Town of Shandaken Flood Mitigation Plan

DRAFT

May 2013

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TOWN OF SHANDAKEN
FLOOD MITIGATION PLAN

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Prepared For:

Shandaken Area Flood Assessment and Remediation Intitiative (SAFARI)
Town of Shandaken
7209 State Route 28
Shandaken, New York, 12480

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SECTION 1: INTRODUCTION

WHY PREPARE THIS PLAN?

Flood hazard mitigation is a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from flooding through long- and short-term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of floods. The responsibility for flood hazard mitigation lies with many, including private property owners, business, industry, and local, state and federal government.

Numerous state and federal programs and regulations promote flood hazard mitigation planning. Notable among these are two programs of the Federal Emergency Management Agency (FEMA): the National Flood Insurance Program (NFIP) and the Community Rating System (CRS). These programs provide benefits in the form of reduced flood insurance costs for communities that meet minimum requirements for floodplain management. The Town of Shandaken participates in the NFIP and is preparing to participate in the CRS.

The Town of Shandaken participated in in the 2009 Ulster County all-hazard mitigation plan but based on the flood history of the town and recent major flooding events, the Town supported the development of a town-specific flood management plan to more clearly address reducing its flood vulnerability. The town has prepared this new flood hazard mitigation plan as an up-to-date tool for flood preparedness and flood hazard mitigation. Elements and strategies in this plan were selected because they meet various state or federal program requirements as well as the needs of the Town of Shandaken and its citizens.

This plan identifies resources, information, and strategies for reducing risk from flood hazards. It will help guide and coordinate mitigation activities. The plan was developed to meet the following objectives:

- Meet the needs of the Town of Shandaken as well as state and federal requirements.
- Meet planning requirements allowing the Town of Shandaken to join CRS with an enhanced classification.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.
- Create a linkage between the flood hazard mitigation plan and established plans of the Town of Shandaken, Ulster County, and the Ashoken Stream Management Program to ensure they can work together in achieving successful mitigation.

All citizens, businesses, and visitors of the Town of Shandaken are the ultimate beneficiaries of this plan. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

GUIDELINES FOR FLOOD PLANNING

The first priority for this plan is to benefit the citizens of the Town of Shandaken by providing the greatest possible protection against the hazard posed by potential flooding. In addition, the plan has been developed to follow as closely as feasible the guidelines for flood planning presented by FEMA for the CRS program.

CRS STEPS FOR COMPREHENSIVE FLOODPLAIN MANAGEMENT PLAN

Developing a comprehensive floodplain management plan is among the activities that earn CRS credits toward reduced flood insurance rates. To earn CRS credit for a floodplain management plan, the

community's process for developing the plan must include at least one item from each of 10 steps (see Appendix B for details):

Planning process steps:

Step 1, Organize

Step 2, Involve the public

Step 3, Coordinate

Risk assessment steps:

Step 4, Assess the hazard

Step 5, Assess the problem

Mitigation strategy steps:

Step 6, Set goals

Step 7, Review possible activities

Step 8, Draft an action plan

Plan maintenance steps:

Step 9, Adopt the plan

Step 10, Implement, evaluate and revise.

BACKGROUND

The Town of Shandaken is vulnerable to flooding and has experienced devastating losses over the years. The Town has developed this Flood Mitigation Plan to identify the Town's known flood problem areas; establish goals, objectives, policies and implementation programs to reduce flooding and flood-related hazards; and to ensure the natural and beneficial functions of the floodplains are protected.

Hazard Mitigation is any sustained action taken to reduce or eliminate the long term risk and effects that can result from specific hazards.

FEMA defines the Community Rating System as A program developed by FEMA to provide incentives for those communities in the Regular Program that have gone beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

The Town of Shandaken is vulnerable to flooding events and has experienced devastating losses over the years. Since 1978, residents have submitted $5,603,540.93 in flood insurance claims (FEMA NFIP Statistics, 2012).

The Town intends to apply for the National Flood Insurance (NFIP) Community Rating System (CRS) as a way to help strengthen floodplain management in the Town and to reduce flood insurance premiums for residents

The Town has an approved hazard mitigation plan (2009 Ulster County Hazard Mitigation Plan) but recognizes that a more focused and detailed plan would benefit the community by having a focused mitigation strategy and to maximize CRS credits and provide discounts for flood insurance.

CRS ORIGINS

The NFIP provides federally backed flood insurance to encourage communities to enact and enforce floodplain regulations. The NFIP's CRS was implemented in 1990 as a mechanism for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP

standards. The National Flood Insurance Reform Act of 1994 codified the CRS in the NFIP. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

There are 10 CRS classes: class 1 requires the most credit points and gives the largest premium reduction; class 10 receives no premium reduction. A community that does not apply for the CRS or that does not obtain the minimum number of credit points is a class 10 community. The CRS recognizes 18 creditable activities, organized under four categories numbered 300 through 600: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness (An Evaluation of the National Flood Insurance Program's Community Rating System, Federal Emergency Management Agency, October 1998).

The Town of Shandaken is a Category "C" community (more than 10 properties on the updated list of repetitive loss properties). As a Category "C" community, in order for the Town of Shandaken to join the CRS program, must first adopt this Plan and then submit an application for the CRS program. Once the Town is accepted into the program, the Town will receive credit for this Plan. Enrolling in the CRS program will help the Town receive a reduction in flood insurance premium for performing activities that reduce the impacts of flooding. Joining the CRS program will also encourage the Town to carry out flood mitigation actions on a regular basis.

ORGANIZATIONS INVOLVED IN THE MITIGATION PLANNING EFFORT

The Town of Shandaken intends to implement this Plan with the participation of its various departments, organizations and governing body, as well as by coordinating with relevant Federal and state entities. Coordination helps to ensure that stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6.

MULTIPLE AGENCY SUPPORT FOR HAZARD MITIGATION

Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within New York State, the New York State Department of Environmental Protection and the Ashoken Watershed Stream Management Program provided hazard mitigation planning assistance to the Town.

Additional input and support for this planning effort was obtained from a range of agencies and through public involvement (as discussed in Section 3). Oversight for the preparation of this plan was provided by the SAFARI Planning Committee (the Flood Management Planning (FMP) Committee), which includes representatives from:

- Town Building Department
- Town Supervisor's Office
- The Town Planning Board and Zoning Board of Appeals
- Town Clerk's Office
- County Engineering
- Town Police Department
- Town Fire Department

- Town Public Works Department

The Shandaken Planning Board provides oversight on land use and comprehensive planning. Additionally the Shandaken Building Inspector/Zoning and Code Enforcement Office is responsible for enforcing codes within the Town limits. Finally, the floodplain administrator is one and the same with the Town Code Officer in the Building Department and provides oversight for all floodplain related issues.

In addition, New York State Department of Transportation, New York City Department of Environmental Protrection,: NewYork State Department of Environmental Conservation, United States Department of Agriculture-National Resources Conservation Service, Ulster County Soil and Water Conservation District, Ulster County Department of Public Works, Cornell Cooperative Extensionattended committee meetings and provided plan support.

This Flood Mitigation Plan was prepared in accordance with the following regulations and guidance:

- 44 Code of Federal Regulations part 78.5 - Flood Mitigation Plan Development in accordance with the National Flood Insurance Act of 1968 (42 U.S.C. 4104c et seq.
- CRS Coordinator's Manual (FIA-/////)
- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA. 2004. "How-To Guide for Using HAZUS-MH for Risk Assessment." FEMA Document No. 433. February.
- FEMA Mitigation Planning How-to Series (FEMA 386-1 through 4, 2002), available at: http://www.fema.gov/fima/planhowto.shtm.

IMPLEMENTATION OF THE PLANNING PROCESS

To support the planning process to develop this Flood Mitigation Plan (FMP), the Town of Shandaken has accomplished the following:

- Developed a FMP Committee
- Profiled the Flood Hazard
- Estimated the inventory at risk and potential losses from flood hazards
- Perform a comprehensive review of mitigation alternatives
- Developed mitigation actions and goals that address the various hazards that impact the area
- Developed mitigation plan maintenance procedures to be executed after adoption of plan.

To address the requirements of CRS and better understand their potential vulnerability to and losses associated with hazards of concern, the Town of Shandaken used the Hazards U.S. – Multi-Hazard (HAZUS-MH) software package (discussed in greater detail later in this Plan) supplemented by local data, as feasible, to support the risk assessment and vulnerability evaluation. HAZUS-MH assesses risk and estimates potential losses for natural hazards. It produces outputs that will assist state and local governments, communities, and the private sector in implementing emergency response, recovery, and mitigation programs, including the development of FMPs.

As required by CRS, the planning process has engaged the public throughout providing opportunities for public comment and input. In addition, numerous agencies and stakeholders have participated as core or support members, providing input and expertise throughout the planning process.

This Flood Mitigation Plan documents the process and outcomes of the Town's efforts. Additional information on the planning process is included in Section 3, Planning Process. Documentation that the prerequisites for plan approval have been met is included in Section 2, Plan Adoption.

BENEFITS OF MITIGATION PLANNING

The planning process will help prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows the Town of Shandaken to remain eligible for mitigation grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning include:

- An increased understanding of flood hazards faced by the Town of Shandaken
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damages to human health and structures and reduced repair costs

BENEFITS OF PARTICIPATING IN THE COMMUNITY RATING SYSTEM

The objective of the CRS is to support the goals of the NFIP. To do this, the CRS provides insurance premium rate discounts to policy holders in recognition that their communities implement activities that work toward its three goals of reducing flood damage, supporting the insurance part of the NFIP, and pursuing a broad approach to floodplain management.

In this process, the "community" part of the Community Rating System includes state and regional agencies and private organizations that support and assist city, county, and tribal governments that are participants in the NFIP. A closer look at how communities can implement these three goals is as follows:

1. Reduce flood damage to insurable property. Communities are encouraged to map and provide regulatory flood data for all their flood hazards. The data should be used in their regulatory programs and shared with all users and inquirers. New buildings in mapped floodplains should be protected from the known local flood hazards, which may require setting standards higher than the minimum national criteria of the NFIP. Communities are encouraged to reduce the exposure of existing buildings to flood damage, especially repetitive loss properties.

2. Strengthen and support the insurance aspects of the NFIP. Communities should encourage their residents to be aware of their flood risk and to purchase and maintain a flood insurance policy to protect themselves from the financial impacts of flooding. Communities should also help make the program more financially sound by implementing mapping and information programs that help to evaluate accurately the individual property risk for flood insurance rating purposes, expand the policy base, and reduce repetitive losses.

3. Encourage a comprehensive approach to floodplain management. Insurable property is not the only floodplain management concern of communities, so the CRS recognizes efforts that protect lives; further public health, safety, and welfare; and protect natural floodplain functions. The community staff should understand the physical and biological processes that form and change floodplains and watersheds and take steps to deal with flooding, erosion, habitat loss, water quality, and special flood-related hazards. Floodplain management programs need to protect buildings, infrastructure, critical facilities, and natural functions and ensure that new development does not cause adverse impacts on others. A comprehensive approach uses all tools, including public information, planning, regulatory authorities, financial support, public works activities, and emergency management (CRS Coordinator's Manual, FIA-15/2007).

HOW TO USE THIS PLAN

This flood hazard mitigation plan is organized into the following primary parts, which follow the organization of the CRS steps for floodplain planning.

- Part 1—Planning Process and Project Background
  - **Section 1**, Introduction: Overview and summary of the Town of Shandaken Flood Mitigation Plan
  - **Section 2**, Plan Adoption: Information regarding the adoption of the Plan by the Town of Shandaken.
  - **Section 3**, Planning Process: A description of the Plan methodology and development process, HMP Committee and stakeholder involvement efforts, and a description of how this Plan will be incorporated into existing programs.
- Part 2—Risk Assessment
  - **Section 4**, Town Profile: An overview of the Town of Shandaken, including: (1) general information, (2) population and demographics, (3) general building stock inventory, (4) land use trends, (5) future growth and development, and (6) critical facilities.

  - **Section 5**, Risk Assessment: Documentation of the hazard identification and ranking process, hazard profiles, and results of the vulnerability assessment (estimates of the impact of hazard events on life, safety and health, general building stock, critical facilities, the economy and future growth and development). Description of the status of local data and planned steps to improve local data to support mitigation planning.

- Part 3—Mitigation Strategy
  - **Section 6**, Mitigation Strategy: Information regarding the mission statement, mitigation goals, objectives, capability assessment and mitigation action items identified by the Town in response to priority hazards of concern. Also under this section is a comprehensive review of alternatives considered with and emphasis on strengths, weaknesses, obstacles and opportunities within the community.
- Part 4—Plan Maintenance
  - **Section 7**, Plan Maintenance Procedures: The system established by the Town of Shandaken to monitor, evaluate, maintain and update the Plan.

Each part includes elements identified in the CRS's 10 steps. These steps are often cited within each subsection to illustrate compliance with the requirement.

The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions
- Appendix B—Description of CRS Planning Requirements
- Appendix C—Public outreach information, including the questionnaire and summary and documentation of public meetings
- Appendix D—A template for progress reports to be completed as this plan is implemented

SECTION 2: PLAN ADOPTION

OVERVIEW

This section contains information regarding adoption of the Plan by the Town of Shandaken.

PLAN ADOPTION BY LOCAL GOVERNING BODY

Adoption by the local governing body demonstrates the commitment of the Town to fulfill the mitigation goals and objectives outlined in the Plan. Adoption legitimizes the Plan and authorizes responsible agencies to execute their responsibilities. In order for the Plan to be approved, the Town's governing body must adopt the Plan before its submission for application to the CRS to it ISO/CRS Specialist.

Adoption of the plan is necessary because:

- It lends authority to the plan to serve as a guiding document for all local and state government officials;
- It gives legal status to the plan in the event it is challenged in court;
- It certifies to program and grant administrators that the plan's recommendations have been properly considered and approved by the governing authority and jurisdictions' citizens; and
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community's future.

Source: FEMA. 2003. "How to Series"-*Bringing the Plan to Life* (FEMA 386-4). August.

SECTION 3: PLANNING PROCESS

INTRODUCTION

This section includes a description of the Planning process used to develop the Plan, including how it was prepared, who was involved in the process, and how the public was involved.

The process followed to develop the Town of Shandaken Flood Mitigation Plan had the following primary objectives to ensure that the Plan met the requirements of the CRS:

- Form a planning team
- Define the planning area
- Establish a steering committee
- Coordinate with other agencies
- Review existing programs
- Engage the public.

These objectives are discussed in the following sections.

FORMATION OF A PLANNING TEAM-ORGANIZE THE RESOURCES

This planning project was initiated and overseen by the Town of Shandaken and the **S**handaken **A**rea **F**lood **A**ssessment and **R**emediation **I**nitiative (SAFARI). SAFARI's mission is to reduce the flood hazard vulnerability in the planning area to ensure that residential and business communities can thrive within a healthy environment. SAFARI in conjunction with the Town of Shandaken represented by the Town Supervisor hired Tetra Tech, Inc. to assist with development and implementation of the plan. While SAFARI is a advisory committee, the Town Supervisor oversees the land use and planning in the town and is committed to supporting the committee's recommendations as appropriate. The Tetra Tech project manager assumed the role of the lead planner, reporting directly to the Town of Shandaken Supervisor. A planning team was formed to lead the planning effort, made up of the following members:

- Robert Stanley—Town of Shandaken Supervisor and Chair of SAFARI
- Richard Stokes—Town of Shandaken Floodplain Manager
- Eric Hoffmeister—Town of Shandaken Department of Public Works
- Candace Balmer—Town Consultant to facilitate data collection and plan review
- Cynthia Bianco, Tetra Tech—Lead Project Planner
- Alison Miskiman—Tetra Tech Risk Assessment Lead

This team provided input to the planning committee and established the guidelines for the planning process.

The Town of Shandaken Flood Mitigation Plan (FMP) was written using the best available information obtained from a wide variety of sources. Throughout Plan development, a concerted effort was made to gather information from municipal and regional agencies and staff as well as stakeholders, federal and state agencies, and the residents of the Town **(CRS Step 1).** SAFARI solicited information from local agencies and individuals with specific knowledge of certain natural hazards and past historical events, as

well as considering Planning and zoning codes, ordinances, and other recent Planning decisions. The natural hazard mitigation strategies identified in this Plan have been developed through an extensive Planning process involving local, county and regional agencies, and Town residents and stakeholders.

This section of the Plan describes the mitigation Planning process, including (1) Planning Committee involvement and efforts; (2) local involvement; (3) stakeholder and public involvement; and (4) integration of existing data, Plans, and information.

DEFINING THE PLANNING AREA

The planning area was defined as the Town of Shandaken with special emphasis on the hamlets of Phoenicia and Mt. Tremper.

PLANNING COMMITTEE AND OTHER STAKEHOLDER SUPPORT

Many entities supported preparation of this Plan; the Planning Committee and other stakeholders involved in the process are presented below.

EARLY PLANNING EFFORTS

While this planning effort represents the first time the Town of Shandaken has worked to develop a CRS compliant local plan, it does not represent the start of hazard risk management efforts in the Town. Various regional, county and local agencies and governments including the Ashoken Watershed Stream Management Program, the NY Department of Environmental Conservation, NY Department of Environmental Protection, Cornell Cooperative Extension Service, and the Ulster County Soil and Water Conservation District have been involved in natural hazard risk assessment, mitigation planning and project activities, prior to and/or unrelated to the current planning effort. Such activities provide a strong foundation for subsequent efforts, and an awareness and understanding of the need for and benefits of mitigation planning across a broad range of regional, county and local governments and stakeholders.

PLANNING COMMITTEE INVOLVEMENT AND EFFORTS

The Town Board was of the opinion that SAFARI comprised of appropriate municipal personnel, local emergency first responders, and other stakeholders would be an effective body to guide the overall process, provide significant input, and effectively partner with Tetra Tech to develop a successful Plan. Thus, the Board approved the SAFARI committee by resolution to guide and oversee all phases of the planning effort. (Table 3-1).

Leadership roles and ground rules were established during the meeting on March 14, 2012. SAFARI agreed to meet bi-monthly or as needed throughout the course of the plan's development. The planning team facilitated each SAFARI meeting, which addressed a set of objectives based on the established scope. SAFARI met 8 times from 11/17/11 through 1/20/12. Meeting agendas, notes and attendance logs areas available are provided in Appendix C.

Table 3-1. Town of Shandaken **SAFARI (Shandaken Area Flood Assessment and Remediation Initiative)** Flood Mitigation Planning Committee

Name	Organization	Title
Robert Stanley	Town of Shandaken	Town Supervisor, Committee Chair
Eric Hofmeister	Town of Shandaken	Town DPW Director
Rich Stokes	Town of Shandaken	Code Enforcement, Floodplain Administrator

Name	Organization	Title
Candace Balmer	RCAP Solutions	Consultant, Data Collection and Review Facilitator
Liz Higgins/Leslie Zucker	Cornell Cooperative Extension (CCE)/Ashoken Watershed Stream Management Program	
Vincent Bernstein	Town of Shandaken	
John Horn	Town of Shandaken	
David Corrigan	NYS DOT	
Danyelle Davis	NYC DEP	
Deron Davis	USDA NRCS	
Doug Dekoskie	NY DEP	
Brian Drumm	NYS DEC Region 3	
Amanda Lavalle	Ulster County DOE '	
Mark Lewis	NY DEC	
Elizabeth Reichheld	NYC DEP	
Cory Ritz	UCSWCD	
Keith Savoury	NYS- DOT	
Pat Ferracane	NY DEC	
Dave Bolles	UCDPW	
Andrew Emrich	UCDPW	
Doris Nieves	Mt. Tremper Landowner	
Aaron Bennett	Ulster County DOE	
Brent Gotsch	CCE	
Bob McCormack	CCE	
Faye Storms	Save Our Shandaken (S.O.S).	

Notes:
NY DOT- New York State Department of Transportation
NY DEP: New York City Department of Environmental Protrection
NYS DEC: NewYork State Department of Environmental Conservation
USDA NRCS: United States Department of Agriculture-National Resources Conservation Service
UCSWCD: Ulster County Soil and Water Conservation District
Ulster County DOE: Ulster County Department of
UCDPW: Ulster County Department of Public Works
CCE: Cornell Cooperative Extension

The Committee supported the following planning activities, under the guidance and direction of the contract consultant:

- Establish Plan development goals;
- Establish a timeline for completion of the Plan;

- Ensure that the Plan meets the requirements of CRS, FMA, and FEMA and NYSOEM guidance;
- Solicit and encourage the participation of regional agencies, a range of stakeholders, and citizens in the Plan development process;
- Assist in gathering information for inclusion in the Plan, including the use of previously developed reports and data;
- Organize and oversee the public involvement process;
- Consider a comprehensive range of alternatives;
- Review and prioritize actions;
- Develop, revise, adopt, and maintain the Plan.

Members of SAFARI (individually and as a whole), as well as key stakeholders, convened and/or communticated on an as-needed basis to share information and participate in workshops to identify hazards; assess risks; identify critical facilities; assist in developing mitigation goals, objectives and actions; and provide continuity through the Plan development process to ensure that natural hazards vulnerability information and appropriate mitigation strategies were incorporated into the Plan. Each member of SAFARI reviewed the Plan, supported interaction with other stakeholders and assisted with public involvement efforts.

Table 3-2 presents a summary of SAFARI and general project planning efforts implemented during the development process for this Plan. It also identifies which DMA 2000 requirements the activities satisfy.

Table 3-2. Summary of Mitigation Planning Activities / Efforts

Date	Activity/ CRS Requirement	Description of Activity	Participants
11/17/11	SAFARI Meeting	Project schedule, scope, contractual agreement	Rob Stanley - Shandaken Candace Balmer - RCAP Solutions John Horn - Shandaken Danny Davis - NYC DEP Doris Nieves - Mt. Tremper Landowner Aaron Bennett - UC DOE Cory Ritz - UCSWCD Gretchen Rae - CCE
1/20/2012	SAFARI Meeting	Kick-Off Data Collection and Public Outreach Planning, Public Questionnaire	Candace Balmer – RCAP Solutions John Horn – Shandaken Liz Higgins – CCE Eric Hofmeister – Shandaken Elizabeth Reichheld – NYCDEP Rich Stokes – Shandaken Cory Ritz – UC SWCD Robert Stanley – Shandaken Brent Gotsch – CCE Bob McCormack – CCD Faye Storms – S.O.S. Cynthia Bianco – Tetra Tech
2/13/2012	Working Group Meeting	Data Collection, Project Status	
3/5/2012	Public Meeting	Presentation of Planning Process, Public Input	Kathy Nolan – Shandaken Resident Sandi Walker – Phoenicia Resident Helen Morelli - Phoenicia Resident Jacqui Gagliemetti - Phoenicia Resident Tina Rice - Phoenicia Resident Robert Slits – Shandaken Resident

Date	Activity/ CRS Requirement	Description of Activity	Participants
			Brian Grant – Chichester Resident Grace Grant – Chichester Resident Jerome Litwack - Phoenicia Resident Dave Cannon – Shandaken Resident Alfred Peavy - Phoenicia Resident
3/15/2012	SAFARI Meeting	Flood Response Plan input, status, NFIP request, Mission Statement, Goals and Objectives, Resident outreach cover letter.	
5/31/2012	SAFARI Meeting	Draft Flood Response Plan comments, data needs for risk assessment, public outreach/questionnaire status, Goals and Objectives discussion,	Candace Blamer – RCAP John Horn – Shandaken Planning Board Elizabeth Reichheld – NYCDEP Rich Stokes – Shandaken CEO Cory Ritz – UCSWCD Rob Stanley – Shandaken Supervisor Brent Gotsch – CCEUC Aaron Bennett – UC Dept. of Env. Gretchen Rae – CCE Doris Nieves – Mt Tremper Resident
7/19/2012	SAFARI Meeting	Update of Flood Mitigation Plan status	Brent Gotsch – CCEUC Cory Ritz – UCSWCD Rob Stanley – Shandaken Supervisor Danyelle Davis – NYCDEP John Horn – Shandaken Planning Board Candace Blamer – RCAP Aaron Bennett – UC Dept. of Env. Eric Hofmeister – Shandaken Hwy Superintendent Doris Nieves – Save our Shandaken; Mt. Tremper Resident Gretchen Rae – CCE Ulster County Rich Stokes – Shandaken CEO Cynthia Bianco – Tetra Tech Alison Miskiman – Tetra Tech
11/1/2012	SAFARI Meeting	Report of updated vulnerability analysis based on new list of critical facilities, project status, review of goals and objectives	Cory Ritz – UCSWCD Leslie Zucker – CCEUC Brent Gotsch – CCEUC Gretchen Rae – CCEUC Beth Reichheld – NYCDEP Dennis Dempsey – NYCDEP John Horn – Shandaken Planning Board Candace Balmer – RCAP Aaron Bennett – UC Dept. of Env. Cynthia Bianco – Tetra Tech (via phone)
12/11/2012	SWOO Meeting	Strengths, Weaknesses, Obstacles and Opportunities workshop.	
1/24/2013	SAFARI Meeting	Review of action items	Brent Gotsch, Danyelle David, John Horn, Rob Stanley, Eric Hofmeister, Aaron Bennet, Beth Reichfeld, Leslie Zucker, Adam Doan, Christina Appleby, Cynthia Bianco, Candace Balmer
2/4/2013	Public Meeting	Presentation of Planning Process and Vulnerability Assessment	
2/6/3013	Working Group Meeting	Revisions to Flood Warning and Response Pan, Mitigation strategy discussion.	

Date	Activity/ CRS Requirement	Description of Activity	Participants
2/20/2013	SAFARI Meeting	Mitigation strategy discussion	Brent Gotsch, Aaron Bennet, John Horn, Robert Stanley, Adam Doan, Ruth Hughes, Danyelle Davis, Eric Hofmeister, Doris Nieves, Leslie Zucker, Candace Balmer
3/23/13	Public Meeting	Presentatioin of Draft Plan to the Public	Public, Alison Miskiman, Tetra Tech, Paul Miller Tetra Tech, Shandaken Town Board

Stakeholders Involved in Mitigation Planning

This section presents (1) Town involvement, (2) State and regional agency involvement, and (3) public participation – citizen involvement.

Municipal and Local Involvement

SAFARI and/or its members and contract consultant met and communicated with relevant representatives of the Town to obtain data and information, review existing Plans and capabilities, and facilitate the identification of appropriate mitigation initiatives. Further, these departments have reviewed the Draft Plan and provided direct input during its development.

The Town of Shandaken departments and agencies that have been involved in this effort include:

Town of Shandaken Department
Town Supervisor
Building Department
Clerk's Office
Fire Department
Public Works
Planning Board
Code Official-Floodplain Administrator

Specifically the committee members provided input as detailed below.

- Town of Shandaken Officials: Town Supervisor responsible for project and grant contract management, Chair of Hazard Mitigation Planning Committee, provided administrative services, plan review, facilitation of meetings, assisted with public outreach; liaison for press releases, web postings, communications. Town clerk provided communication support. Shandaken Public Works Department: Planning Committee members; provided data and information on hazards, inventory, vulnerabilities; developed goals and objectives; identified and developed potential mitigation actions; reviewed plan sections; assisted with public and stakeholder outreach.

- Town of Shandaken Department of Public Works: Planning Committee member; provided data and information on hazards, inventory, vulnerabilities; developed goals and objectives; identified and developed potential mitigation actions; reviewed plan sections; assisted with public and stakeholder outreach.

- Town of Shandaken Planning Board: Informed of planning process; provided data and input to plan including identifying specific hazard areas that need to be addressed in the Plan; supported public outreach through local civic website coverage.

- Town of Shandaken Building Department-Code Official, Floodplain Administrator: Provided site visit to view flood-stricken areas, provided code enforcement data,
- Ashoken Stream Management Program, Cornell Cooperative Extension Service, NYDEP, NYDEC: Provided data and input to plan including identifying specific hazard areas that need to be addressed in the Plan and available hydrological data.

Coordination with Other Agencies- Federal, State, County, and Regional Agency Involvement

Opportunities for involvement in the planning process were provided to local and regional agencies involved in flood hazard mitigation, agencies with authority to regulate development, businesses, and other private and nonprofit interests **(CRS Step 3).** This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development from the beginning and were kept apprised of plan development milestones:

  These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. These agencies supported the effort by attending meetings or providing feedback on issues.
- **Pre-Adoption Review**—All the agencies listed below were provided an opportunity to review and comment on this plan, primarily through the plan secure shared site and the plan website (see Section-PUBLIC INVOLVEMENT). Each agency was sent an e-mail message informing them that draft portions of the plan were available for review. In addition, the complete draft plan was sent to the Insurance Services Office, FEMA's CRS contractor, for a pre-adoption review to ensure CRS program compliance.

Throughout this Planning process, the Town of Shandaken actively sought the involvement of a wide range of county, state and regional stakeholders, including:

Stakeholder
Ashoken Stream Management Program
NY Department of Environmental Conservation
Ulster County Department of the Environment
Ulster County Soil and Water Conservation District
Cornell Cooperative Extension Services
FEMA RiskMap Representatives
Ulster County Department of Public Works

At a minimum, these stakeholders were advised of the planning process and provided the opportunity to review and provide direct input to the Plan during its development. Further, SAFARI and/or its members and contract consultant, met and/or directly communicated with many of these stakeholders to obtain data and information, review existing plans, and facilitate the identification of appropriate mitigation initiatives. Specific information obtained from these stakeholder is cited and/or referenced throughout this Plan.

PUBLIC INVOLVMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. CRS credits are available for providing opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval, as well as for optional public involvement activities **(CRS Step 2).**

Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee.
- Use a questionnaire to determine the public's perception of flood risk and support of mitigation initiatives.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of this plan. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders targeted for this process included:

- Property Owners
- Owners/operators of businesses within the floodplain
- Environmental advocacy groups/Citizen Action Group (Save Our Shandaken S.O.S)

Questionnaire

An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact the Town and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. The questionnaire asked 24 quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The questionnaire also asked several demographic questions to help analyze trends.

The answers to its 24 questions helped guide the Steering Committee in selecting goals, objectives and mitigation initiatives. The Town embarked on a door-to-door campaign to contact Floodplain residents and assist them personally with filling out the questionnaire. This campaign focused on residents in historically floodprone areas and those with NFIP claim history. The town has committed to maintaining lists of floodplain residents based on those with property exposure as indicated by the analysis presented in Section 5 of this plan. Approximately 50 residents were contacted in this manner. The questionnaire was also advertised in a public Town Board Meeting (televised) and posted on the Town website.

Over 80 questionnaires were completed both online and in person during the course of this planning process. This number is not sufficient to establish trends, but the responses did provide SAFARI and planning team with feedback to use throughout the planning process. SAFARI used survey results to support the selection of guiding principles, goals and objectives discussed in Section 6. The survey results were also used in the review of alternatives and selection of mitigation initiatives. The complete questionnaire and a summary of its findings can be found in Appendix C.

Public Meetings

An open public meeting to present the planning process was held on March 5, 2012 at the Shandaken Town Hall. During that meeting the planning process was presented including a description to flood mitigation planning, its benefits, and a description of the National Flood Insurance Program and the Community Rating System and how it can help reduce flood vulnerability in the town. A copy of the presentation is included in Appendix C. A second public meeting to present the planning process and

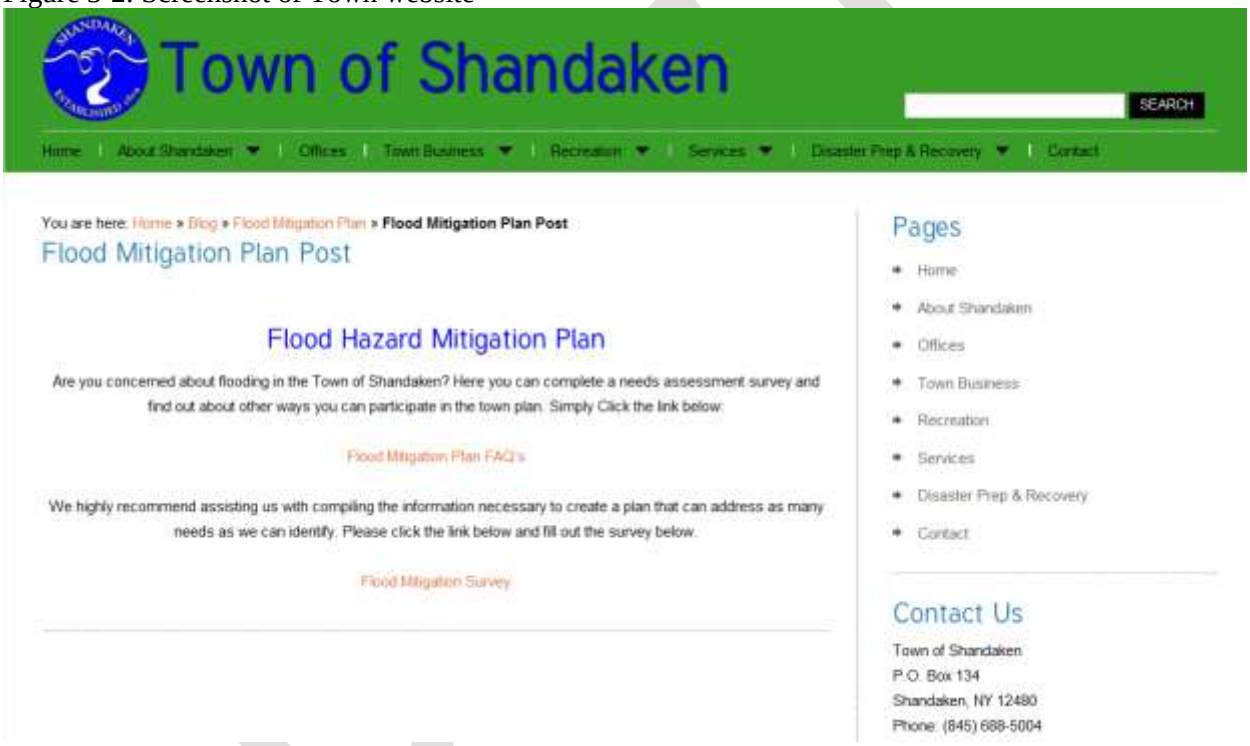
vulnerability assessment was held on February 20, 2013 at the Shandaken Town Hall. The purpose of this meeting was to present the planning process status in addition to highlighting the vulnerability assessment. A copy of the presentation is included in Appendix ?

The final public meeting to present the draft plan was held on May23, 2013 at the Shandaken Town Hall. This meeting was advertised via a press release sent to all media outlets . This meeting was held at the beginning of the published public comment period, which ran until July XX, 2013.

Internet

At the beginning of the plan development process, a website (http://www.shandaken.us/flood-mitigation-plan/flood-mitigation-plan-post/)was created to keep the public posted on plan development milestones and to solicit relevant input (see figure 3-2):

Figure 3-2: Screenshot of Town website



The site's address was publicized in all press releases and public meetings. Information on the plan development process, SAFARI, the questionnaire and draft of the plan was made available to the public on the site throughout the process. The Town intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates. The Draft Plan was posted to the public website on June 24, 2013.

COORDINATION WITH EXISTING PLANNING EFFORTS AND PROGRAMS

Local municipalities are charged with the development of local FMPs required under Section 322 of the Stafford Act. Therefore, the FHMP Committee coordinated the development of this FMP. In the State of New York , local municipalities are authorized to prepare local disaster Plans based on the contention that they are best equipped to assess their strengths and weaknesses, opportunities, and constraints. Local governments have intimate knowledge of the local geography, and in a disaster, local government personnel are on the front lines providing personnel and equipment to support the community.

Examples of other hazard mitigation programs in which the Town is involved with are the National Flood Insurance Program (NFIP) and the Hazard Mitigation Grant Program (HMGP). These programs assist the Town in receiving funding for flood mitigation projects and flood insurance (this Plan can also provide funds to mitigate other natural hazards). Data from the Town, based on participation in these programs, was incorporated in the risk assessment in Section 5 and used to identify mitigation options in Section 6. Continued involvement in these flood-related programs will help to administer funds and resources to support this HMP.

DISASTER MITIGATION ACT OF 2000

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local and Indian tribal governments as a condition of mitigation grant assistance. The DMA amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by replacing previous mitigation planning provisions with new requirements that emphasize the need for planning entities to coordinate mitigation planning and implementation efforts. The law added incentives for increased coordination and integration of mitigation activities at the state level by establishing two levels of state plans. The DMA also established a new requirement for local mitigation plans and authorized up to 7 percent of Hazard Mitigation Grant Program funds to be available for development of state, local, and Indian tribal mitigation plans.

Participation in FEMA 404 HMGP may cover mitigation activities including raising, removing, relocating or replacing structures within flood hazard areas.

National Flood Insurance Program

Established in 1968, the NFIP provides federally-backed flood insurance to residents of communities that enact and enforce regulations that more carefully regulate development within floodplain areas. For individual property owners to be eligible to buy the federally-backed flood insurance, their property must be located within a community that participates in NFIP.

For a community to be eligible in NFIP, it must adopt and enforce a floodplain management ordinance to regulate proposed development in floodplains and officially designate a local floodplain coordinator/administrator. The intent of the program is to ensure that new construction does not exacerbate existing flood hazards and is designed to better withstand flooding. The community also has Digital Flood Insurance Rate Maps (DFIRM) that at a minimum show floodways, 100-year flood zones, and 500-year flood zones. Mitigation activities related to this program are included in Section 6 and data from FEMA Region II regarding NFIP Insurance Reports was used in the risk assessment for the flood hazard included in Section 5.

The Town of Shandaken floodplain adminstrator is Mr. Nunzio Pietrosanti who has been involved in this planning process, at minimun providing specific flood-related information and mitigation initiatives, as well as providing review and input on the planning documents.

Community Rating System (CRS)

The NFIP has been successful in protecting property owners who acquire flood insurance through the program from catastrophic financial losses due to flooding, and in requiring that new buildings constructed within 100-year flood plains are better protected from flood damage.

In the 1990s, the Flood Insurance Administration (FIA) established the CRS to encourage local governments to increase their standards for floodplain development. The goal of this program is to encourage communities, through flood insurance rate adjustments, to implement standards above and beyond the minimum required in order to:

- Reduce losses from floods
- Facilitate accurate insurance ratings
- Promote public awareness of the availability of flood insurance

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions to meet the CRS goals of reducing flood losses, facilitating accurate insurance rating and promoting awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

THE CLEAN WATER ACT

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of

stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

INTEGRATION OF EXISTING DATA AND PLANS INTO MITIGATION PLAN

The Mitigation Plan integrates local and federal data and plans as discussed below.

Local Regulations, Codes, Ordinances and Plans

The following local regulations, codes, ordinances and plans were reviewed during this planning process in an effort to develop mitigation planning goals, objectives and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms; and thus develop complementary and mutually supportive plans.

The "Legal and Regulatory" capability assessment, included as Table 6-1 in Section 6, provides a listing of the local codes, ordinances, regulations and planning mechanisms available in the Town, and reviewed during this planning process.

Local Data

SAFARI and the contract consultant reviewed and incorporated existing data and plans to support the Mitigation Plan. A number of electronic and hard copy documents were made available to support the planning process. These documents are too numerous to list below; therefore, a summary is provided. A complete listing is included in the references section of this document.

- Local and regional Geographic Information System (GIS) data
- Documentation of past mitigation actions and grant applications
- Historic maps
- FEMA Flood Insurance Study and Flood Insurance Rate Maps
- Town and Regional Emergency Management Plans
- Watershed and Hydrologic Reports, Studies, and Analyses
- State, County, and Town Land Use Planning Codes, Regulations, and Ordinances
- Town Budget Summaries
- Articles from Local News and Media Outlets

Cross-referencing this Plan with documents like those above as they are updated will need to occur and has been included in Section 6 as mitigation activities.

Federal and State Data

Federal and State data was collected and used throughout the mitigation process including:

- US Census data
- HAZUS-MH provided data
- FEMA "How To" Series (386-1 to 386-4, and 386-7)

Other Plans, Reports, and Data

A summary of the reports and plans provided by the Town of Shandaken and reviewed in the preparation of this plan is included in the following Record of Review Matrix.

Record of the review of existing programs, policies, and technical documents

Existing Program/Policy/Technical Documents
Section 905(b) Reconnaissance Study – Esopus and Plattekill Creeks Watershed, Ulster and Greene Counties, New York (USACE, August 2008)
Upper Esopus Creek Management Plan (Cornell Cooperative Extension, January 2007)
Flood of April 2-3, 2005, Esopus Creek Basin, New York (USGS Open File Report 2007-1036, 2007)
Magnitude and Frequency of Floods in New York. (USGS Scientific Investigation Report 2006-5112, 2006)
The Stony Clove Creek Stream Management Plan (Greene County Soil and Water Conservation District and NYCDEP, March 2005)
Comprehensive Plan for the Town of Shandaken (July 2005)
Ashokan Reservoir Watershed Hydrologic Study, New York (FEMA, August 2012)
Ulster County, New York, Comprehensive Emergency Management Plan (April 2007)
Ulster County, New York, Multi-Jurisdictional Natural Hazard Mitigation Plan (February, 2009)
Ulster County Planning Board Land Use Referral Guide: Local Wetland Regulations (November, 2008)
Water Quality Monitoring Plan (Ashokan Watershed – Release Channel Operations) (May, 2013)
Interim Ashokan Release Protocol (NYSDEC/New York City DEP, October 18, 2011)
Hydrologic Analysis Technical Support Data Notebook for Ashokan Reservoir Watershed Hydrologic Study, New York (FEMA, July, 2012)
Town of Shandaken, New York, Flood Insurance Study (FEMA, February 17, 1989)
Town of Shandaken, New York, Flood Damage Prevention Ordinance (April14, 1993)
Stormwater Pollution Prevention Plan Permit Requirements by Ulster County (Ulster County DPW, March 7, 2008)
Ulster County Transportation Plan (April, 2003)
Ulster County Planning Board. Planner's Memo. Mining: The Regulatory Split (October, 1993)
Ulster County Planning Board. Planner's Memo. Outdoor Lighting (September, 2000)
Historical Flooding in Phoenicia, NY 1779 – Present - Technical Report (Taylor, Ritz, and Higgins, Date Unknown)
NOVEMBER 6, 2010. Operations and Services - Hydrologic Services Program, NWSPD 10-9. DEFINITIONS AND GENERAL TERMINOLOGY. (Signed) October 22, 2010. David B. Caldwell Date Director, Office of Climate, Water, and Weather Services
National Weather Service Manual 10-950, Operations and Services: Hydrologic Services Program (NOAA NWS, November 6, 2010)
National Weather Service Instruction 10-922, Operations and Services: Hydrologic Services Program (NOAA NWS, November 8, 2011)
Daily Freeman News. Study: Expect more eroded material in Ashokan Reservoir (Kemble, Tuesday, October 2, 2012)
Ulster County Department of Highway Subdivision Requirements
Ulster County Charter, Article VII: Department of Planning (Date Unknown)
Ulster County Subdivision Requirements. Ulster County DPW. November, 2008.
NYS Realty Subdivision Laws. Article 11, Title II Public Health Law. Article 17, Title 15 Environmental Conservation Law. New York State Department of Health, Division of Environmental Health Protection. February, 2003.

A complete list of the existing data and plans used to support this HMP is included in the references section of this document. By incorporating data from existing programs into this Plan, the Town also was able to identify the relevance of mitigation planning to these existing programs. Implementation of this Plan through these existing plans is identified as a specific mitigation action in several areas in Section 6 of this Plan.

CONTINUED PUBLIC INVOLVEMENT

The Town of Shandaken is committed to the continued involvement of the public. Therefore, copies of the Plan are available for review on their public website (), as well as at the Town Clerks Office at .

After completion of the Plan, implementation and ongoing maintenance will become a function of the HMP Committee. SAFARI will review the Plan and accept public comment as part of an annual review and as part of five-year mitigation Plan updates.

A notice regarding annual updates of the Plan and the location of Plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site.

Mr.Robert Stanley , has been identified as the ongoing Town Flood Mitigation Plan Coordinator (see Section 7), and is responsible for receiving, tracking, and filing public comments regarding this Plan. Contact information is:

Rob Stanley, Town Supervisor
Town of Shandaken
Town Hall
Phone: (845) 688-7165

The public will have an opportunity to comment on the Plan as a part of the annual mitigation planning evaluation process and the five-year mitigation Plan update. The Flood Mitigation Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the five-year Plan update as appropriate; however, members of SAFARI will assist the Coordinator. Additional meetings may also be held as deemed necessary by SAFARI. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the Plan.

SECTION 4: TOWN PROFILE

The Town of Shandaken profile information is presented in the plan and analyzed to develop an understanding of a study area, including the economic, structural, and population assets at risk and the particular concerns that may be present related to hazards analyzed later in this plan (e.g., low lying areas prone to flooding or a high percentage of vulnerable persons in an area). This profile provides general information for the Town of Shandaken (physical setting, population and demographics, general building stock, and land use and population trends) and critical facilities located within the Town.

GENERAL INFORMATION

The Town of Shandaken is located in the Catskill Mountains, in the northwest corner of Ulster County. The Town's name is of Native American origin and means 'land of rapid waters'. The Town is located along the Route 28 corridor within the Catskill Park and State Forest Preserve. The Town lands are over two-thirds state-owned and include Slide Mountain which is the highest peak in the Catskill range at 4,180 feet. The Town was originally settled around the Revolutionary War period and was formally established on April 9, 1804 (Town of Shandaken, Date Unknown) (http://www.shandaken.us/about-2/).

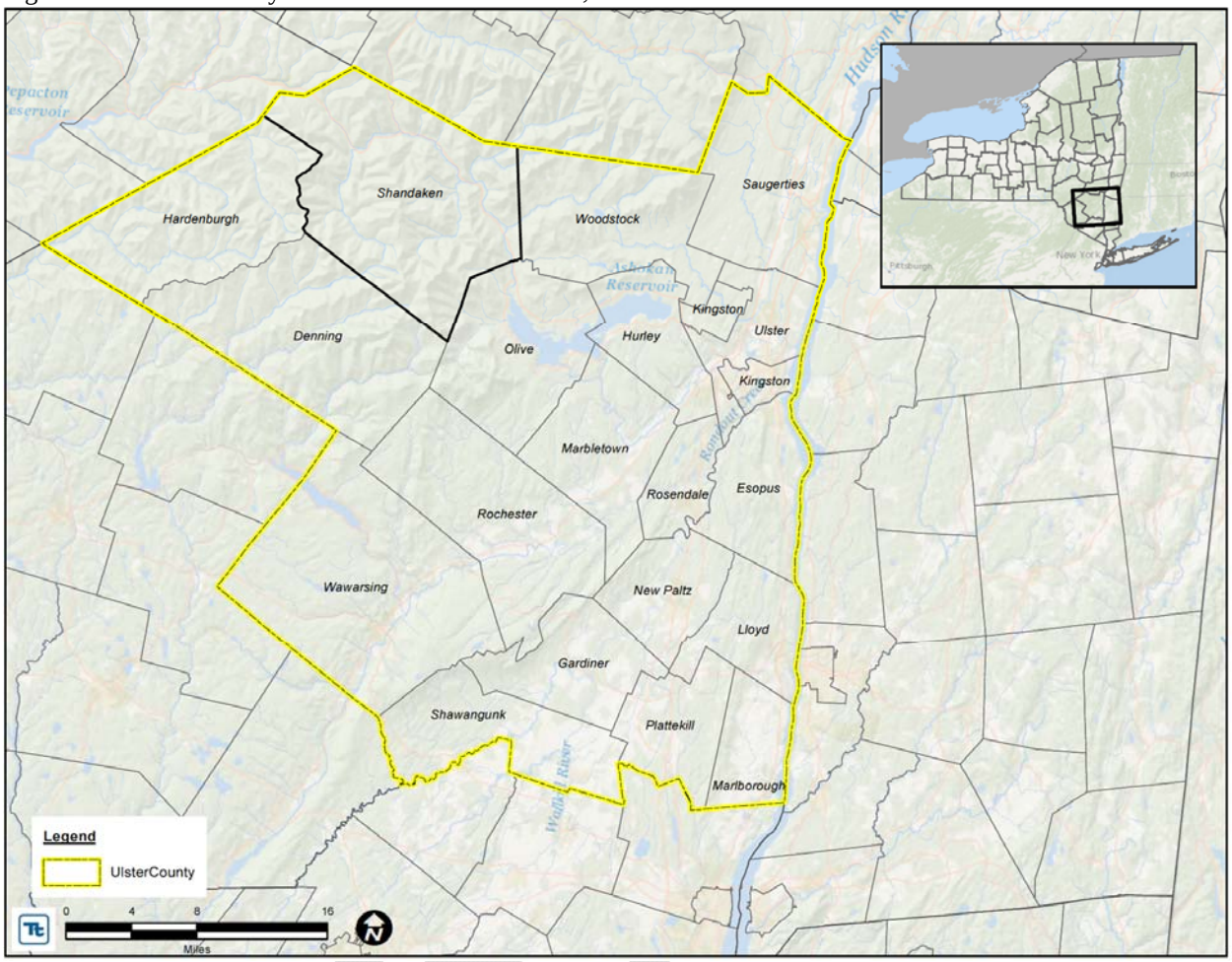
Physical Setting

This section presents the physical setting of the County, including: location, hydrography and hydrology, topography and geology, climate, and land use/land cover.

Location

The Town of Shandaken is one of the 24 municipalities that make up Ulster County. Ulster County is located in southeast New York State, in the Mid-Hudson Region of the Hudson Valley. It has a total area of 1,161 square miles. Ulster County is bordered to the north by Greene County, to the northeast by Columbia County, to the east by Dutchess County, to the south by Orange County and to the west by Sullivan and Delaware Counties (Ulster County Hazard Mitigation Plan, 2009). Figure 4-1 illustrates the location of the Town of Shandaken within Ulster County.

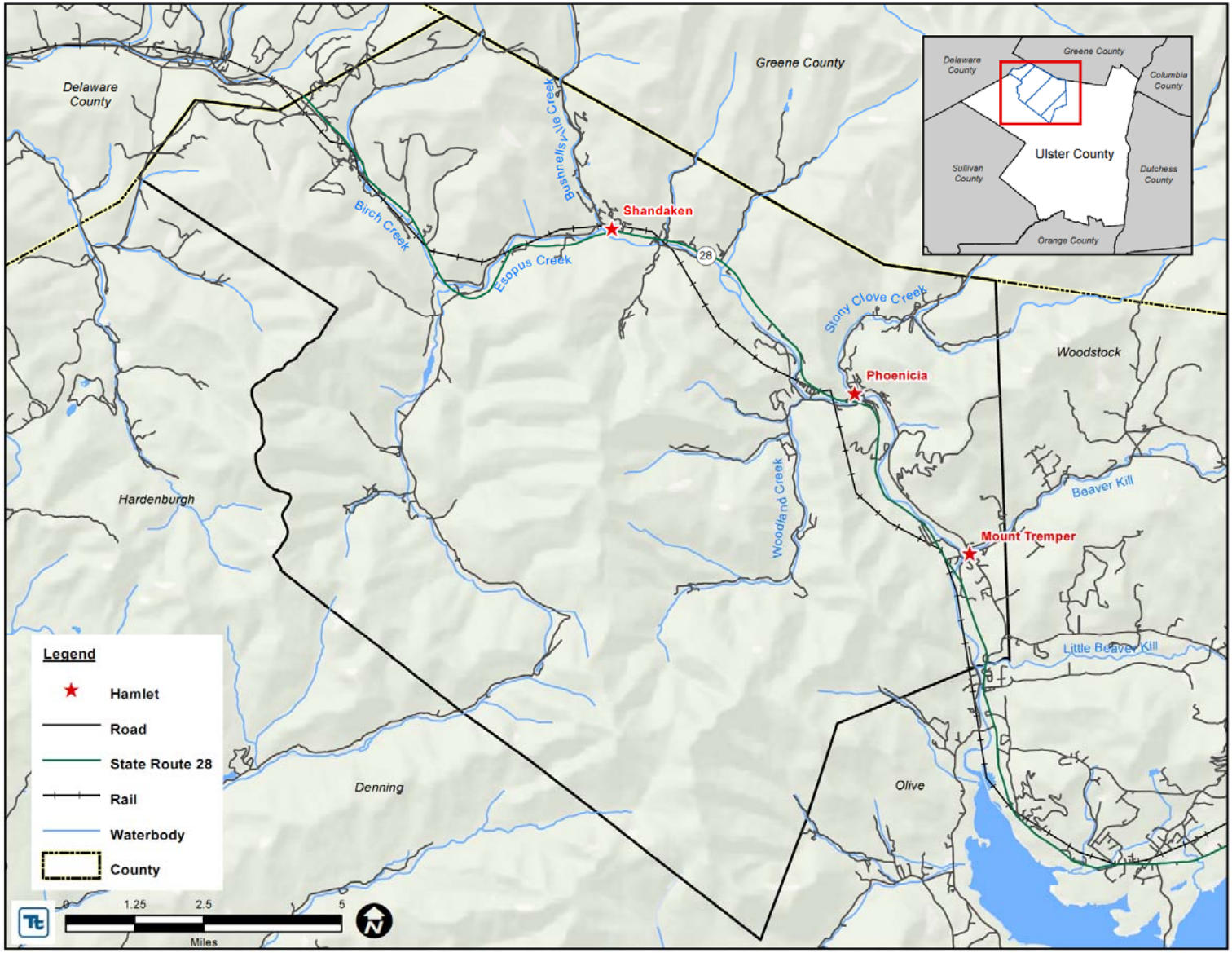
Figure 4-1. Ulster County and the Town of Shandaken, New York



Source: Ulster County, 2012; ESRI Ocean Map

The Town of Shandaken is located within the Central Catskill region of New York State (Town of Shandaken Comprehensive Plan, 2005). The Town is found in the northwestern portion of Ulster County. The Town of Shandaken is bordered to the east by the Town of Woodstock, to the south by the Towns of Denning and Olive, to the west by the Town of Hardenburgh, to the west and north by the Town of Middletown, and to the north by the Towns of Hunter and Lexington (FEMA, 1989). The Town is made up of 12 hamlets: Woodland Valley, Oliverea, Chichester, Bushnellsville, Mt. Pleasant, Mt. Tremper, Phoenicia, Shandaken, Allaben, Big Indian, Pine Hill and Highmount (Town of Shandaken Comprehensive Plan, 2005). Figure 4-2 illustrates the location of the hamlets of Shandaken, Phoenecia, and Mt. Tremper.

Figure 4-2. Town of Shandaken, New York



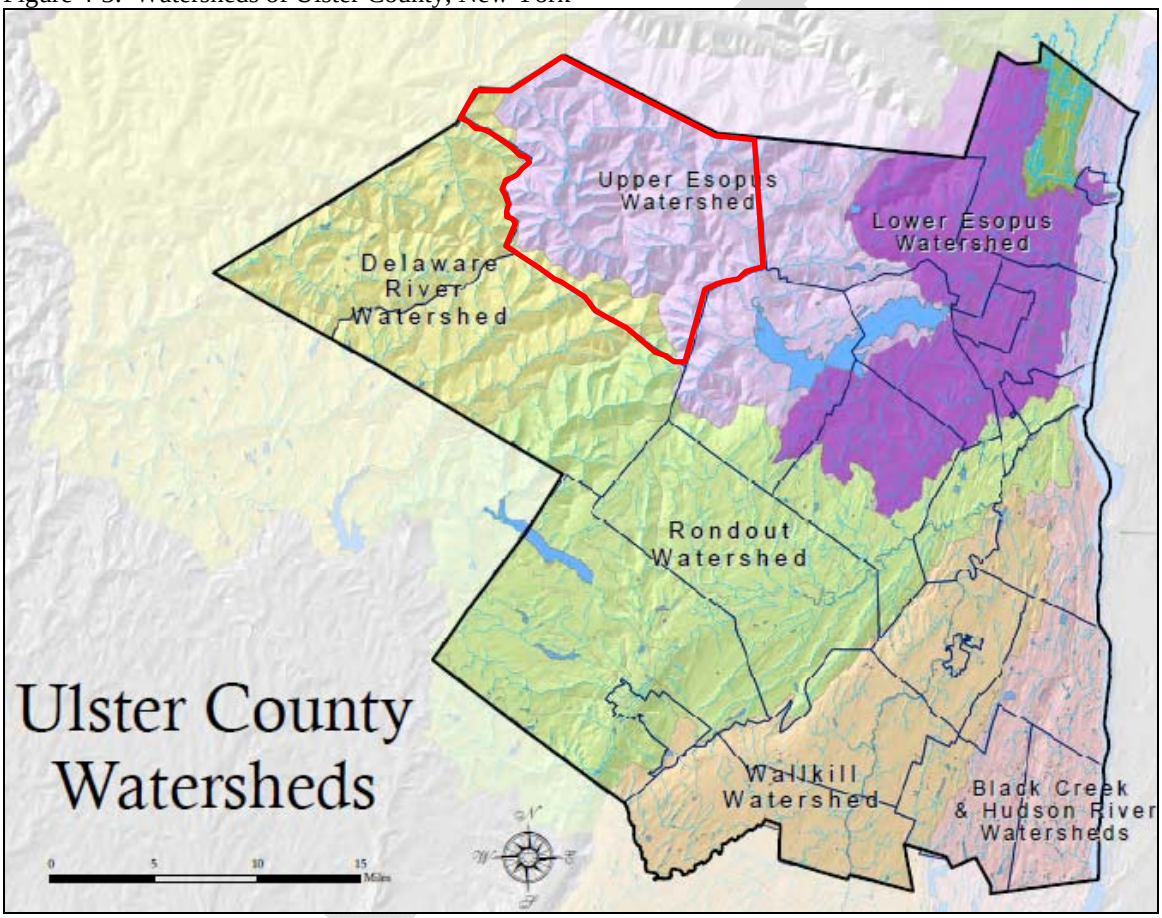
Source: Ulster County, 2012; ESRI Ocean Map

Hydrography and Hydrology

Every single piece of land and water is part of a watershed. A watershed is the land area that drains water into a particular waterbody, such as a stream or wetland. The Town of Shandaken is located within the Upper Esopus and Delaware River Watersheds (Town of Shandaken, 2012; Ulster County, Date Unknown).

The Town of Shandaken is located within the 425-square mile Esopus Creek Watershed in the Catskill Mountains (Figure 4-3). The watershed is divided into two parts by the Ashokan Reservoir; the area above the dam is referred to as the Upper Esopus Watershed and the area below the dam is the Lower Esopus Watershed. The Town of Shandaken is located in the Upper Esopus Watershed.

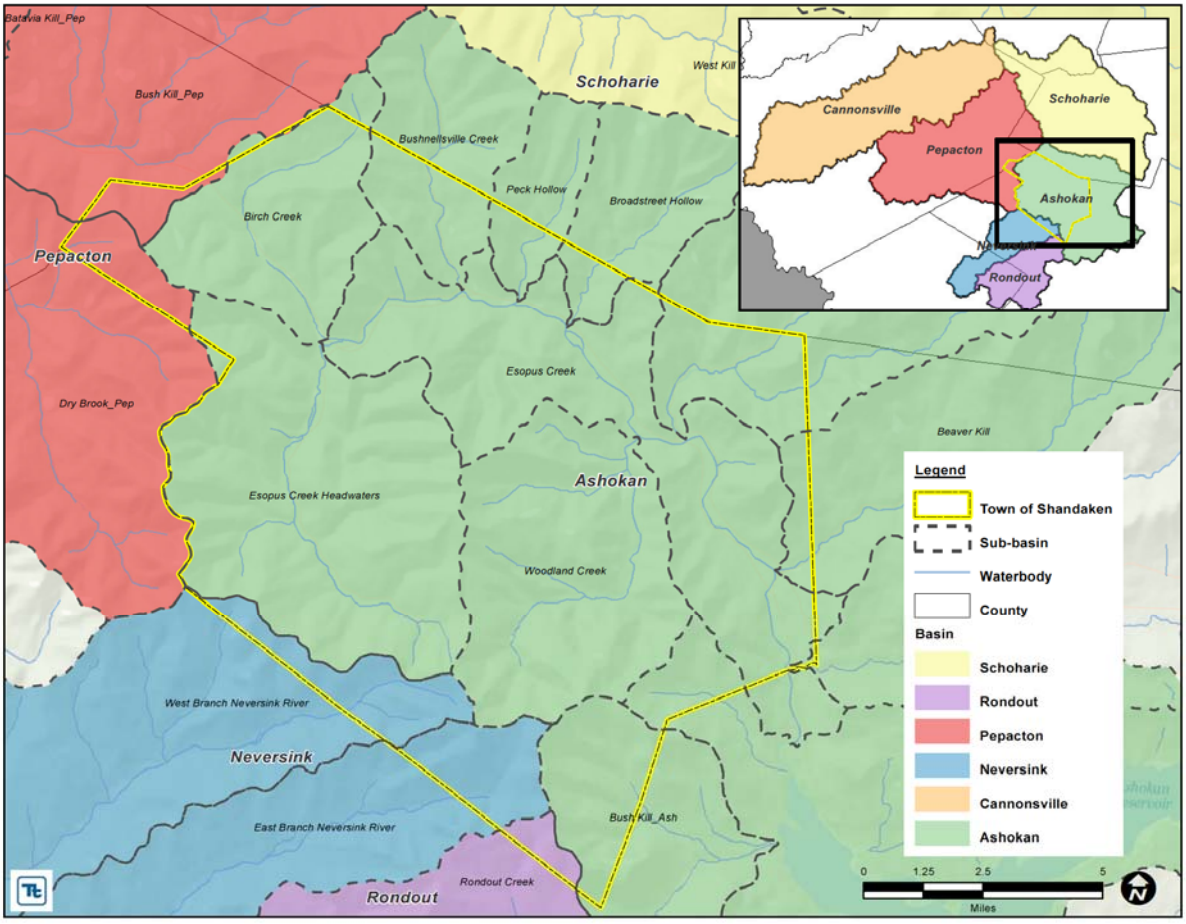
Figure 4-3. Watersheds of Ulster County, New York



Source: Ulster County Environmental, Date Unknown (http://www.co.ulster.ny.us/environment/docs/county_watersheds.pdf)
Note: Red highlight added to outline the approximate boundary of the Town of Shandaken.

The Town of Shandaken is in the Ashoken, Neversink, Pepacton and Rondout basins (refer to Figure 4-4) (NYCDEP, 2012). The Town is within 17 sub-basins. Refer to Table 4-1.

Figure 4-4. Basins and Subbasins of the Town of Shandaken, New York



Source: NYCDEP, 2012

Table 4-1. Basins and Subbasins of the Town of Shandaken, New York

Basin	Sub-Basin		
Ashokan	Bushnellsville Creek	Neversink	West Branch Neversink River
	Birch Creek		East Branch Neversink River
	Peck Hollow	Pepacton	Bush Kill_Pep
	Broadstreet Hollow		Dry Brook_Pep
	Stony Clove Creek	Rondout	Rondout Creek
	Beaver Kill		
	Esopus Creek		
	Esopus Creek Headwaters		
	Woodland Creek		
	Little Beaverkill		
	Ashokan Reservoir		
	Bush Kill_Ash		

The Upper Esopus Creek runs mostly through the Town of Shandaken and crosses the Town of Olive for approximately one mile before reaching the Ashokan Reservoir. The Upper Esopus Creek Watershed covers approximately 192 square miles in the south-central Catskill Mountain Region of southeast New York State. The Upper Esopus Creek is a regulated river by inter-basin transfer of water. The Shandaken Tunnel and its outfall, often referred to as the "Portal" is a handmade, 18-mile aqueduct that connects the Schoharie Reservoir to the Upper Esopus. The Catskill District of New York City's West-of-Hudson water supply is one of the three systems that provides water to New York City and it includes the Schoharie Reservoir, Shandaken Tunnel, Ashokan Reservoir, and the Catskill Aqueduct west of the Hudson River. Approximately 40% of the City's average water supply is provided by the Catskill System (Cornell Cooperative Extension – Ulster County, 2007). Figure 4-5 displays the water supply system of New York City. Figure 4-6 displays the water supply system from the Catskill District.

The Esopus Creek Watershed is an important source of water for the City of New York. According to the Upper Esopus Creek Management Plan, the water supply of the Catskill District System is summarized as the following: 'The Upper Esopus Creek is a regulated river by inter-basin transfer of water. The Shandaken Tunnel, and its outfall – often referred to as the "Portal," is a handmade 18 mile aqueduct that connects the Schoharie Reservoir to the Upper Esopus. The Catskill District of New York City's West-of-Hudson water supply system is one of three systems that supply water to New York City, and it includes the Schoharie Reservoir, Shandaken Tunnel, Ashokan Reservoir and the Catskill Aqueduct west of the Hudson River. Approximately 40% of the City's average water supply demand is provided by the Catskill System.

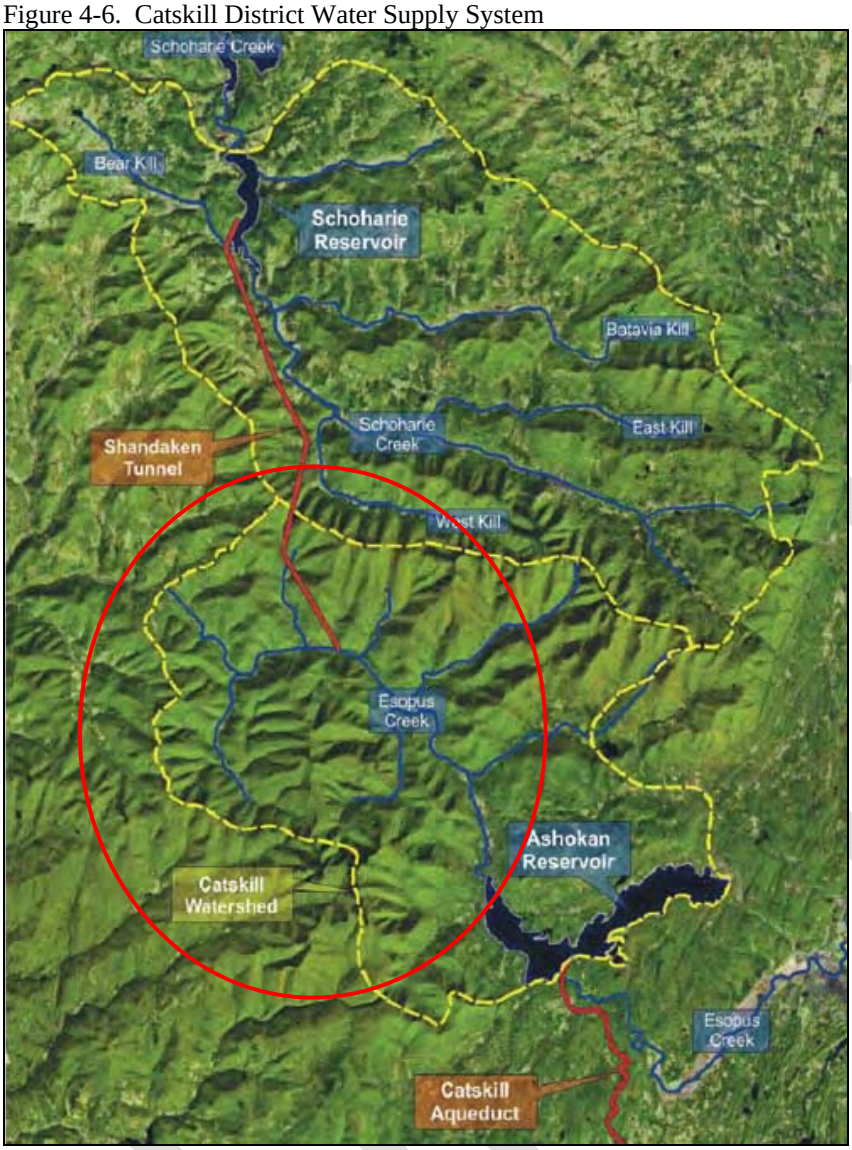
New York City must abide by two regulatory documents administered by the New York State Department of Environmental Conservation (DEC) when operating the Shandaken Tunnel: Title 6 NYCRR Part 670 "Reservoir Release Regulations: Schoharie Reservoir - Shandaken Tunnel – Esopus Creek" and a State Pollution Discharge Elimination System or "SPDES" permit. Together, these two regulations provide for flow, temperature, and turbidity thresholds to protect aquatic biota. Also, Part 670 allows up to four recreational releases for whitewater recreation to be granted per year by the NYSDEC (Cornell Cooperative Extension – Ulster County, 2007).

It is important to note that a separate "Catskill Turbidity Control Study" has been conducted in parallel with this effort. The recently concluded Phase II of that study has outlined structural and operational modification options for controlling turbidity releases from the Shandaken Tunnel that are currently being considered by Federal, State, and local authorities' (Cornell Cooperative Extension, January 2007)

Figure 4-5. New York City's Water Supply System

Source: NYCDEP, 2007 (http://www.nyc.gov/html/dep/html/drinking_water/wsmaps_wide.shtml)

Figure 4-6. Catskill District Water Supply System



Source: Cornell Cooperative Extension – Ulster County, 2007
Note: Red circle indicates the approximate location of the Town of Shandaken.

Flow from the Upper Esopus Watershed has been regulated by the Ashokan Reservoir since 1913. The Upper Esopus Creek is a regulated river by inter-basin transfer of water. Additional water enters the Esopus Creek through the Shandaken Tunnel, approximately 12 miles upstream of the Ashokan Reservoir (Lower Esopus Watershed Partnership, Date Unknown) (http://www.loweresopus.org/watershed/overview/).

Approximately 95% of the total Upper Esopus Watershed consists of forested land. Historical practices of logging and bark peeling activities have altered the stream flow. The watershed receives approximately 50 to 60 inches of precipitation each year (From Section 905(b) Reconnaissance Study – Esopus and Plattekill Creeks Watershed, Ulster and Greene Counties, New York (August 2008).

According to the Stony Clove Creek Stream Management Plan, the Stony Clove Creek watershed is also partially located in the Town of Shandaken. It is located in the central Catskill Mountain region of southeast New York State and drains an area of 32.3 square miles. The Stony Clove Creek flows from its

headwaters at Notch Lake to its confluence with the Esopus Creek in the hamlet of Phoenicia. Approximately 80% of the watershed is located in Greene County and the remainder of it is located in Ulster County. The Stony Clove Creek watershed is bounded by some of the highest peaks in the Catskills, ranging in altitude from 2,220 to 4,040 feet (Greene County Soil and Water Conservation District, 2005).

Topography

Mountaintops and valleys, wooded and steep hillsides, and natural communities of beech, maple, hemlock, ash, oak, and other northern hardwood and conifer forests, all makeup the landscape of the Town of Shandaken. There are few relatively flat plateaus in the Town and many streams that feed the main watercourse, Esopus Creek. There are also expanses of relatively flat land and open fields along the Esopus Valley (Route 28 Corridor). Interspersed throughout the natural land features are the Town's hamlets, developed over the years where the terrain was accessible and conducive, mainly in the valleys and along major streams, such as the Esopus Creek, Woodland Valley, Birch Creek, and the Stony Clove.

Many of the mountaintops in the Town of Shandaken are protected under the New York State Constitution Forest Preserve and are to be kept "Forever Wild". There are portions of several significant mountains in the Town that are not included in the Forest Preserve and include Belleayre and Rose Mountain (Shandaken Comprehensive Plan, 2005; Town of Shandaken, 2012).

Climate

The climate of New York State is very similar to most of the Northeast U.S. and is classified as Humid Continental. Differences in latitude, character of topography, and proximity to large bodies of water all have an effect on the climate across New York State. Precipitation during the warm, growing season (April through September) is characterized by convective storms that generally form in advance of an eastward moving cold front or during periods of local atmospheric instability. Occasionally, tropical cyclones will move up from southern coastal areas and produce large quantities of rain. Both types of storms typically are characterized by relatively short periods of intense precipitation that produce large amounts of surface runoff and little recharge (Cornell, Date Unknown).

The cool season (October through March) is characterized by large, low-pressure systems that move northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms that form in these systems are characterized by long periods of steady precipitation in the form of rain, snow, or ice, and tend to produce less surface runoff and more recharge than the summer storms because they have a longer duration and occasionally result in snowmelt (Cornell, Date Unknown).

The climate of the Town of Shandaken features substantial precipitation, with cold, snowy winters and short, cool summers. The annual precipitation averages 46 inches in the valleys and up to 60 inches in the mountains, and is evenly distributed throughout the year (FEMA FIS, 1989). Mean annual precipitation in the Upper Esopus watershed ranges from approximately 52 inches at Ashokan Reservoir and approximately 63.5 inches at Slide Mountain (Cornell Cooperative Extension – Ulster County, 2007). The average annual high temperature is approximately 57°F and average annual low temperature is approximately 35°F, with a minimum temperature in January averaging 11°F and a maximum July temperature averaging 81°F (The Weather Channel, 2012).

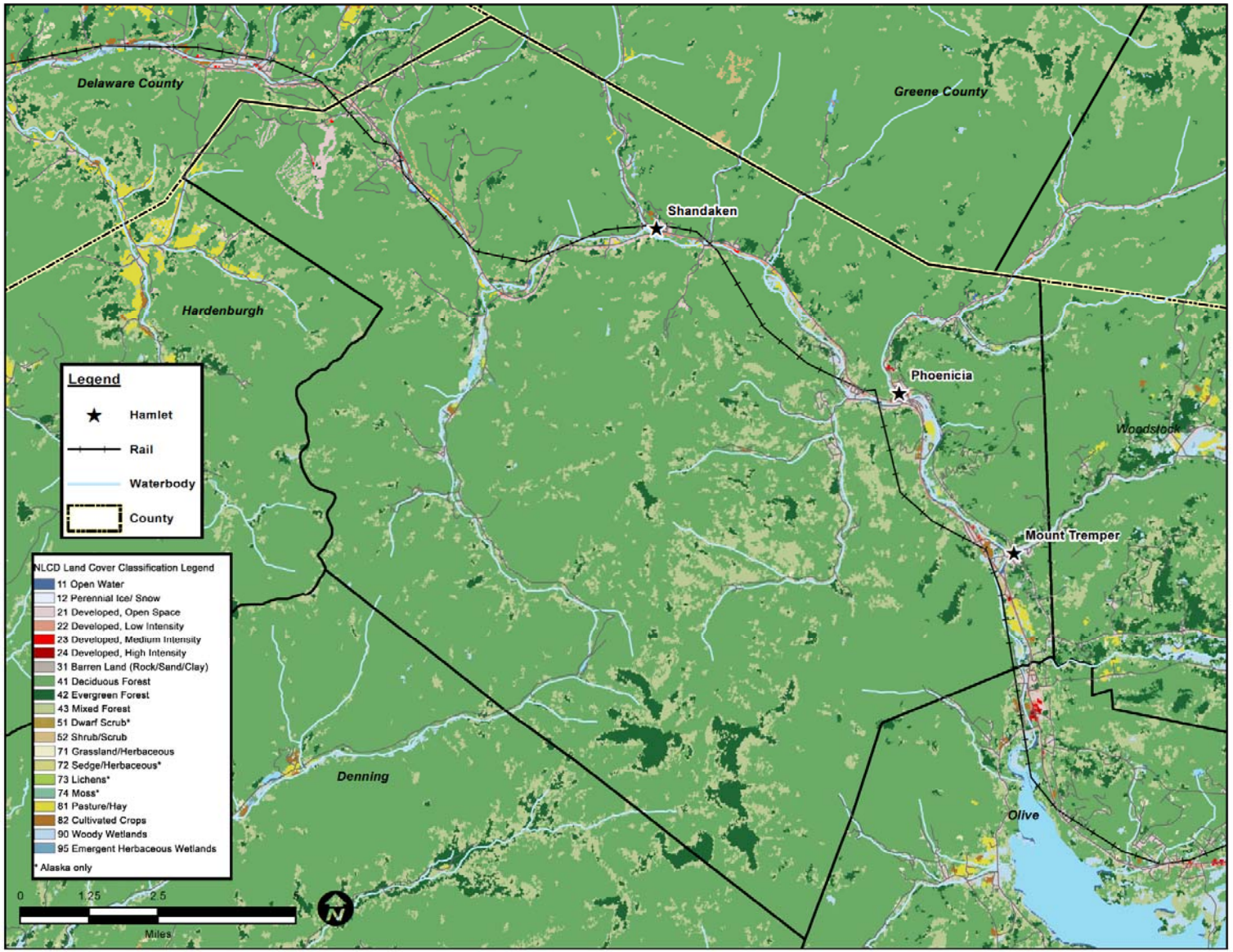
Land Use and Land Cover

The land use pattern of the Town of Shandaken has been influenced by the historic pattern of hamlet development, highway-oriented transportation, and state land ownership. Roadside development includes

older dwellings and tourist-oriented businesses. Areas of resource-related industries, such as sawmills and bluestone, still exist but are not considered an economic factor that they were a century ago. Other factors such as floodplains, environmental legislations, and land acquisitions by the NYCDEP, in addition to the scenic natural terrain characteristics, have affected and limited land use and development. As per the 2005 Comprehensive Plan for the Town of Shandaken, 94% of the Town is developed, has significant development limitations or is highly regulated. The Town is comprised of approximately 79,200 acres with 66% of its land under public ownership and designated as public open space; 14% is residential land use; 9% private open space; 7% vacant land; and 4% miscellaneous (Shandaken Comprehensive Plan, 2005).

Figure 4-7 illustrates land use throughout the Town of Shandaken. Table 4-2 below shows the land use categories and their total square miles and percentages in the Town.

Figure 4-7. Land Use in the Town of Shandaken



Source: USGS, 2011 (2006 National Land Cover Database)

Table 4-2. Land Use (2006) in the Town of Shandaken

Land Use	Total Area (sq. mi.)	Percent of Town (%)
Open Water	0.14	0.11
Developed	2.86	2.32
Barren	0.016	0.01
Forested	118.81	96.31
Farmland	0.39	0.32
Wetlands	1.15	0.93
Total	**123.37**	**100**

Source: FEMA, 2012; USGS, 2011 (2006 National Land Cover Database)
Note: sq. mi. = square miles

POPULATION AND DEMOGRAPHICS

According to the 2010 U.S. Census, the Town of Shandaken had a population of 3,085 people. The U.S. Census data in HAZUS-MH is based on the 2000 data in which there were 3,235 people in the Town. Table 4-3 presents the population statistics for the Town of Shandaken based on the 2010 U.S. Census data. Figure 4-8 shows the distribution of the general population density (persons per square mile) by Census block. For the purposes of this plan, U.S. Census 2010 data was used where possible for exposure analysis; however, estimated results from HAZUS-MH represents 2000 data. Because of the decrease in population from 2000 to 2010, the HAZUS results are considered conservative.

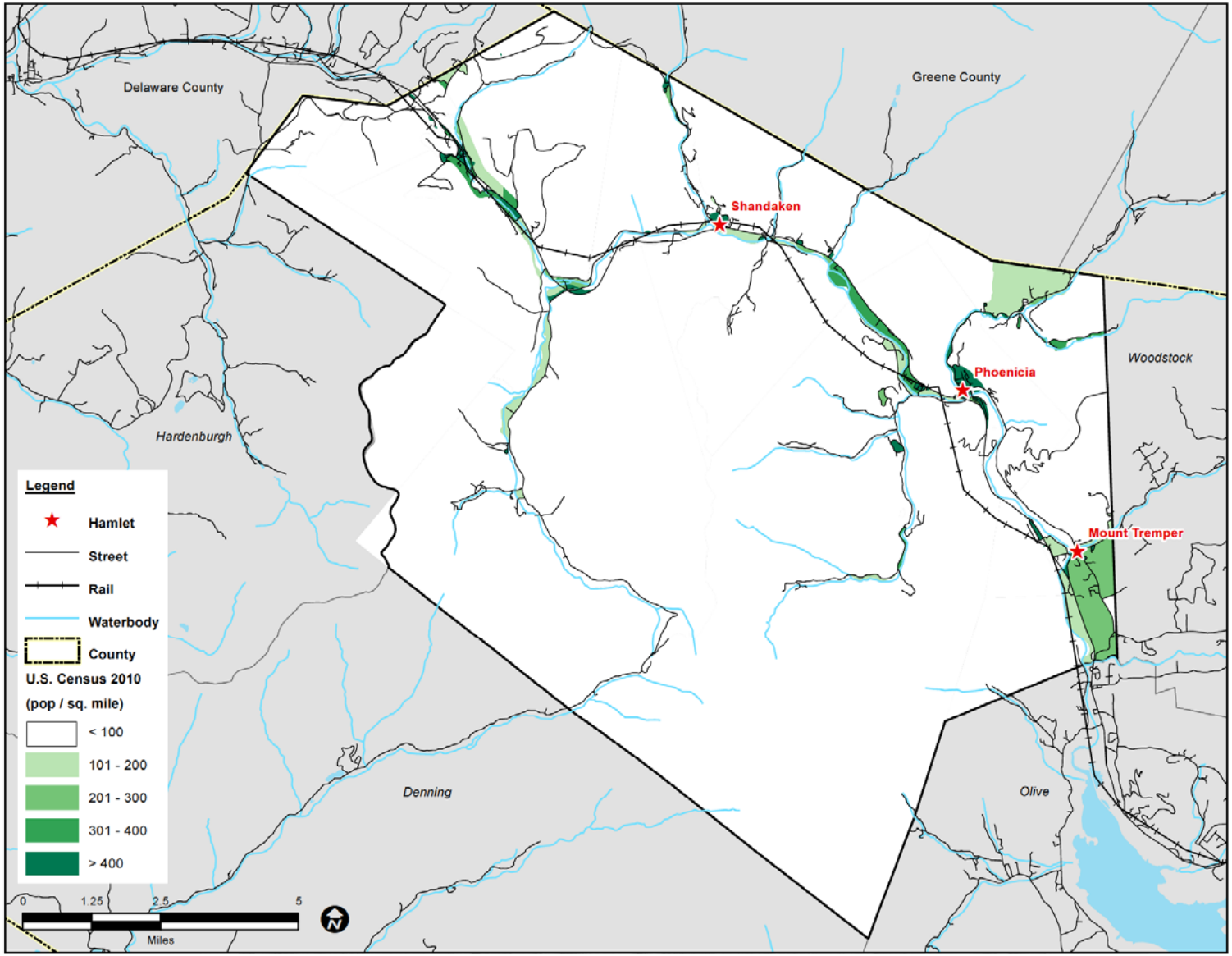
The Disaster Mitigation Act of 2000 (DMA 2000) requires that hazard mitigation plans (HMPs) consider socially vulnerable populations. These populations can be more susceptible to hazard events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For the purposes of this study, vulnerable populations shall include (1) the elderly (persons aged 65 and over) and (2) those living in low-income households.

Table 4-3. Town of Shandaken Population Statistics (2010 and 2000 U.S. Census)

Census 2010 Pop.	HAZUS-HM 2000 Pop.	HAZUS-MH Pop. Over 65*	Percent of HAZUS-MH Pop. Over 65*	HAZUS-MH Low-Income Pop. **	Percent of HAZUS-MH Low-Income Pop. **
3,085	3,235	569	17.6	647	20

Source: Census 2010 (U.S. Census Bureau); HAZUS-MH 2.1
Note: Pop. = population
* Individuals over the age of 65. Percentage is calculated out of U.S. Census 2000 total population of municipality.
** Households with an income of less than $25,000. Percentage is calculated out of U.S. Census 2000 total population of municipality.

Figure 4-8. Distribution of General Population for the Town of Shandaken, New York



Source: U.S. Census, 2010

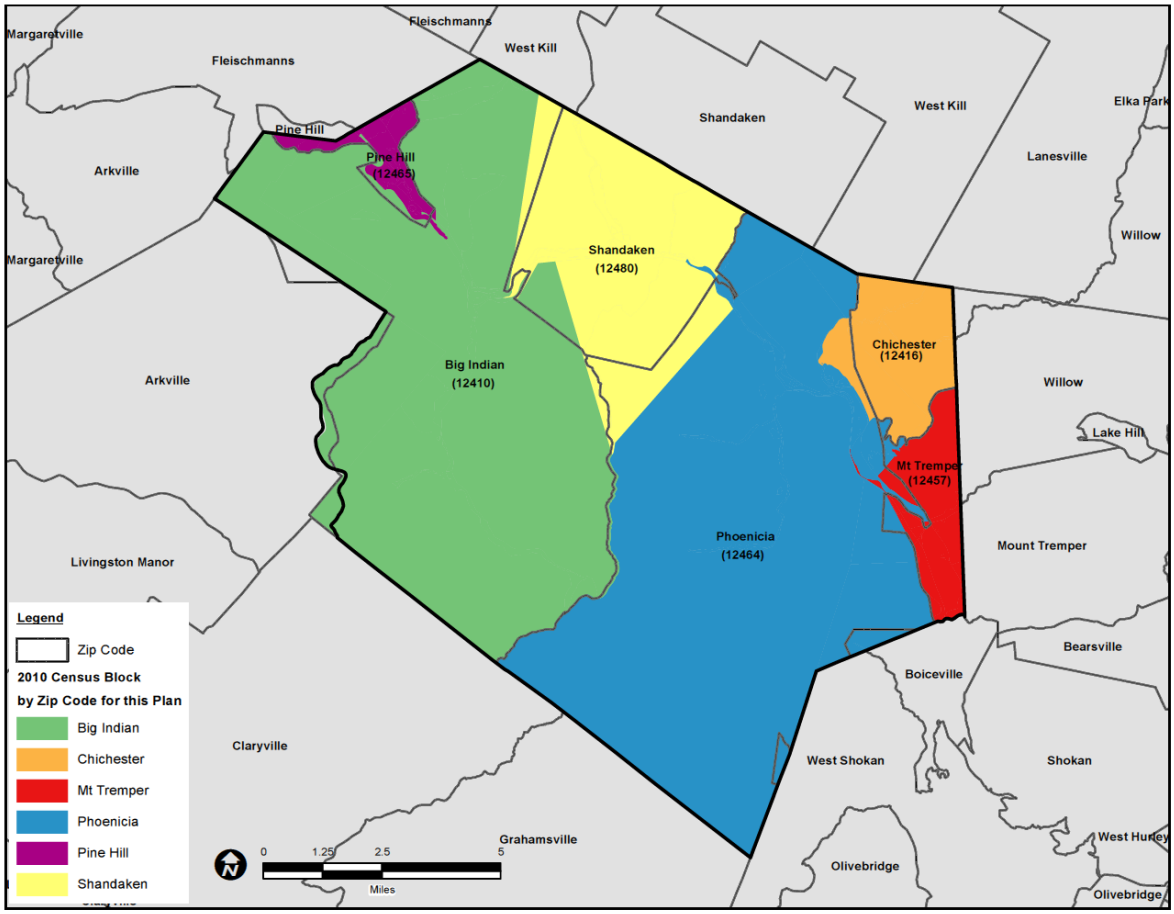
Table 4-4 presents a summary of the 2010 U.S. Census general population statistics for the Town of Shandaken by zip code. Census blocks do not follow the boundaries of each zip code. The Census blocks with their centroid in the zip code boundary was used to calculate the population within the zip code. Figure 4-9 displays the Census blocks relative to the zip code boundaries used for this Plan. Please note Census Block 361119553001065, located in the Town of Shandaken, has two zip codes: Phoenicia and Boiceville. For the purposes of this analysis, the entire block is considered within the Phoenicia zip code and is reported as such in this Plan. Further, the zip codes may not accurately portray the hamlet boundaries or demographic statistics.

Table 4-4. Town of Shandaken Population Statistics by Zip Code (2010 U.S. Census)

Zip Code	Total Population (U.S. Census 2010)	Percent Population
Big Indian	457	14.8
Chichester	345	11.2
Mt Tremper	478	15.5
Phoenicia	1,021	33.1
Pine Hill	242	7.8
Shandaken	542	17.6
Total – Town of Shandaken	**3,085**	**100**

Source: Census 2010 (U.S. Census Bureau); HAZUS-MH 2.1

Figure 4-9. U.S. Census 2010 Blocks by Zip Code for Plan Analysis



Source: U.S. Census 2010; Ulster County GIS

It is noted that the census data for household income provided in HAZUS-MH includes two ranges ($0-10,000 and $10,000-$20,000/year) that were totaled to provide the "low-income" data used in this study. This does not correspond exactly with the "poverty" thresholds established by the U.S. Census Bureau, which identifies households with an annual household income below $15,000 per year as "low income" for this region. This difference is not believed to be significant for the purposes of this planning effort.

The 2010 U.S. Census data also identified 330 of the 1,520 households as having an annual income of less than $15,000. The 2000 U.S. Census data indicates a total of 647 persons living in households below the annual income level of $25,000 (20%). Figure 4-10 shows the distribution of persons over age 65 in the Town, while Figure 4-11 shows the distribution of low income persons. Viewing exposure distribution maps can assist communities in visualizing areas of high exposure and in evaluating aspects of the study area in relation to the specific hazard risks.

Race, Ethnicity, and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the 2010 U.S. Census Bureau's American Community Survey, the racial composition of the planning area is predominantly white, at 92.9 percent. The largest minority populations are Asian at 1.6 percent and two or more races at 2.4 percent. **Error! Reference source not found.** shows the racial distribution in the planning area. (U.S. Census, 2012)

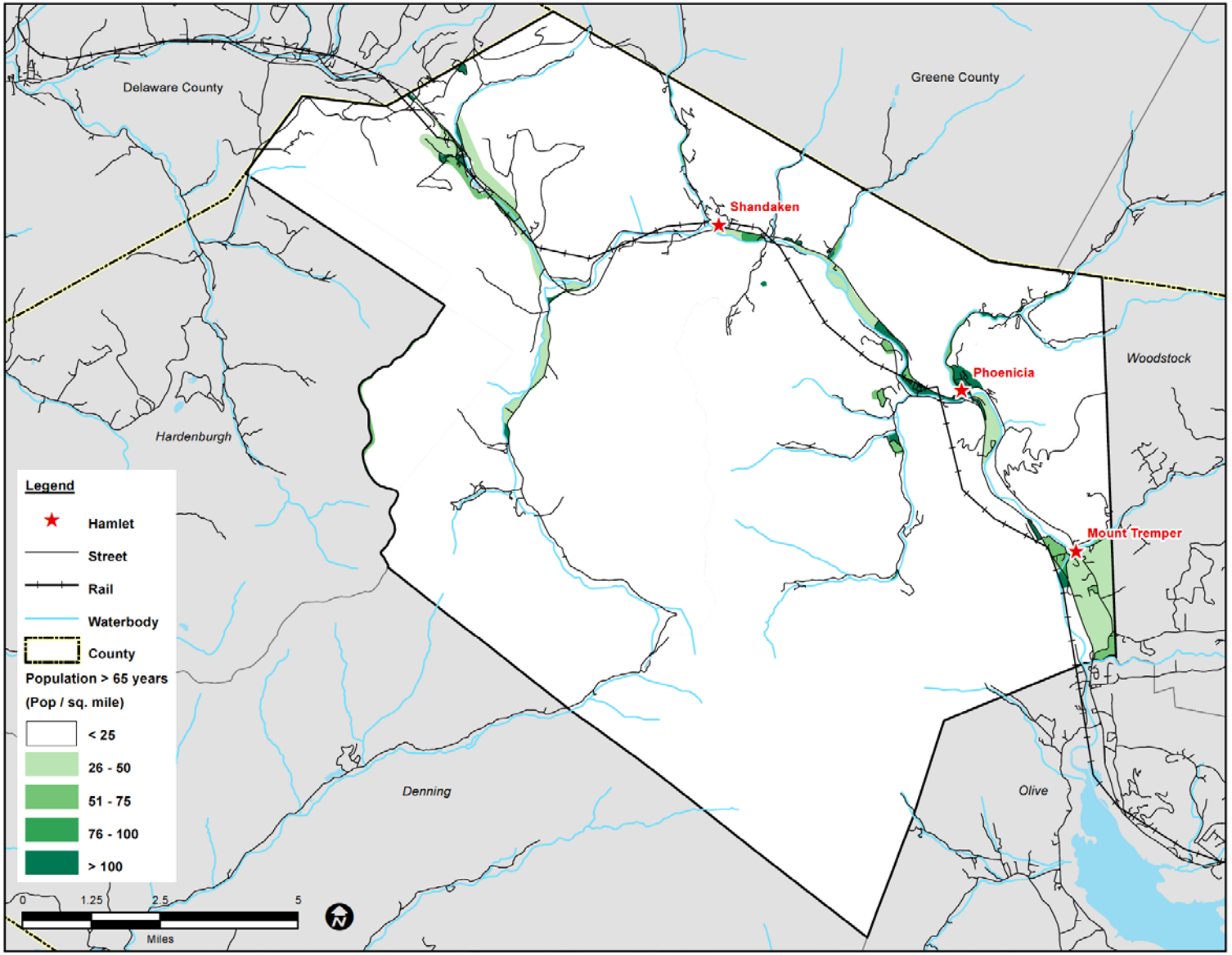
The planning area has a 7.1-percent foreign-born population. Other than English, the most commonly spoken languages in the planning area is Spanish at 3.3 percent. The census estimates that 0.6 percent of the residents speak English "less than very well." (U.S. Census, 2012).

Disabled Populations

The 2010 U.S. Census estimates that 54 million non-institutionalized Americans with disabilities live in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs.

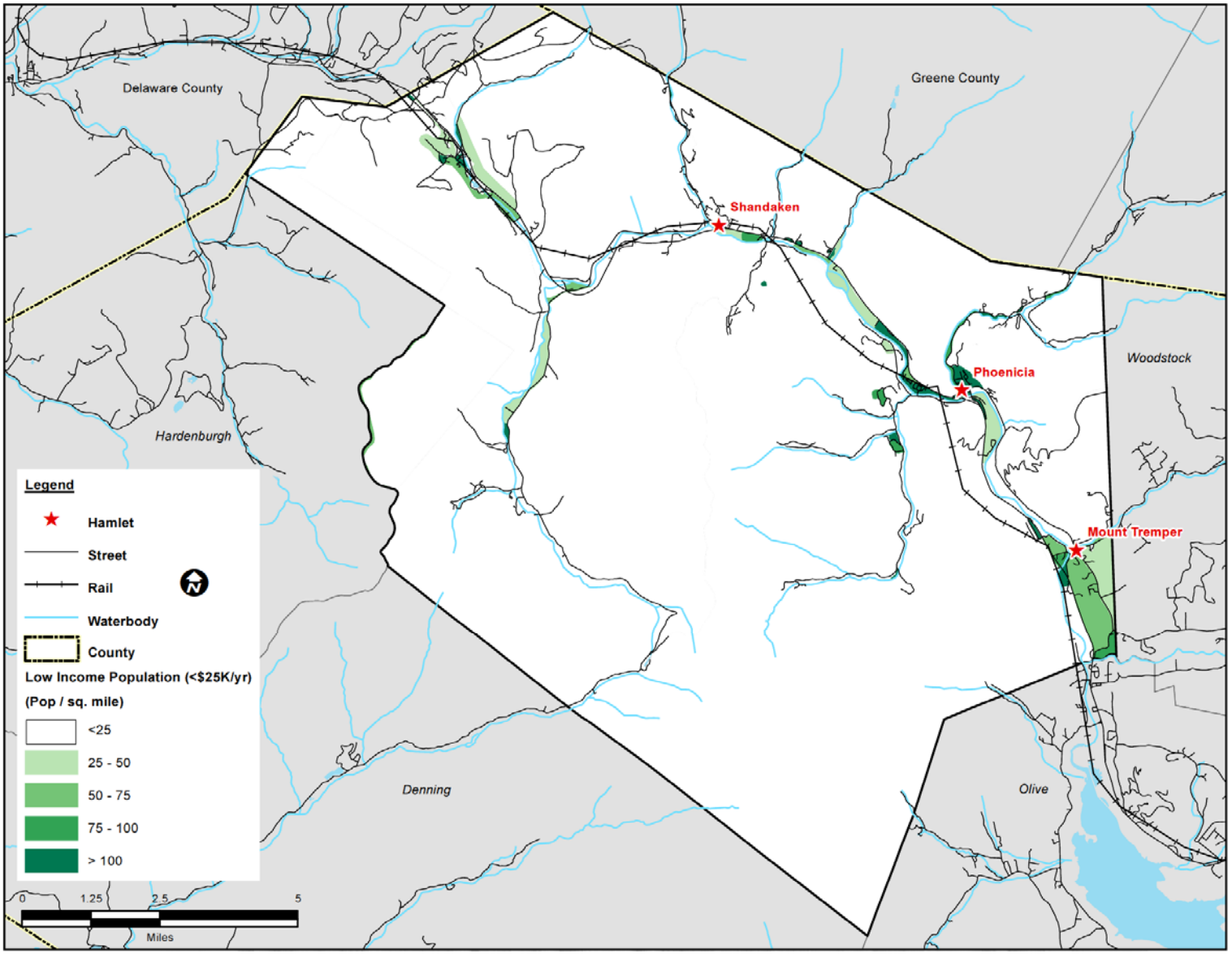
Specific statistics on disabilities in the planning area are not available through the US Census Bureau

Figure 4-10. Distribution of Persons over the Age of 65 in the Town of Shandaken, New York



Source: HAZUS-MH 2.1 (U.S. Census 2000)

Figure 4-11. Distribution of Low-Income Population in the Town of Shandaken, New York



Source: HAZUS-MH 2.1 (U.S. Census 2000)

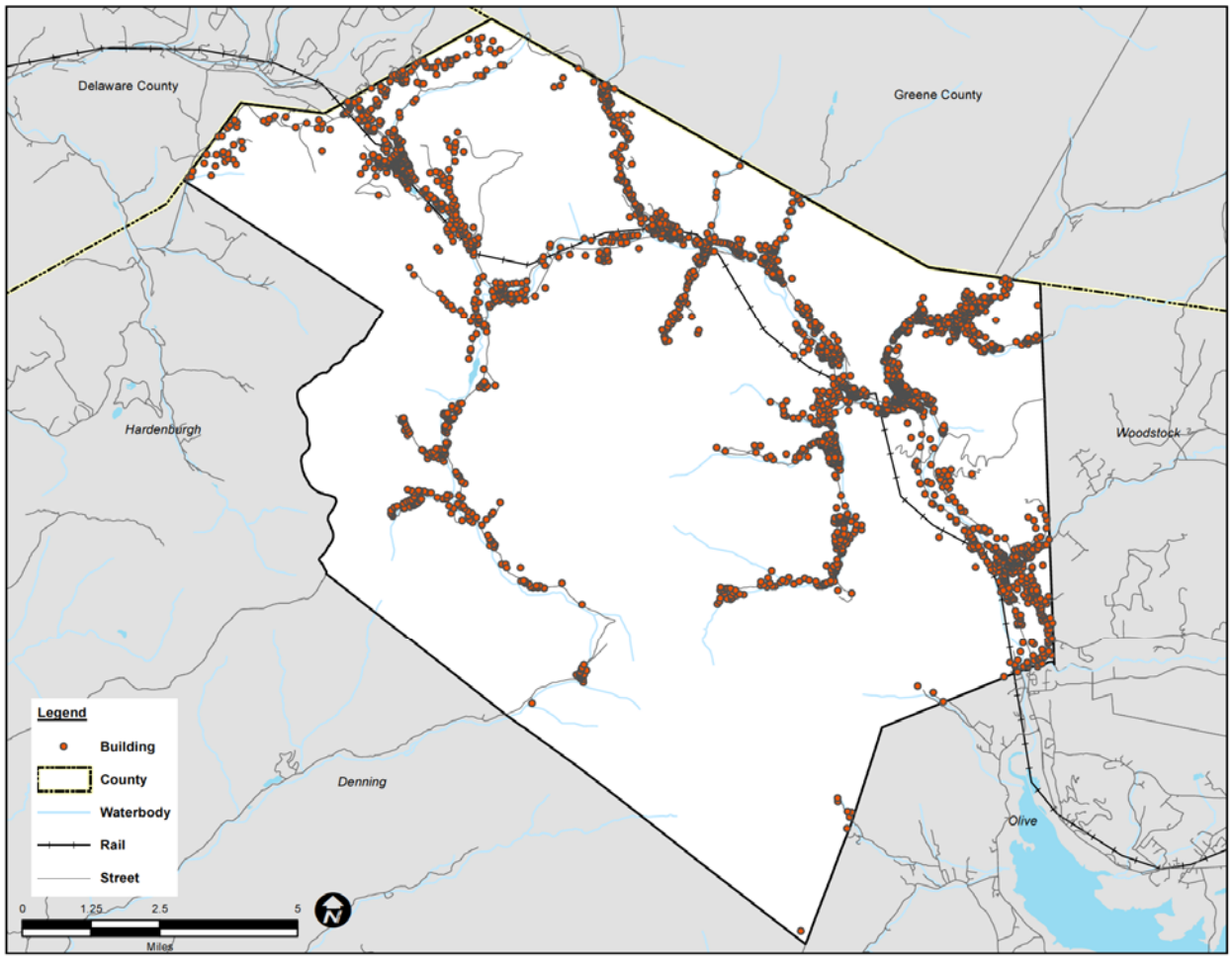
GENERAL BUILDING STOCK

The 2010 U.S. Census data identifies 1,520 households in the Town of Shandaken. The U.S. Census data identified 2,776 housing units in the Town of Shandaken in 2010, with 1,505 of those being occupied housing units and 1,271 being vacant housing units. . The median price of a single family home in the Town of Shandaken was estimated at $218,800 in 2010 (U.S. Census, 2010).

The HAZUS-MH default building inventory was updated and replaced at the structure level for the Town of Shandaken. A custom building inventory was developed using detailed structure-specific assessor data, as well as parcel and address point location information. Structural and content replacement cost values were calculated for each building utilizing available assessor data and RSMeans 2011 values.

The building inventory generated for the Town contains 2,381 structures with a total building replacement value (structure and content) of $815,199,625. According to the building inventory developed for this plan, approximately 2,235 buildings ($581,837,608) or approximately 94% of the total buildings are residential housing. More specifically, the 2010 Census data identify that more than 80% of housing units in the Town are single-family detached units. Table 4-5 and Figure 4-12 the building stock for the Town of Shandaken used for this analysis. As Figure 4-12 illustrates, the majority of the buildings are along the riverine reaches in the Town.

Figure 4-12. Distribution of Buildings in the Town of Shandaken



Source: Ulster County, 2012; Tetra Tech, 2012

Table 4-5. Building Stock Count and Replacement Value by Occupancy Class

Zip Code	Total		Residential		Commercial		Industrial	
	Count	Value	Count	Value	Count	Value	Count	Value
Big Indian	443	$150,118,372	423	$123,265,186	19	$24,391,902	0	$0
Chichester	276	$72,636,483	271	$60,240,253	4	$3,842,730	0	$0
Mt Tremper	259	$90,876,459	244	$63,663,324	6	$6,542,570	2	$873,956
Phoenicia	791	$289,931,165	724	$172,537,840	54	$64,914,297	1	$436,978
Pine Hill	244	$96,548,248	223	$73,913,958	19	$19,588,585	0	$0
Shandaken	368	$115,088,897	350	$88,217,047	12	$11,791,084	1	$436,978
Town of Shandaken	**2,381**	**$815,199,625**	**2,235**	**$581,837,608**	**114**	**$131,071,168**	**4**	**$1,747,911**

Zip Code	Agriculture		Religious		Government		Education	
	Count	Value	Count	Value	Count	Value	Count	Value
Big Indian	0	$0	0	$0	1	$2,461,284	0	$0
Chichester	0	$0	0	$0	0	$0	1	$8,553,500
Mt Tremper	0	$0	3	$13,705,200	4	$6,091,410	0	$0
Phoenicia	0	$0	9	$48,729,600	3	$3,312,450	0	$0
Pine Hill	0	$0	0	$0	2	$3,045,705	0	$0
Shandaken	0	$0	2	$9,136,800	3	$5,506,989	0	$0
Town of Shandaken	**0**	**$0**	**14**	**$71,571,600**	**13**	**$20,417,837**	**1**	**$8,553,500**

Source: Ulster County, 2012

LAND USE AND POPULATION TRENDS

Land use regulatory authority is vested in New York State's towns, villages, and cities. However, many development and preservation issues transcend location political boundaries. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

This Plan provides a general overview of population and land use and types of development occurring within the study area. An understanding of these development trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

Land Use Trends

The following section presents an overview of the Town's land use trends.

Economy

The County Business Pattern is provided by the U.S. Census Bureau and is an annual series that presents sub-national economic data by industry. County Business Patterns covers most of the country's economic activity. The ZIP Code Business Patterns data is available after the release of the County Business Patterns and provides the number of establishments by employment-size classes by detailed industry in the U.S. (U.S Census Bureau, 2010).

According to the 2010 ZIP Code Business Pattern for the Town of Shandaken and several hamlets, the Town had a total of 109 business establishments, with accommodation and food services having the highest number of establishments in the Town and hamlets. Table 4-6 provides the 2010 business pattern information for the Town of Shandaken and the hamlets of Mt. Tremper, Phoenicia, Chichester, Big Indian, Pine Hill, and Highmount.

Table 4-6. The Town of Shandaken 2010 Business Patterns

Industry	Number of Establishments
Accommodation and food services	28
Administrative and Support and Waste Mang and Remediation Srvs	1
Arts, entertainment, and recreation	5
Construction	13
Finance and insurance	3
Health care and social assistance	8
Information	4
Manufacturing	3
Other services (except public administration)	8
Professional, scientific, and technical services	11
Real estate and rental and leasing	6
Retail trade	11
Transportation and warehousing	4
Wholesale trade	4
Total	**109**

Source: U.S. Census Bureau, 2010

Population Trends

Table 4-7. Town of Shandaken Population Trends, 1950 to 2010

Year	Population	Change in Population	Percent (%) Population Change
1990	3,013		
2000	3,235	222	7.3%
2010	3,085	(150)	(4.6%)

Source: U.S. Census Bureau, 2012

Future Growth and Development

At present no areas are targeted for future growth and development. Growth is expected to be minimal due to the steep slope topography of available land parcels and the amount of state owned land which prohibits development. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas.

CRITICAL FACILITIES

A comprehensive inventory of critical facilities in the Town of Shandaken was developed from various sources including Ulster County GIS and input from the Planning Committee. The inventory of critical facilities presented in this section represents the current state of this effort at the time of publication and used for the risk assessment in Section 5.

Critical Facilities are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, EMS, schools/colleges, shelters, senior facilities, and medical facilities.

Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, shelters, schools, and senior care and living facilities.

Emergency Facilities

For the purposes of this Plan, emergency facilities include emergency operation centers (EOCs), police, fire and emergency medical services (EMS). Table 4-8 through Table 4-10 provide an inventory of EOCs, police stations, fire stations and EMS facilities in the Town of Shandaken. Figure 4-13 displays the location of these facilities based on the HAZUS-MH inventory data, County GIS and input from the Planning Committee.

Table 4-8. Emergency Operation Centers in the Town of Shandaken

Name	Address	Municipality (Hamlet)	Building Type	Backup Power
Shandaken Town Hall	7209 Route 28	Shandaken (Shandaken)	Wood	Yes (phone and lighting for 12 hours)
Phoenicia Fire House		Shandaken (Phoenicia)	Wood	Yes
Belleayre Mt Ski Center		Shandaken (Pine Hill)	Wood	Yes

Table 4-9. Police Stations in the Town of Shandaken

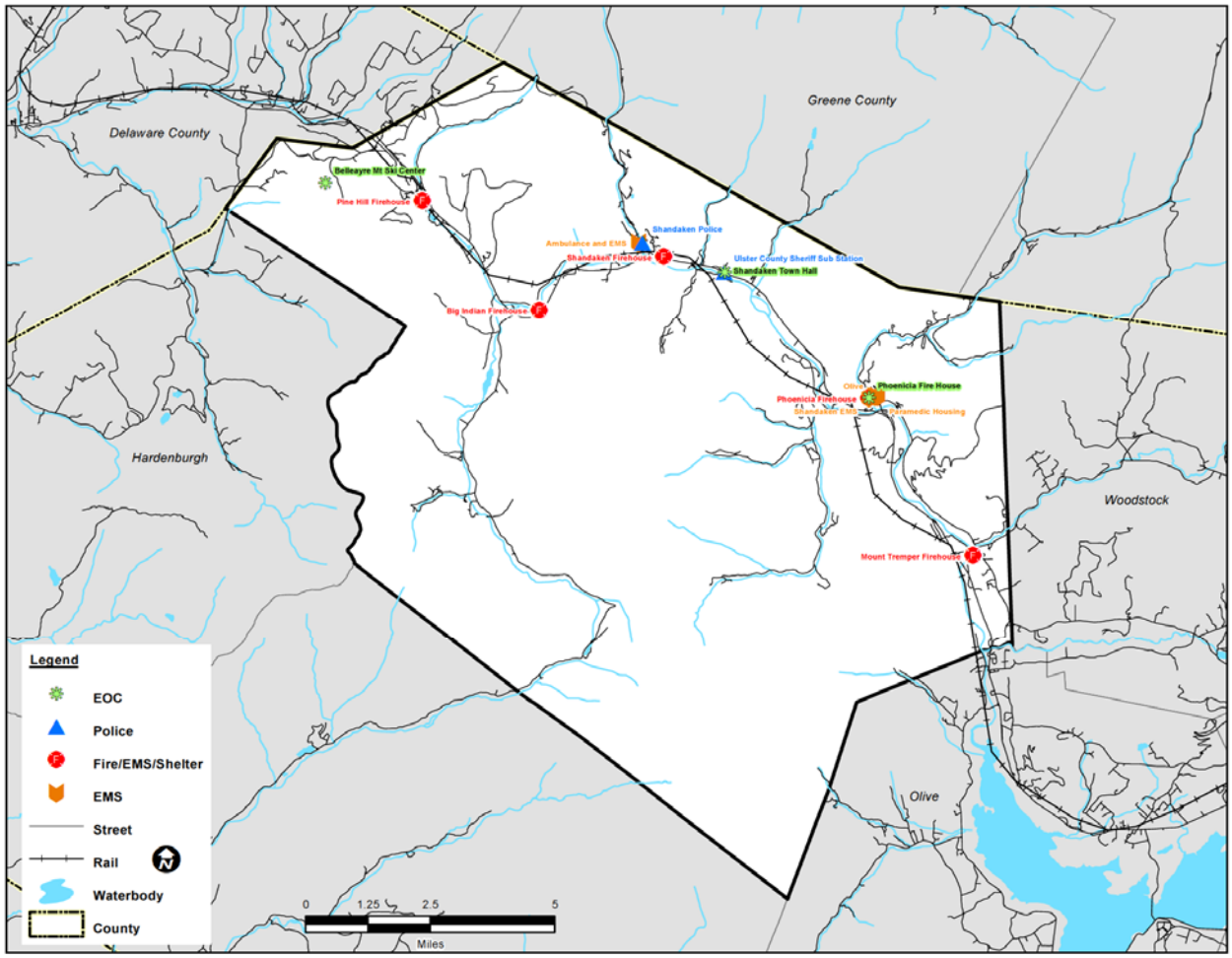
Name	Address	Municipality (Hamlet)	Building Type	Backup Power
Shandaken	48 State Route 42	Shandaken (Shandaken)	Steel	TBD
Ulster County Sheriff Sub Station	7209 State Route 28	Shandaken (Shandaken)	Wood	TBD

Table 4-10. Fire/EMS in the Town of Shandaken

Name	Address	Municipality (Hamlet)	Type	Building Type	Backup Power
Mount Tremper Firehouse	24 Ingersoll Road	Shandaken (Mt. Tremper)	Fire/EMS	Wood	TBD
Pine Hill Firehouse	265 Main Street	Shandaken (Pine Hill)	Fire/EMS	Steel	Yes
Big Indian Firehouse	8 Firehouse Road	Shandaken (Big Indian)	Fire/EMS	Masonry	Yes
Shandaken Firehouse	7390 Route 28	Shandaken (Shandaken)	Fire/EMS	Wood	No (Portable Generator)
Phoenicia Firehouse	58 Route 214	Shandaken	Fire/EMS	Concrete	Yes

Name	Address	Municipality (Hamlet)	Type	Building Type	Backup Power
		(Phoenicia)			
Paramedics Housing	Ave Maria Drive	Shandaken (Shandaken)	EMS	Wood	No
Ambulance and EMS	Route 42	Shandaken (Shandaken)	EMS	Steel	No (Portable Generator)

Figure 4-13. Emergency Facilities in the Town of Shandaken



Hospitals and Medical Centers

There are no hospitals located within the Town of Shandaken. The closest hospitals include the Margaretville Memorial Hospital located in the Village of Margaretville in Delaware County, New York and Kingston Hospital in Kingston, New York.

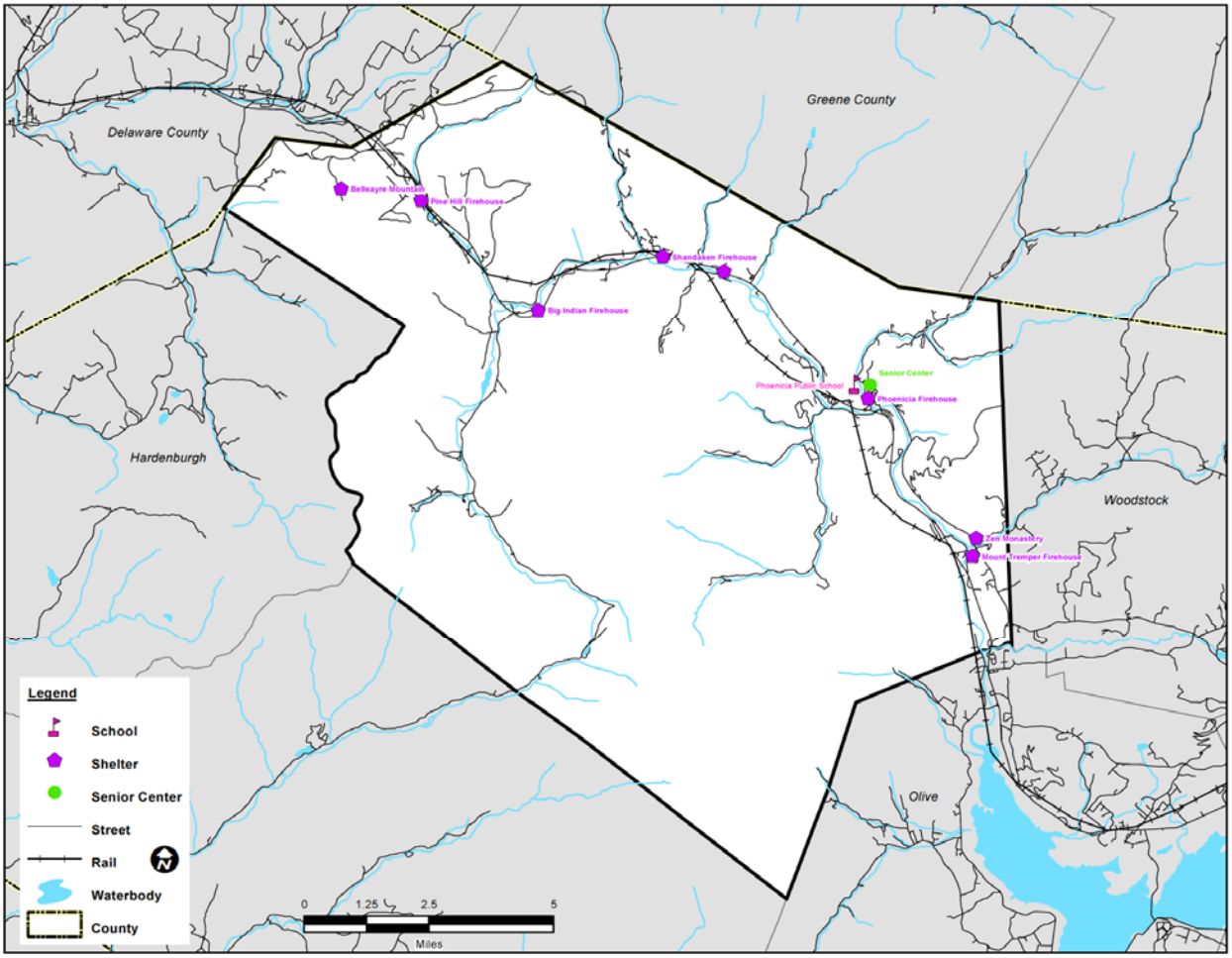
Schools

Table 4-11 lists all schools and other education facilities in the Town. Figure 4-14 displays the locations of these schools within the Town of Shandaken.

Table 4-11. Education Facilities in the Town of Shandaken

Name	Address	Municipality (Hamlet)	Enroll.	Desig-nated Shelter /Shelter Capacity	Building Type	Backup Power
Phoenicia Elementary	School Lane	Shandaken (Phoenicia)	TBD	TBD	Masonry	Yes

Figure 4-14. Schools, Shelters and Senior Centers in the Town of Shandaken



Shelters

Table 4-12 provides an inventory of the shelters in the Town of Shandaken.

Table 4-12. Shelter Facilities in the Town of Shandaken

Name	Municipality (Hamlet)	Capacity	Building Type	Backup Power
Belleayre Ski	Shandaken (Pine Hill)	TBD	Wood/Concrete	Yes
Town Hall	Shandaken	TBD	Wood/Concrete	TBD
Zen Monastery	Shandaken (Mt. Tremper)	TBD	Masonry	Yes
Mount Tremper Firehouse	Shandaken (Mt. Tremper)	TBD	Wood/Concrete	TBD
Pine Hill Firehouse	Shandaken (Pine Hill)	TBD	TBD	TBD
Big Indian Firehouse	Shandaken (Big Indian)	TBD	Wood/Concrete	TBD
Shandaken Firehouse	Shandaken	TBD	Wood/Concrete	TBD
Phoenicia Firehouse	Shandaken (Phoenicia)	TBD	Wood/Concrete	TBD

Senior Care and Senior Living Facilities

Table 4-13 provides an inventory of senior facilities in the Town.

Table 4-13. Senior Facilities in the Town of Shandaken

Name	Address	Municipality (Hamlet)	Building Type	Backup Power
Senior Center	Ave Maria Drive	Shandaken	Masonry/ Concrete	Yes

Figure 4-14 displays the location of the Shelter and Senior Living/Senior Care facilities.

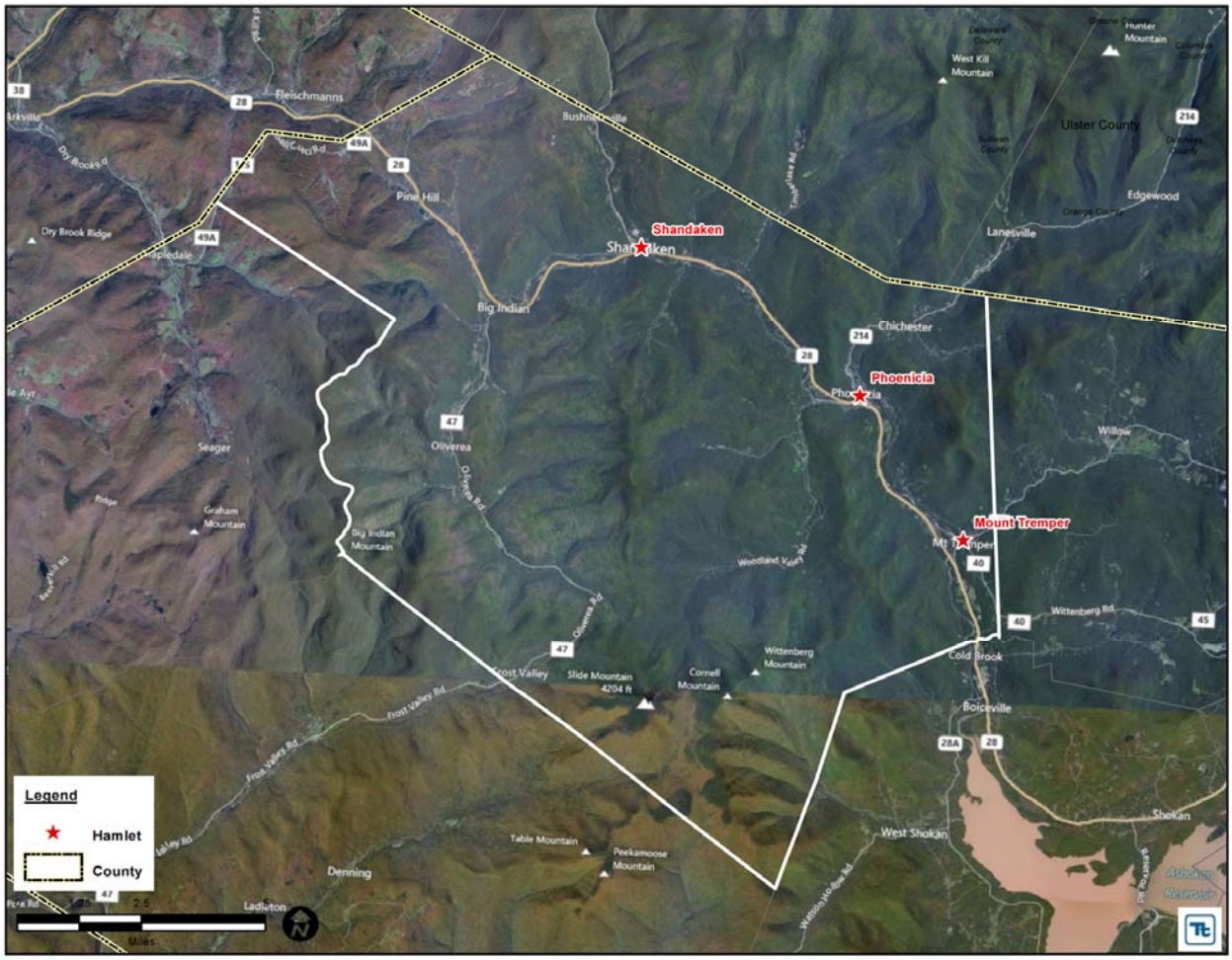
Transportation Systems

This section presents available inventory data for major transportation systems in the Town of Shandaken. There are no airports in the Town. Figure 4-15 shows regional transportation lifelines serving the Town of Shandaken.

Highway, Roadways and Associated Systems

The Catskill Mountain Railroad services the Town of Shandaken, through the hamlets of Pine Hill, Shandaken, Phoenicia, and Mount Tremper. Currently the railroad is inactive from the hamlet of Phoenicia west to the Town line. State Route 28 enters the Town from Delaware County and is the main highway that generally runs east to west across the Town following sections of the Esopus Creek. County Route 47 runs north to south connecting the hamlets of Big Indian and Oliverea. Routes 42 and 214 connect the Town with Greene County to the north. Figure 4-15 below illustrates the major transportation systems in the Town.

Figure 4-15. Transportation System in the Town of Shandaken

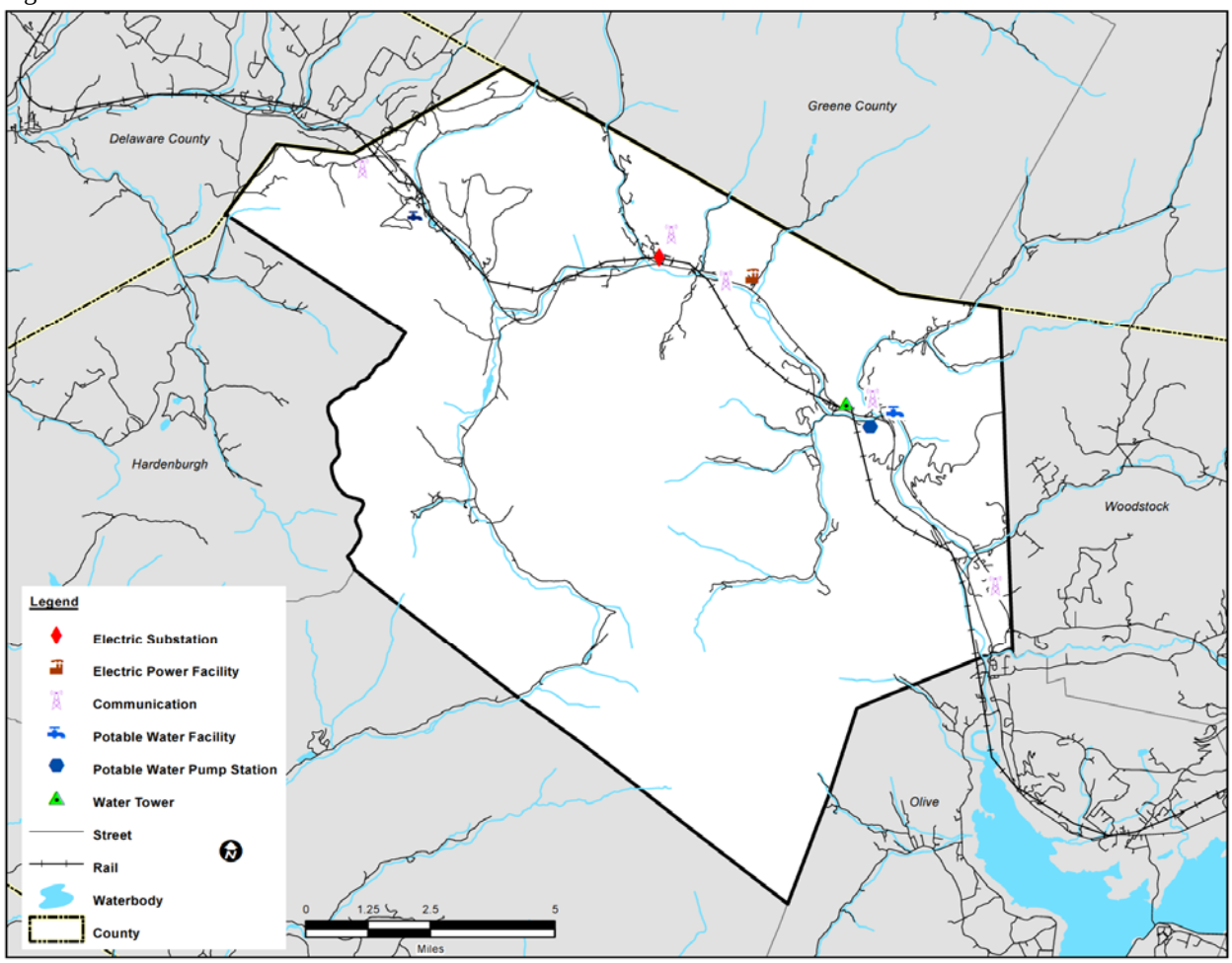


Source: Bing Aerial Photography dated 2010

Lifeline Utility Systems

This section presents potable water, wastewater, and energy resource utility system data. Due to heightened security concerns, local utility lifeline data sufficient to complete the analysis have only partially been obtained. Utility data are included in HAZUS-MH but are not sufficient to support detailed analyses for this Town. Figure 4-16 illustrates the locations of the provided utilities in the Town of Shandaken.

Figure 4-16. Utilities in the Town of Shandaken



Potable Water Supply

The Phoenicia Water District supplies about 40,000 gallons of water per day to residents and businesses in the hamlet of Phoenicia. The water system consists of three water sources; a filtration plant; a storage tank and a water distribution system. Water from two surface water sources, an infiltration gallery and a spring supply, are treated at the water filtration plant. The third source (High Street Wells) consists of two drilled wells that convey water directly into the water distribution system. The Phoenicia treatment building has a back-up generator.

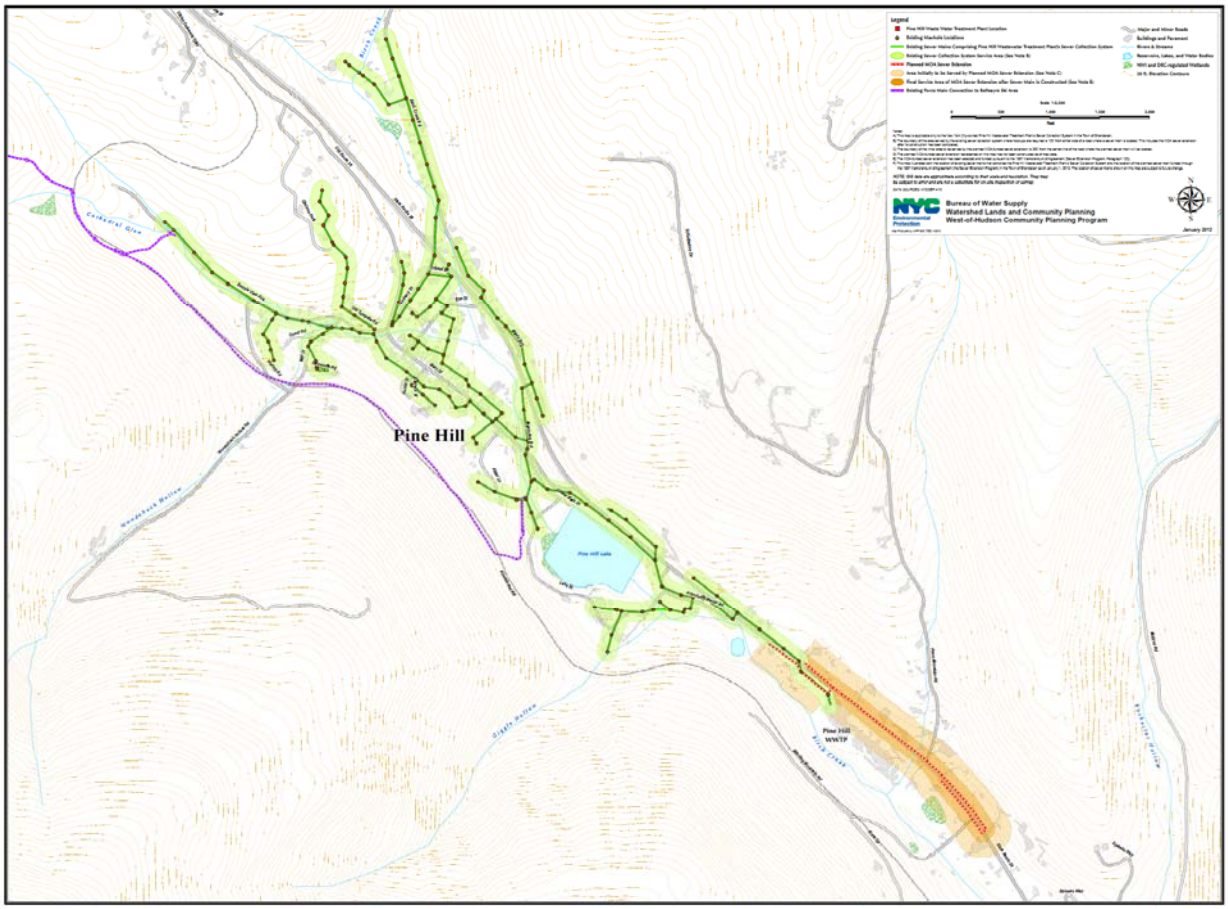
The Pine Hill Water District supplies an average of about 15,000 gallons per day to its largely residential users. The system includes the water supply, storage reservoir, treatment building and distribution system. The water supply consists of several springs and a back up well.

Municipal and public non-municipal wells and water towers are present in the Town of Shandaken. Facilities in the Town include the Phoenicia Water District Main Filtration Plant and the Pine Hill Water District Treatment building. In addition, there is a water tower and a pump house located in the Town.

Wastewater Facilities

NYC DEP owns and operates two wastewater systems in the Town, a wastewater treatment facility on State Route 28 that serves the hamlet of Pine Hill, and a community septic system in the hamlet of Chichester that treats about 13,000 gpd. Figure 4-17 below displays the Pine Hill Water Treatment Plant's sewer collection system service area.

Figure 4-17. Pine Hill Wastewater Treatment Plant's Sewer Collection System Service Area in the Town of Shandaken



Source: Appendix A of the Town of Shandaken's Sewer Use Law

Communication Resources

Table 4-14 lists the communication facilities (facilities, radio stations, radio towers) located in the Town of Shandaken. Figure 4-16 displays the locations of all communication facilities located within the Town.

Table 4-14. Communication Facility

Name	Municipality (Hamlet)	Building Type	Backup Power
Town Hall / TV	Shandaken	Wood	TBD
Highway Garage / Radio	Shandaken	Steel	TBD
Verizon	Shandaken	Concrete	TBD
Verizon	Shandaken	TBD	TBD
Cell Tower	Shandaken	NA	TBD
Cell Tower	Shandaken	NA	TBD

NA = Not applicable

High-Potential Loss Facilities

High-potential loss facilities include dams, levees, nuclear power plants, military installations and hazardous materials (HAZMAT) facilities. No nuclear power plants, military installations or HAZMAT facilities were identified in the Town. Dams and levees are discussed below.

Dams/Levees

There are five dams located within the Town of Shandaken, one of which is classified as a high hazard dam (Pine Hill Lake Dam) (Table 4-15). In addition, the Town has identified locations of four 'levees' along Esopus Creek in the Town: Route 212 in Mount Tremper; Dike Road; a former dike on Plank Road which was wiped out in Irene; and on Route 42 in Shandaken. Refer to Figure 4-19 through Figure 4-21. Other small dams include a private on the Birch Creek, and another at the end of Lower Birch Creek Road on New York State Land.

There are 10 USGS riverine gages (one proposed) in the Town of Shandaken summarized below and displayed on Figure 4-15. The Esopus Creek at Coldbrook, New York is located just outside the Town's boundaries and is also displayed on Figure 4-15.

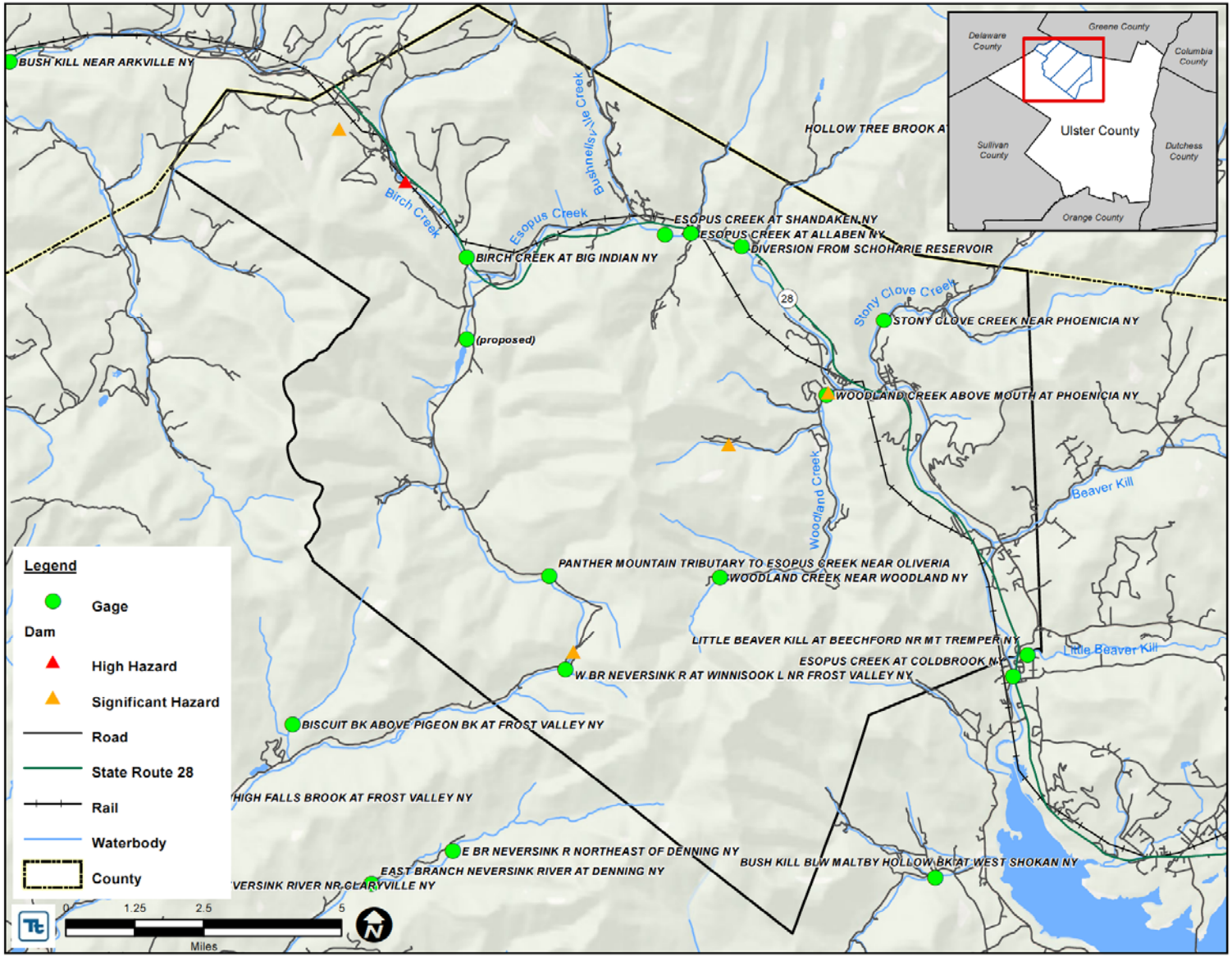
- Esopus Creek at AllabenDiversion from Schoharie Reservoir (DEP gage)
- Birch Creek at Big Indian, New York
- Stony Clove Creek near Phoenicia, New York
- Woodland Creek near Woodland Valley, New York
- Hollow Tree Brook in Lanesville (Town of Hunter)
- Bushnellsville Creek near Shandaken
- Esopus Creek at Coldbrook (Town of Olive)
- Little Beaverkill at Beechford

Table 4-15. Dams in the Town of Shandaken

ID	Name	Owner	River	Nearest City	Distance To City (miles)	Year Completed	Dam Length	Dam Height	NID Hazard	NYSDEC Hazard	EAP
NY000280	SNOW MAKING POND DAM	BELLEAYRE SKI CENTER	CATHDRAL GLEN BROOK	PINE HILL	0	1975	325	36	Unknown	B	N
NY000281	PINE HILL LAKE DAM	NYS DEC	BIRCH CREEK	BIG INDIAN	2	1987	1,257	28	H	C	Y
NY000282	MUDDY BROOK POND DAM	CAMP WOODLAND INC	MUDDY BROOK	PHOENICIA	1	1946	0	6	S	B	N
NY000284	DAY POND DAM	RICK DAY	PANTHER KILL	PHOENICIA	2	1930	50	6	S	B	N
NY000285	WINNISOOK LAKE DAM	WINNISOOK INC	ESOPUS CREEK	OLIVEREA	4	0	344	42	S	B	NR

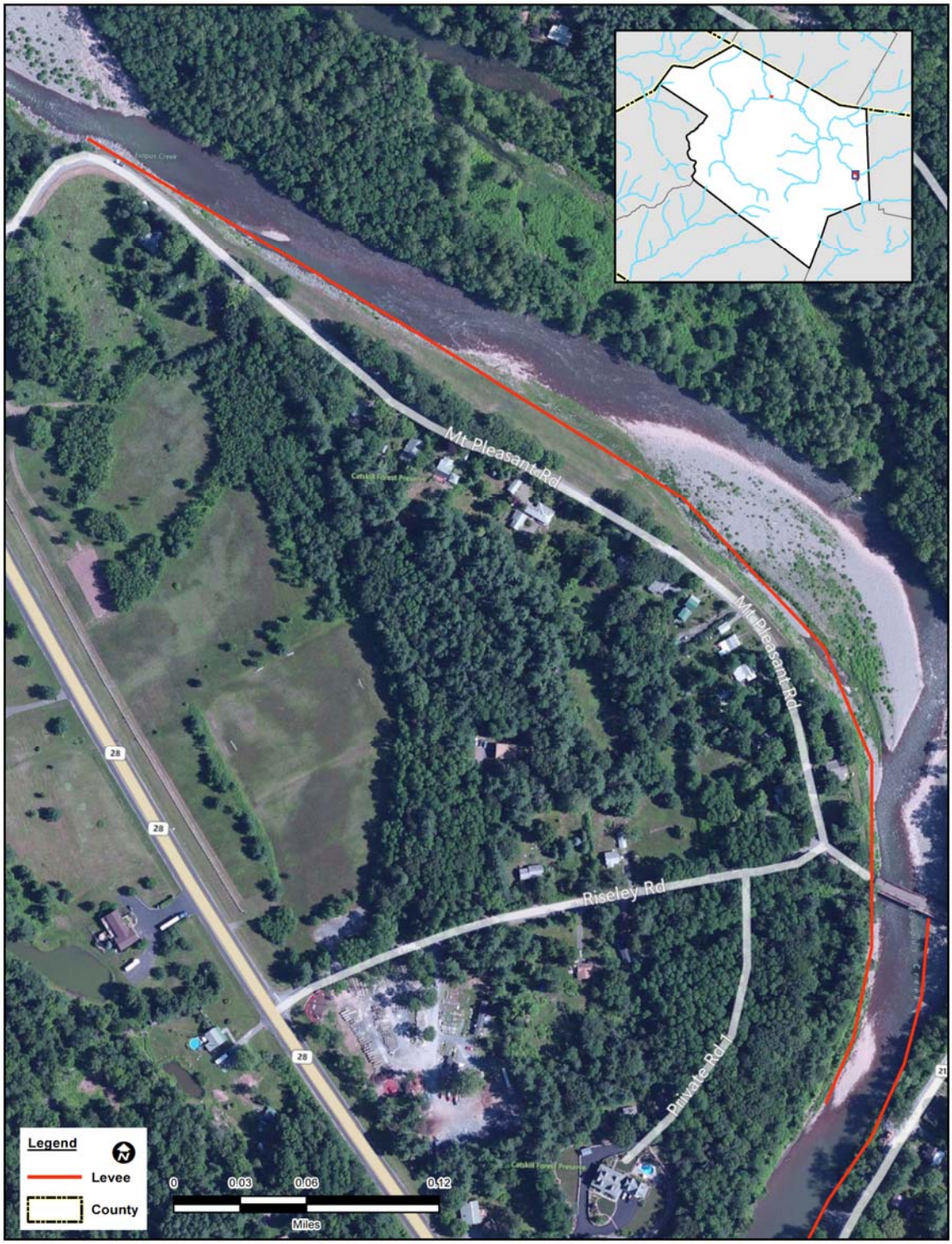
Source: NID, 2012

Figure 4-18. USGS Gages and Dams in the Town of Shandaken



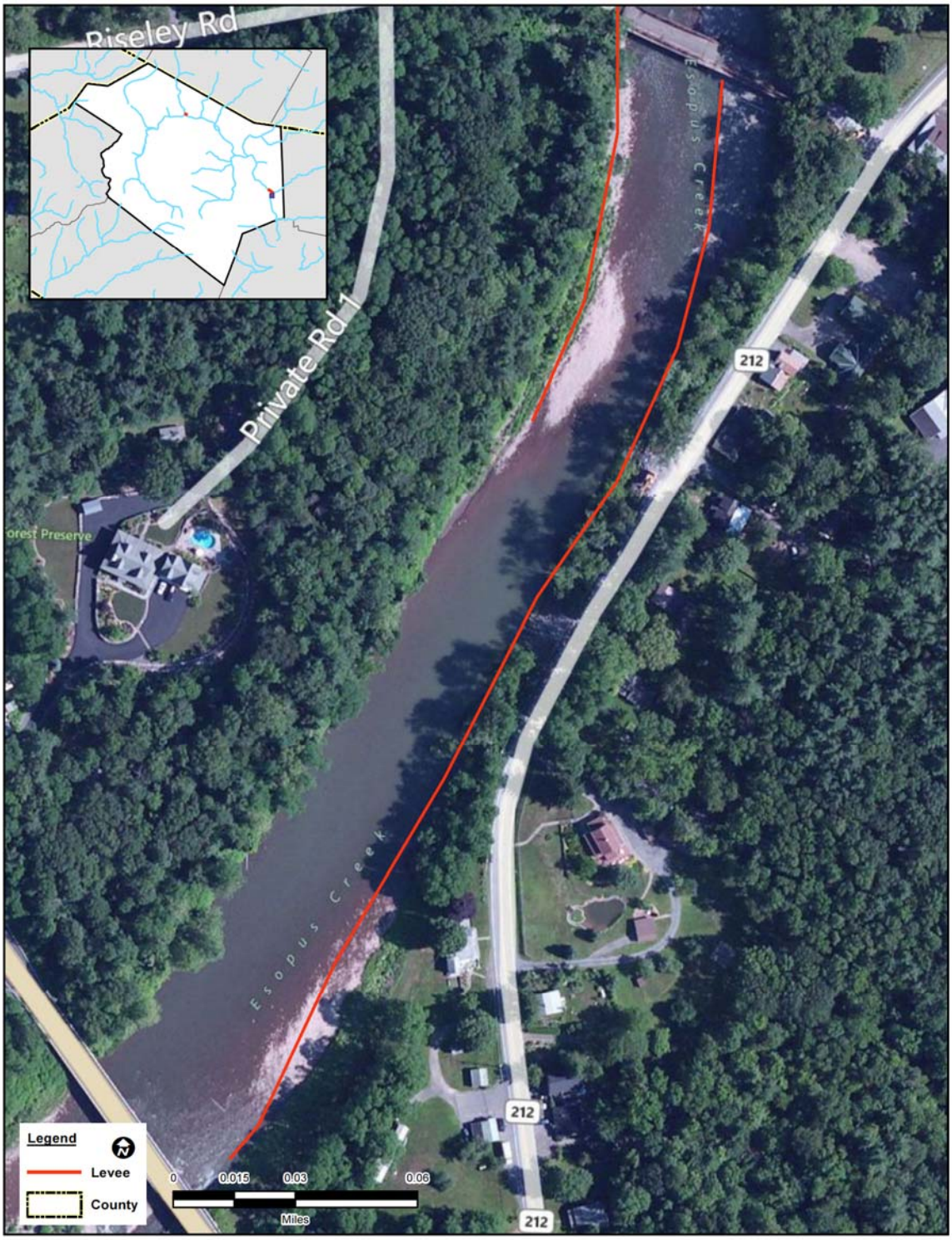
Source: NID, 2012; NYCDEP, 2012

Figure 4-19. Levee on the Esopus Creek along Mount Pleasant Road



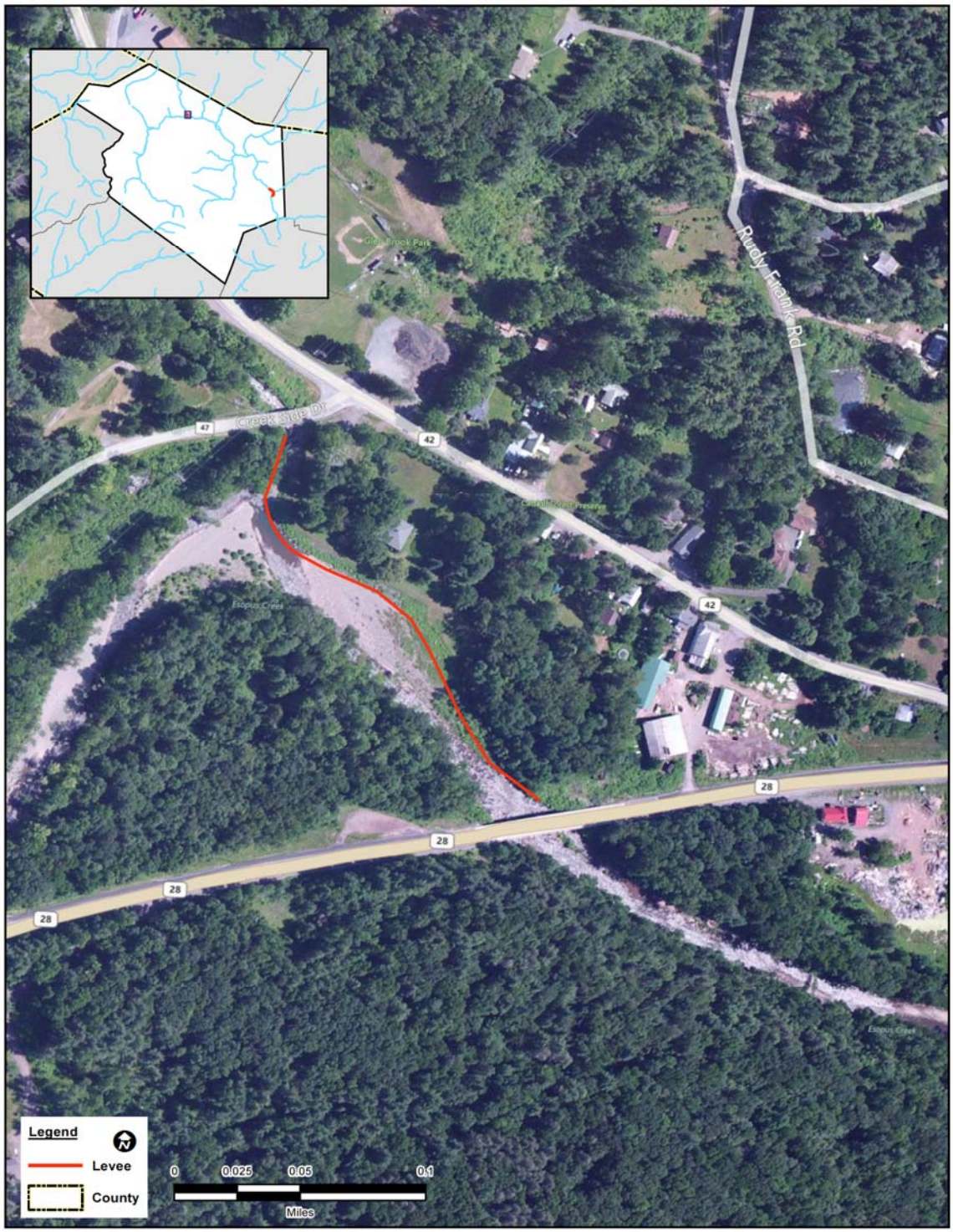
Source: Planning Committee, 2012

Figure 4-20. Levee on the Esopus Creek along Route 212



Source: Planning Committee, 2012

Figure 4-21. Levee on the Esopus Creek along Route 42



Source: Planning Committee, 2012

Other Facilities

The Planning Committee identified additional facilities (user-defined facilities) as critical. These facilities were included in the risk assessment conducted for the Town. Table 4-16 lists the other critical facilities identified by the Town of Shandaken.

Table 4-16. Public Buildings in the Town of Shandaken

Name	Municipality (Hamlet)	Building Type	Backup Power
Town Hall	Shandaken	Wood/Concrete	Yes (Battery back-up for phones/lights)
Town Highway Garage	Shandaken	Steel	Yes

SECTION 5: FLOOD RISK ASSESSMENT

This section provides a profile and vulnerability assessment for the flood hazard in order to quantify the description, location, extent, history, probability, and impact of flood events in the Town of Shandaken.

5.1 HAZARD PROFILE

This section provides profile information including description, location, extent, previous occurrences and losses and the probability of future occurrences.

5.1.1 Description

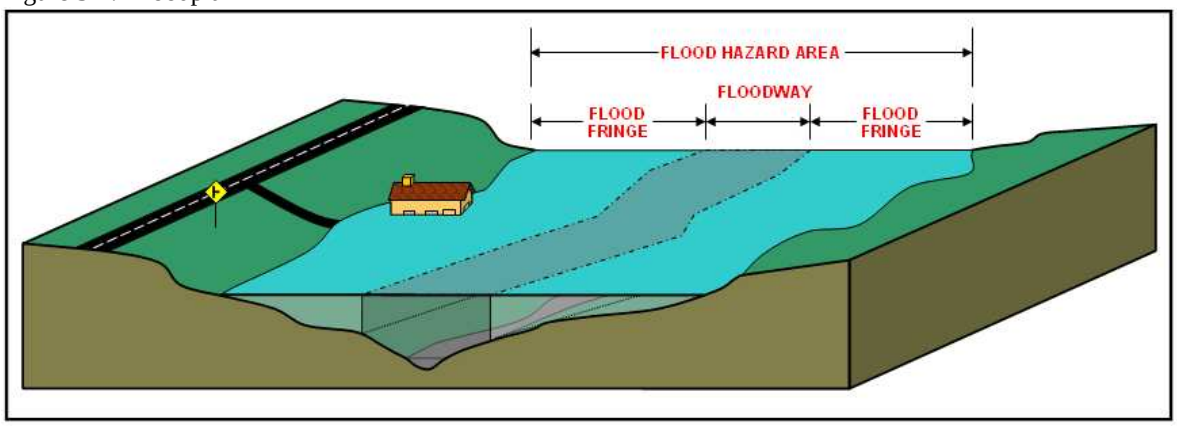
Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (Federal Emergency Management Agency [FEMA], 2010). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws (George Washington University, 2001). Floods are the most frequent and costly natural hazards in New York State in terms of human hardship and economic loss, particularly to communities that lie within flood prone areas or flood plains of a major water source. As defined in the NYS HMP, flooding is a general and temporary condition of partial or complete inundation on normally dry land from the following:

- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, dam- break floods and ice jam floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding;
- Coastal erosion (NYS HMP, 2011 – need proper reference)
- Unusual and rapid accumulation or runoff of surface waters from any source;
- Mudflows (or mudslides);
- Collapse or subsidence of land along the shore of a lake or similar body of water caused by erosion, waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above (Floodsmart.gov, 2012);
- Sea Level Rise; or
- Climate Change (USEPA, 2012).

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not the flood that will occur once every 100 years, rather it is the flood that has a one-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. With this term being misleading, FEMA has properly defined it as the one-percent annual chance flood. This one percent annual chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program (NFIP) (FEMA, 2005).

Figure 5-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5-1. Floodplain



Source: NJDEP, Date Unknown

Many floods fall into three categories: riverine, coastal and shallow (FEMA, 2008). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this HMP and as deemed appropriate by the County, riverine/flash, dam failure and ice jam flooding are the main flood types of concern for the Planning Area. These types of flood or further discussed below.

Riverine/Flash Floods – Riverine floods are the most common flood type and occur along a channel, and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA, 2008; The Illinois Association for Floodplain and Stormwater Management, 2006).

Flash floods are "a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters" (NWS, 2009).

Ice-Jam Floods – An ice jam is an accumulation of ice that acts as a natural dam and restricts flow of a body of water. Ice jams occur when warm temperatures and heavy rains cause rapid snow melt. The melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). Ice jams may build up to a thickness great enough to raise the water level and cause flooding (NESEC, Date Unknown; FEMA, 2008).

There are two different types of ice jams: freeze-up and breakup. Freeze-up jams occur in the early to mid-winter when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt or warmer temperatures (USACE, 2002).

Dam Failure Floods – A dam is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA, 2010). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream

(FEMA, 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affect a dam's primary function of impounding water (FEMA, 2011). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage (terrorism);
- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA, 2010).

5.1.2 Extent

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS, 2011).

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2001).

Flood severity from a dam failure can be measured with a low, medium or high severity, which are further defined as follows:

- Low severity - No buildings are washed off their foundations; structures are exposed to depths of less than 10 feet.
- Medium severity - Homes are destroyed but trees or mangled homes remain for people to seek refuge in or on; structures are exposed to depths of more than 10 feet.
- High severity - Floodwaters sweep the area clean and nothing remains. Locations are flooded by the near instantaneous failure of a concrete dam, or an earthfill dam that turns into "jello" and washes out in seconds rather than minutes or hours. In addition, the flooding caused by the dam failure sweeps the area clean and little or no evidence of the prior human habitation remains after the floodwater recedes (Graham, 1999).

Two factors which influence the potential severity of a full or partial dam failure include (1) The amount of water impounded; and (2) The density, type, and value of development and infrastructure located downstream (City of Sacramento Development Service Department, 2005).

5.1.3 Location

Flooding is the primary natural hazard in New York State because the State exhibits a unique blend of climatological and meteorological features that influence the potential for flooding. These factors include topography, elevations, latitude and water bodies and waterways. Flooding is the primary natural hazard in New York State and they occur in every part of the State. Some areas are more flood prone than others, but no area is exempt, including the Town of Shandaken. There are over 52,000 miles of river and streams in New York State, and along their banks there are 1,480 communities that are designated as flood prone. It is estimated that 1.5 million people live in these flood-prone areas. Millions more work, travel through or use recreational facilities located in areas subject to flooding. Areas outside recognized and mapped flood hazard zones can also experience flooding (NYS HMP, 2011).

The NYSDEC conducted a vulnerability assessment that depicted how vulnerable a county may be to flood hazards. This was determined by a rating score; each county accumulated points based on the value of each vulnerability indicator. The higher the indication for flood exposure, the more points assigned, resulting in a final rating score. The result of this assessment presented an indication of a county's vulnerability to the flood hazard. Ulster County's rating is 28, out of a possible 35. The rating was based on number of NFIP insurance policies, number of NFIP claims, total amount of NFIP claims, total amount of NFIP policy coverage, number of repetitive flood loss properties, and number of flood disasters (NYS HMP, 2011).

Riverine flooding is most severe in the Delaware, Susquehanna, Chemung, Erie-Niagara, Genesese, Allegany, Hudson and Mohawk River Basins (NYS HMP, 2011). The Town of Shandaken is located with the Upper Hudson River Basin (NYSDEC, Date Unknown).

The majority of the Town's development is located in the valleys of Esopus Creek and its tributaries, which creates a high potential for significant flood impacts (Town of Shandaken Comprehensive Plan, 2005). Esopus Creek, Woodland Valley, Birch Creek and Stony Clove are the main watercourses in the Town of Shandaken, and those most vulnerable to flash flooding. Other tributaries include Beaver Kill, Birch Creek, Neversink River, and Giggle Hollow. The Town has indicated that the hamlets of Phoenicia, Mt Pleasant, Allaben, Mt. Tremper, Oliverea, Shandaken, Chichester and Woodland Valley have experiencedextensive flooding resulting from riverine reaches in the Upper Esopus Watershed.

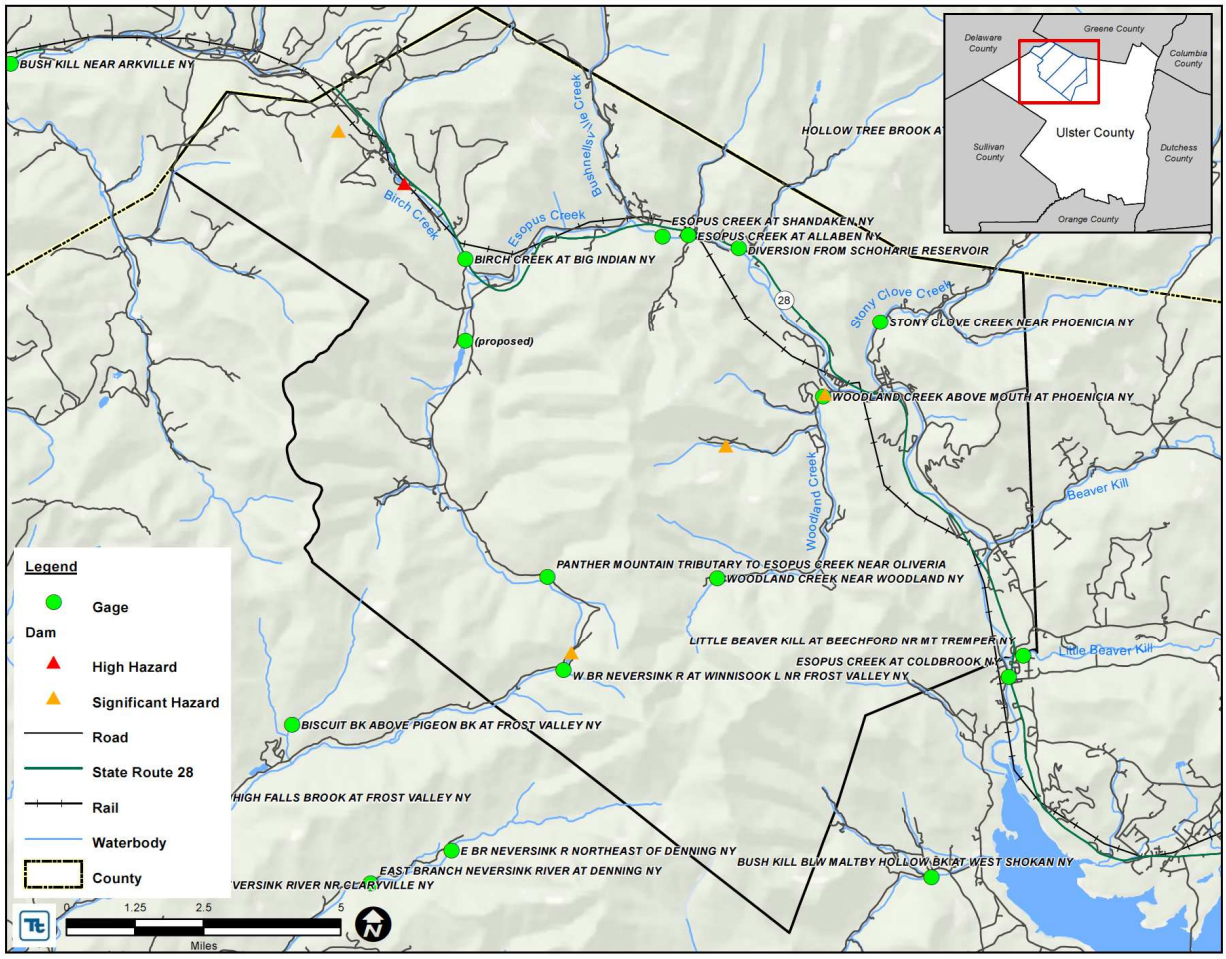
Flood stages on Esopus Creek tributaries may be further elevated in the vicinity of the tributary confluence with Esopus Creek. This is particularly so, in settings such as the village of Phoenicia, in which development occupies much of the available flood plain and the channel is confined. In this instance, Stony Clove Creek has a relatively low slope and the flood stage on Esopus Creek can be higher than Stony Clove's flood stage, inducing a backwater effect that raises the Stony Clove stage. The consequence is locally enhanced inundation in the village.
Main Street, Bridge Street, High Street, Plank Road and Station Road in the village of Phoenicia are particularly acute hazard problem areas for flooding. Figure 5- shows the Main Street Bridge over Stony Clove Creek in Phoenicia.

Highway infrastructure construction has also contributed to flood vulnerability. For example, below the

hamlet of Big Indian, the Esopus Creek flows along Route 28, and is locally impacted by the road corridor, especially where former meander bends were cut off by installation of the roadway.

The town relies on input from stream gages in the area to predict potential flooding and flash flooding. Locations USGS gages in the area are noted in the map below.

Figure 5-2. USGS Gages and Dams in the Town of Shandaken



Source: NID, 2012; NYCDEP, 2012

Figure 5-3. Main Street Bridge Over Stony Clove Creek in the Hamlet of Phoenicia, New York

Source: Upper Esopus Creek Management Plan. Available at:
http://www.ashokanstreams.org/stream%20management%20plans-esopus.html

5.1.4 Frequency

Floods are commonly described as having a 10-, 50-, 100-, and 500-year recurrence interval meaning that floods of these magnitudes have (respectively) a 10-, 2-, 1-, or 0.2-percent chance of occurring in any given year. These measurements are statistical averages only; it is possible for two or more rare floods (with a 100-yer or higher recurrence interval) to occur within a short time period.

Recent history has shown that the Town of Shandaken can expect an average of 7 episodes of major river flooding each 10 years. According to FEMA, flood hazard areas are defined as areas that are shown to be inundated by a flood of a given magnitude on a map. These areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has indicated both the Special Flood Hazard Areas (SFHA) and the risk premium zones applicable to the community. These maps identify the SFHAs; the location of a specific property in relation to the SFHA; the base (100-year) flood elevation (BFE) at a specific site; the magnitude of a flood hazard in a specific area; the undeveloped coastal barriers where flood insurance is not available and locates regulatory floodways and floodplain boundaries (100-year and 500-year floodplain boundaries) (FEMA, 2003; FEMA, 2005; FEMA, 2008).

The land area covered by the floodwaters of the base flood is the SFHA on a FIRM. It is the area where the National Flood Insurance Programs (NFIP) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones B and X (shaded), C and X (unshaded) A, AE, A1-30, AH, AO, AR, A99, V, VE, V1-30, and. (FEMA, 2013). This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year" flood designation. The BFE on a FIRM is the elevation of a base flood event, or a flood which has a 1-percent chance of occurring in any given year as defined by the NFIP. The BFE describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating the potential damage to occur in a given area. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood damage where $P=1-[1-1/T)]^n$ where P=probability, T=return period (100), and n=number of years (30)
during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by Federal agencies and most states, to administer floodplain management programs. The 100-year flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or

exceeded in any given year (FEMA, 2005; FEMA, 2003).

5.1.5 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges.

In addition to FIRMs, FEMA also provides FISs for entire counties and individual jurisdictions. These studies aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of the flood areas studied and the engineered methods used, principal flood problems, flood protection measures and graphic profiles of the flood sources (FEMA, Date Unknown). A town-wide FIS for the Town of Shandaken has been completed however digitized FIRMs are not available at this time and are projected to be completed in 2013. The 1989 Town of Shandaken FIS discussed the principal flood problems in the Town. The FIS stated that the Esopus Creek has a long history of flooding upstream of Ashoken Reservoir.

Table 5-1 lists peak flows used by FEMA to map the floodplains of the planning area as noted in the effective Flood Insurance Study for the town. Updated discharges are expected to be made available pending release of final FEMA flood mapping in the Summer of 2013.

Table 5-1, Summary of Discharges within the Town of Shandaken

Flooding Source and Location	Drainage Area (Sq. miles)	Peak Discharges (cfs)			
		10-year	50-year	100-year	500-year
ESOPUS CREEK at downstream corporate limits	169.7	36,000	72,000	92,599	165,000
At the confluence of Beaver Kill	132.7	30,000	60,000	74,619	142,000
At the confluence of Woodland Creek	84.2	20,000	39,000	48,801	89,500
At the confluence of Broad Street Hollow Creek	59.4	16,000	30,000	37,529	67,000

(FEMA FIS, 1989)

According to the Draft Hydrologic Analysis Technical Support Data Notebook (FEMA, July 2012), Floods in Ashokan Reservoir Watershed can occur anytime during a year. The floods that occur in summer and fall seasons are caused mainly by heavy rainfall produced by hurricanes and tropical storms. Floods that occur in winter or spring are mainly due snowmelt caused by rising temperatures and or due to mixing of rain with snow. The largest storm on the record occurred due to the passing Hurricane Irene in August 2011. The estimated peak discharge on Esopus Creek at Coldbrook is 75,800 cubic feet per second (cfs). This peak discharge is highest on the record, beating the previous highest of 65,300 cfs, which occurred in March 1980. The peak discharge records at several other gages in the basin were also broken by the damaging

discharges caused by Hurricane Irene. Other notable locations include Esopus Creek at Allaben, Stony Clove Creek at Chichester. The flood damages incurred due to the March 1980 flood were estimated at 6 million dollars. A flood similar intensity occurred on March 30, 1951. According to local and newspaper accounts, the flood resulted in a dam break on Birch Creek (FEMA, 1989). Some of the other notable floods that recorded at the Coldbrook gage include the flooding events of April 2005, January 1996 and April 1987 and April 1984, which rank 4th, 7th, 8th and 11th respectively. Some of the floods that occurred before 1980's include the flooding events of August 1933, October 1955 and December 1957. Table 5-2 provides a summary of discharges recorded at Coldbrook gage on Esopus Creek for the top floods.

Table 5-2: Historic Flood Discharges in Ashokan Reservoir Watershed

Rank	Date	Peak Discharges (cfs)
1	28-Aug-11	75,800
2	21-Mar-80	65,300
3	30-Mar-51	59,600
4	3-Apr-05	55,200
5	24-Aug-33	55,000
6	15-Oct-55	54,000
7	19-Jan-96	53,600
8	4-Apr-87	51,700
9	21-Dec-57	46,900
10	2-Mar-36	38,500
11	5-Apr-84	37,400

Source: Draft Hydrologic Analysis Technical Support Data Notebook (FEMA, July 2012)

Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

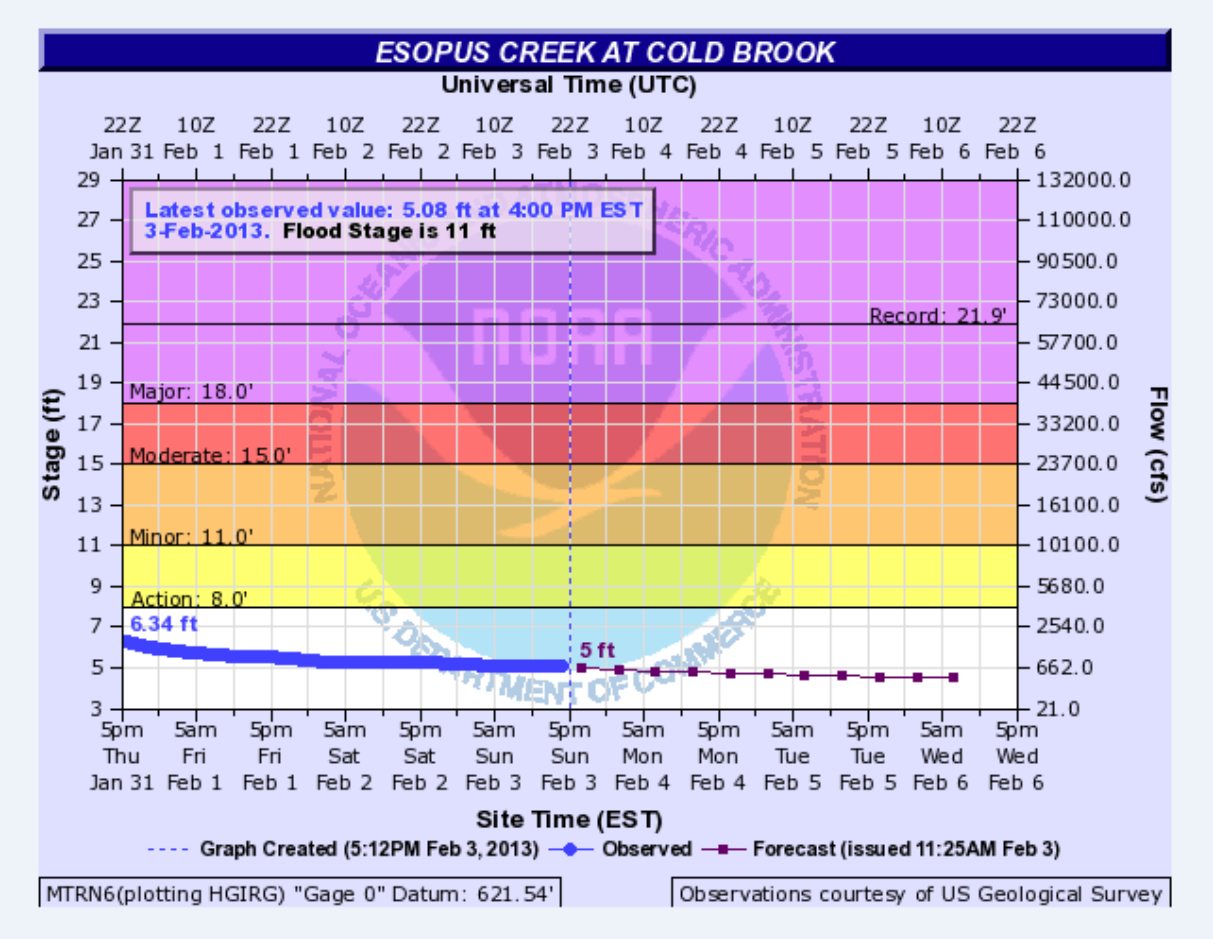
Each watershed has unique qualities that affect its response to rainfall. A hydrograph, which is a graph or chart illustrating stream flow in relation to time (see Figure xx), is a useful tool for examining a stream's response to rainfall. Once rainfall starts falling over a watershed, runoff begins and the stream begins to rise. Water depth in the stream channel (stage of flow) will continue to rise in response to runoff even after rainfall ends. Eventually, the runoff will reach a peak and the stage of flow will crest. It is at this point that the stream stage will remain the most stable, exhibiting little change over time until it begins to fall and eventually subside to a level below flooding stage.

The potential warning time a community has to respond to a flooding threat is a function of the time between the first measurable rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time to the time that a community has to take actions to protect lives and property. Another element that characterizes a community's flood threat is the length of time floodwaters remain above flood stage.

The Town of Shandaken relies on data and flood warning information is provided by the National Weather Service (NWS) Cold Brook gage. This information is analyzed to evaluate the flood threat and possible evacuation needs. Other gages within the watershed provide historical information, but do not supply real-time information that can be utilized pending a flood event. A hydrograph from the

Coldbrook gage is provided in Figure 5-4 below.

Figure 5-4-Cold Brook Gage Hydrograph

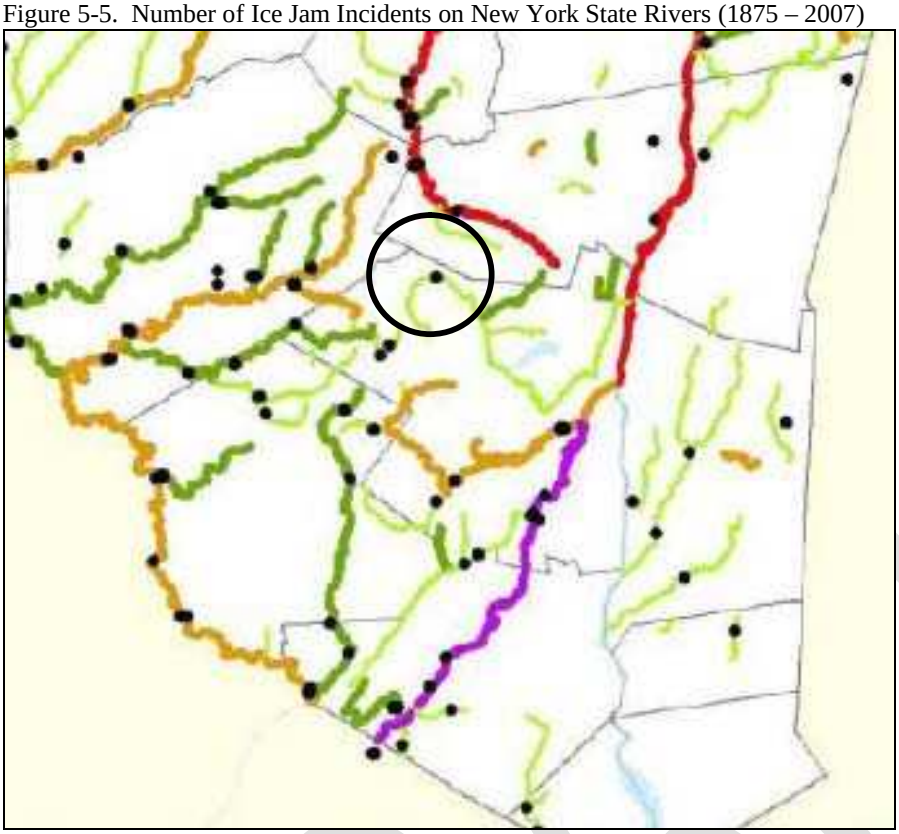


Source: USGS

5.1.6 Ice Jam Hazard Areas

Ice jams are common in the Northeast U.S. and New York is not an exception. In fact, according to the USACE, New York State ranks second in the U.S. for total number of ice jam events, with over 1,500 incidents documented between 1867 and 2010. Areas of New York State that include characteristics lending to ice jam flooding include the northern counties of the Finger Lakes region and far western New York, the Mohawk Valley of central and eastern New York State and the North Country (NYS HMP, 2011). Figure 5-5 presents the general location and number of ice jam incidences within the vicinity of Ulster County between 1875 and 2007.

Figure 5-5. Number of Ice Jam Incidents on New York State Rivers (1875 – 2007)



Source: NYS HMP, 2011
Note (1): Circle indicates location of the Town of Shandaken
Note (2): This map displays the number of instances a river was referenced as being the location for an ice jam in the USACE Cold Regions Research and Engineering Laboratory (CRREL) database.
Note (3): Multiple instances of ice jams can be associated to a single point location.

5.1.7 Dam Break Hazard Area

According to the NYSDEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 NYCRR Part 673.3. Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below:

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or misoperation would result in no probable loss of human life. Losses are principally limited to the owner's property
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities, and/or will cause significant economic loss or serious environmental damage. Failure or misoperation would result in no probable loss of human life, but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main

highways or railroads and/or will cause extensive economic loss. This is a downstream hazard classification for dams in which more than 6 lives would be in jeopardy and excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure (NYSDEC, Date Unknown).

There are five dams located within the Town of Shandaken, one of which is classified as a high hazard dam (Pine Hill Lake Dam). Refer to the Town Profile (Section 4) for dams located in the Town of Shandaken.

5.1.8 Flash Flooding Hazard Areas

Flash flooding hazards can be assumed to be present on all streams in the Town of Shandaken, given the hydrology and topography of the watershed. Due to the geography of the Town of Shandaken, steep mountainous slopes with narrow stream valleys and severely varying slopes on these channels, many of the smaller valleys, especially along tributaries to the Esopus Creek, have the propensity for flash flooding, whether due to a large storm encompassing the entire Town or very small isolated storm cells effecting smaller portions of the Town. Vulnerable areas are Fox Hollow, Birch Creek, Broad Street Hollow, Peck Hollow, Warner Creek, Stony Clove, Giggle Hollow, Bushnellsville, the Bush Kill, and the Esopus Creek in the hamlet of Oliverea.

Secondary Hazards

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, or rivers.

5.1.9 Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout New York State, Ulster County and the Town of Shandaken. With many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

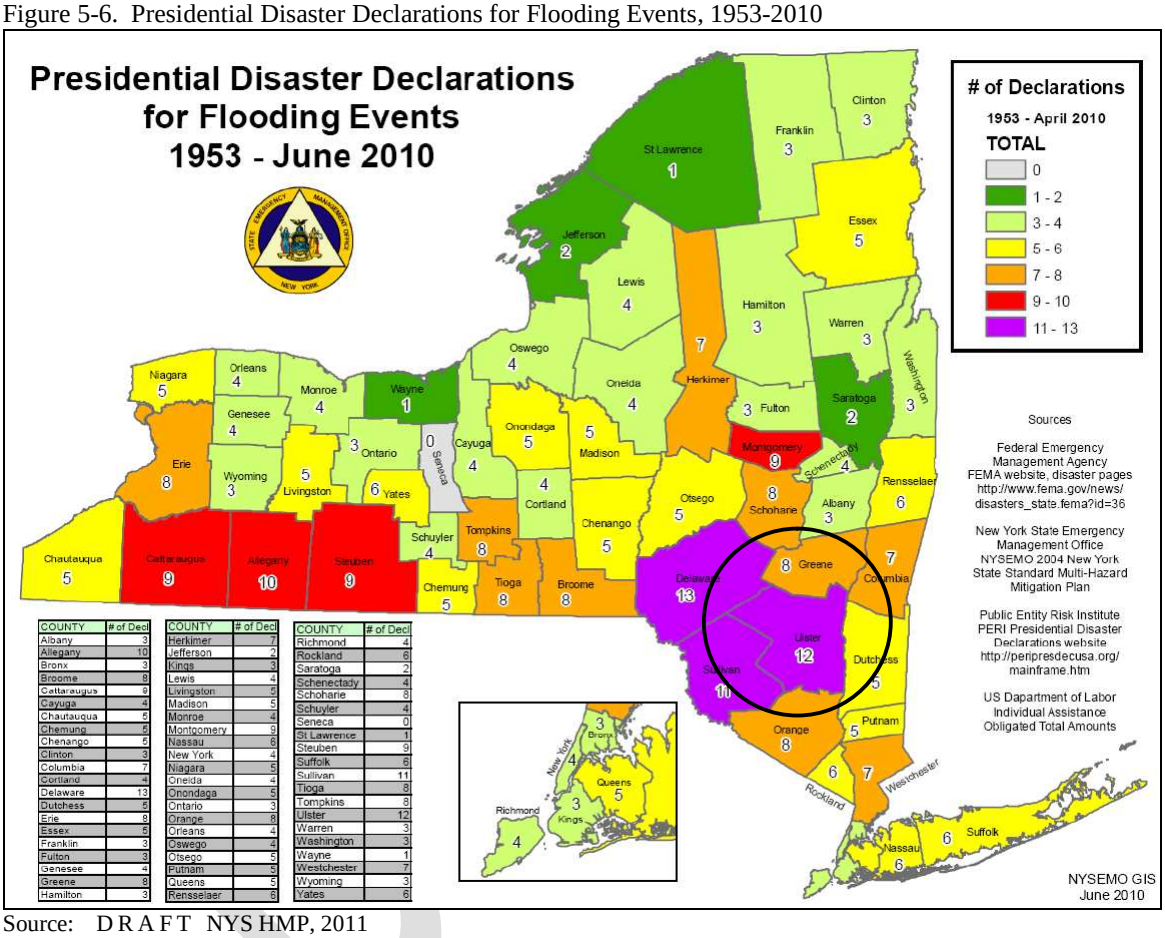
According to NOAA's NCDC storm events database, Ulster County experienced 97 flood events between April 30, 1950 and April 2012. Total property damages, as a result of these flood events, were estimated at $12.3 million. There were no crop damages reported. This total also includes damages to other counties. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, 81 flood events occurred within the County. The database indicated that severe storm events and losses specifically associated with Ulster County and its municipalities totaled over $69 million in property damage and over $1 million in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2011, FEMA declared that New York State experienced 40 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, coastal storms, flash flooding, heavy rain, tropical storm, hurricane, high winds, ice jam, wave action, high tide and tornado. Generally, these disasters cover a wide region of the State; therefore, they

may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, the NYS HMP and other sources indicate that Ulster County has been declared as a disaster area as a result of 13 flood events (FEMA, 2012; NYSOEM, 2012).

Figure 5-6 shows the FEMA disaster declarations (DR) for flooding events in New York State, from 1953 to June 2010. This figure indicates that Ulster County was included in 12 disaster declarations. Since the date of this figure, Ulster County has been included in one additional FEMA disaster declarations for flooding.

Figure 5-6. Presidential Disaster Declarations for Flooding Events, 1953-2010



COUNTY	# of Decl
Albany	3
Allegany	10
Bronx	3
Broome	8
Cattaraugus	9
Cayuga	4
Chautauqua	5
Chemung	5
Chenango	5
Clinton	3
Columbia	7
Cortland	4
Delaware	13
Dutchess	5
Erie	8
Essex	5
Franklin	3
Fulton	3
Genesee	4
Greene	8
Hamilton	3

COUNTY	# of Decl
Herkimer	7
Jefferson	2
Kings	3
Lewis	4
Livingston	5
Madison	5
Monroe	4
Montgomery	9
Nassau	6
New York	4
Niagara	5
Oneida	4
Onondaga	5
Ontario	3
Orange	8
Orleans	4
Oswego	4
Otsego	5
Putnam	5
Queens	5
Rensselaer	6

COUNTY	# of Decl
Richmond	4
Rockland	6
Saratoga	2
Schenectady	4
Schoharie	8
Seneca	0
St Lawrence	1
Steuben	9
Suffolk	6
Sullivan	11
Tioga	8
Tompkins	8
Ulster	12
Warren	3
Washington	3
Wayne	1
Westchester	7
Wyoming	3
Yates	6

Source: D R A F T NYS HMP, 2011
Note: The black circle indicates the approximate location of Ulster County.

Based on all sources researched, known flooding events that have affected the Town of Shandaken are identified in Table 5-3. With flood documentation for New York State being extensive, not all sources have been identified or researched. Therefore, Table 5-3 may not include all events that have occurred throughout the Town and region.

Table 5-3. Flooding Events Between 1950 and 2012

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
December 8, 1950	Flooding	N/A	N/A	During a storm event, the Esopus Creek did a devastating job and by the time it reached Oliverea, it took out bridges and rushed over the road four feet deep. Where the Hatchery Stream crosses Oliverea Road, the little bridge remained but the roadway was washed out on either side. Where the Esopus Creek reaches the turn near Platt's barn, it tore out a corner and carried away a car. It cut gouges out of the bank within one or two feet of some tourist cottages just above the Dunham Bridge. The Stream, as it joined the Birch Creek, it completed flooded the Fennelly meadow with eight to ten feet of water. A home was lifted from its foundation and took out the Weybridge and road. Birch Creek took out the bridge at Greenbergs and undermined a barn.	Catskill Mountain News, Town Input
April 6, 1951	Flooding	N/A	N/A	Heavy rains and melting snow caused the Esopus Creek to raise above its November highwater mark. It caused widespread damage in Ulster County. Most of the damage was at Phoenicia and areas below. The Chichester and Woodland Valley streams combined in this area. The streets of Phoenicia were flooded and some people had to leave their homes. Many businesses were flooded as well. A bridge was carried away near the Stony Clove Notch. In Lanesville, residents called this event one of the worst floods. The Stony Clove Valley Stream dug out a chunk of pavement on Notch Road, 100 feet long and 50 feet deep.	Catskill Mountain News, Town Input
October 18-20, 1955	Heavy Rain and Flooding	N/A	N/A	Heavy rains flooded the Oliverea Valley, completely destroying the post off and a small cottage in Oliverea. Land and roads washed away. Telephone and electricity were cut off. Guests at the Valley View House and at the Slide Mountain House were caught in the Valley and were unable to return home. A bridge was washed out behind a home in the Big Indian Mountain club. The Manor House bridge was almost impassable due to debris and gravel. In Pine Hill, a bank behind a home gave way and slide down, breaking through kitchen doors and spreading through the entire first floor. Several other people experienced damages to their homes. Many basements were flooded, oil burners were put out and several lawns washed out. One water main was broken which caused a few homes to be without water.	Catskill Mountain News, Town Input

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				Several residents in Woodland Valley had to evacuate due to the rising waters of the Esopus and its tributaries. Many roadways were blocked and traffic had to be rerouted. Road damage due to undermining was severe along sections of Route 28. Other damage included the washing away of part of the Shandaken Manor Hotel. In Bushnellville, Route 42 was closed with large sections washed out. Homes near the Bushnellville Creek were the hardest hit. The Creek overflowed its banks and flowed towards the main street. The Shandaken post office was flooded. The road from Route 28 to Fox Hollow was under four feet of water. Small bridges were washed out in this area, which included the Percy White Bridge over the Esopus and the Claude Gossco Bridge and bridges at Rossingers and at Mountain Lodge Inn on Bushnellville Road. This flooding event caused one fatality in Woodland Valley.	
September 13, 1971	Severe Storms and Flooding	DR-311	Yes	N/A	FEMA
June 23, 1972	Tropical Storm Agnes	DR-338	Yes	Tropical Storm Agnes caused some damage in the Catskill area. Several bridges and roads suffered minor damage and there were reports of damage to private properties in the Town of Shandaken. Esopus Creek and its tributaries crested during the morning. Four campers had to be rescued from Woodland Valley when their exit was cut off and one of them suffered leg burns from a gas lantern explosion. Ulster County highway crews cleared fallen trees from county roads in the Woodland Valley and Phoenicia area. In Oliverea Valley, the main damage was seen on the property of Suzie's Cabins, where several feet of lawn and fill next to the stream were washed away. Further inspection of bridges and streams in the Town was made by federal and state officials.	FEMA, Town Input
July 20, 1973	Severe Storms, Flooding	DR-401	Yes	N/A	FEMA
December 27, 1973	Severe Storms, Flooding	N/A	N/A	Torrential rain fell in the Town of Shandaken, causing large amounts of damage due to water running off the mountain side. Residents in the area of the Woodland Valley county bridge reported to the supervisor's office Friday morning that water was up to the floor of the bridge and the span seemed to be swaying	Town Input

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				in the current of the Esopus. Two 8-foot by 50-foot culvert pipes, each weighing several tons, were washed away from the property of Ray Smith, where contractors are replacing a highway bridge on Route 212, Willow Road. One of the pipes wedged under the old Route 28 bridge was Mount Tremper Four Corners was partially sticking out, diverting the water to Brookside Road, which became flooded. Plank Road, the former Route 28, was washed out and closed to traffic. The worst flooding conditions was at the O'Donnell Five-Star camp near Mount Tremper. The former Hoffman diner and a property in the vicinity of the Hoffman bridge were flooded. Three trailers were damaged by water, and two cars were towed out. A new housing development off Plank Road was hit hard. A new road was being completed, with bridges and culvert installations, and these were destroyed. The Sleepy Hollow campsite below Phoenicia had two or three feet of water by the parked trailers, and three trailers were flooded at their foundations. The site of the proposed Odell shopping area on new Route 28 had slight flooding. The Mount Tremper fire trail constructed by the Department of Environmental Conservation was completely washed out.	
March 28 – April 8, 1984	Coastal Storms, Flooding	DR-702	Yes	N/A	FEMA
April 3-6, 1987	Flooding	DR-792	Yes	A low-pressure system associated with a cold front produced heavy rain over the Catskills on March 30 and 31 and showers on April 1. More than three inches fell over the headwaters of the Schoharie and Esopus basins, while generally less than two inches fell elsewhere. The maximum rain recorded during the 24-hour period that ended on April 5 exceeded six inches and was centered on the highest peaks in the Catskills, Slide Mountain (4,204 ft) and Hunter Mountain (4,025 ft). Prevailing winds from the east and southeast and orographic effects of the Catskills combined to generate the greatest rainfall totals on the eastern slopes of the mountains. Five counties in southeastern New York were declared major disaster areas after intense rainfall on April 3-5, 1987, caused widespread flooding. Severe frontal storms often cause flooding in the narrow, steep valleys of the Catskill Mountains. This storm occurred at a time when soils were saturated, reservoir storage was near capacity, and stream discharge was high from	FEMA, Town Input

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				snowmelt. Rainfall during the storm period totaled 9.09 inches at Slide Mountain and 8.20 inches at Tannersville. Schoharie, Cat.skill, Esopus, and Rondout Creeks and East Branch Delaware and Neversink Rivers and their tributaries underwent the most severe flooding.	
November 11, 1995	Flooding	N/A	N/A	Between three and four inches of rain fell in eastern New York State which resulted in flooding. In the hamlet of Phoenicia, the Esopus Creek flooded and a state of emergency was declared. Several families were evacuated in the hamlet of Woodland Valley. Ulster County had approximately $100 K in damages.	NOAA-NCDC, Ulster County HMP
January 19 – 21, 1996	Flooding	N/A	N/A	Warm temperatures caused rapid snowmelt in Ulster County. Along with the melting snow, a storm brought one to three inches of rain, resulting in widespread flooding in the County. Small streams flooded across the County, washing out roads. Extensive flooding occurred along the Hudson River and Esopus Creek. Many towns in Ulster County experienced flooding. In the Town of Shandaken, five town roads were destroyed and several homes were damaged. Evacuations occurred in the hamlets of Phoenicia and Shandaken. Ulster County experienced $10 M in damages.	NOAA-NCDC, Ulster County HMP
January 27-28, 1996	Flooding	DR-1095	Yes	One to two inches of rain fell across eastern New York State, with some areas in the Catskills receiving three inches of rain. This storm, on top of already saturated soils, caused many small streams to flood in Ulster County. The Wallkill River and Rondout and Esopus Creeks flooded in the County. Evacuations occurred along the Esopus Creek and Route 28. Along the Rondout Creek at Eddyville, flooding was severe and widespread. In the Town of Shandaken, numerous roads were washed out and the Town declared a state of emergency. Overall, the County experienced $400 K in damages.	NOAA-NCDC, FEMA, Ulster County HMP
June 12-14, 1998	Flooding	N/A	N/A	Heavy rain fell across the Catskills and eastern Mohawk Valley. Three-day precipitation totals ranged from eight to 10 inches. Flooding of creeks and tributaries occurred in Ulster, Fulton, Montgomery and Greene Counties. In Ulster County, the Esopus Creek above the Ashokan Reservoir flooded. At the hamlet of Mount Tremper, the creek crested at 12.5 feet (flood stage is 11 feet). Overall, Ulster County experienced approximately $45 K in damages.	NOAA-NCDC, Ulster County HMP
September 16-18, 1999	Hurricane Floyd	DR-1296	Yes	Rainfall totals for Ulster County ranged from 4.56 inches in the Town of Kingston to 6.57 inches at Slide Mountain. In the hamlet of Phoenicia, 5.91 inches of rain was reported.	FEMA, NWS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				Throughout the County, many trees and wires were down. Roofs of homes were blown off. Many back roads were blocked by downed trees.	
May 18, 2000	TSTM	N/A	N/A	TSTM winds knocked down trees and powerlines at several locations in Albany, Columbia, Greene, Montgomery, Saratoga, Schoharie and Ulster Counties. The Town had approximately $87,000 in property damage.	NOAA-NCDC
December 17, 2000	Flooding	N/A	N/A	A record-breaking rainstorm struck eastern New York State, bringing between two and four inches of rain. Ulster County has hit hard. Six towns declared a state of emergency. In the Town of Shandaken, a boy drowned when he attempted to cross the West Branch of the Neversink River. Overall, the County experienced $500 K in damages.	NOAA-NCDC
May 3 - August 12, 2000	Severe Storms and Flooding	DR-1335	Yes	N/A	FEMA
May 13 – June 17, 2004	Severe Storms and Flooding	DR-1534	Yes	In the Town of Shandaken, Birch Creek flooded, topping the Academy Street Bridge and closing Main Street. Birch Creek Road washed out between Academy and Upper Birch Roads. Numerous culverts were washed out and roads were closed due to flooding. The Town had approximately $500 K in damages.	NOAA-NCDC, FEMA, Ulster County HMP
August 13 – September 16, 2004	Severe Storms and Flooding	DR-1564	Yes	In the hamlet of Phoenicia, streams in the area flowed over County Route 40.	FEMA, NOAA-NCDC
September 17-18, 2004	Tropical Depression Ivan	DR-1565	Yes	Streams overflowed onto Route 40 in Phoenicia.	FEMA, Town Input
April 2-4, 2005	Severe Storms and Flooding	DR-1589	Yes	A state of emergency was declared, due to flooding, throughout Ulster County. Rainfall totals in the County ranged from 2.67 inches in Saugerties and 6.15 inches in West Shokan. In the Town of Shandaken, Bushnellsville Creek overflowed its banks and flooded Route 42. Overall, the County had approximately $275 K in damages. FEMA approved over $1.6 M in public assistance for Ulster County.	NOAA-NCDC, FEMA, NWS
June 26 – July 10, 2006	Severe Storms and Flooding	DR-1650	Yes	N/A	FEMA
April 15-16, 2007	Severe Storms and Inland/Coastal Flooding	DR-1692	Yes	An intense storm brought flooding, heavy rain and wet snow to the region. Rainfall amounts of six to eight inches were reported across the eastern Catskills, mid-Hudson Valley and western New England. Rainfall totals for Ulster County ranged	FEMA, NWS

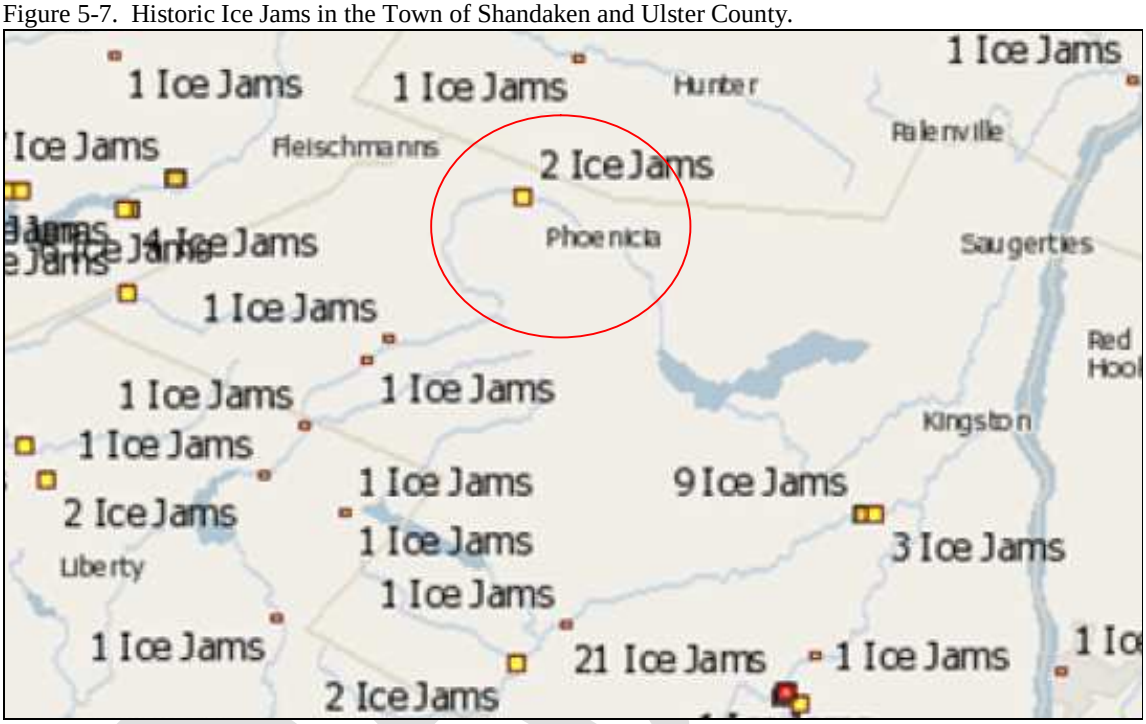
Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				from 4.30 inches in Kingston to 7.43 inches in West Shokan.	
June 19, 2007	Severe Storms and Flooding	DR-1710	Yes	FEMA approved over $960 K in disaster assistance for Ulster County.	FEMA
September 30 – October 1, 2010	Severe Storms and Flooding	N/A	N/A	Rainfall totals in Ulster County ranged from 3.14 inches in Saugerties to 8.27 inches in the hamlet of Phoenicia. In the Town of Shandaken, Route 214 was closed in both directions due to flooding.	NWS
December 2010	Flood	N/A	N/A	N/A	Town of Shandaken
April 25 – 30, 2011	Severe Storms, Flooding, Tornadoes and Straight-line Winds	DR-1993	Yes	Rainfall totals in Ulster County ranged from 0.75 inches in Kingston to 2.24 inches in the hamlet of Phoenicia.	FEMA, NWS
August 28-29, 2011	Tropical Storm Irene	DR-4020	Yes	Tropical Storm Irene tracked across eastern New York State, producing widespread flooding and damaging winds. Rainfall totals ranged between eight and 12 inches, with higher amounts in the eastern Catskills and Schoharie Valley. In the Town of Shandaken, Route 42 was closed due to the flooding, between Route 23A in the Town of Lexington and Route 28 in the Town of Shandaken.	NOAA-NCDC, FEMA
September 7-11, 2011	Remnants of Tropical Storm Lee	DR-4031	Yes	Remnants of Tropical Storm Lee caused minor flooding along the Esopus Creek in the Town of Shandaken, upstream of the Ashokan Reservoir.	NOAA-NCDC
September 18, 2012	Flood	N/A	N/A	Flooding in the hamlet of Oliverea washed out a recently repaired road on County Route 47, below the intersection of McKinley Hollow Road.	Town of Shandaken

Note (1): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

DR Federal Disaster Declaration
EM Federal Emergency Declaration
FEMA Federal Emergency Management Agency
K Thousand ($)
M Million ($)
N/A Not applicable/available
NCDC National Climate Data Center
NOAA National Oceanic Atmospheric Administration
NWS National Weather Service

The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of over 18,000 records from across the U.S. According to the USACE-CRREL, Ulster County experienced 61 historic ice jam events between 1780 and 2012. According to the CRREL database, ice jams have historically formed at various points in Ulster County along Allen Creek, Esopus Creek, Genesee River, Rondout Creek, Sandburg Creek and the Wallkill River, with two ice jams occurring along Esopus Creek in the Town of Shandaken (Ice Engineering Research Group, 2011). Locations of historical ice jam events are indicated in Figure 5-7 below.

Figure 5-7. Historic Ice Jams in the Town of Shandaken and Ulster County.



Source: CRREL, 2012
Note: The red circle indicates the approximate location of the Town of Shandaken.

Based on review of the CRREL Database, Table 5-4 lists the ice jam events that have occurred in the Town between 1780 and 2012. Information regarding losses associated with these reported ice jams was limited.

Table 5-4. Ice Jam Events in the Town of Shandaken between 1780 and 2012

Event Date	River / Location	Gage Number	Description	Source(s)
February 2, 1981	Esopus Creek at Shandaken	1362198	An ice jam occurred resulting in a gage height of 7.82 ft. and discharge of 120 cfs.	CRREL
February 11, 1981	Esopus Creek at Shandaken	1362198	An ice jam occurred resulting in a gage height of 7.78 and discharge of 450 cfs.	CRREL

Source: CRREL, 2012
Note: Although many events were reported for Ulster County, information pertaining to every event was not easily ascertainable; therefore this table may not represent all ice jams in the Town of Shandaken.

National Flood Insurance Program

The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*). The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. As stated in the NYS HMP, the NFIP collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance policies, number of claims per insured property, dollar value of each claim and aggregate value of claims, repetitive flood loss properties, etc. NFIP data presents a strong indication of the location of flood events among other indicators (NYSDPC, 2008).

There are three components to NFIP: flood insurance, floodplain management and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (FEMA, 2008).

NFIP data for the Town of Shandaken is presented further in the Vulnerability Assessment section of this profile.

As an additional component of NFIP, the CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance (FEMA, 2007). According to FEMA, the Town of Shandaken does not participate in the CRS; therefore specific repetitive loss areas other than those identified by FEMA are not available for the Town (FEMA, 2011).

5.1.10 Probability of Future Events

Given the history of flood events that have impacted the Town of Shandaken, it is apparent that future flooding of varying degrees will occur. The fact that the elements required for flooding exist and that major flooding has occurred throughout the Town in the past suggests that many people and properties are at risk from the flood hazard in the future.

In addition to riverine flooding, ice jams frequently occur in New York State and Ulster County is no exception. According to the New York State HMP, New York State is ranked as the second highest state with the highest number of ice jam events compared to the remainder of the U.S. (DRAFT NYSHMP, 2011). Please refer to the Vulnerability Assessment for a complete discussion of vulnerable population, facilities, utilities and infrastructure in the Town.

It is estimated that the Town of Shandaken will continue to experience direct and indirect impacts of floods annually. Table 5-5 summarizes the occurrences of flood events and their annual occurrence (on

average).

Table 5-5. Occurrences of Flood Events in the Town of Shandaken, 1950 - 2012

Event Type	Total Number of Occurrences	Annual Number of Events (average)
Flash Flood	8	0.13
Flood	3	0.05
Total:	**11**	**0.18**

Source: NOAA-NCDC, 2011
Note: On average, the Town of Shandaken experiences 0.18 flood events each year.

The Role of Global Climate Change on Future Probability

"Climate change" refers to changes over a long period of time in patterns of temperature, precipitation, humidity, wind and seasons. Climate change is expected to have significant impacts on the Pacific Northwest by mid-21st century. Climate plays a fundamental role in shaping ecosystems and the human economies and cultures that depend on them. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of flooding. As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels and levees, as well as the design of local sewers and storm drains.

.Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. The Town of Shandaken is part of Region 2, Catskill Mountains and West Hudson River Valley. Some of the issues in this region, affected by climate change, include: the watershed for New York City's water supply, spruce/fir forests disappear from mountains, decline in popular apple varieties, winter recreation declines/summer opportunities increase, Hemlock wooly adelgid destroys trees, and native brook trout decline and replaced by bass (NYSERDA, 2011).

Temperatures are expected to increase throughout the State, by 1.5 to 3ºF by the 2020s, 3 to 5.5ºF by the 2050s and 4 to 9ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas emissions scenarios and the higher ends for higher emissions scenarios. Annual average precipitation is projected to increase by up to five-percent by the 2020s, up to 10-percent by the 2050s and up to 15-percent by the 2080s. During the winter months is when this additional precipitation will most likely occur, in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall. Table 5-6 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA, 2011).

Table 5-6. Projected Seasonal Precipitation Change in Region 2, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA, 2011

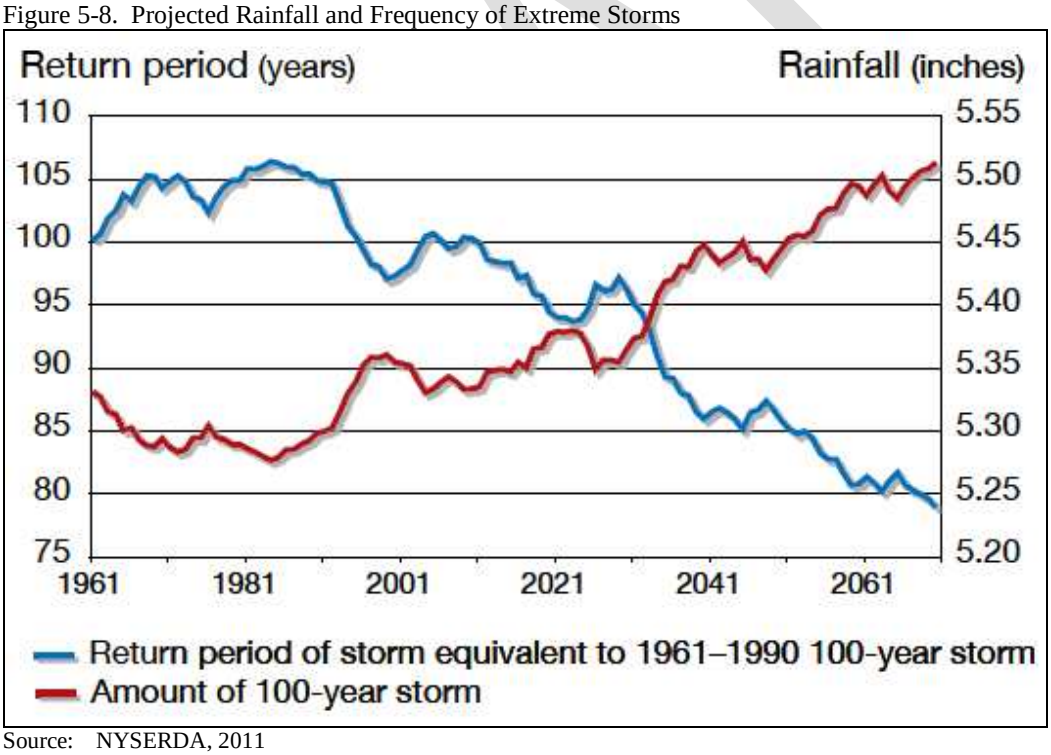
The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hugs; and increase delays and hazards related to extreme weather events (NYSERDA, 2011).

Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA, 2011).

Over the past 50 years, heavy downpours have increased and this trend is projected to continue. This can cause an increase in localized flash flooding in urban areas and hilly regions. Flooding has the potential to increase pollutants in the water supply and inundate wastewater treatment plants and other vulnerable facilities located within floodplains. Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA, 2011).

Figure 5-8 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA, 2011).

Figure 5-8. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA, 2011

Total precipitation amounts have slightly increased in the Northeast U.S., by approximately 3.3 inches over the last 100 years. There has also been an increase in the number of two-inch rainfall events over a 48-hour period since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well. More rain heightens the danger of

localized flash flooding, streambank erosion and storm damage (DeGaetano et al [Cornell University], 2010).

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events in particular (e.g. 10-year floods) will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding.

Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

Scenario

The primary water courses in the planning area have the potential to flood at regular intervals, generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between early November and late March. A series of such weather events can cause severe flooding in the planning area. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. This could overwhelm response and floodplain management capabilities within the planning area. Major roads could be blocked, preventing critical access for many residents and critical functions. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. In the case of multi-basin flooding, the Town of Shandaken would not be able to make repairs quickly enough to restore critical facilities and infrastructure. The floodplains mapped and identified by the Town of Shandaken will continue to be impacted by these floods.

Issues

Important issues associated with flood hazards in the planning area include but are not limited to the following issues identified by the planning team:

- There needs to be a sustained effort to gather historical damage data, such as high water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between the town, county and state and local agencies
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The potential impact of climate change on flood conditions in the planning area needs to be better understood.
- The capability for prediction forecast modeling needs to be enhanced.
- Flood warning capability should be tied to flood phases. Action stages on the Cold Brook gage should be tied to observed flood levels at critical areas in the town.
- Action stages must be established for all gages it the Ashoken Watershed
- There needs to be enhanced modeling to better understand the true flood risk.
- Post-flood disaster response and recovery actions need to be solidified.
- Staff capacity is required to maintain the existing level of floodplain management within the planning area.
- Floodplain management actions require interagency coordination.

5.2 VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the flood hazard, the hazard areas identified in the Town of Shandaken include the 100- and 500- year regulatory FEMA floodplains. The following text evaluates and estimates the potential impact of flooding on the Town including:

- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

5.2.1 Data and Methodology

The 1-percent and 0.2-percent annual chance flood events were examined to evaluate the Town of Shandaken's risk and vulnerability to the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP. Hazards U.S. Multi-Hazard or HAZUS (Hazards United States)-MH version 2.1 was used to generate the Town of Shandaken's potential loss estimates.

HAZUS-MH is a geographic information system (GIS)-based natural hazard loss estimation software package developed and distributed free of cost by the Federal Emergency Management Agency (FEMA). In 1997, FEMA developed the HAZUS standardized model for estimating losses caused by earthquakes. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard (MH) methodology with new models for estimating potential losses from wind (hurricanes including a storm surge option) and flood (riverine and coastal) hazards.

HAZUS-MH applies engineering and scientific risk calculations that have been developed by hazard and information technology experts to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards. HAZUS-MH can serve as a basis to quantify risk and to allocate limited resources for prioritization of mitigation projects. Refer to the Methodology section of this Plan for further details on HAZUS-MH.

The HAZUS-MH flood model is designed for three levels of analysis. A Level 1 analysis is the simplest type of analysis based on default data provided with the software. A Level 2 HAZUS-MH riverine flood analysis was performed for the Town of Shandaken. The default general building stock in HAZUS- MH was updated and replaced with data available from Ulster County including assessor data, parcels, address points and detailed structure-specific information. The buildings were incorporated into the HAZUS-MH flood model as individual buildings so that more accurate potential loss estimates could be obtained versus running the mode and reporting results at the aggregate level (Census block). An updated critical facility inventory was used in place of the HAZUS-MH defaults for essential facilities and utilities. As DFIRMs and other data are available in the future, enhanced Level 2 and Level 3 analyses can be performed for the Town of Shandaken. Please refer to the 'Additional Data and Next Steps' subsection below.

Flood Insurance Rate Maps (FIRMs) show floodways and other floodplain management information,

such as cross-sections, that were previously provided on separate Flood Boundary and Floodway maps. They also include simplified flood insurance zones designations. Digital FIRMs (DFIRMs) contain the same information as the previous FIRMs in a digital format which provide many benefits. For example, they can be revised and updated easily and can be incorporated into the community's mapping system and tied with other geographic information systems, such as the zoning map. It is noted that the simple conversion of FIRMs to a digital format does not improve the engineering quality of the product (FEMA 480, Floodplain Management Requirements, February 2005).

FEMA Digital Flood Insurance Rate Maps (DFIRMs) are not yet available for the Town of Shandaken. The Town has digital Quality 3 (Q3) mapping. The Q3 data was developed to support insurance related activities and are designed to show the general location of floodplains or special flood hazard areas (SFHAs). The Q3 data used for this analysis included SFHA (1-percent annual chance flood) and 0.2-percent annual chance floodplain boundaries. Updated maps are expected in 2013 and the Town intends to review the outcomes of this plan in the context of the new maps, when they are available.

The available Q3 floodplain boundaries, the Flood Insurance Rate Study (February 1989), the 2009 3-meter Light Detection and Ranging (LiDAR) Bare Earth Digital Elevation Model (DEM) from the New York City Department of Environmental Protection (NYCDEP) and discharge rates for each riverine reach as provided by NYCDEP were used to generate flood boundaries and flood depth grids for the 1-percent and 0.2-percent annual chance flood events in the HAZUS-MH 2.1 riverine flood model. Please note that several areas of the Q3 do not align with the riverine reaches in the Town and were therefore only used as a guide to identify the riverine reaches with flood risk as determined by FEMA to select in the HAZUS model. Because of this misalignment, the Q3 boundaries were not used to estimate exposure. Instead, the flood boundaries generated by HAZUS were used. The resulting 1-percent and 0.2-percent flood boundaries and depth grids generated by HAZUS follow the riverine reaches based on the terrain used and are considered an estimate of the flood hazard areas in the Town of Shandaken until DFIRMs are available.

To estimate exposure, the HAZUS-generated flood boundaries, an updated list of buildings and facilities provided by Ulster County and updated by the SAFARI group and the Town of Shandaken tax assessor, and 2010 U.S. Census population data were used. HAZUS-MH 2.1 estimated sheltering needs (based on 2000 U.S. Census data) and potential damages to the updated general building stock and critical facility inventories based on the depth grid generated and the default HAZUS damage functions in the flood model. Figure 5- illustrates the flood boundaries used for this vulnerability assessment. Estimated potential exposure and loss estimates were provided for the Town as a whole, as well as by zip code.

During the development of this plan and after the vulnerability analysis was performed, the preliminary Ulster County FEMA Flood Insurance Rate Maps were made available in PDF to compare to the estimated flood boundaries HAZUS-MH generated for the 1-percent and 0.2-percent annual chance flood events.

In the Hamlet of Phoenicia, the preliminary FEMA maps indicate a larger 1-percent and 0.2-percent annual chance floodplain north of Main Street and east of Route 24 when compared with the estimated HAZUS flood boundaries. The floodplains along the Esopus Creek, between Main Street and State Route 28, appear very similar.

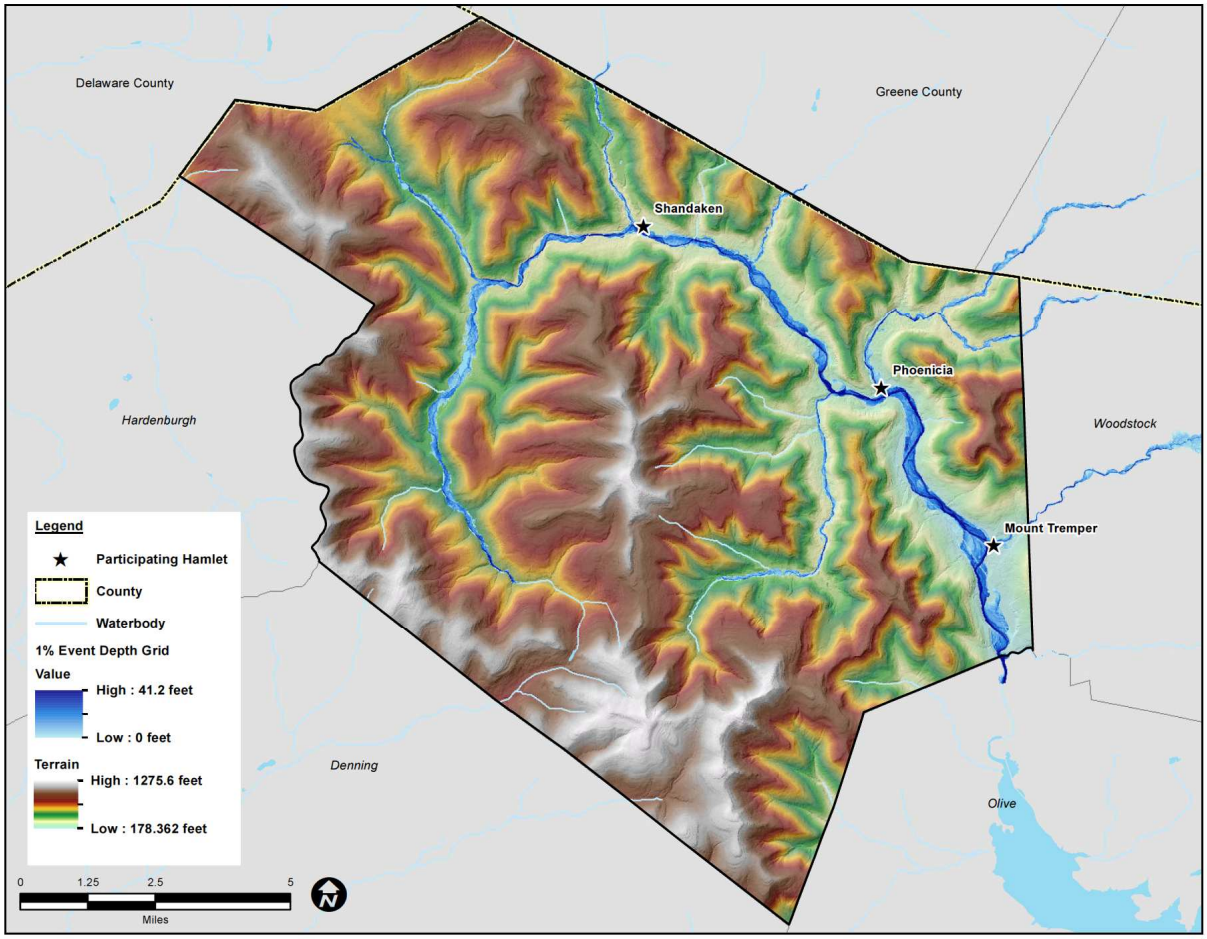
In the Hamlet of Mt. Tremper, the estimated 1-percent flood boundaries generated by HAZUS are similar to the preliminary FEMA maps 1-percent annual probability floodplain. However, greater differences appear with the 0.2-percent annual chance flood boundaries where the HAZUS-generated area is smaller in some areas (e.g., near Hudler Road and State Route 28) and larger in others (e.g., along Mt Pleasant Road west of State Route 28).

Further analysis to determine the exposure or estimated damages based on the updated maps is included as an action item in the mitigation strategy in Section 6 of this plan.

In terms of the dam failure hazard, there are five dams located within the Town of Shandaken. According to NYSDEC, one dam is classified as a high hazard dam (Pine Hill Lake Dam) or a class 'C'; and four dams are classified as intermediate hazard dams or class 'B' (Day Pond Dam, Muddy Brook Pond Dam, Winnisook Lake Dam, Snow Making Pond Dam). Refer to the Town Profile (Section 4) for dams located in the Town of Shandaken. The Stanford University's National Performance of Dams web site does not provide any information on 'dam incidents' related to these dams (i.e., safety related events). Pine Hill Lake Dam is the only dam that is required to have an Emergency Action Plan (EAP). Failure of this dam may cause loss of life, serious damage to buildings, public utilities, highways and economic loss.

There have been no recorded dam failures in the Town of Shandaken. Digitized dam inundation areas were not available at the time of this HMP. For dam failures of high hazard dams, inundation areas are likely to be similar to the 1-percent and 0.2-percent annual chance flood events downstream of each dam. A qualitative assessment of the dam failure hazard is provided below.

Figure 5-9 Town of Shandaken 1% Flood Event Depth Grid



Source: NYCDEP, 2009; Tetra Tech, 2012

5.2.2 Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not measurable.

To estimate the population exposed to the 1% and 0.2% annual chance flood events, the floodplain boundaries generated for this planning effort were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). Census blocks do not follow the boundaries of the floodplain. Similarly, Census blocks to not follow zip code boundaries. The Census blocks with their centroid in the flood boundaries were used to calculate the estimated population exposed to this hazard. Table 5-7 lists the estimated population located within the 1% and 0.2% flood zones for the Town as a whole and by zip code. Refer to Section 4 which discusses how the 2010 Census blocks were assigned to a zip code and to Figure 4-7 which displays the zip codes in the Town of Shandaken.

Table 5-7. Estimated Population Vulnerable to the 1% and 0.2% Flood Events

Zip Code	Total Population (U.S. Census 2010)	Population in 1% Hazard Area	Percent Population	Population in 0.2% Hazard Area	Percent Population
Big Indian	457	69	15.1	69	15.1
Chichester	345	8	2.3	8	2.3
Mt Tremper	478	41	8.6	98	20.5
Phoenicia	1,021	140	13.7	163	16.0
Pine Hill	242	4	1.7	4	1.7
Shandaken	542	62	11.4	73	13.5
Town of Shandaken	**3,085**	**324**	**10.5**	**415**	**13.5**

Source: Census, 2010
Note: Census Block 361119553001065, located entirely in the Town of Shandaken, has two zip codes: Phoenicia and Boiceville. For the purposes of this analysis, the entire block is considered within the Phoenicia zip code.

Of the population exposed, the most vulnerable include the economically disadvantaged and population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating.

Using 2000 U.S. Census data, HAZUS-MH 2.1 estimates the potential sheltering needs as a result of the 1% and 0.2% flood events. For the 1% flood event, HAZUS-MH 2.1 estimates 902 people will be displaced and 461 people will seek short-term sheltering, representing 27.9% and 14.3% of the Shandaken 2000 population, respectively. For the 0.2% flood event, HAZUS-MH 2.1 estimates 990 people will be displaced and 547 people will seek short-term sheltering, representing 30.6% and 16.9% of the Shandaken 2000 population, respectively. Refer to Table 5-8.

Table 5-8. Estimated Population Displaced or Seeking Short-Term Shelter from the 1% and 0.2% Annual Chance Flood Events

Zip Code	1% Annual Chance Event		0.2% Annual Chance Event	
	Displaced Persons	Persons Seeking Short-Term Sheltering	Displaced Persons	Persons Seeking Short-Term Sheltering
Big Indian	71	27	80	34
Chichester	28	5	34	11
Mt Tremper	110	50	143	70
Phoenicia	280	157	363	226
Pine Hill	27	3	33	4
Shandaken	126	38	145	45
Town of Shandaken	**642**	**280**	**798**	**390**

Source: HAZUS-MH 2.1
Note: The percent of the population displaced and seeking shelter was calculated using the 2000 U.S. Census data

The total number of injuries and casualties resulting from typical riverine flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place.

All population in a dam failure inundation zone is considered exposed and vulnerable. Similar to riverine flooding, of the population exposed to dam failure and flash flooding, the most vulnerable include the economically disadvantaged and the population over the age of 65.

There is often limited warning time for dam failure and flash flooding. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

5.2.3 Impact on General Building Stock

After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure in the flood zone includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

The total land area located in the 1-percent and 0.2-percent annual chance flood zones created for this planning effort was calculated. Refer to Table 5-7 below. To provide a general estimate of number of structures, parcels, and structural/content replacement value exposure, the flood boundaries (1- and 0.2-percent annual chance flood zones) were overlaid upon Shandaken's parcel and the updated building stock inventory point shapefiles. The parcels that intersect the 1-percent and/or 0.2-percent annual chance flood zones were totaled for the municipality. The total number of buildings with their centroid located in the 1-percent and 0.2-percent flood boundaries was also determined and their estimated building stock replacement value (structure and contents) is listed as well. Refer to Table 5-9 through Table 5-1 below for exposure estimates for the Town of Shandaken. Figure 5-10 through Figure 5-11 illustrate the 1-percent flood event depth grid and the parcels that intersect.

Table 5-9. Area Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries

Zip Code	Total Area (sq. mi.)	1% Annual Chance Event		0.2% Annual Chance Event	
		Area Exposed (sq. mi.)	% of Total	Area Exposed (sq. mi.)	% of Total
Big Indian	42.7	0.72	1.7	0.84	2.0
Chichester	4.9	0.18	3.7	0.23	4.7
Mt Tremper	4.2	0.94	22.4	1.02	24.3
Phoenicia	51.3	1.41	2.7	1.64	3.2
Pine Hill	2	0.03	1.5	0.04	2.0
Shandaken	13.8	0.48	3.5	0.58	4.2
Town of Shandaken	**118.9**	**3.76**	**3.2**	**4.35**	**3.7**

Source: Tetra Tech, 2012
Note: sq.mi. = Square miles; % = Percent

Table 5-10. Estimated Number of Parcels that Intersect the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries

Municipality	Total Number of Parcels	1% Annual Chance Event		0.2% Annual Chance Event	
		Number	% Total	Number	% Total
Town of Shandaken	3,547	1,216	34.3	1,382	39.0

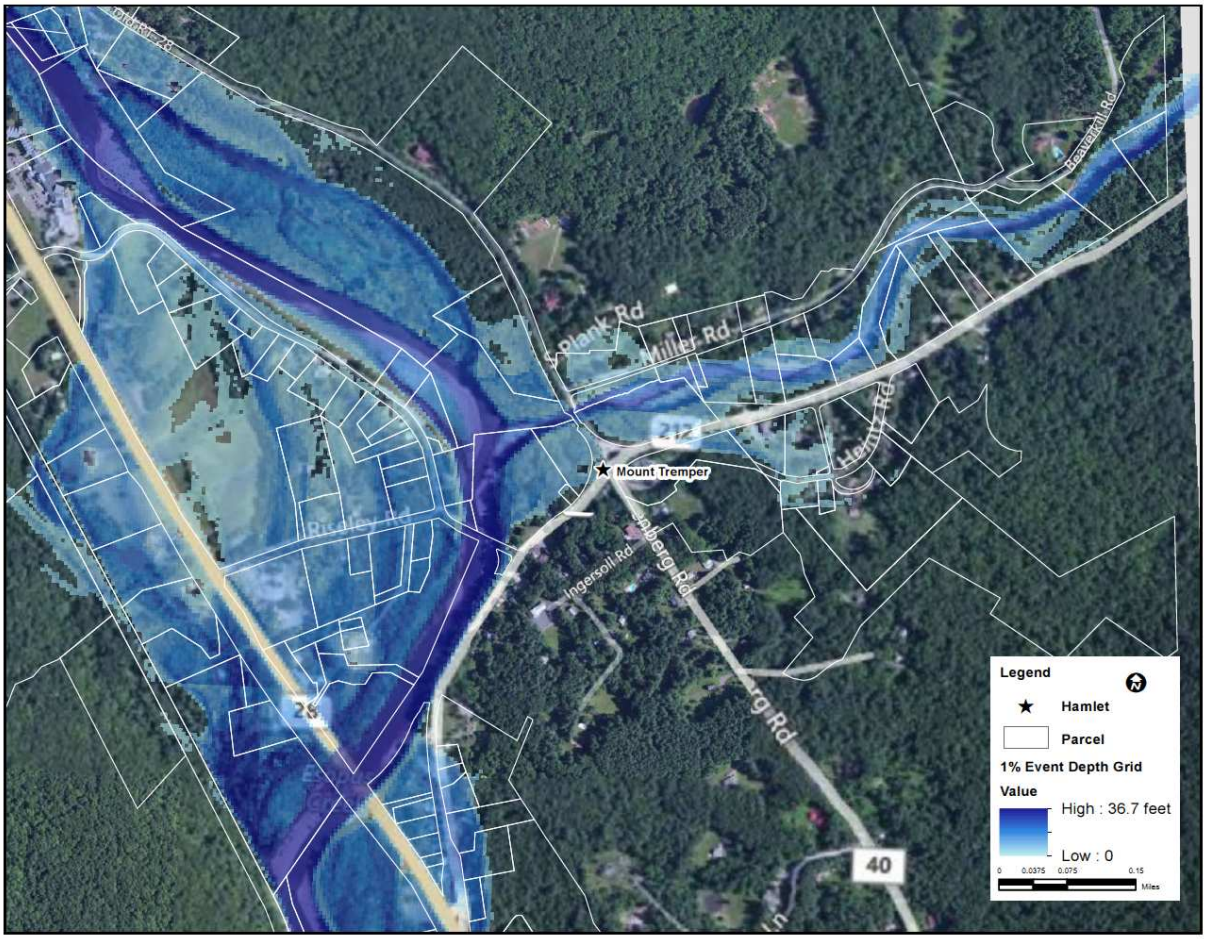
Source: Ulster County, 2012; Tetra Tech, 2012
Note: % = Percent

Table 5-11. Estimated General Building Stock Exposure to the 1-Percent and 0.2-Percent Annual Chance Flood Events

Zip Code	Total Number of Buildings	Total RCV	1% Annual Chance Event				0.2% Annual Chance Event			
			Number of Buildings	% of Total	RCV	% of Total	Number of Buildings	% of Total	RCV	% of Total
Big Indian	443	$150,118,372	46	10.4	$15,385,739	10.2	64	14.4	$19,436,674	12.9
Chichester	276	$72,636,483	25	9.1	$5,096,270	7.0	43	15.6	$9,516,681	13.1
Mt Tremper	259	$90,876,459	60	23.2	$24,432,339	26.9	77	29.7	$29,039,894	32.0
Phoenicia	791	$289,931,165	136	17.2	$69,055,747	23.8	209	26.4	$94,006,610	32.4
Pine Hill	244	$96,548,248	14	5.7	$2,887,916	3.0	15	6.1	$3,808,642	3.9
Shandaken	368	$115,088,897	39	10.6	$14,339,876	12.5	63	17.1	$20,532,504	17.8
Town of Shandaken	**2,381**	**$815,199,625**	**320**	**13.4**	**$131,197,887**	**16.1**	**471**	**19.8**	**$176,341,005**	**21.6**

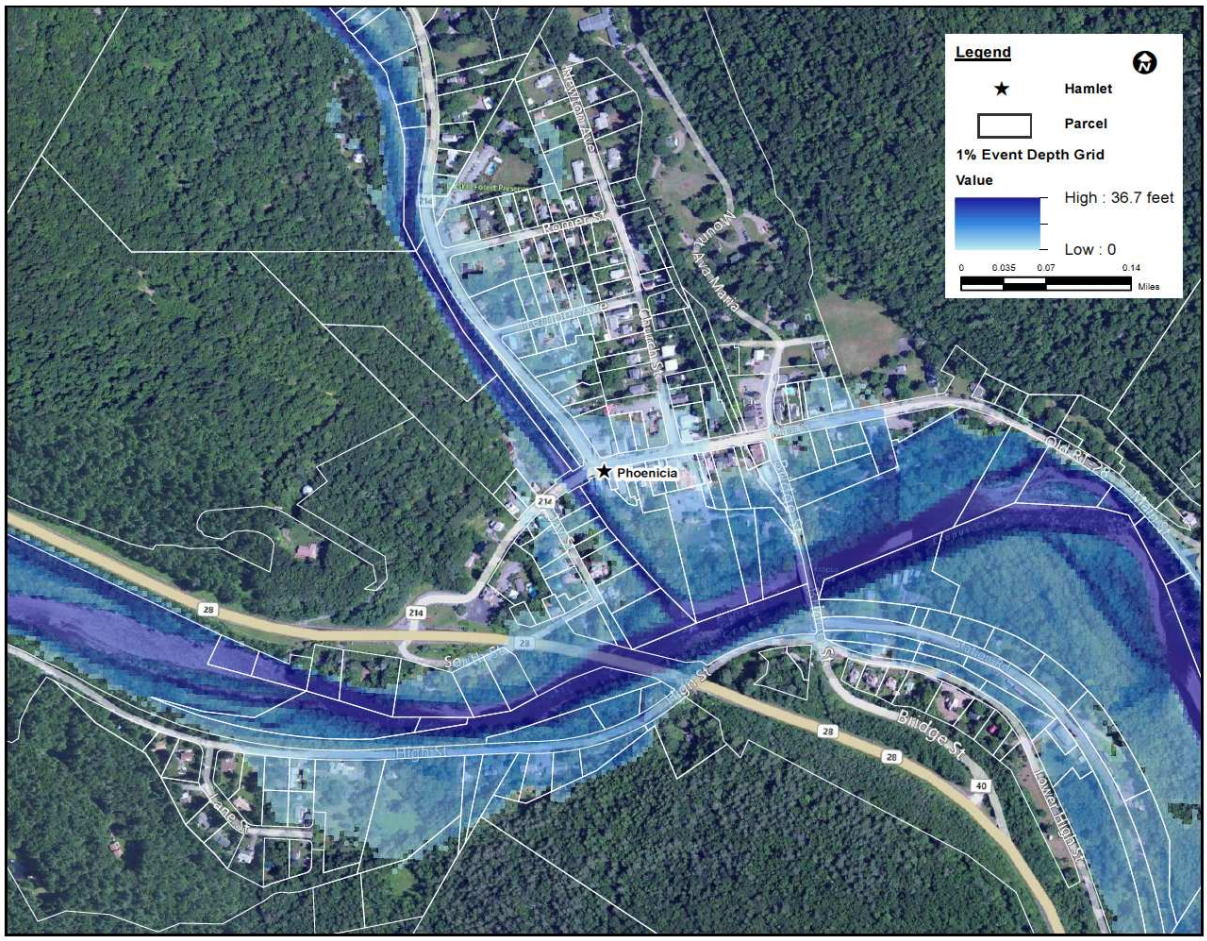
Source: Ulster County, 2012; Tetra Tech, 2012
Notes: Total RCV for Town = $815,199,625
% = Percent
RCV = Replacement cost value

Figure 5-10. Mount Tremper 1-Percent Flood Event Depth Grid and Parcels that Intersect the Grid



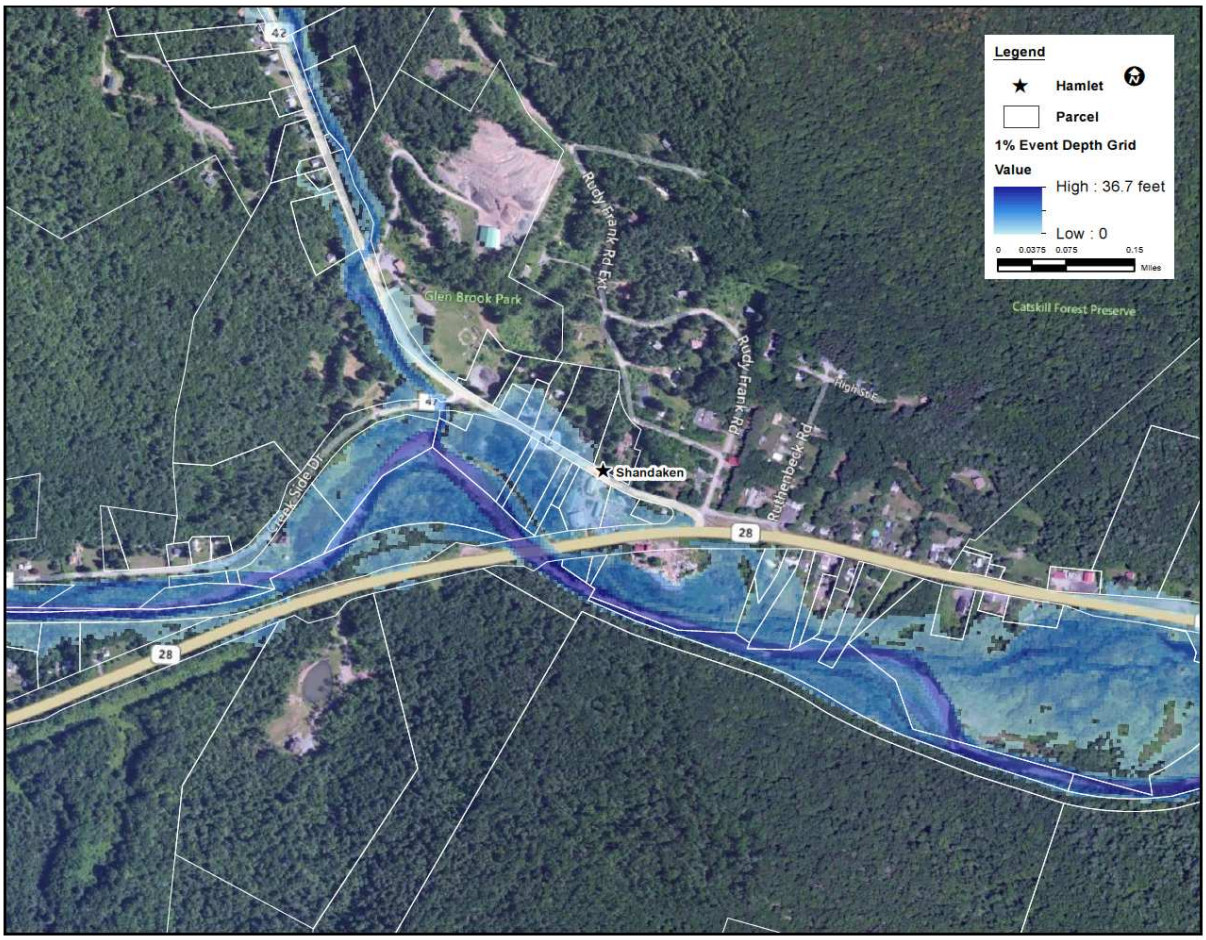
Source: Ulster County, 2012; Tetra Tech, 2012

Figure 5-11. The Hamlet of Phoenicia 1-Percent Flood Event Depth Grid and Parcels that Intersect the Grid



Source: Ulster County, 2012; Tetra Tech, 2012

Figure 5-12. Shandaken 1-Percent Flood Event Depth Grid and Parcels that Intersect the Grid



Source: Ulster County, 2012; Tetra Tech, 2012

Table 5-2 through Table 5- summarize the estimated potential general building stock damages (structure and contents) in the Town of Shandaken as a result of the 1-percent and 0.2-percent flood events, respectively.

Table 5-12. Estimated General Building Stock Replacement Value (Structure and Contents) Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries by Occupancy Class

Zip Code	Total Buildings (All Occupancy Classes)				Residential Buildings		Commercial Buildings		Industrial Buildings	
	1% Event	% Total	0.2% Event	% Total	1% Event	0.2% Event	1% Event	0.2% Event	1% Event	0.2% Event
Big Indian	$15,385,739	10.2	$19,436,674	12.9	$12,924,455	$16,054,663	$0	$920,727	$0	$0
Chichester	$5,096,270	7.0	$9,516,681	13.1	$4,175,543	$7,675,227	$920,727	$1,841,454	$0	$0
Mt Tremper	$24,432,339	26.9	$29,039,894	32.0	$18,457,496	$21,624,319	$822,022	$2,262,754	$0	$0
Phoenicia	$69,055,747	23.8	$94,006,610	32.4	$22,758,963	$38,341,604	$33,677,302	$38,477,124	$436,978	$436,978
Pine Hill	$2,887,916	3.0	$3,808,642	3.9	$2,887,916	$2,887,916	$0	$920,727	$0	$0
Shandaken	$14,339,876	12.5	$20,532,504	17.8	$6,837,272	$11,589,168	$4,604,342	$6,045,075	$436,978	$436,978
Town of Shandaken	**$131,197,887**	**16.1**	**$176,341,005**	**21.6**	**$68,041,645**	**$98,172,897**	**$40,024,393**	**$50,467,860**	**$873,955**	**$873,955**

Zip Code	Agriculture		Religious		Government		Education	
	1% Event	0.2% Event	1% Event	0.2% Event	1% Event	0.2% Event	1% Event	0.2% Event
Big Indian	$0	$0	$0	$0	$2,461,284	$2,461,284	$0	$0
Chichester	$0	$0	$0	$0	$0	$0	$0	$0
Mt Tremper	$0	$0	$4,568,400	$4,568,400	$584,421	$584,421	$0	$0
Phoenicia	$0	$0	$9,136,800	$13,705,200	$3,045,705	$3,045,705	$0	$0
Pine Hill	$0	$0	$0	$0	$0	$0	$0	$0
Shandaken	$0	$0	$0	$0	$2,461,284	$2,461,284	$0	$0
Town of Shandaken	**$0**	**$0**	**$13,705,200**	**$18,273,600**	**$8,552,693**	**$8,552,693**	**$0**	**$0**

Source: Ulster County, 2012; Tetra Tech, 2012

Note: The 1-Percent and 0.2-Percent Annual Chance Flood Boundaries were generated by HAZUS-MH 2.1 based on the terrain, discharges and n-values input into the riverine flood model.

Table 5-13. Estimated Potential General Building Stock Loss (Structure and Contents) by the 1-Percent Annual Chance Flood Event

Zip Code	Total Buildings (All Occupancies)	Percentage of Total Building Value	Residential Buildings	Commercial Buildings	Industrial Buildings	Agriculture Buildings	Religious Buildings	Government Buildings	Education Buildings
Big Indian	$946,684	<1	$946,684	$0	$0	$0	$0	$0	$0
Chichester	$572,016	<1	$546,577	$25,439	$0	$0	$0	$0	$0
Mt Tremper	$3,951,526	4.3	$3,000,118	$440,330	$0	$0	$104,799	$406,278	$0
Phoenicia	$14,136,990	4.9	$3,089,271	$7,945,249	$245,438	$0	$2,469,051	$387,980	$0
Pine Hill	$441,562	<1	$441,562	$0	$0	$0	$0	$0	$0
Shandaken	$2,782,619	2.4	$1,219,144	$510,294	$109,297	$0	$0	$943,884	$0
Town of Shandaken	**$22,831,396**	**2.8**	**$9,243,357**	**$8,921,312**	**$354,735**	**$0**	**$2,573,850**	**$1,738,142**	**$0**

Source: HAZUS-MH 2.1
Notes: Values represent replacement values (RCV) for building structure and contents. Total RCV for Town = $815,199,625.
The 1-Percent and 0.2-Percent Annual Chance Flood Boundaries were generated by HAZUS-MH 2.1 based on the terrain, discharges and n-values input into the riverine flood model.

Table 5-14. Estimated Potential General Building Stock Loss (Structure and Contents) by the 0.2-Percent Annual Chance Flood Event

Zip Code	Total Buildings (All Occupancies)	Percentage of Total Building Value	Residential Buildings	Commercial Buildings	Industrial Buildings	Agriculture Buildings	Religious Buildings	Government Buildings	Education Buildings
Big Indian	$2,073,665	1.4	$1,764,632	$11,911	$0	$0	$0	$297,122	$0
Chichester	$1,624,603	2.2	$1,326,036	$298,566	$0	$0	$0		$0
Mt Tremper	$7,366,566	8.1	$5,835,879	$550,427	$0	$0	$534,646	$445,614	$0
Phoenicia	$26,782,711	9.2	$7,307,045	$14,287,489	$283,362	$0	$4,095,733	$809,082	$0
Pine Hill	$737,901	<1	$642,455	$95,446	$0	$0	$0		$0
Shandaken	$5,344,752	4.6	$2,233,045	$1,521,828	$186,670	$0	$0	$1,403,208	$0
Town of Shandaken	**$43,930,197**	**5**	**$19,109,092**	**$16,765,668**	**$470,032**	**$0**	**$4,630,379**	**$2,955,027**	**$0**

Source: HAZUS-MH 2.1
Notes: Values represent replacement values (RCV) for building structure and contents. Total RCV for Town = $815,199,625.
The 1-Percent and 0.2-Percent Annual Chance Flood Boundaries were generated by HAZUS-MH 2.1 based on the terrain, discharges and n-values input into the riverine flood model.

In addition to total building stock modeling, individual data available on flood policies, claims, RLP and severe RLP (SRLs) were analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims and multiple claims (RLPs). According to the metadata provided: "The NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered."

Severe RLPs (SRL) were then examined for the Town. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10-year period, and must be greater than 10 days apart.

Table 5-15 and Figure 5-13 summarize the NFIP policies, claims and repetitive loss statistics for the Town of Shandaken. According to FEMA, there are 22 RL properties and two SRL properties in the Town of Shandaken. The two SRL properties are classified as 'single family' (FEMA Region 2, 2013). This information is current as of March 31, 2013.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

Table 5-15. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the estimated 1% Flood Boundary (3)	# Policies in the estimated 0.2% Flood Boundary (3)	# Policies Outside the 500-year Flood Hazard (3)
Town of Shandaken	204	214	$5,496,910	22	2	123	128	76

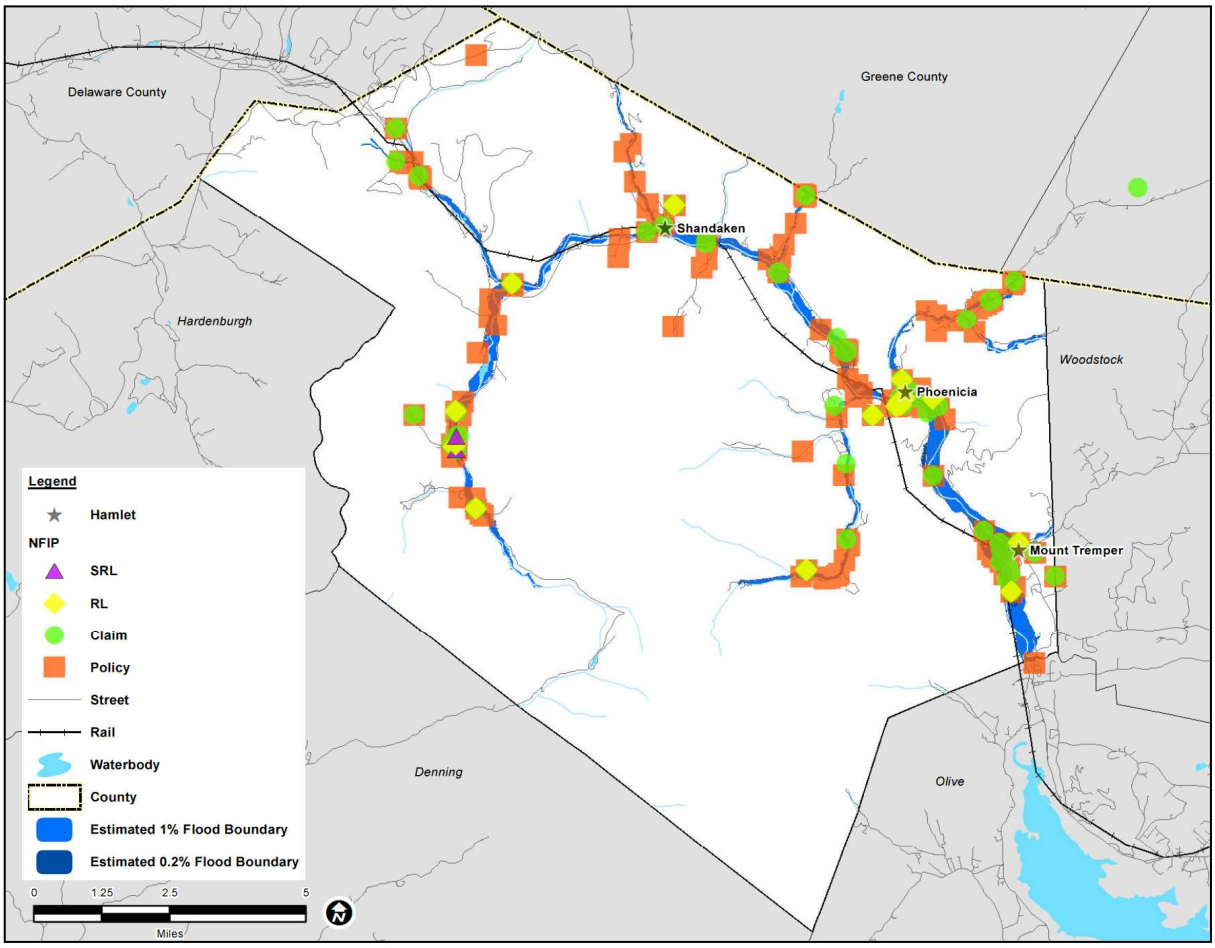
Source: FEMA Region 2, 2012

(1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, in May 2013. These statistics are current as of March 31, 2013. Please note the total number of repetitive loss properties includes the severe repetitive loss properties; only insured properties are included in these statistics. The number of claims represents the number of claims closed by March 31, 2013. Claims without payment are not included.

(2) Total building and content losses from the claims file provided by FEMA Region 2.

(3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.

Figure 5-13. NFIP Polices, Claims, Repetitive Loss and Severe Repetitive Loss Properties



Source: FEMA Region 2, 2013

5.2.4 Impact on Critical Facilities

In addition to considering general building stock at risk, the risk of flood to critical facilities, utilities and user-defined facilities was evaluated. HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, HAZUS estimates the percent of damage to the building and contents of critical facilities. Table 5-6 lists the critical facilities and utilities located in the FEMA flood zones and the percent damage HAZUS-MH 2.1 estimates to the facility as a result of the 1% and 0.2% events.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 5-16. Critical Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries and Estimated Potential Damage

Name	Type	Exposure		Potential Loss from 1% Flood Event			Potential Loss from 0.2% Flood Event		
		1% Event	0.2% Event	Percent Structure Damage	Percent Content Damage	Days to 100-Percent Functional	Percent Structure Damage	Percent Content Damage	Days to 100-Percent Functional
Phoenicia Fire House	Fire/EOC	X	X	10.2	24.0	480	11.6	47.8	480
Phoenicia Main Filtration Plant	Potable Water Facility	X	X	2	-	-	25.7	-	-
Phoenicia Water District Storage	Potable Water Facility	X	X	40	-	-	40	-	-
Town Hall	Municipal	X	X	2.3	2.5	-	24.9	38.8	-
Town Highway	Municipal	X	X	10.4	66.3	-	14.9	99.1	-

Source: HAZUS-MH 2.1
Note:
- = No loss calculated by HAZUS-MH 2.1

5.2.5 Impact on the Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to the Town of Shandaken. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty. For the purposes of this analysis, general building stock damages are discussed further.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown).

Direct building losses are the estimated costs to repair or replace the damage caused to the building. The potential damage estimated to the general building stock inventory associated with the 1-percent flood is approximately $105 Million. This estimated building damage represents approximately 13-percent of the Town's overall total general building stock inventory. The potential damage estimated to the general building stock inventory associated with the 0.2-percent flood is approximately $125 Million, or nearly 16- percent of the Town's total building inventory. These dollar value losses to the Town's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH estimates the amount of debris generated from the flood events as a result of 1% and 0.2% events. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5-7 summarizes the debris HAZUS-MH 2.1 estimates for these events. However, a major issue with debris in the Town includes gravel deposition and woody debris in stream beds, deposited after major storm and flood events. The Town indicates that the areas of concern are mostly at confluences in populated areas including the

following areas:

- Stony Clove - Esopus in Phoenicia
- Woodland Valley - Esopus in Woodland Valley
- Beaverkill - Esopus in Mt. Tremper
- McKenley - Esopus in Oliverea
- Busnellsville - Esopus in Shandaken

There areas are significantly impacted by gravel deposition due to the effects on infrastructure and residential and commercial structures.

Below are summary estimates of debris generated from flood events. These estimates can provide a basis for estimation of Town debris removal costs for future events to support fiscal planning.

Table 5-17. Estimated Debris Generated from the 1-Percent and 0.2-Percent Flood Events

Zip Code	1% Flood Event				0.2% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Big Indian	257	205	27	26	486	303	111	71
Chichester	135	72	33	30	255	117	75	63
Mt Tremper	960	342	363	255	1,558	494	634	430
Phoenicia	2,304	824	835	645	4,163	1,259	1,652	1,252
Pine Hill	58	52	4	2	101	87	9	6
Shandaken	370	175	109	85	697	266	244	187
Town of Shandaken	**4,085**	**1,670**	**1,371**	**1,043**	**7,260**	**2,526**	**2,725**	**2,008**

Source: HAZUS-MH 2.1

All buildings and infrastructure located in the dam failure inundation zone are considered exposed and vulnerable. Property located closest to the dam inundation area has the greatest potential to experience the largest, most destructive surge of water. All transportation infrastructures in the dam failure inundation zone are vulnerable to damage and potentially cutting off evacuation routes, limiting emergency access and creating isolation issues. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

5.2.6 Future Growth and Development

As discussed in Section 4, no areas targeted for future growth and development have been identified across the Town. Growth, however is expected to be minimal due to the steep slope topography of available land parcels and the amount of state owned land which prohibits development. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. illustrates the identified areas of potential new development in relation to the flood boundaries.

5.2.7 Additional Data and Next Steps

A HAZUS-MH riverine flood analysis was conducted for the Town of Shandaken using the most current and best available data including updated building and critical facility inventories, FIS, and 2009 three-

meter LiDAR DEM. For future plan updates, more accurate exposure and loss estimates can be produced by replacing the national default demographic inventory with 2010 U.S. Census data when it becomes available in the HAZUS_MH model. As Assessor databases continue to be updated, the building inventory should also be maintained.

FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) will be providing the flood depth and analysis grids as part of the publicly available DFIRM deliverable; estimated in 2013. According to NYC DEP, the DFIRM deliverable will include flood depth grids for the 10, 25, 50, 100 and 500-year recurrence intervals. The inundation from Hurricane Irene will be incorporated into the recurrence interval calculations. In addition the deliverable will include the ability to see the changes in the previous regulatory floodplains compared with the new/current floodplains. Once these depth grids are available, they can be incorporated into HAZUS and used to recalculate the potential losses to the Town's inventory for these recurrence intervals.

The preliminary Ulster County FEMA Flood Insurance Rate Maps were made available in PDF prior to the finalization of this plan to enable comparison of the estimated flood boundaries HAZUS-MH generated for the 1-percent and 0.2-percent annual chance flood events.

In the Hamlet of Phoenicia, the preliminary FEMA maps indicate a larger 1-percent and 0.2-percent annual chance floodplain north of Main Street and east of Route 24 when compared with the estimated HAZUS flood boundaries. The floodplains along the Esopus Creek, between Main Street and State Route 28, appear very similar.

In the Hamlet of Mt. Tremper, the estimated 1-percent flood boundaries generated by HAZUS are similar to the preliminary FEMA maps 1-percent annual probability floodplain. However, greater differences appear with the 0.2-percent annual chance flood boundaries where the HAZUS-generated area is smaller in some areas (e.g., near Hudler Road and State Route 28) and larger in others (e.g., along Mt Pleasant Road west of State Route 28).

For future plan updates, if digitized boundaries of dam inundation zones (extent/location) and water surface elevations are available, depth grids can be developed using LiDAR terrain data. These boundaries and depth grids can be incorporated into HAZUS-MH riverine flood model and run to estimate potential losses to population, buildings, utilities, infrastructure and shelter estimates generated. This data is generally available with the dam Emergency Action Plan. Once this data is available, the methodology outlined can be followed to estimate potential losses for the dam break hazard.Similar to the riverine flood hazard, using accurate building and infrastructure inventories for the dam failure hazard will create more accurate exposure and loss estimates.

SECTION 6: MITIGATION STRATEGIES

This section presents mitigation actions for the Town of Shandaken to reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) reviewed the Risk Assessment to identify and develop these mitigation actions, which are presented herein.

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as: revisions to and enforcement of building codes, revisions to land-use planning, training and education, and structural and nonstructural safety measures.

This section includes:

(1) Background and past mitigation accomplishments
(2) General mitigation planning approach
(3) Town mitigation goals and objectives (CRS Step 6)
(4) Town capability assessment
(5) Identification, analysis, and implementation of potential mitigation actions for each hazard (CRS Step 7)
(6) Proposed hazard mitigation actions (CRS Step 8)

This section addresses both mitigation actions that are specific to particular hazards, as well as those that apply to multiple hazards.

BACKGROUND AND PAST ACCOMPLISHMENTS

An overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and actions outlined in this HMP. Vulnerabilities include:

- **Hamlets:** Phoenicia, Mt. Tremper, Oliverea, Shandaken, Chichester
- **Roads:** Brown Road, Oliverea Road, Deer Lane, Woodland Valley Road in Oliverea; Main Street and Bridge Street, High Street, Plank Road and Station Road in Phoenicia
- **Bridges:** Main Street Bridge and Bridge Street Bridge in Phoenicia, Route 28 Bridge in Big Indian, and multiple bridges in Pine Hill.

  (Historically, there has been no loss of life but significant damage to structures and municipal infrastructure including roads and utilities have been experienced.)

FEMA defines ***Goals*** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.

FEMA defines ***Objectives*** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.

FEMA defines ***Mitigation Actions*** as specific actions that help to achieve the mitigation goals and objectives.

A list of flood inundation and erosion areas is provided below to indicate the areas of concern in the town.

Table 6.1 Inundation and erosion hazard areas (this table must be regularly updated to reflect changing stream conditions and available data).

Hamlet	Hazard Type	Issues	Priority
Phoenicia	Inundation	Main Street and Bridge Street (bridges), High Street (pump station), Plank Road, and Station Road	High
Chichester	Erosion	Stony Clove Creek (4 sites)	High
Mt. Pleasant/ Mt. Tremper	Inundation	Esopus Creek	High
	Erosion?*	Esopus Creek	Low
Oliverea	Inundation	Brown Road, Oliverea Road, and Deer Lane	High
	Erosion	Brown Road, McKinley Hollow, Maben Hollow, Little Peck Hollow	High
Woodland Valley	Inundation	Woodland Valley Road	Low
	Erosion	Systemic; Fawn Hill Road, Panther Kill, Muddy Brook	Med
Shandaken	Inundation	Route 42 Flood Control Structure	High
	Erosion	Route 42 and Bushnellsville Creek	Med
Allaben	inundation/Erosion	Fox Hollow and Wettje Road	Med
Bushnellsville	Erosion	High channelized	Low
Big Indian	Erosion	Route 28 (bridge)	Low
	Inundation	Church Street	
Pine Hill	Inundation	Multiple Roads (bridges)	Low
	Stormwater	Retrofit	High
	Erosion	Various infrastructure: Rock walls and historic bridges	
Highmount	Inundation	Potential threat with new impoundment	Low
Outside Hamlet	Erosion	Route 28 at Shandaken Tunnel	Med
Outside Hamlet	Erosion	Esopus Creek near Kinsey Road and Route 28	Low

Source: Town of Shandaken, 2013

* Post-flood cross-sections are needed to determine erosion risk related to sediment aggradation; there is a need to further explore sediment management areas throughout the watershed.

The Town, through previous and ongoing hazard mitigation actions, has demonstrated that it is pro-active in protecting its physical assets and citizens against losses from natural hazards.

Examples of previous and recent actions and projects include:

- Stony Clove Creek: Completion of channel modification in Phoenicia.
- Removal of bungalows at end of Fox Hollow Road along Esopus Creek after repeated flood damage
- Brown Road, Oliverea: Implementation of protective mitigation measures including installation of rock fill and planned re-vegetation; and the design of the Pine Hill stormwater retrofit which includes replacement of old stone tiles with stormwater conveyance.
- Woodland Valley Road: The Town is implementing three flood mitigation embankment projects.
- Townwide: The Town is supporting elevation and/or acquisition of flood prone structures in vulnerable hamlets including 39 properties targeted for post-Irene HMGP funding.

- Levees/Other Flood Control Structures: DEC and ACOE are evaluating restoration of the levees in Shandaken, Plank Road and Mt Tremper.
- The Ashokan Watershed Stream Management Program, in conjunction with the Town of Shandaken, has been actively evaluating projects to restore and mitigate damage from Hurricane Irene. Below are maps that summarize ongoing projects in the Town.

In addition, the Town is contemplating ordinances for increased code requirements for structures in floodplain, is actively preparing a flood warning and response plan, and is preparing to apply to the Community Rating System (CRS) to provide incentive to reduce flood vulnerability and reduce National Insurance Flood Program (NFIP) premiums.

These past and ongoing actions have contributed to the Town's understanding of its hazard preparedness and future mitigation action needs, costs, and benefits. These efforts provide a foundation for the SAFARI to use in developing this HMP.

GENERAL MITIGATION PLANNING APPROACH

The general mitigation planning approach used to develop this plan is based on four steps, which were used to support mitigation planning. These steps are summarized below and presented in more detail in the following sections.

- **Develop mitigation goals and objectives:** Mitigation goals were developed using the hazard characteristics, inventory, and findings of the risk assessment, and through the results of the public outreach program. By reviewing these outputs and other municipal and state policy documents, objectives tying to these overarching goals were identified and characterized into similar themes.

- **Identify and prioritize mitigation actions:** Based on the risk assessment outputs, the mitigation goals and objectives, existing literature and resources, and input from the participating entities, alternative mitigation actions were identified. The potential mitigation actions were qualitatively evaluated against the mitigation goals and objectives and other evaluation criteria. The mitigation capabilities within the Town (regulatory, administrative and fiscal) were assessed and considered in the selection and prioritization of appropriate, feasible actions. These actions were then prioritized into three categories: high, medium, and low.

- **Prepare an implementation strategy:** High priority mitigation actions are recommended for first consideration for implementation, as discussed under each hazard description in the following sections. However, based on community-specific needs and goals and available funding and costs, some low or medium priority mitigation actions may also be addressed or could be addressed before some of the high priority actions.

- **Document the mitigation planning process:** The mitigation planning process is documented throughout this plan.

FLOOD MITIGATION PLANNING GOALS AND OBJECTIVES

This section presents the hazard mitigation mission statement, planning goals, and objectives identified to reduce or avoid long-term vulnerabilities to the identified hazards.

From the Mission Statement and goals, objectives were identified, and the objectives were used in the selection and prioritization of recommended mitigation initiatives. These planning components all directly support one another. Mitigation initiatives were prioritized based on meeting multiple objectives.

Mission Statement

The mission of the Town of Shandaken's Flood Mitigation Plan (the Plan) is to develop and promote appropriate Town policy and practices to protect the residents, private property, public essential facilities and the environment from probable flood hazards.

Goals and Objectives:

The Town and the SAFARI eveloped these goals and objectives based on the risk assessment results, input received, and the existing authorities, policies, programs, resources, and capabilities within the Town, County and region. The mitigation goals serve as general guidelines that clarify desired hazard reduction outcomes. The goals represent a long-term vision for hazard reduction and the enhancement of mitigation capabilities.

The goals are compatible with the needs and goals expressed in other available community planning documents, including:

- New York State Hazard Mitigation Plan
- Ulster County Hazard Mitigation Plan
- Comprehensive Plan-Town of Shandaken, (2005)
- Upper Esopus Stream Management Plan (2007)
- Stony Clove Stream Management Plan (2005)

Each goal has a number of corresponding objectives that further define the specific actions or implementation steps. Objectives were developed and/or selected by the SAFARI hrough its knowledge of the local area, review of past efforts, findings of the risk assessment, qualitative evaluations, and identification of mitigation options.

The overall goal of the Plan is to improve the Town's capability to prepare for, respond to, recover from, mitigate against and reduce vulnerability to flooding. The plan identifies and encourages partnerships for coordinated implementation, funding, public awareness and the development of strategies for carefully planned mitigation efforts designed to protect the health, safety, quality of life, environment and economy of the Town of Shandaken.

The five mitigation goals with their respective objectives are presented below:

Goal 1. Protect Life and Property

- *Objective 1-1:* Protect the ongoing operation of critical facilities and infrastructure.
- *Objective 1-2:* Retrofit, purchase or relocate repetitive and severe repetitive loss assets in the Town.
- *Objective 1-3:* Encourage the establishment of policies to help ensure the prioritization and implementation of mitigation actions and/or projects designed to benefit essential facilities, services, and infrastructure.
- *Objective 1-4:* Implement mitigation actions that enhance the capabilities of the Town to better profile and assess exposure of floods.
- *Objective 1-5:* Better characterize flood/stormwater hazard events by conducting additional hazard studies and identify inadequate stormwater facilities and poorly drained areas and maintain or improve drainage or flood control systems.
- *Objective 1-6:* Develop, maintain, strengthen and promote enforcement of ordinances, regulations, plans and other mechanisms that facilitate hazard mitigation and result in a higher level of natural hazard risk reduction.
- *Objective 1-7:* Ensure that development is done according to modern and appropriate standards, including the consideration of natural hazard risk.
- *Objective 1-8*: Identify and pursue funding opportunities to develop and implement local flood mitigation activities.
- *Objective 1-9:* Address the specific needs of vulnerable populations

Goal 2. Increase Public Awareness and Preparedness

- *Objective 2-1:* Develop and implement program(s) to better understand the public's level of individual and household preparedness.
- *Objective 2-2:* Develop and implement additional education and outreach programs to increase public awareness of hazard areas and the risks associated with flooding, and to educate the public on specific, individual preparedness activities.
- *Objective 2-3:* Promote awareness among homeowners, renters, and businesses about obtaining insurance coverage available for flooding.
- *Objective 2-4:* Develop and implement programs to inform vulnerable property owners of appropriate mitigation activities and available funding programs.

- *Objective 2-5:* Provide information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.

Goal 3. Enhance Disaster Preparedness, Response and Recovery

- *Objective 3-1:* Encourage the establishment of policies to help ensure the prioritization and implementation of mitigation actions and/or projects designed to benefit essential facilities, services, and infrastructure.

- *Objective 3-2:* Where appropriate, coordinate and integrate hazard mitigation actions with existing local emergency operations plans.

- *Objective 3-3:* Identify the need for, and acquire, any special emergency services, training, equipment, facilities and infrastructure to enhance response capabilities for flooding.

- *Objective 3-4:* Review and improve, if necessary, emergency traffic routes; communicate such routes to the public and communities.

- *Objective 3-5:* Ensure continuity of governmental operations, emergency services, and essential facilities at the local level during and immediately after flood events.

- *Objective 3-6:* Maintain and expand shared services in acquiring, maintaining and providing emergency services and equipment.

Goal 4. Protect the Environment and Natural Resources

- *Objective 4-1:* Protect and restore natural lands and features that serve to mitigate losses (including wetlands, floodplains, stream corridors, hillsides and ridge lines). Such lands should be clearly mapped and identified for protection.

- *Objective 4-1*: Continue to preserve, protect and acquire open space, particularly in high hazard areas. Include hazard considerations into the prioritization strategy for land acquisition.

- *Objective 4-2*: Incorporate hazard considerations into land-use planning and natural resource management and encourage hazard mitigation measures that result in the least adverse effect on the natural environment.

Goal 5. Promote Mitigation Efforts through Existing Programs and Partnerships

- *Objective 5-1:* Maintain and expand shared services in acquiring, maintaining and providing emergency services and equipment.
- *Objective 5*-2: Strengthen inter-jurisdiction and interagency communication, coordination, and partnerships to foster hazard mitigation actions or projects.
- *Objective 5*-3: Maintain awareness of available funding and partnership opportunities
- *Objective 5*-4: Serve as a model for other communities.

The Town of Shandaken Capability Assessment

A capability assessment is an inventory of a community's missions, programs and policies; and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. It identifies, reviews and analyzes local and state programs, policies, regulations, funding and practices currently in place that may either facilitate or hinder mitigation.

A capability assessment was prepared by the Town. By completing this assessment, the Town learned how or whether they would be able to implement certain mitigation actions by determining the following:

- Types of mitigation actions that may be prohibited by law;
- Limitations that may exist on undertaking actions; and
- The range of local and/or state administrative, programmatic, regulatory, financial and technical resources available to assist in implementing their mitigation actions.
- Action is currently outside the scope of capabilities (e.g. funding)

Table 6-2 presents legal and regulatory capabilities. Table 6-3 presents the administrative and technical capabilities. Table 6-4 presents fiscal capabilities, and Table 6-5 presents the community classifications for the Town.

Table 6-2. Legal and Regulatory Capabilities

Regulatory Tools (Codes, Ordinances., Plans)	D you have this capability?	Local Authority (Y or N)	Prohibitions (State or Federal) (Y or N)	Higher Jurisdictional Authority (Y or N)	State Mandated (Y or N)	Code Citation (Section, Paragraph, Page Number, date of adoption)
1) Building Code	Y	N	N	N	N	New York State Code (IBC)
2) Zoning Ordinance	Y	N	N	N	N	Town, LOCAL LAW #2 December 1987, Chapter 116
3) Subdivision Ordinance	Y	Y	N	Y	Y	12/71 Subdivision Ordinance Section 105 Town Code
4) NFIP Protection Ordinance	Y	Y	Y	N	Y	9/9/87 Local Law #1, Chapter 77
5) Growth Management	N	N	N	N	N	
6) Floodplain Management / Basin Plan	N	Y	N	N	N	This plan will become the floodplain management plan of record for Shandaken once it is adopted by town.
7) Stormwater Management Plan/Ordinance	Y	Y	Y	Y	Y	Under NYC DEP Watershed Rules and Regulations, Stormwater Protection Plans are required for all building in the town
8) Comprehensive Plan / Master Plan	Y	Y	N	Y	Y	July 2005

Regulatory Tools (Codes, Ordinances., Plans)	D you have this capability?	Local Authority (Y or N)	Prohibitions (State or Federal) (Y or N)	Higher Jurisdictional Authority (Y or N)	State Mandated (Y or N)	Code Citation (Section, Paragraph, Page Number, date of adoption)
9) Capital Improvements Plan	N	N	N	N	N	
10) Site Plan Review Requirements	Y	N	N	N	N	Chapter 116 Article 8, Local Law #2 of 1997
11) Open Space Plan	Y	N	Y	N	N	Catskill Park State Land Master Plan (2008)
12) Stream Corridor Management or Protection Plan	Y	N	N	N	N	Esopus Creek Corridor Management and Protection, adopted by Town in 2008.
13) Economic Development Plan	N	N	Y	Y	N	
14) Emergency Response Plan	N	Y	Y	N	Y	Town is working on standardized response plan.
15) Post Disaster Recovery Plan	N	N	N	N	N	
16) Post Disaster Recovery Ordinance eq.	N	N	N	N	N	
17) Real Estate Disclosure	Y	N	N	N	N	NYS real estate law
18) Highway Management Plan	N	Y	N	N	N	
19) COOP/COG Plan	N	Y	N	N	N	Continuity of Operations, Continuity of Government
20) Other [Special Purpose Ordinances (i.e., critical or sensitive areas)]	Y	Y	Y	Y	N	NYC Watershed Regulations; NYS DEC, Town Zoning 116-29 and 41, Standards Within a Flood Fringe Overlay District (as mapped by FEMA). 1993

Table 6-3. Administrative and Technical Capabilities

Staff/ Personnel Resources	Available (Y or N)	Department/ Agency/Position
1) Planner(s) or Engineer(s) with knowledge of land development and land management practices	Y	Shandaken Planning Board
2) Engineer(s) or Professional(s) trained in construction practices related to buildings and/or infrastructure	Y	Knowledgeable Town staff: Supervisor, Building Inspector and Highway Superintendent
3) Planners or engineers with an understanding of natural hazards	Y	Town and County Planning Boards, AWSMP
4) NFIP Floodplain Administrator *	Y	Code Enforcement Officer
5) Surveyor(s) hired independently as needed	Y	Hired independently as needed
6) Personnel skilled or trained in "GIS" applications	Y	AWSMP, Ulster County Department of Planning
7) Scientist(s) familiar with natural hazards in the Town of Shandaken.	Y	AWSMP, NYSDEC
8) Emergency Manager	Y	Ulster County Emergency Coordinator; Town Civil Defense Coordinator, Fire Chiefs, Police, EMS; Incident Commander
9) Grant Writer(s)	Y	SHARP, RCAP Solutions, AWSMP, M-ARK Project
10) Staff with expertise or training in FEMA benefit/cost analysis	N	NYSOEM provides support

This plan was prepared with input and under the supervision of the Town of Shandaken NFIP Floodplain Administrator who participated as a member of SAFARI and had access to all documents for review and comment throughout the planning process.

Table 6-4. Fiscal Capabilities

Financial Resources	Accessible or Eligible to use (Yes/No/Don't know)
1) Community Development Block Grants (CDBG)	Yes
2) Capital Improvements Project Funding	Yes, DWSRF for Pine Hill Water District
3) Authority to Levy Taxes for specific purposes	Fire Districts, Water Districts, Lighting, Library
4) User fees for water, sewer, gas or electric service	Yes, water
5) Impact Fees for homebuyers or developers of new development/homes	No
6) Incur debt through general obligation bonds	Yes
7) Incur debt through special tax bonds	Yes
8) Incur debt through private activity bonds	No
9) Withhold public expenditures in hazard-prone areas	Yes
10) Government mitigation grant programs (e.g. NYSDEC, FEMA)	Yes
11) Other-Catskill Watershed Corporation (CWC)NRCS Emergency Watershed Protection (EWP), Ashokan Watershed Stream Management Program (AWSMP)	Yes

grants	

TBD = To be determined.

Table 6-5. Community Classifications

Program	Classification	Date Classified
Community Rating System (CRS)	NP	NA
Building Code Effectiveness Grading Schedule (BCEGS)	NP	NA
Storm Ready	NP	NA
Firewise	NP	NA
Public Protection (ISO) Classification	Class 7B	NA

NA = Not applicable. NP = Not participating. TBD = To be determined.

The classifications listed above relate to the community's effectiveness in providing services that may impact its vulnerability to the natural hazards identified. These classifications can be viewed as a gauge of the community's capabilities in all phases of emergency management (preparedness, response, recovery and mitigation) and are used as an underwriting parameter for determining the costs of various forms of insurance. The CRS class applies to flood insurance while the BCEGS and Public Protection classifications apply to standard property insurance. CRS classifications range on a scale of 1 to 10 with class one (1) being the best possible classification, and class 10 representing no classification benefit. Firewise classifications include a higher classification when the subject property is located beyond 1000 feet of a creditable fire hydrant and is within 5 road miles of a recognized Fire Station.

- Criteria for classification credits are outlined in the following documents:
- The Community Rating System Coordinators Manual
- The Building Code Effectiveness Grading Schedule
- The ISO Mitigation online ISO's Public Protection website at http://www.isomitigation.com/ppc/0000/ppc0001.html
- The National Weather Service Storm Ready website at http://www.weather.gov/stormready/howto.htm
- The National Firewise Communities website at http://firewise.org/

Identification, Prioritization, Analysis, and Implementation of Mitigation Actions

This subsection discusses the identification, prioritization, analysis and implementation of mitigation actions for the Town of Shandaken.

Mitigation Action Identification – Comprehensive Review of Mitigation Activities

On December 12, 2012, a Strengths, Weaknesses, Obstacles, and Opportunities workshop was conducted with stakeholders and the working group of SAFARI.The purpose of this session was to review information garnered from the risk assessment and the public involvement strategy to identify strengths, weaknesses, obstacles and opportunities in hazard mitigation within the Town through a facilitated brainstorming session on risks, vulnerabilities, and capabilities. All information shared during this session was documented and used to help screen a broad range of potential mitigation activities.

Mitigation Alternatives

By way of a facilitated session, the SAFARI was able to develop a mitigation catalog which includes a comprehensive list of mitigation actions to be considered that met the following objectives:

- Use information obtained from the public involvement strategy;
- Use information provided in the risk and vulnerability assessment;
- Seek mitigation actions consistent with the goals and objectives of this local Plan;
- Identify mitigation actions that are within the capabilities of the Town.

The SAFARI developed a catalog of flood hazard mitigation alternatives through a facilitated process with Town staff involved in floodplain management. A session held December 12, 2012 to look at local strengths, weaknesses, obstacles and opportunities was the basis for the alternatives considered as well as the mitigation initiatives selected for implementation. The catalog represents the comprehensive range of alternatives considered for complying with Step 7 of the CRS 10-step process. The SAFARI reviewed this catalog in conjunction with the findings of public outreach efforts and the risk assessment results. The catalog was enhanced based on this review and then used by Committee to select hazard mitigation initiatives.

The catalog of flood hazard mitigation alternatives was developed to represent a broad range of alternatives to be considered for use in the planning area (CRS Step 7). The mitigation alternatives are listed in Table 6-6 through Table 6-9. The catalog presents alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government.

Flood hazard mitigation initiatives recommended in this plan were selected from among the alternatives presented in the catalog. The catalog provides a baseline of mitigation alternatives that are backed by a planning process, are consistent with the goals and objectives, and are within the capabilities of the Town of Shandaken to implement. However, not all the alternatives meet all the selection criteria.

Selected Mitigation Initiatives

The Steering Committee determined that some initiatives from the flood hazard mitigation catalog could be implemented to provide flood hazard mitigation benefits. Table 10 lists the recommended initiatives, the lead agency for each, and the proposed timeline. The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

TABLE 6-6.
MITIGATION ALTERNATIVES TO MANIPULATE THE FLOOD HAZARD

Personal Scale	Corporate Scale	Government Scale
1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Maintain drainage system 2. Institute low-impact development techniques on property 3. Sediment management and debris removal and providing regional retention areas 4. Streambank protection 5. Stormwater management regulations and master planning 6. 7. Strategize responsible land protection methods to maintain/restore natural floodplain functions

TABLE 6-7.
MITIGATION ALTERNATIVES TO REDUCE EXPOSURE TO THE FLOOD HAZARD

Personal Scale	Corporate Scale	Government Scale
1. Locate outside of hazard area 2. Elevate utilities above base flood elevation 3. Institute low impact development techniques on property	1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property	1. Locate or relocate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote flood-compatible land uses in identified high hazard areas via techniques such as: community education;natural resource inventory; comprehensive planning; zoning provisions; floodplain protection ordinance; and the environmental review process.. 4. Adopt appropriate land development criteria 5. Institute low impact development techniques on property 6.

TABLE 6-8.
MITIGATION ALTERNATIVES TO REDUCE VULNERABILITY TO THE FLOOD HAZARD

Personal Scale	Corporate Scale	Government Scale
1. Retrofit structures (elevate structures above base flood elevation) 2. Elevate items within house above base flood elevation 3. Build new homes above base flood elevation 4. Flood-proof existing structures	1. Build redundancy for critical functions or retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains	1. Participate in CRS 2. Implement as-built regulatory requirements 3. Implement site review ordinances/requirements 4. Harden infrastructure, bridge replacement program 5.. Provide redundancy for critical functions and infrastructure 6. Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. 7. Stormwater management regulations and master planning. 8. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities. 9. Update existing regulations to account for the impacts of climate change as flooding is becoming more frequent and severe.

TABLE 6-9.
MITIGATION ALTERNATIVES TO INCREASE PREPARATION CAPABILITY

Personal Scale	Corporate Scale	Government Scale
1. Buy flood insurance 2. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event 3. Comply with NFIP requirements	1. Keep cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits. 4. Develop a flood response plan	1. Participate in CRS 2. Produce better hazard maps- Create flood hazard identification maps that reflect future conditions including the probable impacts from sedimentation and climate change. 3. Develop codes and standards for bridges and culverts 4. Increase radio communication capability in Town 5. Require appropriate municipal officials to get floodplain management education and certification. 6. Implement/participate in regional precipitation monitoring networks. 7. Provide technical information and guidance 8. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 9. Incorporate retrofitting or replacement of critical system elements in capital improvement plan 10. Utilize post-disaster assistance 11. Warehouse critical infrastructure components 12. Develop and adopt a continuity of operations plan (COOP) 13. Consider participation in the Community Rating System 15. Maintain existing data and gather new data needed to define risks and vulnerability 16. Train emergency responders 17. Identify critical facilities/infrastructure that require early notification during flood responses 18. Create a levee failure response plan 19. Enhance flood threat recognition capability 20. Create a building and elevation inventory of structures in the floodplain 21. Develop and implement a public information strategy 22. Integrate floodplain management policies into other planning mechanisms within the planning area. 23. Consider the residual risk associated with structural flood control in future land use decisions 24. Enforce National Flood Insurance Program requirements 26. Capture/survey high water marks after flood events.

The list of potential mitigation actions identified for this planning process, include a range of options in line with the six types of mitigation actions including:

1. **Prevention:** (planning and zoning, storm water management)
2. **Property Protection:** (retrofitting, insurance. relocation, elevation)
3. **Public Education and Awareness:** (maps, outreach projects, technical assistance and training)
4. **Natural Resource Protection:** (erosion control, wetlands protection, floodplain protection)
5. **Emergency Services:** (flood warning, flood response, critical facilities protection)
6. **Structural Projects:** (stream channel modifications, storm sewers, bridge or culvert sizing)

Though this exercise, the SAFARI was able to identify a baseline of appropriate mitigation actions backed by a planning process, consistent with the goals and objectives of the planning area, and within the capabilities of the Town. Many of the strategies identified, such as community outreach, could be applied to multiple hazards. Actions that were not selected by the Town were not selected based on the following:

- Action is not feasible
- Action is currently outside the scope of capabilities
- Action is not in line with established community goals and vision
- Action is not considered cost-effective
- Action is already being implemented

Mitigation Actions

On February 20, 2013, the SAFARI conducted a meeting to work through the hazard mitigation catalog. The resulting mitigation strategy is provided in Table 6-10 below.

Mitigation actions are activities designed to reduce or eliminate losses resulting from natural hazards.

A series of mitigation actions were identified by the Town. These actions are summarized in Table 6-10 along with the hazards mitigated, goals and objectives met; lead agency, estimated cost, potential funding sources and the proposed timeline are identified. The parameters for the timeline are as follows:

- Short Term = To be completed in 1 to 5 years
- Long Term = To be completed in greater than 5 years
- Ongoing = Currently being funded and implemented under existing programs.

Benefit/Cost Review

Section 201.6.c.3iii of 44CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. The Town was asked to weigh the estimated benefits of a project versus the estimated costs to establish a parameter to be used in the prioritization of a project.

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-1—Continue to maintain compliance and good standing with the programmatic requirements of the National Flood Insurance Program.						
Floodplain Administrator/Code Official Town Supervisor/DPW/FPA/CEO	Department budgets	Low/Medium	Ongoing	1-3, 1-4, 1-6, 1-7, 4-3	Prevention	H
FMI-2—Expand watershed and multi-stakeholder coordination efforts and seek inter-local agreements or other contractual relationships in support of achieving long-term comprehensive flood risk reduction solutions.						
	Department Budgets/AWSMP	Low	Ongoing	1-4, 5-2	Prevention	L/M
FMI-3—Form a flood warning sub-committee of SAFARI to identify alternate methods of flood recognition for the Town of Shandaken and to expand on the warning system. Potential topics could include additional stream gage locations, support of gage automation at specific sites, installation of precipitation monitoring stations, formation of volunteer spotters corps.						
SAFARI, Town Supervisor, AWSMP	AWSMP/ Town Budget	Low	short term	1-3, 1-4, 5-2	Prevention	M/H
FMI-4—Assist AWSMP to create a flood model to provide data on potential stream migration and sediment locations along waterways. This will provide a basis for future flood mitigation and streambank stabilization measures. Map the channel migration zones for all rivers in the region and the extent of high quality riparian habitat.						
AWSMP	Grants/AWSMP	Medium	short-term	1-3, 1-4, 1-5	Prevention	H
FMI-5—Invest in flood prediction and forecast modeling to support all facets of the Town of Shandaken floodplain management program, including but not limited to flood hazard identification, flood threat recognition in support of flood notification programs, climate change adaptation, and risk assessment.						
Town of Supervisor	Department Budgets / Grants/AWSMP	Medium	short-term	1-4, 3-1, 3-3	Prevention	L
FMI-6—Develop codes and standards for existing and new culverts/bridges in Town including bridges on privately owned property.						
Code Official, Supervisor	Department budget	Medium	short term	1-1, 1-3, 1-6, 1-7	Prevention	TOWN H PRIVATE L
FMI-7—Create an inventory and establish a priority list for culvert replacement that takes into account flood depth reduction and future losses avoided.						
Town DPW	Department Budget	Low	short term	1-1, 1-3, 3-1	Prevention	H
FMI-8—Utilizing the best available data, science and technology, enhance the existing flood notification program, striving to identify a notification protocol that has real-time flood threat recognition capability.						
Emergency Management	Department Budget / Grants	Medium	short term	1-9, 3-3	Prevention	M (TIED TO FM6)
FMI-9—Utilizing the best available data, science and technology, maintain and enhance (including input of pending Digital Flood Insurance Rate Maps (DFIRMs) the user-defined HAZUS-MH model that was constructed to support this planning effort, as data becomes available and utilize the DFIRM flood depth grids to calculate estimated potential future losses to structures and critical facilities.						
Emergency Management	Department Budgets	Medium	short term	1-3, 3-1	Prevention	L/M
FMI-10—Develop a post-flood disaster action plan that establishes protocols for the Town such as substantial damage determination, the recording of perishable data (such as high water marks), grant support, staffing, continuity of operations, and recovery.						
Emergency Management /Public Works	Department Budgets / Grant	Medium	short term	1-1, 1-4, 3-1	Prevention	H

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-11—Finalize and adopt a town-wide Flood Response Plan						
Town Supervisor/Emergency Management	Grants	Low	short term	1-9, 2-2, 3-3, 3-5	Prevention	H
FMI-12—Work with the Town departments responsible for implementation and maintenance of the Town's current and future infrastructure to identify flood hazard mitigation projects that are eligible for hazard mitigation grants. Once projects are identified, pursue grant funding for those projects shown to be cost-effective.						
Town Supervisor/DPW	Department Budgets	Low	short term	1-1, 1-3, 1-8	Prevention	M
FMI-13— Establish a link between the Town of Shandaken Flood Hazard Mitigation Plan and the Ulster County All-Hazards Mitigation Plan. The Flood Hazard Mitigation Plan will become the flood hazard component of the Natural Hazards Mitigation Plan upon its next update. All future updates to the two plans will occur on the same planning cycle upon plan integration.						
FPA/Emergency Management	Department Budgets, Grants,	Low	short term	4-3	Prevention	M
FMI-14—Draft a prioritized list of Town road segments and bridges that should be elevated above the 100-year floodplain and culverts that will fail under flood flow. Upgrade these structures if state or federal funds become available.						
DPW	CIP, Grants	Low	short term	1-1 1-3, 1-4	Prevention	M
FMI-15—Where feasible, consider the adoption of appropriate higher regulatory standards (including but not limited to freeboard, compensatory floodwater storage, lower substantial damage thresholds, setbacks and fill restrictions) as means to reduce future flood risk and support a no-adverse-impact philosophy of floodplain management.						
Town Supervisor, GPA	Department Budgets, Grants	Low	short-term	1-3, 1-6, 1-7	Prevention	M
FMI-16— Maintain relationship with AWSMP						
Town Supervisor	Department Budgets	Low	Long-term	5-2	Prevention	H
FMI-17—Support AWSMP's continued prioritization of riverine erosion hazard areas, especially hill slope failures and stream bank erosion areas in order to evaluate stream management feasibility.						
Town Board/FPA	Operating Budget/AWSMP	Low	Short-term	1-4, 5-2	Prevention	H
FMI-18—Participate in the Community Rating System (CRS) to further manage flood risk and reduce flood insurance premiums for NFIP policyholders. This shall start with the submission to FEMA-DHS of a Letter of Intent to join CRS, followed by the completion and submission of an application to the program once the community's current compliance with the NFIP is established.						
Town Supervisor/DPW/FPA	Operating Budget	Medium	Short-term	1-1, 1-3, 2-2, 2-3, 2-4, 2-5	Prevention	H
FMI-19— Determine if a Community Assistance Visit (CAV) or Community Assistance Contact (CAC) is needed, and schedule if needed.						
Town Supervisor/DPW/FPA	Operating Budget	Low	Short-term	5-2	Prevention	M (SEE 18)
FMI-20—Inventory monuments; obtain recommendations from local surveyors for sites for additional monuments in the area to reduce the costs of elevation certificates.						
Town Supervisor/DPW/FPA	Operating Budget	Low	Short-term	1-3, 1-7, 1-8	Prevention	H (TIED TO 65C)
FMI-21— Require and archive elevation certificates for floodplain -related building and zoning permits.						
Town Supervisor/DPW	Operating Budget	Low	Short-term	1-4, 1-7, 1-9	Prevention	H
FMI-22— Evaluate, adopt or amend local land use laws that prevent inappropriate development in areas of high flood risk and foster uses that are compatible with the anticipated flooding conditions.						
Town Supervisor/DPW/FPA	Operating Budget	Low	Short-term	1-6, 4-3	Prevention	H
FMI-23— Integrate a strong emphasis on stream corridor management in the municipal comprehensive plan, site plan review laws, zoning and other appropriate local ordinances.						

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
Town Supervisor/Planning	Operating Budget	Low	Short-term	1-6, 4-3, 5-2	Prevention	L/M
FMI-24— Facilitate development of a flood damage reporting system to track types of flooding, their location and the associated costs. Database development should attempt to collect records on past floods to get started; all flooding damages should be reported even if localized. Program will require training, and administrative support to insure success.						
Town Supervisor/DPW/FPA	Operating Budget/AWSMP	Low	Short-term	1-3, 1-4	Prevention	L
FMI-25— Continue to support the implementation, monitoring, maintenance, and updating of Flood Plan.						
Town Supervisor/DPW/FPA	Operating Budget	Low	Short-term	all	Prevention	M
FMI-26— Update the Town of Shandaken's general building stock inventory in HAZUS-MH with the new assessor's data which was not available in electronic format at the time this Plan was written.						
Town Supervisor/DPW/FPA	Operating Budget	Low-Medium	Short-term	1-3, 3-1	Prevention	L/M
FMI-27— Support the continued improvement of the Upper Esopus Creek hydraulics and hydrology models.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget/AWSMP	Low	Short-term	1-3, 1-5, 5-2	Prevention	M
FMI-28— Support local sustainability of a watershed management organization and other working groups, eg SAFARI and Highway Management Group.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget/AWSMP	Low	Short-term	5-2	Prevention	H
FMI-29— Continue to participate in the CWC Stormwater Retrofits Grant Program to address stormwater quality issues.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget	Low	Short-term	1-8, 5-2	Prevention	M
FMI-30— Participate in future flood hazard mitigation funding programs at CWC and AWSMP.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget	Low	Short-term	1-8, 5-2	Prevention	M/H
FMI-31—Support continued characterization of flooding and erosion hazards in the tributary streams to the Esopus that have not been previously assessed.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget/AWSMP	medium	Short-term	1-3, 1-5, 5-2	Prevention	M
FMI-32—Support AWSMP in providing streamside landowners and others detailed technical information on the establishment and maintenance of riparian buffers and Continue to Support/promote long term riparian buffer protection for municipal properties and infrastructure.						
Town Supervisor//FPA	AWSMP	Low	Short-term	4-1, 4-3	Prevention	M
FMI-33— Make stream side landowners and local timber harvesters who practice forest harvest aware of the opportunity to participate in the NYC Watershed Forestry Program (WFP) to ensure that timber harvesting operations use appropriate methods to reduce or eliminate impacts to the riparian buffer and improve its condition whenever possible.						
Town Supervisor//FPA	Operating Budget	Low	Short-term	2-2, 2-4	Prevention	L (NOT MUCH LOGGING HAPPENING)
FMI-34— Encourage a community education campaign for recreational safety on the Esopus Creek. Support the placement of information kiosks at common put-in and take-out locations as a means to share pertinent information about the location of hazards.						
Town Supervisor/ UC Dept of Env	Operating Budget/ Ulster County	Low	Short-term	2-2	Prevention	L/M
FMI-35—Require NFIP Floodplain Administrator (FPA) become a Certified Floodplain Manager through the ASFPM, and pursue relevant continuing education training such as FEMA Benefit-Cost Analysis.						
Town Supervisor//FPA	Operating Budget	Low	Short-term	1-3, 1-7	Prevention	H

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-36— Support periodic training sessions on flood related issues for municipal leaders, code enforcement staff, and planning boards.						
Town Board/Town Supervisor//FPA	Operating Budget/AWSMP	Low	Short-term	1-3, 5-2	Prevention	M
FMI-37— Integrate geomorphology principles in all new town projects and routine maintenance activities related to the stream system. Support trainings in stream management for highway department staff and other resource managers.						
Town Supervisor//FPA/DPW	Operating Budget/AWSMP	Low	Short-term	1-3, 1-4, 1-7	Prevention	M (ALREADY DOING THIS)
FMI-38— Continue to work on improving municipal communications network to provide complete coverage of the Town. Ensure redundancy of Town communications capabilities. Review annually.						
Emergency Services, Ulster County	Operating Budget, HLS Grants/EMPG/SHSP	Low	Short-term	3-3, 3-5, 5-2	Prevention	H
FMI-39— Request NYSEG personnel at EOC for all disasters. Set up dedicated contacts from utilities including NYSEG, Verizon and Time Warner.						
Emergency Services	Operating Budget	Low	Short-term	3-2, 5-2	Prevention	H
FMI-40— Conduct Town pre-disaster planning meeting(s), defining EOC roles and anticipated response.						
Town Supervisor//Emergency Services	Operating Budget	Low	Short-term	3-3, 3-4, 3-5	Prevention	M (ALREADY DO PART OF NIMS)
FMI-41— Streamline procedure for updating County Emergency Management of emergency activities and infrastructure damages (power, phone, road closures etc.)						
Town Supervisor//Emergency Services	Operating Budget/EMPG/SHSP	Low	Short-term	3-3, 3-5, 5-2	Prevention	H
FMI-42— Ensure dedicated phone line for town emergency management communications.						
Town Supervisor/Emergency Services	Operating Budget/EMPG/SHSP	Low	Short-term	3-3	Prevention	H
FMI-43— Craft strategy to ensure redundancy of emergency public communications capabilities. Investigate automatic emergency notifications via phone.						
Town Supervisor/Emergency Services	Operating Budget/EMPG/SHSP	Low	Short-term	3-2, 3-3, 5-2	Prevention	M
FMI-44— Create/enhance/ maintain mutual aid agreements with neighboring communities for continuity of operations and eligibility for FEMA reimbursements.						
Town Supervisor/Emergency Services	Operating Budget/EMPG/SHSP	Low	Short-term	1-8, 5-1, 5-2	Prevention	M
FMI-45— Identify and develop agreements with entities that can provide support with FEMA/SOEM paperwork after disasters; ensure qualified damage assessment capabilities and personnel – Improve post-disaster capabilities – damage assessment; FEMA/SOEM paperwork compilation, submissions, record-keeping.						
Town Supervisor/Emergency Services	Operating Budget, FEMA grants/EMPG/SHSP	Low	Short-term	5-2	Prevention	L (HAVE A LOT IN PLACE ALREADY)
FMI-46— Pursue all pre-disaster funding through FEMA Section 404.						
Town Supervisor/FPA/DPW	Operating Budget	Low	Short-term	1-1, 1-8	Prevention	H

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-47— Pursue all post-disaster funding through FEMA Section 406.						
Town Supervisor/FPA/DPW	Operating Budget	Low	Short-term	1-2, 1-8	Prevention	H
FMI-48— Facilitate biannual \notification to landowners who have special flood hazard areas (SFHA) located on their property.						
Town Supervisor//FPA	Operating Budget/EMPG/SHSP	Low	Short-term	2-2, 2-3, 2-5	Prevention	L/M
FMI-49— Enable command center call-in capability to Birch Creek, Stony Clove, Woodland Valley, Allaben and any newly established USGS gages.						
Town Supervisor/FPA/AWSMP	Operating Budget/EMPG/SHSP	medium	Short-term	1-4, 1-8, 3-3, 5-2	Prevention	H
FMI-50— Support new town-wide weather data collection stations as part of the flash flood warning system.						
Town Supervisor//FPA/AWSMP	Operating Budget	Low	Short-term	1-4, 1-8, 3-3, 5-2	Prevention	M/H
FMI-51— Explore funding for town-wide weather stations.						
Town Supervisor/FPA	Operating Budget, CWC funds/AWSMP/ OTHERS	Low	Short-term	1-8	Prevention	M/H
FMI-52— Work with AWSMP on flood emergency preparedness for residents.						
Town Supervisor/FPA	Operating Budget	Low	Short-term	2-2, 5-2	Prevention	H
FMI-53— Ensure regularly scheduled releases of flood emergency info, e.g. periodic, not ad hoc						
Town Supervisor//FPA	Operating Budget/EMPG/SHSP	Low	Short-term	2-2, 2-3, 2-4, 2-5	Prevention	H (PART OF CRS ALREADY)
FMI-54— Maintain generators; hard wire installation at all town buildings especially EOC and all fire houses						
Town Supervisor/DPW/Emergency Management	Operating Budget/EMPG/SHSP	medium	Short-term	1-1, 3-3, 3-5	Prevention	H
FM-55-floodproof or relocate critical town facilities.						
Town Supervisor//FPA	Operating Budget/FEMA, HLS grants	high	ShortLong-term	1-1, 1-2, 1-8	Prevention	L/M
FMI-56— Create, and conduct an annual inventory of, an emergency equipment box including lap tops, cell phones, walkie talkies, portable battery charger, list of emergency equipment and plan of attack should be on the computer and thumb drives. Explore funding – list items, cost out, apply for FEMA planning money.						
Town Supervisor/FPA/Emergency Management	Operating Budget/ FEMA, EMPG, HLS grants	Low-medium	Short-term	1-1, 3-3, 3-5	Prevention	M
FMI-57— Improve preparedness activities for care of town-sheltered dogs. Construct an emergency kennel on higher ground.						
Emergency Services	Operating Budget/ASPCA grants	Low	ShortLong-term	3-3, 5-2	Prevention	M
FMI-58— Work with regional agencies (i.e. County and SOEM) to help develop damage assessment capabilities at the local level through such things as training programs, certification of qualified individuals (e.g. code officials, floodplain managers, engineers).						

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
Town Supervisor/FPA	Operating Budget	Low	Short-term/ ongoing	3-3, 5-2	Prevention	L/M (ONGOING)
FMI-59— Ensure that command staff, department heads and elected officials are up to date on their NIMS training through FEMA.						
Town Supervisor/Emergency Services	Operating Budget	Low	Short-term/ ongoing	3-3, 5-2	Prevention	H
FMI-60— Create strategy for pre-emergency parking to prevent storm isolation.						
Town Supervisor/Emergency Services	Operating Budget	Low	Short-term	3-2, 3-4	Prevention	L/M
FMI-61— Create priority list of emergency evacuation zones and a notification and action procedure.						
Town Supervisor/Emergency Services	Operating Budget/EMPG/SHSP	Low	Short-term	3-2, 3-4	Prevention	H
FMI-62— Identify and explore sheltering at government and non-government locations.						
Town Supervisor/Emergency Services	Operating Budget	Low	Short-term	3-2, 3-4	Prevention	L/M (PRETTY SOLID NOW)
FMI-63— Explore designation of Belleayre as a State/ regional shelter.						
Town Supervisor/Emergency Services	Operating Budget, American Red Cross	Low	Short-term	3-2	Prevention	H
FMI-64— Incorporate appropriate specialized individuals into town EOC staff (e.g. technical assistance from AWSMP).						
Town Supervisor/Emergency Services	Operating Budget	Low	Short-term	1-3, 3-3	Prevention	H
FMI-65—Identify properties that are potential candidates for elevation, relocation or buyout based on an evaluation of flood risks, project feasibility, and planned flood risk reduction capital projects. A list of targeted high-priority acquisitions should be prepared and annually updated. An example of a high-priority project would be a property identified by FEMA as a repetitive loss property. Once the list is established, pursue funding opportunities to implement the projects.						
Town Supervisor/Flood Plain Administrator (FPA)	HMGP/Community Development Block Grant / Federal Grants	Med	Short-term, Ongoing	1-2, 1-8	Property Protection	M (ONGOING)
FMI-65a--Support the acquisition of the 39 properties identified for post-Irene HMGP funding						
Town Supervisor/FPA	HMGP/Community Development Block Grant / Federal Grants	Low	Short-term, Ongoing	1-2, 1-8	Property Protection	H
FMI-65b--Implement public outreach to floodprone property owners to document interest in participating in acquisition or elevation projects.						
Town Supervisor/FPA	HMGP/Town Operating Budget	Low	Short-term, Ongoing	2-2, 2-4, 2-5	Property Protection	L/M
FMI-66—To support initiative # FMI-1, undertake a Repetitive Loss Area Analysis to determine the following: • Repetitive losses not captured by flood insurance data • Causes of the repetitive flooding • Assets impacted by the repetitive flooding (this would include assets such as livestock, out-buildings and rescue costs not already identified by FEMA) • Possible alternatives to remediate the repetitive flooding						
Town Supervisor, FPA	Department Budgets, Grants	Medium	long term, depends on funding	1-3, 1-5	Property Protection	L

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-67— Pursue demolition of vacant/abandoned structures in town that are subject to environmental hazards such as mold.						
DPWCEO	Grants	Medium	long term	1-2, 1-6	Property Protection	M
FMI-68—Using the best available data on flood risk, conduct outreach to property owners to alert them to the risks and ways to deal with them, to inform them about potential opportunities to mitigate the risks, and to assess their interest in participation should funding be available. Property owners who are interested in participating in one of these programs should be informed that having flood insurance might help qualify them for funding assistance.						
Town Supervisor/FPA	Town Operating Budget	Low	Ongoing	2-1, 2-2, 2-4, 2-5	Public Education	H (CRS OUTREACH)
FMI-69—Advocate for educational services and programs to town residents to explain the basics of stream processes and the effect that human influences have on streams.						
AWSMP/Town Supervisor	Town operating budget/AWSMP	Low	Short	2-2	Public Education	H
FMI-70—Continue to develop and implement an annual public outreach strategy that seeks to leverage public information resources and capabilities within the town.						
Town Supervisor/Emergency Management	Department Budget	Low	Ongoing	2-1, 2-2, 2-3, 2-4, 2-5	Public Education	18 (CRS RELATED)
FMI-71— Add tab to Town website to provide information to watershed stakeholders. Upgrade site to allow landowners interaction such as reporting stream changes, problems etc.						
Town Supervisor	Operating Budget	Low	Short-term	2-2, 2-3, 2-4, 2-5	Public Education	L/M
FMI-72—Where streambanks are being restored, explore opportunities to reestablish floodplain connectivity to improve flood water retention while simultaneously creating or restoring floodplain habitat.						
AWSMP/FPA	Grants /AWSMP	Medium-High	Short-term	1-4, 4-1, 5-2	Natural Resource Protection	L
FMI-73— Support the creation of and assist in utilizing a document that describes appropriate best stream management practices in the Ashokan watershed for emergency stream work.						
Town Board/AWSMP	Operating Budget/AWSMP	Low	Short-term	1-5, 1-7, 4-1	Natural Resource Protection	L/M
FMI-74— Utilize wetland inventory as provided by DEC to preserve flood retention capacity in the basin.						
Town Board/FPA	Operating Budget/DEC	Low	Short-term	4-1, 4-1, 4-2	Natural Resource Protection	L/M
FMI-75— Encourage and support AWSMP's physical stream monitoring program (e.g. cross sections, longitudinal profiles etc) to assist in evaluating pre- and post-flood stream conditions.						
DPW/FPA	Operating Budget/AWSMP	Low	Short-term	1-4	Natural Resource Protection	H
FMI-76— Encourage implementation of successful stream projects as verified by AWSMP'S stream monitoring program.						
Town Supervisor/DPW/FPA	Operating Budget/AWSMP/GRANTS	Low	Short-term	1-8, 4-1, 4-1, 5-2	Natural Resource Protection	M/H

TABLE 6-10.
ACTION PLAN—FLOOD MITIGATION INITIATIVES (FMI)

Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-77— Encourage control of invasive species, particularly Japanese knotweed, during riparian construction projects.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget/AWSMP	Low	Short-term	4-1	Natural Resource Protection	L/M
FMI-78— Manage vegetation on critical areas such as roadside ditches and steep slopes; encourage multi-agency and public collaboration.						
Town Supervisor/DPW/FPA/ AWSMP	Operating Budget	Medium	Short-term	4-1, 5-2	Natural Resource Protection	L/M
FMI-79—Support Ulster County in implementing improved radio communication system for Town.						
Emergency Management / Public Works	Emergency Management funds/Grants-HLS/EMPG/SHSP	Low	short term	3-3, 5-2	Emergency Services	H
FMI-80—Update the Town emergency response plan to reflect any changes to flood notification protocol within the Town.						
Emergency Management	Department Budget / Grant-HLS/EMPG/SHSP	Low	short term	1-9, 3-2	Emergency Services	L (AS NEEDED)
FMI-81— Provide follow-up Community Emergency Response Team (CERT) coordination.						
Emergency Management	Grants/Town/EMPG/SHSP	Low	ongoing	3-1, 3-3	Emergency Services	L
FMI-82—. Address evacuation by planning, developing, and providing signage and information regarding evacuation routes						
Emergency Management	Fees and Grants/EMPG/SHSP	Medium	short term	3-4	Emergency Services	L/M
FMI-83- Designate emergency parking to accommodate evacuee vehicles in town.						
Emergency Management	Operating Budget	Low	Short-term	3-4	Emergency Services	L/M (SEE 86)
FMI-84—Coordinate/integrate and maintain a swift water rescue team with Sheriff and fire company						
Emergency Management	Operating Budget/AFG	Low-medium	Short-term	3-3	Emergency Services	H (ALREADY EXISTS)
FMI-85—Advocate an active monitoring program for large woody debris (LWD) that focuses upon the identification and removal of debris that poses a flood hazard to infrastructure and a threat to human welfare. Identify sites for clearing and snagging to prevent woody debris build up.						
Town Board/FPA	Operating Budget	Medium	Short-term	4-1	Structural Projects	M
FMI-86— Evaluate options to alleviate aggregation of sediment at the Bridge Street bridge in Phoenicia. Options to include economic impact of loss of bridge to local economy.						
DPW, AWSMP	Department Budget, CWC grant	Medium	short term	1-1, 1-5	Structural Projects	H

AWSMP –Ashoken Watershed Stream Management Program
EMPG-Local Emergency Management Performance Grant
SHSP-State Homeland Security Grant Program
PASP-Public Safety Answering Point Consolidation, Improvements, and Enhancements Grant
AFG-Assistance to Firefighters Grant

HMPG-Hazard Mitigation Grant Program
HMA-hazard Mitigation Assistance Program
NYSEFP_NY State Environmental Facilities Corporation Grants
NYDRC-New York Department of Environmental Conservation Grants.
ASPCA-Association for the Prevention of Cruelty to Animals Grants

This benefit/cost review was qualitative; that is, it did not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. This qualitative approach was used because projects may not be implemented for up to 10 years, and the associated costs and benefits could change dramatically in that time. Each project was assessed by assigning subjective ratings (high, medium, and low) to its costs and benefits, described in Table 6-7.

Costs: The project cost for each mitigation initiative was reasonably estimated (including preliminary engineering, engineering, design, construction). Costs are presented as follows: Low = < $10,000; Medium = $10,000 to $100,000; High = > $100,000. Where actual project costs could not be reasonably established at this time, a best estimate was provided:

- Low = Possible to fund under existing budget. Project is part of, or can be part of an existing on-going program.
- Medium = Could budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- High = Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Benefits: Mitigation benefits are future damages and losses that would be eliminated and/or reduced by implementing the proposed mitigation project. When possible, benefits (e.g., physical damages, loss of service or function, emergency management costs, etc.) associated with the project were identified. The benefits value noted (in dollars) is the expected avoided damages and is presented as: Low = < $10,000; Medium = $10,000 to $100,000; High = > $100,000. Where benefits are not quantifiable, a best estimate was provided:

- Low: Long term benefits of the project are difficult to quantify in the short term.
- Medium: Project will have a long-term impact on the reduction of risk exposure to life and property, or project will provide an immediate reduction in the risk exposure to property.
- High: Project will have an immediate impact on the reduction of risk exposure to life and property.

Table 6-11. Project Assessment

Costs	
High	Project cost is =>$100,000 or if unknown, existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	Project cost is $10,000 to $100,000 or if unknown, the project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project cost is <$10,000 or if unknown, the project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project mitigation benefits are => $100,000 or if unknown, the project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project mitigation benefits are $10,000 to $100,000 or if unknown, the project will have a

Costs	
	long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Project mitigation benefits are< $10,000 or if unknown, the long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. For some of the County initiatives identified, the Town may seek financial assistance under FEMA's HMGP or PDM programs. Both of these programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA BCA model process. The SAFARIs committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the SAFARI reserves the right to define "benefits" according to parameters that meet its needs and the goals and objectives of this plan.

Prioritization:

Section 201.c.3.iii of 44 CFR requires an action plan describing how the actions identified will be prioritized. The SAFARI, along with their contract consultant, developed a prioritization methodology for the Plan that meets the needs of the Town while at the same time meeting the requirements of Section 201.6 of 44 CFR. The mitigation actions identified were prioritized according to the criteria defined below.

- **High Priority:** A project that meets multiple plan goals and objectives, benefits exceed cost, has funding secured under existing programs or authorizations, or is grant-eligible, and can be completed in 1 to 5 years (short-term project) once project is funded.
- **Medium Priority:** A project that meets at least one plan goal and objective, benefits exceed costs, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in 1 to 5 years once project is funded.
- **Low Priority:** A project that will mitigate the risk of a hazard, benefits exceed costs, funding has not been secured, and project is not grant-eligible and/or timeline for completion is considered long-term (5 to 10 years).

It should be noted that these priority definitions are considered to be dynamic and can change from one category to another based on changes to a parameter such as availability of funding. For example, a project might be assigned a medium priority because of the uncertainty of a funding source. This priority could be changed to high once a funding source has been identified such as a grant. The prioritization schedule for this Plan will be reviewed and updated as needed annually through the plan maintenance strategy described in Section 7 of this Plan.

Table 6-8 presents the results of applying the prioritization methodology presented to the set of mitigation actions identified by the Town, and includes the following prioritization parameters:

- Number of goals/objectives met by the initiative
- Benefits of the project (high, medium, or low)
- Cost of the project (high, medium, or low)
- Do the benefits equal or exceed the costs?

- Is the project grant-eligible?
- Can the project be funded under existing programs and budgets?
- Priority (high, medium, or low)

The Town's mitigation action implementation strategy includes:

- Mitigation actions for individual and multiple hazards
- Mitigation goals/objectives supported by each action.
- Implementation priority
- Potential funding sources for the mitigation action (grant programs, current operating budgets or funding, or the agency or jurisdiction that will supply the funding; additional potential funding resources are identified).
- Estimated budget for the mitigation action (financial requirements for new funding or indication that the action is addressed under current operating budgets)
- Time estimated to implement and complete the mitigation action
- Existing policies, programs, and resources to support implementation of the mitigation action (additional policies, programs, and resources identified)

Specific mitigation actions were identified to prevent future losses; however, current funding is not identified for all of these actions at present. The Town has limited resources to take on new responsibilities or projects. The implementation of these mitigation actions is dependent on the approval of the local elected governing body and the ability of the community to obtain funding from local or outside sources. Where such actions are high priorities, the community will work together with NYSOEM, FEMA and other Federal, State and County agencies to secure funds.

In general, mitigation actions ranked as high priorities will be addressed first. However, medium or even low priority mitigation actions will be considered for concurrent implementation. Therefore, the ranking levels should be considered as a first-cut, preliminary ranking and will evolve based on input from the Town departments and representatives, municipal government departments and representatives, the public, municipal government departments and representatives, NYSOEM, and FEMA as the Plan is implemented.

Table 6-12. Prioritization of Mitigation Initiatives

Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
FMI-1	3	M	L/M	Y	N	N	H
FMI-2	2	M	L	Y	N	Y-AWSMP*	L/M
FMI-3	3	M	L	Y	N	N	M/H
FMI-4	3	M	M	Y	Y	N-AWSMP*	H
FMI-5	3	M	M	Y	Y	Y-AWSMP*	L
FMI-6	4	H	M	Y	N	N	TOWN H; PRIVATE L
FMI-7	3	H	L	Y	N	N	H
FMI-8	2	M	M	Y	Y	N	M (TIED TO FM6)
FMI-9	2	M	L	Y	N	N	L/M
FMI-10	3	M	M	Y	Y	N	H
FMI-11	4	M	L	Y	N	N	H
FMI-12	3	M	L	Y	N	N	M
FMI-13	1	M	L	Y	N	Y HMGP, PDM	M
FMI-14	3	H	L	Y	Y	N	M
FMI-15	3	H	L	Y	N	N	M
FMI-16	1	H	L	Y	N	N	H
FMI-17	2	L	L	Y	N	N	H
FMI-18	6	M	M	Y	N	N	H
FMI-19	1	L	L	Y	N	N	M (SEE 18)
FMI-20	3	M	L	Y	N	N	H (TIED TO 1C)
FMI-21	3	M	L	Y	N	N	H
FMI-22	2	H	L	Y	N	N	H
FMI-23	3	L	L	Y	N	N	L/M
FMI-24	2	M	L	Y	N	N	L
FMI-25	ALL	M	L	Y	N	N	M
FMI-26	2	M	M	Y	N	N	L/M
FMI-27	3	L	L	Y	N	N	M
FMI-28	1	M	L	Y	N	N	H
FMI-29	2	M	L	Y	N	N	M
FMI-30	2	M	L	Y	N	N	M/H
FMI-31	3	M	M	Y	N	N	M
FMI-32	2	L	L	Y	N	N	M
FMI-33	2	L	L	Y	N	N	L (NOT MUCH LOGGING HAPPENING)
FMI-34	1	M	L	Y	N	Y (HMGP, PDM)	L/M
FMI-35	2	H	L	Y	N	Y-AWSMP*	H
FMI-36	2	M	L	Y	N	Y-AWSMP*	M
FMI-37	3	M	L	Y	N	Y-AWSMP*	M(ALREADY DOING THIS)
FMI-38	3	H	L	Y	N	N	H

Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
FMI-39	2	M	L	Y	N	N	H
FMI-40	3	M	L	Y	N	N	M (ALREADY DO –PART OF NIMS)
FMI-41	3	M	L	Y	N	N	H
FMI-42	1	H	L	Y	N	N	H
FMI-43	3	H	L	Y	N	N	M
FMI-44	3	H	L	Y	N	N	M
FMI-45	1	M	L	Y	Y	N	L (HAVE A LOT IN PLACE ALREADY)
FMI-46	2	H	L	Y	N	N	H
FMI-47	2	H	L	Y	N	N	H
FMI-48	3	L	L	Y	N	N	L/M
FMI-49	4	M	M	Y	N	N	H
FMI-50	4	M	L	Y	N	N	M/H
FMI-51	1	M	L	Y	Y	N	M/H
FMI-52	2	M	L	Y	N	Y-AWSMP*	H
FMI-53	4	M	L	Y	N	N	H (PART OF CRS OUTREACH)
FMI-54	3	H	M	Y	N	N	H
FMI-55	3	H	H	Y	Y	N	L/M
FMI-56	3	H	L/M	Y	Y	N	M
FMI-57	2	M	L	Y	Y	N	M
FMI-58	2	H	L	Y	N	N	L/M (ONGOING)
FMI-59	2	H	L	Y	N	N	H
FMI-60	2	H	L	Y	N	N	L/M
FMI-61	2	H	L	Y	N	N	H
FMI-62	2	M	L	Y	N	N	L/M (pretty solid now)
FMI-63	1	H	L	Y	N	N	H
FMI-64	2	M	L	Y	N	N	H
						N	
FMI-65	2	H	M	Y	Y	Y HMPG, PDM	M, ONGOING
FMI-65a	2	H	L	Y	Y	Y HMPG, PDM	H
FMI-65b	3	H	L	Y	N	Y HMPG, PDM	L/M
FMI-66	2	H	M	Y	Y	N	L
FMI-67	2	H	M	Y	Y	N	M
FMI-68	4	M	L	Y	N	Y-AWSMP*, HMPG, PDM	H (CRS OUTREACH)
FMI-69	1	M	L	Y	N	Y-AWSMP*, HMPG, PDM	H
FMI-70	5	M	L	Y	N	Y HMPG, PDM	18(CRS

Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
							RELATED)
FMI-71	4	L	L	Y	N	N	L/M
FMI-72	3	M/H	M/H	Y	Y	N	L
FMI-73	3	M	L	Y	N	N	L/M
FMI-74	3	L	L	Y	N	N	L/M
FMI-75	1	L	L	Y	N	N	H
FMI-76	4	M	L	Y	N	N	M/H
FMI-77	1	L	L	Y	N	N	L/M
FMI-78	2	L	L	Y	N	N	L/M
FMI-79	2	H	L	Y	Y	N	H
FMI-80	2	M	L	Y	Y	N	L (AS NEEDED)
FMI-81	2	M	L	Y	N	N	L
FMI-82	1	M	M	Y	N	N	L/M
FMI-83	1	M	L	Y	N	N	L/M(SEE 86)
FMI-84	1	H	L/M	Y	N	N	H(ALREADY EXISTS)
FMI-85	1	M	M	Y	N	N	M
FMI-86	2	M	M	Y	Y	Y-AWSMP*	H

Notes: H = High. L = Low. M = Medium. N = No. N/A = Not applicable. Y = Yes. TBD = To Be Determined.
HMPG-Hazard Mitigation Grant Program
PDM-Pre-Disaster Mitigation Program
AWSMP-Ashoken Watershed Stream Management Program

*"Yes" indicates the strategy is likely to fall within the objectives of the 2014-2019 SMIP grant program. Does not indicate a project will automatically be funded.

SECTION 7: PLAN MAINTENANCE PROCEDURES

This chapter presents a plan maintenance process that includes the following (CRS Step 10):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

The plan maintenance strategy is the formal process that will ensure that the flood hazard mitigation plan remains an active and relevant document and that The Town of Shandaken maintains its eligibility for applicable funding sources. It includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. The strategy also describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

Plan Implementation

The effectiveness of the flood hazard mitigation plan depends on its implementation and incorporation of its action items into existing local plans, policies and programs. Together, the action items in the Plan provide a framework for activities that The Town of Shandaken can implement over the next 5 years. The planning team and SAFARI have established goals and objectives and have prioritized mitigation initiatives that will be implemented through existing plans, policies, and programs.

The Town of Shandaken SAFARI committee will have lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) Planning Committee

SAFARI is a total volunteer body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. This committee had a broad composition of stakeholders including municipal officials, residents, federal, state, and local agencies. It was the committee's position that an oversight committee with representation similar to that of SAFARI should have an active role in the Plan maintenance strategy. Therefore, it is recommended that SAFARI remain a viable body involved in key elements of the Plan maintenance strategy. The preparation of future updates of this plan will be benefited by keeping this committee intact.

The principal role of SAFARI in this plan maintenance strategy will be to review the annual progress report and provide input to the Town of Shandaken Planning Board on possible enhancements to be considered at the next update. It will be the role of SAFARI to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

Annual Progress Report

The minimum task of the ongoing annual steering committee meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any flood hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

The planning team has created a template for preparing a progress report (see Appendix D). The plan maintenance steering committee will provide feedback to the planning team on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Town website page dedicated to the flood hazard mitigation plan
- Provided to the local media through a press release
- Presented to the Town of Shandaken Board to inform them of the progress of mitigation initiatives implemented during the reporting period
- Provided as part of the CRS annual re-certification package. The CRS requires an annual recertification to be submitted by October 1 of every calendar year for which the community has not received a formal audit. To meet this recertification timeline, the planning team will strive to complete progress reports between June and September each year.

Annual progress reporting is credited under CRS Step 10.

Plan Update

The Town of Shandaken intends to update the flood hazard mitigation plan on a 5-year cycle from the date of initial plan adoption (CRS Step 10). This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of The Town of Shandaken comprehensive plan.

It will not be the intent of future updates to develop a complete new flood hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.

- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The Town of Shandaken Board will adopt the updated plan.

It is the Town of Shandaken's intention to fully integrate this Flood Hazard Mitigation Plan into the Ulster County All-Hazard Mitigation Plan at some time. This will allow for a uniform update cycle for both plans and eliminate redundant planning.

Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Town of Shandaken website and by providing copies of annual progress reports to the media. The website will not only house the final plan, it will become the one-stop shop for information regarding the plan and plan implementation. Copies of the plan will be distributed to the Town of Shandaken library. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from SAFARI. This strategy will be based on the needs and capabilities of the Town of Shandaken at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Town of Shandaken Comprehensive Plan is considered to be an integral part of this plan. Town of Shandaken, through adoption of a flood damage protection ordinance, has planned for the impact of flooding. The plan development process provided the opportunity to review and expand on policies in these planning mechanisms. The comprehensive plan and the flood hazard mitigation plan are complementary documents that work together to achieve the goal of reducing risk exposure. An update to a comprehensive plan may trigger an update to the flood hazard mitigation plan.

The Town of Shandaken will create a linkage between the flood hazard mitigation plan and the comprehensive plan by identifying a mitigation initiative as such and giving that initiative a high priority.

Other planning processes and programs to be coordinated with the recommendations of the flood hazard mitigation plan include the following:

- Ulster County All Hazard Mitigation Plan
- Emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

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This resource defines terms that are used in or support the risk assessment document. These definitions were based on terms defined in documents included in the reference section, with modifications as appropriate to address the Village of Scarsdale specific definitions and requirements.

100-year flood – A flood that has a 1-percent chance of being equaled or exceeded in any given year. This flood event is also referred to as the base flood. The term "100-year flood" can be misleading; it is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Therefore, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management to determine the need for flood insurance.

500-year flood – A flood that has a 0.2-percent chance of being equaled or exceeded in any one year.

Aggregate Data – Data gathered together across an area or region (for example, census tract or census block data).

Annualized Loss – The estimated long-term value of losses from potential future hazard occurrences of a particular type in any given single year in a specified geographic area. In other words, the average annual loss that is likely to be incurred each year based on frequency of occurrence and loss estimates. Note that the loss in any given year can be substantially higher or lower than the estimated annualized loss.

Annualized Loss Ratio – Represents the annualized loss estimate as a fraction of the replacement value of the local building inventory. This ratio is calculated using the following formula: Annualized Loss Ratio = Annualized Losses / Exposure at Risk. The annualized loss ratio gauges the relationship between average annualized loss and building value at risk. This ratio can be used as a measure of relative risk between hazards as well as across different geographic units

Asset – Any man-made or natural feature that has value, including but not limited to people, buildings, infrastructure (such as bridges, roads, and sewer and water systems), and lifelines (such as electricity and communication resources or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks).

At-Risk – Exposure values that include the entire building inventory value in census blocks that lie within or border the inundation areas or any area potentially exposed to a hazard based on location.

Base Flood – Flood that has a 1-percent probability of being equaled or exceeded in any given year. It is also known as the 100-year flood.

Base Flood Elevation (BFE) – Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The BFE is used as the standard for the National Flood Insurance Program.

Benefit – Net project outcomes, usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of conducting a benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including a reduction in expected property losses (building, content, and function) and protection of human life.

Benefit-cost analysis (BCA) – Benefit-cost analysis is a systematic, quantitative method of comparing the projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building – A structure that is walled and roofed, principally aboveground and permanently fixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Building Codes – Regulations that set forth standards and requirements for construction, maintenance, operation, occupancy, use, or appearance of buildings, premises, and dwelling units. Building codes can include standards for structures to withstand natural disasters.

Capability Assessment – An assessment that provides a description and analysis of a community or state's current capacity to address the threats associated with hazards. The capability assessment attempts to identify and evaluate existing policies, regulations, programs, and practices that positively or negatively affect the community or state's vulnerability to hazards or specific threats.

Community Rating System (CRS) – CRS is a program that provides incentives for National Flood Insurance Program communities to complete activities that reduce flood hazard risk. When the community completes specific activities, the insurance premiums of these policyholders in communities are reduced.

Comprehensive Plan – A document, also known as a "general plan", covering the entire geographic area of a community and expressing community goals and objectives. The plan lays out the vision, policies, and strategies for the future of the community, including all of the physical elements that will determine the community's future development. This plan can discuss the community's desired physical development, desired rate and quantity of growth, community character, transportation services, location of growth, and siting of public facilities and transportation. In most states, the comprehensive plan has no authority in and of itself, but serves as a guide for community decision-making.

Critical Facility – Facilities that are critical to the health and welfare of the population and that are especially important following a hazard. Critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities. As defined for the Village of Scarsdale risk assessment, this category includes police stations, fire and/or EMS stations, major medical care facilities and emergency communications.

Debris – The scattered remains of assets broken or destroyed during the occurrence of a hazard. Debris caused by a wind or water hazard event can cause additional damage to other assets.

Digital Elevation Model (DEM) – U.S. Geological Survey (USGS) Digital Elevation Model (DEM) data files that are digital representations of cartographic information in a raster form. DEMs include a sampled array of elevations for a number of ground positions at regularly spaced intervals. These digital cartographic/geographic data files are produced by USGS as part of the National Mapping Program.

Digital Flood Insurance Rate Maps (DFIRMs) – These maps are used to calculate the cost insurance premiums, establish flood risk zones and base flood elevations to mitigate against potential future flood damages to properties.

Displacement Time – After a hazard occurs, the average time (in days) that a building's occupants must operate from a temporary location while repairs are made to the original building due to damages resulting from the hazard.

Disaster Mitigation Act of 2000 (DMA 2000) – Law that requires and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening state-wide mitigation planning.

Duration – The length of time a hazard occurs.

Essential Facility – A facility that is important to ensure a full recovery of a community or state following the occurrence of a hazard. These facilities can include: government facilities, major employers, banks, schools, and certain commercial establishments (such as grocery stores, hardware stores, and gas stations). For the Village of Scarsdale risk assessment, this category was defined to include schools, colleges, shelters, adult living and adult care facilities, medical facilities and health clinics, hospitals.

Exposure – The number and dollar value of assets that are considered to be at risk during the occurrence of a specific hazard.

Extent – The size of an area affected by a hazard or the occurrence of a hazard.

Flood Depth – Height of the flood water surface above the ground surface.

Flood Elevation – Height of the water surface above an established datum (for example, the National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or mean sea level).

Flood Hazard Area – Area shown to be inundated by a flood of a given magnitude on a map.

Flood Insurance Rate Map (FIRM) – Map of a community, prepared by the FEMA that shows both the special flood hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) – A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

Flood Mitigation Assistance (FMA) Program – A program created as a part of the National Flood Insurance Report Act of 1994. FMA provides funding to assist communities and states in implementing actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other NFIP insurance structures, with a focus on repetitive loss properties.

Floodplain – Any land area, including a watercourse, susceptible to partial or complete inundation by water from any source.

Flood Polygon – A geographic information system vector file outlining the area exposed to the flood hazard. HAZUS-MH generates this polygon at the end of the flood computations in order to analyze the inventory at risk.

Frequency – A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1-percent chance of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Goals – General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term in nature, and represent global visions.

Geographic Information Systems (GIS) – A computer software application that relates data regarding physical and other features on the earth to a database to be used for mapping and analysis.

GIS Shape Files – A type of GIS vector file developed by ESRI for their ArcView software. This type of file contains a table and a graphic. The records in the table are linked to corresponding objects in the graphic.

Hazard – A source of potential danger or an adverse condition that can cause harm to people or cause property damage. For this risk assessment, priority hazards were identified and selected for the pilot project effort. A natural hazard is a hazard that occurs naturally (such as flood, wind, and earthquake). A man-made hazard is one that is caused by humans (for example, a terrorist act or a hazardous material spill). Hazards are of concern if they have the potential to harm people or property.

Hazards of Interest – A comprehensive listing of hazards that may affect an area.

Hazards of Concern – Those hazards that have been analytically determined to pose significant risk in an area, and thus the focus of the particular mitigation plan for that area (a subset of the Hazards of Interest).

Hazard Identification – The process of identifying hazards that threaten an area.

Hazardous Material Facilities – Facilities housing industrial and hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.

Hazard Mitigation – Sustained actions taken to reduce or eliminate the long-term risk and effects that can result from the occurrence of a specific hazard. For example, building a retaining wall can protect an area from flooding.

Hazard Mitigation Grant Program (HMGP) – Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Flood/Hazard Mitigation Plan – A collaborative document in which flood hazards affecting the community are identified, vulnerability to hazards assessed, and consensus reached on how to minimize or eliminate the effects of these hazards.

Hazard Profile – A description of the physical characteristics of a hazard, including a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.

Hazard Risk Gauge – The graphic icon used during the initial planning process to convey the relative risk of a given hazard in the study area. The scale ranges from green indicating relatively low or no risk to red indicating severe risk.

Hazards U.S. – Multi-Hazard (HAZUS-MH) – A GIS-based nationally standardized earthquake, flood, and wind loss estimation tool developed by FEMA. The purpose of this pilot project is to demonstrate and implement the use of HAZUS-MH to support risk assessments

HAZUS-MH Risk Assessment Methodology – This analysis uses the HAZUS-MH modules (earthquake, wind--hurricane and flood) to analyze potential damages and losses. For this pilot project risk assessment, the flood and hurricane hazards were evaluated using this methodology.

HAZUS-MH-Driven Risk Assessment Methodology – This analysis involves using inventory data in HAZUS-MH combined with knowledge such as (1) information about potentially exposed areas, (2) expected impacts, and (3) data regarding likelihood of occurrence for hazards. For this risk assessment, a HAZUS-Driven Risk Assessment Methodology could not be used to estimate losses associated with any hazards because of a lack of adequate data. However, the methodology was used, based on more limited data to estimate exposure for the dam failure, urban fire, fuel pipeline breach, and HazMat release hazards.

High Potential Loss Facilities – Facilities that would have a high loss associated with them, such as nuclear power plants, dams, and military installations.

Hydraulics – That branch of science, or of engineering, which addresses fluids (especially, water) in motion, its action in rivers and canals, the works and machinery for conducting or raising it, its use as a prime mover, and other fluid-related areas.

Hydrology – The science of dealing with the waters of the earth (for example, a flood discharge estimate is developed through conduct of a hydrologic study).

Infrastructure – The public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, transportation system (such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams).

Intensity – A measure of the effects of a hazard occurring at a particular place.

Inventory – The assets identified in a study region. It includes assets that can be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Level 1 Analysis – A HAZUS-MH analysis that yields a rough estimate or preliminary analysis based on the nationwide default database included in HAZUS-MH. A Level 1 analysis is a great way to begin the risk assessment process and prioritize high-risk communities without collecting or using local data.

Level 2 Analysis – A HAZUS-MH analysis that requires the input of additional or refined data and hazard maps that will produce more accurate risk and loss estimates. Assistance from local emergency management personnel, city planners, GIS professionals, and others may be necessary for this level of analysis.

Level 3 Analysis – A HAZUS-MH analysis that yields the most accurate estimate of loss and typically requires the involvement of technical experts such as structural and geotechnical engineers who can modify loss parameters based on the specific conditions of a community. This level analysis will allow users to supply their own techniques to study special conditions such as dam breaks and tsunamis. Engineering and other expertise is needed at this level.

Lifelines – Critical facilities that include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways).

Loss Estimation – The process of assigning hazard-related damage and loss estimates to inventory, infrastructure, lifelines, and population data. HAZUS-MH can estimate the economic and social loss for specific hazard occurrences. Loss estimation is essential to decision making at all levels of government and provides a basis for developing mitigation plans and policies. It also supports planning for emergency preparedness, response, and recovery.

Lowest Floor – Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure. For the HAZUS-MH flood model, this information can be used to assist in assessing the damage to buildings.

Magnitude – A measure of the strength of a hazard occurrence. The magnitude (also referred to as severity) of a given hazard occurrence is usually determined using technical measures specific to the hazard. For example, ranges of wind speeds are used to categorize tornados.

Major Disaster Declarations – Post-disaster status requested by a state's governor when local and state resources are not sufficient to meet disaster needs. It is based on the damage assessment, and an agreement to commit state funds and resources to the long-term recovery. The event must be clearly more than the state or local government can handle alone.

Mean Return Period (MRP) – The average period of time, in years, between occurrences of a particular hazard (equal to the inverse of the annual frequency of exceedance).

Mitigation Actions – Specific actions that help you achieve your goals and objectives.

Mitigation Goals – General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term, and represent global visions.

Mitigation Objectives – Strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Mitigation Plan – A plan that documents the process used for a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in a state or community. The plan includes a description of actions to minimize future vulnerability to hazards. This plan should be developed with local experts and significant community involvement.

National Flood Insurance Program (NFIP) – Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 Code of Federal Regulations (CFR) §60.3.

Objectives – Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Occupancy Classes – Categories of buildings used by HAZUS-MH (for example, commercial, residential, industrial, government, and "other").

Ordinance – A term for a law or regulation adopted by local government.

Outflow – Associated with coastal hazards and follows water inundation creating strong currents that rip at structures and pound them with debris, and erode beaches and coastal structures.

Parametric Model – A model relating to or including the evaluation of parameters. For example, HAZUS-MH uses parametric models that address different parameters for hazards such as earthquake, flood and wind (hurricane). For example, parameters considered for the earthquake hazard include soil type, peak ground acceleration, building construction type and other parameters.

Planimetric – Maps that indicate only man-made features like buildings.

Planning – The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

Post-disaster mitigation – Mitigation actions taken after a disaster has occurred, usually during recovery and reconstruction.

Presidential Disaster Declaration – A post-disaster status that puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities in the areas of human services, public assistance (infrastructure support), and hazard mitigation. If declared, funding comes from the President's Disaster Relief Fund and disaster aid programs of other participating federal agencies.

Preparedness – Actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Priority Hazards – Hazards considered most likely to impact a community based on frequency, severity, or other factors such as public perception. These are identified using available data and local knowledge.

Provided Data – The databases included in the HAZUS-MH software that allow users to run a preliminary analysis without collecting or using local data.

Probability – A statistical measure of the likelihood that a hazard event will occur.

Public Education and Outreach Programs – Any campaign to make the public more aware of hazard mitigation and mitigation programs, including hazard information centers, mailings, public meetings, etc.

Recovery – The actions taken by an individual or community after a catastrophic event to restore order and lifelines in the community.

Regulation – Most states have granted local jurisdictions broad regulatory powers to enable the enactment and enforcement of ordinances that deal with public health, safety, and welfare. These include building codes, building inspections, zoning, floodplain and subdivision ordinances, and growth management initiatives.

Recurrence Interval – The average time between the occurrences of hazardous events of similar size in a given location. This interval is based on the probability that the given event will be equaled or exceeded in any given year.

Repetitive Loss Property – A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1,000 each have been paid within any 10-year period since 1978.

Replacement Value – The cost of rebuilding a structure. This cost is usually expressed in terms of cost per square foot and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.

Resolutions – Expressions of a governing body's opinion, will, or intention that can be executive or administrative in nature. Most planning documents must undergo a council resolution, which must be supported in an official vote by a majority of representatives to be adopted. Other methods of making a statement or announcement about a particular issue or topic include proclamations or declarations.

Resources – Resources include the people, materials, technologies, money, etc., required to implement strategies or processes. The costs of these resources are often included in a budget.

Risk – The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment – A methodology used to assess potential exposure and estimated losses associated with priority hazards. The risk assessment process includes four steps: (1) identifying hazards, (2) profiling hazards, (3) conducting an inventory of assets, and (4) estimating losses. This pilot project report documents this process for selected hazards addressed as part of the pilot project.

Risk Factors – Characteristics of a hazard that contribute to the severity of potential losses in the study area.

Riverine – Of or produced by a river (for example, a riverine flood is one that is caused by a river overflowing its banks).

Scale – A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.

Scour – Removal of soil or fill material by the flow of floodwaters. This term is frequently used to describe storm-induced, localized, conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

Special Flood Hazard Area (SFHA) – An area within a floodplain having a 1-percent or greater chance of flood occurrence in any given year (that is, the 100-year or base flood zone); represented on FIRMS as darkly shaded areas with zone designations that include the letter "A" or "V."

Stafford Act – The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law (PL) 100-107 was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.

Stakeholder – Stakeholders are individuals or groups, including businesses, private organizations, and citizens, that will be affected in any way by an action or policy.

State Hazard Mitigation Officer (SHMO) – The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

Structure – Something constructed (for example, a residential or commercial building).

Study Area – The geographic unit for which data are collected and analyzed. A study area can be any combination of states, counties, cities, census tracts, or census blocks. The study area definition depends on the purpose of the loss study and in many cases will follow political boundaries or jurisdictions such as city limits.

Substantial Damage – Damage of any origin sustained by a structure in a SFHA, for which the cost of restoring the structure to its pre-hazard event condition would equal or exceed 50 percent of its pre-hazard event market value.

Topographic – Map that shows natural features and indicate the physical shape of the land using contour lines based on land elevation. These maps also can include man-made features (such as buildings and roads).

Transportation Systems – One of the lifeline system categories. This category includes: airways (airports, heliports, highways), bridges, tunnels, roadbeds, overpasses, transfer centers; railways (tracks, tunnels, bridges, rail yards, depots), and waterways (canals, locks, seaports, ferries, harbors, dry docks, piers).

Utility Systems – One of the lifeline systems categories. This category includes potable water, wastewater, oil, natural gas, electric power facilities and communication systems.

Vulnerability – Description of how exposed or susceptible an asset is to damage. This value depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. If an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect affects can be much more widespread and damaging than direct affects.

Vulnerability Assessment – Evaluation of the extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard occurrences on the existing and future built environment.

Watershed – Area of land that drains down gradient (from areas of higher land to areas of lower land) to the lowest point; a common drainage basin. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves downstream, eventually reaching an estuary, lake, or ocean.

Zone – A geographical area shown on a National FIRM that reflects the severity or type of flooding in the area.

Zoning Ordinance – Designation of allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.