Local Flood Analysis

Village of Tannersville
Greene County, New York
January 2018

Milone & MacBroom

Engineering | Planning | Landscape Architecture | Environmental Science

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Prepared for:
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ABBREVIATIONS/ACRONYMS

BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
CDBG	Community Development Block Grant
CFS	Cubic Feet per Second
CRS	Community Rating System
CWC	Catskill Watershed Corporation
CY	Cubic Yards
DEM	Digital Elevation Model
DPW	Department of Public Works
EWP	Emergency Watershed Protection
FAC	Flood Advisory Committee
FEMA	Federal Emergency Management Agency
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
GIS	Geographic Information System
HEC-HMS	Hydrologic Engineering Center – *Hydrologic Modeling System*
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 Resource Conservation Service
NWIS	National Water Information System
NYCFFBO	New York City Funded Flood Buyout Program
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
PDM	Pre-Disaster Mitigation
RFC	Repetitive Flood Claims
SFHA	Special Flood Hazard Area
SMIP	Stream Management Implementation Program
SMP	Stream Management Plan
SRL	Severe Repetitive Loss
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WI/PWL	Waterbody Inventory/Priority Waterbodies List
WSEL	Water Surface Elevation

EXECUTIVE SUMMARY

The Village of Tannersville has retained Milone & MacBroom, Inc. to complete a Local Flood Analysis in the Village of Tannersville. A Local Flood Analysis 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. The flood analysis focuses on Gooseberry Creek, Sawmill Creek, and Allen Brook.

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 Mountain Top Library at the beginning of the Local Flood Analysis process. Attendees were provided with an overview of the project, the Local Flood Analysis 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 historic 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 areas were identified within the project area as being prone to flooding during flood events. Alternatives were developed and assessed at each area where flooding is known to have caused extensive damage to homes and properties.

A number of flood mitigation approaches to reduce water surface elevations were evaluated. The following is a summary of flood mitigation recommendations. More detailed descriptions of the recommendations are provided in Section 6.0 of this report.

- The relocation of the Village of Tannersville Highway Department garage out of the Special Flood Hazard Area (SFHA) (commonly referred to as the 100-year floodplain) is recommended. The facility is located within the SFHA and was flooded in Tropical Storm Irene with substantial damage to the structure. In addition to eliminating flood risks at the facility, the relocation would also result in benefits to water quality by removing potential pollutants from floodprone areas.

- The Main Street bridge over Sawmill Creek was found to be undersized, and it overtops during the 50-year flood event. When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge is adequately sized. The bridge should be inspected for sediment aggradation at least every 1 to 2 years and also immediately following flood events. When removal of sediment at the bridge is necessary, a methodology should be developed to maintain the proper channel dimensions and slope. This is crucial to avoid destabilizing the physical channel, which could have long-term effects. More details are provided in Section 6.0 of this report.

- It is recommended that a channel assessment and, if necessary, bank stabilization be undertaken in Sawmill Creek upstream of the bridge to reduce channel instability and input of woody debris.

- The Railroad Avenue bridge over Sawmill Creek is capable of passing the 10-year flood event but overtops in the 50-year flood event. When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the bridge opening is adequately sized and that the new bridge spans the channel and floodplain.

- Bridges along Gooseberry Creek were assessed and found to overtop during the 10- or 25-year discharge events. None of these bridges were found to contribute to flooding of structures. When each bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that these bridge openings are adequately sized.

- If plans to pursue the construction of pedestrian bridges over Sawmill Creek move forward, hydraulic analysis is recommended to ensure that the structures do not contribute to flooding in the village. The following guidelines are offered:

    - Any new bridge should pass a 100-year storm with a margin of safety.
    - The bridge abutments should not encroach upon the Federal Emergency Management Agency (FEMA) regulatory floodway.
    - The bridge should span the floodplain as well as the channel.

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

- An engineering analysis of the embankment of Sawmill Creek along Railroad Avenue and implementation of bank stabilization measures are recommended.

- A range of floodplain enhancement scenarios were evaluated along Sawmill Creek. These did not result in significant reductions in flooding and are not recommended.

- The use of Lake Rip Van Winkle for stormwater storage purposes is not recommended.

- 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 out of the FEMA-designated floodway.
  - Disallow new development in the floodway and require new construction within the Special Flood Hazard Area to meet National Flood Insurance Program criteria.
  - Disallow elevation of existing structures in the floodway.

- For properties located within the Special Flood Hazard Area, it is recommended that the 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 to mitigate damage from flooding
  - Encouraging property owners to purchase flood insurance under the National Flood Insurance Program and to make claims when damage occurs

- Floodprone manufactured homes should be elevated on a permanent foundation such that the lowest floor is elevated to or above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.

- 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 FEMA develop mapping of the SFHA and floodway along Allen Brook and the tributary to Allen Brook using detailed engineering methods.

- It is recommended that the village gather and file flood-related lost revenue information as provided by businesses.

- It is recommended that the 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 village.

A number of potential funding sources are identified in Section 6.0 of this report. As the recommendations of this Local Flood Analysis are implemented, the Village of Tannersville 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 village to identify combinations of funding sources in order to reduce its own requirement to provide matching funds.

1.0 INTRODUCTION

1.1 Project Background

The Village of Tannersville in conjunction with the Town of Hunter and 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 Milone & MacBroom, Inc. (MMI) to complete two Local Flood Analysis (LFA) reports. The work under this agreement is being segmented into two project components beginning with the Village of Tannersville study area followed by the Village of Hunter/Town of Hunter study area. The two study areas are collectively referred to as the Hunter Corridor Communities.

The focus of this LFA report is the Village of Tannersville. The LFA builds upon Federal Emergency Management Agency (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, or the NYCDEP-funded Buyout Program. A more detailed list of potential funding sources is provided in this report.

1.2 Study Area

The Village of Tannersville LFA project study area includes Gooseberry Creek, Sawmill Creek, and Allen Brook as well as the area around the Tops Supermarket Plaza on State Route 23. The largest stream in this project area is Gooseberry Creek, which is a tributary of Schoharie Creek. The stream originates in hills located just north and east of the Village of Tannersville. Gooseberry Creek first flows south where it passes under State Route 23A. It continues south for about a half mile before turning and flowing to the west along the southern edge of the Village of Tannersville. After leaving the village, Gooseberry Creek flows for approximately 1.4 miles before reaching Schoharie Creek. Two additional watercourses of interest are Sawmill Creek and Allen Brook. These streams have their headwaters in the hills north of the village. Both streams flow in a southerly direction and pass under Main Street (State Route 23A). Figure 1-1 depicts the Tannersville LFA project area.

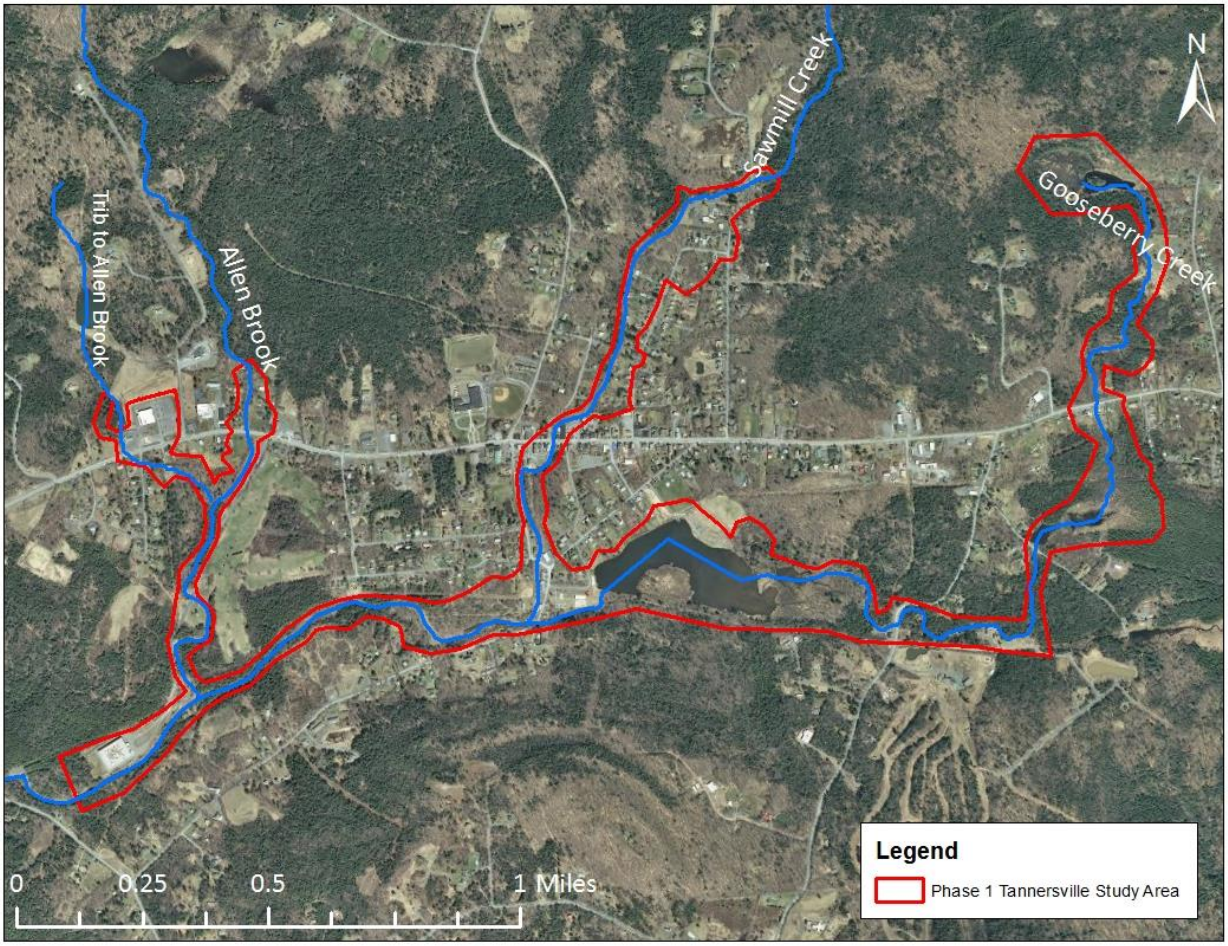

Figure 1-1
Village of Tannersville LFA Project Study Area

In regard to Gooseberry Creek, the project boundary begins a half mile upstream of the intersection of State Route 23A and County Route 25 and ends immediately downstream of the Village of Tannersville waste water treatment plant. The project area also extends approximately 1.1 miles up Sawmill Creek and 1.3 miles up Allen Brook from their confluences with Gooseberry Creek. The effective watershed area measured from the wastewater treatment plant is 9.3 square miles.

Within the Village of Tannersville, the main flood risk is along the Sawmill Creek corridor from the bridge crossing Spring Street to the confluence with Gooseberry Creek. At the upper extent of the project area, the stream flows south along the western edge of Spring Street and Park Lane with homes situated on the east bank of the stream. A field visit and review of FEMA floodplain mapping indicate that many of the homes are well within the 100-year floodplain. As Sawmill Creek approaches the Tannersville business district on Main Street, it is tightly confined by infrastructure and businesses. Near the confluence with Gooseberry Creek, the 100-year flood extent floodprone area broadens with many structures on Railroad Avenue and South Main Street at risk of inundation.

1.3 Community Involvement

The Tannersville LFA was undertaken in close consultation with the 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 Tannersville LFA process to review results and provide input on flood mitigation alternatives (Figure 2-1). Meeting minutes are appended to this report. The group members include representatives from the following organizations:

- Village of Tannersville
- Town of Hunter
- The Hunter Foundation
- Tannersville Residents and Business Owners
- Greene County Soil & Water Conservation District
- New York City Department of Environmental Protection
- Catskill Watershed Corporation
- Milone & MacBroom, Inc.

A public meeting was convened at the Mountain Top Library in Tannersville on June 6, 2017, to introduce the LFA process to members of the community and to solicit information regarding flooding and flood damages within the village. A follow-up public meeting is planned at the conclusion of the study to present final results.

Figure 1-2
Flood Advisory Committee Members Discuss Flood Mitigation Alternatives
July 13, 2017, FAC Meeting at Mountain Top Library

1.4 Nomenclature

In order to provide a common standard, FEMA's National Flood Insurance Program (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 Special Flood Hazard Area (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 1-3 illustrates the SFHA, floodway, and flood fringe on a typical channel cross section.

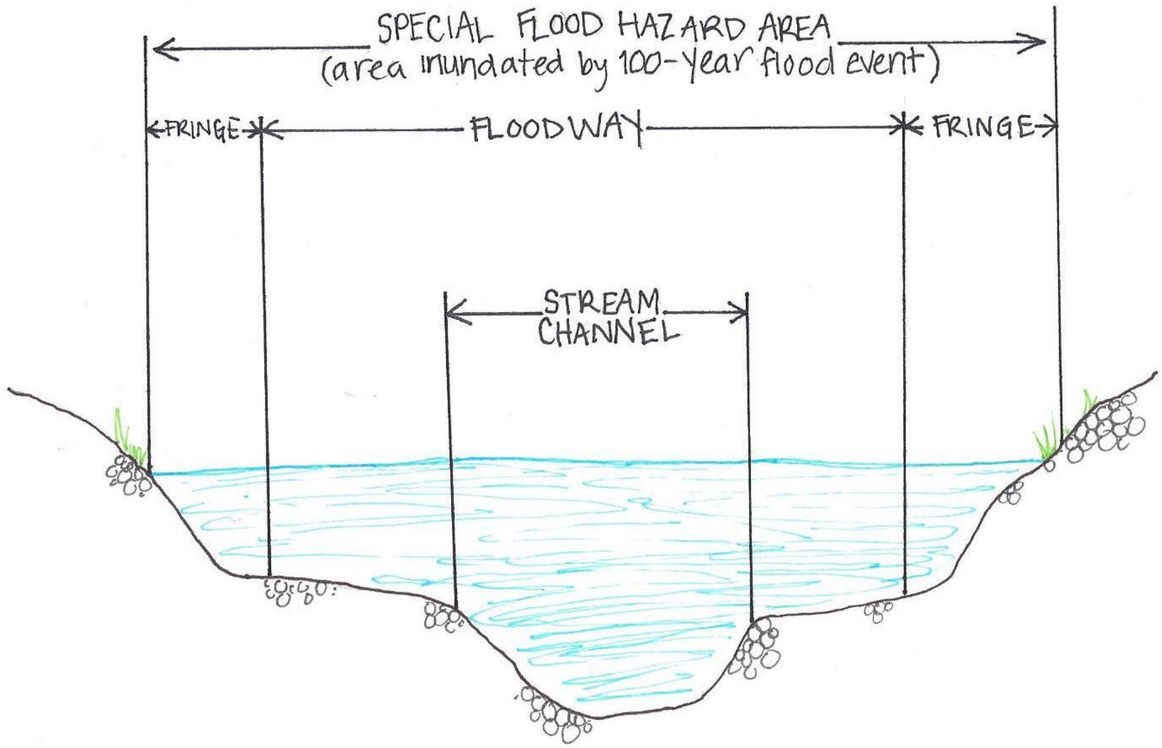

Figure 1-3
Special Flood Hazard Area, Floodway, and Flood Fringe

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 meeting held in the Village of Tannersville. A summary of key documents follows.

Flood Insurance Study (FIS)

FEMA has produced a Flood Insurance Study (FIS) dated June 2, 2015, for Greene County. The purpose of the FEMA study is to determine potential floodwater elevations and delineate existing floodplains in order to identify flood hazards and establish insurance rates. The FIS includes detailed studies of Gooseberry Creek and Sawmill Creek. Although the FIS mentions that an approximate hydrologic analysis was conducted for Allen Brook and the tributary to Allen Brook, no data regarding either stream is included in the FIS. The hydrologic and hydraulic analyses for Sawmill Creek were completed during the May 16, 2008, revision of the current FIS while the Gooseberry Creek analysis was completed during the June 2, 2015, revision.

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. Detailed HEC-RAS models were created for Gooseberry Creek and Sawmill Creek. Models created for Allen Brook and the tributary to Allen Brook used approximate methods and are characterized by the following:

- No survey is conducted to characterize the channel and overbank areas.
- Bridges and culverts are modeled as weirs/inline structures.
- The only modeled discharge is the 100-year event.

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 streams of interest to the Village of Tannersville LFA (Gooseberry Creek, Sawmill Creek, and Allen Brook) are located within the Schoharie Creek watershed, they are not discussed in this SMP.

USGS Stream Gauging Network

The United States Geological Survey (USGS) does not operate any stream flow gauges on Sawmill Creek, Gooseberry Creek, or Allen Brook. 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 floodflows 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.

Hazard Mitigation Plans

The purpose of hazard mitigation plans is to identify policies and actions that will reduce risk in order to limit losses to 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 National Flood Insurance Program (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).

Greene County Multijurisdictional All-Hazard Mitigation Plan

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 postdisaster 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 Village of Tannersville. 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 waterbodies 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.

There are four watercourses in the project area: Gooseberry Creek, Sawmill Creek, Allen Brook, and a tributary to Allen Brook. All of these streams were classified by the NYSDEC as a Class C (TS) waterbody with the exception of a segment of Gooseberry Creek that becomes Lake Rip Van Winkle, which is a Class B waterbody. Class C waterbodies are suitable for support of aquatic life and noncontact activities but not as water supply. The additional TS classification indicates that the watercourse may support trout spawning. Class B denotes that this waterbody is suitable for swimming and other contact recreation but not for drinking water.

The Mohawk River Waterbody Inventory/Priority Waterbodies List (WI/WPL) provides water quality assessment data for waterbodies in the Mohawk River Basin. This document can be found online at http://www.dec.ny.gov/chemical/36739.html. A macroinvertebrate assessment of Gooseberry Creek indicated nonimpact conditions. These results are consistent with sampling conducted in 2000 and reflect a significant improvement over an assessment conducted in 1986 that found impacts due to chlorine toxicity from the Tannersville waste water treatment plant. The Mohawk River WI/WPL notes that the tributaries to Allen Brook and Lake Rip Van Winkle were not assessed for water quality. Sawmill Creek and Allen Brook are not included in the document.

None of the watercourses in the Tannersville LFA study area are listed in the 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

The Village of Tannersville has adopted a local code for flood damage prevention. It was adopted by the village on August 11, 2015, and filed with the New York Department of State (NYSDOS) on August 25, 2015. The present code is consistent with the federal guidelines, a requirement for participation in the NFIP.

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 that are involved in the accommodation of floodwaters

- Control filling, grading, dredging, and other development that may increase erosion or flood damages
- Regulate the construction of flood barriers that will unnaturally divert floodwaters or which may increase flood hazards to other lands
- Qualify and maintain for participation in the NFIP

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 Village Code Enforcement Officer is empowered as the Local Administrator and is responsible for administering and implementing the local Flood Damage Prevention code. 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 their 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 and is 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% annual chance flood zone, Zone A indicates the approximated 1% annual chance flood zone, Zones AE and A1-30 indicate the calculated 1% annual chance flood zone, Zone AH is a 1% 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 base flood elevation 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 base flood elevation. 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.

2.2 Field Assessment

During the LFA process, MMI staff conducted numerous field visits to the project area. Field visits were carried out during spring and summer 2017 and focused on two areas: (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 Gooseberry Creek, Sawmill Creek, Allen Brook, and the tributary to Allen 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).

2.3 Watershed Land Use

The project area is located within the Gooseberry Creek watershed, which itself is situated in the larger watershed of Schoharie Creek. 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.

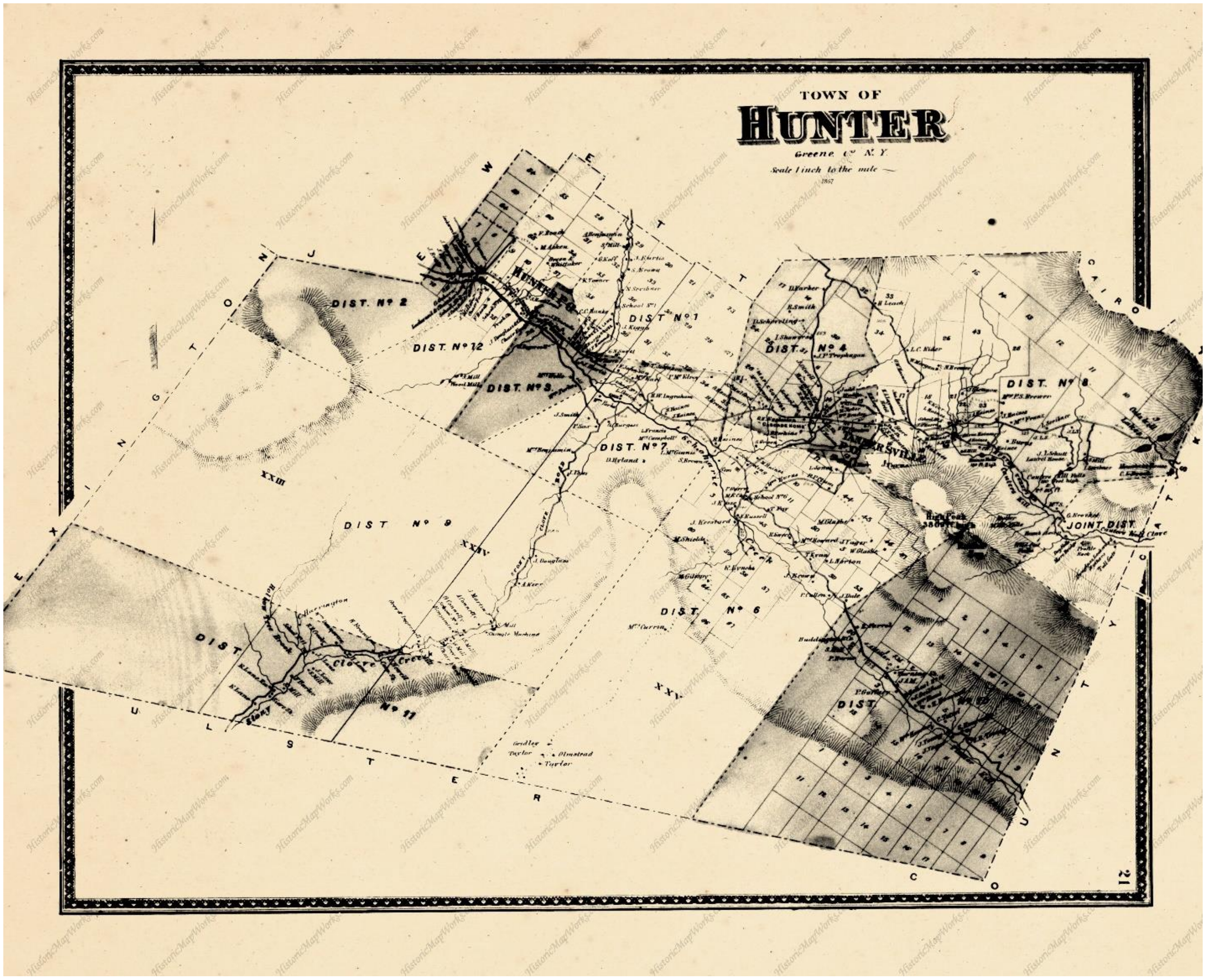

Figure 2-1
Historic Map of Hunter and Tannersville

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). Within the Gooseberry Creek watershed, the USGS *StreamStats* program estimates a forest cover of 91.6 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 the Main Street/Route 23A corridor.

2.4 Watershed and Stream Characteristics

The effective area of the Gooseberry Creek watershed is 9.3 square miles with a northeast to southwest 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 subwatersheds of Sawmill Creek, Allen Brook, and the tributary to Allen Brook have respective areas of 3.2 square miles, 2.7 square miles, and 0.3 square miles. Figure 2-2 depicts these watersheds as well as the project study area.

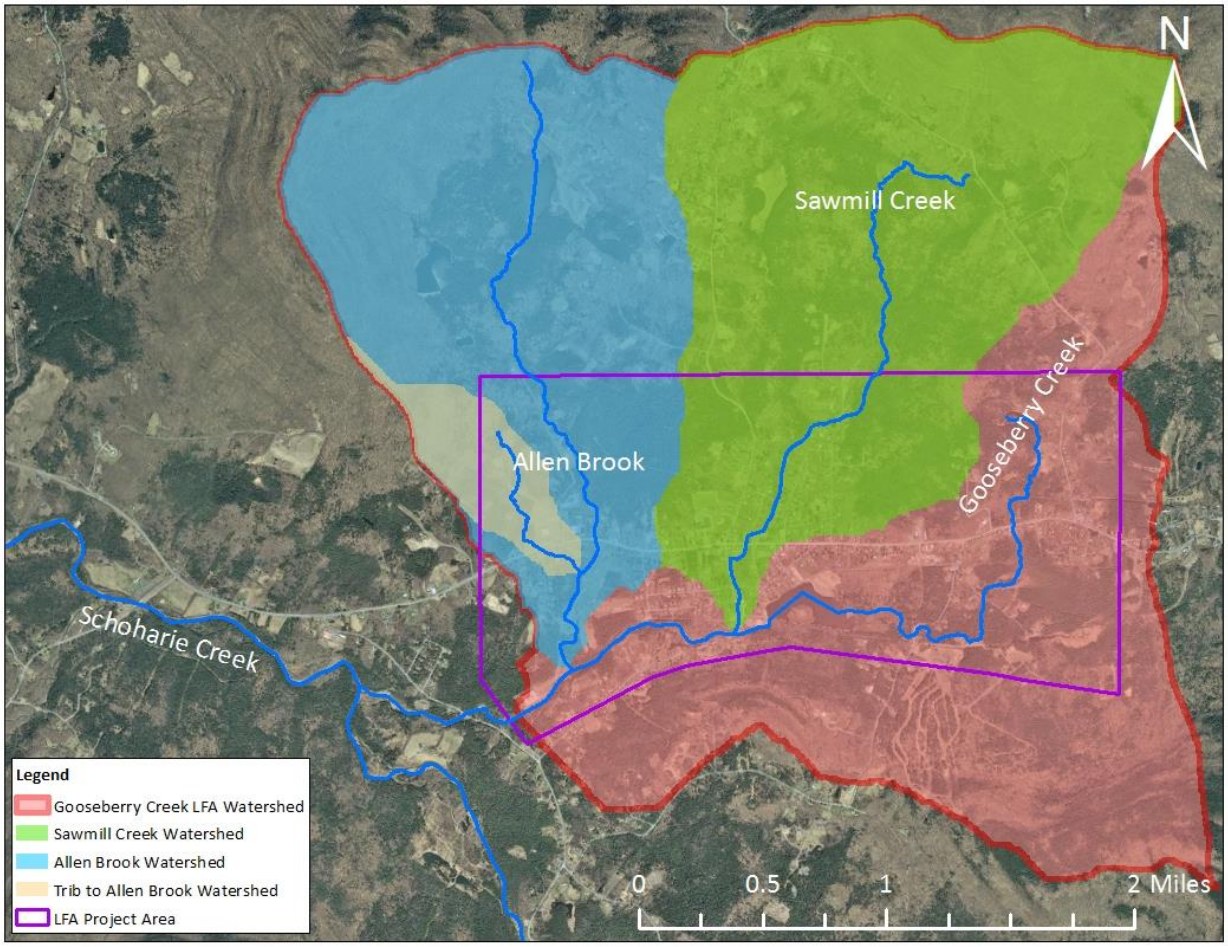

Figure 2-2
Gooseberry Creek Effective Watershed Area for the Village of Tannersville LFA

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 four watercourses: Gooseberry Creek, Sawmill Creek, Allen Brook, and the tributary to Allen Brook. These watercourses all have their headwaters in the hillslopes north of the Village of

Tannersville. While the largest watercourse is Gooseberry Creek, it does not pose the largest flood risk as it flows through an area of relatively low population density with few structures located directly along its banks. Sawmill Creek is the second largest stream and the primary source of flood-related damages in the project area. Sawmill Creek flows through the population center of the village including the main business district with numerous structures along the banks that are at risk of flooding. Allen Brook and its tributary are relatively small streams. Although both of them pass under Main Street, they have not been reported as a significant cause of flood-related damages.

From its headwaters north and east of the Village of Tannersville, Gooseberry Creek flows south, then makes a sharp turn after passing under Route 23A to the east of Clum Hill Road and flows west into Lake Rip Van Winkle. After emerging on the western shore of Lake Rip Van Winkle, Gooseberry Creek stays to the south of Main Street in the village and continues to flow west before joining with Schoharie Creek. Gooseberry Creek extends approximately 4.3 miles. Figure 2-3 is a longitudinal profile of Gooseberry Creek. A longitudinal profile of a river depicts the change in elevation of the channel between two points thereby showing the rate of change in slope, or gradient, for a certain distance downstream.

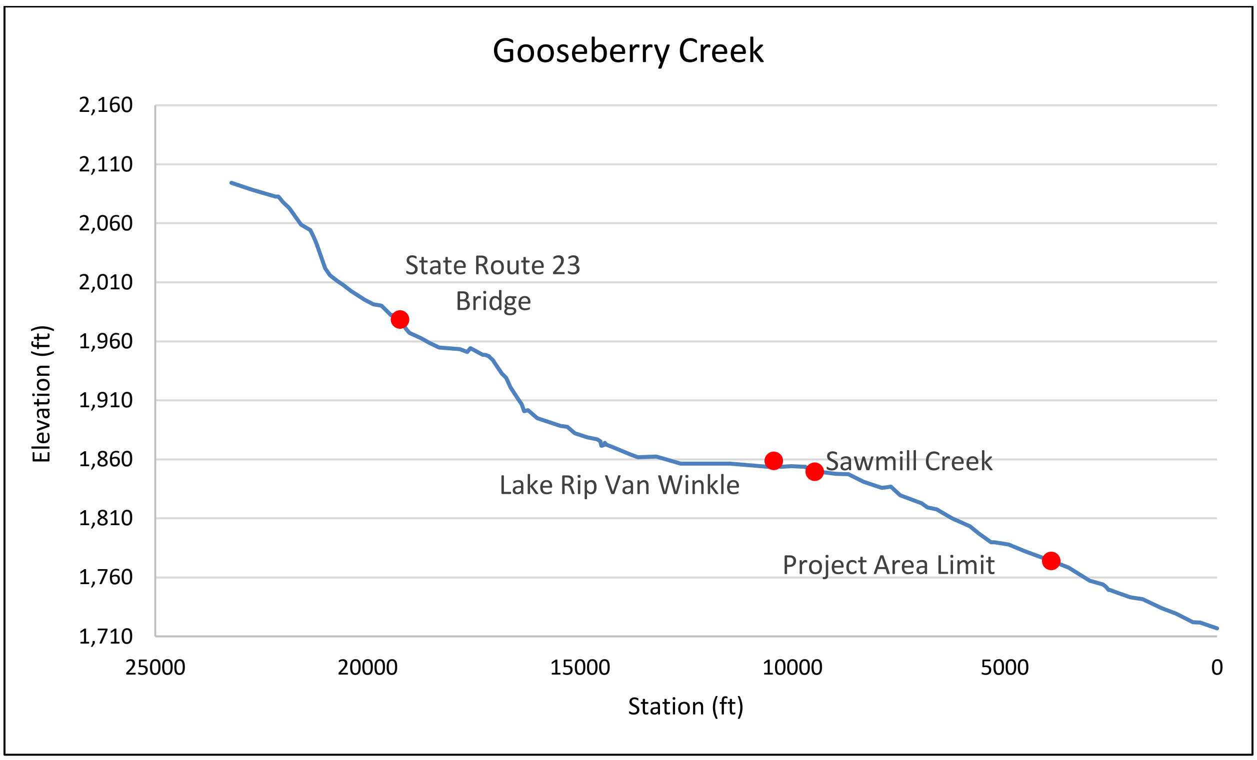

Figure 2-3
Gooseberry Creek Longitudinal Profile

With its headwaters located to the north of the Village of Tannersville, Sawmill Creek generally flows south for 2.8 miles before joining with Gooseberry Creek near Spruce Street and just south of the village. Sawmill Creek passes through the most densely populated commercial area of Tannersville. A longitudinal profile of Sawmill Creek is depicted in Figure 2-4.

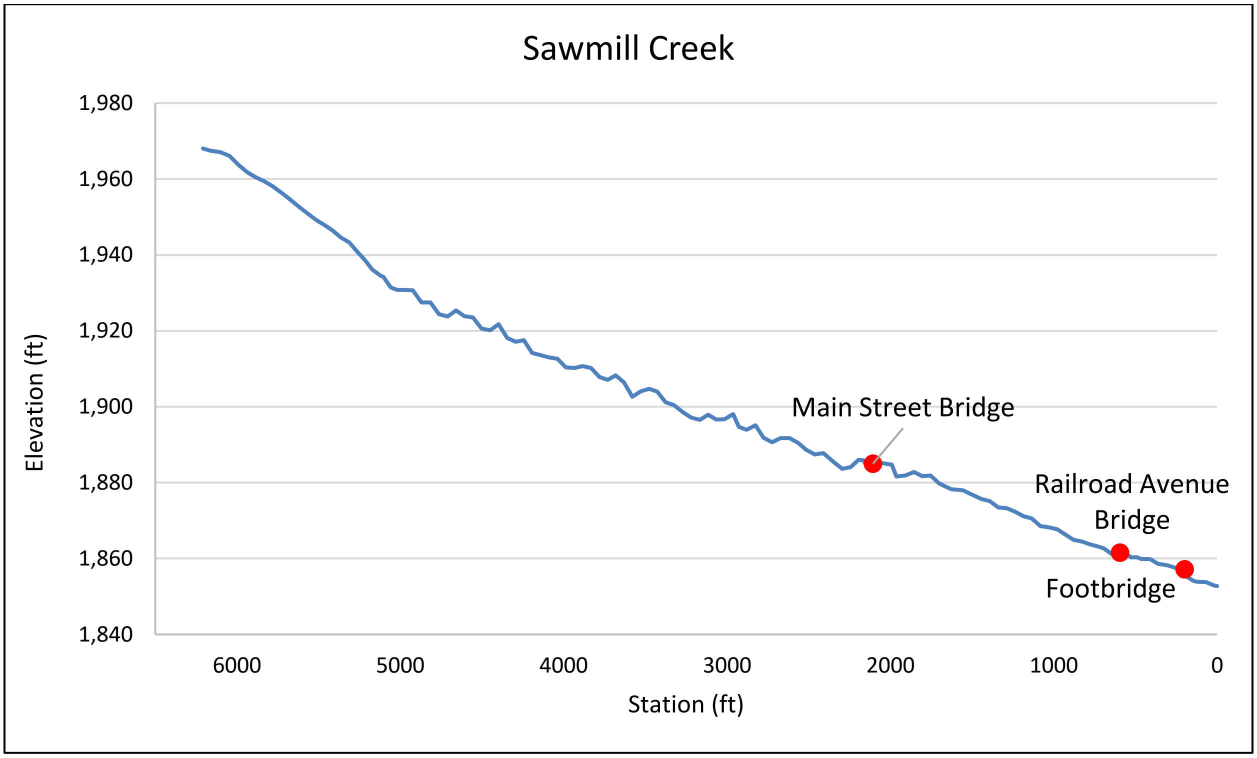

Figure 2-4
Sawmill Creek Longitudinal Profile with Bridges

Allen Brook begins with its headwaters north and west of the village near the base of Onteora Mountain. It flows south, passing through Onteora Pond, and continues south toward the village. After flowing for approximately 3 miles, Allen Brook then empties into Gooseberry Creek near Allen Lane.

The unnamed tributary to Allen Brook joins with Allen Brook just south of Main Street and near Allen Lane after flowing to the south and east from its headwaters for approximately 0.9 miles. This stream crossing is under Main Street and Raspberry Lane.

2.5 Infrastructure and Critical Facilities

In-stream infrastructure within the project area consists of eight bridges, five culverts, and two dams. There are five structures on Gooseberry Creek, three on Sawmill Creek, three on Allen Brook, and two on the unnamed tributary to Allen Brook. There are no available data on the hydraulic performance of the structures on Allen Brook and the tributary to Allen Brook. These two streams were only analyzed by FEMA using approximate methods. Based on discussions with the FAC, these structures appeared to have functioned well during Tropical Storm Irene and did not significantly contribute to flooding.

Table 2-1 lists the bridges along Gooseberry Creek and Sawmill Creek from upstream to downstream. Water surface elevations were derived from baseline hydraulic modeling and are in close agreement with elevations in the 2016 FEMA FIS bridge profiles. Modeling indicates that the decks of all the bridges listed are projected to overtop during the 100-year flood event.

TABLE 2-1
Bridges along Gooseberry and Sawmill Creeks

Watercourse	Bridge Crossing	Bridge Deck Elevation (feet)	Predicted 100-Year WSEL (feet)	Bridge Deck Overtops in 100-Year Event (Y/N)
Gooseberry Creek	Main Street	1,985.8	1,986.6	Y
Gooseberry Creek	Terns Road	1,953.2	1,954.4	Y
Gooseberry Creek	Clum Hill Road	1,882.0	1,882.4	Y
Gooseberry Creek	Lake Street	1,862.1	1,866.6	Y
Gooseberry Creek	Spruce Street	1,865.1	1,866.3	Y
Sawmill Creek	Main Street	1,896.9	1,897.9	Y
Sawmill Creek	Railroad Avenue	1,869.4	1,871.2	Y
Sawmill Creek	Railroad Avenue Footbridge	1,864.2	1,864.6	Y

*WSEL = Water surface elevation

There are two low-head dams within the project area on Gooseberry Creek. The first dam is located at the downstream end of Lake Rip Van Winkle. The second dam is located approximately 47 feet upstream of Ternes Road. Both of these dams are included in the Gooseberry Creek hydraulic model.

The NYS Inventory of Dams maintains a list of dams within the state that meet certain height or impoundment volume thresholds. The Lake Rip Van Winkle dam is listed within the inventory (State ID: 192-0460, Federal ID: NY13125) as a Class A, low hazard dam. It is a concrete gravity dam constructed for recreation. At 6 feet high and 410 feet long, it meets the thresholds to be regulated by the NYSDEC dam safety program. The data for this dam was last updated on July 6, 2009.

Figure 2-5 is a map of the LFA project area showing the locations of the bridges evaluated in this LFA.

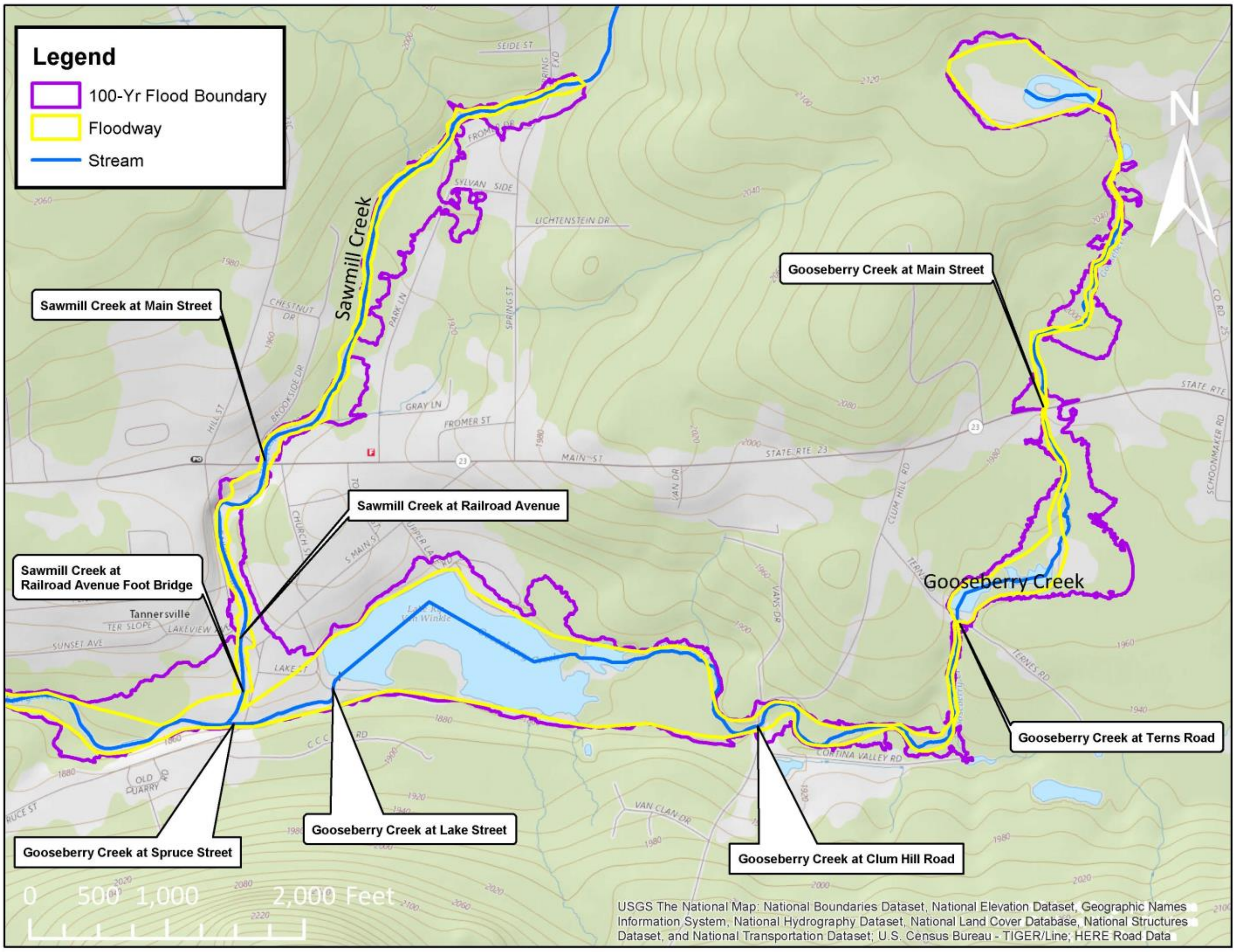

Figure 2-5
Bridges Evaluated in Tannersville LFA

There are three critical facilities in the project area. These facilities are essential for the administration of the Village of Tannersville. Furthermore, they are vital for disaster response and recovery. With the exception of the Village of Tannersville Department of Public Works (DPW), all of these facilities are located outside of floodprone areas. The Village of Tannersville DPW garage is located along Sawmill Creek immediately upstream of the Railroad Avenue bridge. This facility is located in the FEMA 100-year flood zone and was subject to extensive flood damage during Tropical Storm Irene. The facilities are listed in Table 2-2 and depicted on the map in Figure 2-6.

TABLE 2-2
Critical Municipal Facilities in the Project Area

Facility	Located in SFHA?	Located in Floodway?
Village Clerk's Office	No	No
Fire Department	No	No
Department of Public Works	Yes	No

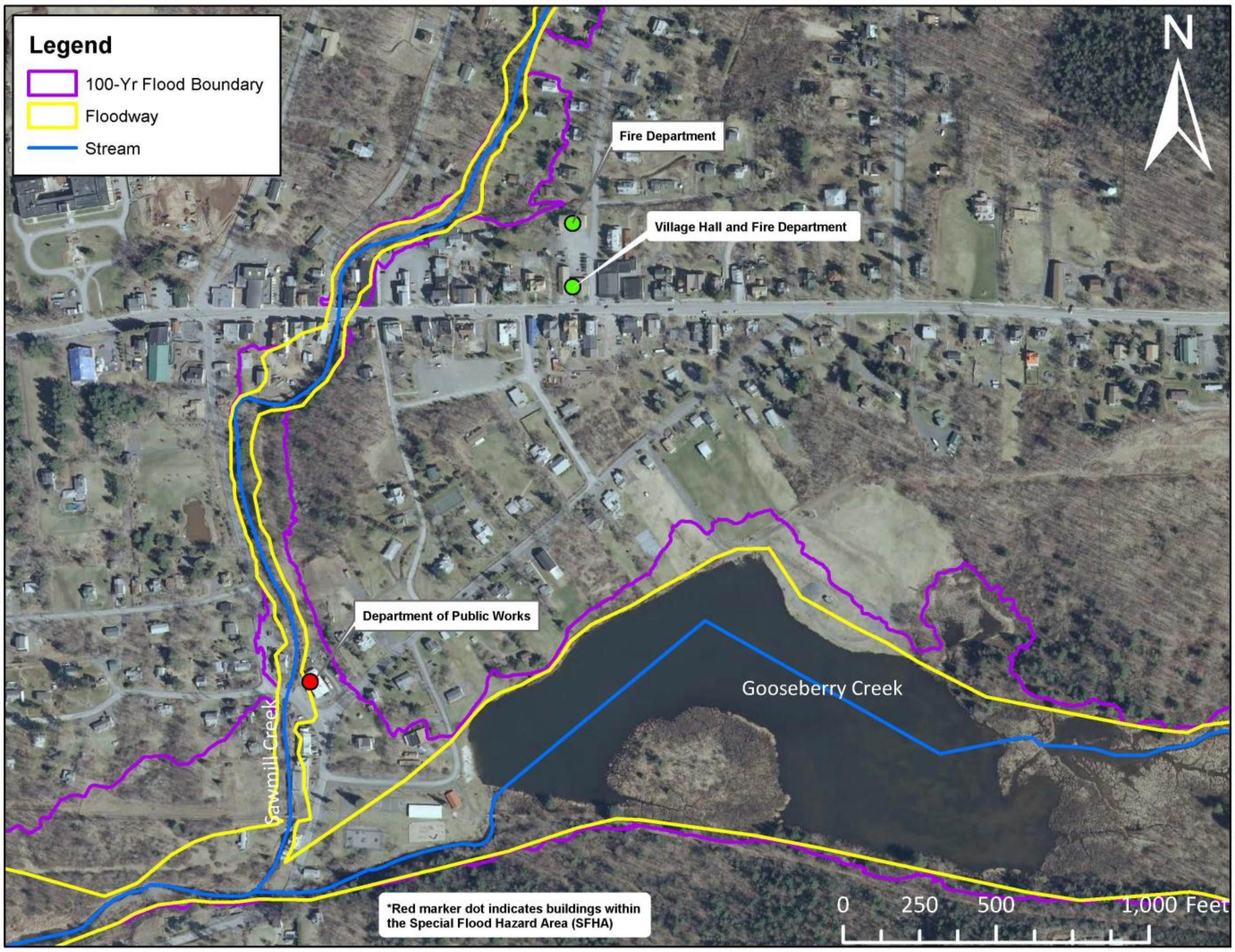

Figure 2-6
Locations of Critical Facilities in Tannersville

2.6 Hydrology

Hydrologic studies are conducted to understand historic 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 floodflows. 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 Village of Tannersville LFA project area. The NWIS mapper was also checked for historic 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 within the project area is the Greene County FIS dated June 2, 2015.

Discharges for Sawmill Creek were calculated by FEMA using regional regression equations according to a procedure described in the USGS publication 90-4197, *Regionalization of Flood Discharges for Rural, Unregulated Streams in New York, Excluding Long Island* (USGS, 1991). Greene County watersheds are located in USGS Region 4 for NYS. Within this region, the parameters included in the regression equation include mean annual precipitation, watershed area, and basin storage. Using this method, discharges were developed for the 10-, 50-, 100-, and 500-year recurrence intervals (FEMA, 2015).

Peak flows for Gooseberry Creek were developed by FEMA using Hydrologic Engineering Center – *Hydrologic Modeling System* (HEC-HMS) 3.5, according to guidelines in Appendix C of the FEMA *Guidelines and Specifications*. Discharges were calculated for the 10-, 25-, 50-, 100-, and 500-year recurrence intervals. The model was calibrated using Tropical Storm Irene (August 2011) and verified against Tropical Storm Lee (September 2011) and a second storm that occurred in October 2005 (FEMA, 2015). The discharge for the 25-year event was not included in the Summary of Discharges in the FIS (Table 6). However, the discharge is included in the Steady Flow File of the FEMA HEC-RAS model.

Approximate Hydrologic Analyses were conducted by FEMA for Allen Brook and the tributary to Allen Brook. The analyses were based on a HEC-HMS watershed model and only calculated for the 100-year return interval (FEMA, 2015). These flows were not included in the FIS but were included in the Steady Flow Files of their respective FEMA HEC-RAS models.

Peak flows reported in the FEMA FIS were compared against those 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 NYS (Mulvihill, et al., 2009). The Tannersville LFA study area falls within Region 3. Flows reported in the FEMA FIS were found to be generally higher than those calculated using USGS *StreamStats.* Because the FEMA flows are (a) more conservative and (b) the jurisdictional standard, the FEMA flows were used in the subsequent hydraulic analysis. Table 2-3 lists the peak discharges as reported in the 2015 FEMA FIS and used in the FEMA HEC-RAS models.

TABLE 2-3
FEMA Peak Discharges for Village of Tannersville LFA (all flow values in cfs)

Stream	Location	Basin Area (square miles)	10-Year	25-Year	50-Year	100-Year	500-Year
Gooseberry Creek	Approximately 2,000 feet upstream of Clum Hill Road	0.4	191	274	348	436	704
	Upstream of confluence with Sawmill Creek	2.6	902	1,384	1,821	2,337	3,937
	Upstream of confluence with Allen Brook	6.1	1,927	2,928	3,810	4,857	8,086
	At confluence with Schoharie Creek	9.5	2,985	4,398	5,753	7,341	12,233
Sawmill Creek	Upstream of confluence with Sawmill Creek Tributary	1.6	530	*	1,120	1,450	2,440
	At Tannersville upstream corporate limit	2.4	750	*	1,540	1,990	3,310
	Upstream of confluence with Gooseberry Creek	3.2	990	*	2,030	2,620	4,360
Allen Brook	At confluence with Gooseberry Creek	2.7	*	*	*	2,266	*
Tributary to Allen Brook	At confluence with Allen Brook	0.3	*	*	*	445	*

*No data recorded in FEMA 2015 FIS or HEC-RAS model

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 larger 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, the 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).

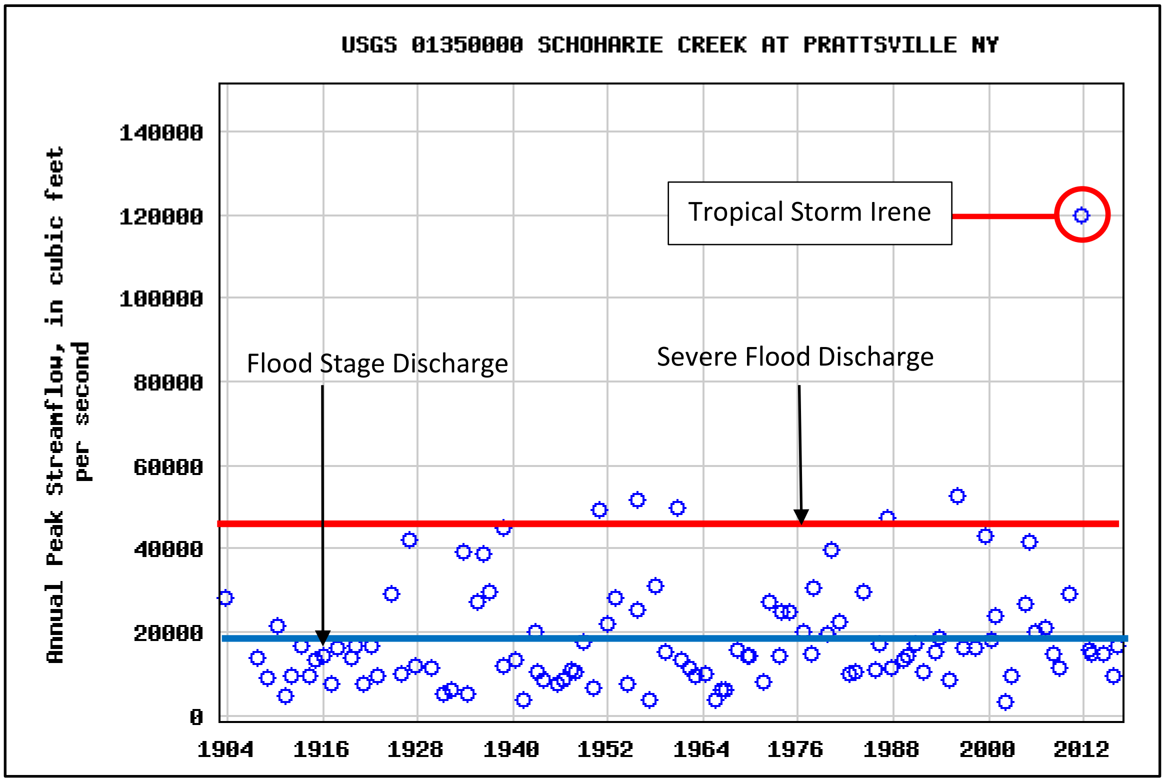

Figure 3-1
Annual Peak Discharge at USGS #1350000 in Prattsville, New York

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 of the most recent 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 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, 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).

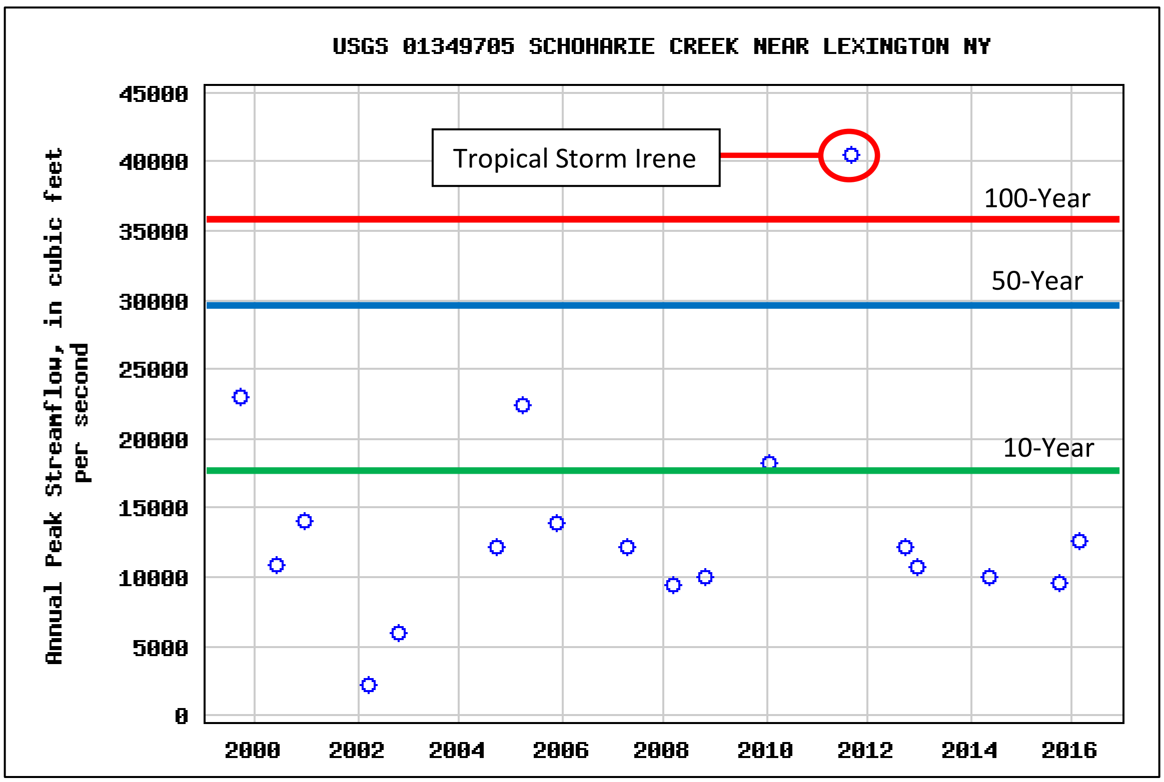

Figure 3-2
Annual Peak Discharge on Schoharie Creek at USGS #1362200 near Lexington, New York

There are no stream flow gauges within the project area. However, photographs, videos, and anecdotal accounts paint a vivid picture of the extensive damage that occurred in the study area. Although flooding occurred on all watercourses throughout the village, it was especially severe along the Sawmill Creek corridor and in the vicinity of the confluence of Gooseberry and Sawmill Creeks.

On the upper reaches of Sawmill Creek between Spring Street and Main Street, bank failures contributed woody debris to the stream that obstructed the Main Street bridge opening by approximately 50 percent. The bridge was overtopped, inundating the roadway as well as local businesses. Figure 3-3 shows the Sawmill Creek channel upstream of Main Street in the vicinity of Sylvan Street.

Figure 3-3
Sawmill Creek Channel near Sylvan Street

Three houses located on the left bank, two upstream and one downstream of the bridge, sustained damage. The house situated upstream was rebuilt while the house located downstream was demolished and not replaced. Immediately downstream of Main Street, the GCSWCD parking lot was flooded.

The most severe damage along Sawmill Creek occurred along Railroad Avenue between the GCSWCD building and Gooseberry Creek. Upstream of the DPW facility, Sawmill Creek left its banks and ran down Railroad Avenue, resulting in extensive damage to the DPW facility, Legg's Garage, and the roadway itself (Figures 3-4 through 3-6). It was reported that there was about 3.5 feet of water in the DPW facility and 4 feet at Legg's Garage and the former Mountain Eagle News building.

Figure 3-4
View of the Railroad Avenue bridge on the left and the DPW garage on the right the day after the flood

Figure 3-5
View of Railroad Avenue and Legg's Garage during the flood

Figure 3-6
View of Railroad Avenue and Legg's Garage the day after the flood

Fewer instances of flooding were reported on other watercourses in the study area. However, Lake Rip Van Winkle overflowed and flooded the associated park to a depth of approximately 2 feet. The State

Route 23A bridge over Allen Brook was not overtopped although there was extensive flooding of the Colonial Country Club golf course immediately downstream of the bridge.

3.3 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, 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).

FEMA FIRMs that are relevant to the project area include 36039C0405G, 36039C0384G, and 36039C0392G. These FIRMs all have an effective date of June 2, 2015. The maps address the following areas:

- 36039C0405G: Gooseberry Creek upstream of Lake Rip Van Winkle
- 36039C0384G: This FIRM covers the bulk of the project area including Sawmill Creek, Allen Brook, the tributary to Allen Brook, and Gooseberry Creek from Lake Rip Van Winkle to the waste water treatment facility.
- 36039C0392G: This FIRM covers Gooseberry Creek in the vicinity of the waste water treatment facility.

The FIRMs are accessible to the public on the FEMA Flood Map Service Center website (https://msc.fema.gov/portal). A brief description of the SFHA and floodway within the project area is given below. The FEMA flood zones are depicted in Figure 3-7.

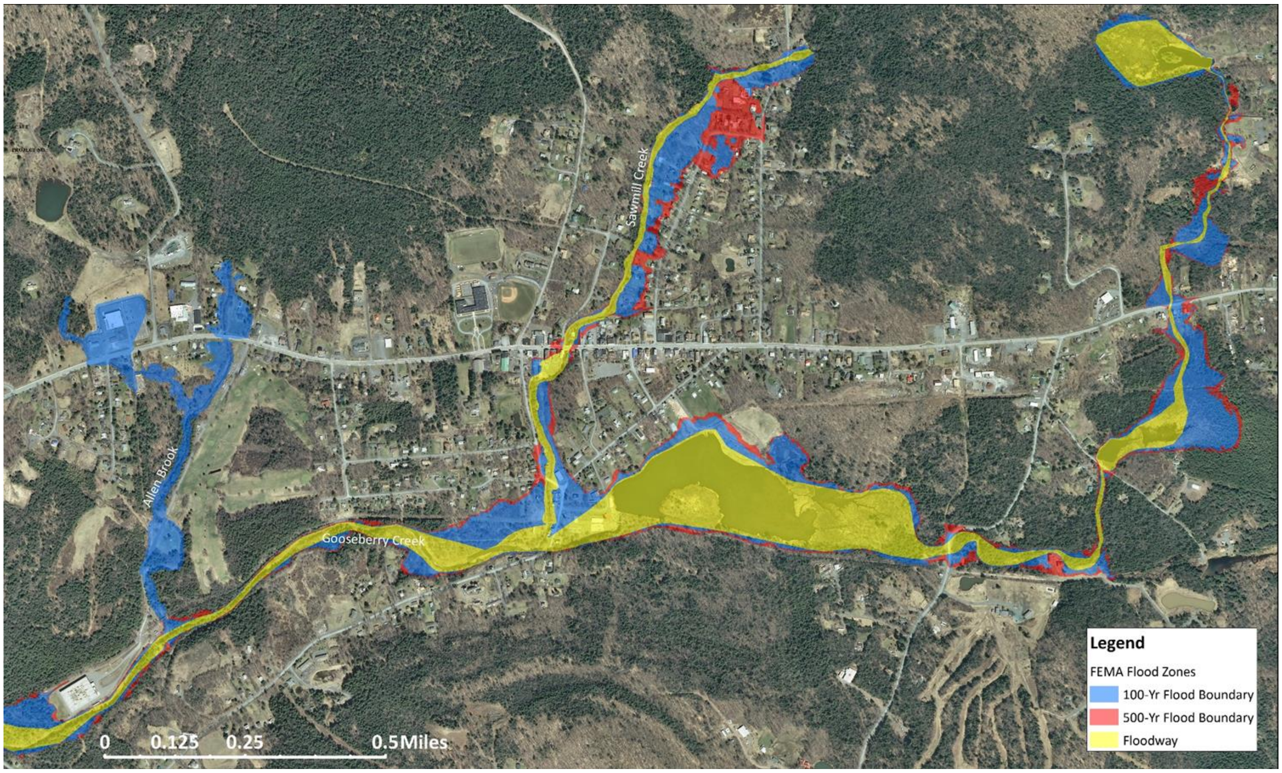

Figure 3-7
FEMA Flood Zones in the Village of Tannersville

From its source to the confluence with Sawmill Creek, Gooseberry Creek is characterized by a series of ponds and associated marshy areas. These areas are located at the creek's headwaters, Ternes Road, and Lake Rip Van Winkle. In these areas, the floodway is quite wide. The associated SFHA may also be quite wide or form a thin border around the floodway. Between these ponds and marshy areas, the floodways and SFHA tend to be relatively narrow. In the region of the confluence, the floodway is well developed, and the SFHA widens to cover much of the low-lying floodplains.

Buildings are located within the SFHA primarily at two locations. The first location is along the left bank of Gooseberry Creek immediately downstream of State Route 23A. At this point, there are three structures located within the SFHA. The main location where buildings are located within the SFHA along Gooseberry Creek lies between the downstream end of Lake Rip Van Winkle and the confluence with Sawmill Creek. Several structures on Lake Street and Railroad Avenue are in the SFHA, and Lake Rip Van Winkle Park is located directly in the floodway. Additionally, on the right bank at the upstream end of the culvert that passes under Railroad Avenue/Spruce Street, there is a single structure located in the Gooseberry Creek floodway.

Downstream of the confluence, the channel of Gooseberry Creek is relatively confined, and the SFHA and floodway are relatively narrow. Based on FEMA mapping, no structures along this reach appear to be vulnerable to flooding from the 100-year discharge.

Along the length of Sawmill Creek, the floodway is fairly narrow for most of the stream's course. However, it broadens in the region of the Main Street bridge, especially on the downstream side. The floodway also widens slightly in the vicinity of the Railroad Avenue bridge. The stream is confined by a low hillslope on its right bank until it reaches Gooseberry Creek. As a result, the SFHA extends from the floodway on the left bank into the adjoining floodplain. This is most pronounced where Sawmill Creek parallels Park Lane between Sylvan Side Avenue and Gray's Lane. Beginning at the Railroad Avenue bridge, the valley opens up, and the SFHA broadens on both banks for the remainder of its course.

Along Sawmill Creek, there are three locations where clusters of properties are located within the SFHA. These areas include the following:

- The area between Sawmill Creek and Park Lane between Sylvan Side Road and Gray's Road
- The Sawmill Creek corridor between Bear Square Plaza and the GCSWCD building
- The Sawmill Creek corridor from upstream of the Railroad Avenue bridge to the Gooseberry Creek confluence

The FEMA FIRMS for Allen Brook and the tributary to Allen Brook only depict the SFHA. The floodway is not delineated as these streams were only modeled using approximate methods. In regard to Allen Brook, the SFHA indicates that flooding would primarily occur just upstream and downstream of the State Route 23A bridge. At-risk structures along the stream are generally confined to the region immediately upstream of the State Route 23 bridge.

The SFHA for the tributary to Allen Brook was only delineated in its lower regions, from the confluence with Allen Brook to a distance of about 2,040 feet upstream. The SFHA generally follows the channel of the creek and extends a short distance into both the left and right overbank areas. However, it significantly expands in the area of the Tops Supermarket Plaza and includes State Route 23A. The FIRM indicates that three commercial buildings upstream of State Route 23A, including the Tops Supermarket, are within the SFHA. A single residential structure located on the left bank immediately downstream of the highway is also located within the SFHA.

4.0 FLOOD MITIGATION ANALYSIS AND ALTERNATIVES

The purpose of a hydraulic assessment is to evaluate historic 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 village have been identified as being prone to flooding during severe flood 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 analyses of Gooseberry Creek and Sawmill Creek were 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 Gooseberry Creek from the NYCDEP. The NYCDEP also provided non-effective models for Allen Brook and the tributary to Allen Brook, which were constructed using approximate methods. The effective FEMA model for Sawmill Creek was provided by the NYSDEC. At the conclusion of the LFA, all hydraulic modeling files used in the hydraulic analysis are shared with GCSWCD and NYCDEP to ensure future access.

These HEC-RAS models provided the starting point for the current analysis. Duplicate effective models were created for Gooseberry Creek and Sawmill Creek. The output of the duplicate effective models were compared to those provided by the NYCDEP and the NYSDEC and were 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 HEC-RAS models were reviewed to assess variables and coefficients, hydrology, and geometry. The Manning's n-values for the Gooseberry Creek model were extremely coarse with values typically assigned only to the channel and the left and right overbanks. The Sawmill Creek model is unusual in that the stream channel is characterized by three Manning's n-values that appear to characterize the bed as well as the lower banks on the left and right sides of the channel. Additionally, the values are quite high. The Manning's n-values in the channel range from 0.025 to 0.075 with most greater than 0.04. The overbank values are typically 0.2 or a little less. Typically, overbank values are closer to 0.1.

An examination of the steady flow data for Sawmill Creek indicated that the stream was modeled under backwater conditions from Gooseberry Creek. This is relevant as there is a property on the left bank of the creek, approximately 200 feet upstream of the confluence, and a bridge situated 250 feet upstream of the confluence.

A review of the models found a discrepancy in the geometry file of the Sawmill Creek model. The FEMA Sawmill Creek model contains a small bridge located about 230 feet upstream of the confluence with Gooseberry Creek between model cross sections 221+11 and 254+60. This bridge no longer exists. The bridge can clearly be seen in aerial imagery from 2009. However, the bridge is absent in the next available aerial imagery, which is from 2013. It is assumed that the bridge was washed out or damaged and removed during Tropical Storm Irene.

An anomaly was also detected in the output of the Sawmill Creek model. At the Railroad Avenue bridge, the 100-year discharge transitioned to supercritical flow within the bridge. This resulted in the water surface elevations that were more than 2 feet lower than the 50-year discharge. Additionally, the extent of flooding in the area of Railroad Avenue and the DPW garage was underrepresented.

4.2 <u>Existing Conditions Analysis</u>

Copies of the duplicate effective models for Gooseberry and Sawmill Creeks were made to create operational models. The output of these models was compared to the original models and found to be identical. Digital Elevation Models (DEMs) were added to the HEC-RAS models so that depth grid and water surface elevation mapping could be carried out.

A "corrected operational" model was created for Sawmill Creek. This was done due to a discrepancy between the geometry file and actual conditions as well as an anomaly in the output. The first change made to this model was the removal of the bridge located about 230 feet upstream of the confluence, which no longer exists. Additionally, a change was made to the bridge modeling approach at the Railroad Avenue bridge. All of the bridges in the model used the Pressure and/or Weir method for high-energy flows. At the Railroad Avenue bridge, this was changed to the Energy Only method.

Removal of the downstream bridge from the hydraulic model resulted in water surface elevation reductions at all flows (Table 4-1). However, decreases in water surface elevations were more pronounced at lower discharges, especially the 10-year return interval. At the 10-year discharge, there was a 1-foot reduction in water surface elevation over a 30-foot length of the stream. Reductions in water surface elevations were less at larger flows and did not extend very far upstream (Figures 4-1 and 4-2).

TABLE 4-1
Change in Water Surface Elevations due to Removing Bridge on Sawmill Creek (no longer in place)

HEC-RAS Cross Section Location	Profile	FEMA Effective Model Water Surface Elevation (feet)	MMI Corrected Operational Model Water Surface Elevations (feet)	Change (feet)
35 feet upstream of bridge	10-year	1,862.04	1,861.03	1.0
	50-year	1,862.53	1,862.14	0.4
	100-year	1,862.87	1,862.87	0.0
	500-year	1,865.55	1,865.55	0.0
31 feet upstream of bridge	10-year	1,862.08	1,861.03	1.0
	50-year	1,862.93	1,862.48	0.5
	100-year	1,863.15	1,863.03	0.1
	500-year	1,864.01	1,864.01	0.0
26 feet upstream of bridge	10-year	1,862.13	1,861.11	1.0
	50-year	1,863.05	1,862.1	1.0
	100-year	1,863.32	1,862.68	0.6
	500-year	1,863.91	1,863.58	0.3
23 feet upstream of bridge	10-year	1,862.13	1,861.09	1.0
	50-year	1,863.06	1,862.12	0.9
	100-year	1,863.34	1,862.54	0.8
	500-year	1,863.94	1,863.26	0.7
at bridge	Bridge	1,861.86		
11 feet downstream of bridge	10-year	1,860.64	1,860.64	0.0
	50-year	1,861.59	1,861.59	0.0
	100-year	1,861.93	1,861.93	0.0
	500-year	1,862.72	1,862.72	0.0

Changing the high-energy flow bridge modeling approach caused the 100-year discharge in the vicinity of the Railroad Avenue bridge to switch from supercritical flow to subcritical flow. As a result, water surface elevations increased over a length of approximately 132 feet between the Railroad Avenue bridge and the DPW garage (Table 4-2 and Figure 4-2). Furthermore, the extent of the flooding at the 100-year discharge now closely matches the FEMA flood extent.

TABLE 4-2
Difference in Water Surface Elevations at Railroad Avenue Bridge due to the Change in Bridge Modeling Approach

HEC-RAS Cross Section	Profile	FEMA Effective Model Water Surface Elevation (feet)	MMI Corrected Operational Model Water Surface Elevations (feet)	Change (feet)
132 feet upstream of bridge	10-year	1,868.82	1,868.82	0.0
	50-year	1,871.45	1,871.45	0.0
	100-year	1,870.57	1,871.6	-1.0
	500-year	1,872.75	1,872.75	0.0
101 feet upstream of bridge	10-year	1,868.76	1,868.76	0.0
	50-year	1,871.35	1,871.35	0.0
	100-year	1,869.8	1,871.44	-1.6
	500-year	1,872.49	1,872.49	0.0
50 feet upstream of bridge	10-year	1,868.14	1,868.14	0.0
	50-year	1,871.26	1,871.26	0.0
	100-year	1,869.03	1,871.3	-2.3
	500-year	1,872.29	1,872.29	0.0
upstream face of bridge	10-year	1,867.4	1,867.4	0.0
	50-year	1,871.2	1,871.2	0.0
	100-year	1,869.03	1,871.18	-2.2
	500-year	1,872.21	1,872.21	0.0
downstream face of bridge	10-year	1,866.94	1,866.94	0.0
	50-year	1,870.97	1,870.97	0.0
	100-year	1,869.03	1,870.23	-1.2
	500-year	1,870.85	1,870.85	0.0
28 feet downstream of bridge	10-year	1,866.82	1,866.82	0.0
	50-year	1,868.28	1,868.28	0.0
	100-year	1,869.1	1,869.1	0.0
	500-year	1,870.46	1,870.46	0.0

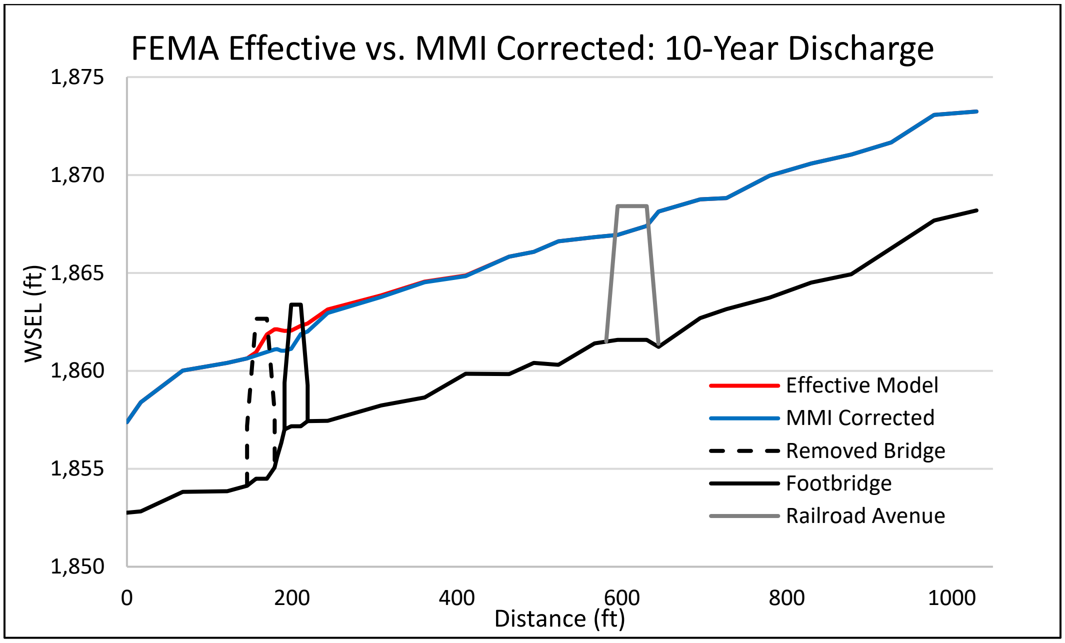

Figure 4-1
Sawmill Creek: Comparison of FEMA Effective Model and MMI Corrected Operational at 10-Year Discharge

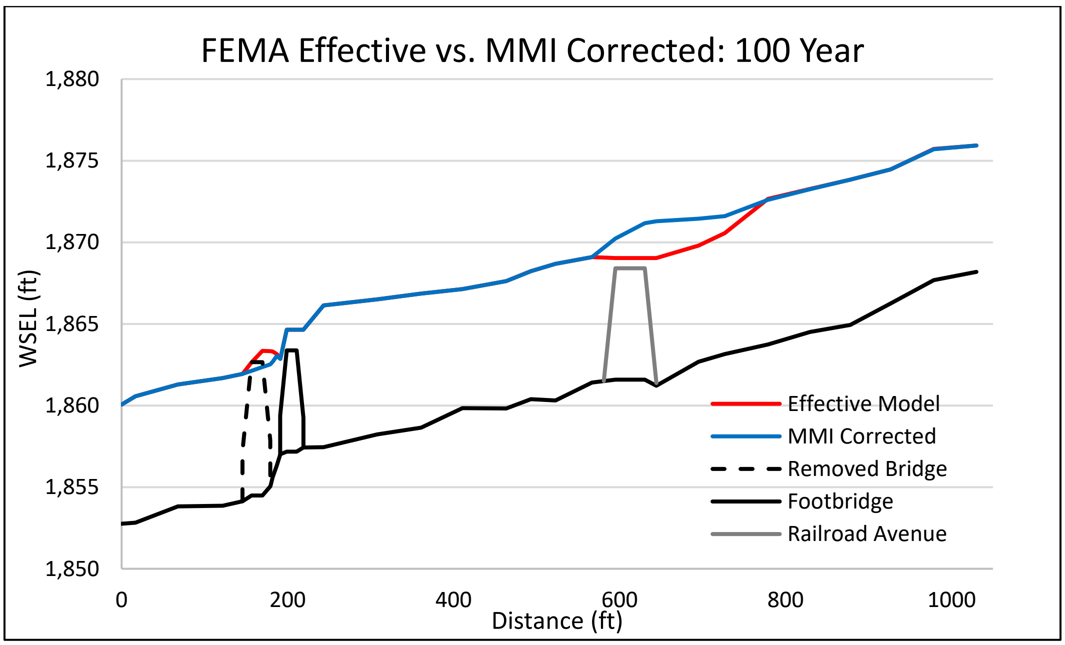

Figure 4-2
Sawmill Creek: Comparison of FEMA Effective Model and MMI Corrected Operational at 100-Year Discharge

4.3 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 replacement
- Debris jamming at the Main Street bridge over Sawmill Creek
- Floodplain enhancement
- Flood attenuation through stormwater storage

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.

4.4 Bridge Replacement

Undersized bridges can act as hydraulic constrictions, exacerbating flooding during high-flow events by increasing water surface elevations upstream of the bridge. Bridges were 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.

Three bridges on Sawmill Creek and five bridges on Gooseberry Creek were evaluated. HEC-RAS modeling was performed to simulate the replacement of these bridges with structures that have greater hydraulic capacity. Greater capacity is achieved by either increasing the height of the bridge or increasing the width of the bridge. In order to simulate bridge replacement in the modeling program, the existing bridge is simply removed entirely as a feature within the watercourse. This allows the model to show a scenario in which the bridge causes no impediment to the flow of water through the stream channel. Table 4-3 lists the bridges that were assessed.

TABLE 4-3
Bridge Removals Evaluated in the Project Area

Stream	Bridge Crossing	Type of Structure
Sawmill Creek	Main Street/State Route 23A	Bridge
Sawmill Creek	Railroad Avenue	Bridge
Sawmill Creek	Footbridge	Bridge
Gooseberry Creek	State Route 23A	Box Culvert
Gooseberry Creek	Ternes Road	Pipe Arch Culvert
Gooseberry Creek	Clum Hill Road	Bridge
Gooseberry Creek	Bridge below Lake Rip Van Winkle Dam	Bridge
Gooseberry Creek	Spruce Street	Arch Culvert

Along Sawmill Creek, according to the HEC-RAS modeling, removal of the Main Street bridge from the model results in decreases in water surface elevations upstream of the bridge, particularly at the larger discharges (Table 4-4).

Under current conditions, the bridge is able to pass the 10-year discharge. In contrast to the 10-year discharge, the 50-, 100-, and 500-year events all overtop the bridge. The bridge was overtopped during the Tropical Storm Irene flood in August 2011 (Figure 4-3).

Figure 4-3
Main Street Bridge over Sawmill Creek overtopping in Tropical Storm Irene

TABLE 4-4
Water Surface Reductions due to Removal of the Main Street/State Route 23A Bridge

HEC-RAS Cross Section	Profile	Water Surface Elevation with Bridge (feet)	Water Surface Elevation without Bridge (feet)	Change (feet)
187 feet upstream of bridge	10-year	1,893.39	1,892.53	0.9
	50-year	1,897.4	1,894.94	2.5
	100-year	1,898.22	1,895.78	2.4
	500-year	1,899.43	1,897.83	1.6
136 feet upstream of bridge	10-year	1,893.22	1,892.35	0.9
	50-year	1,897.34	1,894.68	2.7
	100-year	1,898.16	1,895.52	2.6
	500-year	1,899.33	1,897.61	1.7
89 feet upstream of bridge	10-year	1,892.72	1,891.25	1.5
	50-year	1,897.18	1,893.46	3.7
	100-year	1,897.96	1,894.37	3.6
	500-year	1,898.95	1,896.63	2.3
58 feet upstream of bridge	10-year	1,892.29	1,891.28	1.0
	50-year	1,897.14	1,893.33	3.8
	100-year	1,897.92	1,894.2	3.7
	500-year	1,898.87	1,896.4	2.5
at bridge	Bridge			
20 feet downstream of bridge	10-year	1,889.62	1,889.67	-0.1
	50-year	1,891.25	1,890.67	0.6
	100-year	1,892.19	1,891.3	0.9
	500-year	1,894.67	1,892.84	1.8

The 10-year flood event passes through the bridge without overtopping, and removal of the bridge from the hydraulic model results in minimal reductions in water surface elevation upstream of the bridge (Figure 4-4). During the 50-year flood event, removal of the bridge from the model results in decreases in water surface elevations, with reductions of nearly 4 feet immediately upstream of the bridge (Figure 4-5). Similar reductions in water surface elevations also occur under the 100-year event and extend a distance of approximately 300 feet upstream of the Main Street bridge (Figure 4-6). Under the bridge removal scenario, a reduction of 2.5 feet is seen at the bridge opening during the 500-year discharge. However, flooding is so extensive that removal of the bridge provides little to no benefit.

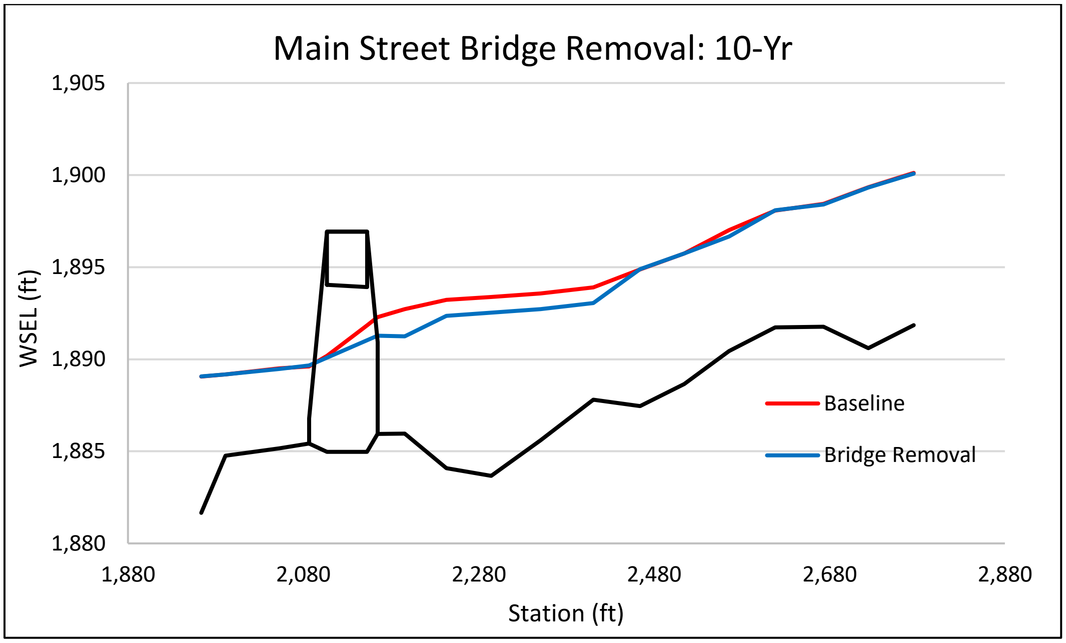

Figure 4-4
Change in Water Surface Elevations at the Main Street/State Route 23A Bridge over Sawmill Creek: 10-Year Discharge

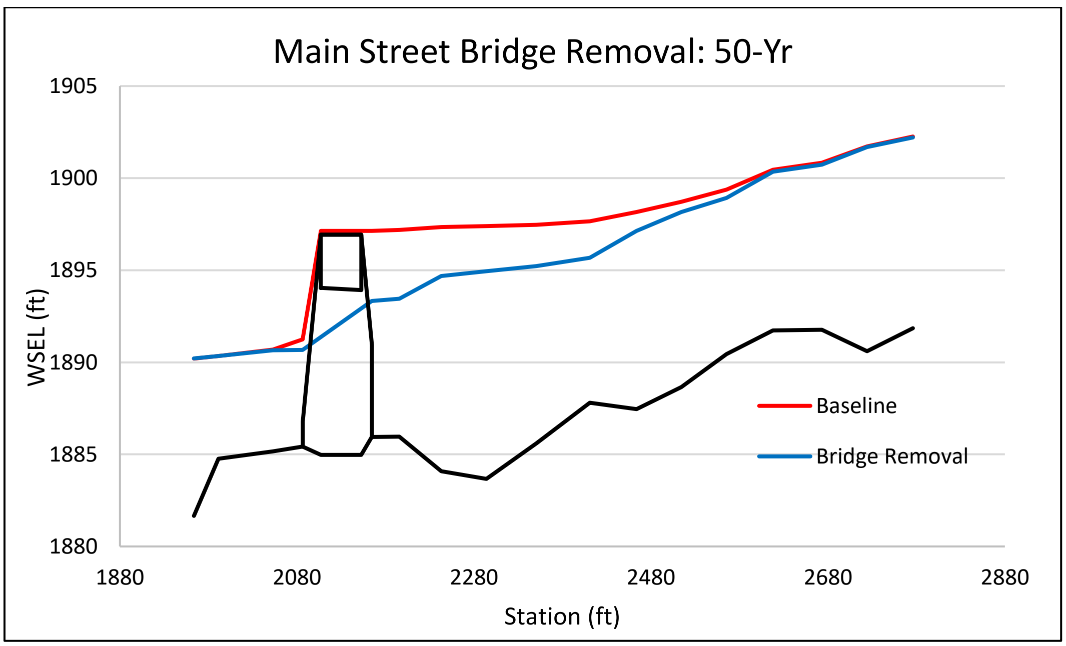

Figure 4-5
Change in Water Surface Elevations at the Main Street/State Route 23A Bridge over Sawmill Creek: 50-Year Discharge

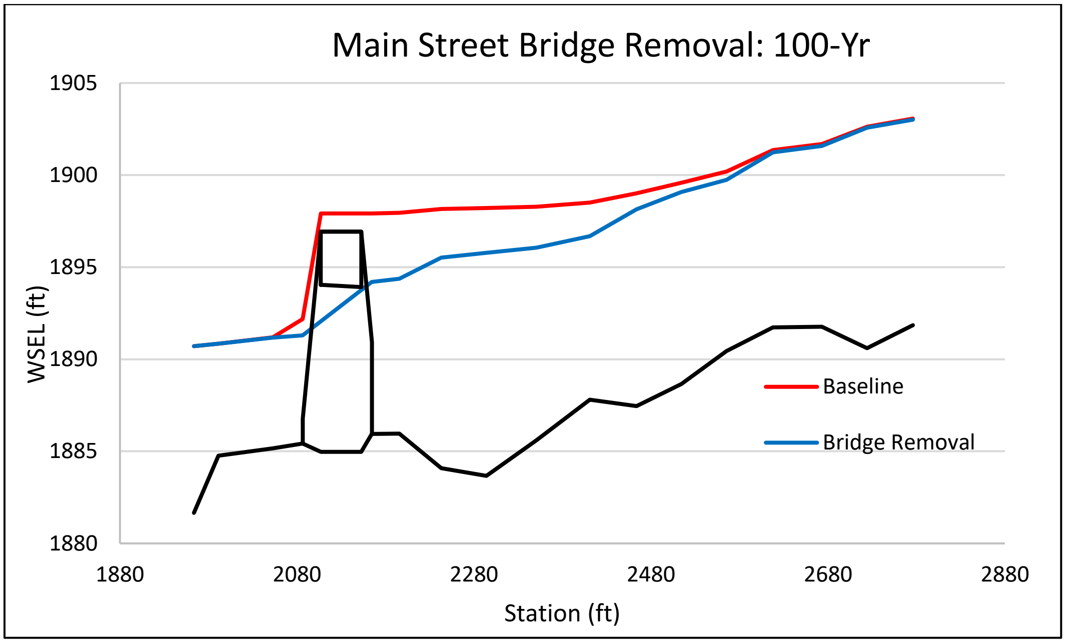

Figure 4-6
Change in Water Surface Elevations at the Main Street/State Route 23A Bridge over Sawmill Creek: 100-Year Discharge

Removal of the Railroad Avenue bridge results in minor to moderate reductions in water surface elevations (Table 4-5) with little in the way of flood reduction benefits. During the 10-year event, reductions in water surface elevations are minimal, and the stream remains in the channel under both the baseline and "no bridge" scenarios (Figure 4-7). The "no bridge" alternative at the 50- and 100-year discharge events results in moderate reductions in water surface elevation; however, even with the bridge removed, water surface elevations exceed the height of the bridge deck (Figure 4-8). Additionally, the stream leaves the channel on the left bank in the vicinity of the DPW garage, causing flooding to the road and adjacent buildings.

TABLE 4-5
Water Surface Reductions due to Removal of the Railroad Avenue Bridge

HEC-RAS Cross Section	Profile	Water Surface Elevation with Bridge (feet)	Water Surface Elevation without Bridge (feet)	Change (feet)
184 feet upstream of bridge	10-year	1,869.96	1,869.89	0.1
	50-year	1,872.14	1,871.95	0.2
	100-year	1,872.61	1,872.75	-0.1
	500-year	1,873.78	1,873.95	-0.2
132 feet upstream of bridge	10-year	1,868.82	1,867.94	0.9
	50-year	1,871.45	1,869.79	1.7
	100-year	1,871.6	1,870.54	1.1
	500-year	1,872.75	1,872.16	0.6
100 feet upstream of bridge	10-year	1,868.76	1,868.18	0.6
	50-year	1,871.35	1,869.93	1.4
	100-year	1,871.44	1,870.47	1.0
	500-year	1,872.49	1,871.58	0.9
50 feet upstream of bridge	10-year	1,868.14	1,867.95	0.2
	50-year	1,871.26	1,869.62	1.6
	100-year	1,871.3	1,870.12	1.2
	500-year	1,872.29	1,871.15	1.1
at bridge	Bridge			
28 feet downstream of bridge	10-year	1,866.82	1,866.87	0.0
	50-year	1,868.28	1,868.71	-0.4
	100-year	1,869.1	1,869.08	0.0
	500-year	1,870.46	1,870.47	0.0

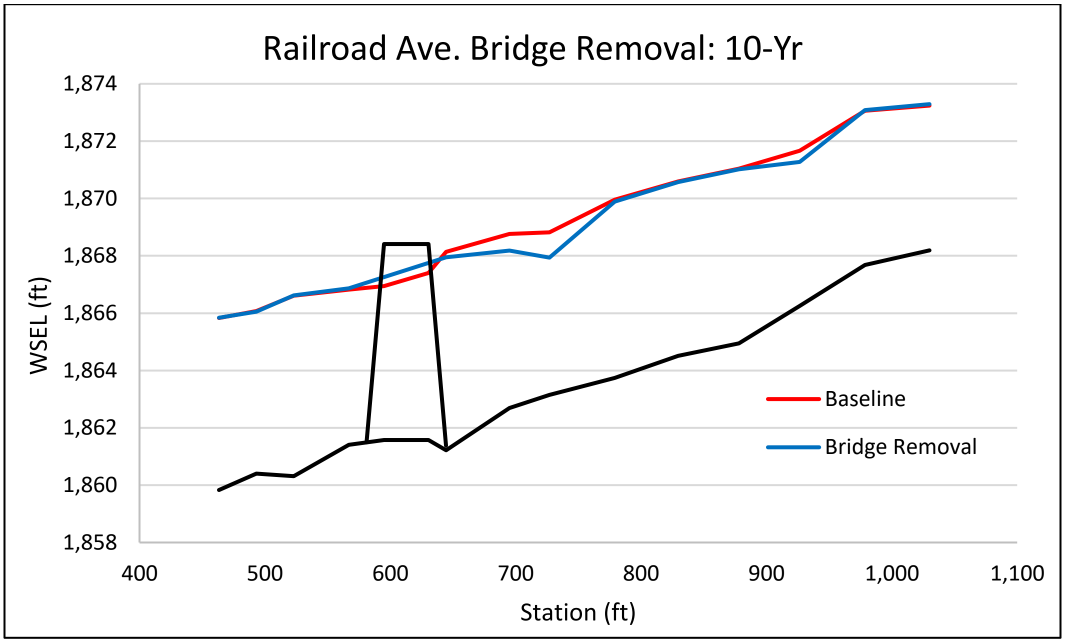

Figure 4-7
Change in Water Surface Elevations at the Railroad Avenue Bridge over Sawmill Creek: 10-Year Discharge

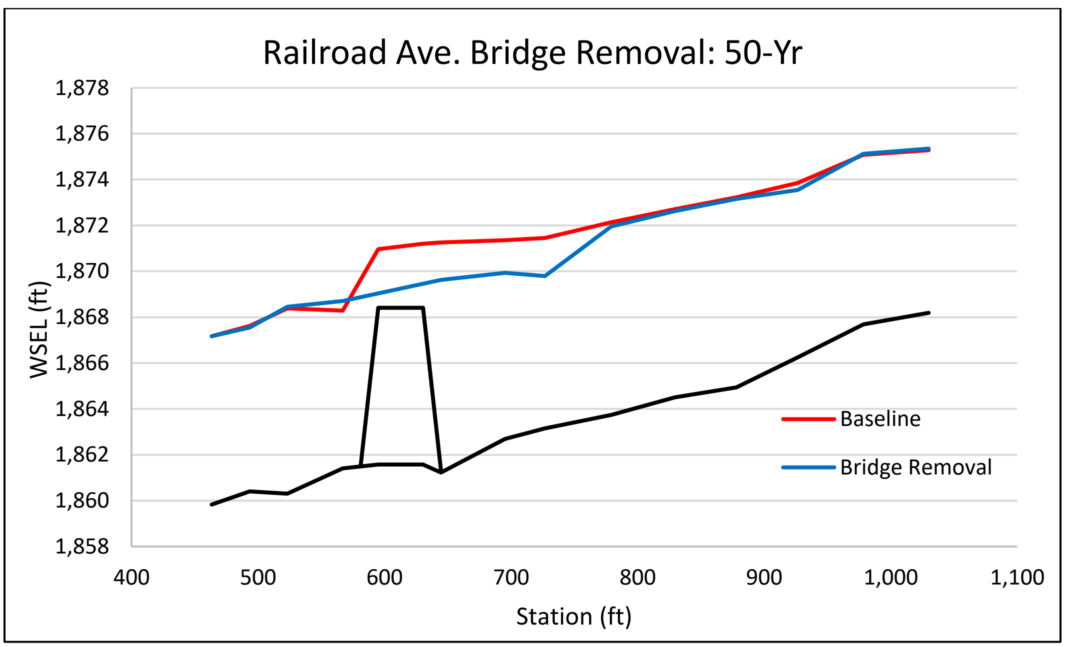

Figure 4-8
Change in Water Surface Elevations at the Railroad Avenue Bridge over Sawmill Creek: 50-Year Discharge

Eliminating the rail trail footbridge over Sawmill Creek from the model had only minor impacts on water surface elevations and did not provide any flood reduction benefits (Table 4-6). The bridge is easily able to pass the 10-year discharge event, and removing the bridge from the model has negligible effects on water surface elevations under this scenario (Figure 4-9). At the 50-year discharge and greater, the Sawmill Creek water surface elevations exceed the height of the bridge even under the no bridge alternative (Figure 4-10). Furthermore, regardless of whether there is a bridge, the stream overtops the banks, inundating Railroad Avenue as well as structures located on the left bank between the footbridge and the Railroad Avenue bridge (Legg's Garage and the former Mountain Eagle News building).

TABLE 4-6
Water Surface Reductions due to Removal of the Rail Trail Footbridge

HEC-RAS Cross Section	Profile	Water Surface Elevation with Bridge (feet)	Water Surface Elevation without Bridge (feet)	Change (feet)
109 feet upstream of bridge	10-year	1,863.78	1,863.76	0.02
	50-year	1,865.91	1,865.87	0.04
	100-year	1,866.51	1,866.81	-0.3
	500-year	1,868.64	1,868.34	0.3
44 feet upstream of bridge	10-year	1,862.96	1,862.92	0.04
	50-year	1,865.47	1,865.42	0.05
	100-year	1,866.14	1,866.56	-0.42
	500-year	1,868.46	1,868.12	0.34
20 feet upstream of bridge	10-year	1,862.01	1,861.79	0.22
	50-year	1,864.6	1,864.48	0.12
	100-year	1,864.64	1,865.71	-1.07
	500-year	1,867.53	1,866.67	0.86
at bridge	Bridge			
8 feet downstream of bridge	10-year	1,861.03	1,861.02	0.01
	50-year	1,862.14	1,862.12	0.02
	100-year	1,862.87	1,862.86	0.01
	500-year	1,865.55	1,865.55	0

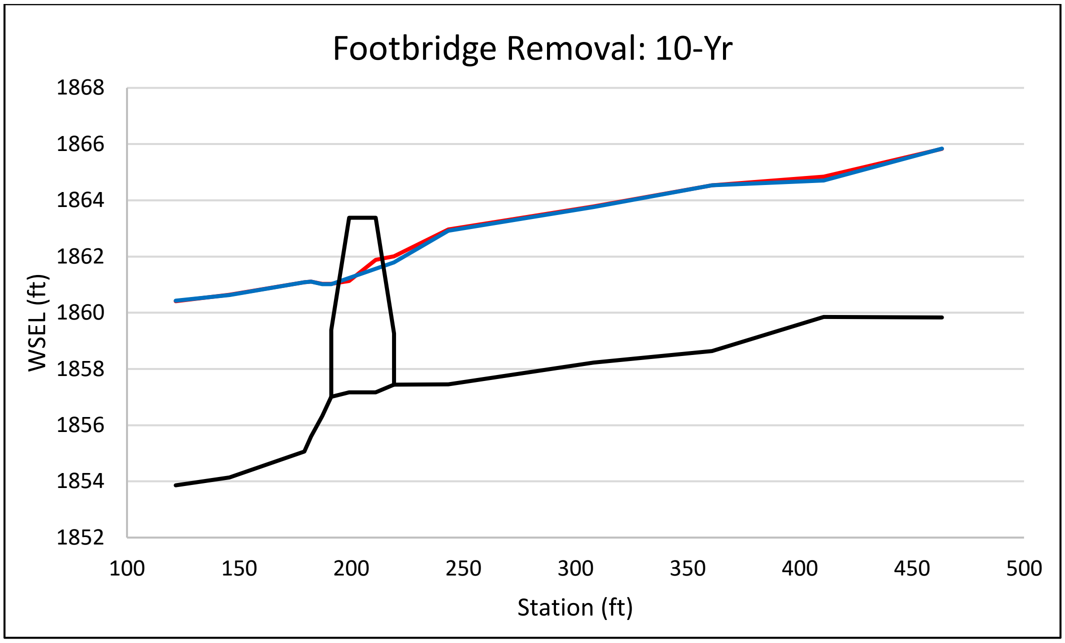

Figure 4-9
Change in Water Surface Elevations at the Rail Trail Footbridge over Sawmill Creek: 10-Year Discharge

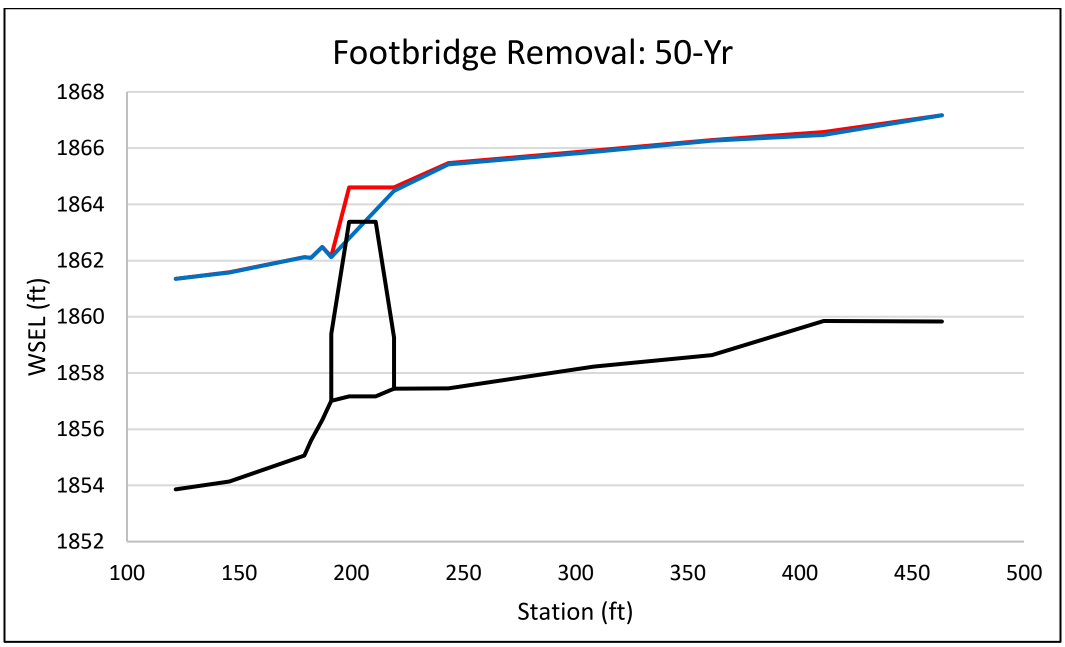

Figure 4-10
Change in Water Surface Elevations at the Rail Trail Footbridge over Sawmill Creek: 50-Year Discharge

Removal of the five structures on Gooseberry Creek, including the Main Street bridge, Terns Road bridge, Clum Hill Road bridge, Lake Street bridge, and Spruce Street bridge, all of which are located between State Route 23A and Spruce Street, was simulated in the hydraulic model. Hydraulic modeling indicates that most of these structures are overtopped during the 10- or 25-year discharge events; however, during meetings with local residents as well as the FAC, no complaints or concerns were voiced regarding overtopping of these structures.

In the hydraulic analysis of bridges presented above, several bridges were identified as being hydraulically undersized. When these bridges are scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge is adequately sized.

4.5 Debris Jamming at the Main Street Bridge

Some bridges are prone to blockage with debris during flood events. This is further exacerbated in forested areas with steep hillslopes that readily contribute large amounts of woody debris to stream channels. Hydraulic modeling can be employed to predict water surface levels based on decreases in the effective cross section area of the bridge opening.

Main Street/State Route 23A is the most important road in the Village of Tannersville. It is the primary street within the business district as well as a critical transportation corridor linking the village to other communities in the Catskills and the Hudson Valley. One comment heard during meetings with the Village of Tannersville FAC was that the Main Street bridge over Sawmill Creek became at least 50 percent blocked with sediment and woody debris during Tropical Storm Irene. Members of the FAC were concerned that blockage of the bridge contributed to overtopping of the bridge and the flooding of Main Street.

HEC-RAS modeling was carried out to assess the effects of blockage or obstruction of the Main Street bridge. The hydraulic performance of the bridge was evaluated at various flows under normal conditions compared to blockages in bridge height of 10%, 25%, and 50%. In addition to determining how obstruction of the bridge affects hydraulic performance, the results of the evaluation may be used to inform maintenance activities such as removing debris from the opening or clearing woody debris from the stream channel to prevent clogging during future flood events.

The Main Street bridge has an opening height of 8.9 feet, an opening width of 22.9 feet, and an effective area of 1,203.8 square feet. This was confirmed with field measurements. Under baseline conditions with no blockage, the bridge will pass the 10-year discharge but overtops at the 50-year event and greater. To simulate blockage, the bottom and top of the bridge opening were raised and lowered by the same amount. The modeling scenarios to simulate obstruction of the Main Street bridge are given in the table below (Table 4-7).

TABLE 4-7
Obstruction Scenarios for the Main Street Bridge over Sawmill Creek

Percent Obstructed (%)	Bridge Opening Height (feet)	Bridge Opening Width (feet)	Bridge Opening Area (square feet)
0	8.9	22.9	203.8
10	8.1	22.9	185.5
25	6.7	22.9	153.4
50	4.5	22.9	103.1

The results of the hydraulic modeling indicate that the bridge can easily accommodate the 10-year discharge under conditions where it is obstructed to 10 percent and 25 percent of its opening height. When the opening is 50 percent blocked, the water surface elevation hits the lower deck of the existing bridge. However, the bridge is still able to pass the 10-year flow (Figure 4-11). Baseline hydraulic modeling has previously shown that the Main Street bridge overtops at the 50-year discharge. Obstruction of the bridge at this discharge increases the height of the water overtopping the bridge. When the structure is 10%, 25%, and 50% blocked, the increases in water surface elevation are 0.2 feet, 0.6 feet, and 1.2 feet, respectively (Figure 4-12).

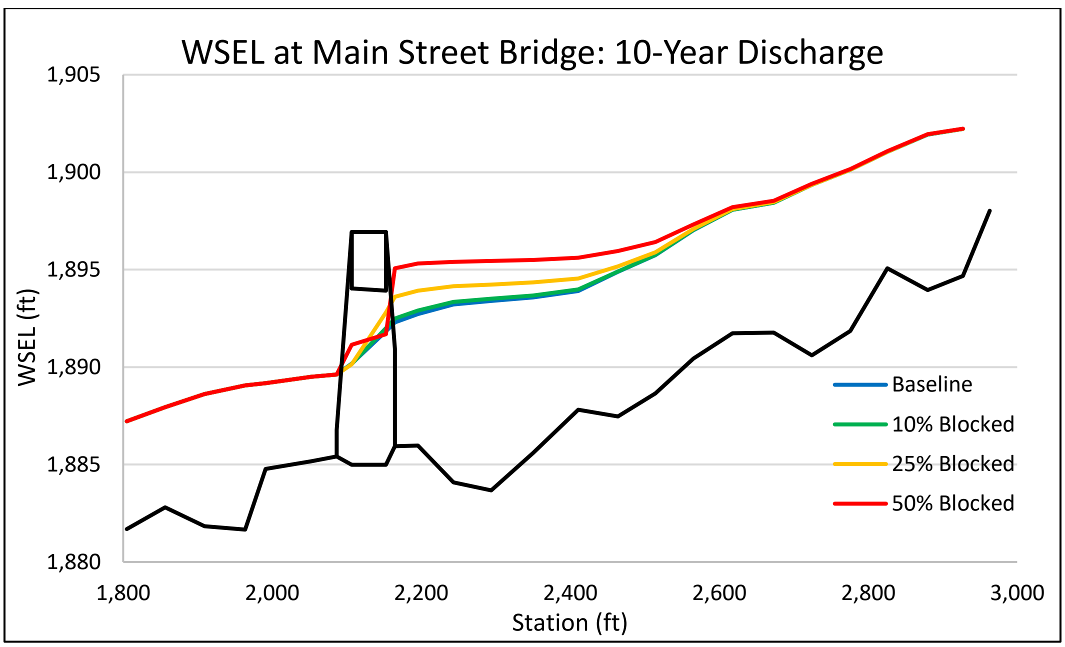

Figure 4-11
Water Surface Elevations for the 10-Year Discharge at the Main Street Bridge

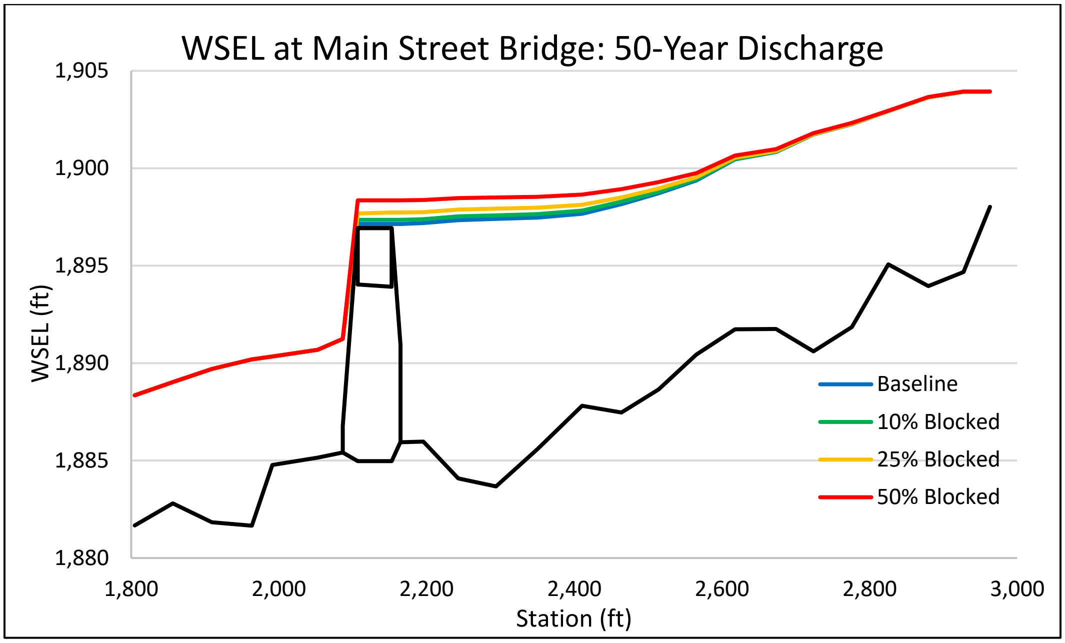

Figure 4-12
Water Surface Elevations for the 50-Year Discharge at the Main Street Bridge

In summary, the Main Street bridge can pass the 10-year discharge even when the opening height is reduced by 50 percent. In contrast, the bridge is overtopped during the 50-year discharge under baseline conditions without any obstruction. There are discharges between the 10-year and 50-year recurrence intervals where blockage of the bridge will cause the structure to be overtopped.

It is recommended that the bridge opening be inspected and kept free of woody debris. The channel bed should be inspected for sediment aggradation at least every 2 years and also immediately following flood events. When removal of sediment at the bridge is necessary, a methodology should be developed to maintain the proper channel dimensions and slope. This is crucial to avoid destabilizing the physical channel, which could have long-term effects. In order to reduce the volume of woody debris entering the channel, an assessment of the upstream channel and, if necessary, bank stabilization techniques to reduce channel instability and the input of woody debris is recommended.

4.6 Floodplain Enhancement

There are four watercourses through the Village of Tannersville (Gooseberry Creek, Sawmill Creek, Allen Brook, and the tributary to Allen Brook). The main source of serious flood damage is Sawmill Creek. This was clearly expressed by the FAC as well as members of the local community. The extensive flood damage that occurred along the Sawmill Creek corridor during Tropical Storm Irene has been well documented in both photos and video.

Historic 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 Sawmill Creek. Dense development and placement of fill in the natural floodplain of a river can severely hinder a river's ability to convey floodflows 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 removal of 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 floodflow conveyance. These excavated areas are sometimes referred to as floodplain benches.

Figure 4-13 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.

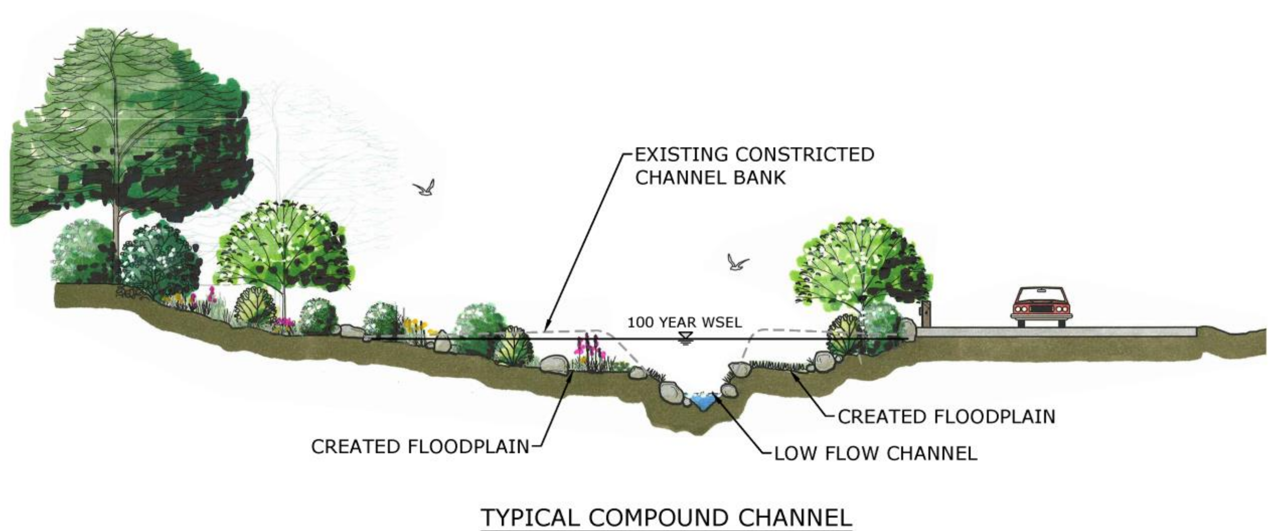

Figure 4-13
Cross Section of a Compound Channel

Based on the concerns of the community, several floodplain enhancement scenarios were put forward, focusing on the reach of Sawmill Creek that begins upstream of the Main Street bridge and continues to its confluence with Gooseberry Creek. These scenarios are depicted on Figure 4-14 and described in more detail below.

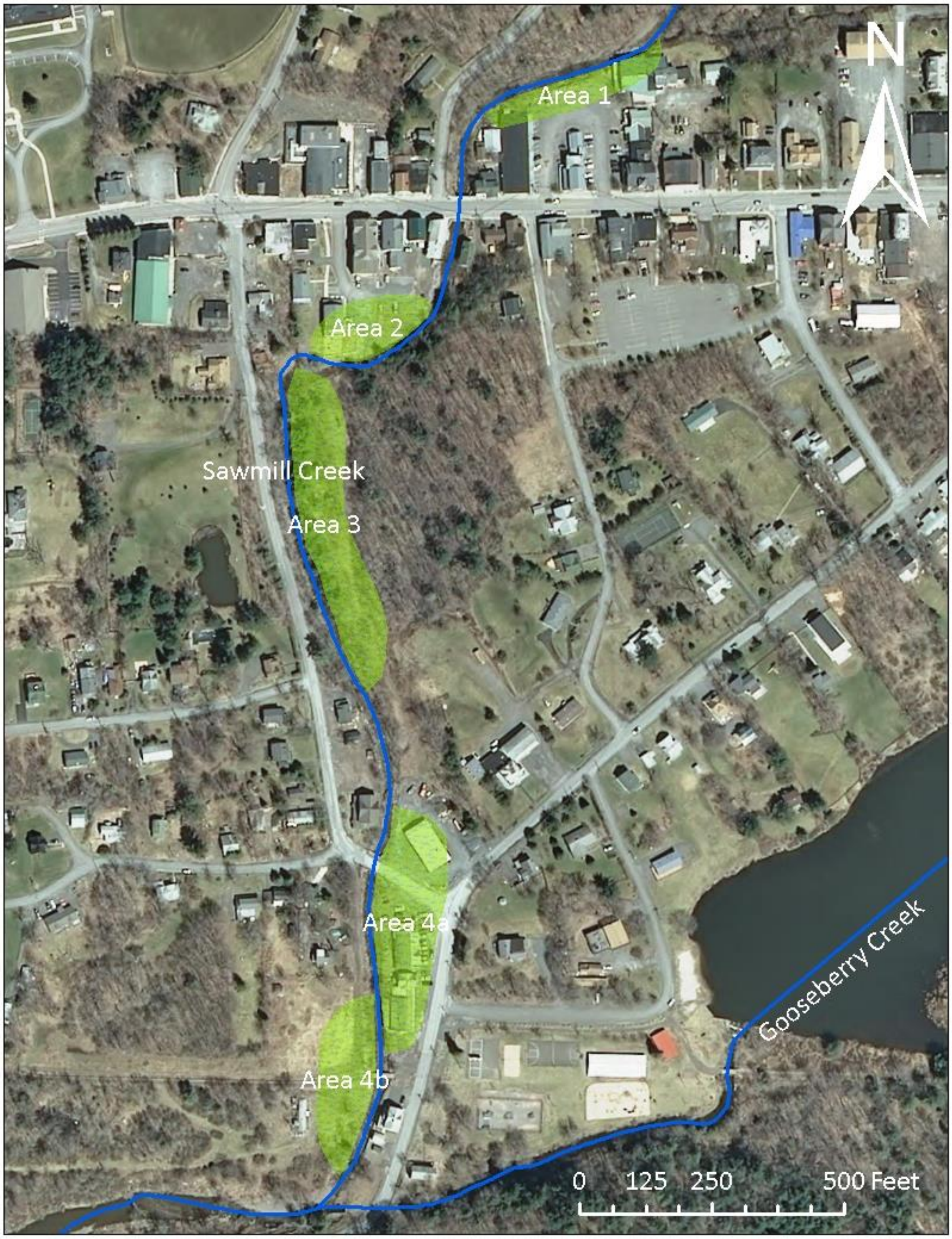

Figure 4-14
Areas of Floodplain Enhancement along Sawmill Creek

4.6.1 Floodplain Enhancement Scenario 1

This scenario would entail creation of floodplain enhancement along the left bank of Sawmill Creek in the Bear Square Plaza parking lot (Area 1 on Figure 4-14). This scenario would likely require the removal of one or two of the buildings in the plaza. The goal of this alternative was to reduce water surface elevations between Bear Square Plaza and the Main Street bridge in order to alleviate flooding of businesses in the plaza and to prevent overtopping of the Main Street bridge at discharges equal to and less than the 50-year event. During the July FAC meeting, there was a general consensus from the committee that this floodplain bench alternative would not be feasible since it calls for the removal of current businesses and crucial parking area. Therefore, this alternative was not assessed further.

4.6.2 Floodplain Enhancement Scenario 2

This scenario would involve the creation of a floodplain bench on the right bank of the creek where the GCSWCD parking lot is currently located (Area 2 on Figure 4-14). This alternative would require the relocation of the GCSWCD building and the possible relocation of a second structure. The intended purpose would be to reduce floodwater levels in the parking lot and mitigate flooding at the rear of the businesses that face Main Street.

Hydraulic modeling indicates that enhancement of the floodplain in this area would result in water surface elevation reductions ranging from 0.0 to 0.4 feet during the 10-year flood event, with no major benefits further upstream (Figure 4-15). During the 50-year flood event, water surface elevation reductions ranged from 0.2 to 0.4 feet, with minor inundation reductions in flooding along the backs of buildings that front on the south side of Main Street (Figure 4-16). Results in the 100-year flood event were similar to those from the 50-year flood event (Figure 4-17).

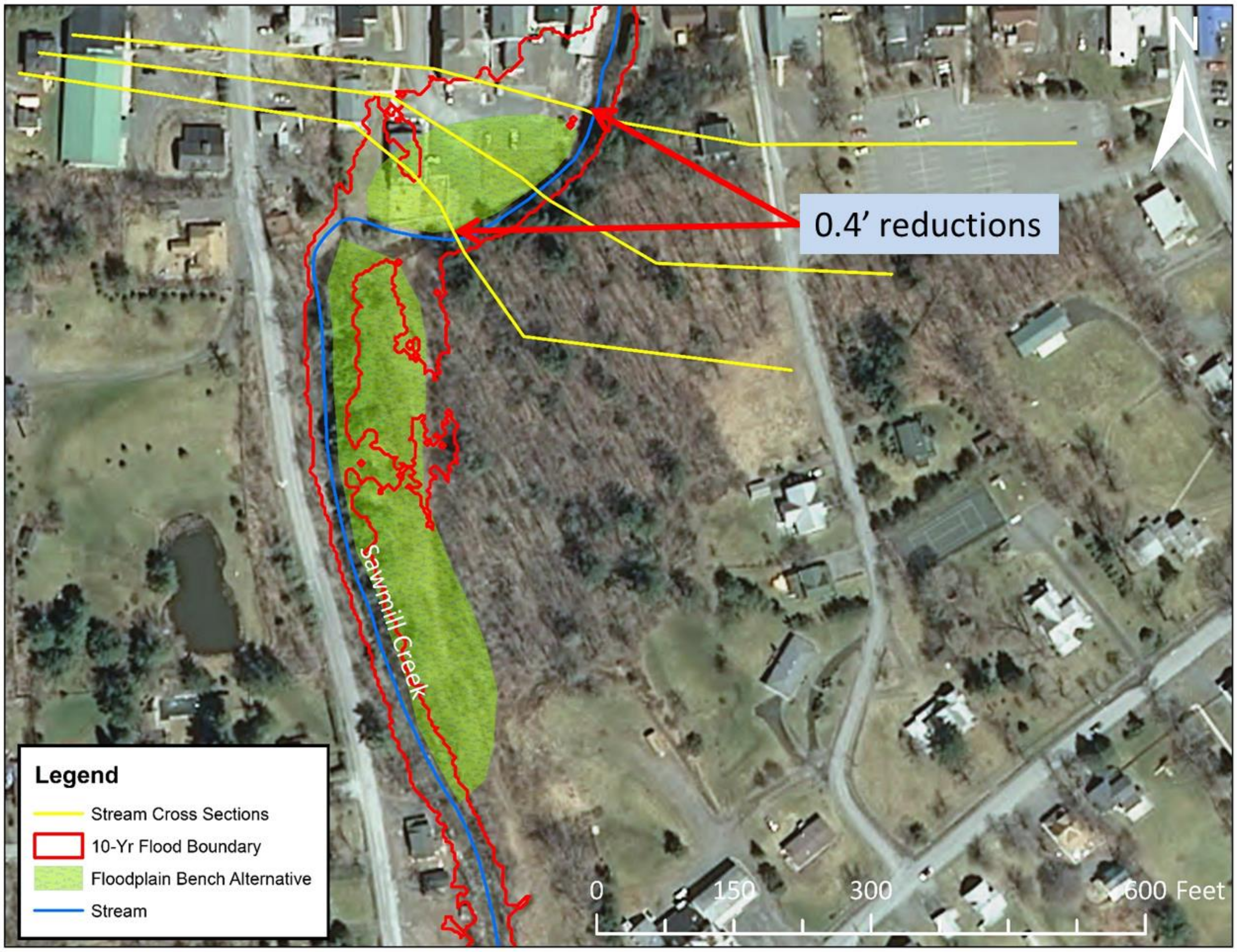

Figure 4-15
Floodplain Enhancement Scenario 2 – 10-Year Flood Event

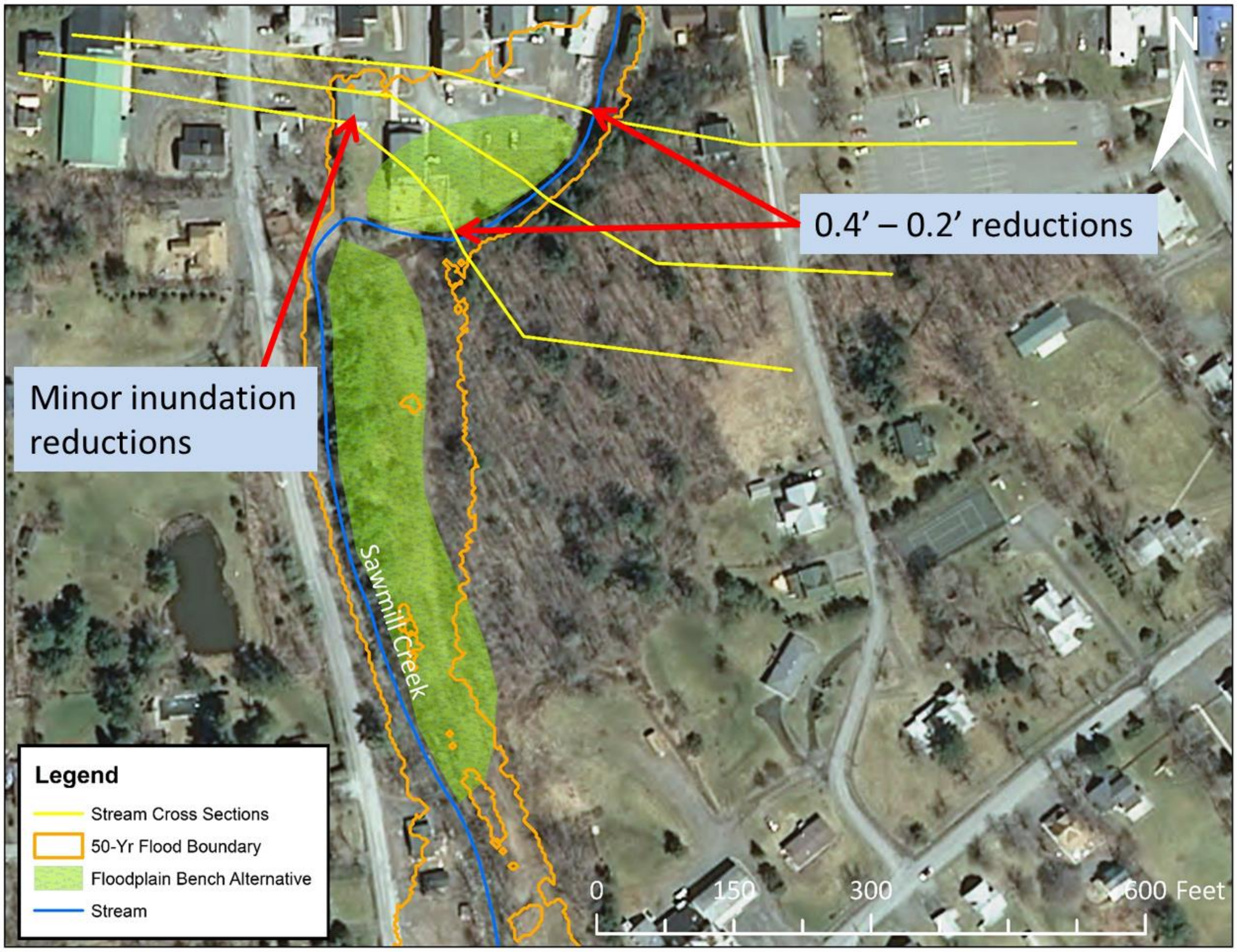

Figure 4-16
Floodplain Enhancement Scenario 2 – 50-Year Flood Event

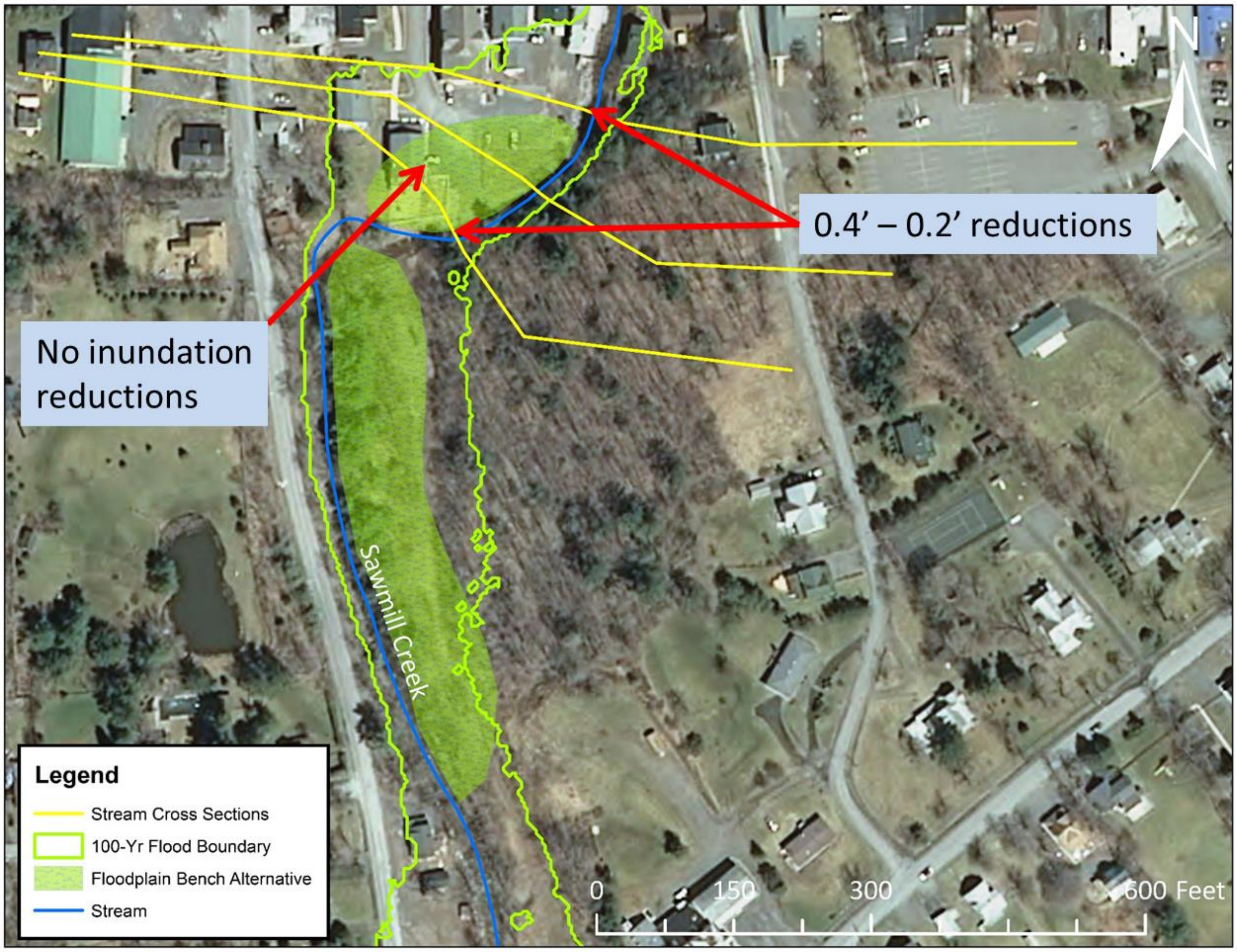

Figure 4-17
Floodplain Enhancement Scenario 2 – 100-Year Flood Event

4.6.3 Floodplain Enhancement Scenario 3

This scenario is the same as Scenario 2 with the addition of a floodplain enhancement on the left bank of Sawmill Creek. The floodplain enhancement would begin at the downstream end of the GCSWCD parking lot and extend downstream a distance of approximately 650 feet (Areas 2 and 3 on Figure 4-14). The goal of this alternative would be to lower flood elevations in the area of the GCSWCD parking lot and reduce the inundation of structures located on the left and right banks upstream of the Railroad Avenue bridge. A potential secondary benefit would be the lowering of flow velocities and shear stress in the channel along Railroad Avenue where active bank erosion is occurring.

The hydraulic model showed water surface elevation reductions of between 0.4 and 1.2 feet at the GCSWCD parking lot and reductions between 0.3 to 0.5 feet across Area 3 during the 10-year flood event (Figure 5-18). Reductions were slightly greater during the 50-year (Figure 5-19) and 100-year (Figure 4-20) flood events. These reductions do not provide any real benefit to homes upstream or further downstream along Railroad Avenue. The Area 2 floodplain reduced stream velocities by between 0.7 and 1.1 feet per second on average for the various flood events.

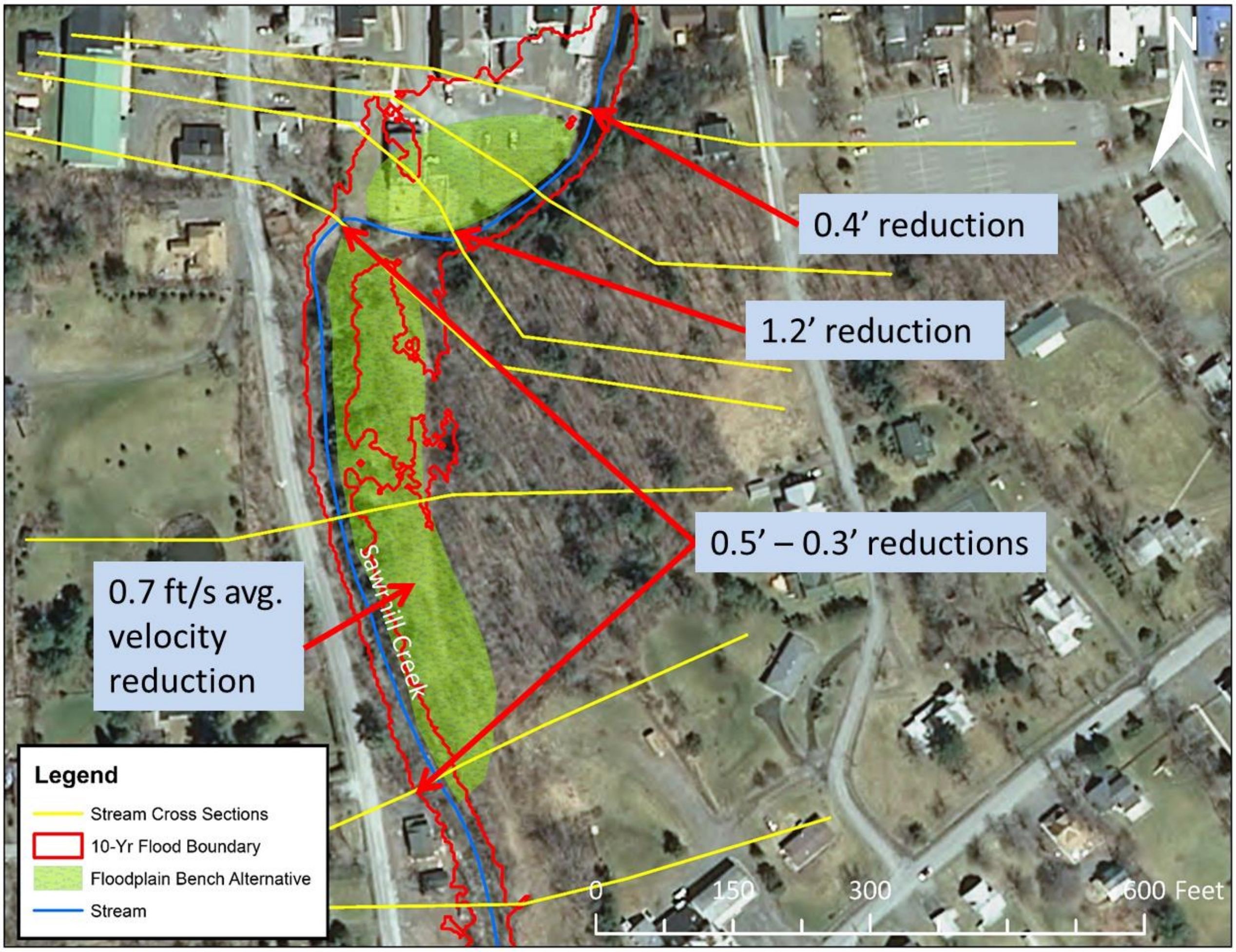

Figure 4-18
Floodplain Enhancement Scenario 3 – 10-Year Flood Event

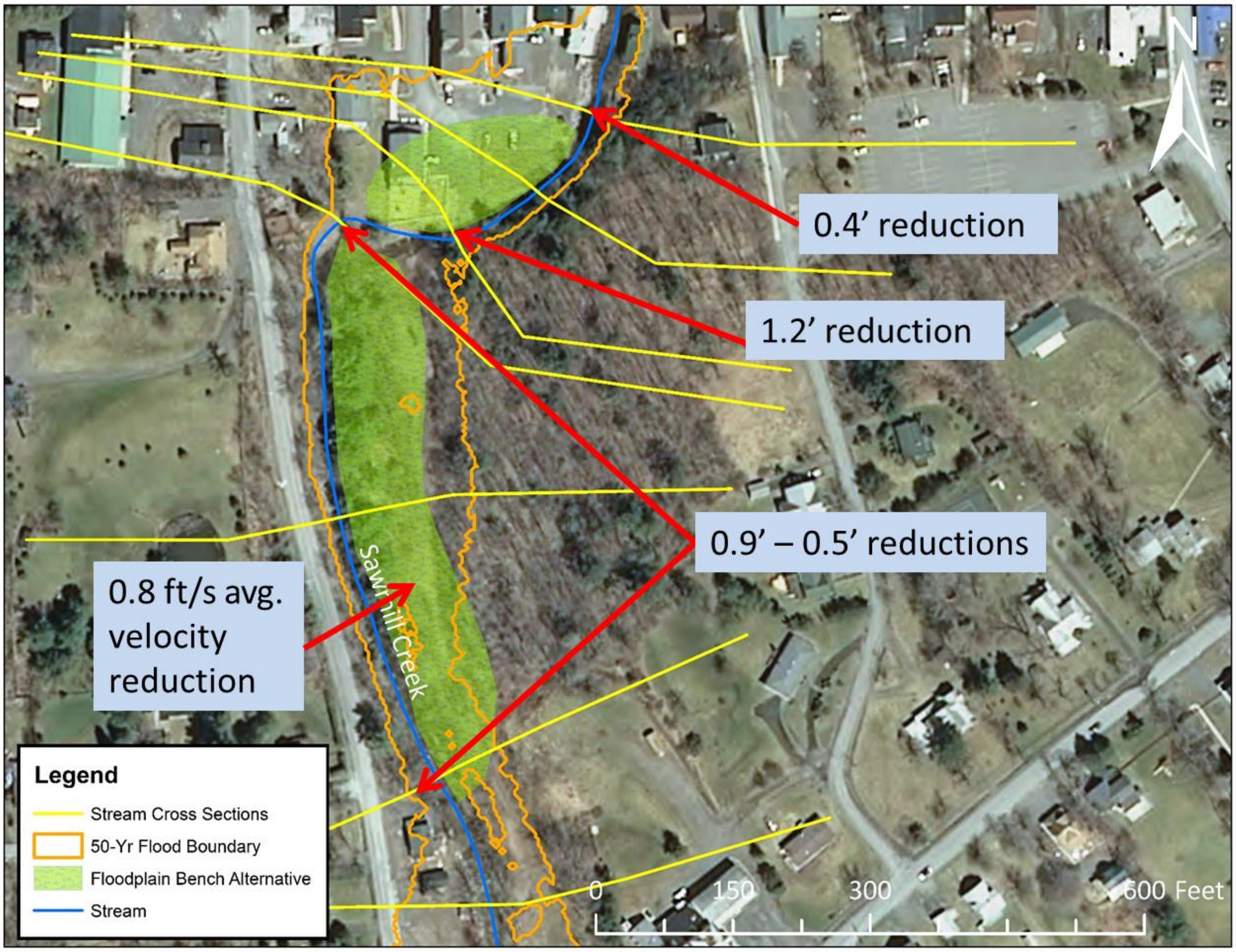

Figure 4-19
Floodplain Enhancement Scenario 3 – 50-Year Flood Event

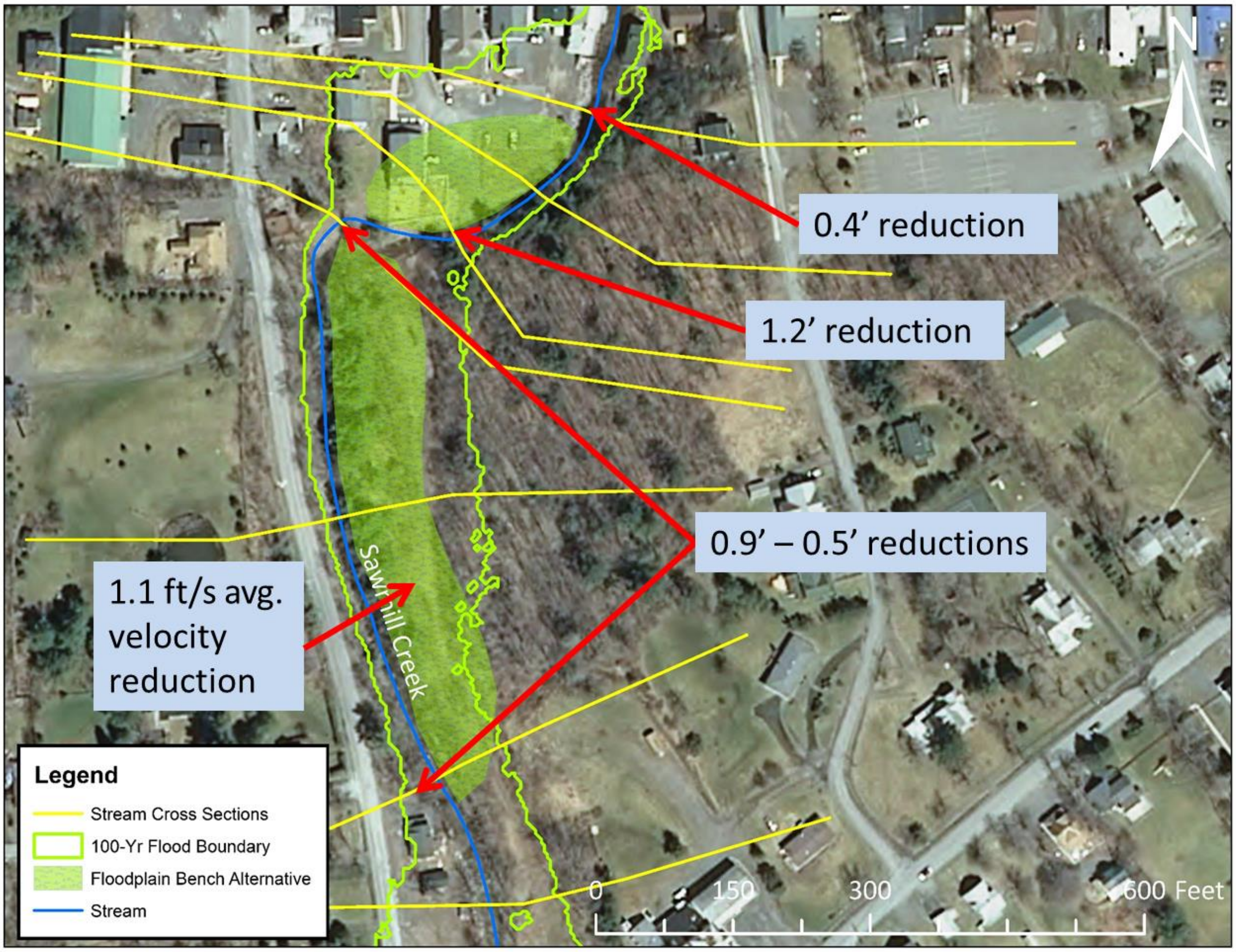

Figure 4-20
Floodplain Enhancement Scenario 3 – 100-Year Flood Event

4.6.4 Floodplain Enhancement Scenario 4

This alternative would involve the creation of two floodplain benches along the lower end of Sawmill Creek. The first floodplain is located along the left bank extending from the DPW garage to the former Mountain Eagle News building, a distance of 480 feet (Area 4a on Figure 4-14). The second floodplain would be constructed on the right bank beginning at the upstream end of the Mountain Eagle News building and continuing almost to the confluence with Gooseberry Creek (Area 4b on Figure 4-14). This floodplain bench would be 360 feet in length. Construction of this alternative would require the relocation of the DPW garage, Legg's Garage, and the Mountain Eagle News building. The objective is to alleviate flooding primarily along the left bank of Sawmill Creek between Railroad Avenue and the confluence.

This combination of floodplain enhancements would result in reductions in water surface elevations and an elimination of flooding along some sections of Railroad Avenue. Flood depths decreased by between 0.4 to 1.9 feet across the area and relieved a few homes from flooding. The floodplain enhancements eliminated flooding on Lake Road during the 50- and 100-year storm events; however, waters from

Gooseberry Creek will still flood this area. Figures 4-21, 4-22, and 4-23 show reductions in flood elevations during the 10-, 50-, and 100-year flood events, respectively.

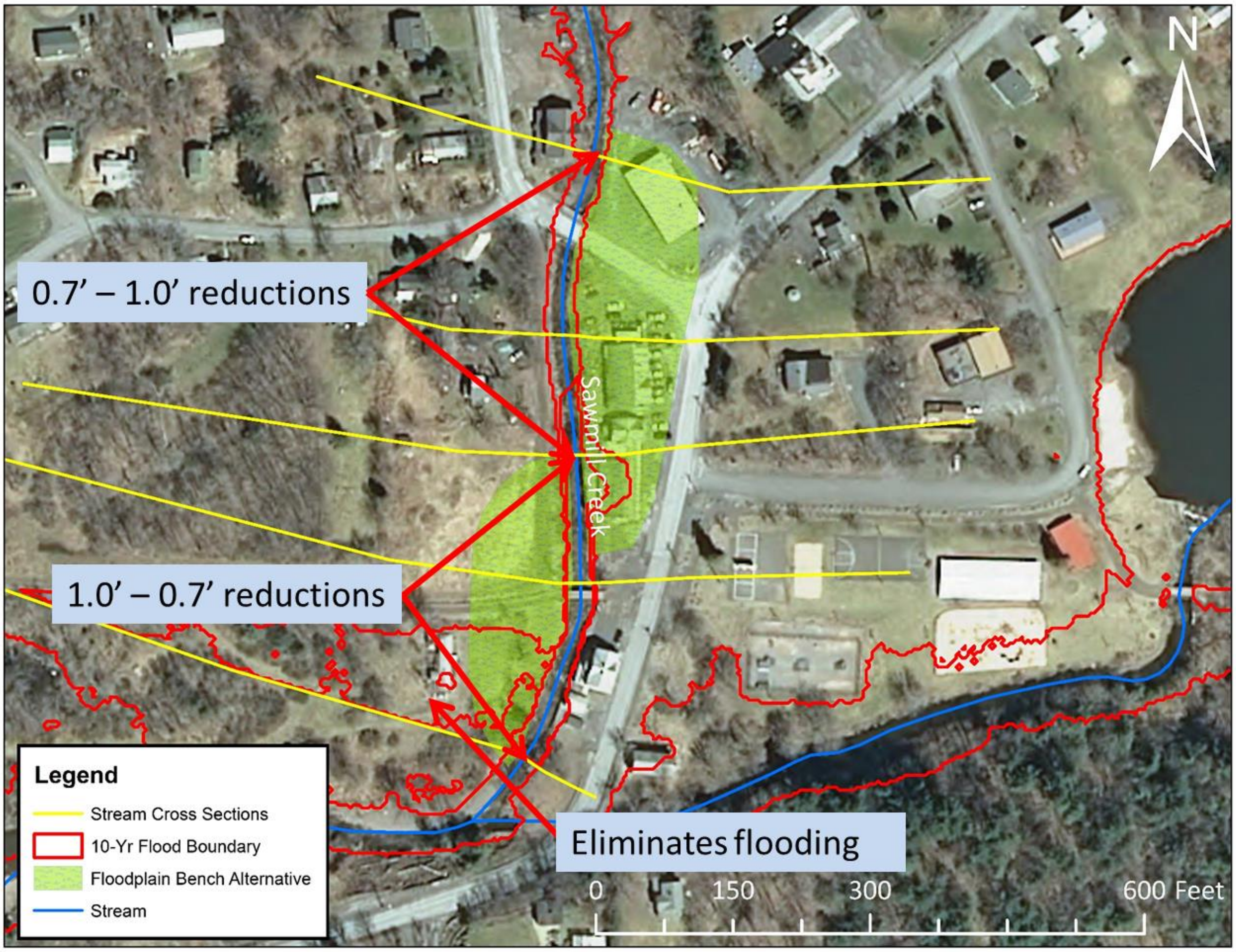

Figure 4-21
Floodplain Enhancement Scenario 4 – 10-Year Flood Event

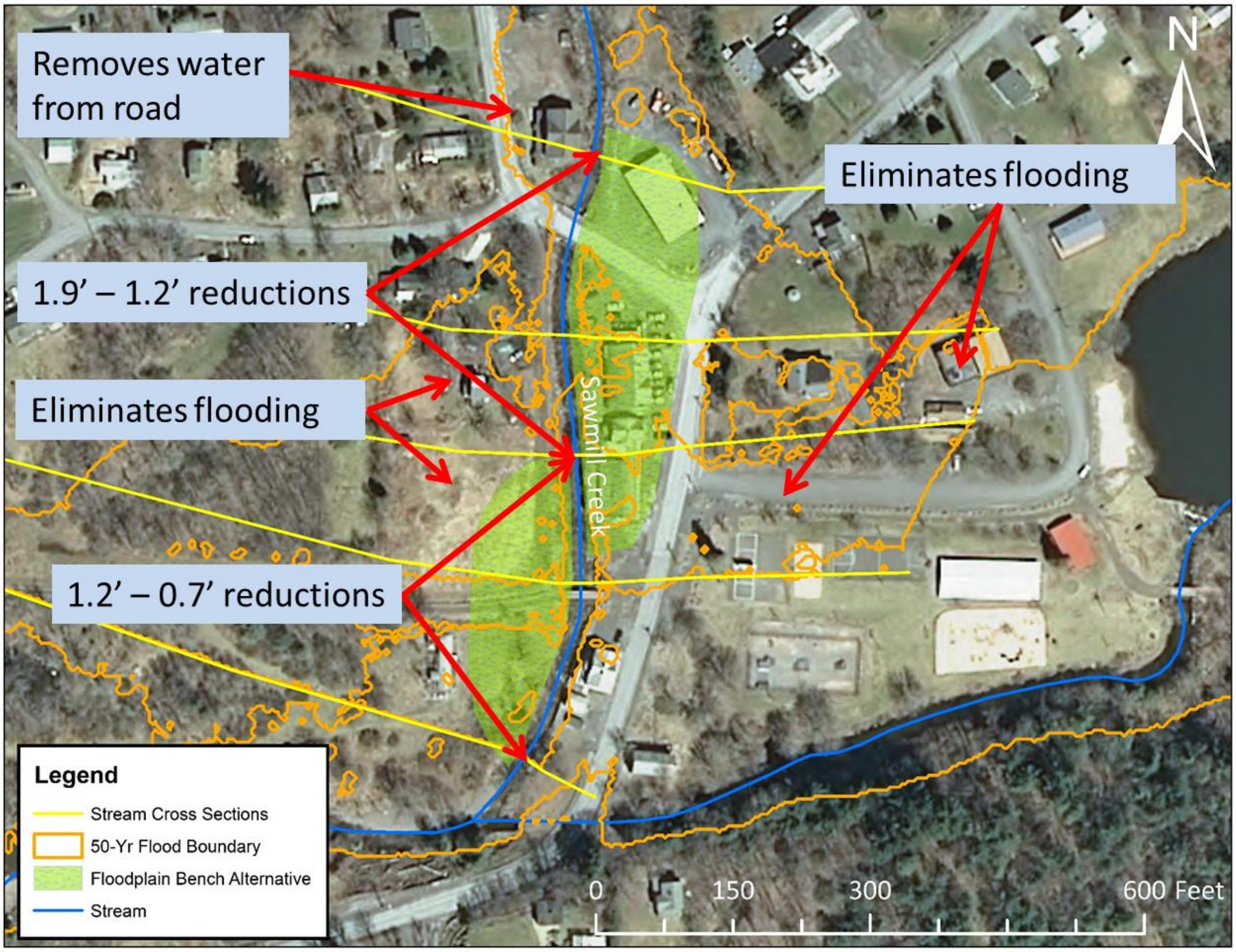

Figure 4-22
Floodplain Enhancement Scenario 4 – 50-Year Flood Event

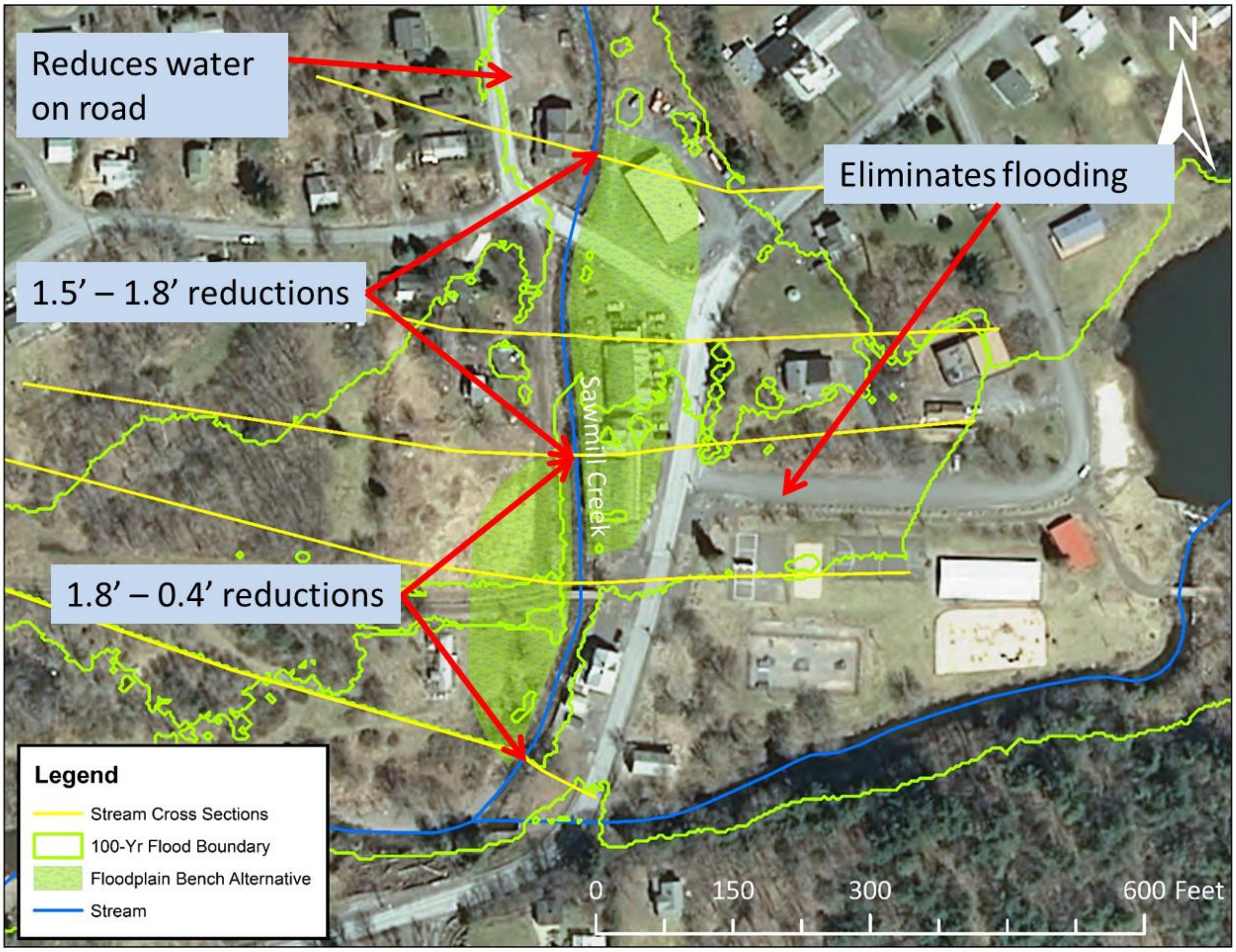

Figure 4-23
Floodplain Enhancement Scenario 4 – 100-Year Flood Event

In the above analysis of floodplain enhancement scenarios, a range of floodplain enhancement scenarios were evaluated along Sawmill Creek. These would require extensive earthwork, would be quite costly and disruptive to the village, and would result in relatively minor reductions in flooding. Also, in several cases, the most floodprone structures would need to be removed in order to construct the floodplain enhancement projects, thereby negating any flood reduction benefits. For these reasons, floodplain enhancement is not recommended. If some or all of the structures are removed in the future, restoration of the individual properties to create or improve floodplain habitat is recommended.

4.7 Flood Attenuation through Stormwater Storage

Another flood mitigation alternative considered the potential use of Lake Rip Van Winkle for floodwater storage and flow attenuation during severe storms. Information on water depth and volume in Lake Rip Van Winkle was obtained from River Stream Planning & Development (Figure 4-24). For the purpose of this analysis, it was assumed that the Village of Tannersville would construct a control structure at the lake outlet and would have ample time prior to the arrival of a storm to draw down the water level in the lake. A storage calculation was conducted for a 24-hour duration, 100-year rainfall event, and it was determined that the lake could capture approximately 14 percent of the total watershed runoff volume. Potential storage was then also calculated at the 10- and 50-year recurrence intervals. A summary of the results is displayed in the table below (Table 4-8).

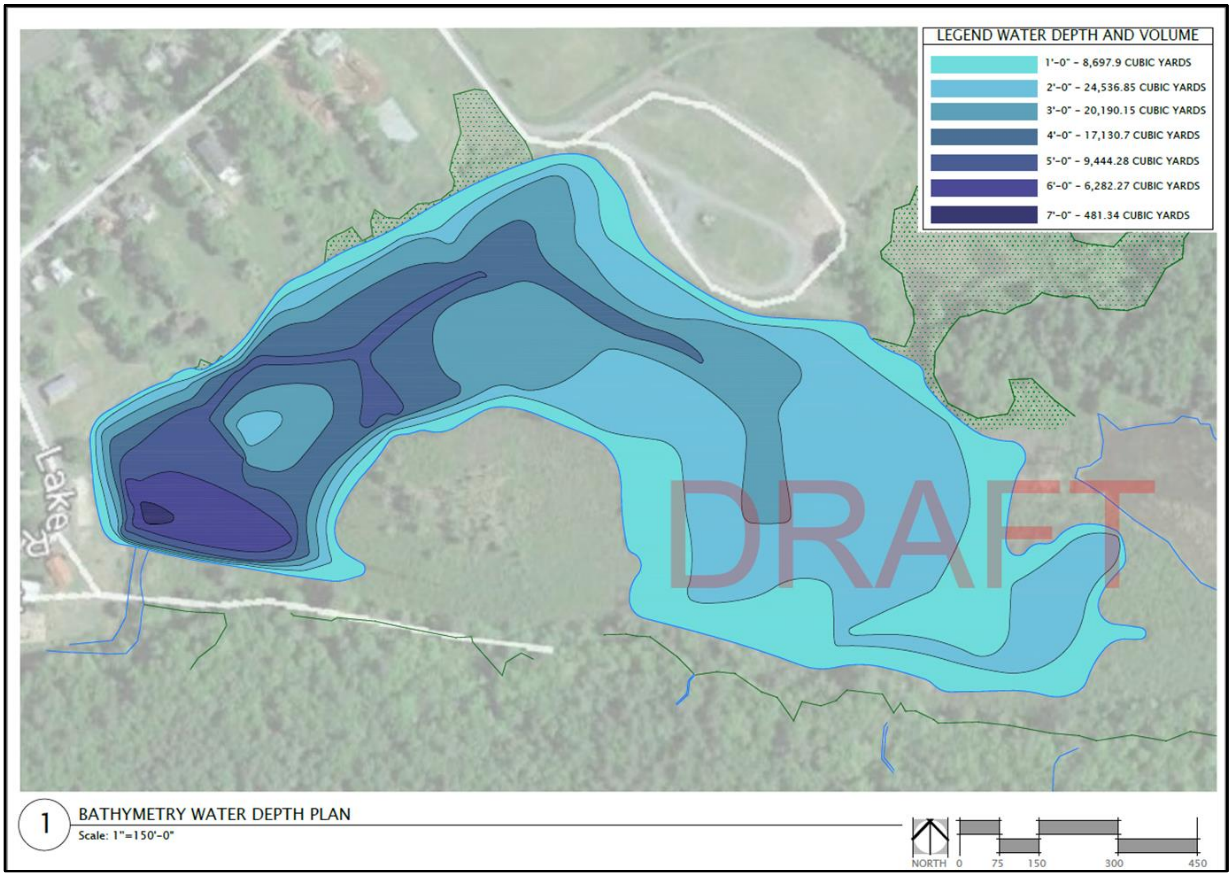

Figure 4-24
Lake Rip Van Winkle Water Depth and Volume
(Provided by River Stream Planning & Development)

TABLE 4-8
Lake Rip Van Winkle Potential Runoff Storage (24-Hour Duration)

Recurrence interval	Rainfall Amount (inch)	Watershed Runoff (yard³)	Lake Storage (yard³)	Storage (%)
10-year	7.08	500,758	86,763	17%
50-year	9.98	705,871	86,763	12%
100-year	11.20	792,160	86,763	11%

An assessment of potential flow reductions was then conducted. Discharge amounts at the confluence of Sawmill and Gooseberry Creeks were gathered from the 2015 Greene County FEMA FIS. These flows were then compared to the attenuation that Lake Rip Van Winkle would provide for a 24-hour rainfall event at the 10-, 50-, and 100-year recurrence intervals. As seen in Table 4-9, the results reveal minimal runoff storage and no significant reductions in flows.

TABLE 4-9
Lake Rip Van Winkle Flow Attenuation (24-Hour Duration)

Recurrence Interval	Peak Discharge (cfs)	Attenuated Flow (cfs)	Flow Reduction (%)
10-year	902	875	3.0%
50-year	1,821	1,794	1.5%
100-year	2,337	2,310	1.2%

The results of the above analysis indicate that there would be very little reduction in downstream peak stream flow if the village were to modify the outlet at Lake Rip Van Winkle and use the lake for floodwater storage purposes. The inherent uncertainty in accurately predicting major storm events could potentially lead to "false alarms" when the lake is preemptively drained. The village would be required to forgo use of its recreational lake whenever a major storm is anticipated. Additionally, Lake Rip Van Winkle is mapped by the NYSDEC as a regulated freshwater wetland, with portions of the lake also mapped as wetland ecosystems by the National Wetland Inventory. Draining of the lake would require a Freshwater Wetland permit from the NYSDEC and a federal permit from the USACE. Based on the above analysis, it was determined that the cost and operational effort of using Lake Rip Van Winkle for floodwater storage outweighs any minimal downstream flood mitigation benefits that would be derived.

4.8 Buyout and Relocation Scenarios

The flood mitigation approaches that were analyzed in the sections above seek to reduce or eliminate flood damages by reducing water surface elevations. In the section that follows, scenarios involving the buyout and relocation of floodprone homes and businesses are explored.

4.8.1 Village of Tannersville Highway Garage

The Village of Tannersville Highway Department garage is located on Railroad Avenue, close to Sawmill Creek and within the SFHA. The highway garage is a critical facility and provides essential services to the village, especially during flood events and other emergencies. The garage and surrounding parking and equipment storage areas were severely flooded during Tropical Storm Irene. Figures 4-25 and 4-26 show the damaged highway garage and surrounding area on the day following Tropical Storm Irene. The Tannersville Highway Superintendent has indicated that the flood caused the walls of the highway garage to move and the roof to buckle.

A report by Lamont Engineers (appended) details the results of an inspection of the highway garage building conducted in October 2017. The report is summarized below:

- The existing building is an 80-foot by 40-foot pre-engineered steel-framed building constructed in the late 1980s.
- Approximately 1/3 of the building is used as office/workspace area, and the remaining 2/3 is used as a truck bay/equipment storage area.

- An observable "mud" waterline is visible on the walls approximately 30 inches above the finished floor of the building.
- No floodproof containment of diesel fuel, gasoline, or road materials stored within or at the site is provided; therefore, any flood event will likely convey these materials into the surrounding environment or into the building's interior.
- The structure is approximately 30 years old. The useful life of a highway garage is generally 40 years.

Based on tax assessor information made available by Greene County, adjusted for equalization, the highway garage parcel is assessed at $190,132. The land, adjusted for equalization, is assessed at $34,714. The assessed value of the structure is $155,418.

The Lamont report describes a number of deficiencies and includes an engineer's opinion of probable cost of $212,500 to repair or mitigate the deficiencies identified. The report also includes an estimate to construct a new, pre-engineered steel-framed building similar to the existing highway garage, in the amount of $448,000. It states the opinion that while the current condition of the building does not present an imminent threat to health and safety failure to make repairs/improvements to the building could eventually compromise the integrity of the structure.

The report states that the recommended improvements are only intended to repair existing damage and will not mitigate future flooding. It also states that relocation of the highway garage to another site out of the floodplain is the only way to mitigate future flood damage.

The report concludes by stating that the repair costs for a building at this location exceed the capital costs for the building (which excludes the cost of flood damaged equipment and lost materials), which indicates that the continued use of a structure at this site is cost prohibitive to the village.

Figure 4-25
Tannersville Highway Department Garage following Tropical Storm Irene

Figure 4-26
Tannersville Highway Department Garage following Tropical Storm Irene

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. Flooding is known to cause impaired water quality. Reduction of flooding reduces water quality impairment by reducing the area of land and buildings exposed to floodwaters and by reducing the depth and velocity of floodwaters that mobilize pollutants.

The Tannersville Highway Department garage stores the following materials on a regular basis:

- 275 gallons of diesel fuel
- Approximately 35 gallons of waste oil
- 55-gallon drums of hydraulic oil, windshield fluid, antifreeze
- 500 gallons of gasoline
- 500- to 1,000-gallon underground storage tank for heating oil
- 110 gallons of motor oil
- Other products like cold patch (for roads), paint thinners, spray paint

By removing these potential pollutants out of the floodprone SFHA, the relocation of the Highway Department garage would provide water-quality-related benefits.

Based on the information presented above, it is recommended that the Village of Tannersville Highway Department garage be relocated to a location outside the SFHA.

4.8.2 Structures Located within the FEMA Floodway

Several structures, some occupied and some abandoned, were identified in Tannersville that are located fully or partially within the floodway (Figure 4-27). The floodway, designated by FEMA, is the stream channel, and that portion of the adjacent floodplain 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). Where there is owner interest and programmatic funding available, it is recommended that existing structures be relocated out of the FEMA-designated floodway. 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. It is also recommended that any new development or elevation of existing structures in the floodway be disallowed.

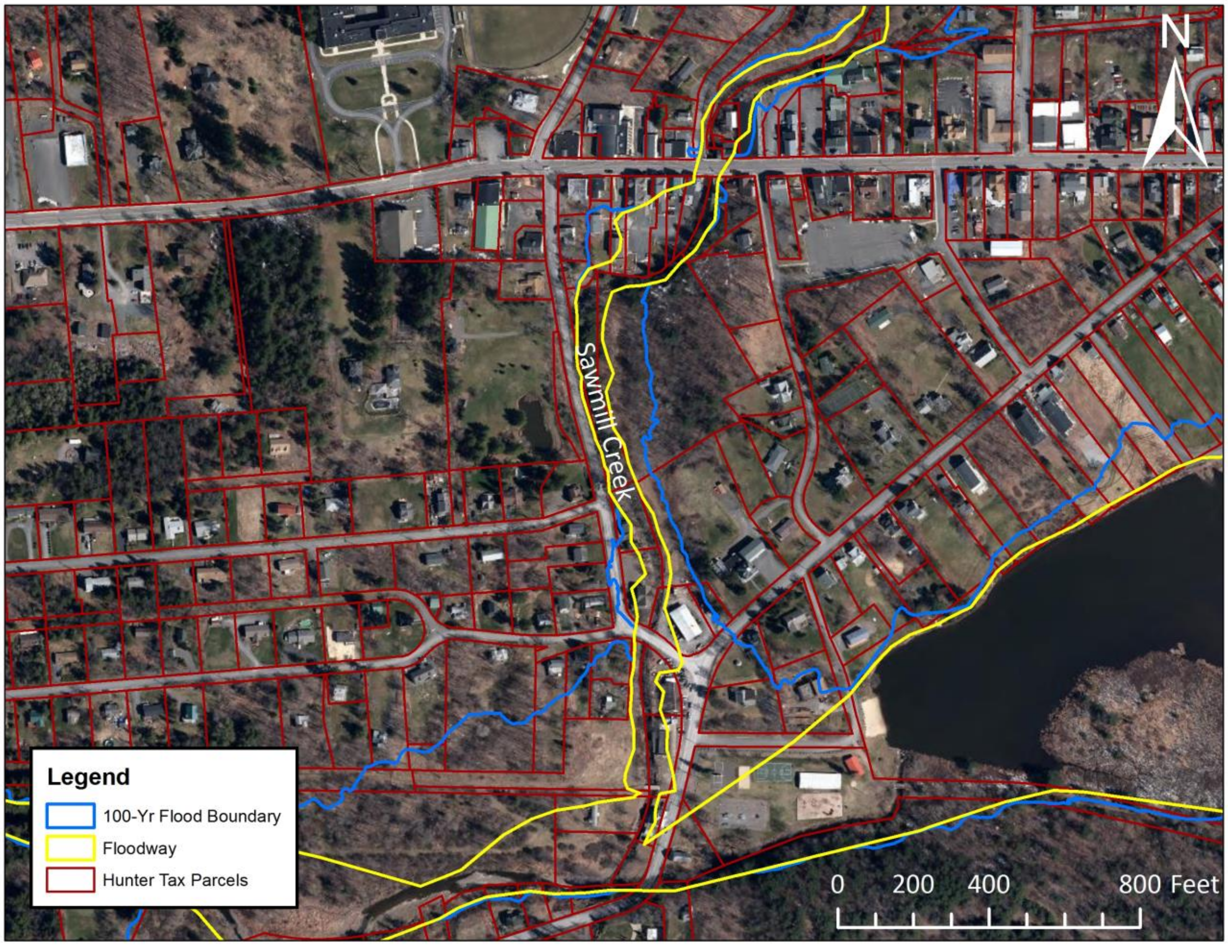

Figure 4-27
Map of Tannersville showing FEMA Floodway

4.8.3 Structures Located within the FEMA SFHA

The homes and businesses located within the SFHA in Tannersville 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. In order to evaluate the level of flood risk for individual structures within the SFHA in Tannersville, MMI conducted a Benefit-Cost Analysis (BCA) and calculated a Benefit-Cost Ratio (BCR) for each structure. The BCR is a numerical expression of the cost effectiveness of a project. This is discussed in more detail in the BCA section of this report.

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 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 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, 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?

The BCA was conducted to evaluate the economic feasibility of acquiring properties under a buyout program so that their respective structure or structures could be removed from the floodplain. 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 for the Village of Tannersville.
- Building information (area, basement, number of stories, etc.) came primarily from the Greene County Parcel Viewer. Where necessary, this information was supplemented from 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 of 56.75 percent 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.

A BCA was conducted for potentially floodprone properties located in the lower reach of Sawmill Creek. The assessed properties were selected based on the FAC priority and included commercial structures such as the Village of Tannersville Highway Department garage and a privately owned automotive garage as well as residential structures. The BCA analyses do not include benefits that could have been generated for avoiding future street cleanup, avoided detours, avoided emergency response, etc.

5.2 BCA Results

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.

Based on input from the FAC, BCRs for individual properties are not provided in this report. The BCRs for the assessed residential structures ranged from a low of 0.05 to a high of 0.13. BCRs for commercial buildings ranged from 0.11 to 0.15. Using these results alone, it is unlikely that any of the assessed structures would qualify for buyout funding. It should be noted that BCRs would likely increase if information was available on damages incurred during floods other than Tropical Storm Irene. It is recommended that the Village of Tannersville continue to work with GCSWCD to gather flood damage information in Tannersville. If information gathered about previous flood damages support the removal of a structure from the SFHA, it is recommended that the village work to relocate these uses where there is owner interest and programmatic funding available through flood buyout and relocation programs.

6.0 FINDINGS AND RECOMMENDATIONS

The purpose of this LFA is to evaluate potential flood mitigation options within the Village of Tannersville. The village experienced extensive flooding and devastation during Tropical Storm Irene in 2011. A range of flood mitigation alternatives were evaluated, including the replacement of undersized bridges, removing sediment and debris from bridge openings, floodplain enhancement, storage of stormwater runoff, and relocation of floodprone homes and businesses. Flood mitigation alternatives were evaluated using hydraulic modeling and BCA.

6.1 Flood Mitigation Recommendations

The following flood mitigation recommendations are offered:

6.1.1 Relocation of Village Highway Department Garage

The relocation of the Village of Tannersville Highway Department garage out of the SFHA is recommended. In its current configuration, the facility is located within the SFHA and was flooded in Tropical Storm Irene with substantial damage to the structure. In addition to eliminating flood risks at the facility, the relocation would also result in benefits to water quality by removing potential pollutants from floodprone areas.

6.1.2 Bridges

Main Street Bridge over Sawmill Creek:

- This bridge was found to be undersized, and it overtops during the 50-year flood event. When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge is adequately sized.

- The bridge should be inspected for sediment aggradation at least every 1 to 2 years and also immediately following flood events.

- When removal of sediment at the bridge is necessary, a methodology should be developed to maintain the proper channel dimensions and slope. This is crucial to avoid destabilizing the physical channel, which could have long-term effects. As a starting point, the following guidelines are recommended:

    - Sediment excavation requires regulatory permits. Prior to initiation of any in-stream activities, NYSDEC should be contacted, and appropriate local, state, and federal permitting should be obtained.

    - Maintain the original channel slope, and do not overly deepen or widen the channel. Excavation should not extend beyond the channel's estimated bankfull width unless it is to match an even wider natural channel.

- Best available practices should be followed to control sedimentation and erosion of the streambed or bank, which may release fine-grained sediments that cause turbidity.

- Disposal of excavated sediments should always occur outside of the floodplain. If such materials are placed on the adjacent bank, they will be vulnerable to remobilization and redeposition during the next large storm event.

- No sediment excavation should be undertaken in areas where aquatic-based rare or endangered species are located.

- It is recommended that a channel assessment and, if necessary, bank stabilization be undertaken in Sawmill Creek upstream of the bridge to reduce channel instability and input of woody debris.

Railroad Avenue Bridge over Sawmill Creek:

- This bridge is capable of passing the 10-year flood event, but it overtops in the 50-year flood event. When the bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the bridge opening is adequately sized and that the new bridge spans the channel and floodplain.

Bridges along Gooseberry Creek:

- Bridges along Gooseberry Creek were assessed and found to overtop during the 10- or 25-year discharge events. None of these bridges were found to contribute to flooding of structures. When each bridge is scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that these bridge openings are adequately sized.

Proposed Pedestrian Bridges:

- If plans to pursue the construction of pedestrian bridges over Sawmill Creek move forward, hydraulic analysis is recommended to ensure that the structures do not contribute to flooding in the village. The following guidelines are offered:

  - Any new bridge should pass the 100-year storm with a margin of safety.
  - The bridge abutments should not encroach upon the FEMA regulatory floodway.
  - The bridge should span the floodplain as well as the channel.

6.1.3 Road Closures

Flooding of 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 over a roadway 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 roadways be reduced by temporarily closing floodprone roads during flooding events. This requires effective signage, road closure barriers, and consideration of alternative routes.

6.1.4 Road Protection Measures

Field inspection and reports from FAC members indicates that Railroad Avenue is at risk due to severe erosion and bank failure.

- An engineering analysis of the embankment and implementation of bank stabilization measures is recommended.

Figure 6-1
Eroded Hillslope along Railroad Avenue, Viewed from GCSWCD Building

6.1.5 Floodplain Enhancement

A range of floodplain enhancement scenarios were evaluated along Sawmill Creek. These did not result in significant reductions in flooding and are not recommended.

6.1.6 Stormwater Storage

An evaluation was conducted to assess the feasibility of storing floodwater in Lake Rip Van Winkle. This approach was considered unfeasible for a number of reasons. It did not result in significant reductions in flooding. It would necessitate renovations to the lake outlet dam along with construction of a drawdown structure. Regulatory permit approval would be required due to NYS regulated freshwater wetlands in the vicinity of the lake inlet. The lake would need to be drawn down pre-emptively when a flood is forecast, which may impact recreational uses. The use of Lake Rip Van Winkle for stormwater storage purposes is not recommended.

6.1.7 Structures within FEMA Floodway

Several structures, some occupied and some abandoned, were identified that are located within the floodway. The floodway designated by FEMA is the stream channel, and that portion of the adjacent floodplain 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 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.
- Disallow new development in the floodway and require new construction within the SFHA to meet NFIP criteria.
- Disallow elevation of existing structures in the floodway.

6.1.8 Floodprone Structures within FEMA's SFHA

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

- It is recommended that the village work to 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 6-2) and residential (Figure 6-3) properties.

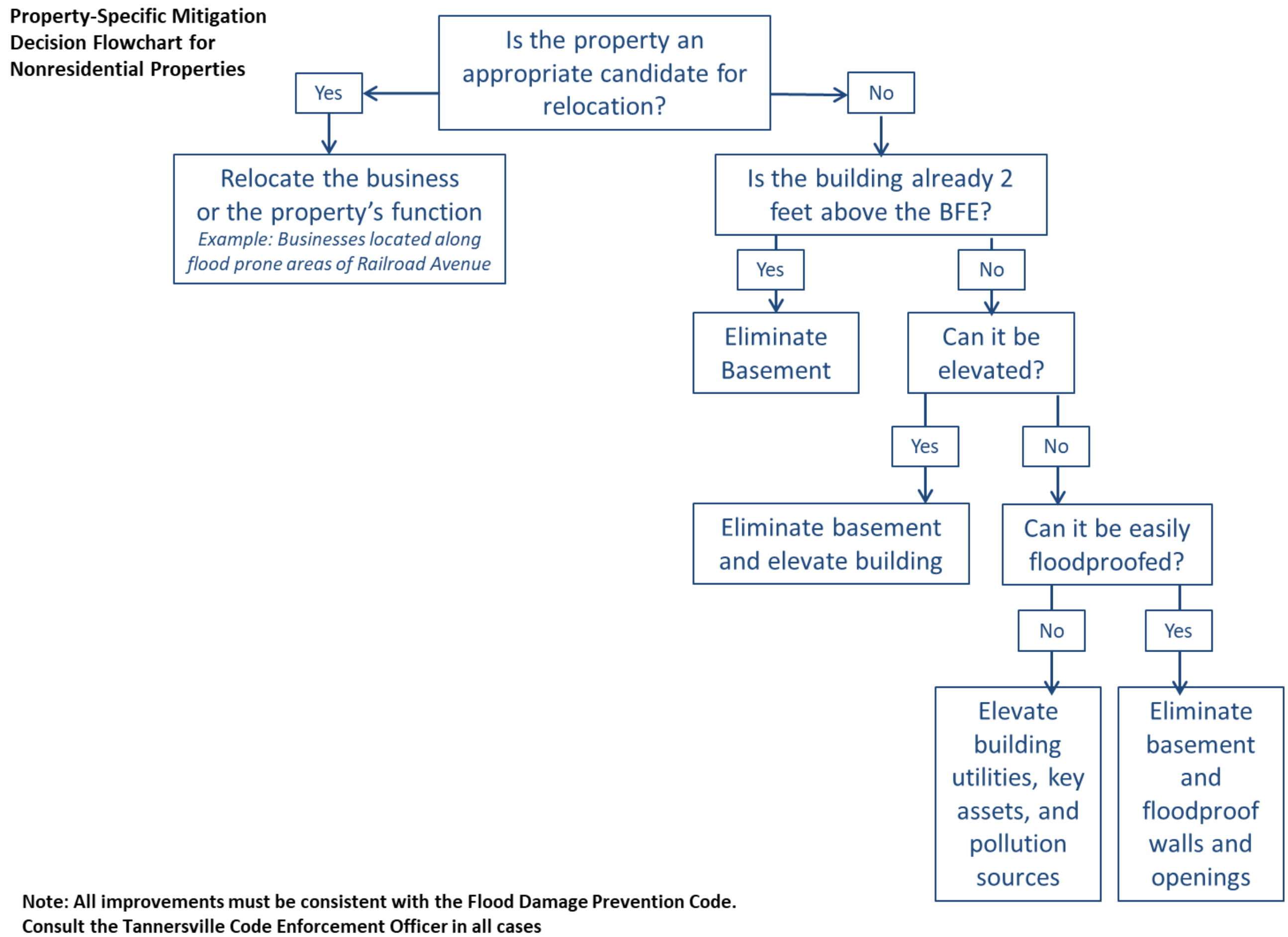

Figure 6-2
Property-Specific Mitigation for Nonresidential Properties

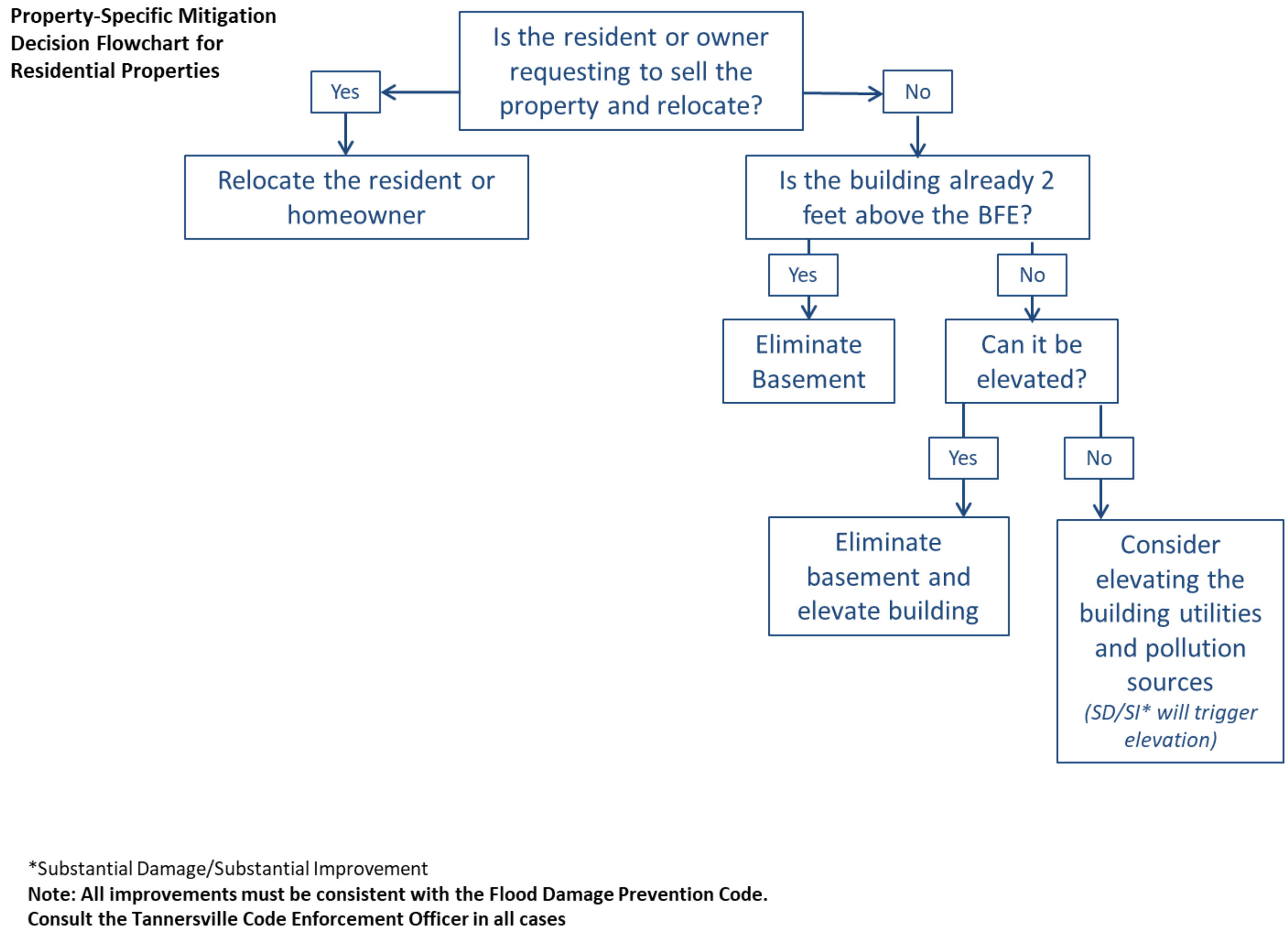

Figure 6-3
Property-Specific Mitigation for Residential Properties

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 to 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 village floodplain administrator or code enforcement officer. Potential measures for property protection include the following:

> Elevation of the structure – Home elevation involves 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.

6.1.9 Manufactured Homes

The potential risk to manufactured homes warrants consideration. According to FEMA guidance, manufactured homes located in the 100-year flood zone should be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated 2 feet or more above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation, collapse and lateral movement. FEMA recommends that the best way to meet this requirement is to elevate the bottom of the steel frame to 2 feet above the height of the 100-year water surface elevation. An exception to this guidance is given for lots in existing manufactured home parks. In this case, homes must be properly elevated no less than 36 inches above grade unless special conditions apply (FEMA, 2009). For specific guidance, refer to FEMA documentation regarding manufactured homes, which may be found online at https://www.fema.gov/media-library-data/20130726-1502-20490-8377/fema_p85.pdf.

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:

- Relocation of the Tannersville Highway Department garage outside the SFHA in order to prevent chemicals 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 Catskill Watershed Corporation (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 Flood Mapping

Mapping of the SFHA and floodway along Sawmill Creek and Gooseberry Creek has been developed by FEMA using detailed engineering methods. The FEMA FIRMS for Allen Brook and the tributary to Allen Brook only depict the SFHA. The floodway is not delineated as these streams were only modeled using approximate methods. To improve the accuracy of flood mapping in Tannersville, the following is recommended:

- It is recommended that FEMA develop mapping of the SFHA and floodway along Allen Brook and the tributary to Allen Brook using detailed engineering methods.

6.1.13 Procedural Recommendations

- It is recommended that the village gather and file flood-related lost revenue information as provided by businesses.
- It is recommended that the 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 village.

6.2 Funding Sources

Several funding sources may be available to the Village of Tannersville for the implementation of recommendations made in this report.

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 county. 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 or critical community facility. 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.

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 severe repetitive loss 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 Streambank 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 floodflows, 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.

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 Village of Tannersville 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 of Tannersville 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

DATE: April 27, 2017
TIME: 7:00pm

PROJECT: Tannersville LFA
SUBJECT: Project Kick-off Meeting Minutes
LOCATION: Mountain Top Library
MMI #: 2884-10

The kick-off meeting for the Tannersville Local Flood Analysis (LFA) was held on the evening of April 27, 2017 at the Mountain Top Library in Tannersville. In attendance were Mark Carabetta and Vernon Bevan from Milone and MacBroom (MMI), as well as members of the Tannersville Flood Advisory Committee (FAC). FAC members included representatives from the Village of Tannersville, the Catskill Watershed Corporation (CWC), the New York City Department of Environmental Protection (NYCDEP), the Green County Soil and Water Conservation District (GCSWCD), the Hunter Foundation as well as local business owners. 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 the flood history in Tannersville, 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 the Village of Tannersville.

Following the presentation, members of the committee discussed their experiences with flooding in the village as well as future plans for village revitalization that may impact flood mitigation efforts. MMI provided large scale maps so that flood advisory members could identify both areas of extensive flood damage and areas of planned improvements. MMI collected information and took detailed notes.

Based on input from attendees, the main area of concern is the Sawmill Creek corridor from lower Park Lane to the confluence with Gooseberry Creek. During Tropical Storm Irene, flooding resulted in extensive damage to businesses, houses and infrastructure. MMI staff also learned that little to no damages occurred along Allen Brook or its tributary.

An important part of the discussions focused on plans to connect the Main Street business district with recreation facilities at Rip Van Winkle Lake through pedestrian bridges and a walking trail. Although these plans impose certain constraints they also provide potential mitigation opportunities that will be considered during hydraulic analyses.

The meeting ended with a discussion of next steps and setting a date for the public meeting, which will take place in June.

DATE: July 13, 2017
TIME: 4:00pm
MMI #: 2884-10
PROJECT: Tannersville LFA

SUBJECT: Flood Advisory Commission Meeting
LOCATION: Mountain Top Public Library

A meeting of the Tannersville Flood Advisory Commission was held on the evening of July 10, 2017, for the Tannersville Local Flood Analysis (LFA) project. Attendees of the meeting included Mark Carabetta and Miguel Castellanos from Milone and MacBroom, Inc. (MMI), as well as representatives from the Village of Tannersville Flood Commission, the New York City Department of Environmental Protection, the Greene County Soil and Water Conservation District, the Catskill Watershed Corporation and River Street Planning and Development. The purpose of the meeting was to:

- Explain flood mitigation options
- Review preliminary model results
- Gather comments and feedback
- Set date for next Flood Advisory Commission (FAC) meeting

The meeting began with everyone looking over a large-scale map of the proposed flood mitigation alternatives for the Tannersville LFA project area. Mark Carabetta summarized mitigation recommendations then went on to present preliminary modeling results. The presentation slides were circulated prior to the meeting.

Following is a summary of the discussion points:

- General consensus that the proposed floodplain bench in the parking lot between Country Kitchen (6002 Main Street) and Mountain Top Chiropractor (6022 Main Street) is not viable because it would impact occupied buildings and would require taking an area currently used for valuable parking.
- Comment that foreclosure is imminent at the abandoned home at 83 Railroad Avenue and that it will soon be owned by the County.
- Suggestion that a floodplain bench be modeled in the area across the stream from the Soil and Water Conservation District building. This would require a very large amount of excavation.
- Clarification that Railroad Avenue bridge is owned by the County.
- Suggestion that monitoring or stabilization recommendations be made for Railroad Avenue channel instability.
- Suggestion that recommendations for new pedestrian bridge placement be provided.
- Comment that woody debris/bank erosion along Railroad Ave and upstream of Main Street may contribute to bridge blockage.
- Clarification that mobile home (100 Railroad Avenue) and house (145 Railroad Avenue) are empty.
- Comment that Rip Van Winkle Lake drawdown would require NYSDEC permitting.

- General consensus that MMI will emphasize removal/relocations of key structures as well as replacement of Railroad Avenue bridge in its LFA recommendations.

Lee McGunnigle will provide MMI with FEMA flood damage reports from 1996 flood.

Margaret Irwin from River Street Planning will provide bathymetric map and report for Rip Van Winkle Lake.

Date of Thursday, September 14 at 4:00pm was set for the next FAC meeting.

Minutes

DATE: September 14, 2017
TIME: 4:00pm
MMI #: 2884-10
PROJECT: Tannersville LFA

SUBJECT: Flood Advisory Commission Meeting
LOCATION: GCSWCD Building

A meeting of the Tannersville Flood Advisory Commission (FAC) was held on the evening of September 14, 2017, for the Tannersville Local Flood Analysis (LFA) project. Attendees of the meeting included Mark Carabetta and Miguel Castellanos from Milone and MacBroom, Inc. (MMI), as well as representatives from the Village of Tannersville Flood Commission, the New York City Department of Environmental Protection, and the Greene County Soil and Water Conservation District. The purpose of the meeting was to:

- Update the Commission on Rip Van Winkle Lake potential storage
- Provide general suggestions for the construction of pedestrian bridges
- Discuss Railroad Avenue channel stabilization
- Present preliminary Benefit Cost Analysis (BCA) results
- Gather comments and feedback
- Set date for next FAC meeting

The presentation slides were circulated prior to the meeting.

Following is a summary of the discussion points:

- General consensus that Rip Van Winkle Lake storage would not provide significant flood attenuation downstream and therefore would no longer be sought out for flood storage.
- Discussion that Railroad Avenue is a very important access road and that channel bank instability threatens its integrity. In the LFA report, MMI will make note of the additional travel time and repair cost if road were to be lost, and will recommend bank assessment and engineering design to stabilize bank.
- Comment that additional information about the 1996 flood exists at the Town Hall. Damage information will be forwarded to MMI and included in the BCA.
- Comment that removal and relocation of the Highway Department garage would lead to water quality benefits and should be noted in the LFA report.
- Suggestion that the property adjacent to the abandoned home, at 73 Railroad Avenue, should be included in the BCA.
- Suggestion that MMI include the recommendation that FEMA develop a detailed model for Allen Brook. It was also noted that the properties located at the headwaters of Allen Brook are not being inundated as indicated in the current FEMA map.

Dr. Lee McGunnigle will provide MMI with damage information for the 1996 flood.

Pending date for the next FAC meeting, sometime late October early November, until damage reports are received.

DATE: December 11, 2017
TIME: 3:00pm
MMI #: 2884-10
PROJECT: Tannersville LFA

SUBJECT: Flood Advisory Commission Meeting
LOCATION: GCSWCD Building

A meeting of the Tannersville Flood Advisory Commission (FAC) was held on the afternoon of December 11, 2017, for the Tannersville Local Flood Analysis (LFA) project. An attendee sign-in sheet is appended.

Meeting topics and discussion points were as follows:

MMI provided a summary recap of flood analysis findings, including results of bridge analyses, floodplain enhancement scenarios, potential for floodwater storage in Rip Van Winkle Lake. These topics and outcomes were discussed in detail during previous FAC meetings.

There was lengthy discussion on the topics of Benefit-Cost Analysis (BCA) findings and criteria for buyout recommendations. The following assessments were done to determine qualification for buyout recommendations:

- Located partially or fully within FEMA Floodway
- Favorable Benefit-Cost Ratio (BCR)
- Documented damages
- FEMA pre-calculated benefit

It was agreed that the LFA report will recommend that properties located within FEMA designated Floodway be considered for voluntary buyout/relocation, provided landowner and village willingness and agreement, and availability of funding. Specific properties will not be listed.

Most properties evaluated had a low BCR and would likely not qualify for a buyout without additional information from floods other than Irene.

At the village highway garage, Highway Superintendent indicated the 2011 flood caused the walls to move and the roof to buckle. Total repairs of $212,500 (Lamont Engineers) versus $190,132 Total Market Value. This indicates that the building was substantially damaged. It will be recommended for relocation out of SFHA. A recipient parcel will not be recommended.

To further support relocation of highway garage out of SFHA, potential threats to water quality were compiled and will be included in report.

There was discussion of the FEMA Pre-Qualification Threshold of $302,496 being used as criteria for buyout. Joseph Sikora, Deputy Chief of Mitigation Programs at NYS Division of Homeland Security & Emergency Services, provided a memo summarizing FEMA analysis. It was agreed that this information was useful and would be appended to LFA report, but would not be used as a measure of NYCFFBO eligibility.

MMI provided an overview of recommendations to be included in final LFA report.

MMI will circulate first draft of LFA report to FAC members by December 21, 2017. FAC deadline for comments was set as January 11, 2018. Public meeting to present findings of Tannersville LFA was set for January 23, 2018 at 6:00pm at the Mountain Top Library (snow date January 25). Final draft LFA report will be ready for distribution at the public meeting.

TANNERSVILLE FAC MEETING SIGN-IN SHEET

MILONE & MACBROOM		Meeting Date:	12/11/17 @ 3:00
Project:	Tannersville-Hunter LFA #2884-10	**Place/Room:**	GCSWCD Building

Name	Title	Company	Phone	E-Mail
Mark Carabetta		Milone & MacBroom	845-633-8153	MCarabetta@mminc.com
DAVE KASHMAN		Village Trustee	646-221-3075	DAVE@lastchanceonline.com
Michelle Yost	GCSWCD WAP Coordinator		518-589-6871	michelle@gcswcd.com
NANCY ALLEN		FAC member	518-569-5033	46er2355@gmail.com
Lee McGunnigle		Village of Tann.	518 589 5850	
Wesley Thorington	Highway Super	Vill of Tann	518-894-4242	
SEAN MAHONEY	CO-CHAIR	HUNTER FOUNDATION	845-399-7667	SEAN@hunterfoundation.org
Joel DuBois	Prog. Spec.	GCSWCD	(518) 622-3620	joel@gcswcd.com
PHIL ESKELI	FAHM COOR.	NYCDEP	845 340-7853	peskeli@dep.nyc.gov
John Mathiesen	Environmental Engineering Specialist CWC	CWC	845 586-1400	jmathiesen@cwconline.org
Miguel Castellanos	Water Resources Engineer	MMI	845.633.8153	mcastellanos@mminc.com

APPENDIX B

Lamont Engineering Report

Lamont Engineers
ENGINEERS • PLANNERS • FACILITY OPERATIONS
Dedicated to Service…Committed to Excellence

October 31, 2017

Lee McGunnigle, PhD, Mayor
and Village Trustees
1 Park Lane, PO Box 967
Tannersville, NY 12485

Re: Village of Tannersville
Highway Garage Evaluation

Dear Mayor McGunnigle and Village Trustees:

On October 26, 2017 I conducted a review of the Village of Tannersville Highway Garage to evaluate the condition of the building and identify deficiencies. The existing highway garage is an 80' x 40' Pre-Engineered Steel frame building that was constructed in the late 1980's. The exterior walls and roof of the building consist of metal siding overlaying batt insulation, metal purlins and metal girts. Approximately 1/3 of the building is used as an office/workshop area with the remaining 2/3 being used as a truck bay/equipment storage area.

During my review of the building, it was brought to my attention that the Highway Garage experienced significant flooding during Tropical Storm Irene and prior flood events. A observable "mud" waterline approximately 30" above the finished floor of the building is apparent on the walls within the building. Additionally, it was brought to my attention that no effort to strip the building to remove the wet insulation and dry the interior wall finishes was made after the flood event which has resulted in the deterioration of the building's exterior and interior finishes. In particular:

1. The metal base angle, end-wall posts and door jambs that tie the metal framing to the foundation along its perimeter are rusted. This is likely the result of the combination of road salt and water intrusion into the walls. The base angle around the perimeter of the building is rusted to the extent that during heavy rainfall events, water flows from the parking areas through the base angle and into the building. A large puddle was observed on the floor of the buildings office area and was created by heavy rain a few days before my site visit.

2. Where the interior finishes are dislodged or removed, water damage to the exterior wall insulation system can be observed. The insulation is mud colored and is damaged to the extent that it no longer provides its intended insulation value. Additionally, flooding has also likely facilitated the growth of mold within the interior and exterior wall cavities. The extent of this growth is unknown.

Select photos of the deteriorated elements are shown in Exhibit A. In order to repair the above deficiencies, it will be necessary to remove the interior and exterior wall finishes along the entire perimeter of the building, remove and replace the insulation, and replace the existing rusted steel framing as necessary.

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Other deficiencies observed during my site visit include:

1. The building does not provide any form of ventilation for the exhaust fumes in the truck bay area. The only way to exhaust the building is to open the large garage door at the end of the building. In the winter this is prohibitive because it exhausts all of the heat out of the building.

2. As detailed on the FEMA website, the building resides within the 100-year floodplain. No flood proof containment of diesel fuel, gasoline, or road materials stored within or at the Highway Garage site is provided, therefore any flood event will likely convey these materials into the surrounding environment or into the building's interior.

The Engineers Opinion of Probable Cost (includes labor at prevailing wage rates) to repair or mitigate the deficiencies identified is summarized as follows:

Exterior/Interior Wall Cleaning/Steel Repair………………….	$145,000
New Truck Bay Ventilation………………………………...	$10,000
Bulk Storage Containment Improvements……………………	$15,000
Subtotal……………………………………………..	$170,000
Technical/Administrative/Contingency (25%)………..	$42,500
Total Repairs………………………………………	**$212,500**

The above improvements are only intended to repair existing damage and will not mitigate future flooding. Relocation of the Highway Garage to another site, out of the floodplain, is the only way to mitigate future flood damage.

For discussion purposes, a pre-engineered steel framed building similar to the Village's existing highway garage can be constructed at an approximate cost of $140/SF, or 3,200 SF x $140/SF = $448,000 (excludes property acquisition). The proposed repairs to the building are anticipated to cost $66/SF ($212,500/3,200 SF) or nearly ½ the cost of a new building. The useful life of a highway garage is generally 40 years. A laymen's observations of flooding in the Catskills indicates that a significant flood impacts the region every 10 to 15 years. This means that during the 40 year lifetime of a building at the existing site, it would generally experience 2 or 3 flood events. Review of the cost figures described above indicates that repair costs for a building at this location exceed the capital costs for the building (which excludes the cost of flood damaged equipment and lost materials). This indicates that the continued use of a structure at this site is cost prohibitive to the Village.

It is our pinion that the current condition of the building does not present an imminent threat to health and safety, but failure to make repairs/improvements to the building could eventually compromise integrity of the structure.

If you require additional information or would like to discuss the above deficiencies or costs, please feel free to contact me at your convenience.

Sincerely,

Jason R. Preisner, P.E.
Project Engineer
Lamont Engineers, P.C.

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Photo #1 – Typical Water Mark on Interior of Building

Photo #2 – Typical Example of Rusted Baseplate

Photo #2 – Typical Damaged Insulation