Reach 4d (County Route 17 to Maier Farm Bridge)

Reach 4d is 3,375 feet in length and includes that section of the Batavia Kill that lies between the County Route 17 bridge and a private bridge located on Dr. Maier's farm **(Map VI-5 & Figure IV-61)**. The drainage area ranges from 51.2mi^2 to 52.7mi^2, with four small intermittent tributaries contributing to the reach. Reach 4d is also located in Valley Zone 2, which is characterized by a flat slope (0.3%) and a broad floodplain **(Figure V-11)**. The reach runs immediately adjacent to NYS Route 23 for a short distance. Adjacent land use includes low density residential development and both active and inactive farm fields.

Stream Morphology/Stability

The Phase I Inventory and Assessment conducted in 1997 revealed significant signs of instability in reach 4d, with active streambank erosion noted in the lower end of the reach. The inventory of stream conditions found the section of stream through the Maier Farm property was experiencing adjustments in its meander pattern, with extensive slumping of the banks **(Figure IV-54)**.

Figure VI-54: Eroding streambank on Maier Farm property prior to restoration.

The reach averaged 2.3 ft^2 of exposed streambank per linear foot of channel, with 19% of the reach's streambanks experiencing erosion. The inventory also noted one meander bend in the center of the reach that had been hardened by rock rip-rap. Approximately 325 feet of rip-rap was installed by NYSDOT to stabilize the streambank where the reach runs close to NYS Route 23. The Phase I inventory documented the majority of the active erosion as occurring exclusively in the lower half of the reach.

After the Phase I inventory, the GCSWCD examined a time series of aerial photographs to evaluate the past history of disturbances in this reach. While the upper section of the reach, just below the County Route 17 bridge, has exhibited a stable planform since at least 1959, the lower end of the reach has been more active. By comparing aerial photographs from 1959, 1980 and 1995 **(Figure VI-55)**, the GCSWCD discovered that the lower end of the reach has been experiencing planform adjustments for at least 40 years. The review of the aerial photographs indicates the reach was characterized by a very low sinuosity in

1959, with the channel slowly progressing toward a more sinuous meandering pattern as time goes on. Localized channel braiding in the area upstream of the Maier Farm bridge is present in more recent aerial photographs. Based on observations and monitoring at the site, interviews with landowners and a review of old photographs, the GCSWCD feels that the planform adjustments and the increasing sinuosity can be attributed to a number of factors.

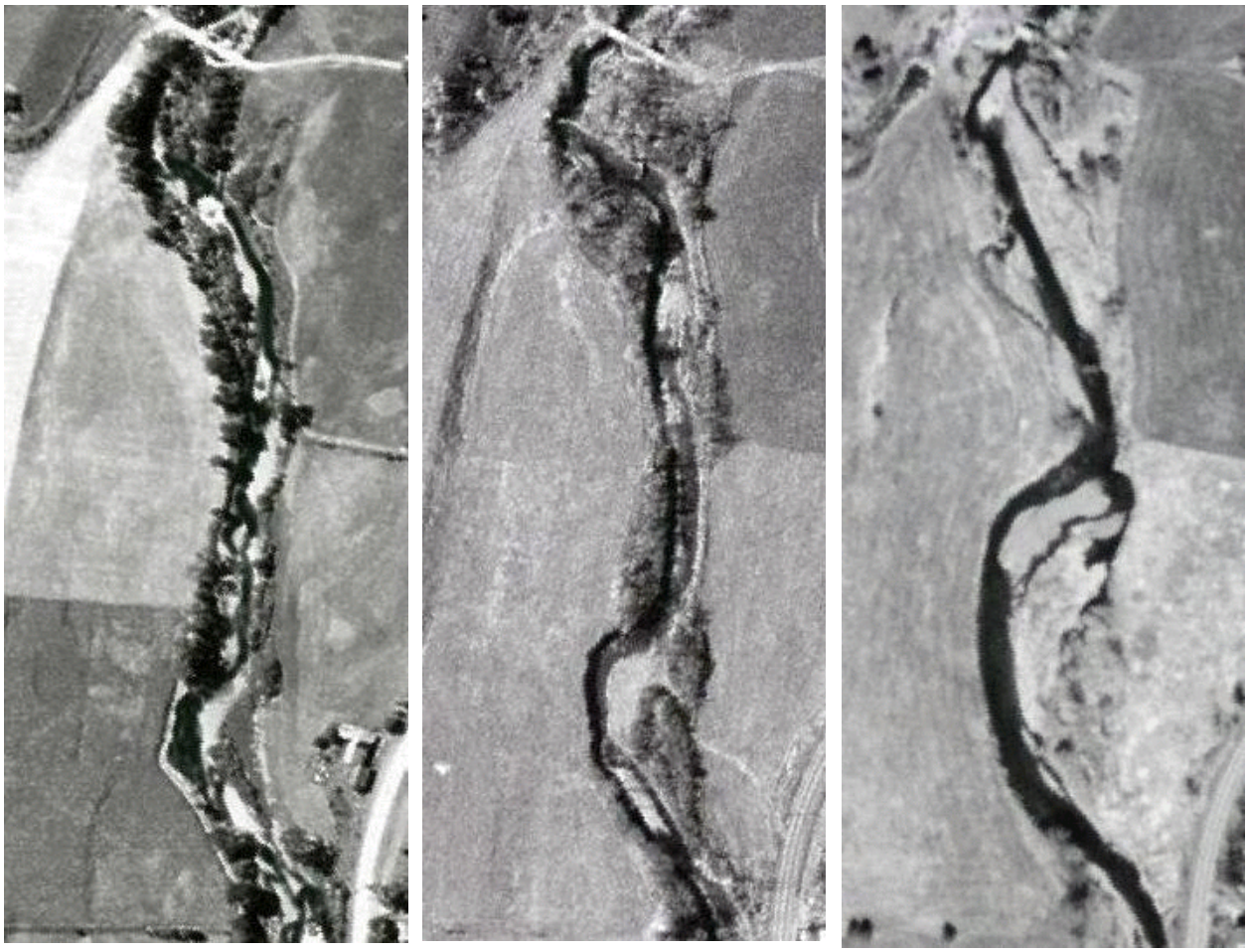


Figure VI-55: Aerial comparison of reach 4d from 1959 (left) 1980 (center) and 1995 (right).

Phase II, III and IV assessment of the lower end of reach 4d (Maier Farm site) was initiated in 1997 with the installation of two monumented cross sections in the areas of observed instability. Cross sections were installed in the areas that exhibited the worse signs of erosion, and were monitored annually between 1997 and 1999. In addition to the two cross sections, over 1,700 feet of longitudinal profile was also surveyed on an annual basis. Analysis of the cross sections indicated that the channel was a C4 stream type (Rosgen 1996) with a very coarse gravel dominating the channel sediment size. The width/depth ratio is highly variable within reach 4d, with the more confined section just below the County Route 17 bridge being characterized by a width to depth ratio of 17, and increasing to a width to depth ratio of 130 at the bottom of the reach where the channel was clearly over

widened.

Cross section #1 was located at a point where the stream was meandering to the south (left bank), approximately 50 yards below the end of the rip-rap at NYS Route 23. As shown in **Figure VI-56**, analysis of changes at the cross section over the two year monitoring period indicated that lateral migration of the channel had exceeded eight feet, with 32 ft^2 of erosion on the south bank. Deposition on the opposite bank of a similar volume to that lost appeared to indicate that the width to depth ratio was not substantially changed during the monitoring period and the channel was not over widening in this area. The cross section also did not indicate any signs of channel degradation.

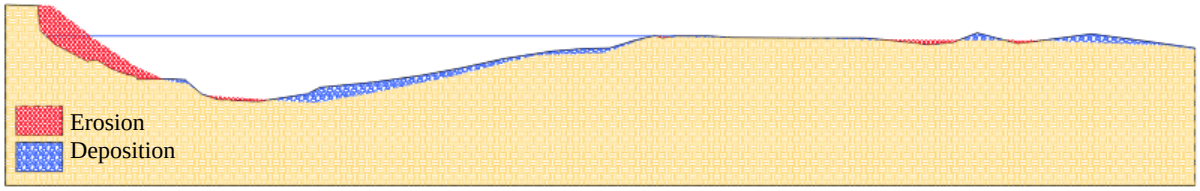


Figure VI-56: Overlay of Maier Farm cross section #1, 1997 - 1999 (looking downstream).

A second cross section was located approximately 100 feet upstream of the private bridge at the bottom of reach 4d. The cross section was placed in an area that exhibited a braided channel condition, with both active and inactive channels included in the cross section. As seen in **Figure VI-57**, the cross section monitoring between 1997 and1999 measured approximately 1.7 feet of degradation (downcutting) in the center of the cross section, with lesser amounts of erosion associated with scour of two secondary channels. The cross section also indicated aggradation, or deposition of materials on the south bank. The combined process of erosion and deposition is typical of unstable stream reaches that are seeking to build a defined bankfull channel and decrease their width to depth ratio to better transport sediment.

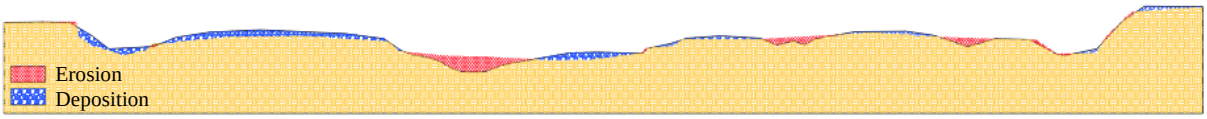


Figure VI-57: Overlay of cross section #2 between 1997 - 1999 (looking downstream).

Based on the data collected from the project reach, as well as a review of aerial photographs, historical photos, and landowner knowledge of past land uses in the reach, the GCSWCD identified several primary factors that may be a factor in the on-going instability in the reach. First, it is suspected that channel maintenance activities were common when agriculture and tourism was active in the watershed. Traditionally, landowners responded to flood damage by dredging and straightening channels, sometimes on a fairly frequent basis. This practice was significantly curtailed in the mid 1970's with the passage of Article 15 of Environmental Conservation Law (stream

protection law). As seen in the 1959 aerial photo **(Figure VI-55, left)**, most of the reach is actively being farmed and the channel planform is much straighter than would be expected for the given valley conditions. Over the past 20 years or more, as agricultural uses have declined and in-stream activities became less frequent, the reach has been attempting to establish a more sinuous form.

Another factor that may be contributing to planform instability in reach 4d is the presence of NYS Route23. The road right-of-way, and the rip-rap used to protect it from erosion, presents a hardened condition that disrupts natural channel planform evolution. After recent floods, the rock rip-rap has been repaired and work associated with the rip-rap repair may have initiated new disturbance downstream. Hardening of meander bends with rip-rap truncates meander planform and often transfers erosive forces downstream of the rip-rap.

A major factor impacting stream stability on reach 4d is the private bridge at the bottom of the reach. The bridge is thought to pre-date 1900, and at one time contained two long wing walls extending upstream. Old photos owned by the current landowners show that the bridge structure once contained a system of flash boards that were used to close off the bridge openings to create a pool upstream of the bridge. During the days when the Maier Farm was operated as a summer boarding house the temporary lake was used for swimming and fishing. While it appears that the flash board system had has not been used for 60 years or more, temporary damming of the stream would have flattened the local stream slope, reduced sediment transport through the reach, and resulted in aggradation of the channel.

Figure VI-58: View of private bridge on Maier Farm post restoration work. Note the two openings with the large, solid center section.

At the time of the GCSWCD's assessment of reach 4d, it was noted that the bridge was in an extreme state of disrepair. The bridge is characterized by two hydraulic openings on either side of the stream, with a large center pier made up of rock and fill that traps large woody debris being carried through the reach **(Figure VI-58)**.The structure has suffered extensive damage, presumably caused by debris blockages, abutment scour, channel migration and weathering. Horizontal and vertical cracks several inches in width were noted along the abutments and the invert (bottom) of the bridge openings have been essentially stripped of their concrete covering **(Figure VI-59)**. The GCSWCD also noted extensive scour under the concrete abutments, and in certain locations a survey rod could be inserted over 12 feet under the abutment.

At the time of the Phase I Inventory and Assessment, the GCSWCD observed debris trapped by the center pier of the bridge **(Figure IV-60)**. The debris was lodged on the center pier, resulting in blockage of the left opening. It was also noted that the debris was causing localized divergence of stream flow and scour. While some of the debris was fresh, most likely from the 1996 flood, it was obvious that the structure presented a significant obstacle and was frequently impacted by debris.

Figure VI-59: Invert of right bridge opening. The hemlock logs had been covered by concrete.

After reviewing the data from cross section #2 located upstream of the bridge, as well as the relationship between the bridge design and stream function, it was confirmed that the bridge was influencing channel stability. The GCSWCD found that neither of the openings alone was adequate to pass the bankfull flow, and when combined with the presence of the large center pier localized deposition was occurring above the bridge.

Figure VI-60: View looking downstream of debris at Maier Farm bridge.

At the time of the assessment, the deposition was primarily above the right bridge cell as that area was also characterized as the tailing end of a developing point bar. There was evidence that localized deposition was influenced by the variability of the debris jam.

In addition to the localized deposition, it also appeared that a significant backwater effect was created during the larger flood events, and channel impacts upstream may extend further than the immediate bridge opening. Cross section #2, as well as visual observations, indicated significant deposition of sediment upstream of the bridge. The bridge's north abutment was had sediment extending over 100 feet in an upstream direction, and was buried in fine sediment covered with vegetation. With the small size of the bridge openings and the large center pier, channel capacity can be greatly diminished during a major flood event. The result is a reduction in the hydraulic slope through the reach, which in turn reduces the channel's ability to transport the large quantities of sediment being moved by the flood. In the restoration design, the influence of the bridge

was a primary factor, and the GCSWCD undertook several channel/floodplain modifications in an attempt to mitigate this problem.

In addition to the primary instability noted in the lower end of the reach, the GCSWCD has been observing a small depositional feature located just below the County Route 17 bridge **(Figure VI-61, photo,D,H)**. In 1997, the GCSWCD noted the presence of a small, low depositional feature in the center of the channel. This central bar appeared to be stable, with much of it covered in dense sod. In recent years, the GCSWCD has observed an increase in fresh deposition on the bar, and it appears to be getting higher. The GCSWCD has also noted that the streambanks in the immediate area have been showing signs of increased scour on both sides of the deposition area. This would be a typical response when mid-channel deposition features deflect stream velocities against the streambanks. The GCSWCD does not currently have any monitoring cross sections in this section but continues to make routine observations of the channel condition. Further assessment of this section of the reach will be completed in association with future restoration work planned for reach 4c above.

Riparian Vegetation

At the time of the Phase I Inventory and Assessment in 1997, the GCSWCD characterized the riparian vegetation as being in poor condition through most of the reach. While the upper end near the County Route 17 bridge does have some woody vegetation in the riparian area, it is intermittent, and the width is not adequate to achieve the desired benefits of riparian buffers. The upper reach contains a narrow band of hardwood trees on the left bank (south), with extensive areas of Japanese knotweed dominating the understory. In some sections of the reach, such as the north bank just below the bridge, no woody vegetation is present and grasses are the dominant vegetative cover.

In the lower reach, the riparian vegetation was essentially dominated by grasses where the channel was adjacent to the farm fields, with limited areas of trees and other woody vegetation present. In some areas, where the channel appeared to be correcting for its over widened condition, old channels were being repopulated by willow and forbes. As shown in **Figure VI-55**, the limited band of woody vegetation in 1959 is essentially completely gone by 1997. The lower end of reach 4d was also very heavily dominated by Japanese knotweed.

Water Quality

Any stream or streamside activity that would increase streambed incision or streambank erosion will increase the Batavia Kill's cutting into glacial lake clay deposits and clay rich glacial tills that underlay or are adjacent to the stream, negatively impacting clarity of the stream.

Water quality impacts on the stream from upland sources is limited in reach 4d. While some

impact may be expected from stormwater runoff, the GCSWCD did not inventory any specific problems. Additionally, all structures with in the reach are elevated, and at least a couple hundred feet from the stream providing adequate buffering for on-site waste water treatment.

A portion of the fields on the south floodplain have recently been put back into active agricultural use. The operator is a participant in the Watershed Agricultural Program, and these activities would be covered by the farmer's Whole Farm Plan. In general, the Watershed Agricultural Program has found manure nutrient management to be one of the most effective water quality BMPs that can be implemented in the NYC watershed. Extensive soil sampling has found that many of the currently active fields in the watershed have elevated levels of phosphorous, and effective long term management of manure requires a greater land base. Reactivation of old farm fields can actually be very beneficial to water quality overall on the watershed scale. The GCSWCD works closely with the Watershed Agricultural Program to evaluate stream stability and management on all participating farms.

Infrastructure

Infrastructure within reach 4d is limited to a short segment of NYS Route 23 and the private bridge at the bottom of the reach. As discussed previously, the section of NYS Route 23 is located on a meander in the stream and the roadway has been damaged here in the past. As recently as the 1996 flood event, NYSDOT replaced the rock rip-rap on the bend as well as removed a gravel bar on the opposite side of the channel. As discussed at length above, the bridge at the bottom of the reach is having a number of impacts on stream stability. Initially, the GCSWCD discussed removal of the structure with the landowners, but it is their sole access to the majority of their property. While the bridge would not support a heavy load, it is still accessible by light trucks and farm wagons. In the future, the landowners may find it easier to get approvals for a repair/replacement of an existing bridge than building a new bridge. As discussed in the reach summary below, the GCSWCD identified bridge impacts and used the final design to mitigate these to the maximum extent possible while leaving the bridge in place during the demonstration project.

Habitat

While the GCSWCD did not specifically conduct detailed assessments of the fisheries habitat in the reach, over all observations and some limited information would suggest that conditions prior to the restoration project were fair at best. The reach had a limited riffle-pool bedform structure prior to the restoration work, and habitat was impacted by the actively shifting channel. Prior to the restoration project, the GCSWCD worked with the NYSDEC to electrofish the reach at the point where it was first de-watered. While some fish were caught and relocated, the entire reach only yielded a single trout fingerling. Prior to construction, the GCSWCD observed temperature readings taken by NYSDEC that

indicated that the reach waters were as high as the mid 70's (F), which is extremely stressful for cold water species (brown, brook and rainbow trout). Such fish are adapted to surviving only short periods of time at these temperatures.

Flooding Issues

Flooding issues within the reach are primarily associated with streambank erosion, but some property damage from inundation during the larger flood events has also been observed. As noted above, NYS Route 23 has experienced minor damage in the past. While the GCSWCD is not aware of any instances where the road was washed out in this location, NYSDOT has had to make repairs to the rip-rap on occasion. During the September 1999 flood event, property damage did occur at the Maier Farm. The in-ground pool was flooded, leaving behind significant sediment and debris. Also, several of the farm buildings nearest to the stream also experienced several feet of flooding. The main house and large barn appear to be just high enough to stay above the flood elevation. The September 1999 flood event appears to have been a flood of record for the watershed. The GCSWCD will be better able to assess potential flooding issues when the new digital flood maps for the watershed are completed.

Reach 4d Summary

As noted above, the initial assessment of the Batavia Kill indicated that the lower end of reach 4d was highly unstable. The assessment indicated that the reach exhibited an over-widened channel, with a high width/depth ratio The active channel process was determined to be planform adjustment, with down valley migration of the stream meanders occurring. Additionally, the stream appeared be responding to aggradation caused by the private bridge. The lack of effective riparian vegetation, past management activities and the encroachment of NYS Route 23 may all be additional contributing factors to the instability.

As discussed in **Section VII Demonstration Projects**, the GCSWCD implemented a full restoration of the channel in 1999. The work was completed approximately 21 days before the September 1999 flood event, and the site did experience some damage during the flood. The restoration project focused on the development of a stable channel morphology, and included the reconstruction of four meander bends, the construction of 14 rock structures, and extensive riparian plantings. The final design also included several considerations to address the impact of the private bridge at the bottom of the reach.

First, a rock structure called a W-weir **(Figure VI-58)** was placed just upstream of the bridge, and was designed to manipulate the flow through each side of the bridge. The w-weir was placed such that under low flow conditions, all flows were directed through the left bridge cell which was in the best shape. As the stream stage rises, and approaches the half bankfull elevation, the W-weir deflects increasing flow though the right side of the bridge opening. The W-weir was also placed so that the expected downstream deposition at the center point in the weir would develop in front of the undermined bridge abutments. The

goal was to promote fine gravels settling in and under the abutments to mitigate the scour that was occurring.

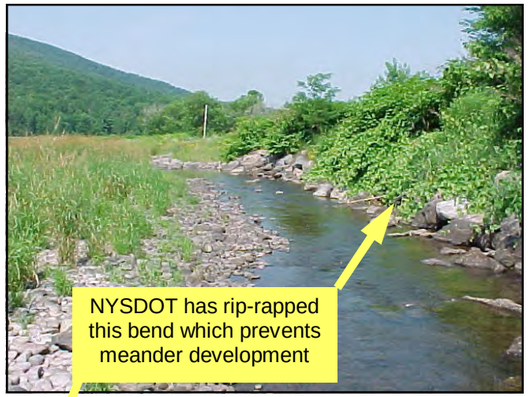
In addition to the W-weir, the GCSWCD also undertook modifications on the floodplain in an attempt to reduce the backwater effect. On the north floodplain, the project included the construction of a bypass channel that would become active when the stream reached the bankfull stage. The channel is sod covered and provides improved floodplain relief at the bridge. The GCSWCD will continue to monitor the impacts of the restoration project to determine if these strategies were effective in protecting it.

Table VI-14: Management Recommendations Reach 4d.

Reach 4d: County Route 17 to Bridge on Maier Farm Property.	
Intervention Level	Full Restoration (lower reach - demonstration Project) Assisted Self Recovery/Full Restoration (lower)
Stream Morphology	Two thirds of reach 4d is included in the Maier Farm Demonstration Project. The GCSWCD will be continuing activities to reestablish a riparian buffer, as well as to monitor the project's success. The depositional activities in the upper end of the reach will be further evaluated at the time that reach 4c is restored.
Riparian Buffers	In the demonstration project area, ongoing establishment of an effective riparian buffer is a high priority. The riparian zone for the upper reach will be addressed as a component of the reach 4c restoration project. Japanese knotweed control will be critical in the demonstration project area to allow for success of more desirable vegetation. The site should be evaluated for control of Japanese knotweed.
Water Quality	1. The GCSWCD will continue to work with agricultural operators to implement their Whole Farm Plans. See General Recommendations
Infrastructure	1. County Route 17 bridge at top of reach will be a critical consideration in restoration design for reach 4c. 2. The GCSWCD will continue to monitor the channel features at the Maier Farm bridge to determine if efforts are effective in mitigating stream channel impacts. 3. The GCSWCD will work with NYSDOT to address potential stream impacts from maintenance activities related to NYS Route 23, especially the rip-rap protection of the bank.
Habitat	The GCSWCD is working with NYCDEP and the USGS to undertake post-construction assessments of habitat improvements at restoration sites. While the Maier Farm site is not a monitoring location, information from similar projects can be used for comparison.
Flooding	1. Avoid development within the floodplain. Prohibit fill and additional construction in flood vulnerable areas. 2. Evaluate current structures upon completion of the new digital flood mapping project.
Future Assessments	1. Continue to monitor demonstration project for effectiveness in restoring channel stability. 2. Evaluate hydraulic impact of County Route 17 bridge, monitor aggradation occurring downstream. Address stability problems in reach 4c restoration project.

A

B



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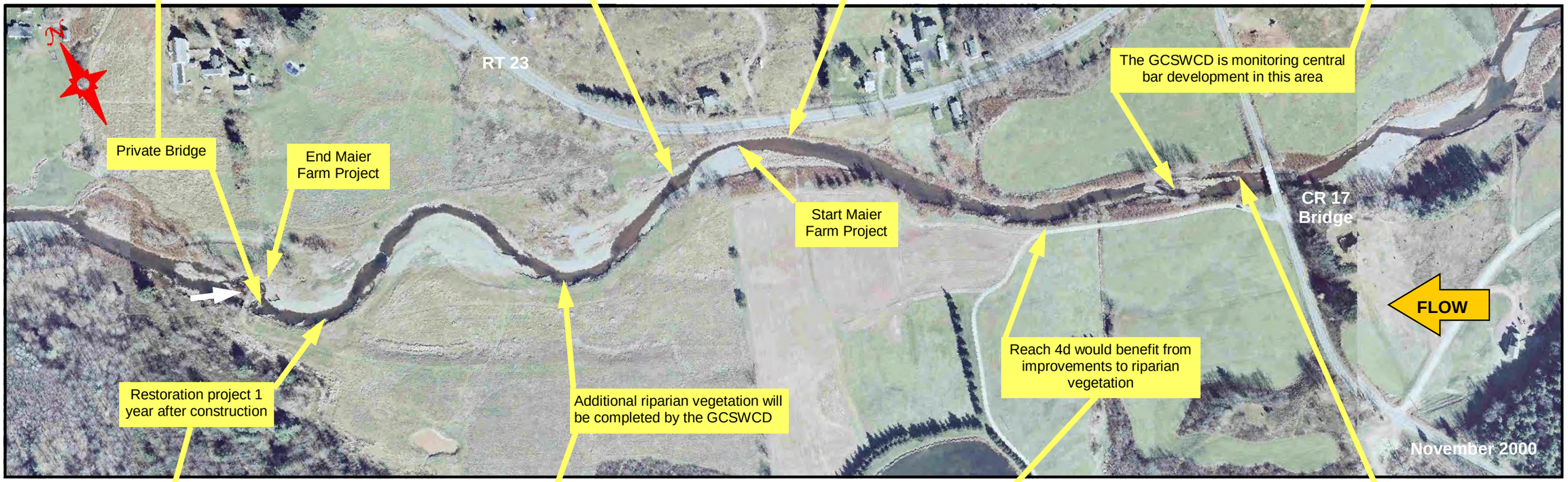

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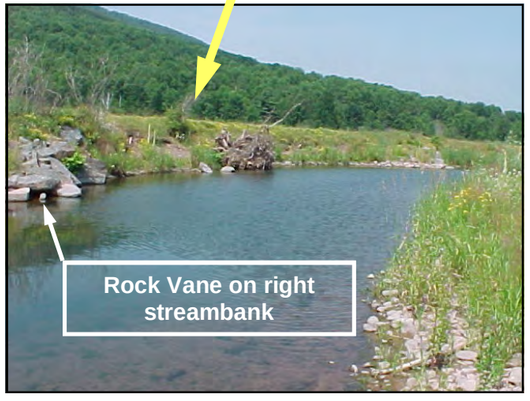

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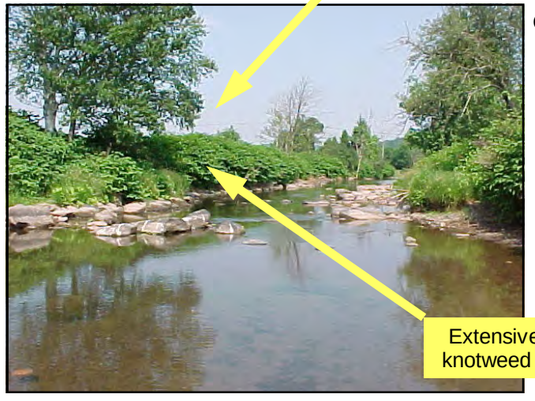

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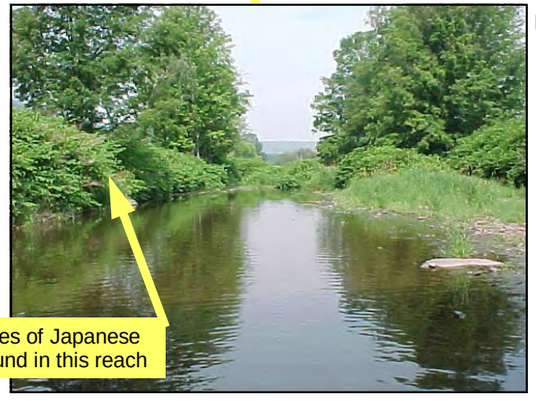

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Figure VI-53: Reach 4d