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Oriskany Creek Watershed Sediment & Debris Management Study

Oriskany Creek, Oneida County, New York

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Prepared by	**Kadir Goz, CFM and Alyssa Flint**
Checked by	**Nicole Del Monaco, PE, CFM, ENV SP**
Approved by	**Shaun Gannon, P.E., D.WRE, CFM, P.H.**

Ramboll
101 First Stret
4th Floor
Utica, NY 13501
USA

T 315-956-6950
https://ramboll.com

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Acronyms/Abbreviations

1-D/2-D	1-Dimensional/2-Dimensional
6NYCRR	New York Codes, Rules, and Regulations – Title 6
AEP	Annual Exceedance Probability
BFE	Base Flood Elevation
BMPs	Best Management Practices
BRIC	Building Resilient Infrastructure and Communities
CAP	Continuing Authorities Program
CFA	Consolidated Funding Applications
CRRA	Community Risk and Resiliency Act
CSC	Climate Smart Communities
DEM	Digital Elevation Model
DHS	United States Department of Homeland Security
EWP	Emergency Watershed Protection Program
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FT	Feet
GIS	Geographic Information Systems
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
H&H	Hydrologic & Hydraulic

HEC-RAS	Hydrologic Engineering Center River Analysis System
HMGP	Hazard Mitigation Grant Program
HSGP	Homeland Security Grant Program
IPaC	Information for Planning and Consultation
LiDAR	Light Detention and Ranging
LOMR	Letter of Map Revision
MMI	Milone and MacBroom, Inc.
MPH	Miles Per Hour
NAD83	North American Datum of 1983
NASS	National Agricultural Statistics Service
NAVD88	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NGVD29	National Geodetic Vertical Datum of 1929
NHD	National Hydrography Dataset
NPS	National Park Service
NRCS	Natural Resources Conservation Services
NWI	National Wetlands Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDHSES	New York State Division of Homeland Security and Emergency Services
NYSDOT	New York State Department of Transportation
NYSOEM	New York State Office of Emergency Management
NYSOPRHP	New York State Office of Parks, Recreation, and Historic Places
POW	Protection of Waters
Ramboll	Ramboll Americas Engineering Solutions, Inc.
REHAB	Watershed Rehabilitation Program
ROM	Rough Order of Magnitude
MI^2/SQ MI	Square Miles
STORM	Safeguarding Tomorrow through Ongoing Risk Mitigation Act
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UTM	Universal Transverse Mercator
WFPO	Watershed Protection and Flood Prevention Operations Program
WQIP	Water Quality Improvement Project
WSELs	Water Surface Elevations

1. Executive Summary

1.1 Introduction

Oriskany Creek is located within the Madison and Oneida Counties in Upstate New York (NY) and runs through the Towns of Stockbridge, Madison, Augusta, Marshall, Kirkland, Westmoreland, and Whitestown and the Villages of Oriskany Falls and Oriskany. In the most recent years, Oriskany Creek has become the source of devastating flooding, erosion, and sedimentation in different reaches along the creek which has cost over a million dollars in damages to nearby residential properties, agricultural fields, recreational fields, roadways and infrastructure. The Oriskany Creek Watershed Commission has initiated the Oriskany Creek Watershed Sediment and Debris Management Study in cooperation with Oneida County Planning and their *Flood Mitigation Grant Program*.

This comprehensive flood study will address the impacts and root causes where sediment and debris build-up contribute to flooding risk along the Oriskany Creek by collecting the information necessary to develop a management plan to reduce flood risks. This study will identify and evaluate mitigation strategies along the creek to address the risks found within different communities. A primary goal will be to reduce flooding by lowering surface water elevations caused by undersized infrastructure, excessive deposition and debris, uncontrolled sediment sources, head cutting or downcutting of the channel, and loss of natural floodplains.

1.2 Flood and Sediment Mitigation Analysis Methodology

This study includes a review of historic and climate change hydrological and meteorological data, and historical flood reports, community engagement meetings, field assessment, and development of updated hydrologic and hydraulic (H&H) modeling to evaluate the effectiveness of proposed streambank strategies to reduce sediment and debris jams.

An in-person project engagement meeting was held November 16, 2023, with representatives of Ramboll Americas Engineering Solutions, Inc. (Ramboll), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Transportation (NYSDOT), Oneida County Department of Planning, Oneida County Soil and Water Conservation District, Village of Clinton, and other local stakeholders (Appendix B). The outreach effort assisted in the identification of current high-risk areas to focus on for the sediment and debris analysis.

Following the initial data gathering, field data collection efforts identified high-risk areas, or zones, within the watershed. Initial field assessments of the watershed were conducted on October 31 - November 1, 2023, with a second field investigation occurring on July 29, 2024.

Hydraulic analysis of Oriskany Creek was conducted using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) model software. A 1-D HEC-RAS existing conditions model was developed starting at the confluence with the Mohawk River (river station 0+00) and extending upstream to the headwaters of Oriskany Creek in the Town of Stockbridge, Madison County, NY (river station 1770+00) using the following data and software:

- HEC-RAS v6.5 software (USACE 2023)
- Oneida County, New York 1-meter LiDAR DEM data with an exposed ground vertical accuracy of 0.3-ft (10 cm) and vegetated ground vertical accuracy of 0.4-ft (12 cm; USGS 2017)
- Madison County, New York 1-meter LiDAR DEM data with an exposed ground vertical accuracy of 0.2-ft (6 cm) and vegetated ground vertical accuracy of 0.3-ft (8 cm; NYSOITS 2016)
- New York State Digital Orthoimagery Program imagery for Onondaga County (NYSOITS 2022)
- USDA National Agricultural Statistics Service (NASS) cropland database (NASS 2024)
- Hydraulic structure data from field investigation surveys and NYSDOT data for bridges and culverts (NYSDOT 2023a; NYSDOT 2023b)
- NYSDEC dam data (NYSDEC 2024b)

The review of existing reports, historic flooding, and stakeholder input at the public engagement meeting identified four high risk areas within the study watershed as focus areas. These high-risk areas include the following:

- Town of Madison
- Town of Augusta/Village of Oriskany Falls
- Town of Marshall
- Town of Kirkland
- Town of Whitestown

The following are proposed flood mitigation and stream stabilization strategies that were evaluated along Oriskany Creek in the study watershed based on the location of the five zones:

- Zone 1 - Town of Madison
  - Removal of Madison Power Company Dam Upstream of Solsville Road (Alternative #1-1)
- Zone 2 - Town of Augusta/Village of Oriskany Falls
  - Removal of In-Channel Piers Upstream of Division Street (Alternative #2-1)
  - Floodplain Bench Upstream of Division Street (Alternative #2-3)
- Zone 3 - Town of Marshall
  - Restore Hydraulic Capacity of the NY-315 Bridge along Oriskany Creek (Alternative #3-3)
- Zone 4 - Town of Kirkland
  - Increase Hydraulic Capacity of the NY-5 Bridge along Oriskany Creek (Alternative #4-2)
  - Remove Clarks Mills Dam (Alternative #4-3)
  - Remove Abandoned Railroad Bridge Downstream of Main Street (Alternative #4-4)
- Zone 5 - Town of Whitestown
  - Removal of Oriskany Falls Dam (Alternative #5-2)

The mitigation analysis includes strategies that are structural (restore hydraulic capacity of bridges; removal of bridges, dams, or in-channel piers) or non-structural (flood benches; natural stream restoration; establish/increase riparian buffers stream stabilization; streambank stabilization strategies). The structural strategies and flood benches are based on the results from the 1%-ACE (100-yr storm event). The streambank stabilization strategies are based on treatments identified in the Natural Resources Conservation Service (NRCS) Engineering Field Handbook (NRCS 2009). These stabilization treatments are based on the maximum 10% ACE (10-year storm event) velocity and shear stress values.

1.3 Results

The research and analysis that supported each proposed mitigation alternative in this study should be considered preliminary but provides the guidance necessary for implementation of the proposed solutions identified for each high-risk area. Additional design and hydraulic modeling and analyses would be necessary to implement many of the strategies discussed within this study. A comprehensive, organized, effective flood mitigation plan outlines a path for successful results in improving resiliency throughout the watershed.

Next steps to implement a flood mitigation or stream stabilization project would involve obtaining stakeholder and public input to assess feasibility and support; completing additional technical analyses, as needed; selection of preferred projects; development of preliminary engineering design reports; and assessing and obtaining funding sources.

Funding sources can cover up to 100% of awarded funds, such as grants, or a percentage of the total funds awarded, like matching or cost-sharing programs, and can be awarded for both design and permitting, or construction. These types of awards are available from federal, state, and local agencies or non-governmental organizations (NGO).

Table 1 summarizes the streambank stabilization treatments proposed in this study based on the results of the technical analysis.

Table 1. Summary of Results for Oriskany Creek Sediment and Debris Management Study in the Five Zone Areas

Alternative No.	Description	Benefits Related to Alternative
#1-1	Removal of Madison Power Company Dam Upstream of Solsville Road	1-D model simulated WSEL reductions of up to **0.2-ft**.
#1-2	Streambank Stabilization Strategies	Reduction in bank and channel erosion, lower flow velocities, and decreases in sediment accumulation
#2-1	Removal of In-Channel Piers Upstream of Division Street	1-D model simulated WSEL reductions of up to **0.1-ft.**
#2-2	Natural Stream Restoration Upstream of Division Street	Restores natural habitats, reduces/manages runoff, and improves water quality
#2-3	Floodplain Bench Upstream of Division Street	1-D model simulated WSEL reductions of up to **2.4-ft.**
#2-4	Streambank Stabilization Strategies	Reduction in bank and channel erosion, lower flow velocities, and decreases in sediment accumulation
#3-1	Increase Riparian Buffers along Oriskany Creek for the Reach Adjacent to Heidelberg Materials Quarry	Increases in erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and reductions in flood impacts
#3-2	Establish/Increase Riparian Buffers along Agricultural Lands Adjacent to Oriskany Creek	Increases in erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and reductions in flood impacts
#3-3	Restore Hydraulic capacity of the NY-315 Bridge along Oriskany Creek	1-D model simulated WSEL reductions of up to **2.5-ft.**

Alternative No.	Description	Benefits Related to Alternative
#3-4	Streambank Stabilization Strategies	Reduction in bank and channel erosion, lower flow velocities, and decreases in sediment accumulation
#4-1	Establish/Increase Riparian Buffers along Agricultural Lands Adjacent to Oriskany Creek	Increases in erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and reductions in flood impacts
#4-2	Increase Hydraulic capacity of the NY-5 Bridge along Oriskany Creek	1-D model simulated WSEL reductions of up to **0.0-ft**.
#4-2	Remove Clarks Mills Dam	1-D model simulated WSEL reductions of up to **0.0-ft**.
#4-4	Remove Abandoned Railroad Bridge downstream of Main Street	1-D model simulated WSEL reductions of up to **3.9-ft**.
#4-5	Streambank Stabilization Strategies	Reduction in bank and channel erosion, lower flow velocities, and decreases in sediment accumulation
#5-1	Bank Restoration Downstream of Valley Road	Restores natural habitats, reduces/manages runoff, and improves water quality
#5-2	Removal of Oriskany Falls Dam	1-D model simulated WSEL reductions of up to **0.2-ft.**
#5-3	Establish/Increase Riparian Buffers along Agricultural Lands Adjacent to Oriskany Creek	Increases in erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and reductions in flood impacts
#5-4	Streambank Stabilization Strategies	Reduction in bank and channel erosion, lower flow velocities, and decreases in sediment accumulation

2. Introduction

2.1 Background and Objectives

Ecosystem-based management and holistic approaches to natural resource management are essential to protecting and repairing vital natural ecosystems throughout New York State. It is recognized that numerous watershed-wide characteristics and conditions can contribute to or cause increased flooding risk. Incompletely understood and poorly planned actions may worsen flooding risk, create negative unintended consequences, be prohibitively expensive, be ineffective, a waste of dollars and cause unnecessary ecological damage. A full understanding of these conditions is necessary (NYOGLECC 2009; NYSDEC 2020).

The objective of this study is to provide an effective method to identify areas within the Oriskany Creek basin where sediment and debris build-up contribute to flooding risk, and to collect the information necessary to develop a management plan to reduce those risks. A primary goal will be to reduce flooding by lowering surface water elevations caused by undersized infrastructure, excessive deposition and debris, uncontrolled sediment sources, head cutting or downcutting of the channel, and loss of natural floodplains. Many of these situations are a result of basin-wide conditions related to changes in land use or land cover, runoff, stormwater management, upstream sediment sources, upstream woody debris, and stream bed and bank erosion. Practical solutions and actions will be presented to meet these goals in an ecologically sustainable manner.

This study is not intended to replace or prevent flood recovery actions during actual flooding emergencies. At such times, emergency permitting, and guidance will be provided by regulatory agencies to safeguard life and property.

2.2 Prior Planning Reports

There have been previous studies and planning reports developed for the Oriskany Creek watershed basin:

- Milone and MacBroom, Inc. (MMI) completed the *Emergency Transportation Infrastructure Recovery Water Basin Assessment and Flood Hazard Mitigation Alternatives, Oriskany Creek, Oneida County, New York* (2014) study in response to an extensive flooding event in June of 2013. MMI conducted field surveys, hydrologic assessment, hydraulic modeling, and identification of long-term recommendations for mitigation of future flood hazards. The report recommended 13 flood mitigation strategies that ranged from infrastructure updates and/or removal to floodplain regulations and sediment management plans (MMI 2014).

2.3 Schedule for Plan Updates

A management plan is a process that should incorporate the input of all stakeholders within the watershed when determining how the watershed should be managed. This Sediment and Debris Management Plan should be a dynamic, ever changing, process-driven document that helps to define future direction for the watershed. The following is an implementation schedule for the Oriskany Creek Sediment and Debris Management Plan document:

- Complete field surveys, hydrologic assessments, and stakeholder engagement by November 2023
- Complete hydraulic modeling of existing, future, and proposed mitigation conditions by April 2024
- Complete draft Sediment and Debris Management Plan and submit for review by June 2024
- Address comments, complete revisions, and develop Final Plan document by August 2024

This document is the first release and will be updated periodically, as and if improvements or changes in conditions within the creek basin occur, such as creation of floodplain areas, bridge/culvert resizing, or alterations to creek channel dimensions.

3. Study Area

3.1 Oriskany Creek Watershed

Oriskany Creek, a tributary to the Mohawk River, is approximately 33.5 miles long with a drainage area of 147 miles. It is located within Madison and Oneida Counties in Upstate New York (Figure 3-1). The headwaters flow south then east/northeast through Madison County and the Towns of Stockbridge and Madison. Oriskany Creek enters Oneida County in the Village of Oriskany Falls and Town of Augusta flowing north/northeast then continues through the Towns of Marshall, Kirkland, Westmoreland, and Whitestown before emptying into the Mohawk River (USGS 2018).

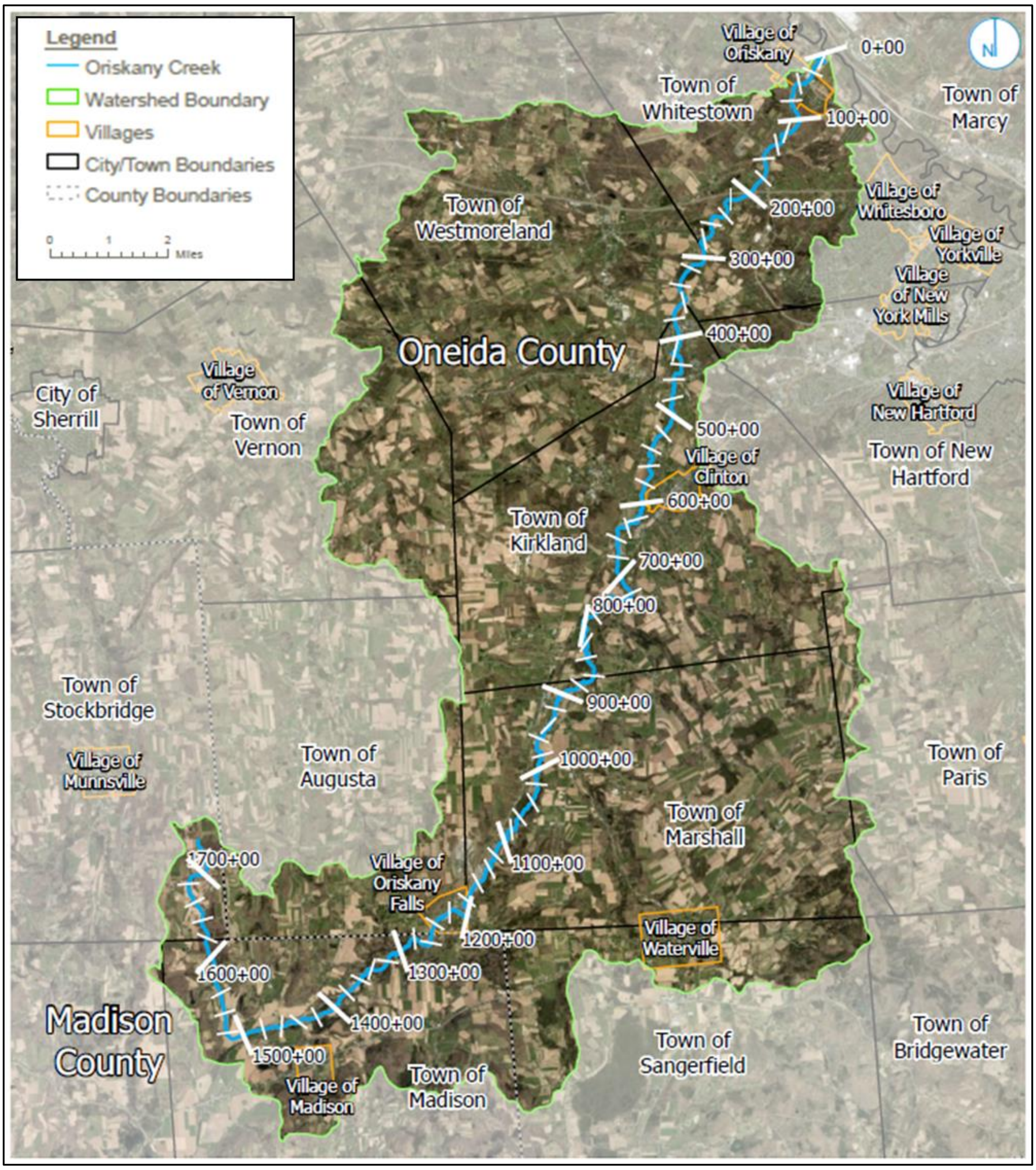


Figure 3-1. Oriskany Creek Watershed, Oneida and Madison Counties, NY.

Due to its relatively low gradient and minimal number of high-energy reaches, Oriskany Creek has limited erosion and sediment transport capabilities during “normal” flow conditions. However, high discharges caused by various types of events (i.e., long duration rainfall, cloudburst, rain-on-snow, snowmelt, or some combination) can cause significant erosion and sediment transport along Oriskany Creek. In addition, there are eight major tributaries to Oriskany Creek (Buckley Mill Creek, Lindsey Brook, Watermans Brook, Big Creek, Turkey Creek, White Creek, St. Mary's Brook, and Deans Creek) that all contribute to the flooding and sediment issues along the main channel of the creek (MMI 2014).

It should be noted, for this study all references to “right bank” and “left bank” in this report refer to "channel right" and "channel left," meaning the orientation assumes that the reader is standing in the waterway channel looking downstream.

3.2 Principal Watershed Issues

Oriskany Creek watershed suffers from both open water flooding and erosion and sedimentation issues in different reaches along the creek. Open water flooding is primarily associated with undersized infrastructure crossing the waterway (i.e., roads and railroads), creating hydraulic pinch points, which cause backwater flooding. Several locations have been identified as being susceptible to open water flooding, including:

- In the vicinity of Van Hyning Road, downstream of Oriskany Falls (MMI 2014)
- At the Norton Avenue bridge in Kirkland (MMI 2014)
- Along Valley Road (MMI 2014)
- In the vicinity of the Little League field in Oriskany (MMI 2014)
- In the vicinity of Dugway and Lumbard Roads near the confluence of Turkey Creek (Ramboll 2023b)

Erosion and sedimentation are naturally occurring processes that can be exacerbated by human activities within the floodplain. When this process is disrupted or imbalanced, erosion can severely degrade banks and contribute sediment and woody debris to downstream areas of the creek that can restrict channel and infrastructure flow capacities (MMI 2014). Within the Oriskany Creek watershed, areas with identified bank erosion and/or sediment deposition were:

- Downstream of the dam in Whitestown adjacent to the Village of Oriskany (MMI 2014)
- Right bank downstream of Valley Road (CR-32) in Whitestown (MMI 2014)
- Downstream of NY-5 in Kirkland (MMI 2014)
- Downstream of Norton Ave in the vicinity of the Golf Club in Kirkland (MMI 2014)
- In the vicinity of College Street in Kirkland (MMI 2014)

3.3 Existing Mitigation Measures

In the Village of Oriskany Falls, there is a dam downstream of Cassidy Street, however, the dam does not provide any flood protection to the community (FEMA 2013). Additionally, the purpose of the dam is unknown.

There are no structural or non-structural flood protection measures, existing or planned, in the Towns of Kirkland, Westmoreland, Marshall, and Madison and in the Villages of Clinton and Oriskany Falls (FEMA 1982; FEMA 2013).

4. Watershed Characteristics

4.1 Physiography

Oneida County is divided into seven different physiographic provinces: Ontario (Oneida) Lake Plain; Erie-Ontario Lowland; Alleghany Plateau; Black River-Mohawk River Lowland; Tug Hill Plateau; Adirondack Foothills; Mohawk Valley and other valleys. Each region differs in terms of localized climate, relief, types of flora and fauna, bedrock, and glacial geological history (NRCS 2008).

The bedrock of Oneida County primarily consists of sedimentary rocks from the Paleozoic age and dips approximately 50 feet per mile to the southwest. Where bedrock to exposed to the surface, generally in the east-west trending zone, the younger bedrock outcrops tend to be in the northern portion of the county (NRCS 2008).

Nearly all the parent materials of Oneida County soils were deposited because of glaciation, either directly or indirectly, through a process known as solifluction. Solifluction is a type of mass wasting when under free-thaw conditions water-saturated glacial drift is deposited on valley sides and then flows or slumps downhill to the lower valley slopes and bottoms. Erosion and the accumulation of sediment continue to affect the landscape. The rates of these processes can be greatly accelerated by human activities (NRCS 2008).

Waterways in Oneida County drain in many different directions forming a dendritic pattern, which has been modified in places by bedrock and glacial features. Depending on its location, a waterway can flow west to the Great Lakes, east to the Hudson, and south to the Susquehanna River in the county. The county is divided by five major drainage basins: the Black River basin to the northeast, Eastern Oswego basin to the west, Mohawk basin to the east, West Canada Creek subbasin to the east, and Susquehanna basin to the south (NRCS 2008). Oriskany Creek drains into the Mohawk River, which flows east to the Hudson River then south eventually emptying into the Atlantic Ocean.

The topography of Oneida County ranges from very steep hillsides at the foothills of the Adirondacks in the northeastern portion of the county to nearly level river valleys. For the areas of the county north of the Mohawk River, about 32% are above 1,000-feet in elevation, which is generally considered a frigid temperature regime for soils (NRCS 2008). Figure 4-1 is a stream bed elevation and channel distance from the confluence with the Mohawk River to the headwaters of Oriskany Creek using 1-meter light detection and ranging (LiDAR) data from 2016 (NYSOITS 2016; USGS 2017).

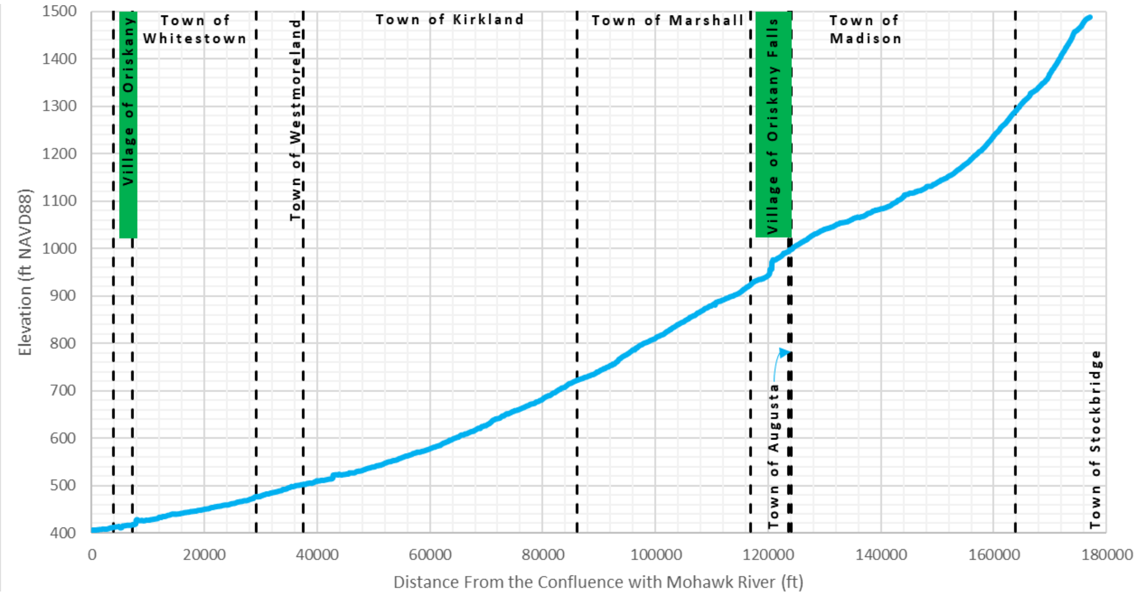


Figure 4-1. Oriskany Creek profile of stream bed elevation and channel distance from the confluence with the Mohawk River.

Oriskany Creek has an average slope of 0.6% over the main branch profile length. The creek's streambed lowers approximately 1080 vertical feet over this reach from an elevation of 1488-feet above sea level (NAVD 88) at the headwaters in the Town of Stockbridge, to 405-feet above sea level at the confluence of Mohawk River in the Town of Whitestown.

4.2 Morphometric Analysis

The shape of the Oriskany Creek watershed was evaluated by performing a morphometric analysis of the basin and calculating the form factor (RF), circularity ratio (RC), and elongation ratio (RE). Form factor is the dimensionless ratio of the basin area to the square of basin length (Horton 1932). A form factor value of 0 indicates a highly elongated shape, and the value of 1.0 indicates a circular shape. Low form factor basins tend to have flatter peak flows for longer durations, while high form factor basins have high peak flows for shorter durations. The flood flows of elongated basins (e.g., low form factor) can be managed easier than that of more circular (e.g., high form factors) basins (Joji et al. 2013).

Circularity Ratio is the ratio of the area of a basin to the area of circle having the same circumference as the perimeter of the basin (Miller 1953). It is a dimensionless ratio that is influenced by length and frequency of streams, geological structures, land use/cover, climate, relief and slope of the basin. Low circularity ratios indicate that the basin is elongated in shape with low discharge of runoff and high permeability of the subsoil condition, while high circularity ratios indicate the basin is circular in shape with high discharge of runoff and low permeability of the subsoil condition (Joji et al. 2013; Aparna et al. 2015).

Elongation ratio is the ratio of the diameter of a circle having the same area as of the basin and maximum basin length (Schumm 1956). It is a measure of the shape of the river basin where values generally range between 0.6 and 1. Values near 1.0 are typical of regions of low relief, whereas values in the range of 0.6 to 0.8 are generally associated with high relief, steep ground slopes and elongated basin shapes (Chow 1964). Basins with high elongation ratios tend to be more efficient in the discharge of runoff than low elongation ratio basins due to the concentration time of precipitation being lower in circular basins than in more elongated ones; thus, elongation ratios help in flood forecasting (Joji et al. 2013).

Table 2 is a summary of the basin characteristic formulas and calculated values for the Oriskany Creek watershed, where A is the drainage area of the basin in square miles (mi²), BL is the basin length in miles, and BP is the basin perimeter in miles. The basin characteristics factors indicate that the Oriskany Creek watershed can be characterized as having as an elongated basin with lower peak discharges of longer durations, high permeability of the subsoil condition, high-relief topography, and steep ground slopes.

Table 2. Oriskany Creek Basin Characteristics Factors

Factor	Formula	Value
Form Factor (R_F)	A / B_L^2	0.20
Circularity Ratio (R_C)	$4 * pi * A / B_P^2$	0.15
Elongation Ratio (R_E)	$2 * (A/pi)0.5 / B_L$	0.50

4.3 Climate

Oneida County is generally warm in the summer and cold and snowy in the winter. The county can be split into two climatic zones between north and south with the southern part having lower precipitation and snowfall, slightly warmer temperatures, and slightly longer growing season than the northern part of the county (NRCS 2008).

During winter months, snow squalls are common in different areas of the county and total snowfall is normally heavy with an average seasonal snowfall of roughly 96 inches in Utica (south) and 216 inches in Boonville (north). Temperatures average about 24° Fahrenheit (F) in Utica and 19°F in Boonville. During warmer months, the total annual precipitation averages around 45 inches at Utica and 60 inches at Boonville. Temperatures average 68°F in Utica and 64°F in Boonville during the summer months (NRCS 2008).

4.4 Wetlands

Wetlands play a vital role in sediment transport and flooding. The loss of wetlands has significant effects on local ecosystems. Wetlands are adversely affected by many human activities, including hydrologic alterations (i.e., drainage for development/agriculture, dredging, channelization, damming, etc.); pollution and runoff from urban, agricultural, mining, and industrial areas; and vegetation damage by grazing domestic animals and invasive plant species (USEPA 2001).

Wetlands are significant and provide numerous benefits, not only to the environment, but to the community as well. For instance, wetlands improve drinking water quality by removing sediments and pollutants and absorbing excess nutrients from agricultural and stormwater runoff; wetlands have the potential to reduce the frequency and intensity of floods by acting as natural buffers and significant storage areas for flood waters; wetlands promote a diverse species of habitats due to the biological production that occurs within a healthy wetland and, as a result, are home to numerous threatened and endangered species; and this biological production also makes wetlands popular for outdoor recreational activities, such as hiking, fishing, hunting, etc., which can provide a significant boost to local economies through licenses, equipment sales, tourism, etc. (USEPA 2006).

The United States Fish & Wildlife Service (USFWS) National Wetlands Inventory (NWI) database shows the approximate location of wetlands and surface waters regulated within the Oriskany Creek watershed (Figure 4-2). Both freshwater forested/shrub wetlands and emergent wetlands areas are located within the watershed, including freshwater ponds and riverine habitats. According to the NWI data, freshwater wetlands (both forested/shrub and emergent) comprise 13.3 square miles (mi²) of the total land area within the watershed (USFWS 2023).

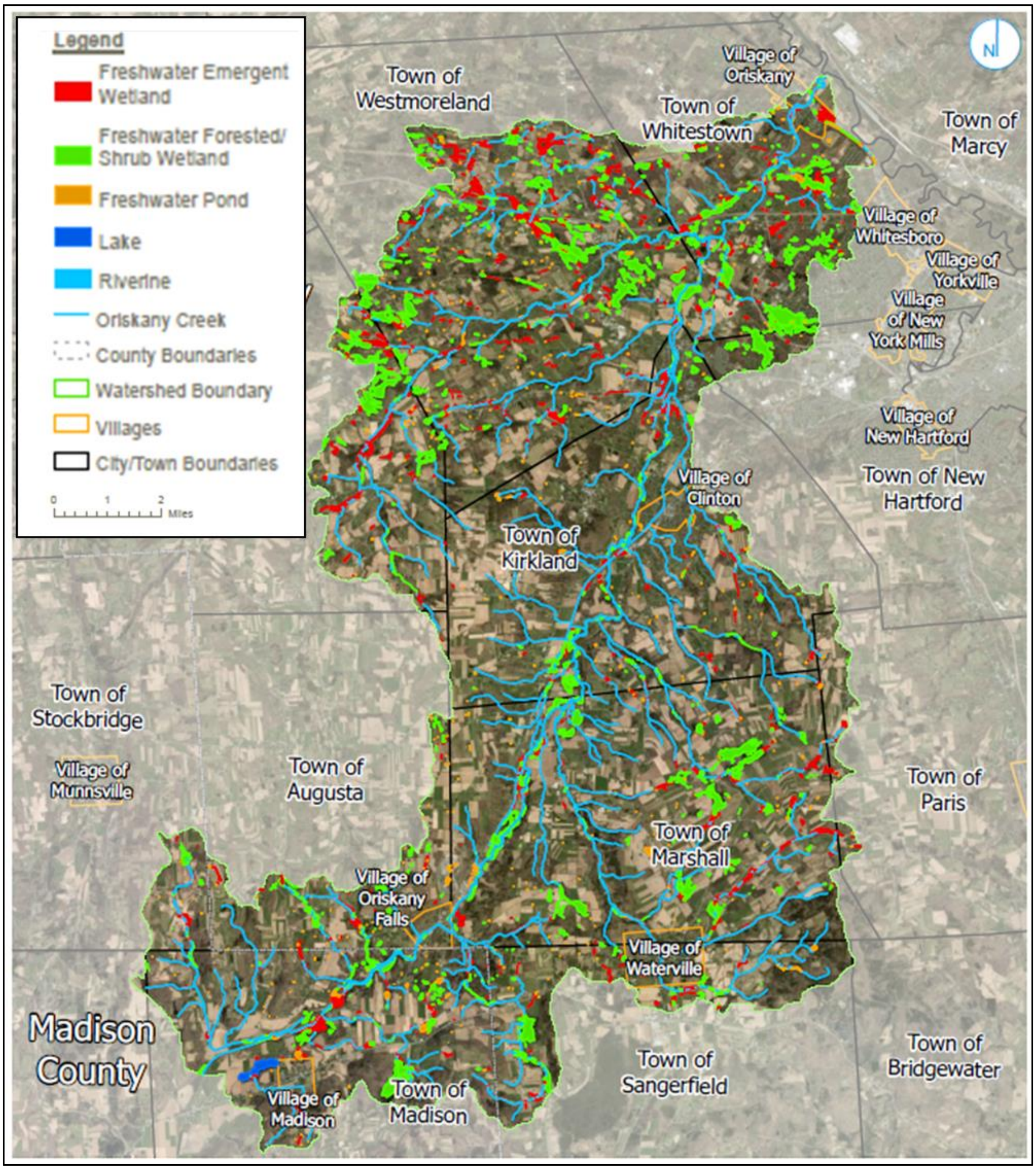


Figure 4-2. National Wetlands Inventory (NWI), Oriskany Creek Watershed, Oneida and Madison Counties, NY.

4.5 Sensitive Natural Resources

Sensitive natural resources are considered habitats that support endangered and threatened species. These natural resources include rare or high-quality wetlands, forests, grasslands, ponds, streams, and other types of habitats, ecosystems, and ecological areas. Threatened and endangered species are protected by both State (6NYCRR Part 182 and ECL 11-0535 for animals; 6NYCRR Part 193 and ECL 9-1503 for plants) and federal laws.

Areas designated as significant natural communities are mapped by the NYSDEC using the *Environmental Resource Mapper* web-application. The *Environmental Resource Mapper* is an interactive mapping application that can be used to identify natural resources and environmental features that are state or federally protected, or of conservation concern throughout the state. Based on the *Environmental Resource Mapper* data for Oriskany Creek, the watershed contains no significant natural communities and one area of rare plants and/or animals located in the Town of Madison (Figure 4-3; NYSDEC 2024a). The NYSDEC Regional Office should be contacted to determine the potential presence of any endangered and/or threatened species.

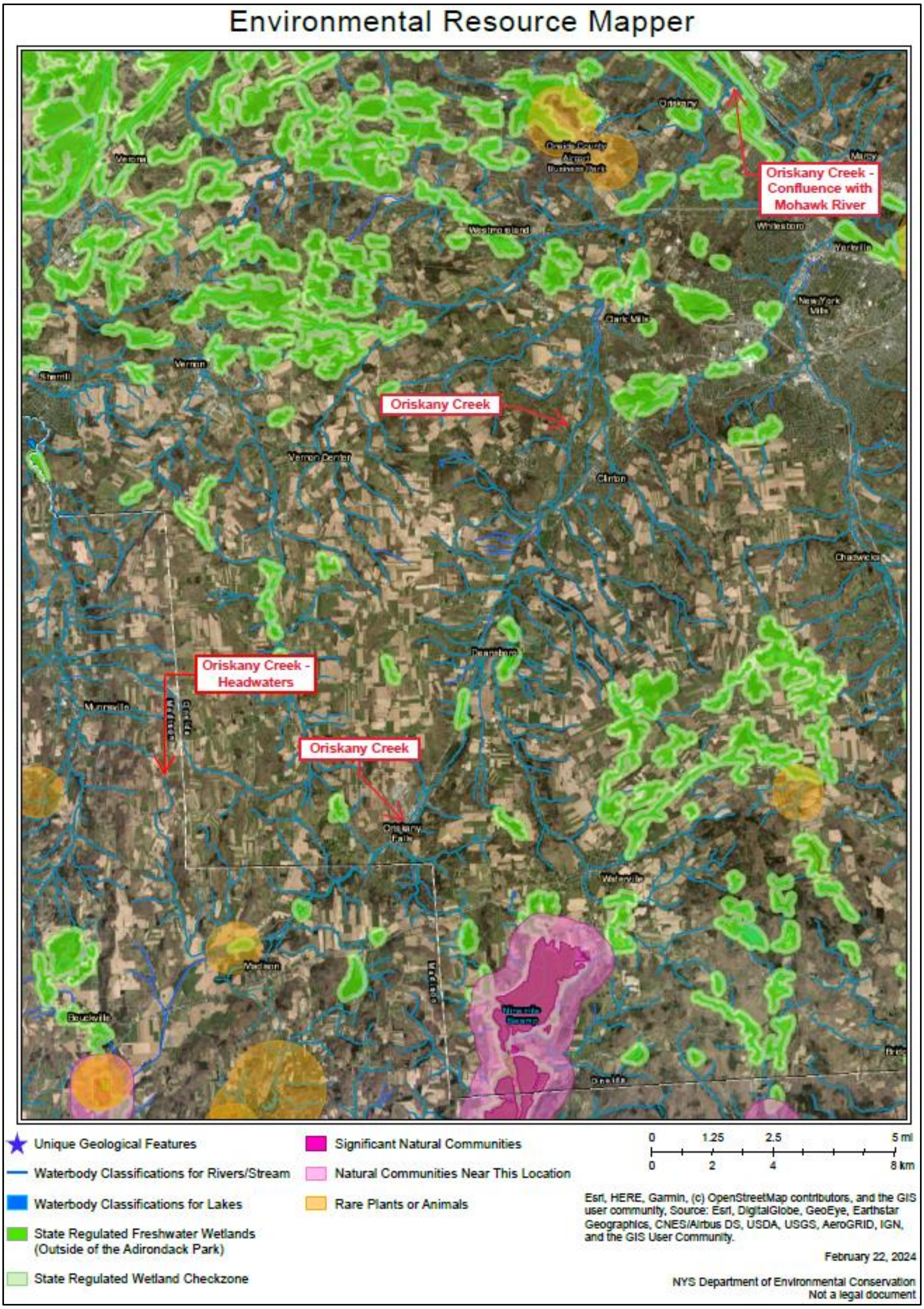


Figure 4-3. NYSDEC Environmental Resource Mapper for the Oriskany Creek Watershed.

In addition, the USFWS developed the *Information for Planning and Consultation* (IPaC) web-application that performs as a project planning tool and allows users to explore natural resources in specific locations, such as wetlands, wildlife refuges, GAP land cover, and other important biological resources and provides a streamlined environmental review process by following the IPaC Endangered Species Review process.

Based on the IPaC database, there is one endangered (Northern Long-eared Bat), one proposed threatened (Green Floater Clam), one candidate (Monarch Butterfly), one threatened species (American Hart's-tongue Fern), and no critical habitats, National Wildlife Refuge lands, or fish hatcheries within the Oriskany Creek watershed. There are 23 migratory birds that are of concern either because they are on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention, such as the Bald and Golden Eagles, which are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Table 3 lists the migratory bird species that either migrate over, nest, and/or breed within the Oriskany Creek watershed (USFWS 2024).

Table 3. USFWS IPaC Listed Migratory Bird Species

Source: USFWS 2024			
Common Name	**Scientific Name**	**Level of Concern**	**Breeding Season**
Bald Eagle	*Haliaeetus leucocephalus*	Non-BCC Vulnerable [1]	December – August
Belted Kingfisher	*Megaceryle alcyon*	BCC (BCR) [2]	March – July
Black-billed Cuckoo	*Coccyzus erythropthalmus*	BCC Rangewide (CON) [3]	May – October
Black-capped Chickadee	*Poecile atricapillus practicus*	BCC (BCR)	April – July
Blue-winged Warbler	*Vermivora pinus*	BCC (BCR)	May – June
Bobolink	*Dolichonyx oryzivorus*	BCC Rangewide (CON)	May – July
Canada Warbler	*Cardellina canadensis*	BCC Rangewide (CON)	May – August
Cerulean Warbler	*Dendroica cerulea*	BCC Rangewide (CON)	April – July
Chimney Swift	*Chaetura pelagica*	BCC Rangewide (CON)	March – August
Eastern Meadowlark	*Sturnella magna*	BCC (BCR)	April – August
Evening Grosbeak	*Coccothraustes vespertinus*	BCC Rangewide (CON)	May – August
Golden Eagle	*Aquila chrysaetos*	Non-BCC Vulnerable	January – August
Golder-winged Warbler	*Vermivora chrysoptera*	BCC Rangewide (CON)	May – July
Lesser Yellowlegs	*Tringa flavipes*	BCC Rangewide (CON)	N/A
Northern Saw-whet Owl	*Aegolius acadicus*	BCC (BCR)	March – July
Pectoral Sandpiper	*Calidris melanotos*	BCC Rangewide (CON)	N/A
Prairie Warbler	*Dendroica discolor*	BCC Rangewide (CON)	May – July
Prothonotary Warbler	*Protonotaria citrea*	BCC Rangewide (CON)	April – July
Red-headed Woodpecker	*Melanerpes erythrocephalus*	BCC Rangewide (CON)	May – September
Ruddy Turnstone	*Arenaria interpres morinella*	BCC (BCR)	N/A
Rusty Blackbird	*Euphagus carolinus*	BCC (BCR)	N/A
Short-billed Dowitcher	*Limnodromus griseus*	BCC Rangewide (CON)	N/A
Wood Thrush	*Hylocichla mustelina*	BCC Rangewide (CON)	May – August

[1] This is not a Bird of Conservation Concern (BCC) in this area but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

[2] This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA.

[3] This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska (CON).

4.6 Cultural Resources

Both the New York State Office of Parks, Recreation & Historic Preservation (NYSOPRHP) and United States National Park Service (NPS) maintain databases that include information on historic buildings, structures, objects, and districts. The Oriskany Creek watershed is located within the Mohawk Valley heritage corridor and contains 14 registered historic sites and parks. Consultation with NYSOPRHP should be performed to identify the potential presence of archeological resources and the subsequent need to perform a cultural resources investigation (NYSOPRHP 2024; NPS 2021). Table 4 lists the New York State Historic Sites and Park Boundaries and National Register of Historic Places sites. Figure 4-4 displays the locations of the historic sites and parks within the Oriskany Creek watershed.

Table 4. New York State Historic Sites and Park Boundaries and National Register of Historic Places Sites

Source: NYSOPRHP 2024; NPS 2021		
Name	**County**	**City**
Chenango Canal Summit Level	Madison	Bouckville and Vicinity
Clinton Village Historic District	Oneida	Clinton
Deansboro Railroad Station	Oneida	Deansboro
Edward W. Stanley Recreation Center	Oneida	Kirkland
First Congregational Free Church	Oneida	Oriskany Falls
Hamilton College Chapel	Oneida	Clinton
Norton, Rev. Asahel, Homestead	Oneida	Kirkland
Pleasant Valley Grange Hall	Oneida	Pleasant Valley
Root, Elihu, House	Oneida	Clinton
St. Mark's Church (Episcopal)	Oneida	Clinton
St. Paul's Episcopal Church and Cemetery	Oneida	Paris Hill
Tower Homestead and Masonic Temple	Oneida	Waterville
Vernon Center Green Historic District	Oneida	Vernon
Waterville Triangle Historic District	Oneida	Waterville

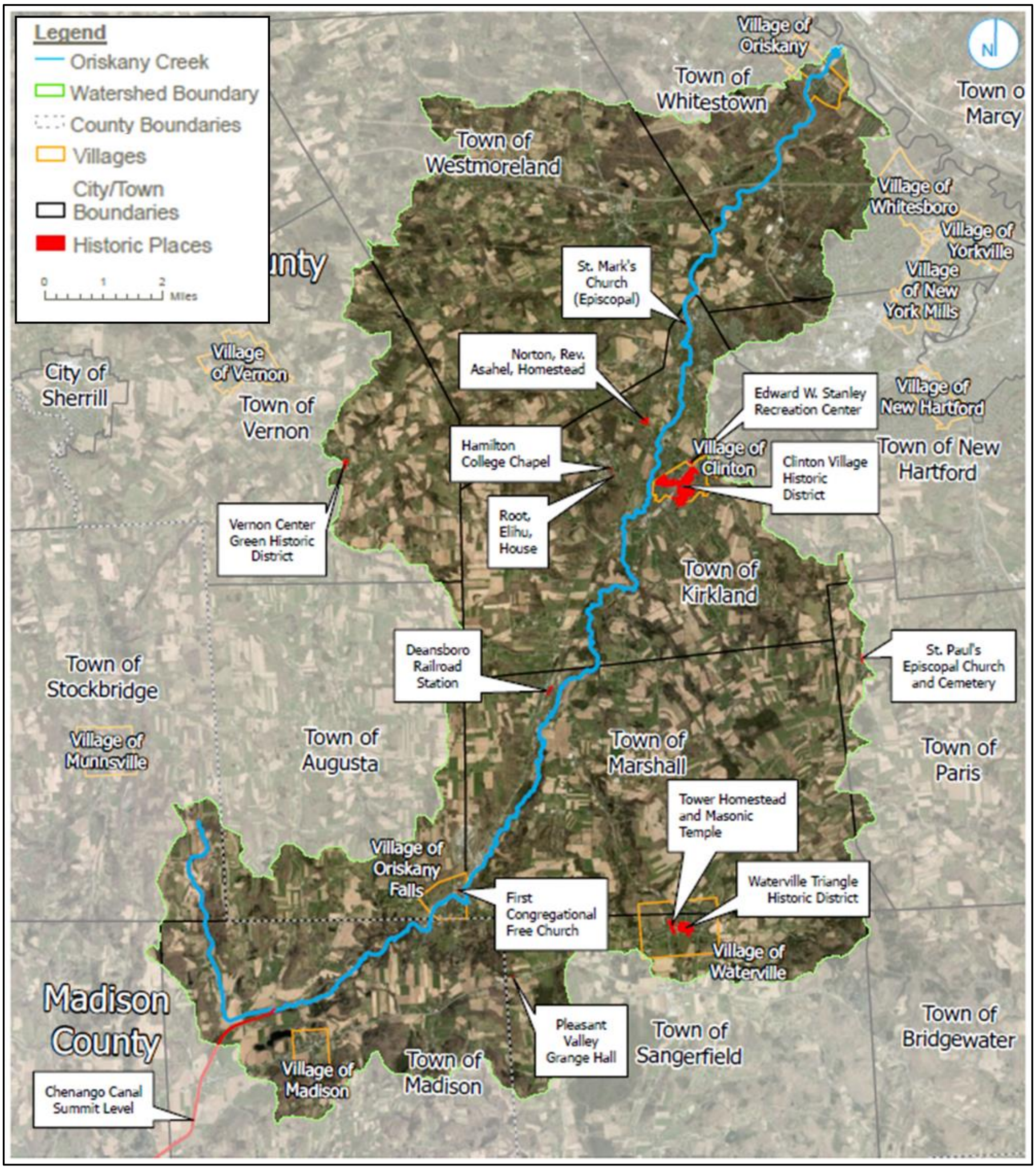


Figure 4-4. Register of Historic Places, Oriskany Creek, Oneida and Madison Counties, NY.

4.7 Land Use

The United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) cropland database provides consistent land cover data for the Oriskany Creek watershed starting in 2008 through 2023. Based on the land use data, a land cover analysis was performed to determine current land usage and changes in land use since 2008. Figure 4-5 displays the NASS land cover data for 2023. Table 5 is a summary table of land use by class, in acres, between 2008 and 2023 (NASS 2024).

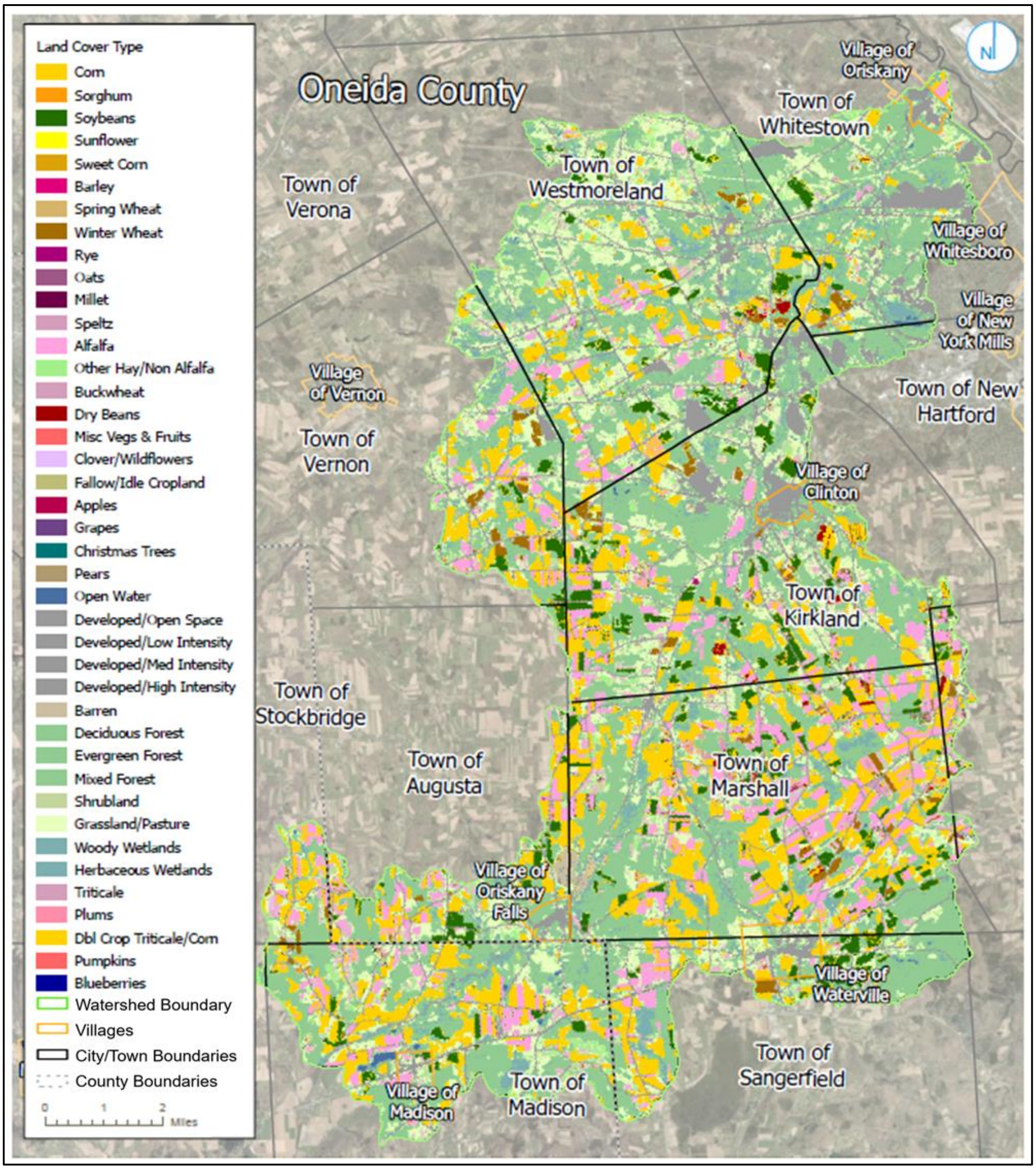


Figure 4-5. NASS Land Cover Data for the Oriskany Creek Watershed (2023).

Table 5. 2008 and 2023 Land Cover Comparison in the Oriskany Creek Watershed

Source: NASS 2024			
Land Cover Class	**2008 Area (acres)**	**2023 Area (acres)**	**Percent Change (%) ***
Agricultural	53,921	48,034	–11.5
Developed	5,658	9,848	+54.1
Forest/Shrubland	32,910	31,425	–4.6
Wetland	1,132	4,383	+117.9
Open Water	234	164	–34.8
Total	**93,854**	**93,854**	**0.0**

*Note: A positive percent difference indicates the land cover class increased in acreage since 2008, while a negative percent difference indicates the land cover class decreased in acreage since 2008.

The land cover analysis determined agricultural lands are the predominant land cover type in the Oriskany Creek watershed, however, there was a decrease of 11.5% in agricultural lands from 2008 to 2023. Agricultural lands have a significant impact on water quality and sediment deposition. Agricultural production practices have led to radically altered water flow regimes within agricultural watersheds. Modification of virgin (non-cultivated) land typically involves deforestation and drainage activities. In combination with cropping and grazing practices, these disruptions of the natural vegetation and soil resulted in the loss of the land's sediment filtering capacity. Compared to naturally vegetated, forested, and/or areas with stream buffers, surface runoff from rural and/or agricultural lands enter nearby waterways and contain large amounts of sediments, fertilizers, manure, etc., which negatively affects water quality and increases sediment loads in a waterway (NRC 1993).

Developed land in the Oriskany Creek watershed has increased by 54.1% since 2008 predominately in the middle to downstream reaches in the Towns of Kirkland and Whitestown. Developed areas consist of primarily impervious surfaces, which have significant effects on the hydrology of nearby waterways, including water quality, streamflow, and flooding characteristics. Impervious surfaces increase storm water discharge to waterways without stormwater management practices that are properly designed and maintained. Existing stormwater management practices base system designs and pipe sizes on historical precipitation data (i.e., rainfall and snow melt); however, system designs and pipe sizes should be considered under future climate change contexts and stormwater management practices should take into account "future" proofing systems (HOCCPP 1997). Figure 4-6 depicts the effect land cover changes can have over time with development in a waterway's natural floodplain.

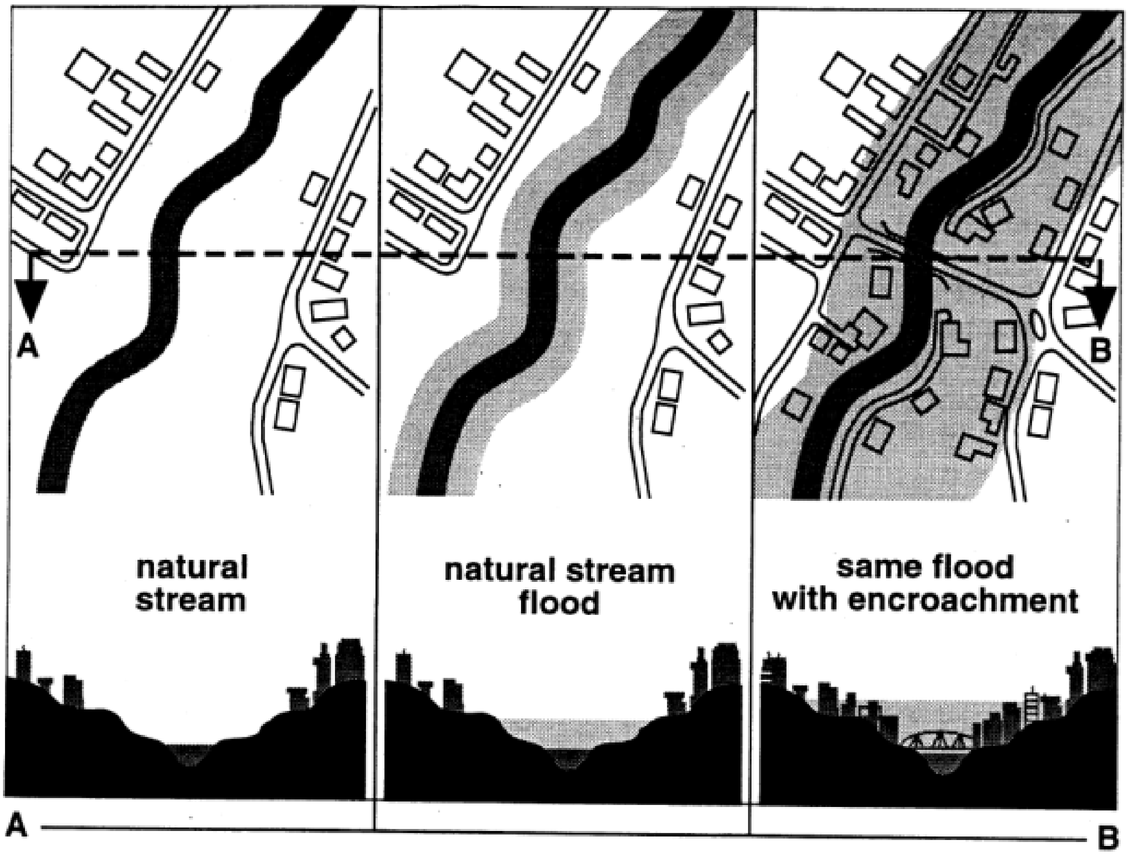


Figure 4-6. Effect of land cover changes due to development of a waterway's natural floodplain (HOCCPP 1997).

In addition, water quality can be affected through runoff, where precipitation falls on impervious surfaces or construction sites and transports sediments, debris, pollutants, etc. into nearby waterways. The timing of streamflow peaks can be affected by increased impervious surfaces by increasing the occurrence and intensity of peak streamflow's during precipitation events, as depicted in Figure 4-7. This, in turn, can affect the flooding characteristics of a waterbody when streamflow's that did not cause flooding in the past do cause flooding in areas that have been developed over time (HOCCPP 1997).

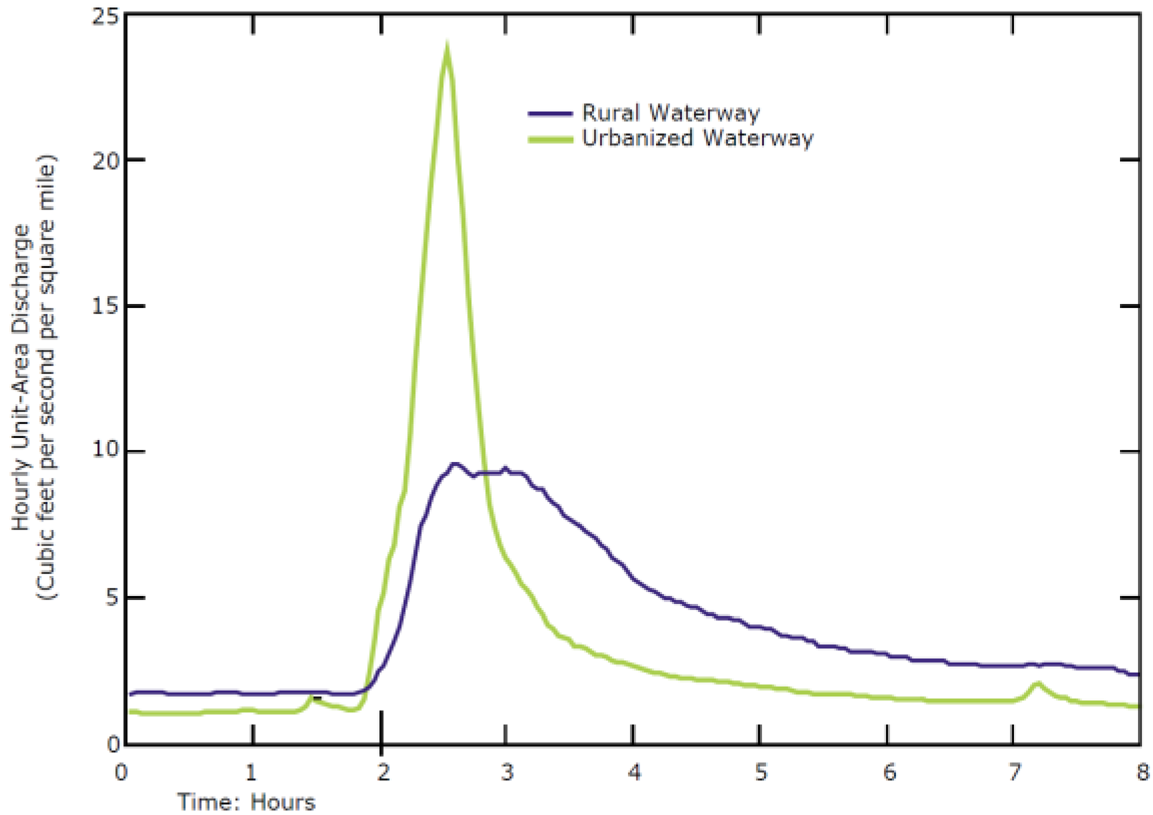


Figure 4-7. Idealized hydrograph comparing streamflow rates of a rural and urbanized waterway (adapted from USGS 2003).

The discharge of a waterway will vary greatly over time depending on the weather within its watershed. As a precipitation event begins, the discharge of a river will not instantaneously increase. It takes time for the rain to reach the river. The delay between when rainfall occurs and when the discharge of the river increases is known as lag time. Lag times will vary depending on characteristics of the watershed. Urbanized waterway basins tend to have large amounts of impermeable surfaces, such as roof tops and parking lots, which restrict infiltration into the soil. Surface runoff travels quicker to waterways, which produces higher discharges and increases the potential for flooding. Rural waterway basins, on the other hand, tend to have large, vegetated areas, which allow precipitation to infiltrate into the soil and travel towards waterways at a slower rate. As a result, discharges are lower and the potential for flooding is reduced (USGS 2003).

4.8 Hydrology

There is one USGS gage station along Oriskany Creek: USGS 01338000 Oriskany Creek near Oriskany, NY. The gage is located upstream of the Valley Road (CR-32) bridge crossing in the Town of Whitestown. The gage has been active since October of 2014 and has collected data for 10 consecutive years (USGS 2024).

Since the USGS gage on Oriskany Creek was in service for only a short period (i.e., 10 years of record), for the hydrologic analysis in this study, Oriskany Creek is considered to be an ungaged site. Thus, a Bulletin 17C gage analysis cannot be performed to estimate peak flows. Therefore, peak discharges were evaluated using two different methodologies: the FEMA FIS peak discharges and USGS *StreamStats* streamflow statistics. The effective FEMA FIS for Oneida County was released September 27, 2013; however, the most recent H&H analyses performed by FEMA for Oriskany Creek was completed between 1980 and 1984. The hydrologic analyses performed by FEMA used the standard log-Pearson Type III method based on a regional analysis of stream flow gages in central New York (FEMA 2013). Table 6 summarizes the FEMA FIS peak discharges for Oriskany Creek.

Table 6. FEMA FIS Peak Discharges for Oriskany Creek

Source: FEMA 2013						
Flooding Source and Location	**Drainage Area (mi^2)**	**River Station (ft)**	**Peak Discharges (cfs)**			
			10-percent	**2-percent**	**1-percent**	**0.2-percent**
At the confluence with the Mohawk River Reach 1	146	0+00	6,690	10,002	11,493	15,000
Upstream of Deans Creek	105.7	257+00	5,212	7,818	8,994	12,000
At the corporate limits of the Westmoreland/Town of Whitestown	102.75	307+50	5,610	7,785	8,700	11,000
At the corporate limits of the Town of Kirkland/Town of Westmoreland	95.17	379+50	6,030	9,210	10,820	14,400
Downstream of the confluence of St. Mary's Brook	94.38	444+50	5,995	9,150	10,750	14,300
Downstream of the confluence of White Creek	82.65	626+00	5,420	8,300	9,760	13,900
Downstream of the confluence of Turkey Creek	70.07	745+50	4,775	7,345	8,650	11,800
At the downstream corporate limits of the Town of Marshall/Town of Kirkland	58.56	859+50	3,750	5,200	5,850	7,350
Upstream of confluence with Big Creek	38.12	889+00	2,715	3,765	4,250	5,375
A point approximately 73 feet downstream of Hyning Road	34.04	1068+00	2,520	3,495	3,900	4,925
At corporate limits of Town of Marshall/Village of Oriskany Falls	29.6	1168+50	2,250	3,120	3,530	4,425

The USGS *StreamStats* v4.19.4 software is a map-based web application that provides an assortment of analytical tools that are useful for water-resources planning and management, and engineering purposes. Developed by the USGS, the primary purpose of *StreamStats* is to provide estimates of streamflow statistics for user selected ungaged sites on streams and for USGS stream gages, which are locations where streamflow data are collected (Ries et al. 2017, USGS 2023).

For ungaged sites, *StreamStats* relies on regional regression equations that were developed by statistically relating the streamflow statistics to the basin characteristics for a group of stream gages within a region. Estimates of streamflow statistics for an ungaged site can then be obtained by measuring its basin characteristics and inserting them into the regression equations. *StreamStats* delineates the drainage basin boundary for a selected site by use of an evenly-spaced grid of land-surface elevations, also referred to as a digital elevation model (DEM), and a digital representation of the stream network. Using this data, the application calculates multiple basin characteristics, including drainage area, main channel slope, and mean annual precipitation (Ries et al. 2017). Table 7 summarizes the USGS *StreamStats* streamflow statistics for Oriskany Creek.

Table 7. USGS *StreamStats* Streamflow Statistics for Oriskany Creek

Source: USGS 2023						
Flooding Source and Location	**Drainage Area (mi²)**	**River Station (ft)**	**Peak Discharges (cfs)**			
			10-percent	**2-percent**	**1-percent**	**0.2-percent**
At the confluence with the Mohawk River Reach 1	146	0+00	9,560	13,700	15,700	20,400
Upstream of Deans Creek	103	257+00	7,590	11,000	12,600	16,500
At the corporate limits of the Westmoreland/Town of Whitestown	101	307+50	7,690	11,100	12,800	16,800
At the corporate limits of the Town of Kirkland/Town of Westmoreland	95	379+50	7,280	10,500	12,200	15,900
Downstream of the confluence of St. Mary's Brook	92.4	444+50	7,140	10,300	11,900	15,600
Downstream of the confluence of White Creek	83.3	626+00	6,600	9,570	11,100	14,500
Downstream of the confluence of Turkey Creek	70.3	745+50	5,710	8,300	9,580	12,600
At the downstream corporate limits of the Town of Marshall/Town of Kirkland	58.9	859+50	4,980	7,260	8,390	11,000
Upstream of confluence with Big Creek	38	889+00	3,240	4,730	5,470	7,210
A point approximately 73 feet downstream of Hyning Road	33.7	1068+00	2,980	4,360	5,050	6,660
At corporate limits of Town of Marshall/Village of Oriskany Falls	29.5	1168+50	2,580	3,770	4,370	5,760

It should be noted that estimates of streamflow statistics that are obtained from regression equations are based on the assumption of natural flow conditions at the ungaged site (unless the reports that document the equations state otherwise). As such, human activities or disruptions to the natural flow conditions (e.g., dams, water withdrawals, etc.) can affect the regression-equation estimates and should be taken into consideration (Ries et al. 2017).

Using the standard error calculations from the regression equation analysis in *StreamStats*, an acceptable range at the 95% confidence interval for peak discharge values at the 10-, 2-, 1-, and 0.2% annual exceedance probability (AEP) flood hazards were determined. Standard error gives an indication of how accurate the calculated peak discharges are when compared to the actual peak discharges since about two-thirds (68.3%) of the calculated peak discharges would be within one standard error of the actual peak discharge, 95.4% would be within two standard errors, and almost all (99.7%) would be within three standard errors (McDonald 2014). Table 8 is a summary table of the USGS *StreamStats* standard errors at each AEP flood hazard.

Table 8. USGS *StreamStats* Average Standard Errors (in percent) for Hydrologic Region 6 Full Regression Equations

Source: USGS 2023							
	80-percent	**50-percent**	**20-percent**	**10-percent**	**2-percent**	**1-percent**	**0.2-percent**
Mean Standard Error (Percent %)	34.7	32.3	32.2	32.9	35.8	37.2	41.4

4.8.1 Bankfull Discharge

Bankfull discharge is defined as the flow that reaches the transition between the channel and its flood plain. Bankfull discharge is considered to be the most effective flow for moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphological characteristics of channels (Mulvihill et al. 2009).

The bankfull width and depth of Oriskany Creek is important in understanding the distribution of available energy within the channel and the ability of various discharges occurring within the channel to erode, deposit, and move sediment (Rosgen and Silvey 1996). Infrastructure where the bankfull width upstream of the structure exceeds the structure's length are particularly vulnerable to scour and bank destabilization.

StreamStats calculates bankfull statistics by using stream survey data and discharge records from 281 cross-sections at 82 streamflow-gaging stations in a linear regression analyses to relate drainage area to bankfull discharge and bankfull-channel width, depth, and cross-sectional area for streams across New York State. These equations are intended to serve as a guide for streams in areas of the same hydrologic region, which contain similar hydrologic, climatic, and physiographic conditions (Mulvihill et al. 2009). Table 9 summarizes the USGS *StreamStats* bankfull statistics at select locations along Oriskany Creek and its tributaries.

Table 9. USGS *StreamStats* Estimated Bankfull Discharge, Width, and Depth at Select Locations along Oriskany Creek

Source: USGS 2023				
Location	**River Station (ft)**	**Bankfull Depth (ft)**	**Bankfull Discharge (cfs)**	**Bankfull Width (ft)**
At the confluence with the Mohawk River Reach 1	0+00	5.2	3,180	126
Upstream of Deans Creek	257+00	4.59	2,360	107
At the corporate limits of the Westmoreland/Town of Whitestown	307+50	4.56	2,320	106
At the corporate limits of the Town of Kirkland/Town of Westmoreland	379+50	4.45	2,200	103
Downstream of the confluence of St. Mary's Brook	444+50	4.42	2,150	102
Downstream of the confluence of White Creek	626+00	4.24	1,960	97.6
Downstream of the confluence of Turkey Creek	745+50	3.99	1,700	90.5
At the downstream corporate limits of the Town of Marshall/Town of Kirkland	859+50	3.73	1,450	83.5
Upstream of confluence with Big Creek	889+00	3.17	986	68.1
A point approximately 73 feet downstream of Hyning Road	1068+00	3.04	886	64.5
At corporate limits of Town of Marshall/Village of Oriskany Falls	1168+50	2.9	788	60.6

4.9 Infrastructure

According to the NYSDEC Inventory of Dams dataset, there are five dams along Oriskany Creek as identified by the NYSDEC. Three of the dams are purposed as "Hydroelectric," while the other two are listed as "Other." Three dams have a hazard class of A, while there is one dam with a classification of B and one with a classification of 0. Class "A" dams are considered low hazard where "a dam failure is unlikely to result in damage to anything more than isolated or unoccupied buildings, undeveloped lands, minor roads such as town or county roads; is unlikely to result in the interruption of important utilities, including water supply, sewage treatment, fuel, power, cable or telephone infrastructure; and/or is otherwise unlikely to pose the threat of personal injury, substantial economic loss or substantial environmental damage." Class "B" dams are considered intermediate hazards where "a dam failure may result in damage to isolated homes, main highways, and minor railroads; may result in the interruption of important utilities, including water supply, sewage treatment, fuel, power, cable or telephone infrastructure; and/or is otherwise likely to pose the threat of personal injury and/or substantial economic loss or substantial environmental damage and where loss of human life is not expected." Class 0 dams have not been assigned hazard codes (NYSDEC 2024b).

In addition, the Chenango Canal Summit Level empties into Oriskany Creek in the Town of Madison near Bouckville. All that remains of the former canal crossing is the canal prism, towpath, and a pair of stone bridge abutments (Ramboll 2023a). Table 10 lists the dams and weirs that are along Oriskany Creek, including hazard codes and purpose for the dam.

Table 10. Inventory of Dams along Oriskany Creek

Source: NYSDEC 2024b						
Municipality	**State ID**	**Structure Name**	**Owner**	**River Station (ft)**	**Hazard Code**	**Purpose**
Town of Whitestown	115-0864	Waterburys Dam	Private	106+00	A	Other
Town of Whitestown	115-0873	Clark Mills Dam	Private	430+00	B	Other
Village of Oriskany Falls	116-0895	Hatheway & Reynolds Dam	N/A	1205+00	0	Hydroelectri c
Village of Oriskany Falls	116-0896	E C Hambun Co Dam	N/A	1220+00	A	Hydroelectri c
Town of Madison	104-0923	Madison Power Co Dam	Private	1440+00	A	Hydroelectri c

There are culverts classified by the NYSDOT as "large" along Oriskany Creek. A large culvert is defined by the NYSDOT as a structure that has an opening measured perpendicular to its skew that is greater than or equal to 5 feet and measured along the centerline of the roadway that is less than or equal to 20 feet (NYSDOT 2023a). In total, there are 34 structures (bridges, culverts, and railroads) that cross Oriskany Creek. Table 11 lists the identification numbers, owners, and structural characteristics of the hydraulic structures along Oriskany Creek (NYSDOT 2023a; NYSDOT 2023b). Figure 4-8 displays the locations of the hydraulic structures crossing Oriskany Creek.

Table 11. Infrastructure Crossing Oriskany Creek

Source: NYSDOT 2023a; NYSDOT 2023b; Ramboll 2023a							
Structure Type	**Roadway Carried**	**ID (BIN)**	**Structure Owner**	**River Station (ft)**	**Width[1] (ft)**	**Span/Length[2] (ft)**	**Diameter/Height[3] (ft)**
Railroad Bridge	CSX Railroad	-	CSX Transportation, Inc.	41+00	58	60	-
Bridge	NY-69/Oriskany Street	1060220	NYSDOT	50+50	40	112	-
Bridge	Utica St	2206300	Town of Whitestown	53+00	32	104	-
Bridge	Valley Rd	3311410	Oneida County	120+50	30	131	-
Bridge	CR-840/Judd Rd	3311420	Oneida County	151+50	32	76	-
Bridge	Old Judd Rd	2206270	Town of Whitestown	183+50	24	106	-
Bridge	Interstate-90	5513069	NYS Thruway Authority	198+00	138	212	-
Bridge	Stone Rd	3311430	Oneida County	272+50	28	95	-
Bridge	Peckville Rd	2205430	Town of Whitestown	304+00	28	70	-
Railroad Bridge	Abandon Railroad	-	-	380+50	12	100	-
Bridge	CR-19/Main St	3310690	Oneida County	385+50	38	82	-
Bridge	NY-5	1002200	NYSDOT	455+50	66	100	-
Bridge	CR-15A/Norton Ave	2205770	Town of Kirkland	537+00	30	74	-
Bridge	NY-412/College St	1047960	NYSDOT	583+50	58	107	-
Bridge	NY-12B	1009890	NYSDOT	665+00	36	66	-
Bridge	Dugway Rd	3311480	Oneida County	702+50	28	84	-
Bridge	Lumbard Rd	3311470	Oneida County	725+00	32	74	-
Bridge	NY-315	1045640	NYSDOT	897+00	40	157	-
Bridge	Burnham Rd	3310840	Oneida County	991+50	28	67	-
Bridge	Van Hyning Rd	2205880	Town of Marshall	1046+00	24	34	-
Bridge	Broad St	3310820	Oneida County	1162+50	34	90	-
Bridge	Cassidy St	3310420	Oneida County	1177+50	30	41	-

Source: NYSDOT 2023a; NYSDOT 2023b; Ramboll 2023a							
Structure Type	**Roadway Carried**	**ID (BIN)**	**Structure Owner**	**River Station (ft)**	**Width[1] (ft)**	**Span/Length[2] (ft)**	**Diameter/Height[3] (ft)**
Bridge	Madison St	1009870	NYSDOT	1181+00	38	60	-
Bridge	Division St	2205370	Town of Augusta	1188+50	30	56	-
Bridge	Water St	2308900	Madison County	1390+00	28	33	-
Bridge	CR-41/Solsville Rd	3308890	Madison County	1440+00	24	36	-
Culvert (Box)	Canal Rd	-	Madison County	1467+50	28	18	6
Culvert (Pipe)	Elm St	-	Town of Madison	1495+00	44	-	8
Culvert (Pipe)	Fuess Rd	-	Town of Madison	1547+00	32	-	6
Culvert (Box)	Cole St (3)	-	Madison County	1550+00	70	10	6
Culvert (Pipe)	Strip Rd	-	Town of Stockbridge	1665+00	42	-	7
Culvert (Box)	Cole St (2)	-	Madison County	1668+00	43	7	7
Culvert (Arch)	Cole St	-	Madison County	1685+00	68	11	6

[1] Note: Width refers to bridge deck measurement parallel to stream flow/channel.

[2] Note: Span/length refers to bridge structure measurement perpendicular to stream flow/channel.

[3] Note: Diameter refers to the diameter of a pipe culvert, while Height refers to the height from the bottom of channel to the low chord of a bridge or arch/box culvert.

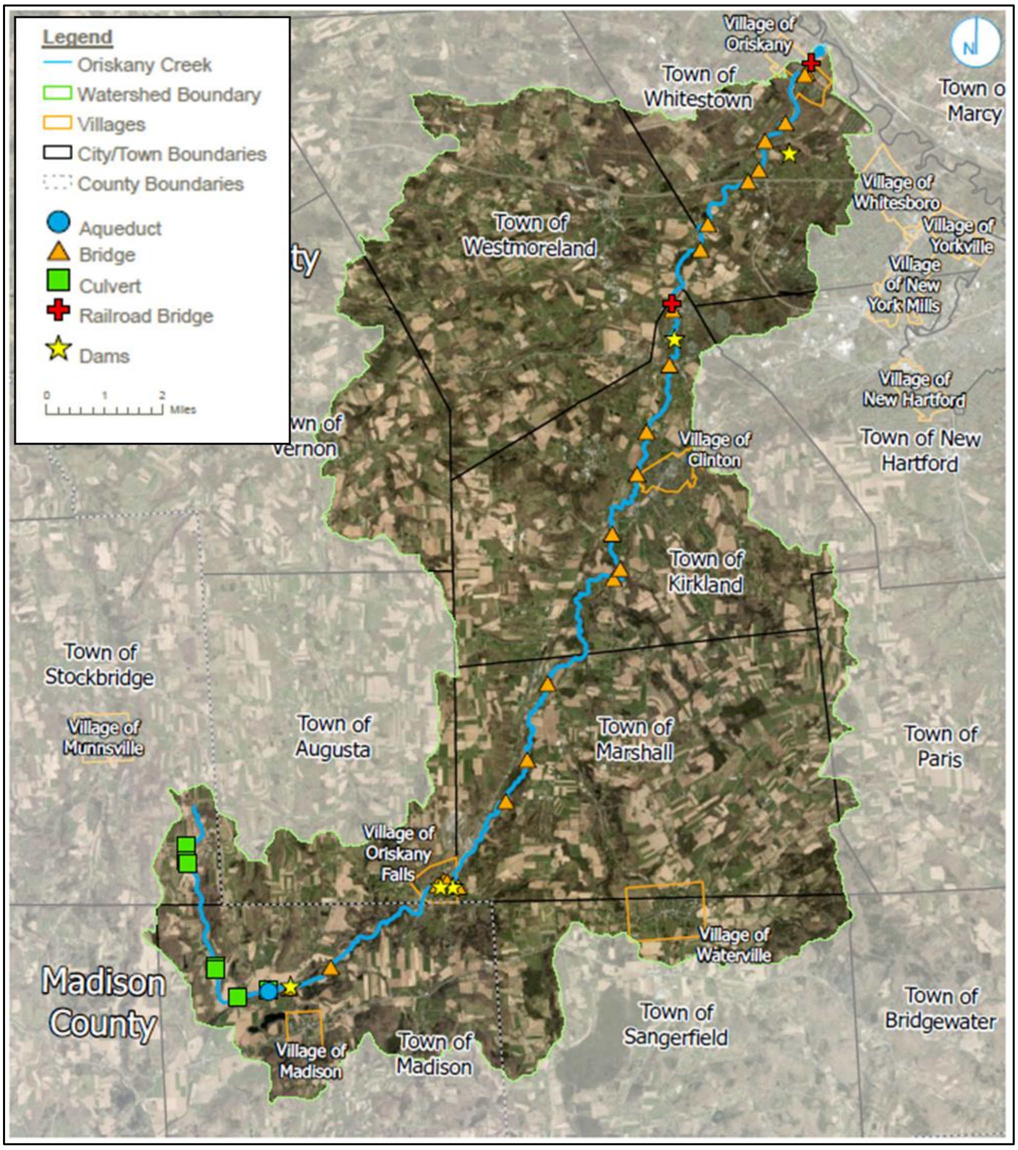


Figure 4-8. Infrastructure locations crossing Oriskany Creek, Oneida and Madison Counties, NY.

Due to safety concerns and limited access, field staff were unable to perform measurements on some of the waterway crossing structures. For these structures, publicly available structural measurements were obtained from various sources. However, if no public data was available, a combination of orthoimagery and GIS spatial analysis tools were used to approximate structural measurements.

4.9.1 Hydraulic Capacity

Hydraulic capacity is the measure of the amount of water that can pass through a structure or watercourse. Exceeding the hydraulic capacity of a structure can cause significant flooding and damages to surrounding areas, so hydraulic design is essential to the structures that cross waterways in any watershed (Zevenbergen et al. 2012). In assessing hydraulic capacity of the culverts and bridges along Oriskany Creek, the FEMA FIS profiles in the Village of Oriskany Falls and Oriskany and Towns of Marshall, Kirkland, Westmoreland, and Whitestown were used to determine the lowest annual chance flood elevation to flow under the low chord of a bridge or culvert, without causing an appreciable backwater condition upstream.

In New York State, hydraulic and hydrologic regulations for bridges and culverts were developed by the NYSDOT. The NYSDOT guidelines require a factor of safety for bridges that cross waterways, known as freeboard. Freeboard is the additional capacity, expressed as a distance in feet, in a waterway above the calculated capacity required for a specified flood level, usually the Base Flood Elevation (BFE; also referred to as the 1% AEP or 100-year flood). The purpose of freeboard is to compensate for the unknown variables that contribute to flood heights being greater than the calculated flood levels of a waterway, such as wave action, minor silt and debris deposits, the hydrological effect of urbanization of the watershed, etc. However, freeboard is not intended to compensate for higher flood levels expected under projected climatic change conditions, such as increases due to sea-level rise or cloudburst precipitation events (NYSDEC 2020). Table 12 displays the 1% AEP (100-year recurrence interval) water surface elevations (WSELs) and freeboard height (feet) at infrastructure locations using the FEMA FIS profiles for Oriskany Creek.

Table 12. FEMA FIS 1% AEP Flood Elevations and Freeboard Values for Infrastructure Along Oriskany Creek

Source: FEMA 1982; FEMA 1983; FEMA 2013				
Infrastructure Name	**River Station (ft)**	**1% AEP WSEL (ft NAVD88)**	**2% AEP WSEL (ft NAVD88)**	**Freeboard for 2% AEP (ft)**
CSX Railroad	41+00	418.5	418.0	0.0
NY-69/Erie Blvd	50+50	422.5	421.0	5.5
Utica St	53+00	425.25	423.75	1.25
Valley Rd	120+50	440.5	439.75	4.0
CR-840/Judd Rd	151+50	453.0	452.5	22.5
Old Judd Rd	183+50	455.75	455.0	5.5
Interstate-90	198+00	458.5	457.5	6.5
Stone Rd	272+50	477.0	476.5	–1.0
Peckville Rd	304+00	486.75	486.5	6.0
Abandon Railroad	380+50	511.0	510.5	2.5
CR-19/Main St	385+50	515.5	514.5	–5.0
NY-5	455+50	529.75	529.5	–0.5
CR-15A/Norton Ave	537+00	563.0	563.0	0.5
NY-412/College St	583+50	585.0	584.5	–1.5
NY-12B	665+00	627.5	627.0	–2.0
Dugway Rd	702+50	648.0	647.5	4.0
Lumbard Rd	725+00	665.5	665.0	–5.0
NY-315	897+00	755.75	755.5	–1.5
Burnham Rd	991+50	825.25	825.0	–0.5
Van Hyning Rd	1046+00	865.75	865.5	–2.5
Broad St	1162+50	944.0	943.5	–1.5
Cassidy St	1177+50	962.5	962.0	–2.0
Madison St	1181+00	984.5	984.0	–4.0
Division St	1188+50	985.0	984.5	–3.5
Water St **	1390+00	1083.0 **	1082.5 **	0.5
CR-41/Solsville Rd **	1440+00	1118.75 **	1118.25 **	1.0
Canal Rd ***	1467+50	N/A	N/A	N/A
Elm St ***	1495+00	N/A	N/A	N/A
Fuess Rd ***	1547+00	N/A	N/A	N/A
Cole St (3) ***	1550+00	N/A	N/A	N/A
Strip Rd ***	1665+00	N/A	N/A	N/A
Cole St (2) ***	1668+00	N/A	N/A	N/A
Cole St ***	1685+00	N/A	N/A	N/A

* Note: Negative freeboard heights indicate overtopping and are measured from the computed water surface elevation down to the low chord of a bridge. Positive freeboard heights indicate flow passes through the structure and are measured from the computed water surface elevation up to the low chord of a bridge.

** Note: Water Street and Solsville Road (CR-41) profiles from the Town of Madison FIS (1982) reported water surface elevations in NGVD29.

*** Note: No data was available from the FEMA FIS reports for these structures.

According to the NYSDOT Bridge Manual (2021) for Oneida and Madison Counties (Region 2), new and replacement bridges are required to meet certain standards, which include (NYSDOT 2021a):

- The proposed low chord shall not be lower than the existing low chord.
- A minimum of 2’-0” of freeboard for the projected 2% ACE (50-yr flood) is required for the proposed structure. The freeboard shall be measured at the lowest point of the superstructure between the two edges of the bottom angle for all structures.
- The projected 1% ACE (100-yr flood) flow shall pass below the proposed low chord without touching it.
- The maximum skew of the pier to the flow shall not exceed 10 degrees.
- Critical bridges freeboard shall be increased to 3’-0”.

For culverts, the NYSDOT guidelines require designs to be based upon an assessment of the likely damage to the highway and adjacent landowners from a given flow, and the costs of the drainage facility. The design flood frequency for drainage structures and channels is typically the 2% AEP (50-year) flood event for Interstates and other Freeways, Principal Arterials, and Minor Arterials, Collectors, Local Roads, and Streets. If the proposed highway is in an established regulatory floodway or floodplain, then the 1% AEP (100-year) flood event requirement must be checked (NYSDOT 2021b).

Based on the freeboard analysis, nearly all the bridges and culverts along Oriskany Creek fail to meet the freeboard requirements. The structures that meet or exceed current freeboard requirements are Dugway Road and the Abandoned Railroad in the Town of Kirkland, Interstate-90, Old Judd Road, Judd Road (CR-840), and Valley Road in the Town of Whitestown, and Erie Boulevard (NY-69) in the Village of Oriskany.

5. Sediment Characteristics in Streams

A detailed discussion of sediment characteristics and transport in waterways can be found in Appendix A.

5.1 Sediment and Debris Transport in Streams

Transport of sediment and debris in streams is predominantly controlled by sediment transport capacity, sediment physiochemical characteristics, and supply rate. Larger sediments and debris generally experience more episodic movement and rely on larger more powerful flows for transport, which occur less frequently, while smaller sediments generally move more continuously and within a shorter time scale (USEPA 2009a).

Several hydraulic and geomorphologic factors determine stream transport capacity including channel width, flow depth and cross-sectional geometry, bed slope and roughness, and discharge velocity and volume. In general, the more turbulent energy available for suspension and mobilization of sediment, the greater the sediment transport capacity per unit of stream width, and the larger the size of sediment particles that can be moved (USEPA 2009a).

Oriskany Creek, like most streams in NY, possesses a strong seasonal discharge cycle with spring discharge volumes typically many times larger than those of late summer and autumn flows. Intense or prolonged rainfall events can also generate flood pulses of hourly to daily duration, which often have significant turbulent energy. Movement of sediments varies with time for most stream systems. As a result, the majority of sediment flux in a given year may occur over a relatively short period of time, such as during a single flood event. Between such events, sediments are usually stored within the channel and/or overbank areas (USEPA 2009a).

Erosion and deposition of sediments within a stream network also exhibits spatial patterns strongly related to stream morphology (i.e., erosion on the outside bend and deposition on the inside bend of a meander). Reaches with smaller cross-sectional flow area, steeper slopes, and higher flow velocities discourage the deposition of sediments. These traits tend to be characteristic of smaller streams or in the upper elevation catchments often at the headwaters of larger watersheds. By contrast, Oriskany Creek exhibits a wider channel with lower bed slopes and flow velocities, which act as regions of relative sediment deposition. Channel bottoms tend to be covered with finer sediments with some areas containing exposed rocks, boulders, and gravels in the channel beds of higher energy sections of Oriskany Creek. Natural sediment deposition is more characteristic of channels at lower elevations in a watershed (USEPA 2009a).

Hydraulic and geomorphologic variables provide one set of controls on sediment transport capacity. Sediment transport is also regulated by the rate and quality of sediment supply (Julien 1995). Sediment supply can outpace, match, or fall below the ability of a channel to transport it. Within a particular reach, sediment fluxes can originate from land surface erosion, streambank erosion, upstream reach sediment input, or remobilization of sediments previously deposited within the reach. Channels whose sediment supplies outpace their transport capacity will accumulate sediments. The size of a channel can decrease as sediments accumulate, increasing the likelihood of flooding and other overbank flow events. Channels with sediment supplies falling below transport capacity will work to mobilize additional material from channel beds and banks. In all streams, sediments are preferentially deposited in regions of low-energy flow, including pools and the inside of bends (Chapra 1997). If sufficient quantities of sediment are deposited, the deposition features can alter channel morphology and flow patterns, obstruct flow, and exacerbate flood events (USEPA 2009a).

Individual sediment deposits are often not permanent features since they can be scoured and moved downstream during major flow events. Streams can also flow outside their normal channels during major flow events and deposit sediments on low-lying areas adjacent to the channel such as banks, floodplains, and terraces. These sediments, in addition to lose debris, may at a later time be remobilized during an even larger flow event (USEPA 2009a).

5.2 Sediment Transport Modeling Variables

There are four major variables when modeling sediment transport: velocity, shear stress, invert change, and mass bed load. Each variable can significantly affect sediment transport results.

Velocity, created by flowing water, is a very important mechanism for erosion, transportation and deposition of sediments. Water flow in a stream is primarily related to the stream's friction slope, but it is also controlled by the geometry of the stream channel. Water flow velocity is decreased by friction along the stream bed, so it is slowest at the bottom and edges and fastest near the surface and in the middle. In addition, the velocity just below the surface is typically a little higher than right at the surface because of weak friction between the water and the air. On a meandering section of a stream, flow is fastest on the outside of the bend and slowest on the inside of the bend, which creates a secondary flow that rotates in a counterclockwise direction (Figure 5-1).

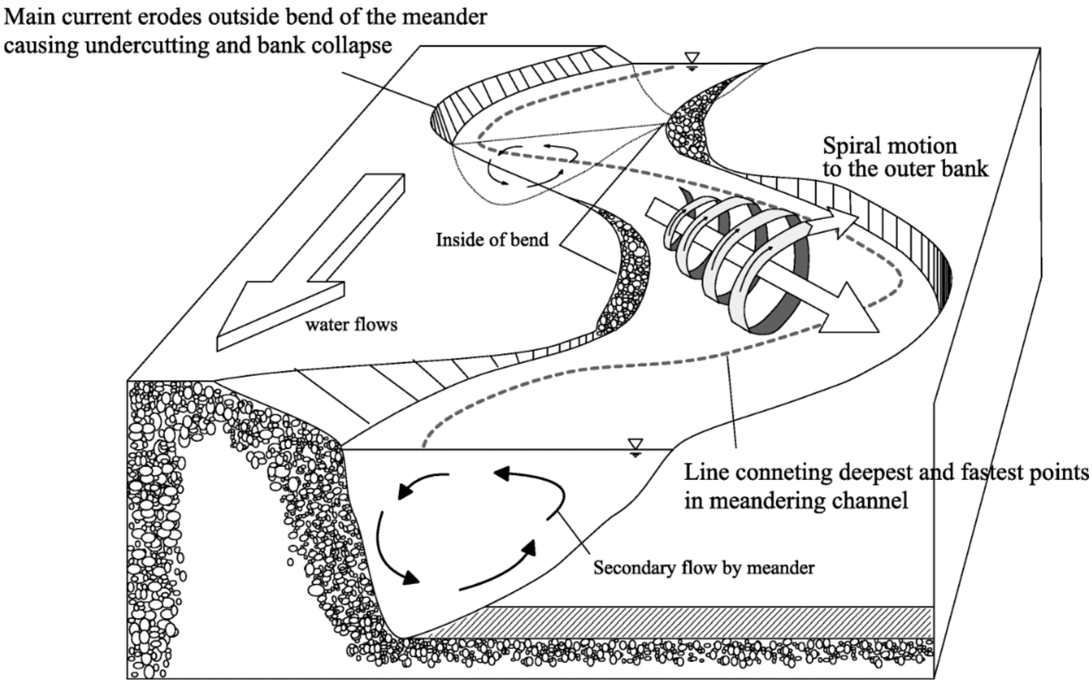


Figure 5-1. Movement of water through a meandering stream (Park and Ahn 2019).

This secondary current erodes and re-suspends sediments on the creek bed and carries the suspended sediments towards the inside of the bend depositing them in the lower velocity zone near the interior bend of the meander (Park and Ahn 2019). Other factors that affect velocity are the size of sediments on the stream bed and the discharge, or volume, of water. Smaller particles may rest on the stream bed where they can be moved by saltation and traction or they can also be held in suspension in the flowing water, especially at higher velocities. Streams that flow fast tend to be turbulent and the water may be muddy, while those that flow more slowly tend to have laminar flow and clear water. Turbulent flow is more effective than laminar flow at keeping sediments in suspension and transporting suspended sediments downstream (Earle 2019).

Shear stress is the parameter often used as a measure of the stream's ability to entrain bed material, which is created by the friction from water acting on the bed material. Generally, shear stress acts in the direction of the flow in a uniform channel as it slides along the channel bed and banks. Within a natural stream channel, shear stress is spatially distributed and is necessary to evaluate many important hydraulic characteristics, such as bed roughness, sediment and non-mixing pollutant transport, riverbank stability, flood defense and river management (Ardıçlıoğlu et al. 2011; VTANR 2004). A given particle will move only when the shear stress acting on it is greater than the resistance of the particle to movement. The resistance of the particles to movement and thus its entrainment will vary depending on its size, shape, its size relative to surrounding particles, how it is oriented and the degree to which it is embedded. The size of the particle will influence the weight of the particle, while the shape will influence the flow pattern and resistance around the particle. Turbulence can result in shear stress spikes that are four times greater than the average shear stress. Thus, a particle exposed to turbulence will experience greater fluid force than a particle not exposed to the turbulence (VTANR 2004).

The invert change is defined as the total change in the lowest elevation of a cross-section over time. Change in the invert elevation is determined by calculating the difference between the lowest station-elevation point between the bank stations of a given cross-section over the time interval. Invert changes are used to identify areas of deposition and erosion along a cross-section. When the invert change is positive, deposition has occurred since the elevation has increased over time. In contrast, if the invert change is negative, then erosion has occurred since the elevation has decreased over time (USACE 2024).

6. Watershed Assessment Methodology

6.1 Data Collection

A public engagement meeting was held on November 16, 2023, with representatives of Ramboll Americas Engineering Solutions, Inc. (Ramboll), NYSDEC, NYSDOT, Oneida County Department of Planning, Oneida County Soil and Water Conservation District, Village of Clinton, and other local stakeholders (Appendix B). At the meeting, project specifics including background, purpose, funding, roles, and timelines were discussed. Discussions involved a variety of topics, including:

- Firsthand accounts of sediment issues along Oriskany Creek
- Identification of the primary sediment management concerns
- Identification of specific areas that aggregate/erode sediment
- Discussion of past and/or planned mitigation projects
- Discussion of potential mitigation strategies

In addition, a questionnaire was electronically distributed to each attendee and other stakeholders who did not attend the meeting. This questionnaire solicited information including existing or planned mitigation projects, known areas with flooding/sediment/erosion issues, past flood events, and recommended mitigation projects (Appendix C). This outreach effort assisted in the identification of high-risk areas, which were the focus of the field investigations and sediment management plan.

Hydrological and meteorological data were obtained from readily available state and federal government databases, including orthoimagery, flood zone maps, streamflow, and precipitation. Stream survey reports, newspaper articles, social media posts, and geographic information system (GIS) software were used in conjunction with information from the public engagement meeting to identify sediment concerns and identify high-risk areas. These studies and data were obtained and used, all or in part, as part of this effort.

There is only one existing H&H model available from FEMA for Oriskany Creek; however, the effective FEMA model was developed between 1980 and 1984 and was in the outdated HEC-2 paper format (FEMA 2013). As a result, an updated HEC-RAS model was developed for this study.

Following the data gathering and engagement meeting, field staff from Ramboll undertook field data collection efforts with special attention given to high-risk areas along Oriskany Creek as identified in the data collection process. Initial field assessments of Oriskany Creek were conducted on October 31 - November 1, 2023, with a second field investigation occurring on July 29, 2024. Information collected during field investigations included the following:

- Rapid "windshield" hydrologic corridor inspection
- Photo documentation of inspected areas
- Measurement and rapid hydraulic assessment of bridges, culverts, and/or dams
- Survey data was obtained at select locations by project staff during the second field investigation and used to inform and update the H&H model
- Geomorphic classification and assessment, including measurement of bankfull channel widths and depths at key cross sections
- Wolman pebble counts
- Characterization of key stream bank failures, head cuts, bed erosion, aggradation areas, and other unstable stream channel features
- Preliminary identification of potential mitigation areas and alternatives, including those requiring further analysis

Appendix C is a summary listing of data and reports collected. Appendix D includes copies of the field work materials including the Stream Channel Classification Form, Field Observation Form for the inspection of hydraulic structures, Wolman Pebble Count Form, location map of where field work was completed, and a photo log of select locations along Oriskany Creek. The collected data was categorized, summarized, indexed, and spatially located within a GIS database. This GIS database will be made available to the NYSDEC upon completion of the project.

6.2 Survey Data

Survey data was collected at the upstream face for 20 of the 30 structures measured. This survey data will be used in the development of an updated existing conditions hydrologic and hydraulic (H&H) model for Oriskany Creek. Appendix D contains the raw survey data collected for Oriskany Creek.

Survey data was collected using the Arrow Gold global navigation satellite system (GNSS) developed by Eos Positioning Systems, Inc. The Arrow Gold is a global positioning system (GPS) based survey equipment with a horizontal and vertical accuracy of 2 centimeters (1 inch) or better (Eos Positional Systems, Inc. 2015).

Survey points were recorded for each major feature of the stream channel: edge of bank, edge of water, thalweg, and any significant changes in depth. Figure 6-1 displays an example cross-section surveyed for CR-15A/Norton Avenue.

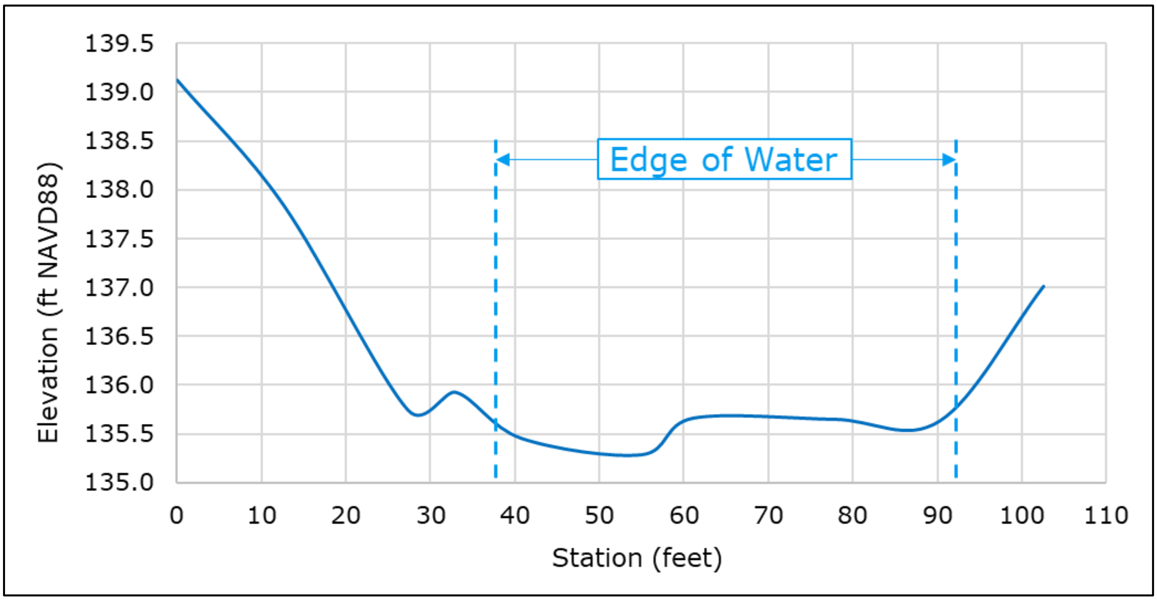


Figure 6-1. Example survey cross-section at CR-15A/Norton Avenue bridge.

6.3 Flood Mitigation Analysis (Hydraulic Modeling)

Hydraulic analysis of Oriskany Creek was conducted using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) model software. The HEC-RAS computer program is considered to be the industry standard for riverine flood analysis. HEC-RAS version 6.5 was used for this study (USACE 2023).

The HEC-RAS model is used to compute water surface profiles for 1- and 2-Dimensional (2-D), steady-state, or time-varied (unsteady) flow. In 1-Dimensional (1-D) solutions, the water surface profiles are computed from one cross section to the next by solving the one-dimensional St. Venant equation with an iterative procedure (i.e., standard step backwater method). Energy losses are evaluated by friction (Manning's Equation) and the contraction/expansion of flow through the channel. The momentum equation is used in situations where the water surface profile is rapidly varied, such as hydraulic jumps, mixed-flow regime calculations, hydraulics of dams and bridges, and evaluating profiles at a river confluence (USACE 2016).

A 1-D HEC-RAS existing conditions model was developed starting at the confluence with the Mohawk River (river station 0+00) and extending upstream to the headwaters of Oriskany Creek in the Town of Stockbridge, Madison County, NY (river station 1770+00) using the following data and software:

- HEC-RAS v6.5 software (USACE 2023)
- Oneida County, New York 1-meter LiDAR DEM data with an exposed ground vertical accuracy of 0.3-ft (10 cm) and vegetated ground vertical accuracy of 0.4-ft (12 cm; USGS 2017)
- Madison County, New York 1-meter LiDAR DEM data with an exposed ground vertical accuracy of 0.2-ft (6 cm) and vegetated ground vertical accuracy of 0.3-ft (8 cm; NYSOITS 2016)
- New York State Digital Orthoimagery Program imagery for Onondaga County (NYSOITS 2022)
- USDA National Agricultural Statistics Service (NASS) cropland database (NASS 2024)
- Hydraulic structure data from field investigation surveys and NYSDOT data for bridges and culverts (NYSDOT 2023a; NYSDOT 2023b)
- NYSDEC dam data (NYSDEC 2024b)

Using the LiDAR DEM data, orthoimagery, land cover data, and the RAS Mapper extension in the HEC-RAS software, an existing condition hydraulic model was developed using the following methodology:

- LiDAR DEM converted from horizontal North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) coordinate system to the New York State Plane Central to convert DEM units from meters to feet
- Main channel, bank lines, flow paths, and cross-sections, which were drawn along the main channel at stream meanders, contraction/expansion points, and at structures were digitized using the RAS Mapper extension in the HEC-RAS software
- Using the LiDAR DEM data and NASS land cover data, terrain profiles with elevations, cross-section downstream reach lengths, and Manning's n Values were assigned to each cross-section using built-in tools within the RAS Mapper extension in the HECRAS software
- Once all features were digitized, assigned, and updated, a 1-D steady flow simulation was performed using USGS *StreamStats* peak discharges in HEC-RAS

Downstream boundary conditions for the base and future conditions models were assessed using the Normal Depth method. Normal depth is calculated using the friction slope (Sf in Manning's equation), which is the slope of the energy grade line, and can be estimated by measuring the slope of the bed at the downstream reach (USACE 2024). For this model, the slope for the 300-ft immediately upstream of the confluence with the Mohawk River for Oriskany Creek was used and calculated to be 0.0003.

The existing condition model water surface elevation results were then compared to past flood events with known water surface elevations and the effective FEMA FIS elevation profiles to validate the model. After the existing condition model was verified, it was then used to develop proposed condition models to simulate potential mitigation strategies. The flood mitigation strategies that were modeled were:

Zone 1

- Removal of Madison Power Company Dam Upstream of Solsville Road (Alternative #1-1)

Zone 2

- Removal of In-Channel Piers Upstream of Division Street (Alternative #2-1)
- Floodplain Bench Upstream of Division Street (Alternative #2-3)

Zone 3

- Restore Hydraulic capacity of the NY-315 Bridge along Oriskany Creek (Alternative #3-3)

Zone 4

- Increase Hydraulic capacity of the NY-5 Bridge along Oriskany Creek (Alternative #4-2)
- Remove Clarks Mills Dam (Alternative #4-3)
- Remove Abandoned Railroad Bridge downstream of Main Street (Alternative #4-4)

Zone 5

- Removal of Oriskany Falls Dam (Alternative #5-2)

The remaining alternatives were either qualitative in nature or required additional advanced H&H modeling (i.e., 2-D, 3-D, etc.) outside of the scope of this study.

As the mitigation strategies discussed in this study are at this point, preliminary, inundation mapping was not developed from the computed water surface profiles for each potential mitigation alternative.

Note that stationing references for Oriskany Creek for Sections 1 through 6 of this report are based on the USGS National Hydrography Dataset (NHD) for Oriskany Creek (USGS 2024); however, stationing references for the flood mitigation measures (Section 7) are based on the HEC-RAS model software. While every attempt was made to ensure consistency in the stationing values, the values may differ as a result of the differences in the data sources and methodologies.

6.4 Sediment Data

Sediment transport processes depend on several factors, including sediment particle size distribution, catchment characteristics (area, basin slope, river slope, and channel width), catchment's land cover, effects of climate change and flood events. To simulate sediment transport, both overland and within the channel of drainageways within the Oriskany Creek watershed, the 1-D sediment transport capabilities in the HEC-RAS model software were employed.

Sediment data was obtained from soil samples and Wolman pebble counts taken during the field investigations by the project team and incorporated into the model. Samples were taken at two locations: downstream Division Road in the Village of Oriskany Falls and upstream Lumbard Road in the Town of Kirkland. These sampling locations were the safest and most accessible locations to sample along Oriskany Creek. Table 13 displays the soil characteristics by type, in percent, from sediment samples taken during the field investigations. Full sediment data used for this study can be found in Appendix D.

Table 13. Sediment Characteristics (in percent) of Soil Samples Taken along Oriskany Creek

Source: Ramboll 2023a		
Soil Type	**Downstream Division Road (Oriskany Falls)**	**Upstream Lumbard Road (Kirkland)**
Silt/Clay	3%	3%
Sand	11%	3%
Gravel	49%	17%
Cobble	23%	63%
Boulder	14%	14%
Total	100%	100%

The sediment data represents the soil characteristics at the locations from which the samples were taken.

Table 14 summarizes the USGS *StreamStats* peak streamflow statistics for the sediment transport modeling.

Table 14. Sediment Transport Modeling Peak Streamflow Statistics from USGS *StreamStats*

Source: USGS 2023						
Flooding Source and Location	**Drainage Area (mi^2)**	**River Station (ft)**	**Peak Discharges (cfs)**			
			80-percent	**50-percent**	**20-percent**	**10-percent**
At the confluence with the Mohawk River Reach 1	146	0+00	3,770	5,370	7,800	9,560
Upstream of Deans Creek	103	257+00	2,900	4,190	6,160	7,590
At the corporate limits of the Westmoreland/Town of Whitestown	101	307+50	2,910	4,220	6,230	7,690
At the corporate limits of the Town of Kirkland/Town of Westmoreland	95	379+50	2,750	3,990	5,900	7,280
Downstream of the confluence of St. Mary's Brook	92.4	444+50	2,690	3,910	5,780	7,140
Downstream of the confluence of White Creek	83.3	626+00	2,460	3,590	5,330	6,600
Downstream of the confluence of Turkey Creek	70.3	745+50	2,120	3,100	4,610	5,710
At the downstream corporate limits of the Town of Marshall/Town of Kirkland	58.9	859+50	1,830	2,680	4,010	4,980
Upstream of confluence with Big Creek	38	889+00	1,180	1,740	2,600	3,240
A point approximately 73 feet downstream of Hyning Road	33.7	1068+00	1,080	1,600	2,390	2,980
At corporate limits of Town of Marshall/Village of Oriskany Falls	29.5	1168+50	934	1,380	2,070	2,580

6.5 Climate Change Implications

In an effort to improve flood resiliency in light of future climate change, New York State passed the *Community Risk and Resiliency Act* (CRRA) in 2014. In accordance with the guidelines of the CRRA, the NYSDEC released the *New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act* (2020) report. In the report, the end of design life multiplier method is discussed for estimating projected future discharges (NYSDEC 2020).

The end of design life multiplier is described as an adjustment to current peak-flow values by multiplying relevant peak-flow parameters by a factor specific to the expected service life of the structure and geographic location of the project to estimate future peak-flow conditions (NYSDEC 2020).

In general, climate models are better at forecasting temperature than precipitation and contain some level of uncertainty with their calculations and results. Based on the current future flood projection models, flood magnitudes are expected to increase in nearly all cases in New York State, but the magnitudes vary among regions. The NYSDEC recommends that future peak flow conditions should be adjusted by multiplying relevant peak flow parameters by a factor specific to the expected service life of the structure and geographic location of the project.

The CRRA acknowledges that anticipated increase in peak flows are associated with projected increases in heavy-precipitation events and runoff (NYSDEC 2020). For this study, precipitation intensity data from the NRCC was increased by 10%, in line with the CRRA end of design-life multiplier for the Oriskany Creek watershed. Table 15 summarizes the USGS *StreamStats* peak streamflow statistics and the NYSDEC CRRA 20% end of design life multiplier.

Table 15. Climate Change Modified USGS *StreamStats* Peak Streamflow Statistics with the CRRA 20% End of Design Life Multiplier

Source: NYSDEC 2020; USGS 2023						
Flooding Source and Location	**Drainage Area (mi^2)**	**River Station (ft)**	**Peak Discharges (cfs)**			
			10-percent	**2-percent**	**1-percent**	**0.2-percent**
At the confluence with the Mohawk River Reach 1	146	0+00	11,472	16,440	18,840	24,480
Upstream of Deans Creek	103	257+00	9,108	13,200	15,120	19,800
At the corporate limits of the Westmoreland/Town of Whitestown	101	307+50	9,228	13,320	15,360	20,160
At the corporate limits of the Town of Kirkland/Town of Westmoreland	95	379+50	8,736	12,600	14,640	19,080
Downstream of the confluence of St. Mary's Brook	92.4	444+50	8,568	12,360	14,280	18,720
Downstream of the confluence of White Creek	83.3	626+00	7,920	11,484	13,320	17,400
Downstream of the confluence of Turkey Creek	70.3	745+50	6,852	9,960	11,496	15,120
At the downstream corporate limits of the Town of Marshall/Town of Kirkland	58.9	859+50	5,976	8,712	10,068	13,200
Upstream of confluence with Big Creek	38	889+00	3,888	5,676	6,564	8,652
A point approximately 73 feet downstream of Hyning Road	33.7	1068+00	3,576	5,232	6,060	7,992
At corporate limits of Town of Marshall/Village of Oriskany Falls	29.5	1168+50	3,096	4,524	5,244	6,912

7. Planning and Mitigation Strategies

The Oriskany Creek Sediment and Debris Management Plan should be a fluid document that incorporates the input and vision of all interested parties, including stakeholders, local and state officials, environmental groups, etc. The management plan should include a watershed planning process to help define the current goals and objectives, but also the future direction for the watershed. Figure 7-1 depicts general guidelines for developing, assessing, and revising watershed management strategies (HOCCPP 1997).

Figure 7-1. Oriskany Creek Sediment and Debris Management Planning Process (adapted from HOCCPP 1997).

Effective, systematic, and institutionalized control of development activities is a key component of any plan to address water resource issues. In addition, each management strategy should be evaluated based on both its local and watershed-wide impacts. The contemporary flood management strategy should address the problem by considering the best mix of management options available, selected among both the structural works and nonstructural measures. It should be based on an integrated and environmentally sustainable approach, which addresses fully all aspects of issues in the watershed basin (HOCCPP 1997).

7.1 Institutional and Regulatory Framework

Concerns about regulatory controls and institutional arrangements in the Oriskany Creek watershed tend to fall into one of five categories relating to: master planning, regulation, financing, technical guidance for decision making, and an institutional framework or centralized managing entity that fosters a basin-wide approach to decision making (HOCCPP 1997).

1. Master Planning: the general belief that development must be accomplished in concert with transportation, environmental, and economic planning on both a regional and local level.
2. Regulation: institutional issues relating to regulatory concerns within the basin focus on the complexity of some regulations, the lack of certain regulations, ineffective methods of enforcement, and the lack of uniformity. A need to transition from reactive to proactive strategies and to promote consistent, community-to-community regulatory controls throughout the entire basin.
3. Financing: commonly identified as the major obstacle which prevents the implementation of many solutions and management practices.
4. Technical Guidance for Decision Making: a general need to use more accurate and appropriate sources of technical information when making land-use decisions in the watershed based on the most up-to-date scientific techniques, data, and technologies and using effective educational tools to provide the best possible technical guidance for decision making.
5. Institutional Framework: establishment of a framework or mechanism that allows issues to be addressed based on the "good of the many" and the watershed as a whole (HOCCPP 1997).

7.2 Permitting Requirements

Stream restoration and design activities are subject to various Federal, state, and local regulatory programs. Most of these regulations are aimed at protecting natural resources and the integrity of the Nation's water resources. Designers should be aware of project permitting requirements and develop a project plan and budget identifying resources and project approaches that meet permit conditions. Depending on the type of project and its location, these can range from minimal to a full set of required Federal, state, and local permits. The applicable programs and permits can include (NRCS 2007):

- National Environmental Policy Act
- Endangered Species Act
- National Historic Preservation Act
- Wild and Scenic Rivers Act
- Fish and Wildlife Coordination Act
- Clean Water Act
- Rivers and Harbors Act of 1899
- Magnuson-Stevens Fishery Conservation and Management Act
- Local and state water quality permits
- Water rights
- National Flood Insurance Program (NFIP)
- Local and state flood permits
- Local zoning permits

Permitting agencies should be approached as soon as conceptual plans are developed. In regulatory-intensive areas, as well as in areas of high environmental risk, it may be advisable to consult with them in the early planning stages. Each state has individual statutes and codes that provide the legal framework for developing and managing water resource-related projects. A variety of permits are required to work within rivers, streams, and/or wetlands. State fish and wildlife agencies and land management agencies are the typical implementing agency. Local permit requirements should be fully identified when developing project plans, designs, and construction specifications. Prior to initiation of any in-stream activities, the NYSDEC should be contacted and appropriate local, state, and federal permitting should be obtained (NRCS 2007).

7.3 Management and Mitigation Strategies

Streambank erosion is a natural process that occurs when the forces of flowing water exceed the ability of the soil and vegetation to hold the banks in place. The forces that cause erosion increase during flood events, and most erosion occurs at these times. Human disturbances to watersheds that increase frequency and magnitude of runoff events also increase streambank erosion. Human disturbances include logging, mining, agriculture, and urbanization. Typical urban or suburban developments which may impact a stream include houses, garages, parking lots, and walkways, including areas cleared of forest that have been replaced by tailored lawns (GASWCC 2000).

Loss of streambank and streamside vegetation reduces the resisting forces and makes streambanks more susceptible to erosion. This is often the single greatest contributing factor to harmful or accelerated erosion on small and medium-size streams. Streambank vegetation may be removed intentionally for various reasons, or its loss may be inadvertent due to trampling by animals or humans (GASWCC 2000).

Streambank stabilization measures work either by reducing the force of flowing water, by increasing the resistance of the bank to erosion, or by some combination of both. Generally speaking, there are four approaches to streambank protection: 1) the use of vegetation; 2) soil bioengineering; 3) the use of rock work in conjunction with plants; and 4) conventional bank armoring. Re-vegetation includes seeding and sodding of grasses, seeding in combination with erosion control fabrics, and the planting of woody vegetation (shrubs and trees). Soil bioengineering systems use woody vegetation installed in specific configurations that offer immediate erosion protection, reinforcement of the soils, and in time a woody vegetative surface cover and root network. The use of rock work in conjunction with plants is a technique which combines vegetation with rock work. Over time, the plants grow and the area appears and functions more naturally. Conventional armoring is a fourth technique which includes the use of rock, known as riprap, to protect eroding streambanks (NRC 2013).

There are two types of engineering strategies to sediment and debris management and flood mitigation: structural and non-structural. Structural adjustments involve two different approaches: hard and soft structures. Hard engineering strategies act as a barrier between the river and the surrounding land where artificial structures are used to change or disrupt natural processes. Soft engineering does not involve building artificial structures, but takes a more sustainable and natural approach to managing the potential for erosion, deposition, and flooding by enhancing or protecting a river’s natural features (NRC 2013).

Examples of hard engineering strategies include (NRC 2013):

- Dams (new construction or restoration)
- Pump Stations
- Engineered Drainage Systems
- Increase Bridge & Culvert Openings
- Levees
- Floodways, Spillways, and Channels

Examples of soft engineering strategies include (USACE 2001; NRCS 2002; NRC 2013):

- Flood Benches
- Streambank Stabilization and Protection
    - Live willow staking with some biodegradable soil stabilization
    - Vegetated Coir Roles
    - Burlap tiers
    - Rootwads with boulders
    - Riprap with live stakes
    - Live Fascines
    - Slope softening and vegetation
    - Hardwood tree planting
    - Brush layers
- Sediment Detention Basin/Retention Ponds
- Removal of Debris/Loose Vegetation from Floodplain
- In-channel Obstruction/Barrier Removal (i.e., dams, large debris, etc.)
- Sediment Removal

The purpose of non-structural flood mitigation is to change the way that people interact with the floodplain and aims to move people away from flood-prone areas. Non-structural techniques have proven to be extremely viable in alternatives consisting of total non-structural, or a combination of non-structural and structural measures. A distinct advantage of non-structural strategies is that they do not disturb the environment and can often times lead to environmental restoration. Examples of non-structural measures include the following (USACE 2001; NRC 2013):

- Riparian Vegetation Restoration
- Retention Basin and Wetland Management
- Soil and Watershed Promotion Legislation
- Land Use Planning/Ordinances
- Floodproofing Residential/Commercial Properties
- Flood Buyouts
- Flood Monitoring & Warning System
- Community Flood Awareness and Preparedness Programs/Education

8. Oriskany Creek Sediment and Debris Management Plan

The Oriskany Creek watershed basin was sub-divided into five different zones based on geographic and political boundaries. The zone discussions within this section are organized starting with the upstream most reach of Oriskany Creek and moving downstream to the confluence with the Mohawk River.

8.1 ZONE 1 – Town of Madison, Madison County

8.1.1 Removal of Madison Power Company Dam Upstream of Solsville Road

The abandoned dam located upstream of Solsville Road in Oriskany Creek is owned by Madison Power Company and is no longer maintained (NYSDEC 2024b). This dam is collapsed in the channel and restricts the natural flow of water while collecting woody debris upstream of the dilapidated dam (Figure 8-1). Remnants of the dam are located downstream in the channel. Water flows through the middle cracks of the damaged dam where one side of the dam is raised more than the other side (Figure 8-2). Originally, the dam was built in 1926, almost 100 years old, for the purposes of hydroelectric. The spillway height is approximately 10-ft to 14-ft, and its width is 62-ft (NYSDEC 2024b).

Figure 8-1. Woody debris collection upstream of the Madison Power Company Dam, Town of Madison, NY.

Figure 8-2. Madison Power Company Dam upstream of Solsville Road, Town of Madison, NY.

The dam is considered a low hazard which may be defined as upon dam failure, or in this case, the dam condition is worsened or removed from the channel, the likelihood of downstream damages to occupied spaces, necessary utilities, and major roads is low. The removal of the dam, according to its hazard class, is unlikely to pose the threat to individuals, severe economic loss, or significant environmental damage (NYSDEC 2024b); however, evaluation and detailed H&H modeling of a dam removal scenario is recommended to identify the necessary flood risks within the proximate areas of the dam.

Removal of the dam has been selected to be analyzed at a base level of modelling and to determine the flooding impacts downstream of Oriskany Creek. The removal of the dam alternative is located at river station (RS) 1441+00-ft (Figure 8-3). The project would involve removing all the concrete and stone aggregates in the channel and along the banks to ensure natural flow in Oriskany Creek. Removal of woody debris or other debris should be performed during this project. Further investigation will be needed to fully access this alternative which includes field surveys of dam measurements, soil testing for suitability, dam removal modelling, etc. The base-level analysis will show if flood risk is reduced when the dam is removed to the natural state of the floodplain.

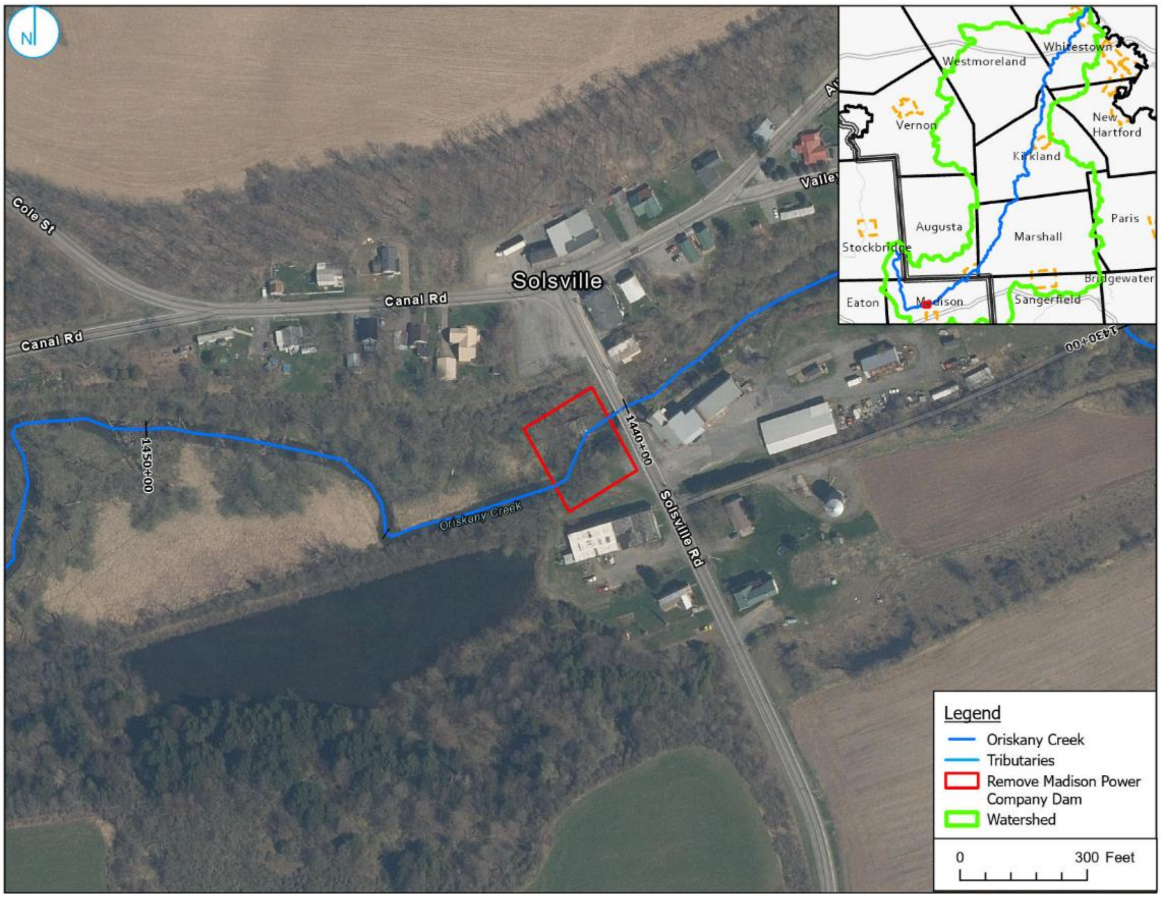


Figure 8-3. Location map of proposed dam removal.

Table 16 outlines the results of the proposed conditions from the model simulation. Figure 8-4 displays the profile plots for the dam removal alternative. Full model outputs for this alternative can be found in Appendix E.

Table 16. Summary of Results for Alternative #1-1 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	Dam Removal
Reductions in Water Surface Elevations	Up to 0.2-ft
Total Length of Benefited Area	2650-ft
River Stations	1441+00 to 1467+50

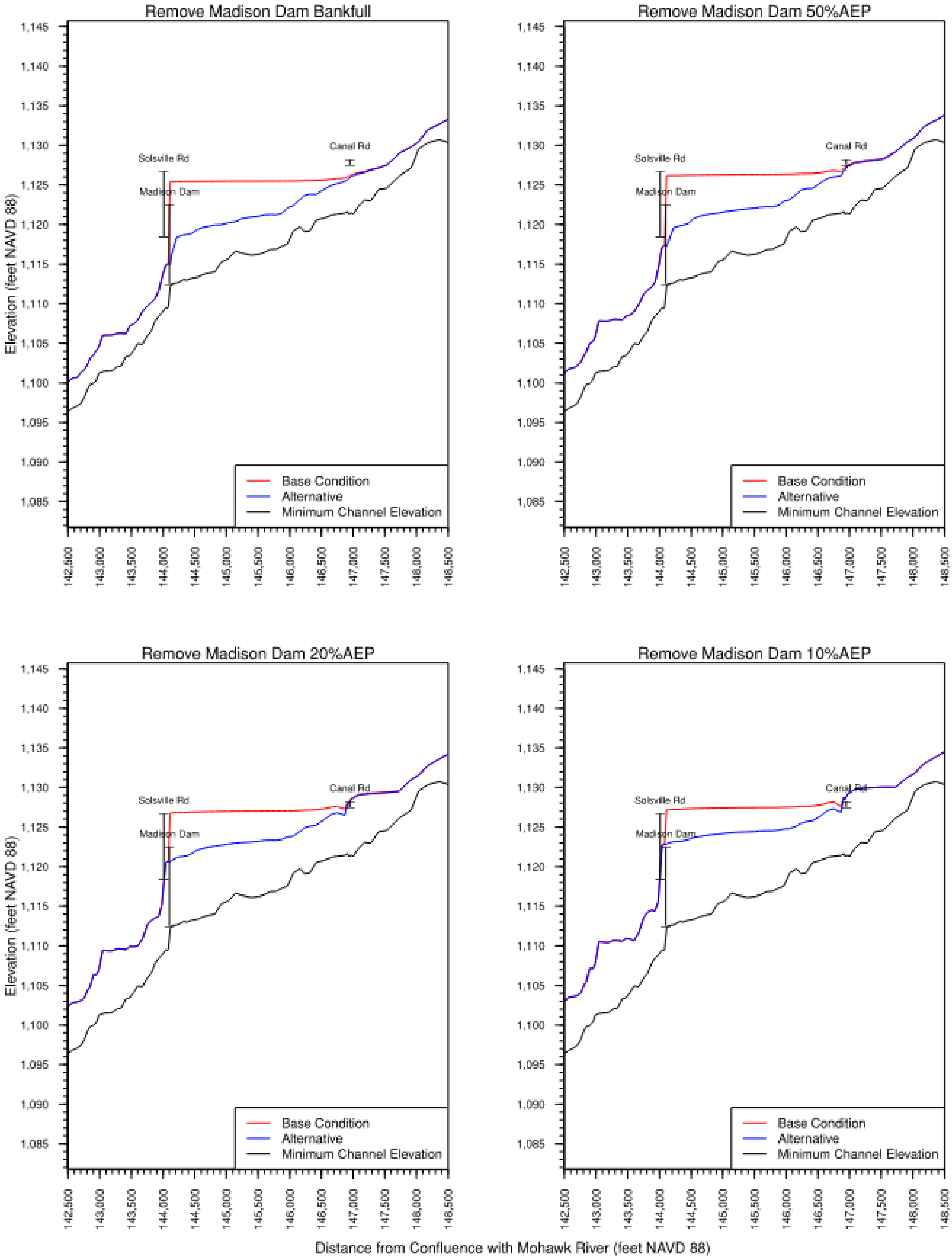


Figure 8-4. HEC-RAS model simulation output results for Alternative #1-1 for the existing condition (red) and proposed alternative (blue) scenarios.

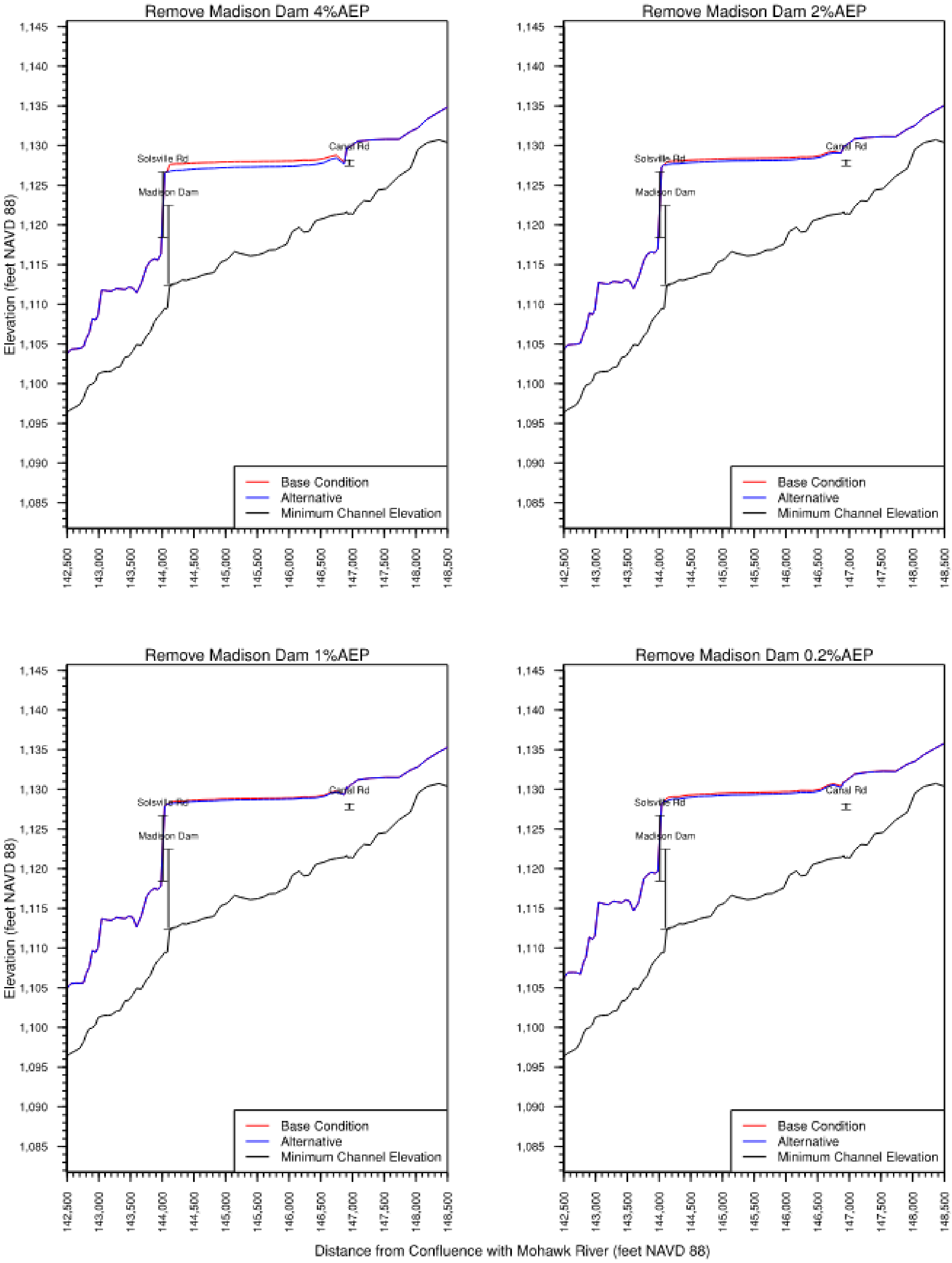


Figure 8-4 (continued). HEC-RAS model simulation output results for Alternative #1-1 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 0.2-ft in the 1-D model simulations for alternative #1-1. The primary benefits of removing the dam would be to increase the cross-section flow area of the channel and reduce the potential for sediment, debris, and ice to accumulate or catch on the dam, thereby reducing the flood risk to areas adjacent to and immediately upstream of the dam.

Several factors must be considered when evaluating potential dam removal projects, including the following (Duda and Bellmore 2021):

- Legal requirements, such as obtaining the necessary federal and local permits;
- Obtaining funding, identifying and getting input from stakeholders;
- Determining whether mitigation projects are necessary or required to minimize dam removal effects;
- Technical difficulty, expense, and time horizon of a proposed dam removal;
- Dam ownership (whether the dam is publicly or privately owned) and the purpose and size of the dam;
- Reservoir sedimentation, the status and ecology of the river and surrounding project lands;
- Testing requirements to categorize sediment held behind the dam for the presence or absence of hazardous materials;
- Infrastructure downstream of the dam; and
- Any necessary environmental compliance mandates.

Dam removal is an important tool for river restoration and addressing aging infrastructure. It is an ongoing activity that will continue as a large number of aging dams that are no longer serving their original purposes, have become safety liabilities, or represent potential for significant restoration action, are taken down (Duda and Bellmore 2021).

Rivers are resilient to the changes and disturbance that accompany the removal of a dam, with many of the changes occurring rapidly and representing an improvement in water quality, hydrological flows, and migratory movement of aquatic animals. Yet, some of the outcomes of dam removal may play out over longer time periods, depending on such factors as the life history of key species or implementation of other complementary river restoration actions (Duda and Bellmore 2021).

In New York State, a joint permit application from the NYSDEC and USACE may be required in order to remove a dam or other impoundment. The NYSDEC is entrusted with the regulatory power to oversee dam safety. To protect people from the loss of life and property due to flooding and/or dam failure, the NYSDEC Dam Safety Section, in cooperation with the USACE, reviews proposed dam removals, conducts dam safety inspections, and monitors projects for compliance with dam safety criteria.

It should be noted that by removing the dam, the potential flood risk for downstream areas could be altered resulting in negative effects to downstream areas. Ramboll recommends additional research, data, and modeling, including advanced 2-D modeling, to more accurately determine the effects of removing the dam to downstream areas.

8.1.2 Streambank Stabilization Strategies

Streambank erosion is a natural process that occurs when the forces of flowing water exceed the ability of the soil and vegetation to hold the banks in place. The forces that cause erosion increase during flood events, as most erosion occurs at these times. Human disturbances to watersheds that increase frequency and magnitude of runoff events also increase streambank erosion. Human disturbances include logging, mining, agriculture, and urbanization. Typical urban or suburban developments that may impact a stream include houses, garages, parking lots, and walkways, including areas cleared of forest and replaced by tailored lawns (GASWCC 2000).
Loss of streambank and streamside vegetation reduces the resisting forces and makes streambanks more susceptible to erosion. This is often the single greatest contributing factor to harmful or accelerated erosion on small- and medium-size streams. Streambank vegetation may be removed intentionally for various reasons, or its loss may be inadvertent due to trampling by animals or humans (GASWCC 2000).

Streambank stabilization measures work either by reducing the force of flowing water, increasing the resistance of the bank to erosion, or some combination of both. Generally speaking, there are four approaches to streambank protection: 1) the use of vegetation, 2) soil bioengineering, 3) use of rock work in conjunction with plants, and 4) conventional bank armoring. Re-vegetation includes seeding and sodding of grasses, seeding in combination with erosion-control fabrics, and planting of woody vegetation (shrubs and trees). Soil bioengineering systems use woody vegetation installed in specific configurations that offer immediate erosion protection, reinforcement of the soils, and in time a woody vegetative surface cover and root network. The use of rock work in conjunction with plants is a technique which combines vegetation with rock work. Over time, the plants grow, and the area appears and functions more naturally. Conventional armoring is a fourth technique which includes the use of rock, known as riprap, to protect eroding streambanks (GASWCC 2000). This technique is only used when other alternatives will not withstand the high velocities or shear stress in the channel.

Streambank stabilization can also play a vital role in flood-risk management in areas located in flood-prone areas. The magnitude of that risk is a function of the following: flood hazards; the characteristics of a particular location (i.e., elevation, proximity to the waterway, susceptibility to fast-moving flows, etc.); existing mitigation measures that reduce the potential impacts of flooding; the vulnerability of people and property; and the consequences that result from a particular flood event. A flood risk management strategy identifies and implements measures that reduce the overall risk, and what remains is the residual risk. In developing the strategy, those responsible judge the costs and benefits of each measure and their overall impact in reducing the risk (NRC 2013).

Transport of sediment and debris in streams is predominantly controlled by stream transport capacity, sediment physiochemical characteristics, and supply rate. Several hydraulic and geomorphologic factors determine stream transport capacity including channel width, flow depth and cross-sectional geometry, bed slope and roughness, and discharge velocity and volume. In general, the more turbulent energy available for suspension and mobilization of sediment, the greater the sediment transport capacity per unit of stream width, and the larger the size of sediment particles that can be moved (USEPA 2009a).

Larger sediments and debris generally experience more episodic movement over longer time scales through watersheds. Smaller sediments generally move more continuously and within a shorter time scale. This difference is due to the fact that larger sediments and debris rely on larger, more powerful flows for transport, which occur episodically and less frequently than flows able to move smaller particles, such as the bankfull discharge (USEPA 2009a).

To assess the applicability of different streambank stabilization strategies under higher frequency lower-flow conditions, channel velocity (feet per second) and shear stress (pounds per square foot) were calculated using the HEC-RAS software for the existing conditions model at the 10% AEP. A description of the velocity and shear stress variables are identified in Section 5.2.

Based on the channel velocities and shear stresses, Table 17 summarizes the potential streambank stabilization measures along Oriskany Creek in Zone 1. The entire reach was studied for all possible streambank stabilization strategies and can be applied for future projects if applicable.

Table 18 lists the average cost per linear foot for each streambank stabilization type discussed in Table 17. Figure 8-5 displays the results of the hydraulic model simulations for Zone 1 for the eight different annual chance flood events and the two erosional/depositional variables. Additional geomorphic and engineering analyses, including additional modeling, would be necessary in order to determine the most appropriate streambank stabilization strategy and its associated costs.

Table 17. Streambank Stabilization Strategies for Zone 1, the Town of Madison

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Brush Mattresses	Staked only w/rock riprap toe (initial)	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1421+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1600+00 to 1620+00; 1620+00 to 1630+00	Brush mattresses include live stakes and fascine bundles with branch cuttings, dead stout stakes, and geotextile fabric.
	Staked only w/rock riprap toe (grown)	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1430+00; 1440+00 to 1640+00	
Coir Geotextile Roll	Roll with coir rope mesh staked only without rock riprap toe	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1600+00 to 1620+00; 1620+00 to 1630+00	Vegetative logs placed in densely packed coconut fiber rolls act as a natural retaining wall to prevent erosion.
	Roll with Polypropylene rope mesh staked only without rock riprap toe	1240+00 to 1260+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1280+00 to 1300+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	
	Roll with Polypropylene rope mesh staked and with rock riprap toe	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1430+00; 1440+00 to 1640+00	
Live Fascine	Live Fascine Bundle with rock riprap toe	1240+00 to 1260+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	Live fascine bundles include live woody cuttings in a bundle and buried into the bank of the stream parallel to the stream's flow.

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Soils	Shale and Hardpan	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1470+00 to 1480+00; 1570+00 to 1580+00; 1600+00 to 1640+00	Shale and hardpan are compact rocks that can protect the streambank from erosion in areas with low shear stress and velocities. This treatment may be difficult for vegetation to establish along the banks with the presence of shale and hardpan.
Gravel/Cobble	6-in diameter	1240+00 to 1260+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	Lining the streambank with gravel that has a diameter of at least 6-inches will help protect the streambank from erosion.
	12-in diameter	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1430+00; 1440+00 to 1640+00	
Vegetation	Class A turf (ret class)	1240+00 to 1260+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	A streambank that is covered with native vegetation such as Class A, Class B, or Class C turf (ret class), long grasses, or hardwood tree plantings will establish protection and increase erosion resistance along the bank.
	Class B turf (ret class)	1240+00 to 1250+00; 1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	
	Class C turf (ret class)	1330+00 to 1340+00; 1440+00 to 1460+00; 1470+00 to 1490+00	
	Long native grasses	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1530+00 to 1540+00; 1550+00 to 1560+00; 1570+00 to 1580+00; 1600+00 to 1640+00	
	Wattles	1440+00 to 1460+00; 1480+00 to 1490+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Soil Bioengineering	Reed fascine	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1410+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1600+00 to 1610+00; 1620+00 to 1630+00;	Soil bioengineering treatments to reduce streambank erosion in this area includes wattles, reed fascines, coir roll, vegetated coir mat, live brush mattress, brush layering, and live willow stakes. Place live stakes in areas with increased deposition and minimal erosion.
	Coir roll	1240+00 to 1260+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1450+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	
	Vegetated coir mat	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1490+00; 1510+00 to 1640+00	
	Live brush mattress (initial)	1330+00 to 1340+00; 1390+00 to 1410+00; 1440+00 to 1460+00; 1470+00 to 1490+00	
	Live brush mattress (grown)	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1430+00; 1440+00 to 1640+00	
	Brush layering (initial/grown)	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1430+00; 1440+00 to 1640+00	
	Live fascine	1240+00 to 1260+00; 1380+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	
	Live willow stakes	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1500+00; 1510+00 to 1640+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Boulder Clusters	Very large (>80-inch diameter)	1240+00 to 1640+00	Boulders of different diameters may protect the stream and protect the stream from erosion.
	Large (>40-in diameter)	1240+00 to 1640+00	
	Medium (>20-inch diameter)	1240+00 to 1640+00	
	Small (>10-inch diameter)	1240+00 to 1340+00; 1350+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1500+00; 1510+00 to 1640+00	
	Large (>5-inch diameter)	1240+00 to 1250+00; 1280+00 to 1300+00; 1310+00 to 1320+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1420+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1510+00 to 1520+00; 1530+00 to 1580+00; 1590+00 to 1640+00	
	Small (>2.5-inch diameter)	1280+00 to 1300+00; 1330+00 to 1340+00; 1360+00 to 1370+00; 1390+00 to 1400+00; 1440+00 to 1460+00; 1470+00 to 1490+00; 1600+00 to 1610+00; 1620+00 to 1630+00	

Table 18. Streambank Stabilization Cost Summaries

Streambank Stabilization Type	Cost ($U.S. Dollars)
Brush Mattresses	
Staked only w/ rock riprap toe (initial)	$4 - $8 per square ft
Staked only w/ rock riprap toe (grown)	$4 - $8 per square ft
Coir Geotextile Roll	
Roll with coir rope mesh staked only without rock riprap toe	$15 per linear ft
Roll with Polypropylene rope mesh staked only without rock riprap toe	$20-$30 per linear ft
Roll with Polypropylene rope mesh staked and with rock riprap toe	$25-$35 per linear ft
Live Fascine	
Live Fascine Bundle w/ rock riprap toe	$15-$30 ft of 6-8 inch bundles
Gravel/Cobble	
6-inch	$40-$60 per linear ft
12-inch	$45-$65 per linear ft
Soil Bioengineering	
Wattles	$40 per linear ft
Reed fascine	$20 per linear ft
Coir roll	$40 per linear ft
Vegetated coir mat	$50 per linear ft
Live brush mattress (initial)	$4-$8 per square ft
Live brush mattress (grown)	$2-$4 per square ft
Brush layering (initial/grown)	$6-$12 per square ft
Live fascine	$10 - $30 per ft for 6 – 8 inch bundles
Live willow stakes	$1 - $5 per stake
Boulder Clusters	
Boulder - Very large (>80-inch diameter)	$90 per ton
Boulder - Large (>40-in diameter)	$85 per ton
Boulder - Medium (>20-inch diameter)	$80 per ton
Boulder - Small (>10-inch diameter)	$75 per ton
Cobble - Large (>5-inch diameter)	$70 per ton
Cobble - Small (>2.5-inch diameter)	$65 per ton

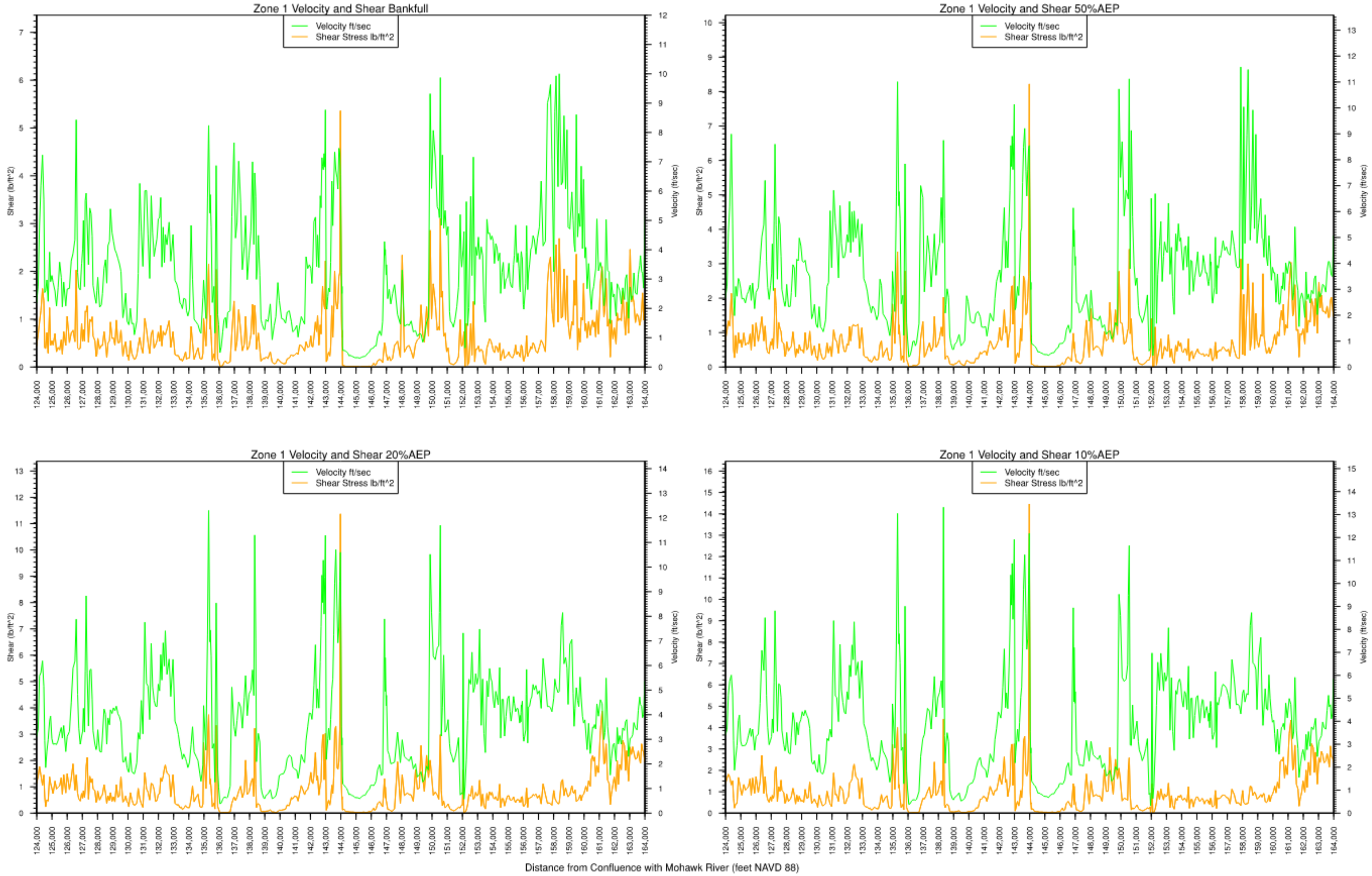


Figure 8-5. Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 1.

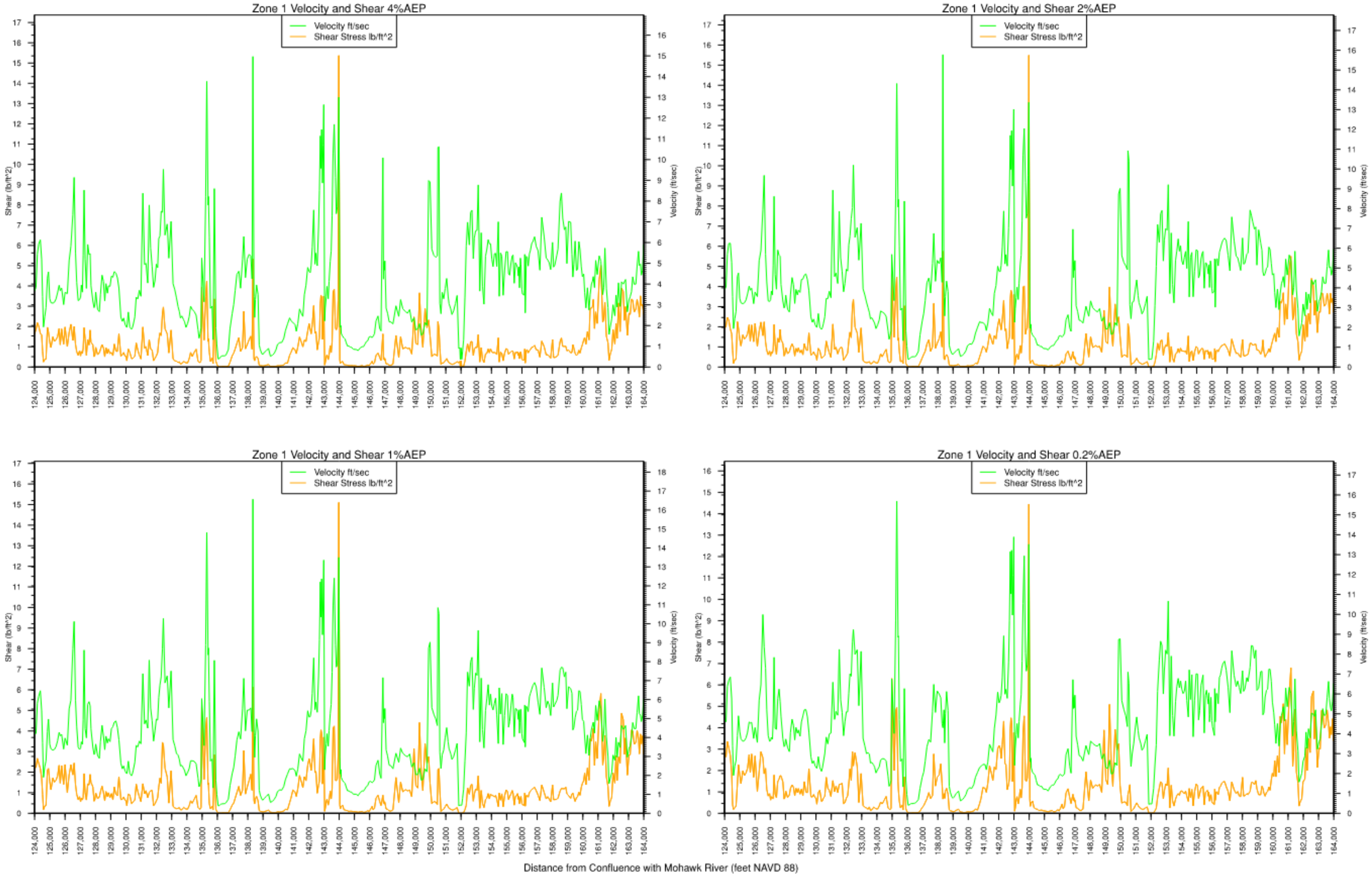


Figure 8-5 (continued). Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 1.

Appendix F contains detailed discussion of various streambank stabilization strategies, including drawings, definitions, ideal locations, design and construction considerations, and maintenance. It is important to note that the streambank stabilization measures discussed in this report and in Appendix F are not meant to be exhaustive, and other measures not discussed could be considered as well.

8.2 ZONE 2 – Town of Augusta/Village of Oriskany Falls, Oneida County

8.2.1 Removal of In-channel Piers Upstream of Division Street

Immediately upstream of Division Street in the Village of Oriskany Falls was a multi-purpose site with buildings located on each side of the streambank connected by a building that was built on top of piers in the channel. The site served the community as a place of work as a knitting mill in 1897, then it was transformed into a medical supply manufacturing company, Covidien, until 2011. In December 2016, the site was severely damaged beyond repair by a fire that burnt down multiple buildings. The USEPA funded a remediation action under the Comprehensive Environmental Response, Compensation, and Liability Act pf 1980 (CERCLA) to safely remove structurally unsound buildings in the area and in Oriskany Creek. The cleanup project was completed in September 2019 and the property is currently owned by B & B Recycling, LLC. (USEPA 2019).

Afterwards, NYSDEC assigned TRC Engineers, Inc. to monitor and sample the site in April through May of 2021 (NYSDEC 2021). Figure 8-6 represents aerial imagery from Google Earth from the years 2015 (prior to the site fire), 2017 (remnants of the destruction caused by the fire), and 2020 (after USEPA cleaned up the site and the current state of the site).

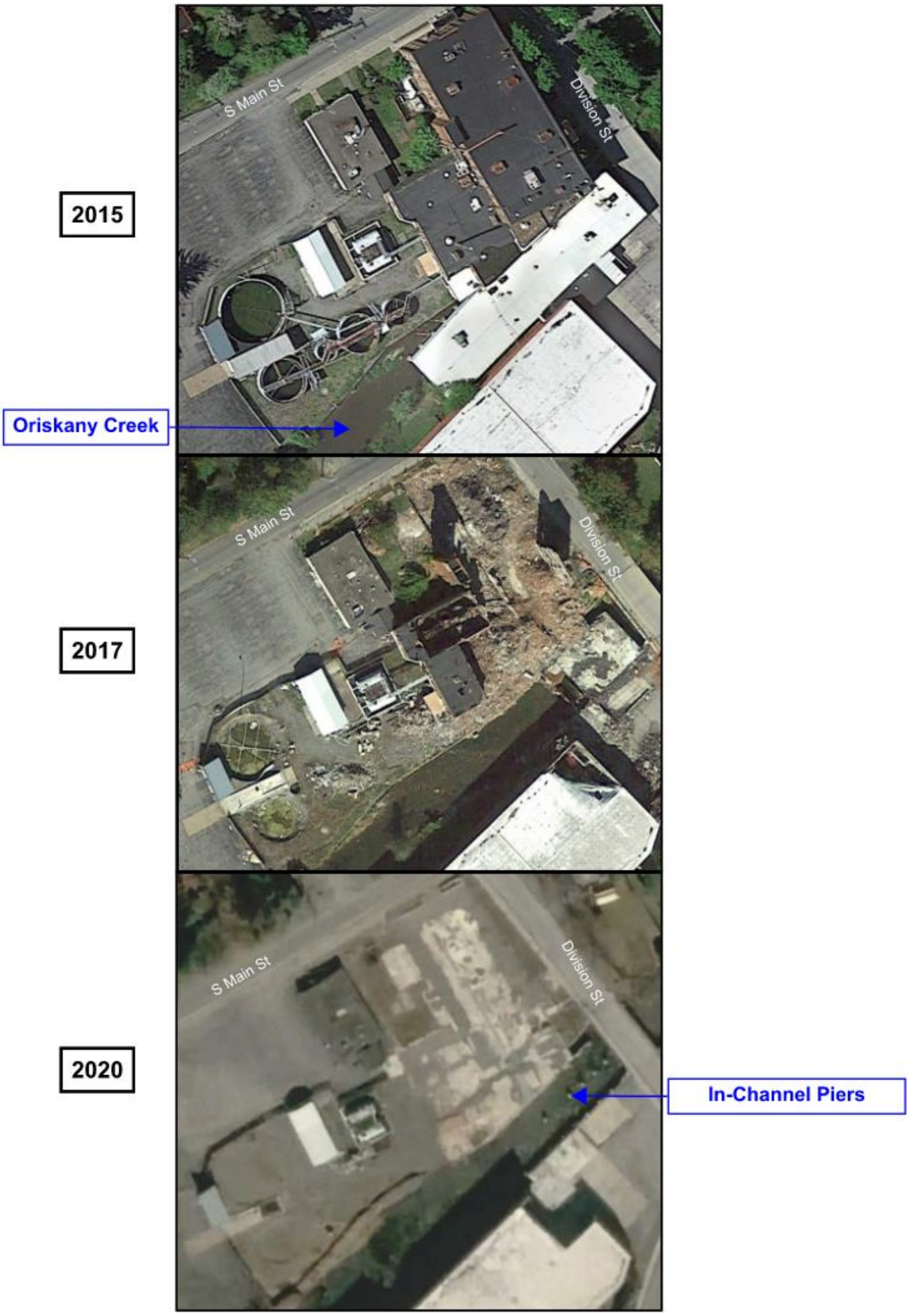


Figure 8-6. Image capture dates of the site upstream of Division Street, Village of Oriskany Falls, NY.

This alternative will focus on the removal of the in-channel piers that once held up a building on the site, formally occupied by Covidien. Figure 8-7 depicts the in-channel piers from Division Street looking upstream of Oriskany Creek. The in-channel piers are an obstruction of flow to water moving in the channel which restricts the channel flow area, and may cause water surfaces to rise and potentially overtop banks or back water upstream of structures and/or meanders. Benefits of removing the in-channel piers would be to reduce the potential of debris and ice from catching and creating obstructions/jams upstream of the bridge.

Figure 8-7. In-channel piers upstream of Division Street in Oriskany Creek.

The removal of the in-channel piers alternative is located at RS 1214+80 to 1215+00 (Figure 8-8). The project would involve removing all the concrete and stone aggregates in the channel, and, if possible, along the banks to ensure natural flow in Oriskany Creek.

The analysis will show if flood risk is reduced when the piers are removed to the natural state of the floodplain.

Figure 8-8. Location map of in-channel pier removal.

Table 19 outlines the results of the proposed conditions from the model simulation. Figure 8-9 displays the profile plots for the in-channel removal alternative. Full model outputs for this alternative can be found in Appendix E.

Table 19. Summary of Results for Alternative #2-1 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	In-Channel Pier Removal
Reductions in Water Surface Elevations	Up to 0.1-ft
Total Length of Benefited Area	950-ft
River Stations	1214+75 to 1224+25

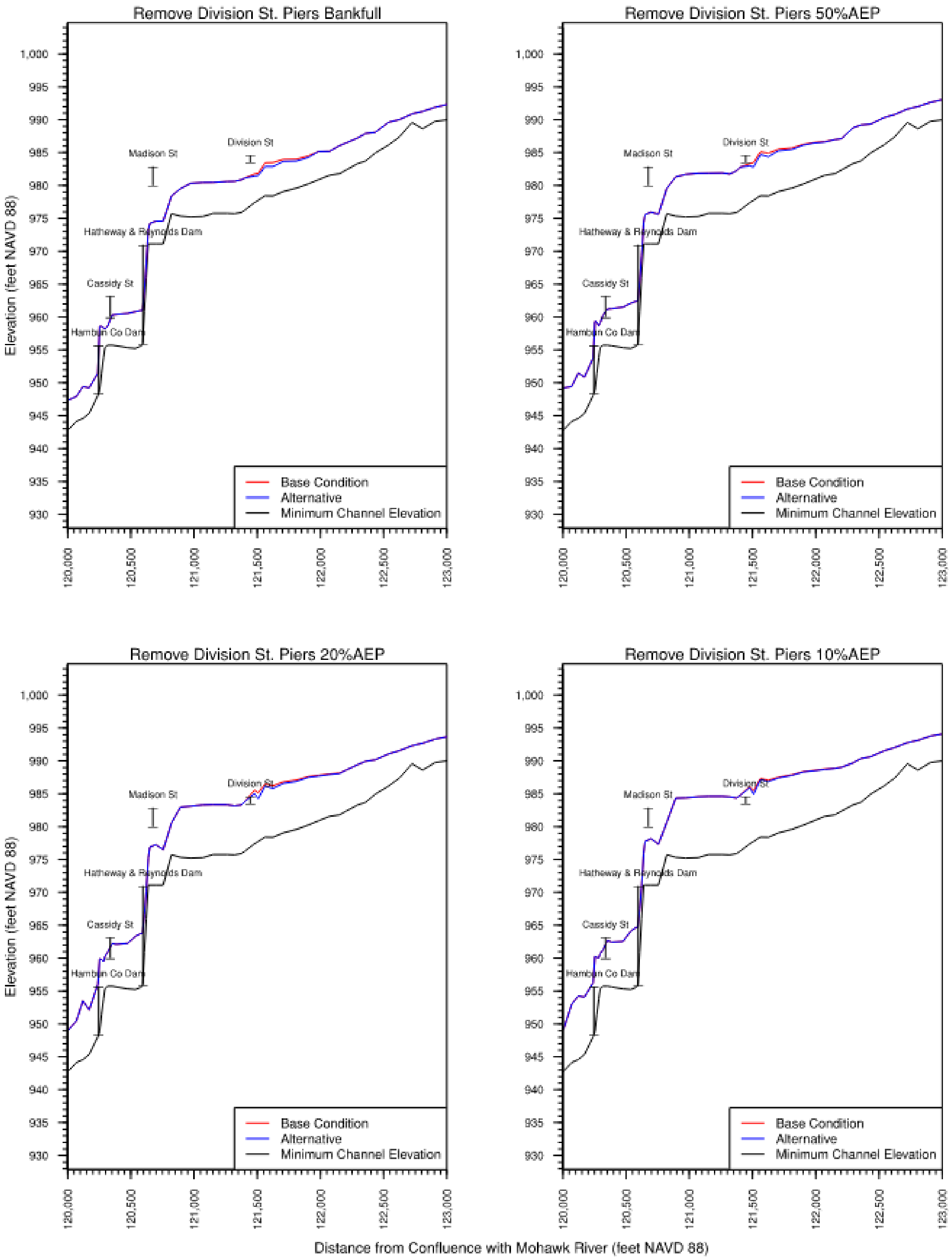


Figure 8-9. HEC-RAS model simulation output results for Alternative #2-1 for the existing condition (red) and proposed alternative (blue) scenarios.

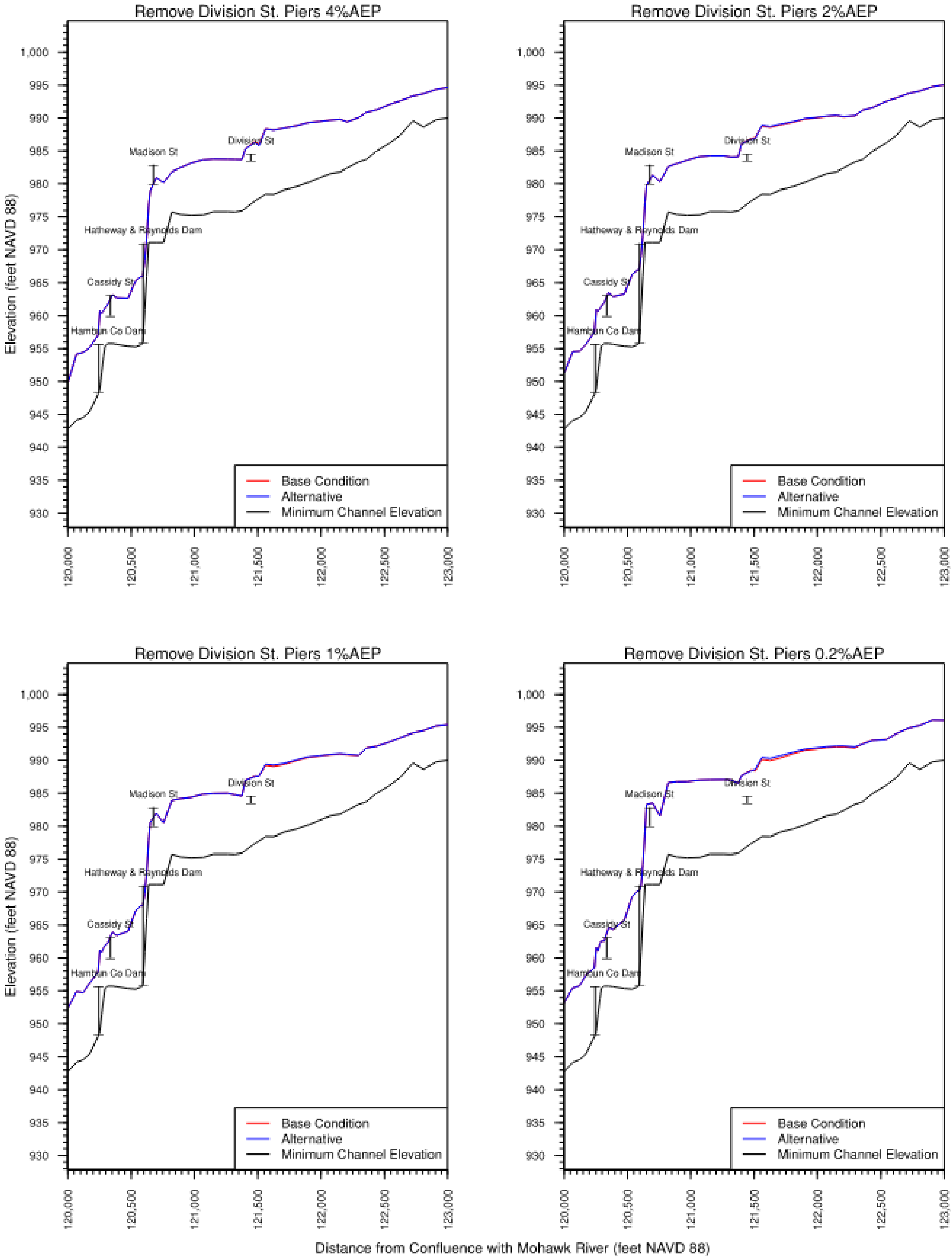


Figure 8-9 (continued). HEC-RAS model simulation output results for Alternative #2-1 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 0.1-ft in the 1-D model simulations for alternative #2-1. The primary benefits of removing the piers in the channel would be to increase the cross-section flow area of the channel and reduce the potential for sediment, debris, and ice to accumulate or catch on the dam. Additionally, the natural flow of the creek will be restored.

8.2.2 Natural Stream Restoration Upstream of Division Street

As mentioned above, the site upstream of Division Street in the Village of Oriskany Falls includes in-channel piers and concrete walls bordering the banks of Oriskany Falls (Figure 8-7).

Natural stream restoration techniques can improve water quality, enhance aesthetic value, improve wildlife habitat and enhance floodplain function. A successful natural stream restoration

project requires following a multi-step process to ensure thorough consideration is given to the planning and design stage before any work in the stream corridor occurs. These steps include (Fleming, et al. 2017):

- Defining the objectives such as flood control, improving recreation, improving habitat, or reducing bank erosion;
- Assessing the current condition of the stream including:
    - noting any downcutting or widening;
    - the amount, type, and condition of bank vegetation;
    - changes in the watershed upstream, or features downstream that are constricting flow;
- Determining the best course of action, which can include re-vegetation plans, riparian buffers, channel and bank stabilization, and other stream redesign and construction projects; and
- Constructing the selected stream restoration strategy, which can involve reshaping the stream channel and floodplain, building in-stream structures, protecting the banks, and removing invasive vegetation.

This mitigation strategy proposes restoring the channel of Oriskany Creek upstream of Division Street to a natural stream employing restoration techniques discussed to reduce sediment aggradation and flood risk for downstream areas of Oriskany Creek (Figure 8-10).

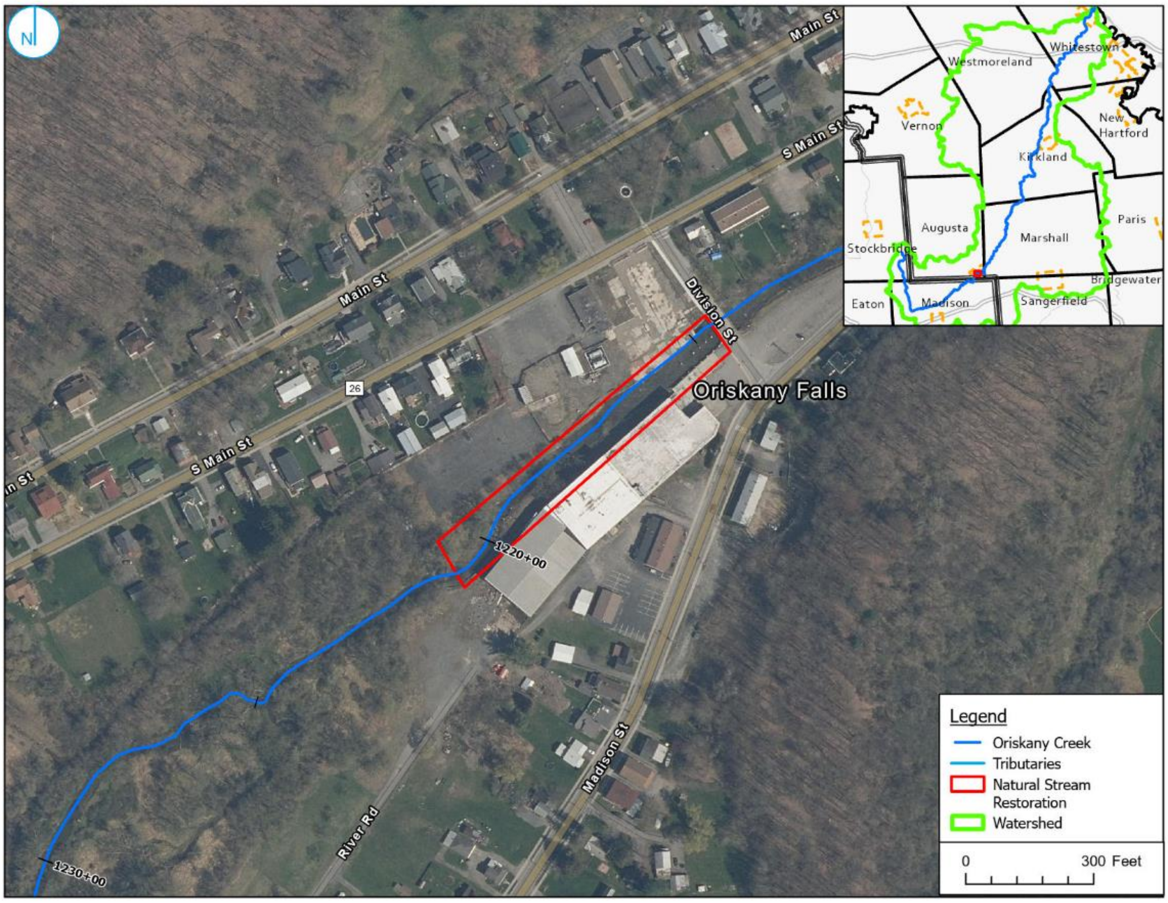


Figure 8-10. Location map for proposed stream restoration upstream of Division Street, Oriskany Falls, NY.

The primary benefits of restoring the channel geometry of Oriskany Creek in this reach would be to increase the flow capacity through the bridge structure and help prevent debris and ice from catching on sediment bars and large debris that have accumulated in this reach.

8.2.3 Floodplain Bench Upstream of Division Street

This mitigation alternative will reconnect the floodplain to the creek with a flood bench at the property upstream of Division Street. More information about the property is located in Section 8.2.1. The benefits of a flood bench will provide additional water storage and increase the floodplain width compared to the current storage and width from the concrete armored channel. Additionally, floodplain benches have shown to trap sediment, stimulate sediment eddies and promote sediment retention (Iowa Department of Natural Resources 2018). Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench.

Two flood bench alternatives were modelled for Alternative #2-3. Both benches are preliminarily designed to be the same size, approximately 2.3-acres, and they are both located between RS 1214+80 to 1220+70 (Figure 8-11). Flood bench A is designed to the adjacent areas on the left bank of Oriskany Creek. The design of flood bench B includes the same area and the removal on the in-channel piers. The current conditions of the property are shown in Figure 8-12. The image is taken from Division Street in the Village of Oriskany Falls.

Figure 8-11. Placement of proposed flood benches in the Village of Oriskany Falls.

Figure 8-12. Current conditions of the property looking upstream of Division Street.

The flood bench used for the proposed condition model simulation is designed to ensure the minimum bench elevation is approximately equal to the bankfull elevation. The average depth of the bench is about 9-ft.
The flood bench is within the FEMA designated Zone A or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood event) as determined in the FIS by detailed methods and where base flood elevations are provided (FEMA 2013). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 20 outlines the results of the proposed conditions from the model simulation. Figure 8-13 displays the profile plots for the flood bench alternatives. Full model outputs for this alternative can be found in Appendix E.

Table 20. Summary of results for Alternative #2-3 with proposed conditions based on the 1% ACE

Proposed Conditions	Flood Bench A	Flood Bench B
Reductions in Water Surface Elevations	Up to 2.4-ft	Up to 2.4-ft
Total Length of Benefited Area	875-ft	875-ft
River Stations	1215+50 to 1224+25	1215+50 to 1224+25

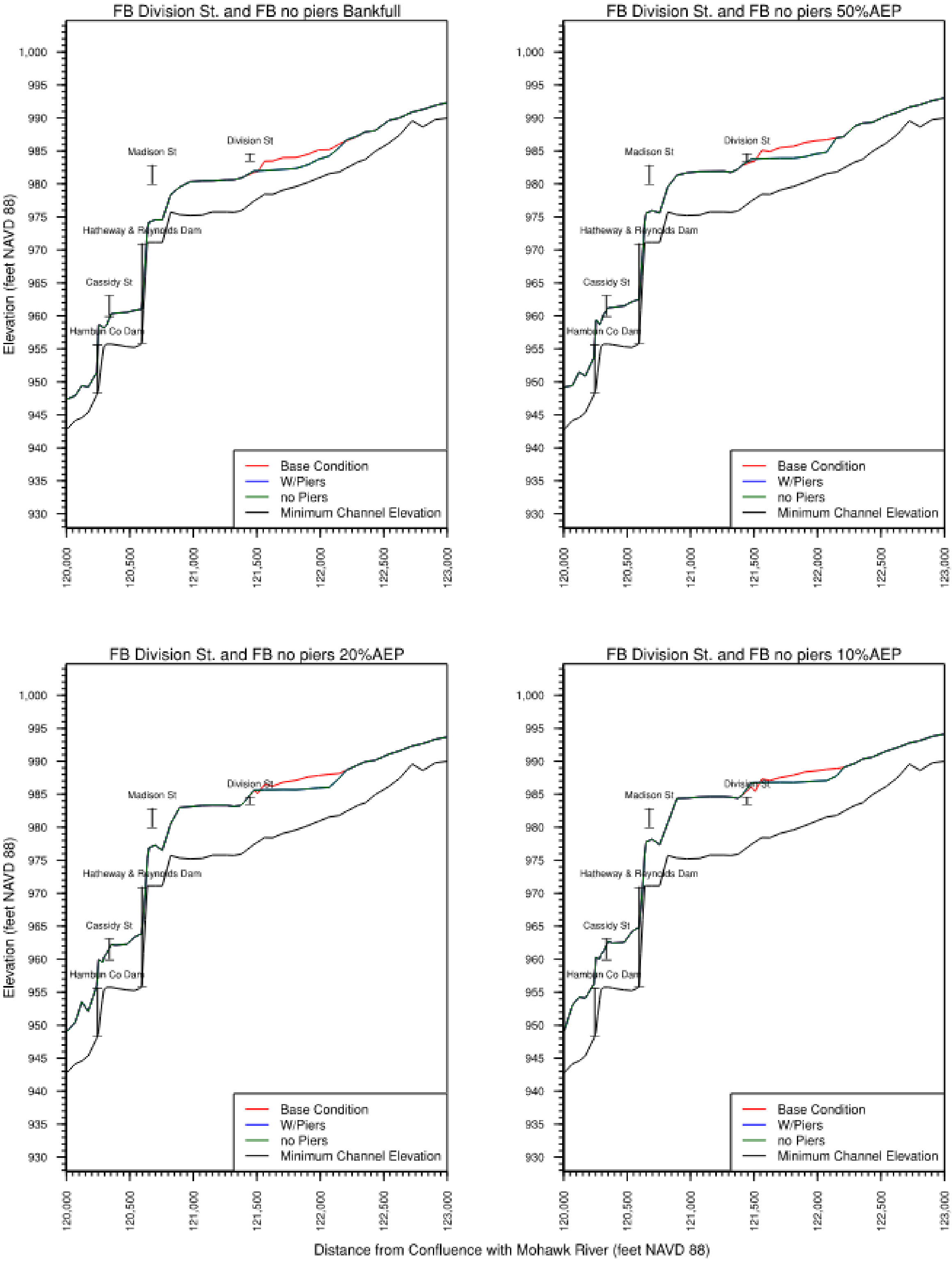


Figure 8-13. HEC-RAS model simulation output results for Alternative #2-3 for the existing condition (red) and proposed alternative (blue) scenarios.

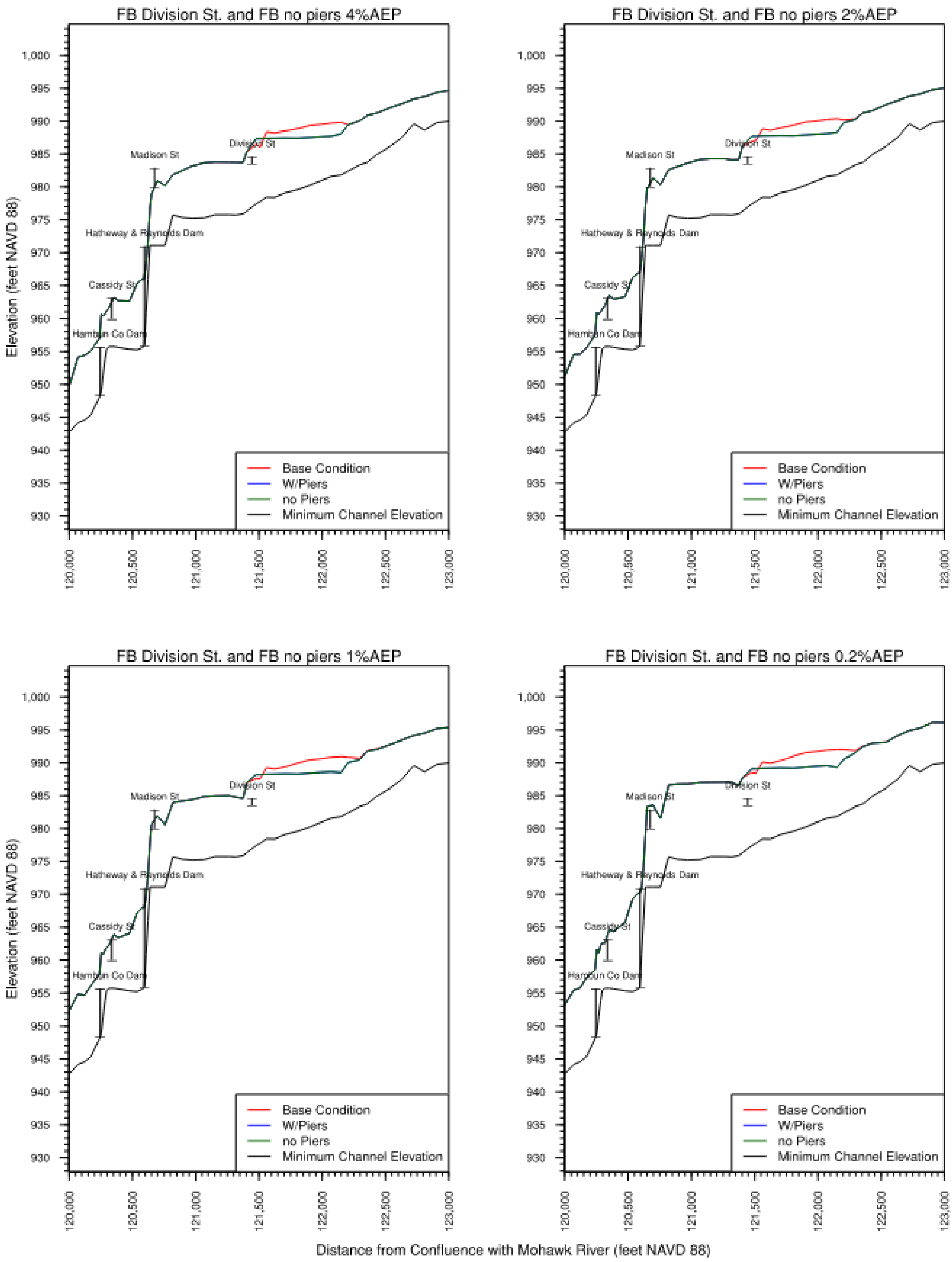


Figure 8-13 (continued). HEC-RAS model simulation output results for Alternative #2-3 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 2.4-ft in the 1-D model simulations for both flood benches in alternative #2-3.

For this alternative to be feasible, a land acquisition is required to convert the recreational area into a natural area which will increase the water storage along the channel. Flood benches create a natural environment and during dry periods, this area could be utilized as a recreational area. Additionally, according to the *NYSDEC Site Characterizations Report* for this site, some toxic metals and volatile organic compounds (VOCs) are present at this location which might affect the project costs for disposal of the excavated material (NYSDEC 2021).

8.2.4 Streambank Stabilization Strategies

Erosion of streambanks in several locations threaten property damage and also increase the amount of sediment entering the creek. To assess the applicability of different streambank stabilization strategies under higher frequency lower-flow conditions, channel velocity (feet per second) and shear stress (pounds per square foot) were calculated using the HEC-RAS software for the existing conditions model at the 10% AEP. A description of the velocity and shear stress variables are identified in section 5.2.

Based on the channel velocities and shear stresses, Table 21 summarizes the potential streambank stabilization measures along Oriskany Creek in Zone 2. The entire reach was studied for all possible streambank stabilization strategies and can be applied for future projects if applicable.

Table 18 lists the average cost per linear foot for each streambank stabilization type discussed in Table 21. Figure 8-14 displays the results of the hydraulic model simulations for Zone 2 for the eight different annual chance flood events and the two erosional/depositional variables. Additional geomorphic and engineering analyses, including additional modeling, would be necessary in order to determine the most appropriate streambank stabilization strategy and its associated costs.

Table 21. Streambank Stabilization Strategies for Zone 2, the Town of Augusta

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Brush Mattresses	Staked only w/ rock riprap toe (initial)	1220+00 to 1230+00	Brush mattresses include live stakes and fascine bundles with branch cuttings, dead stout stakes, and geotextile fabric.
	Staked only w/ rock riprap toe (grown)	1190+00 to 1240+00	
Coir Geotextile Roll	Roll with coir rope mesh staked only without rock riprap toe	1220+00 to 1230+00	Vegetative logs placed in densely packed coconut fiber rolls act as a natural retaining wall to prevent erosion.
	Roll with Polypropylene rope mesh staked only without rock riprap toe	1210+00 to 1240+00	
	Roll with Polypropylene rope mesh staked and with rock riprap toe	1190+00 to 1240+00	
Live Fascine	Live Fascine Bundle with rock riprap toe	1210+00 to 1240+00	Live fascine bundles include live woody cuttings in a bundle and buried into the bank of the stream parallel to the stream's flow.
Soils	Shale and Hardpan	1220+00 to 1230+00	Shale and hardpan are compact rocks that can protect the streambank from erosion in areas with low shear stress and velocities. This treatment may be difficult for vegetation to establish along the banks with the presence of shale and hardpan.
Gravel/Cobble	6-in diameter	1210+00 to 1240+00	Lining the streambank with gravel that has a diameter of at least 6-inches will help protect the streambank from erosion.
	12-in diameter	1190+00 to 1240+00	
Vegetation	Class A turf (ret class)	1210+00 to 1240+00	A streambank that is covered with native vegetation such as Class A, Class B, or Class C turf (ret class), long grasses, or hardwood tree plantings will establish protection and increase erosion resistance along the bank.
	Class B turf (ret class)	1210+00 to 1240+00	
	Class C turf (ret class)	none	
	Long native grasses	1220+00 to 1230+00	
Soil Bioengineering	Wattles	none	Soil bioengineering treatments to reduce streambank erosion in this area includes wattles, reed fascines, coir roll, vegetated coir
	Reed fascine	1220+00 to 1230+00	
	Coir roll	1210+00 to 1240+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
	Vegetated coir mat	1190+00 to 1200+00; 1210+00 to 1240+00	mat, live brush mattress, brush layering, and live willow stakes. Place live stakes in areas with increased deposition and minimal erosion.
	Live brush mattress (initial)	none	
	Live brush mattress (grown)	1190+00 to 1240+00	
	Brush layering (initial/grown)	1190+00 to 1240+00	
	Live fascine	1210+00 to 1240+00	
	Live willow stakes	1190+00 to 1200+00; 1210+00 to 1240+00	
Boulder Clusters	Very large (>80-inch diameter)	1190+00 to 1240+04	Boulders of different diameters may protect the stream and protect the stream from erosion.
	Large (>40-in diameter)	1190+00 to 1240+00	
	Medium (>20-inch diameter)	1190+00 to 1240+00	
	Small (>10-inch diameter)	1190+00 to 1200+00; 1210+00 to 1240+00	
	Large (>5-inch diameter)	1210+00 to 1240+00	
	Small (>2.5-inch diameter)	1220+00 to 1230+00	

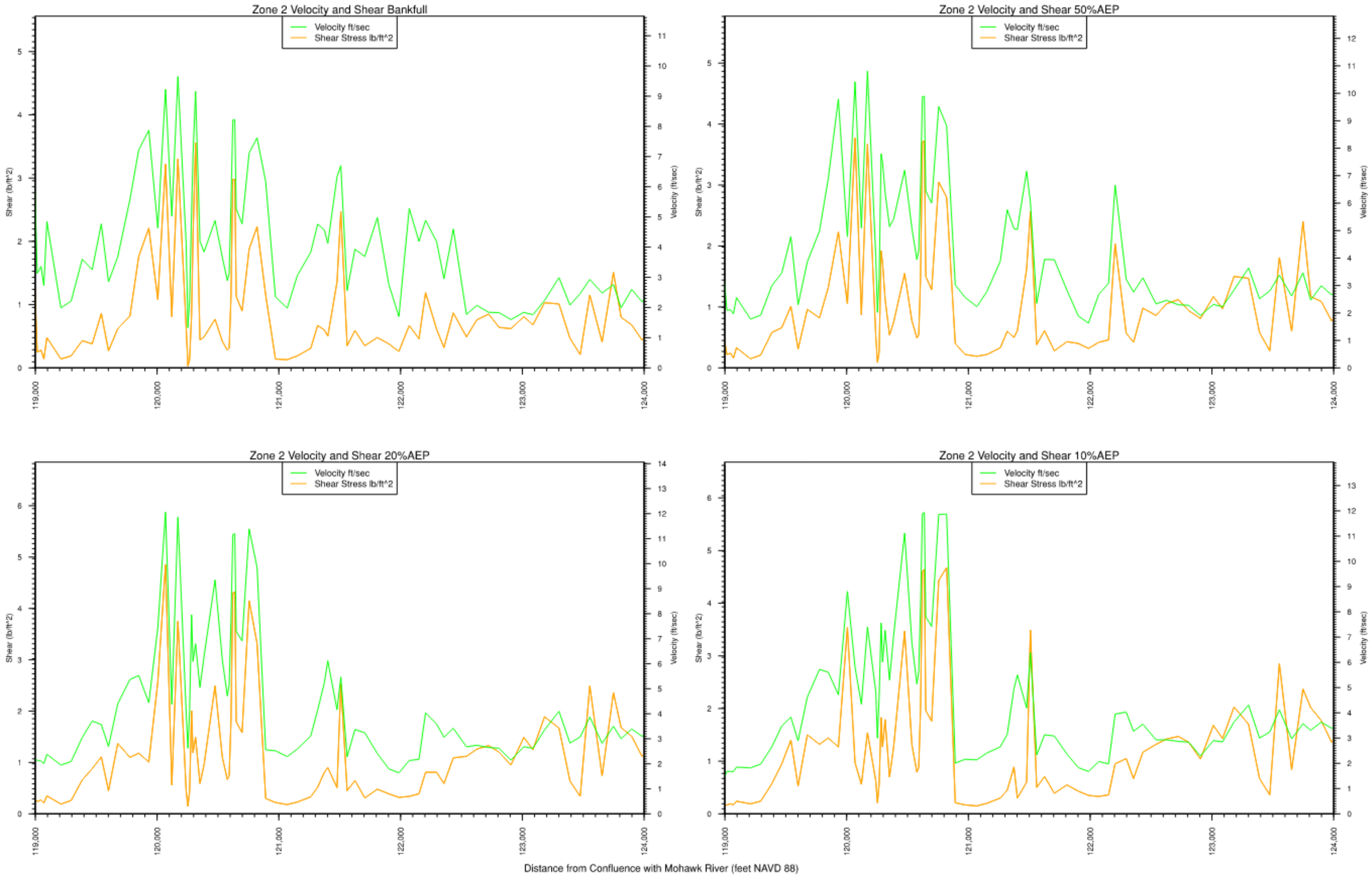


Figure 8-14. Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 2.

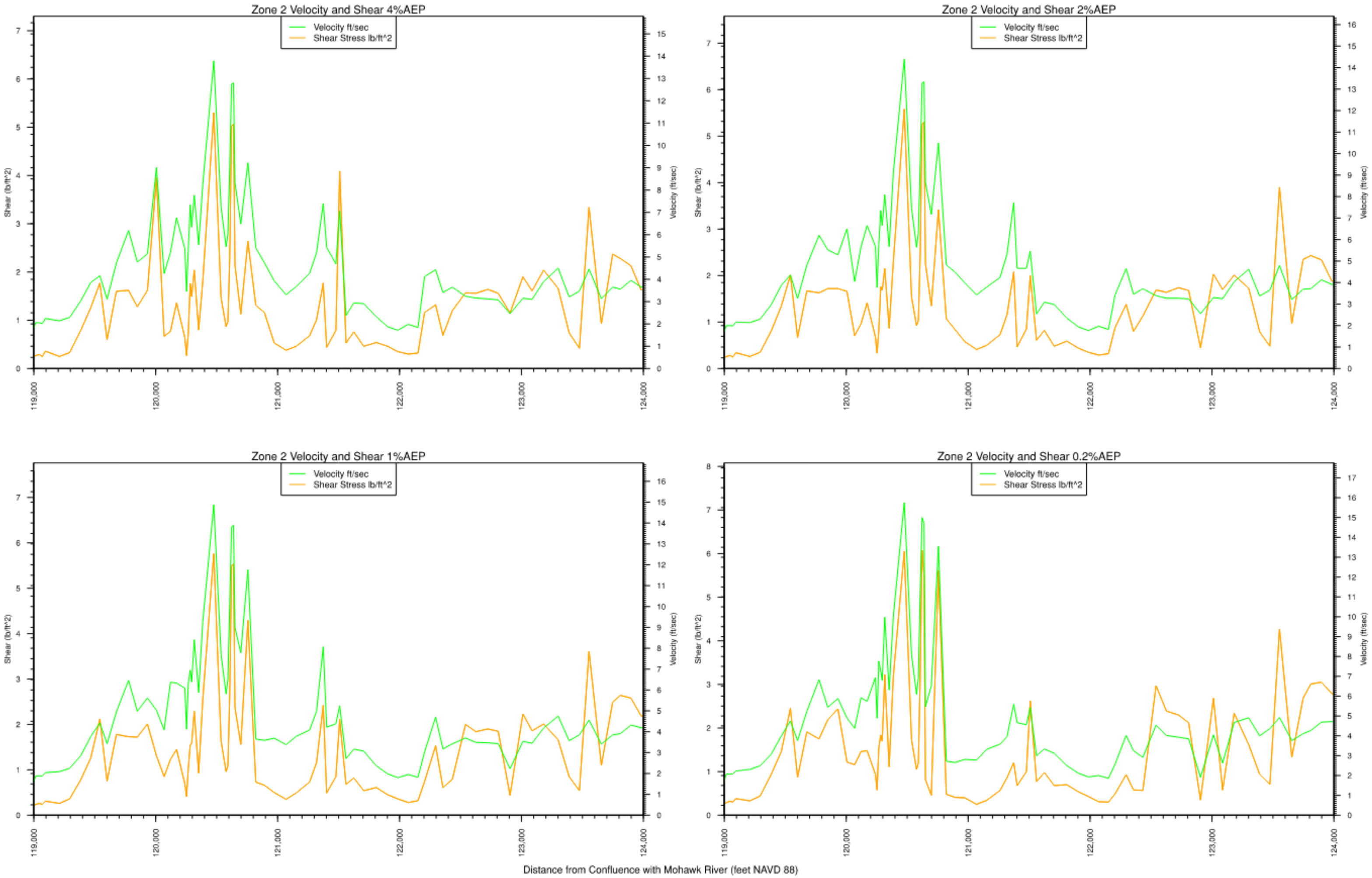


Figure 8-14 (continued). Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 2.

8.3 ZONE 3 - TOWN OF MARSHALL, ONEIDA COUNTY

8.3.1 Increase Riparian Buffers along Oriskany Creek for the Reach Adjacent to Heidelberg Materials Quarry

Riparian buffers are areas adjacent to waterbodies where trees, shrubs, grass, or other vegetation are planted to create a natural space between the waterway channel and overbank areas. Riparian buffers are intended to protect water quality and aquatic habitats, but provide a variety of other benefits including erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and can reduce the impact from floods (NRCS 1998).

Riparian buffers should be designed using the "three-zone" concept. Zone 1 is the area closest to the waterway channel where native and water-tolerant trees and large shrubs that require minimal maintenance should be planted. These trees and shrubs provide streambank stabilization, leaf litter inputs to the stream and overbank, and shade to the waterway. Ideally, Zone 1 should be at least 15-feet wide. Upland from Zone 1 is Zone 2 that can range from 20 to 60-feet wide and should incorporate vegetation with native, fast growing, small, and shade-tolerant tree or shrub species. In Zone 2, runoff is absorbed and infiltrated into the soil where nutrient and other pollutants are filtered by the soil. Zone 3, furthest from the waterway channel and ranging in width from 15 to 60 feet, should include vegetation with plants that slow fast-moving water runoff and filter sediment, such as native grasses, wildflowers, and other herbaceous plants. The total minimum recommended width for all three zones is 100 feet by the NYSDEC (NYSDEC [unknown] a).

Along Oriskany Creek, the reach between RS 1105+00 and 1166+00 is adjacent to Heidelberg Materials Quarry currently has a minimal riparian buffer (Figure 8-15). The main product of the active quarry is limestone aggregates, and the quarry operates over an approximate area or 195.2-acres. There is little to no buffer that prevents runoff, sediment, and/or pollutants from directly entering the creek. By installing a riparian buffer with all three zones along this reach, the runoff from the quarry will be reduced. Additional consideration would also be required to determine the most appropriate riparian buffer vegetation and range of zones.

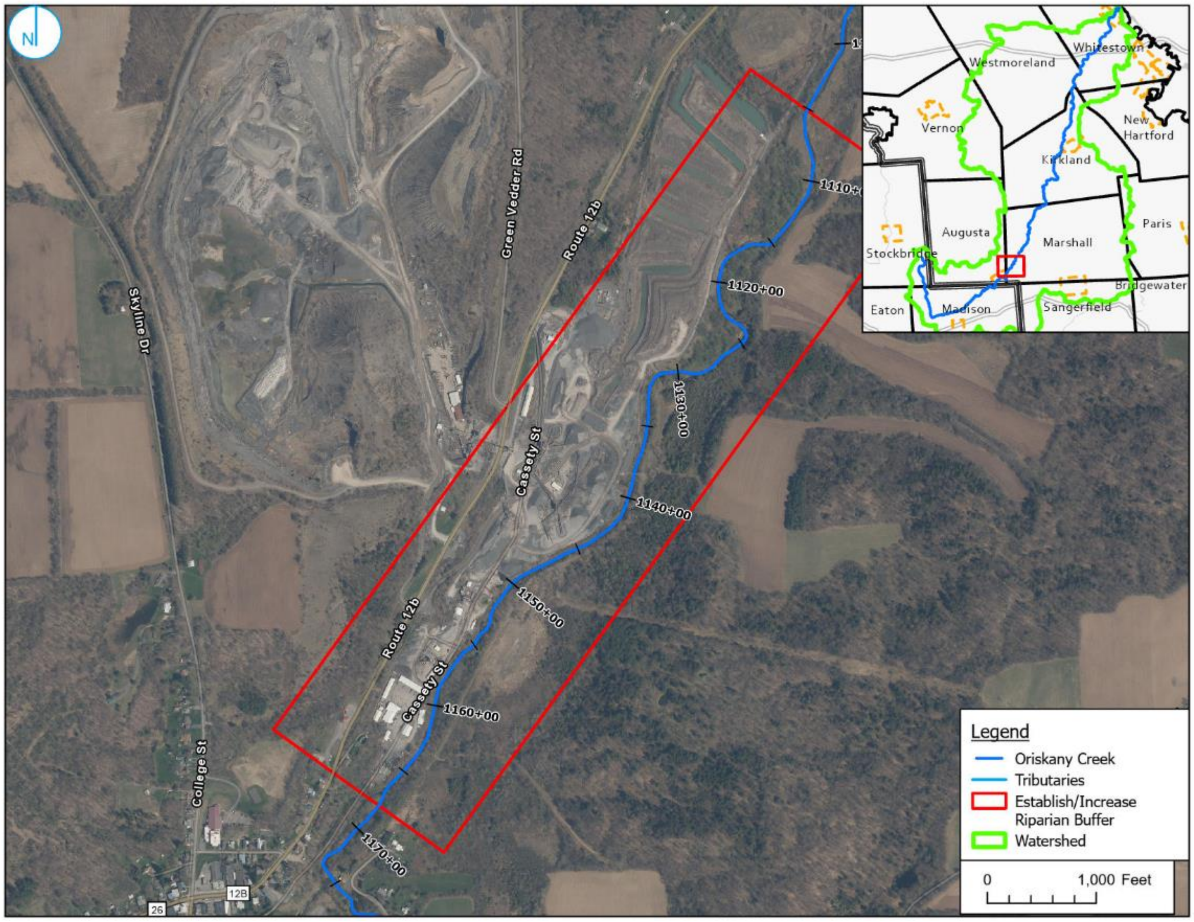


Figure 8-15. Location map for riparian buffer along Oriskany Creek for Alternative #3-1.

8.3.2 Establish/Increase Riparian Buffers along Agricultural Lands Adjacent to Oriskany Creek

Along Oriskany Creek, four different reaches along agricultural fields in the Town of Marshall between the following river stations (ft):

- 872+50 to 926+00
- 944+00 to 984+00
- 1070+00 to 1126+00

Figure 8-16 shows these reaches have little to no buffer that prevents runoff, sediment, and/or pollutants from directly entering the creek. By installing a riparian buffer with all three zones along this reach, the runoff from the agricultural fields will be reduced. Additional consideration would also be required to determine the most appropriate riparian buffer vegetation and range of zones.

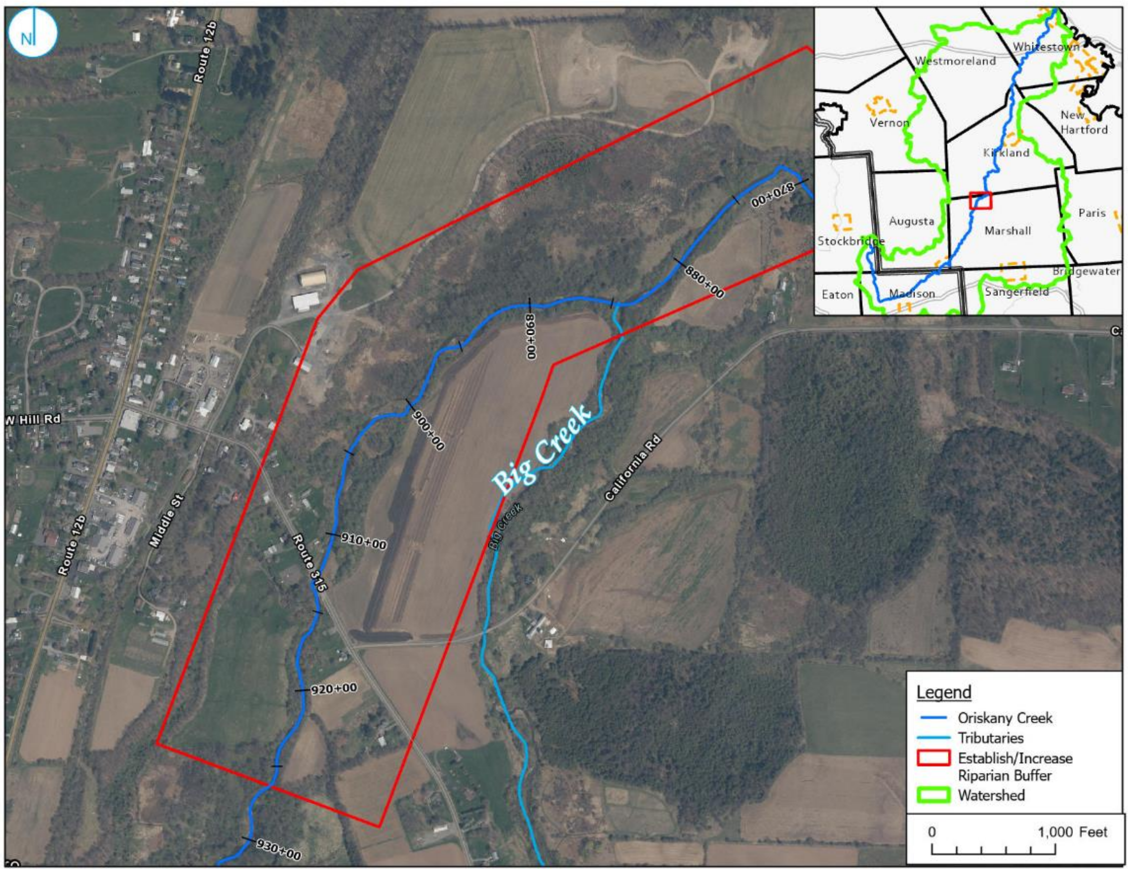


Figure 8-16. Location map for riparian buffers along Oriskany Creek for Alternative #3-1.

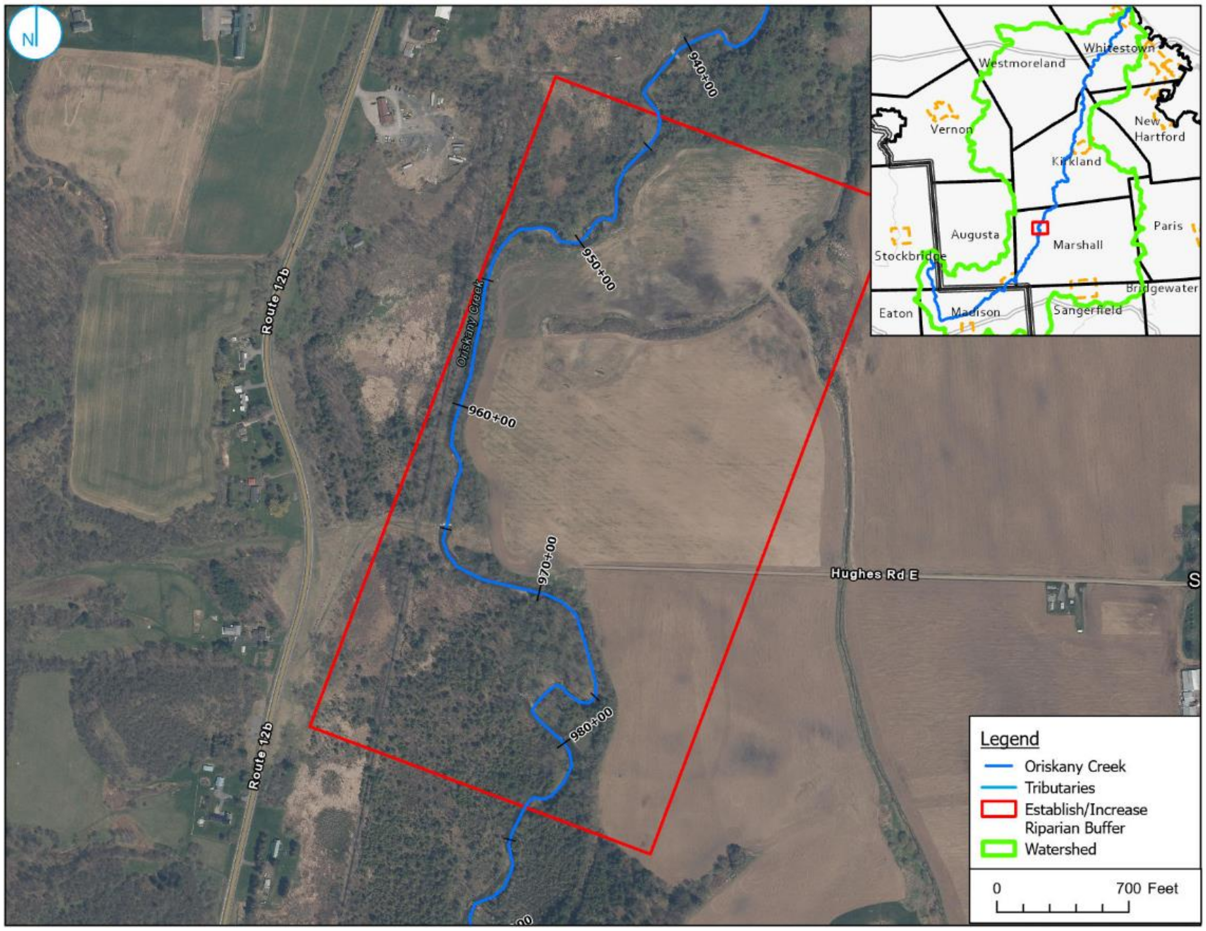


Figure 8-16. (continued). Location map for riparian buffers along Oriskany Creek for Alternative #3-1.

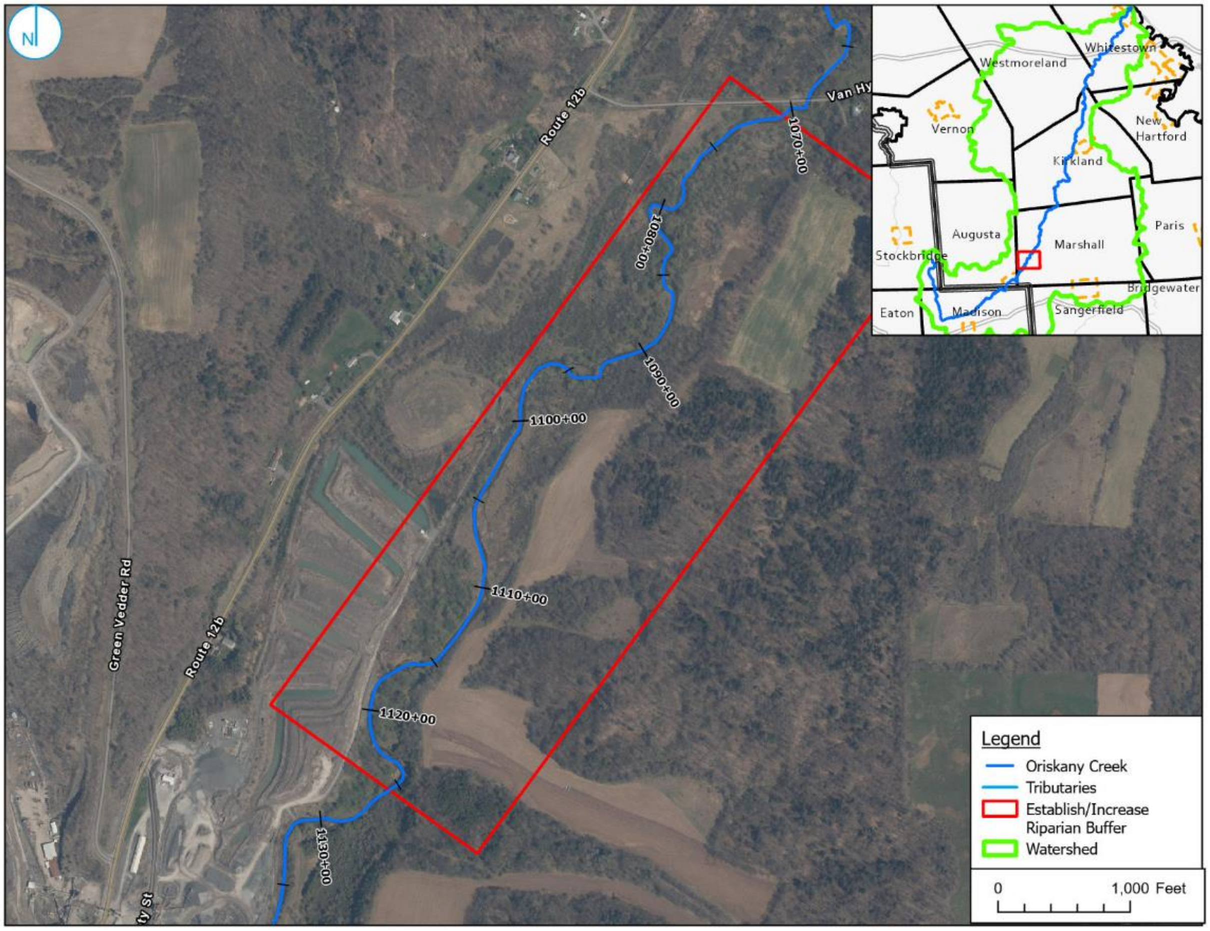


Figure 8-16 (continued). Location map for riparian buffer along Oriskany Creek for Alternative #3-1.

8.3.3 Restore Hydraulic Capacity of the NY-315 Bridge along Oriskany Creek

The NY-315 bridge (BIN #1045640) that crosses Oriskany Creek is owned by NYSDOT and replaced in 2016. The creek experiences a sharp turn under the bridge as shown in Figure 8-17. The right bank is armored with stone conglomerates and blocks half of the bridge opening from the pier in the middle to the right bank. Additionally, large rocks, like rip-rap, protect the left bank.

Figure 8-17. Upstream view of Oriskany Creek under the NY-315 Bridge in the Town of Marshall, NY.

The H&H modeling incorporates blocked obstructions to simulate the blockage of the stream halfway through the bridge. The model for the proposed alternative is a scenario where the blocked obstruction under the bridge is removed. No adjustments were made to the bridge dimensions in this scenario. By eliminating the blocked obstruction, the cross-sectional flow area of the channel will increase at RS 913+00 (Figure 8-18).

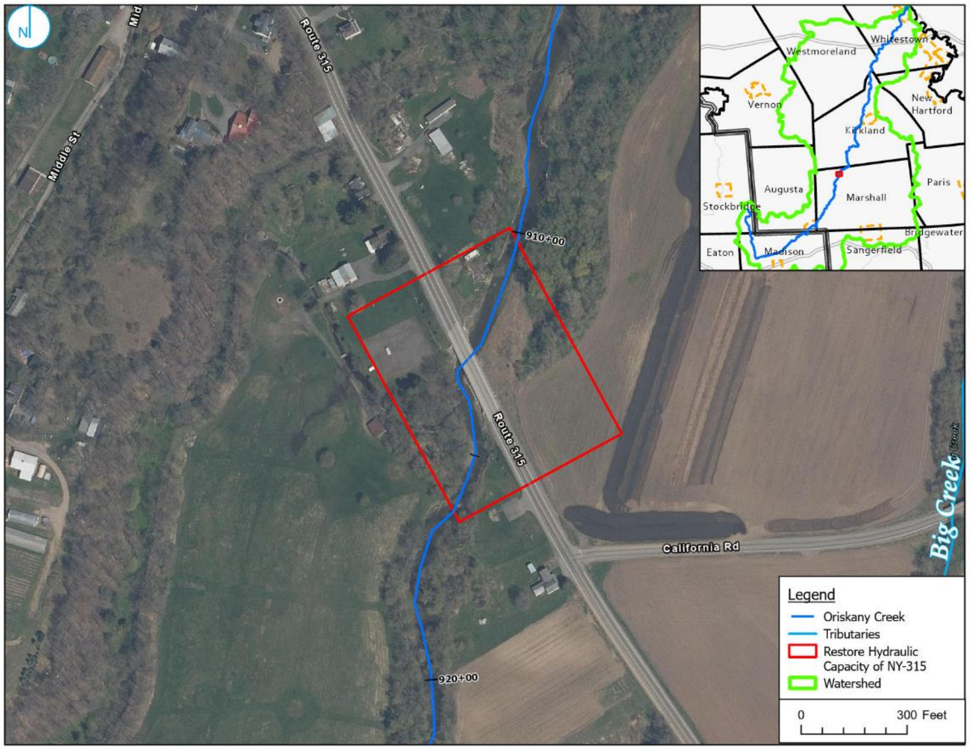


Figure 8-18. Location Map of NY-315 bridge for Alternative #3-3.

The existing conditions model shows the 10%, 4%, 2%, 1% and 0.2% ACE WSELs do not successfully pass under the NY-315 bridge. Additionally, the bridge and the blocked obstructions in the channel act as a catchpoint for large sediment and debris. Restoring the cross-sectional flow area of the channel under the bridge will increase movement of water during high-flood events and decrease the potential for sediment and debris to accumulate, thereby reducing flood risk to areas adjacent to and immediately upstream of the bridge.

For this alternative, open-water simulations were performed to test the effectiveness of the alternative at reducing water surface elevations for restoring the hydraulic capacity at the NY-315 bridge over Oriskany Creek. Table 22 outlines the results of the proposed conditions from the model simulation. Figure 8-19 displays the profile plots for restoring the hydraulic capacity of NY-315 simulation. Full model outputs for this alternative can be found in Appendix E. The flooding in the vicinity of the NY-315 bridge poses a flood-risk threat to nearby residential properties, agricultural lands, and infrastructure.

Table 22. Summary of Results for Alternative #3-3 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	Increased Hydraulic Capacity
Reductions in Water Surface Elevations	Up to 2.5-ft
Total Length of Benefited Area	500-ft
River Stations	914+00 to 919+00

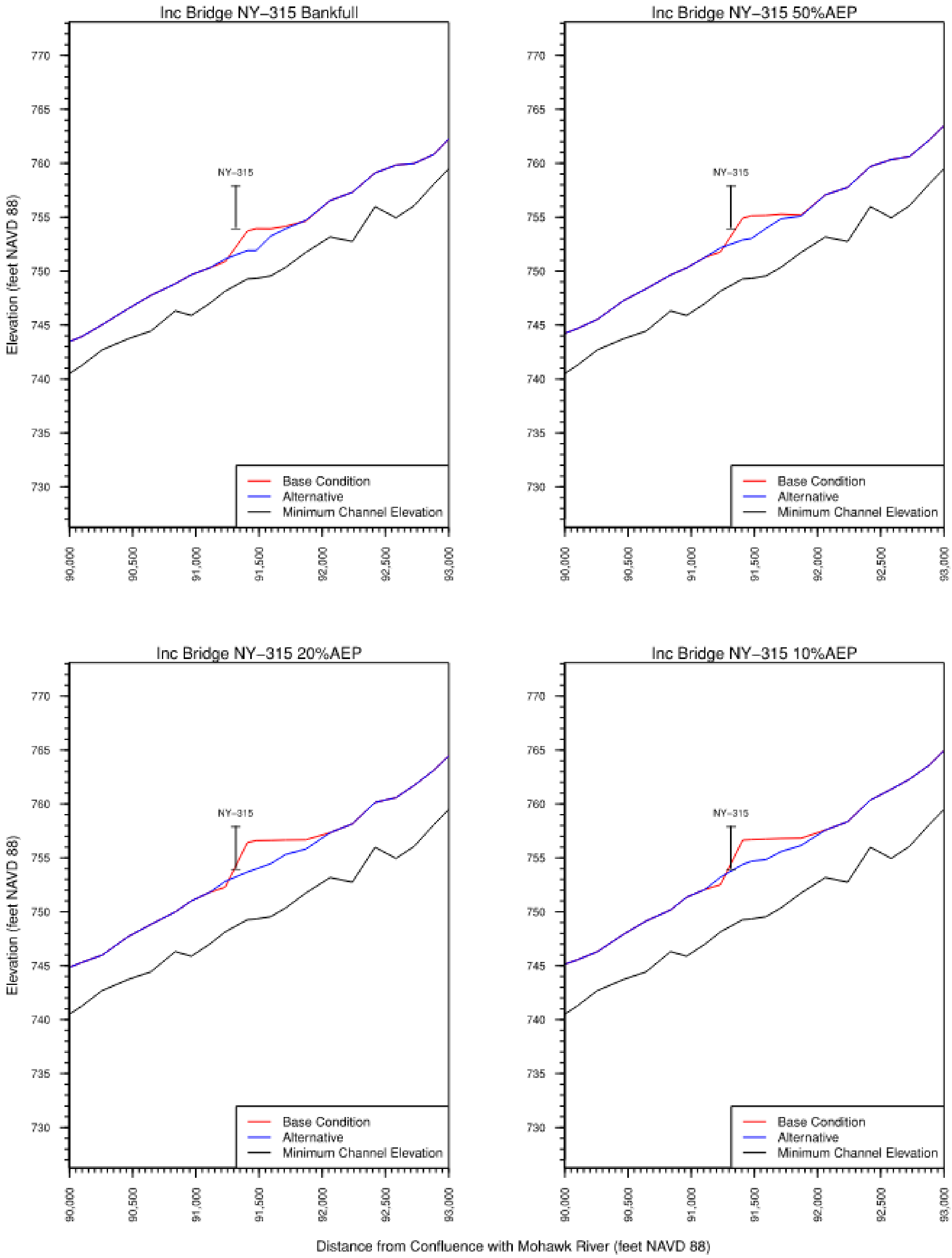


Figure 8-19. HEC-RAS model simulation output results for Alternative #3-3 for the existing condition (red) and proposed alternative (blue) scenarios.

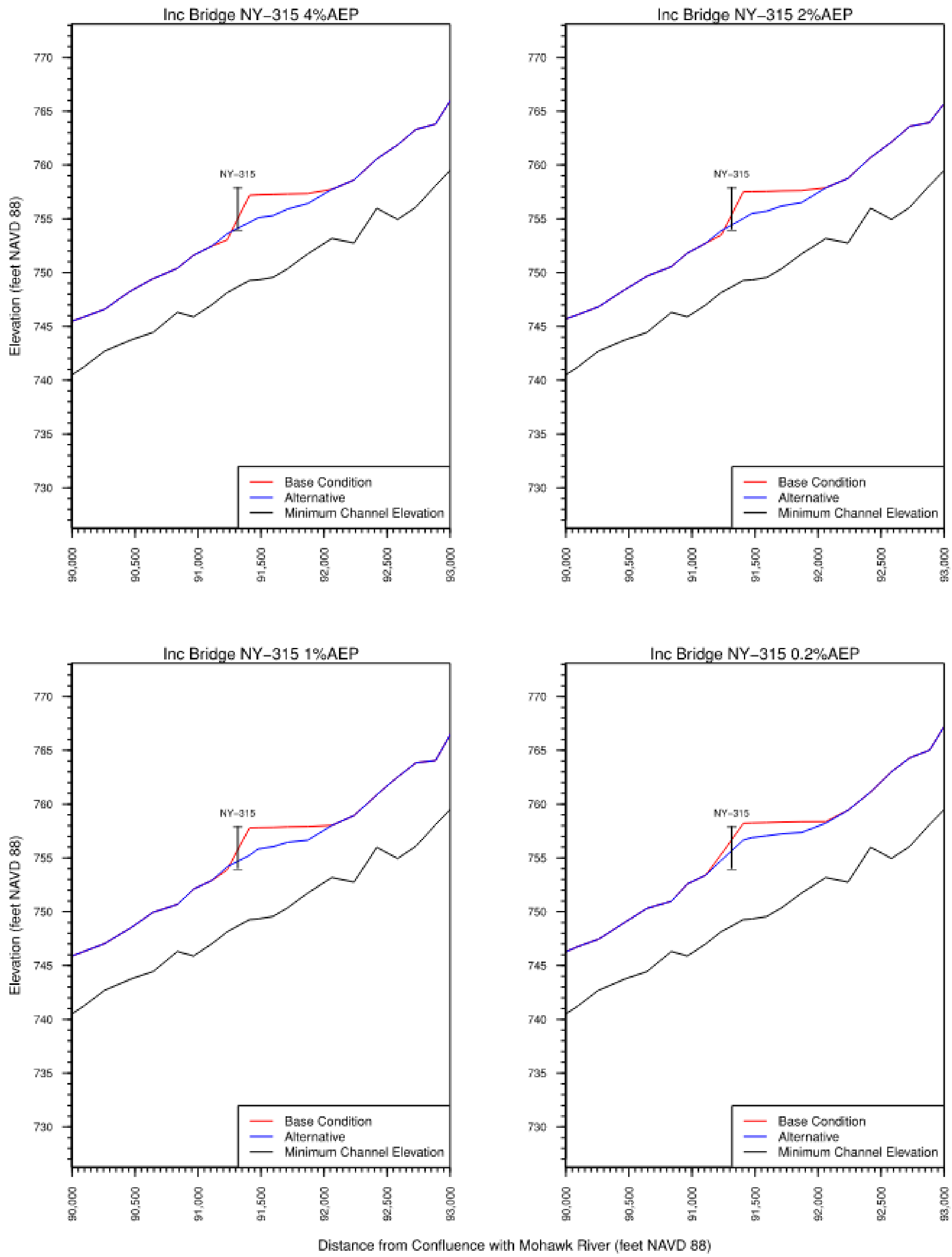


Figure 8-19 (continued). HEC-RAS model simulation output results for Alternative #3-3 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 2.5-ft in the 1-D model simulations in alternative #3-3. Results also indicate an adverse effect immediately upstream of the NY-315 bridge where the proposed alterative will increase the WSEL by 0.3-ft. Additional 2-D modelling coupled with a terrain survey is recommended to further investigate the potential water surface reductions.

8.3.4 Streambank Stabilization Strategies

To assess the applicability of different streambank stabilization strategies under higher frequency lower-flow conditions, channel velocity (feet per second) and shear stress (pounds per square foot) were calculated using the HEC-RAS software for the existing conditions model at the 10% AEP. A description of the velocity and shear stress variables are identified in section 5.2.

Based on the channel velocities and shear stresses, Table 23 summarizes the potential streambank stabilization measures along Oriskany Creek in Zone 3. The entire reach was studied for all possible streambank stabilization strategies and can be applied for future projects if applicable.

Table 18 lists the average cost per linear foot for each streambank stabilization type discussed in Table 23. Figure 8-20 displays the results of the hydraulic model simulations for Zone 3 for the eight different annual chance flood events and the two erosional/depositional variables. Additional geomorphic and engineering analyses, including additional modeling, would be necessary in order to determine the most appropriate streambank stabilization strategy and its associated costs.

Table 23. Streambank Stabilization Strategies for Zone 3, the Town of Marshall

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Brush Mattresses	Staked only w/ rock riprap toe (initial)	860+00 to 900+00; 910+00 to 920+00; 930+00 to 950+00; 960+00 to 1000+00; 1020+00 to 1040+00; 1070+00 to 1130+00	Brush mattresses include live stakes and fascine bundles with branch cuttings, dead stout stakes, and geotextile fabric.
	Staked only w/ rock riprap toe (grown)	860+00 to 950+00; 960+00 to 1130+00; 1150+00 to 1190+00	
Coir Geotextile Roll	Roll with coir rope mesh staked only without rock riprap toe	1110+00 to 113+00	Vegetative logs placed in densely packed coconut fiber rolls act as a natural retaining wall to prevent erosion.
	Roll with Polypropylene rope mesh staked only without rock riprap toe	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00; 1020+00 to 1130+00; 1180+00 to 1190+00	
	Roll with Polypropylene rope mesh staked and with rock riprap toe	860+00 to 950+00; 960+00 to 1130+00; 1150+00 to 1190+00	
Live Fascine	Live Fascine Bundle with rock riprap toe	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00; 1020+00 to 1130+00; 1180+00 to 1190+00	Live fascine bundles include live woody cuttings in a bundle and buried into the bank of the stream parallel to the stream's flow.
Soils	Shale and Hardpan	1120+00 to 1130+00; 1180+00 to 1190+00	Shale and hardpan are compact rocks that can protect the streambank from erosion in areas with low shear stress and velocities. This treatment may be difficult for vegetation to establish along the banks with the presence of shale and hardpan.
Gravel/Cobble	6-in diameter	860+00 to 900+00; 910+00 to 950+00; 1020+00 to 1130+00; 1180+00 to 1190+00	Lining the streambank with gravel that has a diameter of at least 6-inches will help protect the streambank from erosion.
	12-in diameter	860+00 to 950+00; 960+00 to 1130+00; 1150+00 to 1190+00	
Vegetation	Class A turf (ret class)	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00;	A streambank that is covered with native vegetation such as Class A, Class B, or Class C turf (ret class), long grasses, or

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
		1020+00 to 1130+00; 1180+00 to 1190+00	hardwood tree plantings will establish protection and increase erosion resistance along the bank.
	Class B turf (ret class)	860+00 to 900+00; 910+00 to 950+00; 1020+00 to 1130+00; 1180+00 to 1190+00	
	Class C turf (ret class)	860+00 to 880+00; 1080+00 to 1090+00	
	Long native grasses	860+00 to 900+00; 910+00 to 940+00; 1020+00 to 1130+00; 1180+00 to 1190+00	
Soil Bioengineering	Wattles	1080+00 to 1090+00	Soil bioengineering treatments to reduce streambank erosion in this area includes wattles, reed fascines, coir roll, vegetated coir mat, live brush mattress, brush layering, and live willow stakes. Place live stakes in areas with increased deposition and minimal erosion.
	Reed fascine	860+00 to 900+00; 1020+00 to 1040+00; 1070+00 to 1130+00	
	Coir roll	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00; 1020+00 to 1130+00; 1180+00 to 1190+00	
	Vegetated coir mat	860+00 to 950+00; 960+00 to 1130+00; 1170+00 to 1190+00	
	Live brush mattress (initial)	860+00 to 900+00; 930+00 to 940+00; 960+00 to 1000+00; 1020+00 to 1030+00; 1070+00 to 1100+00	
	Live brush mattress (grown)	860+00 to 950+00; 960+00 to 1130+00; 1150+00 to 1190+00	
	Brush layering (initial/grown)	860+00 to 950+00; 960+00 to 1130+00; 1150+00 to 1190+00	
	Live fascine	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00; 1020+00 to 1130+00; 1180+00 to 1190+00	
	Live willow stakes	860+00 to 950+00; 960+00 to 1130+00; 1170+00 to 1190+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Boulder Clusters	Very large (>80-inch diameter)	860+00 to 360+00	Boulders of different diameters may protect the stream and protect the stream from erosion.
	Large (>40-in diameter)	860+00 to 360+00	
	Medium (>20-inch diameter)	860+00 to 360+00	
	Small (>10-inch diameter)	860+00 to 950+00; 960+00 to 1130+00; 1170+00 to 1190+00	
	Large (>5-inch diameter)	860+00 to 900+00; 910+00 to 950+00; 960+00 to 1000+00; 102+00 to 1130+00; 1180+00 to 1190+00	
	Small (>2.5-inch diameter)	860+00 to 900+00; 910+00 to 920+00; 930+00 to 950+00; 960+00 to 1000+00; 1030+00 to 1040+00; 1070+00 to 1130+00	

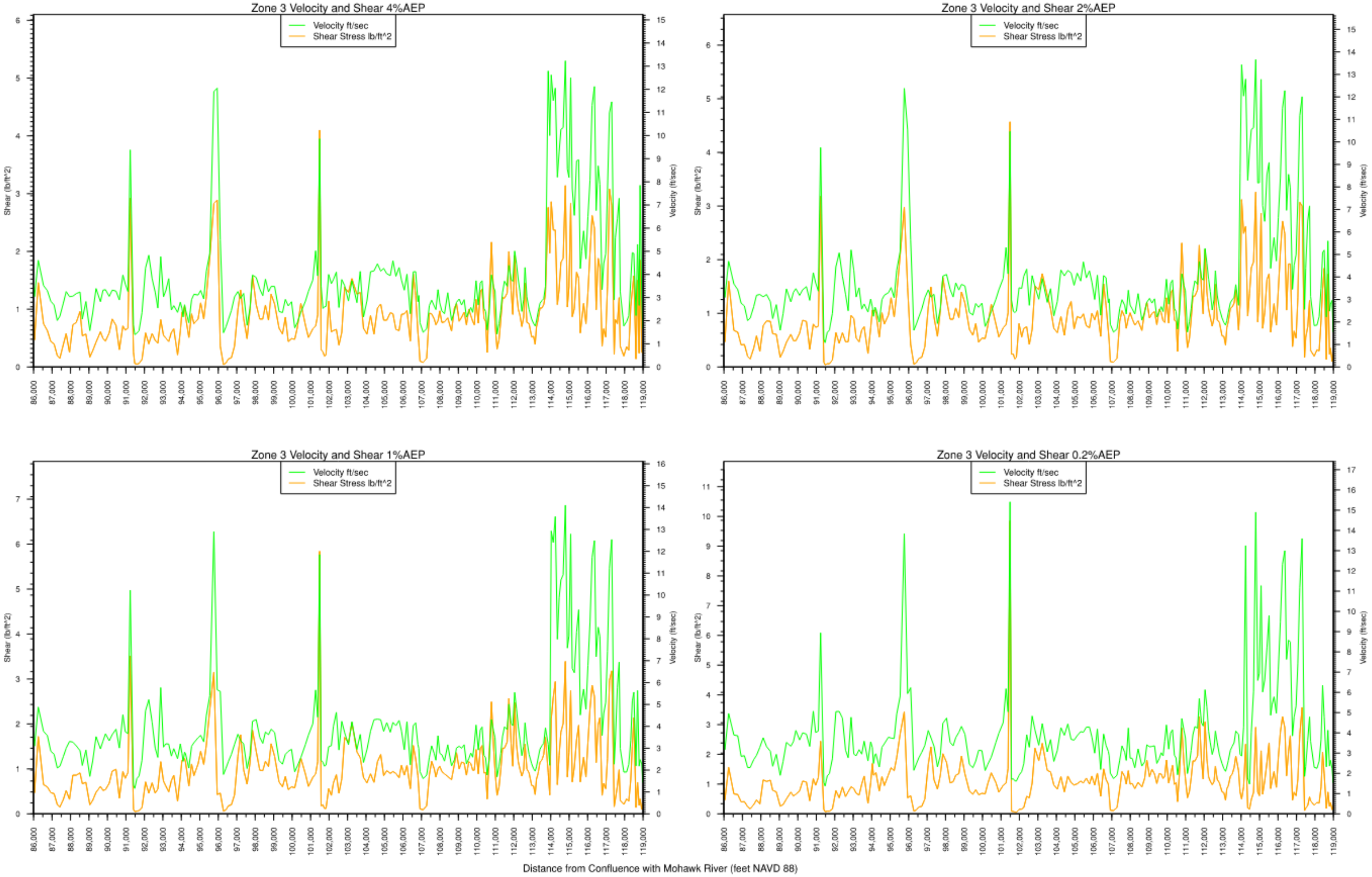


Figure 8-20. Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 3.

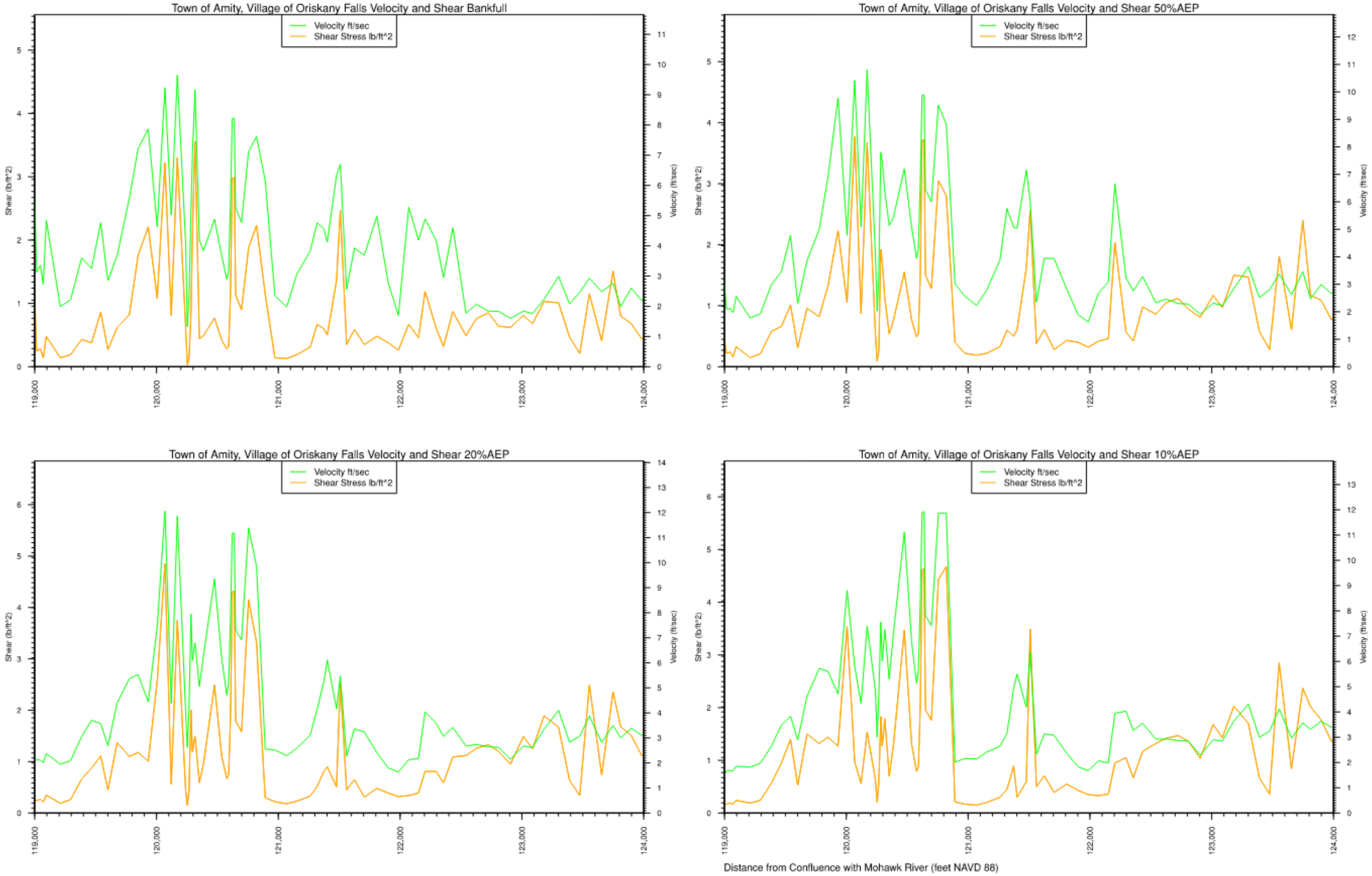


Figure 8-20 (continued). Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 3.

8.4 ZONE 4 – Town of Kirkland, Oneida County

8.4.1 Establish/Increase Riparian Buffers along Agricultural Lands Adjacent to Oriskany Creek

Riparian buffers are areas adjacent to waterbodies where trees, shrubs, grass, or other vegetation are planted to create a natural space between the waterway channel and overbank areas. Riparian buffers are intended to protect water quality and aquatic habitats, but provide a variety of other benefits including erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and can reduce the impact from floods (NRCS 1998).

Riparian buffers should be designed using the "three-zone" concept. Zone 1 is the area closest to the waterway channel where native and water-tolerant trees and large shrubs that require minimal maintenance should be planted. These trees and shrubs provide streambank stabilization, leaf litter inputs to the stream and overbank, and shade to the waterway. Ideally, Zone 1 should be at least 15-feet wide. Upland from Zone 1 is Zone 2 that can range from 20 to 60-feet wide and should incorporate vegetation with native, fast growing, small, and shade-tolerant tree or shrub species. In Zone 2, runoff is absorbed and infiltrated into the soil where nutrient and other pollutants are filtered by the soil. Zone 3, furthest from the waterway channel and ranging in width from 15 to 60 feet, should include vegetation with plants that slow fast-moving water runoff and filter sediment, such as native grasses, wildflowers, and other herbaceous plants. The total minimum recommended width for all three zones is 100 feet by the NYSDEC (NYSDEC [unknown] a).

Along Oriskany Creek, four different reaches along agricultural fields in the Town of Kirkland between the following river stations (ft):

- 354+00 to 375+50 (portions of this reach is within the Town of Whitestown)
- 560+00 to 585+00
- 660+00 to 703+00
- 755+00 to 813+00

Figure 8-21 shows these reaches have little to no buffer that prevents runoff, sediment, and/or pollutants from directly entering the creek. By installing a riparian buffer with all three zones along this reach, the runoff from the agricultural fields will be reduced. Additional consideration would also be required to determine the most appropriate riparian buffer vegetation and range of zones.

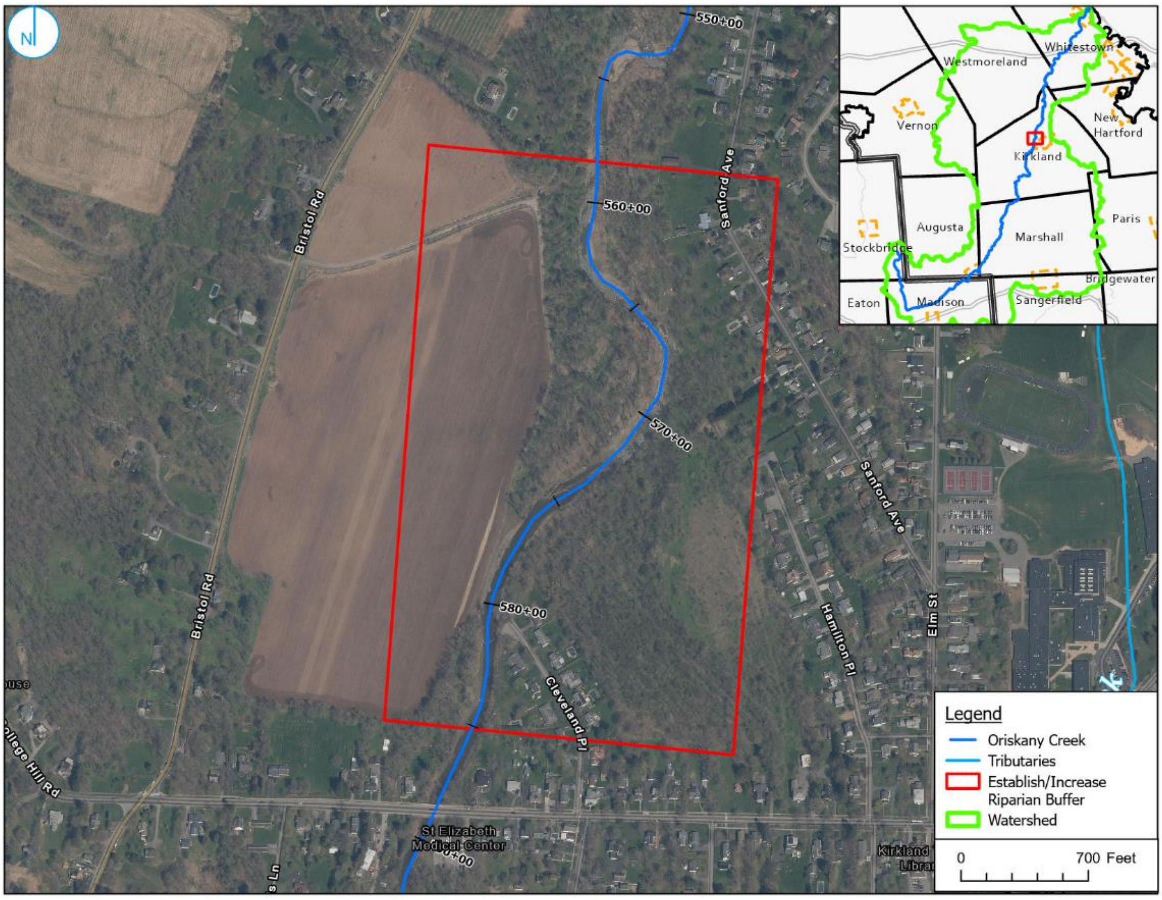
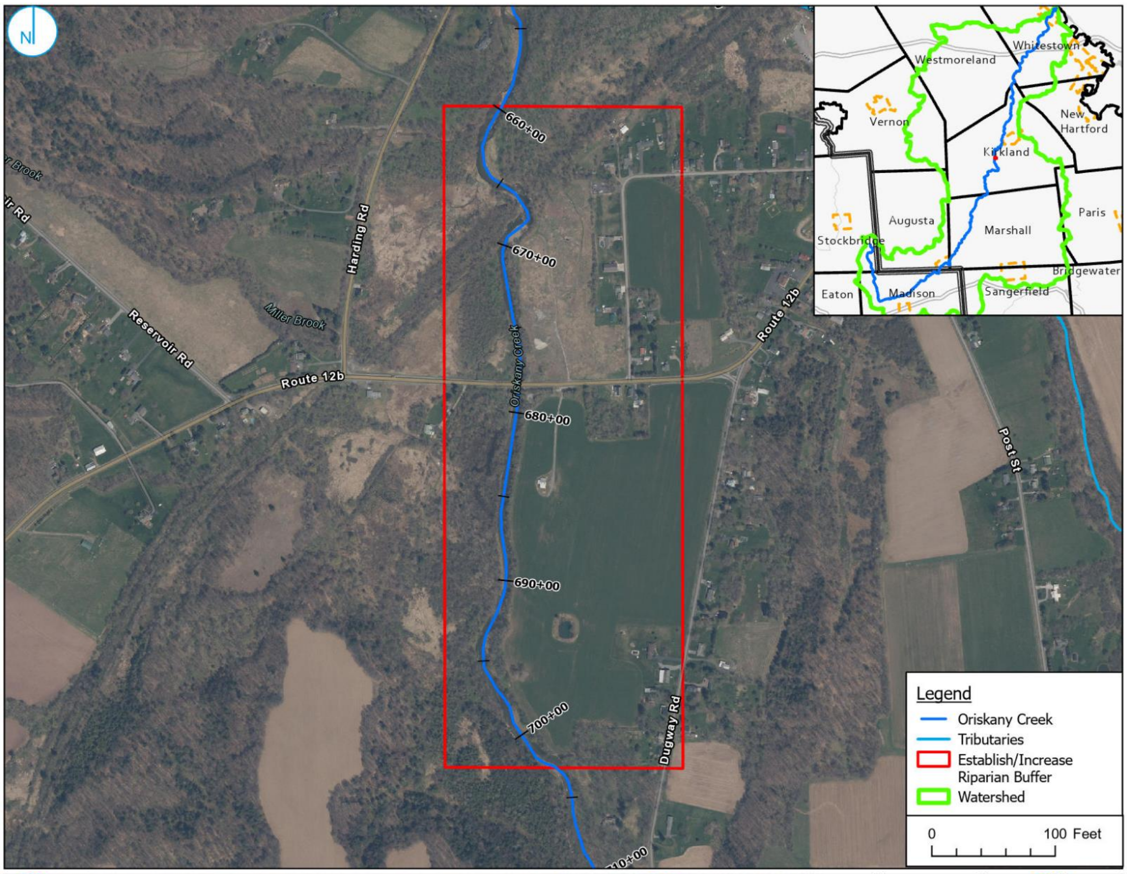


Figure 8-21. Location map for riparian buffer along Oriskany Creek for Alternative #4-1.



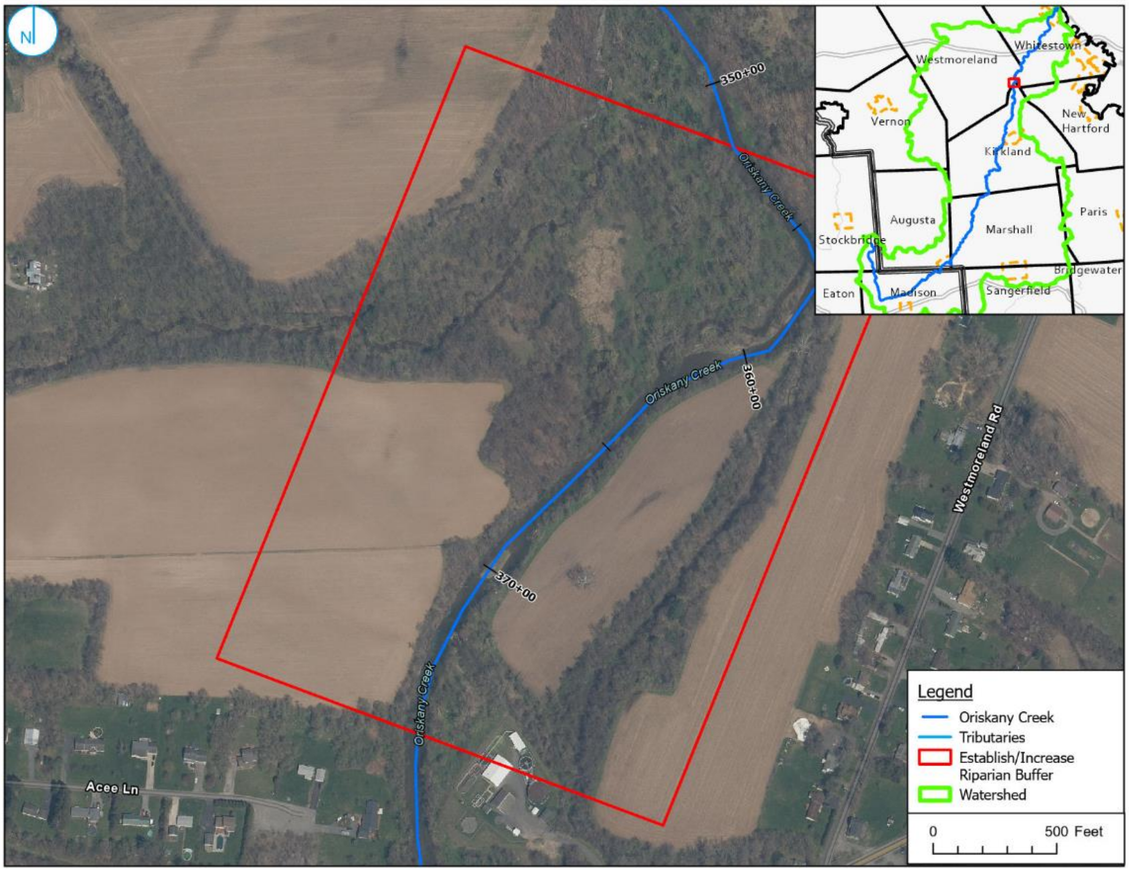


Figure 8-21 (continued). Location map for riparian buffer along Oriskany Creek for Alternative #4-1.

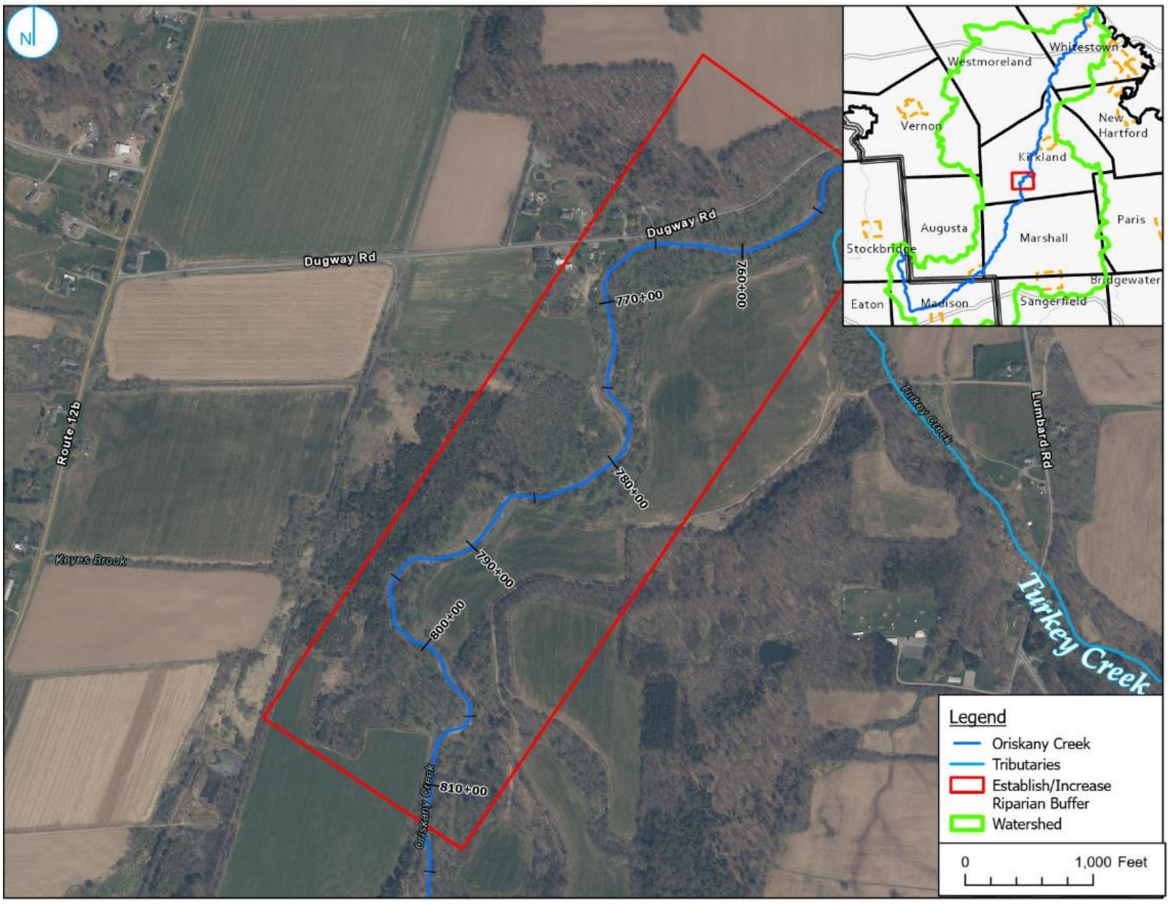


Figure 8-21 (continued). Location map for riparian buffer along Oriskany Creek for Alternative #4-1.

8.4.2 Increase Hydraulic Capacity of the NY-5 Bridge along Oriskany Creek

The NY-5 bridge (BIN #1002200) that crosses Oriskany Creek is owned by NYSDOT and built in 1998. The right bank is heavily vegetated with grasses, brush, and trees on a sediment pile. This vegetation blocks the opening of the bridge at the right bank as shown in Figure 8-22, and limits the cross-sectional flow in this area. The NY-5 bridge is located at RS 913+00 (Figure 8-23).

Figure 8-22. Upstream view of Oriskany Creek under the NY-5 Bridge in the Town of Marshall, NY.

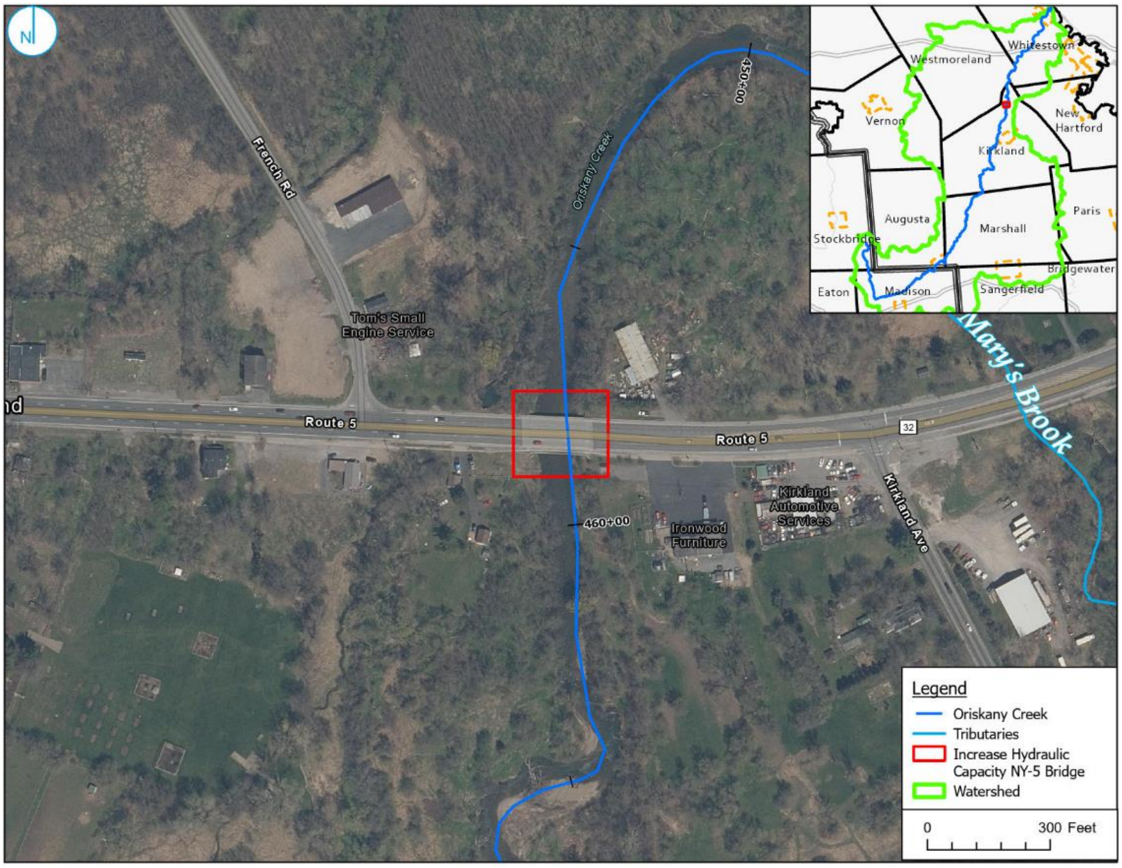


Figure 8-23. Location Map of NY-5 bridge for Alternative #4-2.

The existing high chord to low chord height of the structure is 4.6 with a span length of 100-ft. The model for this proposed alternative incorporates adjusting the road elevation height by 0.5-ft, decreasing the high chord to low chord height by 2.3-ft, and increase the span length of the bridge by 40-ft. Clearing the cross section from vegetation and sediment to increase flow is also modelled in this alternative.
The existing conditions show the 2%, 1% and 0.2% ACE WSELs do not successfully pass under the NY-5 bridge (FEMA 2013). Additionally, the bridge and the vegetation in the channel act as a catchpoint for large sediment and debris. Restoring the cross-sectional flow area of the channel under the bridge will increase movement of water during high-flood events and decrease the potential for sediment and debris to accumulate, thereby reducing flood risk to areas adjacent to and immediately upstream of the bridge.

For this alternative, open-water simulations were performed to test the effectiveness of the alternative at reducing water surface elevations for restoring the hydraulic capacity at the NY-5 bridge over Oriskany Creek. Table 24 outlines the results of the proposed conditions from the model simulation. Figure 8-24 displays the profile plots for restoring the hydraulic capacity of NY-5 simulation. Full model outputs for this alternative can be found in Appendix E. The flooding in the vicinity of the NY-5 bridge poses a flood-risk threat to nearby residential properties, agricultural lands, and infrastructure.

Table 24. Summary of Results for Alternative #4-2 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	Increased Hydraulic Capacity
Reductions in Water Surface Elevations	Up to 0-ft
Total Length of Benefited Area	10-ft
River Station	486+00

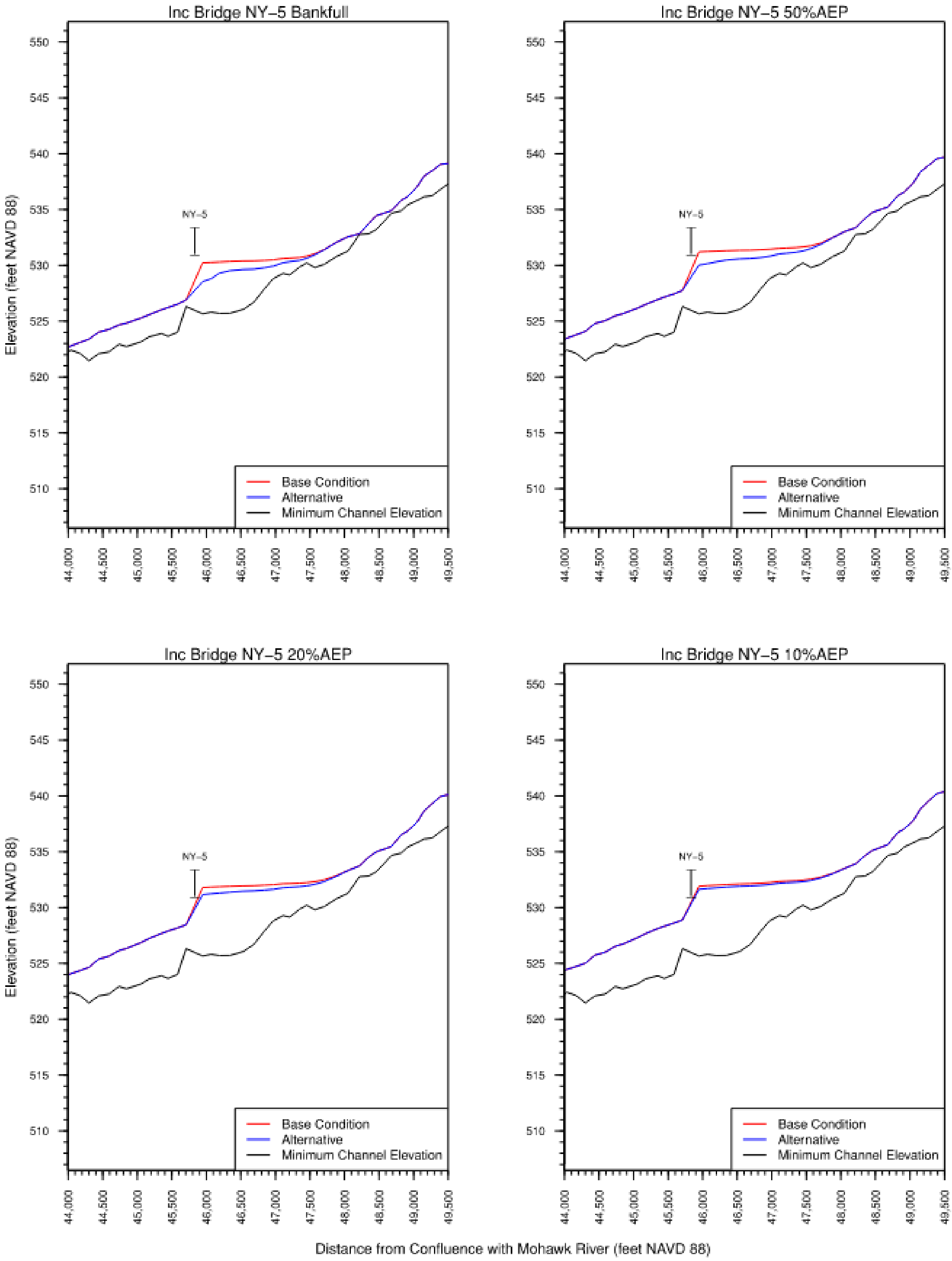


Figure 8-24. HEC-RAS model simulation output results for Alternative #4-2 **for the existing condition (red) and proposed alternative (blue) scenarios.**

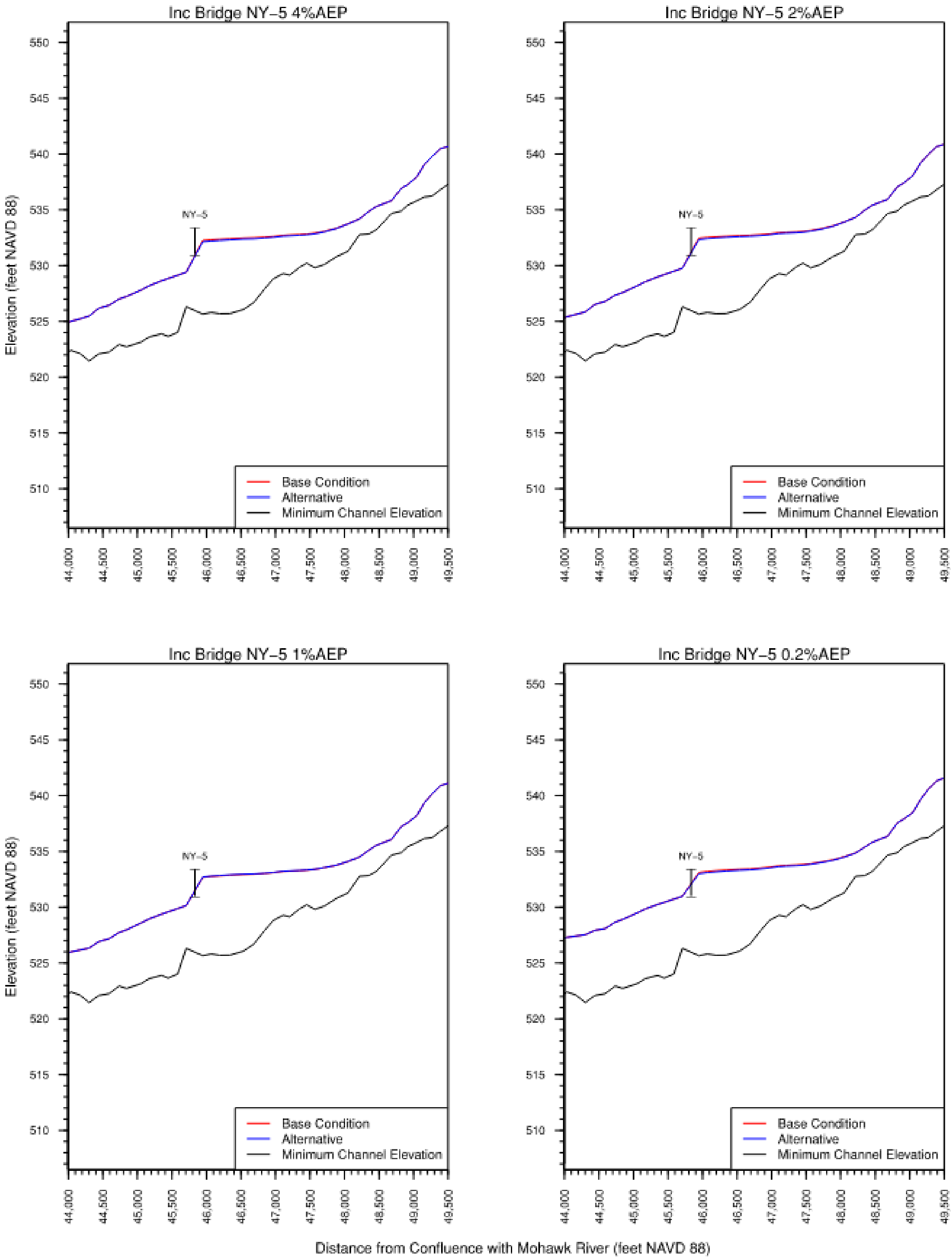


Figure 8-24 (continued). HEC-RAS model simulation output results for Alternative #4-2 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show no reduction in the WSEL with all 1-D model simulations for alternative #4-2. Additional 2-D modelling coupled with a terrain survey is recommended to further investigate the potential water surface reductions.

8.4.3 Remove Clark Mills Dam

The Clarks Mills dam located in between NY-5 and Main Street in Oriskany Creek is privately owned (NYSDEC 2024b). Dams restrict the natural flow of water and collect woody debris upstream of the dam. The dam was built in 1915 for unknown purposes and flow movement is controlled by gravity over the spillway. Field assessments at this location was not performed due to inaccessibility on private lands at that time. The spillway height is approximately 7-ft, and its width is 200-ft (NYSDEC 2024b).

The dam is considered an intermediate hazard which may be defined as upon dam failure, or in this case, a dam removal, downstream damages may affect remote homes, necessary utilities, major highways and minor railroads. The removal of the dam, according to its hazard class, is likely to pose the threat to individuals, significant economic loss, or substantial environmental damage (NYSDEC 2024b); however, evaluation and detailed H&H modeling of a dam removal scenario is recommended to identify the necessary flood risks within the proximate areas of the dam.

Removal of the dam has been selected to be analyzed at a base level of modelling and to determine the flooding impacts downstream of Oriskany Creek. The removal of the dam alternative is located at RS 428+00-ft (Figure 8-25). The project would involve removing all the concrete from the channel to ensure natural flow in Oriskany Creek. Removal of woody debris or other debris should be performed during this project. Further investigation will be needed to fully access this alternative which includes field surveys of dam measurements, soil testing for suitability, dam removal modelling, etc. The base-level analysis will show if flood risk is reduced when the dam is removed to the natural state of the floodplain.

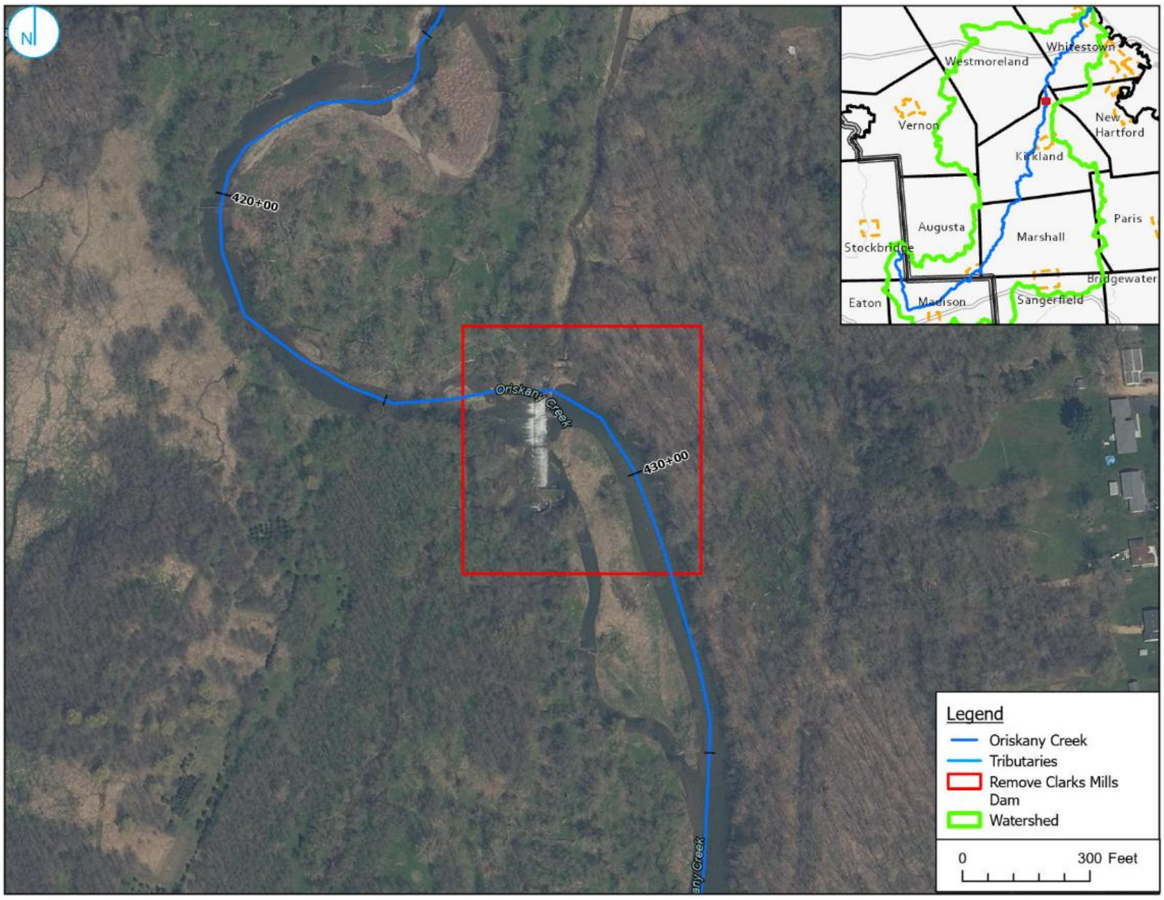


Figure 8-25. Location map of proposed dam removal for Alternative #4-3.

Table 25 outlines the results of the proposed conditions from the model simulation. Figure 8-26 displays the profile plots for the dam removal alternative. Full model outputs for this alternative can be found in Appendix E.

Table 25. Summary of Results for Alternative #4-3 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	Dam Removal
Reductions in Water Surface Elevations	Up to 0-ft
Total Length of Benefited Area	0-ft
River Station	428+00

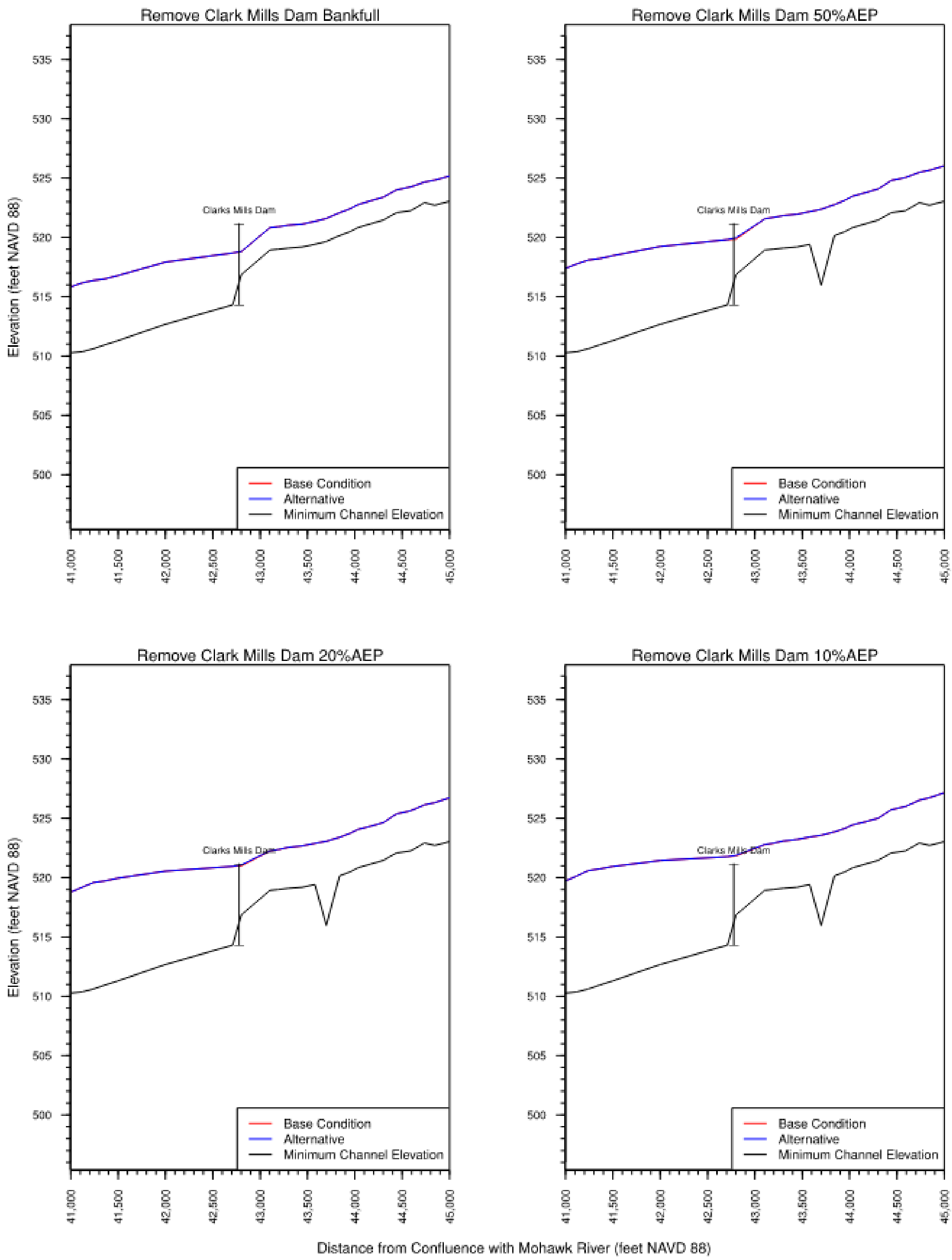


Figure 8-26. HEC-RAS model simulation output results for Alternative #4-3 for the existing condition (red) and proposed alternative (blue) scenarios.

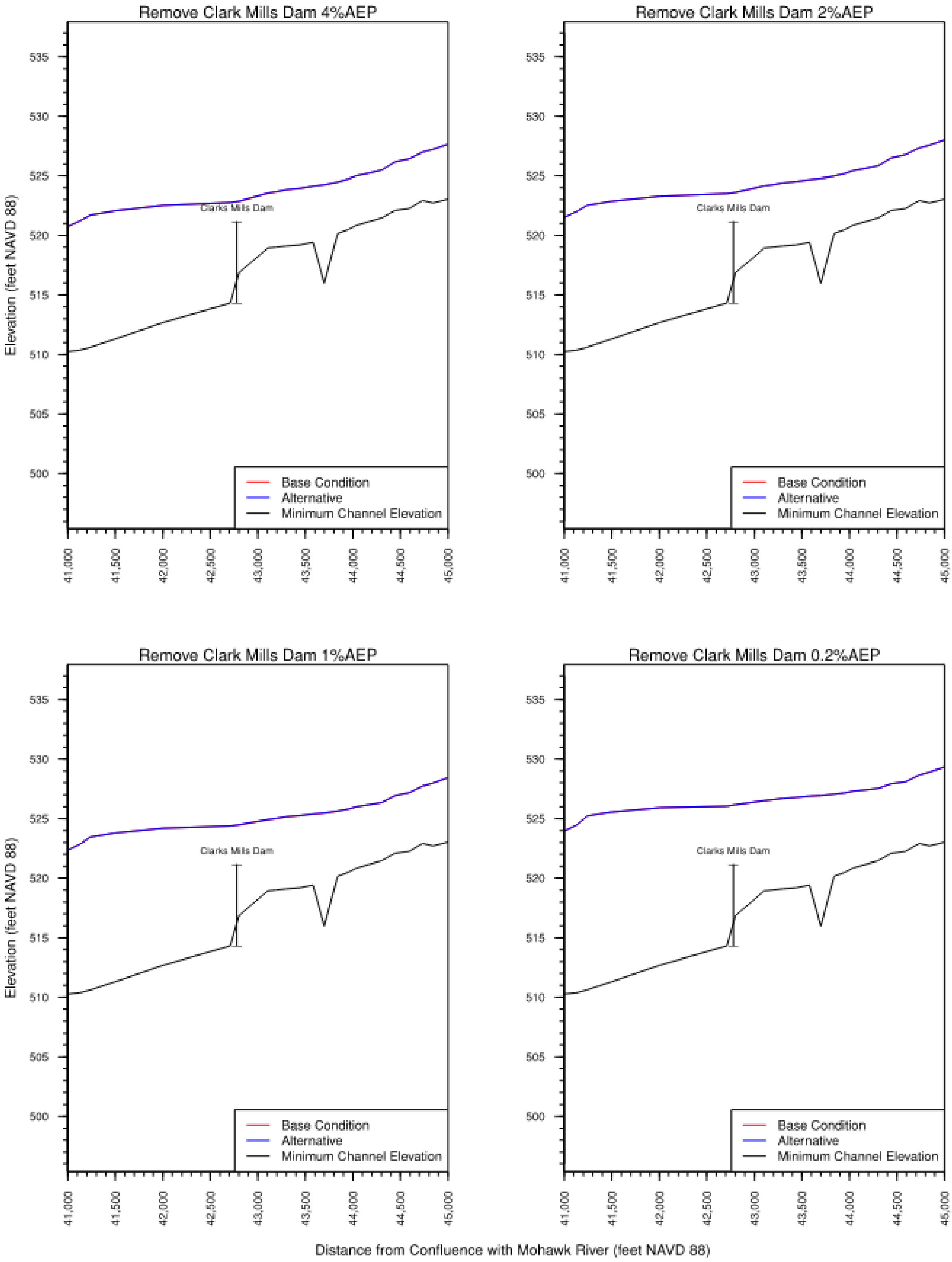


Figure 8-26 (continued). HEC-RAS model simulation output results for Alternative #4-3 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show no reduction in the WSEL with all 1-D model simulations for Alternative #4-3. Primary benefits of removing the dam would be to increase the cross-section flow area of the channel and reduce the potential for sediment, debris, and ice to accumulate/catch on the dam, thereby reducing the flood risk to areas adjacent to and immediately upstream of the dam.

Several factors must be considered when evaluating potential dam removal projects, including the following (Duda and Bellmore 2021):

- Legal requirements, such as obtaining the necessary federal and local permits;
- Obtaining funding, identifying and getting input from stakeholders;
- Determining whether mitigation projects are necessary or required to minimize dam removal effects;
- Technical difficulty, expense, and time horizon of a proposed dam removal;
- Dam ownership (whether the dam is publicly or privately owned) and the purpose and size of the dam;
- Reservoir sedimentation, the status and ecology of the river and surrounding project lands;
- Testing requirements to categorize sediment held behind the dam for the presence or absence of hazardous materials;
- Infrastructure downstream of the dam; and
- Any necessary environmental compliance mandates.

Dam removal is an important tool for river restoration and addressing aging infrastructure. It is an ongoing activity that will continue as a large number of aging dams that are no longer serving their original purposes, have become safety liabilities, or represent potential for significant restoration action, are taken down (Duda and Bellmore 2021).

Rivers are resilient to the changes and disturbance that accompany the removal of a dam, with many of the changes occurring rapidly and representing an improvement in water quality, hydrological flows, and migratory movement of aquatic animals. Yet, some of the outcomes of dam removal may play out over longer time periods, depending on such factors as the life history of key species or implementation of other complementary river restoration actions (Duda and Bellmore 2021).

In New York State, a joint permit application from the NYSDEC and USACE may be required in order to remove a dam or other impoundment. The NYSDEC is entrusted with the regulatory power to oversee dam safety. To protect people from the loss of life and property due to flooding and/or dam failure, the NYSDEC Dam Safety Section, in cooperation with the USACE, reviews proposed dam removals, conducts dam safety inspections, and monitors projects for compliance with dam safety criteria.

It should be noted that by removing the dam, the potential flood risk for downstream areas could be altered resulting in negative effects to downstream areas. Ramboll recommends additional research, data, and modeling, including advanced 2-D modeling, to determine more accurately the effects of removing the dam to downstream areas.

8.4.4 Remove Abandoned Railroad Bridge Downstream of Main Street

This measure intends to increase cross-sectional flow area of the channel and remove any potential impediments/catch points for sediment and debris by removing the abandoned railroad bridge located at river station 380+60 and 500-ft downstream of Main Street (Figure 8-27).

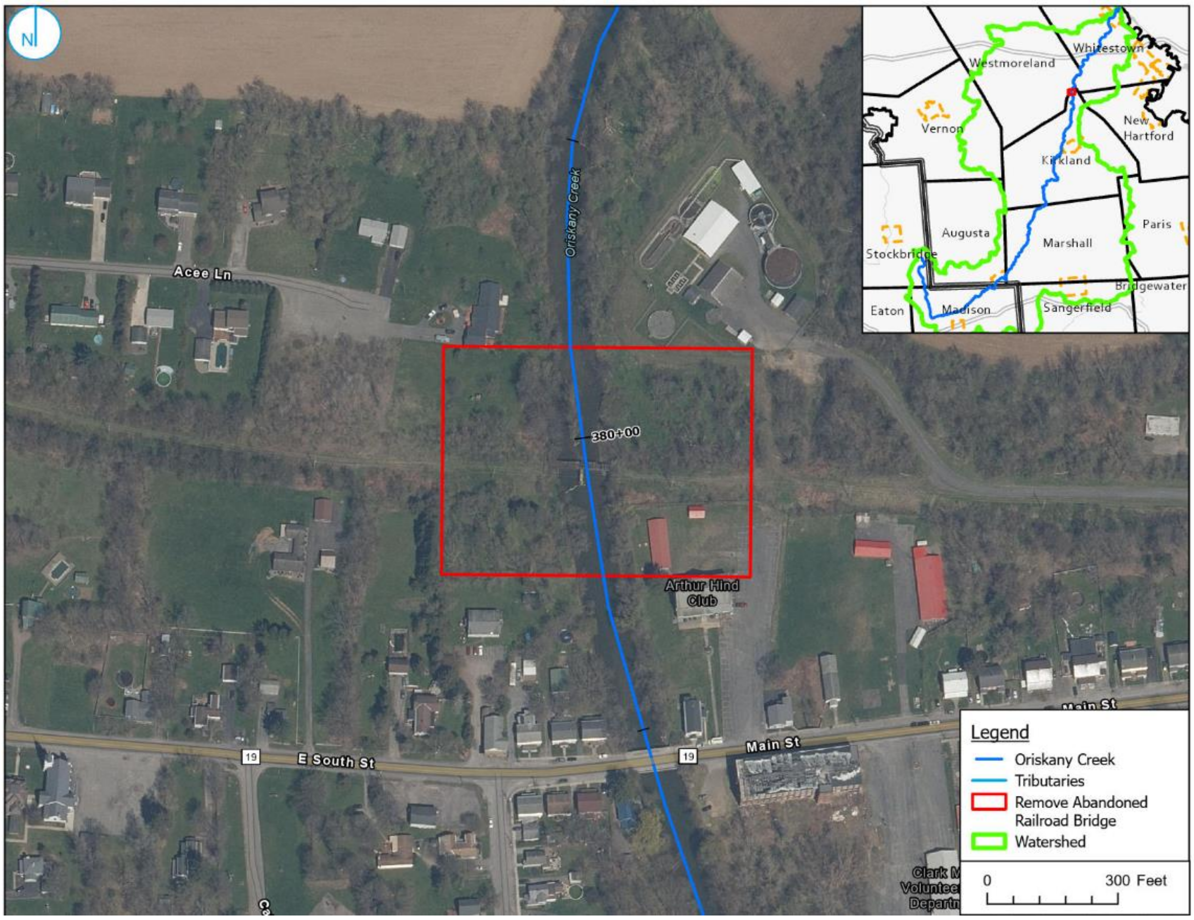


Figure 8-27. Location map for Alternative #4-4.

The bridge was a part of the N.Y. Ontario & Western East Branch railroad system which was scrapped away in the 1959 after abandoning the rails in 1957. The existing bridge structure has a bridge span of 100-ft and an approximate width of 12-ft with one pier in the middle (Figure 8-28). The flooding in the vicinity of the abandoned railroad bridge poses a flood-risk threat to the American Legion, water treatment facility, nearby residential properties, and county-owned infrastructure.

Figure 8-28. Existing conditions of the abandoned railroad bridge in Village of Clarks Mills, Kirkland, NY.

The FEMA FIS profile plot for the railroad bridge indicates the hydraulic capacity of the bridge is insufficient to successfully pass the 0.2% ACE events (FEMA 2013). In addition, the FEMA FIS displays significant backwater upstream of Main Street bridge crossing (FEMA 2013).

The bridge no longer functions for any transportation purposes and is unsafe to cross for walking trails. The dilapidated bridge has no significant function or benefit to the community. By removing the bridge structure and pier remnants within the channel, the cross-sectional flow area of the channel would increase and the potential for sediment, debris, and ice to accumulate or catch on the upstream face of the bridge would be reduced, thereby reducing flood risk to areas adjacent to and immediately upstream of the bridge.

For this alternative, open-water simulations were performed to test the effectiveness of the alternative at reducing water surface elevations for restoring the hydraulic capacity at the NY-5 bridge over Oriskany Creek. Table 26 outlines the results of the proposed conditions from the model simulation. Figure 8-29 displays the profile plots for restoring the hydraulic capacity of NY-5 simulation. Full model outputs for this alternative can be found in Appendix E. The flooding in the vicinity of the NY-5 bridge poses a flood-risk threat to nearby residential properties, agricultural lands, and infrastructure.

Table 26. Summary of results for Alternative #4-4 with proposed conditions based on the 1% ACE

Proposed Conditions	Bridge Removal
Reductions in Water Surface Elevations	Up to 3.9-ft
Total Length of Benefited Area	400-ft
River Stations	381+00 to 385+00

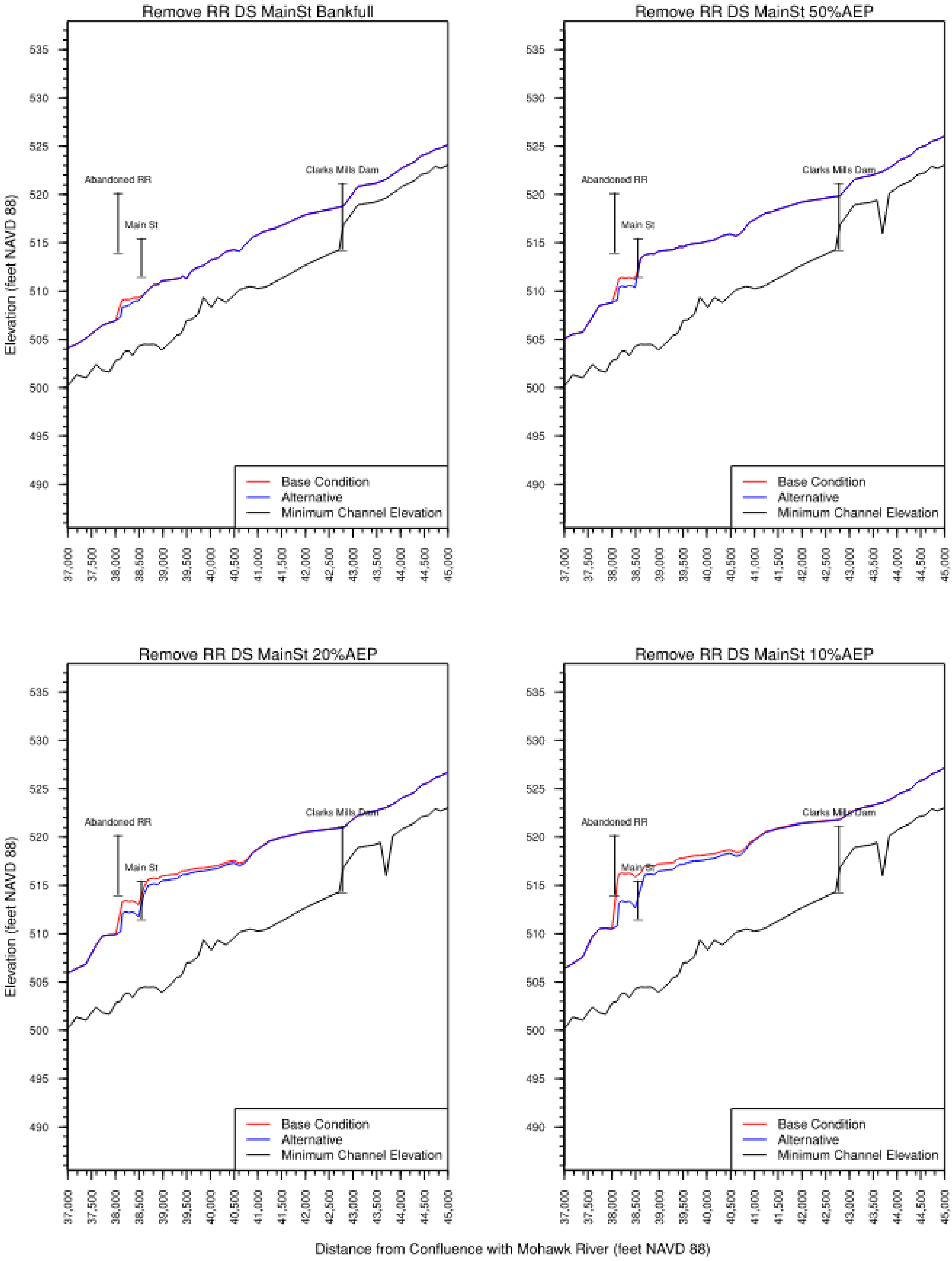


Figure 8-29. HEC-RAS model simulation output results for Alternative #4-4 for the existing condition (red) and proposed alternative (blue) scenarios.

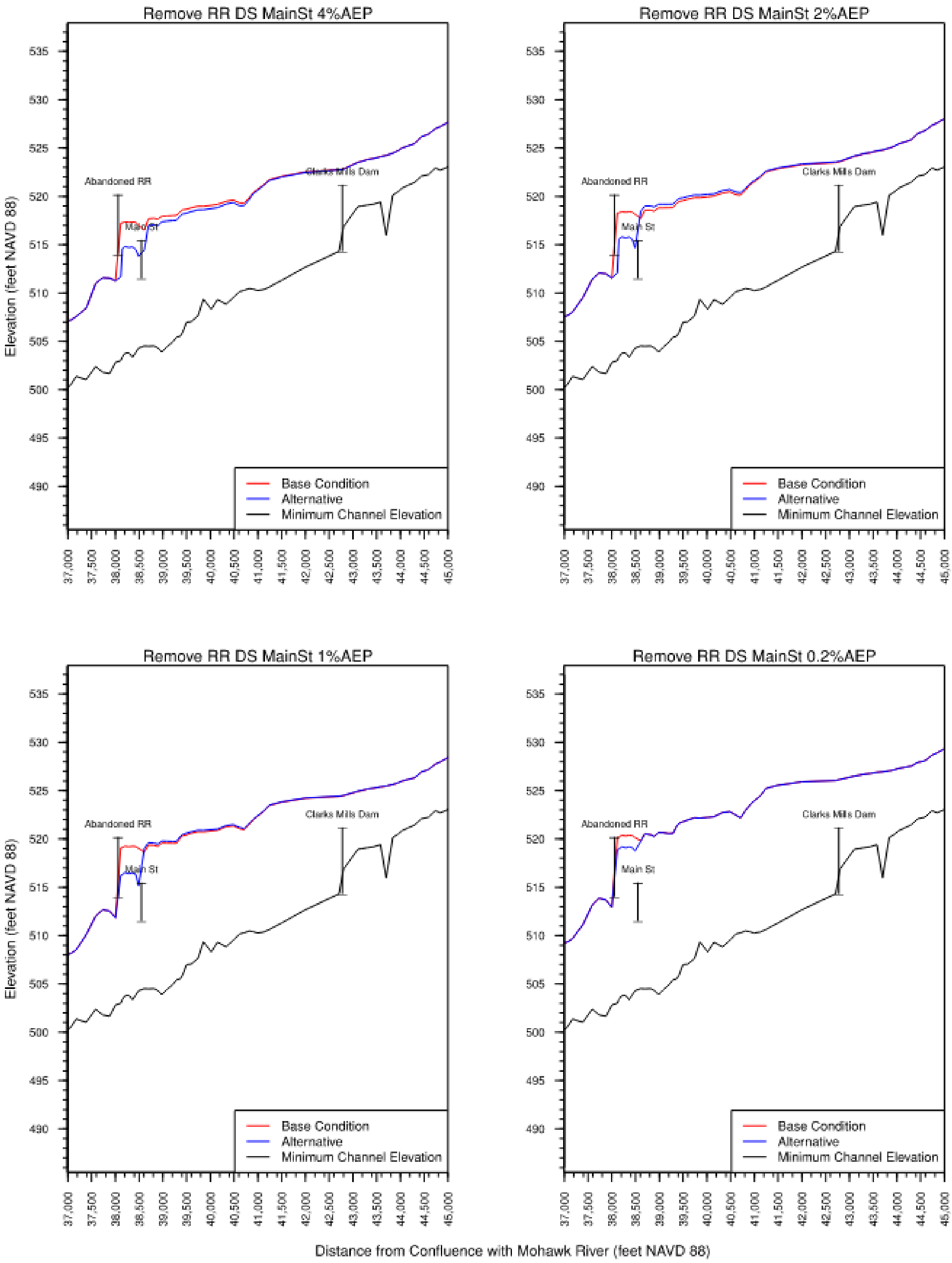


Figure 8-29 (continued). HEC-RAS model simulation output results for Alternative #4-4 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 3.9-ft in the 1-D model simulations for alternative #4-4. Additional 2-D modelling coupled with a terrain survey is recommended to further investigate the potential water surface reductions. The potential benefits of this strategy are shown to reduce WSEL immediately upstream of the railroad bridge and upstream of Main Street. Additional engineering consideration would also be required to determine if removing the bridge would affect water surface elevations downstream of the railroad bridge.

8.4.5 Streambank Stabilization Strategies

Erosion of streambanks in several locations threaten property damage and also increase the amount of sediment entering the creek. Figure 8-30 shows bank instabilities and headcutting upstream of Lumbard Road at RS 742+00. To assess the applicability of different streambank stabilization strategies under higher frequency lower-flow conditions, channel velocity (feet per second) and shear stress (pounds per square foot) were calculated using the HEC-RAS software for the existing conditions model at the 10% AEP. A description of the velocity and shear stress variables are identified in section 5.2.

Figure 8-30. Headcutting upstream of Lumbard Road at RS 742+00.

Based on the channel velocities and shear stresses, Table 27 summarizes the potential streambank stabilization measures along Oriskany Creek in Zone 4. The entire reach was studied for all possible streambank stabilization strategies and can be applied for future projects if applicable.

Table 18 lists the average cost per linear foot for each streambank stabilization type discussed in Table 27. Figure 8-31 displays the results of the hydraulic model simulations for Zone 4 for the eight different annual chance flood events and the two erosional/depositional variables. Additional geomorphic and engineering analyses, including additional modeling, would be necessary in order to determine the most appropriate streambank stabilization strategy and its associated costs.

Table 27. Streambank Stabilization Strategies for Zone 4, the Town of Kirkland

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Brush Mattresses	Staked only w/ rock riprap toe (initial)	390+00 to 490+00; 510+00 to 530+00; 540+00 to 580+00; 630+00 to 660+00; 680+00 to 690+00; 740+00 to 760+00; 780+00 to 790+00; 800+00 to 830+00	Brush mattresses include live stakes and fascine bundles with branch cuttings, dead stout stakes, and geotextile fabric.
	Staked only w/ rock riprap toe (grown)	360+00 to 660+00; 680+00 to 860+00	
Coir Geotextile Roll	Roll with coir rope mesh staked only without rock riprap toe	390+00 to 490+00; 510+00 to 530+00; 540+00 to 580+00; 630+00 to 660+00; 680+00 to 690+00; 740+00 to 760+00; 780+00 to 790+00; 800+00 to 830+00	Vegetative logs placed in densely packed coconut fiber rolls act as a natural retaining wall to prevent erosion.
	Roll with Polypropylene rope mesh staked only without rock riprap toe	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	
	Roll with Polypropylene rope mesh staked and with rock riprap toe	360+00 to 660+00; 680+00 to 860+00	
Live Fascine	Live Fascine Bundle with rock riprap toe	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	Live fascine bundles include live woody cuttings in a bundle and buried into the bank of the stream parallel to the stream's flow.
Soils	Shale and Hardpan	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 620+00 to 660+00; 680+00 to 690+00; 740+00 to 850+00	Shale and hardpan are compact rocks that can protect the streambank from erosion in areas with low shear stress and velocities. This treatment may be difficult for vegetation to establish along the banks with the presence of shale and hardpan.
Gravel/Cobble	6-in diameter	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	Lining the streambank with gravel that has a diameter of at least 6-inches will help protect the streambank from erosion.
	12-in diameter	360+00 to 660+00; 680+00 to 860+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Vegetation	Class A turf (ret class)	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	A streambank that is covered with native vegetation such as Class A, Class B, or Class C turf (ret class), long grasses, or hardwood tree plantings will establish protection and increase erosion resistance along the bank.
	Class B turf (ret class)	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	
	Class C turf (ret class)	390+00 to 400+00; 410+00 to 490+00; 510+00 to 530+00; 540+00 to 570+00; 640+00 to 650+00; 680+00 to 690+00; 740+00 to 750+00	
	Long native grasses	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 620+00 to 660+00; 680+00 to 690+00; 740+00 to 860+00	
Soil Bioengineering	Wattles	390+00 to 400+00; 410+00 to 490+00; 510+00 to 530+00; 540+00 to 550+00; 740+00 to 750+00	Soil bioengineering treatments to reduce streambank erosion in this area includes wattles, reed fascines, coir roll, vegetated coir mat, live brush mattress, brush layering, and live willow stakes. Place live stakes in areas with increased deposition and minimal erosion.
	Reed fascine	390+00 to 490+00; 510+00 to 530+00; 540+00 to 580+00; 630+00 to 660+00; 680+00 to 690+00; 740+00 to 760+00; 780+00 to 790+00; 800+00 to 830+00	
	Coir roll	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 660+00; 680+00 to 730+00; 740+00 to 860+00	
	Vegetated coir mat	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	
	Live brush mattress (initial)	390+00 to 400+00; 410+00 to 490+00; 510+00 to 530+00; 540+00 to 580+00; 630+00 to 660+00; 740+00 to 750+00	
	Live brush mattress (grown)	360+00 to 660+00; 680+00 to 860+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
	Brush layering (initial/grown)	360+00 to 660+00; 680+00 to 860+00	
	Live fascine	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	
	Live willow stakes	360+00 to 530+00; 540+00 to 660+00; 680+00 to 730+00; 740+00 to 860+00	
Boulder Clusters	Very large (>80-inch diameter)	360+00 to 860+00	Boulders of different diameters may protect the stream and protect the stream from erosion.
	Large (>40-in diameter)	360+00 to 860+00	
	Medium (>20-inch diameter)	360+00 to 860+00	
	Small (>10-inch diameter)	360+00 to 530+00; 540+00 to 660+00; 680+00 to 730+00; 740+00 to 860+00	
	Large (>5-inch diameter)	360+00 to 370+00; 380+00 to 530+00; 540+00 to 580+00; 600+00 to 610+00; 620+00 to 660+00; 680+00 to 700+00; 720+00 to 730+00; 740+00 to 860+00	
	Small (>2.5-inch diameter)	390+00 to 490+00; 510+00 to 520+00; 540+00 to 580+00; 630+00 to 660+00; 680+00 to 690+00; 740+00 to 760+00; 780+00 to 790+00; 800+00 to 830+00	

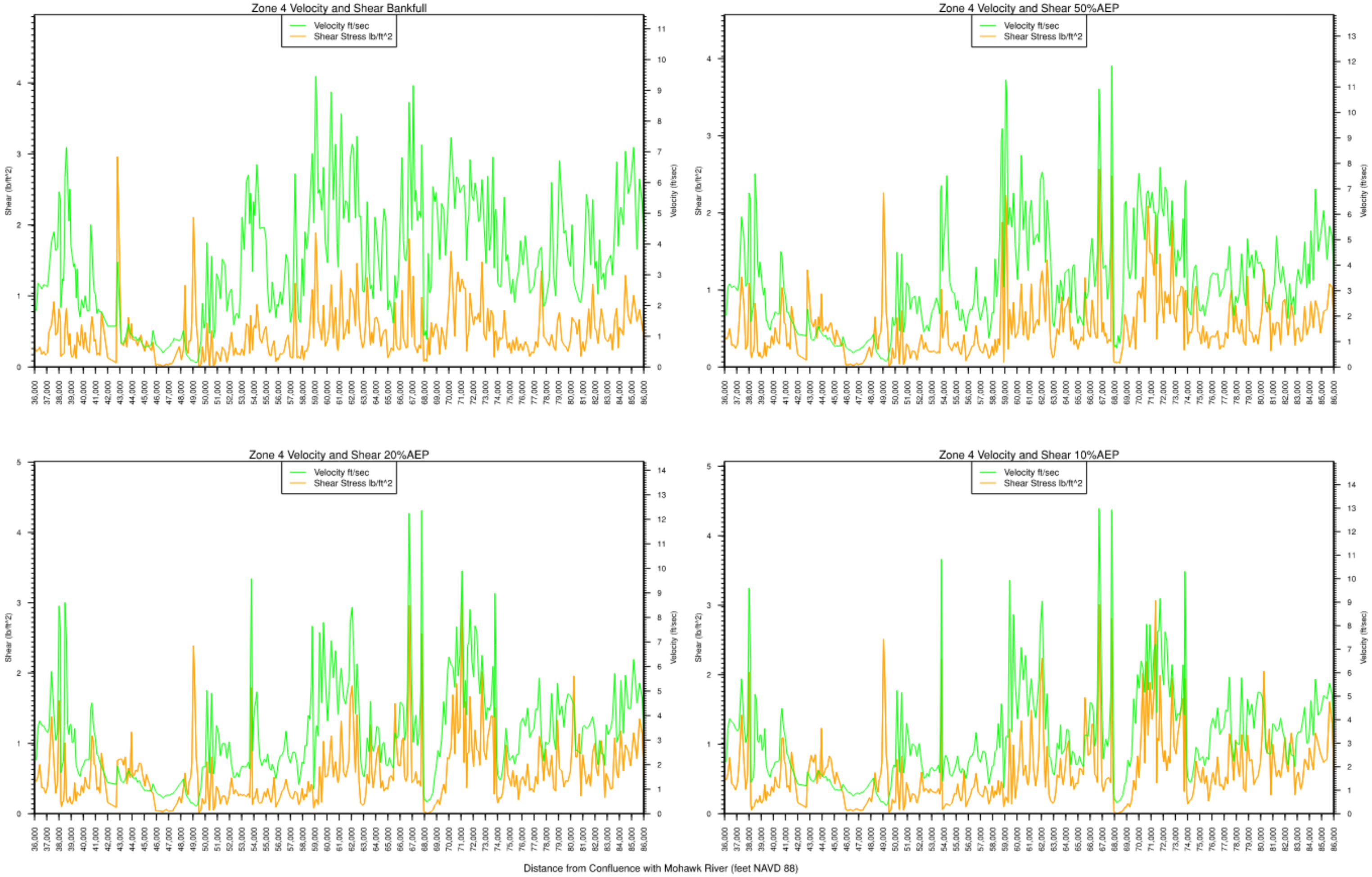


Figure 8-31. Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 4.

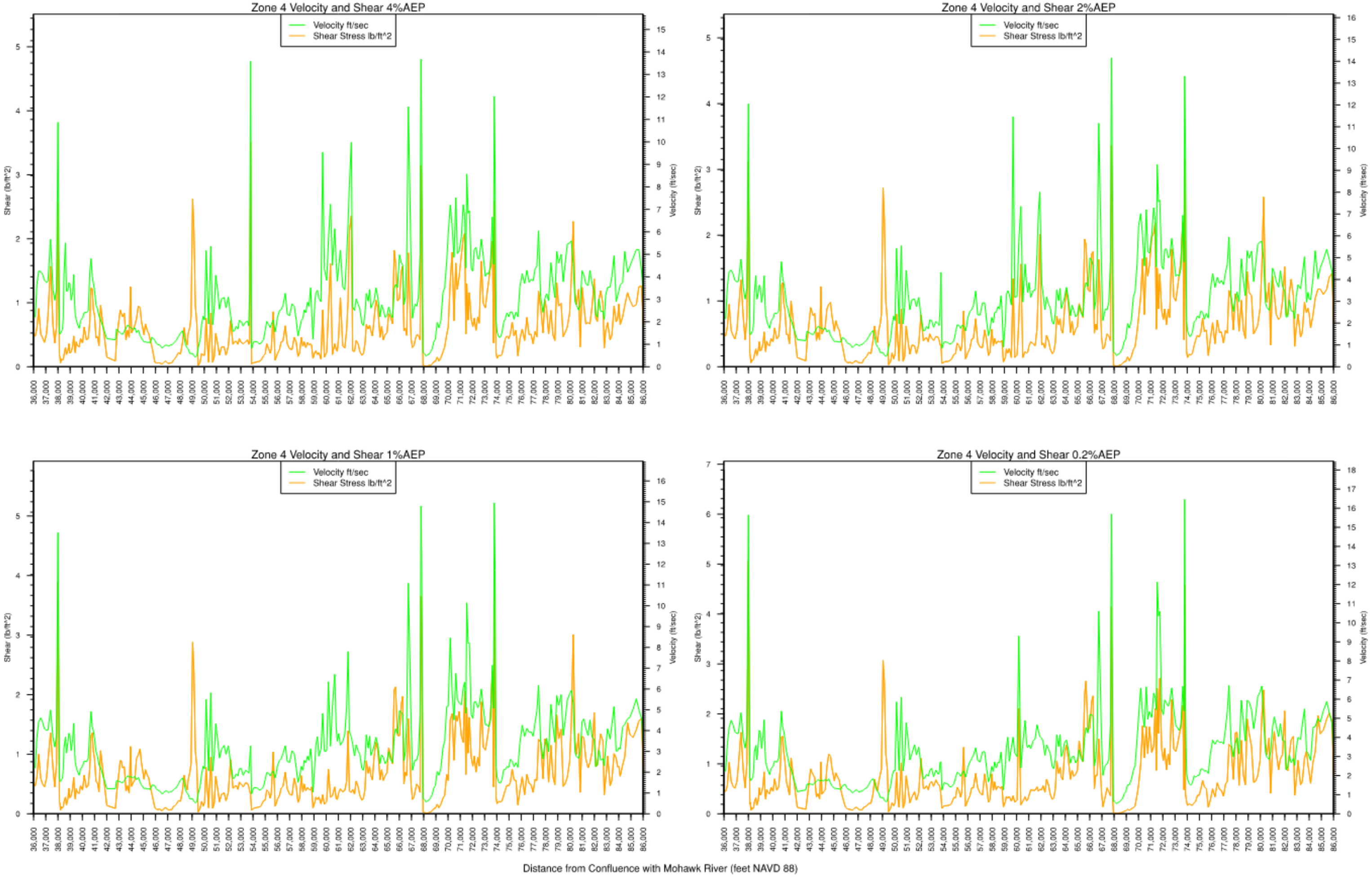


Figure 8-31 (continued). Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 4.

8.5 ZONE 5 - TOWN OF WHITESTOWN, ONEIDA COUNTY

8.5.1 Bank Restoration Downstream of Valley Road

The creek meanders downstream of Valley Road where a steep bank shows signs of frequent erosion (Figure 8-32). This bank is a crucial location to restore with bank stabilization techniques or vegetation. Streambank stabilization techniques will be discussed further in Section 8.5.6.

Figure 8-32. Bank erosion downstream of Valley Road, Town of Whitestown, NY.

A vegetated area along the channel helps decrease the stormwater runoff flow, filter sediments and pollutants that are most likely applied to nearby agricultural fields and stabilize the stream banks from erosion. The benefits expand the interactions between hydrology, soil, and biotic communities and increase their health along the stream.

Sediment piles are increasing in size and frequency upstream and downstream of Valley Road. During high-flow periods, bank erosion from upstream sources has deposited large amounts of sediment and debris in the channel while scouring away and destabilizing the banks. Additionally, the natural meanders on the channel may influence the instabilities of the bank at

this location. As a result, the original natural channel geometry has been disrupted in this reach.
Natural stream restoration techniques can improve water quality, enhance aesthetic value, improve wildlife habitat and enhance floodplain function. A successful natural stream restoration
project requires following a multi-step process to ensure thorough consideration is given to the planning and design stage before any work in the stream corridor occurs. These steps include the
following (Fleming et al. 2017):

- Defining the objectives such as flood control, improving recreation, improving habitat, or reducing bank erosion;
- Assessing the current condition of the stream including noting any downcutting or widening; the amount, type, and condition of bank vegetation; changes in the watershed upstream, or features downstream that are constricting flow;
- Determining the best course of action, which can include re-vegetation plans, riparian buffers, channel and bank stabilization, and other stream redesign and construction projects;
- Constructing the selected stream restoration strategy, which can involve reshaping the stream channel and floodplain, building in-stream structures, protecting the banks, and removing invasive vegetation.

This mitigation strategy proposes restoring the channel banks of Oriskany Creek downstream of Valley Road and employing the stream restoration techniques discussed to reduce sediment aggradation, improve water quality, enhance aesthetic value, improve wildlife habitat, and enhance floodplain function along this reach. Figure 8-33 represents the location of the channel restoration area from river station 114+00 to 119+00.

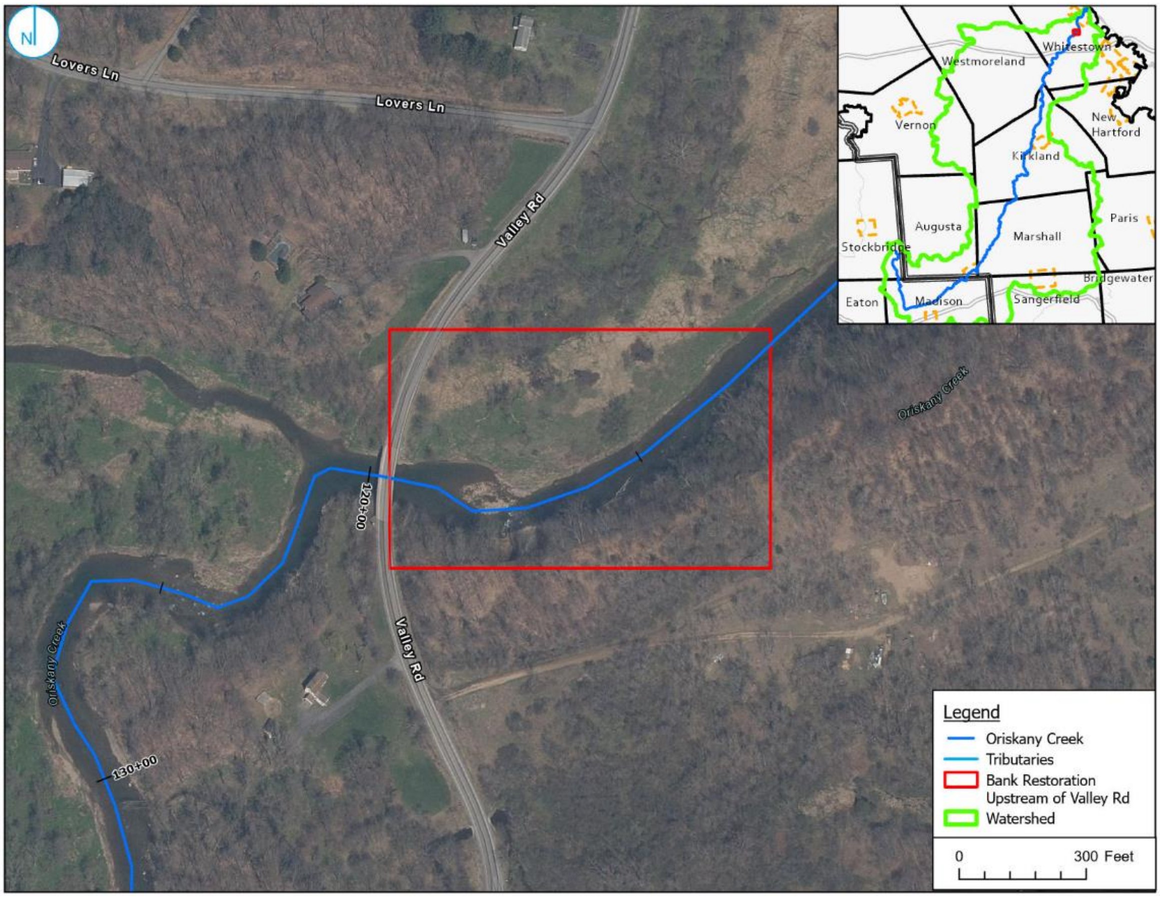


Figure 8-33. Location map for Alternative #5-1.

By removing sediment and debris within the channel, the cross-sectional flow area would increase allowing a larger volume of water to flow through this reach unobstructed, thereby reducing flood risk while stabilizing the channel banks, which would make the banks more resistant to erosion and bank failure and would reduce overall sediment loads in this reach and lower reaches of Oriskany Creek.

The primary benefits of restoring the channel geometry of Oriskany Creek in this reach would be to increase the flow capacity and help prevent debris from catching on sediment bars and large debris that have accumulated in this reach.

It is important to note that the removal of aggraded sediment and debris alone is not an adequate flood mitigation strategy unless the upstream sources of sediment and debris are addressed. The sources and potential strategies are best analyzed to address sediment and debris in a Sediment and Debris Management Study. The NYSDEC highly recommends identifying and addressing upstream sediment and debris sources before addressing any potential mitigation strategy that includes sediment and/or debris removal.

8.5.2 Removal of Oriskany Falls Dam

The Oriskany Falls dam located in between Valley Road and Utica Street in Oriskany Creek is owned by Waterbury Sons & Company (NYSDEC 2024b). Dams restrict the natural flow of water causing backup of water and collects woody debris upstream of the dam. The dam was built in 1916 for unknown purposes and flow movement is controlled by gravity over the spillway. The spillway height is approximately 3-ft, and its width is 110-ft (NYSDEC 2024b). Figure 8-34 shows the current conditions of the Oriskany Falls Dam.

Figure 8-34. Oriskany Falls Dam in the Town of Whitestown, NY.

The dam is considered a low hazard which may be defined as upon dam failure, or in this case, the dam condition is worsened or removed from the channel, the likelihood of downstream damages to occupied spaces, necessary utilities, and major roads is low. The removal of the dam, according to its hazard class, is unlikely to pose the threat to individuals, severe economic loss, or significant environmental damage (NYSDEC 2024b); however, evaluation and detailed H&H modeling of a dam removal scenario is recommended to identify the necessary flood risks within the proximate areas of the dam.

Removal of the dam has been selected to be analyzed at a base level of modelling and to determine the flooding impacts downstream of Oriskany Creek. The removal of the dam alternative is located at RS 78+00-ft (Figure 8-35). The project would involve removing all or partially remove the rock spillway from the channel to ensure natural flow in Oriskany Creek. Removal of woody debris or other debris should be performed during this project. Further investigation will be needed to fully access this alternative which includes field surveys of dam measurements, soil testing for suitability, dam removal modelling, etc. The base-level analysis will show if flood risk is reduced when the dam is removed to the natural state of the floodplain.

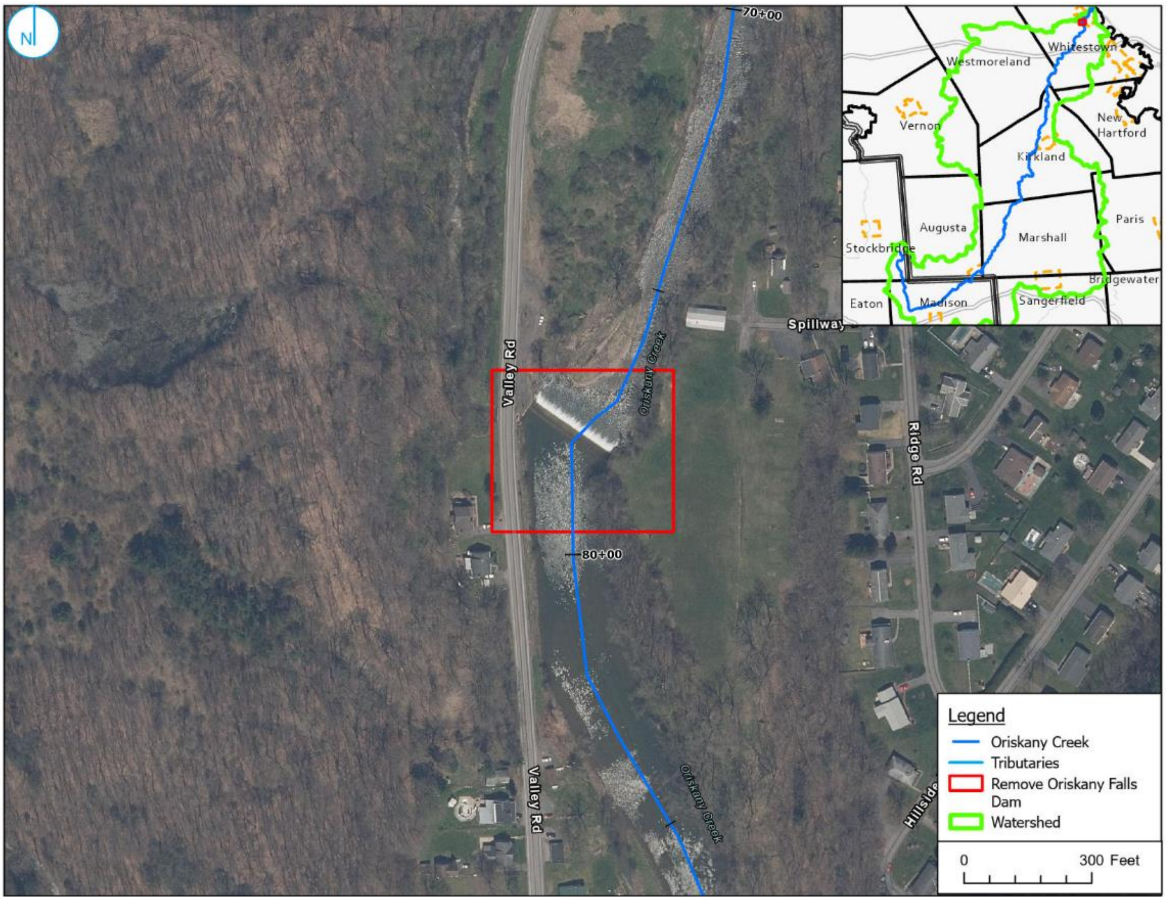


Figure 8-35. Location map of proposed dam removal for Alternative #5-2.

Table 28 outlines the results of the proposed conditions from the model simulation. Figure 8-36 displays the profile plots for the dam removal alternative. Full model outputs for this alternative can be found in Appendix E.

Table 28. Summary of Results for Alternative #5-2 with Proposed Conditions Based on the 1% ACE

Proposed Conditions	Dam Removal
Reductions in Water Surface Elevations	Up to 0.2-ft
Total Length of Benefited Area	75-ft
River Stations	78+50 to 79+25

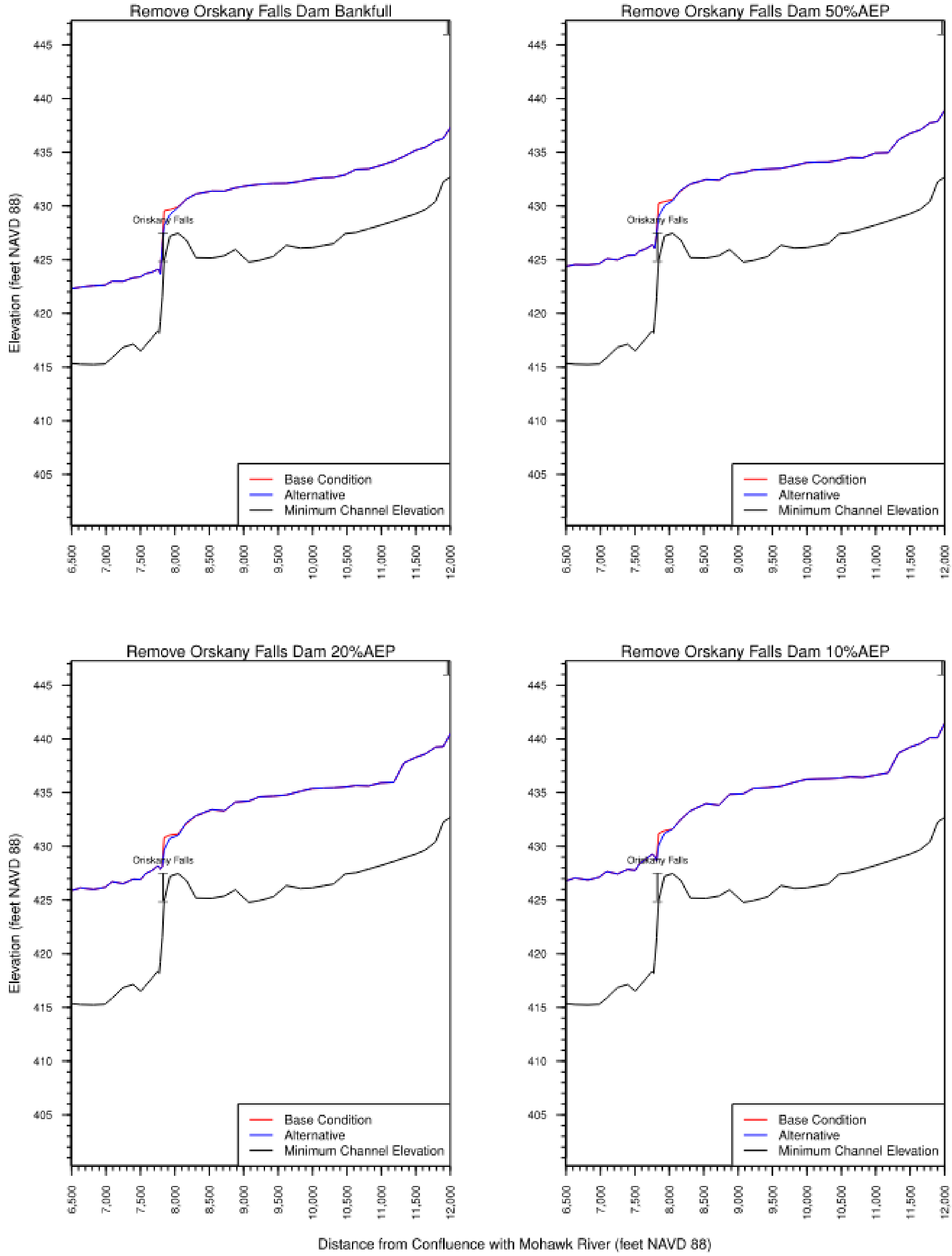


Figure 8-36. HEC-RAS model simulation output results for Alternative #5-2 for the existing condition (red) and proposed alternative (blue) scenarios.

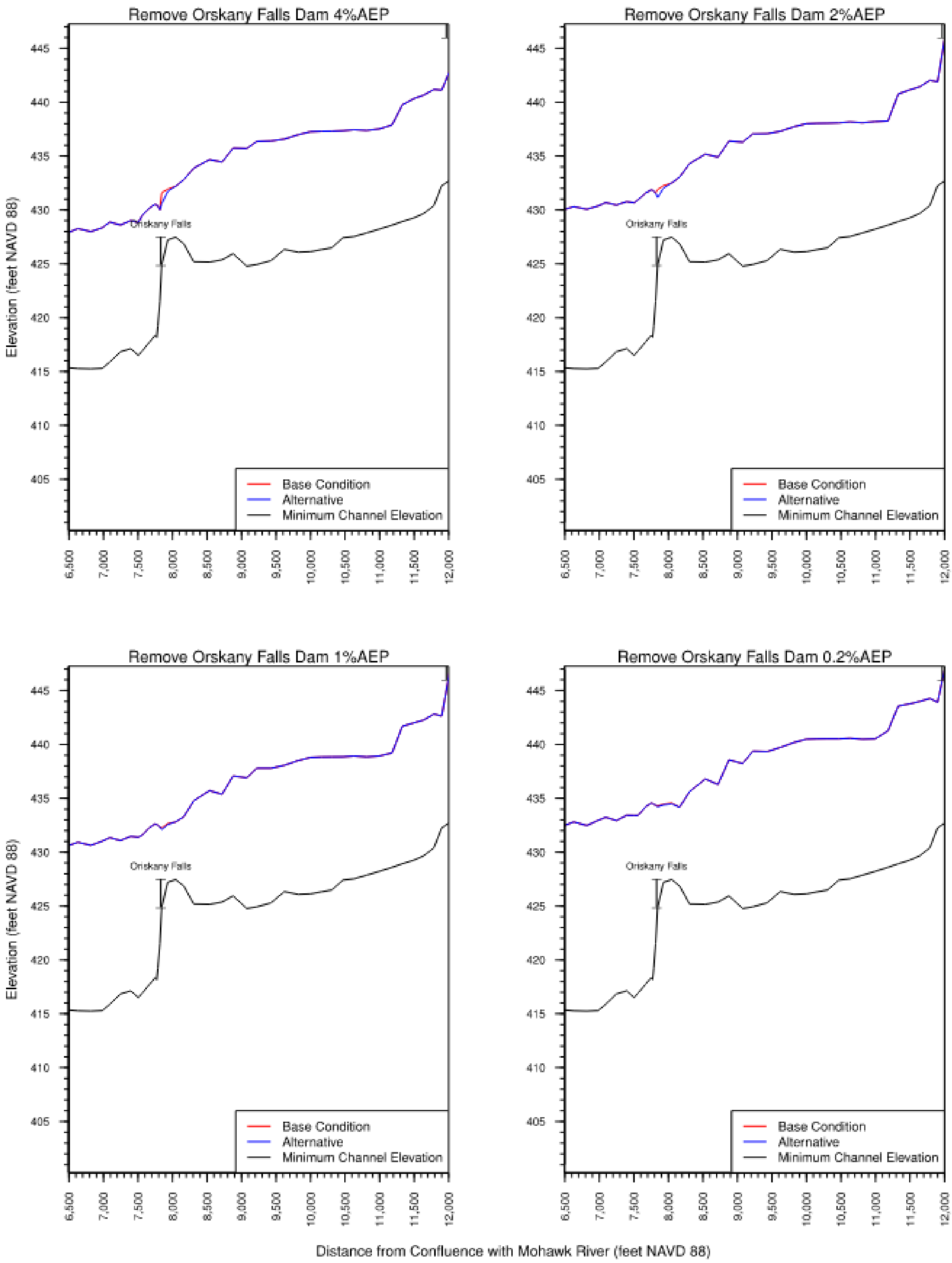


Figure 8-36 (Continued). HEC-RAS model simulation output results for Alternative #5-2 for the existing condition (red) and proposed alternative (blue) scenarios.

The results show a maximum reduction in the WSEL of about 0.2-ft in the 1-D model simulations for alternative #5-2. The primary benefits of removing the dam would be to increase the cross-section flow area of the channel and reduce the potential for sediment, debris, and ice to accumulate or catch on the dam, thereby reducing the flood risk to areas adjacent to and immediately upstream of the dam.

Several factors must be considered when evaluating potential dam removal projects, including the following (Duda and Bellmore 2021):

- Legal requirements, such as obtaining the necessary federal and local permits;
- Obtaining funding, identifying and getting input from stakeholders;
- Determining whether mitigation projects are necessary or required to minimize dam removal effects;
- Technical difficulty, expense, and time horizon of a proposed dam removal;
- Dam ownership (whether the dam is publicly or privately owned) and the purpose and size of the dam;
- Reservoir sedimentation, the status and ecology of the river and surrounding project lands;
- Testing requirements to categorize sediment held behind the dam for the presence or absence of hazardous materials;
- Infrastructure downstream of the dam; and
- Any necessary environmental compliance mandates.

Dam removal is an important tool for river restoration and addressing aging infrastructure. It is an ongoing activity that will continue as a large number of aging dams that are no longer serving their original purposes, have become safety liabilities, or represent potential for significant restoration action, are taken down (Duda and Bellmore 2021).

Rivers are resilient to the changes and disturbance that accompany the removal of a dam, with many of the changes occurring rapidly and representing an improvement in water quality, hydrological flows, and migratory movement of aquatic animals. Yet, some of the outcomes of dam removal may play out over longer time periods, depending on such factors as the life history of key species or implementation of other complementary river restoration actions (Duda and Bellmore 2021).

In New York State, a joint permit application from the NYSDEC and USACE may be required in order to remove a dam or other impoundment. The NYSDEC is entrusted with the regulatory power to oversee dam safety. To protect people from the loss of life and property due to flooding and/or dam failure, the NYSDEC Dam Safety Section, in cooperation with the USACE, reviews proposed dam removals, conducts dam safety inspections, and monitors projects for compliance with dam safety criteria.

It should be noted that by removing the dam, the potential flood risk for downstream areas could be altered resulting in negative effects to downstream areas. Ramboll recommends additional research, data, and modeling, including advanced 2-D modeling, to determine more accurately the effects of removing the dam to downstream areas.

8.5.3 Establish/Increase Riparian Buffers along Agricultural Lands and a Commercial Property Adjacent to Oriskany Creek

Riparian buffers are areas adjacent to waterbodies where trees, shrubs, grass, or other vegetation are planted to create a natural space between the waterway channel and overbank areas. Riparian buffers are intended to protect water quality and aquatic habitats, but provide a variety of other benefits including erosion and sediment control, streambank stabilization, shade for streams, habitat and food for terrestrial and aquatic wildlife, and can reduce the impact from floods (NRCS 1998).

Riparian buffers should be designed using the “three-zone” concept. Zone 1 is the area closest to the waterway channel where native and water-tolerant trees and large shrubs that require minimal maintenance should be planted. These trees and shrubs provide streambank stabilization, leaf litter inputs to the stream and overbank, and shade to the waterway. Ideally, Zone 1 should be at least 15-feet wide. Upland from Zone 1 is Zone 2 that can range from 20 to 60-feet wide and should incorporate vegetation with native, fast growing, small, and shade-tolerant tree or shrub species. In Zone 2, runoff is absorbed and infiltrated into the soil where nutrient and other pollutants are filtered by the soil. Zone 3, furthest from the waterway channel and ranging in width from 15 to 60 feet, should include vegetation with plants that slow fast-moving water runoff and filter sediment, such as native grasses, wildflowers, and other herbaceous plants. The total minimum recommended width for all three zones is 100 feet by the NYSDEC (NYSDEC [unknown] a).
Along Oriskany Creek, four different reaches along agricultural fields in the Town of Whitestown between the following river stations (ft):

- 0+00 to 39+00
- 40+00 to 50+00 (Between NY-69 and CSX Railroad Bridge at the Clemente Fane Concrete property)
- 246+00 to 266+00
- 285+00 to 293+00

Figure 8-37 shows these reaches have little to no buffer that prevents runoff, sediment, and/or pollutants from directly entering the creek. By installing a riparian buffer with all three zones along this reach, the runoff from the agricultural fields will be reduced. Additional consideration would also be required to determine the most appropriate riparian buffer vegetation and range of zones.

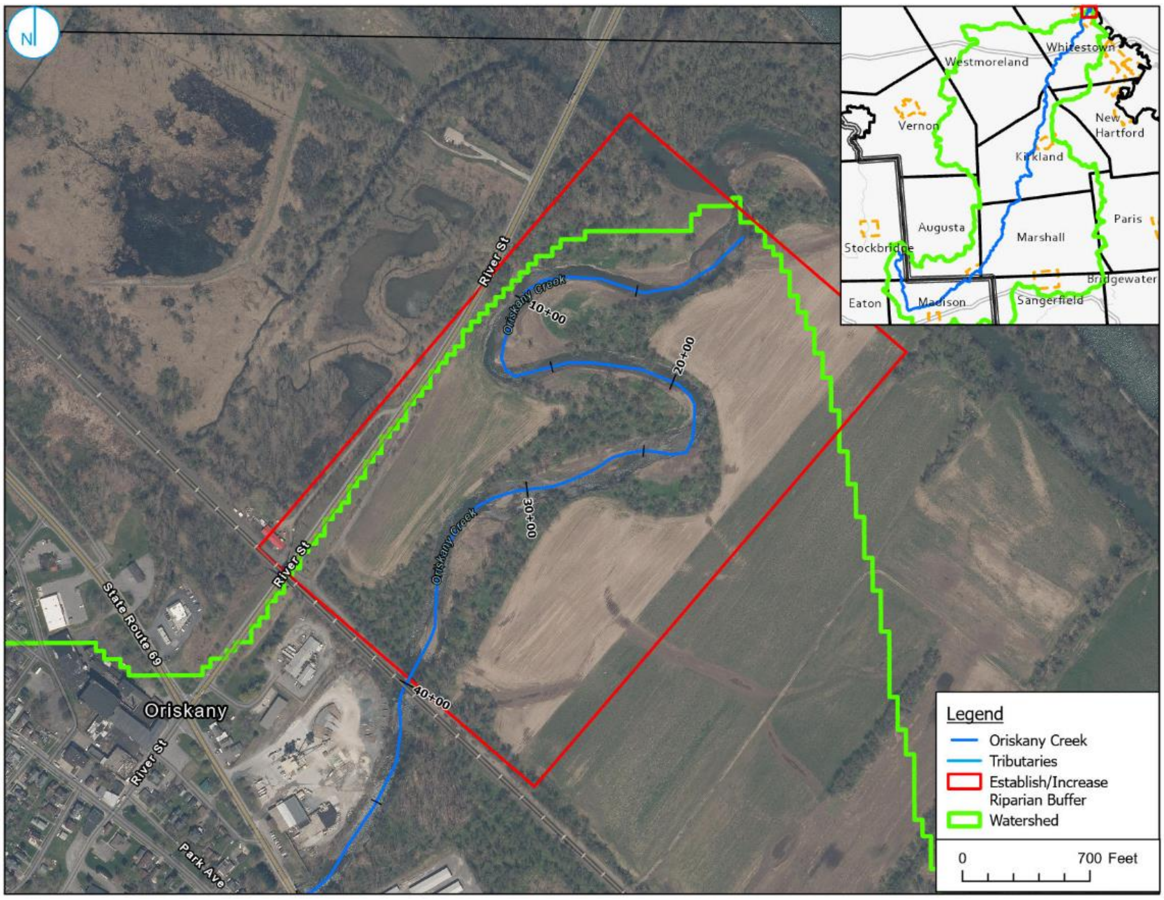
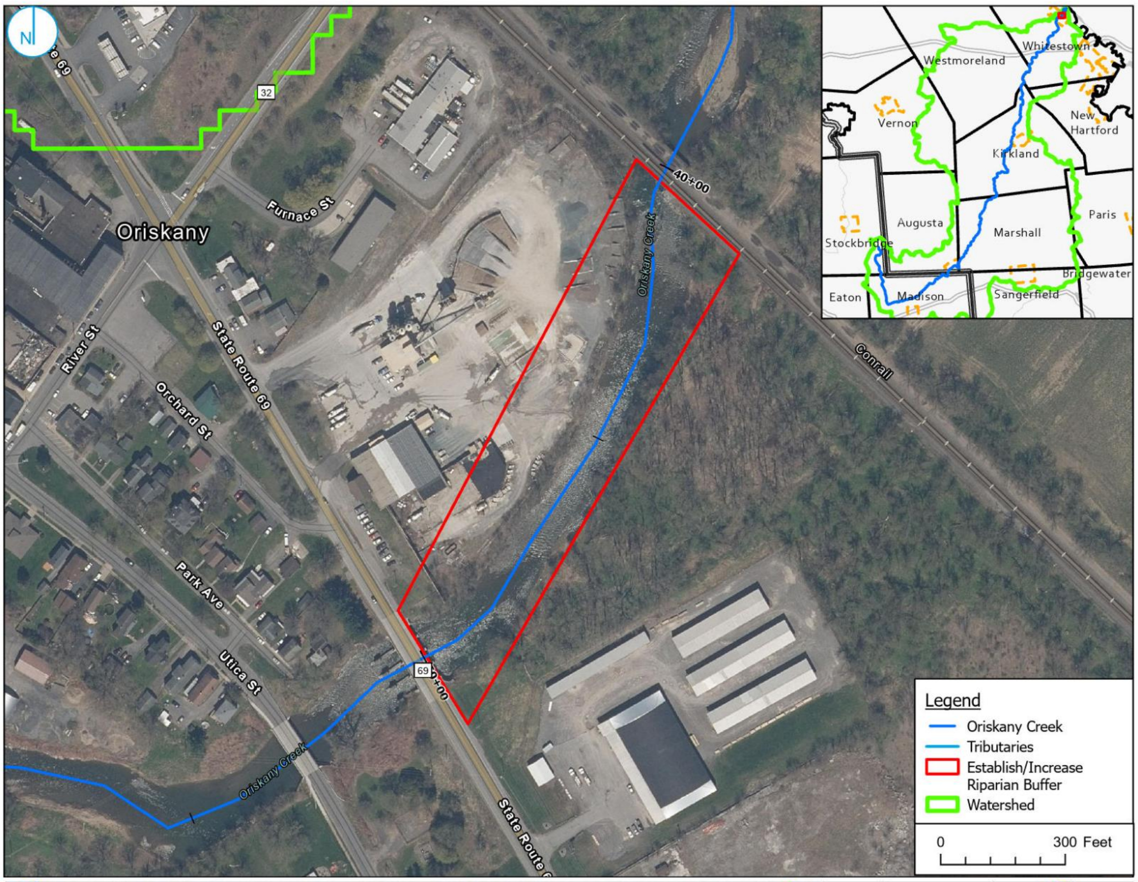


Figure 8-37. Location map for riparian buffer along Oriskany Creek for Alternative #5-3.



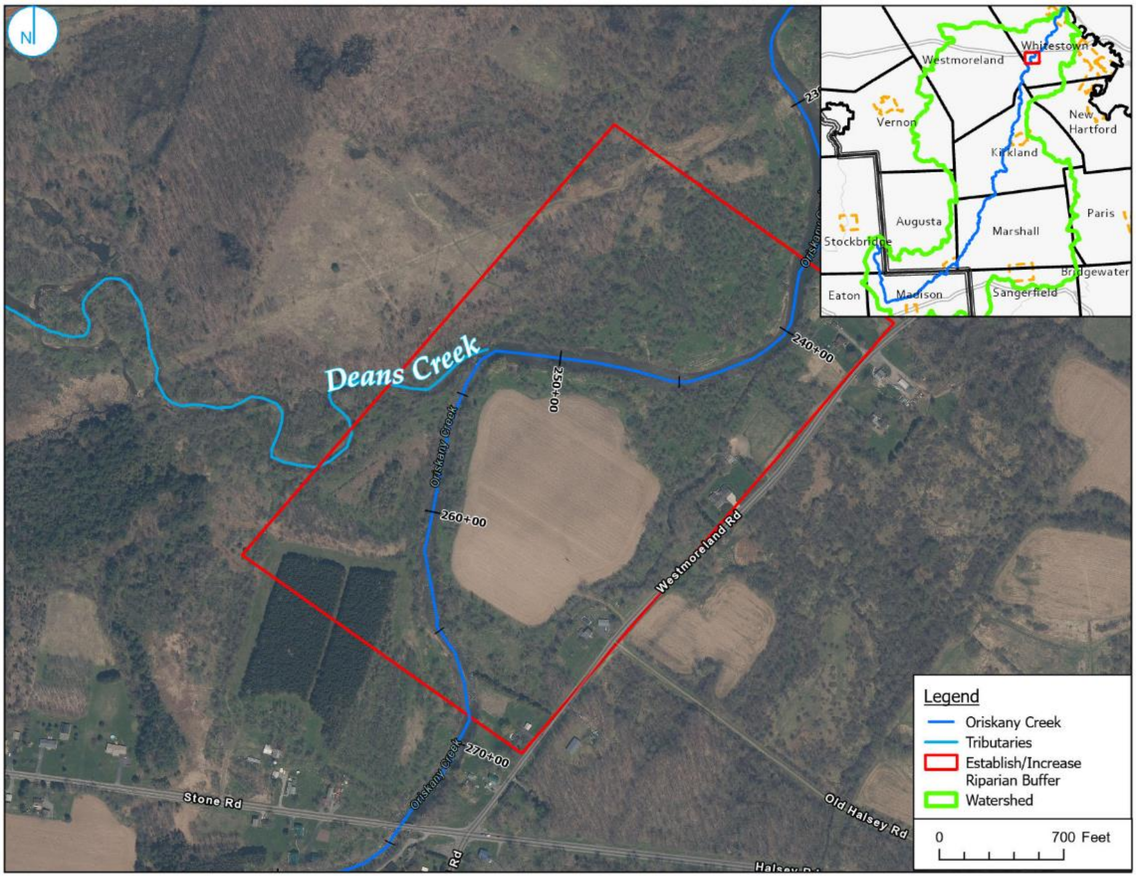


Figure 8-37 (continued). Location map for riparian buffer along Oriskany Creek for Alternative #5-3.

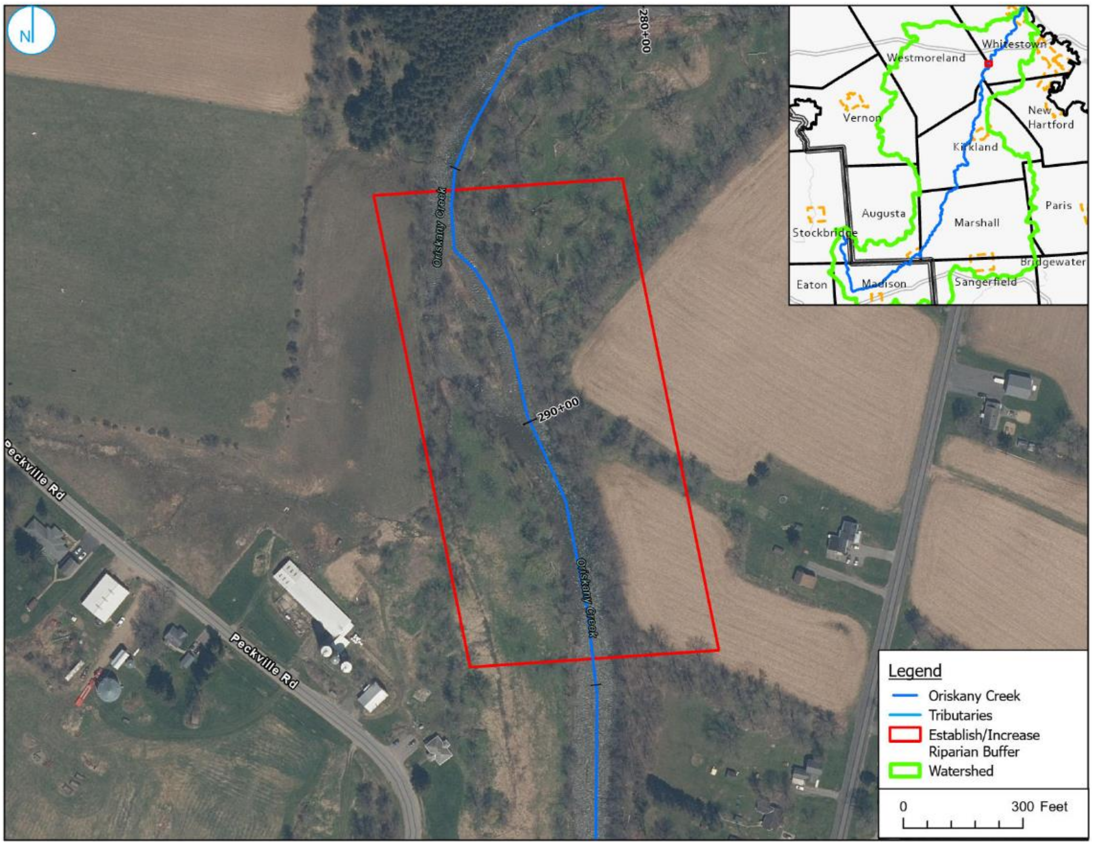


Figure 8-37 (continued). Location map for riparian buffer along Oriskany Creek for Alternative #5-3.

8.5.4 Streambank Stabilization

Erosion of the creek banks in several locations threaten property damage and also increase the amount of sediment entering the creek especially at the following locations:

- Little League park on the right bank at RS 59+00 to 70+00
- Upstream Utica Street on the left bank at RS 52+00 to 59+00
- Between NY-69 and CSX Railroad Bridge at the Clemente Fane Concrete property at RS 40+00 to 50+00

To assess applicability of different streambank stabilization strategies under higher frequency lower-flow conditions, channel velocity (feet per second) and shear stress (pounds per square foot) were calculated using the HEC-RAS software for the existing conditions model at the 10% AEP. A description of the velocity and shear stress variables are identified in Section 5.2.

Based on the channel velocities and shear stresses, Table 29 summarizes the potential streambank stabilization measures along Oriskany Creek in Zone 5. The entire reach was studied for all possible streambank stabilization strategies and can be applied for future projects if applicable.

Table 18 lists average cost per linear foot for each streambank stabilization type discussed in Table 29. Figure 8-38 displays the results of the hydraulic model simulations for Zone 5 for the eight different annual chance flood events and the two erosional/depositional variables. Additional geomorphic and engineering analyses, including additional modeling, would be necessary in order to determine the most appropriate streambank stabilization strategy and its associated costs.

Table 29. Streambank Stabilization Strategies for Zone 5, the Town of Whitestown

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Brush Mattresses	Staked only w/ rock riprap toe (initial)	0+00 to 30+00; 90+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 250+00; 280+00 to 360+00	Brush mattresses include live stakes and fascine bundles with branch cuttings, dead stout stakes, and geotextile fabric.
	Staked only w/ rock riprap toe (grown)	0+00 to 30+00; 40+00 to 290+00; 310+00 to 360+00	
Coir Geotextile Roll	Roll with coir rope mesh staked only without rock riprap toe	0+00 to 30+00; 90+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 250+00; 280+00 to 360+00	Vegetative logs placed in densely packed coconut fiber rolls act as a natural retaining wall to prevent erosion.
	Roll with Polypropylene rope mesh staked only without rock riprap toe	0+00 to 30+00; 40+00 to 70+00; 80+00 to 110+00; 120+00 to 140+00; 160+00 to 180+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Roll with Polypropylene rope mesh staked and with rock riprap toe	0+00 to 30+00; 40+00 to 290+00; 310+00 to 360+00	
Live Fascine	Live Fascine Bundle with rock riprap toe	0+00 to 30+00; 40+00 to 70+00; 80+00 to 110+00; 120+00 to 140+00; 160+00 to 180+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	Live fascine bundles include live woody cuttings in a bundle and buried into the bank of the stream parallel to the stream's flow.
Soils	Shale and Hardpan	0+00 to 30+00; 60+00 to 70+00; 80+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	Shale and hardpan are compact rocks that can protect the streambank from erosion in areas with low shear stress and velocities. This treatment may be difficult for vegetation to establish along the banks with the presence of shale and hardpan.
Gravel/Cobble	6-in diameter	0+00 to 30+00; 40+00 to 70+00; 80+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	Lining the streambank with gravel that has a diameter of at least 6-inches will help protect the streambank from erosion.
	12-in diameter	0+00 to 30+00; 40+00 to 290+00; 310+00 to 360+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
Vegetation	Class A turf (ret class)	0+00 to 30+00; 40+00 to 70+00; 80+00 to 110+00; 120+00 to 140+00; 160+00 to 180+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	A streambank that is covered with native vegetation such as Class A, Class B, or Class C turf (ret class), long grasses, or hardwood tree plantings will establish protection and increase erosion resistance along the bank.
	Class B turf (ret class)	0+00 to 30+00; 40+00 to 70+00; 80+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Class C turf (ret class)	0+00 to 30+00; 120+00 to 130+00; 200+00 to 250+00; 280+00 to 290+00	
	Long native grasses	0+00 to 30+00; 60+00 to 70+00; 80+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
Soil Bioengineering	Wattles	0+00 to 30+00; 120+00 to 130+00; 210+00 to 250+00; 280+00 to 290+00	Soil bioengineering treatments to reduce streambank erosion in this area includes wattles, reed fascines, coir roll, vegetated coir mat, live brush mattress, brush layering, and live willow stakes. Place live stakes in areas with increased deposition and minimal erosion.
	Reed fascine	0+00 to 30+00; 90+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 250+00; 280+00 to 290+00; 310+00 to 360+00	
	Coir roll	0+00 to 30+00; 40+00 to 70+00; 80+00 to 110+00; 120+00 to 140+00; 160+00 to 180+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Vegetated coir mat	0+00 to 30+00; 40+00 to 140+00; 160+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Live brush mattress (initial)	0+00 to 30+00; 120+00 to 130+00; 160+00 to 170+00; 200+00 to 250+00; 280+00 to 290+00; 310+00 to 320+00	
	Live brush mattress (grown)	0+00 to 30+00; 40+00 to 290+00; 310+00 to 360+00	
	Brush layering (initial/grown)	0+00 to 30+00; 40+00 to 290+00; 310+00 to 360+00	

Treatment Group	Type of Treatment	River Station (ft)	Description of Treatment
	Live fascine	0+00 to 30+00; 40+00 to 70+00; 80+00 to 110+00; 120+00 to 140+00; 160+00 to 180+00; 190+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Live willow stakes	0+00 to 30+00; 40+00 to 140+00; 150+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
Boulder Clusters	Very large (>80-inch diameter)	0+00 to 360+00	Boulders of different diameters may protect the stream and protect the stream from erosion.
	Large (>40-in diameter)	0+00 to 360+00	
	Medium (>20-inch diameter)	0+00 to 360+00	
	Small (>10-inch diameter)	0+00 to 30+00; 40+00 to 140+00; 150+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Large (>5-inch diameter)	0+00 to 30+00; 40+00 to 70+00; 80+00 to 100+00; 120+00 to 140+00; 160+00 to 170+00; 200+00 to 260+00; 280+00 to 290+00; 310+00 to 360+00	
	Small (>2.5-inch diameter)	0+00 to 30+00; 90+00 to 100+00; 120+00 to 140+00; 200+00 to 250+00; 280+00 to 290+00; 310+00 to 360+00	

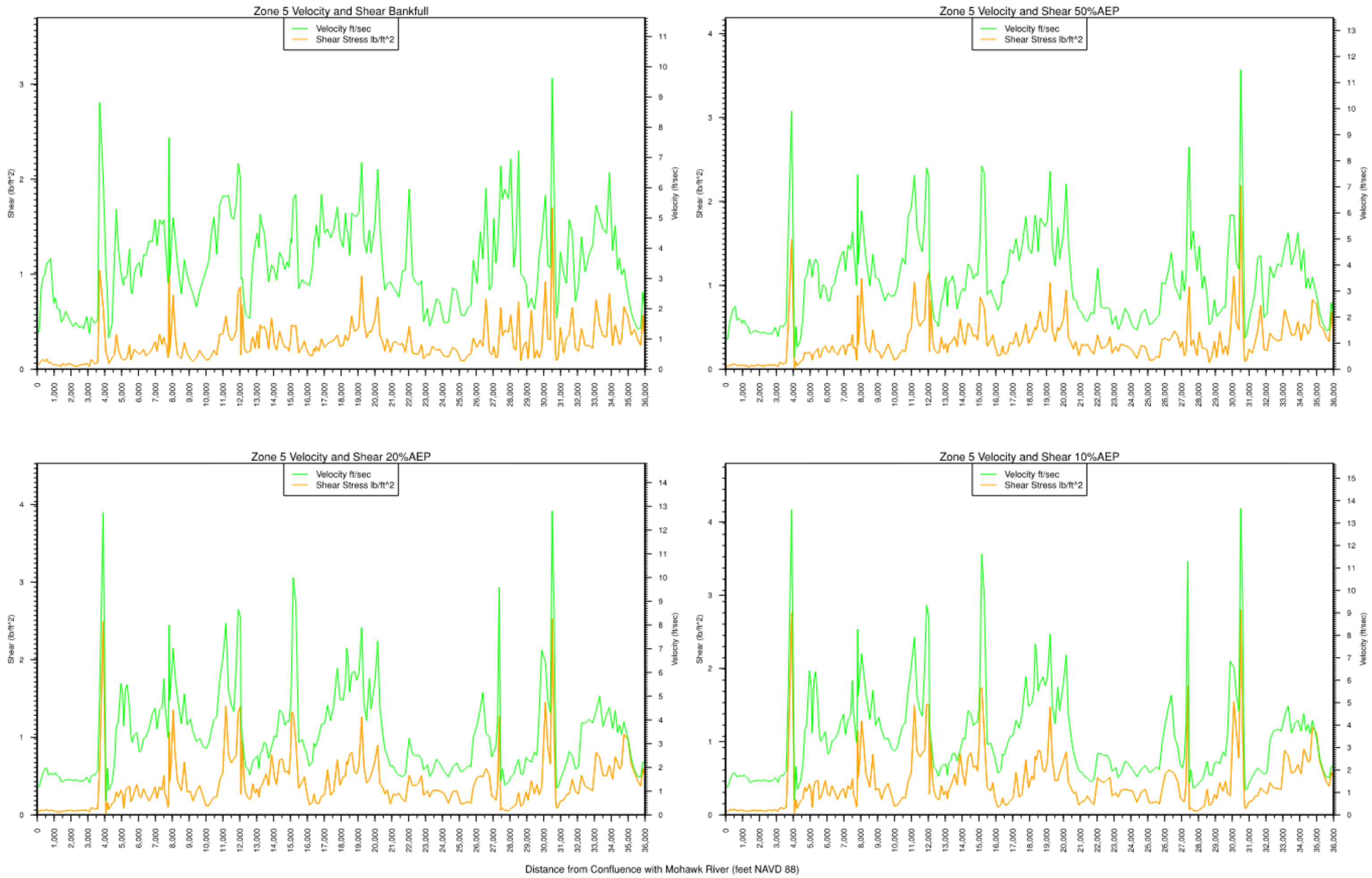


Figure 8-38. Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 5.

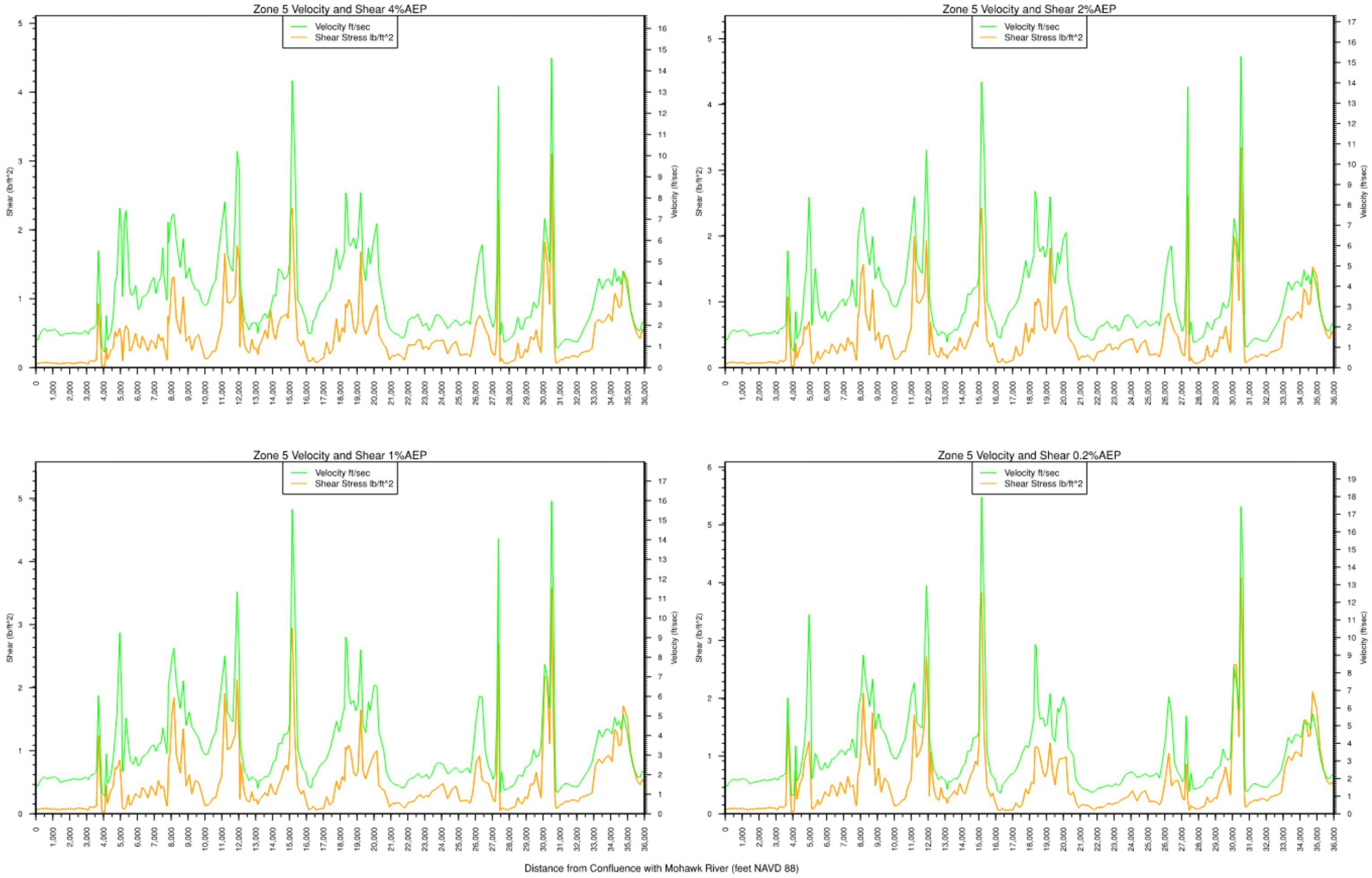


Figure 8-38 (continued). Analysis of velocity (ft/s) and shear stress (lbs./sq ft) based on the HEC-RAS model results for Zone 5.

8.6 BASIN-WIDE MANAGEMENT STRATEGIES

Sediment management measures attempt to either control erosion, sediment, or both. Erosion control is the primary means of preventing degradation of channel and streambank stability, while sediment controls should be established to support erosion control efforts and remove excess sediment and debris from a waterway (USEPA 2003).

8.6.1 Sediment and Debris Management Study for Big Creek, Turkey Creek, White Creek, and Deans Creek

Similar to this report, this measure is intended to perform one or multiple sediment and debris management studies on tributaries to Oriskany Creek including Big Creek, Turkey Creek, White Creek, and Deans Creek. The objective of these studies would be to provide an effective method to identify areas within the selected watershed where sediment and debris accumulation contributes to flooding risk, and gather information necessary to develop a management plan to reduce those risks. The plan would necessitate the collection and assessment of watershed-wide conditions in a holistic systems-based approach to best understand and plan mitigative measures.

Big Creek, Turkey Creek, White Creek, and Deans Creek are tributaries identified by stakeholders that have elevated total suspended sediment levels, bank instabilities, and sediment and debris accumulation based on stream sampling and observations after flood events. These four tributaries should be selected as priority sediment and debris management studies.

A primary goal will be to reduce flooding by lowering surface water elevations caused by undersized infrastructure, excessive deposition and debris, uncontrolled sediment sources, head cutting or downcutting of the channel, and loss of natural floodplains and properties. Many of these situations are a result of basin-wide conditions related to changes in land use, landcover and runoff, stormwater management, upstream sediment sources, upstream woody debris, and stream bed and bank erosion. Practical solutions and actions would be presented to meet these goals in an ecologically sustainable manner.

Numerous watershed-wide characteristics and conditions can contribute to or cause increased flooding risk. Incompletely understood and poorly planned actions may worsen flooding risk, create negative unintended consequences, be prohibitively expensive, ineffective, a waste of dollars, and cause unnecessary ecological damage.

A management plan is a process that should incorporate the input of all the different people who live, work and play in the watershed when determining how the watershed should be managed. The sediment and debris management plan should be a dynamic, ever changing, process-driven document that helps define future direction for the watershed and be updated periodically, as and if improvements or changes in conditions within the watershed occur, such as creation of floodplain areas, bridge/culvert resizing, or alterations to creek channel dimensions.

The study would provide an understanding of the intricacies, complexities, and interrelationships involved in water resource management; outline common issues faced by different municipalities within these watersheds; and identify specific strategies and measures to address these issues. Within these watershed, diverse solutions and abatement programs of various county, state, local, and federal agencies should be integrated into a coordinated, comprehensive, interagency, watershed-based approach to management. A uniform, organized, well thought-out water resources strategy would: provide for a more effective delivery of programs; reduce duplication of efforts and agency conflicts; identify program gaps; clarify agency roles and responsibilities; provide a means of identifying and obtaining future funding opportunities; and would result in the overall enhancement of water resources within the Oriskany Creek watershed.

8.6.2 Agricultural Sedimentation

On agricultural land, movement of soil and rock is caused by three different forms of erosion: water, wind, and groundwater. Water erosion can occur in many different forms on agricultural lands: sheet, rill, gully, streambank/streambed, and irrigation. Sheet erosion occurs due to sheet flow over the surface during a precipitation event or excessive irrigation. Rill erosion is when small channels or streamlets form as a result of surface runoff. Gully erosion occurs when water in rills concentrates to form larger and persistent channels. Streambank/streambed erosion occurs in stream channels typically during higher flow events when the force of water dislodges sediments from loose or undercut banks (USEPA 2003).

Wind erosion occurs when soil particles on the surface are dislodged by wind. Wind velocities can exceed 12 miles per hour (mph) at one foot above the ground surface. The wind moves detached soil in three ways: suspension, saltation, and surface creep. Suspension happens when soil particles with diameters smaller than 0.05 millimeters (mm) are picked up and carried by the wind and do not fall out until either rain knocks the particle out of the air column or the wind velocity slows, and the particles fall out of the air column. Saltation is when soil particles of intermediate size (0.05 to 0.5 mm) move in a series of steps as wind causes these particles to rise into the air then fall after a short flight. Surface creep occurs when larger soil particles (0.5 to 1.0 mm) are too heavily to be lifted, but instead are pushed along the surface by other saltating soil particles or directly by the wind (USEPA 2003).

Sediment movement into groundwater is fairly uncommon, but under specific conditions, sediment and sediment-borne pollutants can enter groundwater through direct connections with the surface. Groundwater conditions should always be taken into consideration when erosion and sediment control systems are being designed and implemented. Surface erosion and sediment issues should never be corrected at the expense of groundwater (USEPA 2003).

Erosion and sediment control practices typically involve similar strategies: reduce soil detachment; reduce sediment transport; and trap sediments before they can reach nearby waterways or waterbodies. Source area stabilization (i.e., keeping sufficient cover on the soil) is fundamental to erosion and sediment control. There are numerous control practices that can achieve each strategy. For example, practices to reduce soil detachment include cover/conservation crops, residue management, diversions, windbreaks/shelterbelts, mulching, irrigation water management, prescribed grazing, surface roughening, tree planting, and brush management, among other practices (USEPA 2003).

Practices to reduce sediment transport within the agricultural field include contour farming, windbreaks/barriers, grassed waterways, terraces, and buffer strips, among other practices. Practices to trap sediments below the field or in critical areas before they reach nearby waterway or waterbodies include sediment basins, field borders, filter strips, and water/sediment control basins (USEPA 2003).

The Oriskany Creek watershed is comprised of nearly 51% agricultural lands (NASS 2024). The best management practices (BMPs) for erosion and sediment control should be considered for all agricultural lands that border Oriskany Creek or its tributaries. Local stakeholders should partner with knowledge experts to combine local information with sound erosion and sediment control BMPs to develop effective strategies for erosion and sediment control (USEPA 2003).

8.6.3 Large Woody Debris Removal

Debris, such as trees, branches and stumps, are an important feature of natural and healthy stream systems. In a healthy stream network, woody debris helps to stabilize the stream and its banks, reduce sediment erosion, and slow storm-induced high streamflow events. Fallen trees and brush also form the basis for the entire aquatic ecosystem by providing food, shelter, and other benefits to fish and wildlife. In the headwaters of many streams, woody debris influences flooding events by increasing channel roughness, dissipating energy, and slowing floodwaters. Any woody debris that does not pose a hazard to infrastructure or property should be left in place and undisturbed, thereby saving time and money for more critical work at other locations (NYSDEC 2013).

However, in some instances, significant debris can impact flows by blocking bridge and culvert openings and accumulating along the stream path at meanders, contraction/expansion points, etc., which can divert stream flow and cause backwater and bank erosion. When debris poses a risk to infrastructure, such as bridges or homes, it should be removed. Provided fallen trees, limbs, debris and trash can be pulled, cabled or otherwise removed from a stream or bank without significant disruption of the stream bed and banks, a permit from the NYSDEC is not required. Woody debris and trash can be removed from a stream without the need for a permit under the following guidelines (NYSDEC 2013):

- Fallen trees and debris may be pulled from the stream by vehicles and motorized equipment operating from the top of the streambanks using winches, chains and or cables.
- Hand-held tools, such as chainsaws, axes, handsaws, etc., may be used to cut up the debris into manageable sized pieces.
- Downed trees that are still attached to the banks should be cut off near the stump. Do not grub (pull out) tree stumps from the bank; stumps hold the bank from eroding.
- All trees, brush, and trash that is removed from the channel should not be left on the floodplain. Trash should be properly disposed of at a waste management facility. Trees and brush can be utilized as firewood. To prevent the spread of invasive species, such as Emerald Ash Borer, firewood cannot be moved more than 50 miles from its point of origin.
- Equipment may not be operated in the water, and any increase in stream turbidity from the removal must be avoided.

Routine maintenance of removing large woody debris is recommended at the confluence of White Creek and Dean’s Creek, upstream of bridges/culverts obstructing flow of Oriskany Creek, and dams within the creek. Multiple in-channel piers from bridge structures are a critical catchpoint for large woody debris in the channel. An example location for multiple in-channel piers is at NY-69/Erie Blvd shown in Figure 8-39. The piers cannot be removed because of their historical significance with the Erie Canal.

Figure 8-39. In-channel piers at NY-69/Erie Boulevard in the Town of Whitestown, NY.

Any work that will disturb the bed or banks of a protected stream (sediment removal, stream restoration, bank stabilization, installation, repair, replacements of culverts or bridges, objects embedded in the stream that require digging out, etc.) will require an Article 15 permit from the NYSDEC. Projects that will require disturbance of the stream bed or banks, such as excavating sand and gravel, digging embedded debris from the streambed or the use of motorized, vehicular equipment, such as a tractor, backhoe, bulldozer, log skidder, four-wheel drive truck, etc. (any heavy equipment), in the stream channel, or anywhere below the top of banks, will require either a Protection of Waters or Excavation or Fill in Navigable Waters Permit (NYSDEC 2013).

Consultation with the NYSDEC can help determine if, when and how sediment and debris should be managed and whether a permit will be required.

8.6.4 Riparian Restoration

Riparian ecosystems support many critically important ecological functions, but most riparian areas have been severely degraded by a variety of human disturbances within the Oriskany Creek watershed. Restoration, which is defined as the process of re-establishing historical ecosystem structures and processes, is being used more often to mitigate some of the past degradation of these ecosystems (Goodwin et al. 1997).

Adoption of a process-based approach for riparian restoration is key to a successful restoration plan, and in riparian systems, flooding disturbance is a key process to consider. Successful restoration depends on understanding both the physical and biological processes that influence natural riparian ecosystems. Anthropogenic modifications, such as altering historical flooding processes, can cause a variety of disturbances to natural ecosystems that can degrade riparian areas (Goodwin et al. 1997).

Riparian ecosystems generally consist of two zones: Zone I occupies the active floodplain and is frequently inundated, and Zone II extends from the active floodplain to the valley wall. Successful restoration depends on understanding the physical and biological processes that influence natural riparian ecosystems and the types of disturbance that have degraded riparian areas. Adoption of a process-based approach for riparian restoration is key to a successful restoration plan (Goodwin et al. 1997). Disturbances to riparian ecosystems in the Oriskany Creek watershed have resulted from streamflow modifications by dams, reservoirs, and diversions; stream channelization; direct modification of the riparian ecosystem; and watershed disturbances (Ramboll 2023b).

With ecological processes in mind, a successful riparian restoration plan should focus on four key areas: (1) interdisciplinary approaches, (2) a unified framework, (3) a better understanding of fundamental riparian ecosystem processes, and (4) restoration potential more closely related to disturbance type (Goodwin et al. 1997).

Riparian restoration requires a deep understanding of physical and ecological conditions that exist and that are desired at a restoration site. These conditions must be naturally sustainable given a set of water, sediment, and energy fluxes. If the conditions cannot be naturally sustained, the restoration will fail to meet the original goals (Goodwin et al. 1997).

8.6.5 Retention Basin and Wetland Management

Retention basins and wetlands are designed and constructed to contain and/or filter pollutants that flush off of the landscape. Without proper maintenance, nutrients, such as nitrogen and phosphorus that are typically found in stormwater runoff, can accumulate in basins and wetlands leading to degraded conditions such as low dissolved oxygen, algae blooms, unsightly conditions, and odors. Excess sediment from the watershed upstream can also accumulate in basins and wetlands. This sediment can smother the vegetation and clog any filtering structures or outlets. In addition, standing water in basins can heat up during the summer months. This warmer water is later released into neighboring waters, which can have negative impacts on aquatic life (USEPA 2009b).

Without proper maintenance, excess pollutants in basins and wetlands may actually become sources of water quality issues such as poor watercolor/clarity/odor, low dissolved oxygen leading to plant die off, and prevalence of algal blooms. When these basins and wetlands are “flushed” during a large rain event, the excess nutrients causing these problems may be transferred to the receiving waterbody (USEPA 2009b).

Maintenance is necessary for a retention basins or wetlands to operate as designed on a long-term basis. The pollutant removal, channel protection, and flood control capabilities of basin and wetlands will decrease if any of the following occur (USEPA 2009b):

- Sediment accumulates reducing the storage volume
- Debris blocks the outlet structure
- Pipes or the riser are damaged
- Invasive plants take over the planted vegetation
- Slope stabilizing vegetation is lost
- The structural integrity of the embankment, weir, or riser is compromised

Retention basin and wetland maintenance activities range in terms of the level of effort and expertise required to perform them. Routine maintenance, such as mowing and removing debris or trash, is needed multiple times each year, but can be performed by citizen volunteers. More significant maintenance such as removing accumulated sediment is needed less frequently but requires more skilled labor and special equipment. Inspection and repair of critical structural features such as embankments and risers, needs to be performed by a qualified professional (e.g., structural engineer) who has experience in the construction, inspection, and repair of these features. Water level management, if control structures are available, can be an effective tool to meet a range of habitats and process management objectives (USEPA 2009b).

Program managers and responsible parties need to recognize and understand that neglecting routine maintenance and inspection can lead to more serious problems that threaten public safety, impact water quality, and require more expensive corrective actions (USEPA 2009b).

8.6.6 Land Use Planning/Ordinances

This alternative proposes municipalities within the Oriskany Creek watershed consider floodplain management practices such as preservation and/or conservation of areas along with land use ordinances that could minimize future development of sensitive areas, such as wetlands, forests, riparian areas, and other open spaces. It could also include areas in the floodplain that are currently free from development and providing floodplain storage.

A watershed approach to land use planning and management is an important part of water protection and restoration efforts. New York State's watersheds are the basis for management, monitoring, and assessment activities. The New York State Open Space Conservation Plan, NYSDEC Smart Growth initiative, and the Climate Smart Communities Program address land use within a watershed (NYSDEC [date unknown]b). Land use planning should be incorporated into a municipalities comprehensive plan or, if a comprehensive plan does not exist, passed as a series of ordinances that consider more restrictive floodplain development regulations besides the New York State minimum requirements.

Natural floodplains provide flood risk reduction benefits by slowing runoff and storing flood water. They also provide other benefits of considerable economic, social, and environmental value that should be considered in local land-use decisions. Floodplains frequently contain wetlands and other important ecological areas which directly affect the quality of the local environment. Floodplain management is the operation of a community program of preventive and corrective measures to reduce the risk of current and future flooding, resulting in a more resilient community. These measures take a variety of forms, are carried out by multiple stakeholders with a vested interest in responsible floodplain management, and generally include requirements for zoning, subdivision or building, building codes and special-purpose floodplain ordinances. While FEMA has minimum floodplain management standards for communities participating in the NFIP, best practices demonstrate the adoption of higher standards which will lead to safer, stronger, and more resilient communities (FEMA 2006).

Further hydrology and hydraulic model scenarios could be performed to illustrate how future watershed and floodplain management techniques could benefit the communities within the Oriskany Creek watershed.

8.6.7 Development/Updating of a Comprehensive Plan

Local governments are responsible for planning in a number of areas, including housing, transportation, water, open space, waste management, energy, and disaster preparedness. In New York State, these planning efforts can be combined into a comprehensive plan that steers investments by local governments and guides future development through zoning regulations. A comprehensive plan will guide the development of government structure as well as natural and built environment. Significant features of comprehensive planning in most communities include its foundations for land use controls for the purpose of protecting the health, safety, and general welfare of the community's citizens. The plan will focus on immediate and long-range protection, enhancement, growth, and development of a community's assets. Materials included in the comprehensive plan will incorporate text and graphics, including but not limited to maps, charts, studies, resolutions, reports, and other descriptive materials. Once the comprehensive plan is completed, the governing board motions to adopt it (i.e., town or village board; EFC 2015).

Development of a comprehensive plan in general is optional, as is the development of a plan in accordance with state comprehensive plan statutes. However, statutes can guide plan developers through the process. Comprehensive plans provide the following benefits to municipal leaders and community members (EFC 2015):

- Provides a legal defense for regulations
- Provides a basis for other actions affecting the development of the community (i.e., land use planning and zoning)
- Helps establish policies relating to the creation and enhancement of community assets

All communities within the Oriskany Creek watershed should develop or update their respective comprehensive plans in an effort to coordinate and manage any and all land use changes and development.

In addition, any comprehensive plan developed for communities within the watershed should include future climate change and NYS Smart Growth practices. Local governments should incorporate sustainability elements throughout the comprehensive plan. "Future-proofing" management and mitigation strategies by taking climate change into consideration would ensure that any strategy pursued would have the greatest possible chance for success. NYS Smart Growth practices would maximize the social, economic, and environmental benefits from public infrastructure development, while minimizing unnecessary environmental degradation, disinvestment in urban and suburban communities, and loss of open space facilitated by the development of new or expanded public infrastructure (NYSDEC [date unknown]).

9. Next Steps

9.1 Additional Data Collection and H&H Modeling

Additional data collection and modeling would be necessary to more precisely model water surface elevations for potential flooding and erosion and sedimentation areas. Site and project specific 2-D unsteady flow modeling using the HEC-RAS program would incorporate additional spatial information in model simulations producing more robust results with a higher degree of confidence than the currently modeled watershed-scale simulations.

9.2 State and Local Regulations

Prior to implementation of any mitigation alternative, pertinent local municipalities' laws, NYSDEC Part 502 regulations (for state-related facilities), and any other applicable state and local laws or regulations should be determined, and appropriate steps taken to ensure compliance. These laws and regulations should also reflect the FEMA requirements for work within the regulated floodplain.

9.3 State/Federal Wetlands Investigation

Any mitigation strategy that proposes using wetlands in any capacity, needs to be evaluated based on federal and state wetland criteria before that mitigation strategy can be recommended for final consideration.

The proposed mitigation alternatives for Oriskany Creek involve state regulated freshwater wetlands and several alternatives are within the wetland check zones. The NYSDEC recommends wetland delineations where mapped NYSDEC wetlands either presently occupy, have historically existed, or are in close proximity. Wetland delineations will verify whether the NYSDEC would require an Article 24 Wetland Permit for any mitigation project.

9.4 NYSDEC Protection of Waters Program

Oriskany Creek is protected under Article 15 of Title 6 of the New York Codes, Rules, and Regulations (6NYCRR Part 608). Oriskany Creek has a designation of classifications C and B(TS). Classification C indicates non-contact activities and fisheries. Classification B indicates the waterway is suitable for swimming and other recreation, but not for drinking. “TS” is defined as waterways that support trout spawning. Special requirements apply to waterways that provide habitats to valuable and sensitive fisheries resources (NYSDEC 2024a).

Under the NYSDEC Protection of Waters (POW) program, any work considered along Oriskany Creek is subject to POW regulations, which require permits for activities, including disturbing the bed or banks, excavation or placement of fill, and water quality certifications. Any changes to the bed or bank of Oriskany Creek would need to be reviewed and approved by the NYSDEC (NYSDEC 2024c).

9.5 Funding Sources

There are numerous potential funding programs and grants for mitigation projects that may be used to offset municipal financing. NYSDEC has developed a “Funding Finder Tool” to assist in the process of searching for applicable grants. The tool is found at https://dec.ny.gov/get-involved/grant-applications/funding-finder-tool. Other funding opportunities include the following:

- New York State Office of Emergency Management (NYSOEM)
  https://www.dhses.ny.gov/office-emergency-management
- New York State Department of Transportation (NYSDOT) Bridge NY Program
  https://www.dot.ny.gov/bridgeny
- Regional Economic Development Councils/Consolidated Funding Applications (CFA)
  https://regionalcouncils.ny.gov/cfa
- Natural Resources Conservation Services (NRCS) Watershed Funding Programs
  https://www.nrcs.usda.gov/programs-initiatives/watershed-programs
- FEMA Unified Hazard Mitigation Assistance (HMA) Program
  https://www.fema.gov/grants/mitigation/guide
- FEMA Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act
  https://www.fema.gov/grants/mitigation/storm-rlf
- USACE Continuing Authorities Program (CAP)
  https://www.nae.usace.army.mil/Missions/Public-Services/Continuing-Authorities-Program/
- New York State Environmental Corporation (NYSEFC) Clean Water, Clean Air, and Green Jobs Environmental Bond Act of 2022 (i.e., Resilient Watershed Implementation Grant Program)
  https://environmentalbondact.ny.gov/
- Environmental Facilities Corporation’s (EFC's) Green Resilient Grant Program (GRGP)
  https://efc.ny.gov/grg
- Great Lakes Restoration Initiative (GLRI) Funding Opportunities
  https://www.glri.us/funding
- Climate Resilient Farming
- Source Water Buffer Program
  https://agriculture.ny.gov/rfp-0320-climate-resilient-farming
  https://agriculture.ny.gov/soil-and-water/rfa-0181-source-water-buffer-program

<u>New York State Office of Emergency Management (NYSOEM)</u>
The NYSOEM, through the United States Department of Homeland Security (DHS), offers several funding opportunities under the Homeland Security Grant Program (HSGP). The priority for these programs is to provide resources to strengthen national preparedness for catastrophic events.

<u>NYSDOT Bridge NY Program</u>
The NYSDOT Bridge NY program provides enhanced assistance for local governments to rehabilitate and replace bridges and culverts. Particular emphasis is provided for projects that address poor structural conditions; mitigate weight restrictions or detours; facilitate economic development or increase competitiveness; improve resiliency and/or reduce the risk of flooding.

Regional Economic Development Councils/Consolidated Funding Applications (CFA)
The Consolidated Funding Application (CFA) is a single application for state economic development resources from numerous state agencies. Potential CFA programs that would apply to mitigation projects include:

- **Water Quality Improvement Project (WQIP) Program**: administered through the NYSDEC, the WQIP is a statewide reimbursement grant program to address documented water quality impairments.

- **Climate Smart Communities (CSC) Grant Program**: administered by the NYS Office of Climate Change under the New York State Environmental Protection Fund, the CSC Grant Program is a 50/50 matching grant program to fund climate change adaptation and mitigation projects and includes support for projects that are part of a strategy to become a Certified Climate Smart Community.

- **Green Innovation Grant Program (GIGP)**: The GIGP is a funding initiative designed to support and encourage the development of innovative solutions that address environmental challenges such as water quality. Applicants may receive funds to finance projects focused on creating sustainable technologies, processes, or practices. The GIGP intends to stimulate research and development in areas such as renewable energy, waste reduction, conservation, etc. This initiative plays a crucial role in promoting environmental stewardship while fostering economic growth and innovation.

Natural Resources Conservation Services (NRCS) Watershed Funding Programs

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers three separate funding programs to promote landscape planning, flood prevention, and rehabilitation projects in communities throughout the country.

1. The Emergency Watershed Protection (EWP) Program responds to emergencies created by natural disasters. The EWP Program is a recovery effort aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural disasters.

2. The Watershed and Flood Prevention Operations (WFPO) Program provides technical and financial assistance for cooperation between the federal government and the states and their political subdivisions to address resource concerns due to erosion, floodwater, and sediment and provide for improved utilization of the land and water resources.

3. The Watershed Rehabilitation (REHAB) Program helps project sponsors rehabilitate aging dams that are reaching the end of their design life and/or no longer meet federal or state standards.

FEMA Hazard Mitigation Grant Program (HMGP)
The Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP), offered by the New York State Division of Homeland Security and Emergency Services (NYSDHSES), provides funding for creating/updating hazard mitigation plans and implementing hazard mitigation projects.

FEMA Building Resilient Infrastructure and Communities (BRIC)
The BRIC grant program, which was created as part of Disaster Recovery Reform Act of 2018 (DRRA), supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards, and aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience.

FEMA Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act
The STORM Act provides capitalization grants to participating states and tribes in order to loan money to local governments for hazard mitigation projects to reduce risks from disasters and natural hazards.

USACE Continuing Authorities Program (CAP)
The CAP is a group of nine legislative authorities under which the Corps of Engineers can plan, design, and implement water resources projects of limited size, cost, scope and complexity without additional project-specific congressional authorization.

NYSEFC Clean Water, Clean Air, and Green Jobs Environmental Bond Act of 2022
On November 8, 2022, voter participants of New York State passed the $4.2 billion NYSEFC Clean Water, Clean Air, and Green Jobs Environmental Bond Act (Bond Act). The Bond Act is structured to fund critical environmental restoration projects throughout the state in four categories:

1. Water Quality & Resilient Infrastructure
2. Open Space Conservation & Recreation
3. Restoration & Flood Risk Reduction
4. Climate Change Mitigation

The Bond Act includes, but is not limited to, funding projects to achieve the following (NYDEC 2024):

- Improve and protect the water quality of drinking water
- Reduce water and air pollution
- Create sustaining environmental jobs
- Update infrastructure which includes roads, sewers, and drinking water pipes
- Conserve and preserve wildlife habitats, agricultural lands, forests, and wetlands
- Improve public health by planting street trees
- Reduce the potential for lead exposure
- Increase renewable energy improvements in public buildings
- Protect communities and natural resources from climate change

Bond Act investments will help municipalities reimagine, redesign, and rebuild with climate resilience to strengthen communities' abilities to withstand future high-water and storm events, extreme heat risks, and other long-term environmental changes. All projects funded by the Bond Act will advance climate action priorities to reduce greenhouse gas emissions, thereby driving critical building, transportation and electrification, and advance the state's commitment to economy-wide carbon neutrality, consistent with the New York State Climate Act (NYDEC 2024).

EFC's Green Resilient Grant Program (GRGP)
The GRGP is a funding opportunity for flood-prone communities to finance a green infrastructure project including a green roof, green streets, and permeable pavement. Qualified projects are supported under the GRGP for up to 90 percent of the costs with a maximum grant of $10 million. Requirements under the GRGP include having a minimum total project cost of $1 million and benefiting a minimum of 100,000 cubic feet of stormwater runoff each year. Additionally, projects must address combined and/or sanitary sewer overflow during extreme weather events with a proposed plan that includes green infrastructure and nature-based features to ensure climate resilient infrastructure.

Great Lakes Restoration Initiative (GLRI) Funding Opportunities
GLRI supports funding the following list of project types:

- Toxic Substances and Areas of Concern
- Invasive Species
- Nonpoint Source Pollution Impacts on Nearshore Health
- Habitat and Species
- Foundations for Future Restoration Actions

Climate Resilient Farming
The New York State Department of Agriculture and Markets supports the Climate Resilient Farming. This application will fund projects that mitigates the impacts of agricultural practices in response to climate change and prepares agriculture lands for resiliency projects. The RFP 0320 supports projects that is applicable to one of the following:

- Livestock Management: Alternative Waste Management and Precision Feed Management
- Cover and Flare Projects
- Adaptation and Resiliency
- Healthy Soils NY (Systems and BMPs that support soil health and agroforestry);
- Soil Health System
- Agricultural Forest Management.

The Source Water Buffer Program
The New York State Department of Agriculture and Markets supports the Source Water Buffer Program. The purpose of the program is to enhance water quality protection for public drinking water sources. The program supports funding for projects that include conservation easements and the establishment of riparian buffers on farmland that borders public drinking water sources. Vegetated or forested buffers are extremely effective practices to improve and protect water quality and they are beneficial for long-term protection. The program will match funds up to 75% for the purchase of permanent conservation easements or 50-year term conservation easements. Funds may also be utilized for the implementation of a vegetated or forested buffer.

10. Conclusion

Within the Oriskany Creek watershed, five zones were identified to have historical issues along the channel related to high water surface elevations, sediment aggradation and degradation, channel bed and streambank instability, and floodplain connectivity. Based on the technical analysis set forth in this report, a basis of potential solutions was identified to address the flooding and sediment issues within the Oriskany Creek watershed. This study provides an understanding of the complexity, feasibility, and benefits for the different alternatives. The proposed alternatives outlined in this report should be used to support flood mitigation and resiliency projects and is intended to be a high-level overview of proposed mitigation strategies and their potential impacts along Oriskany Creek.

The research and analysis that supported each proposed mitigation alternative in this study should be considered preliminary but provides the guidance necessary for implementation of the proposed solutions identified for each high-risk area. Additional design and hydraulic modeling and analyses would be necessary to implement many of the strategies discussed within this study. A comprehensive, organized, effective flood mitigation plan outlines a path for successful results in improving flood resiliency throughout the watershed.

Next steps are to implement a flood or sediment mitigation project that would involve obtaining stakeholder and public input to assess feasibility and support; completing additional technical analyses, as needed; selection of preferred flood mitigation projects; development of preliminary engineering design reports; and assessing and obtaining funding sources.

Funding sources can cover up to 100% of awarded funds, such as grants, or a percentage of the total funds awarded, like matching or cost-sharing programs, and can be awarded for both design and permitting, or construction. These types of awards are available from federal, state, and local agencies or non-governmental organizations (NGO).

Municipalities affected by erosion and sediment issues along Oriskany Creek can use this report to
support mitigation initiatives within their communities. In order to implement the mitigation strategies proposed in this report, a process of engagement follows the steps below:

1. Obtain stakeholder and public input to assess the feasibility and public support of each mitigation strategy presented in this report.
2. Complete additional data collection and modeling efforts to assess the effectiveness of the proposed flood mitigation strategies.
3. Develop a final flood mitigation plan based on the additional data collection and modeling results.
4. Select a final flood mitigation strategy or series of strategies to be completed for Sherman Brook based on feasibility, permitting, effectiveness, and available funding.
5. Develop a preliminary engineering design report and cost estimate for each selected mitigation strategy.
6. Assess funding sources for the selected flood mitigation strategy.
7. Once funding has been secured and the engineering design has been completed for the final mitigation strategy, construction and/or implementation of the measure should begin.

11. Approvals

Before work commences, final stream sediment and debris management plans must be reviewed and approved by the local Soil and Water Conservation District Office, in consultation with the NYSDEC Regional Office. In some instances, the Soil and Water Conservation District may find specific aspects of the plan require more detailed review and stamped approval by a licensed Professional Engineer.

Approval Signatures

The individuals listed below are authorized to sign and execute this management plan on the date appearing below their respective signatures.

Soil and Water Conservation District	Managing Municipality
By:	By:
Printed Name:	Printed Name:
Title:	Title:
Dated:	Dated:

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