

3.0 Supporting Documentation and Appendices

3.1 Appendices

3.1.1 Landowner Maintenance Guide – Restoration Demonstration Project

3.1.2 List of Native Plants for Use in Riparian Buffers

3.1.3 Useful Resources

3.1.4 Operation and Maintenance of Broadstreet Hollow Demonstration Restoration Project

3.1.5 Bank Stabilization Alternatives and Current Best Management Practices

3.2 Glossary of Terms



3.1.1 Landowner Guide

Broadstreet Hollow Stream Restoration Project



Prepared By
Greene County Soil & Water Conservation District
New York City Department of Environmental Protection Stream Management Program
January 2001

I. Purpose of the Guide

The purpose of this document is to provide you with information to guide you in the maintenance of the stream restoration project completed on your property. It will provide some basic information regarding the project design, how the restored stream is expected to function and what is required in the way of maintenance to achieve maximum benefit from the project. This includes a discussion of the purpose and performance of the rock structures, as well as guidance on how you can help establish and maintain vigorous streamside vegetation.

II. Introduction

In many areas of the watershed, the New York City Department of Environmental Protection Stream Management Program and local Soil & Water Conservation Districts are working as partners to pilot the use of new stream management strategies. Based on the principles of fluvial geomorphology, the study of a stream's function within a landscape, the focus of our work has been on restoring natural stream health while minimizing the need for repeated excavation and riprapping of channels. As a resident of the watershed, you may have noticed how some sections of stream withstand high storm flows with no significant signs of erosion or rock deposition. It is our goal to create such "stable" streams throughout Broadstreet Hollow beginning with your section of the stream.

As we have worked through the assessment and restoration project with the landowners, we have attempted to keep you informed not only of our progress but also of our project goals. We realize that as landowners, you will be our best advocates for this type of restoration and it is important to us that you have an understanding of the processes at work in your backyards. The following information is provided as general background on the development of the project design.

III. The Restoration Design

Prior to designing the restoration project as constructed on your property, the Greene County Soil and Water Conservation District (GCSWCD) and NYCDEP used a number of assessment tools to evaluate the stability of your stream reach and to determine the factors influencing its condition since the 1996 floods. During this assessment process, critical stream features such as the cross sectional area, pattern or alignment and the slope of the stream were surveyed and compared to the same measurements from a stable section of the stream. This stable section was located higher in the watershed and is referred to as a “reference reach” (**Photo 1**). Using historical aerial photographs and detailed measurements from the reference reach as a “blue print”, a new channel was constructed in the project reach.



Photo 1. Survey of the reference reach located above project site

A. Stream Channel Design Features

As you look at the channel, you will notice there is a main channel area, with lower terraces on alternating sides of the stream. The lower channel is known as the “bankfull” channel, and it is designed to convey the runoff and sediment from smaller storm events which occur on a 1-2 year interval. The bankfull flow is often called the dominant flow or channel forming flow, as it is these smaller, more frequent storm events which exert the most influence on the stream’s pattern, profile and dimension. Landowners should expect to see some minor erosion and deposition in this section of the channel as the stream makes some minor adjustments and sorts the loose materials.

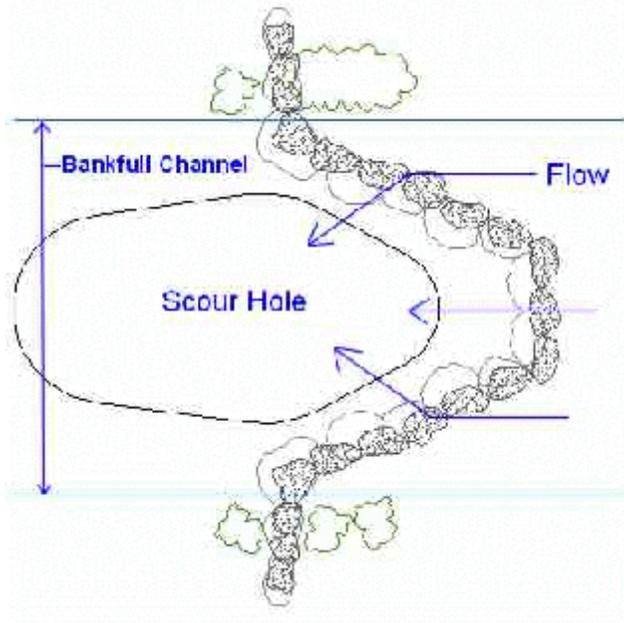
In above the bankfull channel is the floodplain. The floodplain is designed to carry the runoff experienced in larger storm events. The GCSWCD and our engineers have run flood prediction models on the stream reach, and have designed the channel and floodplain to contain the flows associated with storms up to the 100 year flood event. Although the floodplain is far less active than the bankfull channel, it is still an important component of the stream and landowners should not place any fill or other obstructions in this area. The arrangement of this two stage channel can be seen in **Figure 3**.

When we designed and built the project, we also made minor adjustments in the stream’s alignment to help reduce the energy of the water as it moves down stream. Increasing the size and number of meanders in a stream reduces the slope

and resulting energy. To further reduce energy, the stream's slope was designed as a series of steps with water flowing over boulder rock structures into energy dissipating pools.

B. Cross Vane Rock Structures

Once a stable stream channel alignment and slope was determined from the reference reach, the GCSWCD incorporated a number of rock structures to provide this slope and alignment control. These structures are referred to as cross vanes. As you will note in their construction, the cross vanes are two downward angled ramps extending from the bank in an upstream direction, with a solid, level sill of rock set at the elevation of the desired streambed (**Photo 2 and Figure 1**).



The flat sill located in the center of the stream channel provides the grade control, while the two ramps of the structure function to reduce the water surface slope along the streambank upstream of the structure. By reducing (flattening) the water surface slope, the erosive forces on the streambanks (known as shear stress) is also reduced to a point where vegetation can be used to provide bank stability. During higher flows, you should observe an area of flatter water on each side of the channel upstream of the structure with the faster velocities directed to the center of the channel. The cross vanes will maintain a pool just downstream of the sill area. This pool will further dissipate stream energy and help maintain stability in the reach.



Photo 2. Note still water along banks , velocities in center of the stream

C. Maintenance of the Stream Channel and the Cross Vanes

The GCSWCD will continue to monitor the stream channel bed and banks to insure that our design is stable. As the landowner, do not to attempt any excavation or adjustments to the

Figure 1. Overhead view of Rock

channel. Maintenance of the channel bed, banks and rock structures are the responsibility of the GCSWCD. Maintenance of these structures is generally limited to the first few years when a few flood events may dislodge rocks from the cross vanes. The replacement and or adjustment of these rocks are the responsibility of the GCSWCD. Landowners can assist the GCSWCD by reporting damages to these structures. If large woody vegetation becomes trapped on the structures it can be removed, but you are requested to notify the GCSWCD in advance.

D. Groundwater Relief Wells

Across the stream from your homes, the project design called for the installation of several groundwater relief wells to mitigate the silt boil which had developed in the center of the channel. During test borings conducted by our geo-technical engineer, it was discovered that a layer of coarse sand 3' to 4' thick was present under the clays at a depth between 27' and 32'. The sand layer accumulated groundwater flow. Being confined between deep clay layers, enough pressure would build in the sand layer to create an artesian condition. Groundwater pressure in the sand layer was strong enough to push water up to the stream bottom through the overlaying clays. As the groundwater moved upwards, it eroded the clay layer and a highly turbid solution of groundwater and clay particles was entered the stream.

To mitigate this condition, the project installed three groundwater relief wells which basically provide pressure relief to the shallow confined aquifer, and which divert upwelling groundwater flow safely to the stream via a discharge pipe. As designed, the groundwater wells do not require any maintenance other than an occasional inspection to make sure the discharge outlets are clear of obstructions.

E. The Role of Vegetation

Vegetation plays three main roles in providing for stream quality. First, the vegetation plays a critical role in providing for stream bank stability. The roots of trees, shrubs and grasses help to secure the stream bank and keep it from eroding during high stream flows. When trees, shrubs, and grass are planted in combination, their roots form a mosaic

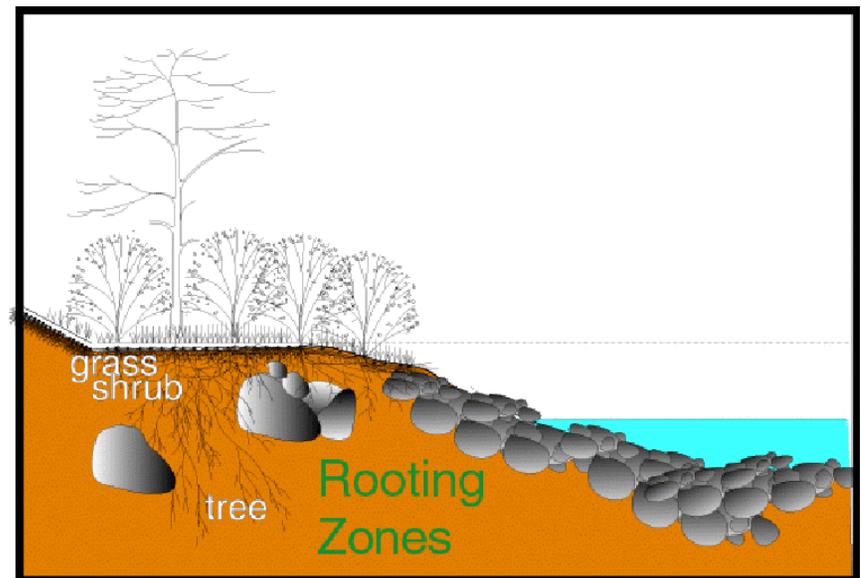


Figure 2. The riparian vegetation rooting zone

capable of holding the soil at all levels. Vegetation in the riparian area also reduces the amount of erosion that can result from surface runoff as it finds its way to the stream. The second way that vegetation helps is by slowing runoff. By allowing surface runoff more time to enter the soil, vegetation is reducing the amount of non-point source pollution -- road salts, excess fertilizers or other chemicals -- which otherwise might be carried into the stream. Finally, streamside vegetation provides cover for the stream. This reduces water temperatures and improves fisheries habitat by providing protection from predators. Organic material, in the form of leaf litter, provides essential nutrients to aquatic insects - a basic food of native fish.

IV. Vegetation Maintenance

The purpose of this section is to help landowners maintain the vigor of the streamside vegetation on the project reach. By keeping riparian vegetation healthy, the landowner is ensuring that the vegetation functions effectively to keep streambanks stable and enhance the quality of the aquatic habitat.

A. Riparian Vegetation Zones and their Management

The establishment of an effective vegetative riparian buffer is extremely critical to this project. Furthermore the success of that vegetation is dependant on *your* assistance.

This section describes the riparian vegetation zones that will be established following construction. Each zone differs in its assortment of plant species and the planting arrangement. The selections of specific plants and their arrangement is intended to maximize the function of the riparian vegetation based on the stresses and conditions expected in each zone. Correspondingly, each zone will have different management recommendations for the landowners to follow. These recommendations are based upon the experience gained from other conservation projects utilizing these plants, and the evaluation of their performance.

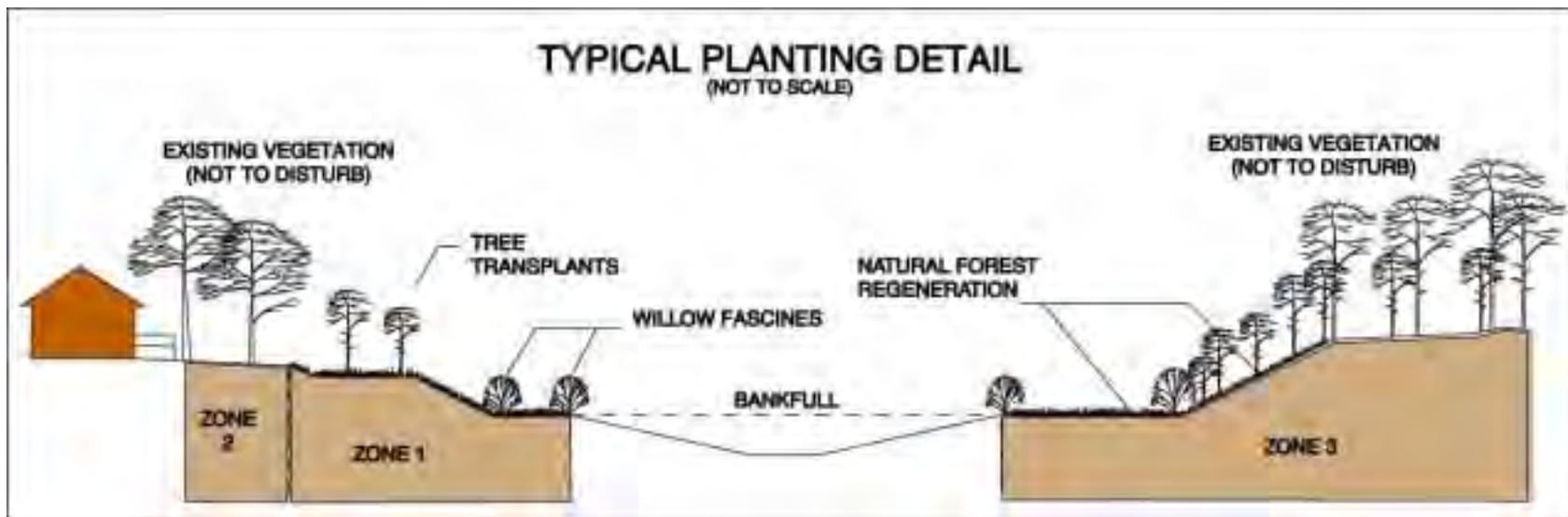


Figure 3. The riparian vegetation zones

For the purpose of vegetation management, the riparian area of the Broadstreet Hollow Creek at the project site is broken into three zones. Each zone experiences differing levels of stress during storm events and high flow conditions. In general, the level of stress declines as distance from the stream increases. Concurrently, the plant selection and arrangement changes as the distance from the stream increases. A view of the limits of the zones is shown in Figure 3.

Zone 1:

This zone is a flood plain and subject to the greatest amount of stress. Here, nearest the stream, the vegetation is managed for maximum root development and occupation of the stream bank in an effort to reduce the effects of erosive stresses on the stream bank. This is accomplished primarily using closely spaced, low growing shrubs and trees. Cool climate perennial grasses are used in this area to provide immediate post-construction soil stability until the shrubs and trees become established. Management here is generally restricted to encouraging rapid growth by watering trees and shrubs and replacing dead plants. Fertilizer applications are generally unnecessary, and could mistakenly make their way into the waterway.

Zone 2:

As you move away from the stream, grasses and more widely spaced taller trees and shrubs become dominant. Here, the function is to provide soil stability, while creating habitat cover and allowing for the infiltration of surface runoff. Management is initially limited to watering, plant protection from deer browse, and plant replacement, with some pruning and mowing allowed outside of the flood prone area.

Zone 3:

On the right bank of the stream the vegetation will include primarily trees and shrubs native to New York forests in an effort to re-establish a natural riparian forest buffer. The upper slope area (above the bankfull floodplain) will be initially seeded with conservation seed mixture for surface erosion control. A number of bare root tree seedlings will be planted in the spring of 2001. This area will primarily be left to regenerate on its own, as there are adequate seed trees present and the area is out of the flood zone. In the first year of establishment, this zone may require some irrigation, but otherwise, will be left to grow without intensive management. Once established, the vegetation in this zone will not require maintenance. Protection against browsing wildlife will be provided by Greene County Soil and Water Conservation District upon establishment and will be necessary until the trees are above the reach of deer.

B. Managing the Vegetation

As a participant in this project, it is the responsibility of each landowner to monitor the general condition of the vegetation and to report any potential problems to the Greene County Soil and Water Conservation District at (518) 622-3620.

Pruning

Landowners should recognize that most riparian vegetation, especially in Zone 1 and 3, is best left to grow without significant trimming or pruning. Top pruning or shearing of shrubs will promote lateral growth and is appropriate once the shrub has reached a height of 4 - 5 feet.

Mowing

Mowing grasses will reduce the rooting depth of individual grass plants and thereby will decrease their effectiveness in protecting the soil from erosive forces. Intensive mowing with lawn tractors can kill or severely damage young trees and natural regeneration, as well as compact the soil. Landowners should respect the suggestion not to mow grass or cut trees and shrubs in Zone 1. Mowing is allowed in Zone 2. Landowners are asked to cut the grass only at the highest settings and to maintain a three foot (3') buffer of grass at the very edge of the zone. This buffer strip should be cut only once each year. Landowners should avoid mowing in the hot summer months and during drought periods.

Mulching

The use of heavy mulches around new plantings, such as bark chips or shredded cypress bark should be avoided, as these will kill off the important grasses needed for soil surface protection. The use of straw as a mulch for preserving soil moisture around new plantings is recommended instead of heavy, less biodegradable mulches.

Unless otherwise approved by the Greene County Soil & Water Conservation District, landowners will not remove or move any trees or shrubs planted by the project. Landowners can supplement the trees and shrubs planted after construction, but should check with the Greene County Soil & Water Conservation District to ensure that the plant species is compatible with the site conditions as well as the designed planting strategy. Remember, it is important to maintain a mix of trees, shrubs, and grasses to provide the best protection against soil erosion.

Hardy, reliable plant material has been used in this project. It should not be necessary to use fertilizer, herbicides, or pesticides on any of the plantings. Any such applications should be made by the Soil and Water Conservation District. Owner application of these materials could complicate efforts to monitor the effectiveness of the project by reducing water quality, adversely affecting fish populations and damaging the vegetation. In addition, landowners are requested to avoid using Zone 1 for disposal of cuttings, grass clippings and other materials. While the GCSWCD recognizes the need for

“compost” areas, placement of these materials in the immediate stream corridor inhibits plant growth and reduces stability. The GCSWCD will discuss on-site composting options with each individual landowner.

C. Access to The Stream

This project is not intended to limit landowner access to the stream. In fact, it is important to the success of the project that you continue to enjoy the experience and benefits of living on the stream. Your assessment of our work as stream management professionals is extremely important to us. We recognize that establishment of thick shrub vegetation along the stream may present an obstacle to your access. However, we have observed many other stream sites where “trails” to the water have become the primary source of stream bank instability. By the use of selective thinning of the shrubs, protection from concentrated surface runoff, and stabilization of the path with stones, a stable access point can be maintained. The Greene County Soil & Water Conservation District will work with each of you to establish safe and stable access points along your property.

D. Modifying the Plan

This guide contains recommendations to be followed by current and future residents of the project site. The recommendations are made in an effort to protect local property from the hazards that accompany unstable stream conditions. Should the Greene County Soil & Water Conservation District find that conditions warrant an alteration to the vegetation plan or the management strategy of this document, the District may act to correct the conditions.

E. Advice and information

Additional information or advice is available through the Greene County Soil and Water Conservation District at (518) 622-3620 or the NYC Department of Environmental Protection’s Stream Management Program at (845) 340-7518.

Appendix 3.1.2 Table of Native Plants for Use in Riparian Buffers

Shrubs		
Willow - <i>Salix purpurea</i> (Streamco cultivar)	Zone 1/3	<p>Establishment - planted as live stakes, fascines, seedlings</p> <p>Benefit - bank stabilization, storm water run-off protection, wildlife habitat</p> <p>Needs/Management - Irrigation in first year during dry spells, browse control, can be top pruned after they reaches 4-5 feet to keep in bush form. Later years prune deadwood.</p>
Red Osier Dogwood	1/2/3	
Button Bush	1/2/3	
Trees		
Cottonwood - Populus deltoides (male clones)	3	<p>Establishment - Live stakes, stump sprout, natural repopulation, seedlings, balled & burlapped</p> <p>Benefit - deep rooting, selection based on soil conditions, stabilization, stream cover.</p> <p>Needs/Management - Irrigation during initial establishment, report dead, diseased or downed trees to GCSWCD</p>
Grasses		
<p>Conservation Seed Mixture</p> <p>00% Fescue 00% Rye 00% Legume 00% _____</p>	<p>Zones</p> <p>All</p>	<p>Establishment - hydro-seeded</p> <p>Benefit - fast coverage, strong fibrous root mass provide protection from both stream flows and surface runoff.</p> <p>Needs/Management - Landowners may routinely mow the grass up to a point three feet (3') from the top of the floodplain bank (edge Zone 2/3) and may annually mow all the way to the edge of Zone 3 to prevent woody growth in this area. A narrow buffer of grass which is not routinely mowed will allow the grass to put energy into root development instead of regenerating top growth.</p>

Appendix 3.1.3 Broadstreet Hollow Historical Information Resource List

(Note: Broadstreet Hollow in the past has also been called Forest Valley, Bradstreet Hollow, Bradstreet Bush Kill)

Kudish, Michael. *The Catskill Forest: A History*. Fleischmanns: Purple Mountain Press, Ltd., 2000.

Rich, John Lyon. *Glacial Geology of the Catskills*. Albany: The University of the State of New York, 1934.

New York State Library, Albany:

- Land Use and Natural Resources Inventory and Land Related Information System Land Use Overlay Maps, 1968-1977. (overlay 7.5' USGS topographic maps)
- Topographic maps from early 1900's and on
- 9"x 9" prints of 1968 aerial photography, 1" = 2000'

County Soil and Water Districts:

- FEMA and FIRM maps
- Aerial photographs from various years

Shandaken Town Historian:

Charles Zimmerman
845-688-5286

Lexington Town Historian:

Karen Deeter
518-989-6027

Other Resources available at Ulster County Soil and Water Conservation District, Highland & NYC DEP SMP, Kingston:

- 1930 glacial geology map (hard copy and digital format, georeferenced)
- 1900 15' Phoenicia quad (photocopy of original and digital format of copy, georeferenced)
- 1903 15' Phoenicia quad (2 versions – one has been hand colored in according to land use, by whom is unknown) (digital format, georeferenced)
- FEMA and FIRM maps
- current topographic maps and doqq's (digital and hard copy)
- 2001 BSH aerial photography

GIS Coverages:

geo_bed
sfgeo250
fema_uls (no greene county?)
nwipnt24woh (wetlands)
nwipol24woh (wetlands)

forest100
lu_th_woh (landuse)
parcel_woh (landuse)
public_woh (public land)
parcel_grn & uls
parcel_history
hse24woh (houses)
stlnd24woh (state land)
woh_towns
road24uls & grn
climatewoh
precip_ny
siteclim
sitebiom
sitehyd (stream sampling locations)
hydric24woh (hydric soils)
soil24woh

Available at Albany State Library:

- Land use maps, 1968-1977, which overlay 7.5' USGS quads.
- Topographic maps from early 1900's and on
- 9"x 9" prints of 1968 aerial photography, 1" = 2000'

Appendix 3.1.4 Operation and Maintenance of Broadstreet Hollow Demonstration Restoration Project

Proper operation and maintenance is a critical element for the success of restoration projects, which use geomorphic and natural channel design techniques. Based on experience with local conditions, and the five NCD projects completed to date, the GCSWCD and NYCDEP SMP believe that attaining acceptable channel stability requires an extended period for the project to become "established". While site conditions and hydrological conditions strongly influence the amount of time a project needs to become established, it appears that at least a two-year establishment period must be considered. This "establishment" period must include allowances for reestablishment of vegetation and adjustments/repairs to rock structures. It is critical to have a clear understanding that typically, restoration goals are not achieved the day the contractor leaves the project area, and the evaluation of project success must be based on performance over a longer period of time.

During the initial years after establishment, as the restoration site experiences a range of flows and the sediment regime becomes "naturalized", projects usually require modifications and design enhancements. Project sponsors must be prepared to undertake adjustments in the channel form and/or rock structures as indicated by the project monitoring. It is believed that as project vegetation becomes established the overall operation and maintenance of the project will decrease. The Broadstreet Hollow Operation and Maintenance Plan is included, in draft form, in Appendix C.

A management plan and strategy is currently being developed for the Broadstreet Hollow watershed by the NYCDEP SMP and the Ulster County SWCD. The plan will provide a working document to assist with resource management in the watershed, which will ultimately assist in the operation and maintenance of the project reach.

A Landowner Guide for the adjacent property owners is included in Appendix D. The focus of the Landowners Guide is to support and educate the landowners around the project area regarding the physical components of the stream channel, floodplain, and project vegetation. Additionally, the Landowner Guide incorporates distinct actions the landowners will need to follow in order to maximize the benefits from the restored project reach. These actions include, defining the roles of the project stakeholders, techniques for managing riparian vegetation, accessing the stream, modification of the plan, general advice, as well as project contacts and general information.

Rock Structures

In stream rock structures may require some modification and enhancement. This is detailed in the Operation and Maintenance Plan for the site, which addresses the replacement of rocks to ensure structural integrity, intended functions of the vanes, and debris and sediment maintenance

considerations. The Operation and Maintenance Plan also outlines the modification and repair, as well as monitoring schemes.

Vegetation

Vegetative establishment in the project area is a critical component to the project's long term stability. General site constraints and gravelly soil conditions limit the success and establishment of the designated vegetative element of the project. Careful planning, monitoring and maintenance is required for all of the installed vegetation. Increased browsing pressure from mammals, potential for disease, and extreme weather conditions can reduce the success of the plant materials. Inspection and monitoring of the plant materials throughout the initial stage of development will assist in ensuring plant viability.

Supplemental installation of plant material, as needed, in the form of bioengineering and riparian planting will ensure effective riparian establishment. During supplemental planting, a variety of bio-engineering techniques will be used to increase woody vegetation at the site. These plantings will require maintenance to ensure proper moisture at critical times. The development of the monitoring plan for vegetation is addressed in the monitoring component of the Operation and Maintenance Plan and the Landowners Guide found in the attached appendices (***See also The Broadstreet Hollow Stream Management Plan Volume I**).

Appendix 3.1.5 Management Unit Workbooks- MU1-19

Management Unit 1

Description: Management Unit 1 is located in Greene County, NY, beginning approximately 100 feet upstream of the border of NYS DEC maintained parcel 204.00-1-22, the Unit extends 2417 feet downstream to southerly boundary and the Broadstreet Hollow Road intersection of parcel # 204.00-2-39.

County: Greene

LP Station: 0-2417'

Total reach length (ft): 2417

Feature	Length	% of Bank	Total #	Description
bridge	0	0.0	0	
eroding bank	0	0.0	0	
behi	N/A	N/A	0	
cross-sections	N/A	N/A	39	XS1-39
Known structures	N/A	N/A	7	
property owners	N/A	N/A	8	see below
rights of way				
culverts	N/A	N/A	10	7 are 1-2"d with 3 of them dry/3 are 2-3"d running
tributaries	N/A	N/A	4	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	0	0.0	0	
berm	0	0.0	0	
riprap	638	13.2	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #1**

Feature	Length	% of Bank	Total #	Description
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	2	old well & utility pole # 72284 30510
divergence/convergence	N/A	N/A	4	2div/2con
grade control	0	0.0	0	
other	contains reference reach and 12 cross sections monumented during assessment GCSWCD/DEP			

Farthest stream distance from BSH road = 138

Shortest stream distance from
road = 14 ft

**Broadstreet Hollow
Management Unit #1**

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B3	0	203	203	3.05
F3b	230	335	105	3.5
B3	335	446	111	2.93
DA4b	446	610	164	2.95
F4b	610	895	285	3.88
Bc	895	935	40	1.95
F3b	935	1261	326	3.47
G3	1261	1311	50	2.56
F3a	1311	1603	292	5.3
B4	1603	1673	70	3.27
F3a	1673	1894	221	4.24
B3	1894	2008	114	2.22
W3	2008	2085	77	6.31
B3a	2085	2420	335	4.3

Management Unit slope %:

ws =4.1% bf =4.0%

fisheries

reference reach - fisheries, habitat, geomorphic monitoring (BMP study)

**Broadstreet Hollow
Management Unit #1**

<i>Parcel #:</i>	<i>Acres:</i>
204.00-2-21	2.5
204.00-2-23	22.5
204.00-1-22	54.7
204.00-2-22	0.5
204.00-2-20	2.3
204.00-2-39	13.87
<i>204.00-1-15</i>	<i>33</i>

Current monitoring:

reference reach - fisheries, habitat, geomorphic
monitoring (BMP study)

**Broadstreet Hollow
Management Unit #2**

Description: Management Unit 2 is located in Greene County, NY, beginning approximately 200 feet above rebar monumented BEHI 28, at the upstream end of the rip-rap and log crib wall. The Unit extends downstream 1484 feet to the outlet of County Bridge # 3201230 at Regina's Way.

County: Greene

LP Station: 2417-3901

Total reach length (ft): 1484

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	3	privat crossings at Shinbach, Albeli,& County bridge #3201230
eroding bank	505	17.0	5	associated with behi's 22, 23, 25, (length included in clay exposure) 27, 28
behi	N/A	N/A	7	behi 22-28
cross-sections	N/A	N/A	17	xs40-57
known structures	N/A	N/A	10	
property owners	N/A	N/A	10	see below
rights of way				
culverts	N/A	N/A	2	both dry
tributaries	N/A	N/A	1	on left bank
wetlands	0	0.0	0	
landfills	182	6.1	1	abandoned property-falling down house
clay exposure	229	7.7	2	glacial lake clay in left bank and bed
berm	153	5.1	2	
riprap	63	2.1	N/A	native bldr & dumped rock

**Broadstreet Hollow
Management Unit #2**

Feature	Length (ft)	% of Bank	Total #	Description
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	125	4.2	N/A	
gabions	0	0.0	N/A	
dumped rock fill	292	9.8	N/A	
concrete slabs	122	4.1	N/A	eroding fill for house
knotweed	95	3.2	N/A	
utilities	N/A	N/A	2	wells, not used
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road = 89'

Shortest stream distance from road = 0 (at bridge above project site)

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b	2420	2660	240	3.17
D3a/DA3a	2660	2768	108	5.92
F3b	2768	3203	435	3.3
B3a	3203	3252	49	4.6
G3	3252	3285	33	none
F3b	3285	3675	390	2.7
G3	3675	3766	91	3.64
B3	3766	3831	65	2.2
F3b	3831	3918	87	2.36

**Broadstreet Hollow
Broadstreet Hollow
Management Unit #2**

Management Unit slope%:

ws = 3.32% bf = 3.12%

Landowners N/F:

adjacent to/near stream:

<i>Parcel #:</i>	<i>Acres:</i>
204.00-2-23	22.5
204.00-2-25	2
204.00-2-26	41.66
204.00-2-15	2.31
204.00-2-24	0.13
204.00-2-35	0.65
204.00-2-18	1
204.00-1-111	48.4
204.00-2-17	0.7
204.00-2-34	1
204.00-2-39	13.87

Current monitoring: Behi 22-28 monumented xs

**Broadstreet Hollow
Management Unit #3**

Begins just downstream of Regina's Way Bridge, crossing at the south westerly edge of N/F Patience Parcel 204.00-2-35 Extends 1148' through the Demonstration Restoration project.

Description:

Ends just above Timberlake Rd. Bridge at south westerly boundary Torregrossa/ Magnani parcel 204.00-2-36/204.00-2-12

County: Greene

LP Station:

3918-5066

Total reach length (ft):

1148

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0		
eroding bank		0.0		
behi	N/A	N/A		
cross-sections	N/A	N/A		58-69
known structures	N/A	N/A	8	
property owners	N/A	N/A	11	
rights of way				
culverts	N/A	N/A	3	1, 1-2' corrugated/wet 1, 3-4' corr/dry 1, corr/running
tributaries	N/A	N/A	6	
wetlands		0.0		
landfills		0.0		
clay exposure	138	6.0	4	along banks and in channel bed
berm		0.0		
habitat structures	874	38.1		
riprap	218	9.5	N/A	
stacked rock wall		0.0		
sheetpile	110	4.8	1	N/F Torregrossa Sr. 204.00-2-38
cribwall		0.0	N/A	
gabions		0.0	N/A	
dumped rock fill		0.0	N/A	
concrete slabs		0.0	N/A	

**Broadstreet Hollow
Management Unit #3**

Feature	Length (ft)	% of Bank	Total #	Description
knotweed		0.0	N/A	
utilities	N/A	N/A		
divergence/convergence	N/A	N/A		
grade control		0.0		
other			13	Habitat/fluvial geomorphic structures in demo project site
relief wells			5	For artesian wells in demo site

Farthest stream distance from BSH road = 230'
 Shortest stream distance from road = 65'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B3c	3918	4064	146	1.73
F3a	4064	4116	52	4.58
B3	4116	4394	278	3
F3b	4394	4493	99	3.49
B3	4493	4598	105	2.92
F3b	4598	4714	116	3.37
B3	4717	4830	113	2.12
F3b	4830	5151	321	2.93

Management Unit slope%:

ws = 3.01% bf =2.73%

Fisheries: USGS 3 year habitat study

**Broadstreet Hollow
Management Unit #3**

Landowners, N/F

Adjacent to / *near stream*

<i>Parcel #:</i>	<i>Acres:</i>
204.00-2-16	0.93
204.00-2-12	0.96
204.00-2-36	0.42
204.00-2-37	0.21
204.00-2-38	0.21
204.00-2-15	2.31
204.00-2-1.111	48.4
204.00-2-30	0.98
204.00-2-28	3
204.00-2-29	0.22
204.00-2-31	0.17

Current monitoring:

USGS fish study, Operation and Maintenance of habitat structures in Demonstration Project site/
Riparian vegetation plantings (GCSWCD)

**Broadstreet Hollow
Management Unit #4**

Description: Management Unit 4 is located in Greene County, NY, beginning at the inlet of County Bridge # 3201240 at Jay Hand Hollow Road. The Unit continues downstream 1658 feet to the northeasterly tip of parcel # 204.00-3-6.

County: Greene

LP Station: 5066-6724

Total reach length (ft): 1658

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	2	BSH Rd. near State land County Bridge #3201220, TimberLake Rd. #3201240, wood/concrete & steel
eroding bank	459	13.8	7	Associated with BEHIs listed below
behi	N/A	N/A	3	BEHIs 19,20 & 21
cross-sections	N/A	N/A	29	70-99
known structures	N/A	N/A	5	
property owners	N/A	N/A	6	
rights of way				
culverts	N/A	N/A	6	3-4'corrugated/wet, 1-2' corrugated/wet
tributaries	N/A	N/A	1	
wetlands		0.0		
landfills		0.0		
clay exposure		0.0		
berm	694	20.9	7	
riprap	307	9.2	2	
stacked rock wall	206	6.2	3	
sheetpile		0.0	N/A	
cribwall		0.0	N/A	
gabions		0.0	N/A	

**Broadstreet Hollow
Management Unit #4**

Feature	Length (ft)	% of Bank	Total #	Description
dumped rock fill		0.0	N/A	
concrete slabs		0.0	N/A	
knotweed		0.0	N/A	
utilities	N/A	N/A	2	phone poles
divergence/convergence	N/A	N/A	1	stable inactive over flow channel
grade control		0.0		
other				

Farthest stream distance from BSH road = 99'
 Shortest stream distance from road = 0' @bridge

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b	4830	5151	<u>321</u>	2.93
B3a	5151	5194	43	4.67
F3b	5194	5349	155	3.1
C3a	5349	5472	123	4.57
F3b/G3	5472	5539	67	2.39
B3	5539	5604	65	2.84
F3	5604	5710	106	1.19
B3	5710	5752	42	2.35
F3b	5752	5801	49	3.75
B3	5801	5849	48	4.18
F3b	5849	5893	44	2.4
B3	5893	6055	162	3.89

**Broadstreet Hollow
Management Unit #4**

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b	6055	6205	150	2.06
B3c	6205	6273	68	1.72
F3	6273	6523	250	1.86
B3c/F3	6523	6623	100	1.77
F3	6623	6724	101	1.3

Management Unit slope:

ws = 2.69%

bf = 2.66%

Landowners N/F:

Parcel #:

Acres:

Adfacent to/ Near stream

204.00-3-10	47.5
204.00-3-2	27.6
204.00-2-10	0.26
204.00-2-9	1.2
204.00-3-11	245.5
<i>204.00-3-1</i>	<i>2.17</i>

Current monitoring:

BEHIs 19,20 & 21

monumented xs

Broadstreet Hollow Stream

Management Unit #5

Description: Management Unit 5 is located in Greene County, NY, beginning at the northeasterly tip of 204.00-3-6 continuing downstream 671 feet downstream to the westerly boundary 5.4-1-3-13.
 County: Greene
 LP Station: 6724-7395
 Total reach length (ft): 671

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	0	
eroding bank	467	34.8	1	Left lower length included in clay exposure also
behi	N/A	N/A	1	#18
cross-sections	N/A	N/A	7	100-106
known structures	N/A	N/A	6	
property owners	N/A	N/A	4	See below
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	50	3.7	1	mostly metal
clay exposure	491	36.6		24' part of 206' total, left bank, glacial lake clay in unit 6
berm	67	5.0		67' over from Unit 4
riprap	0	0.0	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #5**

Feature	Length (ft)	% of Bank	Total #	Description
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control		0.0		
other				

Farthest stream distance from BSH road = 260'

Shortest stream distance from road = 50'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B3c/F3	6724	6873	149	2.72
F3b	6873	7170	297	2.74
B3c/F3	7170	7323	153	1.97
B4c/C4	7323	7395	72	1.2

Management Unit slope%:

ws = 2.4% bf = 2.09%

Landowners N/F:

Adjacent to / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
204.00-3-2	27.6
204.00-3-6	1.6
204.00-3-13	0.69
204.00-3-4	6.82

Current monitoring:

Behi 18 monumented xs

Broadstreet Hollow**Management Unit #6**

Management Unit 6 is located in Greene and Ulster Counties, NY, beginning at the easterly boundary of 204.00-3-7 continuing downstream 514 feet

Description: across the Ulster- Greene County line to the northwesterly boundary 5.4-1-4.

County: Ulster/ Greene

LP Station: 7395-7909

Total reach length (ft): 514

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	0	
eroding bank	0	0.0	0	
behi	N/A	N/A	0	
cross-sections	N/A	N/A	5	107-111
known structures	N/A	N/A	1	
property owners	N/A	N/A	4	see below
rights of way				
culverts	N/A	N/A	0	
tributaries	N/A	N/A	1	srping near road
wetlands	0	0.0	0	
landfills	143	13.9	1	mixed, mostly grass and tin
clay exposure	182	17.7	1	no behi some bed
berm	76	7.4	1	old mossy cobl-blldr w trees
riprap	0	0.0	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #6**

Feature	Length (ft)	% of Bank	Total #	Description
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control		0.0		
other				

Farthest stream distance from BSH road = 260'
Shortest stream distance from road = 60'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B4c/F4	7395	7448	53	1.11
F3b	7448	7608	160	3.08
C3a	7608	7641	33	5.03
B3	7641	8109	468	2.27 Two Hundred feet of this stream type in MU 7

Management Unit slope

%:

ws = 1.81% bf = 2.25%

Landowners N/F:

Adjacent to / Near stream

Parcel #:	Acres:
204.00-3-9	66.6
204.00-3-7	1.5

**Broadstreet Hollow
Management Unit #6**

Landowners N/F:

Adjacent to / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-5	0.15
5.4-1-6	29.3
5.4-1-7.100	108.98

Current monitoring: none

Broadstreet Hollow**Management Unit #7**

Description:

Management Unit 7 is located in Ulster County, NY, beginning at the northeasterly boundary of 5.4-1-4 just beyond the Ulster-Greene County line. The Unit continues downstream 517 feet to the end of rip-rap area and ends just before rebarmonumented BEHI 16 at the northeasterly boundary of 5.4-1-47.100

County: Ulster

LP Station:

7909-8426

Total reach length (ft):

517

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	0	
eroding bank	59	5.7	1	associated with behi 17
behi	N/A	N/A	1	Behi 17
cross-sections	N/A	N/A	4	113-116 112 not surveyed
known structures	N/A	N/A	3	
property owners	N/A	N/A	5	see below
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	3	all smooth metal, 2 running, 1 dry
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	Channon swail
landfills	0	0.0	0	
clay exposure	20	1.9	1	
berm	0	0.0	0	
riprap	247	23.9	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #7**

Feature	Length (ft)	% of Bank	Total #	Description
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	1	
grade control		0.0		
other				

Farthest stream distance from BSH road = 170'
Shortest stream distance from road = 25'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B3	7641	8109	468	2.27
F3/B3c	8109	8223	114	0.71
C3b	8223	8331	108	3.7
B3c/C3	8331	8426	95	1.52

Approximately 250 feet of this stream type is in MU6

Management Unit slope %:

ws =1.51% bf =1.86 %

**Broadstreet Hollow
Management Unit #7**

Landowners N/F:

Adjacent to / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-7.100	108.98
5.4-1-3	0.25
5.4-1-4	0.2
5.4-1-2	1
5.4-1-50	4

Current monitoring:

Behi 17 monumented
erosion xs.

Broadstreet Hollow

Management Unit #8

Description:

Management Unit 8 is located in Ulster County, NY, beginning at monumented BEHI 16, at the northeasterly boundary of parcel # 5.4-1-47.100, approximately 120 feet above the private bridge on parcel 5.4-1-7.100. The Unit extends 1630 feet, downstream to the southwesterly portion of the same parcel.

County: Ulster

LP Station:

10056-8426

Total reach length (ft):

1630

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	1	Cahill Bridge,private
eroding bank	437	13.4	2	associated with behi's 11-16
				BEHI 11,12b&13 contain 308' clay exposure listed below
behi	N/A	N/A	6	Behi 11-16
cross-sections	N/A	N/A	20	117-136
known structures	N/A	N/A		
property owners	N/A	N/A	6	adjacent to or near stream
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	4	all smooth metal, 2 running, 2 dry
tributaries	N/A	N/A	1	Thalweg
wetlands	0	0.0	1	Foss not GPSd
landfills	0	0.0	0	
clay exposure	370	11.3	0	
berm	149	4.6	1	pushed up grvl cobble Foss
riprap	53	1.6	N/A	native bldr
stacked rock wall	50	1.5	1	metal bldr with band run on top
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #8**

Feature	Length (ft)	% of Bank Total #		Description
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road = 95'

Shortest stream distance from road = 25'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3a	8426	8471	45	5.02
B3/F3b	8471	8525	54	2.87
B3c	8525	8707	182	1.87
B3/F3b	8707	8837	130	3.26
B3c	8837	8934	97	1.23
B3c/F3	8934	9042	108	1.92
F3b	9042	9205	163	2.81
C3a	9205	9264	59	4.01
B3c	9264	9621	357	1.82
F3b	9621	10056	435	2.44

Management Unit slope %:

ws = 2.18 %

bf = 2.22 %

**Broadstreet Hollow
Management Unit #8**

Landowners N/F:

Adjacent / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-47.100	2.03
5.4-1-7.100	108.98
5.4-1-48	3
5.4-1-49.100	2.5
5.4-1-49.200	2.34
5.4-1-47.200	79.86

Current monitoring:

BEHI 11-16 monumented XS

**Broadstreet Hollow
Management Unit #9**

Description: Management Unit 9 is located in Ulster County, NY, beginning approximately 50 feet below monumented BEHI 11, just below parcel # 5.4-1-47.100. The Unit extends 815 feet, extending downstream to the southwesterly portion of parcel # 5.4-1-7.

County: Ulster

LP Station: 10056-10871

Total reach length (ft): 815

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0	0	
behi	N/A	N/A	0	
cross-sections	N/A	N/A	9	137-145
houses	N/A	N/A	0	
property owners	N/A	N/A	2	see below
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	2	3-4'smooth metal,running, 1-2' dry
tributaries	N/A	N/A	1	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	0	0.0	0	
berm	116	7.1	1	
riprap	446	27.3	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	327	20.1	N/A	

**Broadstreet Hollow
Management Unit #9**

Feature	Length (ft)	% of Bank	Total #	Description
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control		0.0		
other				

Farthest stream distance from BSH road = 75'
 Shortest stream distance from road = 20'

Stream Type:	Station:	Station:	Station Length:	Reach	Slope %
B3c	10056	10242		186	1.99
F3b	10242	10363		121	2.94
B3c	10363	10570		207	1.5
C4	10570	10690		120	1.3
B3	10690	10871		181	3.85

**Management Unit
slope %:**

ws = 2.58 % bf = 2.02%

**Broadstreet Hollow
Management Unit #9**

Landowners N/F

Adjacent / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-43	72.03
5.4-1-7.100	108.98
5.4-1-45-100	53.19
5.4-1-45.200	5.5

Current monitoring: none

Broadstreet Hollow Stream

Management Unit #10

Description:

Management Unit 10 is located in Ulster County, NY, beginning just below the tributary on the left bank, below the dump rock fill and above the stacked rock wall. This Unit extends 649 feet downstream just below the riprap on the left bank, and above another tributary from a wetland area, also on the left bank.

County: Ulster

LP Station:

10871-11520

Total reach length (ft):

649

Feature	Length (ft)	% of Bank	Total #	Description
bridge	0	0.0	1	Private bridge on parcel 5.4-1-8
eroding bank	138	10.6	2	associated with behi's 9,10
behi	N/A	N/A	2	behi 9,10
cross-sections	N/A	N/A	7	146-152
known structures	N/A	N/A	1	
property owners	N/A	N/A	4	see below
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	9	3 corrugated, 2 plastic, 2 smooth metal; running, 2 smooth metal; dry
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	227	17.5	0	mixed material intermittent stones
clay exposure	0	0.0	0	
berm	0	0.0	0	
riprap	93	7.2	N/A	mixed bldr new nonveg

**Broadstreet Hollow Stream
Management Unit #10**

Feature	Length (ft)	% of Bank	Total #	Description
stacked rock wall	134	10.3	1	w/dumped rock, no trees
sheetpile	0	0.0	N/A	
cribwall	28	2.2	N/A	
gabions	0	0.0	N/A	
dumped rock fill	46	3.6	N/A	very loose new w/ cut trees
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road = 125'
Shortest stream distance from road = 40'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b/B3	10871	10964	93	2.07
F3b	10964	11205	241	2.89
B3	11205	11348	143	2.79
C3	11348	11377	29	1.75
B3c	11377	11520	143	1.32

**Broadstreet Hollow Stream
Management Unit #10**

Management Unit slope:

ws = 2.39 %

bf = 2.24 %

Landowners N/F:

Adjacent to / *Near stream*

Parcel #:

Acres:

5.4-1-8.100

66.75

5.4-1-44

2

5.4-1-43

72.03

5.4-1-45.300

1.19

Reported Landowner

Issues/Concerns:

fill material eroding

Current management practices:

New replacement culvert with splash rock
planned 15".

New rockwall ledge

Replacing guardrail next
year(crib rotting)

Current monitoring:

BEHI 9 & 10 monumented xs.

Broadstreet Hollow**Management Unit #11**

Description:

Management Unit 11 is located in Ulster County, NY, beginning 200' downstream of monumented BEHI 9, just below rip-rap and small culvert on left bank of parcel #5.4-1-8, and above wetland and tributary on left bank. This Unit extends downstream 429 feet just below tributary and culvert on left bank.

County: Ulster

LP Station:

11520-11949

Total reach length (ft):

429

Feature	Length (ft)	% of Bank	Total #	Description
bridge	0	0.0	0	
eroding bank	43	5.0	1	associated with behi 8 (left bank 15 feet clay exposure noted below)
behi	N/A	N/A	1	behi 8
cross-sections	N/A	N/A	4	153-156
known structures	N/A	N/A	0	
property owners	N/A	N/A	3	see below check this
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	1	corrugated, running, rusted out private rd.
tributaries	N/A	N/A	2	1 from wetland, 1 from culvert / thalweg
wetlands	62	7.2	1	lb wetland
landfills	0	0.0	0	
clay exposure	15	1.7	0	
berm	0	0.0	0	
riprap	78	9.1	N/A	

**Broadstreet Hollow
Management Unit #11**

Feature	Length (ft)	% of Bank	Total #	Description
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road = 145'

Shortest stream distance from road = 40'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b	11520	12235	715	2.77

Management Unit slope%:

ws = 2.50% bf = 2.07 %

Landowners N/F: adjacent to/near stream:

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-8.100	66.75
5.4-1-43	72.03

Current monitoring:

BEHI 8 monumented xs

Broadstreet Hollow

Management Unit 12

Description:

County: Ulster

LP Station:

Total reach length (ft):

Management Unit 12 is located in Ulster County, NY, beginning at the top of the riprap section approximately 200 feet above David Merwin County Bridge 2224570, extending downstream 1127 feet,, to below the bermed area, approximately 170 feet below County Bridge 3346710.

11949-13076

1127

Feature	Length (ft)	% of Bank	Total #	Description
bridge	N/A	N/A	2	David Merwin County Bridge 2224570 and County Bridge 3345710.
eroding bank	0	0.0	0	
behi	N/A	N/A	0	
cross-sections	N/A	N/A	0	157-164
known structures	N/A	N/A	0	
property owners	N/A	N/A	6	see below check this parcel coverage in gis dep
rights of way	N/A	N/A	N/A	
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	0	0.0	0	
berm	203	9.0	0	
riprap	282	12.5	N/A	
stacked rock wall	115	5.1	1	
sheetpile	34	1.5	N/A	
cribwall	0	0.0	N/A	
gabions	61	2.7	N/A	
dumped rock fill	0	0.0	N/A	
cemented rock wall	35	1.5		

**Broadstreet Hollow
Management Unit 12**

Feature	Length (ft)	% of Bank	Total #	Description
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A		
divergence/convergence	N/A	N/A		
grade control	0	0.0		
other				benchmark, UCHD ctrl pt merwin br up rt

Farthest stream distance from BSH road = 180'
Shortest stream distance from road = 0'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
F3b	11520	12235	715	2.77
G3a	12235	12268	33	4.06
DA3b	12268	12615	347	3.25
F3b	12615	12873	258	3
G3	12873	12955	82	no value
B3	12955	13076	121	no value

Management Unit slope %:

ws = 2.60% bf = 2.94 %

Landowners N/F Adjacent / Near stream

Parcel #:	Acres:
5.4-1-8.100	66.75
5.4-1-10	0.75
5.4-1-43	72.03
5.4-1-9	3
5.4-1-42	0.79

Broadstreet Hollow Stream

Management Unit #13 Management Unit 13 is located in Ulster County, NY, beginning approximately 150 feet below County Bridge 3346710, extending through the braided DA channel, extending downstream approximately 965 feet to the end of the guardrail on Broadstreet Hollow Road

Description:
 County: Ulster
 LP Station: 13076-14041
 Total reach length (ft): 965

Feature	Length (ft)	% of Bank	Total #	Description
bridge		0.0		
eroding bank		0.0		
behi	N/A	N/A		
cross-sections	N/A	N/A	0	none conducted
Known structures	N/A	N/A		
property owners	N/A	N/A	3	
rights of way		N/A		
culverts	N/A	N/A	2	1-2' smooth metal, 1 wet, 1 dry and rusted
tributaries	N/A	N/A		
wetlands		0.0		
landfills		0.0		
clay exposure	94	4.9		Glacial Lake Clay, Right bank and bed
berm		0.0		
riprap		0.0	N/A	
stacked rock wall		0.0		
sheetpile		0.0	N/A	
cribwall		0.0	N/A	
gabions		0.0	N/A	
dumped rock fill		0.0	N/A	

Broadstreet Hollow Stream

Management Unit #13

Feature	Length (ft)	% of Bank	Total #	Description
concrete slabs		0.0	N/A	
knotweed		0.0	N/A	
utilities	N/A	N/A		
divergence/convergence	N/A	N/A		
grade control		0.0		
other				

Farthest stream distance from BSH road = 255'
Shortest stream distance from road = 40'

Stream Type:	Station:	Station:	Station Length:	Reach Slope
DA3	13076	14041	965.0	no slope value

Management Unit slope%:

ws = 2.9% bf = % No bankfull calls made

Landowners N/F

Adjacent to / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-12	8.45
5.4-1-11	3
5.4-1-41	40.61

**Broadstreet Hollow Stream
Management Unit #14**

Description:

County: Ulster

LP Station: 14041-14559

Total reach length (ft): 518

Management Unit 14 is located in Ulster County, NY, beginning just below the braided DA stream type at the end of the guardrail along Broadstreet Hollow Road. It extends downstream approximately 518 feet, for the duration of the F3 stream type, midway into parcel # 5.4-1-29.

Feature	Length (ft)	% of Bank	Total #	Description
bridge	0	0.0	0	
eroding bank	211	20.4	1	associated with behi 7
behi	N/A	N/A	1	behi 7
cross-sections	N/A	N/A	4	xs166-169
known structures	N/A	N/A	1	
adjacent property owners	N/A	N/A	2	
rights of way				
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	211	20.4	0	
berm	0	0.0	0	
riprap	0	0.0	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #14**

Feature	Length (ft)	% of Bank	Total #	Description
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road = 210'

Shortest stream distance from road = 180'

Stream Type:	Station:	Station:	Station Length:	Reach Slope
<u>F3b</u>	14041	14559	518	2.2

Management Unit slope %:

ws = 2.23 %

bf = 2.03%

Landowners N/F

Adjacent to / *Near stream*

Parcel #:

Acres:

5.4-1-12

8.45

5.4-1-29

10.68

Current monitoring:

BEHI 7 monumented xs

Broadstreet Hollow Stream

Management Unit #15

Management Unit 15 is located in Ulster County, NY, beginning at the stream type change from F to B, just above the northern boundary of parcel #5.4-1-14, continuing downstream approximately 880 feet, just beyond the berm on the right bank and the pond outlet for parcel # 5.4-1-29.

Description:

County: Ulster

LP Station: 14559-15439'

Total reach length (ft): 880

Feature	Length (ft)	% of Reach	Total #	Description
bridge		0.0	0	
eroding bank	501	28.5	2	associated with behi (239' clay exposure BEHI 5, noted below)
behi	N/A	N/A	2	5,6
cross-sections	N/A	N/A	5	170-175
Known structures	N/A	N/A	2	
property owners	N/A	N/A	3	
rights of way			0	
culverts	N/A	N/A	4	2 stone, 1 corrugated (dry), 1 plastic. All 1-2' Cohn Pond
tributaries	N/A	N/A	1	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	304	17.3	1	
berm	293	16.7	1	
riprap	0	0.0	N/A	
stacked rock wall		0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	

**Broadstreet Hollow Stream
Management Unit #15**

Feature	Length (ft)	% of Reach	Total #	Description
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other			1	Water Supply from Cohn Pond

Farthest stream distance from BSH Rd. = 720'

Shrotest stream distance from road. = 310'

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
B3c	14559	14879	320	2.5
F3b	14879	15282	403	0.84
C3	15282	15334	52	2.14
F3b	15334	15439	105	1.36

Management Unit slope%:

ws = 1.47% bf = 1.63%

Landowners N/F Adjacent to / *Near stream*

Parcel ID:	Acres:
5.4-1-14	1.35
5.4-1-29	10.68
5.4-1-52	11.58

Current monitoring:

BEHI 5 & 6 monumented xs.

Broadstreet Hollow Stream

Management Unit #16 Management Unit 16 is located in Ulster County, NY,
 Description: beginning just below the berm and culverts for the pond outlet on parcel # 5.4-01-29,
 County: Ulster extending approximately 333 feet downstream to the pond inlet and north easterly boundary of parcel # 5.4-01-26.
 LP Station: 15439-15772

Total reach length (ft): 333

Feature	Length (ft)	% of Bank	Total #	Description
eroding bank	132	19.7	1	associated with behi 4
behi	N/A	N/A	1	BEHI 4
cross-sections	N/A	N/A	3	176-178,
Known structures	N/A	N/A	1	
property owners	N/A	N/A	2	adjacent to/near stream
rights of way			0	
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	7	1.1	0	glass
clay exposure	0	0.0	0	
berm	0	0.0	0	
riprap	24	3.6	1	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	
knotweed	0	0.0	N/A	
utilities	N/A	N/A	0	

**Broadstreet Hollow
Management Unit 16**

Feature	Length (ft)	% of Bank	Total #	Description
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
Other	Inlet point for Fischzang pond			

Farthest stream distance from BSH road = 590 ft

Shortest stream distance from road=520 ft

Stream Type:	Station:	Station:	Station Length:	Reach Slope %
C3b	15439	15772	333	2.01

Management Unit slope

%:

ws = 1.47%

bf = 1.63%

Landowners N/F

Adjacent to / *Near stream*

Parcel #

Acres:

5.4-1-29

10.68

5.4-1-52

11.58

Current monitoring:

BEHI 4 monumented xs.

Broadstreet Hollow Stream

Management Unit#17 Management Unit 17 is located in Ulster County, NY, beginning above the left bank bermed area at the pond inlet at the north easterly boundary of parcel # 5.4-01.26, extending approximately 438 feet downstream stream past the pond outlet and before the berm on the left bank.

County: Ulster
 LP Station: 15772-16210
 Total reach length (ft): 438

Feature	Length (ft)	% of Bank	Total #	Description
bridge	0	0.0	0	
eroding bank	135	15.4	1	associated with behi 3,3.5(length included in clay exposure also)
behi	N/A	N/A	2	3, 3.5
cross-sections	N/A	N/A	3	179-181
known structures	N/A	N/A	4	
property owners	N/A	N/A	2	
rights of way				
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	67	7.6	1	mixed materials;glass and metal 70-80' from stream tw
clay exposure	135	15.4	0	all clay LB
berm	467	53.3	4	
riprap	0	0.0	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0		0.0	N/A
concrete slabs	0		0.0	N/A

**Broadstreet Hollow
Management Unit#17**

Feature	Length (ft)	% of Bank	Total #	Description
knotweed	0		0.0	N/A
utilities	N/A		N/A	0
divergence/convergence	N/A		N/A	0
grade control	0		0.0	0
other	Inlet and outlet points for Fischzang pond			

Farthest stream distance from BSH road= 611'
Shortest stream distance from road= 525'

Stream Type:	Station:	Station:	Station Length:	Reach slope %
B3	15772	15844	72	2.5
F3	15844	16679	835	1.89

Management Unit slope %:

ws = -1.8963% bf = -1.9%

fisheries

control reach at Fischzang - fisheries, habitat, geomorphic monitoring (BMP study)

Landowners N/F:

adjacent to stream:

Parcel #:	Acres:
5.4-1-26	4.5
5.4-1-52	11.58

Current monitoring:

control reach at Fischzang - fisheries, habitat, geomorphic monitoring (BMP study)
monumented cross sections at BEHI 3 3.5

Broadstreet Hollow Stream

Management Unit #18

Description: Management Unit 18 is located in Ulster County, NY, beginning below the pond outlet at parcel#5.4-01-26, extending approximately 469 feet downstream to the outlet of State Route 28 Bridge.

County: Ulster

LP Station: 16210-16679'

Total reach length (ft): 469

Feature	Length (ft)	% of Bank	Total #	Description
bridge	82	8.7	1	Rt. 28 bridge, max dimensions = 67'x14.25'
eroding bank	75	8.0	1	associated with behi 2
behi	N/A	N/A	1	2
cross-sections	N/A	N/A	5	182-183
known structures	N/A	N/A	4	
property owners	N/A	N/A	6	
rights of way				state bridge Rte 28
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	149	15.9	1	mixed materials; 15-25" from stream tw
clay exposure	0	0.0	0	
berm	170	18.2	1	pushed cobble/trees
riprap	191	20.4	N/A	
stacked rock wall	0	0.0	0	
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	148	15.8	N/A	
concrete slabs	0	0.0	N/A	

**Broadstreet Hollow
Management Unit #18**

Feature	Length (ft)	% of Bank	Total #	Description
knotweed	50	5.3	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other				

Farthest stream distance from BSH road= 530'
Shortest stream distance from road= 500'

Stream Type:	Station:	Station:	Station Length:	Reach slope %
F3	15844	16679	835.0	1.89

(Station length includes total length of F3 stream type, not all encompassed in this unit.)

Management Unit slope %:

ws = -1.8963% bf = -1.9%

Landowners N/F:

Adjacent to / Near stream

<i>Parcel #:</i>	<i>Acres:</i>
5.4-1-25	0.5
5.4-1-22	0.67
5.4-1-23	0.19
5.4-1-26	3.9
5.4-1-52	40.1
5.4-1-24	0.25

Current monitoring:

control reach at Fischzang - fisheries, habitat, geomorphic monitoring (BMP study)
monumented cross sections at BEHI 2

Broadstreet Hollow Stream

Management Unit #19

Description: Management Unit 19 is located in Ulster County, NY, beginning just below State Route 28 Bridge,
 County: Ulster extending 463 feet downstream to the confluence of the Esopus Creek.
 LP Station: 16679-17142'
 Total reach length (ft): 463

Feature	Length (ft)	% of Reach	Total #	Description
bridge	0	0.0	0	
eroding bank	348	37.6	2	associated with behi 1
behi	N/A	N/A	1	behi1
cross-sections	N/A	N/A	2	184-185
known structures	N/A	N/A	2	
property owners	N/A	N/A	3	
rights of way			0	N/A
culverts	N/A	N/A	0	
tributaries	N/A	N/A	0	
wetlands	0	0.0	0	
landfills	0	0.0	0	
clay exposure	0	0.0	0	
berm	73	7.9	1	
riprap	0	0.0	N/A	
stacked rock wall	52	5.6	2	stone walls for Paultre pond
sheetpile	0	0.0	N/A	
cribwall	0	0.0	N/A	
gabions	0	0.0	N/A	
dumped rock fill	0	0.0	N/A	
concrete slabs	0	0.0	N/A	

**Broadstreet Hollow
Stream
Management Unit #19**

Feature	Length (ft) % of Reach		Total #	Description
knotweed	15	1.7	N/A	
utilities	N/A	N/A	0	
divergence/convergence	N/A	N/A	0	
grade control	0	0.0	0	
other	Pond inlet near Paultre's			

Farthest Stream Distance from BSH Rd.= 660'
Shortest Stream Distance from BSH Rd. = 480'

Stream Type:	Station:	Station:	Station Length:	Stream Type Length	Reach slope %
C3	16679	17142	463		1.87

Management Unit slope% :

ws = -1.87% bf = -1.68%

Landowners N/F:

Adjacent to / Near stream

<i>Parcel ID:</i>	<i>Acres:</i>
5.18-2.-22	6.75
5.4.-2.-23	0.8
5.4-2.-22.200	3.78

Current monitoring:

monumented cross sections at BEHI 1

3.2 Glossary of Terms

GLOSSARY OF STREAM AND FLOODPLAIN TERMS

Note: where a word within a definition is italicized, it is defined elsewhere within the glossary

aquatic habitat – Physical attributes of the stream channel and *riparian area* that are important to the health of all or some life stages of fish, aquatic insects and other stream organisms. Attributes include water quality (temperature, pH), *riparian* vegetation characteristics (shade, cover, density, species), stream bed *sediment* characteristics, and *pool/riffle* spacing.

artesian – A condition in which groundwater trapped between confining layers of *clay* or other materials is under pressure. When the *clay* or other material has been breached (by fault formation or digging) groundwater can rise to, or near, the ground surface, forming springs. There are many shallow “dug” wells and deeper drilled wells in the Broadstreet Hollow valley that tap into these artesian layers.

Bank Erodibility Hazard Index (BEHI) – An index for predicting *erosion potential* on selected stream banks, usually associated with a *monitoring cross-section* for measurement of actual *erosion* rates over time (Rosgen, 1996).

berm – A mound of earth or other materials, usually linear, constructed along streams, roads, *embankments* or other areas. Berms are often constructed to protect land from flooding or eroding, or to control water drainage (as along a road-side ditch). Some berms are constructed as a byproduct of a stream management practice whereby stream bed *sediment* is pushed out of the channel and mounded on (and along the length of) the stream bank - these berms may or may not be constructed for flood control purposes; some are simply piles of excess material. These berms often interfere with other stream processes such as *floodplain* function, and can exacerbate flood-related *erosion* or stream *instability*.

bioengineering – The use of live vegetation, either alone or in combination with harder materials such as rock or (dead) wood, to stabilize soils associated with stream banks or hillslopes. Roots stabilize the soil, while stems, branches and foliage slow high *velocity* water, reducing *erosion* and encourage deposition of fine *sediment*.

boulder – In the context of *stream assessment surveys*, a boulder is stream *sediment* that measures between 256 mm and 4096 mm (about 10 inches to 13.3 feet).

braided – A stream form in which the channel splits into 3 or more separate sub-channels, often criss-crossing to produce a “braided” pattern of connected channel with large or small islands between them. Islands formed between the channels can be either bare *gravel* or *cobble* materials, or contain mature forest vegetation.

clay, clay exposure (see also glacial lake clay) – Clay is the smallest *sediment* size present in a stream, measuring less than 0.0039mm in size. Clay can be identified by its smooth and slippery texture. Clay deposits can be seen in sections of the Broadstreet Hollow valley and in the

stream, and can produce *turbidity* in stream water when it is disturbed either during floods or by activity in the stream. For a detailed description of ‘*glacial lake clay*,’ see Chapter 3.1.1, Geology.

cobble – In the context of *stream assessment surveys*, cobble material is *sediment* that measures between 64 mm and 256 mm (about 2.5 inches to 10 inches).

confluence – The location of the joining of two separate streams, each with its own *watershed*.

convergence – The downstream end of a split channel, where the stream merges back to one channel; the two channels having the same *watershed*.

cross-section (see also monitoring cross-section) – In the context of *stream assessment surveys*, a *cross-section* is a location on a stream channel where stream *morphology* is measured perpendicular to the stream flow direction (as if taking a slice through the stream), including width, depth, height of banks and/or *terraces*, and area of flow.

culvert – A closed conduit for the free passage of surface drainage water³. In Broadstreet Hollow, culverts are typically used by the Town and County to control water running along and under the road, and to provide a crossing point for water from road side drainage ditches to the stream, as well as for routing *tributary* streams under the road to join the main Broadstreet Hollow stream. Culverts are also used by landowners to route roadside drainage ditch water under their driveways to reduce or prevent *erosion*.

degradation – The process by which a stream *reach* or channel becomes deeper by eroding downward into its bed over time, also called “downcutting”, either by periodic episodes of bed scouring without filling, or by longer term transport of *sediment* out of a *reach* without replacement.

demonstration stream restoration project, (demonstration project) – A *stream (stability) restoration* project that is designed and located to maximize opportunities for *monitoring* of project success, public and agency education about different *stream restoration* techniques, and interagency partnerships for funding and cooperation.

destabilized (see also instability, unstable) – Describing a section of stream that has been made *unstable*, by natural or human activity.

discharge (stream flow) – The amount of water flowing in a stream, measured as a volume per unit time, usually cubic feet per second (cfs).

discontinuous floodplains (see also floodplain) – A series of small *floodplains*, formed as a series of small benches along stream banks. These *floodplain* features, typically seen in steeper mountain streams, are not connected sequentially following the valley floor, but still provide the critical *floodplain* functions of reducing water *velocity* and enhancing *sediment* deposition and infiltration (water sinking into the ground rather than running straight to the stream).

dumping site – For the purposes of the Broadstreet Hollow stream assessment survey, these are areas in the stream or on the *floodplain* where refuse or other non-natural or non-biodegradable materials were documented. A dumping site is not necessarily an actively used area, and may be the result of material washing downstream.

embankment – A linear structure, usually of earth or *gravel*, constructed so as to extend above the natural ground surface³. Similar to a *berm*, but usually associated with *road fill* areas, and extending up the hillside from the road, or from the stream up to the road surface.

entrenched – In stream classification (see *stream type*), entrenchment (or entrenchment ratio) is defined by stream *cross-sectional* shape in relation to its *floodplain* and valley shape, and has a specific numerical value that in part determines stream type. For example, if this number is less than 1.4, the stream is said to be highly entrenched, if between 1.4 and 2.2 it is mildly entrenched, and greater than 2.2 it is not entrenched. Entrenchment ratio is used with other stream shape data to determine *stream type*, and define baseline data for future *monitoring* (Rosgen, 1996).

equilibrium (see also Astable@) – The degree to which a stream has achieved a balance in transporting its water and *sediment* loads over time without aggrading (building up), degrading (cutting down), or migrating laterally (eroding its banks and changing course).

erosion B The wearing away, detachment, and movement of the land surface (*sediment*), by running water, wind, ice, or other geological agents, including such processes as gravitational creep or *slumping*.¹ In streams, erosion is a natural process, but can be accelerated by poor stream management practices.

erosion potential – The amount of *erosion* that may be expected under given climatic, topographic, soil, and cultural conditions.¹

fascines – A *bioengineering* method using bundles of small branches of willow or other *riparian* tree species, tied together and laid into shallow trenches along a stream to stabilize and revegetate stream bank areas.

floodplain B The portion of a river valley, adjacent to river channel, which is covered with water when river overflows its banks at flood *stage*. The floodplain usually consists of *sediment* deposited by the stream, in addition to *riparian* vegetation.⁴ The floodplain acts to reduce the *velocity* of floodwaters, increase infiltration (water sinking into the ground rather than running straight to the stream - this reduces the height of the flood for downstream areas), reduce stream bank *erosion* and encourage deposition of *sediment*. Vegetation on floodplains greatly improves their functions.

gabions – Large wire-mesh baskets filled with rock material used to *harden* or *stabilize* road *embankments* and sometimes stream banks.

Geographic Information System (GIS) B Desktop software with a graphical user interface that allows loading and querying, analysis and presentation of spatial and tabular data that can be

displayed as maps, tables and charts.⁵ The maps in the Broadstreet Hollow stream management plan were produced with a GIS, and can be updated as new information becomes available.

glacial lake, glacial lake clay – The layered *clay* (often referred to as *varved*, or layered, *clay*) observable in certain stream banks along Broadstreet Hollow (and other Catskill streams) was deposited several thousand years ago in small (pond-size) to large (lake-size) impoundments of glacial meltwater (glacial lakes) during the deglaciation of the Catskills. This clay is the primary source of the *suspended sediment* observable in the stream, which produces *turbidity*.

Global Positioning System (GPS) – A satellite-based positioning system operated by the U.S. Department of Defense (DoD). When fully deployed, GPS will provide all-weather, worldwide, 24-hour position and time information.⁶ The *stream assessment survey* done for the Broadstreet Hollow stream management plan included the use of a GPS unit to document the locations of all mapped stream features. This information was added to the *GIS* to produce the maps.

gravel – In the context of *stream assessment survey*, gravel is *sediment* that measures between 2 mm and 64 mm (about 0.08 inches to 2.5 inches).

hardening – Any structural *revetment* that fixes in place an eroding stream bank, *embankment* or hillside by using hard materials, such as rock, sheet piling or concrete, that does not allow for revegetation or enhancement of *aquatic habitat*. *Rip-rap* and *stacked rock walls* are typically considered to be hardening measures, though some revegetation of these areas is possible.

head-cut – A marked change in stream bed slope, as in a *step* or waterfall, that is unprotected or of greater height than the stream can maintain. This location, also referred to as a *knick point*, moves upstream, eventually reaching an *equilibrium* slope.

hydroseeding – A method of spreading seed and mulch material with a specialized machine, to cover bare ground areas with groundcover vegetation. Seed, mulch and water are added together to make a slurry that can be sprayed onto the ground surface from a distance. This method is more efficient for seeding bare ground areas to establish groundcover, because it provides the mulch material and water in the same step with the seed (traditional manual methods require three separate steps to spread seeds, mulch and water, and are labor intensive).

inboard – Referring to a roadside ditch that is between the road and adjacent hillside, on the higher or uphill side of the road.

ice-contact deposit – Complex glacial deposits that are deposited along the ice margin. The deposits are typically unconsolidated assemblages of *silt* through *boulder* size material. In the Catskills these include unsorted moraine deposits as well as stratified and somewhat sorted deposits such as kames, kame terraces and eskers. Kame terrace deposits form hillslope margins along portions of the Broadstreet Hollow.

in-situ – A reference to something being in its original location, in place.

instability (see also **Unstable**) **B** An imbalance in a stream's capacity to transport *sediment* and maintain its channel shape, pattern and profile.

invasive plants – Species that are not native to a region or country that have the ability to compete with and replace native species in natural habitats, also referred to as **Exotic** plants. (Erich Haber, *Impact of Invasive Plants*, 2002).

Japanese Knotweed (see also **invasive plants**) – An *invasive plant*, not native to the Catskill region, that colonizes disturbed or wet areas, especially stream banks, road-side ditches and *floodplains*. This plant out-competes natives and other beneficial plants, and may contribute to *unstable* stream conditions.

large organic debris – Any woody material, such as from trees or shrubs, that washes into a stream channel or is deposited on a *floodplain* area. Organic debris provides important *aquatic habitat* functions, including *nutrient* sources and micro-habitats for aquatic insects and fish. Large wood is especially influential to stream *morphology* in small streams, though may be detrimental in the vicinity of structures or infrastructure.

leaching – The process by which chemical or mineral materials are removed from a physical *matrix* (such as soil, or mixed *sediment* materials) by water running through and creating a solution of those chemicals.

left bank – The left stream bank as looking or navigating downstream. This is a standard used in *stream assessment surveys*.

matrix – The framework material within which other materials are lodged or included. For example, *cobbles* could be embedded in a matrix of *sand* and fine *gravel*.

meander – Refers both to a location on a stream channel that is curved (a “meander bend”), and to the process by which a stream curves as it passes through the landscape (a “meandering stream”).

monitoring – The practice of taking similar measurements at the same site, or under the same conditions, to document changes over time.

monitoring cross-section – For the purposes of the Broadstreet Hollow stream management plan, this is a location where metal rebar rods have been used to permanently locate an actively eroding stream bank. At this site, detailed data have been gathered to document the stream condition. The site is permanently marked to enable future measurements that, when compared to the existing condition, provide information about the stream's change. Measuring change over time is considered ‘*monitoring*,’ and this information provides early warning to stream managers about important but perhaps visually imperceptible changes in the stream.

monumented – Refers to a location, usually a *cross-section*, that is marked with a permanent or semi-permanent marker, or “monument”, to enable future *monitoring* at the same place.

morphology, stream morphology – The physical shape, or form, of a landscape or stream channel, that can be measured and used to analyze stream or landscape condition, type or behavior.

native material – *Sediment* material with a local or on-site source, as in material pushed up out of a stream channel to armor the banks.

non-quarried, or natural boulders – *Boulder*-sized rock material, either *native* or imported material, not harvested from a quarry. This material has been used in the past in stream bank stabilization, usually harvested directly from the stream or from nearby hillsides.

nutrient – The term "nutrients" refers broadly to those chemical elements essential to life on earth, but more specifically to nitrogen and phosphorus in a water pollution context. In a water quality sense nutrients really deals with those elements that are necessary for plant growth, but are likely to be **limiting** -- that is, where used up or absent, plant growth stops.

pathogen – Disease-causing agent, especially microorganisms such as bacteria, protozoa, and viruses.

pool – A small section of stream characterized by having a flat or nearly flat water surface compared to the average *reach* slope (at low flow), and deep and often asymmetrical *cross-sectional* shape.

reach – A section of stream with consistent or distinctive *morphological* characteristics¹.

reference reach, stable reference reach – A *stable* portion of a stream that is used to model restoration on an *unstable* portion of stream. Stream *morphology* in the reference reach is documented in detail, and that *morphology* is used as a blueprint for design of a *stream stability restoration* project.

revetment – Any structural measure undertaken to stabilize a road *embankment*, stream bank or hillside.

riffle – A small section of stream characterized by having a steep water surface slope compared to the average *reach* slope (at low flow), and a shallow and often uniform *cross-sectional* shape.

right bank – The right stream bank as looking or navigating downstream. This is a standard used in *stream assessment surveys*.

riparian (area, buffer, vegetation, zone) – The area of land along stream channels, within the valley walls, where vegetation and other landuses directly influence stream processes, including flooding behavior, *erosion*, *aquatic habitat* condition, and certain water quality parameters.

rip-rap – Broken rock, *cobbles*, or *boulders* placed on earth surfaces, such as a road *embankment* or the bank of a stream, for protection against the action of water; materials used for soil *erosion* control.¹

road fill (see also *embankment*) – Typically *gravel*- and *sand*-sized material used to elevate the level of the road, control the road grade, or provide a buffer for the road grade from stream *erosion*.

rotational failure – A geotechnical term referring to the shape and mechanism of a hillslope failure that results in a section of land surface that falls, or “fails”, by rotating out of place along a curved plane surface (as opposed to sliding along a straight line or flat plane surface). This type of failure is common in the Broadstreet Hollow valley, easily recognized by “back leaning” trees on displaced sections of the slope, separated by fault scarps (cracks in the ground surface perpendicular to the failure direction, also often curved) as these blocks of land rotate downward and outward (see Section 3.2.4, Geology, for description and diagrams of this phenomenon, as well as MU3 where such a failure occurred prior to the *Demonstration Project*).

runoff – The portion of precipitation (i.e., rainfall) that reaches the stream channel over the land surface.

sand – In the context of *stream assessment surveys*, sand material is *sediment* that measures between 0.063 mm and 2 mm (up to 0.08 inches).

sediment, stream bed sediment - Material such as *clay*, *sand*, *gravel* and *cobble* that is transported by water from the place of origin (stream banks or hillsides) to the place of deposition (in the stream bed or on the *floodplain*).³

silt – In the context of *stream assessment surveys*, silt material is *sediment* that measures between 0.0039 mm and 0.063 mm.

slump – The product or process of mass-wasting when a portion of hillslope slips or collapses downslope, with a backward rotation (also a rotational failure).

stable (see also *equilibrium*) – A stable stream is defined as maintaining the capacity to transport water and *sediment* loads over time without aggrading (building up), degrading (cutting down), or migrating laterally (eroding its banks and changing course). Stable streams resist flood damage and *erosion*, and provide beneficial *aquatic habitat* and good water quality for the particular setting.

stability – In stream channels, the relative condition of the stream on a continuum between *stable* (in *equilibrium* or balance) and *unstable* (out of *equilibrium* or balance). Stream stability assessment seeks to quantify the relative *stability* of stream *reaches*, and can be used to rank or prioritize sections of streams for management.

stacked rock wall – A *boulder revetment* used to line stream banks for stabilization. Stacked rock walls can be constructed on a steeper angle than *rip-rap*, so they take up less of the stream *cross-section*, provide a wider road surface, and provide less surface area for solar heating, allowing stream temperature to remain cooler relative to banks lined with *rip-rap*. These features can be augmented with *bioengineering* to enhance *aquatic habitat* and *stability* functions.

stage – In streams, stage refers to the level or height of the water surface, either at the current condition (i.e., current stage), or referring to another specific water level (i.e., flood stage).

stream assessment, stream assessment survey – The methods and summary information gathered in a stream *reach* or series of *reaches*, primarily focused on stream *morphology*. Stream assessment for the Broadstreet Hollow included detailed characterization and mapping of stream channel patterns, *cross-section* shapes and slope.

stream flow (discharge) – The amount of water flowing in a stream, measured as a volume per unit time, usually cubic feet per second (cfs).

stream stability restoration (design, project) – An *unstable* portion of stream that has been reconstructed, using *morphology* characteristics obtained from a *stable reference reach* in a similar valley setting, that returns the stream to a *stable* form (that is, to a shape that may allow the stream to transport its water and *sediment* load over time without dramatic changes in its overall shape).

stream type – As defined by Rosgen (1996), one of several categories defined in a stream classification system, based on a set of delineative criteria in which measurements of channel parameters are used to group similar *reaches*.

summer base-flow – Stream discharge primarily from groundwater (not from surface *runoff*).¹ Typically this is the lowest flow of the year, occurring in late summer, or following extended periods of drought.

suspended sediment – *Sediment* carried in the water column (above the stream bed), including *clay*, *silt* and sometimes fine *sand*. These materials contribute to *turbidity*.

terrace – A level area in a stream valley, above the active *floodplain*, that was deposited by the stream but has been abandoned as the stream has cut downward into the landscape. These areas may be inundated (submerged) in higher floods, but are typically not at risk in more common floods.

thalweg – The line followed by the majority of the stream flow.¹ In *stream assessment*, this location is used as a reference location for surveys and other measurements, and is most often associated with the deepest point in the stream *cross-section* (i.e., the stream channel that would still have water flowing in it at even the lowest flow conditions).

toe – The bottom, or base, of a stream bank or *embankment*.

tributary – A stream that feeds into another stream; usually the tributary is smaller in size than the main stream (also called “mainstem”). The location of the joining of the two streams is the *confluence*.

turbidity – A measure of opacity of a substance; the degree to which light is scattered or absorbed by a fluid. Streams with high turbidity are often referred to as being “turbid”.

unstable (see also instability) – Describing a stream that is out of balance in its capacity to transport *sediment* and maintain its channel shape, pattern and profile over time.

watershed – A unit of land on which all the water that falls (or emanates from springs) collects by gravity and runs off via a common outlet (stream).²

wetland – An area that is saturated by surface water or ground water with vegetation adapted for life under those soil conditions, as in swamps, bogs, fens, and marshes.

velocity – In streams, the speed at which water is flowing, usually measured in feet per second.

¹New York Guidelines for Urban Erosion and Sediment Control, USDA SCS, 1972

²Black, P., Watershed Hydrology, 1991, Prentice-Hall Inc., Englewood Cliffs, NJ

³Lo, S. 1992. Glossary of Hydrology. Water Resources Publications, PO Box 2841, Littleton, CO. 80161

⁴Rosgen, D.L. 1996. Applied River Morphology.

⁵ArcView GIS: The Geographic Information System for Everyone. Environmental Systems Research Institute, Inc. 1996.

⁶GPS Pathfinder Office: Getting Started Guide. Trimble Navigation Limited. 1999.