Local Flood Analysis

Village of Hunter
Town of Hunter
Greene County, New York
October 2018

MILONE & MACBROOM
Engineering | Planning | Landscape Architecture | Environmental Science

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Prepared for:
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MMI #2884-10-06

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

ABBREVIATIONS/ACRONYMS

BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
CDBG	Community Development Block Grant
CFS	Cubic Feet per Second
CR	County Route
CRRA	Community Risk and Resiliency Act
CRS	Community Rating System
CWC	Catskill Watershed Corporation
DEM	Digital Elevation Model
EWP	Emergency Watershed Protection
FAC	Flood Advisory Committee
FEMA	Federal Emergency Management Agency
FHM	Flood Hazard Mitigation (funding category in SMIP)
FHMIP	Flood Hazard Mitigation Implementation Program
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPMS	Floodplain Management Services Program
GCSWCD	Greene County Soil and Water Conservation District
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
LFA	Local Flood Analysis
MMI	Milone & MacBroom, Inc.
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NRCS	Natural Resources Conservation Service
NWIS	National Water Information System
NYCDEP	New York City Department of Environmental Protection
NYCFFBO	New York City Funded Flood Buyout
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
PDM	Pre-Disaster Mitigation
RFC	Repetitive Flood Claims
SFHA	Special Flood Hazard Area
SMIP	Stream Management Implementation Program
SMP	Stream Management Plan
SR	State Route
SRL	Severe Repetitive Loss
TS	Trout Spawning
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WI/PWL	Waterbody Inventory/Priority Waterbodies List

EXECUTIVE SUMMARY

The Town and Village of Hunter have retained Milone & MacBroom, Inc. (MMI) to complete a Local Flood Analysis (LFA). A LFA is an engineering feasibility analysis that seeks to develop a range of hazard mitigation alternatives. Its primary purpose is to identify flood hazards and mitigation options for the community to implement. In the long term, these mitigation options are designed to reduce flooding and facilitate recovery from flood events. The flood analysis focuses on Schoharie Creek and several tributaries.

The Catskill Mountains are subject to large storm events that are often unevenly distributed across watersheds. As a result, local flash floods can occur in one basin while an adjacent basin receives little rainfall. In addition to local flash floods, larger storm events can cause widespread flooding. Major floods have occurred periodically over the last century with at least 11 major floods occurring between 1933 and 2011. Floods can take place any time of the year but are commonly divided into those occurring in winter and spring and those occurring in summer and fall. Floods that take place in summer and fall are typically due to extreme rainfall events caused by hurricanes and tropical storms. Floods in winter and spring are associated with rain on snow events and spring snowmelt.

A public meeting was convened at the Hunter Village Library at the beginning of the LFA process. Attendees were provided with an overview of the project, the LFA process, and hydraulic modeling techniques. Attendees were provided with large-format maps and asked to point out locations of flooding and flood damages during both Tropical Storm Irene and previous flood events. Information was collected on flood damage and potential flood mitigation alternatives. This information was then used throughout the process to verify flood damages, pinpoint problem areas, and develop flood mitigation alternatives.

Hydraulic assessment was used to evaluate historical and predicted water surface elevations, to identify floodprone areas, and to help develop mitigation strategies to minimize future flood damages and protect water quality. Specific locations were identified within the project area as being prone to flooding. Alternatives were developed and assessed at each area where flooding is known to have caused damage to homes and properties.

A number of flood mitigation approaches to reduce water surface elevations were evaluated. The recommendations are summarized in Table ES-1. More detailed descriptions of the recommendations are provided in Section 6.0 of this report.

Table ES-1
Summary of Recommendations

Bridges, Culverts, and Dams	
Bridge Street Bridge	• Replacement of the bridge with an appropriately sized structure is recommended. • It is recommended that the village work with Greene County to prioritize design and replacement of the bridge and secure funds. • It is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge meets New York State Department of Transportation (NYSDOT) design criteria.
Hunter Mountain Bridge	• When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria. • Increasing the capacity of the culvert located adjacent to the bridge is not recommended.
Elka Park Road Bridge	• When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria.
Dam Downstream of Elka Park Road Bridge	• Removal of the dam is recommended.
Deming Road Bridge	• When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria.
Pedestrian Bridge	• Closure of the bridge is recommended when major floods are forecast. • If and when the bridge is slated for replacement, the new bridge should be designed to pass the 100-year flood with no rise in water surface elevations.
Road and Bridge Closures	• It is recommended that risks associated with the flooding of bridges and roadways be reduced by temporarily closing floodprone roads during flooding events. • This requires effective signage, road closure barriers, and consideration of alternative routes.
Mad Brook Culvert at Main Street	• It is recommend that the existing culvert be replaced with a new culvert sized to pass the 50-year flow. • A full hydraulic analysis is recommended. • Periodic removal of sediments from the culvert is recommended. • Realignment of Mad Brook to eliminate the hard bend downstream of Main Street is recommended.
Mad Brook Culvert at Glen Avenue	• It is recommend that the existing culvert be replaced with a new culvert sized to pass the 50-year flow. • A full hydraulic analysis is recommended.
Ski Bowl Culvert over Shanty Hollow Brook	• Greene County has indicated that the culvert is scheduled for replacement in 2019 with a design that passes the 50-year flow. The channel design will include check dams to control sediment.

Table ES-1
Summary of Recommendations (Continued)

Floodplain Enhancement	
Floodplain Enhancement Scenarios	• Floodplain Enhancement Scenario 2c or 2d is recommended. • It is recommended that the village continue to work with landowners to find an amenable approach. • It is recommended that floodplain enhancement be combined with realignment of the Mad Brook channel to eliminate the hard bend and redirect the alignment across the floodplain to Schoharie Creek.
Critical Facilities and Anchor Businesses	
Hunter Firehouse	• The current location of the firehouse may be an obstacle to bridge replacement. • It is recommended that relocation of the firehouse out of the Special Flood Hazard Area be considered.
Village Hall	• Replacement of the Bridge Street bridge (recommended above) would alleviate flooding. • Floodproofing is recommended as an interim measure.
Post Office	• Replacement of the Bridge Street bridge (recommended above) would alleviate flooding. • Floodproofing is recommended as an interim measure.
Hardware Store	• Replacement of the Bridge Street bridge (recommended above) would alleviate flooding. • Floodproofing is recommended as an interim measure.
FEMA Floodway and Special Flood Hazard Area	
Federal Emergency Management Agency (FEMA) Floodway	• It is recommended that decisions about relocations out of the floodway take place on a case-by-case basis. • Where there is owner interest and programmatic funding available, move existing structures out of the floodway. • Elevation of structures in the floodway is not advisable but may be considered on a case-by-case basis as property owners approach the Flood Advisory Committee (FAC) or town/village boards about mitigation options. • It is recommended that stockpiled fill material be removed from the floodway. • It is recommended that proposed new development in the floodway not be permitted or that a "no rise" certification be required for proposed new development or placement of fill in the floodway.
Floodprone Structures within the Special Flood Hazard Area (SFHA)	• It is recommended that the town and village work to floodproof or relocate the most vulnerable properties where there is owner interest and programmatic funding available through flood buyout and relocation programs. • It is recommended that the town and village identify priority areas and structures that are prone to most frequent and deepest flooding.
Anchoring of Fuel Tanks	• It is recommended that sources of man-made pollution be reduced or eliminated through the relocation or securing of fuel oil and propane tanks.

Table ES-1
Summary of Recommendations (Continued)

Other Flood Protection Measures	
Protection of Water Quality	• Take action to reduce flooding at the Hunter Fire Station either through Bridge Street bridge replacement or relocation outside the SFHA in order to prevent pollutants from coming in contact with floodwaters. • Effort should be made to identify additional parcels that could benefit from securing or relocating fuel tanks to eliminate a potential source of man-made pollution. • Equipment that has the potential to be washed away in a flood should be securely anchored, housed in a shed/garage, or stored outside the 100-year flood boundary.
Stream Gauging Station	• It is recommended that the town and village work with the New York City Department of Environmental Protection (NYCDEP) and United States Geological Survey (USGS) to explore the possibility of a cost-sharing agreement and the installation of a stream gauge on Schoharie Creek. • A crest or staff gauge should be considered as a lower-cost alternative.
Procedural Recommendations	• The Town and Village of Hunter Flood Damage Prevention Laws should be strictly enforced. • The Village of Hunter Flood Damage Prevention Law should be made widely available. The law can be placed on the village website along with Zoning and Subdivision laws to increase awareness of the law. • It is recommended that town and village staff seek training regarding the content and implementation of the law. • It is recommended that the town and village gather and file flood-related lost revenue information as provided by businesses. • It is recommended that the town and village record and compile municipal, county, and state costs related to cleanup and recovery. • During and after future floods, it is recommended that high water marks be recorded throughout the town and village.

Seven bridges were evaluated using hydraulic modeling. The Bridge Street bridge over Schoharie Creek was found to be undersized, acting as a hydraulic constriction during the 10-year flood event and greater. The bridge overtops during the 50-year flood event and greater and contributes to flooding of buildings along Bridge Street and Main Street. Replacement of the bridge with an appropriately sized structure is recommended.

The Hunter Mountain bridge, Elka Park Road bridge, and Deming Road bridge over Schoharie Creek were also found to be deficient, either acting as a hydraulic constriction or overtopping during flood events. When these bridges are scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridges meet NYSDOT design criteria.

Flooding of bridges and roadways during flood events has been reported at several locations in Hunter. It is recommended that risks associated with the flooding of bridges and roadways be reduced by temporarily closing floodprone roads during flooding events. This requires effective signage, road closure barriers, and consideration of alternative routes.

Three culverts on tributaries to Schoharie Creek were evaluated and found to be undersized, and their replacement is recommended. These include the Main Street culvert at Mad Brook, the Glen Avenue culvert at Mad Brook, and the Ski Bowl culvert at Shanty Hollow Brook.

A range of floodplain enhancement scenarios were evaluated along Schoharie Creek:

- Floodplain enhancement scenario 2c or 2d is recommended.
- It is recommended that the village continue to work with landowners to find an amenable approach.
- It is recommended that floodplain enhancement be combined with realignment of the Mad Brook channel to eliminate the hard bend and redirect the alignment across the floodplain to Schoharie Creek.

A dam located in the Schoharie Creek channel downstream of the Elka Park Road bridge is in poor condition and does not appear to perform a useful function. The dam has a tendency to accumulate woody debris, which under high flow conditions could potentially back up water and contribute to elevated water surface conditions at the bridge. Removal of this dam is recommended.

Critical facilities are public facilities which if destroyed or damaged would impair the health and/or safety of the community. The following recommendations are offered to reduce flooding at critical facilities:

- It is recommended that relocation of the Hunter Firehouse out of the SFHA be considered.
- Floodproofing is recommended at the Village Hall, library, and Post Office.

Several structures, some occupied and some abandoned, were identified that are located within the floodway. The following recommendations are offered for the FEMA floodway:

  - It is recommended that decisions about relocations out of the floodway take place on a case-by-case basis, depending on the location of each structure and each structure's past history of flood damage.

- Where there is owner interest and programmatic funding available, move existing structures or move the uses within a structure out of the FEMA-designated floodway.
- Disallow new development in the floodway and require new construction within the SFHA to meet National Flood Insurance Program (NFIP) criteria.
- Elevation of structures in the floodway is not advisable but may be considered on a case-by-case basis as property owners approach the Municipal Floodplain Administrator about mitigation options.

For properties located within the SFHA, it is recommended that the town and village work to relocate the most flood-vulnerable properties where there is owner interest and programmatic funding available through flood buyout and relocation programs.

Some homes in the 100-year flood zone are rarely flooded. Residents and businesses may benefit from minor individual property improvements. Providing landowners with information regarding individual property protection is recommended. In areas where properties are vulnerable to flooding, improvements to individual properties and structures may be appropriate. Potential measures for property protection include the following:

- Elevation of the structure
- Construction of property improvements such as barriers, floodwalls, and earthen berms
- Dry floodproofing of the structure to keep floodwaters from entering
- Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded
- Performing other home improvements, such as elevating utilities, to mitigate damage from flooding
- Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs

The Village of Hunter adopted a local Flood Damage Prevention Law as local law No. 3 in 2015. The law is not currently widely available or easily accessible. In addition, general awareness of the law appears to be limited. It is recommended that the law be placed on the village's website, to accompany the Zoning and Subdivision laws, for increased access to and awareness of the law. In addition, it is recommended that both the town and village government staff seek training regarding the content and implementation of the law. This will allow the town and village officials to successfully disseminate information regarding the law to the public and to implement the law accurately.

It is recommended that sources of man-made pollution be reduced or eliminated through the relocation or securing of fuel oil and propane tanks. It is recommended that the town and village gather and file flood-related lost revenue information as provided by businesses and that the town and village record and compile municipal, county, and state costs related to cleanup and recovery. During and after future floods, it is recommended that high water marks be recorded.

A number of potential funding sources are identified in Section 6.0 of this report. As the recommendations of this LFA are implemented, the Town and Village of Hunter should work closely with potential funders to ensure that the best combinations of funds are secured for the recommended flood mitigation alternatives. It would be advantageous for the Town and Village of Hunter to identify combinations of funding sources in order to reduce their own requirement to provide matching funds.

1.0 INTRODUCTION

1.1 Project Background

The Village of Tannersville, the Town of Hunter, and the Village of Hunter are utilizing funding provided by the New York City Department of Environmental Protection (NYCDEP), through the Greene County Soil and Water Conservation District (GCSWCD), to retain MMI to complete two LFA reports. The work under this agreement is being segmented into two project components: (1) the Village of Tannersville study area; and (2) the Village of Hunter and Town of Hunter study area. The two study areas are collectively referred to as the Hunter Corridor Communities.

The LFA report for the Village of Tannersville study area was completed by MMI in February 2018. The full report is available on the Catskill Streams website at http://catskillstreams.org/wp-content/uploads/2018/03/Tannersville_LFA.pdf.

The focus area of the current LFA report is the Village of Hunter and the Town of Hunter. The LFA builds upon FEMA modeling to evaluate a variety of flooding issues in these communities and assess potential mitigation measures aimed at reducing flood inundation. The LFA is a program specific to the New York City water supply watersheds that was initiated following Tropical Storm Irene to help communities identify long-term, cost-effective projects to mitigate flood hazards. The intent of the LFA is to help municipalities do the following:

- Confirm where significant inundation flood hazards exist in the study area through engineering analysis.
- Use engineering analysis to develop a range of hazard mitigation alternatives; the primary focus of the analysis is to identify the potential for reducing floodwater elevations through channel and floodplain restoration as the first alternative to other hazard mitigation solutions.
- Evaluate both the technical effectiveness and the benefit-cost effectiveness of each solution and compare different solutions to each other for the most practical, sustainable outcome (NYCDEP, 2014).

Project recommendations generated through an approved LFA may be eligible for Flood Hazard Mitigation funding available through the Stream Management Implementation Program (SMIP) administered by GCSWCD, the Catskill Watershed Corporation's (CWC) Flood Hazard Mitigation Implementation Program (FHMIP), or the NYCDEP-funded Buyout Program. A more detailed list of potential funding sources is provided in this report.

1.2 Study Area

The study area is focused on the village of Hunter and portions of the town of Hunter along the Schoharie Creek corridor (Figure 1-1). The project area begins along Schoharie Creek at Elka Park Road and extends downstream to Deming Road, which is just beyond the boundaries of the village. Other watercourses in the study area include the following:

- A tributary of Schoharie Creek that flows along Stony Clove Road and State Route (SR) 214
- Shanty Hollow Brook, which originates on the east side of Hunter Mountain and enters Schoharie Creek near the SR 83 bridge
- An unnamed tributary that flows under Botti Drive, Dolans Avenue, and Central Avenue, passing behind the Hunter Elementary School before crossing under Main Street (SR 23A) and entering Schoharie Creek
- A tributary, known locally as Mad Brook, that parallels Glen Avenue and passes under Main Street before entering Schoharie Creek

An additional area of interest is the residential neighborhood that includes Pine Lane and Maple Avenue.

Schoharie Creek, the largest stream in the project area, originates at Indian Head Mountain in the southeast corner of the town of Hunter. It flows to the northwest, passing through the village of Hunter before entering the Schoharie Reservoir near Prattsville. After passing through the reservoir, it travels north eventually draining into the Mohawk River. The effective watershed area from the downstream end of the study area is 44.7 square miles.

Within the village of Hunter, the main flood risk occurs along the Schoharie Creek corridor. Homes and businesses along SR 23A are at risk of inundation during high-flow conditions. Several critical facilities are located along this stretch of roadway, including the Village Hall, Hunter Fire Department, and the Hunter Elementary School.

Mad Brook and the unnamed tributary that runs behind the Hunter Elementary School are not by themselves major causes of inundation. However, they contribute to the flooding that occurs along Main Street when Schoharie Creek overtops its banks. Additionally, both creeks pass through culverts that are poorly designed or undersized. Within the project area, Mad Brook passes through two culverts (Glen Avenue and Main Street) and under a private bridge. The two culverts are poorly aligned, and the channel makes an abrupt right turn before passing under the bridge. These poor alignments are creating backwater conditions under high discharges, which exacerbate flooding. The tributary that runs behind Hunter Elementary School also passes through several culverts along its course. These culverts contributed to flooding during larger discharges, but it has been reported that following recent improvements flooding associated with this tributary has not occurred.

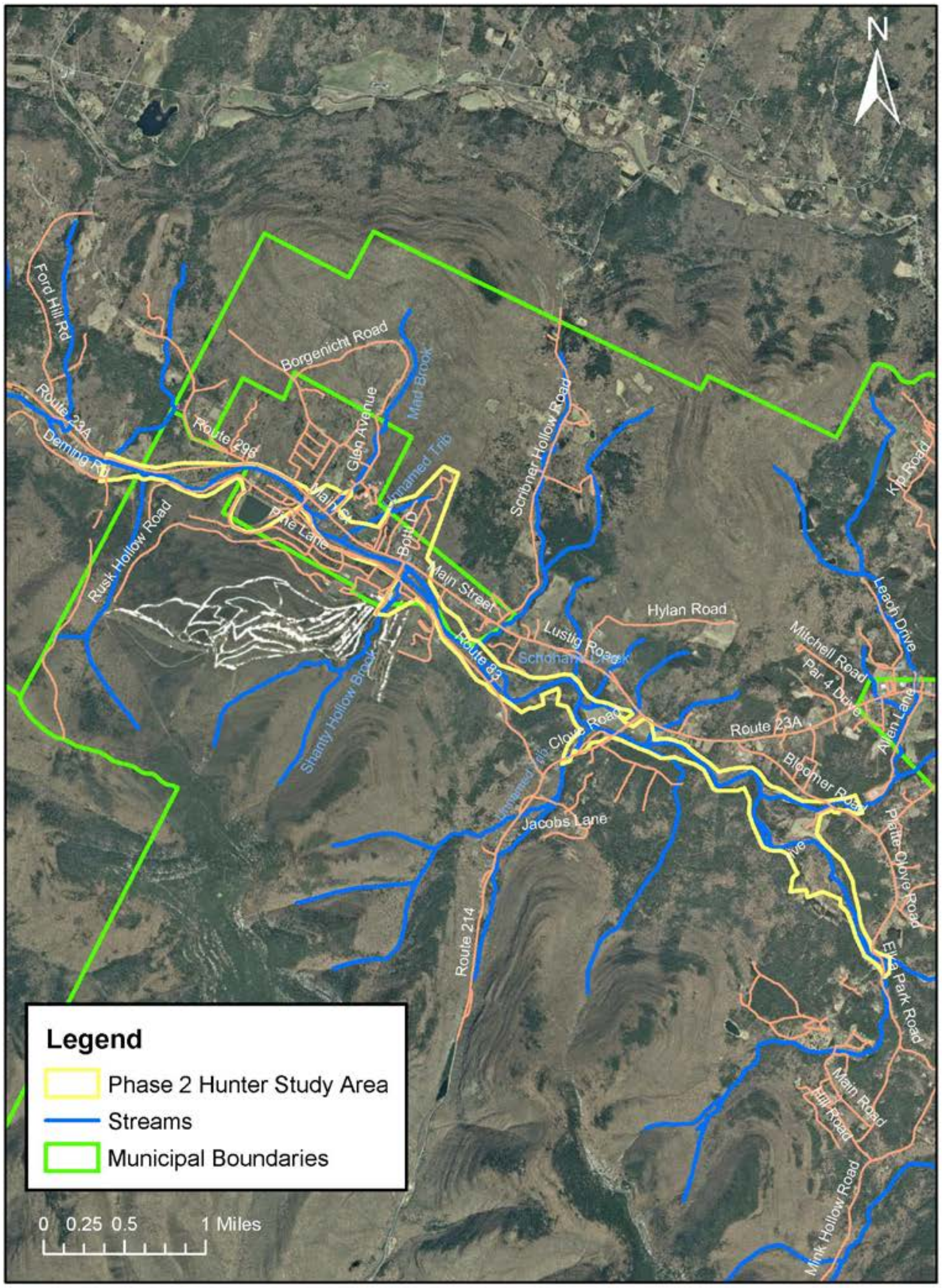


Figure 1-1
Hunter LFA Project Area

1.3 Community Involvement

The LFA was undertaken in close consultation with the Hunter Flood Advisory Committee (FAC). The FAC is comprised of individuals with technical and nontechnical backgrounds and is meant to represent various interests and stakeholders at the village, town, and county levels as well as the NYCDEP. The FAC met regularly with MMI staff over the course of the LFA process to review results and provide input on flood mitigation alternatives. It also participated in a site walk to visit an area where floodplain enhancement is recommended and the site of a recommended bridge replacement. Minutes from the FAC meetings are included in Appendix B. The group members include representatives from the following organizations:

- Village of Hunter
- Town of Hunter
- The Hunter Foundation
- Hunter Residents and Business Owners
- Greene County Highway Department
- GCSWCD
- NYCDEP
- CWC
- MMI

Figure 1-2
Hunter FAC members discuss flood mitigation alternatives on February 28, 2018, at FAC meeting at Hunter Village Hall.

Figure 1-3 graphically presents the community involvement efforts throughout the Hunter LFA process.

FAC Meeting #1 -
Introduction to and overview of Hunter LFA (February 28, 2018)

↓

Public Meeting #1 -
Introduce public to LFA process and gather information about flooding and property damage.
(April 19, 2018)

↓

FAC Meeting #2 -
Present results of initial hydraulic modeling (June 4, 2018).

↓

FAC Meeting #3 -
Present results of Benefit-Cost Analysis (July 18, 2018).

↓

FAC Meeting #4 -
Present flood mitigation recommendations (August 21, 2018).

↓

Public Meeting #2 -
Present final results of hydraulic modeling and benefit-cost analysis.
(October 24, 2018)

↓

Present final project analysis and results to Town Board.
(Date to be determined)

Figure 1-3
FAC and Public LFA Meetings

1.4 Nomenclature

In order to provide a common standard, FEMA's NFIP has adopted a baseline probability called the base flood. The base flood has a 1 percent (one in 100) chance of occurring in any given year, and the base flood elevation (BFE) is the elevation of this level. For the purpose of this report, the 1 percent annual chance flood is referred to as the ***100-year flood event***. Other recurrence probabilities used in this report include the ***2-year flood event*** (50 percent annual chance flood), the ***10-year flood event*** (10 percent annual chance flood), the ***25-year flood event*** (4 percent annual chance flood), the ***50-year flood event*** (2 percent annual chance flood), and the ***500-year flood event*** (0.2 percent annual chance flood). The SFHA is the area inundated by flooding during the 100-year flood event.

It should be noted that over the time period of a standard 30-year property mortgage a property located within the SFHA will have a 26 percent chance of experiencing a 100-year flood event. Structures falling within the SFHA may be at an even greater risk of flooding because if a house is low enough it may be subject to flooding during the 25-year or 10-year flood events. During the period of a 30-year mortgage, the chance of being hit by a 25-year flood event is 71 percent, and the chance of being hit by a 10-year flood event is 96 percent, which is a near certainty.

The FEMA-designated floodway is defined as the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. The portion of the floodplain that is outside the floodway is referred to as the flood fringe and is generally (but not in all cases) associated with less rapidly flowing water. Figure 1-4 illustrates the SFHA, floodway, and flood fringe on a typical channel cross section.

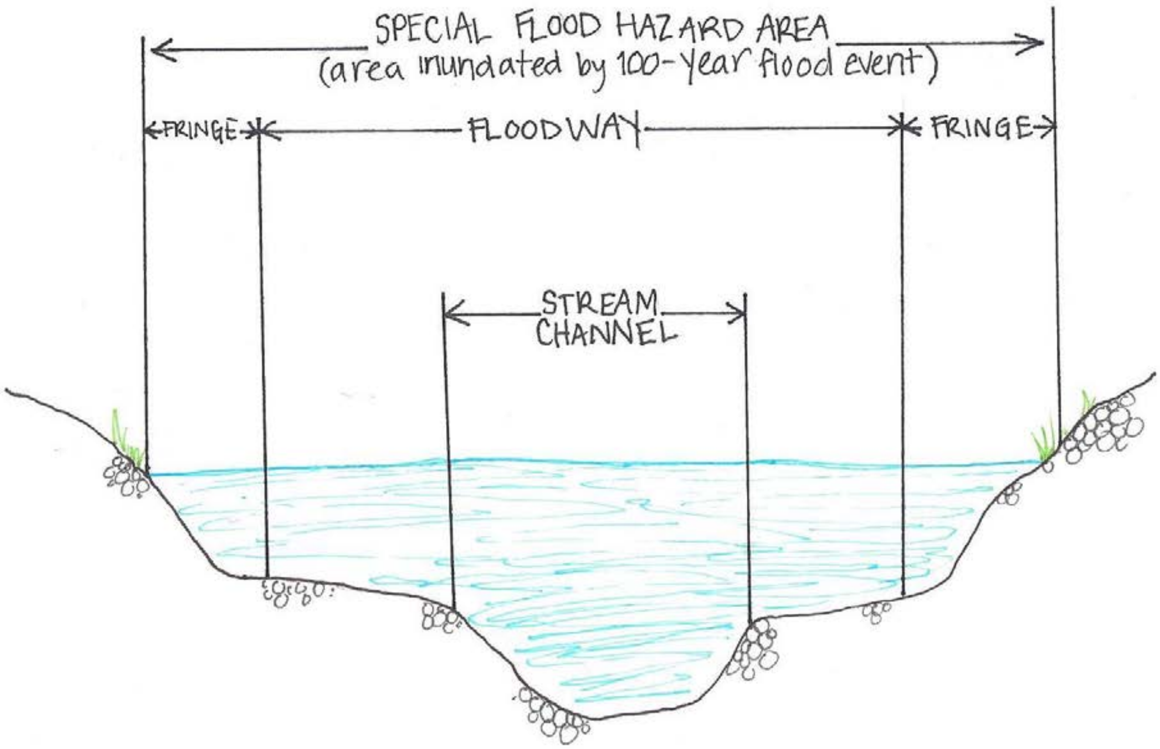


Figure 1-4
Special Flood Hazard Area, Floodway, and Flood Fringe

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

2.0 WATERSHED INFORMATION

2.1 Initial Data Collection

Initial data collected for this study and analysis included publicly available data as well as input from the FAC and from the public meetings held within the village of Hunter. A summary of key documents follows.

Flood Insurance Study (FIS)

FEMA has produced a FIS with an effective date of June 2, 2015, for Greene County. The purpose of the FEMA FIS is to determine potential floodwater elevations and delineate existing floodplains in order to identify flood hazards and establish insurance rates. For the subject study area, the FIS includes a detailed study of Schoharie Creek. While the tributary to Schoharie Creek that flows along Stony Clove Road has been mapped utilizing approximate hydrologic analyses, the remaining tributaries within the study area have not been mapped to identify their SFHA. The hydrologic and hydraulic analyses for Schoharie Creek below the confluence with Gooseberry Creek were completed during the May 16, 2008 revision of the FIS.

An important byproduct of the FIS is a series of Hydrologic Engineering Center – *River Analysis System* (HEC-RAS) computer models that are available for professional use and are an important component of the subject study. A key element of the HEC-RAS analysis is the determination of the area flooded during the 100-year frequency event, referred to as the SFHA. A detailed HEC-RAS model was created for Schoharie Creek. The tributary to Schoharie Creek that flows along Stony Clove Road was modeled using approximate methods.

Stream Management Plans

A detailed description of the Schoharie Creek watershed and channel is contained in the Schoharie Creek Stream Management Plan (SMP) prepared by the NYCDEP with assistance from the GCSWCD. This report presents information on the regional setting, climate, physiography, hydrology and flood history, watershed geology, and land use/land cover. A digital copy of this document is available at http://www.catskillstreams.org/Schoharie_Creek_Management_Plan.html. While the tributary streams are located within the Schoharie Creek watershed, they are not discussed in this SMP.

United States Geological Survey (USGS) Stream Gauging Network

The United States Geological Survey (USGS) does not operate any stream flow gauges within the Village of Hunter. The nearest downstream USGS stream gauge is located on Schoharie Creek near the hamlet of Lexington, New York (Gauge #01349705). The gauge records daily stream flow, including flood flows that are essential to understanding long-term runoff trends. Gauge data can be utilized to determine flood magnitudes and frequencies. Additionally, real time data is available to monitor water levels and provide flood alerts. Stream flow data and water levels are available at http://waterdata.usgs.gov/ny/nwis/sw.

Greene County Multijurisdictional All-Hazard Mitigation Plan

The purpose of hazard mitigation plans (HMP) is to identify policies and actions that will reduce risk in order to limit losses of property and life. Flood hazard mitigation, in particular, seeks to implement long- and short-term strategies that will successfully limit loss of life, personal injury, and property damage that can occur due to flooding (URS, 2009). Flood mitigation strategies are most successful when private property owners; businesses; and local, state, and federal governments work together to identify hazards and develop strategies for mitigation (Tetra Tech, 2009).

Flood hazard mitigation planning is promoted by various state and federal programs. At the federal level, FEMA administers two programs that provide reduced flood insurance costs for communities meeting minimum requirements: the NFIP and the Community Rating System (CRS) (Tetra Tech, 2013). Flood hazard planning is a necessary step in acquiring eligibility to participate in these programs (URS, 2009).

In 2009, Greene County completed a multijurisdictional natural Hazard Mitigation Plan (HMP). By participating in the plan, jurisdictions within the county comply with the Federal Disaster Mitigation Act of 2000. Compliance with this act allows jurisdictions to apply for federal aid for technical assistance and post-disaster mitigation project funding. A new HMP dated January 2016 is currently posted on the Greene County website. This new report has been finalized and accepted by FEMA. It has been adopted via resolution by Greene County and is in process for adoption by the towns. Both plans are available on the Greene County website.

2009 Plan: https://www.greenegovernment.com/wp-content/uploads/2015/01/HMP.pdf

2016 Plan: https://www.greenegovernment.com/wp-content/uploads/2016/02/hazplan2016.pdf

The 2009 HMP identifies flooding as a significant hazard in both Greene County and the town and village of Hunter. Hazards were ranked based on probability of occurrence and impact on the community. Flooding received the highest rating of 3, which means that flooding is frequent and likely to occur within 25 years. The impact of a particular hazard was evaluated based on effect on the population, property, and the economy. Flooding was found to have a "high" impact on all these categories. Due to the probability of occurrence and impact on the community, flooding was assigned an overall risk of "high."

Water Quality Reports

In order to fulfill requirements of the Federal Clean Water Act, the New York State Department of Environmental Conservation (NYSDEC) must provide periodic assessments of the quality of the water resources in the state regarding their ability to support specific uses. These assessments reflect monitoring and water quality information drawn from a number of programs and sources both within and outside the department. This information has been compiled by the NYSDEC Division of Water and merged into an inventory database of all water bodies in New York State. The database is used to record current water quality information, characterize known and/or suspected water quality problems and issues, and track progress toward their resolution.

The subject LFA will focus on five watercourses in the project area: Schoharie Creek, a tributary to Schoharie Creek that flows along Stony Clove Road, Shanty Hollow Brook, a tributary to Schoharie Creek that passes behind Hunter Elementary School and then under SR 23A toward Schoharie Creek, and a tributary to Schoharie Creek that parallels Glen Avenue, commonly known as Mad Brook. Each of these streams was classified by the NYSDEC as follows:

- Schoharie Creek is a Class B (TS).
- The tributary to Schoharie Creek that flows along Stony Clove Road is a Class C (TS).
- Shanty Hollow Brook is a Class C.
- The tributary to Schoharie Creek that passes behind Hunter Elementary School and then under SR 23A toward Schoharie Creek is a Class C (TS).
- Mad Brook is a Class C.

A Class B watercourse indicates that the best usage for this water is swimming and other contact recreation activities but not for drinking water. A Class C waterbody is considered suitable to support aquatic life and noncontact activities but not for water supply. The additional standard of TS indicates that the watercourse may support trout spawning, and special requirements by NYSDEC apply to sustain these waters that support these valuable and sensitive fisheries resources.

The Mohawk River Waterbody Inventory/Priority Waterbodies List (WI/PWL) provides water quality assessment data for waterbodies in the Mohawk River Basin. This document can be found on-line at http://www.dec.ny.gov/chemical/36739.html. Within the LFA study area, the Schoharie Creek main stem was assessed.

The Schoharie Creek main stem was categorized as having "minor impacts," i.e., stream bank erosion resulting in silt and sediment affecting water quality and natural resource habitat although macroinvertebrate assessments performed on this watercourse found nonimpacted conditions and no significant water quality impact at any of the five sampling sites.

The Mohawk River WI/PWL notes that the tributary to Schoharie Creek known as Shanty Hollow Brook and the tributary of Schoharie Creek that runs near Clove Road and SR 214 were not assessed for water quality. The remainder of the tributaries to Schoharie Creek within the LFA study area were not included in the document.

None of the watercourses in the LFA study area is listed in New York State's 2014 Section 303(d) inventory lists, a list of impaired waters that do not support appropriate uses.

Local Flood Damage Prevention Codes

Town of Hunter

The Town of Hunter has adopted a local "Flood Damage Prevention Law." The present code is authorized by the New York State Constitution and consistent with the federal guidelines, which are requirements for participation in the NFIP. The law can be found online here: http://townofhuntergov.com/wp-content/uploads/2015/01/52.Flood_Plan.pdf

The stated purposes of this local law are as follows:

- Regulate uses that are dangerous to health, safety, and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities.
- Require that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction.
- Control the alteration of natural floodplains, stream channels, and natural protective barriers which are involved in the accommodation of flood waters.
- Control filling, grading, dredging, and other development that may increase erosion or flood damages.
- Regulate the construction of flood barriers that will unnaturally divert flood waters or which may increase flood hazards to other lands.
- Qualify for and maintain participation in the National Flood Insurance Program.

The stated objectives of the local law are as follows:

- To protect human life and health
- To minimize the expenditure of public money for costly flood-control projects
- To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public
- To minimize prolonged business interruptions
- To minimize damage to public facilities and utilities such as water and gas mains; electric, telephone, and sewer lines; and streets and bridges located in areas of special flood hazard
- To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas
- To provide that developers are notified that property is in an area of special flood hazard
- To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions

The Town Code Enforcement Officer is empowered as the local administrator and is responsible for administering and implementing the local Flood Damage Prevention code. The Town of Hunter requires a $100 application fee, and it is the duty of the local administrator to grant or deny floodplain development permits in accordance with the code. The local administrator must conduct a permit application review prior to approval and must review the subdivision or other proposed new development to determine if the proposed site is reasonably safe from flooding. It is also his/her responsibility to determine if proposed development in an area of special flood hazard may result in physical damage to other property.

The local law identifies a series of Construction Standards for development in the floodplain, broken down into General Standards, Standards for All Structures, Residential Structures, Non-Residential Structures, and Manufactured Homes and Recreational Vehicles. The mapped FEMA flood zones are utilized to guide many of the regulations. For reference, the SFHA indicates all areas within the 1 percent annual chance flood zone, Zone A indicates the approximated 1 percent annual chance flood zone, Zones AE and A1-30 indicate the calculated 1 percent annual chance flood zone, Zone AH is a 1 percent annual chance flood zone where shallow ponding occurs, and Zones X and C are outside of the SFHA.

The General Standards section is broken down into standards for subdivision proposals and encroachments. These standards apply to both new development and substantially improved structures. All new subdivision proposals and other development proposed in a SFHA must be consistent with the need to minimize flood damage. Public utilities and facilities should be located or constructed in order to minimize flood damage, and adequate drainage should be provided. When encroaching within Zones A1-A30 and AE, along streams without a regulatory floodway, development must not increase the BFE by more than 1 foot. Along streams with a regulatory floodway, development must not create any increase in the BFE.

Standards for all structures include provisions for anchoring, construction materials and methods, and utilities. New structures must be anchored so as to prevent flotation, collapse, or lateral movement during the base flood. Construction materials must be resistant to flood damage, and construction methods must minimize flood damage. Enclosed areas below the lowest floor in zones A1-A30, AE, AH, and in some cases Zone A must be designed to allow for the entry and exit of floodwaters. Utility equipment such as electrical, HVAC, and plumbing connections must be elevated to or above the base flood height. Water supply and sanitary sewage systems must be designed to minimize or eliminate the infiltration of floodwaters.

The elevation of residential and nonresidential structures is required in areas of special flood hazard. In zones A1-A30, AE, AH, and in some cases Zone A, new residential construction and substantial improvements must have their lowest floor (including basement) elevated to an elevation that is 2 feet above the BFE. In cases where BFE data is not known for Zone A, new residential construction and substantial improvements must have their lowest floor elevated to 3 feet above the highest adjacent grade.

For nonresidential structures in zones A1-A30, AE, AH, and in some cases Zone A, developers have the option of either elevating the structures or making improvements to the structure such as floodproofing the structure to 2 feet above the BFE. In cases where BFE data is not known within Zone A, new construction and substantial improvements must have their lowest floor elevated to 3 feet above the highest adjacent grade.

Recreational vehicles are only allowed in zones A1-A30, AE, and AH if they are on site fewer than 180 consecutive days and are licensed and ready for highway use or meet the construction standards for manufactured homes. Manufactured homes in the A1-A30, AE, and AH zones must be placed on a permanent foundation with the lowest floor elevated 2 feet above the BFE. In Zone A, such structures must be placed on reinforced piers or similar elements that are at least 3 feet above the lowest adjacent grade.

Village of Hunter

The Village of Hunter adopted a local Flood Damage Prevention Law as Local Law No. 3 in 2015. The law is not currently available on the village's website, but a paper copy of the law was located when requested. In summary, the overall objective of this law is to protect human life and health and alleviate the damage caused by flooding. As required by FEMA's NFIP, the law contains all of the same language as the law adopted by the Town of Hunter and is summarized above. The one exception is that the Village of Hunter requires a $50 application fee.

There is a clause within the village's subdivision law that targets development within areas that are subject to flooding. Article XI – General Requirements and Design Standards, Section 5. Drainage Improvements, subsection E. Land Subject to Flooding states that, "development of land subject to flooding shall meet all local, State and Federal floodplain regulations. Ideally, such land shall be set aside for uses that are not endangered by periodic or occasional inundation." The subdivision law can be found online here:
http://villageofhunterny.org/content/Laws/View/1:field=documents;/content/Documents/File/8.pdf

New York State Community Risk and Resiliency Act

The New York State Community Risk and Resiliency Act (CRRA) was adopted in 2014 for the purpose of ensuring that projects receiving state funding or requiring permits include consideration of the effects of climate risk and extreme-weather events.

To meet its obligation to develop guidance for the implementation of CRRA, NYSDEC has proposed a new document, State Flood Risk Management Guidance, which is intended to inform state agencies as they develop program-specific guidance to require that applicants demonstrate consideration of sea-level rise, storm surge, and flooding as permitted by program-authorizing statutes and operating regulations. The guidance incorporates possible future conditions, including the greater risks of coastal flooding presented by sea-level rise and enhanced storm surge and of inland flooding expected to result from increasingly frequent extreme-precipitation events.

NYSDEC is also proposing a new guidance document entitled, "Guidance for Smart Growth Public Infrastructure Assessment." This new document is intended to guide state agencies as they assess mitigation of sea-level rise, storm surge, and flooding in design of public-infrastructure projects as required by CRRA.

In response to CRRA, the NYSDOT has provided updates to its guidelines and manuals relating to the design of bridges and culverts, including a revision to Chapter 8 of the *Highway Design Manual* and a revised *Bridge Manual*. For new and replacement bridges and culverts, current peak flows are to be increased to account for future projected peak flows, which range from 10 to 20 percent. Bridges are required to pass the 50-year flow with a minimum of 2 feet of freeboard and must pass the 100-year flow without causing a rise in water surface elevations. Culverts must pass the 50-year flow and meet allowable headwater limits.

2.2 Field Assessment

During the LFA process, MMI staff conducted numerous field visits to the project area. Field visits were carried out during late winter, spring, and summer of 2018 and focused on: (1) the river channel and its banks (bank and channel conditions, sediment bars, and vegetation along the stream corridor); and (2) development in the floodplains.

Stream channels assessed as part of the LFA included Schoharie Creek, two unnamed tributaries to Schoharie Creek, Mad Brook, and Shanty Hollow Brook. Inspection of the streams was conducted to inform hydraulic modeling and the alternative analysis. Fieldwork that focused on development in the floodprone areas identified at-risk buildings and infrastructure. Data was collected on these structures for use during the benefit-cost analysis (BCA).

A field site walk was conducted with members of the Hunter FAC for the purpose of visiting an area where floodplain enhancement is recommended and to visit the site of a recommended bridge replacement.

2.3 Watershed Land Use

The project area is located within the Schoharie Creek watershed. According to the Schoharie Creek SMP, the valley was inhabited by a tribe of the Mohawk people prior to arrival of the Europeans. The first Europeans to settle in the area in large numbers were Germans who began arriving in the early 1700s. These settlers cleared much of the forested land for farming. Combined with logging and the tanning industry, which focused on harvesting hemlock, most of the original first growth forest was cleared by the mid-1800s. Figure 2-1 is a historical map showing the town of Hunter.

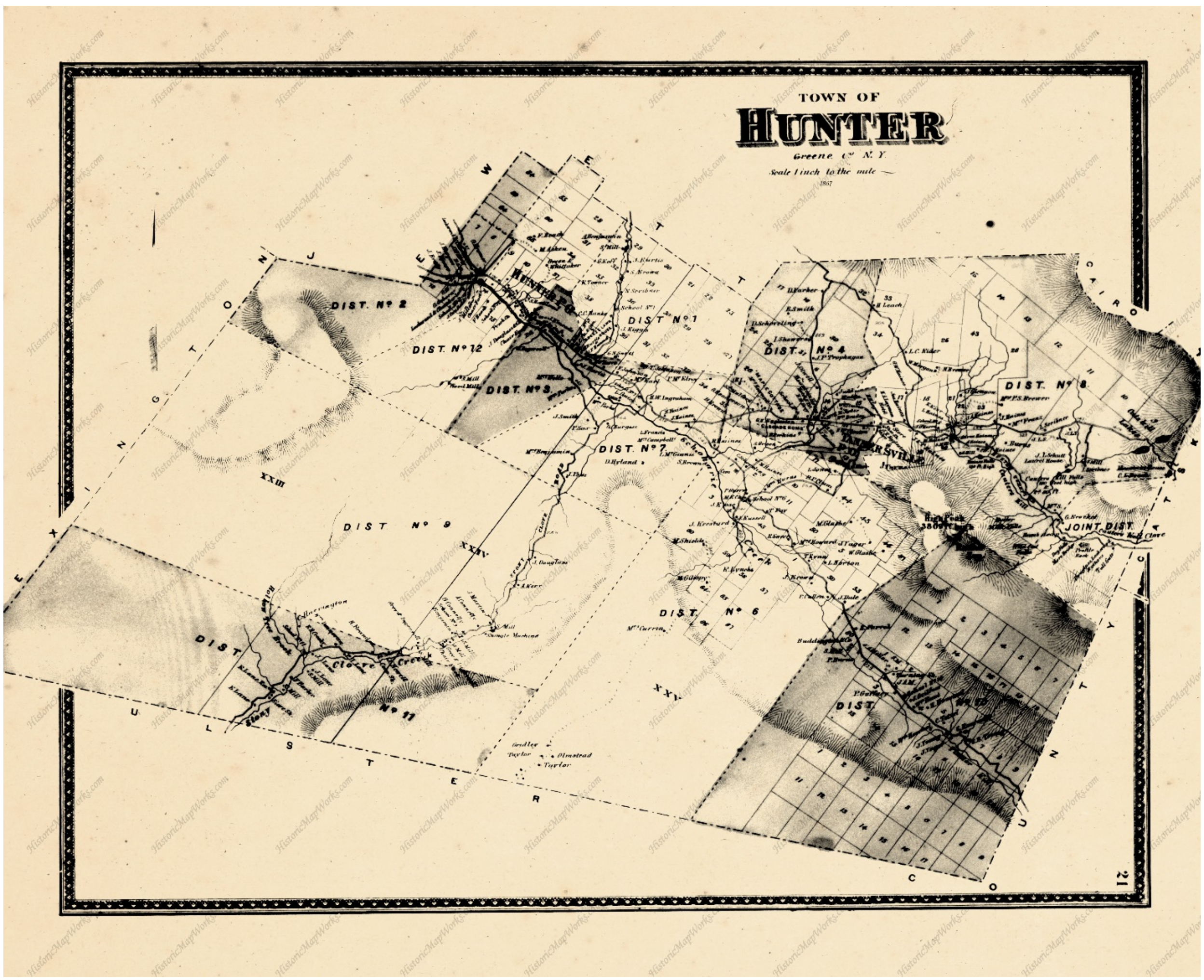


Figure 2-1
Historical Map - Town of Hunter

In 1885, the Catskill Forest Preserve was created, and in 1926 the Schoharie Reservoir was constructed and entered into service. Since the early part of the 20th century, forest cover has increased with the decline in agriculture, forestry, and the disappearance of the tannery industry. Forest cover in the watershed contributing to the Schoharie Reservoir is approximately 85 percent (GCSWCD, 2007). According to the USGS *StreamStats* program, the Schoharie Creek watershed beginning at the downstream end of the LFA study area is estimated to have a forest cover of nearly 100 percent. Today, there is almost no agricultural land use in the project area, and impervious cover consists of residential and commercial development. These areas tend to be located along river valleys, with most development occurring along and near Main Street. Hunter Mountain is an important feature and tourist attraction in the project area, providing skiing, festivals, concerts, zip-lining, and other activities as well as lodging. Figure 2-2 shows images that depict Hunter, including a historical photograph of the village of Hunter showing the Bridge Street bridge crossing as well as a plaque and the window decal for Hunter.

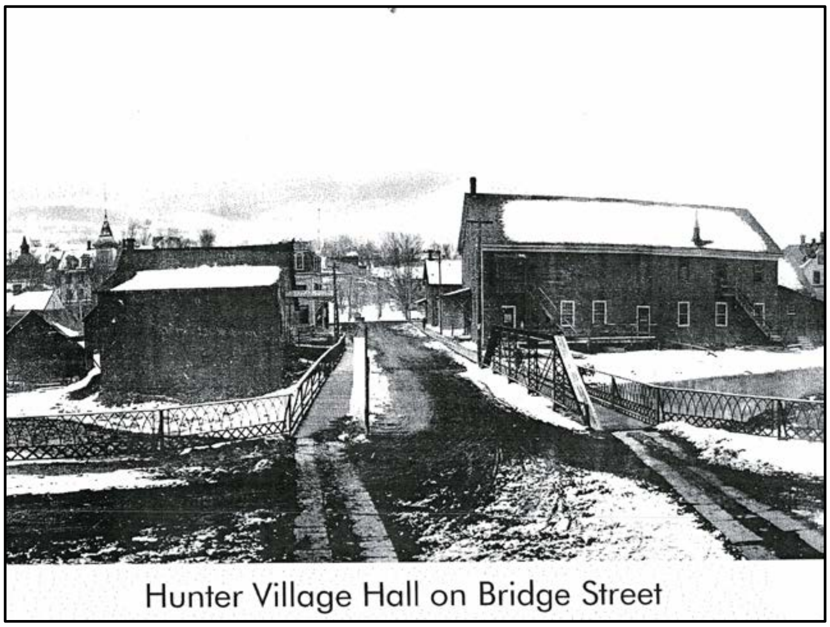


Figure 2-2
Historical Photo Showing Bridge Street Bridge, Hunter Window Decal, and Historical Sign

2.4 Watershed and Stream Characteristics

The effective area of the Schoharie Creek watershed within the LFA study area is 44.7 square miles with a northwest to southeast orientation. The watershed is characterized by steep hillslopes to the north and the south with narrow river and stream valleys that widen in their lower reaches.

The underlying bedrock geology of the watershed consists of alternating layers of sandstone and siltstone/shale. Streambed particles are typically made up of eroded sedimentary bedrock (GCSWCD, 2007). The surficial material overlying the bedrock consists of ice age glacial deposits such as till, outwash and lake sediment, as well as more recent stream deposits (GCSWCD). When exposed to the erosive action of the river, silts and clays can become mobilized, resulting in high turbidity and contributing to water quality impairment (NYCDEP, 2007).

This LFA considers five watercourses: Schoharie Creek, Shanty Hollow Brook, and three tributaries to Schoharie Creek (one along Glen Avenue [locally referred to as Mad Brook]; one along Clove Road and SR 214; and one along Botti Drive and the elementary school). The largest inundation risk is posed by the largest watercourse within the village of Hunter, Schoharie Creek. Schoharie Creek originates in Indian Head Mountain in the southeast corner of the town of Hunter. It flows to the northwest, passing through the village of Hunter before entering the Schoharie Reservoir near Prattsville. As Schoharie Creek passes through the village of Hunter, it essentially parallels Main Street/SR 23A and flows adjacent to and in close proximity to the main business district and numerous structures. As such, all buildings located along SR 23A are mapped within either the 100-year or 500-year flood event zones.

Two tributaries, one that parallels Glen Avenue and the other that runs behind the Hunter Elementary School, are not major sources of flooding, but they contribute to flooding along Main Street when Schoharie Creek overtops its banks. Both of these tributaries have infrastructure such as culverts and bridges at numerous locations along their course.

Shanty Hollow Brook originates on Hunter Mountain and flows for approximately 2.4 miles before entering Schoharie Creek near the County Route (CR) 83 bridge. There is an impoundment along Shanty Hollow Brook that is reportedly used for snowmaking at Hunter Mountain. At the base of Hunter Mountain as it approaches Schoharie Creek, the brook passes through a culvert under Hunter Drive. This culvert is reportedly undersized and has been overtopped on previous occasions.

2.5 Critical Infrastructure and Anchor Businesses

An important component of the LFA information-gathering stage is the identification of critical facilities and anchor businesses. Critical facilities are defined as follows: public facilities such as a firehouse, school, town hall, drinking water supply treatment or distribution facility, or wastewater treatment plant or collection facility, which if destroyed or damaged would impair the health and/or safety of the community.

The known critical facilities in the Hunter LFA area are listed in Table 2-1 and mapped on Figure 2-3.

TABLE 2-1
Critical Municipal Facilities in the Project Area

Facility	Address	Located in SFHA?	Located in Floodway?
Hunter Village Hall	7955 Main Street	Yes	No
Hunter Fire Department	17 Bridge Street	Yes	No
Post Office	7975 Main Street	Yes	No
Hunter Elementary School	7794 Main Street	No*	No

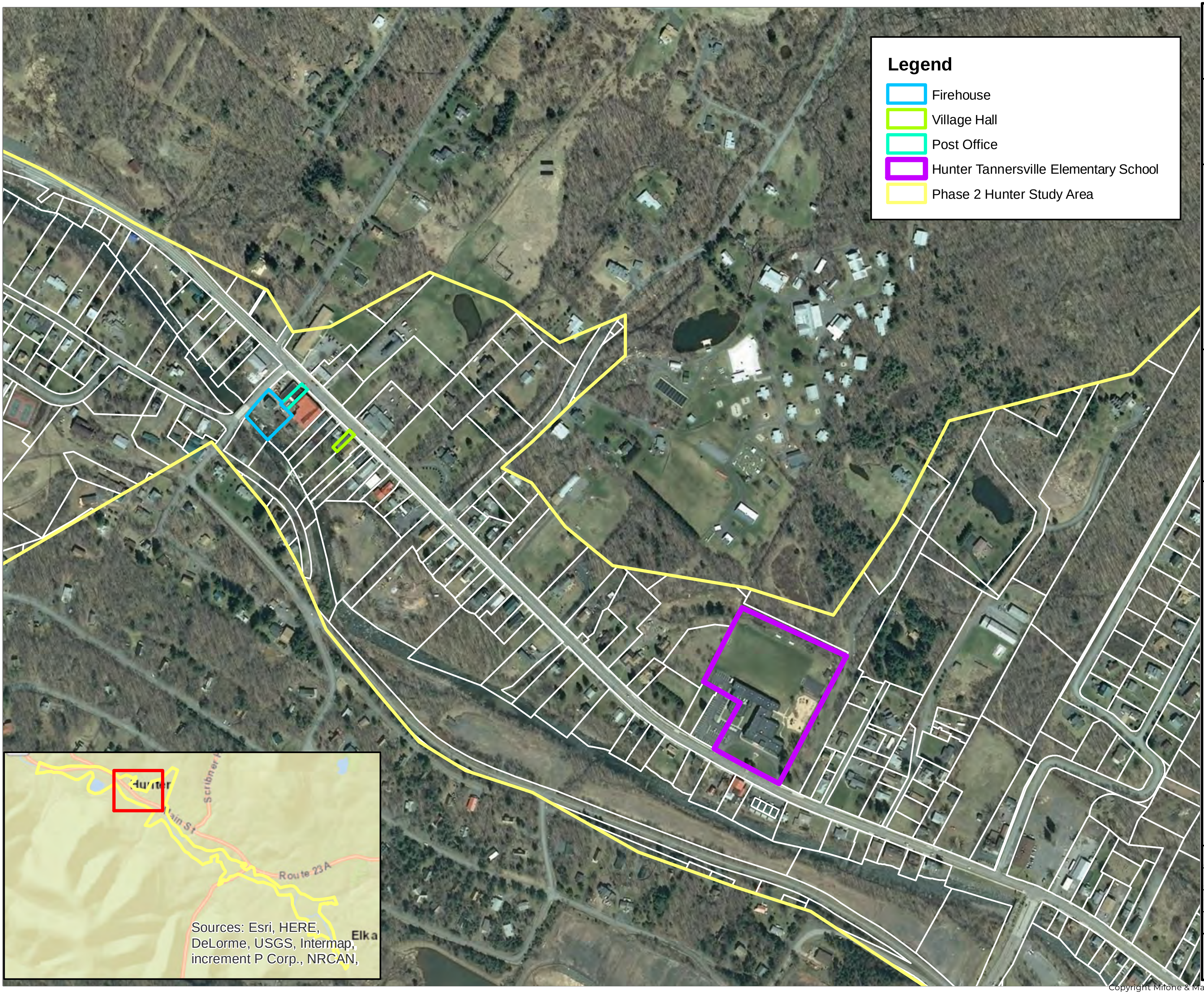
*Portions of the school parking lot fall within the SFHA.

Anchor businesses are defined as follows: private gas stations, grocery stores, lumber yards, hardware stores, and medical doctor's office or pharmacy, which if destroyed or damaged would impair the health and/or safety of the community. Anchor businesses in Hunter include Do It Best Hardware and the Cumberland Farms and Valero gas stations.

The known anchor businesses in or near the Hunter LFA area are listed in Table 2-2 and mapped on Figure 2-4.

TABLE 2-2
Anchor Businesses in the Project Area

Facility	Address	Located in SFHA?	Located in Floodway?
Do It Best Hardware	7953 Main Street	Yes	No
Cumberland Farms	7582 Main Street	No	No
Valero Gas Station	7738 Main Street	Yes	No



N
W E
S

MILONE & MACBROOM
231 Main Street, Suite 102
New Paltz, New York 12561
(845) 633-8153
www.mminc.com

CRITICAL FACILITIES

LOCAL FLOOD ANALYSIS
VILLAGE OF HUNTER
STUDY AREA
HUNTER, NEW YORK

EMH	EMH	MC
DESIGNED	DRAWN	CHECKED

1"=500'
SCALE

01 JANUARY 2018
DATE

1000-09
PROJECT NUMBER

Figure 2-3
SHEET NAME


Legend
Anchor Businesses
Do It Best Hardware Store
Valero Gas Station
Cumberland Farms
Phase 2 Hunter Study Area
Hunter
Route 23A
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN,
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MILONE & MACBROOM
231 Main Street, Suite 102
New Paltz, New York 12561
(845) 633-8153
www.mminc.com
ANCHOR BUSINESSES
LOCAL FLOOD ANALYSIS
VILLAGE OF HUNTER
STUDY AREA
HUNTER, NEW YORK
EMH EMH MC
DESIGNED DRAWN CHECKED
1"=500'
SCALE
SEPTEMBER 2018
DATE
1000-09
PROJECT NUMBER
FIGURE 2-4
SHEET NAME

2.6 Hydrology

Hydrologic studies are conducted to understand historical and potential future river flow rates. Hydrologic data in terms of stream flow is a critical input for hydraulic models such as HEC-RAS. Stream flow is typically determined from USGS stream gauging stations or from regression equations based on variables such as precipitation and watershed area.

USGS operates and maintains stream flow gauges that record daily stream flow, including flood flows. This data is essential to understanding long-term trends. Gauge data can be utilized to determine flood magnitudes and frequencies. USGS stream flow data can be accessed on the National Water Information System (NWIS) mapper (https://maps.waterdata.usgs.gov/mapper/index.html). Unfortunately, there are no active USGS gauges on any of the streams within the Hunter LFA project area. The NWIS mapper was also checked for historical gauge sites without success. The nearest downstream USGS stream gauge is located on Schoharie Creek near the hamlet of Lexington, New York, (Gauge #01349705). Due to the lack of field data, the most reliable source of hydrologic data for Schoharie Creek within the project area is the Greene County FIS dated June 2, 2015. This is summarized in Table 2-3.

TABLE 2-3
Peak Discharges for Schoharie Creek in Hunter (from FEMA FIS)
All Values in Cubic Feet per Second

Stream	Location	Basin Area (square miles)	10-Year	50-Year	100-Year	500-Year
Schoharie Creek	At Hunter/Jewett upstream municipal border	43.20	10,650	19,660	24,400	37,780
	At Bridge Street	40.12	10,130	18,770	23,330	36,240
	At Hunter Village upstream corporate limits	36.28	9,370	17,440	21,710	33,830
	At SR 214	28.89	7,770	14,580	18,190	28,490
	At confluence with Gooseberry Creek	17.23	5,430	10,510	13,250	21,180

For watercourses for which peak discharges are not provided in the FEMA FIS, peak discharges were calculated using USGS *StreamStats,* which is a web implementation of USGS *Report SIR 2006-5112* (Lumia, et al., 2006). This report provides methods of computing flood discharges in New York based on regression equations. These equations relate discharge to the mean annual precipitation and several other parameters based on watershed basin characteristics within a number of geographically distinct regions in New York State (Mulvihill, et al., 2009). The Hunter LFA study area falls within Region 3. Peak discharges are summarized in Table 2-4.

TABLE 2-4
Peak Discharges for Hunter Tributaries (calculated using *StreamStats*)
All Values in Cubic Feet per Second

Location	Basin Area (square miles)	10-Year	25-Year	50-Year	100-Year	500-Year
Mad Brook at Glen Avenue culvert	1.04	198	276	347	422	622
Mad Brook at Main Street culvert	1.06	202	281	353	430	633
Unnamed tributary at Ski Bowl Road culvert	1.59	315	437	549	669	987

3.0 EXISTING FLOODING HAZARDS

3.1 Flooding History in the Schoharie Watershed

The Catskill Mountains are subject to large storm events that are often unevenly distributed across watersheds. As a result, local flash floods can occur in one basin while an adjacent basin receives little rainfall. In addition to local flash floods, larger storm events can cause widespread flooding. An examination of stream flow gauges indicates that floods can take place any time of the year but are commonly divided into those occurring in winter and spring and those occurring in summer and fall. Floods that take place in summer and fall are typically due to extreme rainfall events caused by hurricanes and tropical storms. Floods in winter and spring are associated with rain on snow events and spring snowmelt (FEMA, 2015).

The project area is located within the Schoharie Creek watershed. Schoharie Creek is monitored by two USGS gauging stations. The first gauge (USGS #01350000) is located in Prattsville, New York, just upstream of the Schoharie Reservoir and has a period of record from 1902 to the present. The second gauge is located closer to the project area in Lexington, New York, with a period of record only extending back to 1999.

Within the watershed, minor flooding occurs relatively frequently. The National Weather Service considers flood stage at Prattsville to be approximately 18,000 cubic feet per second (cfs) (GCSWCD, 2007). Between 1902 and 2016, this discharge has been equaled or exceeded 38 times (Figure 3-1). Discharges in excess of 45,500 cfs are considered severe floods (GCSWCD), and there have been six of these events since installation of the gauge (Table 3-1).

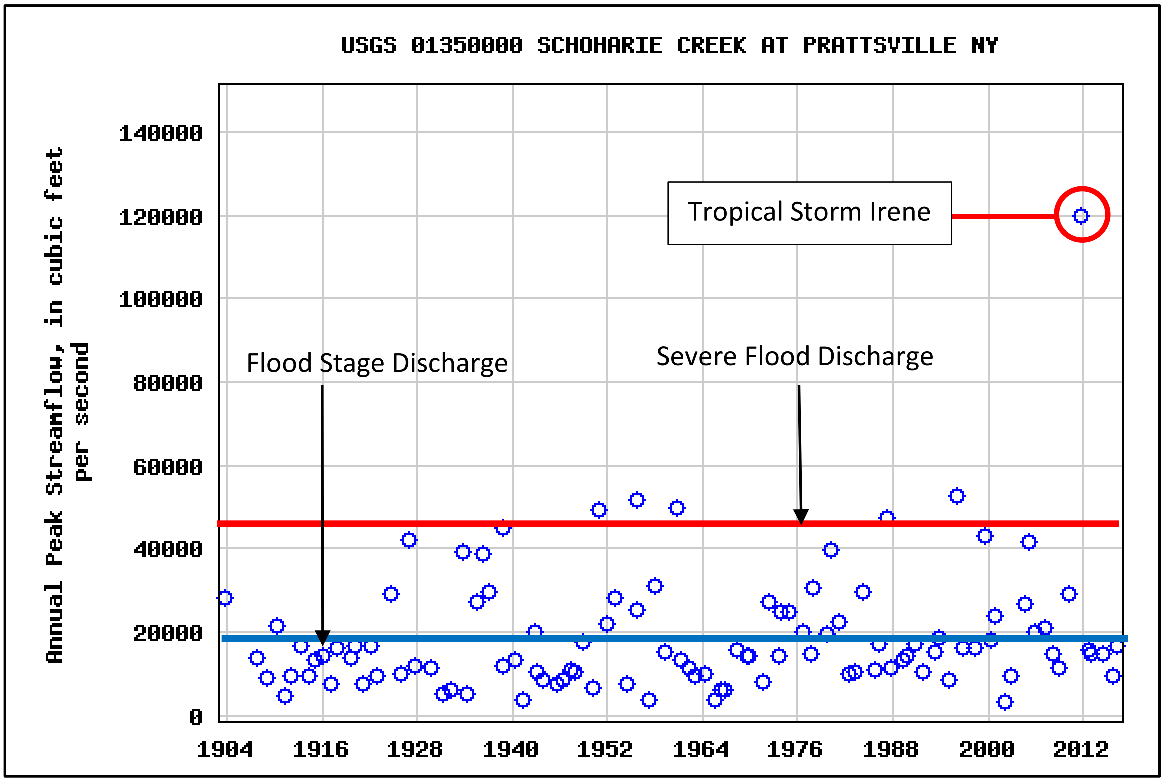


Figure 3-1
Annual Peak Discharge at USGS #1350000 in Prattsville, New York

TABLE 3-1
Historic Peak Discharges at Prattsville, New York

Date	Rank	Discharge (cfs)
8/28/2011	1	120,000
1/19/1996	2	52,800
10/16/1955	3	51,600
9/12/1960	4	49,900
11/25/1950	5	49,500
4/4/1987	6	47,600

(USGS stream flow gauge #1350000)

Two large flood events occurred in April 1987 and January 1996. Both floods were rain on snow events where unseasonably warm weather produced significant melting of the snowpack, which was followed by intense rainfall (FEMA, 2015). The April 1987 storm resulted in more than $65 million in flood damages to homes, businesses, farms, crops, roadways, and bridges within New York State (NYS). Damage to public infrastructure in the West Kill watershed alone was approximately $2 million (AECOM, 2016).

The January 1996 event was the second largest flood of record in the watershed. Flooding in the region was extensive, and FEMA estimated that statewide damages were approximately $102 million. Following the flood, $15.2 million in state and federal aid was allocated to 377 municipalities in the state (GCSWCD, 2007).

3.2 Tropical Storm Irene

On August 28, 2011, Tropical Storm Irene caused extensive flooding and devastation in eastern New York. Discharge on Schoharie Creek at the USGS gauge (#01350000) located in Prattsville peaked at 120,000 cfs. This exceeded the 100-year discharge and was more than twice the next largest flood event (Figure 3-1 and Table 3-1). Closer to the project area, the USGS gauge in Lexington (#01362200) also exceeded the 100-year discharge. The discharge measured 40,500 cfs, which was the largest flood of record at that gauge and almost twice the next largest flood event (Figure 3-2).

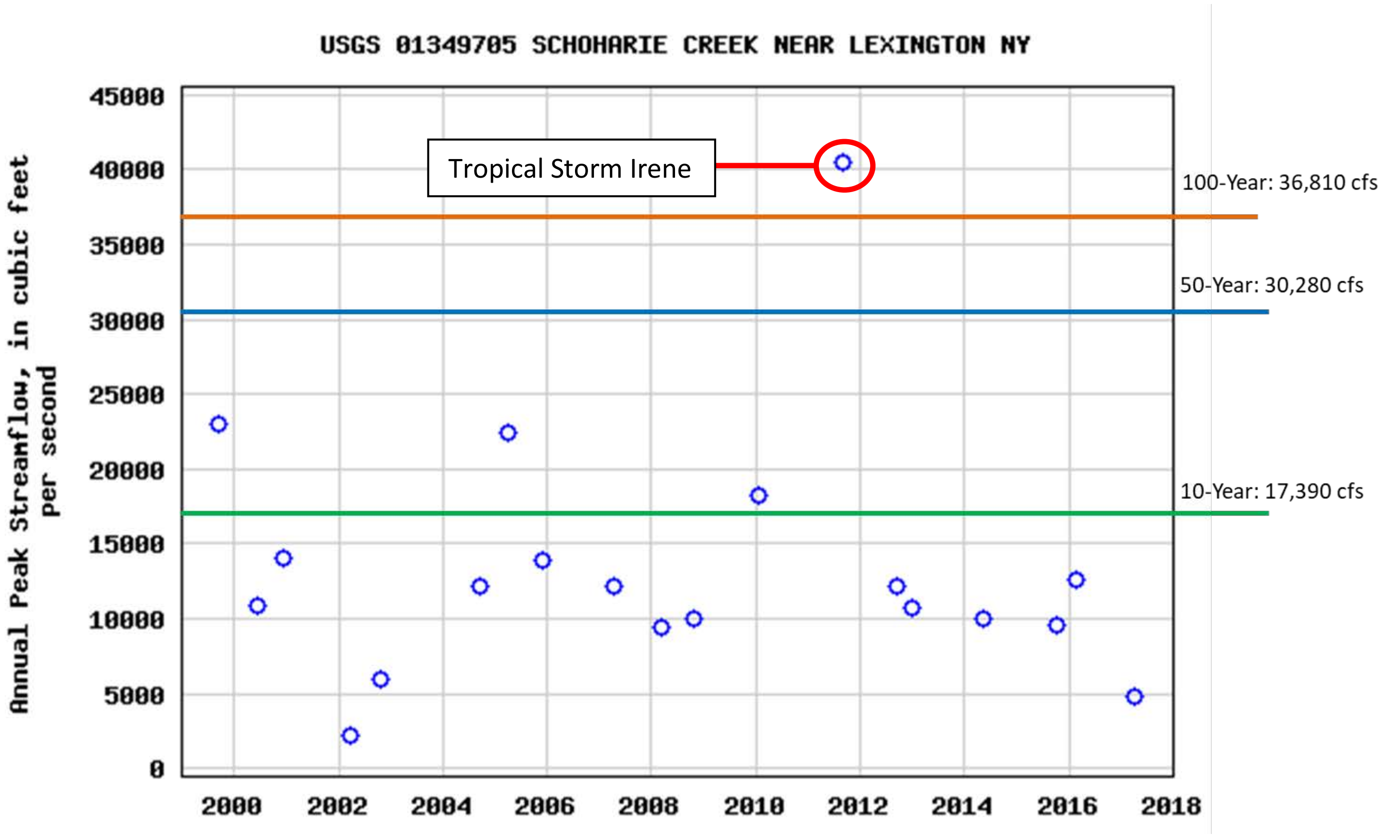


Figure 3-2
Annual Peak Discharge on Schoharie Creek at USGS #1362200 near Lexington, New York

There are no stream flow gauges within the project area. However, photographs, videos, and anecdotal accounts from FAC members and residents help paint a picture of the damage that occurred in Hunter. Several bridges were damaged or made impassable during the flood. High flows in Schoharie Creek caused flooding and erosion at the Hunter Mountain bridge (CR 83), and a building on the left bank downstream of the bridge was damaged by erosion. The Bridge Street bridge overtopped, and buildings in the vicinity of the bridge (such as the Hunter firehouse) were flooded. The Deming Road bridge over

Schoharie Creek was flanked to its left, leaving the road washed out. Reportedly, the only bridge over Schoharie Creek that was accessible during Tropical Storm Irene was the SR 214 bridge.

Water flooded onto Main Street reportedly due to excessive flows in Schoharie Creek combined with high flows on the smaller tributaries. Figures 3-3 through 3-7 depict conditions in Hunter during Tropical Storm Irene.

Figure 3-3
Floodwaters across Main Street near Mason Hall in Hunter
Tropical Storm Irene, August 28, 2011

Figure 3-4
Floodwaters at Hunter Synagogue
Tropical Storm Irene, August 28, 2011

Figure 3-5
Floodwaters at Hunter Firehouse
Tropical Storm Irene, August 28, 2011

Figure 3-6
Home along Schoharie Creek Damaged by Flooding and Bank Erosion
Tropical Storm Irene, August 28, 2011

Figure 3-7
Homes along Schoharie Creek following Tropical Storm Irene, August 28, 2011

3.3 High Water Marks

The USGS has collected the elevations of high water marks at a variety of locations along Schoharie Creek, including marks left by floods that occurred in 1987, 1996, and 2011. The elevations of high water marks collected at the SR 214 bridge in Hunter can be compared to water surface elevations predicted by the HEC-RAS model for Schoharie Creek (Figure 3-8) to determine the reoccurrence intervals of these flood events.

The results indicate that the 1996 flood was less than the modeled 10-year flood event. The 1987 flood was greater than the modeled 10-year flood but less than the modeled 50-year flood event. High water marks measured during the 2011 flood (Tropical Storm Irene) were clustered around the level of the modeled 100-year flood event, indicating that Tropical Storm Irene was close to a 100-year event in Hunter.

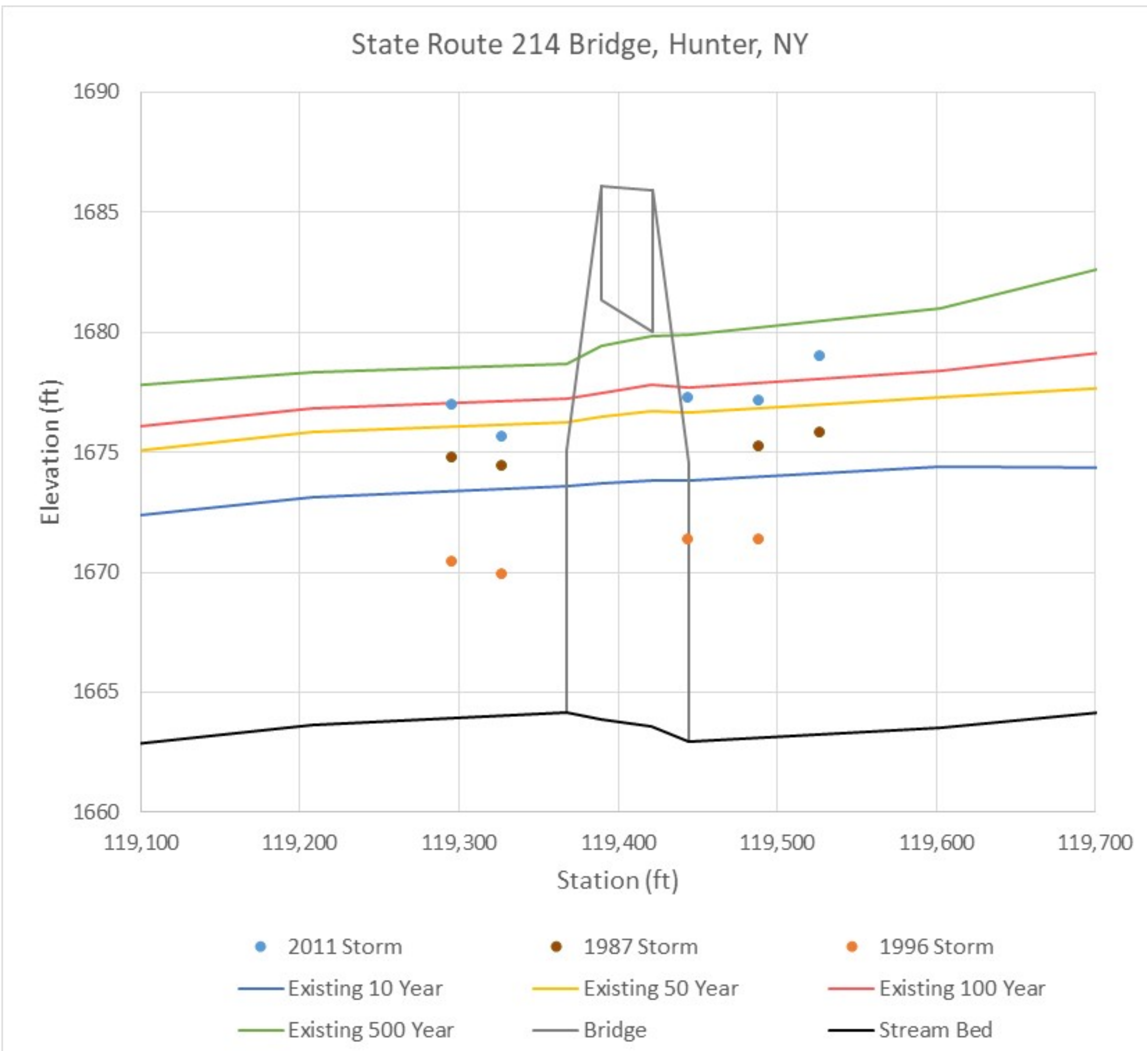


Figure 3-8
High Water Marks Measured by USGS at Route 214 following Flood Events in 1987, 1996, and 2011

3.4 FEMA Mapping

FEMA Flood Insurance Rate Maps (FIRM) are available for the study area and depict the SFHA, which is the area inundated by flooding during the statistical 100-year flood event. The maps also depict the FEMA designated floodway along Schoharie Creek, which is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood (FEMA, 2008).

The tributary to Schoharie Creek that flows along Stony Clove Road was modeled using approximate methods, and the FIRMS only depict the SFHA. The floodway is not delineated. The remaining tributaries within the study area have not been mapped to identify their SFHA.

FEMA FIRMs that are relevant to the project area include 36039C0378G, 36039C0379G, and 36039C0383G. These FIRMs all have an effective date of June 2, 2015. The maps address the following areas:

- 36039C0378G: This FIRM covers Schoharie Creek from Deming Road upstream to Bridge Street.
- 36039C0379G: This FIRM covers Schoharie Creek from Bridge Street upstream to the vicinity of the SR 214 bridge.
- 36039C0383G: This FIRM covers Schoharie Creek from Route 214 to the upstream end of the project area.

The FIRMs are accessible to the public on the FEMA Flood Map Service Center website (https://msc.fema.gov/portal).

4.0 FLOOD MITIGATION ANALYSIS

The purpose of a hydraulic assessment is to evaluate historical and predicted water surface elevations, identify floodprone areas, and help develop mitigation strategies to minimize future flood damages and protect water quality. Hydraulic analysis techniques can also help predict flow velocities, sediment transport, scour, and deposition if these outcomes are desired.

Specific areas within the town and village of Hunter have been identified as being prone to flooding during severe rain events. Several alternatives were developed and assessed at areas where flooding is known to have caused extensive damage to homes and properties. Alternatives were assessed with hydraulic modeling to determine their effectiveness. The narrative below describes the alternatives and the results of modeling analysis.

4.1 Analysis Approach

Hydraulic analysis along Schoharie Creek was conducted using the HEC-RAS hydraulic modeling program. The HEC-RAS software (*River Analysis System*) was written by the United States Army Corps of Engineers (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 one-dimensional, steady-state, or time-varied flow. The system can accommodate a full network of channels, a dendritic system, or a single river reach. HEC-RAS is capable of modeling water surface profiles under subcritical, supercritical, and mixed-flow conditions.

Water surface profiles are computed from one cross section to the next by solving the one-dimensional energy equation with an iterative procedure called the standard step 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.

In order to carry out hydraulic modeling of baseline conditions and alternatives, MMI obtained the effective FEMA HEC-RAS model for Schoharie Creek from the NYCDEP. This HEC-RAS model provided the starting point for the current analysis. A duplicate effective model was created for Schoharie Creek. The output of the duplicate effective model was compared to the model provided by the NYCDEP and found to be identical. Additionally, the water surface elevations of the HEC-RAS models were compared to those published in Table 8 of the Revised FEMA FIS and the online FIRMs and verified for accuracy.

The culvert analysis was done using the hydraulic modeling software *Hydraflow Express*. This software is capable of modeling culverts of various slopes, lengths, sizes, materials, and shapes and is used to compute capacities, rating tables, and hydraulic properties for highway-type culverts. It can be used in settings with inlet control and outlet control in any flow regime from partial depth, full depth, surcharged, or roadway overtopping. Methods used are those generally described in the publication *Hydraulic Design of Highway Culverts*.

4.2 Existing Conditions Analysis

A copy of the duplicate effective model for Schoharie Creek was made to create an operational model. The output of this model was compared to the original models and to water surface elevations reported in the FEMA FIS and found to be identical. Digital Elevation Models (DEMs) were added to the HEC-RAS model so that depth grid and water surface elevation mapping could be carried out.

4.3 Predicted Water Surface Elevations

The hydraulic model for Schoharie Creek was used to predict water surface elevations at several buildings within the LFA area, including those that have been identified as critical facilities or anchor businesses. These elevations were then converted to flooding depths, which were superimposed as lines onto photos of the buildings (Figures 4-1 through 4-5). When the 50-year flooding depth is not shown, this indicates that the building is not flooded during the 50-year flood event.

Figure 4-1
50- and 100-Year Flooding Depths
Hunter Fire Station on Bridge Street

Figure 4-2
100-Year Flooding Depth
Hunter Village Hall on Main Street

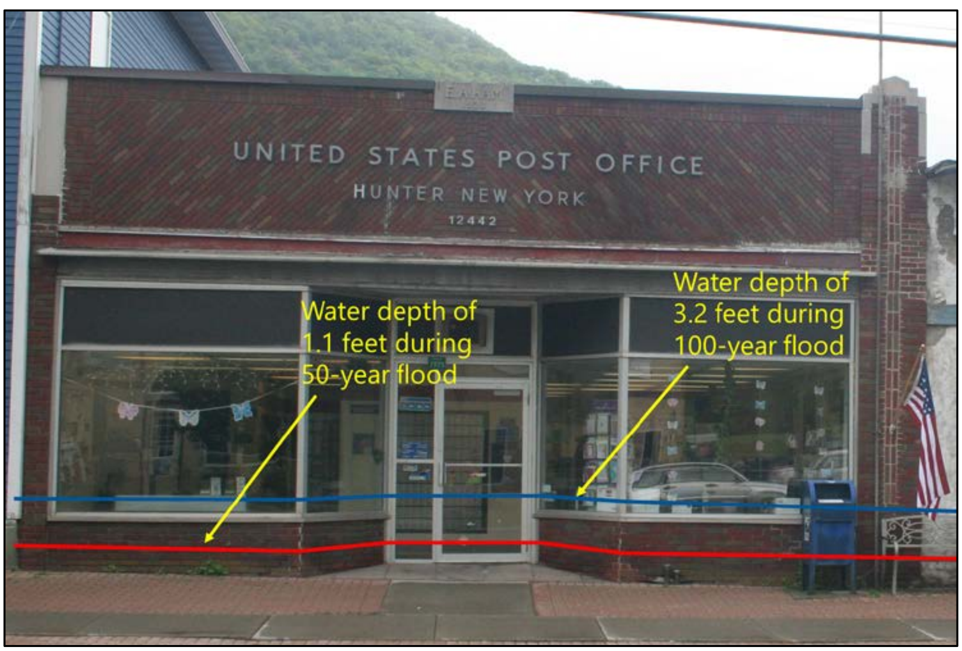


Figure 4-3
50- and 100-Year Flooding Depths
United States Post Office on Main Street

Figure 4-4
100-Year Flooding Depth
Hunter Library on Main Street

Figure 4-5
100-Year Flooding Depth
Hardware Store on Main Street

4.4 Flood Mitigation Approaches

A number of flood mitigation approaches to reduce water surface elevations were evaluated in the project area. These are listed below and described in more detail in the sections that follow.

- Bridge improvements
- Culvert improvements
- Floodplain enhancement

In addition to the flood mitigation approaches listed above, which seek to reduce or eliminate flood damages by reducing water surface elevations, a number of property buyout and relocation scenarios were explored. These scenarios would seek to reduce flood-related damages by moving homes and businesses out of floodprone areas.

4.5 Bridge Improvement Assessment

Inadequately sized bridges can be overtopped or flanked by floodwaters during a flood event. This can create a safety hazard for travelers and can cut off important evacuation and emergency access routes. Undersized bridges can act as hydraulic constrictions, exacerbating flooding during high-flow events by increasing water surface elevations upstream of the bridge.

For the purpose of this LFA, each bridge was evaluated to determine whether it would be overtopped or flanked during a flood event. Bridges were also assessed by removing the bridges from the hydraulic model. This simulates the complete removal of the bridge from the channel. If removal of a bridge from the model results in a significant reduction in water surface elevations and a resulting reduction of the flooding of structures and/or roads in the model, bridge replacement with a more hydraulically adequate structure is evaluated and advanced for consideration.

Six bridges on Schoharie Creek and one bridge on Gooseberry Creek were evaluated, and the modeling results for each bridge are discussed in the sections that follow. The bridge locations are shown in Figure 4-6.

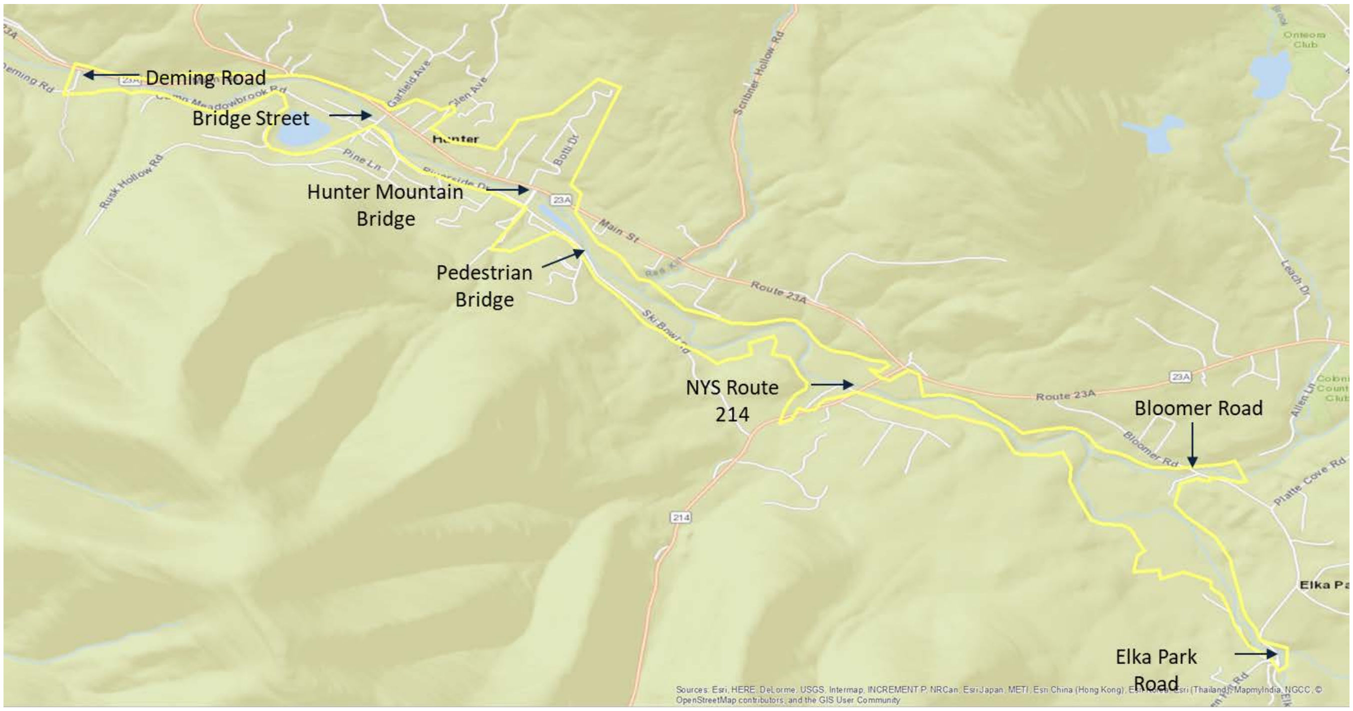


Figure 4-6
Bridges Assessed in Hunter LFA

4.5.1 <u>Elka Park Road Bridge</u>

Elka Park Road crosses Schoharie Creek at the upstream end of the LFA project area and connects the Elka Park community with Route 23A and the Hunter/Tannersville area. The bridge is of modern construction and consists of concrete abutments and a concrete deck supported by steel beams (Figure 4-7). A United States Post Office is located along Elka Park Road adjacent to the bridge.

Hydraulic modeling indicates that the Elka Park Road bridge is flanked to its left (south) by floodwaters during the 50-year flood event, flooding the adjacent roadway, and the bridge deck is overtopped during the 100-year flood event. The bridge acts as a hydraulic constriction during the 50- and 100-year flood events, causing an increase in water surface elevations of approximately 2 feet at the upstream face of the bridge. The area along Schoharie Creek upstream of the bridge is sparsely developed with very few structures located close to the banks of the creek.

A dam was observed in Schoharie Creek downstream of the Elka Park Road bridge. The dam is in poor condition and does not appear to perform a useful function. At the time of the field investigations, the dam had accumulated woody debris (Figure 4-8), which under high-flow conditions could potentially act to back up water and contribute to elevated water surface conditions at the bridge.

When the Elka Park Road bridge is due for a regularly scheduled replacement, the new bridge should be adequately sized so that the 100-year flood can safely pass without overtopping the bridge or the adjacent roadway. If the dam located downstream of the bridge is no longer providing a useful service, its removal should be considered. Recommendations are discussed in Section 6.

Figure 4-7
Elka Park Road Bridge over Schoharie Creek

Figure 4-8
Dam Located Downstream of Elka Park Road Bridge

4.5.2 <u>NYS Route 214 Bridge</u>

NYS Route 214 (Figure 4-9) connects the Hunter/Tannersville area to Route 28 in Phoenicia. No reports of flooding or roadway overtopping have been received for the Route 214 bridge over Schoharie Creek, and it was reported that this bridge remained open during Tropical Storm Irene. Hydraulic modeling indicates that the bridge is able to pass the 100-year flood event with nearly 2 feet of freeboard and does not act as a hydraulic constriction.

Figure 4-9
NYS Route 214 Bridge over Schoharie Creek

Aside from regular inspection and maintenance, no actions are recommended at the NYS Route 214 bridge.

4.5.3 <u>Hunter Pedestrian Bridge</u>

A pedestrian bridge crosses Schoharie Creek just upstream of the village of Hunter (Figure 4-10). No reports of flooding or overtopping were received for this bridge. Hydraulic modeling indicates that the bridge can pass the 50-year flood event but is overtopped by floodwaters during the 100-year flood. Also, the bridge acts as a hydraulic constriction during the 100-year flood event. Removal of the bridge from the hydraulic model results in a 6-foot reduction in water surface elevations at the upstream face of the bridge. This reduction diminishes moving upstream of the bridge, resulting in a reduction of 1 foot at a point 480 feet upstream of the bridge and a negligible reduction at a point 1,000 feet upstream of the bridge (Figure 4-11). Inundation mapping depicts the depth and extent of flooding during the 100-year flood event with and without the pedestrian bridge in place (Figures 4-12 and 4-13).

Figure 4-10
Pedestrian Bridge over Schoharie Creek

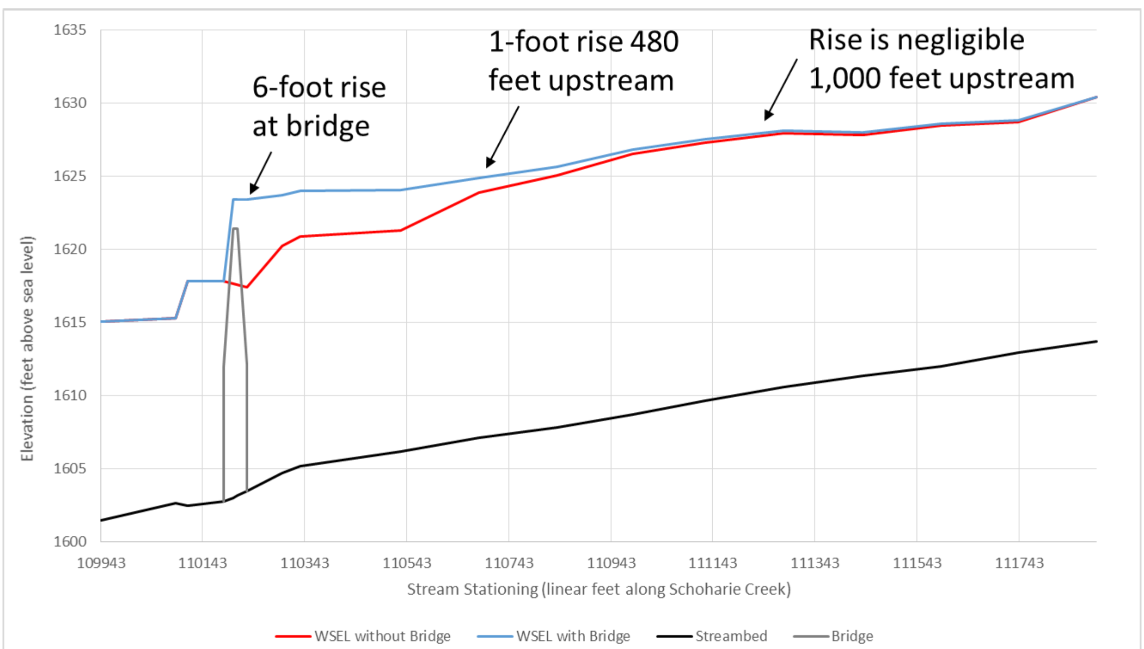


Figure 4-11
Longitudinal Profile – 100-Year Flood
Pedestrian Bridge over Schoharie Creek

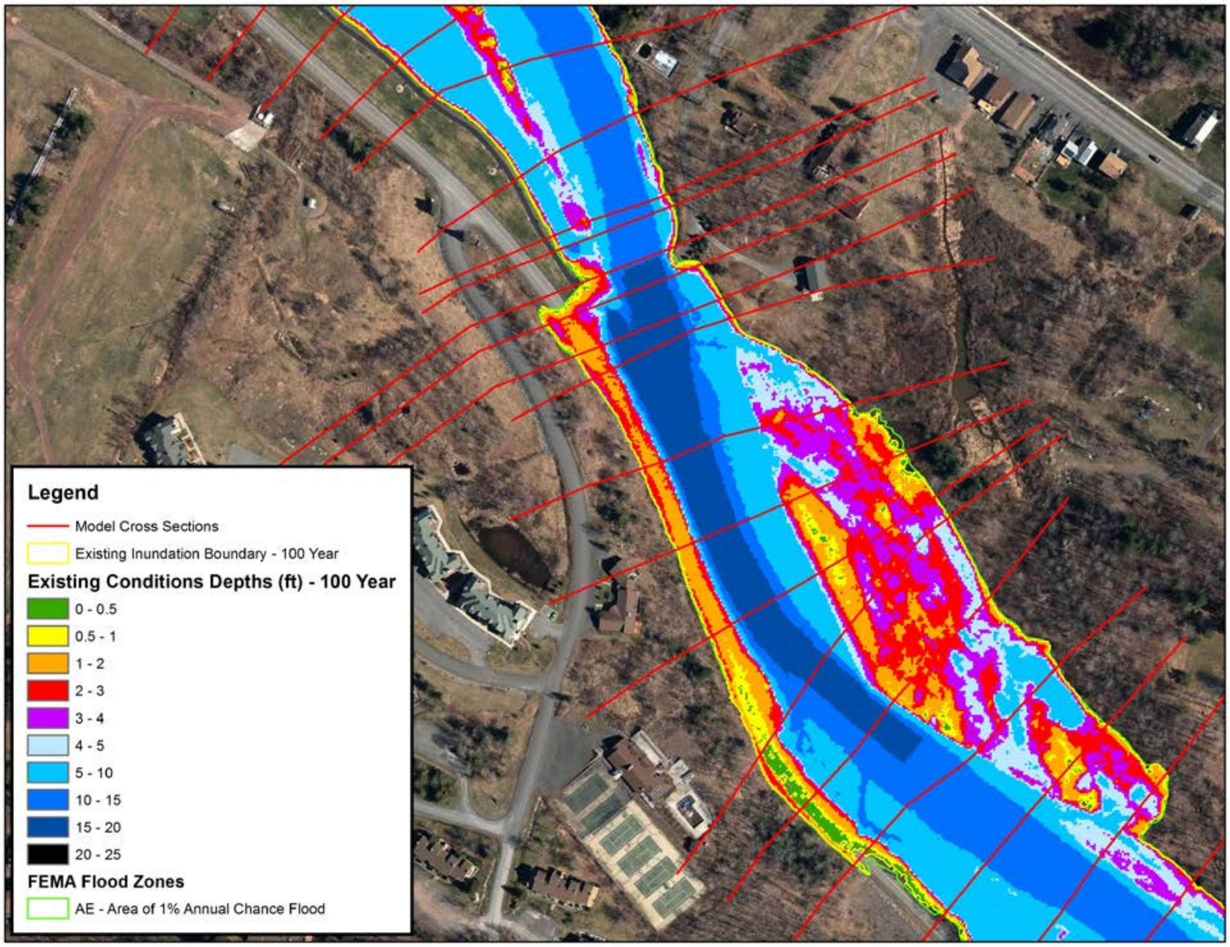


Figure 4-12
Inundation Map – Existing Conditions (bridge in place) - 100-Year Flood
Pedestrian Bridge over Schoharie Creek

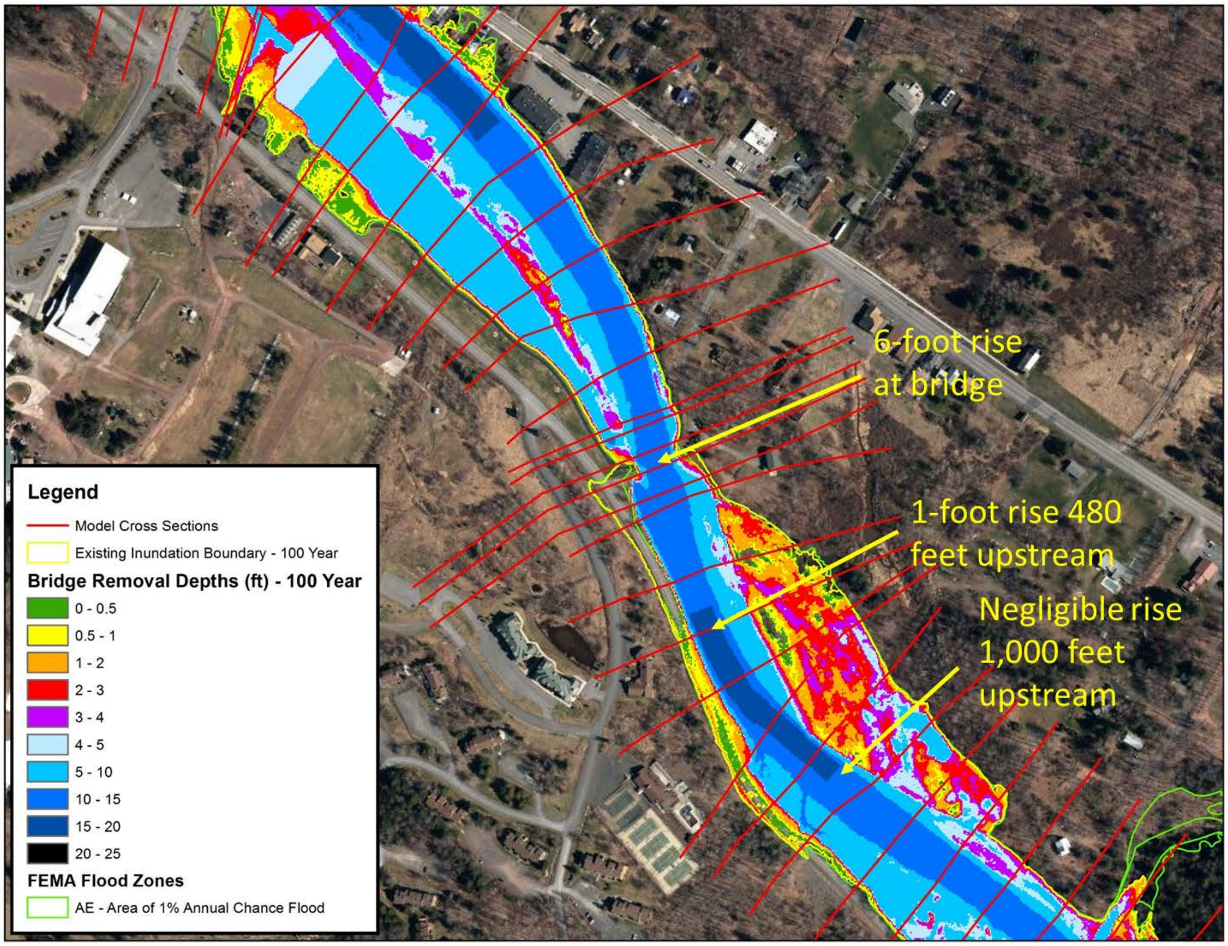


Figure 4-13
Inundation Map – Proposed Conditions (bridge removed) - 100-Year Flood
Pedestrian Bridge over Schoharie Creek

The pedestrian bridge over Schoharie Creek does act as a hydraulic constriction resulting in an increase in water surface elevations upstream of the bridge. However, the increased flooding caused by the bridge is limited to an area of forested floodplain north of Schoharie Creek and an approximately 300-foot length of Ski Bowl Road to the south of Schoharie Creek (sections of Ski Bowl Road further upstream would continue to flood during the 100-year flood event regardless of whether or not the bridge was in place). Recommendations are discussed in Section 6.

4.5.4 CR 83 (Hunter Mountain Bridge)

CR 83 (more commonly referred to as the Hunter Mountain Bridge) crosses Schoharie Creek adjacent to the Hunter Mountain Ski Area. The crossing actually consists of two bridges, a newer bridge for vehicles and a second that serves as a walking bridge (Figure 4-14). For the purpose of hydraulic modeling, it is treated as one bridge. During Tropical Storm Irene, reports indicate that floodwater backed up behind the bridge and partially overtopped the structure, flooding the area and causing erosion (Figure 4-15).

Dolans Pond is located along Schoharie Creek, just upstream of the Hunter Mountain bridge. The pond is reportedly used for snowmaking at Hunter Mountain and as an emergency source of drinking water for the village. Under high flows in Schoharie Creek, water flows into Dolans Pond from Schoharie Creek and then exits the pond through a sluice gate before flowing along a channel, through a culvert under CR 83, and back to Schoharie Creek.

Analysis using hydraulic modeling indicates that the Hunter Mountain bridge overtops during the 50- and 100-year flood events. The bridge acts as a hydraulic constriction during the 50- and 100-year flood events. During the 50-year event, removal of the bridge from the hydraulic model results in a 3.6-foot reduction in water surface elevations at the upstream face of the bridge. This diminishes moving upstream of the bridge, resulting in a reduction of 1.3 foot at a point 1,000 feet upstream of the bridge and a negligible reduction at a point 1,800 feet upstream of the bridge (Figure 4-16). Inundation mapping depicts the depth and extent of flooding during the 50-year flood event with and without the Hunter Mountain bridge in place (Figures 4-17 and 4-18).

During the 100-year event, removal of the bridge from the hydraulic model results in a 2.4-foot reduction in water surface elevations at the upstream face of the Hunter Mountain bridge. The reduction diminishes moving upstream of the bridge, resulting in a reduction of 0.8 feet at a point 1,000 feet upstream of the bridge and a negligible reduction at a point 1,800 feet upstream of the bridge (Figure 4-19). Inundation mapping depicts the depth and extent of flooding during the 100-year flood event with and without the bridge in place (Figures 4-20 and 4-21).

Figure 4-14
Hunter Mountain Bridge over Schoharie Creek
(original truss bridge to left, traffic bridge in center)

Figure 4-15
Hunter Mountain Bridge over Schoharie Creek
Evidence of Erosion following Tropical Storm Irene

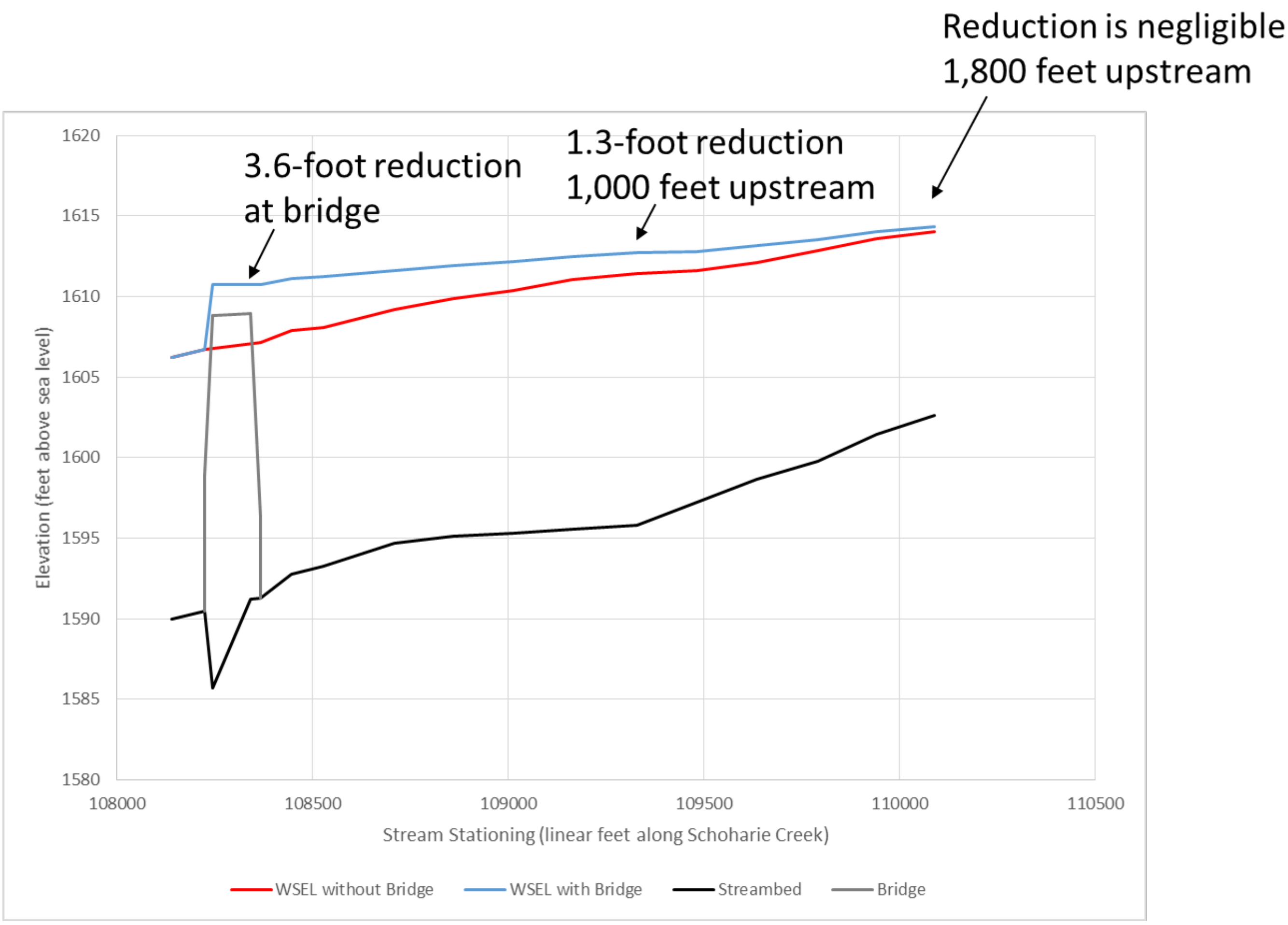


Figure 4-16
Longitudinal Profile – 50-Year Flood
Hunter Mountain Bridge over Schoharie Creek

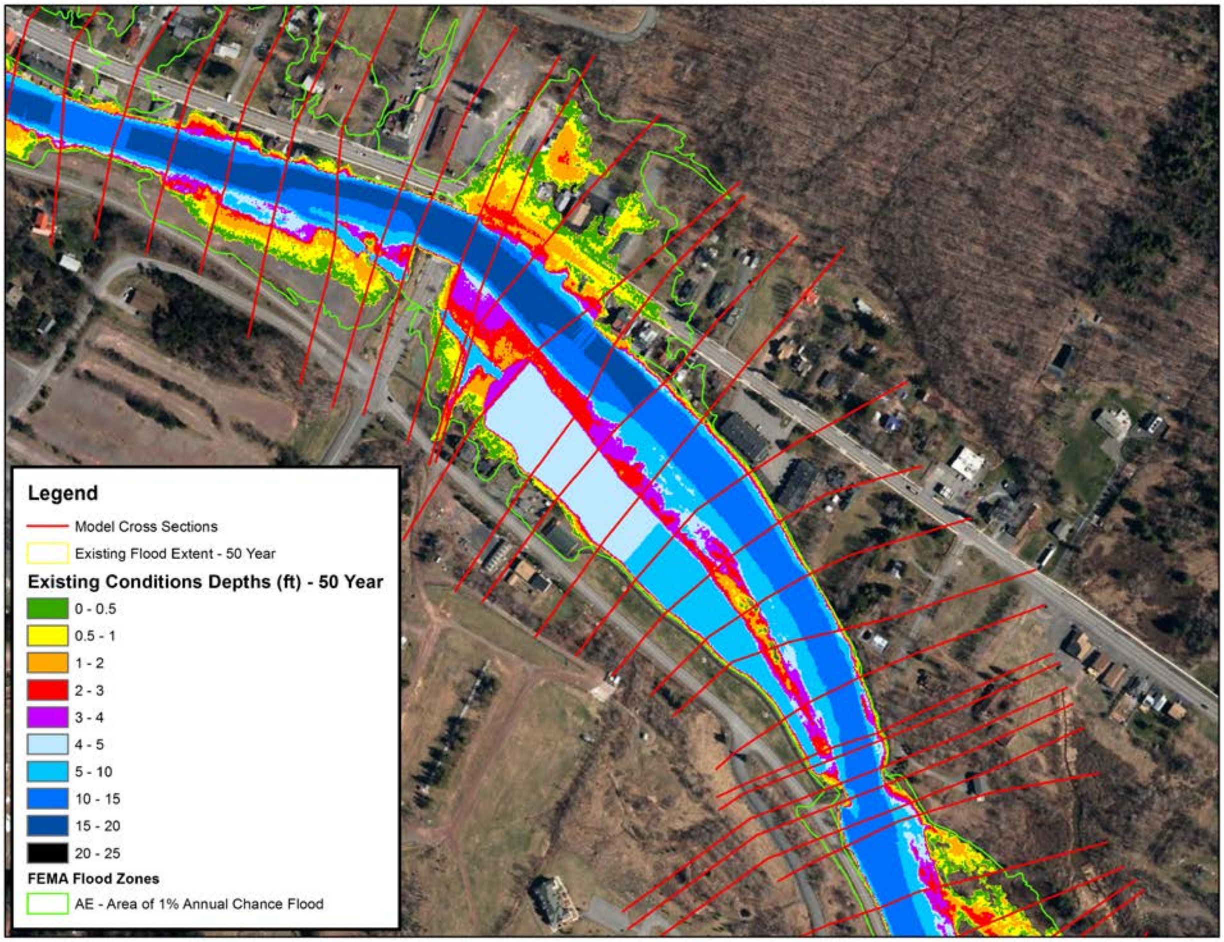


Figure 4-17
Inundation Map – Existing Conditions (bridge in place) - 50-Year Flood
Hunter Mountain Bridge over Schoharie Creek

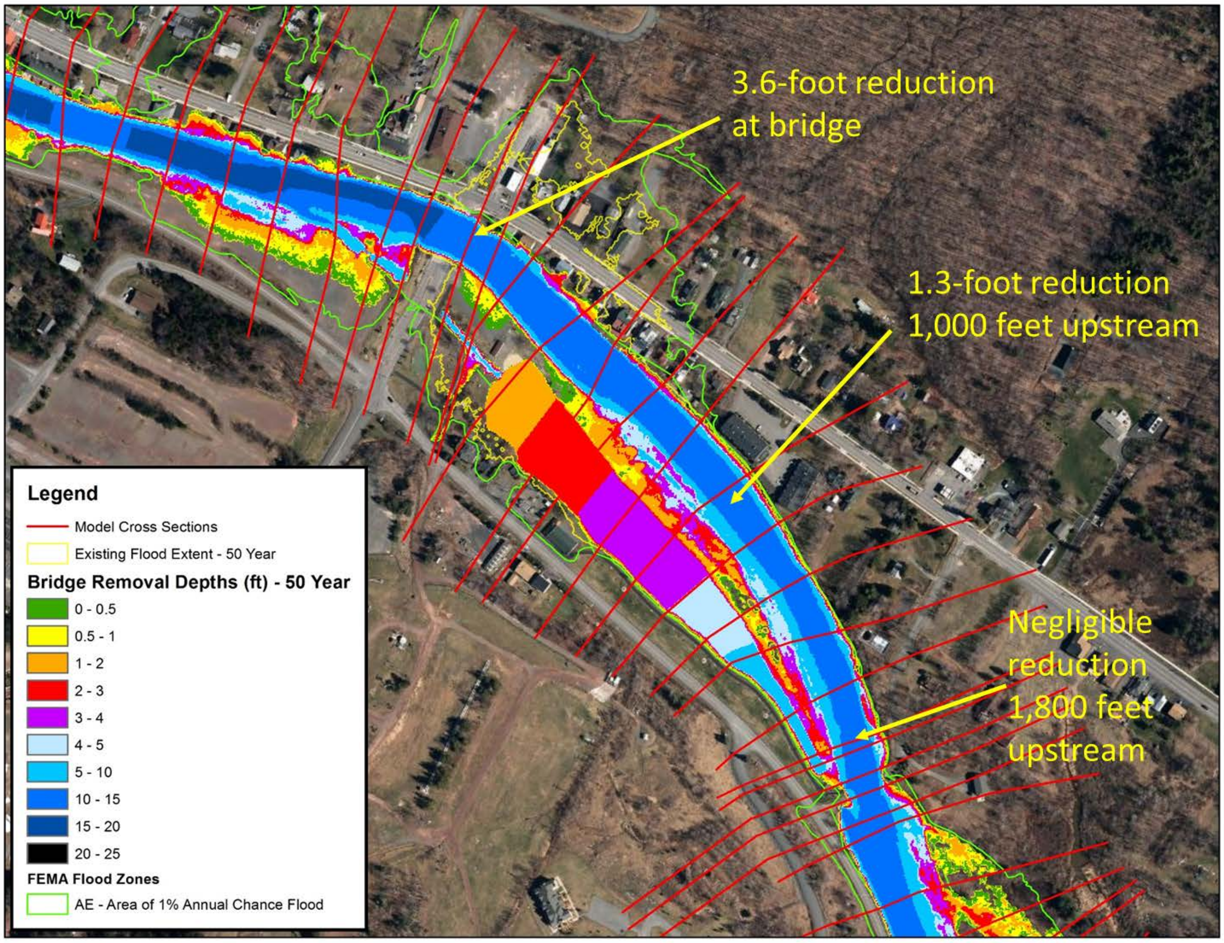


Figure 4-18
Inundation Map – Proposed Conditions (bridge removed) - 50-Year Flood
Hunter Mountain Bridge over Schoharie Creek

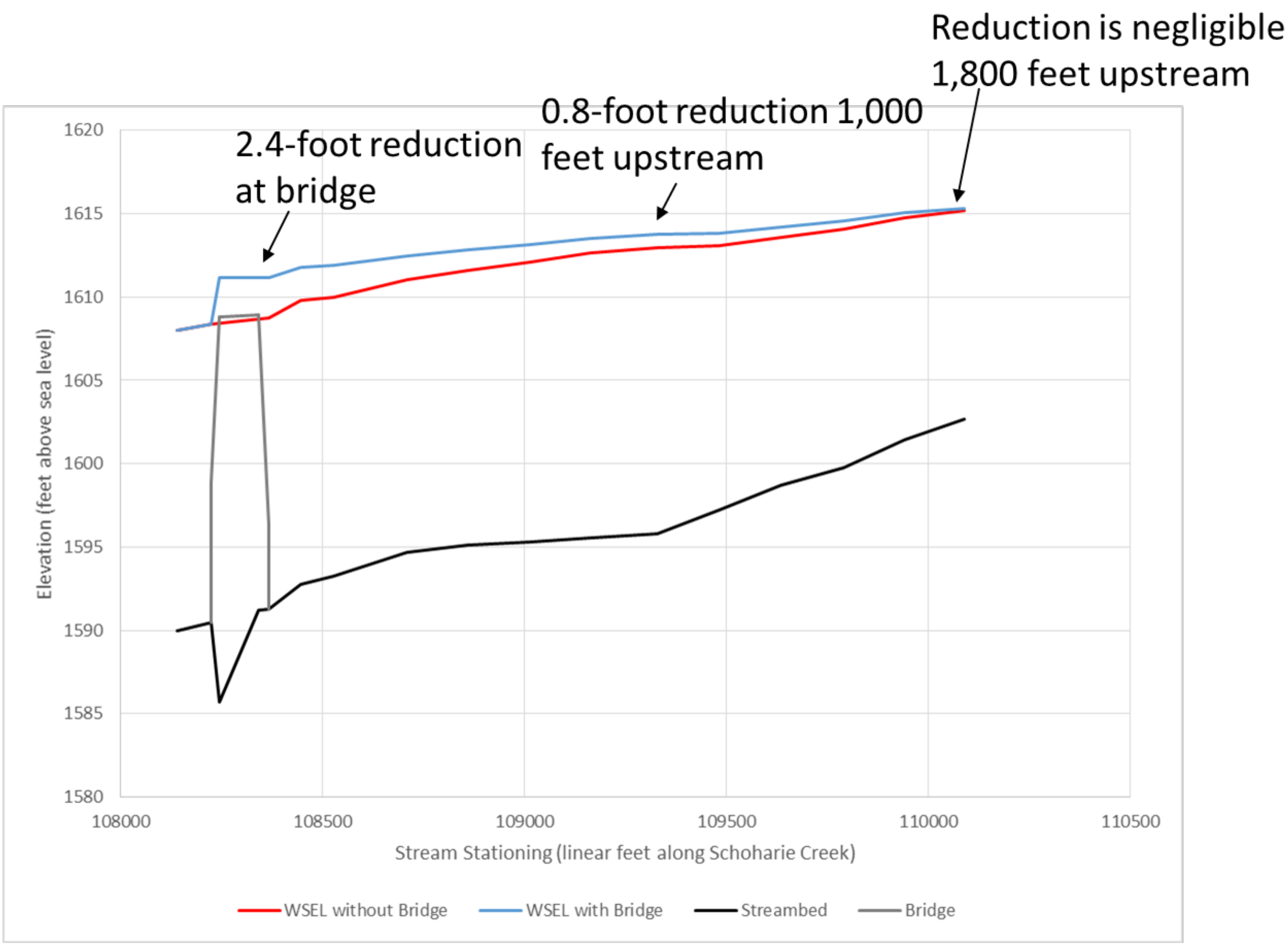


Figure 4-19
Longitudinal Profile – 100-Year Flood
Hunter Mountain Bridge over Schoharie Creek

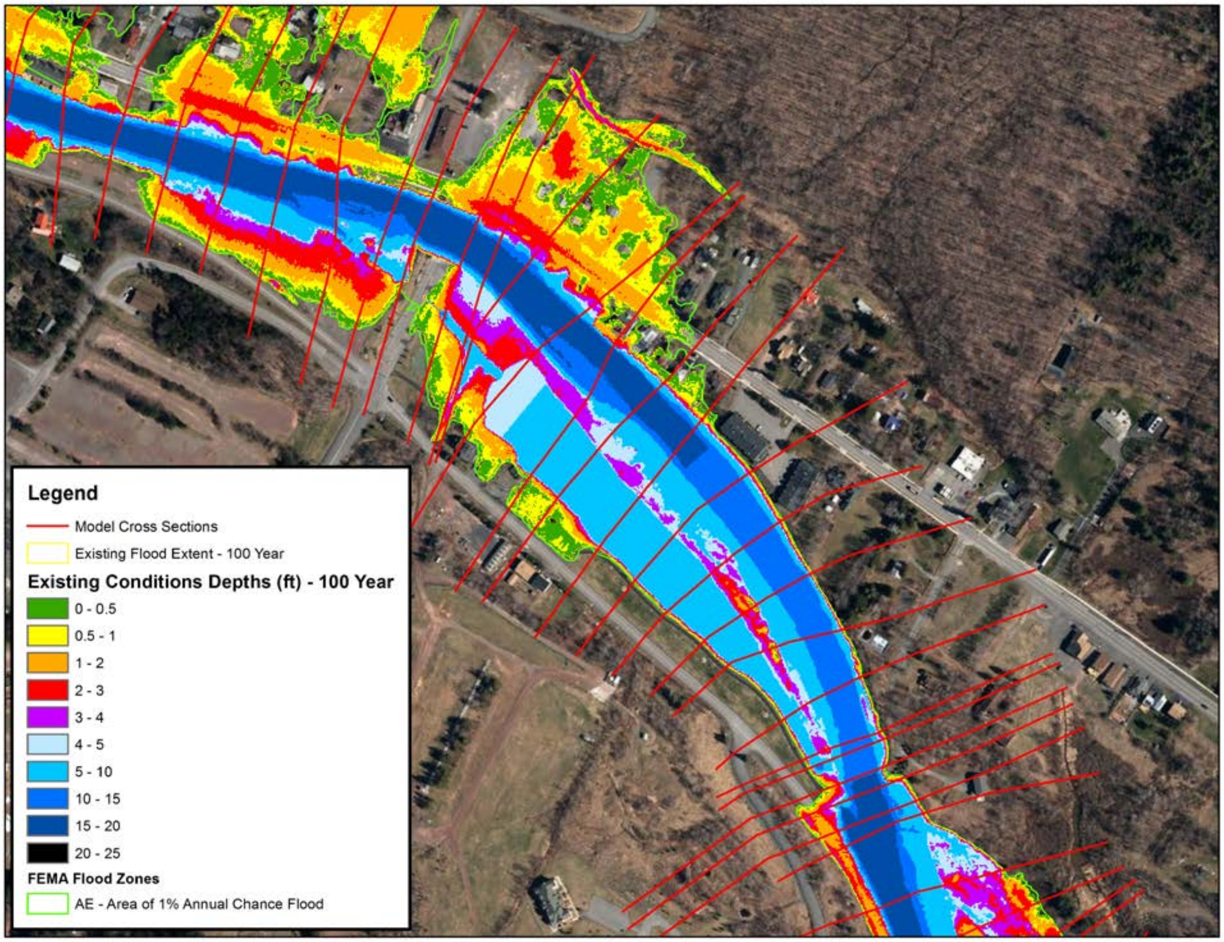


Figure 4-20
Inundation Map – Existing Conditions (bridge in place) - 100-Year Flood
Hunter Mountain Bridge over Schoharie Creek

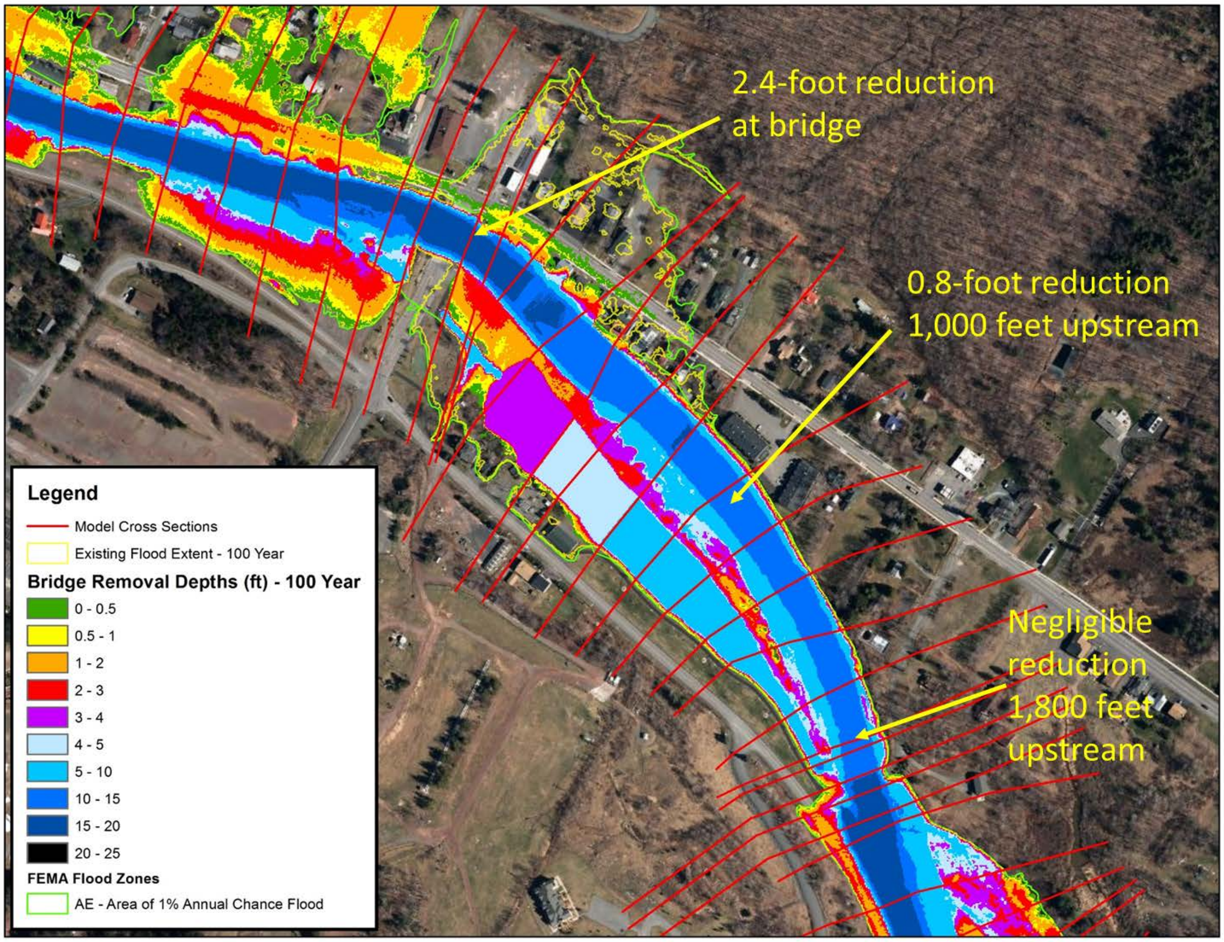


Figure 4-21
Inundation Map – Proposed Conditions (bridge removed) - 100-Year Flood
Hunter Mountain Bridge over Schoharie Creek

A culvert located adjacent to the Hunter Mountain bridge was investigated to determine whether enlarging the culvert would reduce water surface elevations upstream of the Hunter Mountain bridge. The 13-foot-wide by 7-foot-high culvert is located on a side channel that flows out of Dolans Pond and through the culvert under CR 83 before returning to Schoharie Creek. It was determined that placing a second culvert in parallel with the existing culvert, increasing the effective hydraulic opening from 91 square feet to 161 square feet, does not substantially reduce water surface elevations at the Hunter Mountain bridge or prevent it from overtopping during the 50- and 100-year flood events. Enlargement of the culvert is not recommended.

When the Hunter Mountain bridge is due for a regularly scheduled replacement, it is recommended that the new bridge be adequately sized so that the 100-year flood can safely pass without overtopping the bridge or causing a rise in water surface elevations. Recommendations are discussed in Section 6.

4.5.5 Bridge Street Bridge

Bridge Street crosses Schoharie Creek near the firehouse and was overtopped during Tropical Storm Irene (Figure 4-22). Water backed up at the bridge resulting in flooding at the firehouse.

The 2017 NYSDOT bridge inspection report for the Bridge Street bridge (BIN: 3201430) indicates that the bridge was built in 1967; is county owned; and is of prestressed concrete, box beam, or box girder construction. The bridge has a posted 15-ton limit. The bridge foundation is set on bedrock. The inspection report does not identify any major deficiencies or recommended action items.

Hydraulic modeling indicates that the Bridge Street bridge overtops during the 50- and 100-year flood events and acts as a hydraulic constriction during the 10-, 50-, and 100-year flood events. During the 10-year event, the removal of the bridge from the hydraulic model results in a 3.9-foot reduction in water surface elevations at the upstream face of the bridge. The reduction diminishes moving upstream of the bridge and is negligible at a point approximately 600 feet upstream of the bridge. During the 50-year event, there is a 10.0-foot reduction at the upstream face of the bridge. This reduction diminishes moving upstream of the bridge, resulting in a reduction of 5.0 feet at a point approximately 580 feet upstream of the bridge and a negligible reduction at a point 1,200 feet upstream of the bridge (Figure 4-23). Inundation mapping depicts the depth and extent of flooding during the 50-year flood event with and without the Bridge Street bridge in place (Figures 4-24 and 4-25).

During the 100-year event with the removal of the bridge, there is a reduction of 10.4 feet at the upstream face of the bridge when the bridge is removed from the model, a reduction of 5.0 feet at a point approximately 580 feet upstream of the bridge, and a negligible reduction at a point 1,200 feet upstream of the bridge (Figure 4-26). Inundation mapping depicts the depth and extent of flooding during the 100-year flood event with and without the Bridge Street bridge in place (Figures 4-27 and 4-28).

Figure 4-22
Bridge Street over Schoharie Creek during Tropical Storm Irene

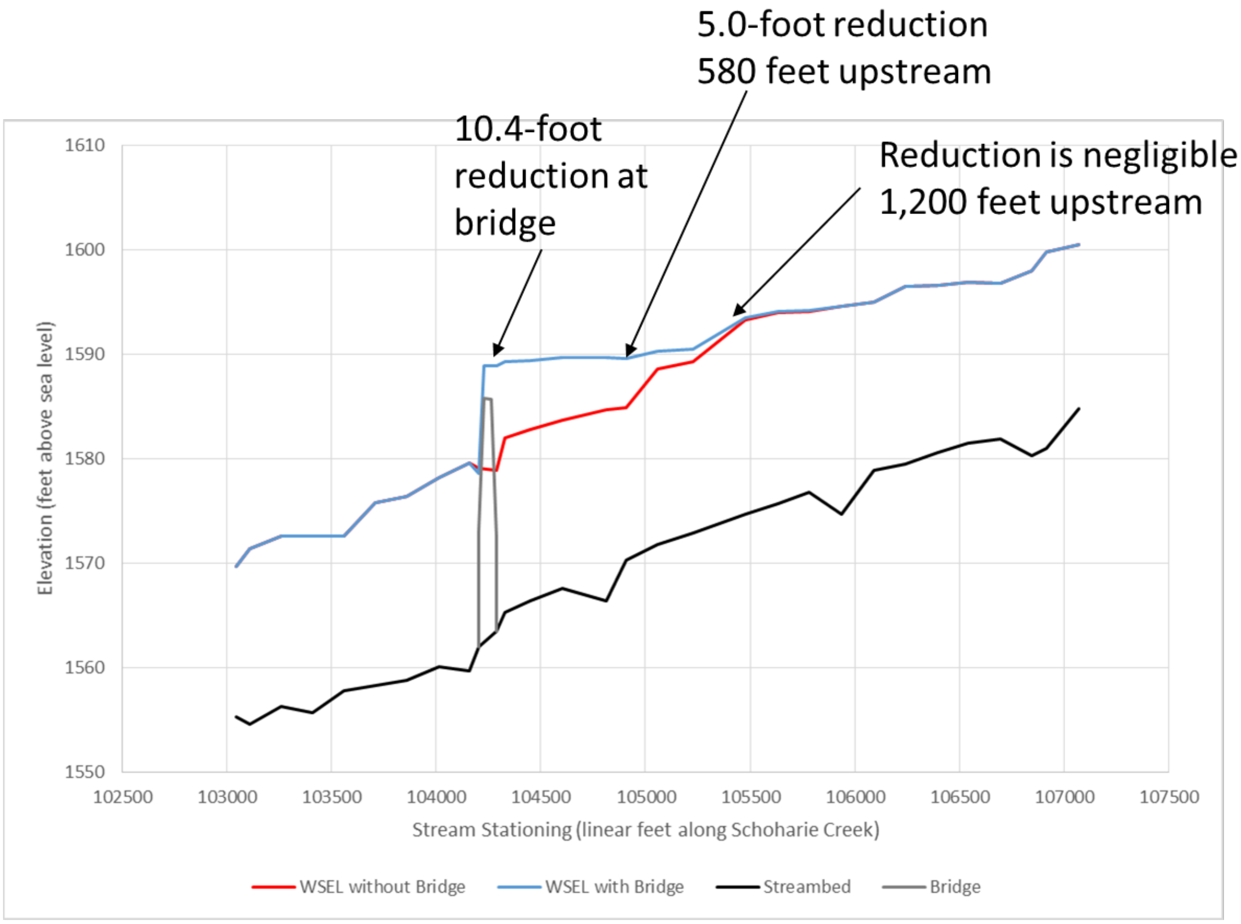


Figure 4-23
Longitudinal Profile – 50-Year Flood
Bridge Street Bridge over Schoharie Creek

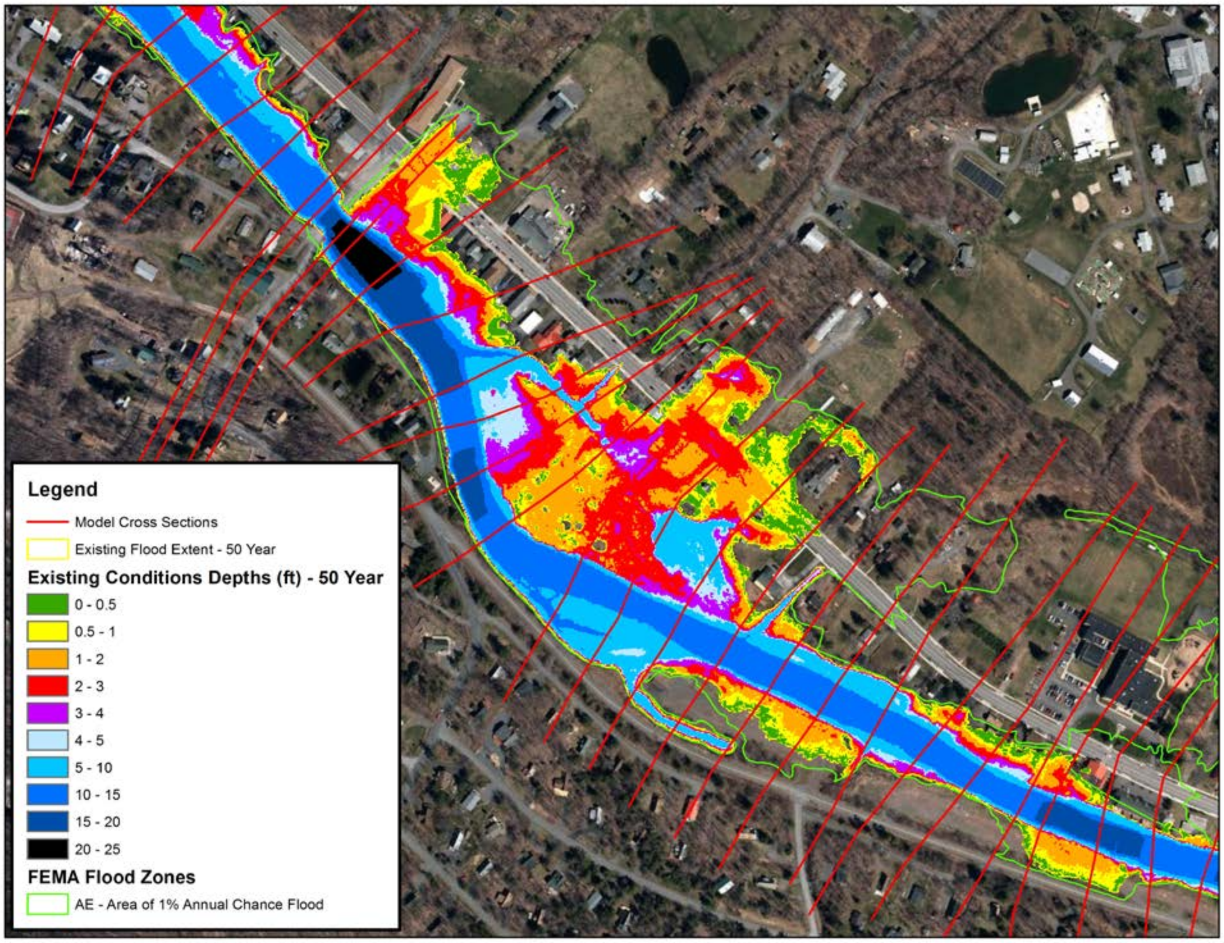


Figure 4-24
Inundation Map – Existing Conditions (bridge in place) - 50-Year Flood
Bridge Street Bridge over Schoharie Creek

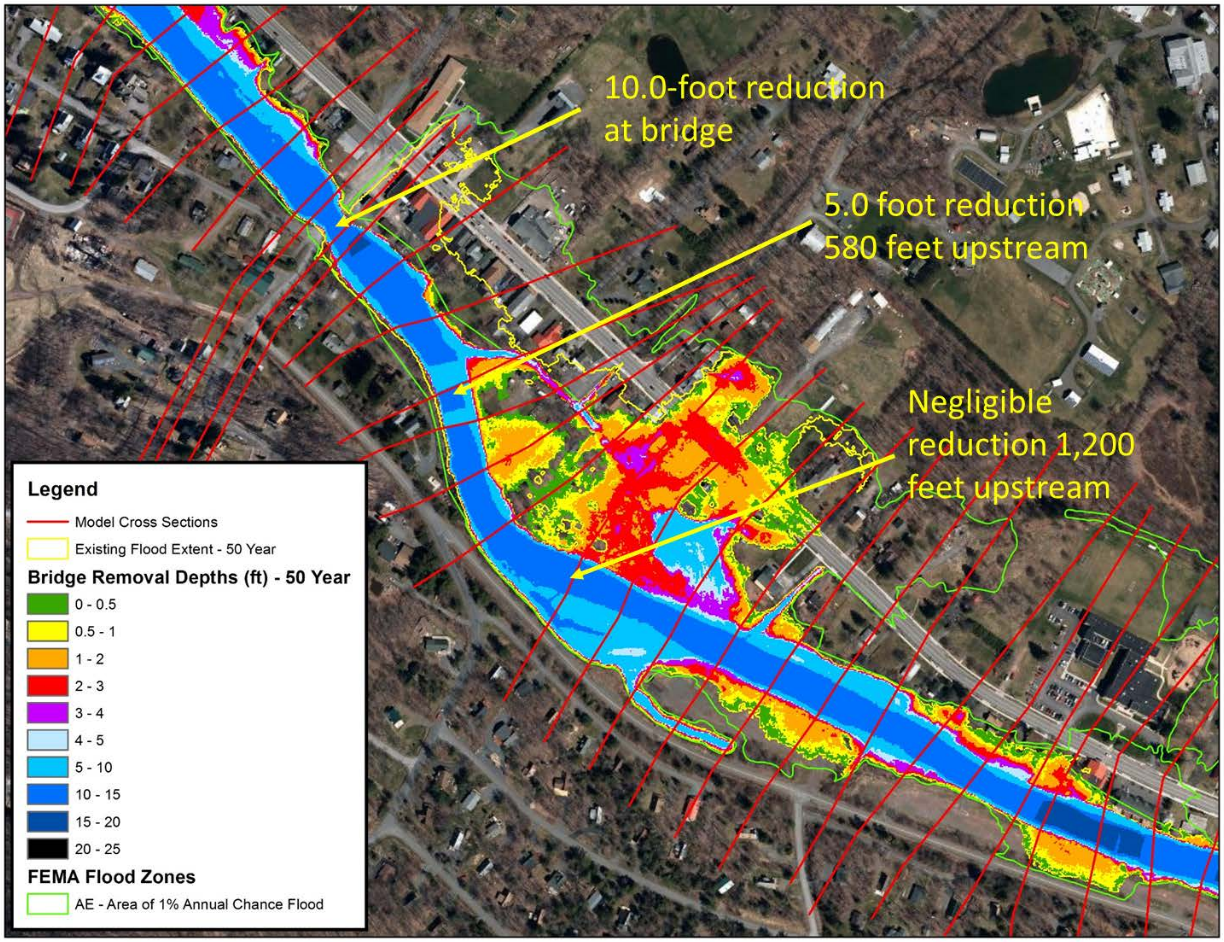


Figure 4-25
Inundation Map – Proposed Conditions (bridge removed) - 50-Year Flood
Bridge Street Bridge over Schoharie Creek

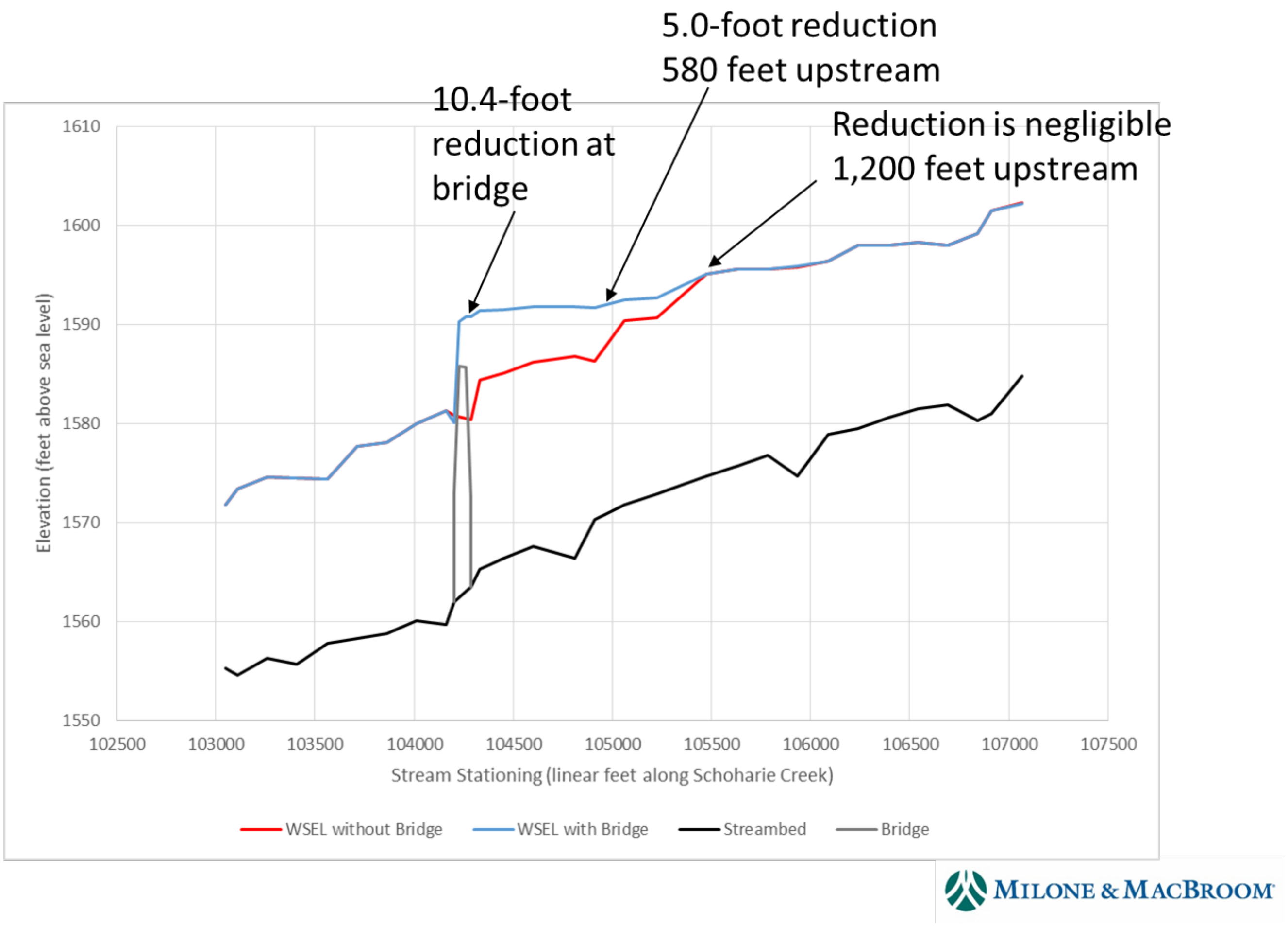


Figure 4-26
Longitudinal Profile – 100-Year Flood
Bridge Street Bridge over Schoharie Creek

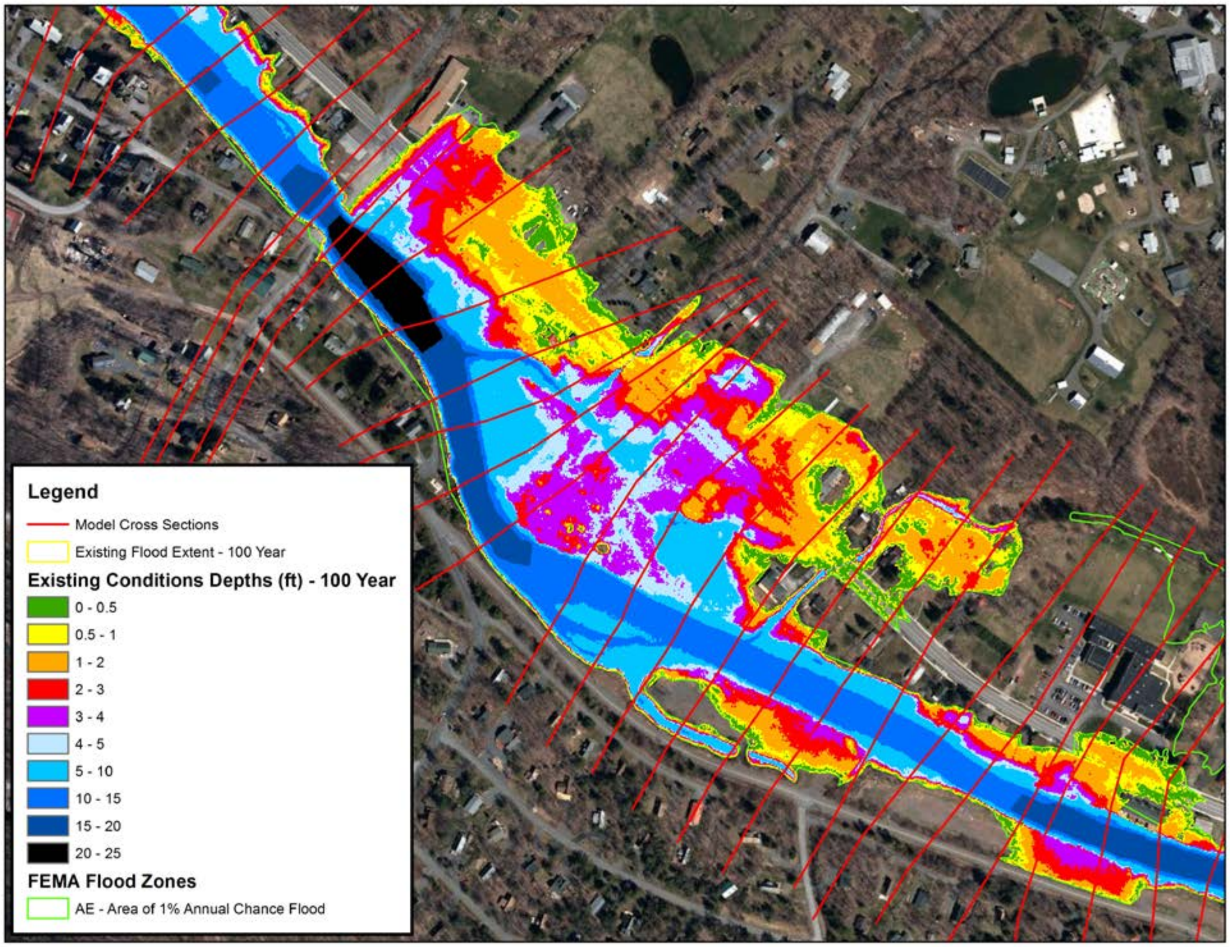


Figure 4-27
Inundation Map – Existing Conditions (bridge in place) - 100-Year Flood
Bridge Street Bridge over Schoharie Creek

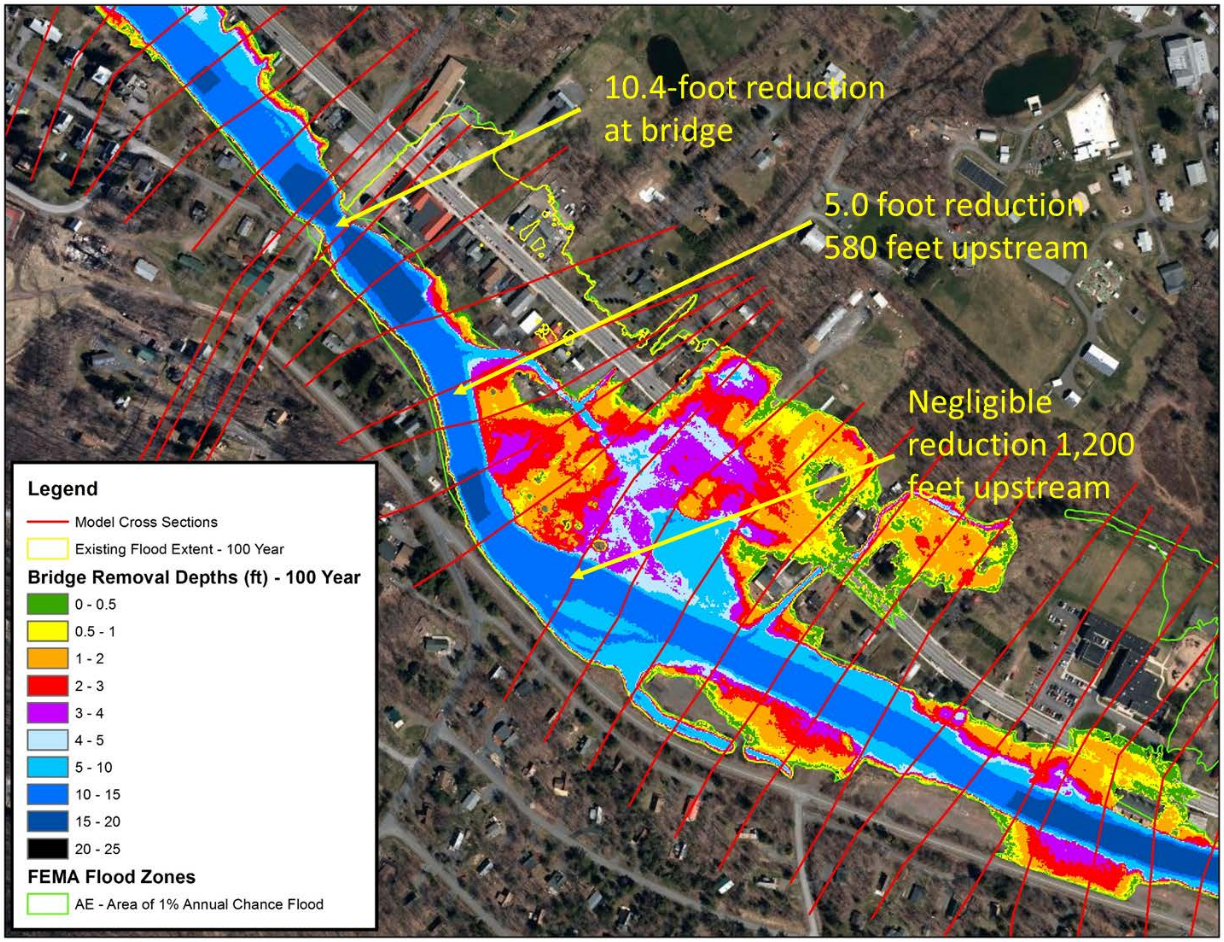


Figure 4-28
Inundation Map – Proposed Conditions (bridge removed) - 100-Year Flood
Bridge Street Bridge over Schoharie Creek

Replacement of the Bridge Street bridge with an adequately sized replacement bridge would prevent the bridge from being overtopped by floodwaters during the 100-year flood event and would substantially reduce flooding of buildings in the vicinity of the bridge, including critical facilities such as the Hunter Firehouse, the Village Hall, and the Post Office. It should be noted that changes to the Bridge Street bridge height or length may limit access to the firehouse and potentially necessitate relocation of the firehouse. Recommendations for the Bridge Street bridge are discussed further in Section 6.0.

4.5.6 Deming Road Bridge

Deming Road crosses Schoharie Creek downstream of the village of Hunter (Figure 4-29). It is a dead-end road that leads to several rural residences. There are reportedly plans for a new parking area and the terminus of a new ski trail planned for this area, which would increase vehicular use of the Deming Road bridge.

Hydraulic modeling indicates that the Deming Road bridge overtops during the 50- and 100-year flood events and acts as a hydraulic constriction during the 50- and 100-year flood events. During Tropical

Storm Irene, the bridge was flanked, and the roadway to the left (south) side of the bridge was overtopped by floodwaters from Schoharie Creek (Figure 4-30).

During the 50-year event, the bridge causes a 2.4-foot rise at the upstream face of the bridge. This rise diminishes moving upstream of the bridge, resulting in a negligible rise at a point approximately 1,200 feet upstream of the bridge. During the 100-year event, the bridge causes a 2.8-foot rise at the upstream face of the bridge. This rise diminishes moving upstream of the bridge, resulting in a negligible rise at a point approximately 1,200 feet upstream of the bridge. The area along Schoharie Creek within 1,200 feet upstream of the bridge is sparsely populated.

Figure 4-29
Deming Road over Schoharie Creek

Figure 4-30
Deming Road over Schoharie Creek during Tropical Storm Irene

When the Deming Road bridge is due for a regularly scheduled replacement, it is recommended that the new bridge span the channel and adjacent floodplain and be sized so that the 100-year flood can safely pass without flanking or overtopping the bridge or causing a rise in water surface elevations. Recommendations are discussed in Section 6.0.

4.5.7 Bloomer Road Bridge

Bloomer Road crosses over Gooseberry Creek just upstream of its confluence with Schoharie Creek. No reports of flooding or roadway overtopping were received for this bridge. Hydraulic modeling indicates that the bridge is able to pass the 100-year flood event and does not act as a significant hydraulic constriction.

Aside from regular inspection and maintenance, no actions are recommended at the Bloomer Road bridge.

4.5.8 Summary of Bridge Analysis

Table 4-1 summarizes the results of the hydraulic analysis of bridges within the LFA project area.

TABLE 4-1
Bridges within Hunter LFA Study Area

Watercourse	Bridge Crossing	Bridge or Roadway Overtops in 50-Year Event (Y/N)	Bridge or Roadway Overtops in 100-Year Event (Y/N)	Bridge Contributes to Upstream Flooding (Y/N)
Schoharie Creek	Elka Park Road	**Y**	**Y**	**N**
Schoharie Creek	NYS Route 214	**N**	**N**	**N**
Schoharie Creek	Hunter Pedestrian Bridge	**N**	**Y**	**Y**
Schoharie Creek	Hunter Mountain Bridge	**Y**	**Y**	**Y**
Schoharie Creek	Bridge Street	**Y**	**Y**	**Y**
Schoharie Creek	Deming Road	**Y**	**Y**	**N**
Gooseberry Creek	Bloomer Road	**N**	**N**	**N**

4.6 Floodplain Enhancement Assessment

Historical settlement and human desire to build near water have led to centuries of development clustered along the banks of rivers all over the nation, including along Schoharie Creek in Hunter. Dense development and placement of fill in the natural floodplain of a river can severely hinder a river's ability to convey flood flows without overtopping its banks and/or causing heavy flood damages. A river in flood stage must convey large amounts of water through a finite floodplain. When a channel is constricted or confined, velocities can become destructively high during a flood, with dramatic erosion and damage. When obstructions are placed in the floodplain, whether they are in the form of structures, infrastructure, or fill, they are vulnerable to flooding and damage.

In certain instances, an existing floodplain can be altered through reclamation, creation, or enhancement to increase flood conveyance capacity. Floodplain reclamation can be accomplished by excavating previously filled areas, removing berms or obstructions from the floodplain, or removing structures. Floodplain creation can be accomplished by excavating land to create new floodplain where there is none today. Finally, floodplain enhancement can be accomplished by excavating within the existing floodplain adjacent to the river to increase flood flow conveyance. These excavated areas are sometimes referred to as floodplain benches.

Figure 4-31 shows a typical cross section of a compound channel with excavated floodplain benches on both banks. The graphic shows flood benches on both banks; however, flood benches can occur on either or both banks of a river.

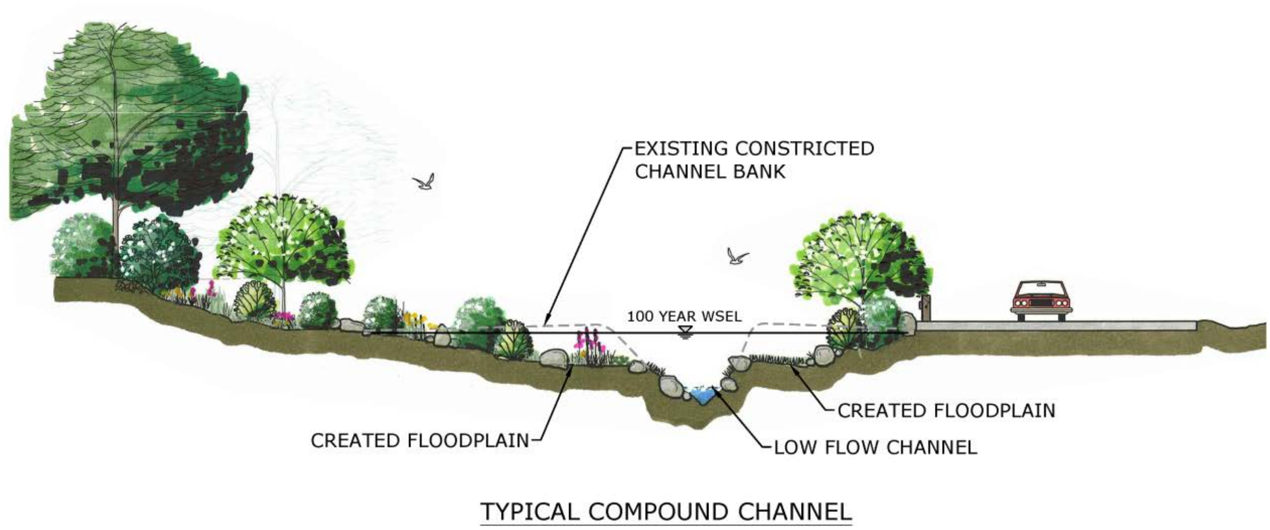


Figure 4-31
Cross Section of a Compound Channel with Enhanced Floodplain

Several floodplain enhancement scenarios were evaluated along a reach of Schoharie Creek that begins upstream of the Hunter Mountain bridge and continues to downstream of the Bridge Street bridge. These scenarios are depicted on Figure 4-32 and described in more detail below.

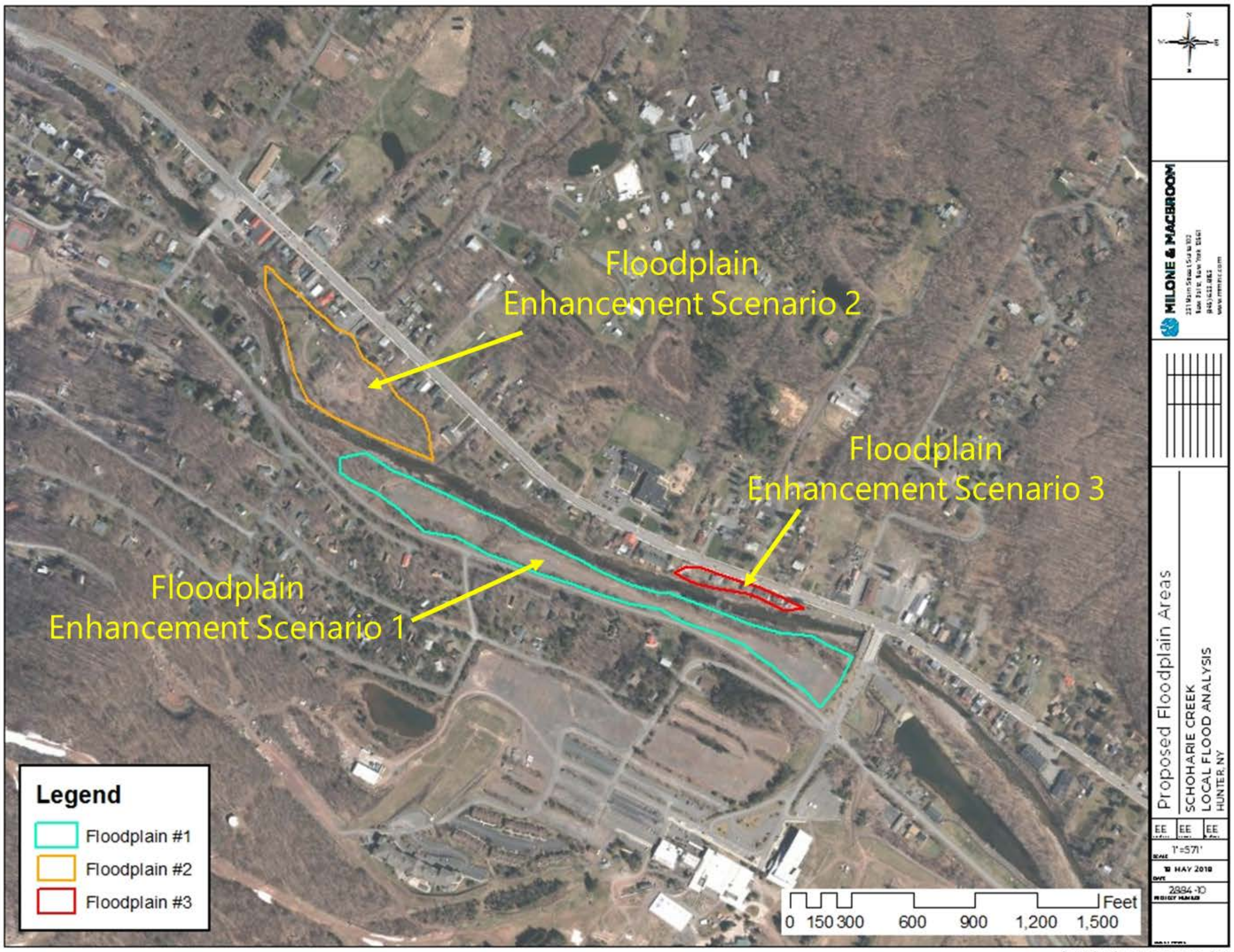


Figure 4-32
Locations of Floodplain Enhancement Scenarios

4.6.1 Floodplain Enhancement Scenario 1

Floodplain Enhancement Scenario 1 would entail lowering of the floodplain along the left bank of Schoharie Creek beginning downstream of the Hunter Mountain bridge in the area used as overflow parking by the Hunter Mountain Ski Area. Under this scenario, the area now used for overflow parking would be excavated down to a lower elevation so that the area would convey flows during flood events, creating more space for floodwaters to be conveyed downstream without flooding inhabited areas. Two iterations of Floodplain Enhancement Scenario 1 were evaluated.

Under Scenario 1a, the parking area would be lowered so that the area would convey flows during the 5-year flood event and greater. Based on hydraulic modeling of Scenario 1a, water surface elevation reductions would occur along approximately 2,700 linear feet of the Schoharie Creek channel during the 10-, 50-, and 100-year flood events. During the 10-year flood event, reduction in water surface elevations would be up to 1.0 foot. During the 50-year event, reduction of up to 2.3 feet would occur. During the 100-year event, reduction in water surface elevations would be up to 3.0 feet.

Scenario 1b would involve floodplain enhancement within the same footprint as described under Scenario 1a above, but the amount of excavation would be reduced. The parking area would be lowered so that the area would convey flows during the 10-year flood event and greater. This would create more space for floodwaters to be conveyed downstream but would also allow for the area to be used for parking provided that measures were taken to ensure that the parking area was not used if any chance of flooding is forecast. Scenario 1b would result in water surface elevation reductions along approximately 2,100 linear feet of Schoharie Creek during the 50- and 100-year flood events (reductions during the 10-year flood event would be negligible). During the 50-year flood event, reduction in water surface elevations would be up to 1.0 foot. During the 100-year event, reduction in water surface elevations would be up to 1.6 feet. Flood inundation mapping for the 100-year flood event under existing conditions and under floodplain enhancement scenario 1b is depicted on Figures 4-33 and 4-34, respectively.

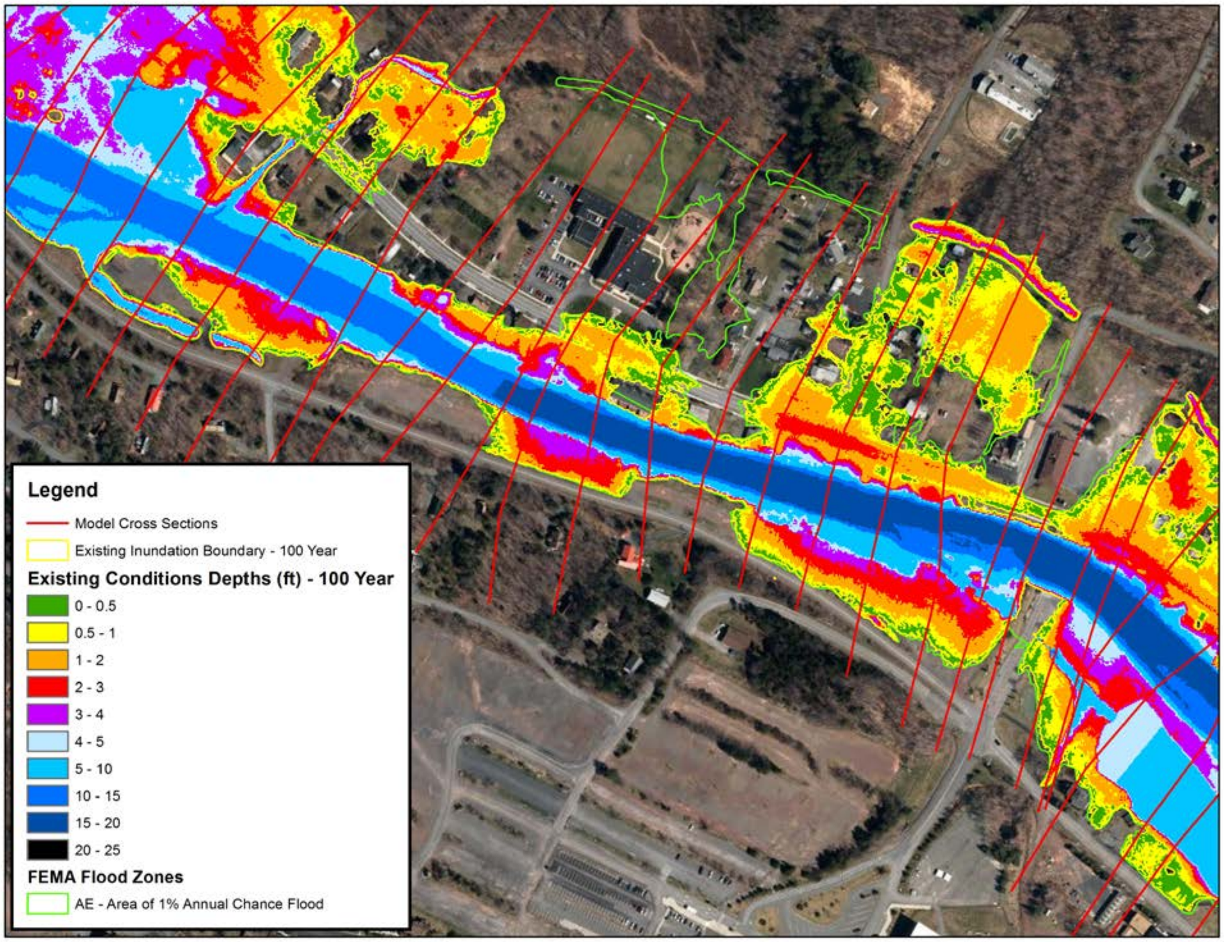


Figure 4-33
Inundation Map – 100-Year Flood
Existing Conditions

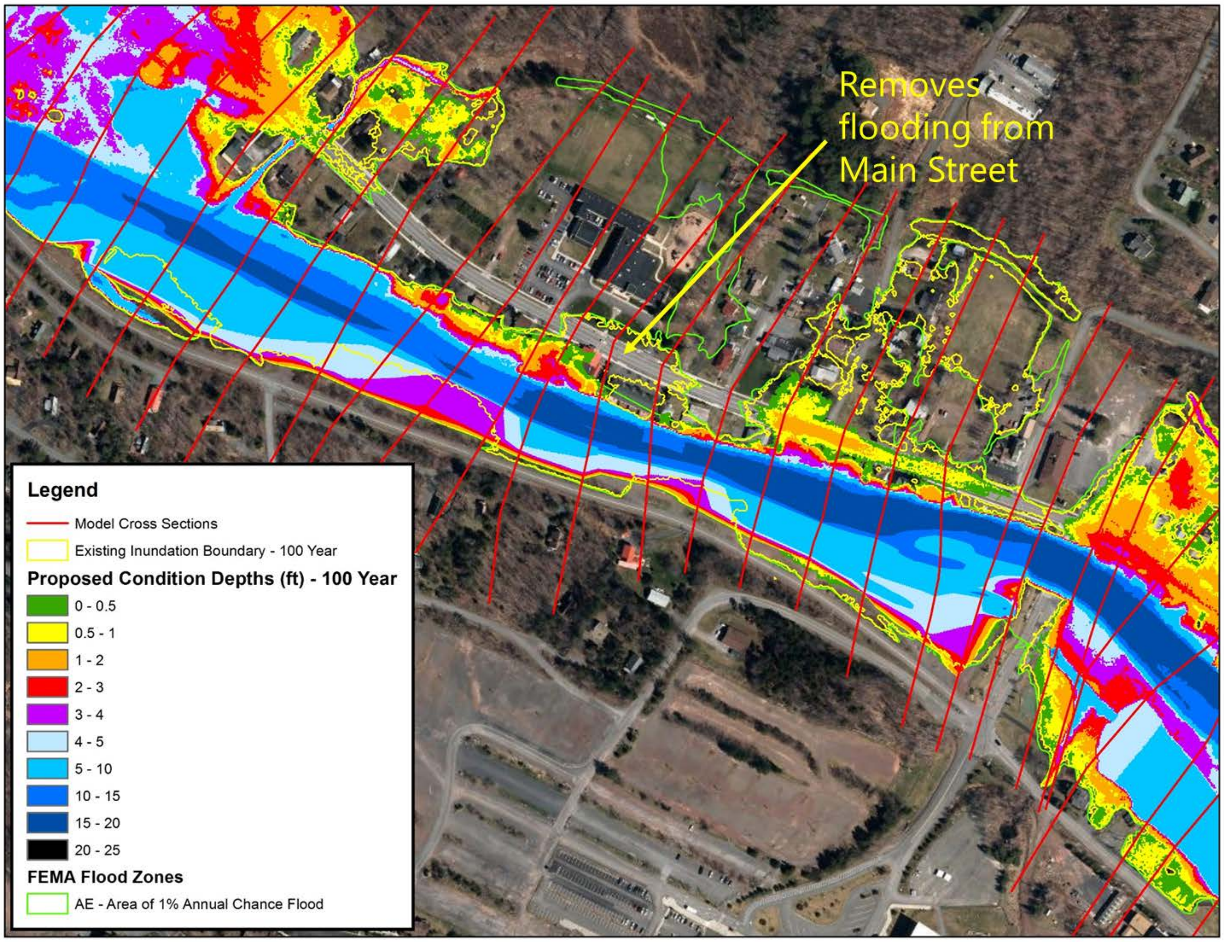


Figure 4-34
Inundation Map – 100-Year Flood
Floodplain Enhancement Scenario 1b

While both iterations of Floodplain Enhancement Scenario 1 do reduce water surface elevations, reductions in flooding along Main Street in Hunter would be moderate, and opportunities for parking at Hunter Mountain would be reduced or limited. Therefore, Floodplain Enhancement Scenario 1 is not recommended.

4.6.2 Floodplain Enhancement Scenario 2

Scenario 2 would entail floodplain enhancement along the right bank of Schoharie Creek in an area of vacant land downstream of the floodplain enhancement areas proposed under Scenarios 1a and 1b and upstream of the Bridge Street bridge. Four scenarios (2 a, 2b, 2c, and 2d) were evaluated.

Under Scenario 2a, the area would be cleared and excavated down to a lower elevation so that the excavated area would convey flows during the 5-year flood event and greater, creating more space for floodwaters to be conveyed downstream without flooding inhabited areas. This would result in reductions in water surface elevations along approximately 1,400 linear feet of the Schoharie Creek channel during the 10-, 50-, and 100-year flood events. During the 10-year flood event, reduction in water surface elevations would be up to 2.2 feet. During the 50-year event, reduction of up to 3.9 feet would occur. During the 100-year event, reduction in water surface elevations would be up to 4.2 feet.

Scenario 2b would involve floodplain enhancement within the same footprint as described under Scenario 2a, but the amount of excavation would be reduced. The vacant area would be lowered so that the area would convey flows during the 10-year flood event and greater. This would create more space for floodwaters to be conveyed downstream but would also allow for the area to be used as a park or recreational area as long as measures were taken to ensure that the area was not used during floods. Scenario 2b would result in reductions in water surface elevations along approximately 1,400 linear feet of channel during the 50- and 100-year flood events. Reductions during the 10-year flood would be negligible. During the 50-year flood event, reduction in water surface elevations would be up to 2.4 feet. During the 100-year event, reduction in water surface elevations would be up to 2.7 feet.

Scenarios 2c and 2d involve reconfigurations aimed at minimizing impacts to properties and the net amount of excavation while at the same time maximizing flood-reduction benefits. Flood inundation mapping for the 50-year flood event under existing conditions and under Floodplain Enhancement Scenario 2c is depicted on Figures 4-35 and 4-36, respectively. Mapping for the 100-year flood event under existing conditions and Scenario 2c is depicted on Figures 4-37 and 4-38, respectively. The reduction in flooding under Scenario 2d would be very similar to those shown under Scenario 2c.

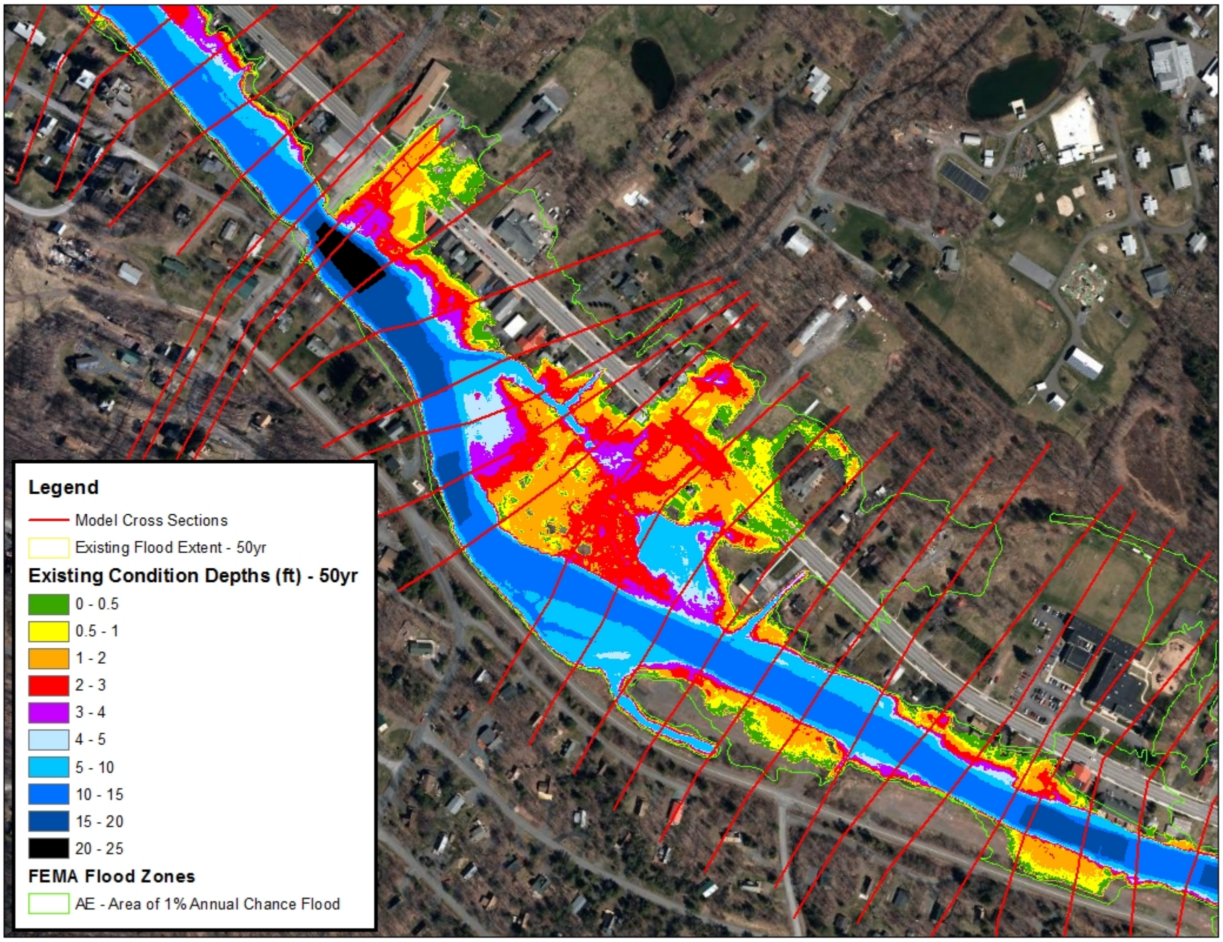


Figure 4-35
Inundation Map – 50-Year Flood
Existing Conditions

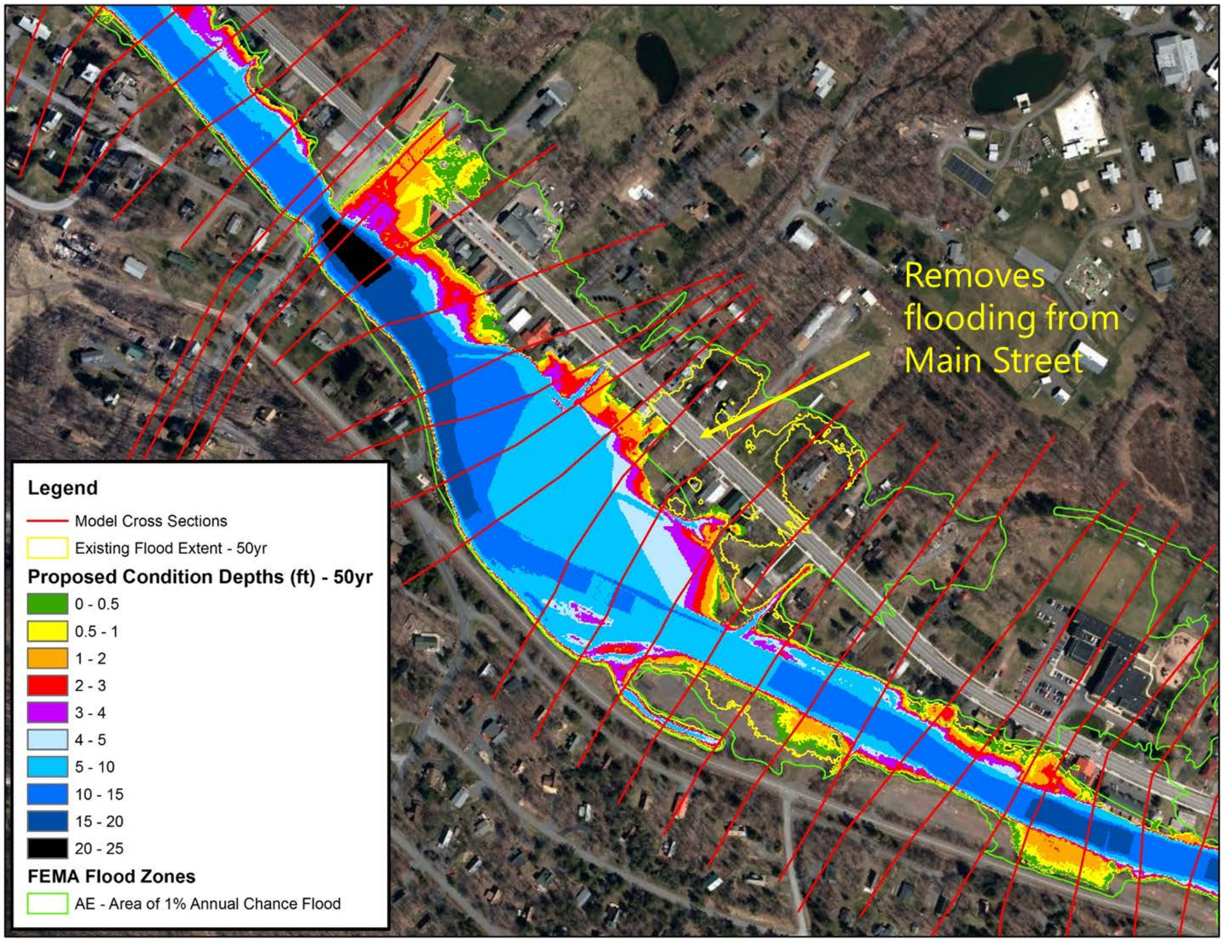


Figure 4-36
Inundation Map – 50-Year Flood
Floodplain Enhancement Scenario 2c

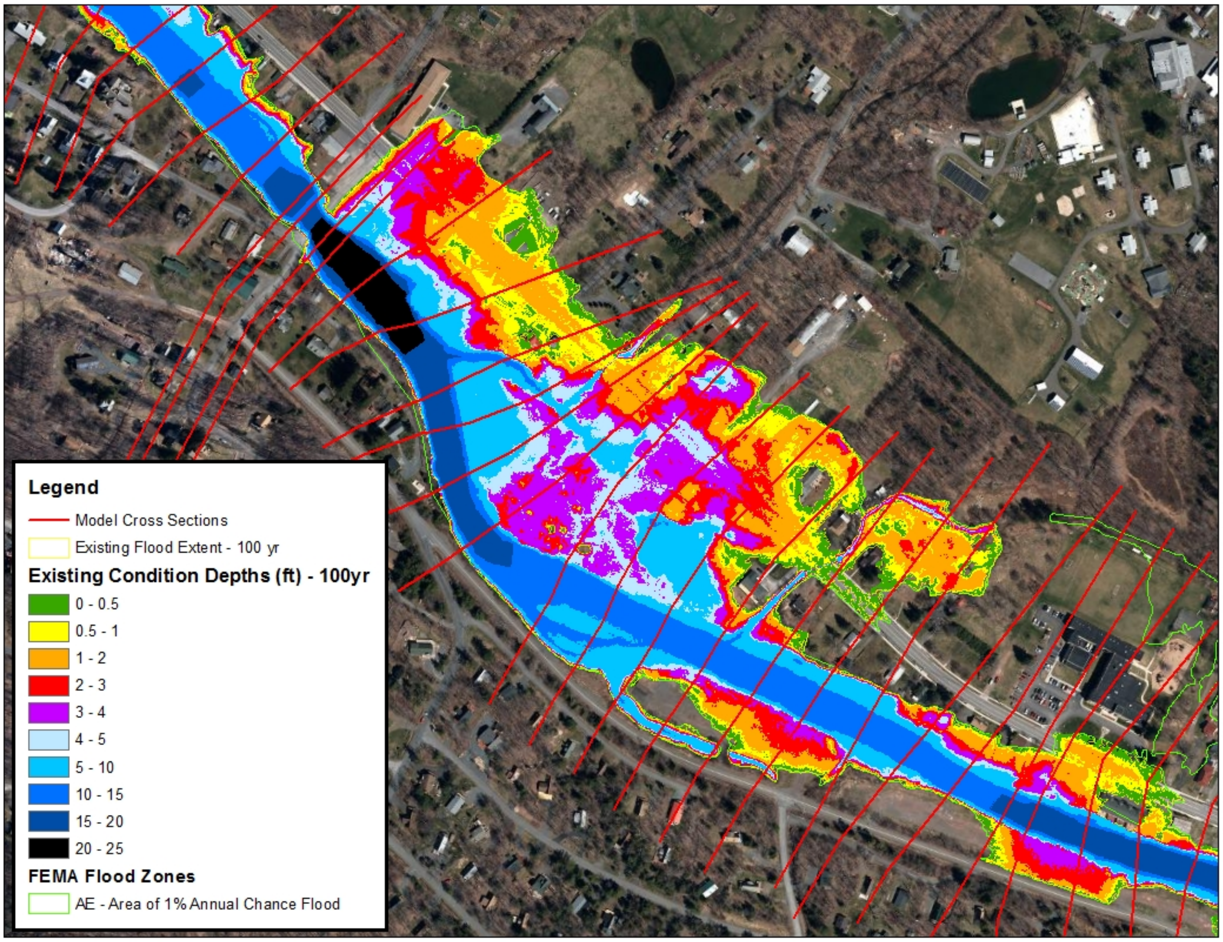


Figure 4-37
Inundation Map – 100-Year Flood
Existing Conditions

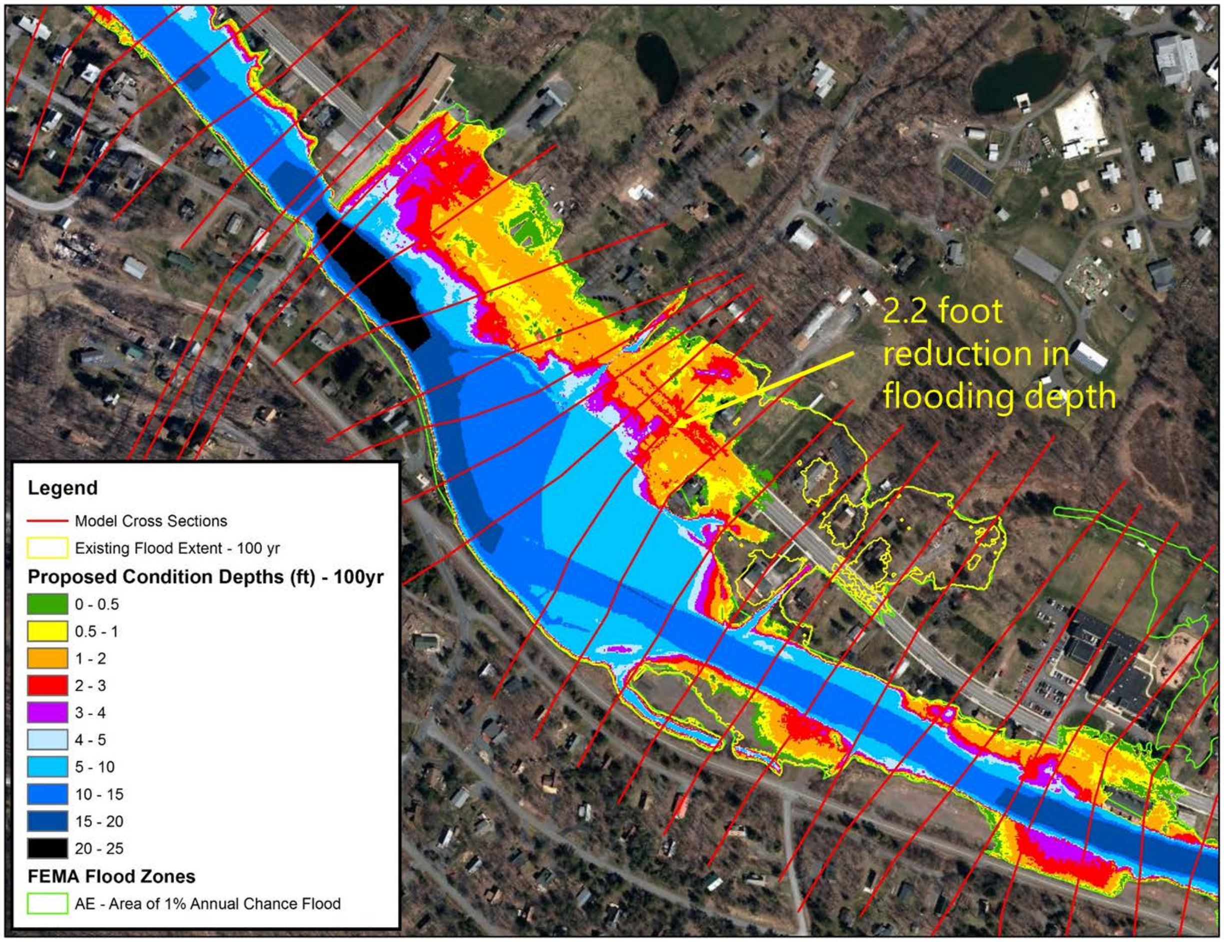


Figure 4-38
Inundation Map – 100-Year Flood
Floodplain Enhancement Scenario 2c

Floodplain Enhancement Scenarios 2c and 2d are effective at reducing water surface elevations along Main Street during the 50- and 100-year flood events. Recommendations are discussed in Section 6.

4.6.3 Floodplain Enhancement Scenario 3

Scenario 3 would entail floodplain enhancement along the right bank of Schoharie Creek downstream of the Hunter Mountain bridge in an area where several flood-damaged buildings, some of them vacant, line Schoharie Creek. Under this scenario, the buildings would be acquired through voluntary buyouts and demolished, and the area would be cleared and excavated down to a lower elevation so that the excavated area would convey flows during the 5-year flood event and greater.

Floodplain Enhancement Scenario 3 would result in reductions in water surface elevations along approximately 720 linear feet of the Schoharie Creek channel during the 10-, 50-, and 100-year flood events. During the 10-year flood event, reduction in water surface elevations would be up to 1.4 feet. During the 50-year event, reduction of up to 2.2 feet would occur. During the 100-year event, reduction in water surface elevations would be up to 2.4 feet.

Floodplain Enhancement Scenario 3 reduces water surface elevations along Schoharie Creek. However, reductions in flooding along Main Street would be moderate, and the project would require the buyout and removal of buildings. Floodplain Enhancement Scenario 3 is not recommended.

4.7 Assessment of Bridge Improvement and Floodplain Enhancement Combinations

Under certain circumstances, individual flood reduction measures can be combined. The bridge improvement and floodplain enhancement scenarios discussed above were examined in combination.

Floodplain Enhancement Scenarios 2c and 2d were modeled in combination with removal of the Bridge Street bridge. The results show that either of these combinations would remove flooding from Main Street during the 50- and 100-year flood events. Flood inundation mapping for the 50-year flood event under existing conditions and under the combination of floodplain enhancement Scenario 2c and Bridge Street bridge improvement is depicted on Figures 4-39 and 4-40, respectively. Mapping for the 100-year flood event is depicted on Figures 4-41 and 4-42. Scenario 2d combined with the Bridge Street bridge improvement would have very similar results as those depicted below.

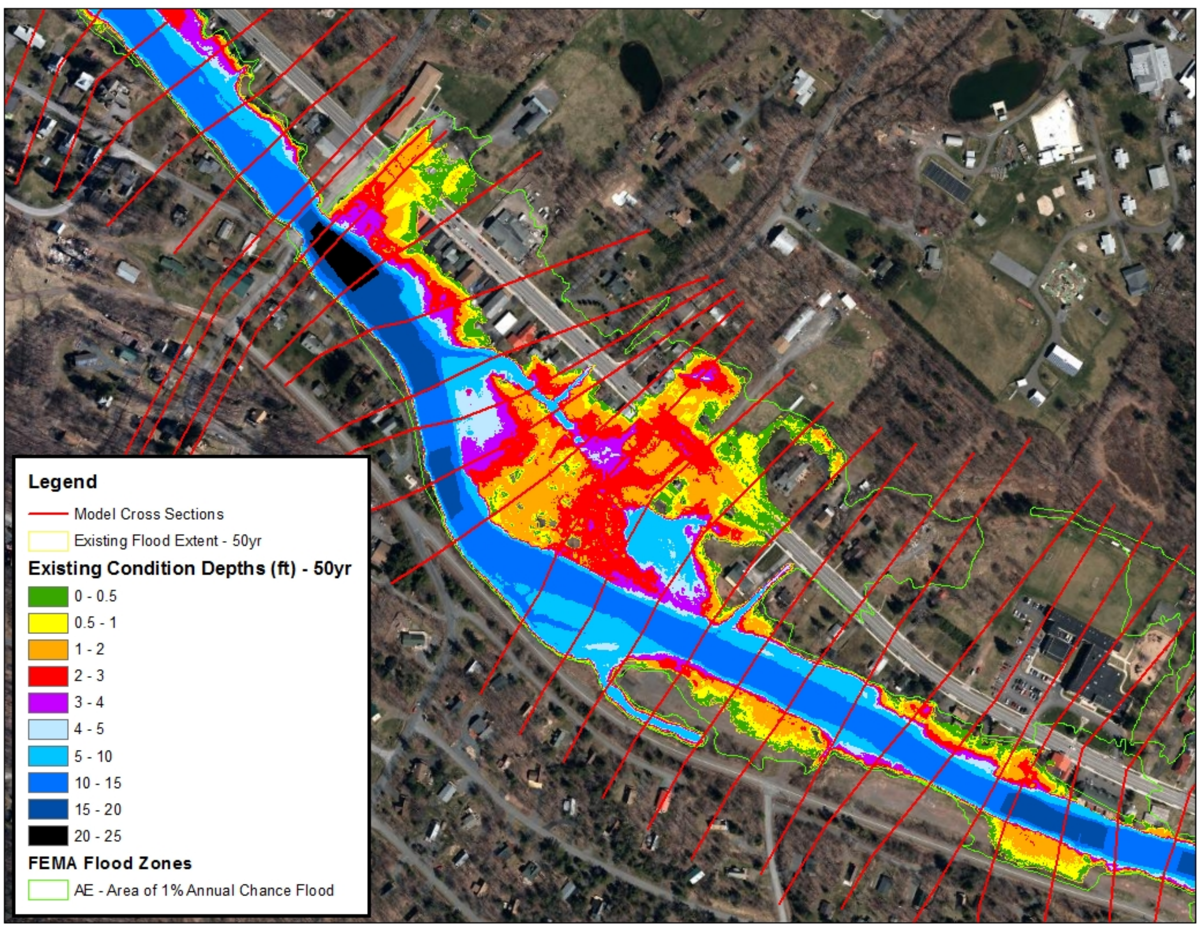


Figure 4-39
Inundation Map – 50-Year Flood
Existing Conditions

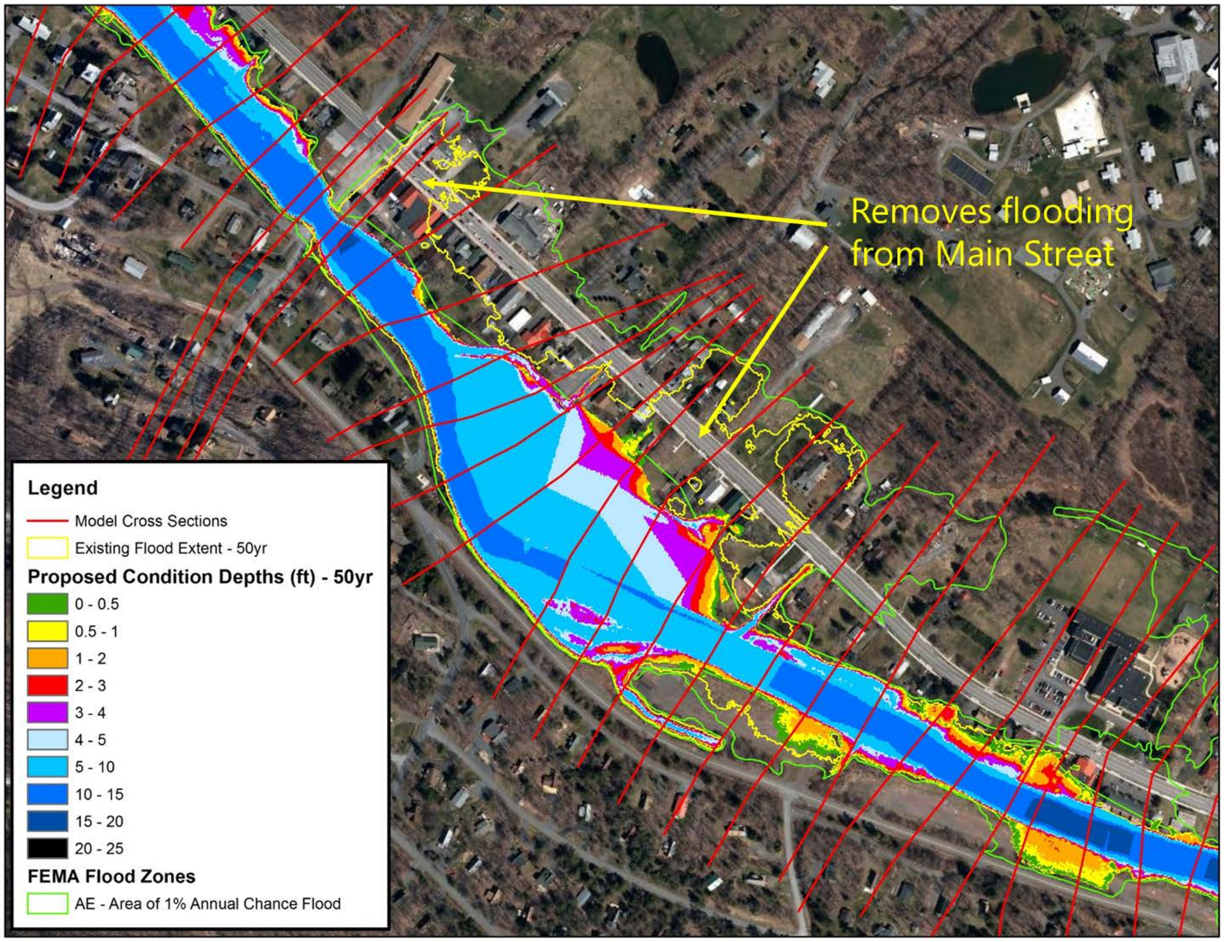


Figure 4-40
Inundation Map – 50-Year Flood
Combined Floodplain Enhancement Scenario 2c and Bridge Street Bridge Improvement

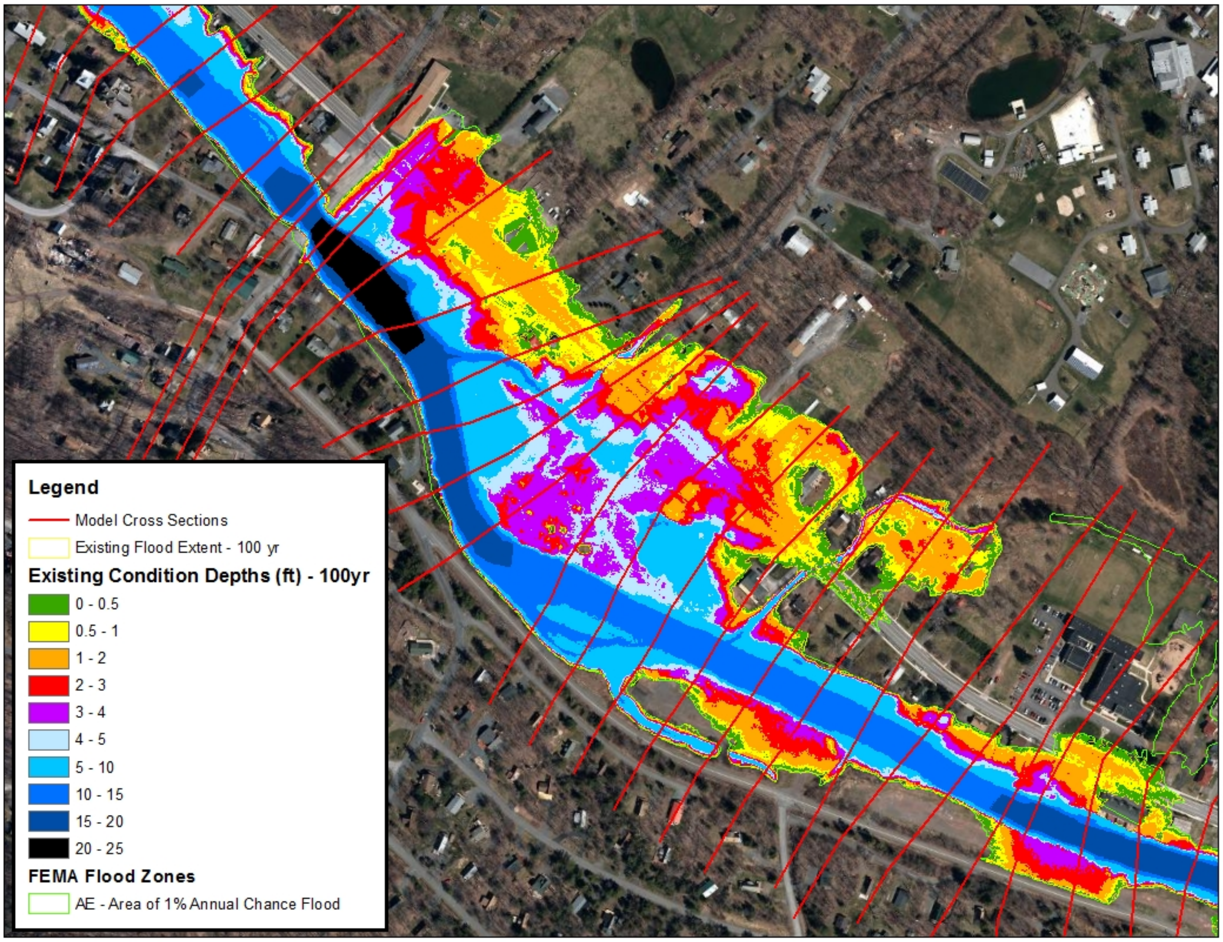


Figure 4-41
Inundation Map – 100-Year Flood
Existing Conditions

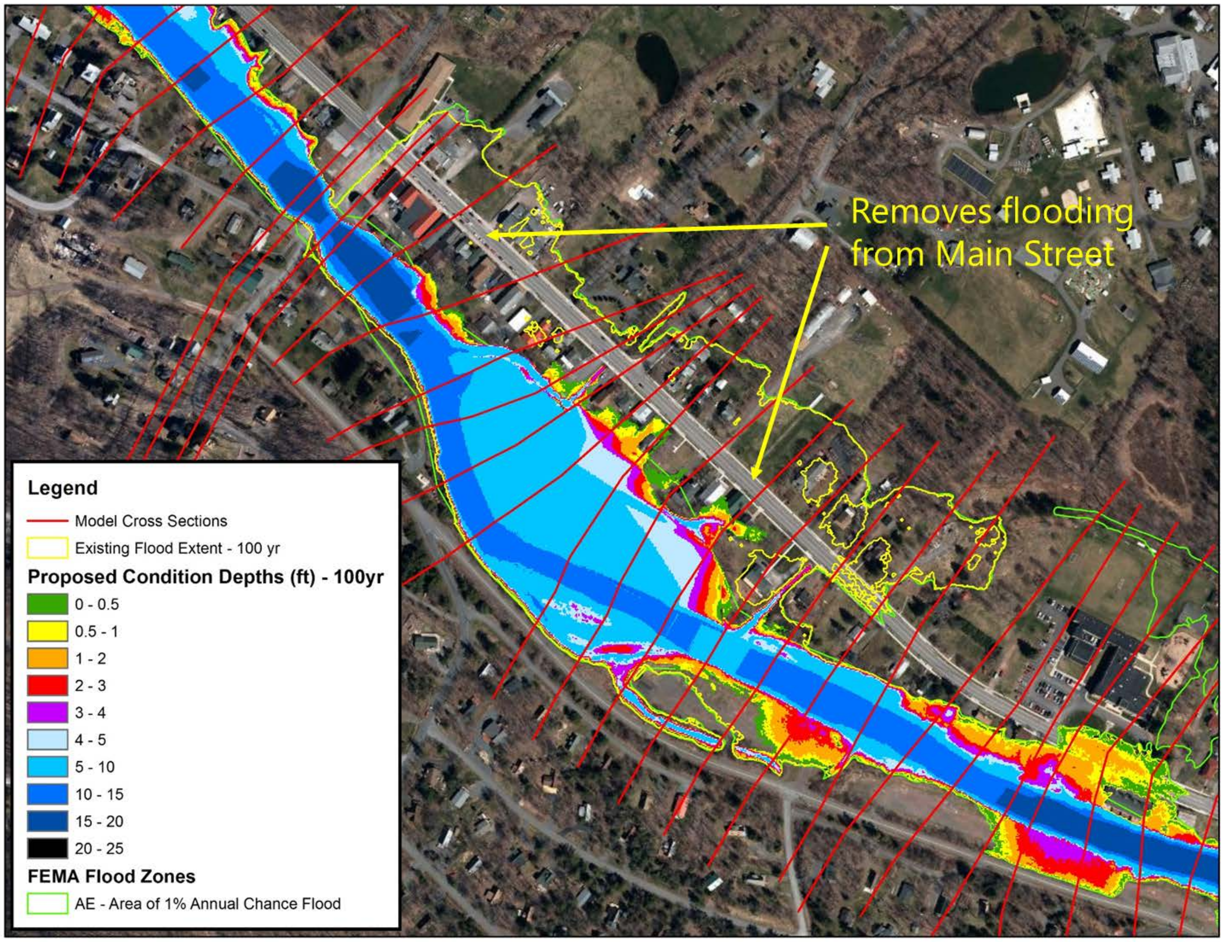


Figure 4-42
Inundation Map – 100-Year Flood
Combined Floodplain Enhancement Scenario 2c and Bridge Street Bridge Improvement

Recommendations for floodplain enhancement and bridge improvement scenarios are discussed further in Section 6.

4.8 Culvert Improvement Assessment

Three culverts were evaluated, two along Mad Brook (Figure 4-43) and one on Shanty Hollow Brook (Figure 4-44), which originates on Hunter Mountain and flows to Schoharie Creek near Doland Pond and the Hunter Mountain bridge. Analysis was done using the hydraulic modeling software *Hydraflow Express*.

The Camp Loyaltown culvert on Glen Avenue was replaced with a larger diameter culvert prior to the start of this LFA. The project was funded by a SMIP grant.

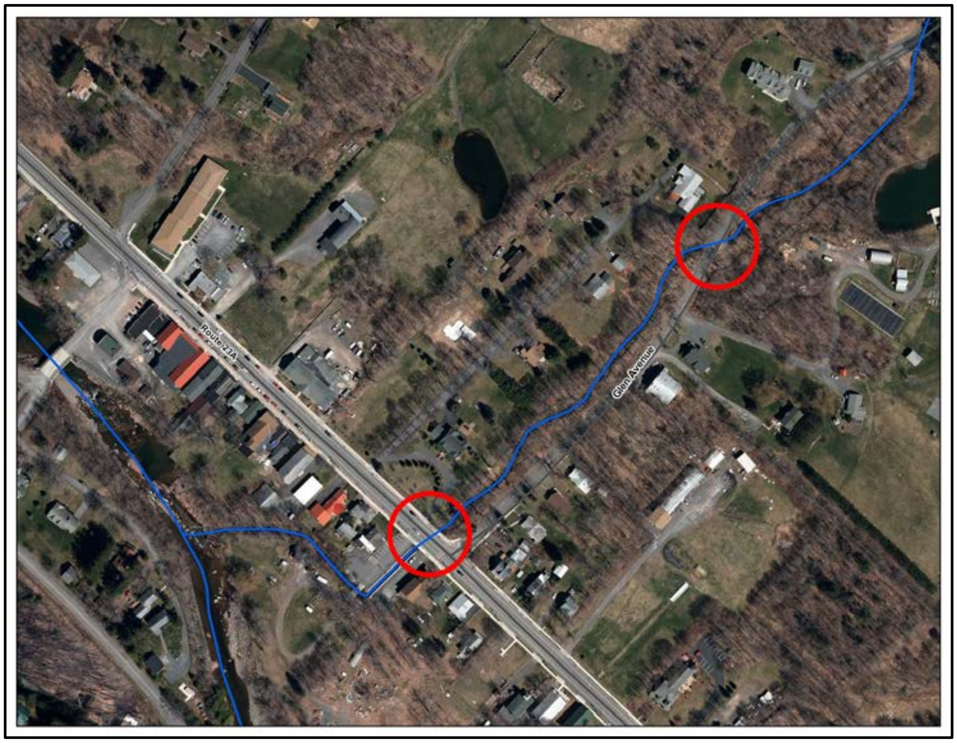


Figure 4-44
Locations of Culverts along Mad Brook

Figure 4-45
Location of Culvert on Shanty Hollow Brook

4.8.1 Main Street Culvert over Mad Brook

The existing culvert conveying Mad Brook under Main Street (Figure 4-46) is a four-sided concrete box culvert with approximately 1 foot of accumulated sediment at the time of the field visit. Hydraulic analysis indicates that this culvert has the capacity to convey 306 cfs. The culvert passes the 25-year flow of 281 cfs but not the 50-year flow of 353 cfs. Downstream of the culvert, Mad Brook passes through a narrow concrete channel and then takes a hard bend to the right before flowing under a private bridge (see Figure 4-44). Utilities including sewer and water are located in close proximity to the culvert.

Figure 4-46
Main Street Culvert over Mad Brook

Initial modeling indicates that a 13-foot x 5-foot concrete box culvert at this location would pass 405 cfs, which exceeds the 50-year flood event.

4.8.2 Mad Brook at Glen Avenue

The existing culvert along Mad Brook at Glen Avenue (Figure 4-47) is a 6-foot-diameter iron culvert that overtops at 220 cfs and does not pass the 25-year flow of 276 cfs. The culvert has a vertical drop at its outlet that prevents passage of aquatic organisms.

Figure 4-47
Glen Avenue Culvert over Mad Brook

Based on hydraulic modeling, it is recommend that the existing culvert be replaced with a new culvert sized to pass the 50-year flow. Based on initial sizing, a 9-foot x 5-foot concrete box culvert or a 10-foot x 5-foot corrugated metal arch will be required.

4.8.3 Ski Bowl Culvert at Shanty Hollow Brook

Based on hydraulic modeling, this culvert was found to be undersized, passing the 25-year flow but not the 50-year flow. Greene County has indicated that the culvert is scheduled for replacement in 2019 with a design that passes the 50-year flow. The channel design will include check dams to control sediment.

Recommendations for culverts are discussed in more detail in Section 6.0.

4.9 Buyout and Relocation Scenarios

4.9.1 Structures Located within the FEMA Floodway

Several structures, some occupied and some abandoned, were identified in Hunter that are located fully or partially within the floodway. The floodway, designated by FEMA, is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood (FEMA, 2008). Structures located fully within the floodway are at high risk of flooding while those located partially within the floodway may be less at risk. Decisions about relocations will need to take place on a case-by-case basis depending on the location of each structure and each structure's past history of flood damage. The floodway mapping within the Hunter LFA project area is shown in Figure 4-48. Further discussion of recommendations pertaining to the FEMA floodway are included in Section 6.0 of this report.

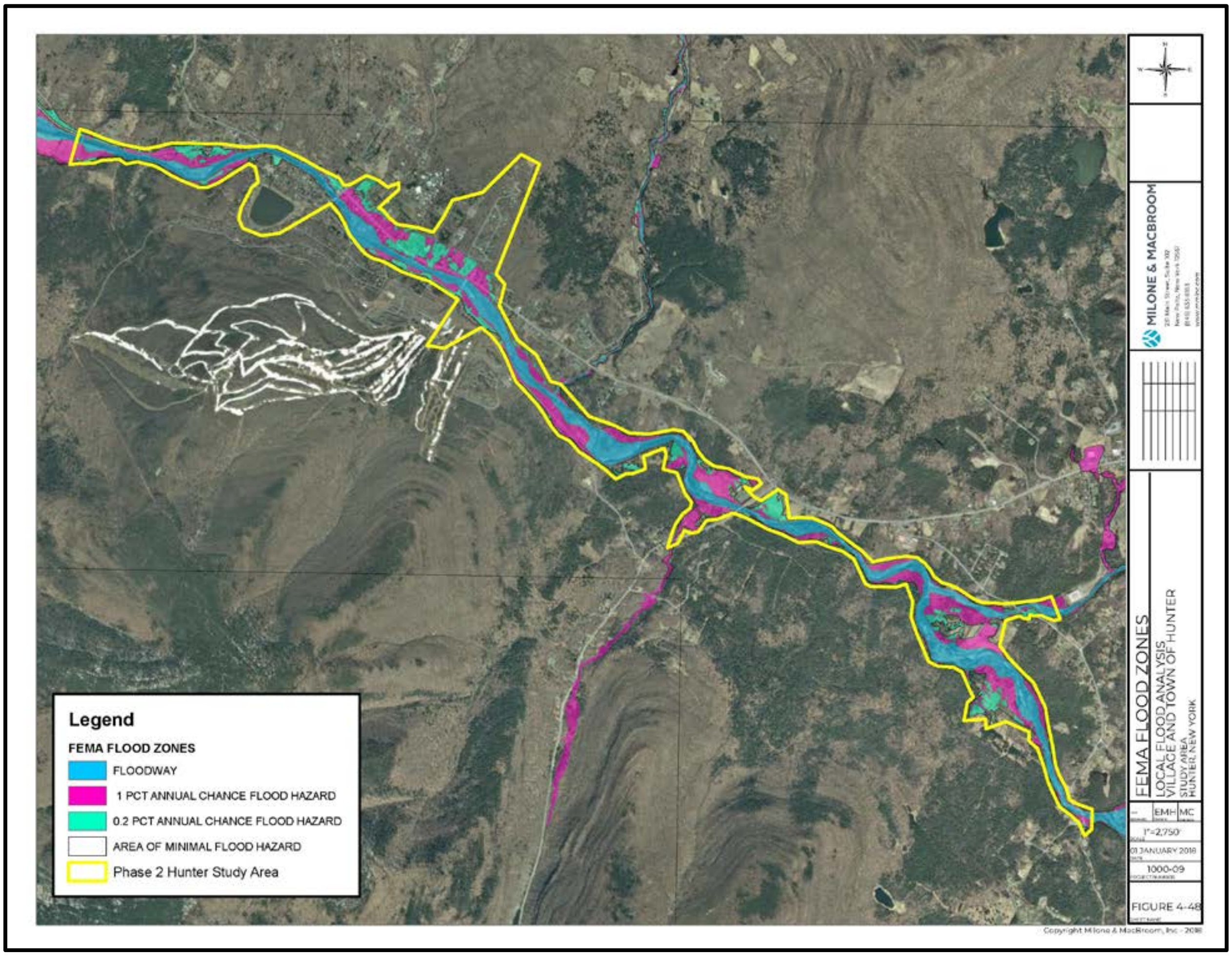


Figure 4-48
FEMA Flood Zones: Hunter LFA Study Area

4.9.2 Structures Located within the FEMA SFHA

The homes and businesses located within the SFHA in Hunter are at varying degrees of flood risk. Some are located near the fringes of the SFHA or have a first-floor elevation that is near or above the BFE. It is likely that the flood risk for these structures is relatively low, and some saw no flooding during Tropical Storm Irene. Other homes and businesses are located well within the SFHA and/or have a first floor that is below the elevation of the base flood. Mapping of the SFHA within the Hunter LFA project area is shown in Figure 4-48. Recommendations pertaining to the FEMA SFHA are included in Section 6.0.

5.0 BENEFIT-COST ANALYSIS

5.1 Overview of Benefit-Cost Analysis

A BCA is used to validate the cost effectiveness of a proposed hazard mitigation project. A BCA is a method by which the future benefits of a project are estimated 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 by FEMA when the BCR is 1.0 or greater, indicating that the benefits of the project are sufficient to justify the costs.

To facilitate the BCA, a field visit for structures in the SFHA was carried out. The following features were noted and verified against data contained in the Greene County Parcel Viewer (http://gis.greenegovernment.com/giswebmap/):

- Is the structure commercial or residential?
- If the structure is commercial, is it a retail establishment, a warehouse, office, or vacant?
- Does the structure have a basement, crawlspace, or slab foundation?
- What is the number of stories?
- Is the structure split level?
- What is the elevation of the first floor in relation to the grade?

Assumptions for the BCA include the following:

- Benefits for acquired/relocated properties were determined as acquisitions.
- Lost revenue was included only for businesses that provided such information.
- Default depth-damage curves were used in the program.
- HEC-RAS modeling was conducted to determine water surface elevations for the 10-, 50-, 100-, and 500-year discharge events at individual structures.
- The first-floor elevations of the structures were estimated from DEM topographic mapping.
- Building information (area, basement, number of stories, etc.) came primarily from the Greene County Parcel Viewer. Where necessary, this information was supplemented with data collected during a field visit.
- If the area of a structure was not included on the Greene County Parcel Viewer, it was estimated using aerial imagery and *ArcGIS*.
- Parcel values (full market value) came from assessment data on the Greene County Parcel Viewer. An equalization rate was applied.
- Demolition costs were not included in the calculation of project cost.
- For residential parcels with multiple structures, determination of inundation was based upon the first habitable structure on the property to become flooded.
- For typical commercial parcels with multiple structures, determination of inundation was based upon the first permanent structure on the property to become flooded.

5.2 BCA for Bridge Street Bridge Replacement

The design, permitting, and construction costs and the flood reduction benefits of the replacement of the Bridge Street bridge are summarized in Table 5-1.

TABLE 5-1
Summary of Costs and Benefits – Bridge Street Bridge Replacement

Benefit Summary	
Total Benefits: Water Surface Reductions	$440,474
Total Cost of Bridge Replacement	$4,175,000
BCR	**0.11**

5.3 BCA for Floodplain Enhancement

The design, permitting, and construction costs and the flood reduction benefits of Floodplain Enhancement Scenario 2c are summarized in Table 5-2. Floodplain Enhancement Scenario 2d or other similar scenarios would result in a similar benefit BCR.

TABLE 5-2
Summary of Costs and Benefits – Floodplain Enhancement Scenario 2c

Benefit Summary	
Total Benefits: Water Surface Reductions	$147,811
Total Cost of Floodplain Enhancement	$1,520,000
BCR	**0.10**

5.4 BCA for Combination Scenarios

The design, permitting, and construction costs and the flood reduction benefits of a combined Bridge Street bridge replacement and Floodplain Enhancement Scenario 2c are summarized in Table 5-3. Table 5-4 is a summary of the combined scenario with the assumption that the Bridge Street bridge has been replaced with a hydraulically adequate structure. This scenario assumes that Greene County, NYSDOT, or some other funding entity has replaced the bridge as part of a normal replacement cycle. The cost of the new bridge is not included in the BCA, but the value of the flood reduction benefit is attributed to the project.

TABLE 5-3
Summary of Costs and Benefits – Bridge Replacement/Floodplain Enhancement Combination

Benefit Summary	
Total Benefits: Water Surface Reductions	$572,591
Total Cost of Floodplain and Bridge	$5,695,000
BCR	**0.10**

TABLE 5-4
Summary of Costs and Benefits – Bridge Replacement/Floodplain Enhancement Combination

Benefit Summary*	
Total Benefits: Water Surface Reductions	$572,591
Total Cost of Floodplain Enhancement	$1,520,000
BCR	**0.38**

*assumes that Bridge Street bridge has been replaced with a hydraulically adequate structure with cost of bridge replacement borne by another funding agency

5.5 BCA for Individual Properties

A BCA was conducted to evaluate the economic feasibility of flood mitigation measures, which may include elevation of structures, floodproofing, or acquiring properties under a buyout program so that their respective structure or structures could be removed from the floodplain. Recommendations for individual structures are included in Section 6.

The Flood Module component of the BCA analyzes proposed mitigation projects based on flood hazard conditions of riverine flood sources. The Flood Module is designed for evaluating individual buildings within a project and is used when flood hazard information and structural data are available.

It is important to note that the LFA/BCA process is a planning exercise to identify flood risks and possible mitigation efforts. BCR results in this study are dependent on the FEMA HEC-RAS models as well as the best possible information available regarding real property. Therefore, BCR values should be viewed in the context of proximity to waterbodies, hydraulic modeling, and local topography.

6.0 FINDINGS AND RECOMMENDATIONS

The purpose of this LFA is to evaluate potential flood mitigation options within the town and village of Hunter. This area experienced flooding during Tropical Storm Irene in 2011. A range of flood mitigation alternatives were evaluated, including the replacement of undersized bridges, floodplain enhancement, replacement of undersized culverts, and relocation or floodproofing of floodprone homes and businesses. Flood mitigation alternatives were evaluated using hydraulic modeling.

6.1 Flood Mitigation Recommendations

The following flood mitigation recommendations are offered:

6.1.1 Bridges

Seven bridges were evaluated using hydraulic modeling. The following recommendations are offered.

Bridge Street Bridge over Schoharie Creek:

- This bridge was found to be undersized, acting as a hydraulic constriction during the 10-year flood event and greater. The bridge overtops during the 50-year flood event and greater and contributes to flooding of buildings along Bridge Street and Main Street.
- Replacement of the bridge with an appropriately sized structure is recommended.
- It is recommended that the village work with Greene County to prioritize design and replacement of the bridge and secure funds.
- It is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge meets NYSDOT design criteria.

Hunter Mountain Bridge over Schoharie Creek:

- The bridge was found to be undersized, acting as a hydraulic constriction during the 50-year flood event and greater. The bridge overtops during the 50-year flood event and greater and contributes to flooding of buildings in the vicinity of the bridge along Main Street.
- The bridge consists of two structures, one of which has historic significance and is the gateway to Hunter Mountain.
- When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria.
- Increasing the capacity of the culvert located adjacent to the bridge would have a minimal effect on flooding, would not be cost effective, and is not recommended.

Elka Park Road Bridge over Schoharie Creek:

- Hydraulic modeling indicates that this bridge is flanked to the left (south) during the 50-year flood event. The bridge deck is overtopped during the 100-year flood event. The bridge acts as a hydraulic constriction during the 50-year flood event and greater, causing a rise of approximately 2 feet at the upstream face of the bridge. The area upstream of the bridge is sparsely developed.

- When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria.
- A dam located in Schoharie Creek downstream of the Elka Park Road bridge is in poor condition and does not appear to perform a useful function. The dam has a tendency to accumulate woody debris, which under high-flow conditions could potentially back up water and contribute to elevated water surface conditions at the bridge. Removal of the dam is recommended.

Deming Road Bridge over Schoharie Creek:

- Observations during Tropical Storm Irene indicate that the bridge was flanked to the left, overtopping the roadway approach to the bridge. Hydraulic modeling indicates that the bridge deck overtops during the 50-year flood event and greater. The bridge acts as a hydraulic constriction during the 50-year flood event and greater causing a rise of approximately 2.8 feet at the upstream face of the bridge. The area upstream of the bridge is sparsely developed, and no structures are flooded.
- When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new bridge meets NYSDOT design criteria.

Pedestrian Bridge over Schoharie Creek:

- Observations indicate that this bridge did not overtop during Tropical Storm Irene. Hydraulic modeling indicates that the bridge deck overtops during the 100-year flood event and greater. The bridge acts as a hydraulic constriction during the 100-year flood event and greater causing a rise of approximately 6 feet at the upstream face of the bridge. The area upstream of the bridge consists primarily of forested floodplain.
- Closure of the bridge is recommended when major floods are forecast.
- If and when the bridge is slated for replacement, the new bridge should be designed to pass the 100-year flood event with no rise in water surface elevations.

6.1.2 Bridge and Road Closures

Flooding of bridges and roadways during flood events has been reported at several locations. Approximately 75 percent of all flood fatalities occur in vehicles. Shallow water flowing across a flooded roadway can be deceptively swift and wash a vehicle off the road. Water can conceal a washed out section of roadway or bridge. When a roadway is flooded, travelers should not take the chance of attempting to cross the flooded area. It is not possible to tell if a flooded road is safe to cross just by looking at it.

- It is recommended that risks associated with the flooding of bridges and roadways be reduced by temporarily closing floodprone roads during flooding events. This requires effective signage, road closure barriers, and consideration of alternative routes.

6.1.3 Culverts

Three culverts on tributaries to Schoharie Creek were evaluated. The following recommendations are offered.

Mad Brook at Main Street:

- This culvert was found to be undersized, passing the 25-year flow but not the 50-year flow.
- It is recommend that the existing culvert be replaced with a new culvert sized to pass the 50-year flow.
- Initial modeling indicates that a 13-foot x 5-foot concrete box culvert will be required.
- A full hydraulic analysis is recommended.
- Periodic removal of sediments from the culvert is recommended.
- Realignment of Mad Brook to eliminate the hard bend downstream of Main Street is recommended.
- Utilities are present at the culvert and will increase project design and construction costs.

Mad Brook at Glen Avenue:

- Hydraulic modeling indicated that this culvert is undersized and does not pass the 25-year flow.
- It is recommend that the culvert be replaced with a new culvert sized to pass the 50-year flow.
- Initial modeling indicates that a 9-foot x 5-foot concrete box culvert or a 10-foot x 5-foot corrugated metal arch will be required.
- A full hydraulic analysis is recommended.

Ski Bowl Culvert:

- This culvert was found to be undersized, passing the 25-year flow but not the 50-year flow.
- Greene County has indicated that the culvert is scheduled for replacement in 2019 with a design that passes the 50-year flow. The channel design will include check dams to control sediment.

6.1.4 Floodplain Enhancement

A range of floodplain enhancement scenarios was evaluated along Schoharie Creek.

- Floodplain Enhancement Scenario 2c or 2d is recommended.
- It is recommended that the village continue to work with landowners to find an amenable approach.
- It is recommended that floodplain enhancement be combined with realignment of the Mad Brook channel to eliminate the hard bend and redirect the alignment across the floodplain to Schoharie Creek.

6.1.5 Dam Removal

As discussed under Section 6.1.1, the dam located in the Schoharie Creek channel downstream of the Elka Park Road bridge is in poor condition and does not appear to perform a useful function. The dam has a tendency to accumulate woody debris, which under high-flow conditions could potentially back up water and contribute to elevated water surface conditions at the bridge. Removal of this dam is recommended.

6.1.6 Critical Facilities

Critical facilities are public facilities such as a firehouse, school, town hall, drinking water supply treatment or distribution facility, or wastewater treatment plant or collection facility which if destroyed or damaged would impair the health and/or safety of the community. The following recommendations are offered to reduce flooding at critical facilities.

Hunter Firehouse

- Hydraulic modeling indicates water depths of 3.5 feet at the Hunter Firehouse during the 100-year flood event.
- Replacement of the Bridge Street bridge (recommended above) would alleviate flooding at the Hunter Firehouse.
- The current location of the firehouse may be an obstacle to bridge replacement.
- It is recommended that relocation of the firehouse out of the SFHA be considered.

Village Hall

- Hydraulic modeling indicates water depths of 1.1 feet at the Village Hall during the 100-year flood event.
- Replacement of the Bridge Street bridge (recommended above) would alleviate flooding.
- Floodproofing is recommended as an interim measure. See below for further explanation of floodproofing options.

Post Office

- Hydraulic modeling indicates water depths of 3.2 feet at the Village Hall during the 100-year flood event.
- Replacement of the Bridge Street bridge (recommended above) would alleviate flooding.
- Floodproofing is recommended as an interim measure. It should be noted that a structural assessment of the building will be required due to flooding depths exceeding 2 to 3 feet.

6.1.7 Anchor Businesses

Hardware Store

- Hydraulic modeling indicates water depths of 1.0 foot during the 100-year flood event.
- Replacement of the Bridge Street bridge (recommended above) would alleviate flooding.
- Floodproofing is recommended as an interim measure.

6.1.8 Structures within FEMA Floodway

Several structures, some occupied and some abandoned, were identified that are located within or partially within the floodway. The floodway designated by FEMA is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. Structures located fully within the floodway are at high risk of flooding while those located partially within the floodway may be less at risk. The following recommendations are offered for the FEMA floodway:

- It is recommended that decisions about relocations out of the floodway take place on a case-by-case basis depending on the elevation and location of each structure and each structure's past history of flood damage.

- Where there is owner interest and programmatic funding available, move existing structures out of the FEMA-designated floodway.

- Elevation of structures in the floodway is not advisable but may be considered on a case-by-case basis as property owners approach the FAC or town/village boards about mitigation options.

- It is recommended that stockpiled fill material be removed from the floodway.

- It is recommended that proposed new development in the floodway not be permitted or that a "no rise" certification be required for proposed new development or placement of fill in the floodway.

6.1.9 Floodprone Structures within FEMA SFHA

The SFHA is the area inundated by flooding during the 100-year flood event.

- It is recommended that the town and village work to flood proof or relocate the most flood-vulnerable properties where there is owner interest and programmatic funding available through flood buyout and relocation programs. The two flow charts below provide decision-making guidance for nonresidential (Figure 6-1) and residential (Figure 6-2) properties.

- It is recommended that the town and village identify priority areas and structures that are prone to most frequent and deepest flooding. Figure 6-3 shows the boundaries of the FEMA floodway in Hunter and also highlights areas along Main Street where flooding depths may exceed a 2-foot depth during the 100-year flood event. These areas should be considered the highest priority for individual flood protection measures.

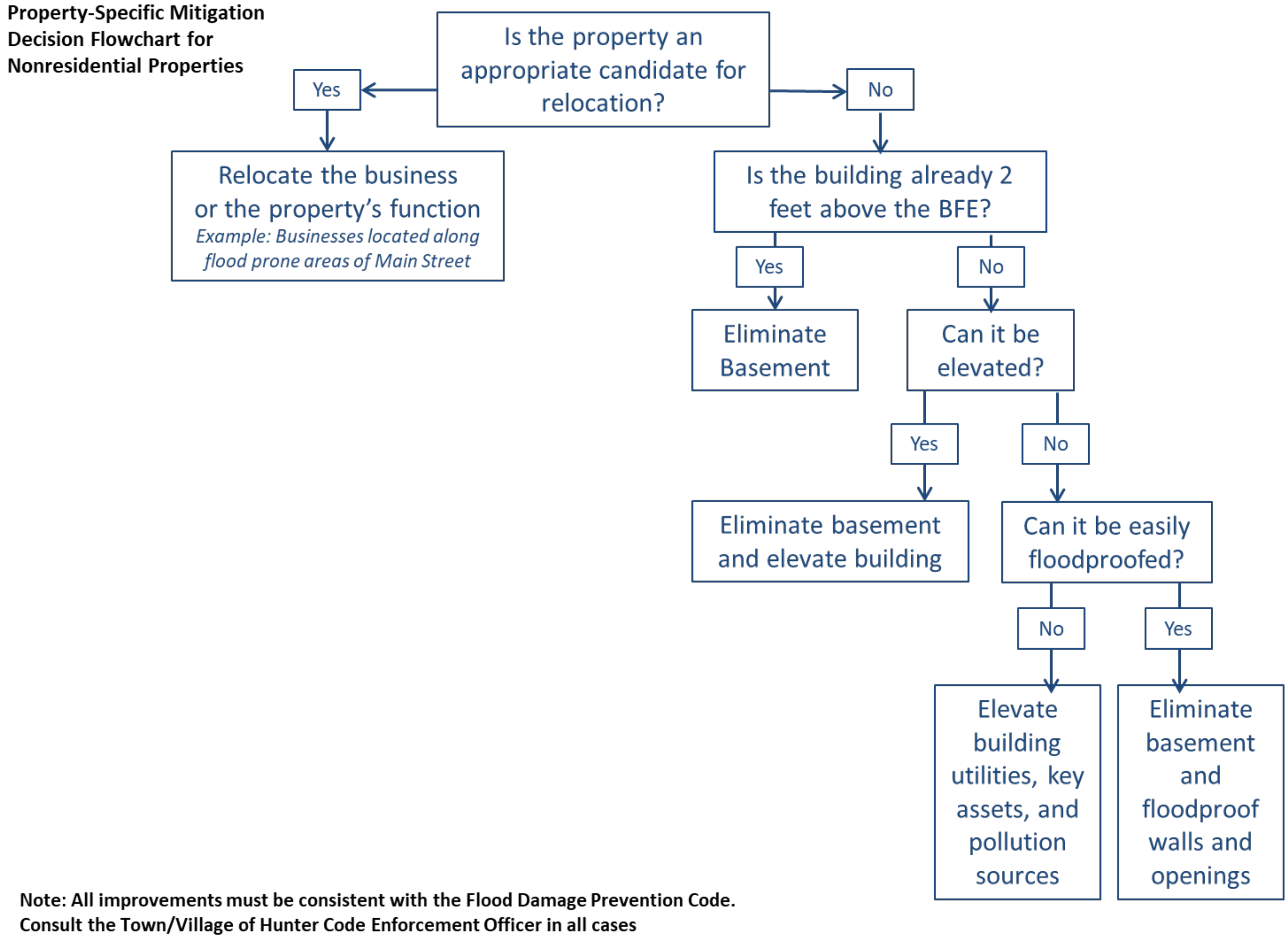
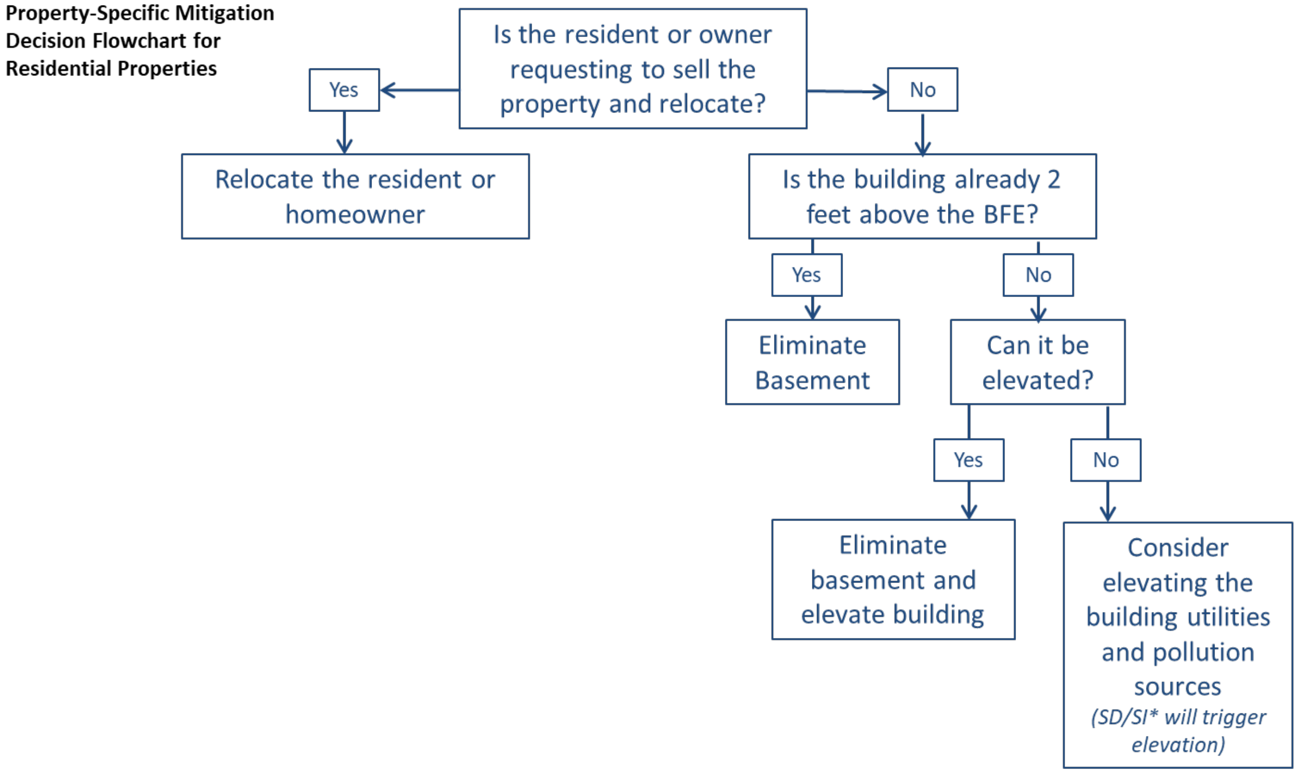


Figure 6-1
Property-Specific Mitigation for Nonresidential Properties



*Substantial Damage/Substantial Improvement

Note: All improvements must be consistent with the Flood Damage Prevention Code.
Consult the Town/Village of Hunter Code Enforcement Officer in all cases

Figure 6-2
Property-Specific Mitigation for Residential Properties

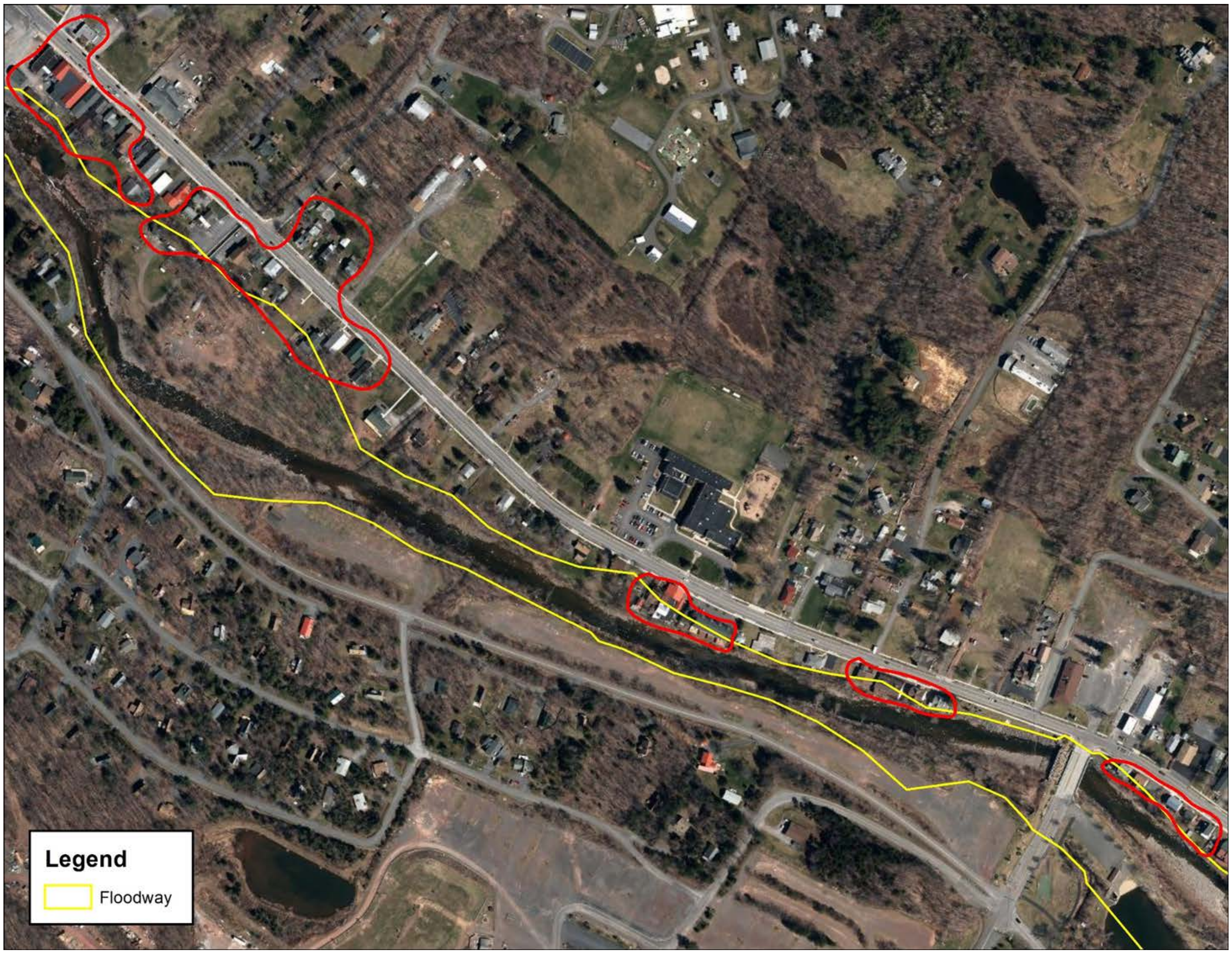


Figure 6-3
Map Depicting FEMA Floodway and Areas Prone to Flooding Depth of Greater Than 2 Feet during 100-Year Flood

Some of the homes in the SFHA are rarely flooded. Residents and businesses may benefit from minor individual property improvements. Providing landowners with information regarding individual property protection is recommended.

In areas where properties are vulnerable to flooding, improvements of individual properties and structures may be appropriate. All practices to protect property within a floodplain must comply with local flood law and obtain the approval of the town or village floodplain administrator or code enforcement officer. Potential measures for property protection include the following:

> Elevation of the structure – Home elevation entails the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located 2 feet or more above the level of the 100-year flood event (Figure 6-4). The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the first-floor level or installed from basement joists or similar mechanism at an elevation no less than 2 feet above the BFE.

Figure 6-4
Example of an Elevated Structure

Construction of property improvements such as barriers, floodwalls, and earthen berms – Such structural projects can be used to prevent shallow flooding. There may be properties within the village where implementation of such measures will serve to protect structures. Such barriers must not be permitted unless designed by a qualified engineer and shown to comply with NFIP/local floodplain laws.

Dry floodproofing of the structure to keep floodwaters from entering – Dry floodproofing refers to the act of making areas below the flood level watertight. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents would be either permanently closed or covered with removable shields. Flood protection should extend only 2 to 3 feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water.

Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded – Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures. Wet floodproofing should only be used as a last resort. If considered, furniture and electrical appliances should be moved away or elevated above the 100-year flood elevation.

Performing other home improvements to mitigate damage from flooding – The following measures can be undertaken to protect home utilities and belongings:

- Relocate valuable belongings above the 100-year flood elevation to reduce the amount of damage caused during a flood event.
- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the BFE (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
- Anchor the fuel tank to the wall or floor with noncorrosive metal strapping and lag bolts.
- Install a backflow valve to prevent sewer backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor and elevate electric outlets to at least 12 inches above the high water mark.

Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs – While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. Property owners should be encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

6.1.10 Anchoring of Fuel Tanks

It is recommended that sources of man-made pollution be reduced or eliminated through the relocation or securing of fuel oil and propane tanks.

6.1.11 Water Quality

In addition to helping communities identify and mitigate flood hazards, the LFA program mandate includes protecting water quality in the New York City water supply watershed. In order to protect water quality during flood events, MMI recommends the following:

- Take action to reduce flooding at the Hunter Fire Station either through Bridge Street bridge replacement or relocation outside the SFHA in order to prevent pollutants from coming in contact with floodwaters.
- Effort should be made to identify additional parcels that could benefit from securing or relocating fuel tanks to eliminate a potential source of man-made pollution and apply for funding through the CWC (http://cwconline.org/fhmi-program-flood-analysis-relocation-assistance-fuel-tank-anchoring).
- Equipment that has the potential to be washed away in a flood (e.g., generators, snowmobiles, ATVs, construction equipment, etc.) should be securely anchored, housed in a shed/garage, or stored outside the 100-year flood boundary.

6.1.12 Stream Gauging Station

USGS gauges should be used by town and village officials, emergency responders, and residents as an alert system to predict flooding. The distance between Hunter and the USGS gauge on Schoharie Creek in Lexington is quite far, making accurate recording of stage and discharge in Hunter difficult. Many of the USGS stream gauges within the New York City water supply watershed are funded through a cooperative agreement between USGS and NYCDEP. Over the last decade, the number of stream gauges funded by NYCDEP has reduced. While the installation cost is not typically an issue for agencies, the yearly maintenance costs can be prohibitive. Local cost sharing agreements are likely to be more appealing to agencies operating these stream gauge networks. It is recommended that the town work with NYCDEP and USGS to explore the possibility of the installation of a stream gauge on Schoharie Creek in Hunter. A crest or staff gauge should be considered as a lower-cost alternative.

6.1.13 Procedural Recommendations

- The Town and Village of Hunter Flood Damage Prevention Laws should be strictly enforced.
- The village Hunter adopted a local Flood Damage Prevention Law as local law No. 3 in 2015. The law should be made widely available. The law can be placed on the Village's website along with the Zoning and Subdivision laws to increase awareness of the law.
- It is recommended that the town and village government staff seek training regarding the content and implementation of the law. This will allow the government staff to successfully disseminate information regarding the law to the public and to implement the law accurately.
- It is recommended that the town and village gather and file flood-related lost revenue information as provided by businesses.
- It is recommended that the town and village record and compile municipal, county, and state costs related to cleanup and recovery.
- During and after future floods, it is recommended that high water marks be recorded throughout the town and village.

6.2 Funding Sources

Several funding sources may be available for the implementation of recommendations made in this report. Table 6-1 lists potential funding sources. These and other potential funding sources are discussed in more detail below.

TABLE 6-1
Potential Funding Sources for Flood Mitigation Alternatives

Recommendation	Federal	State	Other
Replace Bridge Street bridge with an appropriately sized structure.		Bridge NY	CWC, SMIP-FHM*
Replace three undersized culverts along Mad Brook and Shanty Hollow Brook.		Bridge NY	SMIP-FHM*
Work with landowners to enact Floodplain Enhancement Scenario 2c or 2d.			CWC/SMIP-FHM*
Eliminate hard bend in Mad Brook downstream of Main Street.			SMIP-FHM*
Remove dam downstream of Elka Park Road bridge.			SMIP-FHM*
Relocate Hunter Firehouse out of SFHA.	FEMA		CWC/NYC Buyout
Install floodproofing at critical facilities and anchor businesses.	FEMA		CWC
Floodproof or relocate the most flood-vulnerable properties where there is owner interest.	FEMA		CWC/NYC Buyout
Anchor fuel tanks.			CWC
Install stream gauging station.	USGS		NYCDEP

*Stream Management Implementation Program Flood Hazard Mitigation Grants

Stream Management Implementation Program Flood Hazard Mitigation Grants (SMIP-FHM)

FHM is a funding category in the SMIP for LFA communities and those participating in the NY Community Reconstruction Program. Municipalities may apply to implement one or more recommendations contained in their LFA and approved by the municipal board. All projects must have modeled off-site flood reduction benefits. Eligible projects include the following:

- Design/construction of floodplain restoration and reconnection
- Design/construction of naturally stable stream channel dimensions and sediment transport processes
- Design/construction of public infrastructure to reduce water velocity, flow path, and/or elevation
- Correction of hydraulic constrictions

Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; routine annual maintenance; or replacement of privately owned bridges, culverts, or roads. Municipalities must apply to the Stream Management Program in their respective counties. Contact information is as follows:

Greene County Soil and Water Conservation District
907 Greene County Office Building
Cairo, NY 12413
Phone: (518) 622-3620

New York City Funded Flood Buyout Program

The New York City Funded Flood Buyout Program (NYCFFBO) is a voluntary program intended to assist property owners who were not eligible for or chose not to participate in the FEMA flood buyout program. It is intended to operate between flood events, not as an immediate response to one. Categories of eligible properties include the following:

1. Properties identified in community LFAs
2. Anchor businesses, critical community facilities, and LFA-identified properties applying to the CWC for relocation assistance
3. Properties needed for a stream project
4. Erosion hazard properties
5. Inundation properties

Risk assessments and BCA are required for these purchases. Municipalities may choose to own and manage the properties after they are purchased and cleared of structures. Conservation easements must be given to NYSDEC, and there are limits to what may be placed on these parcels. Allowed structures are public restrooms served by public sewers or by septic systems whose leach field is located outside the 100-year floodplain or open-sided structures.

The NYCFFBO is governed by the Water Supply Permit and the Property Evaluation and Selection Process document (Process document). Communities work through Outreach and Assessment Leads appointed by the municipality to inform potential applicants about the program and evaluate the eligibility of properties based on the program criteria established in the Process document.

Local Flood Hazard Mitigation Implementation Program

The CWC funds LFA-recommended projects to prevent and mitigate flood damage in the West of Hudson watershed, specifically to remedy situations where an imminent and substantial danger to persons or properties exists or to improve community-scale flood resilience while providing a water quality benefit.

Municipalities and individual property owners may apply directly to the CWC. Municipalities may apply for grants for projects identified in an LFA or New York Rising planning process.

Eligible LFA-derived projects could include the following:

- Alterations to public infrastructure that are expected to reduce/minimize flood damage
- Private property protection measures such as elevation or floodproofing of a structure
- Elimination of sources of man-made pollution such as the relocation or securing of fuel oil/propane tanks
- Stream-related construction (Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; or annual maintenance.)
- Relocation assistance for a residence or business recommended by an LFA to a location within the same town or village

Property owners may apply for the following assistance:

- Funds for relocation assistance of an anchor business. Anchor businesses must be located in a floodplain in a watershed hamlet where an LFA has been conducted though their relocation does NOT have to be recommended in the LFA. They include gas stations, grocery stores, lumberyard/hardware stores, medical offices, or pharmacies which if damaged or destroyed would immediately impair the health and/or safety of a community.
- Funds for relocation of critical community facilities, such as a firehouse, school, town hall, public drinking water treatment or distribution facility, or wastewater treatment plant or collection system which if destroyed or damaged would impair the health and/or safety of a community. Facilities must have been substantially damaged by flooding. They do NOT have to be recommended by an LFA but MUST be located in an LFA community.
- Funds for assistance to relocate homes and/or businesses within the same town where the NYCFFBO covers purchase of former property (does NOT have to be in an LFA community)
- Stream debris removal after a serious flood event (does NOT have to be recommended in an LFA)

Sustainable Community Planning Program

This CWC program is for municipalities that have prepared LFAs. It is intended to fund revisions to local zoning codes or zoning maps or to upgrade comprehensive plans in order to identify areas within those municipalities that can serve as new locations for residences and/or businesses to be moved after purchase under the voluntary NYCFFBO. Grants of up to $20,000 are available through this program, part of the CWC's Local Technical Assistance Program. The CWC program rules can be accessed by clicking the 'Flood Hazard Mitigation Program Rules' link found here: http://cwconline.org/fhmi-program-overview

Emergency Watershed Protection Program (EWP)

Through the EWP program, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) can help communities address watershed impairments that pose imminent threats to lives and property. Most EWP work is for the protection of threatened infrastructure from continued stream erosion. NRCS may pay up to 75 percent of the construction costs of emergency measures. The remaining costs must come from local sources and can be made in cash or in-kind services. EWP projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.

FEMA Pre-Disaster Mitigation (PDM) Program

The PDM program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through PDM planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. The PDM program is subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

FEMA Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.

The HMGP is one of the FEMA programs with the greatest potential fit to potential projects in this LFA. However, it is available only in the months subsequent to a federal disaster declaration in the State of New York. Because the state administers the HMGP directly, application cycles will need to be closely monitored after disasters are declared in New York.

FEMA Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and SRL properties have been modified.
- Cost-share requirements have changed to allow more federal funds for properties with RFC and SRL properties.
- There is no longer a limit on in-kind contributions for the nonfederal cost share.

One limitation of the FMA program is that it is used to provide mitigation for *structures* that are insured or located in SFHAs. Therefore, the individual property mitigation options described in this LFA are best suited for FMA funds. Like PDM, FMA programs are subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

NYS Department of State

The Department of State may be able to fund some of the projects described in this report. In order to be eligible, a project should link water quality improvement to economic benefits.

U.S. Army Corps of Engineers (USACE)

The USACE provides 100 percent funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services Program (FPMS). Specific programs used by the USACE for mitigation are listed below.

- Section 205 – Small Flood Damage Reduction Projects: This section of the 1948 Flood Control Act authorizes the USACE to study, design, and construct small flood control projects in partnership with nonfederal government agencies. Feasibility studies are 100 percent federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent nonfederal match. In certain cases, the nonfederal share for construction could be as high as 50 percent. The maximum federal expenditure for any project is $7 million.

- Section 14 – Emergency Stream Bank and Shoreline Protection: This section of the 1946 Flood Control Act authorizes the USACE to construct emergency shoreline and stream bank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and nonprofit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- Section 208 – Clearing and Snagging Projects: This section of the 1954 Flood Control Act authorizes the USACE to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- Section 206 – Floodplain Management Services: This section of the 1960 Flood Control Act, as amended, authorizes the USACE to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of floodprone structures. When funding is available, this work is 100 percent federally funded.

In addition, the USACE provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and postflood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

Other Potential Sources of Funding

New York State Grants – All New York State grants are now announced on the NYS Grants Gateway (a direct link is in the "Links Leaving DEC's Website" section of the right-hand column of this page). The Grants Gateway is designed to allow grant applicants to browse all NYS agency anticipated and available grant opportunities, providing a one-stop location that streamlines the way grants are administered by the State of New York.

Bridge NY Program - The Bridge NY program, administered by NYSDOT, is open to all municipal owners of bridges and culverts. Projects are awarded through a competitive process and support all phases of project development. Projects selected for funding are evaluated based on the resiliency of the structure, including such factors as hydraulic vulnerability and structural resiliency; the significance and importance of the bridge including traffic volumes, detour considerations, number and types of businesses served and impacts on commerce; and the current bridge and culvert structural conditions. https://www.dot.ny.gov/BRIDGENY.

Community Development Block Grant (CDBG) – The Office of Community Renewal administers the CDBG program for the State of New York. The NYS CDBG program provides financial assistance to eligible cities, towns, and villages in order to develop viable communities by providing affordable housing and suitable living environments as well as expanding economic opportunities principally for persons of low and moderate income. It is possible that the CDBG funding program could be applicable for floodproofing and elevating residential and nonresidential buildings depending on eligibility of those buildings relative to the program requirements.

Empire State Development – The state's Empire State Development program offers loans, grants, and tax credits as well as other financing and technical assistance to support businesses and encourage their growth. It is possible that the program could be applicable for floodproofing, elevating, or relocating nonresidential buildings depending on eligibility of those businesses relative to the program requirements.

Private Foundations – Private entities such as foundations are potential funding sources in many communities. The Town and Village of Hunter and FAC members will need to identify the foundations that are potentially appropriate for some of the actions proposed in this report.

In addition to the funding sources listed above, other resources are available for technical assistance, planning, and information. While the following sources do not provide direct funding, they offer other services that may be useful for proposed flood mitigation projects.

Land Trust and Conservation Groups – These groups play an important role in the protection of watersheds including forests, open space, and water resources.

As the recommendations of this LFA are implemented, the Village and Town of Hunter will need to work closely with potential funders to ensure that the best combinations of funds are secured for the modeled alternatives and for the property-specific mitigation such as floodproofing, elevations, and relocations. It will be advantageous for the town to identify combinations of funding sources in order to reduce its own requirement to provide matching funds.

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APPENDIX A

FAC Meeting Minutes

MILONE & MACBROOM

MEMORANDUM

TO: Hunter Flood Advisory Committee

FROM: Milone & MacBroom, Inc.

RE: Hunter LFA FAC Kick-Off Meeting

DATE: February 28, 2018

MMI #: 2884-10

A kick-off meeting for the Hunter Local Flood Analysis (LFA) was held on the evening of February 28, 2018 at the Hunter Village Hall. In attendance were Mark Carabetta, Ellen Hart and Miguel Castellanos from Milone and MacBroom (MMI), as well as members of the Hunter Flood Advisory Committee (FAC). FAC members included representatives from the Village and Town of Hunter, the Catskill Watershed Corporation (CWC), the New York City Department of Environmental Protection (NYCDEP), the Green County Soil and Water Conservation District (GCSWCD), and local business owners and residents. The sign-in sheet is appended.

The purpose of the meeting was to:

- Review the study area
- Recap the LFA process and intended outcomes
- Collect information about flooding, flood damage and future village improvements
- Discuss next steps in the LFA process and set a date for the next meeting

The meeting began with introductions and a short presentation of the LFA process and intended outcomes. During the presentation, MMI discussed what is known about the flood history in Hunter, steps involved in an LFA and potential flood mitigation strategies. Flood mitigation strategies from other LFA studies in the Catskills were presented to provide examples of options that may be attempted in Hunter. The presentation slides are appended.

Following the presentation, members of the committee discussed their experiences with flooding. MMI provided large scale maps so that flood advisory members could identify areas where flood damage occurred. MMI staff collected information and took detailed notes.

The meeting included a discussion of next steps and setting a date for the first public meeting, where more information on flooding will be gathered. The meeting will take place in mid-April.

Following is a summary of notes collected at the meeting:

- The pedestrian bridge is for access to the Town Park. It is approximately 15 years old. There is scour near one of the abutments. Was a vehicle bridge in this location in the 1930s.

- The Botti Drive area is not within the 500-year floodplain, but it has been included in the study area because of frequent past flooding in the area. The flooding has been attributed to a tributary that appears to flow through a series of undersized culverts as the tributary passes Dolans Lane and Central Ave. At least one of the culverts was replaced with a larger culvert recently. There is a 90 degree bend in this tributary somewhere near Main St and before it joins with Schoharie Creek. A cutoff culvert was installed in 2006 to divert flows directly to Schoharie Creek.
- It was noted that any buyouts must be approved by the local municipality and also by the owner of the building/property as well.
- For the Bridge St bridge, Irene was the 1st time it overtopped. Other FAC members reported that the bridge has overtopped several times in the past.
- There was approximately 8 inches (others report 4") of water on the 1st floor of the fire house. The firehouse is a critical facility located within the SFHA.
- The Catskill Mountain Foundation owns buildings on either side of Main Street. The building on the Creek side of Main St, # 7971, experienced flooding in its basement during Irene. The building on the opposite side of Main St. did not experience any flooding.
- County Route 83 bridge (which is referred to locally as Hunter Mountain Bridge, Ski Bowl bridge (or maybe ski lift bridge) did overtop during Irene. Other FAC members report that the water hit the low beam of the bridge and then flanked to the right. This is a double bridge. The older bridge is used for walking and is an historic welded truss bridge. The newer bridge, used for cars, was raised up in 2004 or 2005. The older bridge did not overtop.
- Near the beach/park area there is a sub station and a sewer plant for the condos. The 'lake' is water that is used for snow making and emergency water supply.
- The more downstream lake is used for snowmaking.
- The Deming Road bridge flanked to the left during Irene and the road washed out (see Michelle's photo). The channel narrows down several hundred feet upstream of the bridge.
- New parking area and terminus of ski trail planned for Deming Road bridge area.
- Runnoff along Klein Avenue causes problems, roadways and gravel parking lots wash out.

<u>Comments tied to the Map:</u>

- #1 on map - Glen Avenue culvert backs up and causes flooding on Main Street.
- #2 Electric light dam – in disrepair
- #3 Former Tannersville Water Supply Dam. In disrepair. Believed to be no longer used.
- #4 - Maple Avenue used to experience frequent flooding from the lake overflowing during storm events. A ditch was excavated (before Irene) to increase outflow and the

lake is lowered in advance of a storm event. There is no longer flooding in this neighborhood and there was no flooding during Irene.

- #6 Evergreen contracting used to frequently get flooded. It is believed that a berm has been constructed to stop flooding. Across the stream from Evergreen there is a large bank failure. The bank failure is approximately 30 feet tall and is a large source of sediment.
- #8 is the proposed location for the fire house. It is JUST outside the 100-yr floodplain. A large amount of funding needs to happen before this will be built.
- # 9 is a sewer facility for the Village.
- # 10 is the Village Highway Dept.
- # 11 is a drinking water supply of some sort.
- For anchor businesses, there are 2 gas stations (Cumberland Farms and Valero Gas Station). Their associated markets are the only ‘grocery stores’ in the Village. There’s a hardware store at 7953 Main St.
- For critical facilities, the Hunter Tannersville Elementary School at 7794 Main St, Firehouse,
- Elka park road; downstream of bridge there’s a dam. Is the post office being flooded?

<u>Comments on Presentation and Maps:</u>

- Remove the Windham/GNH lumber example from the presentation.
- Use Leaf-off aerials for the map. Add tax parcels and impervious surface (i.e., bldgs.) layer (from DEP).
- Make a large map focused only on the Village so that it will be larger and make a 2nd map for the remainder of the study area.
- Please discuss the amount of funding that is available from the CWC for different types of projects. (John)

HUNTER FAC MEETING SIGN-IN SHEET

MILONE & MACBROOM

Project:	Tannersville-Hunter LFA #2884-10	**Meeting Date:**	2/28/18 @ 6:00PM
		Place/Room:	Hunter Village Hall

Name	Title	Company	Phone	E-Mail
Miguel Castellanos	Water Resources Engineer	MMI	(845)633-8153	mcastellanos@mminc.com
Mark Carabetta	Project Manager	Milone & MacBroom	"	mCarabetta@mminc.com
Charles Sweet	Supper	Village of Hunter	518 263 4690	
John Mathiesen	Environmental Engineering Spec.	CWC	845 586-1400	jmathiesen@cwconline.org
Carl Giangrande	Planning board member	Village of Hunter	518 653-7632	CARLGIANGRANDE@GMAIL.COM
GARY GOODRICH	PRESIDENT HUNTER FIRE CO.	HUNTER FIRE CO.	845-590-4201	GGOODRICH24@HOTMAIL.com
GERI MARINO	Trustee	S-Bird Hunter	518-965-3300	GERMAR4@AOL.COM
Alan Higgins	Mayor/Hunter	Village of Hunter	518-390-5830	alan.trec@me.com
Ben Sommers	VILLAGE RESIDENT NFD		518 263 4065	BARNOWL@HVC.RR.com
Michelle Yost	WAP Coordinator	GCSWCD	518-589-6871	michelle@gcswcd.com
Harold Goldberg	Village Hunter PB	Village Hunter	518 263 4053	unkshi@aol.com
PHIL ESKELI	FLOOD HAZARD MITIGATION	NYCDEP	845-340-7853	peskeli@dep.nyc.gov
Candy McKee	Director of Finance & Administration	Catskill mountain Foundation	(518)263-2020	mckeec@catskillmtn.org

MILONE & MACBROOM

MEMORANDUM

TO: Hunter Flood Advisory Committee

FROM: Milone & MacBroom, Inc.

RE: Hunter LFA Meeting

DATE: April 26, 2018

MMI #: 2884-10

The first public meeting for the Hunter Local Flood Analysis (LFA) was held on the evening of April 19, 2018 at the Hunter Village Library. In attendance were Mark Carabetta, Ellen Hart and Miguel Castellanos from Milone and MacBroom (MMI), as well as members of the Hunter Flood Advisory Committee (FAC). FAC members included representatives from the Village and Town of Hunter, the Catskill Watershed Corporation (CWC), the New York City Department of Environmental Protection (NYCDEP), the Green County Soil and Water Conservation District (GCSWCD), and local business owners and residents. Several members of the public were in attendance as well. The sign-in sheet is appended.

The purpose of the meeting was to:

- Review the study area
- Recap the LFA process and intended outcomes
- Collect information about flooding, flood damage and future village improvements
- Discuss next steps in the LFA process and set a date for the next meeting

The meeting began with introductions and a short presentation of the LFA process and intended outcomes. During the presentation, MMI discussed what is known about the flood history in Hunter, steps involved in an LFA and potential flood mitigation strategies. The presentation slides are appended.

Following the presentation, members of the committee and the public discussed their experiences with flooding. MMI provided large scale maps so that individuals could identify areas where flood damage occurred. MMI staff collected information and took detailed notes. The meeting included a discussion of next steps and setting a date for the next FAC meeting, where the results of the field visits and preliminary model results will be discussed, the flood mitigation options will be explained, and comments and feedback will be gathered.
The meeting will take place on June 4 at 7pm at the Hunter Village Hall.

Following is a summary of notes collected at the meeting:

- Deming bridge has been replaced once before
- West of Bridge Street bridge there were some channels that are no longer there.
- The only bridge that was accessible during Irene was the Rt 214 State Bridge.
- A house at 8007 Main St was flooded from waters coming off of Garfield Rd and not from Schoharie Creek, which it abuts. The Creek was approximately 5 ft below the first level of the house.
- Glen Ave culvert washed out during Irene and was replaced by GCSCWD.
- Glen Avenue, near Mama's Pizza and Mad Brook, is the location of a buried fiber optics line. The channel in this location cannot be deepened.

- The area behind the Doctorow Center (7971 Main St) has been negatively affected by past flood damage. One individual suggested that it is an area that could serve as a community park or community resource. It's on the creek side of Main St and a few buildings upstream of the Bridge St bridge.
- An individual requested that dredging and cleaning out the creek be considered.
- Residents note that trees get stuck behind the bridges during flooding condition. CWC representative noted that there is an emergency stream debris program to handle debris is the channel following a flood event. It was also noted that DEC offers an emergency stream disturbance permit following a large storm.
- There was a suggestion that increasing the size of the Bridge St bridge should be modelled to determine if that would stop flooding in that area.
- There is a rock wall just above the Bridge St. bridge
- There is currently a new slab on the creek side of the firehouse which is slated to be a new bay for the firehouse.
- On March 21, 1980 flood, a property upstream of the CR 83 bridge had huge log on stoop, which is an indication of the power of the flood flows. This was back when the CR 83 bridge was a single structure, that is now the pedestrian bridge. It has been flooded 2-3 times.

<u>Comments tied to the Map:</u>

A) Water leaves channels, undersized channel (interest in conducting culvert analysis)
B) Hard right turn (might have been there even pre-Irene)
C) Change in drainage ditch alignment. Previous channels were filled in and now drain to Schoharie creek in a more direct path. Drainage ditch now follow the red line drawn on the map.
D) Failure to drain the pond before Irene and it caused flooding on Maple Ave. Since then, ditching work has been done and there has not been any additional flooding. An individual mentioned that the outlet structure for the pond was a weir and that there's potential to raise it to impound more water. There is a concrete outlet structure. It's like a simple weir. It can be notched to further reduce flooding.
E) Dolans Lake is an emergency drinking water supply. There is a Creek coming off the mountain and feeding Dolan's Lake that is subject to flooding.
F) This is the location of a proposed, 30-lot subdivision development
G) Hunter Mountain is expanding with new ski trails, a new lodge, and 250-space parking lot located below Rusk Road. Deming road will be used for access and an entirely new road will be added for parking area. Part of Rusk Road will be removed to accommodate this expansion.
H) SWCD protected a pipe with 25ft of stacked rock.
I) There is stacked rock and sheet pile on the right bank to protect from bank erosion.
J) This is a major bank failure area. A berm was reportedly placed in this area, which probably lead to the bank failure on the other side of the creek.
K) Remnants of a concrete dam *Potential floodplain bench area*
L) "Zombie" properties, vacant, potential for floodplain work. Village may be interested in buyouts for these properties. Snowbird skiing supplies might be the only active business in this strip of abandoned buildings.
M) This is the limit of buyouts, near renovated condos that cannot be touched.

N) Hunter Village Square was flooded from the road.
O) Doctorow Center had water in its basement during Irene.

HUNTER PUBLIC MEETING SIGN-IN SHEET

MILONE & MACBROOM		Meeting Date:	04/19/18 @ 7:00PM
Project:	Tannersville-Hunter LFA #2884-10	**Place/Room:**	Hunter Public Library

Name	Address	Phone	E-Mail
Miguel Castellanos	231 Suite 102, New Paltz,	(845) 633-8153	mcastellanos@mminc.com
Ben Sommers	7862 RT 23A Hunter	518 263 4065	BARNOWL barnowl@HVC.RR.COM
Joe Gallagher	18 Division St Hunter, NY	518 263 4107	jgallagher66@hotmail.com
Gary Goodrich	99 Division St, Hunter, NY	845-590-4201	GGOODRICH24@HOTMAIL.COM
John Mathiesen	Margaretville	845 586-2400	jmathiesen@cwconline.org
Joel DuBois	GCSWCD	518-622-3620	joel@gcswcd.com
Phil Eskeli	NYC DEP	845 340-7853	peskeli@dep.nyc.gov
Karen Wright	PO Box 652, Hunter, NY	(914) 319-1799	karenwrightll@att.net
M Yost	GCSWCD	518-589-6871	michelle@gcswcd.com
Pam Weisberg	Catskill Mtn. Fndtn. 7971 Rt. 23A Hunter	518/263 2066	weisbergp@catskillmtn.org
Regina Johnson	Hunter Public Library Hunter, NY 12450	518-263-4655	hunterpubliclibrary@gmail.com
Ellen Hart	231 Main St, Ste 102 New Paltz, NY 12561	845-633-8153	ehart@mminc.com
Mark Carabetta	Milone & MacBroom, Inc. 231 Main St., New Paltz	845-633-8153	mcarabetta@mminc.com

MEMORANDUM

TO: Hunter Flood Advisory Committee
FROM: Milone & MacBroom, Inc.
RE: Hunter LFA FAC Meeting
DATE: June 4, 2018
MMI #: 2884-10

A meeting for the Hunter Local Flood Analysis (LFA) was held on the evening of June 4, 2018 at 7pm the Hunter Village Hall. In attendance were Mark Carabetta, Ethan Ely and Miguel Castellanos from Milone and MacBroom (MMI), as well as members of the Hunter Flood Advisory Committee (FAC). A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to discuss preliminary modeling results and discuss next steps. The modeling results included analysis of the following:

1. Seven bridges within the study area, on Schoharie Creek and Gooseberry Creek
2. Five floodplain enhancement scenarios along Schoharie Creek
3. Combinations of bridge improvements and floodplain enhancement scenarios
4. Three culverts on tributaries to Schoharie Creek

Discussion points are summarized below:

<u>General Topics</u>

Discussion of using gauge analysis to update/calibrate flows used in hydraulic model. Nearest USGA gauge on Schoharie Creek is located in Lexington, which has 19 years of peak flow data, not enough for a rigorous gauge analysis. The next nearest gauge is in Prattsville, which was judged to be too far from the project site. Therefore, the flows in the FEMA FIS were used in the model.

Discussion of accuracy and limitations of the FEMA hydraulic model, depth grid mapping process and LiDAR-derived digital elevation models.

In next set of maps, MMI will add line showing FEMA 100-year flood zone.

Discussion of locations of sanitary sewer pump stations and whether they are within Special Flood Hazard Area.

Discussion of storage of materials at fire house that could potentially contribute to water quality problems, if firehouse were to flood. Items include fuel, firefighting foam.

<u>Bridge Analysis</u>

Elka Park Road Bridge

- Modeling indicates that bridge overtops/flanks in 50- and 100-year flood events. Hydraulic constriction results in some rise at bridge, but not many structures along creek in this area.
- Suggestion to provide flood protection options for properties upstream of this bridge on the left bank (post office is in the 100-YR; Allen residence in the 500-YR zone).

NYS Route 214 Bridge

- Modeling indicates no problems at this bridge

Hunter Pedestrian Bridge

- Modeling indicates bridge passes 50-year but overtops in 100-year
- Causes water to back up during 100-year resulting in a 6-foot rise at bridge, which does not result in flooding of structures.

Hunter Mountain Bridge

- Hydraulic modeling indicates that the bridge is overtopped during the 50- and 100-year flood.
- Acts as a hydraulic constriction during the 50- and 100-year flood events.
- Comment that during Irene the bridge was closed and skiers coming down from Hunter Mountain could not cross.
- Suggestion of having existing outlet culvert to Dolan's Lake resized to convey a larger flow. This will be evaluated.

Bridge Street Bridge

- Backed up water/overtopped in Irene.
- Fire house was flooded by 6 inches of water. Had not flooded previously.
- Modeling shows bridge is overtopped during 50- and 100-year flood.
- Acts as a hydraulic constriction during the 10-, 50- and 100-year flood events. Substantial reductions in flooding if bridge and abutments are removed from model.
- Comment that there are utilities on bridge: gravity sewer (downstream side) and water main (upstream side).
- Comment that abutments jut out into creek, causing constriction.
- Comment that previous bridge was wider, not as high. Remnants of old abutments probably still visible in the field.
- Discussion of whether maps accurately reflect flooding that occurred in Irene.

Deming Road Bridge

- Modeling indicates that bridge overtops/flanks in 50- and 100-year flood events. Hydraulic constriction results in some rise at bridge, but not many structures along creek in this area.
- Comment that in photo used in presentation, the water that we see flanking the bridge is both from Schoharie and a side tributary that runs adjacent to the red barn.
- Comment that campers use the field.

Bloomer Road

- Modeling indicates no problems at this bridge

Floodplain Enhancement Scenarios

Five floodplain enhancement scenarios were evaluated at three locations along Schoharie Creek.

Scenarios 1a and 1b involved lowing overflow parking areas at Hunter Mountain.

- These scenarios would be costly, and Hunter Mountain is unlikely to be agreeable to giving up parking areas.
- Modeling indicates some reduction in flooding in the village, but not a large reduction and probably not cost effective.
- Portions of parking areas currently do not flood in 50- and 100-year events.
- Comment that old bridge is buried under parking area.

Scenarios 2a and 2b involve lowering an area of mostly vacant land (see map).

- Results showed some promise in reducing flooding along Main Street, worth exploring more closely.
- Comment that 4 property owners own this area. These properties might be eligible for flood acquisition. If recommended in the LFA as such, property owners can go forward with a "NYC Flood Buyout".
- Comment that this area would make a nice park.

Scenario 3 involves floodplain enhancement along right bank where there is now a row of buildings (some abandoned).

- Modeling indicates some reduction in flooding i, but not a large reduction and probably not cost effective.
- Suggestion that voluntary buyouts/flood protection options be made available to these landowners.

Combination Scenarios

The combination of improvements to/replacement of the Bridge Street Bridge and the floodplain enhancement scenario 2a or 2b shows real promise in reducing flooding of homes and businesses along Main Street in Hunter.

- This combination of scenarios will be examined more closely.
- MMI will conduct a field visit to examine channel and potential floodplain in this area.

Culvert Assessment

Mad Brook at Main Street

- Model indicates existing 9.9 x 5-foot, 4-sided concrete box culvert (with approximately 1 foot of sediment) overtops at 306 cfs. It passes the 25-year flow of 281 cfs but not the 50-year flow of 353 cfs.
- 13 x 5-foot concrete box culvert would pass 405 cfs, which exceeds the 50-year. Cleaning of sediment would also help.
- Comment that culvert has overtopped numerous times including during Irene.

- Comment that utilities cross under creek in this area (sewer line and water main), which limit depth of culvert.
- Comment that if culvert is upsized, narrow channel walls downstream of culvert would then become pinch point.
- Comment that 90-degree bend downstream of culvert contributes to flooding problems.
- Discussion of combining Floodplain Enhancement scenario 2 with relocating of Mad Brook to eliminate 90-degree bend.

Mad Brook at Glen Avenue

- Existing 6-foot diameter iron culvert overtops at 220 cfs and does not pass 25-year flow of 276 cfs.
- 7 x 5-foot concrete box culvert would pass 25-year.
- 9 x 5-foot concrete box culvert would pass 50-year (347 cfs).
- 10 x 5-foot corrugated metal arch would also pass 50-year.
- Comment that existing culvert has a drop at outlet, which prevents aquatic organism passage.
- Comment that this culvert overtops the road a few times every year.

Ski Bowl Culvert

- Existing 15.6 x 4.1-foot open bottom box culvert overtops at 527 cfs. It passes the 25-year flow of 437 cfs but not the 50-year flow of 549 cfs.
- 25-year design may be adequate if road receives low traffic flow and has alternate route.
- 18 x 4.1-foot concrete box culvert would pass 606 cfs, which exceeds the 50-year.
- Comment that snow melt from Hunter Mountain may contribute to flows here, which is not accounted for in *StreamStats* assessment of hydrology.
- Comment that house below culvert floods regularly.

Unnamed Tributary near School

- Reports indicate that culverts along this tributary have not been a problem since bypass to Schoharie Creek was installed.
- Suggestion that next culvert upstream of Main Street is partially block and requires maintenance.
- Comment that the channel itself near school may be undersized and creating a pinch point, even if culverts are adequately sized.

<u>Next Meeting Date</u>

Next FAC meeting date has been set for July 18 at 7pm at the Village Hall.

Suggestion that available members of the FAC meet at 5pm to tour the potential bridge improvement/floodplain enhancement sites prior to the meeting. More information to be provided.

HUNTER FAC MEETING SIGN-IN SHEET

MILONE & MACBROOM		Meeting Date:	06/04/18 @ 7:00PM
Project:	Tannersville-Hunter LFA #2884-10	**Place/Room:**	Hunter Village Hall

Name	Affiliation	E-Mail
Mark Carabetta	Milone & MacBroom	845-633-8153
Ethan Ely	Milone + MacBroom	845-633-8153
Alan Higgins	Village of Hunter	518-390-5830 alan.trec@me.com
Phil Eskeli	NYC DEP	845-340-7853
John Mathiesen	CWC	jmathiesen@cwconline.org
GARY GOODRICH	HUNTER FIRE CO	GGOODRICH24@HOTMAIL
Ben Sommers	VOH	barnowc@hvc.rr.com
Karen Wright	VOH	518 263-4065 karenwrightllc@att.net
GERI MARINO	Village of Hunter	GERMAR4@AOL.COM

MILONE & MACBROOM

MEMORANDUM

TO: Hunter Flood Advisory Committee
FROM: Milone & MacBroom, Inc.
RE: Hunter LFA FAC Meeting
DATE: July 18, 2018
MMI #: 2884-10

A meeting for the Hunter Local Flood Analysis (LFA) was held on the evening of July 18, 2018 at 7pm the Hunter Village Hall. In attendance were Mark Carabetta, Ethan Ely and Miguel Castellanos from Milone and MacBroom (MMI), as well as members of the Hunter Flood Advisory Committee (FAC). The group was joined by Stan Wase from the Greene County Highway Department, and by Wade Spanhake, Code Enforcement Officer for Hunter. A sign-in sheet and the presentation slides are appended.

A site walk was held immediately prior to the meeting. FAC members and MMI staff toured the site of floodplain enhancement scenario 2C which included the properties owned by Walter Higgins, Alan Higgins, and the Hebrew Congregation. Attendees of the site walk included MMI staff, Walter Higgins, Michelle Yost, Phil Eskeli, Joel DuBois, Wade Spanhake, Ben Sommers, and Stan Wase. After the FAC meeting, a visit was made to the Bridge Street bridge and firehouse.

The agenda for this FAC meeting was to discuss modeling results, preliminary BCA results, and next steps.

General Comments

- Comment was made that images of fire house and village hall showing water depths during flood events is very effective and that more buildings should be shown this way in final report. MMI replied that this can be done for public buildings such as post office and library, and possibly for hardware store which is an anchor business.
- Question was raised whether Route 23a is inundated by floodwaters anywhere between Hunter and Prattsville. This information may be helpful in calling attention to flooding along this state highway. MMI replied that this can be checked using FEMA FIRMs.
- Stan Waze reported that the Ski Bowl culvert is scheduled to be replaced in 2019. The culvert will most likely be sized to pass the 50-year flood event and possibly check dams will be placed in the channel to control sediment. MMI noted that this information will be included in the LFA report.
- In LFA report, the suggestion was made that recommendations for flood protection of individual properties should highlight specific areas where flooding is deeper and/or more frequent, such as along the south side of Main Street.

Bridge Street Bridge

- MMI shared hydraulic modeling and BCA results for replacing this bridge with a larger structure.
- MMI raised question of 15-ton weight limit posting at bridge. Do firetrucks exceed this limit? Gary Goodrich answered yes, some fire trucks are 19 tons. Stan Wase

commented that the bridge beams cannot be rated and there are no shop drawings available and therefore the weight limit posting may be arbitrary.

- Stan shared the most recent NYSDOT general bridge inspection report. The last inspection date is May 24, 2017. The bridge has not been red flagged.
- Stan also commented that the bridge has a low daily traffic count, has a nearby alternative crossing at Hunter Mountain bridge, and has no major structural issues, and is therefore not likely to be recommended as a priority for replacement by Greene County.
- Preliminary BCA results presented by MMI indicate benefits of $440,474 and costs of $4,175,000, resulting in a BCR of 0.11. The cost estimate is based on a proposed span of 150 feet, replacing the current span of 90 feet. The estimate includes $4,000,000 for bridge construction and $175,000 for design, geotechnical investigations and permitting.
- Stan commented that a pony truss bridge may be appropriate for this site because a low beam thickness can be maintained over a longer span. Cost may be lower than MMI's estimate. Maintaining a large enough hydraulic opening while limiting the need to elevate the road profile and not impact access to the firehouse may present a design challenge.

Floodplain Enhancement Scenario 2c

- MMI shared hydraulic modeling and BCA results for this scenario. The scenario differs from scenarios 2a and 2b in that it attempts to minimize the volume of material to be excavated and removed from the site, which is costly, while maximizing flood relief with the goal of removing flooding from Main Street during the 100-year flood event.
- Preliminary BCA results presented by MMI indicate benefits of $147,811 and costs of $1,520,000, resulting in a BCR of 0.10. The cost estimate includes design, permitting and construction, but does not include land acquisition costs because it is unclear at this point whether the project would require full acquisition or construction easements.
- Based on comments from the landowner stating the desire to continue to use the portion of the property with the building, a scenario 2d will be developed that eliminates the need to cut down the floodplain in this area. MMI will evaluate this alternative and present results at the next FAC meeting.

Combination Scenario

- MMI shared hydraulic modeling and BCA results for replacing the Bridge Street bridge with a larger structure and implementing floodplain enhancement scenario 2c.
- The combination shows real promise in eliminating flooding of Main Street.
- Preliminary BCA results presented by MMI indicate benefits of $572,591 and costs of $5,695,000, resulting in a BCR of 0.10.

Hunter Mountain Bridge

- Suggestion of having existing outlet culvert to Dolan's Lake resized to convey a larger flow. This will be evaluated.

Next Meeting Date

Next FAC meeting date has been set for August 21 at 7pm at the Village Hall.

The suggestion was made that available members of the FAC meet early to tour LFA areas prior to the meeting. More information to be provided.

HUNTER FAC MEETING SIGN-IN SHEET

MILONE & MACBROOM		**Meeting Date:**	06/18/2018 @ 7:00PM
Project:	Tannersville-Hunter LFA #2884-10	**Place/Room:**	Hunter Village Hall

Name	Affiliation	E-Mail
Karen Wright	WECS	karenwright11@att.net
GERI M MARINO	Village Board	germar4@aol.com
Joel DuBois	GCSWCD	joel@gcswcd.com
STAN WASE	G.C.H.D.	SWASE@DISCOVERGREENE.COM
PHIL ESKELI	NYCDEP	peskeli@dep.nyc.gov
BEN SOMMERS	VILLAGE BOARD	BARNOWL@HVC.RR.COM
GARY GOODRICH	HUNTER FIRE	GGOODRICH24@HOTMAIL.com
Mark Carabetta	MMI	mcarabetta@MMINC.com
Miguel Castellanos	MMI	mcastellanos@mminc.com
Wade SPANHaKe	Hunter Code	WSPANHaKe@yAHoo.COM
Ethan Ely	MMI	
Michelle Yost	GCSWCD	you have ☺

MILONE & MACBROOM

MEMORANDUM

TO: Hunter Flood Advisory Committee
FROM: Milone & MacBroom, Inc.
RE: Hunter LFA FAC Meeting
DATE: August 23, 2018
MMI #: 2884-10

A meeting for the Hunter Local Flood Analysis (LFA) was held on the evening of August 21, 2018 at 7pm the Hunter Village Hall. In attendance were Mark Carabetta and Miguel Castellanos from Milone and MacBroom (MMI), as well as members of the Hunter Flood Advisory Committee (FAC) and Stan Wase from the Greene County Highway Department. A sign-in sheet and the presentation slides are appended.

The agenda for this FAC meeting was to discuss modeling results, go through and discuss the flood mitigation recommendations, set a timeline for report review, and discuss next steps including setting a date for a public meeting to present LFA findings.

Discussion points are summarized below.

- For the recommended replacement of Bridge Street bridge, it was noted that bridge replacement will be unlikely to be funded at a municipal/county level and that state or federal funds would be required. It was also mentioned that expansion of the bridge could potentially put the fire house in a hole, and that a truss bridge could allow for more free board. Several funding sources where mentioned for the replacement of the bridge.

- Floodplain Enhancement Scenario 2d was presented, with similar flood reduction benefits as were seen under Scenario 2c. Question was asked on whether there exists any incentives/compensation for getting property owners to give up their land for floodplain restoration. Can become tricky when talking about giving up only a segment of a land parcel.

- Modeling results were discussed for installation of a larger culvert adjacent to the Hunter Mountain Bridge. This did not result in significant flood reduction and is not recommended.

- Flood mitigation recommendations included flood proofing at critical facilities. Key Bank in Phoenicia and a CVS in Margaretville were mentioned as good examples of flood proofing measures for businesses.

- It was mentioned that both the Hardware store and post office have basements. The BCA tool doesn't have a checkbox for basement for non-residential buildings. FFE was selected at the back of the buildings in the BCA model. Floodproofing of these buildings may be complicated since water won't be only coming from the front of the building, but rising up from the basement as well.

- There was discussion of how best to show properties that are most at risk of flooding. The “blob map” showing areas subject to greater than 2 feet of flooding during the Q100 may be a viable way to illustrate properties that could be eligible for a buyout, and should be followed with a narrative in the report (give options; buyout or elevate). The floodway line will be added to the map.

- There was discussion about whether Village of Hunter has a Flood Damage Prevention Law, which is an NFIP requirement. MMI to contact Clerk to obtain language.

- There was discussion of cost to install a USGS gauge. Installation cost is estimated to be $18,000 and yearly maintenance would be $18,000 (agreement between DEP and USGS). Suggestion that a crest or staff gauge be considered as a lower cost alternative.

- Suggestion that side tributaries should be mapped during next FEMA re-mapping.

- Suggestion that recommendations include removal or modification of old abandoned dam downstream of Elka Park Bridge.

- Suggestion that the funding table that was used in previous MMI LFA reports be used for the Hunter LFA report.

- Timeline for review of LFA report: MMI to issue first draft report to FAC members by September 7; deadline for review comments by September 21; final draft issued by October 5; public meeting to be scheduled in October; town/village adoption/acceptance in November or December.

- Michelle Yost will contact landowners with invitations to attend public meeting. Public meeting date TBD, either 10, 17, 24 or 30 of October. Location: TBD

HUNTER FAC MEETING SIGN-IN SHEET

MILONE & MACBROOM		Meeting Date:	08/21/2018 @ 7:00PM
Project:	Tannersville-Hunter LFA #2884-10	**Place/Room:**	Hunter Village Hall

Name	Affiliation	E-Mail
Mark Carabetta	MMI	mcarabetta@mminc.com
Karen Wright	Resident	karenwright11@att.net
PHIL ESKELI	NYC DEP	peskeli@dep.nyc.gov
STAN WASE	G.C.H.D.	SWASE@DISCOVERGREENE.COM
BEN SOMMERS	Village of Hunter	barnowl@HVC.RR.COM
GARY GOODRICH	HUNTER FIRE CO.	GGOODRICH24@HOTMAIL.COM
Michelle Yost	GCSWCD WAP	michelle@gcswcd.com
Miguel Castellanos	MMI	mcastellanos@mminc.com
John Mathiesen	CWC	jmathiesen@cwconline.org
GERI MARINO	Village of Hunter	GERMAR24@AOL.COM
Joel DuBois	GCSWCD	joel@gcswcd.com

HUNTER LFA MEETING SIGN-IN SHEET

MILONE & MACBROOM		Meeting Date:	10/24/2018 @ 7:00PM
Project:	Hunter LFA #2884-10	Place/Room:	Hunter Public Library

Name	Affiliation	Phone/E-Mail
Mark Carabetta	Milone & MacBroom	845-633-8153 mcarabetta@mminc.com
Ben Sommers	Village of Hunter	518-263-4065 btrnowl@hvc.rr.com
Phil Eskeli	NYC DEP	845-340-7853 peskeli@dep.nyc.gov
Geri Marino	Village Board	518-965-3300 GERMAR4@AOL.COM
Gary Goodrich	Hunter Fire Co.	GGOODRICH24@HOTMAIL.COM
Carol Sluzky-Jenerowicz	Hunter Synagogue	littlebirdarts46@gmail.com

APPENDIX B

Benefit Cost Analysis

Hunter LFA BCA Results

BRIDGE REMOVAL		FLOODPLAIN ENHANCEMENT		COMBINED SCENARIOS	
Building Number	**Benefits**	**Building Number**	**Benefits**	**Building Number**	**Benefits**
7856	*Negligible?*	7856	$ 13,956	7856	$ 13,954
7862	*Negligible?*	7862	$ 13,129	7862	$ 13,129
7867	*Negligible?*	7867	$ 11,568	7867	$ 11,568
7872	*Negligible?*	7872	$ 10,094	7872	$ 10,094
7879	*Negligible?*	7879	$ 14,888	7879	$ 14,888
7883	*Negligible?*	7883	$ 2,967	7883	$ 2,967
7887	*Negligible?*	7887	$ 6,371	7887	$ 6,371
7889	*Negligible?*	7889	$ 5,940	7889	$ 5,940
7896	*Negligible?*	7896	$ 11,424	7896	$ 11,424
7902	*Negligible?*	7902	$ 14,455	7902	$ 14,455
7903	*Negligible?*	7903	$ 27,498	7903	$ 27,498
7907	$ 15,521	7907	$ 15,521	7907	$ 15,521
7910	$ 7,043	7910	*Negligible?*	7910	$ 7,043
7913	$ 9,287	7913	*Negligible?*	7913	$ 9,116
7917	$ 26,162	7917	*Negligible?*	7917	$ 26,162
7925	$ 12,258	7925	*Negligible?*	7925	$ 12,258
7931	$ 7,467	7931	*Negligible?*	7931	$ 7,467
7933	$ 5,820	7933	*Negligible?*	7933	$ 5,820
7935	$ 7,862	7935	*Negligible?*	7935	$ 7,862
7941	$ 6,548	7941	*Negligible?*	7941	$ 6,548
7943	$ 7,162	7943	*Negligible?*	7943	$ 7,162
7947	$ 6,308	7947	*Negligible?*	7947	$ 6,308
7949	$ 4,089	7949	*Negligible?*	7949	$ 4,089
7950	$ 37,166	7950	*Negligible?*	7950	$ 37,166
7953	$ 7,658	7953	*Negligible?*	7953	$ 7,658
7955	$ 7,999	7955	*Negligible?*	7955	$ 7,999
7959	$ 19,304	7959	*Negligible?*	7959	$ 19,304
7961	$ 4,864	7961	*Negligible?*	7961	$ 4,864
7965	$ 3,849	7965	*Negligible?*	7965	$ 3,849
7971	$ 142,399	7971	*Negligible?*	7971	$ 142,399
7974	$ 9,203	7974	*Negligible?*	7974	$ 9,203
7975	$ 12,047	7975	*Negligible?*	7975	$ 12,047
7979	$ 17,262	7979	*Negligible?*	7979	$ 17,262
17	$ 53,716	17	*Negligible?*	17	$ 53,716
12	$ 9,480	12	*Negligible?*	12	$ 9,480
TOTAL BENEFITS	$ 440,474	**TOTAL BENEFITS**	$ 147,811	**TOTAL BENEFITS**	$ 572,591
BRIDGE DESIGN COST ESTIMATE	$ 175,000	**FLOODPLAIN COST ESTIMATE**	$ 1,520,000	**COMBINED COST ESTIMATE**	$ 5,695,000
BRIDGE REPLACEMENT ESTIMATE	$ 4,000,000	**BCR**	$ 0.10	**BCR**	$ 0.10
BCR	$ 0.11				

If DOT paid for BOTH design and construction

TOTAL BENEFITS	$ 572,591
ESTIMATED TOTAL COST	$ 1,520,000
BCR	$ 0.38

PROPERTY ACQUISITION BCA

Building Number	Benefits
7747	$ 14,054
7751	$ 5,495
7753	$ 10,733
7755	$ 4,836
7756	$ 11,657
7759	$ 5,748
7765	$ 4,127
7748	$ -
7752	$ 12,380
6	$ 5,158
CONDOS	N/A
7791	$ 8,023
7799	$ 13,327
7809	$ 12,574
7817	$ 6,151
Total Benefits:	$ 114,263

KEY:

: North of main street but in 100-yr Flood Zone

Cost Analysis for Floodplain Enhancement Scenario FP2c

Total area of floodplain (acres)		5.1
Area of Forest (acres)		2.8
Soil removed for FP (cf)		1,221,730.0
Soil removed for FP (cy)		45,249.3
Excavation costs ($4/CY)	$	180,997
Export costs ($20/CY)	$	904,985
Clearing Forest ($10,000/ac)	$	28,426
Topsoil cost ($25/CY), assume 0.5ft topsoil	$	102,347
Seedmix cost ($0.75/SF)	$	165,802
Design/Permitting	$	137,443
Total Cost	**$**	**1,520,000**

It is estimated that Floodplain Enhancement Scenario FP2d or other similar scearios would have a similar cost

Cost Estimate for Replacement of Bridge Street Bridge

Bridge Construction	$	4,000,000
Design/Geotech/Permitting	$	175,000

Notes and assumptions:
Assume concrete deck
150 foot span
Detour required
low risk of scour
may need to raise road elevation due to thicker beam
Greene County suggests truss style bridge at lower cost
Cost estimate does not include relocation of Fire House
utilities water and gravity sewer on bridge
current bridge has posted 15 ton limit