Intended for

New York State Department of Environmental Conservation

625 Broadway

Albany, New York 12233

Document type

Final Report

Date

November 2022

RESILIENT NEW YORK FLOOD MITIGATION INITIATIVE

ONEIDA CREEK, ONEIDA & MADISON COUNTIES, NEW YORK

Prepared for:

Project Team

RESILIENT NEW YORK FLOOD MITIGATION INITIATIVE

ONEIDA CREEK, ONEIDA & MADISON COUNTIES, NEW YORK

Project name	Resilient New York Flood Mitigation Initiative – Oneida Creek, Oneida & Madison Counties, New York
Project no.	SC915 / 1940101847
Recipient	New York State Office of General Services
Document type	Report
Version	1
Date	November 7, 2022
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IN NOVEMBER 2018, NEW YORK STATE GOVERNOR ANDREW CUOMO COMMITTED FUNDING TO UNDERTAKE ADVANCED MODELING TECHNIQUES AND FIELD ASSESSMENTS OF 48 FLOOD PRONE STREAMS TO IDENTIFY PRIORITY PROJECTS AND ACTIONS TO REDUCE COMMUNITY FLOOD AND ICE JAM RISKS, WHILE IMPROVING HABITAT. THE OVERALL GOAL OF THE PROGRAM IS TO MAKE NEW YORK STATE MORE RESILIENT TO FUTURE FLOODING.

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APPENDICES

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Appendix B: Agency and Stakeholder Meeting Sign-in Sheet

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Appendix D: Photo Logs

Appendix E: Ice-Jam Mitigation Strategies

Appendix F: Mitigation Renderings

Appendix G: HEC-RAS Simulation Output

ACRONYMS/ABBREVIATIONS

1-, 2-D	1- and 2-Dimensional
ACE	Annual Chance Flood Event
BCA	Benefit-Cost Analysis
BCC	Bird of Conservation Concern
BCR	Benefit-Cost Ratio
BCR	Bird Conservation Region
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
CAP	Continuing Authorities Program
CDBG	Community Development Block Grants
CFA	Consolidated Funding Applications
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second (ft3/s)
CON	Continental USA and Alaska
CRISSP	Comprehensive River Ice Simulation System

CRRA	Community Risk and Resiliency Act
CRREL	Cold Regions Research and Engineering Laboratory
CSC	Climate Smart Communities
DEM	Digital Elevation Model
DHS	Department of Homeland Security
DRRA	Disaster Recovery Reform Act of 2018
EWP	Emergency Watershed Protection Program
FCA	Flood Control Act
FCSA	Feasibility Cost Sharing Agreement
FDD	Freezing Degree-Day
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
GLS	Generalized Least-Squares
GSE	Gomez & Sullivan Engineers
H&H	Hydrologic and Hydraulic
HEC	Hydrologic Engineering Center
HEC-RAS	Hydrologic Engineering Center River Analysis System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HSGP	Homeland Security Grant Program
HUD	United States Department of Housing and Urban Development
I-90	New York State Thruway/Interstate-90
IPaC	Information for Planning and Consultation
IPCC	Intergovernmental Panel on Climate Change
LiDAR	Light Detection and Ranging
LOMR	Letter of Map Revision
LP3	Log-Pearson Type III
MCEM	Madison County Emergency Management
MCSWC	Madison County Soil and Water Conservation District
MSC	Map Service Center
MHWL	Mean High Water Line
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NGVD29	National Geodetic Vertical Datum of 1929
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Services
NWI	National Wetlands Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservations
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
NYSOGS	New York State Office of General Services
NYSOPRHP	New York State Office of Parks, Recreation, and Historic Places
PDM	Pre-Disaster Mitigation
PPA	Project Partnership agreement
RAMBOLL	Ramboll Americas Engineering Solutions, Inc.
RC	Circularity Ratio
RCP	Representative Concentration Pathway
RE	Elongation Ratio
REHAB	Watershed Rehabilitation Program
RF	Form Factor
RICEN	River Ice Simulation Model
RL	Repetitive Loss
ROM	Rough Order of Magnitude
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Areas
SRL	Severe Repetitive Loss
STORM	Safeguarding Tomorrow through Ongoing Risk Mitigation Act
TOGS	Technical & Operations Guidance Series
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geologic Service
UTM	Universal Transverse Mercator
VERTCON	Vertical Datum Coordinate Conversion Program
WFPO	Watershed Protection and Flood Prevention Operations Program
WQIP	Water Quality Improvement Project
WRI	Water Resources Investigation
WSEL	Water Surface Elevation
WSP	Water Supply Paper

1. INTRODUCTION

1.1 HISTORICAL INITIATIVES

Flood mitigation has historically been an initiative in central New York and in the Oneida Creek watershed.

In Madison County, the City of Oneida constructed a dike on the western bank of Oneida Creek from 1949 to 1952. It is made of material removed from the riverbed and placed to the known flood level at that time. The dike does not meet the current minimum FEMA freeboard requirement, and therefore, does not protect the area behind it from the 100-year (1-percent annual chance exceedance) flood. In addition, the Soil Conservation Service (SCS) of the United States Department of Agriculture (USDA) constructed a floodwater retarding dam in 1978. The dam impounds much of the runoff from the upper portion of the drainage basin, approximately 0.8 square mile. There have been no reports of flooding from Higinbotham Brook since construction of the dam (FEMA 2001). The remaining communities along Oneida Creek in Madison County, which are the Towns of Lenox and Stockbridge and the Village of Munnsville, have no existing flood protection structures (FEMA 1983a; FEMA 1983b; FEMA 1988a).

In Oneida County, there are no existing structures or non-structural flood protection measures along Oneida Creek in the Villages of Oneida Castle and Vernon, City of Sherrill, and the Towns of Verona and Vernon (FEMA 2013).

1.2 FLOODPLAIN DEVELOPMENT

General recommendations for high-risk floodplain development follow four basic strategies:

1. Remove the flood-prone facilities from the floodplain
2. Adapt the facilities to be flood resilient under repetitive inundation scenarios
3. Develop nature-based mitigation measures (e.g., floodplain benches, constructed wetlands, etc.) to lower flood stages in effected areas
4. Up-size bridges and culverts to be more resilient to ice jams, high-flow events, and projected future flood flows due to climate change in effected areas

In order to effectively mitigate flooding along substantial lengths of a watercourse corridor, floodplain management should restrict the encroachment on natural floodplain areas. Floodplains act to convey floodwater downstream, mitigate damaging velocities, and provide areas for sediment to accumulate safely. The reduction in floodplain width of one reach of a stream often leads to the increase in flooding upstream or downstream. During a flood event, finite amounts of water with an unchanging volume must be conveyed and, as certain conveyance areas are encroached upon, floodwaters will often expand into other sensitive areas.

A critical evaluation of existing floodplain law and policies should be undertaken to evaluate the effectiveness of current practices and requirements within this watershed. Local floodplain regulations should be consistent with the National Flood Insurance

Program (NFIP) and FEMA regulations since all the municipalities along Oneida Creek in Oneida and Madison Counties are participating communities in the NFIP and should involve a floodplain coordinator and a site plan review process for all proposed developments. This review should be in accordance with local regulations and NFIP requirements, which require the community to determine if any future proposed development could adversely impact the floodplain or floodway resulting in higher flood stages and sequentially greater economic losses to the community. The communities and their NFIP community IDs along Oneida Creek are as follows:

- City of Sherrill (Oneida County) Community ID #360544
- Town of Vernon (Oneida County) Community ID #360559
- Town of Verona (Oneida County) Community ID #360561
- Village of Oneida Castle (Oneida County) Community ID #361526
- Village of Vernon (Oneida County) Community ID #360560
- City of Oneida (Madison County) Community ID #360408
- Town of Lenox (Madison County) Community ID #360404
- Town of Stockbridge (Madison County) Community ID #361412
- Village of Munnsville (Madison County) Community ID #360407

1.3 RESILIENT NY INITIATIVE

In November of 2018, New York State Governor Andrew Cuomo announced the Resilient NY program in response to devastating flooding in communities across the state in the preceding years. A total of 48 high priority flood-prone watersheds across New York state are being addressed through the Resilient NY program. Flood mitigation studies were commissioned using advanced modeling techniques and field assessments to identify priority projects in these 48 flood-prone watersheds, develop state-of-the-art studies to reduce flooding and ice jams, and to improve ecological habitats in the watersheds (NYSGPO 2018). The Oneida Creek watershed was chosen as a study site for this initiative.

The New York State Department of Environmental Conservation (NYSDEC) is responsible for implementing the Resilient NY program with contractual assistance from the New York State Office of General Services (NYSOGS). High-priority watersheds were selected based on several factors, such as frequency and severity of flooding and ice jams, extent of previous flood damage, and susceptibility to future flooding and ice-jam formations (NYSGPO 2018).

The Resilient NY flood studies will identify the causes of flooding within each watershed and develop, evaluate, and recommend effective and ecologically sustainable flood and ice-jam hazard mitigation projects. Proposed flood mitigation measures will be identified and evaluated using hydrologic and hydraulic modeling to quantitatively determine flood mitigation recommendations that would result in the greatest flood reduction benefits. In addition, the flood mitigation studies incorporate the latest climate change forecasts and assess ice-jam hazards where jams have been identified as a threat to public health and safety.

This report is not intended to address detailed design considerations for individual flood mitigation alternatives. The mitigation alternatives discussed are conceptual projects that have been initially developed and evaluated to determine their flood mitigation benefits. A more in-depth engineering design study would still be required for any mitigation alternative chosen to further define the engineering project details. However, the information contained within this study can inform such in-depth engineering design studies and be used in the application of state and federal funding and/or grant programs.

The goals of the Resilient NY Program are to:

1. Perform comprehensive flood and ice-jam studies to identify known and potential flood risks in flood-prone watersheds
2. Incorporate climate change predictions into future flood models
3. Develop and evaluate flood hazard mitigation alternatives for each flood-prone stream area, with a focus on ice-jam hazards

The overarching purpose of the initiative is to recommend a suite of flood and ice-jam mitigation projects that local municipalities can undertake to make their community more resilient to future floods. The projects should be affordable, attainable through grant funding programs, able to be implemented either individually or in combination in phases over the course of several years, achieve measurable improvement at the completion of each phase, and fit with the community way of life.

The flood mitigation and resiliency study for Oneida Creek began in April of 2022 and this final flood study report was issued in November of 2022.

2. DATA COLLECTION

2.1 INITIAL DATA COLLECTION

Hydrological and meteorological data were obtained from readily available state and federal government databases, including ortho-imagery, flood zone maps, streamflow, precipitation, flooding, and ice-jam reports. Historical flood reports, newspaper articles, social media posts, community engagement meeting notes, and geographic information system (GIS) mapping were used to identify stakeholder concerns, produce watershed maps, and identify current high-risk areas. New York State Community Risk and Resiliency Act (NYSDEC 2020b) guidelines, New York State Department of Transportation (NYSDOT) bridge and culvert standards, and United States Geologic Service (USGS) *Future Flow Explorer* v1.5 (USGS 2016) and *StreamStats* v4.10.1 (USGS 2022b) software were used to develop current and future potential discharges and bankfull widths and depths at various points along the stream channel.

Hydrologic and hydraulic (H&H) modeling was performed previously, as part of the effective FEMA Flood Insurance Studies (FIS) for each municipality along Oneida Creek, which includes:

- City of Oneida (Madison County) February 23, 2001
- Town of Lenox (Madison County) June 3, 1988
- Town of Stockbridge (Madison County) March 15, 1983
- Village of Munnsville (Madison County) March 15, 1983
- Town of Vernon (Oneida County) August 16, 1988
- Town of Verona (Oneida County) October 20, 1999
- Village of Oneida Castle (Oneida County) July 4, 1989
- City of Sherrill (Oneida County) March 15, 1983

FEMA released an updated effective FIS for Oneida County, which included the Towns of Vernon and Verona, City of Sherrill, and Villages of Oneida Castle and Vernon, on September 27, 2013.

Updated H&H modeling was performed in this study using the USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS) v6.2.0 (USACE 2021) software to determine water stage at current and potential future levels for high-risk areas, and to evaluate the effectiveness of proposed flood mitigation strategies. These studies and data were obtained and used, all or in part, as part of this effort. Appendix A is a summary listing of data and reports collected.

2.2 PUBLIC OUTREACH

An initial virtual project kickoff meeting was held on April 7, 2022, with representatives of the NYSDEC, NYSOGS, Ramboll Americas Engineering Solutions, Inc. (Ramboll), Gomez & Sullivan Engineers (GSE), Highland Planning, the USACE, Town of Oneida,

Oneida County, City of Oneida, Madison County, and Town of Lenox (Appendix B). At the project kickoff meeting, project specifics including background, purpose, funding, roles, and timelines were discussed. Discussions included a variety of topics, including:

- Firsthand accounts of past flooding events
- Identification of specific areas that flooded in each community, and the extent and severity of flood damage
- Information on post-flood efforts, such as temporary floodwalls

This outreach effort assisted in the identification of current high-risk areas to focus on during the future flood risk assessments.

2.3 FIELD ASSESSMENT

Following the initial data gathering and agency meetings, field staff from Ramboll undertook field data collection efforts with special attention given to high-risk areas in the Cities of Oneida (Madison) and Sherrill (Oneida) and Villages of Oneida Castle (Oneida) and Munnsville (Madison), as identified in the initial data collection process. Initial field assessments of Oneida Creek were conducted in June of 2022. Information collected during field investigations included the following:

- Rapid "windshield" river corridor inspection
- Photo documentation of inspected areas
- Measurement and rapid hydraulic assessment of bridges, culverts, and dams
- Geomorphic classification and assessment, including measurement of bankfull channel widths and depths at key cross sections
- Field identification of potential flood storage areas
- 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 flood hazard mitigation alternatives, including those requiring further analysis

Included in Appendix C is a copy of the Stream Channel Classification Form, Field Observation Form for the inspection of bridges and culverts, and Wolman Pebble Count Form, as well as a location map of where field work was completed. Appendix D is a Photo Log of select locations within the river corridor. The collected field data was categorized, summarized, indexed, and geographically located within a GIS database. This GIS database will be made available to the NYSDEC and NYSOGS upon completion of the project.

All references to "right bank" and "left bank" in this report refer to "river right" and "river left," meaning the orientation assumes that the reader is standing in the river looking downstream.

3. WATERSHED CHARACTERISTICS

3.1 STUDY AREA

The Oneida Creek watershed lies within both Oneida and Madison Counties in central New York. The watershed encompasses areas between the Towns of Verona, Vernon, and Augusta, Villages of Oneida Castle and Vernon, the City of Sherrill in Oneida County; and the Towns of Lenox, Stockbridge, Eaton, Smithfield, and Fenner, Village of Munnsville, and City of Oneida in Madison County. The creek flows in a general east then north/northwest direction with its headwaters in the Town of Smithfield and empties into Oneida Lake at the border of Madison and Oneida Counties (Figure 3-1).

Within the Oneida Creek watershed, the Village of Munnsville and the area between the Cities of Oneida and Sherrill and the Village of Oneida Castle were chosen as target areas due to their historical and recent flooding issues, and the hydrologic conditions of the creek in these respective reaches. Figures 3-2 through 3-4 depict stream stationing along Oneida Creek in Oneida and Madison Counties, New York, and in the study areas of the Cities of Oneida (Madison) and Sherrill (Oneida) and Village of Oneida Castle (Oneida) and the Village of Munnsville (Madison), respectively.

The Town of Verona is located in south-central Oneida County, New York. The total land area contained within the corporate limits is approximately 69.3 square miles. The town is situated approximately 25 miles east of Syracuse and 15 miles west of Utica. The town is bordered by the City of Rome and Town of Westmoreland to the east, Town of Vienna and Village of Sylvan Beach to the north, Town of Lenox and City of Oneida to the west, and Village of Oneida Castle and Town of Vernon to the south (FEMA 1999).

The Town of Vernon is located in south-central Oneida County, New York. The total land area contained within the corporate limits of Vernon is approximately 37.4 square miles. The town is situated approximately 8 miles northwest of Utica and 25 miles northeast of Syracuse. It is bordered by the Towns of Westmoreland and Kirkland to the east, Town of Verona to the north, Village and Town of Oneida to the west, and Towns of Stockbridge and Augusta to the south. (FEMA 1988b).

The Village of Vernon is located in south-central Oneida County, New York. The total land area contained within the corporate limits of the village is approximately 0.9 square mile. It is completely surrounded by the Town of Vernon (FEMA 1988b).

The City of Sherrill is located in the southwestern portion of Oneida County in central New York. The total land area contained within the corporate limits of Sherrill is three square miles. It is bordered by the City of Oneida to the west, Village of Oneida Castle to the north, and Town of Vernon to the east and south (FEMA 1983a).

The Town of Lenox is located in the northern portion of Madison County in central New York, approximately 14 miles southwest of the City of Rome. It is bordered by the Town of Vienna to the north, Town of Verona to the northeast, City of Oneida to the east, Town of Lincoln to the south, and Town of Sullivan to the west. The total land area contained within the corporate limits of Lenox is 35.2 square miles (FEMA 1988a).

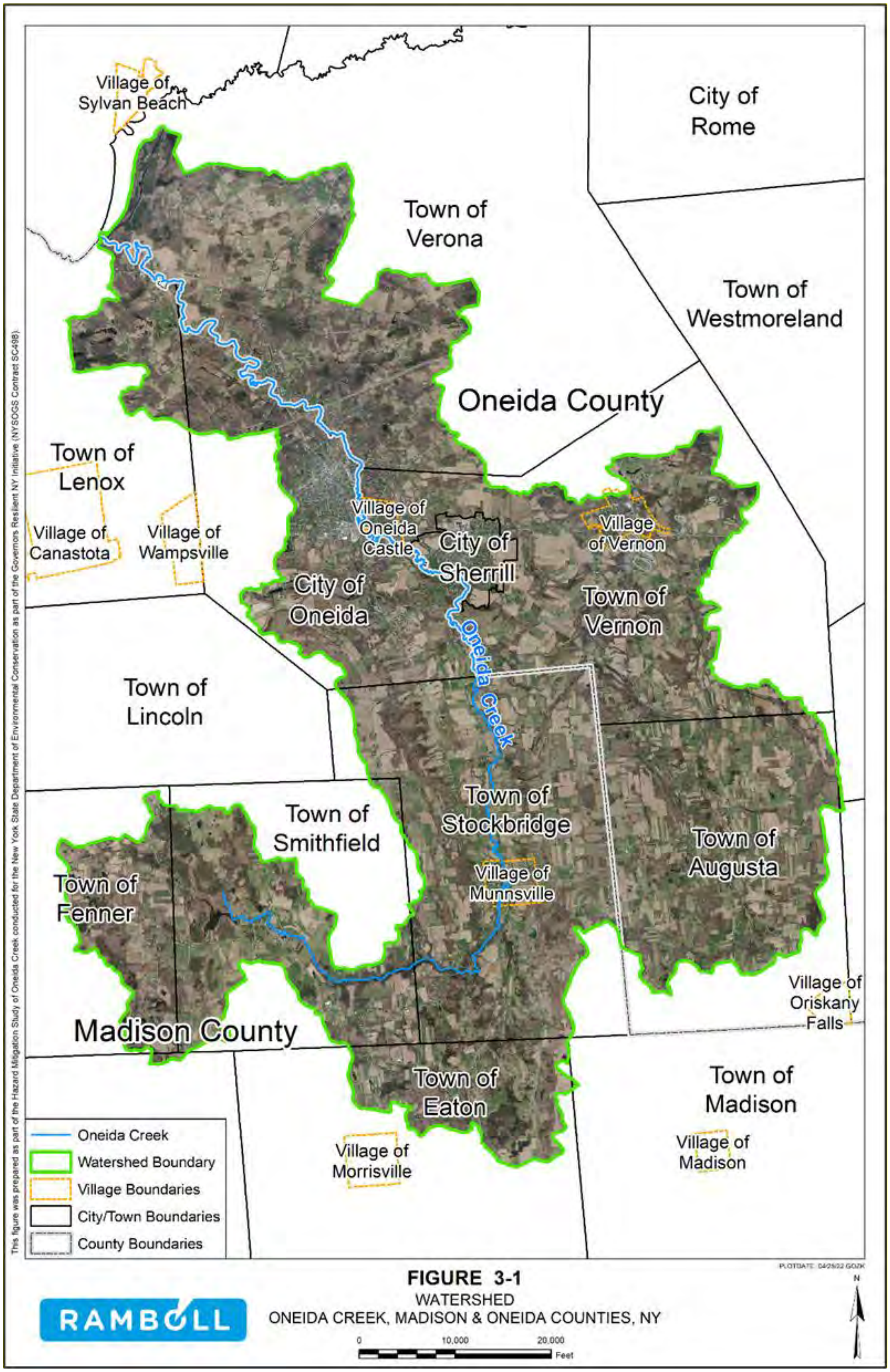

Figure 3-1. Oneida Creek Watershed, Oneida and Madison Counties, NY.

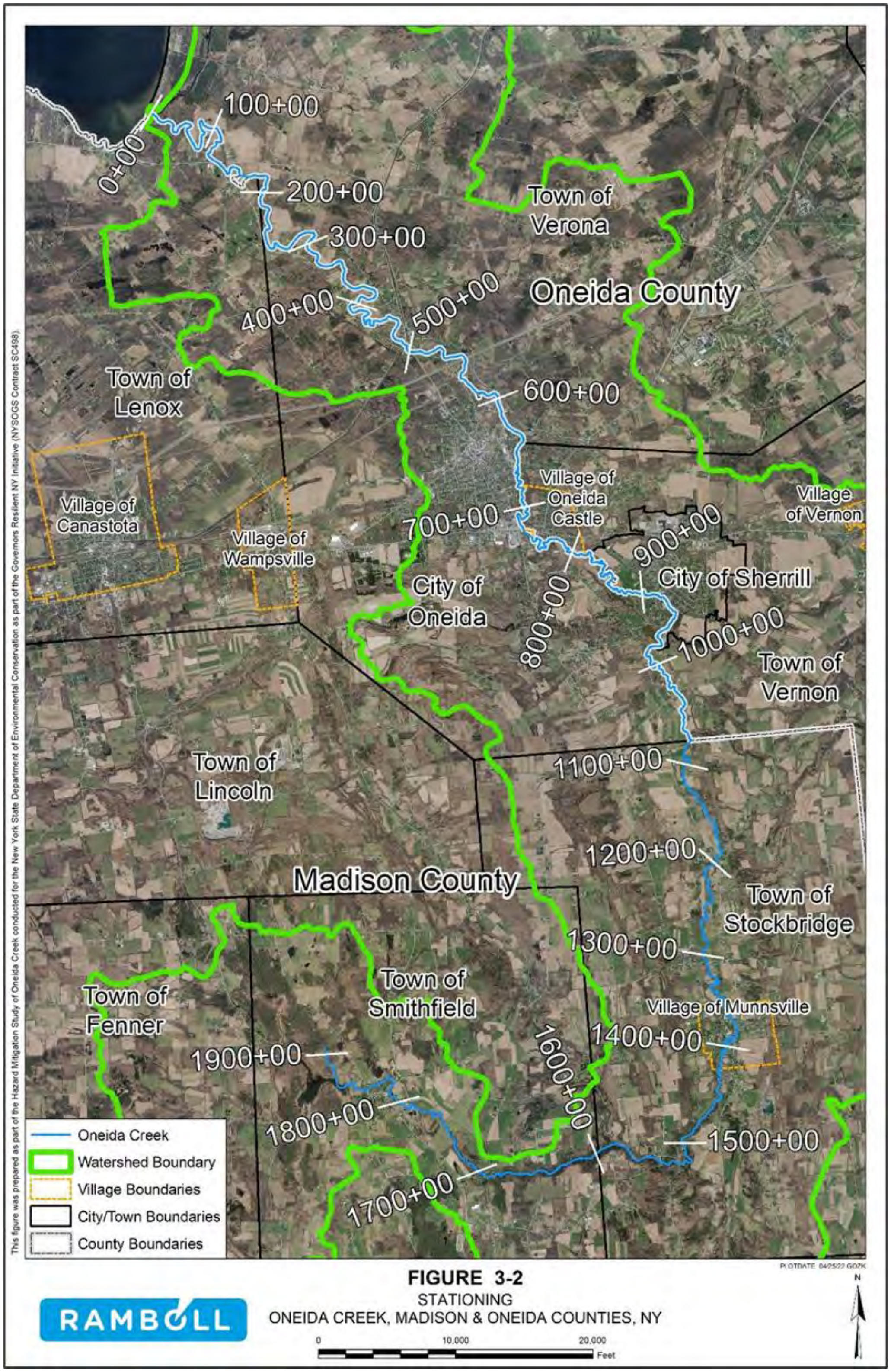

Figure 3-2. Oneida Creek Stationing, Oneida and Madison Counties, NY.

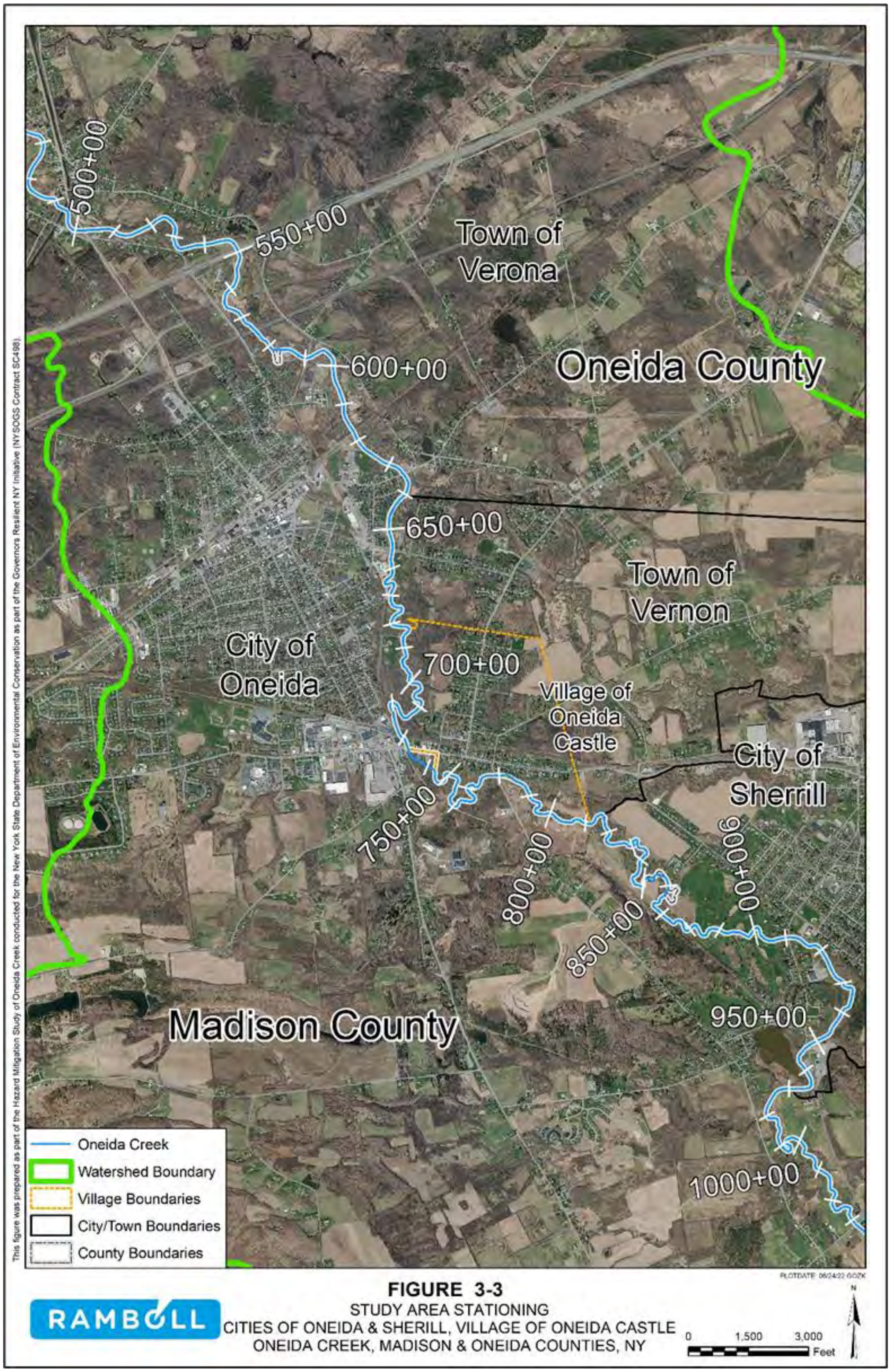

Figure 3-3. Oneida Creek Study Area Stationing, Cities of Oneida & Sherrill and the Village of Oneida Castle, Oneida and Madison Counties, NY.

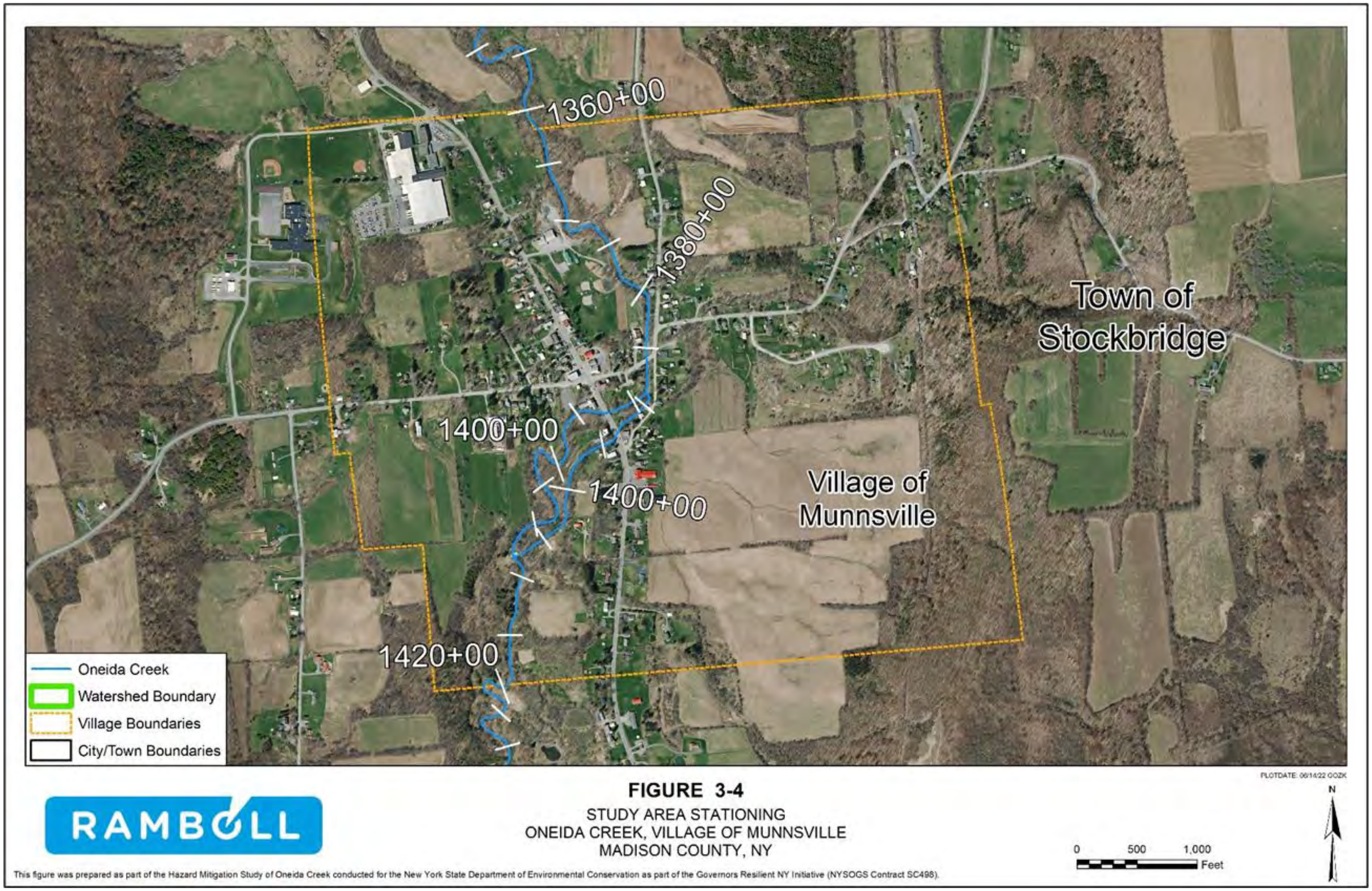

Figure 3-4. Oneida Creek Study Area Stationing, Village of Munnsville, Madison Counties, NY.

The City of Oneida is located in the northeastern portion of Madison County in central New York. It is bordered by the Town of Vernon, Village of Oneida Castle and City of Sherrill to the east, Town of Verona to the north, Towns of Lenox and Lincoln to the west, and Town of Stockbridge to the south. The total land area contained within the corporate limits of Oneida is 22 square miles (FEMA 2001).

The Town of Stockbridge is located in the east-central portion of Madison County in central New York. It is bordered by the Towns of Lincoln and Smithfield to the west, Towns of Eaton and Madison to the south, Town of Augusta to the east, and Town of Vernon and City of Oneida to the north. Stockbridge contains a total land area of approximately 32 square miles (FEMA 1983b).

The Village of Munnsville is located in the east-central portion of Madison County in central New York, approximately 8 miles south of the City of Oneida. It is completely surrounded by the Town of Stockbridge. Munnsville contains a total land area of approximately 1 square mile (FEMA 1983c).

3.2 ENVIRONMENTAL CONDITIONS

An overview of the environmental and cultural resources within the Oneida Creek watershed was compiled using the following online tools:

- Environmental Resource Mapper – The Environmental Resource Mapper is a tool used to identify mapped federal and state wetlands, state designated significant natural communities, and plants and animals identified as endangered or threatened by the NYSDEC (NYSDEC 2021a).
- National Wetlands Inventory (NWI) – The NWI is a digital map database available on the Environmental Resource Mapper that provides information on the "status, extent, characteristics and functions of wetlands, riparian, and deep water habitats" (NYSDEC 2021a).
- Information for Planning and Consultation (IPaC) – The IPaC database provides information about endangered/threatened species and migratory birds regulated by the U.S. Fish and Wildlife Service (USFWS 2021).
- Register of Historic Places – The New York State Historic Sites and Park Boundaries and National Register of Historic Places datasets list historic places worthy of preservation, as authorized by the National Historic Preservation Act of 1966 (NYSOPRHP 2018a; NYSOPRHP 2018b).

3.2.1 Wetlands

The State Regulated Freshwater Wetlands database shows the approximate location of wetlands regulated by New York State. The National Wetlands Inventory was reviewed to identify national wetlands and surface waters (Figure 3-5). The Oneida Creek watershed includes riverine habitat, freshwater forested/shrub wetlands, freshwater ponds, lakes, and freshwater emergent wetlands (NYSDEC 2022a).

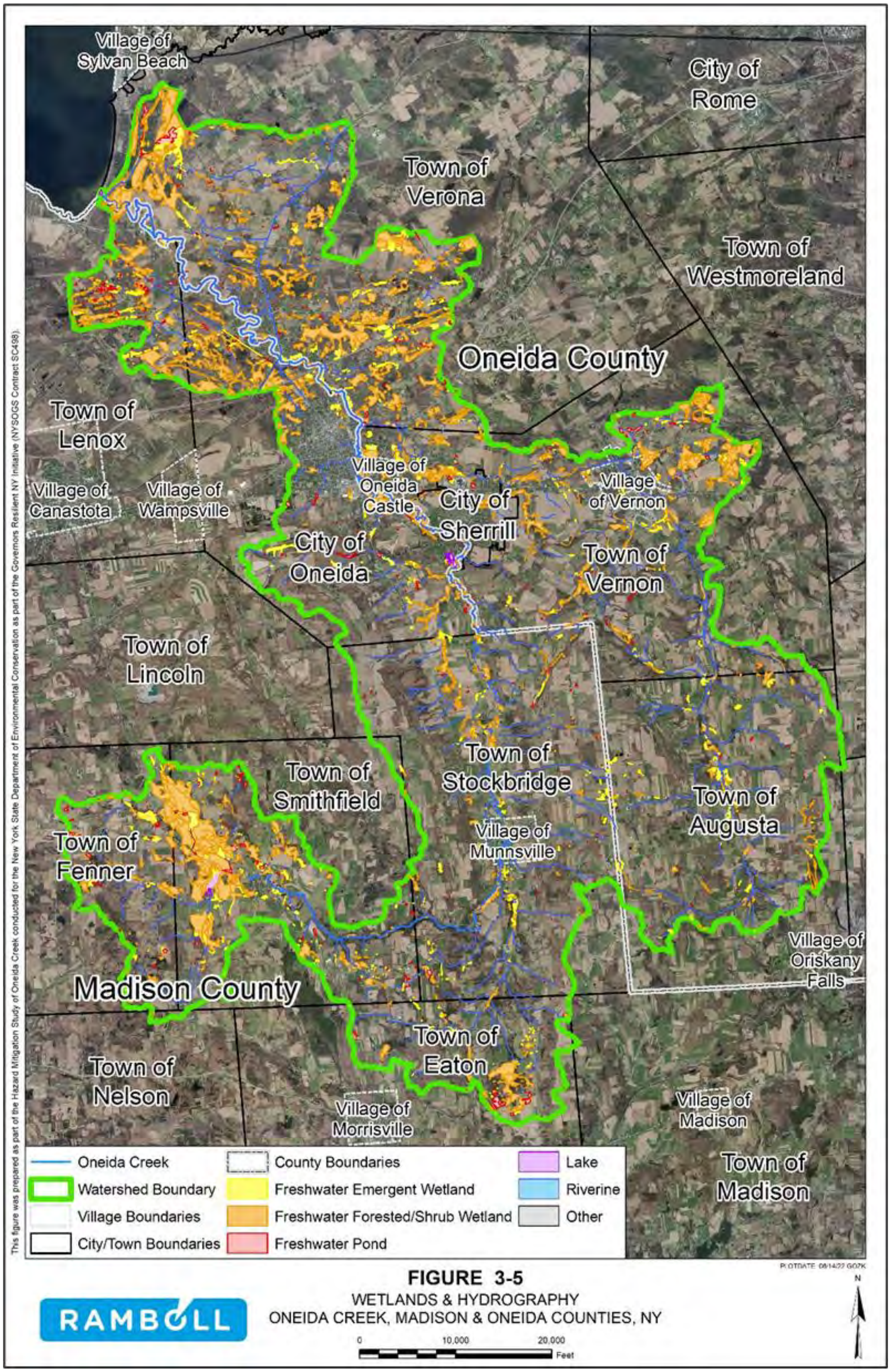

Figure 3-5. Oneida Creek Wetlands and Hydrography, Oneida and Madison Counties, NY.

Maps of NYS Regulatory Freshwater Wetlands indicate the approximate boundaries of wetlands. Field investigation is necessary to identify the actual regulated wetland boundaries in the field. The NYSDEC regulates freshwater wetlands that are 12.4 acres (5 hectares) or larger and the 100-ft adjacent area surrounding such wetlands.

3.2.2 Sensitive Natural Resources

Areas designated as significant natural communities by the NYSDEC were mapped in the Oneida Creek watershed. There were no significant natural communities identified by the Environmental Resource Mapper in the Oneida Creek watershed (NYSDEC 2022a) (Figure 3-6).

3.2.3 Endangered or Threatened Species

The Environmental Resource Mapper shows that the Oneida Creek watershed contains rare plants listed as endangered, threatened, or rare by NYS, and rare animals listed as endangered or threatened; however, the rare plants and animals are not listed by the NYSDEC due to their sensitive nature.

The State’s Natural Heritage records include the following additional Threatened and Endangered species along Oneida Creek:

- Lake Surgeon (threatened) – Towns of Lenox and Verona – not likely to be significantly impacted
- Chittenango Ovate Amber Snail (endangered) – found throughout the watershed

Opportunities to enhance habitat for some of these species may exist when restoring floodplains or when constructing retention basins or constructed wetlands. Planning should include consideration of habitat requirements of these species; in particular, the NYSDEC would be concerned about the loss of large tracts of open unforested land. The NYSDEC Regional Office should be contacted to determine the potential presence of the species identified (NYSDEC 2022a; NYSDEC 2022b).

The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) results for the Oneida Creek watershed lists two threatened and one candidate species: Chittenango Ovate Amber Snail (succinea chittenangoensis - threatened), Monarch Butterfly (danaus plexippus - candidate), and the American Hart’s-tongue Fern (asplenium scolopendrium var. Americanum - threatened). No critical habitat has been designated for the species at this location (USFWS 2022). The migratory bird species listed in Table 1 are transient species that may pass over but are not known to nest within the project area.

It should be noted, coordination with the NYSDEC will be critical to fully understand the implications of any flood mitigation alternative on any endangered species and their habitats within the Oneida Creek watershed.

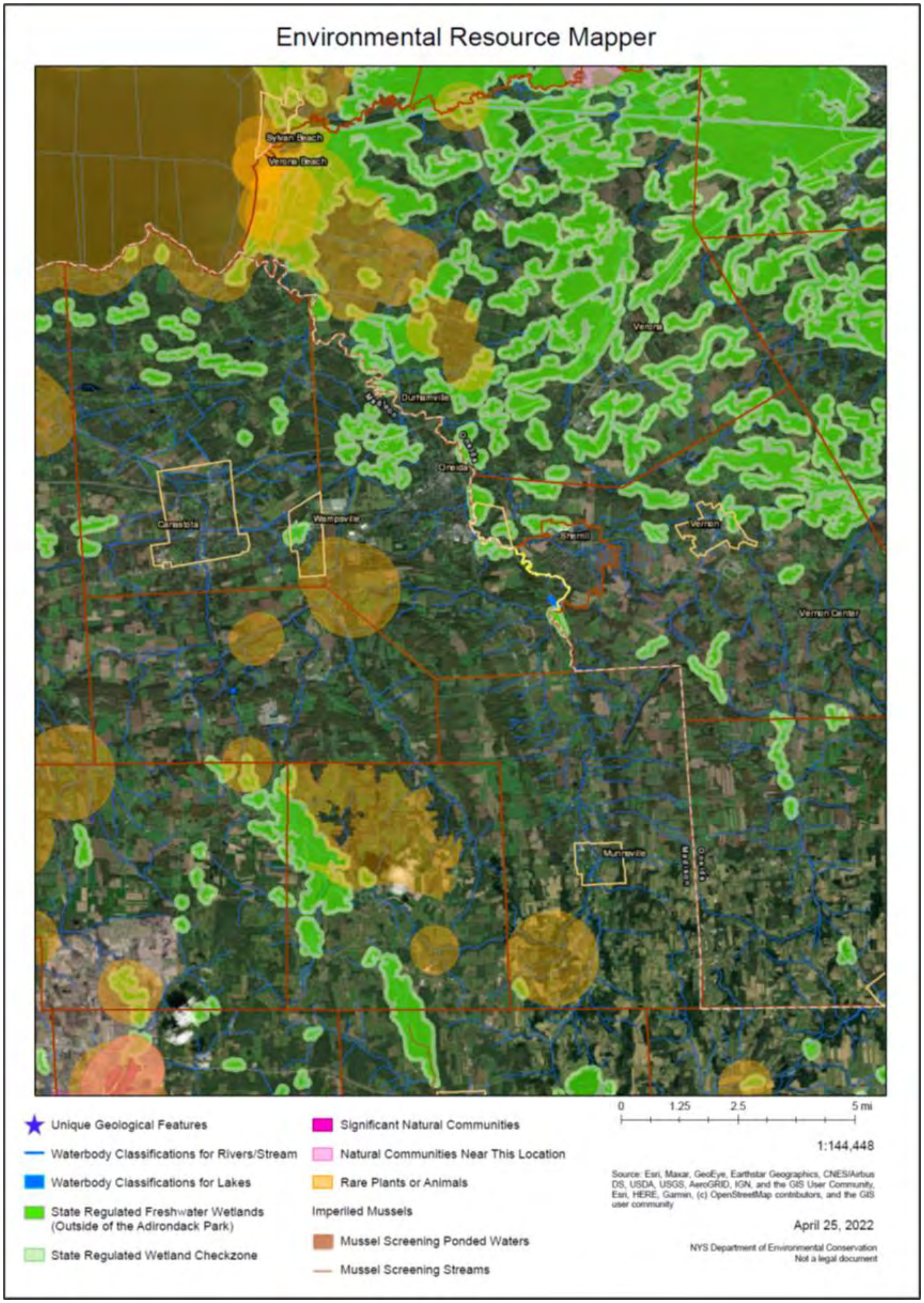

Figure 3-6. Significant Natural Communities and Rare Plants or Animals, Oneida Creek, Oneida and Madison Counties, NY.

Table 1. UFWS IPaC Listed Migratory Bird Species

Source: USFWS 2022			
Common Name	Scientific Name	Level of Concern	Breeding Season
American Golden-plover	*Pluvialis dominica*	BCC Rangewide (CON) [1]	Breeds elsewhere
Bald Eagle	Haliaeetus leucocephalus	Non-BCC Vulnerable [2]	Breeds Dec 1 to Aug 31
Black-billed Cuckoo	Coccyzus erythropthalmus	BCC Rangewide (CON) [1]	Breeds May 15 to Oct 10
Blue-winged Warbler	Vermivora pinus	BCC – BCR [3]	Breeds May 1 to Jun 30
Bobolink	Dolichonyx oryzivorus	BCC Rangewide (CON) [1]	Breeds May 20 to Jul 31
Canada Warbler	Cardellina canadensis	BCC Rangewide (CON) [1]	Breeds May 20 to Aug 10
Cerulean Warbler	Dendroica cerulea	BCC Rangewide (CON) [1]	Breeds Apr 20 to Jul 20
Evening Grosbeak	Coccothraustes vespertinus	BCC Rangewide (CON) [1]	Breeds May 15 to Aug 10
Golden Eagle	Aquila chrysaetos	Non-BCC Vulnerable [2]	Breeds Jan 1 to Aug 31
Golden-winged Warbler	Vermivora chrysoptera	BCC Rangewide (CON) [1]	Breeds May 1 to Jul 20
Lesser Yellowlegs	Tringa flavipes	BCC Rangewide (CON) [1]	Breeds elsewhere
Prairie Warbler	Dendroica discolor	BCC Rangewide (CON) [1]	Breeds May 1 to Jul 31
Red-headed Woodpecker	Melanerpes erythrocephalus	BCC Rangewide (CON) [1]	Breeds May 10 to Sep 10
Ruddy Turnstone	Arenaria interpres morinella	BCC – BCR [3]	Breeds elsewhere
Short-billed Dowitcher	Limnodromus griseus	BCC Rangewide (CON) [1]	Breeds elsewhere
Wood Thrush	Hylocichla mustelina	BCC Rangewide (CON) [1]	Breeds May 10 to Aug 31

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

[2] Non-BCC Vulnerable: 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.

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

3.2.4 Cultural Resources

According to the National Register of Historic Places, there are 14 registered historic sites and parks within the Oneida Creek watershed. Consultation with New York State Office of Parks, Recreation, and Historic Places (NYSOPRHP) should be performed to identify the potential presence of archeological resources and the subsequent need to perform a cultural resources investigation (NYSOPRHP 2018a; NYSOPRHP 2018b).

Table 2 lists the New York State Historic Sites and Park Boundaries and National Register of Historic Places sites. Figure 3-7 displays the locations of the historic sites and parks within the Oneida Creek watershed.

Table 2. New York State Historic Sites and Park Boundaries and National Register of Historic Places Sites

Source: NYSOPRHP 2018a; NYSOPRHP 2018b		
Name	County	City
Main-Broad-Grove Streets Historic District	Madison	Oneida
Mount Hope Reservoir	Madison	Oneida
Smith/Gerritt Estate	Madison	Peterboro
Oneida Community Mansion House	Madison	Oneida
Cottage Lawn	Madison	Oneida
Peterboro Land Office	Madison	Peterboro
Vernon Center Green Historic District	Oneida	Vernon
US Post Office (Oneida)	Madison	Oneida
Smithfield Presbyterian Church	Madison	Peterboro
Oneida Armory	Madison	Oneida
Vernon Methodist Church	Oneida	Vernon
Oneida Downtown Commercial Historic District	Madison	Oneida
Verona Beach	Oneida	Verona
Old Erie Canal	Madison/Oneida	Verona/Oneida

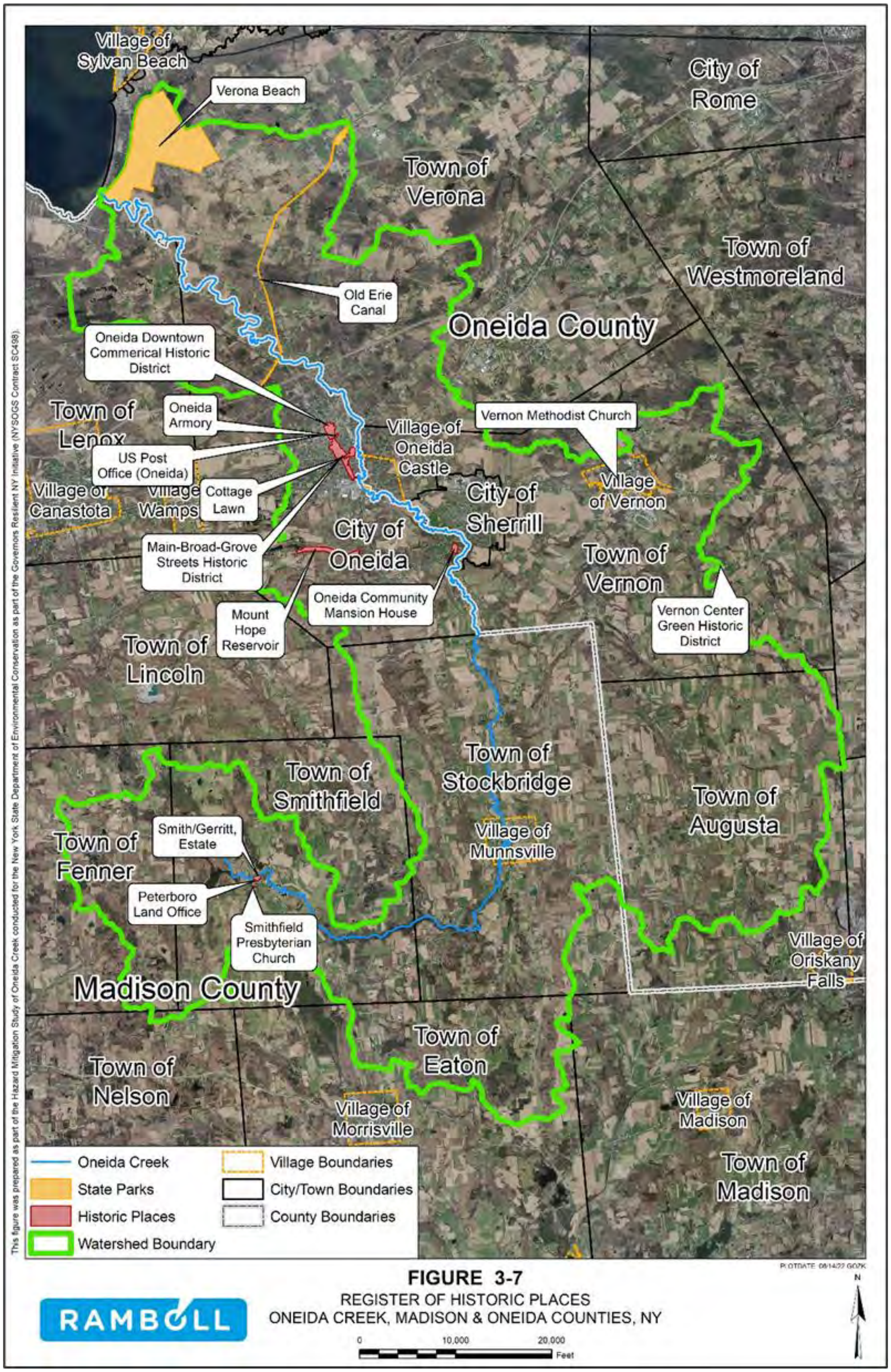

Figure 3-7. Register of Historic Places, Oneida Creek, Oneida and Madison Counties, NY.

3.2.5 FEMA Mapping and Flood Zones

The FEMA Flood Map Service Center (MSC) (https://msc.fema.gov/portal/home) is a database that contains FEMA Flood Insurance Rate Maps (FIRMs) for areas that have had FEMA flood insurance studies completed throughout the United States (FEMA 2022). The current effective FEMA FIS reports for the municipalities within the Oneida Creek watershed are:

- City of Oneida (Madison County) February 23, 2001
- Town of Lenox (Madison County) June 3, 1988
- Town of Stockbridge (Madison County) March 15, 1983
- Village of Munnsville (Madison County) March 15, 1983
- Town of Vernon (Oneida County) August 16, 1988
- Town of Verona (Oneida County) October 20, 1999
- Village of Oneida Castle (Oneida County) July 4, 1989
- City of Sherrill (Oneida County) March 15, 1983

For a detailed study, FEMA can perform a limited detailed or detailed study. For both methods, semiautomated hydrologic, hydraulic, and mapping tools, coupled with digital elevation data, are used to predict floodplain limits, especially in lower-risk areas. If the tools are used with some data collected in the field (e.g., sketches of bridges to determine the clear opening) then the study is considered a limited detailed study. Limited detailed analysis sometimes results in the publishing of Base Flood Elevations (BFEs), also referred to as the 100-yr flood elevation, on the maps. The decision to place BFEs on a limited detailed study analysis is based on the desire of the community for the BFEs to be shown, plus the accuracy of the elevation data and the data on bridges, dams, and culverts that may impede flow on the flooding source. A study performed using these same tools and the same underlying map, with the addition of field-surveyed cross sections, field surveys of bridges, culverts, and dams, along with a more rigorous analysis including products such as floodways, new calibrations for hydrologic and hydraulic models, and the modeling of additional frequencies, is a detailed study. Detailed studies provide BFE information and flood profiles, and usually a floodway, whereas approximate studies do not (NRC 2007).

Oneida Creek is a Regulatory Floodway, which is defined as the watercourse channel and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than 1 foot over the 1% ACE hazard (ACE) WSEL (i.e., BFE). In the regulatory floodway, communities must regulate encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway, and demonstrate through hydrologic and hydraulic analyses performed in accordance with standard engineering practice, that the proposed encroachment would not increase flood levels within the community during the occurrence of the base flood. Development in the portions of the floodplain beyond the floodway, referred to as the floodway fringe, is allowed as long as it does not increase the BFE more than 1.0 ft (FEMA 2000). Figure 3-8 displays the floodway data from the FIS for Oneida Creek in the City of Oneida, New York (FEMA 2001b).

The FIRMs for all of the municipalities that encompass Oneida Creek indicate Special Flood Hazard Areas (SFHAs), which are land areas covered by floodwaters during the 1% ACE. The flood zones indicated in the Oneida Creek study area are Zones A and AE, where mandatory flood insurance purchase requirements apply. "A" Zones are areas subject to inundation by the 1% ACE. Where detailed hydraulic analyses have not been performed, no BFEs or flood depths are shown. "AE" Zones are areas that have a 1% annual chance of flooding where BFEs are provided by FEMA (FEMA 2001b; FEMA 1999; FEMA 1989; FEMA 1988b). Figure 3-9 is a FIRM that includes a portion of Oneida Creek in the City of Oneida, New York (FEMA 2001a).

For the flood zones within Madison County, New York, digitized Q3 flood zone data derived from FEMA FIRMs was used to produce flood zone maps in this study. Digital Q3 flood data files contain only certain features from the FIRM hardcopy in effect at the time of scanning and do not replace the existing FIRM hardcopy maps. In addition, the process of georeferencing paper maps to digital images can distort certain features over large areas between known points. This process is not recommended to use for detailed flood zone delineation or analysis (FEMA 1996).

The hydraulic analyses performed by FEMA were based on unobstructed flow for all three communities. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. With regards to ice-jam flooding, the effective FEMA FIRMs only reflect flooding related to open-water or free-flow conditions (FEMA 2001b; FEMA 1999; FEMA 1989; FEMA 1988b).

For this study, ice-jam flooding extents were determined using a wide variety of sources, including stakeholder input, news reports, computer models, etc. References to ice-jam flood extents are based solely on these sources and do not reflect the flood zone areas from the effective FEMA FIRMs.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oneida Creek								
A	760	217	1,885	6.3	387.3	387.3	388.3	1.0
B	4,985	514	3,334	3.5	393.8	393.8	394.7	0.9
C	7,163	529	4,809	2.5	397.7	397.7	398.6	0.9
D	9,634	365	3,755	3.1	398.2	398.2	399.1	0.9
E	13,044	226	2,060	5.7	398.9	398.9	399.9	1.0
F	16,394	587	5,533	2.1	402.7	402.7	403.7	1.0
G	19,854	251	2,008	5.7	407.2	407.2	408.2	1.0
H	25,064	848	5,411	2.1	412.0	412.0	412.9	0.9
I	27,364	858	4,984	2.3	412.8	412.8	413.6	0.8
J	31,234	95	1,693	6.7	417.6	417.6	418.2	0.6
K	32,079	180	2,471	4.6	418.8	418.8	419.0	0.2
L	36,859	430	4,667	2.3	421.5	421.5	422.3	0.8
M	40,199	520	5,164	2.1	423.4	423.4	424.2	0.8
N	43,654	350	3,977	2.7	425.7	425.7	426.3	0.6
O	47,349	965	5,746	1.3	427.0	427.0	427.8	0.8
P	50,679	1,165	2,089	3.5	428.3	428.3	428.7	0.4
Q	51,959	791	2,037	3.6	431.8	431.8	432.2	0.4
R	54,064	90	1,017	7.2	443.0	443.0	443.0	0.0
S	55,954	629	4,649	1.6	446.0	446.0	446.0	0.0
T	58,864	920	2,577	2.9	446.8	446.8	446.9	0.1
U	60,919	502	2,399	2.8	450.8	450.8	451.1	0.3

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ONEIDA, NY
(MADISON CO.)

FLOODWAY DATA

ONEIDA CREEK

Figure 3-8. Regulatory Floodway Data, Oneida Creek, City of Oneida, Madison County, NY (FEMA 2001b).

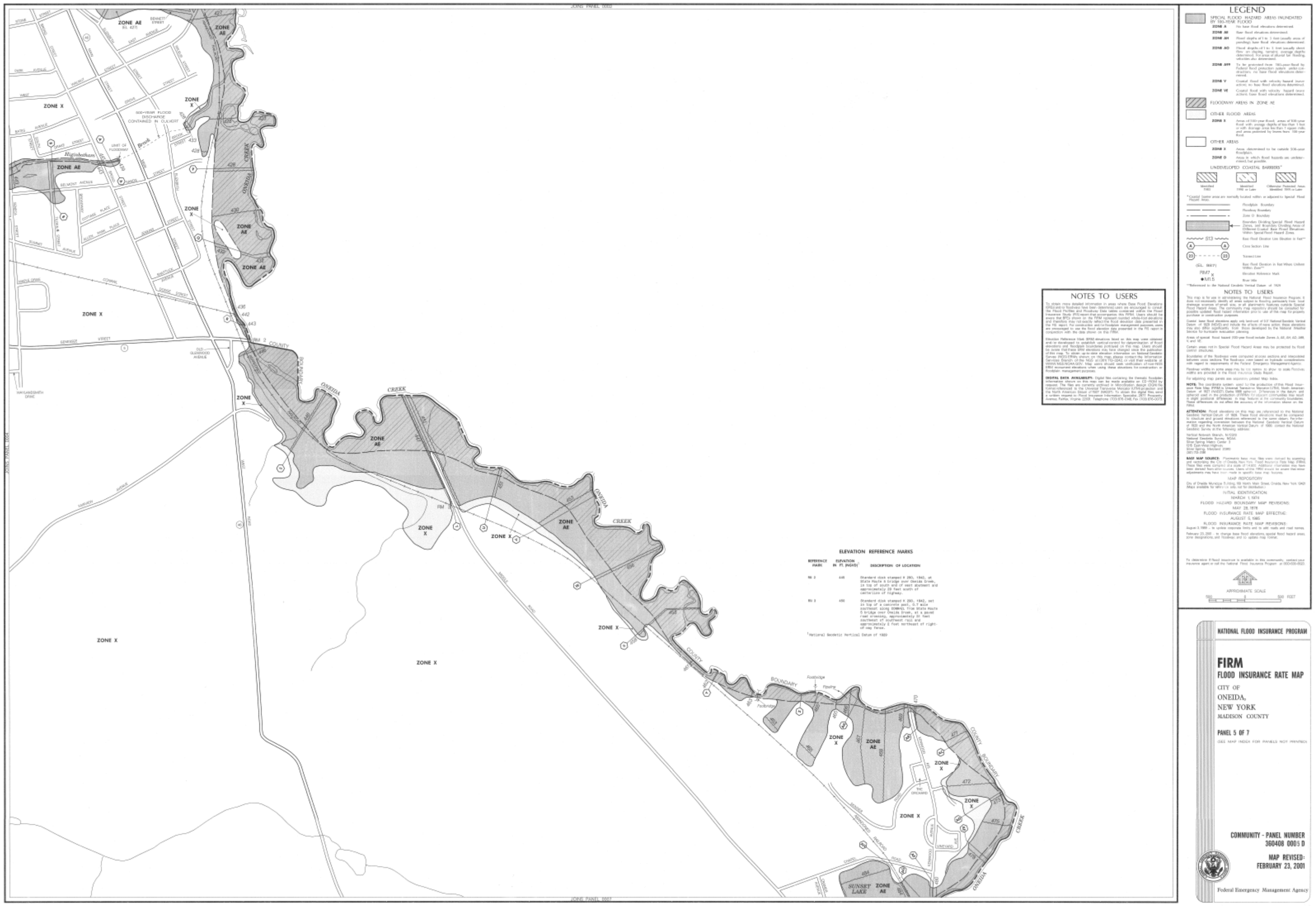

Figure 3-9. FEMA FIRM, Oneida Creek, City of Oneida, Madison County, NY (FEMA 2001a).

3.3 WATERSHED LAND USE

The Oneida Creek stream corridor is largely comprised of agricultural land (48%), forests (29%), developed lands (10.1%), and wetlands (9%) in the basin (USGS 2021). Hay/pasture (26%) and cultivated crops (22%) encompass the largest percentages of agricultural lands, while deciduous forest (24%) comprises the largest proportion of forested lands (USGS 2021).

The distribution of different land use and cover types varies throughout the Oneida Creek basin. The upper portions of the basin, in the Towns of Lenox and Verona, are primarily comprised of cultivated, forested, wetlands, and small areas of developed lands along Oneida Creek. The middle portions of the basin, in the City of Oneida, Towns of Sherrill and Vernon, and Villages of Oneida Castle and Vernon contain cultivated and developed lands with small areas of forests and wetlands. The lower portions of the basin, in the Towns of Stockbridge, Augusta, Smithfield, Fener, Eaton, and the Village Munnsville, are primarily cultivated, forested, and wetlands (USGS 2021).

3.4 GEOMORPHOLOGY

Oneida County is in the central part of New York State. It is bounded on the north by Lewis County, east by Herkimer County, south and southwest by Otsego and Madison Counties, and west by Oneida Lake and Oswego County. The total area of Oneida County is 805,900 acres, or about 1,259 square miles (including water). Utica is the county seat (NRCS 2008).

Oneida County is in seven distinct land regions or major physiographic provinces of New York State: Ontario (Oneida) Lake Plain; Erie-Ontario Lowland; Alleghany Plateau; Black River-Mohawk River Lowland; Tug Hill Plateau; Adirondack Foothills; Mohawk Valley and other valleys. These regions are different in terms of climate, relief, types of flora and fauna, bedrock, and glacial geological history. The accumulated effects of these differences result in different soils and therefore in various land uses and potentials for those uses (NRCS 2008).

The topography ranges from the nearly level terrain of river valleys to very steep hillsides in the foothills of the Adirondack Mountains in the northeastern part of the county. Low elevations, about 370 feet above sea level, are at the western edge of the county, along Oneida Lake. High points include Penn Mountain (1,813 ft above sea level), southwest of Alder Creek, in the town of Steuben, and several ridgetops in the southeastern part of the county (about 1,920 feet above sea level). The highest point in the county is east of Waterville, on Tassel Hill (1,945 ft above sea level). About 32% of the land in the county north of the Mohawk River is above an elevation of 1,000 ft (the elevation above which soils generally have a frigid temperature regime) (NRCS 2008).

The soils in Oneida County formed mainly in glacial deposits. Under freeze-thaw conditions, which were common in areas of postglacial and periglacial conditions, water-saturated glacial drift that was deposited on valley sides flowed or slumped onto some of the lower valley slopes and bottoms. This type of mass wasting, referred to as solifluction, leaves behind poorly sorted sediment. The epoch since the glaciers left their new deposits on the landscape in Oneida County, the Pleistocene Epoch (approximately 2 million years ago) with the most recent glacier during the Wisconsin Glaciation approximately 10 to 12 thousand years ago, is a short period of time in terms of geology and soil formation. 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).

Except for the Proterozoic crystalline rocks of the Adirondacks, Oneida County is underlain primarily by sedimentary rocks that are of Paleozoic age and dip to the southwest at approximately 50 feet per mile. Bedrock surface exposures, generally in east-west trending zones, become younger from north to south across the county (NRCS 2008).

The principal drainage pattern in Oneida County is dendritic. This pattern is somewhat modified in places by bedrock and glacial features. The streams in the county flow west to the Great Lakes, east to the Hudson River, and south to the Susquehanna River. Five river drainage basins divide the county— 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).

Although the county has distinct drainage basins, waters from the major basins intermingle in the county because of the New York State Barge Canal system. Oswego basin waters enter the Mohawk River via Oneida Lake and the canal. Black River waters enter the Mohawk River via old canals and feeder canals that enter streams, such as Nine Mile Creek (NRCS 2008).

Madison County is adjacent to the southern shore of Oneida Lake in the central part of New York State. It is bounded on the northeast and east by Oneida and Otsego Counties, the south by Chenango County, and the west by Onondaga and Cortland Counties. The county is rural and covers an area of 423,040 acres or 661 square miles. It is roughly triangular in shape, and the northern end is the narrowest dimension. Average width, from east to west, is 22 miles. Average length, from north to south, is approximately 30 miles. Elevation ranges from 368-feet above mean sea level at Oneida Lake to 2,142 ft at a point midway between Georgetown and Erieville in the southwestern part of the county. The steep, north-facing Onondaga Limestone escarpment divides the county into two physiographic provinces: the Appalachian Plateau in the south and the lower-lying Ontario (Oneida) Plain in the north (SCS 1981).

Most of the soil in Madison County formed in parent material that was deposited as a result of glaciation. During the Pleistocene period, the survey area was completely covered by a continental ice sheet several hundred feet thick. Evidence indicates that the ice made at least two or more major advances in the survey area during this period. Before overriding the uplands, advanced lobes of ice extended southward through the major valleys. As these advanced lobes moved, they deepened, and widened the valleys. Eventually the ice sheet crept into the uplands and covered even the highest hills. Glacial till deposits cover about 60% of the land area in the county (SCS 1981).

Madison County is underlain by bedrock of the Silurian and Devonian Periods. Formations of the Middle to Upper Silurian Period underlie the Oneida Plain in the northern part of the county. The younger Devonian Formations underlie the upland plateau in the southern part of the county. The bedrock of both periods lies nearly flat, except it has a slight regional dip to the south of about 50 feet per mile (SCS 1981).

There are three main types of streams in the county. In the northern third of the county, gradient is low and the streams meander across broad flood plains. In the escarpment area and in the upland areas of the southern two-thirds of the county, gradient is very steep, valleys generally are V-shaped, and alignment is relatively straight. In the major valleys in the southern two-thirds of the county, streams flow on mature flood plains, gradient is relatively low, and the alignment meanders over reworked flood plain deposits (SCS 1981).

The principal drainage pattern in the county is dendritic. This pattern is somewhat modified in places by bedrock and by remnant glacial features. The northern half of the county is drained to the north into Oneida Lake. From here, water flows into the Ontario-St. Lawrence Basin. The main north-flowing streams are Chittenango, Oneida, Canastota, and Cowaselon Creeks. The northern part of the Town of Madison is drained to the northeast by Oriskany Creek, which joins the Mohawk River. The southern half of the county is drained to the south by the Susquehanna River system. The principal south-flowing streams are the Unadilla, Chenango, and Otselic Rivers and Tioughnioga Creek (SCS 1981).

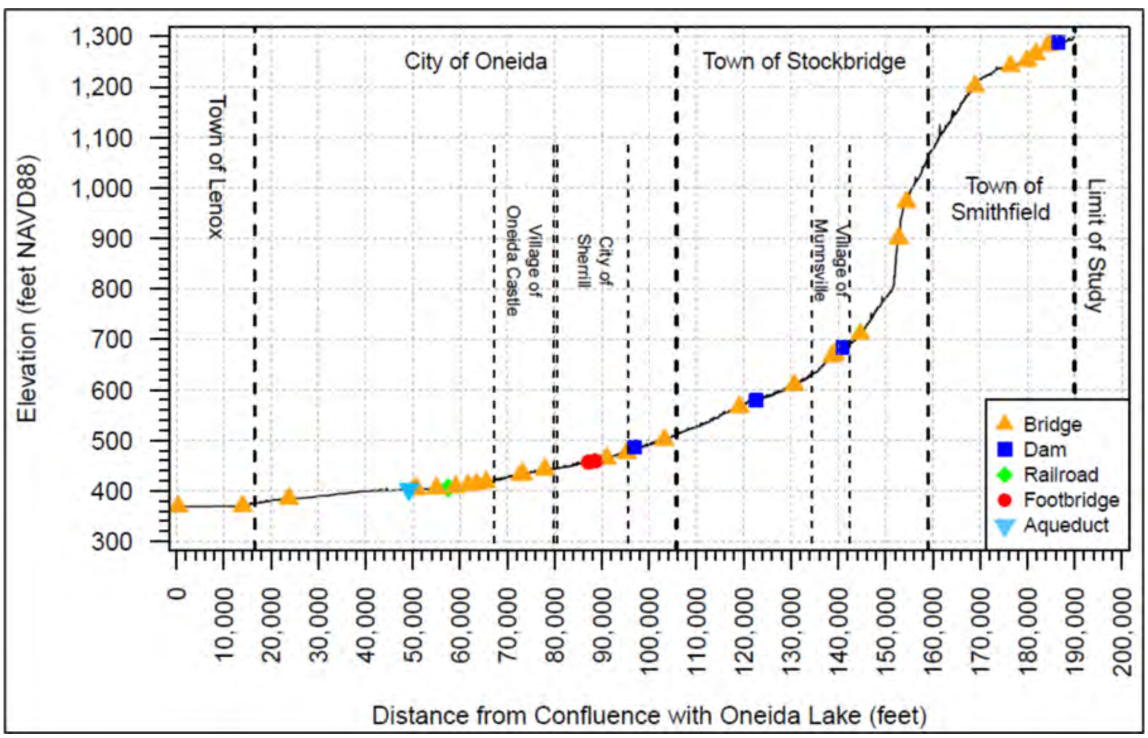

Figure 3-10. Oneida Creek profile of stream bed elevation and channel distance from the confluence with Oneida Lake.

Figure 3-11 is a profile of streambed elevation and channel distance from the confluence with Oneida Lake using 1-meter light detection and ranging (LiDAR) data for Oneida Creek. Oneida Creek has a steep slope in the upstream reaches, primarily in the Towns of Stockbridge and Smithfield, including the Village of Munnsville. Stockbridge Falls, located in the Town of Stockbridge upstream of the Village of Munnsville, accounts for a large elevation drop of approximately 190 feet (NYSOITS 2015).

In addition, there are numerous locations where sediment depositional aggradation is occurring within the channel of Oneida Creek. Aggradation is a natural fluvial process where sediment and other materials are deposited in a stream channel when the supply of sediment is greater than the amount of material that the system is able to transport. Over time, aggradation can lead to the development of sand and sediment bars within the stream channel. These sand and sediment bars may restrict flow by reducing the in-channel flow area and may act as catchpoints for ice pieces during ice breakup events, potentially increasing open water flood risks and ice-jam formations (Mugade and Sapkale 2015).

3.5 HYDROLOGY

Oneida Creek drains an area of 148 square miles, is approximately 41 miles in length, and is located in central New York State southeast of Oneida Lake along the border of Oneida and Madison Counties. Oneida Creek rises in the vicinity of Oxbow Road in the Town of Smithfield (Madison County) and flows east into Stockbridge before turning and flowing north through the Village of Munnsville and along the border of Madison and Oneida Counties, passing through the municipalities of the City of Oneida, Town of Vernon (including the City of Sherrill and Village of Oneida Castle) and the Towns of Lenox and Verona before emptying into Oneida Lake (USGS 2021b).

There are two main tributaries that flow into Oneida Creek: Taylor Creek and Sconondoa Creek. Taylor Creek has a drainage area of 6.6 square miles and is approximately 11.1 miles long. It rises in the Town of Vernon at the border with the Town of Stockbridge (and Oneida and Madison County border) and flows north then west through the City of Sherrill along the border with the Town of Vernon until merging with Oneida Creek. Sconondoa Creek has a drainage area of 38.1 square miles and is approximately 22.2 miles long. It rises in the Town of Augusta near the border with the Town of Stockbridge (and Oneida and Madison County border) and flows east then north and west through the Town and Village of Vernon, City of Sherrill and Town of Verona before merging with Oneida Creek (USGS 2021b).

Table 3 is a summary of the basin characteristic formulas and calculated values for the Oneida Creek watershed, where A is the drainage area of the basin in square miles, BL is the basin length in miles, and BP is the basin perimeter in miles (USGS 1978).

Table 3. Oneida Creek Basin Characteristics Factors

Factor	Formula	Value
Form Factor (R_F)	A / B_L^2	0.16
Circularity Ratio (R_C)	$4*\pi*A / B_P^2$	0.15
Elongation Ratio (R_E)	$2 * (A/\pi)^{0.5} / B_L$	0.45

Form Factor (RF) describes the shape of the basin (e.g., circular or elongated) and the intensity of peak discharges over a given duration of time. Circularity Ratio (RC) gives an indication of topography where the higher the circularity ratio, the lower the relief and less disturbance to drainage systems by structures within the channel. Elongation Ratio (RE) gives an indication of ground slope where values less than 0.7 correlate to steeper ground slopes and elongated basin shapes. Based on the basin characteristics factors, the Oneida Creek watershed can be characterized as an elongated basin with lower peak discharges of longer durations, high-relief topography with structural controls on drainage, and steep ground slopes (Waikar and Nilawar 2014).

There is one USGS stream gage station on Oneida Creek, USGS gage 04243500 Oneida Creek at Oneida, NY. The gage has been active since 1950 and has collected data for 72 consecutive years (USGS 2022b).

As described in Section 3.2.5, there is an effective FEMA FIS for each municipality within the Oneida Creek watershed in which a detailed analysis was performed for both the hydrologic and hydraulic analyses.

For the Village of Munnsville, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing a log-Pearson Type III (LP3)/drainage area-ratio method analysis for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek (FEMA 1983c).

For the Town of Stockbridge, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing a LP3/drainage area-ratio method analysis for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek (FEMA 1983b).

For the City of Oneida, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing an LP3/drainage area-ratio method analysis for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek (FEMA 2001).

For the Town of Lenox, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing an LP3 analysis following the guidelines outlined in USGS Bulletin 17B for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek. The gage discharges were transferred to other points along

Oneida Creek using the USGS Water Resources Investigations (WRI) 79-83 (FEMA 1988a).

For the Village of Oneida Castle, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing a log-Pearson Type III (LP3)/drainage area-ratio method analysis for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek (FEMA 2013).

For the City of Sherrill, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained by performing a log-Pearson Type III (LP3)/drainage area-ratio method analysis for the selected recurrence intervals (10-, 2-, 1-, and 0.2% ACE) using discharge data from the USGS gage on Oneida Creek (FEMA 2013).

For the Town of Verona, hydrologic analyses to determine discharge-frequency relationships and peak discharges for Oneida Creek were obtained from the FIS for the Town of Lenox and City of Oneida for the respective portions of Oneida Creek that border the Town of Verona (FEMA 2013).

For the Town of Vernon, no hydrologic analyses were performed for Oneida Creek. Table 4 summarizes the peak discharges from the FEMA FIS reports for Oneida Creek.

Table 4. Oneida Creek FEMA FIS Peak Discharges

Source: FEMA 1983b; FEMA 1983c; FEMA 2001b; FEMA 2013						
			Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (Sq. Mi)	River Station (ft)	10-Percent	2-Percent	1-Percent	0.2-Percent
At confluence with Oneida Lake	145.9	0+00	7,353	10,712	12,351	16,200
Upstream of confluence of Black Creek	133.9	5+00	7,006	10,228	11,803	15,300
At confluence of Brandy Brook	126.0	338+50	6,769	9,896	11,376	15,000
At confluence of unnamed tributary just upstream of Interstate 90	116.0	552+00	6,446	9,443	10,860	14,300
At Scondoa Street	113	635+00	6,390	9,420	10,800	14,500
Upstream of confluence of Scondoa Creek	78.0	642+50	4,300	6,358	7,362	9,800
At the confluence of Taylor Creek	70.0	815+50	3,857	5,718	6,634	8,800
Upstream of confluence of unnamed tributary from Oneida Reservoir	58	972+00	3,209	4,780	5,560	7,550
At upstream corporate limits (City of Oneida)	49	1074+00	2,734	4,088	4,771	6,420
At downstream corporate limits (Town of Stockbridge)	37	1295+00	1,520	2,160	2,470	3,150
At downstream corporate limits (Village of Munnsville)	34	1360+00	1,340	1,890	2,150	2,900

General limitations of the FEMA FIS methodology are the age of the effective FIS H&H analysis, the age of the methodology, and the different methodologies used over the entire reach of Oneida Creek. The various H&H analyses for Oneida Creek were completed in the early 1980s using the Bulletin 17B, WRI 79-83, and LP3/drainage area-ratio method methodologies. At the time of these FIS reports, there were less than 30 years of available gage records, which is the minimum number of data points required for a statistical analysis. In addition, advancements in our understanding of the complex interactions of hydrologic environments, coupled with improvements in hydrologic and hydraulic modeling and technology, has led to increased accuracy and a reduction in possible error in discharge estimations in recent years.

StreamStats v4.10.1 software (https://streamstats.usgs.gov/ss/) 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 202b).

Methods for computing a peak discharge estimate for a selected recurrence interval at a specific site depend on whether the site is gaged or ungaged, and whether the drainage area lies within a single hydrologic region or crosses into an adjacent hydrologic region or State. Hydrologic regions refer to areas in which streamflow-gaging stations indicate a similarity of peak-discharge response that differs from the peak-discharge response in adjacent regions. These similarities and differences are defined by the regression residuals, which are the differences between the peak discharges calculated from station records and the values computed through the regression equation. There are currently six hydrologic regions in New York State, and Oneida Creek is located in Region 6 (Lumia 1991; Lumia et al. 2006).

For gaged sites, such as Oneida Creek, the generalized least-squares (GLS) regional-regression equations are used to improve streamflow-gaging-station estimates (based on LP3 flood-frequency analysis of the gaged annual peak-discharge record) by using a weighted average of the two estimates (regression and gaged). Incorporating the regression estimate into the weighted average tends to decrease time-sampling errors that result for sites with short periods of record. The weighted-average discharges are generally the most reliable and are computed from the equation:

$$Q_{\mathrm{T(W)}} = \frac{Q_{\mathrm{T(g)}}(\mathrm{N}) + Q_{\mathrm{T(r)}}(\mathrm{E})}{\mathrm{N} + \mathrm{E}}$$

where

$Q_{T(w)}$ is weighted peak discharge at the gaged site, in cubic feet per second, for the T-year recurrence interval;

$Q_{T(g)}$ is peak discharge at gage, in cubic feet per second, calculated through log-Pearson Type III frequency analysis of the station’s peak discharge record, for the T-year recurrence interval;

N is number of years of annual peak-discharge record used to calculate $Q_{T(g)}$ at the gaging station;

$Q_{T(r)}$ is regional regression estimate of the peak discharge at the gaged site, in cubic feet per second, for the T-year recurrence interval; and

E is average equivalent years of record associated with the regression equation that was used to calculate $Q_{T(r)}$ (Lumia et al. 2006).

StreamStats delineates the drainage basin boundary for a selected site by use of an evenly spaced grid of land-surface elevations, known 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. By using these characteristics in the calculation, the peak discharge values have increased accuracy and decreased standard errors by approximately 10% for a 1% annual chance interval (100-yr recurrence) discharge when compared to the drainage-area only regression equation (Lumia et al. 2006; Ries et al. 2017).

When *StreamStats* is used to obtain estimates of streamflow statistics for USGS stream gages, users should be aware that there are errors associated with estimates determined from available data for the stations, as well as estimates determined from regression equations, and some disagreement between the two sets of estimates is expected. If the flows at the stations are affected by human activities, then users should not assume that the differences between the data-based estimates and the regression equation estimates are equivalent to the effects of human activities on streamflow at the stations (Ries et al. 2017).

StreamStats was used to calculate the current peak discharges for Oneida Creek and compared with the effective FIS peak discharges. Table 5 is the summary output of peak discharges calculated by the USGS *StreamStats* software for Oneida Creek at select locations.

Table 5. USGS *StreamStats* Peak Discharge for Oneida Creek at the FEMA FIS Locations

Source: USGS 2022b						
			Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (Sq. Mi.)	River Station (ft)	10-Percent	2-Percent	1-Percent	0.2-Percent
At confluence with Oneida Lake	148	0+00	5,130	7,400	8,400	11,000
Upstream of confluence of Black Creek	137	5+00	5,010	7,170	8,130	10,500
At confluence of Brandy Brook	128	338+50	4,910	7,060	8,020	10,400
At confluence of unnamed tributary just upstream of Interstate 90	116	552+00	4,890	7,000	7,930	10,300
At Sconondoa Street	114	635+00	4,880	6,990	7,920	10,300
Upstream of confluence of Sconondoa Creek	75.1	642+50	3,380	4,830	5,470	7,070
At confluence of Taylor Creek	71.4	815+50	3,310	4,750	5,380	6,970
Upstream of confluence of unnamed tributary from the Oneida Reservoir	61.9	972+00	2,990	4,310	4,900	6,360
At upstream corporate limits (City of Oneida)	49.1	1074+00	2,490	3,610	4,120	5,380
At downstream corporate limits (Town of Stockbridge)	39.3	1295+00	2,090	3,070	3,510	4,620
At downstream corporate limits (Village of Munnsville)	36.8	1360+00	2,030	2,990	3,420	4,510

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% ACE hazards were determined. Standard error gives an indication of how accurate the calculated peak discharges are when compared to the actual peak discharges since approximately 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 6 is a summary table of the USGS *StreamStats* standard errors at each percent annual chance flood hazard for Region 6 in New York State.

Table 6. USGS *StreamStats* Standard Errors for Full Regression Equations

Source: (Lumia 2006)				
	Peak Discharges (cfs)			
	10-Percent	2-Percent	1-Percent	0.2-Percent
Average Standard Error	32.9	35.8	37.2	41.4

Based on the *StreamStats* standard error calculations, the FEMA FIS peak discharges were determined to be outside of the acceptable range (95% confidence interval). For this study, to maintain consistency in the modeling outputs with the FEMA models and to develop a conservative analysis of flood risk in the Oneida Creek watershed, the effective FIS peak discharges were used in the HEC-RAS modeling software simulations.

In addition to peak discharges, the *StreamStats* software also calculates bankfull statistics by using stream survey data and discharge records from 281 cross-sections at 82 streamflow-gaging stations in a linear regression analysis 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).

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 Oneida Creek is important in understanding the distribution of available energy within the stream channel, and the ability of various discharges occurring within the channel to erode, deposit, and move sediment (Rosgen and Silvey 1996). Table 7 lists the estimated bankfull discharge, width, and depth at select locations along Oneida Creek as derived from the USGS *StreamStats* program.

Table 7. USGS *StreamStats* Estimated Drainage Area, Bankfull Discharge, Width, and Depth

Source: USGS 2022b

Flooding Source and Location	Drainage Area (Sq. Mi.)	River Station (ft)	Bankfull Depth (ft)	Bankfull Width (ft)	Bankfull Streamflow (cfs)
At confluence with Oneida Lake	148	0+00	4.1	108	1,800
Upstream of confluence of Black Creek	137	5+00	4.0	104	1,690
At confluence of Brandy Brook	128	338+50	3.9	101	1,610
At confluence of unnamed tributary just upstream of Interstate 90	116	552+00	3.8	96.2	1,470
At Sconondoa Street	114	635+00	3.8	95.4	1,450
Upstream of confluence of Sconondoa Creek	75.1	642+50	3.5	78.5	1,030
At the confluence of Taylor Creek	71.4	815+50	3.5	76.7	994
Upstream of confluence of unnamed tributary from the Oneida Reservoir	61.9	972+00	3.4	72	893
At upstream corporate limits (City of Oneida)	49.1	1074+00	3.2	64.8	752
At downstream corporate limits (Town of Stockbridge)	39.3	1295+00	3.1	58.6	637
At downstream corporate limits (Village of Munnsville)	36.8	1360+00	3.0	56.9	607

3.6 INFRASTRUCTURE

According to NYSDEC Inventory of Dams dataset, there are three dams along Oneida Creek as identified by the NYSDEC. The dams are purposed as Fish and Wildlife, pond recreation or other. All three dams have a hazard class of A or D. 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 (NYSDEC 2022c). Class "D" dams will have no hazardous risk to downstream areas if the dam has been breached or removed, or has failed or otherwise no longer materially impounds waters, or a dam that was planned but never constructed.

In addition, Oneida Creek crosses the Erie Canal in the Town of Verona. The crossing is maintained by a constructed weir that controls water levels in both waterways. Table 8 lists the dams and weirs that are along Oneida Creek, including hazard codes and purpose for the dam (NYSDEC 2022c).

Table 8. Inventory of Dams and Weirs Along Oneida Creek

Source: NYSDEC 2021c

Municipality	State ID	Structure Name	Owner	River Station (ft)	Hazard Code	Purpose
Town of Verona	N/A	Old Erie Canal (Weir)	NYS Canal Corp	493+00	N/A	N/A
Village of Vernon	103-2816	Oneida Ltd Dam #3	Oneida Community Mansion House	969+00	A	Fish and Wildlife Pond, Recreation
Town of Stockbridge	103-0597	(103-0597)	Not Found	1226+00	D	Other
Town of Smithfield	104-5871	Miller lake Dam	Miller Lake Preservation Corporation		A	Not Found

There are two large culverts as identified by the NYSDOT along Oneida Creek. The culvert is located in the Town of Stockbridge and carries Stockbridge Falls Road and Jones Road.

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 2020a). In addition to the NYSDOT large culverts, there are a number of county and town-owned culverts that cross Oneida Creek. Table 9 lists the identification numbers, owners, and structural characteristics of the culverts along Oneida Creek with bankfull widths from *StreamStats* and hydraulic capacities from FEMA (NYSDOT 2019b; NYSDOT 2021).

Table 9. Culverts Along / Over Oneida Creek

Source: NYSDOT 2019b; USGS 2021; NYSDOT 2021								
Roadway Carried	Culvert ID (CIN)	River Station (ft)	Owner	Municipality	Span Length (ft)	Structure Width (ft) [1]	Bankfull Width (ft)	Hydraulic Capacity (% ACE)
Stockbridge Falls Road	N/A	1499+00	Town of Stockbridge	Town of Stockbridge	10	45	43.3	No FEMA FIS data
Jones Road	N/A	1543+50	Town of Stockbridge	Town of Stockbridge	20	32	42.9	No FEMA FIS data

[1] Structure Width is measured parallel to creek flow and refers to the roadway width, which is the minimum distance between the curbs or the railings (if there are no curbs), to the nearest 30mm or tenth of a foot (NYSDOT 2020b).

Major bridge crossings over Oneida Creek include NY-13, NY-31, NY-46/North Main Street, Interstate 90, NY-5/Genesee Street, and NY-46/Main Street.

Bridge lengths and surface widths for NYSDOT bridges and culverts were revised as of 2019. Based on orthographic imagery and field observations of the Oneida Creek watershed, additional structures crossing Oneida Creek were identified.

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.

Table 10 summarizes the infrastructure data for structures that cross Oneida Creek with bankfull widths from *StreamStats* and hydraulic capacities from FEMA. Figure 3-11 displays the locations of the infrastructure along Oneida Creek.

Table 10. Infrastructure Crossings Over Oneida Creek

Source: NYSDOT 2019b; USGS 2022b; NYSDEC 2021b; NYSDOT 2021; FEMA 2013; FEMA 2001; FEMA 1983a; FEMA 1983b							
Structure Carried	Bridge ID (BIN)	River Station (ft)	Owner	Bridge Length (ft)	Surface Width (ft) [1]	Bankfull Width (ft)	Hydraulic Capacity (% ACE)
NY-13	1010610	3+50	NYSDOT	119	35	108	0.2
NY-31	1021990	136+00	NYSDOT	161	40	103	0.2
Swallows Bridge Road	3309380	238+00	Madison County	77	16.2	101	< 10
Oneida Creek Aqueduct[2]	Erie Canal/ Pools Brook	493+00	NYS Canal Corporation	N/A	N/A	97.8	0.2
NY-46/N Main Street	1025680	502+00	NYSDOT	168	38.2	97.4	0.1
Old State Rt 46	3311270	508+00	Oneida County	127	22	97	< 10
Interstate 90	5513059	550+00	NYS Thruway Authority	160	113.2	96.2	0.2
Railroad Bridge (1)[2]	Oneida Creek	575+00	CSX Transportation, Inc.	N/A	N/A	95.8	2
Bennett Road	2309360	591+00	Madison County	92	22	95.8	10
Access Road (1)[2]	Oneida Creek	617+50	City of Oneida	N/A	N/A	95.6	0.2
Sconondoa Street	3309350	634+50	Madison County	80	29.5	95.4	< 10
NY-365A/Prospect Street	1046750	655+00	NYSDOT	106	40	78.4	10
Abandoned Railroad [2]	Oneida Creek	617+50	City of Oneida	N/A	N/A	77.3	0.2
NY-5/Genesee Street	1002180	733+00	NYSDOT	54	44.6	77.3	10
CR-33/Middle Road	2206290	779+00	Oneida County	81	31	76.8	<10

Source: NYSDOT 2019b; USGS 2022b; NYSDEC 2021b; NYSDOT 2021; FEMA 2013; FEMA 2001; FEMA 1983a; FEMA 1983b							
Structure Carried	Bridge ID (BIN)	River Station (ft)	Owner	Bridge Length (ft)	Surface Width (ft) [1]	Bankfull Width (ft)	Hydraulic Capacity (% ACE)
Sherrill Rd/Kenwood Avenue	3311170	911+00	Oneida County	58	22	72.7	2
CR-51/Kenwood Avenue	3309320	953+00	Madison County	51	26.2	72.1	< 10
CR-34/Peterboro Road	3309310	1031+50	Madison County	56	27	66.2	2
CR-35/Valley Mills Road	3308980	1191+50	Madison County	76	33.2	62.5	No FEMA FIS data
CR-38/Haslauer Road	3308970	1307+00	Madison County	49	24	58.6	0.2
Valley Mills Road	2308960	1386+00	Madison County	66	26	56.2	0.2
NY-46/Main Street	1025640	1392+50	NYSDOT	47	44.5	55.8	0.2
Freeman Road	N/A	1476+00	Town of Stockbridge	28	35	43.6	No FEMA FIS data
Falls Road	2205220	1528+00	Town of Stockbridge	25	24	43	No FEMA FIS data

[1] Structure Width is measured parallel to creek flow and refers to the curb-to-curb width, which is the minimum distance between the curbs or the bridge railings (if there are no curbs), to the nearest 30mm or tenth of a foot (NYSDOT 2020b).

[2] Note: Unable to field measure due to safety concerns and no publicly available data for structural measurements. Orthoimagery and GIS spatial analysis tools were used to approximate structural measurements.

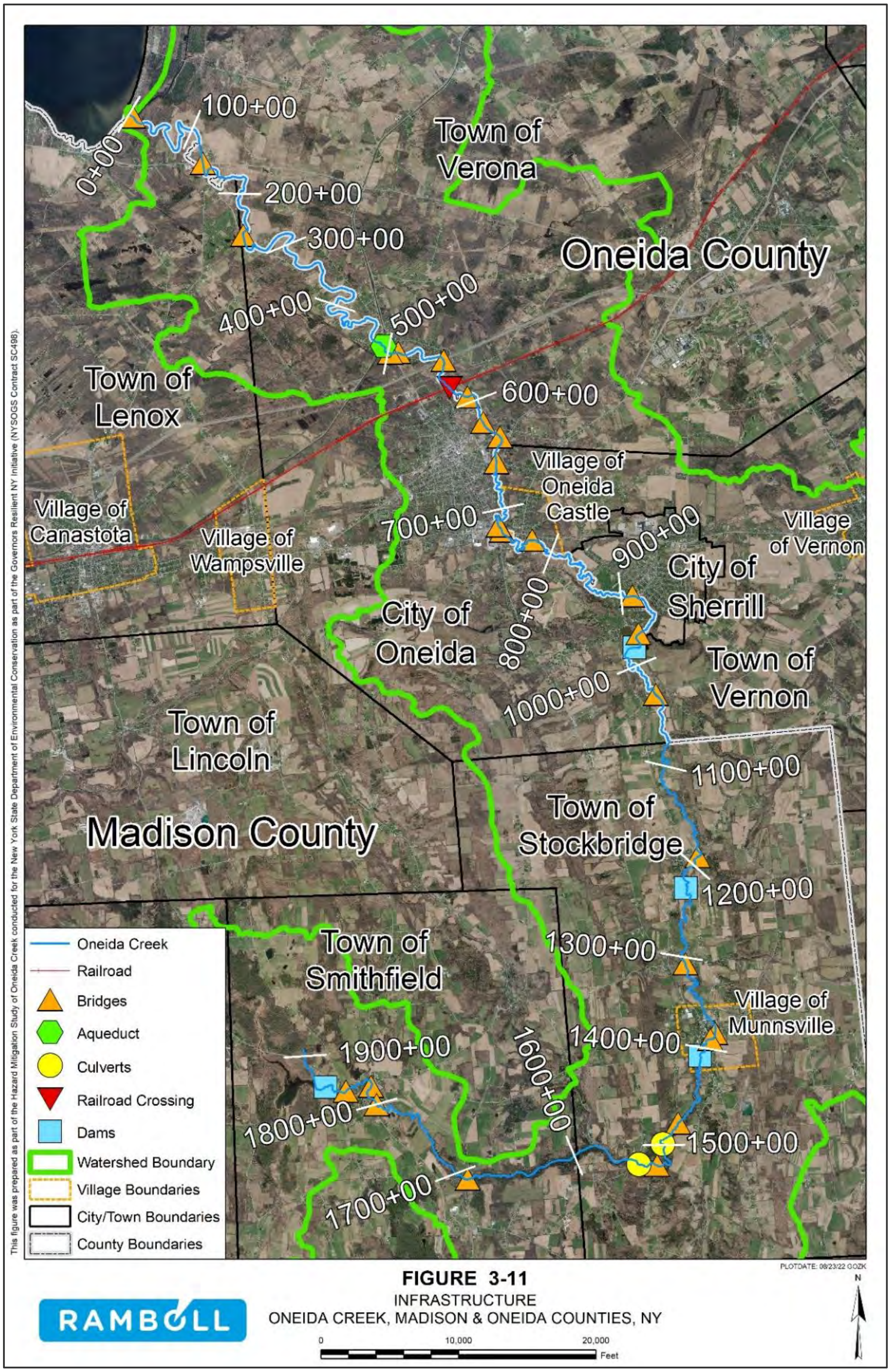

Figure 3-11. Oneida Creek Infrastructure, Oneida and Madison Counties, NY.

3.7 HYDRAULIC CAPACITY

Hydraulic capacity is the measure of the amount of water that can pass through a structure or watercourse. Hydraulic design is an essential function of structures in watersheds. Exceeding the capacity can result in damage or flooding to surrounding areas and infrastructure (Zevenbergen et al. 2012). In assessing hydraulic capacity of the culverts and bridges along Oneida Creek, the FEMA FIS profiles in the Village of Munnsville, Cities of Oneida and Sherill, and Town of Stockbridge 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 (see Tables 9 and 10).

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, usually expressed as a distance in feet, in a waterway above the calculated capacity required for a specified flood level, usually the base flood elevation. Freeboard compensates for the many unknown factors that could contribute to flood heights being greater than calculated, 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 floods expected under future climatic conditions, such as those due to sea-level rise or more extreme precipitation events (NYSDEC 2020b). Table 11 displays the 1% ACE levels (feet NGVD29) and freeboard height (feet) at FEMA FIS infrastructure locations using the FIS profiles for Oneida Creek.

Table 11. FEMA FIS 1% Annual Chance Flood Hazard Levels and Freeboard Values

Source: FEMA 2013; FEMA 2001; FEMA 1983a; FEMA 1983b				
Infrastructure Crossing/Name	River Station (ft)	1-Percent WSEL (ft NGVD)	2-Percent WSEL (ft NGVD)	Freeboard for 2-Percent ACE (ft)
NY-13	3+50	372.8	372.5	3.0
NY-31	136+00	382.0	381.4	10.5
Swallows Bridge Road	238+00	395.8	395.8	-3.0
Oneida Creek Aqueduct	493+00	414.5	413.7	2.8
NY-46/N Main Street	502+00	417.9	416.5	3.5
Old State Rt 46	508+00	418.7	414.4	-3.5
Interstate 90	550+00	420.6	419.4	5.1
Railroad Bridge (1)	575+00	424.1	423.0	11.5
Bennett Road	591+00	423.0	421.8	-1.3
Sconondoa Street	634+50	425.6	424.3	-3.3

Source: FEMA 2013; FEMA 2001; FEMA 1983a; FEMA 1983b				
Infrastructure Crossing/Name	River Station (ft)	1-Percent WSEL (ft NGVD)	2-Percent WSEL (ft NGVD)	Freeboard for 2-Percent ACE (ft)
NY-365A/Prospect Street	655+00	426.3	425.1	-0.2
NY-5/Genesee Street	733+00	443.0	441.8	-2.3
CR-33/Middle Road	779+00	447.0	446.0	-2.5
Sherrill Rd/Kenwood Avenue	911+00	471.5	469.0	1.5
CR-51/Kenwood Avenue	953+00	482.0	481.5	-1.8
CR-34/Peterboro Road	1031+50	507.5	505.0	-0.5
CR-38/Haslauer Road	1307+00	607.6	607.1	2.7
Valley Mills Road	1386+00	659.6	659.2	2.8
NY-46/Main Street	1392+50	664.2	664.0	9.8

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

The term "bridge" shall apply to any structure whether single or multiple span construction with a clear span in excess of 20 feet when measurement is made horizontally along the center line of roadway from face to face of abutments or sidewalls immediately below the copings or fillets; or, if there are no copings or fillets, at 6 inches below the bridge seats or immediately under the top slab, in the case of frame structures. In the case of arches, the span shall be measured from spring line to spring line. All measurements shall include the widths of intervening piers or division walls, as well as the width of copings or fillets (NYSDOT 2020b).

According to the NYSDOT Bridge Manual (2019) for Oneida and Madison Counties (Region 2), new and replacement bridges are required to meet certain standards, which include (NYSDOT 2019a):

- 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.

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% (50-yr) ACE hazard 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% (100-yr) ACE hazard requirement must be checked (NYSDOT 2018).

The term "culvert" is defined as any structure, whether of single or multiple-span construction, with an interior width of 20 ft or less when the measurement is made horizontally along the center line of the roadway from face-to-face of abutments or sidewalls (NYSDOT 2020b).

In assessing the hydraulic capacity of culverts, NYSDOT highway drainage standards require the determination of a design discharge (e.g., 50-yr flood) through the use of flood frequencies. The design flood frequency is the recurrence interval that is expected to be accommodated without exceeding the design criteria for the culvert. There are four recommended methodologies: The Rational Method, the Modified Soil Cover Complex Method, historical data, and the regression equations. Each method should be assessed and the most appropriate method for the specific site should be used to calculate the design flood frequency and discharge (NYSDOT 2018).

To assess hydraulic capacity for this study, the USGS *StreamStats* tool was used to calculate the bankfull widths and discharge for each structure along Oneida Creek. Table 12 indicates that the majority of structures crossing Oneida Creek do not have the appropriate width to successfully pass a bankfull discharge event, including major crossings such as NY-365/Prospect Street and CR-34/Peterboro Road in the City of Oneida; NY-5/Genesee Street, and CR-33/Middle Road in the Village of Oneida Castle; and CR-51/Kenwood Avenue in the City of Sherrill.

The structures with bankfull widths that are wider than or close to the structure's width, such as Bennett Road and Freeman Road, indicate that water velocities have to slow and contract in order to pass through the structures, which can cause sediment depositional aggradation and the accumulation of sediment and debris. Aggradation can lead to the development of sediment and sand bars, which can cause upstream water surfaces to rise, increasing the potential for overtopping banks or backwater flooding. Since the bankfull discharge required for water surface elevations to reach the bankfull width is low (e.g., 80% ACE), the likelihood of relatively low-flow events causing backwater and potential flooding upstream of these structures is fairly high.

Table 12. Hydraulic Capacity of Potential Constriction Point Bridges Crossing Oneida Creek

Source: NYSDOT 2019b; NYSDOT 2019b; USGS 2022b; NYSDEC 2021b; NYSDOT 2021

Structure Carried	Type	River Station (ft)	Structure Width [1] (ft)	Bankfull Width (ft)	Bankfull Discharge (cfs)	Annual Chance Flood Event Equivalent [2]
Swallows Bridge Road	Bridge	238+00	77	101	1620	> 80-percent
Bennett Road	Bridge	591+00	92	95.8	1460	> 80-percent
Scondondoa Street	Bridge	634+50	80	95.4	1450	> 80-percent
NY-5/Genesee Street	Bridge	733+00	54	77.3	1010	> 80-percent
Sherrill Rd/Kenwood Avenue	Bridge	911+00	58	72.7	909	> 80-percent
CR-51/Kenwood Avenue	Bridge	953+00	51	72.1	896	> 80-percent
CR-34/Peterboro Road	Bridge	1031+50	56	66.2	779	> 80-percent
CR-38/Haslauer Road	Bridge	1307+00	49	58.6	637	> 80-percent
NY-46/Main Street	Bridge	1392+50	47	55.8	586	> 80-percent
Freeman Road	Bridge	1476+00	28	43.6	382	> 80-percent
Stockbridge Falls Road	Culvert	1499+00	10	43.3	377	> 80-percent
Falls Road	Bridge	1528+00	25	43	373	> 80-percent
Jones Road	Culvert	1543+50	12	42.9	371	> 80-percent

[1] Structure Width is measured perpendicular to flow.

[2] Annual Chance Flood Event Equivalent describes the equivalent annual chance flood event for the given bankfull discharge as calculated by the USGS *StreamStats* application. The 80% ACE is equal to a 1.25-yr recurrence interval.

4. CLIMATE CHANGE IMPLICATIONS

4.1 FUTURE PROJECTED STREAM FLOW FOR ONEIDA CREEK

In New York State, climate change is expected to exacerbate flooding due to projected increases of 1- to 8% in total annual precipitation coupled with increases in the frequency, intensity, and duration of extreme precipitation events (events with more than 1, 2, or 4 inches of rainfall) (Rosenzweig et al. 2011). In response to these projected changes in climate, NYS 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, two methods for estimating projected future discharges were discussed: an end of design life multiplier and the USGS *Future Flow Explorer* map-based web application (NYSDEC 2020b).

USGS *Future Flow Explorer* v1.5 is discussed as a potential tool to project peak flows under various climate scenarios into the future (USGS 2016). *Future Flow* was developed by the USGS in partnership with the New York State Department of Transportation. This application is an extension for the USGS *StreamStats* map-based web application and projects future stream flows in New York State. The USGS team examined 33 global climate models and selected five that best predicted past precipitation trends in the region. The results were then downscaled to apply to all six hydrologic regions of New York State. Three time periods can be examined: 2024-2049, 2050-2074 and 2075-2099, as well as two Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway (RCP) greenhouse gas emission scenarios: RCP 4.5 and RCP 8.5. RCP 4.5 is considered a midrange-emissions scenario, and RCP 8.5 is a high-emissions scenario (Taylor et al. 2011; NYSDEC 2020b).

In general, climate models are better at forecasting temperature than precipitation and contain some level of uncertainty with their calculations and results. The USGS recommends using *Future Flow* projections as qualitative guidance to see likely trends within any watershed, and as an exploratory tool to inform selection of appropriate design flow. Current future flood projection models will not provide accurate results for basins that extend across more than one hydrologic region in New York (NYSDEC 2020b).

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. While the *Future Flow* application is still being upgraded, it can be used with appropriate caution. Climate model forecasts are expected to improve and as they do, the existing regression approach will be tested and refined further (NYSDEC 2020b).

In an effort to improve flood resiliency of infrastructure in light of future climate change, the NYSDEC outlined infrastructure guidelines for bridges and culverts (NYSDEC 2020b). For bridges, the minimum hydraulic design criteria are 2-ft of freeboard over the 2% ACE elevation, while still allowing the 1% ACE flow to pass under the low chord of the bridge without going into pressure flow. For critical bridges, the minimum hydraulic design criteria are 3-ft of freeboard over the 2% ACE elevation. A critical bridge is considered to be vital infrastructure that the incapacity or destruction of such would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters (NYSDEC 2020b; NYSDOT 2019a; USDHS 2010).

For culverts, the minimum hydraulic design criteria are 2-ft of freeboard over the 2% ACE elevation. For critical culverts, the CRRA guidelines recommend 3-ft of freeboard over the 1% ACE elevation. A critical culvert is considered to be vital infrastructure that the incapacity or destruction of such would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters (NYSDEC 2020b; NYSDOT 2018; USDHS 2010).

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. For Oneida and Madison Counties, the recommended design-flow multiplier is 20% increased flow (NYSDEC 2020b). Table 13 provides a summary of the projected future peak stream flows using the FEMA FIS peak discharges and 20% CRRA design multiplier.

Table 13. Oneida Creek Projected Peak Discharges

Source: USGS 2016						
			Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (Sq. Miles)	River Station (ft)	10-Percent	2-Percent	1-Percent	0.2-Percent
At confluence with Oneida Lake	145.9	0+00	8,820	12,850	14,820	19,440
Upstream of confluence of Black Creek	133.9	5+00	8,410	12,270	14,160	18,360
At confluence of Brandy Brook	126	338+50	8,120	11,880	13,650	18,000
At confluence of unnamed tributary just upstream of Interstate 90	116	552+00	7,740	11,330	13,030	17,160
At Sconondoa Street	113	635+00	7,670	11,300	12,960	17,400
Upstream of confluence of Sconondoa Creek	78	642+50	5,160	7,630	8,830	11,760

Source: USGS 2016						
			Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (Sq. Miles)	River Station (ft)	10-Percent	2-Percent	1-Percent	0.2-Percent
At the confluence of Taylor Creek	70	815+50	4,630	6,860	7,960	10,560
Upstream of confluence of unnamed tributary from the Oneida Reservoir	58	972+00	3,850	5,740	6,670	9,060
At upstream corporate limits (City of Oneida)	49	1074+00	3,280	4,910	5,730	7,700
At downstream corporate limits (Town of Stockbridge)	37	1295+00	1,820	2,590	2,960	3,780
At downstream corporate limits (Village of Munnsville)	34	1360+00	1,610	2,270	2,580	3,480

Appendix G contains the HEC-RAS simulation summary sheets for the proposed and future condition simulations. The HEC-RAS model simulation results for the future condition model parameters using the future projected discharge values are similar to the base-condition model output, with the only difference being future projected water surface elevations are up to 4.7-ft higher at specific locations, generally upstream of bridges or dams due to backwater, as a result of the increased discharges.

Table 14 provides a comparison of HEC-RAS existing condition, using FEMA FIS peak discharges, and future condition, using CRRA 20% design flow multiplier, water surface elevations at select locations along Oneida Creek.

Table 14. HEC-RAS Base and Future Conditions Water Surface Elevation Comparison

Source: USACE 2020						
			Water Surface Elevations (ft NAVD88) [1]			
Flooding Source and Location	Drainage Area (mi^2)	River Station (ft)	10-Percent	2-Percent	1-Percent	0.2-Percent
At confluence with Oneida Lake	145.9	0+00	+ 0.1	+ 0.5	+ 0.6	+ 0.3
Upstream of confluence of Black Creek	133.9	5+00	+ 0.2	+ 0.5	+ 0.6	+ 0.6
At confluence of Brandy Brook	126	338+50	+ 0.7	+ 0.8	+ 0.9	+ 1.0
At confluence of unnamed tributary just upstream of Interstate 90	116	552+00	+ 1.6	+ 1.3	+ 1.4	+ 1.8
At Sconondoa Street	113	635+00	+ 1.6	+ 1.4	+ 1.6	+ 2.9
Upstream of confluence of Sconondoa Creek	78	642+50	+ 1.4	+ 0.8	+ 2.3	+ 4.5
At confluence of Taylor Creek	70	815+50	+ 0.3	+ 0.4	+ 0.4	+ 0.5
Upstream of confluence of unnamed tributary from the Oneida Reservoir	58	972+00	+ 0.2	+ 0.2	+ 0.2	+ 0.3
At upstream corporate limits (City of Oneida)	49	1074+00	+ 0.2	+ 0.2	+ 0.3	+ 0.1
At downstream corporate limits (Town of Stockbridge)	37	1295+00	N/A	N/A	N/A	N/A
At downstream corporate limits (Village of Munnsville)	34	1360+00	+ 0.2	+ 0.2	+ 0.2	+ 0.3

[1] Positive changes in water surface elevation indicate the future conditions water surface elevation is higher than the existing condition.

5. FLOODING CHARACTERISTICS

5.1 FLOODING HISTORY

The history of flooding along Oneida Creek indicates that flooding can occur during any season of the year. However, most major floods have occurred in March, April, and May and are usually the result of spring rains and snowmelt. Storms resulting in floods in the early summer months are often associated with tropical storms moving north along the Atlantic coast.

In the Village of Oneida Castle, also known as "The Flats", the flood of June 1922 inundated the area with up to six feet of water. In June 1972, Hurricane Agnes caused an extreme flood causing residents to evacuate and the water and sewage treatment plant to stop operating. The Village continues to be a problematic area for flooding as there is very little storage capacity in the basin, and the area is relatively flat. Additionally, many of the bridges that span Oneida Creek are obstructive to the flow as the infrastructure is under-sized (USACE 1973).

All municipalities along the creek were affected by runoff from accumulated snow that melted and a rainstorm in January 1996. The storm was comparable to a 50-yr storm at that time. In June 2011, an extreme amount of precipitation washed over the area for 48 hours brought by Tropical Storm Lee with remnants of moisture from Hurricane Katia and caused a benchmark flooding event. The USGS gage measured a new maximum stream water surface height of 15.55 ft. A new record was reached in June 2013 when the USGS stream gage 04243500 recorded the peak discharge of 11,400 cfs and water surface elevation of 17.23-ft. The Town of Verona and the Town of Stockbridge were affected the most during the storm with $3 million and $1 million, respectively, estimated in cost for damaged properties. During the 2011 and 2013 extreme events, water overflowed Oneida Creek inundating roadways, residences, and businesses nearby the creek (NCEI 2022; FEMA 2013, USGS 2022b).

Other major reported flooding and damage to property occurred in March 1936, March 1950, August 2004, and November 2019. Some minor flooding in areas along Oneida Creek occurred in January 1999, May 2000, June 2006, and March 2007 (FEMA 2013).

According to FEMA flood loss data, there has been a total of eight NFIP claims totaling approximately $377,657 in building and contents payments within the City of Oneida and the Village of Munnsville from 1979 to 2016. The total cost of property damage caused by flooding in Oneida Creek from 1996-2019 is $5,353,658 in the municipalities along the creek. Table 15 summarizes the total number of NFIP policies, claims, loss payments, and repetitive loss properties for the City of Oneida, Towns of Verona and Stockbridge, and Villages of Munnsville and Oneida Castle.

Table 15. FEMA NFIP Summary Statistics for Oneida and Madison Counties, NY from 1979 to 2016

Source: MCEM 2016; NCEI 2022

Community Name	No. of Losses	Date of Losses	Total Paid ($ USD)
Munnsville (Village)	2	10/29/2012 8/28/2011	$297,996
Oneida (City)	2	5/13/2000 1/19/1996	$56,671
Oneida (City)	2	6/28/2013 7/12/2006	$19,800
Oneida (City)	2	3/9/2008 3/15/2007	$3,190
Oneida (City)	No data	9/7/2011	$800,000
Stockbridge (Town)	No data	6/28/2013	$1,000,000
Oneida Castle (Village)	No data	11/2/2019	$75,000
Verona (Town)	No data	7/2/2017	$100,000
Verona (Town)	No data	8/3/2007	$1,000
Verona (Town)	No data	6/28/2013	$3,000,000

A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-yr period, since 1978. A Severe Repetitive Loss (SRL) property is any insurable building for which four or more claims of more than $5,000 (or cumulative amount exceeding $20,000) were paid by the NFIP, or at least two separate claims payments have been made with the cumulative amount exceeding the fair market value of the insured building on the day before each loss within any rolling 10-yr period, since 1978 (FEMA 2019; FEMA 2020). It is important to note that the FEMA flood loss data only represents losses for property owners who participate in the NFIP and have flood insurance.

Figures 5-1 through 5-3 display the Zone A (1% ACE) boundaries for Oneida Creek, as determined by FEMA, for the reaches in the lower range along the City of Oneida and Village of Oneida Castle, middle reach along the Cities of Oneida and Sherrill, and upper reach between the Towns of Stockbridge and Vernon and City of Oneida, respectively (FEMA 1996). The maps indicate that in the Oneida Creek watershed, the areas that are considered high flood risk areas include:

- The area between the City of Oneida and Village of Oneida Castle corporate limits
- The area between the Cities of Oneida and Sherrill corporate limits
- The area between Valley Mills Road upstream of the dam in the Village of Munnsville

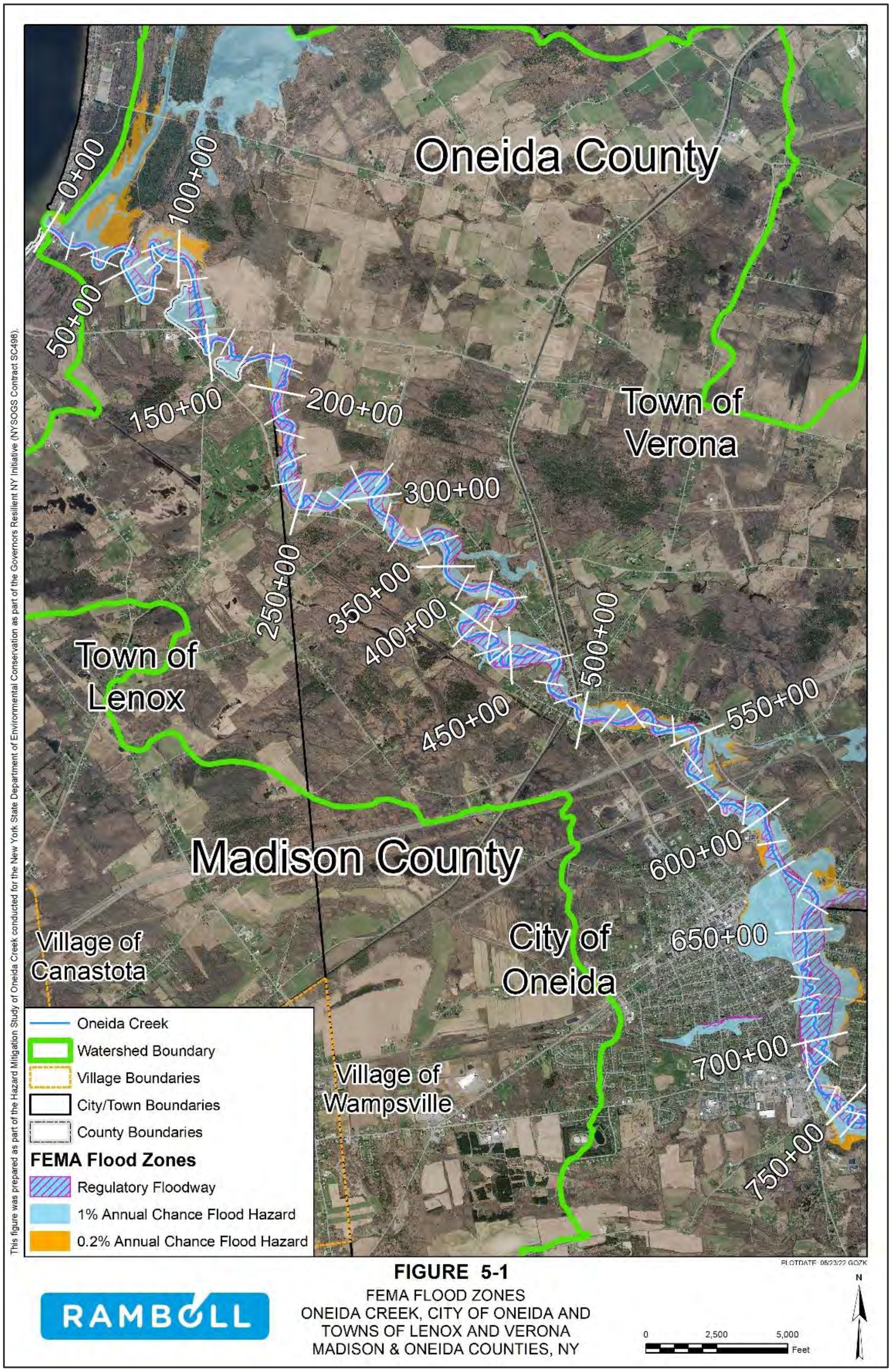

Figure 5-1. Oneida Creek, FEMA flood zones, City of Oneida, Towns of Lenox and Verona, Oneida & Madison Counties, NY.

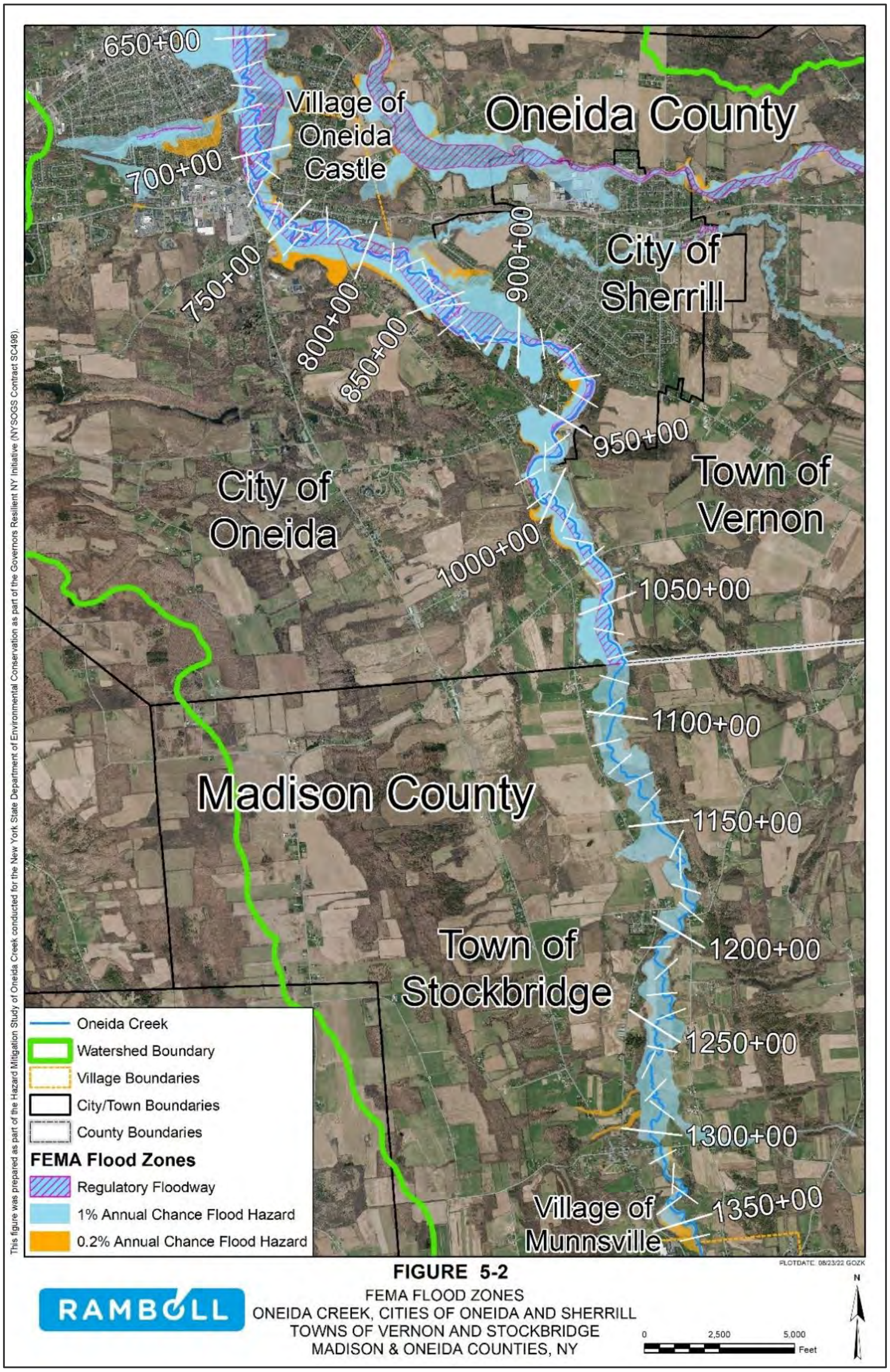

Figure 5-2. Oneida Creek, FEMA flood zones, Cities of Oneida and Sherrill, Towns of Vernon and Stockbridge, Oneida & Madison Counties, NY.

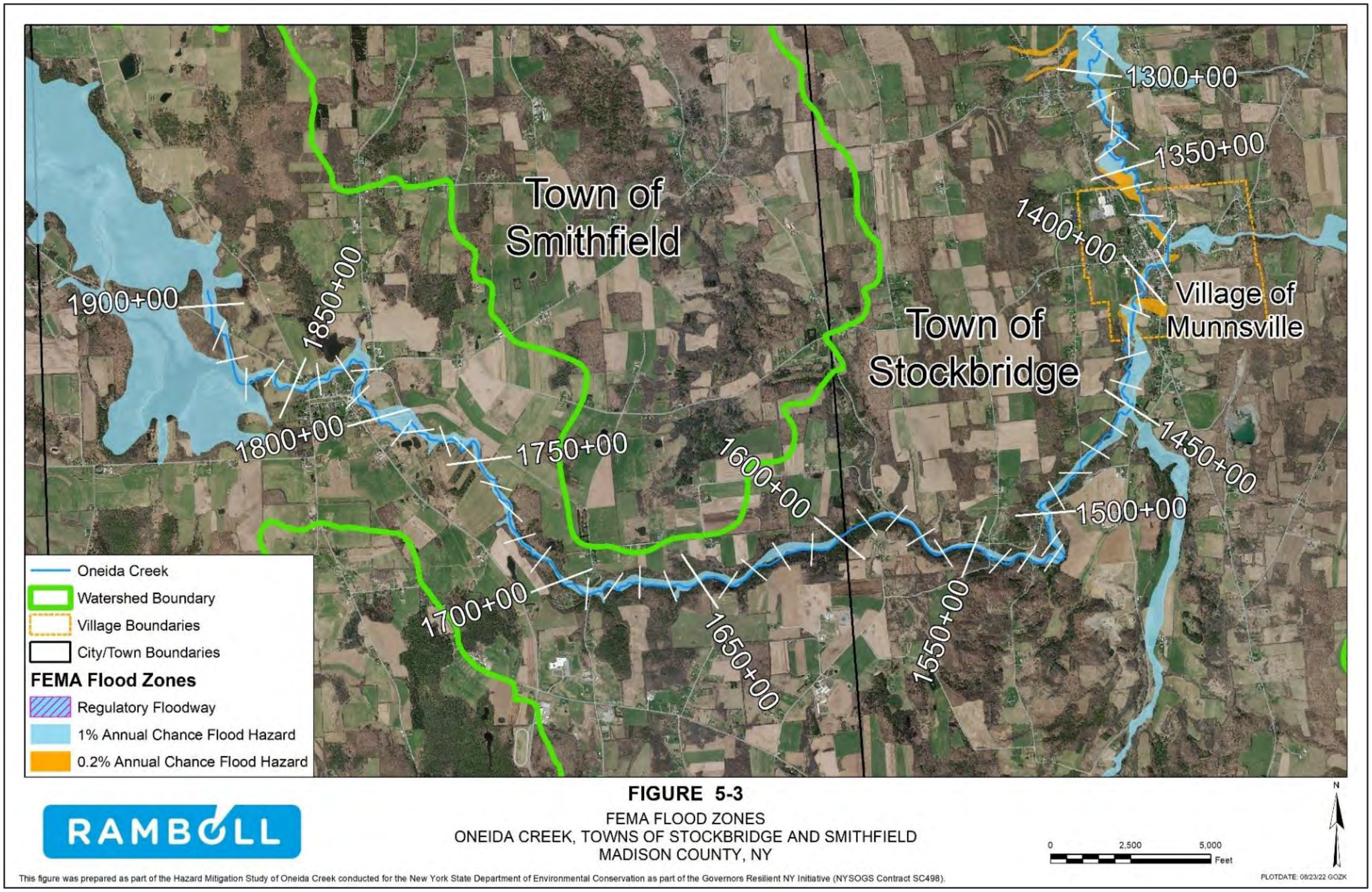

Figure 5-3. Oneida Creek, FEMA flood zones, Towns of Stockbridge and Smithfield, Madison County, NY.

5.2 ICE-JAM FLOODING

An ice jam typically occurs in the late winter and early spring in ice-covered streams when ice accumulates at man-made (e.g., bridge piers, dams) or natural narrower or shallower sections or meanders of a river slowing down or blocking the incoming ice by bridging the ice across the width of the river (USACE 2006).

As the air temperature drops, the water temperature reaches freezing temperatures and starts to form frazil ice crystals in the water column. These ice crystals travel in the water column (suspended ice) with the river currents, growing in concentration, and losing heat while traveling. They float on the surface (surface ice), and as the crystals grow in size, they form surface frazil ice. As the air temperature continues to drop, temperature losses from the water and frazil ice create more surface ice, and thicken the existing surface frazil ice, increasing the surface ice concentrations on the river as it approaches colder winter temperatures. The presence of surface and suspended frazil ice increases resistance to the flow, thus increasing the water levels of rivers in the wintertime. Increasing concentrations of surface and suspended frazil ice increase the potential for ice jam formation, which can inhibit the flow of water in the channel, affecting both upstream and downstream water levels (USACE 2006).

An existing ice jam can break-up and travel downstream along with larger ice particles with the higher flows of a flash flood and accumulate at a constricted downstream location creating another break-up ice jam, or damage downstream riverbanks or downstream infrastructures severely. Ice-jam flooding presents a complex problem for scientists and engineers since the resulting flood stage can be significantly higher than the flood stage caused from streamflow alone. In other words, a relatively minor discharge of streamflow can result in a major flooding event during an ice jam (USACE 2006).

According to the USACE Cold Regions Research and Engineering Laboratory (CRREL) ice jam database, National Centers for Environmental Information (NCEI) storm events database, and the stakeholder engagement meeting, there have been at least six ice-jam flooding events along Oneida Creek since 1950 (CRREL 2022; NCEI 2022; NYSDEC 2022b).

On January 22, 1959, the USGS reported that the gage on Oneida Creek near the City of Oneida measured a maximum annual gage height of 14.30 feet, affected by backwater from ice, which was the maximum gage height for the period 1949-1963 (CRREL 2022).

Based on the historical ice-jam records and stakeholder input, the area along Oneida Creek with the highest potential for ice-jam formation is in the City of Oneida upstream of the Old Erie Canal. The study area for this report focused on the Towns of Stockbridge and Verona, City of Oneida and the Villages of Munnsville and Oneida Castle, and includes an analysis of the effects each flood mitigation measure would have on the aforementioned ice-jam prone area. This area is vulnerable to ice-jam flooding due to a combination of infrastructure, development, and channel characteristics of Oneida Creek.

In order to determine the most appropriate mitigation measures to address ice-jam flooding along Oneida Creek, additional hydraulic and hydrologic modeling using ice simulation models and ice-jam specific mitigation measures, as outlined in Appendix E, are recommended for each ice-jam prone area.

6. FLOOD RISK ASSESSMENT

6.1 FLOOD MITIGATION ANALYSIS

For this study of Oneida Creek, standard hydrologic and hydraulic study methods were used to determine and evaluate flood hazard data. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-yr period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-yr floods, have a 10-, 2-, 1-, and 0.2% chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this study (FEMA 2001b).

Hydraulic analysis of Oneida Creek was conducted using the HEC-RAS v6.2.0 program (USACE 2021). The HEC-RAS computer program was written by the USACE Hydrologic Engineering Center (HEC) and is considered to be the industry standard for riverine flood analysis. The 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 2016b).

Hydraulic and Hydrologic modeling of Oneida Creek was completed by FEMA between 1983 and 2001 in Madison County and 1983 to 1999 in Oneida County. Due to the age and format of the FIS studies, an updated 1-D HEC-RAS model was developed using the following data and software:

- Madison County, New York 1-meter LiDAR DEM data with vertical accuracy of 0.143-meters (5.6 inches) in the North American Vertical Datum of 1988 (NAVD88) (NYSOITS 2015)
- Oneida County, New York 2-meter LiDAR DEM with vertical accuracy of 0.185-meters (7.3 inches) in the North American Vertical Datum of 1988 (NAVD88) (NYSOITS 2008)
- New York State Digital Ortho-Imagery Program imagery (NYSOITS 2017)
- National Land Cover Database (NLCD) data (USGS 2021a)
- RAS Mapper extension in HEC-RAS software (USACE 2021)
- NYSDOT bridge and culvert data (NYSDOT 2019b; NYSDOT 2019b)
- NYSDEC dam data (NYSDEC 2021c)

Two hydraulic models were developed for Oneida Creek. The first model begins at the confluence with Oneida Lake (river station 0+00) and extends to the upstream corporate limits of the City of Oneida (river station 1095+00), and the second model begins at the downstream corporate limits of the Village of Munnsville (river station 1355+00) and extends to the upstream corporate limits of the Village (river station 1430+00).

6.1.1 Methodology of HEC-RAS Model Development

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 from the effective FEMA hydraulic model 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;
- LiDAR DEM data, and NLCD 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 two different methods: Normal Depth and the FEMA FIS stillwater elevations.

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 2022). For this model, the slope for the 300-ft immediately upstream of the 1% ACE backwater from Oneida Lake zone in the Oneida County FIS profile plot for Oneida Creek was used and calculated to be 0.0002.

The Oneida Lake stillwater elevations were determined by FEMA in the Town of Sullivan and Onondaga County FIS reports (FEMA 1986c; FEMA 2016). The Town of Sullivan FIS stillwater elevations are reported in the National Geodetic Vertical Datum of 1929 (NGVD29) vertical datum and was converted to the NAVD88 datum using the National Oceanic and Atmospheric Administration (NOAA) Vertical Datum Coordinate Conversion Program (VERTCON) version 3.0 (NOAA 2019). The conversion factor used for Oneida Creek was -0.627 ft. Table 15 displays the Oneida Lake stillwater elevations from the Town of Sullivan and Onondaga County FIS reports.

Table 16. Oneida Lake Stillwater Elevations

(Source: FEMA 1986c; FEMA 2016)				
	Stillwater Elevation (ft NAVD88)			
FIS Report	10-Percent	2-Percent	1-Percent	0.2-Percent
Town of Sullivan	371.2	372.2	372.6	373.6
Onondaga County	372.1	372.9	373.3	374.0

For existing conditions modeling, the Oneida Lake stillwater elevations were used as the downstream boundary condition. For future conditions modeling, the Normal Depth method was used as the downstream boundary due to the lack of reliable data for future Oneida Lake water elevations.

The existing condition model water surface elevation results were then compared to the FEMA FIS water surface profiles, 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 flood mitigation strategies. The simulation results of the proposed conditions were evaluated based on their reduction in water surface elevations.

The effectiveness of each potential mitigation strategy was evaluated based on reduction in water surface elevations within the H&H model simulations. The flood mitigation strategies that were modeled were:

- 1-1: Flood Benches Upstream of Oneida Creek/Old Erie Canal Aqueduct
- 1-2: Remove Oneida Street Bridge
- 1-3: Increase the Opening of the Bennett Road Bridge
- 1-4: Flood Benches in Vicinity of the Oneida Sewage Treatment Plant
- 1-5: Levee Along the Oneida Sewage Treatment Plant
- 1-6: Increase the Opening of the Sconondoa Road Bridge
- 1-7: Increase the Opening of the Prospect Street Bridge
- 1-8: Flood Benches Between Access Road and Prospect Street
- 1-9: Flood Benches Between Prospect Street and NY-5/Genesee Street
- 1-11: Remove Abandoned Railroad Bridge
- 1-12: Increase the Opening of the NY-5/Genesee Street Bridge
- 1-13: Flood Benches Upstream of NY-5/Genesee Street
- 1-14: Increase the Opening of the Middle Road Bridge
- 2-2: Levee Along Sherrill Wastewater Treatment Plant
- 2-3: Flood Benches in Vicinity of Sherrill Wastewater Treatment Plant
- 2-4: Increase the Opening of the Sherrill Road/CR-51 Kenwood Avenue

- 2-5: Flood Benches Between Sherrill Road/CR-51 Kenwood Avenue and CR-51 Kenwood Avenue/CR-25 Hamilton Street
- 2-6: Increase the Opening of the CR-51 Kenwood Avenue/CR-25 Hamilton Street Bridge
- 3-1: Increase the Opening of the Valley Mills Road Bridge
- 3-2: Levee Between Valley Mills Road and NY-46/Main Street
- 3-3: Flood Benches Upstream of NY-46/Main Street
- 3-4: Remove Dam Upstream of NY-46/Main Street

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 flood 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. Inundation shown on figures in Section 7 Mitigation Alternatives is based on the computed 1-dimensional (1-D) water surface elevations statically imposed over a 2-dimensional (2-D) ground surface by the built-in RAS Mapper extension in the HEC-RAS v6.0 software. The software horizontally distributes the computed WSEL over the cross-section and any ground elevation below the computed WSEL is inundated up to the computed WSEL. As a result, areas that are not hydrologically connected to the floodplain (i.e., overbank areas) may appear inundated.

Note that stationing references for Oneida Creek for Sections 1 through 6 of this report are based on the USGS National Hydrography Dataset (NHD) for Oneida Creek (USGS 2021b); 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.

6.1.2 1-D Model Limitations

For this study, a 1-D HECRAS model was developed to model the existing conditions and effectiveness of the proposed mitigation alternatives. USACE usually recommends choosing between 1-D and 2-D modeling on a case-by-case basis, but in general there are certain cases where 1-D models can produce results as good as 2-D models with less effort. Those cases include (USACE 2016a):

- Rivers and floodplains in which the dominant flow directions and forces follow the general river flow path.
- Steep streams that are highly gravity driven and have small overbank areas.
- River systems that contain a lot of bridges/culvert crossings, weirs, dams and other gated structures, levees, pump stations, etc. (these structures impact the computed stages and flows within the river system).

- Medium to large river systems, where there is modeling of a large portion of the system (100 or more miles), and it is necessary to run longer time period forecasts (i.e., 2-week to 6-month forecasts).
- Areas in which the basic data does not support the potential gain of using a 2-D model (USACE 2016a).

Based on the topographic and geomorphic features of the Oneida Creek watershed and the recommendations of the USACE for 1-D versus 2-D modeling, the project team concluded the best model for this study was 1-D. However, after developing the 1-D model for Oneida Creek, the project team did determine certain limitations in the 1-D model that should be noted. These limitations include:

- Potential overflow areas, which are areas where WSELs exceed the adjacent terrain geometry, were found in a number of locations along Oneida Creek. These areas were the confluences with Mud, Taylor, Sconondoa, and Black Creeks, Brandy Brook, and Oneida Lake, Sunset Lake, and the Kanon Valley Country Club. The overflow areas were primarily caused by inflow areas from large tributaries or outflow areas into other watersheds or large bodies of water.
- The accuracy of a 1-D model in determining WSELs in the overbank areas outside of the main channel diminishes the further away from the main channel the user defines as an overbank area. Portions of the Oneida Creek watershed, including the areas upstream of the confluence with Oneida Lake and Black Creek, have wide and relatively flat floodplains, which led to relatively wide and distant overbank areas in the 1-D model. A more appropriate analysis of overbank areas would require lateral 2-D storage areas in the overbank parallel to the main channel; however, this type of analysis is outside of the scope of this study.
- In general, LiDAR does not capture channel thalweg due to interference and scattering by water of the LiDAR signal. As a result, no bathematic modifications were done to the existing model to correct for this limitation. However, for this study, some of the flood mitigation strategies that were modeled incorporated modifications to the main channel or in the immediate overbank areas.

The 1-D model results for the existing conditions along Oneida Creek were compared to both the FEMA FIRM and FIS profile plots and were found to be in agreement with both. Therefore, the results from the proposed flood mitigation alternatives model simulations for this study can be accepted with a high degree of confidence.

6.2 DEBRIS ANALYSIS

According to historical flood reports, stakeholder engagement meetings, and field work, the portions of Oneida Creek upstream of the Aqueduct and NY-46 (N Main Street)/NY-316 (Lake Road), in the vicinity of NY-5/Genesee Street, and upstream of Valley Mills Road were identified as areas susceptible to debris and log jams on the upstream face of infrastructure crossing the creek (NYSDEC 2022b).

The Aqueduct for the Old Erie Canal/Pools Brook is a potential catchpoint for logs and debris due to the design of the structure: a large central pier and closed concrete support wall above the aqueducts gate openings.

The NY-5 bridge crossing is susceptible to log and debris jams due to the fact that the bridge has a low hydraulic capacity and cannot successfully pass the 2-, 1-, or 0.2% ACE flood events. In addition, the large, forested area upstream of the NY-5 bridge contributes woody debris to Oneida Creek.

The Valley Mills Road bridge crossing is susceptible to log and debris jams due to the large, forested area upstream of the bridge and steep channel slope of Oneida Creek in the upstream reaches through the Village of Munnsville. In addition, the FEMA FIS profile plot indicates significant backwater upstream of the bridge, which suggests that water velocities are reduced approaching the bridge and would allow larger woody debris and sediment to drop out of the water column.

The debris analysis in this study used the 10% ACE (10-yr) to develop an existing condition with debris obstruction model simulation using the built-in Floating Pier Debris tool within the HEC-RAS model software (USACE 2021). Manual calibration of the width and height of the debris obstruction in the model was performed to reproduce historical flood levels caused by debris jams at known locations. The calibration determined that a 25% obstruction of the structure’s opening reproduced the historical flood levels.

Using the calibrated debris specifications, the existing condition debris simulation model was used to test the effectiveness of the flood mitigation alternatives that influence flow through Oneida Creek under both present and future conditions.

6.3 ICE JAM ANALYSIS

The ice jam analysis in this study used the 10% ACE (10-yr) to develop an existing condition with ice cover model simulation at each identified ice-jam susceptible location using the built-in Ice Cover settings within the HEC-RAS model software. Where ice cover was modeled in the vicinity of bridges, the Ice Jam Computation Option under the Bridge/Culvert Data editor was changed to the option “ice remains constant through the bridge” in the HEC-RAS model software (USACE 2021).

Based on historical ice jam data, ice cover lengths and depths were obtained and input into the model. Manual calibration of the length and depth of the ice cover in the model was performed to reproduce historical flood levels caused by ice-jam events at known locations. For the City of Oneida, the calibration determined that an ice cover of approximately 1-ft deep by 1,000-ft long followed by an additional ice cover of approximately 0.5-ft deep by 500 to 1,000-ft long upstream of an identified structure’s opening reproduced the historical flood levels. For the Village of Munnsville, the calibration determined that an ice cover of approximately 1-ft deep between Valley Mills Rd and NY-46 (approximately 650-ft) followed by an additional ice cover of approximately 0.5-ft deep by 1,000-ft long upstream of NY-46 reproduced the historical flood levels.

Using the calibrated ice cover specifications, the existing condition ice-cover simulation model was used to test the effectiveness of the flood mitigation alternatives that influence flow through Oneida Creek under both present and future conditions.

6.4 COST ESTIMATE ANALYSIS

Rough order of magnitude (ROM) cost estimates were prepared for each mitigation alternative. In order to reflect current construction market conditions, a semi-analogous cost estimating procedure was used by considering costs of a recently completed, similar scope construction project performed in Upstate New York. Phase I of the Sauquoit Creek Channel and Floodplain Restoration Project in Whitestown, New York contained many elements similar to those found in the proposed mitigation alternatives.

Where recent construction cost data was not readily available, RSMeans CostWorks 2019 was used to determine accurate and timely information (RSMeans Data Online 2019). Costs were adjusted for inflation and verified against current market conditions and trends.

For mitigation alternatives where increases in bridge sizes were evaluated, bridge size increases were initially analyzed based on 2 feet of freeboard over the base flood elevation for a 1% ACE event. For mitigation alternatives where increases in culvert sizes were evaluated, culvert size increases were initially analyzed based on the NYSDOT highway drainage standards of successfully passing the 2% ACE hazard.

For mitigation alternatives where increases in culvert sizes were evaluated, culvert size increases were initially analyzed based on 2 feet of freeboard over the base flood elevation for a 1% ACE. Once these optimal sizes were determined, further analysis was completed including site constraints and constructability. Due to these additional constraints, often the size necessary to meet the freeboard requirement was not feasible. Cost estimates were performed based on projects determined to be constructible and practical.

Once the optimal bridge/culvert size was determined, further analyses were completed, including site constraints and constructability. Due to these additional constraints, for some mitigation measures the size necessary to meet existing and/or CRRA freeboard requirements were not feasible. Cost estimates were only performed for projects determined to be constructible and practical.

Infrastructure and hydrologic modifications will require permits and applications to New York State, USACE, and/or FEMA, including construction and environmental permits from the state and accreditation, dam construction/removal, levee construction, Letter of Map Revision (LOMR) applications to FEMA, etc. Application and permit costs were not incorporated in the ROM costs estimates.

In addition, no benefit-cost analyses were performed for any mitigation alternative due to the conceptual nature and preliminary designs of these alternatives, which would require further analysis and engineering to determine the appropriate benefit cost ratios.

It should be noted that all ROM cost estimates are calculated at the time of the study. Cost data is based on current cost estimating data and is subject to change based on economic conditions.

6.5 HIGH-RISK AREAS

Based on the FEMA FIS, NCEI storm events database, CRREL ice jam database, historical flood reports, and stakeholder input from engagement meetings, three areas along Oneida Creek were identified as high-risk flood areas: the City of Oneida and Village of Oneida Castle, the Cities of Oneida and Sherrill, and the Village of Munnsville in the Town of Stockbridge.

6.5.1 High-Risk Area #1: City of Oneida and Village of Oneida Castle (Town of Vernon), Oneida & Madison Counties, NY

High-Risk Area #1 is the downstream reach of Oneida Creek from the upstream corporate limits of the Village of Oneida Castle in the Town of Vernon at river station 490+00 downstream to the Old Erie Canal/Pools Brook Aqueduct in the City of Oneida at river station 810+00 (Figure 6-1). Flooding in this area poses a threat to numerous residential, commercial, and public properties, including critical infrastructure in the City.

Oneida Creek flows adjacent to the most heavily developed areas of the City of Oneida along multiple residential and commercial districts. According to the FEMA FIRM and NFHL data, a number of residential and commercial districts are located within the 1% ACE (100-yr) flood zone. In addition, there are numerous structures within the regulatory floodway of Oneida Creek and, as such, are not allowed to build fences or other structures that will obstruct the creek's flow (FEMA 2001a).

According to the FEMA FIS, there are a number of hydraulic structures along Oneida Creek that flow through the City of Oneida that cannot successfully pass the 1% ACE, including NY-5/Genesee Street, Prospect Street, Sconondoa Street, Bennett Road, the CSX Railroad, and Oneida Street. The only hydraulic structures that provide the NYSDOT required 2-ft of freeboard over the 2% ACE (50-yr flood) event and can successfully pass the 1% ACE event are the NY-46/N Main Street, Interstate-90, and the two abandoned railroad bridge crossings (FEMA 2001b). Figure 6-2 is the FEMA FIS profile plot for Oneida Creek between Bennett Road and immediately downstream of Prospect Street depicting the differing hydraulic capacities along Oneida Creek in the City of Oneida (FEMA 2013).

The NYSDOT uses functional classifications to group roads, streets, and highways into classes based on the character of service each road, street, and highway provides by defining the part that any particular road or street should play in serving the flow of trips through a highway network and the type of access it provides to adjacent properties. Of the identified bridge crossings over Oneida Creek within High-Risk Area #1, Sconondoa Street is classified as a Major Collector (Urban), Prospect Street (NY-365A) is classified as a Minor Arterial (Urban), and NY-5/Genesee Street is classified as a Principal Arterial Other (Urban). NY-5/Genesee Street serves as a major center of activity within the City with the highest traffic volume corridors and carries a high proportion of the total urban area travel on a minimum mileage. Prospect Street (NY-365A) interconnects with and augments the urban principal arterial system (e.g., NY-5/Genesee Street) and provides service to trips of moderate length at somewhat lower of travel mobility than principal arterials. Sconondoa Street provides both land access service and traffic circulation within residential neighborhoods, commercial and industrial areas (NYSDOT 2017).

This reach is also susceptible to sediment aggradation and tree and debris buildup from upstream sources, particularly at the NY-5/Genesee Street. Aggradation and tree/debris buildup restrict the channel flow area, which can cause water surfaces to rise and potentially overtop banks or back water upstream of structures and/or meanders.

High-Risk Area #1 contains multiple areas with NYSDEC regulated wetlands. Except in the Adirondack Park, a wetland must be 12.4 acres or larger for protection under the Freshwater Wetlands Act. Smaller wetlands may be protected when the commissioner determines they have unusual local importance. Under the Freshwater Wetlands Act, the NYSDEC regulates activities in freshwater wetlands and in their adjacent areas. The NYSDEC regulates such activities to prevent, or at least to minimize, impairment of wetland functions. Consultation with the NYSDEC is recommended prior to pursuing or starting any project in the vicinity of a regulated wetland.

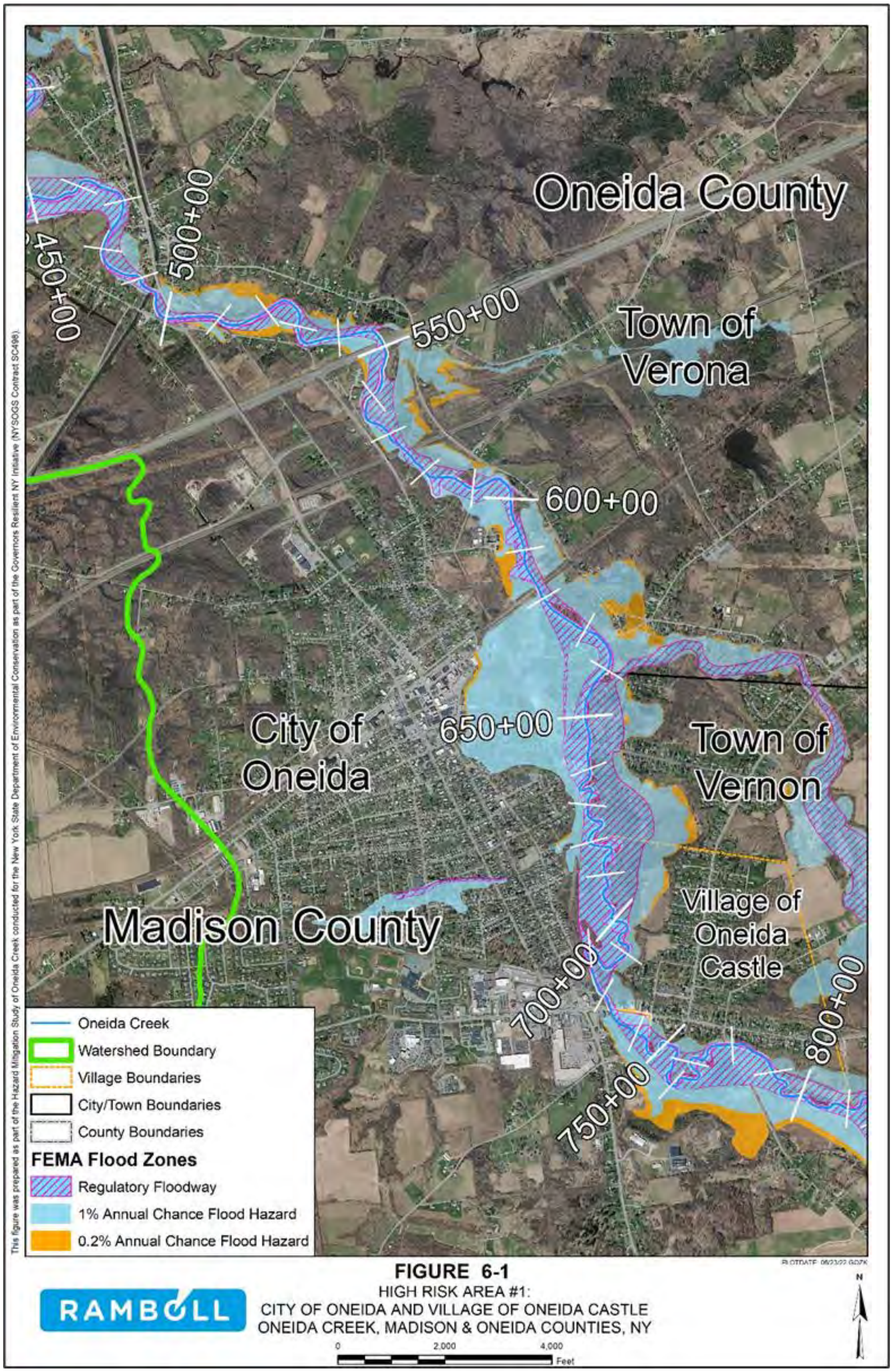

Figure 6-1. High-Risk Area #1: City of Oneida and Village of Oneida Castle (Town of Vernon), Oneida & Madison Counties, NY.

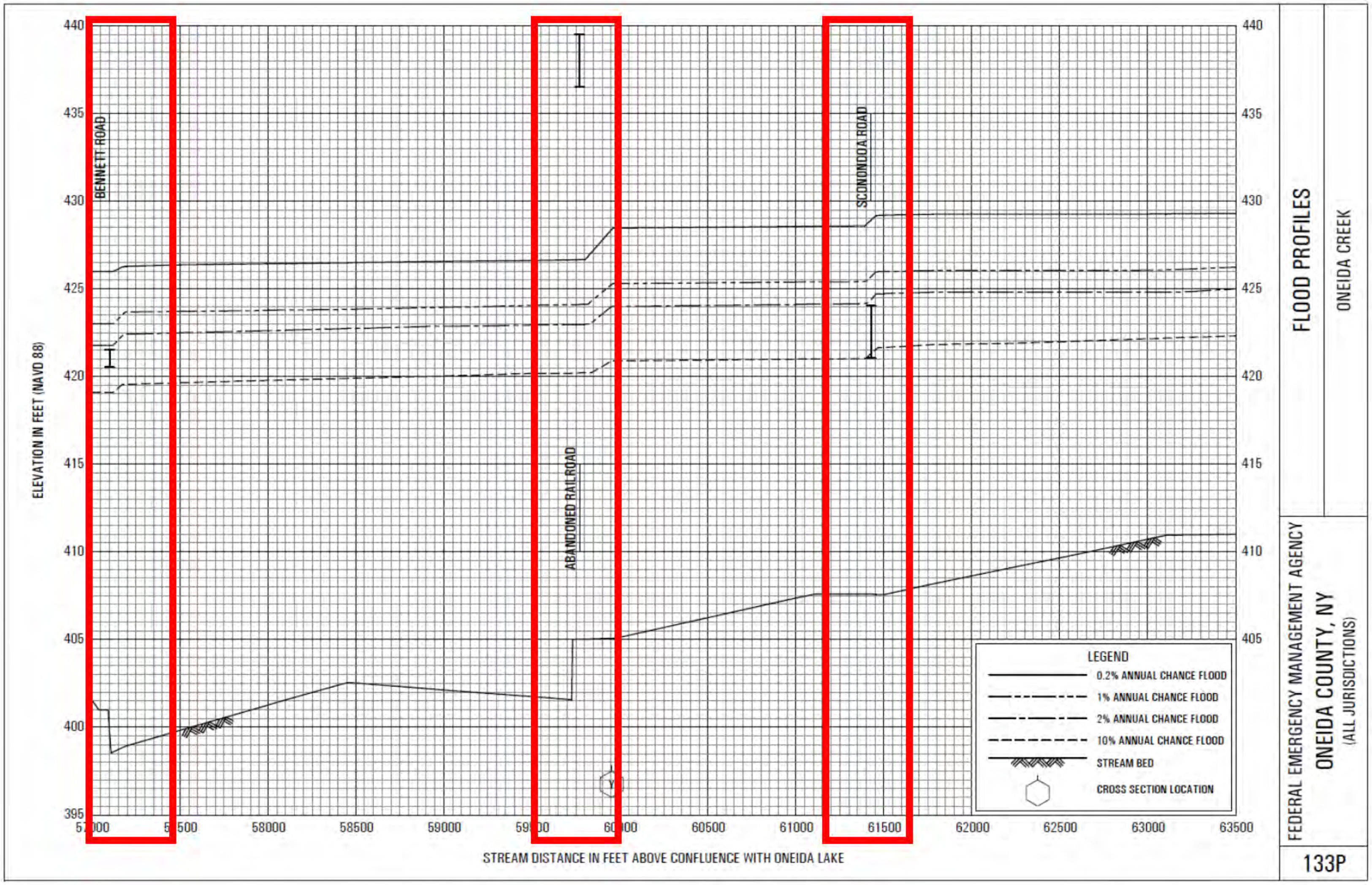

Figure 6-2. FEMA FIS profile for Oneida Creek between Bennett Road and immediately downstream of Prospect Street, Oneida County, NY (FEMA 2013).

6.5.2 High-Risk Area #2: Cities of Oneida and Sherrill (Town of Vernon), Oneida & Madison Counties, NY

High-Risk Area #2 is the area from the downstream corporate limits of the City of Sherrill in the Town of Vernon at river station 820+00 upstream to the upstream corporate limits of the City of Oneida at river station 1075+00 (Figure 6-3). Flooding in this area poses a threat to numerous residential, commercial, and public properties, including critical infrastructure in the City of Sherrill.

Oneida Creek flows adjacent to heavily developed areas of both Cities along multiple residential districts and numerous commercial and historical properties. According to the FEMA FIRM and NFHL data, a number of residential and commercial properties are located within the 1% ACE (100-yr) floodplain, including the Oneida Community Golf Course. In addition, the Sherrill Wastewater Treatment Plant is located directly adjacent to Oneida Creek and its regulatory floodway and is nearly completely surrounded by the 1% and 0.2% ACE flood zones. (FEMA 2001a).

According to the FEMA FIS, there are a number of hydraulic structures along Oneida Creek that flow through High-Risk Area #2 that cannot successfully pass the 1% ACE or provide the NYSDOT required 2-ft of freeboard over the 2% ACE (50-yr flood) event, including the two golf course footbridges and both Kenwood Avenue bridge crossings. The only hydraulic structure that does provide 2-ft of freeboard over the 2% ACE (50-yr flood) event and can successfully pass the 1% ACE event is the Pipe Crossing between Kenwood Avenue and the Golf Course (FEMA 2013). Figure 6-4 is the FEMA FIS profile plot for Oneida Creek between the Golf Course and the upstream Kenwood Avenue crossing depicting the differing hydraulic capacities along Oneida Creek in the Cities of Oneida and Sherrill (FEMA 2013).

There are only two bridge crossings over Oneida Creek in High-Risk Area #2: CR-51 Kenwood Avenue and CR-25 Kenwood Avenue. The NYSDOT functional classification for these two bridge crossings is Major Collector (Urban), which provides both land access service and traffic circulation within residential neighborhoods, commercial and industrial areas (NYSDOT 2017).

This reach is also susceptible to sediment aggradation and tree and debris buildup from upstream sources. Aggradation and tree/debris buildup restrict the channel flow area, which can cause water surfaces to rise and potentially overtop banks or back water upstream of structures and/or meanders.

High-Risk Area #2 contains areas with NYSDEC regulated wetlands. Except in the Adirondack Park, a wetland must be 12.4 acres or larger for protection under the Freshwater Wetlands Act. Smaller wetlands may be protected when the commissioner determines they have unusual local importance. Under the Freshwater Wetlands Act, the NYSDEC regulates activities in freshwater wetlands and in their adjacent areas. The NYSDEC regulates such activities to prevent, or at least to minimize, impairment of wetland functions. Consultation with the NYSDEC is recommended prior to pursuing or starting any project in the vicinity of a regulated wetland.

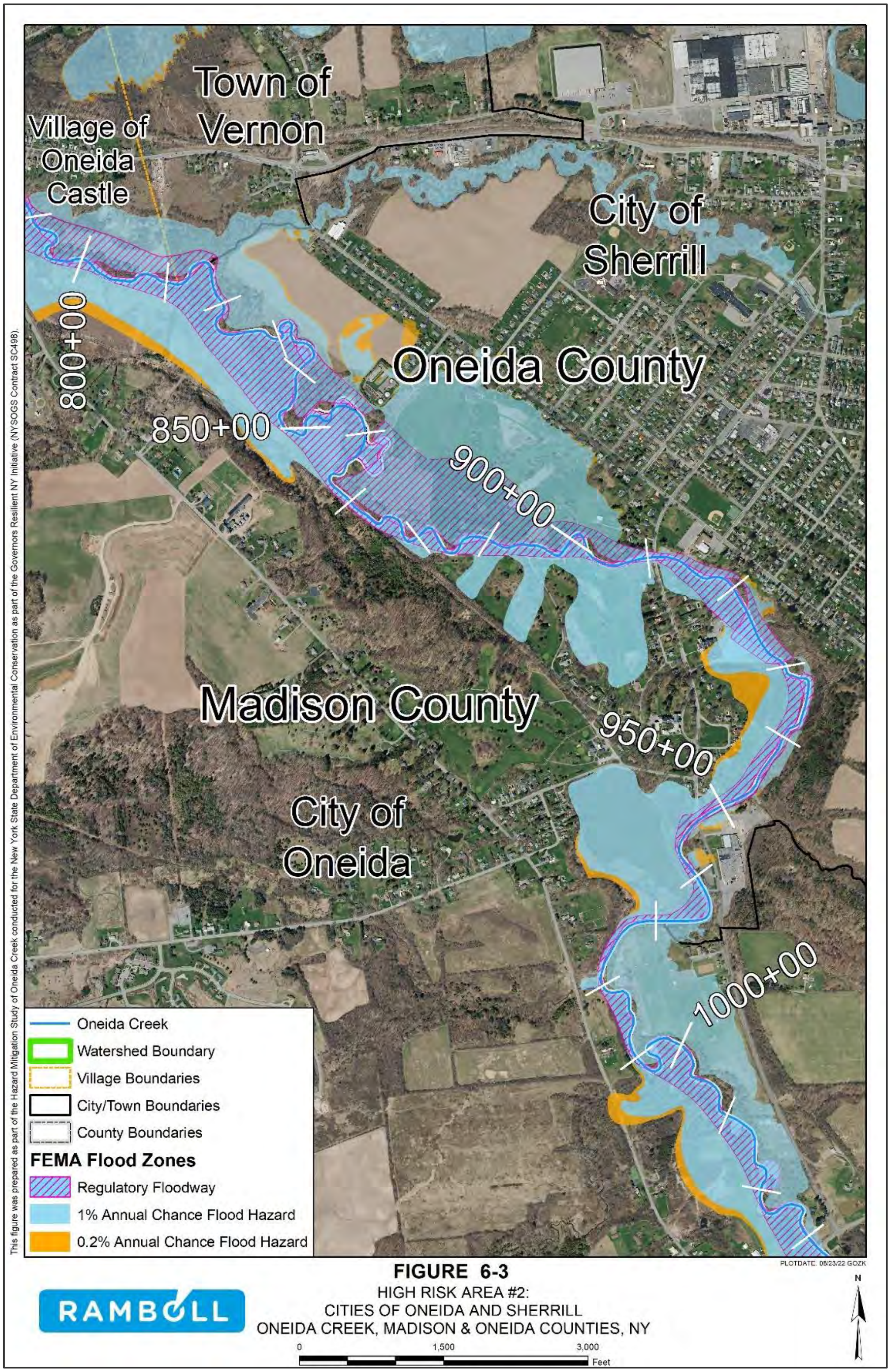

Figure 6-3. High-Risk Area #2: Cities of Oneida and Sherrill (Town of Vernon), Oneida & Madison Counties, NY.

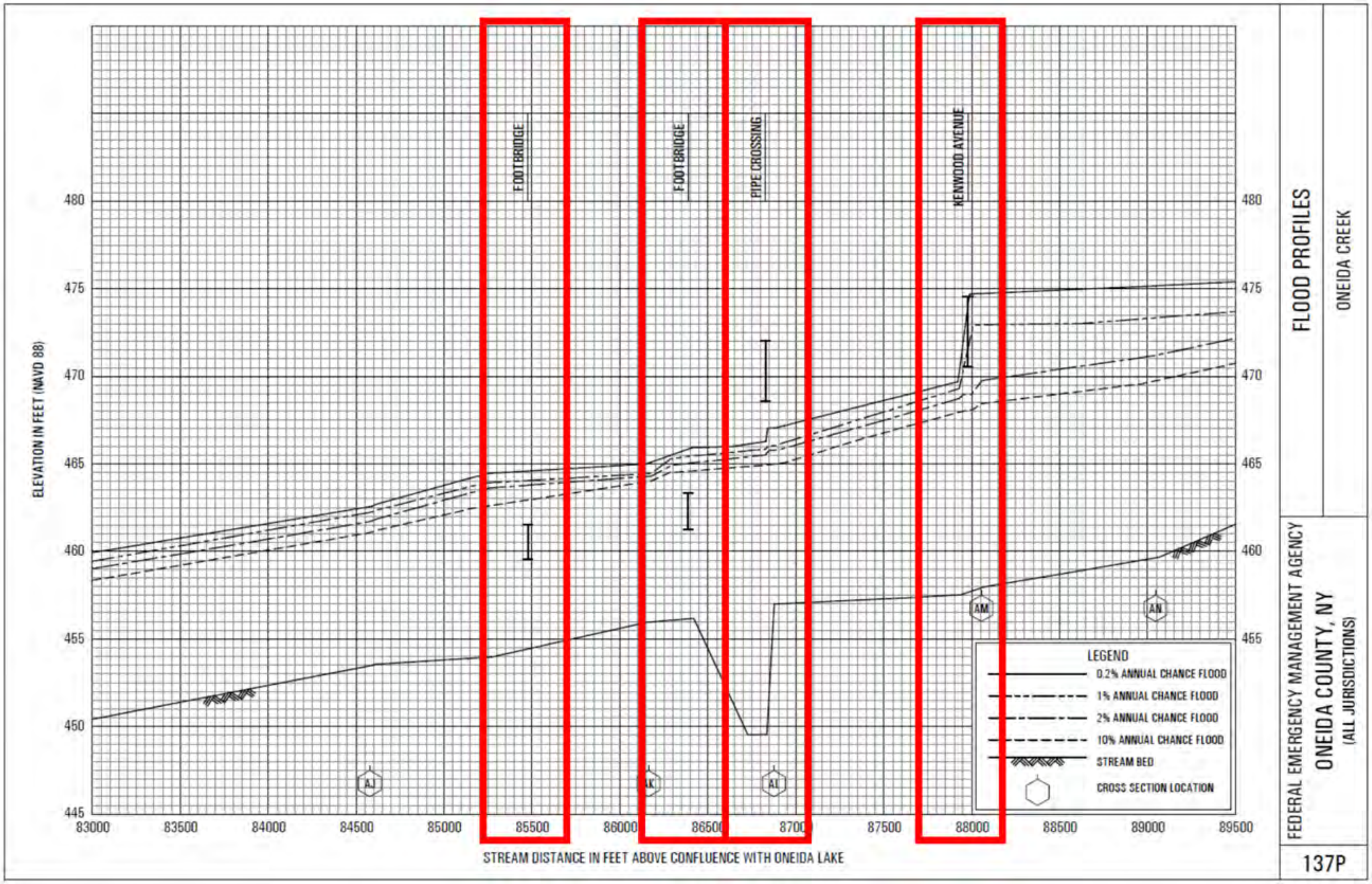

Figure 6-4. FEMA FIS profile for Oneida Creek between the Oneida Community Golf Course and CR-51 Kenwood Avenue, Oneida County, NY (FEMA 2013).

6.5.3 High-Risk Area #3: Village of Munnsville, Madison County, NY

High-Risk Area #3 is the Village of Munnsville in Madison County, NY, specifically the area between upstream of the dam at river station 1420+00 downstream of Valley Mills Road at river station 1370+00 (Figure 6-5). Flooding in this area affects numerous residential and commercial properties, including both public and privately owned areas, which are within the FEMA 1% and 0.2% ACE flood areas. In addition, NY-46/Main Street is an important thoroughfare in the Village where businesses and residences that reside along or adjacent to it depend on the traffic and access.

According to the FEMA FIS and FIRM for the Village of Munnsville, there is significant backwater upstream of the NY-46/Main Street and Valley Mills Road bridge crossings (Figure 6-6). However, according to the FIS profile plots, both bridge crossings do provide the NYSDOT required 2 feet of freeboard over the 2% (50-yr) ACE and can successfully pass the 1% ACE (FEMA 1983a; FEMA 1983b).

According to the NYSDOT Functional Classifications, Valley Mills Road is classified as a Minor Collector (Rural), which has the following characteristics: be spaced at intervals to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector road; provide service to the remaining smaller communities; and link the locally important traffic generators with their rural areas. NY-46/Main Street is classified as a Minor Arterial (Rural), which has the following characteristics: link cities and larger towns (and other traffic generators, such as major resort areas, that are capable of attracting travel over similarly long distances) and form an integrated network providing interstate and intercounty service; be spaced at such intervals so that all developed areas of the state are within a reasonable distance of an arterial highway; and designs that provide for relatively high overall travel speeds, with minimum interference to through movement (NYSDOT 2017).

This reach is also susceptible to sediment aggradation and tree and debris buildup from upstream sources, specifically upstream of Valley Mills Road. Aggradation and tree/debris buildup restrict the channel flow area, which can cause water surfaces to rise and potentially overtop banks or back water upstream of structures and/or meanders.

Oneida Creek within High-Risk Area #3 has a water quality classification of C(T), which indicates the best usage for the creek in this reach is for fishing and that the waters are designated as Trout waters. Under New York State’s Environmental Conservation Law, Title 5 of Article 15, certain waters of the state are protected on the basis of their classification. Streams and small water bodies located in the course of a stream that are designated as C (T) or higher (i.e., C (TS), B, or A) are collectively referred to as "protected streams". A Protection of Waters Permit is required to physically disturb the bed or banks of any stream with a classification standard of C (T) or higher.

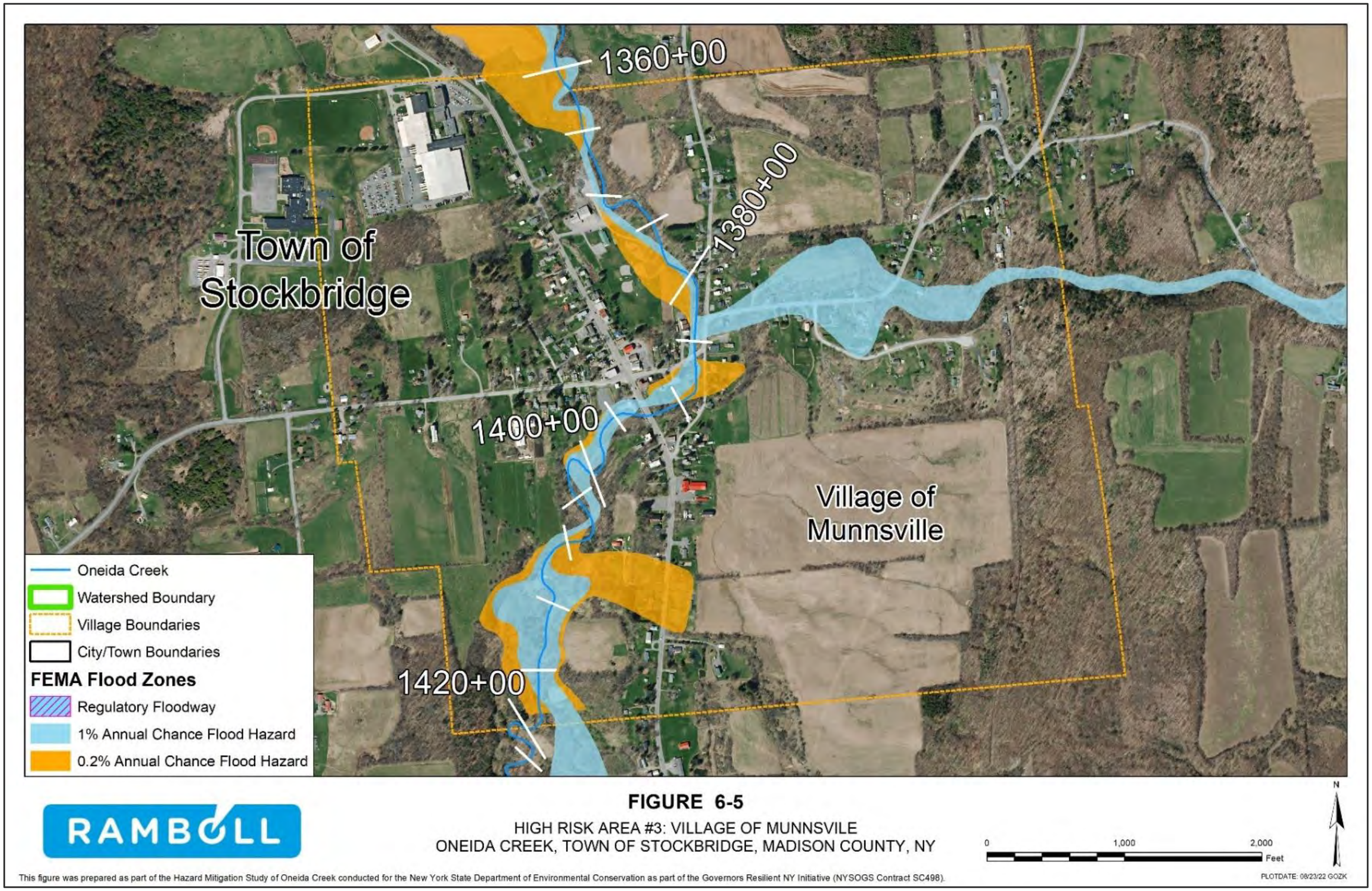

Figure 6-5. High-Risk Area #3: Village of Munnsville (Town of Stockbridge), Madison County, NY.

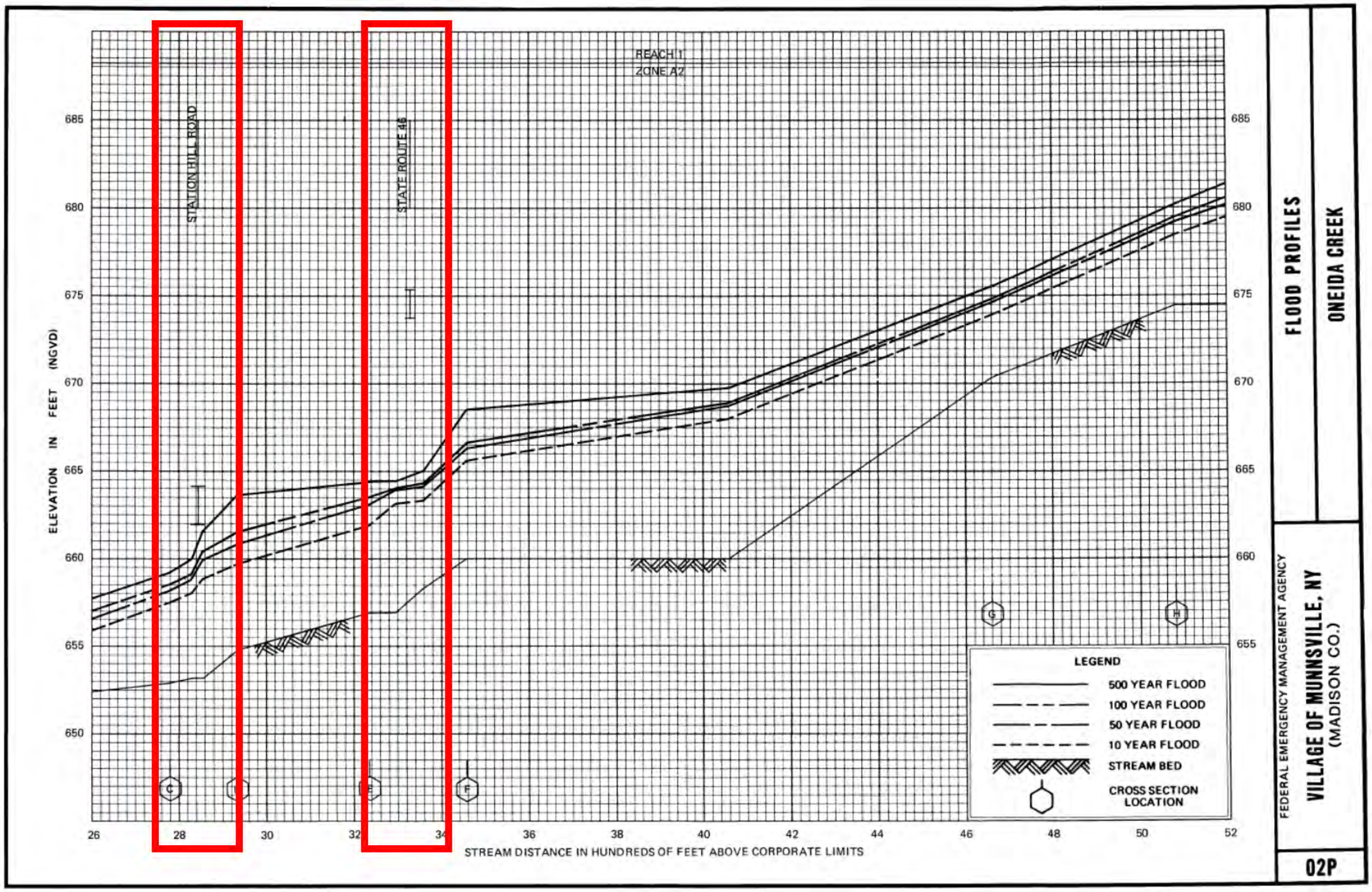

Figure 6-6. FEMA FIS profile for Oneida Creek in the Village of Munnsville (Town of Stockbridge), Madison County, NY (FEMA 1983b).

7. MITIGATION ALTERNATIVES

The following are flood mitigation alternatives that have the potential to reduce water surface elevations along high-risk areas of Oneida Creek. These alternatives could potentially reduce flood-related damages in areas adjacent to the creek.

7.1 HIGH-RISK AREA #1

7.1.1 Alternative #1-1: Flood Benches Upstream of Oneida Creek/Old Erie Canal Aqueduct

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled in the vicinity of the Old Erie Canal Aqueduct and NY-46/N Main Street in the Hamlet of Durhamville (Figure 7-1):

- Flood Bench A is approximately 1.5 acres in size and located between river stations 494+00 to 520+00
- Flood Bench B is approximately 2.5 acres in size and located between river stations 520+00 to 570+50

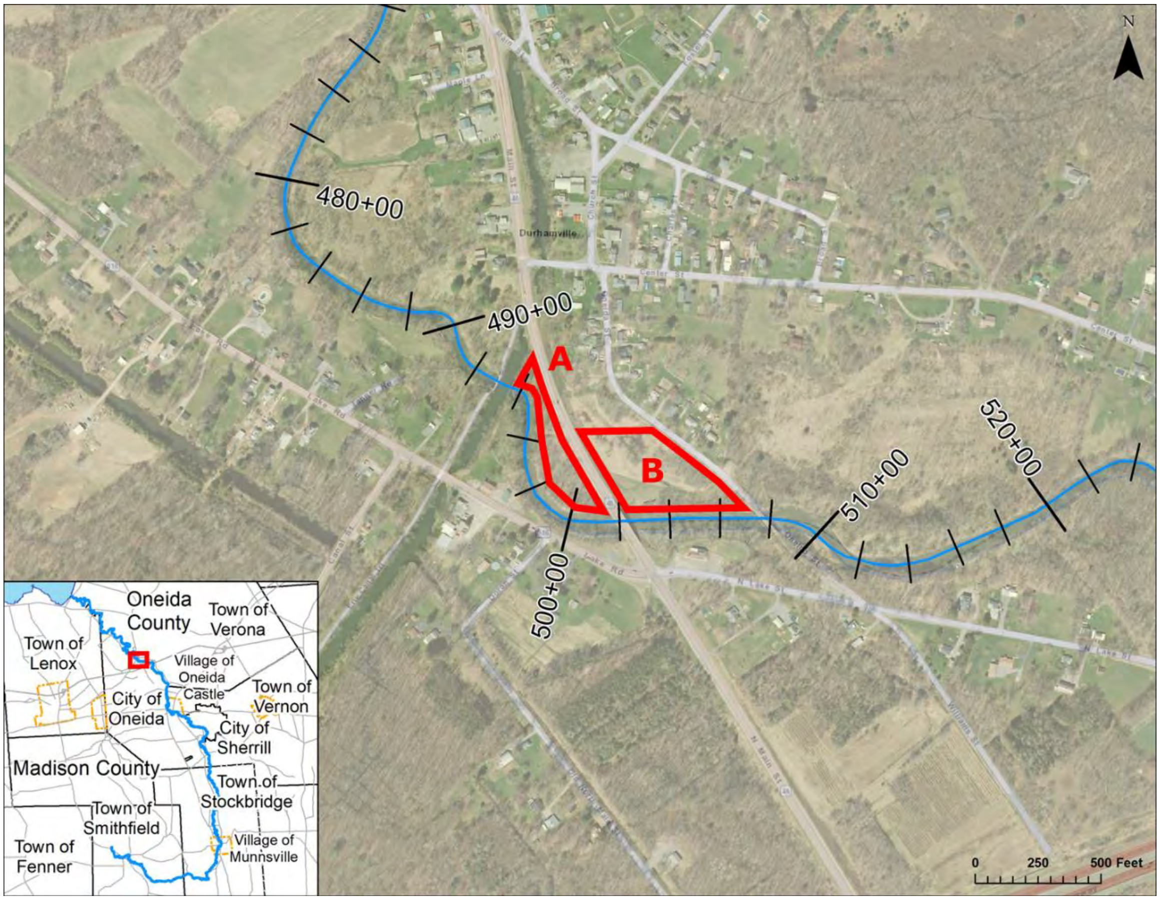

Figure 7-1. Location map for Alternative #1-1.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 4-ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-year flood) as determined in the FIS by detailed methods and where base flood elevations are provided (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

For this alternative, open-water, debris-obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations for both flood benches.

Table 17 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-2 through 7-7 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 17. Summary Table for Alternative #1-1 Existing Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 0.2-ft	No significant change in WSEL
Total Length of Benefited Area	11,550-ft	N/A
River Stations	486+75 to 602+25	N/A
Debris Obstruction	Up to 0.2-ft	No significant change in WSEL
Total Length of Benefited Area	21,025-ft	N/A
River Stations	486+75 to 697+00	N/A
Ice Jam	Up to 0.3-ft	No significant change in WSEL
Total Length of Benefited Area	20,500-ft	N/A
River Stations	483+00 to 688+00	N/A

Table 18 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 18. Summary Table for Alternative #1-1 Future Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Future Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 0.1-ft	No significant change in WSEL
Total Length of Benefited Area	21,025-ft	N/A
River Stations	486+75 to 697+00	N/A
Debris Obstruction	Up to 0.1-ft	No significant change in WSEL
Total Length of Benefited Area	18,175-ft	N/A
River Stations	486+75 to 668+50	N/A
Ice Jam	Up to 0.2-ft	Up to 1.0-ft
Total Length of Benefited Area	21,525-ft	10,625-ft
River Stations	483+00 to 698+25	575+75 to 682+00

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream of the Old Erie Canal Aqueduct would provide minimal flood protection in this reach from open-water and ice-jam flooding. Flood benches upstream of the bridge would provide significant flood protection from debris/log flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $550,000
- Flood Bench B: $1.3 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

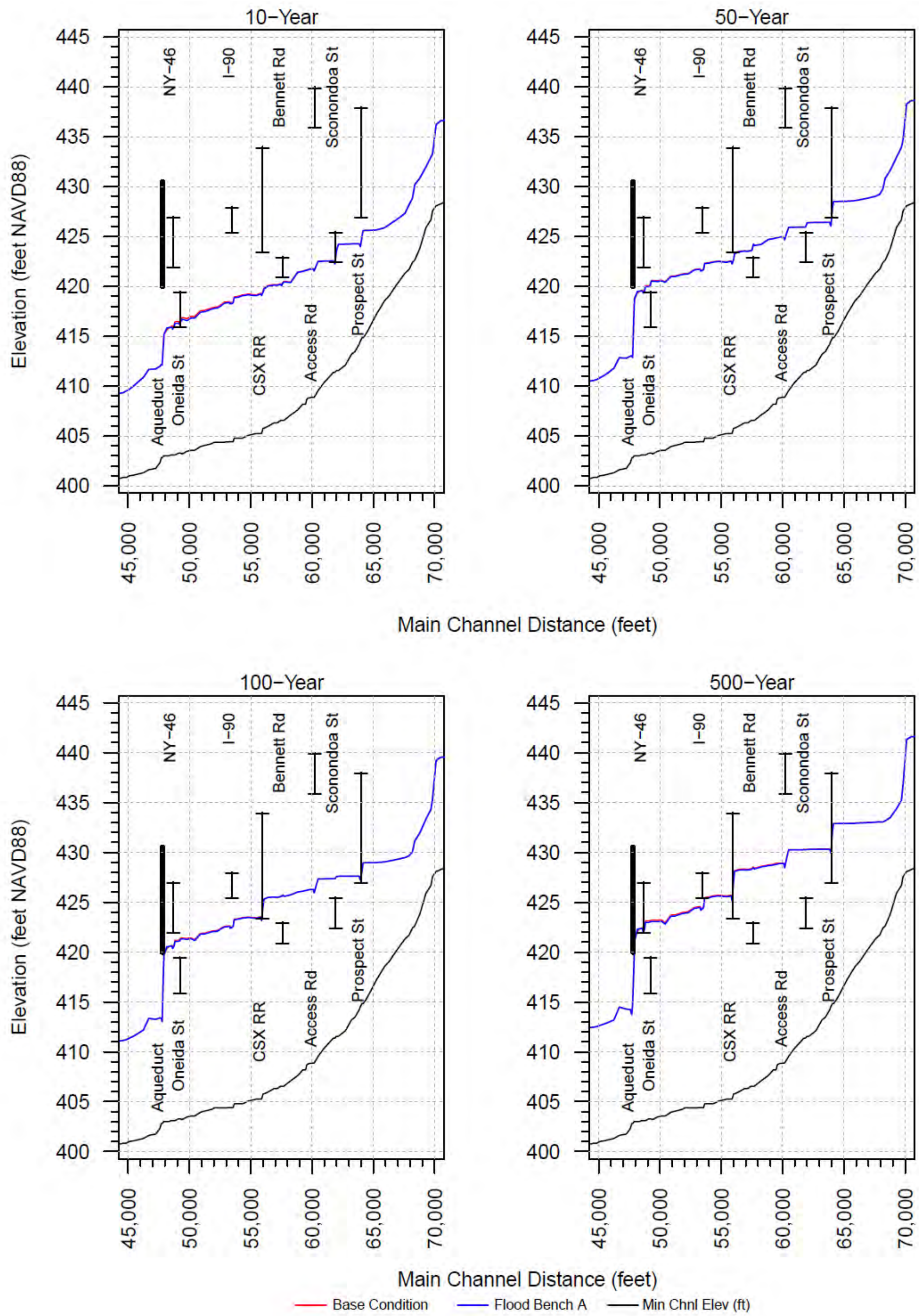

Figure 7-2. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

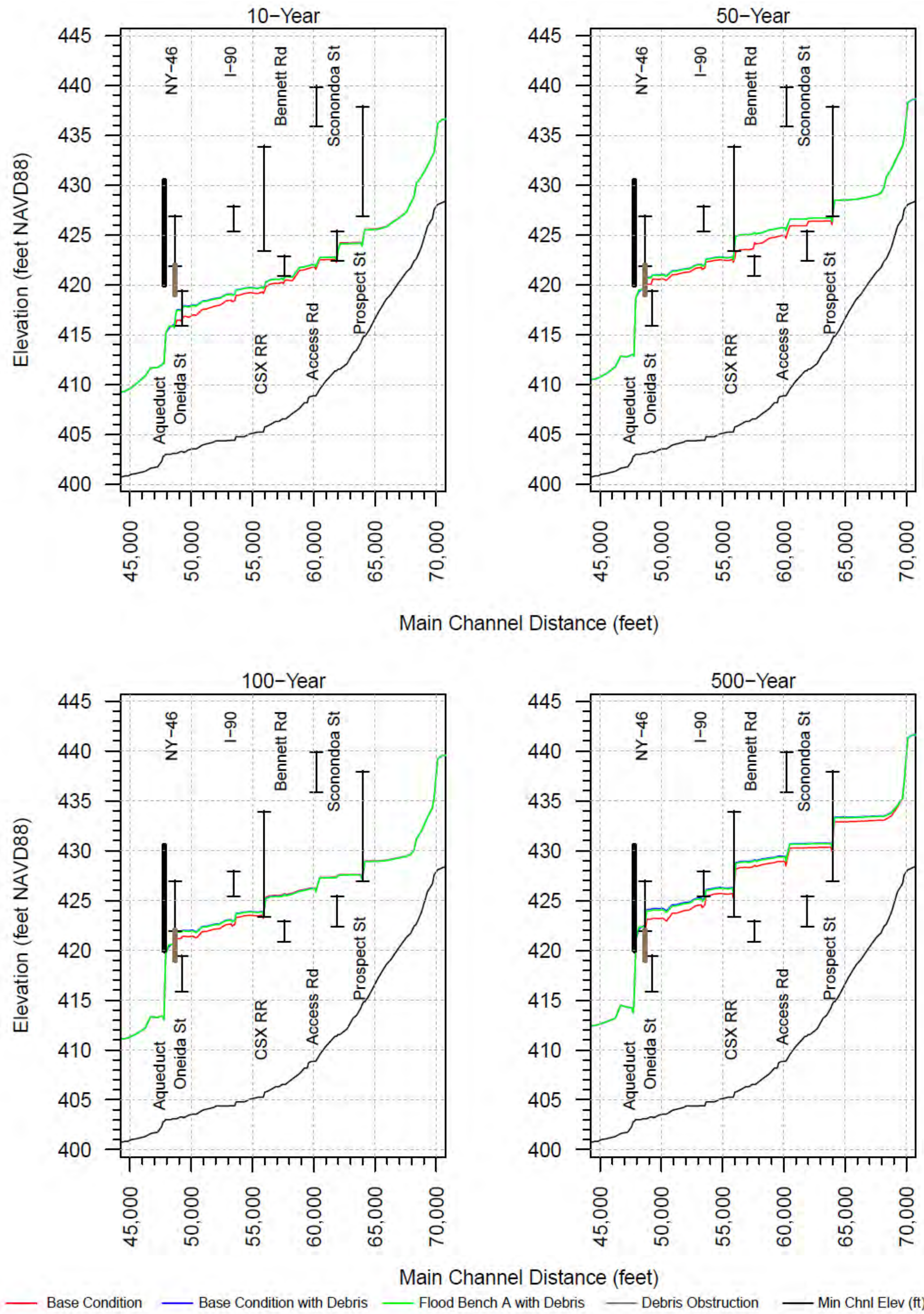

Figure 7-3. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench A for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

*Note: The difference between the existing condition with debris (blue) and flood bench with debris (green) is too small to be visible at this plot scale.

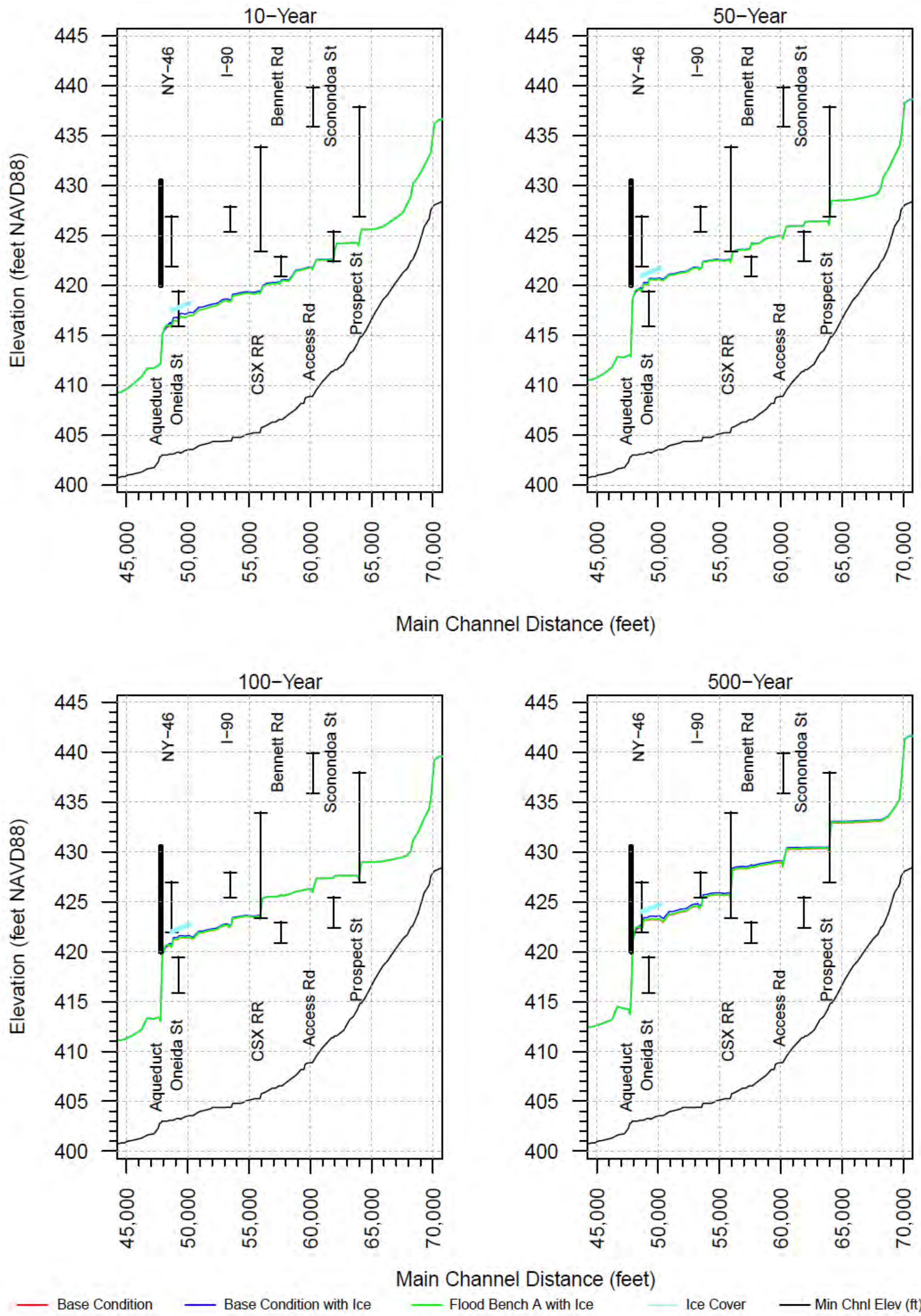

Figure 7-4. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench A for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

*Note: The difference between the existing condition (red), existing condition with ice (blue) and flood bench with debris (green) is too small to be visible at this plot scale.

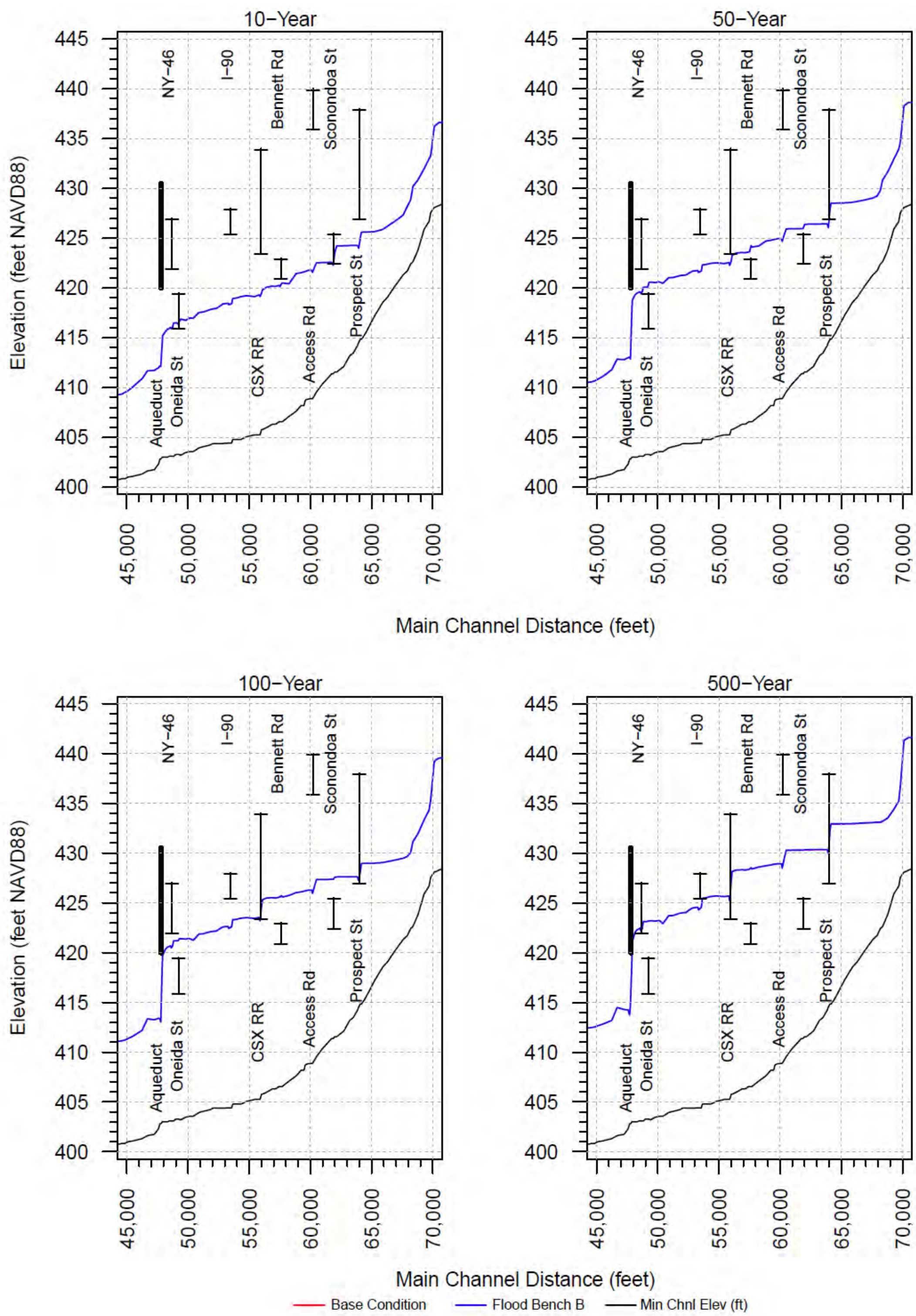

Figure 7-5. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

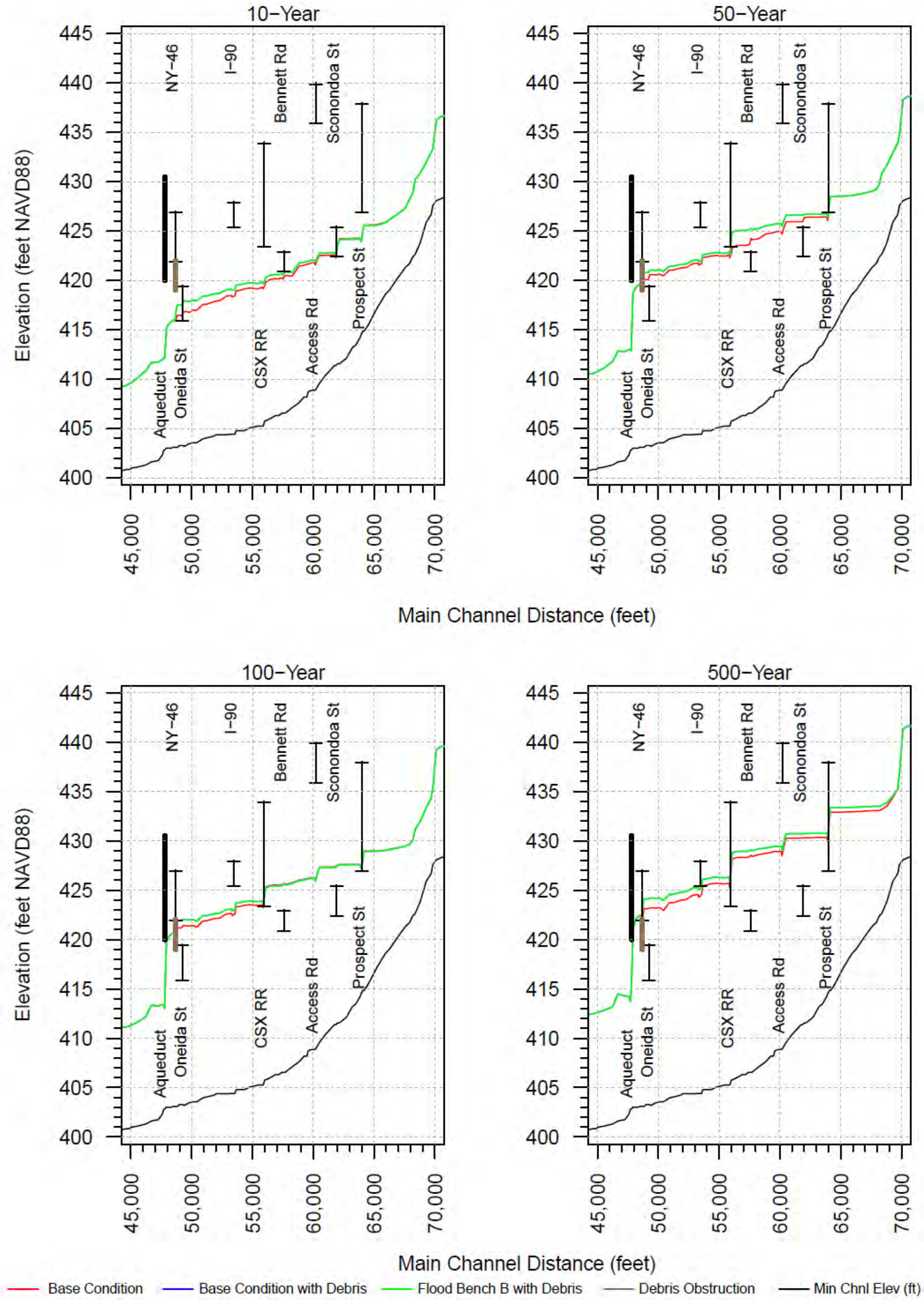

Figure 7-6. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench B for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

*Note: The difference between the existing condition with ice (blue) and flood bench with debris (green) is too small to be visible at this plot scale.

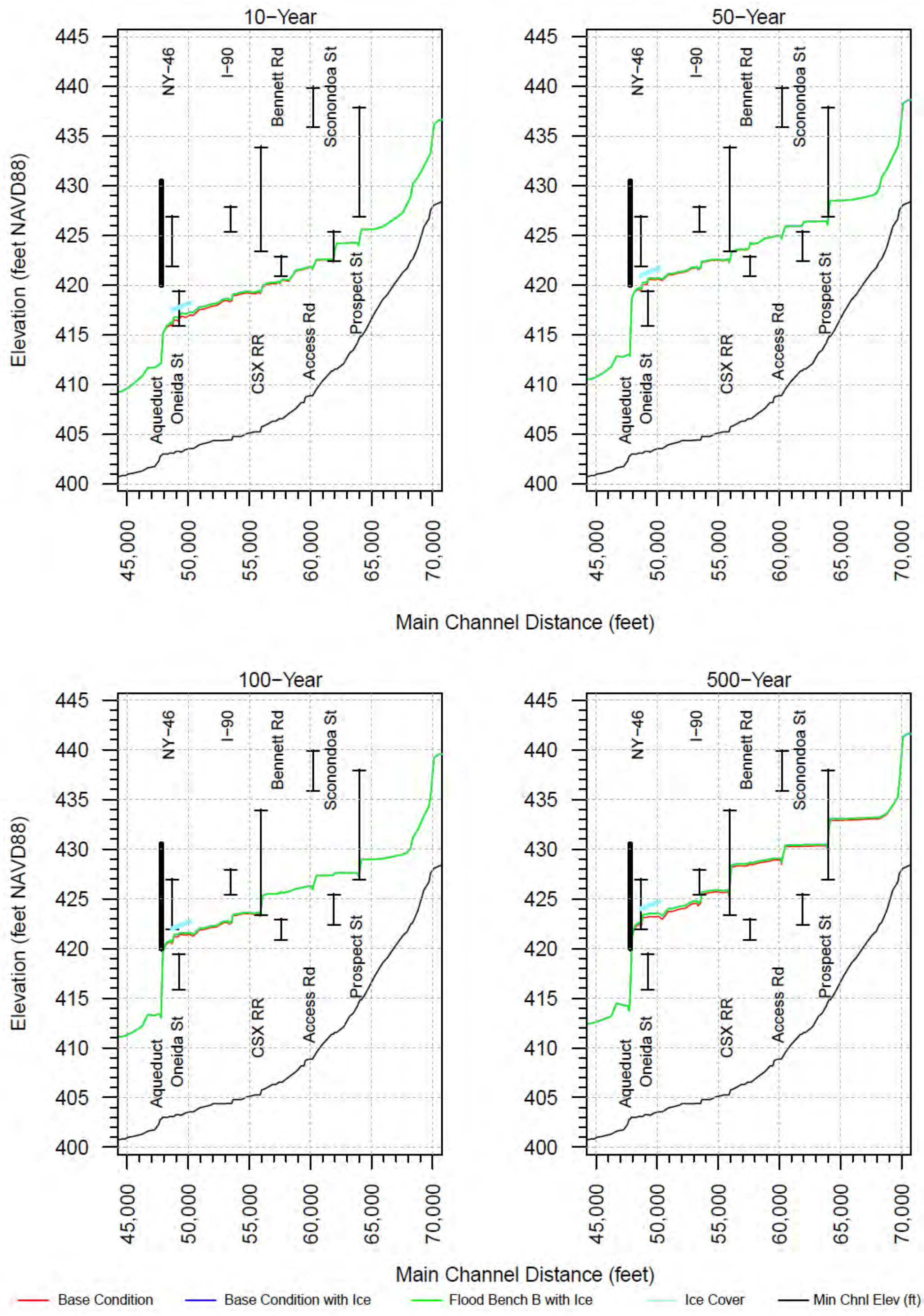

Figure 7-7. HEC-RAS model simulation output results for Alternative #1-1 Flood Bench B for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

*Note: The difference between the existing condition (red), existing condition with ice (blue) and flood bench with debris (green) is too small to be visible at this plot scale.

7.1.2 Alternative #1-2: Remove Oneida Street Bridge

This measure is intended to increase the cross-sectional flow area of the channel and remove any potential impediments or catch points for sediment and debris by removing the Oneida Street bridge (CR-89) located at river station 508+00 (Figure 7-8).

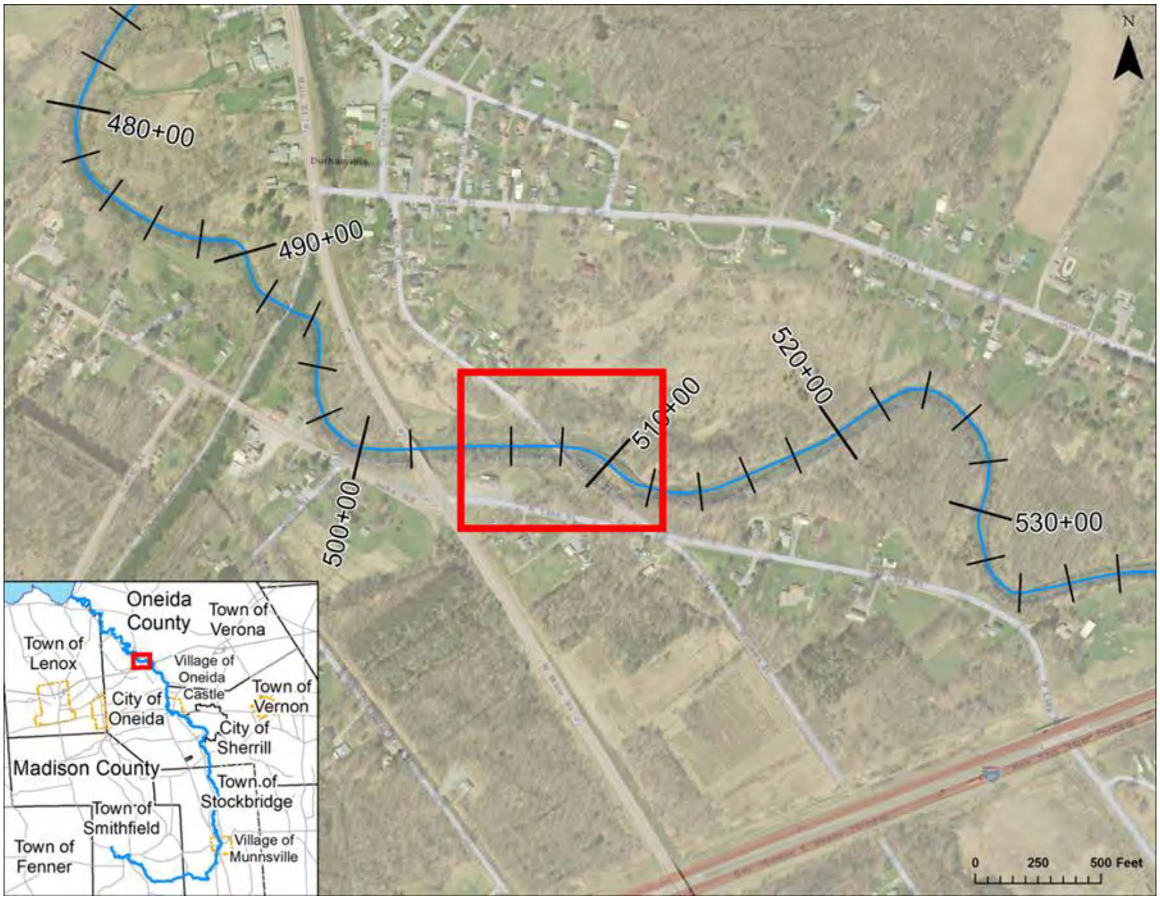

Figure 7-8. Location map for Alternative #1-2.

The bridge is owned by Oneida County and has no pier in the channel. The existing bridge structure has a bridge span of 127 ft and a width of 22 ft (Figure 7-9). The flooding in the vicinity of the Oneida Steet bridge poses a flood-risk threat to nearby residential properties and county and State-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-9. Old State Route 46/Oneida Street bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing coupled with the remnants of a central pier in the channel act as impediments to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

The FEMA FIS profile plot for the Oneida Street bridge indicates the hydraulic capacity of the bridge is insufficient to successfully pass the 10-, 2-, 1-, and 0.2% ACE events (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the NY-46/N Main Street and Oneida Street bridge crossings (FEMA 2001a).

The bridge is no longer in use and sits derelict with 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.

According to historical flood reports, stakeholder engagement meetings, and field work, the Oneida Street bridge was identified as a hydraulic structure that experiences debris blockage and ice jams resulting in backwater flooding during higher peak flow events (NYSDEC 2021b). For this alternative, open-water, debris-obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations.

Table 19 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-10 through 7-12 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 19. Summary Table for Alternative #1-2 Existing Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 0.5-ft
Total Length of Benefited Area	14,775-ft
River Stations	492+250 to 640+00
Debris Obstruction	Up to 0.4-ft
Total Length of Benefited Area	18,975-ft
River Stations	492+25 to 682+00
Ice Jam	Up to 0.4-ft
Total Length of Benefited Area	18,975-ft
River Stations	492+25 to 682+00

Table 20 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 20. Summary Table for Alternative #1-2 Future Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Future Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 0.8-ft
Total Length of Benefited Area	18,975-ft
River Stations	492+25 to 682+00
Debris Obstruction	Up to 0.7-ft
Total Length of Benefited Area	18,975-ft
River Stations	492+25 to 682+00
Ice Jam	Up to 0.8-ft
Total Length of Benefited Area	20,575-ft
River Stations	492+25 to 698+00

The potential benefits of this strategy are limited to immediately upstream of the Oneida Street bridge and for more frequent annual chance events (i.e., 10% ACE/10-year flood). Additional benefits of removing the bridge structure and in-channel pier remnants would be to reduce the potential of debris and ice from catching and creating obstructions/jams upstream of the bridge.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed this alternative independent of any other proposed mitigation alternative. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities (e.g., installing a flood bench and removing the Oneida Street bridge).

The ROM cost for this strategy is approximately $190,000, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if removing the bridge would affect water surface elevations downstream of Oneida Street.

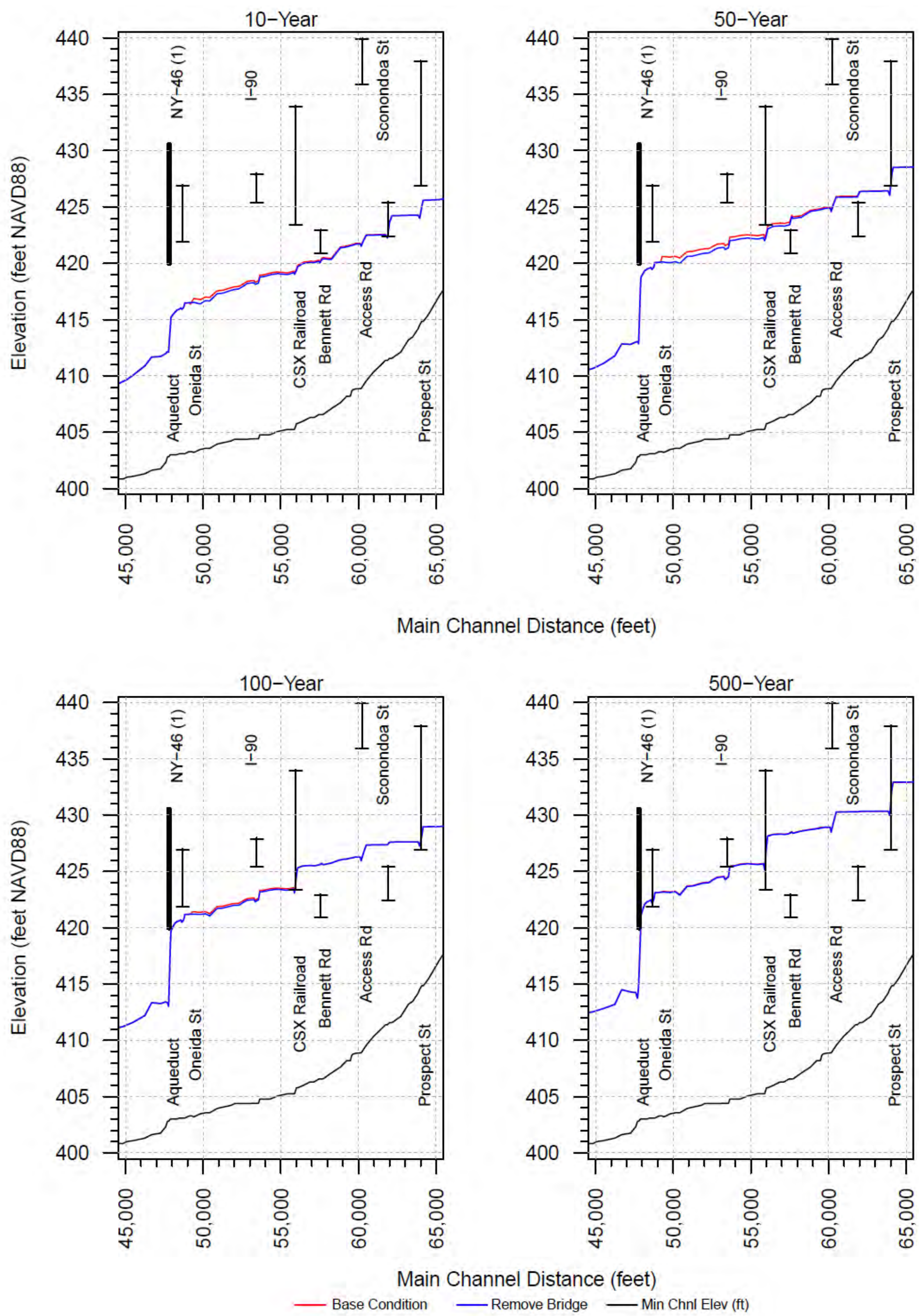

Figure 7-10. HEC-RAS model simulation output results for Alternative #1-2 for the existing condition (red) and proposed alternative (blue) scenarios.

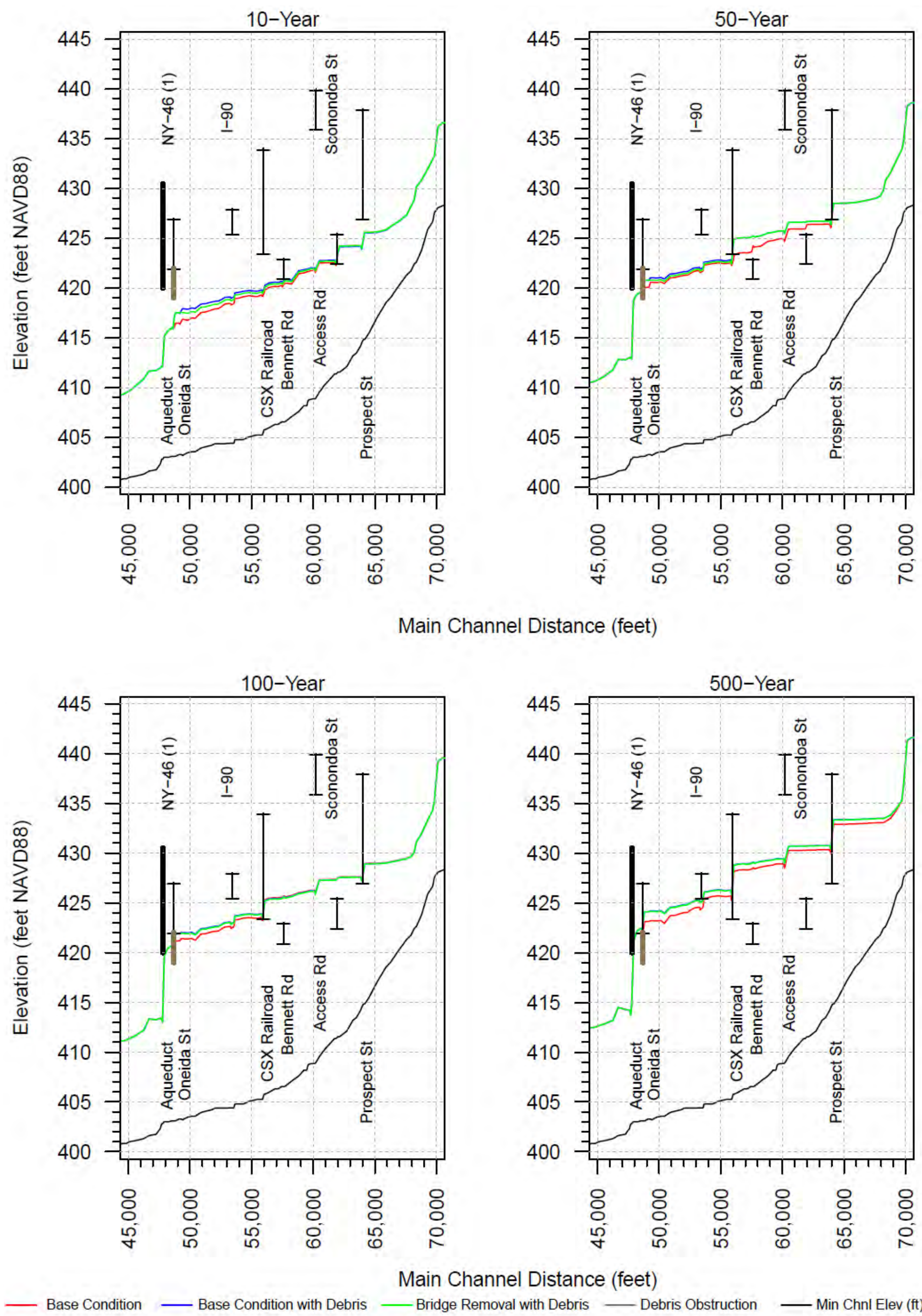

Figure 7-11. HEC-RAS model simulation output results for Alternative #1-2 for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

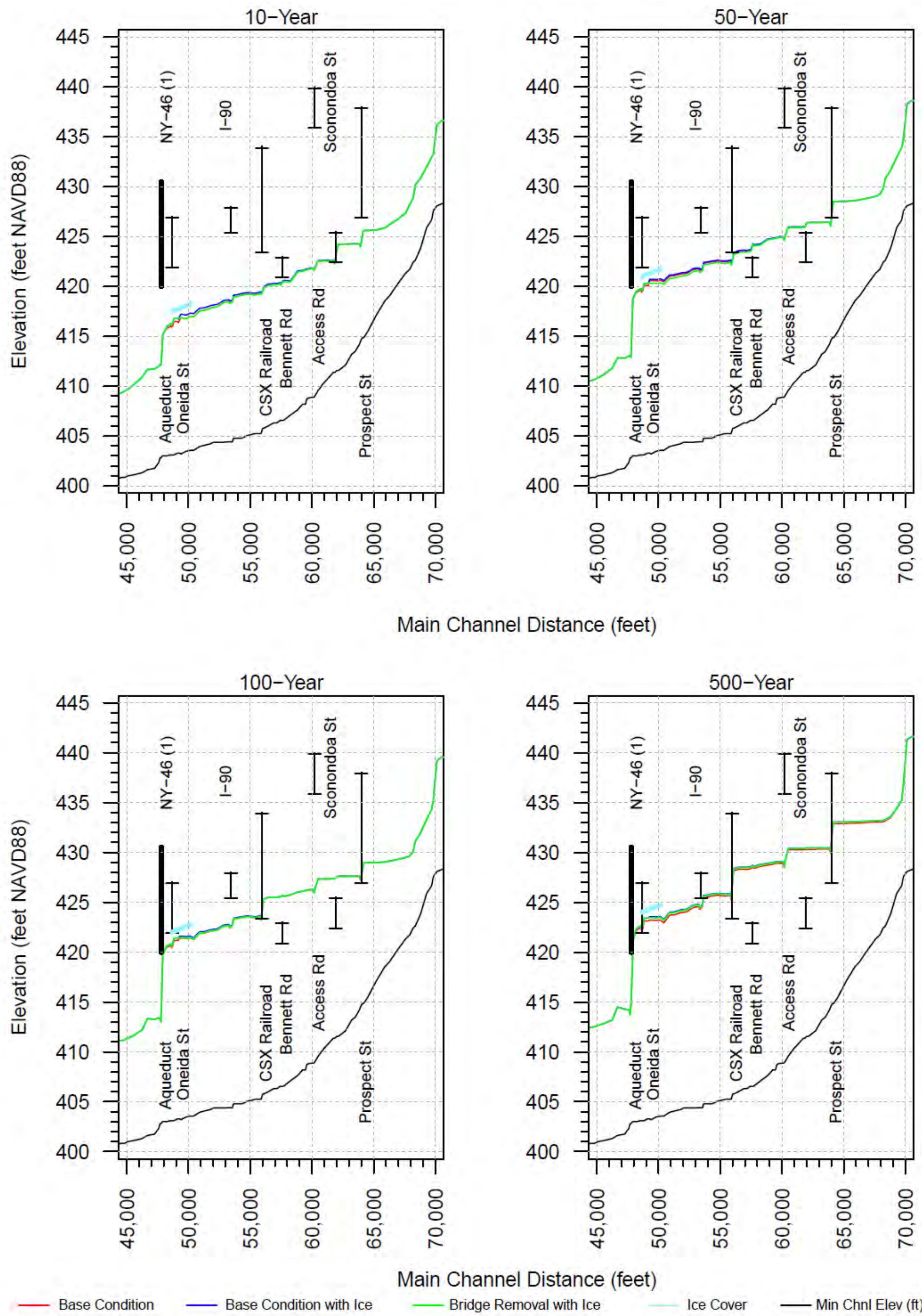

Figure 7-12. HEC-RAS model simulation output results for Alternative #1-2 for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

7.1.3 Alternative #1-3: Increase the Opening of the Bennett Road Bridge

This measure is intended to address issues within High-Risk Area #1 by increasing the width of the Bennett Road bridge opening, which would increase the cross-sectional flow area of the channel located at river station 590+50 (Figure 7-13).

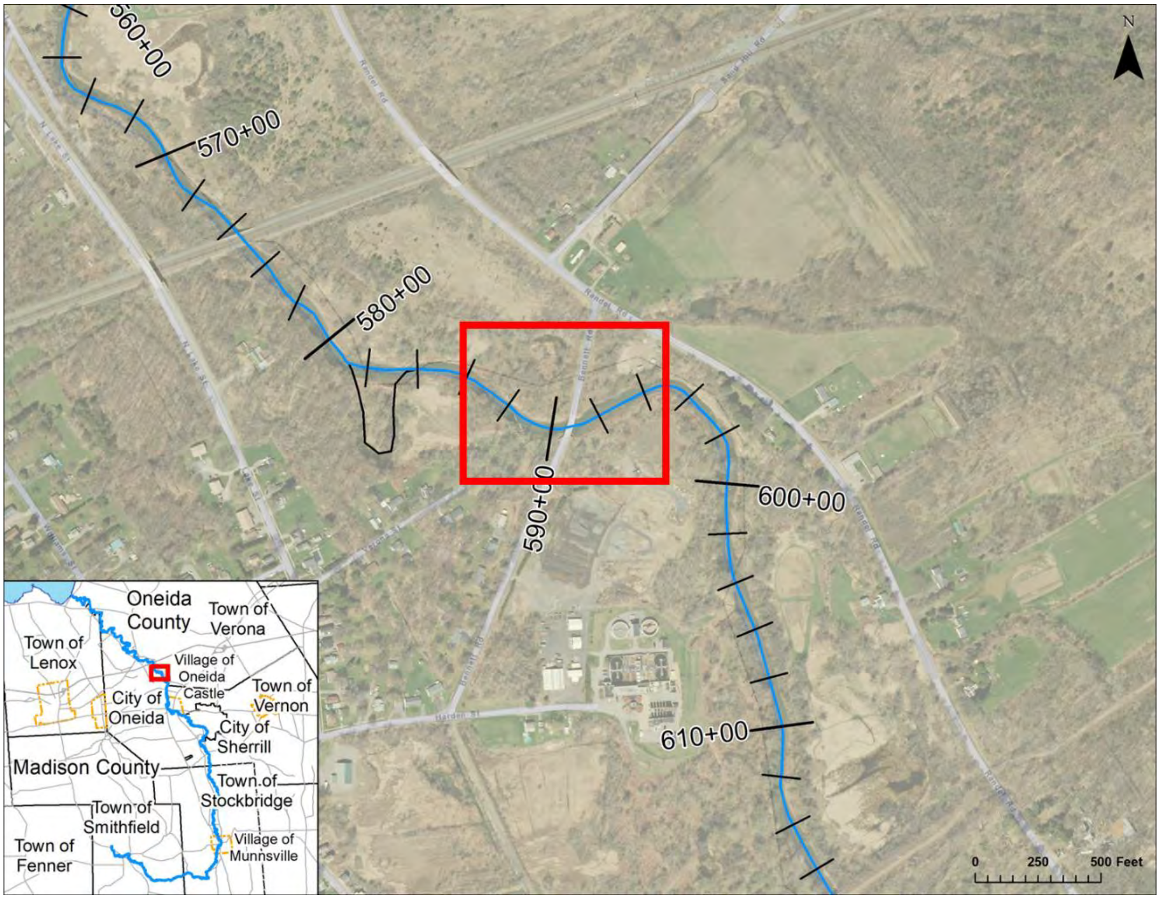

Figure 7-13. Location map for Alternative #1-3.

The bridge is owned by Madison County and has no pier in the channel. The existing bridge structure has a bridge span of 92 ft and a width of 22 ft (Figure 7-14). The flooding in the vicinity of the Bennett Road bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-14. Bennett Road bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

As previously displayed in Figure 6-2, the FEMA FIS for the Bennett Road bridge is unable to successfully pass the 2-, 1-, or 0.2% ACE without significant backwater upstream the of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Bennett Road bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 30-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the Bennett Road bridge successfully passing the 1% ACE. The results displayed for this proposed alternative are based on widening the bridge opening by 15 ft on each bank for a total widening of 30 ft for a total bridge span of 122 ft.

The proposed condition modeling confirmed that the Bennett Road bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 0.3 ft in areas approximately 6,425 ft immediately upstream of the bridge extending up to the Sconondoa Street bridge crossing, specifically along river stations 575+75 to 640+00 (Figure 7-15). The modeling output for future conditions displayed similar results with water surface reductions of up to 0.5 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy extend a significant distance upstream of the Bennett Road bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.6 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 122 ft, cost approximately $2.6 million, and reduce water surface elevations by 0.3 ft immediately upstream of the bridge.

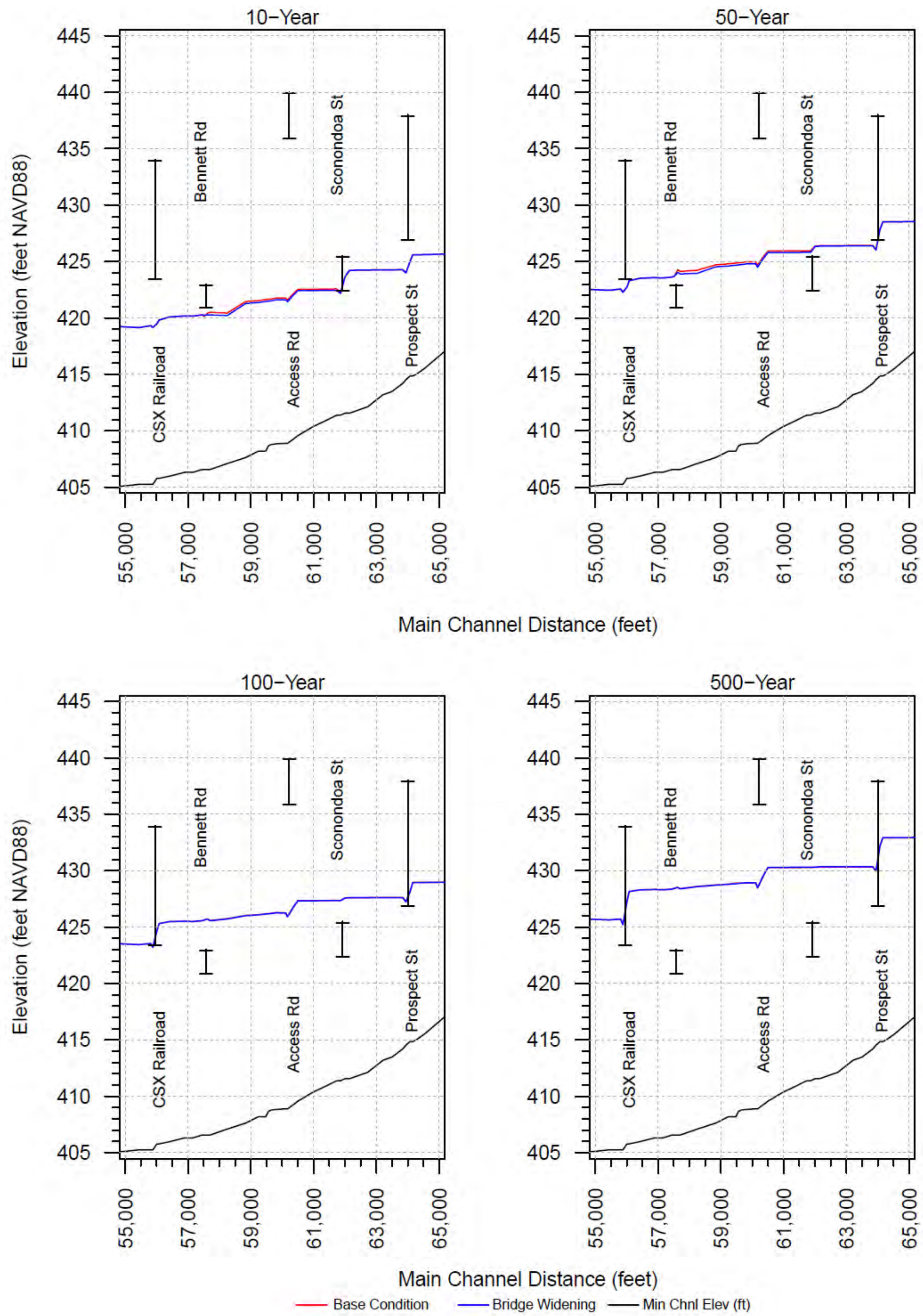

Figure 7-15. HEC-RAS model simulation output results for Alternative #1-3 for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.4 Alternative #1-4: Flood Benches Upstream/Downstream of Lake Road/NY-31

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled in the vicinity of the Oneida Sewage Treatment Plant in the City of Oneida, NY (Figure 7-16):

- Flood Bench A is approximately 8.0 acres in size and located between river stations 607+00 to 617+00
- Flood Bench B is approximately 7.5 acres in size and located between river stations 610+50 to 617+00

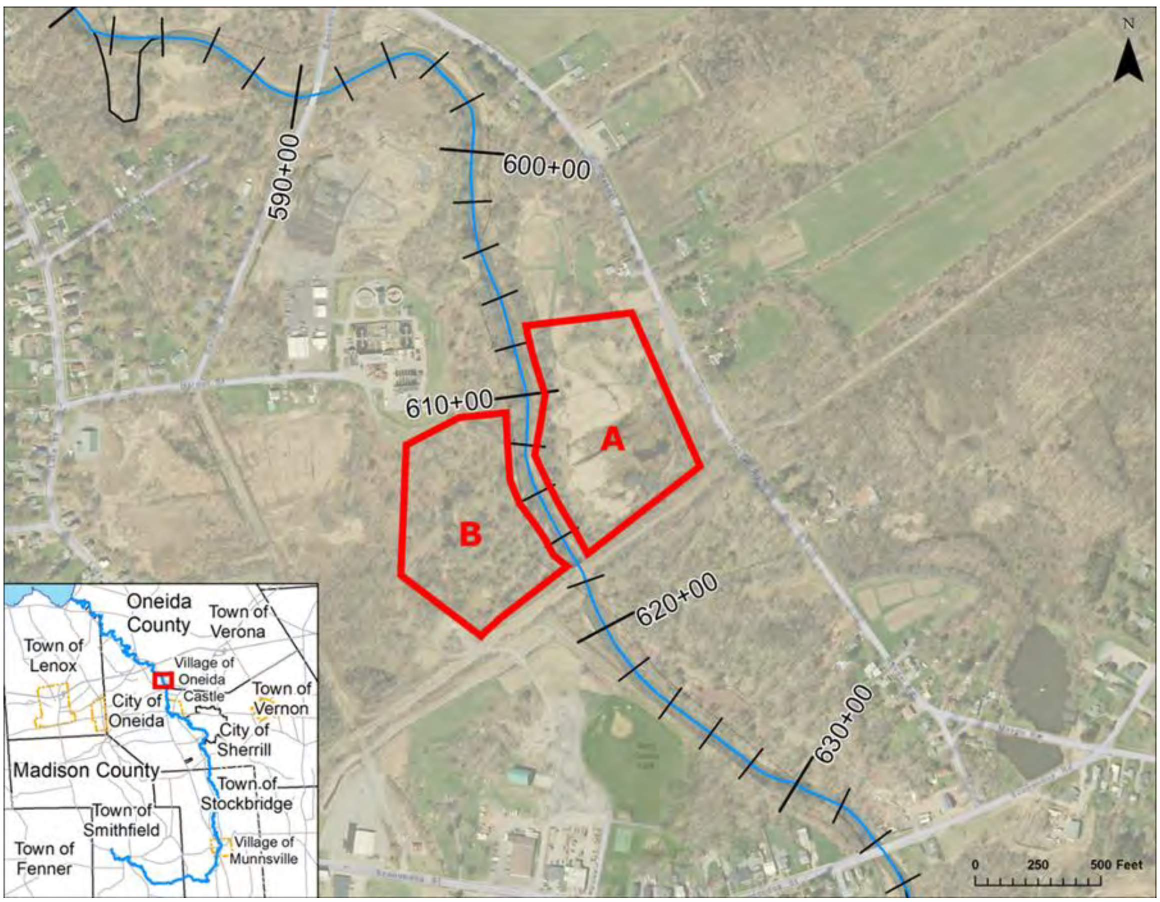

Figure 7-16. Location map for Alternative #1-4.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 4-ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where BFEs are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 21 outlines the results of the proposed present and future conditions model simulations for open-water flooding only. Figures 7-17 and 7-18 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 21. Summary Table for Alternative #1-4 Existing Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 0.1-ft	Up to 0.1-ft
Total Length of Benefited Area	4,350-ft	8,550-ft
River Stations	596+50 to 640+00	596+50 to 682+00
Future Proposed Conditions		
Open-Water	Up to 0.1-ft	Up to 0.1-ft
Total Length of Benefited Area	8,550-ft	8,550-ft
River Stations	596+50 to 682+00	596+50 to 682+00

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream of the Oneida Sewage Treatment Plant would provide minimal flood protection in this reach from open-water flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction (e.g., a bridge widening and flood bench scenario or multiple flood benches along a single reach). For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

This alternative contains areas with NYSDEC regulated wetlands. Under the Freshwater Wetlands Act, the NYSDEC regulates activities in freshwater wetlands and in their adjacent areas. The NYSDEC regulates such activities to prevent, or at least to minimize, impairment of wetland functions. Consultation with the NYSDEC is recommended prior to pursuing or starting any project in the vicinity of a regulated wetland.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $3.8 million
- Flood Bench B: $3.8 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination or permitting for regulatory requirements for work in and around wetlands. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

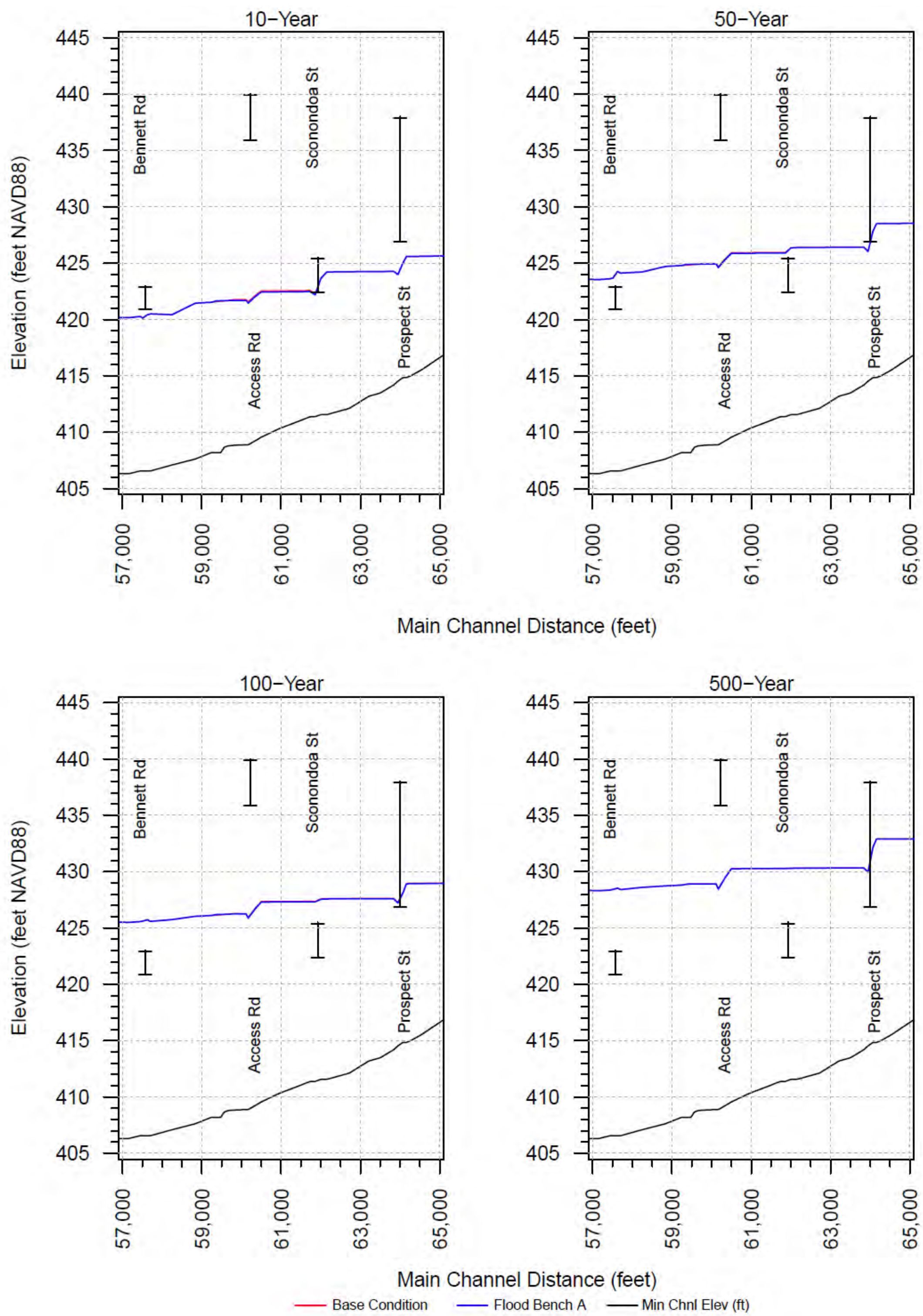

Figure 7-17. HEC-RAS model simulation output results for Alternative #1-4 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

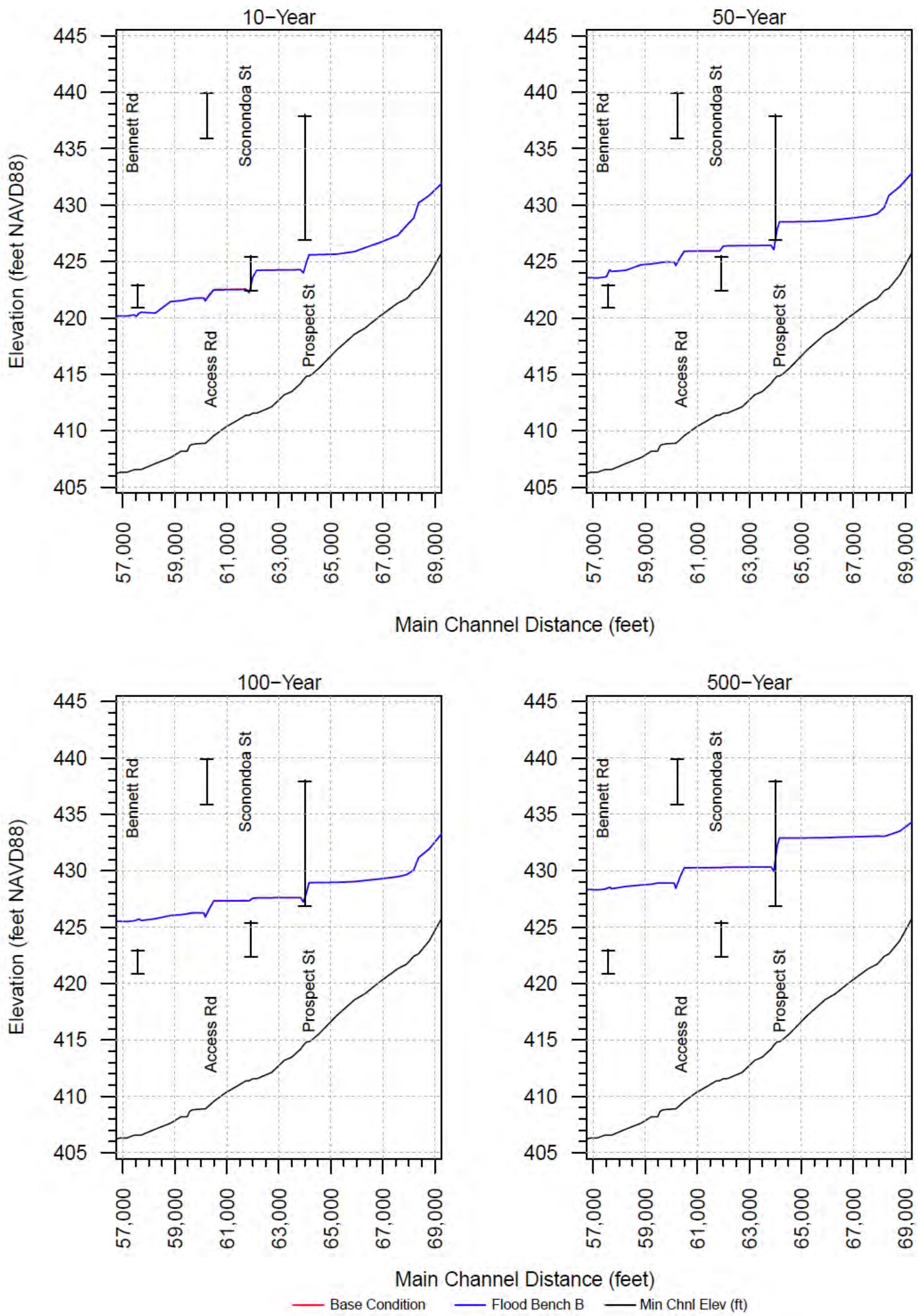

Figure 7-18. HEC-RAS model simulation output results for Alternative #1-4 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.5 Alternative #1-5: Levee Along the Oneida Sewage Treatment Plant

This strategy is intended to restrict high-flow events from overtopping channel banks and flooding the Oneida Sewage Treatment Plant in High-Risk Area #1 by constructing a permanent levee along the left bank of Oneida Creek adjacent to the facility. The levee would be approximately 1,500 linear feet with a height of 2-ft above the flood stage for the 1% ACE flood elevation (436 to 431-ft NAVD 88) and located along river stations 602+50 to 617+50 (Figure 7-19).

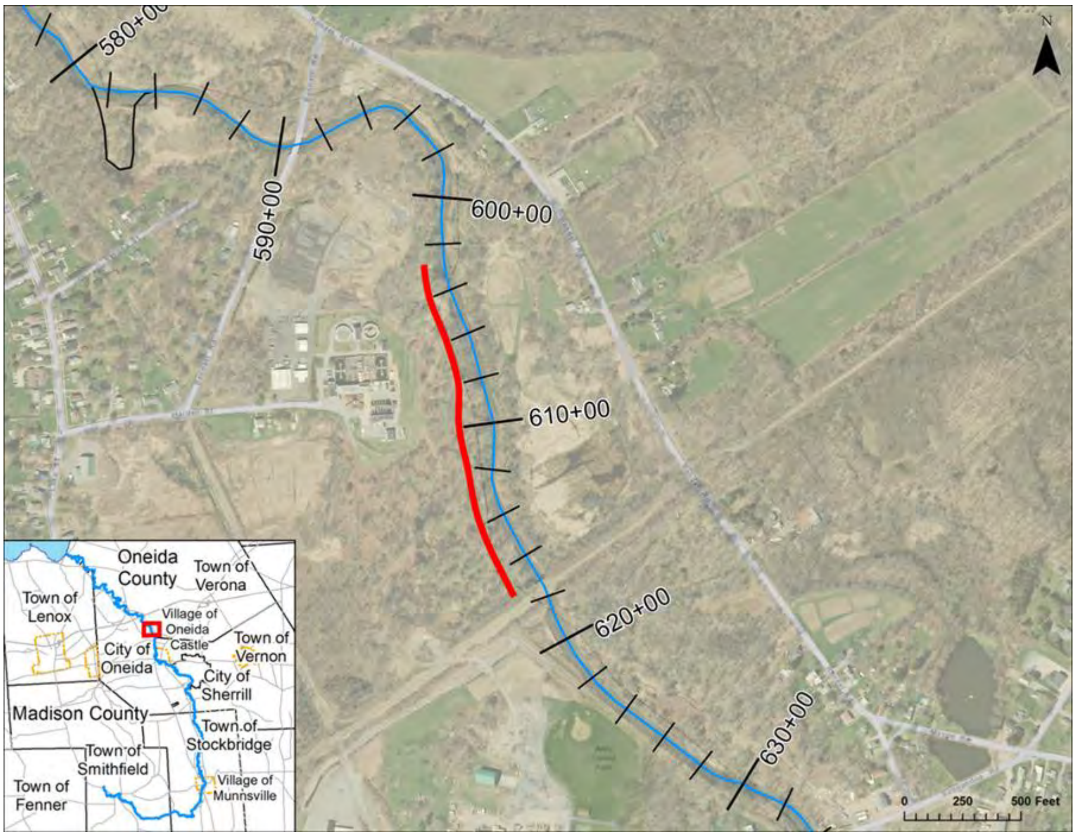

Figure 7-19. Location map for Alternative #1-5.

Compaction and the possibility of using cut material as fill was not accounted for this alternative. Downstream and opposite bank effects of the levee were modelled to determine if the levee would have any measurable effects on upstream or downstream water surface elevations.

The proposed condition modeling simulation results indicated water surface increases of up to 0.1 ft in areas approximately 10,450 ft immediately upstream and downstream of the facility extending upstream near the abandoned railroad and NY-5, specifically along river stations 588+00 to 692+50 (Figure 7-20). The modeling output for future conditions displayed similar results with water surface increases of up to 0.1 ft in the vicinity of the levee. Full model outputs for this alternative can be found in Appendix G.

The proposed present and future conditions modeling confirmed that constructing a levee along Oneida Creek in the reach adjacent to the Oneida Sewage Treatment Plant would decrease the flood risk to the facility, while leaving the flood potential of downstream and opposite bank areas unaffected.

Without the levee, a 1% ACE would overtop the channel banks downstream of the abandoned railroad bridge near river station 618+00, inundating the residences and properties along Randel Road and the Treatment Plant along this reach. With the levee, model simulation results indicated this water would remain in the channel and flow downstream causing water surface elevations to increase without impairing the adjacent properties. The potential benefits of this alternative are in the vicinity of the levee at river stations 602+50 to 617+50. However, the increase in water surface elevations both downstream and upstream of the levee would impact the Bennett Road, Access Rd, Sconondoa Street, and Prospect Street bridges. As a result, additional design, engineering, and analyses would be necessary to determine the best levee design with the least impacts on surrounding areas.

Any levee constructed in the Oneida Creek watershed would need to follow the USACE Design and Construction of Levees (EM 1110-2-1913) guidelines, including obtaining the required individual, regional, and nationwide permits for design, construction, and maintenance of a levee (USACE 2000).

USACE has the authority to construct small flood risk-reduction projects that are engineeringly feasibly, structurally sound and cost efficient through the authority provided under Section 205 of the 1948 Flood Control Act (FCA), as amended. Coordination should also occur with the NYSDEC as they need to be the non-Federal sponsor on these types of projects. In addition, a FEMA BCA would need to be performed to determine the cost-effectiveness of the alternative prior to applying for FEMA mitigation grant programs funding.

A levee would require significant engineering, construction, and maintenance efforts throughout its lifespan, resulting in a relatively high cost burden. Levees should be placed as far away from the creek channel as possible to maximize the capacity of the natural floodplain to convey floodwaters, and designed and constructed in a manner that does not cause flooding downstream of the structure. In addition, strict requirements would need to be met to comply with NFIP requirements (44 CFR §65.10) to affect a building's flood insurance rating. However, it must be noted that a levee would not remove areas from the FEMA mapped floodplain. A levee would only provide additional flood protection for a certain level of annual chance flood event. Homeowners and businesses behind the levee would still be required to purchase flood insurance if they are within any FEMA designated flood zones (FEMA 2000).

The Rough Order Magnitude cost for this strategy is approximately $2.4 million, which does not include permitting, annual maintenance or land acquisition costs for survey, appraisal, and engineering coordination. This estimate also assumes suitable clay material for levee fill that meets USACE requirements is readily available and nearby.

In addition, closure structures, tie-ins and pump stations were not discussed as these structures should be considered on an as-needed basis to address interior drainage. As such, the cost estimate for this alternative did not include the associated costs for these structures.

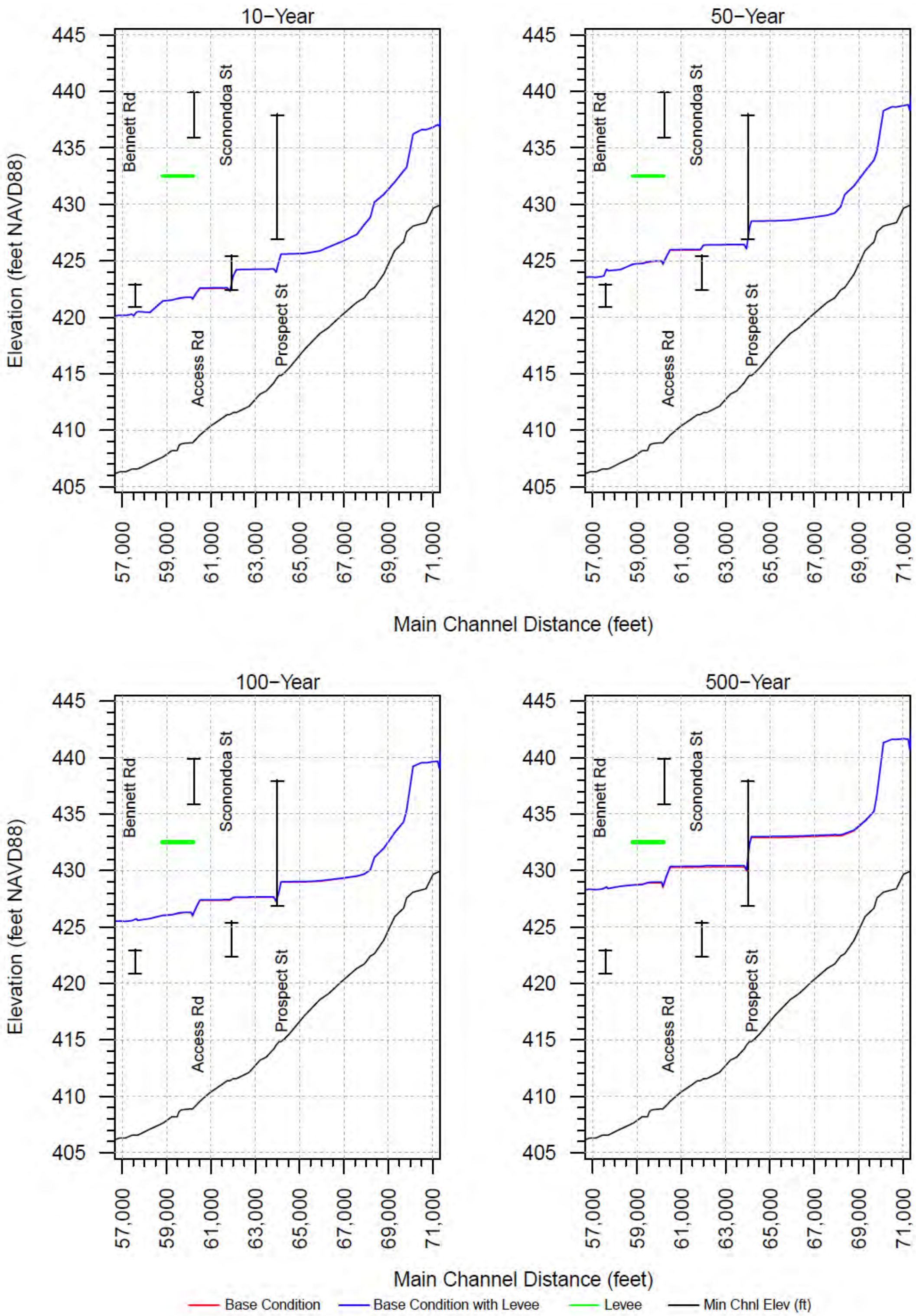

Figure 7-20. HEC-RAS model simulation output results for Alternative #1-5 for the existing condition (blue) and proposed alternative (red) scenarios.

7.1.6 Alternative #1-6: Increase the Opening of the Sconondoa Road Bridge

This measure is intended to address issues within High-Risk Area #1 by increasing the width of the Sconondoa Road bridge opening, which would increase the cross-sectional flow area of the channel located at river station 634+50 (Figure 7-21).

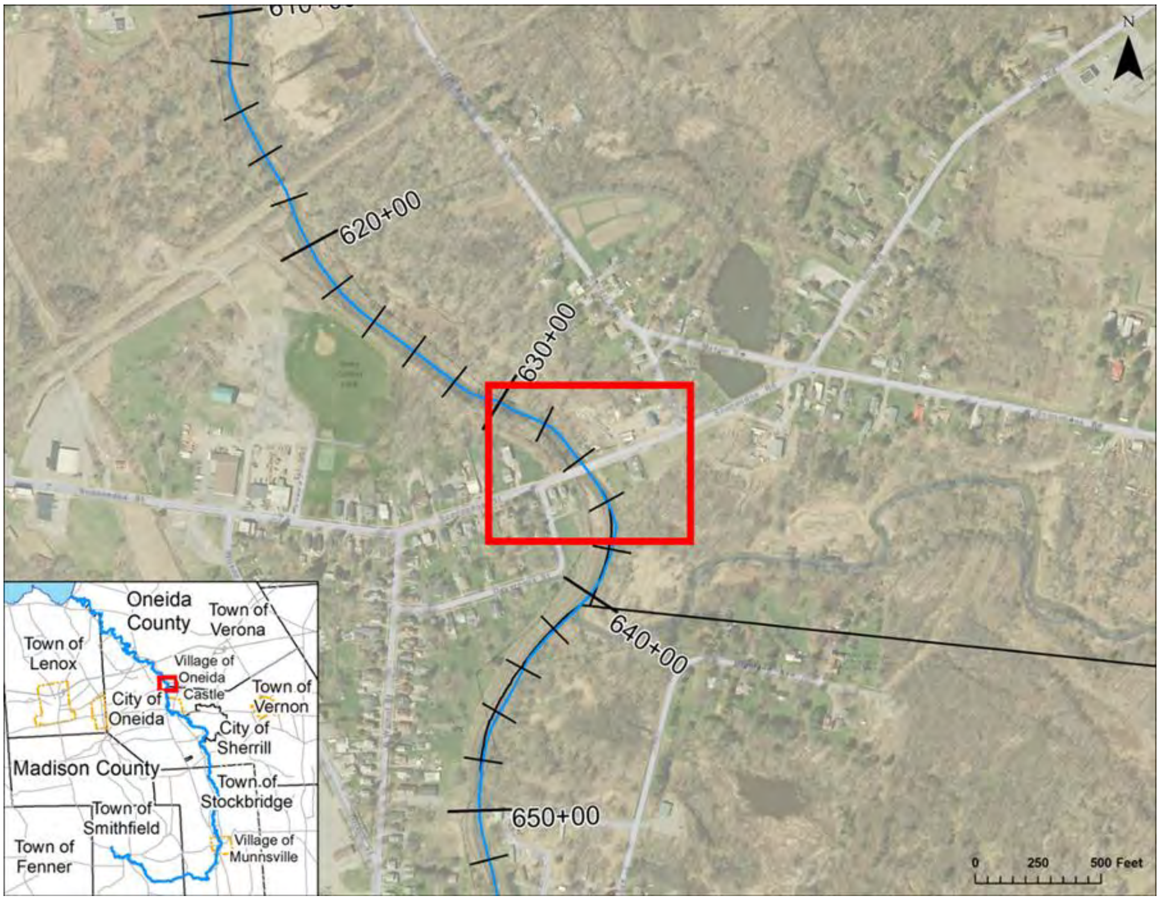

Figure 7-21. Location map for Alternative #1-6.

The bridge is owned by Madison County and has no pier in the channel. The existing bridge structure has a bridge span of 80 ft and a width of 29.5 ft (Figure 7-22). The flooding in the vicinity of the Sconondoa Road bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-22. Sconondoa Road bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

As previously displayed in Figure 6-2, the FEMA FIS for the Sconondoa Road bridge is unable to successfully pass the 10-, 2-, 1-, or 0.2% ACE without significant backwater upstream the of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Sconondoa Road bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 20-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the Sconondoa Road bridge successfully passing the 1% ACE. The results displayed for this proposed alternative are based on widening the bridge opening by 20 ft on the right bank for a total bridge span of 100 ft.

The proposed condition modeling confirmed that the Sconondoa Road bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 0.7 ft in areas approximately 6,075 ft immediately upstream of the bridge extending from Prospect Street to Maxwell Field, specifically along river stations 619+25 to 680+00 (Figure 7-23). The modeling output for future conditions displayed similar results with water surface reductions of up to 0.4 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to upstream of the Sconondoa Road bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.6 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 100 ft, cost approximately $2.6 million, and reduce water surface elevations by 0.7 ft immediately upstream of the bridge.

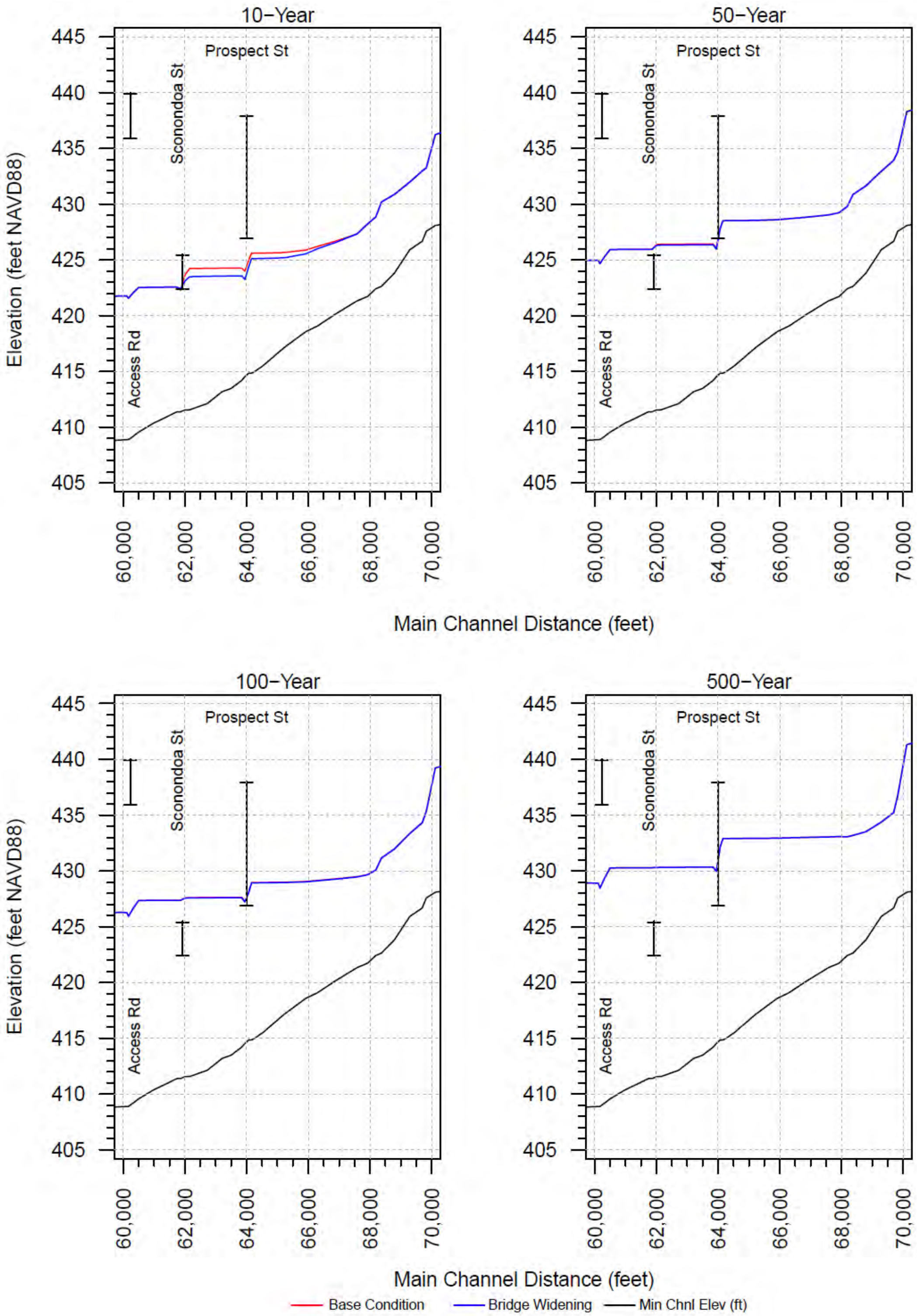

Figure 7-23. HEC-RAS model simulation output results for Alternative #1-6 for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.7 Alternative #1-7: Increase the Opening of the Prospect Street Bridge

This measure is intended to address issues within High-Risk Area #1 by increasing the width of the Prospect Street bridge opening, which would increase the cross-sectional flow area of the channel located at river station 653+50 (Figure 7-24).

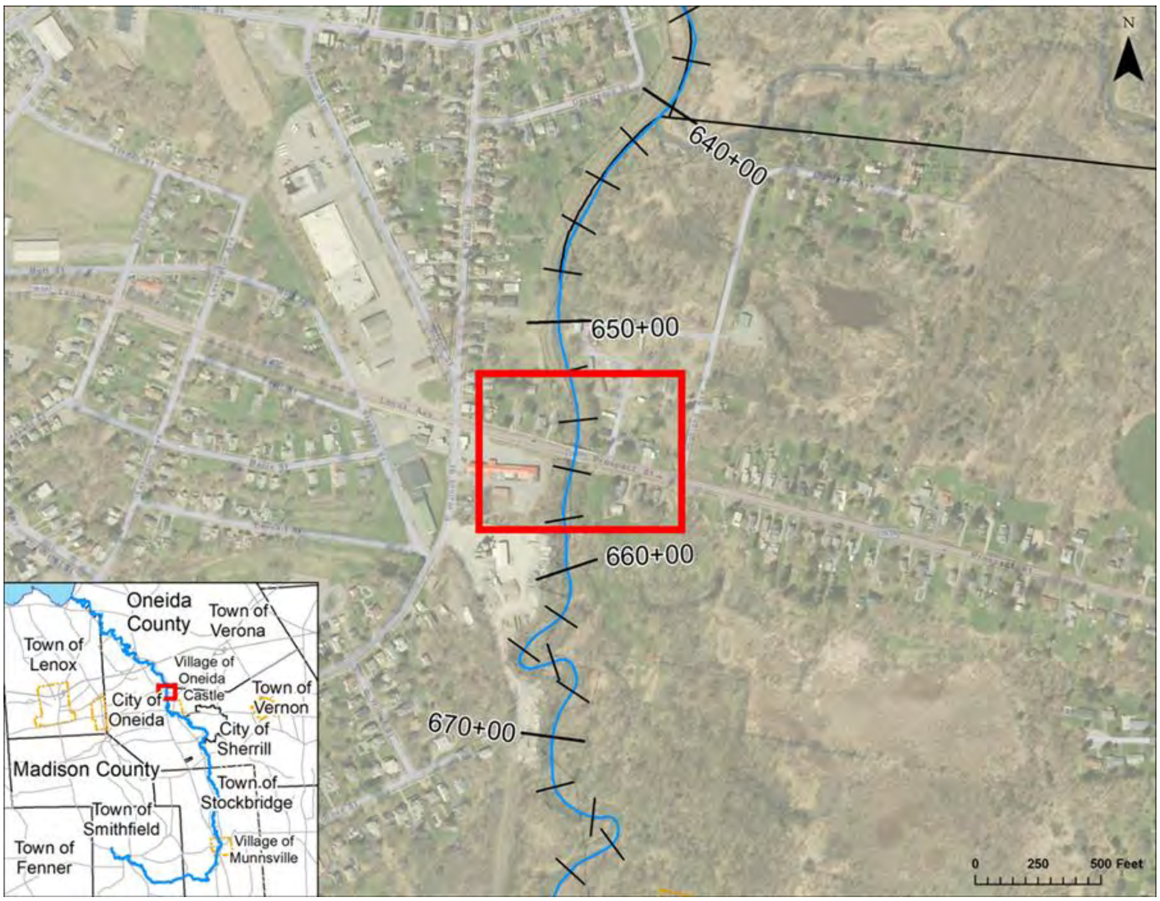

Figure 7-24. Location map for Alternative #1-7.

The bridge is owned by the NYSDOT and has no pier in the channel. The existing bridge structure has a bridge span of 106 ft, a width of 40 ft, and one central pier (Figure 7-25). The flooding in the vicinity of the Prospect Street bridge poses a flood-risk threat to nearby residential and commercial properties, and state-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-25. Prospect Street bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

The FEMA FIS profile plot for the Prospect Street bridge indicates the bridge is unable to successfully pass the 2-, 1-, or 0.2% ACE event without significant backwater upstream the of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Prospect Street bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure and removing the central pier, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 20-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the Prospect Street bridge successfully passing the 1% ACE without significant backwater upstream of the bridge. The results displayed for this proposed alternative are based on widening the bridge opening by 20 ft on the left bank for a total bridge span of 126 ft.

The proposed condition modeling confirmed that the Prospect Street bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 1.6 ft in areas approximately 6,000 ft immediately upstream of the bridge extending to Maxwell Field, specifically along river stations 640+00 to 700+00 (Figure 7-26). The modeling output for future conditions displayed similar results with water surface reductions of up to 2.6 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to upstream of the Prospect Street bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.7 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 126 ft, cost approximately $2.7 million, and reduce water surface elevations by 1.6 ft immediately upstream of the bridge.

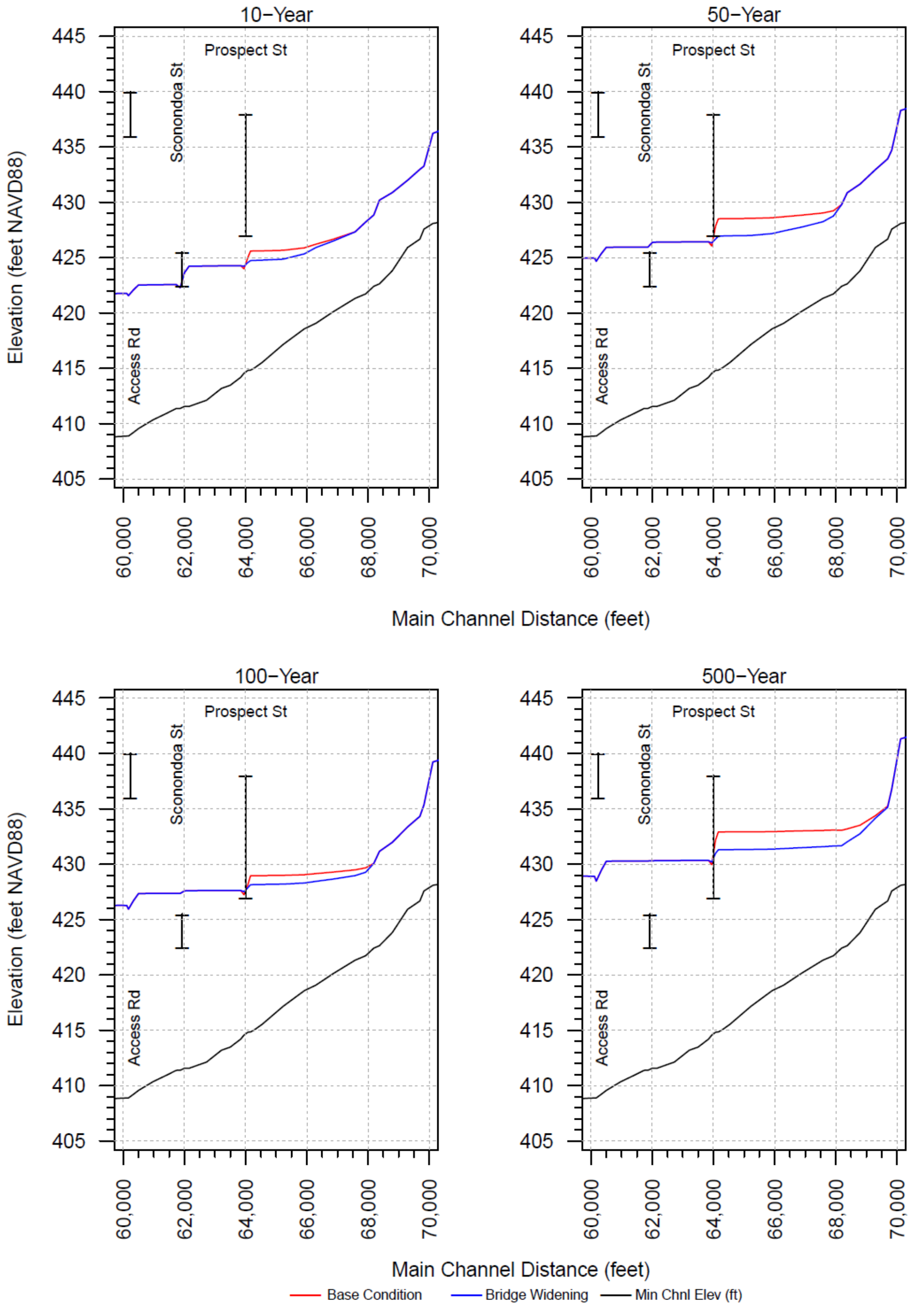

Figure 7-26. HEC-RAS model simulation output results for Alternative #1-7 for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.8 Alternative #1-8: Flood Benches Between Access Road and Prospect Street

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled upstream and downstream of Sconondoa Road in the Towns of Verona and Vernon, NY (Figure 7-27):

- Flood Bench A is approximately 10.0 acres in size and located between river stations 620+50 to 632+00
- Flood Bench B is approximately 8.0 acres in size and located between river stations 641+50 to 649+50

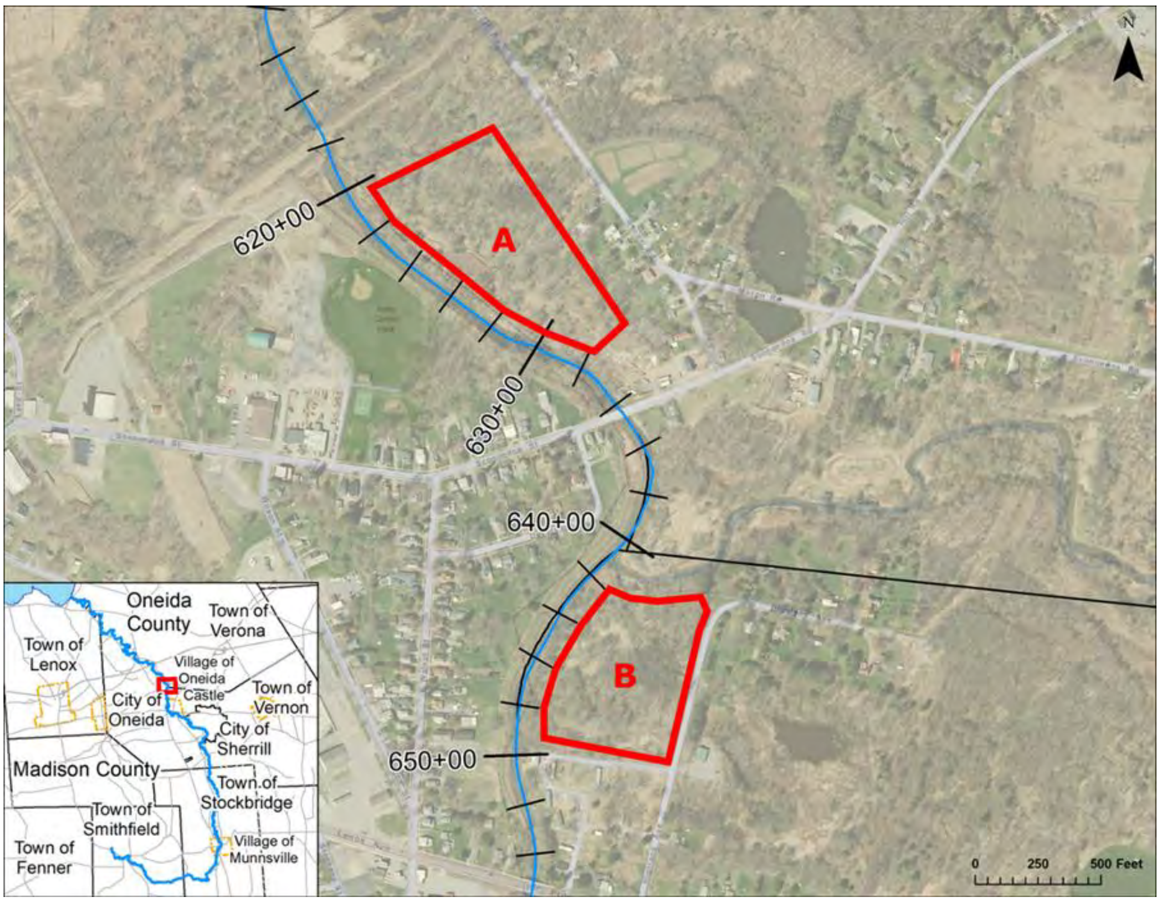

Figure 7-27. Location map for Alternative #1-8.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 3.5-ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where base flood elevations are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 22 outlines the results of the proposed present and future conditions model simulations for open-water flooding only. Figures 7-28 and 7-29 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 22. Summary Table for Alternative #1-8 Existing Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	No significant change in WSEL	No significant change in WSEL
Total Length of Benefited Area	N/A	N/A
River Stations	N/A	N/A
Future Proposed Conditions		
Open-Water	No significant change in WSEL	No significant change in WSEL
Total Length of Benefited Area	N/A	N/A
River Stations	N/A	N/A

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located between the Access Road and Prospect Street would not provide flood protection in this reach from open-water flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $4.7 million
- Flood Bench B: $3.7 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

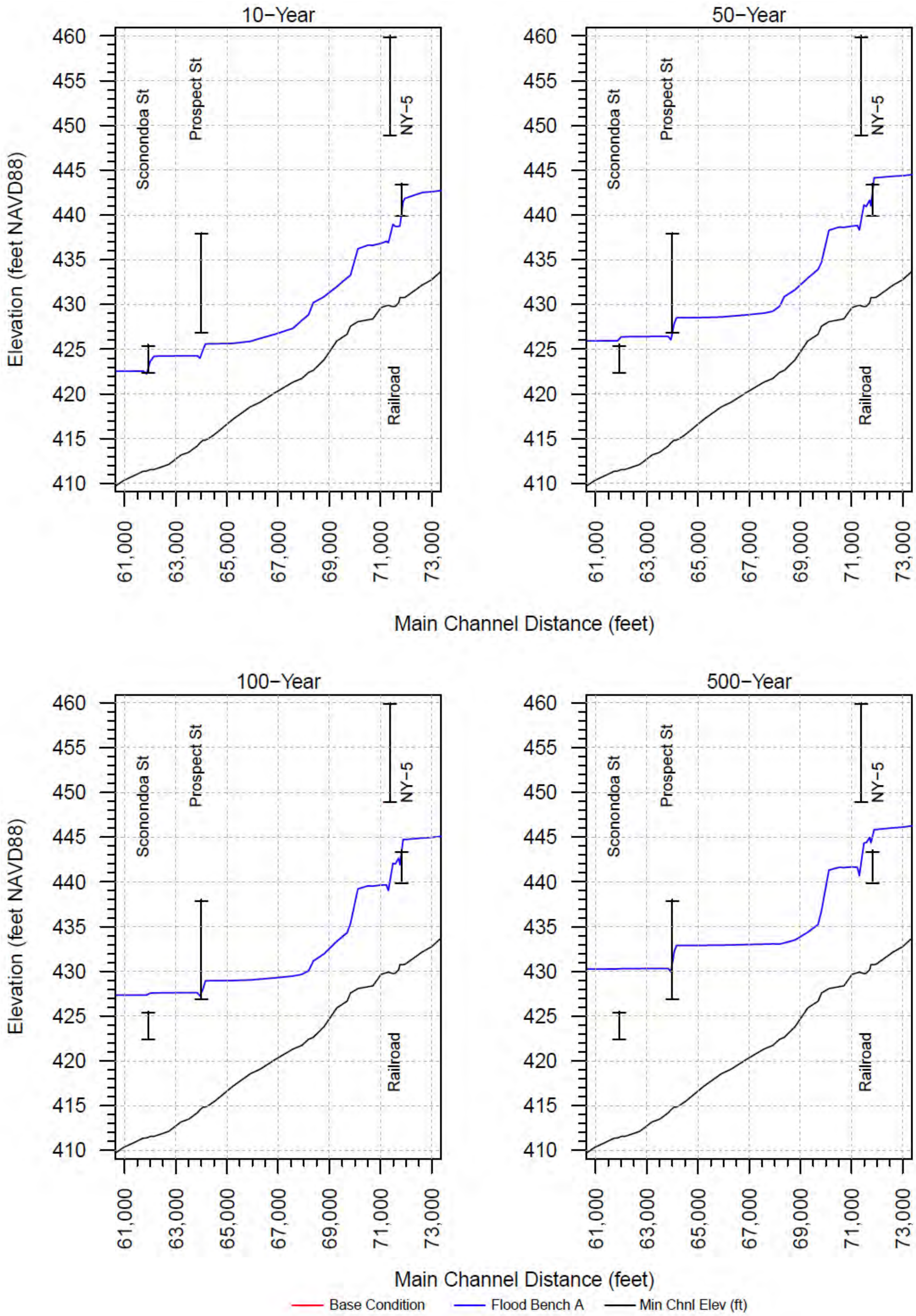

Figure 7-28. HEC-RAS model simulation output results for Alternative #1-8 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

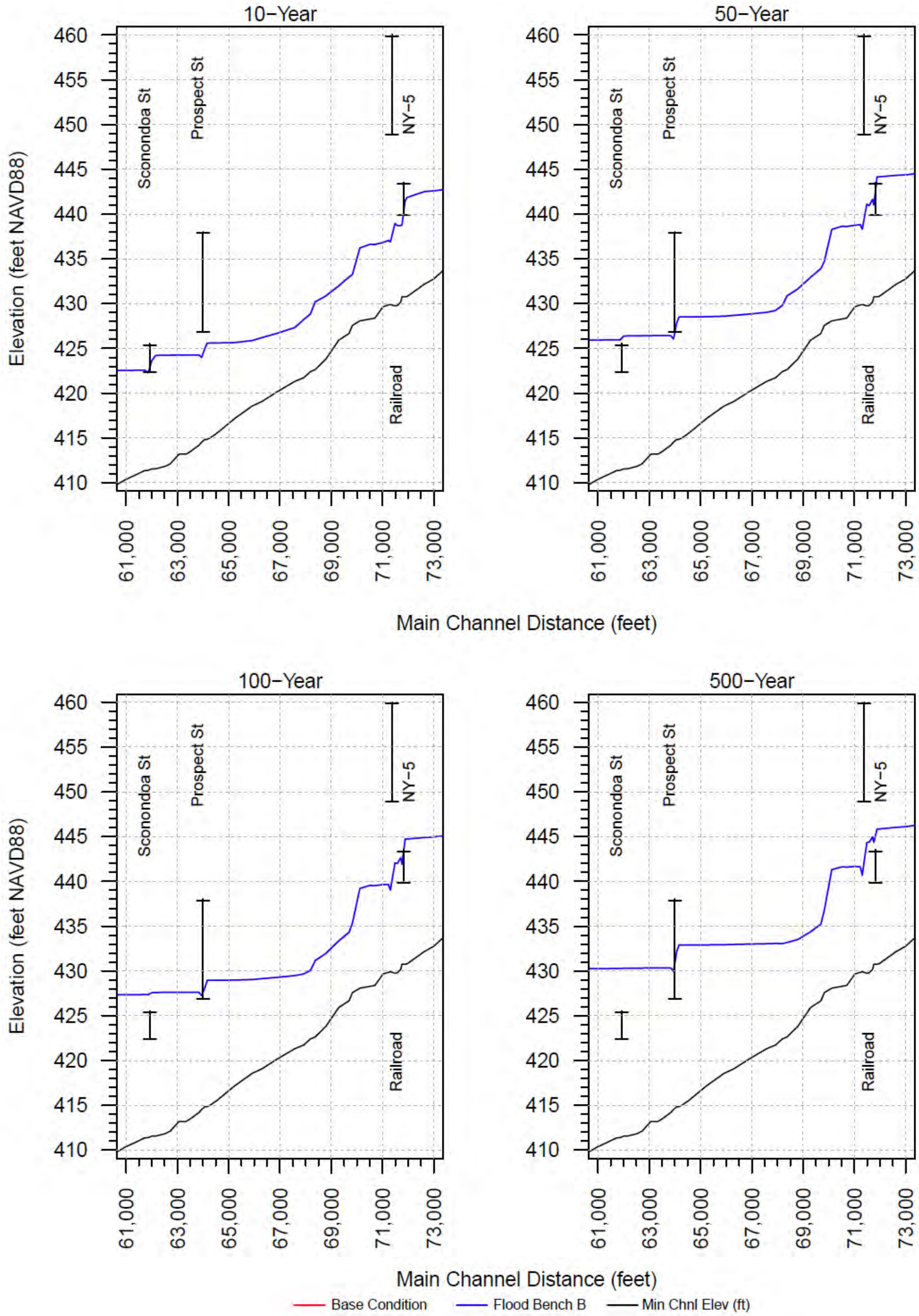

Figure 7-29. HEC-RAS model simulation output results for Alternative #1-8 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.9 Alternative #1-9: Flood Benches Between Prospect Street and NY-5/Genesee Street

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled upstream of Prospect Street in the Town of Vernon and Village of Oneida Castle, NY (Figure 7-30):

- Flood Bench A is approximately 15.5 acres in size and located between river stations 661+00 to 684+50
- Flood Bench B is approximately 14.0 acres in size and located between river stations 685+50 to 697+50

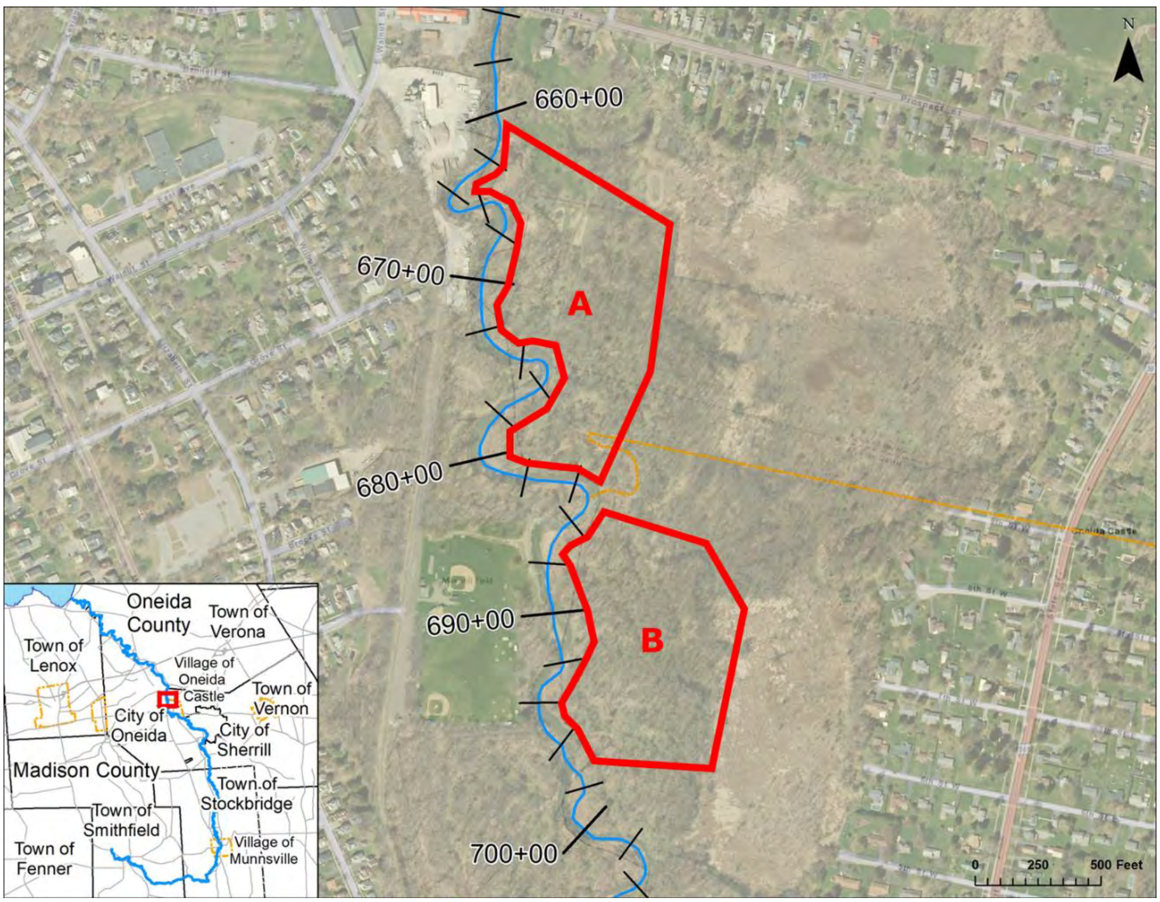

Figure 7-30. Location map for Alternative #1-9.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 3.5 ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the

FIS by detailed methods and where base flood elevations are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 23 outlines the results of the proposed present and future conditions model simulations for open-water flooding only. Figures 7-31 and 7-32 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 23. Summary Table for Alternative #1-9 Existing Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 1.4-ft	Up to 2.2-ft
Total Length of Benefited Area	3,800-ft	1,500-ft
River Stations	645+50 to 683+50	668+50 to 683+50
Future Proposed Conditions		
Open-Water	Up to 0.5-ft	Up to 1.6-ft
Total Length of Benefited Area	3,800-ft	1,500-ft
River Stations	645+50 to 683+50	668+50 to 683+50

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream of Prospect Street would provide minimal flood protection in this reach from open-water flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

This alternative contains areas with NYSDEC regulated wetlands. Under the Freshwater Wetlands Act, the NYSDEC regulates activities in freshwater wetlands and in their adjacent areas. The NYSDEC regulates such activities to prevent, or at least to minimize, impairment of wetland functions. Consultation with the NYSDEC is recommended prior to pursuing or starting any project in the vicinity of a regulated wetland.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $4.9 million
- Flood Bench B: $5.1 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination or permitting for regulatory requirements for work in and around wetlands. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

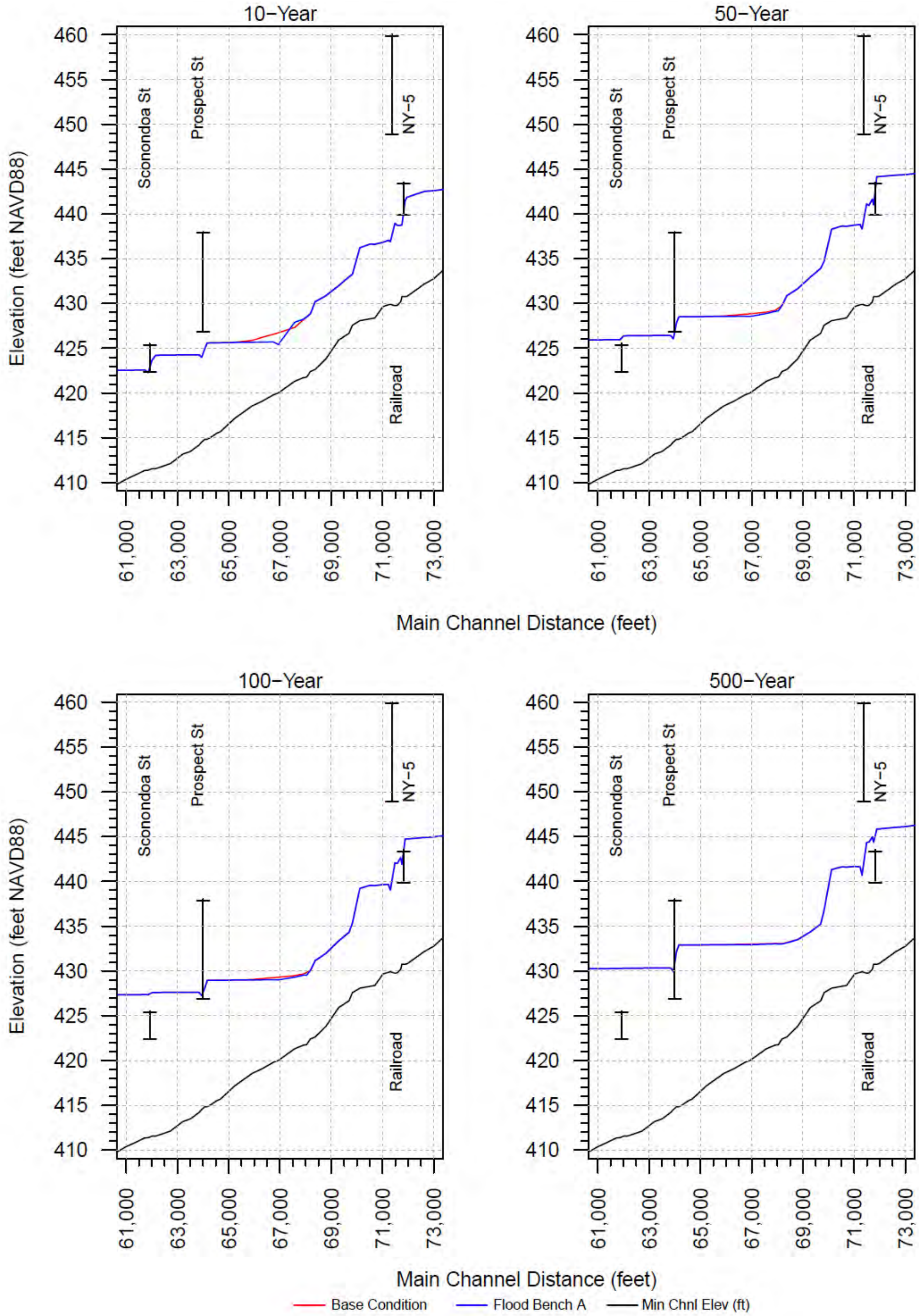

Figure 7-31. HEC-RAS model simulation output results for Alternative #1-9 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

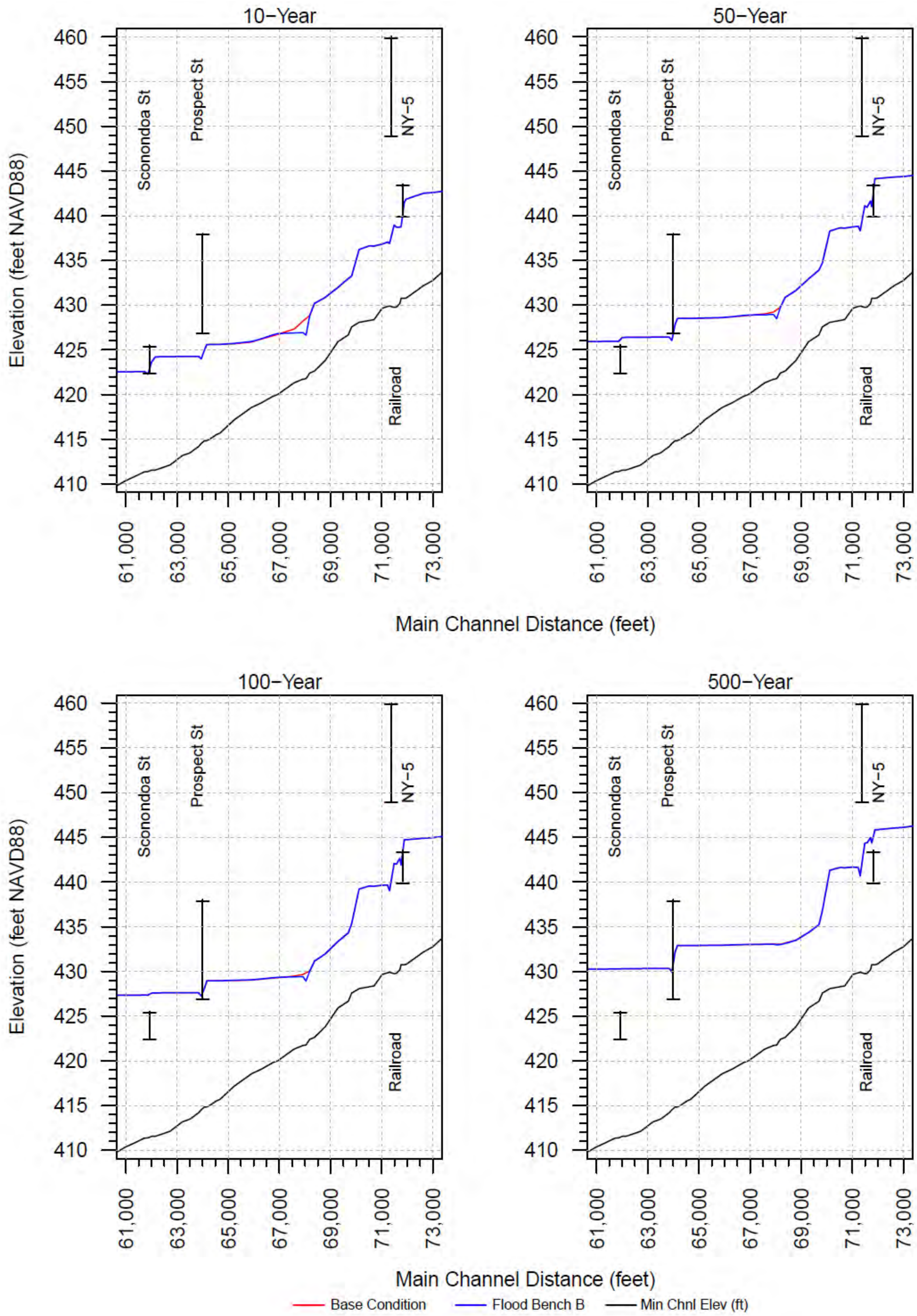

Figure 7-32. HEC-RAS model simulation output results for Alternative #1-9 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.10 Alternative #1-10: Flood Control/Sediment Detention Basin Upstream of Prospect Street

The construction of small flood-control detention structures in the headwaters and tributaries of flood-prone streams has proven successful at preventing flood damage in small towns throughout the United States (Helms 1986). These structures are traditionally located in rural areas in agricultural fields and undeveloped land. They maintain little to no permanent pool and are designed to detain water during larger flow events, decreasing peak-flow water surface elevations and minimizing flooding further downstream in developed areas. The area between river stations 660+00 and 700+00 between Prospect Street and NY-5/Genesee Street in the Town of Vernon and Village of Oneida Castle, NY would be the best location for a flood-control structure in High-Risk Area #1 (Figure 7-33).

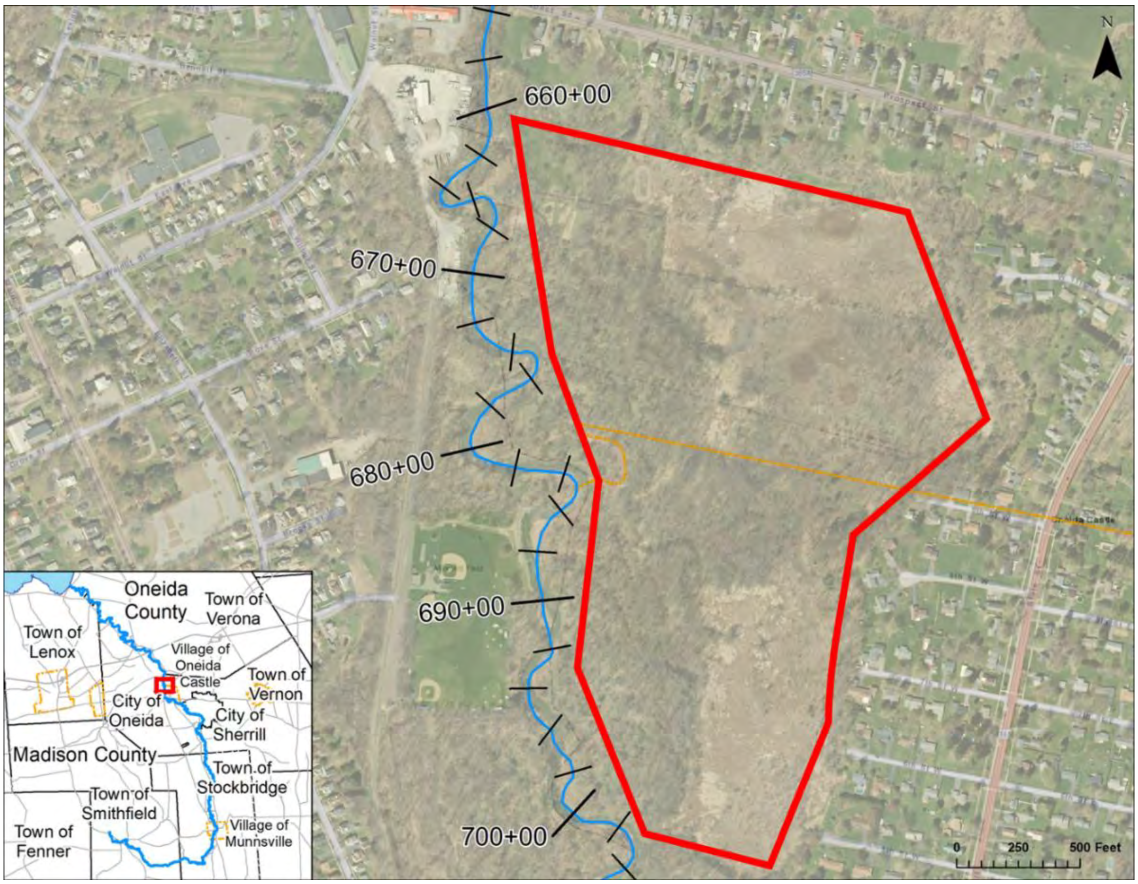

Figure 7-33. Location map for Alternative #1-10.

In addition, the detention structure could be designed to reduce watercourse and gully erosion, trap sediment, reduce and manage runoff near and downstream of the basin, and to improve downstream water quality. Figure 7-34 depicts a representative in-stream sediment detention pond design.

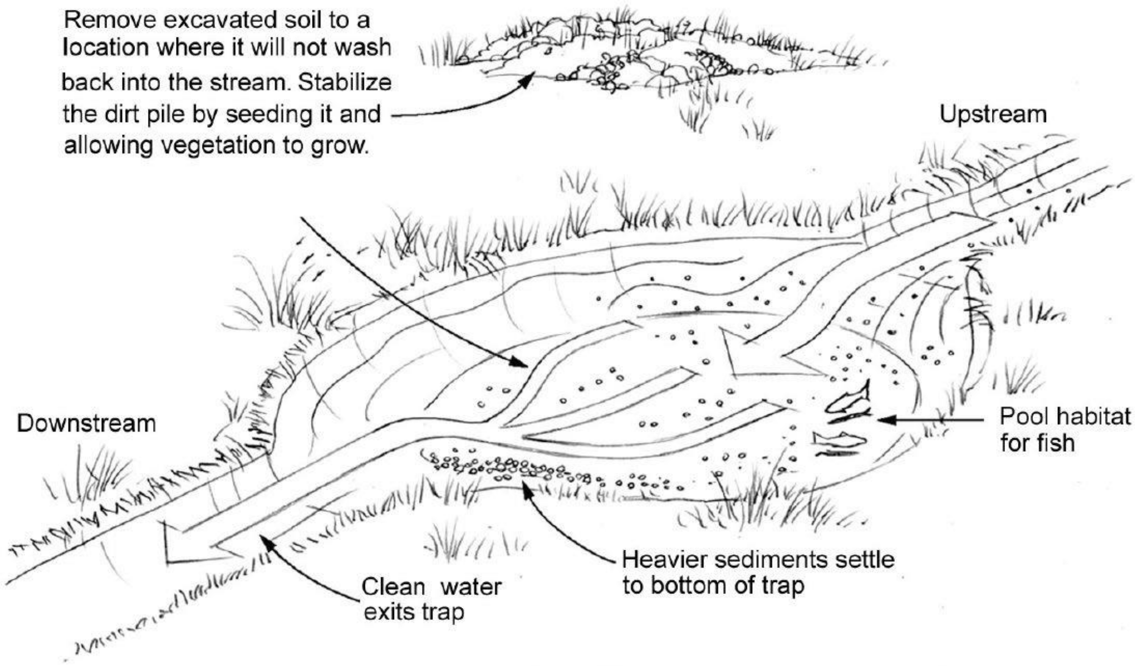

Figure 7-34. Representative diagram of an in-stream sediment detention pond (WCD 2009).

Sediment basin maintenance (i.e., removal of accumulated sediment) is necessary to ensure proper function. A well-functioning sediment basin allows for the trapping and removal of sediments regularly from one location rather than having to maintain an entire watercourse reach, saving money and reducing negative impacts to aquatic life and water quality. However, sediment traps are not naturally occurring features of a watercourse. Sediment traps can have both benefits and drawbacks to fish and other aquatic life (WCD 2009).

Sediment detention basins should be considered on a site-by-site basis where there are large open land areas and where downstream areas, which have historically experienced sediment issues, would benefit the most from the construction of a sediment detention basin (WCD 2009).

In New York State, a joint permit application from the NYSDEC and USACE may be required in order to construct, reconstruct, or repair a dam or other impoundment. The NYSDEC is entrusted with the regulatory power to oversee dam safety, which encompasses flood detention structures. 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 construction and/or modifications, conducts dam safety inspections, and monitors projects for compliance with dam safety criteria.

The USACE has the authority to construct small flood risk reduction projects that are engineeringly feasibly, structurally sound and cost efficient through the authority provided under Section 205 of the 1948 FCA, as amended. Coordination should also occur with the NYSDEC as they need to be the non-Federal sponsor on these types of projects.

In addition, a FEMA Benefit-Cost Analysis (BCA) would need to be performed to determine the cost-effectiveness of the alternative prior to applying for FEMA mitigation grant programs funding. The Benefit-Cost Ratio (BCR) must be greater than or equal to 1.0 in order for the project to be considered cost effective.

Due to the conceptual nature of this measure, and significant amount of data required to produce a reasonable ROM cost, it is not feasible to quantify the costs of this measure without further engineering analysis and modeling. However, the cost of designing, permitting, constructing, and maintaining one or more flood-control dams in the headwaters of the Oneida Creek watershed are expected to be significant. In addition, operation and maintenance costs to maintain the embankment, design capacity, vegetative cover, and outlet of the basin and periodic removal of any materials should be considered (NRCS 2002).

In addition, this alternative contains areas with NYSDEC regulated wetlands. Under the Freshwater Wetlands Act, the NYSDEC regulates activities in freshwater wetlands and in their adjacent areas. The NYSDEC regulates such activities to prevent, or at least to minimize, impairment of wetland functions. Consultation with the NYSDEC is recommended prior to pursuing or starting any project in the vicinity of a regulated wetland.

7.1.11 Alternative #1-11: Remove Abandoned Railroad Bridge

This measure is intended to increase the cross-sectional flow area of the channel and remove any potential impediments or catch points for sediment and debris by removing the Abandoned Railroad bridge located at river station 728+50 (Figure 7-35).

Figure 7-35. Location map for Alternative #1-11.

The FEMA FIS profile plot for the Abandoned Railroad bridge indicates the hydraulic capacity of the bridge is sufficient to successfully pass the 10-, 2-, 1-, and 0.2% ACE events (FEMA 2013). The FEMA FIRM displays significant backwater upstream of the Abandoned Railroad and NY-5/Genesee Street bridge crossings (FEMA 2001a). In addition, the close proximity of NY-5/Genesee Street and its structure immediately upstream act as impediments to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area.

The bridge is no longer operated by the railroad industry and sits derelict with no significant function or benefit to the community. By removing the bridge structure, 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.

The proposed condition modeling results indicated water surface reductions of up to 2.5 ft in areas approximately 4,925 ft immediately upstream of the bridge extending up to the Middle Road bridge crossing, specifically along river stations 713+75 to 763+00 (Figure 7-36). The modeling output for future conditions displayed similar results with water surface reductions of up to 2.6 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to immediately upstream of the Abandoned Railroad bridge. Additional benefits of removing the bridge structure would be to reduce the potential of debris and ice from catching and creating obstructions/jams upstream of the bridge.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed this alternative independent of any other proposed mitigation alternative. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The ROM cost for this strategy is approximately $200,000, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if removing the bridge would affect water surface elevations downstream of NY-5/Genesee Street.

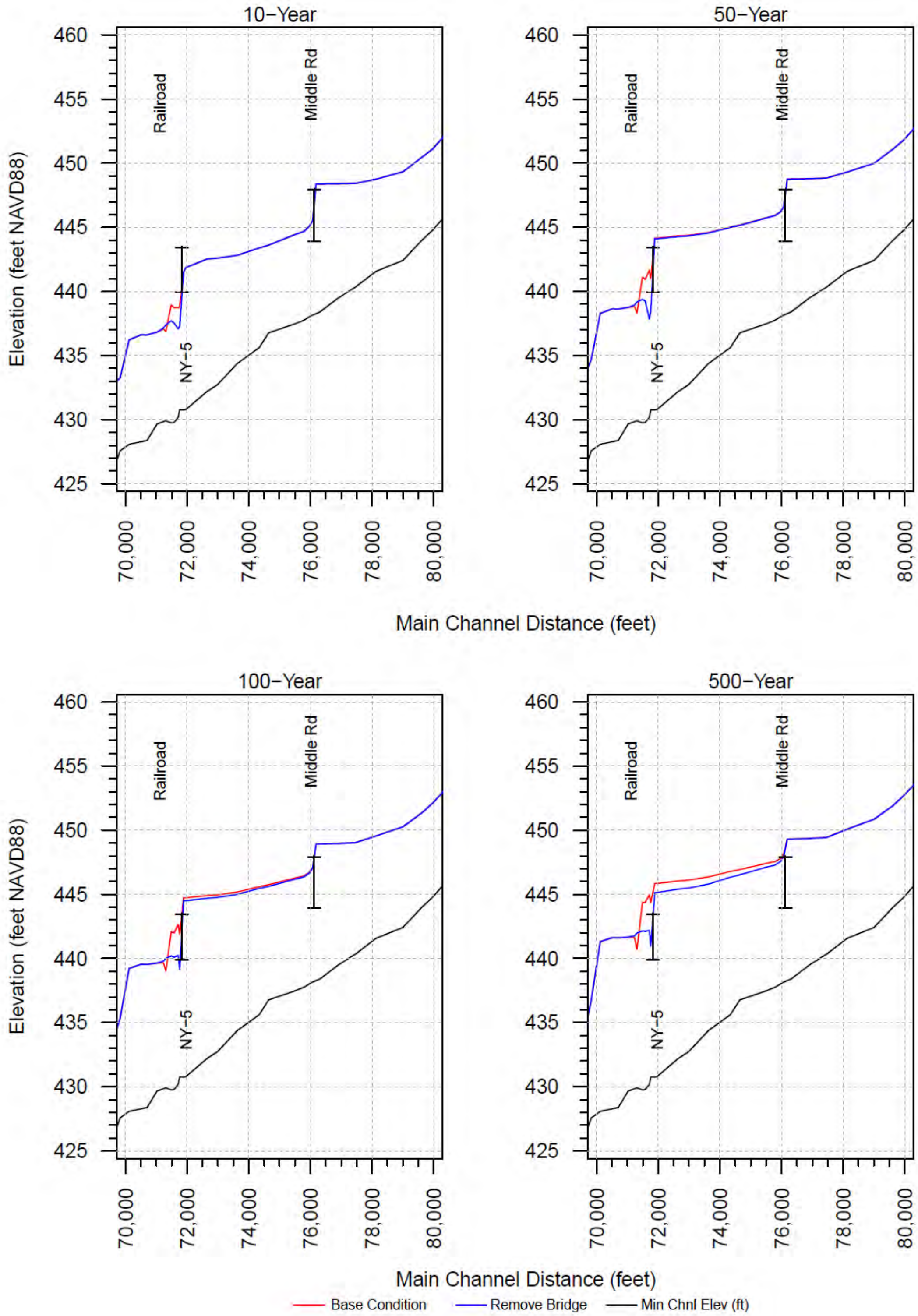

Figure 7-36. HEC-RAS model simulation output results for Alternative #1-11 for the existing condition (red) and proposed alternative (blue) scenarios.

7.1.12 Alternative #1-12: Increase the Opening of the NY-5/Genesee Street Bridge

This measure is intended to address issues within High-Risk Area #1 by increasing the width of the NY-5/Genesee Street bridge opening, which would increase the cross-sectional flow area of the channel located at river station 733+00 (Figure 7-37).

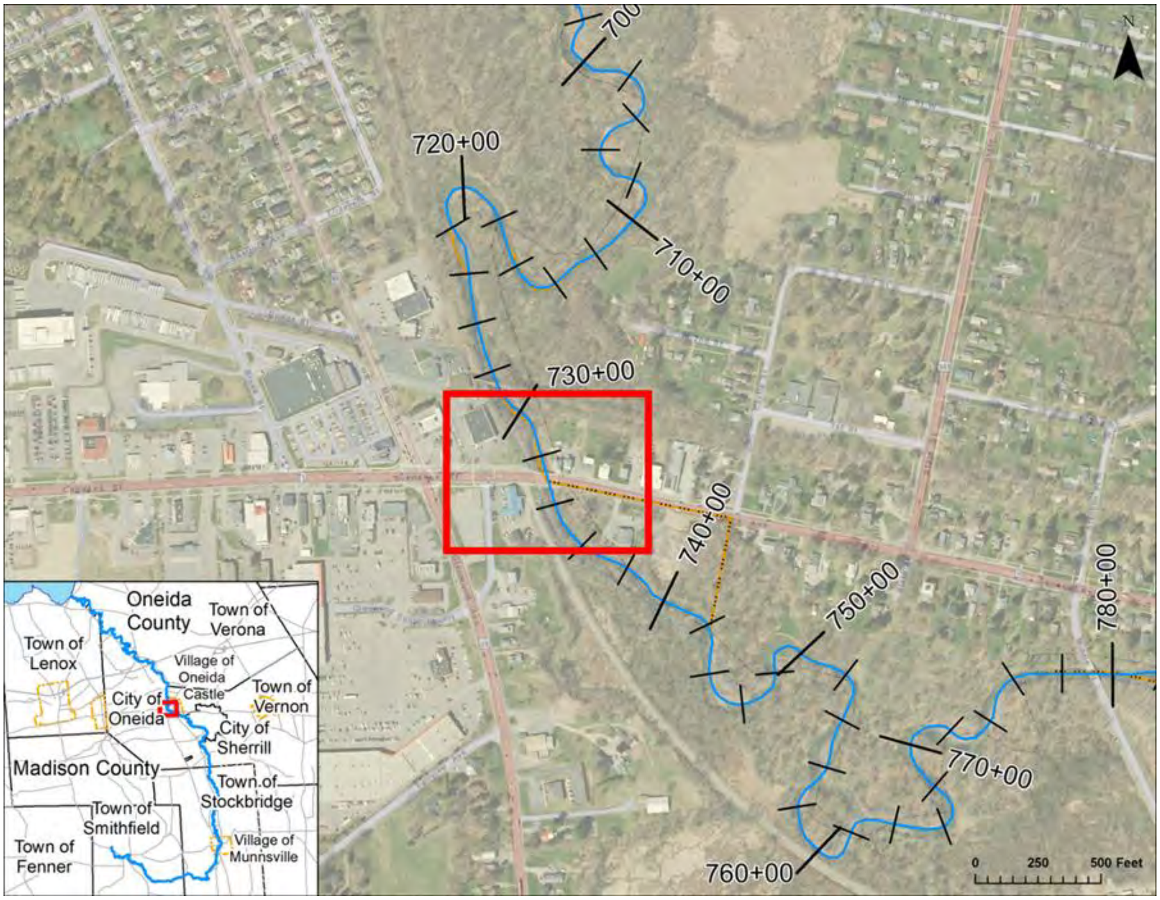

Figure 7-37. Location map for Alternative #1-12.

The bridge is owned by the NYSDOT and has no pier in the channel. The existing bridge structure has a bridge span of 54 ft and a width of 44.6 ft (Figure 7-38). The flooding in the vicinity of the NY-5/Genesee Street bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-38. NY-5/Genesee Street bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

According to the FEMA FIS, the NY-5/Genesee Street bridge is unable to successfully pass the 2-, 1-, or 0.2% ACE without significant backwater upstream of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Bennett Road bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 20-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the NY-5/Genesee Street bridge successfully passing the 1% ACE. The results displayed for this proposed alternative are based on widening the bridge opening by 20 ft on the left bank for a total bridge span of 74 ft.

According to historical flood reports, stakeholder engagement meetings, and field work, the NY-5/Genesee Street bridge was identified as a hydraulic structure that experiences debris blockage and ice jams resulting in backwater flooding during higher peak flow events (NYSDEC 2021b). For this alternative, open-water, debris obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations.

Table 24 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-39 through 7-41 display the profile plots for each initial condition scenario for the bridge widening alternative. Full model outputs for this alternative can be found in Appendix G.

Table 24. Summary Table for Alternative #1-12 Existing Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 1.3-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25
Debris Obstruction	Up to 2.4-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25
Ice Jam	Up to 1.9-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25

Table 25 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 25. Summary Table for Alternative #1-12 Future Conditions Results Based on Open-water, Debris-Obstruction, and Ice-jam Conditions

Future Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 2.1-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25
Debris Obstruction	Up to 1.9-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25
Ice Jam	Up to 1.2-ft
Total Length of Benefited Area	4,300-ft
River Stations	718+25 to 761+25

The potential benefits of this strategy are limited to immediately upstream of the NY-5/Genesee Street bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed this alternative independent of any other proposed mitigation alternative. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The ROM cost for this strategy is approximately $3.2 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

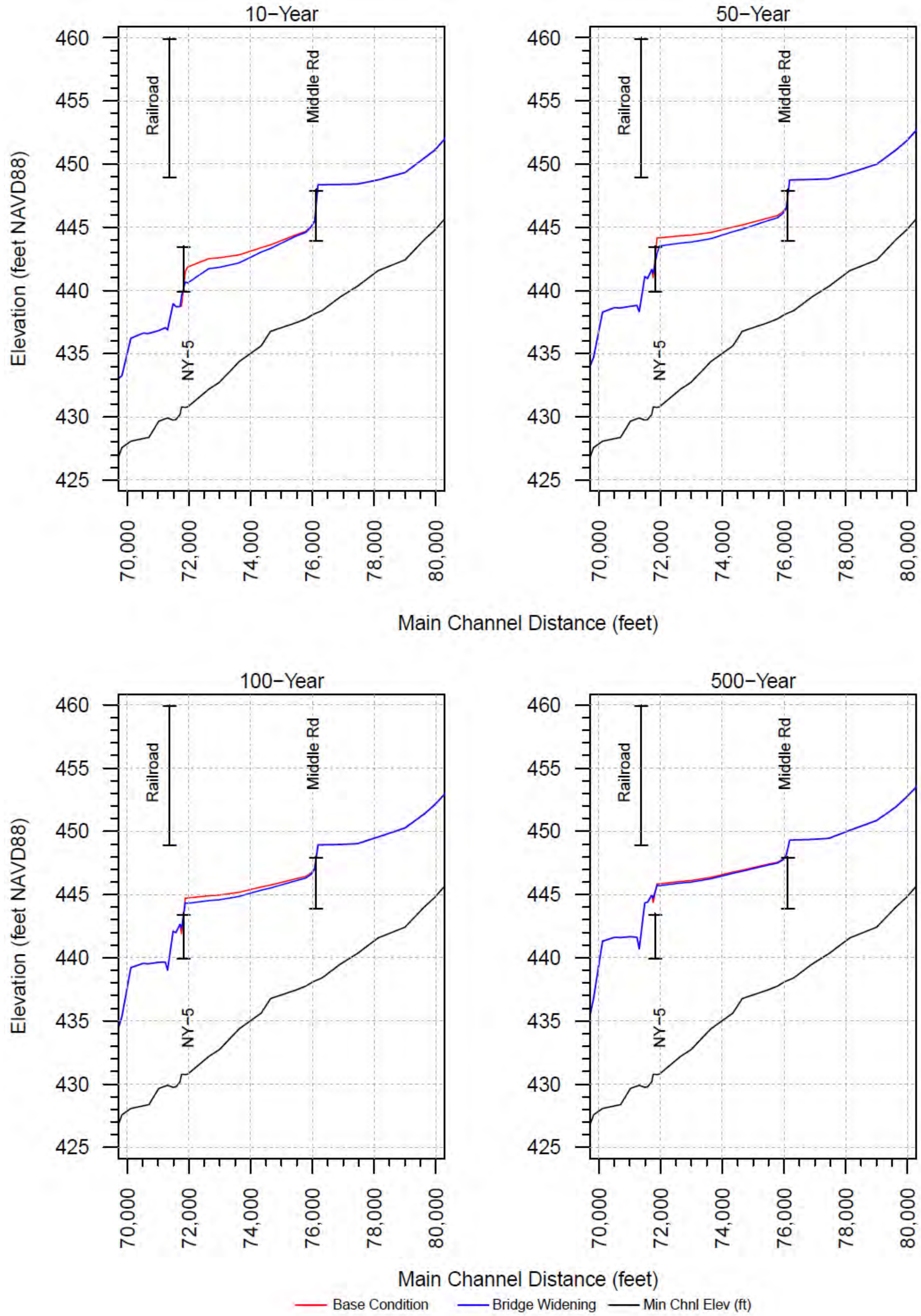

Figure 7-39. HEC-RAS model simulation output results for Alternative #1-12 for the existing condition (red) and proposed alternative (blue) scenarios.

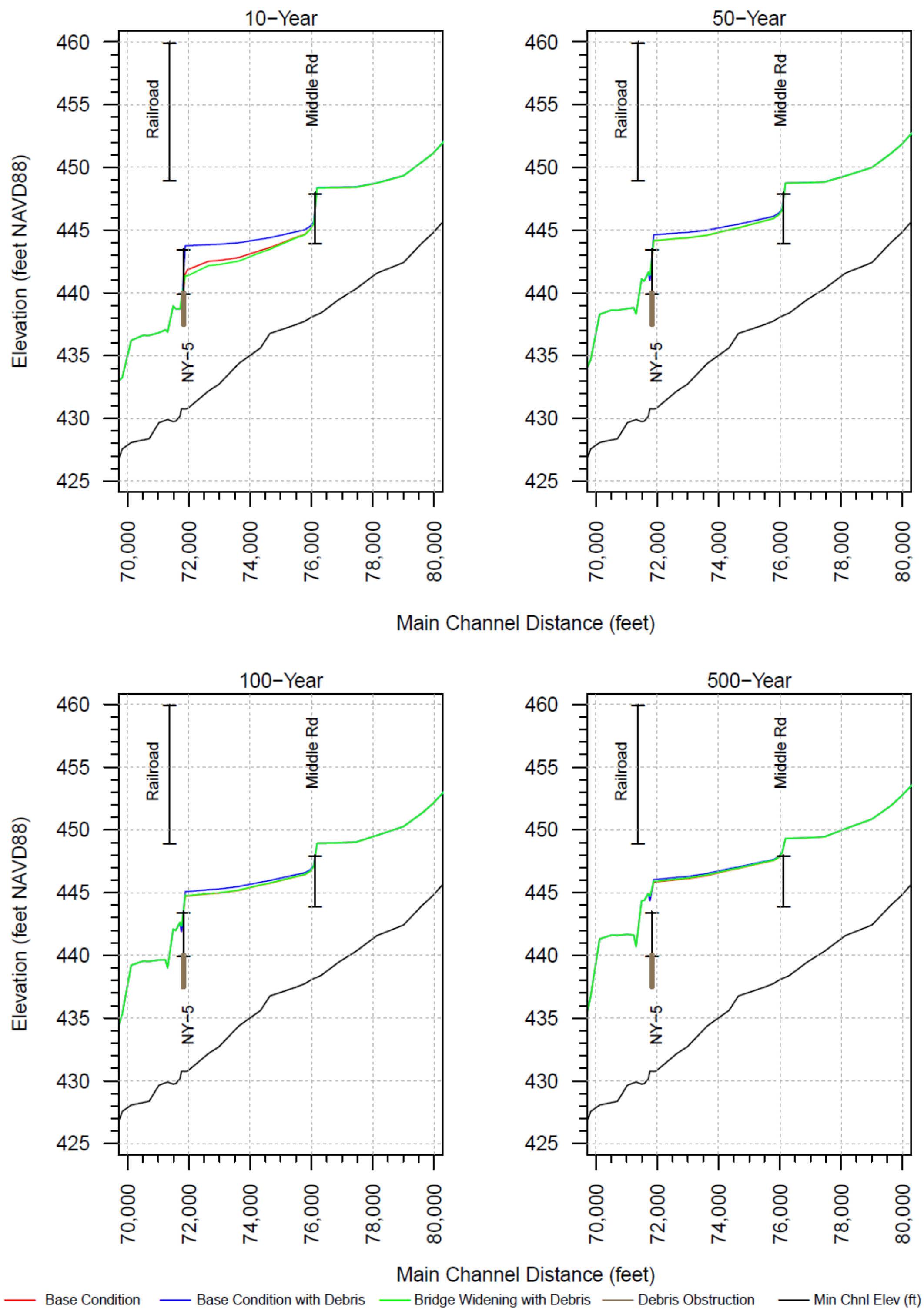

Figure 7-40. HEC-RAS model simulation output results for Alternative #1-12 for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

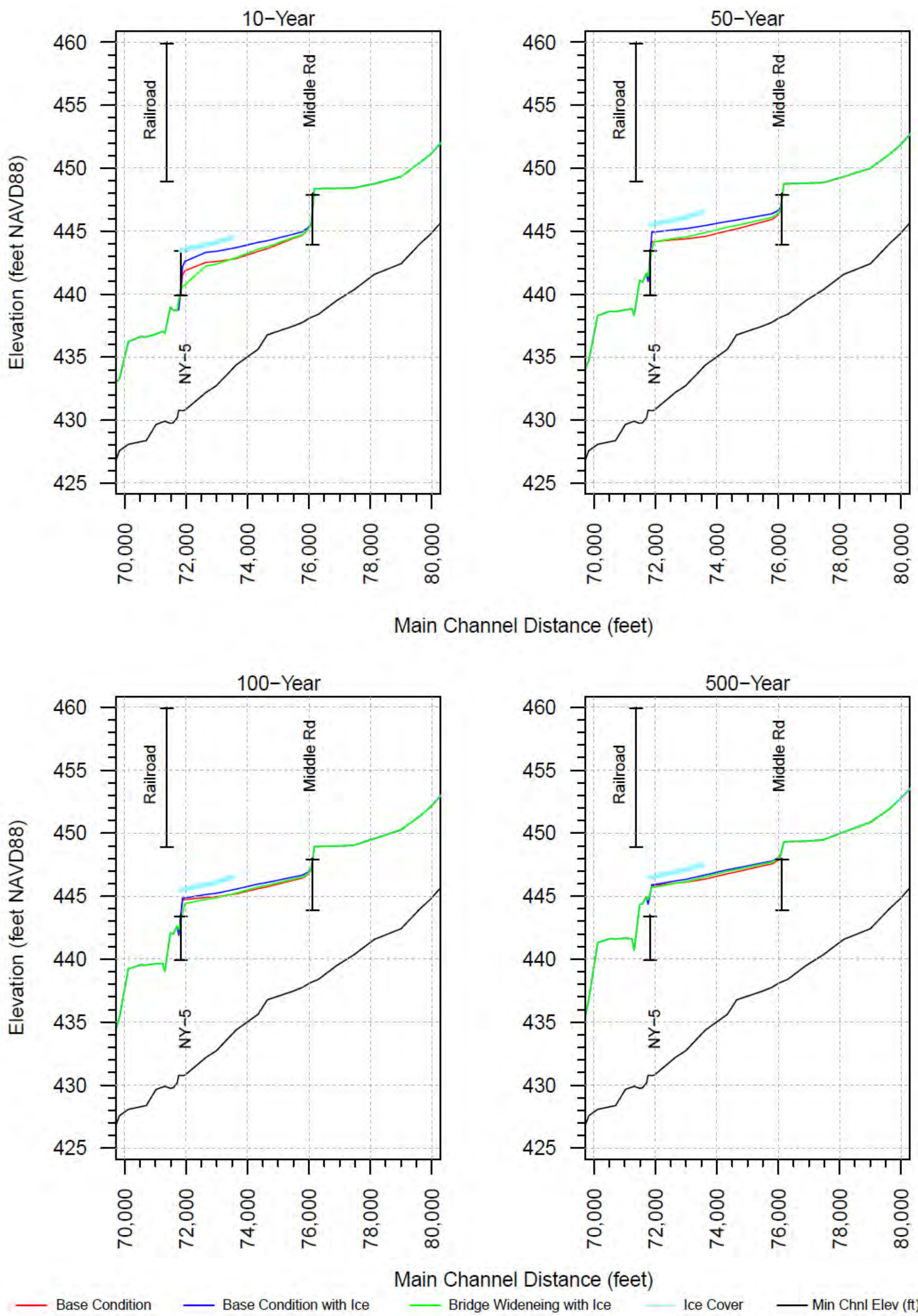

Figure 7-41. HEC-RAS model simulation output results for Alternative #1-12 for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

7.1.13 Alternative #1-13: Flood Benches Upstream of NY-5/Genesee Street

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled upstream of the NY-5/Genesee Street bridge in the City of Oneida (Figure 7-42):

- Flood Bench A is approximately 2.5 acres in size and located between river stations 733+50 to 743+00
- Flood Bench B is approximately 5.5 acres in size and located between river stations 743+00 to 758+50

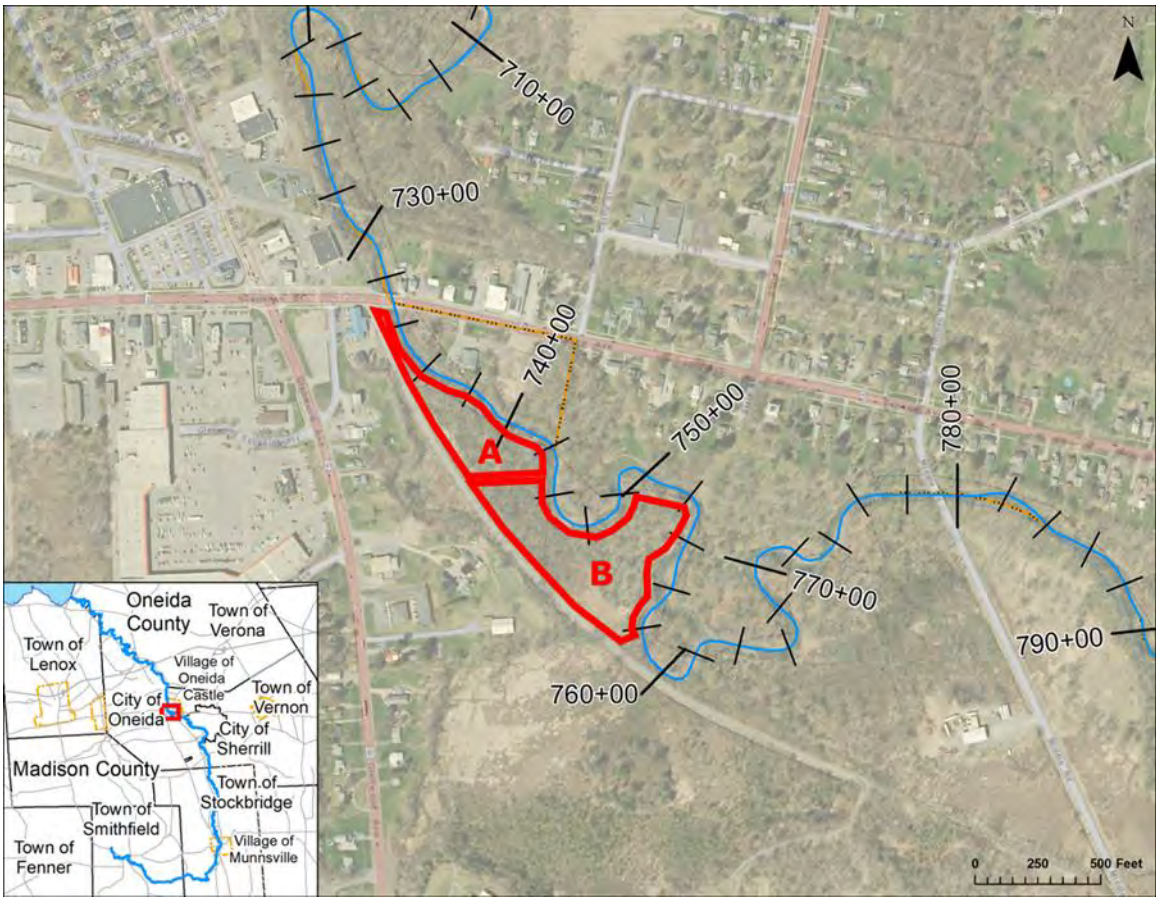

Figure 7-42. Location map for Alternative #1-13.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 3 ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where base flood elevations are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

For this alternative, open-water, debris-obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations for both flood benches.

Table 26 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-43 through 7-48 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 26. Summary Table for Alternative #1-13 Existing Conditions Results Based on Open-Water, Debris Obstruction, and Ice-Jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 0.2-ft	Up to 0.7-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25
Debris Obstruction	Up to 0.1-ft	Up to 0.4-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25
Ice Jam	Up to 0.3-ft	Up to 0.6-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25

Table 27 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 27. Summary Table for Alternative #1-13 Future Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Future Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 0.2-ft	Up to 0.5-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25
Debris Obstruction	Up to 0.1-ft	Up to 0.3-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25
Ice Jam	Up to 0.4-ft	Up to 0.8-ft
Total Length of Benefited Area	4,300-ft	3,475-ft
River Stations	718+25 to 761+25	726+50 to 761+25

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream of the NY-5/Genesee Street bridge would provide moderate flood protection in this reach from open-water and ice-jam flooding. Flood benches upstream of the bridge would also provide significant flood protection from debris/log flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $1.0 million
- Flood Bench B: $2.4 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

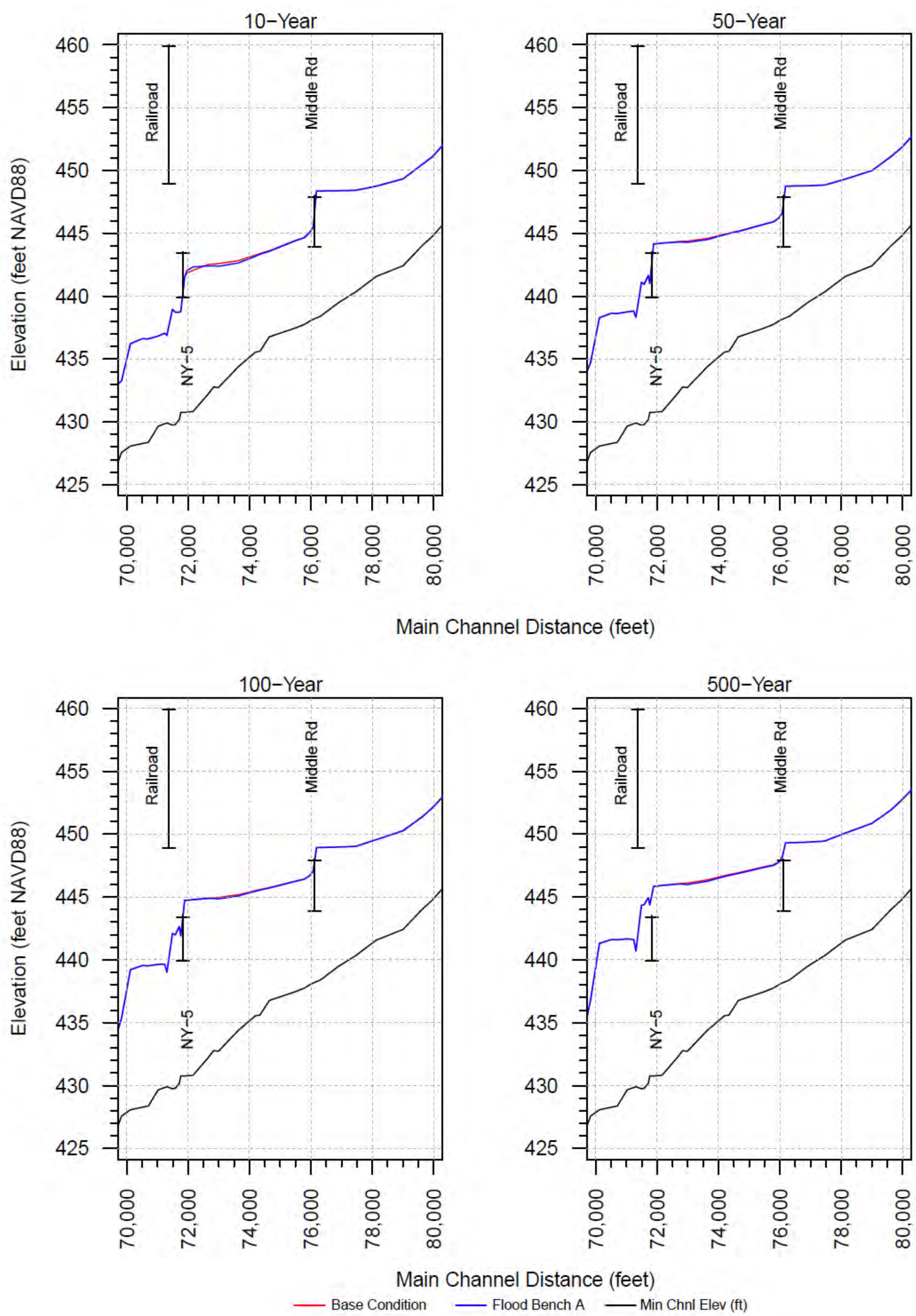

Figure 7-43. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

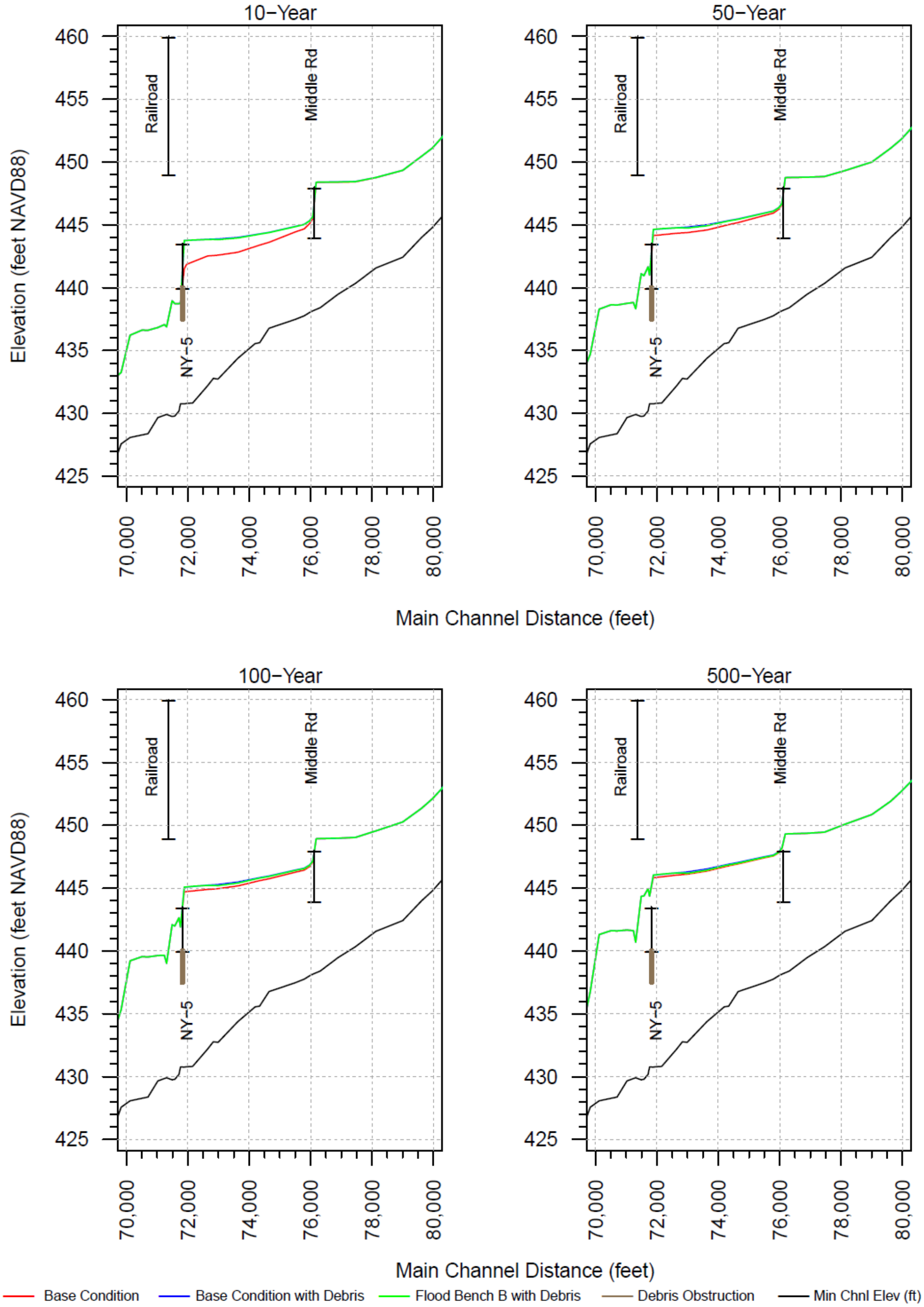

Figure 7-44. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench A for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

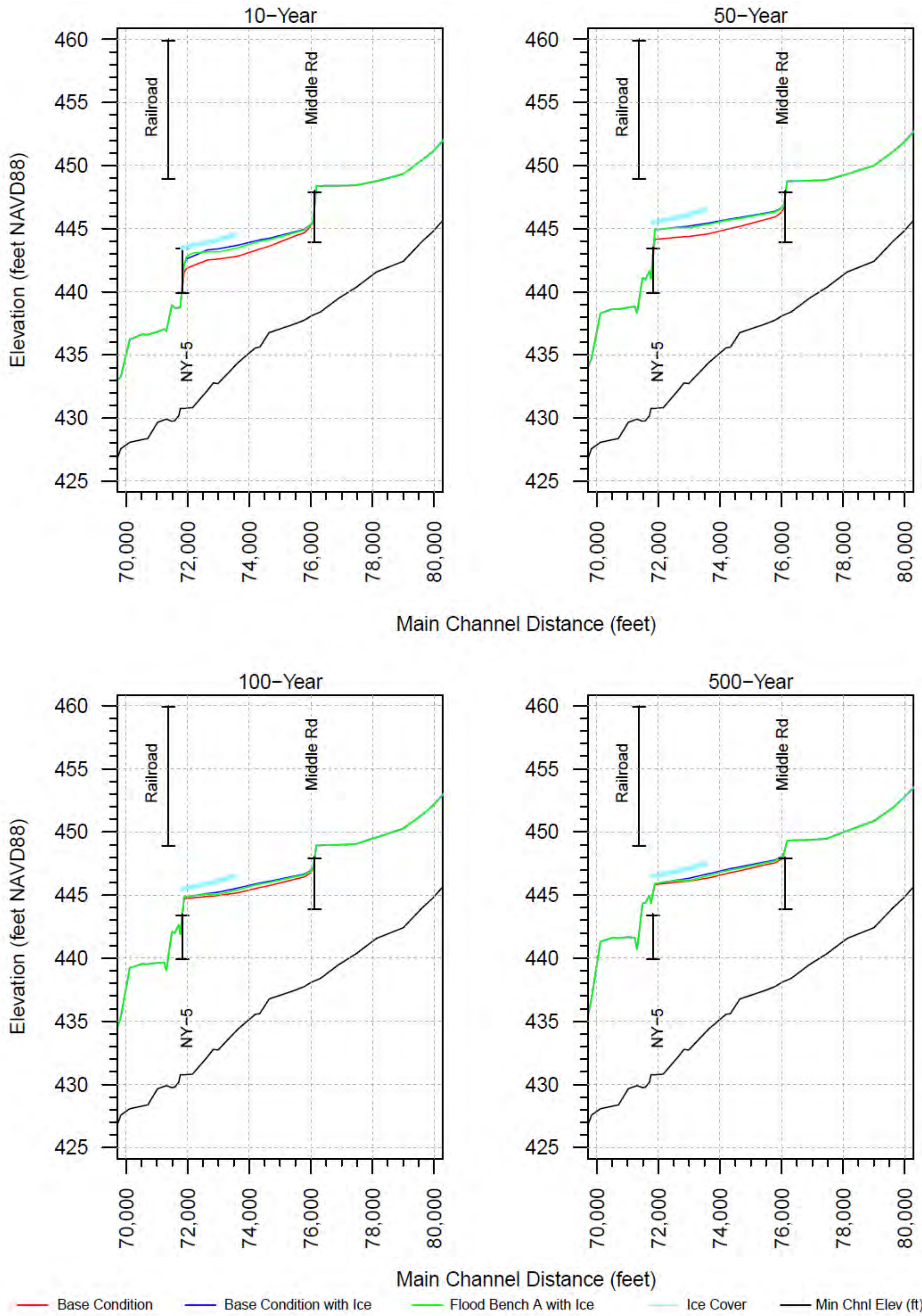

Figure 7-45. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench A for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

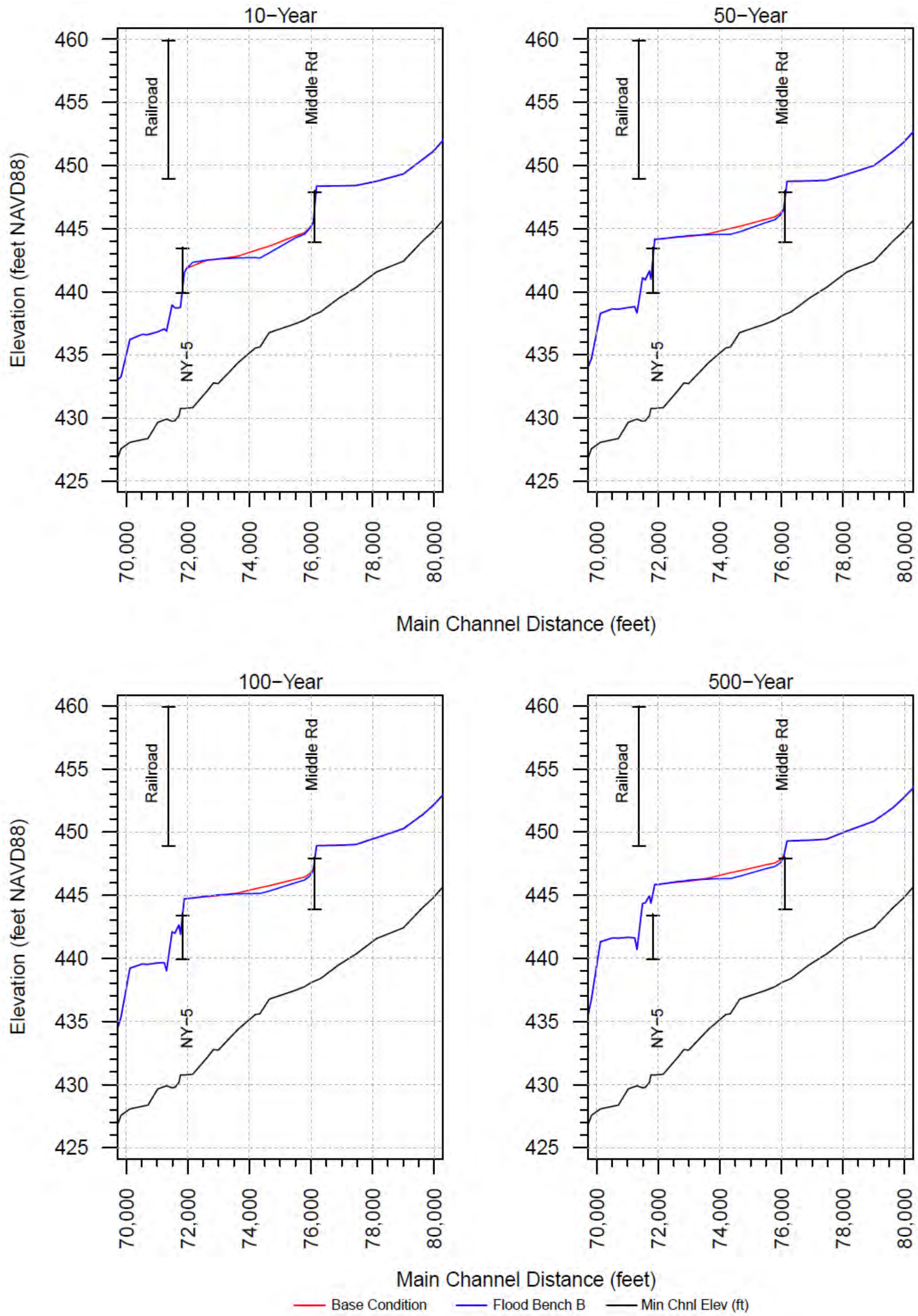

Figure 7-46. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

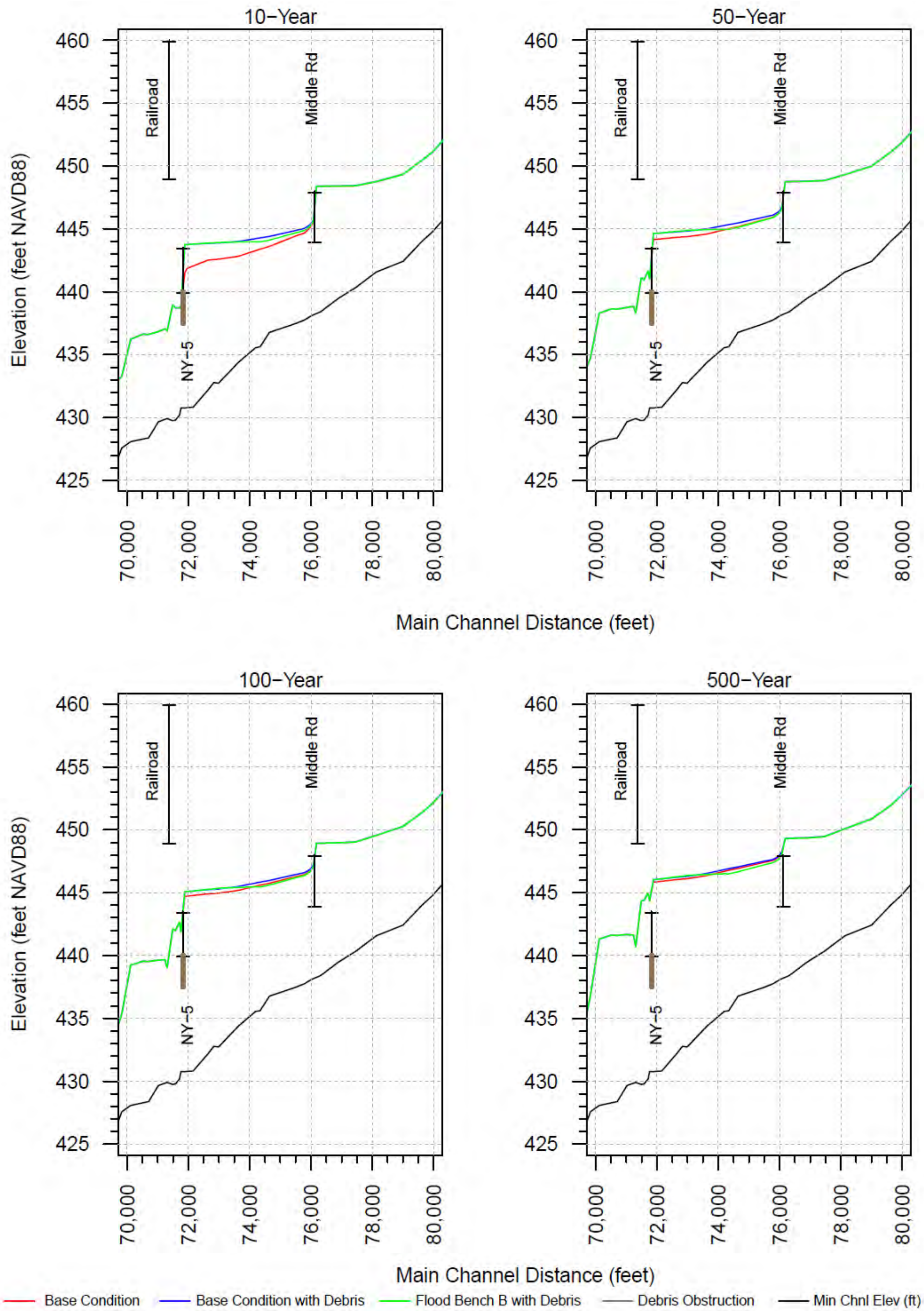

Figure 7-47. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench B for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

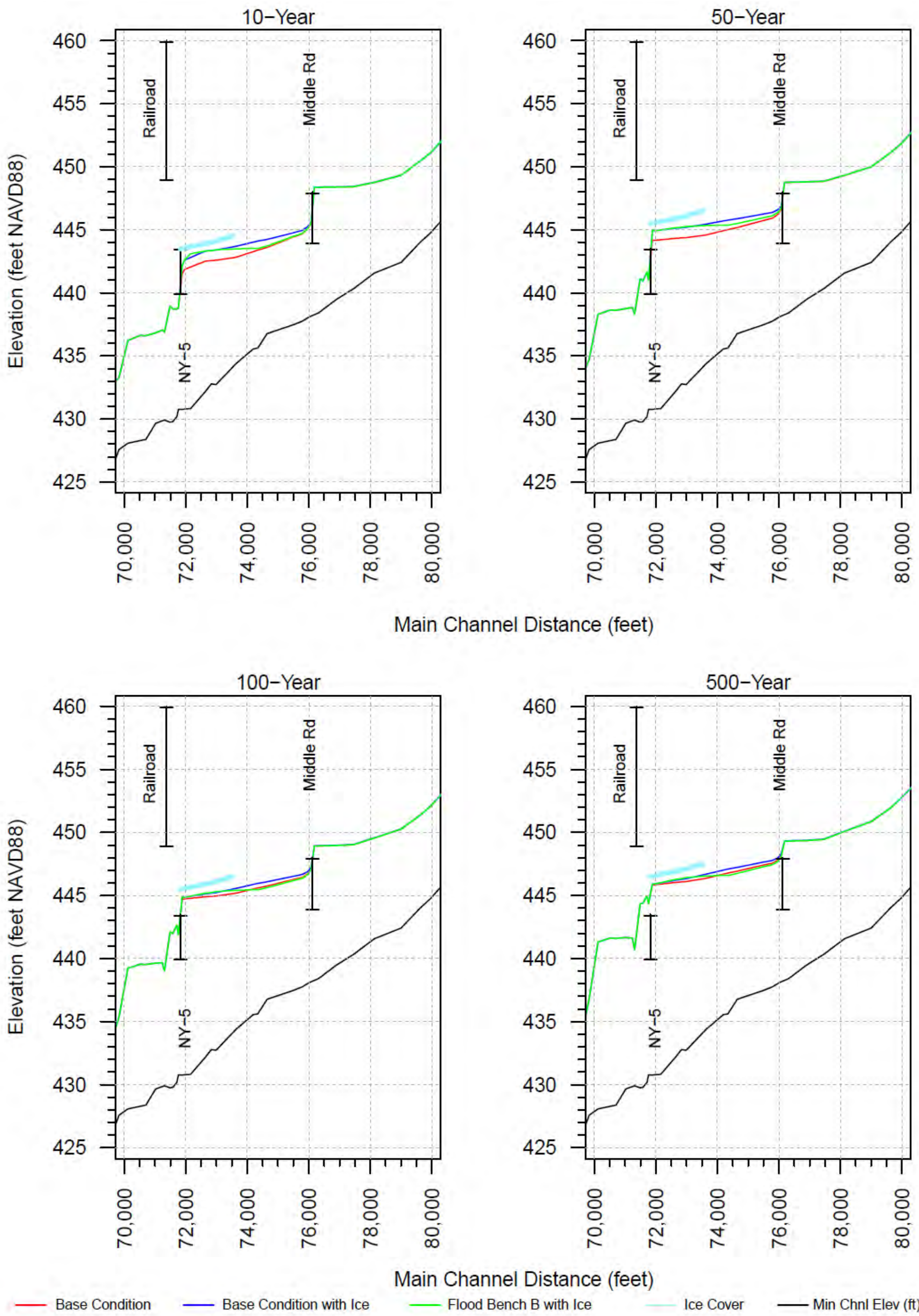

Figure 7-48. HEC-RAS model simulation output results for Alternative #1-13 Flood Bench B for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

7.1.14 Alternative #1-14: Increase the Opening of the Middle Road Bridge

This measure is intended to address issues within High-Risk Area #1 by increasing the width of the Middle Road bridge opening, which would increase the cross-sectional flow area of the channel located at river station 779+50 (Figure 7-49).

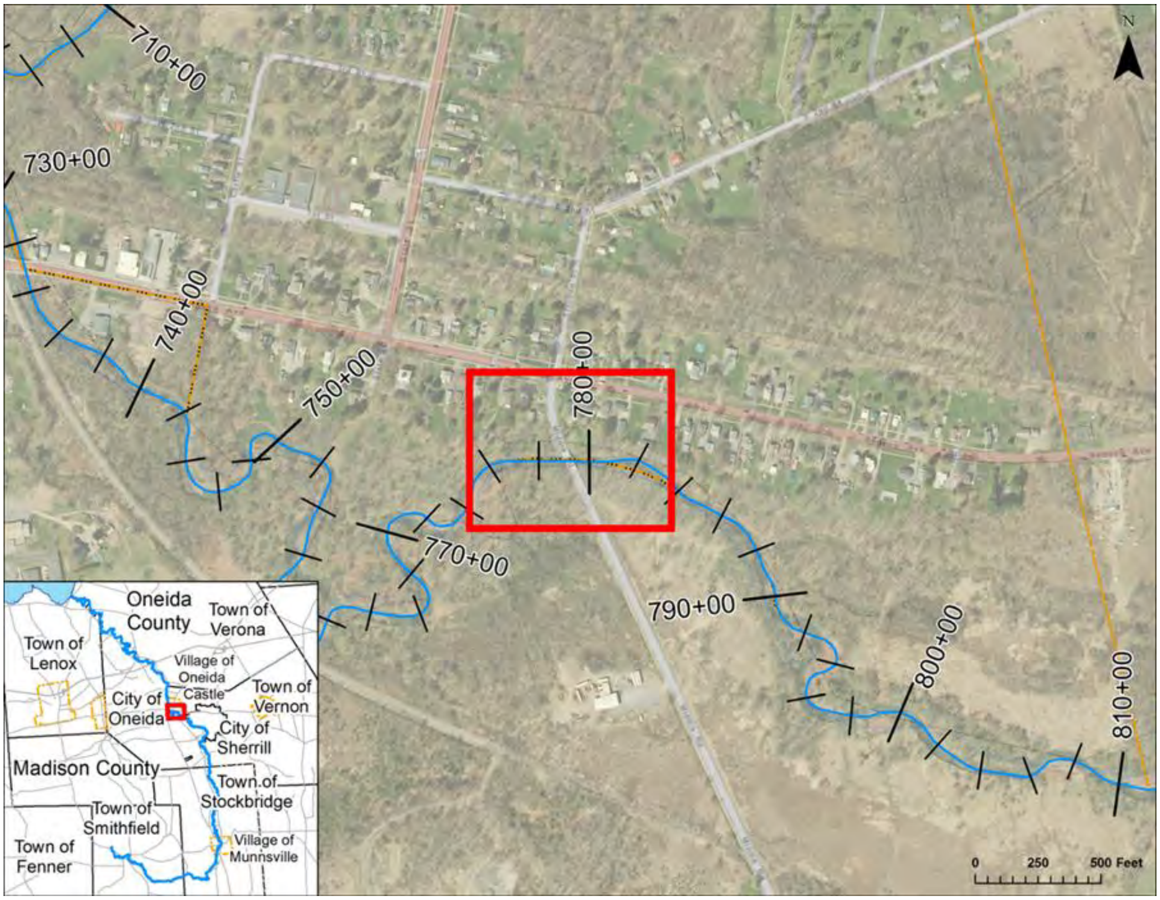

Figure 7-49. Location map for Alternative #1-14.

The bridge is owned by Oneida County and has no pier in the channel. The existing bridge structure has a bridge span of 81 ft and a width of 31 ft (Figure 7-50). The flooding in the vicinity of the Middle Road bridge poses a flood-risk threat to nearby residential properties and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-50. Middle Road bridge, Oneida Castle, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

According to the FEMA FIS, the Middle Road bridge is unable to successfully pass the 10-, 2-, 1-, or 0.2% ACE without significant backwater upstream the of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Middle Road bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 50-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the Middle Road bridge successfully passing the 1% ACE. The results displayed for this proposed alternative are based on widening the bridge opening by 50 ft on the left bank for a total bridge span of 131 ft.

The proposed condition modeling confirmed that the Middle Road bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 2.0 ft in areas approximately 3,875 ft immediately upstream of the bridge, specifically along river stations 761+25 to 800+00 (Figure 7-51). The modeling output for future conditions displayed similar results with water surface reductions of up to 1.3 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to immediately upstream of the Middle Road bridge and to higher frequency (10% ACE) storm events. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $3.3 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 131 ft, cost approximately $3.3 million, and reduce water surface elevations by 2.0 ft immediately upstream of the bridge.

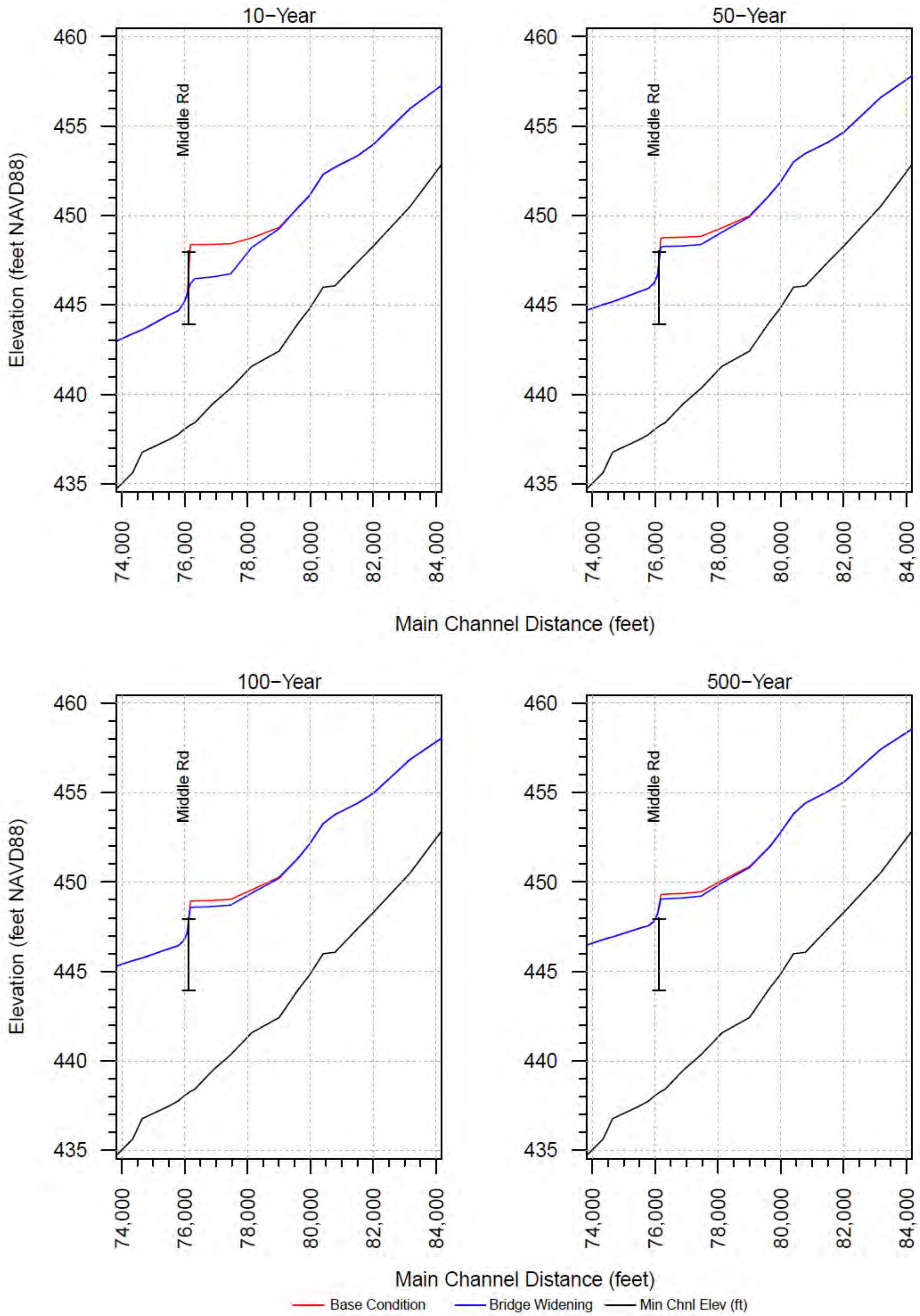

Figure 7-51. HEC-RAS model simulation output results for Alternative #1-14 for the existing condition (red) and proposed alternative (blue) scenarios.

7.2 HIGH-RISK AREA #2

7.2.1 Alternative #2-1: Taylor Creek Sediment & Debris Management Study

This measure is intended to perform a sediment and debris management study on Taylor Creek and the confluence with Oneida Creek. The objective of this study would be to provide an effective method to identify areas within the Taylor Creek basin where sediment and debris build-up contribute to flooding risk and to 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.

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, 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 to define future direction for the watershed and 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.

The study would provide an understanding of the intricacies, complexities, and interrelationships involved in water resource management; outline common issues faced by different municipalities along Taylor Creek; and identify specific strategies and measures to address these issues. Within the Taylor Creek basin, 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 Taylor Creek basin.

The ROM cost estimate for a sediment and debris management study would be $80,000.

7.2.2 Alternative #2-2: Levee Along Sherrill Wastewater Treatment Plant

This strategy is intended to restrict high-flow events from overtopping channel banks and flooding the Sherrill Wastewater Treatment Plant in High-Risk Area #2 by constructing a permanent levee along the right bank of Oneida Creek adjacent to the facility. The levee would be approximately 2,000 linear feet with a height of 2-ft above the flood stage for the 1% ACE flood elevation (461.5 to 459-ft NAVD 88) and located along river stations 848+00 to 864+00 (Figure 7-52).

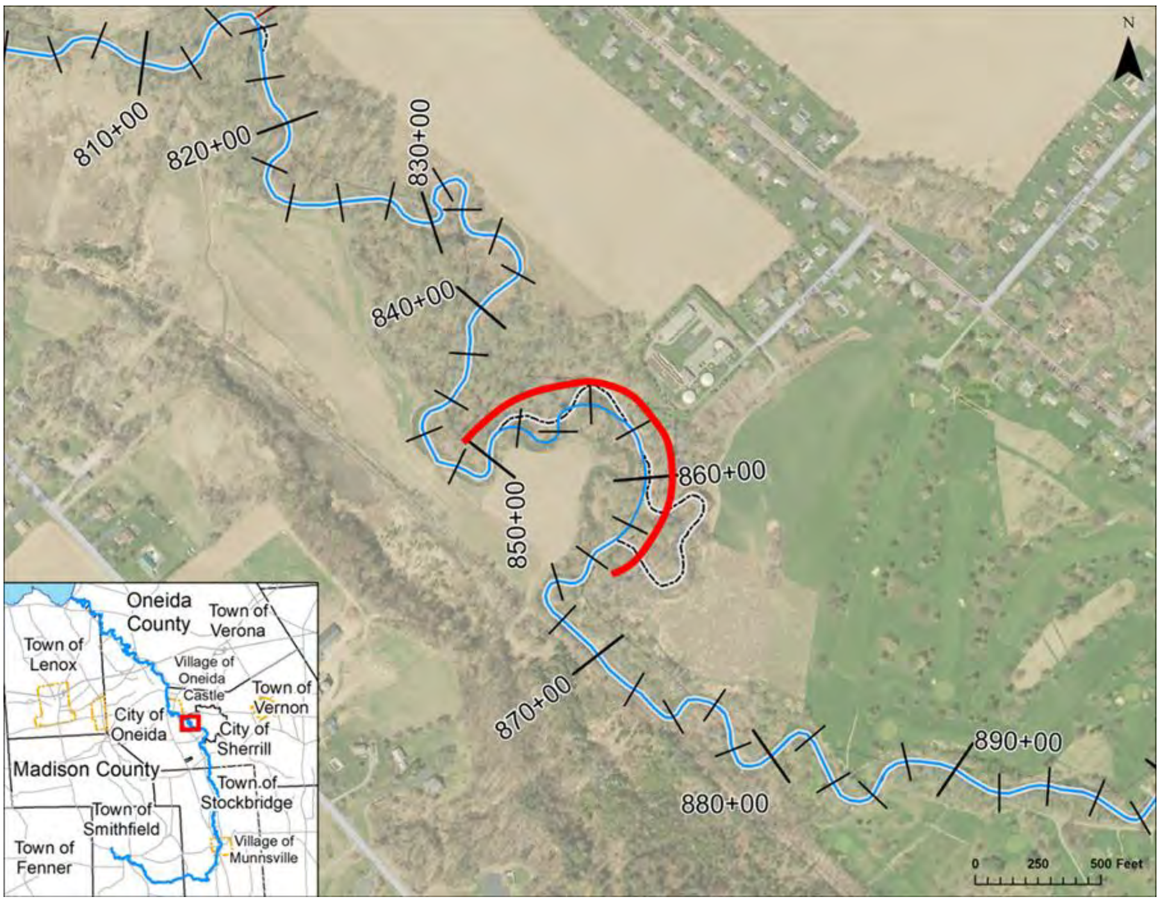

Figure 7-52. Location map for Alternative #2-2.

Compaction and the possibility of using cut material as fill was not accounted for with this alternative. Downstream and opposite bank effects of the levee were modelled to determine if the levee would have any measurable effects on upstream or downstream water surface elevations.

The proposed condition modeling simulation results indicated water surface increases of up to 1.5 ft in areas approximately 4,550 ft immediately upstream and downstream of the facility extending upstream to the Oneida Community Golf Club footbridge (1), specifically along river stations 820+00 to 865+50 (Figure 7-53). The modeling output for future conditions displayed similar results with water surface increases of up to 1.8 ft in the vicinity of the levee. Full model outputs for this alternative can be found in Appendix G.

The proposed present and future conditions modeling confirmed that constructing a levee along Oneida Creek in the reach adjacent to Sherrill Wastewater Treatment Plant would decrease the flood risk to the facility, while leaving the flood potential of downstream and opposite bank areas unaffected.

Without the levee, a 1% ACE would overtop the channel banks upstream of the facility inundating the Oneida Community Golf Club, adjacent residential properties along W Hamilton Avenue, and portions of the facility and surrounding areas. With the levee, model simulation results indicated this water would remain in the channel in the vicinity of the facility and flow downstream causing water surface elevations to increase without impairing the adjacent properties. The potential benefits of this alternative are in the vicinity of the levee at river stations 848+00 to 864+00.

Any levee constructed in the Oneida Creek watershed would need to follow the USACE Design and Construction of Levees (EM 1110-2-1913) guidelines, including obtaining the required individual, regional, and nationwide permits for design, construction, and maintenance of a levee (USACE 2000).

The USACE has the authority to construct small flood risk-reduction projects that are engineeringly feasibly, structurally sound and cost efficient through the authority provided under Section 205 of the 1948 Flood Control Act (FCA), as amended. Coordination should also occur with the NYSDEC as they need to be the non-Federal sponsor on these types of projects. In addition, a FEMA BCA would need to be performed to determine the cost-effectiveness of the alternative prior to applying for FEMA mitigation grant programs funding.

A levee would require significant engineering, construction, and maintenance efforts throughout its lifespan, resulting in a relatively high cost burden. Levees should be placed as far away from the creek channel as possible to maximize the capacity of the natural floodplain to convey floodwaters, and designed and constructed in a manner that does not cause flooding downstream of the structure. In addition, strict requirements would need to be met to comply with NFIP requirements (44 CFR §65.10) to affect a building's flood insurance rating. However, it must be noted that a levee would not remove areas from the FEMA mapped floodplain. A levee would only provide additional flood protection for a certain level of annual chance flood event. Homeowners and businesses behind the levee would still be required to purchase flood insurance if they are within any FEMA designated flood zones (FEMA 2000).

The Rough Order Magnitude cost for this strategy is approximately $1.6 million, which does not include permitting, annual maintenance or land acquisition costs for survey, appraisal, and engineering coordination. This estimate also assumes suitable clay material for levee fill that meets USACE requirements is readily available and nearby.

In addition, closure structures, tie-ins and pump stations were not discussed as these structures should be considered on an as needed basis to address interior drainage. As such, the cost estimate for this alternative did not include the associated costs for these structures.

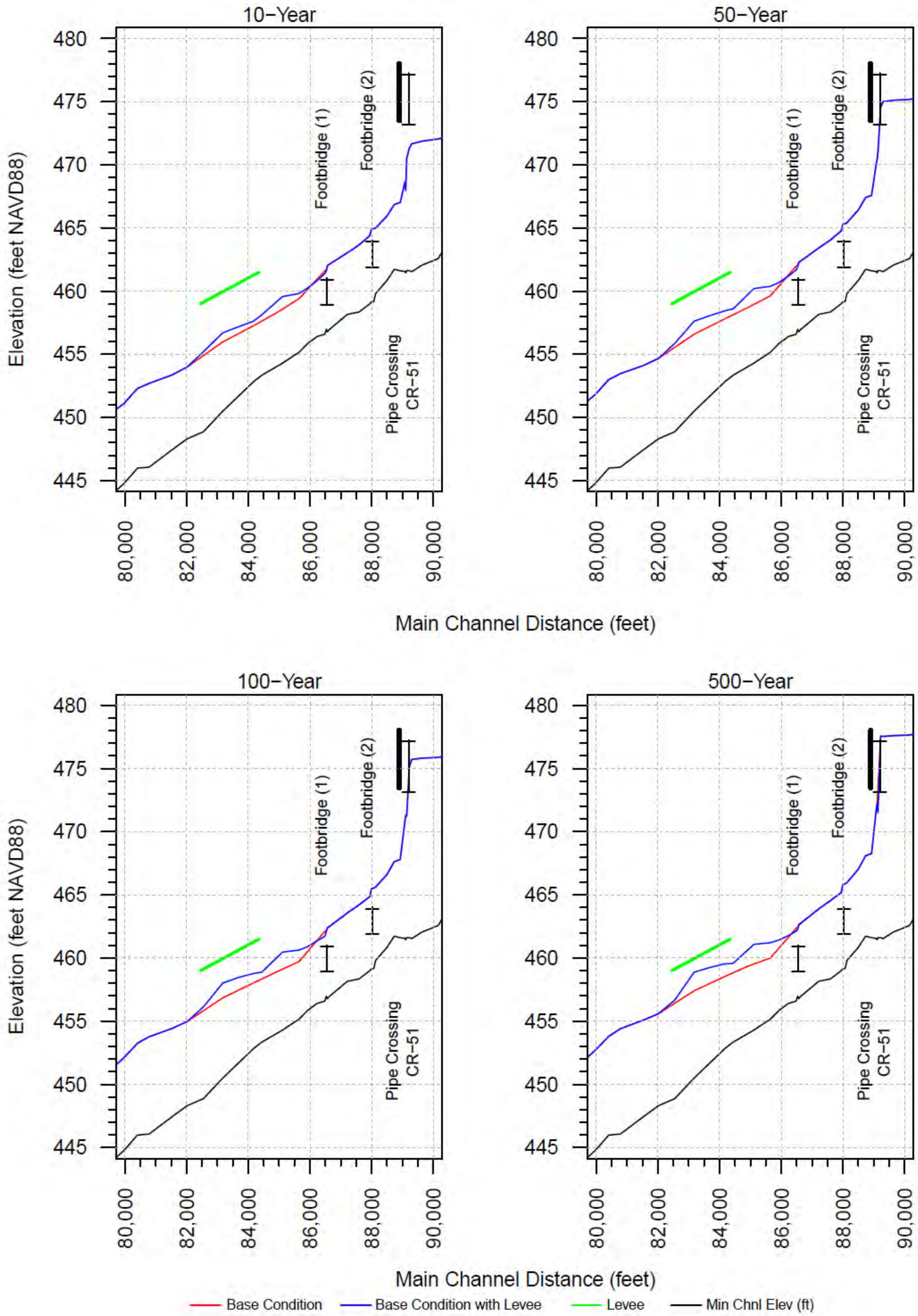

Figure 7-53. HEC-RAS model simulation output results for Alternative #2-2 for the existing condition (red) and proposed alternative (blue) scenarios.

7.2.3 Alternative #2-3: Flood Benches in Vicinity of Sherrill Wastewater Treatment Plant

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #1. Two potential flood benches were modeled upstream and downstream of Sconondoa Road in the Towns of Verona and Vernon, NY (Figure 7-54):

- Flood Bench A is approximately 4.0 acres in size and located between river stations 838+00 to 856+50
- Flood Bench B is approximately 3.0 acres in size and located between river stations 864+00 to 875+00

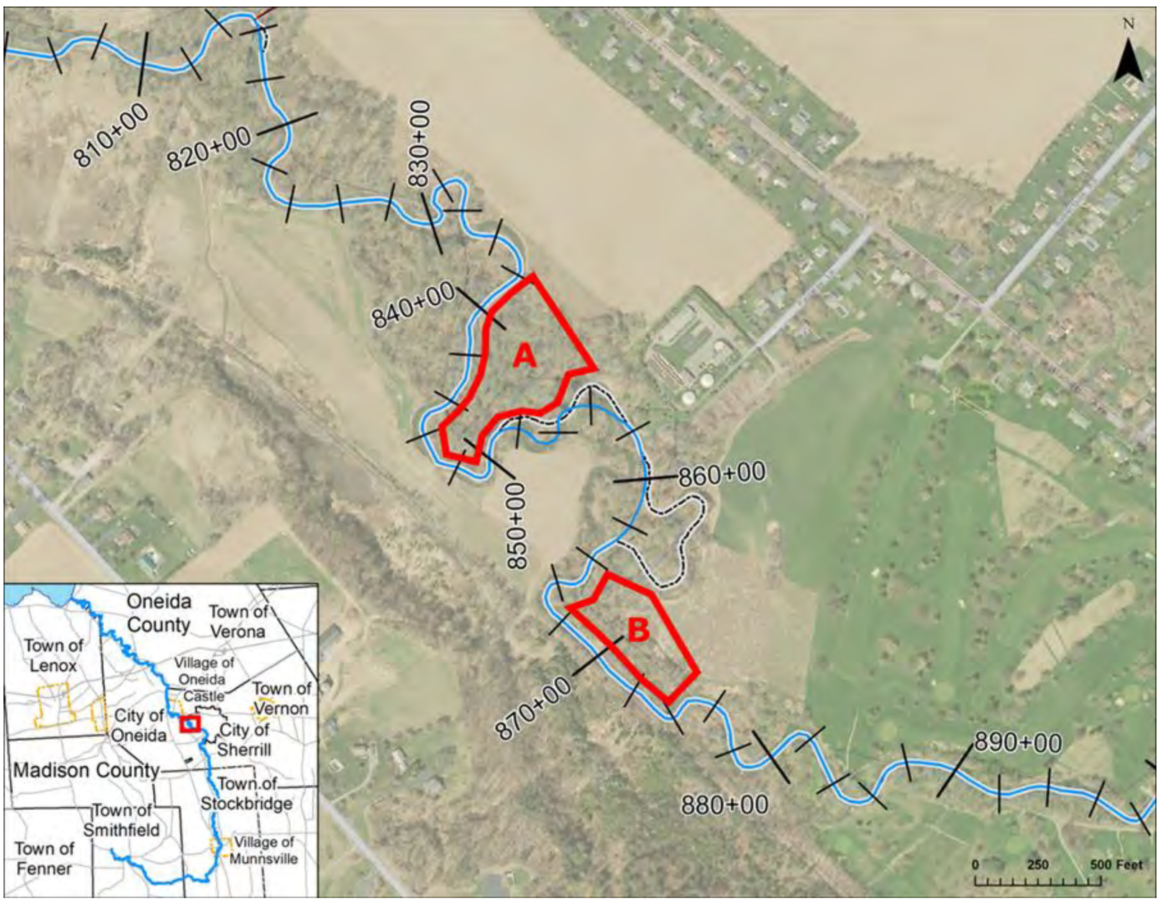

Figure 7-54. Location map for Alternative #2-3.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 2-ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where base flood elevations are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 28 outlines the results of the proposed present and future conditions model simulations for open-water flooding only. Figures 7-55 and 7-56 display the profile plots for each initial condition scenario for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 28. Summary Table for Alternative #2-3 Existing Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 1.7-ft	Up to 0.5-ft
Total Length of Benefited Area	4,900-ft	2,550-ft
River Stations	816+50 to 865+50	840+00 to 865+50
Future Proposed Conditions		
Open-Water	Up to 1.6-ft	Up to 0.4-ft
Total Length of Benefited Area	4,900-ft	2,550-ft
River Stations	816+50 to 865+50	840+00 to 865+50

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream and downstream of the Sherrill Wastewater Treatment Plant would provide significant flood protection in this reach from open-water flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $1.6 million
- Flood Bench B: $1.2 million

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

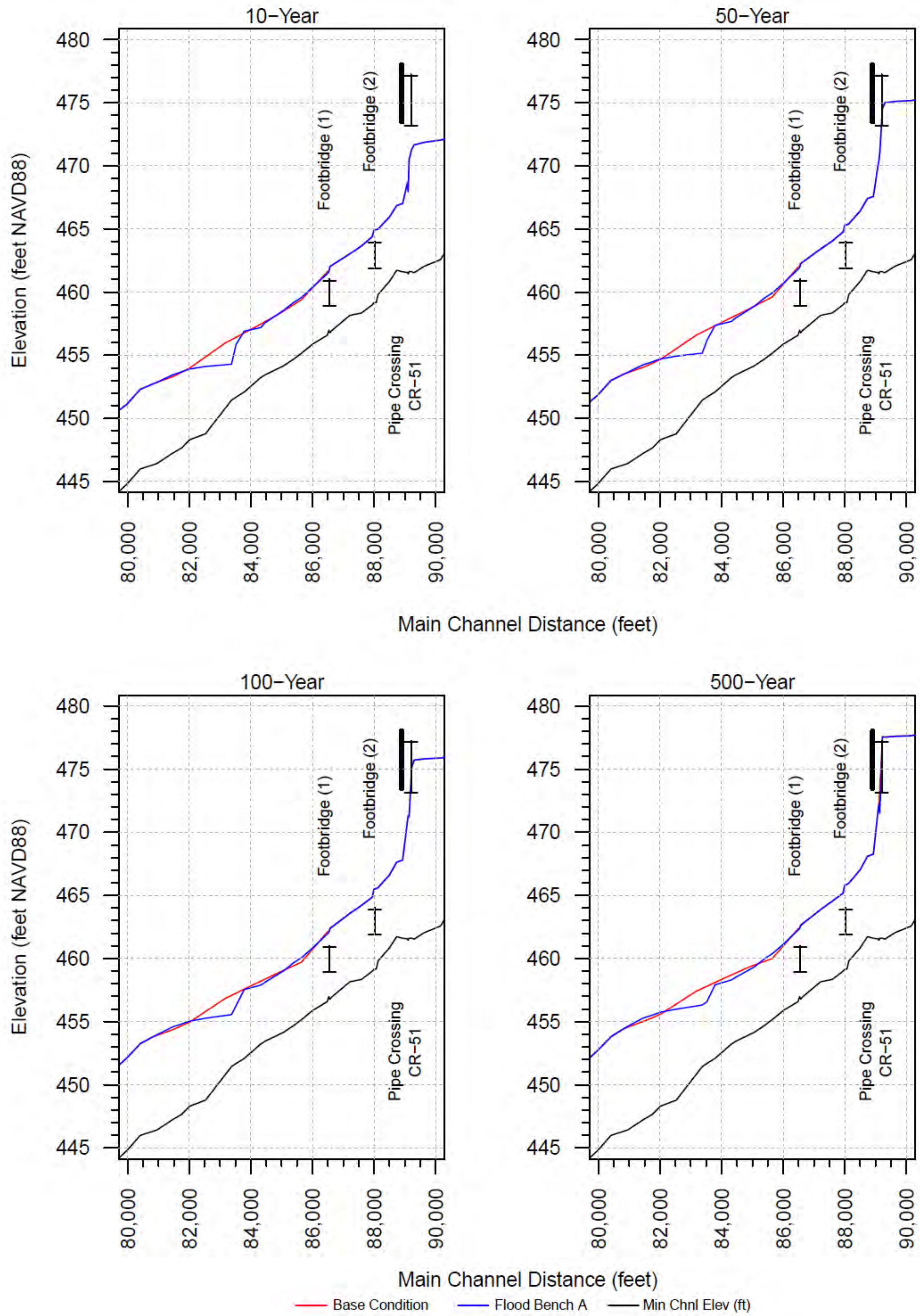

Figure 7-55. HEC-RAS model simulation output results for Alternative #2-3 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

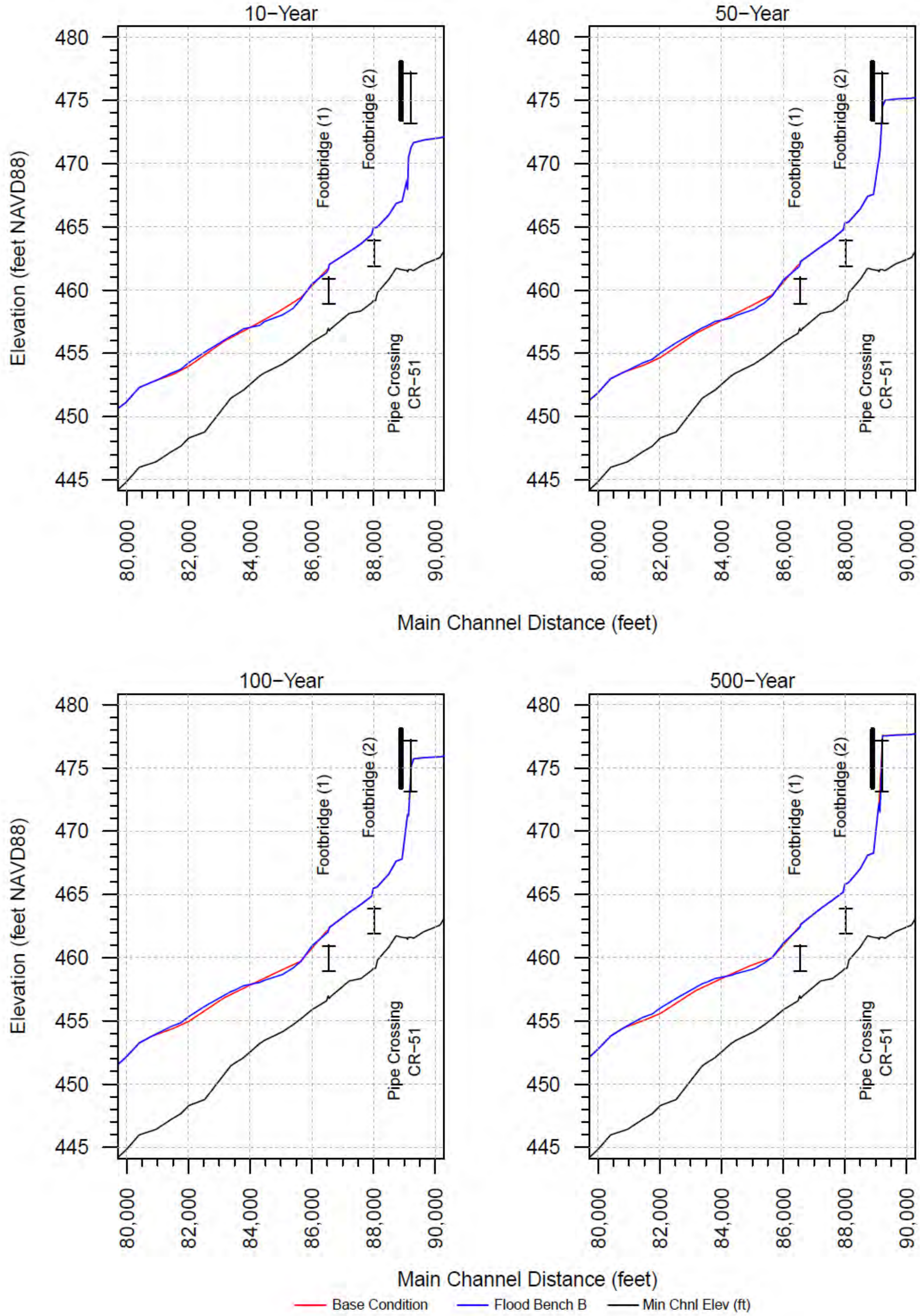

Figure 7-56. HEC-RAS model simulation output results for Alternative #2-3 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

7.2.4 Alternative #2-4: Increase the Opening of the Sherrill Road/CR-51 Kenwood Avenue

This measure is intended to address issues within High-Risk Area #2 by increasing the width of the Sherrill Road/CR-51 Kenwood Avenue bridge opening, which would increase the cross-sectional flow area of the channel located at river station 910+50 (Figure 7-57).

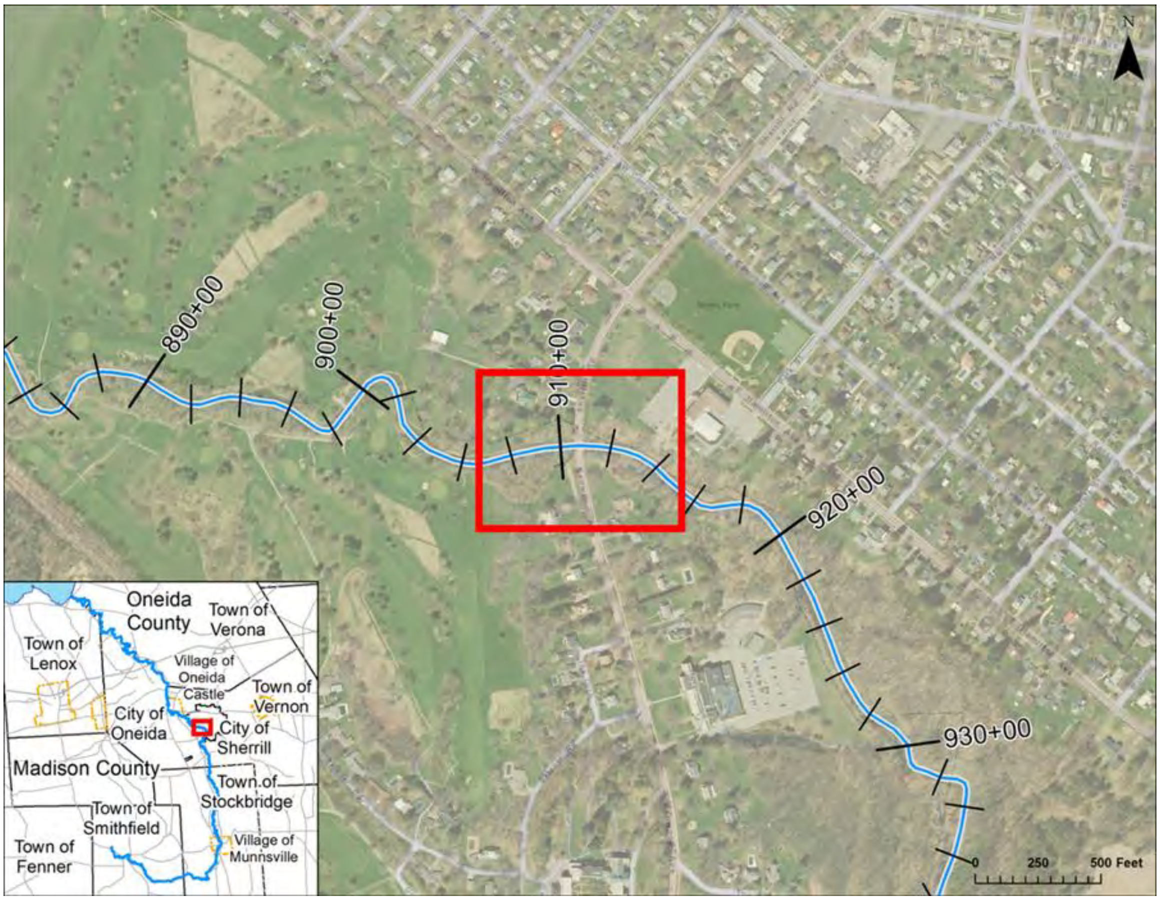

Figure 7-57. Location map for Alternative #2-4.

The bridge is owned by Oneida County and has no pier in the channel. The existing bridge structure has a bridge span of 58 ft and a width of 22 ft (Figure 7-58). The flooding in the vicinity of the Sherrill Road/CR-51 Kenwood Avenue bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-58. Sherrill Road/CR-51 Kenwood Avenue bridge, Sherrill, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

According to the FEMA FIS profile plot, the Sherrill Road/CR-51 Kenwood Avenue bridge indicates the bridge is unable to successfully pass the 1- or 0.2% ACE event without significant backwater upstream the of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the Sherrill Road/CR-51 Kenwood Avenue bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 30-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the Sherrill Road/CR-51 Kenwood Avenue bridge successfully passing the 1% ACE without significant backwater upstream of the bridge. The results displayed for this proposed alternative are based on widening the bridge opening by 30 ft on the right bank for a total bridge span of 88 ft.

The proposed condition modeling confirmed that the Sherrill Road/CR-51 Kenwood Avenue bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 1.7 ft in areas approximately 3,550 ft immediately upstream of the bridge nearly extending to the CR-51 Kenwood

Avenue/CR-25 Hamilton Street bridge, specifically along river stations 892+00 to 927+50 (Figure 7-59). The modeling output for future conditions displayed similar results with water surface reductions of up to 2.0 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to upstream of the Sherrill Road/CR-51 Kenwood Avenue bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.0 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. This cost estimate does include extending the utility pipeline immediately downstream of the bridge. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 88 ft, cost approximately $2.0 million, and reduce water surface elevations by 1.7 ft immediately upstream of the bridge.

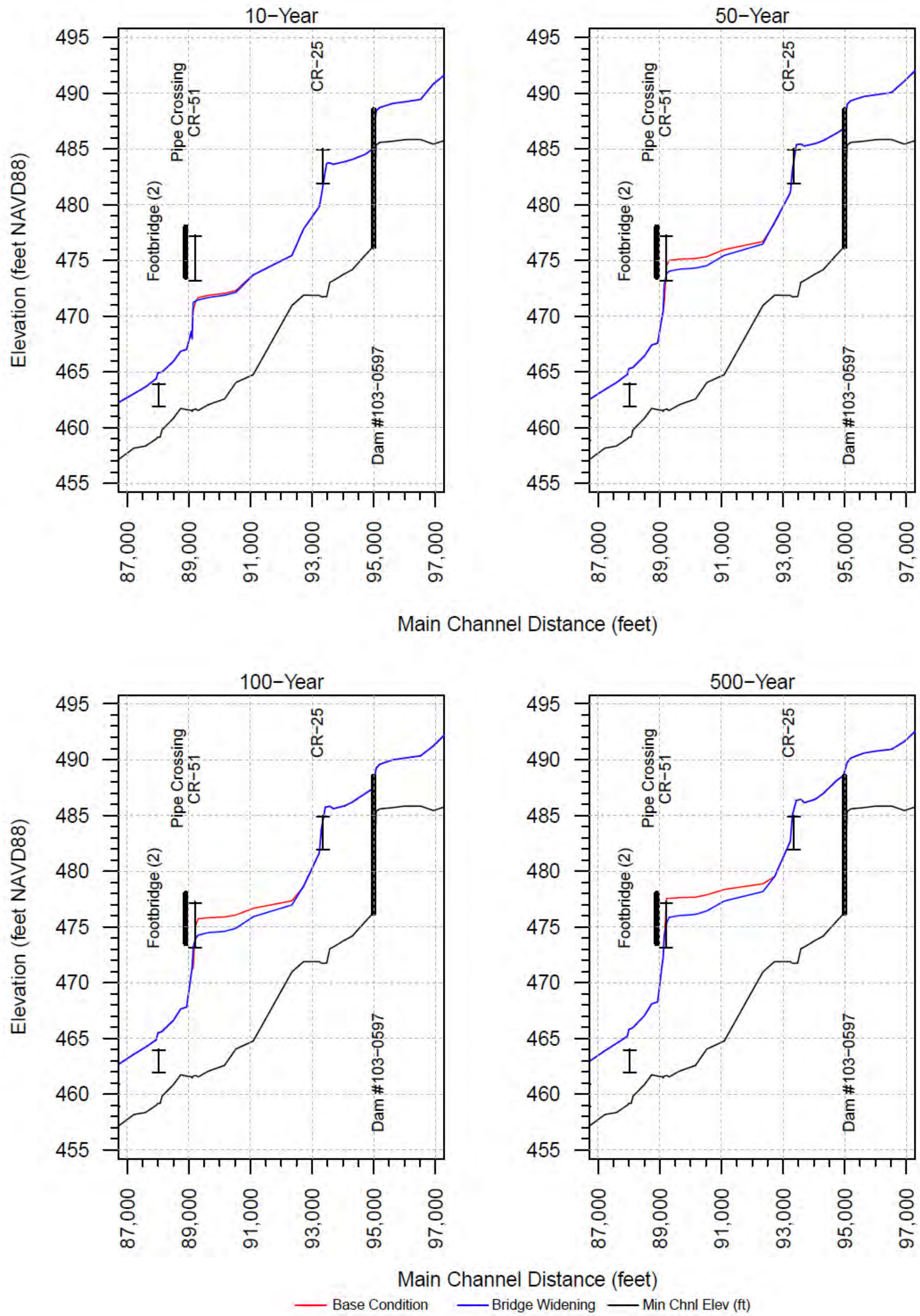

Figure 7-59. HEC-RAS model simulation output results for Alternative #2-4 for the existing condition (red) and proposed alternative (blue) scenarios.

7.2.5 Alternative #2-5: Flood Bench Between Sherrill Road/CR-51 Kenwood Avenue and CR-51 Kenwood Avenue/CR-25 Hamilton Street

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #2. One potential flood bench was modeled between the Sherrill Road/CR-51 Kenwood Avenue and CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge crossings located between river stations 923+00 to 944+00. The flood bench is approximately 7.0 acres in size (Figure 7-60).

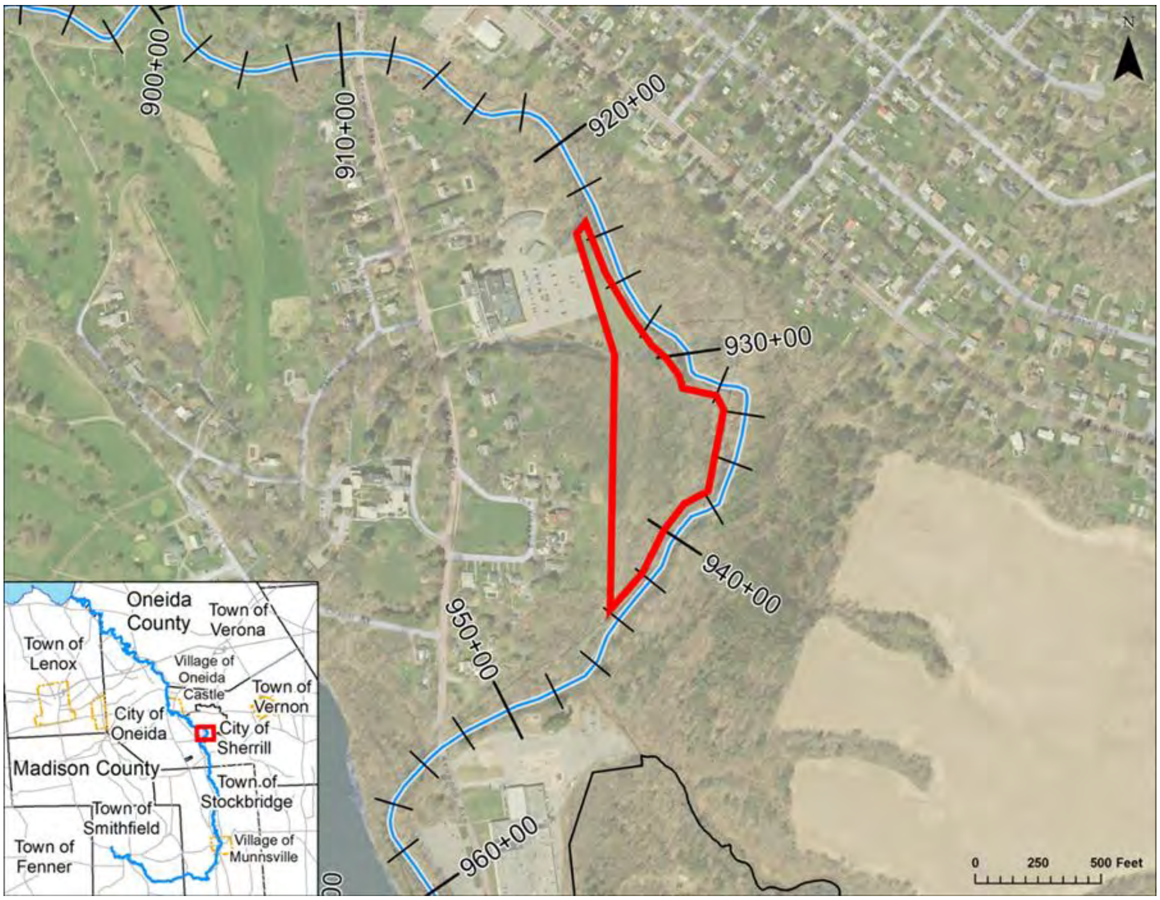

Figure 7-60. Location map for Alternative #2-5.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 3.5-ft for the flood bench.

The flood bench is within the FEMA designated SFHA or Zone AE, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where base flood elevations are provided, and the regulatory floodway (FEMA 2001b). Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 29 outlines the results of the proposed present and future conditions model simulations for open-water conditions only. Figure 7-61 displays the profile plot for the flood bench alternative under open-water conditions. Full model outputs for this alternative can be found in Appendix G.

Table 29. Summary Table for Alternative #2-5 Existing Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 1.4-ft
Total Length of Benefited Area	3,200-ft
River Stations	901+50 to 933+50
Future Proposed Conditions	
Open-Water	Up to 1.4-ft
Total Length of Benefited Area	3,200-ft
River Stations	901+50 to 933+50

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, a flood bench located between the Sherrill Road/CR-51 Kenwood Avenue and CR-51 Kenwood Avenue/CR-25 Hamilton Street would provide significant flood protection in this reach from open-water flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for the flood bench alternative is $3.0 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

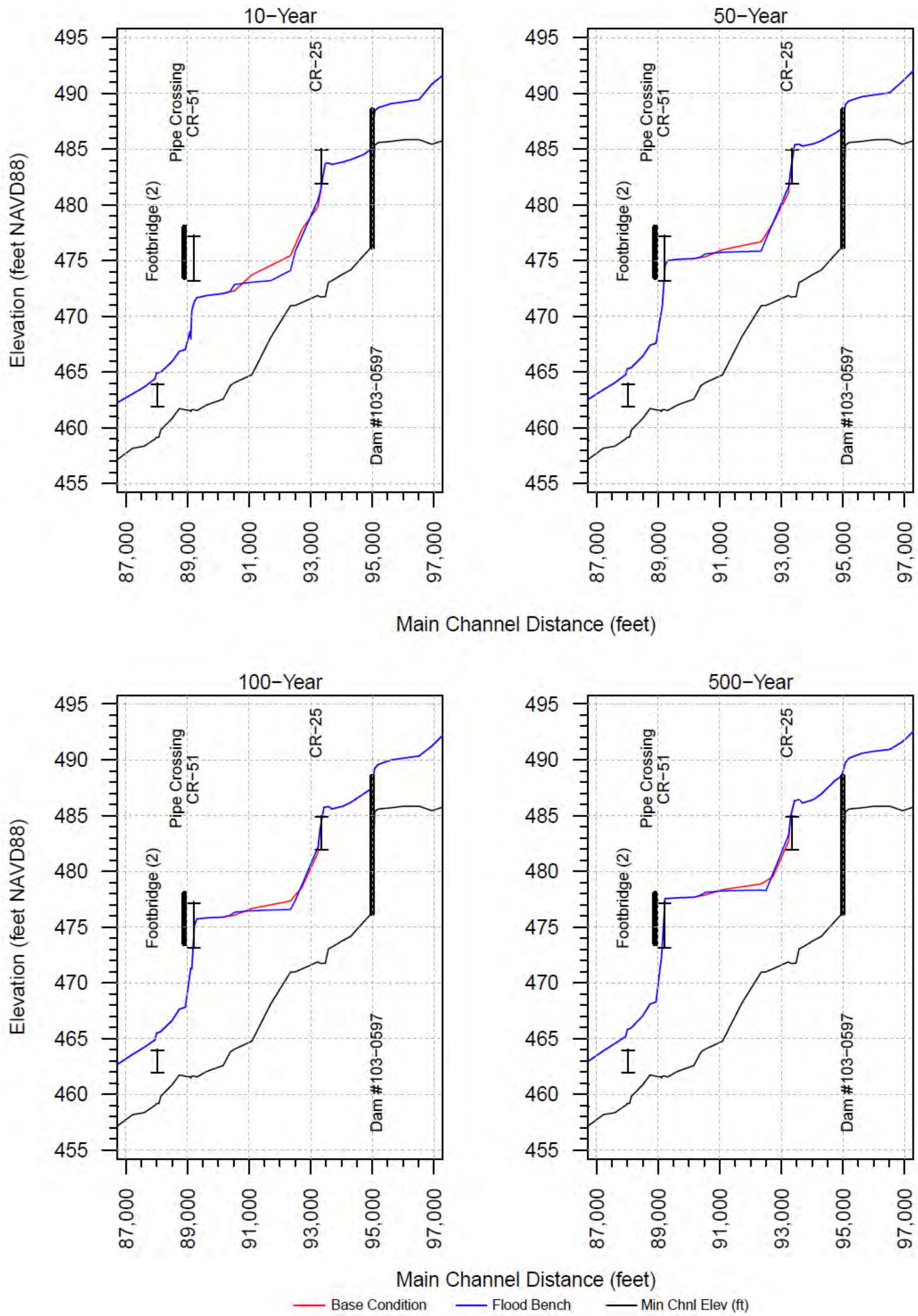

Figure 7-61. HEC-RAS model simulation output results for Alternative #2-5 for the existing condition (blue) and proposed alternative (red) scenarios.

7.2.6 Alternative #2-6: Increase the Opening of the CR-51 Kenwood Avenue/CR-25 Hamilton Street Bridge

This measure is intended to address issues within High-Risk Area #2 by increasing the width of the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge opening, which would increase the cross-sectional flow area of the channel located at river station 953+00 (Figure 7-62).

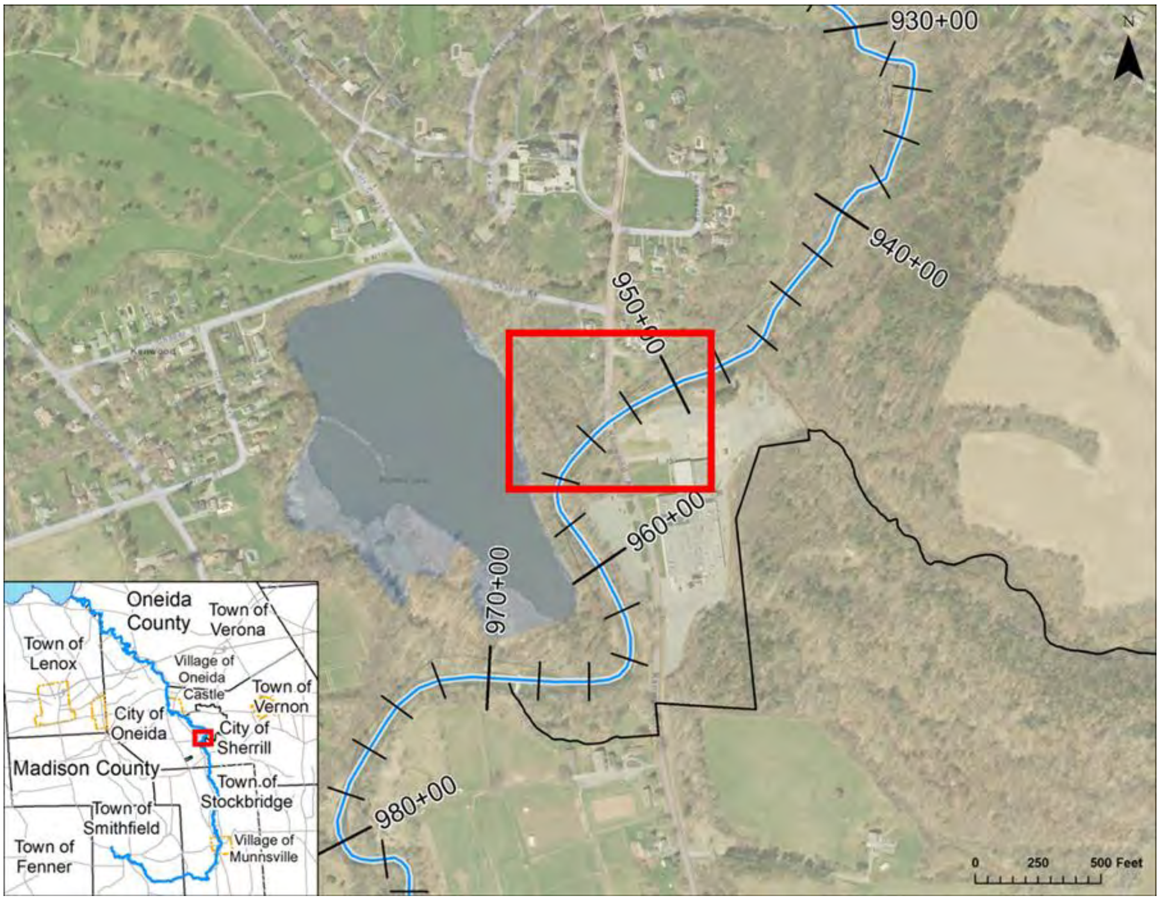

Figure 7-62. Location map for Alternative #2-6.

The bridge is owned by Madison County and has no pier in the channel. The existing bridge structure has a bridge span of 51 ft and a width of 26.2 ft (Figure 7-63). The flooding in the vicinity of the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-63. CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge, Oneida, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

According to the FEMA FIS profile plot, the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge indicates the bridge is unable to successfully pass the 2-, 1- or 0.2% ACE event without significant backwater upstream of the bridge (FEMA 2013). In addition, the FEMA FIRM displays significant backwater upstream of the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge crossing (FEMA 2001a).

By increasing the opening span of the bridge structure, 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 adajcent to and immediately upstream of the bridge.

The bridge widening designs are selected to ensure that the 1% ACE event WSEL could successfully pass under a given bridge structure. Multiple bridge widening designs were simulated of up to 25-ft in an effort to produce the desired result; however, the modeling simulation results for each bridge widening design did not simulate the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge successfully passing the 1% ACE without significant backwater upstream of the bridge. The results displayed for this proposed alternative are based on widening the bridge opening by 25 ft on the left bank for a total bridge span of 76 ft.

The proposed condition modeling confirmed that the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge is a constriction point along Oneida Creek. The modeling simulation results indicated water surface reductions of up to 1.8 ft in areas approximately 1,650 ft immediately upstream of the bridge to Dam #103-0597, specifically along river stations 933+50 to 950+00 (Figure 7-64). The modeling output for future conditions displayed similar results with water surface reductions of up to 1.7 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to upstream of the CR-51 Kenwood Avenue/CR-25 Hamilton Street bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.2 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

In summary, this alternative would widen the bridge span to 76 ft, cost approximately $2.2 million, and reduce water surface elevations by 1.8 ft immediately upstream of the bridge.

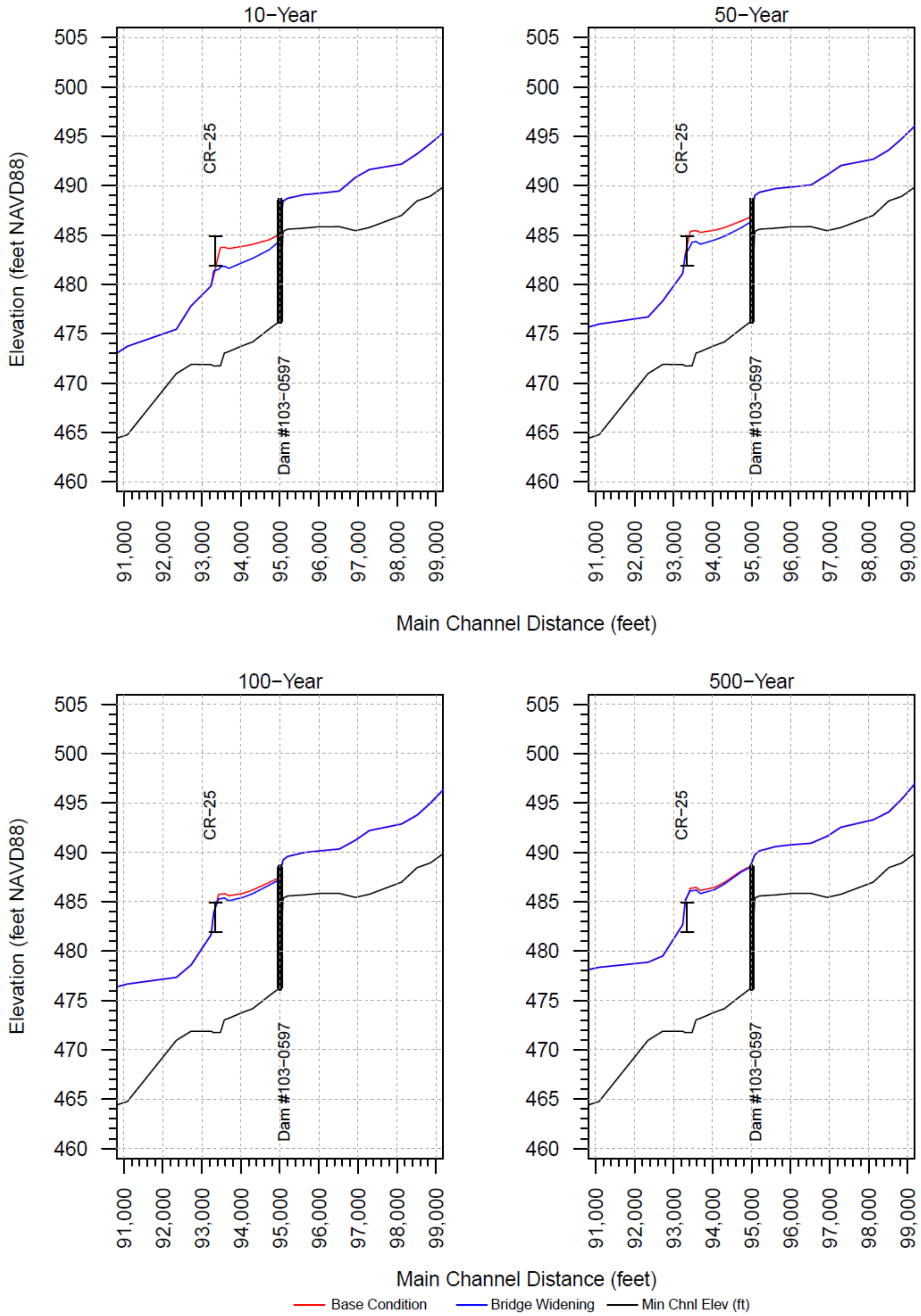

Figure 7-64. HEC-RAS model simulation output results for Alternative #2-6 for the existing condition (blue) and proposed alternative (red) scenarios.

7.3 HIGH-RISK AREA #3

7.3.1 Alternative #3-1: Increase the Opening of the Valley Mills Road Bridge

This measure is intended to address issues within High-Risk Area #3 by increasing the width of the Valley Mills Road bridge opening, which would increase the cross-sectional flow area of the channel located at river station 1386+00 (Figure 7-65).

Figure 7-65. Location map for Alternative #3-1.

The bridge is owned by Madison County and has no pier in the channel. The existing bridge structure has a bridge span of 66 ft and a width of 26 ft (Figure 7-66). The flooding in the vicinity of the Valley Mills Road bridge poses a flood-risk threat to nearby residential and commercial properties, and county-owned infrastructure. Appendix F depicts a flood mitigation rendering of a bridge widening scenario.

Figure 7-66. Valley Mills Road, Munnsville, NY.

Based on orthoimagery of the area, the meander in the creek channel upstream of the bridge crossing acts as an impediment to flow, reducing water velocities and allowing sediment and debris to aggregate and restrict flow in this area (NYSOITS 2017).

As previously displayed in Figure 6-6, the FEMA FIS profile plot for the Valley Mills Road bridge indicates the bridge is able to successfully pass the 10-, 2-, 1- and 0.2% ACE events. However, the FIS profiles indicate significant backwater upstream the of the bridge (FEMA 1983b). In addition, the FEMA FIRM displays significant backwater upstream of the Valley Mills Road bridge crossing (FEMA 1983a).

By increasing the opening span of the bridge structure, 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.

The bridge widening design selected for this proposed condition model simulation was selected to ensure that the 1% ACE WSEL could successfully pass under the Valley Mills Road bridge without significant backwater upstream of the bridge. To achieve the desired result, the bridge widening design increased the span of the bridge opening from 66 ft to 86 ft by widening the bridge on the right bank by 20 ft.

According to historical flood reports, stakeholder engagement meetings, and field work, the Valley Mills Road bridge was identified as a hydraulic structure that experiences debris blockage and ice jams resulting in backwater flooding during higher peak flow events (NYSDEC 2021b). For this alternative, open-water, debris obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations.

Table 30 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-67 through 7-69 display the profile plots for each initial condition scenario for the bridge widening alternative. Full model outputs for this alternative can be found in Appendix G.

Table 30. Summary Table for Alternative #3-1 Existing Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 1.7-ft
Total Length of Benefited Area	650-ft
River Stations	1387+50 to 1394+00
Debris Obstruction	Up to 3.6-ft
Total Length of Benefited Area	750-ft
River Stations	1387+00 to 1394+50
Ice Jam	Up to 2.9-ft
Total Length of Benefited Area	650-ft
River Stations	1387+50 to 1394+00

Table 31 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 31. Summary Table for Alternative #3-1 Future Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Future Proposed Conditions	Reductions in Water Surface Elevations (feet)
Open-Water	Up to 2.3-ft
Total Length of Benefited Area	700-ft
River Stations	1387+00 to 1394+00
Debris Obstruction	Up to 3.8-ft
Total Length of Benefited Area	700-ft
River Stations	1387+00 to 1394+00
Ice Jam	Up to 4.4-ft
Total Length of Benefited Area	650-ft
River Stations	1387+50 to 1394+00

The potential benefits of this strategy are limited to upstream of the Valley Mills Road bridge. The primary benefits of increasing the bridge opening would be to increase the flow capacity of the bridge structure, reduce the potential of backwater from high-flow events, and help prevent debris and ice from catching on the structure and creating obstructions/jams upstream of the bridge.

The ROM cost for this strategy is approximately $2.0 million, which does not include land acquisition costs for survey, appraisal, and engineering coordination. Additional engineering consideration would also be required to determine if increasing the bridge opening would alter the structural integrity of the bridge in any way.

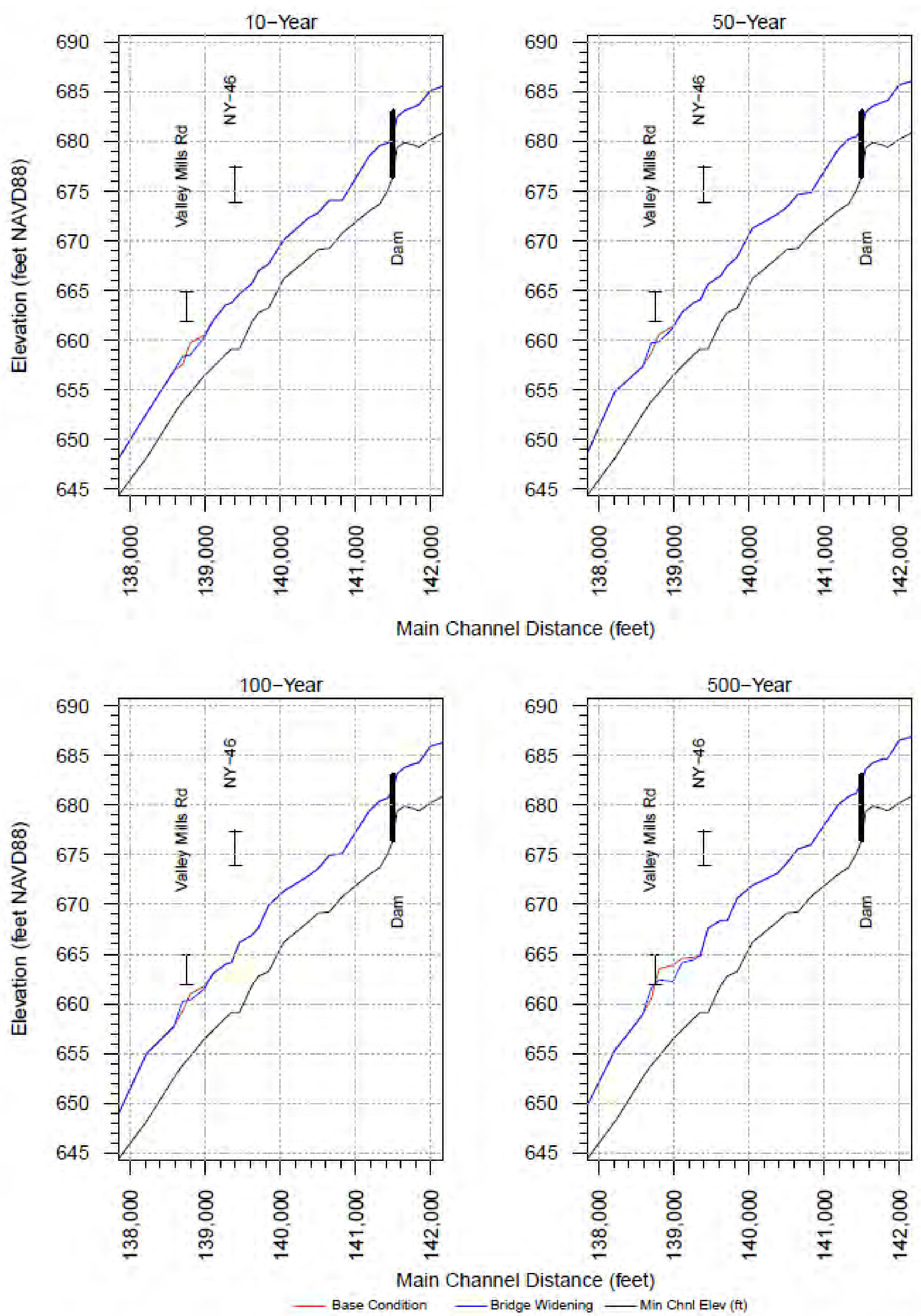

Figure 7-67. HEC-RAS model simulation output results for Alternative #3-1 for the existing condition (red) and proposed alternative (blue) scenarios.

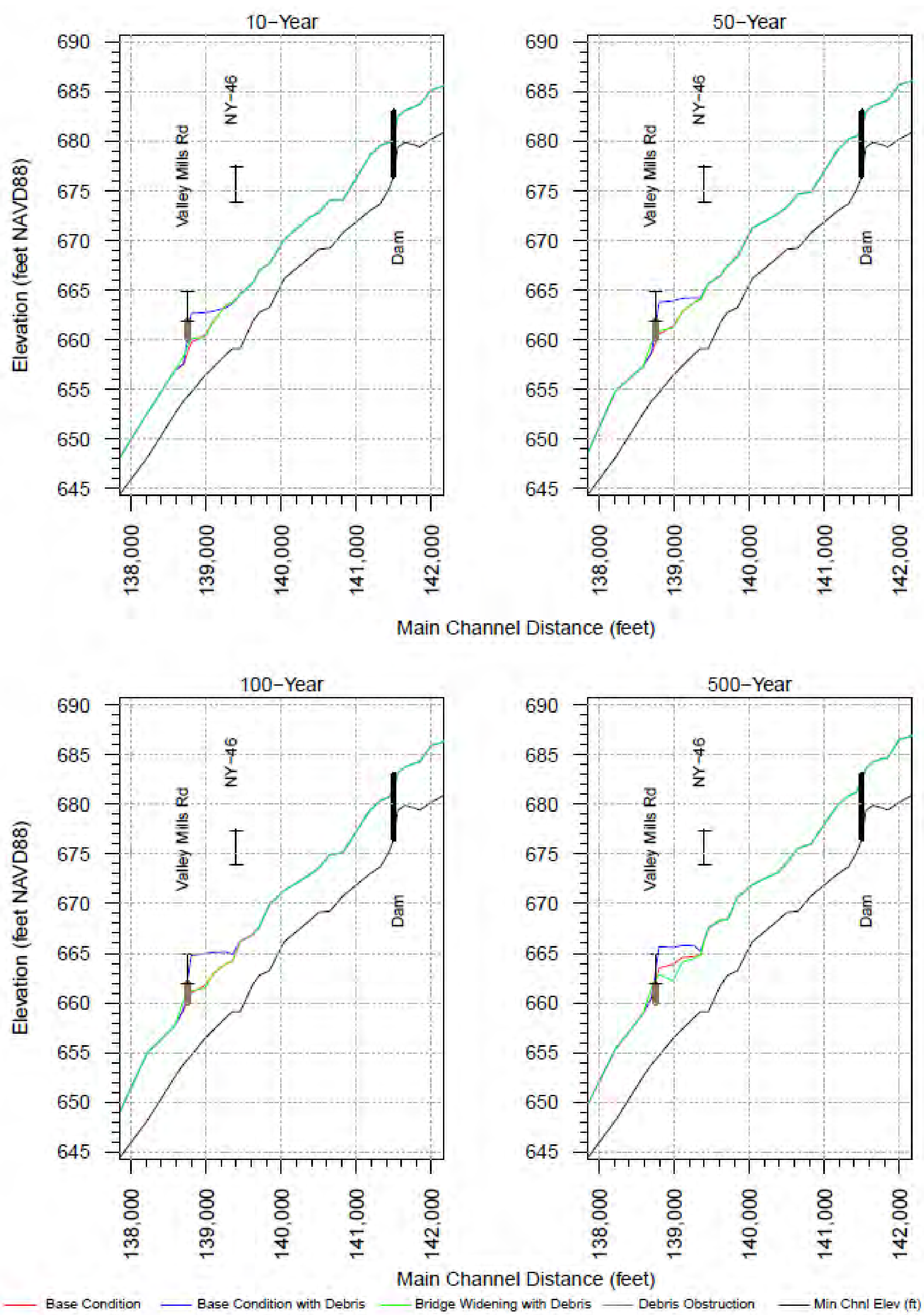

Figure 7-68. HEC-RAS model simulation output results for Alternative #3-1 for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

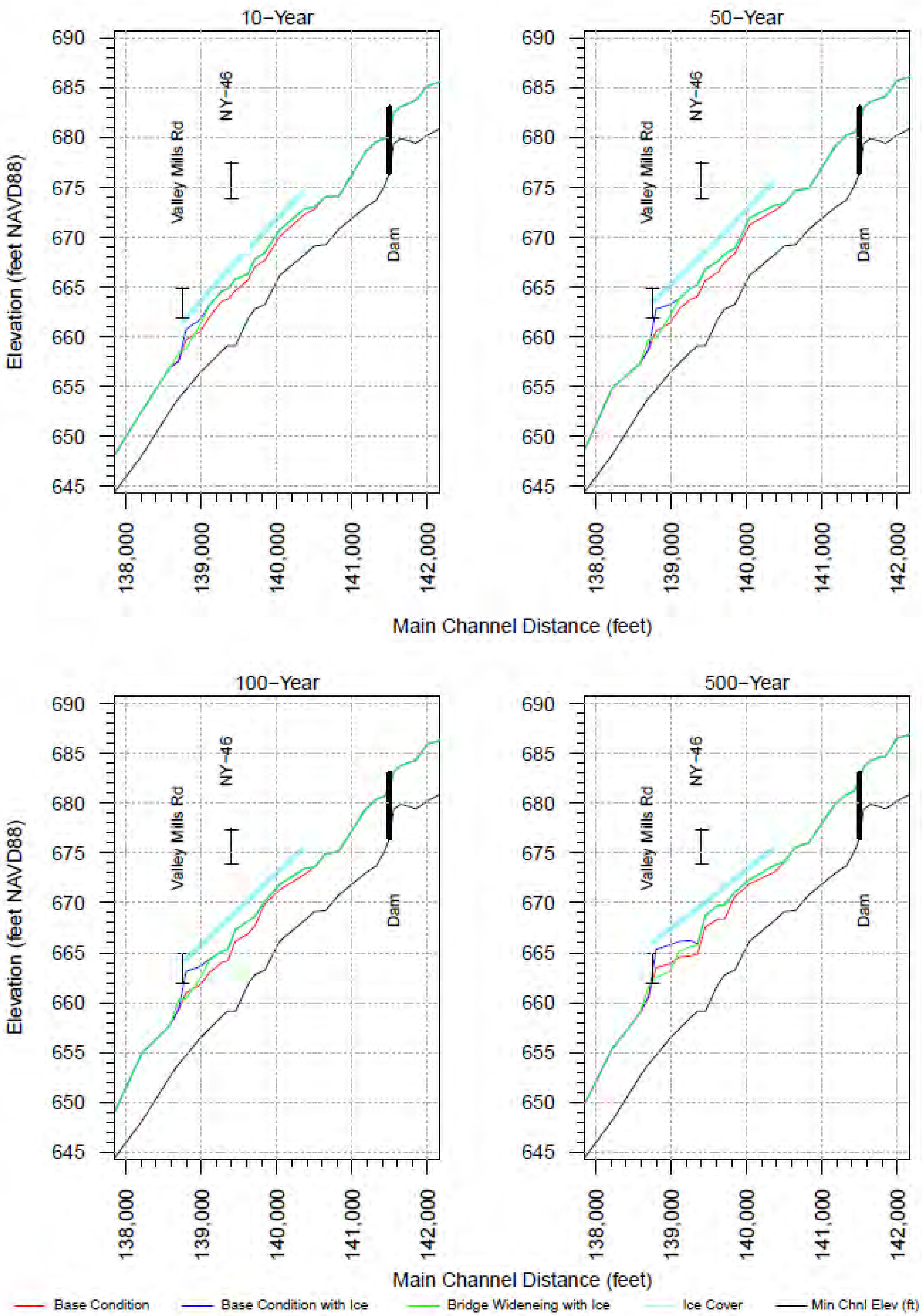

Figure 7-69. HEC-RAS model simulation output results for Alternative #3-1 for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

7.3.2 Alternative #3-2: Levee Between Valley Mills Road and NY-46/Main Street

This strategy is intended to restrict high-flow events from overtopping channel banks and flooding the Oneida Sewage Treatment Plant in High-Risk Area #3 by constructing a permanent levee along the left and right banks of Oneida Creek between Valley Mills Road and NY-46/Main Street. Both levees would be located along river stations 1387+50 to 1394+00. The left bank levee would be approximately 550 linear feet, while the right bank levee would be approximately 400 linear feet. Both levees have a height above the flood stage for the 0.2% ACE flood elevation based on existing and future conditions (668.5 to 667-ft NAVD 88) (Figure 7-70).

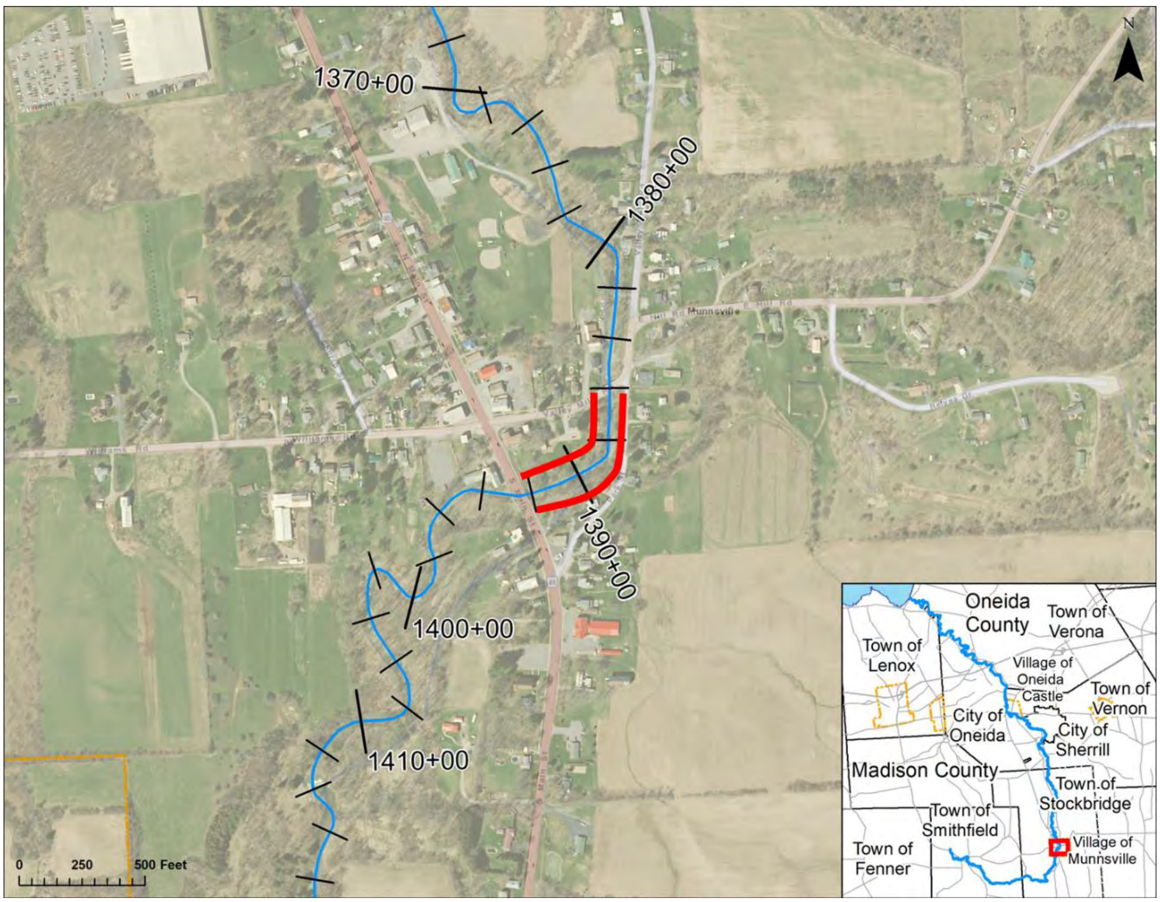

Figure 7-70. Location map for Alternative #3-2.

Compaction and the possibility of using cut material as fill was not accounted for with this alternative. Downstream and opposite bank effects of the levee were modelled to determine if the levee would have any measurable effects on upstream or downstream water surface elevations.

According to historical flood reports, stakeholder engagement meetings, and field work, the Valley Mills Road bridge was identified as a hydraulic structure that experiences debris blockage and ice jams resulting in backwater flooding during higher peak flow events (NYSDEC 2021b). For this alternative, open-water, debris obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at restricting water flow to the channel.

According to historical flood reports, stakeholder engagement meetings, and field work, the Valley Mills Road bridge was identified as a hydraulic structure that experiences debris blockage and ice jams resulting in backwater flooding during higher peak flow events (NYSDEC 2021b). For this alternative, open-water, debris obstruction, and ice-jam simulations were performed to test the effectiveness of the alternative at reducing water surface elevations.

Table 32 outlines the results of the proposed conditions model simulations for each initial condition scenario. Figures 7-71 through 7-73 display the profile plots for each initial condition scenario for the bridge widening alternative. Full model outputs for this alternative can be found in Appendix G.

Table 32. Summary Table for Alternative #3-2 Existing Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Proposed Conditions	Changes in Water Surface Elevations (feet)
Open-Water	Increases of up to 1.9-ft
Total Length of Affected Area	1,100-ft
River Stations	1387+50 to 1398+50
Debris Obstruction	Increases of up to 1.9-ft
Total Length of Affected Area	1,100-ft
River Stations	1387+50 to 1398+50
Ice Jam	Increases of up to 2.4-ft
Total Length of Affected Area	350-ft
River Stations	1395+00 to 1398+50

Table 33 outlines the results of the future conditions model simulations for each initial condition scenario.

Table 33. Summary Table for Alternative #3-2 Future Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Future Proposed Conditions	Changes in Water Surface Elevations (feet)
Open-Water	Increases of up to 2.2-ft
Total Length of Affected Area	1,100-ft
River Stations	1387+50 to 1398+50
Debris Obstruction	Increases of up to 2.1-ft
Total Length of Affected Area	1,100-ft
River Stations	1387+50 to 1398+50
Ice Jam	Increases of up to 2.3-ft
Total Length of Affected Area	350-ft
River Stations	1395+00 to 1398+50

The proposed present and future conditions modeling confirmed that constructing a levee along Oneida Creek in the reach between Valley Mills Road and NY-46/Main Street would decrease the flood risk to adjacent residential and commercial properties, while leaving the flood potential of downstream and opposite bank areas unaffected.

Without the levee, a 1% ACE would overtop the channel banks downstream of the NY-46/Main Street bridge near river station 1392+50, inundating the residences and properties along Valley Mills Road and Park Street. With the levee, model simulation results indicated this water would remain in the channel and flow downstream causing water surface elevations to increase without impairing the adjacent properties. The potential benefits of this alternative are in the vicinity of the levee at river stations 1386+00 to 1392+00, while the increased WSELs return to existing conditions levels immediately upstream of the Valley Mills Road bridge at river station 1387+00.

Any levee constructed in the Oneida Creek watershed would need to follow the USACE Design and Construction of Levees (EM 1110-2-1913) guidelines, including obtaining the required individual, regional, and nationwide permits for design, construction, and maintenance of a levee (USACE 2000).

The USACE has the authority to construct small flood risk-reduction projects that are engineeringly feasibly, structurally sound and cost efficient through the authority provided under Section 205 of the 1948 Flood Control Act (FCA), as amended. Coordination should also occur with the NYSDEC as they need to be the non-federal sponsor on these types of projects. In addition, a FEMA BCA would need to be performed to determine the cost-effectiveness of the alternative prior to applying for FEMA mitigation grant programs funding.

A levee would require significant engineering, construction, and maintenance efforts throughout its lifespan, resulting in a relatively high cost burden. Levees should be placed as far away from the creek channel as possible to maximize the capacity of the natural floodplain to convey floodwaters, and designed and constructed in a manner that does not cause flooding downstream of the structure. In addition, strict requirements would need to be met to comply with NFIP requirements (44 CFR

§65.10) to affect a building’s flood insurance rating. However, it must be noted that a levee would not remove areas from the FEMA mapped floodplain. A levee would only provide additional flood protection for a certain level of ACE. Homeowners and businesses behind the levee would still be required to purchase flood insurance if they are within any FEMA designated flood zones (FEMA 2000).

The Rough Order Magnitude cost for this strategy is approximately $640,000, which does not include permitting, annual maintenance or land acquisition costs for survey, appraisal, and engineering coordination. This estimate also assumes suitable clay material for levee fill that meets USACE requirements is readily available and nearby.

In addition, closure structures, tie-ins and pump stations were not discussed as these structures should be considered on an as needed basis to address interior drainage. As such, the cost estimate for this alternative did not include the associated costs for these structures.

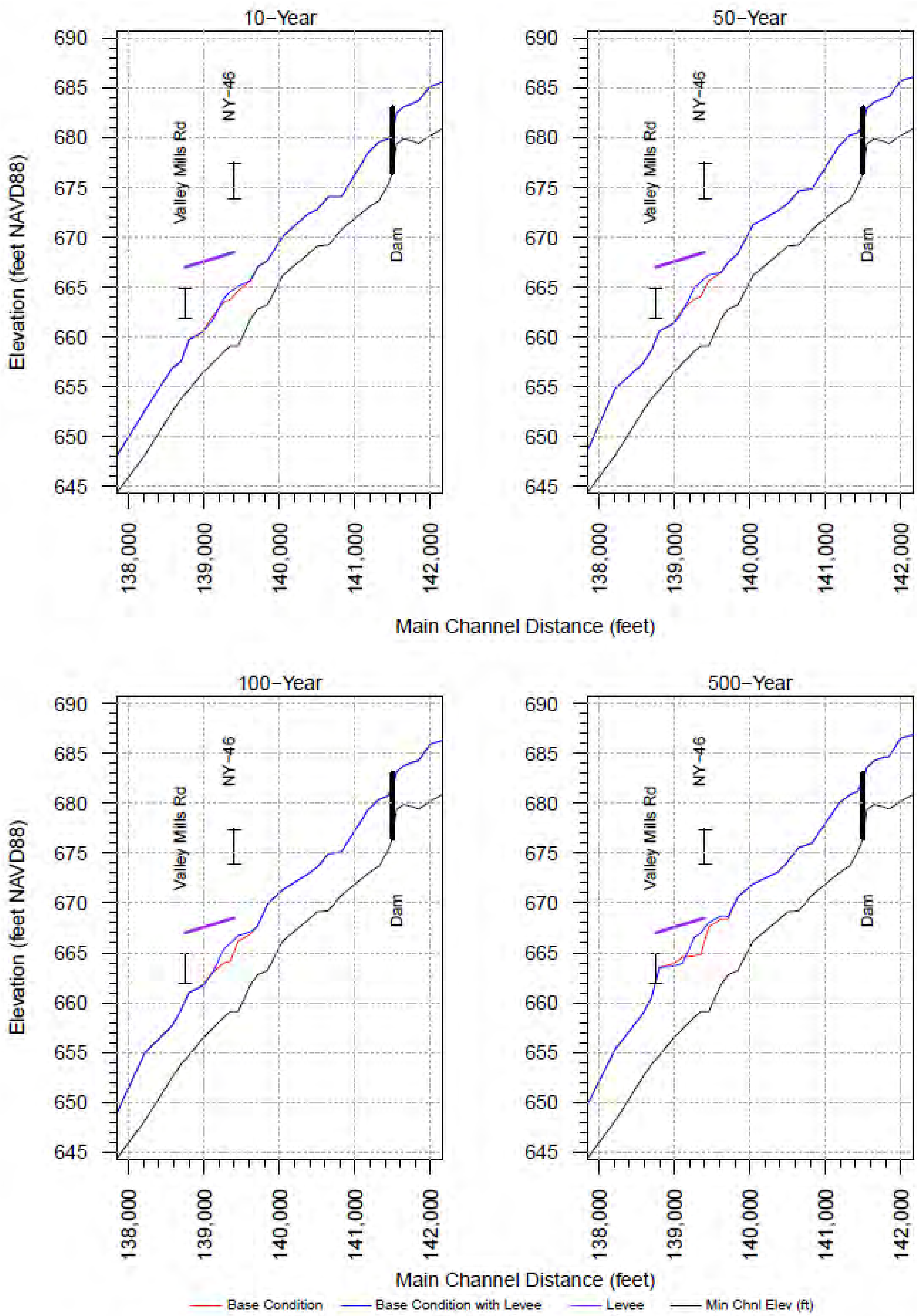

Figure 7-71. HEC-RAS model simulation output results for Alternative #3-2 for the existing condition (red) and proposed alternative (blue) scenarios.

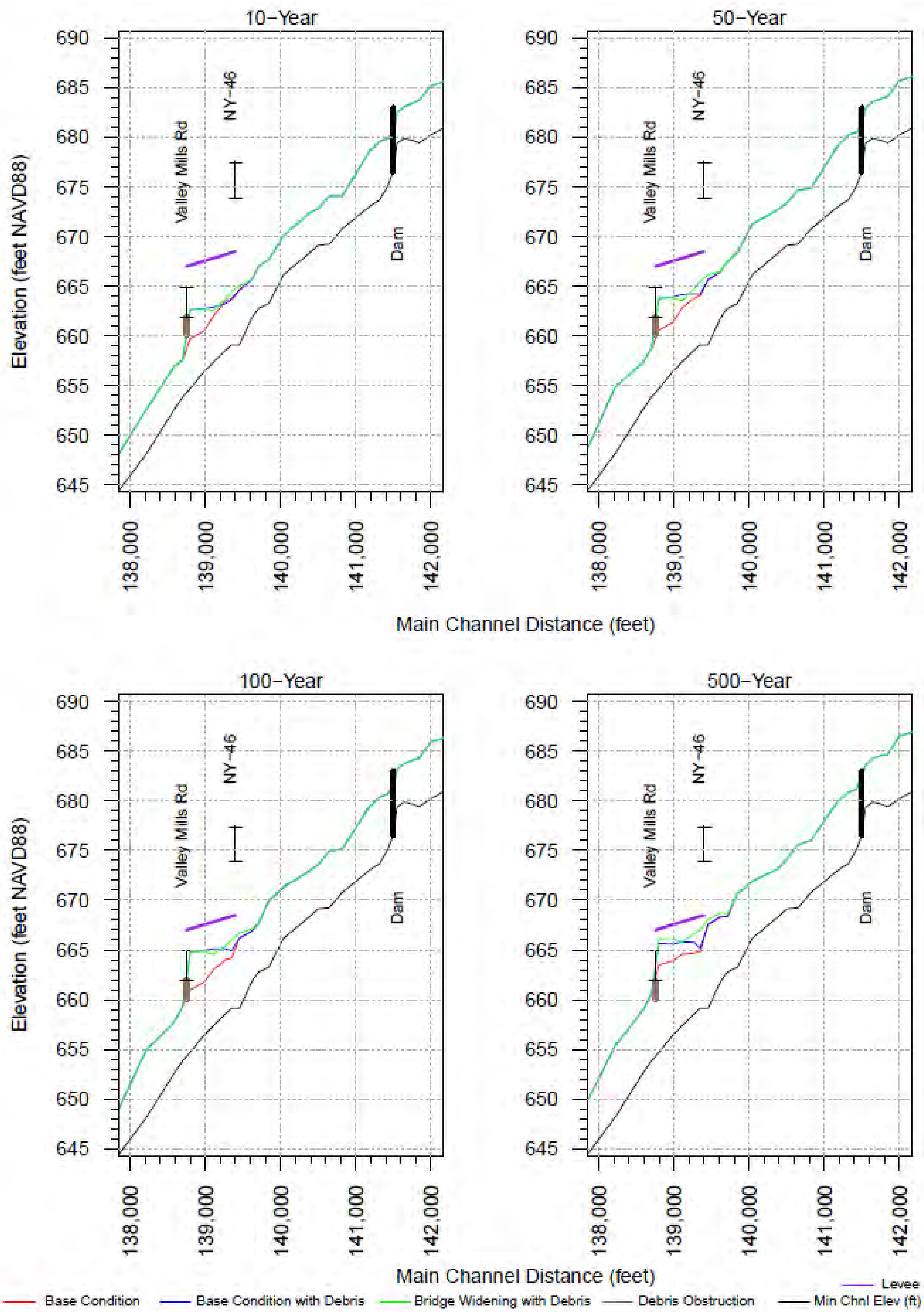

Figure 7-72. HEC-RAS model simulation output results for Alternative #3-2 for the existing condition (red), existing condition with debris obstruction (blue), and proposed alternative with debris (green) scenarios.

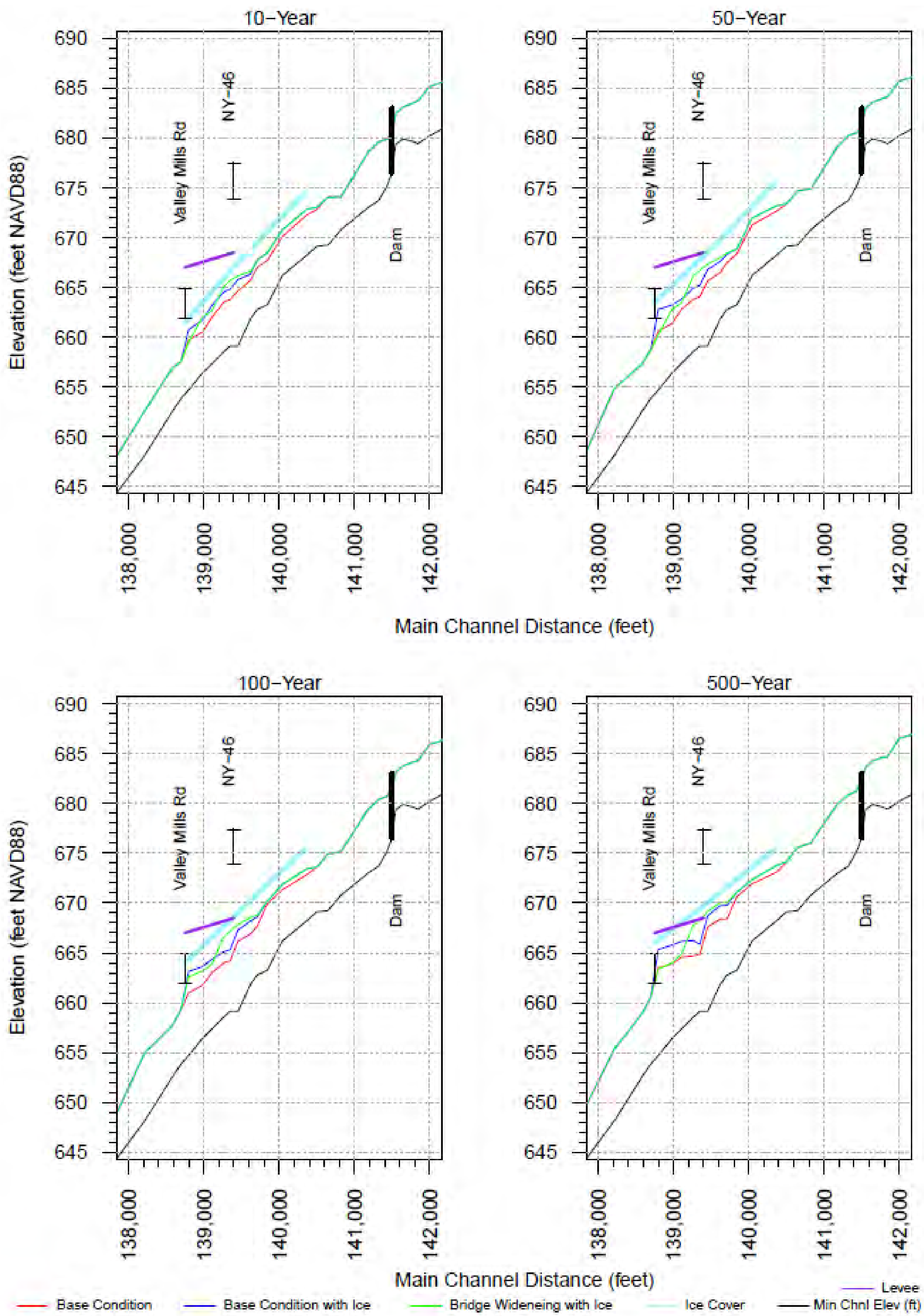

Figure 7-73. HEC-RAS model simulation output results for Alternative #3-2 for the existing condition (red), existing condition with ice cover (blue), and proposed alternative with ice cover (green) scenarios.

7.3.3 Alternative #3-3: Flood Benches Upstream of NY-46/Main Street

Installing a flood bench would provide additional storage and floodplain width over and above the current storage and width provided by the adjacent agricultural and undeveloped lands, which could potentially reduce damages in the event of flooding and address issues within High-Risk Area #3. Two potential flood benches were modeled upstream of NY-46/Main Street in the Village of Munnsville (Figure 7-74):

- Flood Bench A is approximately 0.75 acres in size and located between river stations 1393+00 to 1397+00
- Flood Bench B is approximately 1.0 acres in size and located between river stations 1396+00 to 1402+00

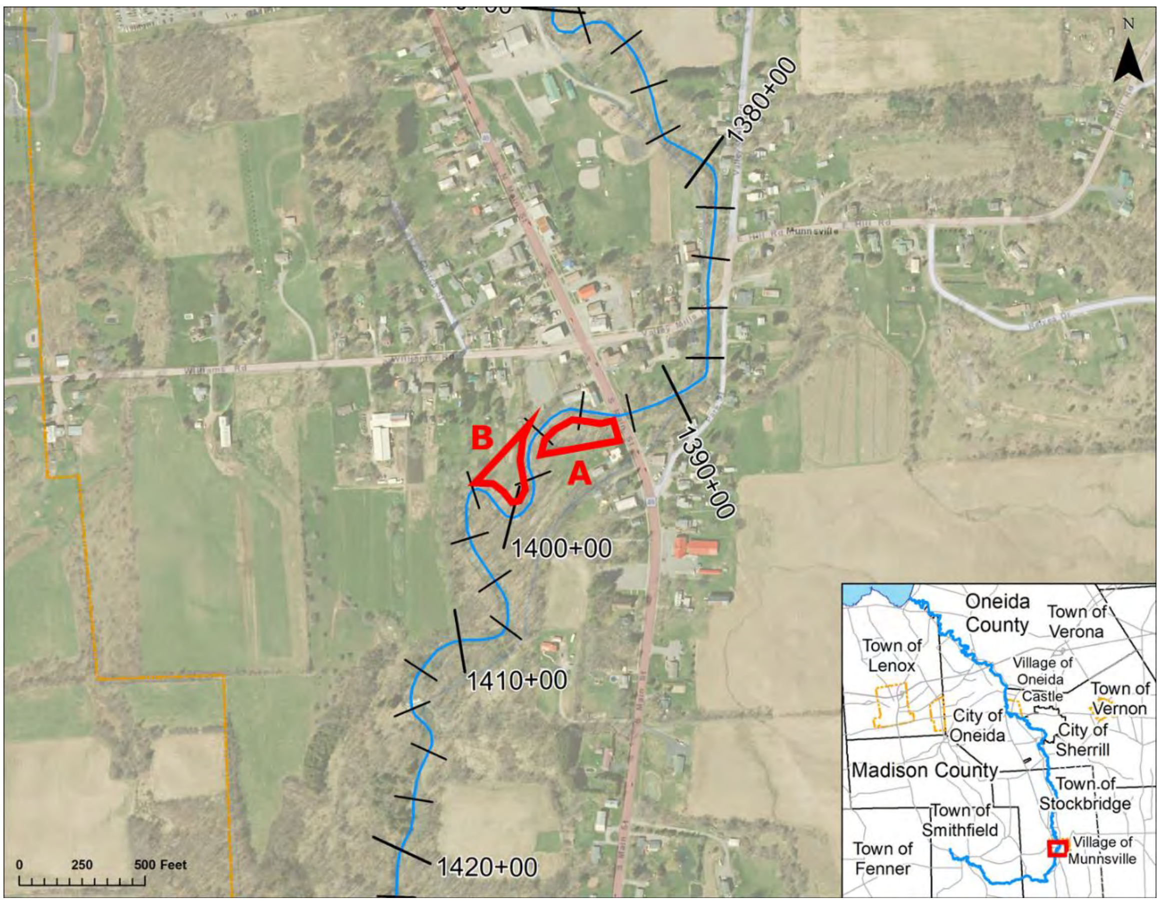

Figure 7-74. Location map for Alternative #3-3.

The flood bench designs used for the proposed condition model simulation set the minimum bench elevation approximately equal to the bankfull elevation, which was an average depth of 2.5-ft for both benches.

The flood benches are within the FEMA designated SFHA or Zone A, which are areas subject to inundation by the 1% ACE (100-yr flood) as determined in the FIS by detailed methods and where base flood elevations were not determined (FEMA 1983b).

Appendix F depicts a flood mitigation rendering of a flood bench illustrating before and after landscape features.

Table 34 outlines the results of the proposed present and future conditions model simulations for open-water conditions only. Figures 7-75 and 7-76 display the profile plots for each flood bench alternative. Full model outputs for this alternative can be found in Appendix G.

Table 34. Summary Table for Alternative #3-3 Existing and Future Conditions Results Based on Open-Water, Debris-Obstruction, and Ice-Jam Conditions

Proposed Conditions	Reductions in Water Surface Elevations (feet)	
	Flood Bench A	Flood Bench B
Open-Water	Up to 1.3-ft	Up to 1.5-ft
Total Length of Benefited Area	550-ft	800-ft
River Stations	1394+50 to 1400+00	1397+00 to 1405+00
Future Proposed Conditions		
Open-Water	Up to 1.4-ft	Up to 1.4-ft
Total Length of Benefited Area	550-ft	800-ft
River Stations	1394+50 to 1400+00	1397+00 to 1405+00

Flood benches generally provide flood protection for localized areas in the vicinity of and immediately upstream and/or downstream of the bench. Based on the analysis of high-risk areas, flood benches located upstream of the NY-46/Main Street bridge would provide minimal flood protection in this reach from open-water and ice-jam flooding. Flood benches upstream of the bridge would provide significant flood protection from debris/log flooding.

To evaluate the effectiveness of the flood mitigation impacts, the project team analyzed each flood bench independently. However, there is the potential for added benefits (i.e., reduction in WSELs, less flooding, reduced erosion, etc.) when multiple flood mitigation projects are built in conjunction. For areas that experience significant flood damages or chronic flooding, it is recommended that multiple flood mitigation strategies in conjunction be considered and evaluated by affected communities.

The Rough Order Magnitude cost for each flood bench alternative is:

- Flood Bench A: $320,000
- Flood Bench B: $510,000

These ROM cost estimates do not include land acquisition costs for survey, appraisal, and engineering coordination. In addition, the NYSDEC will require wetland delineations, an analysis for any endangered and/or threatened species within the proposed project area, and information regarding access during construction for this mitigation alternative.

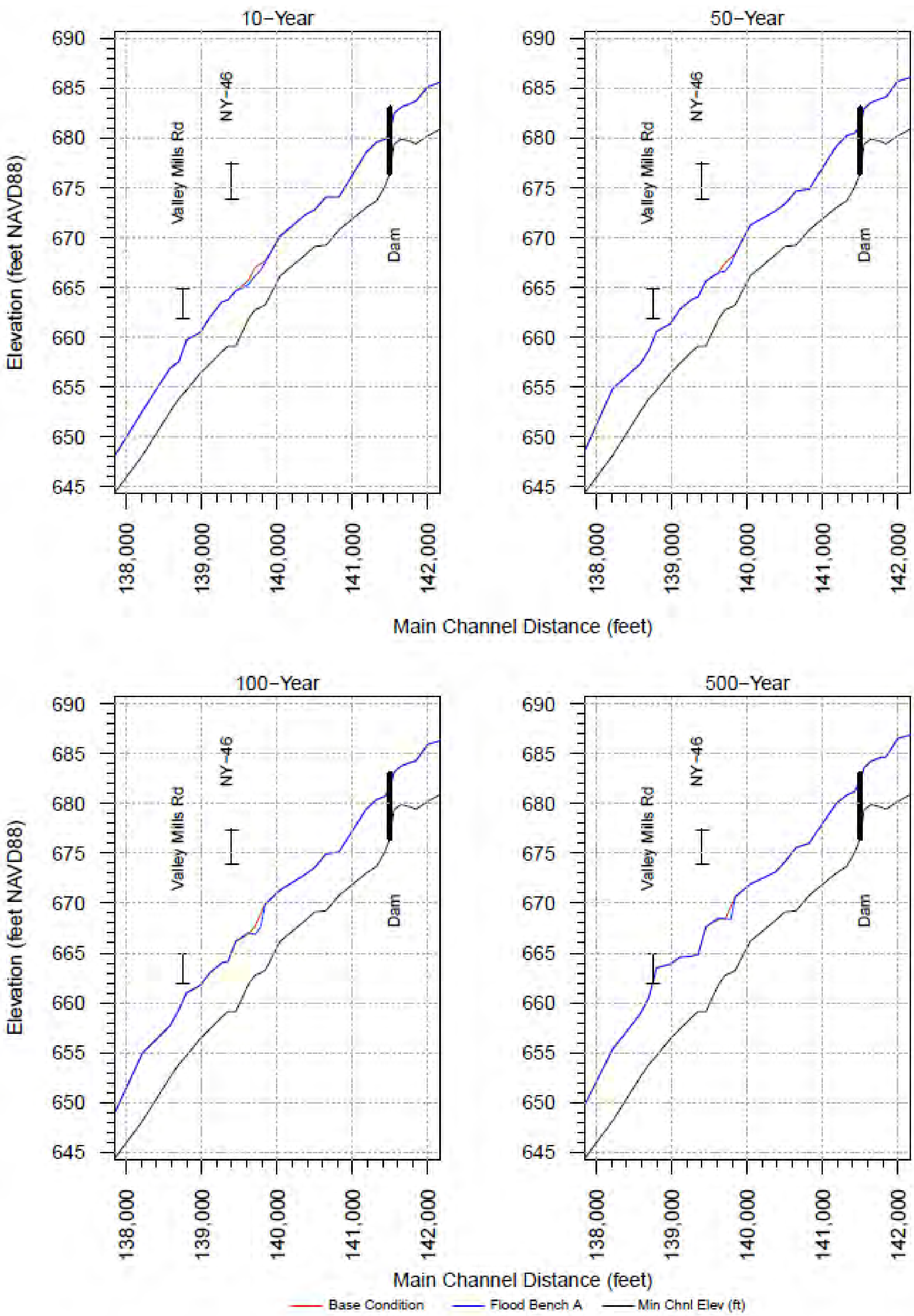

Figure 7-75. HEC-RAS model simulation output results for Alternative #3-3 Flood Bench A for the existing condition (red) and proposed alternative (blue) scenarios.

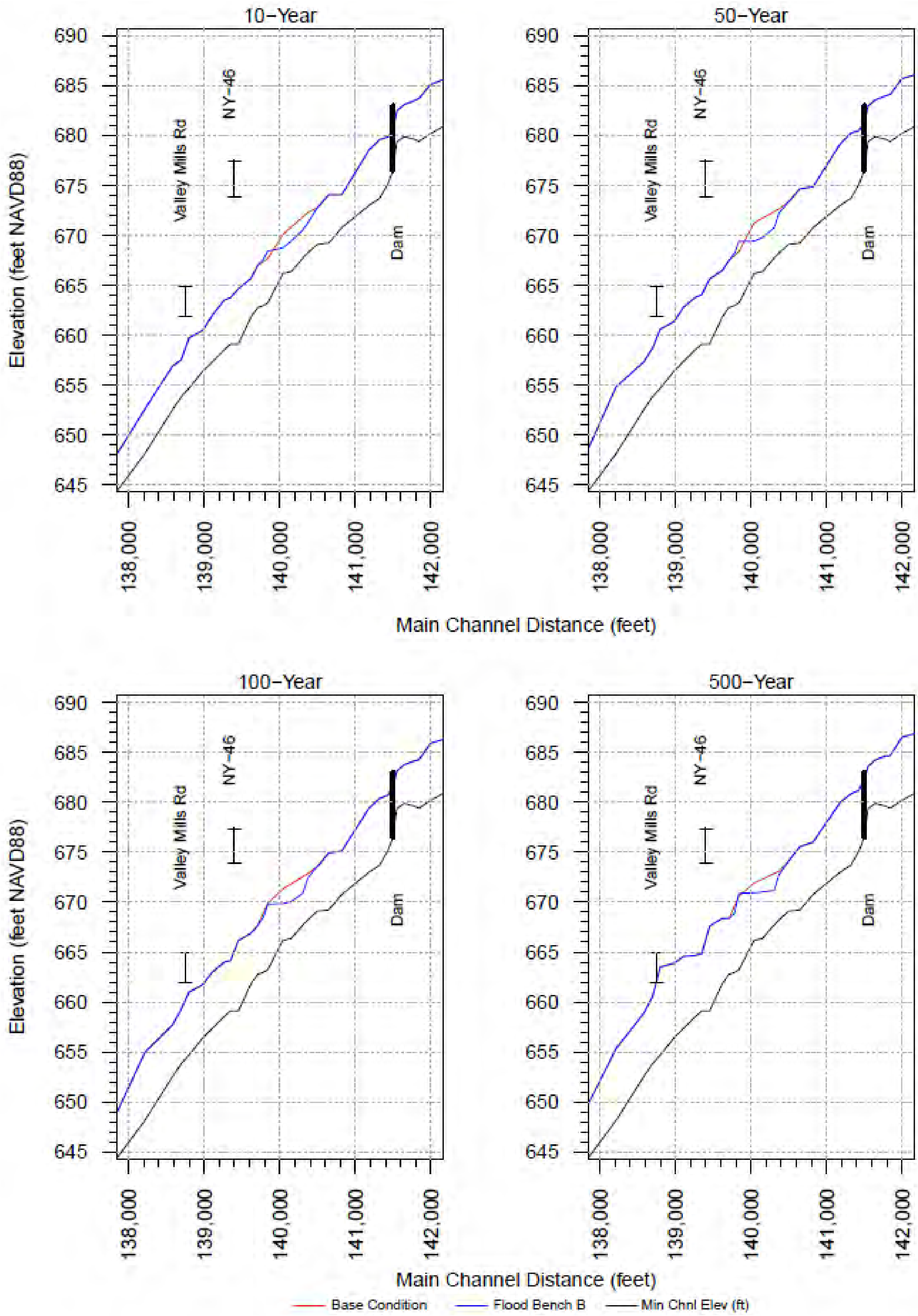

Figure 7-76. HEC-RAS model simulation output results for Alternative #3-3 Flood Bench B for the existing condition (red) and proposed alternative (blue) scenarios.

7.3.4 Alternative #3-4: Remove Dam Upstream of NY-46/Main Street

This measure is intended to assess the effectiveness of removing the Unnamed Dam along Oneida Creek in the Village of Munnsville located at river stations 1414+00 (Figure 7-77).

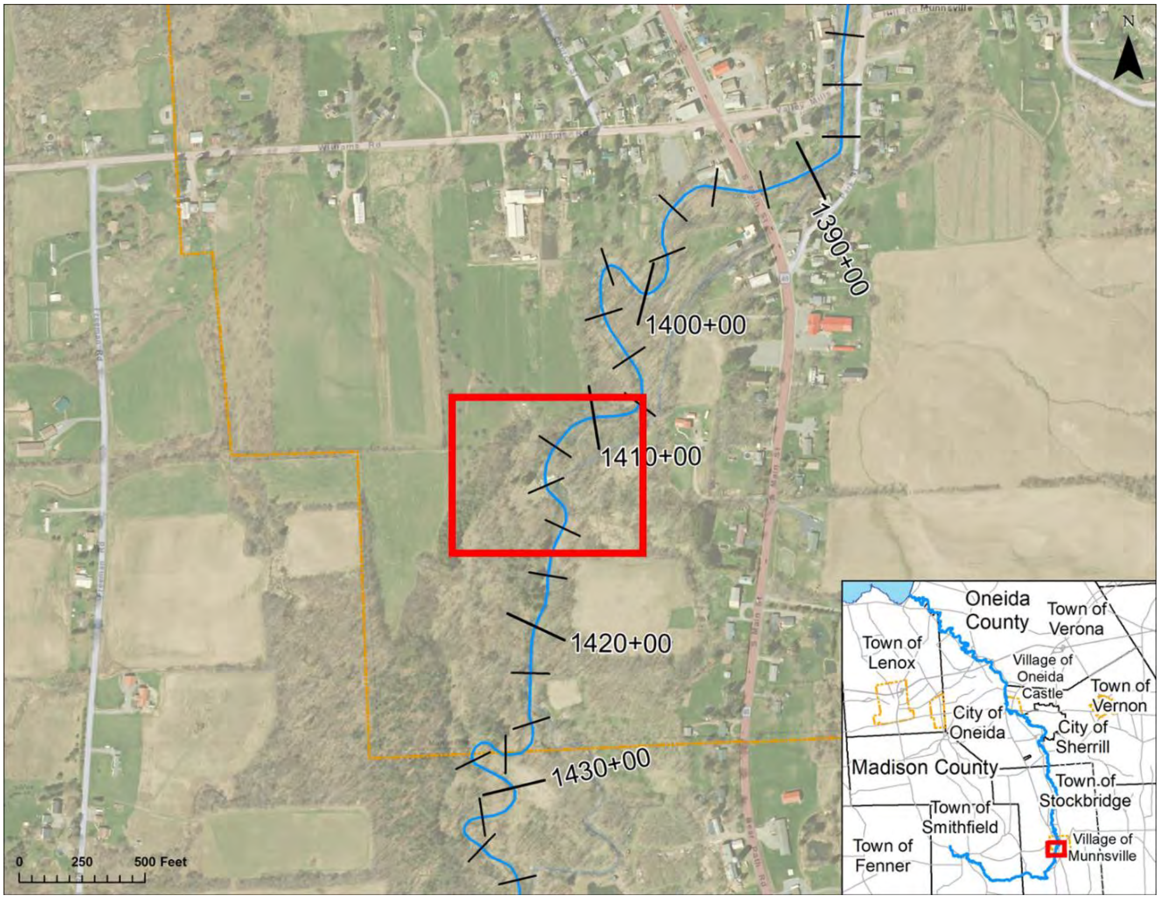

Figure 7-77. Location map for Alternative #3-4.

There is no publicly available data for the unnamed dam from the NYSDEC dams dataset (NYSDEC 2022c). Due to safety concerns, the Ramboll field team was unable to access the dam to complete field measurements.

According to the FEMA FIS profile for Oneida Creek, the unnamed dam can successfully pass the 10-, 2-, 1-, and 0.2-% ACE events without significant backwater (FEMA 1983b). The FEMA FIRM displays significant backwater flooding upstream of the unnamed dam that extends upstream and towards NY-46/Main Street (FEMA 1983a).

By removing the dam, the cross-section flow area of the channel would increase and the potential for sediment, debris, and ice to accumulate or catch on the dam would be reduced, thereby reducing the flood risk to areas adjacent to and immediately upstream of the dam.

The proposed condition modeling simulation results indicated water surface reductions of up to 1.6 ft in areas approximately 500 ft immediately upstream of the unnamed dam, specifically along river stations 1415+00 to 1420+00 (Figure 7-78). The modeling output for future conditions displayed similar results with water surface reductions of up to 1.5 ft. Full model outputs for this alternative can be found in Appendix G.

The potential benefits of this strategy are limited to immediately upstream of the dam. The WSELs downstream of the dam in the vicinity of NY-46/Main Street remain unchanged from the existing conditions model results. The natural waterfall that exists where the unnamed dam structure is located influences WSELs in this reach and limits the potentially benefitted areas both upstream and downstream of the dam.

Several factors must be considered when evaluating potential dam removal projects, including (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
- 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. Coordination should occur with the NYSDEC as they need to be the non-federal sponsor on these types of projects.

In addition, a FEMA Benefit-Cost Analysis (BCA) would need to be performed to determine the cost-effectiveness of the alternative prior to applying for FEMA mitigation grant programs funding. The BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The end result is a Benefit-Cost Ratio (BCR), which is derived from a project's total net benefits divided by its total project cost. The BCR is a numerical expression of the cost effectiveness of a project. A project is considered to be cost effective when the BCR is 1.0 or greater.

The ROM cost estimate for the dam removal scenario is highly dependent on the presence or absence of contaminants in any sediment impounded behind the dam. Therefore, Ramboll was unable to calculate a ROM cost at this time.

It should be noted that by removing one or both of the dams 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 one or both of the dams to downstream areas.

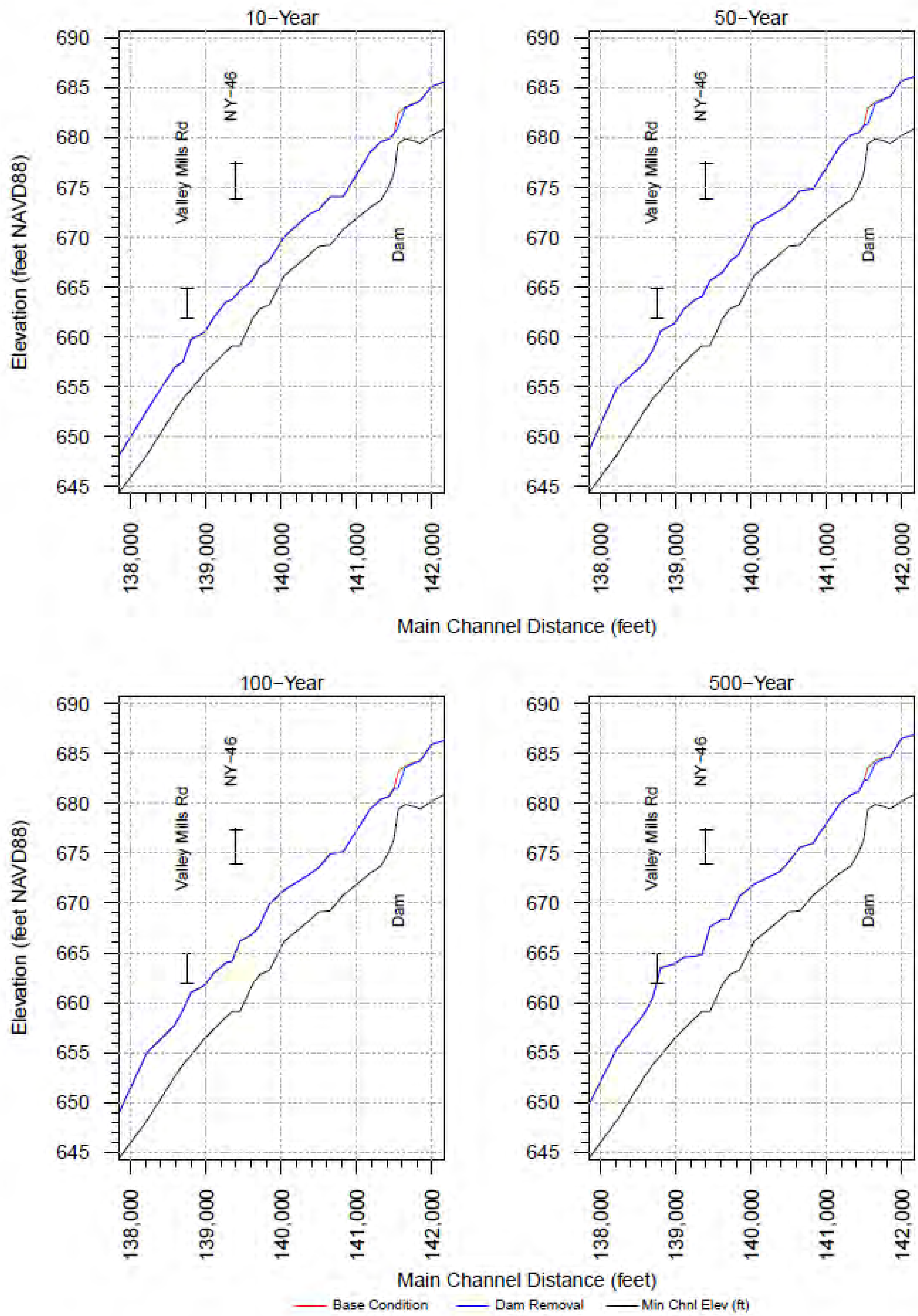

Figure 7-78. HEC-RAS model simulation output results for Alternative #3-4 for the existing condition (red) and proposed alternative (blue) scenarios.

8. BASIN-WIDE MITIGATION ALTERNATIVES

Non-structural measures attempt to avoid flood damages by modifying or removing properties currently located within flood-prone areas. These measures do not affect the frequency or level of flooding within the floodplain; rather, they affect floodplain activities. In considering the range of non-structural measures, the community needs to assess the type of flooding which occurs (depth of water, velocity, duration) prior to determining which measure best suits its needs (USACE 2016c).

8.1 ALTERNATIVE #4-1: EARLY-WARNING FLOOD DETECTION SYSTEM

Early-warning flood detection systems can be implemented, which can provide communities with more advanced warning of potential flood conditions. Early forecast and warning involve the identification of imminent flooding, implementation of a plan to warn the public, and assistance in evacuating persons and some personal property. A typical low cost early-warning flood detection system consists of commercially available off-the-shelf-components. The major components of an early-warning flood detection system are a sensor connected to a data acquisition device with built-in power supply or backup, some type of notification or warning equipment, and a means of communication.

For ice-jam warning systems, condition is generally monitored using a pressure transducer. The data acquisition system performs two functions: it collects and stores real-time flood stage data from the pressure transducer and initiates the notification process once predetermined flood-stage conditions are met (USACE 2016c).

This method can also be supplemented by an ice-jam predicting calculation procedure using the freezing degree-day (FDD) method to forecast the ice thickness at critical locations to inform early action to control ice (Shen and Yapa 2011). The method involves a small computer tool that goes through all the ice calculations and gives the output in a graphical format of the predicted ice thickness with time. This can be quickly implemented and can be a very good solution due to its low cost, and low labor and maintenance requirements. The method needs only the forecasted air temperature and current water level at the critical location. During severe winter conditions, the ice thickness prediction can be used to help prepare and coordinate resources needed for a potential ice-jam event and consequential flooding. For regular winter conditions, the tool can be used as a quick ice-thickness monitoring mechanism.

The pressure transducer system can be powered from an alternating current source via landline, or by batteries that are recharged by solar panels. The notification process can incorporate standard telephone or cellular telephone. Transfer of data from the system can be achieved using standard or cellular telephone, radio frequency (RF) telemetry, wireless internet, or satellite transceivers. Emergency management notification techniques can be implemented through the use of radio, siren, individual notification, or a reverse 911 system. More elaborate means include remote sensors that detect water levels and automatically warn residents. These measures normally serve to reduce flood hazards to life, and damage to portable personal property (USACE 2016c).

The ROM cost for this strategy is approximately $120,000, not including annual maintenance and operational costs.

8.2 ALTERNATIVE #4-2: 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 Oneida Creek watershed. Restoration, which is defined as the process of reestablishing 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 the physical and biological processes that influence natural riparian ecosystems, and the types of disturbances to anthropogenic modifications that cause damage to riparian areas. In this case, alteration of historical flooding processes has caused degradation of the riparian system.

Riparian ecosystems generally consist of two flooding 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. Disturbances to riparian ecosystems in the Oneida Creek watershed have resulted from streamflow modifications by dams, reservoirs, and diversions; stream channelization; direct modification of the riparian ecosystem; and watershed disturbances (Goodwin et al. 1997).

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).

Three issues should be considered regarding the cause of the degraded environment: (1) the location of the anthropogenic modification with respect to the degraded riparian area, (2) whether the anthropogenic modification is ongoing or can be eliminated, and (3) whether or not recovery will occur naturally if the anthropogenic modification is removed (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).

8.3 ALTERNATIVE #4-3: DEBRIS MAINTENANCE AROUND INFRASTRUCTURE

Multiple areas along Oneida Creek were identified as catchpoints for debris and sediment. Areas where debris maintenance should be employed or continued to be employed are:

- NY-31 downstream to the confluence with Oneida Lake (Towns of Lenox and Verona)
- The reach between Prospect Street (NY-365A) and NY-5/Genesee Street (City of Oneida)
- The reach between NY-5/Genesee Street and CR-51 Kenwood Avenue (City of Oneida)
- The reach upstream of CR-25 Kenwood Avenue (Cities of Oneida and Sherrill)
- The reach upstream of NY-46/Main Street (Village of Munnsville)

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, which can potentially reduce flood damages in the downstream reaches. 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 sediment and 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 stream 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: 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.

- 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 (NYSDEC 2013).

Any work that will disturb the bed or banks of a protected stream (gravel 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).

In addition, sediment control basins along Oneida Creek could be established to reduce watercourse and gully erosion, trap sediment, reduce and manage runoff near and downstream of the basin, and to improve downstream water quality. A sediment control basin is an earth embankment, or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin. The basin should be configured to enhance sediment deposition by using flow deflectors, inlet and outlet selection, or by adjusting the length to width ratio of the creek channel. Additional hydrologic and hydraulic studies should be performed to identify the optimal locations for the sediment control basins. Operation and maintenance costs to maintain the embankment, design capacity, vegetative cover, and outlet of the basin should be considered (NRCS 2002).

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

The ROM cost for this strategy is up to $20,000 annually, not including additional maintenance and operational costs.

8.4 ALTERNATIVE #4-4: RETENTION BASIN AND WETLAND MANAGEMENT

Stormwater ponds 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 stormwater ponds 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 wet ponds and wetlands. This sediment can smother the vegetation and clog any filtering structures or outlets. In addition, standing water in ponds 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 2009).

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

Maintenance is necessary for a stormwater pond or wetland to operate as designed on a long-term basis. The pollutant removal, channel protection, and flood control capabilities of ponds and wetlands will decrease if (USEPA 2009):

- 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

Pond and wetland maintenance activities range in terms of the level of effort and expertise required to perform them. Routine pond and wetland 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 (USEPA 2009). Water level management, if control structures are available, can be an effective tool to meet a range of pond and wetland habitat and process management objectives.

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 2009).

8.5 ALTERNATIVE #4-5: FLOOD BUYOUT PROGRAMS

Buyouts allow state and municipal agencies the ability to purchase developed properties within areas vulnerable to flooding from willing owners. Buyouts are effective management tools in response to natural disasters to reduce or eliminate future losses of vulnerable or repetitive loss properties. Buyout programs include the acquisition of private property, demolition of existing structures, and conversion of land into public space or natural buffers. The land is maintained in an undeveloped state for public use in perpetuity. Buyout programs not only assist individual homeowners, but are also intended to improve the resiliency of the entire community in the following ways (Siders 2013):

- Reduce exposure by limiting the people and infrastructure located in vulnerable areas
- Reduce future disaster response costs and flood insurance payments
- Restore natural buffers such as wetlands in order to reduce future flooding levels
- Reduce or eliminate the need to maintain and repair flood control structures
- Reduce or eliminate the need for public expenditures on emergency response, garbage collection and other municipal services in the area
- Provide open space for the community

Resilience achieved through buyouts can have real economic consequences in addition to improved social resilience. According to FEMA, voluntary buyouts cost $1 for every $2 saved in future insurance claims, an estimate which does not include money saved on flood recovery and response actions, such as local flood fighting, evacuation and rescue, and recovery expenses that will not be incurred in the future. In order to achieve these goals, buyouts need to acquire a continuous swatch of land, rather than individual homes in isolated areas, or only some of the homes within flood-prone areas (Siders 2013).

Buyout programs can be funded through a combination of federal, state or local funds, and are generally made available following a nationally recognized disaster. FEMA administers programs to help with buyouts under the Stafford Disaster Act, and the Department of Housing and Urban Development (HUD) administers another program through Community Development Block Grants (CDBG). These funding sources can reduce the economic burden on the local community. However, these funds also come with guidelines and regulations that may constrain policy makers' options on whether to pursue a buyout strategy, and how to shape their programs. FEMA funds may be used to cover 75% of the expenses, but the remaining 25% must come from another non-federal source. In most cases, the buyout must be a cost-effective measure that will substantially reduce the risk of future flooding damage (Siders 2013).

For homes in the Special Flood Hazard Area (SFHA), FEMA has developed precalculated benefits for property acquisition and structure elevation of buildings. Based on a national analysis that derived the average benefits for acquisition and elevation projects, FEMA has determined that acquisition projects that cost $276,000 or less, or elevation projects that costs $175,000 or less, and which are located in the 1% ACE (i.e., 100-yr recurrence interval) floodplain are considered cost-effective and do not require a separate benefit-cost analysis. For projects that contain multiple structures, the average cost of all structures in the project must meet the stated criteria. If the cost to acquire or elevate a structure exceeds the amount of benefits listed above, then a traditional FEMA-approved benefits-cost analysis must be completed (FEMA 2015).

In the Oneida Creek watershed, there are approximately 1,279 tax parcels (919 parcels in Madison County and 360 parcels in Oneida County) within the FEMA 1% annual and 0.2% ACE hazard zones. Of the 1,279 tax parcels, 811 are classified as residential with a total full market value of $95.9 million, and 110 are classified as commercial with a total full market value of $17.7 million. Table 35 summarizes the number of parcels and their full market value within the three high-risk flood areas (NYSGPO 2022). Figure 8-

1 displays the tax parcels that intersect the FEMA flood zones, including generalized locations of FEMA repetitive loss properties.

Table 35. Summary Table for Tax Parcels Within FEMA Flood Zones in High-Risk Areas Along Oneida Creek

Source: NYSGPO 2022			
High-Risk Flood Areas	Number of Parcels		Full Market Value
	Oneida County	Madison County	
#1: City of Oneida and Village of Oneida Castle (Town of Vernon)	204	455	$51.1 million
#2: Cities of Oneida and Sherrill (Town of Vernon)	83	73	$31.8 million
#3: Village of Munnsville	N/A	77	$6.3 million
Total	287	605	$89.2 million

In addition, there are 4 FEMA repetitive loss properties within the Oneida Creek watershed (Figure 8-1). There are 3 RL properties in the City of Oneida in High-Risk Area #1 and 1 RL property in the Town of Lenox at the confluence with Oneida Lake (FEMA 2019).

Due to the variable nature of buyout programs, no ROM cost estimate was produced for this study. It is recommended that any buyout program begin with a cost-benefit analysis for each property. After a substantial benefit has been established, a buyout strategy study should be developed that focuses on properties closest to Oneida Creek in the highest-risk flood areas and progresses outwards from there to maximize flood damage reductions. In addition, structures located adjacent to flood prone infrastructure (i.e., bridges, culverts, etc.) should also be considered high-risk and prioritized in any buyout program strategy. A potential negative consequence of buyout programs is the permanent removal of properties from the floodplain, and resulting tax revenue, which would have long-term implications for local governments and should be considered prior to implementing a buyout program.

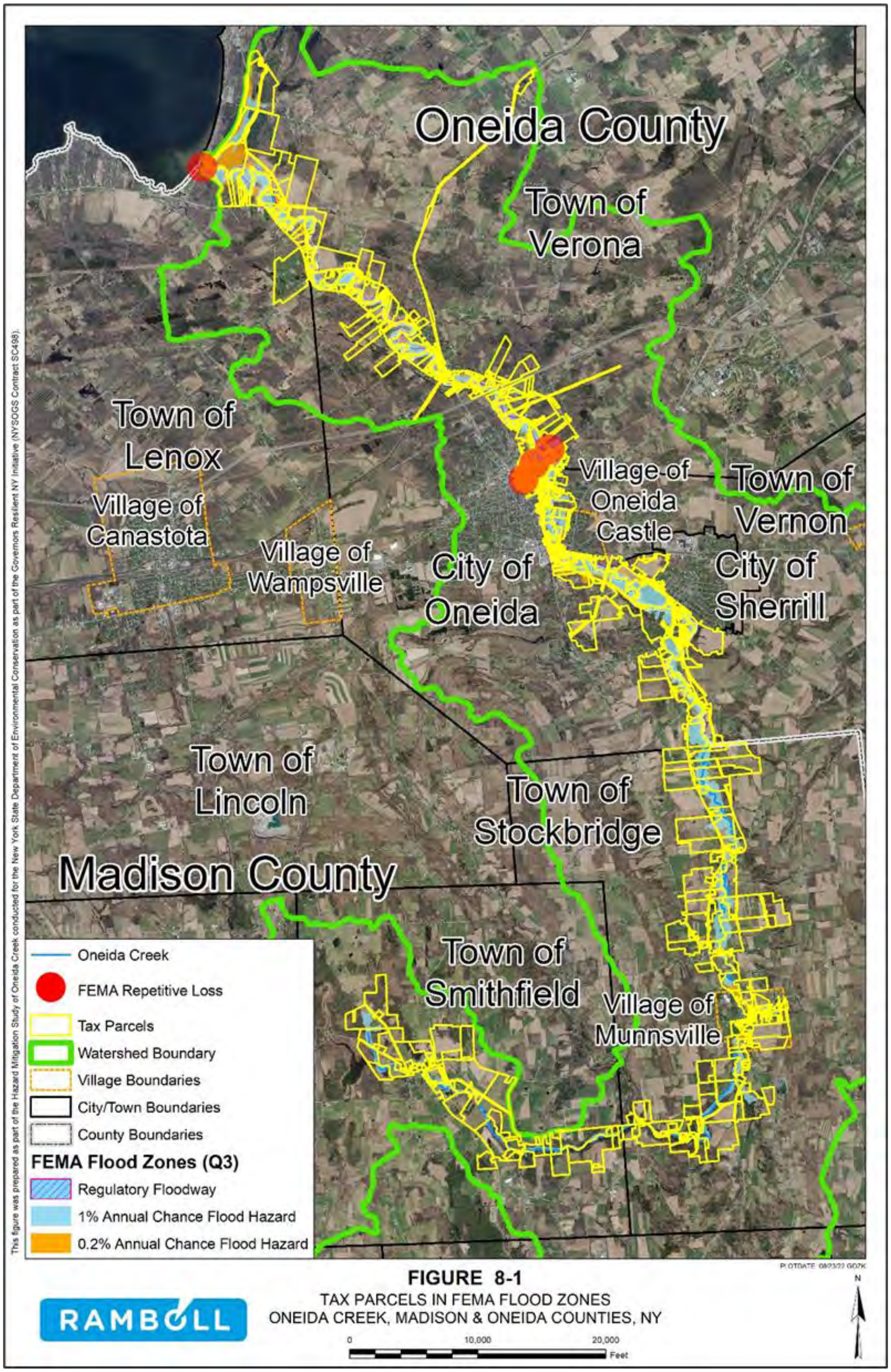

Figure 8-1. Tax parcels within FEMA flood zones, Oneida Creek, Oneida and Madison Counties, NY.

8.6 ALTERNATIVE #4-6: FLOODPROOFING

Floodproofing is defined as any combination of structural or nonstructural adjustments, changes, or actions that reduce or eliminate flood damage to a building, contents, and attendant utilities and equipment (FEMA 2000). Floodproofing can prevent damage to existing buildings and can be used to meet compliance requirements for new construction of residential and non-residential buildings.

The most effective flood mitigation methods are relocation (i.e., moving a home to higher ground outside of a high-risk flood area) and elevation (i.e., raising the entire structure above BFE). The relationship between the BFE and a structure's elevation is one of many factors in determining the flood insurance premium. Buildings that are situated at or above the level of the BFE have lower flood risk than buildings below BFE and tend to have lower insurance premiums than buildings situated below the BFE (FEMA 2015).

In some communities, where non-structural flood mitigation alternatives are not feasible, structural alternatives such as flood proofing may be a viable alternative. The National Flood Insurance Program has specific rules related to flood proofing for residential and non-residential structures. These can be found in the Code of Federal Regulations (CFR) 44 CFR 60.3 (FEMA 2000).

For communities that have been provided an exception by FEMA, the CFR allows for the floodproofing of residential basements as outlined in 44 CFR 60.6 (c) "a permit can be obtained to floodproof a residential building basement, if it can demonstrate an adequate warning time under a flood depth less than 5 feet and a velocity less than 5 fps." Floodproofing residential basements should be considered during the design phase of a structure prior to construction. For existing structures, floodproofing residential basements can be a difficult, complex, and expensive measure to achieve. Instead, residential structures should be raised above the BFE in accordance with local regulations. Floodproofing is allowed for non-residential structures, with design guidelines outlined in FEMA P-936 – Floodproofing Non-Residential Structures (FEMA 2000; FEMA 2013). The local floodplain administrator should carefully review local ordinances, the CFR and available design guidelines before issuing a permit for structural flood proofing. Floodproofing strategies include:

Interior Modification/Retrofit Measures

Interior modification and retrofitting involve making changes to an existing building to protect it from flood damage. When the mitigation is properly completed in accordance with NFIP floodplain management requirements, interior modification/retrofit measures could achieve somewhat similar results as elevating a home above the BFE. Keep in mind, in areas where expected base flood depths are high, the flood protection techniques below may not provide protection on their own to the BFE or, where applicable, the locally required freeboard elevation (FEMA 2015).

Examples include:

- *Basement Infill:* This measure involves filling a basement located below the BFE to grade (ground level).
- *Abandon Lowest Floor:* This measure involves abandoning the lowest floor of a two or more story slab-on-grade residential building.
- *Elevate Lowest Interior Floor:* This measure involves elevating the lowest interior floor within a residential building with high ceilings.

Dry floodproofing:

A combination of measures that results in a structure, including the attendant utilities and equipment, being watertight with all elements substantially impermeable to the entrance of floodwater and with structural components having the capacity to resist flood loads (FEMA 2015).

Although NFIP regulations require non-residential buildings to be watertight and protected only to the BFE for floodplain management purposes (to meet NFIP regulations), protection to a higher level is necessary for dry floodproofing measures to be considered for NFIP flood insurance rating purposes. Because of the additional risk associated with dry floodproofed buildings, to receive an insurance rating based on 1% ACE (100-yr) flood protection, a building must be dry floodproofed to an elevation at least 1 ft above the BFE (FEMA 2013).

Examples include:

- *Passive Dry Floodproofing System*: This measure involves installing a passive (works automatically without human assistance) dry floodproofing system around a home to protect the building from flood damage.
- *Elevation*: This measure involves raising an entire residential or non-residential building structure above BFE.

Wet floodproofing:

The use of flood-damage-resistant materials and construction techniques to minimize flood damage to areas below the flood protection level of a structure, which is intentionally allowed to flood (FEMA 2015).

Examples include:

- *Flood Openings*: This measure involves installing openings in foundation and enclosure walls located below the BFE that allow automatic entry and exit of floodwaters to prevent collapse from the pressures of standing water.
- *Elevate Building Utilities*: This measure involves elevating all building utility systems and associated equipment (e.g., furnaces, septic tanks, and electric and gas meters) to protect utilities from damage or loss of function from flooding.
- *Floodproof Building Utilities*: This measure involves floodproofing all building utility systems and associated equipment to protect it from damage or loss of function from flooding.

- *Flood Damage-Resistant Materials*: This measure involves the use of flood damage-resistant materials such as non-paper-faced gypsum board and terrazzo tile flooring for building materials and furnishings located below the BFE to reduce structural and nonstructural damage and post-flood event cleanup.

Barrier Measures

Barriers, such as floodwalls and levees, can be built around single or multiple residential and non-residential buildings to contain or control floodwaters (FEMA 2015). Although floodwalls or levees can be used to keep floodwaters away from buildings, implementing these measures will not affect a building's flood insurance rating unless the flood control structure is accredited in accordance with NFIP requirements (44 CFR §65.10) and provides protection from at least the 1% ACE (100-yr) flood. Furthermore, floodwalls or levees as a retrofit measure will not bring the building into compliance with NFIP requirements for Substantial Improvement/Damage (FEMA 2013). Barrier measures require ongoing maintenance (i.e., mowing, etc.) which should be factored into any cost analysis. In addition, barrier measures tend to create a false sense of security for the property owners and residents that are protected by them. If a barrier structure is not properly constructed or maintained and fails, catastrophic damages to surrounding areas can occur.

- *Floodwall with Gates and Floodwall without Gates*: These two measures involve installing a reinforced concrete floodwall, which works automatically without human assistance, constructed to a maximum of four feet above grade (ground level). The floodwall with gates is built with passive flood gates that are designed to open or close automatically due to the hydrostatic pressure caused by the floodwater. The floodwall without gates is built using vehicle ramps or pedestrian stairs to avoid the need for passive flood gates.
- *Levee with Gates and Levee without Gates*: These two measures involve installing an earthen levee around a home, which works automatically without human assistance, with a clay or concrete core constructed to a maximum of six feet above grade (ground level). The levee with gates is built with passive flood gates that are designed to open or close automatically due to hydrostatic pressure caused by the floodwater. The levee without gates is built using vehicle access ramps to avoid the need for passive flood gates.

Modifying a residential or non-residential building to protect it from flood damage requires extreme care, will require permits, and may also require complex, engineered designs. Therefore, the following process is recommended to ensure proper and timely completing of any floodproofing project (FEMA 2015):

- Consult a registered design professional (i.e., architect or engineer) who is qualified to deal with the specifics of a flood mitigation project
- Check your community's floodplain management ordinances
- Contact your insurance agent to find out how your flood insurance premium may be affected

- Check what financial assistance might be available
- Hire a qualified contractor
- Contact the local building department to learn about development and permit requirements and to obtain a building permit
- Determine whether the mitigation project will trigger a Substantial Improvement declaration
- See the project through to completion
- Obtain an elevation certificate and an engineering certificate (if necessary)

No cost estimates were prepared for this alternative due to the variable and case-by-case nature of the flood mitigation strategy. Local municipal leaders should contact residential and non-residential building owners that are currently at a high flood risk to inform them about floodproofing measures, the recommended process to complete a floodproofing project, and the associated costs and benefits.

8.7 ALTERNATIVE #4-7: AREA PRESERVATION/FLOODPLAIN ORDINANCES

This alternative proposes municipalities within the Oneida Creek watershed consider watershed and 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 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 NYS Open Space Conservation Plan, NYSDEC Smart Growth initiative and the Climate Smart Communities Program address land use within a watershed (NYSDEC 2014). 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 National Flood Insurance Program (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 Oneida Creek watershed.

8.8 ALTERNATIVE #4-8: COMMUNITY FLOOD AWARENESS AND PREPAREDNESS PROGRAMS/EDUCATION

Disaster resilience encompasses both the principles of preparedness and reaction within the dynamic systems and focuses responses on bridging the gap between pre-disaster activities and post-disaster intervention, and among structural/non-structural mitigation. Integral to these concepts is the role of the community itself, and how the community adapts to being prepared for disasters and, ultimately, how the community takes on the effort of disaster risk reduction. By consulting the community at risk, the local stakeholder concerns can be taken into consideration, and thus be addressed accordingly in the post-disaster recovery stage (Nifa et al. 2017).

Community flood awareness programs should focus on a multi-scale, holistic strategy of preparedness and resilience, and in this way attempt to achieve a substantial reduction of disaster losses, in lives, and in the social, economic, and environmental assets of the community. This approach should incorporate four functions of flood education (Dufty 2008):

- Preparedness conversion: learning related to commencing and maintaining preparations for flooding.
- Mitigation behaviors: learning and putting into practice the appropriate actions for before, during and after a flood.
- Adaptive capability: learning how to change and maintain adaptive systems (e.g., warning systems) and build community competencies to help minimize the impacts of flooding.
- Post-flood learnings: learning how to improve preparedness levels, mitigation behaviors and adaptive capability after a flood.

In developing a program, community leaders should consider a commitment to community participation in the design, implementation, and evaluation of flood education programs. A more participatory approach to community flood and other hazards can enhance community resilience to adversity by stimulating participation and collaboration of stakeholders and decision makers in building its capability for preparedness, response, and recovery. In addition, community flood-education programs should be ongoing as it is unsure when a flood event will occur (Dufty 2008).

8.9 ALTERNATIVE #4-9: 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 include 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):

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

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

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, and disinvestment in urban and suburban communities caused by the development of new or expanded infrastructure.

8.10 ALTERNATIVE #4-10: ICE MANAGEMENT

This strategy is intended to control ice-jam formation by maintaining ice coverage in high-risk sections of Oneida Creek. Ice management strategies include various methods of preventing ice jams by breaking ice using various ice cutting patterns and techniques, as well as various equipment and personnel. Ice-jam mitigation strategies are very much site dependent. A strategy that works for a certain reach of a river may not work for another reach in the same river due to river morphology and hydrodynamics. Therefore, each of these strategies need to be analyzed with numerical modeling and simulations to check if they work for a considered area/reach of a river before implementing or recommending with the previous observational experience alone. Suggested locations for ice cutting operations would be provided based on anticipated effectiveness, site accessibility, and historical occurrences of ice jams. Criteria and scheduling would be provided by county and/or state agencies and determined based on environmental conditions (e.g., temperature, ice thickness, weather forecast) (USACE 2016c).

The standard strategies that are widely accepted and practiced in cold-region engineering, such as in central New York, are listed below with greater detail provided in Appendix E:

- Ice breaking – either through the use of explosives or ice-breaker ferries and cutters that either cut ice free from the banks or cross-cut ice to hasten the release of ice in order to prevent ice-jam formations
- Trenchers and special design trenching equipment – used to dig ditches customarily, but can be used to cut ice to hasten release downstream
- Channeling plow – plow mounted to a sledge drawn by a tractor that breaks and clears ice from channel
- Water jet and thermal cutting – supersonic water streams and thermal cutting tools to separate ice and move it downstream
- Hole cutting – drill large holes into the ice to reduce the integrity of the ice cover and curtail ice formation
- Air bubbler and flow systems – release air bubbles and mix heated effluent into the cold water to suppress ice growth
- Ice forecasting systems – systems designed to monitor ice cover on waterways and alert local communities when there is the potential for an ice jam
- Ice retention structures – such as ice booms or inflatable dams designed to force ice floes into or stop ice floes at a specific area
- Removal of bridge piers, heated bridge piers, or heated riverbank dikes (USACE 2006)

Generally, the FDD method, as previously discussed, is a good technique to first predict the ice thickness at critical locations, such as bridges or any flow constriction structures using the forecasted air temperature. This method will let the community officers know the severity of any possible ice jams based on future air temperature, allowing for time to get equipment and labor ready for the forthcoming ice jam. A small computer program could be used to do the iterative calculations faster, so that any non-technical user can use it to foresee the ice jam (Shen and Yapa 2011).

Another technique is maintaining a calibrated ice model to predict possible ice jam locations using forecasted air temperature and flow. This will be a comprehensive 2-D river ice simulation model (RICEN) (Shen et al. 1995) or Comprehensive River Ice Simulation System (CRISSP 2D) (CEATI 2005) that predicts the fate of ice evolution from fall to spring.

Ramboll suggests performing a freeze-up or a break-up ice model simulation study prior to implementing any of the above discussed strategies. The basic data needs and steps involved in an ice simulation analysis are also outlined in Appendix E.

Due to the variable nature of ice jam occurrence and severity, no cost estimates were prepared for this alternative.

9. NEXT STEPS

Before selecting a flood mitigation strategy, securing funding, or commencing an engineering design phase, Ramboll recommends that additional modeling simulations and wetland investigations be performed.

9.1 ADDITIONAL DATA MODELING

Additional data collection and modeling would be necessary to more precisely model water surface elevations and the extent of potential flooding in overbank areas and the floodplain. 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 1-D steady flow simulations. 2-D ice simulations are highly recommended to access the wintery condition with the suggested alternatives to evaluate the water level rises due to presence of ice, ice-jam or break-up ice jam conditions.

9.2 STATE AND LOCAL REGULATIONS

Prior to implementation of any mitigation alternative, pertinent local municipalities' Flood Damage Prevention 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 flood 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.

None of the proposed mitigation alternatives involved any jurisdictional NYSDEC wetlands; however, several alternatives are on lands that historically were designated wetlands. The NYSDEC recommends wetland delineations where mapped NYSDEC wetlands have historically existed or are in close proximity, such as near the outlet of Oneida Creek into Oneida Lake. 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

Oneida Creek is protected under Article 15 of Title 6 of the New York Codes, Rules, and Regulations (6NYCRR Part 608). Oneida Creek has a designation as classification C in the lower reaches and C(T) in the upper reaches beginning near the City of Oneida and Town of Stockbridge boundary. Classification C indicates a best usage for fishing and that the waters shall be suitable for fish, shellfish and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

The symbol (T) indicates that designated waters are trout waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout or trout waters applies (NYSDEC 2022a).

These designations are important in regard to the standards of quality and purity established for all classifications. Any changes to the bed or bank of Oneida Creek would need to be reviewed and approved by the NYSDEC (NYSDEC 2020a).

9.5 ICE EVALUATION

Due to the complex interaction of ice formation and water flow through a river, it is difficult to draw conclusions regarding proposed flood mitigation strategies and ice-jam formations based on observational data alone. The river bathymetry and channel meanders can complicate the ice dynamics and freeze-up jams. Spring runoff is affected by multiple environmental factors, including:

- Air temperature
- Water temperature
- Snow and ice melt intensity
- Upstream flow
- Upstream ice concentration
- Land cover
- Precipitation

Therefore, river reaches with possible or potential ice jams should be analyzed using more comprehensive ice studies, conceivably a 2-D ice dynamic study, to better understand the nature of the flooding and the necessary mitigation. Ice-jam flooding is very different compared to regular flooding due to the presence of solid and frazil ice. The transportation of frazil ice and solid ice in a river constantly changes the hydrodynamics of the flow, and even at low flows can still raise water levels high enough to cause flooding. The growth of single-layer ice jams can create conditions that change low flood hazards, to high flood hazards, even at low flow conditions.

The impact of these factors will be amplified by climate change. Projected increases in precipitation across New York State indicates the potential for increases in spring runoff, which in turn would increase water levels and velocities in nearby streams and rivers (Rosenzweig et al. 2011). In theory, the increased velocities would move solid ice and frazil ice down the river channel quicker, possibly preventing ice-jam formations. However, due to the limited available research in this area, additional data collection and modeling needs to be performed before a recommendation can be made regarding a flood mitigation strategy, and its specific influence on ice-jam formations.

9.6 EXAMPLE FUNDING SOURCES

There are numerous potential funding programs and grants for flood mitigation projects that may be used to offset municipal financing, including:

- New York State Office of Emergency Management (NYSOEM)
- New York State Department of Transportation Bridge NY Program
- Regional Economic Development Councils/Consolidated Funding Applications (CFA)
- Natural Resources Conservation Services (NRCS) Watershed Funding Programs
- FEMA Unified Hazard Mitigation Assistance (HMA) Program
- FEMA Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act
- USACE Continuing Authorities Program (CAP)

9.6.1 NYS Office of Emergency Management (NYSOEM)

The NYSOEM, through the U.S. 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. These include improvements to cybersecurity, economic recovery, housing, infrastructure systems, natural and cultural resources, and supply chain integrity and security. In 2018, there was no cost share or match requirement.

9.6.2 NYSDOT Bridge NY Program

The NYSDOT, in accordance with Governor Andrew Cuomo’s infrastructure initiatives, announced the creation of the Bridge NY program. The Bridge NY program provides enhanced assistance for local governments to rehabilitate and replace bridges and culverts. Particular emphasis will be 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.

The program is currently open and accepting applications from local municipalities through the State Fiscal Years 2020-21 and 2021-22. A minimum of $200 million was made available for awards in enhanced funding under the Bridge NY program for local system projects during the two-year period. More funding may be added to either the bridge or culvert program if it becomes available after the announcement of the solicitation.

9.6.3 Regional Economic Development Councils/Consolidated Funding Applications (CFA)

The Consolidated Funding Application is a single application for state economic development resources from numerous state agencies. The ninth round of the CFA was offered in 2019.

9.6.3.1 Water Quality Improvement Project (WQIP) Program

The Water Quality Improvement Project Program, administered through the Department of Environmental Conservation, is a statewide reimbursement grant program to address documented water quality impairments. Eligible parties include local governments and not-for-profit corporations. Funding is available for construction/implementation projects; projects exclusively for planning are not eligible. Match for WQIP is a percentage of the award amount, not the total project cost. Deadlines are in accordance with the CFA application cycle.

9.6.3.2 Climate Smart Communities (CSC) Grant Program

The Climate Smart Communities (CSC) Grant Program is a 50/50 matching grant program for municipalities under the New York State Environmental Protection Fund, offered through the CFA by the NYS Office of Climate Change. The purpose of the program is 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. The eligible project types that may be relevant include the following:

- The construction of natural resiliency measures, conservation or restoration of riparian areas and tidal marsh migration areas
- Nature-based solutions such as wetland protections to address physical climate risk due to water level rise, and/or storm surges and/or flooding
- Relocation or retrofit of facilities to address physical climate risk due to water level rise, and/or storm surges and/or flooding
- Flood risk reduction
- Climate change adaptation planning and supporting studies

Eligible projects include implementation and certification projects. Deadlines are in accordance with the CFA cycle.

9.6.4 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.

9.6.4.1 Emergency Watershed Protection (EWP) Program

The NRCS administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. It is not necessary for a national emergency to be declared for an area to be eligible for assistance. 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.

All projects must have a project sponsor. Sponsors include legal subdivisions of the state, such as a city, county, general improvement district, conservation district, or any Native American tribe or tribal organization.

The NRCS may bear up to 75% of the eligible construction cost of emergency measures (90% within limited-resource areas as identified by the U.S. Census data). The remaining costs must come from local sources and can be in the form of cash or in-kind services.

Public and private landowners are eligible for assistance but must be represented by a project sponsor.

Eligible projects include, but are not limited to, debris-clogged stream channels, undermined and unstable streambanks, and jeopardized water control structures and public infrastructures.

9.6.4.2 Watershed and Flood Prevention Operations (WFPO) Program

The Watershed Protection and Flood Prevention Operations (WFPO) Program includes the Flood Prevention Operations Program (Watershed Operations) authorized by the Flood Control Act of 1944 (P.L. 78-534) and the provisions of the Watershed Protection and Flood Prevention Act of 1954 (P.L. 83- 566). It provides 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.

The WFPO Program provides technical and financial assistance to states, local governments, and tribes to plan and implement authorized watershed project plans for the purpose of the following:

- Flood prevention
- Watershed protection
- Public recreation
- Public fish and wildlife
- Agricultural water management
- Municipal and industrial water supply
- Water quality management
- Watershed structure rehabilitation (there is a separate program that manages rehabilitation projects)

9.6.4.3 Watershed Rehabilitation (REHAB) Program

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. Watershed Rehabilitation addresses critical public health and safety concerns. Since 1948, NRCS has assisted local sponsors in constructing 11,850 project dams. Rehabilitation of watershed project dams is authorized for dams originally constructed as part of a watershed project carried out under any of the following four authorities—Public Law 83-566, Public Law 78-534, the Pilot Watershed Program authorized under the Department of Agriculture Appropriation Act of 1954, or the Resource Conservation and Development Program authorized by the Agriculture and Food Act of 1981.

Watershed project sponsors represent interests of the local community in federally assisted watershed projects. Sponsors request assistance from NRCS. When funding is allocated, the sponsor and NRCS enter into an agreement that defines the roles and responsibilities of each party to complete the rehabilitation.

Many aging dams no longer meet current state and NRCS design and safety criteria, and performance standards and may pose a potential hazard to lives and property if dam failure would occur. NRCS provides technical and financial assistance to local project sponsors to rehabilitate aging dams that protect lives and property, and infrastructure. Local sponsors who are interested in rehabilitating their aging dam may request technical and financial assistance from NRCS. NRCS prioritizes dams for rehabilitation based on the risks to life and property if a dam failure would occur.

9.6.5 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. The HMA program consolidates the application process for FEMA's annual mitigation grant programs not tied to a state's Presidential disaster declaration. Funds are available under the Building Resilient Infrastructure and Communities (BRIC) and the Flood Mitigation Assistance (FMA) Programs.

For flood mitigation measures that are being considered for funding through FEMA grant programs, a benefit-to-cost analysis will be required. In order to qualify for FEMA grants and/or funding, the benefit to cost ratio must be greater than one.

9.6.5.1 Building Resilient Infrastructure and Communities (BRIC)

Beginning in 2020, the Building Resilient Infrastructure and Communities grant program, which was created as part of Disaster Recovery Reform Act of 2018 (DRRA), replaced the existing Pre-Disaster Mitigation (PDM) program, and is funded by a 6% set-aside from federal post-disaster grant expenditures. BRIC will support states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. Through BRIC, FEMA will invest in a wide variety of mitigation activities, including community-wide public infrastructure projects. Moreover, FEMA anticipates BRIC will fund projects that demonstrate innovative approaches to partnerships, such as shared funding mechanisms and/or project design.

9.6.5.2 Flood Mitigation Assistance (FMA) Program

The Flood Mitigation Assistance Program provides resources to reduce or eliminate long-term risk of flood damage to structures insured under the National Flood Insurance Program. The FMA project funding categories include Community Flood Mitigation – Advance Assistance (up to $200,000 total federal share funding) and

Community Flood Mitigation Projects (up to $10 million total). Federal funding is available for up to 75% of the eligible activity costs. FEMA may contribute up to 100% federal cost share for severe repetitive loss properties, and up to 90% cost share for repetitive loss properties. Eligible project activities include the following:

- Infrastructure protective measures
- Floodwater storage and diversion
- Utility protective measures
- Stormwater management
- Wetland restoration/creation
- Aquifer storage and recovery
- Localized flood control to protect critical facility
- Floodplain and stream restoration
- Water and sanitary sewer system protective measures

9.6.6 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. The act states that $100 million would be authorized for fiscal years 2022 and 2023. As loans are repaid, the funds are available for other mitigation project loans.

This "resilience revolving loan fund" will be eligible for projects intended to protect against wildfires, earthquakes, flooding, storm surges, chemical spills, seepage resulting from chemical spills and floods, and any other event deemed catastrophic by FEMA. These low-interest funds will allow for cities and states to repay the loan with savings from mitigation projects. It also gives states and localities the flexibility to respond to oncoming disasters without paying high interest rates so they can invest in their communities.

9.6.7 USACE Continuing Authorities Program (CAP)

The USACE Continuing Authorities Program (CAP) is a group of nine legislative authorities under which the Corps of Engineers can plan, design, and implement certain types of water resources projects without additional project-specific congressional authorization. The purpose of the CAP is to plan and implement projects of limited size, cost, scope and complexity. Table 36 lists the CAP authorities and their project purposes (USACE 2019).

Table 36. USACE Continuing Authorities Program (CAP) Authorities and Project Purposes

(Source: USACE 2019)

Authority	Project Purpose
Section 14, Flood Control Act of 1946, as amended	Streambank and shoreline erosion protection of public works and non-profit public services
Section 103, River and Harbor Act of 1962, as amended (amends Public Law 79-727)	Beach erosion and hurricane and storm damage reduction
Section 107, River and Harbor Act of 1960, as amended	Navigation improvements
Section 111, River and Harbor Act of 1968, as amended	Shore damage prevention or mitigation caused by federal navigation projects
Section 204, Water Resources Development Act of 1992, as amended	Beneficial uses of dredged material
Section 205, Flood Control Act of 1948, as amended	Flood control
Section 206, Water Resources Development Act of 1996, as amended	Aquatic ecosystem restoration
Section 208, Flood Control Act of 1954, as amended (amends Section 2, Flood Control Act of August 28, 1937)	Removal of obstructions, clearing channels for flood control
Section 1135, Water Resources Development Act of 1986, as amended	Project modifications for improvement of the environment

All projects in this program include a feasibility phase and an implementation phase. Planning activities, such as development of alternative plans to achieve the project goals, initial design and cost estimating, environmental analyses, and real estate evaluations, are performed during the feasibility phase, to develop enough information to decide whether to implement the project. The feasibility phase is initially federally funded up to $100,000. Any remaining feasibility phase costs are shared 50/50 with the non-federal sponsor after executing a feasibility cost sharing agreement (FCSA). The final design, preparation of contract plans and specifications, permitting, real estate acquisition, project contracting and construction, and any other activities required to construct or implement the approved project are completed during the implementation phase. The USACE and the non-federal sponsor sign a project partnership agreement (PPA) near the beginning of the implementation phase. Costs beyond the feasibility phase are shared as specified in the authorizing legislation for that section (USACE 2019).

10. SUMMARY

The Cities of Oneida and Sherrill and Towns of Vernon and Stockbridge, including the Village of Munnsville, have had a history of flooding events along Oneida Creek. Flooding in the Towns can occur during any season of the year and are usually the result of spring rains and snowmelt, heavy rains by convective systems, log and debris jams, and ice jams caused by above freezing temperatures allowing ice breakups in waterways. In response to persistent flooding, the State of New York in conjunction with the Towns of Vernon and Stockbridge, Village of Munnsville, Cities of Oneida and Sherrill, and Onondaga and Madison Counties, are studying, addressing, and recommending potential flood mitigation projects for Oneida Creek as part of the Resilient NY Initiative.

This report analyzed the historical and present day causes of flooding in the Oneida Creek watershed. Hydraulic and hydrologic data was used to model potential flood mitigation measures. The model simulation results indicated that there are flood mitigation measures that have the potential to reduce water surface elevations along high-risk areas of Oneida Creek, which could potentially reduce flood-related damages in areas adjacent to the creek.

Based on the flood mitigation analyses performed in this report, the mitigation measures that provided the greatest reductions in water surface elevations were increasing the openings of the bridges, flood benches, and removing the abandoned railroad bridge and dam.

Based on the analysis of the bridge widening simulations, the Prospect Street, NY-5/Genesee Street, Middle Road, Sherrill Road/CR-51 Kenwood Ave, CR-51 Kenwood Ave/CR-25 Hamilton Street, and Valley Mills Road bridges all benefited significantly from increased structural openings. However, the bridge widening measures are the costliest of the discussed flood mitigation measures. The benefits of the measures in their respective reaches should be balanced with the associated costs of each widening measure to determine if it would be feasible to move a widening measure forward. In addition, other complications, such as traffic re-routing, should be taken into account when considering any of the bridge widening measures.

The flood bench measures discussed for Oneida Creek would provide significant flood mitigation benefits for the reaches between Prospect Street and NY-5/ Genesee Street, in the vicinity of the Sherrill Wastewater Treatment Plant, between Sherrill Road/CR-51 Kenwood Ave and CR-52 Kenwood Ave/CR-25 Hamilton Street, and upstream of NY-46/Main Street. Flood benches, however, generally only benefit the areas immediately adjacent to and upstream of the constructed bench. Due to the heavily developed nature of the floodplain in the City of Oneida, very few areas were found to be adequate for large scale flood benches that could potentially provide greater flood mitigation protection to historically vulnerable areas in High-risk Area #1. In addition, flood bench measures generally tend to be costly flood mitigation projects so the benefits of these measures in their respective reaches should be balanced with the associated costs of each flood bench measure to determine if it would be feasible to move a flood bench project forward.

Debris maintenance around waterway crossing infrastructure, riparian restoration, and detention basin and wetland management measures would maintain the flow channel area in Oneida Creek, help to reduce and/or manage runoff into the waterway during precipitation events, trap and/or reduce sediment entering the waterway, and improve overall water quality. Sediment and debris that enters the waterway reduces the channel flow area, which over time can reduce the flow capacity of the channel and potentially lead to greater occurrences of, and more damaging flooding.

Ice management to control ice buildup at critical points along Oneida Creek would be highly recommended for areas upstream of known flood-prone zones. An ice prediction method using the FDD would be a good starting point to monitor and mitigate any ice-related flooding before it actually occurs. For example, planning, preparation, equipment, and labor management for ice break-up using amphibious excavators is highly effective at preventing ice jams and potential flooding at key infrastructure points. Therefore, good prediction of possible ice jams enables municipalities to have the appropriate equipment available at the right time and place. This will reduce indirect costs and inconvenience. To alleviate costs of equipment purchase, operation, and maintenance, the county and local townships could share ownership. Recurring maintenance and staffing required in order to operate the equipment should be factored into any cost analysis.

For flood mitigation measures that are being considered for funding through FEMA grant programs, a benefit-to-cost analysis will be required. In order to qualify for FEMA grants and/or funding, the benefit to cost ratio must be greater than one. Flood buyouts/property acquisitions can qualify for FEMA grant programs with a 75% match of funds. The remaining 25% of funds is the responsibility of state, county, and local governments. The case-by-case nature of buyouts and acquisitions requires widespread property owner participation to maximize flood risk reductions. An unintended consequence of buyout programs is the permanent removal of properties from the floodplain, including tax revenue, which would have long-term implications for local governments and should be considered prior to implementing a buyout program.

Floodproofing is an effective mitigation measure but requires a large financial investment in individual residential and non-residential buildings. Floodproofing can reduce the future risk and flood damage but leaves buildings in flood risk areas so that future flood damages remain. A benefit to floodproofing versus buyouts is that property and structures remain intact, thereby maintaining the tax base for the local municipality.

In general, there would be an overall greater effect in water surface elevations if multiple alternatives were built in different phases, rather than a single mitigation project. For example, building multiple flood benches along a single reach would compound the flood mitigation benefits of each bench. Table 37 is a summary of the proposed flood mitigation measures, including modeled water surface elevation reductions and estimated ROM costs.

Table 37. Summary of Flood Mitigation Measures

Alternative No.	Description	Benefits Related to Alternative	ROM cost ($U.S. dollars)
1-1	Flood Benches Upstream Oneida Creek/Old Erie Canal Aqueduct	Model simulated WSEL reductions of: Flood Bench A: up to 0.2-ft Flood Bench B: No significant change	Flood Bench A: $550,000 [i] Flood Bench B: $1.3 million [i]
1-2	Remove Oneida Street Bridge	Model simulated WSEL reductions of up to 0.5-ft	$190,000 [i]
1-3	Increase the Opening of the Bennett Road Bridge	Model simulated WSEL reductions of up to 0.3-ft	$2.6 million [i]
1-4	Flood Benches in Vicinity of the Oneida Sewage Treatment Plant	Model simulated WSEL reductions of: Flood Bench A: up to 0.1-ft Flood Bench B: up to 0.1-ft	Flood Bench A: $3.8 million [i] Flood Bench B: $3.7 million [i]
1-5	Levee Along the Oneida Sewage Treatment Plant	No model simulated upstream or downstream effects	$2.3 million [ii]
1-6	Increase the Opening of the Sconondoa Road Bridge	Model simulated WSEL reductions of up to 0.7-ft	$2.6 million [i]
1-7	Increase the Opening of the Prospect Street Bridge	Model simulated WSEL reductions of up to 1.6-ft	$2.7 million [i]
1-8	Flood Benches Between Access Road and Prospect Street	Model simulated WSEL reductions of: Flood Bench A: No significant change Flood Bench B: No significant change	Flood Bench A: $4.7 million [i] Flood Bench B: $3.7 million [i]
1-9	Flood Benches Between Prospect Street and NY-5/Genesee Street	Model simulated WSEL reductions of: Flood Bench A: up to 1.4-ft Flood Bench B: up to 2.2-ft	Flood Bench A: $4.9 million [i] Flood Bench B: $5.1 million [i]

Alternative No.	Description	Benefits Related to Alternative	ROM cost ($U.S. dollars)
1-10	Sediment/Debris Retention Basin Upstream Prospect Street	Reduce watercourse and gully erosion, trap sediment, reduce and manage runoff near and downstream of the basin, and improve downstream water quality	Variable [ii]
1-11	Remove Abandoned Railroad Bridge	Model simulated WSEL reductions of up to 2.5-ft	$200,000 [i]
1-12	Increase the Opening of the NY-5/Genesee Street Bridge	Model simulated WSEL reductions of up to 1.3-ft	$3.2 million [i]
1-13	Flood Benches Upstream NY-5/Genesee Street	Model simulated WSEL reductions of: Flood Bench A: up to 0.2-ft Flood Bench B: up to 0.7-ft	Flood Bench A: $1.0 million [i] Flood Bench B: $2.4 million [i]
1-14	Increase the Opening of the Middle Road Bridge	Model simulated WSEL reductions of up to 2.0-ft	$3.3 million [i]
2-1	Taylor Creek Sediment & Debris Management Study	Identify areas where sediment and debris build-up contribute to flooding risk and develop a management plan with specific strategies to reduce those risks	$80,000
2-2	Levee Along Sherrill Wastewater Treatment Plant	No model simulated upstream or downstream effects	$1.6 million [ii]
2-3	Flood Benches in Vicinity of Sherrill Wastewater Treatment Plant	Model simulated WSEL reductions of: Flood Bench A: up to 1.7-ft Flood Bench B: up to 0.5-ft	Flood Bench A: $1.6 million [i] Flood Bench B: $1.2 million [i]
2-4	Increase the Opening of the Sherrill Road/CR-51 Kenwood Avenue	Model simulated WSEL reductions of up to 1.7-ft	$2.0 million [i]

Alternative No.	Description	Benefits Related to Alternative	ROM cost ($U.S. dollars)
2-5	Flood Bench Between Sherrill Road/CR-51 Kenwood Avenue and CR-51 Kenwood Avenue/CR-25 Hamilton Street	Model simulated WSEL reductions of up to 1.4-ft	$3.0 million [i]
2-6	Increase the Opening of the CR-51 Kenwood Avenue/CR-25 Hamilton Street Bridge	Model simulated WSEL reductions of up to 1.8-ft	$2.2 million [i]
3-1	Increase the Opening of the Valley Mills Road Bridge	Model simulated WSEL reductions of up to 1.7-ft	$2.0 million [i]
3-2	Levee Between Valley Mills Road and NY-46/Main Street	No model simulated upstream or downstream effects	$640,000 [ii]
3-3	Flood Benches Upstream NY-46/Main Street	Model simulated WSEL reductions of: Flood Bench A: up to 1.3-ft Flood Bench B: up to 1.5-ft	Flood Bench A: $320,000 [i] Flood Bench B: $510,000 [i]
3-4	Remove Dam Upstream NY-46/Main Street	Model simulated WSEL reductions of up to 1.6-ft	Variable [iiii]
4-1	Early-warning Flood Detection System	Early-warning for open-water and ice-jam events	$120,000 [ii]
4-2	Riparian Restoration	Restores natural habitats, reduces/ manages runoff, and improves water quality	Variable (case-by-case)
4-3	Debris Maintenance Around Culverts/Bridges	Maintains channel flow area and reduces flood risk	$20,000 [ii]
4-4	Retention Basin and Wetland Management	Reduces erosion, traps sediments, reduces /manages runoff, and improves water quality	Variable (case-by-case)

Alternative No.	Description	Benefits Related to Alternative	ROM cost ($U.S. dollars)
4-5	Flood Buyouts/Property Acquisitions	Reduces and/or eliminates future losses	Variable (case-by-case)
4-6	Floodproofing	Reduces and/or eliminates future damages	Variable (case-by-case)
4-7	Area Preservation/Floodplain Ordinances	Reduces and/or eliminates future losses	Variable (case-by-case)
4-8	Community Flood Awareness and Preparedness Programs/Education	Engages the community to actively participate in flood mitigation and better understand flood risks	Variable (case-by-case)
4-9	Development of a Comprehensive Plan	Guides future development, provides legal defense for regulations, and helps establish policies related to community assets	Variable (case-by-case)
4-10	Ice Management	Control/prevent ice-jam formation by maintaining ice coverage	$40,000 [ii]

[i] Note: ROM cost does not include land acquisition costs for survey, appraisal, and engineering coordination.

[ii] Note: ROM costs do not include permitting, annual maintenance or land acquisition costs for survey, appraisal, and engineering coordination.

[iii] Note: Due to the variable nature of identifying, designing, and constructing a sediment retention basin, no ROM costs were determined for this alternative.

[iiii] Note: Due to the conceptual nature of this measure, and significant amount of data required to produce a reasonable ROM cost, it is not feasible to quantify the costs of this measure without further engineering analysis and modeling.

11. CONCLUSION

Municipalities affected by flooding along Oneida Creek can use this report to support flood mitigation initiatives within their communities. This report is intended to be a high-level overview of proposed flood mitigation strategies and their potential impacts on water surface elevations in Oneida Creek. The research and analysis that went into each proposed strategy should be considered preliminary, and additional research, field observations, and modeling are recommended before final mitigation strategies are chosen.

In order to implement the flood mitigation strategies proposed in this report, communities should engage in a process that 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 list of final flood mitigation strategies based on the additional data collection and modeling results
4. Select a final flood mitigation strategy or series of strategies to be completed for Oneida Creek 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

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.

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