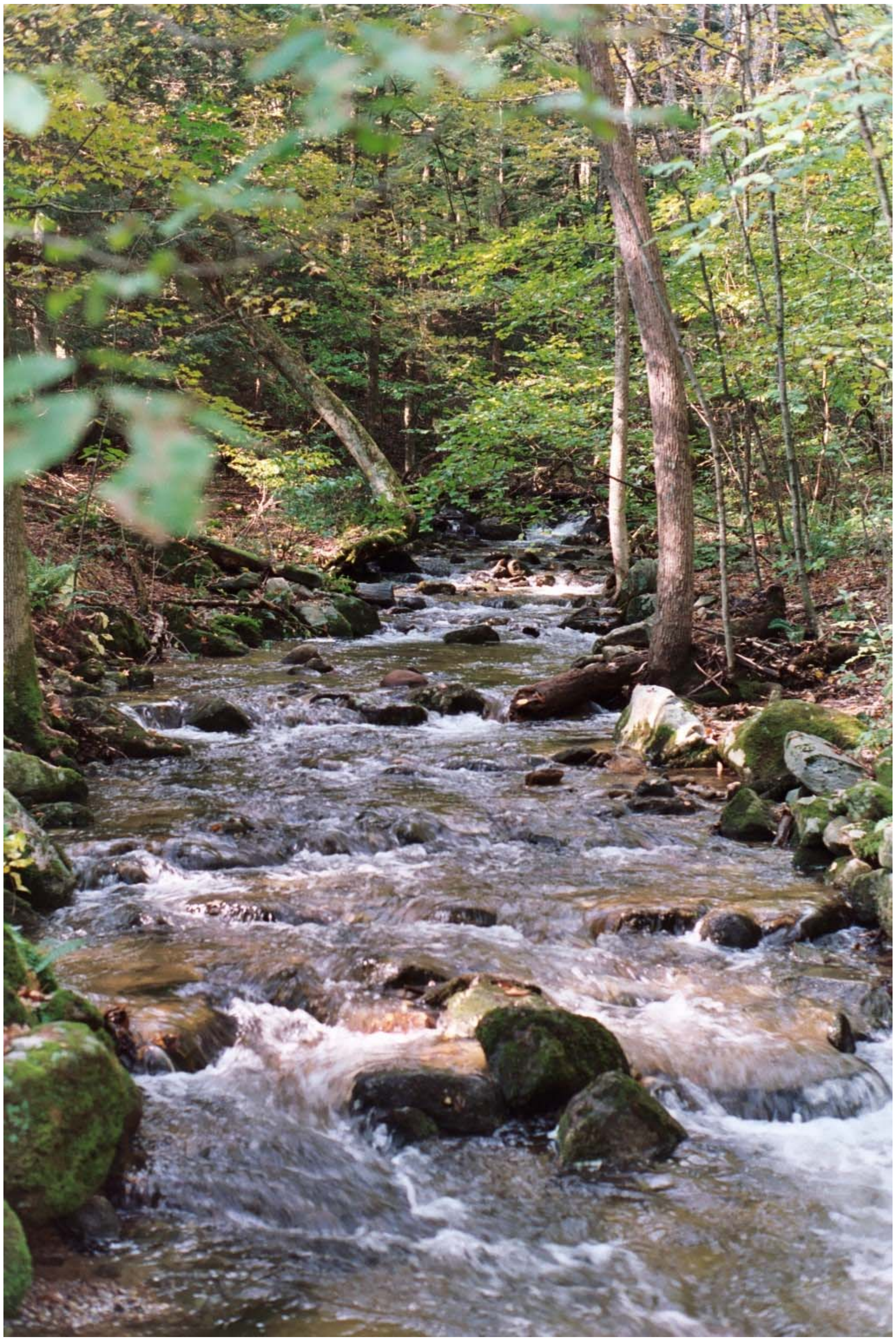
Streamwalk Guidebook



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Section I: The Connecticut Streamwalk Program

Introduction

Managing and protecting natural resources is an increasingly complex task. It requires scientific understanding combined with community participation and support. The streamwalk program developed by the Connecticut USDA-Natural Resources Conservation Service (NRCS) provides an effective first step in assessing watershed stream conditions, connecting local volunteers with the resources in their watershed, and serving as a tool for public outreach and public participation. As local volunteers walk the rivers and streams in their watershed, they are learning how natural and anthropogenic (man-made) elements affect the environment. Collecting information about the physical conditions of the watershed provides local communities with a good base of knowledge and information, that can be used to help them start planning for resource protection and address the concerns they identify as most important.

By engaging local volunteers, the streamwalk program increases their awareness and understanding of potential impairments to the health of the rivers in their watershed; develops community ownership in the stewardship of local natural resources and encourages local voice. Increased awareness and understanding leads to improved chances of finding practical, effective solutions to those issues and concerns. With the investment of time and effort, volunteers take pride in their work and accomplishments and will become the watchdogs to ensure their work continues.

Watershed/drainage basin: a geographically defined area in which all the land and waterways in that area drain to the same body of water, such as a stream, lake, estuary, or wetland; like a bathtub, all the water that falls within the watershed, or tub, drains out of it at the same point.

The Guidebook's Purpose

This Guidebook has three purposes:

1. *Provides a framework for coordinating and conducting a streamwalk, and*
2. *Provides streamwalk volunteers with instructions for using the Segment Survey Sheets for data collection, and*
3. *Presents streamwalk volunteers with basic information about the physical characteristics of stream corridors and the impact of human activity on water quality.*

What is a Streamwalk?

A streamwalk is a volunteer based assessment of the physical conditions of in-stream and streamside characteristics of the perennial (flow all year) streams in a river basin. It serves two purposes: resource evaluation through data collection and community involvement and education.

The data gathered through the survey is a first step toward understanding the physical condition of a stream corridor. The information can be used to identify resources needs such as erosion and sedimentation, lack of adequate riparian (streamside) vegetation, and sources of direct discharges into the stream among others. Once identified, a community can plan and implement conservation measures to address the specific needs. Based on the findings, additional, more detailed evaluations of specific resource conditions may be necessary to determine the appropriate management measures.

- *Perennial streams* carry water year-round and have a fairly stable groundwater flow (baseflow).
- *Intermittent streams* carry water part of the year and receive groundwater flows when the water table is high.
- *Ephemeral streams* carry water only during or immediately after a storm.

Equally important is the community involvement and education generated through a streamwalk. Surveying the river brings volunteers into direct contact with the resources around them and creates the opportunity for them to understand better how a river system works and the ways in which a river and a human community are connected.

Where to Start

Before sending volunteers out to conduct their surveys, the project coordinator needs to think about several logistic and administrative details when planning a streamwalk. Watersheds of a manageable size need to be selected and the survey areas within them need to be identified. In addition, methods of public outreach need to be developed, a volunteer training program must be conducted, and ways to compile and report data need to be considered.

The first step is to determine what watershed or drainage basin will be surveyed. Factors to consider when deciding what watershed(s) to survey include size, community identity, community interest, and resource needs. It is important to select a watershed that can be reasonably surveyed by the corps of volunteers. Choosing too large a watershed without enough volunteers can lead to an incomplete dataset. The successful management of a streamwalk effort depends also on the administrative capability of the coordinating organization.

Once a watershed is selected, survey areas need to be delineated. Survey areas are based on local watershed boundaries. In some cases, it will be necessary to create "artificial" watershed lines to delineate survey areas of a manageable size, or in order to have adequate access to the stream being walked. Typically, survey areas include anywhere between 1-3 linear miles of stream. The length will be dependent upon surrounding terrain and access points to the stream. For survey areas of rivers that can be surveyed using watercraft (e.g. canoe, kayak…) you may be able to include as much as five (5) linear miles of stream. (See Figure 1).

Figure 1: Streamwalk Survey Area Index Map — Illustrating Local Basins Delineated as Survey Areas

After deciding where to conduct the survey, the sponsoring or coordinating group needs to actively recruit volunteers. Public outreach materials need to be developed to inform potential volunteers and community members about the effort and to describe the importance of community participation. Recruiting should begin roughly 2-3 months before volunteers are trained At least two volunteers are required for each survey area for safety and recording reasons.

Local volunteers receive a basic course in stream ecology, morphology, water quality, non-point source pollution, and the relationship between a community and its river. The training session consists of an indoor and outdoor portion. Along with the basic technical information, the training is intended to familiarize volunteers with the survey sheets (see the appendix for a sample of the Survey Sheet) and how to use them. The training helps to increase volunteers' awareness and understanding of potential concerns to the health of a river and gives them a chance to ask questions about the work that is expected of them.

Going Beyond Data Collection

While the streamwalk is a valuable tool in helping to generate a sense of civic environmentalism, it is critical to consider how the data will be compiled, presented, and used. Quantifying the information collected by volunteers helps to determine the predominate resource concerns in the watershed. Activities and strategies for addressing those concerns can than be developed. In addition to identifying concerns, the information gathered can be used as a tool for general education of the public; as a component of a larger watershed plan; or as a resource to obtain funding for implementation projects for habitat rehabilitation, water quality improvement, or land planning efforts.

The data gathered should not be considered static. Conditions in a watershed change over time. Future streamwalks of the same watershed may be planned and the data can become part of a collection that captures trends in the watershed over time. The information can be updated on a regular basis as a way of tracking changes, documenting the implementation of projects, and gauging the impact on the resources. Using a database software program is a helpful way to organize and quantify the data. Depending upon the software it is often possible to query the data and categorize it in different ways. Also, several database software packages are compatible with Geographic Information Systems (GIS) which allows the data to be geographically referenced and associated with other information characterizing the watershed under investigation.

The way in which the information is presented should depend upon the audience. In some cases, graphs and charts will be most effective in conveying the findings, in other cases using photos of the sites may prove more beneficial.

Survey Methodology

The information in this manual was developed based on analysis of stream corridors in the Northeastern United States. Some modification of the manual and survey sheet may be necessary if you plan to conduct a streamwalk in an area outside of the Northeastern United States.

Image 1

Ideally, a streamwalk should aim at surveying the main stem of the stream and all of its perennial tributaries, as this will provide the most comprehensive picture of the watershed. The survey is intended for lotic (flowing waters) not lentic (stationary water) waterbodies. Therefore, information about large ponds (surface area >5 acres), lakes, or reservoirs should be recorded separately. The streamwalk survey should be conducted during the summer, preferably from mid-June to the beginning of September. During this period water flows tend to be lower and slower, water temperatures tend to be warmer, and aquatic plant growth tends to be abundant. The combination of these factors makes it easier to observe potential water quality concerns, stream morphology, stream substrate (streambed), and vegetation. Low flows during this time also provide safer conditions for the streamwalk volunteers.

The survey can be conducted by walking along, wading in, or boating the watercourse. Safety, liability, accessibility, water depth, and availability of resources (canoes, boats, people) should be considered when deciding the method to be used for surveying a section of stream.

Remember this is a screening tool, not the final determination on the status of the river. Therefore, volunteers should feel comfortable giving their best assessment of the conditions they observe. They should not put themselves at risk in order to collect information.

Stream Flow

The continuous presence of water and the relationship between active channel width and water depth are important fish habitat indicators.

- A wide, shallow stream usually does not contain adequate pool habitat or vegetative cover to sustain fish populations, and often resembles continuous riffle habitat (Hunter, 1991).
- A narrow, deep channel usually provides a variety of habitats characterized by undercut banks and overhanging vegetation (Hunter, 1991)
- In addition, stream flow affects the amount of oxygen, organic matter (food), and types of aquatic organisms in a stream.

The two major components of stream flow are *baseflow* and *runoff*.

- *Baseflow* consists of the discharge that originates from groundwater. During prolonged dry periods the natural flow of streams originates from baseflow.
- *Runoff* is that portion of precipitation that reaches a stream channel from shallow subsurface flow, groundwater, and surface runoff (*overland flow*). Surface runoff occurs when precipitation exceeds the infiltration capacity of the soil (the soil cannot absorb all of the precipitation).

Streamwalk Process — Basic Steps

- Identify a Watershed(s) to conduct a streamwalk
- Recruit volunteers
- Conduct a training session
- Collect the Streamwalk Data
- Analyze the collected data
- Prioritize identified areas of concern for restoration/ enhancement based on identified biological and social community needs
- Implement conservation practices to address the identified areas of concern

Section 2: Using The Stream Survey Sheet

Introduction

The Stream Segment Survey Sheet (referred to as "survey sheet" hereafter) is used to collect information about the overall physical characteristics of a particular segment of a stream, and to identify *areas of concern* where management efforts may be pursued. *Areas of concern* are sections of a stream where the physical conditions indicate a problem may exist for aquatic life and/or human uses.

Each survey sheet contains a table for documenting *areas of concern (see Appendix).* Most of the *areas of concern* you will identify during the streamwalk result from human manipulation within the watershed. Areas of concern may affect instream or streamside conditions. Examples include a reduction of riparian vegetation, stream bank or channel erosion, gully erosion, barriers to fish passage, litter, and impoundments. Excessive algae, vascular plant growth, discharge pipes, color and clarity changes in water, and sedimentation may be signs of water quality problems resulting from non-point source pollution. Information about large ponds (surface area >5 acres), lakes, or reservoirs should be recorded separately.

Defining Stream Segments

<u>Dividing Streams into Segments:</u>

As one proceeds from the *head waters* (source) of a stream towards the *outlet* (mouth), changes in the stream's appearance may be observed. Slopes tend to be steeper in the headwaters and less steep as one proceeds downstream. The streambed, or substrate, of upland streams is composed mostly of large materials, while small materials are often found in lowland rivers. Lowland streams tend to be more sinuous, while upland streams tend to have straighter patterns. Major changes of streamside vegetation also may be observed in different reaches of a stream. A separate survey sheet should be filled out every time you observe a consistent change(s) in the physical characteristics of a stream, such as slope, width, depth, substrate materials, streamside vegetation, etc. which would indicate that you are in a different segment or *reach* of the stream system. **The length of a stream segment should be <u>a minimum</u> of 1,000 feet. In rivers where the average active channel width is greater than 100 feet the minimum stream segment length should be 3000 feet.**

You can make some initial speculation about stream segments before you start surveying. USGS topographic maps are a great tool for doing this. From the topographic map you can make determinations about a stream's topography and flow pattern. The maps show wetlands and developed and undeveloped areas, as well as ponds, lakes, and reservoirs larger than five acres which will not be part of the survey. (If you are not familiar with topographic maps you can read Chapter 1 of *Map Reading and Watershed Delineation Skills for Inland Wetland Commissioners* by the Connecticut Department of Environmental Protection). Typically, the scale of the topographic maps used for a stream survey is 1 inch = 2,000 feet (1:24,000).

Using your topographic map you can divide a stream system into segments by following these guidelines:

- Start a new segment at the beginning of every tributary and at every tributary junction.
- Start a new segment at significant slope changes.
- Start a new segment at the outlet of ponds, lakes, or reservoirs (>5 acres).
- Start a new segment with significant changes in one or more of the physical conditions of the stream corridor such as substrate, riparian vegetation, stream width, stream depth, among others.

Figure 3: Survey Segments

Once you begin surveying the stream you can modify your hypothetical segments based on your field observations of changes in substrate materials, changes in stream depth and width, and changes in streamside vegetation (both type and amount). **Remember, the <u>minimum</u> length for a stream segment is 1000 linear feet, and 3000 feet for rivers where the average active channel width is greater than 100 feet.** (See figure 1). Establishing minimum segment lengths creates a way to identify significant changes in stream conditions that are not a result of inherent variability in stream morphology. .

Defining and describing stream segments is important in differentiating the physical characteristics of the stream and to identify significant habitat. This information is also helpful for locating important areas for fish habitat, isolating areas of concern, and locating healthy sections of stream. Once identified, plans for the protection or improvement of these areas can be developed.

<u>Determining Slope from a Topographic Map:</u>
The slope of a stream, or section of stream, can be determined by dividing the change in elevation by the linear distance (i.e. length) of the section. Mathematically determining slope can be written as $(h2 - h1)/d$, where $h1$ is the lower elevation, $h2$ is the higher elevation, and d is the distance between the two points.

- To determine the change in elevation count the number of contour lines within the section of stream (the change in elevation between two contour lines in a topographic map with a scale of 1:24,000 is 10 feet).
- To measure the linear distance of the section use a scale or a ruler placed perpendicular to the contour lines, remember that at a 1:24,000 scale 1 inch = 2,000 feet.
- For example, using Figure 3, assume the elevation at pt A (h2) is 330 feet; at pt C (h1) is 250 feet; linear distance is 1.5 inches = 3000'(d) ; The resulting equation is (330 – 250)/3000 = 0.027 = 2.7%)

Physical Characteristics Used to Describe Streams:

Describing a Stream:

The technical term for describing a stream is stream morphology. Stream morphology examines a stream's dimension, pattern, and profile. Dimension refers to the cross sectional shape of the stream channel. Pattern refers to how a stream meanders over the landscape. Profile refers to a stream's gradient or slope. The profile of a stream characterizes its change in elevation over distance. For many streams, slope decreases continuously from headwaters to mouth, as a function of local topography and geology. Often, in the headwaters a great deal of elevation is lost over short distances; consequently, these sections of streams are generally steep and straight, with a stair-step appearance. As the gradient decreases the stream assumes a pool riffle configuration. Further down-gradient the stream becomes flatter and it meanders through a flat floodplain (Hunter, 1991). (See Figure 2).

The various morphological features that a stream may exhibit from its headwaters to mouth include the following:

- *Cascades* are sections with an extremely high gradient (8-30% slopes). Water flows in these sections are very turbulent. Water may fall freely or bounce off large stones or exposed bedrock in the stream's channel. Spacing of pools is less than one channel width. Pools are small areas of deeper water with slower flows.
- *Step-Pool* sections are high gradient (3-8% slopes). Large substrate materials that form a series of steps and pools characterize these sections. Pools are small areas of deeper water with slower flows. Pool spacing is one to four channel widths.
- *Pool-Riffle* sections are moderate gradient (1-3% slopes) segments with an undulating bed that forms a sequence of pools and riffles. *Riffles* are topographic high points formed by accumulations of coarse sediments. *Pools* are topographic low areas with slower velocities and fine bottom sediments. Pool spacing is five to seven channel widths.
- *Runs* are long channels with somewhat turbulent and fast flows in low to moderate slopes. These sections of stream contain occasional riffles, and diversity of substrate materials.
- *Flats/Glides* sections are typically low gradient (<1% slopes), smooth flowing channels with low velocities and no visible turbulence. The substrate is primarily composed of fine materials.

It is likely that more than one of these stream features will be encountered in any given stream segment that a volunteer surveys. (See figure 4).

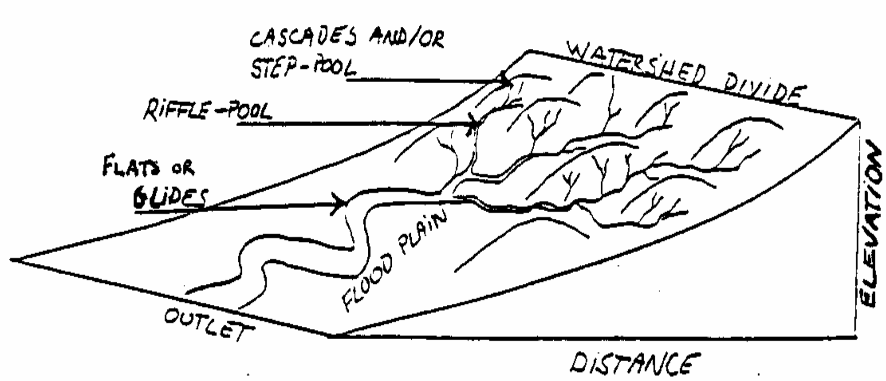

Figure 4: Longitudnal profile of a stream and associated stream systems.

Substrate

Substrate, sometimes referred to as the streambed, includes everything on the bottom of a stream. (See Image 2). The materials on the bottom of a stream are highly variable, consisting of both inorganic and organic material. General composition of the substrate depends on local soils and bedrock, the stream velocity, and the type of streamside vegetation.

Local soils and bedrock conditions will affect the type of inorganic materials comprising a streambed. For example, streams in areas with sandy surficial materials may be more likely to have sandy substrates, whereas a stream running through a region dominated by bedrock might be dominated by gravel and cobbles. Inorganic substrates can be separated into size classes. The following are the most commonly used classifications of inorganic stream substrate materials:

- *Silt* is made up of tiny particles; individual grains are hardly visible to the eye. Silts feel smooth to the touch (like wet flour).
- *Sand* is made up of tiny mineral particles up to 0.1 inch in diameter. The individual grains are readily visible to the eye at close distance. Sand feels gritty to the touch.
- *Gravel* is made up of small stones ranging from 0.1 inch to 2 inches in diameter. Gravel grains are visible to the eye. Gravel feels very gritty.
- *Cobble* is made up of small stones 2 to 10 inches in diameter. The average size is about the size of a grapefruit.
- *Boulders* are stones greater than 10 inches in diameter.
- *Bedrock* is solid rock.

Image 2

A stream's velocity, or flow influences the composition of substrate materials. The faster the current the larger the particle size it can carry. Subsequently, in higher gradient streams with fast flows the smaller particle sized materials (silt, sand, gravel) tend to be transported out of the stream reach, leaving the larger sized particles on the stream bottom. In contrast, in lower gradient streams with slow flows, the smaller sized particles are deposited on the stream bottom. In other words, streams with fast flows tend to have large substrate materials, while slow flowing streams tend to have finer substrate materials.

Allocthonous Material
The organic matter that a stream receives from production that occurred outside the stream channel (*Stream Ecology. Structure and Function of Running Waters*, J. David Allan)

Macroinvertebrates
For the purpose of the streamwalk they are insects that spend a portion of their life cycle in a stream. Examples include Trichoptera, Odonata, Lepidoptera, Plecoptera, mayfly, damselfly, dragonfly…

Along with the inorganic materials found on a streambed, organic materials, primarily composed of plant debris (stems, logs, leaves), can be found on the substrate. The type and amount of streamside vegetation introduces this allocthonous material into the stream system. Organic matter provides food and shelter for aquatic organisms, and, in some cases, can affect stream flow patterns.

Substrate has numerous direct and indirect effects on the living organisms of running waters. It provides a surface to cling to or to burrow into, shelter from current, material for use by macroinvertebrates in the construction of shelter, and refuge from predators. In shallow streams substrate materials can also influence water oxygenation. The larger the substrate material the more turbulent the water flow, which results in more air-water mixing.

Impoundments

Impounding a stream usually alters the stream's temperature, flow patterns, and sediment transport capacity. Impounded areas have larger surface areas that are typically exposed to direct solar radiation. If the flow is relatively slow a reservoir will develop thermal stratification typical of lakes (warm water on top and cold denser water on bottom). Shallow ponds or ponds with high flushing rates may not thermally stratify or only stratify briefly, so increases in temperature from solar radiation are uniform through the water column. Elevated temperatures can lead to a loss of species diversity within the stream system due to decreased levels of dissolved oxygen and/or stream temperatures beyond the tolerance range for specific aquatic species.

In addition to affecting stream temperatures, impoundments usually modify local hydrology. Diminished stream flow due to evaporation losses or consumptive uses may affect a stream dramatically. Modifications to the flow regime of a stream may disrupt normal stream scour patterns, vegetative growth, water quality, flood storage, and other natural processes (CT DEP 1995a). Excavated ponds developed outside of the confines of the flowing watercourse generally have limited impact upon normal hydrologic processes and flow regimes (CT DEP, 1995a)

Created ponds that incorporate a stream will alter the stream's bank, bottom, and flow, and sediment transport. Changes to the vegetative communities along the streambank and alteration of the streambed will result in changes in the suitability of these areas to support aquatic species, terrestrial wildlife, and bird life (CT DEP, 1995a).

Changes in sediment load due to the presence of an impoundment or in-stream excavation may also affect habitat values significantly. Impoundments impede fish passage and may adversely affect fish that rely upon migration for spawning, as well as resident freshwater species with spawning areas distinctly separated from adult holding areas (CT DEP, 1995a).

Effects of Water Temperature

Variations in water temperature from one section of a stream to another result primarily from the extent of streamside vegetation and the temperature of water inputs from ground water, tributaries, and surface runoff.

Less streamside vegetation permits more solar radiation and, therefore, higher stream temperatures. Impoundments also result in higher stream temperatures.

Temperature fluctuations are more common and pronounced in small and intermediate sized streams.

Increased stream temperatures can affect aquatic organisms and the stream environment in many ways:

- High temperatures kill fish directly
- Decrease dissolved oxygen concentrations, which are essential to the respiratory metabolism of most aquatic organisms
- Increase susceptibility of fish to disease by increasing bacteriological activities,
- Affect availability of food
- Alter feeding activities of fish
- Alter the community composition of both macroinvertebrates and fish
- Promote algal and aquatic vascular plant growth

Visual Water Conditions

The clarity, color, and turbidity of water may indicate concentrations of algae or suspended solids. Cloudy or different colored water may be a result of natural processes or pollution from land use within the watershed. Turbidity can be the result of organic or inorganic suspended particles. Algae, decomposing plant materials, sands, silts, and clays are some of the materials that may cause turbidity or color in a stream. Keep in mind that water can be clear (not turbid) and colored at the same time.

In clear streams submerged objects should be visible at depths equal to or greater than 1.5 feet. In clear streams less than 1.5 feet deep substrate materials should be distinctly visible. Brown-red water could be an indicator of naturally occurring iron, iron bacteria from a leaching old pipe, or decomposing organic matter. Yellow or tea color water could indicate that water passed through peaty soils and carries leaching humic acids from decaying organic matter. Foamy water could be an indicator of waste water discharge or detergents. Green water can be an indicator of excessive algal growth. Oily multicolored reflections on the water surface could indicate oil or gasoline.

When examining visual water conditions ask yourself, is the bottom of the stream clearly visible? Is it muddy? Is it tea-colored? Is it clear? Do you see floating particles? By collecting a water sample in a clear glass jar and examining it against a plain white background you can answer these questions. (See image 3). Most streams could seem turbid during or soon after a rain event which is why you should only survey the stream during normal summer flow conditions and not immediately after a storm.


Image 3

Algae and Vascular Aquatic Plants

For the purpose of this survey, *algae* refer to all microscopic photosynthetic organisms including diatoms and blue-green algae. Algae, usually single celled and microscopic, sometimes occur in such abundance that they color the water and give it a distinctive odor. The single cells of some algae are joined together to form chains or mats that resemble dense growths of larger plants.

Algae are important food producers in the aquatic environment. In manufacturing food, algae release oxygen, increasing the amount of dissolved oxygen in the water. When overabundant, their decay may deplete the oxygen in the water and cause "summer kills" of aquatic organisms (fish and macroinvertebrates). Green and blue-green algae are indicators of nutrient rich waters.

Vascular aquatic plants generally have roots, stems, and leaves with tube-like conductive tissues that transfer food and water and aid in supporting the plant. Some vascular plants grow completely submerged, others are rooted in the bottom, but their leaves or flowers may be on or above the surface. Some emergent vegetation, such as rushes, reeds, or grasses, which are adapted to grow in saturated soils and shallow waters, may also be found in streams. (See image 4)

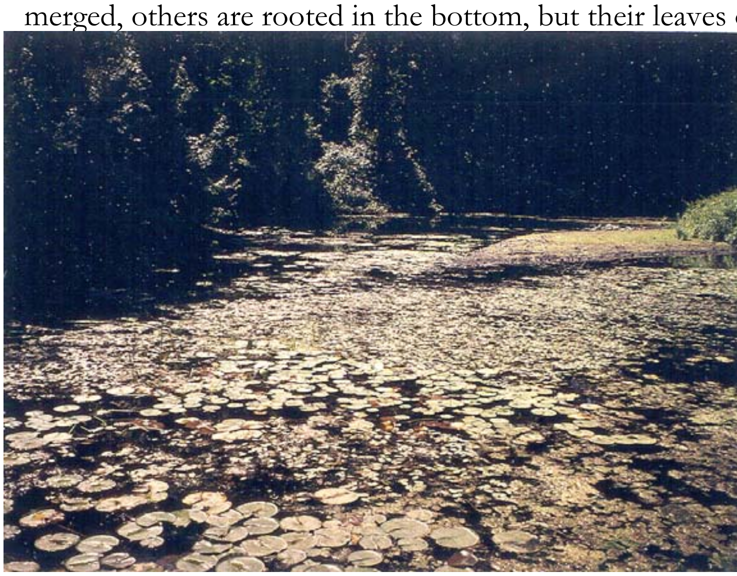
Image 4

Riparian Vegetation

The term "riparian" refers to areas adjacent to stream channels. Riparian zones form an important transition between terrestrial and freshwater systems. "Riparian vegetation" refers to the plants that occur naturally within the riparian zone.

Part of the riparian vegetation can be classified as 'streamside cover' (See Figure 5). Streamside cover is defined as the first 15-20 feet from the edge of the active channel. The vegetation comprising the

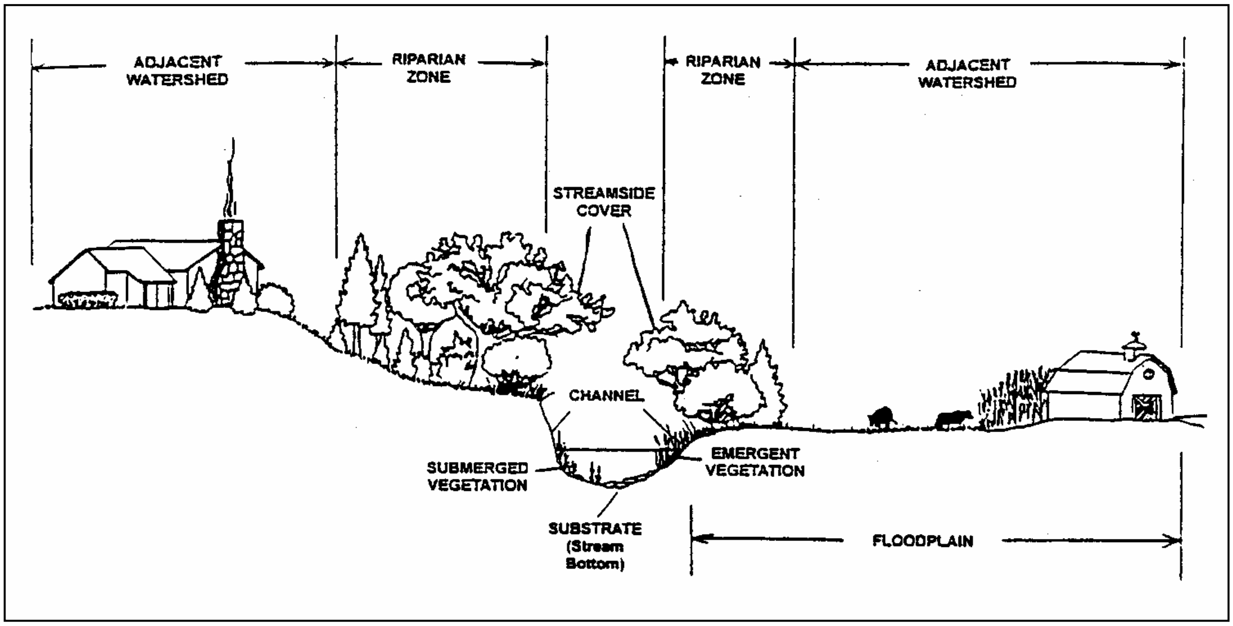

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Figure 5. Basic components of a stream system (USEPA, 1997

streamside cover is an important component of a stream ecosystem because it provides streambank stability, erosion and flood control, water quality protection, fish and wildlife habitat, and scenic beauty. Plant roots bind soil in stream banks and reduce erosion. It can deflect the cutting action of swift flowing stormwater, expanding surface ice, and strong winds. Streamside vegetation keeps the water cool by providing shade, and it provides habitat for aquatic and terrestrial creatures. In addition, plant litter that falls in upland streams, allochthonous material, is a major source of food for organisms in the stream.

Streambank Erosion

Generally, eroding or unstable banks are characterized by a lack of vegetation, steep bank angles, and exposed bank heights greater than 3 feet above the water surface (See Figure 6). Streambank erosion can occur primarily in two ways: the forces of flowing water (hydraulic forces) removing erodible materials, or the forces of gravity acting on streambank materials.

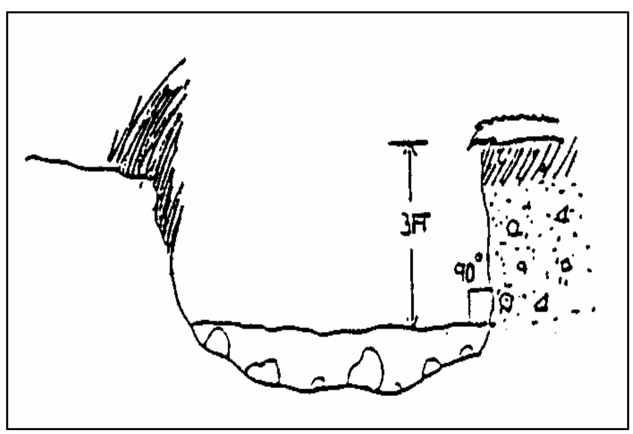

Figure 6: Characteristics of an eroding streambank

Under natural conditions flowing water will follow a *sinuous* pattern (serpentine or wavy form). The stream's *sinuosity* is the measure of how straight or curved a river is. Depending on the degree of sinuosity, streams may be classified as either straight or meandering. Using a topographic map or aerial photograph, volunteers can identify potential streambank erosion sites by locating deep meanders and sediment bars/islands. When a stream flows through two or more channels divided by bars or islands, it is called a braided stream. Braiding results when the stream's sediment load (the amount of sediments carried by running water) is large in relation to its discharge, slope, and channel depth. When these conditions occur, the stream's channel tends to fill, and the stream breaks through its banks to form new channels. The sediment load of a stream can be generated as a result of streambank erosion, streambed erosion, or inputs from the upland watershed area. Sometimes sediment bars occur in isolated sites or are not long enough to represent a separate section of a stream, but they could be a sign of excessive sedimentation from developing or developed areas. Mass wasting (large slumps) of soil at the toe of the bank is a good indication of streambank instabilities.

Sedimentation and Aggradation

- *Sedimentation* occurs when a stream's flow (current or velocity) does not have enough energy to transport the sediment arriving from upstream.
- *Aggradation* occurs when continual deposition of sediments results in a general increase in streambed elevation.
- *Embeddedness* , is another sign of sedimentation. It is the extent to which the larger substrate materials, such as boulders, cobbles, and gravel, are surrounded or covered by fine sediments, such as sands, silts, and clays is another sign of sedimentation . High percentages of embeddedness can result in loss of fish spawning and rearing habitat and aquatic insect habitat (Hunter, 1991). The percent of embeddedness is usually proportional to percent of fine particles in the substrate composition.

Adjacent Land Uses and Non-point Source Pollution

Land uses within a watershed have significant impacts on water quality, water quantity and natural stream processes.

Urban, suburban, and agricultural land uses are major originators of non-point source pollution. Animal and agricultural wastes, eroded sediments, fertilizer, and pesticides can enter streams through surface runoff. Parking lots, industrial sites, roads, and lawns in urban, suburban, and residential areas are sources of sediments, hydrocarbons, heavy metals, and nutrients. Stormwater discharge pipes provide direct inputs of runoff from roads, urban, commercial, and residential areas into streams.

Non-point source pollution primarily results from rain water that becomes contaminated when it falls through the air and flows over the land as it makes its way to a water body. This "contaminated water", typically called stormwater runoff, can enter a water body from an identifiable source such as a separate storm sewer outfall, or it can flow directly into a water body without an easily identified point of entry. In addition, non-point source pollution can also result from groundwater discharges (e.g., septic systems). Regardless of the point of entry, non-point source pollution is diffuse in its origin (CT DEP, 1995b). (See Figure 7).

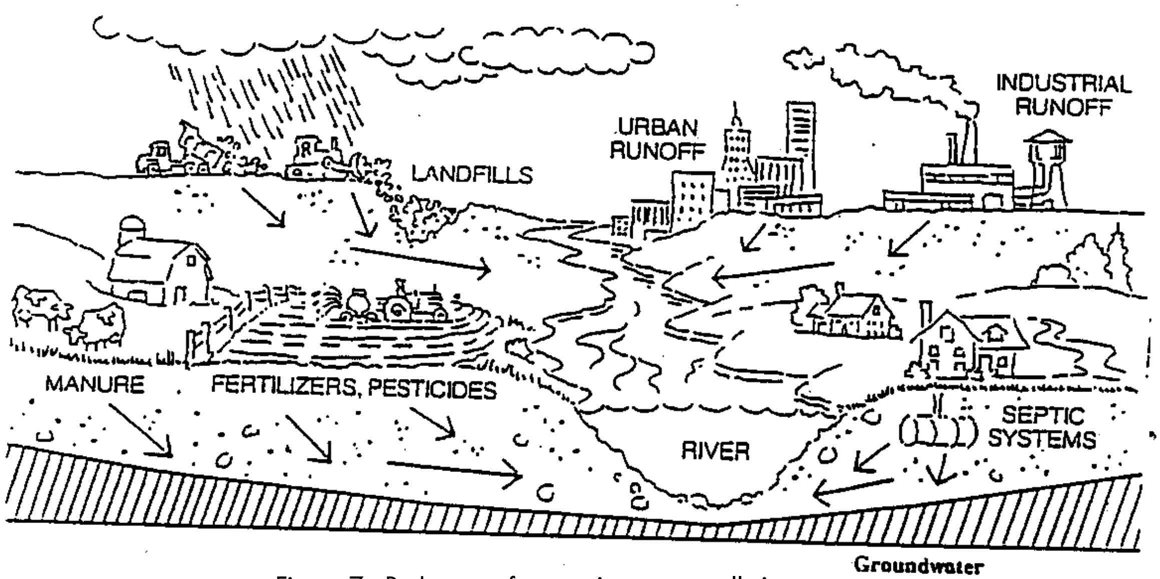

Figure 7. Pathways of non-point source pollution

Areas of Concern and Indicators of Water Quality Problems
During the survey volunteers will be asked to look for areas of concern by recognizing physical conditions indicative of water quality problems or stream habitat degradation. Some of these indicators include lack of riparian vegetation, excessive algae growth, turbidity, and exposed streambanks. Areas with one or more of these issues may suffer from high water temperature, low dissolved oxygen, erosion (streambank, gully, and channel), or inputs from non-point source pollution (nutrients and sediments).

The segment survey sheets include a form for recording information about the areas of concern encountered during the streamwalk. It is important to record and describe accurately the conditions found at the site, so that the potential impacts from the site can be assessed and possible remediation measures investigated. The streamwalk volunteer will assign a site number to each area of concern, record the type(s) of concern(s) observed, describe the location (including a notation on the map), and provide a detailed description of the extent of the condition.

For example, the streamwalk volunteers encountered two areas of concern within their survey area. The first site was an impoundment. They would assign the number one (1) to the site and record that the concern was an impoundment . They would note on the map the approximate location of the impoundment along the river, as well as estimated distances upstream and/or downstream from identifiable landmarks. In describing the impoundment, the volunteer should include approximate height and width of the dam, what the dam is made of, and any other notable information. At the second site, the volunteer notes an eroded streambank that lacks riparian vegetation. They would assign the number two (2) to the site and record the types of concerns (eroded streambank and lack of riparian vegetation). The location would be noted. In describing the site, the volunteer will indicate the approximate linear distance of the eroded streambank and height of the streambank. The length and width of the area lacking riparian vegetation would also be noted.

Concluding Remarks

This manual is a reference document that supplements the stream segment survey sheet training, and offers additional information to enhance understanding of the resources being evaluated by volunteers. The participation of volunteers in a streamwalk accomplishes two goals. First, the data gathered through the process is an initial step in identifying the resource issues affecting a watershed. Second, the participation of volunteers in the effort engages the community not only in the identification of resource concerns, but also in the broader natural resources decision making process. The actions taken based on the streamwalk experience are just the beginning of a process to strengthen and enhance the health of your community's natural resources.

Appendix
Stream Segment Survey Sheet

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