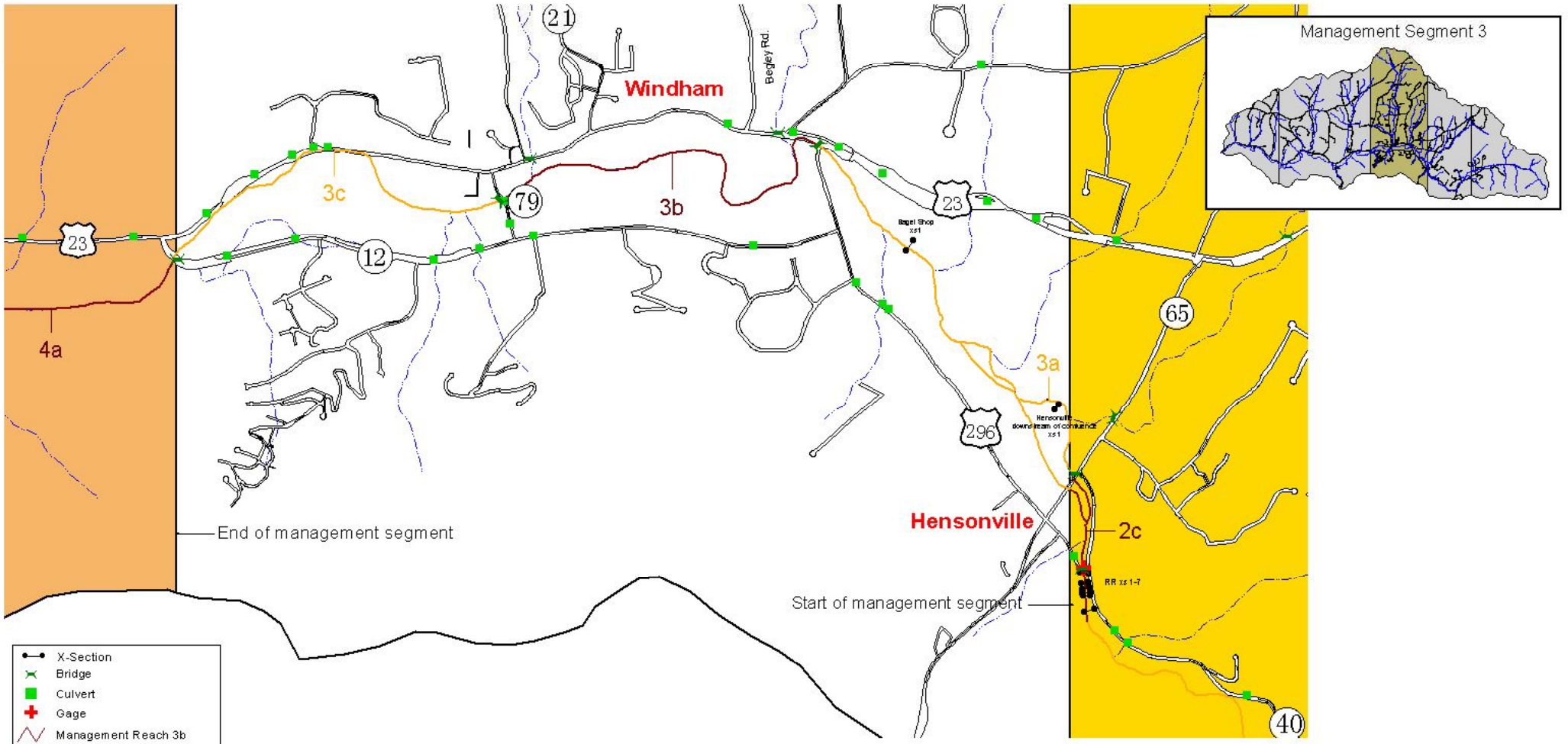
Management Segment 3
(Hensonville CR 65- Windham CR 12 South Street)

Management Segment 3 begins at County Route 65 in Hensonville and runs 4.8 miles west to the intersection of County Route 12 (South Street) in Windham **(Map VI-4)**. The drainage area ranges from 14mi^2 at the top of the segment, to 40mi^2 at the bottom. The management segment contains 9 tributaries, with Mad Brook (Mitchell Hollow) and an unnamed tributary (Nauvo Road) impacted by flood control structures. The segment is located within valley zone 3 **(Figure V-12)** and has an average valley slope of 0.3%. The valley is classified as a Rosgen Type V, denoted by a glacially scoured, "U" shaped valley with slopes generally less than 4%.

The general stream morphology transitions from a wide, non-entrenched valley floor below CR 65, into a more confined floodplain through the hamlet of Windham. The confinement is primarily controlled by a high terrace that runs along the south from State Highway 296, downstream through Church street in Windham to the area near GNH Lumber. Three low head concrete dams are located in this segment. Two of the dams are located on the Batavia Kill mainstem and one is located along an unnamed tributary at its confluence with the Batavia Kill. Historically the Batavia Kill has extensively flooded its floodplain in this area and resulted in flood-related damages. Past management strategies in response to flood damage have included local channel modifications and streambank stabilization.

The Phase I Inventory and Assessment conducted in 1997 revealed stream instabilities spread throughout the management segment with the majority of the instabilities located in the upper and lower portions of the segment. The segment is characterized by an average of 1.7 ft^2 of exposed bank per linear foot of streambank, with 18% of the streambanks having some degree of erosion noted. Level I classification of the segment reveals predominantly C and B stream types, which change as a result of topographic influence on the channel. A stable reference reach was identified through a portion of the segment upstream of Church Street in Windham. Aerial photograph interpretation of the stream channel revealed no major planform changes through the segment, and the constructed dam structures limit the vertical mobility of the segment. Therefore, more extensive assessments within the segment focused on the stable reach with minimal monitoring performed through the other reaches.



Data Sources: Hydrography-NYCDEP, digitized from USGS Quad and SCS soil Survey maps 1993, edited by GCSWCD to show only streams found on USGS topo quads.
Watershed Boundary-NYCDEP, derived from USGS topography 1965.
Bridges & Culverts-GCSWCD, data collected using GPS unit.
Roads-Greene County Real Property Tax.
Gages-GCSWCD, derived from latitide/longitude of USGS gages.
Village/Hamlet-GCSWCD, derived from USGS topographic map .tif file.
Management Segments & Reaches-GCSWCD, based on management segments and reaches detailed in Batavia Kill Stream Corridor Management Plan.
Map produced by Greene County Soil & Water Conservation District, January 2002.
Note: GIS data are approximate according to their scale and resolution. They may be subject to error and are not a substitute for on-site inspection or survey.

Batavia Kill Watershed
Segment 3 Management Reaches

Map VI-4
Greene County Soil & Water Conservation District
Batavia Kill Stream Corridor Management Plan

Because of the variable conditions that exist in Segment 3, further delineation of the segment was necessary to facilitate data collection and analysis. Based upon general valley morphology, physical stream character, and the proximity of the business district, Segment I was broken into three stream reaches (3a, 3b, 3c) to further describe the area in more detail **(Map VI-4).**

Reach 3a (CR 65 Hensonville to Concrete Dam Above SR 296)

Reach Description

Reach 3a begins at County Route 65 in Hensonville, and continues approximately 2.1 miles to State Route 296 by the Thompson House. The drainage area ranges from 14 mi^2 at the top of the reach, to 24 mi^2 at SR 296. The reach includes the 6.6 mi^2 sub-basin in East Windham (Silver Lake) as well as several smaller, unnamed ephemeral tributaries.

Channel Morphology/Stability

Based on information from the 1997 Phase I Inventory & Assessment, and Phase II monitoring, the GCSWCD has noted that reach 3a is experiencing several problems with channel morphology stability. While the very upper reach starts out fairly stable as it exits Hensonville, the Batavia Kill quickly becomes characterized by stream channel aggradation, and active streambank erosion as it reaches the confluence of the unnamed tributary that flows from East Windham (Silver Lake). Reach 3a is the first location in the watershed below CD Lane Park and the Peck Road bridge area where extensive bedload deposition has been observed, and the deposition has been attributed to a combination of factors including a transition in valley slope, the sediment supply from the Silver Lake tributary and the presence of two concrete dams located within in the reach.

Reach 3a is influenced by a transition from a steeper valley slope (1.3%) above the reach, to a flatter slope (0.7%) in Valley Zone 3 **(Figure V-12)** where the reach is located. In addition to the change in valley slope, the introduction of excess sediment from the Silver Lake tributary may also be contributing to the aggradation noted during the assessment period. While the upper Batavia Kill has an altered sediment supply due to the C.D.Lane flood structure, the tributary from East Windham is impacted to a lesser extent by smaller impoundments such as Silver Lake, and extensive beaver dams.

The Phase I Inventory & Assessment (I&) conducted in 1997 indicated that the middle of the reach appeared to be in an unstable state with several areas of bank instability. Nearly 20% of the streambanks through reach 3a were experiencing active erosion at the time of the I&A. The reach was characterized as having an average of 1.14 ft^2 of exposed streambank per foot of streambank length. The principle failure mechanism was noted to be slumping due to hydraulic forces eroding the streambank toe, and is presumed to be the result ongoing adjustments in planform **(Figure VI-28a, Photos C,G, Figure VI-28b**

photos F,G). Streambank height throughout most of the reach is fairly low, averaging around 5 feet, with a well defined floodplain throughout much of the reach **(Figure VI-28a photo C,D,E,G,H and Figure VI-278 photo F,G)**.

The Phase I I&A identified two concrete dam structures in Reach 3a. The first concrete dam structure is located at the confluence of a small unnamed tributary on the Police Anchor Camp property **(Figure VI-28a photo A, Figure VI-28b photo D)**. The structure measures approximately 100 feet long and is nearly 9 feet high. The structure is characterized as being in poor condition, with extensive sedimentation. The tributary has eroded around the east wall of the structure. Currently, the structure impacts both the tributary, as well as the main stem of the Batavia Kill. Stream flow and sediment transport are being impacted, as well as lateral migration of the channel.

The second concrete dam is located near the bottom of the reach, in the area behind the Thompson House **(Figure VI-28b photo E)** with the structure located across the mainstem of the Batavia Kill. In general, this structure is in better condition than the first dam, and while some higher flows by-pass the structure, the stream has not breached the structure. The structure does impact stream slope by causing a localized slope reduction, and modification of the streambed elevation above the structure. The structure is also believed to contribute to the stream bank erosion upstream through Reach 3a due to the reduction in slope and transport capacity of the bedload being delivered from the Silver Lake tributary and ephemeral tributaries. Aggradation, followed by lateral streambank erosion is typical of situations where check dams are created across a channel.

A detailed assessment of the channel stability was initiated in 1998 with the installation of two monumented cross sections. The cross section was placed to monitor observed lateral migration of the channel. The cross section is positioned immediately downstream of the Batavia Kills confluence with the Silver Lake tributary at a drainage area of 21.3mi^2. The stream at this cross section is classified as a C4 stream type, which is typical of the entire reach. During the monitoring period between 1998 and 2000, the bankful channel has widened by 4.5 feet, with aggradation of the streambed of approximately 0.8 feet **(Figure VI-29)**.

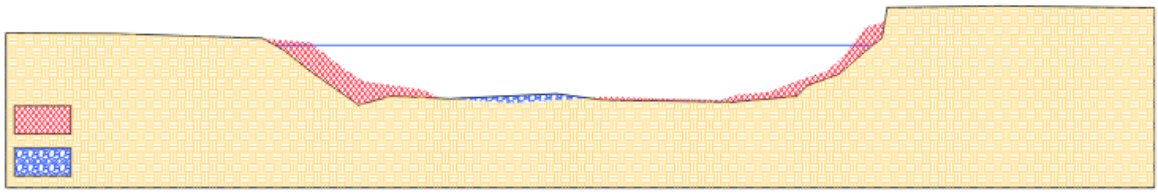


Figure VI-29: Overlay of 1998 and 2000 cross sections taken downstream of the confluence with Silver Lake tributary. Red is erosion, blue deposition.

The second cross section is located at a drainage area of 23.7mi^2 and is located approximately 1600 feet from the bottom of the reach. This section has experience erosion along the left streambank. Erosion was thought to be partially caused by local flow divergance caused by a large woody debris **(Figure VI-30)**. Classification of the channel at this cross section indicates a C4 stream type. Both cross sections in Reach 3a are characterized as riffle features, with dominant sediment size bordering very large gravel and small cobble. During the monitoring period, the reach experienced a record flow during tropical storm Floyd (9/99).

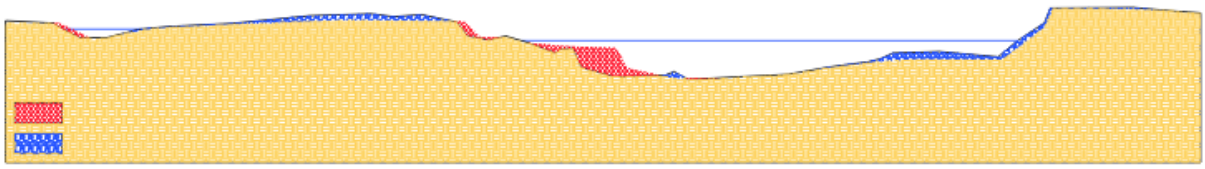


Figure VI-30: Overlay of 1998 and 2000 cross section from Reach 3a. Red represents erosion, blue deposition.

Aggradation and fluctuations in bed material size are considered to be the leading contributors to the reaches instabilities. The source and timing of the sediment is related to the Silver Lake tributary and storm events that mobilize the channel bed. The Silver Lake tributary presents the first appreciable bedload contribution to the stream below the CD Lane FCS. This is reflected in the inventoried delta and point bar formations below its confluence with the Batavia Kill. Storm events, such as that in 1996 and 1999 have left the reach in an unstable state, with numerous raw banks and general disturbed physical characteristics. Recently, visual inspection has revealed that the reach is recovering naturally as evidenced by large areas of willow reestablishment and associated stabilizing of the stream banks. The presence of the concrete dam structure, frequent impacts by floods and the lack of stronger riparian vegetation however, make it unlikely that the reach will reach a stable form in the near future.

A review of aerial photographs from 1959, 1967 and 2000 **(Figure VI-31)** indicates that the reach has been experiencing relatively slow, but continual lateral adjustments in planform. There are several abandoned channels located within the reach presumably caused by channel migration and the rapid formation of chute cutoff during large flow events. The aerials show that the reach is characterized by significant sediment storage, starting at the point below the confluence with the Silver Lake tributary. A June 1980 aerial photograph shows evidence of active gravel mining through the floodplain in the upper extent of the reach.

In general, Reach 3a presents excellent conditions site conditions for restoration. The stream is positioned in the middle of the valley, with extensive floodplains located on both sides. The reach has suitable *belt width* available for meander development and there is little to no anthropogenic constraints such as road, bridges or homes. The overall stream alignment has relatively low sinuosity of 1.12 considering the available floodplain area available for meander development, and the minimal hardening of the streambanks.

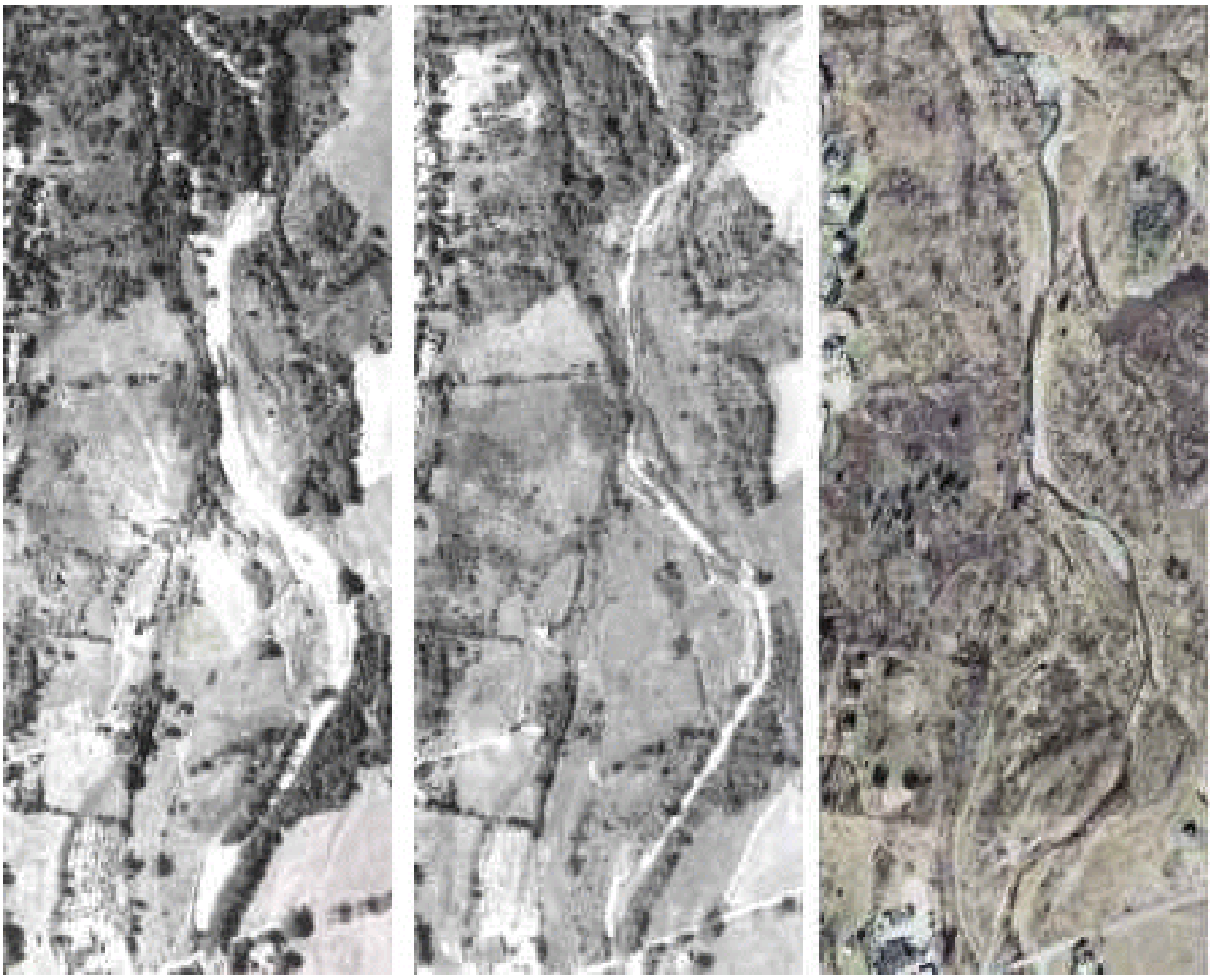


Figure VI-31: Aerial view of upper end of reach 3a from 1959 (l), 1967 (c) and 2000 (r). Bridge at CR 65 in Hensonville is seen at bottom-center of each photo

Restoration would provide multiple benefit, including water quality protection and fisheries habitat enhancement. A restoration strategy which addressed fisheries passage at the lowest concrete dam, would provide access to miles of streams.

Riparian Condition

Though the GCSWCD did not conduct a detailed riparian buffer assessment in Reach 3a, the Phase I inventory and assessment, recent inspections, and review of historical photographs has shown that most of the reach exhibits fair to poor riparian conditions. While some smaller sections of the reach have somewhat adequate forested buffers **(Figure VI-28a photo B,D & Figure VI-28b photo A,C,D)**, the majority of the reach has no riparian vegetation other than grasses and forbes which provide limited stability to the streambanks. In the areas of active erosion, often there is no woody vegetation present,

and the grasses do not provide adequate rooting depth to prevent bank failure **(Figure VI-28b photo F)**. The reach also contains a significant population of Japanese knotweed. As shown in **Figure VI-31**, the reach has exhibited poor riparian conditions as far back as 1959.

Water Quality

During the GCSWCD's observations of the Reach 3a, no specific water quality concerns were noted. While the GCSWCD's assessment of the stream reach did not indicate any clay exposures in either the streambed or banks, the GCSWCD feels that the glacial clays are most likely only a few feet below the existing channel The lack of clay exposures at this time may be attributed to the fact that the concrete structures have prevented degradation of the channel. While there is one trailer structure near the stream at the top of the reach, and the Thompson House facility is near the creek at the bottom, for the most part structures in this reach are set back some distance from the stream. Any potential impacts to water quality from on-site waste water treatment will be adequately mitigated upon construction of the Windham wastewater treatment system in 2003.

Observations have indicated that there are no readily apparent impacts from stormwater systems in the areas. Runoff from most of NYS Route 23 which runs along the reach is treated to some extent by a complex of small tributaries passing through wetland. At the very bottom of the reach, near the SR 296 intersection, road runoff does discharge directly to the stream from SR 23. In addition to the stormwater drainage at the 23/296 intersection, the Thompson House may also present opportunities for stormwater rehabilitation through CWC grant programs..

Infrastructure

Reach 3a has little to no impact on infrastructure. At this time transportation infrastructure is limited to a county bridge at the very top of the bridge, and a state bridge at the bottom. In both cases, the bridges appear to be adequately sized for the stream and there are no observable signs of instability associated with either structure. The county bridge at the top of the reach does include a narrow steel I-beam center pier which does present a hazard for catching debris. Accumulation of debris during a flood event can result in localized flow divergence, causing the stream's energy to become directed against the streambank ultimately resulting in bank failure. The bridge structure at 296 spans the entire narrow floodplain, and appears to have no impact on the channel. The bridge is fairly old, and the GCSWCD presumes that it will require replacement or rehabilitation in the near future. A well house for the Town of Windham is also located on the left floodplain, just below the CR 65 bridge. The well house is several hundred feet from the actual creek and to date no problems have been reported by the Town of Windham.

Habitat

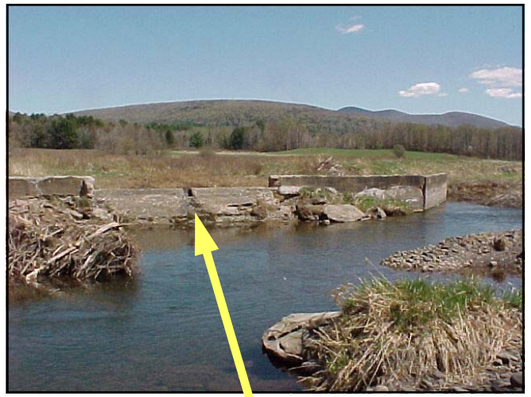
While the GCSWCD did not conduct a detailed habitat assessment, several observations can be made regarding reach 3a. In general, habitat appears to be fair at best, with little pool structure, stream cover and an actively shifting channel. One of the most important habitat issues in the reach involves the concrete structure at the bottom of the reach. Although the dam structure is effective at providing local vertical stability in the Batavia Kill, the dam presents a barrier to fish migration. The presence of the structure prevents fisheries migration between the dam and the CD Lane Park flood control dam, effectively cutting off several miles of headwater stream. The structure also cuts off fisheries access to a significant portion of the large tributary coming from East Windham (Silver Lake).

Flooding Concerns

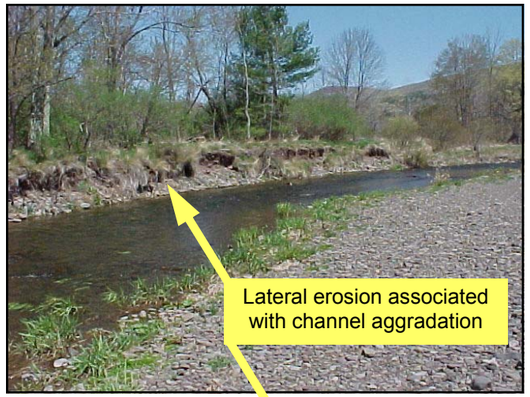
The GCSWCD is aware of limited flooding concerns in reach 3a. At the top of the reach, a trailer and one home appear to be located within the floodplain, but the presence of the C.D.Lane flood control structure has prevented any structural flooding in any of the recent flood events. The lower end of the tributary from East Windham does exhibit signs of accelerated erosion from recent floods in the area just above the confluence with the Batavia Kill. As noted earlier, all structures and roadways in the reach are located away from and high above the creek. The presence of a wide valley floor and available floodplain has reduced the occurrence of flooding problems.

Reach Summary:

Reach 3a is characterized as a transitional zone, where the steeper upper watershed starts to hit the broader, flatter valley. The predominate stream type is C3/4, with the stream becoming more entrenched as it approaches state route 296. The reach has been characterized as being relatively unstable, with aggradation and associated lateral channel adjustments occurring. The presence of a concrete dam near the bottom of the reach has impacted (reduced) the local channel slope which has preventing channel incision but has resulted in aggradation and associated lateral migration as evidenced by accelerated bank erosion. This erosion is exacerbated by the presence of Japanese knotweed and poor riparian vegetative cover to the banks.

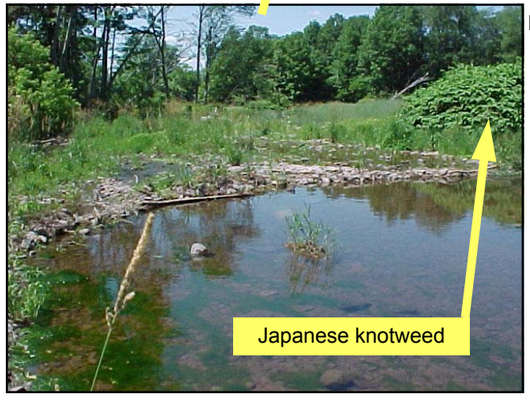

A


B


C


D


E



F


G


H

Batavia Kill Stream Management Plan

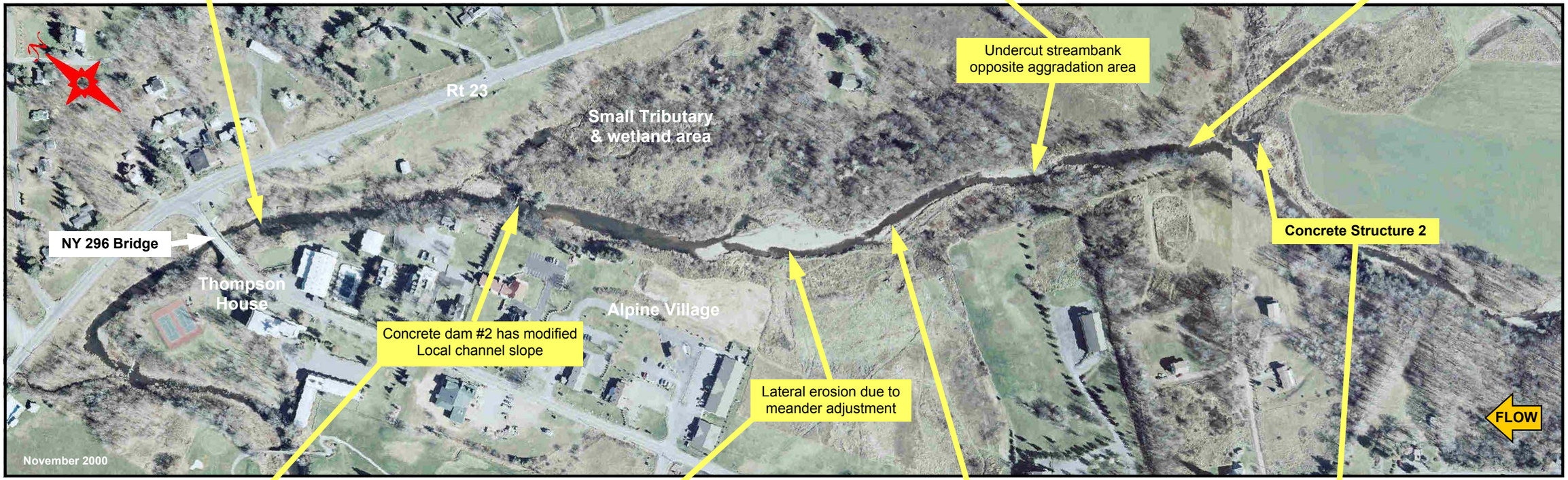
Figure VI-32a: Reach 3a-Upper


A


B


C

D




E


F


G

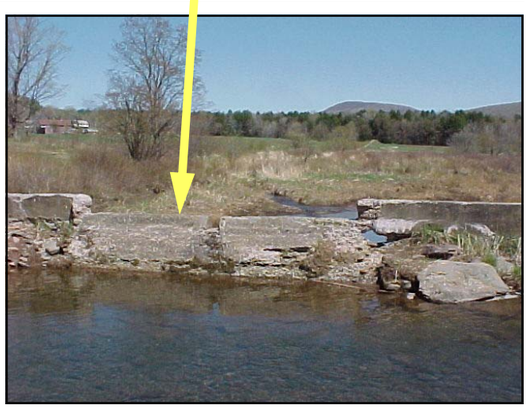

H

Figure VI-32b Reach 3a-Lower

Table VI-8 Reach No. 3a CR 64 Hensonville to SR 296	
Intervention Level	Full/Assisted
Stream Morphology	Based on priorities, restore stream function within the reach. Natural channel stability through most of the reach should not be expected while the concrete structure is influencing the channel form and function. Restoration should restore sediment transport processes through the reach which may necessitate adjustments to or removal of the lower concrete dam.
Riparian Buffers	The reach does not contain adequate riparian buffers. While the upper reach near Hensonville may be appropriate for buffer establishment, the majority of the reach does not exhibit enough stability to advise new buffer establishment without associated channel adjustment. In the lower reach, buffer vegetation is critical to maintain stability of the high terrace where the Thompson House is located, and vegetation should be managed through replanting and selective pruning to increase buffer strength. The reach contains sizable areas of riparian wetland which may be protected by creation of a naturally stable stream channel. Any and all activities should be done to minimize impacts to these existing wetlands.
Water Quality	See general recommendations
Infrastructure	1. CR 65 Bridge - remove debris regularly, inspect bridge frequently for sign of local scour of center pier or streambanks 2. SR 296 Bridge - any future replacement/retrofit should be done so as to maintain current span, with no center pier 3. Construction of the Windham Wastewater system includes a sewer main in the floodplain corridor through the reach. Placement and construction should be done so as to reduce any impacts on the Batavia Kill.
Habitat	1. Removal or adjustments of the concrete dam at the lower end has the potential to substantially increase fish passage through the reach. 2. Construction of a stable channel form with removal or adjustment of the dam would provide a suitable riffle-pool complex, as well as involve establishment of riparian vegetation for shading, and restore fish passage.
Flooding	See General Recommendations
Further Assessment	1. Evaluate impact of the concrete dam on fish passage, as well as impacts upstream such as aggradation and loss of base flow. 2. Evaluate influence of East Windham (Silver Lake) tributary on sediment supply and transport through the reach. 3. Evaluate possibility of improvements to public access. Local resort businesses may from development of fishing access or hiking trails along this reach.

Reach 3b (Concrete Dam at Thompson House to CR 79 Church Street)

Reach Description

Reach 3b begins at the concrete dam structure discussed in reach 3a above, and ends at the county bridge on Church Street in the hamlet. The reach is approximately 1.4 miles in length and includes three bridge crossings. The reach is located in valley zone 3 and has an average valley slope of 0.7%. The contributing drainage area ranges from 24mi^2 at the upper end of the reach to 28.7mi^2 at Church Street. The reach includes Mad Brook, and an unnamed tributary, both of which are influenced by flood control structures.

Stream Morphology/Stability

Reach 3b is characterized by B stream types, primarily influenced by increased entrenchment associated with a high terrace which impinges the stream channel along the entire reach. The sediment regime of the reach falls predominantly into the small cobble category, with small sections of the stream channel dominated by large gravel. The reach is impacted by the influence of two additional flood control structures located on the major tributaries within the reach. These structures, in combination with the C.D.Lane Park dam, control runoff from 33% of the total drainage area at Reach 3b. The reduction in sediment supply caused by these structures is evident in the scarcity of depositional features in reach 3b.

The floodplain through reach 3b is relatively narrow in comparison to upstream reaches and downstream reaches, and is heavily influenced by valley topography **(Figure VI-32a photo B,C,F,H)**. The lower extent of the reach is encroached on the north by the Windham business district, but it appears that the existing floodplain width is adequate for the stream type present. The topography along the southern bank is characterized by a high steep terrace which limits lateral channel migration, making it critical to maintain the available floodplain width along the northern bank.

During the Phase I assessment, the GCSWCD identified a section of the reach which was highly stable, and appropriate for use as a reference reach. The reference reach is located in the middle of reach 1b, with some instability located above and below this section. The Phase I assessment indicated that the reach has an average of 2.2ft^2 of exposed bank for every linear foot of stream bank, with 13% of the reach length containing actively eroding streambanks. The exposed banks are located in the first 0.5 miles of the reach, occurring primarily on the golf course property **(Figure VI-32a photo I)**. The upper section of Reach 3b has numerous signs of past channel modifications, primarily efforts to provide stabilization of the high terrace on the Thompson House and Windham Golf Course Property. Rock rip-rap and steel piling and cribbing have been used in the past to address eroding streambanks. In the 1970's, the GCSWCD worked with the Town of Windham and local landowners to stabilize a large failure of the high terrace on the golf course property.

While no written record for the work exists, the GCSWCD does have some pictures of the site.

An aerial photography analysis of the reach indicated that no significant lateral channel migration had occurred since 1959, and for the most part the channel planform has little opportunity for adjustment due to local topography. The aerial photographs were used to calculate a moderate sinuosity of 1.3 through the reach. The steam channel in the upper third contains an irregular meander patten, changing to regular meanders as the reach progresses with no evidence of channel debris blockages, avulsions or channel braiding.

The field assessment of Reach 3b focused on monitoring a potential reference area located upstream of the Windham-Ashland-Jewett school bus garage. This section of the stream was selected in 1997 for further evaluation as a reference reach based upon its physical appearance and apparent physical health following the January 1996 flood event. The reference area (Church Street reference reach) was initially topographic surveyed in July of 1997, with data collected from 9 cross sections and approximately 1,040 feet of longitudinal profile. Dominant particle analysis was performed for the stream channel and bank erodibility hazard index rating scores taken along both right and left stream bank. The reference reach was re-surveyed in July of 1998 by NYCDEP SMP and included 8 monumented cross sections and an additional 570 feet of longitudinal profile. The reach was documented as having maintained a stable condition between 1997 and 1998.

The reference reach has been classified as a B3c stream type, indicating a moderately entrenched channel with a gradient of less than two percent. The channel bed is dominated by small cobble material, and is characterized by a series of rapids and unevenly spaced scour pools. The stream's energy is dissipated in these bed features and has very little erosion occurring along the streambed and banks. The bank erodibility hazard index averaged 16.1 through the site showing a low potential for stream bank erosion with an increase in the score provided by a moderate bank height to bankfull height because of the high terrace along the left bank.

Riparian Conditions

The condition of the riparian area within Reach 3b is somewhat variable, but overall is in good condition and has remained relatively constant through the past 40 years. Review of aerial photographs from 1959 to present indicate that the riparian condition has not changed significantly. In most cases, the riparian area consists of a narrow band of hardwood, conifer or mixed forest, with some sections along the golf course property lacking woody vegetation. Along the steepest portion of the high terrace, conifer forest is the dominant cover **(Figure VI-32b photo C,D**) and it plays a critical role in maintaining stability of the steep slopes. The lower banks and channel bottom are frequently characterized by dense stands of sedges and forbes, and while present in small patches, knotweed does not appear to be a significant problem.

Water Quality

During the GCSWCD's assessment of Reach 3b, no specific water quality problems were noted. The Phase I Inventory and Assessment did not indicate the presence of any glacial clay exposures, but based on observations in other areas of the watershed the GCSWCD suspects clay layers are only a short distance below the streambed, and any instability which results in channel degradation would expose the clay lens. As noted in Reach 3a, the GCSWCD did not observe any direct impacts from on-site waste water treatment system, but the scheduled construction of the Windham municipal sewer project will eliminate on-site septic systems and protect the stream from potential impacts from failing or sub-standard on-site septic systems.

While not specifically investigated by the GCSWCD, the Windham County Club may present some opportunities to work cooperatively to protect water quality. During implementation of this stream management plan, the GCSWCD will further assess any impacts from the golf course, and work with the Windham Country Club to investigate management practices which would protect water quality. Reach 3b may also present opportunities for future projects related to stormwater retrofits. The lower part of the reach receives runoff form the denser hamlet area, with several outfalls from NYS Route 23 drainage systems located in the lower reach. The GCSWCD has been working with the Town of Windham and CWC to implement a stormwater retrofit project which is located in this reach. The GCSWCD is also aware that the upcoming reconstruction of NYS route 23 in conjunction with the Windham sewer project will include a number of stormwater treatment practices which will protect water quality, as well as reduce the impact of stormwater in stream erosion.

The WAJ bus garage located in the lower end of the reach has also been noted as a potential risk to water quality which requires further evaluation. While observations by the GCSWCD indicate that the WAJ facility is very well maintained, and operates in a clean manner, the location of a fleet of buses so close to the stream could potentially impact water quality in the event of a fuel leak or similar incident. The GCSWCD will seek to work with the WAJ school district to investigate possible funding opportunities and strategies to minimize or eliminate the potential for the facility to impact the stream in the future.

Infrastructure

While reach 3b contains three stream crossings and a well house for the Town of Windham water system, the GCSWCD did not note any particular concerns with any of these features. The public road system is located a safe distance from the stream, and does not appear to have any direct impacts on the stream. In regards to bridges, the reach has three bridges, with a bridge at SR 296 located at the top of the reach, and two private bridge crossings located on the Windham County Club property. The SR 296 bridge spans the entire floodplain, and even though the channel becomes somewhat entrenched as it passes under the bridge, there is no obvious signs of having a negative impact on the

stream system.

The two smaller bridges located on the golf course property **(Figure VI-32a photos A,B,J)** are primarily used by golf carts and service vehicles. While the bridges are currently stable, the presence of old steel sheet piling protection and rip-rap indicate past channel modifications, and there are some signs that the lower bridge may not effectively pass sediment during larger flood events. Reach 3b also contains a well house for the Town of Windham water system. The well house is located on the floodplain, near the WAJ bus garage. While the well is located far enough from the stream to be protected from significant damage by flooding, the Town of Windham would benefit from development of a Wellhead Protection Plan.

Habitat

Again, while the GCSWCD did not conduct a detailed fisheries assessment of the reach, observations have indicated that habitat quality is fair to good. In most places, the stream has some vegetative cover, and while the riffle pool structure is dominated by riffles with infrequent scour pools, the reach does present some areas for holding larger fish in the warm summer months. Further habitat assessments would be likely to identify improvements which would improve fisheries habitat.

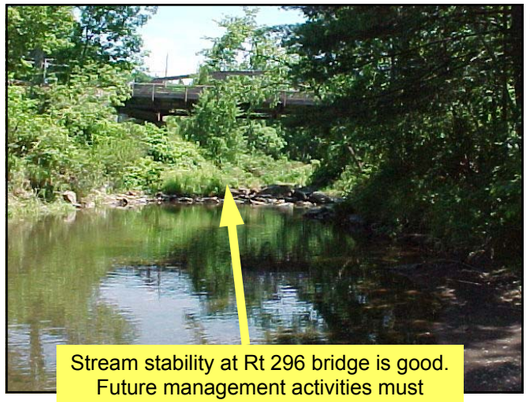
Flood Concerns

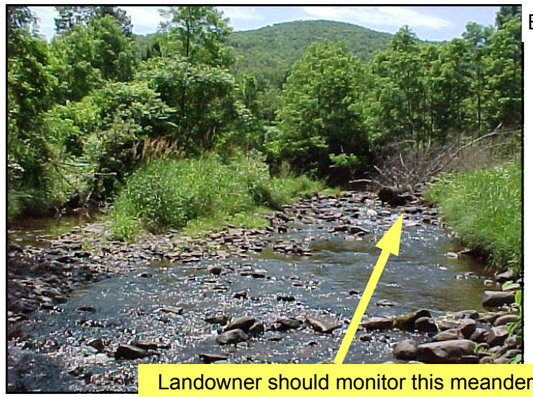
The most significant issue with flooding in Reach 3b is related to those structures located on the right floodplain near the bottom of the reach. While current flood mapping indicates that several structures are located within the 100 year floodplains, the flood control structures at Big Hollow and Narvou Road appear to adequately mitigate flooding impacts. During the larger floods in 1996 and 1999, the GCSWCD did not receive any notice of flood damaged structures, though several landowners reported minor erosion problems. The bridges have withstood many large floods without significant damage.

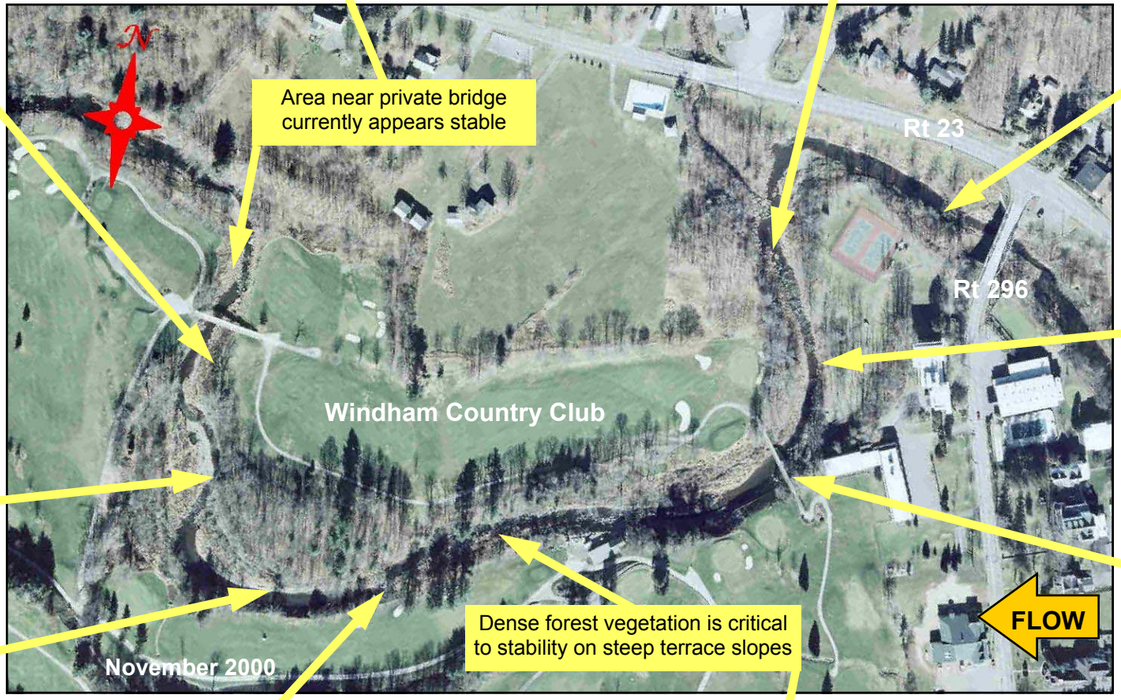
As the reach is already constrained by its entrenchment, any future activities should be undertaken so as to avoid fill in the floodplain. The NYSDEC digital flood mapping project for the Schoharie basin will be very useful in conducting additional assessments of flooding risks to the structures located within the hamlet area. A recurring flooding problem associated with an old mill race system located in this reach is being addressed by a GCSWCD and Town of Windham project under the CWC Stormwater Retrofits program.

Reach 3b Summary

While reach 3b can be currently characterized as being relatively stable, the natural entrenchment of the stream channel, and the presence of development on the adjoining floodplain, are but two of the factors which can potentially influence long term stability. Management activities such as grading in the channel, additional fill on the floodplain or even streambank protection, can initiate local instability which would have strong potential to migrate upstream and downstream. The GCSWCD would suggest that overall, the reach is sensitive to any activities which would increase entrenchment in the reach.







Steel piling streambank protection indicates past instabilities in this area

Area near private bridge currently appears stable

Stream stability at Rt 296 bridge is good. Future management activities must protect stream conditions

Landowner should monitor this meander for erosion. See GCSWCD for assistance prior to any management activities

Dense forest vegetation is critical to stability on steep terrace slopes

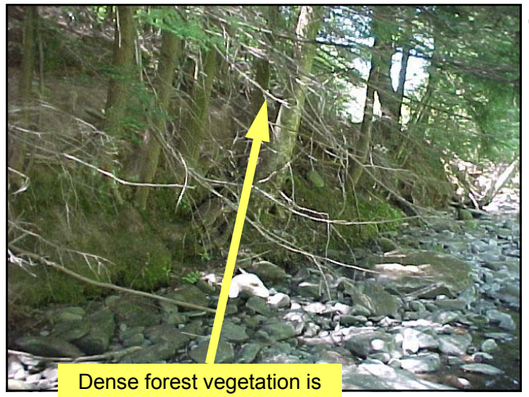
Private bridge exhibits good stability, and does not appear to be impacting the stream

Batavia Kill Stream management Plan

Figure: VI-33a Reach 3b-Upper

A

B



C

D

Reach is moderately entrenched in the hamlet. Avoid additional floodplain fills.

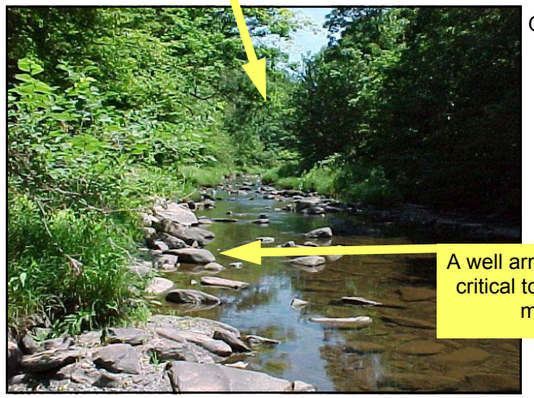
Dense forest vegetation is critical to stability of steep slopes along the high terrace

Potential CWC Stormwater Retrofit project could focus on relocation of bus parking and buffer improvements

Good riparian conditions provide stability and stream shading

E

F



G

H

A well armored stream bottom is critical to stability. Disturbance must be avoided

Figure: VI-33b Reach 3b-Lower

Table VI-9 Reach No. 3b (NY Route 296 to Church Street)	
Intervention Level	Protection
Stream Morphology	Stream channel morphology is basically stable, instability problems are small and localized. The reach is highly constrained by valley topography. Management activities must be conducted so as to protect the channel from further entrenchment. Continue to monitor Church Street reference reach for stability.
Riparian Buffers	The riparian condition in Reach 3b is in fair to good condition through much of the reach. Opportunities may exist for increasing buffer widths, especially on the north bank. See general recommendations
Water Quality	1. Evaluate WAJ bus facility for potential CWC Stormwater Retrofit funding. 2. Work with Windham Country club to evaluate management activities which will preserve water quality. 3. Town of Windham should consider development of a Wellhead Protection Plan. 4. See general recommendations
Infrastructure	1. Future replacement/retrofit of the SR 296 bridge, and the private bridges on the country club property, should be undertaken so as to maintain or increase the current spans. Center piers should be avoided. 2. Activities conducted in response to flood damage repairs should be done so as to prevent any changes in stream morphology. Emergency repairs should not result in entrenchment, over widening or changes in stream slope. Repairs should not set conditions for long term instability.
Habitat	See general recommendations
Flooding	1. Priority must be given to avoiding future floodplain fills 2. Work with Town of Windham to evaluate status of existing development in the floodplain. Assess threat to public/private property within the reach when more detailed flood maps become available. 3. See general recommendations
Further Assessments	1.Upon receipt of the new digital flood maps, evaluate flooding risks to structures at the bottom of the reach. 2. Continue to monitor Church Street reference reach. 3. Conduct detailed riparian assessment, evaluate need for buffer enhancements.

REACH 3c (Church Street to CR 12 South Street)

Reach Description

Reach 3c consists of approximately 1.3 miles of stream channel, located between the Church Street bridge, and the bridge at CR12 (South Street). The reach is located in Valley Zone 3 **(Figure V-12)** and has an average valley slope of 0.7%. The valley morphology is characterized as a wide "U" shaped valley, with evidence of lateral and terminal moraines, well defined floodplains, and alluvial terraces. The drainage area of Reach 3c ranges from 28.7 mi^2 at the upper end of the reach, to 40.6 mi^2 at the lower end of the reach. Three small, unnamed tributaries enter the Batavia Kill in this reach. The reach is characterized by B and C stream types, with varying degrees of entrenchment throughout and stream type being influenced by the adjacent high terrace and road fills.

Channel Morphology/Stability

The Phase I Inventory & Assessment of Reach 3c indicated that the reach was characterized as relatively stable, with minor localized erosion of the streambanks noted. The inventory found that the reach exhibited an average of 2.1ft^2 of exposed streambank per linear foot of stream bank length, with 18% of the total length experiencing some form of bank instability. Bank instability problems are localized, and do not appear to represent a broader scale stream channel instability in the reach. The majority of the exposed streambanks observed were basically low in height, and characterized by slumped vegetation along the toe of the bank, with partially vegetated upper banks. The Phase I Inventory team noted that much of the erosion was fresh, and was most likely associated with the January 1996 flood event. The 1997 inventory also indicated that the reach has experienced fairly extensive channel modifications over the years, with rock rip-rap bank stabilization found in several locations within the hamlet, as well as along Route 23 West of the hamlet.

Figure VI-33: Severe streambank erosion along NYS 23 below GNH Lumber after 1961 flood.

To evaluate stability of the channels planform in Reach 3c, the GCSWCD examined a series of aerial photographs taken between 1959 and 2000. The historical photographs were assembled and compared to evaluate channel planform changes, as well as to inventory any potential channel modifications which may have occurred. While the channel planform in the lower half of the reach has remained fairly consistent over the 40 years of photographic record,

the upper section of the reach between South Street and GNH Lumber **(Figure VI-34)** was shown to have been more active. The aerial photographs indicated that the reach was once split into two channels behind GNH lumber, with only a single channel present in 2000.

The owners of GNH provided the GCSWCD with drawings dating from the mid 1960s

Figure VI-34: Aerial view of western end of Windham hamlet, 1959 left, 1980 center, 2000 right. Note double channel to the left side of photos.

showing plans to dredge the single channel, which cut off a large meander right behind GNH Lumber. As the channel is located in this area, the GCSWCD assumed that this work had been done, though that could not be directly confirmed. The GCSWCD did not note any active headcuts in the reach, and the erosion of the streambanks does not appear to indicate any active adjustment in planform. It is possible that the channel has already responded to this channelization.

In the area near GNH Lumber, and running downstream along NYS Route 23, the stream has experienced significant erosion in the past. NYS Route 23 was washed out in a major flood in 1961, and has required repairs to the rip-rap adjacent to the roadway in 1996 and

1999. A long section of Reach 3c between GNH Lumber and Theo's Restaurant has significant rip-rap. The rip-rap is fairly stable, and has become overgrown with vegetation. along the road which appears to have been installed many years ago. In the area near GNH lumber, the stream starts to become more entrenched, with the channel trapped between the high terrace and floodplain fill where the Lumber yard is located, as well as State Route 23. The lower reach is characterized by relatively stable C channel, as the floodplain widens and the stream is less entrenched.

After the Phase I Inventory and Assessment, the GCSWCD did not install monitoring cross sections in Reach 3c. At the time, the reach appeared fairly stable, and monitoring was determined to be a lower priority than other, more active reaches in the watershed. As time and resources allow in Phase II, the GCSWCD will continue to visually monitor the reach, and will add monitoring cross sections as necessary to refine stream classification and to determine if the stability is self sustaining (natural). The GCSWCD strongly recommends that priority be given to working with the GNH owners to seek effective flood mitigation solutions.

Riparian Condition

The riparian zone in Reach 3c is in fair to good condition through most of the reach. The South side of the stream is still dominated by the steep terrace in the upper reach which is well vegetated, and transitions to flatter floodplain fills which have some, but poorer buffers. On the north side, the riparian buffer is narrow, and in some reaches basically nonexistent. As noted in Reach 3a and Reach 3b, the riparian vegetation and wooded uplands is critical to the stability of the high terrace which runs along half of the reach. The Riparian corridor consists of both hardwoods and conifers, with some non-native species located in areas where the stream runs through the hamlet. The riparian buffer is wider, and clearly more effective on the steeper slopes.

The streambanks and lower areas in the channel are generally dominated by grasses and forbes, with willow and various understory trees/shrubs also present. The reach has significant populations of Japanese knotweed behind GNH, as well as the bottom of the reach. Generally the riparian zones through Reach 3c are narrow in the area behind the hamlet's residences and along the open field above South Street. In some areas, such as at GNH lumber and along sections of NY 23, the riparian buffer is practically nonexistent.

Water Quality

Similar to Reach 3b, water quality impacts in Reach 3c would be primarily related to on-site wastewater and stormwater. The Phase I Inventory and Assessment did not indicate the presence of any glacial clay exposures, but based on observations in other areas of the watershed the GCSWCD suspects clay layers are only a short distance below the streambed All existing on-site septic systems in this reach will be discontinued upon completion of the Windham waste water treatment system, which will effectively mitigate any existing or potential water quality threat. In regards to stormwater, reach 3c receives significant runoff from both the local roads in the hamlet as well as NY Route 23. The building and parking at Windham Mountain are also located in Reach 3c. While no direct stormwater impacts have been noted during the project period, the Town of Windham, NYSDOT, the GCSWCD and Windham Mountain are currently planning stormwater retrofit projects which will have a direct benefit to water quality in the reach.

In 2003, the section of NY Route 23 which passes through this reach will be completely rebuilt in conjunction with the Windham sewer project. The NYSDOT funded project will include a number of stormwater treatment features, including sediment basins. At the time of this SMP, the GCSWCD is working with NYCDEP and Windham Mountain to investigate the development of a state of the art stormwater treatment system. While still in the conceptual planning stages, the project would effectively mitigate the single largest area of impervious surface in the Batavia Kill watershed. It is the intention of the GCSWCD to develop a project which will qualify for CWC stormwater retrofit program funding. A number of other projects planned by the GCSWCD will also have benefits to water quality.

Infrastructure

Infrastructure located within Reach 3c includes bridges at the top and bottom of the reach, a section of NY Route 23, and a water withdrawal point for Windham Mountain. Located near the center of Reach 3c is the water withdrawal point for the Ski Windham snow making operation. The pump house for the water withdrawal is located on the south bank of reach 3c, directly adjacent to the stream and utilizes a sub-surface intake to the pumps **(Figure VI-35b photo H)**.

In 2002, Windham Mountain constructed a large pond closer to the ski center which will reduce the need for withdrawals directly from the stream. Rock revetment installed to protect the pump house foundation has modified the channel cross sectional area, resulting in a point of localized entrenchment. Future work in this area should be conducted so as to prevent any further entrenchment of the stream channel. The presence of the subsurface water intake pipes will provide a good indicator if stream channel degradation starts to occur in this section of the reach.

In regards to transportation infrastructure, the two bridges bot ends of the reach are owned by Greene County. Both the Church Street (top) and South Street (bottom) bridges do not appear to have a negative impact on stream stability. At the Church Street bridge, the abutments and bridge approach are characterized by floodplain fill which does slightly

entrench the stream channel as it passes the bridge, but the hydraulic opening of the bridge appears to be adequate for passing the bankfullflow **(Figure VI-35a photo D)**. There is no evidence that the bridge has reduced sediment transport capacity, and the channel appears to be well vegetated and stable.

At the bottom or Reach 3c, the South street bridge also does not appear to have any negative impact on stream stability. The bridge is longer than the Church Street bridge, and while there is some floodplain fill associated with the roadway approaches, the bridge's long span provides a hydraulic opening which has allowed for development of a stable channel under the bridge **(Figure VI-35b photo E)**. In both cases, the bridges in Reach 3c contain center piers located within the active stream channel. While there is currently no scour problem noted, the bridges should be inspected frequently. As bridge piers can result in the buildup of debris piles which reduce bridge capacity and redirect stream velocities towards the streambanks, the bridge should be inspected frequently and debris removed as appropriate.

Habitat

As noted earlier, the GCSWCD did not conduct a specific assessment of fisheries habitat on the Batavia Kill. Based on the initial Phase I Inventory and Assessment, as well as continued observations of the stream, the habitat would appear to be in fair condition. Similar to reach 3b, this section of the Batavia Kill is also characterized primarily by long riffles, with pools being found infrequently. The pool structure in the stream channel appears to be primarily associated with local scour forces. Stream cover is fair to good.

Flooding Issues

Management concerns related to flooding in this reach include the erosion hazard to infrastructure, as well as flood inundation threats to private property. The Windham Ashland Jewett School property borders the channel as well as numerous private residences and businesses. Of specific interest is the recurring flooding problem associated with the GNH Lumber facility located on the west edge of the hamlet. As noted earlier, GNH has experienced significant problems with flooding in 1987, 1996 and 1999 and even earlier. In both 1996 and 1999, the flooding damage was primarily associated with the loss of building supply materials which were located in the lumber yard. Wood, roofing, pipe and other materials were floated by the flood waters, and later found widely dispersed on the floodplain for miles below the site.

The GNH facility is located within the Batavia Kill's active floodplain, greatly increasing its risk of flooding. GNH has attempted to secure an adjacent property which would allow for construction of a storage area above the floodplain elevation, but has reported to the GCSWCD that the landowners have been unwilling to sell. In 1996, the GCSWCD undertook a preliminary assessment of the property to determine eligibility for relocation funds under the FEMA Hazard Mitigation Grant Program. At that time, the GCSWCD found

that the high cost of relocation could not meet the cost/benefit requirements for funding. In 2001, GNH initiated activities to reduce their losses during flood events. A new storage shed was designed with future flooding in mind, with floatable materials placed on a rack system which is elevated above the flood elevation. Additionally, the building was designed to handle short term inundation by flood waters.

Figure VI-36: 1961 flood damage to Church Street bridge located in Reach 3c.

Other issues related to flooding in this reach includes the recurring flooding of NY Route 23 just west of GNH Lumber, and the threat of erosional damage to the bridges. Just west of GNH Lumber, the roadway has been washed out several times, and in the larger floods such as 1996 and 1999, the moderate entrenchment in the reach has resulted in the stream flooding the roadway. Earlier floods in the 1950's and 1960's resulted in significant infrastructure damage, with both bridges in Reach 3c experiencing total loss. As shown in **Figure VI-36**, the stream channel migrated around the bridge abutments causing them to fail. Since the time of these floods, the Batavia Kill Watershed District flood control structures gave been constructed, and it is unlikely that future flood will result in such extensive damage to the bridges. Flooding impacts a major east-west transportation corridor.

Reach Summary

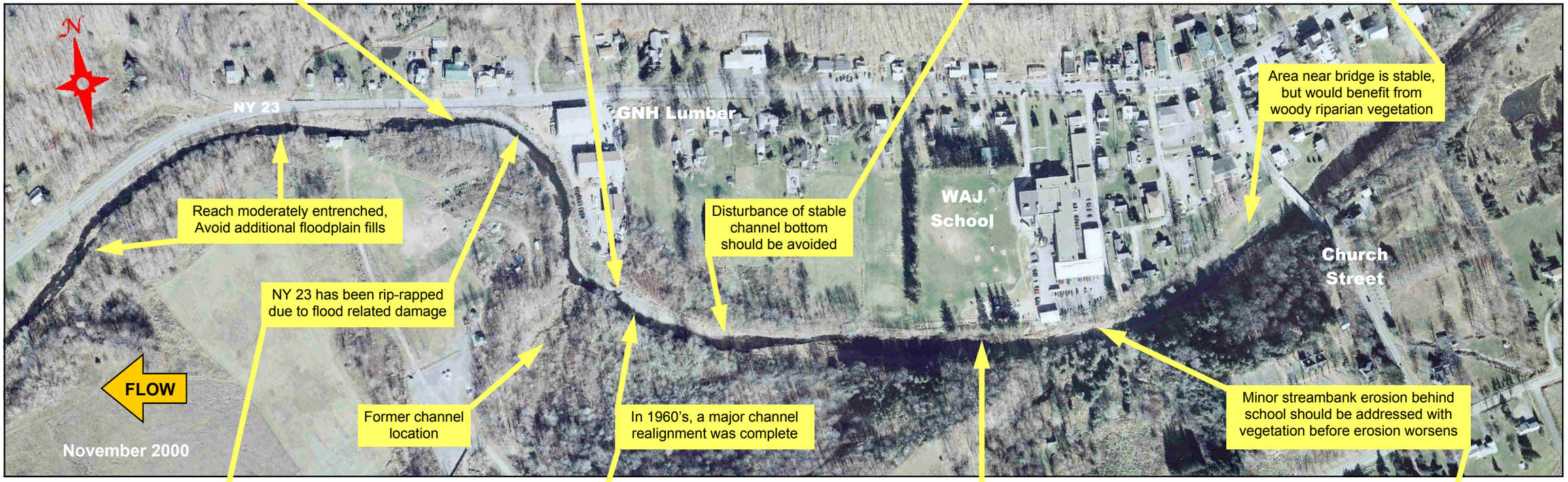
In general, the reach exhibits fairly good stability. While entrenchment is an issue through most of the reach, it does not seem to be causing major instability at this time. The reach is extremely sensitive to changes in grade, and any activities in the stream corridor must be done so as to avoid further entrenchment. A recurring flooding problem in the area of GNH Lumber requires further investigation to determine if the flooding can be mitigated. Reach 3c has a fair to poor riparian condition, and would benefit from additional plantings as well as management of invasive species populations. There are several opportunities of protecting water quality with stormwater retrofit projects, and the recent acquisition of a large parcel by NYCDEP on the lower, south side of the stream may present opportunities of floodplain and riparian buffer improvements.


A


B


C


D




E


F


G

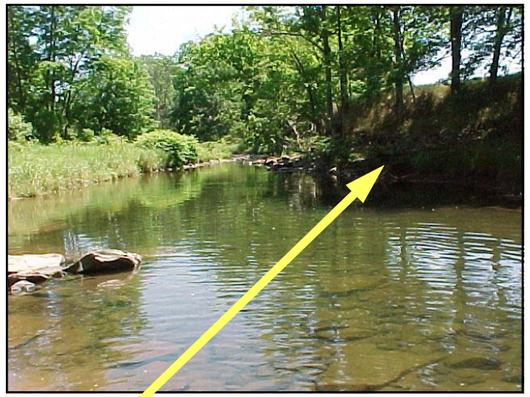

H

Riparian buffer zone in reach 3c would benefit from additional Width And diversity

Batavia Kill Stream Management Plan

Figure VI-37a Reach 3c-Upper

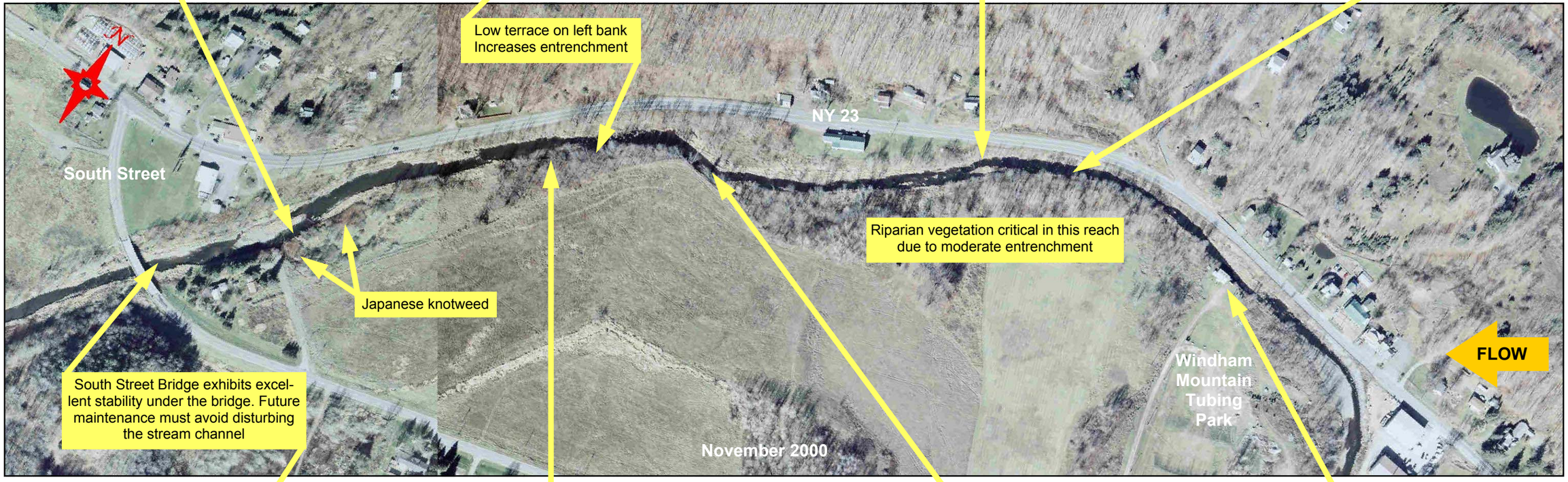

A


B


C


D

Well armored streambed and riparian vegetation are critical to prevent stream channel degradation in this reach

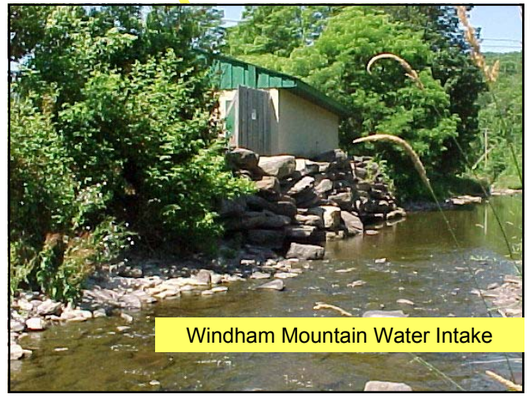



E


F

Channel exhibits good stability but is entrenched by a low terrace and NY route 23. Avoid new floodplain fills


G


H

Windham Mountain Water Intake

Figure VI-37b Reach 3c-Lower

Table VI-10 Reach No. 3c Church Street to South Street	
Intervention Level	Preservation/Full Restoration (GNH site)
Stream Morphology	While stream channel morphology currently exhibits good stability, management activities must prevent any further entrenchment of the channel. Further floodplain fills should be prohibited. Near GNH lumber, additional analysis should be undertaken to investigate the impact of past channelization and evaluate the potential to mitigate the flooding problems associated with GNH and Route 23. Local landowners should observe their streambanks for instability, and mitigate local erosion as it is noted.
Riparian Buffers	Riparian condition is fair to poor. Invasive species (knotweed) control is required, and buffers should be improved. Removal of vegetation on the steep slopes associated with the high terrace should be prevented. See General Recommendations
Water Quality	The GCSWCD should continue to work with the Town of Windham, NYSDOT and local landowners to investigate stormwater projects which can improve or protect water quality. The GCSWCD is currently evaluating a proposal to develop a Stormwater treatment system which will address impervious surfaces at Windham Mountain and have excellent benefits to water quality.
Infrastructure	1. Future bridge repair/replacement should be done so as to prevent further floodplain encroachment, and entrenchment of the stream channel. 2. Any bridge maintenance associated with gravel removal near the bridge, or anywhere in Reach 3c should only be done in extreme cases, and must address stability of the stream slope. Gravel removal operations which result in bed slope changes must be avoided at all costs as they will result in headcuts which would further entrench the reach. 3. Bridge structures should be observed on a regular basis for scour at the bridge center pier or buildup of woody debris.
Habitat	See General Recommendations
Flooding	1. Evaluate 1960's stream channel modification near GNH Lumber. Determine if channel reconstruction or other actions through this reach can mitigate or prevent the transportation corridor from being cut off in floods and the lumber yard from flooding at a reasonable cost. 2. Work with Town of Windham to evaluate status of existing development in the floodplain. Assess threat to public/private property within the reach when more detailed flood maps become available 3. See general recommendations
Further Assessment	1. Install cross sections, undertake level III/IV assessment of the middle and lower reach. Continue visual inspections of overall reach health.