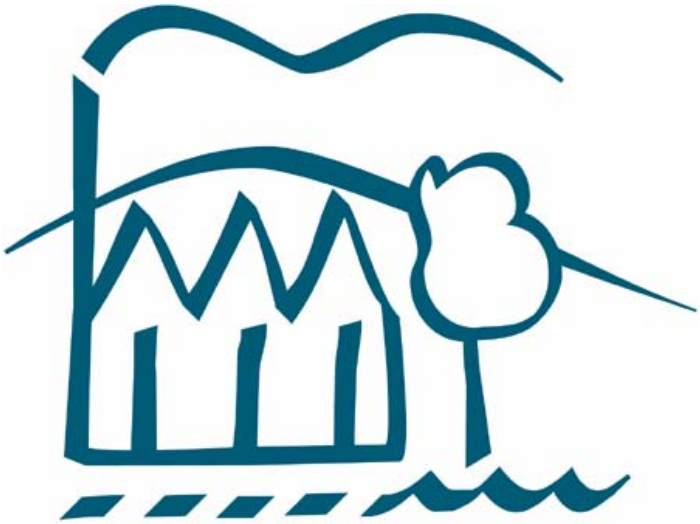
Identification and Analysis of the Riparian Corridor in the Black & Oatka Creek Watersheds



GENESEE/FINGER LAKES
Regional Planning Council

Identification and Analysis
Of the
Riparian Corridor
In the
Black & Oatka Creek Watersheds

March 2005

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2230 Penfield Road
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In Association with
The Black Creek Watershed Coalition
The Oatka Creek Watershed Committee

With funding provided by the Great Lakes Commission for the Controlling Sediment in the Black & Oatka Creek Watershed Project

Site Prioritization

Site inventory data were reviewed from previous stream inventories and assessments completed by Wyoming, Genesee and Monroe County Soil and Water Conservation District Staff for Black and Oatka Creeks. Previous inventories rated sites along the stream channels for bank condition, stream condition, erosion and sedimentation potential. An initial list of high-erosion potential sites was generated from these previous inventories. Additional sites were suggested by SWCD staff. An initial list of 41 candidate sites was developed from SWCD staff suggestions and from the stream inventories. A meeting was held with SWCD staff from Genesee and Wyoming Counties, G/FLRPC staff, and Lu Engineers where the list was further refined. Some sites were eliminated from the list due to inaccessibility or inability to obtain property owner approval for an on-site visit. Table 1 contains a list of sites initially considered for inclusion in the Black/Oatka Creek Riparian Corridor Restoration project.

Several sites with high erosion/sedimentation potential were selected for preliminary on-site reconnaissance and further evaluation. Reconnaissance visits consisted of a site walkover and visual assessment of stream condition, erosion/sedimentation issues noted at the site, and an initial evaluation of potential site remediation or restoration methods.

To facilitate property owner cooperation, initial site reconnaissance visits were conducted jointly by project investigators and SWCD staff in Genesee and Wyoming Counties. Site investigators are indebted to George Squires of the Genesee County SWCD and David Reckahn of the Wyoming County SWCD for their help in arranging site visits and in conducting site investigations. Final site selections were made after on-site consultations with SWCD staff.

Reconnaissance visits to Monroe County sites were made by the project investigator alone. Clear definition of site issues, physical accessibility, landowner cooperation, high erosion potential, potential danger to infrastructure, and project feasibility were some of the factors used in selecting the final list of sites.

Certain sites were rejected because of the number of landowners and complexity of obtaining permission to access the site, and the length of the stream reach. Other sites were rejected because issues were poorly defined, or solutions could not be developed without the active involvement of many government agencies and/or private parties.

Table 1. Initial Site List

Black Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
B-30	42-59-16N 78-4-26W Stafford Country Club, Rt. 237, Stafford	Genesee	October 6, 2004	No	Site is currently being well managed by golf course superintendent. Riparian vegetation is being re-established; mowing is being limited from the edge of the channel. Superintendent would like to relocate a portion of the Black Creek channel. This site was not selected because the cost and time required to get a stream relocation project permitted is prohibitive for country club members. Golf course maintenance crews keep log jams out of creek and maintain banks.
B-37, B-38	43-0-56N 78-4-48W Private drive off Morganville Road Extension, Morganville	Genesee	October 29, 2004	Yes	The property owner is receptive to restoration ideas and wants to implement before channel degrades further. Project is feasible with in-kind labor and equipment contributions from the property owner, and could be representative for other sites with similar problems/issues.
B41, B42	43-2-3N 78-4-33W Griswold Road	Genesee	October 29, 2004	Yes	The property owner is interested in correcting severe erosion problems. The site generates significant erosion and is representative of similar problems in watershed. Prescriptive measures developed for this site would be applicable elsewhere with site specific modifications.

Black Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
B52, B53, B54	43-5-29N 78-3-17W, Intersection of Cole & Mud Roads	Genesee	October 5, 2004	No	Unable to contact property owner. Access permission was not received.
CI-1	43-05-22N 77-47-13W west of Audino Lane Apts., Town of Chili	Monroe	October 6, 2004	Yes	Town of Chili owns south bank, no access permission required. Conditions at site are representative of conditions elsewhere in the watershed. High technology transfer potential.
CI-2	43-05-22N 77-46-50W Stottle Road Bridge, Town of Chili	Monroe	October 6, 2004	Yes	Site is accessible from roadbank.
CI-3	Black Creek from Stottle Road to Genesee River	Monroe	Intermittently between September and November, 2004	No	This site is very large, and includes multiple property owners, several road crossings, and severe access limitations. Solutions require cooperation from multiple parties and agencies.
No number	Black Creek at Churchville Park, Riga	Monroe	Not visited	No	Insufficient information available to define problem or to identify site(s).
No number	Black Creek at Churchville, near gaging station	Monroe	September 29, 2004	No	Project investigator visited this site, and found that site issues were not well defined. Monroe County Water Authority put in a new water line in this area, but this area is being monitored under requirements of SPDES program.

Oatka Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
W1-W4	Warner Creek	Wyoming	October, 2004	Yes	Property owner is willing to allow access and site is representative of cropping conditions in watershed.
Oatr1	Oatka Creek ½ mi. north of Warsaw, Rt. 19 Bridge	Wyoming	October, 2004	No	Stream bank erosion at Rt. 19 bridge. Solution requires NYSDOT cooperation.
Oatn1-Newburg	Newburg area, creek north of Rock Glen	Wyoming	October 4, 2004	No	Stream bank near bridge is eroding. Not selected due to issues with site accessibility.
No number	Stream across from county highway garage`	Wyoming	October 4, 2004	No	Problems at site are common to other areas in the watershed. Lower priority than Kennedy.
Oatm3	Trailer park – Keeney to Munger's Mill Road	Wyoming	October, 2004	No	Visited site and walked area. Issues common to other, more accessible sites.
Oatm5, Oatm6	42-43-9N 78-7-43W to 42-43-15N 78-7-46W	Wyoming	October, 2004	Yes, in part	Site is accessible from Martinsville Road; high bank issue is common to other areas in stream channel. Oatm5 was not selected because it is a nickpoint in the stream (bedrock ledge)
Oatm8-Oatm9	Kennedy site 42-43-24N 78-7-42W	Wyoming	October, 2004	Yes	Property owner is cooperative and willing to have us on premises; site has most serious erosion problem in entire watershed; solutions developed here may be applicable elsewhere in watershed

Oatka Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
No number	Welch's sugar camp, unnamed tributary of Oatka Creek	Wyoming	October, 2004	No	Site was one of the last we looked at during reconnaissance. SWCD staff agreed that design focus should be on Kennedy site because it had the biggest problems.
Oatp1	Pearl Creek	Wyoming	October, 2004	No	Site accessibility issues.
E001-E005	Schumacher, Clayton & Kelkenburg farms adjacent to creek	Wyoming Genesee co. line	October 2004	No	Further property owner contact and discussion is required before specific solutions can be developed.
E-06	42-52-5N 78-1-59W near former B&O track, Pavilion	Genesee	October, 2004	Yes	Access is available from parking lot at rear of Pavilion Fire Hall; railroad embankment is threatened; issues of log jams, sharp bends in stream channel, maintenance are common to many parts of Oatka and Black Creeks
E-10	42-53-53N 78-1-19W	Genesee	September, 2004	No	Insufficient problem definition. No real problem with erosion that could be addressed at that site.
E-17	42-54-32N 78-1-44W Rt. 20 Bridge over Oatka Creek	Genesee	September, 2004	No	Issue appears to be scouring at this bridge site. Stream banks are very steep, channel is deep (>6 ft) with strong currents. Canoe access unavailable due to steepness of banks.

Oatka Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
E-37	42-57-49N 78-0-39W former B&O currently RSR railroad bridge over Oatka Creek, Town of LeRoy	Genesee	October 6, 2004	Yes	Scour issue and undercut bank at northwest bridge abutment; failing retaining wall on south bank; accessible by canoe; issues are common at several other sites. Potential threat to infrastructure.
E42, E43, E44	42-58-26N 77-59-37W Sites in Vg of LeRoy	Genesee	October, 2004	Yes	Bank erosion and undercutting due to water level fluctuations; lack of woody vegetation along channel bank. Recommendations to consist of vegetative and structural measures. Stream channel too deep to permit cross section analysis and estimation of bankfull flows. Water is held bank by the dam at Rt. 5.
E045	42-58-34N 77-59-19W Village of LeRoy	Genesee	October 2004	No	Bank erosion on south side of stream channel is the subject of a remedial plan by Village of LeRoy. Village placed a large amount of rip rap along this bank to protect utilities in the bank. Hard-armoring solution already partially in place.
E-57	43-0-55N 77-57-59W	Genesee	September, 2004	No	Stream channel is on bedrock at this location, and has easy access to flood plain. Erosion is not a significant issue here.
SB-WH1	43-00-25N 77-42-03W 1198 Quaker Road, Wheatland	Monroe	November 16, 2004	Yes	Site is accessible; property owner is cooperative and willing to participate in problem solution. Site was noted in Monroe Co. study as being significant source of sediment.

Oatka Creek					
Site Number	**Location**	**County**	**Inspection Date**	**Selected for Study?**	**Reason for Decision**
SV-2	43-01-08N 77-44-47W (coordinates approximate)	Monroe	Not inspected	No	Site is not easily accessible by foot.

As the site selection process moved forward, the following sites were combined into one site for design purposes: B37 and B38 were combined into one site called the "Morganville Road" site; B41 and B42 were combined into one site called the "Griswold Road" site; Sites E42, E43, and E44 were combined into one site called the "LeRoy Village site".

Lu Engineers reviewed and interpreted high quality, recent aerial photographs to understand the watershed context of erosion and sedimentation problems identified in the stream channel condition assessments prior to going in the field for preliminary site reconnaissance. Site familiarization using aerial photography and U.S.G.S. topographic maps facilitated rapid assessment of land uses and on-site conditions contributing to erosion and sedimentation on the candidate sites.

More detailed site evaluation was done at four sites (Black Creek at Griswold Road and Black Creek at Morganville Road, and Oatka Creek at the Kennedy Site, and Oatka Creek at Martinsville Road) using the Rosgen Level II and some Level III stream channel assessment techniques. Wyoming County SWCD staff assisted site investigators to survey cross sections and reach profiles, and pebble counts. At the Black Creek sites in Genesee County, site investigators completed survey cross sections and profiles and completed pebble counts.

In-stream surveys were not done at sites where stream channel depth exceeded four feet. The following sites were accessed by canoe: Oatka Creek at Pavilion, Oatka Creek at the Rochester & Southern Railroad Bridge (LeRoy), and the LeRoy Village sites, and Black Creek from Union Station Park to Stottle Road (Chili). While cross sections could not be made, maximum depth, typical thalweg depths, and bank height measurements were made at these sites. Notes were also collected on substrate condition, sediment size and distribution, soil types, and bankfull depth. Bankfull stream width was estimated from aerial photographs and on-site notes.

Site investigators developed estimates of bankfull flows based on channel morphology from survey data, as well as stream gage data from U.S.G.S. sites on Oatka Creek at Warsaw and Garbutt. Additional analyses for bankfull flows will be required before final designs can be developed for the Black Creek-Chili sites.

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

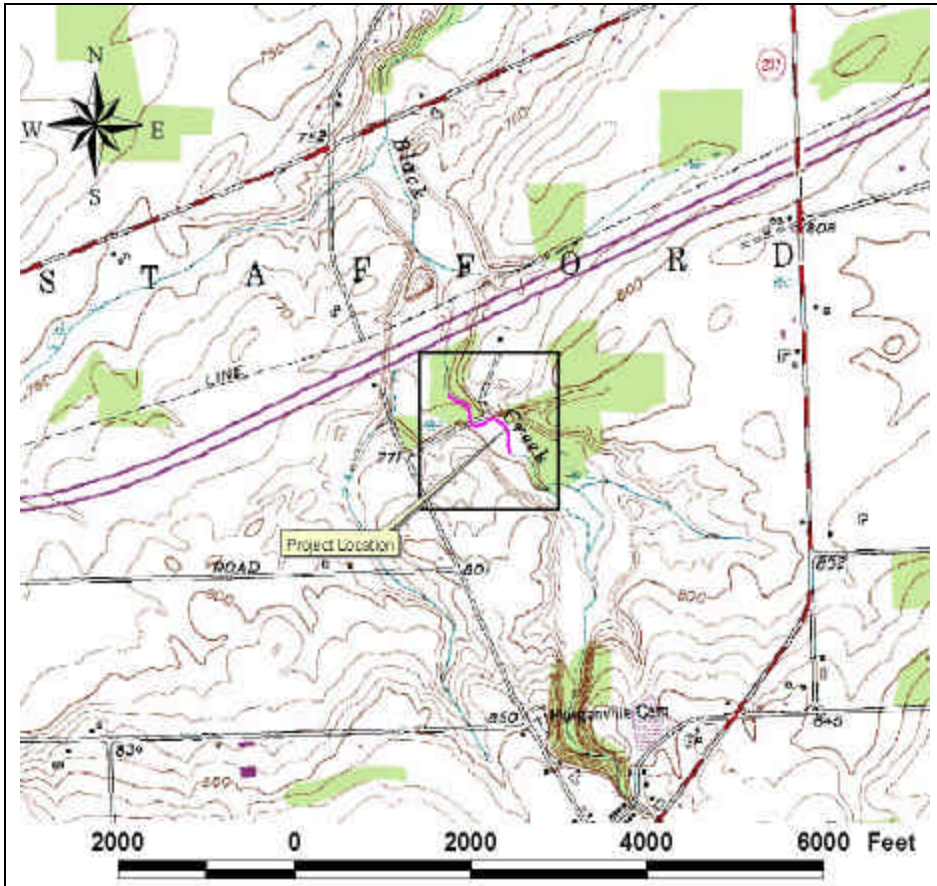
STREAM TYPE: Rosgen C3

STREAM NAME: Black Creek DRAINAGE AREA: 22.7 square miles BASIN NAME: Genesee

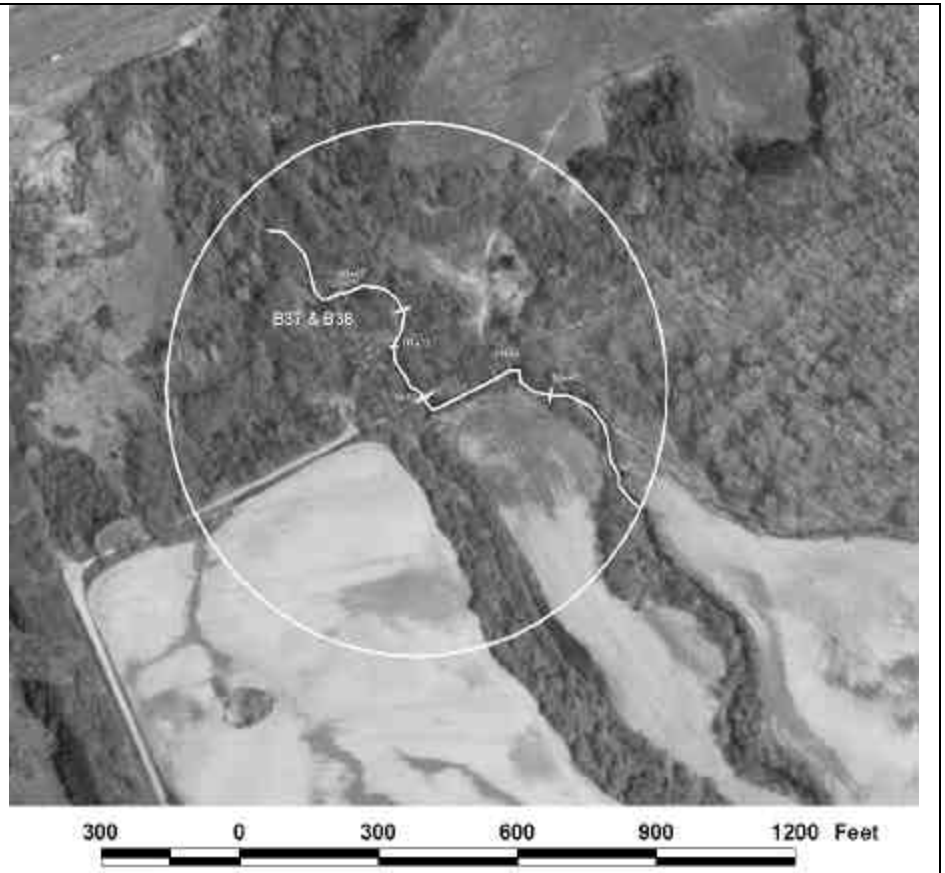
OBSERVERS: J. Hauber, F. Reese, C. Rigerman DATE: 10/29/2004

LOCATION:	Black Creek at Private Drive off Morganville Road, Town of Stafford, Genesee County	**Latitude**	43-0-56	**Longitude**	78-4-48	**Mapped Soil Type(s)**	**K Factor**
						Wakeville silt loam	0.43
						Schoharie silty clay loam, 6-12% slope	0.49
						Schoharie silty clay loam, 12-20% slope, eroded	0.49
						Palmyra and Arkport soils, 25-40% slopes	0.20

Bankfull WIDTH	43	Ft.(W_{bkf})	Bankfull MAX>DEPTH	2.0	Ft.(d_{max})	Channel SLOPE	0.0085	Ft/Ft		%
Bankfull Mean DEPTH	1.37	Ft.(d_{bkf})	Flood Prone Area WIDTH	400	Ft.(W_{FP})	Valley SLOPE	0.010	Ft/Ft		%
WIDTH/DEPTH Ratio	31.3		ENTRENCHMENT Ratio	9.3		SINUOSITY (Stream Dist/Valley Dist.)	1.21			
Channel MATERIALS: (Pebble Count)			D50	90	mm	D84	170	mm		



Site Location Map – Black Creek at Morganville Road



2002 Aerial Photograph – Black Creek at Morganville Road

Photo 1. View of Black Creek near Morganville Road, looking upstream (south) from Station N1+32. Bridge in photo center is Station 0+00.

Photo 2. View of Black Creek near Morganville Road, looking upstream from Station S1+90, approximately 190 feet south of the private road bridge over Black Creek.

Site Description: This site is located at the base of a steep escarpment. The stream channel drops approximately 100 feet from the Morganville Cemetery, about 0.9 mile upstream from the project site. The current is fast, and the channel carries a sizable sediment load, as evidenced in the photos. The channel is generally shallow (less than one foot deep) with numerous riffles and small pools. Flowing northward from the Morganville Cemetery, the creek forms a 90º bend at the upstream side of a private road bridge. A deep scour hole has been created by an eddy in the current that deflects off the western bridge abutment. The property owner placed gravel and stone across the channel to create a ford for all terrain vehicles. Large stone has been placed at strategic points along eastern channel bank south of the bridge. This stone protects a steep hillside from being undercut by the stream channel. The valley widens and flattens as the channel approaches the NYS Thruway, approximately 1500 feet north of the bridge site. Two intermittent streams form confluences with Black Creek in this reach.

North of the bridge site, the creek banks are forested on both sides. Dominant tree species include silver maple, green ash, box elder and eastern cottonwood. South of the bridge, a large cornfield is located on the west side of the channel. The cornfield is separated from the channel by a narrow (15-20 ft. wide) band of woody riparian vegetation. The east side of the channel forms a steep, wooded embankment, with an extension of the private drive continuing up the hill from the bridge.

Statement of Problem: A large scour hole has formed at the northwest abutment of the bridge site. This scour hole may eventually undermine the bridge foundation, causing collapse of the structure. High flows also deposit large amounts of sediment in the channel and cause the formation of gravel bars. A thin line of riparian shrubs is located along the west bank of the creek. Although this vegetation provides some protection for the bank, the field is cultivated as close to the creek as possible, contributing soil erosion to the channel. Some evidence of channel degradation is seen in the formation of mid-channel bars downstream from the bridge site. Downed trees deflect currents into the banks, causing additional undercutting north of the bridge.

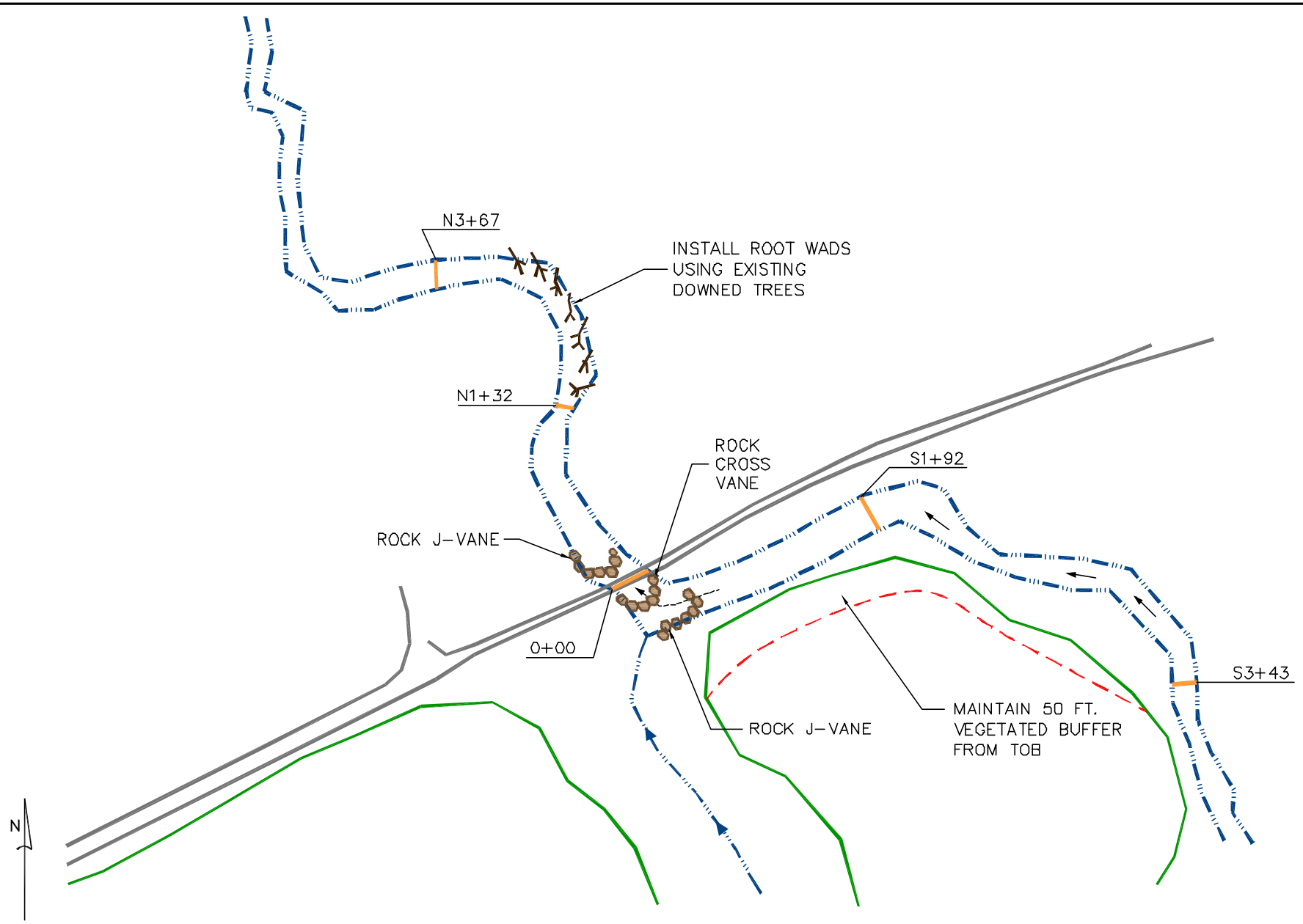
Proposed Restoration/Remediation Methods:

1. Construct a rock J-vane to deflect flow toward the middle of the channel, away from the northwest bridge abutment.
2. Encourage farmers and property owners to maintain at least a 50 ft. wide buffer of woody riparian vegetation along the channel.
3. Utilize deadfalls in the stream as root wads to stabilize failing banks.

Cost Estimate:

Item	Unit	Unit Cost	Extended Cost ($)
Root wads (utilize on site materials)	2 days	$1500	3000
Rock J-vanes (2)	3 cy	46	138
Rock cross vane (1)	2.6 cy	46	120
Excavation	27 cy	12	324
Turbidity curtain	27 sy	30	830
Detailed site survey	1200/day	1	1200
Plans and permits	LS	5000	5000
Total estimated cost			$10612

Conceptual Plan Sheets/Standard Details



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BLACK CREEK NEAR MORGANVILLE ROAD

STREAM RESTORATION STUDY AREAS

P.N. 33602

DATE:	MARCH 2005
APPROX. SCALE:	1" = 100'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: C3? F3

STREAM NAME: Black Creek DRAINAGE AREA: 27.8 sq. miles BASIN NAME: Genesee River

OBSERVERS: J. Hauber, F. Reese, C. Rigerman DATE: 10/29/2004

LOCATION: Black Creek at Griswold Road, Town of Byron, Genesee County, Sites B42 and B43 Latitude 43-02-03 Longitude 78-04-33

Mapped Soil Type(s)	K Factor
Hilton loam, 0-3% slope	0.20
Schoharie soils, eroded, 20-40% slope	0.49
Oatka silty clay loam	0.49
Teel silt loam	0.43

Bankfull WIDTH	30.32 ft	Ft.(W_{bkf})	Bankfull MAX>DEPTH	2.08	Ft.(d_{max})	Channel SLOPE	0.0046 (measured)	Ft/Ft		%
Bankfull Mean DEPTH	1.55	Ft.(d_{bkf})	Flood Prone Area WIDTH	500	Ft.(W_{FP})	Valley SLOPE		Ft/Ft		%
WIDTH/DEPTH Ratio	19.56		ENTRENCHMENT Ratio	16		SINUOSITY (Stream Dist/Valley Dist.)	1.27			
Channel MATERIALS: (Pebble Count)			D50	75	mm	D84	110	mm		

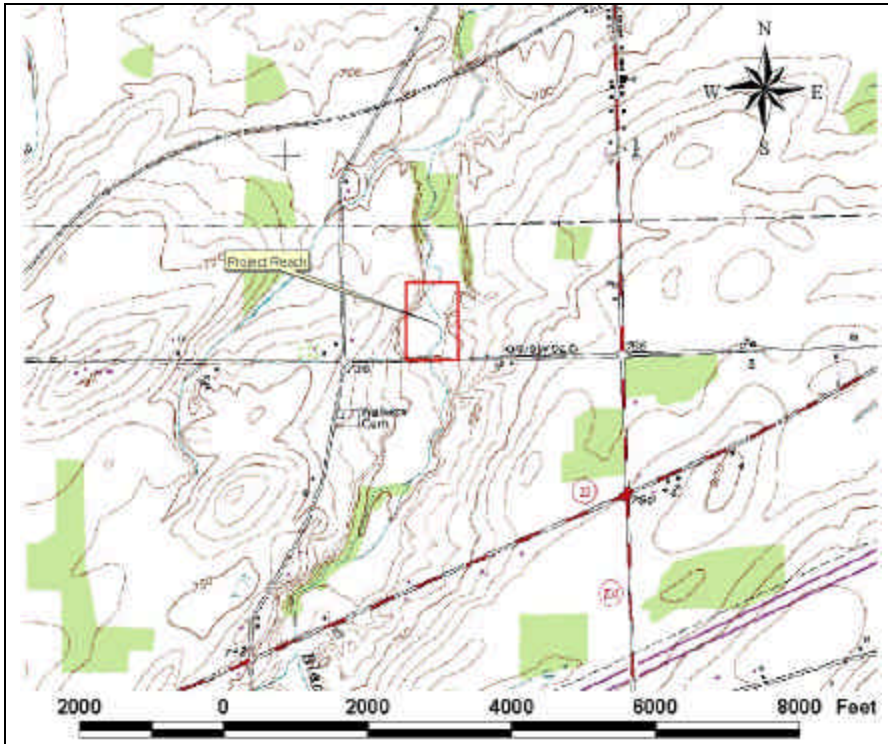
	
Site Location Map – Black Creek at Griswold Road, Town of Byron	2002 Air Photo, Black Creek at Griswold Road

Photo 1. View of project site showing exposed soil on high, undercut bank at outside edge of meander, near Station 4+00, looking northeasterly. Bare soil at photo right is due to mechanical vegetation clearing.

Photo 2. View of exposed soil along west bank of creek at Station 2+10, looking south. Bank height is approximately 2-2.5 feet above water level.

Photo 3. Frequent bankfull flows have caused sloughing of west bank into formerly stable section of stream channel, causing formation of mid-channel bars. Diversion of current around the mid-channel bars contributes to bank undercutting and instability.

Photo 4. Scouring and undercutting have exposed root systems of numerous trees lining the stream channel.

Site Description: This project site extends from the Griswold Road bridge north along the Black Creek channel for a distance of approximately 1000 feet. Land use on the east side of the creek is residential. The lawn is cut up to the top of the stream bank with recent grading after trees were removed near Station 4+00 (Note Photo 1). Land use on the western side of the creek is predominantly pasture, with a woodlot located approximately 600 feet north of Griswold Road. None of the land immediately adjacent to the creek is cropped in this reach. High banks (4-7 feet) with undercut, exposed soils are located at the outside edges of the meanders. The extent of the exposed soil banks is shown in the aerial photograph. Cross sections were taken at five locations to characterize conditions within the reach. Bankfull flow at this site is estimated at approximately 200 cfs, based on channel cross section analysis. Channel slope is approximately 0.0046 over the project reach.

Statement of Problem: The stream channel appears to be downcutting actively at this site. Bank sloughing evident in Photo 3, exposed tree roots, and scoured, undercut outside meander banks all point to a channel in transition. Increased frequency of bankfull flows may contribute to the accelerated rate of channel degradation. Removal of woody vegetation from the top of bank on the east side of the channel has resulted in an accelerated rate of undercutting and bank erosion due to the loss of stabilizing plant roots. Channel currents are undercutting the east bank, causing significant soil erosion and increased channel deposition. Undercutting on the east side of the creek is creating a significant erosion hazard, and loss of property by adjacent landowner.

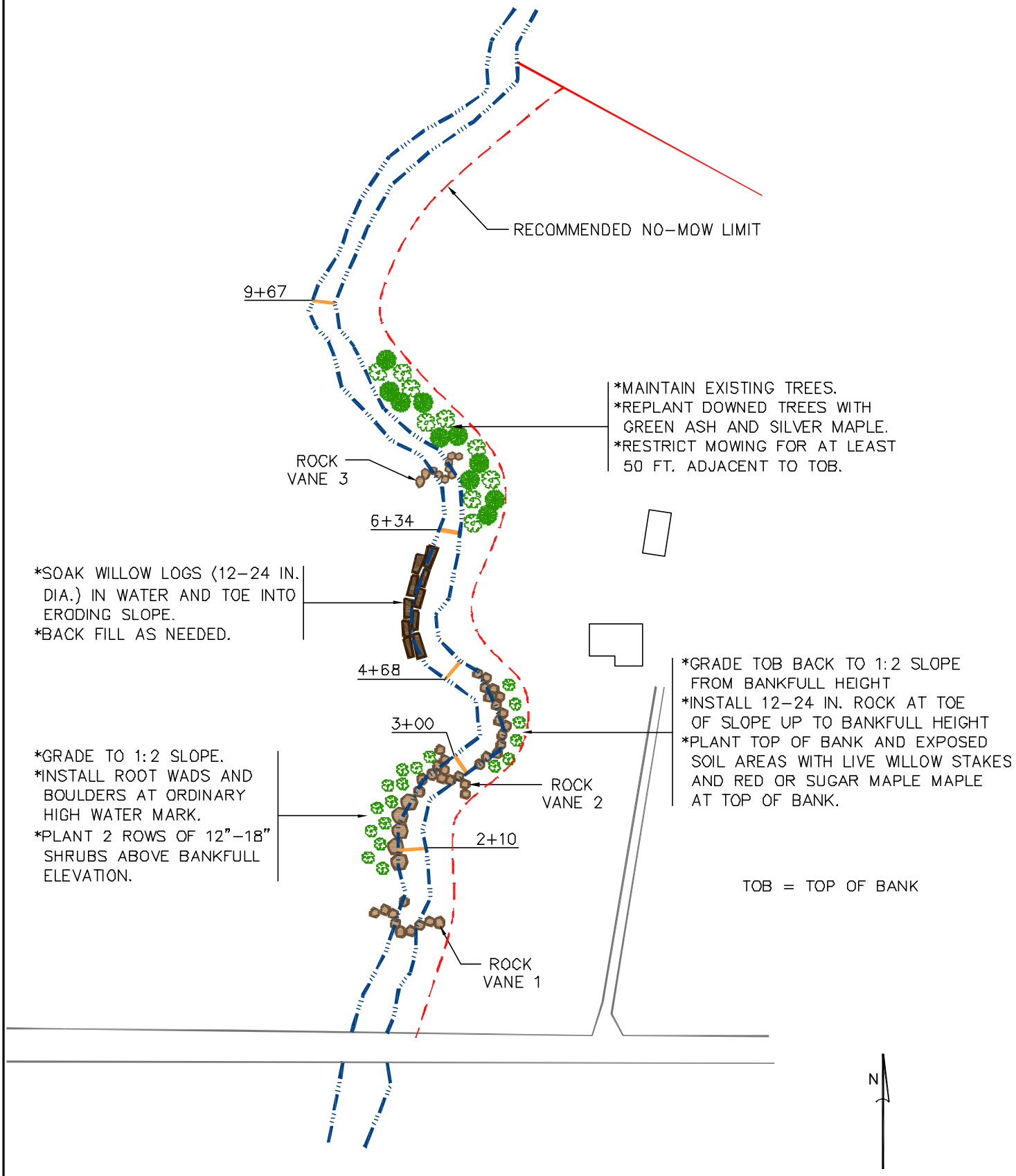
Proposed Restoration/Remediation Methods:

1. Re-establish shrubs and trees along channel banks to at least 30 feet from the top of bank.
2. Establish a "no-mow" zone within 30 feet of channel top of bank.
3. Place riprap (12-24 in. diameter rock) at base of highest eroding meander bank on east side of creek from approximately Station 3+00 to Station 4+90, and on the west side of the creek from approximately Station 2+00 to 3+00 to reduce undercutting by channel currents and high flows.
4. Embed available on-site downed timber as rootwads on the west bank between Station 2+00 and Station 3+00 (approximately). Root wads should deflect current away from outside edge of bank.
5. Utilize willow logs on west bank between Station 4+68 and Station 6+34 to stabilize this slumping bank.
6. Construct three rock cross vanes to hold the channel grade approximately at Stations 1+90, 3+10, and 7+00.

Cost Estimate:

Item	Unit	Unit cost ($)	Extended cost ($)
Rock rip rap	135 cy	46	6210
Rock vanes (3)	80 cy	46	3680
Root wads (on-site or nearby materials – cost is for labor & equipment)	1500/day	2	3000
Willow logs (on-site or nearby materials)	L.S.	1700	1700
Turbidity curtain	13.50 sy	30	405
Plantings	200	15	3000
Mobilization cost			500
Detailed site survey	L.S.	2000	2000
Plans and permits	L.S.	5000	5000
Estimated total cost			$25495

Conceptual Plan Sheets/Standard Details



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BLACK CREEK AT GRISWOLD ROAD
TOWN OF BYRON, GENESEE COUNTY
CONCEPTUAL DESIGN

STREAM RESTORATION STUDY AREAS

P.N. 33602

DATE:	MARCH 2005
APPROX. SCALE:	1" = 150'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

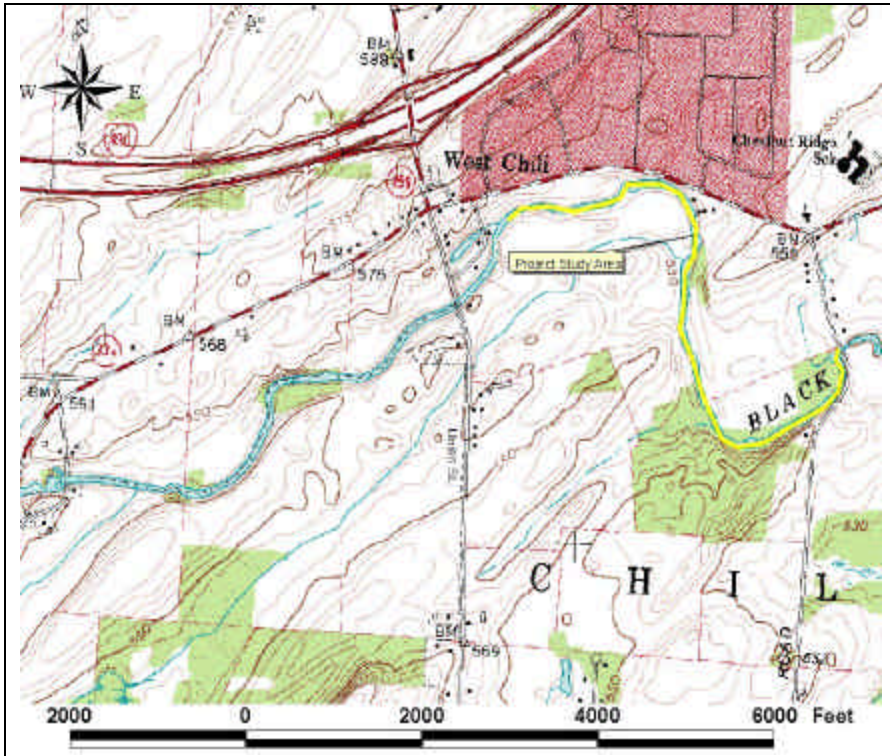
STREAM TYPE: Rosgen C4 to C5

STREAM NAME: Black Creek DRAINAGE AREA: 169 square miles BASIN NAME: Genesee

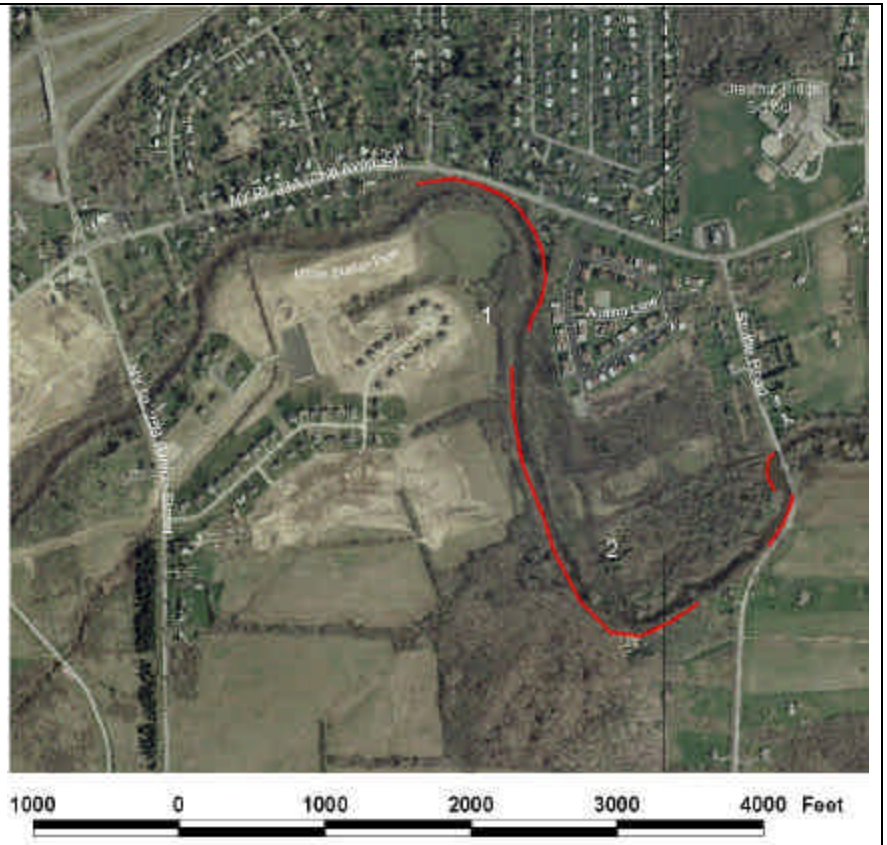
OBSERVERS: J. Hauber, F. Reese DATE: 10/7/2004

LOCATION:	Black Creek between Union Station Park and Stottle Road, Town of Chili, Monroe County	Latitude	From 43-05-29 to 43-05-20	Longitude	From 77-47-42 to 77-46-49	Mapped Soil Type(s)	Appleton silt loam	K Factor	0.43
							Eel silt loam		0.43
							Genesee silt loam		0.43
							Hilton loam		0.24

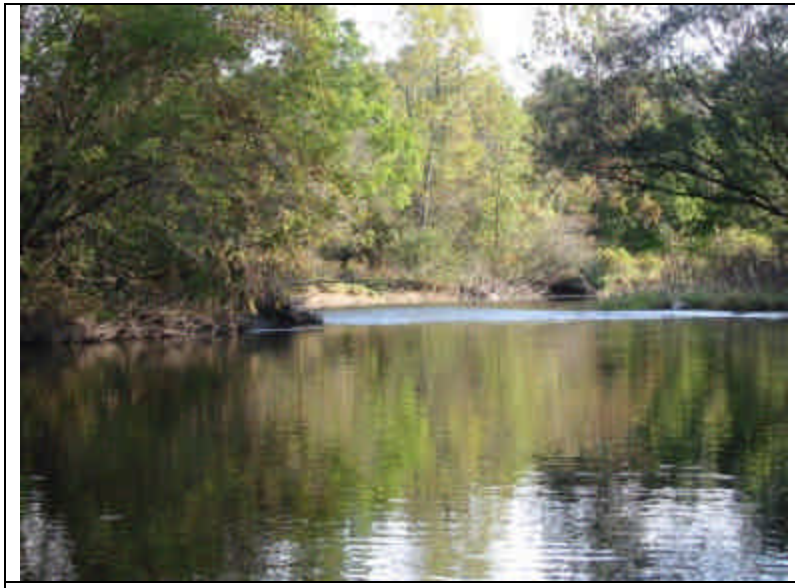
Bankfull WIDTH	100±	Ft.(W_{bkf})	Bankfull MAX>DEPTH	9.5 (estimated)	Ft.(d_{max})	Channel SLOPE	0.001	Ft/Ft		%
Bankfull Mean DEPTH	3.5 (estimated)	Ft.(d_{bkf})	Flood Prone Area WIDTH	400-500 (varies)	Ft.(W_{FP})	Valley SLOPE	0.00074	Ft/Ft		%
WIDTH/DEPTH Ratio	28.5		ENTRENCHMENT Ratio	5		SINUOSITY (Stream Dist/Valley Dist.)	1.49			
Channel MATERIALS: (Pebble Count)			D50		mm	D84		mm		



Black Creek, Sites CI-1 and CI-2, location map



CI-1 and CI-2, Aerial Photo Detail (2002)

	
Exposed high banks on outside edge of meander, near Chili Avenue.	Undercut root systems of sugar maples, south bank of Black Creek, Union Station Park, Chili

Site Description: This study reach extends from Union Station Park in the Town of Chili (east of NY Route 259, Union Street) to Stottle Road, and includes Black Creek Inventory sites CI-1 and CI-2. The site was accessed by canoe from Union Station Park. Bank height and water depth measurements were made from the canoe becaise water depths exceeded 4 feet in several areas. Creek depths from Union Station Park to a point where the creek runs adjacent to Chili Avenue were approximately 1.5 to 2 feet, with long pools separated by gravel riffles. Below the Chili Avenue proximity point, pool depths were 3-4 feet. Green ash, box elder, and black willow form an excellent buffer southward between the creek and Union Station Park. From Route 259 to Stottle Road, the north bank is privately owned. Where single family homes are located close to the creek, lawns are mowed to the top of the bank. Behind the Audino Lane apartments, the north bank is heavily wooded. A nature trail has been established along the creek bank behind the Audino Lane apartments.

Three tributaries form confluences with Black Creek within the study reach. One tributary flows into the creek from the south aapproximately 1500 feet east of Union Street. An intermittent drainage ditch flows into the creek from the north at the point where Chili Avenue is closest to the creek. A second intermittent tributary forms a confluence on the south side of the creek, south of a new housing tract. A third intermittent tributary joins Black Creek just west of the Stottle Road bridge. Some bank erosion was noted near these confluence points. Banks are generally stable where scour has not created high banks on the outside edges of meanders. High banks with exposed soils are subject to scour during high flow conditions. These areas are indicated in red on the photograph above.

Pebble counts were not done for this reach. Sinuosity and entrenchment ratios were estimated from channel pattern and dimensions measured from air photos and field investigation. The substrate appeared to be dominated by gravel and sand, with a few larger cobbles. Evidence of frequent, recent scouring indicates that this reach is experiencing some instability, possibly due to development in the watershed.

Statement of Problem: The project study area is located in a rapidly developing watershed area. A developed watershed area creates more frequent bankfull flow events, eventually leading to deteriorated stream conditions. Where woody riparian vegetation is removed or exists in thin strips along each bank, more frequent high flows undercut banks and create sloughing. Undercutting is more severe when the bank soils consist of fine sands and silts. In this reach, the mapped soil types are predominantly Genesee silt loam and Eel silt loam, both of which are fine sandy to silty alluvial soils. Several large trees were observed on scoured banks, with exposed root systems. Continued undercutting during bankfull flow events will eventually undermine these trees, and cause them to fall into the stream channel. Downed timber in the creek channel creates problems by directing stream flow against easily eroded bank areas. Southern banks near Stottle Road are high (6-8 feet) and show some erosion as the creek makes a broad sweep south and east. Some erosion and exposed tree roots occur here. Several expanses of high, undercut banks were observed on both the north and south creek banks. Undercut banks adjacent to Chili Avenue and Stottle Road may eventually threaten road and utility infrastructures if not corrected.

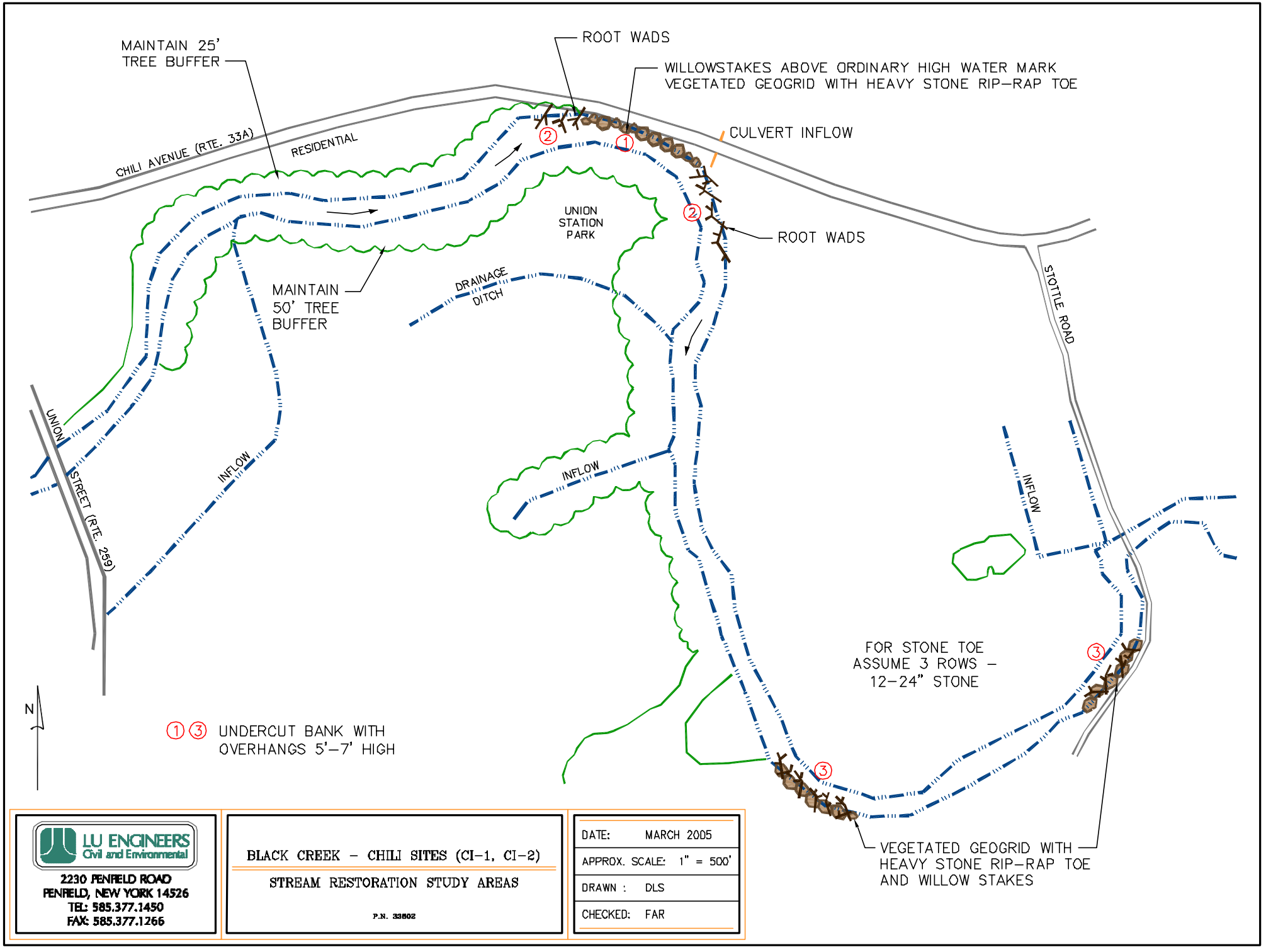
Recommended Restoration/Remediation Methods:

1. Encourage owners of existing properties abutting Black Creek to maintain a vegetated riparian buffer zone extending a minimum of 20 feet back from the creek bank.
2. Provide financial assistance to willing property owners to replant lawn areas adjacent to the creek with native woody species such as red osier dogwood, silky dogwood, and various willows. Encourage the use of live willow stakes, fascines and soaked willow logs to provide rapid cover on exposed soil banks.
3. Develop a streambank protection ordinance for the Town of Chili that requires the maintenance of a woody vegetated riparian buffer zone of at least 20 feet in width (wider in undeveloped areas) on either side of Black Creek and its tributaries.
4. Inspect the channel of Black Creek on a yearly basis to determine potential threats to utilities, roads and structures, particularly Chili Avenue, and to determine the need for removal of channel obstructions (e.g., downed timber) and remedial actions to protect sensitive bank areas.
5. Embed large stone rip rap in the scoured areas adjacent to vulnerable roadways and repair the embankment using vegetated geogrids, root wads, and willow stakes.

Cost Estimate:

Item	Unit	Unit Cost	Extended Cost
Area 1			
Heavy stone rip rap (24 in. +) (cy)	300	46	13800
Backfill soil (cy)	170	16	2720
Biodegradable geotextile (sy)	3000	1.25	3750
Live whips (6 ft. long)	L.S.	4500	4500
Willow stakes	300	8	2400
Turbidity curtain (sy)	45	30	1350
Excavation (cy)	222	12	2664
Mobilization	L.S.	1200	1200
Estimated cost			**32384**
Area 2			
Root wads (on site materials)	1 day labor	1500	1500
Rock	20 cy	46	46
Estimated cost			**1546**
Area 3			
Heavy stone rip rap (cy)	400	46	18400
Backfill soil	474	16	7584
Biodegradable geotextile (sy)	4800	1.25	6000
Live whips (6 ft long)	L.S.	7200	7200
Willow stakes	480	8	3840
Excavation (cy)	360	12	4320
Turbidity curtain	355 sy	30	10650
Mobilization			2300
Estimated cost			**60294**
Design costs			
Survey	5	1200	6000
Plans & permits	(4 dwgs x $5000 ea) + Individual permit ($10K)		30000
Estimated cost			36000
Other costs			
Public education for property owners (newsletter + mass mailing)	1	2000	2000
Streambank protection ordinance (1 time cost)	1	10000	10000
Yearly inspection/monitoring	1	1500	1500
Repair and maintenance of channel stabilization measures	1	2500	2500
Estimated cost			**16000**

Conceptual Plan Sheets/Standard Details



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BLACK CREEK - CHILI SITES (CI-1, CI-2)

STREAM RESTORATION STUDY AREAS

P.N. 33502

DATE:	MARCH 2005
APPROX. SCALE:	1" = 500'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: Rosgen Class B4

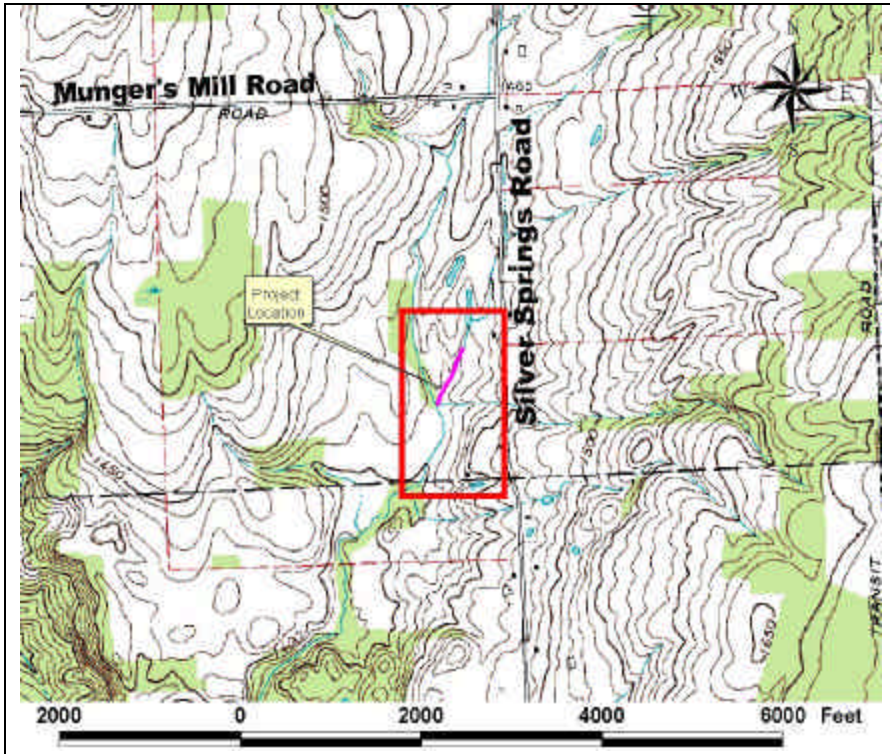
STREAM NAME: Warner Creek (W4) DRAINAGE AREA: 4.6 sq. mi. BASIN NAME: Oatka Creek

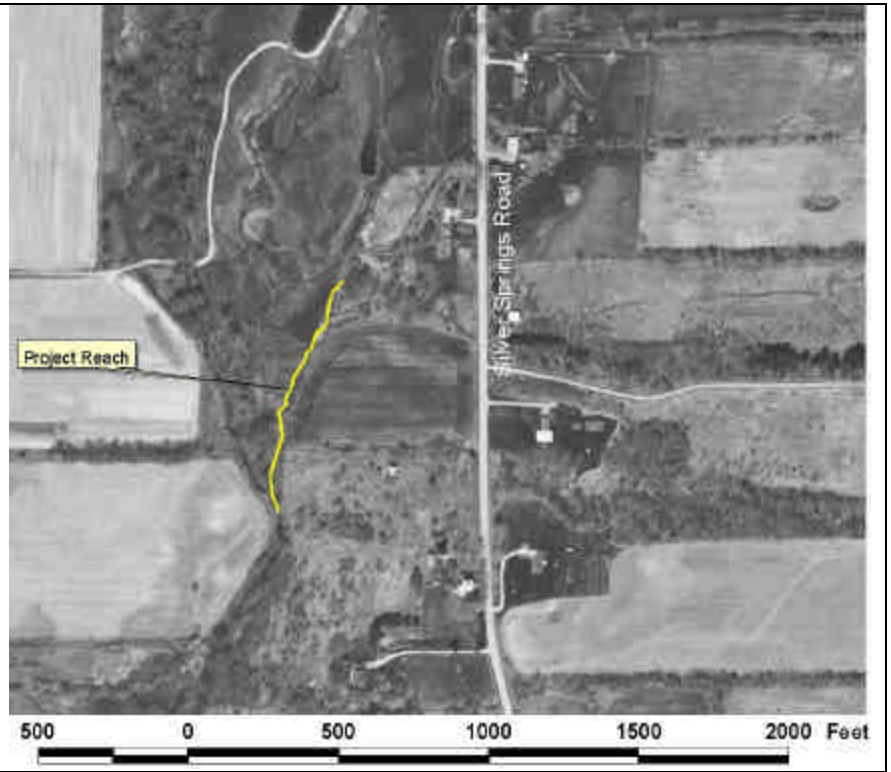
OBSERVERS: D. Reckahn, F. Reese, J. Hauber DATE: 10/13/2004

LOCATION: Silver Springs Road, stream bordering cornfield Latitude 42º41'52" Longitude 78º5'31" Soil Type(s) Chenango gravelly loam, 3-8% slope K-factor 0.24

Bankfull WIDTH	10	Ft.(W_{bkf})	Bankfull MAX DEPTH	8-10	Ft.(d_{max})	Channel SLOPE	20/869	Ft/Ft	0.023	%
Bankfull Mean DEPTH	2	Ft.(d_{bkf})	Flood Prone Area WIDTH	50-120	Ft.(W_{FP})	Valley SLOPE	20/1000	Ft/Ft	0.02	%
WIDTH/DEPTH Ratio	5		ENTRENCHMENT Ratio			SINUOSITY (Stream Dist/Valley Dist.)	1.0±			

Channel MATERIALS: (Pebble Count) D50 _____ mm D84 _____ mm





W4 – Warner Creek, Site Location Map

	
Warner Creek channel at Site W4. Site has about 20 feet of riparian vegetation on the east side of the channel. West side of the channel is well-vegetated.	Erosion from cornfield concentrates at comer of field in a rill, discharging into Warner Creek, one of the headwaters for Oatka Creek.

Site Description: The stream channel lies in a moderately steep, glacial outwash valley in the Appalachian Plateau highlands eco-zone of western New York. The project site is a first-order tributary of Warner Creek, one of the two headwater streams forming Oatka Creek. Land use in the valley portions of the watershed surrounding this site is predominantly agricultural. Row crops such as corn and soybeans are typically grown as cash crops. Steep slope areas of the watershed are maintained as wood lots which may be periodically logged for commercial timber or firewood.

The riparian zone west of the stream channel is well vegetated with flood plain trees, shrubs and emergent species. The stream channel is bordered on the east by a steeply sloped, narrow (10-15 ft. wide) band of riparian vegetation (silky and red-osier dogwoods, willows, joe-pye weed, goldenrod, and grasses). Beyond this narrow riparian fringe of vegetation is a 4.68 acre cornfield.

Statement of Problem: The Warner Creek project site is typical of many locations in the upper watershed of Oatka, Warner and Cotton Creeks. Hillsides are above the field are steep, with slopes typically exceeding 25%. First-order creek channels are steep, with gradients in excess of 0.02 ft/ft. The project reach channel is typical of much of the upper watershed. It is well vegetated with herbaceous species (joe-pye weed, swamp milkweed, cattail, reed canary grass) and scattered trees (mostly willows and eastern cottonwoods). Riparian vegetation zones bordering agricultural fields tend to be thin (20 feet or less in width) from the top of the

stream bank to field dead furrow. Fields are generally plowed as close to the top of the bank as possible. Erosion is accelerated when fields are plowed parallel to the slope direction. The field adjacent to the site was contour-plowed adjacent to the stream channel, but was otherwise plowed parallel to the slope. This cultural practice leads to the formation of rill erosion channels at the lowest points of the field, adjacent to the creek channel.

The microclimate of Wyoming County also contributes to the erosive impact of heavy rainfalls. Wyoming County is located on a plateau about 1000-2000 feet higher in elevation than Lake Erie. During the summer, prevailing winds carry warm, moisture-laden air masses from Lake Erie over the high plateau areas of Wyoming County. Adiabatic cooling occurs, causing sudden, violent thunderstorms during the summer months. When these events occur in early summer, the soil surface is often exposed from recent plowing and planting. Severe erosion results from the sudden, heavy downpours.

The dominant soil types mapped for this site is a Chenango gravelly loam grading into a Halsey loam in the alluvial channel. Both of these soil types have relatively low erodibility. However, even these soils will form rills under extreme circumstances.

From the aerial photograph, it appears that the natural drainage of the system has been altered with the construction of several ponds in the adjacent watershed above the project reach. Stream channels appear to have been straightened slightly from their natural locations. The natural sinuosity of the channel has been altered over the reach of this section of Warner Creek. The site is fairly high in the watershed and has the potential to generate a large amount of sediment if left untended.

Recommended Restoration/Remediation Methods:

1. Increase the width of the vegetated riparian zone from about 20 feet to about 50 feet from the stream channel top of bank. Create a grass filter strip at the edge of the field to retard the formation of rill erosion channels and to provide nutrient uptake and filtration of sediments suspended in sheet flow. The use of switchgrass (*Panicum virgatum*) or other thick, sod-forming grass is recommended. Use of this technique would remove about 0.0.36 acre from cultivation in this field.

2. Use brush wads or other woody vegetation to repair rills. Fill in rills where possible. Stabilize rills with willow or dogwood switches.

Cost to Implement:

Item	Unit	Unit Cost	Extended Cost ($)
Grass filter strip	0.36 acre	$310	$113
Rill repair	0.10 acre	500	50

Equipment Mobilization	1	500	500
Plantings	50	$8	400
Estimated total cost			$1063.00

Additional Information Needs:
More detailed measurements of vegetated riparian zone widths and points of rill erosion concentration are needed to prepare detailed plans for site remediation or restoration.

Warner buffer strip

W4-study reach

N

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FAX: 585.377.1266

WARNER CREEK STUDY REACH

STREAM RESTORATION STUDY AREAS

P.N. 33602

DATE:	MARCH 2005
APPROX. SCALE:	1" = 300'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: C3

STREAM NAME: Oatka Creek

DRAINAGE AREA: 25.5 sq. mi.

BASIN NAME: Oatka

OBSERVERS: J. Hauber, F. Reese, D. Reckahn

DATE: 10/13/2004

LOCATION: South of Martinsville Road, Town of Warsaw, Wyoming County, encompassing sites Oatm6 and Oatm7

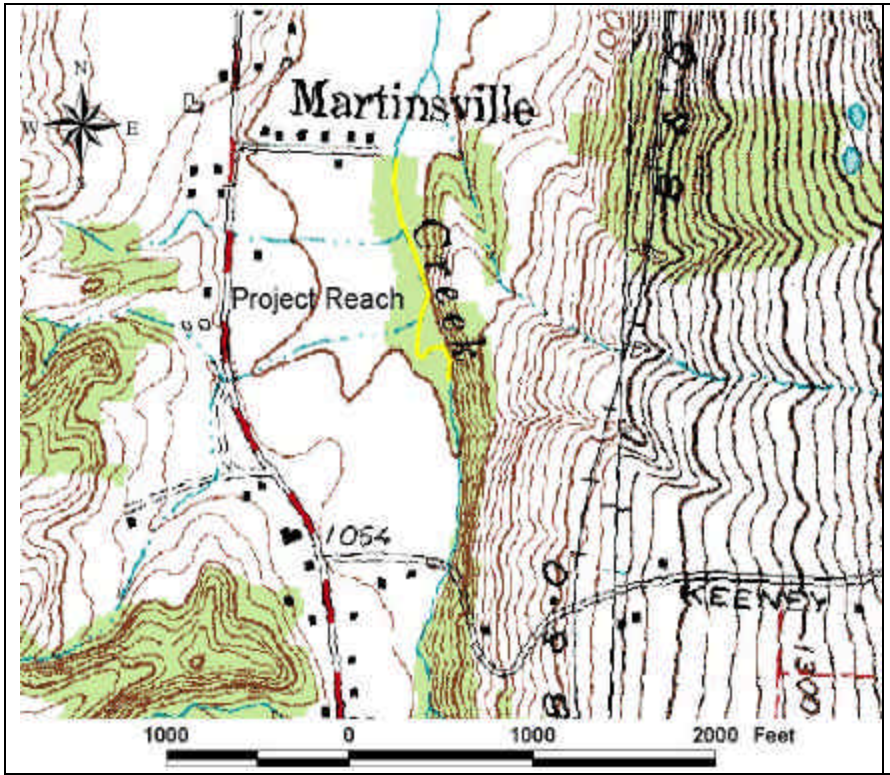
Latitude: 42º43'17"

Longitude: 78º7'45"

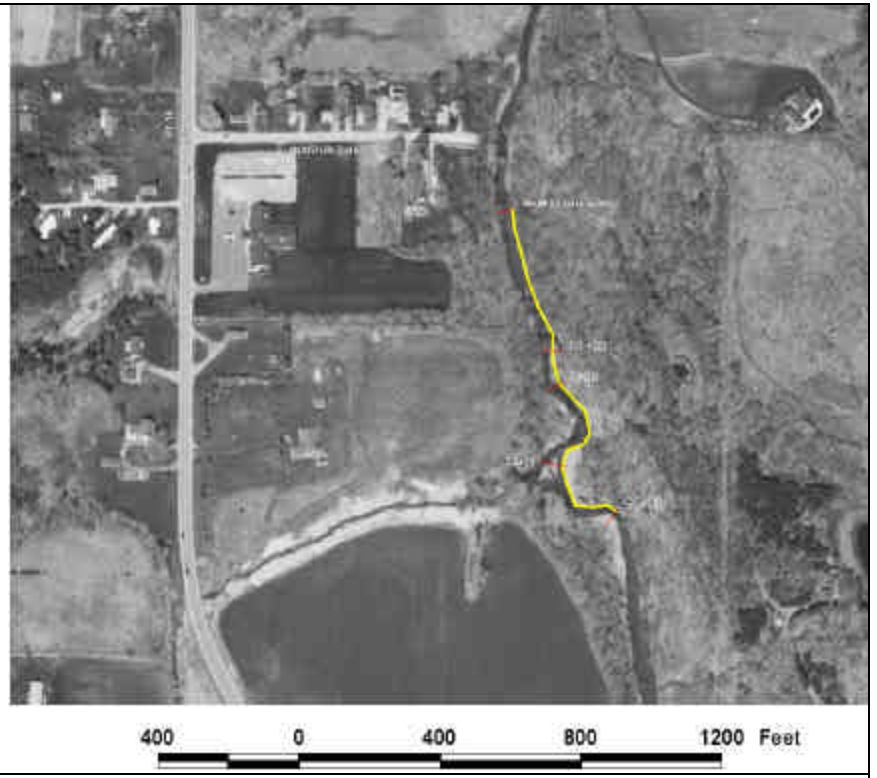
Mapped Soil Type(s)	K-factor(s)
Collamer silt loam	0.49
Manlius shaly silt loam,	0.28
Varysburg gravelly loam	0.24
Alluvial land	0.32
Teel silt loam	0.49

Bankfull WIDTH	62	Ft.(W_{bkf})	Bankfull MAX>DEPTH	5.2	Ft.(d_{max})	Channel SLOPE	0.0065	Ft/Ft		%
Bankfull Mean DEPTH	3.23	Ft.(d_{bkf})	Flood Prone Area WIDTH	700	Ft.(W_{FP})	Valley SLOPE	0.008	Ft/Ft		%
WIDTH/DEPTH Ratio	19.2		ENTRENCHMENT Ratio	11.29		SINUOSITY (Stream Dist/Valley Dist.)	1.23			

Channel MATERIALS: (Pebble Count) D50 52.5 mm D84 139 mm



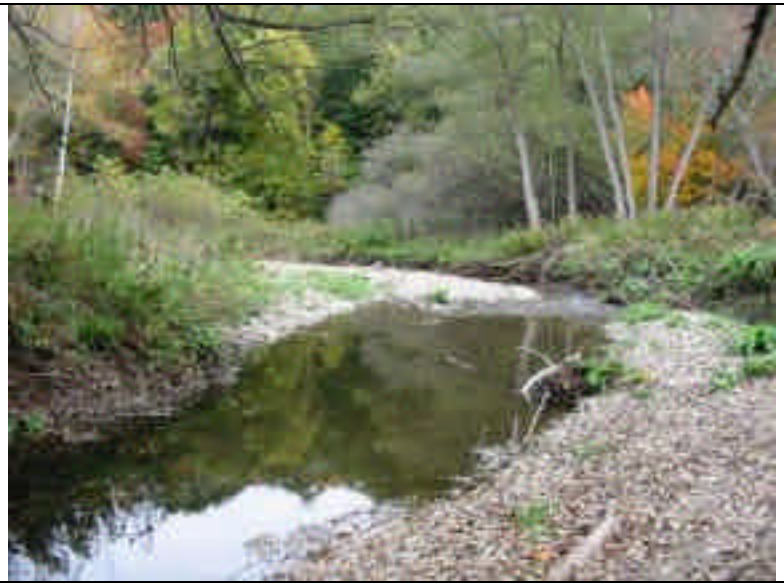
Site Oatm 6 & 7, between Martinsville Road and Keeney Road, Town of Warsaw, Wyoming County



Aerial view of project reach (2002).

	
View of Oatka Creek at Martinsville Station N1+00 (approximately 400 feet south of Martinsville Road), looking south. Note high eroding bank at photo left.	Detail of eroding bank in photo at left. Deep pool in stream channel undercuts clay bank, causing rotational slumping. Re-direction of channel flow away from this bank is needed to allow stabilization.

Oatka Creek at Martinsville, 1000 feet south of Martinsville Road, looking south. Note well vegetated channel banks and good condition of channel.



Oatka Creek, approximately 800 feet south of Martinsville Road. Influent stream channel at photo right deposits large amounts of gravel, causing channel to meander.

Site Description: The project reach begins south of Martinsville Road in the Town of Warsaw, Wyoming County, and extends upstream (south) 1000 feet along the stream channel. Two intermittent streams form confluences with the main stem of Oatka Creek within this reach. The channel is classified as a Rosgen C3 channel because the dominant size of the bedload is in the small cobble range. The stream is only slightly entrenched on the west side, but a steep bank is located on the east side of the channel. The dominant mapped soil type for the east side of the channel is a Manlius shaly silt loam with a slope of 25% or greater. Clay banks are exposed along the east side of the channel within the reach. The channel gradient is approximately 0.0065 over the 1000 foot reach. Bankfull flows are estimated at 500 to 600 cfs, based on channel cross section analysis, comparison with known stream gage records for Oatka Creek in Warsaw, and anecdotal information from local residents and SWCD staff observations.

Land along the stream channel is privately owned, but access to the stream channel is available from Martinsville Road. The channel is used by local anglers. No official public access is permitted in this reach.

Statement of Problem: Site observation showed that influent streams contribute a high sediment load, resulting in the formation of mid-channel gravel bars, and divided thalwegs in the channel. Large trees have been undercut by high flows, and have fallen into the channel. Resulting log jams direct stream flow into steep, erodible, clay banks on the east side of the channel. Undercutting has caused slumping from Station N1+00 to approximately S0+60.

Proposed Restoration or Remediation Methods:

- Place approximately 160 LF of large stone (24 in.+) rip rap along eastern toe of slope from Station N1+00 to Station S0+60. Use willow stakes along with riprap to stabilize bank toe of slope.
- Utilize existing downed trees in the channel to create rootwads and embed them in the banks to deflect current away from erodible banks.
- Construct rock J-vanes to direct flow away from slumping bank areas between Station S2+71 and Station S1+00.
- Place willow stakes on slumped areas above toe of slope.

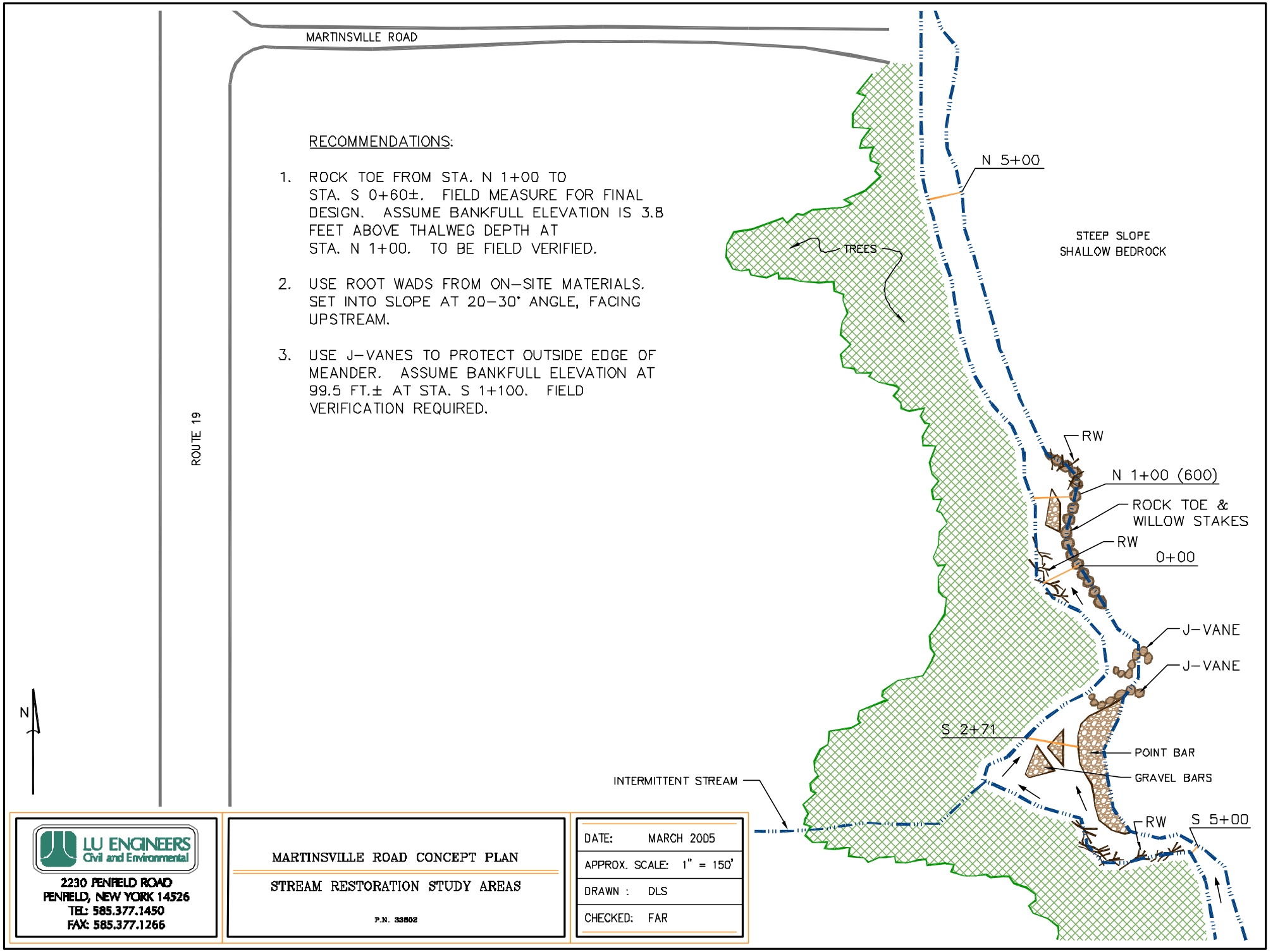
Cost Estimate:

Item	Unit	Unit Cost	Extended Cost ($)
Rock riprap (160 LF)	115 cy	46	5290
Rock J-vanes	7 cy	46	299
Root wad anchor rocks	2 cy	46	92
Excavation	7 cy	12	84
Turbidity curtain	14 sy	30	420
Mobilization	L.S.	400	400
Willow stakes	640 ea	8.00	5120
Detailed stream survey	2	1200	2400
Plans and Permitting	L.S.	8000	8000
Total Estimated Cost			$22105

Institutional or Land Use Recommendations to Remediate or Protect Stream Channel:

1. Monitor accumulation of log jams and develop criteria for removal before significant erosion can develop.
2. Establish a “no-mow zone” to restrict mowing and vegetation removal within 50 feet of the top of bank.
3. Seek conservation easements along the stream channel to allow access for stream monitoring and site remediation/restoration efforts.

Conceptual Plans and Specifications


MARTINSVILLE ROAD
ROUTE 19
RECOMMENDATIONS:
1. ROCK TOE FROM STA. N 1+00 TO STA. S 0+60±. FIELD MEASURE FOR FINAL DESIGN. ASSUME BANKFULL ELEVATION IS 3.8 FEET ABOVE THALWEG DEPTH AT STA. N 1+00. TO BE FIELD VERIFIED.
2. USE ROOT WADS FROM ON-SITE MATERIALS. SET INTO SLOPE AT 20-30° ANGLE, FACING UPSTREAM.
3. USE J-VANES TO PROTECT OUTSIDE EDGE OF MEANDER. ASSUME BANKFULL ELEVATION AT 99.5 FT.± AT STA. S 1+100. FIELD VERIFICATION REQUIRED.
N 5+00
TREES
STEEP SLOPE
SHALLOW BEDROCK
RW
N 1+00 (600)
ROCK TOE &
WILLOW STAKES
RW
0+00
J-VANE
J-VANE
S 2+71
POINT BAR
GRAVEL BARS
INTERMITTENT STREAM
RW
S 5+00
N
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PENFIELD, NEW YORK 14526
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MARTINSVILLE ROAD CONCEPT PLAN
STREAM RESTORATION STUDY AREAS
P.N. 33602
DATE: MARCH 2005
APPROX. SCALE: 1" = 150'
DRAWN : DLS
CHECKED: FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: *E3 grading to DA3

STREAM NAME: Oatka Creek DRAINAGE AREA: 27 sq. miles BASIN NAME: Oatka

OBSERVERS: J. Hauber, F. Reese, J. MacKecknie, R. May, D. Reckahn DATE: 10/8/04

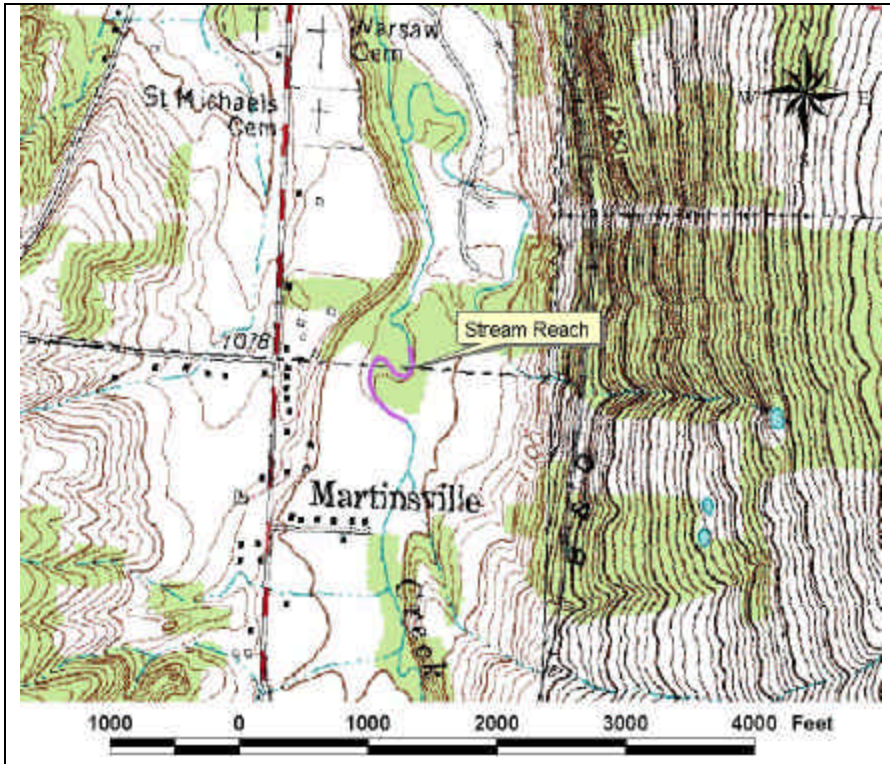
LOCATION: Oatka Creek, beginning at the Kennedy family driveway, approximately 600 feet north of Martinsville Road, extending north to limit of Kennedy property, approximately 2000-3000 feet

Latitude 42-43-27

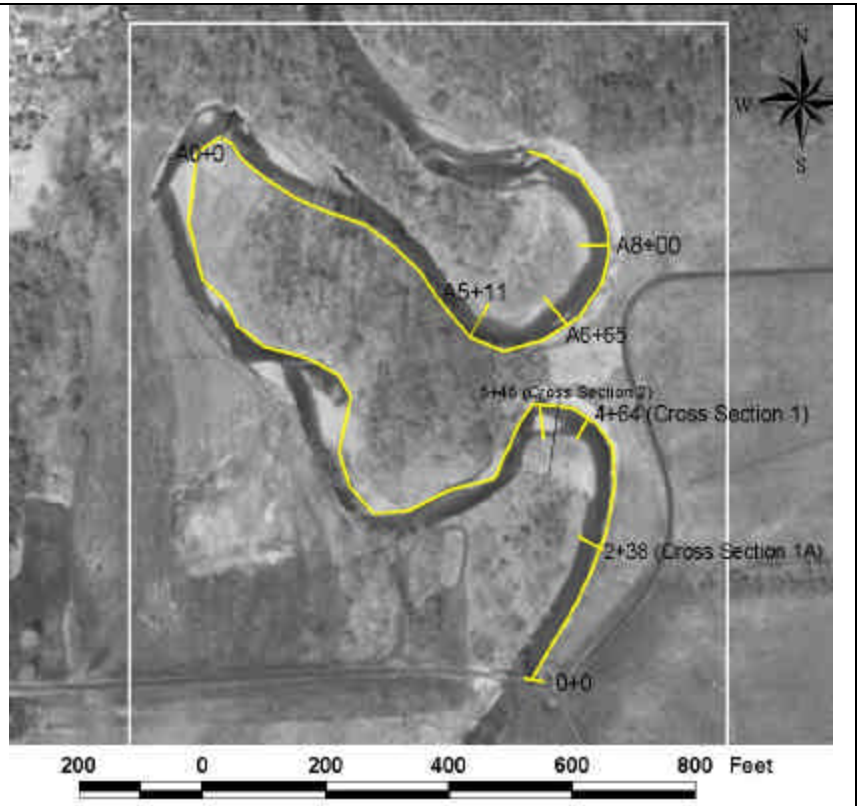
Longitude 78-07-45

Mapped Soil Type(s)	**K Factor**
Arkport very fine sandy loam, 25-40% slope	0.28
Tioga silt loam	0.37
Varysburg gravelly loam, 2-8% slope	0.24
Chenango channery silt loam, fans, 3-8% slope	0.24
Scio silt loam, 0-3% slope	0.49
Collamer silt loam, 3-8% slope	0.49

Bankfull WIDTH	64	Ft.(W_{bkf})	Bankfull MAX>DEPTH	2.2	Ft.(d_{max})	Channel SLOPE	0.0033 (composite)	Ft/Ft		%
Bankfull Mean DEPTH	1.08	Ft.(d_{bkf})	Flood Prone Area WIDTH	200-700	Ft.(W_{FP})	Valley SLOPE		Ft/Ft		%
WIDTH/DEPTH Ratio	59.26		ENTRENCHMENT Ratio	3+		SINUOSITY (Stream Dist/Valley Dist.)	2.8			
Channel MATERIALS: (Pebble Count)			D50	50	mm	D84	126	mm		



Site Location Map for Oatm 9-Kennedy Site, Oatka Creek



2002 Aerial Photograph, Oatm 9-Kennedy Site with Longitudinal Profile Stationing

	
View of Oatka Creek exposed soil bank near Station 2+38, looking north.	View exposed soil bank at Station 4+38, looking northeast.
	
View of Oatka Creek exposed soil bank near Station A0+600, looking northwest along channel.	View of exposed soil bank at Station A0+800, looking northeast.

Site Description: The project site consists of a section of Oatka Creek approximately 2769 feet long, beginning about 600 feet north of Martinsville Road, in the Town of Warsaw, Wyoming County. The channel has been preliminarily classified as a Rosgen C3 channel because of its high sinuosity. The width to depth ratio of the channel is atypical of an E3 stream, but this is one of the indicators of instability. The reach is characterized by several sharp meanders in the channel over the length studied. At one point, the meander has nearly doubled back on itself. An overflow channel was cut through in 2003 to relieve pressure on the outside curve, and protect a driveway access to two homes on the property.

The stream channel gradient decreases markedly over the length of the reach, from 0.0065 to 0.0026. The significance of this gradient drop is that the current slows, and particulates tend to settle out in slower-moving stream sections. Several areas with extremely high banks were observed. The linear distances of these exposed soil banks is shown in the aerial photograph. Sloughing and slumping of the banks is common.

Bankfull flows at the site were estimated using channel cross section dimensions and correlated with known bankfull discharges recorded at the Warsaw U.S.G.S. gaging station. It is estimated that flow in the channel at the Kennedy site is approximately equal to 75% of the flow volume as measured at Warsaw, NY, based on measurements completed by Wyoming County SWCD staff. Bankfull flow at Warsaw is estimated at 1200 cfs, based on peak flow data and recurrence interval analysis. Based on the 75% assumption, peak flow at the Kennedy study site would be 900 cfs. Bankfull flow estimates from cross section analysis ranged from 300 to 400 cfs.

Eroded bank heights at the Kennedy site exceeded 20 feet in several locations. Some vegetation (mostly grasses and annuals) is starting to redevelop in the meander above the bypass channel. However, much of this bank remains exposed. Soil types in the project reach appeared to be predominantly gravelly loam.

The sharp bends in the stream channel also cause accumulation of woody debris, log jams and ice jams, sometimes creating higher-than-normal water elevations.

Land uses adjacent to the channel are mowed lawn, agricultural pasture land, and deciduous woods. The property owner mows his lawn on the east side of the channel to the top of the bank.

Statement of Problems: Several long lengths of high eroding banks totaling 800-1000 linear feet are located within this reach. It has been estimated that this site alone contributes more than 70 T/year of sediment to the Oatka stream channel. Bank stability is reduced because woody vegetation has been removed from the top of the east bank. The owner has noted a severe loss of property adjacent to his driveway since its construction in the mid-1990's.

Historical air photo review indicates that this reach of Oatka Creek has been subject to meandering, probably due to the drop in gradient. Sharp bends in the channel create log jams. Ice jamming may also scour the exposed banks, uprooting and breaking off

vegetation, and causing unusually high water levels and flooding. Log jams also form when logs are deposited in shallow areas of the stream or get caught on sand bars. Log jams can also deflect currents into sensitive, exposed bank areas, creating additional sloughing and slumping.

The driveway of the Kennedy property is located within 30 feet of the top of bank of one of the meanders.

Proposed Restoration/Remediation Methods:

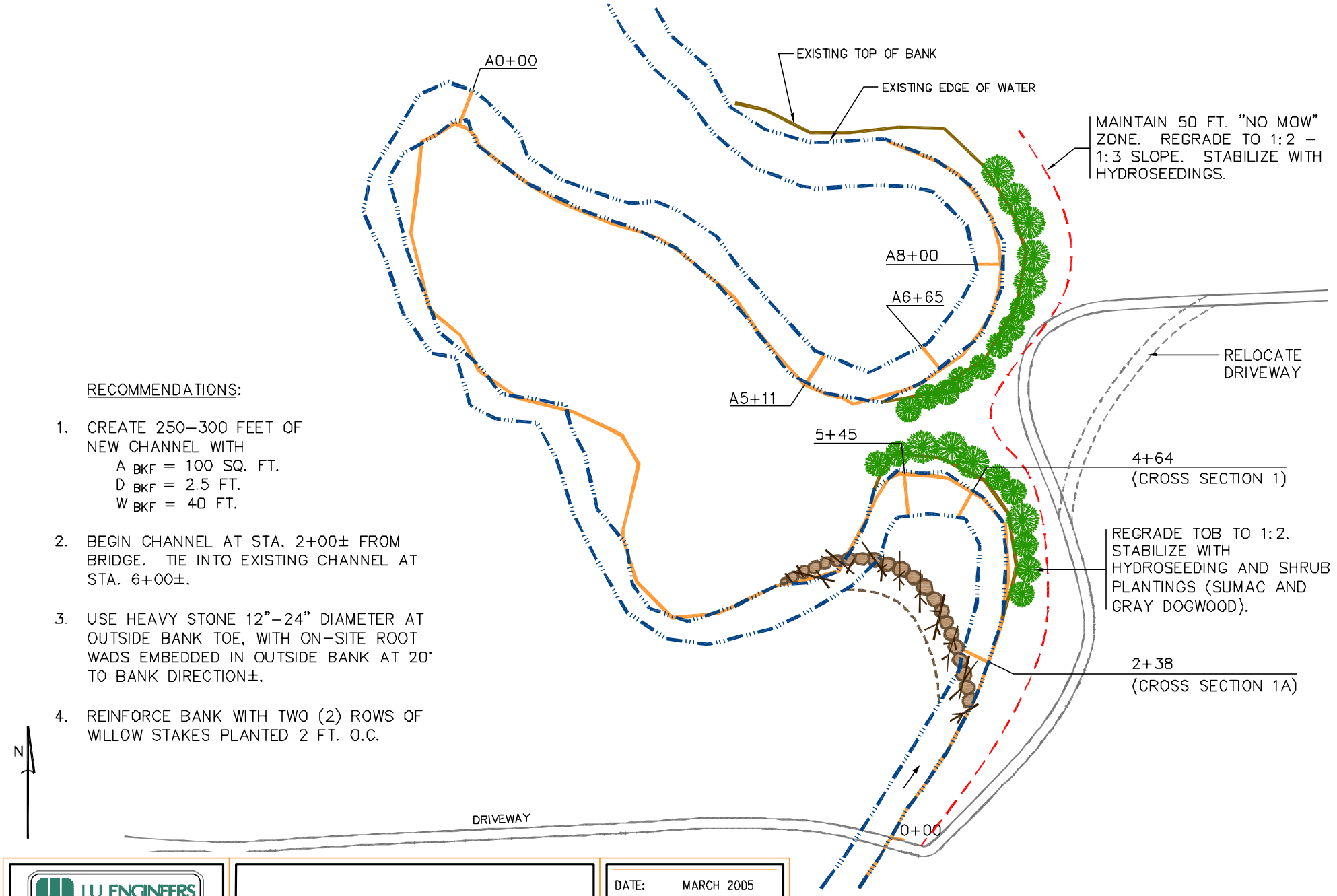
- Excavate a new channel section approximately 250-300 feet long, beginning at Station 2+00 (assuming the bridge is Station 0+00), and rejoining the existing channel at approximately Station 6+00. New channel dimensions should approximately match a stable reach section of Oatka Creek with the following approximate dimensions:
  - A_{BKF} = 100 sq. ft.
  - D_{BKF} = 2.5 ft.
  - W_{BKF} = 40 ft.

  The channel should be capable of passing a bankfull flow of approximately 400 cfs.
- Place approximately 300 LF of heavy stone rip rap (12-24 in. diameter) at the toe of slope of the outside edge of the new channel section to reinforce the channel bank. Utilize on-site materials as rootwads along with the stone at the toe of slope. Rootwads should be placed at an angle of 20-30º out from the outside edge of the bank, with the root end facing into the direction of flow. Root wads should be placed as ordered by engineer.
- Relocate the most vulnerable section of driveway away from the creek channel.
- Regrade the steepest portions of the high banks to a stable slope of 1:2 to 1:3. Hydroseed as needed to establish quick cover.
- Replant approximately 600 LF of top of bank with shrubs.

Cost Estimate:

Item	Units	Unit Cost ($)	Cost ($)
New channel excavation (300 LF)	1111 cy	12	13332
Stone rip rap (12-24 in.)	40 cy	46	1840
Turbidity curtain	5 sy	30	150
Hydroseeding (0.75 ac)	L.S.	1200	1200
Shrub plantings	L.S.	4500	4500
Willow stakes	L.S.	2500	2500
On-site supervision	L.S.	3000	3000
Survey	L.S.	5000	5000
Plans and Permits	L.S.	10000	10000
Total Estimated Cost			$41522

Conceptual Plan Sheets/Standard Details



RECOMMENDATIONS:

1. CREATE 250–300 FEET OF NEW CHANNEL WITH
   - A_{BKF} = 100 SQ. FT.
   - D_{BKF} = 2.5 FT.
   - W_{BKF} = 40 FT.
2. BEGIN CHANNEL AT STA. 2+00± FROM BRIDGE. TIE INTO EXISTING CHANNEL AT STA. 6+00±.
3. USE HEAVY STONE 12"–24" DIAMETER AT OUTSIDE BANK TOE, WITH ON-SITE ROOT WADS EMBEDDED IN OUTSIDE BANK AT 20° TO BANK DIRECTION±.
4. REINFORCE BANK WITH TWO (2) ROWS OF WILLOW STAKES PLANTED 2 FT. O.C.

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KENNEDY CONCEPTUAL DESIGN

STREAM RESTORATION STUDY AREAS

P.N. 33602

DATE:	MARCH 2005
APPROX. SCALE:	1" = 150'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: _____

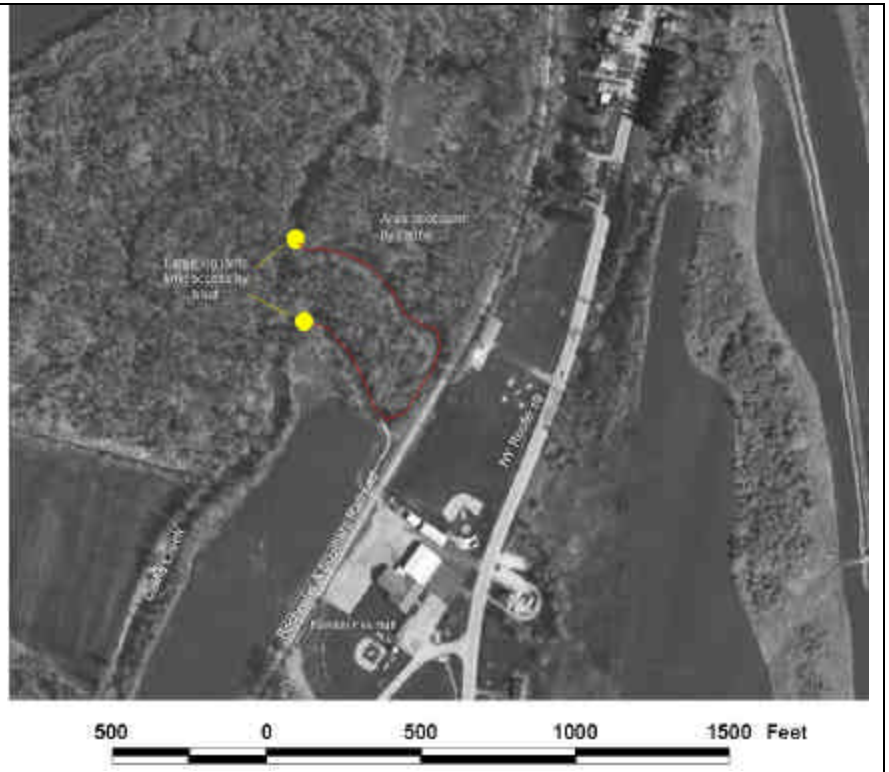
STREAM NAME: Oatka Creek DRAINAGE AREA: 101.6 sq. miles BASIN NAME: Oatka

OBSERVERS: J. Hauber, F. Reese (observed from canoe) DATE: 10/5/2004

LOCATION: Oatka Creek, behind Pavilion Fire Hall Latitude 42º52'5" Longitude 78º1'39"

Mapped Soil Type(s)	K Factor
Eel silt loam	0.43
Genesee silt loam	0.43
Palmyra gravelly loam, 0-3% slope	0.20
Wayland silt loam	0.43

Bankfull WIDTH	51	Ft.(W_{bkf})	Bankfull MAX>DEPTH	11.5	Ft.(d_{max})	Channel SLOPE	0.0018	Ft/Ft		%
Bankfull Mean DEPTH	4+	Ft.(d_{bkf})	Flood Prone Area WIDTH	60	Ft.(W_{FP})	Valley SLOPE	0.0018	Ft/Ft		%
WIDTH/DEPTH Ratio	12.75		ENTRENCHMENT Ratio	1.17		SINUOSITY (Stream Dist /Valley Dist.)	1.87			
Channel MATERIALS: (Pebble Count)			D50		mm	D84		mm		

	
Location of Site E-006, Oatka Creek south of hamlet of Pavilion, Genesee County	Aerial view of Oatka Creek near the Pavilion Fire Hall, Town of Pavilion, Genesee County

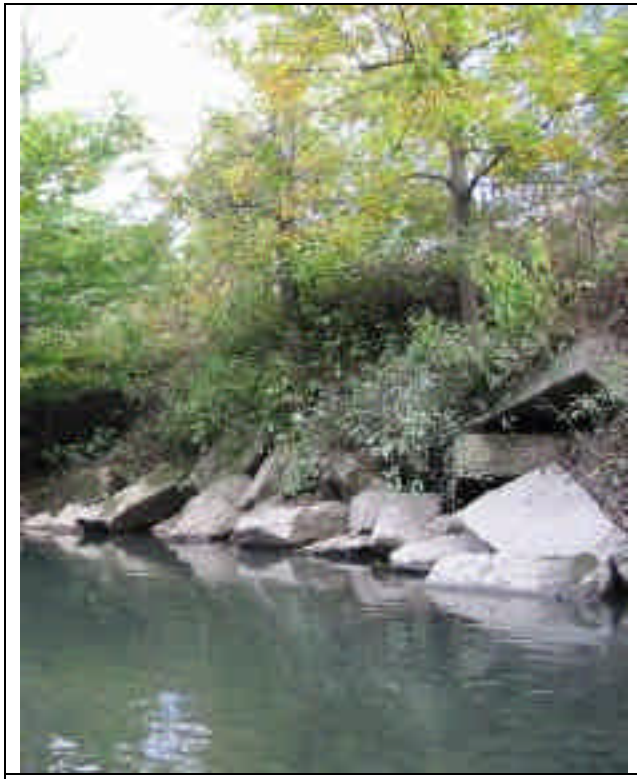


Photo 1. Detailed view of Rochester & Southern Railroad embankment adjacent to Oatka Creek south of Pavilion. Note placement of large concrete blocks, stones and rip rap to protect toe of slope.	Photo 2. Detailed view of exposed roots on large silver maple tree on east bank of Oatka Creek at Pavilion. This condition is typical of many large trees along the bank. Located on the outside curve of a meander, the roots are undercut when the channel flows at bankfull. Frequent bankfull flow conditions exacerbate undercutting and cause trees to fall into the channel.

Photo 3. Panoramic view of exposed bank along outside edge of meander adjacent to Rochester & Southern Railroad tracks. Note the accumulation of large woody debris, high exposed soil banks.

Site Description: This reach of Oatka Creek is located immediately west of the Rochester and Southern Railroad tracks in the hamlet of Pavilion in Genesee County. The railroad embankment has limited the eastward migration of a meander at this location. The channel forms a sharp curve around this site. The channel gradient is estimated at 0.0018 ft./ft through this section, dropping less than 10 feet over a distance of more than 5000 linear feet. A single, perennial tributary forms a confluence with the Oatka main channel just south of the project reach. Oatka Creek flows through a broad, relatively flat-lying flood plain between Wyoming and Pavilion. Agricultural fields are often cultivated as close to the top of the stream bank as possible. Vegetated riparian zones, where they exist, are generally thin (less than 15 feet) from the edge of the field to the stream channel top of bank). As a result, the stream channel carries a heavy suspended sediment load in this reach.

Soil types mapped for the stream channel are Genesee, Eel and Wayland silt loams. These soils are typically medium to fine grained silts. Better drained soils in the flood plain above the incised channel are mapped as Palmyra gravelly loam. Genesee and Eel soils are moderately well drained and somewhat poorly drained alluvial soils. These soils experience flooding, sometimes on an annual or semi-annual basis, but typically do not remain inundated or saturated for long periods of time. Wayland soils are poorly drained, hydric soils that are typically inundated or saturated for long periods of time. Palmyra soils are well drained, medium textured soils that do not usually experience flooding. The finer-textured soils exposed on high, overhanging banks on the outside of meanders are vulnerable to erosion during bankfull flow events.

Lu Engineers inspected this reach of Oatka Creek from a canoe in early October, 2004. The deepest thalweg depth measured 9.5 feet. Exposed soil banks measured 2.5 to 4 feet higher than the water level, indicating that bankfull mean depth is at least 4.5 to 5 feet.

Statement of Problem: This site was selected because the outside edge of the creek is located at the toe of the Rochester and Southern Railroad embankment. The railroad embankment has been damaged during previous flood events. Although large stone riprap has been placed at the toe of the slope to protect the embankment ballast, portions of the embankment are vulnerable to undercutting from the current. Erosion from this site was estimated at 0.395 tons of soil per year.

Portions of the channel banks are vertical or overhanging (Photo 2). Roots of large trees are exposed, and log jams were present at the sharp bends in the channel.

Fields in the watershed immediately above this reach are cultivated nearly to the edge of the stream, causing a high sediment load during precipitation events.

Recommended Restoration/Remediation Methods:

1. Relocate approximately 250 linear feet of stream channel away from the Rochester & Southern Railroad embankment into an existing natural depression bypass channel, leaving the existing channel in place as an oxbow wetland. Deepen the natural depression to create a channel with a dimension and form that blends with the existing channel.
2. Utilize abundant on-site materials to create log vanes and root wads to stabilize the outside edges of existing and the new meander curve. Utilize rip rap reinforcement to stabilize the outside curve of the relocated stream channel. Place root wads and willow wattles in channel banks at strategic locations to protect exposed soil areas. Use large woody debris to direct flow in desired directions.
3. Utilize rock J-vanes to direct the channel flow away from exposed soil banks.

4. Further survey and design will be required to determine appropriate morphology for the proposed channel. It is estimated that the new channel dimensions should be capable of passing approximately 900 cfs under bankfull conditions. This flow is estimated based on rough channel dimensions made during our limited site observation, channel width measurements from aerial photographs, and gradient measurements from U.S.G.S. topographic maps, and standard calculations. Channel cross section and profile survey and drainage calculations will be required for final design.

Land Use Recommendations:

- Coordinate with local private property owners to create and maintain a vegetated riparian zone between cultivated agricultural fields and the stream channel top of bank. The riparian zone should be at least 50 feet in width. A rough estimate of the loss of cultivated land is approximately 1.1 acre per linear foot of field adjacent to stream channel, assuming no riparian vegetation currently present. This riparian zone will serve to reduce the amount of sediment and agricultural chemicals that reach Oatka Creek.

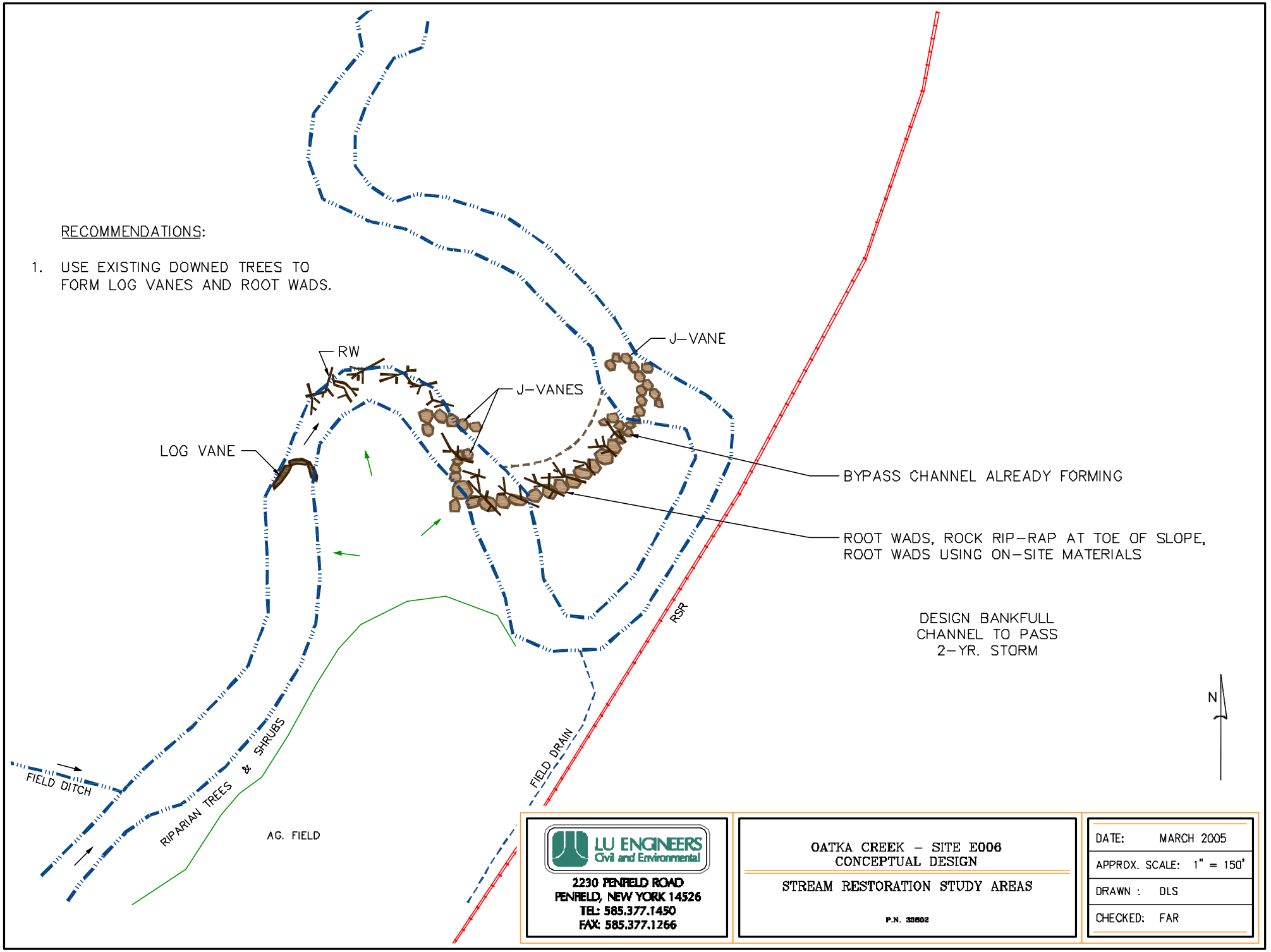
- Establish a drainage easement along the stream channel to allow the local SWCD or other entity to monitor the stream channel for log jams and other obstructions, and to complete necessary bank stabilization and remediation.

- Develop a blanket permit with the U.S. Army Corps of Engineers and NYS Department of Environmental Conservation to cover routine stream maintenance and remediation activities such as construction of j-vanes, rock vanes, and root wads.

Cost Estimate:

Item	Unit	Unit Cost	Extended Cost ($)
Excavation for new channel and embedding rock J-vanes in banks	1920	12	23040
Rock (3 J-vanes, and riprap at toe of slope	210	46	9660
Root wads (using on site materials)	2	1500	3000
Log vane	1	500	500
Turbidity curtain (sq. yd)	40	30	1200
Mobilization			1500
Survey	4	1200	4800
Plans and Permits			20000
Estimated Total Cost			63,700

Conceptual Plan Sheets/Standard Details



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OATKA CREEK – SITE E006
CONCEPTUAL DESIGN

STREAM RESTORATION STUDY AREAS

P.N. 33502

DATE:	MARCH 2005
APPROX. SCALE:	1" = 150'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: _____

STREAM NAME: Oatka Creek DRAINAGE AREA: 135.2 sq. miles BASIN NAME: Oatka

OBSERVERS: J. Hauber, F. Reese DATE: 10/6/2004

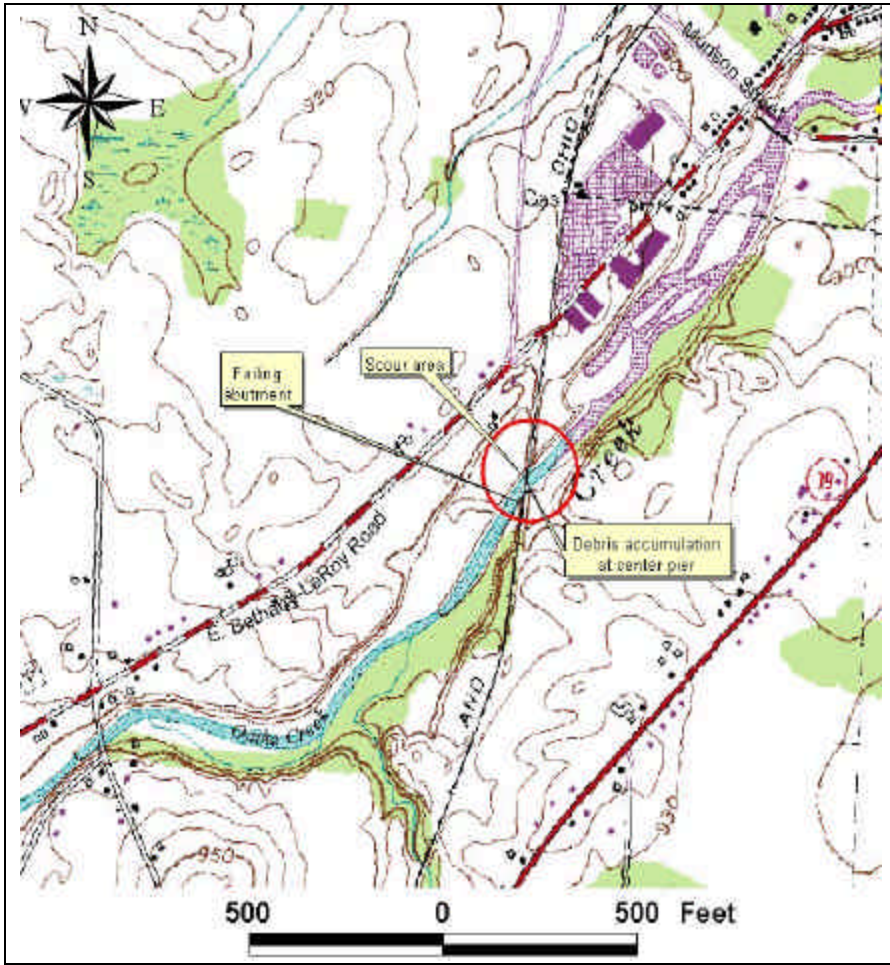
LOCATION: Oatka Creek at Rochester & Southern Railroad Bridge, Town of LeRoy, Genesee County

Latitude: 42º57'49"

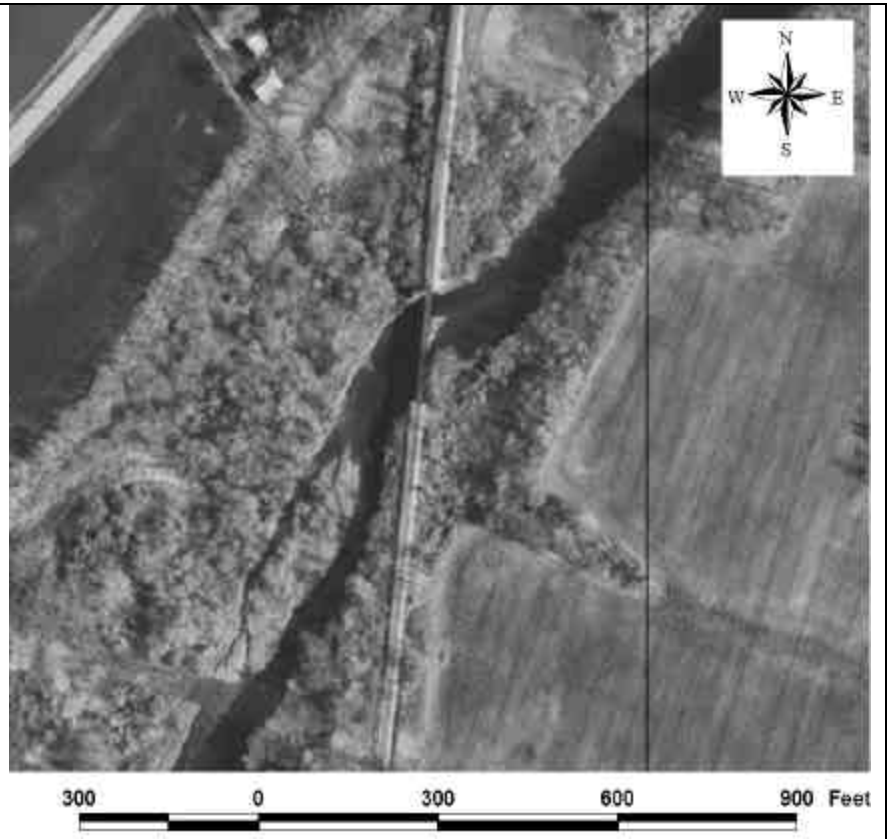
Longitude: 78º0'39"

Mapped Soil Type(s)	K Factor
Wayland silt loam	0.43
Phelps gravelly loam, 0-3%	0.20
Ontario loam, 8-15%	0.20
Kendaia silt loam, 0-3%	0.28
Lima silt loam, 3-8%	0.28
Palmyra gravelly loam, 0-3%	0.20

Bankfull WIDTH	103	Ft.(W_{bkf})	Bankfull MAX>DEPTH	4.5+	Ft.(d_{max})	Channel SLOPE		Ft/Ft		%
Bankfull Mean DEPTH	3+	Ft.(d_{bkf})	Flood Prone Area WIDTH	103	Ft.(W_{FP})	Valley SLOPE		Ft/Ft		%
WIDTH/DEPTH Ratio	33		ENTRENCHMENT Ratio	1		SINUOSITY (Stream Dist/Valley Dist.)	1			
Channel MATERIALS: (Pebble Count)			D50		mm	D84		mm		



Oatka Creek Site E-037, at Rochester & Southern Railroad Bridge, Town of LeRoy, Genesee County



2002 Aerial Photograph of Project Site

	
Failing retaining wall at southwest quadrant of Rochester & Southern Railroad bridge over Oatka Creek	View of northwest quadrant of bridge. Current hits abutment at near right angle, creating scour hole at northwest quadrant.
	
West/north bank of Oatka Creek near railroad bridge (typical). Note exposed soil in scour areas.	View of Oatka Creek looking downstream (east) from center pier of Rochester & Southern railroad bridge.

Site Description: This site was accessed by canoe because stream channel depths exceeded four feet at several locations. Water levels at this location are controlled by an abandoned dam at Munson Street in the Village of LeRoy. Shale bedrock is exposed along the south bank of the creek. The south bank is steep and heavily vegetated. The north bank is generally vegetated with seasonal grasses, wetland forbs and shrubs. Water levels fluctuate rapidly during flood events. Numerous mid-channel bars have developed behind the Munson Street dam. Two intermittent drainage swales form confluences with the main channel of the Oatka near the railroad bridge.

Statement of Problem:

1. A large scour hole has developed at the northwest quadrant of the Rochester & Southern Railroad bridge. Channel flow hits the bridge abutment at a near right angle, creating an eddy, which has scoured a deep hole in the channel substrate. Further evaluation may be required to determine if this scour hole has affected the bridge substructure.

2. Inspection of the southwest quadrant of the bridge showed that a stone retaining wall has partially collapsed into the creek. Further evaluation is needed to determine an appropriate repair strategy before the entire embankment fails.

3. Access to the site is limited by wetlands and a steep railroad embankment. The bridge is approximately 30-40 feet higher than the stream water surface. The channel is too shallow in spots to permit access by anything other than a canoe or kayak. To get a crane or other tracked vehicle in to the site would require clearing of woody vegetation. Steep slopes on the south side limit access also.

Recommended Restoration/Remediation Methods:

- Install a rock J-vane upstream of the northwest abutment to direct current away from the structure into the main channel of the Oatka.

- Install at rock J-vane upstream of the southwest abutment to direct current away from the failing retaining wall.

- Contact the railroad to advise them of the failing retaining wall.

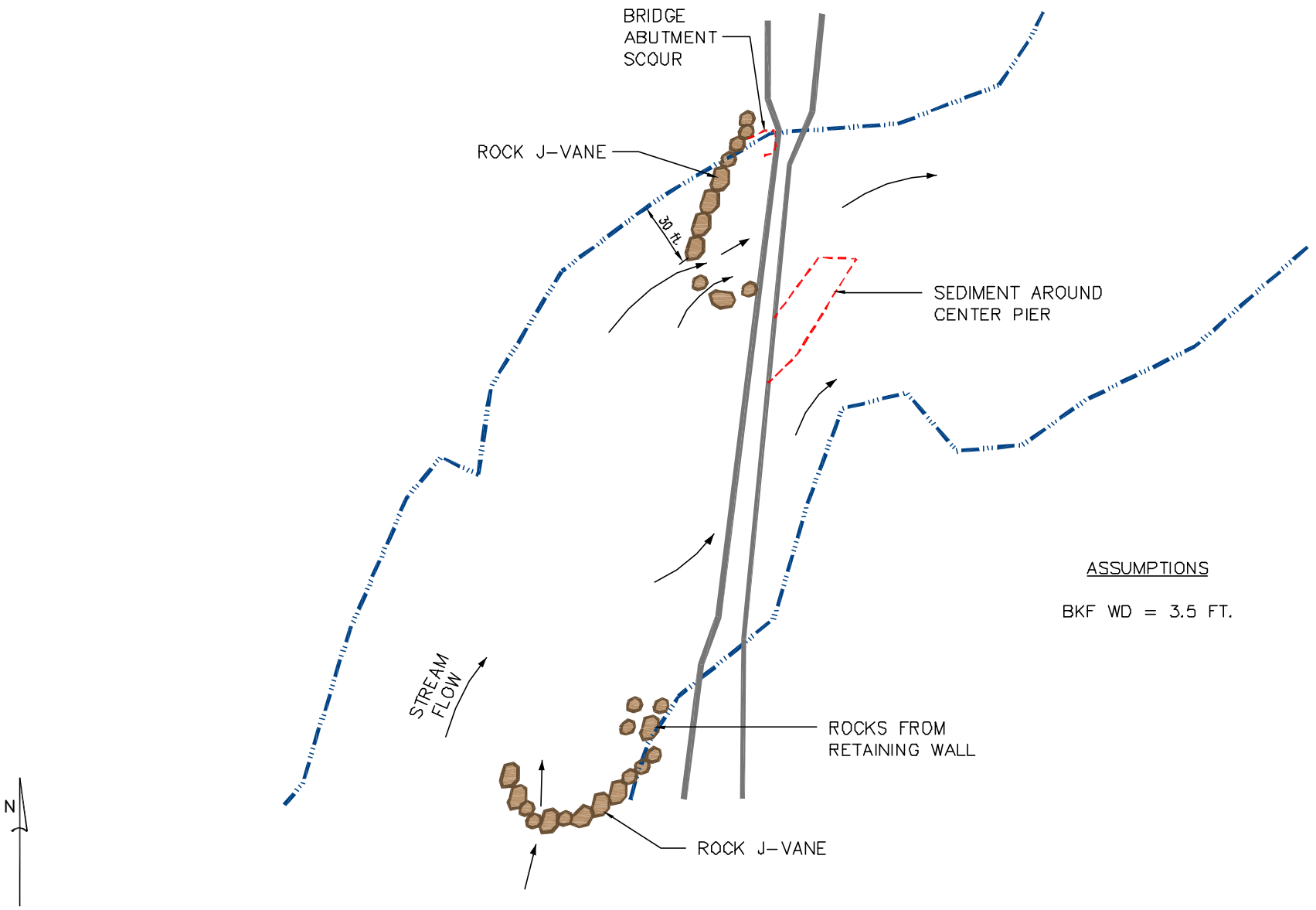
Cost Estimate:

Note: Costs for proposed remediation/restoration measures at this site do not include the cost of securing access easements or certain specialized equipment. Due to the fact that access to the site is controlled by the railroad, and that the railroad would be the prime beneficiary of any remedial activities, it is assumed that the railroad would underwrite these costs. More detailed stream survey and channel morphological analyses will be required to develop a detailed design plan for this site.

Costs for construction of a J-vane to redirect water away from the failing retaining wall were not estimated due to complicated access issues. Further review by the railroad is needed to address this issue.

Item	Unit	Unit Cost	Extended Cost ($)
Rock J-vane, north abutment	70	46	3220
Excavation	27	15	405
Crane	1	3000	3000
Crane operator ($140/hr)	8	140	1120
Mobilization			500
Survey ($1200/day-3 man crew)	2	1200	2400
Plans and permits	L.S.	7500	7500
Estimated Cost for northwest abutment J-vane only			18145

Conceptual Plan Sheets/Standard Details



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SITE E-37, LEROY

STREAM RESTORATION STUDY AREAS

P.N. 33602

DATE:	MARCH 2005
APPROX. SCALE:	1" = 50'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: Rosgen C3 grading to F3 in Village

STREAM NAME: Oatka Creek DRAINAGE AREA: 135 sq. miles ± BASIN NAME: Oatka

OBSERVERS: J. Hauber, F. Reese (observed from canoe) DATE: 10/7/2004

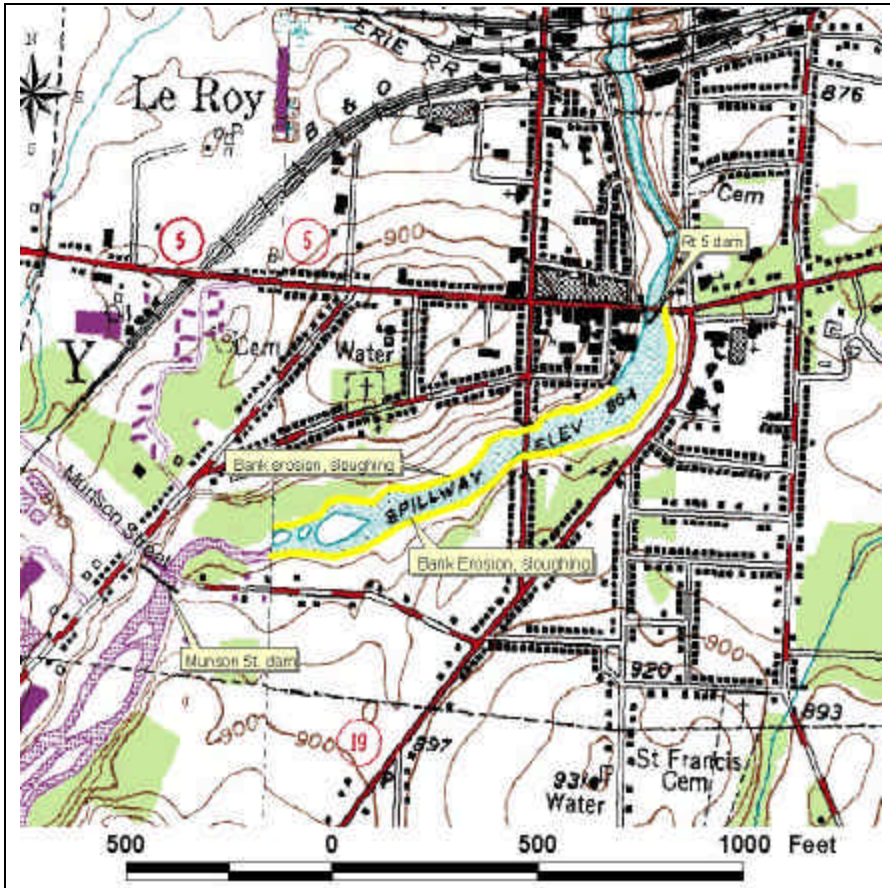
LOCATION: Oatka Creek between Munson Street and Rt. 5 dams, Village of LeRoy, Genesee County

Latitude: 42-58-28

Longitude: 77-59-34

Mapped Soil Type(s)	K Factor
Alden mucky silt loam	0.24
Wayland silt loam	0.43
Ontario loam, 3-8% slope	0.20

Bankfull WIDTH	273	Ft.(W_{bkf})	Bankfull MAX DEPTH	4+	Ft.(d_{max})	Channel SLOPE		Ft/Ft		%
Bankfull Mean DEPTH	4+	Ft.(d_{bkf})	Flood Prone Area WIDTH	273	Ft.(W_{FP})	Valley SLOPE		Ft/Ft		%
WIDTH/DEPTH Ratio	68.25		ENTRENCHMENT Ratio	1		SINUOSITY (Stream Dist/Valley Dist.)	1			
Channel MATERIALS: (Pebble Count)			D50		mm	D84		mm		



Site Location Map – Sites E39 through E45, Oatka Creek, Village of LeRoy, Genesee County

Aerial Photograph ca. 2002, Sites E39 through E45, Oatka Creek, Village of LeRoy

Photo 1. Eroded bank conditions typical of south side of Oatka Creek, immediately east of Rt. 19 bridge

Photo 2. View of south bank of Oatka Creek, with Wolcott Street in the background. Note partial stone riprap along bank at photo left, and growth of riparian vegetation (bur-reed) at photo center.

Photo 3. Bank conditions typical of north bank approximately 1500 feet east of Munson Street bridge. Note muskrat hole in bank just above water level.

Photo 4. Typical bank conditions along south bank west of Rt. 19 bridge.

Site Description: The project reach extends from Munson Street to the Route 5 dam in the Village of LeRoy, Genesee County. This reach was accessed by canoe due to deep water conditions. The normal water elevation behind the dam is 864 feet above mean sea level. Land uses on the south side of the creek are predominantly residential and open space. The Village of LeRoy maintains a park along the south side of the creek adjacent to Wolcott Street. Land uses along the north side of the creek are also predominantly residential and open space. Creek banks are typically steeper on the north bank than on the south bank. From the Rt. 19 bridge west to Munson Street, the north bank is more heavily vegetated, as seen in the aerial photograph and in Photo 3. Woody vegetation is scarce on the south bank between the Route 5 dam and the Route 19 bridge. The Village and adjacent property owners mow the lawn down to the creek bank. West of the Route 19 bridge, some woody vegetation is present along the bank, but the bank has been mowed to the top of the bank on some of the residential lots.

The Village of LeRoy maintains a sanitary sewer main adjacent to the creek channel parallel to Wolcott Street. Flooding from high water levels has exposed this sewer in the past. In 2003, the Village of LeRoy placed approximately approximately 400 LF of heavy stone riprap along the south bank of the creek to protect this sewer. In places, a thin fringe of tall emergent vegetation (Sparganium eurycarpum) has become established. Where this vegetation exists, it protects the bank against the prevailing winds, and cuts down on erosion. The land above this emergent fringe is mowed.

It was also noted that the mowed grass in the park is extensively used by Canada geese for grazing and resting. Goose excrement was very common along the shoreline.

Based on site observations, it appears that the water level fluctuates about 1.5 to 2 feet in this reach. The steep banks restrict the creek's ability to overflow into a flood plain.

Statement of Problem: The south bank experiences severe erosion and undercutting due to fluctuating water levels and currents driven by the prevailing winds between the Rt. 19 bridge and the Rt. 5 bridge. The bank is mowed to the top of the bank in this reach. Visual observation showed that the bank has slumped about 2-4 feet into the creek. The Village reportedly is planning to install more heavy stone riprap along the south bank to protect the shoreline. Where a fringe of riparian marsh type vegetation exists, the bank is better protected.

Some bank erosion is also evident along the south bank of the creek west of the Route 19 bridge. Erosion in this area is also caused by fluctuating water levels, and a lack of woody vegetation to hold the bank in place.

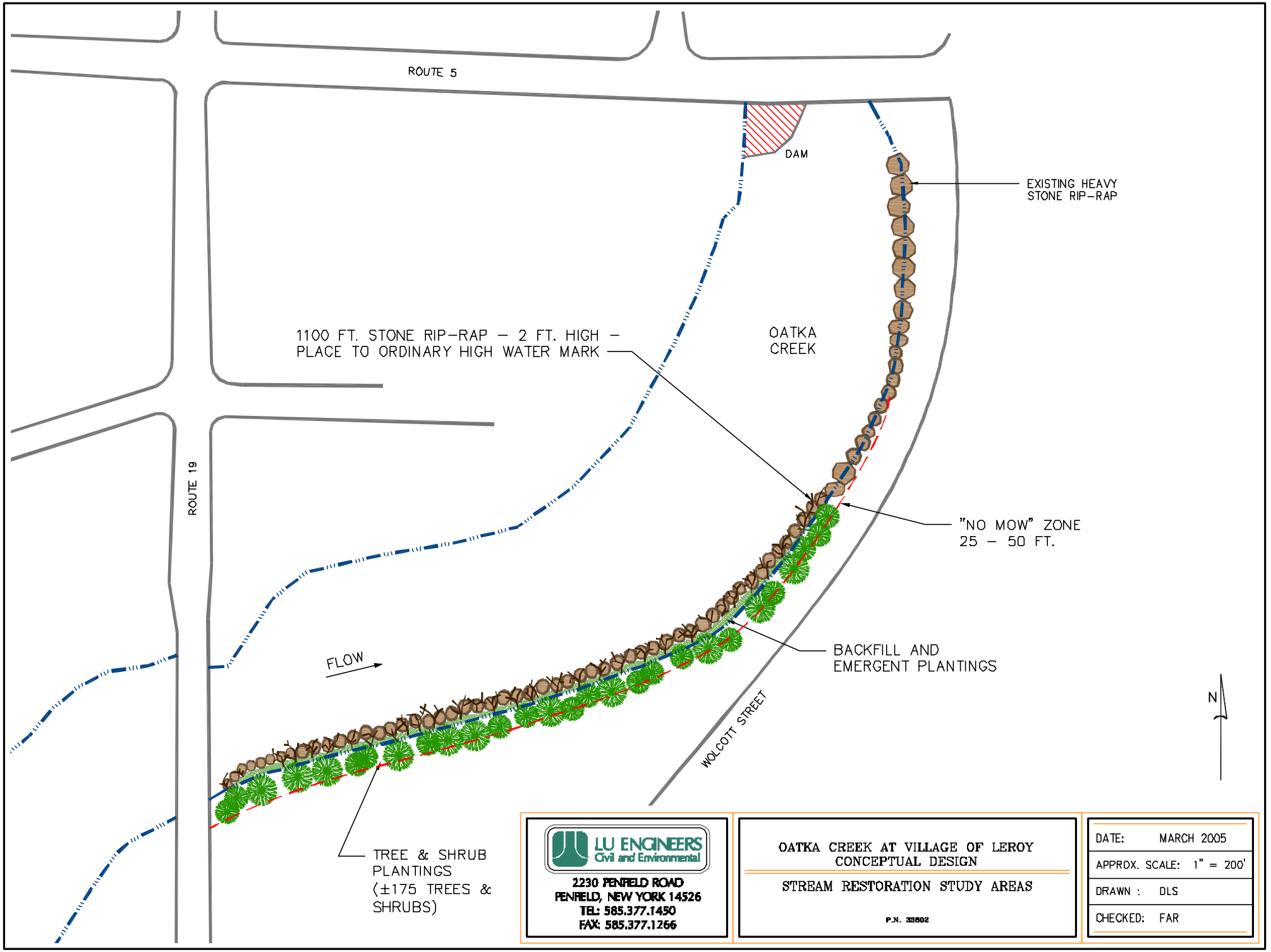
Proposed Restoration/Remediation Methods:

- Establish a 25-50 ft. wide "no mow" zone along south creek bank between the Route 5 dam and the Route 19 bridge with scattered clear areas to maintain the view of the creek. The longer grass along the shoreline will discourage the influx of Canada geese.
- Place riprap out from south bank shoreline approximately 5 feet and backfill with approximately 1-2 feet of soil material as a bed for emergent aquatic vegetation.

- Plant native species such as giant bur-reed (*Sparganium eurycarpum, Scirpus atrovirens, Scirpus validus*) in shallow water areas along the bank behind the rock wall to reduce the impact of waves and currents. [Note: a side benefit of planting tall emergents such as giant bur-reed is that it discourages Canada geese from landing on the water and wading out onto the shoreline).
- Plant groupings of red maple, willow, and dogwood along the shoreline close to the top of the bank to re-establish woody vegetation.
- Offer a public education/outreach program on do-it-yourself streambank protection techniques for homeowners. Encourage the use of vegetative measures to control erosion.

Cost Estimate:

Item	Unit	Unit cost	Extended Cost ($)
Mowing reduction savings 4 hr/week x 26 weeks x $30/hr	104	-30	-3120
Gasoline saved	1	-300	-300
Rock rip rap (1100 LF, 2 ft high, 24 in. diam.)	163 cy	46	7498
Backfill	305 cy	12	3660
Tall emergent vegetation plantings	0.12 ac x 15 lb PLS/ac	150	270
Woody plantings	175	15	2625
Estimated cost			10,633



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OATKA CREEK AT VILLAGE OF LEROY
CONCEPTUAL DESIGN

STREAM RESTORATION STUDY AREAS

P.N. 33502

DATE:	MARCH 2005
APPROX. SCALE:	1" = 200'
DRAWN :	DLS
CHECKED:	FAR

REFERENCE REACH FIELD FORM
STREAM CHANNEL CLASSIFICATION **LEVEL II**

STREAM TYPE: B3 grading into D3

STREAM NAME: Oatka Creek

DRAINAGE AREA: 200 square miles

BASIN NAME: Oatka

OBSERVERS: F. Reese

DATE: 11/16/2004

LOCATION: Oatka Creek, one-half mile east of Union Street bridge, Town of Wheatland, Monroe County Latitude 43º00'25" Longitude 77 º 47'03"

Mapped Soil Type(s)

Wampsville cobbly loam	K Factor	0.20
Eel silt loam	K Factor	0.43
Genesee silt loam	K Factor	0.43

Bankfull WIDTH	203	Ft.(W_{bkf})	Bankfull MAX>DEPTH	6+	Ft.(d_{max})	Channel SLOPE	0.0023	Ft/Ft		%
Bankfull Mean DEPTH	3.5	Ft.(d_{bkf})	Flood Prone Area WIDTH	370	Ft.(W_{FP})	Valley SLOPE	0.0015	Ft/Ft		%
WIDTH/DEPTH Ratio	57		ENTRENCHMENT Ratio	1.82		SINUOSITY (Stream Dist/Valley Dist.)	1.12			
Channel MATERIALS: (Pebble Count)			D50		mm	D84		mm		

Note: This stream channel was observed from the south channel bank. Measurements of depth were estimated from the height of the bank, and from information provided by K. Stollery, the property owner. Flood prone width is estimated from USGS data.

Oatka Creek at 1198 Quaker Road, Site Location Map

2002 Aerial Photograph, 1198 Quaker Road

Erosion on south bank of Oatka Creek at 1198 Quaker Road. Note slumping from undercutting of clay bank.

Single remaining black willow tree holds bank in place. Root system is completely exposed.

View of south bank of Oatka Creek, looking west (upstream) from leaning willow tree in photo above. Current has scoured a large indentation in the south bank.

View of exposed willow tree and mowed bank looking upstream.

	
View of Oatka Creek looking downstream (east) from exposed willow tree point.	View of mid-channel island in Oatka Creek, opposite scour hole.

Site Description: This site is located approximately one-half mile east of the U.S.G.S. gaging station at Garbutt (adjacent to the Union Street bridge over Oatka Creek). The property is privately owned. The owner, Ms. Kathy Stollery, has lived on the property for more than fifty years. Ms. Stollery leases access rights to a private fishing club. With the exception of a mowed area along the south bank, both banks of the creek are well vegetated.

Land use on the south side of the creek is predominantly large-lot residential. On the north side of the creek, the land is heavily wooded for a distance of 400-500 feet back from the creek bank.

Ms. Stollery is concerned that the south bank has been scoured about 30 feet south from the original bank location. The scoured bank appears to be a fine textured clay material with a few stones. A steep bank is located approximately 60 feet south of the top of bank. Ms. Stollery noted that the creek bank has been eroding toward the steep embankment. A perennial stream channel forms a confluence with the Oatka immediately east of Ms. Stollery's property.

Two islands are also located opposite the scoured area. The main channel is divided as it flows around these two islands. Ms. Stolley reported that she owns land on both sides of the creek.

Statement of Problem: This site was selected because it reportedly generates a large amount of sediment into the Oatka system, and Ms. Stollery is willing to cooperate with proposed remedial measures. She noted that the creek erodes about 2-3 feet per year on the south bank, enlarging a natural scour hole. She currently mows most of the flat area adjacent to the creek. She says the bank used to support many large willow trees, which have been undercut and uprooted by frequent flood events.

The biggest problem is a bifurcated riffle at the head end of the meander on Ms. Stollery's property. This riffle has split into two thalweg zones, directing the flow against both banks of the creek. The largest flow comes toward her south bank, creating the meander measured above. The south bank is clay, which has become undercut, causing sloughing into the creek. Sloughing has created a mid-channel bar slightly downstream and opposite of the meander. High flows continue to erode this bank. Bank height is approximately 4.5 ft. Water depths in the scour hole are over 5 feet in the center.

Proposed Remediation/Restoration Methods:

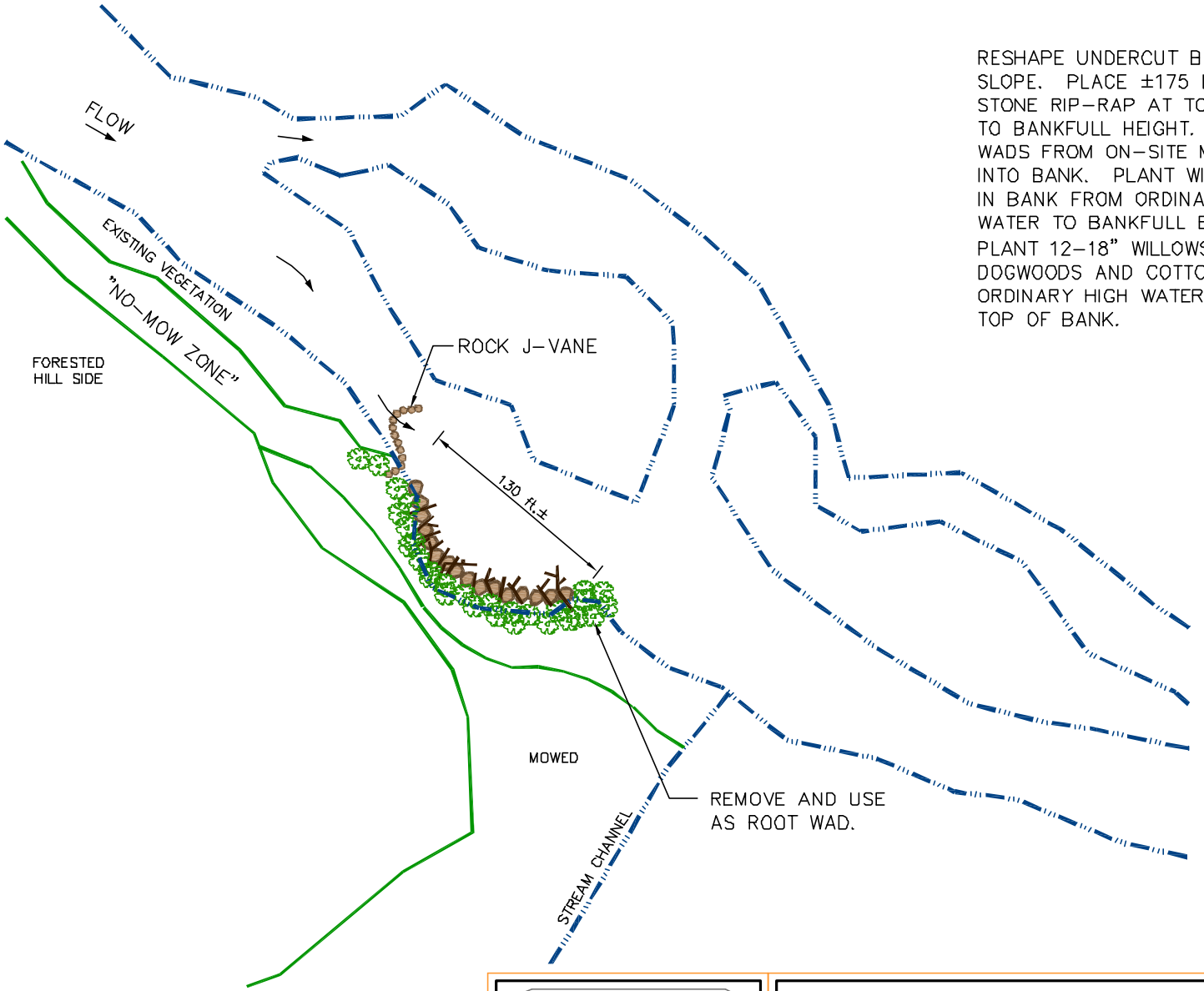
Note: No work is proposed for the north side of the creek, except to obtain plant materials (willow stakes and logs) for use in bank stabilization and restoration on the south side.

1. Establish a 25-50 ft. "no-mow" zone adjacent to the creek
2. Remove existing in-stream obstructions (logs, stones, etc.) directing current toward scoured bank.
3. Plant willows, dogwoods, and cottonwoods to re-establish riparian vegetation on the south side of the creek.
4. Construct a rock J-vane (stream barb) upstream of the scour zone to re-direct flow into the main channel.
5. Embed approximately 175 feet of stone riprap, and on-site rootwads at the toe of the scoured bank. Backfill to 1:2 slope and stabilize with willow stakes. Plant top of bank with dogwood and cottonwood to match existing riparian vegetation.

Cost Estimate:

Item	Unit	Unit cost	Extended Cost ($)
Heavy stone rip rap (24 in.+) at toe of slope	175’ x 6’ x 2‘ (77 cy)	46	3542
Soil backfill (cy)	230	16	3680
Topsoil (cy)	30	16	480
Rock J-vane (cy)	15	46	690
Root wads (constructed from on-site and nearby materials)	10	50	500
Willow stakes (if purchased)	80	8	640
Woody plantings (if purchased)	70	15	1050
Coffer dam	ea.	10,000	10,000
Mobilization fee for earthwork	ea.	600	600
Plans and permits	ea.	6000	6000
Detailed survey	ea.	2000	2000
Estimated Project Cost			29182

Conceptual Plan Sheets/Standard Details



RESHAPE UNDERCUT BANK TO 1:2 SLOPE. PLACE ±175 LF OF HEAVY STONE RIP-RAP AT TOE OF SLOPE TO BANKFULL HEIGHT. EMBED ROOT WADS FROM ON-SITE MATERIALS INTO BANK. PLANT WILLOW STAKES IN BANK FROM ORDINARY HIGH WATER TO BANKFULL ELEVATION. PLANT 12-18" WILLOWS, SILKY DOGWOODS AND COTTONWOODS FROM ORDINARY HIGH WATER MARK TO TOP OF BANK.

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OATKA CREEK AT 1198 QUAKER ROAD
CONCEPTUAL DESIGN

STREAM RESTORATION STUDY AREAS

P.N. 33502

DATE:	MARCH 2005
APPROX. SCALE:	1" = 100'
DRAWN :	DLS
CHECKED:	FAR