# TOWN OF CORNWALL / VILLAGE OF CORNWALL-ON-HUDSON
# 2013 JOINT HAZARD MITIGATION PLAN

Town of Cornwall
Village of Cornwall-on-Hudson
Orange County, New York

**Prepared for:**

Cornwall Town Board
Town of Cornwall
183 Main Street
Cornwall, NY 12518

Telephone No.: (845) 534-9100

Cornwall-on-Hudson Board of Trustees
Village of Cornwall-on-Hudson
325 Hudson Street
Cornwall-on-Hudson, NY 12520

Telephone No.: (845) 534-4200

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Mary Beth Greene-Krafft – Deputy Supervisor
Randolph Clark – Councilman
Alexander Mazzocca – Councilman
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### HAZARD MITIGATION PLANNING TEAM

Mark Edsall – Town Engineer, Village Trustee, Point of Contact (POC)
Todd Hazard, Chief of Police (Town)
Robert Conley, Highway Superintendent (Town)
Steve Dixon, Chief of Police (Village)
David Halvorsen, Superintendent of Public Works (Village)
Robert June, Water Superintendent (Village)
Kurt Hahn, Emergency Manager (Town)
Gary Vinson, Building, Zoning and Fire Inspector (Town)
Robby Vought, Fire Chief – Cornwall-on-Hudson Fire District
Patrick Hines, Fire Chief – Canterbury Fire District
Jerry Bohr, Fire Chief – Vales Gate Fire District
Jeff Garfinkel, 2nd Lieutenant – Salisbury Mills Fire District
Jack Boyle, Chief – Cornwall Volunteer Ambulance Corps
Walter Moran, Superintendent of Buildings & Grounds –
Cornwall Central School District
John Pinckney, Director of Health & Safety – Cornwall Central School District

Federal Emergency Management Agency (FEMA)

New York State Division of Homeland Security and Emergency Services (DHSES),
Office of Emergency Management (OEM)

Orange County Water Authority

Orange County Division of Emergency Management

New York State Thruway Authority

**Preparer / Contact:**

Turner Miller Group New York
2 Executive Boulevard, Suite 108
Suffern, New York 10901
Contact: Fred W. Doneit
Phone: (845) 368-1472

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# I. INTRODUCTION

## A. Overview

Losses from disasters need not be excessive in all cases. The implementation of disaster reduction, or hazard mitigation measures, is essential to ensuring that losses from disasters are eliminated or curtailed.

The Federal Disaster Mitigation Act of 2000 places new emphasis on State and local mitigation planning. The Act created Section 322 and implementing Regulations, 44 CFR Part 201 – "Mitigation Planning." In addressing the requirements for State and local All-Hazard Mitigation Plans, both the law and the regulations indicate that local governments must possess a FEMA-approved Mitigation Plan in order to be eligible for project funding. The effective date of the plan requirement was November 1, 2004.

The purpose of this Hazard Mitigation Plan is to jointly assist the Town of Cornwall and the Village of Cornwall-on-Hudson in identifying all natural hazards facing the communities. It also identifies and outlines strategies to begin reducing risks from those identified hazards through avoidance and other protective measures.

This document will serve as a basis for zoning and other regulatory tools to help guide the continued physical development of the Town and Village.

To prepare this Hazard Mitigation Plan, the Town and Village retained the services of the Turner Miller Group.

The impact of expected yet unpredictable natural and human-caused events can be reduced through community planning. The goal of this Plan is to provide a mechanism that will enable the Town and Village to become more disaster resistant.

Hazard mitigation is defined as any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous efforts, FEMA and state agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This Plan recognizes that the Town of Cornwall and the Village of Cornwall-on-Hudson have and are continuing to take the opportunity to identify mitigation strategies and measures during all phases of emergency management – preparedness, response and recovery. Hazards cannot be eliminated altogether, but it is possible to determine what the hazards are, where the hazards are most severe and identify local actions that can be taken to avoid exposure to or otherwise reduce the severity of the hazard.

The Disaster Mitigation Act of 2000 (DMA 2000) establishes a national program for pre-disaster mitigation which includes mitigation planning and eligibility requirements for state and local governments. The Act is aimed at reducing loss of life and property, human suffering, economic disruption, and disaster costs. High priority is given to

mitigation of hazards at the local level with an increased emphasis on assessment and avoidance of identified risks, implementing loss reduction measures for existing exposures, and ensuring that critical services/facilities are able to survive a disaster.

## 1. State Hazard Mitigation Planning

To comply with the State Hazard Mitigation Plan requirements of DMA 2000, working with other State agencies and other organizations, the New York State Emergency Management Office (SEMO), now the New York State Division of Homeland Security and Emergency Services (DHSES), Office of Emergency Management (OEM) coordinated the preparation of the current New York State Hazard Mitigation Plan. Approved by FEMA on January 4, 2008, the New York State Hazard Mitigation Plan by law must be updated and resubmitted to FEMA for review and approval. All states must comply with the three-year plan review, update and approval process in order to remain eligible for Hazard Mitigation Grant Program (HMGP) funding and public assistance funds authorized under Categories C through H. Based on past disaster experience in New York State, failure to meet this requirement places millions of dollars in post-disaster funding to the State in jeopardy.

## 2. Local Hazard Mitigation Planning

As of November 1, 2004, all local governments are required to have a FEMA-approved All-Hazard Mitigation Plan in order to receive project funding from the Hazard Mitigation Grant Program (HMGP). Additionally, the Pre-Disaster Mitigation Program (PDM) and the Flood Mitigation Assistance Program (FMA) continue to require communities to have a FEMA-approved Multi-Hazard Mitigation Plan in place prior to requesting project implementation funds. A mitigation plan prepared under the all-hazard mitigation guidelines outlined in 44 CFR Part 201.6 should satisfy the planning requirements of the HMGP, PDM and FMA. The plan could also satisfy the mitigation planning requirements of other programs (e.g., the Community Rating System (CRS) planning requirements of the National Flood Insurance Program (NFIP)). The CRS provides for a reduction in NFIP premiums when participating communities implement actions beyond the minimum requirements of the NFIP.

A community's multi-hazard mitigation plan indicates that the community has identified the hazards to which it is exposed, assessed the attendant risks and vulnerabilities, prepared a mitigation strategy to reduce or eliminate those risks and vulnerabilities, and has developed an action plan that will ensure the implementation of the mitigation strategy. Public input and participation by all relevant stakeholders in the planning process is required.

As outlined in the all-hazard mitigation guidelines in 44 CFR Part 201.6, local mitigation plans can be prepared either by a single jurisdiction, e.g., town, village or city, or by multiple jurisdictions, such as several towns, villages and cities together under the auspices of their county or a regional organization. All-hazard mitigation plans must be reviewed, updated and resubmitted for re-approval every five years after initial approval.

### 3. Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) was created by Section 404 of the Robert T. Stafford Act to assist states and communities in implementing long-term hazard mitigation measures following a major disaster declaration. The objective of the HMGP is to prevent future losses of lives and property due to disasters and to enable mitigation measures to be implemented during the immediate recovery from federally declared disasters. Seven percent of HMGP monies can be used for planning purposes.

### 4. Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation Program (PDM), authorized by the Robert T. Stafford Act as amended by Section 102 of the Disaster Mitigation Act (DMA) of 2000, provides states with grants to support local mitigation plan development and implementation of projects. The Disaster Mitigation Act of 2000 requires that local governments have an approved all-hazards mitigation plan to be eligible to receive HMGP funding after November 2004.

### 5. Flood Mitigation Assistance Program

The Flood Mitigation Assistance Program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 with the goal of reducing or eliminating claims under the NFIP. FMA is a pre-disaster grant program. Three types of grants, including planning, project implementation, and technical assistance grants are awarded annually.

Grants for technical assistance are used by the state to administer the program. Funding awarded under planning and project implementation grants are awarded to individual communities.

## B. Description of Community

The Town of Cornwall and the Village of Cornwall-on-Hudson are located along the Hudson River approximately 52 miles north of New York City in eastern Orange County, New York. According to the U.S. Census Bureau, the Town and Village have a total area of 28.2 square miles. Cornwall's terrain is quite diverse, with considerable relief. It is shaped by the valleys of Moodna and Woodbury creeks, and includes estuarine salt marshes, heavily-developed residential and commercial areas, rolling farms, and rocky, scrub-covered ridges and mountaintops. There are two major protected areas mostly within the town, Storm King State Park and the privately-managed Black Rock Forest. (http://en.wikipedia.org/wiki/Cornwall,_New_York.)

The communities are bordered to the north by the Town of New Windsor, to the west by the Town of Woodbury and the Town of Blooming Grove, to the south by the Town of Highlands, and to the east by the Hudson River and Westchester County.

## C. Land Use & Development

Existing land use information for the Town and Village was obtained from the Orange County Geographic Information Systems (OCGIS), and the New York State Office of Real Property Services.

The strength of Cornwall lies in its many small, well-established businesses, its viable downtown area, its historic significance, proximity to major attractions such as West Point and its beautiful natural setting in the Hudson Valley.

Cornwall includes a mix of residential, retail, office, and local commercial uses with few vacant parcels suitable for future development. Many of the buildings in the Town and Village are more than 100 years old, but are generally in good repair, and many have been restored or renovated.

Cornwall has defined it's land use goal as to 'allow for future new development and the conversion of existing uses that will provide a desirable diversity of land uses necessary to meet long-term population growth as well as the fiscal stability of the community.

## D. Critical & Essential Facilities

For the purposes of this Plan, critical facilities are defined as any facility that is an integral part of the Town's and/or Village's emergency response facilities and operations or one that requires a special emergency response as a result of the potential for triggering an additional hazard event. Critical facilities for the purposes of the Plan include utility systems, transportation systems, and high potential loss facilities. Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. Essential facilities for the purposes of the Plan include police, fire, EMS, medical facilities, schools, churches, shelters, and senior care and living facilities.

The identification and assessment of critical and essential facilities throughout the Town and Village was performed by survey of multiple Town and Village departments. The following properties have been identified as critical and essential facilities in the Town and Village (Refer to Tables I-1, I-2, I-3). A basemap illustrating the critical facilities within the Town and Village, the 100- and 500-Year Floodplains, waterbodies, and the road network has been assembled for the purpose of predicting where future hazards could potentially occur (Refer to Figure I-1).

# Cornwall
# New York

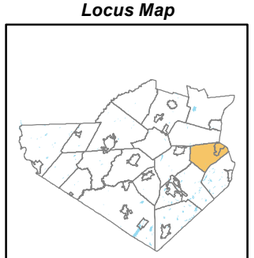
## Critical Infrastructure

## 2013
## Hazard Mitigation Plan

### *Legend*

- Critical Facilities
- Parcels
- Municipal Boundaries
- Village_Boundary
- FEMA 500 Year Flood Zone
- FEMA 100 Year Flood Zone
- Moodna/Woodbury Creeks
- Roads

### *Locus Map*



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## Map Number

# I-2

March 2013
Prepared by: Turner Miller Group NY

**Table I-1 – Critical & Essential Facilities in the Town of Cornwall**

| Facility | Property Address | Section/Block/Lot | Description |
|---|---|---|---|
| Cornwall Highland Engine Co. | 1 Quaker Ave. | 23-3-3.1 | Main Station |
| Mountainville Engine Co. | 10 Star Dr. | 33-1-38.1 | Sub-Station |
| Cornwall Police Department | 183 Main St. | 19-1-24 | Main Station |
| COVAC | 1 Clinton St. | 24-2-41.1 | Main Station |
| Town Hall | 183 Main St. | 19-1-24 | Administrative |
| Highway Department | 1880 Rt. 32 | 34-1-42 | Garage & Offices |
| Sewer Plant | 360 Shore Rd. | 9-1-32 | Main Plant |
| Black Rock Treatment Plant | 100 Pecks Rd. | 32-1-8.1 | Water Treatment Plant |
| Catskill Treatment Plant | 55 Palomino Pl. | 4-2-56 | Main Water Treatment Plant |
| Munger Cottage | 183 Main St. | 19-1-24 | Senior Center |
| Beaver Dam Sewer Pump Station | 137 Shore Dr. | 2-1-16.1 | Pump Station |
| Bede Terrace Sewer Pump Station | 3 Bede Ter. | 16-1-1 | Pump Station |
| Firthcliffe Heights Sewer Pump Station | 117 Winding Brook Ct. | 46-1-32 | Pump Station |
| Howard Street Sewer Pump Station | 35 Howard St. | 9-1-24 | Pump Station |
| Taylor Road Well Field | 290 Taylor Rd. | 29-1-50 | Well Field |
| Jackson Avenue Water Treatment Plant | 10-12 Jackson Ave. | 29-1-54 | Water Treatment Plant |
| Upper Reservoir/Chlorination | 275 Reservoir Rd. | 32-1-17 | Reservoir Valve Building |
| Black Rock Forest Reservoir | Reservoir Rd. | | Reservoir |
| Industry Drive Cell Tower | 20 Industry Dr. | 33-1-49.12 | Cell Tower |
| Town Hall Cell Tower | 183 Main St. | 19-1-24 | Cell Tower |
| WDSD Radio Tower | 1325 Rt. 94 | 4-2-59.12 | Radio Tower |
| Cornwall Hospital Bulk Petroleum Storage | 19 Laurel Ave. | 20-5-1.2 | Bulk Petroleum Storage |
| Town Bulk Fuel Storage | 1880 Rt. 32 | 34-1-42 | Bulk Fuel Storage |
| Cornwall Hospital | 19 Laurel Ave. | 20-5-1.2 | Hospital |
| Cornwall Central High School | 10 Dragon Dr. | 4-2-43.11 | High School |
| Cornwall Central Middle School | 122 Main St. | 18-1-2.1 | Middle School |
| Cornwall Elementary School | 100 Lee Rd. | 18-1-2.2 | Elementary School |
| Willow Avenue Elementary School | 67 Willow Ave. | 21-2-32 | Elementary School |
| New Harvest Christian | 1230 Rt. 94 | 5-1-8 | Church |
| Bethlehem Presbyterian | 1520 Rt. 94 | 1-1-16 | Church |
| Solid Rock Church | 20 Holloran Rd. | 4-3-8 | Church |
| Jehovah Witness | 25 Beakes Rd. | 4-3-11 | Church |
| Maranatha Bible Church | 48 Maranatha Ln. | 36-1-5.1 | Church |
| Quaker Friends Meeting | 60 Quaker Ave. | 23-1-2 | Church |

| | | | |
|---|---|---|---|
| Canterbury Presbyterian Church | 44 Clinton St. | 22-8-4.1 | Church |
| St. John's Episcopal Church | 66 Clinton St. | 22-5-1.1 | Church |
| Mountainville Methodist | 615 Angola Rd. | 34-1-81.4 | Church |
| Cornwall United Methodist | 196 Main St. | 22-1-1 | Church |
| Cornwall Baptist Church | 213 Main St. | 22-3-1 | Church |
| Jogues Retreat | 20 Jogues Dr. | 38-1-2.2 | Church |

Source: Town of Cornwall

**Table I-2 – Critical & Essential Facilities in the Village of Cornwall-on-Hudson**

| Facility | Property Address | Section/Block/Lot | Description |
|---|---|---|---|
| Storm King Engine Co. | 233 Hudson St. | 107-2-14.1 | Main Station |
| Village Police Department | 325 Hudson St. | 106-3-3 | Main Station |
| Village Hall | 325 Hudson St. | 106-3-3 | Administrative |
| Department of Public Works | 50 Shore Rd. | 101-1-5 | Garage & Offices |
| Maple Road Pump House | 205 Maple Rd. | 118-1-5 | Pump Station |
| Water Department Garage | 21 Maple Ave. | 107-2-8 | Garage & Offices |
| Village Bulk Fuel Storage | 50 Shore Rd. | 101-1-5 | 2,000 gallons of gasoline |
| Village Bulk Fuel Storage | 50 Shore Rd. | 101-1-5 | 2,000 gallons of diesel fuel |
| Cornwall Central School District | 24 Idlewild Ave. | 102-10-1 | Administration |
| Cornwall-on-Hudson Elementary School | 234 Hudson St. | 104-1-10 | Elementary School |
| St. Thomas | 340 Hudson St. | 106-2-19 | Church |
| Cornwall Presbyterian | 222 Hudson St. | 104-1-21 | Church |

Source: Village of Cornwall-on-Hudson

The following facilities located in adjoining communities serve the Town of Cornwall and the Village of Cornwall-on-Hudson and are also identified as critical and essential facilties.

**Table I-3 – Critical & Essential Facilities in Other Communities**

| Facility | Property Address | Section/Block/Lot | Community |
|---|---|---|---|
| Salisbury Mills Fire Department | 2128 Rt. 94 | 3-1-30 | Blooming Grove |
| Vails Gate Fire Department | 872 Rt. 94 | 65-2-25.2 | New Windsor |
| Riley Road Water Pump Station | 259 Riley Rd. | 65-1-20 | New Windsor |

Source: Town of Cornwall & Village of Cornwall-on-Hudson

## E. Plan Adoption

This Plan will be adopted after DHSES ad FEMA determine the plan to be "approvable pending adoption." The formal approval process proceeds as follows: 1) A draft plan is submitted and found to be "approvable pending adoption." 2.) The Town and the Village

formally adopt the draft plan and provide documentation of this adoption to DHSES. 3) DHSES notifies FEMA and FEMA approves the plan. A sample adoption resolution is included as part of Appendix A.

# II. THE PLANNING PROCESS

## A. Description of the Planning Process

The development of this joint Town of Cornwall/Village of Cornwall-on-Hudson Hazard Mitigation Plan was initiated in March 2010 by a Hazard Mitigation Planning Team (HMPT) appointed by the Cornwall Town Board and Village Board of Trustees. The HMPT was formed for the purpose of hazard mitigation planning and for the preparation of a written hazard mitigation plan according to the guidelines outlined in 44 CFR Part 201.6. The Turner Miller Group NY was retained by the Town and Village to assist the HMPT in the preparation of the Plan.

The HMPT was chaired by Mark Edsall, Town Engineer. The following individuals served on the HMPT:

- Mark Edsall – Town Engineer, Point of Contact (POC)
- Todd Hazard, Chief of Police (Town)
- Robert Conley, Highway Superintendent (Town)
- Paul Weber, Chief of Police (Village)
- David Halvorsen, Superintendent of Public Works (Village)
- Robert June, Water Superintendent (Village)
- Kurt Hahn, Emergency Manager (Town)
- Gary Vinson, Building, Zoning and Fire Inspector (Town)
- Jeff Armitage, Fire Chief / Chris O'Dell – Cornwall-on-Hudson Fire District
- Patrick Hines, Fire Chief – Canterbury Fire District
- Jerry Bohr, Fire Chief – Vales Gate Fire District
- Jeff Garfinkel, 2nd Lieutenant – Salisbury Mills Fire District
- Jack Boyle, Chief – Cornwall Volunteer Ambulance Corps
- Walter Moran, Superintendent of Buildings & Grounds – Cornwall Central School District
- John Pinckney, Director of Health & Safety – Cornwall Central School District

HMPT members participated in the planning process by:

- Providing specific jurisdictional data and information including, but not limited to: the location and nature of critical infrastructure, policies, and procedures and descriptions of recent and historical incidents, and descriptions of current and past mitigation measures and activities;
- Providing feedback to help make decisions throughout the planning process including hazard and risk analysis, establishment of goals and objectives, and prioritization of mitigation measures; and
- Reviewing, revising and finalizing the draft plan.

Staff support for the development of the Hazard Mitigation Plan was provided by various Town and Village employees. The Town and Village assessors provided information in

regard to land and building values and the Town Supervisor's office and the Village's Mayor's office provided assistance with copying, arrangement of meeting space, and dissemination of public information among other tasks.

General recommendations to local governments for the creation of hazard mitigation plans are offered in several Federal Emergency Management Agency (FEMA) publications. These include the following:

- Federal Emergency Management Agency *State & Local Mitigation Planning How-To-Guide; Getting Started – Building Support of Mitigation Planning*, September 2002.
- Federal Emergency Management Agency *State & Local Mitigation Planning How-To-Guide; Understanding Your Risks*, September 2002.
- Federal Emergency Management Agency *State & Local Mitigation Planning How-To-Guide; Developing the Mitigation Plan*, September 2002.
- Federal Emergency Management Agency *State & Local Mitigation Planning How-To-Guide; Bring the Plan to Life – Implementing the Hazard Mitigation Plan*, September 2002.

Table II-1 represents an accounting of meetings held in regard to the development of the Hazard Mitigation Plan.

**Table II-1 – Meetings Related to Hazard Mitigation Plan**

| Meeting Type | Date | Attendees | Outcome |
|---|---|---|---|
| Town Board | 10/13/2009 | Town Board | Motion passed to authorize Supervisor to execute contract – Turner Miller Group – Pre-Disaster Mitigation Plan. |
| Town Board | 1/4/2010 | Town Board | Motion passed to authorize Supervisor to appoint a Hazard Mitigation Planning Team to assist in the development of the Plan. |
| Village Board | 1/6/2010 | Village Trustees | Motion passed to authorize Mayor to execute contract – Turner Miller Group – Pre-Disaster Mitigation Plan. |
| HMPT | 1/27/2010 | Mark Edsall, Chris O'Dell, Robert June, Paul Weber, Walter Moran, Gary Vinson, John Pinckney, Todd Hazard, David Halvorsen, Robert Conley, Patrick Hines, Jack Boyle, Fred Doneit | Introduction to the hazard mitigation planning process. Establishing expectations of the planning team. |
| HMPT/HIRA-NY | 3/24/2010 | Mark Edsall, Chris O'Dell, Robert June, Paul Weber, Walter Moran, Gary Vinson, John Pinckney, Todd Hazard, David Halvorsen, Robert Conley, Patrick Hines, Jack | Participation in and completion of HIRA-NY analysis. |

| Meeting Type | Date | Attendees | Outcome |
|---|---|---|---|
| | | Boyle, Fred Doneit, Gene Lucchese | |
| Special Meeting | 3/25/2010 | Mark Edsall, Kevin Quigley, Robert Conley | Data collection and plan status. |
| HMPT | 4/22/2010 | Mark Edsall, Paul Weber, Gary Vinson, Patrick Hines, Todd Hazard, Kurt Hahn, Chris O'Dell, Robert June, Walter Moran, Fred Doneit | Review and discussion of requirements for the preparation of the Hazard Mitigation Plan. Assignment of data collection components. |
| Special Meeting | 6/3/2010 | Mark Edsall, Kevin Quigley, Robert Conley | Data collection and plan status. |
| Special Meeting | 8/19/2010 | Mark Edsall, Kevin Quigley, Robert Conley | Data collection and plan status. |
| Town Board | 12/13/2010 | Town Board | Motion passed to enter into multi-year agreement between FEMA/DHSES to complete Hazard Mitigation Plan. |
| Special Meeting | 1/14/2011 | Mark Edsall, Fred Doneit | Plan status report |
| HMPT | 3/2/2011 | Mark Edsall, Paul Weber, Gary Vinson, Patrick Hines, Todd Hazard, Kurt Hahn, Chris O'Dell, Robert June, Walter Moran, Fred Doneit | Discussion of status of Plan, identification of areas where additional information needed/required. |
| Special Meeting | 5/13/2011 | Mark Edsall, Robert Conley | Data collection. |
| Special Meeting | 6/27/2011 | Mark Edsall, Robert Conley | Data collection. |
| Special Meeting | 6/29/2011 | Mark Edsall, Chris O'Dell | Data collection. |
| Special Meeting | 3/30/2012 | Mark Edsall, VCOH Department Heads | Data collection. |
| HMPT | 10/26/2012 | Mark Edsall, Todd Hazard, Robert Conley, Steve Dixon, David Halvorsen, Robert June, Patrick Hines, Walter Moran, John Pinckney, Fred Doneit | Discussion of status of Plan, identification of areas where additional information needed/required. |
| HMPT | 9/12/2013 | Mark Edsall, Robert June, Robert Conley, Todd Hazard, Gary Vinson, Steve Dixon, David Halvorsen, Ben Maggio, Fred Doneit | Discussion of status of Plan, review of comments from NYS DHSES/FEMA. |

Meeting minutes located in Appendix B

## B. Coordination with Existing Planning Efforts and Programs

Local municipalities are charged with the development of local hazard mitigation plans required under Section 322 of the Stafford Act. Local governments have intimate knowledge of the local geography, and in a disaster, local government personnel are on the front lines providing personnel and equipment to support the community. Examples of other hazard mitigation programs in which the Town and Village are involved include

the National Flood Insurance Program (NFIP) and the Hazard Mitigation Grant Program (HMGP). These programs have assisted the Town and Village in receiving funding for flood insurance and flood mitigation projects (this Plan can also provide funds to mitigate other natural hazards). Data from the Town and Village, based on participation in these programs, is incorporated as part of the risk assessment section and is used to identify mitigation options. Continued involvement in these flood-related programs will help to administer funds and resources to support this Plan.

**Hazard Mitigation Grant Program**

Participation in FEMA 404 Hazard Mitigation Grant Program (HMGP) may cover mitigation activities including raising, removing, relocating or replacing structures within flood hazard areas.

**National Flood Insurance Program**

The Town of Cornwall and the Village of Cornwall-on-Hudson both participate in the National Flood Insurance Program (NFIP). Established in 1968, NFIP provides federally-backed flood insurance to residents of communities that enact and enforce regulations that more carefully regulate development within floodplain areas. For individual property owners to be eligible to buy federally-backed flood insurance, their property must be located within a community that participates in NFIP. For a community to be eligible in NFIP, it must adopt and enforce a floodplain management ordinance to regulate proposed development in floodplains and officially designate a local floodplain coordinator/administrator. The intent of the program is to ensure that new construction does not exacerbate existing flood hazards and is designed to better withstand flooding. The Town of Cornwall and the Village of Cornwall-on-Hudson have enacted and enforced floodplain management ordinances as required. Both communities also have Flood Insurance Rate Maps (FIRM's) that at a minimum show floodways, 100-year flood zones, and 500-year flood zones.

**Community Rating System (CRS)**

The NFIP has been successful in protecting property owners who acquire flood insurance through the program from catastrophic financial losses due to flooding, and in requiring that new buildings constructed within 100-year flood plains are better protected from flood damage. In the 1990s, the Flood Insurance Administration (FIA) established the Community Rating System (CRS) to encourage local governments to increase their standards for floodplain development. The goal of this program is to encourage communities through flood insurance rate adjustments to implement standards above and beyond the minimum required in order to:

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

CRS is a voluntary program designed to reward participating jurisdictions for their efforts to create more disaster-resistant communities using the principles of sustainable development and management. While the Town and Village do not currently participate in the CRS program, consideration of participation is one of the mitigation strategies identified in this Plan. Further, this Plan has been developed to meet the Floodplain Management Plan criteria under Activity 510 in the CRS program.

## C. Incorporation and Review of Existing Plans, Studies, Reports and Technical Information

For hazard mitigation planning to be successful it must take into account other plans, programs, and policies that may have an effect on hazard identification and implementation of mitigation measures. The following sources were considered and used as information resources for this plan:

- FEMA's Disaster Declaration Archives;
- NOAA National Environmental Satellite, Data, and Information Service;
- National Climactic Data Center's Storm Event Database;
- U.S. Census Bureau – 2000 and 2010 Census';
- USGS Earthquake Hazard Peak Ground Acceleration Maps;
- New York State Hazard Mitigation Plan;
- Disaster Mitigation Act of 2000;
- Town of Cornwall Comprehensive Plan;
- Town of Cornwall Zoning Code;
- Town of Cornwall Building Code;
- Village of Cornwall-on-Hudson Comprehensive Plan;
- Village of Cornwall-on-Hudson Zoning Code;
- Village of Cornwall-on-Hudson Building Code.

It is anticipated that any master planning and/or land use planning that occurs in the future will use this plan as a reference.

This Plan satisfies the mitigation planning requirements of the Community Rating System (CRS) and of the National Flood Insurance Program (NFIP). The CRS provides for a reduction in NFIP premiums when participating communities implement actions beyond the minimum requirements of the NFIP.

## D. Public Outreach

The public-at-large have been provided a variety opportunities to comment on the draft Plan before submission to DHSES and FEMA. This included opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process. Copies of the Plan, memorandum related to the development of the Plan, and meeting dates were made available to the public at the Town's Clerks Office and the Village's Clerks Office and on the Hazard Mitigation Plan website at:

http://www.cornwallny.com/webpages/DOCUMENTS/HazardMitigationPlan.asp since April 2010.

An announcement of the Plan's development was made at the October 2009 Town Board meeting as recorded in the minutes and certified by the Town Clerk and at the October 2009 Village Board meeting as recorded in the minutes and certified by the Village Board Clerk.

## E. Goals & Objectives of the Plan

The HMPT developed a set of broad goals to help guide the development of the Plan. For the purposes of this Plan, goals were defined as broad policy statements representing long term global visions for the Town and Village. These goals were developed by examining community documents, consideration of community goals for development and discussion among the HMPT members at the outset of the planning process. Each goal has several corresponding objectives that further define and measure specific implementation steps to attain the identified goals.

***Goal: Improve upon the protection of Cornwall's health, well-being, quality of life and private property from natural hazards.***

Objectives:

- Ensure public and private facilities with public access and infrastructure meet established building codes.
- Coordinate and integrate the Hazard Mitigation Plan with Town and Village emergency operation plans.

***Goal: Reduce the potential impact of natural hazards on Cornwall support services, critical facilities, infrastructure, natural environment, and economy.***

Objectives:

- Strengthen communication and coordinate efforts among various federal, state and local public agencies.
- Provide information on tools, partnership opportunities and funding resources to assist in implementing mitigation activities.
- Inventory, test and repair emergency equipment that is essential during hazard events.

***Goal: Implement effective measures to raise the general public's awareness of and acceptance of Cornwall's Hazard Mitigation Plan.***

Objectives:

- Develop and implement educational and outreach programs to increase public awareness of the risks associated with natural hazards.
- Promote natural hazard education programs.

- Participate in disaster preparedness seminars and other information and training sessions sponsored by the American Red Cross or similar organizations.

***Goal: Address stormwater quality and quantity (flooding), through the protection and restoration of natural resources (stream corridors, wetlands, and lakes) while simultaneously complying with emerging Federal and State regulatory mandates.***

Objectives:

- Improve hazard assessment information to make recommendations for discouraging poorly planned development and encouraging enhanced preventive measures for existing development in areas vulnerable to natural hazards.
- Reduce losses and repetitive damages from chronic hazard events through planning and improvements while promoting insurance coverage from catastrophic hazards.
- Balance watershed planning, natural resource management and land use planning with natural hazard mitigation to protect life, property and the environment.
- Preserve, rehabilitate and enhance natural systems to serve natural hazard mitigation functions.
- Develop methodologies to protect structures within stream corridors from damage as a result of erosion.
- Promote involvement in the flood insurance program for those structures in flood prone areas.
- Promote implementation of protection measures such as structure elevation, flood proofing and property buyout.

**Figure II-1 – Hazard Mitigation Planning Process**

# III. HAZARD INVENTORY & RISK ASSESSMENT

According to FEMA Guidance 386-2, "risk assessment is the process of measuring the potential loss of life, personal injury, economic injury and property damage resulting from natural hazards by assessing the vulnerability of people, buildings and infrastructure to natural hazards."

## A. Methodology

The risk assessment process used for this Plan is consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community's decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs.

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA's current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets. Often, natural hazards can be predicted, where they tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, communities must evaluate what assets they possess and which assets are exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical and essential facilities at risk prepares the communities to develop risk scenarios and estimate potential damages and losses for each hazard.

## B. Identifying Hazards

To provide a strong foundation for mitigation strategies, the Town of Cornwall and the Village of Cornwall-on-Hudson considered a full range of natural hazards that could

impact the area, and then identified and ranked those hazards that presented the greatest concern. The natural hazard of concern identification process incorporated input from the New York State Division of Homeland Security and Emergency Services (previously New York State Emergency Management Office – SEMO) and The Orange County Division of Emergency Management; review of the New York State Hazard Mitigation Plan and previous hazard identification efforts; research and local, state, and federal information on the frequency, magnitude, and costs associated with the hazards that have previously, or could feasibly, impact the region; and qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area's assets to them.

For the purposes of this planning effort, the HMPT chose to group some natural hazards together, based on the similarity of hazard events, their typical concurrence or their impacts, consideration of how hazards have been grouped in Federal Emergency Management Agency (FEMA) guidance documents (FEMA 386-1, "Understanding Your Risks, Identifying Hazards and Estimating Losses; FEMA's "Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy"), and consideration of hazard grouping in the NYS HMP.

These groupings do not change the definition of the included specific events/hazards, as defined within FEMA guidance and other risk assessment documents, and does not affect the hazard analysis conducted through the use of HAZUS-MH, either directly or as a risk assessment support tool.

Technological (for example, hazardous material incidents) and man-made hazards (for example, terrorism) are not being addressed in this planning process. The DMA 2000 regulations do not require consideration of such hazards and due to limited funding; these were not chosen for inclusion in this Plan by the Town, the Village, and planning participants. The Town and Village may attempt to expand the scope of this Plan to include other less frequent natural hazards and/or technological and man-made hazards as resources permit.

The first step in planning for natural hazards is to identify the hazard events that have occurred within the Town and Village in the past and have the potential for occurring again.

On March 24, 2010 the HMPT with the assistance of the New York State Emergency Management Office (SEMO) conducted a hazard analysis for the Town and Village using the automated program, HIRA-NY (Hazard Identification and Risk Assessment New York) developed by the American Red Cross and SEMO. The results of this analysis, included as part of Appendix G, form the basis for the communities' risk and vulnerability assessment contained herein.

Each hazard evaluated during the HIRA-NY analysis was assigned a numerical value based on the perceived severity of the hazard. These values are categorized as follows:

- 44 to 160 Low Hazard
- 161 to 240 Moderately Low Hazard
- 241 to 320 Moderately High Hazard
- 321 to 400 High Hazard

The HMPT rated 8 natural hazards. Each of these hazards are profiled as part of this Hazard Mitigation Plan with the exception of the landslide hazard, since it was rated a "low hazard" by the HMPT.

| | | |
|---|---|---|
| 1. | Severe Storm | 258 |
| 2. | Earthquake | 252 |
| 3. | Extreme Temps | 232 |
| 4. | Winter Storm (Severe) | 220 |
| 5. | Ice Storm | 202 |
| 6. | Flood | 197 |
| 7. | Hurricane | 186 |
| 8. | Landslide | 130 |

It is recognized that HIRA-NY does not fully address the FEMA requirements for hazard mitigation plan development. Hazard mitigation planning requires an understanding of geography and spatial relationships between hazards and the population and property at risk. As such, the HMPT utilized GIS based assessment tools along with environmental data from the New York State GIS Clearinghouse and Orange County GIS to map potential environmental hazards in the community. These datasets included FEMA 100- and 500-Year floodplains, NYSDEC and NWI wetlands, waterbodies, wells, aquifers, and others (refer to Figure III-1, Environmental Resources).

## C. Hazard Ranking

After the hazards of concern were identified for the Town of Cornwall and the Village of Cornwall-on-Hudson, the hazards were ranked to describe their probability of occurrence and their impact on population, property (general building stock including critical and essential facilities) and the economy. This section describes factors that influence their ranking including the probability of occurrence and impact; it also presents the ranking process and outcome.

### Methodology

The methodology used to rank the hazards of concern for the Town and Village is described below. Estimates of risk for the community were developed using methodologies promoted by FEMA's hazard mitigation planning guidance and generated by FEMA's HAZUS-MH risk assessment tool and ArcGIS.

# Cornwall
# New York

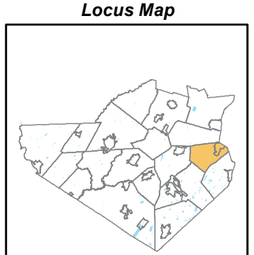
Environmental Resources

2013
Hazard Mitigation Plan

***Legend***

- Parcels
- Municipal Boundaries
- Village_Boundary
- FEMA 500 Year Flood Zone
- FEMA 100 Year Flood Zone
- NYSDEC Wetlands
- NWI Wetlands
- Waterbodies
- Sand & Gravel Aquifers
- Moodna/Woodbury Creeks
- Roads

***Locus Map***



N
W E
S

0 0.5 1
Miles

**Map Number**

# III-1

March 2013
Prepared by: Turner Miller Group NY

Probability of Occurrence

The probability of occurrence is an estimate of how often a hazard event occurs. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions detailed in Table III-1.

**Table III-1 – Probability of Occurrence Ranking Factors**

| Rating | Probability | Definition |
|---|---|---|
| 0 | None | Hazard event is not likely to occur |
| 1 | Rare | Hazard event is not likely to occur within 100 years |
| 2 | Occasional | Hazard event is likely to occur within 100 years |
| 3 | Frequent | Hazard event is likely to occur within 25 years |

Prepared by Turner Miller Group NY

Impact

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical and essential facilities), and impact on the economy. Based on documented historic losses and a subjective assessment by the Hazard Mitigation Planning Team, an impact rating of high, medium, or low was assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor was assigned to each impact category: three (3) for population, two (2) for property, and one (1) for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard.

Table III-2 presents the numerical rating, weighted factor and description for each impact category. The impact rating definitions for population and property are consistent with the New York State Hazard Mitigation Plan ranking methodology. Impact to the economy was also evaluated.

**Table III-2 – Numerical Values and Definitions for Impacts on Population, Property, and Economy**

| Category* | Weighing Factor | Low Impact (1) | Medium Impact (2) | High Impact (3) |
|---|---|---|---|---|
| Population | 3 | 14% or less of your developed land area is exposed to a hazard due to its extent and location | 15% to 29% of your developed land area is exposed to a hazard due to its extent and location | 30% or more of your developed land area is exposed to a hazard due to its extent and location |
| Property | 2 | Property exposure is 14% or less of the total replacement cost for your community | Property exposure is 15% to 29% of the total replacement for your community | Property exposure is 30% or more of the total replacement cost for your community |
| Economy | 1 | Loss estimate is 9% or less of the total replacement cost for your community | Loss estimate is 10% to 19% of the total replacement cost for your community | Loss estimate is 20% or more of the total replacement cost for your community |

Prepared by Turner Miller Group NY

*For the purposes of this exercise, "impacted refers to exposed for population and property and loss for economy

Risk Ranking Value

The risk ranking for each hazard is then calculated by multiplying the numerical value for probability of occurrence by the sum of the numerical values for impact. The equation is as follows: Impact Value (1, 2, or 3) X Impact Value (6 to 18) = Hazard Ranking Value. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low).

Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for the Town and Village. Based on the combined risk values for probability of occurrence and impact to the community, a priority ranking of "high", "medium" or "low" risk was assigned. The hazard rankings for the Town and Village, from high to low risk, are summarized below:

1. Flooding
2. Severe Storms
3. Winter Storms (Severe)
4. Ice Storms
5. Extreme Temperatures and Drought
6. Windstorms (Hurricanes & Tropical Storms)
7. Earthquakes
8. Landslides

Table III-3 shows the probability ranking assigned for likelihood of occurrence for each hazard.

**Table III-3 – Probability of Occurrence Ranking for Hazards of Concern**

| Hazard | Probability | Value |
|---|---|---|
| Flooding | Frequent | 3 |
| Severe Storms | Frequent | 3 |
| Severe Winter Storms | Frequent | 3 |
| Ice Storms | Frequent | 3 |
| Extreme Temperatures and Drought | Frequent | 3 |
| Windstorms | Frequent | 3 |
| Earthquakes | Rare | 1 |
| Landslides | Rare | 1 |

Prepared by Turner Miller Group NY

## D. Natural Hazard Risk & Loss Estimation

The following represents the property at risk for each identified hazard in the Town of Cornwall and the Village of Cornwall-on-Hudson. Tables III-4 and III-5 show the inventory of structures while tables III-6 and III-7 show the exposure within the Town and Village to each hazard and the aggregate value of structures and their contents. These values were obtained by identifying structures at risk from various hazards, adding up property values from the Assessor's records, and then adding contents values estimated using the FEMA methodology. Table III-8 describes the FEMA contents value estimation method.

**Table III-4 – Town-Wide Structures at Risk**

| Category | Number of Occupancies / Infrastructure at Risk | Property Value |
|---|---|---|
| Residential | 28 | $9,049,246 |
| Commercial | 3 | $1,055,922 |
| Community Service | 1 | $1,888,346 |
| Public Service | 4 | $1,126,093 |
| Recreation | 0 | $0 |
| Industrial | 0 | $0 |
| Agriculture | 0 | $0 |
| Forest | 1 | $411,090 |
| Vacant | 16 | $1,577,068 |

Prepared by Turner Miller Group NY
Source: New York State Division of Homeland Security and Emergency Services (DHSES)

## Table III-5 – Village-Wide Structures at Risk

| Category | Number of Occupancies / Infrastructure at Risk | Property Value |
|---|---|---|
| Residential | 17 | $5,020770 |
| Commercial | 2 | $651,222 |
| Community Service | 1 | $618,421 |
| Public Service | 0 | $0 |
| Recreation | 1 | $2,435,338 |
| Industrial | 1 | $1,468,045 |
| Agriculture | 0 | $0 |
| Forest | 1 | $$275,940 |
| Vacant | 3 | $8,835 |

Prepared by Turner Miller Group NY
Source: New York State Division of Homeland Security and Emergency Services (DHSES)

## Table III-6 – Town-Wide Hazards

| Hazard | Potential Risk | Total Value |
|---|---|---|
| Earthquakes | All areas of the Town of Cornwall have at least some risk from identified hazards | $14,696,675 |
| Extreme Temperatures and Drought | | |
| Flooding | | |
| Windstorms (Hurricanes & Tropical Storms) | | |
| Severe Winter Storms | | |
| Landslides | | |

Prepared by Turner Miller Group NY
Source: New York State Division of Homeland Security and Emergency Services (DHSES)

## Table III-7 – Village Wide Hazards

| Hazard | Potential Risk | Total Value |
|---|---|---|
| Earthquakes | All areas of the Village of Cornwall-on-Hudson have at least some risk from identified hazards | $10,202,631 |
| Extreme Temperatures and Drought | | |
| Flooding | | |
| Windstorms (Hurricanes & Tropical Storms) | | |
| Severe Winter Storms | | |
| Landslides | | |

Prepared by Turner Miller Group NY
Source: New York State Division of Homeland Security and Emergency Services (DHSES)

**Table III-8 – Contents Value as Percentage of Building Replacement Value**

| Occupancy Class | Contents Value (%) |
|---|---|
| Residential | 50 |
| Commercial | 100 |
| Medical | 150 |
| Parking | 50 |
| Industrial | 150 |
| Construction | 100 |
| Agriculture | 100 |
| Religious/Non-Profit | 100 |
| Emergency Response | 150 |
| Government | 100 |
| Schools/Libraries | 100 |
| Colleges/Universities | 150 |

Prepared by Turner Miller Group
Source: New York State Division of Homeland Security and Emergency Services (DHSES)

## E. Natural Hazard Profiles & Vulnerability

### 1. Earthquakes

Earthquakes are defined as the sudden motion or trembling that is caused by a release of subterranean strain energy accumulated within or along the edge of the earth's tectonic plates. Earthquakes typically occur without warning and after just a few seconds can cause significant damage and extensive casualties.

The intensity of an earthquake is based on observed effects of ground shaking on people, buildings, and natural features and varies with location. There are several common measures of earthquakes including the following:

- Peak Ground Acceleration (PGA) – A measure of earthquake acceleration based on the strength of ground movements relative to the established rate of acceleration of gravity (980 cm/sec/sec).
- Ground Motion – Vibration or shaking of the ground during an earthquake. The severity of the vibration increases with the amount of energy released and decreases with distance from the epicenter.
- Surface Faulting – Differential movement of the two sides along a fracture.
- Liquefaction – A phenomenon that occurs when ground shaking causes loose soils to lose strength and act like a viscous fluid.

## Extent

Seismic waves are the vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a measured value of the earthquake size, or amplitude of the seismic waves, using a seismograph. The Richter magnitude scale was developed in 1932 as a mathematical device to compare the sizes of earthquakes (USGS). The Richter Scale is the most widely-known scale that measures the magnitude of earthquakes (Shedlock and Pakiser, 1997; USGS). It has no upper limit and is not used to express damage. An earthquake in a densely populated area, which results in many deaths and considerable damage, may have the same magnitude and shock in a remote area that did not cause any damage (USGS). Table III-9 presents the Richter Scale magnitudes and corresponding earthquake effects.

**Table III-9 – Richter Scale**

| Richter Magnitude | Earthquake Effects |
|---|---|
| 2.5 or less | Usually not felt, but can be recorded by seismograph |
| 2.5 to 5.4 | Often felt, but only causes minor damage |
| 5.5 to 6.0 | Slight damage to buildings and other structures |
| 6.1 to 6.9 | May cause a lot of damage in very populated areas |
| 7.0 to 7.9 | Major earthquake; serious damage |
| 9.0 or greater | Great earthquake; can totally destroy communities near the epicenter |

Prepared by Turner Miller Group NY
Source: USGS

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. The Modified Mercalli Scale expresses intensity; a subjective measure that describes how strong a shock was felt at a particular location (Shedlock and Pakiser, 1997; USGS). The Modified Mercalli Scale expresses the intensity of an earthquake's effects in a given locality in values ranging from I to XII. Table III-10 summarizes earthquake intensity as expressed by the Modified Mercalli Scale. Table III-11 displays the Modified Mercalli Scale and peak ground acceleration equivalent.

**Table III-10 – Modified Mercalli Intensity Scale**

| Mercalli Intensity | Description |
|---|---|
| I | Felt by very few people; barely noticeable |
| II | Felt by few people, especially on upper floors |
| III | Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake |
| IV | Felt by many indoors, few outdoors; may feel like a passing truck |
| V | Felt by almost everyone, some people awakened; small objects move, trees and poles may shake |
| VI | Felt by everyone; people have difficulty standing; heavy furniture can move, plaster can fall off walls; chimneys may be slightly damaged |
| VII | People have difficulty standing; drivers feel their cars shaking; some furniture breaks; loose bricks fall from buildings; damage is slight to moderate in well built buildings; considerable damage in poorly build buildings |
| VIII | Well built buildings suffer slight damage; poorly built structures suffer severe damage; some walls collapse |
| IX | Considerable damage to specially built structures; buildings shift off their foundations; the ground cracks; landslides may occur |
| X | Most buildings and their foundations are destroyed; some bridges are destroyed; dams are seriously damaged; large landslides occur; water is thrown on the banks of canals, rivers, lakes; the ground cracks in large areas |
| XI | Most buildings collapse; some bridges are destroyed; large cracks appear in the ground; underground pipelines are destroyed |
| XII | Almost everything is destroyed; objects are thrown into the air; the ground moves in waves or ripples; large amounts of rock may move |

Prepared by Turner Miller Group NY
Source: Michigan Tech University; Nevada Seismological Laboratory

**Table III-11 – Modified Mercalli Intensity and PGA Equivalents**

| MMI | Acceleration (%g) (PGA) | Perceived Shaking | Potential Damage |
|---|---|---|---|
| I | < .17 | Not Felt | None |
| II | .17 – 1.4 | Weak | None |
| III | .17 – 1.4 | Weak | None |
| IV | 1.4 – 3.9 | Light | None |
| V | 3.9 – 9.2 | Moderate | Very Light |
| VI | 9.2 – 18 | Strong | Light |
| VII | 18 – 34 | Very Strong | Moderate |
| VIII | 34 – 65 | Severe | Moderate to Heavy |

Prepared by Turner Miller Group NY
Source: NYSDPC

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: 'PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical

rod having the same natural period of vibration as the building' (USGS, Date Unknown). Both PGA and SA can be measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities (NYSDPC).

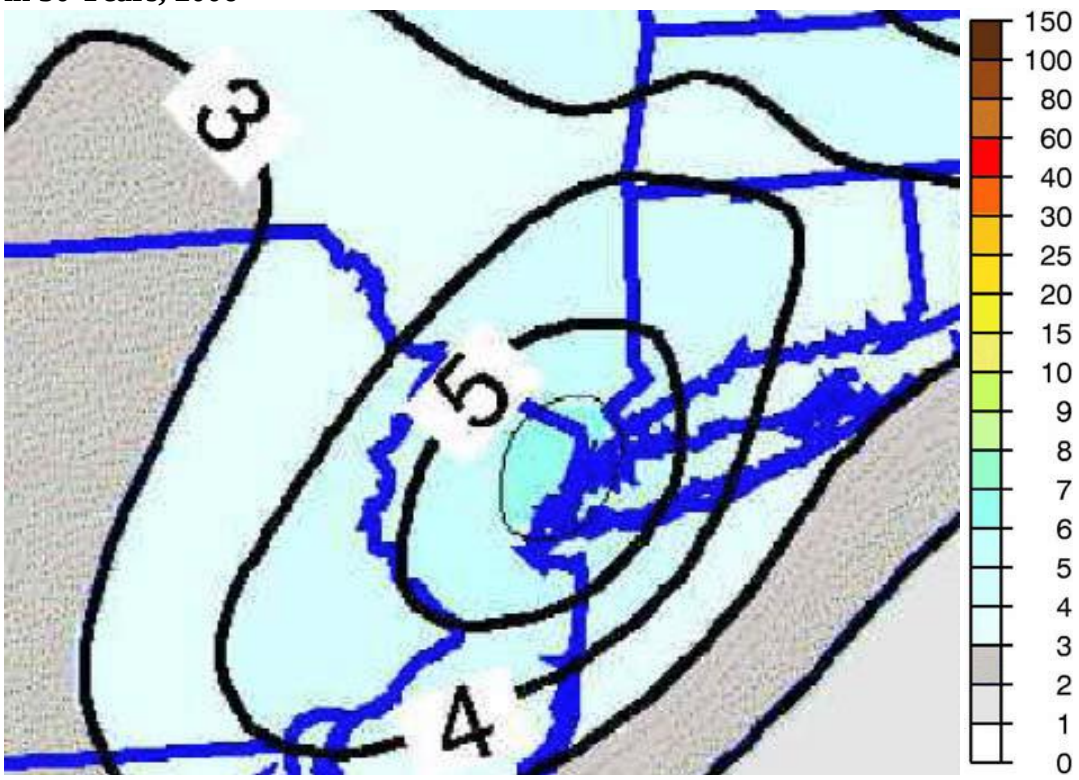
PGA is a common earthquake measurement that shows three things: the geographic area affected, the probability of an earthquake of each given level of severity, and the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes (or accelerates) in a given geographic area (NYSDPC, 2008).

National maps of earthquake shaking hazards have been produced since 1948. They provide information essential to creating and updating the seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damages and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 1996).

The USGS last updated the National Seismic Hazard Maps in 2008. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps. The 2008 map represents the best available data as determined by the USGS.

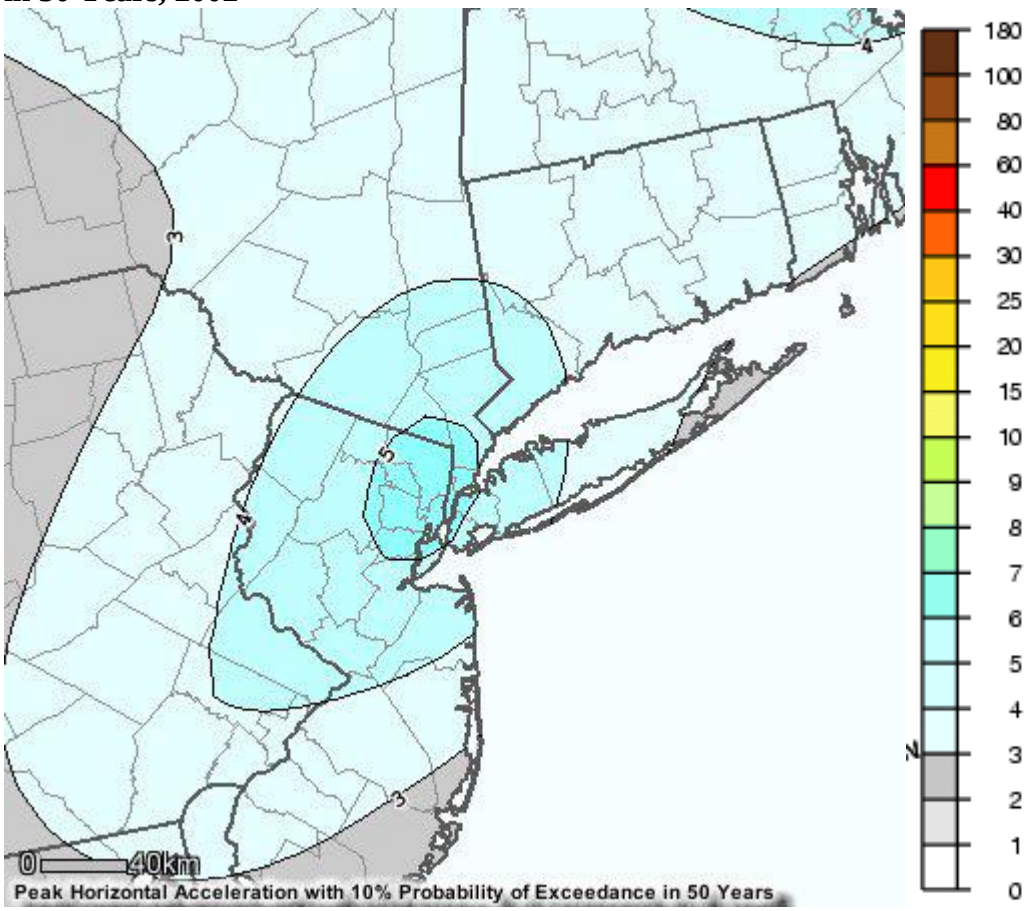
The 1996 Seismic Hazard Map shows that Orange County has a PGA between 4% and 5% (Figure III-2). The 2002 Seismic Hazard Map shows that Orange County has a PGA between 3% and 4% (Figure III-3). The 2008 Seismic Hazard Map shows that the majority of Orange County, including all of the Town of Cornwall and the Village of Cornwall-on-Hudson has a PGA between 2 and 3% (Figure III-4). According to FEMA this would equate to only light perceived shaking and no potential for damage. This rating is decreased from the 1996 and 2002 Seismic Hazard Maps most likely due to the incorporation of new data.

**Figure III-2 – Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years, 2006**



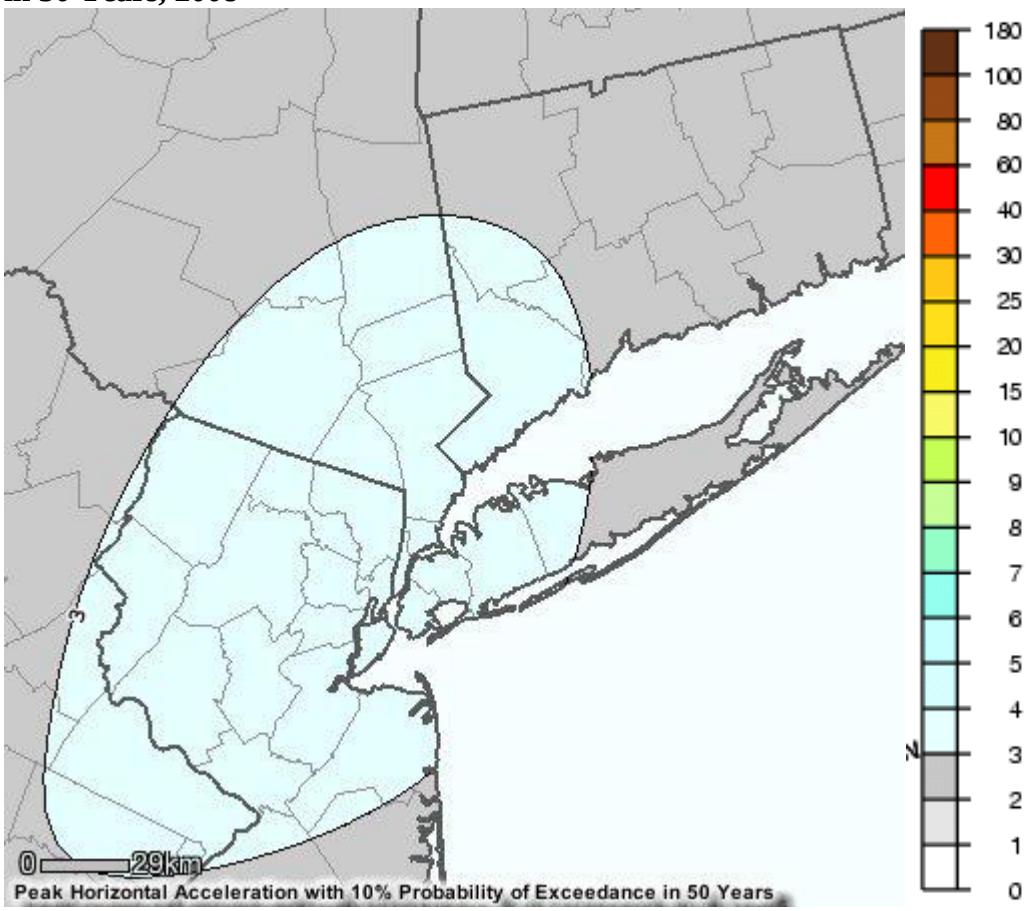

Source: USGS

**Figure III-3 – Peak Acceleration (%g) with 10% Probaability of Exceedance in 50 Years, 2002**




Source: USGS

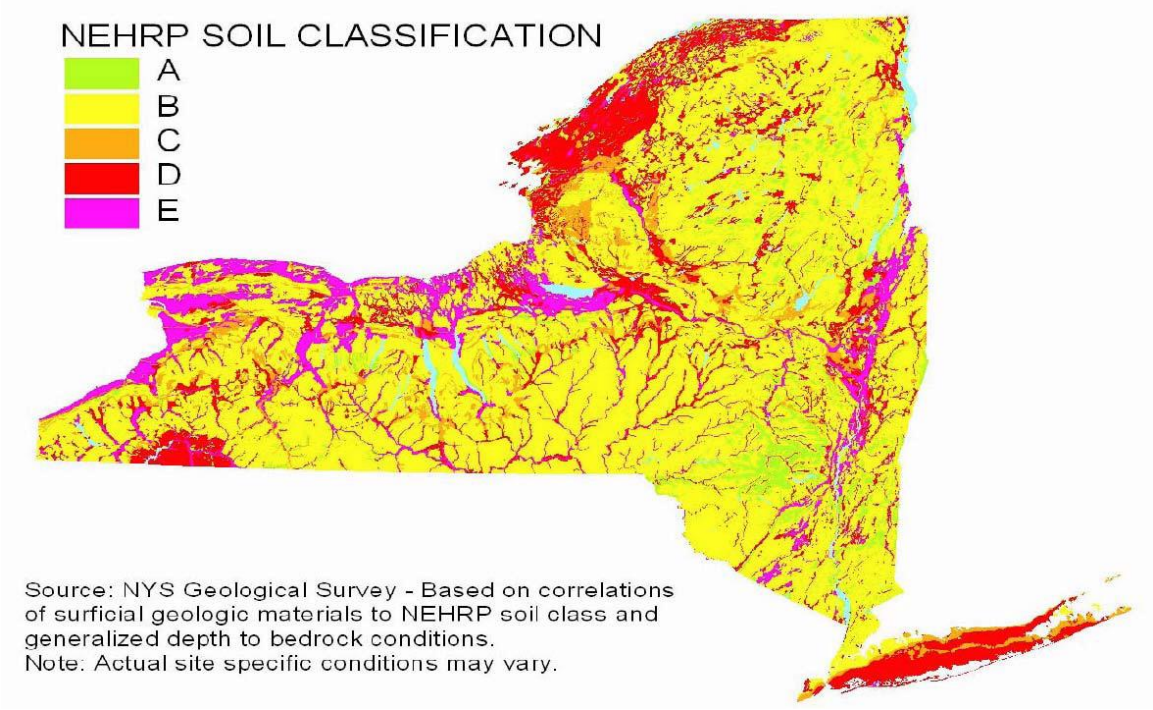
**Figure III-4 – Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years, 2008**




Source: USGS

The New York State Geological Survey conducted seismic shear-wave tests of the State's surficial geology (glacial deposits). Based on these test results, the surficial geologic materials of New York State were categorized according to the National Earthquake Hazard Reduction Program's (NEHRP) Soil Site Classifications (Figure III-5). The NEHRP developed five soil classifications that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. Table III-12 summarizes the NEHRP soil classifications. Locations with softer soils may be more vulnerable to earthquake hazards. The Town Cornwall is comprised primarily of soil class A (very hard rock); however, classes B, C, D, and E are also present, primarily along and adjacent to the Moodna Creek (sedimentary rock or firm ground, stiff clay, Soft to medium clays or sands, and Soft soil including fill, loose sand, waterfront, lake bed clays). The Village of Cornwall-on-Hudson is comprised of soil classes B and C (sedimentary rock or firm ground and stiff clay).

**Figure III-5 – NEHRP Soils in New York State**




Source: USGS, 2008

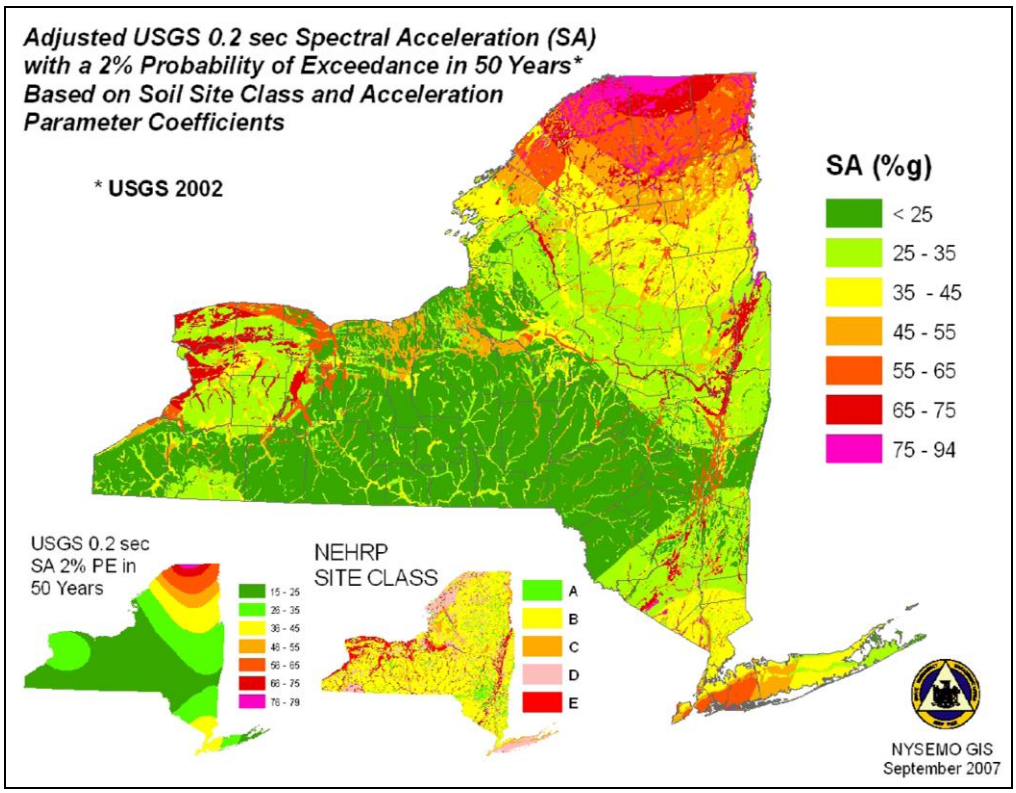
**Table III-12 – NEHRP Soil Classifications**

| Soil Classification | Map Color | Description |
|---|---|---|
| A | Green | Very hard rock (e.g. granite, gneisses) |
| B | Yellow | Sedimentary rock or firm ground |
| C | Orange | Stiff clay |
| D | Red | Soft to medium clays or sands |
| E | Pink | Soft soil including fill, loose sand, waterfront, lake bed clays |

Prepared by Turner Miller Group NY
Source: FEMA, 2007

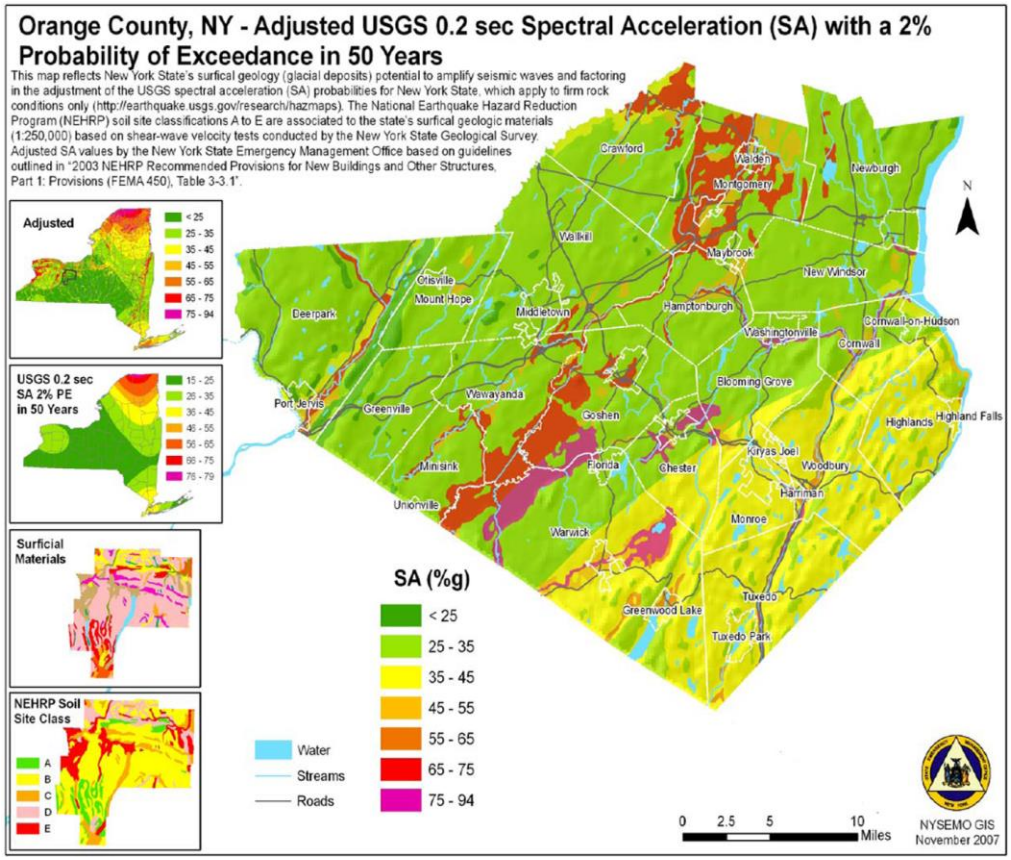
The NEHRP soil classification for the State has enabled the affect of soils to be factored with the 2002 USGS seismic hazard maps. Figure III-6 now illustrates the State's earthquake SA hazard with local soil types factored in. This updated hazard map illustrates a significantly higher hazard for Orange County than that which is shown on the USGS national map (NYSDPC). Figure III-7 indicates Orange County's earthquake adjusted SA hazard.

**Figure III-6 – Spectral Acceleration with 2% Probability of Exceedance in 50 Years**




Source: NYSDPC

**Figure III-7 – Spectral Acceleration with 2% Probability of Exceedance in 50 Years**



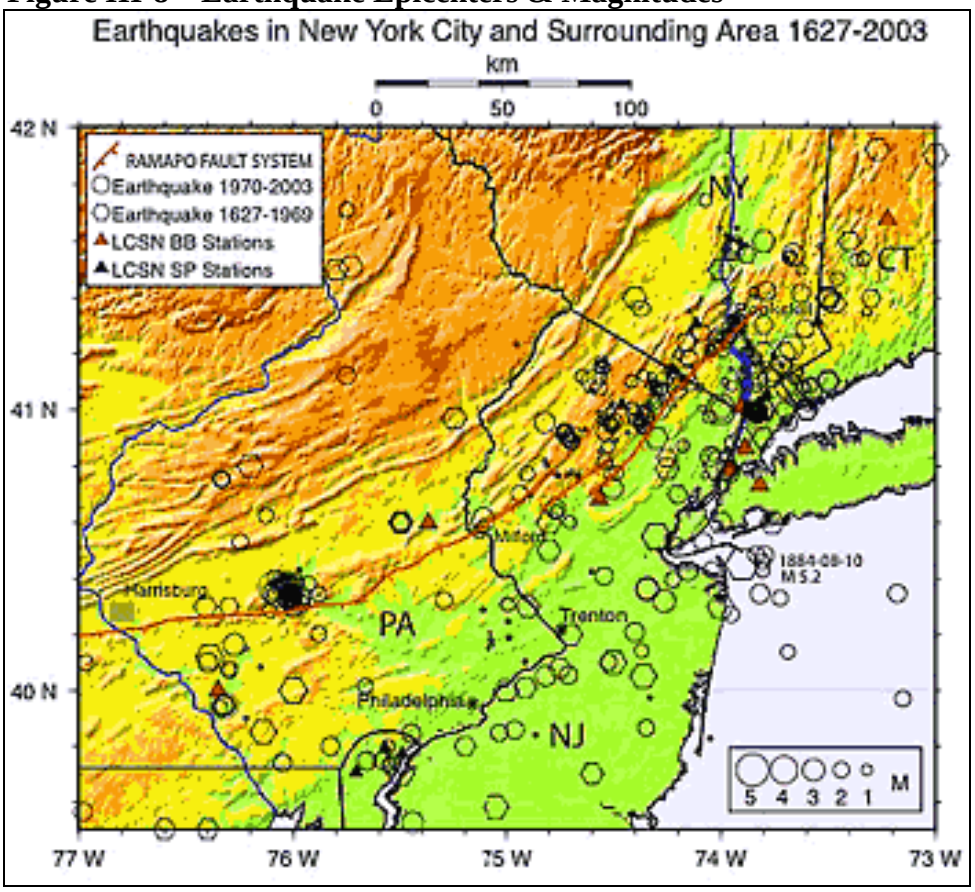

Source: NYSDPC

## Location

As noted in the NYS HMP, the importance of the earthquake hazard in New York State is often underestimated because other natural hazards (for example, hurricanes and floods) occur more frequently and because major floods and hurricanes have occurred more recently than a major earthquake event (NYSDPC). Typically areas east of the Rocky Mountains experience fewer and generally smaller earthquakes than the western U.S. However, the potential for earthquakes exists across all of New York State and the entire northeastern U.S.

The New York City Area Consortium for Earthquake Loss Mitigation (NYCEM) ranks New York State as having the third highest earthquake activity level east of the Mississippi River (Tantala et al., 2003). Figure III-8 illustrates historic earthquake epicenters across the northeast U.S. and New York State between 1627 and 2003.

**Figure III-8 – Earthquake Epicenters & Magnitudes**




Source: http://www.earthinstitute.columbia.edu/

## Previous Occurrences

The most recent earthquake to affect the Town of Cornwall and the Village of Cornwall-on-Hudson occurred August 23, 2011. This 5.9 magnitude event was centered around Washington D.C. and was felt throughout the Northeastern U.S. Prior to 2011 the most recent earthquake to affect the Town and Village occurred on April 20, 2003. This 2.3 magnitude earthquake was centered along Route 17A in the Town of Goshen and was felt throughout Orange County. The New York State Police did not report any related damage or injuries as a result of the earthquake. Prior to the 2003 event, a 4.0 magnitude earthquake centered approximately 15 miles north of Manhattan, in Ardsley, on October 19, 1985, broke windows in Newburgh. Prior to these events, no significant earthquakes had been felt in this region since the 1950's.[1] This earthquake was followed by what seismologist from the Lamont-Doherty Earth Observatory of Columbia University classified as relatively large (3.0+ magnitude) aftershocks throughout the region.

No additional data on past earthquake hazards for the Town of Cornwall or the Village of Cornwall-on-Hudson was available.

[1] http://www.ldeo.columbia.edu/LCSN/big-ny-eq.html

## Earthquakes Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For earthquakes, the entire Town and Village have been identified as a hazard area. The following text evaluates and estimates the potential impact of earthquake hazards on the Town and Village including:

- Overview of vulnerability;
- Data and methodology used for the evaluation; and
- Impact, including: (1) impact on life, safety and health of Town and Village residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development.

### Overview of Vulnerability

The entire population and general building stock inventory of both the Town of Cornwall and the Village of Cornwall-on-Hudson is at risk of being damaged or experiencing losses due to impacts of an earthquake. Potential losses associated with the earth shaking were calculated for the Town and Village for three probabilistic earthquake events, the 100-year, 500-year, and 2,500-year mean return periods (MRP). The impacts on population, existing structures, critical facilities and the economy are presented below.

### Data and Methodology

In addition to reviewing previously conducted earthquake studies in the New York/Orange County area, a probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) through a Level 2 analysis utilizing HAZUS-MH MR4 to analyze the earthquake hazard and provide a range of loss estimates for the Town and Village. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract. The default assumption is a magnitude 7 earthquake for all return periods.

Default data in HAZUS-MH MR4 was used for the earthquake analysis. According to the HAZUS-MH MR4 technical manual, there is considerable uncertainty related to the characteristics of ground motion in the eastern U.S. Therefore, loss estimates may be overestimated.

Data used to assess this hazard include data available in the HAZUS-MH MR4 earthquake model, USGS data, data provided by NYDHSES, professional knowledge, and information provided by the local HMPT.

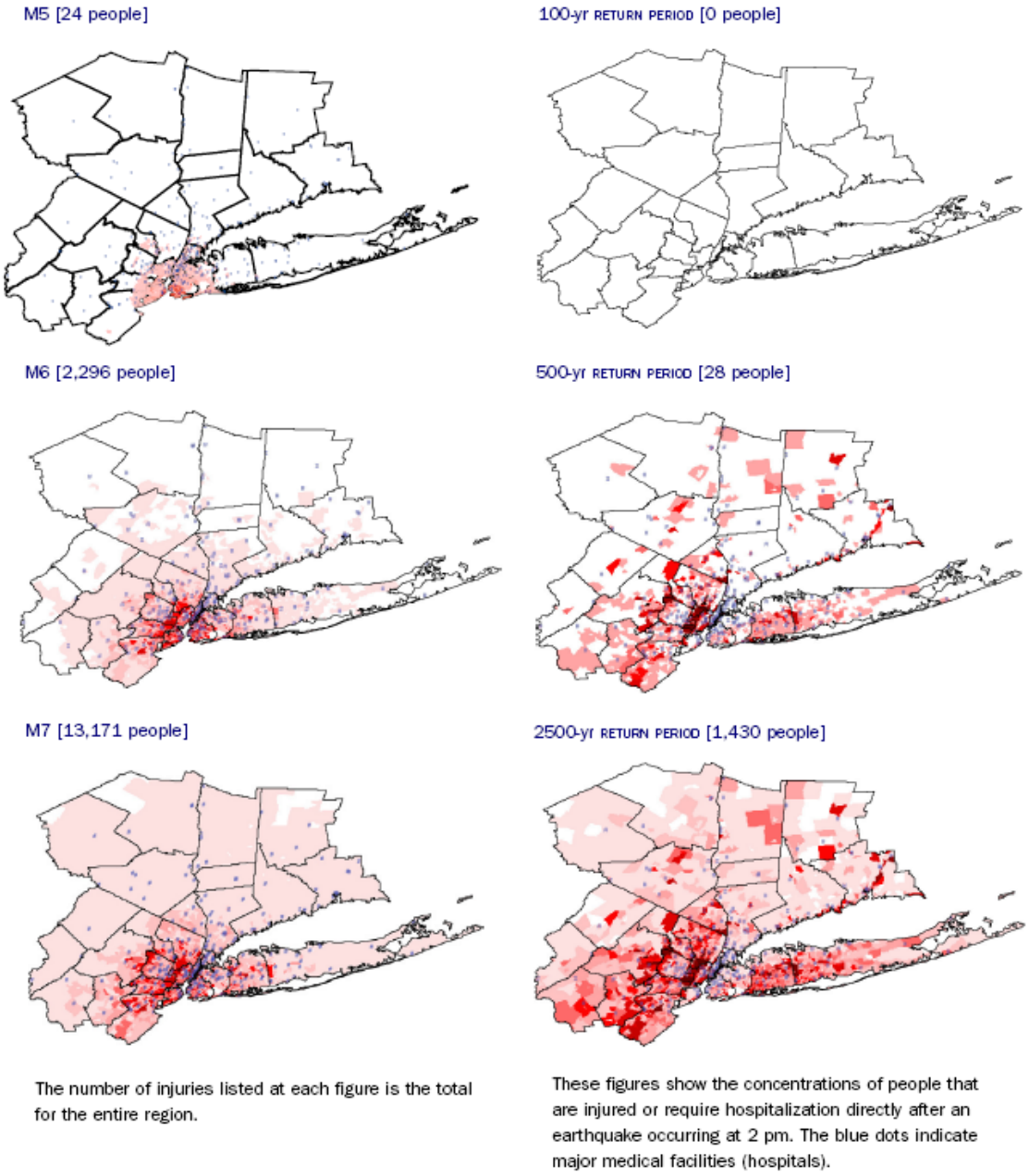
**Impact on Life, Health and Safety**

Overall, the entire population of the Town and Village is exposed to the earthquake hazard event. The impact of earthquakes on life, health and safety is dependent upon the severity of the event. Risk to public safety and loss of life from an earthquake in the Town and Village is minimal with higher risk occurring in buildings as a result of damage to the structure, or people walking below building ornamentation and chimneys that may be shaken loose and fall as a result of the quake. Residents may be displaced or require temporary to long-term shelter as a result of an event.

Populations considered most vulnerable include the elderly (persons over the age of 65) and individuals living below the Census poverty threshold. These socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react to or respond during a hazard event and the location and construction quality of their housing.

According to the 1999-2003 NYCEM Summary Report (Earthquake Risks and Mitigation in the New York/New Jersey/Connecticut Region), there is a strong correlation between structural building damage and the number of injuries and casualties from an earthquake event. NYCEM conducted a HAZUS analysis for the New York, New Jersey, Connecticut region, which included Orange County, for M5, M6 and M7 deterministic scenarios (1884 M5.2 historic earthquake) and three probabilistic scenarios (100-, 500- and 2500-year events). Figure III-9 is a graphic summary of the injury estimates for the different earthquake scenarios in the entire New York, New Jersey, Connecticut region, occurring at 2 pm. The color code indicates that the highest number of injuries would be concentrated in the New York City metropolitan area as a result of high population concentrations.

**Figure III-9 – Injuries in the New York/New Jersey/Connecticut Region based on NYCEM HAZUS Analysis**




Source: NYCEM

For the 100-year MRP event ran in HAZUS-MH for the purposes of this Plan, HAZUS-MH MR4 estimates that zero households will be displaced and zero people will seek temporary shelter. For the 500-year event, HAZUS-MH MR4 estimates 4 households in the Town and Village will be displaced and of these, 3 people in the Town will seek temporary shelter in public shelters. For the 2,500-year MRP, HAZUS-MH MR4

estimates 53 displaced households in the Town and Village will be displaced due an the earthquake event and of these, 40 people in the Town will seek temporary shelter in public shelters. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event.

HAZUS-MH MR4 estimates the number of people that may potentially be injured and/or killed by an earthquake depending upon the time of day the event occurs. These estimates are provided for three times of day (2:00 am, 2:00 pm and 5:00 pm), representing the periods of the day that different sectors of the community are at their peak. The 2:00 am estimate considers the residential occupancy at its maximum, the 2:00 pm estimate considers the educational, commercial and industrial sector at their maximum and the 5:00 pm estimate represents peak commuter time.

No casualties are estimated for the 100-year event in the Town or the Village. For the 500-year event, 2 casualties are estimated at each of the three analyzed times. For the 2,500-year event, 28 casualties are estimated at 2 am; 19 casualties are estimated at 2 pm; and 24 casualties are estimated at 5 pm.

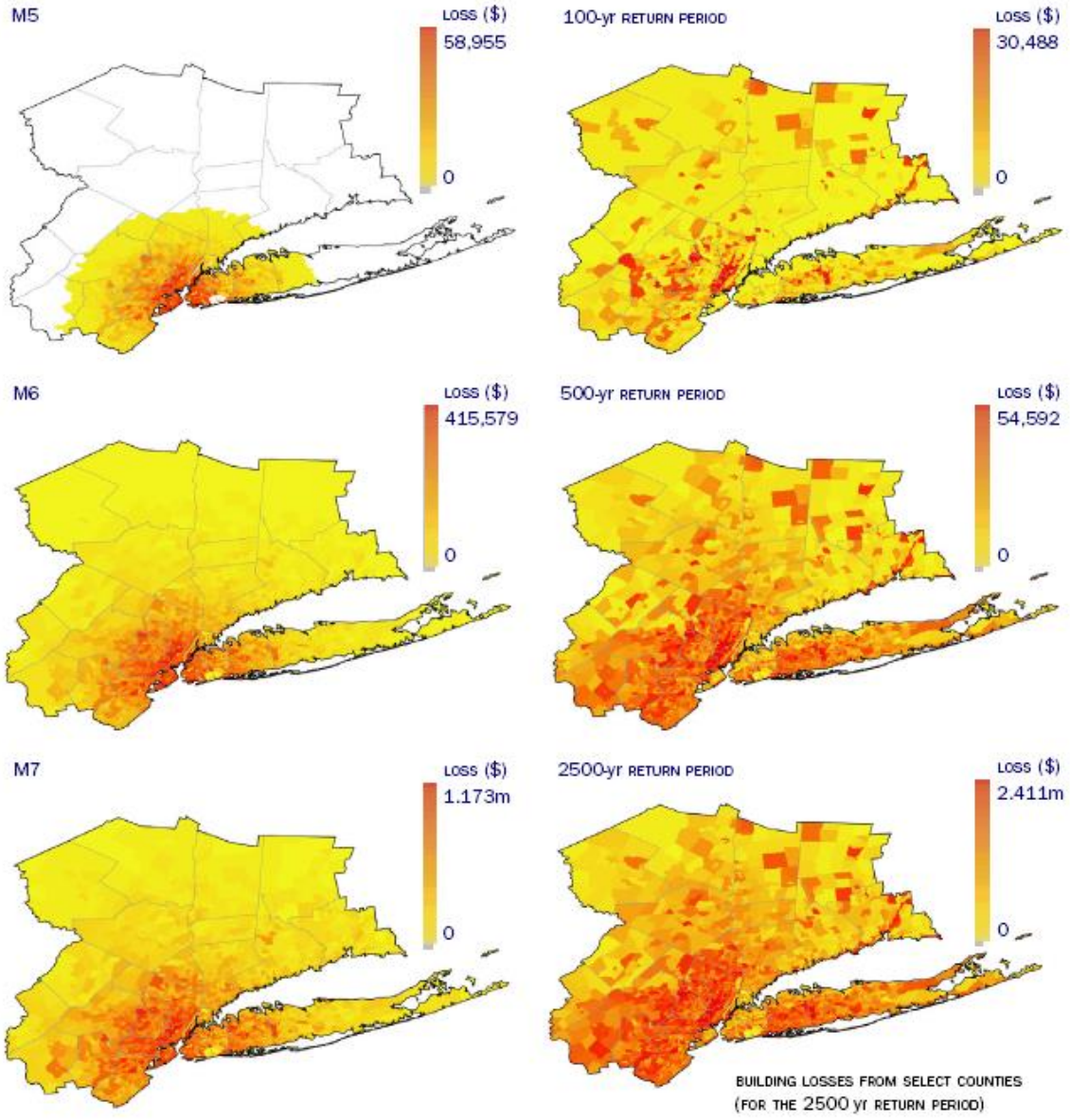
**Impact on General Building Stock**

After considering the population exposed to the earthquake hazard, the value of general building stock exposed to and damaged by 100-, 500- and 2,500-year MRP earthquake events was evaluated. The entire study area's general building stock is considered at risk and exposed to this hazard.

The NYS HMP conducted a HAZUS vulnerability assessment and reports estimates of earthquake losses factoring in NEHRP soil classes by County. For Orange County, the estimated annualized earthquake loss is nearly $0.5 million per year.

Using HAZUS-MH MR4, a probabilistic model was run for the purposes of this Plan to estimate total building related economic losses for the Town and Village. The estimated total losses are zero for the 100-year MRP event; $6,813 for the 500-year MRP event; and $86,444 for the 2,500-year MRP event.

**Figure III-10 – Total Building Related Losses for the NY/NJ/CT Region based on NYCEM HAZUS Analysis**




Source: NYCEM

## Impact on Critical Facilities

All critical facilities in the Town and Village are considered exposed and vulnerable to the earthquake hazard.

HAZUS-MH MR4 estimates the percent functionality for critical facilities days after a 100-, 500- and 2,500-year MRP earthquake event. On day one of the 100-Year MRP event, HAZUS-MH estimates that emergency facilities, schools, police and fire station

facilities will be nearly 99 percent functional. Structural damage to these facilities is estimated to be minimal. The impact to critical facilities is not considered to be significant for the 100-year event. On day one of the 500-Year MRP event, HAZUS-MH estimates that emergency facilities, schools, police and fire station facilities will be nearly 85 percent functional. Structural damage to these facilities is estimated to be minimal to moderate. On day one of the 2,500-Year MRP event, HAZUS-MH estimates that emergency facilities, schools, police and fire station facilities will be nearly 50 percent functional. Structural damage to these facilities is estimated to be moderate to significant.

**Impact on the Economy**

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. A HAZUS-MH analysis estimates the total economic loss associated with each earthquake scenario, which includes building and lifeline related losses based on the available inventory. Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the "Impact on General Building Stock" section discussed earlier. Lifeline-related losses include the direct repair cost to transportation and utility systems and are reported in terms of the probability of reaching or exceeding a specified level of damage when subjected to a given level of ground motion. These losses are discussed below.

For the 100-year MRP event, in terms of utilities, HAZUS-MH MR4 estimates each potable water facility, wastewater facility and communication facility will be fully functional day one of the event. Damage results are not considered to be significant as a result of a 100-year event; therefore, utility loss estimates are not discussed further in this assessment for this Plan.

Table III-13 summarize the HAZUS-MH MR4 estimated probability of damage that each utility may sustain as a result of the 500-year and 2,500-year MRP earthquake events.

**Table III-13 – Direct Economic Loss for Utilities***

| | Potable Water | Waste Water | Natural Gas | Communication | Total |
|---|---|---|---|---|---|
| **500-year Facilities** | 0 | 464 | 0 | 0 | 464 |
| **500-year Pipelines** | 8 | 6 | 6 | NA | 12 |
| **Total** | 8 | 470 | 6 | 0 | 476 |
| **2,500-year Facilities** | 0 | 11,622 | 0 | 9 | 11,631 |
| **2,500-year Pipelines** | 71 | 57 | 60 | NA | 188 |
| **Total** | 71 | 11,678 | 60 | 9 | 11,818 |

Prepared by Turner Miller Group NY
Source: HAZUS-MH MR4
* In thousands of dollars

For this HAZUS-MH analysis, damage estimates were not calculated for roadway segments and railroad tracks. However, it is assumed these features will experience damage due to ground failure and regional transportation and distribution of these materials will be interrupted as a result of an earthquake event. Losses to the community that result from damages to lifelines can be much greater than the cost of repair (HAZUS-MH MR4 Earthquake User Manual).

For the 100-year and 500-year MRP events, HAZUS-MH MR4 estimates all highway and railway bridges in the Town and Village will be fully functional day one of the event. For the 2,500-year MRP event, HAZUS-MH MR4 estimates that railway bridges will be fully functional day one of the event and highway bridges will be nearly 100 percent functional day one of the event. Table III-14 summarizes the estimated damages and functionality of highway bridges in the Town and Village for the 2,500-year MRP event.

**Table III-14 – Highway Bridge Damage**

| | Average for Damage State | | | |
|---|---|---|---|---|
| **Bridges** | **None** | **Slight** | **Moderate** | **Extensive** |
| 39 | 0.97 | 0.02 | 0.01 | 0.00 |

Prepared by Turner Miller Group NY
Source: HAZUS-MH MR4

HAZUS-MH MR4 also estimates the volume of debris that may be generated as a result of an earthquake event to enable the study region to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) concrete and steel; and (2) brick, wood and other debris. For the 100-year MRP event, HAZUS-MH MR4 estimates that no debris will be generated. For the 500-year MRP event, HAZUS-MH MR4 estimates approximately 3,000 tons of debris will be generated (approximately 2,000 tons of brick/wood debris and 1,000 tons of concrete/steel debris). For the 2,500-year MRP event, HAZUS-MH MR4 estimates approximately 30,000 tons of debris will be generated (approximately 14,000 tons of brick/wood debris and 15,000 tons of concrete/steel debris).

## Future Growth and Development

Areas targeted for future growth and development have been identified throughout the Town and Village. New development located in areas with softer NEHRP soil classes may be more vulnerable to the earthquake hazard. Current building codes require seismic provisions that should render new construction less vulnerable to seismic impacts than older, existing construction that may have been built to lower construction standards.

The New York State Standard Multi-Hazard Mitigation Plan identifies Orange County as the 12$^{th}$ most vulnerable county of New York State's 62 counties with respect to exposure and annualized loss and 16$^{th}$ with respect to annualized loss per capita. The New York

State Disaster Preparedness Commission based this vulnerability assessment using FEMA's HAZUS Loss Estimation Tool. In terms of annualized total earthquake dollar loss, Orange County is vulnerable to an earthquake hazard with potential annualized losses totaling more than $1,250,000. In terms of general building stock total dollar value exposure Orange County ranks 8th with a total value of $22.6 billion. Furthermore, Orange County is in the higher area with a 5 percent Peak Ground Acceleration value. This 5 percent value is higher than the average value throughout New York State with the exception of some of the northern Adirondack counties where the Peak Ground Acceleration values range up to 10 percent, but have much lower populations and smaller numbers of structures.

**HIRA-NY Analysis**

Town and Village representatives with the assistance of NYSEMO conducted a hazard analysis for the Town and Village using HIRA-NY (Hazard Identification and Risk Assessment - New York). The results of the analysis in regard to earthquakes are:

Earthquakes Score = 252, Moderately High Hazard

**Potential Impact:** Throughout a large region
**Cascade Effects:** Highly likely
**Frequency:** A rare event
**Onset:** No warning
**Hazard Duration:** Less then one day
**Recovery Time:** More than two weeks
**Impacts:**

- Serious injury or death to large numbers
- Severe damage to private property
- Severe structural damage to public facilities

**Earthquakes Estimating Potential Losses**

Earthquake hazard maps illustrate the distribution of earthquake shaking levels that have a certain probability of occurring over a given time period. According to the USGS, in 2008, Orange County and Cornwall had a PGA between 2% and 3 %g for earthquakes with a 10-percent probability of occurring within 50 years. Moderate shaking and very light damage is generally associated with a 3 to 4%g earthquake.

The NYSDPC indicates that the earthquake hazard in New York State is often understated because other natural hazards occur more frequently (for example: hurricanes, tornadoes and flooding) and are much more visible. However, the potential for earthquakes does exist across the entire northeastern U.S., and New York State is no exception (NYSDPC).

Earlier in this section, the identified hazards of concern for the Town and Village were ranked. DHSES conducts a similar ranking process for hazards that affect the State. The

probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the HMPT, the probability of occurrence for earthquakes in the Town and Village is considered "rare" (that is, not likely to occur within 100 years). Although no reported incidences have occurred within the Town or Village, it is anticipated that Cornwall will continue to experience indirect impacts from earthquakes that may affect the general building stock, local economy and may induce secondary hazards.

## 2. Extreme Temperatures

Extreme temperatures are defined as extended periods of excessive cold or hot weather with a serious impact on human and/or animal populations particularly the elderly, children, and/or persons with respiratory ailments.

### Extreme Heat and Drought

Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. Humid conditions, which add to the discomfort of high temperatures, occur when a dome of high atmospheric pressure traps hazy, damp air near the ground.

Heat kills by pushing the human body beyond its physical limits. In extreme heat and high humidity, evaporation is slowed and the body must work harder to maintain a normal and healthy temperature.

Extreme heat temperatures occur throughout New York State during summer months except for areas with higher altitudes. The New York State Climate Office reports average summer daytime temperatures usually range from the upper 70's to mid 80's over much of the state including the Hudson Valley Region. The New York City Area and lower portions of the Hudson Valley, including Orange County, experience the highest average summer temperatures in the State. According to The Weather Channel the average high temperature the month of July (generally the warmest of the year) in Cornwall is 85°F with the highest recorded temperature set at 103°F in 1953.

A drought is an extended period of time when a region experiences deficiency in its water supply. Generally this occurs when a region receives consistently below average amounts of precipitation. Many quantitative measures of drought have been developed in the U.S., those developed by Wayne Palmer (Palmer Drought Severity Index [PDSI] and the Crop Moisture Index [CMI] as well as the Standardized Precipitation Index are the most useful for describing the may scales of drought. The PDSI index is most effective in determining long term (several months) drought events and is not as good with short-term (weekly) forecasts, while the CMI responds more rapidly to conditions and is more effective in calculating short term dryness.

Extreme Cold

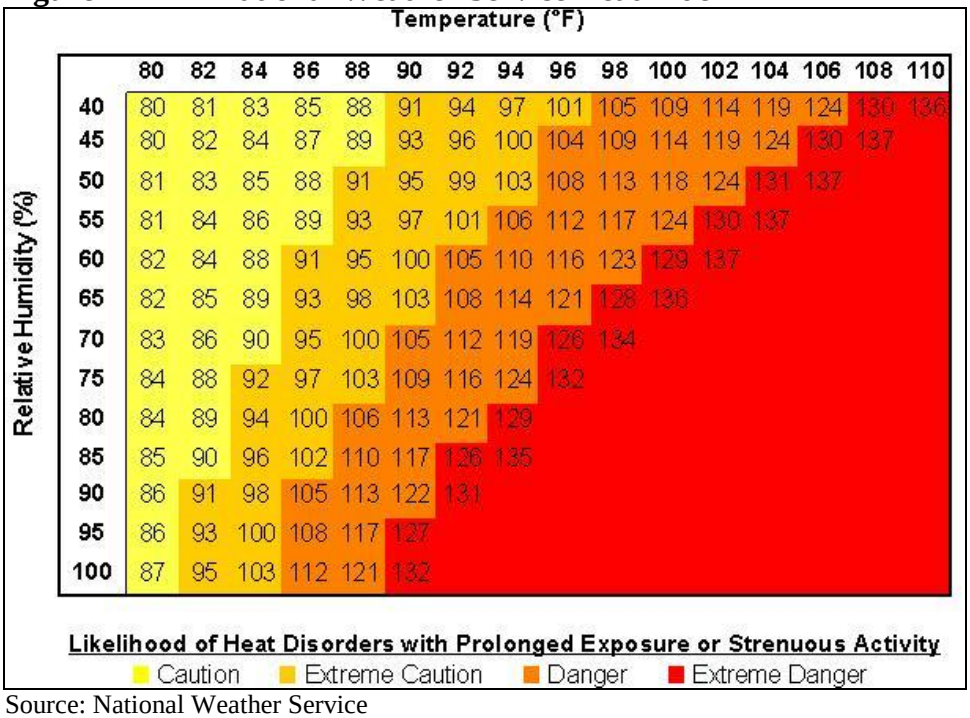
Extreme cold events occur when the mean daily temperature (average of the high and low temperature of a 24 hour period) falls below 32 degrees Fahrenheit. The daily average low in Cornwall in its coldest month (January) is 19°F with the coldest temperature recorded at -15°F in 1994.

**Extent**

Extreme Heat and Drought

In an effort to more effectively alert the general public about extreme heat episodes and measure the extent of extreme heat temperatures, the National Weather Service created the Heat Index (Figure III-11). This chart measures the apparent temperature of the air as it increases with relative humidity and shows what effects the apparent temperature will have on the population after long term exposure.

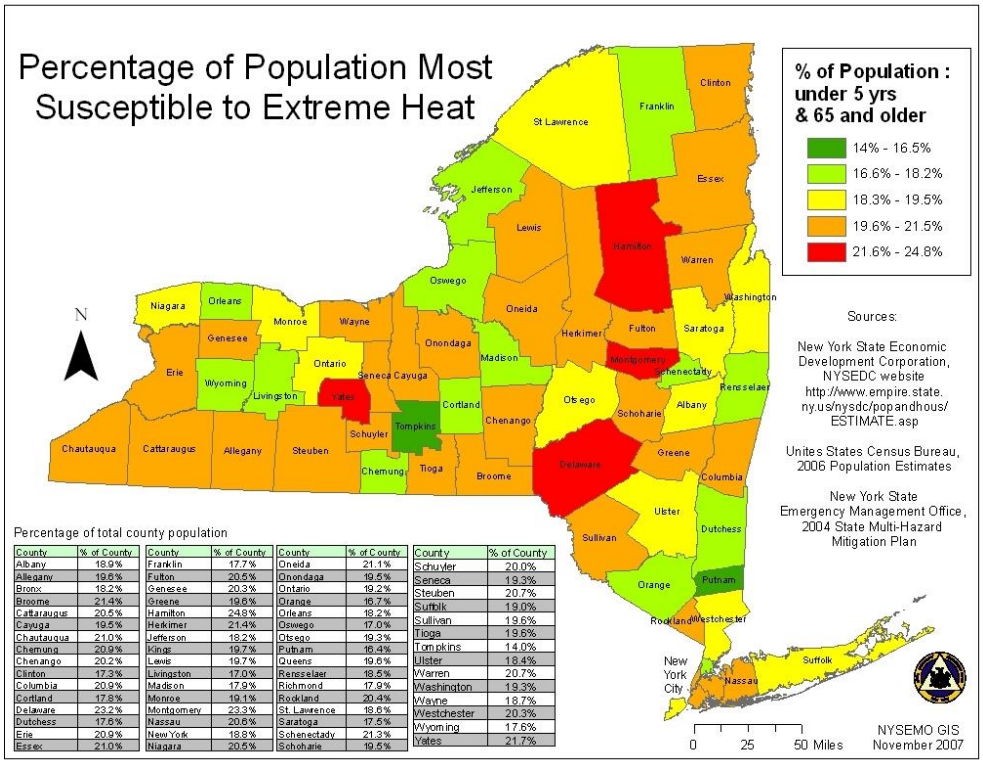
**Figure III-11 – National Weather Service Heat Index**




Source: National Weather Service

Figure III-12 below illustrates the percentage of population for New York State most susceptible to extreme heat.

**Figure III-12 – Percentage of Population Most Susceptible to Extreme Heat**




Percentage of total county population

| County | % of County | County | % of County | County | % of County | County | % of County |
|---|---|---|---|---|---|---|---|
| Albany | 18.9% | Franklin | 17.7% | Oneida | 21.1% | Schuyler | 20.0% |
| Allegany | 19.6% | Fulton | 20.5% | Onondaga | 19.5% | Seneca | 19.3% |
| Bronx | 18.2% | Genesee | 20.3% | Ontario | 19.2% | Steuben | 20.7% |
| Broome | 21.4% | Greene | 19.6% | Orange | 16.7% | Suffolk | 19.0% |
| Cattaraugus | 20.5% | Hamilton | 24.8% | Orleans | 18.2% | Sullivan | 19.6% |
| Cayuga | 19.5% | Herkimer | 21.4% | Oswego | 17.0% | Tioga | 19.6% |
| Chautauqua | 21.0% | Jefferson | 18.2% | Otsego | 19.3% | Tompkins | 14.0% |
| Chemung | 20.9% | Kings | 19.7% | Putnam | 16.4% | Ulster | 18.4% |
| Chenango | 20.2% | Lewis | 19.7% | Queens | 19.6% | Warren | 20.7% |
| Clinton | 17.3% | Livingston | 17.0% | Rensselaer | 18.5% | Washington | 19.3% |
| Columbia | 20.9% | Madison | 17.9% | Richmond | 17.9% | Wayne | 18.7% |
| Cortland | 17.8% | Monroe | 19.1% | Rockland | 20.4% | Westchester | 20.3% |
| Delaware | 23.2% | Montgomery | 23.3% | St. Lawrence | 18.6% | Wyoming | 17.6% |
| Dutchess | 17.6% | Nassau | 20.6% | Saratoga | 17.5% | Yates | 21.7% |
| Erie | 20.9% | New York | 18.8% | Schenectady | 21.3% | | |
| Essex | 21.0% | Niagara | 20.6% | Schoharie | 19.5% | | |

Source: SEMO

Extreme heat conditions which can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality. The higher the temperature and more direct sunlight is present the more ozone is produced. Ozone forms in the air from other pollutants such as volatile organic compounds (VOC's) and nitrogen oxides (NOx). Under normal weather conditions, pollutants rise and blow away from sources without buildup to an unsafe level. However, during extreme heat and humid conditions air pollution such as ozone becomes stagnate and trapped close to the ground. According to the EPA high ozone levels can also decrease lung function, increase susceptibility to respiratory infection, and aggravate asthma or other lung diseases.

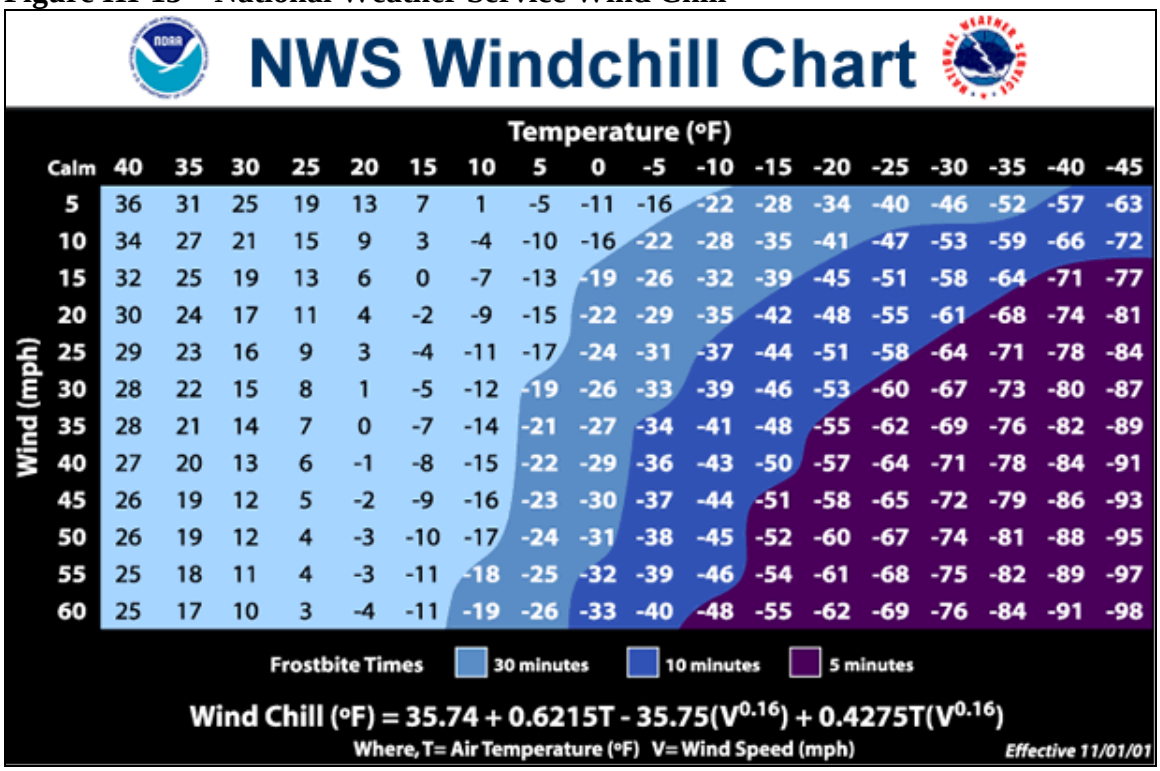
According to FEMA the extent of drought depends on the duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The intensity of impacts from the drought could be minor with total damage in a localized area or regional damage effecting human health and the economy. The wide spread impacts of drought, its diverse geographical and temperature distribution and the many scales drought operates on makes it difficult to develop both a definition to describe drought and an index by which to measure it. Drought can have a substantial impact on the local or regional ecosystem and agriculture and as a result substantially harm the local and regional economy. A number of farms, including a portion of NYS Agricultural District Number 1, exist within Cornwall and could be jeopardized by extreme heat and drought conditions. Also at risk would be the flora and fauna within

Storm King State Park, Black Rock Forest and throughout the Town and Village. Forest lands are especially susceptible to forest fires during drought conditions. When dead brush material on the forest floor becomes dried it increases the susceptibility to forest fires and the possibility that a small, normally controllable, fire will spread.

Extreme Cold

Prolonged exposure to extreme cold temperatures will lead to serious health problems such as hypothermia, cold stress, frostbite, or freezing. A condition known as the wind chill effect can exacerbate an extreme cold event. Similar to the heat index, the National Weather Service has created a wind chill chart to measure the apparent temperature felt on exposed skin due to the combination of temperature and wind speed and the amount of time it likely would take frost bite to occur.

**Figure III-13 – National Weather Service Wind Chill**




| Wind (mph) | Calm | 40 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | 36 | 31 | 25 | 19 | 13 | 7 | 1 | -5 | -11 | -16 | -22 | -28 | -34 | -40 | -46 | -52 | -57 | -63 |
| 10 | | 34 | 27 | 21 | 15 | 9 | 3 | -4 | -10 | -16 | -22 | -28 | -35 | -41 | -47 | -53 | -59 | -66 | -72 |
| 15 | | 32 | 25 | 19 | 13 | 6 | 0 | -7 | -13 | -19 | -26 | -32 | -39 | -45 | -51 | -58 | -64 | -71 | -77 |
| 20 | | 30 | 24 | 17 | 11 | 4 | -2 | -9 | -15 | -22 | -29 | -35 | -42 | -48 | -55 | -61 | -68 | -74 | -81 |
| 25 | | 29 | 23 | 16 | 9 | 3 | -4 | -11 | -17 | -24 | -31 | -37 | -44 | -51 | -58 | -64 | -71 | -78 | -84 |
| 30 | | 28 | 22 | 15 | 8 | 1 | -5 | -12 | -19 | -26 | -33 | -39 | -46 | -53 | -60 | -67 | -73 | -80 | -87 |
| 35 | | 28 | 21 | 14 | 7 | 0 | -7 | -14 | -21 | -27 | -34 | -41 | -48 | -55 | -62 | -69 | -76 | -82 | -89 |
| 40 | | 27 | 20 | 13 | 6 | -1 | -8 | -15 | -22 | -29 | -36 | -43 | -50 | -57 | -64 | -71 | -78 | -84 | -91 |
| 45 | | 26 | 19 | 12 | 5 | -2 | -9 | -16 | -23 | -30 | -37 | -44 | -51 | -58 | -65 | -72 | -79 | -86 | -93 |
| 50 | | 26 | 19 | 12 | 4 | -3 | -10 | -17 | -24 | -31 | -38 | -45 | -52 | -60 | -67 | -74 | -81 | -88 | -95 |
| 55 | | 25 | 18 | 11 | 4 | -3 | -11 | -18 | -25 | -32 | -39 | -46 | -54 | -61 | -68 | -75 | -82 | -89 | -97 |
| 60 | | 25 | 17 | 10 | 3 | -4 | -11 | -19 | -26 | -33 | -40 | -48 | -55 | -62 | -69 | -76 | -84 | -91 | -98 |

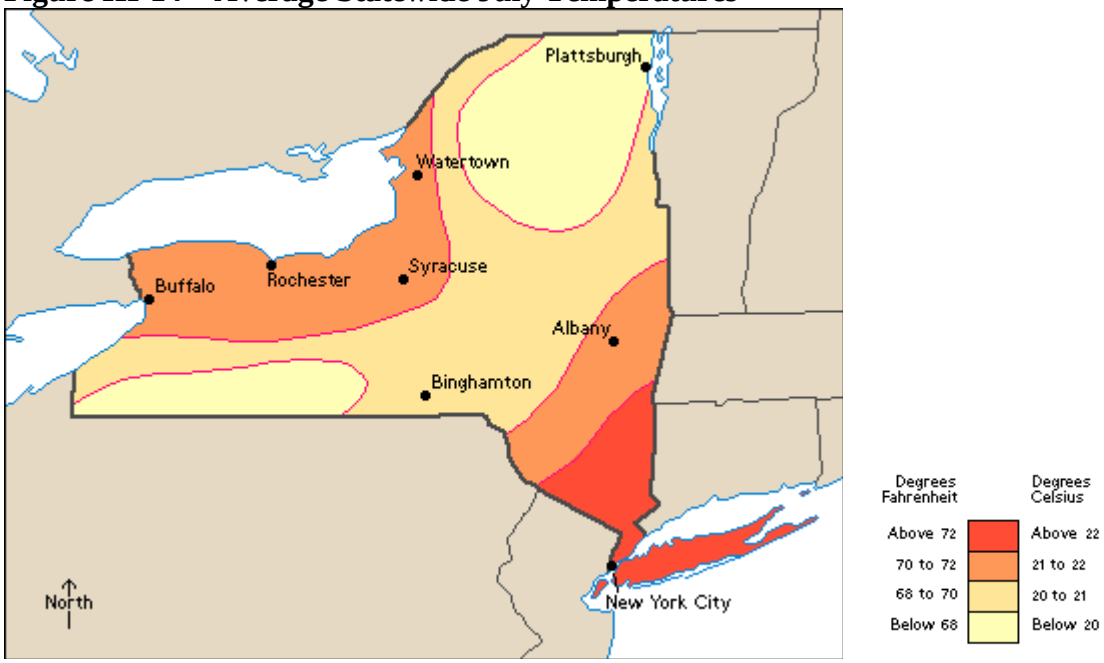
Source: National Weather Service, 2009

## Location

Extreme Heat

Extreme heat temperatures of varying degrees are existent throughout the State for most of the summer season, except for areas with high altitudes. Figure III-14 identifies the average July temperatures of the State, with the southeast and northwest sections experiencing the hottest conditions.

**Figure III-14 – Average Statewide July Temperatures**




Source: Worldbook

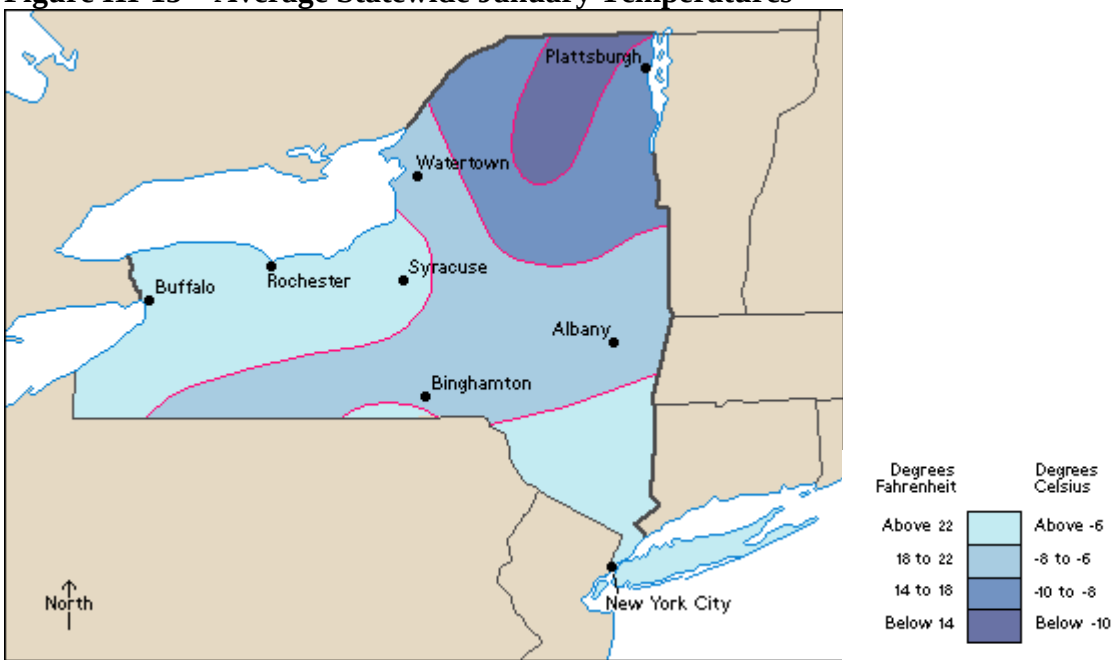
The New York State Climate (NYSC) Office of Cornell University indicates that the summer climate in the State is generally cool in the higher elevations of the Northern Plateau (Adirondack Mountains) and Eastern Plateau (Catskill Mountains) climate divisions. The New York City area (Coastal climate division) and lower portions of the Hudson Valley climate division have rather warm summers by comparison, with some periods of high, uncomfortable humidity. The remainder of New York State, which encompasses the Mohawk Valley climate division, experiences warm summers with occasional, brief intervals of extreme heat. Average summer daytime temperatures usually range from the upper 70's to mid-80's over much of the State (NYSC). The 10 climate divisions of the State are: Western Plateau (1), Eastern Plateau (Catskill Mountains) (2), Northern Plateau (Adirondack Mountains) (3), Coastal (4), Hudson Valley (5), Mohawk Valley (6), Champlain Valley (7), St. Lawrence Valley (8), Great Lakes (9), and Central Lakes (10) (NOAA).

Extreme Cold

Extreme cold temperatures exist throughout the winter season in New York State and generally accompany winter storm events. The New York State Climate Office at Cornell University indicates that cold temperatures prevail over the state whenever arctic air masses, under high barometric pressure, flow southward from central Canada of from Hudson Bay. Atmospheric and physiographic controls on the climate result in considerable variation of temperature conditions over New York State. In January (generally the coldest month according to The Weather Channel) the average mean temperature is approximately 16°F in the Adirondacks and St. Lawrence Valley, while

rising to approximately 26°F along Lake Erie and in the Lower Hudson Valley and to 31°F in Long Island. Temperatures in the Lower Hudson Valley including Cornwall are moderated by the Atlantic Ocean keeping average low temperatures slightly higher than those in the adjacent Catskill Region. Figure III-15 identifies the average January temperatures of New York State. No extreme cold events have resulted in Federal Disaster declarations at any location in Orange County.

**Figure III-15 – Average Statewide January Temperatures**




Source: Worldbook

## Previous Occurrences

Extreme Heat and Drought

According to the National Weather Service, approximately 175 Americans die each year as a result of extreme heat. Refer to Table III-15 for an accounting of past extreme heat episodes in Orange County:

**Table III-15 – Extreme Heat in Orange County**

| Date | Description |
|---|---|
| 07/04-06/1999 | Temperatures in the mid to upper 90's while most heat indices ranged from 100 to 105. No injuries or deaths were reported in Orange County. |
| 08/08-10/2001 | Temperatures ranged from 91 to 99 degrees with heat indices spiking from 105 to 110 degrees. Crop damage was reported but no injuries or deaths were reported. |
| 07/02-04/2002 | Temperatures rose into the mid- to upper 90's with heat indices ranging from 100 to 105. No injuries or deaths were reported in Orange County. |
| 07/29-31/2002 | High temperatures in the mid- to upper 90's were reported as part of an eight day heat wave the affected the entire Hudson Valley region. Heat indices ranged from 95 to 105 during the hottest three day period. No injuries or deaths were reported in Orange County. |
| 08/01-03/2006 | Over a three day period temperatures ranged from the low 90's to 100 degrees with heat indices reaching as high as 115. While 42 deaths were reported in the region (mainly in New York City), no injuries or deaths were reported in Orange County. |

Prepared by Turner Miller Group NY
Source: NOAA

Based on the Palmer Drought Severity Index, the National Climatic Data Center has reported the following periods of drought in the Hudson Valley Region within the last 25 years:

- April, 1985 – May, 1985
- August, 1993 – December 1993
- August, 1995 – September, 1995
- November, 2001 – October, 2002

No additional data on past extreme heat and drought episodes for the Town and Village of Cornwall was available.

Extreme Cold

Fatalities caused by extreme cold temperatures ranks the highest of any natural weather disaster in the United States with an average of 170 deaths per year (nationally) over the last ten years. Refer to Table III-16 for an accounting of all recorded past extreme cold episodes in Orange County:

**Table III-16 – Extreme Cold in Orange County**

| Date | Description |
|---|---|
| 02/01-02/1993 | Temperatures between 5 and 10 degrees below zero were experienced and were coupled with wind chill readings of 30 to 40 degrees below zero. No injuries or deaths were reported in Orange County |
| 01/17-18/2000 | Wind speeds of 15 to 20 mph combined with temperatures from 5 to 10 degrees produced wind chill values of 20 to 30 degrees below zero in the lower Hudson Valley. No injuries or deaths were reported in Orange County. |
| 01/21/2000 | Winds up to 38 mph (reported at Montgomery Airport) combined with temperatures around 10 degrees to produce wind chill values as low as 35 degrees below zero. No injuries or deaths reported in Orange County. |
| 01/27-28/2000 | Temperatures around 5 degrees and wind speeds of up to 25 mph produced wind chill values of 35 degrees below zero (reported at Stewart Airport). |
| 01/15-16/2004 | A low temperature of 3 degrees below zero was reported at Montgomery Airport. Wind chill values were as low as 26 degrees below zero. No injuries or deaths were reported in Orange County. |

Prepared by Turner Miller Group NY
Source: NOAA

No additional data on past extreme cold episodes for the Town and Village or Cornwall was available.

### Extreme Temperatures Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For extreme temperatures and drought, all of Cornwall has been identified as a hazard area. The following evaluates and estimates the potential impact of the drought/extreme heat hazard on the Town and Village including:

- Overview of vulnerability.
- Data and methodology used for the evaluation.
- Impact, including: (1) impact on life, safety and health of Town and Village residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development.

### Overview of Vulnerability

Essentially, all of Cornwall is vulnerable to extreme temperatures and drought. However, areas at particular risk are areas where elderly, impoverished or otherwise vulnerable populations are located. The Town and Village are prepared for drought events with emergency back-up potable-water supplies in place. Further, the Town and Village are able to contract with state DEP to use tankers. The Town and Village encourages all residents to follow water conservation measures at all times.

### Data and Methodology

Data was collected from HAZUS-MH MR4, Town, Village, County, and HMPT sources. At the time of the development of this Plan, insufficient data was available to model the

long-term potential impacts of extreme temperatures or a drought on the Town and Village. Over time additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

**Impact on Life, Health and Safety**

For the purposes of this Plan, the entire population in the Town and Village is vulnerable to extreme temperatures and drought events. Drought conditions can cause a shortage of water for human consumption and reduce local firefighting capabilities. The New York State HMP also lists mental and physical stress as social impacts of a drought (NYSDPC).

Situational and physical characteristics help to identify vulnerable populations that may not comfortably or safely access and use disaster resources. Specifically, when discussing heat related emergency preparedness, the following groups could be considered vulnerable or at greater risk in a heat emergency:

- Homeless;
- Infants and small children under age five;
- Women who are pregnant;
- Elderly people (age 65 and older);
- Persons who are obese;
- Persons who are bedridden;
- Persons with mental illness/disabilities;
- Persons with cognitive disorders;
- Persons with medical conditions (e.g., heart disease, diabetes, high blood pressure, insulin);
- Persons requiring life-saving medications (e.g., for high blood pressure, depression, insomnia);
- Persons who utilize medical equipment (e.g., ventilators, oxygen);
- Individuals with drug or alcohol addictions;
- Persons who use mobility devices (e.g., wheelchairs, walkers, canes);
- Persons who are non-ambulatory;
- Those with sensory impairments (blind/visually impaired or deaf/hard of hearing);
- Persons who are under extreme working conditions;
- Persons who are poor;
- Persons who are socially isolated;
- Persons who do not speak English with minimal access to information.

Meteorologists can accurately forecast extreme heat event development and the severity of the associated conditions with several days of lead time. These forecasts provide an opportunity for public health and other officials to notify vulnerable populations, implement short-term emergency response actions and focus on surveillance and relief efforts on those at greatest risk (EPA).

Extreme cold temperatures are often associated with severe winter storms. The high cost of fuel to heat residential homes can create a financial strain on populations with low or fixed incomes (a portion of which includes the elderly population). Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).

**Impact on General Building Stock**

No structures are anticipated to be directly impacted by an extreme temperature or drought event. However, extreme heat and drought events contribute to conditions conducive to wildfires and reduced fire-fighting capabilities. Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial, and industrial uses).

Additionally, cold winter temperatures cause streams and rivers to freeze. A rise in the water level due to snow/ice melt or a thaw breaking the river ice/compacted snow into large pieces can become jammed at man-made and natural obstructions. Ice jams can act as a dam, resulting in severe flash riverine flooding.

**Impact on Critical Facilities**

It is expected that critical facilities will continue to be operational during extreme temperature or drought events.

**Impact on the Economy**

A prolonged extreme temperature or drought event can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and a higher cost for these resources (FEMA). Industries that rely on water for business may be impacted the hardest. Even though most businesses will still be operational, they may be impacted aesthetically. In addition, droughts in another area could impact the food supply/price of food for residents.

Specific economic monetary losses associated with drought and/or extreme heat events were not identified for Cornwall. The Town and Village is prepared for drought events with emergency back-up potable-water supplies in place. Further, the Town and Village are able to contract with state DEP to use tankers. The Town and Village encourages all residents to follow water conservation measures at all times.

**Future Growth and Development**

Areas targeted for future growth and development have been identified throughout the Town and Village. Future growth could impact the amount of potable water available due to a drain on available water resources.

The New York State Standard Multi-Hazard Mitigation Plan identifies Orange County as the 60th most vulnerable county of New York State's 62 counties with respect to the percentage of the population most susceptible to extreme temperatures (population under 5 years old and 65 years and older).

**HIRA-NY Analysis**

Town and Village representatives with the assistance of NYSEMO conducted a hazard analysis for the Town and Village using HIRA-NY (Hazard Identification and Risk Assessment - New York). The results of the analysis in regard to extreme temperatures are:

Extreme Temperatures Score = 232, Moderately Low Hazard

**Potential Impact:** Throughout a large region
**Cascade Effects:** Some potential
**Frequency:** A frequent event
**Onset:** Several days warning
**Hazard Duration:** Four days to one week
**Recovery Time:** Less than one day
**Impacts:**

- 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

**Extreme Temperatures Estimating Potential Losses**

Using historical information to predict future occurrences, it was determined the Town and Village of Cornwall may expect extreme temperatures on a semi-annual basis. All areas of the Town and Village are equally susceptible to the affects of extreme temperatures.

Extreme Heat and Drought

Several extreme heat events of varying degrees occur each year throughout New York State, including Cornwall. It is anticipated that the State will continue to experience heat events annually, particularly during summer months. However, the severity of future extreme heat events is expected to vary from county to county within the State, as a result of topography, geographical conditions, the potential impact of future climate change and other factors.

Occasional drought is a normal, recurrent feature of virtually every climate in the U.S. including New York State. However, due to growing water needs as a result of population growth; adverse consequences from drought are likely to increase in the future. As indicated by the NYSDEC, New York State is rich with water resources, with

streams, lakes, rivers and coasts fed by an average annual precipitation that ranges from 60 inches in the Catskills to 28 inches in the Lake Champlain Valley. However, even in New York State's "temperate moist" climate, normal fluctuations in regional weather patterns can lead to periods of dry weather and precipitation deficiencies throughout the state (NYSDEC).

Earlier in this section, the identified hazards of concern for the Town and Village were ranked. Based on historical records and input from the HMPT, the probability of occurrence for drought events in the Town is "Frequent". It is estimated that Cornwall will continue to experience drought events annually that may induce secondary hazards.

Extreme Cold

It is anticipated that the State will continue to experience cold temperature events during the winter weather months. However, the severity of extreme cold events is expected to vary from county to county within the State, due to topography, geographical conditions, the potential impact of future climate change and other factors. Future climate change could become a large factor in influencing the frequency of extreme cold temperatures throughout the United States.

### 3. **Flooding**

According the National Flood Insurance Program, a flood is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from:

- Overflow of inland or tidal waters;
- Unusual and rapid accumulation or runoff of surface waters from any source;
- Mudflow; and/or
- Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

Flooding usually is a natural, cyclic occurrence in existing waterbodies. When a waterbody overflows its banks, a potentially violent and/or destructive waterway can form. A flash flood is a sudden transformation of a small stream into a violent waterway after heavy rain and/or rapid snowmelt.

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is a flood that has a one-percent chance of being equaled or exceeded each year. Thus, the 100-year floodplain could occur more than once in a relatively short period of time. The National Flood Insurance Program encourages states and local governments to adopt sound flood plain management programs. To provide a national standard, the 100-year flood has been adopted by FEMA as the base for flood plain management programs. The

100- and 500-year flood plain boundaries are illustrated on Figures I-2, III-1, and in Appendix D.

Flash Flooding can also occur almost anywhere in the state. The distinctive flash flood event is characterized by a rapid rise in water level, high velocity and violent damaging results which are usually exacerbated by steep topography.

**Extent**

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

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

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2008).

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

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

Two factors which influence the potential severity of a full or partial dam failure include (1) The amount of water impounded; and (2) The density, type, and value of development

and infrastructure located downstream (City of Sacramento Development Service Department, 2005).

**Location**

Flooding has always been and continues to be a statewide concern for New York State. With over 52,000 miles of rivers and streams and 1,480 designated flood prone communities there is nowhere in the state that is exempt from flood hazards. Overbank flooding is the most common type of flood event. Flooding from large rivers and its major tributaries typically results from large-scale weather systems that generate prolonged rainfall over wide areas.

Flooding is the primary natural hazard in New York State because the State exhibits a unique blend of weather (climatological and meteorological) features that influence the potential for flooding. Factors include: temperature, which is affected by latitude, elevation, proximity to waterbodies and source of air masses; and precipitation which includes snowfall and rainfall. Precipitation intensities and effects are influenced by temperature, proximity to waterbodies, and general frequency of storm systems. The Cornell Climate Report indicates that the geographic position of New York State makes it vulnerable to frequent precipitation events. This is because nearly all storms and frontal systems moving eastward across the continent pass through, or in close proximity to, New York State. Additionally, the potential for prolonged periods of heavy precipitation is increased due to the available moisture from the Atlantic Ocean. The heavy rain can quickly saturate the ground, leading to increased runoff and flooding. Flood problems in the State are most severe in the Delaware, Susquehanna, Genessee, Chemung, Hudson, Mohawk, and Alleghany River Basins. These major waterways, along with their tributary streams in the basins, are subject to direct flooding throughout New York State (NYSDPC).

Orange County communities, including the Town of Cornwall and the Village of Cornwall-On-Hudson, have experienced flooding events during all seasons. As a result of the flooding that has historically occurred within Orange County, the County is ranked as the 5th most flood vulnerable county in New York State, based on potential flood exposure and vulnerability to loss. Over 9 percent of the County is located in a 100-year floodplain (NYSDPC).

The Town and Village are located within 3 major watersheds; the Moodna, the Upper Hudson River South, and the Upper Hudson River North. These watersheds can be further segmented into seven distinct drainage pathways within the Town and Village. These include the Moodna Creek, the Silver Stream, Idlewild Creek, the Mineral Spring Brook, the Popolopen Creek, the Upper Hudson South, and the Upper Hudson North.

The Moodna and Woodbury Creeks run through the developed portions of the Town of Cornwall. The majority of the flooding hazards within the Town occur adjacent to these areas and within the Moodna watershed.

Federal Emergency Management Agency (FEMA)

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

The land area covered by the floodwaters of the base flood is the SFHA on a FIRM. It is the area where the National Flood Insurance Programs (NFIP) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V. (FEMA). This regulatory boundary is a useful tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year" flood designation. The BFE on a FIRM is the elevation of a base flood event, or a flood which has a 1-percent chance of occurring in any given year as defined by the NFIP. The BFE describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating the potential damage to occur in a given area. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by Federal agencies and most states, to administer floodplain management programs. The 100-year flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict the 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year (FEMA, 2003; FEMA, 2006). Available FIRMs and Digital FIRMS (DFIRMS) through FEMA for the Town and Village of Cornwall are included as part of Appendix D.

**Previous Occurrences**

The HMPT researched several data sources for historical flood records including disaster declarations, fire department records, and the National Oceanic & Atmospheric Administration's (NOAA) National Climatic Data Center Storm Event Database. Table III-17 shows a partial record of flood incidents that have affected Cornwall.

**Table III-17 – Flash Flood Incidents Affecting Cornwall**

| Flood Type | Date | Description |
|---|---|---|
| Flash Flood | 09/18/1999 | Hurricane Floyd produced torrential rains, high winds and flooding from the Bahamas all the way to Canada. Orange County reported over 10 inches of rain and reported $1.7M in flood damages. |
| Flash Flood | 08/03/2000 | A line of thunderstorms produced torrential rain that caused localized flooding of low-lying and poor drainage areas across Northern Orange County. |
| Flash Flood | 09/01/2000 | Slow moving thunderstorms produced periods of torrential rain that caused flash flooding of many low-lying and poor drainage areas in Cornwall. NWS radar estimated a 3 to 4 inch rainfall, which began around 3:50 pm EDT and ended around 6:50 pm. Staff from The Times Herald Record reported significant serious street flooding along with some basement flooding in Cornwall. |
| Flash Flood | 12/17/2000 | Heavy rain caused significant flooding in Orange and Rockland Counties. It also caused localized flooding of low-lying and poor drainage areas. Heavy showers, some associated with severe thunderstorms, produced wind damage at several locations. The axis of the heaviest rain extended from Western New Jersey northeast across Orange County, where 3 to 4 inches of rain fell, mainly across Western and Northern Orange County. Widespread flash flooding of low lying and poor drainage areas occurred at several locations throughout Orange County. In Orange County, rainfall amounts from available locations ranged from 2.1 inches at Gardnerville to 2.8 inches at Sterling Forest. |
| Flash Flood | 05/28/2002 | Slow moving clusters of heavy showers and thunderstorms produced widespread flash flooding of poor drainage areas and streets in Cornwall. |
| Flash Flood | 09/23/2003 | Storms produced areas of heavy rain that resulted in widespread rainfall amounts of between 1 and 1.5 inches with isolated locales receiving around 2 inches of rain. This created flooding problems across the lower Hudson Valley and in New York City. |
| Flash Flood | 09/28/2004 | The remnants of Hurricane Jeane dropped anywhere between 3 and 6 inches across Southeastern New York State. This resulted in numerous occurrences of flash flooding across the area. |
| Flash Flood | 04/02/2005 | Storm Total Rainfall amounts ranged from around 1 inch on parts of Long Island to nearly 4 inches across parts of the Lower Hudson Valley. During March 28th and 29th, only 3 to 5 days earlier, another low dumped 2 to 3 inches of rain across the region as it moved north to northeast along the eastern seaboard. These wet antecedent conditions primed the local area for additional widespread urban flooding with 3 to 7 inches of rain occurring in less than 5 days. Heavy rain caused widespread urban flooding. Most small streams and rivers overflowed their banks. In addition, high wind gusts from 46 to 57 mph, associated with heavier showers, downed trees. Orange County - from 2 inches at Blooming Grove to 3.8 inches at Monroe. At Port Jervis, the cooperative weather observer measured 3.2 inches. |
| Flash Flood | 06/16/2005 | Torrential rain from thunderstorms occurred. |
| Flash Flood | 10/08/2005 | As a cold front moved slowly east, a wave of low pressure developed along the Southeast U.S. Coast and moved slowly north as a large area of high pressure off the New England Coast remained nearly stationary. Abundant moisture from the remnants of tropical system Tammy over the Southeast also interacted with and |

| Flood Type | Date | Description |
|---|---|---|
| | | converged north along this front. Rain moved north and developed across the region during October 7th. As the wave of low pressure moved north along the front, periods of heavy rain spread north across the region through October 8th. Rain ended from west to east during October 9th as the low moved northeast of the region. The heaviest rain fell across the Lower Hudson Valley. Heavy rain resulted in significant flooding on some rivers, most small brooks and streams, and throughout urban areas in low lying and poor drainage areas. Rainfall amounts ranged from 1.1 inch at Westhampton Beach in Suffolk County to more than 10 inches in Cornwall. Spotters reported flash flooding of many roads throughout Orange County. |
| Flash Flood | 10/12/2005 | Periods of heavy rain caused flooding of low lying and poor drainage areas, including many streets. Trained spotters reported flooding of many area local streets. |
| Flash Flood | 04/15/2007 | A Nor'easter occurred during April 15th and 16th. It brought heavy rain and high winds that caused widespread and significant river, stream, and urban flooding of low lying and poor drainage areas. Orange County rainfall ranged from 4.26 inches in Westtown to 8.00 inches in Cornwall. Many small rivers, streams, and brooks rose over their banks within 12 hours of the heavy rainfall during April 15th. Many road closures were reported in the towns of Cornwall, New Windsor, Newburgh, Blooming Grove, and many other towns and villages throughout the county. |
| Flash Flood | 02/01/2008 | A low pressure system moved from the Ohio Valley to Northern New England from February 1 to February 2, 2008. A strong arctic high pressure system preceded this low with a prolonged period of subfreezing ground temperatures. Precipitation began as freezing rain with ice accumulations of 1/10 to 1/2 inch with localized amounts around an inch across interior portions of the Lower Hudson Valley before changing over to plain rain. This allowed for increased runoff causing flash flooding across parts of the local area. Rainfall totals across the Lower Hudson Valley ranged from 1 to 2 inches. |
| Flash Flood | 07/23/2008 | Several waves of low pressure rode along a slow moving cold front approaching the area. A tropical airmass was already in place across the local area from Tropical Storm Cristobal which passed by the previous day. The combination of these systems interacting with this airmass led to torrential rainfall and flash flooding. |
| Flash Flood | 09/06/2008 | Tropical Storm Hanna impacted Southeast New York, making landfall near the Nassau/Suffolk County border on the 6th. Storm total rainfall ranged from 1.66 inches at Port Jervis to 5.92 inches at New City. Periods of torrential rain from heavy showers and thunderstorms caused flash flooding in many locations, which included urban, small stream and river flooding. |
| Flash Flood | 09/09/2008 | A strong cold front swept through the tri-state area, resulting in numerous thunderstorms that produced isolated flash flooding in Orange County. |
| Flash Flood | 06/26/2009 | A shortwave rotating around a deep upper trough over New England acted on warm humid air in place at the surface to allow for supercell thunderstorms to form and track across the Lower Hudson Valley and Long Island. These storms were prolific hail producers and also caused flash flooding. |
| Flash Flood | 07/01/2009 | An occluded front coupled with shortwave energy moving through |

| Flood Type | Date | Description |
|---|---|---|
| | | associated with a vigorous upper low over the Great Lakes, combined to produce thunderstorms with heavy rain and flash flooding over northern portions of the Lower Hudson Valley. Several streams exceeded bankfull in Cornwall-On-Hudson. |
| Flash Flood | 08/12/2009 | Slow moving thunderstorms developed in a tropical airmass, which resulted in very heavy rain and flash flooding in Orange County. All lanes were closed northbound and southbound on NY 218 between Cornwall-on-Hudson and West Point due to flooding. |
| Flood | 03/13/2010 | A Nor'easter developed off the Delmarva peninsula which produced an extended period of heavy rainfall across the area as it tracked very slowly to the northeast. This caused widespread flooding across portions of southeast New York. |
| Flood | 03/07/2011 | Several waves of low pressure tracked north along a slow moving cold front that extended from the Gulf Coast to Maine. The combination of this slow moving boundary and a sub-tropical moisture feed aided in the production of heavy rainfall that resulted in moderate to major flooding across portions of Southeast New York. |
| Flood | 03/11/2011 | Very wet antecedent conditions were already in place from heavy rain a few days earlier. This in combination with a slow moving frontal boundary and a sub-tropical moisture feed from a deep southerly wind flow aided in the production of more heavy rainfall that resulted in widespread flooding across the Lower Hudson Valley. |
| Flood | 08/28/2011 | Hurricane Irene produced torrential rains, high winds and flooding from the Bahamas all the way to northern New England. Orange County reported between 6 and more than 10 inches of rain. |
| Flood | 10/29/2012 | Hurricane Sandy produced torrential rains, high winds and flooding from the Bahamas all the way to northern New England. Orange County reported between 2 and more than 4 inches of rain. Damages are presently being assessed. |

Prepared by Turner Miller Group NY
Source: NOAA

To date, the largest flood was the result of hurricane Sandy which dropped more than three inches of rain on Cornwall within twelve hours (NOAA).

No additional data on past flooding events for Cornwall was available.

**National Flood Insurance Program (NFIP)**

According to FEMA's National Flood Insurance Program (NFIP): Program Description, the U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. The NFIP collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance polices, number of claims per insured property, dollar value of each claim and aggregate value of claims,

repetitive flood loss properties, etc. NFIP data presents a strong indication of the location of flood events among other indicators (NYSDPC).

Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction and substantial improvements in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (FEMA).

There are three components to NFIP: flood insurance, floodplain management and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities (FEMA).

The NFIP program also tracks properties that file several claims of a certain value over a specific period of time, termed Repetitive Loss (RL) Properties make up only one to two percent of the flood insurance policies currently in force nationally, yet they account for 40-percent of the country's flood insurance claim payments. The NFIP is concerned with RL properties because structures that flood frequently strain the National Flood Insurance Fund. In fact, the RL properties are the biggest draw on the Fund by not only increasing the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the RL property problem because residents' lives are disrupted and may be threatened by the continual flooding (FEMA).

FEMA NFIP statistics indicate that over 8,000 RLP's exist in New York State. The distribution of RLP's is a clear indicator of the location of the flood hazard in the State. According to the 2008 NYS HMP, Orange County has 82 RLP's, mostly in Deer Park and Washingtonville within the Delaware River Basin watershed (NYSDPC). It is noted that the Town of Cornwall has one RLP, the Village does not have any.

As an additional component of NFIP, the CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance. The Town and Village do not participate in the CRS.

## Flooding Vulnerability Assessment

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

- Overview of vulnerability.
- Data and methodology used for the evaluation.
- Impact, including: (1) impact on life, safety and health of Town and Village residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development.

## Overview of Vulnerability

Flooding is a significant concern for the Town and Village. The HMPT determined flooding to be the primary hazard affecting the community. Floods are the most frequent and costly natural disaster accounting for $3.1 billion annually (1995 – 1994) across the nation and $100 million in New York State alone (USGS).

According to the Flood Insurance Study prepared by FEMA, the history of flooding along the Moodna and Woodbury Creeks indicates that flooding may occur during any season of the year. During the spring, flooding results from rain and snowfall while during the summer flooding results from rain and hurricanes/tropical storms moving up the Atlantic coastline.

## Data and Methodology

Data collected and reviewed for the flood hazard included local spatial data, FEMA Digital Flood Insurance Rate Map (DFIRM) data, and input from the HMPT and the public. The current Digital Flood Insurance Rate Maps (DFIRMs) for the Town and Village were used as part of the analysis and are included as part of Appendix D.

## Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event. The degree of that impact will vary and is not measurable.

A small percentage of the total population in the Town and the Village are exposed to the 500-year flood event and an even smaller population is exposed to the 100-year flood

event. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur.

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

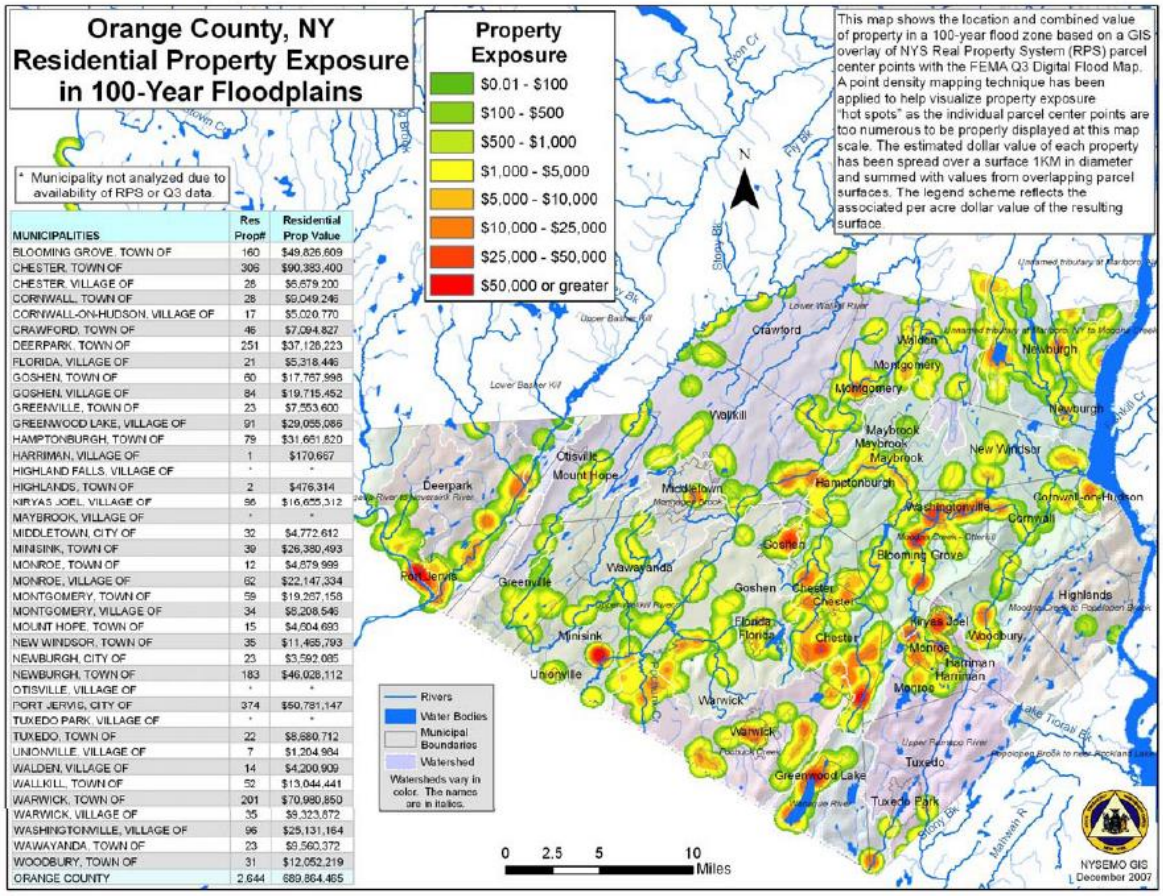
The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results form persons trying to cross flooded roadways or channels during a flood.

**Impact on General Building Stock**

The general building stock exposed to, and damaged by, the 100- and 500-year MRP flood events was evaluated. Exposure in the flood zone includes those buildings located within the regulatory floodplain boundaries. Potential damage is the loss that could occur to the exposed inventory, including structural and content value.

The NYS HMP analyzed property exposure to the 100-year floodplain using FEMA's Q3 digital flood maps and NYS Real Property System parcel centroids. This analysis provides an indication of the extent and distribution of a community's flood risk. According to this analysis, Orange County has 2,644 residential properties with an estimated property value of $689,864,465 located in a 100-year flood zone. The Town of Cornwall has 28 residential properties with an estimated property value of $9,049,246. The Village of Cornwall-On-Hudson has 17 residential properties with an estimated property value of $5,020,770. Figure III-16 illustrates the residential properties exposed to the 100-year floodplain in Orange County (NYSDPC). There is one identified repetitive loss property in FEMA's NFIP database for the Town and none for the Village.

**Figure III-16 – Orange County Residential Property Exposure in 100-year Floodplains**




| MUNICIPALITIES | Res Prop# | Residential Prop Value |
|---|---|---|
| BLOOMING GROVE, TOWN OF | 160 | $49,826,609 |
| CHESTER, TOWN OF | 306 | $90,383,400 |
| CHESTER, VILLAGE OF | 28 | $6,679,200 |
| CORNWALL, TOWN OF | 28 | $9,049,246 |
| CORNWALL-ON-HUDSON, VILLAGE OF | 17 | $5,020,770 |
| CRAWFORD, TOWN OF | 46 | $7,094,827 |
| DEERPARK, TOWN OF | 251 | $37,126,223 |
| FLORIDA, VILLAGE OF | 21 | $5,318,446 |
| GOSHEN, TOWN OF | 60 | $17,767,998 |
| GOSHEN, VILLAGE OF | 84 | $19,715,452 |
| GREENVILLE, TOWN OF | 23 | $7,553,600 |
| GREENWOOD LAKE, VILLAGE OF | 91 | $29,055,086 |
| HAMPTONBURGH, TOWN OF | 79 | $31,661,820 |
| HARRIMAN, VILLAGE OF | 1 | $170,667 |
| HIGHLAND FALLS, VILLAGE OF | * | * |
| HIGHLANDS, TOWN OF | 2 | $476,314 |
| KIRYAS JOEL, VILLAGE OF | 86 | $16,655,312 |
| MAYBROOK, VILLAGE OF | * | * |
| MIDDLETOWN, CITY OF | 32 | $4,772,612 |
| MINISINK, TOWN OF | 39 | $26,380,493 |
| MONROE, TOWN OF | 12 | $4,879,999 |
| MONROE, VILLAGE OF | 62 | $22,147,334 |
| MONTGOMERY, TOWN OF | 59 | $19,267,158 |
| MONTGOMERY, VILLAGE OF | 34 | $8,208,546 |
| MOUNT HOPE, TOWN OF | 15 | $4,604,693 |
| NEW WINDSOR, TOWN OF | 35 | $11,465,793 |
| NEWBURGH, CITY OF | 23 | $3,592,085 |
| NEWBURGH, TOWN OF | 183 | $46,028,112 |
| OTISVILLE, VILLAGE OF | * | * |
| PORT JERVIS, CITY OF | 374 | $50,781,147 |
| TUXEDO PARK, VILLAGE OF | * | * |
| TUXEDO, TOWN OF | 22 | $8,680,712 |
| UNIONVILLE, VILLAGE OF | 7 | $1,264,964 |
| WALDEN, VILLAGE OF | 14 | $4,200,909 |
| WALLKILL, TOWN OF | 52 | $13,044,441 |
| WARWICK, TOWN OF | 201 | $70,980,850 |
| WARWICK, VILLAGE OF | 35 | $8,323,872 |
| WASHINGTONVILLE, VILLAGE OF | 96 | $25,131,164 |
| WAWAYANDA, TOWN OF | 23 | $9,560,372 |
| WOODBURY, TOWN OF | 31 | $12,052,219 |
| ORANGE COUNTY | 2,644 | 689,864,455 |

Source: NYSDPC, 2008

The Flood Insurance Administration (FIA) in its management of the National Flood Insurance Program (NFIP) collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance policies, number of claims per insured property, dollar value of each claim and aggregate value of claims and repetitive flood loss properties. According to the New York State Standard Multi-Hazard Mitigation Plan, the National Flood Insurance Program data presents a strong indication of the location of flood events.

The National Flood Insurance Program also tracks properties that file several claims of a minimum value over a specific period of time. According to the New York State Standard Multi-Hazard Mitigation Plan, the definition of these properties change from time to time; however, they may be classified as repetitive loss properties. The Federal Emergency Management Agency's mitigation efforts that are directed at National Flood Insurance Program insured structures targets repetitive loss properties as a means of reducing impact on the insured.

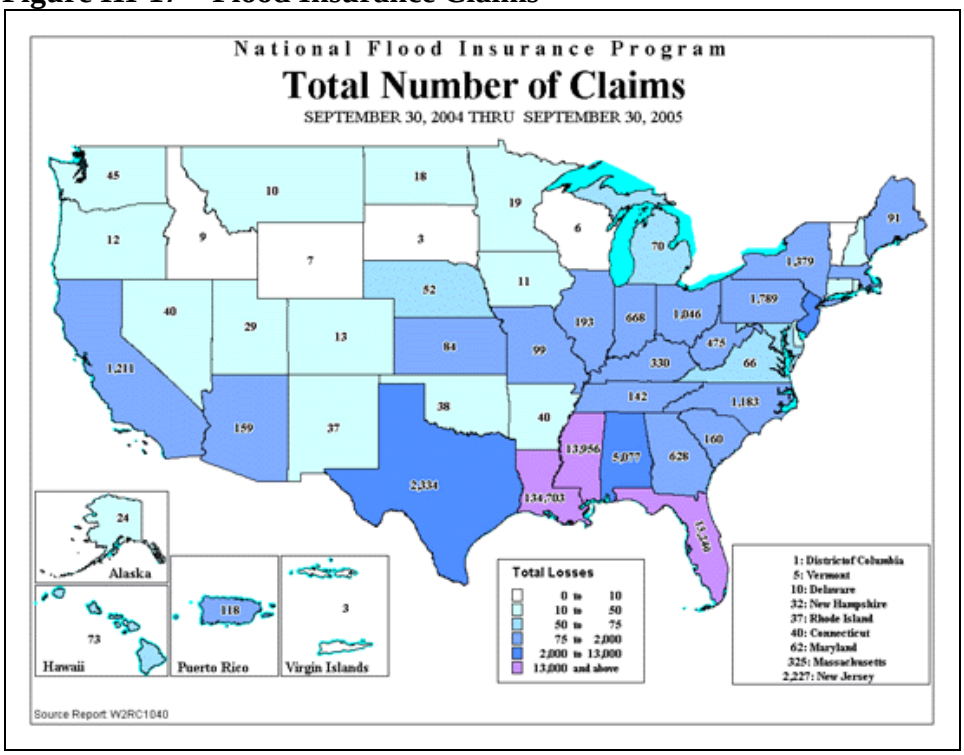
The New York State Standard Multi-Hazard Mitigation Plan identifies Orange County as the 8th most vulnerable county of New York State's 62 counties with respect to flooding with 1,025 National Flood Insurance Program policies and 45 repetitive loss properties. Of the approximately 91,000 residential structures with Orange County, 5,824 or 6.4 percent are within the 100-year flood plain. The New York State Disaster Preparedness Commission based this vulnerability assessment on a correlation between National Flood Insurance Program policies and the location of actual flood areas. In terms of total flood related dollar loss, Orange County's potential approaches $532,400,000. In terms of dollar value exposure Orange County ranks 8th.

The Town of Cornwall has 17 current National Flood Insurance Program policies and has had 14 flood insurance claims since 1978. The aggregate value of these claims was $42,705 or approximately 0.6 percent of the total Orange County paid claims of $7,609,349. Of the total claims paid, $35,954 was attributable to a single Repetitive Loss Property. The total flood insurance in force is $4,338,700. The total premiums equal $5,978. The Town is in good standing with the NFIP and there are no outstanding compliance issues.

The Village of Cornwall-On-Hudson has 13 current National Flood Insurance Program policies and has had 9 flood insurance claims since 1978. The aggregate value of these claims was $12,915 or approximately 0.2 percent of the total Orange County paid claims of $7,609,349. The total flood insurance in force is $2,534,100. The total premiums equal $9,152. The Town is in good standing with the NFIP and there are no outstanding compliance issues.

The total number of national flood insurance claims within the United States during the period between September 30, 2004 and September 30, 2005 are illustrated in Figure III-17.

**Figure III-17 – Flood Insurance Claims**




Source: http://www.fema.gov/business/nfip/statistics/totclaims2005.shtm

## Impact on Critical Facilities

Table III-18 lists the critical facilities and structures, including their value, exposed to the 500-year MRP flood event. Figure I-2 illustrates the critical facilities relative to the 100- and 500-year floodplains in Cornwall.

**Table III-18 – Critical Facilities Exposed to the 500-year Flood in Cornwall**

| Name | Property Address |
|---|---|
| Town of Cornwall Sewer Plant | 360 Shore Rd. |
| Cornwall Elementary School | 100 Lee Rd. |
| Cornwall Middle School | 122 Main St. |
| Taylor Road Well Field | 290 Taylor Rd. |
| Village Department of Public Works | 50 Shore Rd. |

Prepared by Turner Miller Group NY
Source: Orange County RPS

The following roads have been identified as vulnerable to flood events in the Town and Village:

Town of Cornwall

- Tamara Lane – this area needs drainage and the road curbed and resurfaced.
- Hasbrouck Avenue
- Clinton Street (between Hasbrouck Ave. and Union St.)
- Boulevard (between Contintal Rd. and Hasbrouck Ave.)
- Union Street (between Robert Rd. and Clinton St.)
- Murry Road
- Beakes Road
- Taylor Road Flats
- Beaver Dam Lake Area (Sycamore Dr. and Alder Dr.)

Village of Cornwall-On-Hudson

- Mountain Road
- Boulevard
- Shore Road
- Washington Street
- Lafayette Street
- Taylor Place

**Impact on the Economy**

Losses include but are not limited to general building stock damages, transportation, business interruption, and impacts to tourism and tax base to Cornwall. It is estimated that dollar value losses to total exposed resources in the Town and Village would not significantly impact the tax bases and local economy as a very small percentage of the Town's and Village's resources are located in the 100- and 500-year floodplains.

**Future Growth and Development**

Areas targeted for future growth and development have been identified throughout the Town and Village. Any new development within the identified flood hazard areas will be at risk to flooding.

**HIRA-NY Analysis**

Town and Village representatives with the assistance of NYSEMO conducted a hazard analysis for the Town and Village using HIRA-NY (Hazard Identification and Risk Assessment - New York). The results of the analysis in regard to flooding are:

Flooding Score = 197, Moderately Low Hazard

**Potential Impact:** Several locations
**Cascade Effects:** Highly likely
**Frequency:** A regular event
**Onset:** One day warning
**Hazard Duration:** Two to three days
**Recovery Time:** One to two days
**Impacts:**

- Serious injury or death unlikely
- Little or no damage to private property
- Moderate structural damage to public facilities

**Flooding Estimating Potential Losses**

Using historical information to predict future occurrences, it was determined the Town and Village may expect damaging floods on an annual basis. The most costly of these flood events are likely to occur in the areas of the Town and Village adjacent to the Moodna and Woodbury Creeks and the Hudson River.

For areas located within 100-year flood zones there is a 1 in 100, or 1 percent chance annually of a flood. In the 500-year flood zone there is 1 in 500, or 0.2 percent chance annually of a flood occurring.

As a result of the flooding that has historically occurred within Orange County, the County is ranked as the 5th most flood vulnerable county in New York State, based on potential flood exposure and vulnerability to loss.

Earlier in the Plan, the identified hazards of concern for the Town and Village were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records, FIRMs, and the HMPT the probability of occurrence for flood events in the Town and Village is considered “regular”.

## 4. **Windstorms (Hurricanes, Tornadoes and Tropical Storms)**

For the purpose of this Hazard Mitigation Plan, windstorms have been classified into four distinct categories and include the following:

Hurricanes – Hurricanes are formed in the atmosphere over warm ocean areas, in which wind speeds reach 74 miles per hour or more and blow in a large spiral around a relatively calm center or "eye". Circulation is counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Tornadoes – A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud usually of short duration. It is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly.

Tropical Storms – An organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 miles per hour.

Tropical Depressions – An organized system of clouds and thunderstorms with a defined circulation and maximum sustained winds of less than 39 miles per hour.

### Extent

Hurricanes & Tropical Storms

Hurricanes are extremely dangerous in terms of potential loss and likelihood of occurrence. In general, a single hurricane can last for more then two weeks over water and can extend outward from the eye up to 400 miles. The hurricane season for the Atlantic Coast and the Gulf of Mexico is June 1 through November 30. On average, five hurricanes strike the United States every year. In a two year period, an average of three Category 3 or higher hurricanes will strike the United States with duration, reach and damage being a function of forward motion and the availability of a warm water source. The vast majority of these hurricanes have tracked through the New York City metropolitan area and the lower Hudson Valley, including Orange County and Cornwall. Refer to Figure III-18 for an illustration of hurricanes that have tracked through New York State between 1888 and 1989.

**Figure III-18 – Hurricanes Tracking through New York State**


Source: NYSEMO

The extent of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall.

Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region (National Hurricane Center). Table III-19 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes land fall.

**Table III-19 – The Saffir-Simpson Scale**

| Category | Wind Speed (mph) | Storm Surge (ft. above normal sea level) | Expected Damage |
|---|---|---|---|
| 1 | 74-95 | 4-5 | Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged; no real damage is done to structures |
| 2 | 96-110 | 6-8 | Some trees are toppled, some roof coverings are damaged, and major damage is done to mobile homes |
| 3 | 111-130 | 9-12 | Large trees are toppled, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings |
| 4 | 131-155 | 13-18 | Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail |
| 5 | > 155 | > 18 | Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail |
| Additional Classifications | | | |
| Tropical Storm | 39-73 | 0-3 | NA |
| Tropical Depression | < 38 | 0 | NA |

Prepared by Turner Miller Group NY
Source: FEMA

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. MRP is the average period of time, in years, between occurrences of a particular hazard event (equal to the inverse of the annual frequency of exceedance) (Dinicola, 2005).

Tornado

Tornadoes are one of natures most violent storms. According to FEMA, tornado season in the northeast is between June and August but tornadoes can occur at any time of the year.

The magnitude or severity of a tornado was originally categorized using the Fujita Scale (F-Scale) or Pearson Fujita Scale introduced in 1971, based on a relationship between the Beaufort Wind Scales (BScales) (measure of wind intensity) and the Mach number scale (measure of relative speed). It is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. The F-Scale categorizes each tornado by intensity and area. The scale is divided into six

categories, F0 (Gale) to F5 (Incredible) (SPC). Table III-20 explains each of the six F-Scale categories.

**Table III-20 – Fujita Damage Scale**

| Scale | Wind Estimate (mph) | Typical Damage |
|---|---|---|
| F0 | < 73 | Light damage, some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign board damaged |
| F1 | 73-112 | Moderate damage, peels surface off roofs; mobile homes pushed off foundations or overturned, moving autos blown off roads |
| F2 | 113-157 | Considerable damage, roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground |
| F3 | 158-206 | Severe damage, roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown |
| F4 | 207-260 | Devastating damage, well-constructed house leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated |
| F5 | 261-318 | Incredible damage, strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109) yards); trees debarked; incredible phenomena will occur |

Prepared by Turner Miller Group NY
Source: SPC

Although the F-Scale has been in use for over 30 years, there are limitations of the scale. The primary limitations are a lack of damage indicators, no account of construction quality and variability, and no definitive correlation between damage and wind speed. These limitations have led to the inconsistent rating of tornadoes and, in some cases, an overestimate of tornado wind speeds. These limitations led to the development of the Enhanced Fujita Scale (EF Scale). The Texas Tech University Wind Science and Engineering Center, along with a forum of nationally renowned meteorologists and wind engineers from across the country, developed the Enhanced Fujita Scale (NOAA).

The EF Scale became operational on February 1, 2007. It is used to assign tornadoes a 'rating' based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DIs) and Degrees of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, similar to that of the F-Scale, with six categories from EF0 to EF5, representing increasing degrees of damage. The EF Scale was revised from the original F-Scale to reflect better examinations of tornado damage surveys. This new scale has to do with how most structures are designed (NOAA). Table III-21 displays the EF Scale and each of its six categories.

**Table III-21 – Enhanced Fujita Damage Scale**

| F-Scale | Intensity | Wind Speed (mph) | Damage |
|---|---|---|---|
| EF0 | Light tornado | 65-85 | Light damage, peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over |
| EF1 | Moderate tornado | 86-110 | Moderate damage, roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken |
| EF2 | Significant tornado | 111-135 | Considerable damage, roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground |
| EF3 | Severe tornado | 136-165 | Severe damage, entire stories of well-constructed house destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance |
| EF4 | Devastating tornado | 166-200 | Devastating damage, well-constructed house and whole frame house completely leveled; cars thrown and small missiles generated |
| EF5 | Incredible tornado | > 200 | Incredible damage, strong frame house leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters; high-rise buildings have significant structural deformation; incredible phenomena will occur |

Prepared by Turner Miller Group NY
Source: SPC

In the Fujita Scale, there was a lack of clearly defined and easily identifiable damage indicators. The EF Scale takes into account more variables than the original F-Scale did when assigning a wind speed rating to a tornado. The EF Scale incorporates 28 damage indicators, such as building type, structures, and trees. For each damage indicator, there are 8 degrees of damage (DOD), ranging from the beginning of visible damage to complete destruction of the damage indicator. Table III-22 lists the 28 Damage Indicators. Each one of these indicators has a description of the typical construction for that category of indicator. Each DOD in every category is given an expected estimate of wind speed, a lower bound of wind speed, and an upper bound of wind speed.

**Table III-22 – Enhanced F-Scale Damage Indicators**

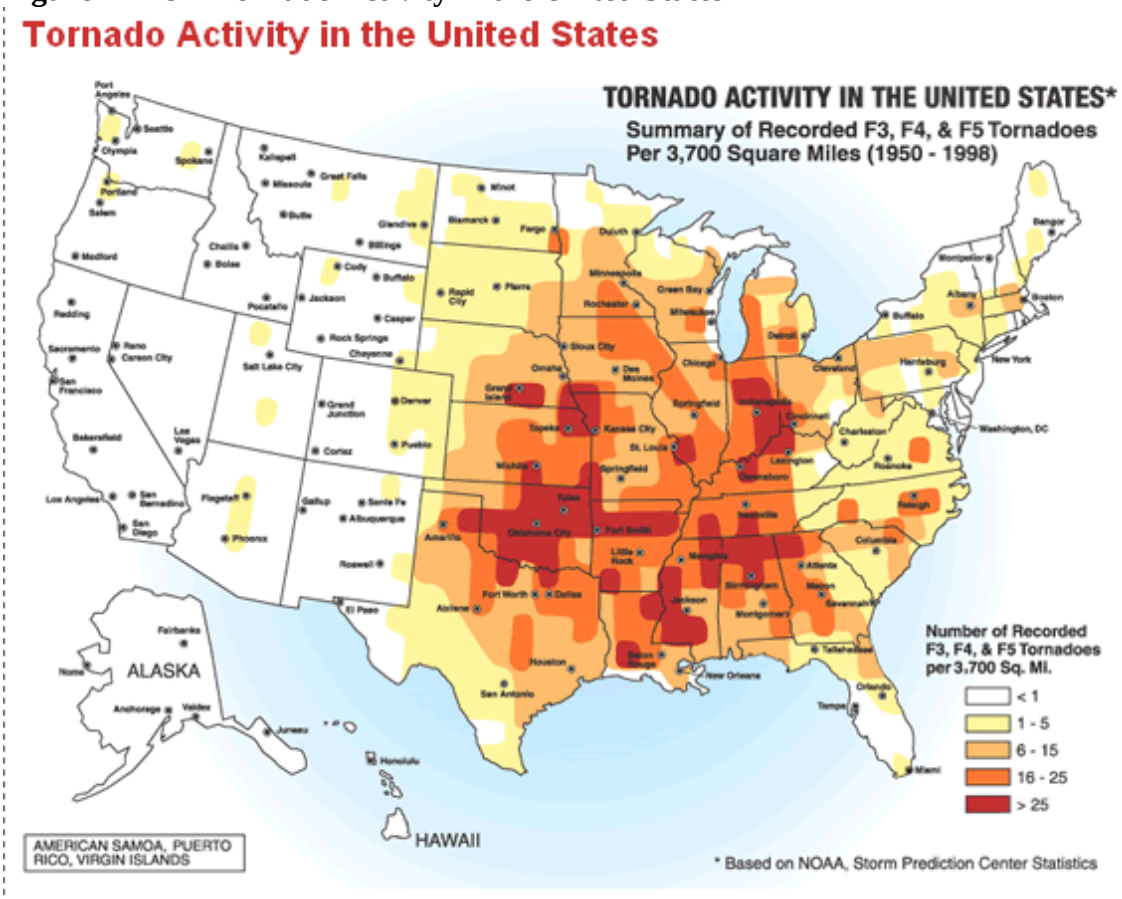
| No. | Damage Indicator | Abbreviation | No. | Damage Indicator | Abbreviation |
|---|---|---|---|---|---|
| 1 | Small barns, farm outbuildings | SBO | 15 | One story elementary school | ES |
| 2 | One- or two-family residences | FR12 | 16 | Jr. or Sr. high school | JHSH |
| 3 | Single-wide mobile home | MHSW | 17 | 1-4 story low-rise building | LRB |
| 4 | Double-wide mobile home | MHDW | 18 | 5-20 story mid-rise building | MRB |
| 5 | Apt, condo, townhouse (3 stories or less) | ACT | 19 | High-rise (over 20 stories) | HRB |
| 6 | Motel | M | 20 | Institutional bldg. (hospital, gov't) | IB |
| 7 | Masonry apt. or motel | MAM | 21 | Metal building system | MBS |
| 8 | Small retail bldg. (fast food) | SRB | 22 | Service station canopy | SSC |
| 9 | Small professional bldg. (doctors office, branch bank) | SPB | 23 | Warehouse (tilt-up walls or heavy timber) | WHB |
| 10 | Strip mall | SM | 24 | Transmission line tower | TLT |
| 11 | Large shopping mall | LSM | 25 | Free-standing tower | FST |
| 12 | Large isolated ("big box") retail bldg. | LIRB | 26 | Free standing pole (light, flag, luminary) | FSP |
| 13 | Automobile showroom | ASR | 27 | Tree – hardwood | TH |
| 14 | Automotive service building | ASB | 28 | Tree – softwood | TS |

Prepared by Turner Miller Group NY
Source: SPC

Since the EF Scale recently went into effect in February 2007, previous occurrences and losses associated with historic tornado events of this hazard profile are based on the former Fujita Scale.

According to the National Weather Service, an average of 800 tornadoes affects the U.S. each year. These tornadoes typically result in approximately 80 deaths and over 1,500 injuries annually. Figure III-19 shows tornado activity in the U.S. between 1950 and 1998, based on the number of recorded tornadoes per 3,700 square miles.

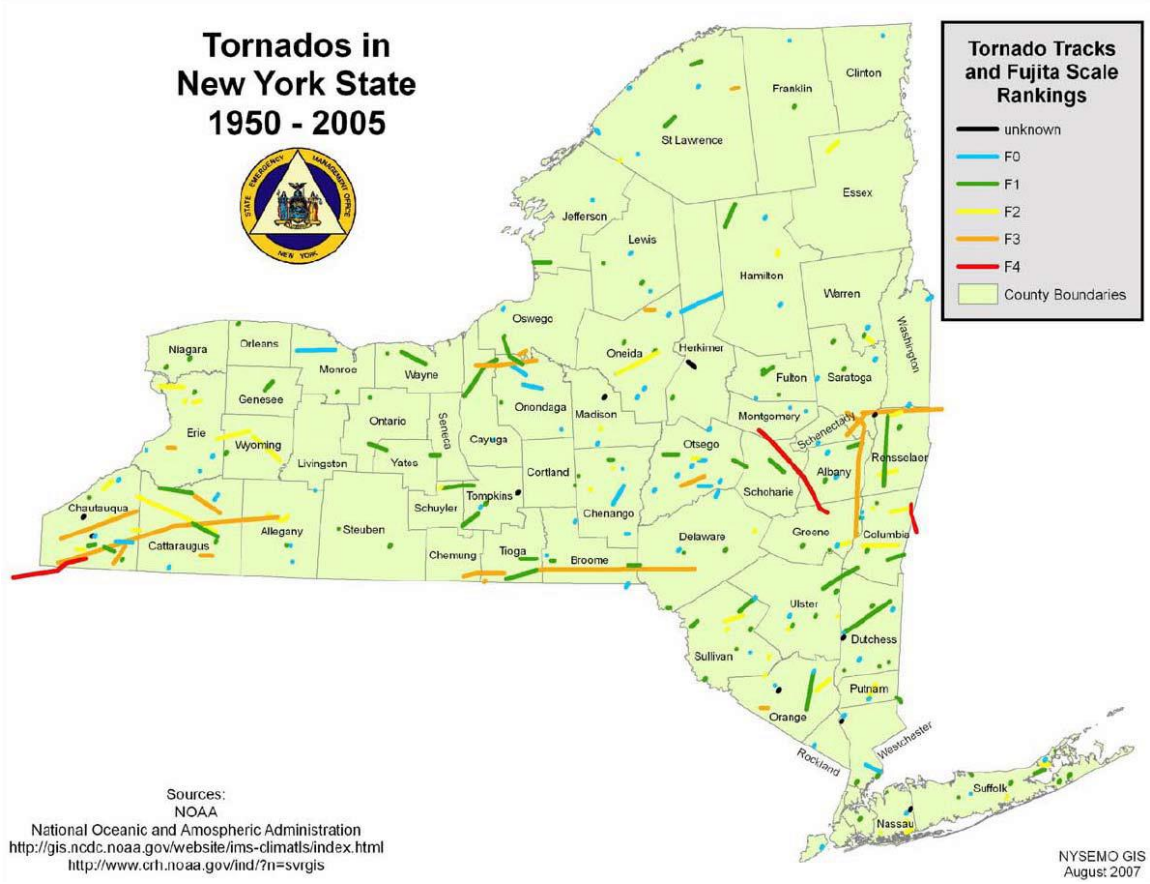
**Figure III-19 – Tornado Activity in the United States**




Source: FEMA

New York State ranks 30th in the U.S. for frequency of tornadoes. When compared to other states on the frequency of tornadoes per square mile, New York ranks 35th (Tornado Disaster Center). New York State has a definite vulnerability to tornadoes and can occur, based on historical occurrences, in any part of the State. According to Figure III-20, New York State has experienced between 0 and 15 tornadoes per 3,700 square miles since 1950. The New York State Emergency Management office reports that the State has experienced 359 tornadoes since 1950, ranging from F0 to F4 on the Fujita-Pearson Tornado Intensity Scale. Every county in New York State has experienced a tornado between 1950 and 2007 (NYSDPC) (Figure III-20).

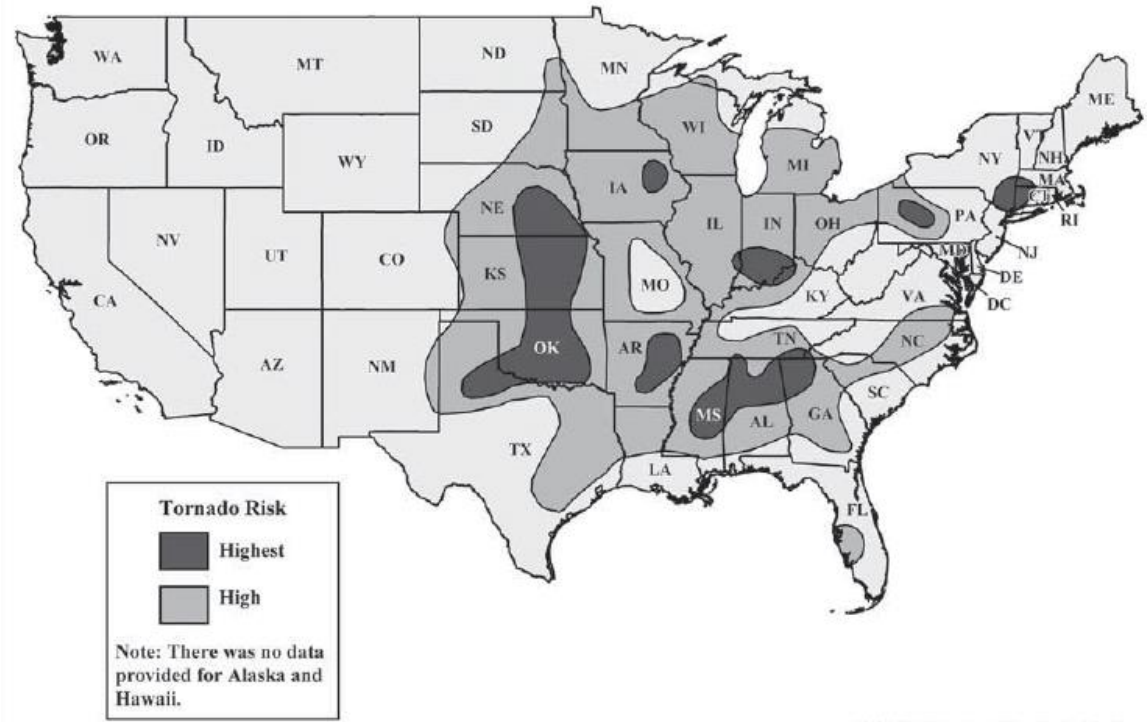
**Figure III-20 – Tornado Activity in New York State**




Source: NYSDPC

Figure III-21 indicates that a majority of the State, with the exception of the southeastern section (Mid-Hudson Region), has an overall low risk of tornado activity.

**Figure III-21 – Tornado Risk in the United States**




Source: NYSDPC

## Location

Windstorms are a common natural hazard in New York State because the State exhibits a unique blend of weather (geographically and meteorological) features that influence the potential for windstorms and associated flooding. Factors include temperature, which is affected by latitude, elevation, proximity to waterbodies and source of air masses; and precipitation which includes snowfall and rainfall. Precipitation intensities and effects are influenced by temperature, proximity to water bodies, and general frequency of storm systems. The Cornell Climate Report also indicates that the geographic position of the State makes it vulnerable to frequent storm and precipitation events. This is because nearly all storms and frontal systems moving eastward across the continent pass through, or in close proximity to New York State. Additionally, the potential for prolonged thunderstorms or coastal storms and periods of heavy precipitation is increased throughout the state because of the available moisture that originates from the Atlantic Ocean (NYSDPC).

## Previous Occurrences

Between 1950 and 2007 there have been eight tornadoes reported in Orange County with a maximum rating of F-3 occurring on July 14, 1988. The most deadly and notable

tornado[2] occurred close to Cornwall in the Town of Newburgh when a storm caused a wall to collapse at East Coldenham Elementary School killing nine students.

Table III-23 shows a record of hurricanes that have affected Cornwall and their numeric classification based on the Saffir-Simpson scale. The most recent hurricane to strike the Town and Village was Hurricane Irene which caused severe damage throughout the Hudson Valley on August 28, 2011 by dropping between six and more than ten inches of rain within twelve hours.

**Table III-23 – Hurricanes Tracking through New York State**

| Name | Date | Saffir-Simpson Category |
|---|---|---|
| Unnamed | 08/14/1888 | NA |
| Unnamed | 08/15/1893 | NA |
| Unnamed | 09/25/1893 | NA |
| Unnamed | 10/01/1894 | NA |
| Unnamed | 10/23/1899 | 1 |
| Unnamed | 09/12/1903 | 1 |
| Unnamed | 09/06/1928 | 4 |
| Unnamed | 09/22/1929 | 3 |
| Unnamed | 09/17/1933 | 2 |
| Unnamed | 06/04/1934 | 3 |
| Unnamed | 09/10/1938 | 3 |
| Unnamed | 08/07/1939 | 1 |
| Unnamed | 09/09/1944 | 3 |
| Unnamed | 09/12/1945 | 3 |
| Unnamed | 08/23/1949 | 3 |
| Able | 08/18/1952 | 1 |
| Carol | 08/25/1954 | 3 |
| Hazel | 10/05/1954 | 4 |
| Connie | 08/03/1955 | 3 |
| Dianne | 08/07/1955 | 1 |
| Audrey | 06/25/1957 | 4 |
| Gracie | 09/20/1959 | 3 |
| Donna | 08/29/1960 | 4 |
| Agnes | 06/14/1972 | 1 |
| Belle | 08/06/1976 | 1 |

[2] According to tornadoproject.com experts disagree on whether or not this storm event should be classified as a tornado.

| Name | Date | Saffir-Simpson Category |
|---|---|---|
| David | 08/25/1979 | 2 |
| Frederick | 08/29/1979 | 3 |
| Gloria | 09/16/1985 | 3 |
| Hugo | 09/10/1989 | 4 |
| Floyd | 9/19/1999 | 4 |
| Irene | 9/28/2011 | 3 |
| Sandy | 10/29/2012 | 3 |

Prepared by Turner Miller Group NY
Source: http://www.semo.state.ny.us/

**Table III-24 – Tropical Storms & Depressions**

| Incident Type | Date | Damage |
|---|---|---|
| Hail | 05/18/2000 | As a line containing severe thunderstorms swept southeast across the region, it produced damaging wind gusts, large hail (from 0.75 to 1.00 inch in diameter), heavy rain and lightning "mainly" from New York City north and west. |
| Hail | 08/11/2008 | Penny size hail was reported. A strong upper level low pressure system spawned numerous severe thunderstorms over the Lower Hudson Valley, New York City Metro, and Long Island. |
| Tropical Storm | 09/06/2008 | No fatalities or injuries were attributed to the winds. All of the associated effects of Tropical Storm Hanna resulted in estimated property damage of just under $70,000 and a minimal amount of property and crop damage. |

Prepared by Turner Miller Group NY
Source: http://www.ncdc.noaa.gov/

No additional data on past windstorm events for Cornwall was available.

### Windstorms Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For windstorm hazards, the entire Town and Village has been identified as a hazard area. The following evaluates and estimates the potential impact of windstorms on Cornwall including:

- Overview of vulnerability.
- Data and methodology used for the evaluation.
- Impact, including: (1) impact on life, safety and health of Town and Village residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development.

## Overview of Vulnerability

Severe storms include high winds and air speeds that result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people.

The Town and Village are generally impacted by tropical storm/hurricane remnant rains and severe winds. Secondary flooding associated with torrential downpours during these storms is also a primary concern to the Town and Village.

Potential losses associated with high wind events were calculated for the Town and Village for two probabilistic hurricane events; the 100-year and 500-year mean return period (MRP) hurricane events. The impacts on population, existing structures and critical facilities are presented below.

## Data and Methodology

National weather databases and local resources were used to collect and analyze windstorm impacts on the Town and Village.

## Impact on Life, Health and Safety

The impact of severe storms on life, health and safety is dependent upon the severity of the storm event. Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings and debris carried by high winds can lead to injury or loss of life. It is assumed that the entire Town and Village population is exposed to the severe storm hazard. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Additionally, residents living in mobile homes are particularly vulnerable to wind events due to the construction of their housing.

## Impact on General Building Stock

The entire general building stock inventory in the Town and Village are exposed and vulnerable to severe storm hazards. In general, structural impacts include damage to roofs and building frames.

A specific area that is vulnerable to the severe storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood hazard profile. In summary, strong winds and heavy rain can contribute to both riverine and urban flooding.

**Impact on Critical Facilities**

Full functionality of critical facilities such as police, fire and medical facilities are essential for response during and after a severe storm. Fire and police stations are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Infrastructure at risk for this hazard includes roadways and buildings that could be damaged due to flooding and high winds. Resources are required before a storm event to alert citizens to dangerous conditions, and following a storm event for road, building, and grounds maintenance and repair.

**Impact on the Economy**

Severe storms also have impacts on the economy including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings and roads. Business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during a storm. Additionally, losses include the temporary living expenses for those people displaced from their homes because of a storm.

**Future Growth and Development**

Areas targeted for future growth and development have been identified throughout the Town and Village. Any areas of growth could be potentially impacted by the windstorm hazard because the entire planning area is exposed and vulnerable.

**HIRA-NY Analysis**

Town and Village representatives with the assistance of NYSEMO conducted a hazard analysis for the Town and Village using HIRA-NY (Hazard Identification and Risk Assessment - New York). The results of the analysis in regard to hurricanes are:

Hurricane Score = 186, Moderately Low Hazard

**Potential Impact:** Throughout a large region
**Cascade Effects:** Highly likely
**Frequency:** A rare event
**Onset:** One day warning
**Hazard Duration:** Less than one day
**Recovery Time:** Three days to one week
**Impacts:**

- Serious injury or death is likely, but not in large numbers
- Severe damage to private property
- Severe structural damage to public facilities

**Windstorms (Hurricanes and Tropical Storms) Estimating Potential Losses**

Earlier in the Plan, the identified hazards of concern for the Town and Village were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the HMPT, the probability of occurrence for windstorms in Cornwall is considered to be "frequent" (that is, likely to occur within 25 years).

It is estimated that the Town and Village will continue to experience direct and indirect impacts of windstorms annually that may induce secondary hazards.

5. **Severe Winter Storms**

For the purpose of this Plan a severe winter storm is defined as a storm system that develops in late fall to early spring and deposits wintry precipitation, such as snow, sleet, or freezing rain, with a significant impact on transportation systems, utilities, and public safety. The following could meet this definition:

Heavy Snow: Characterized by six inches of snow in 12 hours or less.

Blizzard: Characterized by low temperatures, winds of 35 mph or greater, and sufficient falling and/or blowing snow in the air to frequently reduce visibility to ¼ of a mile or less for a duration of at least three hours.

Blizzard (Severe): Characterized by temperatures near or below 10 degrees F, winds exceeding 45 mph, and visibility reduced by snow to near zero for a duration of at least three hours.

Ice Storm: An ice storm involves freezing rain or rain that freezes upon impact. Ice coating at least one-fourth inch in thickness is heavy enough to damage trees, overhead wires and produce widespread power outages.

Nor'easter: A Nor'easter is a large weather system traveling from south to north, passing along or near the seacoast. As the storm approaches New England and intensifies, the counterclockwise cyclonic winds impact the coast and inland areas from a northeasterly direction.

In general, the winter storm season for the Atlantic Coast including New York State falls between October and April. While it is almost certain that a number of significant winter storms will occur during this period, it is impossible to determine how many storms will occur during any particular winter season. Similarly, the frequency of winter storms and the annual snowfall amount cannot be accurately predicted.

Severe winter weather can cause significant damage to trees in the form of bending and breaking limbs and branches, and toppling trees outright. The resulting debris can disrupt power distribution, block roads and damage residential and commercial structures.

A significant winter storm generally occurs over more then a single day, two days being common, and three days being rare.

**Extent**

The magnitude or severity of a severe winter storm depends on several factors including a region's susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography and time of occurrence during the year. Unlike hurricanes and tornados there is no widely used scale to classify winter storm events. The extent of a severe winter storm can be classified by meteorological measurements such as those above or can be measured by societal impacts. The Northeast Snowfall Impact Scale (NESIS), shown in Table III-25 below, categorizes and ranks high-impact snowstorms in this manner. This scale was created due to the major impacts a severe winter storm event can have on transportation and the economy of the entire country due to the number of major population centers in the northeast. In recent history there have been two Category 5, Extreme Winter storms recorded, both dumping more than a foot of snow in northwestern Orange County and Cornwall, March 12-14, 1993 and January 6-8, 1996.

**Table III-25 – NESIS Ranking Categories**

| Category | Description | NESIS Range | Definition |
|---|---|---|---|
| 1 | Notable | 1.0-2.49 | These storms are notable for their large areas of 4 inch snow accumulations and small areas of 10 inch snow accumulations. |
| 2 | Significant | 2.5-3.99 | Includes storms that produce significant areas of greater than 10 inches of snow while some include areas of 20 inch snowfalls. A few cases may even include small areas of very heavy snowfall (greater than 30 inches). |
| 3 | Major | 4.0-5.99 | This encompasses the typical major Northeast snowstorm with large areas of 10 inch snows and multiple areas with 20 inches of accumulation |
| 4 | Crippling | 6.0-9.99 | These storms consist of widespread, heavy snows with significant areas receiving 20 inches or greater amounts of accumulation and can be best described as crippling to the entire northeast with impacts to transportation and the economy felt throughout the country. |
| 5 | Extreme | 10 + | These storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls as high as 30 inches. These storms could effect more than 60 million people. |

Source: National Climatic Data Center

Though the occurrence of a Nor'Easter can be forecasted with some accuracy, predicting their impact can be a little more complex. The extent of a Nor'Easter can be categorized by the Dolan-Davis Nor'Easter Intensity Scale. In 1993, researchers Robert Davis and Robert Dolan created this Nor'Easter intensity scale, but it deals primarily with beach and coastal deterioration. This scale, presented as Table III-26, categorizes the intensity of

Nor'Easters from 1 (weak) to 5 (extreme) based on their storm class. This is used to give an estimate of the potential beach erosion, dune erosion, overwash and property damages expected from a Nor'Easter (Multi-County Environmental Storm Observatory).

**Table III-26 – The Dolan-Davis Nor'Easter Intensity Scale**

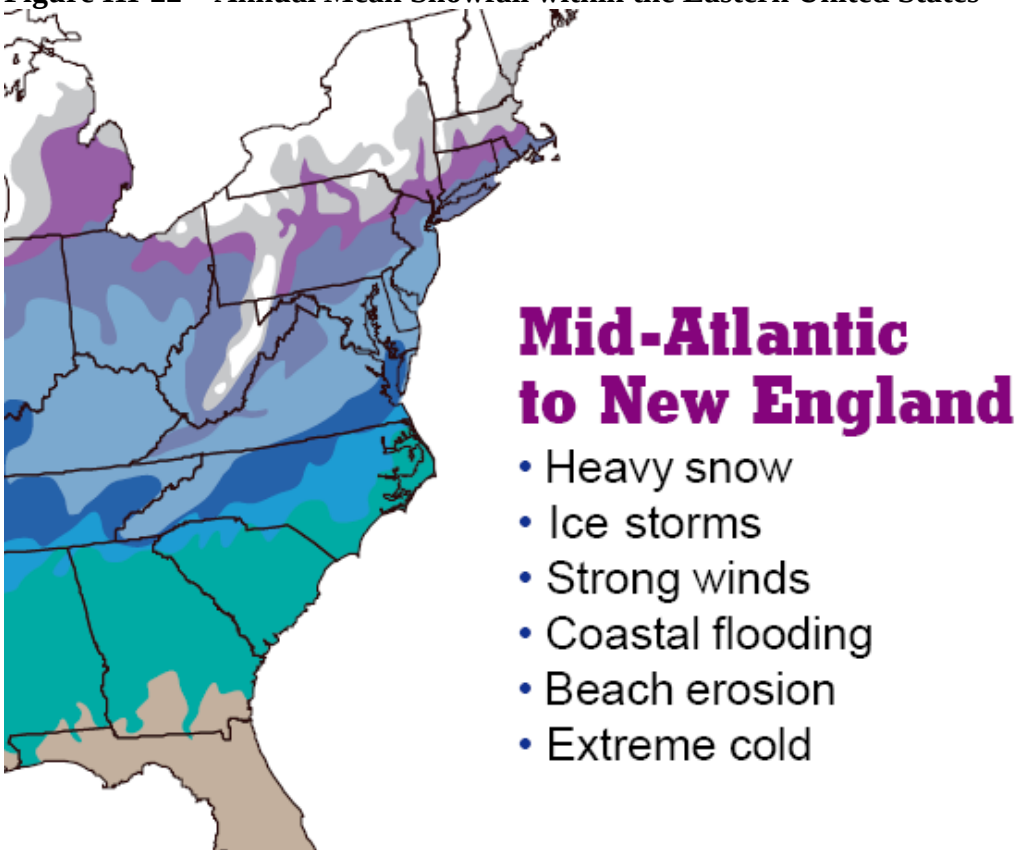
| Storm Class | Overwash | Beach Erosion | Dune Erosion | Property Damage |
|---|---|---|---|---|
| 1 | No | Minor changes | None | No |
| 2 | No | Modest; mostly to lower beach | Minor | Modest |
| 3 | No | Erosion extends across the beach | Can be significant | Loss of many structures at local level |
| 4 | On low beaches | Severe beach erosion and recession | Severe dune erosion or destruction | Loss of structures at community level |
| 5 | Massive in sheets and channels | Extreme beach erosion | Dunes destroyed over extensive areas | Extensive at regional scale; millions of dollars in damage |

Source: MESO

## Location

Winter weather, particularly snowstorm events, have historically affected many U.S. states, mainly in the Northeast and Midwest. The climate of New York State is marked by abundant snowfall. Winter weather can reach New York State as early as October and is usually in full force by late November with average winter temperatures between 20 and 40 degrees F. As indicated in the NYS HMP, communities in New York State receive more snow than most other communities in the Nation. The Cities of Syracuse, Buffalo, Rochester, and Albany are typically in the top 10 cities in the Nation in annual snowfall. These municipalities are located in Onondaga, Erie, Monroe, and Albany Counties. Although the entire State is subject to winter storms, the eastern and west-central portions of the State are more likely to suffer under winter storm occurrences than any other location (NYSDPC). With the exception of coastal New York State, the State receives an average seasonal amount of 40 inches of snow or more. The average annual snowfall is greater than 70 inches over 60 percent of New York State's area; however, this does not include Orange County which receives between 36 and 48 inches (Figure III-22).

**Figure III-22 – Annual Mean Snowfall within the Eastern United States**




Source: National Weather Service

Topography, elevation and proximity to large bodies of water result in a great variation of snowfall in the State's interior, even within relatively short distances. Maximum seasonal snowfall, averaging more than 175 inches, occurs on the western and southwestern slopes of the Adirondacks and Tug Hill. A secondary maximum of 150 to 180 inches prevails in the southwestern highlands, some 10 to 30 miles inland from Lake Erie. Record heavy snow accumulations, averaging from 100 to 120 inches, also occur within (1) the uplands of southwestern Onondaga County and adjoining counties; the Cherry Valley section of northern Otsego and southern Herkimer counties; and (3) the Catskill highlands in Ulster, Delaware and Sullivan counties. Minimum seasonal snowfall of 40 to 50 inches occur upstate in (1) Niagara County, near the south shore of Lake Ontario, (2) the Chemung and mid-Genesee River Valleys of western New York, and (3) near the Hudson River in Orange, Rockland, and Westchester Counties upstream to the southern portion of Albany County (NCDC).

The New York City metropolitan area, which encompasses Orange County, in comparison to the rest of the state, is milder in the winter. Due in part to geography (its proximity to the Atlantic and being shielded to the north and west by hillier terrain), the New York metro area usually sees far less snow than the rest of the state. Lake-effect snow rarely affects the New York metro area, except for its extreme northwestern

suburbs. Winters also tend to be noticeably shorter here than the rest of the state. Based on this information, all of Orange County is susceptible to winter storms.

The NYSDPC and NYDHSES list Orange County as the 12th County in the State most threatened by and vulnerable to snow and snow loss, with an annual average snowfall of 40.1 inches. Orange County is also listed as the 26th County in New York State most threatened by and vulnerable to ice storms and ice storm loss. The New York State Disaster Preparedness Commission based this vulnerability assessment using the annual average snowfall amount, the potential for extreme snowfall events and the number of snow related disasters. The identification of specifically vulnerable populations, facilities and areas within the Town and Village may not be appropriate beyond the generally mentioning historic or pre-code constructed buildings and mobile homes. Instead, the analysis results may best be used as a guide to help target facilities that might benefit from further analysis. Further analysis may include the estimation of potential losses based on historical events as well as continued collaboration between Town and Village officials and state agency representatives (NYSDPC).

**Previous Occurrences**

The HMPT researched several data sources for winter storms including disaster declarations and the National Oceanic & Atmospheric Administration's (NOAA) National Climatic Data Center Storm Event Database. Tables III-27 and III-28 include recordings of severe winter storms and ice storms that have affected Cornwall.

**Table III-27 – Severe Winter Storms Affecting Cornwall**

| Date | Description |
|---|---|
| 01/22/2005 | This system produced near blizzard conditions with heavy snow, strong and gusty winds, blowing snow, and drifting snow. Across the Lower Hudson Valley, temperatures rose from the single digits into the teens as northeast winds increased up to 15 to 25 mph during this time. Driving was hazardous and there were widespread impacts to mass transit. Storm total snowfalls ranged from around 7 to 20 inches across the region. Most locations measured between 8 and 16 inches. Orange County - from 8.0 inches at Campbell Hall to 15.0 inches at Highland Mills. |
| 02/21/2005 | Bands of moderate to heavy snow developed and moved slowly northeast across the region, before dissipating. Storm Total Snowfall amounts ranged from 5 to 8 inches, as follows: Orange County - from 5.0 inches at Newburgh to 8 inches at Montgomery. |
| 02/28/2005 | Bands of heavy snow swept northeast across the region. Storm Total Snowfall amounts ranged from 8.8 inches at East Middletown to 11.0 inches at Salisbury Mills. |
| 03/23/2005 | Snow quickly developed and spread northeast across the region. In Orange County, snowfall accumulations ranged from 6.0 inches at Cornwall-On-Hudson to 10.0 inches at Circleville. |
| 12/09/2005 | A vigorous upper level disturbance tracked across the Great Lakes with heavy snows breaking out across the region. Snowfall amounts ranged from 6 inches in Manhattan to just over a foot in northern portions of the Lower Hudson Valley. |
| 01/03/2006 | Rain developed and changed over to a mix of snow, sleet, and freezing rain before changing over to all snow. Here are selected snowfall amounts: Mount Hope - 12.8 inches Chester - 11.3 inches Harriman - 7.5 inches. |
| 01/15/2006 | Rain at the onset of the event mixed with sleet and snow and then went over to all snow. The snow fell heavy at times. Here are selected snowfall amounts for Orange County: Highland Mills - 7.0 inches Goshen - 5.8 inches New Windsor - 5.7 inches. |
| 02/12/2006 | Snow spread north across the area. The snow fell steadily and heavily at times in many areas. During the event, many areas experienced very heavy snowfall rates, up to 3 to 4 inches per hour. As the strongest band of snow moved through the lower Hudson Valley, reports of "thundersnow" were received, which supported the very intense snowfall rates. The highest snowfall amounts fell across New York City and Westchester and Putnam counties with 15 to 27 inches. Elsewhere, 10 to 20 inches of snowfall was common. Winds ranged from 10 to 20 mph with gusts to 30 mph. Snow and blowing snow created near blizzard conditions with very hazardous driving conditions due to poor visibilities in many areas. |
| 12/13/2007 | This event produced 4 to 8 inches of snow in Orange and Putnam counties. Montgomery and Walden received 8 inches. |
| 02/22/2008 | Widespread heavy snowfall blanketed the region. This was the biggest event for the tri-state area during the 2007-2008 winter season. Snowfall amounts generally ranged from 5 to 8 inches with a few higher spots. Monroe in Orange County received 10 inches. |
| 12/19/2008 | Snowfall amounts averaged between 6 and 10 inches, with the highest amounts occurring across northern portions of Orange county. The following are snowfall ranges across the area: Orange County, 4.3 inches in New Milford to 10.0 inches in Monroe, Newburgh, Highland Mills and Fort Montgomery. |
| 03/01/2009 | A heavy snowfall event across the tri-state area with snowfall rates of 2 to 3 inches an hour. Snowfall amounts across southeast New York generally ranged from 7 to 12 inches. The following are selected snowfall amounts across the area: 11.2 inches at Tuxedo in the Lower Hudson Valley, 13.0 inches at Great Kills on Staten Island, 8.0 inches at the Central Park Zoo in Manhattan, and 15.7 inches at Mastic on eastern Long Island. |
| 12/09/2009 | A low tracked northeast producing a 6 to 8 hour period of heavy precipitation across the region. A marginally cold thermal profile and strong dynamics allowed for a 2 to 4 hour period of moderate to heavy snow across interior zones with snowfall rates up to 1 inch per hour. Snowfall amounts ranged from 6.0 inches at Newburgh to 7.0 inches |

| Date | Description |
|---|---|
| | at Westtown, including 6.2 inches at Middletown. |
| 01/28/2010 | A 3 to 5 hour period of moderate snowfall occurred over the region as an Alberta clipper system moved across the area. The timing and intensity of the event during the morning rush hour caused numerous traffic accidents. |
| 02/09/2010 | Periods of heavy snow and strong northeasterly winds to the region. Between ten to sixteen inches of snow fell across NYC and Long Island, with six to twelve inches across the Lower Hudson Valley. |
| 02/15/2010 | A heavy snowfall to Orange County during the day with between six to nine inches of snow. |
| 02/22/2010 | A low pressure system in combination with a strong upper level disturbance brought an extended period of mainly snow mixed with sleet and freezing rain to Orange County. Snowfall amounts ranged from 6.0 inches in Monroe to 11.3 inches in Mount Hope. |
| 02/25/2010 | A low brought a combination of heavy snow, heavy rain, coastal flooding and strong winds to the region. Up to 3 feet of snow fell across interior portions of the Lower Hudson Valley, one to two feet across the NYC metropolitan region and six to twelve inches of snow across eastern Long Island. |
| 01/11/2011 | An upper level disturbance worked over the region as a semi-stationary north to south band of very heavy snow developed just east of the Hudson River into the New York City metropolitan area. This band was responsible for snowfall rates of 3 to 4 inches per hour. In total, Eastern Long Island received 10 to 18 inches, with a few lower amounts across coastal Nassau County. New York City received 7 to 12 inches and the Lower Hudson Valley received 8 to 16 inches. At Central Park, 9.1 inches of snow fell. A weather emergency was declared by the New York City Mayor's Office. Regarding area airports, hundreds of international and domestic flights were cancelled and postponed. |
| 01/18/2011 | Low pressure tracked up the coast bringing a wintry mix of snow, sleet, freezing rain and rain to the region. Light snow overspread the region and then changed to sleet and eventually freezing rain, before ending as a mix of freezing rain and rain. Between 2 and 4 inches of snow and sleet fell across the region, with one quarter to one half of an inch of ice accumulation on top of that. This made for dangerous road conditions. |
| 01/26/2011 | A period of moderate to heavy snow overspread the region in response to a subtropical moisture feed ahead of a Mid Atlantic low pressure system. This bout of snow produced 2 to 5 inches across the region. A second heavier round of precipitation with convection then worked into the region. A very heavy snow band developed over the NYC Metro, Southern and Eastern Portions of the Lower Hudson Valley and Northern and Western Long Island. This band was responsible for snowfall rates of 3 to 4 inches per hour over a 4 to 6 hr period, raising snow totals to 15-20 inches across much of the region. Over 19 inches of snow accumulated in Central Park. Mayor Michael Bloomberg declared a weather emergency for New York City. A total of 36 inches had fallen in Central Park. Snow accumulations caused massive transportation delays including over a thousand airline cancellations at all of the major New York airports. Amtrak suspended its passenger rail service from New York to Boston and cut service between New York and Albany. |

Prepared by Turner Miller Group NY
Source: NOAA

## Table III-28 – Ice Storms Affecting Cornwall

| Date | Description |
|---|---|
| 12/14/2000 | A mixture of freezing rain and sleet created treacherous travel for the morning commute. In addition, power outages resulted as tree limbs fell due to significant ice accretion. Ice accumulated at least one quarter inch throughout the area, with some locations receiving up to one half inch of ice. |
| 02/25/2001 | Total ice accumulations ranged from 1/4 to 1/3-inch, which resulted in some power outages. Several minor traffic accidents were reported in Orange County. |
| 12/26/2005 | A mixture of snow, sleet, and freezing began during the evening hours and quickly changed to freezing rain. The freezing rain persisted for 6 to 8 hours before it changed to rain. A trained spotter in Middletown reported 0.50 inches of ice accumulation with roadways glazed over. Many traffic accidents occurred. |
| 02/01/2008 | Light to moderate freezing rain broke out across the Lower Hudson Valley and Northeast New Jersey ahead of a warm front over the Middle Atlantic states. The storm left about half an inch of ice across Orange and Putnam counties. |
| 12/11/2008 | Spotters supported ice accumulations around one half inch across the northern half of Orange county. There was a major automobile accident on the Newburgh-Beacon Bridge in Orange County with eight injuries. There were also scattered reports of trees and power lines down with the American Red Cross opening a shelter in Central Valley the following day. |
| 01/06/2009 | Ice amounts averaged around one-half inch, with up to almost an inch in spots. The following are ice accumulation ranges across the area: Orange County, 0.30 inches in Warwick to 0.80 inches in Middletown and Monroe; and Putnam County, 0.50 inches in Mahopac to 0.60 inches in Putnam Lake and Carmel. Emergency management officials in both Orange and Putnam counties reported trees and wires down during the late morning hours. |
| 01/18/2011 | Low pressure tracked up the coast bringing a wintry mix of snow, sleet, freezing rain and rain to the region. Light snow overspread the region and then changed to sleet and eventually freezing rain, before ending as a mix of freezing rain and rain. Between 2 and 4 inches of snow and sleet fell across the region, with one quarter to one half of an inch of ice accumulation on top of that. This made for dangerous road conditions. |

Prepared by Turner Miller Group NY
Source: NOAA

## Table III-29 – Historic Winter Storms Affecting Cornwall

| Storm | Date | Damage |
|---|---|---|
| Blizzard of 1888 | 03/1888 | With 21 inches of snow falling over a two-day period (the third largest accumulation on record) the Blizzard of 1888 hit New York City at the end of a warm March day. As two storms, one approaching from the south and one from the north, met over the City, heavy precipitation and winds gusting up to almost 75 mph resulted in snowdrifts up to 30 feet high. |
| Blizzard of 1947 | 1947 | Dropping 26.4 inches of snow in Central Park, the Blizzard of 1947 holds rank as the biggest snowstorm in New York City history. As moisture in the Gulf Stream fed the storm's energy, the City was paralyzed when the blizzard barreled its way through, stranding cars and busses in the streets, halting subway service and claiming 77 lives. |
| Blizzard of 1996 | 01/07/1996 | Dumping more then 20 inches of snow in Central Park, the Blizzard of 1996, marked the second biggest snowstorm in New York City history. With winds gusting to more then 50 mph, the powerful nor'easter caused widespread power outages, scores of fatalities and $1 billion in damages from Washington D.C. to Boston. |

| Storm | Date | Damage |
|---|---|---|
| Presidents Day Storm 2003 | 02/17/2003 | Nearly two feet of snow blanketed the New York City area. The storm claimed 42 lives, stranded thousands of travelers and cost the City more then $20 million. |
| Blizzard of 2011 | 01/26/2011 | A period of moderate to heavy snow overspread the region in response to a subtropical moisture feed ahead of a Mid Atlantic low pressure system. This bout of snow produced 2 to 5 inches across the region. A second heavier round of precipitation with convection then worked into the region. A very heavy snow band developed over the NYC Metro, Southern and Eastern Portions of the Lower Hudson Valley and Northern and Western Long Island. This band was responsible for snowfall rates of 3 to 4 inches per hour over a 4 to 6 hr period, raising snow totals to 15-20 inches across much of the region. Over 19 inches of snow accumulated in Central Park. Mayor Michael Bloomberg declared a weather emergency for New York City. A total of 36 inches had fallen in Central Park. Snow accumulations caused massive transportation delays including over a thousand airline cancellations at all of the major New York airports. Amtrak suspended its passenger rail service from New York to Boston and cut service between New York and Albany. |

Prepared by Turner Miller Group
Source: http://www.ncdc.noaa.gov/

No additional data on past severe winter storm events for Cornwall was available.

**Severe Winter Storms Vulnerability Assessment**

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe winter storm hazards, the entire Town and Village has been identified as a hazard area. The following evaluates and estimates the potential impact of severe winter storms on the Town and Village including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health of Town and Village residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development

**Overview of Vulnerability**

Severe winter storm events are of significant concern to Cornwall because of their frequency and magnitude in the region. Additionally, they are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms; and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure (power outages) and traffic accidents, and stress on community resources.

## Data and Methodology

National weather databases and local resources were used to collect and analyze severe winter storm impacts on the Town and Village.

## Impact on Life, Health and Safety

For the purposes of this Plan, the entire population in Cornwall is exposed to severe winter storm and extreme cold temperature events. Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, severe winter storm events can reduce the ability of these populations to access emergency services.

## Impact on General Building Stock

The entire general building stock inventory in the Town and Village are exposed and vulnerable to severe winter storm hazards. In general, structural impacts include damage to roofs and building frames. Current modeling tools are not available to estimate specific losses for this hazard.

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood hazard profile. In summary, snow and ice melt can cause both riverine and urban flooding.

Additionally, cold winter temperatures cause rivers to freeze. A rise in the water level due to snow/ice melt or a thaw breaking the river ice/compacted snow into large pieces can become jammed at man-made and natural obstructions. Ice jams can act as a dam, resulting in severe flash riverine flooding.

## Impact on Critical Facilities

Full functionality of critical facilities such as police, fire and medical facilities are essential for response during and after a severe winter storm. Fire and police stations are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires infrastructure to clear roadways, alert citizens to dangerous conditions, and following the winter requires resources for road maintenance and repair.

**Impact on the Economy**

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. Another impact on the economy includes impacts on commuting into, or out of, the area for work or school. The loss of power and closure of roads prevents the commuter population from traveling to work within and outside of the Town and Village.

**Future Growth and Development**

Areas targeted for future growth and development have been identified throughout the Town and Village. Any areas of growth could be potentially impacted by severe winter storm hazards because the entire planning area is exposed and vulnerable.

**HIRA-NY Analysis**

Town and Village representatives with the assistance of NYSEMO conducted a hazard analysis for the Town and Village using HIRA-NY (Hazard Identification and Risk Assessment - New York). The results of the analysis in regard to severe winter storms and ice storms are:

Severe Winter Storms Score = 220, Moderately Low Hazard

**Potential Impact:** Throughout a large region
**Cascade Effects:** Highly likely
**Frequency:** A regular event
**Onset:** Several days warning
**Hazard Duration:** Two to three days
**Recovery Time:** One to two days
**Impacts:**

- Serious injury or death is likely, but not in large numbers
- Moderate damage to private property
- Moderate structural damage to public facilities

The results of the HIRA-NY Analysis in regard to ice storms are:

Ice Storms Score = 202, Moderately Low 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:** One to two days
**Impacts:**

- Serious injury or death is likely, but not in large numbers

- Moderate damage to private property
- Little or no structural damage to public facilities

**Severe Winter Storms Estimating Potential Losses**

Winter storm hazards in New York State are inevitable yearly since the State is located at relatively high latitudes. These latitudes generally result in winter temperatures ranging between 0 degrees F and 32 degrees F for a good deal of the fall through early spring season (late October until Mid-April). In addition, the State is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the Winter and Fall season, how many such storms will occur during that time frame is not easily determined (NYSDPC). Similar to winter storms, the frequency of occurrence for ice storms cannot be easily predicted.

Earlier in this section, the identified hazards of concern for the Town and Village were ranked. The New York State HMP includes a similar ranking process for hazards that affect the State. The probability of occurrence, or likelihood of an event, is one parameter used in this ranking process. Based on historical snow related disaster declaration occurrences, New York State can expect a snow storm of disaster declaration proportions, on average, once every 3-5 years. Similarly, for ice storms, based on historical disaster declarations, it is expected that on average, ice storms of disaster proportions will occur once every 7-10 years within the State (NYSDPC).

As indicated previously in this hazard profile, Orange County is currently listed as the 12th County in the state most threatened by and vulnerable to snow and snow loss, with an annual average snowfalls of 40.1 inches. Orange County is also listed as the 26th County in New York State most threatened by and vulnerable to ice storms and ice storm loss (NYSDPC). Therefore, the probability of future events in Orange County and Cornwall is considered "frequent" (that is, likely to occur within 25 years). It is estimated that Orange County and all of its jurisdictions, will continue to experience direct and indirect impacts of severe winter storms annually that may induce secondary hazards.

# IV. LOSS MITIGATION STRATEGIES

This section presents mitigation strategies for the Town of Cornwall and the Village of Cornwall-On-Hudson to reduce the potential exposure and losses identified as concerns in the risk assessment based on the frequency, severity and impact of each hazard. This section addresses both mitigation activities that are specific to particular hazards and approaches that apply to multiple hazards.

## General Mitigation Planning Approach

The general mitigation planning approach used to develop this plan was developed using the Federal Emergency Management Agency publication: Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies. The FEMA document included four steps, which were used to support mitigation planning as summarized below:

- Develop mitigation goals and objectives – Mitigation goals and objectives were developed using the hazard profiles summarized in the risk assessment.

- Identify and prioritize mitigation actions – The potential mitigation activities were qualitatively evaluated against the goals and objectives and evaluation criteria and prioritized.

- Prepare an implementation strategy – High priority mitigation activities are recommended for first consideration for implementation; however, some lower priority mitigation activities could be addressed based on community-specific needs. Planning meetings will support further evaluation and selection of mitigation activities with input and recommendations from DHSES.

- Document the mitigation planning process – The mitigation planning process is documented throughout the Plan.

The hazard mitigation strategies presented in this Plan were arrived at by first reviewing existing practices by Town and Village departments at mitigating hazards. In the past the Town and Village have worked with various local, State, and Federal agencies to mitigate impacts. The following is a partial list of Town and Village policies and programs intended to reduce or eliminate long-term susceptibility to identified hazards.

## Background and Past Accomplishments

Although DMA 2000 does not require a discussion regarding past mitigation efforts, an overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and actions outlined in this Plan. The Town and Village, through previous and ongoing hazard mitigation actions, have demonstrated that they are pro-active in protecting their physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

Town of Cornwall

- The Town participates in the NFIP, which requires the adoption of FEMA floodplain mapping and certain minimum construction standards for building within the floodplain.
- The Town has actively participated in recent floodplain re-mapping efforts.
- Firthcliff Heights drainage improvements.
- Rose Hill Park drainage improvements.
- Long Hill Road drainage improvements.
- Hazen Street drainage improvements and road resurfacing.
- Torrey Lane drainage improvements, road resurfacing, and installation of sidewalks.
- Clinton Street drainage improvements and installation of sidewalks.
- Mailler Avenue drainage improvements and installation of sidewalks.
- The Town is currently working on improvements to existing road crossings which have been identified by the Highway Department as being deficient.

Village of Cornwall-On-Hudson

- The Village participates in the NFIP, which requires the adoption of FEMA floodplain mapping and certain minimum construction standards for building within the floodplain.
- The Village has actively participated in recent floodplain re-mapping efforts.
- Black Rock Water Plant drainage and access road improvements.
- Catskill Treatment Plant drainage and protection improvements.
- Taylor Road well control and generator.
- Maple Road tank and PS drainage and protection improvements.
- River Avenue drainage improvements and road resurfacing.

- Boulevard drainage improvements and road resurfacing.

- Wood Avenue drainage improvements and road resurfacing.

- The Village is currently working on improvements to existing road crossings which have been identified by the Department of Public Works as being deficient.

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

**Table IV-1 – Existing Mitigation Strategies in Cornwall**

| Existing Mitigation | Description | Department | Improvements Needed |
|---|---|---|---|
| Building Codes | Adopted to ensure public safety under all hazard conditions | Planning and Building | N/A |
| Tree Maintenance | Tree pruning to minimize damage from fallen trees | Highway and Public Works | N/A |
| Emergency Generators | Provide standby power at all Town, Village, and school buildings utilized during a hazard event | Individual Town and Village Departments and School Districts | Need to install generators in all essential Town, Village, and school facilities |
| Storm Drain Maintenance | Inspection and clearing of piped storm drains, water courses, streams and ditches to minimize overflows during storm events | Highway and Public Works | N/A |
| NIMS Training | Training among police, fire, EMS, Highway, and Public Works Department employees | Individual Departments | Continue |
| National Flood Insurance Program | Encourage residents to obtain flood insurance | N/A | N/A |
| Fire Protection (hydrants) | The Town and Village has municipal water service capable of providing needed fire flows | Water | N/A |
| Fire Protection (Apparatus) | Current apparatus meets ISO standards | Fire | N/A |

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## A. Goals & Objectives

The HMPT developed a set of broad goals to help guide the development of the Plan. For the purposes of this Plan, goals were defined as broad policy statements representing long term global visions for the Town and Village. These goals were developed by examining community documents, consideration of community goals for development and discussion among the HMPT members at the outset of the planning process. Each

goal has several corresponding objectives that further define and measure specific implementation steps to attain the identified goals.

***Goal: Improve upon the protection of Cornwall's health, well-being, quality of life and private property from natural hazards.***

Objectives:

- Ensure public and private facilities with public access and infrastructure meet established building codes.
- Coordinate and integrate the Hazard Mitigation Plan with Town and Village emergency operation plans.

***Goal: Reduce the potential impact of natural hazards on Cornwall support services, critical facilities, infrastructure, natural environment, and economy.***

Objectives:

- Strengthen communication and coordinate efforts among various federal, state and local public agencies.
- Provide information on tools, partnership opportunities and funding resources to assist in implementing mitigation activities.
- Inventory, test and repair emergency equipment that is essential during hazard events.

***Goal: Implement effective measures to raise the general public's awareness of and acceptance of Cornwall's Hazard Mitigation Plan.***

Objectives:

- Develop and implement educational and outreach programs to increase public awareness of the risks associated with natural hazards.
- Promote natural hazard education programs.
- Participate in disaster preparedness seminars and other information and training sessions sponsored by the American Red Cross or similar organizations.

***Goal: Address stormwater quality and quantity (flooding), through the protection and restoration of natural resources (stream corridors, wetlands, and lakes) while simultaneously complying with emerging Federal and State regulatory mandates.***

Objectives:

- Improve hazard assessment information to make recommendations for discouraging poorly planned development and encouraging enhanced preventive measures for existing development in areas vulnerable to natural hazards.
- Reduce losses and repetitive damages from chronic hazard events through planning and improvements while promoting insurance coverage from catastrophic hazards.

- Balance watershed planning, natural resource management and land use planning with natural hazard mitigation to protect life, property and the environment.
- Preserve, rehabilitate and enhance natural systems to serve natural hazard mitigation functions.
- Develop methodologies to protect structures within stream corridors from damage as a result of erosion.
- Promote involvement in the flood insurance program for those structures in flood prone areas.
- Promote implementation of protection measures such as structure elevation, flood proofing and property buyout.

## B. Range of Considered Actions

This section identifies a range of potential mitigation actions and capital projects necessary to achieve the goals and objective identified in the previous section. The mitigation actions included in this section were developed through the review of the New York State Disaster Preparedness Commission Comprehensive Emergency Management Plan Volume I, New York State Standard Multi-Hazard Mitigation Plan. The mitigation activities include a range of options in line with six types of mitigation strategies described in the Federal Emergency Management Agency State and Local Mitigation Planning How-To Guide: Developing the Mitigation Plan including the following:

**Table IV-2 – Hazard Mitigation Strategies**

| Strategy | Description | Examples |
|---|---|---|
| Prevention | Government administration or regulatory actions or processes that influence land development | Planning and zoning regulations |
| Property Protection | Modification of existing structures or removal of structures from the hazard area | Utility relocation and Flood proofing |
| Structural Protection | Construction of structures to reduce the impact of hazards | Dams, flood/retaining walls and culverts |
| Emergency Services | Actions that protect people and property during a hazard event | Mutual aid agreements and warning systems |
| Public Education & Awareness | Actions to inform citizens and officials about hazards and mitigation | Outreach projects and mapping initiatives |
| Resource Protection | Actions that preserve or restore the functions of natural systems | Stream corridor clearing and wetland restoration |

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The initial consideration in the planning process was to develop a list of actions and capital project that if implemented would potentially mitigate the specified natural hazards.

## Table IV-3 – Range of Considered Actions

| Strategy | Description |
|---|---|
| Hazard Awareness | Provide hazard mitigation information at various locations throughout the Town and Village (existing media). Primary location for information including emergency preparedness lists, flood plain maps, and NFIP information will be the Town and Village websites. |
| Flood Education and Evacuation Routes | Provide existing emergency preparedness lists and NFIP information to residents in high-risk flood areas. Considered actions include:<br>• Provide public education regarding evacuation routes via information provided on the Town and Village websites.<br>• Inspect and improve existing evacuation routes through repair or replacement of roads, culvers and bridges (also see Flood Proofing and Structural Measures below). |
| Training | Continue training Town and Village staff within the National Incident Management System (NIMS). |
| Flood Proofing and Structural Measures | Construct mitigation or relocate structures as necessary within flood prone areas. Considered actions include:<br>• Relocate wastewater treatment plant out of floodway. Raise structural walls.<br>• Stream improvements for protection of bridges and roadways within the Idlewild drainage area. Areas of greatest concern are located along Continental, Hasbrouk, Boulevard, Main St., Clinton Ave. and connecting roads.<br>• Stream improvements for protection of bridges and roadways within the Moodna drainage area. Areas of greatest concern are located along Taylor Rd., Otterkill, Pleasant Hill and connecting roads.<br>• Relocate Taylor Road well houses above flood elevations with new controls and generators.<br>• Construct retaining wall along Dock Hill Rd. and Mine Hill Rd. to stabilize slopes. |
| Reception Centers | Identify, map and publicize the reception centers throughout the Town and Village. Shelters should be evaluated to confirm hazard resistance and added to the critical facilities list. Considered actions include:<br>• Modify/retrofit Lee Road School to make suitable for Town/Village primary reception center.<br>• Enhance coordination with school district to identify ancillary reception centers. |
| Generators | Obtain funding to purchase or replace emergency standby generators for critical facilities. Facilities include:<br>• Lee Road School – purchase new generator<br>• Taylor Road Well Field – purchase new generators<br>• Reilly Road Well Field – purchase new generators<br>• Bede Terrace Pump Stations – purchase new generator<br>• Town Hall – upgrade generator<br>• Town Highway Department – upgrade transfer switch |
| Winter Storm Preparedness | Obtain funding to purchase or replace equipment and supplies utilized by the Town Highway Department and Village of Public Works during winter storm events. Considered actions include:<br>• Purchase Zodiac or Argo high water/high land vehicle.<br>• Purchase two-stage snow blowers.<br>• Build larger Town and Village material storage facilities for Highway Departments. |

| Strategy | Description |
|---|---|
| Channel Stabilization | Construct channel stabilization measure including retaining wall and bridge replacements. |

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## Other Mitigation Actions

The following roads have been identified as vulnerable to flood events in the Town and Village. These projects are anticipated to be completed by the Town and Village as funds are made available:

Town of Cornwall

- Hasbrouck Avenue – Drainage improvements are needed between Robert Road and Idlewild Creek.
- Clinton Street – Drainage improvements are needed between Hasbrouck Avenue and Union Street.
- Union Street – Drainage improvements are needed between Robert Road and Clinton Street (extension of Clinton Street improvements).
- Murry Road – Drainage improvements are needed between Lee Road Middle School to Mailer Avenue.

Village of Cornwall-On-Hudson

- Mountain Road – Drainage improvements are needed. Projects include installation of larger diameter pipes along a 1.5 mile stretch of the road between Routes 218 and 9W, replacement of one bridge/box culvert, resurfacing of roadway, and add support for water system.
- Boulevard – Drainage improvements are needed. Projects include installation of larger diameter pipes from the Village line to the Museum of Hudson Highlands, resurfacing roadway, and add support for water system.

The HMPT has also developed a comprehensive list of potential mitigation actions, for future consideration, including projects intended to reduce the effects of hazards on new and existing buildings and infrastructure within the Town and Village. The list of potential mitigation actions, presented in Appendix E is organized according to the hazards of concern identified for this Plan, includes a range of options in line with the six types of mitigation actions described in FEMA guidance (FEMA 386-3), including:

1. Prevention – Government, administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, floodplain local laws, capital improvement programs, open space preservation, and stormwater management regulations.

2. Property Protection – Actions that involve (1) modification of existing buildings or structures to protect them from a hazard or (2) removal of the structures from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.

3. Public Education and Awareness – Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

4. Natural Resource Protection – Actions that minimize hazard loss and also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

5. Emergency Services – Actions that protect people and property, during and immediately following, a disaster or hazard event. Services include warning systems, emergency response services, and the protection of essential facilities.

6. Structural Projects – Actions that involve the construction of structures to reduce the impact of hazards. Such structures include dams, levees, floodwalls, retaining walls, and safe rooms.

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

- Action is currently outside the scope of capabilities;
- Action is not inline with established community goals and vision; and/or
- Action is already being implemented.

## C. Analysis of Mitigation Actions

The purpose of this Hazard Mitigation Plan is to reduce long-term risks to human life and property while simultaneously reducing the Town's and Village's reliance on post disaster declarations for assistance. While the Town and Village would prefer to institute all of the mitigation actions detailed in the previous section not all of these mitigation measures will be feasible or cost effective. To facilitate the prioritization of considered mitigation activities all actions were reviewed and ranked using a STAPLEE action evaluation table. The STAPLEE method analyses the social, technical, administrative, political, legal, economic, and environmental (STAPLEE) aspects of an action and is commonly used by public administration officials for making planning decisions. The following questions were asked regarding the proposed mitigation actions:

**Table IV-4 – STAPLEE Method Utilized to Analyze Mitigation Actions**

| STAPLEE Component | Question Asked |
|---|---|
| Social | Is the proposed strategy socially acceptable to the Town and/or Village? Will the action create an inequitable condition? |
| Technical | Will the proposed strategy work? Is there potential for the proposed strategy to create further problems? |
| Administrative | Can the Town and/or Village implement the strategy? Is there someone to coordinate and lead the effort? |
| Political | Is there public support to implement and maintain the strategy? |
| Legal | Is the Town and/or Village authorized to implement the proposed strategy? |
| Economic | What are the costs and benefits of this strategy? Does the cost seem reasonable for the size of the problem and anticipated benefits? |
| Environmental | How will the strategy impact the environment? Will the strategy require environmental regulatory approvals? |

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Following the STAPLEE evaluation, the proposed actions were prioritized by considering the potential mitigation effectiveness, the vulnerability to each hazard and associated cost. Detailed economic analysis for each proposed action is beyond the scope of this Hazard Mitigation Plan. Costs were evaluated in part on the personal and professional experiences of the HMPT. The priority of proposed mitigation actions were also based on the extent to which benefits are maximized according to a cost-benefit review. For example, low cost actions that support multiple hazard benefits were assigned a high priority based on the cost to benefit ratio. The proposed actions were divided into three priority classes as detailed in Table IV-6.

## Table IV-5 – STAPLEE Evaluation of Mitigation Actions

| | S | | T | | A | | P | L | | E | | E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alternative Actions** | Community Acceptance | Effect on Population | Technical Feasibility | Secondary Impacts | Staff/Coordination | Maintenance/Operations | Political Support | Authority | Potential Challenge | Cost of Action | Outside Funding Required | Land/Water | Endangered Species | Town Environmental Goals |
| Hazard Awareness | + | + | + | N | - | N | + | N | N | - | - | + | + | + |
| Flood Education and Evacuation Routes | + | + | + | N | + | N | + | + | N | + | + | + | + | + |
| Training | + | + | + | N | + | N | + | + | N | + | + | + | + | + |
| Flood Proofing and Structural Measures | - | + | - | - | - | + | N | - | - | - | - | + | + | + |
| Reception Centers | + | - | + | - | - | - | + | - | N | N | - | + | + | + |
| Generators | + | + | + | - | + | - | + | + | N | - | - | + | + | - |
| Winter Storm Preparedness | + | + | + | N | N | N | + | + | N | - | - | - | - | - |
| Channel Stabilization | - | - | + | - | + | - | - | + | - | - | - | - | + | + |

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\+ Favorable

\- Less Favorable

N Not Applicable

## Table IV-6 – Priority Classes for Proposed Hazard Mitigation Actions

| Priority Class | Description |
|---|---|
| High | An action that will produce results which would largely reduce vulnerability to damage, eliminate eminent danger, be technically and environmentally sound, easily maintained, implemented and supported politically. |
| Moderate | An action that would provide marginal results or may have implementation barriers (funding, schedule, regulatory or support). |
| Low | An action that would provide minimal results or have serious implementation barriers (funding, schedule, regulatory or support). |

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## Table IV-7 – Prioritization of Proposed Mitigation Actions

| Strategy | Priority | Potential Implementation Barriers |
|---|---|---|
| Hazard Awareness | High | Administrative/Economic |
| Flood Education and Evacuation Routes | High | Administrative/Economic |
| Training | High | Administrative |
| Flood Proofing and Structural Measures | High | Social/Technical/Administrative/ Legal/Economic |
| Reception Centers | High | Administrative/Economic |
| Generators | High | Administrative/Economic |
| Winter Storm Preparedness | Moderate | Economic/Environmental |
| Channel Stabilization | Moderate | Social/Political/Legal/Economic |

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## Table IV-8 – Implementation Schedule for Priority Mitigation Activities

| Mitigation Action | Priority | Funding Source | Implementation Timeline | Lead Agency* |
|---|---|---|---|---|
| Hazard Awareness | High | Federal/State | 0 – 5 Years | Police and Fire Departments |
| Flood Education and Evacuation Routes | High | Federal/State/ Town/Village | 0 – 5 Years | Highway Departments |
| Training | High | Town/Village | 0 – 5 Years | Supervisor/Mayor's Office |
| Flood Proofing and Structural Measures | High | Federal/State | 0 – 5 Years | Building and Highway Departments |
| Reception Centers | High | Federal/State | 0 – 5 Years | Police Department and School District |
| Generators | High | Federal/State | 0 – 5 Years | Highway and Water & Sewer Departments |
| Winter Storm Preparedness | Moderate | Town/Village | 0 – 5 Years | Highway Departments |
| Channel Stabilization | Moderate | Federal/State | 0 – 5 Years | Highway Departments |

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*Agency responsible for overseeing implementation and reporting progress

**Table IV-9 – Potential Funding Sources**

| Funding Source | Earthquakes | Extreme Temperatures | Flooding | Windstorms | Winter Storms | Landslides |
|---|---|---|---|---|---|---|
| Community Assistance Program-State Support Services Element (NFIP) | | | + | | | |
| Community Development Block Grant / Economic Development Initiative | | | + | + | | |
| Community Development Block Grant / Entitlement Grant | + | + | + | + | + | + |
| Community Development Block Grant / Small Cities Program | + | + | + | + | + | + |
| Community Disaster Loan | + | + | + | + | + | + |
| Cooperative Forestry Research | | | | | | + |
| Emergency Community Water Assistance Grants | | | + | | | |
| Emergency Conservation Program | | | + | | | |
| Emergency Flood and Shelter National Board Program | + | + | + | + | + | + |
| Emergency Management Institute Training Assistance | + | + | + | + | + | + |
| Emergency Rehabilitation of Flood control Works | | | + | | | |
| Flood Plain Management Services | | | + | | | |
| Hazard Mitigation Grant Program | + | + | + | + | + | + |
| Project Impact: Building Disaster Resistant Communities | + | + | + | + | + | + |
| Public Assistance Grant Program | + | + | + | + | + | + |

Prepared by Turner Miller Group NY

Specific mitigation actions were identified to prevent future losses. The implementation of these mitigation actions is dependent on the approval of the local elected governing bodies and the ability of the Town and Village to obtain funding from local or outside sources. Where such actions are high priorities, the Town and Village will work together with DHSES, FEMA and other Federal, State and County agencies to secure funding.

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

A comprehensive list of potential mitigation actions is presented in Appendix E. These actions include projects intended to reduce the effects of hazards on new and existing buildings and infrastructure within the Town and Village.

**Continued Compliance with NFIP**

As described previously, the NFIP makes available federally backed insurance to homeowners, renters, and business owners in communities that have adopted and are enforcing floodplain management ordinances. The NFIP also provides minimum criteria for floodplain management ordinances to provide for the safety of those living within areas subject to flooding. To identify those areas, the NFIP is also responsible for identifying and mapping the Nation's floodplains. Floodplain mapping provides needed data for floodplain management programs.

Many of the projects identified in Appendix E are projects related to flood control. These efforts specifically are designed to remain compliant with NFIP standards. Orange County and the Town of Cornwall and the Village of Cornwall-On-Hudson have been actively working to accurately update its floodplain mapping program. The projects in Appendix E, in conjunction with projects underway or completed by Orange County and the Town and Village have served to reduce future flood damages for residents. The overall result of the identified projects will be to reduce federal expenditures for disaster assistance and flood control.

As part of the National Flood Insurance Act of 1968, FEMA is prohibited from providing flood insurance unless the community adopts and enforces floodplain management regulations that meet or exceed criteria established by FEMA. It is anticipated that with the completion of the proposed projects, some of the identified Special Flood Hazard Areas (SFHA) in the Town and Village will be removed from the NFIP maps. Those that do remain will continue to comply with established floodplain ordinances.

**Cost-Benefit Considerations**

FEMA defines cost-benefit analysis at its most basic level as determining whether the cost of investing in a mitigation project will result in sufficiently reduced damages in the future to justify spending money on the project. Cost-effective mitigation strategies and projects are those in which the benefits outweigh the costs. Because a key criterion for determining funding eligibility for mitigation projects is its cost-effectiveness, all identified projects took cost-benefit considerations into account.

Cost effectiveness considerations played a role in the prioritization of all projects and strategies. Those projects that were not believed to be cost effective were not included as a potential project. More detailed cost-benefit reviews will be completed for each project at the time of funding. Also refer to STAPLEE Method Utilized to Analyze Mitigation Actions above.

It is noted that FEMA is trying to maximize its investment in damage reduction by focusing mitigation resources on those projects that have the best chance of making an impact on losses in property and life. The HMPT recognizes this and has made every effort to ensure that the identified mitigation projects meet FEMA's standards.

# V. PLAN IMPLEMENTATION & MAINTENANCE

## A. Plan Implementation

This section identifies the cost effective and feasible actions that should be developed into an action plan describing how the actions identified in the preceding section will be implemented and administered by the Town of Cornwall and the Village of Cornwall-On-Hudson. The following questions were asked to develop an implementation schedule for the identified priority mitigation strategies:

- Who will coordinate the implementation efforts including applying for funding requests and submitting applications?
- How will the Town and/or Village fund the proposed action?
- When will the proposed action be implemented?

The local HMPT has identified the high priority actions that will satisfy the previously outlined goals and objectives. The Town and Village have limited resources to accept new responsibilities and projects. The implementation of these mitigation actions are dependent on the approval of the respective elected Town and Village Boards and the ability of the Town and/or Village to secure funding from various sources. Where such actions are high priorities, the Town and Village will work with Orange County, the New York State Division of Homeland Security and Emergency Services (DHSES) and other agencies to secure funding.

The draft Hazard Mitigation Plan was submitted to the New York State Division of Homeland Security & Emergency Services (DHSES) and the Federal Emergency Management Agency (FEMA) for review and comments. The mitigation development effort continued through the performance period and culminated in a final submission to DHSES. Activities included:

- Submission of draft plan to DHSES and incorporation of revisions;
- Ongoing public involvement and incorporation of comments;
- Ongoing key stakeholders (agencies, organizations, and municipalities) involvement;
- Additional vulnerability assessment including refinement of estimation of potential losses; and
- Ongoing pre-disaster mitigation meetings to refine the priority of actions.

The input of all stakeholders was received by the HMPT, documents, discussed and incorporated into the Final Hazard Mitigation Plan for adoption by the Town of Cornwall Town Board and the Village of Cornwall-on-Hudson Board of Trustees.

## B. Evaluating & Monitoring the Plan

This section presents the procedures for evaluating, monitoring, and updating the plan. The local Hazard Mitigation Planning Team (HMPT) intends to remain intact as the organization responsible for evaluating, monitoring, and updating this Plan. The acting Point of Contact (POC) Mr. Mark Edsall shall be the Hazard Mitigation Planning Coordinator and shall continue to act as the coordinator for the local HMPT. It is recognized that individual commitments change over time, and it shall be the responsibility of each HMPT member to inform the HMP Coordinator of any changes in representation.

Evaluating the Plan

The evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, if the Plan goals are being reached, and whether changes are needed. The Plan will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that may affect mitigation priorities or available funding. The status of the Plan will be discussed and documented at an annual plan review meeting of the Mitigation Planning Committee. At least one month before the annual plan review meeting, the HMP Coordinator will advise HMPT members of the meeting date, agenda and expectations of the members. The HMP Coordinator will be responsible for calling and coordinating the annual plan review meeting, and assessing progress toward meeting plan goals and objectives. These evaluations will assess whether:

- Goals and objectives address current and expected conditions;
- The nature or magnitude of the risks has changed;
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available;
- Actions were cost effective;
- Schedules and budgets are feasible;
- Implementation problems, such as technical, political, legal or coordination issues with other agencies exist;
- Outcomes have occurred as expected;
- Changes in municipal resources impacted plan implementation (e.g., funding, personnel, and equipment);
- New agencies/departments/staff should be included, including other local governments as defined under 44 CFR 201.6; and
- Documentation for hazards that occurred within the Town and/or Village during the last year.

Specifically, the HMPT will review the mitigation goals, objectives, and activities/projects using performance based indicators, including:

- New agencies/departments created that have authority to implement mitigation actions or are required to meet goals, objectives, and actions;

- Project evaluation based on current needs of the mitigation plan;
- Project completion regarding progress of proposed or ongoing actions;
- Under/over spending regarding proposed mitigation action budgets;
- Achievement of the goals and objectives;
- Resource allocation to note if resources are required to implement mitigation activities;
- Timeframes comment on whether proposed schedules are sufficient to address actions;
- Budgets note if budget basis should be changed or is sufficient;
- Lead/support agency commitment note if there is a lack of commitment on the part of lead or support agencies;
- Resources regarding whether resources are available to implement actions; and
- Feasibility comment regarding whether certain goals, objectives, or actions prove to be unfeasible.

Finally, the HMPT will evaluate how other programs and policies have conflicted or augmented planned or implemented measures, and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions. Other programs and policies can include those that address:

- Economic Development;
- Environmental Preservation & Permitting;
- Historic Preservation;
- Redevelopment;
- Health and/or safety;
- Recreation;
- Land use/zoning;
- Public Education and Outreach; and
- Transportation.

The HMPT may refer to the evaluation forms, Worksheets #2 and #4 in the FEMA 386-4 guidance document (provided in Appendix F), to assist in the evaluation process.

The HMPT Coordinator shall be responsible for preparing an Annual HMP Progress Report. These annual reports will provide data for the 5-year update of this HMP and will assist in pinpointing implementation challenges. By monitoring the implementation of the Plan on an annual basis, the HMPT will be able to assess which projects are completed, which are no longer feasible, and what projects may require additional funding. During the annual HMPT meeting, the planning partners shall establish a schedule for the draft development, review, comment, amendment and submission of the Annual HMP Progress Report to DHSES. The Annual HMP Progress Report shall be posted on the websites of the Town of Cornwall and the Village of Cornwall-on-Hudson (when available) to keep the public apprised of the Plan's implementation. The Plan will also be evaluated and revised following any major disasters, to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be

revisited to see if any changes are necessary based on the pattern of disaster damages or if data listed in the Hazard Profiles Section of this Plan has been collected to facilitate the risk assessment. This is an opportunity to increase the community's disaster resistance and build a better and stronger community.

Monitoring the Plan

The Hazard Mitigation Plan will be updated every five (5) years. The updated plan shall be submitted to DHSES, which will in turn submit the plan to FEMA for review and approval. The periodic review and updating of the plan is required for the Town and Village to remain eligible for federal funding under the FEMA mitigation grant program.

The HMPT shall be responsible for monitoring progress on and evaluating the effectiveness of the Plan and documenting this in an annual progress report. During each year, and prior to the annual meeting of the HMPT, committee representatives will collect and process the annual reports from the departments, agencies and organizations involved in implementing mitigation projects or activities identified in the Mitigation Strategy Section of this Plan, or conduct phone calls and meetings with persons responsible for initiating and/or overseeing the mitigation projects to obtain progress information. The HMPT shall be expected to document, as needed and appropriate:

- Hazard events and losses occurring in the Town, Village, and region including their nature and extent and the effects that hazard mitigation actions have had on impacts and losses;
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding for mitigation actions;
- Any obstacles or impediments to the implementation of actions;
- Additional mitigation actions believed to be appropriate and feasible; and
- Public and stakeholder input and comment on the Plan.

The HMPT may use the progress reporting forms, Worksheets #1 and #3 in the FEMA 386-4 guidance document, to facilitate collection of progress data and information on specific mitigation actions. FEMA guidance worksheets are provided in Appendix F of this document.

## C. Updating the Plan

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed and revised as appropriate and resubmitted for approval in order to remain eligible for benefits awarded under DMA 2000. It is the intent of the local HMPT to update this Plan on a five (5) year cycle from the date of initial plan adoption.

To facilitate the update process, the HMP Coordinator, with support of the HMPT, shall use the third annual HMPT meeting to develop and commence the implementation of a detailed Plan update program. The Town HMP Coordinator shall invite representatives from DHSES to this meeting to provide guidance on plan update procedures. This

program shall, at a minimum, establish who shall be responsible for managing and completing the Plan update effort, what needs to be included in the updated plan, and a detailed timeline with milestones to assure that the update is completed according to regulatory requirements.

At this meeting, the HMPT shall determine what resources will be needed to complete the update. The HMP Coordinator shall be responsible for assuring that needed resources are secured. Following each five year update of the mitigation plan, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all municipal planning committee members, special purpose district participants and the New York State Hazard Mitigation Officer.

## D. Incorporating the Plan into Existing Planning Mechanisms

It is the intention of the Town of Cornwall and the Village of Cornwall-on-Hudson to incorporate mitigation planning as an integral component of government operations. The HMPT consists of representatives from various Town and Village Departments and the Cornwall Central School District and will work with Town and Village officials to integrate the hazard mitigation goals and objectives into daily operations of the Town and Village. The Town and Village will establish provisions for review of future capital improvement projects for hazard vulnerability. Specifically, the Town and Village will work to incorporate hazard resistant design and siting considerations for new infrastructure and critical facilities. Further, the sample adoption resolutions included as part of Appendix A, includes resolution items stating the intent of the Town Board and the Village Board of Trustees to incorporate mitigation planning as an integral component of government operations. By doing so, the HMPT anticipates that:

1. Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts;
2. The Hazard Mitigation Plan and the Town's Comprehensive Plan and the Village's Comprehensive Plan will become mutually supportive documents that work in concert to meet the goals and needs of Town and Village residents; and
3. Duplication of effort can be minimized.

The information on hazard, risk, vulnerability and mitigation contained in this Plan is based on the best science and technology available at the time of the Plan's preparation. It is recognized that this information can be invaluable in making decisions under other planning programs, such as comprehensive, capital improvement, and emergency management plans. Table V-1 below includes existing processes and programs through which the mitigation plan should be implemented:

**Table V-1 – Existing Processes and Programs for Mitigation Plan Implementation**

| Process | Action | Implementation of Plan |
|---|---|---|
| Administrative | Departmental or organizational work plans, policies, and procedural changes | • Department of Public Works<br>• Building and Engineering Department<br>• Advisory Boards<br>• Other sources as yet to be identified |
| Administrative | Other organizations' plans | • Include reference to this Plan in future updates of the Cornwall Hazard Mitigation Plan. |
| Administrative | Job/Job descriptions | • Unpaid internships to assist in hazard mitigation plan maintenance<br>• Other sources as yet to be identified |
| Budgetary | Capital and operational budgets | • Continue to include mitigation related projects in annual Capital Improvement Programs<br>• Leverage mitigation grant funding to support local funding for such mitigation projects<br>• Other sources as yet to be identified |
| Regulatory | Executive orders, ordinances and other directives | • Comprehensive planning – institutionalize hazard mitigation for new construction and land use<br>• Zoning and ordinances<br>• Building codes – enforcement of codes or higher standard in identified hazard areas<br>• National Flood Insurance Program – continue participation in this program<br>• Continue to implement storm water management plans<br>• Prior to formal changes (amendments) to the Comprehensive Plan, zoning, ordinances, capital improvement plans, or other mechanisms that control development, ensure that they are consistent with the Hazard Mitigation Plan<br>• Other sources as yet to be identified |
| Funding | Secure traditional sources of funding | • Apply for grants from Federal (including FEMA Hazard Mitigation Assistance (HMA) funding programs), state government, nonprofit organizations, foundations, and private sources<br>• Continue to make use of grant opportunities through the U.S. Department of Housing and Urban Development's Community Development Block Grant<br>• Other potential federal funding sources include:<br>o Stafford Act, Section 406 – Public Assistance Program Mitigation Grants<br>o Federal Highway Administration<br>o Catalog of Federal Domestic Assistance<br>o United States Fire Administration – Assistance to Firefighter Grants<br>o United States Small Business Administration Pre and Post Disaster Mitigation Loans<br>o United States Department of Economic Development Administration Grants<br>o United States Army Corps of Engineers<br>o United States Department of Interior, Bureau of Land Management<br>• Other sources as yet to be identified |
| Partnerships | Develop creative partnerships, funding | • Public-Private partnerships |

| Process | Action | Implementation of Plan |
|---|---|---|
| Administrative | Departmental or organizational work plans, policies, and procedural changes | • Department of Public Works<br>• Building and Engineering Department<br>• Advisory Boards<br>• Other sources as yet to be identified |
| | and incentives | • State Cooperation<br>• In-kind resources<br>• Other sources as yet to be identified |
| Partnerships | Existing committees and councils | • Local school districts<br>• Local Government Committees<br>  ○ Planning Board<br>  ○ Zoning Board of Appeals<br>  ○ Other<br>• Commerce and merchants associations<br>• Homeowner associations<br>• County Park Commission<br>• Other sources as yet to be identified |
| Partnerships | Working with other federal, state, and local agencies | • Army Corps of Engineers (ACOE)<br>• American Red Cross<br>• Department of Homeland Security and Emergency Services (DHSES)<br>• Federal Emergency Management Agency (FEMA)<br>• National Oceanic and Atmosphere Agency (NOAA)<br>• National Weather Service (NWS)<br>• New York State Department of Transportation (NYDOT)<br>• New York State Department of Environmental Conservation (NYSDEC)<br>• United States Department of Agriculture (USDA)<br>• United States Department of Transportation (USDOT)<br>• United States Geological Service (USGS)<br>• Watershed associations<br>• Other sources as yet to be identified |

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During the annual Plan evaluation process, the HMPT will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions, and include these findings and recommendations in the Annual HMP Progress Report.

The Town and Village address statewide planning goals and legislative requirements through their respective zoning codes, capital improvement plans, and building codes. This Hazard Mitigation Plan provides a series of recommendations which are closely related to the goals and objectives of existing planning programs. The Town and Village will have the opportunity to implement recommended mitigation action items through existing programs and procedures. The local HMPT will work with the Town and Village building departments to ensure the building codes are adequate to mitigate or prevent damage from natural hazards. This is to ensure life/safety criteria are met for new construction. Upon review of capital improvement plans, the HMPT will work with

the Town and Village department heads to identify areas where the Hazard Mitigation Plan goals and objectives are consistent with capital plans and integrate them where appropriate.

## E. Continued Public Involvement

In keeping with the public outreach involvement goals described in prior sections of the Plan, the HMPT will be responsible for ensuring the public-at-large will have adequate opportunity to participate in the maintenance and updating of the Hazard Mitigation Plan. During the maintenance process, the following techniques may be utilized to ensure continued public involvement and support:

- Provide personal invitations to Town and Village officials, department and committee heads and key stakeholders to participate in the hazard mitigation planning process;
- Post notices of hazard mitigation planning meetings at Town Hall, Village Hall, libraries, and on the Town's and Village's website;
- Keep review copies of the most recently adopted Hazard Mitigation Plan at the Town Hall, Village Hall, and libraries; and
- Adopt all revisions to the Hazard Mitigation Plan at public meetings and afford opportunity for public involvement.

**Table V-2 – Hazard Mitigation Plan Updating Timeline**

| Timeframe | Action |
|---|---|
| After Major Disaster | The Town and Village Engineer will request department heads to gather data and resources and report to Engineer. Engineer will compile information and reconvene the HMPT who will compare the results of the disaster (losses, vulnerabilities, etc.) to the Hazard Mitigation Plan and suggest/recommend revisions. |
| September 2013 | The Chairperson of the HMPT will hold an annual meeting to assess the condition of the Hazard Mitigation Plan. Meeting agenda will include (1) monitoring progress of implemented and ongoing actions; (2) examination of goals and objectives to confirm relevancy; (3) review new/revised resources including potential sources of funding. |
| September 2018 | The Chairperson of the HMPT to reconvene the HMPT for the purpose of initiating the next revision process. |

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The HMP Coordinator shall be responsible to assure that public comment and input on the Plan, and hazard mitigation in general, are recorded and addressed as appropriate. Opportunity to comment on the Plan will be provided directly on the Town's and Village's website. Provisions for public comment in writing will also be made.

## VI. SOURCES

City of Sacramento Development Service Department. City of Sacramento General Plan Update: Technical Background Report. June 2005.

Multi-Community Environmental Storm Observatory (MESO).

National Oceanic and Atmospheric Administration (NOAA).
National Climatic Data Center (NCDC)

National Weather Service (NWS). National Hurricane Center (NHC).

New York State Uniform Fire Prevention and Building Code.

New York State Disaster Preparedness Commission (NYSDPC). New York State Comprehensive Emergency Management Plan.

New York State Division of Homeland Security and Emergency Services (DHSES). New York State Standard Multi-Hazard Mitigation Plan.

New York State Climate Office (NYSC).

New York State Department of Environmental Conservation (NYSDEC).

Orange County Geographic Information Systems (OSGIS) Division. GIS Interactive Mapping Database.

The Weather Channel. Averages and Records.

Town of Cornwall Comprehensive Plan.

Town of Cornwall Zoning Local Law.

Town of Cornwall Building Code.

Town of Cornwall-On-Hudson Comprehensive Plan.

Town of Cornwall-On-Hudson Zoning Local Law.

Town of Cornwall-On-Hudson Building Code.

United States Environmental Protection Agency (EPA).

World Book, Inc. North American Climates: New York.