Management Unit 6

Greene County - Town of Hunter
Cross Section 107 to Cross Section 116

Management Unit Description

This management unit begins at the private bridge at Cross Section 107 and continues approximately 2,501 ft. to Cross Section 116. The drainage area ranges from 8.2 mi^2 at the top of the management unit to 8.8 mi^2 at the bottom of the unit. The valley slope is 1.6% and water surface slope is 2%.

While the history of this unit indicates aggradation and channel shifting, much of the stream length appears to be stabilizing and generally well-vegetated. However, woody debris blockages and compromised streamside vegetation communities are found at several locations in the unit, and present management challenges. The character of channel and floodplain geometry in the unit makes it particularly sensitive to disturbance of streamside vegetation, fluctuations in sediment loading, and channel obstructions.
A stream crossing at the upstream end of the unit, and bedrock at the downstream end of the unit provide grade control. Aquatic habitat is generally good, but could be enhanced through improved vegetation at several locations. Water quality impairments in the unit are only marginally significant.

Summary of Recommendations Management Unit 6	
Intervention Level	Assisted Self-Recovery
Stream Morphology	Remove debris jam in abandoned channel at erosion site #15, to promote reestablishment of previous planform Encourage narrowing and deepening of channel through plantings at identified planting site (PS #25) Vegetative stabilization measures at bank erosion monitoring sites #14 & #15
Riparian Vegetation	Riparian plantings at two identified sites (PS #25 and #26)
Infrastructure	Replacement of private road crossing at the top of the management unit with a geomorphically appropriate bridge design
Aquatic Habitat	Enhance overhead cover by joint plantings of rip-rap revetments (PS #25)
Flood Related Threats	Resurvey National Flood Insurance Program (NFIP) maps to more accurately reflect the active stream channel
Water Quality	Address clay exposures through encouraging the abandonment of the active channel at bank erosion site #15
Further Assessment	Ongoing monitoring of bank erosion monitoring sites #14 & #15 Monitor clay exposures Evaluate stormwater treatment options for culvert outfall

Historic Conditions

As the glaciers retreated about 12,000 years ago, they left their "tracks' in the Catskills. In this management unit, the Stony Clove would have met the impounded glacial lake (See Section 2.4, Geology of the Stony Clove Creek, for a description of these deposits), evident in the transition to a lower gradient valley slope and broadening floodplain. Consequently the history of channel evolution in this unit begins to shift from one characterized primarily by vertical erosion, as in Management Unit #5, to one characterized primarily by lateral erosion. Following the emptying of the glacial lake, the history of this section of stream would have involved complex interplay between new alluvial and outwash deposits over lake-bottom clays. In such a setting, beaver may have played a significant role in shaping the local topography.

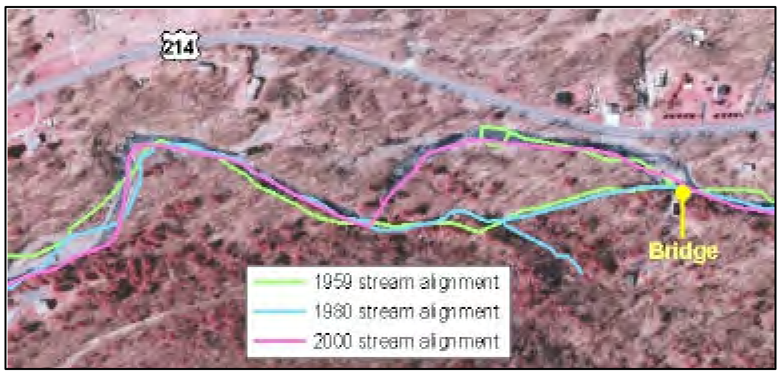


Figure 2a Historical stream channel alignments of Management Unit 6

Significant channel migration and manipulation have occurred over the last 50 years, as can be seen in the historical stream alignments. The 1959 stream alignment in Figure 2a shows the stream channel originally flowed to the left after the bridge at the end of Management Unit #5. Another stream channel once flowed to the right along NYS Route 214, to a small pond, known as Echo Lake (Fig. 2b). At one time The Echo Cottage was situated on high ground nearby. A old advertisement notes the area's healthful climate; pure dry air; and good water supply.

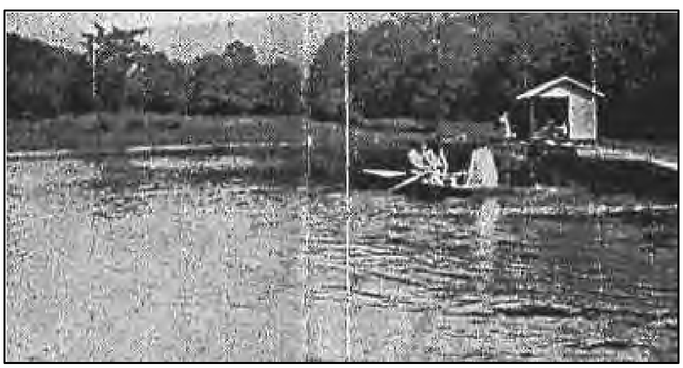


Figure 2b Echo Lake
Photo courtesy of Ben and Sylvia Weinstock

Some time after 1980 the main stream channel shifted to the right channel and abandoned the left stream channel. This dramatic change probably occurred during a flood event.

According to available NYS DEC records there have been three stream disturbance permits issued in this management unit area. All of these permits were issued between 1994-1996 to Benjamin Weinstock to install rip-rap on eroding banks and to remove gravel accumulations in efforts to restore and prevent the stream from migrating. As discussed in the previous section, this reach of stream has experienced major shifts in channel location.

Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2001 stream feature inventory revealed that 3% (132 ft.) of the stream banks exhibited signs of active erosion along 2,501 ft. of total channel length (Fig. 1). Revetment has been installed on 5% (270 ft.) of the stream banks. No berms were identified in this management unit at the time of the stream feature inventory.

Stream Morphology

The following description of stream morphology references insets in the foldout Figure 24. “Left” and “right” references are oriented looking downstream, photos are also oriented looking downstream unless otherwise noted. Italicized terms are defined in the glossary. This characterization is the result of a survey conducted in 2001.

Stream morphology, or shape (i.e., slope, width and depth) is more consistent in this unit than in previous units (Fig. 3), with longer reaches of the same *stream type* (See Section 3.1 for stream type descriptions).

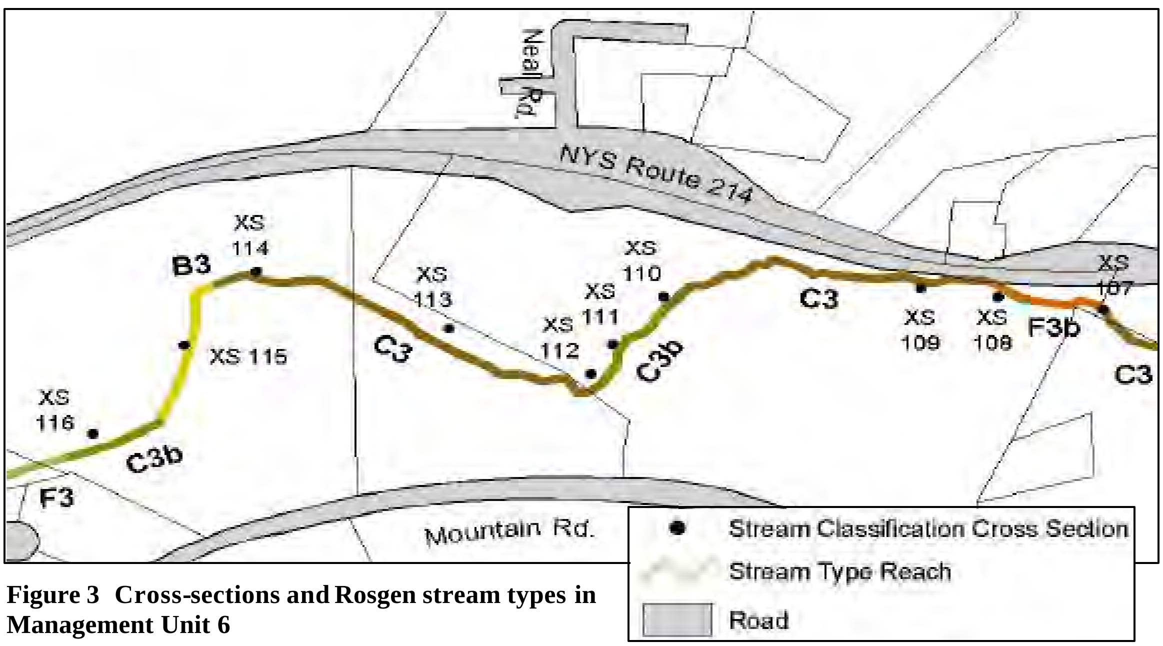


Figure 3 Cross-sections and Rosgen stream types in Management Unit 6

The predominant stream type in this unit is a “C” channel, which are particularly sensitive to disturbance of streamside vegetation, and sediment supply fluctuations. Historical channel migration has left areas of degraded vegetation in the floodplain which have not yet fully recovered. *Radius of curvature* at two locations is smaller than expected at this valley setting; one of the sites is exhibiting bank erosion, while the other appears stable. Bedrock at the downstream end of the management unit provides grade control.

Management unit #6 begins with a 217 ft. reach of F3b stream type (Fig. 4). The stream channel is *entrenched*, or confined within the stream banks during high flood events, which can result in *incision*. This reach is fairly steep at 3.1% slope with cobble-dominated bed material.

Figure 4 Cross-section 108 Stream Type F3b

At the upstream end of this management unit, the stream splits into three channels as it must pass a road crossing (Inset H). The majority of the stream passes through the culvert bridge on the right side of the stream at low flows. The remaining stream flow flows straight and falls into two smaller culverts which pass under the road crossing just above the stream grade level. Higher flows spill directly across the roadway, rendering it impassable and requiring significant maintenance after flood flows ebb.

This overflow also occurs during smaller rain events, when debris clogs the two smaller culverts. This road crossing causes channel instability downstream by dividing channel forming flows and creating a barrier to sediment transport.

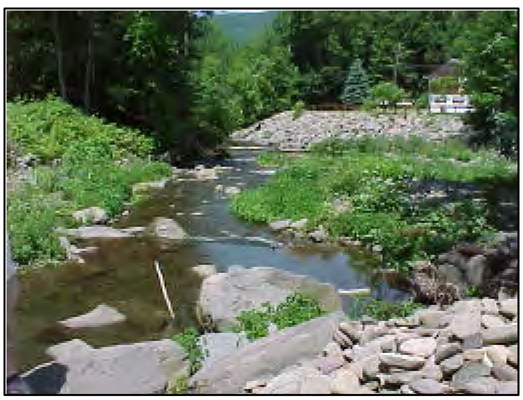


Figure 5 Left stream channel

As the stream emerges from underneath this bridge, the stream is split into three channels. One channel flows directly against the left bank (Fig. 5). Bank erosion monitoring site #14 is located along 75 ft. of this bank (Inset G). This bank has been undercut causing loss of vegetation, including trees, from the top and face of the bank.

The Bank Erodibility Hazard Index (*BEHI*) score of site #14 is ranked “High”, the third highest prioritization category in terms of its vulnerability to erosion. Previous geologic mapping did not identify lodgement till or glacial lake clays at this site, and none were identified during the stream feature inventory. This bank erosion site is considered a medium priority for restoration because of its threat to infrastructure downstream but has a small eroding area (551 ft^2) and does not threaten water quality.

At low flows, the right stream channel, which passes through the large culvert, splits into two channels as it comes out of the culvert (Fig. 6). The bed elevation of these channels is higher than the channel flowing along the left stream bank. *Aggradation*, or a rise in stream bed elevation due to sediment deposition, is occurring as a result of insufficient sediment transport capacity in these channels. A lateral bar is building along the right stream bank and a mid-channel bar is forming at the outfall of the large culvert. Both bars are beginning to vegetate, as can be seen in Figure 6.

Figure 6 Right stream channels

The NYS Department of Transportation (NYS DOT) has installed 279 ft. of rip-rap along the right bank to protect the NYS Route 214 road embankment (Inset D). At the downstream end of this rip-rap, midway up the bank, there is a stormwater culvert (Inset C). The culvert outlets onto the rip-rap, which prevents the stream bank erosion below the outlet. The culvert drains the roadside ditch on the north side of the highway, which receives upland drainage as well, which is frequently turbid.

Figure 7 Cross-section 110
Stream Type C3

As the rip-rap comes to an end, the channel reconnects with its floodplain. This reduces the threat of erosion because flood flows are able to spread out over a floodplain instead of remaining contained within the stream banks. Slope decreases to 1.7% during this 688 ft. reach of C3 stream (Fig. 7).

As the channel slope steepens to 2.5%, stream type adjusts to C3b for the next 245 ft. Although large boulders are abundant in the reach, dominant bed material remains cobble.

Figure 8 Cross-section 113
Stream Type C3

At the end of this reach the stream turns sharply to the right and slope decreases to 1.6%, as stream type transitions back to C3 for the next 848 ft. reach (Fig. 8).

At the top of this reach a small unnamed tributary enters the Stony Clove Creek from the left bank (Inset F). This tributary is not classified under the NYS DEC best usage classification system.

As the stream straightens, the channel widens. The *thalweg* is located directly against the left bank. The right side of the channel is aggrading and does not pass water during low flow. Although no NYS DEC stream disturbance permits are on record for this area, the channel shape and evidence of *sidecast* stream bed material indicate this channel was probably reshaped by excavating equipment. Riparian vegetation is fairly healthy young forest providing good overhead cover.

At the end of this straightened reach, beyond the right stream bank, there is a wetland area at the downstream end of an abandoned channel (Fig. 9). The stream may use this abandoned channel and wetland area during flood events as an overflow channel. The United States Geological Survey topographic map indicates that the wetland also receives a small, unnamed tributary originating across NYS Route 214 (USGS, 1981). The wetland apparently drains subsurface to the Stony Clove, as there was no evident surface flow emerging from the wetland at the time of the inventory. This wetland area does not appear on NYS or Federal regulated wetland maps.

Figure 9 Wetland Area

As the stream begins to meander, the thalweg flows against the right stream bank. At the toe of this bank is a clay exposure (Inset B). According to Rubin's (1996) stream corridor geologic mapping, glacial lake clay outcrops just downstream of this site (Section 2.4). It is likely that the clay exposed in this bank is glacial lake clay and is more easily entrained than the clay present in the lodgement till encountered upstream of this reach. Clay inputs into a stream are a serious water quality concern, causing *turbidity*, degrading fish habitat, and can act as a carrier for other pollutants and pathogens.

Figure 10 Overflow Channel

Beyond the left bank is an overflow channel used by the stream during high flows (Fig. 10). Woody debris moved during high flows has been deposited at the top of this channel.

Bank erosion monitoring site #15 is located along the high right bank (Inset A). High *shear stress* during flood events has eroded the toe of this bank leading to a 56 ft. long bank failure. This failure has left the stream bank raw, and exposed underlying clay. At the downstream end of this eroding bank is a debris jam.

The high bank with shallow slope angles and exposed silts/clays is indicative of a common form of bank failure associated with the glacial lake deposits known as *rotational failure*. A 680 ft. *rotational failure* has occurred above the failing bank (Fig. 11). A rotational failure is typically a deep-seated failure which occurs in cohesive materials when a block of disturbed, bank material slides along a curved failure surface (fault). The block tends to rotate (appears to "slump") back toward the bank as it slides, in a rotational slip (Fig. 12) (USDA, 2003).

Figure 11 Rotational failure at BEMS #15

The rotational failure does not threaten any road infrastructure but has uncovered some buried utilities, which are at risk as the stream bank continues to fail, and may present a safety hazard.

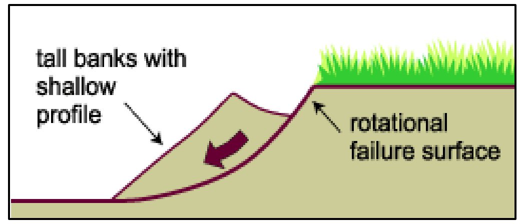


Figure 12 Rotational failure (USDA, 2003)

The BEHI score of site #15 is ranked "Very High", the second highest prioritization category in terms of its vulnerability to erosion. While this site presents a water quality concern, it is rated a medium priority for restoration because of its lack of threat to infrastructure and its small actively eroding area (931 ft^2).

Recommendations for this site include woody debris management, realignment of the active stream channel to relieve stress on the right bank, and installation of a well-vegetated bench along the bank failure. Abundant woody debris in the area could be installed as *root wads* along the right bank. Root wads are often used in stream restoration projects to deflect stream flows away from the banks, while improving fish habitat. In-depth survey and design would be required to plan a stream restoration project at this site.

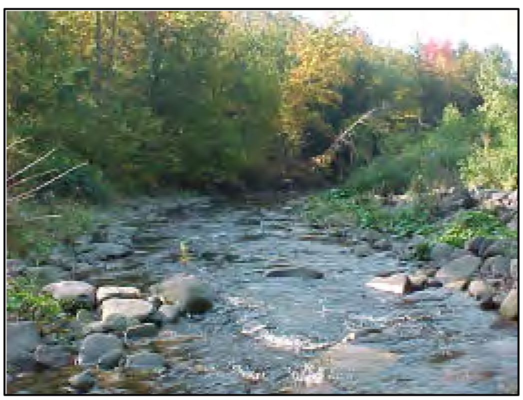


Figure 13 Cross-section 115
Stream Type B3

Emerging from the debris jam, the channel bends to the left and splits for a short length around a central bar. The channel becomes moderately entrenched and slope increases to 1.9%, transitioning into a B3 stream type for the next 360 ft (Fig. 13).

Figure 14 Cross-section 116
Stream Type C3b

As the stream reconnects with its floodplain, stream type changes to C3b for the final 143 ft. of this management unit (Fig. 14). The slope steepens to 2.4%. Bedrock armors the left bank and channel invert, setting the grade here, while a large gravel bar has formed on the right bank. Gravel is often deposited on the inside meander of a stream where flow velocities are slower.

Sediment Transport

Streams move sediment as well as water. Channel and floodplain conditions determine whether the reach aggrades, degrades, or remains in balance over time. If more sediment enters than leaves, the reach aggrades. If more leaves than enters, the stream degrades (See Section 3.1 for more details on Stream Processes).

There is significant historical and current evidence of sediment transport problems in this unit. Historical channel migration, evidence of recent channel management, and woody debris blockages remaining in the channel, all suggest channel aggradation needs to be addressed.

Riparian Vegetation

One of the most cost-effective methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the bank, especially within the first 30 to 50 ft. of the stream. A dense mat of roots under trees and shrubs bind the soil together, and makes it much less susceptible to erosion under flood flows. Grass does not provide adequate erosion protection on stream banks because it has a very shallow rooting system. Interplanting with native trees and shrubs can significantly increase the working life of existing rock rip-rap placed on streambanks for erosion protection. *Riparian*, or streamside, forest can buffer and filter contaminants coming from upland sources or overbank flows. Riparian plantings can include a great variety of flowering trees and shrubs native to the Catskills. Native species are adapted to regional climate and soil conditions and typically require little maintenance following installation and establishment.

Plant species that are not native can create difficulties for stream management, particularly if they are invasive. Japanese knotweed (*Polygonum cuspidatum*), for example, has become a widespread problem in recent years. Knotweed shades out other species with it's dense canopy structure (many large, overlapping leaves), but stands are sparse at ground level, with much bare space between narrow stems, and without adequate root structure to hold the soil of streambanks. The result can include rapid streambank erosion and increased surface runoff impacts.

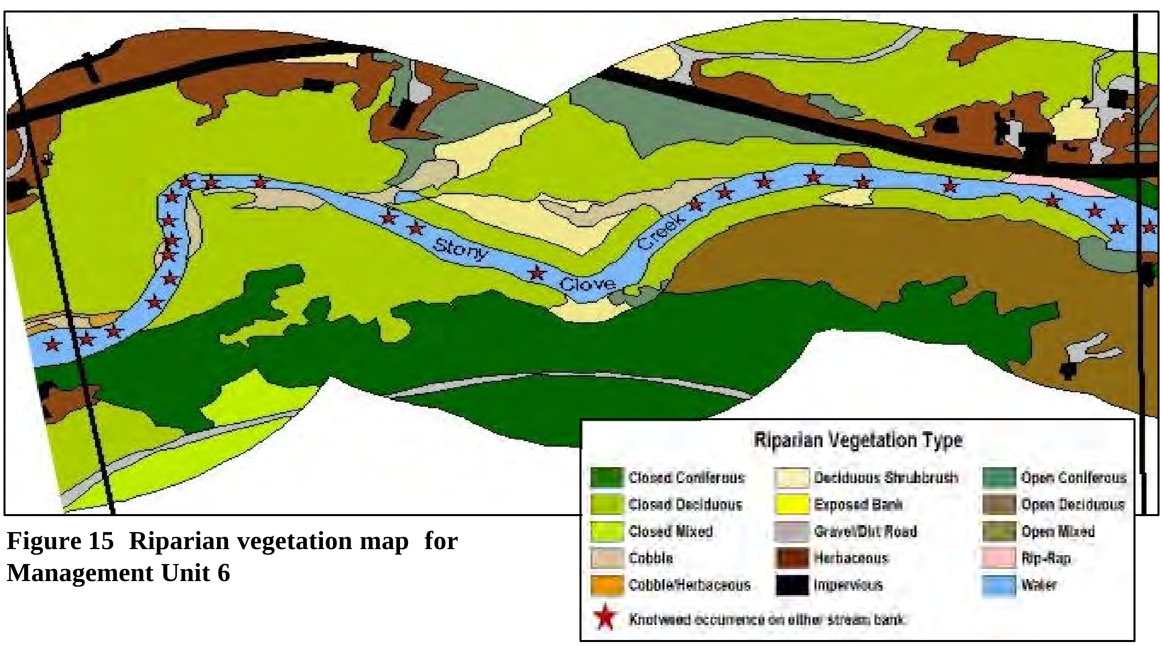


Figure 15 Riparian vegetation map for Management Unit 6

An analysis of vegetation was conducted using aerial photography from 2001 and field inventories (Fig. 15 & Appendix A). Japanese knotweed occurrences were documented as part of the MesoHABSIM aquatic habitat inventory conducted during the summer of 2002 (Appendix B).

The predominant vegetation type within the 300 ft. riparian buffer is forested (79%) followed by herbaceous (8%). Areas of herbaceous (non-woody) cover provide opportunities to improve the riparian buffer with more flood-resistant species. *Impervious* area (4%) within this unit's buffer is primarily the NYS Route 214 roadway and private residences.

In June 2003, suitable riparian improvement planting sites were identified through a watershed-wide field evaluation of current riparian buffer conditions and existing stream channel morphology (Fig. 16). These locations indicate where plantings of trees and shrubs on and near stream banks can help reduce the threat of serious bank erosion, and can help improve aquatic habitat as well. In some cases, eligible locations include stream banks where rock rip-rap has already been placed, but where additional plantings could significantly improve stream channel stability in the long-term, as well as biological integrity of the stream and floodplain. Areas with serious erosion problems where the stream channel requires extensive reconstruction to restore long-term stability have been eliminated from this effort. In most cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include re-vegetation components. Two appropriate planting sites were documented within this management unit.

Figure 16 Planting sites location map for Management Unit 6

Planting site #25 is located at the top of the management unit, downstream from the only road crossing in the unit (Fig. 17). This crossing has caused stream channel to split into three separate channels. The channel along the left bank has caused toe erosion and bank failure. Rip-rap has been installed along the right bank.

One recommendation for this site is to install in-channel plantings of native willows and sedges, to force the two right channels to rejoin. It is also recommended to *joint plant* the existing rip-rap, by inserting plantings into the soil between the openings in the rip-rap rocks. Joint planting will strengthen and increase the longevity of this rip-rap. These plantings will also improve the aquatic habitat by providing shade, thereby cooling water temperatures.

Figure 17 Planting Site #25

Additional plantings and *willow fascines* may be installed along the toe and face of the left stream bank. This stream bank is actively eroding making it a difficult planting site. However, it may be possible to stabilize this bank solely with vegetation with the proper design.

Figure 18 Planting Site #26
Right Bank - Looking Upstream

Planting site #26 is located along the reach of C3b stream type between cross sections 110 to 112. The right stream bank is experiencing some minor erosion (Fig. 18), while there is a gravel bar along the left stream bank. Japanese Knotweed is beginning to establish on the disturbed right bank. The upland area is mainly cobble material (Fig. 19).

Recommendations for this site include installation of native willows and sedges along the right stream bank. These plantings will protect the bank from erosion, while providing shade for the deep pool in the reach. Japanese Knotweed at the site should be removed. For the upland area, tree and shrub plantings are recommended to increase the density and functionality of the upland stream buffer.

Figure 19 Planting Site #26
Upland Area

<u>Flood Threats</u>

Inundation

As part of its National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) performs hydrologic and hydraulic studies to produce

Figure 20 100-year floodplain boundary in Management Unit 6

Flood Insurance Rate Maps (FIRM), which identify areas prone to flooding. Initial identification for these maps was completed in 1976. Some areas of these maps may contain errors due to stream channel migration or infrastructure changes over time.

To address the dated NFIP maps, the NYS DEC Bureau of Flood Protection is currently developing floodplain maps, using a new methodology called Light Detection And Ranging (LIDAR). LIDAR produces extremely detailed and accurate maps, which will indicate the depth of water across the floodplain under 100-year and other flood conditions. These maps should be completed for the Stony Clove Watershed in 2004.

According to the NFIP maps, there are no houses located within the 100-year flood boundary in this management unit (Fig. 20). The current NFIP maps are available for review at the Greene and Ulster County Soil & Water Conservation District offices.

Bank Erosion

Most of the stream banks within the management unit are stable, with only 3% of the stream banks experiencing erosion. There are two bank erosion sites, totaling 132 ft. in length, in this management unit.

One reason that bank erosion site #14 is rated a low priority for a restoration project is its small size and lack of water quality threat (Inset G). However, as discussed in the riparian vegetation section, this site could benefit from vegetation and minor bank grading.

Bank erosion site #15 is considered a medium priority because of its threat to water quality (Inset A&B). This site is contributing turbidity to the stream. While not directly threatening infrastructure, the potential for *geotechnical* failure presents an indirect threat to downstream reaches in the form of significant debris and sediment loading. The site should be monitored closely for acceleration of the failure.

Infrastructure

The private road crossing at the top of this management unit has been severely damaged in past flood events. This infrastructure threat is discussed in the management unit #5.

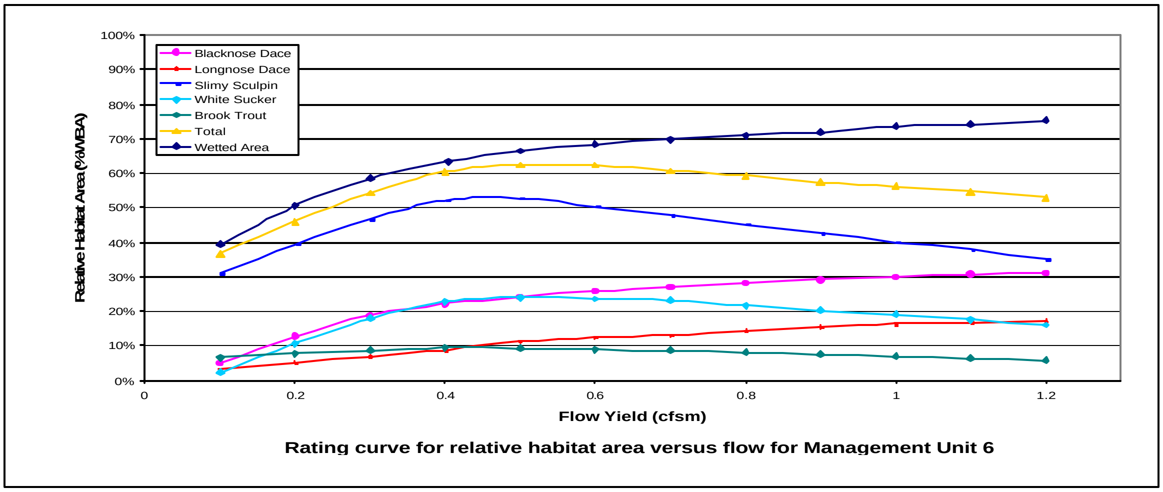
The right stream bank at the top of the management unit is heavily armored with rip-rap to protect the road embankment of NYS Route 214 (Inset D). If this rip-rap was not installed, channel and bank instability would likely cause damage to the roadway. Rip-rap and other hard controls may provide temporary, local relief from erosion at sites such as this where immediate stabilization is a priority. They are, however, expensive to install, can degrade habitat, require ongoing maintenance or transfer erosion problems to upstream or downstream areas. As mentioned above, some of these effects could be mitigated with appropriately designed vegetative treatments.

Figure 21 Road Crossing March 21,2003 (967cfs)

Aquatic Habitat

Aquatic habitat was analyzed for each management unit using Cornell University Instream Habitat Program's model called MesoHABSIM. This approach attempts to characterize the suitability of instream habitat for a *target community* of native fish, at the scale of individual stream features (the "meso" scale), such as riffles and pools. Habitat is mapped at this scale for a range of flows. Then the suitability of each type of habitat, for each species in the target community, is assessed through electrofishing. These are combined to predict the amount of habitat available in the management unit as a whole. The habitat rating curves in the figure below depict the amount of suitable habitat available at different flows. See Appendix B for a more detailed explanation of methods.

The upper portion of management unit #6 runs very close to the road, but then veers away in the lower half. The unit consists mostly of fast-flowing, shallow habitats (riffles and rapids) with boulders, shading, and woody debris. The wetted area increases from 40% to 80% of bankfull wetted area with an inflection point near 0.5 cfsm. The majority of wetted area is highly suitable for the target community. The overall suitable habitat level increases strongly before flows reach 0.7 cfsm and then gradually declines. For the majority of species, the habitat increases appreciably between flows of 0.2 and 0.4 cfsm, though white sucker and slimy sculpin habitat has a peak a little after 0.45 cfsm. Brook trout habitat stays relatively constant at a 10% level. Brown and rainbow trout habitat increases significantly at higher flows. Habitat could be improved in this reach through the vegetative treatments recommended above at erosion sites #14 and 15. (See general recommendations for aquatic habitat improvement in Section 6.6)



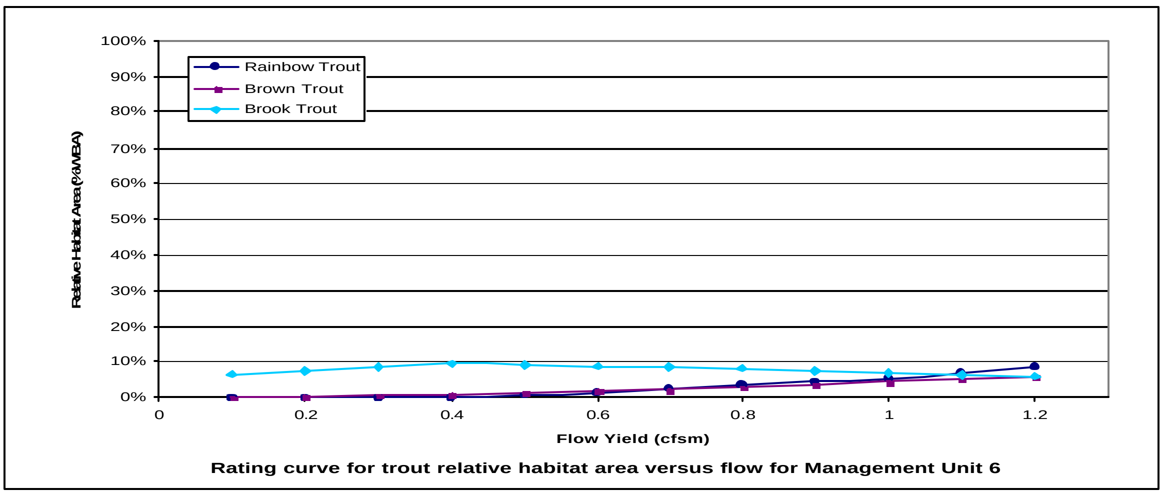


Figure 22 MesHABSIM habitat rating curves for Management Unit 6

Water Quality

Clay exposures and sediment from stream bank and channel erosion pose a significant threat to water quality in Stony Clove Creek. Clay and sediment inputs into a stream may increase *turbidity* and act as a carrier for other pollutants and pathogens. There are currently two clay exposures along the right stream bank in the lower half of the management unit.

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and flows untreated directly into Stony Clove Creek. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly impact water quality.   There is one stormwater culvert in this management unit.

As shown in Figure 23, the culvert at the top of the management unit does contribute sediment into the Stony Clove Creek. The majority of this sediment is washed off of a dirt road on the opposite side of NYS Route 214. While the culvert outfall does not offer evident opportunities for treatment of this problem, options for treatment of the turbidity source, or appropriate stormwater retrofit technology installed on the opposite shoulder of NYS Route 214 should be evaluated.

Figure 23 Culvert During Rain Event

Nutrient loading from failing septic systems is another potential source of water pollution. Leaking septic systems can contaminate water making it unhealthy for swimming or wading. Although there are few houses located in close proximity to the stream channel in this management unit, homeowners should inspect their septic systems annually to make sure they are functioning properly. Each household should be on a regular septic service schedule to prevent over-accumulation of solids in their system. Servicing frequency varies per household and is determined by the following factors: household size, tank size, and presence of a garbage disposal. Pumping the septic system out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.

The New York City Watershed Memorandum of Agreement (MOA) allocated 13.6 million dollars for residential septic system repair and replacement in the West-of-Hudson Watershed through 2002. Eligible systems include those that were less than 1,000-gallon capacity serving one- or two-family residences, or home and business combinations (CWC, 2003). Two homeowners in this management unit have made use of this program to replace or repair their septic systems.