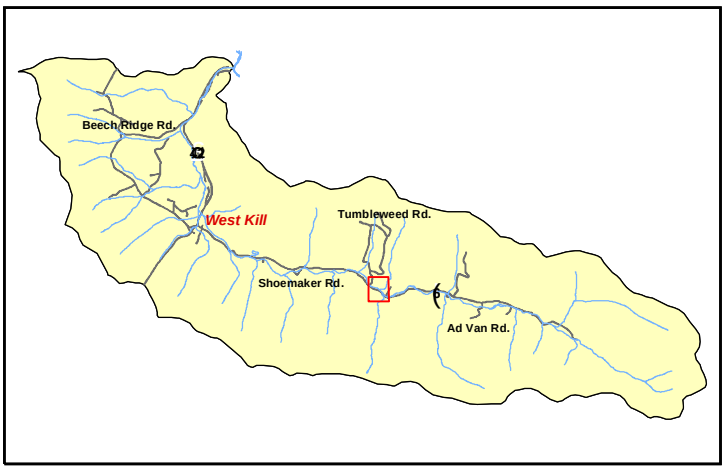


West Kill Management Unit 8

Stream Feature Statistics

7% of stream length is experiencing erosion
28% of stream length has been stabilized
11.4 acres of inadequate vegetation within the 300 ft. buffer
181 ft. stream is within 50 ft. of the road
3 houses located within the 100-year floodplain boundary

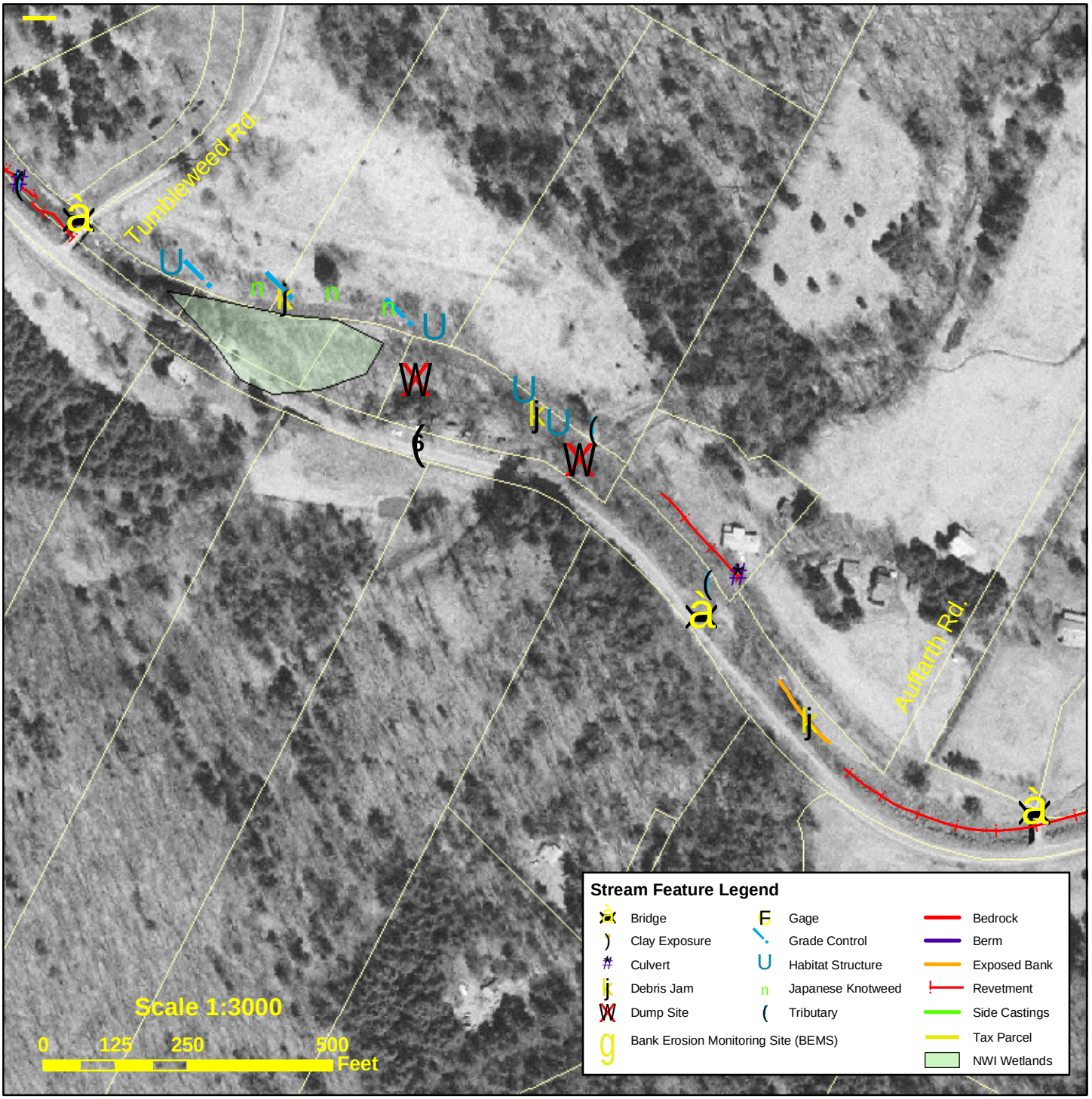


Figure 4.8.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 8
Between 36944 and 34845

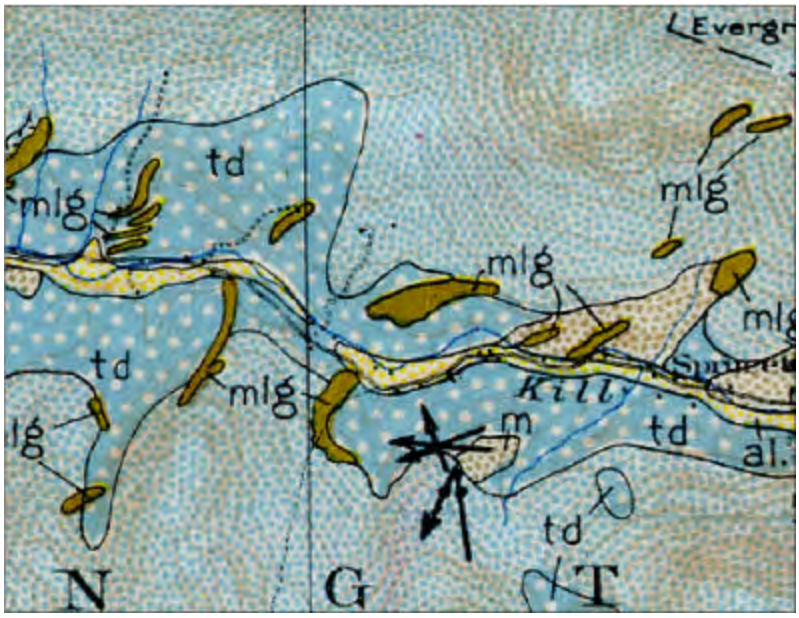
Management Unit Description

This management unit begins just downstream of the Aufarth Road Bridge (Station 36944), continuing approximately 2,099 ft. to the Tumbleweed Ranch Road bridge. The drainage area ranges from 11.2 mi^2 at the top of the management unit to 13.4 mi^2 at the bottom of the unit. The valley slope is 1.65%.

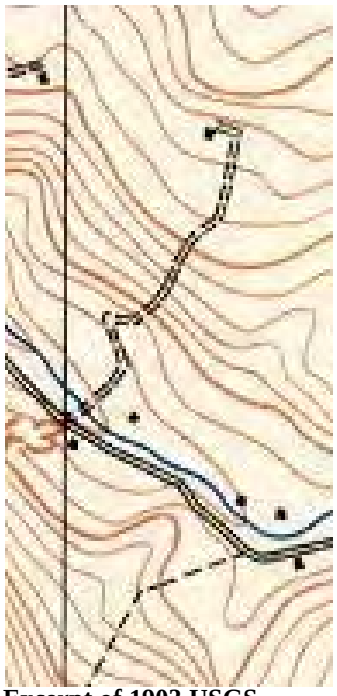
Summary of Recommendations Management Unit 8	
Intervention Level	Assisted Self-Recovery
Stream Morphology	None
Riparian Vegetation	Interplant rip-rap and enhance riparian vegetation upstream and downstream of Tumbleweed Road Bridge. Improve road side buffer at upstream end of unit.
Infrastructure	Interplant rip-rap near Aufarth Road, stabilize Greene County Route 6 embankment near station 36500. Below Tumbleweed Road Bridge, add rip-rap and interplant new and existing rip-rap.
Aquatic Habitat	Watershed wide study.
Flood Related Threats	None
Water Quality	Removal of refuse from identified dump sites.
Further Assessment	Investigate stormwater impacts from Tumbleweed Ranch subdivision.

Historic Conditions

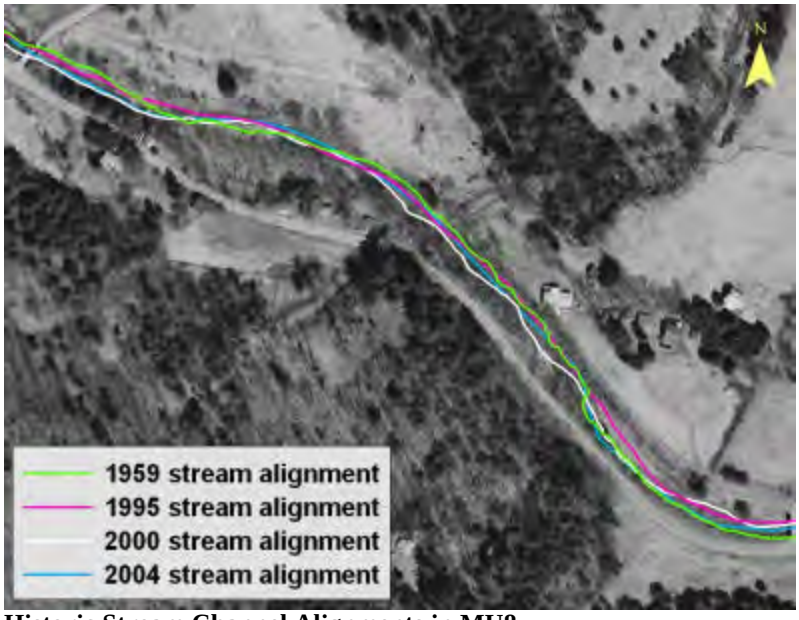
As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.4, Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935



Excerpt of 1903 USGS topographic map MU8



Historic Stream Channel Alignments in MU8

As seen from the historical stream alignments, the channel alignment has not changed significantly over the years. The lateral stability apparent from the aerial photography may be attributable, in part, to the sediment storage areas in Management Unit 7.

According to available NYS DEC records there were no stream disturbance permits issued in this management unit following the flood of 1996.

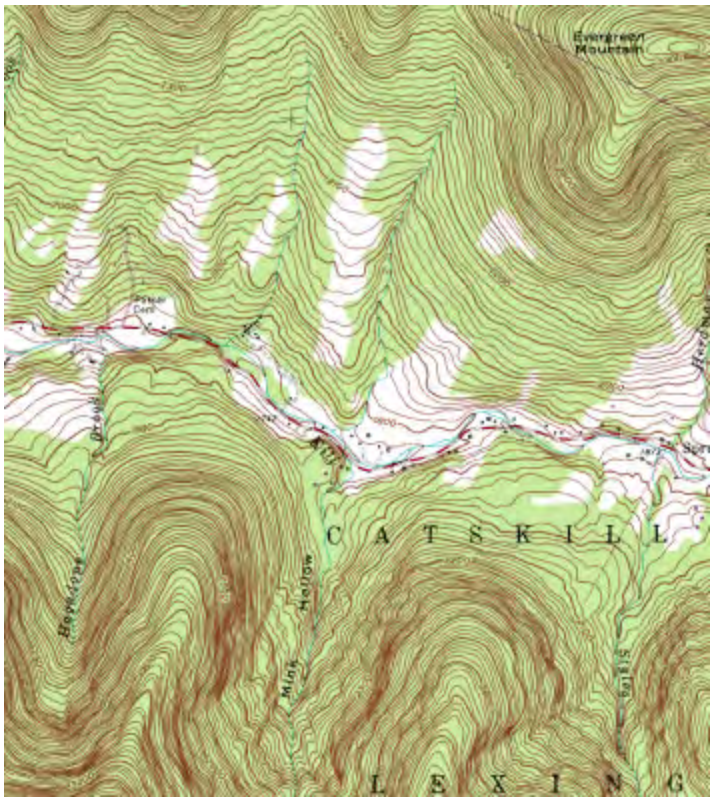
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 7% (138 ft.) of the stream exhibited signs of active erosion along 2,099 ft. of total channel length. Revetment has been installed on 28 % (595 ft.) of the stream length. 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 4.8.2. "Left" and "right" references are oriented looking downstream. Stationing references proceed upstream, in feet, from an origin (Station 0) at the confluence with the Schoharie Creek at Lexington. Italicized terms are defined in the glossary. This characterization is the result of surveys conducted in 2004 and 2005.



Excerpt of 1980 USGS topographic map

In Management Unit 8, the West Kill hugs Spruceton Road. The valley slope here remains 1.65%, which in a wild river would result in increased channel sinuosity, a wider beltwidth and consequently, greater tendency and capacity for sediment storage. The development of a split channel and aggradation in the upper reaches of the unit does create significant bedload storage conditions, but in the lower half of the unit, the stream has abandoned its former floodplain through incision. These conditions are possibly the result of historic channelization to create conditions more favorable for agriculture. The low *sinuosity*, or curviness, and *beltwidth*, or the width of the stream corridor from outside-to-outside of meanders, are uncharacteristic of this valley slope, and due to the proximity of the channel to the southern valley wall and terraces, the reach may be producing more sediment than it stores, through the entrainment of material scoured from the toe of these hillslopes. Streams in valleys of this gradient tend to dissipate stream power laterally during high flows, with excess *shear stress*, or the force the stream exerts in the direction of its flow, often producing erosion of streambanks. In

contrast, steeper streams often dissipate excess energy on the streambed, resulting in *incision*.

Stream morphology, or shape (i.e., slope, width and depth) changes several times in this unit (Fig. 5), creating small reaches with differing morphologic characteristics, which are classified as different *stream types* (See Section 3.2 for description of stream types).

Cross-sections and Rosgen stream types in Management Unit 8

View form Aufarth Road Bridge, start of MU8

Aufarth Road bridge marks the upstream extent of Management Unit 8 (MU8). Management Unit 8 begins with a 344 ft. section of F3 streamtype, continuing from Management Unit 7 (MU7) where a monumented cross-section near the end of MU7 (Station 37179) documents the F3 streamtype. F streamtypes are entrenched, or confined within their banks at high flow. Channel slope is 1.3%, and the bed material is dominated by cobble.

The rip-rap at the left of the photo also continues from Management Unit 7 (Inset H, Fig. 4.8.2). The rip-rap protects the Aufarth Road Bridge abutments, and the County Route 6 embankment. It is made of large, angular quarry stone and is in good condition. This reach has virtually no riparian vegetation to buffer the stream from the potential thermal impacts and road runoff. The end of the rip-rap installation marks the transition from the F3 stream type to B3c. Recommendations here include interplanting of the rip-rap, and enhancement of the riparian buffer using ecologically appropriate tree and shrub species. The vegetative treatments will extend the longevity of the rip-rap installation, enhance the function of the riparian buffer, and improve fish habitat in this reach.

Bank Erosion

Just downstream of the rip-rap, bank erosion is evident on the left bank (Inset G, Fig. 4.8.2). The erosion is mild, and the buffer of trees, though quite narrow, offers a dense root mat which improves this bank's resistance to erosion. From a riparian buffer perspective, the vegetation here is inadequate to protect the stream from road runoff

pollutants. Despite the density of the soil stabilizing root mass, this bank erosion poses a threat to Greene County Route 6 due to its proximity to the roadway. A vigorous colony of willow between the end of the rip-rap and the start of the eroded bank may present material to stabilize the toe of the road embankment, using willow fascines and stakes crafted from locally harvested materials.


Debris Jam

A small debris jam is observed along the eroded bank. A single tree obstructs all but the lowest flows, but is fairly light and likely to be mobilized in a moderate flow event.

The first monumented cross-section in this management unit is located at the downstream end of the erosion (Station 36414). Entrenchment moderates near station 36600 while other morphological indicators remain fairly constant. This monumented cross-section documents a B3c stream type, with a channel slope of 1.7% and a cobble dominated bed structure. This reach of B3c stream extends approximately 900 ft., and includes the second monumented cross-section in this management unit.


Tributary confluence, left

Mink Hollow, a 1.2 mi^2 tributary, joins the West Kill near station 36200 from the left. It passes under County Route 6 through a small bridge (Inset F, Fig. 4.8.2), and is well connected to the West Kill at its confluence.


Culvert, right

A culvert emerges from the right bank, opposite the Mink Hollow Tributary. The culvert appears to convey upland drainage from a residential area on the terrace at stream right. Although the culvert is perched and has only minimal outfall protection, no erosion was observed at the outfall.


Rip Rap, right

Immediately downstream of the culvert, a 200 ft. long rip-rap installation is found on the right bank (Inset D, Fig. 4.8.2). The rip-rap protects a stream side residence, located on the terrace just beyond the rip-rap. The rip-rap is made of rounded river stone, and armors the bank against erosive flows delivered by both the West Kill and the Mink Hollow tributary.

The second monumented cross-section in this unit is installed at the downstream end of the rip-rap (Station 36013). While the stream type remains B3c, slope is markedly reduced from the upstream cross section of the same stream type, to 0.7%.

Road side dumping on stream

Continuing downstream, appliances and trash are found dumped on the left stream bank, as Greene County Route 6 peals away from the stream side. Appliances, trash and other refuse often contain metals, lubricants and various chemicals that can be detrimental to water quality. The dumpsite also degrades the aesthetic quality of this reach. Removal of the trash and appliances is recommended in order to protect water quality and limit further soil contamination.

Tributary, right

Opposite the dumpsite, an unnamed tributary finds its confluence with the West Kill (Inset C, Fig. 4.8.2). The 0.9 mi^2 catchment appears to deliver moderate sediment loads, however, and a headcut is noted in the tributary near the confluence, which could result in accelerated sediment delivery as incision extends upstream. Recommendations for this tributary would include installation of a grade control structure at its mouth to prevent headward migration of the degradational processes noted here. The catchment for this tributary includes a recently developed residential subdivision; stormwater impacts upstream in this tributary should be investigated, both in terms of hydrology and water quality.

Habitat Structure

A habitat structure near station 35800 is partially buried in the stream bed. Habitat structures were historically installed throughout the West Kill mainstem by the New York State Department of Environmental Conservation (NYSDEC), often to create scour pools. These scour pools offer deeper holding habitat, sometimes with associated cover, and the spillways raise the level of dissolved oxygen in the water. The structures, often in the form of a log weir perpendicular to the channel, also provided grade control. Because they provide only minimal lateral control, however, higher flows frequently flank these structures. In some settings, this can promote lateral channel migration, increase width-to-depth ratios and result in bank erosion up- or downstream. In wild streams, these functions – both positive and negative – are performed to a large extent by large woody debris. This log structure forms a "V" pointed downstream, which spreads flow and appears to promote channel widening. The structure is in poor condition and is no longer likely to have a significant impact on channel process.

Debris Jam

A debris jam located approximately 50 ft. downstream of the habitat structure lies against the left bank. The jam presents only a minimal obstruction through the range of flows, and appears to provide some measure of bank protection.

Habitat Structure

Another habitat structure is found near station 35710. This log sill is in good condition, and appears to widen the channel cross section.

Monumented cross-sections at stations 35615 and 35086 document a 700 ft. reach of C3 stream type. The channel slope in the reach ranges from 1.0% - 1.8 %, with slope increasing as the channel approaches the bridge at Tumbleweed Ranch Road.

Dump Site, right

A second dump site was discovered, in this management unit, approximately 85 ft. downstream of the monumented cross-section at station 35615. This site again consists of appliances and other trash that may threaten water quality. Removal of the refuse is recommended.

Habitat Structure

A third habitat structure was documented in this management unit at station 35530 (Inset B, Fig. 4.8.2). The log structure appears to have been similar to the "V" shaped structure described at station 35800. The structure is intact at the right bank, but there were no remnants of the structure evident at the left bank.

Rock grade control

Three rock grade control weirs were found in this Management Unit between stations 35500 and 35100. The weirs are formed from native rocks that appear to have been pushed into place. The structures provide effective grade control, and no adverse impacts are evident.

Japanese knotweed

Three occurrences of Japanese knotweed were located in this Management Unit between stations 35450 and 35200 at the time of the 2004 walkover. The colonization of knotweed in MU8 was confined to the right bank of this reach. Knotweed spreads rapidly in favorable soil and moisture conditions, and removal of the noted occurrences is recommended to prevent proliferation of the species. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.

The last habitat structure (station 35050) located in MU8 is a log sill buried at the right bank, with the center protruding from the streambed (Inset E, Fig. 4.8.2). No remnants of the structure are evident at the left bank.

Habitat Structure

Bridge at Tumbleweed Ranch Road

As the channel approaches the terminus of MU 8 at the Tumbleweed Road Bridge (Inset A, Fig. 4.8.2), entrenchment increases, and the stream type transitions to B3c for the remaining 155 ft. of MU8. This stream type change is documented by a monumented cross-section (Station 34647) near start of Management Unit 9.

The bridge at Tumbleweed Ranch Road has concrete wing walls and rock placed at the inlet to protect the abutments from scour. Bedrock spans the entire channel bottom between the abutments, providing grade control.

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).

Sediment transport in Management Unit 8 appears very stable. This may be due in large part to the sediment storage areas found in MU 7. This unit may present opportunities to gather reference information on channel dimension, pattern and profile to support the development of future stream restoration designs.

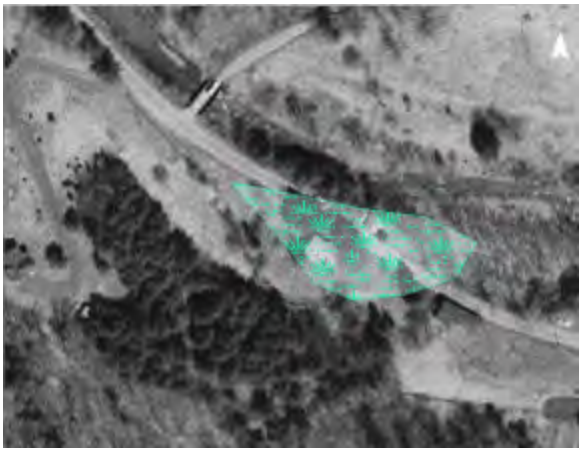
Riparian Vegetation

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. Mowed lawn does not provide adequate erosion protection on stream banks because it typically 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, which are adapted to our regional climate and soil conditions and typically require less maintenance following planting and establishment.

Some plant species that are not native can create difficulties for stream management, particularly if they are invasive. Japanese knotweed (*Fallopia japonica*), 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.

An analysis of vegetation was conducted using aerial photography from 2005 and field inventories (Fig. 4.8.3, Appendix A). One Japanese knotweed occurrence was documented as part of the stream feature inventory conducted during the summer of 2004, with four additional occurrences identified in 2005. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.

In this management unit, the predominant vegetation type within the 300 ft. riparian buffer is Forest (47 %) followed by Herbaceous (34 %). *Impervious* area (7 %) within this unit's buffer is primarily the Greene County Route 6, along with private residences and associated roads. Three occurrences of Japanese knotweed were documented in this management unit during the 2004 inventory.



National Wetland Inventory wetland in MU4

There is one wetland within this management unit mapped in the National Wetland Inventory (see Section 2.5, Wetlands and Floodplains for more information on the National Wetland Inventory and wetlands in the West Kill watershed). Wetlands are important features in the landscape that provide numerous beneficial functions including protecting and improving water quality, providing fish and wildlife habitats, storing

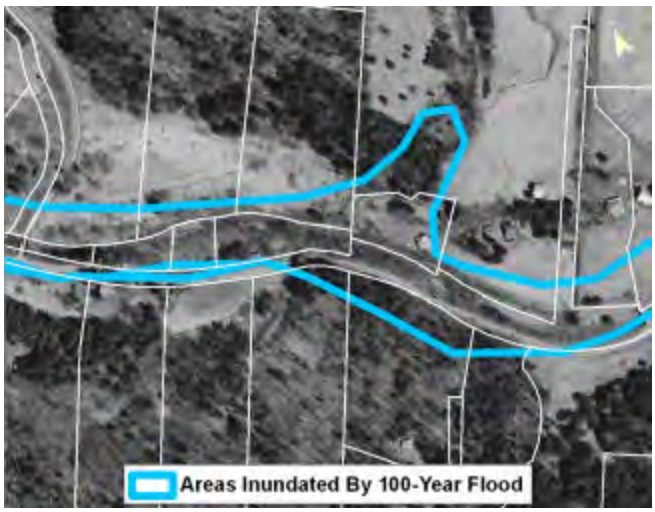
floodwaters, and maintaining surface water flow during dry periods (See Section 2.6 for wetland type descriptions and regulations). The wetland, just upstream of the Tumbleweed Ranch Road bridge on the left bank, is 0.8 acres in size, and is classified as Palustrine, Forested, Broad-Leaved Deciduous, Temporarily Flooded (PFO1A).

Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with tree plantings, to promote a more mature vegetation community along the streambank and in the floodplain. In November 2005, suitable riparian improvement planting sites were identified through a watershed-wide remote evaluation of current riparian buffer conditions. 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 long-term stream channel stability, 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 many cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include channel restoration components in addition to vegetative treatments.

Twenty potential planting sites were documented within this management unit (Fig. 4.8.4).

Recommendations for this unit include planting native trees and shrubs along the edge of the stream bank and the upland area. Buffer width should be increased by the greatest amount agreeable to the landowners, but increasing the buffer width by at least 35 feet will increase the buffer functionality and improve stream bank stability while still allowing a significant lawn area.

Flood Threats



100 yr floodplain, MU8

As part of its National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) performs hydrologic and hydraulic studies to produce Flood Insurance Rate Maps (FIRM), which identify areas prone to flooding. There are three houses within the 100-year flood boundary. The NYS DEC Bureau of Flood Protection is currently developing new floodplain maps for the West Kill on the basis of recent surveys. These maps should be completed for the West Kill watershed in 2006.

The 100-year floodplain is that area predicted to be inundated by floods of a magnitude that is expected to occur once in any 100 year period, on the basis of a statistical analysis of the local flood record. Most communities regulate the type of development that can occur in areas subject to these flood risks. The current NFIP maps are available for review at the Greene County Soil & Water Conservation District office.

Bank Erosion

Most of the stream banks within the management unit are considered stable, although 12% (258 ft.) of the stream length is experiencing major erosion, and 11% has been stabilized, there are ongoing stability problems. There are no Bank Erosion Monitoring Sites in MU8.

Infrastructure

Eleven percent of the stream length in this management unit has been treated with some form of revetment. However, there are no immediate threats to roadways or bridges in this management unit.

Aquatic Habitat

It is recommended that a habitat study be conducted on the West Kill Creek, with particular attention paid to possible physical and temperature barriers in aggrading sections, to the frequency of disturbance of the bed due to incision at numerous points in the system, and to embeddedness resulting from excessive entrainment of fine sediment from upstream sources.

The continued deterioration of the NYSDEC habitat structure will reduce erosion threats in their vicinity, and is unlikely to meaningfully reduce the quality of the habitat in the unit.

Generally good conditions of habitat in this management unit make it a potential candidate for a habitat reference site for the West Kill.

Water Quality

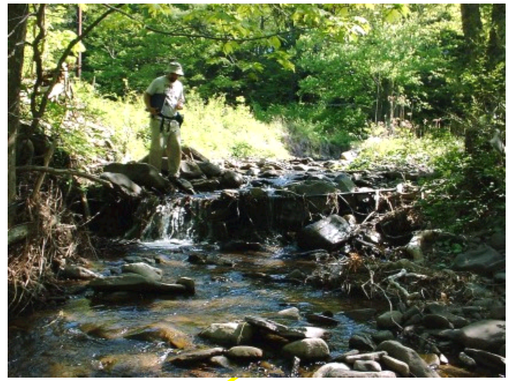
Clay exposures and sediment from stream bank and channel erosion pose a potential threat to water quality in West Kill Creek. Clay and sediment inputs into a stream may increase *turbidity* and act as a carrier for other pollutants and pathogens. There were no clay exposures documented in this management unit.

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and flows untreated directly into West Kill Creek. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly degrade water quality. There are no stormwater culverts in this management unit. Less than 1% of the stream lies within 50 ft. of a road.

The intensive subdivision of Tumble Ranch Road is unique in the West Kill watershed, and its associated stormwater drainages should be investigated for potential hydrological and water quality impacts.

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. There are numerous houses located in close proximity to the stream channel in this management unit. These 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 included those that were less than 1,000-gallon capacity serving one- or two-family residences, or home and business combinations. No homeowners in this management unit made use of this program to replace or repair a septic system.



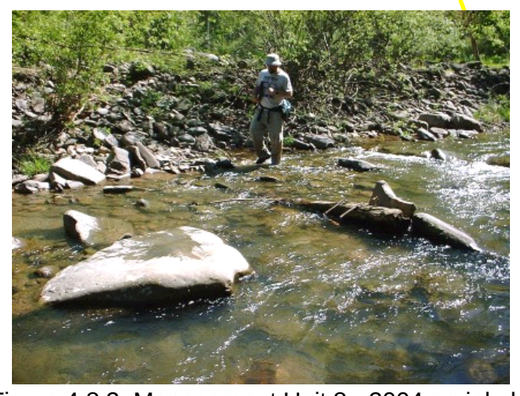


Figure 4.8.2 Management Unit 8 - 2004 aerial photography