or floating debris should also be included.	Basic descriptive information on type, condition, and discharge characteristics associated with leaks (odors, color, etc). If leaking, this information should be reported immediately to appropriate authorities. Record relevant information if potential fish barrier.*	Discharge prevention Stream restoration
Structured Crossing	Include all manmade or natural structures that cross the stream, such as road culverts, railroad crossings, dams, or natural feature. Pipe crossings are not included (see Utility impacts). Channelized stream sections (see Channel Modification)	Type of crossing, culvert dimensions, relative information if suspected fish barrier*	Stormwater Retrofit Stream restoration
Channel Modification	Includes all channelized, straightened, enclosed, or reinforced sections of stream, regardless of construction material used. Locations of existing stream restoration or bank stabilization projects should also be noted.	Type of modification, length of stream impacted	Stream restoration
Trash and Debris	Areas of significant trash and debris accumulation greater than average levels observed across the survey reach. Any areas where potentially hazardous or unknown drums have been dumped.	Mobility, dispersal, amount and type of trash; level of effort and type of equipment required for removal; location on public or private property	Riparian reforestation and stream restoration
Miscellaneous	Record descriptive information for any unusual feature or condition impacting the riparian corridor not recorded on other *Site Condition* forms. This may include debris jams, nick points, ATV crossings, near stream construction, floodplain excavation, or other stream or floodplain features worth noting.		Depends on feature
* Suspected fish barriers are features that create at least a 6" water drop or allow less than ½" water depth during normal flow conditions. Structured crossings and utility crossings should be evaluated; channelized sections automatically are suspect.			

Storm Water Outfalls (OT)

Volunteers should assess all storm water outfalls or other pipes that discharge to the stream corridor. Specifically, you will be looking for suspected illicit discharges, enclosed pipes for potential daylighting, off-line storage retrofits, and local opportunities to stabilize or repair streams and outfalls.

About Outfalls

Storm water outfalls are ubiquitous to urban streams. They consist of open channels or closed pipes that discharge storm water runoff from the subwatershed into the stream corridor after a rain event. As impervious cover in the subwatershed increases, less rainwater infiltrates into the ground and larger volumes of storm water runoff are conveyed through the storm drain system. This causes increased flooding, peak flows, and stream erosion, along with declines in stream habitat and water quality. In some cases, storm water outfalls may contain illicit discharges of sewage and other pollutants that can create water quality problems. Figure B.3 illustrates some types of storm water outfalls you may encounter during the stream walk.

Introduction to the OT Form

While an outfall is just the final discharge point of a much larger underground network of pipes, its physical characteristics can tell a lot about local restoration potential. This section introduces the outfall impact form (OT) used to evaluate outfalls encountered during your stream walk. The OT form is used to collect basic information on the location, condition, flow characteristics, and potential restoration opportunities at each outfall.

The first part of the OT form contains general header information common to all impact assessment forms, most of which is self-explanatory.

You may need to modify the header section depending on your reach and site labeling system, and whether you are using GPS units to fix locations. If you are using GPS units,

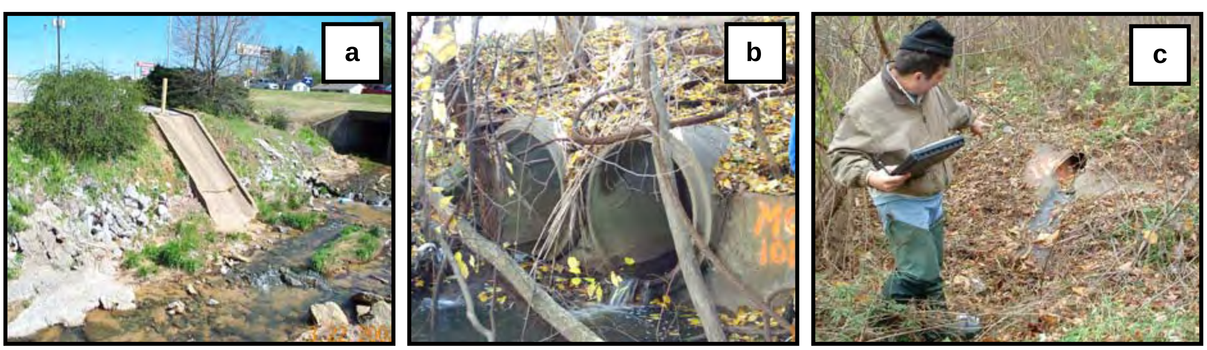


Figure B.3: Storm water outfalls come in a variety of shapes and sizes. For example, not all outfalls will be closed pipes, such as the open channel draining the corner of a commercial parking lot (panel a). Some outfalls may be single or double concrete pipes draining directly to the stream (panel b), while others may be quite small, such as the six-inch diameter pipes discharging into the buffer in panel c.

Questions to ask when assessing an outfall:

What is the general condition of the outfall?

Is there flowing discharge? If so, what are the characteristics of that flow?

Is there any noticeable stream or bank erosion near the outfall?

Is this outfall a candidate for retrofitting or daylighting?

record the coordinates for each site, the **GPS unit ID #**, and an **LMK** number. The LMK is an internal ID assigned to the latitude and longitude coordinates recorded by the GPS unit. This ID carries over when coordinates files are downloaded from the GPS unit to your computer. The LMK serves as a backup in case field crews are sloppy in recording location information on their field sheets. While not critical, recording the LMK on the field form also serves as a reminder to save the coordinates to the GPS unit so they can be downloaded.

The next part of the OT form asks for the location, type, size, and condition of the outfall and its immediate environs.

You need to determine if the outfall is an **enclosed pipe** or **open channel** and then record its material, shape, and dimensions. For enclosed pipes, record whether it is a single or a multiple pipe, its **pipe diameter**, and whether it discharges above the water level or is submerged. Pipe diameter at the outfall can be used to get a rough estimate of the upland area draining to the outfall (Table B.2). Pipe diameters can vary, but most have a diameter that is a multiple of six inches (6, 12, 24, 36, and 48 inches). Trapezoidal channels have distinct angles, while parabolic channels are smoothly curved.

Table B.2: Relationship Between Outfall Pipe Diameter and Contributing Drainage Area

Pipe Diameter[1] (inches)	Area (square feet)	Discharge (cfs)	Average Velocity (fps)	Drainage Area (approximate acres)
6	0.3	1	4	0.1 to 1
12	0.8	3	6	1 to 2
24	3.4	25	10	2 to 5
36	7.1	90	12	5 to 25
48	12.6	150	14	25 to 100
60	19	350	18	100 to 200

1. For concrete pipes flowing full, with one percent slope.

You should also note whether the outfall exhibits signs of **physical deterioration** such as corroding metal, cracking concrete, or peeling paint. Use your nose to detect if any odors emanate from the pipe, which may suggest a potential illicit discharge worthy of follow-up investigation. For example, if you detect a sulfur, or "rotten egg" smell, this may indicate the presence of sewage or high organic loads. Rancid or sour smells are sometimes associated with food wastes or industrial discharges.

Vegetative density refers to the presence of vascular plants directly below an outfall, whereas pipe **benthic growth** asks you to check for algal or bacterial growth within the pipe itself. Orange colored growths, called flocs, are generally derived from the natural presence of manganese and iron in the water and may not always indicate pollution. Green or brown growths, on the other hand, are often associated with high nutrient levels. If a **pool** has formed directly below an outfall, you should check to see if any suds, oil sheens, algae, or signs of water pollution are present. **Floatables** are defined as trash and debris carried in storm flows that float on the surface of the pool.

If you find a **flowing outfall**, check the color, turbidity, and physical content of the flow. These simple characteristics can help classify the likely sources of contaminants. If other concerns such as excessive trash, bank erosion, or heavy sediment deposition are associated with the outfall, note these on the OT form, as well. Table B.3 illustrates some common characteristics to look for during an outfall assessment.

The last part of the OT form asks you to recommend any potential restoration projects you feel may be appropriate for the outfall.

Restoration projects might include further discharge investigations, stream daylighting, storm water retrofits, or local outfall or stream repairs. If dry weather flow is observed at the outfall, or unusual odors, stains, or growths are associated with it, it should be considered a suspect outfall for further discharge investigation (Figure B.4). You should also assign a **discharge severity** score on a scale of one to five, where 5 is the most severe, based on the type of discharge observed. Descriptions to rate the severity score are included on the OT forms, which are used later to screen the most severe discharges in the subwatershed.

Daylighting is a stream repair practice that opens up a stream back up by uncovering and removing sections of storm drain pipe. Daylighting re-establishes historic streams that are currently enclosed, or are artificially channelized. To evaluate daylighting potential, you should estimate the length above the existing pipe that is open and available (i.e., no structures or utilities), and the depth of over burden above the top of the pipe. Figure B.5 shows potential locations for daylighting opportunities.

Stream repair techniques may be needed to protect infrastructure or stabilize an eroding stream bank near the outfall (Figure B.6). As always, emergency maintenance concerns should immediately be reported to the local utility.

Figure B.4: Discharge investigations will involve more extensive assessments at outfall locations. Local illicit discharge detection and elimination (IDDE) protocols often involve marking outfalls with spray paint and sampling suspected illicit discharges (Brown and Caraco, 2004).

Table B.3: Outfall Characteristics to Note During Site Assessment

 Elliptical, single barrel, concrete pipe. You may want to measure both horizontal and vertical diameter	 Small diameter (<2”) plastic pipe. Often a sump pump (legal), or used to discharge laundry water (illicit).	 Measuring the diameter of a partially submerged single barrel, concrete outfall
 Excessive vegetation may indicate enriched flows associated with sewage	 Bacterial growth at the outfall indicates nutrient enrichment and a likely sewage source.	 This bright orange bacterial growth often indicates high manganese and iron concentrations
 Green benthic growth on an outfall and high turbidity in pool	 Suds in pool may indicate raw sewage	 Unlike synthetic oils that swirl upon touch, sheen from bacteria such as iron floc forms a sheet-like film that cracks if disturbed
 Check for staining or obvious deposits indicating suspect discharges	 Floatables collecting in the discharge pool at an outfall location	 Look for oils or other pollutants collecting at the outfall pool

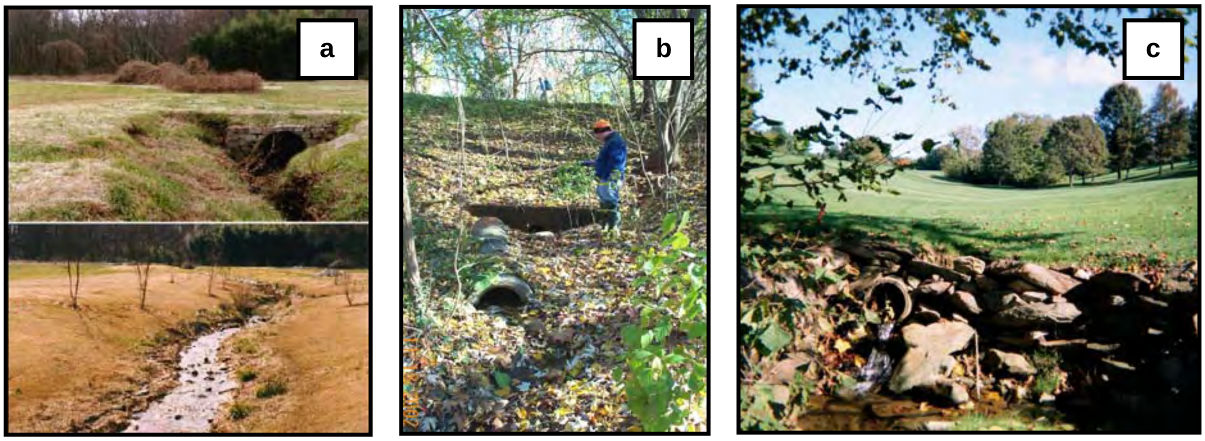


Figure B.5: Panel a shows a before and after example of a stream daylighting project. Notice the flat slope and grass vegetative cover of the site, which increased the feasibility of excavating the pipe and exposing the stream to its natural condition. In Panel b, the field crew is shown pondering the potential for opening this stream back up, particularly given the slope of this location. Panel c illustrates another location where daylighting could be combined with a reforestation effort.

Storm water retrofit opportunities should be assessed at each outfall. Volunteers are not expected to come up with detailed concept designs, just good locations that may warrant further investigation. First, trace the outfall pipe backward to assess the potential feasibility of a storage retrofit within the flood plain. Key points to note are the elevation of the bottom of the pipe (known as the invert) in relationship to the stream channel. If the elevation difference is greater than three feet, look to see if unutilized land is available in the stream corridor to provide storage. Try to determine how much downgradient land area is available to insert an offline retrofit between the drain pipe and the stream. Figure B.7 shows how a storm water retrofit can be inserted into the stream corridor. You should also check to see if the outfall is connected to a nearby storm water practice (e.g., pond , wetland, or other structure). Existing storm water practices should be noted for further investigation during a retrofit inventory (Figure B.8).

Figure B.6: This is an example of catastrophic failure of an outfall caused by significant erosion that could have been prevented if caught early in the process. Conditions like this should be reported to the appropriate local authorities.

What Outfalls Should I Assess?

You should decide in advance the minimum outfall diameter you will sample. Depending on your goals, you may sample all outfalls, or only record those that have suspect discharges. It is a good idea to assess **all** stormwater outfalls in highly urban subwatersheds, regardless of impact, diameter, or restoration potential (Table B.4). In less developed watersheds, you may only want to sample outfalls with a diameter of six inches or greater.

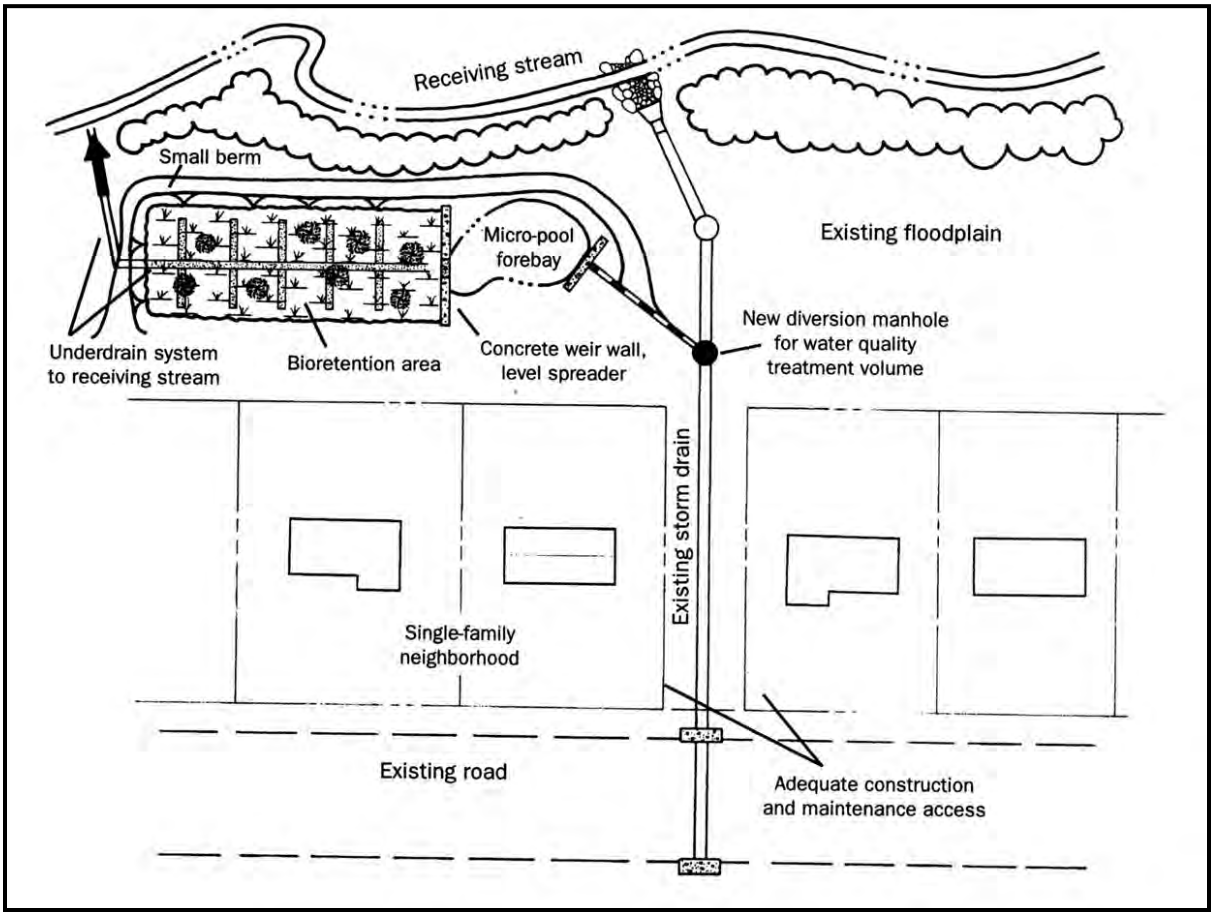


Figure B.7: This is a schematic detailing how a water quality retrofit can be inserted into the stream corridor.

Figure B.8: When assessing an outfall, you may want to take a quick trip up-pipe to determine if the discharge is controlled by a storm water facility. In this case, the outfall is the discharge point for a dry pond. Dry ponds do little for water quality and are therefore good candidates for storm water retrofits.

Table B.4: Recommended Outfalls to Assess	
Types of outfalls you should count include: • Large and small diameter closed pipes • Open channels • Outfalls that appear to be piped headwater streams • Field connections to culverts • Submerged or partially submerged outfalls • Outfalls that are sedimented in or blocked with debris • Pipes that appear to be outfalls from storm water treatment practices • Flexible HDPE that appear to serve as slope drains • Pipes that are clearly connected to roof drains • Small diameter ductile pipes that appear abandoned	Types of outfalls to ignore: • Drop inlets from roads in culverts • Cross-drainage culverts in transportation right-of-way (i.e., can see through other end) • Weep holes

Field Assessment Tips

Some quick tips for assessing outfalls are offered below:

- Thick vegetation can make outfalls hard to see or gain access to, so OT surveys work best during late fall, winter, or early spring.
- You may need to make more than one pass through the survey reach to discover all the outfalls.
- Illicit discharges are most easily discovered during extended periods of dry weather, when flows are more obvious.
- If you want to sample water quality at outfalls, take along test strips or field probes to sample water quality parameters, such as ammonia and conductivity.
- Not all outfalls discharge directly to the stream, so keep an eye out for outfalls that discharge farther away to slopes or flood plains. Often, you can find outfalls by tracing channels away from the stream corridor.
- Bridges and culverts should not be considered in the OT assessment unless you can clearly and safely see an internal outfall within a culvert.
- Natural oil sheens crack into irregular shapes when poked; synthetic oils will not break up.
- Don’t taste anything.
- All outfalls with dry weather flows should be considered suspect and identified for further discharge investigations.

Severe Erosion (ER)

Volunteers should assess the most severe eroding banks along the survey reach, particularly at places where valuable infrastructure is threatened. Specifically, you will look for potential stream repair or restoration opportunities such as bank stabilization or grade control.

About Erosion

Stream erosion reflects the natural process of channel migration and adjustment, whereby streams continuously meander, widen and narrow in an attempt to reach a stable equilibrium. The balance between sediment load and discharge can be disrupted by urbanization. Severe erosion can occur when a stream's current velocity exceeds stability thresholds for bank materials at channel boundaries. Reduced bank stability caused by increased bankfull flooding can lead to rapid and excessive bank erosion as the stream adjusts to the changing hydrologic conditions.

The process of channel widening or downcutting can worsen as streams become progressively disconnected from their flood plain. Nick points occur where significant changes in streambed elevation are caused by channel incision, and are indicators of dynamic channel processes at work. Eroding banks can cause loss of property, destroy in-stream habitat, and contribute significant sediment loads downstream. Trimble (1997) estimated that more than half of the sediment loads from highly urban watersheds were derived from eroded stream banks. Figure B.9 shows various examples of stream erosion you may encounter while conducting an ER assessment.

Extensive bank erosion and channel headcuts should be expected in urban subwatersheds. The ER form only collects information on specific nickpoint, and banks where erosion greatly exceeds average reach conditions. Broader bank stability conditions are assessed as part of the overall Visual Survey.

Figure B.9: Active bank erosion you can expect along meander bends in urban settings (panel a), extreme erosion events that contribute significant sediment loads to receiving waters (panel b), and in-stream nick points indicating channel erosion occurring in an upstream direction (panel c) are examples of severe erosion you will want to record on ER forms.

Introduction to the ER Form

<u>Questions to ask when assessing eroded banks:</u>

Is this area more severe than the rest of the survey reach?

Is infrastructure or property threatened?

What appears to be the cause of the erosion?

Are the banks actively contributing sediment to the stream?

Is this site a candidate for bank stabilization or grade control?

This section introduces the severe erosion impact form (ER) that assesses individual locations of eroded stream banks encountered during your stream walk. You are asked to record basic data on the location of erosion sites, estimate current channel dynamics and dimensions, and identify potential bank stabilization opportunities at each problem site. This section describes each part of the ER form, and provides guidance on how to complete it.

The first part of the ER form contains general header information common to all impact forms, and is self-explanatory.

You may want to modify the header section to reflect your reach and site labeling system, and whether you are using GPS units to fix locations. If you are using GPS units, record the beginning and end coordinates for each site, the **GPS unit ID #** and an **LMK** number. If the eroded bank is less than a hundred feet long GPS cannot calculate an accurate length, and you should measure it by pacing or with a tape measure.

The next part of the ER form asks you to describe the general channel processes that affect the eroding bank or stream channel. You should note the location and dimensions of the eroding area, as well as the ownership of the adjacent stream corridor.
You are asked to determine the overall **channel process** affecting the erosion site (e.g., is it aggrading or degrading), and to characterize how the channel process exerts itself on the stream (e.g., scour, slope failure, etc.). Of significant interest are headcuts and **nick points**, which are locations where active channel erosion is migrating in an upstream direction. Nick points are excellent indicators of the active channel erosion dynamics and directly affect the design of stream restoration projects. Headcuts observed on the side of a stream may also indicate the presence of an outfall discharging to the flood plain or side slope. You should trace these headcuts to their source. **Scour** is the process of removing bed or bank material through the erosive action of flowing water. **Bank failure** occurs when the toe of the stream bank is eroded beyond the point of bank support. **Slope failure** is often used describe the failure at steep bank slopes.

Not everyone has a full understanding of urban stream geomorphology, but Table B.5 gives some tips on how to determine the dominant channel processes in the stream. Table B.6 also illustrates what many of these channel processes look like in the stream. If you feel uncomfortable about describing the channel process, simply check the **currently unknown** box.

Table B.5: Features Used to Determine Current Channel Process		
Process	**Definition**	**Geomorphic Evidence**
Aggradation	The geologic process by which a streambed is raised in elevation by the deposition of additional material transported from upstream (opposite of degradation)*	• Mid-channel bars • Embedded riffles • Siltation in pools • Accretion on point bars • Deposition in the overbank zone
Degradation	The removal of streambed materials caused by the erosional force of water flow that results in a lowering of the bed elevation throughout the reach (opposite of downcutting)*	• Deepened or "entrenched" stream bed • Cut face on bar forms • Headcutting and nickpoint migration • Suspended armor layer in bank • Terrace cut through older bar material • Exposed sanitary or storm sewers
Downcutting (or incision)	Deepening of stream channel cross section resulting from process of degradation*	• Tall banks (may see stratification) • Disconnection from flood plain • May occur if widening prohibited
Headcutting	The erosion of the channel bed, progressing in an upstream direction*	• Nickpoints • Small drops in elevation (mini waterfalls) • Abnormally steeped channel segments
Widening	Increased width of stream channel cross section resulting from degradation process	• Falling/leaning trees • Scour on both banks through riffle • Exposed tree roots; Fracture lines along top of bank • Exposed infrastructure
Stable	Channel in balance between aggrading and degrading forces	• Water reaches toe of each bank • Moss on rocks or extending down into bottom of bank Banks are stable; connected to flood plain • Erosion is slight and limited to meander bends
* Definitions from the Washington State Aquatic Habitat Guidelines Program (2002)		

Each eroded bank section should be recorded as either left, right, or both banks, and whether it occurs on a bend in the stream, or along a relatively straight section. Headcuts branching off the stream should also be recorded as either left or right bank, while nickpoints are, by definition, located within the stream channel itself. Bank erosion is typically found along meander bends and may be enhanced if the bend occurs against a steep slope.

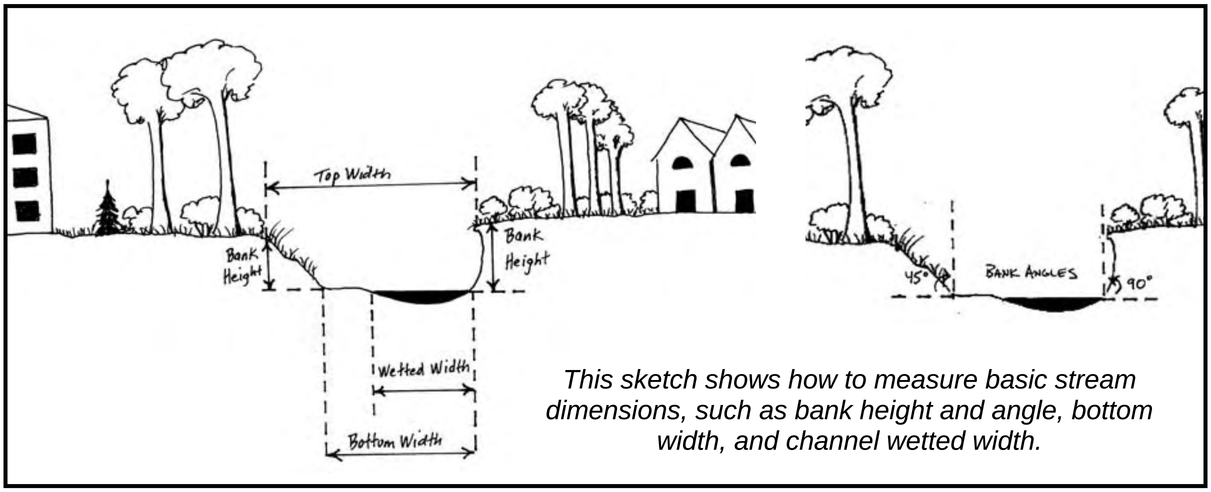
The ER form also asks you for some basic channel and bank dimensions. Figure B.10 provides guidance on how to measure the cross-sectional area of a stream channel. **Bank height** is typically the distance from top of water to top of bank. At streamside headcuts, be sure to estimate the length of active erosion, as well as its potential distance if the headcut has not migrated all the way to its source. For nick points, record the height and distance to the next upstream grade control structure such as a road crossing or channelized section.

Alternatively, you can simply note the location of the next grade control structure and calculate the length back in the office.

Table B.6: Erosion Characteristics to Note During Site Assessment

 Stable reach, with low banks, stream still has access to flood plain at high flows.	 Aggrading reach with obvious formation of mid channel bars.	 Signs of degradation include visible stratification lines in stream bank.
 Downcutting reach with tall banks on either side.	 Presence of manhole stack in stream is evidence of stream widening process.	 Moss covered banks are indicators that banks have since stabilized.
 Extreme erosion can occur when streams cut into steep slopes. Check level of soil consolidation in these areas to see if actively eroding.	 Below this eroded bench is a stabilized stream bank. This should not be considered as active bank erosion.	 Headcut rapidly migrating upwards towards an outfall. Note collapse of adjacent vegetation.

The last part of the ER form for any recommendations for potential restoration practices may be appropriate for the eroded bank. Envisioning stream restoration potential can seem hard at first for beginners, but can be acquired with a little study and a lot of practice. Some practices to consider include bank stabilization, grade control, or other stream restoration techniques. **Rigid bank stabilization** includes such things as boulder revetments, root wads, rip rap, or other relatively hard structures. **Soft bank stabilization** practices include coir fiber logs, live fascines, brush mattresses, or other bioengineering techniques that use vegetation to protect the banks (Figure B.11). **Grade control** techniques refer to step pools, rock vanes, or log drops that prevent the migration of headcuts (Figure B.12).



This sketch shows how to measure basic stream dimensions, such as bank height and angle, bottom width, and channel wetted width.

Figure B.10: Stream Features Diagram

The **erosion severity score** rates the extent of erosion on a five-point scale, where 5 is the most severe. You should also check to see if access is available to get heavy equipment to the site. Erosion severity and access scores should be marked on the ER form to identify the most severe and accessible eroded banks in the subwatershed.

Which Eroded Banks Should I Record?

Some bank erosion should be expected in most urban streams and it is unrealistic to have field crews GPS and assess every foot of eroded bank along an urban stream if restoration is not impractical. Therefore, slope failures, bank sloughing, incision, or channel enlargement should only be recorded for banks that are noticeably worse than the "average" eroded bank along the survey reach (Figure B.13). Sites with average bank erosion should only be counted if adjacent infrastructure is threatened or significant property loss is evident. Streamside headcuts and channel nick points with elevation changes of at least two feet should always be recorded, since they signal that active channel erosion is migrating upstream.

Figure B.11: Bank stabilization practices can be rigid or soft. Panel a shows an example of the use of rip rap to restore eroded section of stream; Panel b shows the mixed use of coir fiber logs and riprap to stabilize outfall and repair adjacent stream bank.

Figure B.12: Steps pools can be used as grade control.

Figure B.13: In highly urban settings, 3 to 4 foot eroded banks are probably the norm.

Field Assessment Tips

Some quick tips for assessing stream erosion are provided:

- Track all headcuts to their source, even if they are lateral to the stream.
- Only include channel nick points if the vertical change in stream elevation is more than a foot.
- Look for the presence of root hairs on stream banks to determine active erosion.
- Look for signs of major sediment deposition to determine channel degradation.
- Stratified layers in the bank may be a clue that the stream is downcutting.
- Banks composed of unconsolidated materials such as gravel, sand, or silt are often more unstable than those of compacted clay.
- If bedrock is present, then stream widening may be the dominant channel process. In this case, bank height may not be greater than average reach conditions, but the increase in cross sectional area may be greater.
- Make sure to look behind overhanging vegetation to determine extent of bank erosion and vegetative cover.
- Be sure not to confuse historic channel migration features with newly formed, actively eroding benches.

Inadequate Buffers (IB)

Volunteers should assess portions of the stream corridor that lack an adequate stream buffer. You will specifically be looking for sites where active reforestation, greenway design, natural regeneration, and buffer management practices can be targeted.

About Inadequate Buffers

Streamside buffers are important to stabilize banks, create habitat, and remove pollutants. The vegetative species found in the stream buffer vary by ecoregion, but a mature forest represents the optimal condition in most temperate climates. Urbanization often results in encroachment, tree clearing and mowing of the buffer. These changes can interrupt the continuity of the stream buffer corridor and undermine its many benefits. Urban stream buffers may also be fragmented by road and utility crossings, and are often short circuited by storm water pipes. In commercial settings, buffers are often cleared and replaced with parking lots and rip-rap directly adjacent to the stream. Homeowners may also replace natural buffer cover with turf grass that lacks the root depth needed to maintain bank stability. Remaining buffer fragments can become overrun with invasive plant species such as kudzu, ivy, and honey suckle. As access to buffer fragments becomes more limited, active management and reforestation of remaining buffer areas becomes difficult. Figure B.14 shows various types of stream buffers conditions you may observe during an IB assessment.

Introduction to the IB Form

This section introduces you to the impacted buffer form (IB), which evaluates inadequate buffers encountered during your stream walk. You are asked to record basic information on the location and quality of buffers, along with adjacent wetland restoration and reforestation opportunities at each site. This section describes each part of the IB form, and presents guidance on how to complete it.

The first part of the IB form contains general header information.

Figure B.14: Wide, naturally vegetated buffers provide many benefits to streams. Panel a shows optimal buffer conditions rare in urban systems. Panel b shows an impacted buffer often seen in parks and residential settings. Panel c shows an example of the paved buffer frequently observed in more highly urban settings.

You should modify the header to reflect your reach and site labeling system, and whether you are using GPS units to fix locations. If you use GPS units, record the beginning and end coordinates for each buffer segment, the **GPS unit ID #,** and an **LMK** number. If you are not using a GPS unit, then measure the buffer length using calibrated paces or a tape measure.

Questions to ask when assessing the buffer:

Why is this buffer considered inadequate?

What is the adjacent land use and how does it impact the buffer?

What is the density and diversity of vegetative cover (grass, shrub, woody)? Are invasive plant species present?

What kinds of reforestation opportunities exist?

The next part of the IB form asks which side of the stream lacks a buffer and the reason(s) you consider it inadequate.

You should decide in advance what criteria you will use to define the adequacy of buffers. **Buffer adequacy** can be defined based on your local buffer protection criteria. For example, if your local ordinance requires a minimum buffer width of 25 feet, then this may be a benchmark to judge whether a buffer is too narrow. Adjacent land ownership is also a useful criterion since parks and public lands are often the best places for buffer restoration. Buffer expansion on public land can be sometimes be accomplished by changing mowing practices used by local maintenance crews. The IB form also asks you to estimate the extent of **invasive plant** coverage, as well as the amount of **stream shading** provided by the overhead tree canopy. You should also note if wetlands are present in unbuffered segment that may be suitable for potential enhancement or restoration projects. Table B.7 illustrates what many buffer features can look like in the field.

The last part of the IB form asks you to recommend any potential management practices you feel may be appropriate for the inadequate buffer.

Some buffer management practices to consider are natural regeneration, active reforestation, greenway design, and control of invasive species. **Active reforestation** involves the planting of native tree species to eventually produce a streamside forest. **Natural regeneration** is a more hands-off approach that allows nature to take the area back on its own. This is done in areas where mowing stops and existing plants and seed banks allow trees to regenerate after invasives are removed (Figure B.15). In some cases, unbuffered segments may be associated with **greenways**, trail systems, or other open space areas. Integrating appropriate management practices in these buffer segments may be a restoration opportunity (Figure B.16). Watershed groups can be a great source of support for active reforestation planting and invasive species control projects (Figure B.17).

To evaluate reforestation potential, first estimate the available area or length suitable for reforestation, and then assign a **reforestation potential** score based on adjacent land use, access, and site constraints. The reforestation score is based on a five-point scale, where five is the most suitable. You should look for any potential conflicts that might hinder successful reforestation (e.g., lack of adjacent water, or presence of beaver, utilities, or invasive plants). Feasibility factors are used later to rank the most promising riparian management sites in the subwatershed.

Table B.7: Buffer Characteristics to Note During Site Assessment

 Aerial photography showing wide, forested buffer between residential area (top left) and stream.	 Lack of buffer on one side of stream; impacted buffer should be at least 100 ft long to record.	 Example of inadequate buffer on both sides of stream; potential site for active reforestation.
 Turf grass mowed to stream edge in public open space should be targeted for bufferscaping projects.	 Buffer management at golf courses should integrate course requirements with bank stability and in-stream goals.	 If forest cover is not practical, buffers should, at a minimum, contain shrubs or tall grass.
 Sometimes impacted buffers may have been recently planted. This should be noted on your field form.	 The extensive presence of invasive plant species can threaten an otherwise healthy buffer system.	 Note the width of the restorable area. Structural encroachment may limit the available restorable width.

Figure B.15: Active reforestation can be done even in utility corridors (panel a). These activities can serve as educational opportunities, particularly if appropriate signage is used (panel b). Some areas can regenerate vegetation themselves if access is limited and invasive plants are controlled (panel c).

Figure B.16: Panel a shows a community greenway where buffer enhancement should be part of a master planning process. Panel b shows poor backyard landscaping practices where vegetation is mowed frequently and chemical sprays are used to remove vegetation from the stream edge.

Figure B.17: Watershed groups can generate volunteer support for removing invasive species (panel a) or active planting (panel b).

Which Impacted Buffers Should I Record?

The IB form is designed to help you find the total length of buffered/unbuffered stream miles in a subwatershed, even if full reforestation is impractical. You may want to set criteria based on minimum widths cited in local buffer ordinances, or based on protection goals (e.g., 100 feet). At a minimum, field crews should evaluate buffers that extend outward at least 25 feet from the stream, as measured from the top of each bank.

To avoid repetitive starts and stops, field crews should only record inadequate buffer areas greater than 100 feet in length. In some cases, a wide vegetated buffer may be considered inadequate if its health is compromised by invasive species or diseased vegetation.

Not all impacted buffer sites can be successfully reforested due to physical site or land use constraints. In commercial settings, for example, roads, buildings, or other encroachments may often constrain buffer width. While it is important to record these inadequate buffers, they may not be considered prime candidates for reforestation, although options for riparian management should be explored.

Field Assessment Tips

Keeping track of inadequate buffer sites can become a field nightmare if crews are sloppy in recording data. Some tips to guide your buffer assessments are provided below:

- If you have access to good aerial photos, analyze survey reaches based on the presence or absence of buffer vegetation.
- If vegetative conditions in the buffer change significantly, fill out a new IB form. This generally occurs when you switch from one to both banks, or vice versa, or if there is a shift in land cover or other features.
- Remember to only record inadequate buffer segments longer than 100 feet, otherwise you'll find yourself completing too many forms. Fragmented buffer conditions are best reported on the Visual Survey form.
- Take some clippers with you, since many urban buffers contain dense thickets with invasive vines and shrubs such as multiflora rose (ouch!).
- Watch out for poison ivy! You should also consult a local plant guide to learn the common invasive and poisonous plants you may encounter on your streamwalk.
- Look closely at your map beforehand and try to determine if multiple buffer sites exist within your survey reach.
- Start a new IB form if you cross over to a new survey reach. Alternatively, consider redefining the boundaries of the survey reaches to accommodate the full extent of the inadequate buffer.
- Reforestation on public lands or large parcels such as schools or golf courses will generally take a higher priority than small, privately-owned parcels.

Utilities in the Stream Corridor (UT)

Volunteers should assess all locations where utilities cross the stream corridor, and can cause water quality, stream habitat, or channel stability problems. Utilities may include leaking or exposed sewer pipes, sewer overflows at manhole stacks, and overhead power line crossings. You will be specifically looking for locations where stream repairs or discharge investigations may be needed.

About Utilities

Utility pipes and rights-of-way are frequently located within urban stream corridors, often parallel to or underneath the stream itself. When sewer lines leak or overflow, they can be a direct discharge source of raw sewage into the stream. Leaking water pipes can increase dry weather stream flows. Pipe infrastructure may physically impact the stream, particularly at crossings that cause bank destabilization, stream scouring, or create fish barriers. Exposed pipes in the channel are also susceptible to damage from floating debris, especially during large storm events. Vegetative maintenance under power line crossings can also impact stream buffers, through removal of native cover, spread of invasive plant species, and regular herbicide spraying. On the other hand, sewer, water, and power utilities have a strong interest in protecting their infrastructure, and can become good partners in subwatershed restoration. Figure B.18 illustrates various impacts that utilities can cause along the stream corridor.

Introduction to the UT Form

This section introduces the utility impacts (UT) form that evaluates the impact utilities on the stream corridor. At each manhole or crossing, you are asked to collect basic information on its location, structural features, evidence of discharge, and potential repair opportunities. This section describes each part of the UT form and provides guidance on how to complete them.

As with other Site Conditions forms, the first part of the UT form contains general header information.

Figure B.18: Common utility-related impacts you may observe include sewer overflows (panel a), damaged and leaking pipe crossings (panel b), or power line rights-of-way interrupting the stream buffer (panel c).

As always, the header should be modified to reflect your reach and site labeling system, and whether you are using a GPS unit. If you are using GPS, record the coordinates for each site, the **GPS unit ID #**, and an **LMK** number.

> **<u>Questions to ask when assessing utility impacts:</u>**
>
> **How is the utility impacting the stream corridor?**
>
> **Are there any maintenance issues that should be reported?**

The next part of the UT form asks you to describe the type, location, and structural condition of the utility feature.

Manhole stacks should always be checked for signs of external **deterioration** or recent **overflows**. Sewer lines that cross stream channels should be evaluated for their potential to act as **fish barriers** or whether they might be subject to damage from channel erosion or flooding. If a pipe crosses the stream and creates at least a six-inch vertical water drop, you should classify it as a potential fish barrier. In many cases, sewer pipes are located on the stream bottom and are encased in a layer of protective concrete. Note any damage exposed sewers or coverings in the **condition** box. If there is any evidence of sewer **discharge**, you should note colors, odors, or types of deposit observed. Table B.8 illustrates what many of these utility features look like in the field.

In the last part of the UT form, you are asked to recommend any potential restoration practices you feel may be appropriate for the utility.

You may want to consider practices such as **structural repairs**, **pipe testing**, **citizen hotlines**, or dry weather **water quality sampling**, to fix the utility problem. If the pipe is a potential barrier to fish migration, record the height of the water drop (Figure B.19).

Figure B.19: Structural repair or relocation of sewer lines may be necessary to stop leaking pipes as shown here (panel a), or to restore fish passage at potential fish barriers like the one shown here (panel b).

Table B.8: Utility Characteristics to Note During Site Assessment

 Utilities crossing above the stream can be susceptible to floating debris during storm events. You should note the length and condition of exposed pipes.	 The structural condition of manhole stacks in-stream due to bank erosion should be examined. This site may rank highly for restoration to prevent future degradation.	 Manholes are typically spaced 200-400 feet apart. You should examine the condition of each
 Look for any colored discharges or structural problems with manholes sitting in flood plain wetlands.	 The presence of toilet paper and solid waste are evidence of overflows.	 Powdered agents spread over sewer overflows in the flood plain are a sign of clean-up efforts.
 Popped manhole covers and toilet paper in branches are good evidence of past discharge.	 Check condition of concrete or brick manhole stacks. Open or missing manhole cover may indicate recent overflow.	 Pipes crossing the stream can be at risk from floating debris or contribute to debris jams, as shown here.

The UT form asks you to assign a **utility impact severity** score based on the extent and potential for discharge on a scale of one to five, where five is the most severe condition. If a sewage discharge is detected, the site automatically scores a five and should be immediately referred to local authorities. Guidance on how to estimate discharge severity and access scores are provided on the UT form, and are used later to identify the most severe utility impacts in the subwatershed.

What Utility Data Should I Record?

All leaking or exposed sewer infrastructure in the stream corridor that causes (or threatens to cause) water quality, aquatic habitat, or channel stability problems should be recorded. This can include manhole stacks, sewer or water lines, or rights-of-way. Exposed pipes along the stream bottom, in the stream bank, along the stream corridor, or crossing the stream should always be assessed. Particular attention should be paid to utilities that are vulnerable to damage due to lack of maintenance or floating debris. Overhead utility crossings such as major power lines should be recorded as well.

Field Assessment Tips

Some quick tips for assessing utility impacts are provided below:

- Manhole stacks typically occur every 200 to 400 feet along the stream corridor.
- To be safe, perform an external inspection of utility pipes only. Do not open manhole covers or climb into open sewer pipes.
- If you smell something, take extra time to look for visual evidence of a leak or spills.
- Visual cues of recent sewer overflows may include open manholes, toilet paper and other sanitary deposits, obvious staining or dried residues, lime, or “stay out” signage.
- Report any spills or leaks to appropriate authority on your emergency contact list.
- Record any phone numbers or identification information written on utility poles or manhole covers to help response crews find the “address” of the problem.

Stream Crossings (SC)

Volunteers should examine each structured crossing that occurs within the stream corridor, which can include bridges, culverts, railways, and dams. Note that sewer and water line crossings are evaluated on the UT form. You will be looking for potential fish barriers, culverts in need of repair or replacement, opportunities for upstream storage retrofits, or associated stream repair projects at each crossing.

About Stream Crossings

As subwatersheds urbanize and transportation networks expand, the number of stream crossings increases. Stream crossings interrupt the stream corridor, alter local stream hydrology, impact bank stability, and prevent fish migration. Stream crossings are generally designed based on the width of the road and the stream, the slope of the flood plain, and runoff volumes generated by extreme storms. In many cases, crossings enclose the stream for an extended distance. Known as culverts, these involve a long pipe or box-like structure installed to pass storm water safely through. When culverts are poorly designed, they can degrade habitat, create fish barriers, and contribute to local flooding and erosion problems (i.e., if they are clogged, misaligned, or under capacity). Both manmade and beaver dams are considered to be stream crossings. Figure B.20 illustrates various types of stream crossings you may encounter in the field.

Introduction to the SC Form

This section introduces you to the stream crossing (SC) assessment form. The SC form asks you to record basic information on the location, dimensions, condition, and restoration potential of each stream crossing. This section describes each part of the SC form, and provides guidance on how to complete it in the field.

The first part of the SC form contains general header information that locates the subwatershed, survey reach, crossing identifier, and GPS coordinates for the crossing.

Figure B.20: Roadways (panel a), dams (panel b), and pedestrian bridges (panel c) are structured crossings that you may observe. You should assess all crossings that have a direct impact on the stream. Structures like the one shown in panel c that do not have a significant impact should not be assessed.

Questions to ask when assessing stream crossings:

What impact is the crossing having on the stream?

Is this a potential fish barrier?

Is there any maintenance or flooding concerns related to this crossing?

Is this crossing a candidate for removal or retrofitting?

The next part of the SC form asks you to describe the type and general features of each stream crossing. Structured crossings can be quite diverse in urban subwatersheds. Table B.9 shows examples of some of the different crossings you may find in the field. If the crossing is not related to a road or a culvert, you can skip to the next section. If it is a culvert, record some basic information describing its shape and condition. In particular, note whether the culvert is **bottomless** (i.e., has a natural stream bottom) and what, if any, impact it may be exerting on the stream. For example, does the culvert cause a **scour hole**, promote upstream sediment deposition (occurs when floodwaters back up behind the crossing), or threaten adjacent embankments (often caused by misdirected flow).

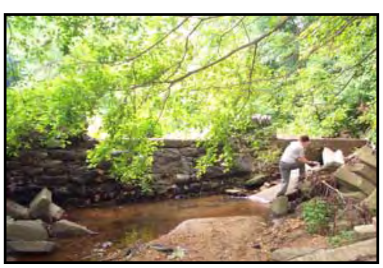
If you want to perform flooding analysis, measure the general barrel dimensions, as well as roadway elevation, alignment, and slope. **Roadway elevation** is measured from the stream bed to the road surface. **Alignment** refers to the direction of the culvert in relation to stream flow (i.e., does the upstream culvert line up with the direction of stream flow, or does it angle away?). Try to gauge the relative **slope** of the culvert, by looking upstream through the culvert. Keep in mind that a 2% slope represents a rise of two feet over a run of 100 feet.

In the last part of the SC form, you are asked to recommend any restoration projects that are suitable for the crossing, and determine whether it is a potential fish barrier.

Potential practices to consider at crossings include fish barrier removal, culvert repair/replacement (Figure B.21), and local stream repair. Additionally, you should check out the potential to have an upstream **storage retrofit** at the stream crossing (Figure B.22).

It is a good idea to consult with a local fishery biologist to determine the criteria to define fish blockages before sending crews out in the field. In the mid-Atlantic region, **fish barriers** are defined as crossings that create at least a six-inch water drop and/or have an average depth of flow less than one-half inch deep during normal conditions. If you consider the crossing a potential fish barrier, describe the extent of the blockage (spatially), classify it as total, temporary, or partial, and note your rationale for your decision. Note that some fish barriers can also be created by steep culverts slopes or extended culvert lengths (100 feet or more). You should assign a **blockage severity** score for the crossings (one to five, where five is the most severe). The SC form contains criteria to help you rate the severity of the potential blockage.

Figure B.21: Example of where culvert repair may be needed in combination with buffer planting and storm water control.

Table B.9: Stream Crossing Characteristics to Note During Site Assessment		
 Elliptical, concrete, single-barrel roadway culvert, with an associated outfall.	 Round, metal culvert. Estimate culvert length by walking above ground.	 This arched, corrugated metal culvert is bottomless (or is it? Be sure to check!).
 Single box culvert not well-aligned with flow path.	 Replacing existing culverts with ones like this provides a natural channel bottom.	 Double-barrel, concrete road culvert with significant sediment deposition.
 Double box culvert with in-stream sediment deposits forming on the left side and a distinct vegetated bar forming on the right.	 Culverts or dams that result in at least a six-inch water drop should be considered potential fish barriers.	 Culverts with a significant slope or over a certain length (100 feet or more) may prevent fish passage.
 Dams should also be recorded as stream crossing features. Measure dam heights, if you can.	 Culvert being blocked by large vegetation established on in-stream bar formations.	 While tempting, we do not encourage field crews to walk through long, dark culverts.

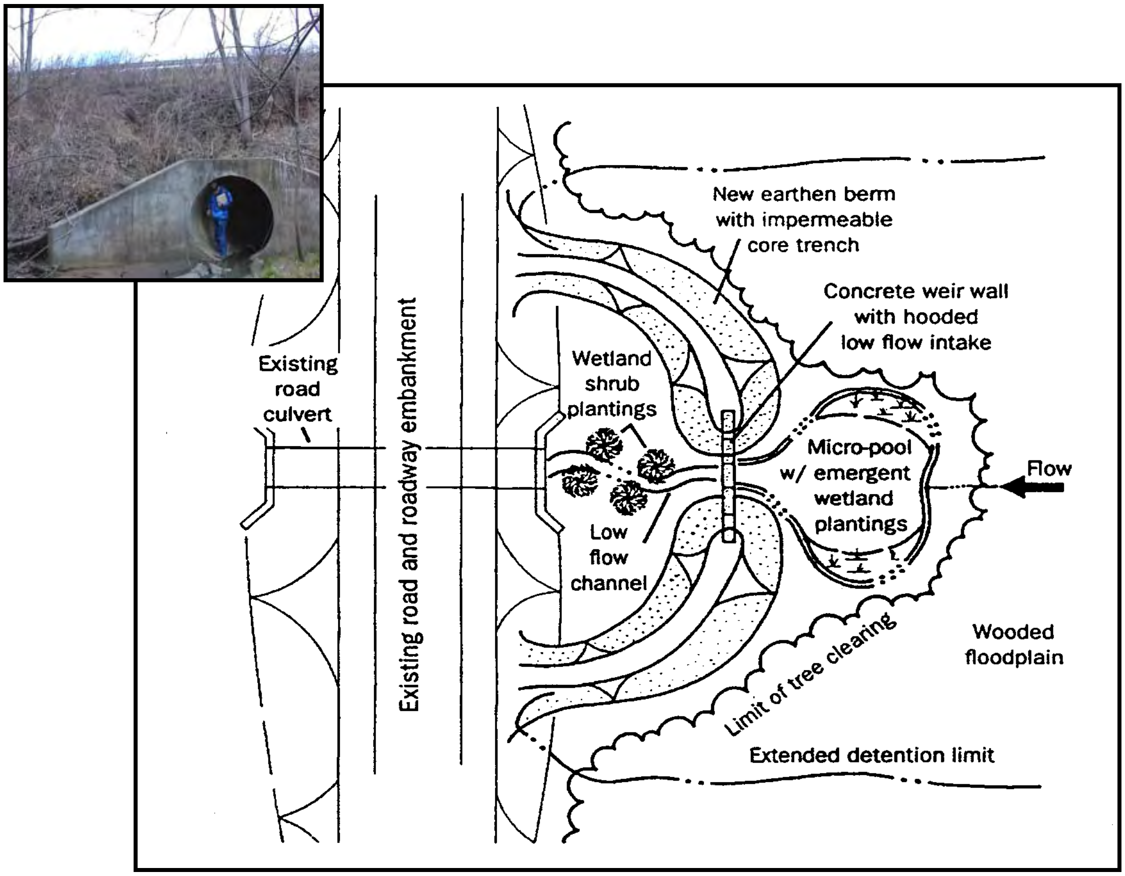


Figure B.22: Schematic of upstream storage retrofit proposed at highway culvert pictured at top right.

The SC form also asks you to determine whether the culvert serves as **grade control**, meaning that the bottom of the culvert controls the invert or bottom elevation of the stream. A grade control often acts to prevent upstream channel incision, and stops the upward migration of nick points. If you see a vertical drop in water elevation at the downstream end of the culvert (a little waterfall), this often signals that the culvert could be acting as grade control for stream erosion (Figure B.23). It is helpful to understand grade control in stream restoration and fish passage design to predict what might happen to stream channel dynamics if a culvert is repaired or replaced.

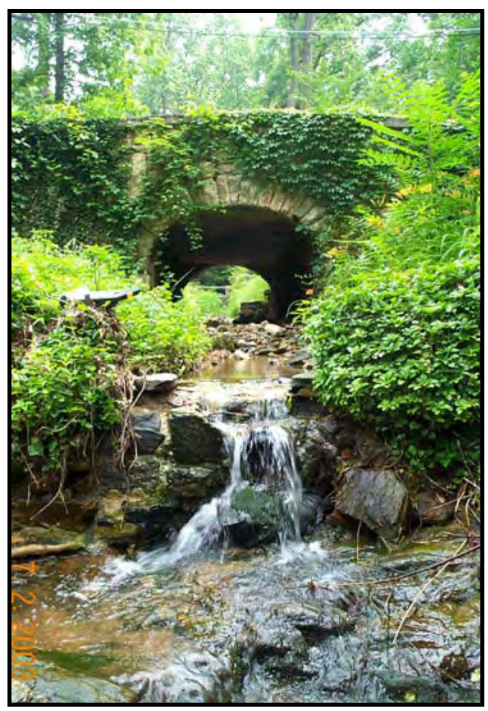


Figure B.23: Crossing acting as grade control and potential fish

What Stream Crossings Should I Record?

You should try to assess all man-made or natural structures that cross the stream, such as road culverts, railroad crossings, dams, or natural falls that create a change in grade or elevation in the stream. Exceptions include sewers or other utility crossings, which are evaluated using the UT field form, and channelized stream sections longer than 100 feet, which are separately assessed by the Channel Modification (CM) field form. Overhead crossings that appear to have minimal impact on the stream corridor can be skipped.

Field Assessment Tips

Some tips for assessing stream crossings in the field are offered below:

- Be careful investigating culverts. Do not enter them unless you can clearly see through to the other side AND enough light is available for walking.
- Be on the look out for outfalls inside culverts.
- Many culverts and other crossings lack enough capacity to pass floodwaters; you can often observe this if you see a lot of sediment deposition, debris jams, or slack or standing water upstream of the culvert.
- Since road crossings may often be your end/start points for survey reaches, make sure to track them on the Visual Survey form.

Channel Modification (CM)

Volunteers should examine the extent to which stream channels are modified within the urban stream corridor. Examples of channel modifications include channelization, bank armoring, channel lining, and flood plain encroachment. During the channel modification (CM) assessment, you will be specifically looking for channel segments that may need structural repair or present opportunities for a more natural stream channel design.

About Channel Modification

Many urban stream segments have been historically modified to safely convey floodwaters, maintain a stable channel, restrict channel migration, or realign channels around property or infrastructure. The basic engineering approach is to "design" a new channel or flood plain with less roughness (e.g., boulders, vegetation, large woody debris, meander bends), greater slope, and expanded cross-sectional area to pass floodwaters more quickly and efficiently. As a consequence, some urban streams are converted into straight channels that are often lined with concrete to reduce roughness. In other streams with little room for channel migration, banks are often fixed in place by armoring them with rip-rap and rock. In other situations, the capacity of the flood plain to accommodate floodwaters has been structurally altered by filling, dikes, or other measures.

In the most extreme instances, streams are entirely enclosed in underground pipes or extended culverts (note: this category of channel modification is already assessed by the SC form). Both stream and riparian habitat can be degraded or eliminated by channel modifications, and in some cases, fish passage may also be prevented. Newer, more environmentally-sensitive channel design may be a viable option to restore some natural features within modified channels. Figure B.24 illustrates some of the typical of channel modifications you may encounter during the assessment.

Figure B.24: Various types of channelized streams include a concrete channel and flood plain (panel a), a concrete-lined channel (panel b), and an armored stream segment (panel c).

Introduction to the CM Form

This section introduces you to the channel modification (CM) assessment form. The form asks you to record basic data on the length and nature of the channel modification, and determine whether it might be a candidate for possible restoration. This section describes the four parts of the CM form, and provides guidance on how to complete each one.

The first part of the CM form contains general header information that locates where the modified channel section is in the survey reach.

As always, the header should be modified to reflect your reach and site labeling system. If you are using a GPS unit, record the beginning and ending coordinates for each channel segment, and remember to note the **GPS unit ID #** and an **LMK** number. If the modified section is shorter than 50 feet long, GPS units cannot calculate an accurate length. Instead, measure these sections by pacing or with a tape measure. Depending on how extensively channels have been modified in the subwatershed, you may want to skip these short sections altogether.

The next part of the CM form asks you to describe the type of channel modification and the dominant material that comprises it.

Four basic options are available. **Channelization** refers to a channel that has been excavated and straightened to eliminate natural meanders and bends. **Bank armoring** consists of an extended length of bank protected by hard stabilization measures, such as rip-rap, gabions, rock, or retaining walls. Armoring can occur on one or both banks and should only be recorded if it extends more than 50 feet. **Concrete channels** should be checked on the CM form if the natural stream or banks have been replaced with concrete lining that extends more than 50 feet. Lastly, **flood plain encroachment** should be checked if you see obvious signs of earth fill, levees, or dikes in the flood plain or stream corridor. Note that more than one type of channel modification can occur in each segment. If only one bank is affected by the modification, indicate this in the notes section on the CM form. Table B.10 illustrates a number of common channel modifications you may encounter in the field.

Next, assess the condition of the channel, and note any perennial flow, sediment deposition, vegetative growth, or apparent connection with the flood plain. Each of these conditions provides useful clues about sediment and flow dynamics through the modified channel. You should also measure the basic dimensions of the channel modification, take a photo, and draw a rough sketch.

Questions to ask when assessing channel modifications:

How severely is this modification affecting stream corridor habitat?

What is the length and purpose of the modification?

Can softer bank stabilization methods be used?

Can more natural channel design be employed?

<table>
<tr><th colspan="3">Table B.10: Channel Modifications to Note During Site Assessment</th></tr>
<tr>
<td>
At crossings, only record on CM form if modification extends at least 100 feet up or downstream.</td>
<td>
Measure the width of the channel bottom. If there is perennial flow, measure the water depth.</td>
<td>
Channelized and concrete-lined segment that maintains good connectivity with the flood plain.</td>
</tr>
<tr>
<td>
Sediment deposits and algal growth on bottom of a concrete-lined channel.</td>
<td>
Rock revetments should be recorded as bank armoring.</td>
<td>

Imbricated rip-rap used for bank stabilization; Record if 50 feet or longer.</td>
</tr>
<tr>
<td>
Gabion baskets used to stabilize a stream bank.</td>
<td>
Highly urban subwatersheds frequently have most of their surface streams piped.</td>
<td>
Exposed portion of an enclosed stream in a commercial area.</td>
</tr>
</table>

The last part of the CM form asks you to assess the nature of the stream corridor adjacent to the channel modification and the current baseflow channel segment. Both factors are crucial to determine if natural channel design may be suitable for the channel segment.

You should estimate the "**available**" width of the adjacent stream corridor on both sides of the channel. Available means open ground, with no obvious structures or utilities present. Also, note if any earthen fill, dikes, or levees occur in the adjacent stream corridor, which could constrain flood plain capacity. Lastly, you should examine the **baseflow channel**, noting the average depth of flow, and the fraction of the channel bottom over which it flows. Check to see if there is a defined low-flow channel, and record its average depth of flow.

The last part of the CM form asks you to recommend whether the modified channel might be a candidate for structural repair, more natural channel design, or fish barrier removal. If you don’t feel comfortable about making a restoration recommendation, simply check the “Can't tell” box. The CM form provides some guidance on how to score the overall severity of channel modification on a scale of one to five (five being the most severe). Figure B.25 illustrates modified channel segments that should be considered restoration candidates.

Figure B.25: Candidate site for structural repair (panel a) and natural channel restoration (panel b)

Which Modified Channels Should I Record?

Most urban streams are extensively modified over much of their length, so only record "hard" channel modifications longer than 50 feet. Do not record channel modifications that are immediately associated with structured stream crossings unless they extend 100 feet above or below the crossing. "Soft" bank stabilization practices should not be counted.

Field Assessment Tips

Some quick tips to evaluate channel modifications in the field are provided below:

- To reduce the number of forms you will need to complete, only record channel modifications that are at least 50 feet long.
- Also you only need to record channel modifications associated with stream crossings if they extend at least 100 feet upstream or downstream of the crossing.
- Keep in mind that channel modifications can occur on the bed, banks, and flood plain of the stream corridor.
- If a channel modification extends on both sides of a road crossing that is used as a survey reach boundary, make sure to extend the survey reach to include the entire modified channel.
- Enclosed sections or extended culverts are picked up on the SC form and should not be recorded on the CM form.

Trash and Debris (TR)

Volunteers should evaluate the stream corridor to find locations where trash and debris (TR) are dumped or have accumulated. TR data helps you target stream reaches for routine stream clean-ups, adoption, or major removal of dumped materials (bulk or hazardous).

About Trash and Debris

Nothing is more unsightly than the accumulation of bags, cans, bottles, and other trash and debris along the stream corridor. Despite decades of anti-litter campaigns, trash still finds its way into streams and flood plains either from direct dumping or through transport through the storm drain system. Since the stream corridor is the low point of the urban landscape, considerable quantities of trash and debris build up over time. Yard wastes such as grass clippings, leaves, and trees are often dumped from the backyard to the stream. In more urban subwatersheds, fill material, construction debris, and rubble are frequently dumped in remaining flood plains, since they are perceived as vacant land. The presence of trash and debris can degrade resident perceptions about stream quality, reduce community amenities, contribute pollutants (e.g., nutrients, oil, bacteria), and create blockages at outfalls or other locations in the stream. Some examples of trash conditions you may observe are shown in Figure B.26.

Introduction to the TR Form

<u>Questions to ask when assessing trash and debris:</u>

Is this area trashier than the rest of the survey reach?

What kind of trash is it, and is it hazardous?

Is there an illegal dump, or other obvious source?

What level of effort will it take to clean this up?

This section introduces you to the trash and debris assessment form (TR) to report problems in the stream corridor. You are asked to collect basic information on location, type, and amount of trash at each site, and estimate the level of effort needed to clean it up. Each part of the TR form is described in this section, and is followed by guidance on how to complete each of them.

Figure B.26: Floating trash can accumulate at debris jams (a) or along banks, or be deposited in the flood plain during storms. No urban stream is complete without its signature trash item—the shopping cart (b). Outfalls often convey trash to the stream corridor (c).

Figure 31: Quantify the volume of trash in the area by estimating the number of pickup truck loads it would take to haul it away

The first part of the TR form contains general header information.

The header information should be modified to reflect your reach and labeling system, and whether you are using GPS. If you are using GPS units, record the coordinates for each site, and provide the **GPS unit ID #** and an **LMK** number.

The next section of the TR form asks you to describe the type, location, and likely source of the trash or debris. **Industrial** trash refers to large drums, construction debris and rubble, while **commercial** trash may include fast food items, plastic bags, grocery carts, car parts, or other items generated from commercial areas. **Residential** trash may include yard waste, toys, and household items that originate from backyard dumping. You should assess the dominant type of trash (e.g., is it mostly plastic bags or lumber from a nearby construction site), and try to find the likely source. If you find hazardous materials, record it as "other," describe it as best as you can, and report it to the appropriate authorities listed on your emergency contact list. While you may not always be able to tell where the trash came from, you can usually guess how it was delivered—either by stream flooding, dumping, or from the nearest storm water outfall. Delivery information can help determine the best clean-up or prevention option to explore. Lastly, try to estimate the quantity of trash at the site by envisioning the number of pickup truck loads it would take to remove it (Figure B.27).

In the last part of the TR form, you are asked to recommend potential clean-up or prevention practices that you feel are appropriate for the site. Practices to consider include routine stream clean-ups, stream adoption, municipal removal, upstream source control, and enforcement. Stream clean-ups organized by watershed groups can be great outreach tools to involve citizens in restoration (Figure B.28). If a storm water outfall is thought to be a chronic source of trash, upstream catch basin clean-outs, storm drain stenciling, or

Figure B.28: Identify target locations for organized stream clean-up events.

retrofitting to reduce floatables may be an option. If dumping appears to be associated with easy vehicle access, restricting or eliminating access may also solve the problem (Figure B.29).

If trash needs to be removed from the site, you need to estimate the type of equipment and personnel that are most suitable for the job. Also, look around for the best location to store all the trash you will collect (ideally a nearby dumpster). The TR form asks you to assign a clean-up potential score based on the trash volume and site access (on a scale of one to five, where five is the best). The TR form provides descriptive scoring criteria to help make this determination.

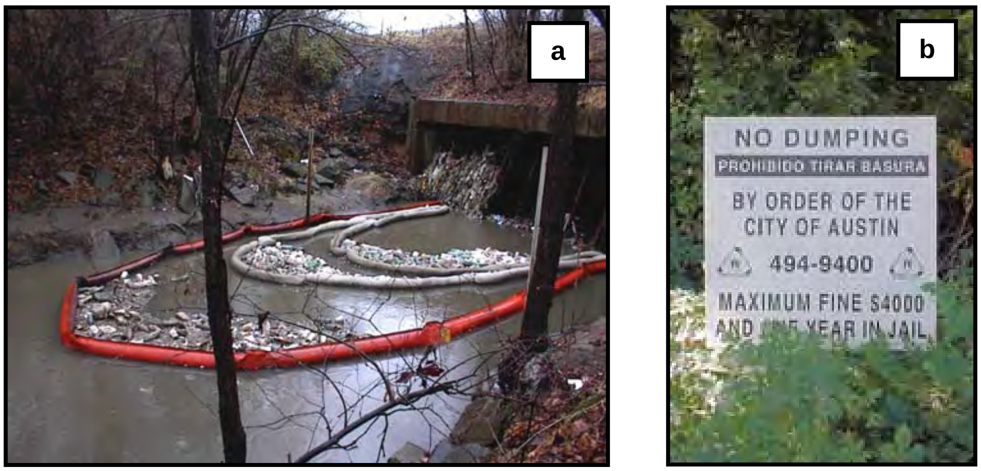


Figure B.29: Prevention and enforcement practices for addressing trash in highly urban watersheds may include inserting a trash boom downstream of a storm water outfall to catch floatables (panel a), or removing vehicle access and posting "no dumping" sign.

What Trash/Debris Impacts Should I Record?

You don't need to record every bottle, beer can, or plastic bag you find along the stream corridor. As a general rule, only note areas where trash and debris has accumulated well above the average level observed for the survey reach, or where potentially hazardous or unknown chemical containers are found.

Field Assessment Tips

Some quick field tips to assess trash and debris impacts are offered below:

- If trash is a known or potential hazard, contact appropriate authorities immediately.
- Trash tends to accumulate around debris jams and may be mobile during storm flows.
- Try to note the presence of poison ivy or other hazards (e.g., traffic or deep, fast-flowing water) that may limit volunteer clean-ups to older teens and adults.
- Look around for a nearby dumpster, and think about accessibility and available parking for clean-up volunteers.
- Do your part and take a plastic bag along to pick up some trash during the survey.

Miscellaneous Stream Features (MI)

The Miscellaneous stream features (MI) form is used to track any unusual impact or notable feature impact during the stream walk that cannot be assessed by any of the other impact forms. Specifically, the MI form is used to record high quality habitats or rare biota in the stream corridor, grade controls that could influence stream restoration, disturbances in the stream corridor, or in-stream water quality problems that may warrant further investigation.

About Miscellaneous Stream Features

When walking a stream, you inevitably encounter features that may be important for restoration planning but do not conveniently fit into the other seven impact forms. You can either choose to note these features on the overall Visual Survey form, or you can track them on the MI form to ensure that they are included in restoration planning. For example, you may want to track the locations of high quality habitats such as emergent wetlands, disturbances to the stream corridor due to construction, excavation, and livestock access. You may also want to record in-stream water quality problems not visibly associated with storm water outfalls, or any other features you feel are important. Miscellaneous features should be considered in the context of stream corridor restoration potential and how they might relate to discharge prevention, riparian management, stream restoration, and storm water retrofit strategies. Table B.11 illustrates some miscellaneous features worth tracking.

Introduction to the MI Form

The miscellaneous feature form (MI) is used to track stream and flood plain features that don't fit into one of the other seven Site Condition forms or the overall Visual Survey assessment. Simply note basic data on the location of your feature on the MI form, and a brief description of any potential restoration recommendations.

What Stream Features Should I Record?

This is the catch-all form to record unusual features that you want to track, but aren't sure where to record them. Include any features you want on the MI form, but make sure that the feature relates to your overall restoration goals.

Field Assessment Tips

The following tips should help you use the MI form:

- If you end up reporting a lot of the same kinds of features on your MI form (such as livestock crossings), consider developing a new impact form to specifically evaluate the feature.

- Waterfalls or other hard features that provide a fixed location for change in vertical elevation (at least two feet) should be recorded (excluding pipes, stream crossings, or modified channels).
- Nickpoints, where softer substrates are actively eroding, should be recorded on the ER form.
- If you see water quality impairments, look around for outfalls, pipes, or other potential sources.
- Construction activity associated with a known stream restoration project need not be recorded.
- Note the presence of log and debris jams, particularly if they could clog or block downstream road crossings.
- Document as much information as possible about suspicious activities, and take photos, which are extremely helpful to support local enforcement measures.
- Write down whatever information you can ascertain from stream gauges or monitoring station markers.
- Don’t forget about these miscellaneous features during data analysis and review.

Table B.11: Examples of Miscellaneous Stream Corridor Features		
 Excavation, dumping, or construction activities in the stream corridor may require enforcement.	 Unstructured crossings such as culvertless roads, ATV trails, or gravel livestock crossings.	 Failed erosion and control practices causing sediment loading into stream.
 Cattle in the stream can contribute to water quality, stream habitat, and riparian degradation.	 Stream gauges or other features denoting repeat sampling or monitoring locations.	 Water quality problems like excessive algae, fish kills, or sediment plumes.
 Unusual deposits not associated with an immediate source.	 Special natural areas, such as wetlands, heron rookeries, and vernal pools.	 Specimen trees or rare plant or animal species found within stream corridor.
 Log jams that may create flooding or erosion problems.	 Grade control features such as exposed bedrock, rock outcroppings, or water falls.	 Stream sinks or sources, particularly in karst areas where caves and sinkholes are common.

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Stream Watch Site Condition Form

Outfalls **OT**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________
Site ID#: **(mark on map)** OT – _____________	**Lat**____°______'______" **Long**______°______'______" **LMK**__________	**GPS #:** **(unit ID)** ___________

Bank: ☐ LT ☐ RT ☐ head	**Type:**	**Material:**	**Shape:**	**Dimensions:**	**Submerged:**
Flow: ☐ none ☐ trickle ☐ moderate ☐ substantial ☐ other:______	☐ closed pipe →	☐ concrete ☐ metal ☐ pvc / plastic ☐ brick ☐ other:__________ →	☐ circular ☐ single ☐ elliptical ☐ double ☐ triple ☐ other:__________ →	diameter:______(in) →	☐ no ☐ partially ☐ fully
	☐ open drainage →	☐ concrete ☐ earthen ☐ other:__________ →	☐ trapezoid ☐ parabolic ☐ other:__________ →	depth:________(in) width (top):_____(in) " (bottom):_____(in)	

Condition:	**Odor:**	**Deposits / Stains:**	**Vegetative Density:**	**Pipe Benthic Growth:**
☐ none ☐ chipped/cracked ☐ peeling paint ☐ corrosion ☐ other:______	☐ none ☐ gas ☐ sewage ☐ rancid/sour ☐ sulfide ☐ other:______	☐ none ☐ oily ☐ flow line ☐ paint ☐ other:______	☐ none ☐ normal ☐ inhibited ☐ excessive ☐ other:______	☐ none ☐ brown ☐ orange ☐ green ☐ other:________________ **Pool Quality:** ☐ no pool ☐ good ☐ odors ☐ colors ☐ oil ☐ suds ☐ algae ☐ floatables ☐ other:_____________

For Flowing Only	**Color:**	☐ clear ☐ brown ☐ grey ☐ yellow ☐ green ☐ orange ☐ red ☐ other:____
	Turbidity:	☐ none ☐ slight cloudiness ☐ cloudy ☐ opaque
	Floatables:	☐ none ☐ sewage (toilet paper, etc.) ☐ petroleum (oil sheen) ☐ other:______________
Other Concerns:	☐ excess trash (paper/plastic bags) ☐ dumping (large items) ☐ excessive sedimentation ☐ needs regular maintenance ☐ bank erosion ☐ other:______________________________________	

Restoration Potential

Daylighting:	Potential: ☐ yes ☐ no ☐ not investigated	Length of vegetative cover from outfall:_________ft Type of existing vegetation:____________________ Slope:____°
Stormwater Retrofit:	Potential: ☐ yes ☐ no ☐ not investigated	Stormwater currently: ☐ uncontrolled ☐ controlled
	Drainage area land use description:____ Acreage available:____	

Severity: **(circle #)**	Has a strong discharge with a distinct color and/or a strong smell. The amount of discharge is large compared to the amount of normal flow in the stream that is receiving it, and the discharge appears to be having a significant impact downstream.	Has a small discharge coming out of it but the discharge is usually clear and has no odor associated with it. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Storm water outfall pipes or other channels and/or pipes that appear to be designed to carry storm water runoff and does not have dry weather discharge nor does it appear to be causing any erosion problems.
	5 4	3 2	1

Refer for Local Compliance: ☐ yes ☐ no

Sketch/Notes:

Stream Watch Site Condition Form

Erosion **ER**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** MI – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Description:
- ☐ downcutting
- ☐ widening
- ☐ headcutting
- ☐ unknown
- ☐ other:________________________
- ☐ bed scour
- ☐ sloughing
- ☐ undercut bank
- ☐ slope failure

Dimensions: **(looking downstream; either OR both sides)**

Bank of concern	☐ left (LT)	☐ right (RT)	☐ both
Length (if no gps)	LT_____ft	and/or RT____ft	bottom width______ft
Bank ht	LT_____ft	and/or RT____ft	top width_________ft
Bank angle	LT_____°	and/or RT____°	wetted width_______ft

Loss of Property:	☐ no	☐ potential	☐ yes, currently (describe):_________________________
Threat to Infrastructure:	☐ no	☐ potential	☐ yes, currently (describe):_________________________

Location: ☐ meander bend ☐ straight section ☐ steep slope/valley wall ☐ other:__________

Existing Riparian Width: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

Land Use: ☐ private ☐ public ☐ unknown ☐ forest ☐ field/ag ☐ developed:___________________

Site Severity Compared to Rest of Reach: **(circle #)**	Major incision, with very high banks on both sides of the stream that are unstable and eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.		High banks, evidence that the stream is eroding at a fast rate; no threat to property or infrastructure.		Erosion is limited to small area; is being caused by a pipe outfall and the area affected is fairly limited.
	5	4	3	2	1
Access:	Easily accessible by car and on foot (an open area inside a public park where there is sufficient room to park safely near the site; heavy equipment could easily access using existing roads or trails).		Easily accessible by foot only (stream section that could be reached by crossing a large field or a site accessible only by 4-wheel drive vehicles).		Difficult to reach. Ex. site on private land with no roads or trails nearby; hike over a mile to reach site; need to build access road for equipment over a long distance through rough terrain.
	5	4	3	2	1

Plan View:

Cross Section:

LT Bank **RT Bank**

Notes:

Stream Watch Site Condition Form **Impacted Buffer** **IB**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** IB – ______________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** ___________

Impacted Bank:
☐ LT
☐ RT
☐ both

Reason Inadequate:
☐ lack of vegetation ☐ too narrow ☐ widespread invasive plants
☐ recently planted ☐ other:_______________________________

Land Use: **(facing downstream)**		Private	Institutional	Golf Course	Park	Other Public
	LT bank	☐	☐	☐	☐	☐:________________
	RT bank	☐	☐	☐	☐	☐:________________

Dominant Land Cover:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT bank	☐	☐	☐	☐	☐	☐	☐:___________
RT bank	☐	☐	☐	☐	☐	☐	☐:___________

Invasive Plants: ☐ none ☐ rare ☐ partial coverage ☐ extensive coverage ☐ unknown

Stream Shade Provided? ☐ none ☐ partial ☐ full **Wetlands Present?** ☐ no ☐ yes ☐ unknown

Potential Restoration Candidate: ☐ active reforestation ☐ greenway design ☐ natural regeneration
☐ no ☐ invasives removal ☐ other:______________________________

Restorable Area:	**Reforestation Potential:** **(Circle #)**	Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting.	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate.	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting.
LT bank RT Length (ft): ____ ____ Width (ft): ____ ____		5 4	3	2 1

Potential Conflicts with Reforestation:
☐ widespread invasive plants ☐ potential contamination ☐ lack of sun ☐ poor/unsafe access to site
☐ existing impervious cover ☐ severe animal impacts (deer, beaver) ☐ other:____________________

Notes:

Stream Watch Site Condition Form | **Utility Impacts** | **UT**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** UT – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Type: ☐ leaking sewer ☐ exposed pipe ☐ exposed manhole ☐ other:__________	**Material:** ☐ concrete ☐ plastic ☐ smooth metal ☐ other:______	**Location:** ☐ floodplain ☐ stream bank ☐ above stream ☐ stream bottom ☐ other:______	**Potential Fish Barrier:** ☐ yes ☐ no water drop:________(inches)	**Dimensions:** diameter:_____________(ft) length exposed:_______(ft)
			Condition: ☐ joint failure ☐ pipe corrosion/cracking ☐ manhole cover absent ☐ protective covering broken ☐ other:____	

Evidence of Discharge:	**Color:** ☐ none ☐ clear ☐ dark brown ☐ lt brown ☐ yellowish ☐ greenish ☐ other:______
	Odor: ☐ none ☐ sewage ☐ oily ☐ sulfide ☐ chlorine ☐ other:________________________
	Deposits: ☐ none ☐ toilet paper ☐ lime ☐ surface oils ☐ stains ☐ other:______________

Severity: **(circle #)**	Any pipe that is leaking; a section of pipe undermined by erosion and could collapse in the near future;; a long section is exposed; and a manhole stack located in the center of the stream channel and there is evidence that the stack is failing.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	A small section of pipe exposed and the stream bank near the pipe appears to be stable; the pipe is exposed but has been reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.
	5 4	3	2 1

Refer for Local Compliance: ☐ yes ☐ no

Notes:

Stream Watch Site Condition Form **Structured Crossing** **SC**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** SC – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Type*: ☐ road crossing ☐ railroad crossing ☐ manmade dam ☐ beaver dam ☐ geological formation ☐ other:____

For Road/ Railroad Crossings Only	**Shape:** ☐ arch ☐ bottomless ☐ box ☐ circular ☐ elliptical ☐ other:______	**# Barrels:** ☐ single ☐ double ☐ triple ☐ other:______	**Material:** ☐ concrete ☐ metal ☐ other:______	**Alignment:** ☐ flow-aligned ☐ not flow-aligned ☐ do not know	**Dimensions:** **(if variable, include in sketch)** barrel diameter:______(ft) barrel height:________(ft) culvert length:________(ft) culvert width:________(ft) roadway elevation:___(ft)
	Condition: **(evidence of…)** ☐ cracking/chipping/corrosion ☐ scouring downstream ☐ sediment deposition ☐ failing embankment ☐ other (describe):			**Culvert Slope:** ☐ flat ☐ slight (2^{o}-5^{o}) ☐ obvious (>5^{o})	

For Potential Fish Blockages	**Extent of Physical Blockage:** ☐ total ☐ partial ☐ temporary ☐ unknown	**Severity:** **(circle #)**		
		A structure such as a dam or road culvert on a 3rd order or greater stream that would totally block the upstream movement of anadromous fish and there is no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream or a partial blockage that could interfere with the migration of anadromous fish.	A temporary fish barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it. Natural fish barriers such as waterfalls.
	Blockage: ☐ drop too high water drop:________(in) ☐ flow too shallow water depth:_______(in) ☐ other:___________________________	5 4	3	2 1

Notes:	**Sketch:**

* **Pipe crossings and channelization have separate forms. Debris jams fall into miscellaneous.**

Stream Watch Site Condition Form — **Channel Modification** **CM**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** CM – ____________	**Start:** Lat____°______'______" Long____°______'______" LMK_______ **End:** Lat____°______'______" Long____°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Type: ☐ straightening ☐ bank stabilization ☐ channel protection ☐ underground ☐ other:__________

Material: ☐ concrete ☐ gabion ☐ rip rap ☐ earthen ☐ metal ☐ other:_____________	**Does channel have perennial flow?**	☐ yes ☐ no	**Dimensions:** Bottom Width_________(ft) Water Depth:_________(in) Length:______________(ft)
	Is there evidence of channel deposition?	☐ yes ☐ no	
	Is vegetation growing in channel?	☐ yes ☐ no	
	Is this a fish barrier?	☐ yes ☐ no	

Severity: **(circle #)**	A significant section of concrete stream (i.e., >500 ft.) channel where water is very shallow (<inch deep) with no natural sediments present in the channel.	A moderate length of stream (i.e., > 200 ft.), but the channel has stabilized over time and is beginning to show signs that it is functioning as a natural stream channel. Bars may have formed in channel & vegetation may be present on the bars.	An earthen channel of less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3 2	1

Notes:

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** CM – ____________	**Start:** Lat____°______'______" Long____°______'______" LMK_______ **End:** Lat____°______'______" Long____°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Type: ☐ straightening ☐ bank stabilization ☐ channel protection ☐ underground ☐ other:__________

Material: ☐ concrete ☐ gabion ☐ rip rap ☐ earthen ☐ metal ☐ other:_____________	**Does channel have perennial flow?**	☐ yes ☐ no	**Dimensions:** Bottom Width_________(ft) Water Depth:_________(in) Length:______________(ft)
	Is there evidence of channel deposition?	☐ yes ☐ no	
	Is vegetation growing in channel?	☐ yes ☐ no	
	Is this a fish barrier?	☐ yes ☐ no	

Severity: **(circle #)**	A significant section of concrete stream (i.e., >500 ft.) channel where water is very shallow (<inch deep) with no natural sediments present in the channel.	A moderate length of stream (i.e., > 200 ft.), but the channel has stabilized over time and is beginning to show signs that it is functioning as a natural stream channel. Bars may have formed in channel & vegetation may be present on the bars.	An earthen channel of less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3 2	1

Notes:

Stream Watch Site Condition Form **Trash and Debris** **TR**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID: (camera / picture #)** ________ / #________
Site ID#: (mark on map) TR – ____________	**Start:** Lat____°______'______" Long____°______'______" LMK_______ **End:** Lat____°______'______" Long____°______'______" LMK_______	**GPS #: (unit ID)** __________

Type: ☐ industrial ☐ commercial ☐ residential	**Material:** ☐ plastic ☐ tires ☐ appliances ☐ yard waste ☐ automotive ☐ medical ☐ construction ☐ metal ☐ paper ☐ other:__________	**Source:** ☐ unknown ☐ flooding ☐ illegal dump ☐ local outfall ☐ other:_____________	**Location:** ☐ stream ☐ riparian area ☐ LT bank ☐ RT bank	**Land Ownership:** ☐ public ☐ private ☐ unknown **Amount of Trash:** **(# trash bags)**________

Clean Up Effort:	Equipment: ☐ heavy equipment ☐ trash bags ☐ unknown Who: ☐ volunteers ☐ local gov ☐ hazmat ☐ unknown	**Dumpster within 100 ft:** ☐ yes ☐ no

Severity: **(circle #)**	A large amount of trash scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials.	A fairly large amount of trash in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access.
	5 4	3	2 1

Refer for Local Compliance: ☐ yes ☐ no

Notes:

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID: (camera / picture #)** ________ / #________
Site ID#: (mark on map) TR – ____________	**Start:** Lat____°______'______" Long____°______'______" LMK_______ **End:** Lat____°______'______" Long____°______'______" LMK_______	**GPS #: (unit ID)** __________

Type: ☐ industrial ☐ commercial ☐ residential	**Material:** ☐ plastic ☐ tires ☐ appliances ☐ yard waste ☐ automotive ☐ medical ☐ construction ☐ metal ☐ paper ☐ other:__________	**Source:** ☐ unknown ☐ flooding ☐ illegal dump ☐ local outfall ☐ other:_____________	**Location:** ☐ stream ☐ riparian area ☐ LT bank ☐ RT bank	**Land Ownership:** ☐ public ☐ private ☐ unknown **Amount of Trash:** **(# trash bags)**________

Clean Up Effort:	Equipment: ☐ heavy equipment ☐ trash bags ☐ unknown Who: ☐ volunteers ☐ local gov ☐ hazmat ☐ unknown	**Dumpster within 100 ft:** ☐ yes ☐ no

Severity: **(circle #)**	A large amount of trash scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	A fairly large amount of trash in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access.
	5 4	3	2 1

Refer for Local Compliance: ☐ yes ☐ no

Notes:

Stream Watch Site Condition Form **Miscellaneous** **MI**

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** MI – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Describe:

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** MI – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Describe:

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** MI – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Describe:

Watershed:	**Date:**_____/______/______	**Assessed by:**
Stream ID:	**Time:**_____:______am/pm	**Photo ID:** **(camera / picture #)** ________ / #________

Site ID#: **(mark on map)** MI – _____________	**Start:** Lat____°______'______" Long___°______'______" LMK_______ **End:** Lat____°______'______" Long___°______'______" LMK_______	**GPS #:** **(unit ID)** __________

Describe:

Developing and Implementing a Stream Watch Program

Appendix C
Data Interpretation: Water Quality and Macroinvertebrate Sampling

Appendix C.
Data Interpretation: Water Quality and Macroinvertebrate Sampling

In order to assist watershed groups with interpretation of data three tables have been provided:

- Table C.1 summarizes concentrations of bacteria and nutrients in different source waters
- Table C.2 provides some generic thresholds for helping groups determine where and why potential water quality problems may be occurring
- Table C.3 lists minimum levels of E. coli that may indicate a problem
- Table C.4 provides a narrative description of different IBI scores for the interpretation of macroinvertebrate and fish populations

Due to the complex nature of water quality issues and interpretation of data, a number of recommended publications where individuals can learn more about water quality issues and data interpretation have been provided at the end of this Appendix.

Table C.1 provides source water concentrations for three of the parameters recommended for synoptic water quality sampling. The data includes concentrations found in polluted source waters including raw sewage, and a non-polluted source from a typical forested watershed. Standard and benchmarks are also provided for the bacteria and nutrient parameters.

Table C.1: Source Water Bacteria and Nutrient Concentrations

Source	Fecal Coliform (colonies/100 ml)	Total Nitrogen (mg/liter)	Total Phosphorus (mg/liter)
Raw Sewage	1,000,000 - 6,400,000	35 - 80	10 - 27
Combined Sewer Overflow (CSO)*	10,000 - 1,000,000	5 - 12	1 - 5
Stormwater Runoff	5,000 - 100,000	1.0 - 4	0.2 - 0.8
Forest	10 - 100	1	0.05
Standards	< 200 (water contact recreation) < 150 (shellfish)	< 10 (drinking water) 3-5 (eutrophication)	> 1 (indicates problem) 0.1 mg/l (eutrophication)

Data sources: Schueler, 1999; Metcalf and Eddy, 1991; Caraco, 2002; USGS, 2000
* Total Nitrogen and Total Phosphorus for CSOs are estimates and could be higher or lower depending on dilution.

Tables C.2 and C.3 are provided to help provide a framework for understanding data collected during the synoptic assessment. The nutrient levels are based on data from USGS collected nationwide from urban streams, with 85% of the stations evaluated with flow-weighted concentrations less than the designated values. As a result, a sample concentration greater than the referenced value should be considered elevated and perhaps subject to one or more of the water quality problems listed in the table.

Table C.2: Minimum Concentrations that Define a Problem

Parameter	Potential Problem Level *	Possible Cause of Water Quality Problem
Total Nitrogen (TN)	3.5 mg/l	High nutrients in ground water from agriculture, lawn practices or sewage contamination from illicit connection, sanitary line break or failing septic system
Total Kjeldhal Nitrogen (TKN)		
Nitrite & Nitrate		
Total Phosphorus (TP)	0.4 mg/l	Contamination from lawn practices, agriculture, sewage or washwater contamination
Ammonia (NH4)	0.3 mg/l	Sewage or washwater contamination from illicit connection, sanitary line break or failing septic system

* Nutrient parameters based on USGS NAWQA data with 85% of flow weighted samples being less than these values in urban watersheds (Note data from Nevada was not used due to climatic differences and for some parameters they were an order of magnitude higher)

Table C.3: Minimum Levels of E. coli that Indicate a Problem

Recreational Use Category	Potential Problem Level*	Possible Cause of Water Quality Problem
Designated (Permitted) Beach Areas	235 MPN/100 ml	Wildlife sources, sewage contamination from illicit connection, sanitary line break or failing septic system
Moderate Full Body Contact Recreation	298 MPN/100 ml	
Lightly Used Full Body Contact Recreation	410 MPN/100 ml	
Infrequently Used Full Body Contact Recreation	576 MPN/100 ml	

* Source: http://www.mde.state.md.us/ResearchCenter/Data/waterQualityStandards/draftreg.asp

Table C.4 provides general descriptions for the interpretation of results generated from the analysis of the macroinvertebrate data collected by volunteers and analyzed by either DNR or DEPRM. By using the descriptions of different IBI scores a watershed group should be able to interpret the numerical IBI scores generated from the analysis of the macroinvertebrate samples.

Table C.4: Narrative Descriptions of Stream Biological Integrity Associated with Each of the IBI Categories		
Good	IBI score 4.0 - 5.0	Comparable to reference streams considered to be minimally impacted. Fall within the upper 50% of reference site conditions.
Fair	IBI score 3.0 - 3.9	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of these minimally impacted streams. Fall within the lower portion of the range of reference sites (10th to 50th percentile).
Poor	IBI score 2.0 - 2.9	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating some degradation.
Very Poor	IBI score 1.0 - 1.9	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating severe degradation.
Source: Stranko and Rodney, 2001		

References

Caraco, D. 2002. The Watershed Treatment Model . Version 3.1. Center for Watershed Protection. Ellicott City, MD

Metcalf and Eddy, 1991. Wastewater Engineering: Treatment, Disposal and Reuse. McGraw-Hill, Inc. New York, NY

Schueler, T. 1999. Microbes in Urban Watersheds: Concentrations, Sources and Pathways in Watershed Protection Techniques. Vol.3, No. 1, Ellicott, City, MD

Stranko S. and Rodney, W., 2001. Final Data Report: Habitat Quality and Biological Integrity Assessment of Freshwater Streams in the Saint Mary's River Watershed. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division, Annapolis, MD. available online at http://dnrweb.dnr.state.md.us/download/bays/streams/ea01-2_stmary.pdf

USGS, 2000. Summary of nutrient concentrations for streams and ground water. Data provided for use by the Heinz Center for the report "*The State of the Nation's Ecosystems*" published in 2002. http://water.usgs.gov/nawqa/nutrients/datasets/nutconc2000/sw_nuts_Heinz.xls

Wright, J. 2001. Identifying and Eliminating Illicit Connections in the Clear Creek Watershed. In the Proceedings of The State of the Bay Symposium V, January 31 - February 02, 2001. Editors Cathy L. Palmer, Jonathan L. Klamberg, Steward J. Schultz and Scott A. Jones. Galveston Bay Information Center, Texas A&M University at Galveston. CTF-09/01 GBEP T-5, January 2001

Recommended Reading

Macroinvertebrates, Fish and Habitat:

- Allan, J.D. 1995. Stream Ecology -- Structure and Function of Running Waters. Chapman and Hall, UK.
- Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Urban Stormwater, Water Quality and Monitoring:

- Burton, G.A., Jr., and R. Pitt. 2002. Stormwater Effects Handbook: A Tool Box for Watershed Managers, Scientists and Engineers. CRC/Lewis Publishers, Boca Raton, FL, 924 pp.

Good General Reference:

- Jeffries, M. and Mills, D., 1990, Freshwater ecology-Principles and applications: New York, Belhaven Press, 285 p.

Stream Hydrology and Monitoring:

- Gordon N. D, McMahon T. A and Finlayson B. L 1992 Stream Hydrology: An Introduction for Ecologists Wiley Chichester
- Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. W.H. Freeman, San Francisco.

National Data for Comparison:

- *USGS, 2000. Summary of nutrient concentrations for streams and ground water*. Data provided for use by the Heinz Center for the report "*The State of the Nation's Ecosystems*" published in 2002. http://water.usgs.gov/nawqa/nutrients/datasets/nutconc2000/sw_nuts_Heinz.xls

Appendix D
Stream Watch Program Database
(under separate cover)

Appendix E
Stream Watch Program Flyer

Why Adopt-A-Stream?

- Learn more about your local streams
- Help collect valuable data on Baltimore stream health
- Monitoring streams helps to monitor the health of the environment as a whole

How to Adopt -A-Stream

- Contact JFWA and attend a short training
- Choose a local stream to adopt or we can help you find a stream
- Choose adoption level
- Off you go

For more information contact JFWA's Adopt-A-Stream coordinator:

Telephone: 410-261-3515

Fax: 410-261-3506

Email: jfwa@jonesfalls.org

Website: www.jonesfalls.org

Jones Falls Watershed Association

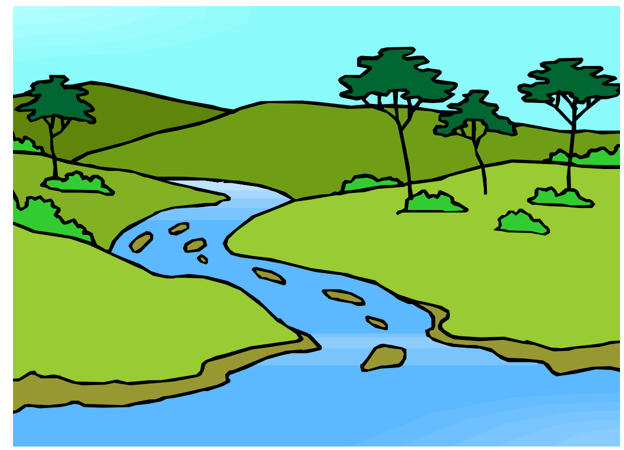
Making a splash close to home.

Jones Falls Watershed Association

3503 N. Charles Street

Baltimore, MD 21218

Jones Falls Watershed ADOPT-A-STREAM Program



Working together to make Baltimore streams healthier

THE JONES FALLS WATERSHED

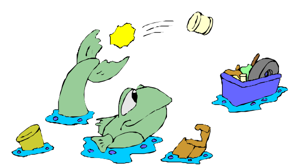
The Jones Falls watershed occupies over 58 square miles of land in Baltimore County and City which eventually drains into the Jones Falls River. The JF watershed includes 10 subwatersheds and over 200 miles of stream. Every stream within the watershed is unique. Some streams in the upper reaches of the Jones Falls support trout reproducing waters while other streams meander undiscovered through lush sections of Baltimore City. Unfortunately, the streams of Jones Falls also have their problems—they are affected by storm water runoff, leaks from sewer and septic systems, erosion and impacted riparian buffers. The Jones Falls Watershed Association (JFWA) implements programs to reduce storm water runoff, clean debris from streams and identify areas impacted by sewage, but we need your help to monitor these streams better.

2003 Snapshot Sample Locations

STREAMWATCH PROGRAM

StreamWatch is a partnership program between the Jones Falls Watershed Association, Center for Watershed Protection and Baltimore County. StreamWatch allows the Jones Falls community to learn more about their local streams while simultaneously assisting JFWA and local governments with the collection of valuable stream health data. Within StreamWatch there is the Adopt-A-Stream program. There are several levels of adoption that a volunteer can choose from—each level has different responsibility and time commitment requirements. Volunteers can adopt as an individual or a group and may choose their own stream to adopt.

ADOPT-A-STREAM LEVELS



Stream Cleaner

As a Stream Cleaner volunteers are responsible for removing trash from their adopted section on a quarterly basis. Removing trash from in and around the streams will not only create a more beautiful area, but will also improve the overall health of the stream.

Stream Walker

Stream Walkers will complete assessment forms designed to collect information on the health of a stream and its riparian area. These forms also help to assess stream habitat and identify major concerns. In the first year of adoption, the assessment will need to be completed twice.

Stream Walker Cont'd

After the initial year, visual assessments are completed unless changes to the stream need to be noted in the form. As a Stream Walker, the responsibilities of the Stream Cleaner also apply.

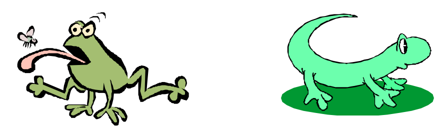
Stream Watcher

In addition to the Stream Cleaner quarterly clean-ups and the Stream Walker assessments, the Stream Watcher will collect specific information on impairments and potential restoration opportunities observed within the stream.

OTHER WAYS TO HELP

StreamWatch supports several other programs that help monitor and improve stream health and water quality.

1. Storm Drain Stenciling
2. Water Quality Monitoring



Volunteers can participate in two annual stream sampling programs. The snapshot sampling occurs in 23 designated sites throughout the Jones Falls watershed. Volunteers help to collect water quality data to better understand watershed conditions and to help identify areas that may be a source of water quality problems. Benthic Macroinvertebrate monitoring also occurs throughout the watershed once a year and results indicate the quality of stream health. StreamWatch also supports a storm drain stenciling program throughout the watershed.

Appendix F
Stream Watch Training Presentation

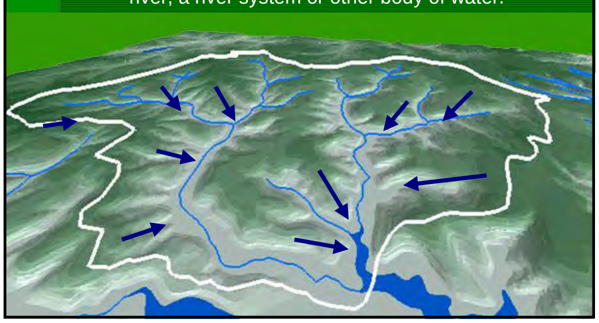
Jones Falls Watershed Stream Watch Program

What is a Watershed?

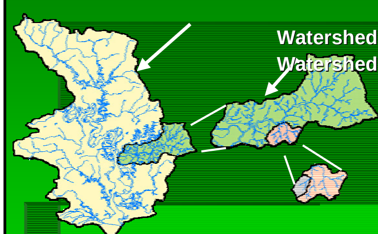
It isn't water!

A watershed is land?

A watershed is the region of land that drains into a river, a river system or other body of water.



Watersheds are different sizes



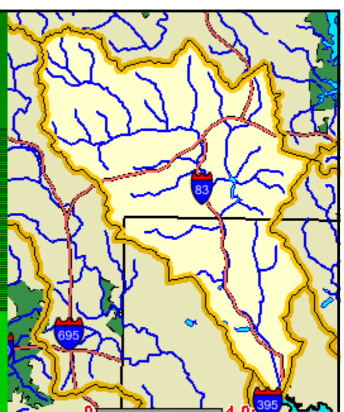
Subasin: i.e. Chesapeake Bay

Watershed: i.e. Jones Falls Watershed

Subwatershed: i.e. Stony Run

You are always in a watershed and can be in more than one watershed at a time.

The **Jones Falls Watershed** is a 58 square mile basin that reaches from Caves Valley in the Northwest to the Inner Harbor.

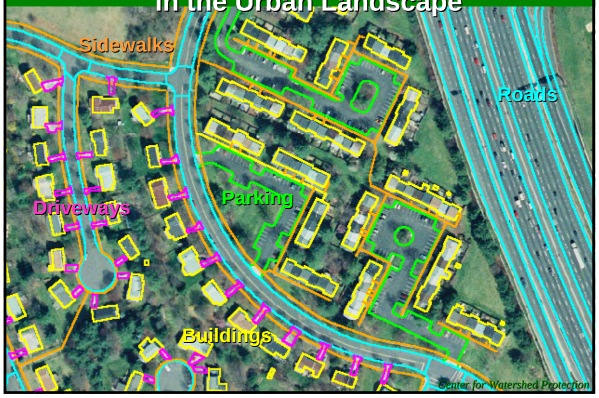


Watershed Issues

- Water Quality
  - Sewer and Septic Leaks
  - Point Source Discharges
  - Run Off Quality
  - Sediment
- Stream Habitat
  - Erosion
  - Sediment
  - Water Quality
  - Riparian Buffer

34% of the Jones Falls Watershed is covered in impervious surfaces

Components of Impervious Cover in the Urban Landscape

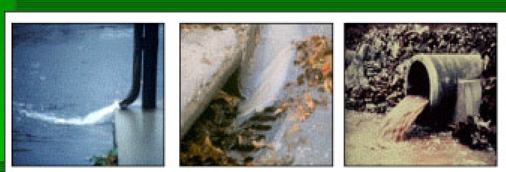


Impervious Cover Influences Base Flow

- Many streams draw from groundwater
- Impervious surfaces can block water from contributing to groundwater supply
- This can result in lower stream flows during dry weather

Impervious cover influences storm flow in streams

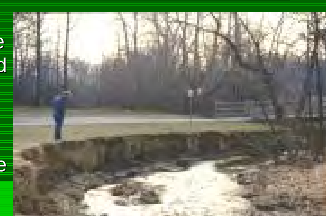
When it rains a, large amount of water…



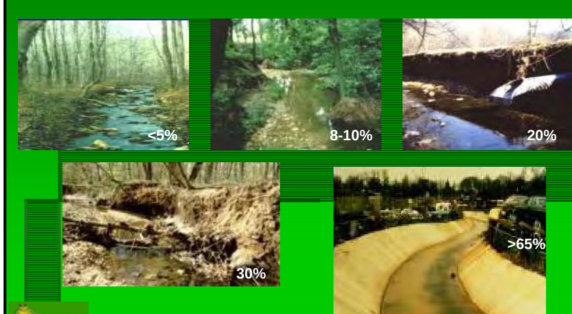
Runs off impervious surfaces → Enters the storm drain → Flows directly to the stream

Increased Storm Flows due to impervious cover

- Erode stream banks, making the banks steeper and the channel wider
- Deposit sediment in the stream bottom making the stream more shallow



Stream Quality is Related to Impervious Cover

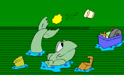


Stream Watch Program Goals

- Identify potential stream restoration and protection projects
- Collect data on stream health
- Actively involve residents in stream health data collection

ADOPT-A-STREAM

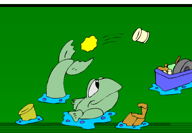
Stream Cleaner



Stream Walker

Stream Watcher

Stream Cleaner



This level of adoption asks requires 4 trash clean-ups a year. In areas with extensive trash or large pieces, larger clean-ups can be coordinated. Hazardous materials should be reported to the proper authorities.

Stream Walker

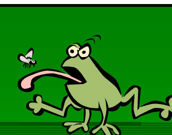
A Stream Walker will complete 4 trash clean-ups a year and at least two assessment forms of their stream. This form is to be completed twice in the first year and only as needed afterwards. The assessment is used to collect information on the stream and its riparian area and the information collected will be used to identify major concerns and assess habitat.

Stream Watcher

In addition to fulfilling the requirements of both the Stream Cleaner and the Stream Walker, the Stream Watcher collects specific information on impairments within their adoptive stream.

OTHER STREAM WATCH PROGRAMS

Stream Monitor: Bug Collector



- Aquatic insect collection
- In coordination with Stream Waders
- Specific sampling sites
- Spring sampling
- Once a year

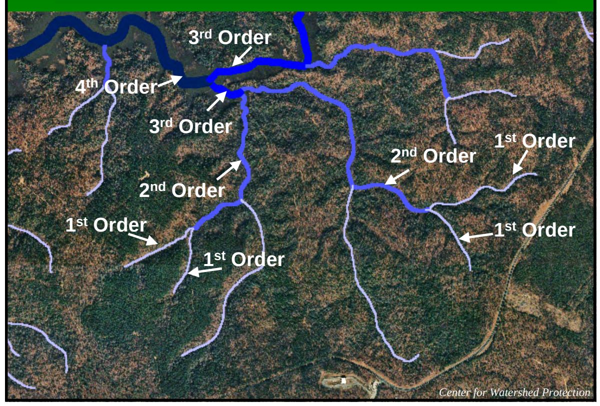
Bugs! So much fun.

Stream Monitor: Snapshot Sampler

- Annual Sampling at 23-26 pre-determined areas throughout the entire watershed
- Training provided immediately before sampling
- Measuring

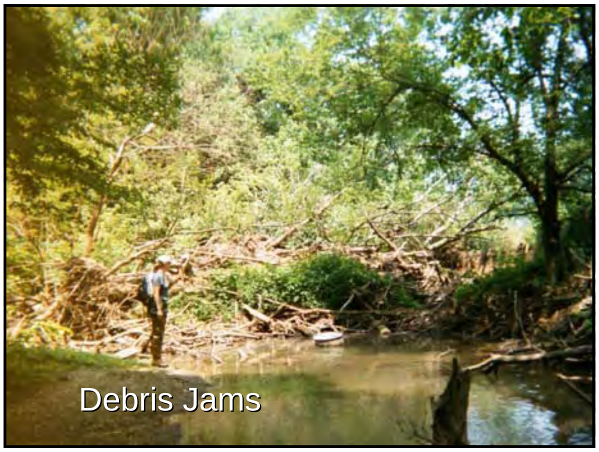
Stream Walker Assessments

The Stream Order Concept

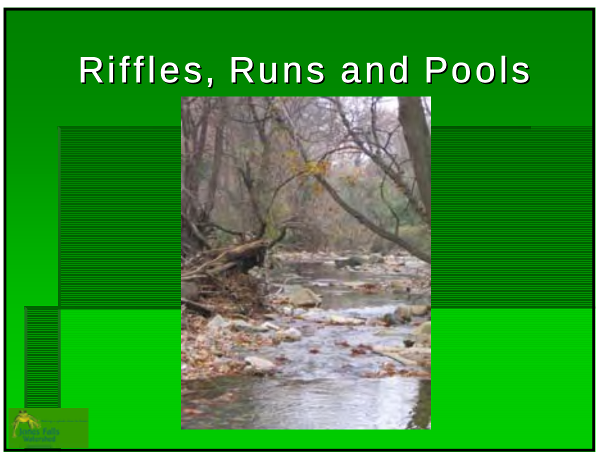


Water Flow in a Stream Channel

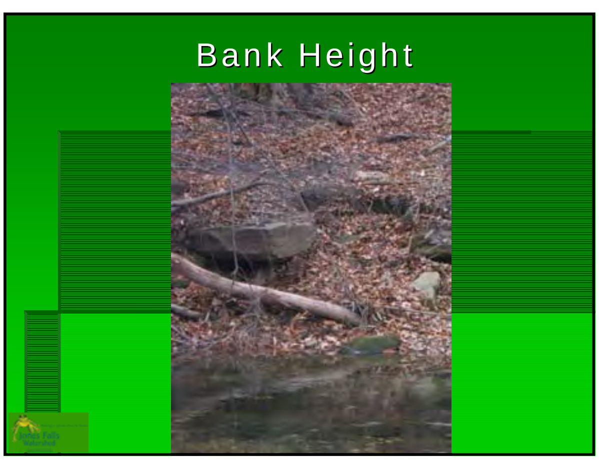
Aquatic Plants


Debris Jams


What is a Riffle?


Riffles, Runs and Pools


Embeddedness


Bank Height


Bottom vs. Wetted Width
Bottom width
Wetted width

You might see some of these in your stream?


(TR) Trash & Debris


(CM) Channel Modification


All one substrate – little habitat


Stream Shading


Bank Vegetative Cover

Bank Stability

Floodplain Connectivity

Can the water escape to these floodplains?

Vegetative Buffer Width

- Human impacts?
- Width of Buffer?

Assessment Tips

- Take regular walks along your stream
- Walk downstream first, taking mental notes, and then complete the form or clean-up trash as you return upstream
- Right and left side can be determined by facing downstream
- Complete different assessment forms for sections of the stream where significantly different conditions exist
- Report any spills, leaks or large dumping areas to proper authorities
- Do not walk through culverts
- Take before and after pictures if possible

Keep your eyes open for……..

Resources Available

- JFWA
- Trash bags
- **Trash pick-up sticks**
- Assessment forms and postcards
- Contact and emergency numbers
- **Camera**
- **GPS unit**
- **Plant identification books**
- **Waders**
- **Tape measure**
- Glossary

Thank you!

Making a splash close to home.

Jones Falls Watershed ASSOCIATION

Pictures provided by Center for Watershed Protection

Appendix G
Stream Watch STREAM CLEANER Pilot Program Volunteer Orientation Packet

Developing and Implementing a Stream Watch Program

Appendix H
Stream Watch STREAM WALKER Pilot Program Volunteer Orientation Packet

Appendix I
Stream Watch STREAM WATCHER Pilot Program Volunteer Orientation Packet

Appendix J
Jones Falls Watershed Stream Watch Program Evaluation Form

Evaluation Form

Jones Falls Watershed Stream Watch Program

Thank you for participating in the Stream Watch program! We would like to make the program enjoyable for all so please take a few minutes to fill out this survey in order to guide us in making the Stream Watch program better.

1. I am a ____Stream Cleaner ____Stream Walker ____Stream Watcher

2. I adopted my stream as a ____individual ____group

   a). If you adopted a stream as a group, how many participants usually attend stream activities? ________

   b). The number of people working on our adoptive streams is
   ____too much ____too little ____just right ____Other ________________________

   c). Our volunteers are mostly ____children ____ young adults ____ adults

3. The Stream Watch training adequately prepared me for my Stream Watch responsibilities
   ____Yes ____ No

   Why/Why not?

   ____
   ____
   ____

4. I could have used more training or assistance with______________________________________
   ____
   ____

5. I was provided with enough tools and materials to do what I need to do ____Yes ____No

   a) What other tools/resources would you like to have? What tools provided have you not needed?

   ____
   ____
   ____

6. Approximately how long is your adoptive stream? ______________

   a). The length of my adoptive stream is ____ too short ____ too long ____ good length

7. Approximately how often do you walk your stream area?
   ____daily ____weekly ____monthly ____Other

8. The Jones Falls Watershed Association staff has been helpful and responsive to my needs
   ____Yes ____No

9. Do you still have questions concerning the Stream Watch program or your responsibilities as an adopter? Let us know - other people probably have the same questions.

____
____
____
____

10. What new things (or most interesting things) have you learned about your stream?

____
____
____

11. The Stream Walker forms can be easily followed ____yes ____no ____n/a

a). Comments on Stream Walker form

____
____
____

12. The Stream Watcher forms can be easily followed ____yes ____no ____n/a

a). Comments on Stream Watcher forms

____
____
____

13. Would you recommend the Stream Watch program to anyone else?
____yes ____no, never in a million years

If no, why? What can we do to make it better? ______________________________
____
____
____

14. I have learned more about streams and stream monitoring through the Stream Watch program
____yes ____no

15. I would like to be more involved with the Stream Watch program than I am currently (i.e. choose another level of adoption, adopt another stream, participate in water quality monitoring or storm drain stenciling, etc….) ____yes ____no

a). Comments:

____
____
____

14. In your opinion, is your adoptive stream ____ in good condition ____in poor condition ____don't know ___Other________________________________

15. What do you most enjoy about working on your adoptive stream?

____

____

16. What do you think would make your time on/by the stream more enjoyable?

____

____

General Comments:

Thank you very much for taking the time to make the Stream Watch program better

Please Return to :
Jones Falls Watershed Association
Stream Watch Program
3503 N. Charles Street
Baltimore, MD 21218