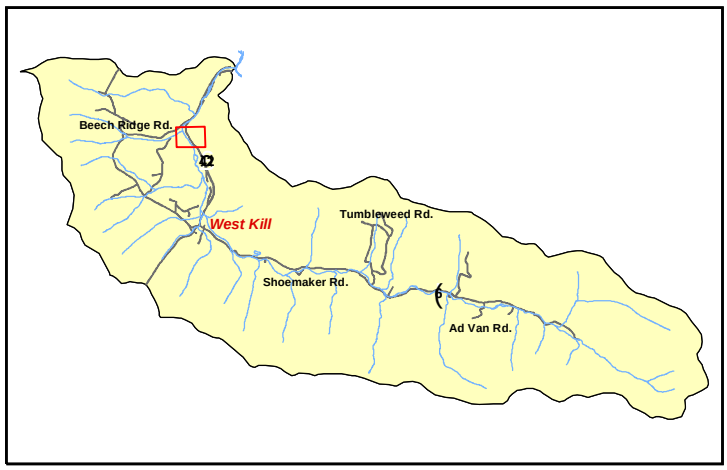


West Kill Management Unit 18

Stream Feature Statistics

7% of stream length is experiencing erosion
16% of stream length has been stabilized
3.2 acres of inadequate vegetation within the 300 ft. buffer
0 ft. of stream is within 50 ft. of the road
0 houses located within the 100-year floodplain boundary

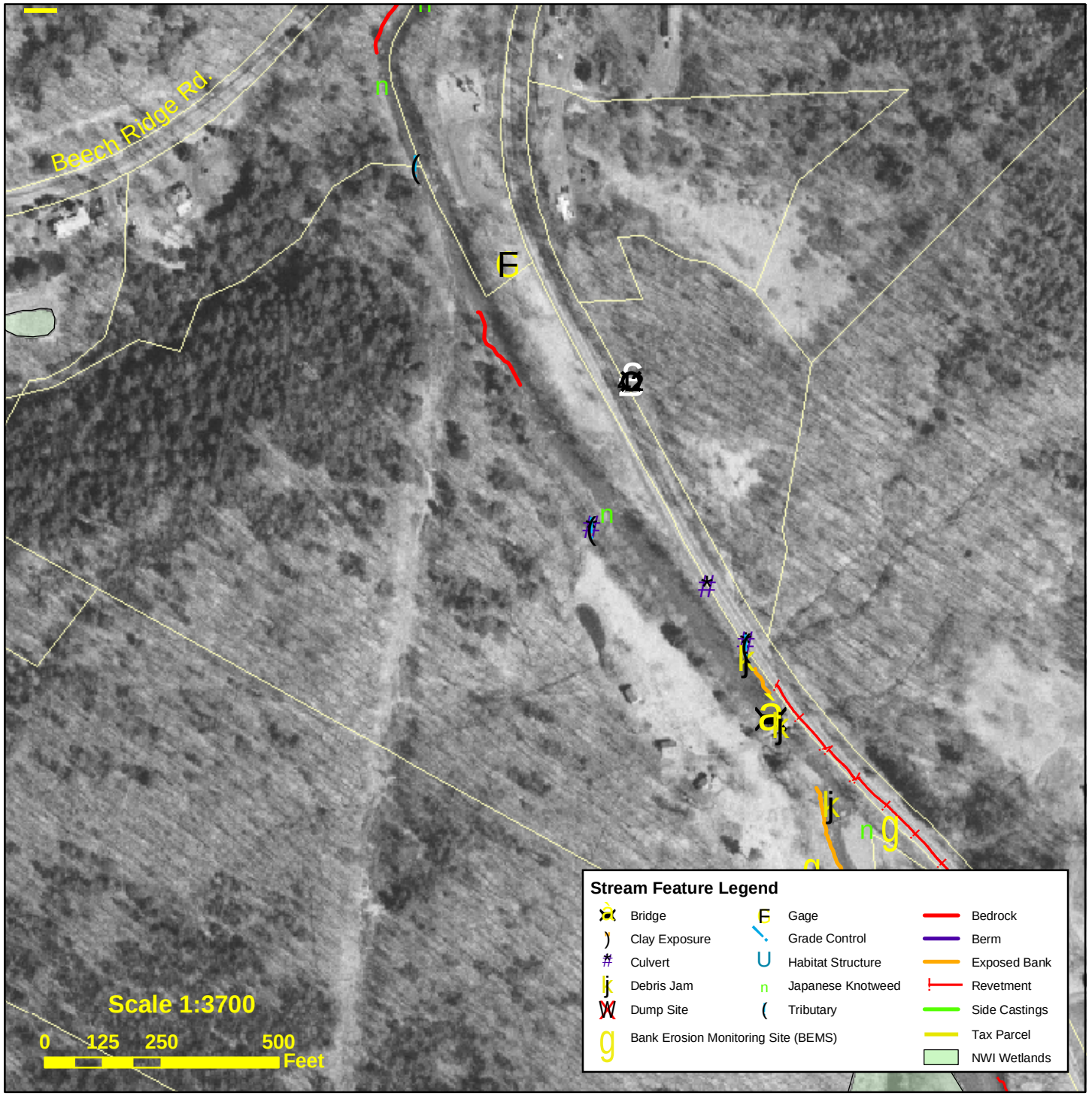


Figure 4.18.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 18

Between Station 9304 and Station 7402

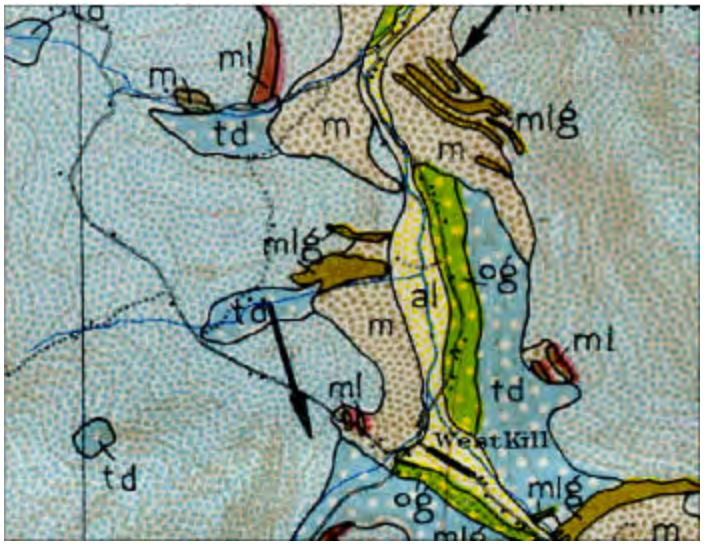
Management Unit Description

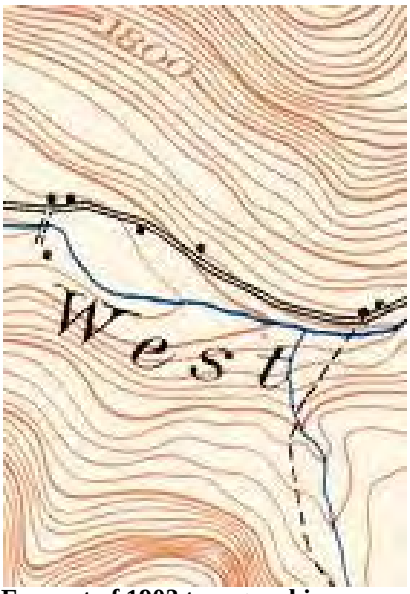
This management unit begins just upstream of the crossing at Lady's Bridge, continuing approximately 1902 ft. to the confluence of Beach Ridge Brook. The drainage area ranges from 26.9 mi^2 at the top of the management unit to 28.7 mi^2 at the bottom of the unit. The valley slope is 0.83%.

Summary of Recommendations Management Unit 18	
Intervention Level	Assisted Self-Recovery
Stream Morphology	None
Riparian Vegetation	Improve buffer along NYS Route 42. Watershed-wide knotweed eradication program.
Infrastructure	Remove debris at Lady's Bridge; Develop multi-institutional strategy for embankment stabilization and buffer improvement.
Aquatic Habitat	Watershed-wide study.
Flood Related Threats	None
Water Quality	Investigate source of fine sediment at unnamed tributary.
Further Assessment	Investigate abutment scour. Explore possibility of developing a stable channel morphology in this unit.

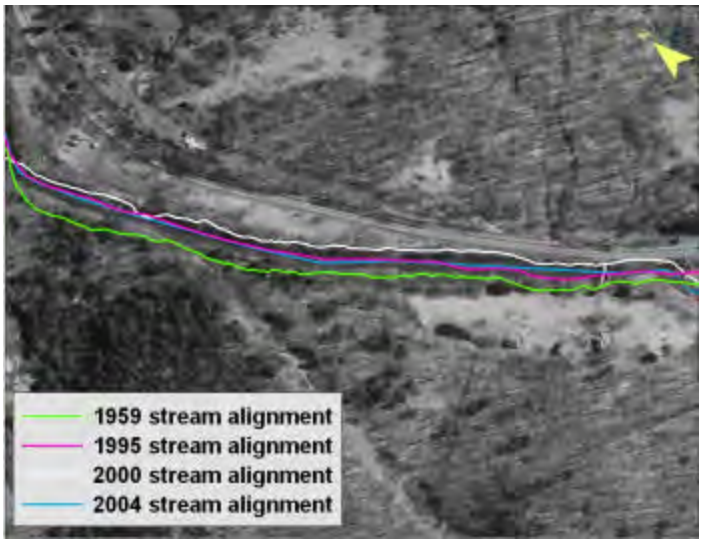
Historic Conditions

As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.2 Geology of the West Kill Creek, for a description of these deposits.





Excerpt of 1903 topographic map MU18



Historic Stream Channel Alignments in MU18

As seen from the earlier maps and aerial images of the historical stream alignments, the channel alignment has not changed significantly over the years. The minor differences between the historical alignments are more likely to be artifacts of nuances in the correlation of the photographs than evidence of actual channel migration. Channel migration in this unit is undetectable at this scale of inquiry.

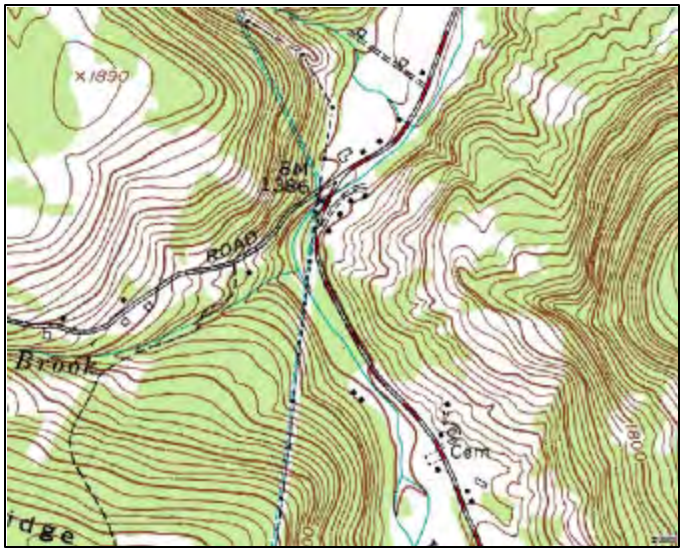
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 7% (138 ft.) of the stream exhibited signs of active erosion along 1902 ft. of total channel length (Fig. 4.18.1). Revetment has been installed on 16% (1902 ft.) of the stream. 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 4.18.2. "Left" and "right" references are oriented looking downstream. Stationing references, however, 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, USGS topographic map, West Kill quadrangle

In Management Unit 18, the valley morphology changes dramatically. At the upstream end of the unit, a pinch point in the valley provides a convenient setting for a stream crossing at Lady's Bridge. The channel is entrenched by the abutments, but also as a result of confinement between the NYS Route 42 road embankment on the right and the glacial and alluvial terrace on the left. The valley then broadens again, but the channel remains entrenched within its valley. In the upstream half of the unit, channel slope is slightly less than in MU17, but increases gradually downstream as entrenchment progressively moderates, until the channel approaches a second valley pinch point at the NYS Route 42 crossing in Management Unit 19.

Cross-section and Rosgen stream types in MU18

Stream morphology, or shape (i.e., slope, width and depth) changes once within this unit (Fig. 5), creating two 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)

Rip-rap on road embankment, right

Management Unit 18 (MU18) begins with a 1004 ft. reach of F3 stream type that extends upstream and downstream of the private stream crossing at Lady's Bridge. As the terrace wall on the left and the NYS Route 42 road embankment begin to converge, the channel becomes *entrenched*, or confined within the stream banks during high flood events. The multiple threads that predominated in MU17 also converge into a single thread.

Rip-rap on road embankment, right

The channel slope is a very flat 0.9 % and the bed material is dominated by cobble. The multiple mid-channel bars upstream converge into a single point bar, with the main channel on the left, and a small overflow backchannel on the right at the toe of the 612 ft. long rip-rapped embankment of the highway.

Debris Jam

Large woody debris —large trees with root balls— has collected on this unvegetated bar upstream of the bridge, presenting an obstruction at all flows and adding to the aggradation caused by backwatering at the bridge.

Stacked Rock

The *thalweg*, or deepest part of the channel, bends to the right around this bar, and then flows against the toe of the stacked rock revetment on the road embankment, right (Inset D, Fig. 4.18.2). This 177 ft. of revetment, which extends downstream of the bridge as well, is failing as a result of the toe scour, is in poor condition generally and in need of repair. The rock is undersized, and there is no vegetative buffer between the stream and the road here.

Debris Jam on approach to bridge

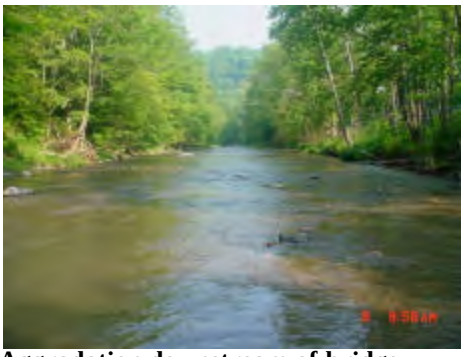
Proceeding downstream, more large woody debris has collected, creating an obstruction at all flows directly upstream of the bridge (Inset H, Fig. 4.18.2). These trees, which are likely to accumulate additional material if not removed, represent a potential hazard to the bridge. They are also contributing to significant abutment scour. Removal of this debris is recommended, and the

Lady's Bridge, looking upstream

extent of scour of the abutments should be evaluated.

Several occurrences of Japanese knotweed were observed in the vicinity of the bridge during the 2005 Inventory which were not observed in 2004.

Lady's Bridge, looking downstream



Aggradation downstream of bridge

Downstream of the bridge, the channel appears overwide, perhaps a consequence of channel grading, but apparently stable, despite some aggradation resulting in minor erosion at the base of the road embankment, right (see Insets G and C, Fig. 4.18.2).

Bank erosion, right, looking upstream

Several trees have been undermined and lay at the channel margin, producing minimal obstruction to flows but creating modest local scour at higher flows. Very little mature vegetation buffers the stream from the roadway, or stabilizes the bank. This site was not monumented as a Bank Erosion Monitoring Site.

Debris jam

Recommendations for the area upstream and downstream of the bridge would 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.

Downstream of this erosion, as the road begins to diverge from the stream, the bank angle moderates and a low floodplain begins to develop on the right. A 24" galvanized culvert on the right, perched and with only vegetative outfall protection and a dumped rip-

Culvert

rap “headwall”, carries a small tributary under NYS Route 42. The tributary flow crosses the narrow floodplain bench, and a significant amount of fine sediment has accumulated at its confluence with the West Kill. Investigation of the source of the sediment is recommended. Downstream a second culvert carries road drainage from across the highway, and is perched without outfall protection. The mowed field on the left transitions to a mature forest buffer.

Culvert

On the left, a low bench separates the channel from a dirt road. A monumented cross-section here (Station 8490) documents the F3 stream type that has predominated since the beginning of the unit. A culvert just downstream of this cross-section carries a small unnamed tributary under the dirt road. The culvert has a dry-stacked stone headwall in good condition, and the tributary confluence is well connected through a floodplain bench well-vegetated with young cherry and ironwood.

Culvert, left

Knotweed

During the 2004 inventory, two stands of Japanese knotweed were documented amongst the sedge at the mouth of this tributary. Japanese knotweed (*Fallopia japonica*) is an invasive, exotic shrub species that can grow rapidly to crowd out more beneficial streamside vegetation, were observed here on the left bank. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.

As the floodplain continues to broaden on the right bank, entrenchment moderates, marking the transition (around Station 8300) to a B3c streamtype. Channel slope increases to 1.29%, dominant channel material remains cobble, but entrenchment reduces as the channel is reconnected with its floodplain.Proceeding downstream, a bedrock outcropping on the left bank, and probably extending across the bed, provides lateral and perhaps grade control (Inset E, Fig. 4.18.2). The site may have once served as a

Bed Rock

ford crossing.

Downstream and on the right, a USGS gauging station (#01349810) has been established (Inset B, Fig. 4.18.2), providing continuous real-time stage measurements, and with a staff plate and crest stage recorder. A monumented cross-section at Station 7774 documents the B3c stream type.

USGS gauging station, right

Utility right-of-way

A power-line right-of-way crosses the channel obliquely, heading toward the step-down station in the floodplain on the right.

A major tributary, Beach Ridge Brook (1.6 mi.^{2}), confluences on the left, across a well-connected and well-vegetated floodplain. A significant amount of gravel was observed at the mouth, indicating the possibility that the tributary may have recently experienced a headcut.

Beach Ridge Brook confluence, left

Knotweed

At the end of the unit, a small, isolated stand of Japanese knotweed was observed on the left, on the debris near the tributary confluence.

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 3.2 for more details on Stream Processes).

With the exception of backwatering conditions upstream of the Lady's Bridge crossing due to the narrowing of the channel by the bridge abutments, sediment transport in MU18 appears to be relatively stable overall. This is perhaps due to the extent of sediment storage in the previous management unit, and probable grade control near the end of this unit. More entrenched conditions in the upstream reaches are apparently balanced by the

greater channel width, and the increase in slope downstream is apparently checked by the bedrock grade control and more moderate entrenchment.

Riparian Vegetation

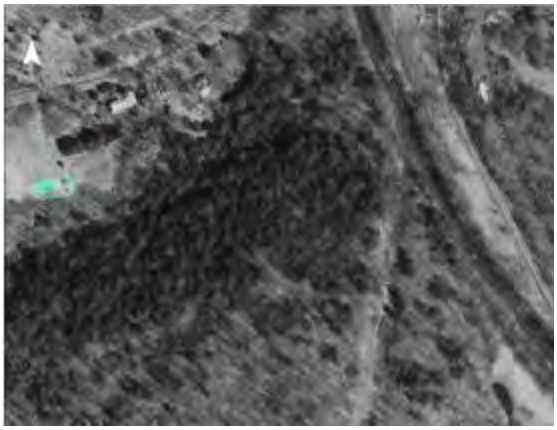
One of the most cost-effective methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the bank, especially within the first 30 to 50 ft. of the stream. A dense mat of roots under trees and shrubs bind the soil together, and makes it 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. 4.18.3). 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 (59 %) followed by Herbaceous (11 %). *Impervious* area (7%) 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 in this management unit during the 2004 stream inventory, but 11 additional occurrences were documented in 2005. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.

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



National Wetland Inventory wetlands in MU18

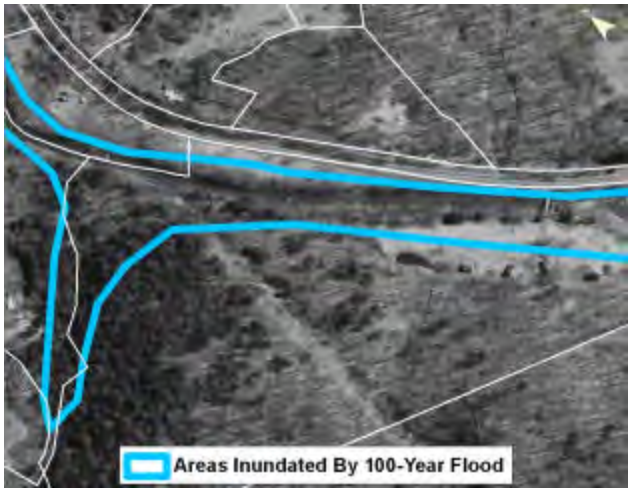
beneficial functions including protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods (See Section 2.6 for wetland type descriptions and regulations). The 0.1 acre wetland mapped in this management unit, located adjacent to a tributary of the West Kill, is designated *palustrine, unconsolidated bottom, semi-permanently flooded, diked/impounded* (PUBFh).

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.

Eight potential planting sites were documented within this management unit (Figure 4.18.4).

Recommendations for this site include planting native trees and shrubs along the edge of the stream bank and the upland area. Particular attention should be paid to the NYS Route 42 road embankment. 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-year floodplain boundary in Management Unit 18

Inundation

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 no 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 7% (138 ft.) of the stream is experiencing minor erosion. There are no Bank Erosion Monitoring sites in MU18.

Infrastructure

Sixteen percent of the stream length in this management unit has been treated with some form of revetment, primarily along the NYS Route 42 road embankment. Much of this revetment is inadequately sized, and/or is being undermined by toe scour. Recommendations for the unit call for a cooperative, multi-institutional effort including NYCDEP, GCSWCD, NYSDEC and NYS Department of Transportation, to evaluate the status of the revetment in the unit and develop an integrated strategy to improve both revetment stability and the functionality of the vegetative buffer.

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. However the reaches upstream and downstream of the bridge have inadequate canopy cover. Improvement of the vegetative buffer here could mitigate this problem.

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 or 2005 stream inventories.

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 three stormwater culverts in this management unit, one of which appears to contribute significant amount of silts and sands. Investigation of the source of this sediment is recommended.

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.

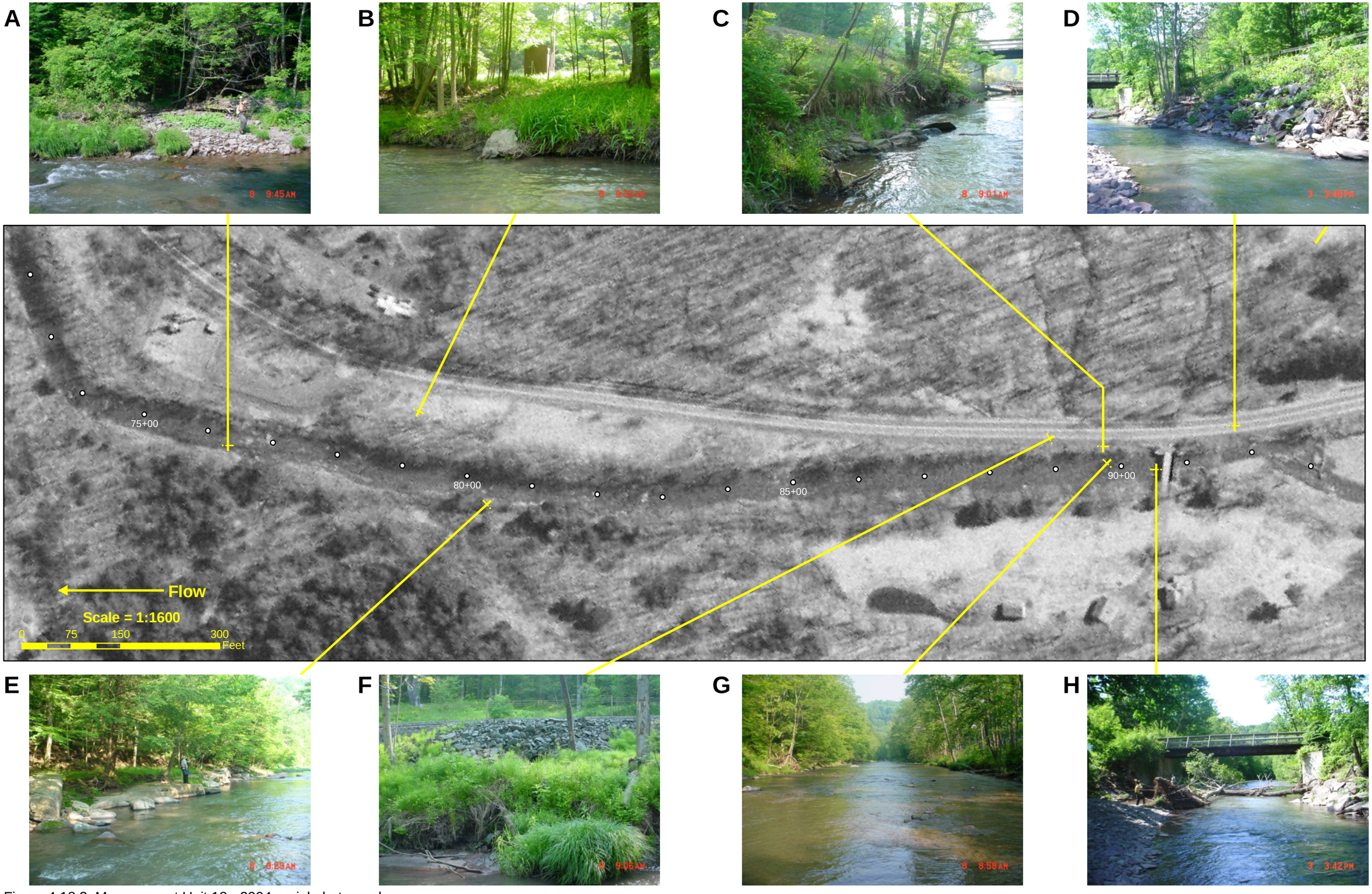


Figure 4.18.2 Management Unit 18 - 2004 aerial photography