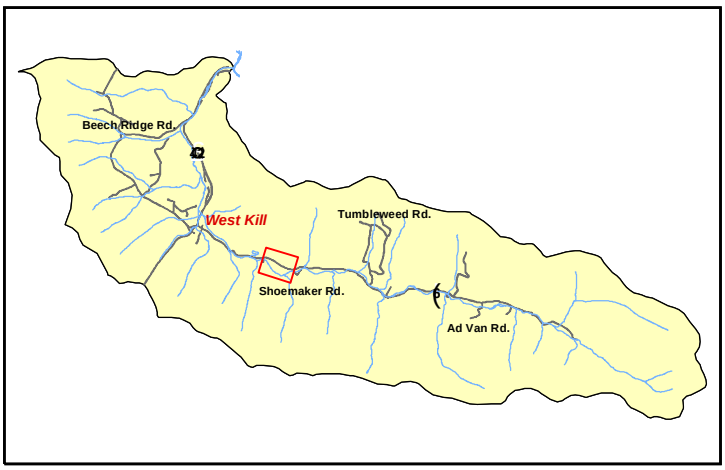



# West Kill Management Unit 12

*Stream Feature Statistics*

35% of stream length is experiencing erosion
39% of stream length has been stabilized
6.7 acres of inadequate vegetation within the 300 ft. buffer
4 ft. of stream is within 50 ft. of the road
3 houses located within the 100-year floodplain boundary

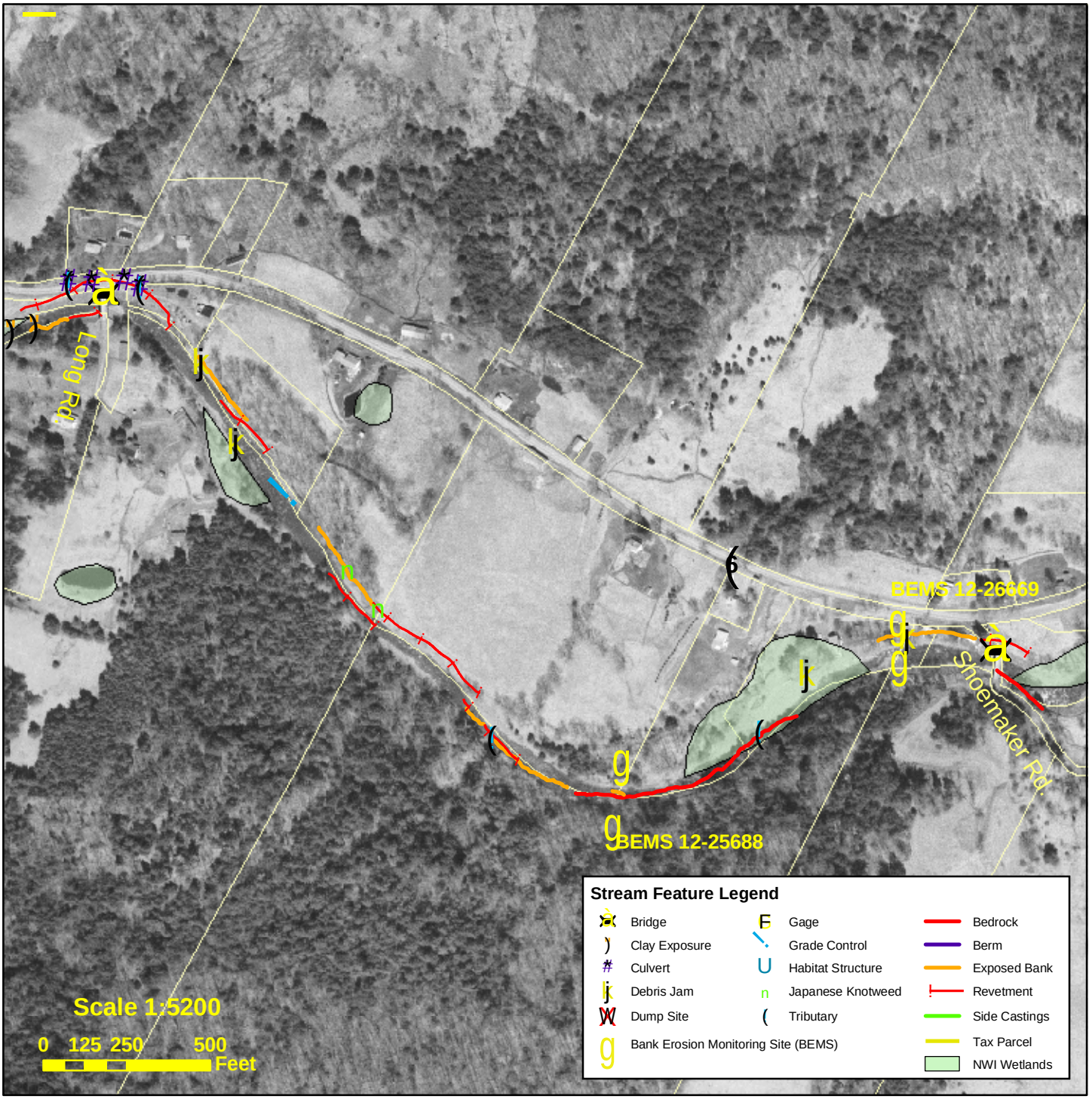



Figure 4.12.1 2004 aerial photography with stream feature inventory and tax parcels

# Management Unit 12

Between Station 26957 and Station 23489

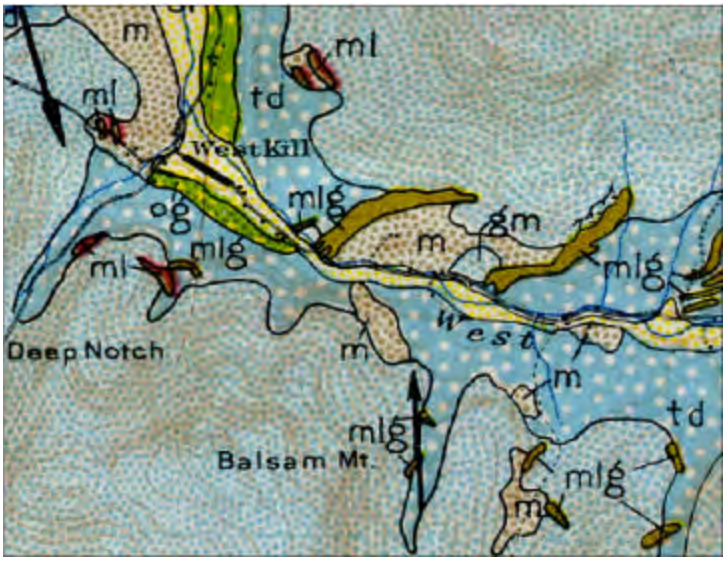
**Management Unit Description**

This management unit begins at the Shoemaker Road bridge crossing, continuing approximately 3468 ft. to the Long Road Bridge. The drainage area ranges from 16.9 $mi^2$ at the top of the management unit to 18.7 $mi^2$ at the bottom of the unit. The valley slope is 1.65%.

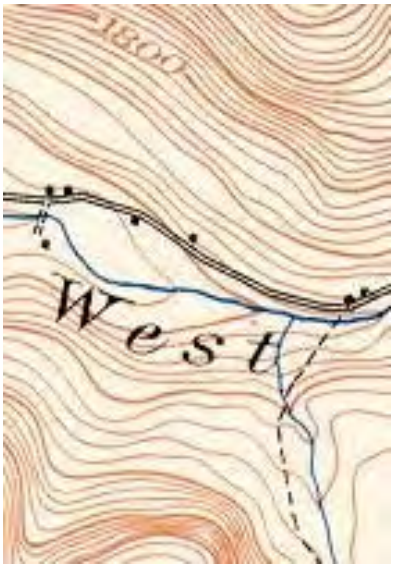
| Summary of Recommendations<br>Management Unit 12 | |
|---|---|
| Intervention Level | Assisted Self-recovery |
| Stream Morphology | None |
| Riparian Vegetation | Enhance riparian buffer along stream side pasture and Long Road bridge approach. |
| Infrastructure | Monitor revetment throughout unit. |
| Aquatic Habitat | Watershed wide study; investigate thermal barriers. |
| Flood Related Threats | None |
| Water Quality | Monitor potential sources of turbidity. |
| Further Assessment | Geotechnical assessment of erosion on glacial terrace. |

## 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.

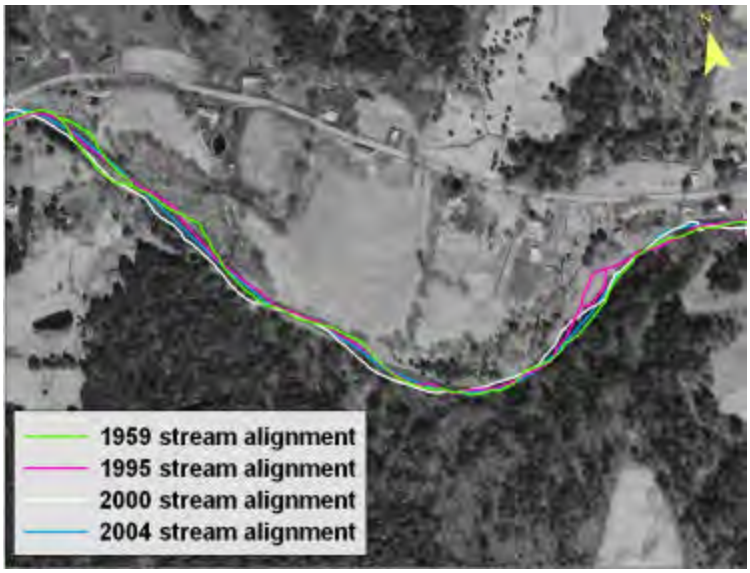



**Excerpt from Rich, 1935**




**Excerpt of 1903 USGS topographic map MU12**

As seen from the historical stream alignments, the channel alignment has not changed significantly over the years. This may be attributable to the high percentage of stabilized banks and bedrock in the unit. Thirty-nine percent of the length in this unit have been stabilized. Only three of the twenty one West Kill Management Units exceed the percentage of stabilized banks found in this unit.




**Historic Stream Channel Alignments in MU12**

**1996 Flood photos courtesy of Dippold**







**1996 flood photos courtesy of Dippold**

According to available NYS DEC records there was one stream disturbance permit issued in this management unit following the flood of January 1996, to Anthony Albanese, to repair rip rap and excavate approximately 100 yards of gravel, over 1300 ft. of the West Kill.

## Stream Channel and Floodplain Current Conditions

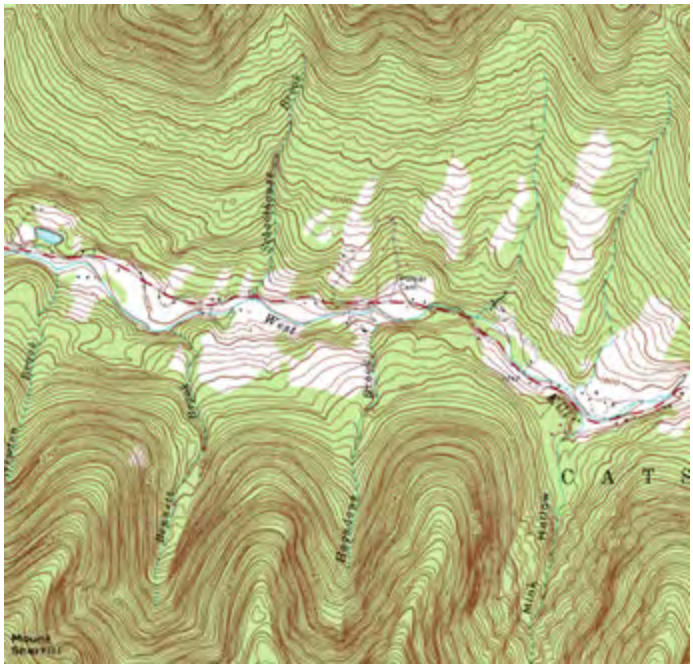
### Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 35% (1230 ft.) of the stream exhibited signs of active erosion along 3468 ft. of total channel length (Fig. 4.12.1). Revetment has

been installed on a remarkably high 39% (1355 ft.) of the stream length. No berms were identified in this management unit at the time of the stream feature inventory.

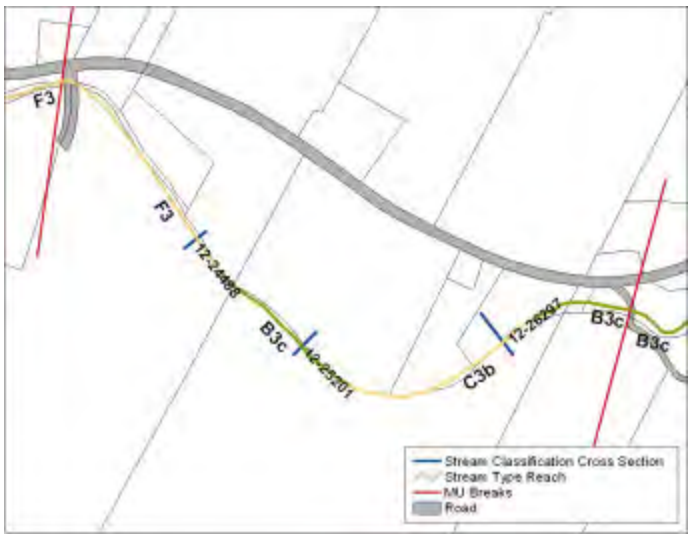
**Stream Morphology**

The following description of stream morphology references insets in the foldout Figure 4.12.2. "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. 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**

The channel in this Management Unit is confined to the south by a high glacial terrace. A broad alluvial terrace lies to the north of the channel. Entrenched conditions through much of the unit have resulted in widespread bank erosion, evident not only from currently active erosion, but also from the high percentage of revetted banks found in the unit. This pattern of erosion and revetment suggests that the channel is trending toward increased belt width and sinuosity, decreased slope, and reduced confinement as it develops more accessible floodplains within its entrenched condition.




**Cross-sections and Rosgen stream types in MU 12**

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, Introduction to Stream Processes, for description of stream types)

**Shoemaker Road bridge, looking upstream**

The Shoemaker Road bridge marks the start of Management Unit #12 (MU12). Data collected upon completion of the demonstration project revealed a 457 ft. reach of B3c stream type. The channel is moderately *entrenched*, or somewhat confined within the stream banks during high flood events. The channel slope is 1.7 % and the bed material is dominated by cobble.

**Shoemaker Road bridge, looking downstream**

**Rip-rap, right, looking downstream**

The bridge at Shoemaker road has poured concrete abutments protected on the right, both upstream and downstream, by large rip-rap. The rip-rap appears relatively new and is in good condition. The left abutment is poured on bedrock, and has no additional scour protection.

**Rip-rap, right, looking upstream**

**Bank erosion, right**

Bank erosion is evident starting immediately downstream of the rip-rap, and extending 303 ft. This erosion threatens three residential structures situated not more than twenty feet from the top of the bank. This bank is introducing moderate amounts of woody debris to the system, as mature trees on the terrace are undercut and fall into the channel. This erosion has been monumented as a Bank Erosion Monitoring Site (BEMS Station 12-26669). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site ranked Medium Priority. The *thalweg*, or deepest part of the stream channel flows up against the terrace here. The terrace is being undermined by toe erosion, leaving sections of the stream bank unvegetated. *Exposed lacustrine clay* deposits found here have a high silt and clay content, contributing sediment through both *wet and dry ravel* and yielding a significant suspended sediment load during high flows. Clay inputs into a stream are a serious water quality concern because they increase *turbidity*, degrade fish habitat, and can act as a carrier for other pollutants and pathogens. A tree, fallen from the eroded terrace, forms a woody debris blockage. The tree presents an obstruction at all flows.

**Debris Jam**

**Debris Jam**

As the channel becomes more connected with its flood plain, point bars are apparent, indicating a transition to C type stream. A second debris jam is located approximately 200 feet downstream of the erosion on the right point bar. The debris presents no obstruction at low flow, appears loose and floatable, and is likely to be mobilized in future flows (see Inset H, Fig. 4.12.2). This area, from the Shoemaker Road bridge to Station 26200, has been restored as a component of Demonstration Project #1 (see Section 5, West Kill Stream Restoration Demonstration Project).

**Bedrock, looking upstream**

A monumented cross-section at Station 26297 documents the transition to 1000 ft. of C3b streamtype. The slope of the reach increases to 2.4% and the channel remains dominated by cobble.

**Bedrock, looking downstream**

A 232 ft. length of bedrock begins at the classification cross-section, lining the left bank and portions of the bed in this reach. The bedrock offers partial grade control to the channel, inhibiting the migration of headcuts through upstream portions of the Management Unit.

**Bennett Brook confluence, left**

Bennett Brook, split into two threads at its mouth, is seen here cascading over the bedrock ledges on the left bank to join the West Kill. This large tributary delivers flow

and sediment from a 1.0 $mi^2$ catchment, and despite its perched confluence, is very stable due in part to its bedrock grade control.

**Bank Erosion, right**

As the channel meanders to the right against the bedrock left bank, a landslide slumps over a bedrock toe. This surficial slide appears to be triggered by upland drainage issues. The slope is composed of high clay content glacial tills (Inset G, Fig. 4.12.2). This erosion has been monumented as a Bank Erosion Monitoring Site (BEMS Station 12-25688). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site ranked Medium Priority. Recommendations for this site include investigation of the drainage issues resulting in the slide.

**Bank Erosion, left**

A 275 ft. length of eroded bank begins immediately downstream of the bedrock. The slope failure also appears to be associated with upland drainage issues, and the slide introduces moderate amounts of woody debris to the system. The bank has a high clay content, and appears to be active, as areas of thick herbaceous vegetation are interlaced with exposures of fresh, bare earth. This site was not monumented as a Bank Erosion Monitoring Site.

**Bank Erosion, left**

**Rip-rap**

The downstream extent of the bank erosion has had rip-rap installed at the toe. The rip-rap is in poor condition, and the landslide persists despite the stabilization effort.

As the erosion ends, an unnamed tributary flows over the rip-rap on the left. The tributary channel is steep, entrenched, but well vegetated. Heavy debris and sediment noted in the channel suggest that a headcut may be actively migrating in this tributary.

**Tributary, left**

**Bank erosion, left**

As the long rip-rap installation comes to an end, more erosion is evident on the left bank. The bank appears to be mass wasting, with clay rich materials slumping from high on the relatively low gradient, well vegetated bank. Toe scour exacerbates the geotechnical failure mechanisms. This site was not monumented as a Bank Erosion Monitoring Site.

A monumented cross-section (Station 25201) is located at this erosion, and documents a B3c streamtype. The slope of the reach declines to 1.3% but the channel remains dominated by cobble. This 800 ft. reach extends from Station 25500 to Station 24700.

A short section of rip-rap is found immediately downstream of the erosion. It appears that this rip-rap is a remnant of a once contiguous installation that unified this and the rip-rap located just upstream.

**Rip-rap, left**

A rip-rap installation begins near station 25175 on the right bank, and extends downstream approximately 425 ft. The bank has dense herbaceous vegetation, but very little woody vegetation. A pasture beyond the rip-rap is mown to the edge of the bank, leaving no forest buffer between the pasture and the stream. The risk to bank stability can be minimized by maintaining mature trees along the stream margin, including a critical buffer zone extending approximately 75 ft. from the centerline of the stream. The risks and benefits associated with management of streamside vegetation will depend partly on the current channel conditions, and local channel surveys are recommended at each site. Recommendations for this area include interplanting of the rip-rap, and enhancement of the riparian buffer with planting of ecologically appropriate tree and shrub species in the adjacent mown field. 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.

**Rip-rap, right**

Another rip-rap installation begins near station 24790 on the left bank. This 215 ft. long treatment offers toe protection to the bank, is in fair condition, and is becoming intergrown with willow, which should further stabilize the site.

**Rip-rap, left**

**Knotweed, right**

During the 2004 inventory, two stands of Japanese knotweed (Fallopia japonica), an invasive, exotic shrub species that can grow rapidly to crowd out more appropriate streamside vegetation, were observed here on the right bank opposite the rip-rap. The stands were isolated and small (approximately 3 ft. x 3 ft.). In the 2005 inventory, the number had increased to six. A program for eradication of Japanese knotweed throughout the West Kill valley is recommended.

The height of the right bank increases through this reach. As the channel becomes more entrenched, indicating transition to F type stream, erosion is evident on the right bank. A sizable gravel bar has formed at the toe, minimizing near bank shear-stress. This bank appears to be trending toward recovery. A large basswood tree, however, remains undercut at the top of the bank. Clay-rich glacial till lies along the toe of this entire bank (Inset C, Fig. 4.12.2). This site was not monumented as a Bank Erosion Monitoring Site.

**Bank Erosion**

A monumented cross-section at station 24488 documents the transition to the F3 stream type. The slope in this 1211 ft. reach reduces yet again to 0.7%, while the channel remains dominated by cobble.

**Aggradation**

Aggradation becomes apparent upstream of a rock grade control treatment. The channel dimension is somewhat overwide, but overall channel conditions are good. The grade control is formed from a combination of native and quarried stone.

**Grade Control**

**Rip-rap**

Rip-rap has been installed along 211 ft. of the right bank near station 24100. The rip-rap protects an abandoned building, setback somewhat on the terrace. Bank erosion behind the rip-rap has compromised the installation and left close to half of the treatment in the active channel, with flow on both the front and back side of the rock. The rip-rap is in poor condition overall. This site was not monumented as a Bank Erosion Monitoring Site; however the addition of a monumented monitoring station is recommended.

**Debris, right**

**Bank Erosion, looking upstream**

The erosion at the downstream end of the rip-rap appears to be exacerbated by the flow obstruction created by the damaged rip-rap (see Inset B, Fig. 4.12.2). To monitor the erosion of this streambank it will be added to the BEMS sites. The toe of this erosion is composed of clay rich glacial till, posing a threat to water quality. Two debris jams were noted in the reach along this rip-rap and erosion.

**Bank Erosion, looking downstream**

**Rip-rap, upstream of bridge**

As the channel makes a sharp bend to the left on its approach to the Long Road Bridge, the right bank is heavily armored with a sheet pile toe and rip-rapped upper banks. The treatment extends both up and downstream of the bridge, and appears fairly new and in good condition. Riparian vegetation, however, is non-existent. Recommendations here include interplanting of the rip-rap, using ecologically appropriate tree and shrub species. The vegetative treatments will enhance the function of the riparian buffer, and improve fish habitat in this reach.

**Rip-rap, downstream of bridge**

**Tributary culvert**

Two culverts convey drainage under County Route 6, and outfall onto the riprap (see Inset A, Fig. 4.12.2). One of the culverts conveys road drainage, and the other conveys an unnamed tributary. The culverts are perched, but have ample outfall protection.

**Culvert**


**Long Road bridge**


**Looking upstream**


**Looking downstream**

The Long Road bridge marks the downstream limit of Management Unit 12. This bridge appears new and is in excellent condition. The span of this bridge is adequate to pass relatively high flows without channel constriction, but the channel meander creates form roughness resulting in significant backwatering (see Inset E, Fig. 4.12.2).

**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).

Frequent occurrences of rip-rap indicate a history of channel maintenance intended to reduce bank erosion. Despite this revetment, active erosion in this unit is producing excess sediment supply, resulting in mild aggradation within this unit, and which may be accelerating aggradational processes observed in Management Unit 13.

**Riparian Vegetation**

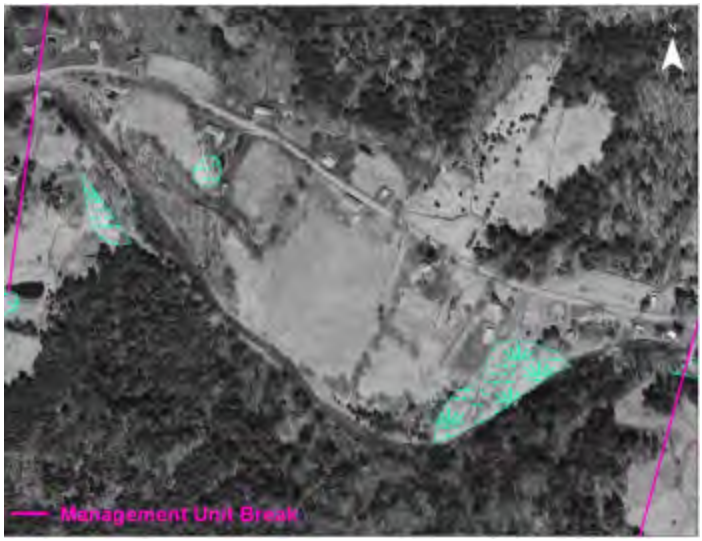
One of the most cost-effective methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the bank, especially within the first 30 to 50 ft. of the stream. A dense mat of roots under trees and shrubs bind the soil together, and makes it 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. 4.12.3). Japanese knotweed occurrences were documented as part of the stream feature inventory conducted during the summer of 2004, with additional occurrences identified in 2005.

In this management unit, the predominant vegetation type within the 300 ft. riparian buffer is Forest (53 %) followed by Herbaceous (30 %). *Impervious* area (3%) within this unit's buffer is primarily the Greene County Route 6, along with private residences and associated roads. Two occurrences of Japanese knotweed were documented during the 2004 stream inventory and four additional occurrences were documented in 2005.



**National Wetland Inventory wetlands in MU12**

There are 4 wetlands 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 upstream most wetland, which is 2.2 acres in size, is classified as Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporarily Flooded (PSS1A). Moving downstream, the next wetland is 0.5 acres in size, and is designated as Riverine, Lower Perennial, Unconsolidated Shore, Temporarily Flooded (R2USA). A wetland on the terrace to the north of the channel is 0.3 acres in size and is designated as Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded (PUBHh). The forth wetland in the unit lies on the terrace to the south of the channel is 0.4 acres in size and is also designated as Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded (PUBHh).

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 and existing stream channel morphology. 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-five potential planting sites were documented within this management unit (Fig. 4.12.4).

One area that presents opportunities for riparian buffer enhancement lies between stations 25200 and 24700. The right bank here is rip-rapped and the pasture beyond the rip-rap is mowed to the edge of the field, leaving no buffer between the pasture and the channel. Recommendations for this site 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 pasture area.

This treatment will also be beneficial at the Long Road bridge approach.

## Flood Threats

### Inundation

**100-year floodplain boundary in Management Unit 12**

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. 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.

According to this existing floodplain maps, there are 3 houses located within the 100-year floodplain boundary in this management. 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, but 35% (1230 ft.) of the stream length is experiencing significant erosion. The notably high percentage of stream length that has been revetted indicates a history of instability. Excess sediment load resulting from bank erosion in this unit appears to be having detrimental affects on the unit immediately downstream.

There are two Bank Erosion Monitoring sites in MU12 (BEMS 12-26669 and 12-25688). The first has been treated as part of the West Kill Demonstration Restoration Project #1. Investigation of the drainage issues causing the landslide at the second site is recommended.

**Infrastructure**

Thirty-nine percent of the stream length in this management unit has been treated with some form of revetment, in various states of disrepair. Ongoing monitoring of the revetment in this management unit is recommended.

**Aquatic Habitat**

It is recommended that a habitat study be conducted on the West Kill Creek, with particular attention paid to possible 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.

Habitat was fairly good throughout this management unit, with adequate woody debris, and just one potential temperature barrier. However several reaches appear somewhat impaired by inadequate canopy cover, low diversity of bedform and introduction of fine sediment from eroding banks.

**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 significant clay exposures identified in the 2004 Inventory, and 10 clay exposures identified in 2005. These sites should be investigated for water quality impacts.

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 two stormwater culverts in this management unit.

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.

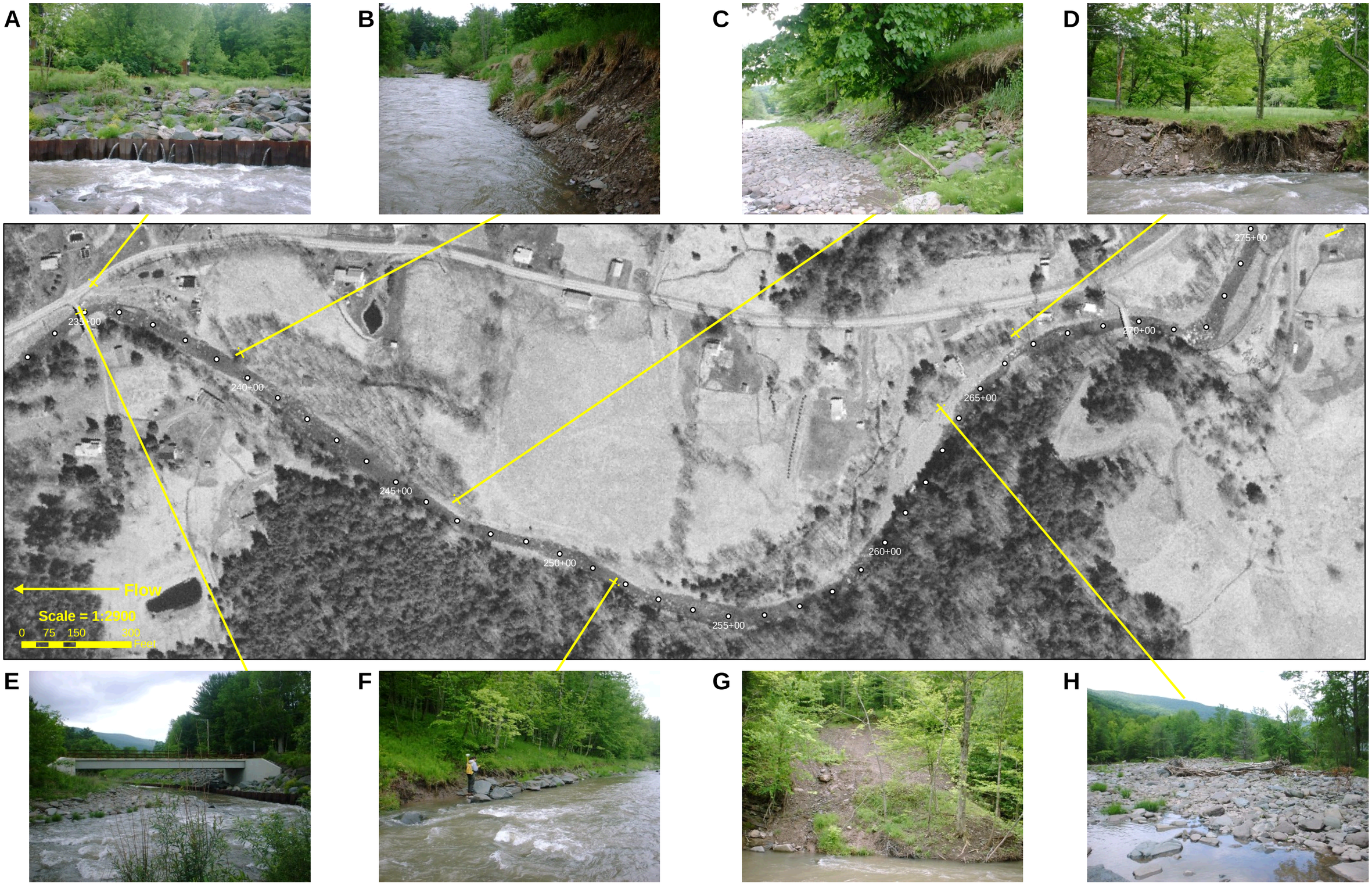



Figure 4.12.2 Management Unit 12 - 2004 aerial photography