Section 7 – West Branch of the Delaware River Stream Segments and Management Units

January 10, 2005

7. West Branch of the Delaware River Stream Segments and Management Units

7.1 Introduction

This section of the plan presents the observations of the condition of the West Branch of the Delaware River made during the walkover assessment that was conducted in the summers of 2002-2004. During the assessment, teams walked the entire length of the main stem from Lake Utsayantha to the Cannonsville Reservoir inventorying and mapping stream features, man-made structures, and conditions influencing the stream's function. The purpose of this assessment was to inventory and characterize the condition of the river, identify and describe problem areas, and where possible, provide an indication of the source(s) of the problem(s). This assessment is the Stream Corridor Management Program's first look at the river as a whole. The best use of the assessment is to document where the problems are located and the extent of the problem. Other surveys employed after the walkover assessment have been analyzed and were used to clearly identify a stream's departure from the *stable* condition and capture the information needed for designing a solution.

The following is a list of conditions that were measured or estimated:

- Eroding bank lengths and heights
- *Cross-section* dimensions including *bankfull* elevation, *bankfull width*, *bankfull depth*, and floodprone zone width and depth
- Bed material size distribution at cross-sections
- Bed and bankfull slope through cross-sections

The following is a list of some of the features that were mapped:

- Stream alignment including the start of *pools* and *riffles*
- Eroding banks
- Eroding beds (or *head-cuts*)
- Depositional bars – point, side, transverse (or diagonal), center bars
- Debris or log jams
- *Culvert* outfalls
- *Revetment* types – *berm*s, walls, riprap, dumped stone, log cribbing
- Cross-section locations
- Grade control features – including bedrock outcrops and dams
- *Japanese knotweed* colony locations
- Bridges and their abutments
- *Clay exposures* in the banks
- Spring seeps
- Tributaries

These features were mapped with a handheld *Global Positioning System (GPS)* unit with a 3-5 meter accuracy and in addition to GPS database entries, notes where written on 1:100 scale copies of the 2000 Emerge digital orthophotographs for the Cannonsville

basin. Photographs were taken of significant features including eroding banks, bars, bridges, etc. The information from this assessment was compiled within a series of Arcview *Geographic Information Systems (GIS)* software shapefiles, which will be maintained by Delaware County Soil and Water Conservation District (DCSWCD) and New York City Department of Environmental Protection (NYCDEP). Inquiries as to the content or availability of this information can be directed to the DCSWCD Project Coordinator or NYCDEP Project Manager.

Characterization of the river is broken into two levels of specificity; a more general description of a larger area or "**segment**" description and a more detailed description of a smaller reach or "**management unit**" description. There are several management units within each segment. Segment descriptions are divided by municipal boundaries. This delineation enables readers to consider the condition and relevant issues regarding the river within the context of local decision making and local history. To some extent, the river within the five different segments may have a character that is physically unique to that town. For example the river through Segment 1, Village of Stamford, is a steeper, narrower, headwaters stream that is physically different than the river in Segment 2, Town of Stamford and Kortright, where the river transitions to a mid-valley stream with its broader *floodplains* and lower slope. But, for the most part, the segment division is made for purposes of reporting to individual communities. A map showing stream type, management unit limits, cross-section locations and bank pin locations within a segment is provided at the beginning of each segment description.

The management unit boundaries are much more specific to stream characteristics that change or evolve from one unit to the next. As rivers are complex systems, the use of a management unit description which focuses more on the stream "*reach*" scale, is an attempt to describe the processes occurring within smaller part of the stream. The problems within a management unit may be related and therefore might be addressed by a common action or set of actions. For example, a sequence of three failing banks within a management unit might be addressed through a restoration project and a concerted *riparian* buffer enhancement effort. The solution will require knowledge of system-wide processes, but the application of a solution will be made for a specific reach of the river.

A set of sample maps for a representative management unit is provided for each segment. Hardcopy of the management units maps are available upon request for the entire mainstem from the Soil and Water District office. Due to the size of the *watershed* and the number of maps required for the entire watershed, a complete set is not included in the hardcopy version of the plan. Digital versions contain copies of all the management unit maps and can be obtained from the Soil and Water District office.

In the management unit descriptions any description of process where a situation exists is to call attention to the obvious relationship. For example, you might read that a center bar is directing flow toward an eroding stream bank and that it is suggested that the center bar may have formed because the stream is too wide. From a walkover assessment we cannot state what caused the over-wide condition or without a series of cross-section surveys that the reach is actually over-wide. We can only identify that there are bars and

eroding banks present as indicators of an *unstable* condition. Therefore, this plan recommends that an additional survey should be conducted before attempting certain remedial actions. Taking action without understanding the cause and effect is a recipe for more problems when working with rivers and streams.

Having made a warning about taking action, it is important to differentiate that some action will improve conditions with little potential for negative impact. Riparian forest buffers play an important role in protecting stream banks and improving water quality. Efforts to expand the size of the riparian forest buffer will not only help the individual landowner, but also the entire river system. It is important to give the river room to move and adjust and a buffer provides that room while knitting together the stream bank.

In this description, the river in a management unit will be rated as to its *stability*. A management unit may be rated as: unstable, moderately stable, moderately stable with unstable reaches, or stable. At this stage, this description is largely based upon the extent of the eroding banks and other indicators of *instability*. The actual level of instability can only be determined with additional survey. The Stream Corridor Management Program will continue to refine this assessment to enable further definition of priorities for remedial action. For other terms and concepts used within these descriptions, see **Section 5.9.**, Introduction to Stream Processes.

Segment 1

Segment 1 - Map 1
Stream Types and Management Unit Locations

XS 1.00
XS 2.00
XS 3.00
XS 4.00
XS 5.00
XS 5.80
XS 6.00
XS 7.00
XS 8.00
XS 7.90
BP 8.90

Unit 1
Unit 2
Unit 3
Unit 4

Legend

Stream Type

B
B3
Bc
B3c
B4c
C
C3
C4
C6c-
D
DA
F

Contours

Minor
Major

Cannonsville Basin Boundary
Management Unit Line
XS 4.00 — Cross Section
BP 8.90 — Bank Pin

Segment 1 Consists of Management Units 1 - 4

Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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7.2 Segment 1 - Village of Stamford

General Description of Segment One

This description of stream segment one covers the section of river from the outlet of Lake Utsayantha above the Village of Stamford to a point below the wastewater treatment plant downstream from the village (see **Segment 1 – Map 1**). The watershed area at the top of this segment is approximately 4.9 square miles and is approximately 13.4 square miles at the bottom of the segment with a total surveyed segment length of 12,057 feet. This segment represents the headwaters for the West Branch of the Delaware River and as such, the stream is narrow, relatively stable and with good feature characteristics. The stream channel dimensions such as its width and depth are generally within expected dimensions, pool and riffle lengths are consistent, and although there are areas with some problems, there is no evidence of significant or systemic *erosion* of the stream banks or stream bed within this segment. Historically, the channel and floodplains have been significantly modified through the Village of Stamford to allow for development, provide stormwater drainage, and protect the banks from the resulting stress that accompanies channelized conditions. The riparian vegetation is very good above the village near the lake, somewhat lacking through the village and then improves as the stream is allowed to reestablish its floodplain below the village. Several residences upstream from the central commercial district along River Street are located within the historic floodplain for the stream and as such are subject to frequent basement flooding and water approaching the first floor elevation.

This segment is composed of Management Units 1 through 4. The table below summarizes the erosion and depositional features that are within this segment by management unit.

Table 7.2.1 – Summary of Erosion and Depositional Features

Management unit	Length (mi)	Linear Feet of Erosion	Surface Area (sq.ft.)	# Erosion Features	# Deposition Features	LF Erosion per Mile	# Erosion Features/mi	# Deposition Features/mi
1	0.57	52	26	1	1	91.23	1.75	1.75
2	0.70	255	951	6	4	364.29	8.57	5.71
3	0.59	87	193	2	3	147.46	3.39	5.08
4	0.37	140	729	2	0	378.38	5.41	0.00

Geomorphology and Geology:

Lake Utsayantha and this headwater segment of the West Branch of the Delaware lie atop and cut through outwash *sands* and *gravels* deposited during the Wisconsin glacial retreat over 10 thousand years ago. The lake, controlled by a low dam, collects water from

surrounding Bald Mountain, Woodchuck Hill and Mount Jefferson, and may be the remnants of a glacial kettle lake. The outwash sands and gravels layers with a thickness of 6-60 feet which form the bottom of the valley are bounded in places by deposits of larger gravel dumped as "kames" or *terraces* along the valley wall. Under the Rosgen classification, the valley along this segment most closely resembles valley type VIII with its wide gentle sloping valley with terraces at the margins of the floodplain. The valley width varies between 2 and 4 hundred feet. As expected for a headwater location, the valley slope, which varies between 2.2 and 1.3 percent through this segment, is the steepest for the entire length of the river. Stream channel slope varied between 2.0 and 1.1 percent and the stream *sinuosity* was about 1.1. Sinuosity is very high (1.4) through one section of Management Unit 3 where channel flattens out after passing through the village. There are several locations above the village where red shale bedrock controls either the bed and/or a bank of the stream.

The river through this segment is predominantly B stream types above the village, C stream types below the village, F channels within the village with a short section of D stream found below the village. Typically only the F channels would present a major management issue, but since these are constructed channels largely lined with *rip rap* or concrete, their stability is not an issue at this time. These revetted sections of stream through the village will continue to require maintenance and may become a problem on private land. A site behind the Great American grocery store in Stamford was, in particular, noted as a site that may cause problems. Of the three cross-sections located within this segment, at one cross-section the stream is over wide and appears to be *aggrading* (cross-section 2), another cross-section is *entrenched* and may be *degrading* (cross-section 7.9), and the third cross-section (cross-section 8) appears stable.

Stream Orders, Floodplains, and Wetlands:

The river below Lake Utsayantha is a third order stream until it receives waters from Lake Rexmere. Lake Utsayantha and other upland ponds above the lake provide a limited degree of regulation for the flows received from the surrounding hills. Fringed by emergent and forested *wetlands*, Lake Utsayantha also supports wildlife habitat and acts to improve the quality of the waters before they are *discharged* over the low dam at the south end of the lake. Below the dam, the river flows through a C channel with a well forested floodplain to the remnants of an old mill pond which also supports a wetland community. Once beyond the mill pond, the stream has been channelized and bermed to control erosion and flooding through the residential neighborhoods and the commercial district of Stamford. In response to repeat flooding along River Street and through Main Street, the U.S. Army Corps of Engineers conducted a reconnaissance flood control study in 1996, which suggested that additional channelization and bridge replacement would be an alternative solution to the flooding worthy of additional study. Below South Street, the river flows through a small wetland that receives water from an unnamed *tributary* with its source above Lake Rexmere. Continuing downstream from Stamford, *runoff* is buffered through riverine wetlands and well vegetated floodplains. Below the South Street, the stream is able to access the floodplain in most locations except where recent development in the floodplain has occurred such as at the wastewater treatment facility.

Protection of the integrity of these vegetated floodplains and wetlands are essential to the maintenance of water quality and stream stability in this section of the river. Conversion of the wetland or floodplains to impervious surface or channelization of the stream to enable development will greatly impact rates of runoff, stream bank erosion and water quality *degradation*.

Land Use/Land Cover:

Above the Village of Stamford, the dominant land use is a mix of forested land with abandoned agricultural land. Once within the limits of the village, residential and commercial land uses associated with impervious and semi-impervious surfaces are the primary land cover. A light industrial and commercial district is found downstream from where the river crosses NYS Route 23, but runoff from these businesses is currently buffered by a vegetated zone before it reaches the stream.

The Village of Stamford historically has supported a tourist industry attracting downstate residents to moderate sized hotels in this Catskill community. Despite the demise of the hotel industry, the economy of Stamford continues to support a stable population and investment in small businesses, light industry and tourism based businesses. Growth in the area has occurred largely east and north of the village along NYS Route 23 and 10, away from the river. While the stream and adjoining lands are not currently threatened by development, protection of the riparian buffer, even in urban areas should be a priority as land use planning options are considered.

Below the village limits, the stream passes through a mix of residential areas gradually changing to agricultural areas as the principle land use. In the past century, the amount of land under agriculture has declined with areas at higher elevations abandoned first and more recently, areas within the central valley converted to residential development or reverting to forest through old field as known as forest succession. In the reaches below the Village of Stamford, development along the stream corridor in this segment has not reached the critical point where floodplain encroachment would begin to dramatically affect stream stability. The maintenance of a continuous riparian buffer of adequate belt width to allow for stream alignment adjustments should be a major objective of landowners and those reviewing plans for development in this area. This buffer would help reduce nitrogen and phosphorus pollution from overland sources including agriculture.

Infrastructure:

At the intersection of NYS Route 10 and 23, the Village of Stamford has numerous smaller stream crossings over the West Branch headwaters including 1 county, 4 towns, 1 state, and 5 privately owned bridges (including 1 railroad bridge). All of these crossings are small and typically allow flood elevations to rise about 5 feet before the structure is overtopped. While there was no significant evidence of bank erosion at any of these bridges, gravel bars were associated with three of the bridges, including the Route 23 Bridge. While the presence of gravel bars can indicate a *sediment* transport constraint, at

the time of assessment the condition of the bars did not suggest that there was a problem worthy of corrective action.

Within this segment few if any of the roads critically impair the ability of the river to access its floodplain. No major highways parallel the stream within the historic floodplain. Only River Road in the village parallels the stream, but the road's influence on the floodplain is minimal as it is constructed at grade with the floodplain and therefore allows for the unrestricted access of high flows to the floodplain.

The Delaware and Ulster Rail Trail crosses the river in Stamford below South Street and upstream from Railroad Ave. This bridge and its approach bisect the floodplain through this reach and limit the stream to a 10.5 ft. wide bridge opening. The stream maybe slightly entrenched through this reach with a short length of eroding bank downstream from the bridge. While the bridge may contribute to the entrenched condition and erosion, the impact is minor and only requires occasional visual *monitoring*.

Sediment Transport and Channel Evolution:

Knowing where a stream lacks the ability to move its sediment is a key indicator of where problems with stream could be expected. If a stream fails to move its sediment, central and transverse gravel bars form and stress grows on the banks resulting in accelerated erosion and bank failure. A process of channel evolution can begin which will require years before the stream is able to return to its stable form. In the Stamford segment of the West Branch of the Delaware, the presence of gravel bars is limited to areas where the stream's capacity to transport its sediment has been altered by bridges and channelization. Transverse bars are the most prevalent of the four bars found in this segment, only one is associated with notable bank erosion. Overall, the sediment appears to be moved adequately by the stream though this segment.

Comparison of stream alignments mapped from a time series of aerial photographs including photographs from 1963, 1971, and 1987 show little change in the stream's current course except where it has been most likely altered by development.

Although the stream management program is sampling *bedload* at point bars on the West Branch Delaware River as part of this planning process, no samples were taken within this stream segment as visual inspection of conditions did not indicate the presence of a sediment transport problem.

Aquatic Habitat Conditions:

In general, the condition of the *aquatic habitats* in this segment were good, with areas of concern found in the urban areas of Stamford which is channelized and may be impaired by inputs of warm water, fine sediment and pollutants associated with runoff from roads and other impervious surfaces in the village. The forested area below Lake Utsayantha provided inputs of woody debris and low overhanging branches for cover, with some of the pool depths adequate to provide refuge for the warmer months. The wetland below

South Street with its deep and narrow channel provide good habitat with plenty of vegetative cover. Just above Railroad Ave, a long deep pool provided excellent habitat for summer refuge, but a series of man made waterfalls above the road culvert could limit fish passage. Protection of the riparian vegetation, especially the avoidance of mowing lawns down to the edge of the stream will help improve the habitat, as well as protect the banks from the erosive force of flood waters.

Water Quality Concerns:

The principle concern for water quality within this segment is stormwater runoff from streets and parking areas in the Village of Stamford. An increase in impervious ground cover can cause an increase in stormwater runoff that contains more contaminants. Without a sufficient riparian buffer zone in place these contaminants are dumped directly into the main stem increasing the risk of *nutrient* overload and/or pollution into the water system.

History of Stream Management:

The construction of a dam in at the mouth of Lake Utsayantha increased the size and provided additional depth to the lake. The dam found above River Street appears to be the remains of a mill. The construction of residences along River Street in the village also probably resulted in a degree of channel modification to protect the homes from flooding. This effort is supported in the Army Corps study of 1996; however the project would only improve flood protection for events with greater than a 4 percent probability of occurrence in any given year (less than the 25 year storm)[1]. Besides the urban channelized reach, there has been little attempt to create berms along the channel to prevent flooding and the use of revetments, such as rock walls and gabion baskets are limited outside the Village of Stamford. **Table 7.2.2** summarizes the quantity of revetments and repairs that have been established within each management unit in this segment.

Table 7.2.2 – Revetment and Repair

Management Units	Length (mi)	Dumped Stone	Rip Rap	Laid-up Stone	Stacked Rock Wall	Gabions	Log Cribwall	Concrete	Sheet Piling	Other	Log Deflectors	Total Revetment Length (ft)	Revetment Length per mile	Berms	Berm Length (ft)
1	0.57	-	-	2	-	-	-	-	-	-	-	58	102	1	146
2	0.70	1	13	10	-	3	-	4	-	1	-	2663	3804	4	385
3	0.59	-	3	2	-	-	-	-	-	-	-	107	181	-	-
4	0.37	5	5	2	-	-	-	1	-	-	-	1485	4014	-	-

Special Concerns:

[1] U.S. Army Corps of Engineers, September 1996, West Branch Delaware River – Flood Control Study (Section 205), Final Reconnaissance Report, Philadelphia District, Philadelphia, Pennsylvania, 19107-3390. 56pgs.

In addition to the repeat flood damages experienced by home owners along River Street, there has been repeated concern with local flooding in a manufactured home park on a tributary below Lake Rexmere. Spillage over the dam at the lake passes through the park as it is conveyed through a system of culverts and ditches to the West Branch below Horner Street. The damages include the loss of access resulting from damages to driveways and parking areas and minor damages to homes and landscaping. Current stormwater management programs of Catskill Watershed Corporation may be a source of funding for addressing such problems.

7.2.1 Management Unit 1

Management Unit 1 is in good condition with a well forested floodplain and wetland areas protecting the stream's stability. The reach is relatively undeveloped, or has returned to a largely undisturbed condition. There are a few low stream banks with evidence of minor erosion and a short section of undercut bank. There are a few short sections that appear slightly over wide, with one small central bar. Cross-Section 2 is located in the middle of the reach and has a width/depth ratio of 27 compared with an upper limit for a C stream type of 24 (see **Figure 7.2.1**). This management unit is rated stable and contains monitored cross-sections 1, 2, and 3.

Figure 7.2.1 Typical scene in Management Unit 1 looking downstream located approximately 1,320 feet from Lake Utsayantha.

There is one small private bridge and an old dam at the bottom of the reach. The Lake Utsayantha dam, a bedrock outcrop just above the mill dam and the old mill dam provide grade controls through this reach (see **Figure 7.2.2**).

Figure 7.2.2 Remains of the old mill dam located approximately 375 feet upstream from River Street stone arch bridge.

The vegetation density, species diversity and width of the riparian buffer is excellent, and could provide a reference of an indigenous riparian forest community. The landowners should ensure that conditions on this reach are conserved as it provides an example of a healthy headwater stream. Above the reach, a Japanese knotweed colony has become established on the shore of Lake Utsayantha. This colony could be a

source of material for invasive colonies downstream and should be controlled.
There are three areas of wetlands and they are all classified as shrub swamp. The first area of wetland is located approximately 200 feet downstream of Lake Utsayantha, the second area is located approximately 300 feet upstream from River Street Bridge, and the third area is located approximately 670 feet upstream from River Street Bridge.

7.2.2 Management Unit 2

Management Unit 2 is rated moderately stable and contains monitored cross-section 4. Management Unit 2 is largely influenced by the development that has occurred in the Village of Stamford. Below the old mill dam, the river loses much of its floodplain and becomes a B stream as it passes under the first of two bridges on River Street. There rip rap and a berm have been constructed to control and confine the stream as it enters the residential neighborhood along the street. The first bridge shows evidence of deposition at its entrance suggesting that there may be a backwater effect at the mouth of the box culvert (see **Figure 7.2.3**). A constriction at this point in the channel enables flow during flood events to jump the *right bank* and run down River Street through the residential neighborhood.

Figure 7.2.3 Deposition at the upstream end of the box culvert located on River Street.

Figure 7.2.4 Looking downstream at NYS Route 23 Bridge.

Other private driveway bridges/culverts allow driveways to cross the channel through this reach before the channel becomes revetted for the last 300 ft before crossing under NYS Route 23 (**Figure 7.2.4**). The landowners living along this section of the river have been plagued with flooding, but the river's low slope and the intensity of land use through this 1700 foot reach provide few options for alleviating this condition. Reestablishment of a limited floodplain (converting the channel from an F to an entrenched E channel) may provide some relief, but would require that landowners along the stream be willing to move their activities away from the channel.

Below Route 23, the stream is channelized. It is tightly squeezed between buildings, first with formed concrete walls, and then rip rap and laid-up stone. Some of the stone walls are aging and may soon need repair. The culvert at South Street is in fair condition. The management unit ends below South Street as the stream enters a wetland and changes from an F channel to a multiple thread D stream type. There are no wetlands located within this unit.

7.2.3 Management Unit 3

Management Unit 3 is rated stable with monitored cross-sections 5, 5.8, and 6. In Management Unit 3, the stream flows through a wetland and through a forested section at the railroad crossing before entering another wetland above Railroad Avenue. The first wetland receives water not only from upstream, but also runoff from surrounding parking areas. Its function and conservation is likely to be very important to water quality along this reach. This multiple thread channel is a well vegetated D channel, before transitioning to a C4 with fairly deep pools and later a B stream type. The riparian vegetation is healthy throughout with a dense grass and shrub community dominating the wetland before transitioning to a forested riparian community in the C and B sections of the stream.

Figure 7.2.5 Typical C stream type located approximately 450 feet upstream from Rail Trail

Figure 7.2.6 Lawn maintained to edge of water located approximately 350 feet upstream from Railroad Avenue culvert.

After passing under the rail trail bridge, the stream returns to a C stream type although the flat slope of the stream is maintained by a small dam at the end of a long pool just upstream from the culvert on Railroad Avenue. In this reach, the riparian buffer on the right bank is weakened by the maintenance of a lawn up to the edge of the water (see **Figure 7.2.6**). Integration of shrubs and a few trees would increase bank stability and help ensure that the river does not circumvent the check dam above the Railroad Avenue culvert.

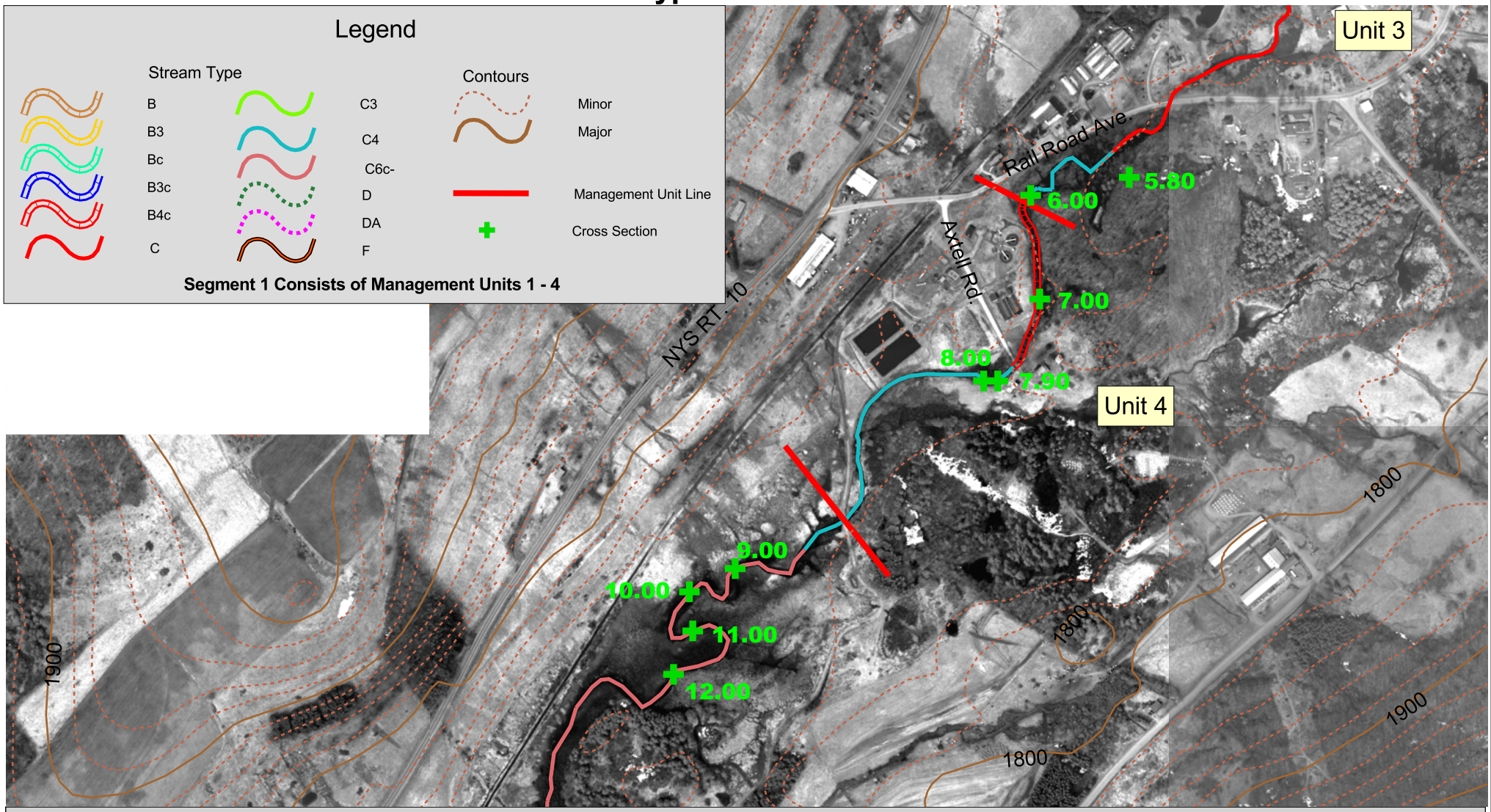
Below Railroad Avenue the river enters a forested wetland, which has a debris jam that splits and reroutes flow through the wetland. This area is not impacted by local development and the strong riparian vegetation community maintains the stream bank stability at the margin of the wetland. Removal of the debris jam is not needed at this time. The wetland and the riparian forest community warrant protection from future potential development.

7.2.4 Management Unit 4

Management Unit 4 is rated moderately stable with unstable reaches and contains monitored cross-sections 7, 7.9 and 8. See **Management Unit 4 - Map 1** through **Map 6** at the end of this unit description. Below the wetland, the river enters a long sweeping bend around the village waste water treatment plant. To protect this facility, the right bank has been armored with dumped stone and rip rap. Also, the stream may have been realigned sometime between 1971 and 1983. This realignment may have been related to a previous aerator/settling tank upgrade to the treatment plant. The entire reach along the treatment plant shows evidence of instability with the frequent use of rip rap indicating the repeated need to strengthen the banks. Even the two residential properties at the end of Axtell Rd have had to rip rap their stream banks. Additional vegetation at key points along the stream bank would help improve the riparian buffer and reduce the need for rip rap maintenance. The stream type below the wetland changes from C4 to B4 and then back to a C4 at the bottom of the reach near the treatment plant outlet. The change is due to the rip rap placement which confines the stream and minimizes its access to a floodplain.

Figure 7.2.7 Typical scene in Management Unit 4 looking downstream located approximately 160 feet upstream from Axtell Road.

Management Unit 4 - Map 1
Stream Types and Cross Sections



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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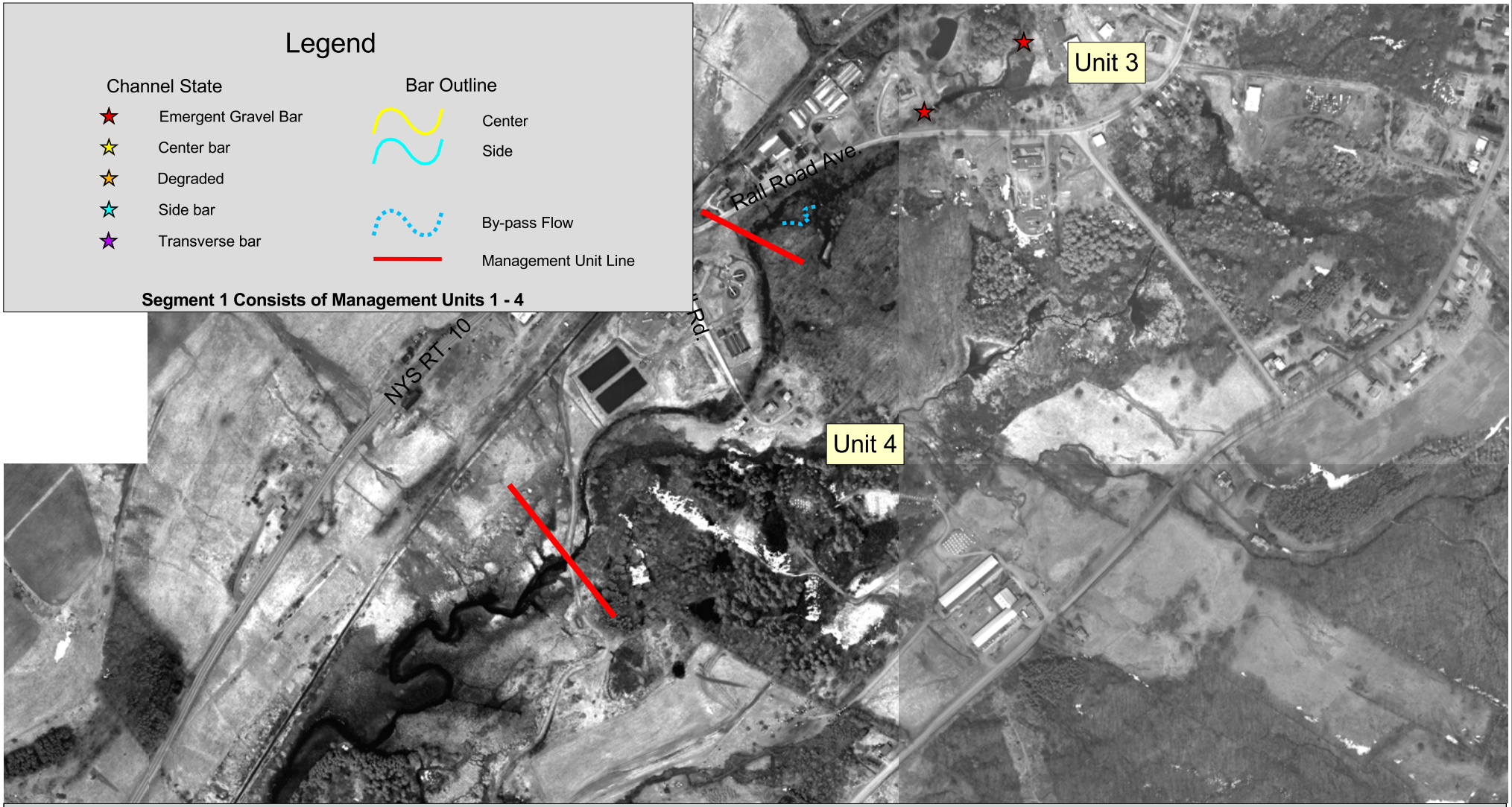
Management Unit 4 - Map 2
Channel State and By-Pass Flow



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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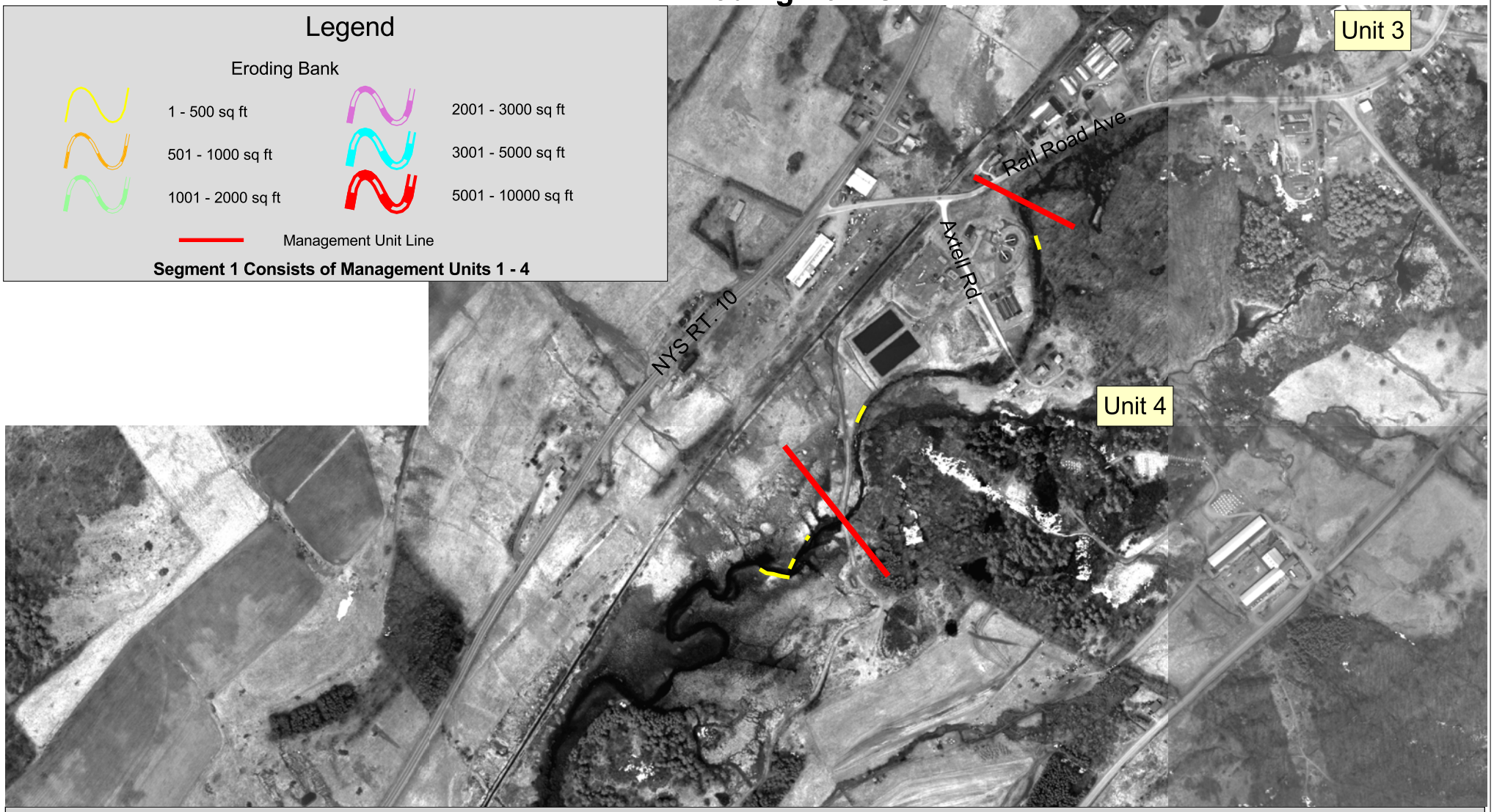
Management Unit 4 - Map 3
Eroding Banks



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
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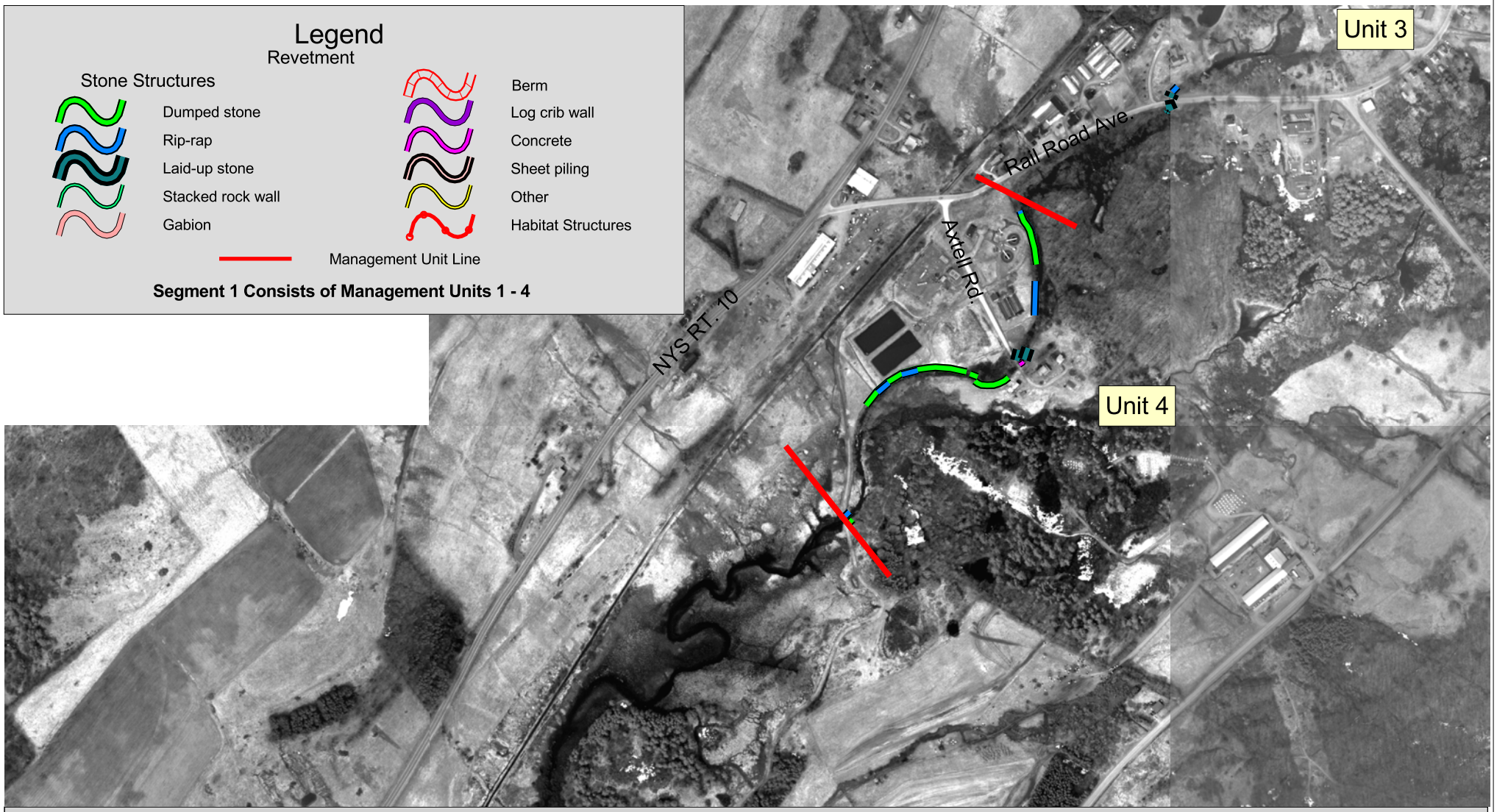
Management Unit 4 - Map 4
Revetment



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W E
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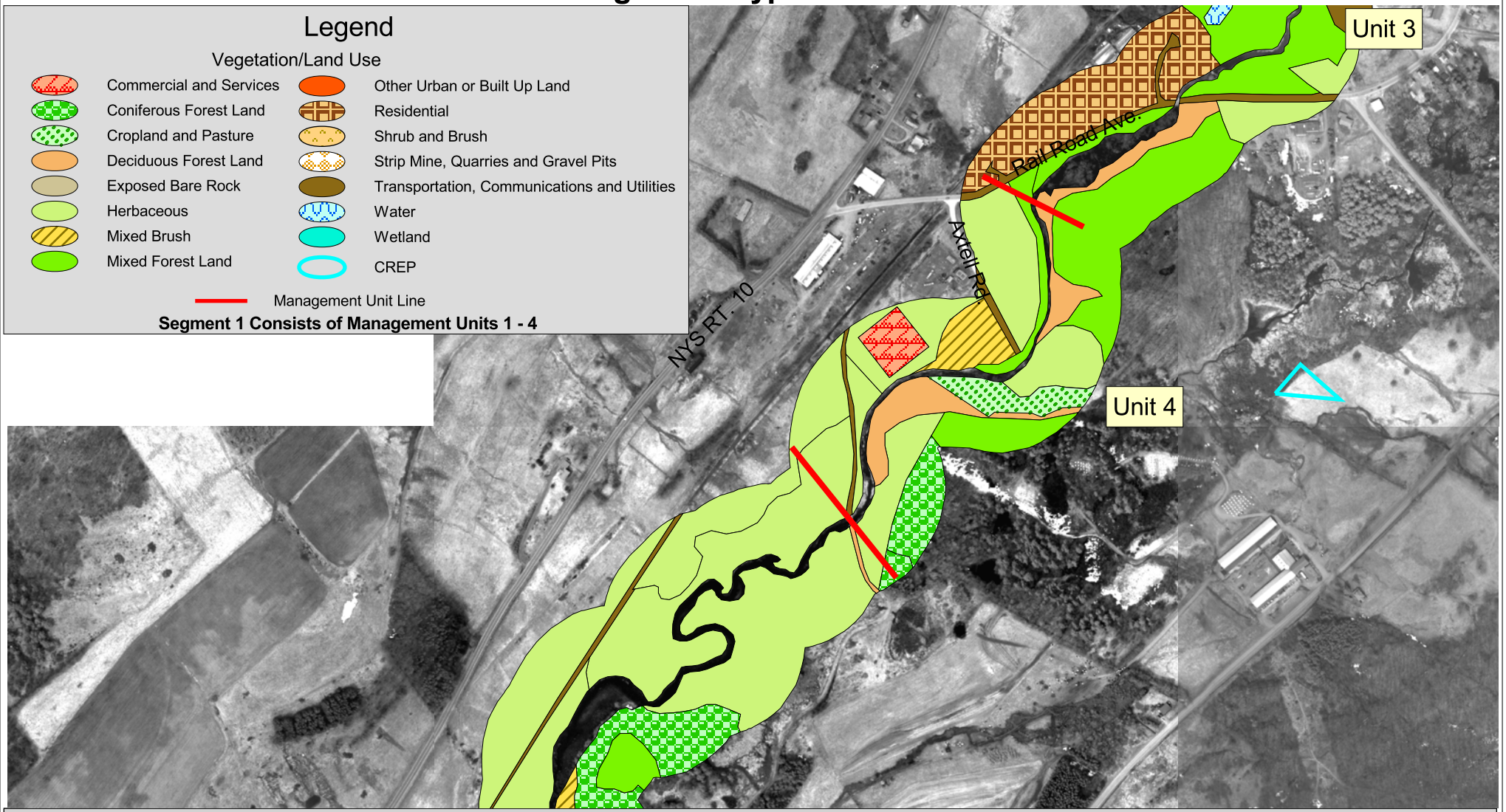
Management Unit 4 - Map 5
VegetationTypes/Land Use



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
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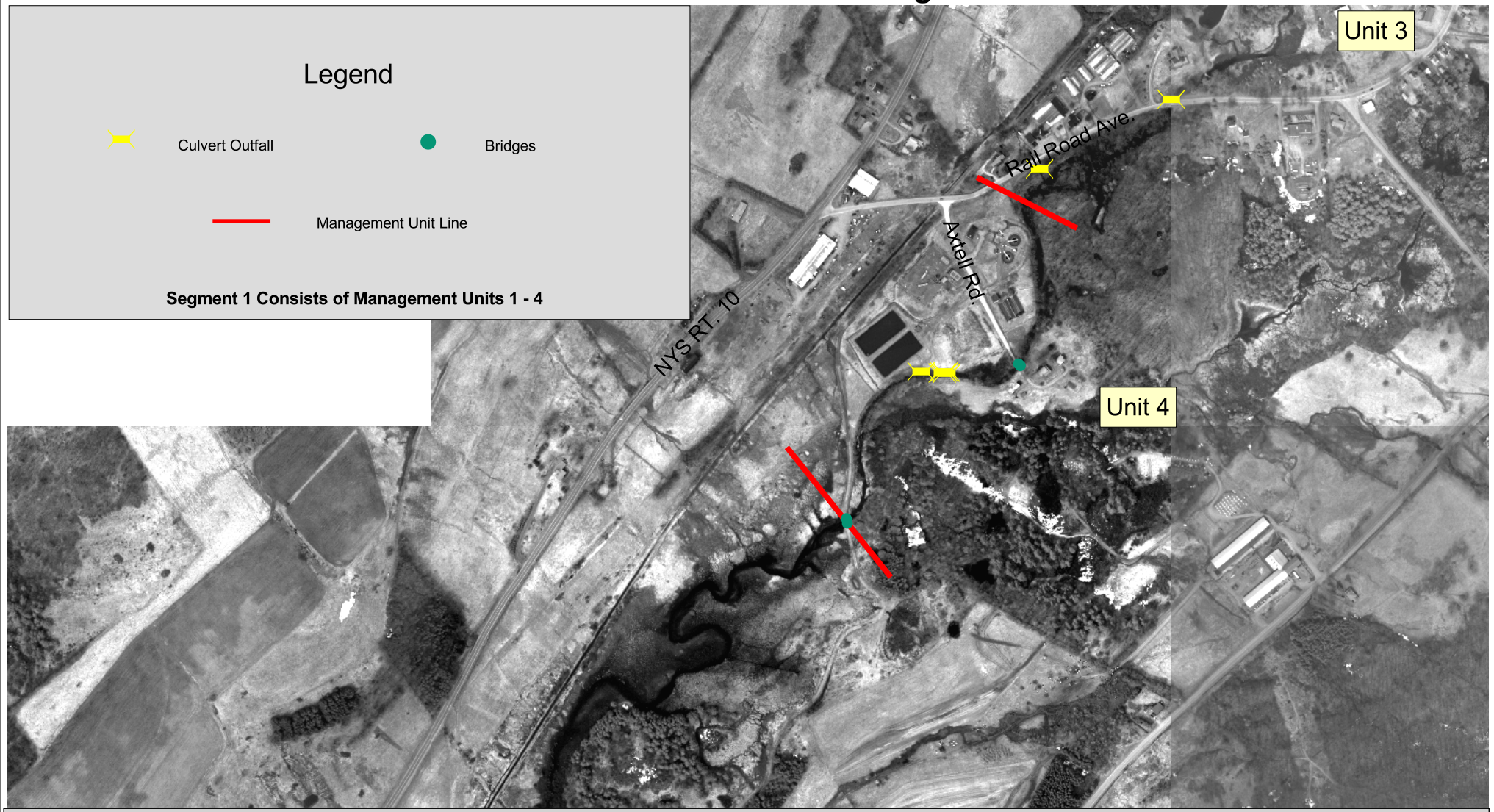
Management Unit 4 - Map 6
Culvert Outfalls and Bridges



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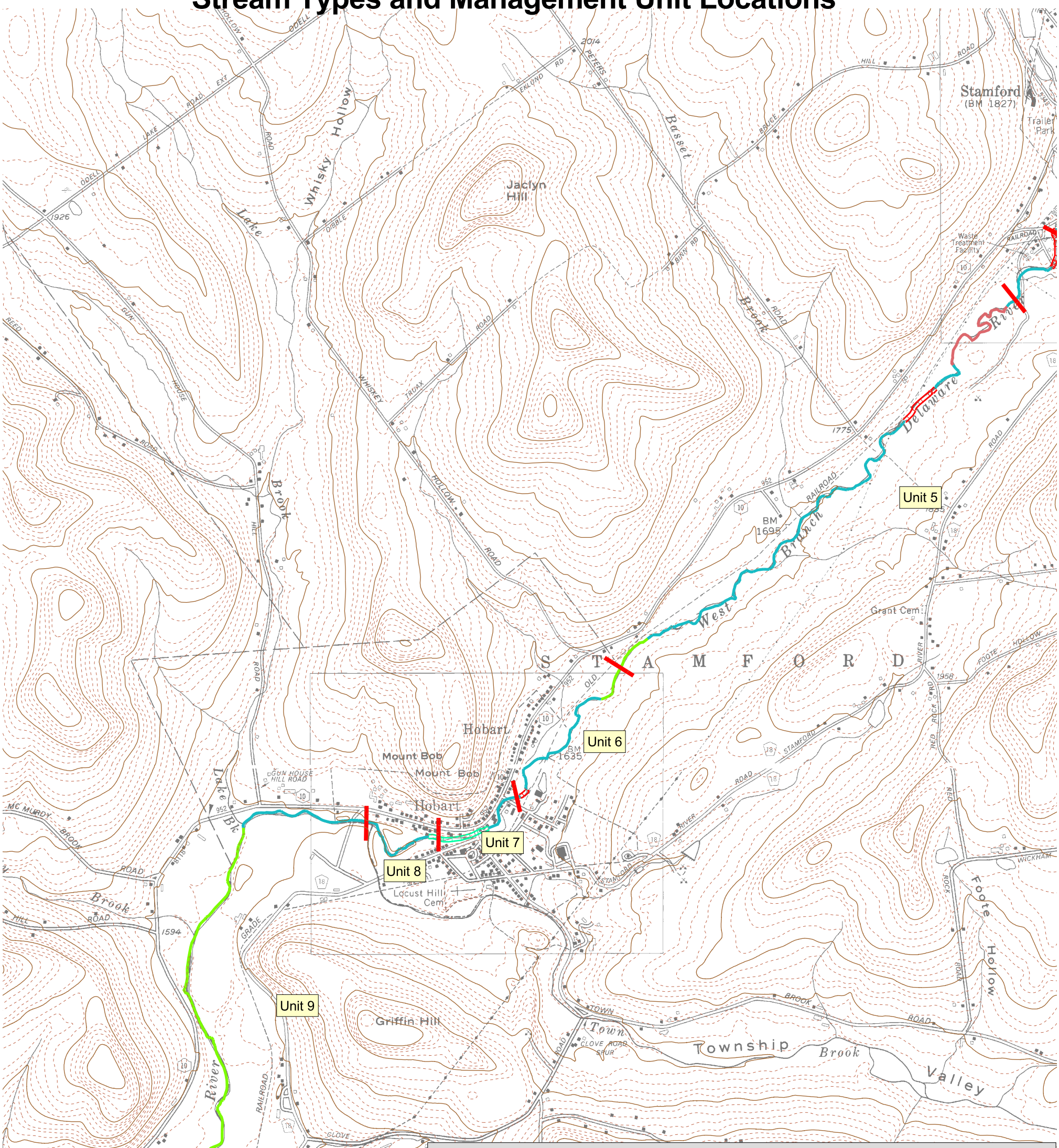
Segment 2

Segment 2 - Map 1
Stream Types and Management Unit Locations



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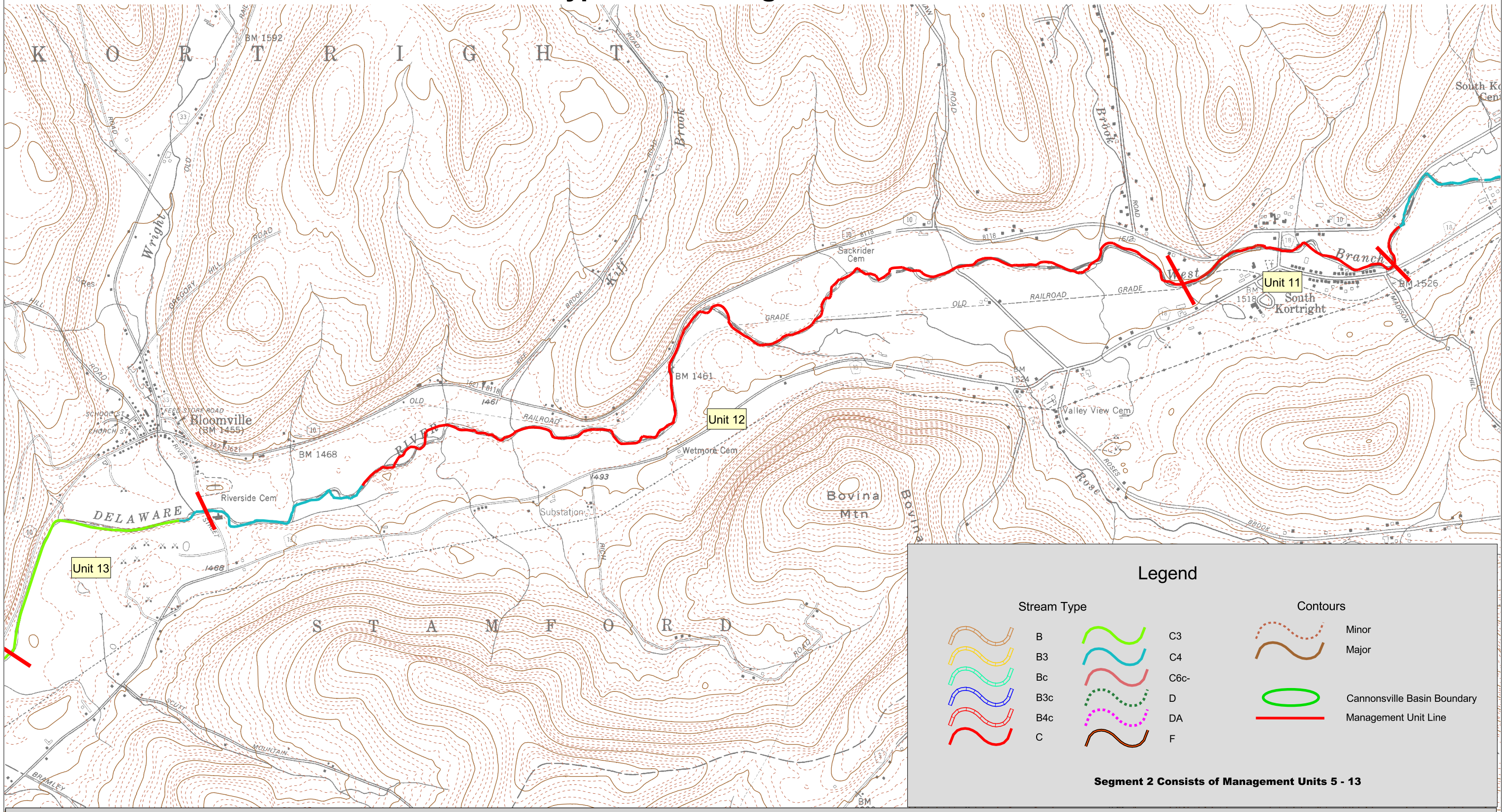
Segment 2 - Map 2
Stream Types and Management Unit Locations



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7.3. Segment 2 – Towns of Stamford and Kortright

General Description of Segment Two

This description of stream segment two covers the section of river from a point below the Village of Stamford wastewater treatment plant to a point just upstream of the Kortright-Delhi town line. The watershed area at the top of the segment is approximately 13.4 square miles and 97 square miles at the bottom of the segment with a total surveyed segment length of 82,441 feet. This segment represents the transition from the headwaters for the West Branch of the Delaware River to the mid valley river stream types. Numerous tributaries, including Town Brook, Lake Brook, Betty Brook, Rose Brook and Wright Brook increase the watershed area and the additional drainage area requires a larger channel to effectively move the water and sediment. As the river valley and channel widens and the slope is reduced, the sinuosity of the river increases. These changes are accompanied by an increase in bank erosion. The land use transitions from urban residential and commercial to rural agriculture with interspersed residential properties.

The stream channel dimensions such as its width and depth and the size of the floodplain varies within this transitional zone. Within this segment of the river, the floodplain widens and plays a more significant role in reducing the energy of the river during flood events. In numerous places, less than bankfull flows break out from the primary river channel and create secondary channels across the floodplain. This situation may be evidence that the river is aggrading and is unable to move its sediment through the primary channel. Frequently, where secondary channels are present, landowners have constructed berms and rock walls to contain the river within its primary channel and protect their property. In an attempt to protect the stream banks, landowners have lined the bank with rip rap and dumped stone. The presence of one or more of these revetments along the stream bank is most prevalent where land use is most intense, the riparian vegetation has been removed and the alignment of the river places extreme stress on the stream bank, such as on a the outside bank of a sharp bend in the river.

Flooding is not a major problem along this segment of the river as most houses and developments are located well outside the floodplain.

This segment is composed of Management Units 5 through 13. The table below summarizes the erosion and depositional features that are within this segment by management unit.

Table 7.3.1 – Summary of Erosion and Depositional Features

Management unit	Length (mi)	Linear Feet of Erosion	Surface Area (sq.ft.)	# Erosion Features	# Deposition Features	LF Erosion per Mile	# Erosion Features/mi	# Deposition Features/mi
5	2.55	905	1901	14	18	354.90	5.49	7.06
6	0.76	417	2703	5	10	548.68	6.58	13.16
7	0.38	0	0	0	0	0.00	0.00	0.00
8	0.39	521	3502	5	7	1335.90	12.82	17.95
9	1.99	1936	9498	18	12	972.86	9.05	6.03
10	1.65	2562	10511	15	11	1552.73	9.09	6.67
11	0.96	1311	7954	6	3	1365.63	6.25	3.13
12	4.89	9054	47441	61	11	1851.53	12.47	2.25
13	1.20	1433	7702	6	5	1194.17	5.00	4.17

Geomorphology and Geology:

The outwash sands and gravel plain deposited during the Wisconsin glacial retreat are the most significant elements of the surficial geology affecting *morphology* of the river in this segment. As with segment one, the sands and gravels layers with a thickness of 6-60 feet at the bottom of the valley are bounded in places by deposits of larger gravel dumped as "kames" or terraces along the valley wall. As tributaries enter the main stem of the West Branch, alluvial fans have formed in the delta. The fans are elevated over the valley floor and provide a site that has been attractive to development as in the case of the hamlets of Hobart and Bloomville. The observation of the geometry of the main stem suggests that the river will migrate to the valley wall opposite the alluvial fan as the river seeks to flow around the fan. On top of the fan, the tributary may migrate back and forth across the delta area as it attempts to move its bedload down through the channel and avoid clogging with sediment. This migration can be troublesome in times of flood for communities that have built on the fan. During flood events, debris from up channel sources is deposited in the delta channel and clogs the channel. The flow will rise over the banks and may create new, *braided* channels across the fan, in the process spreading debris and inundating low areas away from the primary channel.

The valley continues to be a Rosgen valley type VIII with wide gentle sloping valley with terraces at the margins of the floodplain. Based upon approximated measurements from USGS 7.5' quadrangle sheets, the width of the valley floor increases to between 400 and 900 feet as the watershed source area increases. The valley slope decreases from about 1.3 percent in segment one to about 1.0 percent at the top of segment two to about 0.5 percent at the bottom of segment two. Stream channel slope declines from 1.0 percent at the top of the segment to about 0.4 percent at the bottom of the segment. Sinuosity varies between 1.1 and 1.4, with most sections around 1.2. There are three locations (one above South Kortright and two below South Kortright) along the north side of the river along NYS Route 10 where bedrock controls the stream alignment. The bedrock at only one location (approximately 1000 feet below South Kortright) acts as a grade control.

The river through this segment is predominantly C stream type with the exception of small sections of Bc stream. These C stream reaches are typically, somewhat over-wide and have pools that are shallower than should be expected. The bed pavement material is largely *cobble* and gravel, with the exception of the highly sinuous C6c- (*silt*/sand bed) reach below the Village of Stamford waste water treatment plant. This tortuously *meandering* reach is the mythical section of the river where legend tells of Hiawatha shooting an arrow seven times across the Delaware. It is likely that this reach was previously an E6 channel with a lower width to depth ratio, but recent grazing practices have resulted in the cattle damaging the stream banks and altering the character of the stream.

The assessment team identified ten locations along this segment with exposed clay lenses in either the stream bed or bank. These clays are a significant concern for water quality as disturbance and introduction of the material into the river increases *turbidity*. These clays while not as abundant as found in the central Catskill rivers such as the Schoharie and Esopus, still pose a threat and the exposures should be monitored. Prior to any future stream work in these areas, the presence or absence of clays should be ascertained as part of the survey and design process.

Stream Orders, Floodplains, and Wetlands:

The stream is a fourth order stream in this segment. There are eight tributaries that enter the river in this segment: Basset Brook, Town Brook, Lake Brook, McMurdy Brook, Dry Brook, Betty Brook, Rose Brook, and Kiff Brook. Town Brook is a major source of sediment. McMurdy Brook, Rose Brook, and Kiff Brook are moderate sources of sediment. Basset Brook, Lake Brook, Dry Brook, and Betty Brook contribute minimal amounts of sediment to the river.

Upstream of Hobart the floodplain is typically used for agriculture. There is some riparian buffer except for the C6c- reach which has no riparian buffer. The stream has good access to its floodplain.

In the Village of Hobart, due to the man-made conditions which prevail, the river has no access to its floodplain.

Downstream of Hobart the floodplain is used for agriculture, and generally it has a narrower riparian buffer than is found upstream. The river has good access to its floodplain.

There are 12 areas of wetland in this segment. Two areas are shallow emergent marsh and ten areas are shrub swamp.

Land Use/Land Cover:

Below the Village of Stamford, the dominant land use is agricultural land with forested land at the higher elevations and on steeper slopes. Scattered residences are located

along the alluvial terraces and lower side slopes of the hills where access roads can be constructed. Within the riverine lands, cropland and pasture dominate with hayland (herbaceous) the principal land uses/land covers. Forests and mixed shrub as a percentage of riparian land cover is similar to segment one with about 42% of the land cover forest or shrub within 300 feet of the river. This proportion of forested land drops to 36% of the land cover if the analysis is limited to a 100 feet buffer of the river. Herbaceous land cover increases from 15% to 24% as the buffer analysis changes from 300 feet to 100 feet of the river. To improve stream bank stability it would be preferable to reverse this trend and have woody vegetation dominate the area within 100 feet of the river. Within this segment, greater efforts are needed to enhance the woody component of the riparian buffer along the river.

The hamlets of Hobart and South Kortright are stable communities that have not experienced significant growth. In Hobart, Tyco International, a major employer and landowner within the village, directs runoff from its impervious surfaces through stormwater detention ponds located above the floodplain. The O'Connor Foundation sponsored project at the old mill dam has secured the river banks through much of the hamlet. A few older retaining walls above the project area will need continued reinforcement to protect the older structures along the river. Where possible, opportunities to remove or relocate structures should be sought to reduce repetitive flood damages and the cost of maintaining the walls. Commercial and residential development in South Kortright is largely located outside of the floodplain and therefore is not threatened by flooding nor does it impact the river's stability. In both South Kortright and particularly in Hobart, stormwater runoff planning would aid in protecting water quality and facilitating future development. A Japanese knotweed colony was detected on the upstream *left bank* at South Kortright and was probably established from a garden dump. This colony is one of the farthest upstream colony found on the West Branch and should be controlled before it spreads into the floodplain.

Development along the stream corridor in this segment has not reached the critical point where floodplain encroachment would begin to dramatically affect stream stability. The maintenance of a continuous riparian buffer of adequate belt width (at least 100 feet wide) to allow for stream alignment adjustments should be a major objective of landowners and those reviewing plans for development in this area. This buffer would help reduce nitrogen and phosphorus pollution from overland sources including agriculture.

<u>Infrastructure</u>:

The river is paralleled by New York State Route 10 and County Route 18 with bridges in Hobart at Cornell and Maple Avenue, South Kortright and Bloomville. None of these bridges present a problem for stream stability at this time. There are several locations where stormwater drains installed to remove runoff from NYS Route 10, now direct flow over the high stream bank with insufficient protection for the stream bank. Highway construction planners and inspectors need to ensure that stormwater is directed toward the

river in a way that does not destabilize the riverbanks and allows for sufficient filtering/detention.

Sediment Transport and Channel Evolution

The percentage of stream length that had eroding stream bank increased from 4 percent on Segment One to 21 percent in Segment Two. The increase in erosion is correlated with the decrease in the size and decline in quality of the riparian forest buffer.

Nearly half of the river length along segment two has some form of revetment constructed to either retain flows within the channel (berms and walls) or protect the banks (rip rap, stonewall and dumped stone). Berms make up about 12% of total length, rip rap and dumped stone each comprise a similar percentage of the length. Although anglers familiar with this segment are knowledgeable of the log cribbing revetment constructed by the Department of Environmental Conservation, these revetments are generally in disrepair and only make up 4 percent of the total stream length. The willow trees planted in conjunction with the log revetment continue to hold the banks together even though the revetment structures have failed.

There are numerous side channels throughout the segments, particularly in Management Units 9, 11 and 12. These channels reduce the sediment transport capacity of the primary channel and exacerbate the aggradational condition. In some locations, the presence of side channels together with a general aggrading trend could be an indicator that the stream is evolving from a type C to a type D (braided channels). Type D's are generally highly unstable, erosive, and provide very poor habitat.

Aquatic Habitat Conditions:

In general, the condition of the aquatic habitats in this segment were good, with areas of concern found where the riparian vegetation was lacking and provided no cover or woody debris. In some locations the channel was over wide and the shallow conditions may increase in water temperatures during low flow periods. Pool depths through the segment are somewhat shallow due to the process of aggradation which is occurring along this reach. The gravel and small cobble channel substrate are good for spawning. This segment is known as a productive reach by local anglers.

History of Stream Management:

Throughout this segment there is extensive revetment largely constructed by farmers in an effort to protect their fields from bank erosion and flood scour out on the floodplain. **Table 7.3.2** summarizes the quantity of revetments and repairs that have been established within each management unit in this segment.

Table 7.3.2 – Revetment and Repairs

Management Units	Length (mi)	Dumped Stone	Rip Rap	Laid-up Stone	Stacked Rock Wall	Gabions	Log Cribwall	Concrete	Sheet Piling	Other	Log Deflectors	Total Revetment Length (ft)	Revetment Length per mile	Berms	Berm Length (ft)
5	2.55	3	8	4	4	-	-	1	-	-	-	2438	956	-	-
6	0.76	2	5	4	-	-	-	-	-	-	-	1154	1518	-	-
7	0.38	-	3	3	-	13	-	2	-	-	-	2403	6324	-	-
8	0.39	1	3	1	-	-	-	-	-	-	-	381	977	-	-
9	1.99	10	26	2	-	-	4	2	-	-	10	5146	2586	9	3155
10	1.65	7	12	3	-	-	5	-	-	-	10	3884	2354	3	2079
11	0.96	4	3	4	-	1	1	-	1	-	-	1690	1760.4	1	105
12	4.89	34	18	3	-	-	14	2	-	-	3	11124	2275	5	1211
13	1.20	2	1	-	-	-	-	-	-	-	-	1413	1178	4	3464

Special Concerns:

Riparian buffers throughout this segment need to be either established or enhanced to reduce bank erosion, limit nutrient enrichment of river and provide greater cover for aquatic life. Controlling grazing and keeping cattle out of the stream are also management controls that will improve water quality and reduce bank erosion. Control of Japanese knotweed is vital along the river and roadsides to prevent this *invasive plant* from replacing the existing riparian vegetation. Monitoring and further assessment of the distribution of clay lenses in the stream banks may be warranted.

7.3.1 Management Unit 5

Management Unit 5 is a mixture of wooded riparian lands with some agricultural fields. Bank erosion is not serious in this unit. There are about 900 feet of eroding banks with most of the exposures having a bank height of less than two feet. There is about 2400 linear feet of revetment of which almost half is old stone wall. This unit is moderately stable and contains 16 monitored cross-sections (9 through 16, 16.8, 16.9, 17, 19, 19.5, and 20 through 22).

Figure 7.3.1 Typical scene in Management Unit 5 located approximately 3,500 feet upstream from Basset Brook Confluence.

This reach has a private bridge that is in poor condition but there is no evidence of aggradation downstream from the bridge. There are three areas of wetlands within this unit. One wetland that is classified as a shrub swamp is located 2,500 feet upstream from Basset Brook, another

wetland is classified as a shrub swamp located at the *confluence* of Basset Brook, and the third wetland, located 3,000 feet downstream from Basset Brook, is a shallow emergent marsh.

Figure 7.3.2 C6c- stream type that is located at the top of management unit 5 downstream of bridge.

The top portion of this unit is classified as a C6c- stream type. It is very sinuous, with a low width to depth ratio. The C6c- section may have evolved from an E6 type stream. It is currently destabilizing as a result of recent cattle access to the stream and destabilization of the banks by hoof shear. **Figure 7.3.2** provides an example of the C6c- stream type with its broad shallow floodplain. Removal of the cattle may enable the stream to regain its stream bank vegetation, maintain its sinuosity, and remain a stable C6c-.

The results from the surveyed cross-sections suggest the stream is generally over wide. Several of the surveyed cross-sections had width/depth ratios near or over 40. The degree of entrenchment was typically low, with the entrenchment ratio was between 2.3 and 9 for most of the cross-sections. Below the C6c- section, the river transitions to C4 stream type. Numerous high flow or secondary channels divert some of the flow out of the main channel during near bankfull events. Fortunately through this unit, most of these secondary channels flow through well vegetated buffer lands. Maintenance of this land as forested buffer will help ensure that the channel does not migrate to the route of the secondary channel.

7.3.2 Management Unit 6

In Management Unit 6 the river flows through a large wet meadow/pasture above the Village of Hobart. Cattle have access to the stream through much of this reach. At several locations, the stream banks showed signs of erosion caused by farm animals. There are two sections with revetment, a stone wall along a field and rip rap protection that was placed at the approaches to the rail trail bridge just upstream from the village.

Figure 7.3.3 Typical scene of the river located at the top of management unit 6.

There are several center bar deposits in the lower part of this unit before the river enters the village. This management unit is moderately stable and contains monitored cross-section 23. There is one area of wetland within this unit located approximately 600 feet upstream from Cornell Avenue Bridge (County Bridge 69).

7.3.3 Management Unit 7

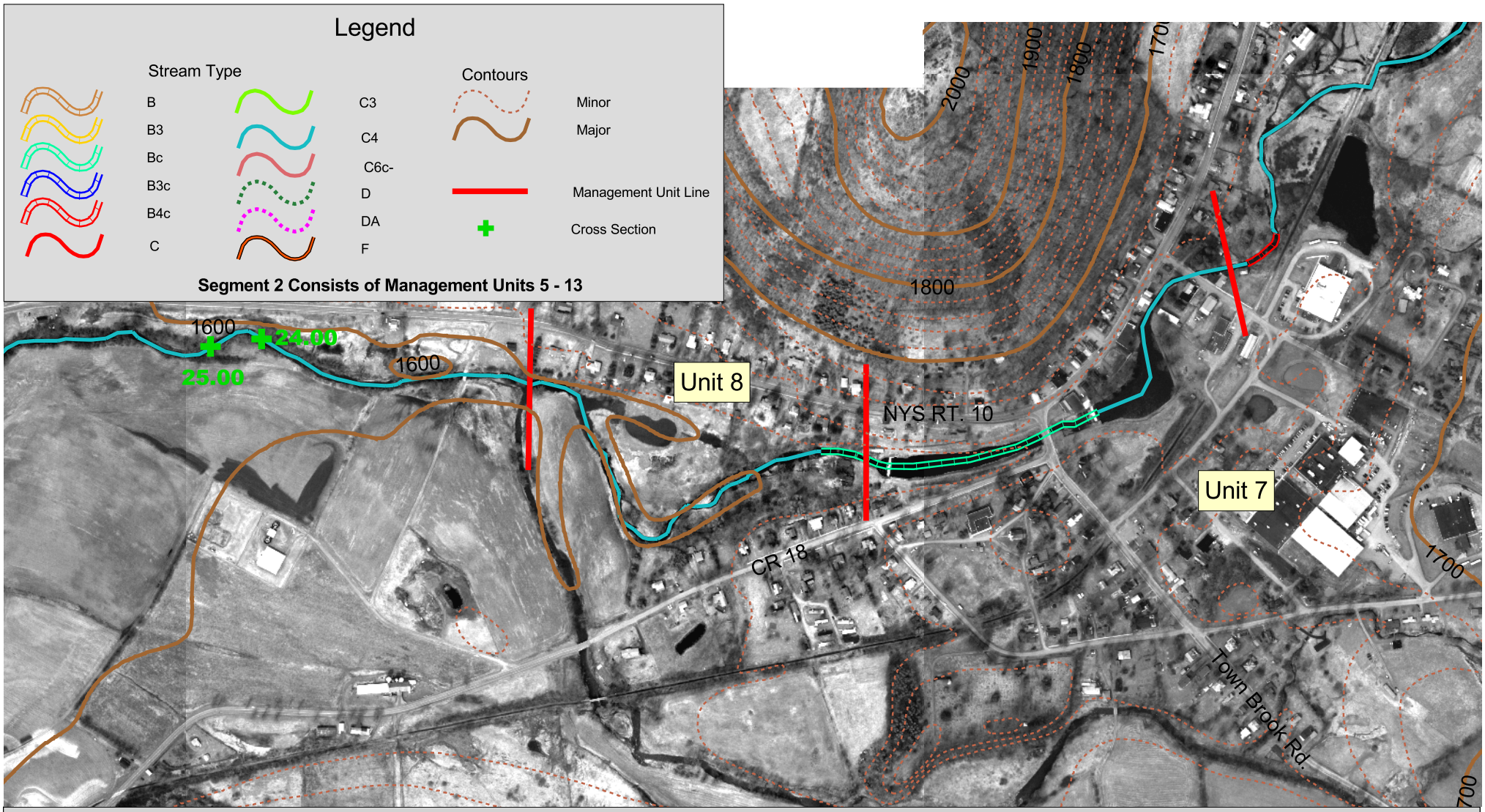
Management Unit 7 is within the Village of Hobart where there are several structures and roads that are in close proximity to the river. New York State Highway 10 runs parallel to the river. See **Management Unit 7 – Map 1** through **Map 6** at the end of this unit description.

This reach contains two dammed ponds connected by a manmade stream. Gabion baskets are found in the river bed and along the banks which continues downstream through Maple Avenue Bridge. **Figure 7.3.4** shows the upper dam from Maple Avenue Bridge. The outfall of the lower pond is of similar construction. These structures trap sediment behind the dams.

Figure 7.3.4 Looking upstream at one of the dams in Hobart from Maple Avenue Bridge.

This unit is in stable condition and has no *monitoring cross-sections* at this time. There is USGS gage station 01421610 (West Branch Delaware River at Hobart NY) which is located at the dam of the upper pond. County Bridge 69 on Cornell Avenue has no evidence of aggradation downstream. The County Bridge has concrete and laid-up stone revetments on both sides of the riverbanks. There are old stone walls above Cornell Avenue that may require maintenance.

Management Unit 7 - Map 1
Stream Types and Cross Sections



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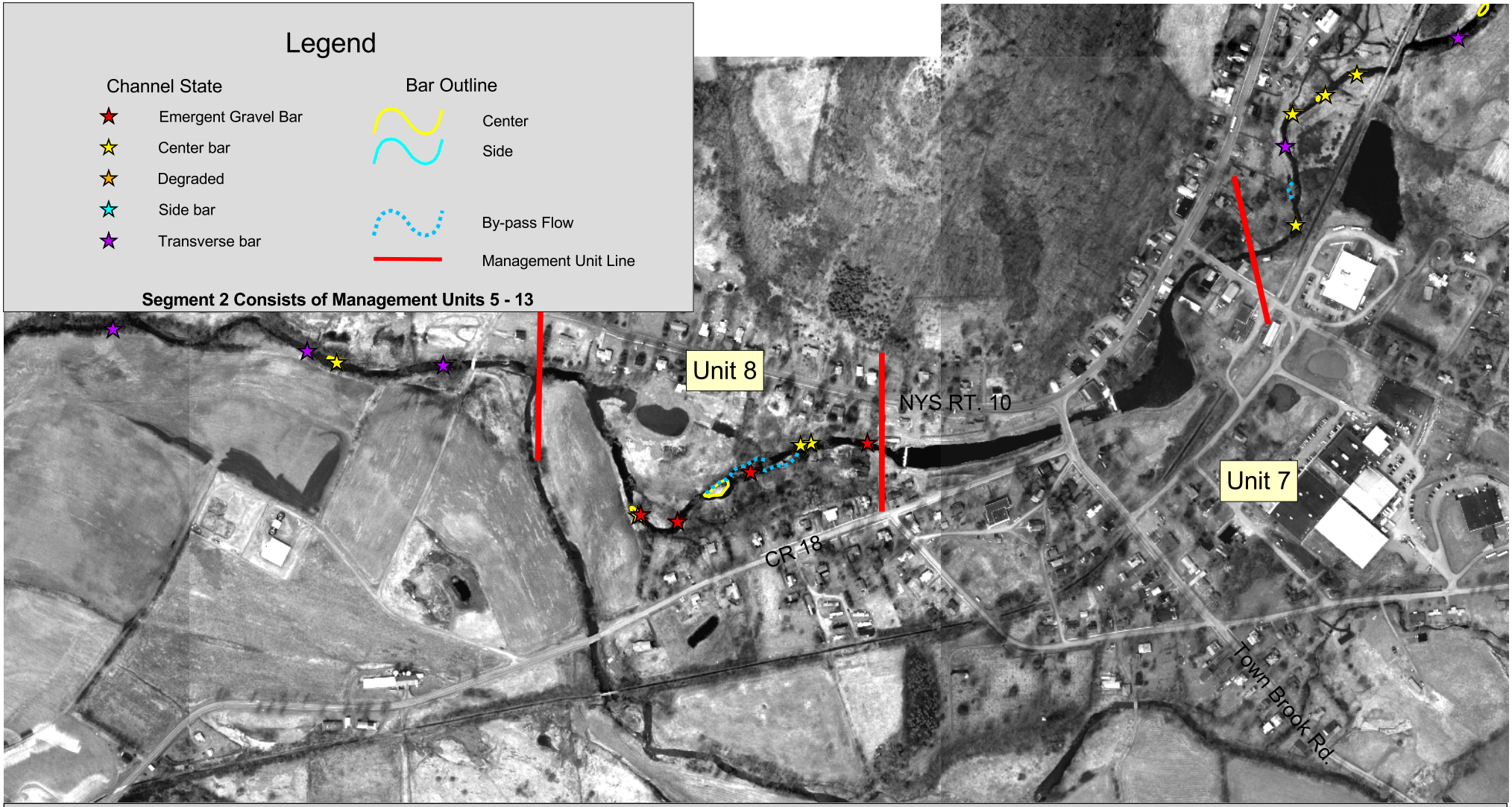
Management Unit 7 - Map 2
Channel State and By-Pass Flow



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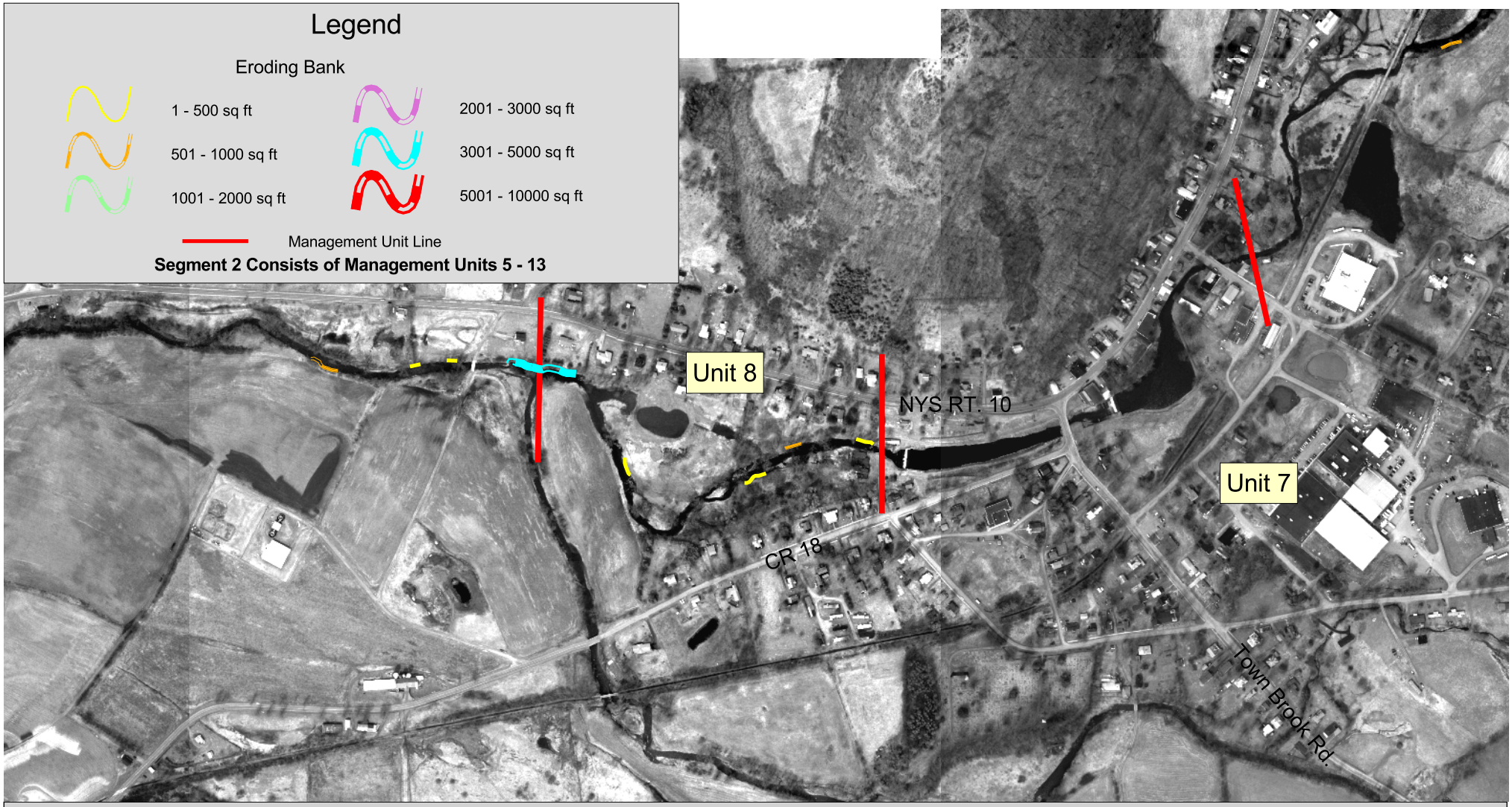
Management Unit 7 - Map 3
Eroding Banks



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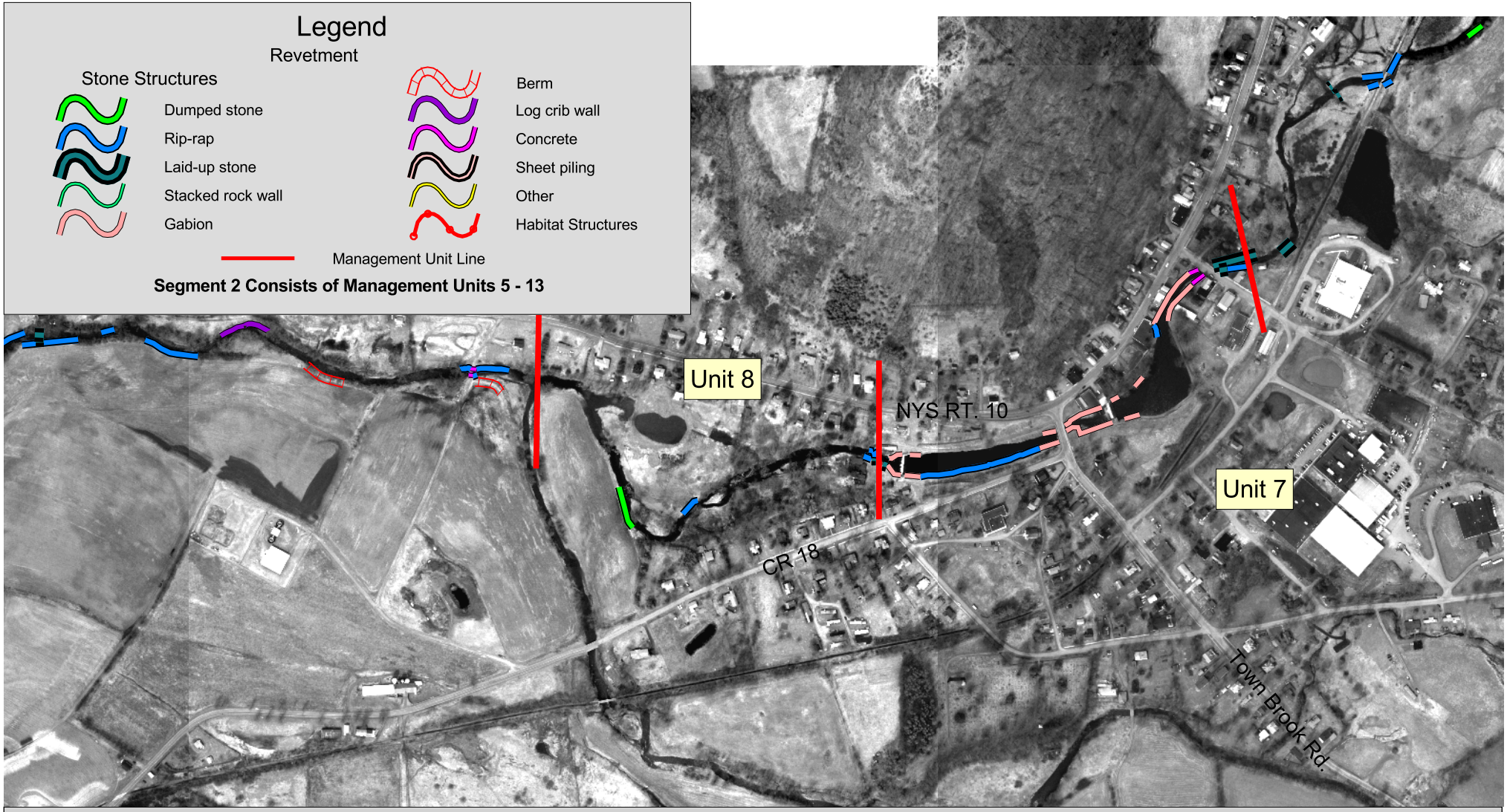
Management Unit 7 - Map 4
Revetment



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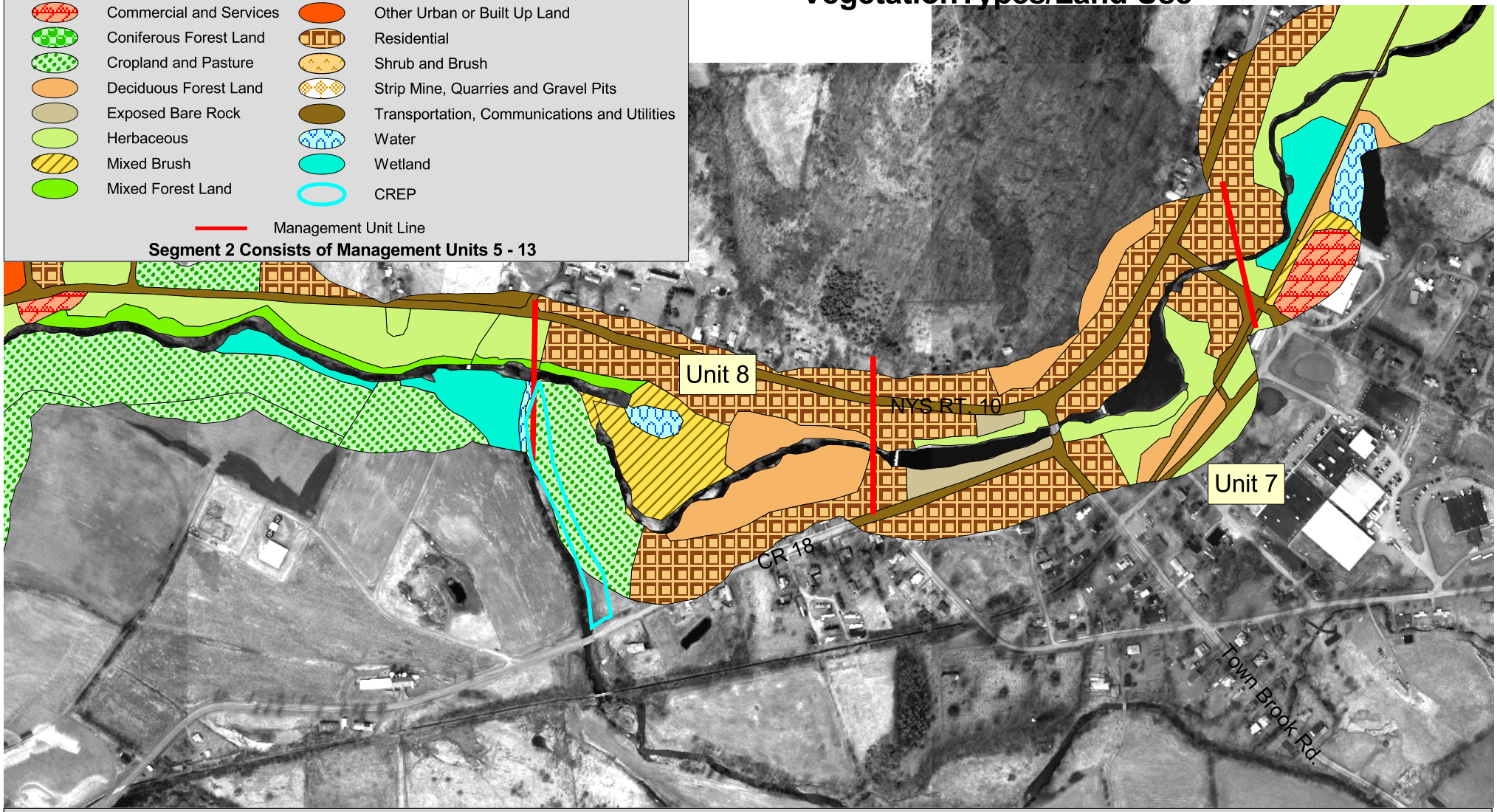
Management Unit 7 - Map 5
VegetationTypes/Land Use



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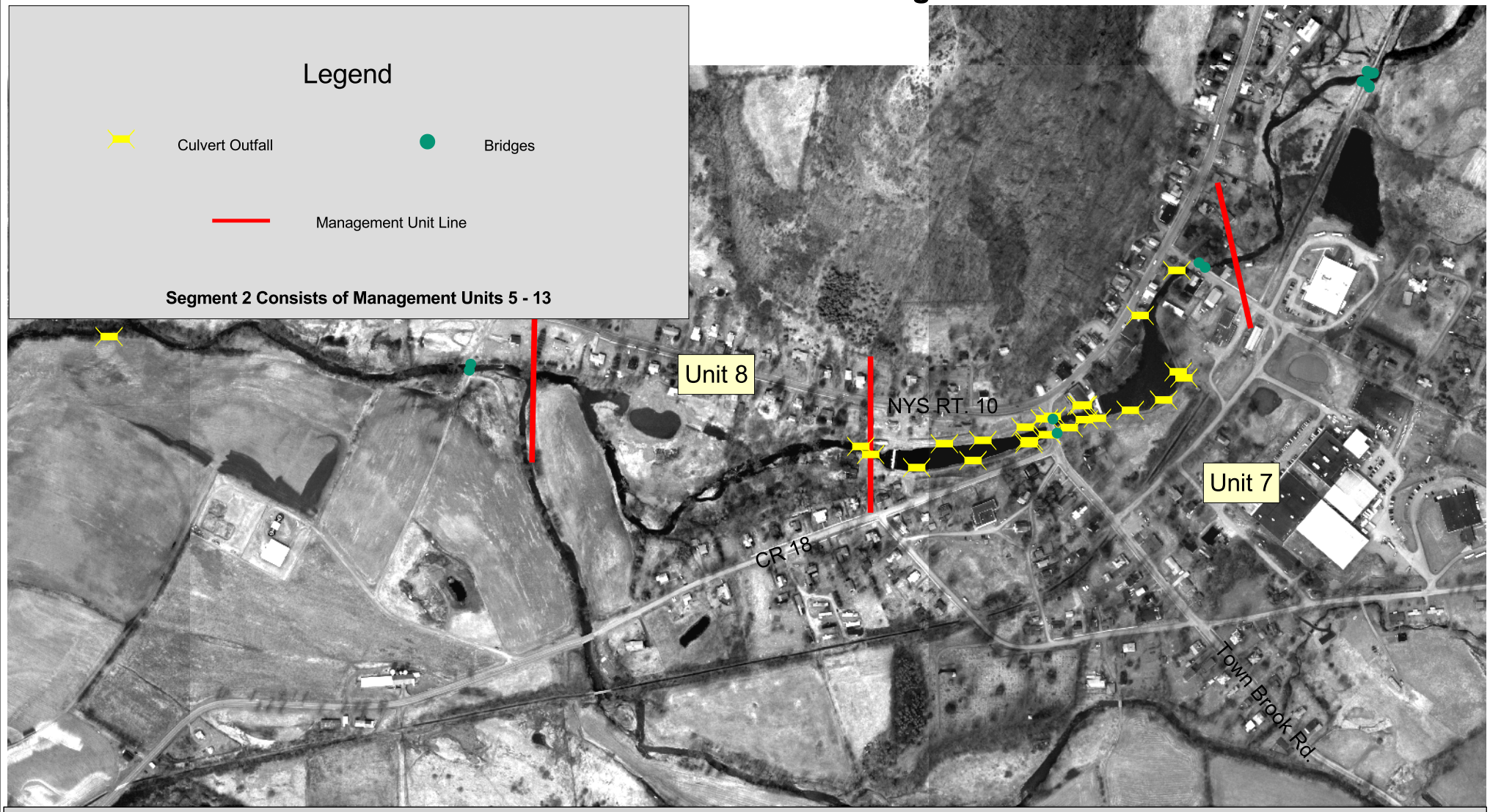
Management Unit 8 - Map 6
Culvert Outfalls and Bridges



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7.3.4 Management Unit 8

Management Unit 8 is a short but unstable reach. There is a short section below the dam, where the flow is confined within a narrow channel with steep banks. It has a high eroding bank at two locations. The eroding bank is a source of material for deposition downstream. Some of the material is deposited before the meander bend where the river takes an abrupt turn to the north before turning again southwest and combining with Town Brook

Figure 7.3.5 Looking downstream at a long, shallow, overly wide pool just upstream of Town Brook confluence.

The pools within this unit are long, shallow and overly wide and the riffles are short and steep. A long pool shallow follows the bend for almost 500 feet before Town Brook confluences with the river.

Short sections of stone structure revetments are found in this unit. This reach does not contain any monitored cross-sections at this time. There are no wetlands within this unit, but a backwater slough is located just above the confluence with Town Brook.

7.3.5 Management Unit 9

Management unit 9 is predominately agricultural lands with a narrow riparian buffer zone along the river bank. There are 23 acres of agricultural land that are enrolled in Conservation Resource Enhancement Program. This management unit is moderately unstable, and contains monitored cross-sections 24, 25, 26, 26.4, 27, and 28.

There are 4 areas of wetlands located within this unit and they are all classified as shrub swamp. One of the wetlands is located

Figure 7.3.6 Typical scene looking downstream in Management Unit 9 located approximately 1,450 feet downstream from Town Brook.

approximately 1,350 feet downstream of Lake Brook confluence, another wetland is located 500 feet downstream of McMurdy Brook confluence, and the last two areas are located on each side of the river 4,000 feet downstream of McMurdy Brook confluence.

Figure 7.3.7 Looking upstream at the confluence of Town Brook.

Lake Brook, Town Brook and McMurdy Brook enter the main stem in this unit. The watershed area of the West Branch Delaware River more than doubles within this mile long reach. McMurdy Brook and Town Brook contribute a large amount of sediment load to the river. Aggradation features appear primarily in the upper half of this unit due to these three tributaries that enter the main stem.

Large sections (8312 ft. total) along the river bank contain revetments such as berms, old log cribbing, rip rap or dumped stone. Numerous Department of Environmental Conservation structures are found in this reach, including log cribbing, log deflectors and fish habitat structures. **Figure 7.3.8** shows log cribbing along the right bank. Bank erosion is common at the downstream ends of these revetments. There was over 2100 feet of bank erosion along this 10,500 foot reach. Over 50% of this eroded bank length had an average bank height of 4.5 feet or greater.

Figure 7.3.8 Log cribwall on the right bank located approximately 1,200 feet downstream from Town Brook confluence.

Despite previous efforts by the DEC and the significant achievements to date under CREP, additional land in this management unit needs to be conserved along the river as riparian buffer.

7.3.6 Management Unit 10

In Management Unit 10, the river continues to flow through primarily agricultural and fallow land.

The uppermost portion of the unit has a significantly aggraded section with a series of long pools and short riffles. Within the first 2,000 feet of the uppermost portion of this unit contains a section of the river that has many by-pass channels and is classified as unstable. This area runs through a low swampy section of wetland classified as shrub swamp on left bank and shallow emergent swamp on the right bank.

Figure 7.3.9 Typical scene in Management Unit 10 located downstream at a Department of Environmental Conservation pool digger located approximately 1,350 feet upstream of the Post private bridge near DEC fishing access parking lot.

Figure 7.3.10 High eroding bank located approximately 3,300 feet upstream from private bridge.

The shallow rooted bank vegetation and the aggradation result in substantial bank erosion in the uppermost 2,000 feet of this unit. Of the 2500 feet of eroding bank in the entire management unit, 1500 feet occurs in the upper 2000 feet of the unit. As this reach is not entrenched, the average heights of these banks are generally less than 4.5 feet high. The remainder of this unit is largely bermed and rip rap. There is a significant amount of dumped stone on the banks which has been used to repair eroding sites. In the lower 4000 feet of the unit, the riparian buffer is less than 50 feet wide in most places. As there are no Conservation Resource Enhancement Program sites in this area at this time, this reach should be a priority for CREP and other riparian buffer enhancement efforts.

This management unit contains monitored cross-section 29.

7.3.7 Management Unit 11

The river in Management Unit 11 flows through the hamlet of South Kortright and is bounded by residential land use fronting on County Route 18. The land on the right bank of the river is predominately agricultural fields. The unit is approximately 5050 feet long and is primarily a C stream type.

Figure 7.3.12 Looking downstream at County Bridge 18-6.

Just upstream from the Dry Brook tributary there is a grade control consisting of massive flat stones set into the streambed. This structure is the remnants of an old dam. The County Route 18 Bridge (18-6) crosses the river in the hamlet. The bridge has two arches with the right arch acting as a high flow by-pass channel. This feature enables the river to function through this reach without significant aggradation or scour. There are only a few bars found downstream of the bridge.

This reach contains a Japanese knotweed colony located below the meander bend on the left bank as the river enters the hamlet. This colony is the furthest upstream knotweed stand found by our survey on the West Branch main stem.

Figure 7.3.13 Looking downstream at an eroding bank located approximately 1,750 feet upstream from County Bridge 18-6.

This management unit has some moderately stable with unstable sections above and below the bridge. **Figure 7.3.13** shows the most significant eroding bank upstream from the bridge. Another high eroding bank is located below the bridge where the river sweeps up against the right valley wall below Route 10. This management unit contains monitored cross-sections 30 and 31. There is a shrub swamp wetland located at the bottom of this management.

7.3.8 Management Unit 12

Management Unit 12 is a long (27,400 feet) reach that receives water from several tributaries including Betty Brook, Roses Brook, Kiff Brook and several unnamed tributaries. Management Unit 12 has been significantly affected by both farming practices and the maintenance of the railroad grade though the river's floodplain. The rail grade crosses the floodplain three times and agricultural land bounds much of the river as it flows through this reach. This management unit is rated unstable with over 12300 feet of revetted bank and 9054 feet of eroding stream bank. Over 50% of this length of eroded stream bank has an average exposed height of greater than 4.5 feet. There are many long by-pass channels throughout the management unit, with 24 center bars and 20 transverse bars on the reach. Kiff Brook and the unnamed tributary contribute sediment load resulting in the formation of some of the central bars found on the reach. Several bars are located above and below the three railroad bridges that cross the river

Figure 7.3.14 Monitor bank pin located in the eroding bank that is shown in the **Figure 7.3.15**.

The assessment team established monitoring cross-sections 32, 33, 35, 36, 37, 38, 38.3 and 38.5.

Figure 7.3. 15 An eroding bank downstream of railroad bridge where bank pin #34.3 is located.

Poorly vegetated banks along the agricultural lands create unstable banks conditions. There is approximately 9200 feet of stream bank with little to no woody vegetative buffer along agricultural land on this reach. This means that 17% of the stream bank in this reach has no natural protection. Many areas where a riparian forest buffer is present, the buffer are less than 50 feet wide. Greater participation in buffer programs is needed from the landowners in this management unit.

The assessment team established two bar erosion monitoring pins on the lower section of this reach. The data gathered from these bank pins will provide information on the amount of river bank that is lost within a year. **Figure 7.3.14** shows bank pin #34.3 which lost 2.2 feet of bank in the spring of 2004.

The upstream portion of the stream contains stone structure revetments such as dumped stone which can be found along agricultural fields. These revetments are used in an attempt to reduce the erosion and to get rid of stone in the fields.

In this unit there are four bridges where 3 of them are railroad bridges and the last bridge is the County Bridge 82 on River Street in Bloomville. There are no wetlands that were identified within this unit.

7.3.9 Management Unit 13

In Management Unit 13 the river flows past the hamlet of Bloomville and receives the Wright Brook tributary. The surrounding land use is primarily agricultural, but there is a steep, wooded *embankment* along of New York State Highway 10 where the river comes in contact with the valley wall. Opposite this embankment, on the left bank, an old earthen berm forces this section of the unit into a very straight channel as shown in **Figure 7.3.16**. This straight stretch has a poor riffle and pool sequence which is inconsistent with the morphology of this stream. The whole embankment along New York State highway 10 has rip rap along the river bank.

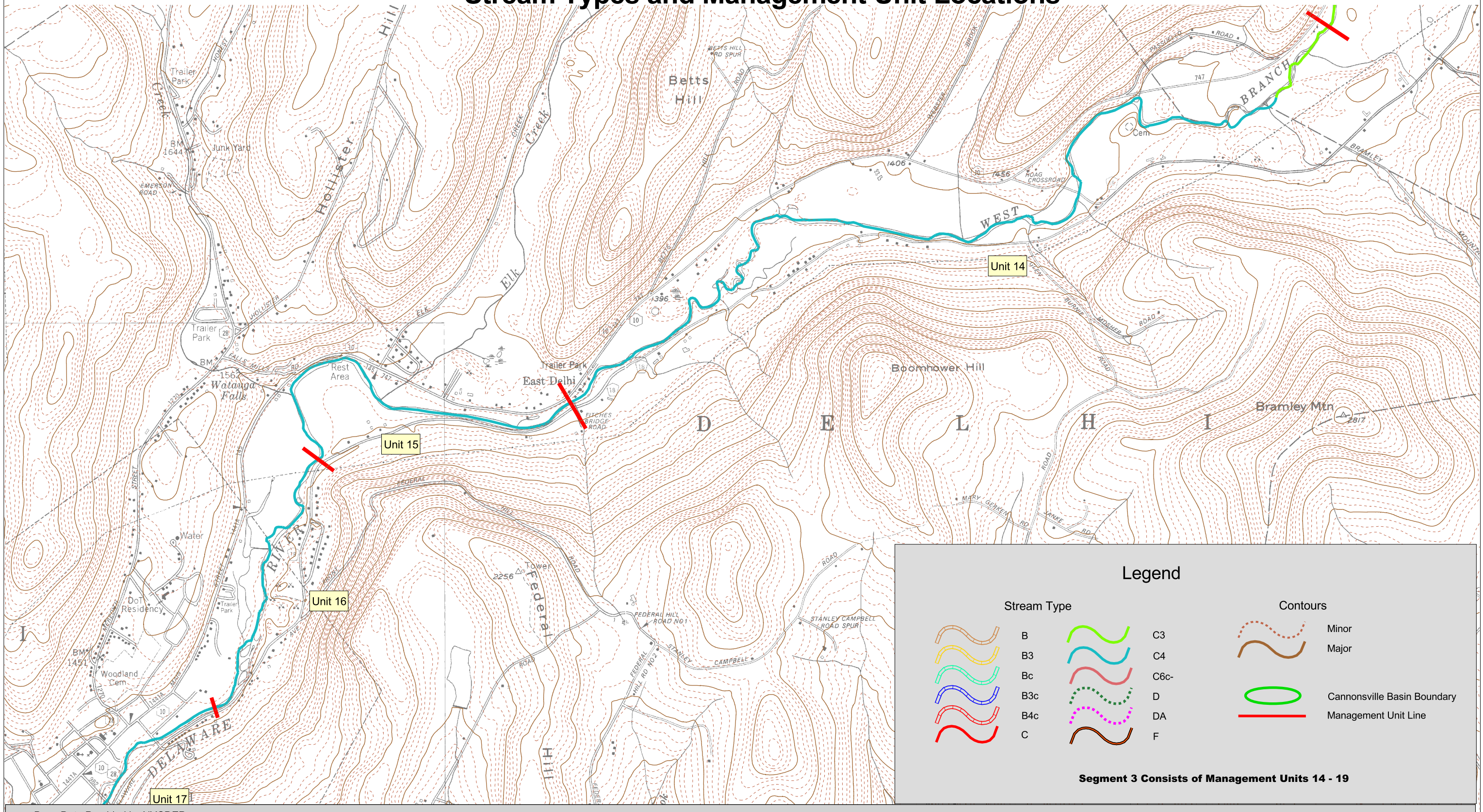
Figure 7.3.16 Typical scene in Management Unit 13 located approximately 4,500 feet downstream from County Bridge 82.

A large center bar located at the downstream end of Management Unit 13 is associated with the very long pool along Route 10. It forms below the point where the berm on the left bank ends and the river is able to again access its full floodplain. This management unit is rated moderately stable and contains monitor cross-sections in this unit include 40, 41, 41.2, 42 and 43. Monitor bank pin #41.3 is also located within this unit.

Wright Brook tributary enters this unit downstream of County Bridge 82 and is not a major source of sediment as much of the sediment is captured above the mill dam in the hamlet. Downstream of County Bridge 82 a large center bar is forming. There is minimal bank erosion occurring within this unit. There are no wetlands located in this unit.

Segment 3

Segment 3 - Map 1
Stream Types and Management Unit Locations



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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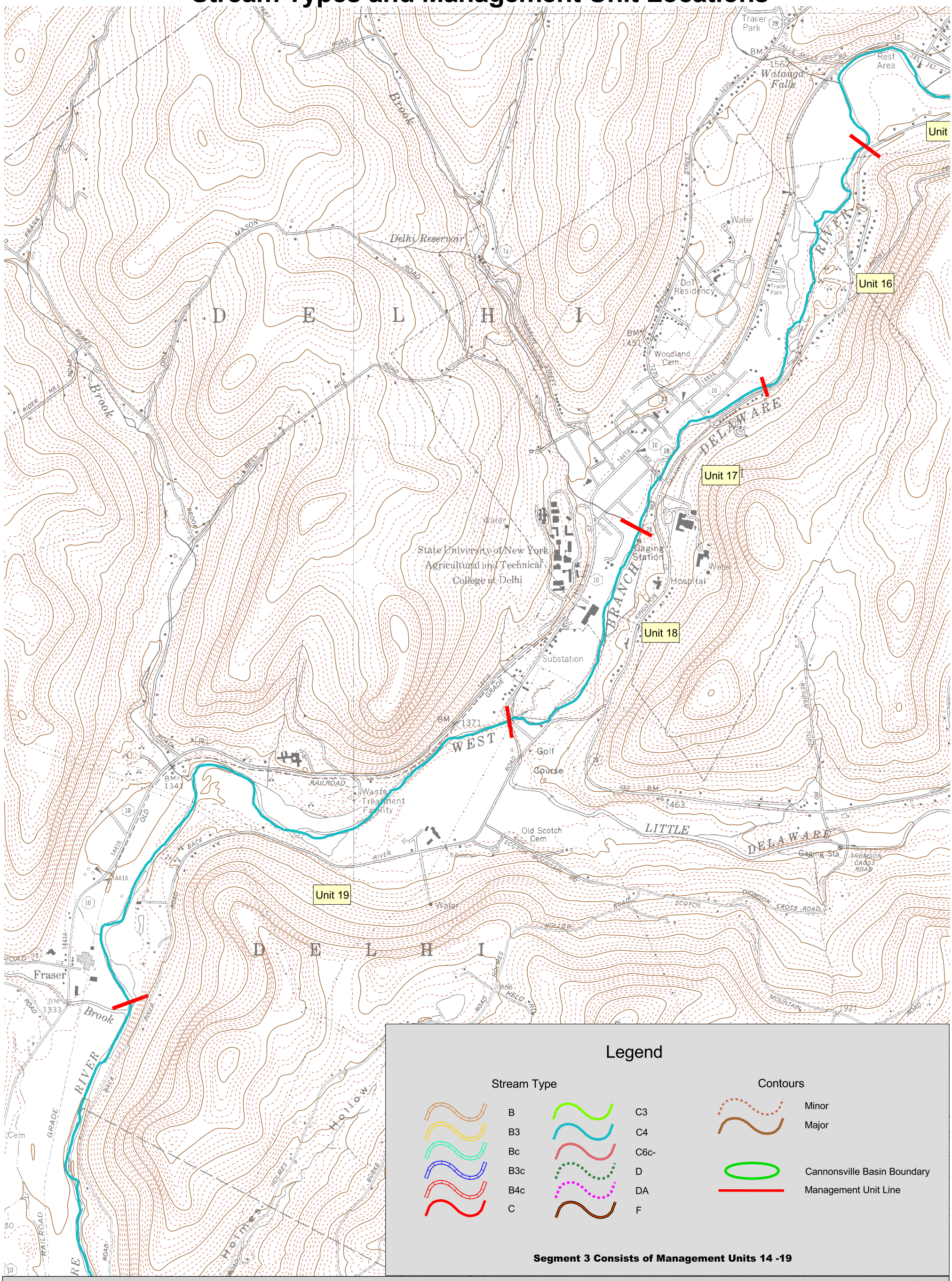
N W E S

Segment 3 - Map 2
Stream Types and Management Unit Locations



Legend

Stream Type

- B
- B3
- Bc
- B3c
- B4c
- C
- C3
- C4
- C6c-
- D
- DA
- F

Contours

- Minor
- Major

- Cannonsville Basin Boundary
- Management Unit Line

Segment 3 Consists of Management Units 14 -19

Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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7.4 Segment 3 – Town and Village of Delhi

General Description of Segment Three

Segment three is generally delineated based on the Delhi town lines, beginning upstream approximately 2,100 feet from the Delhi town line and ending at the confluence of Platner Brook with a total surveyed stream length of 65,310 feet (see **Segment 3 – Map 1** and **Map 2**). It is composed of Management Units 14-19. The Village of Delhi is the only population center in this segment. The drainage area at the top of this segment is approximately 97 square miles and approximately 206 square miles at the bottom. The valley slope in this area is 0.0019 and the majority of the West Branch Delaware River in this section is classified as a C4 stream type with some C3 sections.

The Village of Delhi, a major population center within the county, straddles the river. The first settlers arrived in the Delhi area after 1784, with the Town lands taken from Franklin, Kortright, and Walton towns in the 1790s and the Village of Delhi incorporated in 1821. The some of the first villagers built homesteads along Main Street and Second streets which are located on the Steele Brook alluvial fan. The village has been a commercial center and the county seat since its settlement. This area above and below the village is predominately agricultural, but there has been significant development along the floodplain both within and below the Village of Delhi. This includes two industrial factories downstream of Delhi at Fraser, which are Ultra Dairy: Morning Star and DMV International Nutritionals. The wastewater treatment facility serving the village and the dairies is also located downstream from the village. Two education centers on either side of the valley, Delaware Academy and Central School on one side, and SUNY Delhi College of Technology on the other, support the local economy and cover large tracks of land along the valley's terraces and mid slopes. The college farm, now partially occupied by the College golf course, is also located on an alluvial fan for the Little Delaware River. The buildings along Main Street including the County Offices, Department of Public Works and local telephone company all back on the river are subjected to basement and some first floor flooding in larger storm events. The population of Delhi in the 2000 census is 3324, which does not include the approximately 2200 students seasonally resident at SUNY Delhi.

Stream Orders, Floodplains, and Wetlands:

The river is a fifth order stream throughout this segment. The tributaries that enter the watershed are Webster Brook, Falls Creek, Elk Creek, Kidd Brook, Steele Brook, Little Delaware River, Peakes Brook and several unnamed tributaries.

The river below Hoag's Crossing is able to access its floodplain through the long straight reach opposite confluence with Webster Brook and then becomes highly sinuous just above East Delhi. Below Fitches' Bridge the river looses much of its flood plain and sinuosity as the valley is pinched between Federal Hill and Betts Hill. After flowing around the large glacial outwash terrace at the mouth of Elk Creek and receiving the Falls

Creek tributary, the river temporarily reestablishes its floodplain before it becomes confined again as it enters the village. Through the village the river is confined by the narrow valley, local development and stone retaining walls through the village. Parts of the village were built on the alluvial fan for Steele Brook which keeps the river positioned against the southeast side of the valley until the confluence and fan associated with the Little Delaware force the river to the opposite valley wall at Sherwoods Bridge. The river crosses the valley diagonally from the foot of Bell Hill to the north to the foot of Arbor Hill to the south. This means that the floodplain moves from the right of to the left of the stream as the river moves diagonally across the valley. From the confluence of Peakes Brook to Fraser, the floodplain is once again wide.

There are eleven areas of wetlands located within this segment which includes three types: shrub swamp, shallow emergent marsh, and backwater slough. Wetlands are a very important part in this segment because they help to absorb the nutrients from agricultural and road runoff. Wetlands help to reduce the impact of nutrient overload in the water system. Too much phosphorus and nitrogen in the aquatic ecosystems can cause severe problems such as an increase in algae and plant growth. This is a concern because the increase in plant growth will deplete dissolved oxygen levels within the water system affecting aquatic habitat survival. Other benefits of wetlands consist of sediment control, reduced flood impact, and wildlife habitat.

Land Use/Land Cover:

The predominant land use is forest on the hills and agriculture in the valley except near the Village of Delhi where residential and commercial land uses are dominant. The development in and around the village is stable and regulated by zoning both within the Village and Town. The impervious surfaces associated with streets, large parking areas, and building rooftops pose a concern for stormwater management. Recent reconstruction of Route 10 through the village provided for an upgrade in the stormwater drainage system, but there is little room within the village for catchments to detain the stormwater before it reaches the river.

The riparian buffer is lacking throughout this segment and could be improved both on agricultural lands upstream and downstream of the village. Starting just above the village, Japanese knotweed is a significant and growing problem. Large colonies now exist below Falls Creek all the way through the village and down across the college farm flats through Fraser to the end of the segment. The colonies are rapidly crowding out the native vegetation and may already be causing bank destabilization below the village.

Infrastructure:

The main roads that run parallel to the river are NYS Route 10 and County Route 18, and Arbor Hill Road. These roads have a minimum negative impact on the floodplain. Downstream of Fitches covered bridge is a short section of County Highway 18 road that floods during high flow events that are greater than bankfull. Culverts carry stormwater runoff away from the roads without sufficient protection against additional sediment and

nutrient that input into the water system. Stormwater runoff is recognized as a significant water quality concern as overland flow from impervious surfaces such as roads and parking areas contains contaminants and nutrients that are delivered directly into river. In addition to the stormwater associated with Main Street and the activity of the commercial district of the village, Town and County road ditches can deliver contaminated stormwater to the river. Ditch cleaning without reseeding can also increase the turbidity within the river system

The bridges that are within this segment includes: County Bridge 33, Fitches covered bridge (County Bridge 94), Bridge Street Bridge (County Bridge 31), NYS Route 28, and Sherwood road bridge (County Bridge 10). County Bridge 33, Fitches, and Bridge Street bridges all have minor impact on sediment transportation. State Highway 28 and Sherwood bridges have deposition bars forming upstream and downstream of the structures.

Sediment Transport and Channel Evolution:

The Stream Corridor Management program has surveyed ten cross-sections in this segment. Only one of these cross-sections has a bar sample completed but the rest of the cross-sections have only pebble counts completed. The results from the collected data indicate that the bed material is coarse gravel.

The main stem of the Delaware River has not changed its course according to comparison of aerial photographs from 1938, 1963, 1971, and 1983. Interpretation of the aerial photographs indicates that most of the tributaries seem to have been straightened before the 1938 aerial photos were taken based on their direct route from the State Highway 10 to the main stem Delaware River. Historically these tributaries have been bermed, straightened and maintained as the slope of the stream decreases across their alluvial fans. These channelized reaches frequently become clogged with bedload following storm events and maintenance is required to keep the stream bed from aggrading to the point where flows easily overtop the berms. This straightening may only temporarily improve sediment transport load until the channel becomes laden with deposits following the next major storm event. Steele Brook, which runs through the Village of Delhi, is a good example of a tributary that was straightened and channelized. Outside of the village the tributaries were frequently straightened so that farmers could either avoid damage to their agricultural lands or extend their productive land up to the edge of the stream. Most of the tributaries have small riparian buffer zones as agricultural fields and pastures are cultivated and mowed close to the river banks.

Gravel side bars often form on the West Branch below the confluence of a tributary as the main river attempts to move the tributary sediment downstream. These bars can affect bank stability as the river attempts to move around these depositional features. The location of sediment bars at the mouths of the tributaries indicates that either the tributaries are moving large amounts of sediment or the river is having difficulty moving the added sediment load. Generally, if a type C stream experiences difficulty moving sediments it tends to evolve to a G stream type and then to a F type, or directly from a C

to an F. G and F types are less desirable types than a type C due to their marked tendency towards severe erosion and instability.

The table below summarizes the erosion and depositional features that are within this segment by management unit.

Table 7.4.1 - Summary of Erosion and Depositional Features

Management unit	Length (mi)	Linear Feet of Erosion	Surface Area (sq.ft.)	# Erosion Features	# Deposition Features	LF Erosion per Mile	# Erosion Features/mi	# Deposition Features/mi
14	4.60	8377	41689	50	31	1821.09	10.87	6.74
15	1.67	3282	12718	10	1	1965.27	5.99	0.60
16	1.27	3499	16548	23	10	2755.12	18.11	7.87
17	0.87	1081	3998	7	2	1242.53	8.05	2.30
18	1.12	3953	15705	19	6	3529.46	16.96	5.36
19	2.84	7665	26247	32	8	2698.94	11.27	2.82

History of Stream Management:

The majority of the revetments in this segment consist of dumped stone which are commonly found along agricultural fields. In this segment there seems to be more berms along agricultural fields than in other segments. **Table 7.4.2** shows the extent and types of revetments and length of berms within each management unit. Behind the Ames Plaza there is a long section of berm that continues along the bank into the adjacent crop field. In the village there are several sections of *stacked rock walls* and rip rap along the banks. Most of the revetment is well maintained especially in the Village of Delhi.

Table 7.4.2 Revetment and Repairs

Management Units	Length (mi)	Dumped Stone	Rip Rap	Laid-up Stone	Stacked Rock Wall	Gabions	Log Cribwall	Concrete	Sheet Piling	Other	Log Deflectors	Total Revetment Length (ft)	Revetment Length per mile	Berms	Berm Length (ft)
14	4.60	33	3	1	-	-	3	-	-	-	-	8646	1880	8	4924
15	1.67	10	5	1	-	-	-	-	1	-	-	3988	2388	3	1922
16	1.27	6	2	-	1	-	-	1	-	-	-	794	625	-	-
17	0.87	11	1	-	11	-	-	4	-	-	-	3118	3584	-	-
18	1.12	10	3	-	-	-	-	-	-	-	-	1563	1396	1	448
19	2.84	10	1	1	1	-	2	1	-	-	-	3271	1152	-	-

7.4.1 Management Unit 14

Figure 7.4.1 is a picture of a stretch of the West Branch Delaware River within Management Unit 14. This management unit is rated unstable. There are two locations where the West Branch comes in contact with the valley wall. This section of the West Branch should have wider floodplains where agricultural fields are located. Some of the agricultural lands have extensive berms along their fields that prohibit floodplain access.

Figure 7.4.1 Typical scene in Management Unit 14 located approximately 6,500 feet downstream from County Bridge 33.

The tributaries that enter the West Branch are Kidd Brook and Glen Burnie. Gravel bars downstream from the confluence of the Glen Burnie tributary indicate that it contributes a high sediment load, whereas Kidd Brook contributes less sediment.

There are two bridges located on Hoag's Crossroad (County Bridge 33) and Fitches Road (County Bridge 94).

Figure 7.4.2 High eroding right bank located approximately 2,600 feet upstream from County Bridge 33.

Location and extent of bank or bed erosion is mainly along agricultural fields with no riparian buffer, but there are some areas where the river hugs the valley wall or scours the base of glacial alluvial deposits. Above Hoag's Crossing, the river winds its way around several small hills on the valley floor that are the likely remnants of glacial moraines. **Figure 7.4.2** shows a high eroding bank just downstream of a meander bend where the river is undermining even the deep rooted vegetation. The agricultural land on the opposite bank has been bermed which confines the river and increases the stress on the stream banks. Removing or setting back the berms could improve bank stability and reduce the need for additional revetments.

There is one section approximately one mile upstream from Fitches Bridge where the river becomes very sinuous and unstable. The vegetation has shallow roots and cannot effectively protect the banks.

There are numerous by-pass channels and areas of aggradation located within this unit. The by-pass channels are a special concern because they could indicate that the river is unable to adequately move its sediment.

Figure 7.4.3 Typical rip rap installation approximately 1/2mile upstream of County Bridge 94.

Revetments such as rip rap as shown in **Figure 7.4.3** are used to help protect the stream banks from erosion, but the excessive use of rip rap can accelerate the stream's *velocity* along the bank and result in additional erosion downstream.

Two areas of wetland are located upstream from Fitches Bridge and both are classified as shrub swamps.

Monitoring bank pins where placed in stream banks that have been actively eroding. This unit contains two monitoring pins. Bank pin number 44.40 is located approximately 6,000 feet upstream of Hoag's crossing (County Bridge 33). This bank pin was lost in this reach and was replaced in June 2003 with bank pin number 44.41. Another monitoring bank pin number 47.20 is located downstream of Hoag's Crossing Bridge (County Bridge 33). This unit contains monitored cross-sections 45, 46, 47, and 48.

7.4.2 Management Unit 15

Figure 7.4.4 shows a typical scene that is within Management Unit 15. Most of the river in this unit is bounded by agricultural land with little riparian buffer. Management Unit 15 is moderately stable.

Figure 7.4.4 Typical scene in Management Unit 15 near the Elk Creek tributary.

Tributaries that enter this unit are Elk Creek and Falls Creek. Below Fitches Bridge the river valley is pinched between the two hills and the river loses much of its floodplain. The confluence of Elk Creek is significantly aggraded and

may create the long pool found upstream of the confluence. The length of this pool and its silty bottom are unusual morphologic features of this system.

Figure 7.4.5 Eroding bank on the left bank located at the end of Management Unit 15.

Downstream of Elk Creek confluence the reach appears to be entrenched for approximately 700 feet. This may be due to an area of fill on the right bank associated with the construction of NYS Route 10 and a high glacial outwash terrace on the left bank. This creates some erosion on the left bank and the right bank has been armored with rip rap. The river regains its floodplain further downstream and becomes fairly stable. Some bedrock can be found along the right bank near the Route 10 rest area. Falls Creek confluence appears to be slightly aggraded. Downstream of Falls Creek confluence, the banks are experiencing moderate erosion due to shallow rooted vegetation along agricultural lands which can be seen in **Figure 7.4.5**.

One area of wetland within this unit is located approximately 3,000 feet upstream from Elk Creek confluence. This wetland is classified as a shrub swamp.

There are no measured cross-sections within this management unit at this time. This unit contains two monitoring pins. Bank pin number 51.5 is located downstream of Elk Creek confluence and bank pin number 53.0 is located at the end of Management Unit 15.

Management Unit 16:

Management Unit 16 is unstable with a significant number of center bars, islands and by-pass channels. There are numerous clay/silt exposures on the banks and an increase in the amount of Japanese knotweed through this reach.

Figure 7.4.6 High eroding bank on the left side of the river near the top of this management unit.

The river has historically been unstable and has had problems moving sediment through this reach as evidenced by the numerous by-pass channels, center bars, eroding banks and

Figure 7.4.7 Poorly vegetated eroding bank on the right side approximately 100 feet downstream of **Figure 7.4.6**.

cut-off meander bends. **Figure 7.4.6 and Figure 7.4.7** shows the examples of the erosion within the upper portion of this management unit. There is nearly 3500 feet of eroding bank along the 6670 feet of river in unit 16. Approximately 30 percent of the eroding banks have an average bank height 4.5 feet high or greater.

There are two areas of wetlands within this management unit which are located approximately 3,000 feet and 5,000 feet upstream from the Bridge Street Bridge (County Bridge 31). Both of these wetlands are classified as shrub swamp.

There are no monitoring cross-sections or bank pins within this unit at this time.

7.4.4 Management Unit 17

This management unit runs through the Village of Delhi. See **Management Unit 17 – Map 1** through **Map 6** at the end of this unit description. Development along the banks limits the river's access to its floodplain. The land use in the middle section of this unit is primarily residential and commercial. Delhi has three major bridges that cross the river. One bridge is County bridge 31 located on Bridge Street and two New York State Department of Transportation bridges located on Kingston Street. Within this unit is a USGS gage station 01421900 (West Branch Delaware River Upstream from Delhi NY) which is located upstream from Bridge Street (County bridge 31).

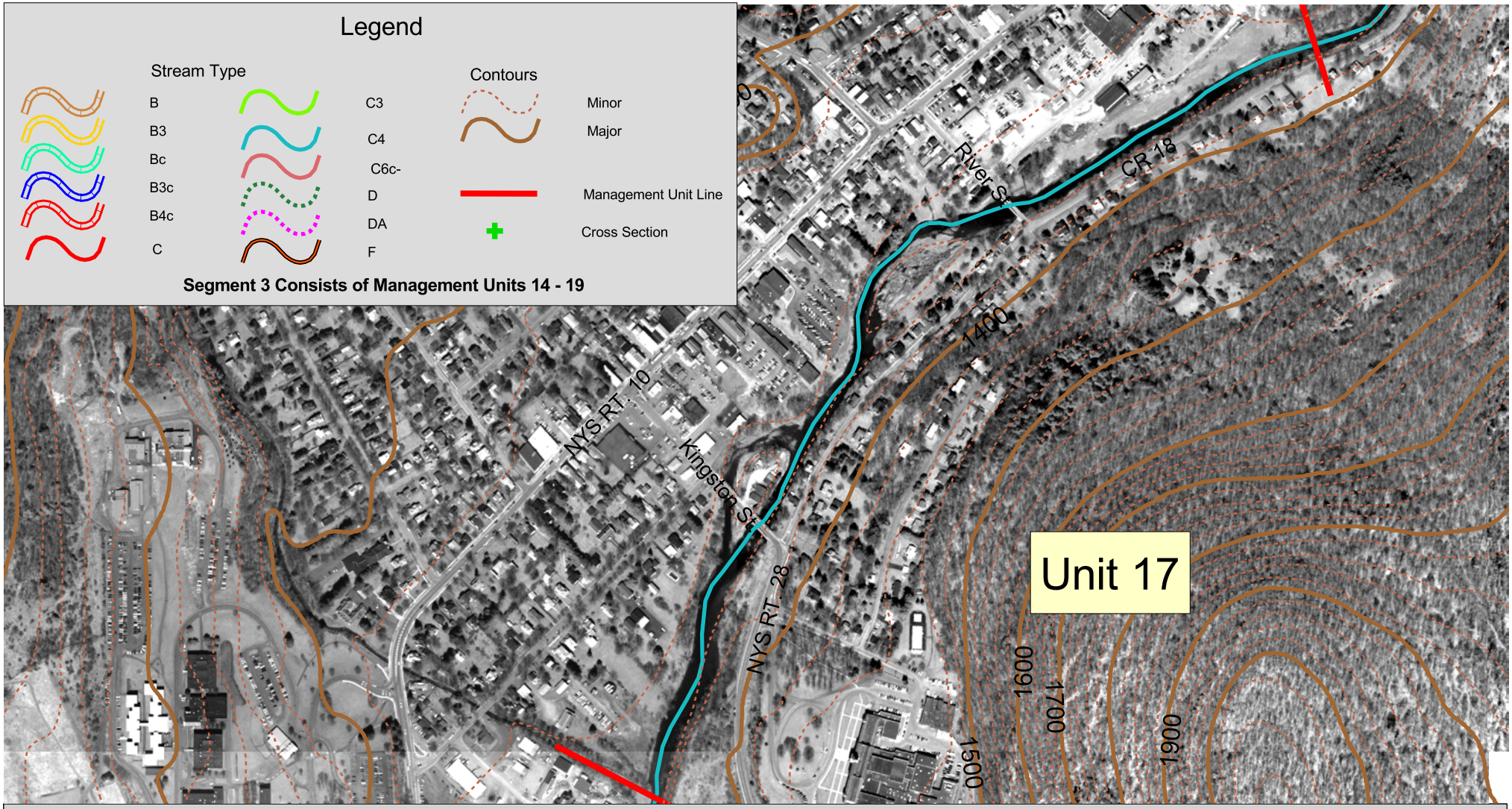
Figure 7.4.8 Rip rap along the island upstream from Kingston Street Bridge.

There are noticeably more revetments along the banks (3110 feet of revetment over 4500 feet of stream) and a decrease of eroding banks (1081 feet). **Figure 7.4.8** shows rip rap along the island upstream from Kingston Street Bridge.

There are few depositional bars possibly due to the confinement of the channel and absence of any tributaries above Steele Brook. This management unit is stable, therefore monitoring cross-sections have not been set at this time. There are no wetlands located within this management unit, however the large vegetated point bar below Bridge Street is an important riparian feature. It provides both habitat, and the wider stream width at this bar provides relief to the stress associated with the confined channel conditions through the village

There is a significant amount of Japanese knotweed colonizing the stream banks through the village. Landowners should exercise caution in attempting to manage the plant (see **Section 5.10.4**).

Management Unit 17- Map 1
Stream Types and Cross Sections



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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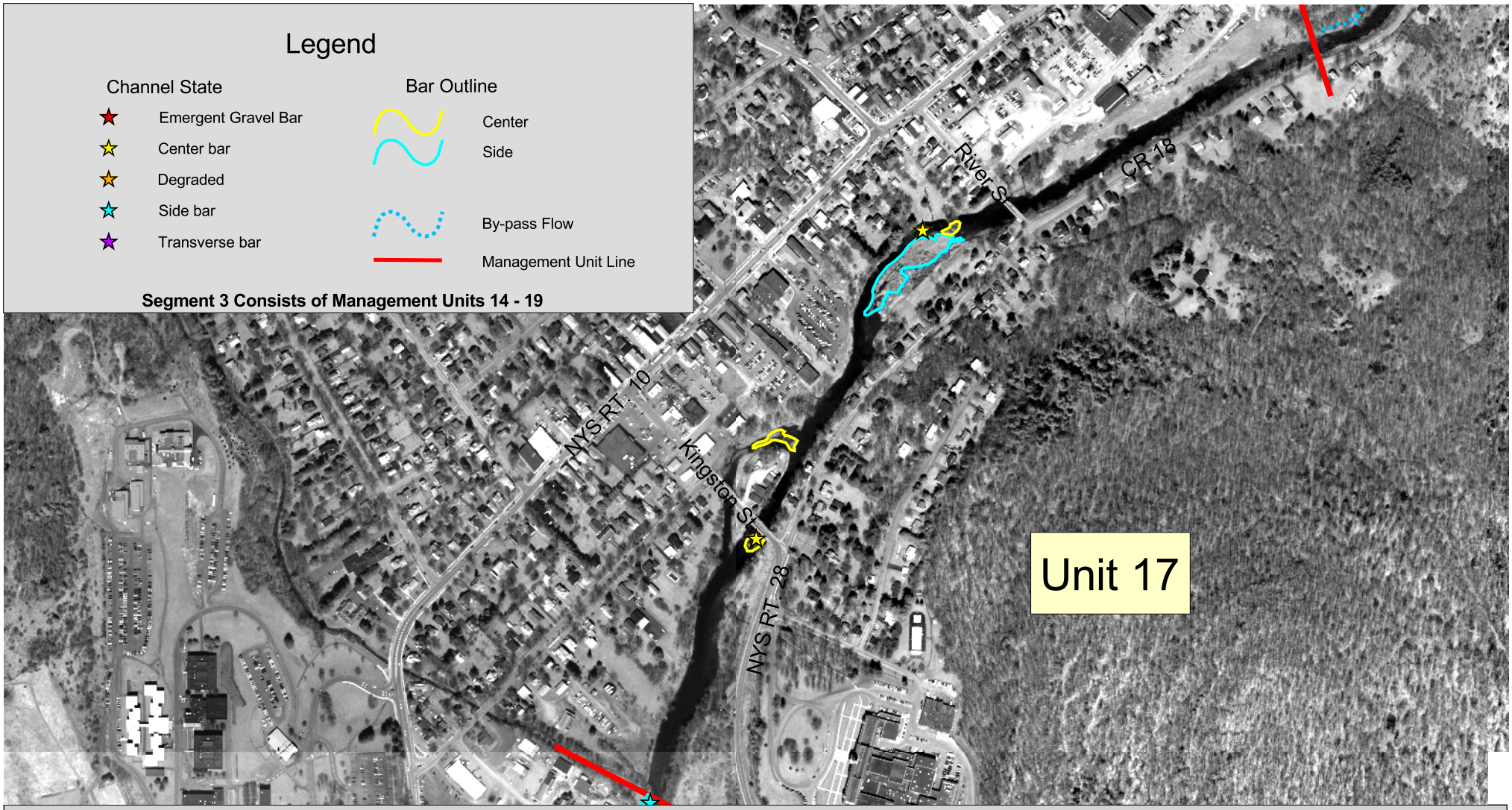
Management Unit 17 - Map 2
Channel State and By-Pass Flow



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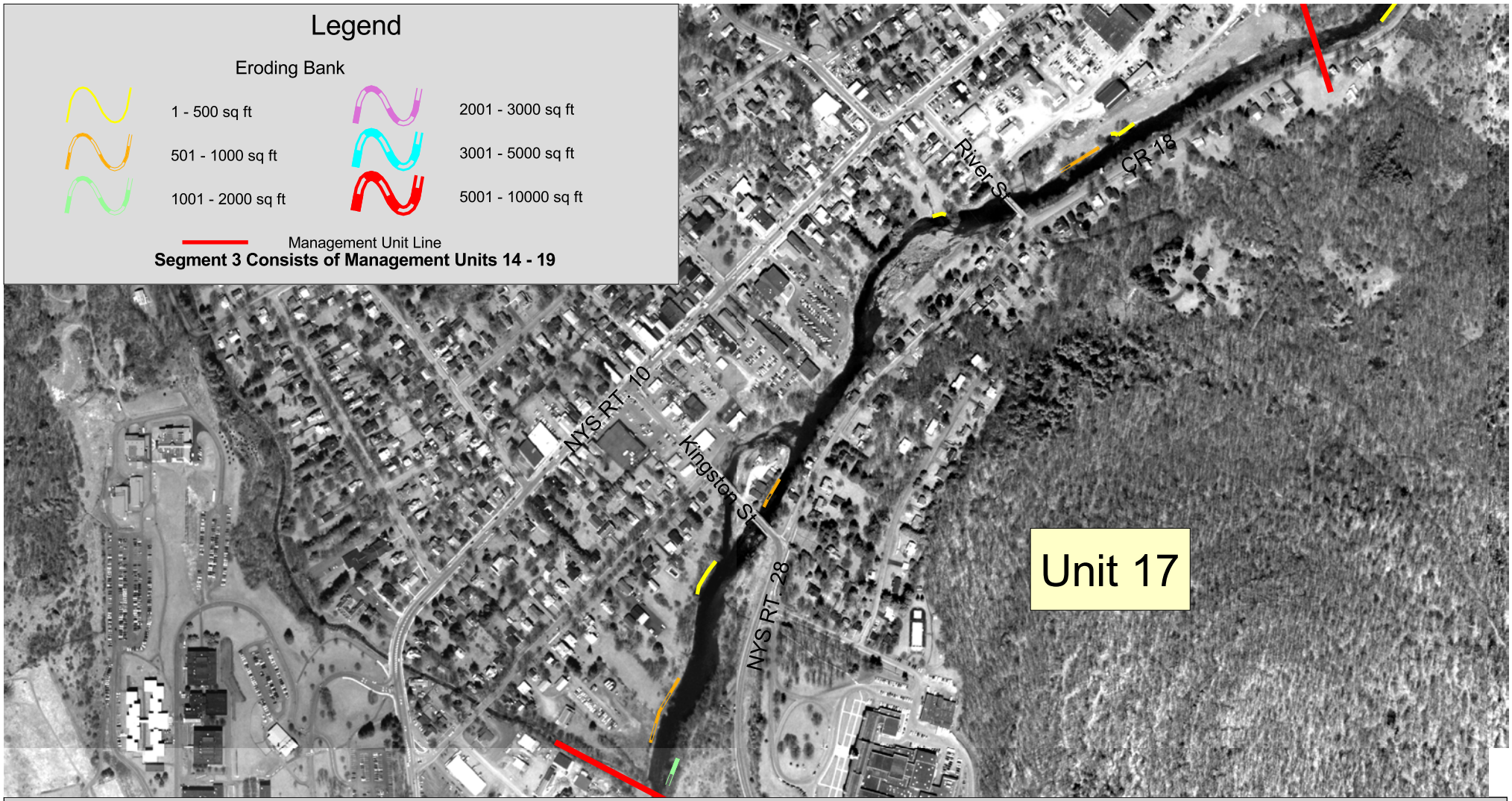
Management Unit 17 - Map 3
Eroding Banks



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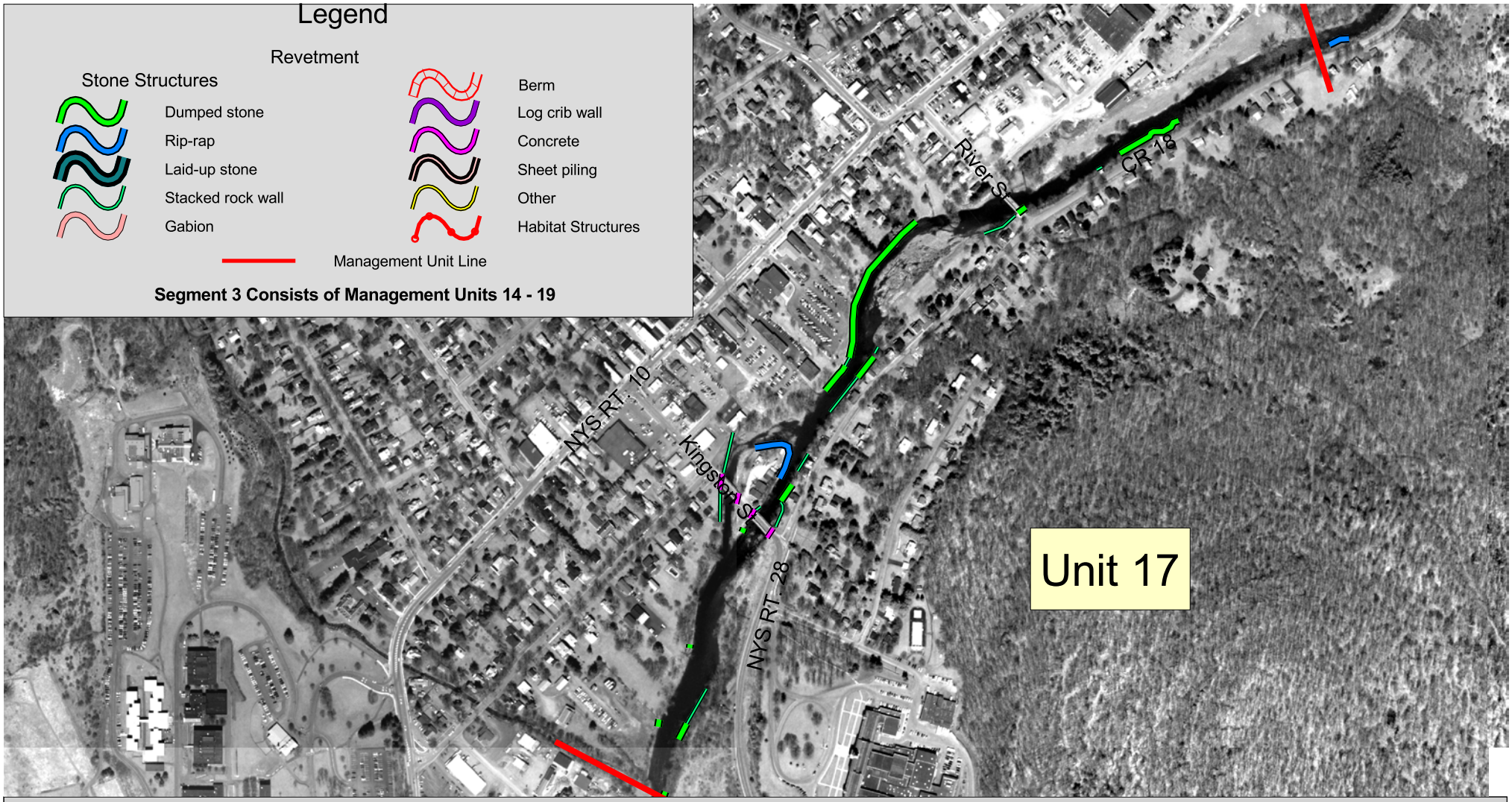
Management Unit 17 - Map 4
Revetment



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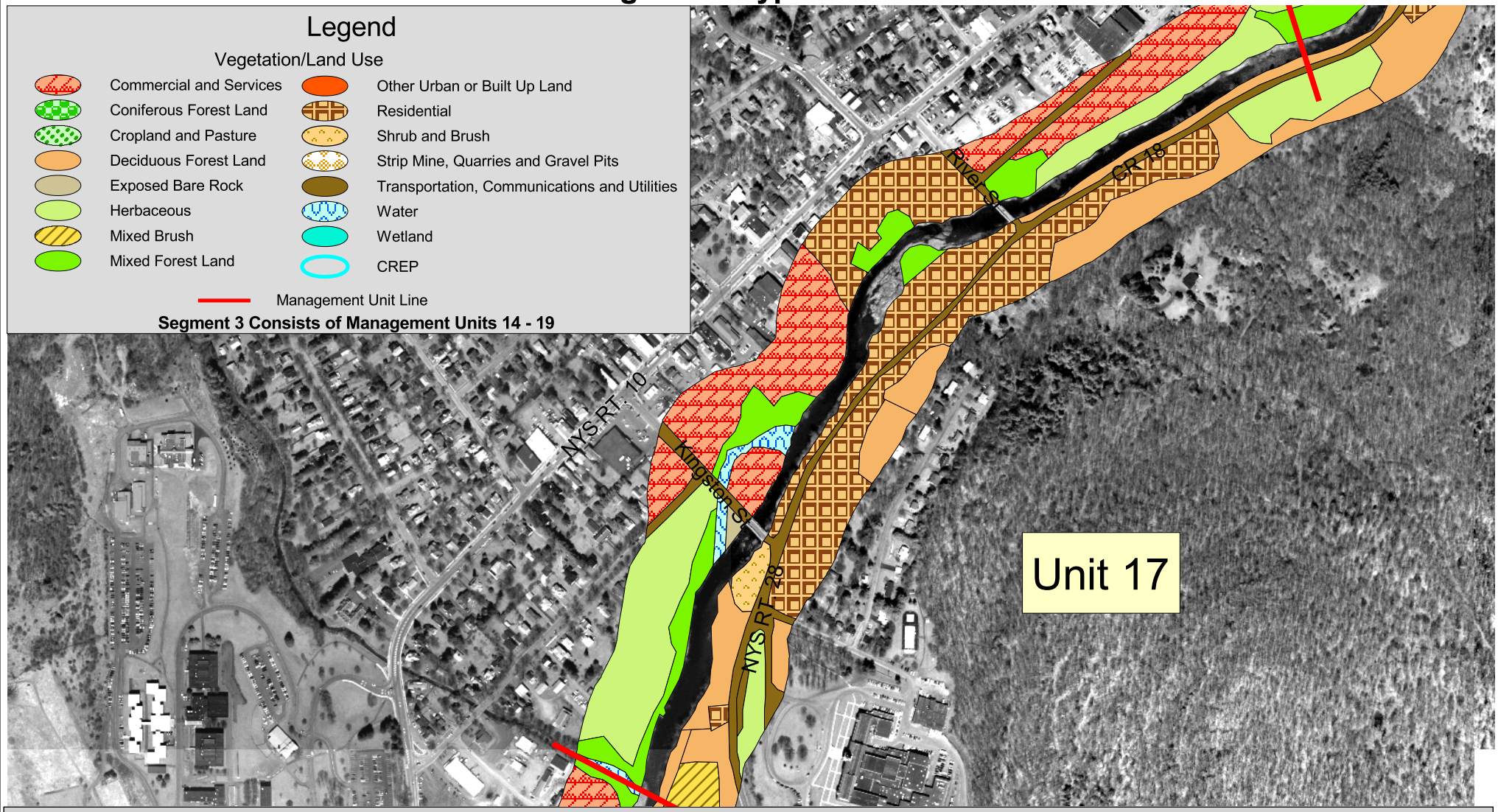
Management Unit 17 - Map 5
VegetationTypes/Land Use



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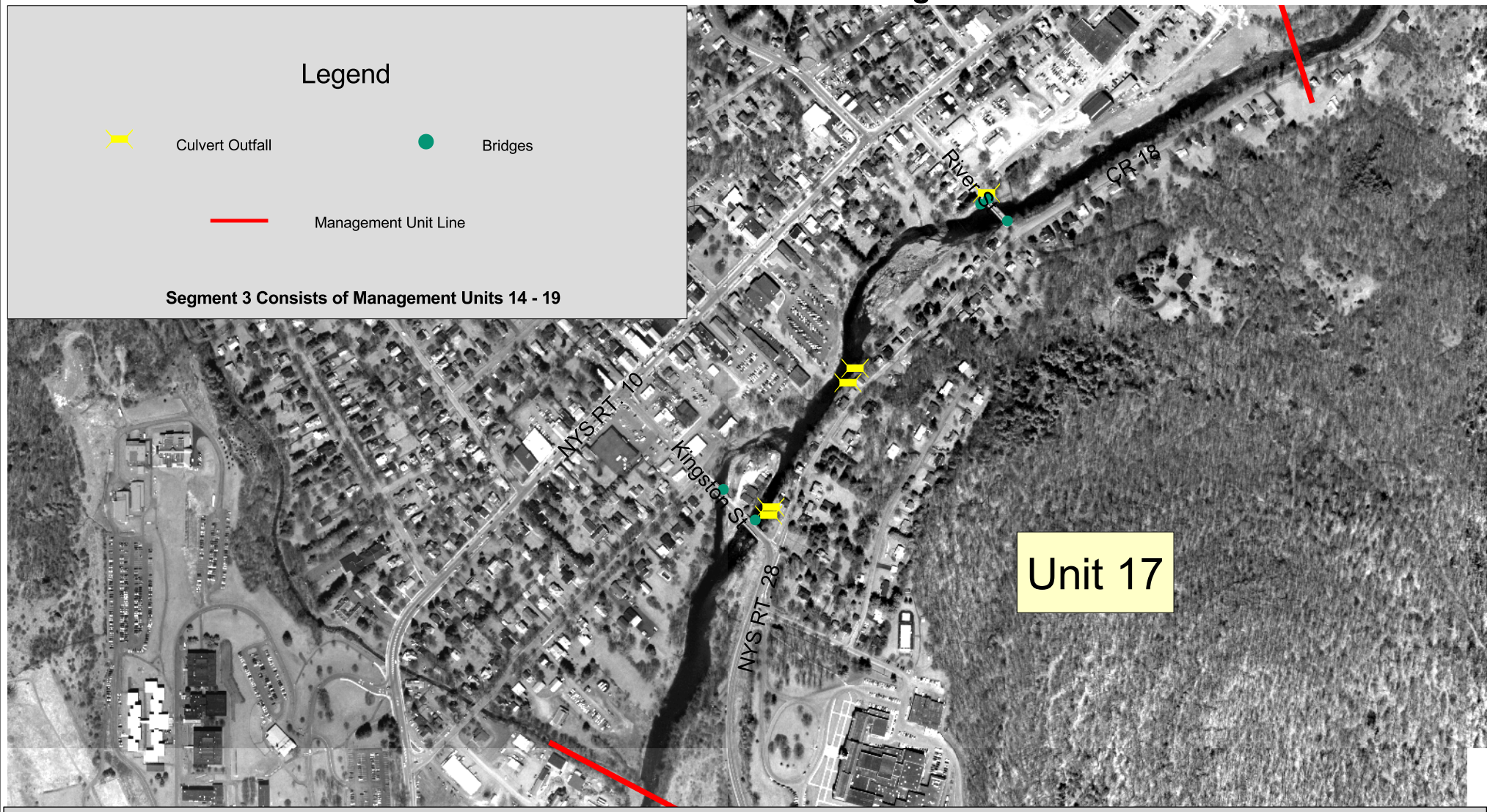
Management Unit 17 - Map 6
Culvert Outfalls and Bridges



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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7.4.5 Management Unit 18

Management Unit 18 begins at the confluence of Steele Brook. The land use along the river through this unit is commercial along the right bank and mixed deciduous forest and successional shrubland along the left bank. The reach is 5,893 feet long, has 3,953 feet of eroding bank (28% is 4.5 feet or more in average bank height) and over 2,000 feet of revetment.

Steele Brook tributary contributes a high sediment load which is forming side, transverse and center bars downstream of its confluence. This excess sediment from Steele Brook is forming a center bar downstream of the outflow forcing the river toward the opposite bank. An old gage station was located just downstream of Steele Brook confluence and now the high bank is presently eroding as shown in **Figure 7.4.9**.

Figure 7.4.9 High eroding bank opposite of Steele Brook confluence.

A large transverse bar on the lower portion of the reach directs flows into the left bank which poses a threat to Arbor Hill Road. The property owner has rip-rapped the bank. The County Department of Public Works has re-enforced the banks where the Delhi sewage plant pipelines run underneath the river just upstream of Sherwood Bridge (County Bridge 10).

Figure 7.4.10 Poorly vegetated bank and a section of Japanese knotweed located approximately 2,000 feet upstream from County Bridge 10.

This management unit is unstable and highly erosive. There are no cross-sections in this unit at this time. Of special concern are the expanding colonies of Japanese knotweed found along the banks. **Figure 7.4.10** shows a section of knotweed along an eroding bank that is poorly vegetated.

7.4.6 Management Unit 19:

Management Unit 19 is 14,780 feet long reach where the West Branch Delaware River valley becomes wider as it accepts flows from the Little Delaware River watershed. Long pools and short riffles are typical through this reach. The river remains a C4 stream type below the confluence with the Little Delaware. The Little Delaware River contributes a moderate amount of sediment to the West Branch main stem. Gravel bars are found both at the confluence and further downstream along the long straight reach which lies at the base of the alluvial fan of the Little Delaware.

Figure 7.4.11 Typical scene in Management Unit 19 located downstream of County Bridge 10.

The land along the river is predominately used for agriculture. Forest land on steep banks are frequently found opposite the agricultural fields as the river hugs the valley walls along the Delhi College farm and at the base of Arbor Hill. The College's agricultural lands also have long stretches of knotweed along banks often associated with bank erosion as shown in **Figure 7.4.12**. Another large colony is found behind the 4-H camp opposite DMV Nutritionals.

Figure 7.4.12 Section of Japanese knotweed and eroding bank found near the Delhi college agricultural land.

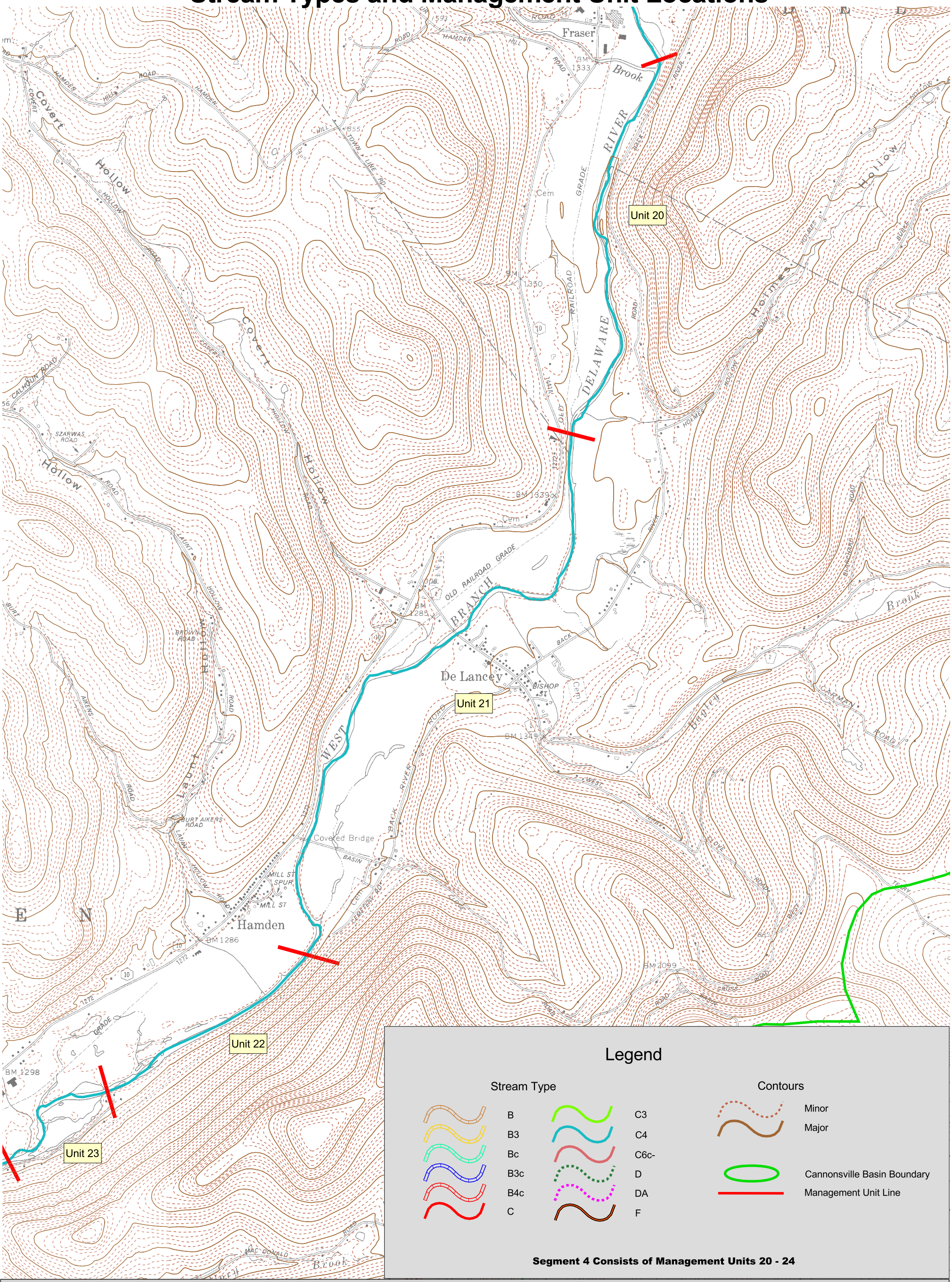
Figure 7.4.13 Poorly vegetated eroding bank located upstream from Peaks Brook confluence.

The majority of erosion occurs along agricultural fields with poorly vegetated banks as illustrated in **Figure 7.4.13**. There was over 7,600 feet of total eroding stream bank in this unit. This management unit is moderately stable with unstable reaches and contains monitored cross-sections 54, 55, 56, 57, 57.9, and 58.

There are three areas of wetlands; including one shallow emergent marsh and two backwater sloughs.

Segment 4

Segment 4 - Map 1
Stream Types and Management Unit Locations



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
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GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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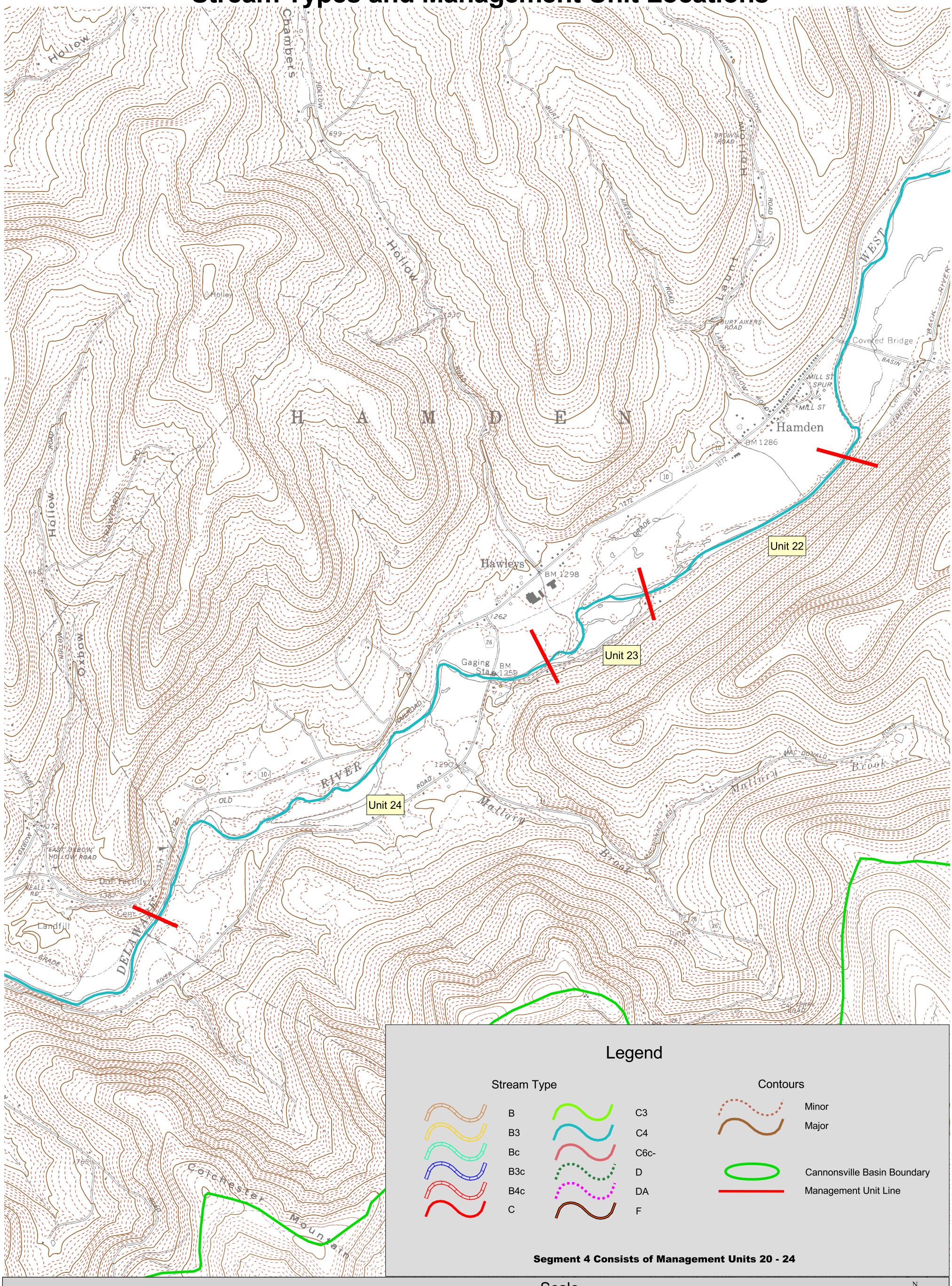
Segment 4 - Map 2
Stream Types and Management Unit Locations



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 11-30-04
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7.5 Segment 4 - Town of Hamden

General Description of Segment Four

Segment four begins at the confluence of Platner Brook and ends at the Hamden/Walton town line (see **Segment 4 – Map 1** and **Map 2**). The total surveyed stream length of this segment is 46,142 feet long. Two population centers are within this segment: the hamlets of Delancey and Hamden. The drainage area at the top of this segment is approximately 206 square miles and approximately 263 square miles at the bottom. The valley slope in this area is 0.0019 and the stream type is classified as a C4. The channel features are mainly long pools and short riffles.

The Town of Hamden was originally settled in the 1700's and incorporated in 1825. Historically, agriculture led the economy of the community and the productive river bottom lands were prized by local farmers. Fields along the banks of the river have been mowed or cropped fields close to the river banks which have reduced the size of the riparian forest buffer. This practice has reduced the protection provided to the stream bank and resulted in accelerated stream bank erosion. To alleviate this problem many farmers have dumped stone along the banks in an attempt to reduce water's impact on the banks.

This segment is broken up into Management Units 20 through 24. The table below summarizes the erosion and depositional features that are within this segment by management unit.

Table 7.5.1 - Summary of Erosion and Depositional Features

Management unit	Length (mi)	Linear Feet of Erosion	Surface Area (sq.ft.)	# Erosion Features	# Deposition Features	LF Erosion per Mile	# Erosion Features/mi	# Deposition Features/mi
20	1.75	7739	31315	25	10	4422.29	14.29	5.71
21	2.97	8307	27497	38	14	2796.97	12.79	4.71
22	1.03	3234	7658	13	4	3139.81	12.62	3.88
23	0.64	2236	9432	12	12	3493.75	18.75	18.75
24	2.35	4970	19346	34	30	2114.89	14.47	12.77

Stream Orders, Floodplains, and Wetlands:

The West Branch Delaware River continues to be a fifth order stream. Tributaries that enter the West Branch of the Delaware River are Bagley Brook, Pettis Brook, Launt Hollow, Chambers Hollow, and Mallory Brook.

Throughout this segment the broad floodplains are used for agriculture. There has been limited development along the margin of the floodplain, typically on alluvial fans for streams flowing from the sides of the valley. The hamlet of Delancey is on the alluvial fan from Bagley Brook and portions of the West Branch floodplain. The hamlet of Hamden is located on the alluvial fan from Launt Hollow. The county office building and New York State Electric and Gas (NYSEG)

offices near Chambers Hollow are built on an alluvial fan at the edge of the floodplain for the West Branch. The location and extent of the regulatory floodplain for the Town of Hamden is not well defined by the community's outdated flood insurance rate maps.

There are only three areas of wetlands along the river including a shallow emergent marsh, a shrub swamp, and a backwater slough. Wetlands in this segment help to absorb some of the nutrients from agricultural and storm water runoff and reduce the impact of nutrient inputs into the river system. Excess phosphorus and nitrogen in the aquatic ecosystems it can increase in algae and plant growth resulting in the depletion of dissolved oxygen levels. Wetlands also function to trap sediment, store flood waters and provide wildlife habitat.

Land Use/Land Cover:

Agriculture remains the dominant land use within this segment. There are a few residential structures in the floodplain in Delancey and Hamden which are affected by major flood events. To date, there has been little commercial development in the flood plain area. Some of the agricultural land is under Conservation Resource Enhancement Program (CREP) to help create a riparian buffer along the river banks on agricultural fields. Still there are some agricultural lands that have little to no riparian buffer because the farmers mow up to the river banks. The riparian buffer is very important because the vegetation helps to stabilize banks and the buffer absorbs nutrients such as nitrogen and phosphorus and keeps them from entering the river.

Infrastructure:

The roads that bridge the river in this segment include County Highway 2, County Highway 26 and the covered bridge on Basin Clove road. The major roads that run parallel to the Delaware River are State Highway 10 and Back River road which have minimal influence on the stream floodplain. The old railway bed travels through the floodplain on occasion, but has limited effect where it encroaches on the floodplain near Delancey and the Chambers Hollow tributary.

Traditionally bridges have been designed and built to allow the passage of major floods under the bridge and with little regard for the natural processes of rivers. This often results in severe upstream aggradation, bed and bank scour through the constriction, and bank erosion below the structure. Delaware County Department of Public Work (DPW) has recognized these problems and working to improve its bridge designs to reduce the stress to the bed and banks and improve sediment transport through the bridge. The County Highway 2 Bridge was re-built in 2002 and includes floodplain culverts. These culverts allow the river to access its floodplain and reduce the constriction previously responsible for undermining the bridge's abutments and destroying approach to the bridge.

Sediment Transport and Channel Evolution:

Bagley Brook and Chambers Hollow Brook yield large quantities of bedload which contributes to channel instability near their confluence with the West Branch. As it enters the hamlet of Delancey, Bagley Brook has been realigned to a location upstream of the hamlet. Its current alignment reduces its slope and does not enable it to effectively move its bedload, as a result the

channel must be maintained to prevent it from clogging with bedload. Both Launt Hollow and Pettis Brook appear to be stable.

The Stream Corridor Management Program has sampled bed material along three cross-sections within this segment. The results indicate that the bed material consist of very coarse gravel to cobble material. There are several depositional bars within this segment that have influence on bank erosion where the water is being forced around the bars and into the banks. Some of the banks are poorly vegetated due to agricultural fields or lawns being mowed to the river banks. Generally, if a type C stream experiences difficulty moving sediments it tends to evolve to type G and then to a type F, or directly from a C to an F. G and F types are less desirable types than a type C due to their marked tendency towards severe erosion and instability.

The West Branch Delaware stream alignment has not changed in most of this segment when compared to aerial photographs from 1938, 1963, 1971, and 1983. Many of the tributaries entering the West Branch had been straightened prior to 1938. Historically these tributaries have been straightened, entrenched, and bermed across their alluvial fans from roads that parallel the West Branch until they enter the main stem. The river's alignment continues to change upstream and downstream of Chambers Hollow and Bagley Brook in response to sediment inputs from those tributaries. Depositional bars at the mouths of Chambers Hollow and Bagley Brook are evidence of a high volume of sediment from these tributaries and that the river is having difficulty moving this sediment.

Aquatic habitat Conditions:

Throughout this section there are at least 6 significant spring seeps that contribute cold water to the stream. These cold water inputs help keep the stream temperature lower and provide refuge for the fish, such as trout in the summer months. Long reaches of the river flow along the south valley wall shaded by the overhanging cover of hemlock trees. This forest type prefers the cool, moist site conditions typically found on north facing slopes of the valley. The lack of tree cover along agricultural fields limits the quality of the habitat.

History of Stream Management:

Landowners and construction agencies have extensively utilized revetments to maintain the position of the river and protect land and facilities from the river. **Table 7.5.2** shows the extent and types of revetments and length of berms within each management unit. There is nearly 14200 feet of bank revetment along the river in this segment. Most of the revetment is dumped stone placed along stream banks near agricultural fields. There are several berms in this segment that limit floodplain access. A berm just above the land fill is constructed of old vehicles.

Table 7.5.2 – Revetment and Repairs

Management Units	Length (mi)	Dumped Stone	Rip Rap	Laid-up Stone	Stacked Rock Wall	Gabions	Log Cribwall	Concrete	Sheet Piling	Other	Log Deflectors	Total Revetment Length (ft)	Revetment Length per mile	Berms	Berm Length (ft)
20	1.75	5	-	-	1	-	-	-	-	-	-	190	109	1	836
21	2.97	29	5	-	1	-	1	2	-	1	-	6625	2231	3	980
22	1.03	6	-	-	-	-	-	-	-	1	-	976	948	-	-
23	0.64	10	-	-	-	-	-	-	-	-	-	1275	1992	-	-
24	2.35	21	2	-	-	-	-	1	-	2	-	5433	2312	1	159

7.5.1 Management Unit 20

Management Unit 20 is predominately agricultural land except for where the river runs close to the south valley wall exposing bedrock on the left bank. Tributaries that enter this unit are Holmes Hollow and Platner Brook. These tributaries contribute sediment load to the main stem resulting in the formation of numerous depositional bars downstream from their confluences. These bars are causing additional bank erosion. This management unit is unstable and is being monitored with cross-sections 59 and 60.

Figure 7.5.1 Typical eroding bank along agricultural field with no riparian buffer approximately 4,000 feet downstream of Platner Brook.

The significant number of eroding banks in the vicinity of aggradation areas suggests that the river is attempting to alter its alignment to enable it to move around the deposits. As many of these banks have little to no vegetation as shown in **Figure 7.5.1**, the river is able to rapidly remove huge sections of bank with each storm event. The riparian buffer width should be increased for almost all of the agricultural fields along the river in this management unit. The stream program should also continue to review stable or "reference" stream alignments for large C streams in an effort to provide recommendations for channel realignment as needed by stream bank stabilization and river restoration efforts.

There are two areas of wetlands located 3,500 feet downstream of Platner Brook. These wetlands are classified as shrub swamp and shallow emergent marsh.

7.5.2 Management Unit 21

Although the land along the stream is primarily agricultural land in Management Unit 21, the unit also includes the Hamlets of Delancey and Hamden. Hamden Covered Bridge (County Bridge 54) and Delaware County Route 2 Bridge (County Bridge 2-1) are within this unit.

Figure 7.5.2 Typical scene of the West Branch in Management Unit 21 located approximately 4,000 feet upstream from Bagley Brook confluence.

Tributaries that enter this unit are Bagley Brook and Pettis Brook and both of these tributaries have high sediment load. Pettis Brook sediment load has been noted near New York State Route 10, but the majority of this excess load has not reached the main stem. Deposition is found in the vicinity of bridges and at the confluence of Bagley Brook. This management unit is classified as moderately stable. The monitored with cross-sections 62 and 63 are located in this reach.

Figure 7.5.3 Eroding bank upstream from Bagley Brook confluence.

Erosion is mainly in the upper portion of this unit along agricultural fields with little to no riparian buffer. An old vehicle revetment (partially buried) can be found just downstream of Bagley Brook confluence. There are fewer revetments located within this unit, with most of the revetment associated with the bridges, New York State Highway Route 10 and some of the agricultural fields.

There is one small area of wetland located 1,600 feet upstream of the County Bridge 2-1. This wetland is classified as a backwater slough.

Other features to observe are the Willow planting project upstream of Bagley Brook confluence and the floodplain culverts at the County Bridge 2-1.

7.5.3 Management Unit 22

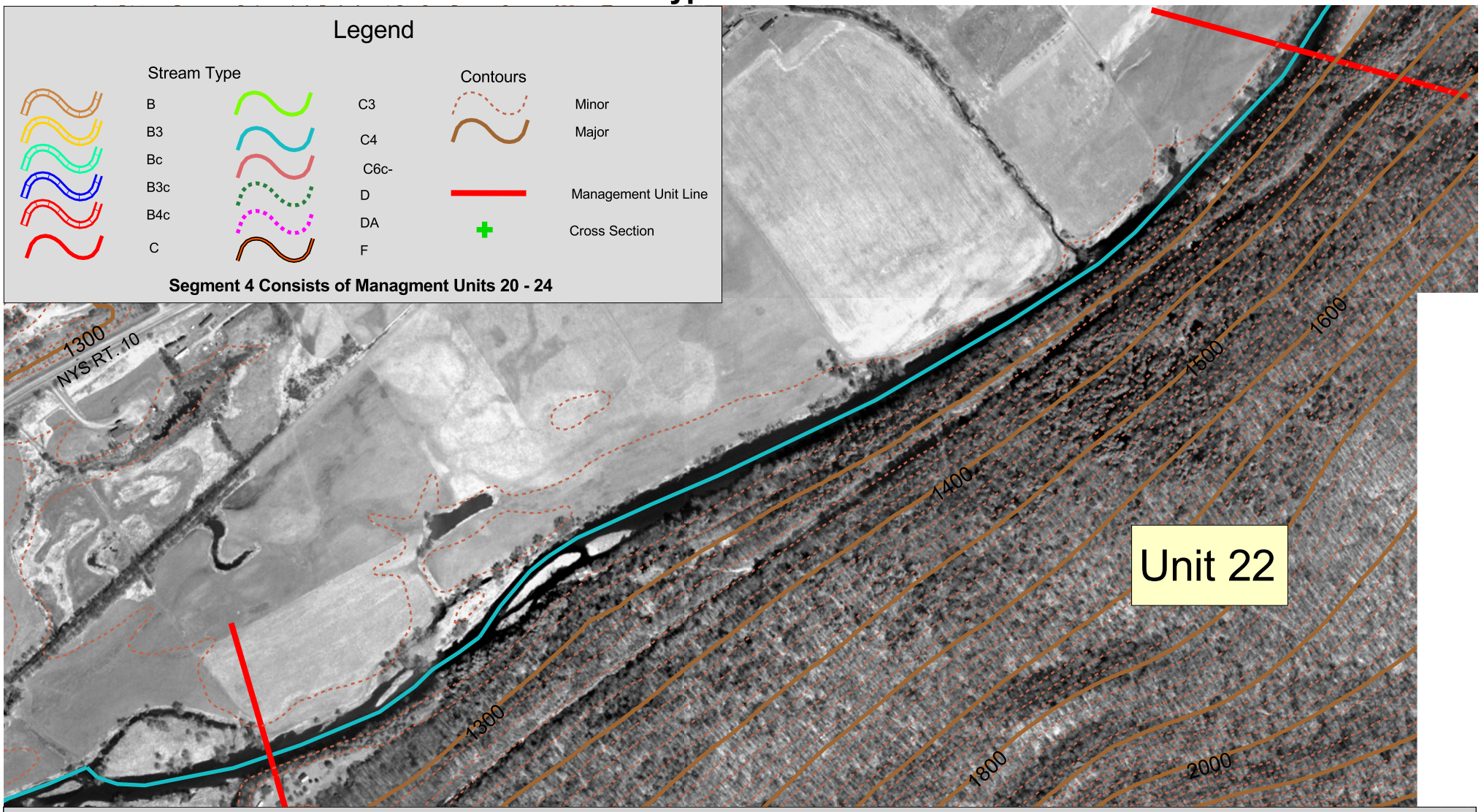
In this management unit the river runs along a steep side hill on the left bank. See **Management Unit 22 – Map 1** through **Map 6** at the end of this unit description. All the floodplain is located on the right side and it has no riparian buffer. Launt Hollow tributary enters the West Branch downstream of the Hamlet of Hamden and has formed a center bar at its confluence which can be seen in **Figure 7.5.5**. There are additional center bars 2,000 feet downstream of Launt Hollow. Bank erosion is mainly occurring in the areas of this group of center bars.

This management unit is moderately stable and contains no monitored cross-section at this time. There are no wetlands located within this unit.

Figure 7.5.4 Typical scene in Management Unit 22 and is located 1,600 feet downstream from Launt

Figure 7.5.5 Confluence of Launt Hollow.

Management Unit 22 - Map 1
Stream Types and Cross Sections



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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Management Unit 22 - Map 2
Channel State and By-Pass Flow

Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
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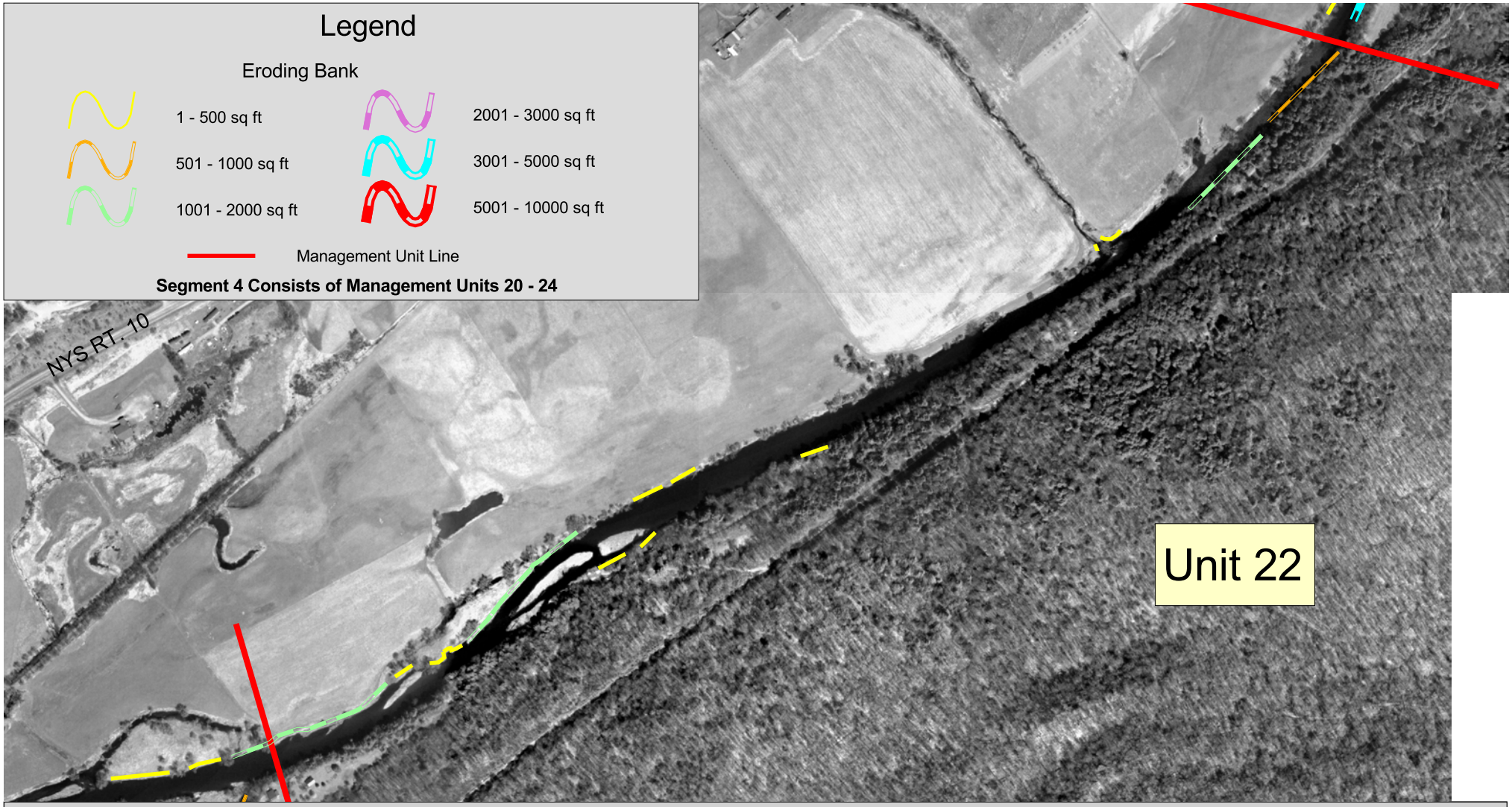
Management Unit 22 - Map 3
Eroding Banks



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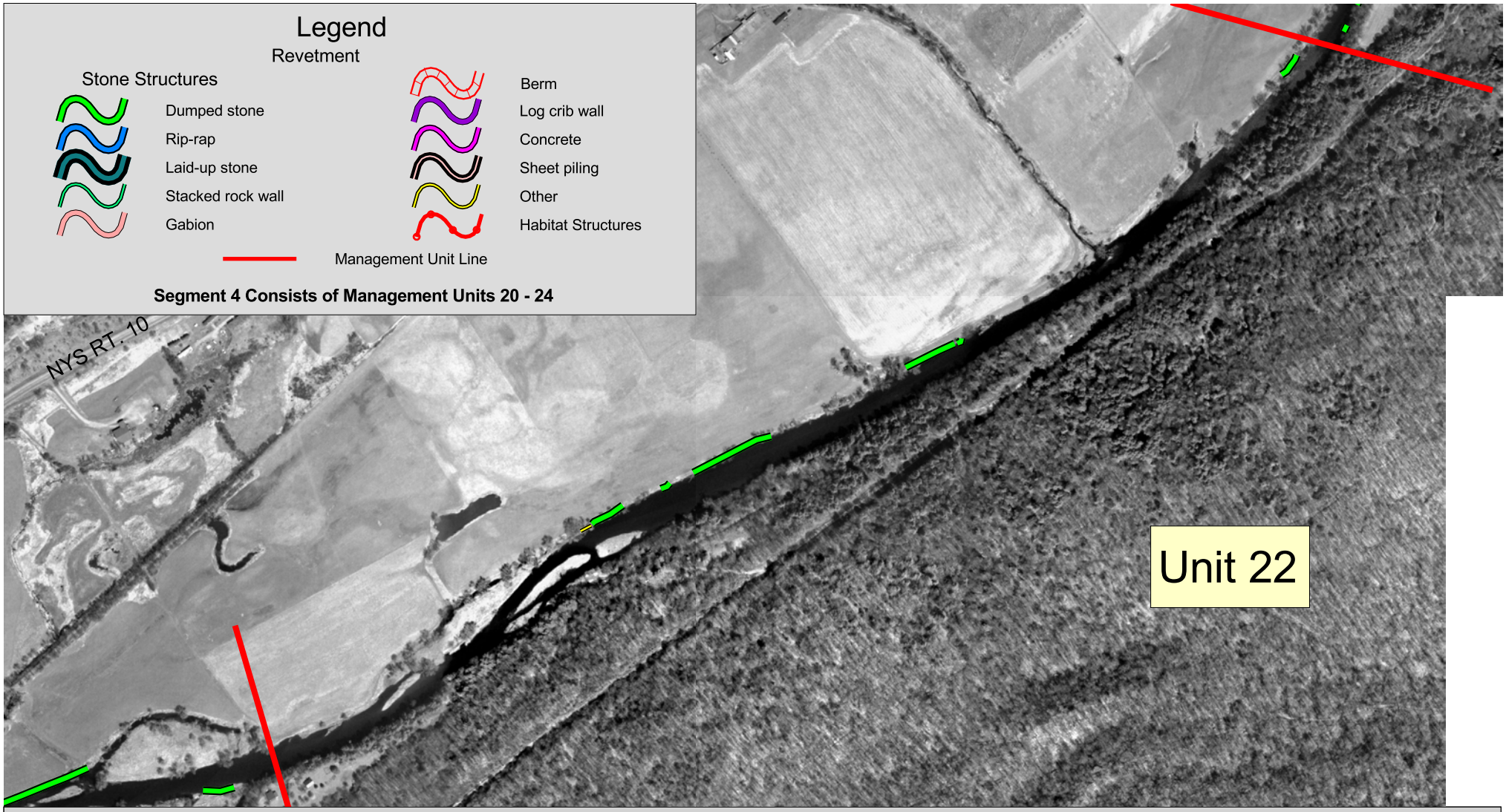
Management Unit 22 - Map 4
Revetment



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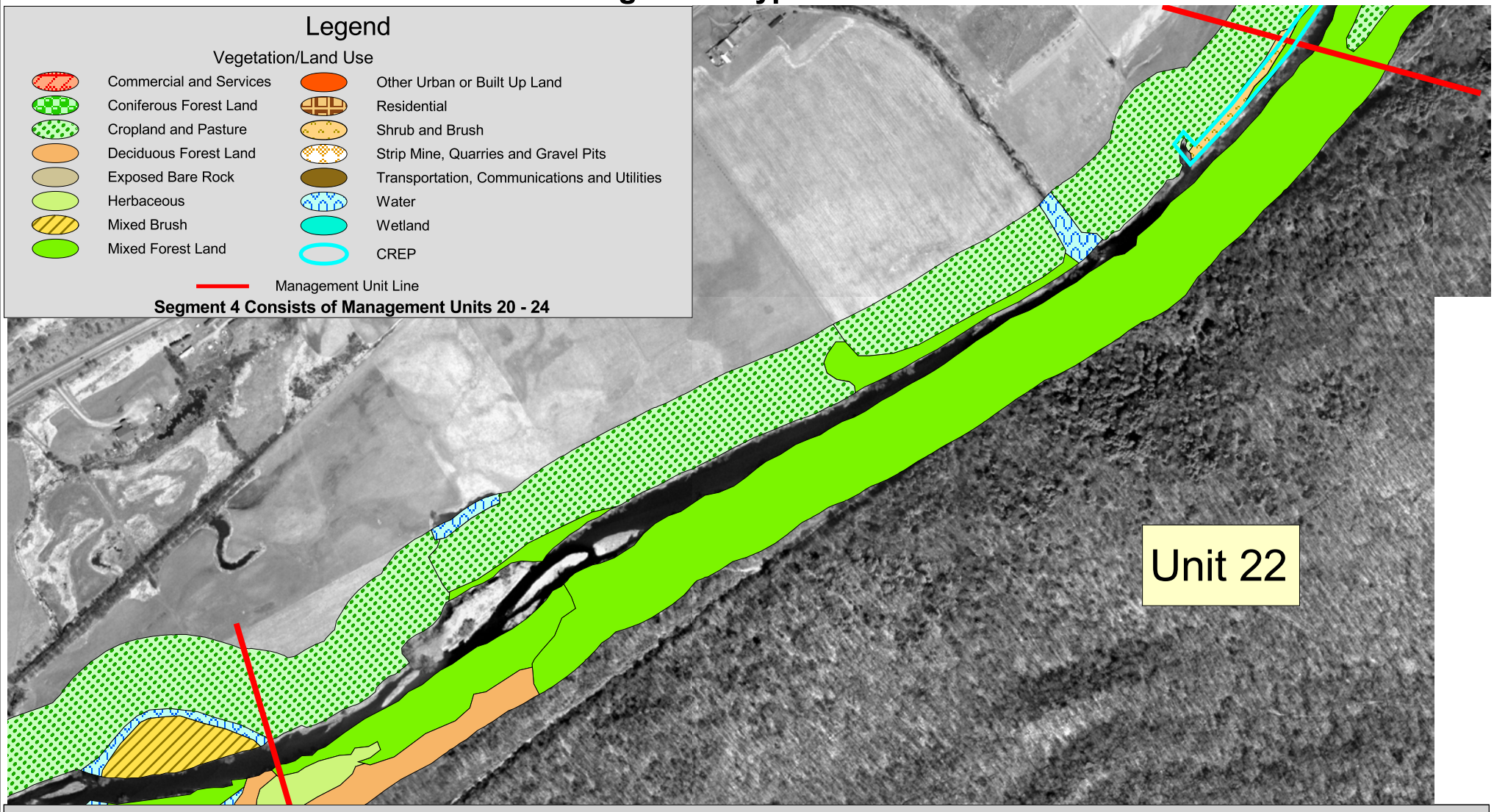
Management Unit 22 - Map 5
VegetationTypes/Land Use



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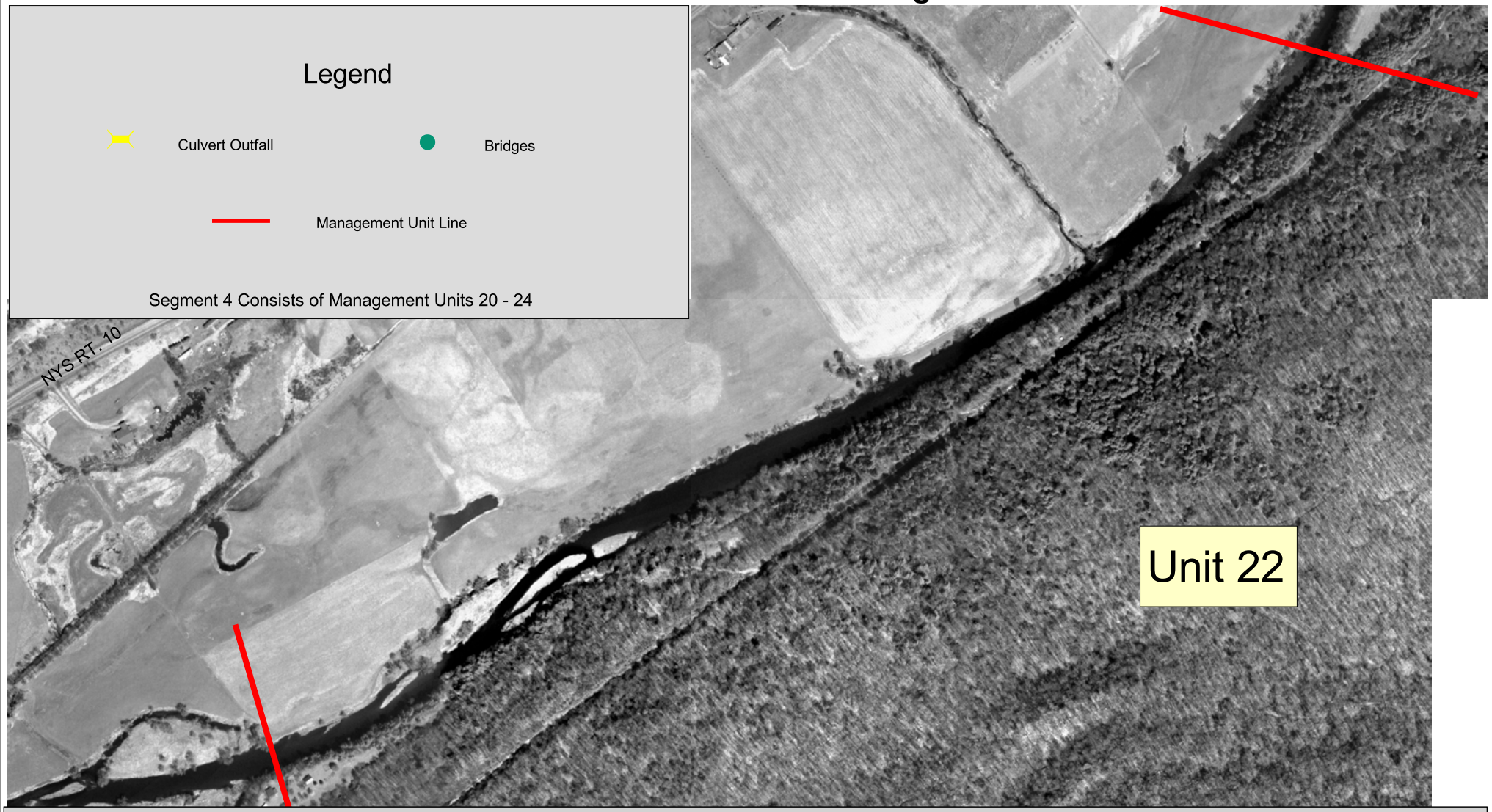
Management Unit 22 - Map 6
Culvert Outfalls and Bridges



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7.5.4 Management Unit 23

This management unit is unstable. In the upper portion of this unit there is a by-pass channel on each sides of the river. Approximately 700 feet downstream is a large gravel deposit that forced water around it creating a second new channel approximately 800 feet long. Chambers Hollow supplies large amounts of sediment to the river system which is shown in **Figure 7.5.6**.

Figure 7.5.6 Confluence of Chambers Hollow tributary with high sediment load.

This area is primarily agricultural lands and there is a significant amount of erosion on poorly vegetated banks. **Figure 7.5.7** shows an eroding bank with poorly vegetated banks.

This unit contains aggraded deposition and many sections of dumped stone revetments. There are no wetlands located in this unit.

There are no established monitoring sections within this unit at this time. The entire reach was topographically surveyed in 2001.

Figure 7.5.7 Poorly vegetated eroding bank that is associated with a transverse bar located 350 feet downstream of the confluence with Chambers Hollow.

7.5.5 Management Unit 24

This management unit is moderately stable. The main stem of the Delaware River makes two very tight radius curves within this unit. County Bridge number 26-6 on County Route 26 is in this unit.

The northwest unnamed tributary across from Mallory Brook confluence contributes large amounts of sediment to the main stem. Mallory Brook does not contribute a significant sediment load.

Figure 7.5.8 Typical scene in Management Unit 24 located 900 feet downstream of Mallory Brook confluence.

Figure 7.5.9 Vehicle revetment that is located approximately 7,400 feet downstream of County Bridge 26-6.

In the lower part of the unit there is a berm constructed of cars and school bus bodies along the left bank approximately 1,100 feet long which can be seen in **Figure 7.5.9**. This revetment is an ill-advised attempt to protect agricultural land during flooding events.

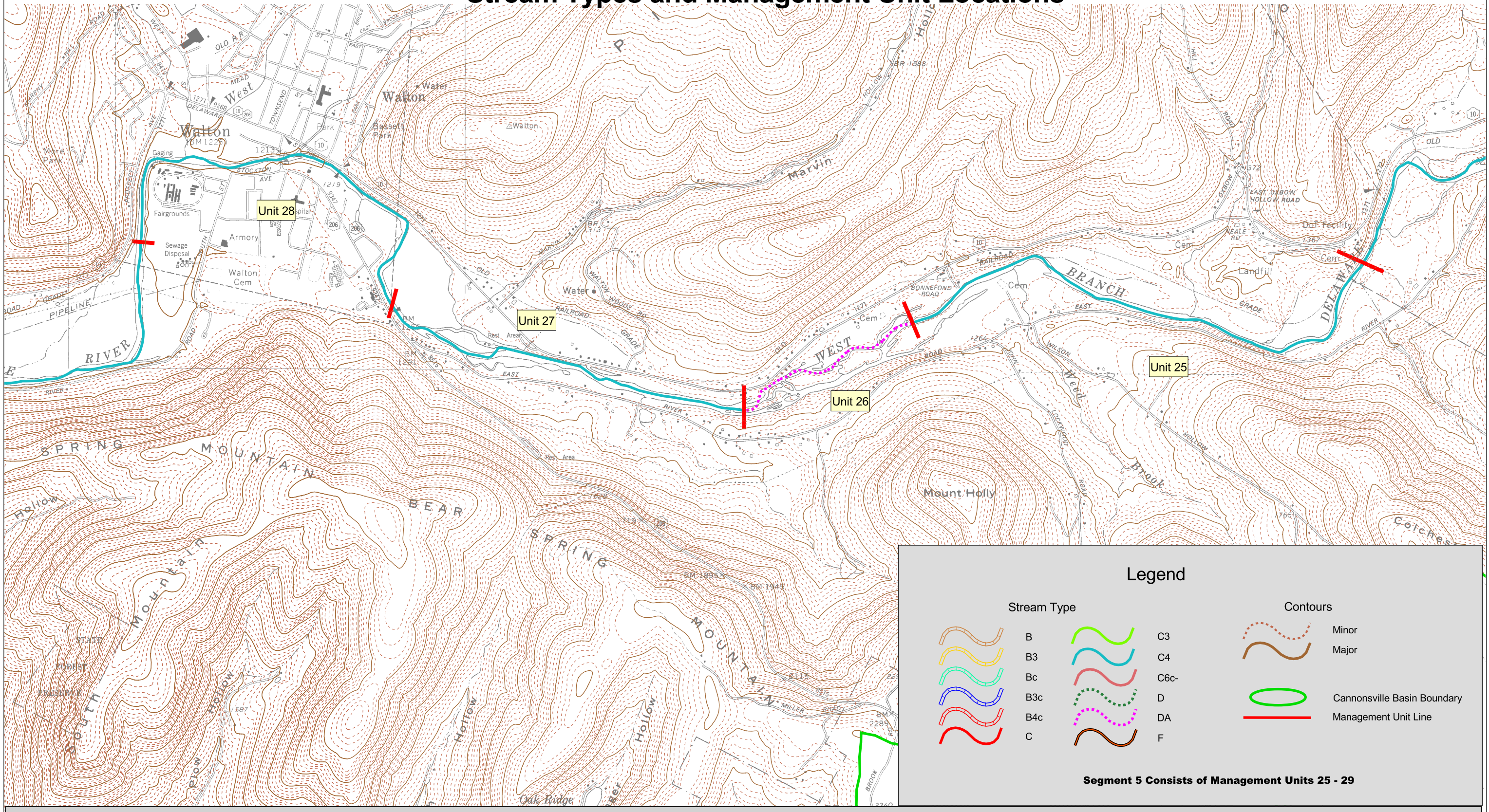
The entire reach seems to have minimal erosion. The most significant erosion is located on an island where there are several aggradation deposits directing water into the banks. These river banks are poorly vegetated and are easily eroded under high flow conditions. See **Figure 7.5.10**.

Management Unit 24 has no monitored cross-sections at this time. There are no wetlands located in this unit.

Figure 7.5.10 Poorly vegetated bank that is easily eroded on the island.

Segment 5

Segment 5 - Map 1
Stream Types and Management Unit Locations



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
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GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 11-30-04
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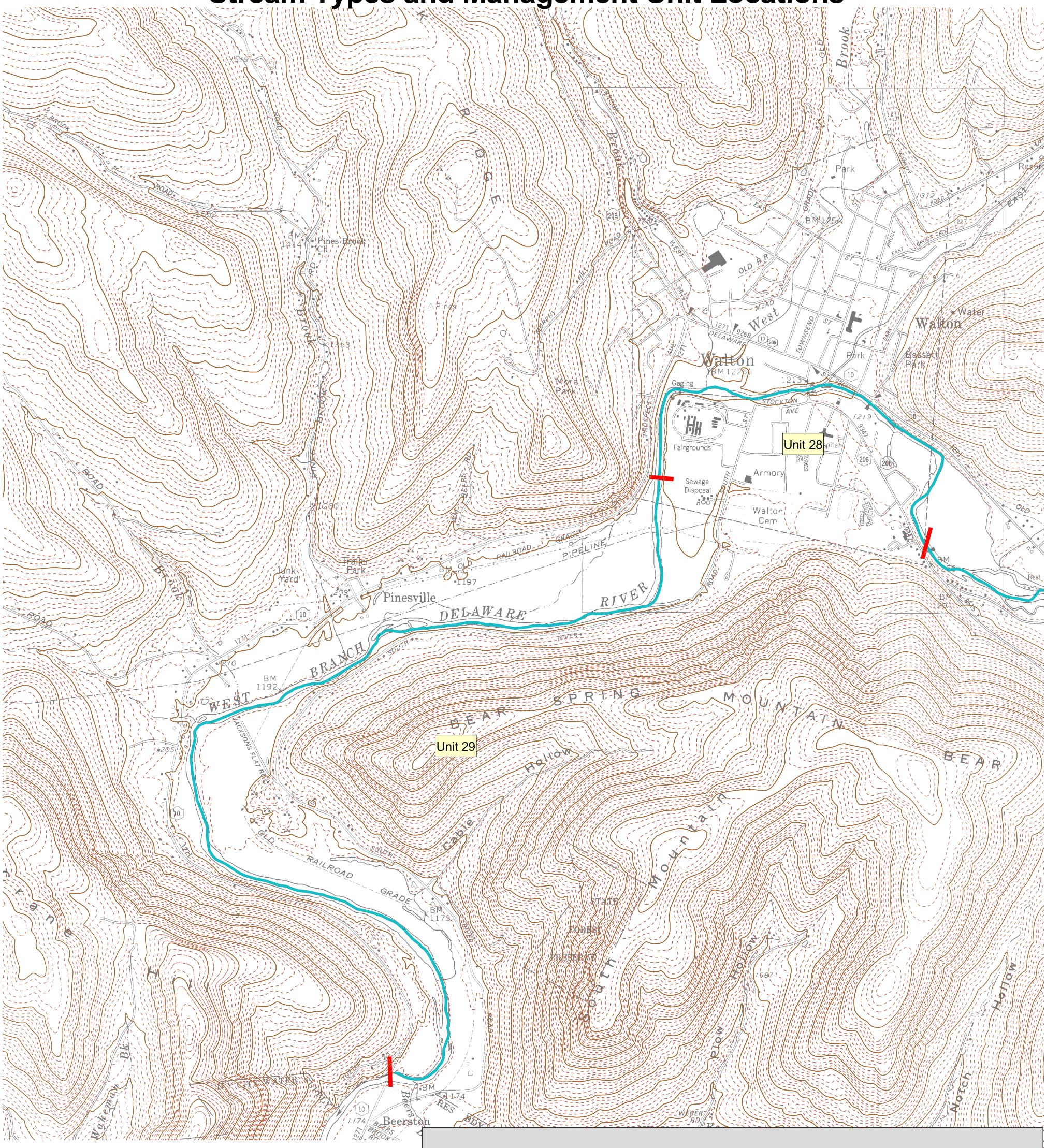
Segment 5 - Map 2
Stream Types and Management Unit Locations



Legend

Stream Type

- B
- B3
- Bc
- B3c
- B4c
- C
- C3
- C4
- C6c-
- D
- DA
- F

Contours

- Minor
- Major

- Cannonsville Basin Boundary
- Management Unit Line

Segment 5 Consists of Management Units 25 -29

Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
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GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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7.6 Segment 5 – Town and Village of Walton

General Description of Segment Five

Segment five begins at the Hamden/Walton town line and ends near Beers Brook Bridge (see **Segment 5 - Map 1** and **Map 2**). The total surveyed stream length of this segment is 57,743 feet. The drainage area at the top of this segment is approximately 263 square miles and approximately 352 square miles at the bottom. The Village of Walton is the only population center within this segment. The valley slope through this segment is 0.0013 and the West Branch Delaware River is mainly a C4 stream type with a small section of DA stream type.

The Village of Walton was formed from the Town of Franklin on March 17, 1797. This area was well known for its tanning and lumbering industries. The south bank of the river is mainly a steep sloped, rocky, mountainous region with conditions that are unsuitable for cultivation and grazing and the north bank is hilly, but generally better adapted to agriculture. The Village of Walton, which was established on the alluvial fans of East and West Brooks, historically floods during high water events. The south side of Walton sits atop a glacially deposited terrace. Although properties on the south bank near the river are still within the 100 year floodplain, the south bank is slightly higher with respect to the floodplain and typically receives less flood damage than properties on the north side of the river.

This segment has more residential development along the floodplain than previous segments. Floodplain development and the filling to raise sites above the *base flood elevation* has the effect of reducing the net effective capacity of the floodplain to convey out-of-bank discharges. This increases the stress on the banks within the channel which results in bank scour and erosion. Development along the river also results in the loss of riparian buffer to lawns and parking areas which do not protect the river banks

The regions above and below the village are used for agriculture with residential/mixed use along the NYS Route 10 corridor.

This segment consists of Management Unit 25 through 29. The table below summarizes the erosion and depositional features that are within this segment by management unit.

Table 7.6.1 - Summary of Erosion and Depositional Features

Management unit	Length (mi)	Linear Feet of Erosion	Surface Area (sq.ft.)	# Erosion Features	# Deposition Features	LF Erosion per Mile	# Erosion Features/mi	# Deposition Features/mi
25	2.21	3600	11054	26	3	1628.96	11.76	1.36
26	0.84	2824	14770	14	19	3361.90	16.67	22.62
27	1.58	2120	8283	24	14	1341.77	15.19	8.86
28	1.86	6204	40272	31	12	3335.48	16.67	6.45
29	4.44	9554	36808	54	49	2151.80	12.16	11.04

Stream Orders, Floodplains, and Wetlands:

The stream remains a fifth order stream until it reaches the Cannonsville reservoir. Tributaries in this segment are Oxbow Hollow, Marvin Hollow, East Brook, West Brook, Third Brook, Pines Brook, Bobs Brook and Beers Brook. East Brook, Third Brook, and West Brook are channelized through the Village of Walton to the main stem. Many of the tributaries carry large amounts of sediment that is deposited in bars at their confluences with the main stem. Where the main stem cannot carry the excessive sediment load from the tributaries and the sediment begins to fill the pools or form aggradation bars. These deposits can create more stress on the river banks and result in banks erosion or failure.

At bankfull flows, the river is generally able to access its floodplain except in the Village of Walton. Outside of the village, the floodplains are typically used for agriculture although land use pressure has grown to where commercial businesses could be expected to expand into the fringe areas of the floodplain. Two sections of berms located in this segment outside the village that are approximately 904 feet in total length also impede floodplain access.

Wetlands are very important because they help reduce the amount of nutrients entering the river from upland sources. In this segment, there are eight wetland areas, classified as shallow emergent marshes and backwater sloughs. These wetlands play an important role in taking up phosphorus and nitrogen before it enters the aquatic ecosystems. These nutrients in the system can cause increase in algae and plant growth and deplete dissolved oxygen levels needed by aquatic life. Other benefits of wetlands consist of sediment control, increase flood storage, and wildlife habitat.

Land Use/Land Cover:

The land use has been and is predominantly agricultural land with more forested areas than the other four segments. The majority of the agricultural lands have only a narrow vegetated riparian buffer to protect the banks. The fields are still cropped close to the river banks which restrict the buffer vegetation to shrubs and shallow rooted herbaceous vegetation. Little or no riparian buffer zone increases the possibility of eroding banks and also allows a greater amount of nutrients from agriculture to enter the water system.

This segment is experiencing residential development encroachment as the Village of Walton continues to develop. Residential and mixed use developments are increasingly filling in along the Route 10 corridor and the floodplain fringe. Increased storm water runoff associated with the expansion of impervious surfaces is also a concern. This can cause more overland flow that contains more contaminants. Without a sufficient riparian buffer zone established in the village, these contaminants are dumped directly into the main stem increasing nutrient load and/or pollution into the water system. Another concern is restricted floodplain access with more development encroaching on the floodplain.

This segment contains Delaware County Solid Waste Management Center (formerly the Delaware County Landfill) which was originally established in 1974. Concern over the possibility of ground water contamination requires the facility to constantly monitor several wells. Surface runoff is controlled through catchment basins such as wetlands to absorb excess nutrient runoff. Water quality and micro-invertebrates are frequently tested above and below the waste facility.

Infrastructure:

The major roadways in this segment are State Highway 10, East River Road, and South River Road which run parallel to the river and have minimal impact on the floodplain. The old railway road runs parallel to the river except at one location where it crosses the river. The railroad bridge has long been removed, but remnants of the abutments are still present. The railway has only a very limited impact on the floodplain function as the elevated grade has been breeched in numerous locations.

The major bridges in this segment are on State Highway 206 and 10. Both bridges have sidebars that have formed near their abutments. However, neither bridge has a significant negative impact on *stream flow*. The State Highway 206 Bridge in the village can be inundated in major flood events which complicates the task of emergency service providers during floods.

Storm water runoff into road way ditches and from impervious ground are a major concern because of the potential problems of added sediment and nutrient supply to the river system without adequate protection.

Sediment Transport and Channel Evolution:

The Stream Management Program has not yet taken any samples of bed material from this segment because there are no monitoring cross-sections that have been established in this region. Since the summers of 2003 and 2004 were exceptionally wet, and water depths were deep it was not possible to survey cross-sections or take bed material samples. Visual inspection of this area shows that the riffles in this segment are poorly spaced and there are shallow long pools. There is a noticeable increase in fines on the river bottom in this segment. Gravel bars occur at the mouths of the tributaries. In

particular, there is a long deposit at the mouth of West Brook tributary in the Village of Walton. Generally, if a type C stream experiences difficulty moving sediments it tends to evolve to type G and then to a type F, or directly from a C to an F. G and F types are less desirable types than a type C due to their marked tendency towards severe erosion and instability.

The main stem of the Delaware River has not changed based on the aerial photographs from 1938, 1963, 1971, and 1983. The tributaries seem to have been straightened before 1938.

History of Stream Management:

When the banks begin to fail and property is lost, property owners typically attempt to protect the banks by placing a revetment along the bank, such as a stone wall, rip rap or simply dumping cobble sized stone from the floodplain into the eroded bank. The majority of the revetments in this segment consist of dumped stone which are commonly found along agricultural fields. Revetments found within the village are mainly stonewalls or rip rap along the banks. Most of the revetment is well maintained especially in the Village of Walton. **Table 7.6.2** summarizes the quantity of revetments and repairs that have been established within each management unit in this segment.

Table 7.6.2 - Revetment and Repairs

Management Units	Length (mi)	Dumped Stone	Rip Rap	Laid-up Stone	Stacked Rock Wall	Gabions	Log Cribwall	Concrete	Sheet Piling	Other	Log Deflectors	Total Revetment Length (ft)	Revetment Length per mile	Berms	Berm Length (ft)
25	2.21	21	-	-	2	-	-	-	-	1	-	3772	1707	1	399
26	0.84	10	-	-	-	-	-	-	-	-	-	1808	2152	-	-
27	1.58	14	-	-	-	-	-	-	-	-	-	3272	2071	-	-
28	1.86	11	5	-	3	-	-	-	-	-	-	5324	2862	-	-
29	4.44	28	1	-	1	-	-	3	-	-	-	3681	829	1	509

7.6.1 Management Unit 25

This management unit consists of lands that are mainly agricultural fields with some forested areas. Delaware County Solid Waste Management Center is located within this unit. Oxbow Hollow tributary enters the West Branch downstream of the waste management center. This management unit is considered to be stable. **Figure 7.6.1** is a picture taken within Management Unit 25.

Figure 7.6.1 Typical scene in Management Unit 25 located at the top of this unit.

The only significant depositional feature in this unit is a center bar located 2,900 feet downstream from the Oxbow Hollow tributary at a sharp bend where the stream is obviously too wide.

There are fewer erosion features in this management unit than most of the other management units. The erosion that does exist ranges from 1.5 feet to 5 feet in height. As usual, it can be found along banks without an adequate riparian buffer.

Figure 7.6.2 Root wad revetment that is located near the Delaware County Solid Waste Management Center.

This management unit is not as highly revetted as most of the other units. Most of the revetments consist of dumped stone placed along the banks. The lack of berms helps ensure that the river can access its floodplain. **Figure 7.6.2** is a picture of root wad revetment constructed by Delaware County Department of Public Works to help protect the bank from erosion located near the Solid Waste facility.

There is one small section of wetland located approximately 300 feet upstream from Oxbow Hollow confluence, which classified as a shallow emergent marsh. There are no monitored cross-sections or bank pins at this time.

7.6.2 Management Unit 26

In this management unit the principal land use along the river continues to be agricultural fields with some forested areas on the left bank of the river. This unit contains four islands with several side and bypass channels. It is rated unstable. See **Management Unit 26 – Map 1** through **Map 6** at the end of this unit description.

This management unit is unique in that the entire reach is a DA (braided – anastomosed) stream type under the Rosgen classification. As a DA, the stream consists of multi-channels around vegetated "islands". In addition to the "islands" there are several side, center, and transverse bars, all of which are evidence of major deposition.

There is a total of 4,054 feet of eroding bank along this 8,545 foot long management unit. The height of the eroding banks varies from about 2 feet to about 8 feet, with about 30 percent of the eroding bank length having an average bank height of greater than 4 feet. It is likely that the stream banks in this management unit contribute a significant amount of sediment to the river.

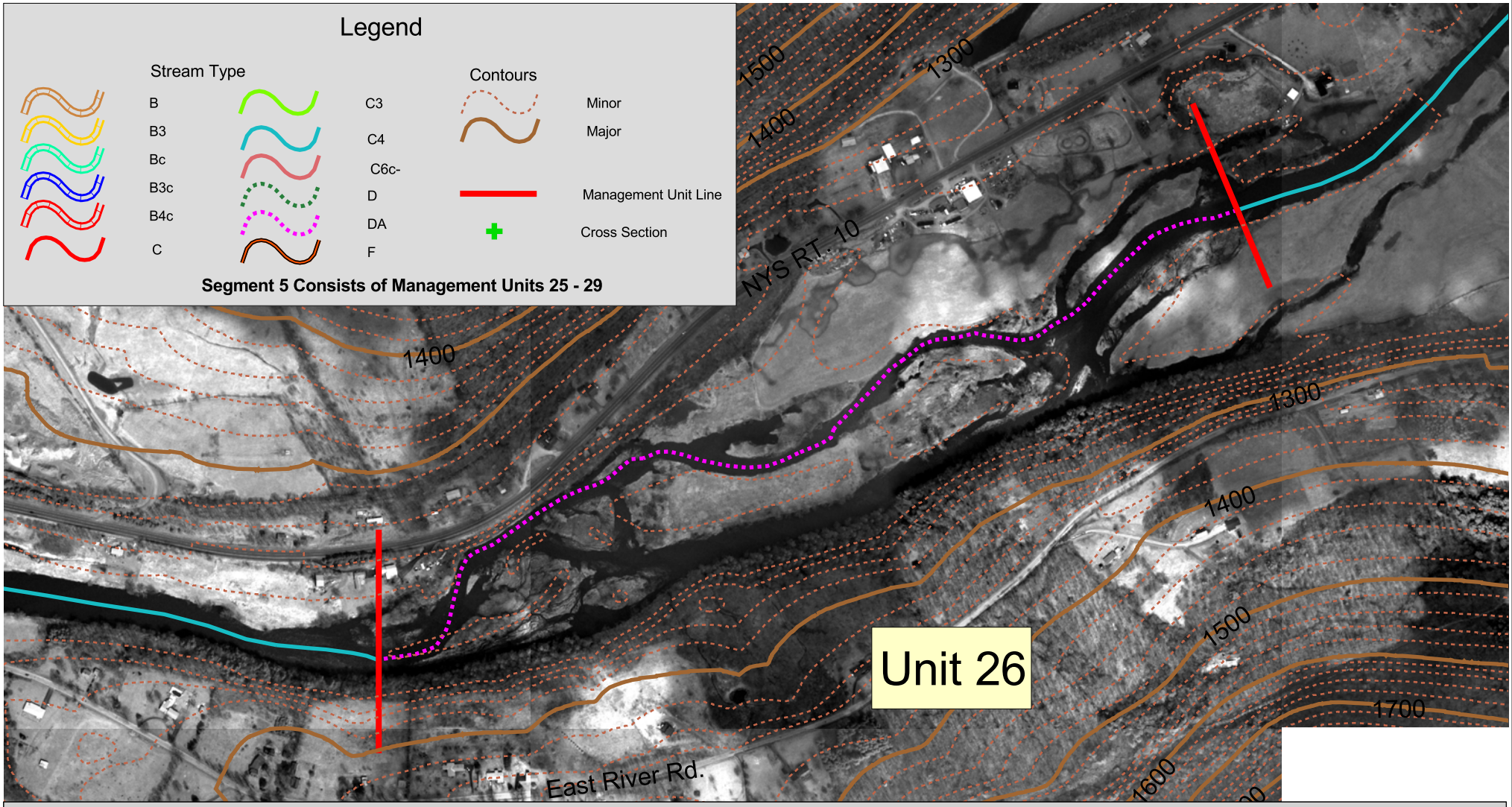
Figure 7.6.3 Poorly vegetated right bank that is eroding located approximately 1,500 feet downstream from Bonnefond Road.

Given the extent of the erosion in this unit, there is, as one would expect, considerable revetment placed along the banks. There is over 3,700 feet of dumped stone along this reach. Adjacent to NYS Route 10 about 1,200 feet of rock has been placed along the highway.

There is one area of wetland located approximately 3,500 feet downstream from Bonnefond Road and is classified as a shallow emergent marsh.

This is an important management unit given the stream classification and the river processes occurring here. Special consideration should be given to this multi-channel reach in an effort to understand why it is occurring at this location within the river valley and the cause of the extensive erosion. This is of special concern when considering the implications for the stable reach upstream. Further investigation and monitoring is required to determine why this unit exhibits such a morphologically extreme form for this watershed. At the present time there are no monitored cross-sections or bank erosion pins in this management unit.

Management Unit 26 - Map 1
Stream Types and Cross Sections



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
Contour Interval 20 feet
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
D:gisprojects\wbd\SCMP\Segment 5\mgt_unit_26.apr

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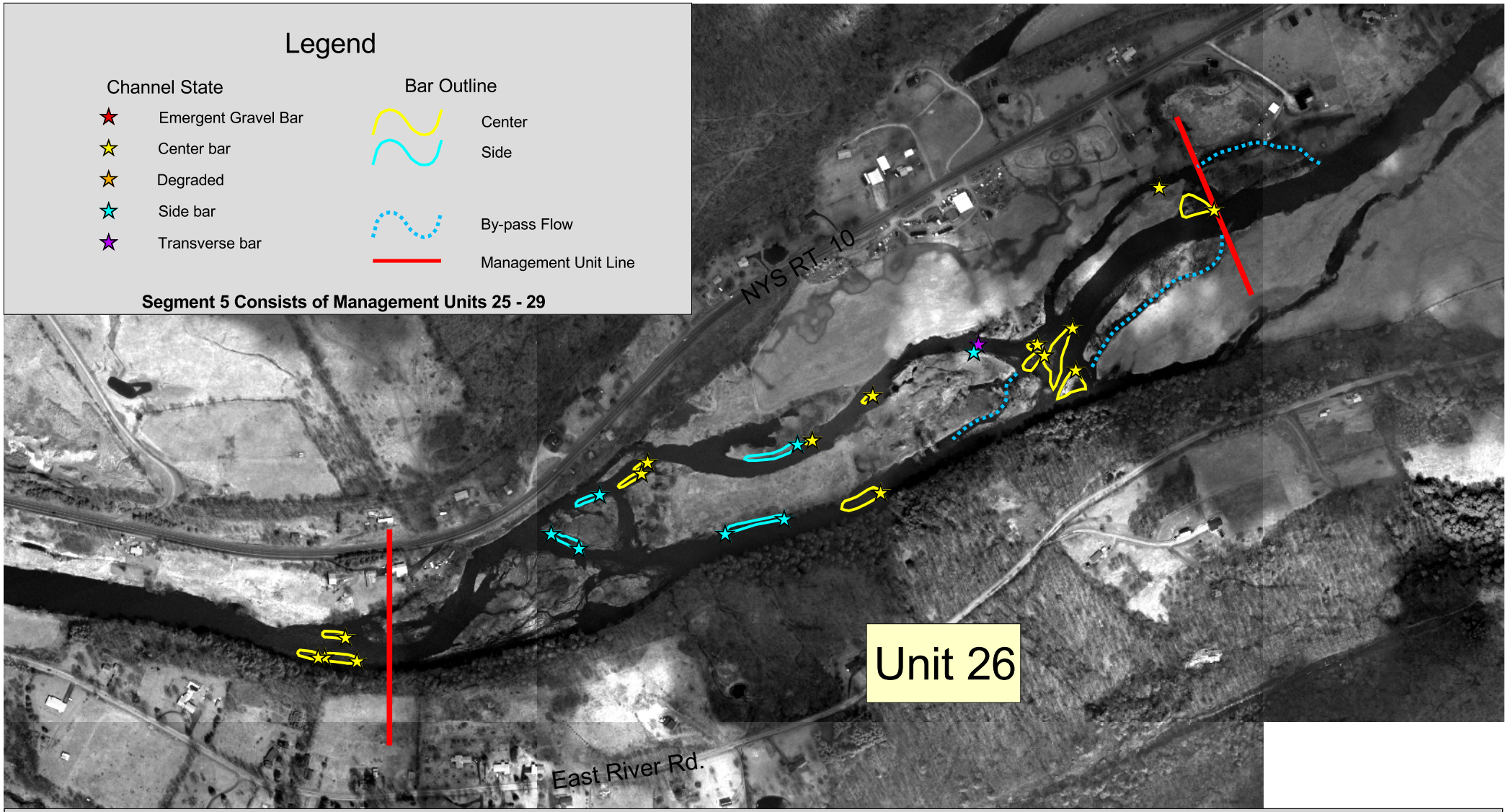
600 0 600 1200 1800 2400 3000 Feet

Management Unit 26 - Map 2
Channel State and By-Pass Flow



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
D:gisprojects\wbd\SCMP\Segment 5\mgt_unit_26.apr

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1:7200

600 0 600 1200 1800 2400 3000 Feet

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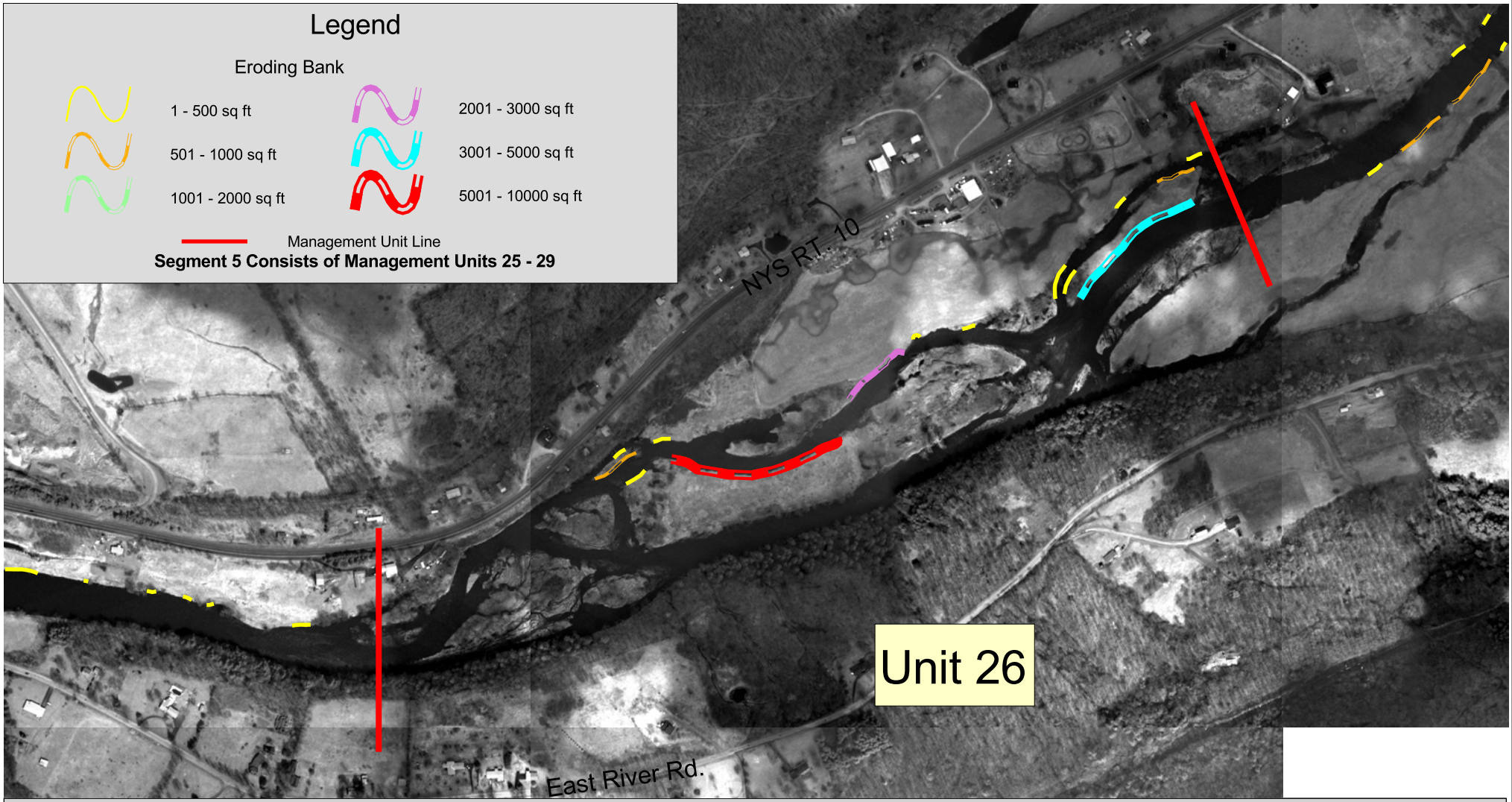
Management Units 26 - Map 3
Eroding Banks



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
D:gisprojects\wbd\SCMP\Segment 5\mgt_unit_26.apr

Scale
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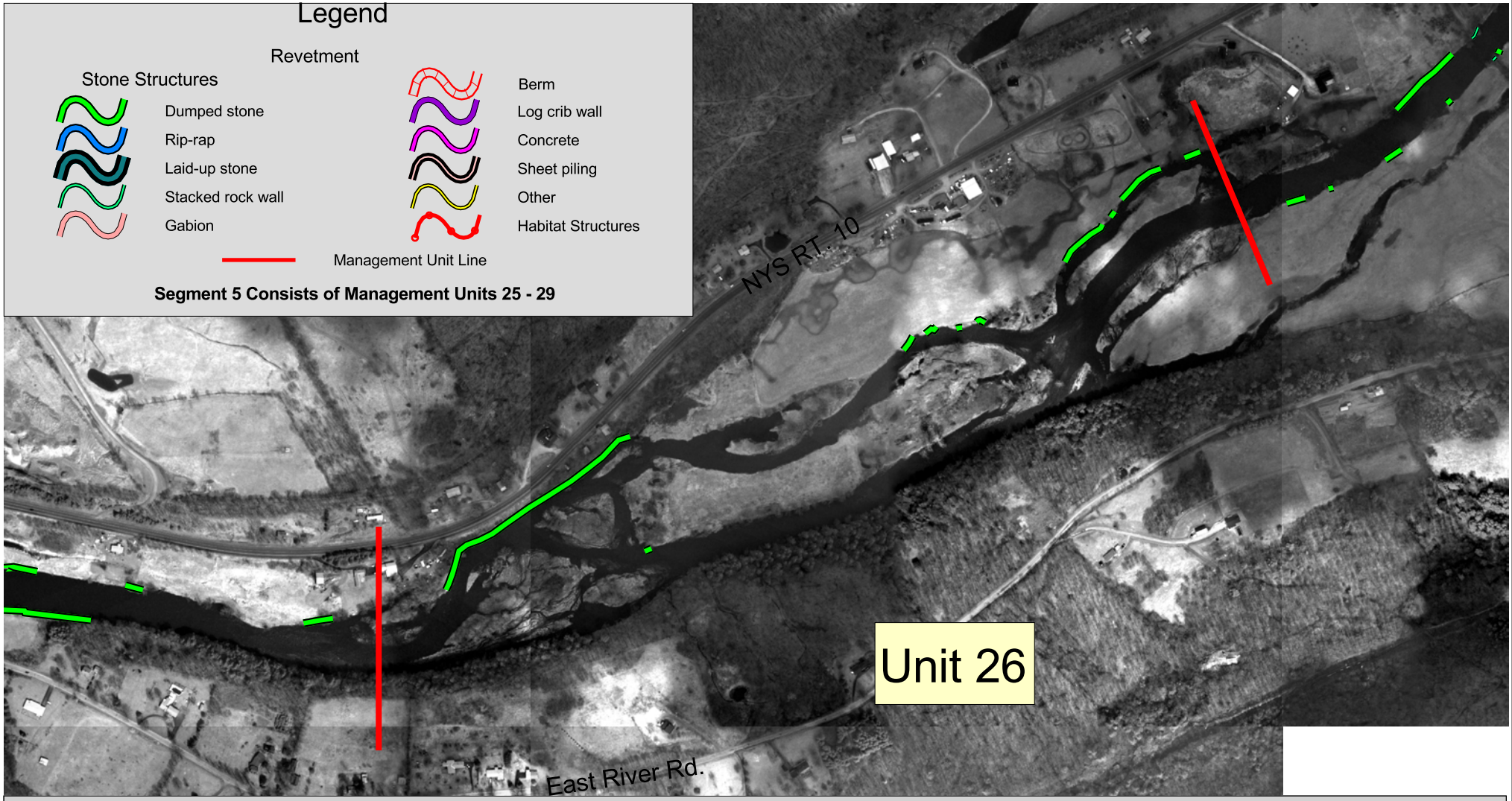
1:7200

600 0 600 1200 1800 2400 3000 Feet

Management Unit 26 - Map 4
Revetment



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
D:gisprojects\wbd\SCMP\Segment 5\mgt_unit_26.apr

Scale
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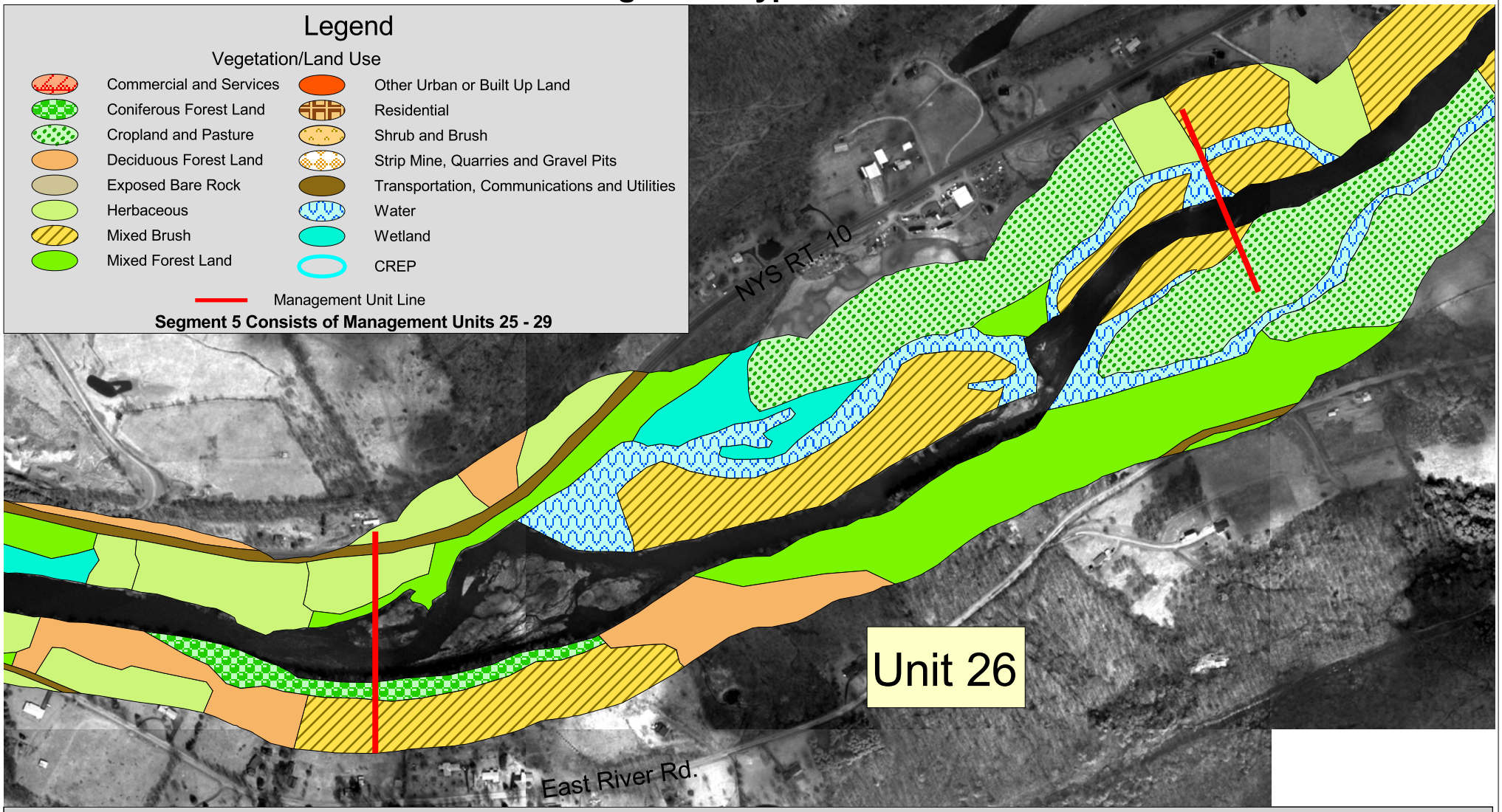
600 0 600 1200 1800 2400 3000 Feet

Management Unit 26 - Map 5
VegetationTypes/Land Use



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

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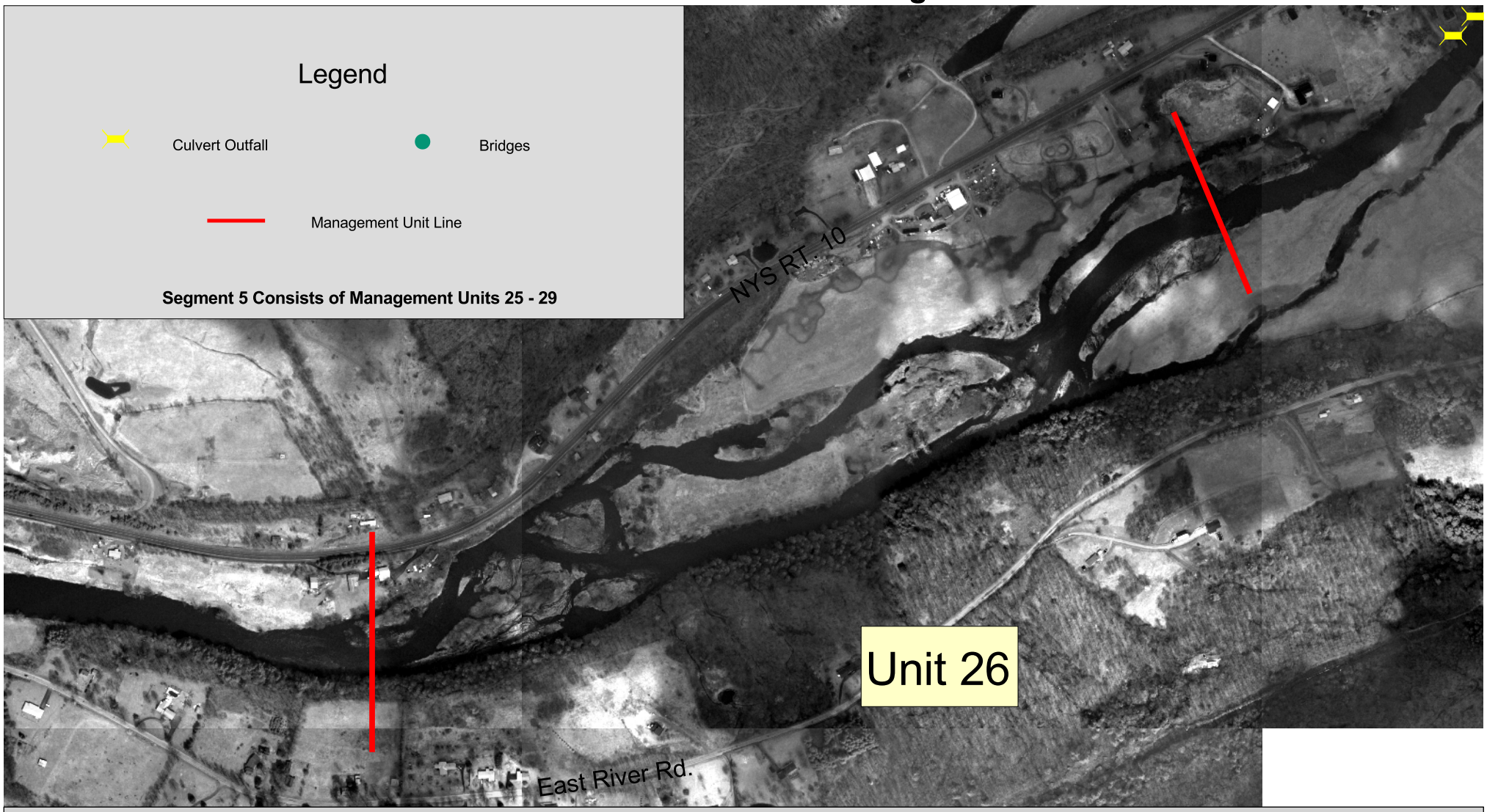
Management Unit 26 - Map 6
Culvert Outfalls and Bridges



Base Data Provided by NYCDEP
Map data provided in NAD 83 UTM Zone 18 North
GIS data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey.

Created by DCSWCD 12-01-04
D:gisprojects\wbd\SCMP\Segment 5\mgt_unit_26.apr

Scale
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1:7200

600 0 600 1200 1800 2400 3000 Feet

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7.6.3 Management Unit 27

This unit consists of lands that are mainly agricultural fields and is on the outskirts of the Village of Walton. Marvin Hollow tributary enters the West Branch upstream from the village line. This unit is rated moderately stable with unstable reaches. **Figure 7.6.4** is a picture taken in this unit.

Figure 7.6.4 Typical scene in Management Unit 27 looking downstream at the top of this management unit.

Aggradation is not a serious concern in this unit. The number of depositional features is consistent with the average number of features per mile for the river. The depositional features are side bars and center bars.

Figure 7.6.5 Poorly vegetated left eroding bank located approximately 1,500 feet upstream from Marvin Hollow confluence.

There are approximately 4,800 feet of eroding banks in this management unit. Eroded banks in this unit range from 1 to 8 feet in height, with nearly half of the eroding bank length (2,322 ft.) having an average bank height between 4' to 8' in height. The height of several of these eroding banks exceeds 10 feet.

There are no berms in this management unit. There are a considerable number of dumped stone revetments. This indicates that the property owners have an ongoing problem with erosion.

There are two small areas of wetlands located upstream approximately 3,600 and 4,900 feet from Marvin Hollow confluence. The wetlands are classified as shallow emergent marsh and backwater slough. At the present time there are no monitored cross-sections or bank erosion pins in this management unit.

7.6.4 Management Unit 28

This management unit is rated unstable. This unit includes the Village of Walton with residential and commercial buildings near the stream banks. The river does not have access to its floodplain at bankfull in the village due to development, fill, and revetment. NYS Highway Route 206 Bridge crosses the river in the Village of Walton. It spans the entire river in the Village of Walton and is not a restriction. Tributaries in this unit are East Brook, Third Brook and West Brook.

Figure 7.6.6 Looking at a high eroding bank on the left side at Terrace Avenue potential project site.

Two sites with serious failing banks include the meander bend near Terrace Avenue and the left bank below the NYS Route 206 Bridge along South Street. Severe erosion has undermined these banks and the adjacent houses and residential properties are threatened by further bank loss. **Figure 5.6.6** shows the Terrace Avenue eroding bank which lost approximately 5 feet of bank during the flood of September 18, 2004. The Terrace Avenue bank is approximately 30 feet high, and South Street is about 25 feet high. These sites are thought to contribute a large amount of sediment to the river during storm events. There is a large center bar downstream from the Terrace Avenue bank that receives material from and may have a role in the process that is undermining the bank. Both of these sites were studied by a consultancy coordinated by the Soil and Water Conservation District with conceptual designs created for addressing the problem.

In addition to these two sites, there is a higher than average number of erosion sites in this unit.

There are 19 revetments (mostly dumped stone) in this unit; further evidence of the ongoing struggle against erosion in this unit. There are relatively few depositional features in this unit. The most outstanding depositional feature is the large gravel deposit at the mouth of West Brook. In recent years, fill has been dumped in sections of the floodplain on the left bank below the NYS Route 206 Bridge. Such activities can reduce the floodplain's capacity to reduce the energy associated with flood flows. Filling of floodplains can result in greater erosion causing sheer stress on stream banks.

At the present time there are no cross-sections or bank erosion pins in this management unit. Within this unit is a USGS gage station 01423000 (West Branch Delaware River at Walton NY) which is located near the Delaware County fairgrounds. This gage was

surveyed as part of an effort by NYC DEP's Stream Management Program to create regional regression curves of hydraulic geometry for streams in the Catskill region.

There are no wetlands located in this management unit.

Management Unit 29:

This is the last management unit and consists mainly of agricultural land with few forested areas. Tributaries that are within this unit are Bob's Brook, Pines Brook, and Beers Brook. These tributaries contribute a large amount of sediment load into the main stem which can not be transported effectively resulting in depositional bars downstream.

This unit has a higher than average number of depositional features. Most of these features are side bars and center bars. There is a 2,000 foot long section within this unit that consists of multiple channels. This same reach has severe erosion along its banks. At the very end of this unit there is a 4,000 foot long reach with a large number of depositional and erosional features concentrated together.

Figure 7.6.7 Poorly vegetated right bank located approximately 1,700 feet upstream from Pines Brook confluence.

In addition to these two specific locations this unit also has a large number of erosion features over its entire length. Taken together with the large number of deposition features, this unit is rated moderately stable with unstable reaches.

There are four areas of wetlands classified as either shallow emergent marsh or backwater slough. The first area of wetland is located approximately 4,200 feet downstream from Walton stream gage, second area is located approximately 3,600 feet upstream from Pines Brook, third is located approximately 2,000 feet upstream from Beers Brook confluence and the forth is located approximately 300 feet from Beers Brook confluence.

There are currently no monitored cross-section or bank pins in this management unit at this time.

TOC AND INTRO--SECTIONS 1 - 4

WATERSHED DESCRIPTION--SECTION 5

FINDINGS--SECTION 6

LANDOWNER SURVEY INFO--SECTION 8

REF & GLOSSARY--SECTIONS 9 & 10