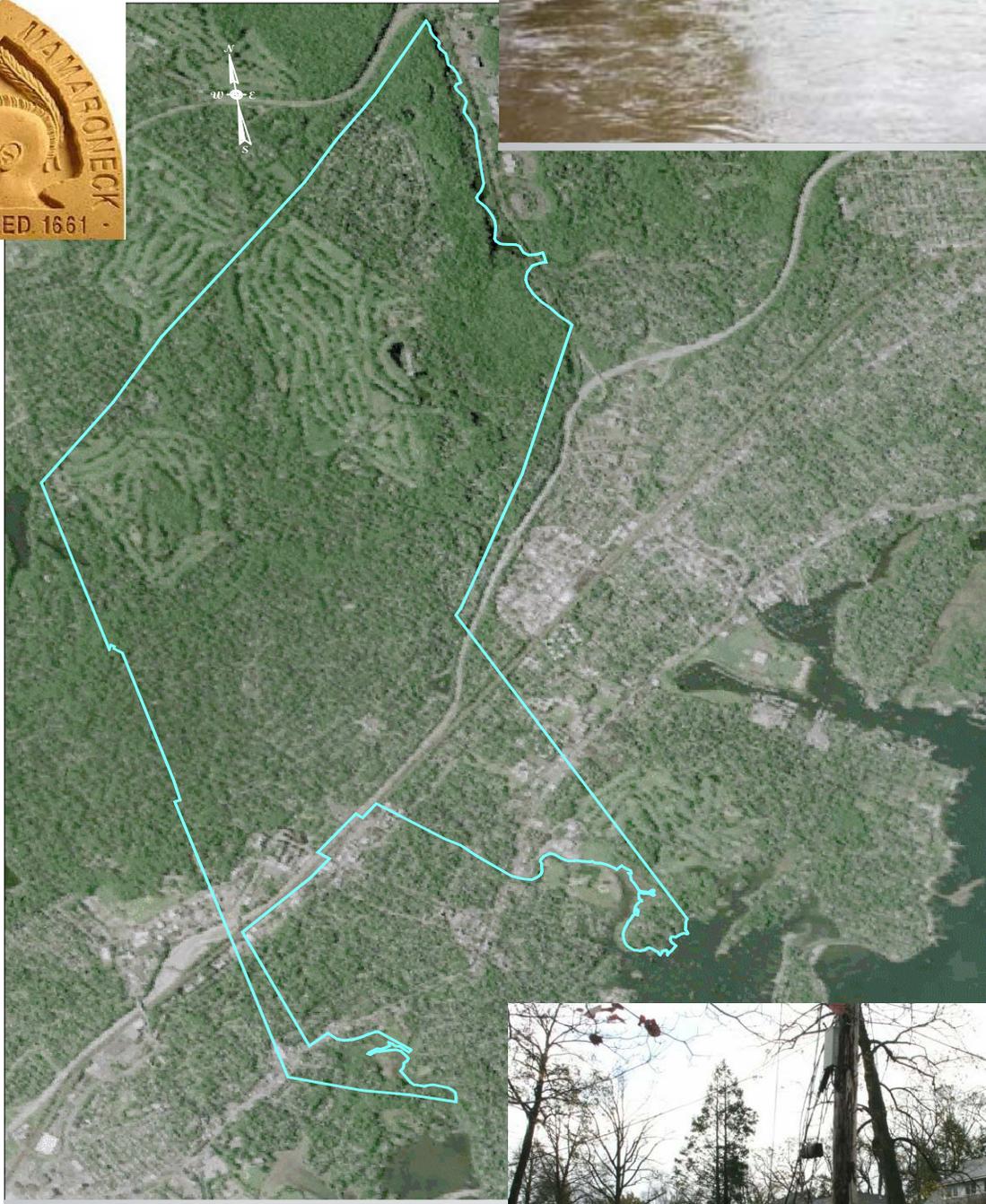


**TOWN OF MAMARONECK,
NEW YORK**

December 2013

**DRAFT 1
MULTI-HAZARD MITIGATION PLAN**



PREPARED BY:



**Environmental
Technology
Group, Inc.**

300 WHEELER ROAD, SUITE 202, HAUPPAUGE, NEW YORK 11788

TOWN OF MAMARONECK, NEW YORK

DRAFT 1

MULTI-HAZARD MITIGATION PLAN

December 6, 2013

Submitted to

Town of Mamaroneck

740 West Boston Post Road

Mamaroneck, New York 10543

Prepared By



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Town of Mamaroneck, NY Multi-Hazard Mitigation Plan

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Town of Mamaroneck

Multi-hazard Mitigation Plan

Executive Summary

Summary Statement

This Multi-Hazard Mitigation Plan is for the jurisdiction of the Town of Mamaroneck, Westchester County, New York (See Figure 0-1). This Plan identifies and assesses natural and manmade hazards that could adversely impact the community. It proposes feasible mitigation activities for the Town, which could reduce the impacts of an identified hazard. The Plan follows the Federal Emergency Management Administration (FEMA) guidance for developing hazard mitigation plans.

Background Information

The Town of Mamaroneck, New York, was officially created on May 17, 1788. The Town includes all of the Village of Larchmont, the portion of the Village of Mamaroneck situated west of the Mamaroneck River bordering Rye Neck, and the Unincorporated area. The incorporated Villages and the Town are all self-governing, yet they define the Town as a political and governmental subdivision of New York State.

This Hazard Mitigation Plan will focus on the Unincorporated area of the Town, which is bordered by the Village of Larchmont and Long Island Sound to the South; the Village of Mamaroneck, Town of Rye, and Town of Harrison to the East; Village of Scarsdale to the North; and the City of New Rochelle to the West (See Figure 0-2).

The Unincorporated Town of Mamaroneck (The Town) has a population of 11,977 (2010 Census). The Town has a temperate coastal climate with an average high July temperature of 84.5 degrees Fahrenheit. The average minimum temperature in January is 22.23 degrees. The average annual rainfall is 42.27 inches. (www.homefacts.com).

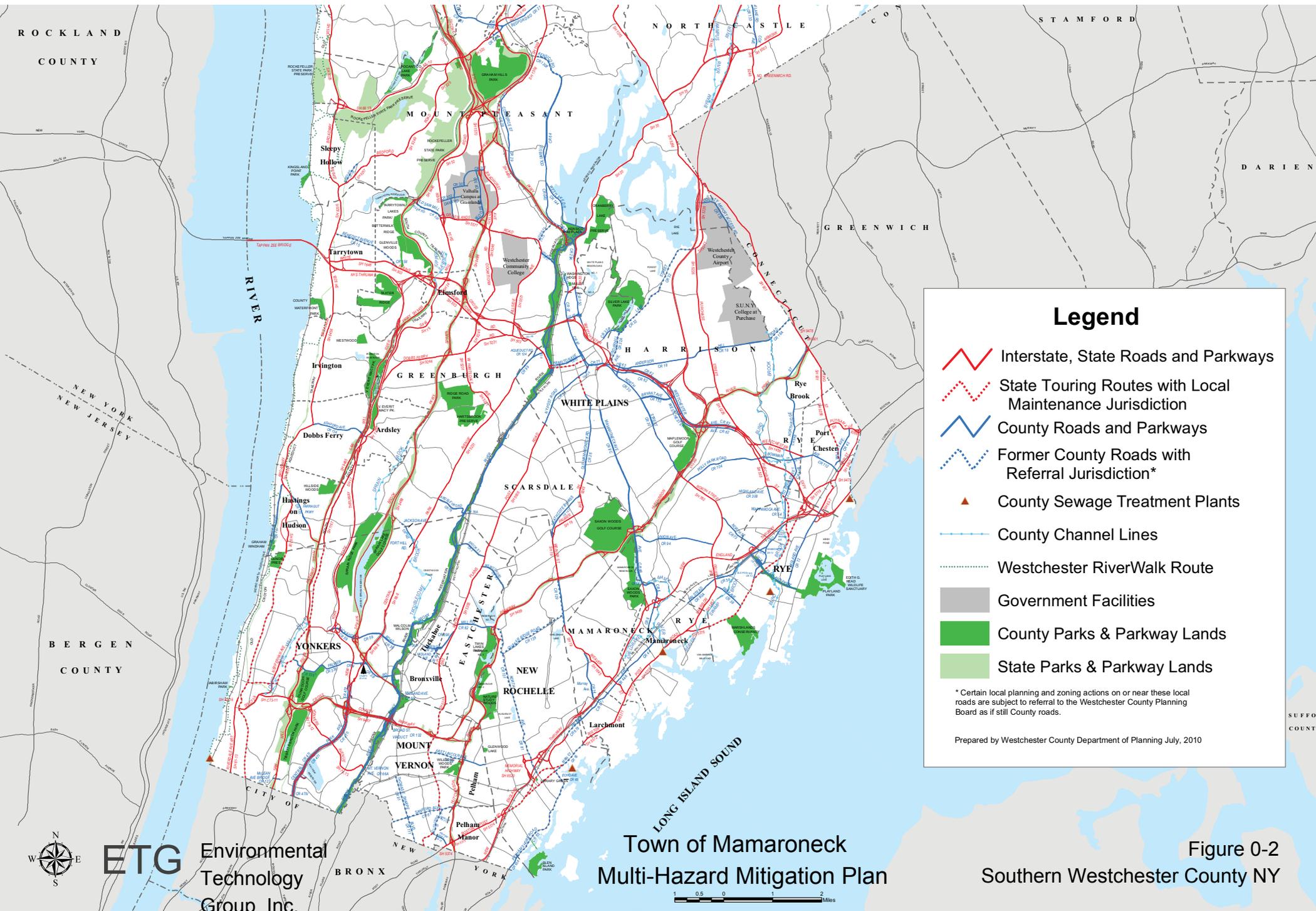
The Town is protected by its Police Department, Fire Department, and Ambulance District. The Police Department protects the citizens in the Unincorporated area of the Town and consists of one Chief, two Patrol Division Lieutenants, one Administrative Lieutenant, one Detective Sergeant, six Patrol Division Sergeants, three Detective Division Detectives, one Youth Division Detective, one Records Police Officer, and 24 Patrol Division Police Officers.

The Fire District provides fire rescue and emergency medical services within the Unincorporated Town of Mamaroneck. The Unincorporated Town borders are also the same borders of the Fire District. The Fire Department consists of three Volunteer Chiefs, fifty Volunteer Firefighters, and fourteen full time Firefighters/EMTs.

The Larchmont/Mamaroneck Volunteer Ambulance Corp. provides emergency medical service and responds to all medical calls within the Village of Larchmont and the Unincorporated Town of Mamaroneck. It also provides additional mutual aid to the Village of Mamaroneck, City of New Rochelle, and other neighboring communities. The Larchmont/Mamaroneck Volunteer Ambulance Corp. consists of twenty Volunteer EMTs and a combined total of thirty Volunteer Drivers, Attendants, and Support Personnel.

The Ambulance District coordinates advanced and basic life support services to the Village of Larchmont, Town of Mamaroneck, and Village of Mamaroneck. It provides Paramedics and coordinates emergency rescue training to all EMTs. The Ambulance District consists of one full time Administrator/Paramedic, one full time Basic Life Support Coordinator/EMT, and twenty-five part time Paramedics.

Flooding has been identified as a major problem in the Town. Major storms, floods, and other hazards that have damaged properties have on several occasions, impacted Mamaroneck. (See Section 4). Past natural disasters have resulted in large expenditures of both private and public funds to repair and rebuild damaged properties and facilities.



Legend

-  Interstate, State Roads and Parkways
-  State Touring Routes with Local Maintenance Jurisdiction
-  County Roads and Parkways
-  Former County Roads with Referral Jurisdiction*
-  County Sewage Treatment Plants
-  County Channel Lines
-  Westchester RiverWalk Route
-  Government Facilities
-  County Parks & Parkway Lands
-  State Parks & Parkway Lands

* Certain local planning and zoning actions on or near these local roads are subject to referral to the Westchester County Planning Board as if still County roads.

Prepared by Westchester County Department of Planning July, 2010



The Town of Mamaroneck's major floodplains are located along the Sheldrake River and its tributaries, stretching from the Northern most section of the East Branch, which flows south from Scarsdale; and the West Branch, which flows from New Rochelle down to the Larchmont Gardens Lake and into the Town of Mamaroneck. The two branches combine into one river at West Brookside Drive. Other floodplains are located along the Premium River in the Southwest section of the Town, the East Creek in the Southeast, and the Mamaroneck Reservoir in the Northeast.

This Plan contains information obtained from a variety of Federal, State and local sources. Flood information shown on the maps in this Plan are approximate and are based on existing data sources such as current FIRM and FIS documents. The plan also takes into account FEMA's Advisory Base Flood Elevations, based on damage from Superstorm Sandy.

Requirements

This Multi-Hazard Mitigation Plan follows FEMA regulations and guidelines for mitigation planning. (See 44 CFR Part 201, FEMA Example Plans 2003, 2012 guidance, and FEMA's most current Local Mitigation Planning Handbook guidance, dated March 2013. The requirements for the Hazard Mitigation Planning and Hazard Mitigation Grant Program are described in the Federal Register (Vol. 67 No. 38/February 26, 2002). The approach involves collecting and profiling hazard information, assessing hazard impacts, setting goals and objectives, developing and reviewing mitigation alternatives, evaluating risks and benefits, establishing priorities and preparing a course of action. This plan also satisfies requirements for several federal programs. Target grant and insurance rate reduction programs include, but are not limited to:

- FMA, (Flood Mitigation Assistance Program)
- PDM (Pre-Disaster Mitigation Grant Program)
- HMGP (Hazard Mitigation Grant Program)
- DMA 2000 (Disaster Mitigation Act of 2000)

The DMA amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act by adding a section, which places emphasis on Mitigation Planning. It requires local governments

to have an approved “All-Hazard Mitigation Plan” in place to be eligible to receive Hazard Mitigation Grant Program funding. The plan must also include criteria established in 44 CFR Part 201.6 Hazard Mitigation Planning and Grant Program. This Multi-Hazard Mitigation Plan for the Town of Mamaroneck incorporates all probable hazards. Under the Community Rating System (CRS) Program, each homeowner’s flood insurance cost could be reduced from 5% to 50%.

Plan Process

This Multi-Hazard Mitigation Plan is the result of a process that involved the work of the Consultant, the Environmental Technology Group (ETG), Inc., and the Town of Mamaroneck’s Hazard Mitigation Planning Committee, the Town Board, Town Administrator, several operating departments in the Town including the EMS/Ambulance District, Fire Department/Rescue, Police Department, Public Works, Code Enforcement & planning, participating citizens, Westchester County Department of Emergency Services and the New York State Office of Emergency Management (NYSOEM). Local, State and Federal stakeholders include local citizens and key stakeholders from neighboring communities. The purpose of this Plan is to address both the past and probable future hazards and to develop action items to mitigate identified hazards. These actions are intended to protect citizens, businesses, properties and infrastructures in the Town. This Plan is divided into 10 Sections. Each of the sections is a step in the FEMA process that addresses a phase in the planning process. The process is based on FEMA’s guidance and example plans established in 2003, 2012, and March 2013.

The first 8 steps of this planning process are:

Step 1- Organize Resources

Step 2- Involve the Public

Step 3- Coordinate with other Agencies and Organizations

Step 4- Assess the Hazards

Step 5- Assess the Problems

Step 6- Set Goals and Objectives

Step 7- Review Possible Activities

Step 8- Prepare a Draft Action Plan

These steps represent the development process of the Multi-Hazard Mitigation Plan. The last two steps are action items which the Town can take once the Plan is approved by FEMA and adopted by the Town Board. They include:

Step 9- Implement, Evaluate and Revise the Plan

Step 10- Adopt the Plan.

Public Participation

The public is invited to participate in development of the plan through the local newspaper, postings in public places and the Town Web Page. Town residents have the opportunity to participate, provide input in public meetings and express concerns about the flood and other hazards they face on a regular basis. The residents provide input for actions that would aid in mitigating the problems. The public will be involved in the Plan's revision and updating process. Public input on key issues will be encouraged and notices and progress will be published in local papers. The Town posts updates on their Website, <http://www.townofmamaroneck.org/index.html>

Assessment of Hazards and Vulnerability

The plan process involves identifying all possible hazards that could harm people in the community or damage buildings and structures. A profile of each hazard was prepared and each hazard is ranked according to their importance. This hazard assessment was based on evaluating the frequency of occurrence, extent and severity of impact to property and people, cascading effects on other hazards, duration of the hazard, warning time prior to onset, and recovery time from the hazard. Historical records and documents for each hazard impacting the Town were summarized and evaluated. Based on the assessment of each hazard profile, only the most significant hazards were analyzed further for a detailed impact analysis, proposed mitigation measures and a cost benefit evaluation.

Goals and Objectives

Five major Goals were developed with the aid of the Hazard Mitigation Committee. These include:

1. Avoid and reduce hazards from flooding.
2. Protect the community from catastrophic disasters to avoid loss of life and injury.
3. Protect public and private property and infrastructure from catastrophic disasters.
4. Protect environmental and natural resources.
5. Involve the community, partners, and stakeholders in identifying and implementing mitigation measures.

In addition, 22 objectives were formulated as a means to obtain these goals. (See Section 6.) Setting of goals and objectives are an important part of the strategy for planning mitigative actions.

Mitigation Strategies

As part of the strategy, specific activities or actions are identified to reduce the risk of identified hazards. Priorities are established for mitigation activities based on these analyses and the goals and objectives set for the community. Mitigative actions are assembled that were effective, feasible and met the objectives specified in Section 6. Approximate costs are compared to the benefits identified.

Prepare Action Plan

About forty mitigation activities are proposed to address principal hazards evaluated in the Plan. The purpose of this action plan is to identify which tasks will be implemented first and to outline the strategy for implementation of each of the items. Most of the proposed activities are dependent on funding from County, State or Federal grants. The Action Plan is a working document which is expected to change as conditions and needs vary. Tables in Section 8 provide action items and priorities, approximate costs, administrative responsibility, schedule and/or duration of the activity and possible funding sources. The cost and benefits for each proposed activity were then evaluated and priorities established in the hazard mitigation action Plan.

Implementation

This Plan will be approved by the Town of Mamaroneck Board and by FEMA. It will then be implemented, updated and modified by the Town according to Step 9 in Section 9. Five-year

updates will include the success of implementing the Plan's activities, availability of funds, availability of new hazard information and changes in priorities.

Town of Mamaroneck Multi-Hazard Mitigation Plan

Section 1 - Planning Process

1.A Background Information

This single jurisdiction Multi-Hazard Mitigation Plan has been developed for the unincorporated section of Town of Mamaroneck, which is located in Westchester County, New York. (See previous Figure 0-2, 1.1 and 1-2 below.) This Plan identifies and assesses natural and manmade hazards that could adversely impact the community. The Plan then proposes and evaluates feasible mitigation activities for Mamaroneck, which meet identified goals and objectives and mitigate the identified hazards based on priorities, costs and benefits. The Town of Mamaroneck will coordinate with any future multi-jurisdictional plan prepared by Westchester County.

1.A.1 Mamaroneck Background Information

The Town of Mamaroneck was officially created in 1788. There are two Villages located within the Town: The entire Village of Larchmont (1 square mile), and part of the Village of Mamaroneck lying west of the Mamaroneck River bordering Rye Neck (2.3 square miles). The remainder of the Town is the unincorporated areas (5.17 square miles), which is not a part of either Village. Though both the incorporated Villages and the unincorporated Town are self-governing, they define the Town as a political and governmental subdivision of the State of New York. Total population, according to the 2010 U.S. Census is 29,156. This Hazard Mitigation Plan will focus on the unincorporated Town of Mamaroneck.

The Unincorporated Town of Mamaroneck is a community located in Southeastern Westchester County with a population of about 11,977 people recorded in the 2010 U.S. Census. It is bordered by the Village of Larchmont and the Long Island Sound to the South; the Village of Mamaroneck, Town of Rye, and Town of Harrison to the East; Village of Scarsdale to the North; and the City of New Rochelle to the West. (See Figures 0-2 and 1-1). The Town has a land area

of 2,265 acres. About 792 acres, or 35% of the Town consists of open space. (Westchester County Department of Planning, 2010.)

Table 1-1. Town of Mamaroneck Open Space Acreage

Total Open Space Acres	Municipal Acreage	Percent Municipality	State Park Acres	Local Parks Acres
792	2,265	35%	210	95

Source: - Westchester County Department of Planning, 2010. Databook.

The Town has a temperate coastal climate with an average high July temperature of 84.5 degrees Fahrenheit. The average minimum temperature in January is 22.23 degrees. The average annual rainfall is 42.27 inches. (www.homefacts.com).

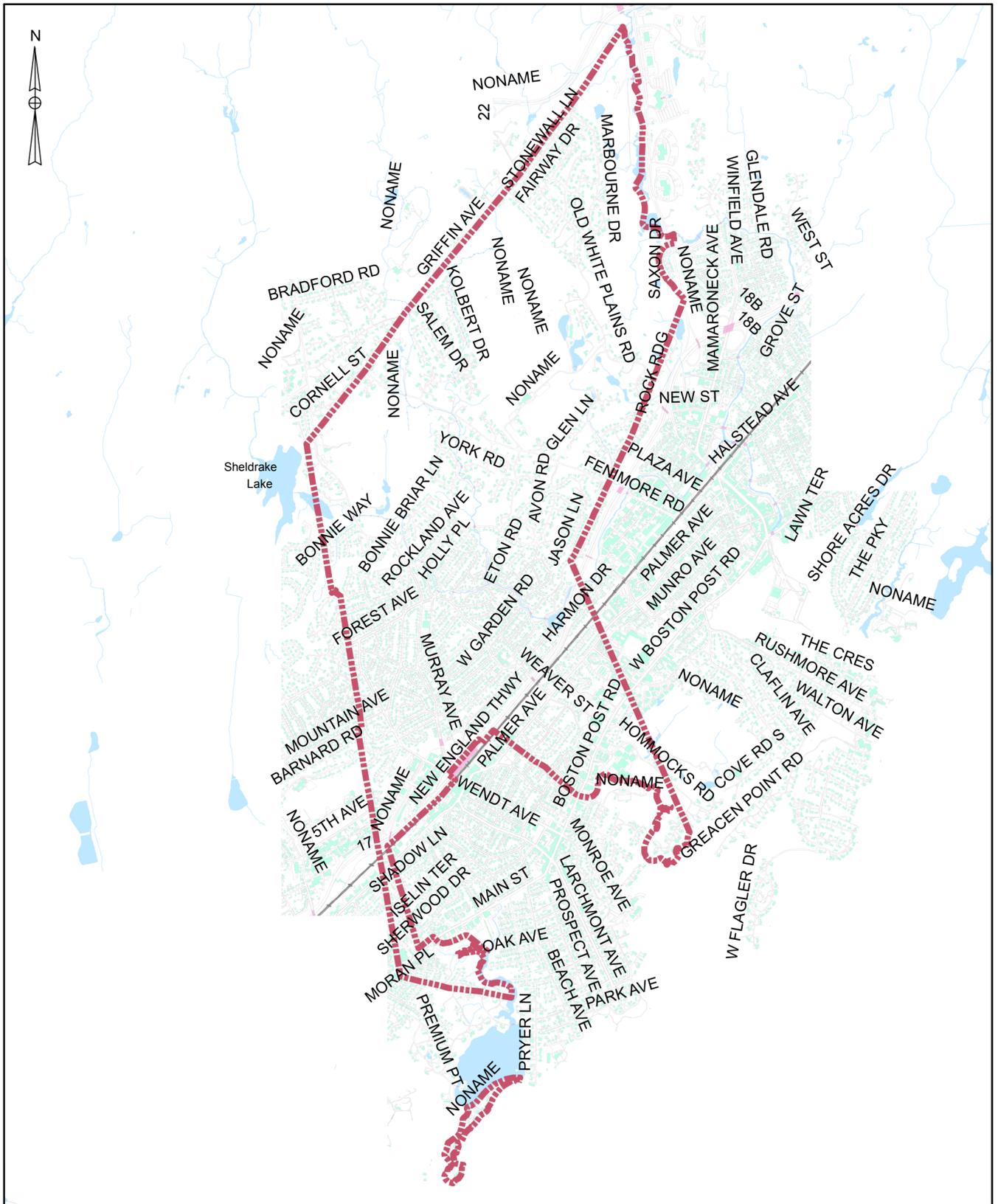


Figure 1-1
Town of Mamaroneck Boundary

Legend

 Municipal Boundaries

**Town of Mamaroneck
All Hazard Mitigation Plan**



Environmental
Technology
Group, Inc.

300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788



DWN BY: YS
CHK BY: JB
SCALE: AS SHOWN
DATE: 08/15/13

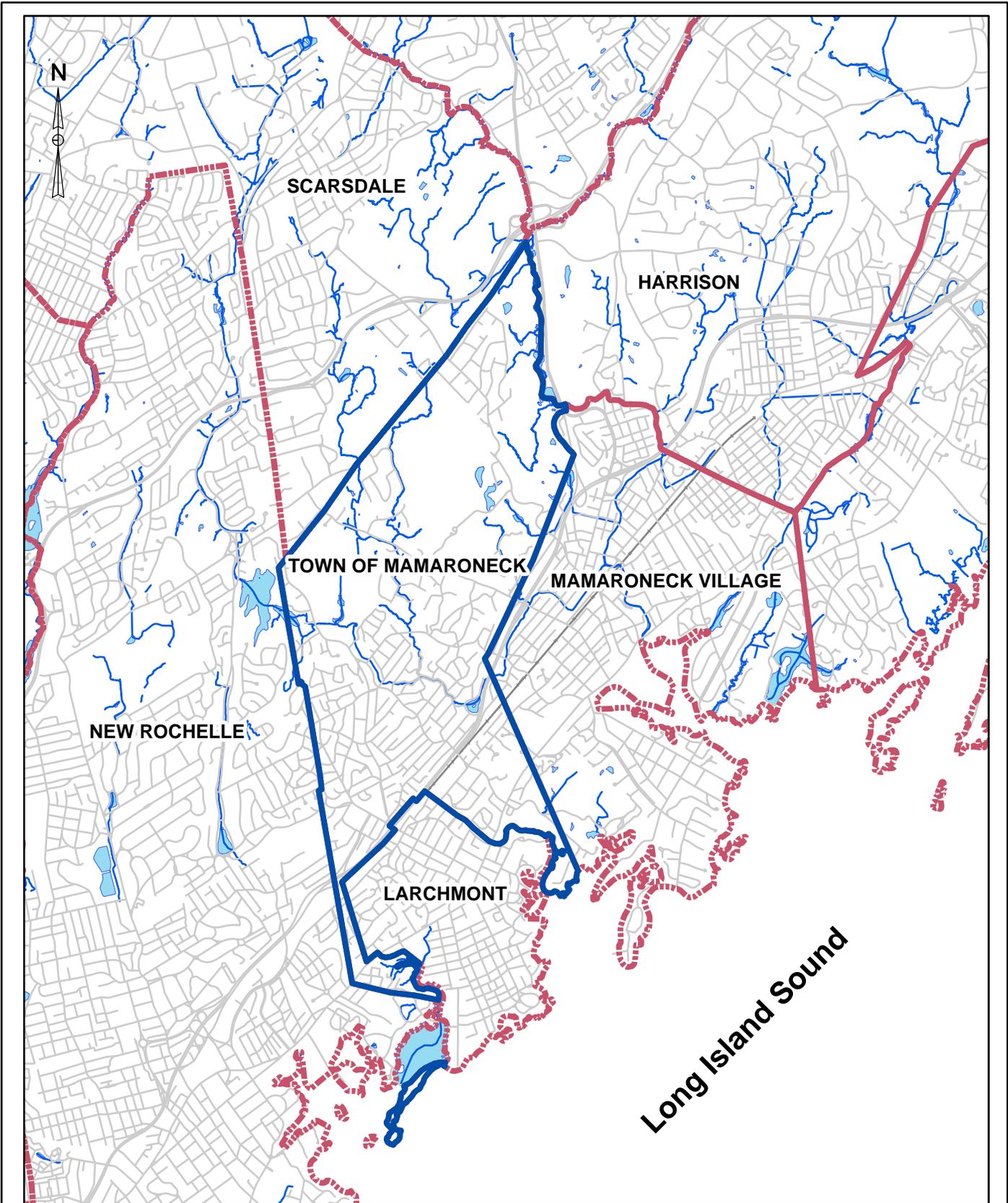


Figure 1-2
Town of Mamaroneck and Surrounding Area

Town of Mamaroneck
All Hazard Mitigation Plan

ETG Environmental
Technology
Group, Inc.
300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788



DWN BY: AJZ
CHK BY: JB
SCALE: AS SHOWN
DATE: 12/04/12

1.A.2 Demographics

The population was 11,977 in the 2010 census with a population density of 3,422/mi². (Table 1-2), US Census Bureau, 2010.) The Town’s population increased by 8% from 11,141 in 2000 to 11,977 in the 2010 census. There were 4,510 occupied housing units in the Town and the median income was \$136,006. The racial makeup of the Town in 2010 was 84.9% White, 6.7% hispanic, 4.6% Asian, 1.8% Black or African American, and 3% from other races.

The Town is largely a residential and a commuter community. A number of commercial small businesses are present in the Town. The Town of Mamaroneck is socioeconomically diverse with most residents being middle to upper middle class professionals.

Table 1-2 Town of Mamaroneck Demographics.

Total Population	Population Density	White	African American	Asian	Hispanic	Median Income
11,977	3,422	10,170	210	548	805	\$136,006

(US Census, 2010)

1.A.3 Characteristics of the Town of Mamaroneck

The Town of Mamaroneck is a largely built-out residential suburban community. The Town is primarily residential. There are some large tracts of recreational land, and small areas of commercial development. Most commercial activity, consisting mainly of local commerce, is located in the small commercial business districts, along the Boston Post Road, Fifth Avenue, and Myrtle Boulevard. There is virtually no manufacturing in the Town.

Interstate-95, also known as the New England Thruway, is a major traffic artery that is heavily travelled by passenger vehicles, trucks, and buses. US-1, also known as the Boston Post Road, is another major traffic artery that is subject to both heavy passenger and commercial vehicular traffic. Other highly traveled roads include Weaver Street, which provides access to Scarsdale and New Rochelle; and Palmer Avenue, which provides access to New Rochelle, Larchmont, and the Village of Mamaroneck. The Metro-North Railroad’s New Haven Line runs from New York City. The Larchmont Train Station services residents in the Town of Mamaroneck. These

tracks are also used by Amtrak, a national commuter line, and limited use by CSX, a freight line.

The Sheldrake River and East Branch Sheldrake River are the major streams in the Town. The Sheldrake River has a drainage area of 6.3 miles. The East Branch Sheldrake River has a drainage area of 1.9 square miles. Both rivers flow through the Town in a generally southeastern direction. Principal flooding areas exist along the Sheldrake River between its confluence with the East Branch and Rockland Avenue.

The Town's primary water supply comes from the New York City Reservoir and Aqueduct System. Westchester Joint Water Works provides the water for the Town.

1.A.4 Town Government

The Town of Mamaroneck is governed by a Town Board, which consists of the Town Supervisor, who serves as Chief Executive Officer, and four council members. (See Figure 1-3.) The Town Board is responsible for legislation, appropriation of monies, and decision making on general local governmental policies. The Board authorizes the annual budget and the collection of taxes. The current Town Supervisor is Nancy Seligson. Current Council members are Phyllis Wittner, Ernest Odierna, Abby Katz, and Jaine Elkind Eney.

The Town Board is supported by the Town Administrator, who serves as the Chief Operating Officer. The Town Administrator provides the Supervisor and the Town Board with background information and recommendations for policy decisions. The Administrator implements all policies created and approved by the Board, and oversees the daily operation of the Town, its various departments and personnel. In addition, the Administrator is responsible for proposing the annual budget to the Board, and implementing it, once authorized.

1.A.5 Town Services

Emergency Services

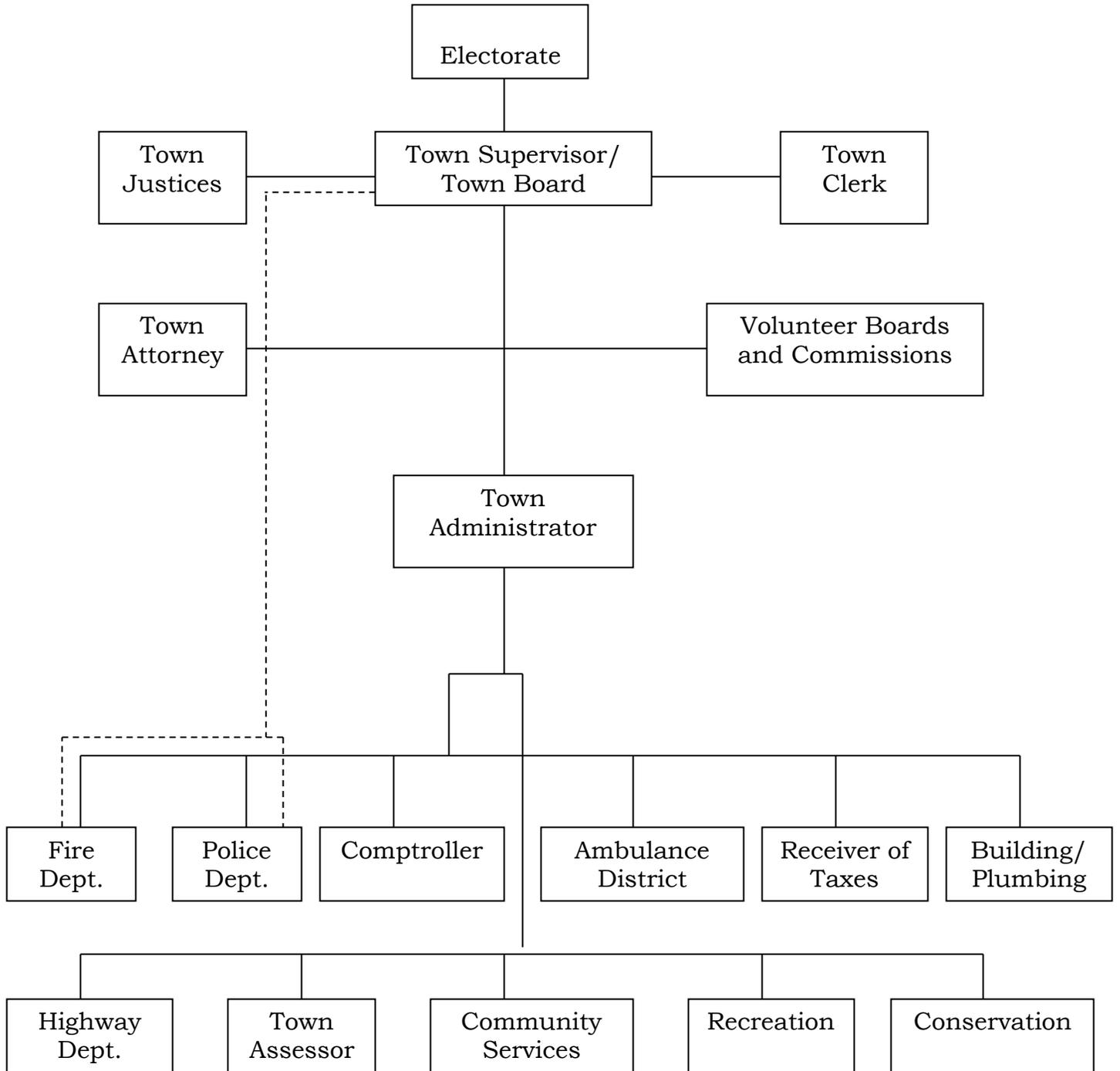
The Town has separate services for Police Department, Fire Department and Ambulance Corps. The Larchmont/Mamaroneck Volunteer Ambulance Corp. is responsible for responding to all medical calls within the Town of Mamaroneck and the Village of Larchmont. It also provides mutual aid to the Village of Mamaroneck, City of New Rochelle, and other neighboring communities. The Ambulance Corp. consists of twenty volunteer Emergency Medical Technicians and thirty volunteer Drivers/Attendants/Support Personnel.

The Ambulance District coordinates advanced and basic life support services for the Town of Mamaroneck, Village of Larchmont, and Village of Mamaroneck. The District provides Paramedics and coordinates training and certification of all Emergency Medical Technicians. The Ambulance District consists of one full-time Ambulance District Administrator (Paramedic), one full-time Basic Life Support Coordinator (EMT), and twenty-five part-time Paramedics.

Fire and Rescue Services:

The Town of Mamaroneck Fire Department operates out of the Weaver Street Firehouse. It provides fire, rescue, and emergency response services to the Town. The Fire District boundaries are the same boundaries as the Unincorporated Town of Mamaroneck. It is run by about seventy volunteer firefighters, fourteen career firefighters and an active Junior Firefighter program. The Town Board serves as the Board of Fire Commissioners, and governs the 5 square mile Town of Mamaroneck Fire District. The Town of Mamaroneck Fire Department's apparatus includes one aerial ladder truck, three engines, two rescue vehicles, three Chief's cars, and two inflatable, gas-powered boats.

Figure 1-3. Town of Mamaroneck Organization Chart



Town of Mamaroneck Police Department: The Police play an integral role in maintaining order in the Town. The Town of Mamaroneck Police Department provides basic police services to the unincorporated area of the Town, such as crime prevention and investigation, patrol and traffic enforcement, and has a youth division. It also assists the Volunteer Ambulance Corps by responding to emergency medical calls.

The Town of Mamaroneck Police Department is run by one Chief and is comprised of two Patrol Division Lieutenants, one Administrative Lieutenant, one Detective Sergeant, six patrol Division Sergeants, three Detectives (Detective Division), one Detective (Youth Division), one Police Officer (Records Office), and twenty-four Police Officers (Patrol Division).

1.B Plan Requirements and Supervision

1.B.1 FEMA Requirements

The Federal Emergency Management Administration (FEMA) requires municipalities to compile a structured hazard mitigation plan to qualify for several FEMA grant programs. Prior to these requirements, local governments could choose if they wanted to implement a hazard mitigation plan or a flood mitigation action program in order to qualify for FEMA funds. The Town is required to prepare a Multi-hazard Mitigation Plan that meets current Federal requirements if it wishes to apply for FEMA funding. FEMA authorized funding under the Pre-Disaster Mitigation program for the Town of Mamaroneck, NY, Multi-hazard Mitigation Project. A major objective of a Hazard Mitigation Plan is to prevent or mitigate hazards that would otherwise require an emergency response under the National Incident Management System (NIMS), which is administered by FEMA.

This Multi-Hazard Mitigation Plan is based on FEMA's Local Mitigation Planning Handbook (2013), and FEMA regulations and guidelines, which were discussed below. This Plan follows the process described in the FEMA State and Local Mitigation Planning How-to Guides (FEMA 386 Parts 1-4, FEMA, 2003a) and follows the FEMA example Plans (FEMA 2003b). The New York State Office of Emergency Management (NYS OEM) oversees the process.

This Multi-Hazard Mitigation Plan follows FEMA regulations and guidelines for State and local mitigation planning. (See 44 CFR Part 201 and FEMA Example Plans, 2003.) The requirements for the Hazard Mitigation Planning and Hazard Mitigation Grant Program are described in the Federal Register (Vol. 67 No. 38/February 26, 2002). The approach involves collecting and profiling hazard information for all probable hazards, assessing the hazard impacts, setting goals and objectives, developing and reviewing mitigation alternatives, evaluating risks and benefits, establishing priorities and preparing a course of action. This plan also satisfies requirements for several Federal programs.

Target grant and insurance rate reduction programs include, but are not limited to:

- FMA, (Flood Mitigation Assistance Program)
- PDM (Pre-Disaster Mitigation Grant Program)
- HMGP (Hazard Mitigation Grant Program)
- DMA 2000 (Disaster Mitigation Act of 2000)

The DMA 2000 amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act by adding a section, which places emphasis on Mitigation Planning. It requires local governments to have an approved “All-Hazard Mitigation Plan” in place to be eligible to receive Hazard Mitigation Grant Program funding. The Plan must also include criteria established in 44 CFR Part 201.6 Hazard Mitigation Planning and Hazard Mitigation Grant Program. Requirements and criteria for developing the Plan are specified in this regulation. This Multi-Hazard Mitigation Plan for the Town of Mamaroneck incorporates all probable hazards in accordance with these requirements. Completion and approval of a Multi-Hazard Mitigation Plan is required by federal regulations in order to receive funding for flood prevention and storm protection projects or other FEMA Programs. For disasters declared after November 1, 2004 a local government must have this Plan approved by FEMA in order to receive grants.

The flood hazards mitigation portion of this plan can be used as the first step in getting approval for the Community Rating System (CRS) Program. This Program is a National Flood Insurance Program (NFIP) that provides incentives for the communities to complete activities that reduce flood hazards risks. When a community completes these activities, the insurance premiums of

these policyholders can be reduced. This Plan, subsequent filing of an application, and receiving approval are necessary for qualifying for this Program. Under the CRS Program, each homeowner's flood insurance cost could be reduced from 5% to 50%.

1.B.2 Planning Steps

This Plan addresses both the known past and potential future hazards and develops action items that the Town can implement to protect its citizens' businesses, and their property. This Plan is divided into 10 Sections. Each of the sections is a step in the FEMA process that addresses a phase in the planning process. The process is based on FEMA's guidance and example plans dated March 2003. These first 8 steps are:

- Step 1 Organize Resources
- Step 2 Involve the Public
- Step 3 Coordinate with other Organizations
- Step 4 Assess the Hazards
- Step 5 Assess the Problems
- Step 6 Set Goals and Objectives
- Step 7 Review Possible Activities
- Step 8 Prepare a Draft Action Plan

These Steps represent the Multi-Hazard Mitigation Plan development. The last two Steps are action items for the Town to take once the Plan is approved by FEMA following its adoption by the Town Board. They are:

- Step 9 Implement, Evaluate and Revise the Plan
- Step 10 Adopt the Plan.

This Multi-Hazard Mitigation Plan is the result of a process that involved the work of the consultant, the Environmental Technology Group (ETG), Inc. and the Town of Mamaroneck's Hazard Mitigation Planning Committee. The Town Board, Town Supervisor, Town Administrator, and several operating departments in the Town including the Town of Mamaroneck's Ambulance Corps, Fire, Police, Building, Highway, and Community Services

Departments provided information and input for the Plan. Participating citizens, Westchester County Department of Emergency Services and the New York State Office of Emergency Management (NYS OEM) were additional resources.

Organizing the Town resources: This is a first step in the planning process. The Town's administrative staff was crucial to the organization of the Hazard Mitigation Planning Committee and in working with the consultant during the development of the Plan. The Town's Ambulance District Coordinator, Michael Liverzani is the designated Town Hazard Mitigation Coordinator, and was active in coordinating resources and public involvement and providing information for the development of the Plan. Town Officials, the Hazard Mitigation Planning Committee, and community participants' reviewed and commented on this Plan.

Using a standard review process FEMA evaluates and comments on the Draft Plan. These comments are resolved and incorporated into the Draft Final Plan prior to approval. The Draft Final Plan is then presented to the Town Board for approval and acceptance and then forwarded by NYS OEM to FEMA for review and approval.

Where applicable, Geographic Information Systems (GIS) maps that identify hazard locations, critical facilities, and vulnerabilities were incorporated in this plan. The Plan includes an appendix with supporting documents and articles and hazard analyses details, which were discussed in the main part of the plan.

The plan process involves identifying all possible hazards that could harm people in the community or damage buildings and structures. A profile of each hazard is prepared and each hazard is ranked according to their importance. Rating and ranking of scores were developed using the New York State Hazards NY (HAZNY) computer program. (See Section 4C.) This assessment is based on the frequency of occurrence, extent of impact, severity of impact to property and people, cascading effects on other hazards, duration of the hazard, warning time prior to onset of the hazard, and recovery time from the hazard.

Based on this analysis and the hazard assessment provided for each profile, only the most significant hazards were analyzed further for a detailed impact analysis, proposed mitigation measures and a cost/benefit evaluation. Priorities were then established for mitigation activities based on these analyses and the goal and objectives set for the community.

This Plan contains information obtained from a variety of Federal, State and local sources. (see Section 3, Coordination with Other Agencies.) The accuracy of this information has been verified to the best extent possible. For the majority of hazards evaluated in Section 4D and 4E (such as hurricanes, high winds, blizzards and ice storms), specific locations or extent of damages could not be specified since the entire Town is at risk. Flood information shown on the maps in this Plan is approximate and is based on existing data sources such as current Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS). Information on these maps is regarded as acceptable for planning purposes.

This Plan will be updated and modified by the Town according to Step 9 in Section 9. Updates will include the success of implementing the Plan's activities, availability of funds, availability of new information and changes in priorities.

1.C Supervision and Direction of the Plan

The planning process included the formation of a project team which coordinated with the Town staff (Figure 1-4). Town officials, the Planning Committee, and community participants reviewed and commented on the Plan. FEMA staff will then review and comment on the Draft Plan so that issues are resolved prior to approval. The Draft Final Plan is presented to the Town Board for approval and acceptance and then forwarded by NYS OEM to FEMA for their final review and approval. The project team, participating citizens and organizations involved in the planning process are discussed below.

Figure 1-4 shows the team members involved in the planning process. Key to the success of the process was the coordination of Town officials, the Consultant, stakeholders and the public.

Michael Liverzani, Ambulance District Coordinator, was the designated coordinator of the Multi-Hazard Mitigation Plan. The Environmental Technology Group, Inc. (ETG), Inc. managed the consultant planning activities. James E. Brower, Ph.D., Environmental Planner, supervised and advised the planning efforts. The Plan was prepared with the assistance of the Town staff and the Planning Committee.

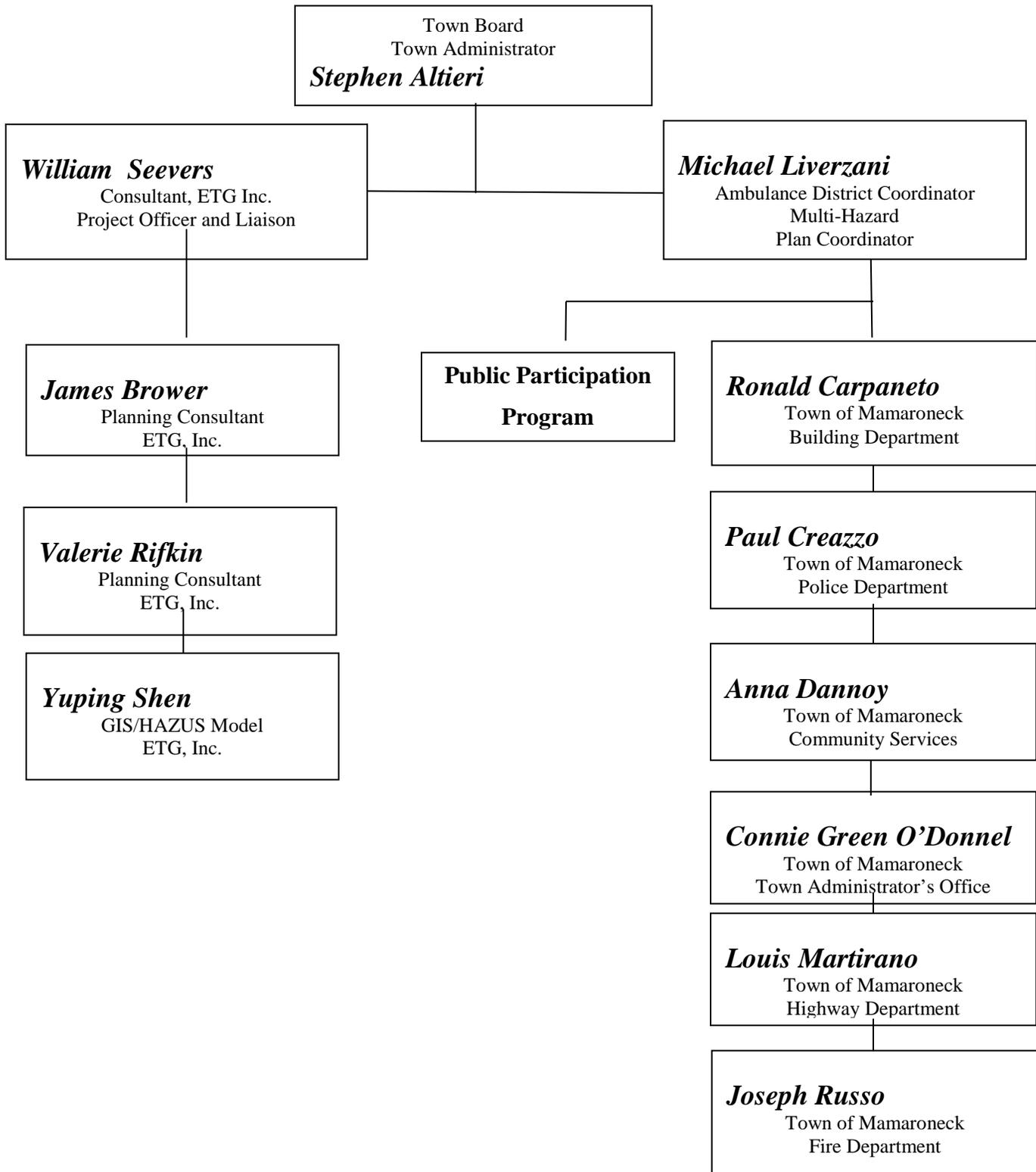
ETG worked closely with the Town Hazard Mitigation Coordinator, the Planning Committee and other Town officials in developing the Plan. William J. Seevers of ETG, served as the Consultant Project Officer and liaison with consulting personnel. Albert Machlin of ETG, assisted with assessing feasibility of mitigative strategies. Valerie Rifkin, an Environmental Planning Specialist, coordinated the plan by collecting, researching and reviewing documents, evaluating hazard information, assessing the hazards, assessing the impacts, and in preparing several sections of the Plan. The GIS mapping, HAZUS modeling and technical assistance were provided by ETG consultant Yuping Shen.

1.D Hazard Mitigation Planning Committee

A Hazard Mitigation Planning Committee was appointed by the Town Hazard Mitigation Coordinator to provide input, guidance, review and information needed to develop the Multi-Hazard Mitigation Plan. (See Figure 1-4) It contained key representatives of the Town who provided various services for the Town affected by the proposed plan. Michael Liverzani served as the Chairperson of the Hazard Mitigation Planning Committee. Members of the Committee are listed in Figure 1-3 and consist of Town staff and public citizens who are familiar with the potential hazards facing the Town. Michael Liverzani served as the primary point of contact for the mitigation planning consultant and the Planning Committee.

The Planning Committee was knowledgeable of the Town needs and was very active and involved in the Plan development. The viewpoints of the Committee regarding hazards of concern and mitigation needs have been solicited through formal meetings. The Committee met frequently during the preparation of the plan to discuss the progress of the Plan and to provide input into the process (see Table 1-4). They have been especially helpful in focusing on the

Figure 1-4. Hazard Mitigation Planning Committee and Consultants



issues that are of greatest importance to the safety of Town property and residents. They have played a large part in identifying major hazards, shaping the goals, objectives and proposing activities given in Section 6 and 7 of the Plan. The committee included a diverse group representing different services in the Town.

The Hazard Mitigation Planning Committee was responsible for the following planning activities:

- Assist and oversee the public involvement process.
- Identify and encourage participation from regional agencies, stakeholders and citizens in the development of the Plan.
- Assist in identifying community hazards.
- Review and comment on the hazard ranking and assessment.
- Develop goals and objectives for mitigation activities.
- Assist in identifying hazard mitigation activities important to the community.
- Assist in gathering information, plans and documents to include in the Plan.
- Oversee the development and review of the Plan drafts.
- Adopt, revise and maintain the Plan.

1.E Public Involvement

Section 2 discusses the second stage of the planning process – public involvement and how the public was involved in the process. Two formal public meetings are held to inform the community and Town Board about the planning process. Drafts of the Plan were made available for community review. Input from the community was actively sought through public notices, public meetings, and direct participation on the Planning Committee.

The Town of Mamaroneck website: www.townofmamaroneck.org provided a good resource for public involvement. The community will continue to be involved in the revision and updating process. Public meetings on key issues will continue and notices ad progress will be published in local papers.

1.F Planning Activities

A kickoff meeting to plan and organize the process was held with Town Administrator and Town Hazard Mitigation Coordinator and staff on April 2, 2013 at the Town of Mamaroneck Town Center. Figure 1-4 shows the staffing used for the developing the Plan. Supervision and direction of the process is discussed in Section 1B below. Table 1-3 lists the key activities and milestones in developing the Multi-Hazard Mitigation Plan. Preparation of this Plan involved:

- Input and coordination from several key Town participants
- Regular meetings and discussions with the Hazard Mitigation Planning Committee,
- Review, comment of the Plan by the Town community
- ***Review and approval by the Town Board***
- Review, comment and approval from FEMA.

In addition several plans, documents and requirements were reviewed including:

- Town Building and Fire Codes
- Town Comprehensive Emergency Response Plan
- Town Development Plans
- Town Waterfront Revitalization Plan
- Westchester County Stream Control Law
- Westchester County Emergency Management Plan
- New York State Building Code
- Town's Flood Insurance Study /Town Flood Insurance Rate Maps
- Federal Disaster Mitigation Act of 2000
- New York State Hazard Mitigation Plan
- FEMA "How-to Guide" (FEMA 386)
- FEMA "Local Mitigation Planning Handbook" (2013)
- National Weather Service Information
- USGS Information

Table 1-3 Key Activities, Meetings and Milestones.

Date	Event	Key Participants
	Town Board authorize the plan	Town Board
3/20/2013	Award consultant contract	Town Board, Town Mgmt. ¹
4/2/2013	Project initiation and kickoff meeting with Town representatives	Town Mgmt., Consultant ²
6/18/13	1 st Committee meeting project review, hazards HAZNY analysis	Town Mgmt., Consultant, Committee ³
7/18/2012	2 nd Committee meeting review of goals and objectives	Town Mgmt., Consultant, Committee
12/18/13	1 st Public Meeting. Briefing on hazards and plan process	Town Board, Consultant, Public ⁴
9/26/13	3 th Committee meeting – review of mitigation measures	Town Mgmt., Consultant, Committee
11/6/13	Consultant Plan Overview with Town Board (Work Session)	Town Board, Consultant
11/15/13	Submit 1 st Draft for Committee review	Town Mgmt., Committee
	4 th Committee Meeting – review comments on Draft Plan	Town Mgmt., Consultant, Committee
	5 th Committee Meeting – review	Consultant
	Submit Draft Plan to NYS OEM /review and comment by FEMA	Town Mgmt.
	Respond to FEMA Crosswalk comments	FEMA, Consultant
	Begin 30-day Public Review Period	Public, Participating Partners ⁵
	2 nd Public meeting, Draft Plan Presentation	Town Board, Public
	Close of Public Comment period	Public
	Resolve FEMA and Public Comments	Town Mgmt., Consultant, FEMA
	Incorporate all Final Comments in Plan	Consultant
	Adoption of Plan by Town Board	Town Board
	Submit Final Draft Plan to NYS OEM and FEMA	Town Mgmt.

1. Town Administrator and Town Hazard Mitigation Coordinator. 2. Consultant – ETG, Environmental Technology Group. 3. Committee – Town of Mamaroneck Hazard Mitigation Planning Committee. 4. Public – Town of Mamaroneck residents. 5. Participating Partners – Organizations having an interest in the Plan.

1.G Formal Community Process and Approval

The preparation of this Multi-Hazard Mitigation Plan is backed by a formal community process and approval. Major stages of planning are reviewed, documented, authorized and approved by the local government Town Board and FEMA. This process and approval includes authorization and funding of the plan development, selection and approval of a consultant to prepare the Plan, approval of the draft and final plan by FEMA and the Town Board, and documentation of public meetings.

A Town of Mamaroneck resolution was offered and officially authorized the acceptance of a proposal for preparation of a Pre-Disaster Hazard Mitigation Plan and establishment of a committee to complete the project. The Hazard Mitigation Committee, consisting of Town staff, interested parties and the planning consultant (Figure 1-4) were given full authority to carry out the steps in the hazards identification, assessment, planning and mitigation process.

Once the draft plan has been accepted by FEMA, the Town Board will adopt the Plan through a formal resolution (See Section 10). The revisions to the Plan will be submitted to FEMA through NYS OEM to assure that all comments and issues have been resolved and for approval of the Plan.

At the Town of Mamaroneck Town Board Meeting 3/20/2013 the Board approved the awarding of the contract for the preparation of the All Hazard Mitigation Plan to the Environmental Technology Group, Inc. (ETG).

Section 2 – Public Involvement and Outreach

The community in the Town of Mamaroneck was invited to participate in the process of developing this Multi-Hazard Mitigation Plan through invitations in newspapers and website notices and postings around the Town. They were asked to provide comments at meetings, in letters and emails (See Appendix). A draft of this Plan was made available to the public at the Town Center, Library and on the Town website. A list of all public and committee meetings and other key activities of this plan were given in Table 1-3 in Section 1. (See Appendix for additional details.)

Public meetings are held in conjunction with the Town Board meetings. These meetings can be accessed through LMC-TV the local public access television station. They can be viewed on Cablevision channel 76 or Verizon channel 35. The Board meetings can be viewed online at www.lmc-tv.org Videos on Demand, Municipal meetings.

2.A Public Meetings

A public meeting was (is to be) held in the Town Center Conference Room (___) to inform interested people in the community about the plan and to obtain their input. A notice for the first public meeting was (is to be) issued on (_____ 2013) announcing the first meeting, which was (is to be) held on December 18, 2013 at 8:00 PM. A copy of this public notice is provided below. The purpose of this first meeting was to summarize for the community the current status of the project, future planning activities and the process for developing the Multi-Hazard Mitigation Plan. Members of the community were encouraged to provide input. Several comments and questions were presented by the Town Board to the consultant. A second meeting (is to be) held _____, 2014 to present the Draft Plan for their review and comment. The purpose of the second meeting is to summarize the Draft Plan, obtain public input and comment, and present the next steps in the planning and approval process.

(Insert 1st Public Meeting Press Release Here)

2.B Public Information Activities

Members of the community were encouraged to attend public meetings and to report on notable hazard issues in the Town. Printed notices were posted in (____) public places in the Town. A notice and meeting summary was also put on the Town Web Page. See the website at www.townofmamaroneck.org.

In order to facilitate coordination and communication between the Hazard Mitigation Planning Committee and Town of Mamaroneck citizens, several methods of public outreach were conducted to inform the public of the Plan and encourage participation in the planning process. The Town has made (will make) the following efforts for public input in the preparation and review of this Plan:

- The Town has created a page on its website devoted to the Multi-Hazard Mitigation Plan to inform residents about the project and allow for direct input.
- A press release, notifying the community about a public meeting on December 18, 2013 was (will be) published in the Journal News and _____ on __/__/2013 in The Town of Mamaroneck and surrounding communities.
- A summary of the first public meeting was (will be) posted to the Town of Mamaroneck's website (www.townofmamaroneck.org) following the December meeting.
- On __/__/2013, the Draft Plan was (will be) posted to the Town of Mamaroneck's website. (www.townofmamaroneck.org)
- A press release notifying the community about the second public meeting on __/__, 2014 was (will be) sent to Journal News and _____ on __/__, 2013.
- A formal opportunity for public comment will be provided for the Draft Plan that will be submitted to NYS OEM and FEMA. A 30 day review period for the Plan will be provided for public comment.

Examples of public outreach efforts are given and public comments that have been received to date are documented in the Appendix.

2.C Public Input

The Town officials and Town Board sought public input on the Plan that would help it identify and prepare for any disasters that could impact the community. The public was invited to provide information by letter or E-mail and by participation at public meetings. The residents were informed that this Plan would qualify the Town for grant money to help mitigate the hazards evaluated in the Plan.

At the first public meeting, the consultant explained that the Town is seeking input from residents about potential hazards the community faces and ways the local government can help residents prepare for and recover from disasters.

Public comments were noted and incorporated into this Plan where applicable and feasible. The meeting was covered by the local press and LMC-TV. The primary hazard of concern is frequent flooding in various areas of the Town. (See Section 4.D in this Plan.) The public was invited to review and comment on the Draft Plan. Many concerns and comments are expected by the end of public review period.

Once the document is complete, it is transmitted to NYS OEM for review and comment by FEMA. Though the planning procedure officially requires a specific 30-day comment period, feedback was continually sought and welcomed from the public. Through public outreach the Town will get ideas from people who have been impacted by these hazards. Anyone wishing to submit comments to the Town could call (914) 381-7838, submit a letter or email to the Town Hazard Mitigation Coordinator. at _____@townofmamaroneck.org.

Section 3 - Coordination with Other Agencies and Organizations

Many government agencies and private organizations have stakeholder interest in the development and implementation of this Plan. Their roles and interests in the Plan preparation and process were evaluated. Some key agencies may fund programs, oversee regulatory requirements or provide technical input or review. These agencies or organizations may also have relevant information useful to the Town needs. Several existing plans and recent studies that are applicable to this Hazard Mitigation Plan involved different interested parties. These documents were reviewed and discussed in this plan. This section discusses the public agencies and organizations that may have stakeholder interest in development and implementation of this Plan.

3.A Community Stakeholders and Participating Partners

Several potential interested agencies, offices, organizations and groups and their potential roles are given in Table 3-1. These stakeholders have the various interests in or potential contributions to this Plan. The following list identifies the group, its role in the planning process. Roles in the process include: providing sources of data and information, funding of projects, regulatory oversight, review and input to this Plan and review of specific mitigation action plans prior to their implementation. Stakeholders were invited to review and comment on the online copy of the Hazard Mitigation Plan. Other groups, identified below, will be invited to participate a later time during the planning phase of a specific mitigation action.

Federal Agencies

- Federal Emergency Management Agency (FEMA) - Provided planning guidance, regulatory oversight, funds and program review for preparation and implementation of this Hazard Mitigation Plan. Approval of this Plan by FEMA is required.

Table 3-1. Stakeholders and Participating Interests.

Federal Agencies	New York State Agencies	Local Agencies	Neighboring Communities	Private Organizations
Federal Emergency Management Administration (FEMA)	NY State Office of Emergency Management (NYS OEM)	Westchester County Dept. of Health	Village of Mamaroneck	Consolidated Edison
U.S. Army Corps of Engineers (USACE)	NYS Dept. of Transportation (NYSDOT)	Westchester County Dept. Emergency Management	Village of Larchmont	Verizon and other Communication Companies
U.S. Environmental Protection Agency (USEPA)	NYS Department of Environmental Conservation (NYSDEC)	Westchester County Dept. of Planning	Town of Harrison	Cablevision
National Oceanographic and Atmospheric Administration (NOAA)	Hudson River Valley Greenway	Westchester County Dept. Public Works	Town of Rye	Metro-North Rail Road
U.S. Geological Survey (USGS)	State Elected Officials	County Elected Officials	Village of Scarsdale	
Federal Elected Representatives	NY State Department of State (NYSDOS)	Mamaroneck Union Free School District	City of New Rochelle	
National Flood Insurance Program (NFIP), FEMA, Region 2, New York		Long Island Sound Watershed Inter-municipal Council (LISWIC)		
		Westchester Joint Water Works		

- National Flood Insurance Program (NFIP), FEMA, Region 2, 26 Federal Plaza, New York, NY. Regional administrator. This office is a key source of information on flood hazard insurance. They will be informed of plan activities that are related to flood mitigation and flood insurance activities.
- National Oceanographic and Atmospheric Administration (NOAA) - This agency is a key source of data and information on natural hazards.
- Federal government elected representatives will be informed of plan activities that may require legislative actions or affect other jurisdictions. The Congressional representative for the Town of Mamaroneck will be requested formally to seek Federal Funds for flooding problems in the Town.

New York State Agencies

- New York State Department of Environmental Conservation - This State Agency would be involved with any State Environmental Quality Review Act (SEQRA) requirements, pollution discharge permits, regulation of hazardous material releases, protection of habitats, wetlands and protected species related to implementation of this Plan protection of habitats, wetlands and protected species that may be related to implementation of this Plan. NYSDEC involvement will be required during the planning stages of specific mitigation actions having potential environmental impacts.
- NY State Office of Emergency Management (NYS OEM) – NYS OEM implements planning guidance from FEMA, regulatory oversight, funding management and other emergency planning documents.
- NYS Dept. of Transportation - Interfacing with this State Agency will be needed for any transportation or State highway projects proposed this Plan. The Town coordinates with DOT for the Traffic Management related to hazard impacts.
- Hudson River Valley Greenway - This State-sponsored program facilitates the development of a voluntary regional strategy for preserving scenic, natural, historic, cultural and recreational resources while encouraging compatible economic development and maintaining the tradition of home rule for land use decision-making. Review and input from this group will be sought for specific projects affecting their interests during the planning phase for that mitigation action.

Local Agencies

- Westchester County Dept. of Health - This agency will be needed for review and approval of any mitigation action plans that may impact drinking water quality of the area or disease vectors.
- Westchester County Dept. of Emergency Management - Any proposed activities that relate to interfacing of the County and Town fire and emergency services will require input from this department. Town emergency plans will be reviewed by this group to assure that they are consistent with the County plans. The Town of Mamaroneck will coordinate with any future multi-jurisdictional hazard mitigation plan. This Hazard Mitigation Plan was available to the County for review and comment.
- Westchester County’s “Restoration of Society” - This initiative includes the County’s plan for recovering and restoring communities following a catastrophic event. It focuses on restoring basic services such as power, water supply and other utilities and infrastructures.
- Westchester County Dept. of Planning - This department will be informed of any Town plans and proposals that relate to County plans.
- Westchester County Dept. Public Works - This department oversees design and construction of infrastructure systems, capital projects and non-recurring repair and replacement projects for the County. Implementation plans and designs involving public works projects will be provided to the County for their review and comment.
- Local and County Elected Representatives - Local and County officials need to be informed of multi-hazard issues and proposed mitigation activities. They may also assist in appropriating legislative funding for needed projects.

Neighboring Communities

The following communities may be involved or affected by the planned actions and will be informed of mitigation activities being proposed. These communities were invited to review and comment on this Hazard Mitigation Plan:

- Village of Mamaroneck
- Village of Larchmont
- Town of Harrison
- Town of Rye

- Village of Scarsdale
- City of New Rochelle

Private Organizations

- Consolidated Edison - Review and coordinate plan activities that could affect power failures; tree damage to power lines or excavation that could affect buried cables.
- Verizon (and other communication companies) - Review and coordinate any plan activities that could affect telephone communications, tree damage to phone lines or excavation that could affect buried lines or cables.
- Metro-North Rail Road – Provides commuter rail service to Town of Mamaroneck residents. They would review and coordinate any plan activities or hazards that could affect rail service.
- Nature Conservancy – Coastal Resilience project. Provides communities, planners, businesses, and officials with easy access to information on projected changes in sea level and coastal storm impacts in order to assist in coastal planning and management decisions.
<http://coastalresilience.org/>

3.B Representative Agency Contacts

Interested parties were invited to review and comment on the Plan, which was posted on the Town Website: www.townofmamaroneck.org

Contacts were made with organization representatives to discuss hazards and mitigation measures relevant to the Town of Mamaroneck. A list of groups recommended for review and comment is given below in Section 3.D.

Existing documents were obtained from some of the agencies cited above. A full listing of available documents and citations is given in Section 3.C below and in the References Cited, Section 11, at the end of Part I of this Plan. A variety of information was obtained from several of these agencies using the Internet. Sources were also obtained from the local newspapers and newspaper websites were used for information on historic events.

3.C Review of Community Needs, Goals and Plans

Community needs, goals and plans were discussed with the Town officials from the beginning of the planning process. Discussions were held at Planning Committee meetings and public meetings. The Community presented their needs at two public meetings, particularly for mitigation of flood hazards. (See Section 2 above.) The public hazards concerns have been incorporated into the Plan. Additional public input to the Draft Plan will be included prior to the final submission of the Plan. The result of this review process is found in Steps 6, 7 and 8 in the establishment of goals, objectives, priorities and a mitigation plan.

Several plans, studies, reports are listed in Section 11 References Cited were used to obtain information for this Hazard Mitigation Plan. Key sources include:

- Flood Mitigation Action (FMA) Plan - February 2008
- Town of Mamaroneck Web Site, www.townofmamaroneck.org
- Town of Mamaroneck Comprehensive Emergency Management Plan
- Town of Mamaroneck Master Plan DEIS–1989 and Updates, Phase 1-1986, Phase 2-1987
- Town of Mamaroneck and Village of Larchmont Waterfront Revitalization Program
- Upper Sheldrake River and Larchmont Reservoir Hydrology Report, 1985
- Sheldrake Watershed Hydrology Study, 1991
- Watershed Advisory Committee Study, 2001
- Emergency Action Plan, Larchmont Reservoir Dam – August 2010
- Pine Brook Drainage Study Draft, 2008
- Feasibility Report - Flood Control Mamaroneck & Sheldrake Rivers – October 1977
- The Nature Conservancy, the Coastal Resilience Project
- U.S. Census Bureau, 2010. Profile of General Demographic Characteristics, Mamaroneck, New York. <http://factfinder.census.gov/>
- Flood Insurance Study, Town of Mamaroneck, New York. September 15, 1989
- Flood Insurance Study, Westchester County (All Jurisdictions) September 28, 2007
- Westchester County Hazard Mitigation Plan.

3.D Draft Action Plan Review

The Draft Hazard Mitigation Plan underwent comprehensive review and comment by Town Administrators, the Hazard Mitigation Planning Committee, members of the Town Board, interested Stakeholders, and the public. The public comment period was 30 days. The Draft Plan was (will be) sent to NYS OEM project manager for FEMA's review and comment. Comments by FEMA were (will be) resolved and incorporated into the plan. The final plan incorporates a resolution of the comments from these reviews.

Several communities, local agencies and groups were openly invited to review and comment on the plan via the Town of Mamaroneck website.

These invitations included:

- Village of Mamaroneck
- Village of Larchmont
- Town of Harrison
- Town of Rye
- Village of Scarsdale
- City of New Rochelle
- Mamaroneck School District
- Westchester County Planning Department

To date no specific comments were received from other parties that required significant changes or additions to this Plan.

Section 4 Assessing the Hazard

4.A Introduction and Background

The Town of Mamaroneck was officially created in 1788. There are two Villages located within the Town: The entire Village of Larchmont (1 square mile), and part of the Village of Mamaroneck lying west of the Mamaroneck River bordering Rye Neck (2.3 square miles). The remainder of the Town is the unincorporated area (5.17 square miles), which is not a part of either Village. Though both the incorporated Villages and the unincorporated Town are self-governing, they define the Town as a political and governmental subdivision of the State of New York. Total population in the three areas, according to the 2010 U.S. Census is 29,156. This Hazard Mitigation Plan will focus on the unincorporated Town of Mamaroneck.

The Unincorporated Town of Mamaroneck is a community located in Southeastern Westchester County with a population of about 11,977 people recorded in the 2010 U.S. Census. It is bordered by the Village of Larchmont and the Long Island Sound to the South; the Village of Mamaroneck, Town of Rye, and Town of Harrison to the East; Village of Scarsdale to the North; and the City of New Rochelle to the West. (See Figures 0-2 and 1-1).

The Town of Mamaroneck is subject to a variety of events that may lead to damage from water, wind and various man-made hazards. From the perspective of FEMA's Community Rating System (CRS) objectives, this water-related hazard is a major concern to the Town. In addition to water-related events, there are severe windstorms, other natural events and man-made hazards to which the community is potentially exposed. This all-hazard mitigation plan evaluates flooding events, storm hazards, other natural hazards and several human-caused hazards as required under the Disaster Mitigation Act 2000 and FEMA 44 CFR Parts 201 and 206, 2002.

Process

The hazard identification and assessment process included four steps:

1. Identify all potential hazards based on the input from the Hazard Mitigation Planning Committee and the public, a review of documents and website searches. A list of potential hazards was developed.
2. Profiles of the hazards of concern were prepared and primary hazards of concern were evaluated for potential risk assessment. Each hazard was then summarized, evaluated and characterized in a hazard profile. (See Section 4D.)
3. Assets were then identified and inventoried for impacts of concern. (See Section 5)
4. Potential losses were estimated and the hazards were evaluated for human health and safety risks and for property damage and losses. (See Section 5.)

A list of potential hazards was prepared and reviewed with the Hazard Mitigation Planning Committee. Those that were not applicable, prevalent or would not cause significant damage or personal harm were screened out and not evaluated further. (See Table 4-2, and Section 4.E Elimination of Hazards.) The list of potential hazards was then evaluated and rated using New York State's HAZNY program (See Section 4.C below). The HAZNY process helps to evaluate the relative degree of hazard posed by each prevalent hazard or significant risk. The New York State Office of Emergency Management (NYS OEM) recommends that the HAZNY analysis program be used as one tool to review and assess the hazards. The American Red Cross together with NYS OEM developed this program. It is an interactive program where members of the Planning Committee and the consultants provided input to the process.

Background information, frequency of occurrence, impacts, severity, extent, location and other data were then summarized for each hazard profile. (See Section 4.D below).

Sources of Information:

In addition to the plans, studies and reports noted in Section 3C, several sources of information were used to identify and characterize the hazards of concern. For definitions of abbreviations and acronyms see Section 12 Acronyms and Glossary. For additional sources and detailed citations see Section 11, References Cited. These sources include, but are not limited to:

- Hazard Mitigation Planning Committee
- Public meeting with residents

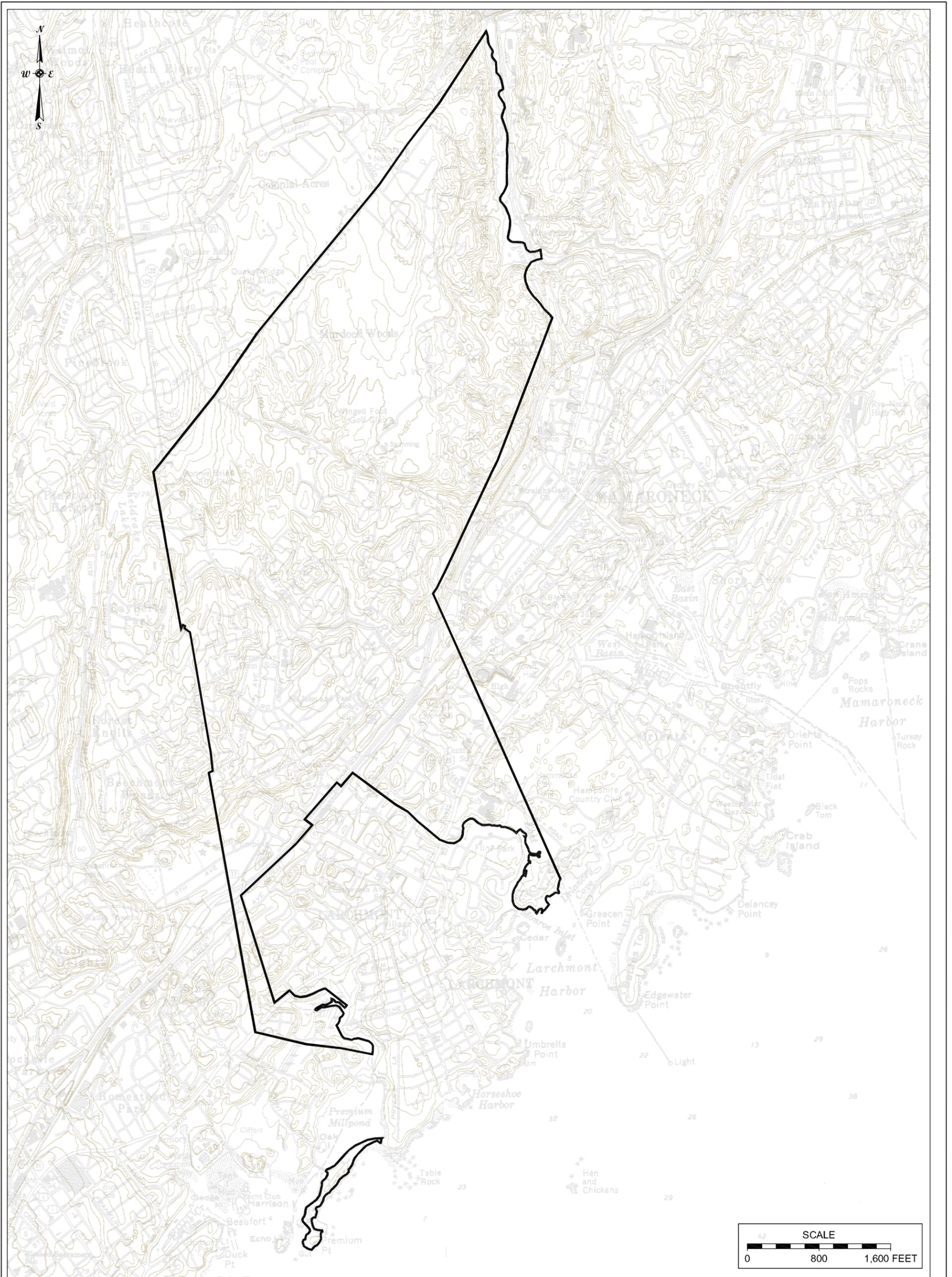
Town of Mamaroneck Officials
Town Board of Supervisors
Local newspaper articles
Town of Mamaroneck website www.townofmamaroneck.org
Documents, plans and Engineering reports supplied by the Town
New York State Standard Multi Hazard Mitigation Plan 2011
<http://www.dhSES.ny.gov/oem/mitigation/plan.cfm>
New York State Standard Multi Hazard Mitigation Plan (Draft) 2014
<http://www.dhSES.ny.gov/oem/mitigation/hm-plan-2013.cfm>
Several NOAA websites <http://noaa.gov/>
National Climate Data Center www.ncdc.noaa.gov
National Weather Service, Hurricane Page, www.nhc.noaa.gov
FEMA website www.fema.gov/
FEMA Region II Coastal Analysis & Mapping <http://www.region2coastal.com/bestdata>
Westchester County Flood Insurance Study (2007)
USGS website <http://earthquake.usgs.gov/>
Seismic Zoning Maps for NYS Seismic Building Code
Lamont-Doherty Earth Observatory, Columbia University Website
<https://www.ldeo.columbia.edu>
Consolidated Edison website, press releases, and studies, www.coned.com/
Westchester County GIS website <http://giswww.westchestergov.com/westchester/emap/wc>
EPA Enviromapper website <http://www.epa.gov/emefdata/em4ef.home>

4.B Hazard Identification

The hazards screened include those given in FEMA 386-2 guidance, FEMA (2003b) examples and Disaster Mitigation Act 2000 guidance (FEMA, 2000), Local Mitigation Plan Review Guide (FEMA, 2011), Local Mitigation Planning Handbook (FEMA 2013), HAZNY guidance, and input from the Town of Mamaroneck Planning Committee. The Hazard Mitigation Planning Committee with the aid of the consultant screened all potential hazards listed and the committee concluded that these hazards are possible in the Town of Mamaroneck and surrounding areas. Historic FEMA disaster declarations for New York State are listed below in Table 4-1. Tables 4-2 and 4-4 summarize the hazards evaluated and the results of their initial screening.

Those hazards in the region that were judged to be prevalent, pose a significant human safety risk or have a potential to cause significant damage were selected for further analysis. This assessment was based on available documents, information from databases, and websites. (See

sources above and Section 11 References Cited.) The sources used to determine the probability of future events for each natural hazard are given in Table 4-3. Knowledge and experience of



Environmental
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Group, Inc.

300 WHEELER ROAD, SUITE 202, HAUPPAUGE, NEW YORK 11788

Project Name

Town of Mamaroneck
Multi-Hazard Mitigation Plan

Figure Title

Topographic Map
Town of Mamaroneck

Figure 4-1

DWN BY: AJZ

CHK BY: JB

SCALE: AS SHOWN

DATE: 10/14/13

local officials and the Hazard Mitigation Planning Committee aided the analyses and assessments made by the consultant. The consultant guided the Committee through the hazard assessment process during the period June through November 2013.

The hazards evaluated include:

- natural hazards (floods, hurricanes, other severe storms, winter snow and ice storms and other natural non-storm hazards),
- technological hazards (environmental releases, fires, explosions and utility failures) and
- human-caused hazards (such as civil unrest and terrorism).

These hazards are individually profiled below in Section 4.D. The prevalent hazards and other hazards judged to be important were then evaluated using the HAZNY hazard ranking system discussed in Step 4.C below.

Table 4-1. Major Historical Disaster Declarations for New York State.

Year	Date	Disaster Types	Active	Disaster Number
2013	07/12	Severe Storms and Flooding	Yes	4129
2013	04/23	Severe Winter Storm and Snowstorm	Yes	4111
2012	10/30	Hurricane Sandy	Yes	4085
2011	09/13	Remnants of Tropical Storm Lee	Yes	4031
2011	08/31	Hurricane Irene	Yes	4020
2011	06/10	Severe Storms, Flooding, Tornadoes, Straight-line winds	Yes	1993
2011	02/18	Severe Winter Storm and Snowstorm	Yes	1957
2010	10/14	Severe Storms, Tornadoes, Straight-line winds	No	1943
2010	04/16	Severe Storms and Flooding	No	1899
2009	12/31	Severe Storms and Flooding, Tropical Depression Ida and Nor'Easter	No	1869
2009	09/01	Severe Storms and Flooding	No	1857
2009	03/04	Severe Winter Storm	No	1827
2007	08/31	Severe Storms, Flooding, and Tornado	No	1724
2007	07/02	Severe Storms and Flooding	No	1710
2007	04/24	Severe Storms and Inland and Coastal Flooding	No	1692
2006	12/12	Severe Storms and Flooding	No	1670
2006	10/24	Severe Storms and Flooding	No	1665
2006	07/01	Severe Storms and Flooding	No	1650
2005	04/19	Severe Storms and Flooding	No	1589
2004	10/01	Tropical Depression Ivan	No	1565
2004	10/01	Severe Storms and Flooding	No	1564
2004	08/03	Severe Storms and Flooding	No	1534
2003	08/29	Severe Storms, Tornadoes and Flooding	No	1486
2003	05/12	Ice Storm	No	1467
2002	05/16	Earthquake	No	1415
2002	03/01	Snowstorm	No	1404
2001	09/11	Terrorist Attack	No	1391
2000	07/21	Severe Storms	No	1335
1999	09/19	Hurricane Floyd	No	1296
1998	09/11	Severe Storms	No	1244
1998	07/07	Severe Storms and Flooding	No	1233
1998	06/16	Severe Thunderstorms and Tornadoes	No	1222
1998	01/10	Severe Winter Storms	No	1196
1996	12/09	Severe Storms/Flooding	No	1148
1996	11/19	Severe Storms/Flooding	No	1146
1996	01/24	Severe Storms/Flooding	No	1095
1996	01/12	Blizzard	No	1083

Table 4-1. Major Historical Disaster Declarations for New York State (Contd.).

Year	Date	Disaster Types	Active	Disaster Number
1993	04/02	World Trade Center Explosion	No	984
1992	12/21	Coastal Storm, High Tides, Heavy Rain, Flooding	No	974
1991	09/16	Hurricane Bob	No	918
1991	03/21	Severe Storm, Winter Storm	No	898
1987	05/15	Flooding	No	792
1985	10/18	Hurricane Gloria	No	750
1985	03/22	Snow Melt, Ice Jams	No	734
1985	03/20	Flooding	No	733
1984	09/25	Severe Storms, Flooding	No	725
1984	04/17	Coastal Storms, Flooding	No	702
1977	02/05	Snowstorms	No	527
1976	09/03	Hurricane Belle	No	520
1976	07/21	Severe Storms, Flooding	No	515
1976	06/29	Flash Flooding	No	512
1976	03/19	Ice Storm, Severe Storms, Flooding	No	494
1975	10/02	Severe Storms, Heavy Rain, Landslides, Flooding	No	487
1974	07/23	Severe Storms, Flooding	No	447
1973	07/20	Severe Storms, Flooding	No	401
1973	03/21	High Winds, Wave Action, Flooding	No	367
1972	06/23	Tropical Storm Agnes	No	338
1971	09/13	Severe Storms, Flooding	No	311
1970	07/22	Heavy Rains, Flooding	No	290
1969	08/26	Heavy Rains, Flooding	No	275
1967	10/30	Severe Storms, Flooding	No	233
1965	08/18	Water Shortage	No	204
1963	08/23	Heavy Rains, Flooding	No	158
1962	03/16	Severe Storm, High Tides, Flooding	No	129
1956	03/29	Flood	No	52
1955	08/22	Hurricane, Floods	No	45
1954	10/07	Hurricanes	No	26

Source: <http://www.fema.gov/disasters/grid/state-tribal-government/38>

Table 4-2. Initial Screening of Potential Hazards.

Potential Hazards	Possible Hazards	Prevalent Hazards*	Potential Hazards	Possible Hazards	Prevalent Hazards*
Natural Hazards					
Flood	X	X	Land Subsidence		
Severe Storm Hazards			Land (Rock) Slide		
Hailstorm	X	X	Mudflow		
Hurricane	X	X	Tsunami		
Coastal Storm **	X	X	Volcano		
Severe Storm & Thunderstorm	X	X	Wildfire	X	
Tornado	X	X	Technological Hazards		
Windstorm	X	X	Air Contamination	X	
Winter Storm Hazards			Building Fire	X	
Avalanche			Explosion	X	
Ice Jam	X		Hazardous Materials Release (Fixed Site)	X	
Ice Storm	X	X	Hazardous Materials Release (Transport)	X	
Severe Snow Storm	X	X	Mine Collapse		
Other Natural Hazards			Oil Spill	X	
Dam Failure	X		Radioactive Release	X	
Drought	X		Structural Collapse	X	
Earthquake	X	X	Utility Failure	X	X
Epidemic	X		Water Supply Contamination	X	
Erosion	X		Human-Caused Hazards		
Expansive Soils			Civil Unrest	X	
Extreme Temperature	X	X	Terrorism	X	
Infestation	X		Transportation Accident	X	

* A frequent or regular event. May occur more than once in 7 years to several times a year.

** Includes Nor'Easter storms

Table 4-3. Sources Used to Determine Probability of Future Events for Natural Hazards.

Hurricane & Storm Hazards	Historical weather data NOAA/National Climatic Data Center US Landfall Hurricane Probability Project, Colorado State University National Weather Service SHELDUS
Flood Hazards	Historical flood data Town Flood Insurance Study Engineering Reports supplied by the Town FEMA Flood Mapping Town FIRM
Earthquake	FEMA NYS OEM USGS NYCEM Lamont-Doherty Cooperative Seismographic Network of Columbia University
Winter Storms	Historical weather data NOAA/NCDC National Weather Service SHELDUS
Tornado and Wind Hazards	Historical data NOAA/NCDC Tornado Project Website SEMO wind zones
Extreme Temperature & Drought	Historical data NOAA/NCDC National Weather Service
Epidemic	Historical data Center for Disease Control Westchester County Health Department

Table 4-4. Summary of Significant Safety Risks and Damage Potential.

Possible Hazards	Health and Safety Risks	Potential for Damage
Natural Hazards		
Flood	X	X
Severe Storm Hazards		
Hailstorm		X
Hurricane	X	X
Coastal Storm	X	X
Severe Rain and Thunder Storm	X	X
Tornado	X	X
Windstorm	X	X
Winter Storm Hazards		
Ice Storm	X	X
Severe Snow Storm	X	X
Other Natural Hazards		
Earthquake		X
Epidemic	X	
Extreme Temperature	X	X
Technological Hazards		
Air Contamination	X	
Explosion	X	X
Fire	X	X
Hazardous Material Spills (Transport)	X	X
Hazardous Material Spills (Fixed)	X	X
Radioactive Release	X	
Water Supply Contamination	X	
Utility Failure	X	X
Human-Caused Hazards		
Civil Unrest	X	X
Terrorism	X	X

Of the 39 listed hazards in Table 4-2, 30 were considered as possible for the region and only 12 were considered to be prevalent hazards to the community. A significant health and safety risk was associated with 20 possible hazards and 18 hazards were linked to significant damages to property, buildings and other structures.

Preliminary Hazard Elimination

Based on the above screening, several Hazards were eliminated from further consideration and include:

Avalanches: There are no mountains in or near the town that could produce avalanches.

Erosion of soils: There are no significant areas subject to severe erosion.

Land Subsidence: There are no significant areas subject to subsidence.

Expansive soil hazards: There are no expansive soils hazards in the area.

Volcanoes: Do not occur in this region of the country.

4.C Hazard Ranking by The HAZNY System

Identification and ranking of all hazards that affect the Town of Mamaroneck is a primary system assessing significant hazards (See Section 4.B above). The Hazards New York (HAZNY) method further identifies and ranks hazards based on a rigorous method, which combines input from the community with the experience of emergency services professionals. The Hazard Mitigation Committee was guided through the HAZNY process to resolve questions concerning the risk level and priority of consideration for several of the risk factors.

This section discusses the process for selecting and ranking the hazards based on the HAZNY process. The results of these analyses are shown in Table 4-5 and are discussed below. The analysis was done under the guidelines of the HAZNY program, which is a New York State organized process for identifying and prioritizing the risks of hazards that might be experienced in the Town. The formation of the list, and the determination of their relative values, is based in part on the actual experience of the Committee members. Additional details are given in the appendix.

4.C.1 HAZNY Process

The HAZNY process involves a logical ordering by priority, and perception of the hazards that affect a community like the Town of Mamaroneck. It analyzes and ranks hazards on the basis of five factors which include:

- Scope covers the aerial extent of the impact and the likelihood that the event itself would trigger another hazard (i.e. Cascade Effect).
- Frequency of the event.

- Impact from the standpoint of the likelihood of injury or death, and damage to private property and public facilities.
- Onset, or how much warning time will be received.
- Duration, or the length of the event and its recovery time.

The detailed summary of Ground Rules is found in the NYS OEM Ground Rules for HAZNY, which is found in attachments in the Appendix of this Plan. We have ranked FEMA-recognized “generic” hazards including hazards that have been identified in Mamaroneck from the standpoint of likelihood of occurrence and prevalence. Using the HAZNY Ground Rules the committee scored the major risk factors for the group of Mamaroneck hazards that are possible and prevalent. These factors can be used to examine and quantify other risk factors that may be identified in the future.

Some potential hazards such as avalanches, mudflows, and volcanoes were excluded since they were considered of low probability and judged insignificant for further evaluation. (See Table 4-4.) Several hazards such as civil unrest, epidemics, and drought were considered to be not prevalent but were included in the HAZNY analysis because they were considered to have potentially significant impacts, although uncommon. The results of the HAZNY analysis are given in Table 4-5.

Table 4-5. Summary of Hazards Scores Based on HAZNY Analysis.

	HAZNY Score Mamaroneck
<u>High Hazard</u>	
	321-400
Flood	321
<u>Moderately High Hazard</u>	
	241-320
Coastal Storm*	253
Hurricane	248
Severe Storm & Thunderstorm **	246
<u>Moderately Low Hazard</u>	
	161-240
Dam Failure	239
Fire	232
Windstorm	230
Winter Storm	230
Transportation Accident	222
Utility Failure	221
Terrorism	219
Tornado	218
Hazmat (In Transit)	210
Extreme Temperatures	204
Earthquake	202
Oil Spill	201
Landslide	199
Explosion	192
Water Supply Contamination	182
Epidemic	179
Transportation Accident (Rail)	172
Hazmat (Fixed Site)	168
Structural Collapse	164
<u>Low Hazard</u>	
	44-160
Drought	152
Fuel Shortage	142
Radioactive Release	140
Infestation	136
Air Contamination	132
Ice Jam	123
Food Shortage	119
Fuel Oil Spill	113

* Including tropical storms, Nor'Easters.

** Including severe and gale force winds as well as other non-winter storms listed. Hurricanes and coastal storms not included

4.C.2 Hazard Ratings

The HAZNY rating scores were used to further screen hazards. The information from the HAZNY analysis contributed to the preparation of the Hazard Profiles in Section 4.D. The Committee concurred in general with the selection of the high, moderately high, moderately low, and low hazards in Table 4-5. The detailed results of scoring for each hazard are given in the Appendix.

The most significant hazard in Table 4-5 is flooding with a High hazard ranking. (See Section 4.D below.) The storm of greatest concern for this area is the coastal storm which includes several types of storms as well as hurricanes, both of which were rated as a moderately high hazard. This may reflect the fact that few high category hurricanes hit the Town of Mamaroneck. By the time a hurricane makes landfall it is often relegated to a tropical storm. By the time Hurricane Sandy made landfall in New Jersey (October 29, 2012), it had lost its hurricane status and was a “post-tropical cyclone with hurricane force winds”. (NWS National Hurricane Center. www.nch.noaa.gov). Floods were considered the most severe hazard which is caused by several types of storms such as coastal storms and severe storms/thunder storms which were rated as number two and four in the HAZNY analysis. Coastal storms scored 253 and were rated the 2nd highest hazard (Table 4-5). Although not as severe as hurricanes, these storms cause severe flooding and wind damage. Such storms often last longer and flood more often than hurricanes. Frequent local flooding is the major community concern expressed in public meetings.

Both localized and regional utility power failures are a concern which can be the result of cascade effects from other hazards discussed in Section 4.D below. Utility failures can also impact critical facilities, rail transportation systems as well as residences, industrial and commercial facilities. Dam failure with a score of 239 was rate as a moderately low hazard in the Table 4-5.

Winter storms ranked 7th had a score 230. These storms include blizzards that can damage buildings, power lines, critical facilities and transportation systems.

4.C.3 Hazard Rating Criteria

A summary of the hazard rating criteria based on the HAZNY process is attached in the Appendix. We have ranked FEMA-recognized “generic” hazards including hazards that have been identified in the Town of Mamaroneck from the standpoint of likelihood of occurrence and prevalence. Using the HAZNY Ground Rules we scored the major risk factors for the group of Mamaroneck hazards that are possible and prevalent. These factors can be used to examine and quantify other risk factors that may be identified in the future.

The HAZNY criteria also provide a basis to specify the relative scope or location of the hazard. For example: if the hazard occurs at a single location, several individual locations, throughout a small region or throughout a large region the score will reflect this scope. Of the prevalent hazards like coastal storms and floods, information on the location/size of the hazard is provided.

The HAZNY scores also incorporate the probability or likelihood of future occurrences. This is one of the specific quantified elements of input in the HAZNY process. The probability or likelihood of future occurrence has been specified for each of the hazards included in this analysis.

The extent or magnitude of each hazard can be expressed and quantified. Such factors as the extent of the area affected, the likelihood of a cascade effect, the frequency of the event and the impact of the hazard on the health and safety of people, the impacts on property and the impacts on infrastructure are all covered in this analysis.

4.D Hazard Profiles

We have assembled a comprehensive summary of past hazard events, which provides accounts that describe the potential impact of these events on the Town of Mamaroneck. These data together with firsthand accounts by members of the committee, historical meteorological reports of hurricanes, Nor’Easters and other storms completes the picture that the Town of Mamaroneck Planning Committee and the consultants use as an important tool of the planning process.

Detailed hazard profiles are presented below for the high hazard of flooding, three moderately high hazards, and seven moderately low hazards listed in Table 4-5 above. The hazard ratings were based on committee meeting discussions and the New York State HAZNY analysis discussed in Section 4.D above. These hazards were considered to have a higher magnitude or severity of impact to the Town and include:

- Floods (Section 4.D.1)
- Coastal Storms (Section 4.D.3.2)
- Hurricanes and Tropical Storms (Sections 4.D.2, 4.D.3.1)
- Severe Storms and Thunderstorms (Section 4.D.3.3)
- Severe Winter Storms (Section 4.D.4)
- Dam Failure (Section 4.D.5.1)
- Wind Storms (Section 4.D. 3.5)
- Tornadoes (Section 4.D.3.4)
- Extreme Temperatures (Section 4.D.5.4)
- Utility Failures (Section 4.D.6.1)
- Fire (Section 4.D.6.7)

Other hazards considered less severe or low magnitude are described in less detail but may be reevaluated in later updates to this Plan. These hazard profiles include summarized information and details on the following hazard features:

- Overall summary
- Definition
- Location
- Extent (magnitude/severity)
- Previous instances
- Future events
- Impact

4.D.1 Floods

Hazard Summary: A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation of runoff or surface waters from any source or (3) from intense

and severe rainfall. Flooding is a frequent occurrence in the Town of Mamaroneck at several locations shown on Figures 4-2, and 5-2. Floods may cover large areas of several streets, brooks, the river flood plains around the Sheldrake and Mamaroneck Rivers, and shore line of the Long Island Sound. Floods of several feet deep have occurred following rain events. A major flood occurred on April 15, 2007. (See Figure 4-3). The most recent major flood was caused by Tropical Storm Irene on August 28, 2011, followed by remnants of Tropical Storm Lee on September 4, 2011. Future flooding problems are expected to continue unless mitigation actions are implemented. A future 100-Year flood is a likely event for the areas identified. Floods are costly from the damage they cause. Numerous homes, families, and businesses have been impacted with flooded basements, stores, and impassible streets and highways. Details of the flood hazards in the Town of Mamaroneck are given below.

Sources of information on floods are included in Section 11, References Cited: Conversations with residents and local officials; Local media articles: Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (Archives), The Journal News, NY Times; Documents and Engineering reports supplied by the Town, NOAA websites, FEMA website, Westchester County Flood Insurance Study. Spatial Hazard Events and Losses Database for the United States (SHELDUS), <http://webra.cas.sc.edu/hvri/products/sheldus.aspx>.

Profile Details: Flooding is a serious problem for the Town of Mamaroneck and ranked 1st with a high HAZNY score of 321. It is a low lying shoreline community that is crisscrossed by a number of rivers and streams, thus making it susceptible to flooding from a variety of sources. Floods in the Town have been caused by hurricanes, coastal storms, windstorms, thunderstorms and melting snow and ice. Notable events that caused major damage were from Tropical Storms Floyd and Ernesto, the Nor'Easter of 2007, and most recently, Tropical Storm Irene in August 2011. Based on the past frequency of flooding, the probability of future floods is very high. The Town's major floodplains are located along the Sheldrake River and its tributaries, stretching from the northernmost part of the East Branch, which flows south from the Town border of Scarsdale; and the West Branch, which flows from the City of New Rochelle down to the Larchmont Gardens Lake and into the Town of Mamaroneck. The two branches combine

into one river at West Brookside Drive. Other floodplains are located along the Premium River in the Southwest of the Town, the East Creek in the Southeast, and the Mamaroneck Reservoir in the Northeast. Properties located along these areas lie within the 100-Year floodplain. Critical flooding occurs in these areas (See Figure 4-2). These areas are also at high risk for personal safety, personal property damage, and severe damage to infrastructures such as utilities, storm and sanitary sewer lines and roads.

Floods are costly and cause extensive damage. According to FEMA, \$4,784,317.08 was paid out in insurance claims for flood damage in the Town between January 1, 1978 and September 30, 2013. However, these flood insurance claims are likely underreported and actual flood damages are probably higher. This amount only covers 546 losses, and only covers insured damages. (<http://bsa.nfipstat.fema.gov/reports/1040.htm#36>).

4.D.1.1 Flood Extent

The Flood Insurance Rate Map (FIRM) indicating flood zones effective September 28, 2007 (National Flood Insurance Program) for the Town of Mamaroneck is shown in Figure 4-2. This map illustrates the hazard areas related to flooding in the Town. This map shows the floodplain area that would be inundated by the 100-Year flood or Base Flood. Also shown are the areas that would be impacted by the 500-Year flood.

According to the FIRM, the most critical areas for flooding in in the town are located along the Sheldrake River between its confluence with the East Branch Sheldrake River and Rockland Avenue. The topography in these flood risk areas is relatively flat, with poor drainage and high chance for flooding (Figure 4-1).

4.D.1.2 Impact on Storm Sewer Backups

There have been many reports of storm drain and sanitary sewer manhole overflows. These backups have been a particular problem in poor drainage areas in the Town. Section 4.D.1.3 of this plan lists these areas.

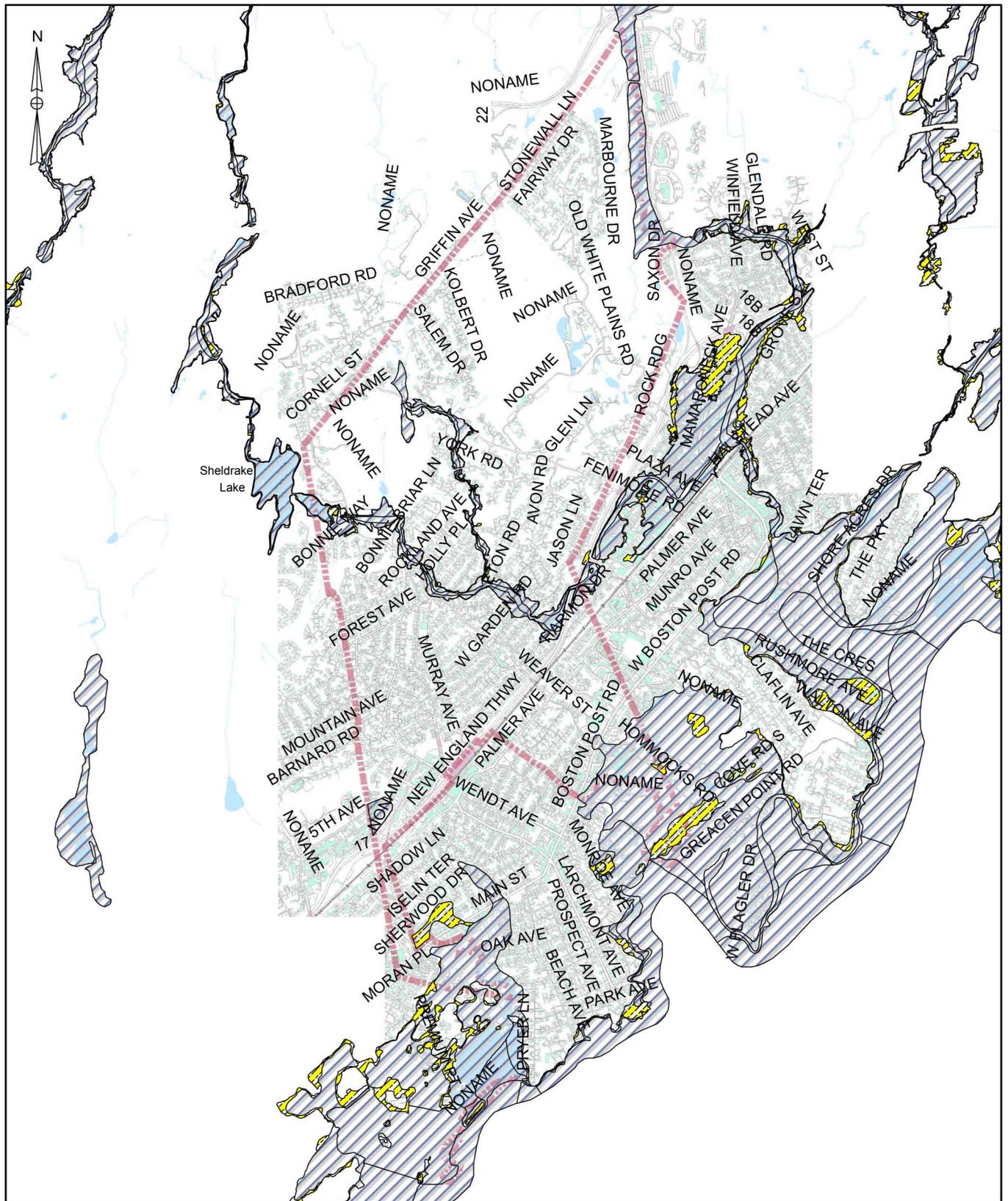


Figure 4-2
 100 and 500-Year Floodplain
 Town of Mamaroneck
 All Hazard Mitigation Plan

Legend

FEMA Flood Mapping

-  100 Year Flood Line
-  500 Year Flood Line

DWN BY: YS
 CHK BY: JB
 SCALE: AS SHOWN
 DATE: 08/27/13



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4.D.1.3 Frequent Local Flooding

Frequent flooding occurs in several areas throughout the Town of Mamaroneck. Areas that have experienced the most damage from flooding (See Figures 4-2 and 5-2) occur in the following locations:

Inland Flooding Areas:

- Adrian Circle
- East & West Brookside Drive
- East Valley Stream Road
- Fenimore Road, from Fenbrook Road to Durham Road
- Forest Avenue & Weaver Street
- Griffen Avenue – from Murdoch Road to Carriage House Lane
- Hilltop Road
- Kolbert Drive
- Lakeside Drive
- North Brook Road
- Old White Plains Road, from Deerfield Lane to Rock Ridge
- Sheldrake Drive
- Sheldrake Place
- York Road & Country Club Drive

Poor Drainage Areas:

- Bonnie Way, from Weaver Street to Addee Circle
- Cabbot Road
- 5th Avenue & Madison Avenue
- Murray Avenue & Colonial Avenue
- Boston Post Road & Weaver Street
- South Drive, from West Drive to Glen Eagles Drive

Coastal Flooding Areas:

- Point Road (Premium Point Island)
- Hommocks Road
- Dillon Road
- Pryor Manor Road
- Wildwood Circle

Flooding has been a major issue in the Town of Mamaroneck, with documentation dating back to 1942 when the U.S. Department of War, New York District Engineer's Office began a Flood Control Study.

In 1945, the Westchester County Harding Report studied alternate approaches on the Mamaroneck and Sheldrake Rivers.

The U.S. Army Corps of Engineers (USACE) started the Mamaroneck and Sheldrake Rivers' mitigation studies in 1977. In 1987 they created a preliminary design for a flood control project to widen and deepen the Mamaroneck River, and to reroute the Sheldrake River under Fenimore Road. This project was not completed due to high costs.

A Federal, State, and County agreement was signed in 2010, which authorized the U.S. Army Corps of Engineers to reexamine opportunities to curtail flooding from the Mamaroneck and Sheldrake Rivers drainage basin, in order to reduce flood risks. The parties are reevaluating the flood mitigation project that was abandoned. Changes to the rivers' flows require further study prior to forging ahead with the project. Cost-Sharing partners of this project are USACE, New York State Department of Conservation (NYSDEC), and Westchester County. The Town of Mamaroneck, along with the Village of Mamaroneck and Town of Harrison are non-cost sharing partners. USACE is expected to reveal which measures it may take to mitigate flooding by mid 2014. Westchester County is currently working on a countywide flood mitigation plan.

**Figure 4-3. Town of Mamaroneck
Street Flooding during the Nor'Easter April 15, 2007**



Flooding on Brookside Drive
Photo by Abby Katz, via Larchmont Gazette



Overflowing Stream – brook and waterfall
Photo by Linnet Tse via Larchmont Gazette

4.D.1.4 The Base Flood

The Base Flood is the 100-Year flood. This is not a flood that occurs once in 100 years but is a large flood elevation that has a one-percent chance of being equaled or exceeded in any given year. Therefore, the 100-Year flood could occur more than once in a relatively short period of time. The "100-Year" flood is a measure of the size of the flood, not how often it occurs. The 100-Year flood is the standard used by most federal and state agencies such as the National Flood Insurance Program (NFIP).

The FEMA 100-Year flood line for the Town of Mamaroneck runs along the shoreline and up along the river corridors. It runs along the Sheldrake River and its tributaries, along the Premium River, Premium Point, the East Creek, and the Mamaroneck Reservoir. (See Figure 4-2).

Properties along these waterways are vulnerable to storm damage during severe northeasters and hurricane conditions. Flooding can come with little warning. Even though they appear to move slowly (three feet per second) a flood two feet deep can knock a man off his feet and float a car. Properties that would be impacted are primarily areas that are vulnerable to the effects of poor drainage, low elevation, and abnormally high tides.

4.D.1.5 The 500-Year Flood

A 500-Year flood is a flood that has a 0.2-percent chance of being equaled or exceeded in any one year. Extensive portions of the Town of Mamaroneck lie directly within the 100-year floodplain and the 500-year floodplain. (See Figure 4-2.)

Numerous structures could potentially be impacted. The 500-Year flood is an infrequent event meaning that it can occur between once in eight years to once in fifty years. However, these storms have been happening more frequently. As with the 100-Year Flood, it does not mean a flood occurs once in 500 years.

4.D.2 Hurricanes

Hazard Summary: Hurricanes are major tropical cyclonic wind and rain storms with winds ranging from 75 to over 155 mph. The last major hurricane to cross Westchester County was the “Great Hurricane of 1938”. Since then, there have been no official hurricanes. Damage is not only from strong wind but also major flooding can occur from storm surges. Hurricanes are among the most threatening and highest ranked natural disasters in the northeast. Heavy rainfall would result in flooded areas shown in Figure 4-2. The extent of wind damage from hurricanes varies but this hazard would impact the entire Town and the surrounding region. Wind and water damage from hurricanes include: serious flooding of streets and homes; utility failures; damage to buildings, roofs, windows and personal property; interruption of traffic and emergency, fire, police services; automobile accidents; food shortages; sewage impacts; economic loss, business loss, loss of employment, downtime, loss of inventory. A major hurricane though infrequent can strike the Town of Mamaroneck. The Town is vulnerable due to its close proximity to the coastline.

Sources of information on Hurricanes are given in Section 11, References Cited and include: National Weather Service Hurricane website; US Landfalling Hurricane Project website; NOAA Hurricane Research Division website; NOAA National Climatic Data Center website and event record details; National Center for Atmospheric Research; Accuweather website; Local papers: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette, Daily Mirror (September 23, 1938, pgs. 3 & 17).

Profile Details: The flood-producing hurricane has a moderately high risk with a HAZNY score of 248. Although most hurricanes have been downgraded to tropical storms by the time they have reached Westchester County, the hazard was given a moderately high HAZNY score due to the damage they can cause. Based on historical records, the last hurricane to cross Westchester County was the “Great Hurricane of 1938”. Since then, there have been no official hurricanes. There have been numerous storms that began as hurricanes, such as Irene in 2011, Hanna in 2008, Ernesto in 2006, and Floyd in 1999, which were downgraded to tropical storms by the time they reached Westchester County. Sandy, also known as Superstorm Sandy, was not classified

as a hurricane when it hit landfall on the coast of New Jersey on October 29, 2012. It was considered to be a post-tropical cyclone with hurricane force winds. This was said to occur due to the alignment of a tropical storm with an extra tropical storm.

These tropical storms will be discussed in detail in Section 4.D3.1. Figure 4-5 shows the paths of the hurricanes listed in Table 4-6 that have been tracked within 50 miles of the Town of Mamaroneck from 1861 through 2012. This map was generated from the NOAA (2013) web site <http://maps.csc.noaa.gov/hurricanes/>.

Hurricanes are among the most threatening and highest ranked natural disasters in the northeast. Heavy rainfall would result in flooded areas shown in Figure 4-2. The extent of wind damage from hurricanes varies but this hazard would impact the entire Town and the surrounding region.

Wind and water damage from hurricanes include:

- Serious flooding problems (streets and homes)
- Utility failures (electricity and telephone)
- Natural resource damage (trees, wetlands)
- Property damage (buildings, roofs, windows, personal property)
- Oil spills (floating and damaged underground tanks)
- Boat damage (destruction and capsizing)
- Serious traffic problems (interruption in emergency, fire, police services)
- Beach and shoreline erosion
- Public health and safety (automobile accidents, food shortages, sewage impacts)
- Economic loss (business loss, loss of employment, downtime, loss of inventory)

From 1971 until 2008 hurricanes were rated according to the Saffir-Simpson Hurricane Scale based on the intensity of the sustained wind speed, pressure, storm surge, and flooding measurements. In 2009, the U.S. National Hurricane Center switched over to the Saffir-Simpson Wind Scale, which is a categorical classification of hurricanes based on their sustained wind speed. The scale underwent minor modifications in 2012.

The scale ranges of the Saffir-Simpson Hurricane Wind Scale are from 1 to 5 as follows:

Saffir-Simpson Hurricane Wind Scale		
Category	Sustained Winds	Types of Damage Due to Hurricane Winds
Category 1	74-95 mph 64-82 kt 119-153 km/h	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days
Category 2	96-110 mph 83-95 kt 154-177 km/h	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
Category 3	111-129 mph 96-112 kt 128-208 km/h	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
Category 4	130-156 mph 113-156 kt 209-251 km/h	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
Category 5	157 mph + 137 kt + 252 km/h +	Catastrophic damage will occur: A high percentage of framed homes will be destroyed with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Weather Service, National Hurricane Center, Saffir-Simpson Hurricane Wind Scale, <http://www.nhc.noaa.gov/aboutsshws.php>

Because the Town of Mamaroneck is in the northeastern U.S., Category 5 hurricanes are considered unlikely. Although possible, no category 4 hurricanes have directly hit Westchester County. The Town of Mamaroneck is located in Wind Zone 2, with wind speeds ranging up to

160 mph. It is also mapped in the Hurricane Susceptible region, which extends along the east coastline.

The Hurricane of 1938, for example, was one of the most damaging events on record. It was a Category 3 storm, but Mamaroneck did not suffer the brunt of the storm. According to news archives, Mamaroneck suffered from flooded cellars, downed telephone and telegraph poles, downed trees along back roads, and power outages for only one half hour. (Daily Mirror, Friday, September 23, 1938).

Climate models project increased rainfall rates, which can lead to stronger hurricanes and rising sea levels. This topic is discussed in Section 4.D.5.7, The Effect of Climate Change on Natural Hazards.

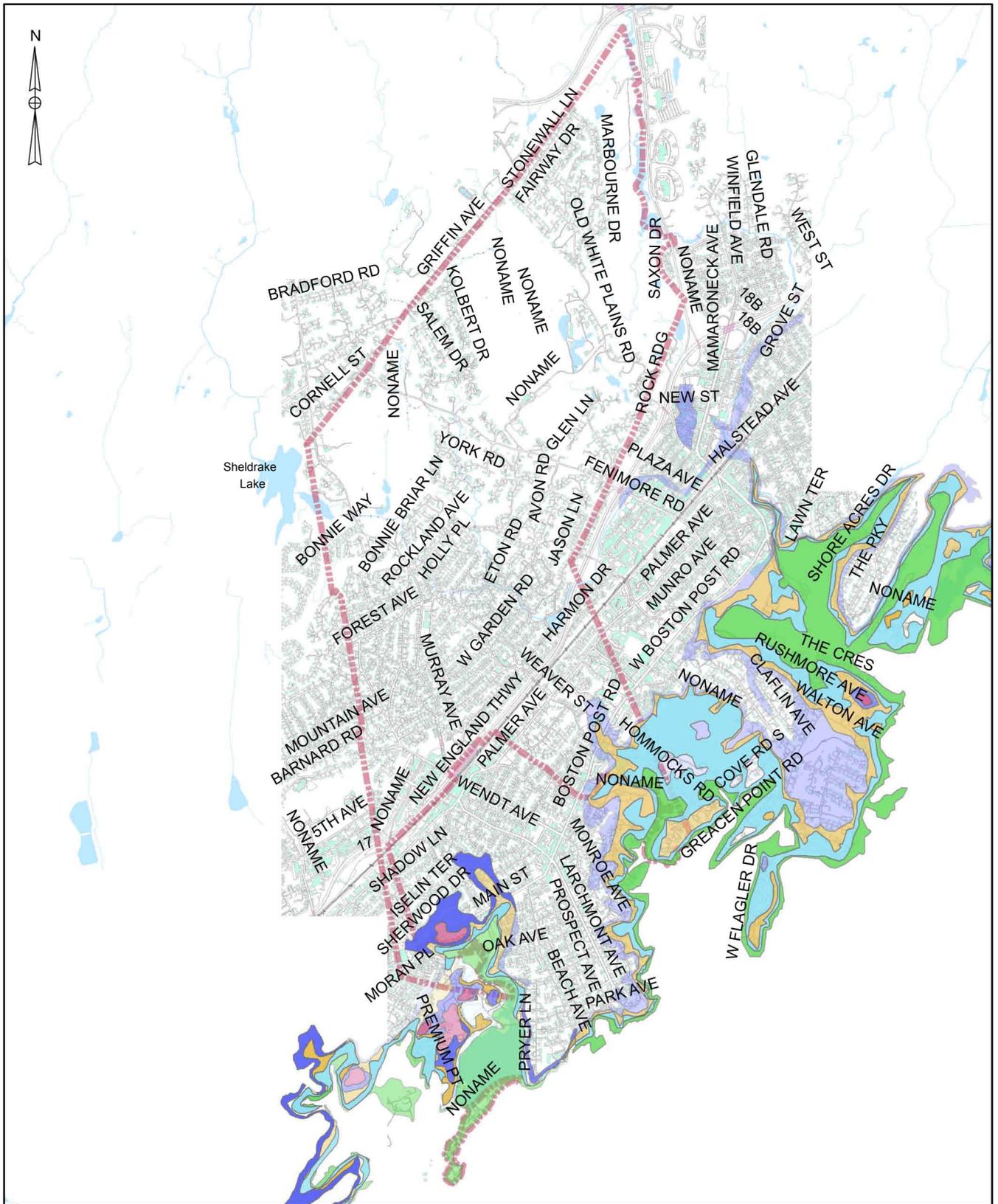
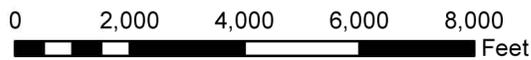


Figure 4-4
Hurricane Inundation Zones
Town of Mamaroneck
All Hazard Mitigation Plan



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DWN BY: YS
CHK BY: JB
SCALE: AS SHOWN
DATE: 08/27/13

Historical Hurricane Tracks

National Oceanic and Atmospheric Administration

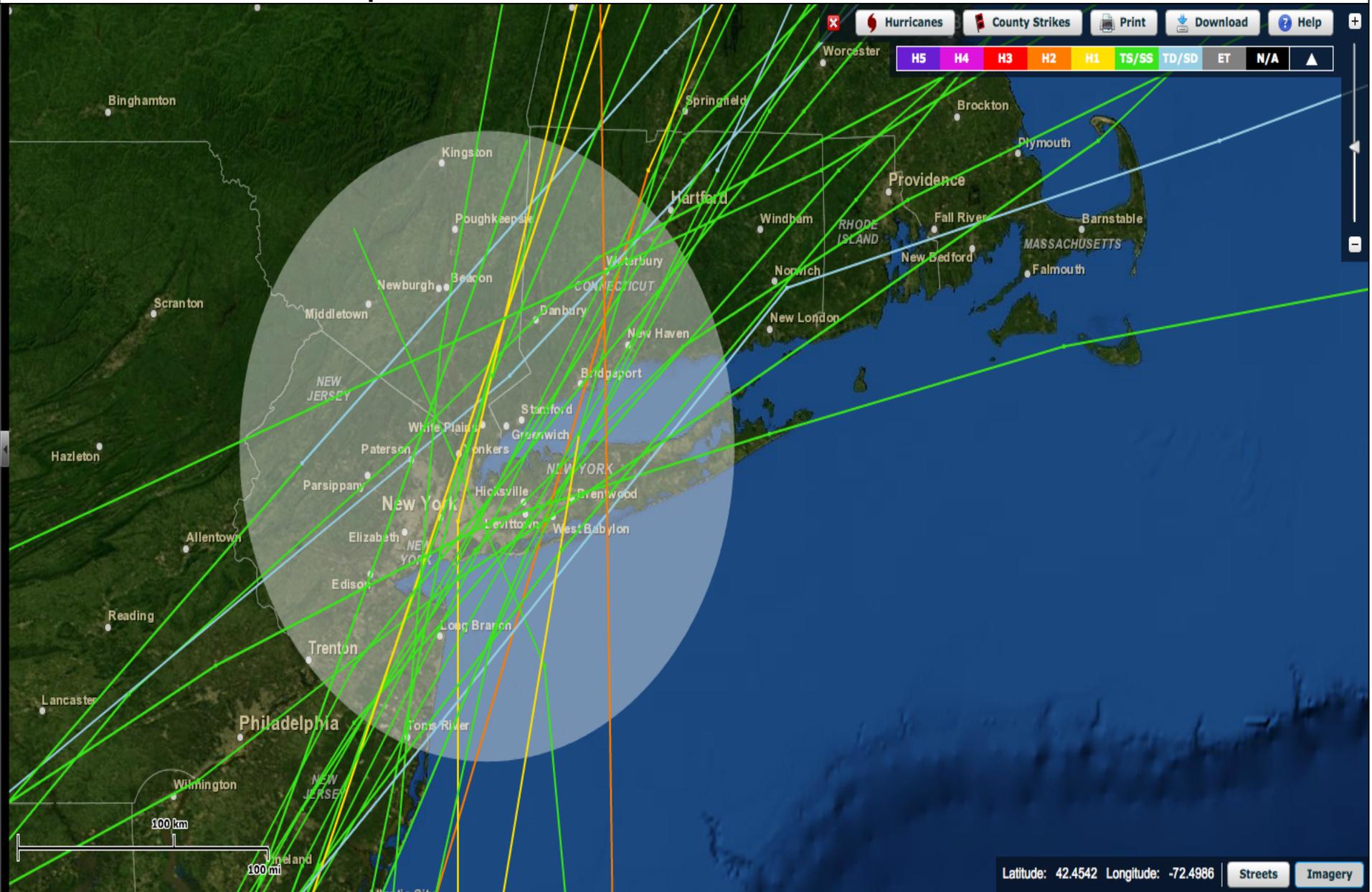


Figure 4-5 Major Regional Hurricane Tracks

Table 4-6. Historical Hurricanes Storm tracks from 1861 - 2012 within 50 Miles of Mamaroneck, NY.

Storm Name	Max Saffir-Simpson	Date
NOT NAMED 1861	H1	Sep. 27, 1861 to Sep. 28, 1861
NOT NAMED 1863	TS	Sep. 16, 1863 to Sep. 19, 1863
NOT NAMED 1866	H1	Oct. 28, 1866 to Oct. 30, 1866
NOT NAMED 1872	H1	Oct. 22, 1872 to Oct. 28, 1872
NOT NAMED 1874	H1	Sep. 25, 1874 to Oct. 1, 1874
NOT NAMED 1888	H3	Aug. 14, 1888 to Aug. 24, 1888
NOT NAMED 1888	TS	Sep. 6, 1888 to Sep. 13, 1888
NOT NAMED 1893	H3	Aug. 15, 1893 to Aug. 26, 1893
NOT NAMED 1900	TS	Oct. 10, 1900 to Oct. 15, 1900
NOT NAMED 1915	H1	Jul. 31, 1915 to Aug. 5, 1915
NOT NAMED 1924	ET	Sep. 27, 1924 to Oct. 1, 1924
NOT NAMED 1934	H1	Jun. 4, 1934 to Jun. 21, 1934
NOT NAMED 1938	H5	Sep. 10, 1938 to Sep. 22, 1938
NOT NAMED 1945	H4	Sep. 12, 1945 to Sep. 20, 1945
ABLE 1952	H2	Aug. 18, 1952 to Sep. 2, 1952
DIANE 1955	H3	Aug. 7, 1955 to Aug. 21, 1955
BRENDA 1960	TS	Jul. 28, 1960 to Aug. 1, 1960
UNNAMED 1961	TS	Sep. 12, 1961 to Sep. 15, 1961
DORIA 1971	TS	Aug. 20, 1971 to Aug. 29, 1971
AGNES 1972	H1	Jun. 14, 1972 to Jun. 23, 1972
BELLE 1976	H3	Aug. 6, 1976 to Aug. 10, 1976
GLORIA 1985	H4	Sep. 16, 1985 to Oct. 2, 1985
CHRIS 1988	TS	Aug. 21, 1988 to Aug. 30, 1988
BERYL 1994	TS	Aug. 14, 1994 to Aug. 19, 1994
BERTHA 1996	H3	Jul. 5, 1996 to Jul. 17, 1996
FLOYD 1999	H5	Sep. 7, 1999 to Sep. 19, 1999
HANNA 2008	H1	Aug. 28, 2008 to Sep. 8, 2008
IRENE 2011	H2	Aug. 21, 2011 to Aug. 30, 2011

Source: <http://maps.csc.noaa.gov/hurricanes>

Note: Hurricane Irene formed on August 20, 2011 and dissipated on August 30, 2011. Its highest rank on the Saffir-Simpson Scale was a Category 3 Hurricane (H3). Irene was downgraded to a Tropical Storm before it reached Westchester County. Hurricane Sandy formed on October 22, 2012 and dissipated on October 31, 2012. Its highest rank was a Category 2 Hurricane (H2). Sandy was downgraded to a post tropical cyclone with hurricane force winds before it reached Westchester County.

4.D.2.1 Notable Northeastern Hurricanes

All of the hurricanes listed below in Table 4-7 struck the northeast portion of the United States. Their total cost, death toll, and relative ranking are based on their overall impact along the Atlantic coast. The 1938 Hurricane (The Long Island Express) was a Category 3 storm when it hit landfall in the Northeast. The Category 4 hurricane such as Donna is a rare event largely because hurricanes generally lose force and intensity as they move into northern areas with colder ocean water.

Table 4-7. Major Northeast Hurricanes and Damage Costs.

National Ranking by Damage	Hurricane Name	Year	Hurricane Category	Total Damage Million Dollars*
9	Agnes	1972	1	11,760
14	Floyd	1999	2	9,225
17	Diane	1955	1	7,408
19	L.I. Express	1938	3	6,325
23	Great Atlantic	1944	3	5,706
26	Carol	1954	3	4,175
29	Donna	1960	4	3,215
30	Bob	1991	2	2,703

Source: NOAA Technical Memorandum NWS NHC-6. “The Deadliest, Costliest and Most Intense U.S. Tropical Cyclones From 1851-2010 (And Other Frequently Requested Hurricane Facts)”. National Weather Service, National Hurricane Center, August 2011. www.nhc.noaa.gov/pdf/nws-nhc-6.pdf

**Damage costs for East Coast U.S. based on Year 2010 deflator.*

Note: Not included above: Hurricane Irene (2011) has an estimated total damage of \$15,800,000,000. Damage costs for Hurricane Sandy (2012) have not been totaled yet, but estimates as of June 2013 assess damage to have been over \$68,000,000,000, a total surpassed only by Hurricane Katrina.

4.D.3 Other Severe Storm Hazards

There are other severe storm hazards that produce damaging winds and flooding. This section discusses warmer season storms. Winter storm hazards are addressed in Section 4.D.4 below. The impact locations and extent of damage and flooding from other severe storms can be similar to hurricanes, and result in 100-Year and 500-Year floods that were discussed above in Section 4.D.1. The geographical extent of wind damage from severe storms may cover large areas and this hazard would likely impact the entire Town. The damage to Mamaroneck from severe storms and coastal storms has been very significant.

Utility failures occur during severe storms such as Nor'Easters, tropical storms, wind and snowstorms. This is usually due to the breakage of utility poles or power lines causing electrical failures in local areas. This damage may be localized in several areas or impact the entire Town. Con Edison reports that during storm events several hundred thousand customers have been without power for several days. Storm related damage has sometimes required help from other utilities outside our region in order to restore power. Utility failure will be discussed in detail in Section 4.D.6.1. Structural damage for each of these storm hazards has not been quantified but can be assumed to be similar to less severe hurricanes.

4.D.3.1 Tropical Storms

Hazard Summary: Tropical storms are tropical cyclones with sustained winds between 39-73 mph. Hurricanes have sustained winds of 74 and up and are often downgraded to tropical storm status by the time they reach Westchester County. It is an organized rotating weather system that develops in the tropics and which has a warm center (or core) of low barometric pressure. The Town of Mamaroneck has felt the effects of many tropical storms. Because of their less severe wind speeds, wind damage is less than a hurricane. However, rainfall, wind, and storm surge from these storms has caused serious flooding in the Town. Areas flooded are shown in Figure 4-2, 4-3, 4-4 and 5-2. Damages are the same as those described for flooding discussed above. Future flooding from tropical storms can be expected.

Sources of information on tropical storms are given in see Section 11, References Cited and include: Meetings with residents; Local papers and websites, including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); Town Documents and Engineering reports; NOAA websites; FEMA website; Westchester County (All Jurisdictions) Flood Insurance Study, September 28, 2007; NYS Office of the Governor Press releases; FEMA Press releases; Con Edison press releases.

Profile Details: Tropical Storm Floyd wreaked havoc on Westchester County on September 16, 1999. Sustained 60 mph winds accompanied torrential rainfalls. Maximum rainfall rates ranges from 1 to 2 inches per hour for at least 3 consecutive hours across parts of Westchester. Total

rainfall at the Westchester County Airport was measured at 6.26 inches. Damage in Westchester County was reported at \$6.6 million.

Tropical Storm Ernesto brought strong winds and heavy rain to Westchester County on September 2, 2006. The hardest hit areas were in the Southern Westchester towns, including Mamaroneck, Larchmont, Greenburgh, Mount Vernon, New Rochelle, North Castle, Ossining, Port Chester, Rye, Scarsdale, Tarrytown, White Plains and Yonkers. The storm caused power outages to approximately 80,000 customers in Westchester County, most located in Southern Westchester. According to Con Edison, approximately 100 trees were downed, and 900 wires fell. Residents of the Town of Mamaroneck experienced high winds, which downed power lines and trees, and caused power outages.

Tropical Storm Hanna hit Westchester County on September 6, 2008. Wind gusts ranges from 35 to 45 miles per hour, and rainfall totaled 4.41 inches of rain at Westchester County Airport.

Tropical Storm Irene hit Westchester County on August 27, 2011. The President declared an Emergency for the State of New York, Including Westchester County (DR-4020). Irene made landfall as a tropical storm along the southeastern New Jersey Coast and New York City. It was made up of sustained tropical storm winds, very heavy rain, and destructive storm surges along the coast. It also brought two tornadoes in the area. This storm brought severe damage to Westchester County. Over 7 inches of rainfall fell on the Town of Mamaroneck. A storm surge reached 5 feet reached the Town. Trees and power lines were also downed. Wind gusts of 75-80 MPH knocked out power to some areas of the Town for several days. An estimate of 233 area residents utilized the emergency shelter located in the Mamaroneck High School Gymnasium (DR-4020).

Hurricane Sandy hit Westchester County on October 29, 2012. Sandy was not a typical hurricane. By the time it made landfall in the Northeast, it had become a post-tropical cyclone with hurricane force winds. Referred to as “Superstorm Sandy”, this phenomenon occurred due to the alignment of a tropical storm with an extra tropical storm.

Sandy did not produce too much rain, but the high force winds downed trees and power lines throughout Westchester County. Con Edison reported more than 206,000 customers lost power in Westchester County; 180 roads were closed in the County. In the Town of Mamaroneck, the storm exceptionally high tides in the coastal areas at Hommocks Road and Pryor Manor road caused some homes to flood. Wind speeds reached as high as 70 MPH, causing downed trees and power lines, knocking out power to approximately 60% of the community and forcing the closure of 70 area roads.

Along with widespread power outages, Sandy created logistical problems, which made it difficult to obtain and transfer fuel from the refineries and terminals to those who needed it, thus creating a gasoline shortage.

A Federal Emergency Declaration was declared for Sandy on October 28, 2012 (EM-3351) for New York State, including Westchester County. On October 30, 2012, a Major Disaster Declaration was declared (DR-4085) for parts of New York, including Westchester County.

4.D.3.2 Coastal Storms

Hazard Summary: A coastal storm is a non-tropical storm that produces gale-force winds and precipitation in the form of heavy rain or snow. An intense extra-tropical coastal storm for the region is called the Nor'Easter. The Town of Mamaroneck has felt the effects of many coastal storms. Because of their less severe wind speeds, wind damage is typically less than a hurricane. However, rainfall and storm surge from these storms has caused serious flooding in the Town. In the winter these storms can cause blizzards. Flooding impacts several streets scattered over the Town. Areas flooded by these storms are the same as for other storms and are shown in Figures 4-2, 4-4, 4-5 and 5-2. Damages are the same as those described for flooding and tropical storms discussed above. Future storms of this type are commonly expected. Future flooding from these storms can be expected.

Sources of information on coastal Nor'Easter storms are given in Section 11, References Cited and include: Public meetings with residents; Local papers and websites, including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town,

Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); Documents and Engineering reports supplied by the Town; NOAA websites; FEMA website; Westchester County (All Jurisdictions) Flood Insurance Study, September 28, 2007; NYS Office of the Governor Press releases; FEMA Press releases; Consolidated Edison press releases.

Profile Details: Nor'Easter storms move north along the east coast and have strong winds with heavy precipitation blowing off the Atlantic Ocean from the northeast. If a Nor'Easter moving up the coast follows a track westerly of New York City, rain is typically the result. However, if the storm maintains a track just off the eastern coast of the city, then snow or mixed precipitation is likely to occur. In the Mamaroneck area these storms have resulted in serious flooding of streets and homes, very high gale force winds, destruction of trees, utility poles, and damage to homes and other buildings. These storms are frequent and cover a large region including Westchester County, Long Island, and New England.

The presence of fronts and a drop in temperature at higher levels of the troposphere keep the storm from being classified as tropical. The most notable Nor'Easters that affect New York City and Westchester County have occurred as snowstorms during the winter weather months. Winter Nor'Easters are discussed below in Section 4.D.4. They may occur as heavy rainstorms or snowstorms. Severe storms have occurred in the Mamaroneck area that resulted in heavy precipitation, serious flooding of streets and homes, very high gale force winds, destruction of trees, utility poles, and damage to homes, businesses, and other buildings.

These storms are frequent events and cover a large region including Westchester County, Long Island, and New England. Wind speeds can approach those of a Category 2 hurricane. These storms may last from one to a few days. There is a potential for serious injury and some deaths. Property damage may be moderate to severe. Damage to infrastructures such as electrical power lines may be moderate to severe. There is a high probability for a major future coastal storm.

The Nor'Easter of December 10-13, 1992 caused torrential rains, gusting winds, massive flooding, power outages, and property damage. Basements were flooded, trees and utility poles were down, and traffic was seriously snarled. This storm caused about \$1-\$2 million in damages

and costs and 19 deaths in the northeastern U.S. (NCDC/NOAA (1998), Billion Dollar Weather Disasters). (FEMA DR-974).

The Nor'Easter of October 19-20, 1996 brought widespread flooding to the area. Approximately 5 inches of rain fell in Westchester County, and there were 30-40mph winds with gusts up to 60 mph. This storm caused more than \$3.5 million in damages to Westchester and Suffolk Counties. (DR-1146). (NOAA, NESDIS, NCDC, Event Record, 19 Oct. 1996).

The Nor'Easter of April 15, 2007 brought high wind gusts and about 8.05 of rain fell on Southern Westchester County within a 24-hour period, leaving scores of homes and businesses underwater. This resulted in what some people call the "worst flooding in half a century". The Town of Mamaroneck was hit hard by this storm, bringing serious flooding to approximately 70 homes in the Town. More than 7 inches of rain fell over 15 hours in the Town. Heavy rains swelled local brooks and rivers releasing torrents of water throughout the town. Homes on East and West Brookside Drives were especially hard hit. "The Brook", a section of the Sheldrake River overflowed and flooded adjacent roads and homes, forcing Con Edison to shut off power. Other areas affected were near Larchmont Gardens Lake, and areas bordering the Sheldrake River and parts of Murray Avenue. Flooding occurred in approximately 70 homes, some level of damage occurred to 222 homes, and power was lost to approximately 600 homes. (DR-1692).

The Nor'Easter of March 13, 2010 brought rain, storm surge, and high wind gusts of up to 62 mph. High winds downed trees, tree limbs, and powerlines, causing significant property damage in the Town of Mamaroneck, leaving over 1,000 homes without power. (DR-1899).

4.D.3.3 Severe Storms and Thunderstorms

Hazard Summary: Severe storms are atmospheric disturbances usually characterized by strong winds, frequently combined with rain, snow, sleet, hail, ice, thunder and lightning. A thunderstorm is an event that produces lightning strikes, thunder, high winds, heavy rains, flooding and hail. Other associated dangers of thunderstorms include tornadoes, and flash flooding. Flash flooding is responsible for more fatalities, more than 140 annually, than any other thunderstorm-associated hazard.

Because their winds can be strong and gusty, wind damage can be severe. Trees, roofs and utility lines are particularly vulnerable from wind and lightning throughout the entire Town. Rainfall from these storms has caused serious flooding in the Town. Areas flooded by these storms are shown in Figure 4-2, and 5-2. Damages are the same as those described for flooding and tropical storms discussed above. Future storms of this type are commonly expected. Future flooding from these storms can be expected.

Sources of information on severe storms and thunderstorms are given in see Section 11, References Cited and include: Public meeting with residents; Local papers and websites, including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); Documents and Engineering reports supplied by the Town; NOAA websites; FEMA website; Spatial Hazard Events and Losses Database for the United States (SHELDUS) website; Consolidated Edison Press releases.

Profile Details: A severe storm and thunderstorm can produce lightning strikes, high winds, heavy rains, flooding, hail, and cause damage to trees, utility poles, power lines, commercial structures and residential homes. Although effects from one these storms is localized, the damage could occur anywhere in the Town. Such severe storms and thunderstorms have a high probability of occurrence in the region.

Deaths from lightning strikes and other accidents occur in Westchester County. Such thunderstorms have a high probability of occurrence in the region. These storms are commonly associated with frontal systems and may result in concentrated heavy down pours of rain. Rapid local flooding may occur without warning.

Hailstorms, which can accompany thunderstorms, occur in Westchester but they are not prevalent. Thunderstorms may also be associated with hurricanes discussed above and with tornados discussed below. This severe storm hazard is prevalent in Westchester County during the warmer months of the year.

Between January 1, 1960 and December 31, 2012, 206 major thunderstorms were listed in the Spatial Hazard Events and Losses database (SHELDUS) for Westchester County. This is not a complete listing of all storms as thunderstorms are more frequent than indicated. These storms are very frequent events and may cover large area across Westchester County. Wind gusts of 50 to 75 mph are not uncommon. A storm may last from less than an hour to several hours. There is a potential for serious injury and limited deaths. Property damage may be moderate to severe. Damage to infrastructures such as electrical power lines is prevalent with downed power lines or damaged transformers or substations.

Westchester County was hit hard by a multitude of weather events, all of which were accompanied by severe thunderstorms. Most notable storms are described below.

Westchester County was hit hard in 2006 by a series of storms that occurred in the summer. They occurred closely together and were all accompanied by severe thunderstorms. Most notable thunderstorms include the ones that accompanied the microburst on July 18, 2006, which affected areas in Westchester County south of I-287. Heavy rains, and wind gusts up to 60-70 mph knocked out power to 35,000 households. This storm damaged many trees in the County.

Another thunderstorm accompanied a microburst electrical storm that occurred just days later on July 21, 2006, which also affected areas south of I-287. The next day, another storm knocked out power to an additional 6,000 households.

A severe storm dropped about 4 inches of rain in lower Westchester County on March 2, 2007, causing flooding of streets near tributaries in the Town of Mamaroneck.

On September 19, 2012, a severe storm occurred in Westchester County. Heavy rainfall and high winds downed trees and powerlines, knocking out power to 118 customers in the Town of Mamaroneck.

On July 13, 2013, a summer storm dropped approximately 2.13 inches of rain on the Town of Mamaroneck. High winds were blamed for knocking down several powerlines.

There is a high probability for future damaging thunderstorms. NOAA scientists predict that more severe thunderstorms with lightning, hail and the potential for tornadoes will occur in the future due to climate change. Prepared by the National Weather Service, Figure 4.6 below identifies the states most prone to these severe storms, including New York State.

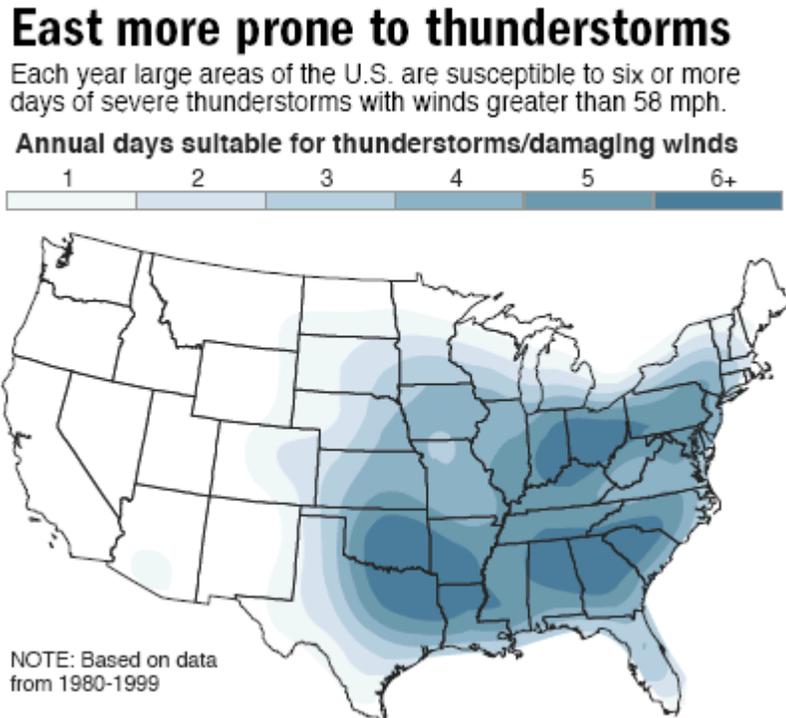


Figure 4-6. States Most Prone to Thunderstorms.

Source: msnbc.com, NWS

4.D.3.4 Tornadoes

Hazard Summary: A tornado is a local atmospheric storm, generally of short duration, formed by winds rotating at very high speeds, in a funnel-shaped cloud striking the ground with whirling winds of up to 318 miles per hour or more. The vortex, up to several hundred yards wide, is visible to the observer as a whirlpool-like column of winds rotating about a hollow cavity or funnel. Winds may reach 300 miles per hour or higher.

They are infrequent and are scattered geographically over the County and cover a relatively narrow path that can produce severe damages. Wood frame building and other weakly

constructed building, trees, and utility lines are particularly vulnerable from wind damage. There is no history of a tornado in the Town of Mamaroneck. There were 7 documented tornadoes in Westchester County between 1958-2004. Four scored an F1 on the Fujita Tornado Scale and 3 scored an F0. There was an 8th tornado on 7/12/2006, which was sighted over the Hudson River and went through Sleepy Hollow, Mt. Pleasant, and the hamlet of Hawthorne. This was an F2 tornado. On July 1, 2013, a tornado scoring an EF0 on the Enhanced Fujita Tornado Scale touched down in Greenwich, Connecticut. Although not located in Westchester County, Greenwich lies less than 10 miles from the Town of Mamaroneck.

Tornadoes have an unpredictable impact and could strike any area in the Town. These storms are a rare event in the County and future storms of this type are possible. Hilly terrain such as that surrounding Mamaroneck has a lower risk and frequency of tornadoes. They are also associated with other severe storm hazards, so they are not evaluated further in the plan as a separate hazard.

Sources of information on tornadoes are given in Section 11, References Cited and include: Tornado History Project website; Bergen SkyWarn website; Accuweather.com; Journal News; NY Times; NOAA websites; FEMA website; New York State Standard Multi-Hazard Mitigation Plan; Westchester County Comprehensive Emergency Management Plan.

Profile Details: Although there have been several tornadoes reported in Westchester County, they are considered infrequent. There is no history of a tornado striking the Town of Mamaroneck. The database for storm events lists eight tornado events for Westchester County between 1950 and 2012 (SHELDUS, 2013) with one death reported. None of the eight reported events have been in or near Mamaroneck. On July 12, 2006, the eighth tornado occurred in Westchester County. A tornado was sighted over the Hudson River near the Tappan Zee Bridge. It quickly moved east over the Village of Sleepy Hollow, then into the town of Mount Pleasant, where it did the most damage in the hamlet of Hawthorne. Winds exceeded 150 MPH along the path. A state trooper's patrol car was picked up in the air and spun around. A two-story brick building was critically damaged; seven large trees toppled onto the Metro-North railroad tracks; and 4,000 Westchester residents lost power due to the severe thunderstorms that accompanied the tornado.

There were 6 injuries reported. The reported path width of the tornado was estimated at 200 to 300 yards based on the damage survey across Westchester County. (National Weather Service, Upton, NY, July 14, 2006). On July 1, 2013, a tornado touched down in Greenwich, Connecticut. The tornado was rated an EF0 on the Enhanced Fujita Tornado Scale, with winds up to 80 MPH, and caused tree damage along a 3.7 mile path that was about 150 yards wide. Although not located in Westchester County, Greenwich, CT lies less than 10 miles from the Town of Mamaroneck.

There have been no other occurrences of tornadoes in Westchester County since 2006, despite several tornado warnings. The last warning was as recent as September 2012.

As of February 1, 2007, the severity of a tornado is rated using the Enhanced Fujita Tornado Scale. All reported tornados in the county were less than a magnitude of F3. The last tornado reached an F2 magnitude, four of the tornadoes were an F1 Magnitude, and three reached an F0 Magnitude.

Enhanced Fujita Tornado Scale

- EF0 = 65 to 85 mph – light damage
- EF1 = 86 to 110 mph – moderate damage
- EF2 = 111 to 135 mph – considerable damage
- EF3 = 136 to 165 mph – severe damage
- EF4 = 166 to 200 mph – devastating damage
- F5 = 201 mph and up – incredible damage

Although infrequent, these tornadoes can produce considerable damage in localized areas anywhere in the Town or County. The reported width of tornados in Westchester County ranged from 13 yards to 300 yards. However, the geographical occurrence could be anywhere in the Town or the county. Tornados are also associated with severe thunderstorms and with hurricanes for which hazards were discussed in Section 4.D.1. NOAA scientists predict that more severe thunderstorms with lightning, hail, and the potential for tornadoes will occur in the future due to climate change.

Because tornadoes are not a frequent hazard, are scattered geographically and are also associated with other severe storm hazards, they are not evaluated further in this plan as a separate hazard.

4.D.3.5 Wind Storms

Hazard Summary: Windstorms are accompanied by strong gale force or stronger winds that may or may not include precipitation. These winds may be associated with tornadoes, thunderstorms, Nor'Easters, tropical storms, and hurricanes. They are violent winds of high velocity and are commonly associated with frontal weather systems. They cover a relatively wide path in the region and they affect the entire geographical area of the Town. Windstorms can produce gale force gusts of wind and can cause severe damage to wood frame buildings, roofs, trees, utility lines and unsecured materials and items.

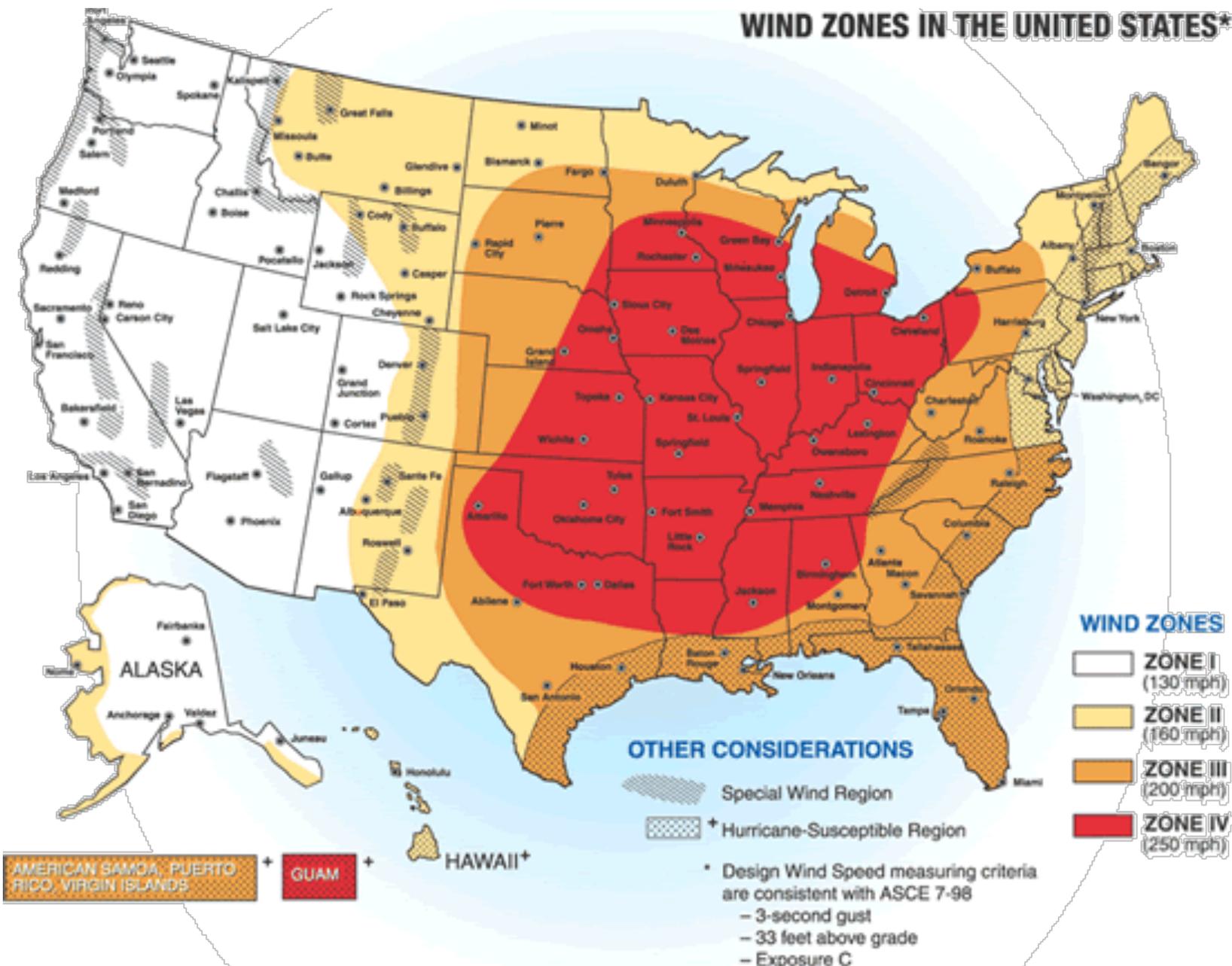
Many notable wind events have crossed the Town of Mamaroneck. In January of 2006, a series of severe windstorms occurred which uprooted trees and caused scattered power outages across Southern Westchester. 61,486 households in Westchester lost power from these storms. NOAA reported a severe windstorm occurred on September 30th and October 1st, 2010, with wind gusts ranging from 40-55 MPH in Southern Westchester. Con Edison reported 1200 households in Southern Westchester lost power as a result of that storm. On October 29, 2012, Super Storm Sandy brought wind gusts of up to 70 MPH through Southern Westchester, causing extensive damage and knocking out power to 60% of the Town of Mamaroneck. On January 31, 2013, high winds reportedly downed trees and powerlines, causing three overhead transformers to explode near the Town of Mamaroneck; knocking out power to about 100 customers in the Town. Maximum wind gusts during this storm were reported to be 54 MPH. On May 25, 2013, a wind event brought sustained wind speeds of 35 MPH and maximum wind gusts of 46 MPH to Southern Westchester.

Wind events are common in the Town of Mamaroneck and they can strike any area the Town. Future storms of this type are highly likely.

Sources of information on wind storms are given in Section 11, References Cited and include: Bergen SkyWarn website; Accuweather.com; local papers and websites including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); NOAA websites; FEMA website; Wind zones of NY, NYS^OEM website; NYS Multi-Hazard Mitigation Plan.

Profile Details: Windstorms can cause destruction of trees, toppling of power and telephone lines, and serious widespread damage to humans and property. Wind zones in the United States, which are used for construction standards, are shown in Figure 4-7. The Town of Mamaroneck is located in Wind Zone II, which makes it susceptible to winds of up to 160 MPH. It is also situated in the hurricane-susceptible region. This wind hazard cannot be geographically determined but can affect the entire Town planning area. These storms have caused power failures, damage to property including window and roof breakage, human injuries from falling objects, and damage and capsizing of boats, beach erosion, and financial losses. Windstorms are similar to and commonly associated with the advance of other storm events such as thunderstorms and tornados.

WIND ZONES IN THE UNITED STATES*



Source:
www.fema.gov/safe-rooms/wind-zones-united-states

Figure 4-7

4.D.4 Winter Storm Hazards

Winter weather for the Town of Mamaroneck is highly variable. Storm systems in winter may deposit snow, sleet or freezing rain, with a significant impact on transportation systems and public safety. These hazards also include severe snow storms and blizzards. Although there are several winter storm hazards, ice storms and snowstorms are the most prevalent. There are no mountains in the area that could produce avalanches. Although ice jams in the Town's rivers can occur in severely cold winters, they are not a hazard causing severe damage or loss of life, but some have caused localized flooding.

The damage to the Town of Mamaroneck from severe winter storms, coastal storms, Nor'Easters, ice storms, and snowstorms has been very significant. Winter storms cover a relatively wide path in the region and they affect the entire geographical area of the Town. Average minimum winter temperatures for the area are approximately 20.1 degrees Fahrenheit. The lowest recorded temperature for New York City was -15 in 1934. (NYSCE 2006, Climate Summary)

4.D.4.1 Snow Storms

Hazard Summary: A severe snowstorm deposits heavy snow amounting to 12 inches in 12 hours or less. Snowstorms are common winter events for the region. The average annual snowfall for Westchester County runs from 25 to 45 inches. The Town of Mamaroneck, located in the coastal area, averages between 25 and 30 inches of snowfall per year. Snow storms deposit several inches of snow over the entire Town and are often accompanied by strong gale force winds. Snow storms with high winds are referred to as blizzards. They blanket a relatively wide area locally and can produce severe damage to buildings, trees, and utility lines. Heavy snowfalls and blizzards affect the entire planning area since access to roads and highways is necessary for residents. In addition they disrupt train service, bus service and traffic as well as school, business and employment activities. The greatest daily snowfall since 1949 was 26.9 inches in February 2006 when a snowstorm occurred in the area. The blizzard of February 12, 2006 was the biggest snowstorm in the New York City region's history. Snow events are common in the Town of Mamaroneck and they generally strike the entire Town. Future storms of this type are highly likely.

Sources of information on snow storms are given in see Section 11, References Cited and include: Accuweather.com; Local newspapers papers and websites, including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); NOAA websites; FEMA website; NYSCE 2006, Climate Summary, NWS Forecast Office, Significant Weather Events Archive; Spatial Hazard Events and Losses Database for the United States (SHELDUS); Current Results, Research News & Science Facts website, www.currentresults.com/weather/new-york/; NYC Weather & Storm Blog www.severeweathervideo.com.

Profile Details: Heavy snowfalls and blizzards affect the entire planning area since access to roads and highways is necessary for residents to travel to work and school, obtain necessary foodstuffs for their families, and allow fire, public safety, and ambulances to reach their destinations when emergencies arise. These storms also cause dangerous situations from fallen electrical lines and trees falling on roofs. Coastal winter snowstorms or Nor'Easters can be particularly severe and hazardous. They can deposit large amounts of snow and produce strong winds that result in blizzard conditions.

A Nor'Easter in December 1992 was a blizzard that covered the eastern U.S. This storm resulted in 19 deaths over the area impacted. \$2.5 billion were reported in damages. These dollar amounts were adjusted to 2013 dollars by using the Consumer Price Index (CPI). (NCDC /NOAA, Billion Dollar Weather/Climate Disasters, 2012). www.ncdc.noaa.gov/billions/events (DR-974).

A Nor'Easter on March 12-14 1993 was a blizzard that covered the eastern U.S. and was called the storm of the century. It affected 26 states and resulted in 270 fatalities. This storm cost \$8.9 billion adjusted 2013 dollars. In New York State the death toll was 23. Hundreds of roof collapses occurred in the northeast due to the weight of the heavy wet snow. Over 3 million customers were without electrical power in the region at one time due to fallen trees and high winds. At least 18 homes fell into the sea on Long Island due to the pounding surf. Winds of 71 mph were reported at La Guardia Airport, NY (NCDC/NOAA, 2013). Westchester County suffered approximately \$8.9 million dollars in damages adjusted for 2013, and received between

10 and 20 inches of snow. Approximately 1,200 customers lost power in Mamaroneck and New Rochelle. (NY Times, “The Blizzard of ‘93”, March 14, 1993). (EM-3107).

The blizzard of January 6-8, 1996 was the biggest snowstorm in the New York City region in 48 years. Over 27 inches of snow fell on some areas of the region. LaGuardia Airport reported 24 inches of snow. Seven deaths in New York State were associated with the storm. The impacts of the storm were compounded by a thaw and heavy rains on January 19. Ten flood fatalities resulted for New York State. According to the National Climate Data Center, “Billion Dollar U.S. Weather/Climate Disasters (NCDC/NOAA, 2013), the total impact from this event on the northeast was 187 fatalities and about \$4.4 billion in total damages and adjusted 2013 costs including snow removal. (DR-1083).

The blizzard of February 12, 2006 was the biggest snowstorm in the New York City region’s history. A classic Northeaster, the storm was 1,200 miles long and 500 miles wide on satellite images, and it had winds that gusted up to 60 miles per hour. It spanned across the Northeast from Virginia to Maine. According to the National Weather Service, a record 26.9 inches fell in Central Park, the most since record keeping began in 1869. The previous record was 26.4 inches set during the great snowstorm of 1947 (Dec 26-27) when 77 people were killed. Another record 25.4 inches fell at LaGuardia Airport. NOAA reported accumulation of 16 to 25 inches of snowfall in Westchester County; 21.5 inches fell at Westchester Airport, and 24.5 inches fell in New Rochelle. Although no power failures were reported in Westchester County, winds downed many trees and power lines. The total impact from this event on the northeast was only 3 fatalities and about \$3 billion in total damages and costs.

Approximately 12 inches of snow fell on the Town of Mamaroneck during the February 25-26, 2010 snowstorm. The storm also brought high wind gusts up to 45 mph to the Town.

The Blizzard of December 26-27, 2010 dropped approximately 22 inches of snowfall on the Town of Mamaroneck. (DR-1957).

Snowfall rates of over 3 inches per hour brought 13 inches of snow on the Town of Mamaroneck during the heavy snow storm of January 26-27, 2011. The storm also brought high wind gusts up to 43 mph to the Town.

On February 8th and 9th, 2013, the Blizzard of 2013 dropped 22 inches of snow on the Town of Mamaroneck.

NOAA's National Climatic Data Center has produced the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5, which is similar to the Fujita scale for tornadoes and the Saffir-Simpson scale for hurricanes. An evolution of the Northeast Snowfall impact Scale (NESIS) that NCDC began producing in 2005, the RSI differs because it includes population data, as well as the amount of snowfall and the spatial extent of the storm.

REGIONAL SNOWWFALL INDEX (RSI)		
Category	RSI Value	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18.0+	Extreme

4.D.4.2 Ice Storms

Hazard Summary: An ice storm is a type of winter storm that is characterized by freezing rain. The National Weather Service defines it as a storm that results in the accumulation of at least one quarter inch of ice on exposed surfaces. Ice storms frequently accompany snowstorms, blizzards, and Nor'Easters, and can manifest itself as hail or freezing rain. Significant accumulations of ice can knock down trees and power lines, and result in loss of power. Extreme slipping hazards are created for motorists and pedestrians.

Sources of information on ice storms are given in see Section 11, References Cited and include: Accuweather.com; Local newspapers papers and websites, including: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); NOAA websites; FEMA website; NYSCE 2006, Climate Summary, NWS Forecast Office, Significant Weather Events Archive; Spatial Hazard Events and Losses Database for the United States (SHELDUS); 2011 New York State Standard Multi-Hazard Mitigation Plan; NY State Division of Homeland Security and Emergency Services, NY State Office of Emergency Management.

Profile Details: Ice storms can affect the entire planning area, since access to roads and highways is necessary for residents to travel to work and school, obtain necessary foodstuffs for their families, and allow fire, public safety, and ambulances to reach their destinations when emergencies arise. These storms also can cause dangerous situations from fallen electrical lines and trees falling on roofs. Ice storms can be particularly severe and hazardous due to the potential slipping hazard.

There have been many ice storms in Westchester County, but there have been no presidential disasters declared for an ice storm alone, that did not accompany a blizzard, severe snowstorm, or Nor'Easter since 1953. According to the 2011 NY State Hazard Mitigation Plan, a vulnerability assessment was performed which indicated the New York counties most vulnerable to ice storms. Westchester County's final rating was a low score of 5 out of a possible 25.

Notable ice storm incidents have occurred in Southern Westchester County. A reported .25 inches of ice dropped in Southern Westchester County during a snow and ice event on January 18, 2011. On February 1, 2011, an ice storm was reported that dropped between 3/10th and 6/10ths of an inch of ice in Southern Westchester County.

4.D.5 Other Natural Hazards

Although other natural hazards occur in the Town of Mamaroneck, only a few are of concern while most others may not be severe or prevalent events. Volcanoes do not occur in this region

of the country. The following potential hazards are discussed below: Dam failure, Earthquakes, Epidemics, Extreme temperature, Drought, Landslides, and Tsunamis.

4.D.5.1 Dam Failure

Hazard Summary: A dam failure is the collapse or failure of an impoundment that causes downstream flooding. This failure could be caused by weakened dam structure or terrorist act, and would result in large volumes of water to rush downstream.

The Kensico Dam, located near Valhalla in central Westchester County (See Figure 0-2) holds 30.6 billion gallons of water in a reservoir covering approximately 2,000 acres. The Dam sits at the head of the narrow canyon of the Bronx.

Should the Kensico Dam fail, countless people would lose their lives, as well as structures in the floods path spanning from White Plains through the Bronx. The destruction would be extensive and impacts would be County wide, running from White Plains through the Bronx. Impacts to the Town of Mamaroneck would be less severe since it is not directly in the Bronx River Valley. Approximately nine million people, including 85% of Westchester County would lose their water supply. It could impact the Town and surrounding areas by running down the Sheldrake and Mamaroneck Rivers, resulting to damage to buildings and utility lines. In addition, it would disrupt train service and traffic. Future events of this type is considered unlikely but with a potential for large impacts.

The Larchmont Reservoir/Sheldrake River Dam, also known as the Upper Dam, or Larchmont Dam #2, is located in the Town of Mamaroneck, bordering the City of New Rochelle. The reservoir is also referred to as lake. James G. Johnson Conservancy, which is a 60-acre park that is owned by the Village of Larchmont, but located within the Town of Mamaroneck. The Dam is owned and operated by the Village of Larchmont. Completed in 1903, the Class C High-hazard dam runs approximately 1,000 feet long with a maximum height of 30 feet, and a spillway width of 50 feet. The spillway is located at the base of the dam with a 20-inch cast iron discharge pipe that can be remotely operated to adjust the freeboard height. The pipe is used to

regulate the reservoir water level, and is manually controlled by a valve downstream of the dam. The Town of Mamaroneck operates the Dam's valve.

The Larchmont dam was originally designed to provide potable drinking water from the Sheldrake River to the Village of Larchmont, but as of 1975, it no longer does so. The Dam is used for conservation and recreational purposes. The Dam also currently provides vital flood control for downstream areas in the Town of Mamaroneck and the Village of Mamaroneck.

A failure of the Larchmont dam could cause serious and damaging flooding of the Sheldrake River Valley from below the dam to the Mamaroneck Harbor. Many houses would be inundated. Several streets and roads along the river from the Sheldrake Reservoir to the Mamaroneck Harbor could be flooded. Water flowing over roads would likely have high velocity and could potentially wash pedestrians or vehicles downstream.

New York City and Westchester County are responsible for the safety and security of the Kensico Dam. Therefore, no mitigation measures will be proposed or evaluated. Since The Town of Mamaroneck is responsible for operating the dam valve on the Larchmont Dam, a damage analysis and health and safety assessments will be discussed further in Section 5. Mitigation measures will also be proposed and evaluated.

Sources of information on dam failures are given in see Section 11, References Cited and include: Town officials, Planning Committee, Association of State Dam Safety Officials, Collins' Assessment of New York City's reservoirs, dams, and aqueducts; 2010 Emergency Action Plan, Larchmont Dam (National Inventory of Dams ID# NY13625, NYSDEC Dam ID# 215-0210); Larchmont Water Company Dam #2,) National Inventory of Dams ID# NY00112, NYSDEC Dam ID# 215-0996).

Profile Details: The Larchmont Reservoir/Sheldrake River Dam (Upper Dam) is a Class C High hazard dam located within the Larchmont Reservoir. Until 1975 the dam was used to provide potable drinking water to the Village of Larchmont. Today it is used for conservation and recreational purposes; and to provide vital flood control for the Town and Village of Mamaroneck. The Town operates the dam valve.

Located in Valhalla, the Kensico Dam is 3,300 feet long, 307 feet high, and holds back 30.6 billion gallons of water in a reservoir covering approximately 2000 acres. 90% of New York City's drinking water is funneled through the Kensico Dam, along with 27 Westchester communities (See Figure 0-2).

According to the Association of State Dam Safety Officials, Dam failures are most likely to happen for the following reasons:

- Overtopping, caused by water spilling over the top of the dam
- Structural failure of materials used in dam construction
- Cracking, caused by movements such as the natural settling of the dam
- Poor maintenance and upkeep
- Poor piping, if seepage is not properly filtered, sink holes can form in the dam.

Since September 11, 2001, in today's society, another potential reason for dam failure is the possibility of terrorism.

Dam failures have been documented in every state in the United States. According to the Association of State Dam safety Officials, there were 173 reported dam failures and 587 incidents (episodes, that, without intervention, would have likely resulted in dam failure) in the United States between January 1, 2005 and June 2013.

The first comprehensive risk assessment of New York's network of reservoirs, dams, and aqueducts was performed by Michael Collins, former head of the NYCDEP's Watershed Police Department, in conjunction with the Federal Bureau of Investigation in 1997. According to the analysis, if the Kensico Dam were to fail, the City of White Plains could encounter water depths of an estimated 70 feet within one hour of dam failure, which would dwindle to 3.5 feet four hours after failure. This surge would be deadly. Table 4-8 shows the 9 worst dam failures in U.S. history.

Table 4-8. Historic U.S. Dam Failures*

Mill River Dam Williamsburg, MA	May 16, 1874	139 deaths, destroyed factories, Destroyed 740 homes in Leeds, Williamsburg, Skinnerville, & Haydenville
South Fork Dam Johnstown, PA	May 31, 1889	Located 9 miles upstream, City was devastated, 2,209 deaths
St. Francis Dam San Franciscquito Canyon, CA	March 12, 1928	450 deaths, 1,200+ homes destroyed, 10 bridges destroyed
Buffalo Creek Dam Logan County, WV	February 26, 1972	125 deaths, 500+ homes destroyed, \$400+ million in damages
Canyon Lake Dam Rapid City, SD	June 9, 1972	Dam failed during severe storm, widespread flooding, 237 deaths, 3,000+ injured, 1,300+ homes destroyed, \$60+ million in damages
Teton Dam Teton, Idaho	June 5, 1976	11 deaths, more than \$1 billion in damages.
Laurel Run Dam Johnstown, PA	July 19-20, 1977	40 deaths, \$5.3 million in damages
Kelly Barnes Dam Toccoa Falls, GA	November 5, 1977	39 deaths, \$2.5 million in damages

*Association of State Dam Safety Officials, www.damsafety.org

The New York City Department of Environmental Protection (NYCDEP) protects the Kensico Reservoir in northern Westchester County at Valhalla (see Figure 0-2). After September 11, 2001, the Dept. of Public Safety created Westchester County’s Office of Intelligence, Security, and Counter-Terrorism (ISCT). The ICST is working with the NYCDEP and has made significant security improvements at the Kensico Dam. Since this hazard is the responsibility of NYCDEP and the County, no further health and safety assessments and damage analysis will be performed for the Kensico Dam in Section 5, and no mitigation measures will be proposed or evaluated.

To date, there has never been a failure of the Larchmont Dam. A failure of the Larchmont dam could cause serious and damaging flooding of the Sheldrake River Valley from below the dam to the Mamaroneck Harbor. The Town of Mamaroneck maintains and operates the dam valve

because the outflow impacts both the Town and Village of Mamaroneck. Further damage analysis and health and safety assessments will be discussed in Section 5. Mitigation measures will also be proposed and evaluated in Section 7.

4.D.5.2 Earthquake

Hazard Summary: An earthquake is a shaking or trembling of the crust of the earth caused by underground breaking and shifting of rock faults beneath the land surface. This can be caused by surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, tsunamis, and seiches. They are infrequent in this region and are scattered. Wood frame buildings and other weakly constructed building are particularly vulnerable to earthquakes. If an earthquake should occur it would impact the entire area of the Town as well as the surrounding region. A measure of earthquake hazard is the peak ground acceleration (PGA), which for the Town of Mamaroneck is 3.78%. (See Figure 4-8) This rating places the entire area of the Town in a low risk category for earthquakes. There have been no reported earthquakes in the Town of Mamaroneck. No earthquakes have been reported with a magnitude greater than 5 on the Richter Scale in Westchester County since 1884. All reported incidents in Westchester Co. have been minor with no significant damage or injuries.

An earthquake is commonly measured on two different scales. The prominent method currently used to evaluate the effects of earthquakes in the United States is the Modified Mercalli Intensity Scale, which measures the intensity of an earthquake by observing its effect on people, the environment and the earth's surface. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects. The Richter Scale measures the energy released by an earthquake using a seismograph. A base-10 logarithmic scale is obtained by calculating the logarithm of the amplitude of waves recorded by the seismograph. Table 4-9 describes typical earthquake impacts as measured by the Modified Mercalli Intensity Scale.

Table 4-9. Typical Earthquake Impacts.

Modified Mercalli Intensity	Observations*	Richter Scale Magnitude
I	Felt only by a very few people under especially favorable conditions.	1 to 2
II	Felt only by a few persons at rest, especially on upper floors of buildings.	3
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.	3.5
IV	Felt indoors by many, outdoors by few during the day. Some awakened at night. Sensation like a heavy truck striking a building. Standing motor cars rocked noticeably.	4
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned.	4.5
VI	Felt by all, many frightened. Some heavy furniture moved; few instances of fallen plaster. Damage slight.	5
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	5.5
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	6
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	6.5
X	Some well-built wooded structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	7
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	7.5
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.	8

*Source: www.USGS.gov

Sources of information on earthquakes are given in see Section 11, References Cited and include: New York Times; NOAA websites; FEMA website; NYS Standard Multi-Hazard Mitigation Plan; NYS Standard Multi-Hazard Mitigation Plan (Draft 2014); USGS website; USGS Seismic Zoning Maps for NYS Seismic Bldg. Code; Lamont-Doherty Earth Observatory, Columbia University website, Bulletin of the Seismological Society of America; The Northeast States Emergency Consortium (NESEC); NYS Geological Survey (NYSGS); NYC Area

Consortium for Earthquake Loss Mitigation (NYCEM); NYS Disaster Preparedness Commission (NYSDPC). SMS-Tsunami-warning website.

Profile Details: Although earthquake tremors have been felt and recorded in the area, they are not considered a very big event in Westchester County. According to the United States Geological Survey (USGS), danger is generally from earthquakes that are rated 4.5 or higher on the Richter Scale. In addition, earthquakes are an infrequent event in Westchester County. According to the USGS, 13 earthquake events occurred in Westchester County between 1973 and 2012. On August 23, 2011, tremors were felt in Westchester County from an earthquake that whose epicenter was northwest of Richmond, Virginia. The earthquake registered 5.8 on the Richter Scale.

The largest quake in the New York area occurred on August 10, 1884. According to the Lamont-Doherty Cooperative Seismographic Network (LCSN) of Columbia University, it registered a 5.2 on the Richter Scale. Only minor tremors occurred from that time until October 19, 2005, when an earthquake and foreshock struck about two minutes apart and were centered in Ardsley, New York. The quake measured 4.0 on the Richter Scale, and the shock measured 2.0. An aftershock occurred on October 22, 1985 measuring 3.0 on the Richter Scale. Six minor aftershocks then followed. On April 23, 1986, a small quake measuring 2.7 occurred in the same area. On January 11, 2003 a quake occurred that measured 1.2, and on January 15, 2003 another occurred measuring 1.4. The fault line that runs southeast from Dobbs Ferry into Greenburgh was responsible for these earthquakes. Based on this information earthquake hazards causing significant damage, personal injury or death in the Town of Mamaroneck are not prevalent, significant or likely. However, if a large quake should strike, significant damage could result.

In 2008, the U.S. Geological Survey updated its National Seismic Hazard Maps. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps, which supersedes the 1996 and 2002 versions. The USGS has determined that the 2008 map represents the best available date. The Peak Ground Acceleration (PGA) is a standard measure of potential earthquake hazard used by FEMA and the

U.S. Geological Survey. This is a measure of the ground surface acceleration from an earthquake relative to gravity, which is recorded as %g. For the Town of Mamaroneck (Latitude: 40.9481N, Longitude: -73.7599W), the %g value is 3.78% (See Figure 4-8). According to the current USGS Seismic Hazard Map for the region the Town of Mamaroneck would be included in that PGA zone. This indicates a low hazard due to earthquakes. There is a 10% chance in 50 years that the PGA would exceed 4%.

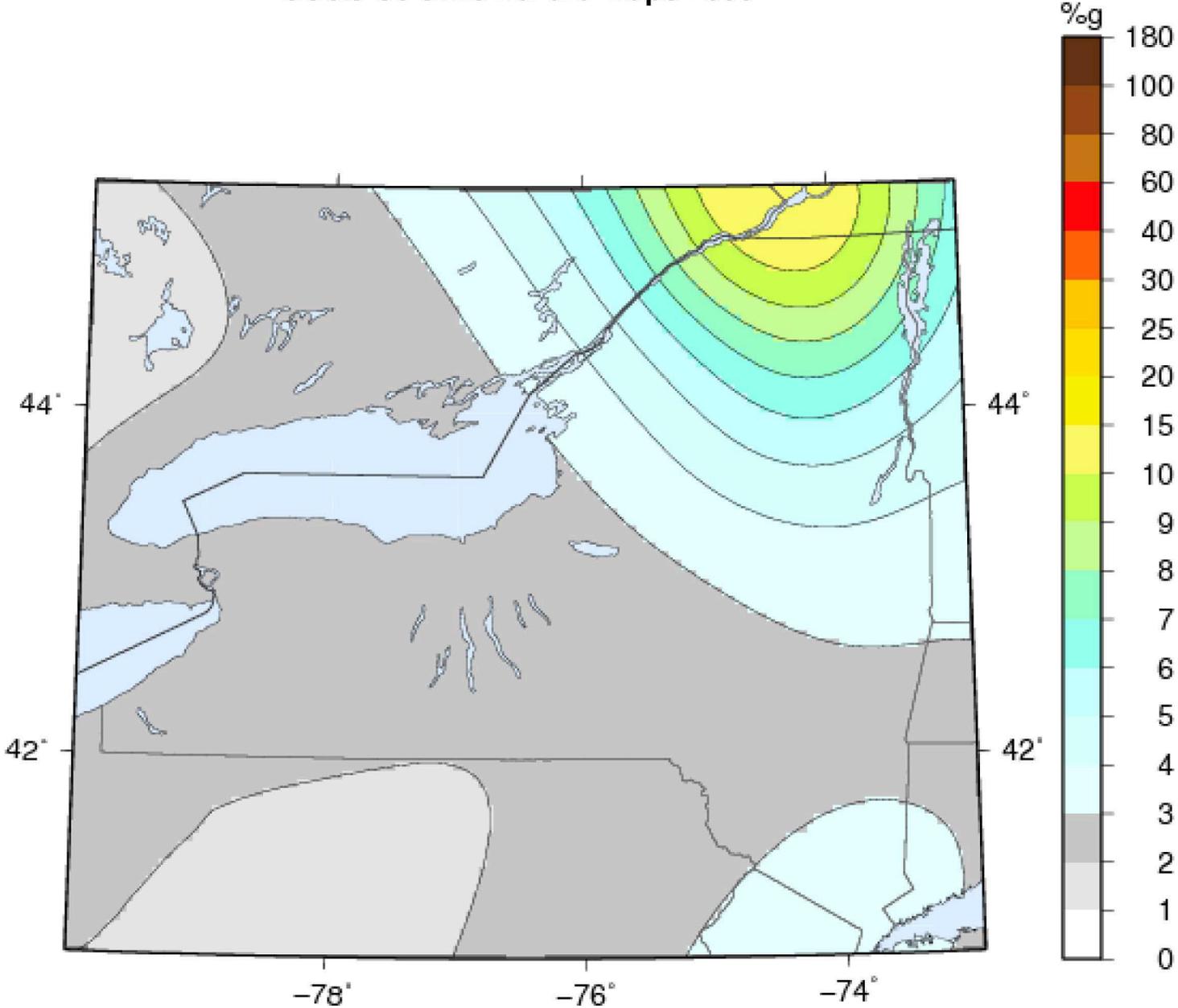
Based on historical evidence, the risk of a damaging earthquake event was thought to be highly unlikely. However, new studies suggest that the probability of such an event may be more prevalent than previously thought. A study published in the Bulletin of the Seismological Society of America analyzed past earthquakes, 383 earthquakes from 1677 to 2007 in a 15,000 square mile area around New York City. New data was also analyzed. The study suggests a pattern of subtle, yet active faults, which increases the risk of earthquake to the greater New York City area.

The study suggests that although earthquakes are an infrequent occurrence in the New York City area, the risk is greater due to the extremely high concentration of people and infrastructure. The population in the New York area is denser than in earthquake-prone areas. In the event a damaging earthquake did occur in the area, the losses would be far more catastrophic.

Based on their research, an earthquake with a Magnitude of 5 is estimated to occur every 100 years. In addition, it is estimated that a Magnitude 6 earthquake will occur every 670 years, and a Magnitude 7 earthquake will occur every 3,400 years (The corresponding probabilities of occurrence in any 50-year period would be 7% and 1.5%).

In addition, the study revealed that the Indian Point Nuclear Power reactor is situated in a very precarious position. A newly discovered seismic zone, that runs from Stamford, Connecticut, to Peekskill, New York, runs less than one mile north of Indian Point. In addition, the Ramapo Seismic Zone, that runs from Eastern Pennsylvania to the Mid-Hudson Valley, passes within two miles northwest of Indian Point. The Indian Point Nuclear Reactor sits on the banks of the Hudson River in Buchanan, New York. It was built to withstand a Magnitude 7 on the Mercalli Scale, or 6.1 on the Richter Scale.

USGS Seismic Hazard Maps 2008



Peak Ground Acceleration
10% Probability of Exceedance in 50 Years

Figure 4-8
Seismic Hazard Zones
in New York State

Table 4-10. Largest Earthquakes Near New York City.

DATE yr/mo/day	TIME hh:mm: sec	LAT. (°N)	LONG. (°W)	LOCATION	MAGNITUDE Richter (ML)	Max. Intensi ty (MM)	Remarks
1884 Aug 10	19:07	40.45	73.90	Greater N.Y. City area	5.2	VII	Threw down chimneys - felt from Virginia to Maine;
1737 Dec 19	03:45	40.80	74.00	Greater N.Y. City area*	5.2	VII	Threw down chimneys
1783 Nov 30	03:50	41.00	74.00	N. Central N.J.*	4.9	VI	Threw down chimneys
1847				Greater N.Y. City area*	4.5	V	Probably offshore
1848 Sep 09		41.11	73.85	Greater N.Y. City area*	4.4	V	Many people in the NY City area felt the earthquake
1895 Sep 01	11:09	40.55	74.30	N. Central N.J.	4.3	VI	Location determined by fire and aftershock
1985 Oct 19	10:07	40.98	73.83	Ardsley, N.Y.	4.0	IV	Many people in the NY City area felt this earthquake
1927 Jun 01	12:23	40.30	74.00	Near Asbury Park, N.J.	3.9	VI-VII	Very high intensity in Asbury Park, NJ - perhaps shallow event
1845 Oct 26	23:15	41.22	73.67	Greater N.Y. City area*	3.8	VI	
1938 Aug 23	05:04:53	40.10	74.50	Central N.J.	3.8	VI	
1951 Sep 03	21:26:24	41.25	74.00	Rockland Co., N.Y.	3.6	V	
1937 Jul 19	03:51	40.60	73.76	Western Long Is., N.Y.	3.5	IV	One or few earthquakes beneath Long Island
1957 Mar 23	19:02	40.60	74.80	Central N.J.	3.5	VI	
1874 Dec 11	03:25	41.05	73.85	Near Nyack and Tarrytown, N.Y.	3.4	VI	
1885 Jan 04	11:06	41.15	73.85	Hudson Valley	3.4	VI	
1979 Mar 10	04:49:39	40.72	74.50	Central N.J.	3.2	V-VI	Felt by some in Manhattan [it is called Chee sequake earthquake]
2001 Oct 17	01:42:21	40.79	73.97	Manhattan, New York City	2.6	IV	Felt in Upper West Side of Manhattan, Astoria and Queens, NYC

(*) Location very poorly determined; may be uncertain by 50 miles., ML=Richter local magnitude
 Source: Lamont-Doherty Earth Observatory of Columbia University
www.ldeo.columbia.edu/lcsn/big-ny-eq.html

4.D.5.3 Epidemic

Hazard Summary: An epidemic is the occurrence or outbreak of disease in a large number of individuals or proportion of human or animal populations. An epidemic affects many people at the same time in an area and spreads from person to person in a locality where the disease is not permanently prevalent. An epidemic would impact the entire Town of Mamaroneck. West Nile Virus is a current threat to the NY area through exposure by mosquito bites. Another epidemic concern is Flu epidemic spread by human contact. Lyme disease is borne by the deer tick, but is seldom fatal, is easily treated through antibiotics and is not an issue in the Town. The probability of future epidemic event in the County and in the Town is low. The expected magnitude and severity of an epidemic is expected to be low. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Sources of information for epidemic hazards are given in Section 11, References Cited and include: Westchester County Health Department; USGS Disease Maps and website; Center for Disease Control Website; Local Papers; NY Times; Journal News; “The Resurgence of West Nile Virus”, Annals of Internal Medicine, December 4, 2012; “West Nile Virus May Get Worse as Climate Gets Hotter”, Los Angeles Times, September 10, 2012.

Profile Details: A current epidemic threat is the possibility of being exposed to the West Nile virus contracted from mosquitoes. This has been a concern in the Westchester area since the mosquito vector breeds in wet areas, flooded areas, streams and shoreline areas in the region. Potential epidemics also relate to the failure of the sanitary and storm sewers that could cause floods, backups, and standing water in homes and streets. This would place the residents at risk of contracting disease. Another major epidemic concern is a Flu epidemic, which can spread quickly worldwide. Lyme disease, which is borne by the deer tick, is a concern in the County but is seldom fatal, is easily treated with antibiotics. Deer as vectors are not common in the Town.

The number of cases of West Nile Virus occurring in Westchester County is minimal. There were only 14 reported cases between 2008 and August 30, 2013. The cases were reported as follows:

2008	2009	2010	2011	2012	2013 (to 08/30/13)	Total
2	1	4	3	4	0	14

There have been no reported cases of West Nile Virus in humans in Westchester County in 2013, as of August 30, 2013. However, the number of cases in the NYC area more than doubled from 2011. Nationally, in 2012 there were 5,674 cases reported to the Center for Disease Control (CDC), representing the highest number of reported cases since 2003. According to the CDC, 70% of these cases occurred in Texas, California, Louisiana, Mississippi, South Dakota, Michigan, Oklahoma, and Illinois. Over 1/3 of these cases occurred in Texas. As of August 30, 2013, there have been 1,134 cases reported to the CDC in 2013.

According to the Annals of internal Medicine, climate change may be a contributing factor to the latest outbreak of West Nile Virus. Extreme weather patterns, such as abnormally high temperatures increase the number of West Nile carrying mosquitoes. High temperatures increase the rate of mosquito breeding as well as the rate of development of viruses within those mosquitoes. As the climate gets hotter, some experts say West Nile Virus outbreaks may get worse. This topic will be discussed further in the Climate Change section of this Hazard Mitigation Plan.

Epidemics, although a concern for the entire planning area, are not considered to be a prevalent or severe hazard. Such health hazards are handled through our current Westchester County Health Department and the Federal health advisory system.

If an epidemic should occur, it would likely cover a wide regional area and not be restricted to the Town geographical. However, an epidemic has a potential for serious illness and a large number of deaths. There is a low probability for a future epidemic event in the Town of Mamaroneck. No unique epidemic hazards were identified as significant or prevalent.

No special mitigation measures beyond current state or county public health activities are called for. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

4.D.5.4 Extreme Temperature

Hazard Summary: Extreme temperatures include extended periods of excessive cold or hot weather with a serious impact on human populations, particularly the elderly and/or persons with respiratory ailments. Heat waves are the primary hazard of concern. The NWS defines a “heat wave” as three consecutive days of temperatures exceeding 90°F. Temperature hazards are region wide and include the entire Town area. The magnitude and severity of cold stress hazard would be low. The magnitude and severity of heat stress would be high when temperatures exceed 100 degrees, particularly when humidity is high. A previous occurrence in 1999 brought a series of heat waves to the NY metropolitan region. The summer of 1999 brought 27 days of 90+ degree days, causing rolling blackouts to the area. The North American heat wave of 2001 brought 32 reported heat related deaths to NYC. Heat hazards can cause heat stroke and death particularly to the chronically ill and elderly. The probability of future events is high. A warning system is handled through the National Weather Service. No further health and safety assessments and damage analysis for extreme temperatures will be performed, and no mitigation measures will be proposed or evaluated.

Sources of information for temperature hazards are given in Section 11, References Cited and include: Local Papers and websites: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Review, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); Climate change documents; National Climate Data Center website; Accuweather website; Westchester County Health Department; NYSERDA website; “Responding to Climate Change in NY State”, Technical Report 11-18, NYSERDA, November 2011.

Profile Details: Although extreme cold temperature is a concern, heat waves are the primary hazard of concern. Extreme heat hazard is associated with summer weather and is typified by a

combination of high temperatures and humid conditions. Extreme heat can be a life-threatening condition, affecting senior residents and those with health problems.

In 1999, New York was hit with a series of heat waves that imposed heat stress and extra energy demands on the New York metropolitan region. High temperatures were widespread throughout most of the eastern portion of the United States in July. During the summer, the New York metropolitan area experienced 27 days of 90 degree temperature or higher. Rolling blackouts occurred in area-wide system failures. More than 80,000 households and businesses in northern Manhattan and the Bronx experienced a blackout for 19 hours. 33 people died from heat-related causes.

In 2001, New York was hit with another heat wave, along with the rest of the east coast. Temperatures in New York City reached a peak of 103 degrees, and Newark, New Jersey reached a record 105 degrees.

In 2006, the North American heat wave spread throughout most of the United States killing at least 225 people. 14 people died in Queens, 10 in Brooklyn, 6 in Manhattan, and 2 in the Bronx; totaling at least 32 reported heat-related deaths in New York City. Blackouts occurred throughout the entire tri-state area, most notably in Astoria Queens, and Westchester County.

In July 2010, a hot air mass developed and settled over the New York City area. Temperatures were in the mid to upper 90s and low 100s. The NYSDEC issued an ozone advisory for the New York metropolitan area. The Westchester County Health Department issued a heat advisory on July 6th due to 101-degree temperature. More than 1300 were without power during this heat wave.

In July 2011, the New York metropolitan area was hit with another heat wave. Temperatures in Southern Westchester reached between 95 and 105 degrees, with heat indices in excess of 105 degrees. The heat index reached 109 degrees at Westchester County Airport on July 22, 2011. There were 11 reported deaths in New York City from this heat wave.

In July of 2013, Westchester County saw 7 consecutive days with temperatures in the mid 90s, between July 14th and July 20th. According to Con Edison, electric usage fell short of its all-time peak, reaching 13,161 MW during this heat wave. The all-time record of electric peak usage was 13,189 MW, which occurred on July 22, 2011.

The National Weather Service (NWS) defines a “heat wave” as three consecutive days of temperatures exceeding 90°F. In addition, there is little wind, and abundant sunshine during the entire day and heat is retained during the humid nights. Heat waves occur when an area of high atmospheric pressure stalls over a region. Westchester County with its warm summer seasons is susceptible to heat waves of this type.

High temperature hazard has occurred frequently in recent years for the entire planning area during the hot summer months, and affects senior residents and those with health problems. The highest recorded temperature since 1869 was 106.5° in 1936 for New York City. The summer of 1999 was one of the hottest periods on record for the New York City area, when they experienced 27 days of 90 degree weather or higher.

Extreme high temperatures also result in power failures due to the high demand for air conditioning during heat waves (See Section 4.D.6.1 below). Power outages during heat waves have become a common occurrence in New York City and Westchester County. Although blackouts and brownouts may be frequent, their direct effect on health, safety and structures is not severe. During extended power failures, the lack of refrigeration results in food spoilage in homes and markets, transportation problems, closing of schools and businesses, as well as great financial losses. Power failures can put the sick or infirmed at risk. Extended power failures associated with brownouts and blackouts have resulted in significant property damage in New York City and Westchester County. The probability of power failures due to heat or storms is high for the Town of Mamaroneck.

Although heat hazards may be frequent, its direct effects on health, safety is limited. It often has impacts on infrastructures such as utilities. Heat waves cover a wide regional area and are not restricted to the Town. However extreme temperatures have a potential to cause illness and

death for sensitive populations such as the chronically ill and elderly. There is a high probability for future heat events in Westchester County. A warning system for this hazard is handled through the National Weather Service.

Temperatures are predicted to increase in New York State by 1.5 to 3 degrees Fahrenheit by 2020, 3.5 to 5.5 degrees Fahrenheit by 2050, and 4.5 – 8.5 degrees Fahrenheit by 2080 (NYSERDA 2011). The link between extreme temperatures and global warming will be discussed further in the Climate Change section of this Hazard Mitigation Plan.

No significant property damage has been reported from past heat waves. Interruption of services and businesses is limited and primarily due to electrical utility failures. No further health and safety assessments and damage analysis for extreme temperatures will be performed, and no mitigation measures will be proposed or evaluated.

4.D.5.5 Drought

Hazard Summary: A drought occurs when a long period of time passes without any substantial precipitation. Droughts can occur at any time of the year. A prolonged drought can have serious economic impacts on an area. Agricultural production can be damaged or destroyed by loss of crops or livestock, resulting in food shortages. Increased demand for water and electricity can result in shortages of these resources particularly those serving the Town and its surrounding areas. Lack of precipitation, accompanied by extreme heat can increase the risk of wildfires and heat stress. Health impacts are worse on the elderly, small children, and immune deficient. A drought is a regional hazard and would impact the entire Town and its surrounding areas. A severe drought during the summer of 1999 affected most of the northeast. Damage of over 1 billion in agricultural losses and 502 deaths occurred in the eastern US. There is a high probability of a future drought. The magnitude and severity on the Town of Mamaroneck would be low if water conservation measures are enforced.

Sources of information related to drought are given in see Section 11, References Cited and include: Local Papers; Journal News, NY Times; Climate change documents; National Climate Data Center website; Accuweather website; National Drought Mitigation Center Website; National Weather Service, Climate Prediction Center; NYS Climate Office, Department of Earth

and Atmospheric Sciences at Cornell University web site; Center for Climate and Energy Solutions website.

Profile Details: Drought impacts are regional and Town wide. The heat wave during the summer of 1999 (see above) led to a major drought, which affected most of the Northeast. It was reportedly the worst drought in the United States since the Dust Bowl of the late 1930s. In New York City, combined rainfall amounts were almost 8 inches below normal for the summer months, and reservoir levels were 15% below normal.

Homeowners were requested not to water their lawns, wash cars, or refill their swimming pools in the New York area. Widespread ground fires broke out in the Hudson Highlands. This drought was blamed for over \$1 billion in agricultural losses and an estimated 502 deaths in the eastern United States (NOAA/NCDC). A drought is an emergency that can lead to untamed fires. The intense summer drought and responses to it may also have contributed to the outbreak of the West Nile Virus, by affecting the habitat of mosquitoes and crows carrying the virus.

The 2012 North American Drought brought drought conditions over much of the United States. In fact, at the peak of the drought, approximately 81 percent of the contiguous United States was under at least abnormally dry conditions. 1,692 Counties in 36 states had been declared primary natural disaster areas.

The connection between drought and global warming will be discussed in the Climate Change section of this Hazard Mitigation Plan. There is a high probability of future drought event. A warning system is handled through the National Weather Service. No significant property damage in the town of Mamaroneck was reported from drought. Interruption of services and businesses is regional and primarily due to electrical utility failures and water shortage. Due to its low hazard rating, no further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

4.D.5.6 Landslides

Hazard Summary: A landslide is a downward and outward movement of loosened rocks or earth down a hillside or slope. According to the NYS Hazard Mitigation Plan, the landslide is identified as a hazard of concern for New York State. However, most of Westchester County is located in a low landslide incidence area. There was only one reported landslide occurrence in Westchester County in the last 50 years, which occurred on July 3, 1969. According to the USGS, the Town of Mamaroneck has a low landslide incidence.

This hazard was ranked as a moderately low hazard. No further health and safety assessments and damage analysis will be performed in Section 5, and no mitigation measures will be proposed or evaluated.

Sources of information on landslide hazards are given in Section 11, References Cited and include: Town Officials; NY State Hazard Mitigation Plan; NY State Hazard Mitigation Plan (Draft 2014); USGS Landslide Hazards Program; Spatial Hazard Events and Losses Database for the United States (SHELDUS) website.

4.D.5.7 Tsunamis

Hazard Summary: Tsunamis are defined as a series of ocean waves that are generated by a rapid large-scale disturbance of the seawater. Most tsunamis are generated by seismic activity such as earthquakes. Volcanic eruptions, landslides, or undersea slumps, and meteorological impacts can also cause tsunamis. They may also be caused by meteorological impacts. Most tsunamis occur in the Pacific, and originate along a hotbed of seismic activity known as the Pacific Ring of Fire. The Atlantic is home to much less seismic and volcanic activity. The primary tsunami source for the east coast of the United States is from under water landslides that occur along the continental slope in the Atlantic Ocean.

The impacts of tsunamis can be great. Loss of life due to drowning can occur, as well as damage and destruction to property and infrastructure. Land erosion can also occur due a tsunami. Although tsunamis in the East Coast are rare, they are still possible, should there be an

underwater earthquake greater than 7.0 in magnitude, a volcanic eruption, or underwater landslide on the other side of the Atlantic Ocean.

Sources of Information: NOAA Tsunami website www.tsunami.noaa.gov; NOAA West Coast and Alaska Tsunami Warning Center website, <http://oldwcatwc.arh.noaa.gov>; “Tsunami, The Great Waves”, 2nd edition, Intergovernmental Oceanographic Commission, 2012; National Tsunami Hazard Mitigation Program website, <http://trhmp.tsunami.gov>; “East Coast Tsunami Threats” presentation. Steve Pfaff, National Weather Service, Wilmington, NC, www.erh.noaa.gov/ilm/stormready/tsunami/player.html.

Profile Details: Tsunamis are generated by a sudden displacement of a large amount of water, usually from below as in earthquakes and submarine landslides. Meteotsunamis are generated by atmospheric effects from above which generate the waves over time through resonance effects.

The most noteworthy tsunami in recent history occurred in November of 1929 when a major earthquake with a magnitude of 7.2 triggered a submarine landslide 250 miles south of Newfoundland. It was felt as far south as New York. The tsunami wave heights reached up to 23-feet and were concentrated on the coast of Newfoundland, but recorded as far as South Carolina. 28 people were killed from this event.

Although meteotsunamis can occur several times a year, they are usually too small to be noticed by people on the coast. Some previous significant meteotsunamis along the east coast have occurred. In October 2008 a meteotsunami with waves reaching 12-feet high occurred in Boothbay Harbor, Maine. Fortunately it occurred during low-tide, or the impacts would have been worse. In July 1992, a meteotsunami with waves reaching 18-feet high occurred in Daytona Beach, Florida, injuring 75 people.

On June 13, 2013 a tsunami-like wave occurred near Long Beach Island in Barnegat Light, along the southern coast of New Jersey. Although the final cause of the tsunami is still under investigation, NOAA confirmed that it was a meteotsunami, which was at least partially generated by meteorological or weather effects occurred. It occurred in close conjunction with a

low-end derecho weather system. It was not spurred by an earthquake or an underwater landslide. There were no life-threatening injuries. Scientists continue to investigate to determine if a shifting at the continental shelf east of New Jersey could have played a role in the incident, as well.

There is no record of a tsunami ever occurring in New York State. The Town of Mamaroneck is not located in a region that is labeled as vulnerable to tsunamis. However, the possibility of an occurrence cannot be ruled out.

4.D.5.8 The Effect of Climate Change on Natural Hazards

Heavier and more extreme weather events have occurred in the United States over the last few decades with increasing incidence of devastating floods. Although no single storm can be attributed directly to global warming, changing climate conditions have affected weather trends. Warmer air can hold more moisture so that the atmosphere will have more water available for rain. Therefore heavier and more precipitation is expected in the future. Climate models project increased rainfall rates in hurricanes. This increased rainfall can lead to stronger hurricanes and rising sea levels for the U.S. Gulf and Atlantic Coasts. In addition, snowfall pattern shifts and river ice melting changes may exacerbate flooding risks.

Although there are conflicting reports on the extent of the impact of climate change, models suggest heavier rainfall, stronger hurricanes, rising sea levels, more extreme heat waves, and an increase in droughts and wildfires. Rising sea levels are expected to increase coastal flood frequency and severity from tropical cyclones, extra tropical cyclones and other severe coastal storms. According to the Intergovernmental Panel on Climate Change, sea level rise of between one to two feet can be expected by the end of this century (IPCC). Recent studies have identified the Northeastern United States as a hotspot of accelerated sea level rise. Over the past 30 years, sea levels in the northeast have risen four times faster than the global average, increasing the risk of storm surges and flooding. (Center for Climate and Energy Solutions).

The average annual temperature in New York has increased by more than 1.5 degrees Fahrenheit since 1970, with winter temperatures rising twice as much. Temperatures are predicted to

increase in the Northeast by 1.5 to 3 degrees Fahrenheit by 2020, 3.5 to 5.5 degrees Fahrenheit by 2050, and 4.5 – 8.5 degrees Fahrenheit by 2080 (NYSERDA). Winter precipitation is projected to increase by 20-30% in the Northeast by the end of the century; Sea level rise is projected to rise from between 7 inches to 2 feet by the end of the century, causing an increase in coastal flooding and damaging storm surges. (NECIA).

Major storms can cause coastal erosion from the combination of high winds and heavy surf and storm surge. Climate change could exacerbate conditions that lead to both coastal and inland erosion.

Rising temperatures along with little predicted change in summer rainfall is projected to increase the frequency of short-term droughts. Higher temperatures combined with increasing levels of carbon dioxide in the air can accelerate seasonal pollen production in plants, and thus extend the allergy season and increase asthma risks. It can also worsen air-quality. Increased temperatures coupled with more frequent droughts can increase the production of vector-borne diseases, such as West Nile Virus and Lyme disease. Other projected casualties of climate change include impacts to forestry, agriculture, fisheries, and dairies.

The Town of Mamaroneck has taken the pledge to combat climate change by joining the Climate Smart Communities Program (NYSDEC), which is a state-local partnership to reduce greenhouse gas emissions, save taxpayer dollars and advance community goals for health and safety, economic vitality, energy independence and quality of life. The Town is identifying sources of greenhouse gases in the community; setting goals for emission reduction; and developing a climate action plan.

Sources of information on the effects of climate change are given in Section 11. References Cited and include: Climate Change Indicators in the United States, U.S. Environmental Protection Agency www.epa.gov/climatechange/science/indicators/; NY State Climate Action Council, “New York State Climate Action Plan Interim Report”, November 9, 2010. <http://www.nyclimatechange.us/InterimReport.cfm>; “Confronting Climate Change in the US Northeast – New York”, NECIA. www.climatechoices.org ; NYSERDA website; “Responding

to Climate Change in NY State”, Technical Report 11-18, NYSERDA, November 2011. www.westchester.gov; “Climate Change and Sustainability”, Westchester County Website, www.climatechange.westchestergov.com, “Climate Science Watch”, www.climatewatch.org; United States Global Change Research Program website www.globalchange.gov/ Center for Climate and Energy Solutions, “Climate Change and Hurricane Sandy”, www.c2es.org/; NY State Department of Environmental Conservation, Climate Change Information Resources www.dec.ny.gov/energy/; Intergovernmental panel on Climate Change website , www.ipcc.ch.

4.D.6 Technological Hazards

Technological hazards such as regional utility blackouts, hazardous material releases, air contamination, explosions, and fires are a community concern.

4.D.6.1 Utility Failures

Hazard Summary: Utility Failure refers to periodic cessation of electrical or communication services due to adverse weather conditions, human error or mechanical failure. These failures can cover an entire region such as northeastern United States, the entire Town, or just a few blocks of the Town. The most frequent causes of outages are severe storms that damage power lines or heat waves that overload power equipment. In 2006 a multitude of utility failures occurred in Westchester County. The summer of 1999 brought 27 days of 90+ degree days, causing rolling blackouts to the area. Impacts from power outages are severe and affect businesses, emergency services, health and safety of the elderly and the ill, rail transportation, communication, food preservation and numerous other impacts. The probability of future events is high. The magnitude and severity of utility failures can be high depending on the area covered by a blackout, the population affected and its duration. Con Edison has been upgrading their distribution system, and has been coordinating their efforts with local municipal officials.

Sources of information are given in Section 11, References Cited and include: Con Edison website, press releases and studies; Local papers and websites: Journal News, NY Times, Soundview Rising, Larchmont-Mamaroneck Patch, Sound & Town, Mamaroneck Review, Mamaroneck Daily Voice, The Loop, Larchmont Gazette (archives); “Westchester County

Severe Wind and Rain Storm January 18-22, 2006”, Consolidated Edison, www.dps.ny.gov/conediso-january2006stormreport.pdf; “Report on Preparation and System Restoration Performance – Hurricane Irene”, Consolidated Edison, November 14, 2011.

Profile Details: Consolidated Edison is the primary supplier of electricity to the Town. Con Edison has had significant problems related to electricity supply and demand. Utility failures have occurred during severe storms such as hurricanes, northeasters, electrical storms, windstorms, tornados, heat waves, and snowstorms (See Sections 4.D.3 and 4.D.5 above). Power outages due to heat waves are a common occurrence in NYC and Westchester County. The breakage of utility poles or power lines is a major cause of electrical failures in local areas during storms. Storm related damage has sometimes required help from other utilities outside our region in order to restore power.

Con Edison serves approximately 349,000 residential and commercial electric customers, and 232,000 residential and commercial gas customers in Westchester County. It is estimated that there are approximately 5,259 Con Edison electrical customers in the Town of Mamaroneck. Their service area encompasses 310 square miles, 15,089 miles of overhead wires, 6,452 miles of underground cable, and 91,593 utility poles. Most notable outages are listed below.

On August 14, 2003, there was a mass power outage that swept across the entire Northeastern United States. FEMA declared an emergency declaration for New York State allotting \$5 million for public assistance relief. (EM-3186).

In 2006 alone, a multitude of utility failures occurred in Westchester County:

- January 18-22, 2006: Thunderstorm, wind and rain storms occurred in Westchester County which uprooted trees and 61,486 Con Edison customers lost power. (Con Edison: Westchester County Severe Wind and Rain Storm January 18-22, 2006, www.dps.ny.gov/conediso-january2006stormreport.pdf)
- July 12, 2006: Severe thunderstorms that accompanied a tornado caused approximately 4,000 households in Westchester County to lose power.

- July 17, 2006: Heat wave caused 10,000 households in Westchester County to lose power. High-energy consumption and an overloaded transformer were blamed for this power outage.
- July 18, 2006: Severe storm caused an additional 35,000 households in Westchester County to lose power.
- July 21, 2006: Storm caused an additional 9,500 households in Westchester to lost power.
- July 22, 2006: An additional 6,000 Westchester households lost power.
- September 2, 2006: The remnants of Tropical Storm Ernesto caused approximately 80,000 households in Westchester County to lose power.

On September 14, 2006, Con Edison representatives met with several Westchester municipal officials to discuss Con Edison's response to the 2006 power outages, and to discuss solutions and future plans. Con Edison agreed to work with the municipal officials on improving response to power outages.

Regarding structural improvements, Con Edison was asked about the feasibility of moving the power lines underground. Con Edison replied that this can be accomplished by a) burying the existing system underground at an estimated cost of \$5 billion; or b) Installing a new underground system costing \$50 billion, plus the additional cost of burying the telephone and cable lines. Every street in Westchester County would have to be excavated, which would create major construction disruptions, environmental, and safety issues. Con Edison stated that neither method was being considered.

The Nor'Easter of March 2010 knocked out power to approximately 173,000 households in Westchester County and New York City. Con Edison reported more than 1,000 households without power in the Town of Mamaroneck.

Tropical Storm Irene, which occurred on August 23, 2011, reportedly knocked out power to approximately 203,821 households in Westchester County and New York City. Con Edison reported approximately 600 households without power in the Town of Mamaroneck.

The Blizzard of October 2011 knocked out power to approximately 71,000 customers in Westchester County. This storm also knocked out power to a reported 1,170 customers in the Town of Mamaroneck.

In late October 2012, Superstorm Sandy knocked out power to approximately 206,000 customers in Westchester County, affecting 3,332 customers in the Town of Mamaroneck. The Town Center lost power for 8 days after the storm.

The Town of Mamaroneck has auxiliary power supplied by generators at the police, fire, and EMS facilities. Their fuel pumps also have auxiliary generators to allow vehicles to function during an emergency.

After Superstorm Sandy, New York State Governor Andrew Cuomo announced that regulators would scrutinize Con Edison's preparations for Sandy, as well as its subsequent attempts to restore power in New York City and Westchester County after the storm. No further health and safety assessments and damage analysis will be performed related to utility failures, and no mitigation measures will be proposed or evaluated.

4.D.6.2 Hazardous Materials Fixed Site Releases

Hazard Summary: This hazard is the release of any substance or material that when involved in an accident and released in sufficient quantities, poses a risk to people's health, safety, and/or property. These substances and materials include explosives, radioactive materials, flammable liquids or solids, combustible liquids or solids, poisons, oxidizers, toxins, and corrosive materials. Release of these materials from a business or industrial operation can impact the health and safety of workers and people near the facility. There are commercial and industrial enterprises that require the storage of chemicals and generate hazardous wastes in the Town of Mamaroneck (See Figure 4-9). Most of the reported materials and wastes are small quantities and are not likely to result in major loss of property and life. Therefore, the magnitude and severity of the hazard would be restricted to local sites in the Town. The location of these sites is mostly in the commercial and industrial sections of the Town. These areas likely have the highest risk of a hazardous materials incident.

Relatively few significant releases that would affect the public and require evacuation have been reported in the Town. The risk is considered to be moderately low. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Sources of information are given in Section 11, References Cited include: Conversations with Town Officials; Incident Reports from the Town of Mamaroneck Fire Department; Westchester County GIS website; EPA Enviromapper website.

Profile Details: The Federal Community Right-to-Know law is enforced by New York State and requires businesses and industries to maintain inventories of hazardous materials. The USEPA and NYS Department of Environmental Conservation closely regulate hazardous wastes and require the reporting of these wastes that are stored on-site.

Hazardous materials can be explosive, inflammable and combustible, toxic, and radioactive. Hazardous materials are manufactured, used or stored at an estimated 4.5 million facilities in the United States, and the "hazardous materials label" can be applied to more than 500,000 products. Hazardous material release from fixed facilities is a hazard of concern. There are a number of commercial and industrial enterprises that require the storage of chemicals and generate hazardous wastes in the Town of Mamaroneck (See Figure 4-9).

Hazardous material releases in the Town of Mamaroneck can occur from activities such as dry cleaning, auto repair and repainting, home building and maintenance, and small quantity home use of chemicals. There could be a problem if materials used in commercial or industrial facilities and homes are spilled, a tank or pipe breaks or leaks, a fire occurs in a facility containing hazardous substances, or if an accident occurs during transportation and delivery of fuels. Minor spills and releases is a common occurrence in the Town due to the numerous fixed sites that are in the Town. There have been no significant hazardous material releases in recent history that have caused injury or loss of life to any people in the Town.

The frequency of hazardous materials distributed in the Town is an important community concern. However, the majority of quantities involved would not result in significant property damage or result in significant injury, illness, or mortality to the public. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

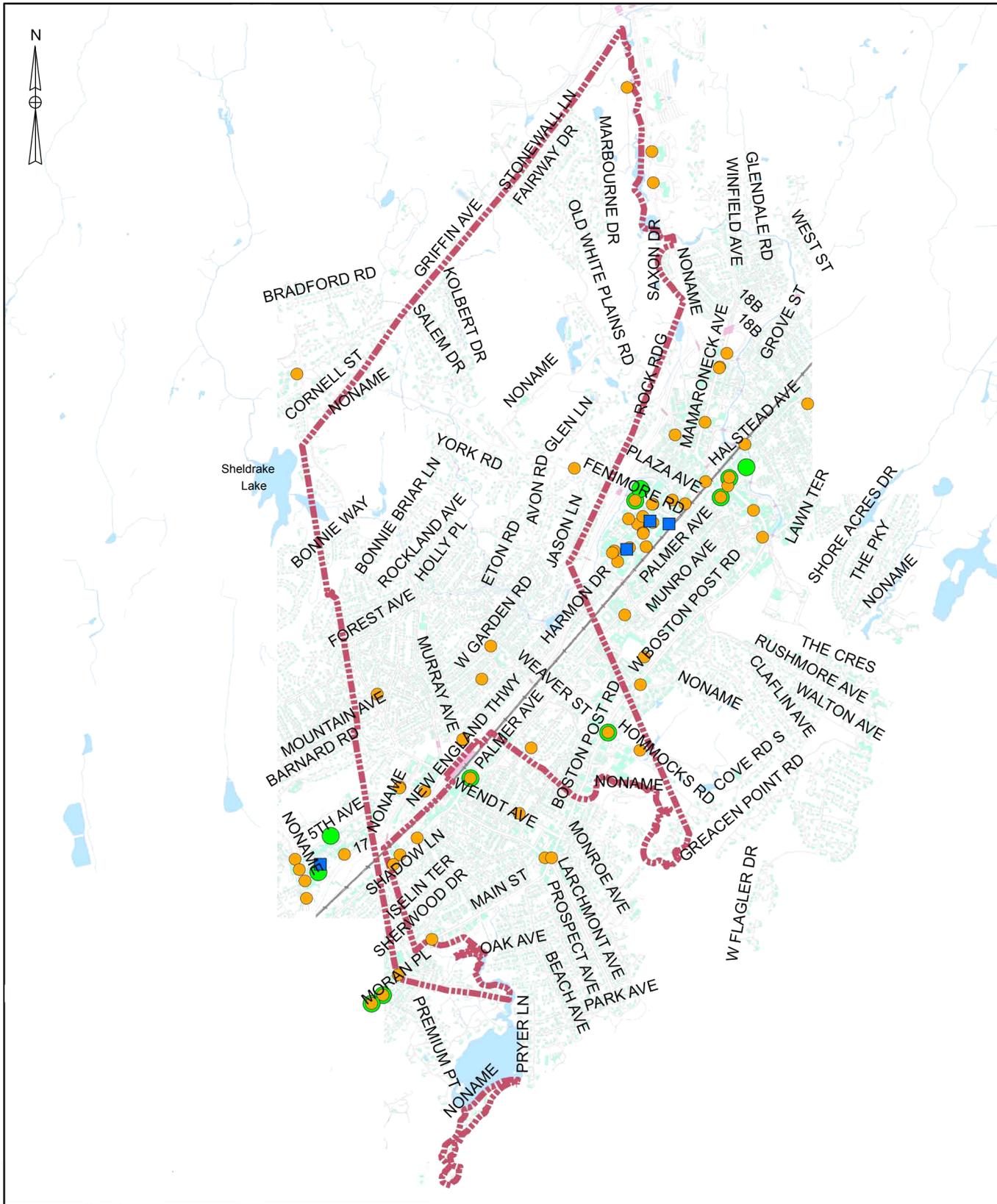


Figure 4-9
 Hazardous Materials Locations
 Town of Mamaroneck
 All Hazard Mitigation Plan

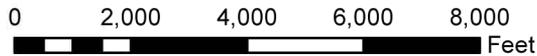
Legend

- Facility Registry System
- Hazardous Waste Generators
- Hazardous Waste Transporters
- Hazardous Waste Treat, Store, Dispose



Environmental
 Technology
 Group, Inc.

300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788



DWN BY: YS
 CHK BY: JB
 SCALE: AS SHOWN
 DATE: 08/27/13

4.D.6.3 Hazardous Materials Transport Releases

Hazard Summary: Hazardous materials can be explosive, flammable and combustible, toxic, and radioactive. Release of these materials during transport within or through the Town can impact the health and safety of its residents. Trucks carrying hazardous materials are likely most at risk at one of the established transportation routes that traverse the Town of Mamaroneck. These routes include Interstate-95, also known as the New England Thruway; and US-1, also known as the Boston Post Road. Metro-North commuter tracks run through Mamaroneck, and are also used by CSX to transport hazardous materials along the route that bisects the Town. Hazardous materials spills or accidents could also occur at one of the many fixed sites located throughout the Town where hazardous materials are used or stored. No significant releases that would affect the public and require evacuation have been reported in the Town of Mamaroneck. Therefore, the magnitude and severity of the hazard is expected to be limited to local areas.

Sources of information are given in Section 11, References Cited include: Westchester County GIS website; Incident Reports from the Town of Mamaroneck Fire Department; Conversations with Town Officials; Metro-North Website; Conrail website.

Profile Details: There are nearly 7,000 hazardous material incidents every year in the United States on average, most of which occur on the highway. U.S. Department of Transportation regulates the transport of hazardous materials and has procedures in place to mitigate hazardous spills. These procedures involve the local fire and public safety departments. The Town of Mamaroneck would rely on the Westchester County Hazardous Materials Response Team as its primary agency to respond to and coordinate the control and cleanup of any hazardous materials event.

The risk is considered to be moderately low. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

4.D.6.4 Air Contamination

Hazard Summary: Air contamination is the result of emissions of chemicals from industry or transportation into the air. Air contamination events in the Town, due to local sources, are small

and isolated and generally do not represent a major increase in health and safety risks to local residents. The primary risks are related to regional problems, rather than local sources. Air contamination in the Town is considered to be a low risk hazard. Region wide ozone alerts are generated by the National Weather service. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Sources of information are given in Section 11, References Cited and include: Conversations with Town Officials; EPA Enviromapper website; Westchester County GIS website; Accuweather website.

Profile Details: The commercial and industrial establishments in the Town of Mamaroneck would generally not cause an air pollution problem of significant concern. Regional air episodes such as ozone alerts occur over the New York City Metropolitan area that does affect Mamaroneck. These alerts are often associated with hot weather. These episodes would have the greatest impact on senior residents and those that have respiratory, heart or other problems.

Events in the Town, due to local sources, have been small and isolated and generally do not represent a major increase in health and safety risks to local residents. These risks are related to regional problems, rather than local sources. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

4.D.6.5 Explosions

Hazard Summary: According to the National Fire Protection Agency, an explosion is defined as “an effect produced by the sudden, violent expansion of gases, which can be accompanied by a shockwave or disruption, or both, of enclosing materials or structures”. Chemical changes, such as rapid oxidation, deflagration, detonation, decomposition of molecules, or runaway polymerization could cause an explosion. Physical changes, such as pressure tank ruptures can also cause an explosion.

Sources of information are given in Section 11, References Cited include: Conversations with Town officials, Town of Mamaroneck Fire Department Incident Reports, National Fire Protection Agency (NFPA) website, EPA Enviromapper website.

Profile Details: An explosion can vary in size and magnitude, from a small incident to a catastrophic failure, causing injury and loss of life, and major property damage. Explosions can occur at a number of sites in the Town of Mamaroneck, especially in locations where hazardous materials are stored. Trucks carrying explosive materials are also most likely at risk for explosion at one of the established transportation routes that traverse the Town. Metro North Commuter tracks run through Mamaroneck, and are also used by CSX to transport hazardous materials along the route that bisects the Town. Ruptures of natural gas mains may result in explosion if favorable conditions exist such as an ignition source.

Few explosions that would affect the public have been reported in the last 5 years. The risk is considered to be moderately low. No further health or safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

4.D.6.6 Transportation Accidents

Hazard Summary: A transportation accident is defined as a mishap involving one or more conveyances on land, sea, and/or in the air that results in mass casualties and/or substantial loss of property. Transportation accidents happen on a regular basis on most highways.

Sources of information are given in Section 11, References cited and include: Conversations with Town Officials; TMFD Incident Type Count Reports, January 1, 2008 – December 31, 2012; The Journal News, Larchmont-Mamaroneck Patch.

Profile details: Transportation accidents can occur on any roadway in the Town of Mamaroneck. Transportation accidents occur frequently with the potential of serious injury or death, but likely not in large numbers and generally with limited public or private property loss.

Most serious accidents would be expected to occur along major transportation corridors. Interstate-95, also known as the New England Thruway, is a major traffic artery that is heavily travelled by passenger vehicles, trucks, and buses. US-1, also known as the Boston Post Road, is another major traffic artery that is subject to both heavy passenger and commercial vehicular traffic. Other highly traveled roads include Weaver Street, which provides access to Scarsdale and New Rochelle; and Palmer Avenue, which provides access to New Rochelle, Larchmont, and the Village of Mamaroneck. Another vulnerable place for transportation accidents would be in the Long Island Sound.

There have been an abundance of accidents that have occurred on I-95 between mile markers 9.5 and 10, particularly at the curve of mile marker 9.8, both Northbound and Southbound. The area is a stretch of curving roadway from Mamaroneck Avenue down to Old White Plains Road. It is reported that the surface of the curved roadway was resurfaced years ago using concrete rather than blacktop. The road got noisier, and instead of resurfacing with blacktop, they used diamond grinding, which cut grooves into the road that was supposed to quiet things down. When the diamond grinding wore down, it created a smooth surface, which would become extremely slick, especially when wet. The NYS Thruway Authority has since laid down a coating of pavement at the 9.8 mile marker.

During the period January 1, 2008 through November 28, 2012, the TMFD reported responding to 304 motor vehicle accidents with injuries, 20 motor vehicle accidents with no injuries, and 24 motor vehicle/pedestrian accidents.

4.D.6.7 Fires

Hazard Summary: Fire hazards result from uncontrolled combustion of materials, buildings or other structures that threaten human life and property. Fires have occurred in residences and commercial establishments in the Town of Mamaroneck. Based on the frequency of calls and alarms and the likelihood that a fire would affect more than one building and that there is a chance that serious injury or death could occur, the hazard was ranked moderately low. Although most fires that have occurred are structural fires, there have been incidences of wildfire

hazard or brush fires. No further health and safety assessments and damage analysis will be performed, and no mitigation measures specific to fire hazards will be proposed or evaluated.

Sources of information: Town officials; Incident Type Reports from Town of Mamaroneck Fire Department, January 1, 2008 – December 31, 2012.

Profile Details: Fires can always occur in residences, commercial establishments, industrial buildings, institutional buildings, and places of public assembly. Most fires occurring in the Town of Mamaroneck are structural fires. There are limited incidences of fires occurring in natural areas in the Town, which could be a concern as a wildfire hazard. The Town of Mamaroneck Fire Department (TMFD) provides fire, rescue, and emergency medical response to all areas within the unincorporated areas of the Town. These areas also make up the Town’s fire district. The fire department consists of both full time and volunteer firefighters and officers, and is managed by one Chief and two Deputy Chiefs.

Vulnerable areas for wildfire would include the Hommocks Conservation Areas, Leatherstocking Trail, Premium Marsh Conservancy, Saxon Woods Park, Sheldrake River Trails, and James G. Johnson, Jr. Conservancy. According to the TMFD, the following fires have occurred in the Town in the last five years:

Type of Situation	2008	2009	2010	2011	2012
Building Fires:	14	6	11	13	21
Vehicle Fires:	4	5	6	8	2
Brush, grass, or natural vegetation Fire:	4	3	0	3	4
Other Fires:	18	20	27	16	16
Total Fires:	40	34	44	40	43

No further health and safety assessments and damage analysis will be performed, and no mitigation measures specific to fire hazards will be proposed or evaluated.

4.D.7 Human-Caused Hazards

4.D.7.1 Civil Unrest

Hazard Summary: Civil unrest may include unruly or violent crowds during public events, and political protests. Civil unrest could include racial, ethnic or political group protests or demonstrations. Although such events can occur any place, the likelihood of civil unrest occurring in the Town of Mamaroneck is low, given the suburban demographics. Historically, civil unrest has not been an issue for the Town. The local Police, Fire and Public Safety Departments can handle the potential for civilians causing local damage. Random events can be a potential concern. There is no history of significant civil unrest that would cause damage to property and injury to numbers of people is low. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Sources of information: Conversations with Town Officials.

4.D.7.2 Terrorism

Hazard Summary: Although acts of terrorism are possible anywhere in Westchester County, this hazard would be less likely in the Town of Mamaroneck. There are no major terrorist targets of interest identified in the Town such as key target populations, high profile historical landmarks, airports, significant infrastructures, important facilities, critical industries or major government institutions and structures.

There are possible targets for terrorism located in or around the Town. The Metro North tracks run through the Town of Mamaroneck with stops in the Village of Mamaroneck and the Village of Larchmont. Railroad facilities have been targets in recent years in European cities. The Westchester County Department of Environmental Facilities Wastewater Treatment Plant is also located nearby in the Village of Mamaroneck. Another target is the Kensico Dam, located further north near Valhalla. The effects of failure of the Dam are discussed in section 4.D.5.1 of this report.

Another possible target is the Indian Point nuclear power plant. Current regulations require evacuation planning for areas located within a ten-mile radius of nuclear facilities. The Town of

Mamaroneck is 23.65 miles from Indian Point and lies outside of this planning zone (<http://itsaboutthehudsonvalley.com/Indian-Point/25-miles.html>). Legislators are currently urging the Nuclear Regulatory Commission (NRC) to expand the NRC evacuation plan requirements to include areas within fifty miles of a nuclear facility.

Because of the absence of important target facilities and key populations, this hazard was not considered significant enough for further evaluation or analysis.

Sources of information: Conversations with Town officials; NY Times; Journal News; United States Nuclear Regulating Commission (USNRC) website www.nrc.gov.

4.E Elimination of Hazards

Several Hazards were eliminated from a detailed risk and damage assessment and evaluation of mitigation measures after an initial profile assessment and discussions with the Committee. These include:

Tornadoes: Tornadoes are not a frequent hazard. Only 8 tornadoes have been documented in Westchester County since 1958, and they are scattered geographically. None of the 8 occurred in the Town of Mamaroneck. Although tornadoes have a moderately low hazard rating, they are occurring more frequently than in the past. Tornadoes are also associated with other severe storm hazards, so they were not evaluated separately from other wind hazards in this plan.

Epidemic: Should an epidemic occur, it would most likely affect the region and not just the Town. No special mitigation measures beyond current state or county public health activities are called for. This hazard has a moderately low hazard rating. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Extreme Temperatures: No significant property damage has been reported from heat waves in the Town of Mamaroneck. Interruption of services and businesses is limited and primarily due to electrical utility failures. This hazard has a moderately low hazard rating, and these risks are

generally related to regional problems. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Drought: No significant property damage in the Town of Mamaroneck was reported from drought. Interruption of services and businesses is regional and primarily due to electrical utility failures and water shortage. Due to its low hazard rating, no further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Hazardous Material Releases (Fixed and In transit): The frequency of hazardous materials distributed in the Town is an important community concern. However, the quantities involved have not resulted in significant property damage or resulted in significant injury, illness, or mortality to the public. These hazards have moderately low hazard ratings. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed.

Air contamination: Events in the Town due to local sources have been small and isolated and do not represent a major increase in health and safety risks to local residents. These risks are related to regional problems, rather than local sources. This hazard has a low hazard rating. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Explosions: Information provided indicates explosion hazards are primarily related to handling and transport of fuels and are discussed under hazardous material hazards. Explosion hazards were ranked moderately low. Therefore, no further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Fire: Building fire hazards are not considered significantly different from neighboring communities. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Civil Unrest: Random events can be a potential concern. There is no history of significant civil unrest that would cause damage to property and injury to numbers of people is low. This hazard has a low hazard rating. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Terrorism: There is an absence of important target facilities and key vulnerable populations in the Town. No further health and safety assessments and damage analysis will be performed, and no mitigation measures will be proposed or evaluated.

Section 5 - Assessing the Impacts

5.A Introduction

The possible hazards affecting the Town of Mamaroneck were identified, profiled and ranked in Section 4 above. The rating and ranking of the hazards used the HAZNY method with input from the local experience of the Town of Mamaroneck’s Hazard Mitigation Planning Committee. The primary purpose of the current section is to identify and assess the Town’s assets and evaluate the impacts from these hazards.

This section is based largely on the recommended organization and methods outlined in the FEMA “How-to Guides” and the State and Local Mitigation Planning guidance manual called “Understanding Your Risks”, and FEMA’s Local Mitigation Planning Handbook, March, 2013. These documents provide an approach to identifying hazards and estimating the losses produced by these hazards. This section was also guided by the FEMA Activity Worksheet: “510 Floodplain Management planning” under Section 511, Credit Points, and follows the outline given in the guides under Section 5, “Assess the Problem”.

The hazard assessment began with the identification and ranking of all hazards that affect the Town of Mamaroneck (See Section 4.B above). The Hazards New York (HAZNY) method was used as a tool to help identify and rank hazards based on input from the community with the experience of emergency services professionals. The results of these analyses are shown in Table 5-1 and are discussed above in Section 4.C. The HAZNY ranking analysis includes the probability or frequency of occurrence of a given hazard and refers to how often a hazard will occur in the future. The HAZNY analysis distinguishes between the following frequencies of occurrences:

- Rare Event Occurs less than once every 50 years.
- Infrequent Event Occurs between once every 8 years to once in 50 years.
- Regular Event Occurs between once a year to once every 7 years.
- Frequent Event Occurs more than once a year.

Table 5-1. Summary of Hazards Scores Based on HAZNY Analysis.

	HAZNY Score Mamaroneck
<u>High Hazard</u>	321-400
Flood	321
<u>Moderately High Hazard</u>	241-320
Coastal Storm*	253
Hurricane	248
Severe Storm & Thunderstorm **	246
<u>Moderately Low Hazard</u>	161-240
Dam Failure	239
Fire	232
Windstorm	230
Winter Storm	230
Transportation Accident	222
Utility Failure	221
Terrorism	219
Tornado	218
Hazmat (In Transit)	210
Extreme Temperatures	204
Earthquake	202
Oil Spill	201
Landslide	199
Explosion	192
Water Supply Contamination	182
Epidemic	179
Transportation Accident (Rail)	172
Hazmat (Fixed Site)	168
Structural Collapse	164
<u>Low Hazard</u>	44-160
Drought	152
Fuel Shortage	142
Radioactive Release	140
Infestation	136
Air Contamination	132
Ice Jam	123
Food Shortage	119
Fuel Oil Spill	113

* Including tropical storms, nor'easters.

** Including severe and gale force winds as well as other non-winter storms listed. Hurricanes and coastal storms not included

No quantitative assessment was prepared for the hazards showing a low impact or risk. Where quantitative data were available, the future likelihood of the hazard was based on the information available. For several hazards, where the probability of future events was not quantified, a qualitative assessment of the likelihood is based on the HAZNY criteria and an evaluation of the current extent of the problem.

An impact and damage analysis is provided in Section 5.E for major hazards impacting the Town of Mamaroneck. This analysis is not given for hazards evaluated in Section 5.C below that were judged to be not significant enough, or found to have a very low probability of occurring in a given year.

5.B Inventory of Assets

The Town of Mamaroneck is a largely built-out residential suburban community. (See Section 1.A.) The Town is primarily residential. There are some large tracts of recreational land, and small areas of commercial development. Most commercial activity, consisting mainly of retail and service establishments, is located in the small commercial business districts, along the Boston Post Road, Fifth Avenue, and Myrtle Boulevard. There is virtually no manufacturing in the Town.

Some studies have been prepared for the Town of Mamaroneck. A Master Plan for the Town of Mamaroneck was adopted in 1966. It was reviewed, with updates added in 1986 and 1987. A Master Plan DEIS was adopted in 1989. A Local Waterfront Revitalization Plan was prepared and adopted for the Town of Mamaroneck and Village of Larchmont in 1986, and further updated in 1995.

The general assets of the Town are evaluated according to the property use code or the category of the building occupied. This breakdown however does not consider the importance of impacts on certain facilities. In addition, there are groups of assets that are evaluated in this section including:

- Critical Facilities
- Key Assets
- Infrastructures
- Resident Populations

5.B.1 Inventory of Buildings According to Property Use

Table 5-2 provides an estimate of residential, commercial, education, recreation, government, religious, light industrial/manufacturing and other buildings in the Town based on the Town of Mamaroneck tax assessments. The number of structures by property use code is listed in Table 5-2. For the most current year 2013, the predominant buildings in the Town are 2,976 single residential properties out of total 3,582 buildings. There are 76 multi-residential structures.

Commercial buildings are located in Use Class Codes 400-486. Recent tax assessment records show a total of 507 commercial buildings. Commercial apartment buildings, cooperatives and condominiums are also included in this class. The Town's commercial activity is located mostly along the Boston Post Road, Fifth Avenue, and Myrtle Boulevard. Marval Industries and Nutech Machine Shop are the only two businesses in the Town classified as lite industrial and manufacturing.

Recreation and Entertainment structures and facilities include 6 country club structures, Badger Sports Club Camp, the Mamaroneck Senior Center, indoor ice rink, indoor pool, outdoor pool club, the Sheldrake Environmental Center and Monroe Camp. Community Services include four schools, four government and protection buildings and one religious property.

Table 5-2. Residential, Commercial, Industrial and other Buildings in the Town of Mamaroneck.

Property Class Code	Building Type by Property Class	Number of Buildings*
210	Single Residential	2,976
220-283	Multi-residential	76
400-486	Commercial	507
500-590, 682	Recreation & Entertainment	12
600-615	Education	4
620	Religious	1
650-670	Government & Protection	4
714	Lite Industrial & Manufacturing	2
	Total	3,582

*** Data provided by the Town of Mamaroneck, Office of the Town Assessor .**

5.B.2 Critical Facilities

The principal critical facilities identified in the Town of Mamaroneck are given in Table 5-3. The location of these facilities is shown in Figure 5-1. They include four schools, Town of Mamaroneck Fire Headquarters, Larchmont/Town of Mamaroneck Volunteer Ambulance Corp, Mamaroneck Town Center, among others.

Table 5-3. Critical Facilities in the Town of Mamaroneck.

<u>Facility Name</u>	<u>Facility Function</u>	<u>Address</u>	<u>Facility Vulnerability to Hazards</u>
Town of Mamaroneck Fire HQ / Town EOC	Emergency Response, Storage of Emergency Response Vehicles & Equipment.	205 Weaver Street	Interruption of fire emergency services. Interruption of emergency & rescue services.
Larchmont/Town of Mamaroneck Volunteer Ambulance Corp (LVAC)	Emergency Response, Storage of Emergency Response Vehicles & Equipment.	155 Weaver Street	Interruption of emergency medical & rescue services.
Mamaroneck Town Center / Town Police HQ / Backup EOC	Emergency Response, Storage of Emergency Response Vehicles & Equipment.	740 West Boston Post Road	Interruption of police emergency services & communication. Interruption of emergency & rescue services.
Mamaroneck Town Yard	Public Works, Central Garage and Maintenance Facility.	40 Maxwell Avenue	Loss of public diesel and gas pumps for entire town fleet, DPW vehicles, generators, pumps, and specialized equipment.
VFW/Mamaroneck Senior Center	Emergency Shelter, Cooling & Heating Center	1288 Boston Post Road	Loss of shelter to vulnerable populations.

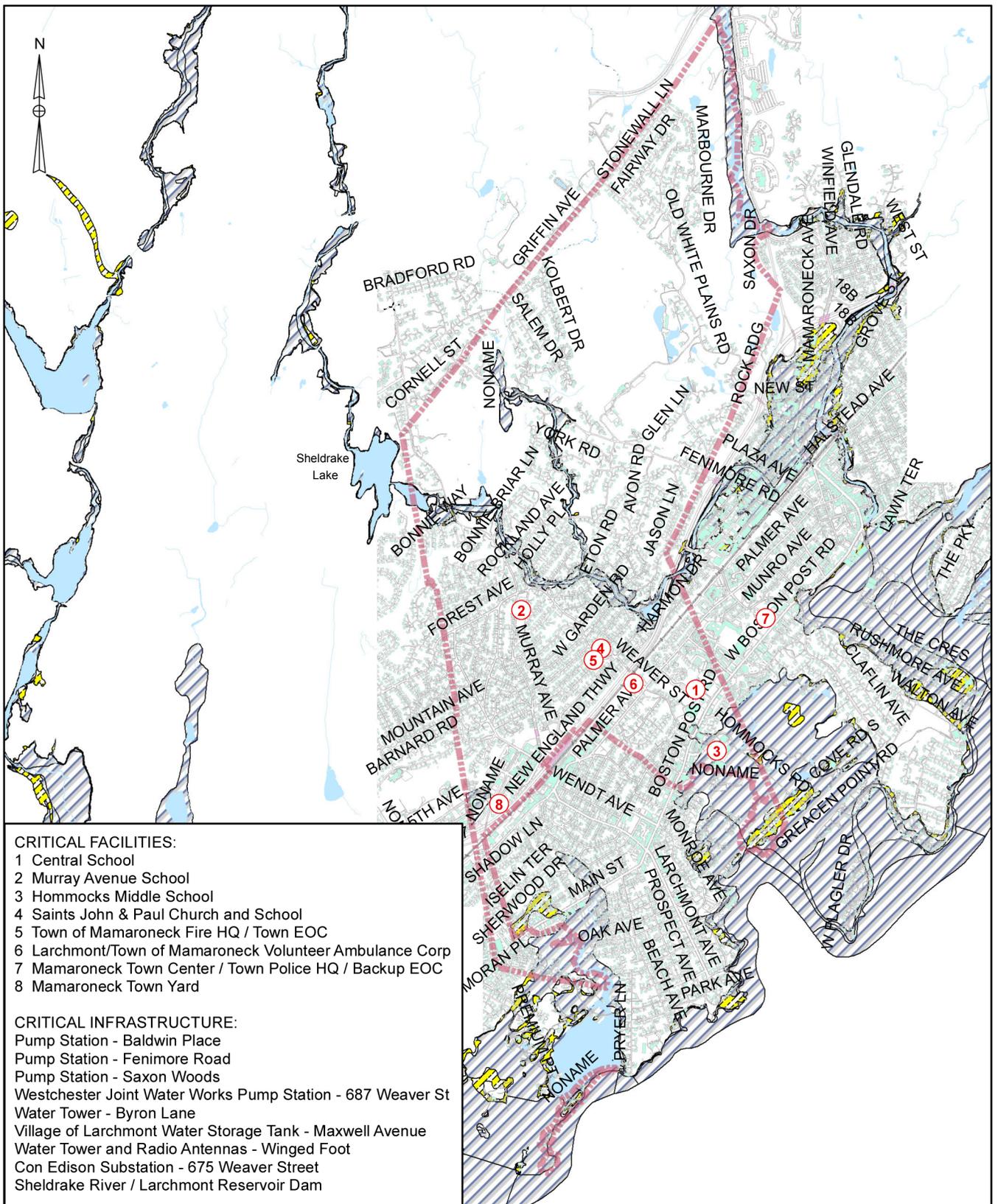


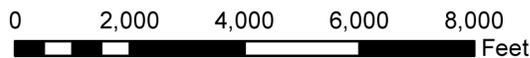
Figure 5-1
Location of Critical Facilities

Town of Mamaroneck
All Hazard Mitigation Plan



Environmental
Technology
Group, Inc.

300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788



Legend

- Municipal Boundaries
- FEMA Flood Mapping**
- 100 Year Flood Line
- 500 Year Flood Line

DWN BY: YS
CHK BY: JB
SCALE: AS SHOWN
DATE: 08/31/13

5.B.3 Key Assets

The Town of Mamaroneck has several economic, cultural and recreational facilities of concern. Key assets in the Town are listed in Table 5-4. These include properties that, if damaged or destroyed, would have significant cultural, economic or social impact on the Town.

Table 5-4. Key Assets in the Town of Mamaroneck.

Type of Asset	Key Asset	Location	Priority Need
Economic/Key Employers	Mamaroneck Union Free School District	Town of Mamaroneck	Major Employer
	Town of Mamaroneck	Town of Mamaroneck	Major Employer
	Commercial Business District	The Boston Post Road, Fifth Ave, Myrtle Ave	Major Employer
Cultural, Historical and Natural Areas	Hommocks Conservation Area	Hommocks Road	
	Larchmont Reservoir, James G. Johnson, Jr Conservatory	Larchmont Reservoir	Wildlife Sanctuary, Nature Trails
	Sheldrake Environmental Center	685 Weaver Street	Nature & Conservation Study
	Leatherstocking Trail	Southern end of the Colonial Greenway Trail	Wildlife Sanctuary, Nature Trails, Tidal Wetlands
	Colonial Greenway	Town of Mamaroneck	Nature Trails, Wetlands
	Premium Marsh Conservation Area	Dillon Road	Wetlands, NYS Significant Fish and Wildlife Habitat.
	Sheldrake River Trails	East Branch of the Sheldrake River	Nature Trails, Wildlife Sanctuary
	Bonnie Briar Club	808 Weaver Street	Golf Course, Wetlands
	Winged Foot Club	851 Fenimore road	Golf Course, Wetlands
	VFW / Mamaroneck Senior Center	1288 Boston Post Road	Community Center serving seniors, Social Club
	Hommocks Pool & Ice Rink	140 Hommocks Road	Recreation
Education & Religious (Noncritical facility) *	Central School	1100 Palmer Avenue	Grade School Pre K-5
	Murray Avenue School	250 Murray Avenue	Grade School K-5
	Hommocks Middle School	130 Hommocks Avenue	Grade School 6-8
	Saints John & Paul School & Church	280 Weaver Street	Private Grade School K-8, Roman Catholic Church.

** These key assets are not currently listed as critical facilities. This designation could change should they operate as emergency shelters or operation centers.*

5.B.4 Infrastructure

Infrastructure needs for the Town of Mamaroneck are provided and maintained by State, County, Town, and several private organizations (See Table 5-5). For example, Con Edison Company of

New York is responsible for supplying electrical power, maintaining the power grid and electrical substations, and providing emergency services for downed power lines, damaged transformers and controlling brownouts. Verizon provides telecommunication infrastructure. The Metro-North Railroad, which maintains the rail and the Larchmont and Mamaroneck Stations provide public rail transportation services. The Westchester County Bee Line Bus system provides intercommunity bus transportation.

Table 5-5. Town of Mamaroneck Key Infrastructures.

Service Provider	Facility Type	Key Locations of Concern	Importance/ Function
NY State	Highway/Roads/ Streets	I-95, New England Thruway	Evacuation Route
NY State	Highway/Roads/ Streets	US-1, The Boston Post Road	Evacuation Route
County/Town	Roads/Streets	Weaver Street	Evacuation Route
County/Town	Roads/Streets	Palmer Avenue	Evacuation Route
Westchester County Bus Service (Bee Line)	Bus Service	Inter-county & local bus routes	Public Transportation
Metro-North Railroad	Rail Service	Station Plaza, Mamaroneck Railroad Way, Larchmont	Commuter & Public Transport
Verizon	Telecommunication Service	Town wide	Telecommunications Infrastructure
Con Edison	Electric Power Service	Town wide	Loss of Electric Power
Sheldrake River / Larchmont Reservoir Dam	Flood Control	Town wide	Loss of Flood Control
Baldwin Place Pump Station	Water Supply	Baldwin Place	Loss of Water Supply
Fenimore Road Pump Station	Water Supply	Fenimore Road	Loss of Water Supply
Saxon Woods Pump Station	Water Supply	Saxon Woods	Loss of Water Supply
Westchester Joint Water Works Pump Station	Water Delivery System	Town wide	Loss of Water Supply
Byran Lane Water Tower	Water Supply	Byron Lane	Loss of Water Supply
VOL Water Storage Tank	Water Supply	Town wide	Loss of Water Supply
Winged Foot Water Tower & Radio Antennas	Water Supply & Antenna equipment	Town wide	Loss of Water Supply & Communications
Con Edison Substation	Power Service	675 Weaver Street	Loss of Electric Power

5.B.5 Vulnerability of Critical Facilities and Key Infrastructures

Critical facilities and vulnerabilities in the Town of Mamaroneck are given in Table 5-3 and include government buildings, fire and emergency response facilities, among others. The loss of any of these from a catastrophic event would be a major setback for the Town. Critical facilities should be designed to withstand the flood plain elevation caused by a 500-Year storm. Table 5-6 gives the vulnerabilities for the Town critical facilities and the geographical extent of the hazard. Table 5-7 gives the vulnerabilities for the key infrastructure facilities and the geographical extent of the hazard.

Table 5-6. Vulnerability of Critical Facilities to Selected Hazards

Critical Facility	Vulnerability	High Hazard	Moderately High Hazard			Moderately Low Hazard													Low Hazard				
		Flood	Coastal Storm *	Hurricane **	Severe Storm ***	Dam Failure	Fire	Windstorm	Winter Storm ****	Trans Accident	Utility Failure	Terrorism	Tornado	Hazmat (Transportation)	Transit	Extreme Temperatures	Earthquake	Explosion	Epidemic	Hazmat (Fixed Site)	Drought	Fuel Shortage	Air Contamination
Town of Mamaroneck Fire HQ / Town EOC	Interruption of fire emergency services. Interruption of emergency & rescue services.	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Larchmont/Town of Mamaroneck Volunteer Ambulance Corp (LVAC)	Interruption of emergency medical & rescue services.	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Mamaroneck Town Center / Town Police HQ / Backup EOC	Interruption of police emergency services & communication. Interruption of emergency & rescue services.	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Mamaroneck Town Yard	Loss of public diesel and gas pumps for entire Town fleet, DPW vehicles, generators, pumps, and specialized equipment.	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
VFW/ Mamaroneck Senior Center	Loss of emergency shelter	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H

* Including nor'easters.
 ** Including tropical storms
 *** Including severe and thunderstorm winds as well as other non-winter storms listed.
 **** Including snow storms and hail storms

Key: T = Town Wide
 C = County Wide
 U = Highly Unlikely
 H = Hazard Localized

Table 5-7. Vulnerability of Key Infrastructure to Selected Hazards

Key Infrastructure	Vulnerability	High Hazard	Moderately High Hazard			Moderately Low Hazard														Low Hazard			
		Flood	Coastal Storm *	Hurricane **	Severe Storm ***	Dam Failure	Fire	Windstorm	Winter Storm ****	Trans Accident	Utility Failure	Terrorism	Tornado	Hazmat (Public Transit)	Extreme Temperatures	Earthquake	Explosion	Epidemic	Hazmat (Fixed Site)	Drought	Fuel Shortage	Air Contamination	Fuel Oil Spill
I-95 (NE Thruway), US-1 (Boston Post Road),	Loss of NYS Evacuation Routes	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Palmer Avenue, Weaver Avenue	Loss of County/Town Evacuation Routes	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Westchester County Bus Service (Bee Line) Commuter & Public Transport	Loss of Major Transportation Service	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Metro-North Railroad. Commuter & Public Transport	Loss of major transportation thoroughfare	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	H
Verizon Telecommunications Infrastructure	Interruption of Telecommunications System	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U
Consolidated Edison Electric Power Service	Interruption of Electric Power Service	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U
Sheldrake River / Larchmont Reservoir Dam	Loss of Flood Control	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U
Con Edison Substation	Loss of Electric Power	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U
Baldwin Place Pump Station	Loss of Water Supply Station	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U
Fenimore Road Pump Station	Loss of Water Supply Station	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U

		High Hazard	Moderately High Hazard			Moderately Low Hazard														Low Hazard					
		Flood	Coastal Storm *	Hurricane **	Severe Storm ***	Dam Failure	Fire	Windstorm	Winter Storm ****	Trans Accident	Utility Failure	Terrorism	Tornado	Hazardous Transit	Extreme Temperatures	Earthquake	Explosion	Epidemic	Hazmat (Fixed Site)	Drought	Fuel Shortage	Air Contamination	Fuel Oil Spill		
Key Infrastructure	Vulnerability																								
Saxon Woods Pump Station	Loss of Water Supply	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U		
Westchester Joint Water Works Pump Station	Loss of Water Supply	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U		
Byran Lane Water Tower	Loss of Water Supply	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U		
VOL Water Storage Tank	Loss of Water Supply	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U		
Winged Foot Water Tower & Radio Antennas	Loss of Water Supply & Communications	T	T	T	T	T	H	T	T	H	T	C	T	U	T	T	H	C	H	T	C	C	U		

- * Including nor'easters.
- ** Including tropical storms
- *** Including severe and thunderstorm winds as well as other non-winter storms listed.
- **** Including snow storms and hail storms

- Key:**
- T = Town Wide
 - C = County Wide
 - U = Highly Unlikely
 - H = Hazard Localized

Other key facilities shown in Table 5-4 such as schools, religious institutions, major employers and commercial businesses are important to the Town since damage to any of these would result in loss of important services to the community. Important infrastructures shown in Table 5-5 provide needed transportation, energy, water, sewage treatment, and communication services.

The loss of the Town Center would result in the following impacts:

- Interruption of services.
- The loss of critical plans and management tools.
- The loss of critical records.

The loss of any fire and emergency response facilities would reduce the ability of these services to respond and help the areas of the Town that are impacted.

The loss of the electrical and telecommunications infrastructure would result in the following problems:

- The whole or partial loss of the community telephone system.
- The whole or partial loss of the electrical service.
- The loss of transportation signals.
- Cascade impacts on other needed services, infrastructure and facilities.

The loss of any of the water towers would result in the loss of the potable water supply to the entire Town; the loss of any of the pump stations would result in the loss of critical pressurized water needed in emergencies, and sewage treatment facilities.

5.B.5.1 Vulnerable Natural Conservation Areas

The Town of Mamaroneck maintains approximately 34% of its municipal land area as open space. The Town is home to, and maintains, several unique conservation areas.

The Hommocks Conservation Area consists of 3 acres of tidal wetlands, plus 7.6 acres of woodland paths, salt marsh estuary, and meadow areas.

12.76 acres of the 60-acre Larchmont Reservoir – James G. Johnson, Jr. Conservancy lie in the Town of Mamaroneck. It is a wildlife sanctuary and nature study area, with lakeside trails and woodland paths. It is also home to the Mamaroneck Environmental Center, which houses the Sheldrake Environmental Center, and Monroe Camp.

The Leather Stocking Trail is nearly 2 miles long and runs through the center of the Town. It features a typical northeastern hardwood forest and occasional riverine areas.

The Colonial Greenway consists of 15 miles of trails, woods, and wetlands that connect local and county parks in the Town of Mamaroneck, Village of Mamaroneck, Scarsdale, Eastchester, and New Rochelle.

The Premium Marsh Conservation Area is part of the 65-acre Premium River – Pine Brook Wetlands Complex. This wetlands complex is 10 acres, plus 8 acres of tidal wetlands, and a New York State designated “Significant Fish and Wildlife Habitat”.

The Sheldrake River Trails consists of 23 acres of woodland parcel and 7 acres of freshwater wetlands that is owned and maintained by the Town of Mamaroneck. It is the central part of a 54-acre tract of natural woodland maintained as a conservation area for native plants and animals.

The Sether Woods Conservation area is a small parcel of approximately ½ acre in size. Donated to the Town by the heirs of Hallie and J. Wendell Sether, the deed stipulated that the land would be used only for conservation purposes. The land serves as an important area for flood retention.

The Revere Road Conservation area is a small ¼ acre parcel that acts as a buffer between the NYS Thruway and neighborhood homes. The Sheldrake River also runs through the parcel.

The Old Mill site is a small parcel of land on Hilltop Road. The Sheldrake River runs through the site and under Hilltop Road. There are no trails within the site.

5.B.5.2 Water Bodies and Wetlands

There are several important water courses in the Town that serve important purposes. The Sheldrake and Mamaroneck Rivers run through the Town. Approximately .75 of the Town is located within the Mamaroneck River watershed, and .87 miles of the Mamaroneck River flows through the Town. Approximately 1.48 miles of the Town is located within the Sheldrake River subwatershed, and 2.13 miles of the Sheldrake River flows through the Town.

The Sheldrake Lake, at the Larchmont Reservoir stores water from the Sheldrake River, serving as a flood control basin. Water is released through the discharge pipes at the Sheldrake Dam and then enters the Goodliffe Pond. The Gardens Lake, also known as the “Duck Pond”, lies adjacent to I-95 and stores water originating from the Sheldrake River.

Premium Mill Pond lies adjacent to the Long Island Sound. Storm water from the Pine Brook empties into the Premium Mill Pond and then drains into the Long Island Sound. The Pine Brook stream enters the Town from New Rochelle and empties into the Premium Mill Pond.

The Long Island Sound borders properties in the Premium Point section of the Town. The majority of land within the Town lies north of the Boston Post Road, and does not border the Sound. The Premium River runs along the southwest of Town through Premium Point, and into the Long Island Sound. The East Creek also flows into the Long Island Sound.

There are several wetlands situated on the Town’s golf courses. They can be found in the Northwestern part of the Town at the Bonnie Briar Club, along the West branch of the Sheldrake River; in the Northeastern part of the Town at the Winged Foot Club, on which irrigation ponds are located; and in the Southeastern border of the Village of Mamaroneck in part of the Hampshire Country Club, near the East Creek.

5.B.5.3 Vulnerable Populations

The population of the Town of Mamaroneck was 11,977 according to the 2010 Federal Census. According to the U.S. Census Bureau, the area of the Town is approximately 3.6 square miles. The Sheldrake River, the East Branch of the Sheldrake River and the Mamaroneck River are the

major rivers flowing through the Town. (See Section 5.B.6.2). 8.6% of the residents were under the age of 5 and 13.2% over the age of 65. The percentage of minority populations consists of 5.3% Asian, 1.9% two or more races, and 1.1% African American. The Town of Mamaroneck is considered to be an upper-middle income community. The annual median household income was reported to be \$136,006 and the per capita income was \$79,436. About 4.3% of the resident individuals are considered to be below the poverty level.

Portions of the Town lie in the Special Flood Hazard Areas. Vulnerable populations to storms and flooding (Figure 5-2 and 4-2) include those residences and businesses located in the following areas:

Inland Flooding Areas:

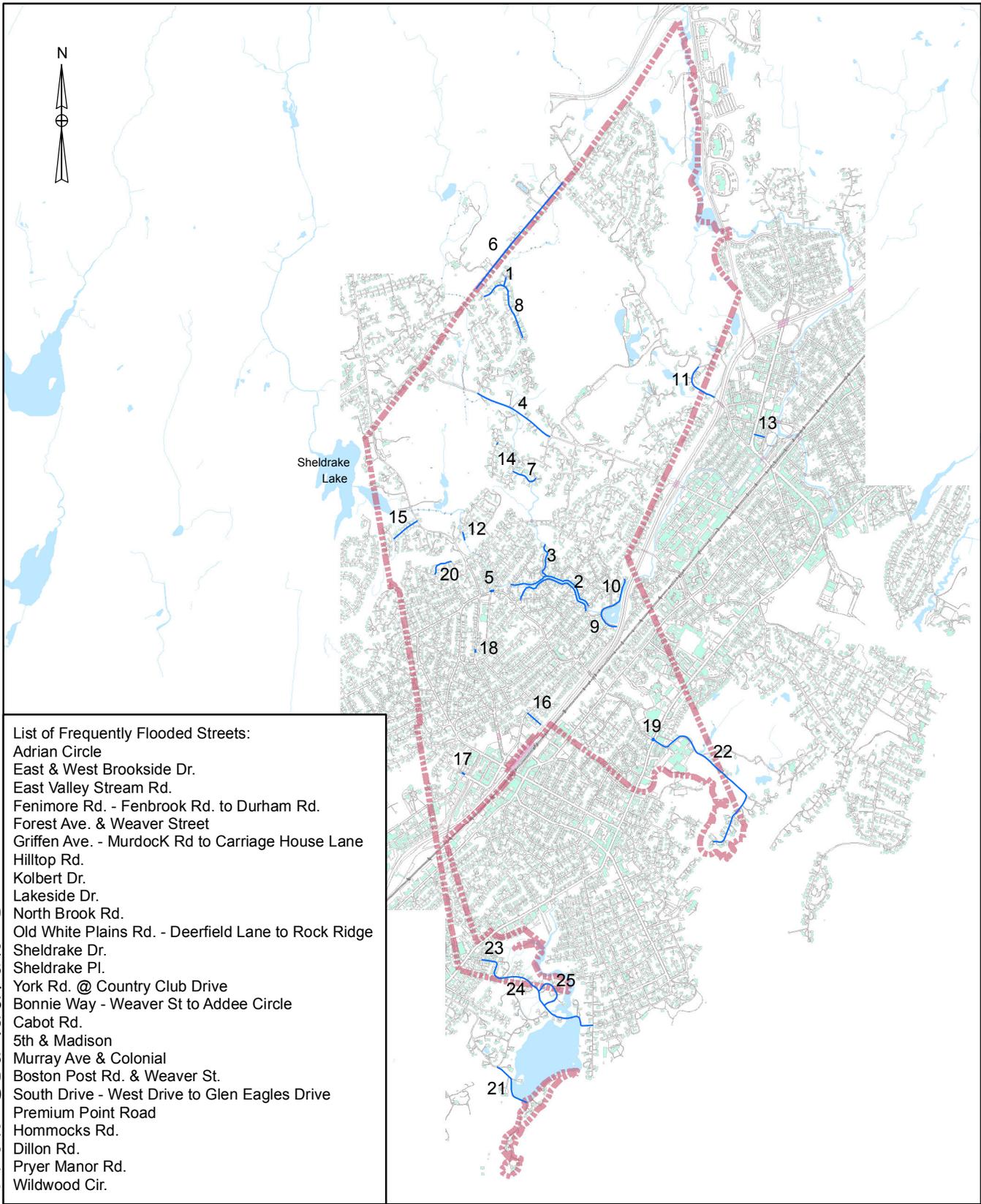
- Adrian Circle
- East & West Brookside Drive
- East Valley Stream Road
- Fenimore Road, from Fenbrook Road to Durham Road
- Forest Avenue & Weaver Street
- Griffen Avenue – from Murdoch Road to Carriage House Lane
- Hilltop Road
- Kolbert Drive
- Lakeside Drive
- North Brook Road
- Old White Plains Road, from Deerfield Lane to Rock Ridge
- Sheldrake Drive
- Sheldrake Place
- York Road & Country Club Drive

Poor Drainage Areas:

- Bonnie Way, from Weaver Street to Addee Circle
- Cabbot Road
- 5th Avenue & Madison Avenue
- Murray Avenue & Colonial Avenue
- Boston Post Road & Weaver Street
- South Drive, from West Drive to Glen Eagles Drive

Coastal Flooding Areas:

- Point Road (Premium Point Island)
- Hommocks Road
- Dillon Road
- Pryor Manor Road
- Wildwood Circle



List of Frequently Flooded Streets:

- 1 Adrian Circle
- 2 East & West Brookside Dr.
- 3 East Valley Stream Rd.
- 4 Fenimore Rd. - Fenbrook Rd. to Durham Rd.
- 5 Forest Ave. & Weaver Street
- 6 Griffen Ave. - Murdock Rd to Carriage House Lane
- 7 Hilltop Rd.
- 8 Kolbert Dr.
- 9 Lakeside Dr.
- 10 North Brook Rd.
- 11 Old White Plains Rd. - Deerfield Lane to Rock Ridge
- 12 Sheldrake Dr.
- 13 Sheldrake Pl.
- 14 York Rd. @ Country Club Drive
- 15 Bonnie Way - Weaver St to Addee Circle
- 16 Cabot Rd.
- 17 5th & Madison
- 18 Murray Ave & Colonial
- 19 Boston Post Rd. & Weaver St.
- 20 South Drive - West Drive to Glen Eagles Drive
- 21 Premium Point Road
- 22 Hommocks Rd.
- 23 Dillon Rd.
- 24 Pryer Manor Rd.
- 25 Wildwood Cir.

Figure 5-2
Frequently Flooded Streets

Town of Mamaroneck
All Hazard Mitigation Plan

Legend

-  Municipal Boundaries
-  Frequently Flooded Streets



Environmental
Technology
Group, Inc.

300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788



DWN BY: YS
CHK BY: JB
SCALE: AS SHOWN
DATE: 09/04/13

Senior citizens are generally at a higher risk. The chronically ill are vulnerable since they lack mobility. With the growing numbers of senior citizens, this vulnerability to hazards may increase in the Town of Mamaroneck in the future.

Several vulnerability factors can affect the impact of hazards to the life, safety, and health of the Town's residents. These include:

- Location of the population relative to the hazard (persons in flood-prone areas or shoreline areas are at greater risk).
- Age of the population (very young and elderly tend to be more vulnerable).
- Current health of the population (persons with chronic illnesses are more vulnerable)
- Mobility of individuals (persons who can't walk or drive have special needs for evacuation and are at higher risk).

Of all the hazards discussed in Section 4 and assessed below in Section 5.C, the population of the Town of Mamaroneck in general and vulnerable populations specifically, are most at risk to severe storm hazards such as flooding and wind damage.

5.C Assessment of Primary Hazards

The following is an assessment of probable hazards identified in Section 4 above and vulnerability to these hazards. Based on this assessment, primary hazards are screened for a more detailed impact assessment on community property and structures. Only some of the hazards evaluated in Section 4 are considered a primary concern to the community. In screening the primary hazards of concern, several criteria were used including:

- Historical occurrence of a damaging event
- HAZNY rating and rank
- Likelihood of a damaging event
- Potential extent of the hazard in the Town
- Likelihood of significant damage
- Severity of damage
- Vulnerable populations
- Impact on safety of people

Hazards considered to have a low impact rating or probable occurrence by these criteria were not considered further for quantitative assessment of damages or for developing objectives and mitigation measures. Therefore the focus of this plan is to assess damages only for those hazards likely to cause significant impacts and to propose remediation measures that will provide the greatest benefit to the community.

5.C.1 Flood Related Hazards

Flooding was rated high with a HAZNY score of 321 and rank of one. Most flooding is due to storms, heavy or extended rainfall and snow melt. The geographical extent of the 100-Year flood, the 500-Year flood is shown in Figure 4-2 and Map 2. These events may be compounded from the concurrence of the moon coupled with high tide events with heavy rains and high winds.

The probability of future flood events is high for a 100-Year flood. It has a 1% probability of occurring in any given year. A 500-Year flood is infrequent, and has a likelihood of occurrence of 0.2% in any given year. However, as sea levels rise, the probability of future flood events for both 100-Year and 500-Year floods increases. (Please see section 4.D.5.8 regarding the effects of climate change on natural hazards). Based on past events, the probability for local flooding in the Town of Mamaroneck for any given year is very high. Maps 2 and 3 show the extent of flooding in the Town. (See Figure 5-3.) Due to the extent and potential depth of flooding there is a high likelihood of significant damage. Severity of damage to areas in the Town that frequently flood could be significant. Impact on safety of people could be significant if advance warning is insufficient and evacuation routes are blocked.

**Figure 5-3. Local Flooding in the Town of Mamaroneck.
Flooding after a severe rainstorm that occurred on March 2, 2007**



Photo by Andrea Fleming, via Larchmont Gazette

Figure 4-2 and Map 2 show the expected extent of flooding for a 100-Year and 500-Year flood. Vulnerable populations include those residences and businesses situated in the Town's major floodplains, which are located along the Sheldrake River and its tributaries, stretching from the Northernmost part of the East Branch, which flows south from the Town border of Scarsdale; and the West Branch, which flows from the City of New Rochelle down to the Larchmont Gardens Lake and into the Town of Mamaroneck. The two branches combine into one river at West Brookside Drive. Other floodplains are located along the Premium River in the Southwest of the Town, the East Creek in the Southeast, and the Mamaroneck Reservoir in the Northeast. Properties located along these areas lie within the 100-Year floodplain. Critical flooding occurs in these areas.

The impacts on health and safety from floods include injuries and deaths caused by:

- Street flooding which would cut off critical emergency access and escape routes from the Town of Mamaroneck..
- Collapsing buildings from water-weakened foundations.
- Falling trees caused by reduced strength of water-saturated soil.
- Infiltration and inflow to storm and sanitary sewers causing backup and overflow of infectious sanitary waste.
- Drowning in low-lying flooded areas.
- Exposure to waves and strong currents in rivers and shoreline areas subject to storm surges.

The following flood impacts have been identified for the Town of Mamaroneck:

- Storm water could exceed the drainage capacity of the natural and manmade drainage systems causing flooding of basements and roads.
- Groundwater levels would rise, causing flooded basements.
- High groundwater levels would cause significant seepage into storm and sanitary sewers.
- Clogged or ineffective storm and sanitary sewers would fail to drain floodwaters.
- Surges could flood and erode natural barriers along the Sheldrake and Mamaroneck Rivers.
- Damage to buried fuel tanks, building foundations and swimming pools.
- Isolation of critical facilities and Town infrastructure; The Town's operations center and emergency centers could be impacted or isolated.
- Repetitive damage to structures in the floodplain and significant flood insurance claims.
- Weakened structural strength of soil resulting in susceptibility to falling trees.

Flooding therefore is one of the major natural hazards facing the Town of Mamaroneck. Based on this evaluation, a damage assessment for flood hazards is provided below in Section 5.D.

5.C.2 Hurricane Hazards

Hurricanes ranked number 3 and were rated moderately high with a HAZNY score of 248. Although hurricanes can produce extensive and devastating damage, the hazard was not given a high HAZNY score due to the rarity of occurrence, as most hurricanes have been downgraded to highly damaging tropical storm or tropical depression status by the time they have reached Westchester County. Most damage from hurricanes is from high winds, and heavy rains. The extent of the flooding depends on the hurricane category. The potential extent of flooding is shown in Map 3 folder at the end of Part I.

The high winds and heavy rains in Westchester County in recent years have resulted in floods, downed trees and power lines. According to the NOAA, based on current weather patterns, the National Weather Service predicts that the upcoming years will show increased hurricane activity.

According to the United States Landfalling Hurricane Probability Project, prepared by the Tropical Meteorology Project at Colorado State University, the probabilities of a hurricane making landfall in Westchester County have increased between 2006 and 2013. Based on 2013 data, the probability of a named Tropical Storm hitting landfall in Westchester County in 50 years is 18.6% (from 11.3% in 2006). The 50 year probability of a hurricane with sustained winds of 75-114 mph is 11.2% (from 3.2% in 2006), and an intense hurricane with sustained winds over 115 mph is 5.4% (from 0.7% in 2006). (<http://typhoon.atmos.colostate.edu>).

According to 2013 Tropical Cyclone Landfall Probabilities, the probability of a named Tropical Storm making landfall in Westchester County during the 2013 hurricane season is .6%. The probability of a hurricane with sustained winds of 75-114 mpg making landfall in Westchester County during the 2013 hurricane season is .3%, and an intense hurricane with sustained winds over 115 mph making landfall in Westchester County during the 2013 hurricane season is .2%. These landfall probabilities are based on Colorado State University's Tropical Meteorology Project's 2013 Tropical Cyclone Forecast. (<http://landfalldisplay.geolabvirtualmaps.com>).

Should a hurricane strike the Town of Mamaroneck, the severity of flood damage throughout the Town would be extensive. The impact on safety of people could be significant if advance warning is insufficient and evacuation routes are blocked.

The following damage impacts from hurricanes are likely to affect the Town of Mamaroneck:

- Wind-driven storm surges could raise the level of the Sheldrake and Mamaroneck Rivers, causing extensive flood damage
- The shorelines of the Town on the Long Island Sound may be inundated by wind-driven storm surges.
- Water may go overtop land barriers and be driven through storm sewers.
- Substantial wind damage to homes and businesses are likely.
- Substantial wind damage to boats is likely.
- Downed power lines would cause power outages and a safety hazard.
- Downed trees would damage homes and vehicles.
- High velocity winds would damage or destroy homes and businesses.

Safety hazards from hurricanes are considered significant. Major hurricanes that strike low-lying areas with limited egress, such as the 1938 Hurricane, can cause drowning. High velocity winds of 74 miles per hour or more may cause significant damage to buildings and property over the entire community and injuries and loss of life by flying debris, wind-propelled glass shards, falling trees and tree limbs, falling poles and downed power lines.

The Town of Mamaroneck Community consists of a population of 11,977 people (2010 US Census). Vulnerable populations include those residents and businesses along the Sheldrake River and its tributaries, the Premium River, the East Creek, and the Mamaroneck Reservoir.

Probable causes of injury and mortality include:

- Downed trees could be the cause of a few deaths and injuries in a major hurricane.
- Downed power lines can cause electrocution.
- Persons near the watercourses are at high risk of drowning from a storm surge.
- Strong winds can blow people to the ground or into flooded areas.

- An increase in motor vehicle accidents is likely to occur.
- Death and injury would result from wind damage to buildings and homes from broken glass and other flying debris.

Hurricanes are one of the most damaging natural hazards facing the Town of Mamaroneck. Based on this evaluation a detailed damage assessment for hurricanes is provided below in Section 5.D.

5.C.3 Severe Storm and Wind Related Hazards

Coastal storm hazard was given a score of 253 in the HAZNY analysis and ranked number 2 in importance. Severe storm events other than hurricanes also cause flooding which was discussed previously in Section 5.C.1. These storm hazards include tropical storms, severe storms, thunderstorms and nor'easter coastal storms. The Severe storm and thunderstorm hazard was given a score of 246 in the HAZNY and ranked number 4 in importance.

Thunderstorms are frequently accompanied by lightning, heavy rains, and heavy winds. Flooding could occur, which would affect the residences and businesses along the flood-prone areas (along the Sheldrake River and its tributaries, the Premium River, the East Creek, and the Mamaroneck Reservoir). Floods could also affect the Town's Key Infrastructures, such as Evacuation Routes (Interstate 95, The Boston Post Road, etc.). Another key infrastructure that could be affected is Con Edison; severe storms could knock out power. It is difficult to determine the extent of the vulnerability.

Severe storm events also generate high velocity wind hazards that can approach hurricane or tornado force. It is this wind hazard that is a primary concern in this section. Tornadoes were ranked 11th with a HAZNY score of 218, and are also included in this storm category. They are relatively uncommon events and will not be analyzed separately. When they do strike, they can cause extensive local damage across a narrow path. Although they periodically occur in Westchester County, no records were found for a tornado strike in the Town of Mamaroneck. Wind storms were ranked 7th with a HAZNY score of 230 and are also included in this storm

category. The probability of significant yearly damage from severe storms is very high. The following severe wind concerns include:

- High winds can cause structural damage to commercial buildings and homes.
- Wind and waves cause erosion of the riverbanks.
- Falling trees damage homes and cars, break overhead power, telephone and cable lines.
- Fallen trees, utility poles and lines can block escape routes.
- Wind and waves can cause structural damage to boats.

Individual severe storms tend to cause local and isolated damages, and impacts occur over a short period of time. New structures are required to meet criteria for withstanding severe winds as shown in Figure 4-7. Unless wind speeds approach those of a Category 1 hurricane or a class F1 tornado, damage is expected to be light. Tropical storms, severe thunderstorms, nor'easters, coastal storms, wind storms, and tornados will not be analyzed separately. A quantitative damage assessment will be made, where applicable, with assessment for windstorm damage provided below in Section 5.D.3.

5.C.4 Winter Storms, Snow and Ice

The HAZNY score for winter snowstorms tied for 7th in rank with windstorms as a moderately high hazard with a score of 230. While major snowstorms may not occur every year, those that do occur can cause considerable local damage. The most significant of these storms are winter nor'easters.

Also notable are ice storms that occur occasionally which can be more damaging than snowstorms. Damaging winter storms have a high probability of occurring every year or two with a high likelihood of damage. They can be regarded as frequent events since they may occur more than once a year.

The impacts associated with these winter storm events include:

- Problems of heavy snow accumulation causing interruptions in private and public transportation, schools and businesses.
- Snow and ice damage to public roads and walkways.

- Roofs collapsing under the weight of snow.
- Damage to trees in parks and on streets stemming from falling branches and blow down of trees.
- A utilities failure from breaks in overhead lines caused by weight of snow/ice and by falling trees and limbs.
- Damage to trees caused by the build-up of ice during ice storms.
- Limited access to escape and rescue routes.

Health and safety impacts from winter storms, ice and snow result in breakdowns in communication, transportation, emergency services, motor vehicle accidents, falling limbs and power lines. Risks to people from winter storms can be significant. The key safety impacts include:

- Downed trees can cause deaths and injuries.
- Downed power lines can cause electrocution.
- An increase in motor vehicle accidents due to slippery roads.
- Back injury and cardiac problems in residents due to shoveling snow.
- Limited visibility conditions while driving.
- Frost bite.

A quantitative damage assessment for winter storms will not be made. Property damage compared with other major storm events is limited and localized. Interruption of services and business is mostly limited to a few days or less. The primary hazards include structurally inadequate roofs, fallen trees and limbs, downed power lines and traffic accidents. Data and analysis are not readily available to conduct a separate analysis for snow and ice damage. Economically these impacts fall most heavily on the Town public works and Con Edison repair crews. Wind impacts are considered more significant than snow and ice and will be considered in Section 5.D.3.

5.C.5 Utility Failure Problems

The hazard level associated with utility failure was ranked 9th with a HAZNY Score of 221. Utility failures are both local in the Town of Mamaroneck and regional (from county wide to the

entire northeast). Power failures may be caused by downed power lines from wind storms, snowstorms, ice storms, fallen trees, heat waves, power grid system failures, substation failures, fires, or terrorism. The local concerns include downed power lines and poles caused by high winds, ice, snow and fallen limbs and trees. The regional utility problems due to far-ranging power grid, regional control and distribution problems are beyond the control of the local community. Regional and local problems are also often related to heat waves. Whatever the cause, the impacts on the community are the same. The probability of local power failures in a given year is high. The probability of a major grid failure or brownout is high over the next several years. The problems associated with utility failures include:

- Loss of life sustaining equipment.
- Loss of refrigeration and spoilage of food.
- Loss of air conditioning in the summer during a heat wave.
- Loss of heating in winter and freezing of water pipes.
- Loss of rail service for the Town.
- Traffic problems from loss of signal lights.
- Economic losses for local businesses.

The summer of 2006 showed record setting peak electricity demand. On September 14, 2006, Con Edison representatives met with several Westchester Municipal Officials to discuss Con Edison's less than optimal response to previous power outages, and to discuss solutions and future plans. Con Edison agreed to work with the municipalities on improving their response to power outages. Con Edison also announced that it would invest 1.2 billion dollars beginning in 2007 to upgrade and reinforce its electric delivery system in New York City and Westchester County. (www.coned.com/publicissues, Con Edison).

Several storms since 2006 have knocked out power to Westchester County. Super storm Sandy knocked out power to more than 3,332 customers in the Town of Mamaroneck, and approximately 206,000 customers in Westchester County. After Superstorm Sandy, New York State Governor Andrew Cuomo announced that regulators will scrutinize Con Edison's preparations for Sandy, as well as its subsequent attempts to restore power in New York City and Westchester County after the storm. No further health and safety assessments and damage

analysis will be performed related to utility failures, and no mitigation measures will be proposed or evaluated.

5.C.6. Dam Failure

Dam Failure was ranked 5th in the moderately low range with a HAZNY score of 239. Located in Valhalla, failure of the Kensico Dam could occur for several reasons; including overtopping, structural failure, cracking, poor maintenance, poor piping, and terrorism.

Failure of the Kensico Dam would be devastating, with little or no warning, resulting in catastrophic damages and fatalities. Approximately nine million people would lose their water supply. A tidal wave would ensue which would affect hundreds of thousands of people. Countless lives would be lost, as well as structures and critical facilities in the tidal wave's path, which would span from White Plains through the Bronx.

The Larchmont Dam is used for conservation and recreational purposes. It also currently provides vital flood control for downstream areas in the Town of Mamaroneck and the Village of Mamaroneck. A failure of the Larchmont Dam could cause serious and damaging flooding of the Sheldrake River Valley from below the Dam to the Mamaroneck Harbor. Many houses would be inundated. Several streets and roads along the river from the Sheldrake Reservoir to the Mamaroneck Harbor could be flooded. Water flowing over roads would likely have high velocity and could potentially wash pedestrians or vehicles downstream. The Town of Mamaroneck is responsible for operating the dam valve on the Larchmont Dam. Mitigation measures will be proposed and evaluated in Sections 7 and 8 of this plan.

5.C.7 Fire

Fire hazard was ranked 6th in the moderately low range with a HAZNY Score of 232. According to incident reports from the Town of Mamaroneck Fire Department, the following fires have occurred in the Town from January 1, 2008 until December 31, 2012:

Type of Situation	2008	2009	2010	2011	2012
Building Fires:	14	6	11	13	21
Vehicle Fires:	4	5	6	8	2
Brush, grass, or natural vegetation Fire:	4	3	0	3	4
Other Fires:	18	20	27	16	16
Total Fires:	40	34	44	40	43

There are approximately 509 commercial and industrial facilities (including commercial apartment buildings) and 3,052 residential buildings in the Town of Mamaroneck (See Table 5-2). Vulnerable fire prone locations include gas stations, restaurants and schools. Densely developed residential areas are likely to be fire risks, including single family and multi-residential buildings, and have the likelihood to affect more than one building. There are approximately 2,976 single-family homes and 76 multi-residential buildings in the Town of Mamaroneck. There are several natural areas that can be at risk for wildfire. However, there have been minimal occurrences of wildfire in the Town. Identified fire risks and concerns in the Town that need attention include:

- Single-Family residences
- Multi-family residences
- Light Industry and commercial
- Natural and conservation areas

Risks to human health and safety, although a major concern, appear to be controlled. Based upon this assumption, further health and safety assessments and a damage analysis due to local fires will not be performed.

5.C.8 Extreme Temperatures

This hazard was ranked 13th in the moderately low range with a HAZNY Score of 204. Summer temperatures have become gradually higher in recent years and may continue to increase in the near term. A heat event between July 4 and 6, 1999 in the New York metropolitan area had temperatures ranging from 100 to 105 degrees F with peak at 110 degrees. This resulted in 33

fatalities in the New York metropolitan area. Rolling electrical blackouts occurred across the region (National Climate Data Center, ncdc.noaa.gov).

In 2001, New York was hit with another heat wave, along with the rest of the east coast, resulting in 4 deaths. Temperatures in New York City reached 103 degrees F. In 2006, the North American Heat wave spread throughout most of the United States, killing more than 225 people. At least 32 deaths were reported in New York City. Massive blackouts occurred in the Tri-state area and Westchester County.

In July of 2010, a hot air mass developed and settled over the New York City area. Temperatures were in the mid to upper 90s and low 100s. The NYSDEC issued an ozone advisory for the New York metropolitan area. The Westchester County Health Department issued a heat advisory on July 6th due to 101-degree temperature. More than 1300 were without power during this heat wave.

In July of 2011, the New York City area was hit with another heat wave which lasted for 8 days. Temperatures in New York City reached 104 degrees, and 11 deaths were reported.

In July of 2013, Westchester County saw 7 consecutive days with temperatures in the mid 90s. According to Con Edison, electric usage fell short of its all time peak, reaching 13,161 MW during this heat wave. The all-time record of electric peak usage was 13,189 MW, which occurred on July 22, 2011.

Since most homes are air-conditioned there is a growing tendency for power failures and brownouts to occur during the warmest weeks of the year. The primary impact of high temperatures is the increased electrical demand and its stress on electrical utilities (see Utility Failure Section 5.C.5 above). Additional concerns are related to health and safety of people sensitive to heat stress and air pollution (see Section 5.C.12). Heat-related problems have a high probability of occurring in the future. Specific structure or facility damage related to high temperatures is limited. In extremely hot weather roads and bridges can buckle. An increase in safety risks to pedestrians and car passengers is probable.

The July 4-6, 1999 heat event resulted in 33 fatalities in the New York metropolitan area. Four deaths in the region were attributed to an August 2001 excessive heat event. 32 deaths in New York City resulted from the heat event in 2006. 11 deaths in New York City resulted from the heat event in 2011. Health impacts from elevated temperatures depend on the population of people sensitive to heat stress. For example, senior citizens are at greater risk for heat stroke. The chronically ill are vulnerable to sudden high temperature heat waves. With the growing populations of the senior citizens in Westchester County, this is the sort of problem that could increase in the Town of Mamaroneck in the future. Although limited, there is a moderate to low likelihood that the elderly and chronically ill would be impacted.

There is no significant property damage from heat waves. Interruption of services and businesses is limited and primarily due to electrical utility failures. Health and safety of vulnerable populations is a concern. Based on this assessment, further health and safety assessment and a damage analysis from extreme temperatures will not be performed nor will mitigation measures be proposed or evaluated for this hazard.

5.C.9 Hazardous Material Releases

This hazard covers materials, which, if released or if not used in a safe manner, could pose a threat to people, property and the environment. This hazard was evaluated from two perspectives. The release of hazardous materials during transit ranked 12th and was rated a moderately low score of 210. Released from fixed locations, hazardous materials were rated moderately low with a HAZNY Score of 168 and a rank of 21.

Trucks carrying hazardous materials are likely most at risk at one of the established transportation routes that traverse the Town of Mamaroneck, including Interstate 95, and Route US-1, also known as The Boston Post Road, which runs parallel to the Long Island Sound. Metro-North commuter tracks run through the Town. These same tracks are also used periodically by CSX to transport hazardous materials through the Town.

Based on the probable sources and quantities of hazardous materials stored and used in the Town of Mamaroneck, the likelihood of significant damage or injury is low from the release of

hazardous materials from a fixed site. The potential releases from small businesses would likely be small quantities and would have a limited local impact.

Releases may occur from activities such as dry cleaning, auto repair and repainting, gasoline and home fuel distributors, marina activities, home building and maintenance services, compressed gas distributors, painting and cleaning and small quantity home use. The following problems from release of hazardous materials include:

- Releases from accidents during handling of chemicals.
- Spill of materials during use.
- Accidental air emission
- Release of toxic chemicals during a fire or explosion.
- Release from improper storage or disposal.
- Release from a truck in an accident.
- Rail car accident.

The frequency of hazardous materials distributed in the Town of Mamaroneck is an important community concern. However, the quantities involved would not generally result in significant property damage or result in significant injury, illness or mortality to the public.

Based on this assessment, further health and safety assessment and a damage analysis from hazardous material releases (fixed or in transit) will not be performed and mitigation measures will not be proposed or evaluated.

5.C.10 Explosion

Explosion hazard was ranked in the moderately low range with a HAZNY Score of 192 and a rank of 17. Fueling activities at gasoline stations and marinas, and natural gas use in homes are risks. Handling and refilling gas cylinders at a local compressed gas distributor requires adherence to strict safety procedures. Accidents from use of flammable solvents in paint shops can cause explosions. Accidents from use of natural gas or propane at commercial and industrial facilities are a concern.

The problem is sporadic and the likelihood and magnitude is considered low. However, explosions though low in occurrence can cause major damage to a facility and surrounding properties and can injure or kill people. At present the Town of Mamaroneck Fire and Police Departments oversee the protection of the community from these hazards and provide emergency fire response for sites with potentially explosive hazards.

Based on this assessment, further health and safety assessment and a damage analysis from explosion hazards will not be performed and mitigation measures will not be proposed or evaluated.

5.C.11 Oil Spills

Oil spills were ranked 15th in the moderately low range with a HAZNY score of 201. Fuel oil spills were ranked 30 in the low range with a HAZNY Score of 113. Fuel oil spills during transport within or through the Town of Mamaroneck or during filling operations, can impact the health and safety of its residents. Trucks carrying fuels are likely most at risk on the commercial roads. No significant releases that have affected the public and required evacuation have been occurred in the Town. The primary concern would be fire and explosion incidents. There are no major fuel oil storage or processing facilities in the Town. Therefore, the magnitude and severity of the hazard is expected to be limited to local areas in the Town.

Oil spills can also occur as a result of failed underground storage tanks at gas stations and home-heating oil businesses. Other than fuel/oil services at local gas stations and heating oil businesses, there are no significant commercial or industrial oil storage or transfer facilities in the Town of Mamaroneck. Fuel oil spills can also occur as a result of fuel transportation and delivery. Flooding can cause fuel tanks to become buoyant causing oil spills. Fuel oil spills can cause contamination of groundwater and surface water resources. Incidences of oil spills have occurred in the Village. According to the Town of Mamaroneck Fire Department Incident Type Reports, there were 29 incidents of “oil or other combustible liquid spill” during the period January 1, 2008 to December 31, 2012. Spills within the Town are most likely to be local and their impacts small.

Although these are important environmental contamination issues that could result in local property damage, this hazard would result in limited damage to buildings and limited injury, illness or mortality. Based on this assessment, further health and safety assessment and damage analysis from oil spills will not be performed nor will mitigation measures be proposed or evaluated.

5.C.12 Air Contamination

This hazard was ranked in the low range ranking 27th with a HAZNY Score of 132. No major industrial sources of air pollution were identified within the Town of Mamaroneck. The Town of Mamaroneck is within the USEPA Non Attainment area that has been designated for ozone. This means that the regional baseline air quality does not meet USEPA requirements and that certain activities with the potential for causing air pollution are not permitted. Therefore, there is a very high probability for the occurrence of air contamination problems. These problems include:

- Air contamination resulting from commercial and light industrial/manufacturing businesses.
- Air contamination resulting from local homes or sources using wood burning fireplaces and stoves in winter.
- Local contamination resulting from outside regional sources.
- Local automobile emissions in the Town of Mamaroneck.
- Local diesel emissions in the Town of Mamaroneck from trucks, busses, and diesel/electric hybrid trains.
- Regional truck transport and commuter travel through the area and its perimeter and surrounding areas.

Air contamination events in the Town of Mamaroneck due to local sources are small and isolated and do not represent a major increase in health and safety risks to local residents. The primary health and safety concern is among the elderly, infirmed and sensitive individuals with respiratory problems. These risks are related to regional problems rather than local sources.

These problems, though important air pollution issues, would not result in significant property damage or result in significant injury, illness or mortality. Based on this assessment, further

safety assessment and a damage analysis from extreme temperatures will not be performed nor will mitigation measures be proposed or evaluated.

5.C.13 Earthquakes

This hazard was ranked 14th in the moderately low hazard range and has a HAZNY Score of 202. Chances of an earthquake occurring in the Town of Mamaroneck are low. None of the 3,582 structures in the Town are particularly at risk. Earthquakes in excess of 5.0 on the Richter Scale are extremely rare in the Northeast while events of lower magnitude occur periodically and minor damage may occur. According to the USGS, the peak ground acceleration (PGA) rating for the Town of Mamaroneck is 3.78%g. This rating places the Town in a low risk category for earthquakes. According to the Lamont-Doherty Cooperative Seismographic Network (LCSN) of Columbia University, no earthquakes have been reported with a magnitude greater than 5 since 1884 in the Greater New York City area. However, in October 1985, an earthquake occurred in Westchester County which was centered in Ardsley and measured 4.0 on the Richter Scale. There have been other minor earthquakes reported in the White Plains and Dobbs Ferry areas. In addition, tremors were felt in Westchester County from an earthquake that occurred on August 23, 2011 and measured 5.8 on the Richter Scale. The epicenter was Northwest of Richmond, Virginia. There is no particular elevated safety risk linked to earthquakes of Richter Scale 5.0 or less.

In 2008 the USGS updated their National Seismic Hazard Maps. The peak ground acceleration (PGA) rating for the Westchester County ranges between 3– 4%g, and represents a moderately low risk category for earthquakes (See Figure 4-8). All reported events in Westchester County have been minor with no significant damage or injuries. Based on this information, there is a low probability that a damaging earthquake would occur in the Town of Mamaroneck.

However, a study published in the Bulletin of the Seismological Society of America analyzed 383 earthquakes from 1677 to 2007 in a 15,000 square mile area around New York City, along with new data. The study suggests a pattern of subtle, yet active faults, which increases the risk of earthquake to the New York City area.

Although earthquakes are an infrequent occurrence in the New York City area, the risk is greater due to the extremely high concentration of people and infrastructure. The population is denser than in more earthquake-prone areas. In the event a damaging earthquake did occur in the area, the losses would be far more catastrophic.

Based upon research in this study, an earthquake with a Magnitude-5 is predicted to occur every 100 years. In addition, it is estimated that a Magnitude-6 will occur every 670 years, and a Magnitude-7 will occur every 3,400 years (The corresponding probabilities of occurrence in any 50-Year period would be 7% and 1.5%, respectively).

In addition, the study has uncovered new seismic zones that have not previously been identified, thereby increasing the risk of a damaging earthquake in the area. For example, a newly discovered seismic zone was identified which runs from Stamford, CT, to Peekskill, NY. This zone runs less than one mile north of the Indian Point Nuclear Power Plant. In addition, the Ramapo Seismic Zone, that runs from Eastern Pennsylvania to the Mid-Hudson Valley, passes within two miles northwest of Indian Point, placing the power plant in a very precarious position.

Indian Point sits on the banks of the Hudson River in Buchanan, New York. It is situated 23.65 miles from Mamaroneck, and was built to withstand a Magnitude-7 on the Mercalli Scale, or 6.1 on the Richter Scale.

The higher-level events could cause substantial damage to structures that are not specifically designed to withstand earthquakes. Beyond damage to structures there would also be damage to underground utilities.

FEMA has run vulnerability assessment studies using HAZUS-MH software. Damage analysis from earthquakes will be discussed in section 5.D.4.

5.C.14 Terrorism

Terrorism was ranked in the moderately low range with a HAZNY score of 219 and a rank of 10. As discussed in Section 4.D.7, this human caused hazard would be low risk in the Town of

Mamaroneck since there are no real major terrorist targets of interest identified in the Town. Key target populations, high profile historical landmarks, airports, significant regional infrastructures, important manufacturing facilities, critical industries or key government institutions and structures are not present in the Town. The commuter rail stations in the Villages of Mamaroneck and Larchmont were identified as possible targets, but they are part of only one of several commuter lines feeding into the greater metropolitan area. Another potential target is the Indian Point nuclear power plant. Current regulations require evacuation planning for areas located within a 10 mile radius of nuclear facilities. Mamaroneck lies 23.65 miles from Indian Point, and is outside of the evacuation planning zone. Legislators are currently urging the Nuclear Regulatory Commission (NRC) to expand the NRC evacuation plan requirements to include areas within fifty miles of a nuclear facility. Another potential target is the Kensico Dam located in Valhalla. Because of the absence of important target facilities and key vulnerable populations, this hazard will not be considered for further evaluation or analysis.

5.C.15 Epidemic

Epidemics are a moderately low risk in the Town of Mamaroneck. Epidemic hazard was ranked 19th in the moderately low range with a HAZNY score of 179. Based on the hazard profile given in Section 4.D.5.3, epidemics are a real concern but rare or infrequent. Epidemics are more likely to be a regional problem than a local one.

No special mitigation measures beyond current state or county public health activities are called for. These issues are currently handled by the Westchester County Department of Health. Based on this assessment, further health and safety assessment and a damage analysis from these hazards will not be performed and potential mitigation measures will not be evaluated.

5.C.16 Other Hazards

The following hazards were rated as low hazards and were ranked the lowest. They are not expected to cause significant damage or have substantial health or safety impacts. They are either rare events - occurring less than once every 50 years or infrequent events occurring between once every 8 years to once in 50 years. They have a low likelihood of causing a significant damaging event and the extent of the hazard in the Town of Mamaroneck is limited. They are

unlikely to have any significant impact on the critical facilities, infrastructure, local economics, or key cultural or historical resources. They could also be more of a regional problem than a local one. These hazards judged to have a low impact or risk include:

- Radiological releases
- Fuel Shortage
- Food Shortage

Further health and safety assessment and a damage analysis from these hazards will not be performed and potential mitigation measures will not be evaluated.

5.D Impact and Damage Analysis of Major Hazards on Town Facilities

5.D.1 Vulnerability and Value of Buildings Subject to Hazards

The Town of Mamaroneck is essentially a residential community and about 85 percent of the total buildings are single-family and multi-family residences (see Table 5-8). Commercial properties, including apartment buildings, represent about 14% of the buildings in the Town.

Table 5-8. Residential, Commercial, Industrial and other Buildings Potentially Exposed to Hazards in the Town of Mamaroneck.

Property Class Code	Building Type by Property Class	Total Number of Buildings *	% of Total Buildings
200-210	Single Residential	2,976	83.08%
215-283	Multi-Residential	76	2.12%
400-486	Commercial	507	14.15%
500-590, 682	Recreation & Entertainment	12	0.34%
600-615	Community Services & Education	4	0.11%
620	Religious	1	0.03%
650-670	Health, Government & Protection	4	0.11%
714	Lite Industrial/Manufacturing	2	0.06%
	Total	3,582	

* Data provided by Town of Mamaroneck Assessor’s office.

The valuation of the buildings at risk is based on the Town of Mamaroneck’s tax assessments. The Town of Mamaroneck completed a town-wide revaluation in 2013 and all properties are assessed at 100% of full market value. Therefore, the Residential Assessment Ratio (RAR) to

determine the value of residential properties for the Town of Mamaroneck is 100%, and the Equalization Rate for the Town of Mamaroneck is 100%. The Town tax assessment information is given in Table 5-9. The total valuation of all occupied buildings in the Town of Mamaroneck is approximately \$2,725.8 million. For the purpose of this assessment, residential and multi-residential were combined. Since the total number of properties was small, community services, education, religious and government services were combined. Apartment buildings are assigned to a commercial code. Recreation, entertainment and Sports facilities were combined with commercial properties since these activities have similar commercial functions in the community.

Table 5-9 also shows the percent of building number exposure to hazards by occupancy type. About 86% of the value is residential and multi-residential property. About 11% of the exposed value is from commercial properties. About 3% of the exposed value is from Education, Religious, Government, and Protection Services.

Table 5-10 shows the replacement value of buildings exposed to hazards by occupancy type. Property values were based on the assessed value of the property and the tax assessment rate of 100% in Table 5-9. HAZUS-MH estimates a total replacement value of structures in the Town of Mamaroneck (excluding contents) to be approximately \$1,170.4 million dollars. HAZUS output parameters use 2006 dollars. This figure was converted from 2006 dollars to 2013 dollars using the Federal Reserve Bank of Minneapolis' Consumer Price Index (www.minneapolisfed.org). Please refer to Section 5.D.2 for more information on the HAZUS Flood Model and Damage Analysis.

Table 5-9. Town of Mamaroneck Property Tax Assessments and Property Values. *

Property Occupancy Code	Building Type by Property Class	Total Number Buildings	Total Assessed Value \$	Average Property Value \$	% Total Value
200-210	Single Residential	2,976	2,289,695,070	769,387	84.0
220-283	Multi-Residential	76	53,497,500	703,914	1.96
400-486	Commercial	507	268,210,760	529,015	9.84
500-590, 682	Recreation & Entertainment	12	33,240,000	12,370,000	1.22
600-615	Community Services & Education	4	61,320,000	15,330,000	2.25
620	Religious	1	12,370,000	12,370,000	0.45
640-670	Health, Government & Protection	4	7,026,000	1,756,500	0.26
710	Lite Industrial/ Manufacturing	2	440,000	220,000	0.02
	Total	3,582	2,725,799,330		100

* Data provided by Town of Mamaroneck Town Assessor’s office.

Table 5-10. Building Exposure by Occupancy type. *

Property Class Code	Occupancy Class	Total Value Properties *	Replacement Value **
210	Single Residential	2,289,695,070	1,138,951,149
220-283	Multi-Residential	53,497,500	26,610,984
400-486	Commercial	268,210,760	133,414,688
500-590	Recreation & Entertainment	33,240,000	16,534,401
600-615,682	Community Services & Education	61,320,000	30,502,090
620	Religious	12,370,000	6,153,145
640-670	Health, Government & Protection	7,026,000	3,494,907
710	Industrial	440,000	218,867
	Total	2,725,799,330	\$1,355,880,230

* Based on data provided by Town of Mamaroneck Town Assessor’s Office.

** Based on data provided by HAZUS-MH.

5.D.1.1 Participation in the National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a Federal program created by Congress in 1968 to mitigate future flood losses nationwide through sound, community-enforced building and

zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. The NFIP is administered by the Federal Emergency Management Agency (FEMA), a component of the U.S. Department of Homeland Security (DHS).

Participation in the NFIP is based on a voluntary agreement between local communities and the Federal Government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses.

Under the NFIP program, construction in floodplains is acceptable provided that floors are elevated to minimize the risk of damage. In exchange, the NFIP makes Federally-backed flood insurance available to homeowners, renters, and business owners in these communities. In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs.

The Town of Mamaroneck participates in FEMA's National Flood Insurance Program. The Town is registered as Community Identification Number (CIN) #360917, and intends to continue its participation. The Town of Mamaroneck actively implements and enforces its Flood Damage Prevention Ordinance, Erosion and Sediment Control Ordinance, and Uniform Building Codes. The Town follows recommendations from its Master Plan and updates, Comprehensive Emergency Management Plan and updates, Town of Mamaroneck and Village of Larchmont Waterfront Revitalization Program, and the Upper Sheldrake River and Larchmont Reservoir Hydrology Report. Please refer to Sections 7 and 8 for NFIP compliant mitigation action items.

5.D.1.1.a Flood Insurance Claims

There was limited information available on insurance claims data for the Town of Mamaroneck. According to the NFIP, as of 09/30/2013, there are currently 287 flood insurance policies for the Town. The total insurance coverage is \$84,699,100 and since 1978 there were 546 claims made for \$4,784,317. However, these flood insurance claims are likely underreported and actual flood damages are probably higher. (<http://bsa.nfipstat.fema.gov>).

The Town of Mamaroneck has a total of forty-one repetitive loss properties. As of July 31, 2013, twenty-one properties are located in the A Zone and have had repetitive loss payments totaling \$687,430.74. \$563,299.11 of this amount represented building coverage and \$124,131.63 was for contents coverage. Twenty properties situated in the B,C,X zones had repetitive loss payments of \$497,282.95. \$384,266.89 represented building coverage, and \$113,016.06 was paid for contents coverage. The combined repetitive loss payments totaled \$1,184,713.69; \$947,566.00 was paid for building coverage, and \$237,147.69 was paid for contents coverage.

FEMA defines a repetitive loss property as any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-Year period since 1978.

5.D.1.2 100-Year and 500-Year Flood Hazards

The 100-Year flood is defined as the base flood standard and the 500-Year flood is a probable worst-case. Flood levels for these events are summarized in the Flood Insurance Study (FIS) for the Town of Mamaroneck, by the Federal Emergency Management Agency (FEMA), September 15, 1989; and in the Flood Insurance Study for Westchester County, NY (All jurisdictions), September 28, 2007. Inundation floods from hurricanes, which may cause more severe wave surges, are evaluated in Section 5.D.3.1.

The Town has been exposed to both coastal and riverine flooding. The risk of the most severe flooding in the Town of Mamaroneck located along the Sheldrake River and its tributaries, the Premium River, the East Creek, and around the Mamaroneck Reservoir. The most severe

riverine floods have been associated with the heavy rains from storms or landfalling hurricanes originating in the Caribbean Sea. Wind-driven storms particularly from hurricanes and Nor'easters cause severe flooding and backup of storm water (See Map 3 at end of Part I).

The Town of Mamaroneck was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Flood Insurance Zone	Description
Zone A	Corresponds to the 1-percent annual chance floodplains that are determined by detailed methods. No Base flood elevations determined.
Zone AE	Corresponds to the 1-percent annual chance floodplains that are determined by detailed methods. Base flood elevations determined.
Zone V	Corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Coastal flood zone with velocity hazard (wave action); No Base flood elevations determined.
Zone VE	Corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Coastal flood zone with velocity hazard (wave action); Base flood elevations determined.
Zone X	Corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Source: Flood Insurance Rate Maps 36119C0332F 36119C0334F, 36119C0342F, 36119C0351F, 36119C0353F, 36119C0361F, Town of Mamaroneck, New York, Westchester County. FEMA. September 28, 2007.

Because of the expanse of the area, there are five transected base flood elevation measurements for the 100-Year flood for the Sheldrake River, and three for the East Branch Sheldrake River shown on the FIRM Maps. Elevation reference marks were measured, resulting in several different base flood elevations along each flooding source. Base flood elevations are shown for these cross sections of the 100-Year flood spanning the Town of Mamaroneck.

Base flood elevations are shown below for the cross sections of the 100-Year flood spanning throughout the Town of Mamaroneck along the Sheldrake and East Branch Sheldrake Rivers:

Flooding Source Cross Section: Sheldrake River	Base Flood Water Surface Elevation
A	32.2
B	59.9
C	74.3
D	78.8
E	80.2

Flooding Source Cross Section: East Branch Sheldrake River	Base Flood Water Surface Elevation
A	62.4
B	78.3
C	97.4

Source: Flood Insurances Study (FIS), Westchester County, NY (All jurisdictions). Effective September 28, 2007; and, FIS Study # 36119CV001A; Flood Insurance Study (FIS), Town of Mamaroneck, New York. Revised September 15, 1989. Community # 360917.

For purposes of this assessment, the referenced base flood elevations were averaged to determine the mean base flood elevation for each zone. Therefore, the mean base flood elevation in the 100-Year flood plains is 70.4 feet.

The impacts of flooding from 100-Year and 500-Year events were assessed counting buildings on properties for the various categories of property use (Maps 1 and 5) (i.e. residential, commercial, industrial and community services). Counts made using overlays for each of the two flood zones from Map 2, and information supplied from the Town are summarized on Table 5-11. Based on the average assessed value for each property type the total assessed value for each category was estimated and is given in Table 5-12. The total dollar value can be viewed as the amount of the total property and buildings at risk. This value does not represent the actual damages or losses of the property since in most cases only a portion of the building is damaged from a flood.

Table 5-11 shows that about 8.6% and 5.8% of the properties in the Town of Mamaroneck would be at risk from a 100-Year and a 500-Year flood event, respectively. The major impacts would be from flooding of single residential homes. For the 100-Year flood, the total value of properties at risk from damage in the Town is about \$344 million (Table 5-12). The 500-Year flood resulted in a risk of about \$159 million (Table 5-12). This compares to a total adjusted property value of about \$2,725.8 million.

There is a large potential loss values for these two classes of floods. Loss values for combined single and multi-residential homes are about \$211.6 million and \$157.7 million respectively. Combined commercial and industrial capital risks are also substantial at about \$12.2 million and \$1.6 million for 100 and 500-Year events. Community services (comprised of schools and other educational facilities) face a risk with about \$46 million for 100-Year flood events.

Table 5-11. Number of Buildings in the Town of Mamaroneck Subject to Flood Hazards*

Category	Single & Multi Residential	Commercial/ Industrial	Recreation & Entertainment	Community Services***	Total Properties at Risk	% Properties at Risk
100-Year Flood	275	23	6	3	307	8.6
500-Year Flood***	205	2	1	0	208	5.8
Total Town Properties	3,052	509	12	9	3,582	

* Information supplied by the Town of Mamaroneck Assessor’s Office.

*** Includes education, government, other community services and religious facilities.

***Total properties in the 100-Year and 500-Year floodplain

Table 5-12 Value of Buildings and Properties in the Town of Mamaroneck Subject To Flood Hazards

Flood Zone	Property Classes	Number of Structures Impacted*	Average Property Value** (\$1,000)	Total Value at Risk (\$1,000)
100-Year	Single & Multi Residential	275	769.4	211,585
	Commercial/Industrial	23	529	12,167
	Recreation & Entertainment	6	12,370	74,220
	Community Services***	3	15,330	45,990
	Totals	307		343,962
500-Year****	Single & Multi Residential	205	769.4	157,727
	Commercial/Industrial	3	529.	1,587
	Recreation & Entertainment	0		
	Community Services***	0		
	Totals	208		159,314

* Estimates based on information supplied by the Town of Mamaroneck.

** Based on assessed rates given in Table 5-9. Includes the market value of the property and structure.

*** Schools & other educational facilities.

****Number of structures is inclusive of 100-Year flood.

5.D.2. HAZUS Flood Model and Damage Analysis

A Level 1 HAZUS-MH model analysis was performed to analyze the risk and vulnerability of a flood hazard in the Town of Mamaroneck, using HAZUS-MH, Version 2.1 software. Scenarios were run to evaluate potential economic and social losses resulting from the 100- and 500-Year floods. It calculated a basic estimate of flood losses based on national databases and using the default data in the model, such as general building stock, demographics, and essential facilities. The default demographic data in HAZUS-MH, based on the 2000 U.S. Census, was used for analysis. The valuation of general building stock and the loss estimates determined in the Town of Mamaroneck were based on the default general building stock database provided in HAZUS-MH. The general building stock valuations provided in HAZUS-MH are estimated Replacement Cost Values from RS Means, 2006, which has a level of accuracy acceptable for planning purposes.

Since the HAZUS model uses data derived from several databases with varying assumptions, the results in Tables 5-13 through 5-16 and in the Attachments included in Appendix 3 of this Hazard Mitigation Plan may differ from the data provided by the Town of Mamaroneck in

Tables 5-8 through 5-10. For example the number of residential houses and commercial buildings differ in part due to different sources of the data, use of regional model estimates for local town parameters, property class codes, and dates the data were collected.

According to HAZUS-MH, it is estimated that 214 people will be displaced and 432 people will seek temporary shelter in a 100-Year flood event, representing 1.87% and 3.78% of the Town population, respectively. For the 500-Year event, HAZUS-MH estimates 257 people will be displaced and 518 will seek temporary shelter representing 2.25% and 4.53% of the Town population, respectively.

Table 5-13. Estimated Persons Displaced from Flood and Seeking Short-term Public Shelter.

	Displaced People	People Seeking Temporary Shelter
100-Year	214	432
500-Year	257	518

There are 307 buildings located in the 100-Year flood zone, representing 8.6% of the total buildings in the Town of Mamaroneck. 208 buildings, or 5.5% of the total buildings lie in the 500-Year (including those in the 100-Year zone) flood zone. (See Table 5-14). 480 residential buildings, or 13.4% of total residential buildings, lie within the 100- and 500- year flood zones. 26 commercial/industrial buildings, or .75% of all commercial buildings, are located in the 100- and 500- year flood zones. Please refer to Table 5-11 for a breakdown of buildings in the flood zones by occupancy type.

Table 5-14. Number of Buildings in 100- and 500-Year Flood Zones*

	Total Town Buildings	Buildings	% Total
100-Year	3,582	307	8.6
500-Year	3,582	208	5.5

* Based on building counts provided by the Town of Mamaroneck.

HAZUS-MH MR2 divides building losses into two categories. Direct building losses represent the estimated costs to repair or replace the damage caused to the buildings and its contents. Business interruption losses consist of the losses associated with the inability to operate a business due to the damage sustained during a flood. Temporary living expenses for those people who are displaced from their homes due to flood are also included in business interruption losses. HAZUS-MH estimated the total economic loss for the flood. Table 5-15 summarizes these losses (including business interruption and building losses) as a result of the 100- and 500-Year flood events. The estimated business interruption loss for the 100-Year flood event is approximately \$.15 million, and it is \$.18 million for the 500-Year flood event. The estimated total loss for the 100-Year flood event is approximately \$31.2 million, or about 2.7% of the Town of Mamaroneck's building stock replacement value. The estimated total loss for the 500-Year flood event is approximately \$38.1 million, or about 3.3% of the Town's building stock replacement value. In the 100-Year flood event, total building-related commercial losses represented 55% of the total losses. In the 500-Year event, commercial losses represented 56% of the losses.

HAZUS-MH estimates the damage that could incur to essential facilities resulting from the 100- and 500-Year flood events. It is estimated that none of the essential facilities are vulnerable and should not experience any structural damage as a result of the 100- and 500-Year flood events. They are not estimated to have any loss of functionality either.

According to FEMA's HAZUS-MH 2.1 Flood Model Technical Manual (<http://www.fema.gov/library/viewRecord.do?id=5120>), the "damage states" are derived from the percent damage to the building. 1-10% damage is considered slight, 11-50% damage is considered moderate, and 51-100% is considered substantial damage. HAZUS estimated the building counts that would incur these damages. It is estimated that about 39 buildings would be at least moderately damaged in a 100-Year flood event, with no buildings being destroyed, compared to 41 buildings moderately damaged and 2 buildings destroyed in a 500-Year flood event. Table 5-16 summarizes the expected building damage by general occupancy.

Table 5-15. Building-related Economic Loss Estimates from Flood (\$1,000).

100-Year	Category	Area	Residential	Commercial	Other	Total
	Building Loss	Building	8.30	4.62	0.10	13.02
		Content	5.22	11.90	0.55	17.67
		Inventory	0.00	0.34	0.01	0.35
		Subtotal	13.52	16.86	0.66	31.04
	Business Interruption	Income	0.00	0.06	0.00	0.06
		Relocation	0.01	0.02	0.00	0.02
		Rental Income	0.00	0.01	0.00	0.01
		Wage	0.00	0.06	0.00	0.07
		Subtotal	0.01	0.14	0.00	0.15
		Total	13.53	17.00	0.66	31.19
	500-Year	Building Loss	Building	9.93	6.08	0.14
Content			6.16	14.51	0.68	21.34
Inventory			0.00	0.44	0.01	0.44
Subtotal			16.09	21.01	0.82	37.93
Business Interruption		Income	0.00	0.06	0.00	0.06
		Relocation	0.01	0.02	0.00	0.03
		Rental Income	0.00	0.01	0.00	0.01
		Wage	0.00	0.07	0.01	0.08
		Subtotal	0.01	0.17	0.01	0.18
		Total	16.10	21.18	0.83	38.11

Table 5-16. Expected Building Damage from Flood by General Occupancy.

		1-10%	11-20%	21-30%	31-40%	41-50%	Substantial	Total
100-Year	Commercial/Industrial	0	0	0	0	0	0	0
	Residential	0	11	15	8	5	0	39
	Total	0	11	15	8	5	0	39
500-Year	Commercial/Industrial	0	0	0	0	0	0	0
	Residential	0	5	15	8	13	2	43
	Total	0	5	15	8	13	2	43

HAZUS estimates that a total of 1,514 tons of debris would be generated in the 100-Year flood. Of this amount, finishes would comprise 69% of the total, followed by structure, which would comprise 18%; foundations would comprise the remainder. This would require an estimated 61

truckloads (assuming 25 tones/truck) to remove the debris that was generated by the 100-Year flood. It is estimated that a total of 3,519 tons of debris would be generated in the 500-Year flood. Of this amount, finishes would comprise 43%, followed by structure, which would comprise 33% of the total; foundations would comprise the remainder. It is estimated that it would require 141 truckloads to remove the debris generated by the 500-Year flood.

5.D.3 Valuation Assessment of Wind Storms

The Town of Mamaroneck is highly vulnerable to wind damage from hurricanes, nor'easters, thunderstorms and other significant wind events. In severe storms, the Town is subject to damaged roofs, siding, windows, utility poles, and trees as well as total building losses. The most significant storm events that cause the greatest damage to the region are remnants of hurricanes. Tornados, because of their low frequency are not as likely to strike the Town of Mamaroneck although their potential for destruction is high. The following section provides a detailed damage and economic assessment of hurricane wind damages and economic impacts in the Town of Mamaroneck.

5.D.3.1 HAZUS Hurricane Model and Damage

Hurricane impacts from wind were assessed using FEMA's HAZUS @MH 2.1 model. HAZUS is a regional multi-hazard loss estimation computer model that was developed by FEMA and the National Institute of Building Sciences. The model was used in conjunction with Esri's ArcGIS software, version 10.0. The HAZUS Hurricane Model provides estimates of the economic losses from hurricane force winds. The damage and loss estimates can be used to plan and propose efforts to mitigate or reduce risks from wind damage, reduce disaster payments and to prepare for emergency response and recovery in the event of a damaging event.

Two runs of the model were used in this assessment: a user-defined historical model and a probabilistic analysis of impacts for different strength hurricanes. The historical model was given worst-case storm parameters as an example of a hurricane that could strike the Town of Mamaroneck directly. The model parameters used were those defined in Section 9.3 of the HAZUS Users Manual for Hurricanes. The HAZUS probabilistic model evaluates risks of future

impacts from hurricanes for several hurricane wind speeds and return periods (i.e. probability of an occurrence in a year).

Since the HAZUS model uses data derived from several databases with varying assumptions, the results in Tables 5-17 through 5-21 and in the Attachments included in Appendix 3 of this Hazard Mitigation Plan may differ from the data provided by the Town of Mamaroneck in Tables 5-8 through 5-10. For example the number of residential houses and commercial buildings differ in part due to different sources of the data, use of regional model estimates for local town parameters, property class codes, and dates the data were collected.

The HAZUS historical model represents a probable worse-case Category 3 hurricane that could strike the Town and would be similar to those storms listed in Table 4-6 and Figure 4-5 except it would track through Mamaroneck (Figure 5-4). Although the storms may begin as Category 3 or 4 hurricanes, they historically deteriorate quickly to Category 1 when they hit land or track closer to the coast, thus avoiding major inland damage for the Westchester County region. Since a Category 4 storm would be a rare event and Category 5 storms are unlikely to reach as far north as New York, a Category 3 Hurricane with maximum 1 minute sustained winds ranging of 102 mph is considered as the most probable worst-case scenario.

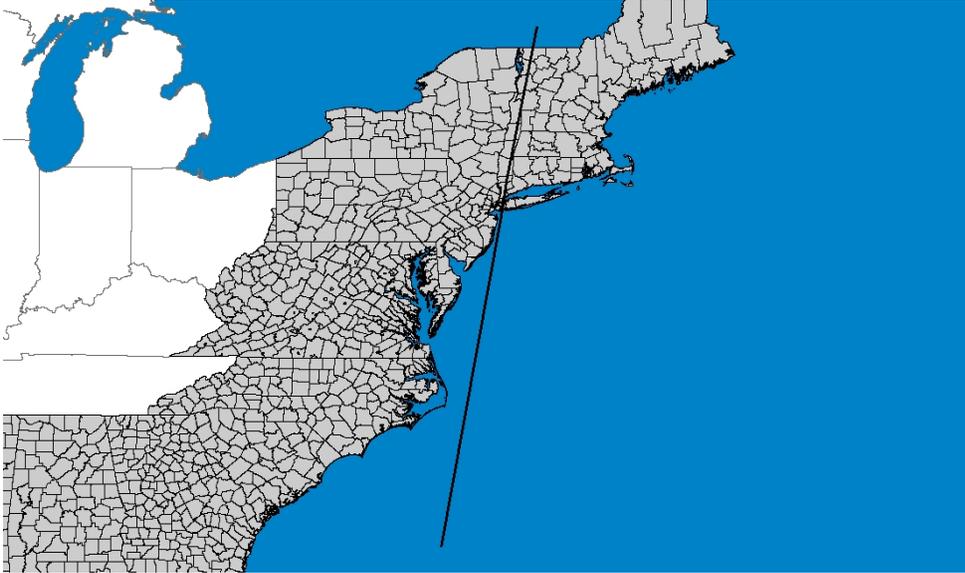


Figure 5-4. HAZUS Historical Model projected track for a hypothetical hurricane through Mamaroneck NY with 120 mph winds.

The model results in Table 5-17 show what could have happened if this model hurricane track struck the Town of Mamaroneck with full force sustained winds of 120 mph with peak 3-second gusts of 143 mph. The model's assumptions and detailed output from the HAZUS historical model is given as an Attachment in Appendix 3. A hurricane of this size could destroy over 378 homes and severely damage 468 more. About 12% or 406 of the homes would escape some damage. A similar type of considerable wind damage could be caused by a tornado rated as F2 but the damages would be over a narrow band of the Town rather than covering the entire area.

The HAZUS probabilistic model was run to evaluate possible future impacts of hurricanes on the Town of Mamaroneck. Using the HAZUS program, probabilities of damage, expected building losses, expected contents losses, and expected loss-of-use are computed for different classes of building use for several probable hurricanes and peak wind gusts. Results of these analyses are given in Tables 5-18 and 5-19.

Table 5-17. Potential Damage to the Town of Mamaroneck Buildings from a Category 3 Hurricane. (120 MPH Sustained Winds) *

Occupancy Class	No Damage		Minor Damage		Moderate Damage		Severe Damage		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Commercial/Industrial	46	13.29	72	20.80	118	34.10	106	30.64	4	1.16
Education/Community Services	1	13.66	1	19.99	2	34.72	2	31.54	0	.09
Religious	2	12.69	4	26.12	5	35.04	4	25.90	0	.25
Residential	406	12.01	1,082	32.04	1,044	30.91	468	13.86	378	11.18
Total	455		1,158		1,170		580		382	

* % and count of Damaged buildings were estimated using the HAZUS Historical Model.

Table 5-18 shows the probabilistic model results for building damages associated with four hurricane “return periods” and peak wind gusts (maximum 3-second wind speed). A return period of 100 years for example, corresponds to a 1% chance per year in the Town of Mamaroneck of exceeding the computed total direct loss shown for the 100-Year event. These periods and winds are specific to the Town. Areas closer or more distant from the coastline will have different values. A 200-Year return event would be in the mid range of a Category 2 storm. A 500-Year return event would be in the lower range of a Category 3 storm having maximum 1-minute sustained winds of 111 mph. This storm would have a probability of 0.2% striking the area in a year. A return period of 1000 years is a rare storm event and is not presented in Tables 5-18 and 5-19. Also the 10 and 20-Year events are not summarized since the model results show either no or minor damages from these more frequent storms. The peak wind gust speeds are estimated by HAZUS for each of the return periods. These wind speeds are the estimated maximum 3-second gusts in open terrain at 10m above ground at the center of each census tract used in the model. The wind gust speeds and return periods are within the ranges of Category 1, 2 and 3 storms. Detailed output from the HAZUS probabilistic model for all return periods is given in the Attachments in Appendix 3.

The data used in the model were from the Town of Mamaroneck US Census tracts that are part of the model’s database. The default conditions were applied to the model, which included information describing the building use inventory, essential facilities, tree coverage, and surface roughness. For the purposes of this hazard mitigation plan, this simplified approach was judged to be sufficient.

Using formulas programmed in HAZUS, damage probabilities, expected building losses, expected contents losses, and expected loss-of-use were estimated for different class uses of buildings. The hurricane loss estimates provided in this report are based on regional census and economic parameters. The area of the Town of Mamaroneck is approximately 3.56 square miles. There are over four thousand households in the Town, which had a total population of 11,429 people in 2 census tracts (Based on the 2000 Census Bureau data used by the HAZUS Model). There are an estimated 3,744 buildings in the region with a total building replacement value, excluding contents, of about 1,170 million dollars (Table 5-9). Approximately 90% of the buildings (and 86% of the building value) are associated with residential housing.

Table 5-18. Probabilistic Building Damage Risks from Hurricanes that Could Strike the Town of Mamaroneck.

Return Period (Yrs.)*	Property Class**	Degree of Wind Damage									
		None		Minor		Moderate		Severe		Destruction	
		Damage Count	(%) Impact	Damage Count	(%) Impact	Damage Count	(%) Impact	Damage Count	(%) Impact	Damage Count	(%) Impact
50	Commercial/Industrial	345	99.71	1	0.29	0	0.00	0	0.00	0	0.00
	Education/Community	6	99.48	0	0.52	0	0.00	0	0.00	0	0.00
	Religious	14	99.59	0	0.40	0	0.01	0	0.00	0	0.00
	Residential	3,365	99.61	12	0.36	1	0.03	0	0.00	0	0.00
	Total	3,729		14		1		0		0	
100	Commercial/Industrial	341	98.42	5	1.42	0	0.16	0	0.00	0	0.00
	Education/Community	6	98.58	0	1.39	0	0.03	0	0.00	0	0.00
	Religious	14	98.69	0	1.27	0	0.04	0	0.00	0	0.00
	Residential	3,299	97.65	70	2.09	9	0.26	0	0.00	0	0.00
	Total	3,659		76		9		0		0	
200	Commercial/Industrial	329	95.04	15	4.23	2	0.65	0	0.08	0	0.00
	Education/Community	6	95.75	0	4.06	0	0.18	0	0.00	0	0.00
	Religious	13	95.47	1	4.34	0	0.18	0	0.01	0	0.00
	Residential	3,096	91.64	244	7.21	38	1.14	0	0.00	0	0.00
	Total	3,444		259		41		1		0	
500	Commercial/Industrial	284	81.97	47	13.73	13	3.65	2	0.65	0	0.00
	Education/Community	5	83.66	1	13.62	0	2.61	0	0.11	0	0.00
	Religious	12	82.47	2	15.03	0	2.39	0	0.11	0	0.00
	Residential	2,541	75.22	672	19.91	156	4.62	6	0.17	3	0.08
	Total	2,841		723		169		8		3	

Table 5-18 Notes:

* Return period, peak wind and % impacts are from HAZUS probabilistic model for hurricane damage for the Town of Mamaroneck.

** Residential includes single and multifamily. Commercial/Industrial includes Agriculture.

Table 5-18 summarizes the expected building damage by hurricane event and general property class in the Town of Mamaroneck. Based on HAZUS percentage estimates, about 259 buildings will suffer from minor damage to destruction from a 200-Year event. This is about 6.9% of the total number of buildings in the Town. There are an estimated 169 buildings, or 4.5% of the total number of Town buildings, that will be moderately damaged in a 500-Year event. In contrast, a 50-Year event showed 3,729 or over 99.5% of the buildings would have no significant wind damage compared to 2,841 or 75.9% unharmed from a 500-Year event.

The hardest hit would be residential buildings. The greatest amount of damage is to wooden structures and the HAZUS model estimated that about 59% of the buildings in the town are constructed of wood. The strong winds of a 500-Year return storm would impact about 36% of these wooden structures but about 2 buildings, or less than 0.1% of the wooden structures would be destroyed. The model estimated that 37 households would be displaced from their homes as a result of a 500-Year hurricane and about 7 people in the Town population will likely need temporary public shelters. (See Attachments in Appendix 3.)

Building losses are divided into two categories: direct property damage losses and business interruption losses. The direct property damage or capital losses include the estimated costs to repair or replace the damage to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

Table 5-19. HAZUS Hurricane Probabilistic Model – Property Damage Capital Losses (X \$1,000)

Return Year	Losses	Residential *	Commercial /Industrial	Others	Total Capital Losses
50	Building	811.18	19.07	2.42	832.67
	Contents	13.27	0.00	0.00	13.27
	Inventory	0.00	0.00	0.00	0.00
	Subtotal	824.45	19.07	2.42	845.93
100	Building	3,022.70	77.46	11.01	3,111.16
	Contents	201.40	6.62	0.27	208.29
	Inventory	0.00	0.15	0.03	0.19
	Subtotal	3,224.10	84.23	11.31	3,319.63
200	Building	7,108.61	230.99	41.30	7,380.90
	Contents	682.85	28.93	5.61	717.39
	Inventory	0.00	1.00	0.21	1.21
	Subtotal	7,791.46	260.92	47.11	8,099.50
500	Building	19,243.22	916.77	116.01	20,326.00
	Contents	3,990.28	227.27	35.93	4,253.49
	Inventory	0.0	9.21	1.68	10.89
	Subtotal	23,233.50	1,153.25	203.62	24,590.37

* Residential includes single and multi-residential properties; Commercial includes Industrial; Others includes Community Services, Educational, Governmental, and Religious Facilities.

Table 5-20. HAZUS Hurricane Probabilistic Model - Business Interruption Losses (X \$1,000)*

Return Year	Losses	Residential	Commercial /Industrial	Community Services	Total Interruption Losses
50	Income	0.00	0.00	0.00	0.00
	Relocation	6.60	0.14	0.01	6.76
	Rental	9.58	0.00	0.00	9.58
	Wage	0.00	0.00	0.00	0.00
	Subtotal	16.19	0.14	0.01	16.34
100	Income	0.00	0.00	0.00	0.00
	Relocation	120.76	1.49	0.09	122.35
	Rental	80.64	0.00	0.00	80.64
	Wage	0.00	0.00	0.00	0.00
	Subtotal	201.40	1.49	0.09	202.98
200	Income	0.00	22.30	10.96	33.26
	Relocation	220.92	26.55	7.20	254.66
	Rental	184.46	15.25	0.71	200.41
	Wage	0.00	23.60	25.76	49.36
	Subtotal	405.38	87.70	44.63	537.69
500	Income	0.00	132.80	23.52	156.31
	Relocation	880.73	150.39	26.32	1,057.44
	Rental	526.71	84.55	2.04	613.30
	Wage	0.00	123.19	55.29	178.48
	Subtotal	1,407.44	490.93	107.17	2,005.53

* Residential includes single and multi-residential properties; Commercial includes Industrial; Others includes Community Services, Educational, Governmental, and Religious Facilities.

Table 5-21. HAZUS Hurricane Probabilistic Model – Summary of Economic Losses (X \$1,000)

Return Year	Total Interruption Losses	Total Capital Losses	Total Town Losses
50	16.34	845.93	862.27
100	202.98	3,319.63	3,522.61
200	537.69	8,099.50	8,637.19
500	2,005.53	24,590.37	26,595.90

Tables 5-19, 5-20, and 5-21 summarize the losses associated with the building damage for the hurricane events with return periods of 50 years through 500 years. The total economic loss estimated by HAZUS MH-2 for a 500-Year return hurricane is nearly \$26.6 million dollars. The total capital property damage costs were about \$25 million dollars with about \$2 million of the estimated losses due to the interruption of business in the Town. The largest capital loss, \$23.2 million, was to residential buildings, which accounted for 94.5% of the total capital losses. The HAZUS model showed just less than \$846 thousand in damages for a 50-Year event.

HAZUS estimates the amount of debris generated by a hurricane. Four general types of debris are evaluated by the model: brick/wood, reinforced concrete/steel, eligible tree debris, and other tree debris. This distinction is made because of the different types of material handling equipment required to handle the debris. A total of 2,163 tons of debris will be generated from wind damage during a 200-Year event. Brick and wood comprises 42% of the total debris, eligible tree debris comprises 41% of the total debris, other tree debris comprises 17% of the total debris, and reinforced concrete and steel comprise of 0% of the total debris. The building debris alone (brick, other tree debris, concrete and steel) generated by the hurricane will require 36 truckloads (@25 tons/truck) to remove the debris. The number of Eligible Tree Debris truckloads will depend on how the 852 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

There are a few essential facilities of concern (see Section 5.B.2). The HAZUS model estimates that loss-of-use time for any of these facilities is expected to be less than one day.

Although HAZUS can provide comprehensive loss estimates, uncertainties are inherent in any model methodology. The next hurricane that may strike the Town of Mamaroneck could be quite different from any model hurricane included in this hurricane analysis. The results of this model analysis for Mamaroneck should not be considered a *prediction or forecast* of future hurricanes but viewed as an indication of what possible hurricanes in the future may do. This probabilistic hurricane analyses can be used to develop estimates of long-term “annualized losses” as well as the expected distribution of losses based on “return period losses”. These damage estimates reflect the expected hurricane tracks and intensities that may likely occur in Mamaroneck. There are significant uncertainties in the results due to the limited history of hurricane observations, limited knowledge of actual local building characteristics, use of simplified modeling assumptions, and other local socio-economic factors. A probabilistic analysis has statistical uncertainties that need to be considered when interpreting the model results.

5.D.4 Valuation Assessment of Earthquakes

An earthquake is a rare event in the Town of Mamaroneck but can cause impacts and losses to the Town’s structures and facilities. The overall hazard ranking determined by the Hazard Mitigation Planning Committee for this hazard is moderately low. The following vulnerability assessment emphasizes that earthquakes are a hazard of concern. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. Possible mitigation actions would include public awareness/ education and reviewing State and local building codes with respect to earthquakes.

In 2008, FEMA reported a study using the HAZUS Estimated Software called “HAZUS-MH Estimated Annualized Earthquake Losses for the United States”. The study showed that New York State ranked 4th in annualized earthquake losses, and 26th in annualized earthquake loss ratio (annualized loss as a fraction of replacement value of building stock). Annualized Earthquake Loss was determined to be \$95,185,000, while Annualized Earthquake Loss Ratio was \$67 per million.

In addition, FEMA ran a vulnerability assessment study using HAZUS-MH software which indicated counties most vulnerable to earthquake hazards. The following maps depict the annualized earthquake losses by county, factoring in soil classifications from the NEHRP

(National Earthquake Hazard Reduction Program). Figure 5-5 shows the annualized earthquake loss for New York State to be \$61,638,517, and the annualized earthquake loss for Westchester County to be \$1,498,958. Figure 5-6 shows the Per Capita Annual Earthquake Loss for Westchester County to be estimated at \$1.01 - \$2.00. Figure 5-7 shows the annualized earthquake loss per square mile to be estimated at \$500.01 - \$10,000.

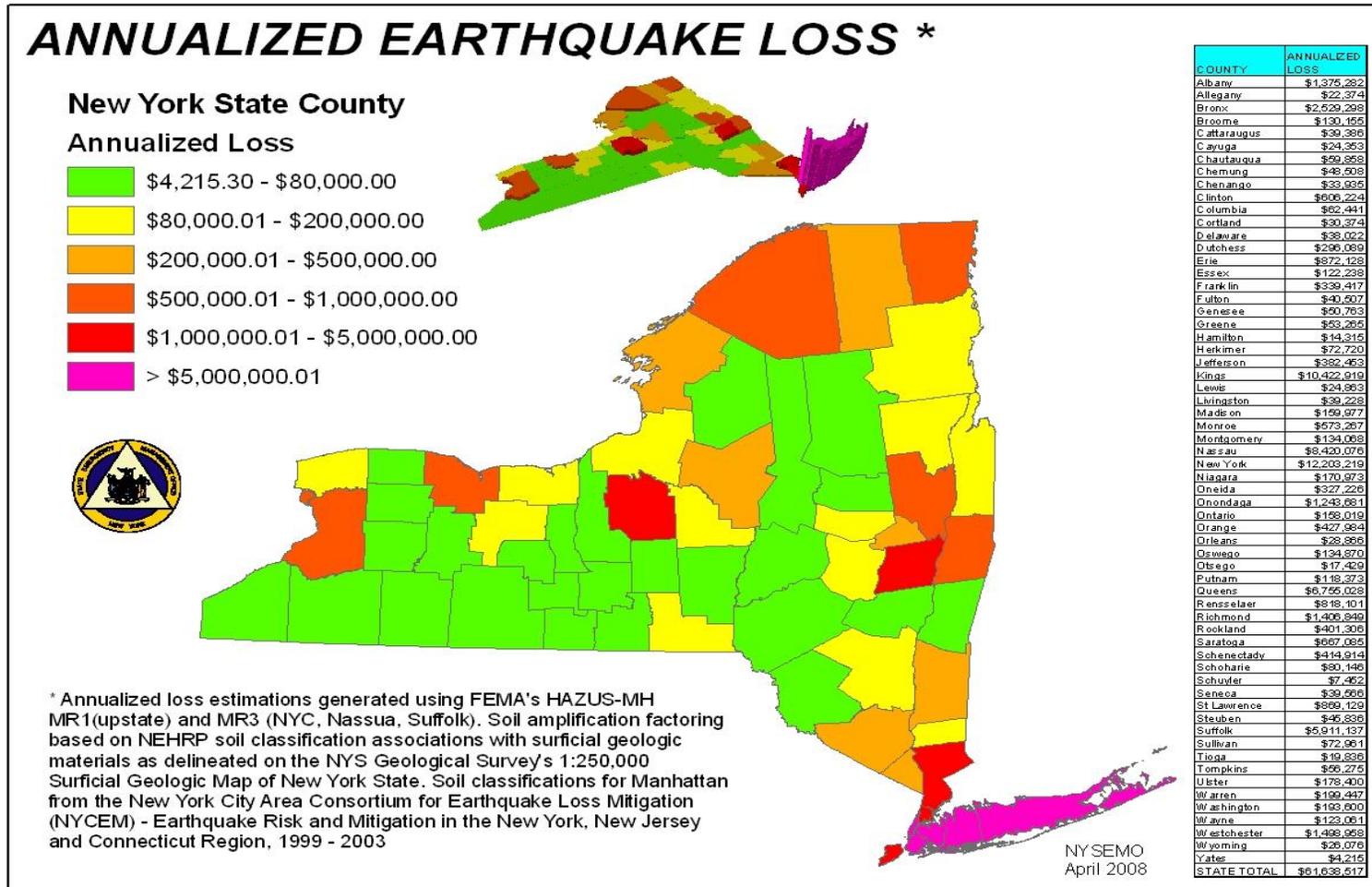


Figure 5-5. Annualized Earthquake Loss

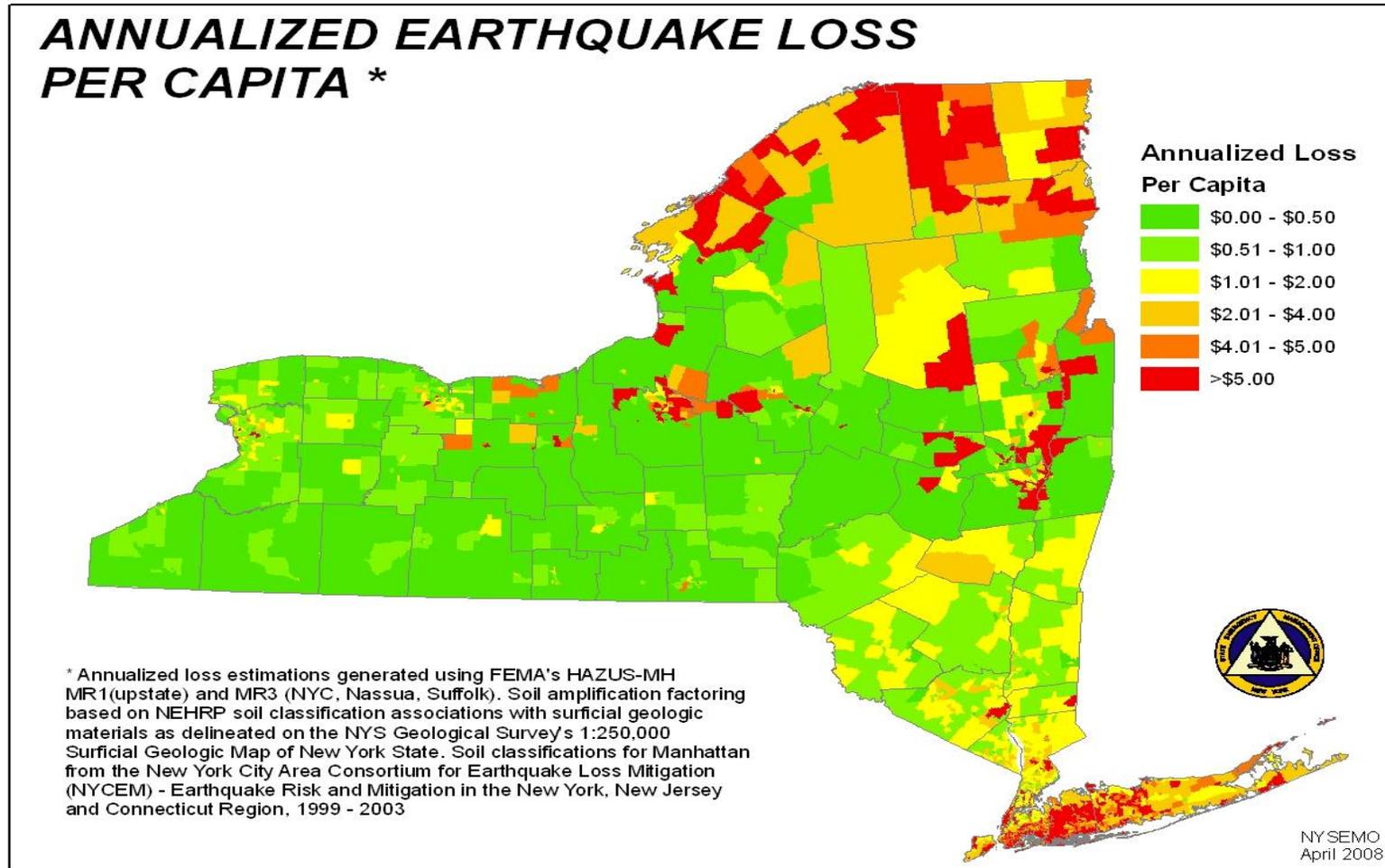


Figure 5-6. Per Capita Annualized Earthquake Loss.

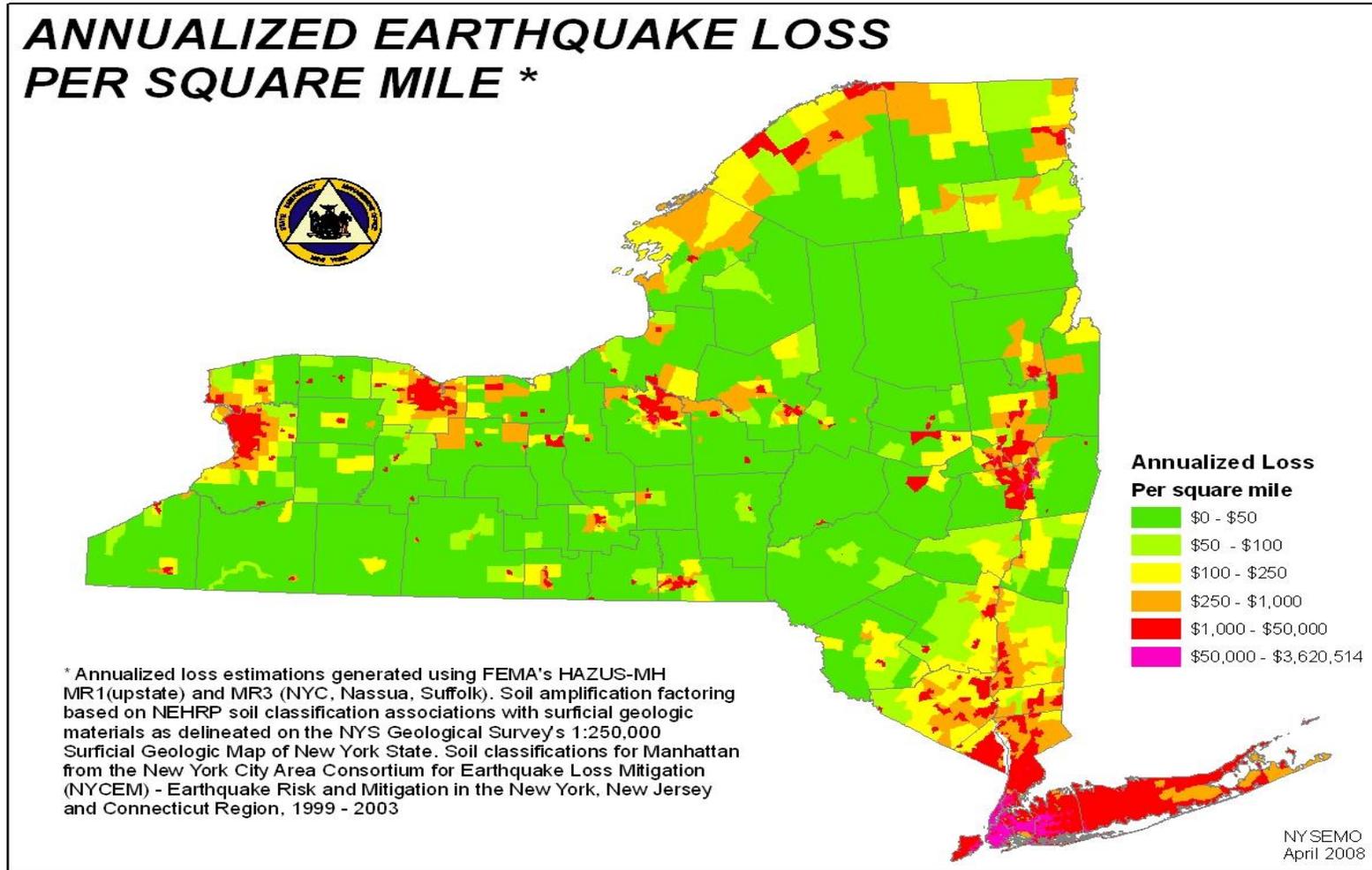


Figure 5-7. Annualized Earthquake Loss Per Square Mile.

5.D.4.1 Earthquake HAZUS Model and Damage Analysis

A probabilistic assessment was conducted for the 100-, 500- and 2,500-Year mean return periods (MRP) through a Level 1 analysis in HAZUS-MH Version 2.1 to analyze the earthquake hazard for the Town of Mamaroneck. The HAZUS-MH analysis evaluates the statistical likelihood that a specific event will occur and what consequences will occur. A 100-Year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. For a 500-Year MRP, there is a 0.2% chance the mapped PGA will be exceeded in any given year. For a 2,500-Year MRP, there is a 0.04% chance the mapped PGA will be exceeded in any given year.

HAZUS-MH calculates its basic estimates of losses based on national databases and using the default data in the model, such as general building stock, demographics, and essential facilities. The default demographic data in HAZUS-MH, based on the 2002 U.S. Census, was used for analysis. The valuation of general building stock and the loss estimates determined in the Town of Mamaroneck were based on the default general building stock database provided in HAZUS-MH. The general building stock valuations provided in HAZUS-MH are estimated Replacement Cost Values from RS Means, 2006, which has a level of accuracy acceptable for planning purposes.

Since the HAZUS model uses data derived from several databases with varying assumptions, the results in Tables 5-22 through 5-28 and in the Attachments included in Appendix 3 of this Hazard Mitigation Plan may differ from the data provided by the Town of Mamaroneck in Tables 5-8 through 5-10. For example the number of residential houses and commercial buildings differ in part due to different sources of the data, use of regional model estimates for local town parameters, property class codes, and dates the data were collected.

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels that describe the extent of the probable injuries:

Severity Level:

1. Injuries will require medical attention but hospitalization is not needed.
2. Injuries will require hospitalization but are not considered life-threatening.
3. Injuries will require hospitalization and can become life threatening if not promptly treated.
4. Victims are killed by the earthquake.

The casualty estimates are provided for three times of day: 2:00 AM, 2:00 PM, and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate assumes that the residential occupancy load is at maximum, the 2:00 PM estimate assumes that the educational, commercial, and industrial sector loads are at maximum, and 5:00 PM represents peak commuting time. See Table 5-22 which summarizes the injuries and casualties for the 100-, 500-, and 2500- year events.

Table 5-22. Earthquake Casualty by Time of Day.

	Time	Level 1	Level 2	Level 3	Level 4	Totals
100-Year	2:00 AM	0	0	0	0	0
	2:00 PM	0	0	0	0	0
	5:00 PM	0	0	0	0	0
	Subtotal	0	0	0	0	0
500-Year	2:00 AM	1	0	0	0	1
	2:00 PM	0	0	0	0	0
	5:00 PM	0	0	0	0	0
	Subtotal	0	0	0	0	0
2500-Year	2:00 AM	10	2	0	0	12
	2:00 PM	8	1	0	0	9
	5:00 PM	8	1	0	0	9
	Subtotal	26	4	0	0	30

HAZUS estimated the number of households that would be displaced from their homes, as well as the number of people in the household that would require the short-term use of a public shelter. There were no displaced households in the 100-Year event. 40 households would be displaced, and 20 people would require the use of a public shelter in a 2500-Year event. Table 5-23 summarizes displaced households and people that would seek shelter for the different mean return periods.

Table 5-23. Earthquake Shelter Requirements.

MRP	Displaced Households	People Requiring Short Term public Shelter
100-Year	0	0
500-Year	1	0
2500-Year	40	20

Fires often occur after an earthquake. HAZUS used a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For 100-, 500-, and 2500-Year events the model estimates that there will be 0 ignitions, and no people will be displaced from fire.

HAZUS estimated the amount of debris that would be generated by the earthquake. The model breaks the debris into two general categories: brick/wood and reinforced concrete/steel. This distinction is made because of the different types of material handling equipment required to handle the debris. The 100-Year and 500-Year events were estimated not to generate any significant amount of debris, requiring no truckloads (assuming 25 tons/truck) to remove the debris generated from the earthquake. The 2500-Year event would generate .01 million tons of debris, with 61% of the total consisting of brick/wood. It would require 400 truckloads (assuming 25 tons/truck) to remove the debris generated by the earthquake.

Entire building stock is considered at risk and exposed to the earthquake hazard. The potential general building stock damage extent was evaluated. Evaluations were made based on the degree of structural damage. Damage parameters used were: None, Slight, Moderate, Extensive, and Complete. According to FEMA’s HAZUS-MH 2.1 User Manual (www.fema.gov/library/viewrecord.do?id=5120), examples of Structural Damage State definitions are as follows:

Slight: Small plaster or gypsum board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.

Moderate: Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.

Extensive: Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in

foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations; small foundation cracks.

Complete: Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Table 5-22 summarizes this damage by building type for the 100-, 500-, and 2500-Year events. Table 5-25 summarizes this damage by general occupancy type.

Table 5-24. Expected Earthquake Building Damage by General Building Type (All Design Levels)

		None		Slight		Moderate		Extensive		Complete	
		Count*	%	Count	%	Count	%	Count	%	Count	%
100-Year	Wood	2,867	76.58	0	0.00	0	0.00	0	0.00	0	0.00
	Steel	165	4.42	0	0.00	0	0.00	0	0.00	0	0.00
	Concrete	65	1.75	0	0.00	0	0.00	0	0.00	0	0.00
	Precast	11	0.28	0	0.00	0	0.00	0	0.00	0	0.00
	RM	59	1.59	0	0.00	0	0.00	0	0.00	0	0.00
	URM	576	15.39	0	0.00	0	0.00	0	0.00	0	0.00
	MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TOTAL	3,744		0	0.00	0	0.00	0	0.00	0	0.00
500-Year	Wood	2,767	77.49	88	0.64	12	36.65	1	15.07	0	0.00
	Steel	157	4.40	6	4.43	2	6.64	0	5.62	0	2.83
	Concrete	62	1.75	2	1.71	1	2.08	0	0.96	0	0.24
	Precast	10	0.27	0	0.32	0	0.92	0	1.58	0	0.10
	RM	56	1.58	2	1.33	1	3.11	0	3.50	0	0.00
	URM	518	14.51	39	28.17	16	50.61	3	73.28	0	96.83
	MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TOTAL	3,570		138		32		4		0	
2500-Year	Wood	2,033	80.91	619	76.87	195	55.79	20	28.97	1	11.34
	Steel	97	3.86	31	3.89	29	8.30	7	10.72	1	8.88
	Concrete	37	1.49	13	1.67	12	3.43	2	3.67	0	2.20
	Precast	5	0.21	2	0.22	2	0.66	1	1.60	0	0.66
	RM	36	1.43	9	1.09	11	3.06	4	5.86	0	1.34
	URM	304	12.10	131	16.27	100	28.76	33	49.18	8	75.57
	MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	TOTAL	2,513		805		349		67		10	

Note:

RM: Reinforced Masonry
 URM: Unreinforced Masonry
 MH: Manufactured Housing

Table 5-25. Expected Earthquake Building Damage by General Occupancy Type

		None		Slight		Moderate		Extensive		Complete	
		Count	%	Count	%	Count	%	Count	%	Count	%
100-Year	Commercial/Industrial	346	9.24	0	0.00	0	0.00	0	0.00	0	0.00
	Education	5	0.16	0	0.00	0	0.00	0	0.00	0	0.00
	Religion	14	0.37	0	0.00	0	0.00	0	0.00	0	0.00
	Residential	3,378	90.22	0	0.00	0	0.00	0	0.00	0	0.00
	TOTAL	3,744		0	0.00	0	0.00	0	0.00	0	0.00
500-Year	Commercial/Industrial	325	9.13	15	10.53	5	15.64	1	17.63	0	14.70
	Education	6	0.16	0	0.17	0	0.24	0	0.26	0	0.28
	Religion	13	0.37	1	0.44	0	0.66	0	0.80	0	0.82
	Residential	3,225	90.34	122	88.85	27	83.46	2	81.30	0	84.19
	TOTAL	3,570		138		32		4		0	
2500-Year	Commercial/Industrial	201	7.99	73	9.13	55	15.91	14	21.61	2	19.92
	Education	4	0.14	1	0.15	1	0.27	0	0.34	0	0.34
	Religion	9	0.34	3	0.36	2	0.54	1	0.77	0	0.79
	Residential	2,300	91.53	728	90.36	290	83.27	52	77.28	8	78.95
	TOTAL	2,513		805		349		67		10	

* Commercial/Industrial includes Agriculture

Building losses are divided into two categories. Direct building losses represent the estimated costs to repair or replace the damage caused to the buildings and its contents. Business interruption losses consist of the losses associated with the inability to operate a business due to the damage sustained during an earthquake. Table 5-26 summarizes the estimated annualized earthquake general building stock losses for both direct building losses (capital stock losses) and business interruption losses (income losses). Total building stock related losses were zero for the 100-Year event, about 3 million for the 500-Year event, and almost 53 million for the 2500-Year event. This figure represents approximately 4.7 percent of the Town of Mamaroneck’s building stock replacement value.

All critical facilities in the Town of Mamaroneck are considered exposed and vulnerable to the earthquake hazard. See section 5.B for a complete list of the critical facilities in the Town. HAZUS estimated the probability that the essential facilities would sustain damages as a result of the earthquake events from different mean return periods. For all three mean return periods, HAZUS did not estimate a significant impact on the Town’s essential facilities, estimating that no facilities would significantly lose functionality.

HAZUS divides lifeline inventory into two categories: transportation and utility lifeline systems. Should an earthquake occur, it is possible that ground failure could cause damage to transportation and utility lifeline systems. HAZUS considers seven transportation systems that include highways, railways, light rail, bus, ports, ferry, and airports; as well as six utility systems that include potable water, wastewater, natural gas, crude and refined oil, electric power, and communications. The total value of the lifeline inventory is over 253 million dollars. The inventory includes over 20 kilometers of highways, 13 bridges, and 147 kilometers of pipes.

Table 5-26. Estimated Annualized Earthquake Building Stock Losses. (X \$1,000)*

MRP	Category	Area	Residential	Commercial/ Industrial	Other	Total
100-Year	Income Losses	Wage	0.00	0.00	0.00	0.00
		Capital-Related	0.00	0.00	0.00	0.00
		Rental	0.00	0.00	0.00	0.00
		Relocation	0.00	0.00	0.00	0.00
		Subtotal	0.00	0.00	0.00	0.00
	Capital Stock Losses	Structural	0.00	0.00	0.00	0.00
		Non-Structural	0.00	0.00	0.00	0.00
		Content	0.00	0.00	0.00	0.00
		Inventory	0.00	0.00	0.00	0.00
		Subtotal	0.00	0.00	0.00	0.00
500-Year	Income Losses	Wage	0.00	0.09	0.00	0.09
		Capital-Related	0.00	0.08	0.00	0.08
		Rental	0.07	0.05	0.00	0.12
		Relocation	0.15	0.06	0.01	0.23
		Subtotal	0.22	0.28	0.02	0.52
	Capital Stock Losses	Structural	0.45	0.09	0.02	0.56
		Non-Structural	1.41	0.27	0.04	1.71
		Content	0.34	0.14	0.02	0.49
		Inventory	0.00	0.00	0.00	0.01
		Subtotal	2.19	0.49	0.07	2.76
2500-Year	Income Losses	Wage	0.03	1.25	0.03	1.32
		Capital-Related	0.01	1.15	0.01	1.18
		Rental	0.89	0.62	0.01	1.52
		Relocation	2.06	0.91	0.17	3.14
		Subtotal	2.99	3.94	0.22	7.15
	Capital Stock Losses	Structural	5.09	1.31	0.22	6.62
		Non-Structural	22.72	4.12	0.64	27.48
		Content	8.49	2.43	0.39	11.31
		Inventory	0.00	0.09	0.01	0.09
		Subtotal	36.30	7.94	1.26	45.50

Regional transportation and distribution of materials may be interrupted due to an earthquake event. HAZUS calculated damage estimates to the different components of the Town of Mamaroneck’s transportation systems. Its assessment analyzed such components as segments, bridges, tunnels, and facilities to the Town’s highways, railways, and bus systems. It is estimated that a 2500-Year event would cost .7 million dollars in damages to the Town of Mamaroneck’s transportation system. Table 5-27 summarizes the economic losses to the Town’s transportation system for a 100-, 500-, and 2500-Year event.

Table 5-27. Transportation System Economic Losses from Earthquake. (X \$1,000)

			100-Year		500-Year		2500-Year	
System	Component	Inventory Value	Economic Loss	% Loss Ratio	Economic Loss	% Loss Ratio	Economic Loss	% Loss Ratio
Highway	Segments	153.39	0.00	0.00	0.00	0.00	0.00	0.00
	Bridges	91.70	0.00	0.00	0.01	0.01	0.65	0.71
	Tunnels	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	245.10	0.00		0.00		0.70	
Railways	Segments	8.12	0.00	0.00	0.00	0.00	0.00	0.00
	Bridges	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Tunnels	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	8.10	0.00		0.00		0.00	
Bus	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00		0.00		0.00	
	Total	253.20	0.00		0.00		0.70	

Utility systems may be damaged due to an earthquake event. A 100-Year event would not cause any damage, a 500-Year event would not cause any significant damage. In a 2500-Year event, the damage ratio (ratio of repair to replacement cost) for the Town’s potable water supply system is .61%. Table 5-28 summarizes the economic losses to the Town’s Utility system for a 100-, 500-, and 2500-Year event.

Table 5-28. Utility System Economic Losses from Earthquake. (X \$1,000)

System	Component	Inventory Value	100-Year		500-Year		2500-Year	
			\$ Economic Loss	% Loss Ratio	\$ Economic Loss	% Loss Ratio	\$ Economic Loss	% Loss Ratio
Potable Water	Pipelines	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dist. Lines	1.50	0.00	0.00	0.00	0.06	0.01	0.61
	Subtotal	1.48	0.00		0.00			
Wastewater	Pipelines	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dist. Lines	0.90	0.00	0.00	0.00	0.05	0.00	0.52
	Subtotal	0.89	0.00		0.00		0.00	
Natural Gas	Pipelines	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dist. Lines	0.60	0.00	0.00	0.00	0.03	0.00	0.27
	Subtotal	0.59	0.00		0.00		0.00	
Oil Systems	Pipelines	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00		0.00		0.00	
Electric Power	Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00		0.00		0.00	
Communication	Facilities	0.00	0.00	0.00	0.00	0.30	0.01	0.00
	Subtotal	0.00	0.00		0.00		0.01	
	Total	2.96	0.00		0.00		0.02	

5.E Valuation Assessment of Other Hazards

The damage to structures for the other hazards was not quantitatively evaluated. Damage was judged to be small for these hazards compared to flooding, wind damage, and earthquakes. Also, these hazards were judged to be rare, improbable or not significant to the Town of Mamaroneck. Further data needs to be collected on these hazards to review and evaluate probable extent of impacts if they are judged to be significant. This additional information would be used to develop future mitigation strategies if needed.

The following hazards were discussed above in Section 5.C and are not expected to have a major impact on properties, people, critical facilities or other key facilities in The Town of Mamaroneck. These include:

- Air Contamination
- Civil Unrest
- Hazardous Material Release
- Oil Spill
- Radiological Release

5.F Natural and Beneficial Functions

Wind, water, ice and snow are part of natural storm events affecting the Town. They are significant events and affect the near-shore shifting of channels, erosion and redistribution and shifting of rivers, lakes, and streams. The Town is home to and maintains several conservation areas, floodplains, and wetlands. There are a number of areas for natural habitats, wetlands and marsh plants and grasses in the Town. Approximately 766 acres, or 34% of its municipal land area is classified as Open Space/Conservation Land, including dedicated preserves, open spaces, and areas with easements that restrict development. Please refer to sections 5.B.6.1 and 5.B.6.2 for detailed descriptions of the Town's vulnerable natural conservation areas, water bodies, and wetlands.

5.G Land Use Development, Redevelopment and Population Trends

The current population in the Town of Mamaroneck is 11,977 according to the 2010 US Census. It is seen as a mature suburban community with an established land use pattern. The socioeconomically diverse population has increased by about 8% over the last 10 years. Housing is varied, consisting of apartment buildings, coops, condominiums, typical suburban homes, historic colonials, and multi-million dollar estates. Although primarily residential, the Town enjoys some large tracts of recreational land and small areas of commercial development along the Boston Post Road and 5th Avenue. The Town is pretty much built out. There is a new apartment building in development on Byron Place. In addition, the Town recently rezoned about 54 acres of land in their business and service zone. There is the potential for up to 300 additional residential housing units to be built as a result of the new zoning.

The Town intends to enforce its Flood Damage Prevention Ordinance, Stormwater Management and Erosion and Sediment Control Ordinance, and Uniform Building Codes, in any new development or redevelopment project it undertakes.

5.H Summary of the Impacts on the Community

Of all of the probable hazards that are likely to cause damage to the Town of Mamaroneck, the ones that cause flooding and high winds are most significant. These hazards include hurricanes, nor'easters, coastal storms, severe thunderstorms and winter storms. These are the events that have the potential to impact the entire community to the highest possible degree.

The next major flooding hazard in terms of probable consequences and costliness is the flooding from an inadequate storm drainage infrastructure. The road, street and basement flooding resulting from these problems are costly.

Flooding damages can be substantial but they do not have the same damaging impact as high wind events due to hurricanes. All of the other hazards listed in Section 5.D and discussed in Section 5.B have been addressed in this plan and are of concern. They have the potential for serious impact. However, none of these hazards, under the most probable circumstances would

cause the same level of damage or would result in the loss of life to the same degree as floods and wind damage.

All of these other hazards are likely to impact the community to some degree and should be addressed. However, the issues deriving from wind and water hazards should be addressed as the first priority. With primarily the issues connected with wind and water hazards, there are many safety and economic benefits that would result from planning mitigation activities that focus on these issues. These are discussed in Section 7 of this plan.

Section 6 - Setting Goals and Objectives

6.A Setting Mitigation Goals

Identifying, profiling and assessing hazards that are likely to cause significant harm to the Town of Mamaroneck was presented in Sections 4 and 5. The next step is to identify planning goals which will guide the development of mitigation actions. The Hazard Mitigation Planning Committee, with the consultant's input and review by the community, proposed the following goals and objectives for developing mitigation measures that are presented in Section 7. The goals listed below are a consensus of the committee and the Town administration and were available for review and comment by the public. Five hazard mitigation goals were proposed for implementing the Town mitigation measures. These goals include:

1. Avoid and reduce hazards from flooding.
2. Protect the community from catastrophic disasters to avoid loss of life and injury.
3. Protect public and private property and infrastructure from catastrophic disasters.
4. Protect environmental and natural resources.
5. Involve the community, partners, and stakeholders in mitigation measures.

The primary hazards of concern identified in Section 4 are flooding and damage from major storms such as coastal storms, thunder storms, severe rain storms, Nor'easters, tropical storms and hurricanes. These hazards have the potential for serious impact, and would likely cause frequent or severe damage or harm to people from major storms that cause flooding and wind damage. Goals that were not directly linked to hazard mitigation issues such as purely economic and development goals or capital construction project goals were excluded. The proposed goals represent the major issues and aims of the community and consider significant hazards and their impacts. These goals are broad and inclusive of technological and human-caused hazards.

These five principal goals consider the existing resources and capabilities of the Town government and strive to reduce vulnerabilities and mitigate hazards having significant risks. These goals will be evaluated in future updates of this Plan. (See Section 9.) Each of the goals established encompass the primary hazards of concern.

6.A.1 Goals for Reduction of Vulnerabilities

Each goal is intended to reduce hazard risks and vulnerabilities that were discussed in Section 5, *Assess the Impacts*. The hazards of concern were discussed in detail in Section 4 and low risk items were eliminated from further evaluation in Section 5. Several hazards that contribute to the major hazard of flooding and wind damage were selected for further evaluation and assessment. These hazards include:

- Floods
- Coastal storms
- Winter storms
- Utility Failure
- Tornados
- Wind storms
- Severe Rain Storms
- Thunderstorms
- Extreme Temperatures
- Ice Storms

Vulnerabilities to these hazards include people, Town buildings, infrastructures and public and private property. Vulnerabilities to people include Town residents, visitors, commuters, travelers and Town workers who are potentially impacted by these hazards. Vulnerabilities of structures include critical facilities, private homes and businesses. Vulnerabilities of public and private property include trees, vehicles and land. Infrastructures include power distribution systems, roads, bridges, rail transportation, storm water systems. (See Section 5 for vulnerability details.)

The first goal (***Avoid and reduce hazards and impacts from flooding***) is intended to protect people and property in flood prone areas that were identified in Sections 4 and 5. This goal focuses on the mitigation of impacts from flooding on vulnerable properties, structures and people. The Town of Mamaroneck is known to flood frequently in several areas. (See Section 4.) This goal is aimed to mitigate impacts related to water damage through upgrading drainage and sewage systems, and improvement of roads. Portions of the existing sewer and storm drain

system are more than 100 years old. In addition, significant structural defects in the storm and sanitary sewer systems could impact the entire system.

The second goal (***Protect the community from catastrophic disasters to avoid loss of life and injury***) is intended to cover any hazard that has the potential to cause catastrophic impacts to the Town. Protecting the safety of the public in the community is of prime concern. This goal includes impacts from natural as well as man-caused hazards. Multiple government services may be involved that include emergency operations command, police, fire and emergency response units, Town administration and Town communications centers as well as State and Federal resources.

The third goal (***Protect public and private property and infrastructure from catastrophic disasters***) is intended to cover any hazard that has the potential to cause catastrophic damage to public and private property, buildings, homes and infrastructures. It is also intended to protect vulnerable businesses and critical facilities from loss of use from any hazard including impacts from natural and man-caused hazards. These impacts may require multiple government services that include response from emergency units, police, and fire department, Town administration resources as well as State and Federal agencies.

The fourth goal (***Protect environmental and natural resources***) includes protecting valuable resources such as open spaces, parks, streams, ponds, air quality, water quality, environmentally sensitive areas, land use as well as hazardous waste and municipal waste. Preparing for global warming impacts is a significant concern in this goal. Potential changes may already be beginning as flooding, coastal storm surges, thunder storms and warmer temperatures in recent decades seem to indicate.

The fifth goal (***Involve the community, partners, and stakeholders in mitigation measures***) emphasizes the importance of community and stakeholder involvement in protecting lives, safety and property. Effective public communication and action is critical in implementing this mitigation goal. Partners include participating neighbors, agencies and groups that share the same problem. Stakeholder involvement includes maintaining inter-jurisdiction involvement of

neighboring communities and interagency coordination of mitigation measures. By involving stakeholders and upgrading existing programs, certain mitigation actions can be efficient and cost effective.

6.A.2 Strategy for Objectives

The Town Hazard Mitigation Committee evaluated several specific objectives for each of the five general primary goals discussed above. These objectives offer a strategy for identifying and proposing mitigation measures presented in Section 7 that meet these established goals. The primary objectives for each goal are listed in Table 6-1. These objectives and the proposed mitigation activities listed in Section 7 comply with relevant criteria provided in FEMA guidance. These criteria include technical, political, legal, economic, environmental, social and administrative evaluation criteria.

The objectives proposed are intended to fulfill at a minimum the following evaluation criteria:

- Technical - Develop technically feasible mitigation efforts
 - Be effective in reduction of long-term losses, impacts and risks
 - Be effective in minimizing secondary losses
 - Be effective in solving the problem and not only the symptoms.
 - Eliminate actions that will not technically meet the goals.
- Political - Acceptable to and supported by community politicians
 - Have full support of the Town Board and Administration
 - Involve political leaders in the planning process
 - Have support and involvement of stakeholders
 - Have public support and involvement
- Legal
 - Have legal authority to undertake an action
 - Meet all applicable regulatory requirements
 - Define the roles of the Village, Town, County, State and Federal governments
 - Provide a legal basis for mitigation actions
 - Assure laws, regulations, ordinances, and resolutions are in place
 - Identify liabilities for an action or lack of an action
 - Consider needs for legal counsel

- Economic - Develop affordable and cost-effective mitigation efforts
 - Obtain budget and funding for an action
 - Provide economic costs and benefits of a mitigation action
 - Have minimal burden to the tax base or local economy
- Environmental - Improve environmental quality
 - Identify and evaluate environmental impacts
 - Comply with all environmental laws and regulations
 - Benefit the environment
- Social - Improve the quality of life and reduce neighborhood impacts.
 - Include public support and involvement
 - Consider effects on selected segments of the population
 - Be compatible with present and future community values
 - Consider cultural impacts on the community
- Administrative - Provide resources and staffing to implement proposed actions
 - Have jurisdiction and capability necessary to implement an action
 - Have jurisdiction to accomplish activities in a timely manner
 - Have jurisdiction to maintain and manage the mitigation measure

The objectives presented are not mutually exclusive and may apply to one or more goals. (See Table 6-2.) For example, several objectives listed under the second goal “*Protect the community from catastrophic disasters*” can also apply to “*Avoid and reduce the impacts from flood hazards*”. For simplicity, objectives are listed once under a primary goal. Each of the objectives discussed below form the basis for the mitigation measures presented and discussed in detail in Section 7.

Table 6-1. Hazard Mitigation Goals and Primary Objectives – Town of Mamaroneck, NY

1. Avoid and reduce the Hazards from flooding.

- 1.1. Prevent flooding from the Long Island Sound (coastal flooding), and riverine flooding from the rivers, brooks and tributaries that run through the Town.
- 1.2. Identify and eliminate inflow and infiltration problems.
- 1.3. Correct storm and sanitary sewer backup problems from floods.
- 1.4. Improve the storm water collection and drainage system.
- 1.5. Control sediment disposition and erosion.

2. Protect the community from catastrophic disasters to avoid loss of life and injury.

- 2.1. Enhance the community awareness of emergency procedures.
- 2.2. Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems.
- 2.3. Develop, update and integrate emergency action plans and coordinate with Red Cross and other agencies.
- 2.4. Reduce impacts of hazards on vulnerable populations.
- 2.5. Ensure continuity of government operations, emergency services, and essential facilities during and immediately after disaster and hazard events.

3. Protect public and private property and Infrastructure from catastrophic disasters.

- 3.1. Protect Critical Facilities, buildings, and infrastructure from damage and loss.
- 3.2. Reduce impacts of hazards on homes, businesses, and institutions.
- 3.3. Manage hazard impacts through planning.
- 3.4. Become a member of the Community Rating System.

4. Protect natural resources and the environment.

- 4.1. Protect and preserve open space and environmentally sensitive and critical areas.
- 4.2. Protect and restore natural lands and features that serve to mitigate losses.
- 4.3. Incorporate hazard considerations into land-use planning and natural resource management.
- 4.4. Encourage hazard mitigation measures that result in the least adverse effect on the natural environment.
- 4.5. Prepare for climate change impacts on the community.

5. Involve the community partners and stakeholders in mitigation measures.

- 5.1. Strengthen inter-jurisdiction and interagency communication, coordination, and partnerships to foster hazard mitigation actions or projects.
- 5.2. Evaluate impacts using engineering analyses and studies of water courses impacting the community.
- 5.3. Coordinate mitigation planning with neighboring communities.

Table 6-2. Town of Mamaroneck Hazard Mitigation Objectives with their Corresponding Goals

OBJECTIVE STATEMENTS	GOAL STATEMENTS				
	1. Avoid/ Reduce Flooding	2. Protect the Community from Disasters	3. Protect Public and Private Property/ Infrastructure	4. Protect Natural Resources/ Environment	5. Promote Community, Partners, Stakeholders
1-1 Prevent flooding from coastal waters, streams, lakes and ponds	*X	x	x	x	
1-2 Identify and eliminate inflow and infiltration problems	*X			x	x
1-3 Correct storm and sanitary sewer backup problems from floods	*X	x	x	x	
1-4 Improve the storm water collection and drainage system	*X	x	x	x	
1-5 Control sediment disposition and erosion	*X		x	x	
2-1 Enhance the community awareness of emergency procedures	x	*X			x
2-2 Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems	x	*X			x
2-3 Develop, integrate, and update emergency action plans and coordinate with Red Cross and other agencies.		*X			x
2-4 Reduce impacts of hazards on vulnerable populations	x	*X		x	
2-5 Ensure continuity of government operations, emergency services, and essential facilities		*X		x	x
*X – Primary Objective x – Secondary Objective					

OBJECTIVE STATEMENTS	1. Avoid/ Reduce Flooding	2. Protect the community from Disasters	3. Protect Property/ Infrastructure from Disasters	4. Protect Environment/ Natural resources	5. Promote Community, Partners, Stakeholder s
3-1 Protect Critical Facilities, buildings, and infrastructure from damage and loss	x		*X		
3-2 Reduce impacts of hazards on homes, businesses, and institutions	x	x	*X		x
3-3 Manage hazard impacts through planning	x		*X		x
3.4 Become a member of the Community Rating System	x		*X		
4-1 Protect and preserve open space and environmentally sensitive and critical areas.	x			*X	
4-2 Protect and restore natural lands and features that serve to mitigate losses	x			*X	
4-3: Incorporate hazard considerations into land-use planning and natural resource management	x			*X	x
4-4 Prepare for climate change impacts on the community	x	x		*X	x
5.1 Strengthen inter-jurisdiction, coordination and partnerships					*X
5.2 Evaluate impacts using engineering analysis and studies	x				*X
5.3 Coordinate mitigation planning with neighboring communities	x			x	*X

***X – Primary Objective for the goal.**
 x – Secondary objective for the goal.

If the nature or magnitude of risks change, goals and objectives will be evaluated to assure that they address current and future conditions. An evaluation process will be implemented to assess whether the current resources are appropriate for implementing the Plan. An assessment will be made of the outcomes of mitigation actions and the roles of participating agencies and other partners identified in this Plan.

6.B. Mitigation Objectives by Goal

6.B.1 Avoid and Reduce Hazards from Flooding

This goal is a focus of major concern for the community since flooding is so frequent and destructive. The following objectives are intended to meet this goal. These include:

1. Prevent flooding from the Long Island Sound (coastal flooding), and riverine flooding from rivers, brooks and tributaries that run through the Town.
2. Identify and eliminate inflow and infiltration problems.
3. Correct storm and sanitary sewer backup problems from floods.
4. Improve the storm water collection and drainage system.
5. Control sediment deposition and erosion.

Flooding is the most significant hazard for the damage it does in the Town of Mamaroneck. Important to this goal is the mitigation of flooding from streams running through the Town such as the Sheldrake and Mamaroneck Rivers and smaller brooks and tributaries that run through the Town. Preventative mitigation measures for flood control would reduce the hazard to the Town. Mitigating impacts from flood hazards is needed in high risk areas which exceed the 100-year/500-Year flood zones levels. Correcting problems in the storm and sanitary sewer systems would help meet this goal by having more drainage capacity and effective removal of storm water. Overflow problems of the sanitary system should be corrected and improved. Actions that prevent sewer backup need to be developed. Actions that would eliminate the inflow and infiltration problems would meet this objective.

The community needs to identify the mitigation activities that require development of plans and implement such plans. Preparing a set of plans for flood control would include improving storm water collection and drainage and implement measures to control sediment deposition and erosion.

6.B.2 Protect the Community from Catastrophic Disasters to Avoid Loss of Life and Injury

Avoiding loss of life and injury from disasters is a central goal for the Town. This goal is also aimed at mitigating losses through various property protection activities before, during and after a hazardous event occurs. Technological and man-caused hazards discussed in Sections 4 and 5 also apply and may be evaluated in future updates to this plan.

Primary objectives to “*Protect the community against catastrophic disasters*” include:

1. Enhance the community’s awareness of emergency procedures.
2. Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems.
3. Develop, integrate, and update emergency action plans and coordinate with Red Cross and other agencies.
4. Reduce impacts of hazards on vulnerable populations.
5. Ensure continuity of government operations, emergency services, and essential facilities during and immediately after disaster and hazard events.

Enhancing residents’ awareness requires effective communication between the Town officials and the community. Such an action would include receiving communication during a hazard event through a reverse 911 call. The objective for heightened public awareness requires involvement at several levels of government. It involves using mass media, email, newspapers, churches, community groups and other organizations.

One of the major objectives is to ensure that adequate planning is conducted and updated to avoid loss of life and injuries during a major storm or other hazardous events by having a well-prepared and approved emergency response and escape plan. Action plans should identify appropriate staff, required training and the necessary equipment and supplies to meet response needs. Town residents need to be aware of emergency procedures to assure that basic emergency services are not disrupted and that emergency services are not disrupted so that people in need of emergency services get them during a hazardous event.

Having a fully compliant and updated National Incident Management System (NIMS) and implementation plans in place is a critical first step. Without a clear definition of roles, available services and resources in the Town, implementation of effective emergency response is limited. Having effective warning systems is a key to communication with the community.

6.B.3 Protect Public and Private Property and Infrastructure from Catastrophic Disasters

This goal is aimed at mitigating losses through various property protection activities before a hazardous event occurs. Protecting residential property from catastrophic disasters is also included. This goal focuses on protecting the Town from major losses. Severe storms are noted for the damage they can do in the Town of Mamaroneck. (See Sections 4 and 5.)

Three prime objectives related to this goal are:

1. Protect Critical Facilities, buildings, and infrastructure from damage and loss.
2. Reduce impacts of hazards on homes, businesses, and institutions.
3. Manage catastrophic impacts through emergency planning.

Critical facilities, commercial and residential buildings and associated infrastructures need to be protected from hazards to assure that basic Town services for healthcare, police, transportation, government, fire and emergency services are not disrupted and that people in need of emergency services get them during a major hazardous event. Mitigation measures that reduce impacts on homes, businesses and institutions also need to be identified and implemented. Town infrastructures, including storm water conveyances need to be reviewed for expansion and enhancement for control of storm water.

Developing comprehensive emergency plans are needed to prepare for impacts from catastrophic events. These emergency plans are required by FEMA.

6.B.4 Protect Environmental And Natural Resources.

The objectives for environmental and resource protection will help conserve resources that are important for preserving open space, plants, wildlife, fish, sensitive ecosystems and wetlands. Four objectives have been developed to help meet this goal.

1. Protect and preserve open space and protect environmentally sensitive and critical areas.
2. Protect and restore natural lands and features that serve to mitigate losses.
3. Incorporate hazard considerations into land-use planning and natural resource management.
4. Prepare for climate change impacts on the community.

Actions that protect and preserve open space and protect environmentally sensitive and critical areas are important for flood control. Depending on the location, actions proposed may involve a variety of measures such as vegetation management, acquisition of impacted properties and structures, redirecting flood water and other methods to restore natural features.

Hazard mitigation actions may require land-use planning and management of natural resources. Any measure proposed must have minimal adverse impact on the natural environment.

6.B.5 Involve the Community, Partners, and Stakeholders in Identifying and Implementing Mitigation Measures.

Three specific objectives were developed that relate to this goal:

1. Strengthen inter-jurisdiction and interagency communication, coordination, and partnerships to foster hazard mitigation actions or projects.
2. Evaluate impacts using engineering analyses and studies of water courses impacting the community.
3. Coordinate with neighboring communities.

Inter-jurisdiction and interagency communication and coordination needs to be strengthened. Partnerships are needed to foster hazard mitigation projects. Since many downstream structures and people could be impacted by mitigation projects in the Town of Mamaroneck, such projects need the cooperation of affected jurisdictions.

Additional engineering analyses and water course studies impacting the Town will likely be required and updated. Such activities may be needed prior implementing a mitigation measure. Existing programs, projects or studies need to be integrated in this Hazard Mitigation Plan. Agencies such as the U.S. Army Corps of Engineers and Westchester County Department of Planning need to be involved.

The above goals and objectives provide a focus for proposing mitigation activities. Section 7 provides a variety mitigation activities and actions intended to meet the goals and objectives outlined above.

Section 7 - Review of Mitigation Activities

7.A Planning Process and Strategy

FEMA provides guidance on developing a hazard mitigation strategy which serves as a long-term blueprint for reducing potential losses that were identified in the risk assessment (Section 5) of this Hazard Mitigation Plan. There are three components to this strategy:

- Develop long-term goals and objectives for outcomes that you want to achieve (Section 6).
- Identify specific activities and actions (this Section 7) that local government agencies or departments, community organizations, neighboring participants, stakeholders and others can take to reduce the risks of identified hazards (Sections 4 and 5).
- Develop an Action Plan (Section 8) that prioritizes each action, identifies who is responsible and how and when they will be implemented.

With the Town's and the Committee's help, the principal goals and objectives were assembled as part of this strategy. The next step identifies specific actions the community can take to meet these objectives. To accomplish this, detailed mitigative actions or activities were assembled that are cost effective, feasible and meet the goals and objectives specified above.

Tables 7-1 through 7-5 in Section 7.B below summarize proposed actions and associated details for each of the five proposed goals discussed. These details include:

- Action/Activity Strategy – Activity or mitigation measure proposed.
- Action Type – Local plans and regulations, structure/infrastructure projects, natural systems protection, education awareness programs, and emergency response projects.
- Primary Objective – The most appropriate objective from the Goals listed in Table 6-1.
- Hazards Mitigated – Flooding, utility failure, wind storm, drought, etc.
- Location – General description of area covered such as “Town-wide”, “Multi-jurisdictional”, “Special flood hazard areas (SFHA)”, “Critical facilities” and/or “Hazmat facilities”

- Priority – A rating of 1 - high, 2 - medium or 3 - low representing the priority to implement.
- Benefits – Effectiveness of the action.
- Cost Estimate – An amount which considers local government and contractor costs to the nearest \$1,000. (See Section 7.A.3 for details.) Detailed cost estimates will be prepared once the scope of the project is defined and funding sources are identified.

This Section proposes mitigation activities that would reduce the impact of hazardous events that could occur in the Town. This process provides a consistent approach for Town, Village, County, State and Federal governments to work effectively and efficiently together with stakeholders to prepare for, respond to and recover from a hazardous event regardless of cause, size or complexity. These objectives are specified under the National Incident Management System (NIMS).

As discussed in Sections 4 and 5, the primary hazard of concern in Town of Mamaroneck is flooding. The fact that flooding is rated as the most serious hazard (see Table 4-5) is due to a variety of storm hazards such as coastal storms, thunderstorms, nor'easters, tropical storms and hurricanes that threaten the Town almost every year and any one of these events can have a devastating impact. For example, the hazard scorings (Table 4-5) show hurricanes as a moderately high hazard. This rating is due to the fact that Category 3 and 4 hurricanes, the most hazardous, are the least encountered, while tropical storms are more frequent and cause less wind damage but cause large-scale flooding. Mitigation measures for hurricane hazards in this section are therefore covered primarily as a flood hazard. These hazards often have secondary effects such as fallen trees, utility failure, dam failure, transportation accidents, water supply contamination and structural collapse. The principal hazards considered in Section 4 for mitigation measures include:

High Hazards

- Floods

Moderately High Hazards

- Coastal Storms (including tropical storms, nor'easters)
- Hurricanes
- Severe Storms (including thunderstorms)
- Storm Surge and Wave Action

Moderately Low Hazards

- Dam Failure
- Tornado
- Utility Failure
- Fires (Structural)
- Hazmat

Other natural hazards like heat waves and earthquakes, technological hazards and man-caused events such as terrorism were evaluated in Section 4 of this Plan. However, these do not have the same frequency or level of impact as flooding.

7.A.1 Mitigation Goals and Objectives

The proposed mitigation measures must help meet the goals, objectives and the criteria outlined in this Plan. The five primary goals are:

1. Avoid and reduce hazards from flooding.
2. Protect the community from catastrophic disasters to avoid loss of life and injury.
3. Protect public and private property and infrastructures from catastrophic disasters.
4. Protect environmental and natural resources.
5. Involve the community, partners, and stakeholders in identifying and implementing mitigation measures.

As discussed previously these objectives are not mutually exclusive and may apply to other goals in addition to the primary goals listed. Likewise, a mitigation action may help meet several objectives. The recommended actions will be discussed in the proposed action plan developed in Section 8.

7.A.2 Mitigation Action Categories

Each mitigation action can be classified according to FEMA guidance under one of several action or activity categories:

- Local Plans and Regulations
- Structure and Infrastructure Projects
- Natural Systems Protection

- Education and Awareness Programs
- Emergency Response Activities

Development of Local Plans and Regulations is a strategy that reduces the impacts from hazards, avoids or limits personal harm and decreases the loss of property value. These actions include administrative or regulatory actions by government authorities and in the preparation of plans, codes and standards. Tables 7-1 through 7-5 indicate these types of activities as ‘Planning’. These measures help keep problems from getting worse and include planning, zoning, building codes, fire codes, laws, regulations, and preservation activities. Improved zoning, building codes and updated plans will discourage future development in inappropriate areas such as flood plains or Town areas prone to flooding.

Structure and Infrastructure Projects affect the way land, buildings and infrastructures are developed or modified to protect them from a hazard. An item is identified as ‘Structure’ to indicate it is a Structure and Infrastructure Projects Activity. These measures are strategies associated with the goals and objectives that protect property from damage or loss of property value. Property owners may protect buildings and properties by retrofitting structures, acquiring properties in safe areas, relocating facilities or elevating structures. This strategy may include projects such as elevating roads or flood control projects such as storm and sanitary sewers, or building retaining walls that direct floodwaters away from an area.

Natural Systems Protection reduces damage and losses to natural systems. It preserves or restores the functions of the natural system. These measures are intended to mitigate sediment accumulation, erosion, stream flow problems, wetland loss and other natural processes. The Town has limited open space and natural areas. Natural resource protection works to preserve or restore natural areas and the natural function of a floodplain. These activities may also include vegetation management, water quality control, pond management or wetland management. Each proposed Natural System Protection Measure is identified as ‘Natural’.

Education and Awareness Programs involve informing, educating, soliciting input and advising the community. This includes informing elected officials, property owners and stakeholders

concerning actions in the proposed plan. These are activities that help save lives and protect property through an informed community. They include public meetings, Web Page productions, local public television, outreach programs and newspaper notices. 'Education' in Tables 7-1 through 7-5 indicates Education and Awareness Program activities. These activities may be performed at various times and may be associated with several mitigation items.

Emergency Response Activities involve activities that prevent or reduce impacts prior to or during a hazard event. This includes training exercises, rescue operations, accident prevention, communications, fire response, ambulance service, first aid, and similar activities.

7.A.3 Estimating Activity Item Costs

Detailed specifications for each activity item are not within the scope of this Hazard Mitigation Plan but will be submitted with specific future proposals for work and grant applications. The proposed activities represent a brief summary or conceptual plan for work items. Most costs in this plan cannot be quantified at this step of planning. A detailed cost estimate will be prepared after the scope of a project is defined and funding sources are identified. The estimated costs given in this plan will be used to evaluate the cost benefit summary for each proposed activity.

The Plan is based on past experience of the Town's staff, size and scope of the activity, known unit costs for similar activities or estimates based on engineering guides. These estimates may have a margin of error of +/- 25% and represent a value in current 2013 dollars. The cost estimates include local government staff and contractor costs to implement the project or program. A qualitative evaluation will be used to evaluate project costs and benefits. The cost to individual property owners may be substantially higher depending on the availability of outside funding.

Costs will be presented as low, medium or high.

- Low: Less than \$25,000
- Low Medium: \$25,000 - \$50,000
- Medium: \$50,000 - \$100,000
- Medium High: \$100,000 - \$500,000
- High: \$500,000 - \$1,000,000

- Very High: Over \$1,000,000

7.A.4 Setting Priorities

A priority is assigned to each Activity Item shown in Tables 7-1 to 7-5. Priorities are qualified as High, Medium and Low. High or Priority 1 activities are considered the most urgent or important projects to start with. Only three priority categories were chosen to keep decision-making easier and to promote consensus among the Committee. Section 8 will provide a detailed ranking of each action item. As the Plan is implemented these priorities are expected to change based on resource availability, funding, new information, and future community needs. Some activity items that may have already started will continue as a top priority. In addition, many of the activities are dependent on other activities and have a higher priority. Many of the proposed items require outside grants or other assistance and may be delayed due to availability of funding.

In this Plan we discuss the process and strategies used to develop and prioritize the mitigation activities to protect the community against the primary hazards identified. In Section 7.B we identify and organize the possible activities according to the goals and objectives. The proposed mitigation activities are each given a general order of priority. Activities will be sorted in Section 8 by priority. The mitigation activity items and associated objectives are given for each goal along with their applicable hazards. All proposed activities, priorities and costs were reviewed by the Hazard Mitigation Planning Committee and were made available to the community for comment and final approval by the Town Board.

Evaluating priorities is based on several criteria. These criteria include:

- Social acceptability
- Technical feasibility
- Administrative capability
- Political support
- Legal authority
- Economically affordable and cost-effective
- Environmentally beneficial

Activities that were most cost-effective were rated higher. Funding resources and availability were also important considerations. Actions that can be done using available resources, or with sources of funds that have been identified, also have a higher priority.

A high priority activity involves maximum benefits relative to the costs even though in most cases, a quantitative estimate of benefits in dollars cannot be made. Qualitative judgments of benefits relative to cost were made based on the benefits listed for the objects at risk and damage estimates that are given in Section 5. Projects having high costs and high benefits or a high risk reduction would also have a higher priority. High-cost items having a lower benefit would have a lower priority. A low-cost item though important, may be given a lower priority because there were fewer direct property and safety benefits to the Town. These activities were proposed, reviewed and evaluated by the Committee, Town officials and the Consultant.

7.A.5 Capability and Resources

The Town of Mamaroneck will have the responsibility, jurisdiction, capability and authority to administer and implement the mitigation actions proposed below. In some instances, a neighboring community or agency may have jurisdiction that requires a joint Memorandum of Understanding or a partnership of shared resources to implement the activity. The Town official in charge of a project will be responsible for interfacing with the public and neighboring jurisdictions, Westchester County, USCOE, NYS OEM, FEMA or other agencies identified in Section 3. Officials for the Town that administer these projects are shown in Figure 1-3 in Section 1 and discussed further in Section 8.D Capabilities and Resources. In many cases, the Town does not have financial or human resources to prepare the plans, studies and engineering designs, or implement public outreach and conduct the construction required for many of the activities proposed. External agency funding for consultants, engineers and contractors will be needed to successfully implement this Hazards Mitigation Plan.

7.B Proposed Mitigation Actions

Numerous possible mitigation activities were identified and screened by the Committee and Town officials. There were 40 mitigation activities identified that met one of the five mitigation goals. The proposed activities are listed by their primary goal in Tables 7-1 through 7-5. Each

proposed mitigation activity is summarized with its action/activity strategy, action type, primary objective, hazard mitigated, location, priority, benefits and cost estimate. These goals, objectives and benefits are consistent with and incorporate several criteria listed in Section 6.A and 7.A.4.

The proposed mitigation actions are consistent with the recommendations developed in the Town of Mamaroneck's Master Plan and its updates, and their Local Waterfront Revitalization Program and amendments. Sections 4 and 5 of this Hazard Mitigation Plan provide the technical support for these proposed activities. In addition, where applicable, those actions that are intended to aid the community with continued National Flood Insurance Program (NFIP) compliance are indicated.

7.B.1 Goal 1 - Avoid and Reduce the Hazards from Flooding

Since the major hazard is flooding, plans to meet Goal 1 will attempt to reduce impacts from storms. Protection of people and properties from floods is first and foremost. Meeting this goal and its five objectives depends on having all planning tools in place, all needed resources ready and all emergency personnel trained. The Town has identified a number of related actions that will result in a reduction of flooding. Table 7-1 lists the proposed mitigation activities, objectives, priorities, hazards mitigated and the potential benefits to promote this goal. These activity items are discussed in the following sections.

7.B.1.1 Upgrade Existing Storm Water Management Plans

Upgrading existing storm water management plans is a planning action for improving the storm water collection and drainage system and is intended to reduce flooding hazards Town-wide. Activities include mitigating losses in repetitive flood areas, inspecting/maintaining drainage system, and acquiring, relocating or retrofitting flood prone structures. Updating the plans is a Community Rating System (CRS) activity which has a high priority and high benefits for a low cost of less than \$25,000.

7.B.1.2 Launch an Aggressive Year- Round Stream Maintenance Program On Rivers and Waterways

A year-round stream maintenance program on rivers and waterways is intended to prevent Town-wide flooding. This activity is primarily concerned with the Sheldrake River and other waterways. It is a natural systems protection action. It has a medium priority with medium benefits and a medium cost. The program would count as a CRS activity for SFHA and Repetitive Loss Properties.

Table 7- 1a. Goal 1: Proposed Activities to Avoid and Reduce Hazards from Flooding. ****

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated#	Location	Priority ***	Benefits	Cost Estimate	Comments
1. Upgrade existing storm water management plans	Planning	1.4 Improve the storm water collection and drainage system	Flooding	Town-wide	High	High	Low	
2. Launch an aggressive year- round stream maintenance program on rivers and waterways	Natural	1.1 Prevent flooding from coastal waters, rivers and brooks	Flooding	Town-wide, Special Flood Hazard Areas (SFHA)	Medium	Medium	Medium	Repetitive Loss Properties
3. Install automated spillway valve control and stream level monitoring	Structure	1.1 Prevent flooding from coastal waters, rivers and brooks	Flooding	Multi-jurisdictional	High	High	High	Repetitive Loss Properties
4. Involve home and business owners in a program to flood-proof their basements and other areas of their building that flood****	Planning	1.1 Prevent flooding from coastal waters, rivers and brooks	Flooding	Special Flood Hazard Areas (SFHA)	High	High	Low	Repetitive Loss Properties
5. Improve stormwater management by updating obsolete stormwater drainage infrastructures	Structure	1.4 Improve the storm water collection and drainage system	Flooding	Town-wide	High	High	Medium - High	

*Action Type: **Planning** – Local Plans and Regulations **Structure** – Structure and Infrastructure Projects ***Priority:
Natural - Natural Systems Protection **Education** – Education Awareness Programs 1 – High 2 – Medium 3 – Low
Emergency – Emergency Response

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7A

**** These items are intended to aid the community with continued NFIP compliance.

Table 7-1b. Goal 1: Proposed Activities to Avoid and Reduce Hazards from Flooding. ****

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
6. Explore retrofits to the Sheldrake River Dam with Larchmont to increase drainage of water from the reservoir	Structure	1.4 Improve the stormwater collection and drainage system	Flooding	SFHA	Low	Low	Medium	Repetitive Loss Properties
7. Purchase and install a Flood Early Warning System complete with water level gauges and automatic notification	Emergency	1.1 Prevent flooding from coastal waters, rivers and brooks	Flooding	SFHA	Low	Medium	Medium - High	Repetitive Loss Properties
8. Replace/upgrade Town-owned sewage pump stations	Structure	1.3 Correct storm and sanitary sewer backup problems from floods	Flooding	Town-wide	High	High	Medium	
9. Develop implement and manage the Town Community Rating System (CRS)	Planning	3.4 Become a member of the Community Rating System	Flooding	Town-wide	High	High	Low to medium	Repetitive Loss Properties

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects ***Priority:
Natural - Natural Systems Protection Education – Education Awareness Programs 1 – High 2 – Medium 3 – Low
Emergency – Emergency Response

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

7.B.1.3 Install Automated Spillway Valve Control and Stream Level Monitoring

This action type is a structure and infrastructure project which would control flooding from rivers. This multi-jurisdictional activity involves the Repetitive Loss Properties in neighboring Towns and Villages and has a high priority, high benefit and a high cost.

7.B.1.4 Involve Home and Business Owners in a Program to Flood-Proof Their Basements and Other Areas of Their Building That Flood

This Planning activity will help prevent flooding of buildings from coastal waters, rivers and streams. It is a CRS activity for Special Flood Hazard Areas (SFHA) and Repetitive Loss Properties. This activity has a high priority, high benefit and a low cost.

7.B.1.5 Improve stormwater management by updating obsolete stormwater drainage infrastructures.

This structure and infrastructure action is intended to improve the stormwater collection, drainage and storage capacity Town-wide to mitigate flooding. This project is given a high priority with high benefits and medium – high costs. This action strategy is a CRS activity.

7.B.1.6 Explore retrofits to the Sheldrake River Dam with Village of Larchmont to increase its effectiveness in drainage of water from the reservoir

This action is intended to improve the storm water collection and drainage system for the Sheldrake River Dam. This structure/infrastructure project with the Village of Larchmont is intended to help mitigate flooding in special flood hazard areas. The priority is low, the benefits are low and cost is medium. It is a CRS activity for Special Flood Hazard Areas (SFHA) and Repetitive Loss Properties.

7.B.1.7 Purchase and Install a Flood Early Warning System Complete With Water Level Gauges and Automatic Notification

This action strategy is an emergency response to prevent flooding from coastal waters and rivers. It is a CRS activity for Special Flood Hazard Areas (SFHA) and Repetitive Loss Properties. The Community Rating System credits activities that protect life and property during a flood through enhanced flood early warning and response programs. The priority is low, the benefits are medium and the costs are medium to high.

7.B.1.8 Replace/Upgrade Town-Owned Sewage Pump Stations

Replacing and upgrading Town-owned sewage pump stations is structure/infrastructure project which would correct storm and sanitary sewer backup problems from floods. It is a high priority with high benefits at a medium cost.

7.B.1.9 Develop implement and manage the Town Community Rating System (CRS)

This activity is intended to develop implement and manage the Town Community Rating System (CRS). To become a member of the Community Rating System, the Town must file required CRS documentation and establish an accurate inventory of Repetitive Loss Properties. Other activities include public information on reducing flood hazards and purchasing flood insurance, mapping and regulations, flood damage reduction and early warning and response programs to protect life and property. This action has a high priority with high benefits at a low cost of less than \$25,000.

7.B.2 Goal 2- Protect the Community from Catastrophic Disasters to Avoid Loss of Life and Injury

Avoiding loss of life and injury from disasters is a central goal for the Town. This goal is also aimed at mitigating losses through various property protection activities before, during and after a hazardous event occurs. Technological and man-caused hazards discussed in Sections 4 and 5 also apply and may be evaluated in future updates to this plan. Tables 7-2a, b and c list the proposed mitigation activities, objectives, priorities, hazards mitigated and the potential benefits to promote this goal.

7.B.2.1 Town-Wide Public Education and Awareness Campaign on Hazard Mitigation and All-Hazard Emergency Preparedness

The focus of this action type is public education with the objective of enhancing community awareness of emergency procedures. This Town-wide effort covers all hazards. The Town has given this action a high priority with a high benefit for a low cost.

7.B.2.2 Upgrade Emergency Management Plans Including Protocols For Preparation, Response, Recovery And Post-Event Mitigation For Hazards

This planning action involves revising local plans and regulations to bring them to current protocols for preparedness, response, recovery and post-event mitigation for all hazards. The Town should coordinate with other agencies including the Red Cross. This Town-wide activity has a medium priority, a medium benefit and a low cost.

7.B.2.3 Establish A Facility And Protocol For An Alternate Seat Of Government (ASOG)

This planning activity is intended to establish a facility and protocol for an Alternate Seat of Government (ASOG) during a disaster. This will ensure government operations, emergency services, and essential facilities during and immediately after a disaster or hazard event. This multi-jurisdictional activity covers all hazards and has a medium priority with medium benefits and a medium to high estimated cost.

7.B.2.4 Participate In A Multi-Jurisdictional Radio, Interoperability Program To Enhance Communications

The objective of this emergency response activity is to maintain, enhance and ensure the efficient operation of early warning, notification and communication systems. This multi-jurisdictional activity covers all hazards and has a medium priority of two with medium benefits and a medium to high estimated cost (\$25,000 - \$100,000). This action is feasible.

7.B.2.5 Install A VHF Radio Repeater System For TMAD And VAC

Installing a VHF radio repeater system for the Ambulance Department and Volunteer Ambulance Corps is an emergency action type covering all hazards. Its objective is to maintain, enhance and ensure the efficient operation of early warning, notification and communication systems. This multi-jurisdictional activity has a high benefit at a medium cost (\$25,000 - \$100,000) and is a highly feasible activity. Based on the feasibility, benefits and costs, this activity is given a priority of one.

7.B.2.6 Acquire modern equipment available to First Responders

The Town needs to acquire modern equipment for First Responders. This activity will enhance and ensure the efficient operation of early warning, notification and communication systems.

The activity type is Emergency Response for all hazards Town-wide. It has a high benefit to the community at a cost of \$25,000 to \$100,000. Pending funding the task is highly feasible and is given a priority of two.

7.B.2.7 Provide Emergency Operations Training To Town, School Emergency Services, Red Cross And Law Enforcement Staff

This emergency response activity is intended to provide emergency operations training to Town, school emergency services, Red Cross and law enforcement staff. This activity is for all hazards Town-wide, especially critical facilities.

7.B.2.8 Obtain Funding For Supplies And Equipment Needed In A Disaster Such As Generators, Pumps And Communication Equipment

The Town needs supplies and equipment to respond to a disaster. This includes generators, pumps and communication equipment. This activity will serve to maintain, enhance and ensure efficient operations, early warning notification and communication systems. This emergency response action will cover all hazards Town-wide. It is a feasible activity with a high benefit and medium high cost of \$100,000 to \$500,000.

7.B.2.9 Purchase And Install Current Technology That Allows Emergency Vehicles To Control Traffic Signals At Intersections

Current technology allows emergency vehicles to control traffic signals at intersections. This technology would be useful for Town police and emergency responders. It would meet the objective to maintain, enhance and ensure efficient operation of early warning notification and communication systems. This emergency response action covers all hazards Town-wide. This action is given a medium feasibility, a low priority of three, low benefit at a low to medium cost of \$25,000 to \$50,000.

7.B.2.10 Create And Maintain A Database Of Special-Needs Individuals And Con Ed LSE Customers Who Voluntarily Provide That Information

A database of special-needs individuals and Con Ed Life-Sustaining Equipment (LSE) customers who voluntarily provide that information would be helpful during a hazard event. It would help reduce impacts of hazards on vulnerable populations. This emergency response action is Town-

wide for all hazards. It is a medium feasible action, with medium benefits at a low cost of less than \$25,000. It is given a priority of two based on this assessment.

7.B.2.11 Draft Emergency Services Plans For Hazardous Materials Sites

An emergency services plan for hazardous materials sites will aid in more effective response to an incident at a site. This planning action type will help to develop, integrate and/or enhance emergency action plans for hazardous materials facilities. It will prevent and/or reduce property damage and injury due to HAZMAT spills/releases. It has a high priority of one, a high benefit a low cost of less than \$25,000 and is highly feasible.

7.B.2.12 Obtain Emergency Traffic Control Devices Such As Message Boards, Jersey Barriers And Portable Signs

Emergency traffic control devices such as message boards, Jersey barriers and portable signs, are an aid in responding to all hazards emergencies Town-wide. The primary objective is to maintain, enhance and ensure efficient operation of early warning notification and communication systems. The activity is highly feasible, with a high benefit and medium cost (\$25,000 - \$100,000). It has been given a high priority of one.

Table 7-2a. Goal 2: Proposed Activities to Protect Community from Catastrophic Disasters to Avoid Loss of Life and Injury.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
1. Town-wide public education and awareness campaign on hazard mitigation and All-Hazard emergency preparedness****	Education	2.1 Enhance the community awareness of emergency procedures	All Hazards	Town-wide	High	High	Low	
2. Upgrade Emergency Management Plans including protocols for preparation, response, recovery and post-event mitigation for hazards	Planning	2.5 Update disaster plans and coordinate with Red Cross and other agencies	All Hazards	Town-wide	Medium	Medium	Low	
3. Establish a facility and protocol for an Alternate Seat of Government (ASOG)	Planning	2.6 Ensure government operations, emergency services, and essential facilities during and immediately after disaster and hazard events	All Hazards	Multi-jurisdictional	Medium	Medium	Medium – High	
4. Participate in a multi-jurisdictional radio, interoperability program to enhance communications	Emergency Response	2.2 Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems	All Hazards	Multi-jurisdictional	Medium	Medium	Medium	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency - Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

Table 7- 2b. Goal 2: Proposed Activities to Protect Community from Catastrophes to Avoid Loss of Life and Injury.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
5. Install a VHF radio repeater system for TMAD and VAC	Emergency Response	2.2 Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems	All Hazards	Multi-jurisdictional	High	High	Medium	
6. Acquire modern equipment available to First Responders	Emergency Response	2.2 Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems	All Hazards	Town-wide	Medium	High	Medium-High	
7. Provide Emergency Operations training to Town, School Emergency Services, Red Cross and Law Enforcement staff	Emergency Response	2.5 Update disaster plans and coordinate with Red Cross and other agencies	All Hazards	Town-wide Critical Facilities	High	High	Low	
8. Obtain funding for supplies and equipment needed in a disaster such as generators, pumps and communication equipment	Emergency Response	2.2 Maintain, enhance and ensure the efficient operation of early warning, notification and communication systems	All Hazards	Town-wide	Medium	High	Medium - High	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency - Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

Table 7-2c. Goal 2: Proposed Activities to Protect Community from Catastrophes to Avoid Loss of Life and Injury.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
9. Purchase and install current technology that allows emergency vehicles to control traffic signals at intersections	Emergency Response	2.2 Maintain, enhance and ensure efficient operation of early warning notification and communication systems	All Hazards	Town-wide	Low	Low-Medium	Medium	
10. Create and maintain a database of special-needs individuals and Con Ed LSE customers who voluntarily provide that information	Emergency Response	2.4 Reduce impacts of hazards on vulnerable populations.	All Hazards	Town-wide	Medium	Medium	Low	
11. Draft emergency services plans for hazardous materials sites	Planning	2.3 Develop, integrate and/or enhance emergency action plans	Hazardous Materials	Hazmat facilities	High	High	Low	
12. Obtain emergency traffic control devices such as message boards, Jersey barriers and portable signs	Emergency Response	2.2 Maintain, enhance and ensure efficient operation of early warning notification and communication systems	All Hazards	Town-wide	High	High	Medium	

*Action Type: Plans – Local Plans and Regulations
Natural - Natural Systems Protection
Emergency - Emergency Response

Structure – Structure and Infrastructure Projects
Education – Education Awareness Programs

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

7.B.3 Protect Public and Private Property and Infrastructure from Catastrophic Disasters

This goal is aimed at mitigating losses through various property protection activities before a hazardous event occurs. Protecting residential property from catastrophic disasters is also included. This goal focuses on protecting the Town from major losses. Severe storms are noted for the damage they can do in the Town of Mamaroneck. (See Sections 4 and 5.) Tables 7-3 a, b and c list the proposed mitigation activities, objectives, priorities, hazards mitigated and the potential benefits to promote this goal.

7.B.3.1 Purchase And Install A GIS Mapping Program

A GIS Mapping Program will help track and map flood-prone areas and locations of critical facilities Town-wide. It will assist in managing all hazard impacts through planning. Mapping and regulations provide increased protection to new development. Activities include mapping areas not shown on FIRM maps, preserving open space and enforcing higher regulatory standards, protecting natural flood plain functions and managing storm water. It has a high benefit and a low to medium cost of about \$25,000. It is a highly feasible action with high priority of one.

7.B.3.2 Assist Town Businesses With Drafting Emergency Preparedness, Business Continuity And Homeland Security Plans

The Town will assist local businesses with drafting emergency preparedness, business continuity and homeland security plans. The objective of this action is to manage all hazard impacts Town-wide through planning. This feasible action has a medium benefit for a low cost of less than \$25,000 and has a priority of three.

7.B.3.3 Educate Residents, Business Owners And Contractors On Flood Mitigation Strategies, Damage Prevention And Safety, Flood Insurance And Flood Loss

This is an educational awareness program with the objective of reducing impacts of hazards on homes, businesses and institutions. It is important to educate the Town's residents, business owners and contractors on ways to reduce flood damage and to promote the purchase of flood insurance. These activities also provide necessary data to insurance agents for accurate flood insurance rating. Public information activities include maintaining elevation certificates,

providing map information, conducting outreach projects about flood hazards, disclosing information about hazards, providing information and advice about flood protection, and providing assistance for flood protection. This is a CRS activity that targets repetitive loss properties. It has high benefit at a low-medium cost of \$25,000 to \$50,000. This feasible strategy has a high priority of one.

Table 7-3a. Goal 3: Proposed Activities to Protect Public/Private Property and Infrastructure from Catastrophic Disasters.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
1. Purchase and install a GIS Mapping Program	Planning	3.3 Manage hazard impacts through planning	All Hazards	Town-wide	High	High	Low - Medium	
2. Assist Town businesses with drafting emergency preparedness, business continuity and Homeland Security plans	Planning	3.3 Manage hazard impacts through planning.	All Hazards	Town-wide	Medium	Medium	Low	
3. Educate residents, business owners and contractors on flood mitigation strategies, damage prevention and safety, flood insurance and flood loss****	Education	3.2 Reduce impacts of hazards on homes, businesses and institutions	Flooding	Town-wide Repetitive Loss Properties	Low	High	Low - Medium	CRS Activity
4. Maintain a database of all residents and businesses that use bulk propane storage tanks as a gas source	Planning	3.3 Manage hazard impacts through planning	Explosions	Town-wide	Medium	Medium	Low	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency- Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

Table 7-3b. Goal 3: Proposed Activities to Protect Public/Private Property and Infrastructure from Catastrophic Disasters.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated [#]	Location	Priority ***	Benefits	Cost Estimate	Comments
5. Coordinate with Con Ed Co. of NY to determine if any upgrades are necessary in the local natural gas and electric delivery infrastructure	Structure	3.1 Protect critical facilities, buildings, and infrastructure from damage and loss	Hazardous Material	Town-wide	Medium	Medium	High	
6. Obtain and increase, Fire Sprinkler ordinances and alarm systems	Planning	3.1 Protect critical facilities, buildings, and infrastructure from damage and loss	Fire	Critical Facilities, Town-wide	High	High	Low	
7. Ensure that all critical facilities, historical sites and apartment buildings are in full compliance with modern building codes	Planning	3.1 Protect critical facilities, buildings, and infrastructure from damage and loss	Structural Collapse	Critical Facilities	Medium	Medium	Low	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency – Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

Table 7-3c. Goal 3: Proposed Activities to Protect Public/Private Property and Infrastructure from Catastrophic Disasters.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
8. Conduct a discrete confidential evaluation of potential targets and security measures at critical and high risk locations	Planning	3-1 Protect critical facilities, buildings, and infrastructure from damage and loss	Terrorism	Town-wide	High	High	Low	
9. Identify homes and businesses, public facilities and historic sites that would benefit from raising structures above the Base Flood Elevation (BFE) ****	Planning	3.2 Reduce impacts of hazards on homes businesses and institutions	Flooding	Special Flood Hazard Areas (SFHA), Repetitive Loss Properties	Medium	Medium	Low	
10. Work with owners of Repetitive Loss Properties to identify ways the buildings can be modified to reduce insurance claims****	Planning	3.4 Become a member of the Community Rating System	Flooding	SFHA and Repetitive Loss Properties	Medium	Medium	Low	
11. Coordinate with utility providers to install the Town's electrical and communication infrastructure underground	Structure	3.2 Reduce impacts of hazards on homes businesses and institutions	Severe Weather	Town-wide	Medium	Medium	High	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency – Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

7.B.3.4 Maintain A Database Of All Residents And Businesses That Use Bulk Propane Storage Tanks As A Gas Source

Maintaining a database of all residents and businesses that use bulk propane storage tanks as a gas source will help manage hazard impacts through planning. This Town-wide action will lessen the risk of explosions and fires. This has a medium benefit at a low cost under \$25,000 and has a priority of two.

7.B.3.5 Coordinate With Consolidated Edison Co. Of NY To Determine If Any Upgrades Are Necessary In The Local Natural Gas And Electric Delivery Infrastructures

The Town should coordinate with Consolidated Edison Co. of NY to determine if any upgrades are necessary in the local natural gas and electric delivery infrastructures. This structure/infrastructure project will protect critical facilities, buildings, and infrastructure Town-wide from damage and loss due to explosions and fire, and help reduce impacts of hazards on homes, businesses and institutions during power outages. The benefits are medium and costs to the Town are low since Consolidated Edison does the evaluation and work. It has been given a low priority of three.

7.B.3.6 Obtain And Increase Fire Sprinkler Ordinances And Alarm Systems In Public Buildings, Critical Facilities, Historical Sites, New And Renovated Structures And Apartment Buildings

The Town needs to strengthen Fire Sprinkler ordinances and alarm systems in public buildings, critical facilities, historical sites, new and renovated structures and apartment buildings. This Town-wide planning action type would protect critical facilities, buildings, and infrastructure Town-wide from damage and loss due to fire. The benefits of this feasible action are high and the costs are low (less than \$25,000). It has a high priority of one.

7.B.3.7 Ensure That All Critical Facilities, Historical Sites And Apartment Buildings Are In Full Compliance

This planning action type would ensure that all critical facilities, historical sites and apartment buildings are in full compliance with modern building codes, where required by law. The objective is protection of critical facilities, buildings, and infrastructure from damage and loss from structural collapse. The benefits are medium with a low cost (less than \$25,000). The priority for this action is two.

7.B.3.8 Conduct a discrete confidential evaluation of potential targets and security measures at critical and high risk locations around Town

This planning action type is to conduct a discrete confidential evaluation of potential targets and security measures at critical and high risk locations around the Town. The primary objective is to protect critical facilities, buildings, and infrastructure from damage and loss due to terrorism. This highly feasible strategy has a high benefit at a low cost (less than \$25,000). It has a high priority of one.

7.B.3.9 Identify Homes And Businesses, Public Facilities And Historic Sites That Would Benefit From Raising Structures Above The Base Flood Elevation (BFE)

This planning action identifies homes and businesses, public facilities and historic sites that would benefit from raising structures above the Base Flood Elevation (BFE). It is intended to reduce impacts of flood hazards on homes, businesses and institutions in Special Flood Hazard Areas (SFHA) and for Repetitive Loss Properties. It is considered to have a medium benefit and a low cost less than \$25,000. This CRS activity is feasible and has a priority of two.

7.B.3.10 Work With Owners Of Repetitive Loss Properties To Identify Ways The Buildings Can Be Modified To Reduce Insurance Claims

This planning action involves working with owners of Repetitive Loss Properties to identify ways the buildings can be modified to reduce insurance claims. The primary objective is to become a member of the Community Rating System and to mitigate flooding in SFHA and Repetitive Loss Properties. The benefits are considered medium and the cost is low (less than \$25,000). This CRS activity is feasible and has a priority of two.

7.B.3.11 Coordinate With Utility Providers To Install The Town's Electrical And Communication Infrastructure Underground In Areas Not Vulnerable To Flooding

The Town would like to coordinate with utility providers to install the Town's electrical and communication infrastructure underground in areas not vulnerable to flooding. This structure/infrastructure action type would reduce impacts of hazards on homes, businesses and institutions in severe weather. The benefits are medium and cost estimates are high (over \$500,000). This feasible action has a priority of two.

7.B.4 Goal 4 - Protect Environmental and Natural Resources.

The objectives for environmental and resource protection will help conserve resources that are important for preserving open space, plants, wildlife, fish, sensitive ecosystems and wetlands. Actions that protect and preserve open space and protect environmentally sensitive and critical areas are important for flood control. Depending on the location, actions proposed may involve a variety of measures such as vegetation management, acquisition of impacted properties and structures, redirecting flood water and other methods to restore natural features.

Hazard mitigation actions may require land-use planning and management of natural resources. Any measure proposed must have minimal adverse impact on the natural environment. Table 7-4 lists the proposed mitigation activities, objectives, priorities, hazards mitigated and the potential benefits to promote this goal.

Table 7-4. Goal 4: Proposed Activities to Protect Natural Resources and the Environment.

Action/Activity Strategy	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
1. Strengthen land-use and development regulations and Special Flood Hazard Areas ****	Planning	4.3 Incorporate hazard considerations into land-use planning and natural resource management.	Flooding	Town-wide	Medium	Medium	Low	
2. Coordinate with Westchester Co. to reduce brush fire hazards in conservation areas and parks	Natural	4.1 Protect and preserve open space and environmentally sensitive and critical areas.	Wildfire	Town-wide	Medium	Medium	Low	

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency – Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

7.B.4.1 Strengthen Land-Use And Development Regulations And Special Flood Hazard Area To Limit Future Development

This planning action strengthens land-use and development regulations and Special Flood Hazard Area (SFHA) to limit future development. The primary objective is to incorporate hazard considerations into land-use planning and natural resource management to mitigate Town-wide flooding. The benefits of this action are medium and the costs are low (less than \$25,000). It is feasible and has a priority of two.

7.B.4.2 Coordinate With Westchester Co. To Reduce Brush Fire Hazards In Conservation Areas And Parks

This action type is natural systems protection. The Town plans to coordinate with Westchester County to reduce brush fire hazards in conservation areas and parks. The primary objective is to protect and preserve open space and environmentally sensitive and critical areas Town-wide from wildfires. This feasible action has medium benefits and the costs are low (less than \$25,000). It has a medium priority of two.

7.B.5. Goal 5 - Involve the Community, Partners, and Stakeholders in Mitigation Measures.

Inter-jurisdiction and interagency communication and coordination need to be strengthened. Partnerships will enhance hazard mitigation projects. Since many downstream structures and people could be impacted in the Town of Mamaroneck, such projects require the cooperation of affected jurisdictions.

Additional engineering analyses and water course studies will likely be required and updated before a mitigation measure is implemented. Existing programs, projects or studies should be integrated into this Hazard Mitigation Plan. Agencies such as the U.S. Army Corps of Engineers and Westchester County Department of Planning need to be involved. Tables 7-5a and 7-5b list the proposed mitigation activities, objectives, priorities, hazards mitigated and the potential benefits to promote this goal.

Table 7-5a. Goal 5: Involve Community, Partners, and Stakeholders in Mitigation Measures.

Action/Activity Item	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
1. Draft a Town-wide Evacuation Plan	Planning	5.3 Coordinate mitigation planning with neighboring communities	All Hazards	Multi-jurisdictional	Medium	Medium	Low	
2. Establish a multi-jurisdictional Emergency Management Plan / Operation Center with Neighboring communities	Planning	5.1 Strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster Hazard mitigation actions and projects	All Hazards	Multi-jurisdictional	High	High	Low	
3. Participate in a multi-jurisdictional effort to secure a Fire Safety and Prevention Simulator and related public education materials	Education	5.1 Strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster Hazard mitigation actions and projects	Fire	Multi-jurisdictional	Medium	Medium	Low - Medium	
4. Coordinate with NYSDEC to conduct periodic in-depth inspections of the Sheldrake Dams. Expand on existing Dam Failure Contingency Plans	Planning	5.1 Strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster Hazard mitigation actions and projects	Dam Failure	Critical Facilities Multi-jurisdictional	High	High	Low	

*Action Type: **Planning** – Local Plans and Regulations **Structure** – Structure and Infrastructure Projects ***Priority:
Natural - Natural Systems Protection **Education** – Education Awareness Programs 1 – High 2 – Medium 3 – Low
Emergency – Emergency Response

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

Table 7-5b. Goal 5: Involve Community, Partners, and Stakeholders in Mitigation Measures.

Action/Activity Item	Action Type *	Primary Objective **	Hazards Mitigated #	Location	Priority ***	Benefits	Cost Estimate	Comments
5. Establish multi-jurisdictional protocols for response to increases in Dept. of Homeland Security Threat Levels.	Planning	5.1 Strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster Hazard mitigation actions and projects	Terrorism	Multi-jurisdictional	High	Medium	Low - Medium	
6. Study and begin a dredging project on the Sheldrake River, Larchmont Reservoir, and areas where streams converge ****	Natural Systems	5.3 Coordinate mitigation planning with neighboring communities	Flooding	Multi-jurisdictional	High	High	High	

*Action Type: Plans – Local Plans and Regulations Structure – Structure and Infrastructure Projects ***Priority:
Natural - Natural Systems Protection Education – Education Awareness Programs 1 – High 2 – Medium 3 – Low
Emergency – Emergency Response

**Activity may also meet other goals and objectives – see Table 6-2. Number for goal and objective from Table 6-1.

For primary hazards included see Page 7-2, Sect. 7.A.

**** These items are intended to aid the community with continued NFIP compliance.

7.B.5.1 Draft a Town-wide Evacuation Plan

The Town will draft a Town-wide Evacuation Plan as a planning action type. They will coordinate mitigation planning of all hazards with neighboring communities and Westchester County. This multi-jurisdictional activity has medium benefits at a low cost of less than \$25,000. It is feasible and has a priority of two.

7.B.5.2 Establish A Multi-Jurisdictional Emergency Management Plan / Operation Center With Neighboring Villages, Towns And County

This is a planning activity which will establish a multi-jurisdictional Emergency Management Plan / Operation Center with neighboring villages, towns and Westchester County. Its objective is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects. This action would have high benefits with low costs of less than \$25,000. It has a high priority of one.

7.B.5.3 Participate In A Multi-Jurisdictional Effort To Secure A Fire Safety And Prevention Simulator And Related Public Education Materials

This activity item is part of an education awareness program to participate in a multi-jurisdictional effort to secure a Fire Safety and Prevention Simulator and related public education materials. The objective is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects with a focus on fire safety and prevention. The benefits are medium and costs low to medium (\$25,000 to \$50,000). This has a medium priority of two.

7.B.5.4 Coordinate With NYSDEC To Conduct Periodic In-Depth Inspections Of The Sheldrake Dams. Expand On Existing Dam Failure Contingency Plans

In this planning action the town will coordinate with NYSDEC to conduct periodic in-depth inspections of the Sheldrake Dams and expand on existing Dam Failure Contingency Plans. This objective will strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects. The hazard of concern is the effect of dam failure on critical facilities. The benefits are high and costs low (less than \$25,000). This CRS activity has a high priority of one.

7.B.5.5 Establish Multi-Jurisdictional Protocols For Response To Increases In Dept. Of Homeland Security Threat Levels

The objective of this planning action is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects to counter terrorism. This action has a medium benefit at a low to medium cost (\$25,000 to \$50,000) and has a high priority of one.

7.B.5.6 Study And Begin A Dredging Project On The Sheldrake River, Larchmont Reservoir, And Areas Where Streams Converge

This natural systems action is to study and dredge the Sheldrake River, Larchmont Reservoir, and areas where streams converge. This CRS activity will coordinate flood mitigation planning with neighboring communities. This feasible action has a high priority of one and high benefits. The cost estimate is high (\$500,000 to \$1,000,000).

Section 8 – Draft Action Plan

8.A Introduction

This Draft Action Plan summarizes mitigation strategies applicable to the Town of Mamaroneck’s potential hazards identified in Section 4, and the vulnerable properties and populations discussed in Section 5. The Action Plan provides a process for implementing the mitigation activities that were identified in Section 7 (See Tables 7-1 to 7-5) based on the goals and objectives discussed in Section 6. The action items recommended in this plan focus on hazards due to flooding and severe storm events discussed in Sections 4 and 5. This Action Plan proposes mitigation activities that provide interoperability and compatibility among Federal, State and local capabilities and improves coordination and cooperation between public and private entities in a variety of hazardous incident management activities as required by FEMA under the NIMS. The priorities established in Section 7 assure that the most serious problems with cost effective solutions are addressed as soon as possible. The Hazard Mitigation Planning Committee also considered several other hazards that are of concern. The recommended actions were reviewed with the Town administration and the Planning Committee and presented to the public.

Criteria for acceptable mitigation actions and priorities

The proposed mitigation actions in Section 7.B meet FEMA’s criteria for developing mitigation actions and priorities. (See Sections 6.A and 7.A.) The criteria include activities that are

- Socially acceptable to the community,
- Technically feasible,
- Protective of or beneficial to the environment,
- Backed by legal authority,
- Consistent with current laws and
- Consider economic benefits and costs.

Current community needs were also considered which are acceptable to political decision makers, town representatives, stakeholders, and the public.

This Action Plan identifies tasks that will be implemented first and outlines a strategy for implementation of each item. This Section discusses the components of the Action Plan:

- Type/ Priority Order
- Action Item
- Relative Cost Benefit/Objectives
- Lead/Administrative Responsibility
- Resources
- Schedule/Duration
- Source of Funding

Many proposed activities are dependent on funding from County, State or Federal grants. (See Table 8-1.) Some activities may require the involvement of Westchester County, several New York State agencies, various Federal agencies, private stakeholders and civic organizations as discussed in Section 3. Some of these proposed actions require more than a year to complete. Some projects may have already started or are in early planning stages which have been integrated into this plan where applicable. Some projects may require multi-jurisdictional cooperation and funding.

The proposed items and priorities can change over time as new information or funding becomes available. There may be a change in priorities due to availability of town resources, community sentiment or availability of funding. Some activities may gain or lose political or community support.

This Action Plan, therefore, is a working document, which is expected to change in response to varying conditions and needs. The activities are summarized in Tables 8-2 through 8-4 in the order of their implementation. In the near-term the focus will be on implementation of priority 1 items in Table 8-2. Priority 2 and 3 items will be evaluated each year and implemented as

funding and resources become available. Updating the Plan and evaluating priorities will be done as items are completed or priorities change as described in Section 10.

8.B Administrative Responsibility for Action Items

Following review and approval by FEMA, the Town Board must approve the Multi-Hazard Mitigation Plan before it can be implemented. This process is documented above in Section 9. This Plan will be implemented and administered by the Town of Mamaroneck through the Town Administrator who reports to the Town Supervisor and Town Board. Various Town departments will be responsible for administering the proposed mitigation activities. (See Figure 1-3 Town Organization Chart and www.townofmamaroneck.org/departments.html) Depending on the type, scope, funding and staff resources needed for a project and funding, a specific Town department or a hired consultant may implement a specific project. In some cases, the Town Administrator may appoint a qualified staff member who will have the authority to administer one or more of the proposed mitigation activities. A management plan consisting of a detailed scope of work, cost plan, work breakdown, task responsibilities and project schedule will be prepared for each project as an amendment to this Plan. In some cases, a project may consist of more than one related activity.

The Town administrator will coordinate with town departments, the Hazard Mitigation Committee (HMC), the Emergency Management Committee (EMC), neighboring jurisdictions, stakeholder agencies and organizations, community groups and funding agencies. All completed action items will be done in accordance with the scope of work, regulatory requirements, planned schedule and budget. The Town Administrator will be responsible for approval and expenditure of project funds. The Multi-Hazard Planning Committee and the Town Board will monitor the progress, accomplishments and budgets of the projects as described in Section 10 of this Plan.

Five categories of mitigation activities are included as “Action Type” in Tables 8-2 through 8-4. The type of action will in part define the type of technical and administrative team required to implement and supervise a project. These categories were discussed in detail in Section 7.A.2 and include:

- Local Plans and Regulations
- Structure and Infrastructure Projects
- Natural Systems Protection
- Education and Awareness Programs
- Emergency Response

8.C Action Plan Priority Groups

The primary strategy for implementing the Plan is to follow the proposed priorities. The activity items in this Plan were organized into three priority groups in Section 7.A.4. The priorities, 1 (high), 2 (medium) and 3 (low) were approved by the Planning Committee. A priority is associated with each action item as shown in Tables 8-2 through 8-4. As the Plan is implemented these priorities may change and be reevaluated based on availability of funding, new information, future community needs and support, stakeholder support, workloads in specific departments and availability of staff resources.

The implementation of “Priority-Order” in Tables 8-2 through 8-4 is a tentative order for the start and implementation of an activity within a priority group. The final order will depend on staff availability, funding, other scheduled activities and/or relative importance of completing a task in a given year. It is advisable to spread the work among the different departments so that one group such as the Building Department is not overloaded in a given year.

The schedules listed in Tables 8-2 through 8-4 are general and flexible given the uncertainties in available funding resources. (See Section 8.D below.) Thus the year and duration of an activity do not include specific start or end dates. In the text for each activity the general time of year for starting and completion is given. Detailed schedules will be provided when detailed scopes of work or specifications are prepared for each activity.

Social, Technical, Administrative, Political, Legal, Economic and Environmental considerations were applied to all of the activity items in Section 7. Funding and available resources were important considerations for setting implementation order. Actions that can be done using available resources or having identified sources of funds have a higher preference. Action items requiring time for procurement of internal or external funds and staff resources would likely be

planned for a future time and have a lower priority of urgency but should not be considered as less important in achieving a goal or objective.

High priority activity items emphasize high benefits relative to the costs of the project. Benefits and costs for each of the proposed actions are given in Section 7.B. Due to the preliminary nature of the activity costs and qualitative assessment of benefits, qualitative judgments of costs vs. benefits were made. For example, the higher priority tasks are those that can be done with low costs relative to high benefits received (e.g. Prepare a Comprehensive Evacuation Plan). Projects having high costs and high benefits (e.g. Storm Drainage Control) would have a lower priority because of the high costs, and length of time to complete the project. Items such as the assisting in a New York City evacuation plan, which have few significant long-term mitigation benefits to the community, would be given a lower priority.

Future updates to this plan will utilize more detailed cost benefit evaluation. These assessments will consider FEMA Guidance 386-5, *Using Benefit Cost Review in Mitigation Planning*.

(www.fema.gov/plan/mitplanning/resources.shtm)

8.D Capabilities and Resources

The Town of Mamaroneck will have the responsibility, jurisdiction, capability and authority to administrate and implement most of the mitigation activities proposed below.

(http://www.townofmamaroneck.org/administrator/assets/2009_annual_report.pdf)

Various volunteer boards and Commissions will provide input and oversight for several projects.

Town departments that will administer and or implement a mitigation activity include:

- Town Administrator
- Fire Department (FD)
- Police Department (PD)
- Building and Plumbing Department
 - *Code Enforcement*
 - *Land Use and Zoning*
 - *Building Permits*
 - *Inspections*
 - *Erosion Control Permits*
 - *Various Permits, Reviews and Applications*
- Highway and Engineering Department

- *Road Maintenance*
- *Park Maintenance*
- *Sanitary and Storm Sewer Maintenance*
- *Streetlights, Signs and Tree Maintenance*
- **Ambulance District**
 - *Emergency Response*
 - *Ambulance Service*
 - *Community Emergency Response Team*
 - *Emergency Medical Services*
- **Conservation Department**
- **Community Services and Housing**
- **Boards and Commissions (Volunteer Committees)**
 - *Hazard Mitigation Committee (HMC)*
 - *Emergency Management Committee (EMC)*
 - *Coastal Zone Management Commission*
 - *Planning Board*

In some instances a neighboring community or other agency may have jurisdiction that requires a joint Memorandum of Understanding to implement an activity. The Town official in charge of a project will be responsible for interfacing with the public and appropriate neighboring jurisdictions, the County, USACE, NYS OEM, FEMA or other agencies identified in Section 3. Responsible officials for the town that may administer these projects are shown in Figure 1-3 in Section 1.

In several cases, the town does not have the financial or human resources to prepare the plans, studies, and engineering designs or to implement public outreach and construction required for many of the activities proposed. Therefore, external agency funding for consultants, engineers and contractors may be needed to successfully implement this Hazards Mitigation Plan.

8.E Funding Strategy and Sources

Estimating costs for the mitigation actions was discussed in Section 7.A.3. Best professional judgment and experience was used to provide an approximate cost for each action proposed. Some costs are included in the annual Town budget and require approval of the Town Board. Many of the proposed projects however, will need to be funded through Federal, State or County grants. The cost estimates are assumed to have a +/- error of 25%. The minimum costs for a

project was assigned a value of \$25,000. Many activities can be done using in-house resources or supported by a consultant.

Available and potential funding sources were reviewed from the State Hazard Mitigation Plan and Web Pages of the various funding agencies. Summaries of major funding sources that are available to the Town of Mamaroneck are listed in Table 8-1. Identifying specific sources of funding for each activity in Table 8-2 through Table 8-4 is tentative and complex. There are numerous agency programs (Table 8-1) and these change each year depending on legislative appropriations, new regulations and laws, competition for funds and agency priorities. The funding sources identified are not a guarantee for that source or for a particular time frame.

Table 8-1 identifies Federal and State agencies that fund activities proposed in mitigation plans. The most significant source of funds is from FEMA. These are obtained through grant applications administered through NYS OEM. Westchester County has a grant bonding program for Hazard Mitigation Assistance grants. Several other agencies are identified that provide funding for related environmental, capital construction, dredging, and engineering projects.

The Town will provide funding support for those projects that are recommended. For example the Town Board may appropriate a capital improvement budget for upgrading or retrofitting town-owned critical facilities. Specific operating budgets such as the Highway and Building Departments can include supply costs, salaries and consultant fees to complete some mitigation activities. Existing staff time can be used as “in-kind” match to Federal or State funding. Community volunteers can contribute effort to certain activities such as serving on committees or review of plans and documents.

8.F Mitigation Action Implementation

The proposed mitigative actions were summarized in Section 7 and the plans for implementing them are discussed below for each of the three priority groups identified. The following activity summaries and tables provide information for each action which includes:

- Priority order of each action item,

- Relative benefit
- Approximate costs,
- Lead administrative responsibility,
- Approximate schedule, duration or time frame
- Possible funding sources
- Resources needed to complete the work.

Table 8-1. Potential Funding Sources for Mitigation Activities.

Federal, Funding Sources		
Program	Description	Agency Reference/Contact*
Flood Mitigation Assistance (FMA)	Provides grants to States and communities for pre- disaster mitigation planning and projects to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program. Aimed to reduce repetitive losses.	FEMA Through NYS OEM http://www.fema.gov/about/divisions/mitigation/mitigation.shtm http://www.NYS OEM.state.ny.us/programs/mitigation/
National Flood Insurance Program	Formula grants to States to assist FEMA communities to comply with NFIP floodplain management requirements (Community Assistance Program).	FEMA http://www.fema.gov/business/nfip/
Hazard Mitigation Grant Program (HMGP)	Provides grants to States and communities for planning and projects providing long-term hazard mitigation measures following a major disaster declaration. Projects are to reduce risks to lives and properties from natural hazards. Enables mitigation measures to be implemented during recovery form a disaster. Projects may include acquiring, retrofitting or relocating structures; constructing localized flood controls; or constructing safe rooms.	FEMA Through NYS OEM http://www.fema.gov/about/divisions/mitigation/mitigation.shtm http://www.fema.gov/government/grant/hmgp/ http://www.NYS OEM.state.ny.us/programs/mitigation/
Pre-Disaster Mitigation (PDM) Competitive Grant Program	Grants to States and communities for planning and projects that provide long-term hazard disaster mitigation measures prior to an event.	FEMA Through NYS OEM http://www.fema.gov/about/divisions/mitigation/mitigation.shtm http://www.fema.gov/government/grant/pdm/ http://www.NYS OEM.state.ny.us/programs/mitigation/
National Dam Safety Program	Technical assistance, training, and grants to help improve State dam safety programs. .	FEMA http://www.fema.gov/plan/prevent/damfailure/ndsp.shtm
National Earthquake Hazards Reduction	Training, planning and technical Program assistance under grants to States or local jurisdictions	FEMA; DOI-US Geological Survey (USGS) Earthquake Program Coordinator: (703) 648-6785 http://www.nehrp.gov/
Disaster Housing Program	Emergency assistance for housing and mortgage and rental assistance. (MRA). Covers disaster-related needs and necessary expenses not covered by insurance. These may include replacement of personal property, and transportation, medical, dental and funeral expenses. Loans are also available for property loss and economic injury.	FEMA http://www.fema.gov/hazard/dproc.shtm
Public Assistance Program (Infrastructure)	Grants to States and Communities to repair damaged infrastructure and public facilities and help restore services following disasters. Mitigation funding is available for work related to damaged components of the eligible building or structure.	FEMA via NYS OEM http://www.fema.gov/government/grant/pa/index.shtm
Repetitive Flood Claims (RFC)	Reduction or elimination of flood damage under the NFIP that have one or more claims. Acquisition, demolition or relocation of severe repetitive loss properties.	FEMA Through NYS OEM http://www.fema.gov/government/grant/rfc/

* Web site addresses as of November 2013. For changed address or additional sources conduct a search on the listed agency’s home page, or <http://www.grants.gov/> or search <http://www.google.com>

Table 8-1. (Continued) Potential Funding Sources for Mitigation Activities.

Program	Description	Agency Reference/Contact*
Clean Water Act Section 319 Grants	Grants to States to implement non-point source programs, including support for non- structural watershed resource restoration activities.	EPA Office of Water Chief, Non-Point Source Control Branch (202) 260-7088. 7100
Emergency Watershed Protection (EWP)	Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazards.	USDA –NRCS National Office -(202) 690-0848 Watersheds and Wetlands Division: (202) 720-3042
Disaster Mitigation Planning and Technical Assistance	Technical and planning assistance grants for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces.	Department of Commerce (DOC), Economic Development Administration (EDA): (800) 345-1222 www.eda.gov/InvestmentsGrants/Investments.xml
Disaster Recovery Initiative	Grants to fund gaps in available recovery assistance after disasters (including mitigation)	Housing and Urban Development (HUD) Community Planning and Development Grant Programs Divisions in their respective HUD field offices or HUD Community Planning and Development: 202-708-2605
Section 108 Loan Guarantee	Enables states and local governments participating in the Community Development Block Grant (CDBG) Program to obtain federally guaranteed loans for disaster distressed areas.	HUD Office of Community Planning and Development Grant Programs 202-708-3587
Section 205 of the 1948 Flood Control Act	Resources for small flood damage reduction projects	DOD-US Army Corps of Engineers (ACE) Emergency Management contact in USACE field office
Post Disaster Economic Recovery Grants and Assistance	Grant Funding to assist with the long-term economic recovery of firms, industries and communities adversely affected by disasters.	Department of Commerce (DOC) - Economic Development Administration (EDA), EDA Headquarters, Disaster Recovery Coordinator 202-482-6225
School Renovation, Idea and Technology Grant	Grant funding for eligible school renovation and emergency response measures.	US Department of Education
Public Housing Modernization Reserve for Disasters and Emergencies	Funding to Public housing agencies for modernization needs resulting from natural disasters (including elevation, flood proofing and retrofits)	Housing and Urban Development (HUD) Director, Office of Capital Improvements 202-708-1640
Surface Transportation Program	Funding for safety and transportation enhancements. Enhancements include a broad range of safety education, environmental and historically related activities.	US Department of Transportation (DOT) Federal Highway Administration FHWA
Wetlands Reserve Program	Financial and technical assistance to protect and restore wetlands through easements and restoration agreement	USDA – NRCS National Policy Coordinator NCRS Watersheds and Wetlands Division 202-720-3042
Physical Disaster Loans and Economic Injury Disaster Loans	Disaster loans to non-farm, private sector owners of disaster damaged property for uninsured losses.	Small Business Administration (SBA) National Headquarters Associate Administrator for Disaster Assistance: (202) 205-6734
National Estuary Program Long Island Sound Preservation (LIS Stewardship Commission)	Established by Congress in 1987 to improve the quality of estuaries of national importance. For LIS, implementation priorities are habitat restoration, watershed management, disposal of dredged materials, and public education and involvement on Long Island Sound issues.	Environmental Protection Agency (EPA) National Estuary Program

Table 8-1. (Continued) Potential Funding Sources for Mitigation Activities.

New York State Funding Sources		
Program	Description	Agency Reference/Contact*
NY State Emergency Management Office (NYS OEM)	Funding for mitigation planning and project activity through FEMA. See items under Federal funding sources.	New York State Office of Emergency Management (OEM) www.dhSES.ny.gov/grants/
Appropriations through the Governor's Office	Funding for mitigation planning and project activity through special appropriations through the Governor's Office	New York State Office of the Governor
Environmental Protection Fund	Funding to support many of the State's environmental needs. Including development and mitigation related planning initiatives and acquisition projects for conserving open.	New York State Department of State (DOS), Department of Environmental Conservation (DEC), Office of Parks Recreation and Historic Preservation (OPRHP)
Hudson River Estuary Grants Program	Grants available to municipalities located within the geographic boundaries of the Hudson River Estuary and associated shore lands. Grants for education projects; open space planning, inventory and acquisition, or river access; community conservation and river stewardship; watershed planning.	Hudson River Valley Greenway Albany, 12224 (518) 473-3835 Email: hrvg@hudsongreenway.state.ny.us http://www.hudsongreenway.state.ny.us/funding/funding.htm
Empire State Flood Recovery Grant Program	Loans for various projects. Discounted Small Business Loans; Small Business Loans/Lines of Credit.	Empire State Development Corporation 633 Third Avenue New York, 10017 (800) 782-8369
Westchester Co. Flood Task Force Grant Bonding		Westchester Co. Flood Action Task Force planning.westchestergov.com/flood-action-task-force
New York State Office of Homeland Security Grants	Supports projects for emergency response, terrorism and other Homeland Security activities.	Office of Homeland Security, Albany 518-402-2227 www.security.state.ny.us/grants.html https://grants.security.state.ny.us/AccessNotice.jsp
New York State Historic Preservation Grant Program	Funds are available from the Environmental Protection Fund of 1993(EPF) for acquisition, development, and improvement of parks, historic properties and Heritage Area resources. Preservation projects may include restoration, preservation, rehabilitation, protection, reconstruction or archeological interpretation of a historic property.	New York State Historic Preservation Office nysparks.state.ny.us/shpo/grants/
Local Waterfront Revitalization Program	Community improvements through planning, preservation and redevelopment of important waterfront resources and brownfields. Assistance includes Environmental Protection Fund and Quality Communities Grant Program.	New York State Department of State (DOS) Division of Coastal Resources http://nyswaterfronts.com/grantopps.asp

* Web site addresses as of November 2013. For changed address or additional sources conduct a search on the listed agency's home page, or <http://www.grants.gov/> or search <http://www.google.com/>.

Each action item will be administered and managed by the Town’s Administrator Office or a Lead Department designated by the Administrator. (See Section 8.D above and Figure 1-3.) The Town Administrator will be the primary contact for projects involving neighboring jurisdictions such as the Village of Larchmont and the Village of Mamaroneck. Where in-house Town resources are limited, a consultant or contractor may be hired to implement the project under a lead Town supervisor or Lead Department. The Town Administrator or designee will have overall responsibility for managing and implementing the items in this Hazard Mitigation Plan.

Schedules will be prepared to identify key tasks and milestones. The Time Frame proposed in this plan should be viewed as a recommendation and will be modified once the scope of work is detailed and funding is approved. Any FEMA funded projects are not likely to be started earlier than several months following submittal of the FEMA approval of this Hazard Mitigation Plan. Town budgeted actions can begin as soon as approval of the Town Board is obtained.

The availability of resources and funding will be a factor in determining when the project can be completed. Costs will be updated to reflect any increased or decreased. The project status will be updated quarterly as the program progresses. The funding received depends on the grants available at the time. Therefore, the funding sources listed in Tables 8-2, 8-3 and 8-4 are suggested sources and may change with time and an agency’s budget. Table 8-1 can serve as a potential resource of funding.

The “Priority” listed in each Table is a proposed implementation sequence for the start of an action. Information for each activity and its primary goal and objective is given in Section 7.B. The total estimated cost for priority 1, 2 and 3 action items is given at the bottom for each priority. Priority one items in general will be implemented first where feasible.

Program management tasks will be the responsibility of the Town Administrator and will be reviewed regularly by the Town board. Additional reviews by Town Volunteer Boards and Commissions may be required for oversight and review. Day to day supervision of activities, actions and projects will be performed by qualified supervisory staff assigned by the Town

Administrator. Figure 8-1 shows the administrative and management organization for the Town.

8.F.1 Implementation of Priority 1 Mitigation Actions

Group 1-priority action items are listed in Table 8-2. These items have a high benefit relative to costs and a high need to be implemented. Several actions are easily implemented, have readily obtainable resources and available funding. Some of these activities may need to be completed prior to starting other activities. The “Priority Order” in Table 8-2 is a tentative implementation order for the start of an action. Other information can be found for each activity and goal in Section 7.B in discussions associated with Tables 7-1 through 7-6. The total estimated cost for these 16 Priority 1 items ranges from a low of \$1,165,000 to a high of \$2,675,000.

8.F.1.1 Upgrade Existing Storm Water Management Plans

Upgrading existing storm water management plans is a planning action for improving the storm water collection and drainage system and is intended to reduce flooding hazards Town-wide. An updated plan is very effective for preventing property loss due to flooding. The Plan content includes mitigating losses in repetitive flood areas, inspecting/maintaining drainage systems, and processes for acquiring, relocating or retrofitting flood prone structures. Updating the plan is a credited Community Rating System (CRS) activity. It is also intended to aid the community with continued NFIP compliance. The upgraded plan has a high priority and high benefits for a low cost of less than \$25,000 in Town support and \$50,000 in consultant fees for a total of \$75,000. This activity is also considered under the Federal and State requirements known as Stormwater Phase II permits for Municipal Separate Storm Sewer Systems (MS4).

This project would need additional funding with public money. An independent consultant would be hired to supplement efforts by Town’s public works employees. Flood mitigation planning grants should be sought out from County, State and Federal agencies in cooperation with neighboring communities.

The Town Highway and Engineering Department will have the lead administrative responsibility and funding would be authorized from the Town budget for planned Town costs and consultant

costs. This activity would be done within one year following authorization of internal and consultant resources.

Table 8- 2a. Priority 1 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority-Item***	Action Item **	Benefits	Cost per \$1,000	Lead/Administrative Responsibility ****	Schedule / Duration	Funding Sources
Planning	1-1	Upgrade existing storm water management plans	High	\$75	Highway Dept.	Complete in 1 year	Town Budget & FEMA/County grants
Structure	1-2	Install automated spillway valve control and stream level monitoring	High	\$500 - \$1,000	Highway Dept.	6 mos. following funding	FEMA, State or County Grant
Planning	1-3	Involve home and business owners in a program to flood-proof their basements and other areas of their building that flood	High	\$25	Building Dept.	1 year following funding	Town Budget
Structure	1-4	Improve stormwater management by updating obsolete stormwater drainage infrastructures	High	\$100 - \$500	Highway Dept.	1 year following funding	NYS DEC or County Grant
Structure	1-5	Replace/upgrade Town-owned sewage pump stations	High	\$100 - \$500	Highway Dept.	1 year following funding	FEMA or NYSDEC
Planning	1-6	Develop, implement and manage the Town Community Rating System (CRS)	High	\$25 - \$50	Hazard Mitigation Committee (HMC)	1 year after Plan approval	Town Budget
Education	1-7	Town-wide public education and awareness campaign on hazard mitigation and All-Hazard emergency preparedness	High	\$25	Emergency Management Committee (EMC)	1 year following funding	Town Budget

*Action Type: **Planning** – Local Plans and Regulations
Natural - Natural Systems Protection
Emergency – Emergency Response

Structure – Structure and Infrastructure Projects
Education – Education Awareness Programs

***Priority:
 1 – High 2 – Medium 3 – Low

** Action Item – See Section 7 for details.

**** May include other Department Services listed in Section 8.D.

Table 8- 2b. Priority 1 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority-Item***	Action Item **	Benefits	Cost per \$1,000	Lead/Administrative Responsibility****	Schedule / Duration	Funding Sources
Emergency Response	1-8	Install a VHF radio repeater system for TMAD and VAC	High	\$25 - \$100	Emergency Management Committee (EMC)	1 year following funding, end 6 mos.	FEMA
Emergency Response	1-9	Provide Emergency Operations training to Town, School Emergency Services, Red Cross and Law Enforcement staff	High	\$25	Emergency Management Committee (EMC)	Begin after Plan approval, annually	Town Budget
Planning	1-10	Draft emergency services plans for hazardous materials sites	High	\$25	Emergency Management Committee (EMC)	1 year following Plan approval	Town Budget
Emergency Response	1-11	Obtain emergency traffic control devices such as message boards, Jersey barriers and portable signs	High	\$25 - \$100	Highway Dept.	1 year following funding	FEMA
Planning	1-12	Purchase and install a GIS Mapping Program	High	\$115 - \$125	Town Administrator (Joint Project, see note below#)	6 months following funding	Combination of Town Budget and Co., State and Federal grants
Planning	1-13	Obtain and increase, Fire Sprinkler ordinances and alarm systems	High	\$25	Fire Dept.	Begin 2 Years after approval, complete 1 yr.	FEMA NYS OEM

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects ***Priority: **1 – High 2 – Medium 3 – Low**
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency – Emergency Response

** Action Item – See Section 7 for details. **** May include other Department Services listed in Section 8.D.
 # Joint effort with Village of Mamaroneck and Westchester Joint Water Works (WJWW). Town-Shared cost.

Table 8- 2c. Priority 1 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority-Item***	Action Item **	Benefits	Cost per \$1,000	Lead/Administrative Responsibility ****	Schedule / Duration	Funding Sources
Planning	1-14	Conduct a discrete confidential evaluation of potential targets and security measures at critical and high risk locations	High	\$25	Emergency Management Committee (EMC) & Police Dept.	Begin 1 year after Plan approval, finish 1 yr.	FEMA
Planning	1-15	Establish a multi-jurisdictional Emergency Management Plan / Operation Center with Neighboring communities	High	\$50	Emergency Management Committee (EMC) and Villages of Mamaroneck and Larchmont	Begin 1 year after Plan approval, finish 1 yr.	FEMA
Planning	1-16	Coordinate with NYSDEC for periodic in-depth inspections of the Sheldrake Dams. Expand on existing Dam Failure Contingency Plans	High	\$25	Building Dept. Highway Dept. Engineer	Begin 2 years after approval, complete 1 yr.	NYS OEM NYSDEC

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects ***Priority:
Natural - Natural Systems Protection Education – Education Awareness Programs 1 – High 2 – Medium 3 – Low
Emergency – Emergency Response

** Action Item – See Section 7 for details. **** May include other Department Services listed in Section 8.D.
 # Joint effort in progress with Village of Mamaroneck and Westchester Co. Joint Water Works (WJWW). Town Shared cost.

8.F.1.2 Install Automated Spillway Valve Control and Stream Level Monitoring

This action type is a structure and infrastructure project which would control flooding from rivers. This multi-jurisdictional activity involves the Repetitive Loss Properties in neighboring Towns and Towns and has a high priority, high benefit and a high cost.

The Highway Department will have administrative responsibility for this action with assistance from the Building Department. It has a high cost estimate of \$500,000 to \$1,000,000. Funding would need to be obtained from Federal, State or County grants. The project would have a high benefit in controlling floods. The project would be completed within 6 months of award of the grant.

8.F.1.3 Involve Home and Business Owners in a Program to Flood-Proof their Basements and Other Areas of their Building that Flood

This Planning activity will help prevent flooding of buildings from coastal waters, rivers and streams. It is a CRS activity for Special Flood Hazard Areas (SFHA) and Repetitive Loss Properties. It is also intended to aid the community with continued NFIP compliance. This activity has a high priority, high benefit and a low cost.

The Building Department will have administrative responsibility for this action. The activity has an estimated cost of \$25,000. Funding would be obtained from the Town budget with the approval of the Town board. The project would have a high benefit in controlling floods. The project would be completed within one year of the project's approval.

8.F.1.4 Improve Stormwater Management by Updating Obsolete Stormwater Drainage Infrastructures

This infrastructure action is intended to improve the stormwater collection and drainage Town-wide and to mitigate flooding. This project is given a high priority with high benefits and medium high costs of \$100,000 to \$500,000. This action strategy is a CRS activity. It is also intended to aid the community with continued NFIP compliance. Aspects of this action will require MS4 reporting compliance for the NYSDEC.

The Highway Department will have lead responsibility for this project. The project would be completed within one year of the project's funding. A grant would need to be obtained from NYSDEC or County resources.

8.F.1.5 Replace/Upgrade Town-owned Sewage Pump Stations

Replacing and upgrading Town-owned sewage pump stations is structure/infrastructure project which would correct storm and sanitary sewer backup problems from floods. It has a high priority with high benefits at a medium-high cost. The Highway Department will have lead responsibility for this project which is expected to cost about \$100,000-\$500,000 and take about a year to complete. It will require funding resources through a FEMA or NYSDEC grant.

8.F.1.6 Develop, Implement, and Manage the Town Community Rating System.

This activity is intended to develop, implement and manage the Town Community Rating System (CRS). It is also intended to aid the community with continued NFIP compliance. To become a member of the Community Rating System, the Town must file required CRS documentation and establish an accurate inventory of Repetitive Loss Properties. Other activities include public information on reducing flood hazards and purchasing flood insurance, mapping and regulations, flood damage reduction and early warning and response programs to protect life and property. This action has a high priority with high benefits at a medium low cost between \$25,000 and \$50,000.

The lead responsibility would be the Town's Hazard Mitigation Committee (HMC). In-house resources including the Highway and Building Departments will be used to implement this activity using Town Board approved funding. This activity will take about one year to complete.

8.F.1.7 Town-Wide Public Education and Awareness Campaign on Hazard Mitigation and All-Hazard Emergency Preparedness

The focus of this action type is public education with the objective of enhancing community awareness of emergency procedures. This Town-wide effort covers all hazards. The Town has given this action a high priority with a high benefit for a low cost of \$25,000 which could come from the Town budget with Board approval. Services can be provided by Town staff. The

Emergency Management Committee (EMC) will serve as the Lead/Administrator. The project will take approximately 1 year following funding.

8.F.1.8 Install a VHF Radio Repeater System for TMAD and VAC

Installing a VHF radio repeater system for the Ambulance District and Volunteer Ambulance Corps is an emergency action type covering all hazards. Its objective is to maintain, enhance and ensure the efficient operation of early warning, notification and communication systems. This multi-jurisdictional activity has a high benefit at a medium cost (\$50,000 - \$100,000) and is a highly feasible activity. Based on the feasibility, benefits and costs, this activity is given a priority of one.

The Lead/Administrative responsibility will be the Emergency Management Committee (EMC). Outside resources will include a contractor for installing the electronic equipment. The work will begin one year after funding and be completed within six months. Funding will be requested from FEMA.

8.F.1.9 Provide Emergency Operations Training to Town, School Emergency Services, Red Cross, and Law Enforcement Staff

This emergency response activity is intended to provide emergency operations training to Town employees, schools, emergency services, Red Cross and law enforcement staff. This activity is for all hazards Town-wide, especially for critical facilities. The benefit of this activity is high and the cost is low (\$25,000).

The Lead/Administrative responsibility will be the Emergency Management Committee (EMC). This action will begin after the Plan is approved and will be repeated annually. Funding will be from the Town Budget pending Board approval.

8.F.1.10 Draft Emergency Services Plans for Hazardous Materials Sites

An emergency services plan for hazardous materials sites will aid in more effective response to an incident at a site. This planning action type will help to develop, integrate and/or enhance emergency action plans for hazardous materials facilities. It will prevent and/or reduce property damage and injury due to HAZMAT spills/releases. It has a high priority of one, a high benefit,

a low cost of less than \$25,000 and is highly feasible. The Lead /Administrative responsibility will be the Emergency Management Committee (EMC). This action will take about one year following Plan approval. Funding will be from the Town Budget pending Board approval.

8.F.1.11 Obtain Emergency Traffic Control Devices such as Message Boards, Jersey Barriers and Portable Signs

Emergency traffic control devices such as message boards, Jersey barriers and portable signs, are an aid in responding to all hazards emergencies Town-wide. The primary objective of this action is to maintain, enhance and ensure efficient operation of early warning notification and communication systems. The activity is highly feasible, with a high benefit and medium cost (\$50,000 - \$100,000). It has been given a high priority of one.

The Lead/Administrative responsibility will be the Highway Department. The schedule/duration for this action item will be one year following funding from FEMA.

8.F.1.12 Purchase and Install a GIS Mapping Program

A GIS Mapping Program will help track and map flood-prone areas and locations of critical facilities Town-wide. It will assist in managing all hazard impacts through planning. Mapping and regulations provide increased protection to new development. Activities include mapping areas not shown on FIRM maps, preserving open space and enforcing higher regulatory standards, protecting natural flood plain functions and managing storm water. It has a high benefit and a low to medium cost of about \$115,000 to \$125,000. It is a highly feasible action with high priority of one.

8.F.1.13 Obtain and Increase Fire Sprinkler Ordinances and Alarm Systems

The Town needs to strengthen Fire Sprinkler ordinances and alarm systems in public buildings, critical facilities, historical sites, new and renovated structures and apartment buildings. This Town-wide planning action type would protect critical facilities, buildings, and infrastructure Town-wide from damage and loss due to fire. The benefits of this feasible action are high and the costs are low (less than \$25,000). It has a high priority of one.

The Lead/Administrative responsibility for this activity is the Fire Department. This activity will begin two years after the Plan is approved and be completed within a year. Funding will be requested from FEMA and NYS OEM.

8.F.1.14 Conduct a Discrete Confidential Evaluation of Potential Targets and Security Measures at Critical and High Risk Locations

This planning action is to conduct a discrete evaluation of potential targets and security measures at critical and high risk locations around the Town. The primary objective is to protect critical facilities, buildings, and infrastructure from damage and loss due to terrorism. This highly feasible strategy has a high benefit at a low cost (\$25,000). It has a high priority of one.

The EMC and Police Department will have the administrative responsibility for this action. It will begin one year following Plan approval and finished in one year pending a FEMA grant.

8.F.1.15 Establish a Multi-jurisdictional Emergency Management Plan/Operation Center with Neighboring Communities

This is a planning activity which will establish a multi-jurisdictional Emergency Management Plan/Operation Center with neighboring towns and villages. Its objective is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects. This action would have high benefits with low costs of less than \$50,000. It has a high priority of one.

EMC and the Town Administrator will have the responsibility to interface with the Villages of Mamaroneck and Larchmont. The action will begin one year after Plan approval and finish in one year pending FEMA funding.

8.F.1.16 Coordinate with NYS DEC to Conduct Periodic In Depth Inspections of the Sheldrake Dams. Expand on Existing Dam Failure Contingency Plans

In this planning action the town will coordinate with NYSDEC to conduct periodic in-depth inspections of the Sheldrake Dams and expand on existing Dam Failure Contingency Plans. This objective will strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects. The hazard of concern is the effect

of dam failure on critical facilities. The benefits are high and costs low (\$25,000). This CRS activity has a high priority of one.

The Administrative responsibility will be the Building Department and the Highway Department Engineer. The activity will begin two years after the Plan is approved and be completed within one year. Funding will be requested from NYS OEM and NYSDEC.

8.F.2 Implementation of Priority 2 Mitigation Actions

Group 2 priority action items are listed in Table 8-3 and are a (2) priority. Some of these action items have relatively high costs but also have high benefits. Priority group 2 contains tasks that protect property, human health and personal safety. The implementation priority (Priority Order) in Table 8-3 is a tentative order for the start of an activity. Other relevant information can be found for each activity in Section 7.B. Mitigation actions were summarized for each of the six listed goals associated with Tables 7-1 through 7-6. The total estimated cost for the priority 2 proposed action items ranges from a low of \$1,100,000 to a high of \$2,675,000.

8.F.2.1 Launch an Aggressive Year-Round Stream Maintenance Program on Rivers and Waterways

A year- round stream maintenance program on rivers and waterways is intended to prevent Town-wide flooding. This activity is primarily concerned with the Sheldrake River as well as other waterways. It is a natural systems protection action. It has a medium priority with medium benefits and a medium cost of \$50,000 - \$100,000. The program would count as a CRS activity for Special Flood Hazard Area (SFHA) and Repetitive Loss Properties. It is also intended to aid the community with continued NFIP compliance.

The Lead/Administrative responsibility will be the Highway Department. Funding will be requested from FEMA or NYS OEM. The action will begin one year after Plan approval and finish in one year pending approval of funding.

8.F.2.2 Upgrade Emergency Management Plans including Protocols for Preparation, Response, Recovery and Post-Event Mitigation for Hazards

This planning action involves revising local plans and regulations to bring them to current protocols for preparedness, response, recovery and post-event mitigation for all hazards. The

Town should coordinate with other agencies including the Red Cross. This Town-wide activity has a medium priority, a medium benefit and a medium low cost of \$50,000. The Lead responsibility for these plans will be the Emergency Management Committee (EMC). This action will take about one year following Plan approval. Funding will be requested from FEMA and NYS OEM.

8.F.2.3 Establish a Facility and Protocol for an Alternate Seat of Government (ASOG)

This planning activity is intended to establish a facility and protocol for an Alternate Seat of Government (ASOG) during a disaster. This will ensure government operations, emergency services, and essential facilities during and immediately after a disaster or hazard event. This multi-jurisdictional activity covers all hazards and has a medium priority with medium benefits and a medium - high estimated cost of \$100,000 to \$500,000.

The Emergency Management Committee (EMC) will provide the administrative responsibility for this activity. The work will begin one year after funding and be completed within six months. Funding will be requested from FEMA.

8.F.2.4 Participate in a Multi-jurisdictional Radio Interoperability Program to Enhance Communications

The objective of this emergency response activity is to maintain, enhance and ensure the efficient operation of early warning, notification and communication systems. This multi-jurisdictional activity covers all hazards and has a medium priority of two with medium benefits and a medium estimated cost (\$50,000 - \$100,000).

The Lead/Administrative responsibility will be the Ambulance District with support from the EMC and Police Department. The activity will begin one year after the Plan is approved and be completed within one year. A grant would need to be obtained from NYS OEM or FEMA.

Table 8- 3a. Priority 2 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority Item***	Action Item **	Benefits	Cost per \$1,000	Lead/Administrative Responsibility	Schedule / Duration	Funding Sources
Natural Systems	2-1	Launch an aggressive year- round stream maintenance program on rivers and waterways	Medium	\$50 - \$100	Highway and Engineering Dept.	1 yr. after Plan approval, finish in 1 yr.	FEMA NYS OEM
Planning	2-2	Upgrade Emergency Management Plans including protocols for preparation, response, recovery and post-event mitigation for hazards	Medium	\$25 - \$50	Emergency Management Committee (EMC)	1 yr. after Plan approval	FEMA NYS OEM
Planning	2-3	Establish a facility and protocol for an Alternate Seat of Government (ASOG)	Medium	\$100 -\$500	Town Administrator/ Emergency Management Committee (EMC)	Begin 1 yr. after funding Complete in 6 mos.	FEMA
Emergency Response	2-4	Participate in a multi-jurisdictional radio, interoperability program to enhance communications	Medium	\$50 - \$100	Town Administrator/ Emergency Management Committee (EMC)	1 yr. after Plan approval Complete in 1 yr.	FEMA NYS OEM
Emergency Response	2-5	Acquire modern equipment available to First Responders	High	\$50 - \$100	Ambulance District with EMC and Police Dept.	Begin 1 yr. after funding Complete in 6 mos.	FEMA NYS OEM
Emergency Response	2-6	Obtain funding for supplies and equipment needed in a disaster such as generators, pumps and communication equipment	High	\$100 - \$500	EMC with Police and Fire Depts.	Begin 1 yr. after funding Complete in 1 yr.	FEMA NYS OEM
Emergency Response	2-7	Create and maintain a data-base of special-needs individuals and Con Ed LSE customers who voluntarily provide that information	Medium	\$25	Emergency Management Committee (EMC)	2 yrs. after Plan approval, finish in 1 yr.	Town Budget

*Action Type: **Planning** – Local Plans and Regulations **Structure** – Structure and Infrastructure Projects
Natural - Natural Systems Protection **Education** – Education Awareness Programs
Emergency – Emergency Response

***Priority:
 1 – High 2 – Medium 3 – Low

** Action Item – See Section 7 for details.

Table 8- 3b. Priority 2 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority Item***	Action Item **	Benefits	Cost per \$1000	Lead/Administrative Responsibility	Schedule / Duration	Funding Sources
Planning	2-8	Assist Town businesses with drafting emergency preparedness, business continuity and Homeland Security plans	Medium	\$25	Emergency Management Committee (EMC)	1 yr. after Plan approval Finish in 1 yr.	Town Budget
Planning	2-9	Maintain a database of all residents and businesses that use bulk propane storage tanks as a gas source	Medium	\$25	Fire Department	After Plan approval Repeat annually	Town Budget
Structure	2-10	Coordinate with Con Ed Co. of NY to determine if any upgrades are necessary in the local natural gas and electric delivery infrastructures	Medium	\$500 - \$1,000	Town Administrator	Schedule Con Ed. after Plan approval	Town Budget Con Ed.
Planning	2-11	Ensure that all critical facilities, historical sites and apartment buildings are in full compliance with modern building codes	Medium	\$25	Building Dept.	1 yr. after approval Complete in 12 mos.	Town Budget
Planning	2-12	Identify homes and businesses, public facilities, historic sites that would benefit from raising structures above BFE (CRS)	Medium	\$25	Building Dept.	2 yrs. after Plan approval Complete in 1 yr.	Town Budget
Planning	2-13	Work with owners of Repetitive Loss Properties to identify ways the buildings can be modified to reduce insurance claims (CRS)	Medium	\$25	Building Dept.	1 yr. after approval	Town Budget
Planning	2-14	Establish Multi-jurisdictional Protocols for Response to Increase in Dept. of Homeland Security Threat Levels	Medium	\$25-\$50	EMC Town Administrator	1 yr. after approval Complete in 1 yr.	FEMA

*Action Type: **Planning** – Local Plans and Regulations **Structure** – Structure and Infrastructure Projects **Natural** - Natural Systems Protection **Education** – Education Awareness Programs **Emergency** – Emergency Response *****Priority:**
 1 – High 2 – Medium 3 – Low

** Action Item – See Section 7 for details.

Table 8- 3c. Priority 2 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority Item***	Action Item **	Benefits	Cost per \$1000	Lead/Administrative Responsibility	Schedule / Duration	Funding Sources
Planning	2-15	Strengthen land-use and development regulations in Special Flood Hazard Areas	Medium	\$25	Building Dept.	Begin 1 yr. after Plan approval Complete in 1 yr.	Town Budget
Planning	2-16	Draft a Town-wide Evacuation Plan	Medium	\$25 - \$50	EMC Police Dept.	After Plan approval Complete in 1 yr.	FEMA NYS OEM
Education	2-17	Participate in a multi-jurisdictional effort to secure a Fire Safety and Prevention Simulator and public education materials	Medium	\$25 - \$50	Fire Dept.	2 yrs. Plan approval Continue annually	FEMA NYS OEM

*Action Type: **Planning** – Local Plans and Regulations
Natural - Natural Systems Protection
Emergency – Emergency Response

Structure – Structure and Infrastructure Projects
Education – Education Awareness Programs

***Priority:
 1 – High 2 – Medium 3 – Low

** Action Item – See Section 7 for details.

8.F.2.5 Acquire Modern Equipment Available to First Responders

The Town needs to acquire modern equipment for First Responders. This activity will ensure the efficient operation of early warning, notification and communication systems. The activity type is Emergency Response for all hazards Town-wide. It has a high benefit at a medium cost of \$50,000 to \$100,000. Pending funding the task is highly feasible and is given a priority of two.

Funding will be requested from FEMA. The lead responsibility would be the Ambulance District. The work will begin one year after funding and be completed within six months.

8.F.2.6 Obtain Funding for Supplies and Equipment Needed in a Disaster such as Generators, Pumps and Communication Equipment

The Town needs supplies and equipment to respond to a disaster. This includes generators, pumps and communication equipment. The benefits of this activity will maintain, enhance and ensure efficient operations, early warning notification and communication systems. This emergency response action will cover all hazards Town-wide. It is a feasible activity with a high benefit and medium high cost of \$100,000 to \$500,000.

The EMC in conjunction with the Police Department and Fire Department will have the administrative responsibility for this action. The action will begin one year after Plan approval and finish within one year pending FEMA or NYS OEM funding.

8.F.2.7 Create and Maintain a Database of Special-Needs Individuals and Con Ed LSE Customers who Voluntarily Provide that Information

A database of special-needs individuals and Con Ed LSE customers who voluntarily provide that information would be helpful during a hazard event. It would help reduce impacts of hazards on vulnerable populations. This emergency response action is Town-wide for all hazards. It is a medium feasible action, with medium benefits at a low cost of \$25,000. It is given a priority of two based on this assessment.

The Lead/Administrative responsibility for this activity is the EMC. This activity will begin two years after the Plan is approved and be completed within a year. Funding will be from the Town Budget pending Board approval.

8.F.2.8 Assist Town Businesses with Drafting Emergency Preparedness, Business Continuity and Homeland Security Plans

The Town will assist local businesses with drafting emergency preparedness, business continuity and homeland security plans. The objective of this action is to manage all hazard impacts Town-wide through planning. This feasible action has a medium benefit with a low cost of \$25,000 and a priority of two.

The Lead/Administrative responsibility for this activity is the EMC. The schedule/duration for this action item will be one year following funding from the Town Budget pending Board approval. It will begin one year following Plan approval and finished in one year.

8.F.2.9 Maintain a Database of All Residents and Businesses that use Bulk Propane Storage Tanks as a Gas Source

Maintaining a database of all residents and businesses that use bulk propane storage tanks as a gas source will help manage hazard impacts through planning. This Town-wide action will lessen the risk of explosions and fires. This has a medium benefit at a low cost \$25,000 and has a priority of two.

The Lead/Administrative responsibility for this activity is the Fire Department. This action will begin after the Plan is approved and will be repeated annually. Funding will be from the Town Budget pending Board approval.

8.F.2.10 Coordinate With Con Ed Co. of NY to Determine if any Upgrades are Necessary in the Local Natural Gas and Electric Delivery Infrastructure

The Town should coordinate with Consolidated Edison Co. of NY to determine if any upgrades are necessary in the local natural gas and electric delivery infrastructures. This structure and infrastructure action type will protect critical facilities, buildings, and infrastructure Town-wide from damage and loss due to explosions and fire, and help reduce impacts of hazards on homes, businesses and institutions during power outages. The benefits are medium and costs to the Town are low (\$25,000) since Consolidated Edison does the evaluation and work (estimated at \$500,000 - \$1,000,000). It has been given a medium priority of two.

The Town Administrator will have the lead responsibility for this action. This can be scheduled with Con Ed once this Plan is approved. Town costs will be absorbed in the Board's budget.

8.F.2.11 Ensure that All Critical Facilities, Historical Sites and Apartment Buildings are in Full Compliance with Modern Building Codes

This planning action type would ensure that all critical facilities, historical sites and apartment buildings are in full compliance with modern building codes, where required by law. The objective is protection of critical facilities, buildings, and infrastructure from damage and loss from structural collapse. The benefits are medium, cost is low (\$25,000) and the priority is two.

The Building Department will administer this task. The work will begin one year after funding and be completed within twelve months. Funding will be requested from the Town Board.

8.F.2.12 Identify Homes and Businesses, Public Facilities, Historic Sites that would Benefit from Raising Structures Above BFE

This planning action identifies homes and businesses, public facilities and historic sites that would benefit from raising structures above the Base Flood Elevation (BFE). It is intended to reduce impacts of flood hazards on homes, businesses and institutions in Special Flood Hazard Area (SFHA) and for Repetitive Loss Properties. It is also intended to aid the community with continued NFIP compliance. It is considered to have a medium benefit and a low cost less than \$25,000. This CRS activity is feasible and has a priority of two.

The Building Department will have administrative responsibility for this action. This activity will begin two years after the Plan is approved and be completed within a year. Funding will be from the Town Budget pending Board approval.

8.F.2.13 Work with Owners of Repetitive Loss Properties to Identify Ways Buildings can be Modified to Reduce Insurance Claims

This planning action involves working with owners of Repetitive Loss Properties to identify ways their buildings can be modified to reduce insurance claims. The primary objective is to become a member of the Community Rating System and to mitigate flooding in SFHA and Repetitive Loss Properties. It is also intended to aid the community with continued NFIP

compliance. The benefits are considered medium and the cost is low (\$25,000). This CRS activity is feasible and has a priority of two.

The Building Department will have administrative responsibility for this action. This activity will begin one year after the Plan is approved and will be completed within a year. Funding will be from the Town Budget pending Board approval.

8.F.2.14 Establish Multi-jurisdictional Protocols for Response to Increase in Dept. of Homeland Security Threat Levels

This is a planning action to establish multi-jurisdictional protocols for response to increases in Dept. of Homeland Security threat levels. The objective is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects to counter terrorism. This action has a medium benefit at a low-medium cost (\$25,000 to \$50,000) and has a priority of two.

EMC and the Town Administrator will have the responsibility to interface with the Villages of Mamaroneck and Larchmont. The work will begin one year after Plan approval and be completed within twelve months. Funding will be requested from FEMA.

8.F.2.15 Strengthen Land-Use and Development Regulations in Special Flood Hazard Areas

This planning action strengthens land-use and development regulations in Special Flood Hazard Areas (SFHA) to limit future development. The primary objective is to incorporate hazard considerations into land-use planning and natural resource management to mitigate Town-wide flooding. It is also intended to aid the community with continued NFIP compliance. The benefits of this action are medium and the costs are low (\$25,000). It is feasible and has a priority of two.

The Building Department will have administrative responsibility for this action. It will begin one year after the Plan is approved and be completed within a year. Funding will be from the Town Budget pending Board approval.

8.F.2.16 Draft a Town-Wide Evacuation Plan

The Town will draft a Town-wide Evacuation Plan as a planning action type. They will coordinate mitigation planning of all hazards with neighboring communities and Westchester County. This multi-jurisdictional activity has medium benefits at a low-medium cost of \$25,000 to \$50,000. It is feasible and has a priority of two.

The EMC and Police Department will have the administrative responsibility for this action. This activity will begin after the Plan is approved and be completed within a year. Funding will be requested from FEMA and NYS OEM.

8.F.2.17 Participate in a Multi-jurisdictional Effort to Secure a Fire Safety and Prevention Simulator and Public Education Materials

This activity item is part of an education awareness program to participate in a multi-jurisdictional effort to secure a Fire Safety and Prevention Simulator and related public education materials. The objective is to strengthen inter-jurisdiction and inter-agency communication, coordination and partnerships to foster hazard mitigation actions and projects with a focus on fire safety and prevention. The benefits are medium and costs are low-medium (\$25,000 - \$50,000). This has a medium priority of two. The Lead/Administrative responsibility for this activity is the Fire Department. This activity will begin two years after the Plan is approved and continue annually.

8.F.3 Implementation of Priority 3 Mitigation Actions

Group 3 Priority items are listed in Table 8-4. The total estimated cost for these six (6) items ranges from a low of \$775,000 to a high of \$2,225,000.

8.F.3.1 Explore Retrofits to the Sheldrake River Dam with Larchmont to Increase Drainage of Water from Reservoir

This action is intended to improve the storm water collection and drainage system for the Sheldrake River Dam. This structure/infrastructure project with the Town of Larchmont is intended to help mitigate flooding in special flood hazard areas. The priority is low, the benefits are low and cost is medium (\$50,000 - \$100,000). It is a CRS activity for Special Flood Hazard

Areas (SFHA) and Repetitive Loss Properties. It is also intended to aid the community with continued NFIP compliance.

The Town Highway and Engineering Department will have the lead administrative responsibility. The schedule/duration for this action item will be one year following notice of funding from FEMA. Funding will be requested from FEMA and NYS OEM.

8.F.3.2 Purchase and Install a Flood Early Warning System complete with Water Level Gauges and Automatic Notification

This action strategy is an emergency response to prevent flooding from coastal waters and rivers. It is a CRS activity for Special Flood Hazard Areas (SFHA) and Repetitive Loss Properties. The Community Rating System credits activities that protect life and property during a flood through enhanced flood early warning and response programs. It is also intended to aid the community with continued NFIP compliance. The priority is low due to the medium – low benefits and the costs which are medium to high (\$100,000 - \$500,000) and uncertainty of funding.

The Town Highway and Engineering Department will have the lead administrative responsibility. This activity will take about one year to complete once funding has been identified and obtained. Funding will be requested from FEMA and NYS OEM. Other sources may be identified.

Table 8- 4. Priority 3 Action Items Implementation – Town of Mamaroneck Hazard Mitigation Plan.

Action Type*	Priority Item***	Action Item **	Benefits	Cost per \$1000	Administrative Responsibility	Schedule / Duration	Funding Sources
Structure	3-1	Explore retrofits to the Sheldrake River Dam with Larchmont to increase drainage of water from the reservoir	Low	\$25	Highway and Engineering Dept.	1 yr. following funding	FEMA / NYS OEM
Emergency Response	3-2	Purchase and install a Flood Early Warning System complete with water level gauges and automatic notification	Medium	\$100 - \$500	Highway and Engineering Dept.	1 yr. following funding	FEMA / NYS OEM
Emergency Response	3-3	Purchase and install current technology that allows emergency vehicles to control traffic signals at intersections	Low	\$25 - \$50	Highway and Engineering Dept.	1 yr. after authorized Finish in 6 mos.	NYSDOT / NYS OEM
Education	3-4	Educate residents, business owners and contractors on flood mitigation strategies, damage prevention and safety, flood insurance and flood loss	Medium	\$25 - \$50	Town HMC	Begin after Plan approval Repeat yearly	Town Budget
Natural Systems	3-5	Study and begin a dredging project on the Sheldrake River, Larchmont Lake and areas where streams converge	High	\$500 - \$1,000	Town Administrator, Highway Dept.	Project on hold	Funding source not yet identified
Structure	3-6	Coordinate with utility providers to install the Town’s electrical and communication infrastructure underground	Low	\$50 - \$500	Building Dept.	1 yr. following approval	Utility companies and Town Budget
Natural Systems	3-7	Coordinate with Westchester Co. to reduce brush fire hazards in conservation areas and parks	Medium	\$25	Fire Dept.	Begin after Plan approval, Annually	Town Budget

*Action Type: Planning – Local Plans and Regulations Structure – Structure and Infrastructure Projects ***Priority: 1 – High 2 – Medium 3 – Low
Natural - Natural Systems Protection Education – Education Awareness Programs
Emergency - Emergency Response

** Action Item – See Section 7 for details.

8.F.3.3 Purchase and Install Current Technology that Allows Emergency Vehicles to Control Traffic Signals at Intersections

Current technology allows emergency vehicles to control traffic signals at intersections. This technology would be useful for Town police and emergency responders. It would meet the objective to maintain, enhance and ensure efficient operation of early warning notification and communication systems. This emergency response action covers all hazards Town-wide. This action is given a medium feasibility, a low priority of three, low benefit at a low to medium cost of \$25,000 to \$50,000.

The Town Highway and Engineering Department will have the lead administrative responsibility. The work will begin one year after funding is authorized and be completed within six months. The NYS Department of Transportation and NYS OEM may be possible sources of funding.

8.F.3.4 Educate Residents, Business Owners, and Contractors on Flood Mitigation Strategies, Damage Prevention, and Safety, Flood Insurance and Flood Loss

This is an educational awareness program with the objective of reducing impacts of hazards on homes, businesses and institutions. It is important to educate the Town's residents, business owners and contractors on ways to reduce flood damage and to promote the purchase of flood insurance. These activities also provide data to insurance agents for accurate flood insurance rating. Public information activities include maintaining elevation certificates, providing map information, conducting outreach projects about flood hazards, disclosing information about hazards, providing information and advice about flood protection, and providing assistance for flood protection. This is a CRS activity that targets repetitive loss properties. It is also intended to aid the community with continued NFIP compliance. It has high benefit at a low-medium cost of \$25,000 to \$50,000. This strategy is given a low priority of three since it may be merged with other CRS activities and may not require separate funding.

The lead responsibility would be the Town's Hazard Mitigation Committee (HMC). This action will begin after the Plan is approved and will be repeated annually. Funding will be from the Town Budget pending Board approval.

8.F.3.5 Study and Dredging Project on the Sheldrake River, Larchmont Lake and Areas where Streams Converge

This natural systems action is to study and dredge the Sheldrake River, Larchmont Lake and areas where streams converge. This CRS activity will coordinate flood mitigation planning with neighboring communities. It is also intended to aid the community with continued NFIP compliance. This feasible action has a low priority of three and moderate benefits. The cost estimate is high (\$500,000 to \$1,000,000). Dredging of water bodies in the Town and neighboring jurisdictions has not been done due to limited funding. There are no immediate plans to proceed with dredging actions at this time.

The Town Administrator and Highway Department will have the lead administrative responsibility.

8.F.3.6 Coordinate with Utility Providers to Install the Town’s Electrical and Communication Infrastructure Underground

The Town would coordinate with utility providers (Con Ed and Verizon) to install the Town’s electrical and communication infrastructure underground in areas not vulnerable to flooding. This structure/infrastructure action type would reduce impacts of hazards on homes, businesses and institutions in severe weather. The benefits are medium and cost estimates are high (over \$500,000 to utility companies). Costs to the Town could be \$50,000. This feasible action has a low priority of three.

The Building Department will have administrative responsibility for this action. This action will take about one year following Plan approval. This project would be funded by the individual utilities with oversight cost provided by the Town Budget.

8.F.3.7 Coordinate with Westchester Co. to Reduce Brush Fire Hazards in Conservation Areas and Parks

This action type is natural systems protection. The Town plans to coordinate with Westchester County to reduce brush fire hazards in conservation areas and parks. The primary objective is to protect and preserve open space and environmentally sensitive and critical areas Town-wide

from wildfires. This feasible action has medium benefits and the costs are low (\$25,000). It has a low priority of three.

The Lead/Administrative responsibility for this activity is the Fire Department. This action will begin after the Plan is approved and will be repeated annually. The FD will implement this activity using Town Board approved funding.

8.G Next Steps

The above action plan emphasizes implementation of the proposed mitigation activities based on priorities that consider costs and benefits as well as Social, Technical, Administrative, Political, Legal, Economic and Environmental considerations. Once the Town officials review and accept this Action Plan, there are two additional steps needed to complete this Flood Plain Management & Hazard Mitigation Plan. They are:

- Section 9 – Adopt the Plan; and
- Section 10 - Implement, Maintain, Evaluate, and Revise the Plan

Prior to the official adoption of the plan, the Town will submit the Plan to NYS OEM for review and comment. NYS OEM will forward the Plan to FEMA for their comments. Upon receipt of the agencies' comments, the Plan will be revised. All required changes will be incorporated and resubmitted for final review and approval by NYS OEM and FEMA.

Section 9 - Implement, Maintain, Evaluate and Revise the Plan

Pending final approval of this Multi-Hazard Mitigation Plan by FEMA, the Mamaroneck Town Board will officially adopt the Plan as documented below in Section 10. This Section begins with the implementation of the Plan, discusses how the plan will be maintained and evaluates the progress and the process of Plan revisions. The Hazard Mitigation Planning Committee, described in Section 1-D and Figure 1-4, under direction of the Chairman, will review and monitor the progress of the Plan. The Town Board is responsible for approving the implementation of the Plan and any substantial revisions. Current officials of the Town or the Committee including the Committee Chairman, Town Administrator, Superintendent of Highways, Community Services Director, Building Department, and Fire and Police Departments, or other Town officials and consultants appointed by the Supervisor or the Board will be responsible for administering or managing specific projects proposed in Section 8.

This Plan is considered an active document. Once the Plan is approved and implemented, the Planning Committee will maintain the Plan through periodic review of the schedule, preparation of detailed plans or specifications for funded activities, monitor the Plan's progress and evaluate the Plan's successes. As this Plan is implemented, the Committee will review and evaluate any additional agencies, organizations, contributors or stakeholders that are needed to advise and participate in a particular activity.

9.A Plan Implementation Process

9.A.1 Plan Administration

The Committee Chairman (currently the Ambulance District Coordinator) will be responsible for the administration of the Plan. The Chairman will assure that the Plan is implemented; maintained, and evaluated for its effectiveness, and that it is updated in a timely manner. Plan updates will be added as Attachments to this present Plan. The progress of the work activities

will be monitored; the schedule tracked in monthly activity progress reports and reviewed by the Committee Chairman.

The Committee Chairman will be responsible for:

- Monitoring and maintaining project budgets,
- Scheduling and coordinating committee meetings,
- Meetings or conference calls with funding agencies,
- Informing and coordinating stakeholders and;
- Keeping community members informed.

The Committee Chairman will work closely with the Committee and the Town Board to assure that they are fully informed of progress on activities. The Chairman will assure that quarterly progress reports and updates are provided to the Committee and to funding agencies via NYS OEM by the end of the first week of each month. The quarterly progress report should contain the following information to help monitor the program:

- Grant Program
- Activity item(s) covered
- Reporting Period
- Town Program Administrator
- Funding Agency
- Type of Plan
- Plan Status
- Key deliverable reports, plans, design drawings or studies
- Activity technical progress
- Key meetings, phone conferences or site visits
- Key Successes
- Problems encountered
- Schedule Status and Progress
- Budget Status
- Evaluation of the Plan's effectiveness

Each Activity Leader or Manager will be responsible for the successful implementation of their project or activity item. Their primary responsibilities include:

- Managing the activity's budget,
- Maintaining the schedule,
- Monitoring and oversight of the work,
- Assuring adherence to the scope of work or specifications,
- Informing the Committee Chairman of progress or problems.

9.A.2 Public Participation

Improving the public participation program is a key goal of this Hazard Mitigation Plan. The Mamaroneck community will continue to be notified of all important project activities, reports, public meetings and recommendations through the expanded Town Website. Notifications will also include news bulletins and public notices that are published in the local newspaper. The Activity Leader for each specific project will be responsible for communicating with the public. The Town web page will be updated and will include items related to emergency planning.

<http://www.townofmamaroneck.org>

At a minimum one public meeting a year will be held to address the status and progress of this Hazard Mitigation Plan. All annual reports, technical reports, plan updates and amendments will be available at the Town Hall and the public library for public review and input.

The public participation program for this Hazard Mitigation Plan was described in Section 2 of this Plan. Residents actively participated and provided input in public meetings and expressed concerns verbally and in writing about the street and home flooding they face with major rain storms. Strong interest and concern was shown by the community.

The public will continue to be involved in the revision and updating process. Meeting notices will be advertised and published. The Committee Chairman, staff, and elected Board Members will continue to meet and discuss hazard issues with the community and impacted residents. Public meetings on key issues will continue and notices and progress will be published in local papers. The Town will continue to post updates on their Website:

<http://www.townofmamaroneck.org> The Town will also send e-mail updates to individuals that request them. These meetings can be accessed through LMC-TV the local public access television station. They can be viewed on Cablevision channel 76 or Verizon channel 35. The Board meetings can be viewed online at www.lmc-tv.org Videos on Demand, Town meetings.

The Committee Chairman will be responsible for implementing, scheduling and coordinating public involvement and assuring that the website is operating and updated. Public comments will be responded to and integrated into the Plan as they are received or with each five-year update. Updates will be submitted three months prior to the due date to allow for review and comment.

9.A.3 Incorporation with Other Plans and Activities

The Town of Mamaroneck has also cited other related or ongoing projects and draft plans as part of this Hazards Mitigation Plan. These projects and plans include:

- Town Emergency Response/Operations Plan
- Comprehensive Flood Action Plan – 2009 Phase
- Mamaroneck and Sheldrake Rivers Basin Flood Risk Management Reevaluation Study
- Phase II Stormwater Management Plan
- Comprehensive Plan – Town of Mamaroneck September 2011 (adopted February 2012)
- Town of Mamaroneck Local Waterfront Revitalization Program Draft September 2011
- Dam Emergency Action Plan

Several of these activities are discussed in Sections 7 and 8 and involve the same Town officials who served on the Planning Committee and were responsible for developing this Multi-Hazard Mitigation Plan.

MS4 Program: Federal and state stormwater regulations (MS4 regulations) are under the responsibility of the Highway and Engineering Department. This Plan provides for control of on-site stormwater and is a NYSDEC and EPA program. Required permit measures include public participation, outreach and involvement; illicit discharge and elimination; runoff controls; and

pollution prevention. The MS4 requirements are being integrated into this Multi-Hazard Mitigation Plan.

Town Emergency Response/Operations Plan: The Town has prepared a Working Copy of an Emergency Response Plan. The revision of this plan needs to be integrated with the State and Westchester County plans. This Plan has leaders and responsibilities assigned, but needs the capabilities to respond to a variety of incidents and hazards discussed in this Multi-Hazards Mitigation Plan. The Town's Emergency Response Plan needs to be updated and will include coordination with Village, County and State Offices as discussed in Section 7.B.2 and 8.F.7. The Fire Department is responsible for the revision and completion of this plan. Completion of this activity has been identified as action item in this plan.

In addition to these projects, several proposed local planning mechanisms incorporate the Plan requirements, address the Plan's goals and objectives, provide Town resources, tap into stakeholder interests and include volunteer assistance. The projects listed below do not require capital funded items and several may require Memoranda of Understanding for government agencies, stakeholders and volunteer organizations. They include:

- Prepare a comprehensive Evacuation Plan
- Obtain certification in the CRS Program
- Evaluate and upgrade Town building and fire codes
- Update the Town Emergency Response Plan

Prepare a Comprehensive Evacuation Plan: This activity is the primary responsibility of the Mamaroneck Police with assistance of the Fire Department. The Police Chief is expected to oversee completion of this Plan. The Town Board will review and adopt the document and assure that it meets all FEMA/NIMS requirements. Several neighboring communities such as Larchmont, Scarsdale, Rye and the Village of Mamaroneck in Westchester County need to be incorporated in planning this document. The Red Cross or other volunteer relief organizations are expected to be involved in the planning.

Obtain Certification in the CRS Program: This application for the CRS Program will also require the Town to perform flood plain preventative activities. Formal approval of this Multi-Hazards Mitigation Plan is a prerequisite for the CRS approval. This activity will be implemented using existing Town resources. Many of the elements of the Town's MS4's Stormwater Quality Improvement Program discussed above are the same as the requirements in the CRS Program and could be integrated with that activity.

Evaluate and Upgrade Town Building, Fire and Zoning Codes: The Building Department will be responsible for administering this activity and implementing updated codes, as may be approved by the Codes Council under the auspices of the New York State Department of State. This activity will need matching funds from the Town budget and in-kind services. The updated codes will be documented in a set of recommendations for the Town Board to review and approve.

Update the Town Emergency Response Plan: This activity will require coordination and cooperation between various Federal, State, and County agencies and the Town for responding to all hazards facing the Town. The Fire Department would manage and administer activity as in kind services under the general operating budget. Input and assistance from stakeholders and volunteer organizations will be needed.

9.B Monitoring and Evaluating the Plan

The Planning Committee will monitor and document the progress of the Plan's recommended mitigation activities. Progress reports will be prepared and submitted quarterly by the Committee Chairman. A sample form of a progress report is provided in the Appendix of this Plan. This progress report will track planned costs, schedules and milestones, Plan successes, work status, and next steps. Status of individual mitigation project actions, risk assessments, and suggested Plan revisions will be evaluated as noted in the Appendix.

The status report will also include any periodic monitoring reports by involved agencies or organizations implementing the proposed actions. An annual report will be prepared that highlights the mitigation activities completed or in progress.

9.C Plan Maintenance Process

A review of the Plan will be conducted annually or with the occurrence of a significant change. Annual committee reviews will be completed by the 31st of January of each year. The Supervisor and Town Board will be informed of the Plan's progress. A yearly summary report, which evaluates progress of the Plan, will also be submitted by the end of January of each year to the Planning Committee and funding agencies via NYS OEM. The Committee Chairman will be responsible for assuring that the Plan's effectiveness is evaluated.

The Committee will review the monthly and annual reports to evaluate the Plan's implementation progress. The Committee Chairman will provide the Committee with updates on the completion of the Plan Action Items. The community will be informed of the Plan's progress through the Town Web Pages <http://www.townofmamaroneck.org> and in annual public meetings.

9.D Evaluate Plan Effectiveness

The Planning Committee will review the Quarterly Reports to evaluate the Plan's effectiveness and to determine if objectives are being achieved. This evaluation will be included as part of periodic reports submitted by the Town's Administrator when activities are completed. The Planning Committee and the Town Board will be provided with all reports, updates on hazard vulnerability or changes in estimated property losses. One measure of the effectiveness is the successful completion of work activities, the number of recommendations implemented and specific action plans accepted.

Estimating the losses avoided can be used as an indicator of success. This is an estimate of costs that would have occurred if mitigation actions were not taken. Participation in the National

Flood Insurance Program can be followed and any information on number of participants and claims will be examined as an indicator of success.

The Committee Chairman will be responsible for assuring that Activity Leaders and participating agencies prepare periodic progress reports including the various parameters to measure the progress of the actions and action completion dates.

9.E Revising the Plan

The Town of Mamaroneck is committed to reviewing and updating the Plan every five years. By March of the fifth year of the program, a review and update of changes in development, recent hazard events, the hazards originally identified, the risk assessment, estimated losses, new studies and technologies and results of recent disasters should be made. The Committee also needs to review any changes in local, State or Federal laws, policies, plans, funding and socioeconomic factors in the Town. Original goals, objectives and mitigation activities need to be reviewed and updated. Following this review and update, the findings will be incorporated into a revised Plan. Worksheet and forms are provided in the Appendix to assist this process.

The Multi-Hazard Mitigation Planning Committee will be responsible for reviewing all updates to the Plan. The updates will be submitted by the Committee Chairman and will incorporate any annual changes to the scope of work such as newly identified activities or hazards, any expansion or deletion of currently planned activities or changes in costs or schedules. Any significant changes in scope, costs or schedule are to be approved by the Town Board.

Changes in property development will be evaluated. Any new projects or measures will be examined and potential losses estimated and evaluated. Over a five-year period there may be applicable changes in local, state, or federal requirements, policies and funding. This may require updating the goals, objectives and actions. The update may require changing a current mitigation measure or implementing a measure for different hazard or loss prevention.

Within two months of completing the review in March of the 5th year of the Plan, a draft revised plan will be submitted to NYS OEM in May for review and comment, revised and then forwarded in July to FEMA for review and comment. After receipt of comments from FEMA in September, the Town will revise the draft within two months and submit it to NYS OEM and FEMA in December for approval.

Section 10 - Adoption of the Plan

10.A Formal Town Government Process

A resolution was officially accepted by the Board of the Town of Mamaroneck NY giving the appointed Hazard Mitigation Planning Committee (see Fig.1-4) and a planning consultant, full authority to prepare a Multi-Hazard Mitigation Plan that will:

- Carry out identification of hazards,
- Assess the hazards risks and impacts,
- Establish goals and objective for mitigating the hazards,
- Identify mitigation measures,
- Prepare a mitigation plan, and
- Implement the Plan.

Key activities are presented in Table 1-3. On March 20, 2013 the Town Board authorized contracting ETG Inc. to prepare the Multi-Hazard Mitigation Plan

On April 2, 2013 The Town Administrator and Planning Committee had a “kickoff” meeting with the consultant ETG to discuss the scope of the project and information needed from the Town Departments and Planning Committee.

On December 9, 2013 copies of the first draft of the Multi-Hazard Mitigation Plan were provided to the Hazard Mitigation Planning Committee for their review and comments.

10.B Official Public Participation:

Documentation of the public participation program and Hazards Mitigation Planning Committee is presented in Section 1.E and Section 2 of this Plan.

Public Meetings: A notice for the first public meeting was published. The first meeting is scheduled for December 18, 2013 at 8:00 PM in the Town Hall meeting room. (See Appendix for a copy of the announcement.

A second public meeting was held ____, 2014 in conjunction with the Town Board to present and review the contents of the Draft Multi-Hazard Mitigation Plan.

10.C Adoption of the Final Plan

At a meeting on _____, 2014 of the Town Board, a motion was made and seconded to adopt the following resolution which reads as follows:

Resolution:

WHEREAS, the Town of Mamaroneck Multi-Hazard Mitigation Plan has been prepared in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the Town of Mamaroneck with assistance of the Environmental Technology Group has gathered information and prepared the Town of Mamaroneck Multi-Hazard Mitigation Plan; and

WHEREAS, the Town of Mamaroneck is a local unit of government that has afforded the citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and

WHEREAS, the Town of Mamaroneck has reviewed the Plan and affirms that the Plan will be updated no less than every five years;

NOW THEREFORE, BE IT RESOLVED by the Board of the Town of Mamaroneck adopts the Multi-Hazard Mitigation Plan as the jurisdiction's Multi-Hazard Mitigation Plan, and resolves to execute the actions of the Plan.

ADOPTED this __ day of _____, 2014 at the meeting of the Town Board.

Town Supervisor

Town Administrator

Section 11 – References Cited

1. Accuweather, www.accuweather.com/
2. Annals of Internal Medicine, “The Resurgence of West Nile Virus. December 4, 2012.
3. Association of State Dam Safety Officials, <http://new.damsafety.org>
4. Bergen County Skywarn,, <http://www.bergenskywarn.org/>
5. Centers For Disease Control, <http://www.cdc.gov>
6. Climate Science Watch Website, www.climatesciencewatch.org
7. Coastal Resilience Website, <http://coastalresilience.org>
8. Colorado State University, Tropical Meteorology Project. <http://typhoon.atmos.colostate.edu>
9. Collins, M. (1997), Assessment of New York City’s Reservoirs, Dams, and Aqueducts. NYCDEP and FBI.
10. Conrail website, <http://www.conrail.com/>
11. Consolidated Edison, “Report on Preparation and System Restoration Performance – Hurricane Irene”. November 14, 2011.
12. Consolidated Edison, Westchester County Severe Wind and Rain Storm, January 18-22, 2006. www.dps.state.ny.us/conediso-january2006stormreport.pdf
13. Consolidated Edison, www.coned.com/publicissues .
14. Daily Mirror, “Storm Damage, Town by Town”. Page 3 & 17. September 23, 1938
15. The Earth Institute at Columbia University. “Earthquakes may endanger more than thought; Nuclear Power Plant seen as Particular Risk”, August 21, 2008.
16. FEMA, Flood Insurance Study, 36119CV001A, Westchester County, NY (All Jurisdictions). September 28, 2007.
17. FEMA, Flood Insurance Study, Town of Mamaroneck, NY, Westchester County. Revised September 15, 1989.

18. FEMA, Flood Insurance Rate Maps for Westchester County, New York, Town of Mamaroneck. 36119C0332F, 36119C0334F, 36119C0342F, 36119C0351F, 36119C0353F, 361190361F. Federal Emergency Management Agency, September 28, 2007.
19. FEMA, “HAZUS99 Estimated Annualized Earthquake Losses for the United States”. September 2000. FEMA (2000), Disaster Mitigation Act of 2000. Public Law 106-390.
20. FEMA, Federal Emergency Management Agency, Part III. 44 CFR Parts 201 and 206. Hazard Mitigation Planning and Hazard Mitigation Grant Program; Interim Final Rule. Federal Register, Tuesday February 26, 2002.
21. FEMA, State and Local Mitigation Planning: How-to Guides. FEMA 386:1-5, 2001-2007.
22. FEMA, FEMA Example Plans. National Flood Insurance Program, Community Rating System. Federal Emergency Management Agency, March 2003.
23. FEMA, Local Mitigation Plan Review Guide. October 2011.
24. FEMA, Local Mitigation Planning Handbook . March 2013.
25. FEMA, Multi-Year Flood Hazard Identification Plan (MHIP), Appendix D FY03-04 Funding Calculations for Adjusted Risk Value, www.fema.gov/pdf/fhm/mh_app_d.pdf. Federal Emergency Management Agency, November, 2004.
26. FEMA, National Flood Insurance Program, Bureau Reports. <http://bsa.nfipstat.fema.gov>
27. FEMA, Wind Zones. <http://www.fema.gov/safe-rooms/wind-zones-united-states>
28. Insurance Journal (2006), www.insurancejournal.com/news/east/2006/01/12/6416.htm January 12, 2006.
29. Intergovernmental Oceanographic Commission, “Tsunami, The Great Waves”, 2nd edition. 2012.
30. Intergovernmental Panel on Climate Change website. www.ipcc.ch
31. The Journal News. Newspaper and website. <http://www.lohud.com>.
32. Larchmont Gazette (Archives) website. www.larchmontgazette.com
33. Larchmont-Mamaroneck Patch website. www.larchmont.patch.com
34. Lamont-Doherty Earth Observatory Website, <http://www.ldeo.columbia.edu/> .

35. Los Angeles Times, “West Nile Virus May Get Worse as Climate Gets Hotter”. September 10, 2012.
36. Mamaroneck Daily Voice website. www.mamaroneck.dailyvoice.com
37. The Mamaroneck Review website. www.mamaroneckreview.com
38. Metro-North Website, <http://www.mta.info/>
39. National Weather Service, National Hurricane Center. www.nhc.noaa.gov
40. National Weather Service, Hurricane Page, National Weather Service, <http://hurricanes.noaa.gov/>
41. National Drought Mitigation Center Website. <http://drought.unl.edu>
42. National Tsunami Hazard Mitigation Program website. <http://trhmp.tsunami.gov>
43. The Nature Conservancy, Coastal Resilience Project. www.coastalresilience.org
44. NY State Climate Action Council, “New York State Climate Action Plan Interim Report”, November 9, 2010. <http://www.nyclimatechange.us/InterimReport.cfm> .
45. NYSC, New York City Climate Office. Central Park Climate Summary. http://nysc.eas.cornell.edu/newyork_c20.html .
46. NCDC/NOAA (2012), Billion Dollar U.S. Weather/Climate Disasters, National Climate Data Center, www.ncdc.noaa.gov/billions/events .
47. NCDC/NOAA, National Climate Data Center, <http://www.ncdc.noaa.gov>
48. The New York Times website. <http://www.nytimes.com> .
49. NY State Building Code.
50. NOAA Technical Memorandum NWS NHC-6, The Deadliest, Costliest, and Most Intense United States Hurricanes from 1851 to 2010. National Hurricane Center, August 2011. www.aoml.noaa.gov/pdf/nws-nhc-6.pdf
51. NOAA, Major Hurricane Tracks, Historical Hurricane Tracks, <http://maps.csc.noaa.gov/hurricanes/>.
52. NOAA Tsunami website. www.tsunami.noaa.gov
53. NOAA West Coast and Alaska Tsunami Warning Center website. <http://oldwcatwc.arh.noaa.gov>

54. NOAA, NESDIS, NCDC, Storm Event Records
55. NY State Climate Action Council, “New York State Climate Action Plan Interim Report”, November 9, 2010. <http://www.nyclimatechange.us/InterimReport.cfm>
56. NYC Weather & Storm Blog website. www.severeweathervideo.com
57. NYCCEM. Estimating Earthquake Losses for the Greater New York City Area, FEMA HAZUS-MH Study for the greater NYC area. http://mceer.buffalo.edu/publications/resacom/01-SP01/rpa_pdfs/16dargusha.pdf
58. The New York City-area Consortium for Earthquake-loss Mitigation (NYCEM). <http://www.nycem.org>
59. New York State Climate Action Council, “New York State Climate Action Plan Interim Report”. November 9, 2010. www.nyclimatechange.us/interimreport.cfm
60. New York State Department of Environmental Conservation, Climate Change Information Resources website. www.dec.ny.gov/energy
61. New York State Disaster Preparedness Commission, (NYSDPC) <http://www.dhSES.ny.gov/oem>
62. Northeast Climate Impacts Assessment (NECIA), “Confronting Climate Change in the US Northeast – New York”. www.climatechoices.org
63. NYSERDA, “Responding to Climate Change in New York State”, Technical Report 11-18. November 2011.
64. NYSOEM, New York State Standard Multi-Hazard Mitigation Plan, 2011. <http://www.dhSES.ny.gov/oem/mitigation/plan.cfm>
65. NYSOEM Wind Zones of New York State, <http://www.semo.state.ny.us/programs/mitigation/windzone.cfm>
66. Pfaff, Steve, National Weather Service, “East Coast Tsunami Threats” Presentation. www.er.noaa.gov/ilm/stormready/tsunami/player.html
67. Research News & Science Facts website, www.currentresults.com/weather/new-york/
68. Soundview Rising website. www.risingmediagroup.com/soundviewnews.html
69. Spatial Hazard Events and Losses Database (SHELDUS). www.sheldus.org

70. Sykes, Lynn R. et al. "Observations and Tectonic Setting of Historic and Instrumentally Located Earthquakes in the Greater New York City – Philadelphia Area", Bulletin of the Seismological Society of America. August, 2008, 98: 1696-171.
71. Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.
72. Tornado Project Online, <http://www.tornadoproject.com>
73. Town of Mamaroneck website, www.townofmamaroneck.org
74. Town of Mamaroneck, Comprehensive Emergency Management Plan. 2003.
75. Town of Mamaroneck, Master Plan Update, Phase 1. 1986.
76. Town of Mamaroneck, Master Plan Update, Phase 2. 1987.
77. Town of Mamaroneck, Master Plan DEIS. 1989
78. Town of Mamaroneck, Sheldrake River Watershed Hydrolic Study. 1991.
79. Town of Mamaroneck and Village of Larchmont, Local Waterfront Revitalization Program. Approved November 1995.
80. United States Landfalling Hurricane Probability Project. <http://www.e-transit.org/hurricane/>.
81. USEPA, "Climate Change Indicators in the United States" EPA 430-R-10-007, April 2010. www.epa.gov/climatechange/indicators.html .
82. USEPA Enviromapper, <http://maps.epa.gov/enviromapper/>
83. USGS, U.S. Geological Survey, National Seismic Hazard Maps, <http://earthquake.usgs.gov/research/hazmaps/interactive/cmmaps/>
85. USGS, U.S. Geological Survey, <http://www.usgs.gov/>
86. USDOT, Office of Hazardous Materials Safety Website, <http://phmsa.dot.gov/hazmat>
87. U.S. Census Bureau, Census (2010). Profile of General Demographic Characteristics, Mamaroneck, NY, <http://factfinder2.census.gov>
88. United States Department of Homeland Security, Threat and Hazard Identification and Risk Assessment Guide, Comprehensive Preparedness Guide. First Edition. April 2012.
89. United States Global Change Research Program Website, www.globalchange.gov

90. United States Nuclear Regulating Commission Website (UANRC). www.nrc.gov
91. Village of Larchmont, Westchester County, NY. Pine Brook Drainage Study (Draft), January 2008.
92. Village of Larchmont, NY. Emergency Action Plan, Larchmont Dam, Larchmont Water Company Dam #2, 2010.
93. Westchester County, “Climate Change and Sustainability”.
<http://climatechange.westchestergov.com>
94. Westchester County Department of Planning, “Stormwater Reconnaissance Plan for the Coastal Long Island Sound Watershed, Westchester County, NY. August 2013
95. Westchester County Department of Planning, “Flooding and Land Use Planning: A Guidance Document for Municipal Officials and Planners”. June 2010.
96. Westchester County Department of Planning, “Controlling Polluted Stormwater, A Management Plan for the Sheldrake and Mamaroneck Rivers and Mamaroneck Harbor”. January 2001.
97. Westchester County Department of Planning, and Watershed Advisory Committee 5. “Controlling Nonpoint Source Pollution in Long Island Sound, A Management Plan for the Watersheds of Stephenson Brook, Burling Brook, Pine Brook and Larchmont Harbor”. June 1997.
98. Westchester County Soil and Water Conservation District, “Final Report on the Upper Sheldrake River and Larchmont Reservoir”. January 1985.
99. Westchester County GIS, <http://giswww.westchestergov.com/westchester/emap/wc1.htm>
100. Westchester County Health Department website, <http://health.westchestergov.com> .

Folded Pocket Maps



Environmental
Technology
Group, Inc.

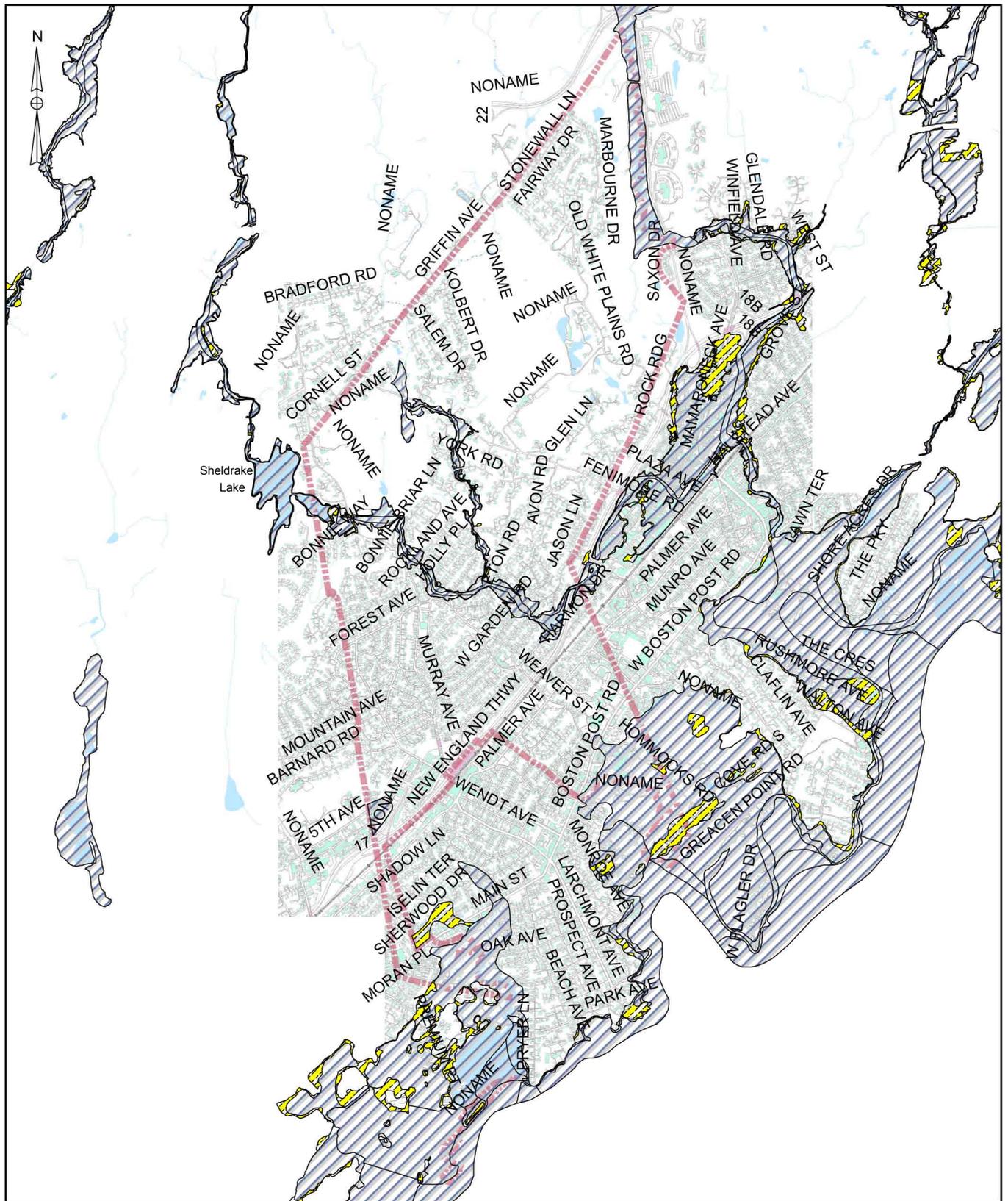
300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788

Basemap Information by Westchester County GIS

Map 1
Aerial Photo
Town of Mamaroneck
All Hazard Mitigation Plan



DWN BY: YS
CHK BY: JB
SCALE: AS SHOWN
DATE: 08/28/13



Map 2
 100 and 500-Year Floodplain
 Town of Mamaroneck
 All Hazard Mitigation Plan

Legend

- FEMA Flood Mapping**
-  100 Year Flood Line
 -  500 Year Flood Line

DWN BY: YS
 CHK BY: JB
 SCALE: AS SHOWN
 DATE: 08/27/13



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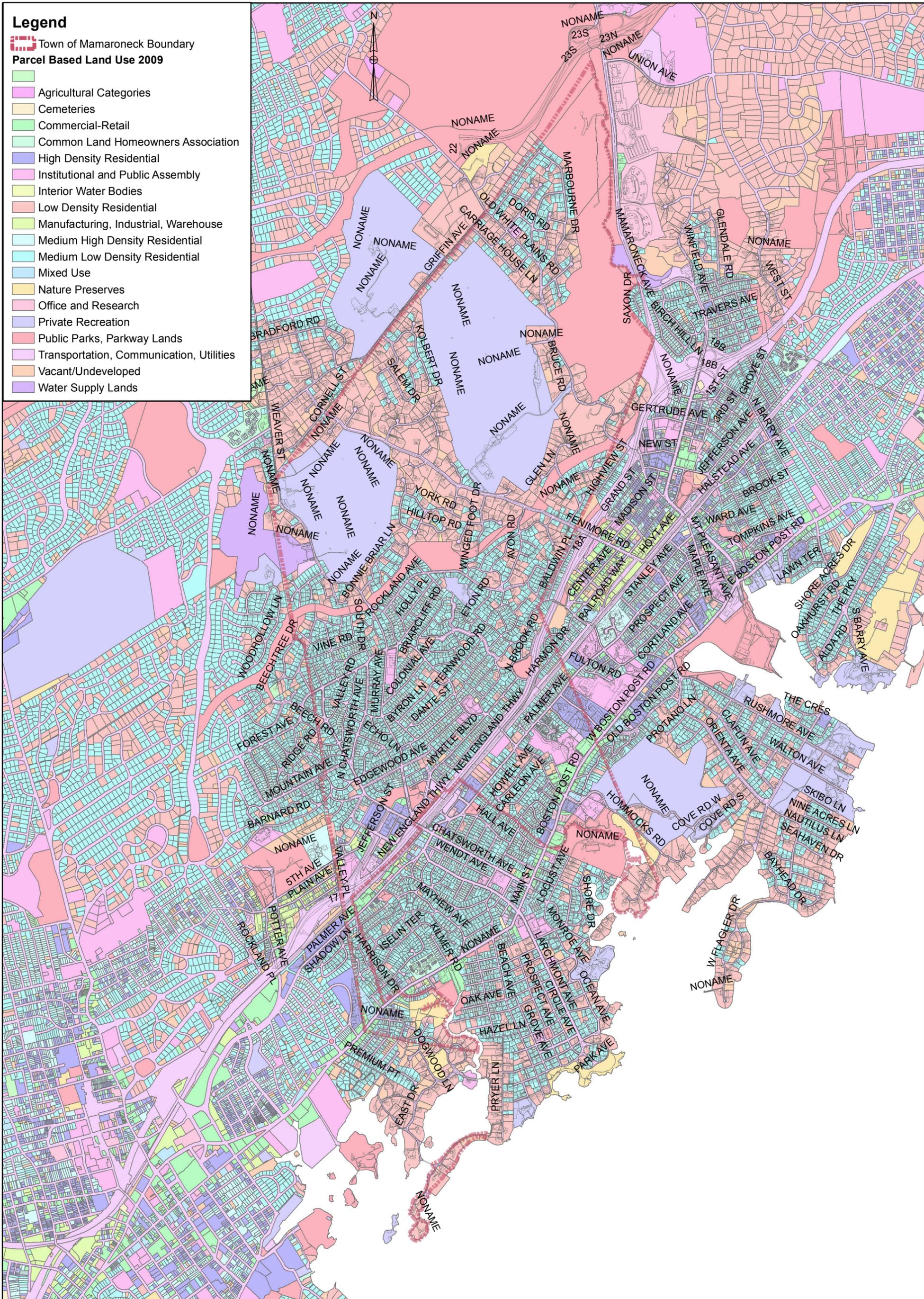
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Legend

 Town of Mamaroneck Boundary
 Parcel Based Land Use 2009

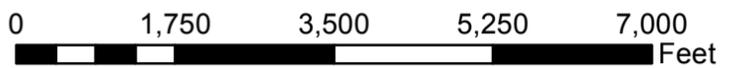
-  Agricultural Categories
-  Cemeteries
-  Commercial-Retail
-  Common Land Homeowners Association
-  High Density Residential
-  Institutional and Public Assembly
-  Interior Water Bodies
-  Low Density Residential
-  Manufacturing, Industrial, Warehouse
-  Medium High Density Residential
-  Medium Low Density Residential
-  Mixed Use
-  Nature Preserves
-  Office and Research
-  Private Recreation
-  Public Parks, Parkway Lands
-  Transportation, Communication, Utilities
-  Vacant/Undeveloped
-  Water Supply Lands



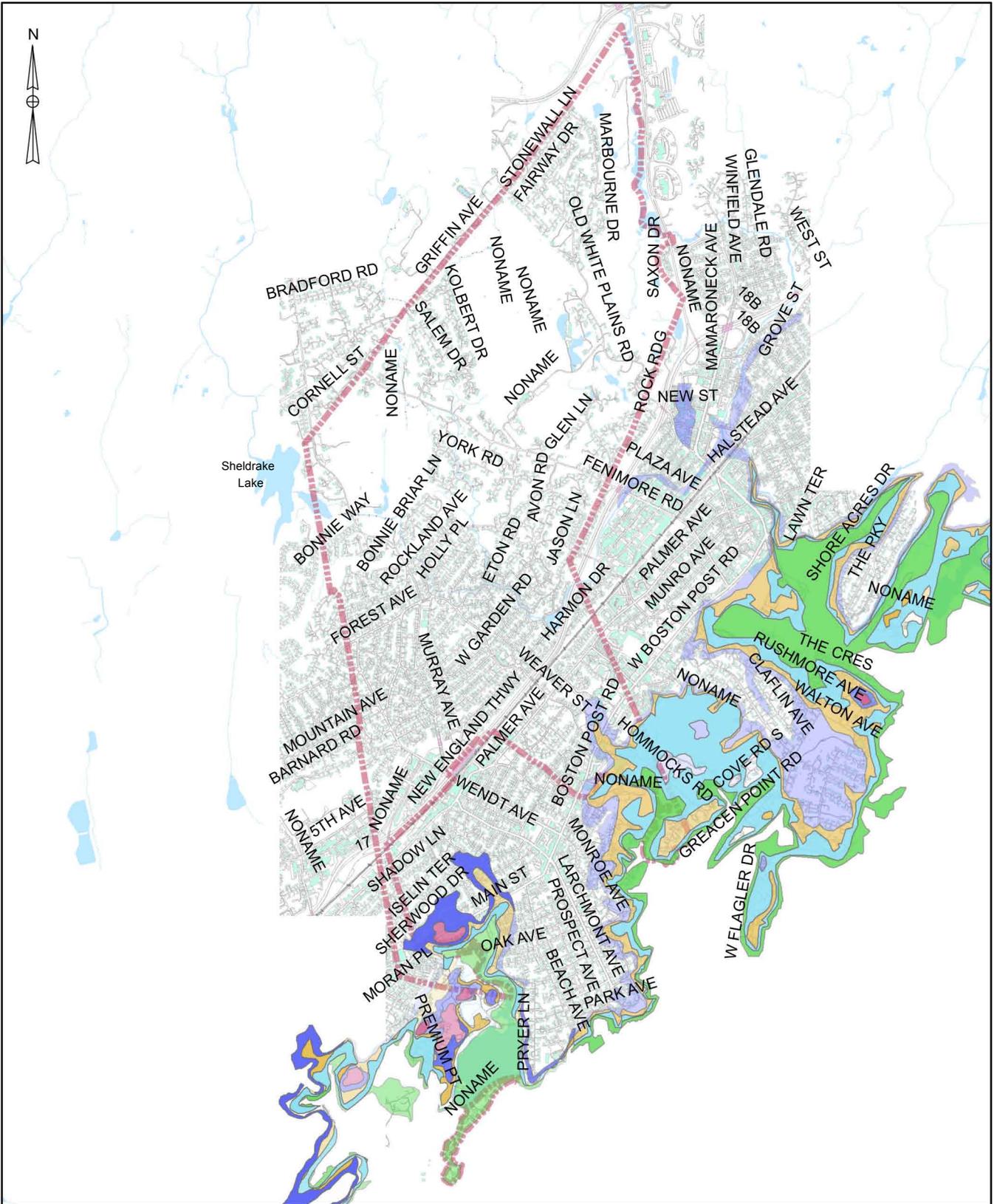
Map 3
 Land Use Designations
 Town of Mamaroneck
 All Hazard Mitigation Plan

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 300 WHEELER ROAD, SUITE 307, HAUPPAUGE, NEW YORK 11788

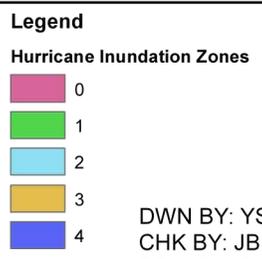
Basemap Information by Westchester County GIS



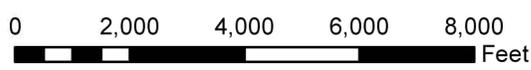
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 CHK BY: JB
 SCALE: AS SHOWN
 DATE: 08/27/13



Map 4
Hurricane Inundation Zones
Town of Mamaroneck
All Hazard Mitigation Plan



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SCALE: AS SHOWN
DATE: 08/27/13

APPENDICES

Attachments and Supporting Documents

ETG, Inc.

Town of Mamaroneck Multi-Hazard Mitigation Plan Draft 1

Appendix 1.

HAZNY Analysis

TOWN OF MAMARONECK HAZARDS RATINGS

HAZNY Analysis

Background Summary

On July 18, 2013 the Town of Mamaroneck, NY conducted a hazard analysis using the automated program, *HAZNY* (Hazards New York). *HAZNY* was developed by the American Red Cross and the New York State Emergency Management Office.

The results of this hazard analysis are presented in this report.

HAZNY Process

HAZNY is an automated interactive spreadsheet that asks specific questions on potential hazards in a community and records and evaluates the responses to these questions. *HAZNY* also includes historical and expert data on selected hazards. *HAZNY* is designed specifically for groups, rather than individual use. The Town of Mamaroneck, NY assembled a group of local officials to consider and discuss the questions and issues raised by the *HAZNY* program. Representatives from the Environmental Technology Group, Inc. (ETG) facilitated the meeting and recorded the results.

The HAZNY Score Results

The Group analyzed hazards potentially affecting the Town of Mamaroneck, NY. *HAZNY* rated each hazard based on the Group's assessment and assigned a numerical value.

These values are categorized as follows:

321 to 400 HIGH HAZARD

241 to 320 MODERATELY HIGH HAZARD

161 to 240 MODERATELY LOW HAZARD

44 to 160 LOW HAZARD

The Group rated the possible hazards as follows:

Hazard	Rating
FLOOD	321
COASTAL STORM	253
HURRICANE	248
SEVERE STORM & THUNDER	246
DAM FAILURE	239
FIRE	232
WINDSTORM	230
WINTER STORM (SEVERE)	230
TRANS ACCIDENT HIGHWAY	222
UTILITY FAILURE	221
TERRORISM	219
TORNADO	218
HAZMAT (IN TRANSIT)	210
EXTREME TEMPS	204
EARTHQUAKE	202
OIL SPILL	201
LANDSLIDE	199
EXPLOSION	192
WATER SUPPLY CONTAMINATION	182
EPIDEMIC	179
TRANS ACCIDENT RAIL	172
HAZMAT (FIXED SITE)	168

STRUCTURAL COLLAPSE	164
DROUGHT	152
FUEL SHORTAGE	142
RADIOLOGICAL RELEASE	140
INFESTATION	136
AIR CONTAMINATION	132
ICE JAM	123
FOOD SHORTAGE	119
FUEL OIL SPILL	113

**HAZARDS THAT OCCUR WITH NO
WARNING***

DAM FAILURE

FIRE

TRANS ACCIDENT HIGHWAY

UTILITY FAILURE

TERRORISM

HAZMAT (IN TRANSIT)

EARTHQUAKE

OIL SPILL

LANDSLIDE

EXPLOSION

TRANS ACCIDENT RAIL

HAZMAT (FIXED SITE)

STRUCTURAL COLLAPSE

RADIOLOGICAL (IN TRANSIT)

AIR CONTAMINATION

FUEL OIL SPILL

* No warning was selected from the Onset Tab.

HAZARDS THAT OCCUR MOST OFTEN*

COASTAL STORM

SEVERE STORM & THUNDER

FIRE

WINTER STORM (SEVERE)

TRANS ACCIDENT HIGHWAY

- A frequent event was selected on frequency Tab.

HAZARDS THAT PRESENT THE GREATEST THREAT TO LIFE*

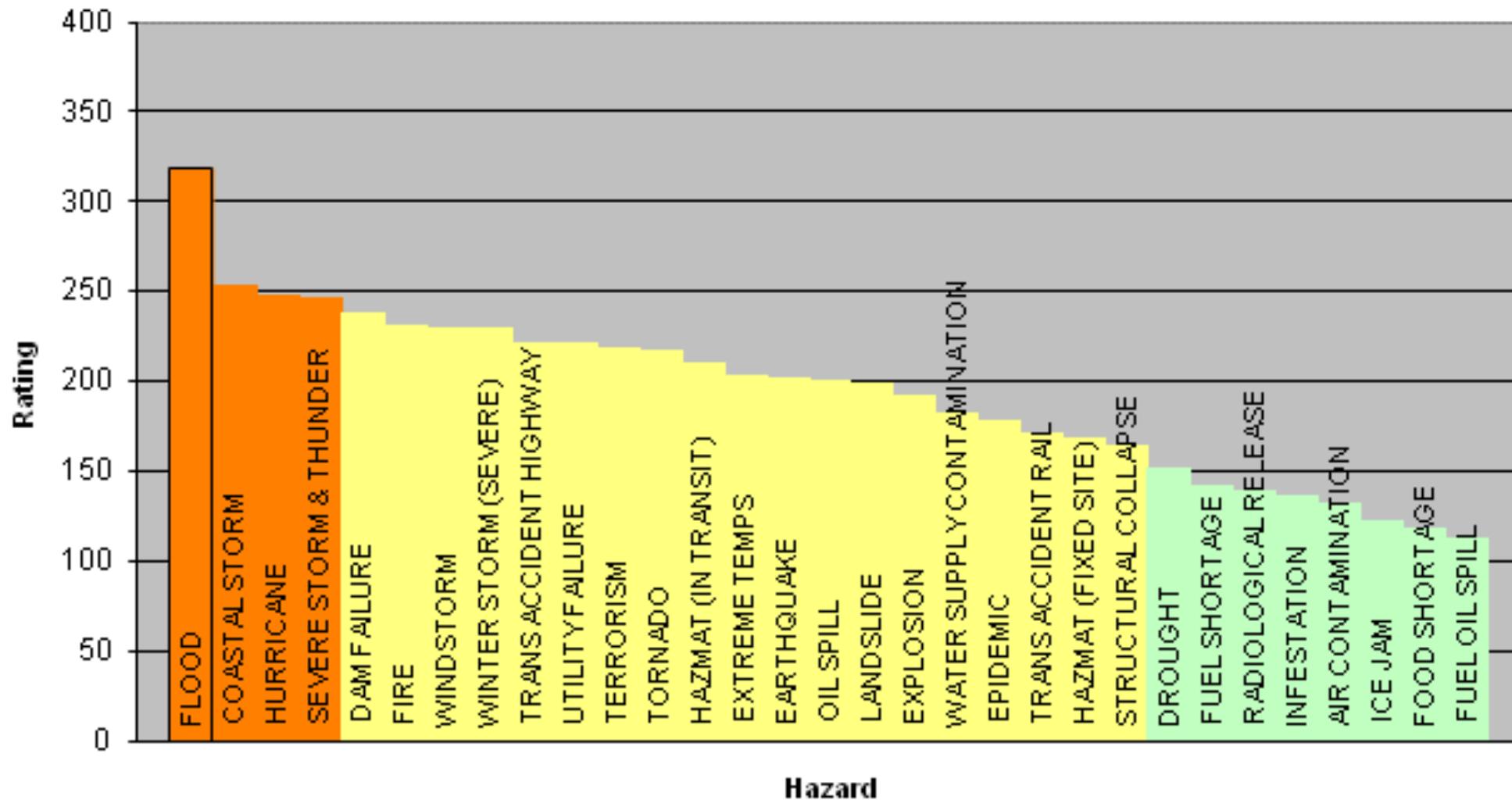
DAM FAILURE

TERRORISM

WATER SUPPLY CONTAMINATION

*Serious injury and death in large or extremely large numbers was selected from the Impact Tab.

Chart of Potential Hazards vs. Ratings
Town of Mamaroneck



Hazard(s) rated as high: FLOOD

FLOOD: 321, High Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Regular Event

Onset: Several Hours Warning

Hazard Duration: Two to Three Days

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Severe Damage to Private Property
- Severe Structural Damage to Public Facilities

Hazard(s) rated as moderately high: FLOOD, COASTAL STORM, HURRICANE, SEVERE STORM & THUNDER

COASTAL STORM: 253, Moderately High Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Frequent Event

Onset: Several Days Warning

Hazard Duration: Two to Three Days

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death Unlikely

- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

HURRICANE: 248, Moderately High Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Regular Event

Onset: Several Days Warning

Hazard Duration: One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Severe Damage to Private Property
- Moderate Structural Damage to Public Facilities

SEVERE STORM & THUNDER: 246, Moderately High Hazard

Potential Impact: Throughout a Small Region

Cascade Effects: Some Potential

Frequency: A Frequent Event

Onset: Several Hours Warning

Hazard Duration: Less Than One Day

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death Unlikely

- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

Hazard(s) rated as moderately low: DAM FAILURE, FIRE, WINDSTORM, WINTER STORM (SEVERE), TRANS ACCIDENT HIGHWAY, UTILITY FAILURE, TERRORISM, TORNADO, HAZMAT (IN TRANSIT), EXTREME TEMPS, EARTHQUAKE, OIL SPILL, LANDSLIDE, EXPLOSION, WATER SUPPLY CONTAMINATION, EPIDEMIC, TRANS ACCIDENT RAIL, HAZMAT (FIXED SITE), STRUCTURAL COLLAPSE

DAM FAILURE: 239, Moderately Low Hazard

Potential Impact: Throughout a Small Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death to Large Numbers
- Severe Damage to Private Property
- Severe Structural Damage to Public Facilities

FIRE: 232, Moderately Low Hazard

Potential Impact: Single Location

Cascade Effects: Highly Unlikely

Frequency: A Frequent Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death Unlikely
- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

WINDSTORM: 230, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: A Regular Event

Onset: Several Hours Warning

Hazard Duration: Less Than One Day

Recovery Time: One to Two Weeks

Impact:

- Serious Injury or Death Unlikely
- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

WINTER STORM (SEVERE): 230, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: A Frequent Event

Onset: Several Days Warning

Hazard Duration: Two to Three Days

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

TRANS ACCIDENT HIGHWAY: 222, Moderately Low Hazard

Potential Impact: Single Location

Cascade Effects: Some Potential

Frequency: A Frequent Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

UTILITY FAILURE: 221, Moderately Low Hazard

Potential Impact: Throughout a Small Region

Cascade Effects: Highly Likely

Frequency: A Regular Event

Onset: No Warning

Hazard Duration: One Day

Recovery Time: One to Two Days

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

TERRORISM: 219, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death to Large Numbers
- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

TORNADO: 218, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: An Infrequent Event

Onset: Several Hours Warning

Hazard Duration: Less Than One Day

Recovery Time: One to Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Severe Damage to Private Property
- Moderate Structural Damage to Public Facilities

HAZMAT (IN TRANSIT): 210, Moderately Low Hazard

Potential Impact: Throughout a Small Region

Cascade Effects: Some Potential

Frequency: An Infrequent Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Moderate Structural Damage to Public Facilities

EXTREME TEMPS: 204, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: A Regular Event

Onset: Several Days Warning

Hazard Duration: Four days to One Week

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Moderate Damage to Private Property
- Little or No Structural Damage to Public Facilities

EARTHQUAKE: 202, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Moderate Damage to Private Property
- Moderate Structural Damage to Public Facilities

OIL SPILL: 201, Moderately Low Hazard

Potential Impact: Several Locations

Cascade Effects: Highly Unlikely

Frequency: A Regular Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

LANDSLIDE: 199, Moderately Low Hazard

Potential Impact: Single Location

Cascade Effects: Some Potential

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Severe Damage to Private Property
- Severe Structural Damage to Public Facilities

EXPLOSION: 192, Moderately Low Hazard

Potential Impact: Single Location

Cascade Effects: Highly Unlikely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Severe Damage to Private Property
- Severe Structural Damage to Public Facilities

WATER SUPPLY CONTAMINATION: 182, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: Several Hours Warning

Hazard Duration: Two to Three Days

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death to Large Numbers
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

EPIDEMIC: 179, Moderately Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: An Infrequent Event

Onset: More Than One Week Warning

Hazard Duration: More Than One Week

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

TRANS ACCIDENT RAIL: 172, Moderately Low Hazard

Potential Impact: Throughout a Small Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: One to Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Moderate Structural Damage to Public Facilities

HAZMAT (FIXED SITE): 168, Moderately Low Hazard

Potential Impact: Several Locations

Cascade Effects: Some Potential

Frequency: An Infrequent Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

STRUCTURAL COLLAPSE: 164, Moderately Low Hazard

Potential Impact: Single Location

Cascade Effects: Some Potential

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: One Day

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Moderate Structural Damage to Public Facilities

Hazard(s) rated as low: DROUGHT, FUEL SHORTAGE, RADIOLOGICAL RELEASE, INFESTATION, AIR CONTAMINATION, ICE JAM, FOOD SHORTAGE, FUEL OIL SPILL

DROUGHT: 152, Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Some Potential

Frequency: An Infrequent Event

Onset: More Than One Week Warning

Hazard Duration: More Than One Week

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death Unlikely
- Moderate Damage to Private Property
- Little or No Structural Damage to Public Facilities

FUEL SHORTAGE: 142, Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Likely

Frequency: A Rare Event

Onset: More Than One Week Warning

Hazard Duration: More Than One Week

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

RADIOLOGICAL RELEASE: 140, Low Hazard

Potential Impact: Single Location

Cascade Effects: Highly Unlikely

Frequency: A Rare Event

Onset: Several Hours Warning

Hazard Duration: More Than One Week

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

INFESTATION: 136, Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Unlikely

Frequency: A Rare Event

Onset: More Than One Week Warning

Hazard Duration: More Than One Week

Recovery Time: More Than Two Weeks

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

AIR CONTAMINATION: 132, Low Hazard

Potential Impact: Several Locations

Cascade Effects: Some Potential

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: Less Than One Day

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death is Likely, but not in Large Numbers
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

ICE JAM: 123, Low Hazard

Potential Impact: Several Locations

Cascade Effects: Highly Unlikely

Frequency: An Infrequent Event

Onset: More Than One Week Warning

Hazard Duration: Four days to One Week

Recovery Time: Three Days to One Week

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

FOOD SHORTAGE: 119, Low Hazard

Potential Impact: Throughout a Large Region

Cascade Effects: Highly Unlikely

Frequency: A Rare Event

Onset: More Than One Week Warning

Hazard Duration: More Than One Week

Recovery Time: One to Two Weeks

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

FUEL OIL SPILL: 113, Low Hazard

Potential Impact: Single Location

Cascade Effects: Highly Unlikely

Frequency: A Rare Event

Onset: No Warning

Hazard Duration: One Day

Recovery Time: Less Than One Day

Impact:

- Serious Injury or Death Unlikely
- Little or No Damage to Private Property
- Little or No Structural Damage to Public Facilities

Appendix 2.
Documents, Meetings and Notices
(To be inserted at a later date)

Appendix 3.

HAZUS-MH: Sample Model Output

3.1 Hurricane Event Report

3.1.1 Hurricane Gloria Historical Model
Event Report

3.1.2 Probabilistic Model Event Report
(Quick Assessment Report)
(100 Year Return Period)
(500 Year Return Period)
(1000 Year Return Period)

3.2 Earthquake Event Report

3.2.1 Historical Model Event Report

3.2.2 Probabilistic Model Event Report
(100 Year Return Period)
(500 Year Return Period)
(1000 Year Return Period)

3.3 Flood Event Report

3.3.1 Probabilistic Model Event Report
(100 Year Return Period)
(500 Year Return Period)

3.1 Hurricane Event Report

3.1.1 Hurricane Gloria Historical Model
Event Report

3.1.2 Probabilistic Model Event Report
(Quick Assessment Report)
(100 Year Return Period)
(500 Year Return Period)
(1000 Year Return Period)

Quick Assessment Report

September 9, 2013

Study Region : TOM-Hurricane

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	4
Number of Census Tracts	2
Number of People in the Region	11,429
General Building Stock	

<u>Occupancy</u>	<u>Building Count</u>	<u>Dollar Exposure (\$ K)</u>
Residential	3,378	1,003,191
Commercial	284	130,641
Other	82	36,522
Total	3,744	1,170,354

Scenario Results

Number of Residential Buildings Damaged

<u>Return Period</u>	<u>Minor</u>	<u>Moderate</u>	<u>Severe</u>	<u>Destruction</u>	<u>Total</u>
10	0	0	0	0	0
20	2	0	0	0	2
50	12	1	0	0	13
100	70	9	0	0	79
200	244	38	0	0	282
500	672	156	6	3	837
1000	1,028	335	30	16	1,408

Number of Buildings Damaged

<u>Return Period</u>	<u>Minor</u>	<u>Moderate</u>	<u>Severe</u>	<u>Destruction</u>	<u>Total</u>
10	0	0	0	0	0
20	3	0	0	0	3
50	14	1	0	0	15
100	76	9	0	0	85
200	259	41	1	0	300
500	723	169	8	3	903
1000	1,112	373	37	16	1,539

Shelter Requirements

<u>Return Period</u>	<u>Displaced Households (#Households)</u>	<u>Short Term Shelter (#People)</u>
10	0	0
20	0	0
50	0	0
100	1	0
200	8	1
500	37	7
1000	89	17

Economic Loss (x 1000)

<u>ReturnPeriod</u>	<u>Property Damage (Capital Stock) Losses</u>		<u>Business Interruption (Income) Losses</u>
	<u>Residential</u>	<u>Total</u>	
10	0	0	0
20	0	0	0
50	824	846	16
100	3,224	3,320	203
200	7,791	8,099	538
500	23,234	24,590	2,006
1000	51,630	55,289	5,316
Annualized	266	285	24

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Hazus-MH: Hurricane Event Report

Region Name: TOM-Hurricane

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Monday, September 09, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religious	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.0%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 9 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 100 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	98.21	0	1.57	0	0.18	0	0.04	0	0.00
Commercial	280	98.42	4	1.42	0	0.16	0	0.00	0	0.00
Education	6	98.58	0	1.39	0	0.03	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	47	98.52	1	1.43	0	0.05	0	0.00	0	0.00
Religion	14	98.69	0	1.27	0	0.04	0	0.00	0	0.00
Residential	3,299	97.65	70	2.09	9	0.26	0	0.00	0	0.00
Total	3,659		76		9		0		0	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	75	98.04	1	1.93	0	0.03	0	0.00	0	0.00
Masonry	610	95.60	22	3.40	6	1.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	162	98.38	2	1.44	0	0.17	0	0.01	0	0.00
Wood	2,819	98.28	47	1.66	2	0.06	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Schools	4	0	0	4

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 999 tons of debris will be generated. Of the total amount, 199 tons (20%) is Other Tree Debris. Of the remaining 800 tons, Brick/Wood comprises 39% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 13 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 484 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 3.5 million dollars, which represents 0.30 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 4 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	3,022.70	72.39	5.07	11.01	3,111.16
	Content	201.40	6.46	0.16	0.27	208.29
	Inventory	0.00	0.12	0.03	0.03	0.19
	Subtotal	3,224.10	78.96	5.26	11.31	3,319.63
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	120.76	1.45	0.04	0.09	122.35
	Rental	80.64	0.00	0.00	0.00	80.64
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	201.40	1.45	0.04	0.09	202.98
<u>Total</u>						
	Total	3,425.49	80.42	5.30	11.41	3,522.62

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		Total
		Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Study Region Total	11,429	1,003,191	167,163	1,170,354

Hazus-MH: Hurricane Event Report

Region Name: TOM-Hurricane

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Monday, September 09, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religious	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.0%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 180 buildings will be at least moderately damaged. This is over 5% of the total number of buildings in the region. There are an estimated 3 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 500 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	11	76.93	2	16.34	1	4.36	0	2.11	0	0.26
Commercial	233	81.97	39	13.73	10	3.65	2	0.65	0	0.00
Education	5	83.66	1	13.62	0	2.61	0	0.11	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	40	83.11	6	13.15	2	3.18	0	0.52	0	0.03
Religion	12	82.47	2	15.03	0	2.39	0	0.11	0	0.00
Residential	2,541	75.22	672	19.91	156	4.62	6	0.17	3	0.08
Total	2,841		723		169		8		3	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	61	80.36	12	15.25	3	4.30	0	0.09	0	0.00
Masonry	451	70.63	117	18.36	69	10.77	1	0.19	0	0.06
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	136	82.39	20	12.32	7	4.22	2	1.06	0	0.01
Wood	2,210	77.07	570	19.88	80	2.80	5	0.18	2	0.08

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 5,145 tons of debris will be generated. Of the total amount, 731 tons (14%) is Other Tree Debris. Of the remaining 4,414 tons, Brick/Wood comprises 59% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 104 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,803 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 37 households to be displaced due to the hurricane. Of these, 7 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 26.6 million dollars, which represents 2.27 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 27 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 93% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	19,243.22	838.74	78.03	166.01	20,326.00
	Content	3,990.28	192.54	34.73	35.93	4,253.49
	Inventory	0.00	5.43	3.78	1.68	10.89
	Subtotal	23,233.50	1,036.71	116.54	203.62	24,590.37
<u>Business Interruption Loss</u>						
	Income	0.00	131.37	1.43	23.52	156.31
	Relocation	880.73	143.62	6.77	26.32	1,057.44
	Rental	526.71	83.62	0.93	2.04	613.30
	Wage	0.00	121.36	1.83	55.29	178.48
	Subtotal	1,407.44	479.96	10.96	107.17	2,005.53
<u>Total</u>						
	Total	24,640.94	1,516.67	127.49	310.79	26,595.90

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		Total
		Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Study Region Total	11,429	1,003,191	167,163	1,170,354

Hazus-MH: Hurricane Event Report

Region Name: TOM-Hurricane

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Monday, September 09, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religious	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.0%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 427 buildings will be at least moderately damaged. This is over 11% of the total number of buildings in the region. There are an estimated 16 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 1000 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	8	58.33	4	26.11	1	10.03	1	4.77	0	0.76
Commercial	183	64.26	65	22.91	30	10.68	6	2.12	0	0.02
Education	4	66.32	1	23.08	1	9.61	0	0.99	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	31	65.47	11	21.91	5	10.52	1	2.00	0	0.10
Religion	9	65.45	4	25.38	1	8.39	0	0.77	0	0.00
Residential	1,970	58.31	1,028	30.43	335	9.91	30	0.88	16	0.47
Total	2,205		1,112		373		37		16	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	47	61.41	18	23.53	11	14.12	1	0.95	0	0.00
Masonry	342	53.53	166	26.05	122	19.15	6	0.95	2	0.32
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	106	64.46	33	20.24	20	12.07	5	3.19	0	0.04
Wood	1,727	60.20	896	31.23	207	7.21	25	0.87	14	0.48

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 10,475 tons of debris will be generated. Of the total amount, 1,500 tons (14%) is Other Tree Debris. Of the remaining 8,975 tons, Brick/Wood comprises 57% of the total, Reinforced Concrete/Steel comprises 1% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 208 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 3,774 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 89 households to be displaced due to the hurricane. Of these, 17 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 60.6 million dollars, which represents 5.18 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 61 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	39,963.04	2,101.39	217.31	387.02	42,668.77
	Content	11,666.89	686.55	121.13	110.88	12,585.45
	Inventory	0.00	18.10	12.59	4.46	35.14
	Subtotal	51,629.93	2,806.03	351.03	502.36	55,289.36
<u>Business Interruption Loss</u>						
	Income	0.15	169.65	2.36	28.50	200.65
	Relocation	2,891.95	386.18	21.98	63.98	3,364.10
	Rental	1,287.68	216.98	2.56	4.60	1,511.82
	Wage	0.35	169.14	3.03	66.64	239.15
	Subtotal	4,180.13	941.94	29.92	163.72	5,315.72
<u>Total</u>						
	Total	55,810.06	3,747.98	380.96	666.08	60,605.07

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		Total
		Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Study Region Total	11,429	1,003,191	167,163	1,170,354

Hazus-MH: Hurricane Event Report

Region Name: TOM-Hurricane

Hurricane Scenario: GLORIA

Print Date: Monday, September 09, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religious	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.0%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	GLORIA
Type:	Historic
Max Peak Gust in Study Region:	59 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	99.83	0	0.17	0	0.00	0	0.00	0	0.00
Commercial	283	99.78	1	0.22	0	0.00	0	0.00	0	0.00
Education	6	99.77	0	0.23	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	48	99.76	0	0.24	0	0.00	0	0.00	0	0.00
Religion	14	99.81	0	0.19	0	0.00	0	0.00	0	0.00
Residential	3,376	99.93	2	0.07	0	0.00	0	0.00	0	0.00
Total	3,741		3		0		0		0	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	76	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Masonry	636	99.71	2	0.29	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	165	99.75	0	0.25	0	0.00	0	0.00	0	0.00
Wood	2,867	99.98	0	0.02	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Schools	4	0	0	4

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 4 tons of debris will be generated. Of the total amount, 0 tons (0%) is Other Tree Debris. Of the remaining 4 tons, Brick/Wood comprises 100% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 0 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 100% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	21.04	0.00	0.00	0.00	21.04
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	21.04	0.00	0.00	0.00	21.04
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.12	0.00	0.00	0.00	0.12
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.12	0.00	0.00	0.00	0.12
<u>Total</u>						
	Total	21.16	0.00	0.00	0.00	21.16

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		Total
		Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Study Region Total	11,429	1,003,191	167,163	1,170,354

3.2 Earthquake Event Report

3.2.1 Historical Model Event Report

3.2.2 Probabilistic Model Event Report

(100 Year Return Period)

(500 Year Return Period)

(1000 Year Return Period)

Hazus-MH: Earthquake Event Report

Region Name: TOM-Earthquake

Earthquake Scenario: probabilistic 100yr

Print Date: September 09, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

New York

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region which has a total population of 11,429 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 (millions of dollars). Approximately 90.00 % of the buildings (and 86.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 253 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,170 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 77% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 4 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 253.00 (millions of dollars). This inventory includes over 20 kilometers of highways, 13 bridges, 147 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	13	91.70
	Segments	9	153.40
	Tunnels	0	0.00
	Subtotal		245.10
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	1	8.10
	Tunnels	0	0.00
	Subtotal		8.10
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		0.00
		Total	253.20

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	1.50
Waste Water	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.90
Natural Gas	Distribution Lines	NA	0.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.60
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.00
Electrical Power	Facilities	0	0.00
		Subtotal	0.00
Communication	Facilities	0	0.00
		Subtotal	0.00
		Total	3.00

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	probabilistic 100yr
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	284	7.59	0	0.00	0	0.00	0	0.00	0	0.00
Education	6	0.16	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	48	1.28	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	343	9.16	0	0.00	0	0.00	0	0.00	0	0.00
Religion	14	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	3,035	81.06	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,744		0		0		0		0	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,867	76.58	0	0.00	0	0.00	0	0.00	0	0.00
Steel	165	4.42	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	65	1.75	0	0.00	0	0.00	0	0.00	0	0.00
Precast	11	0.28	0	0.00	0	0.00	0	0.00	0	0.00
RM	59	1.59	0	0.00	0	0.00	0	0.00	0	0.00
URM	576	15.39	0	0.00	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,744		0		0		0		0	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	9	0	0	9	9
	Bridges	13	0	0	13	13
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	74	0	0
Waste Water	44	0	0
Natural Gas	30	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,269	0	0	0	0	0
Electric Power		0	0	0	0	0

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 0.00 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00	0.00	0.00	0.00	0.00
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non_Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	153.39	\$0.00	0.00
	Bridges	91.70	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Subtotal	245.10	0.00	
Railways	Segments	8.12	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	8.10	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
	Total	253.20	0.00	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.50	\$0.00	0.00
	Subtotal	1.48	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.90	\$0.00	0.00
	Subtotal	0.89	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.60	\$0.00	0.00
	Subtotal	0.59	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Total		2.96	\$0.00	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Westchester, NY

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New York	Westchester	11,429	1,003	167	1,170
Total State		11,429	1,003	167	1,170
Total Region		11,429	1,003	167	1,170

Hazus-MH: Earthquake Event Report

Region Name: TOM-Earthquake

Earthquake Scenario: Probabilistic 500yr

Print Date: September 09, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

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The replacement value of the transportation and utility lifeline systems is estimated to be 253 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

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In terms of building construction types found in the region, wood frame construction makes up 77% of the building inventory. The remaining percentage is distributed between the other general building types.

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 4 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 253.00 (millions of dollars). This inventory includes over 20 kilometers of highways, 13 bridges, 147 kilometers of pipes.

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Highway	Bridges	13	91.70
	Segments	9	153.40
	Tunnels	0	0.00
		Subtotal	245.10
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	1	8.10
	Tunnels	0	0.00
		Subtotal	8.10
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	0.00
Bus	Facilities	0	0.00
		Subtotal	0.00
Ferry	Facilities	0	0.00
		Subtotal	0.00
Port	Facilities	0	0.00
		Subtotal	0.00
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	0.00
		Total	253.20

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	1.50
Waste Water	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.90
Natural Gas	Distribution Lines	NA	0.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.60
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.00
Electrical Power	Facilities	0	0.00
		Subtotal	0.00
Communication	Facilities	0	0.00
		Subtotal	0.00
		Total	3.00

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Probabilistic 500yr
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 35 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	13	0.37	1	0.41	0	0.52	0	0.57	0	0.36
Commercial	267	7.49	12	8.71	4	12.95	1	14.79	0	12.56
Education	6	0.16	0	0.17	0	0.24	0	0.26	0	0.28
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	45	1.27	2	1.41	1	2.17	0	2.27	0	1.78
Other Residential	325	9.11	13	9.67	4	11.74	0	12.83	0	12.78
Religion	13	0.37	1	0.44	0	0.66	0	0.80	0	0.82
Single Family	2,900	81.23	109	79.18	23	71.72	2	68.47	0	71.41
Total	3,570		138		32		4		0	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,767	77.49	88	64.04	12	36.65	1	15.07	0	0.00
Steel	157	4.40	6	4.43	2	6.64	0	5.62	0	2.83
Concrete	62	1.75	2	1.71	1	2.08	0	0.96	0	0.24
Precast	10	0.27	0	0.32	0	0.92	0	1.58	0	0.10
RM	56	1.58	2	1.33	1	3.11	0	3.50	0	0.00
URM	518	14.51	39	28.17	16	50.61	3	73.28	0	96.83
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,570		138		32		4		0	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	9	0	0	9	9
	Bridges	13	0	0	13	13
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	74	0	0
Waste Water	44	0	0
Natural Gas	30	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,269	0	0	0	0	0
Electric Power		0	0	0	0	0

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 77.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 household to be displaced due to the earthquake. Of these, 0 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	1	0	0	0
	Total	1	0	0	0
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 3.30 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 3.29 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 74 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.09	0.00	0.00	0.09
	Capital-Related	0.00	0.00	0.08	0.00	0.00	0.08
	Rental	0.04	0.03	0.05	0.00	0.00	0.12
	Relocation	0.13	0.02	0.06	0.00	0.01	0.23
	Subtotal	0.17	0.06	0.27	0.00	0.02	0.52
Capital Stock Losses							
	Structural	0.39	0.06	0.08	0.01	0.02	0.56
	Non_Structural	1.15	0.26	0.24	0.03	0.04	1.71
	Content	0.28	0.06	0.12	0.02	0.02	0.49
	Inventory	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	1.82	0.37	0.44	0.05	0.07	2.76
	Total	1.99	0.43	0.71	0.06	0.09	3.29

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	153.39	\$0.00	0.00
	Bridges	91.70	\$0.01	0.01
	Tunnels	0.00	\$0.00	0.00
	Subtotal	245.10	0.00	
Railways	Segments	8.12	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	8.10	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
	Total	253.20	0.00	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.50	\$0.00	0.06
	Subtotal	1.48	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.90	\$0.00	0.05
	Subtotal	0.89	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.60	\$0.00	0.03
	Subtotal	0.59	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Total		2.96	\$0.00	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Westchester, NY

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New York	Westchester	11,429	1,003	167	1,170
Total State		11,429	1,003	167	1,170
Total Region		11,429	1,003	167	1,170

Hazus-MH: Earthquake Event Report

Region Name: TOM-Earthquake

Earthquake Scenario: Probabilistic 1000 yr

Print Date: September 09, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

New York

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region which has a total population of 11,429 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 (millions of dollars). Approximately 90.00 % of the buildings (and 86.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 253 and 0 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,170 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 77% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 4 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 253.00 (millions of dollars). This inventory includes over 20 kilometers of highways, 13 bridges, 147 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	13	91.70
	Segments	9	153.40
	Tunnels	0	0.00
	Subtotal		245.10
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	1	8.10
	Tunnels	0	0.00
	Subtotal		8.10
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		0.00
		Total	253.20

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	1.50
Waste Water	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.90
Natural Gas	Distribution Lines	NA	0.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.60
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.00
Electrical Power	Facilities	0	0.00
		Subtotal	0.00
Communication	Facilities	0	0.00
		Subtotal	0.00
		Total	3.00

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Probabilistic 1000 yr
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	1,000.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 114 buildings will be at least moderately damaged. This is over 3.00 % of the buildings in the region. There are an estimated 1 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	12	0.36	1	0.41	1	0.54	0	0.66	0	0.44
Commercial	240	7.31	29	8.21	13	13.11	2	15.83	0	13.53
Education	5	0.16	1	0.17	0	0.26	0	0.27	0	0.29
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	41	1.24	5	1.35	2	2.34	0	2.64	0	2.09
Other Residential	298	9.07	32	9.28	11	11.23	2	12.45	0	12.55
Religion	12	0.36	1	0.40	1	0.60	0	0.76	0	0.79
Single Family	2,674	81.49	279	80.19	72	71.92	9	67.40	1	70.32
Total	3,282		347		100		13		1	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,573	78.41	245	70.60	46	45.83	3	21.67	0	6.73
Steel	141	4.29	15	4.42	8	8.09	1	8.14	0	4.99
Concrete	56	1.70	6	1.82	3	2.99	0	1.87	0	1.10
Precast	9	0.26	1	0.26	1	0.75	0	1.43	0	0.21
RM	52	1.59	4	1.12	3	2.76	0	3.68	0	0.14
URM	451	13.75	76	21.78	40	39.58	9	63.22	1	86.83
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,282		347		100		13		1	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	9	0	0	9	9
	Bridges	13	0	0	13	13
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	74	1	0
Waste Water	44	0	0
Natural Gas	30	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,269	0	0	0	0	0
Electric Power		0	0	0	0	0

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 71.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 80 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 7 households to be displaced due to the earthquake. Of these, 3 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	2	0	0	0
	Total	2	0	0	0
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	2	0	0	0
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	1	0	0	0
	Total	2	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 12.66 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 12.58 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 74 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.01	0.30	0.00	0.01	0.31
	Capital-Related	0.00	0.00	0.27	0.00	0.00	0.27
	Rental	0.12	0.11	0.15	0.00	0.00	0.38
	Relocation	0.44	0.08	0.20	0.01	0.04	0.77
	Subtotal	0.56	0.19	0.92	0.02	0.05	1.75
Capital Stock Losses							
	Structural	1.21	0.18	0.28	0.02	0.05	1.74
	Non_Structural	4.42	1.03	0.94	0.11	0.16	6.65
	Content	1.45	0.28	0.53	0.07	0.09	2.42
	Inventory	0.00	0.00	0.01	0.01	0.00	0.02
	Subtotal	7.07	1.49	1.76	0.21	0.30	10.83
	Total	7.63	1.69	2.68	0.23	0.35	12.58

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	153.39	\$0.00	0.00
	Bridges	91.70	\$0.08	0.09
	Tunnels	0.00	\$0.00	0.00
	Subtotal	245.10	0.10	
Railways	Segments	8.12	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	8.10	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
	Total	253.20	0.10	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.50	\$0.00	0.18
	Subtotal	1.48	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.90	\$0.00	0.15
	Subtotal	0.89	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.60	\$0.00	0.07
	Subtotal	0.59	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Total		2.96	\$0.00	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Westchester, NY

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New York	Westchester	11,429	1,003	167	1,170
Total State		11,429	1,003	167	1,170
Total Region		11,429	1,003	167	1,170

Hazus-MH: Earthquake Event Report

Region Name: TOM-Earthquake

Earthquake Scenario: HistoricalNYEpienter4582

Print Date: September 09, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

New York

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3.56 square miles and contains 2 census tracts. There are over 4 thousand households in the region which has a total population of 11,429 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,170 (millions of dollars). Approximately 90.00 % of the buildings (and 86.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 253 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,170 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 77% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 4 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 253.00 (millions of dollars). This inventory includes over 20 kilometers of highways, 13 bridges, 147 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	13	91.70
	Segments	9	153.40
	Tunnels	0	0.00
	Subtotal		245.10
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	1	8.10
	Tunnels	0	0.00
	Subtotal		8.10
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		0.00
		Total	253.20

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	1.50
Waste Water	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.90
Natural Gas	Distribution Lines	NA	0.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.60
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	0.00
Electrical Power	Facilities	0	0.00
		Subtotal	0.00
Communication	Facilities	0	0.00
		Subtotal	0.00
		Total	3.00

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	HistoricalNYEpicenter4582
Type of Earthquake	Historical
Fault Name	NA
Historical Epicenter ID #	4582
Probabilistic Return Period	NA
Longitude of Epicenter	-74.31
Latitude of Epicenter	44.03
Earthquake Magnitude	5.20
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	284	7.59	0	0.00	0	0.00	0	0.00	0	0.00
Education	6	0.16	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	48	1.28	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	343	9.16	0	0.00	0	0.00	0	0.00	0	0.00
Religion	14	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	3,035	81.06	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,744		0		0		0		0	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,867	76.58	0	0.00	0	0.00	0	0.00	0	0.00
Steel	165	4.42	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	65	1.75	0	0.00	0	0.00	0	0.00	0	0.00
Precast	11	0.28	0	0.00	0	0.00	0	0.00	0	0.00
RM	59	1.59	0	0.00	0	0.00	0	0.00	0	0.00
URM	576	15.39	0	0.00	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	3,744		0		0		0		0	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	9	0	0	9	9
	Bridges	13	0	0	13	13
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	74	0	0
Waste Water	44	0	0
Natural Gas	30	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,269	0	0	0	0	0
Electric Power		0	0	0	0	0

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
	2 PM	Commercial	0	0	0
Commuting		0	0	0	0
Educational		0	0	0	0
Hotels		0	0	0	0
Industrial		0	0	0	0
Other-Residential		0	0	0	0
Single Family		0	0	0	0
Total		0	0	0	0
5 PM		Commercial	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 0.00 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00	0.00	0.00	0.00	0.00
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non_Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	153.39	\$0.00	0.00
	Bridges	91.70	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Subtotal	245.10	0.00	
Railways	Segments	8.12	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	8.10	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
	Total	253.20	0.00	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.50	\$0.00	0.00
	Subtotal	1.48	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.90	\$0.00	0.00
	Subtotal	0.89	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	0.60	\$0.00	0.00
	Subtotal	0.59	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	2.96	\$0.00	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Westchester, NY

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New York	Westchester	11,429	1,003	167	1,170
Total State		11,429	1,003	167	1,170
Total Region		11,429	1,003	167	1,170

3.3 Flood Event Report

3.3.1 Probabilistic Model Event Report

(100 Year Return Period)

(500 Year Return Period)

Hazus-MH: Flood Event Report

Region Name: TOM-Flood

Flood Scenario: RiverineCoastalCase

Print Date: Wednesday, September 11, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 4 square miles and contains 189 census blocks. The region contains over 4 thousand households and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 3,744 buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90.22% of the buildings (and 85.72% of the building value) are associated with residential housing.

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure (\$1000)	Percent of Total
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religion	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.00%

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure (\$1000)	Percent of Total
Residential	340,345	78.5%
Commercial	77,841	18.0%
Industrial	9,124	2.1%
Agricultural	1,736	0.4%
Religion	3,878	0.9%
Government	0	0.0%
Education	468	0.1%
Total	433,392	100.00%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire station, no police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	TOM-Flood
Scenario Name:	RiverineCoastalCase
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

General Building Stock Damage

Hazus estimates that about 39 buildings will be at least moderately damaged. This is over 22% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	11	28.21	15	38.46	8	20.51	5	12.82	0	0.00
Total	0		11		15		8		5		0	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	2	33.33	3	50.00	1	16.67	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	9	27.27	12	36.36	7	21.21	5	15.15	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	0	0	0	0
Schools	4	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

- (1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.
- (2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1,514 tons of debris will be generated. Of the total amount, Finishes comprises 69% of the total, Structure comprises 18% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 61 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 214 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 432 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 31.19 million dollars, which represents 7.20 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 31.04 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 43.36% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Building Loss</u>						
	Building	8.30	4.27	0.35	0.10	13.01
	Content	5.22	11.39	0.51	0.55	17.68
	Inventory	0.00	0.27	0.07	0.01	0.35
	Subtotal	13.52	15.94	0.92	0.66	31.04
<u>Business Interruption</u>						
	Income	0.00	0.06	0.00	0.00	0.06
	Relocation	0.01	0.02	0.00	0.00	0.02
	Rental Income	0.00	0.01	0.00	0.00	0.01
	Wage	0.00	0.06	0.00	0.00	0.07
	Subtotal	0.01	0.14	0.00	0.01	0.15
ALL	Total	13.53	16.08	0.92	0.66	31.19

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Building Value (thousands of dollars)			Total
	Population	Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Total Study Region	11,429	1,003,191	167,163	1,170,354

Hazus-MH: Flood Event Report

Region Name: TOM-Flood

Flood Scenario: RiverineCoastalCase

Print Date: Wednesday, September 11, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

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The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- New York

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 4 square miles and contains 189 census blocks. The region contains over 4 thousand households and has a total population of 11,429 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 3,744 buildings in the region with a total building replacement value (excluding contents) of 1,170 million dollars (2006 dollars). Approximately 90.22% of the buildings (and 85.72% of the building value) are associated with residential housing.

General Building Stock

Hazus estimates that there are 3,744 buildings in the region which have an aggregate total replacement value of 1,170 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

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Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure (\$1000)	Percent of Total
Residential	1,003,191	85.7%
Commercial	130,641	11.2%
Industrial	13,482	1.2%
Agricultural	2,711	0.2%
Religion	17,919	1.5%
Government	0	0.0%
Education	2,410	0.2%
Total	1,170,354	100.00%

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure (\$1000)	Percent of Total
Residential	340,345	78.5%
Commercial	77,841	18.0%
Industrial	9,124	2.1%
Agricultural	1,736	0.4%
Religion	3,878	0.9%
Government	0	0.0%
Education	468	0.1%
Total	433,392	100.00%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 1 fire station, no police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	TOM-Flood
Scenario Name:	RiverineCoastalCase
Return Period Analyzed:	500
Analysis Options Analyzed:	No What-Ifs

General Building Stock Damage

Hazus estimates that about 43 buildings will be at least moderately damaged. This is over 14% of the total number of buildings in the scenario. There are an estimated 2 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	5	11.63	15	34.88	8	18.60	13	30.23	2	4.65
Total	0		5		15		8		13		2	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	2	40.00	1	20.00	2	40.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	5	13.16	13	34.21	7	18.42	11	28.95	2	5.26

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	0	0	0	0
Schools	4	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

- (1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.
- (2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3,519 tons of debris will be generated. Of the total amount, Finishes comprises 43% of the total, Structure comprises 33% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 141 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 257 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 518 people (out of a total population of 11,429) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 38.11 million dollars, which represents 8.79 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 37.93 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 42.25% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Building Loss</u>						
	Building	9.93	5.69	0.39	0.14	16.15
	Content	6.16	13.93	0.58	0.68	21.34
	Inventory	0.00	0.36	0.08	0.01	0.44
	Subtotal	16.09	19.97	1.04	0.82	37.93
<u>Business Interruption</u>						
	Income	0.00	0.06	0.00	0.00	0.06
	Relocation	0.01	0.02	0.00	0.00	0.03
	Rental Income	0.00	0.01	0.00	0.00	0.01
	Wage	0.00	0.07	0.00	0.01	0.08
	Subtotal	0.01	0.17	0.00	0.01	0.18
ALL	Total	16.10	20.14	1.04	0.83	38.11

Appendix A: County Listing for the Region

New York

- Westchester

Appendix B: Regional Population and Building Value Data

	Building Value (thousands of dollars)			Total
	Population	Residential	Non-Residential	
New York				
Westchester	11,429	1,003,191	167,163	1,170,354
Total	11,429	1,003,191	167,163	1,170,354
Total Study Region	11,429	1,003,191	167,163	1,170,354