

Town of Wallkill / City of Middletown

NATURAL HAZARDS MITIGATION PLAN



HMGP 1899-0019 – MAY 2014 PUBLIC REVIEW

NEW YORK STATE OFFICE OF EMERGENCY MANAGEMENT | HAZARD MITIGATION GRANT PROGRAM

PREPARED BY



PREPARED FOR



Town of Wallkill / City of Middletown

NATURAL HAZARDS MITIGATION PLAN

Credits / Acknowledgements

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Orange County Division of Emergency Management
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Orange & Rockland Utilities
American Red Cross
Town of Wallkill, New York
City of Middletown, New York
Fire, Police and Ambulance Emergency Services of the Town of Wallkill and City of Middletown
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Dave Fritts, Consulting Engineer for Town of Wallkill

Consulting Planners & Engineers



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PLAN ADOPTION

In accordance with Part 201.6 of the Disaster Mitigation Act of 2000 (DMA 2000), the Town of Wallkill and City of Middletown have developed this Multi-Jurisdiction Natural Hazard Mitigation Plan to identify hazards which threaten the area and actions to mitigate future damages from them.

This plan was reviewed and "approved pending adoption" by FEMA on *[DATE]* and subsequently adopted by the local municipalities on *[DATE]* and *[DATE]*. The Plan was then formally approved by FEMA on *[DATE]*.

The following pages include the signed adoption resolutions from both municipalities adopting this mitigation plan and authorizing local staff to carry out the recommendations it contains.

[NOTE: INSERT COPIES OF ADOPTION RESOLUTIONS]

EXECUTIVE SUMMARY

The *Stafford Act* and *Disaster Mitigation Act of 2000* requires that in order for states and local municipalities to qualify for Federal disaster assistance, they must first complete a Hazards Mitigation Plan which identifies potential local threats and develops mitigations to reduce future damages from them. At a minimum, such a plan must address potential hazards from natural events, such as hurricanes, floods or storms, but may optionally study man-made emergencies such as technological disasters.

In February 2011, a *Single-Jurisdiction Natural Hazard Mitigation Plan* was developed for Orange County, however this plan was limited in scope to only assessing the potential threats to County-owned properties. In order for the local municipalities to qualify for Federal disaster relief in the future, they would need to develop their own local plan(s).

In 2011, the Town of Wallkill and City of Middletown together applied for and received a grant from the New York State Division of Homeland Security & Emergency Services office as part of the Hazard Mitigation Grant Program. These funds were to be used to develop this local hazard mitigation plan for both municipalities so that they could qualify for future Federal funding.

The planning process for this effort began in late November 2011 and continued through September 2013. Team members including officials from both municipalities and their consulting planners and engineers conducted several coordination meetings and held public workshops to solicit comments and recommendation from local citizens. As part of the work, the team identified critical facilities which were important to the health and human safety of area residents and analyzed potential threats to these facilities from common natural hazards. At the conclusion of the work, specific recommendations were made on how to bolster local defenses in a way which would reduce the risk and damage from future events. Below is a short summary of the key findings and recommendation of this plan.

Highest Ranked Threats. The number one priority issue identified for both municipalities related to the damages and impacts caused from flooding. This was followed by Ice Storms and Hurricane / Tropical Storm events. Tornado and Extreme Wind events also scored highly due to potential damage.

Solutions. A number of mitigations were identified to address potential threats in both municipalities, most of which were related to flooding. In the Town of Wallkill, at least 48 separate mitigation recommendations were identified, the majority of which were considered higher priority because their expected benefit was ranked higher than their expected cost. In the City of Middletown, there were at least 43 recommended mitigations, a majority of which were also ranked as high priority. Individual rankings for each municipality were provided so that they could pursue their own project funding, if desired. However joint/multi-jurisdictional projects were also identified so that both jurisdictions could work together on improvements which would be mutually beneficial.

Implementation Schedule. Due to the relatively large number of recommended mitigations which achieved "high" priority ranking, a timeline and suggested order of implementation was found to be somewhat impractical. Instead, it is recommended that an appointed committee meet to review the list on an annual basis to re-evaluate the priority mitigations and select which ones should be currently pursued based on the most recent information and needs. In addition to a regular 5-year update process, this approach helps to keep the mitigations listing a living and evolving document which can adjust as conditions change.

Priority Projects. Despite the large number of high-priority recommendations, a few select mitigation efforts were identified as outstanding projects which should be pursued as soon as possible. These included: the design and construction of a large detention basin within the Monhagen Brook watershed area to capture downstream floodwaters before it enters the City of Middletown (joint project); The cleanup of brush and vegetation along both public and private waterway banks in combination with a public awareness campaign, new local codes and enforcement to prevent the dumping of debris along waterways which results in channel blockages and flooding (joint project), and; Replace the culverts and repair damaged banks along the Winding Brook. These projects rose to the top due to the fact that they would have an immediate improvement effect and would potentially affect a large number of residents overall. The inspection and potential upgrade of the Prosperous Valley Road spillway is also considered an item to be addressed in the near-term. A full list of the **Mitigation Action Items** for each municipality has been included in Section VII.

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SECTION I - PURPOSE & SCOPE

Purpose

The Town of Wallkill and City of Middletown both experience common natural hazards, some which may be more rare and devastating than others, and all which have an impact on the life and safety of local residents. The Federal Emergency Management Agency (FEMA) encourages towns, cities and states to prepare for these events in order to reduce the risk and impact. More specifically, FEMA requires that local municipalities develop their own *hazard mitigation plans* before they may qualify for future Federal disaster relief aid. The Town of Wallkill and City of Middletown therefore together sought and received funding to prepare this local plan for the following purpose:

1. To reduce the risk of damage and threat to human safety resulting from a natural disaster;
2. To identify ways of reducing the costs associated with response and repair after a disaster; and
3. To qualify for future Federal disaster relief aid from FEMA programs.

Scope of Plan

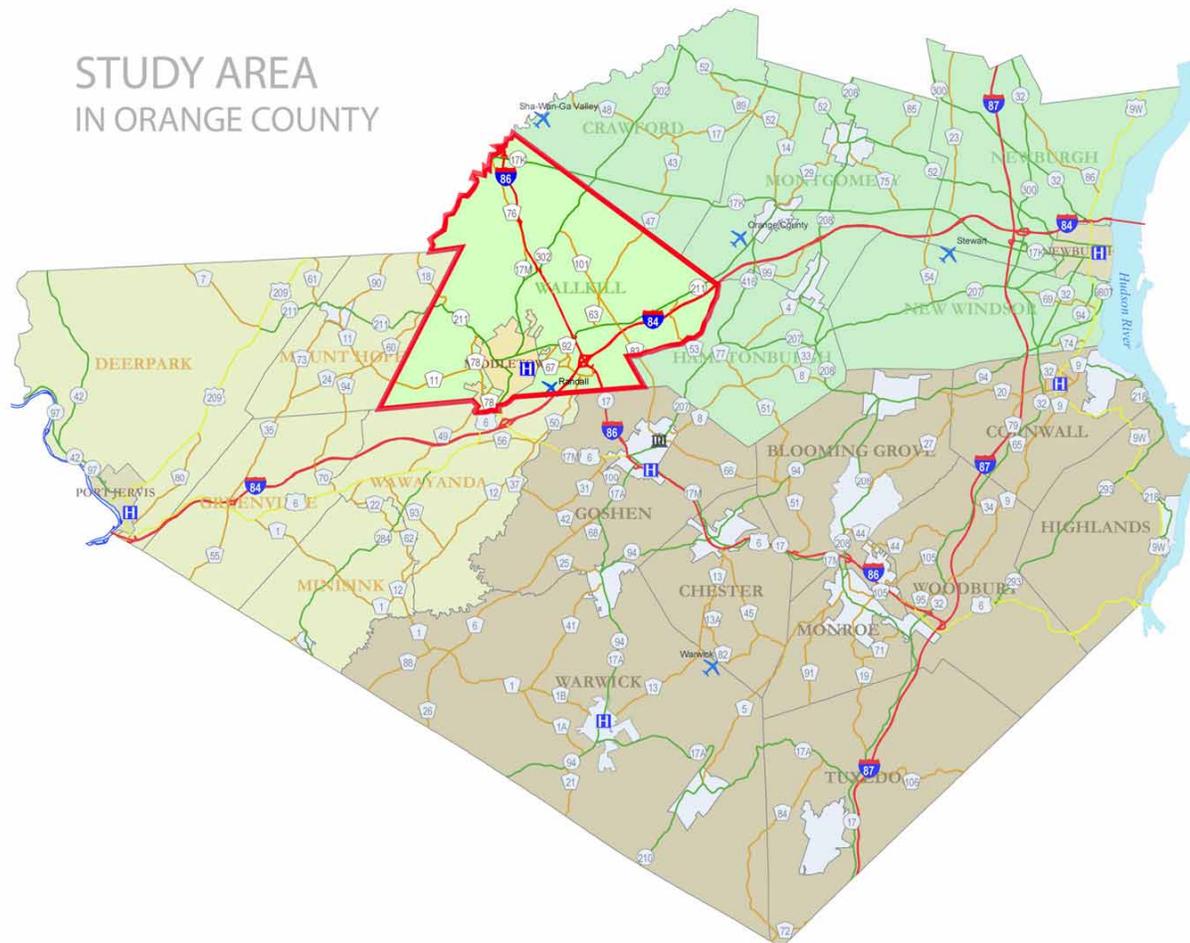
The "Study Area" for this plan includes the entire Town of Wallkill, NY as well as the City of Middletown. Due to the fact that the City of Middletown is almost entirely surrounded by the larger Town of Wallkill, it was logical to assess both municipalities together in terms of common infrastructure and threats. The scope of this plan includes essentially six phases of work, outlined as follows:

1. Identify natural hazards which are reasonably likely to occur within the Study Area.
2. Identify critical facilities and population centers within the Study Area.
3. Analyze the potential or likely damages to occur to these critical facilities and population centers from each of the natural hazards.
4. Develop recommendations to mitigate the potential damages from different natural events, where possible.
5. Develop a listing of priority action items based on the potential threat to human safety and cost of potential damages relative to expected mitigation costs.
6. Develop a process for the future monitoring and evaluation of the strategies recommended so that the plan can be updated and modified in the future.

Due to the fact that two separate municipalities are involved in the plan—and could potentially have different vulnerabilities—it was agreed that this plan should include separate recommendation lists. This would enable each municipality to pursue Federal funding for their own mitigation priorities, or optionally seek funding together for common objectives.

It is important to note that, in the context of this plan, **mitigations** are designed to lessen the impact or damage before it occurs, requiring less emergency response and repair costs afterwards. In this context, mitigations are different and separate from emergency response, which occurs afterwards. As such, the mitigations recommended in this plan are often limited to steps which can be taken before a disaster

occurs to lessen its impact, instead of 'response' items, such as hiring additional police officers or purchasing emergency generators.



Planning Process

Due to the fact that the City of Middletown and the Town of Wallkill are closely intertwined geographically, a multi-jurisdictional approach was adopted where both municipalities teamed together for this hazard mitigation planning process. *Behan Planning and Design* was retained as the primary planning consultant with direct local engineering support from *McGoey, Hauser and Edsall Engineers* and *Clark Patterson Lee* due to their local engineering knowledge of both municipalities and work with surrounding townships.

A preliminary Kickoff Meeting was held in March of 2012 with several members of the project team as well as the Mayor of Middletown and the Supervisor of Wallkill. The purpose of this meeting was to review the scope and goals of the project with officials from both municipalities and secure their

commitment to providing necessary assistance and information over the course of the project. Shortly afterwards, select local representatives from both municipalities were chosen to assist in the effort as Project Team Advisors due to their knowledge of the local infrastructure in both municipalities. These individuals included:

Lou Ingrassia, *Director of Public Works - Town of Wallkill*

John Lippert, *Deputy Commissioner of Public Works - Town of Wallkill*

Jacob Tawil, *Commissioner of Public Works - City of Middletown*

Dave Fritts, *Consulting Engineer for Town of Wallkill - McGoey, Hauser & Edsall Engineers*

Gef Chumard, *Consulting Engineer for City of Middletown - Clark Patterson, Lee Engineers*

Dominic Greene, *Orange County Hazard Mitigation Coordinator*

Michael Allen, *Senior Planner – Behan Planning and Design*

In addition to the regular Project Team Advisors, other representatives from each municipality assisted in the planning process and attended meetings, including :

Daniel Depew, *Supervisor - Town of Wallkill*

Joseph M. DeStefano, *Mayor - City of Middletown*

Project Kickoff. At the beginning stages of the planning process, the consultants began gathering data and mapping information for the asset inventory, and reviewed the relevant FEMA guidelines on natural hazard mitigation planning. A Project Team Kickoff meeting was held on August 7th, 2012 where an information packet was distributed to each individual which included a meeting agenda, scope of work, project schedule, status report and an overview of the roles and responsibilities for each person. A preliminary Inventory map and list was distributed for review, as well as a draft list of potential hazards to be analyzed.

The Project Team Advisors continued to communicate via phone and email, and would meet as needed to review and discuss the details of the analysis. This included the inventory of critical facilities and assets, hazard profiles, public meeting format, risk/loss assessments, evaluation of mitigation techniques and general discussion over the course of the plan's development. Copies of meeting minutes and related material have been included in Appendix – Part B, at the end of this document.

Public Involvement. Two Public Information Sessions were conducted on *January 17th, 2013* and *February 5th, 2013* in the Town of Wallkill and the City of Middletown, respectively. The public meetings were advertised by Public Notices, advertisements in the local papers, announcements on each municipal web site, town board and city council meetings, email invitations to key stakeholders and by flyers which were posted at numerous public places around the study area. These public sessions were hosted by the consultant team who presented an overview of the natural hazard mitigation process which was taking place, explained how the public could help and solicited suggestions and comments from the public. An open discussion was encouraged, where participants could ask questions about the process, and comment on problem areas they are concerned about. Participants were also given instructions on how to submit additional comments or suggestions after the meeting, if they desired, to

an email address of the project team members. Several of the comments and suggestions provided by members of the public were incorporated into the plan as potential mitigation actions.

Copies of some of the materials printed for these presentations, including maps and a *Natural Hazard Mitigation Fact-Sheet*, have been included for reference in the Appendix – Part C. A copy of the public meeting notes for each municipality have been included in Appendix – Part B.

In addition to the public meetings, a customized questionnaire was developed specifically to gather input from local emergency responders, public works, utilities, service providers and school districts. This questionnaire inquired if their facilities or operations had been affected by any natural disasters; what types, frequency, duration, damage and performance impacts they had experienced, as well as asking for any recommendations they may have to be included in the plan. A copy of this and associated responses have been included in the Appendix – Part C.

[NOTE: THIS PLAN MUST BE REVIEWED BY THE PUBLIC PRIOR TO FEMA DESIGNATING IT "APPROVAL PENDING ADOPTION". AFTER THE PUBLIC HEARING, INSERT DESCRIPTION AND NOTES OF PUBLIC COMMENTS HERE.]

Additional Stakeholders. In addition to the open public forums, specific stakeholders were informed of the planning project and were invited to attend the meetings directly. These stakeholders were also sent a questionnaire with follow-up phone interviews where necessary to determine their concerns or suggestions for mitigation planning. These stakeholders included:

City Council and Town Board members
Orange & Rockland Utilities
Orange County Water Authority
Orange County Division of Emergency Management
Orange County Regional Medical Center
American Red Cross
New York State Police
New York State Emergency Management Office
New York State Department of Transportation
Local municipal fire departments
Local municipal police departments
Local ambulance service providers
Local school districts
Local municipal public works, sewer and water departments

Surrounding Municipalities. Planning efforts were shared with the surrounding municipalities of Mount Hope, Crawford, Montgomery, Hamptonburgh, Goshen, Wawayanda and Mamakating. The two project engineers for this effort, *McGoey, Hauser and Edsall Engineers* and *Clark Patterson Lee*, act as consulting planners and engineers to most of these municipalities, and were aware of the interrelated planning issues. Furthermore, on December 3rd, 2013 a draft of this plan was sent to the supervisor and

planning officials in each municipality, inviting their review and comment. Officials from these municipalities were invited to attend and provide comment on the plan during the Public Hearing process.

Existing Reports, Plans and Data. During the course of the development of this plan, several other sources of information were reviewed and incorporated where applicable. These included:

The New York State Hazard Mitigation Plan (January 2014) – Information regarding hazard profiles as they pertain to New York State, previous hazard events, has been included in the plan.

Orange County Hazard Mitigation Plan (February 2011) – Information regarding hazard profiles as they have pertained to Orange County, previous hazard events, inundation mapping, recommended mitigation strategies have been incorporated into the plan.

Town of Wallkill Local Laws – Information regarding building code limitations, zoning restrictions, floodplain regulations, floodplain and building code administration have been incorporated into the plan.

City of Middletown Local Laws – Information regarding building code limitations, zoning restrictions, floodplain regulations, floodplain and building code administration have been incorporated into the plan.

Emergency Action Plan for the Monhagen Lake Dike – Information regarding inundation mapping and projected damages has been incorporated into the plan.

Orange County Government Center Hurricane Irene and Tropical Storm Lee Analysis – Information regarding the impacts of Hurricane Irene and Tropical Storm Lee were researched to determine potential impacts to government installations.

FEMA-480 – Floodplain management requirements were referenced to determine probability analysis of different flooding events and were incorporated into this plan.

Times Herald Record news articles (RecordOnline) – Information regarding previous hazard events affecting the study area were researched and incorporated into this plan or were used for confirmation of National Climate Data Center records to determine locality.

U.S. Code Title 44: Part 201, Mitigation Planning – Information regarding the lawfully accepted procedures for mitigation planning were used in the preparation of this plan.

Orange County NY GIS – Latest GIS DFIRM data relating to topography, soils, floodplains, roads, bridges, public facilities, municipal facilities, emergency services, water supply watersheds, utilities and other inventory items have been incorporated into the plan.

National Oceanic and Atmospheric Administration (NOAA) – Information and data from the Storm Events Database was used to research and compile listings of notable weather-related events which have affected the study area, information from the Severe Storms Laboratory was used to research storm and tornado probability and were incorporated into the plan.

National Hurricane Center Online Database – Information and data was used to research and compile listings of notable hurricane and tropical storm-related events which have affected the study area were incorporated into the plan.

National Weather Service North Atlantic Hurricane Tracking Charts – Information was used to research and confirm hurricane-related data.

New York State Office of Emergency Management – Information regarding the 2014 NYS Hazard Mitigation Plan, local hazard mitigation planning tools, planning handbooks, mitigation plan review guides and hazard maps were used in the preparation of this plan.

New York State Public Service Commission - Information regarding power failure instances, cause of power failures and probability have been incorporated into the plan.

NYS OEM Hazard Mitigation Programs Project Management Handbook – Information regarding the procedures and management of a hazard mitigation plan were used in the preparation of this plan.

NYS DEC Floodplain Management – Information regarding the determination of repetitive loss property claims due to flooding were incorporated into this plan.

U.S. Census Bureau - Census data regarding population, densities, arrangement and age-group statistics were incorporated into the plan.

USGS Earthquake Hazards Program – Information regarding previous earthquake events affecting the study area and hazard event analysis were incorporated into the plan.

USGS NEIC Earthquake Database – Information regarding previous earthquake events affecting the study area were incorporated into the plan.

USACE Cold regions Research and Engineering Laboratory – Information regarding historical events of ice jams and related damages, probability of occurrence was incorporated into the plan.

Northeast Regional Climate Data Center – Information regarding drought history and drought severity index comparisons were incorporated into the plan.

Other Reference Guides – Additional reference guides were used in the preparation of this plan, including but not limited to:

FEMA 386-3 – Developing the Mitigation Plan (April 2003)

FEMA Local Multi-Hazard Mitigation Planning Guidance (July 2008)

FEMA Local Mitigation Plan Review Guide (October 2011)

The reports and studies listed above were used as a preliminary clearinghouse to identify potential threats or mitigations for consideration in this plan. Recommended mitigations, where appropriate to the study area, were discussed for inclusion in Potential Mitigations Listing, and included where applicable for later review. The data sources listed above were used to try and quantify historical or

probability data where needed. The reference documents listed above were reviewed by the project team to determine best approaches and procedures to mitigation planning.

Planning Process. The planning process which took place over the course of this work is summarized as follows:

Step 1. Critical Facilities and Asset Inventory. At the beginning of the planning work, the consultants worked with the project team advisors to compile an inventory of critical facilities, population centers and other local assets which were important in terms of health and human safety to area residents. Facilities included fire stations, police stations, hospitals, emergency shelters, schools, bridges, dams, water towers and similar services. This information was documented on an Inventory map and periodically updated as new information became available. The inventory list and associated mapping can be found in Section II – Asset Identification.

Step 2. Hazard Identification. A listing of potential natural hazards which were reasonably likely to affect the study area was then compiled. This list was initially generated from the New York State Hazard Mitigation Plan and the Orange County Single Jurisdiction Natural Hazard Mitigation Plan, and then was adapted to more accurately reflect the hazards specifically associated with the study area. A profile of each hazard type was developed, and can be found in Section III – Hazard Identification, and were loosely ranked for the purposes of preliminary priority.

Step 3. Risk and Loss Assessment. Once the local study area inventory was developed and the hazards identified, each hazard was analyzed to determine its potential for causing damage, probability of occurrence, impacts to local critical facilities and health and human safety. Where possible, locational analysis was used to determine what specific areas of the study area, if any, were more likely to be impacted and what estimated damages might occur. This information was used to develop a more specific ranking system to determine which hazards posed the greatest relative local threat of damage or human injury. The rankings were developed using a scoring system which estimated the following variables; the size of affected area, frequency of occurrence, human safety threat, property damage threat, warning time, duration of hazard and duration of recovery. Each hazard was then ranked according to their relative threat potential. The assessments and rankings can be found in Section IV – Risk and Loss Assessment.

Step 4. Mitigation Planning. Once the different threats were identified, mitigation ideas were developed which would prepare or respond to the different hazards. These mitigations ranged from general policy level changes and wide recommendations to specific and tangible improvements which could be made. Each individual mitigation idea was reviewed and weighed according to timeframe to implement; potential cost and potential benefit, and scored by a low, medium or high-priority ranking. Generally speaking, mitigation plans which had a low timeframe and cost with a high benefit scored as high priority. Mitigations which were specific to each municipality were ranked separately, while mitigations which were common or joint projects were identified as such. The mitigations and scoring can be found in Section V – Mitigation Alternatives.

SECTION II - ASSET IDENTIFICATION

Summary

The project area includes a number of important assets which were inventoried as part of the analysis to determine overall threat vulnerability. These included: critical infrastructure such as water supply, power supply and waste treatment facilities; emergency facilities such as hospitals, fire and police stations; important community facilities such as schools, senior housing and emergency shelters; potential hazardous waste sites; dams and general population centers.

Asset Tables

Inventory – Water Supply			
Feature	Owner	Location	Notes
Water Pump	Town of Wallkill	30 Scotchtown Pl	Pump house - old in appearance
	Fairways Wallkill LLC	146 Golf Links Rd	Pump house - appears active
	Town of Wallkill	End of Mt Joy Rd	Pump house - old in appearance
	Town of Wallkill	2459 Goshen Tpke	Pump house and possible treatment
	City of Middletown	Pilgrim Corners Rd	Three facilities in one location – turn of the century facility decommissioned in 2010, 2003 Package plant with 1.5 MGD
	Town of Wallkill	Golf Links Road	Primary Well field and treatment
	Town of Wallkill	Dundee Circle	Scotswood Wells
	Town of Wallkill	Sands Road	Woodland Acres Wells

Inventory – Sewer Treatment			
Feature	Owner	Location	Notes
Sewer Treatment	City of Middletown	159 Dolson Ave	
	Town of Wallkill	Golf Links Road	

Inventory – Water Towers			
Feature	Owner	Location	Notes
Water Tower	City of Middletown	358-360 Highland Ave Ext	
	City of Middletown	Pilgrim Corners Rd	
	City of Middletown	Ws Magar St	
	Town of Wallkill	Overhill Rd	
	Town of Wallkill	Beakes Ave	
	Town of Wallkill	77 Tower Dr	

Inventory – Electrical Supply			
Feature	Owner	Location	Notes
Electrical Substation	O&R Utility Inc	Dolsontown Rd	
	O&R Utility Inc	48 Gunung St	
	O&R Utility Inc	20-24 Industrial Pl	
	O&R Utility Inc	45 Maltese Dr	
	O&R Utility Inc	14 Wesley CT	
	O&R Utility Inc	1422 St Route 302, Crawford	

Inventory – Fire Stations			
Feature	Owner	Location	Notes
Fire Stations	City of Middletown	81-93 E Main St	4 bays
	Mechanicstown Fire	22 Victory St	5 bays
	Mechanicstown Fire	384 Stony Ford Rd	Station 2 – 4 bay (2 blgs, 2
	Washington Heights Volunteer Fire	10 Ohio Pl	2 bays – large non-bay
	Circleville Fire District	1500 Goshen Tpke	2 bays and outdoor training
	Pocatello Fire	5 Pocatello Rd	3 bays
	Howells Fire Company	20 Elm St	4 bays – large “garage”
	Silver Lake Fire District	26 Maltese Dr	3 bays, 1 double wide bay, “garage” with overhead door
	Circleville Fire District	2147 Rte 302	4 bays

Inventory – Police Stations			
Feature	Owner	Location	Notes
Police Station	City of Middletown	2 James Street	Also Middletown City Hall
	Town of Wallkill	99 Tower Drive	Also Wallkill Town Offices
	State Police	55 Crystal Run Rd	Troop F Headquarters

Inventory – Emergency Shelters			
Feature	Name	Location	Notes
Emergency Shelters	Middletown Senior High School	18 Gardner Ave Ext	
	Monhagen Middle School	555 Co Rte 78	
	Red Cross Warehouse	135 Crotty Road	Supply storage only
	Medical College	60 Prospect Ave	Former Horton Hosp.
	Homeless Shelter	18 Seward Ave	

Inventory – Schools			
Feature	Name	Location	Notes
Schools	Circleville Elementary School	2100 St Rte 302	
	Circleville Middle School	1951 St Rte 302	Same location as Pakanasink Elementary School
	Arc Orange County Chapter	28 Ingrassia Rd	Private Pre-K
	Mechanicstown Elementary School	459 E Main St	
	Middletown Senior High School	18 Gardner Ave Ext	
	Twin Towers Middle School	112 Grand Ave	
	Pakanasink Elementary School	1953 St Rte 302	Same location as Circleville Middle School
	Monhagen Middle School	555 Co Rte 78	Maple Hill Elementary
	Maple Hill Elementary School	Egerton Road	Shared campus
	John W Chorley School*	50 Roosevelt Avenue	New school being constructed
	Truman Moon School*	53 Bedford Avenue	
	Harmony Christian School*	1790 Route 211 E	Private Pre-K to 12
	Middletown Christian School – Sda*	70 Highland Ave	Private Pre-K to 8
	New Beginnings Montessori*	33 Albert St	Private Pre-K to 2
	Our Lady of Mount Carmel School*	205 Wawayanda Ave	Private Pre-K to 8
	St Joseph School*	113 Cottage St	Private Pre-K to 8
	Orange County Employ & Training	18 Seward Ave	Middletown
	Orange County Community College	115 South Street	Middletown
Medical College (Former Horton Hospital)	60 Prospect Ave	Middletown	

Inventory – Hospitals / Medical Services			
Feature	Name	Location	Notes
Hospital	Orange Regional Medical Center	707 E Main St	
	Orange Regional Medical Pavilion	75 Crystal Run Road	
	Middletown Medical	111 Maltese Dr	
	Crystal Run Healthcare	155 Crystal Run Road	

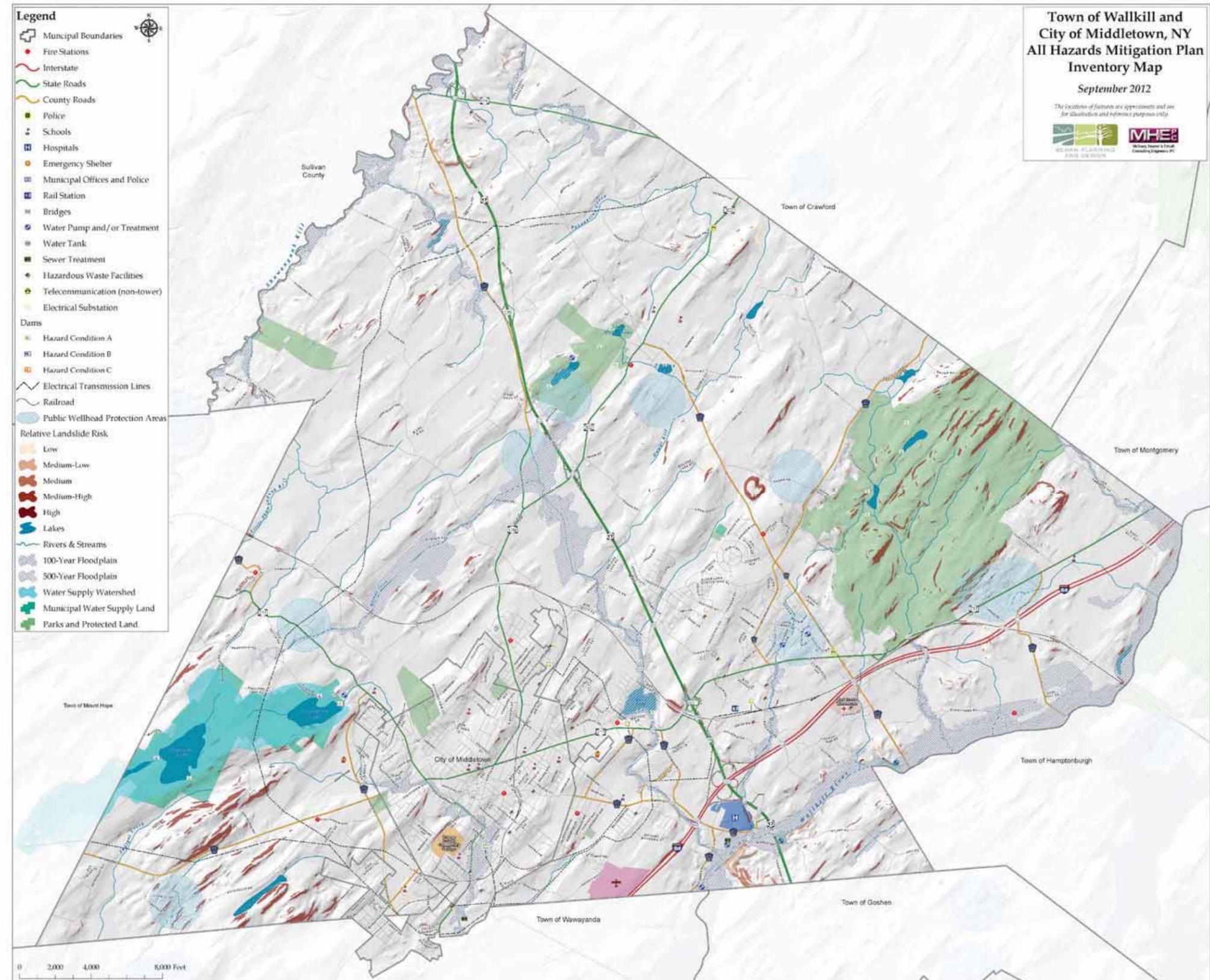
Inventory – Communications Structures			
Feature	Name	Location	Notes
Non-Tower Telecommunications	Citizens Telecommunications	2021 Goshen Tpke	Windowless building
	Citizens Telecommunications	1715 Rte 302	Windowless building

Inventory – Hazardous Waste			
Feature	Name	Location	Notes
EPA Regulated Hazardous Waste Generators	Westwood Chemical Corp, Middletown Site	46 Tower Drive	
	Orange Recycling & Ethanol Prod Fac	159 Dolson Avenue	
	Quick Roll Leaf Manufacturing Co	53 Smith Road	
	A & N Technologies	366 Highland Ave	
	Wallkill Farms Home Owners Association	270 Schutt Rd	
	Ball Metal Beverage Container Corp	95 Ballard Road	
	Spill - 92 Fitzgerald, Middletown (Dec#0703367)	92 Fitzgerald Drive	
	Middletown (C) Stp	159 Dolson Avenue	
	East Coast Environmental, Inc.	35 Goshen Tpke	
	Genpak Llc Middletown Main Plant	26 Republic Plaza	
	Cvs Pharmacy #2361	245 E Main St	
	Delford Industries Inc	84 Washington Street	
	Tesa Tape - Middletown	135 Crotty Road	
	O&R - Middletown Op Ctr	71 Dolson Avenue	
	Wallkill (T) Stp	600 Route 211 East	
	Interceram Ceramx Corporation	Fortune Road West	
General Switch Corporation	20 Industrial Place		
Fleurchem	33 Sprague Avenue		
Revere Smelting & Refining Corp	65 Ballard Road		

Population – U.S. Census			
Municipality	1990	2000	2010
Wallkill Town	23,016	24,659	27,426
Middletown City	24,160	25,388	28,086

Inventory Map

A full size copy of this map is available for viewing or download as a separate file for reference.



SECTION III - HAZARD IDENTIFICATION

Summary

FEMA's requirements for a Hazards Mitigation Plan require the evaluation of a full range of potential natural hazards which could likely occur within the study area. Although man-made hazards can be considered as part of an approved plan, they are optional, and were not evaluated during the course of this study.

In 2010, Orange County completed their "*Single-Jurisdiction Natural Hazard Mitigation Plan*". Although the scope of that study was limited to mitigating threats to county-owned property only, it included an extensive amount of research on the full range of potential natural hazards which were judged to be applicable for the area. In order to maintain consistency with the county plan and avoid duplication of effort, much of the hazard identification findings of that plan have been adopted for this study. More recent hazard events which have occurred since the county plan was written have been updated and incorporated in this document to keep the analysis data up-to-date.

Hazard Profiles

The following table outlines the natural hazards which were identified as potentially applicable to this study.

Hazards Profiles – Initial Considerations			
Hazard Type	Orange County HAZNY 2009 Hazard Ranking	Assessed in County Hazard Plan	Assessed in This Hazard Plan
Flood	High Hazard (1st)	YES	YES
Severe Storm / Nor'easter ¹	Moderately High (3rd)	YES	YES
Extreme Wind	Moderately High (3rd)*	YES	YES
Tornado ²	Moderately High (4th)	YES	YES
Ice Jam ³	Moderately High (5th)	YES	YES
Wildfire	Moderately High (6th)	YES	YES
Winter Storm	Moderately Low (7th)	YES	YES
Hurricane / Tropical Storm	Moderately Low (8th)	YES	YES
Extreme Temperatures	Moderately Low (9th)	YES	YES
Drought	Moderately Low (10th)	YES	YES
Earthquake	Moderately Low (11th)	YES	YES
Dam Failure ³	Moderately Low (12th)	YES	YES
Landslide	Not Ranked	YES	NO
Lightning	Not Ranked	YES	YES
Power Failure ⁴	Not Ranked	NO	YES
Avalanche	Not Ranked	NO	NO
Hailstorm	Not Ranked	NO	NO
Coastal Erosion	Not Ranked	NO	NO
Climate Change	Not Ranked	NO	NO
Land Subsidence and Expansive Soils	Not Ranked	NO	NO
Tsunami	Not Ranked	NO	NO
<p><i>Rankings based on Orange County HAZNY Study of 2009, *Ranked as a subset of a larger weather event.</i></p> <p>¹NY HAZMIT Plan includes Nor'easter with Hurricanes; ²NY HAZMIT Plan includes Tornado with High Wind Events; ³NY HAZMIT Plan includes Ice Jams and Dam Failures with Flood; ⁴NY HAZMIT Plan no longer includes Power Failure as a separate hazard type as it is associated with one of the other types, however this plan was substantially completed prior to the removal from the NY HAZMIT Plan and has been retained here.</p>			

The New York State HAZMIT Plan of 2014 specifically identifies the following hazards to be of concern for State and Local assessment: Drought, Earthquake, Hurricane, Landslide, Severe Winter Storm, Flood, Land Subsidence and Expansive Soils, High Wind Events, Wildfire, Coastal Erosion, Extreme Temperatures, Hailstorm, Climate Change, Avalanche and Tsunami. The State HAZMIT Plan stipulates that the full range of hazards be “initially considered during the local hazard mitigation planning process, but accepts that some hazards relevant at the state level may not need to be fully profiled and assessed for risk in local plans, if it is determined that they present a low probability or risk to the local

jurisdiction.” As such, the following events were not profiled for this study due to the low probability and/or risk to the City and/or Town:

Avalanche. Avalanche events were not profiled for the following reasons: There are no areas of significant elevation and slope within the study area for which a volume of snow and/or ice could develop in a quantity large enough to create an avalanche. Furthermore the NY HAZMIT Plan noted that documented Avalanches within the state have only occurred within the Adirondack Mountains.

Landslide. Landslide events were not profiled for the following reasons: Although USGS landslide hazard maps indicate portions of Orange County which are considered of "High incidence", these areas were outside of the study area which was considered "Low incidence"; Furthermore, the majority of steep slopes in the Town of Wallkill are located in parkland, while Middletown is mostly devoid of steep slopes.

Land Subsidence. Subsidence events were not profiled for the following reasons: According to the USGS, the project area is located in a geologic area where land subsidence is not likely; The Orange County Single Jurisdiction Hazard Mitigation Plan noted that there are no known historical occurrences of subsidence in the project area; Furthermore, the Orange County HAZNY Study did not include land subsidence as a discrete hazard.

Coastal Erosion. Coastal Erosion events were not profiled for the following reasons: The project area contains no coastline, and the New York State Hazard Mitigation Plan does not map any coastal erosion hazard areas within the study area. For these reasons, coastal erosion was not profiled in this study.

Hailstorms. Hailstorm events were not profiled for the following reasons: Since 1996 there are no documented damages or fatalities associated with hailstorms in the project area according to NOAA database. Furthermore, Orange County is located in a region where the average annual number of days with hail events is less than 0.25; and there are minimal mitigation techniques available to protect from hail damage. Hailstorms can be profiled as part of a larger storm event. For these reasons, hailstorms were not profiled separately in this study.

Tsunami. Tsunami events were not profiled for the following reasons: The project area is significantly inland (50+ miles) and therefore removed from threat of even the most severe tsunami event.

Climate Change. Climate Change was not specifically profiled for the following reasons: As noted in the NY HAZ MIT Plan, climate change has the potential to impact the entire state of NY, with coastal communities most at risk. Climate change could lead to more severe storms, more frequent and severe flooding, drought, wildfires, and many other potential meteorological impacts. As such climate change has been factored into the individual hazards discussed below.

A brief description of hazards which have been identified for assessment in this study are provided below. It should be noted that although the scope of this study is limited to the municipalities of Middletown and Wallkill, most of the historical weather event data is available at the county level, and therefore county-wide data on past events is primarily used in these descriptions.

Flooding

Considered the most significant natural hazard within the project area. There are over 2,600 residences within 100-Yr flood zone, ranking Orange County as the 4th most at-risk in terms of potential residential loss. The Orange County Hazard Plan indicated there have been 53 flood events in the county between 1993 and 2010. Since that report, the study area was subjected to heavy flooding from Hurricane Irene in 2011, as well as additional flooding during Tropical Storm Lee and Hurricane Sandy. Within the project area there are estimated to be 179 and 72 residential structures located within the 100-year flood plain in the City of Middletown and Town of Wallkill, respectively.

Severe Storm

The study area is susceptible to severe storms and thunderstorms, and are a common cause of flooding and power failures. The Orange County Single-Jurisdiction Hazard Mitigation Plan noted that this area was subject to major disaster declarations in 1992 and 2007 as a result of such storms.

Extreme Wind

Extreme wind is included in the New York State Hazard Mitigation Plan in the context of other storms such as hurricanes and tornados. The state plan ranks Orange County as 6th out of 62 counties in the state for the threat of extreme wind and vulnerability to extreme wind losses.

Extreme wind events are commonly associated with thunderstorms and straight line winds in this region, which is also susceptible to hurricane activity. The FEMA publication 320 noted that Orange County lies within a zone where wind speeds of up to 160 mph are possible. The Orange County Hazard Plan noted 235 high wind events affecting the county between 1955 and 2010. Since that report, NCDC data reports approximately 5 additional events, resulting in at least 1 injury.

Tornado

NCDC data indicates there have been 10 reported tornado events within the county since 1969, resulting in at least nine deaths, 18 injuries and approximately \$28 million in property damage. While most of these events were light damage (F0 Fujita Scale), one created moderate damage (F1), two were categorized as considerable damage (F2) and one was considered severe damage (F3). The Orange County Hazard Mitigation Plan noted that while the likelihood of tornados in the study area is low, they remain a possibility, with potential for loss of life serious injury and damage. NCDC data indicated one occurrence of a tornado in Middletown, however no damage estimates or loss of life were reported.

Ice Jam

Ice jams are a known hazard within New York State, as well as within the study area, causing winter flooding. According to the US Army Corp of Engineers (USACE), York State ranks second in the Nation for total number of ice jams, having experienced 1435 events between February of 1867 thru March 2007 (NYS HAZ Mit 2008). In the period from 1875-2013, the USACE recorded 54 ice jam events on the Wallkill River, six within the Town of Wallkill (the most recent in 1958), and four on the Shawangunk Kill (none within the study area).

Wildfire

The Orange County Single Jurisdiction Hazard Mitigation Plan noted that there were no records of any significant wildfire events in the county since 1950, however such events were ranked as the 6th largest potential hazard for the area, and were assessed in that study, and have the potential to be of increased risk with potential warming temperatures and increased drought potential due to climate change

Winter Storm

For the purposes of this threat analysis, severe winter storms include ice and heavy snow storms. The New York State Hazard Mitigation Plan noted that Orange County averages about 40 inches of snowfall per year, ranking it in 12th place out of 62 other counties for threat from snow damage. The Orange County SJHMP reported 73 significant snow and ice events since 1993.

Hurricane / Tropical Storm

According to the National Hurricane Center, between 1900-1996 there have been a total of 9 hurricanes which have hit the State of New York, 5 of which were considered major (Category 3 or above). Since that time, eastern New York has been affected by hurricanes/tropical storms Floyd (1999), Hanna (2008) and Irene (2011). Hurricane Irene was the cause of severe flooding in the local region, including Middletown and Wallkill.

Extreme Temperatures

Extreme heat events can often cause power failures due to high electrical demand, with potential loss of life due to heat exhaustion. The State Hazard Mitigation Plan noted that approximately 17% of the population in Orange County is most susceptible to extreme heat events (under 5 years of age and over 65 years of age). Additionally, the homeless, obese, and people who work in uncontrolled environments are also vulnerable. Statewide, there have been 86 fatalities between 1994-2006 as a result of extreme heat. (NYS MP) Extreme cold events can cause hypothermia, frostbite, with a potential for loss of life. Similar to extreme heat, certain portions of the population are most susceptible – notably the elderly, infants and the homeless. These types of events are regional in nature, and not localized to just the study area.

Drought

Drought is caused by a prolonged period of little or no rainfall over a long period of time, often associated with above-average temperatures. A prolonged drought can significantly hurt local water supply, damage crops, kill fish and wildlife and increase the risk of fires. These types of events are regional in nature, and not typically localized to just the study area.

Earthquake

Based on the USGS NEIC Earthquake Database, there have been no recorded earthquakes of magnitude 3.0 or larger in the immediate vicinity of Walkkill or Middletown. Although there have been earthquakes of lesser magnitude in the vicinity, these were generally considered to be too weak to cause notable damage for the purposes of this study.

Dam Failure

Dam failures can be caused by significant rainfall, structural failure, hurricanes, earthquakes, landslides or human interaction. They result in the sudden downstream flooding of an area with potentially high velocity and little or no warning. There are two dams of potential concern in the study area, one that could impact parts of the Town of Walkkill and one that could impact both the town and the City of Middletown were it to fail.

Lightning

Lightning strikes can often cause power failures, structural damage, fires or even sometimes serious personal injury or death. Mostly occurring during the warmer summer months, it is extremely unpredictable when or where they may strike. The NCDC database only has five documented lightning events in Walkkill, and two in Middletown, however there are likely many non-documented events that have caused damage or personal injury.

Power Failure

Power failures are typically a "cascade" effect of a separate natural hazard, although they can occur on their own. Power failures can cause significant health and safety risks, with loss of heating, cooling, water and fuel. The NYS Hazard Mitigation Plan defines a Power Failure as: Any interruption or loss of electrical service due to disruption of power transmission caused by accident, sabotage, natural hazards or equipment failure. A significant power failure is defined as any incident of a long duration which would require the involvement of the local and/or state emergency management organizations to coordinate provision of food, water, heating, shelter, etc.

Hazards Profiles – Profile Summary by Municipality

Hazard Type	Assessed for Town of Wallkill	Assessed for City of Middletown
Flood	YES	YES
Severe Storm / Nor'easter	YES	YES
Extreme Wind	YES	YES
Tornado	YES	YES
Ice Jam	YES	YES
Wildfire	YES	YES
Winter Storm	YES	YES
Hurricane / Tropical Storm	YES	YES
Extreme Temperatures	YES	YES
Drought	YES	YES
Earthquake	YES	YES
Dam Failure	YES	YES
Lightning	YES	YES
Power Failure	YES	YES

Emergency and Disaster Declarations**Major Disaster Declarations - Designating Orange County, New York (1965-2013)**

Date	Event	Disaster Declaration
October 30, 2012	Hurricane Sandy	DR-4085
September 13, 2011	Tropical Storm Lee	DR-4031
August 31, 2011	Hurricane Irene	DR-4020
April 16, 2010	Severe Storms and Flooding	DR-1899
April 24, 2007	Severe Storms / Inland Flooding	DR-1692
July 1, 2006	Severe Storms and Flooding	DR-1650
April 19, 2005	Severe Storms and Flooding	DR-1589
October 1, 2004	Tropical Depression Ivan	DR-1565
October 1, 2004	Severe Storms and Flooding	DR-1564
September 19, 1999	Hurricane Floyd	DR-1296
January 24, 1996	Severe Storms/Flooding	DR-1095
January 12, 1996	Blizzard	DR-1083
April 17, 1984	Coastal Storms / Flooding	DR-702
June 23, 1972	Tropical Storm Agnes	DR-338
September 13, 1971	Severe Storms/Flooding	DR-311
August 18, 1965	Water Shortage	DR-204

Source: www.fema.gov; Orange County Hazard Mitigation Plan

Emergency Declarations - Designating Orange County, New York (1965-2013)

Date	Event	Emerg. Declaration
October 28, 2012	Hurricane Sandy	EM-3351
September 8, 2011	Tropical Storm Lee	EM-3341
August 26, 2011	Hurricane Irene	EM-3328
December 18, 2008	Severe Winter Storm	EM-3299
September 30, 2005	Hurricane Katrina Evacuation	EM-3262
August 23, 2003	Power Outage	EM-3186
March 27, 2003	Snowstorm	EM-3184
March 17, 1993	Severe Blizzard	EM-3107

Source: www.fema.gov; Orange County Hazard Mitigation Plan

RECORDED EVENTS: Jan 1996 through Oct 2013 NOAA Storm Events Database

Event Type	Occurrences		Deaths / Injuries		Property / Crop Damage	
	Wallkill	Middletown	Wallkill	Middletown	Wallkill	Middletown
Flood	8		nda		≥\$17 Million / nda	
Flash Flood	7	6	nda	nda	≥\$1.7 Million / nda	
Blizzard	2		nda		nda	
Heavy Snow	44		nda		nda	
Hail	1	0	nda		nda	
Ice Storm	8		nda		nda	
Winter Storm	19		nda		nda	
Strong Wind (35+ kts)	5		1 / 2		≥\$7,500 / nda	
High Wind (50+ kts)	16		1 / 1		≥\$300,000 / nda	
Thunderstorm Wind (50+ kts)	7	11	nda	nda / 1	≥\$9,500 / nda	≥\$83,500 / nda
Tornado	0	1	nda	nda	nda	nda
Hurricane	0		0		0	
Tropical Storm	1		nda		\$4,000 / nda	
Extreme Temperatures	7		1 / nda		nda	
Drought	10		nda		nda	
Wildfire	0		0		0	
Avalanche	0		0		0	
Landslide	0		0		0	
Lightning	5	2	nda	nda	\$40,750 / nda	\$10,000 / nda

Source: NOAA Storm Events Database, January 2014. Wallkill and Middletown data include events coded as county-wide or in the "Orange Zone". Numbers shown across both columns are county-wide events. nda = no data available.

SECTION IV - RISK AND LOSS ASSESSMENT

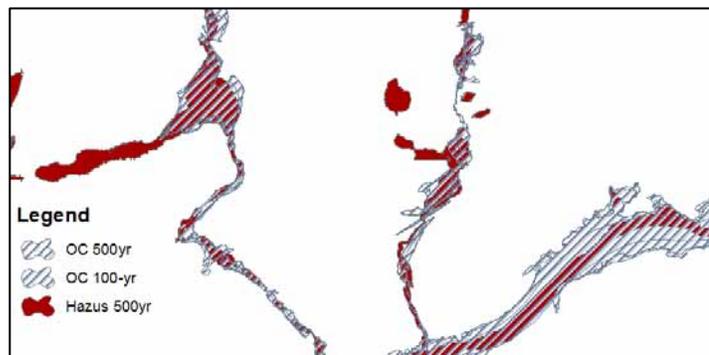
In order to develop appropriate mitigation strategies for the Town of Wallkill and City of Middletown several potential hazards of concern were evaluated for both their likelihood of occurrence and their potential impact to vulnerable assets within the study area. Many of the hazards identified tend to be regional in nature, and therefore identifying specific areas of vulnerability is not practical. The primary hazard that has been identified to have the potential impact on the most vulnerable assets is flooding. Flooding is seen as a significant problem in both Wallkill and Middletown, both related to storm events, and also in the event of a dam failure. While other types of hazards could have significant impact on the community, such as tornados or drought, these types of hazards are too infrequent and/or random to necessitate a mitigation strategy at this time.

To complete some of the hazard analyses and loss estimations, FEMA's Hazards-United States (Hazus) software was utilized. The software allows for a standardized method for estimating potential losses from earthquakes, floods, and hurricanes. Hazus uses Geographic Information Systems (GIS) technology and a set of standard demographic and infrastructure data evaluated at the Census Tract level.

In addition to the HAZUS software, other sources and methods of mapping and analysis were used to determine extent and vulnerability, including documented local reports of previous storm damage.

Flooding

Location. As noted in the 2011 Orange County Natural Hazard Mitigation Plan, local data regarding flooding and property data is more accurate than the data available with the Hazus software. The Hazus software was used to predict inundation areas for several flood events, from a 10-year event (10% chance of flood occurring in a given year) to a 500-year event (0.2% chance of a flood occurring in a given year). While these areas have general agreement with the DFIRM data available from Orange County, they cover more areas of the study area, but at narrower widths. (See illustration).

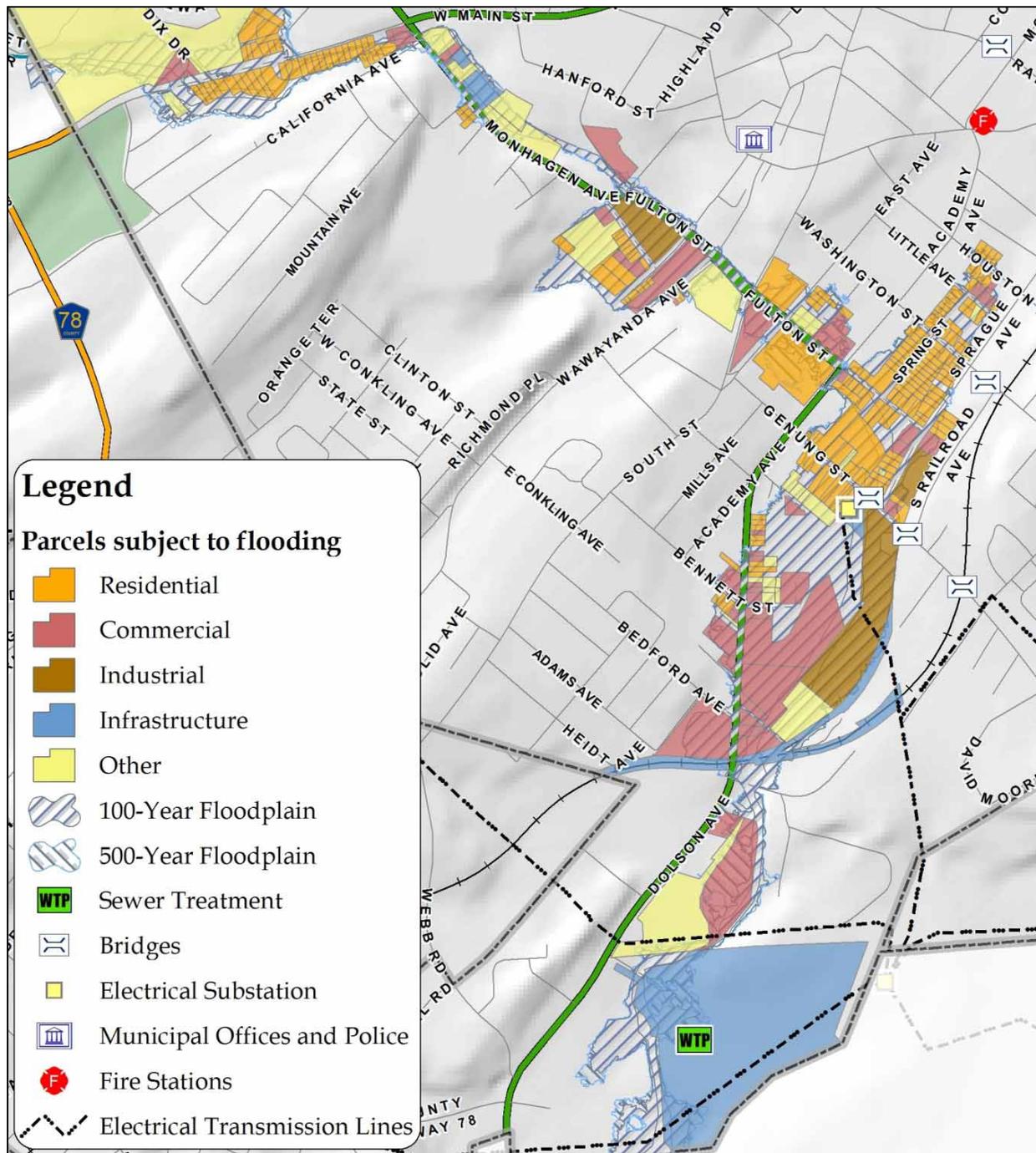


Comparison of Orange County DFIRM 100 and 500 year flood plain mapping and the Hazus predicted floodplain.

Extent & Severity. Using the Hazus software it was determined that the majority of impacts that would likely be incurred in the study area would be to automobiles and the expense of debris clean-up. Building damage would be relatively minor. As a comparison the 2009 DFIRM data was reviewed in conjunction with 2012 real property data to estimate potential impacts as a result of 100-year flood event and a 500-year flood event. These results are summarized in the following tables. Values shown are for property improvements, based on 2012 Orange County Real Property tax data.

Flooding—Flood Hazards Areas (acres and percentages)				
Municipality	Total Land Area	100-yr Flood Risk Area	500-yr Flood Risk Area	Low Flood Risk Area
Middletown	3,286	151 (5%)	21 (1%)	3,114 (94%)
Walkkill	40,207	2,079 (5%)	345 (1%)	37,746 (94%)

Source: HAZUS; Orange County DFIRM data



Parcels containing structures likely to be impacted by a 100-year and/or 500-year flood event in the City of Middletown.

As can be seen in the following table, in addition to the approximately 250 homes located within flood-prone areas, there are also numerous critical facilities, including water extraction/treatment buildings, an electrical substation, a fire house, a pre-school, retirement homes, and a state-run home. Included in the garage total are municipal garages on the City of Middletown, and there are numerous automotive service facilities included in the commercial building tally. Were these facilities to be inundated with flood waters there could be environmental impacts to the surrounding down-stream area from petroleum and other chemical releases.

Structures in 100- Year Floodplain	Total Number			Approximate Value (x\$1000)		
	Town	City	Total	Town	City	Total
Houses / Condos	72	179	251	\$6,772	\$15,424	\$22,196
Commercial Buildings	3	47	50	\$1,967	\$13,705	\$15,672
Industrial Buildings	2	3	5	\$6,310	\$3,896	\$10,206
Pre-School	1	-	1	\$1,188	-	\$1,188
Garage / Barn / Shed	10	7	17	N/A	N/A	-
Utility Building (water)	5	1	6	N/A	N/A	-
Apartment Building	-	1	1	-	N/A	-
Retirement Home	-	1	1	-	N/A	-
State-run Housing	-	1	1	-	N/A	-
Electrical Substation	-	1	1	-	N/A	-
Equipment Storage Lot	-	9	9	-	N/A	-
Total	93	250	343	\$16,237	\$33,025	\$49,262

Structures in 500- Year Floodplain	Total Number			Approximate Value (x\$1000)		
	Town	City	Total	Town	City	Total
Houses / Condos	17	5	22	\$3,284	\$498	\$3,782
Commercial Buildings	1	2	3	\$82	\$674	\$756
Garage / Barn / Shed	2	-	2	N/A	-	-
Apartment Building	1	1	2	N/A	N/A	-
Retirement Home	-	1	1	-	N/A	-
Dorm	1	-	1	N/A	-	-
Fire House	1	-	1	N/A	-	-
Utility Building (water)	1	-	1	N/A		
Total	24	9	33	\$3,366	\$1,172	\$4,538

Historical Occurrences. According to the Orange County Hazard Mitigation Plan, Orange County was affected by 10 Presidential Disaster Declarations due to flooding in the time period between 1971 and 2007. Since that time, there has been one additional Emergency Declaration, and three more Disaster Declarations affecting the study area which resulted from flooding.

Flooding-Related Disaster and Emergency Declarations Affecting Study Area		
Date	Event	FEMA Designation
Sept. 13, 1971	Severe Storms and Flooding	DR-0311
June 23, 1972	Tropical Storm Agnes	DR-0338
April 17, 1984	Flooding	DR-0702
January 24, 1996	Flooding	DR-1095
Sept. 19, 1999	Hurricane Floyd	DR-1296
October 1, 2004	Severe Storms	DR-1564
October 1, 2004	Tropical Depression	DR-1565
April 19, 2005	Severe Rain and Floods	DR-1589
July 1, 2006	Severe Storms and Flooding	DR-1650
April 27, 2007	Nor'easter	DR-1692
April 16, 2010	Severe Storms and Flooding	DR-1899
August 26, 2011	Hurricane Irene	EM-3328
August 31, 2011	Hurricane Irene	DR-4020
Sept. 8, 2011	Tropical Storm Lee	EM-3341
Sept. 13, 2011	Tropical Storm Lee	DR-4031

Source: FEMA

In addition to the emergency and disaster declarations listed above, there have been several smaller flooding events recorded as specifically affecting the study area. Data is only available for these events back to 1996.

Flooding – Specific Recorded Events within Study Area; 1996 thru 2013				
Date	Type	Location	Deaths / Injuries	Property / Crop Damage
10/28/2006	Flash Flood	Howells / Middletown	0/0	0/0
4/15/2007	Flood	Washingtonville / Wallkill	0/0	0/0
3/8/2008	Flash Flood	Middletown	0/0	0/0
3/8/2008	Flash Flood	Mechanicstown	0/0	0/0
6/26/2009	Flash Flood	Washington Heights	0/0	0/0
6/30/2009	Flash Flood	Mechanicstown	0/0	0/0
7/26/2009	Flash Flood	Mechanicstown	0/0	0/0
8/9/2013	Flash Flood	Middletown	0/0	0/0

Source: NOAA Storm Events database. Deaths, injuries, property and crop damage numbers as reported or recorded by NOAA.

Probability of Occurrence. Based on historical trends, the probability of subsequent flood damage within the study area for the foreseeable future is relatively high. The mathematical probability of flooding is typically expressed in terms of a flood of a particular size happening in any given year. The "100 year flood", for example, has a 1% chance of occurring within any given year, however smaller floods occur more frequently, and larger floods also occur less frequently. Another way of assessing this threat is to look at the probability of a particular flood event occurring within the span of a standard home 30-year mortgage, as illustrated in the table below. Using this method, there is a 26% chance of a structure within the floodplain of being damaged by a large 100-year flood during the life of the mortgage, and a 96% chance of being flooded by a 10-year flood.

Probability of Flood Within Floodplain During 30-Year Mortgage				
Time Period	Size / Magnitude of Flood			
	10 Year Flood	25 Year Flood	50 Year Flood	100 Year Flood
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Source: FEMA NFIP Floodplain Management Requirements (FEMA-480)

Given these statistical odds and historical trends, flood hazards have been determined to be of high probability for the purposes of this assessment.

Vulnerable Areas. During the course of this project, numerous areas associated with flooding vulnerability were identified throughout the study area, particularly within the City of Middletown. In fact, flooding is the primary hazard in both Wallkill and Middletown. Much of this data was based on flooding events caused by recent hurricanes or tropical storms. These are identified below and categorized by their associated watercourse / watershed area.

MONHAGEN BROOK DRAINAGEWAY. The Monhagen Brook drainageway represents one of the most significant problem areas for flooding within the study area. This is due in part to the large watershed area which collects water and channels it directly downstream into and through the City of Middletown. This problem is sometimes compounded by undersized culverts and debris which often clogs the channel during significant storm events, preventing outflow to continue downstream out of the city to the Wallkill River beyond. Within this area there are several vulnerable assets including multiple residential structures, and numerous critical facilities, including water extraction/treatment buildings, an electrical substation, a fire house, a pre-school, retirement homes, and a state-run home. The noted problem areas include:

- Pilgrim Estates neighborhood – Brewster Drive, other streets and properties within Pilgrim Estates flooded.
- County Road 78 near Monhagen Middle School, Egerton Road – Flooding here has prevented access to the middle school and adjacent Maple Ave elementary school.
- Rear portion of properties along W. Main Street - Channel of drainageway has been damaged by significant storm events, concrete sidewalls collapsed.
- Boyce Excavating Property, east side of Monhagen Ave – Culvert entrance undersized, Boyce property and downstream city properties flooded.
- City Water Department / City Street Dept garages, Monhagen Ave – Damage to building caused by flooding.
- City Salt Storage Facility, Monhagen Ave – Flooding caused destruction of 12x8 concrete box culvert, destruction of staging/loading area at Salt Storage facility.

- Mill Street to Genung Street – Flooding along the open channel upstream from Mill Street resulted in debris clogging downstream enclosed section of drainageway. Fulton Street and areas downstream to Genung street were flooded, including Monhagen ave.
- Dolson Ave – Entrance to City wastewater treatment plant blocked by flooding.

TRIBUTARIES TO MONHAGEN BROOK

- Maple Hill Park Pond – Park damaged by flooding from outlet of pond to maple Ave.

POCATELLO LAKE OUTLET

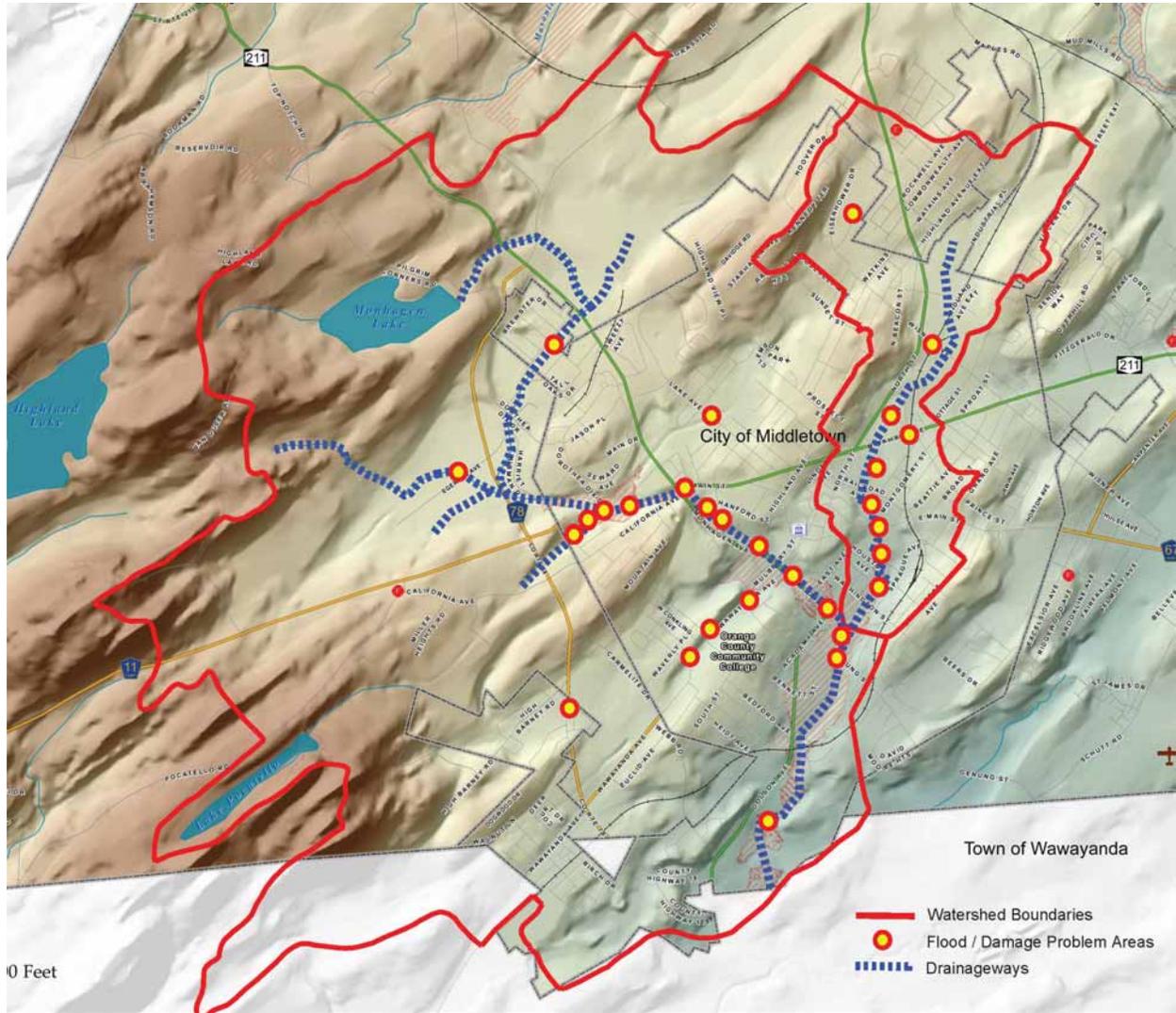
- Pocatello Lake Outlet – County Route 78 at Aspen Townhouses. County Route 78 flooded, flood diversion wall destroyed (Irene), townhouse roads and city streets flooded, drainage channels along CR78 and North Aspen Drive eroded.
- SUNY Orange campus – Damage to Wawayanda Ave and sidewalks along SUNY Orange campus, drainage structures adjacent to SUNY parking lot adjacent to Wawayanda Ave.
- Wawayanda Ave and sidewalks near post office.

DRAPER BROOK DRAINAGEWAY

- Along railroad, from Baker Development property to Wisner Ave – flooding and damage to railroad bed, street dept. garage, parking lot at end of Midland Ave.
- Streets and sidewalks flooded along portions of Low Ave, Smith St, Wickham Ave.
- Thrall Park – park inundated by flooding.
- Streets and sidewalks flooded along Railroad Ave from Grove St. to Cottage St.
- Streets and sidewalks on Cottage St from Railroad Ave to Roberts St flooded.
- Flooding along Roberts Street – Across from East Main, prevented access to Central Firehouse.
- Streets and sidewalks, private properties – lower portion of Draper Brook, from Grant St. to Genung St., flooding prevented access by emergency vehicles.
- Since tropical storm Irene, the city has experienced repeated flooding problems from the north feeding into Draper Brook drainageway; flooding repeatedly occurring along Wisner Ave, Smith St, Route 211, Grove St, Grant St. An investigation into the cause of this increase in flooding may be necessary.

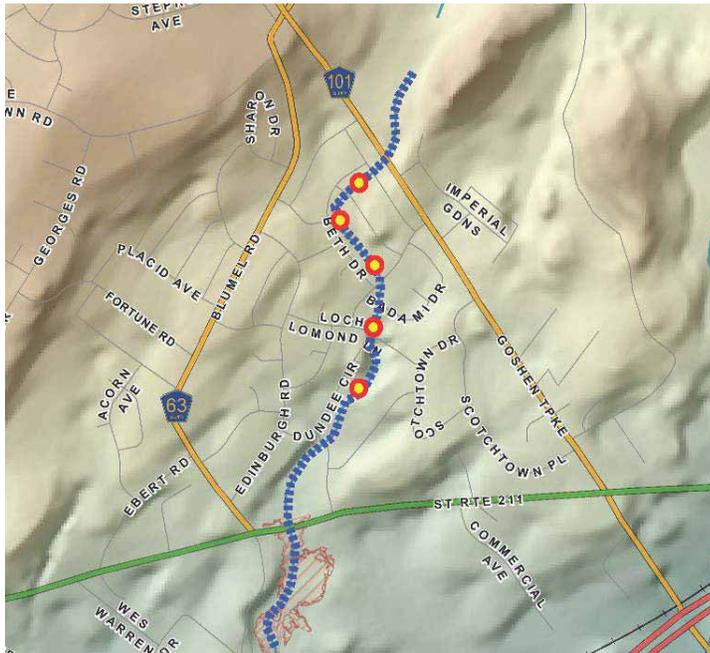
MILL POND DAM

- Overtopping of dam during hurricane Irene resulted in damage to dam face.



City of Middletown – Exaggerated relief map showing approximate watershed areas of Monhagen Lake and Draper Brook drainageways and the vulnerabilities from recent problem flooding areas.

SCOTCHTOWN – Winding Brook



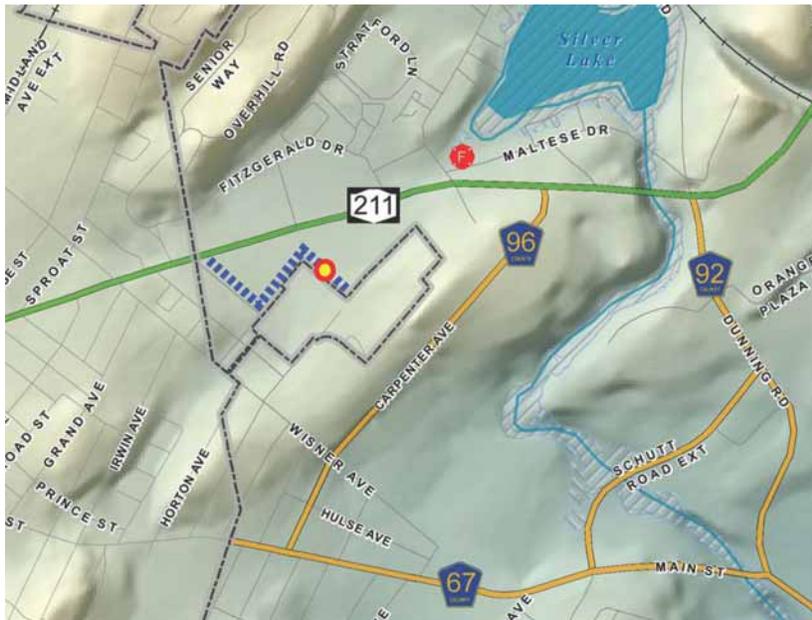
Although not listed as potential floodplain area, various streets and parcels in the Scotchtown neighborhood of Wallkill have experienced recent flooding events in the vicinity of Winding Brook. Flooding has been notable along Mabel Road, Beth Drive, Badami Drive, Loch Lomond Lane and Dundee Circle. This flooding appears to be due in part to the winding turns which the waterway takes—where excessive flows can jump the banks—however is severely compounded by residential debris which is left near the brook that is carried away and clogs the flow.

Field inspections of this area show that many residential homeowners continue to pile vegetative debris and trash along the banks of the water. Trash, including discarded Christmas trees and brush, were found in the brook. Other notable problems observed were severe scouring of the banks, a private retaining wall which is being undermined by erosion, and culverts in need of replacement, including a culvert under Loch Lomond which appeared to be under some structural strain.



Debris commonly found alongside the brook (left). Severe scouring and erosion along the banks (right).

ROUTE 211 – Middletown High School / Shop Rite Plaza



Although not included within the recognized floodplain, the drainageway which runs between the Middletown High School and the ShopRite Plaza in Wallkill has experienced recent flooding problems. This drainageway, which collects runoff from the nearby athletic fields and surrounding areas, feeds into a 6 foot diameter underground pipe running underneath the commercial plaza. This pipe inlet has repeatedly clogged from debris causing backup flooding of the surrounding properties.

Although the Town of Wallkill had made maintenance arrangements for the property owners to keep this passage clear of debris, it continues to be a problem. Field inspections of the channel found that debris had recently been picked up, but had not been removed from site and was instead piled a few feet just to the side of the water, where it would likely clog the system again in the next storm.



PROSPEROUS VALLEY LAKE

Significant flooding has been observed along the banks of Prosperous Valley Lake, notably along the north bank where it is bordered by Prosperous Valley Road. This has resulted in flooding which has closed this road which acts as one of the few east-west connection routes underneath Route 17.

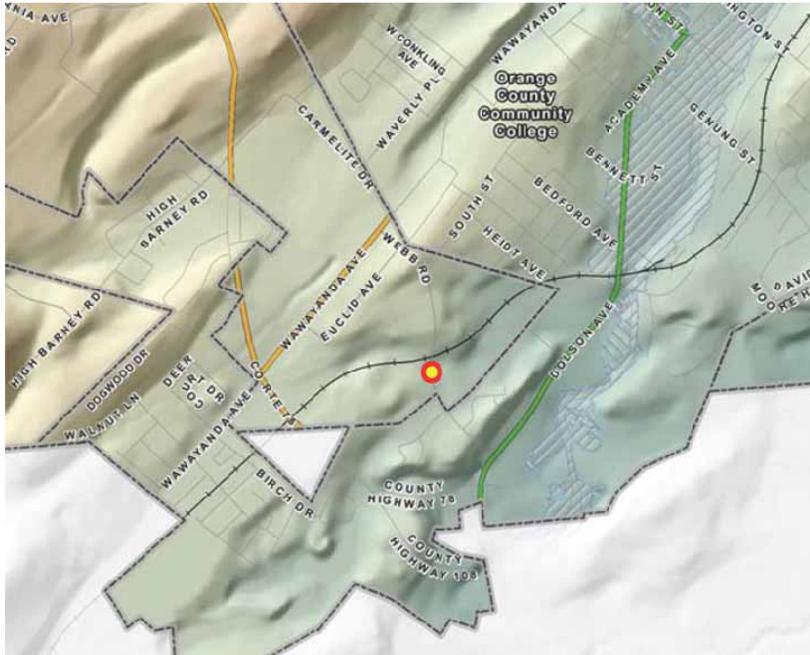
Flooding from this lake has also caused significant washout of the steep wooded area downstream, collecting downed trees and vegetative debris which clogged the channel and resulted in residential property flooding along York Road below. A site inspection of the spillway at this location noted that the wooden spillway wall may be in need of replacement in the near future.



View of Prosperous Valley Lake, looking south.

IMPOUNDMENT DOWNSTREAM FROM WEBB ROAD

Notable flooding and deterioration has been observed near the impoundment behind the Playtogs Plaza near Webb Road. Significant water flow events have undermined the spillway and retaining walls along this course. These structures are currently in need of inspection and repair.



Approximate location of impoundment.



View of impoundment on watercourse downstream from Webb Road. Spillway structure has been noted as generally deteriorated, with undermined abutment. Image courtesy of Clark Patterson Lee Design Professionals.



View of damage to timber retaining wall at the rear of Playtogs Plaza. Image courtesy of Clark Patterson Lee Design Professionals.

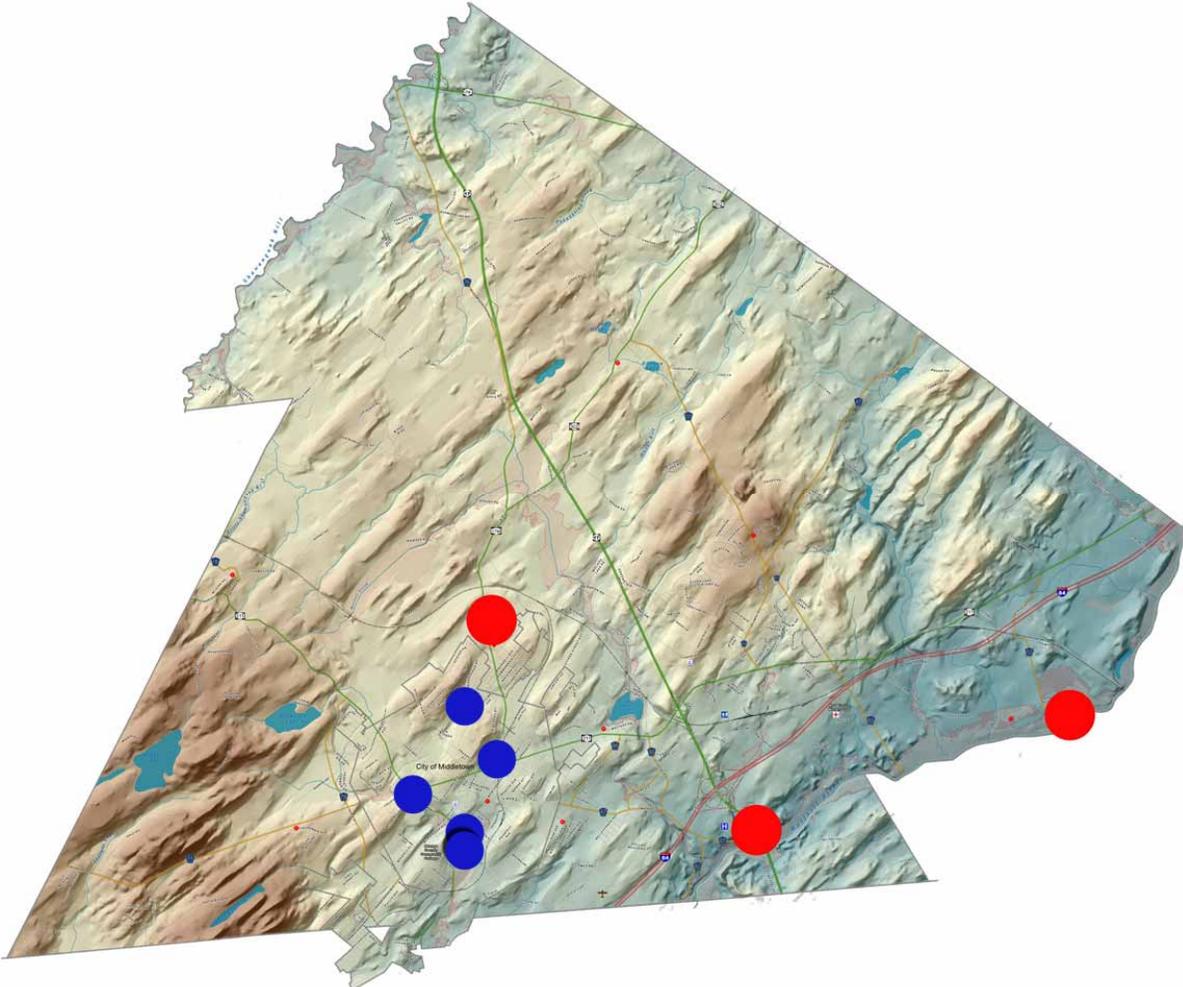
Repetitive Loss Properties / National Flood Insurance Program. A Repetitive Loss (RL) property is defined as an insurable structure which has experienced two or more claims exceeding \$1,000 which have been paid by the National Flood Insurance Program (NFIP) in a 10 year period. A Hazard Mitigation Plan is required to describe a communities participation in the plan, and identify repetitive loss properties within its study area.

Both the City of Middletown and the Town of Wallkill are in good standing with the NFIP, with no known outstanding compliance issues. Both municipalities have adopted a Floodplain Ordinance, and both have a Floodplain Administrator – the Building Inspector in Wallkill, and the Commissioner of Public Works in Middletown. Additional data about their participation in the NFIP can be found in the table below.

National Flood Insurance Program – Participation Data		
NFIP Data / Characteristics	Town of Wallkill	City of Middletown
What date did the municipality join the NFIP	09/04/86	03/02/83
Is the municipality in good standing with the NFIP	Yes	Yes
How many NFIP policies are in effect	83	119
How many claims have been paid	38	55
What is the total amount of claims paid	\$372,527	\$528,087
Number of claims which were for 'substantial damage'	1	1
Number of Repetitive Loss claims	3	5
Number of structures in 100-year flood plain	93	250
When did current FIRMS become effective	08/03/09	08/03/09
Are FIRMS digital or paper format	--	--
Does municipality have a floodplain ordinance	Yes	Yes
Municipality participates in the Community Rating System	No	No
What is the municipalities CRS ranking	n/a	n/a
What CRS activities are conducted	n/a	n/a
Any outstanding NFIP compliance issues?	No	No
Is the local Flood Plain Administrator certified		
<i>Source: New York State Dept. of Environmental Conservation, FEMA, local municipalities.</i>		

Based on information from the New York State Department of Environmental Conservation, as of April 2013 there were 3 repetitive loss properties in the Town of Wallkill and 5 repetitive loss properties in the City of Middletown. These were respectively located on: East Main Street; Stony Ford Road; along North Street; Monhagen Ave; Roosevelt Ave; Sterling Street; Smith Street and Genung Street. (See map next page.) In order to comply with the Privacy Act of 1974, no identifying characteristics or data for these properties have been included, and their mapped locations have been generalized.

Two of the properties are located along the Wallkill River within the 100-year floodplain. The three properties within the Town of Wallkill accounted for a total of eight losses which have been paid an average of \$10,121 for a total of \$80,966. There were no known properties identified as Severe Repetitive Loss.



Locations of NFIP Repetitive Loss Properties within the Town of Walkkill (red) and City of Middletown (blue).

Severe Storms

Location. Severe storms and thunderstorms are found throughout the entire United States, though more common in the central and southern states. Although they are typically smaller in nature than winter storms or hurricanes, no one portion of the study area is more susceptible than another, except in localized areas where sustained wind speeds, localized winds or flooding is more likely to occur.

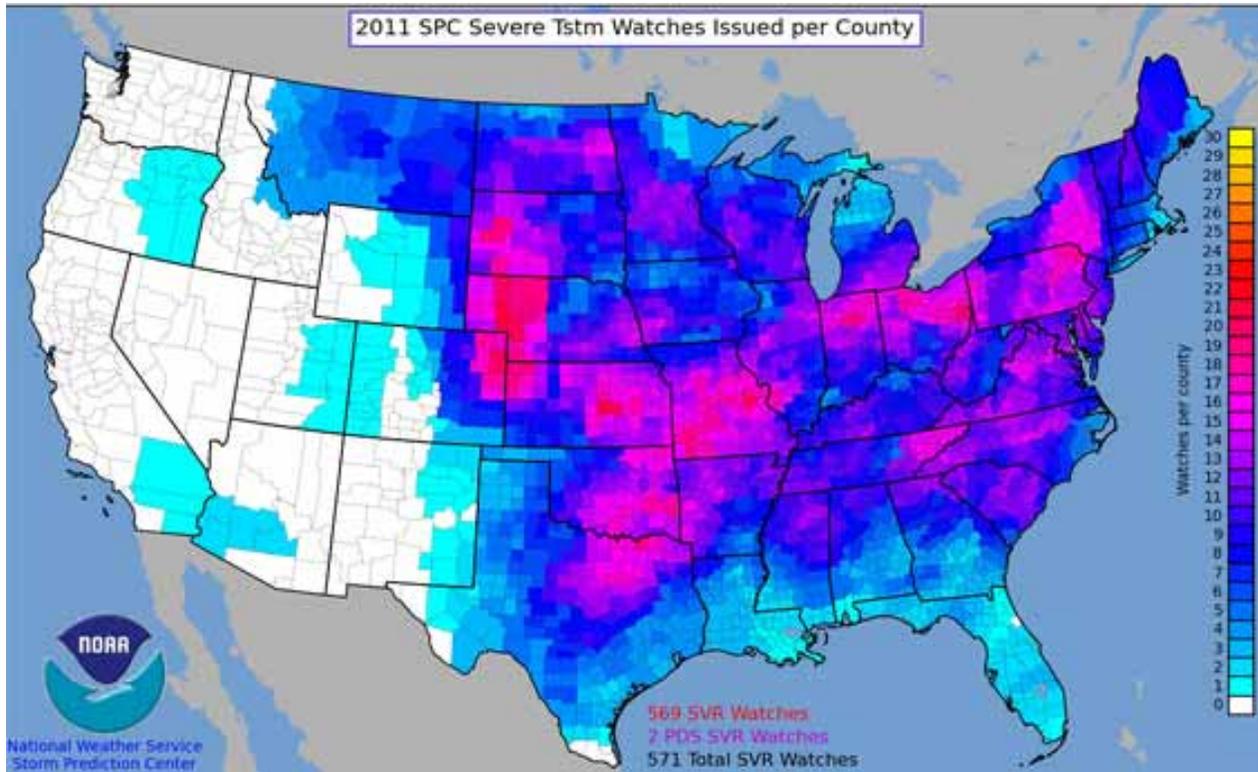
Extent & Severity. Severe storms are commonly defined as those which produce wind gusts in excess of 58 mph, hail $\frac{3}{4}$ " or greater, or a tornado. The damage caused by severe storms is most commonly attributed to high winds, heavy rainfall and lightning. Resulting damage can occur from flooding, downed limbs, trees and power failures. Based on NOAA data, severe thunderstorm events have been directly attributed to at least approximately \$119,500 in property damage in the vicinity of the study area since 2009.

Historical Occurrences.

Severe Storm – Specific Recorded Events Affecting Study Area; May 1997 thru 2012				
Date	Type	Location	Deaths / Injuries	Property / Crop Damage
5/6/1997	Thunderstorm Wind	Middletown	0/0	0/0
5/19/1997	Thunderstorm Wind	Middletown	0/0	0/0
7/9/1997	Thunderstorm Wind	Middletown	0/0	0/0
7/9/1997	Thunderstorm Wind	Middletown	0/0	0/0
5/18/2000	Thunderstorm Wind	Middletown	0/0	0/0
5/28/2002	Thunderstorm Wind	Scotchtown	0/0	0/0
8/16/2002	Thunderstorm Wind	Scotchtown	0/0	0/0
6/1/2006	Thunderstorm Wind	Middletown	0/0	0/0
7/17/2009	Thunderstorm Wind	Michigan Corners	0/0	\$7.50K/0
7/31/2009	Thunderstorm Wind	Middletown	0/0	\$3.00K/0
8/21/2009	Thunderstorm Wind	Middletown	0/0	\$12.00K/0
6/24/2010	Thunderstorm Wind	Middletown	0/0	\$67.50K/0
6/9/2011	Thunderstorm Wind	Orange County	0/0	\$26.50K/0
7/29/2011	Thunderstorm Wind	Scotchtown	0/0	\$2.00K/0
7/26/2012	Thunderstorm Wind	Fair Oaks	0/0	0/0
9/8/2012	Thunderstorm Wind	Middletown	0/0	\$1.00K/0

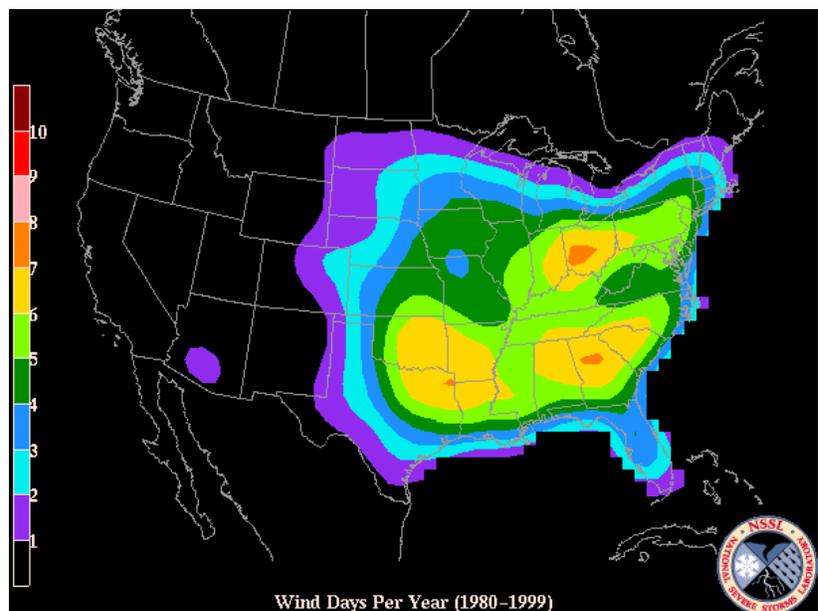
Source: NOAA Storm Events database. Events limited to accounts of 'Thunderstorm Winds'.

According to NOAA records, Orange County was included in approximately 11 severe thunderstorm watches in 2011 (see figure below). This represented an increase of 1 above average compared to the ten-year period from 1999-2008. In 2010, there were also 11 watches issues in the county, and approximately 5 in 2009. The Orange County Natural Hazards Mitigation Plan noted that the area experiences between 20 to 30 thunderstorm days per year.



Probability of Occurrence. The NOAA National Severe Storms Laboratory has calculated that the average number incidents of thunderstorm winds in excess of 50 kts for this region is approximately 4 to 6 days per year.

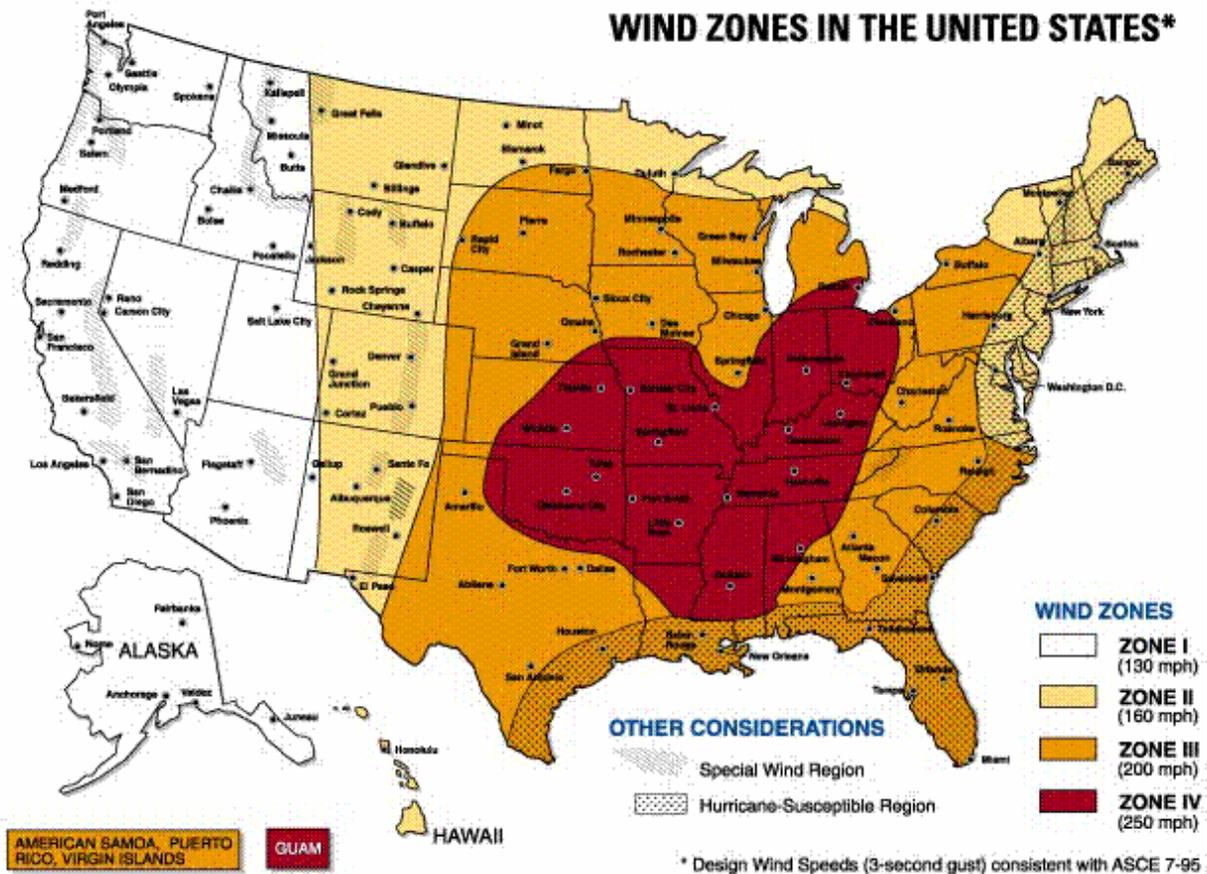
Vulnerable Areas. Because of the size and widespread nature of these storms, no one portion of the study area is more susceptible than others, except for areas prone to flooding.



Extreme Wind

Extreme wind events are commonly associated with thunderstorms and straight line winds in this region, but can also be attributed to tropical storms, hurricanes, tornados and nor'easters. The study area lies within a zone where wind speeds of up to 160 mph are possible.

Location. Extreme winds can occur in any part of the study area, which lies within a zone classified by the American Society of Civil Engineers as 'Zone II – Hurricane Susceptible'.



Extent & Severity. The severity of extreme wind is based on the maximum sustained wind speed generated, as described in the following table.

Wind Speed Scales and Damage Descriptions			
Wind Speed	Hurricane Scale	Tornado Scale	Damage Description
40-72 mph 35-62 knots	Tropical Storm (39-73 mph)	F0	Minimal damage; Broken signs, tree branches, windows.
73-112 mph 63-97 knots	Category 1 (74-95 mph) Category 2 (96-110 mph) Category 3 (111-130 mph)	F1	Moderate damage; Roof shingles torn off, small outbuildings or mobile homes pushed over, trees broken.
113-157 mph 98-136 knots	Category 4 (131-155 mph) Category 5 (155+ mph)	F2	Considerable; Roof frames torn off homes, large trees broken or uprooted, weak foundation structures tipped over or demolished.
158-206 mph 137-179 knots	Category 5 (155+ mph)	F3	Severe; Trees in forests uprooted, heavy cars lifted or thrown, roofs and walls torn from buildings.
207-260 mph 180-226 knots	Hurricanes not likely to reach these speeds	F4	Devastating; Cars thrown and demolished, houses and buildings leveled, trees uprooted and thrown, large damage from flying missile debris.
261-318 mph 227-276 knots	Hurricanes not expected to reach these speeds	F5	Incredible; Strong structures and cars lifted and carried considerable distances and disintegrated.

Historical Occurrences. The Orange County Hazard Plan noted 235 high wind events affecting the county between 1950 and July 2009, resulting in 4 deaths, 19 injuries and approximately \$56,000 worth of property damage. Since that report was published, NOAA's NCD data reports approximately 6 additional events have occurred, resulting in at least 1 injury, as noted below.

Extreme / Thunderstorm Wind – Specific Recorded Events within Study Area; July 2009 thru 2012				
Date	Type	Location / Speed	Deaths / Injuries	Property / Crop Damage
8/21/2009	High Wind	Middletown / 61 kts	0/0	\$12K/0
6/24/2010	High Wind	Middletown / 52 kts	0/0	\$7.5K/0
6/24/2010	High Wind	Middletown / 70 kts	0/1	\$60K/0
2/19/2011	High Wind	Orange County / 50 kts	0/0	\$100.00K/0
7/29/2011	High Wind	Scotchtown / 61 kts	0/0	\$2K/0
7/26/2012	High Wind	Fair Oaks / 52 kts	0/0	0/0
9/8/2012	High Wind	Middletown / 52 kts	0/0	\$1k/0

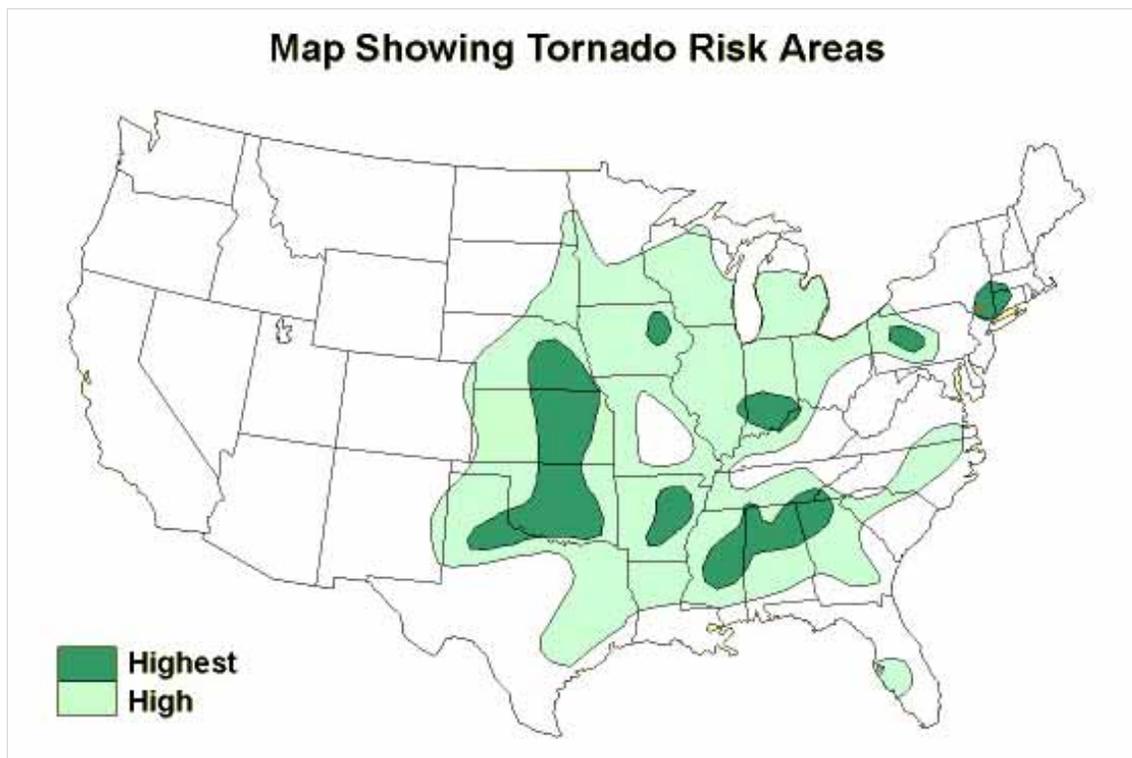
Source: NOAA Storm Events database. Recorded events limited to wind speeds of 50 knots (57.5 mph) or greater.

Vulnerable Areas. Because of the widespread nature of extreme wind, no one portion of the study area is considered more susceptible than others.

Tornado

Strong thunderstorms have been known to be responsible for creating tornado or tornado-like conditions in the northeast.

Location. Although tornadoes can occur anywhere in the United States, their frequency and concentration is largely limited to the central plains states. However, tornadoes are known to occur in New York State, and the southeastern area of the state is considered highly susceptible. Orange County, including the study area, still falls within the highest risk zone. Due to their potential range and unpredictability, no one portion of the study area is known to be more susceptible than another.



Source: American Red Cross

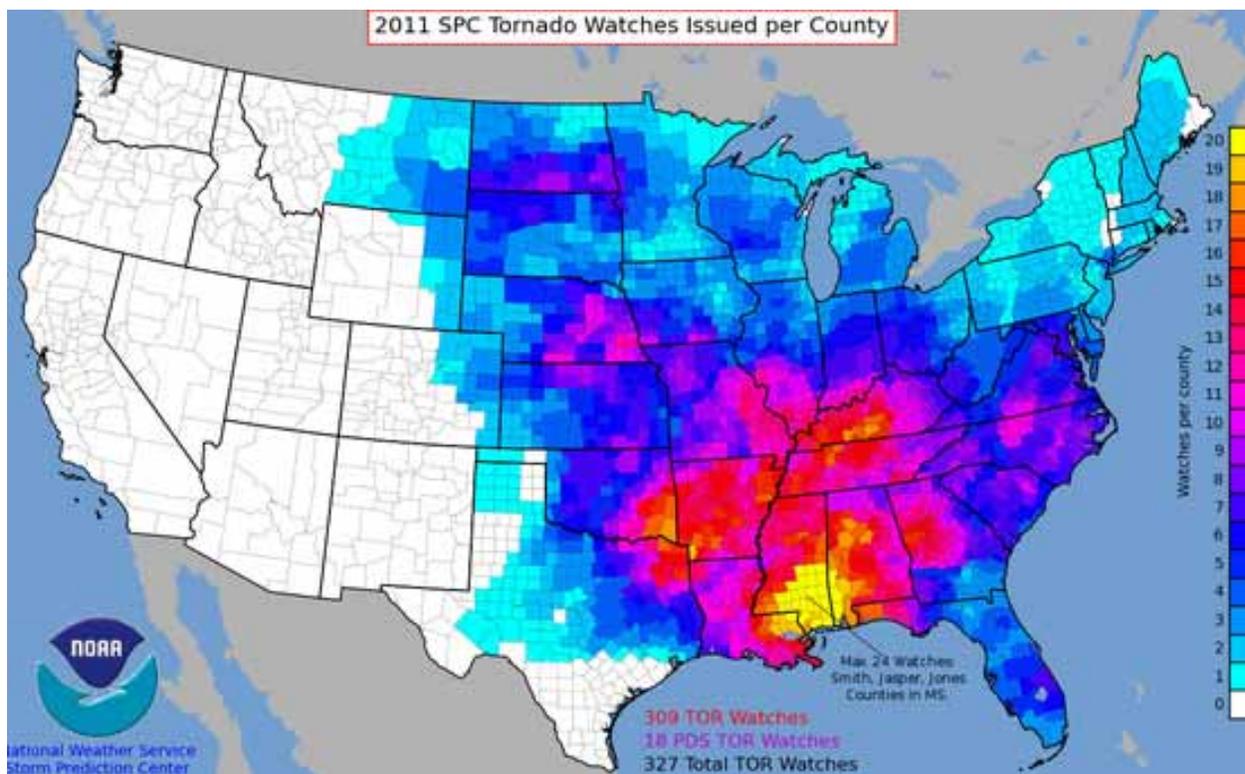
Extent & Severity. The extent or potential severity of a tornado depends on the wind speed, similar to hurricanes or high winds. (See **Wind Speed Scales and Damage Descriptions** table, from Extreme Winds). Unlike other more widespread hazard events, tornadoes are mostly known for causing extensive damage in small, discrete areas, with little or no warning. Although they can occur at any time of the year, they are most common during the spring and summer months.

Historical Occurrences. The Orange County Hazard Mitigation Plan noted that there were 10 recorded tornado events during the 40-year period between July 1969 and July 2009, causing 9 deaths, 19 injuries and more than \$28 million in damage. These events ranged in severity of between Fujita Scale of F0 and F3, with at least one F0 touching down close to Middletown in 1996. Since that report was published, the National Climate Data Center has recorded two funnel cloud formations within or near the study area.

Tornado / Funnel Cloud – Specific Recorded Events Near or Within Study Area; July 2009 thru 2012				
Date	Type / (Scale)	Location / Speed	Deaths / Injuries	Property / Crop Damage
7/25/1969	Tornado (n/a)	Wawayanda	0/0	0/0
7/29/1971	Tornado (F2)	Blooming Grove	0/0	\$250,000
6/16/1974	Tornado (F2)	Mount Hope	0/0	0/0
7/14/1988	Tornado (F3)	Minisink / Wawayanda	0/1	\$2,500,000
11/16/1989	Tornado (F1)	Monroe/Blooming Grove	9/18	\$25,000,000
6/29/1990	Tornado (F0)	Newburgh	0/0	\$250,000
5/29/1995	Tornado (F0)	West of Steward Airport	0/0	\$5,000
4/30/1996	Tornado (F0)	Near Middletown	0/0	n/a
6/16/2008	Tornado (F0)	Newburgh	0/0	n/a
7/29/2009	Tornado (F0)	Unionville	0/0	n/a
8/21/2009	Funnel Cloud	Middletown / (n/a)	0/0	0/0
6/9/2011	Funnel Cloud	West of Newburgh (n/a)	0/0	0/0

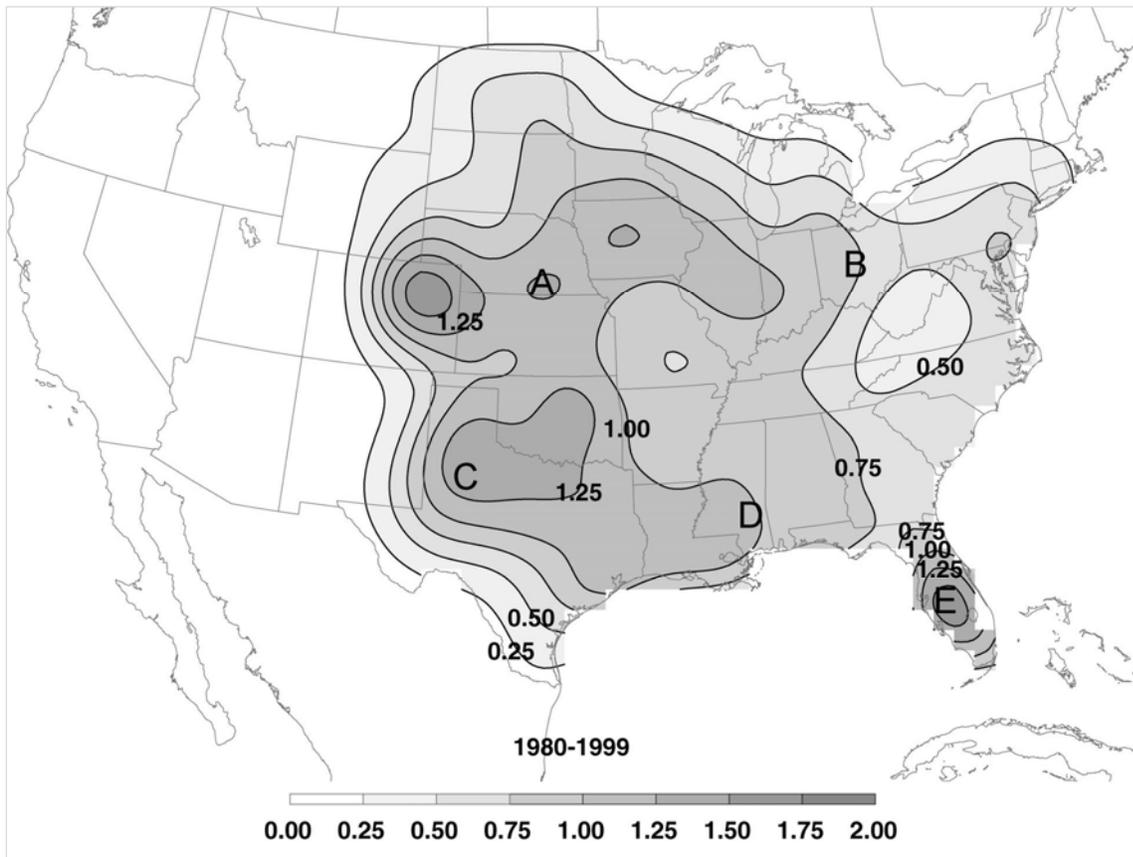
Source: NOAA Storm Events database, Orange County Hazard Mitigation Plan.

NOAA records indicate that the county occasionally experiences tornado watches, with 0 recorded in 2009; 3 recorded in 2010 and 2 recorded in 2011. The 2 tornado watches experienced in 2011 represented an increase of 2 above the average experienced during the period from 1999-2008.



Probability of Occurrence. Historical records research conducted by the National Severe Storms Laboratory estimates that the this area of New York State, including the study area, can expect to

experience between 0.5 – 0.75 Tornado Days per year (See Figure below). Another way of looking at this probability is during a peak period of July, the NSSL estimates that the probability of any size tornado in the study area is between 5% and 10% for that month. It is expected that tornados ranging in severity of between F0 and F3 will continue to take place every few years.



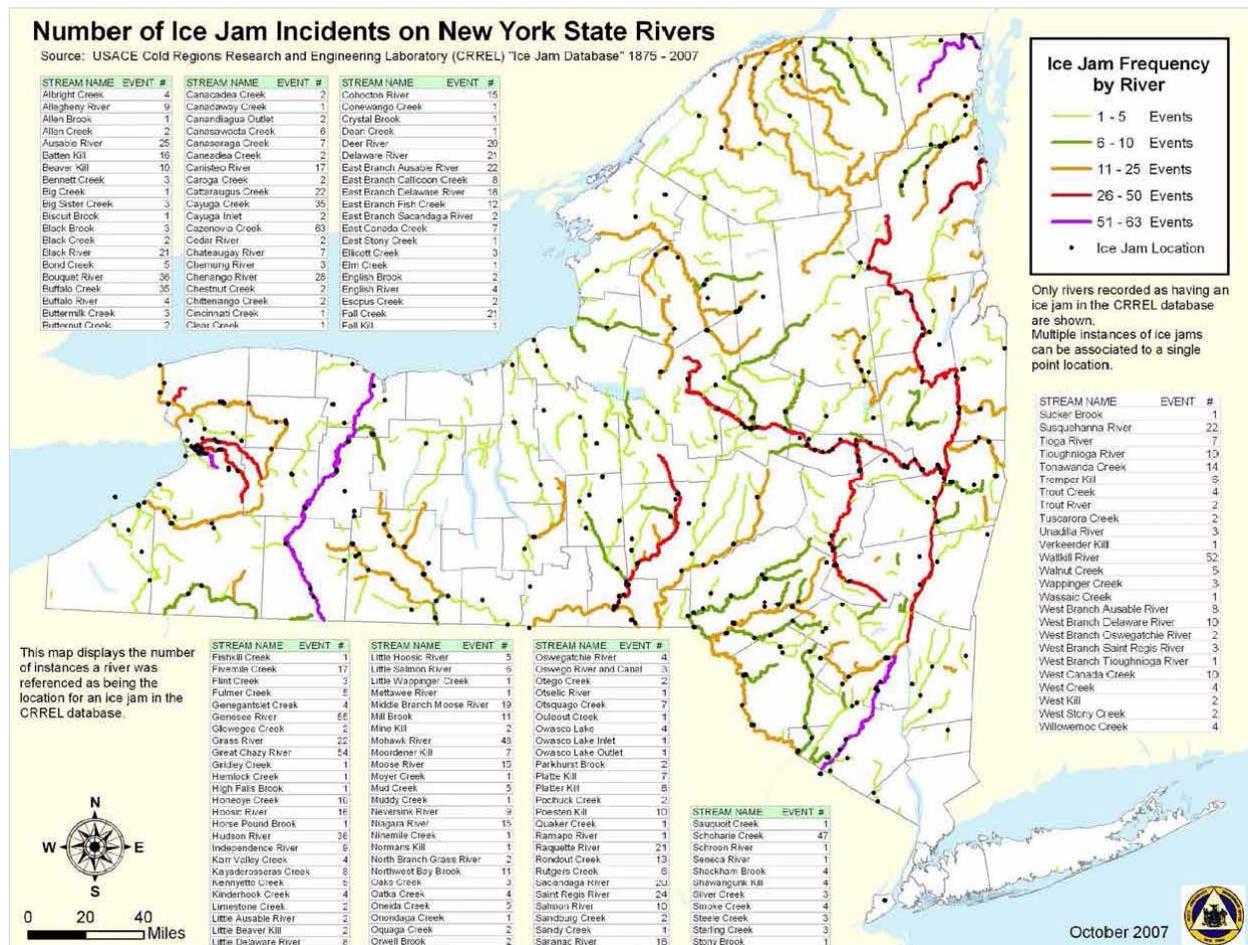
Tornado Days Per Year. Source: NOAA National Severe Storms Laboratory – Estimates of Local Daily Tornado Probability for the United States (2003).

Vulnerable Areas. Due to the unknown location of where a tornado may occur, there are no known vulnerability areas associated with this hazard.

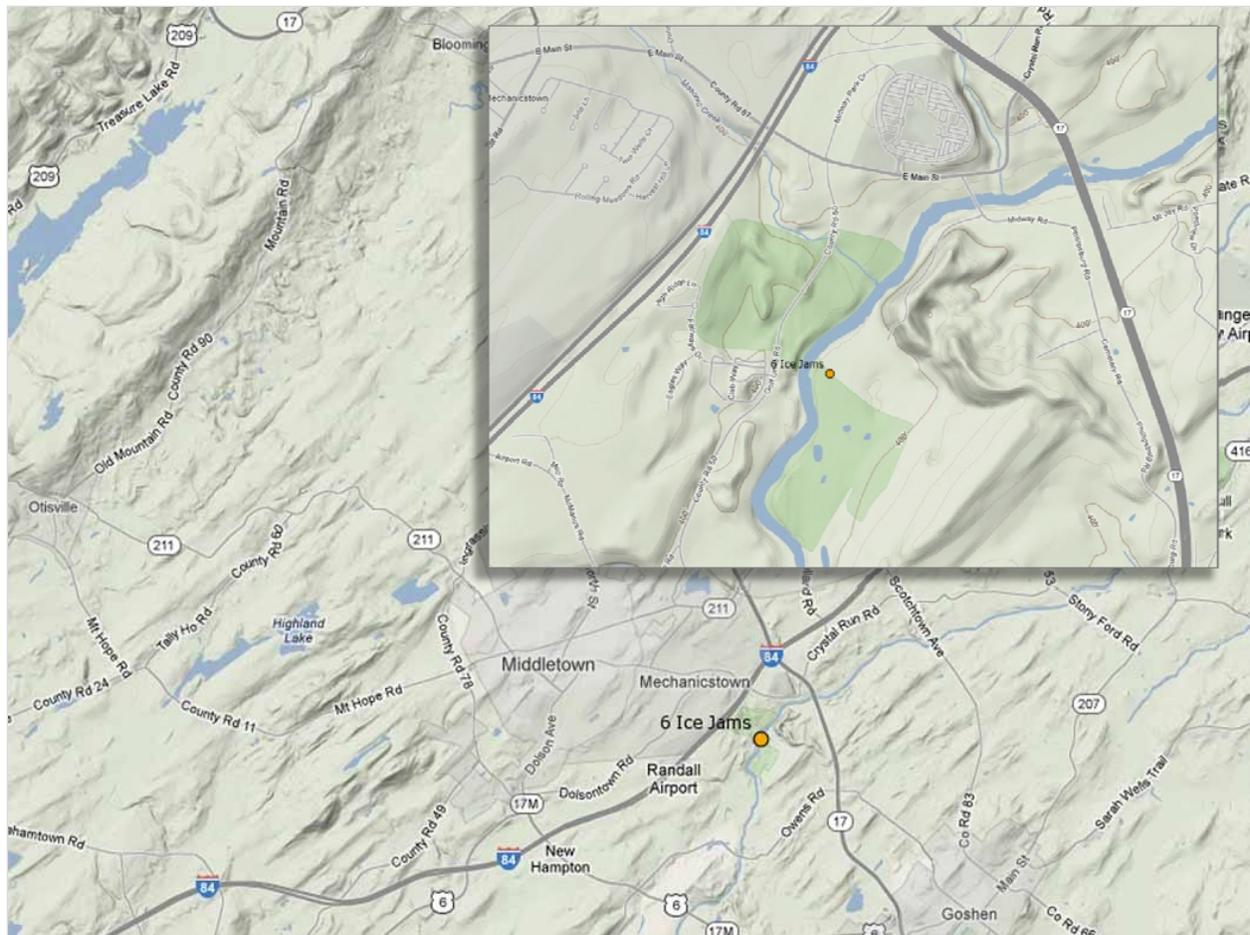
Ice Jam

Ice jams commonly form during freeze/thaw cycles when broken ice fragments floating downstream get bottlenecked at narrow passages in the river and continue to build up until they block the passage of water. These bottleneck conditions typically occur at bridge overpasses, bends in the watercourse or where there are waterway obstructions such as fallen trees or unbroken ice sheets. The resulting buildup effectively dams the watercourse, sometimes causing the local area to experience a sudden flash flood as the water is diverted along a different, unintended course. A sudden failure of a built-up ice jam can also create downstream flooding as the rush of water is released.

Location. The U.S. Army Corp of Engineers has tracked ice jam incidents and locations in New York State going back over 100 years. In the period between 1875 and 2013, the USACE reports that the Wallkill River experienced 54 ice jam incidents, and the Shawangunk Kill experienced 4. Information on smaller rivers or streams in or near the study area was not available.



Ice Jam Incidents in NYS. Source: USACE Cold regions Research and Engineering Laboratory.



Historical Occurrences. A closer look using the USACE Ice Jam Database Map indicates only 6 recorded ice jam incidents within the study area, all of which appeared to take place at one location just southeast of Middletown on the Walkkill River, in an area known as Phillipsburg. See map and detail inset above.

Ice Jam – Specific Recorded Events within Study Area; 1941 thru 2012				
Date	Type	River / Gage Height	Town	Location
2/8/1941	Ice Jam	Walkkill River / 7.17'	Walkkill	Phillipsburg
2/22/1943	Ice Jam	Walkkill River / 9.61'	Walkkill	Phillipsburg
12/27/1945	Ice Jam	Walkkill River / 6.90'	Walkkill	Phillipsburg
2/11/1951	Ice Jam	Walkkill River / 6.85'	Walkkill	Phillipsburg
2/28/1958	Ice Jam	Walkkill River / 7.73'	Walkkill	Phillipsburg
1/22/1959	Ice Jam	Walkkill River / 6.73'	Walkkill	Phillipsburg

Source: USACE CRREL Ice Jam Database

Extent & Severity. It is not clear if these records correctly indicate that there have been no notable ice jams since 1959, nor do the records indicate the extent of any flooding or damage which may have occurred. The lack of available data on impacts and damages makes determining the likely extent or severity of any future ice jams very difficult.

Probability of Occurrence. Using the historical data of past events, the Orange County Hazard Mitigation Plan extrapolated that a notable ice jam event occurred in the county roughly once every two to three years, however it was not clear how this determination was reached. An extrapolation of their 31 recorded events occurring over a span of 125 years would indicate they generally took place once every four years. Nonetheless, these estimates are based on a much larger study area involving over 30 incidents on many more waterways. It is far less reliable to extrapolate a probability from the six known occurrences within this smaller study area, especially considering the lack of any recorded incidents over the past 54 years. For the purposes of this study, it is assumed to be far less, and is considered to be of low probability.

Vulnerable Areas. The one recorded location area on the Wallkill River in the vicinity of Phillipsburg is the only historically known location of this event. The lack of any recurring problems being noted in over 50 years might suggest that the terrain or man-made structures which were once impeding the waterway at this location have changed or have been removed.

Wildfire

Wildfires are known as an uncontrolled burning of natural vegetation, trees and brush which can occur most commonly during the warmer drier months of the summer. They are commonly caused by human carelessness, arson or lightning. Conditions which help to allow or spread wildfires more easily include significant dry spells, winds, the presence of uninterrupted natural vegetation, steep slopes, high temperatures and low humidity. They are ranked "moderately high" as the 6th most important natural hazard in the state by the HAZNY 2009 hazard ranking. The potential risks of wildfires are expected to increase over time due to the increasingly hot, dry weather being experienced in the U.S., changing weather patterns and more homes being built in the wildland/urban interface.

Location. Areas considered to be more prone to wildfires include open, natural undeveloped lands with low population densities, or relatively little human development to break their spread.

Extent & Severity.

The Orange County Hazard Mitigation Plan estimated the relative risks of exposure to wildfires for the entire county based on the amount of urban/wildland interface area and the amount and value of improved properties. This plan noted that the longest municipal urban/wildland interface in the county was within the Town of Wallkill, at 45 miles long. These calculations for the study area are summarized in the table below.

Exposure To Wildfire Risk Assessment								
	Urban/Wildland Interface (feet)	Wildfire Risk Area – No Improved Properties (acres)	Wildfire Risk Area – With Improved Properties (acres)	Total Area (acres)	Total Area Within Wildfire Risk Zones (%)	Total Value of Improvements in Municipal Areas	Improved Value Within Wildfire Risk Zones	Improved Value Within Wildfire Risk Zones (%)
Wallkill	238,702	9,467	8,430	40,207	45%	\$2.789B	\$478.916M	17%
Middletown	48,190	191	99	3,286	9%	\$1.613B	\$67.206M	4%
TOTAL	286,892	9,658	8,529	43,493	54%	\$4.402B	\$546.122M	21%

Source: Orange County Hazard Mitigation Plan 2011

Winter Storm

Location. Winter storms can be attributed to the entire northern portion of the United States. A specific type of winter storm known as a Nor'easter is somewhat common in this region due to its proximity to the Atlantic Ocean, which can bring significant moisture and snowfall amounts. Due to their size, no one portion of the study area is more susceptible than another.

Extent & Severity. Winter storms can include high winds, heavy snowfall, ice, hail and extreme cold hazards. The damage caused by winter storms is most commonly attributed to heavy snowfall, but damage from high winds, ice or hail is not uncommon. Secondary effects of power failures, traffic accidents and business disruption are common. According to the New York State Natural Hazard Mitigation Plan, the region of this study area experiences about 40 inches of snowfall per year.

Historical Occurrences. The Orange County Natural Hazards Mitigation Plan noted that there have been approximately 73 "significant" snow or ice events affecting the area between 1993 and May 2009. Since that time, approximately 11 new instances were found in the NOAA Storm Events database.

Winter Storm – Specific Recorded Events affecting Study Area; 2007 thru 2012				
Date	Type	Location	Deaths / Injuries	Property / Crop Damage
2/13/2007	Winter Storm	Orange County	0/0	0/0
3/16/2007	Winter Storm	Orange County	0/0	0/0
12/13/2007	Heavy Snow	Orange County	0/0	0/0
2/1/2008	Ice Storm	Orange County	0/0	0/0
2/12/2008	Winter Storm	Orange County	0/0	0/0
2/22/2008	Heavy Snow	Orange County	0/0	0/0
12/11/2008	Ice Storm	Orange County	0/0	0/0
12/19/2008	Heavy Snow	Orange County	0/0	0/0
1/6/2009	Ice Storm	Orange County	0/0	0/0
3/1/2009	Heavy Snow	Orange County	0/0	0/0
12/9/2009	Heavy Snow	Orange County	0/0	0/0
2/9/2010	Heavy Snow	Orange County	0/0	0/0
2/15/2010	Heavy Snow	Orange County	0/0	0/0
2/22/2010	Heavy Snow	Orange County	0/0	0/0
2/25/2010	Heavy Snow	Orange County	0/0	0/0
12/26/2010	Blizzard	Orange County	0/0	0/0
1/11/2011	Heavy Snow	Orange County	0/0	0/0
1/18/2011	Winter Storm	Orange County	0/0	0/0
1/26/2011	Heavy Snow	Orange County	0/0	0/0
10/29/2011	Heavy Snow	Orange County	0/0	0/0

Source: NOAA Storm Events database.

There have been three snow-related Emergency Declarations affecting the study area in the past 30 years, and one Disaster Declaration.

Nor'easters. Due to the somewhat ambiguous nature of a nor'easter, historical research on these specific events can be difficult, since they are not consistently classified as nor'easters in all weather records. The Orange County Hazard Mitigation Plan noted five particular nor'easter events in the period between December 1992 and April 2007, however only three of these occurred during the winter. Since that time, there have been no storms affecting the study area which are specifically classified as "nor'easters" in the National Weather Service Weather Event Archive.

Ice Storms. According to the Orange County Natural Hazards Mitigation Plan, this region experienced 11 ice storm events in the period between 1993 and 2009. Since then, no additional accounts have been found in the NOAA Storm Events database.

Probability of Occurrence. The probability of occurrence for additional severe storms and Nor'easters is considered relatively high, with approximately three to four happening per year for the past few years. This trend is expected to continue or potentially worsen with severe weather patterns resulting from progressive climate change.

Vulnerable Areas. The primary areas of high vulnerability for wildfires to occur is in the non-urban areas with a high amount of forestry to fuel a fire, and residential properties and population to be placed at risk. While much of the Middletown City area and points east are heavily urbanized and considered low risk, the remainder of the study area is considered moderate to higher risk of starting a wildfire. Hiking and camping areas where people may light fires in densely wooded areas are also significantly vulnerable. The zones where the wooded areas and urban areas meet (the urban-wildland interface) are considered the most vulnerable due to the presence of improved property and increased chance of a fire starting from debris burning or other human negligence. With the comparatively rural areas in the Town of Wallkill surrounding the more densely populated urban areas of Middletown, this creates the largest urban-wildland interface in the county. The areas of highest vulnerability include the rural areas which surround the developed portions of City of Middletown, the Town of Wallkill east of the city and the Highland Lakes State park further east.

Hurricane / Tropical Storm

Location. Due to their nature and size, hurricanes and tropical storms would be expected to impact the entire study area at once, although some areas would be more prone to the side-effects of flooding and high winds, which are covered in more detail in separate sections. In most cases, hurricanes which reach the inland region of the study area are often downgraded to tropical storms, and commonly have a reduced effect.

Extent & Severity. The severity of a tropical storm or hurricane is measured by the five categories of the Saffir-Simpson Scale, as illustrated in the table below, with tropical storm levels included for comparison.

Wind Speed Scales and Damage Descriptions			
Wind Speed	Saffir-Simpson Hurricane Scale	Tornado Scale	Damage Description
40-72 mph 35-62 knots	Tropical Storm (39-73 mph)	F0	Minimal damage; Broken signs, tree branches, windows.
73-112 mph 63-97 knots	Category 1 (74-95 mph) Category 2 (96-110 mph) Category 3 (111-130 mph)	F1	Moderate damage; Roof shingles torn off, small outbuildings or mobile homes pushed over, trees broken.
113-157 mph 98-136 knots	Category 4 (131-155 mph) Category 5 (155+ mph)	F2	Considerable; Roof frames torn off homes, large trees broken or uprooted, weak foundation structures tipped over or demolished.
158-206 mph 137-179 knots	Category 5 (155+ mph)	F3	Severe; Trees in forests uprooted, heavy cars lifted or thrown, roofs and walls torn from buildings.
207-260 mph 180-226 knots	<i>Hurricanes not likely to reach these speeds</i>	F4	Devastating; Cars thrown and demolished, houses and buildings leveled, trees uprooted and thrown, large damage from flying missile debris.
261-318 mph 227-276 knots	<i>Hurricanes not expected to reach these speeds</i>	F5	Incredible; Strong structures and cars lifted and carried considerable distances and disintegrated.

Historical Occurrences. The Orange County Natural Hazards Mitigation Plan noted that two category 1 hurricanes and 15 tropical storms have tracked within 65 miles of the study area since 1861, 5 of which passed directly over the county. Due to their size however, the study area is often affected by hurricanes and tropical storms which pass much further away. A summary of notable hurricane and tropical storm related events which have impacted the study area since 1950 is provided below.

Noted Hurricane-Related Events Affecting Study Area: 1950 - 2012				
Date	Name	Deaths/Injuries	Damages	Category at Landfall (or) Category When Impacting Area
Aug 25, 1954	Carol			Category 3
Aug 7, 1955	Diane			Category 1 / Tropical Storm
Aug 29, 1960	Donna			Category 3 / Tropical Storm
Aug 20, 1971	Doria			Tropical Storm
June 23, 1972	Agnes	24/unknown	\$750m	Tropical Storm
Aug 6, 1976	Belle			Category 1 / Tropical Storm
Aug 25, 1979	David			Tropical Storm
Sept 16, 1985	Gloria			Category 3 / Hurricane
Aug 21, 1988	Chris			Tropical Depression
Aug 16, 1991	Bob			Category 2 / Hurricane
Aug 14, 1994	Beryl			Tropical Depression
Jul 5, 1996	Bertha			Tropical Storm
Sept 7, 1999	Floyd		\$62m	Tropical Storm
Sept 18, 2004	Ivan		\$15m	Tropical Depression
Aug 28, 2008	Hanna			Tropical Storm
Aug 21, 2011	Irene			Category 1 / Tropical Storm
Sept 13, 2011	Lee			Tropical Storm
Oct 22, 2012	Sandy			Major Hurricane / Extratropical

Sources: National Weather Service North Atlantic Hurricane Tracking Charts; Orange County Natural Hazards Mitigation Plan. Deaths, injuries and damages include figures from outside of the study area.

Of particular note, Tropical Storm Agnes, Hurricane Floyd, Tropical Depression Ivan, Hurricane Irene, Tropical Storm Lee and Hurricane Sandy were all responsible for Major Disaster Declarations within Orange County.

The primary concern with hurricanes in this study area is from flooding. Wind damage directly from a hurricane is expected to be somewhat minimal due to Wallkill and Middletown's inland location. Wind damage from secondary tornados associated with a hurricane is potentially more damaging, but nearly impossible to predict. As such, the hazard assessment associated with flooding serves also as the hazards assessment associated with hurricanes and tropical storms.

Probability of Occurrence. The Orange County Natural Hazards Mitigation Plan estimated that the county is within a region which can expect a roughly 12% chance of being affected by a "named storm" in any given year. The likelihood of such impact is inverse to the relative strength of the storm: with a 6% chance of a category 1 storm; a 2.5% chance of a category 2 storm; and a 1.5% chance of a category 3 storm. Despite these apparently low mathematical chances, it must be remembered that significant damage has occurred to the study area from tropical storms and depressions which rank below these strength categories and which would appear to take place historically about once every 3 or 4 years. The damages typically sustained at the inland region of the study area are often driven by the substantial rainfall amounts generated, rather than the strength of the winds. The damages recently experienced during Irene, Lee and Sandy are examples of this.

For the past 3 years, the Atlantic region has generated 19 storms each hurricane season, the third most active periods on record since 1851. The most active hurricane season on record was in 2005, with 28 storms. It might also be noted that Colorado State University researchers announced in April 2013 that the 2013 hurricane season was estimated to be "above average", with the chances of a major (Category 3 or greater) hurricane striking the U.S. at 72%, compared to the average of 52%. It is believed that the potential frequency and intensity of such storms may be expected to increase due in part to climate change trends.

Vulnerable Areas. Because of the size and widespread nature of hurricanes, no one portion of the study area is considered more susceptible than others.

Extreme Temperatures

Location. Due to their nature, extreme heat events would be expected to cover the entire study area at once.

Extent & Severity. The potential impact of an extreme heat event would most likely affect certain populations such as the elderly, infants or the homeless, which would have an increased risk of heatstroke, heat exhaustion or death. These can also create a cascade effect of power outages, often caused by the high electricity demand for cooling. Extreme heat events typically have a greater impact in urban metro areas where deaths are more common, especially when compounded with power outages. Similar to drought events, it can also have a negative impact on agriculture, fish and wildlife as well as a slightly increased chance for fires. According to NOAA, heat events have caused the second most weather-related fatalities over the past ten years—second only to hurricanes—and were the number one cause in 2010.

According to a 2010 analysis by the NYS Office of Emergency Management, Orange County ranked as one of the counties with the lowest percentage of population which is vulnerable to extreme temperatures, with approximately 10% at 65 or older, and 7% younger than age 5—the two age groups considered most vulnerable to extreme temperatures—for a combined population of about 17% of the total. The overall impact of these events is relatively minimal however, with very few injuries, deaths or damages being reported as a direct result of such events in this area.

Historical Occurrences. According to the Orange County Hazard Mitigation Plan, there have been no Federal Disaster or Emergency Declarations due to extreme heat. No additional instances since that report could be found.

Extreme Heat Events in Orange County – 1999 - 2012				
Date	Deaths	Injuries	Property Damage	Crop Damage
7/4/1999	0	0	0	0
8/8/2001	0	0	0	0
8/1/2006	0	0	0	0
7/22/2011	1	0	0	0
7/18/2012	0	0	0	0

Sources: Orange County Natural Hazards Mitigation Plan; NOAA Storm Events Database.

Probability of Occurrence. The probability of future extreme heat events within the study areas is somewhat high. The Orange County Natural Hazard Mitigation Plan noted that historically, New York State experiences extreme heat events 1.4 times per year, and within Orange County that number is approximately 0.8 times per year.

Vulnerable Areas. Because of the widespread nature of extreme heat, no one portion of the study area is considered more susceptible than others.

Drought

Location. Due to their nature, the extent of drought conditions would be expected to cover the entire study area and beyond. The particular study area of this mitigation project is located within "Drought Region II" (Catskills) by the New York Department of Environmental Conservation.

Extent & Severity. Potential drought impacts would be primarily to the local agricultural industry in the rural areas of the Town of Wallkill, potentially affecting the City of Middletown to a lesser extent due to their lack of farming operations. Agricultural output losses would be expected. An extended drought could also have an impact on aquifer recharge and groundwater wells. Although most of the land area in the Town of Wallkill relies on groundwater wells, municipal water service is provided to a majority of the study area population. The potential impact on business and industry would be a restriction on water usage, which could affect manufacturing output. Similar impacts or stress on the local fish and wildlife would be expected. The 1988 NYS Drought Plan identified that Orange County had the most number of "drought vulnerable community water systems" of 18, followed by Essex County with 16 and adjacent Ulster County with 11.

Historical Occurrences. At the time of this writing, reliable information on drought events from the National Climate Data Center database was unavailable. However, according to the NYS Drought Plan (1988), significant drought events occurred in 1980-81 and 1984-85 which prompted a revision of the state plan and new requirements for drought emergency plans to be developed. It is noted that the 1984-85 drought was declared a disaster emergency which directly affected Orange County, among others. By October of 1985, 14 of the 20 public water supply systems in Orange County had developed and endorsed drought emergency plans. The Orange County Hazards Mitigation plan noted that there were significant droughts in May of 1964 to September 1966; August to December 1993; and November 2001 to October 2002.

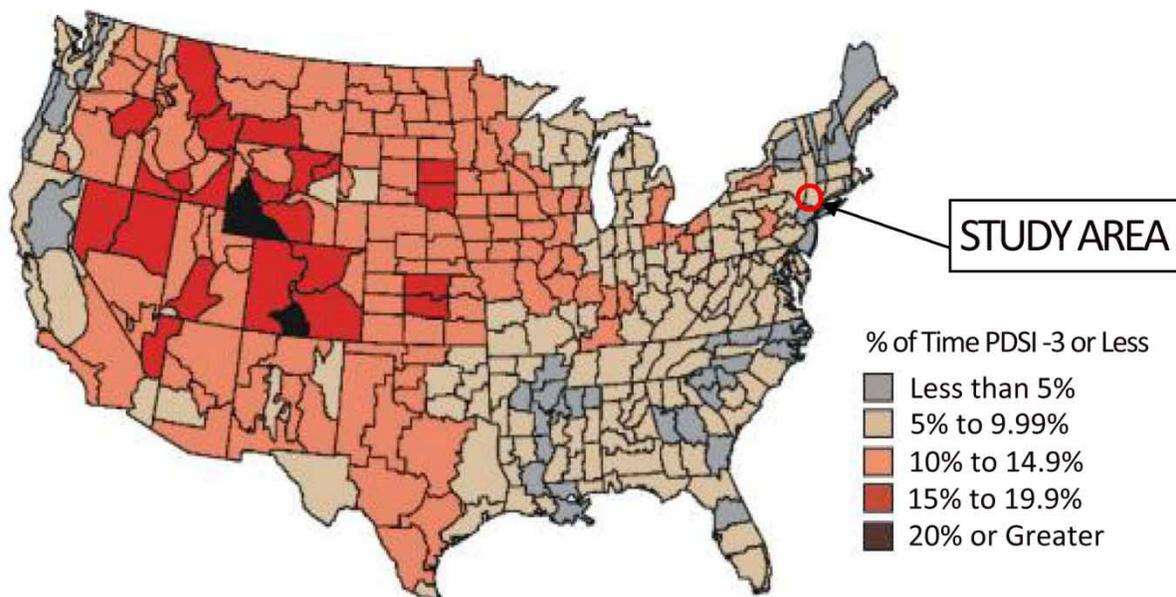
The occurrence of droughts can be indicated through a number of different measurements, including precipitation amounts, soil moisture conditions and reservoir/water levels. The following table identifies droughts ranking as severe or extreme which have occurred in the Hudson Valley region (including much of Orange County), based on measurements of meteorological records. Based on this table, a severe or extreme drought has occurred in the Hudson Valley region approximately 15 times since 1895, or about once every 7.4 years.

Severe Drought History in Hudson Valley Region – Based on Meteorological Records 1895-2006			
Start Date	End Date	Duration	Severity (PDSI)
Nov 1908	Jan 1909	3 months	-3.50
Nov 1909	Dec 1909	2 months	-3.61
Oct 1910	Jan 1911	4 months	-3.20
Apr 1911	July 1911	4 months	-4.02
Dec 1930	Jan 1931	2 months	-3.15
Oct 1941	Feb 1942	5 months	-3.76
Apr 1942	May 1942	2 months	-3.12
Oct 1949	Dec 1949	3 months	-3.97

Aug 1957	Nov 1967	4 months	-3.54
Oct 1963	Dec 1963	3 months	-3.74
May 1964	Sept 1966	29 months	-6.66
Jan 1967	Feb 1967	2 months	-3.13
Apr 1985	May 1985	2 months	-3.38
Aug 1995	Set 1995	2 months	-3.14
Dec 2001	Feb 2002	3 months	-3.60

Source: Northeast Regional Climate Center, Cornell / NIEHS Superfund Research Center, Columbia University. PDSI is the Palmer Drought Severity Index. Values between -3.0 to -3.99 indicate severe drought. Values beyond -4.0 indicate extreme drought.

Probability of Occurrence. It is difficult to obtain long-term drought predictability trends data, particularly in the more moderate climate of the northeast. Scientists do not currently know how to predict a drought more than a month in advance, and for this reason drought predictions are typically provided in weekly event monitors. However, the Palmer Drought Severity Index Summary Map of the United States has tracked these event monitors overall for the period between 1895 to 1995, as shown below.



This summary map indicates that the study area is within a region which has typically experienced severe to extreme drought conditions between 5% and 10% of the time over the course of the 100-year period. This would suggest that drought conditions are a relatively low risk. It should be noted however that less severe drought conditions may be possible more frequently, and that the potential frequency of drought events overall could increase due to climate change.

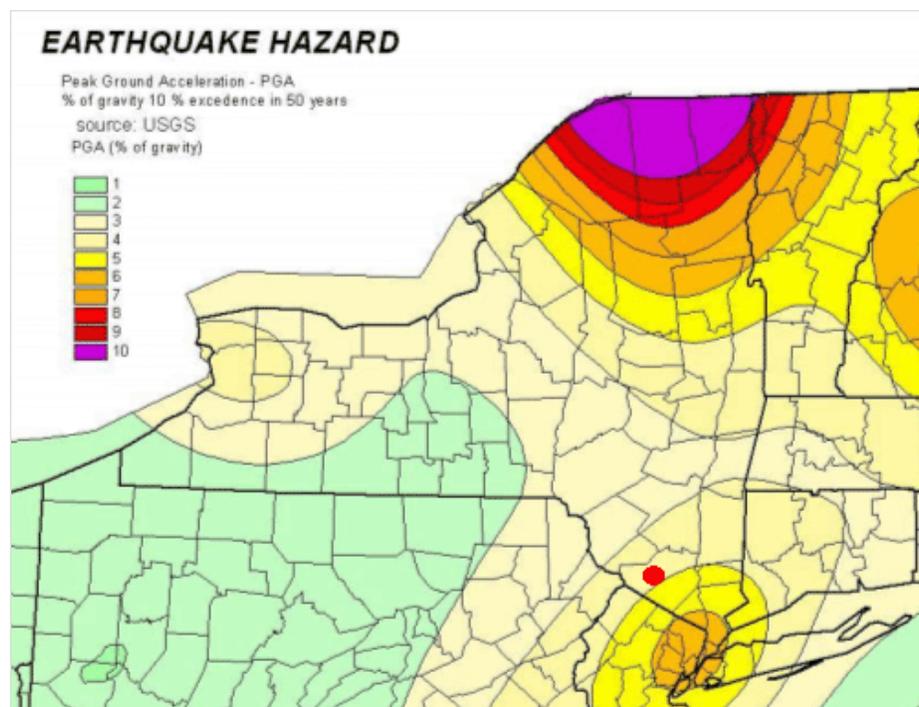
Vulnerable Areas. Because of the widespread nature of drought, no one portion of the study area is considered more susceptible than others.

Earthquakes

Location. Due to their nature, earthquake events would be expected to affect the entire study area, with no one area being particularly likely to experience an earthquake over another. However, local soils conditions may amplify or dampen an event somewhat.

Extent & Severity. The minimum intensity of an earthquake that the Hazus software will evaluate is a magnitude 5.0, which historically have not occurred in the immediate region. In fact the nearest historical occurrence of a magnitude 5.0 or greater was a 5.2 earthquake located approximately 48 miles south-southeast, centered near North Bergen, NJ, across the river from Manhattan. Based on this information two scenarios were run with the Hazus software, the first a probabilistic model, and the second an historical occurrence model. Not surprisingly, for the probabilistic method the software predicted no damage

would occur in the study area from an earthquake over a 100 year period. Using the historical occurrence method however, based on the NJ earthquake, minor damage to the southernmost portion of the study area was predicted, totaling approximately \$73,000 in damages. Damage prediction was primarily in the City of Middletown, and east of Middletown. No loss of life or significant damage to infrastructure was predicted however.



Historical Occurrences. Based on the USGS NEIC Earthquake Database, there have been no recorded earthquakes of magnitude 3.0 or larger in the immediate vicinity of Wallkill or Middletown. Although there have been earthquakes of lesser magnitude in the vicinity, these are generally considered to be too weak to cause notable damage for the purposes of this study.

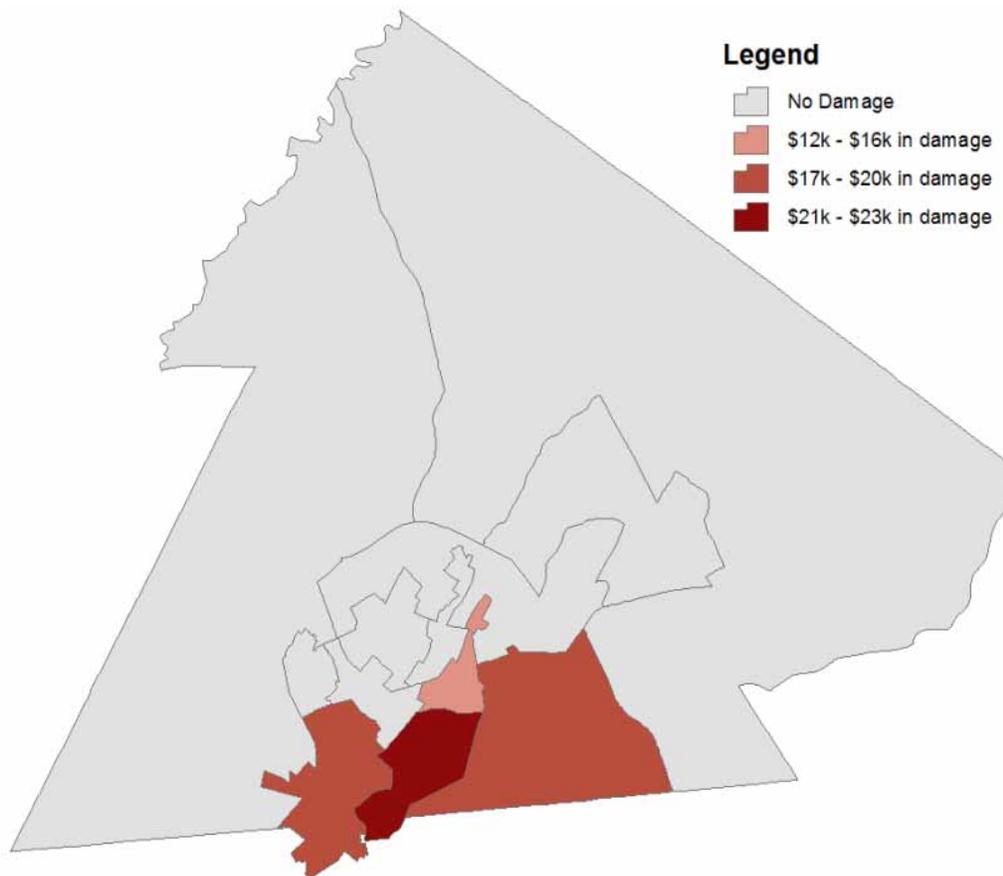
Vulnerable Areas. Because of the widespread nature of earthquakes, no one portion of the study area is considered more susceptible than others, however soil conditions can amplify or dampen the effects. A majority of the study area is composed of rock and harder soils which would dampen these effects, except for small areas just east of the City of Middletown.

Earthquake Data – Historical Earthquake Events within 35 km of Study Area				
Date	Latitude	Longitude	Distance from center of Wallkill	Magnitude
3/5/1978	41.35	-74.15	26 km	2.1
4/20/2003	41.36	-74.37	15 km	2.3
3/14/2008	41.34	-74.45	18 km	2.3
3/15/2008	41.34	-74.46	18 km	1.9

Source: USGS NEIC Earthquake Database

Probability of Occurrence.

The 2011 Orange County Natural Hazard Mitigation plan states that the “earthquake hazard is relatively low but essentially uniform across the County. Therefore, according to the currently available earthquake hazard mapping of New York State, there is a 10 percent chance over 50 years that an earthquake with a minimum [Peak Ground Acceleration (PGA)] of 3%g to 4%g will be centered within Orange County and its component jurisdictions. This earthquake, if it did occur, would likely have associated with it light to moderate perceived shaking and little to no significant damage.” A PGA of 1.4 to 9.2 is generally associated with a magnitude 4.0 to 4.9 earthquake, which generally results in little to no significant damage.



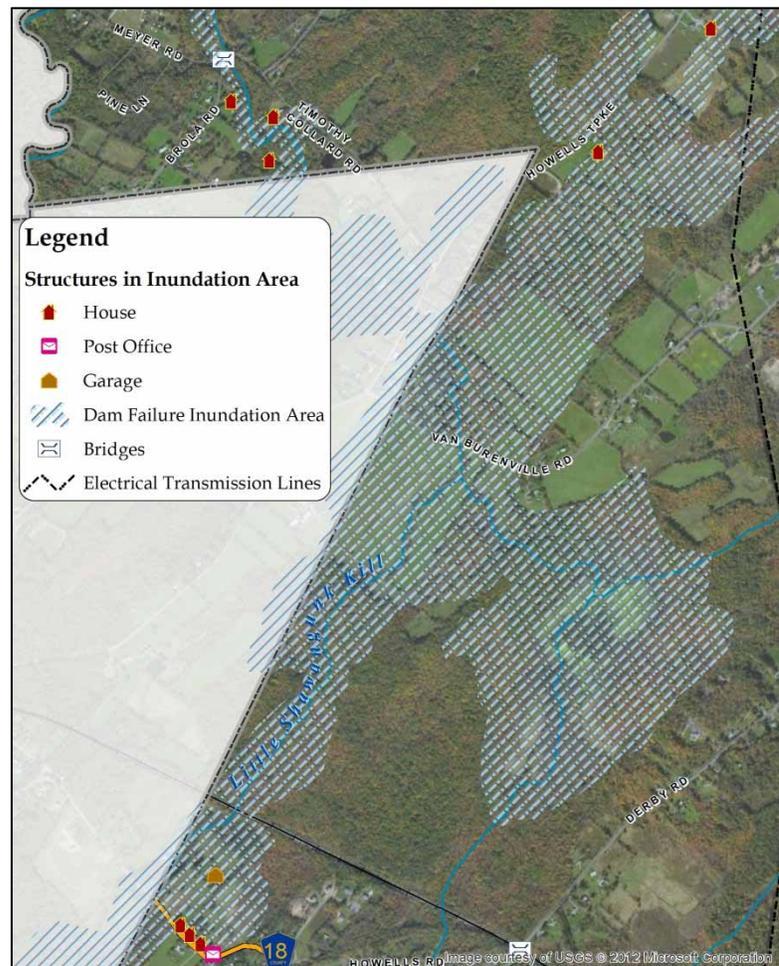
Damage predicted from a magnitude 5.2 earthquake located near NYC.

Dam Failure

Location. There were 24 individual dams located within the study area of this project, 21 of which were categorized as "low hazard" (Class A), 2 of which were categorized as "moderate hazard" (Class B) and one which is categorized as "high hazard" (Class C). None of the dams within the study area are classified as "major dams" based on their height or storage capacity. Other dams outside of the study area which have projected inundation within the project limits include the Woodward Dam in Mount Hope. For security purposes, the map indicating the location and hazard ranking of each individual dam within the study area has been omitted.

Extent & Severity. Inundation mapping was included as part of the Orange County planning process, and indicates the northwest edge of Wallkill could experience flooding as a result of a breach of the Woodward Dam/Greenleaf Dike in the Town of Mount Hope. Based on the mapped data provided, it is estimated that eight houses, one garage/barn, and one US Post Office could be impacted within the town boundaries of Wallkill by a failure of the Woodward Dam/Greenleaf Dike. These structures have a combined market value of approximately \$1.7 million based on 2012 assessment data. Additional structures outside the boundary within the Town of New Hope would be impacted, but have not been estimated for this report. However, the Orange County Natural Hazards Mitigation Plan estimated the total improved value of all exposed properties – including those outside the study area - to be in excess of \$7.9 million.

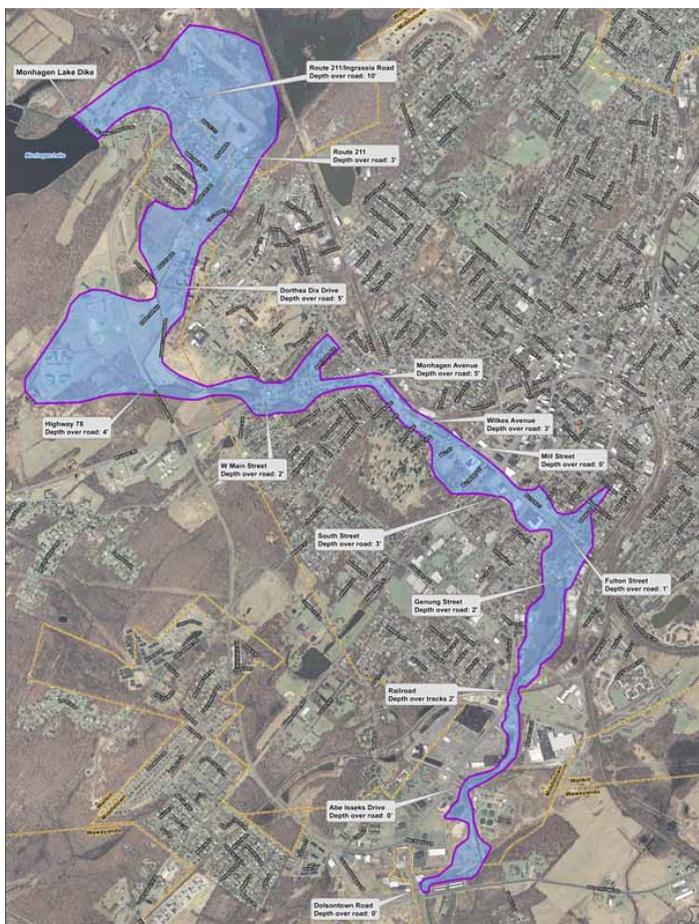
Within the Town and City limits there is one dike considered to be a "high hazard" and that is the Monhagen Lake Dike, constructed in 1867. This dike—in conjunction with a dam of the same name—are owned by the City of Middletown and contain the primary water supply for the city. The lake is approximately 65 acres in surface area, with a normal storage capacity of 630 acre feet and a maximum storage capacity of 825 acre feet. By comparison, the



Inundation area and potential structures affected by a failure of the Woodward Dam/Greenleaf Dike. Inundation area extrapolated from Figure 3a.11 of the 2011 Orange County Natural Hazard Mitigation plan.

Woodward Dam/Greenleaf Dike, a moderate risk dam, has nearly double the water storage of the Monhagen Lake Dike, with normal and maximum storage of 1,332 and 1,633 acre feet respectively.

Although the Monhagen Lake Dam is currently considered a moderate hazard dam, a November 2012 inspection letter by the NYS DEC noted that because the dam and dike have nearly identical inundation areas, the dam should be re-classified as "high hazard", but suggests that this re-classification should not occur right away to avoid confusion, since there had recently been a reclassification. The Monhagen Lake Dike was reclassified from "Moderate Hazard" to "High Hazard" in 2008 because of the potential for a breach to cause serious damage to State Route 211. The Orange County Natural Hazards Mitigation plan did not profile this dam or the dike, likely because both structures were classified as a moderate hazard at the time that plan was being developed.



Inundation area estimated by a failure of the Monhagen Lake Dike, taken from the Emergency Action Plan at the Monhagen Lake Dike.

A copy of the Emergency Action Plan (EAP) for the Monhagen Lake Dike, updated in 2010, was obtained and reviewed as part of this report. The EAP calculated three levels of failure, including a "worst-case scenario" involving the complete failure of the dike during a rainstorm and the potential downstream flooding. Under this scenario, flooding would be experienced northeast of the dike across State Route 211 to the rail line, then travelling south/southwest affecting Pilgrim Estates, Monhagen Middle School, Maple Hill Elementary, down West Main Street through the City of Middletown along Fulton Street and Genung Street to the city line with Wawayanda. Notable projected water depths at key roadways include: ten feet at Route 211 and Ingrassia Road, five feet at Dorthea Dix Drive; four feet at County Highway 78 and five feet at Monhagen Avenue. This flood profile would likely mimic the flood area and path of the 100-year flood along Monhagen Avenue and Fulton Street.

The EAP outlines a specific process by which the dike is to be monitored and specific steps which should be followed if different levels of failure are observed to be imminent. In the worst case scenario, a chain of command notification system has been established for the evacuation of the entire projected flood area involving over 500 properties.

An analysis of the inundation area estimated in the EAP showed that there are approximately 350 parcels that have improvements within the inundation area, with a total market value of approximately \$138,350,000. For properties that have multiple buildings, only the proportion within the inundation area was used for the estimate. However it should be noted that the Middletown water treatment plant just below the dam, the Middletown State Hospital Campus, and the Middletown Highway Department are within the inundation area but do not have known improvement values. Therefore the total improved value within the inundation area is presumed to be at least \$140 million.

Monhagen Lake Dike Inundation Area Analysis – Full Market Value of Properties						
# of Properties	% in Wallkill	% in Middletown	% Residential	% Commercial	% Institutional	Full Market Value
350	10%	90%	80%	16%	4%	\$138,350,000
<i>Based on 2012 tax assessment data and applicable equalization rates</i>						

It is not expected that all of the properties would be a total loss in the event of a dam failure, and therefore the actual value of *damages sustained* would be substantially less. There would however be potential damage and disruption to the nearby water treatment plant and substantial disruption to area roads and neighborhoods.

Additional Considerations. Prosperous Valley Lake spillway. The small spillway which controls water flow from Prosperous Valley Lake underneath the adjacent roadway is believed to be in need of potential repairs or replacement. The headwall, which appears to be constructed of wood planks, is heavily encased in algae and appears to be rotting. Recent flooding events from this location have caused significant downstream waterflow damage below at York Road, including residential property flooding and the washout of the roadway, causing York Road to be closed. It is believed that failure of this headwall would cause similar or more severe damage should it ever fail.

This dam currently utilizes an uncontrolled overflow spillway. An advance release of water prior to a significant rain event is not apparently feasible, but could be considered in a future upgrade



replacement.



View on the north side of Prosperous Lake Road of the water outlet from Prosperous Lake.

Historical Occurrences. According to the National Performance of Dams Program at Stanford University, there have been 43 incidents in New York State which were classified as "failure" events. A review of these records did not appear to include any dams within the study area.

Probability of Occurrence. The probability of a future dam failure event within the study area is considered to be relatively low. Historically, there have been no dam failure events reported in the past, and these facilities also undergo routine inspections and repairs which are designed to limit vulnerability.

Vulnerable Areas. The areas considered vulnerable to a dam failure have been noted in the inundation maps.

Lightning

Location. Lightning strikes can occur anywhere within the study area. Due to their random nature, it is not possible to predict where and when a lightning strike will occur, however they are almost always associated with thunderstorm activity which can be predicted in advance. Although the location of property damage strikes cannot be predicted, strikes which result in personal injury or death are most commonly found in open areas such as fields, golf courses or parks.

Extent & Severity. Lightning strikes can result in property damage, loss of power or communications, fires, injury or death. Property damage is typically relatively minor, and limited to a small area. Since 1995, lightning strikes in Orange County have been attributed to 1 fatality, seven injuries and over \$95,000 in damages.

Historical Occurrences. The Orange County Natural Hazards Mitigation Plan indicated that there have been 14 lightning events which warranted recording within the county since 1995. Since that report was published, 2 additional events were found in Michigan Corners and Middletown. A summary of the specific events within the study area is included in the table below.

Lightning - Recorded Events in Study Area – 1998 - 2012					
Date	Location	Deaths	Injuries	Property Damage	Crop Damage
6/29/1998	Wallkill	0	0	\$40,000	0
6/1/2006	Countywide / Middletown	0	0	House fires	0
6/9/2009	Mechanicstown	0	0	\$5.00k	0
6/26/2009	Circleville	0	0	\$5.00K	0
6/26/2009	Washington Heights	0	0	\$30.00K	0
8/21/2009	Michigan Corners	0	0	\$0.75K	0
5/31/2010	Middletown	0	0	\$10.00K	0

Sources: NOAA Storm Events Database, Orange County Natural Hazards Mitigation Plan.

Probability of Occurrence. The probability of continued lightning strikes within the study area is accepted as a common threat which occurs every year. According to the Orange County Natural Hazard Mitigation Plan, the county is in a region of the country which can expect about 3 to 5 lightning flashes per square mile per year. It is expected that this intensity of future lightning strikes will continue, and possibly increase, into the foreseeable future.

Vulnerable Areas. Because of the unpredictable nature of lightning, no one portion of the study area is considered more susceptible than others.

Power Failure

Location. The location of power failure events is most likely attributed to areas which are susceptible to other hazard events, causing a cascade effect which results in a power loss.

Extent & Severity. Power failures usually result in the loss of heating or cooling capability, putting population areas at risk of extreme temperature exposure, and can interrupt water supply. Power failures which interrupt traffic signal operation can cause gridlock conditions which hamper emergency service response and cause traffic accidents. Significant power failures can also cause economic loss, fuel shortages and spark civil unrest.

In the aftermath of Hurricane Sandy, the loss of electrical power to many traffic signals in the Town of Wallkill caused gridlock conditions which hampered or prevented emergency vehicle movement. Additionally, the NYSDOT "Guidelines for Traffic Signal Energy Back-Up Systems" (2009) noted that injuries at 'dark-signal' intersections are twice as likely as non-injury accidents.

Specific data on the financial cost of power outages in or around the study area is not readily available, in part because they are often the cascade result of a separate event. It is estimated however that the economic losses attributed to a significant power failure from loss of work, overtime of emergency personnel, utility response, spoiling of food and related symptoms can quickly escalate into the hundreds of thousands or millions of dollars. A post-blackout survey conducted of manufacturing businesses affected by the major August 2003 blackout concluded that a quarter of the companies were losing more than \$50,000 an hour.

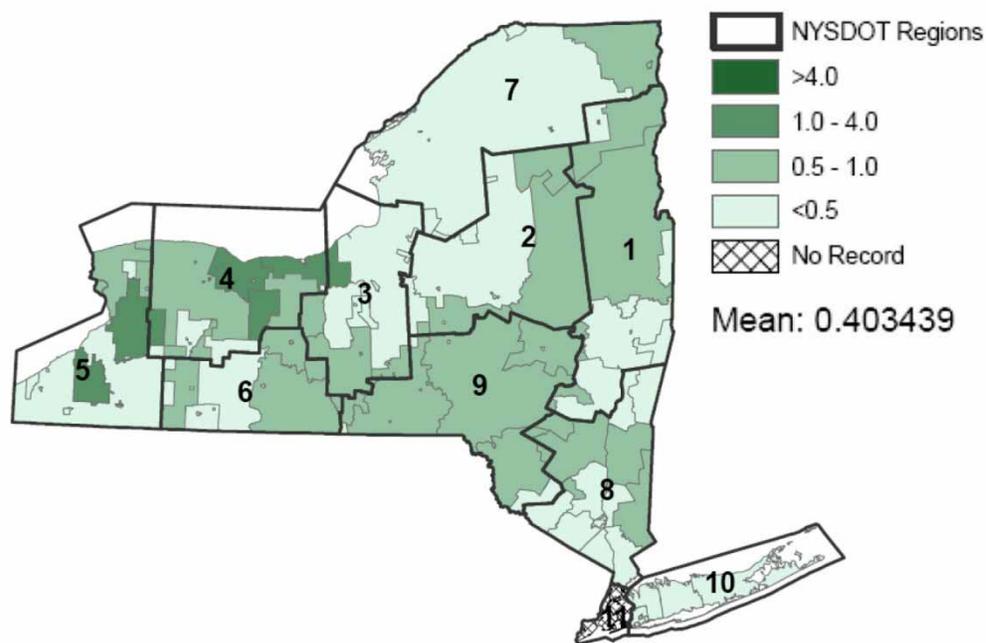
Power Failures – Top 3 reasons for Power Failure in NYS, by Utility Company

Utility Provider	Top 3 Reasons for Power Failure	
	Cause of Failure	Percentage of Failures
Con Edison / Orange & Rockland	Equipment	74%
	Tree	12%
	Accident	8%
National Grid	Equipment	26%
	Tree	23%
	(unknown)	16%
New York State Gas & Electric	Equipment	21%
	Tree	39%
	Accident	16%
Rochester Gas & Electric	Equipment	29%
	Tree	20%
	Accident	18%
Central Hudson Gas & Electric	Equipment	17%
	Tree	39%
	Accident	23%

Source: Public Service Commission, 2007 Electric Reliability Performance Report

As can be seen in the above table, equipment failures and downed trees account for the majority of power outages in New York State. These results can vary widely by region however, with trees having a higher probability of cause in rural areas compared to urbanized utility regions.

Historical Occurrences. In August of 2003, a cascading power outage disrupted electrical service across much of New York State and the surrounding region, resulting in a statewide Emergency Declaration. Orange & Rockland Utilities noted that other major outages affecting the study area would include the February blizzard of 2012, a March 2011 Nor'easter, Hurricane Irene and Lee in 2011, the Halloween snowstorm of 2011 and Hurricane Sandy in 2012. A review of power outage averages seems to indicate that the study area is in a region which experiences a relatively low number of power interruptions per person compared to many other areas of the state.



Radial event power outage hours per customer averaged between 2003 and 2006. Source: New York State DOT Guidelines for Traffic Signal Energy Back-Up Systems (2009).

Probability of Occurrence. Study of power outage instances by month have shown that power failures are more likely to occur during the summer months of June July and August, suggesting that they are more susceptible to summer storms than to winter storms. It is expected that power failures will continue to be a recurring problem in the study area much as they have been in the past. Ongoing efforts by the local utilities to develop response drills, continue tree trimming operations and other efforts will help to reduce their frequency or duration slightly, as will an increased use of emergency generators. The extent and severity of power failures could potentially increase in the future if storm severity or frequency increases with climate change.

HAZARD SUMMARY RANKINGS

PRELIMINARY HAZARD SUMMARY BY MUNICIPALITY

Summary Table – Natural Hazard Threat Assessment <i>Summary of estimated potential damages over a 5-year period, by municipality (where available)</i>				
Municipality	Town of Wallkill	City of Middletown	Probability of Occurrence	Estimated Potential Impact
Hazard				
Flood (100 year flood)	\$811,850	\$1,651,250	High	Significant
Winter Storm	Unavailable	Unavailable	High	Significant
Severe Storm	\$120,000			
Hurricane / Tropical Storm	Unavailable	Unavailable	Medium	Significant
Lightning	\$521	\$301	High	Negligible
Power Failure	Unavailable	Unavailable	High	Negligible
Extreme Wind	\$182,500		Medium	Significant
Wildfire	Unavailable	Unavailable	Medium	Significant
Drought	\$85,993	\$0	Medium	Significant
Ice Jam	Unavailable	Unavailable	Medium	Negligible
Dam Failure	Unavailable	Unavailable	Medium	Negligible
Extreme Temperatures	Unavailable	Unavailable	Medium	Negligible
Tornado	\$258,300	\$178,620	Low	Significant
Earthquake	\$36,714	\$21,237	Low	Significant
<i>Data based on prior recorded damages (where available); Summary of Annual Damage Estimates – Orange County Natural Hazards Mitigation Plan; Estimates of number of facilities within delineated hazard areas. Flood damage calculated at 100-year flood damage rate multiplied at 0.05% chance of occurring in 5 year period.</i>				

RISK AND LOSS ASSESSMENT RANKINGS

In order to assess the variety of potential threats from the different hazards, a summary ranking table was established which identified the most common hazards which had the greatest potential impact to human safety, critical infrastructure and property. Many of the hazards which are profiled in this plan cannot be delineated on a map – we cannot predict where they may strike or how large and area they may affect – and are therefore very difficult to quantify in terms of likely costs. In some cases, area-wide hazards do not typically cause damage to infrastructure and buildings, such as in the case of drought or extreme temperatures. For this reason, these hazards cannot easily be quantified or ranked in terms of potential impact the ways the delineable ones can. Therefore, in order to compare these threats to each other, a modified version of the HIRA (Hazard Identification and Risk Assessment) scoring program was utilized.

For each profiled hazard, consideration was given to the likely location, extents, impact of an event, previous occurrences and probability of recurrence.

This assessment process profiles five considerations—detailed below—as follows; Scope of affected area, Frequency of occurrence, Impact, Warning time and Duration. These five considerations are

further detailed in some instances to assess the likelihood of a hazard triggering another hazard (the "cascade effect"), potential impacts to private property vs. municipal infrastructure and the estimated amount of time to recover from the hazard. Each potential result was given a weighted points system (lowest points attributed to lowest risk / highest point attributed to highest risk) and scored individually for each hazard. The results of this scoring and ranking system are provided in the chart following the scoring profiles.

HAZARD RANKING SYSTEM SCORING PROFILES

SCOPE OF HAZARD	
Likely Affected Area	Description of Criteria
Single Location / "Street level" area	Likely to only occur in a single, isolated area. Produces lowest score.
Several Locations / "Neighborhood level" area	Likely to occur in several individual locations or affect an entire neighborhood.
Regions / "District level" area	Likely to affect a large region or district within the town.
Very Large Regions / "Town wide" area	Likely to affect very large regions or the entire town. Produces highest score.
Potential For Cascade Effect	
No, Highly unlikely	Cannot, or very unlikely hazard could trigger another hazard.
Yes, Some potential	Some potential for hazard to trigger another hazard.
Yes, Very Likely	Very likely hazard could trigger another hazard.

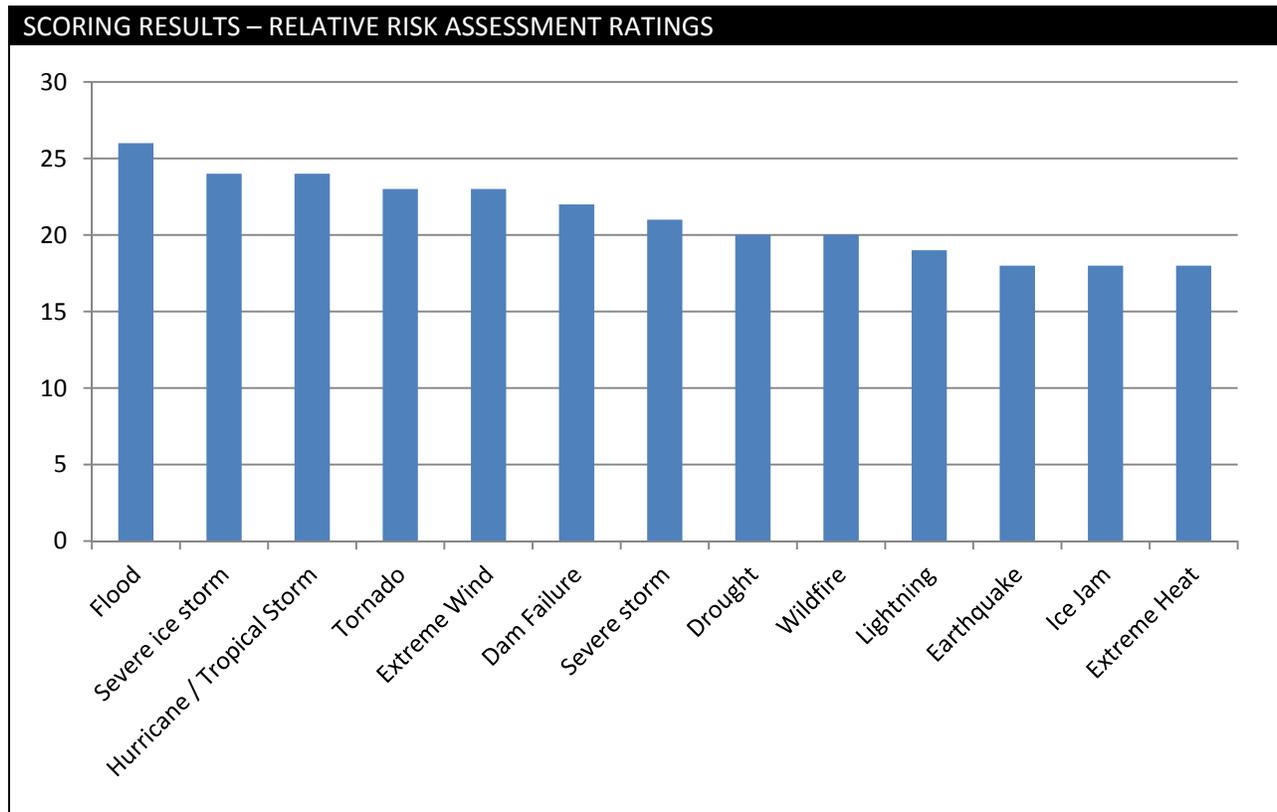
FREQUENCY OF HAZARD	
Estimated Potential Frequency	Description of Criteria
Rare	Occurs only once every 50 years or more.
Infrequent	Occurs only once every 8 to 49 years.
Regular	Occurs only once every 1 to 8 years.
Frequent	Occurs more than once a year.

IMPACT OF HAZARD

Population, Health and Safety	Description of Criteria
Injury or death unlikely	Serious injury or death unlikely. Serious injuries classified as those which would require immediate medical attention to prevent loss of life or permanent bodily injury.
Injury or death possible	Serious injury or death possible, but injured can be adequately treated through the normal operations of local medical system.
Injury or death possible in large numbers	Serious injury or death possible, but in numbers which could challenge response capacity of local medical system.
Injury or death likely in very large numbers	Serious injury or death possible in numbers which would overwhelm response capacity of local medical system and require outside assistance.
Private Property Damage	
Little or no structural damage	Very minor or no structural damage expected.
Moderate structural damage	Moderate structural damage expected.
Severe structural damage	Severe structural damage expected.
Community Infrastructure Damage	
Little or no structural damage	Very minor or no structural damage expected.
Moderate structural damage	Moderate structural damage expected.
Severe structural damage	Severe structural damage expected.

WARNING TIME	
Estimated Potential Warning Time	Description of Criteria
A week or more of warning time	Estimated amount of time between the initial recognition of a threat and the time when the hazard begins to affect the area. Larger durations given lower score.
Several days of warning	
One day of warning	
Several hours of warning	
No warning	

DURATION OF HAZARD AND RECOVERY	
Duration of Hazard	Description of Criteria
Less than one day	Estimated amount of time which a hazard would remain active. Shorter durations given lower score.
One day	
Two to three days	
Four to seven days	
A week or more	
Emergency Recovery Time	
Less than one day	Estimated amount of time emergency operations would continue after the hazard has ended. Shorter durations given lower score. Does not include overall time the community would need to fully recover and repair all damages to return to normal operations.
One to two days	
Three to seven days	
One to two weeks	



The results of the Risk Assessment scoring indicate that Flooding is the predominant threat. This is followed by Ice Storms, Hurricanes and Tropical Storms. Tornadoes, although unlikely, scored high due to their potential damage, along with high winds.

RISK AND LOSS ASSESSMENT CONSIDERATIONS. The above methodology of risk and loss assessment has been chosen for a variety of reasons. While an "apples-to-apples" comparison of recorded damages from each hazard type would seem to be a very logical approach to determining relative hazard threats, this approach suffers from several shortfalls. First, the available data on prior damages from hazard events is very spotty and inconsistent. Damage estimates are available for *some* events, and for *some* types of hazards, but not all. In many cases, these damage figures range from local estimates, to county-wide, to state-wide or regional. For this reason, comparing the damage estimates for two or more different types of hazards—or even two different events of the same hazard type—will produce skewed results. Secondly, in some cases the damages recorded are cascaded from one hazard type to another. For example, the damage estimates from a hurricane would also include the damages resulting from flooding. For this reason, comparing these two types of events side-by-side would result in erroneous figures, and would skew their relative threats.

SECTION V - EXISTING CAPABILITIES AND RESOURCES

In order to understand the potential threats to a community, one must also make an assessment of their existing capabilities to avoid future problems, handle events, and coordinate between departments. The purpose of this section is to identify municipal capability and policies which are in need of improvement with regard to hazard mitigation. The following capabilities and resources were measured:

Building Code. Local building codes provide a municipality with basic construction standards for health and human safety. They can also be specialized to require stricter standards in certain areas of town which may have special requirements, and therefore can be used as a mitigation tool to protect against known hazards. Both municipalities utilize a building code.

Comprehensive Plan. A comprehensive plan acts as an overall vision and guidance document for a municipality as it grows to plan ahead for future needs. Any official policies regarding land use, such as zoning, must comply with the intent of the comprehensive plan, and therefore it is a useful long-term strategy guide for mitigation planning. Both municipalities utilize a comprehensive plan.

Capital Improvements Plan. A capital improvements plan is used to schedule the long-term spending and budget allocations for known municipal expenditures, such as planned roadway improvements, emergency services needs and other improvements. It acts as a financial blueprint for longer-term financing which often runs the course of multiple administrations, and is therefore useful for planning long-term purchases, such as mitigation upgrades. The Town of Wallkill has a capital improvements plan which is in progress, but not yet fully implemented.

Emergency Response/Action Plan. Emergency response plans allow municipalities to anticipate a potential emergency and plan contingency responses ahead of time, allowing staff to train and practice drills in advance. The City of Middletown has an Emergency Action Plan, as well as a Water Supply Emergency Response Plan and an active EAP for the Monhagen Lake Dike. The Middletown School District also has a district-wide safety plan in place. The Town of Wallkill OEM has an emergency response plan, as well as the Water & Sewer Department.

Emergency Alert System. Emergency alert systems can vary in complexity, from a simple local siren to a complex notification system which directly notifies people in areas of danger. The Town of Wallkill has in operation a "reverse-911" public safety alert system which can notify residents via email, pager or text message of dangerous situations. This is a very robust system, however it relies on residents to voluntarily sign up to receive notifications. Additional sign-up would expand its reach. The City of Middletown does not have a similar system in place, and experienced trouble broadcasting emergency alerts and declarations during tropical storms Irene and Lee. Additional coordination with the school district and Time Warner Cable is needed in order to obtain direct access to a public access channel for such emergencies.

Floodplain Regulations. A specialized part of the municipal and zoning code which can be used to mandate specific standards which must be met in areas which are prone to flooding.

Standards may include stronger foundation engineering, increased first floor height or other restrictions. Very useful in reducing flood damages. Both municipalities have adopted Flood Damage Prevention codes which are tied to the National Flood Insurance Program (NFIP) maps.

Floodplain Administrator. A full or part time position in municipal government which is tasked with keeping up to date on the latest flood prevention requirements, flood mapping information and ensuring that both new and existing development is protected from flood damage. Both municipalities have a full-time employee who also acts as the designated Floodplain Administrator.

Real Estate Disclosure Code. A real estate disclosure clause requires the sale or transfer of real estate to inform the new owners of any known hazards which the property may be subject to, such as within a known flood plain.

Site Plan Review. Site plan review procedures allow a municipality to review and amend proposed developments with regard to building size, location, drainage and other characteristics. This allows for some on-site mitigation by relocating elements where they would be better suited. Both municipalities utilize a site plan review process.

Subdivision Code. Subdivision ordinances regulate how land is divided up into individual properties for future development, and can regulate specific provisions which go with the land. Both municipalities have a subdivision code, and the Town of Walkkill has a Conservation Subdivision Code, which allows for additional land conservation which can provide additional flood control potential.

Zoning Code. Zoning codes regulate the placement, density and uses of the land areas within a municipality, and are therefore one of the most direct tools which can be used for disaster mitigation. Both municipalities have a zoning code in place.

Capabilities & Resources - Summary		
Mitigation Resources	Town of Walkkill	City of Middletown
Building Code	Yes	Yes
Comprehensive Plan	Yes	Yes
Capital Improvements Plan	In Progress	Yes
Emergency Response Plan	Yes	Yes
Emergency Alert System	Yes	No
Floodplain Regulations	Yes	Yes
Floodplain Administrator	Yes	Yes
Real Estate Disclosure Code	No	No
Site Plan Review	Yes	Yes
Subdivision Code	Yes	Yes
Zoning Code	Yes	Yes

In summary, both municipalities have most of the capabilities and resources commonly needed to help mitigate damage, however, there is some room for improvement. Expansion of the emergency alert system and adoption of a real estate disclosure code would be recommended. While both municipalities have a Floodplain Administrator, these positions could be improved by having the administrators certified. Likewise, joining and participating in activities as part of the NFIP Community Rating System would benefit both municipalities. The periodic review and update of the local floodplain management programs and monitoring activities would help to keep these programs up-to-date on the latest best practices.

SECTION VI - MITIGATION ALTERNATIVES

Mitigation Goals

The goals of this Natural Hazards Mitigation Plan were developed by incorporating the broader hazard mitigation goals of both New York State and Orange County with the specific hazard findings of this study area. Where possible, overlaps or common mitigation goals between the county and the local municipalities were highlighted to indicate a potential multi-jurisdictional approach. Although there are sometimes different priorities between the City of Middletown and the Town of Wallkill, it has been presumed that the overall goals of each municipality are the same.

1. Reduce the risk to public safety and damage from recurring natural disasters.
2. Promote future disaster-resistant development, particularly outside of identified hazard areas.
3. Promote hazard mitigation awareness to enable the public to prepare for, respond to and recover from natural disasters.

Types of Mitigations

The proposed mitigations considered during the course of this study can be generally grouped into five categories, as follows:

1. **Structural Projects.** Physical improvements which are constructed to reduce the impact of a hazard. This is often achieved through the construction of retention basins, dams, floodwalls or levees.
2. **Emergency Services.** The ability to protect people and property during and immediately after a hazard event. This is often achieved through improvements to emergency response facilities, capacities and early warning systems.
3. **Inventory Protection.** Strengthening or relocating of existing structures to make them more resistant or less vulnerable to hazards. This is often achieved through property acquisitions and relocations, structural improvements or elevation of buildings.
4. **Planning and Prevention Projects and Policies.** Administrative processes or changes which can reduce the risk of exposure to known hazards by strategically directing future development. This is often achieved through long-term planning efforts, zoning districts and codes, storm water management efforts or open space preservation.
5. **Public Awareness.** Informing and educating the general public and officials about the known hazards and what they can do to mitigate them or protect themselves. This is often achieved through public outreach programs and real estate disclosure requirements.
6. **Long-Term Natural Resource Protection and Enhancement.** The preservation or enhancement of natural resource systems to help facilitate mitigation. This is often achieved through stream or river corridor cleanup, erosion control, watershed management and wetland restoration.

The proposed mitigations cover a range among the six types of actions. While some of the recommendations of this plan include maintenance or improvements which would not be eligible

for Federal mitigation assistance funding, they have been included in this plan so that each municipality could potentially pursue them through alternate funding mechanisms, if desired. It is expected that this list will be updated and expanded over time in future revisions as part of the plan maintenance process.

In evaluating each potential mitigation, consideration must be given to the relative costs and benefits which are associated with them. To establish this, a cost-benefit matrix was developed to help rank these relative characteristics so that mitigations with a low cost and high benefit could be ranked as a higher priority than those which were relatively high cost and low benefit.

Cost / Benefit Analysis Scoring of Mitigations			
	High (H)	Medium (M)	Low (L)
Costs	Funding for this action does not currently exist and would require significant augmentation from outside sources. Estimated above \$100,000	Funding for this action exists, but would have to be budgeted over multiple years and/or augmented from outside sources. Estimated between \$10,000 and \$100,000	Funding for this action could be allocated or reallocated from existing budget - Estimated below \$10,000
Benefits	Action would have an immediate and tangible reduction of potential losses.	Action would likely have a moderate reduction of potential losses.	Action would potentially have an eventual reduction in losses, but is difficult to quantify.
Timeframe	Long-Greater than 5 years	Moderate-within 5 years	Short-Within 1-2 years

For the purposes of preliminary rankings, each potential mitigation action which was estimated to have a higher benefit level than cost level was considered as being "High" priority. Mitigation actions which had the same cost and benefit levels were considered "Moderate" priority, unless it was determined that the potential benefit would be highly significant, such as those which would jointly benefit both municipalities. Those with benefit levels below the costs were generally considered "Low" priority.

Potential Mitigations Identified

The potential mitigations identified during the course of this study are outlined in the following tables. For the purposes of separate grant funding, mitigations have been listed separately for each municipality, as well as "joint" multi-jurisdictional projects of use to both.

Mitigation Actions Prioritization Analysis						
TOWN OF WALKKILL – Structural Projects						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Replace Gordon Road box culvert in Wallkill with increased flow capacity (completed/recent project)	Flood	1	M	M	L	M
Cleanup of Wallkill River waterway, remove debris and trees to prevent blockages.	Flood	1	L	M	L	High
Cleanup of debris, trees in waterways on private properties/in coordination with property owners.	Flood	1	L	L	L	L
Conduct enhanced stormwater management/flood mitigation study of the Masonic-Silver Creek-Silver Lake Watershed.	Flood	1	M	M	M	M
Investigate capacity and downstream flooding issues from Silver Lake down to Middletown School fields along Route 211.	Flood	1	M	M	M	M
Develop study and design for construction of detention basin(s) to capture downstream flow from Monhegan Lake watershed area into downtown Middletown.	Flood / Dam	1	H	H	M	High
Conduct feasibility study with Palisades Interstate Park Commission on enhanced regional stormwater management in Highland Lakes State Park .	Flood	1	M	M	M	M
Redesign and reinforce drainage channel at intersection of Mt Hope Road and Pocatello Road behind Firehouse. Repair damage.	Flood	1	M	M	L	M
Identify existing infrastructure repair projects as opportunities for mitigation improvements.	Flood	1	L	L	L	L

TOWN OF WALKKILL – Structural Projects (Cont)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Inspect, investigate Prosperous Valley Road spillway for repairs or improvements. Consider telemetry remote retrofit with control gate for pre-release.	Dam	1	L	M	L	High
Investigate improvements at stream down from High Barney Road.	Flood	1	L	M	L	M
Investigate improvements / repairs at Farm Pond on Kunkel property near Playtogs / Redners.	Flood	1	L	L	L	M
Work with O&R Utilites to identify critical power grid priorities and vulnerable areas. Develop plan to strengthen these priority and vulnerable grid components to reduce likelihood of future outages.	Severe Ice Storm / High WInd	1	L	M	L	High
Provide general cleanup of debris in channels, streams and rivers to reduce blockages.	Flood	1	L	M	L	High
Stream bank cleanup and stabilization projects.	Flood	1	L	M	L	High
Investigate structural improvements at water treatment plant to protect it in the event of a breach of Monhagen Lake Dike.	Dam	1	H	H	H	M
Establish alternate emergency shelter location from Monhagen MS / Maple Hill Elementary in the event of a breach of Monhagen Lake Dike.	Dam	1	L	M	L	High
Investigate structural improvements or relocation of sewer treatment plant and water treatment plant/pumps within floodplain of Walkkill River.	Flood	1	H	H	H	M
Replace culverts and stabilize banks along Winding Brook.	Flood	1	M	H	L	High

TOWN OF WALKKILL – Emergency Services						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Provide backup power for key traffic signals in the event of widespread outages to reduce gridlock conditions from hampering emergency vehicle access.	Extreme Weather	3	M	M	M	M
Increase capacity of emergency fuel storage tanks in the Town of Wallkill.	Severe Storm	3	M	M	M	M
Develop "Selective Reduction / Rationing Plan" for local emergency services fuel storage with tiered system for different levels of alert during fuel shortage.	Severe Storm	3	L	M	L	High
Establish or expand access to public cooling centers.	Extreme Temperatures	3	L	L	L	M
Assess needs of backup electrical power generators at emergency service centers, sewer and water systems.	Severe Storm / Extreme Temperatures	3	L	M	M	High
TOWN OF WALKKILL – Inventory Protection						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Investigate improvements or relocation of Fire substation in flood plain on Stony Ford Road	Flood	1	M	L	M	L
TOWN OF WALKKILL – Planning and Prevention						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Conduct vulnerability assessment of shelters and multi-family facilities, such as senior housing or large apartment complexes and review emergency backup power needs and solutions.	Severe Ice Storm	3	L	M	L	High
Get standing approval/agreement between local municipalities and Orange County to be able to clear debris from drainage crossings in County jurisdiction without regulatory approvals.	Flood	1	L	L	L	L

TOWN OF WALKKILL – Planning and Prevention (Cont.)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Adopt Wallkill/Middletown Hazard Mitigation Plan as an amendment to the larger Orange County Hazard Mitigation Plan so that they can work together.	All	3	L	L	L	M
Develop agreements / action plan for use of large private facilities, such as Galleria Mall, for population shelters in case of widespread emergency.	All	3	L	H	L	High
Investigate telemetry remote capabilities to conduct an "advance release" of water from local dams/spillways to increase capacity prior to a significant incoming rainfall event.	Flood	1	M	M	L	M
Update existing zoning code / building code requirements to provide stronger mitigation practices.	All	2	L	M	L	M
Incorporate / adopt Wallkill/Middletown Hazard Mitigation Plan into Town and City Comprehensive Plans.	All	3	L	L	L	M
Update town, city and county hazard mapping information to include latest data.	All	3	L	M	L	High
Provide changes in development review process to evaluate future development projects with an eye toward hazard mitigation.	All	3	L	M	L	High
Develop agreement with DEC to have ability to cleanup Wallkill River waterway via 'Bed&Banks' permits as needed for regular maintenance without normal regulatory approvals.	Flood	1	L	M	L	High
Provide planning review officials with access to continued training on enhanced stormwater management and low impact development techniques.	Flood	1	L	M	M	High

TOWN OF WALKKILL – Planning and Prevention (Cont.)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Incorporate local law prohibiting the storage of debris, brush or similar clogging elements near the banks of waterways.	Flood	1	L	M	L	High
Conduct bi-annual waterway inspections to identify properties which are violating debris storage restrictions along banks of waterways.	Flood	3	L	L	L	M
Have local Floodplain Administrator obtain certification.	Flood	3	L	L	L	L
Develop an Emergency Response Plan.	All	3	M	M	M	M
Join and participate in activities for the NFIP Community Rating System.	Flood	2, 3	L	M	L	High
Periodically review and update floodplain management program and monitoring activities.	Flood	2	L	M	L	High
Establish a Capital Improvements Plan to budget for long term improvements.	All	3	M	L	L	L
TOWN OF WALKKILL – Public Awareness						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Expand awareness, outreach and sign-ups for the existing Public Safety Alert system in the Town of Walkkill. Coordinate with county 'code red' system.	All	3	L	M	L	High
Educate public about emergency preparation and response actions.	All	3	L	L	L	L
Support disaster preparedness training for agencies serving vulnerable populations and the general public.	All	3	M	H	L	High
Inform local residents of the flooding problems associated with debris and brush located near the banks of waterways.	Flood	3	L	M	L	High
Update flood hazard maps--in particular in densely settled areas and promote resident and business owners' awareness of the flood	All	3	L	M	L	High

hazard locations.						
Adopt a Real Estate Disclosure code to inform property buyers of local hazards.	Flood	3	L	L	L	L
Develop community outreach program to private property owners to encourage cleanup of waterways on their property, or secure permission for the municipality to do it.	Flood	3	L	L	L	L
TOWN OF WALKKILL – Natural Resource Protection						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Establish a system to create/protect undeveloped buffers around wetlands, streams and rivers. Encourage riparian vegetation.	Flood	2	L	M	M	High
Develop a plan that identifies local and regional flood mitigation capacity areas which could be used to mitigate large stormwater events in vulnerable areas of town.	Flood	2	M	M	M	M
SUMMARY – TOWN OF WALKKILL						
Lower Priority Mitigations				9		
Moderate Priority Mitigations				19		
High Priority Mitigations				24		
TOTAL				52		

CITY OF MIDDLETOWN – Structural Projects						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Repair or replace drainageway channel concrete sidewalks along the rear portion of West Main Street in Middletown.	Flood	1	L	M	L	High
Replace with increased capacity, culvert near Boyce Excavating property on east side of West Main Street.	Flood	1	M	M	M	High
Repair or replace with increased capacity, concrete box culvert near Middletown City salt storage facility. [IN PROGRESS]	Flood	1	M	M	M	M
Reinforce open channel waterways from erosion and scour within the City of Middletown.	Flood	1	L	L	L	M
Cleanup of debris and trees upstream from enclosed waterway channel from Mill Street to city limits in Middletown.	Flood	1	L	M	L	High
Cleanup of debris, trees in waterways on private properties in collaboration with property owners. Develop letter of release / hold harmless agreement.	Flood	1	L	L	L	M
Replace or repair enclosed box culvert portion of waterway from Mill Street to Genung Street in Middletown.	Flood	1	M	M	M	M
Repair or replace flood diversion wall near County Road 78 at Aspen Townhouses [COMPLETED]	Flood	1	L	M	L	High
Increase culvert and channel capacity leaving the Middletown city area to the southeast to reduce bottlenecks. Coordinate efforts downstream with the Towns of Wallkill and Wawayanda to continue capacity and unrestricted flow of drainage.	Flood	1	H	H	H	M
Identify existing infrastructure repair projects as opportunities for mitigation improvements.	Flood	1	L	L	L	M
Inspect and repair damage to face of Mill Pond Dam. [IN PROGRESS]	Dam	1	L	L	L	M

CITY OF MIDDLETOWN – Structural Projects (Cont)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Develop study and design for construction of detention basin(s) to capture downstream flow from Monhegan Lake watershed area into City of Middletown.	Flood	1	H	H	H	High
Work with O&R Utilites to identify critical power grid priority areas for "first repair" response. Develop plan to strengthen these priority and vulnerable grid components to reduce likelihood of future outages.	Wind / Ice Storm	1	L	M	M	High
CITY OF MIDDLETOWN - Emergency Services						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Install emergency fuel storage tanks in or near the City of Middletown to reduce their dependency on the Town of Wallkill surplus.	Severe Storm	3	M	M	L	M
Develop "Selective Reduction / Rationing Plan" for local emergency services fuel storage with tiered system for different levels of alert during fuel shortage.	Severe Storm	3	L	M	L	High
Provide backup power for key traffic signals in the event of widespread outages to reduce gridlock conditions from hampering emergency vehicle access.	Extreme Weather	3	M	M	M	M
Establish or expand access to public cooling centers.	Extreme Temperatures	3	L	L	L	M
Assess needs of backup electrical power generators at emergency service centers, sewer and water systems. [COMPLETED]	Severe Storm / Extreme Temperatures	3	L	M	M	High
Review inundation map and practice the procedures for the Emergency Response Plan for Monhagen Lake Dam.	Dam	1, 3	L	M	L	High

CITY OF MIDDLETOWN – Inventory Protection						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Investigate structural improvements to protect wastewater treatment plant in flood plain along Dolson Ave from damage or loss of access due to flood. [COMPLETED]	Flood	1	H	H	H	M
CITY OF MIDDLETOWN - Planning and Prevention						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Conduct vulnerability assessment of shelters and multi-family facilities, such as senior housing or large apartment complexes and review emergency backup power needs and solutions.	Severe Ice Storm	3	L	M	L	High
Get standing approval/agreement between City and Orange County to be able to clear debris from drainage crossings in County jurisdiction without regulatory approvals.	Flood	1	L	L	L	L
Investigate watershed and impervious area which is contributing to increased flooding south toward Wisner Ave / Draper Brook corridor	Flood	1	L	M	L	High
Adopt Walkkill/Middletown Hazard Mitigation Plan as an amendment to the larger Orange County Hazard Mitigation Plan so that they can work together.	All	3	L	L	L	M
Have local Floodplain Administrator obtain certification.	Flood	3	L	L	L	L
Identify additional facilities outside of hazard prone areas for population shelters in case of widespread emergency.	All	3	L	H	L	High
Update existing zoning code / building code requirements to provide stronger mitigation practices.	All	2	L	M	L	M

CITY OF MIDDLETOWN - Planning and Prevention (Cont.)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Incorporate / adopt Walkkill/Middletown Hazard Mitigation Plan into City Comprehensive Plan.	All	3	L	L	L	M
Update town, city and county hazard mapping information to include latest data.	All	3	L	M	L	High
Provide changes in development review process to evaluate future development projects with an eye toward hazard mitigation.	All	3	L	M	L	High
Develop agreement with DEC to have ability cleanup Walkkill River waterway as needed for regular maintenance without normal regulatory approvals.	Flood	1	L	M	L	High
Provide planning review officials with access to continued training on enhanced stormwater management and low impact development techniques.	Flood	1	L	M	M	High
Revise zoning and site plan regulations to reduce impervious surface area and create larger riparian buffers along floodways / waterways	Flood	2	L	M	M	High
Incorporate local law prohibiting the storage of debris, brush or similar clogging elements near the banks of waterways.	Flood	1	L	M	L	High
Join and participate in activities for the NFIP Community Rating System.	Flood	2, 3	L	M	L	High
Periodically review and update floodplain management program and monitoring activities.	Flood	2	L	M	L	High
Conduct bi-annual waterway inspections to identify properties which are violating debris storage restrictions along banks of waterways.	Flood	3	L	L	L	M

CITY OF MIDDLETOWN - Public Awareness						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Expand similar Public Safety Alert system used in Wallkill into City of Middletown.	All	3	L	M	L	High
Coordinatate with school district and Time Warner Cable to have direct access to broadcast capability.	All	3	L	M	L	High
Educate public about emergency preparation and response actions.	All	3	L	L	L	L
Support disaster preparedness training for agencies serving vulnerable populations and the general public.	All	3	M	H	L	High
Inform local residents of the flooding problems associated with debris and brush located near the banks of waterways.	Flood	3	L	M	L	High
Adopt a Real Estate Disclosure code to notify property buyers of potential hazards.	Flood	3	L	L	L	L
CITY OF MIDDLETOWN - Natural Resource Protection						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Update flood hazard maps--in particular in densely settled areas and promote resident and business owners' awareness of the flood hazard locations.	All	3	L	M	L	High
Develop community outreach program to private property owners to encourage cleanup of waterways on their property, or secure permission for the municipality to do it.	Flood	3	L	L	L	L
SUMMARY - CITY OF MIDDLETOWN						
Lower Priority Mitigations					5	
Moderate Priority Mitigations					15	
High Priority Mitigations					25	
TOTAL					45	

Joint / Multijurisdictional Projects

The following is a listing of recommended mitigations which were identified as potential "Multi-jurisdictional / Joint Projects" between the City of Middletown and the Town of Walkkill.

MULTI-JURISDICTIONAL / JOINT PROJECTS						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Develop study and design for construction of detention basin(s) to capture downstream flow from Monhegan Lake watershed area into City of Middletown.	Flood / Dam	1	H	H	M	High
Develop "Selective reduction / Rationing Plan" for local emergency services fuel storage with tiered system for different levels of alert during fuel shortage.	Severe Storm	3	L	M	L	High
Cleanup of debris and trees upstream from enclosed waterway channel from Mill Street to city limits – beyond into Town of Walkkill.	Flood	1	L	M	L	High
Adopt Walkkill / Middletown Hazard Mitigation Plan as an amendment to Town and City Comprehensive Plans.	All	3	L	M	L	High
Identify facilities outside of hazard prone areas for additional population shelters in the event of a widespread emergency.	All	3	L	H	L	High
Develop agreement with DEC to have ability to cleanup Walkkill River waterway via 'Bed&Banks' permits as needed for regular maintenance without normal regulatory approvals.	Flood	1	L	M	L	High
Update town, city and county hazard mapping information to include latest data.	All	3	L	M	L	High
Expand similar Public Safety Alert system used in Town of Walkkill into City of Middletown. Coordinate alerts.	All	3	L	M	L	High
Investigate watershed and impervious area which is contributing to increased flooding south toward Wisner Ave / Draper Brook corridor	Flood	1	L	M	L	High

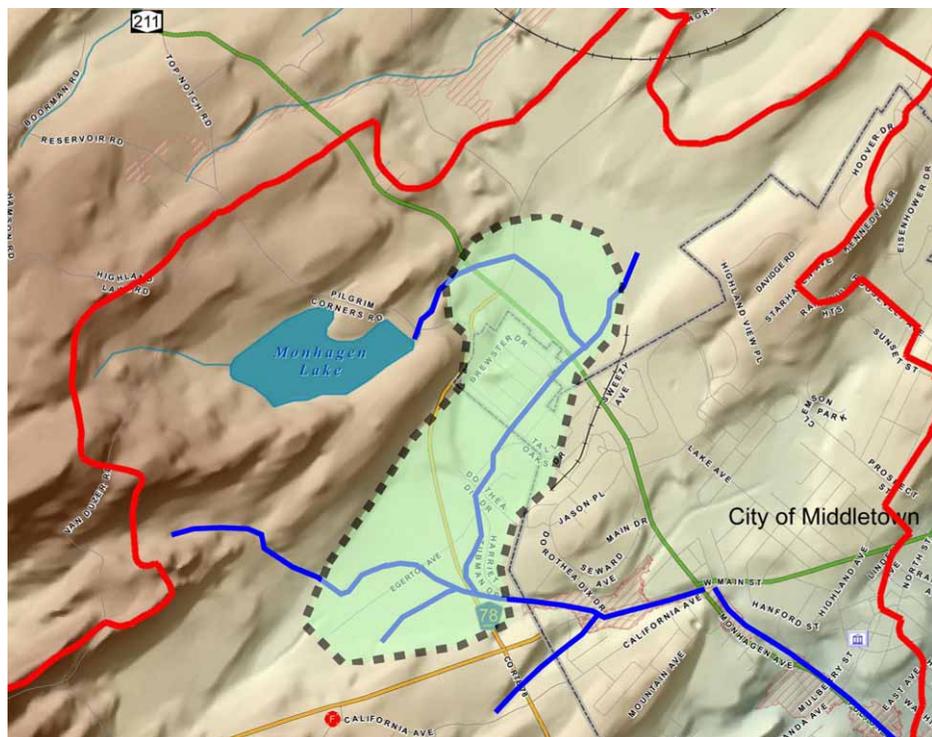
MULTI-JURISDICTIONAL / JOINT PROJECTS (Continued)						
Mitigation	Hazards	Goals	Costs	Benefits	Time	Priority
Participate in the NFIP Community Rating System.	Flood	2, 3	L	M	L	High
Adopt Wallkill / Middletown Hazard Mitigation Plan as an amendment to the larger Orange County Hazard Mitigation Plan so that they can work together.	All	3	L	L	L	M
Increase culvert and channel capacity leaving the Middletown city area to the southeast to reduce bottlenecks. Coordinate efforts downstream with Town of Wallkill and Wawayanda.	Flood	1	H	H	H	M
Investigate improvements at stream down from High Barney Road.	Flood	1	L	M	L	M
Investigate improvements / repairs at Farm Pond on Kunkel property near Playtogs / Redners.	Flood	1	L	L	L	M
Investigate structural improvements at water treatment plant to protect it in the event of a breach of Monhagen Lake Dike.	Dam	1	H	H	H	M
Increase capacity of emergency fuel storage tanks in the Town of Wallkill	Severe Storm	3	M	M	M	M
Cleanup of debris, trees in waterways on private properties in collaboration with property owners. Develop letter of release / hold harmless agreement.	Flood	1	L	L	L	M
SUMMARY – JOINT PROJECTS						
Lower Priority Mitigations					0	
Moderate Priority Mitigations					7	
High Priority Mitigations					10	
TOTAL					17	

Specific Mitigation Concepts Described

Throughout the course of the development of this plan, certain hazards began to emerge as recurring culprits of primary concern to local residents and officials. Flooding was a predominant issue, particularly in the City of Middletown. Particular attention was paid to these events, and many discussions were conducted concerning different strategies to combat their impact. Some of these strategies warrant additional description in this plan beyond what can be provided in a simple table of recommendations. Other mitigations were identified as "priority" projects due to the fact they could affect a relatively large number of people immediately once implemented. For this reason, these mitigation concepts have been described below.

Monhagen Brook Watershed Detention. Several branches of the Monhagen Brook converge in the Town of Walkill, and further converge downstream in the City of Middletown. The northern branch outlets through Monhagen Lake (a city-owned reservoir in the Town of Walkill); a central branch converges with the northern branch at West Main Street near Dorthea Drive; and two southerly branches converge at the pond at the former St. Alberts' Junior Seminary off Wayawanda Avenue and Carmelite Drive (see image next page). These branches run through the city and converge near Monhagen Avenue and Hardin Street.

The upland or "headwaters" of these streams offer great potential to mitigate flood hazards in the lower reaches of the town and city. First, maintaining the natural landscape as much as possible would be very helpful to limit the chance of increased storm flows, and secondly, these headwater areas could potentially be enhanced for increased stormwater storage with a large detention basin which could trap and slow flood waters before they enter the city. This system should be investigated to greatly reduce flooding in the City of Middletown.



Waterways converging down into the City of Middletown. The shaded "upland" area from the city provides an opportunity to capture this stormwater and hold it before it reaches the city during large storm events.

Public Awareness, Enforcement Codes for Waterway Cleanup

Several of the individual mitigations described in this plan are actually part of a larger strategy to reduce flooding caused by common waterway blockages. These are:

1. Cleanup of brush, vegetative debris and trash along the banks of public and private waterways;
2. Public awareness campaign about the hazards of leaving or storing brush and trash near waterway banks;
3. Develop new local codes which impose fines for storing brush or trash along waterway banks;
4. Conduct bi-annual inspections of waterways to identify properties in violation of the above and impose fines.
5. Develop standing agreement with DEC to have ability to cleanup waterways as needed;
6. Increase capacity of existing undersized or damaged culverts where needed;

The above items are designed to work in concert with one another as part of a larger plan to keep the waterways free and clear of trash and vegetative debris which clogs channels causes local flooding. This approach is seen as a very cost-effective method of essentially increasing the capacity of all local channels, via the removal of the obstructions which limit them.

Flood Damage Mitigation Through Enhanced Watershed Management



Similar to the Monhagen Brook watershed recommendation above, storm water detention and storm water management can be applied to other areas of the town as well. If this is seen as a desired strategy, the town and city, with the help of state and federal partners and with the collaboration of property owners, could advance this concept of enhancing the flood storage potential of other upstream areas. This would involve working together to identify such possibilities along the stream corridors, working cooperatively with land owners to determine what approaches may be worth exploring together and then creating design concepts that would be able to be evaluated by all parties for

benefits, costs, and feasibility of implementation. Ideally, an enhanced stormwater management system would add to the value of the land, create environmental benefits, and help reduce flooding. Other locations where this concept could also be particularly beneficial in terms of mitigation of potential flooding and stormwater damage would be the Masonic Creek-Silver Lake Watershed.



There are also opportunities to explore options for preventative flood control by enhanced management of the outflow from Silver Lake or Prosperous Valley Lake in advance of storm events. This could be achieved through the use of remote telemetry controls to lower the water level in advance of a major storm so that it has increased capacity to hold back the new rainfall, resulting in less floodwaters downstream. Given the size of this watershed, and the locations of existing large wetland and floodplain areas upstream, this could be well suited for considering creative methods for enhanced stormwater management in collaboration with property owners.

Palisades Interstate Park. A larger, more regional opportunity to mitigate flooding hazards lies in the lands owned by the Palisades Interstate Park Commission within the town. These 3,115 acres of undeveloped parkland—"Highland Lakes State Park" is the largest of the park commission's undeveloped parks—is popular for fishing, hiking, horseback riding, and model airplane flying, among other activities. These lands also serve important function in mitigating flooding downstream along the unnamed stream and the Wallkill River. The aerial photo below depicts one of the existing impoundments that could be improved to provide additional flood storage capacity, among other benefits to the park and the region.



From a regional perspective the Wallkill River (and as it merges and becomes the Rondout Creek) has had a long history of flooding. From the Rondout section of Kingston, up through New Paltz and through the current Town of Wallkill and City of Middletown study area, Wallkill flooding has caused numerous disruptions, evacuations, property damage and economic loss. There is the potential for a regional approach to mitigating flood damages through this valley with a series of upstream enhancements which could align with park commission goals and provide recreational opportunities.

Power Failure

The majority of power outages are due to weather and weather-related effects. In addition to seasonal weather conditions, the risk of a power disruption due to solar activity which could create a large electromagnetic pulse that could interfere with electrical systems. Mitigation of the potential loss of electrical power is particularly critical in the winter months. The loss of electric power renders most heating systems inoperable and which could lead to widespread freezing and subsequent severe public health and safety problems. These problems would be compounded with the damage to the communication system, and as experienced in other areas, roads can become impassable with the combination of downed power lines, tree limbs and snow and road icing.

For the town and city, a balanced approach to help reduce damage from severe storm events for overhead power distribution systems includes:

- Strengthening the overhead system.
- Undergrounding conversion.
- Rerouting and redundancy.



A recent study by the Edison Electric Institute (Hall, 2013) concluded that given the high cost, underground conversion should not be considered a widespread solution, rather it is a solution that may be most helpful in select areas. It is recommended that a balanced approach which utilizes each of the above mitigation measures be implemented to increase the reliability of local electric services. Critical service areas which would be top priority for power restoration should be identified in advance by the municipalities and the power companies – such as those serving hospitals, emergency services, elderly population centers – and then develop a plan for strengthening, undergrounding and rerouting as necessary. In the event of a widespread power failure, the utility company would have priority areas for service restoration so that the municipalities would not have to direct them.

The next step in the process would be advancing a cooperative approach for identifying key service corridors by Orange and Rockland and the other utility companies and the municipalities. Once these key corridors are identified, a more specific mitigation program could be designed and implemented.

SECTION VII – PLAN IMPLEMENTATION & MAINTENANCE

Plan Implementation

This Natural Hazards Mitigation Plan is intended to be an ongoing and evolving document which is used to guide the selection of future mitigation projects based on priorities and available funding. Once adopted, this Plan should immediately be referenced to select mitigation projects. This selection shall be conducted by a **Mitigation Action Group**, led by an official from the Department of Public Works. This group shall be appointed by both municipalities and composed of select local officials and specialists familiar with local infrastructure and the elements of hazard mitigation planning.

Because of the relatively large number of high-priority mitigations identified in this Plan, it was determined that a priority "listed order" of implementation would not be completely beneficial because it would be a static list that cannot adjust to changing conditions. Instead, the Mitigation Action Group shall use the plan review and maintenance process to regularly assess the various strategies and select the priority projects which should be currently pursued. This approach gives both municipalities greater flexibility to address issues which are at the current forefront of concern based on latest available data, and be able to pursue different funding opportunities as they arise. Therefore, priority project **Action Items** listed on the following pages shall be used as a guide in selecting mitigation projects and the maintenance process described below.

In determining which Action Items should be selected for current projects, the Mitigation Action Group shall utilize the following methodology:

1. Determine available or upcoming grant funding opportunities, which may be referenced from the potential funding sources listed at the end of this section.
2. Review the Action Items list on the following pages;
3. Select at least one (1) action item which can be accomplished with Local Staff Labor, without the need for additional funding. Priority for selection should be given as follows: **Joint projects > High priority > Moderate priority > Low priority**. Each year the municipalities should attempt to accomplish one action item solely with the use of local staff labor, where possible;
4. Select at least one (1) action item which can be accomplished with Local Funds and/or Grant Funding. Priority for selection should be given as follows: **Those which could be accomplished with available local funding > Those which are eligible to be funded by an upcoming grant opportunity > Joint projects > High priority > Moderate priority > Low priority**;
5. A brief description of the action items selected above, and reasons for their selection, should be written up by the Mitigation Action Group and provided to the Town Board / City Council (as appropriate) for their review and approval to move forward.

Plan Maintenance

This Natural Hazards Mitigation Plan is required to be an ongoing and evolving document which is periodically re-assessed and revised to meet the latest threat assessments. The Town and City, through the Mitigation Action Group, shall regularly review, assess and update the various strategies outlined in this Plan as part of a recurring update process. These reviews and updates shall be conducted by the Mitigation Action Group, as follows:

One Year Review. The Mitigation Action Group shall meet annually to review and consider the following:

1. The progress made on the action plan recommendations since the last update;
2. Status of mitigation projects in progress - likelihood of completion, estimated completion timeframe, estimated funding capacities or problems;
3. The potential cancellation of planned or underway mitigation projects, with justification for the decision;
4. Significant events which may have occurred which warrant an assessment of local preparedness and vulnerability;
5. New data or information which is available which may improve threat assessment;
6. New mitigation projects or initiatives which may be needed;
7. **Select priority mitigation projects which should be advanced;**
8. Changes in the Mitigation Action Group membership which may be necessary or beneficial to the work.

It is during this initial (and recurring) review where the priority mitigation projects or efforts shall be chosen and advanced. Recommendations made from this review shall be documented in a Mitigation Assessment Memo and shared with pertinent local government officials and stakeholders for ongoing coordination, and retained for inclusion in future plan updates.

Post Disaster Assessments. The Mitigation Action Group shall also convene to review the Plan within three months following any major disaster which would warrant a Major Disaster Declaration or an Emergency Declaration affecting the area. In such cases, the review group shall meet to consider any post disaster "lessons learned", what existing or new vulnerabilities remain and any new problems identified. These observations shall be documented and retained for inclusion in future plan updates.

Five-Year Plan Update. The Mitigation Action Group shall also convene no less than every five years to review and update the Plan with all relevant issues raised during previous reviews, taking into account post disaster assessments and lessons learned. They shall re-assess the overall priority of each suggested mitigation, as well as the functionality of the maintenance update process. As part of this update, the Plan—as well as proposed changes to it—shall be made publically available for review and comment in advance of a scheduled public discussion. Prior to any update decisions being made, the Mitigation Action Group shall:

1. Make the latest Mitigation Plan available for public review on the municipal web site(s), along with an outline of preliminary changes to the Plan which are being considered;
2. Invite the public to an advertised meeting to discuss the changes being considered, and to document any public comments on the Plan update. In addition to an open invitation to the public, officials from the County and adjacent municipalities should also be directly informed and invited to the meeting;
3. Direct the public and area officials on a method of submitting comments on the Plan revisions should they not be able to attend the meeting.

After this discussion and a sufficient comment period of 30 days, the Mitigation Action Group shall review all comments and make final update recommendations to the Town Board/City Council for their approval. The Town Board/City Council may then direct the Mitigation Action Group to update the Plan accordingly prior to adoption.

This process ensures that the current Mitigation Plan is updated to address the latest threats and opportunities to both municipalities.

Mitigations – Action Items

The following Action Plan list includes all identified mitigations which should be pursued by each municipality, with the associated position, department or agency who is primarily responsible for implementing the work. In addition, potential funding sources for each action have been provided.

Mitigations – Action Plan			
TOWN OF WALKKILL – Structural Projects			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Replace Gordon Road box culvert in Wallkill with increased flow capacity	[COMPLETED]	n/a	M
Cleanup of Wallkill River waterway, remove debris and trees to prevent blockages.	Department of Public Works	Local Staff Labor	High
Cleanup of debris, trees in waterways on private properties/in coordination with property owners.	Department of Public Works	Local Staff Labor	L (Joint)
Conduct enhanced stormwater management/flood mitigation study of the Masonic-Silver Creek-Silver Lake Watershed.	Town Board, Planning Board, Consulting Team	Local Funding; HMGP, USDA-NRCS, NY Rising Grant Funding	M
Investigate capacity and downstream flooding issues from Silver Lake down to Middletown School fields along Route 211.	Town Board, Planning Board, Consulting Team	Local Funding; HMGP, USDA-NRCS, NY Rising Grant Funding	M
Develop study and design for construction of detention basin(s) to capture downstream flow from Monhegan Lake watershed area into downtown Middletown.	Town Board, Planning Board, Consulting Team	Local Funding; HMGP, PDM, CFA, NY Rising Grant Funding	High (Joint)
Conduct feasibility study with Palisades Interstate Park Commission (PIPC) on enhanced regional stormwater management in Highland Lakes State Park .	Orange County Planning	County Funding; PIPC, OPRHP/EPF, USDA-NRCS, HMGP Grant Funding	M
Redesign and reinforce drainage channel at intersection of Mt Hope Road and Pocatello Road behind Firehouse. Repair damage.	Department of Public Works	Local Staff Labor, USDA-NRCS, HMGP, PDM, NYSDOT Grant Funding	M
Identify existing infrastructure repair projects as opportunities for mitigation improvements.	Department of Public Works	Local Staff Labor, HMGP, PDM Grant Funding	L

TOWN OF WALLKILL – Structural Projects (Cont)			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Inspect, investigate Prosperous Valley Road spillway for repairs or improvements. Consider telemetry remote retrofit with control gate for pre-release.	Department of Public Works, Consulting Team	Local Staff Labor, Local Funding, HMGP, PDM Grant Funding	High
Investigate improvements at stream down from High Barney Road.	Department of Public Works	Local Staff Labor, Local Funding, USDA-NRCS Grant Funding	M (Joint)
Investigate improvements / repairs at Farm Pond on Kunkel property near Playtogs / Redners.	Department of Public Works	Local Staff Labor, Local Funding, USDA-NRCS Grant Funding	M (Joint)
Work with O&R Utilites to identify critical power grid priorities and vulnerable areas. Develop plan to strengthen these priority and vulnerable grid components to reduce likelihood of future outages.	Town Board, Orange County Planning, O&R, Consulting Team	Local Funding, O&R, HMGP, PDM, CFA Grant Funding	High
Provide general cleanup of debris in channels, streams and rivers to reduce blockages.	Department of Public Works	Local Staff Labor	High (Joint)
Stream bank cleanup and stabilization projects.	Department of Public Works	Local Staff Labor	High
Investigate structural improvements at water treatment plant to protect it in the event of a breach of Monhagen Lake Dike.	Town Board, Consulting Team	Local Funding, HMGP, PDM Grant Funding	M (Joint)
Establish alternate emergency shelter location from Monhagen MS / Maple Hill Elementary in the event of a breach of Monhagen Lake Dike.	Town Board	Local Funding	High
Investigate structural improvements or relocation of sewer treatment plant and water treatment plant/pumps within floodplain of Wallkill River.	Town Board, Consulting Team	Local Funding, HMGP, PDM Grant Funding	M
Replace culverts and stabilize banks along Winding Brook.	Department of Public Works	Local Staff Labor	High

TOWN OF WALKKILL – Emergency Services			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Provide backup power for key traffic signals in the event of widespread outages to reduce gridlock conditions from hampering emergency vehicle access.	Town Board, Department of Public Works	NYSDOT, HMGP, PDM Grant Funding	M
Increase capacity of emergency fuel storage tanks in the Town of Walkkill.	Town Board, Department of Public Works	HMGP, PDM, CFA Grant Funding	M (Joint)
Develop "Selective Reduction / Rationing Plan" for local emergency services fuel storage with tiered system for different levels of alert during fuel shortage.	Town Board, Department of Public Works	Local Funding	High (Joint)
Establish or expand access to public cooling centers.	Town Board	HMGP Grant Funding	M
Assess needs of backup electrical power generators at emergency service centers, sewer and water systems.	Town Board, Department of Public Works	HMGP, NY Rising Grant Funding	High
TOWN OF WALKKILL – Inventory Protection			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Investigate improvements or relocation of Fire substation in flood plain on Stony Ford Road	Department of Public Works	Local Funding, HMGP, PDM Grant Funding	L
TOWN OF WALKKILL – Planning and Prevention			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Conduct vulnerability assessment of shelters and multi-family facilities, such as senior housing or large apartment complexes and review emergency backup power needs and solutions.	Department of Public Works, Consulting Team	HMGP, PDM Grant Funding	High
Get standing approval/agreement between local municipalities and Orange County to be able to clear debris from drainage crossings in County jurisdiction without regulatory approvals.	Town Board, Orange County	Local Staff Labor	L

TOWN OF WALKKILL – Planning and Prevention (Cont.)			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Adopt Walkkill/Middletown Hazard Mitigation Plan as an amendment to the larger Orange County Hazard Mitigation Plan so that they can work together.	Town Board, Orange County	Local Staff Labor	M (Joint)
Develop agreements / action plan for use of large private facilities, such as Galleria Mall, for population shelters in case of widespread emergency.	Town Board	Local Staff Labor	High (Joint)
Investigate telemetry remote capabilities to conduct an "advance release" of water from local dams/spillways to increase capacity prior to a significant incoming rainfall event.	Town Board, Consulting Team	HMGP, PDM, NY Rising Grant Funding	M
Update existing zoning code / building code requirements to provide stronger mitigation practices.	Town Board, Planning Board, Consulting Team	Local Staff Labor, Local Funding; CFA, NY Rising Grant Funding	M
Incorporate / adopt Walkkill/Middletown Hazard Mitigation Plan into Town and City Comprehensive Plans.	Town Board, City Council	Local Staff Labor	M (Joint)
Update town, city and county hazard mapping information to include latest data.	Planning Department	Local Staff Labor	High (Joint)
Provide changes in development review process to evaluate future development projects with an eye toward hazard mitigation.	Planning Department, Town Board	Local Staff Labor; NY Rising Grant Funding	High
Develop agreement with DEC to have ability to cleanup Walkkill River waterway via 'Bed&Banks' permits as needed for regular maintenance without normal regulatory approvals.	Town Board, Department of Public Works	Local Staff Labor	High (Joint)
Provide planning review officials with access to continued training on enhanced stormwater management and low impact development techniques.	Town Board, Planning Board	Local Staff Labor, Local Funds	High

TOWN OF WALLKILL – Planning and Prevention (Cont.)			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Incorporate local law prohibiting the storage of debris, brush or similar clogging elements near the banks of waterways.	Town Board, Planning Board, Consulting Team	Local Staff Labor, DEC Grant Funding	High
Conduct bi-annual waterway inspections to identify properties which are violating debris storage restrictions along banks of waterways.	Department of Public Works, Consulting team	Local Staff Labor, Local Funds	M
Have local Floodplain Administrator obtain certification.	Department of Public Works	Local Staff Labor	L
Develop an Emergency Response Plan.	Town Board, Consulting Team	Local Funds; HMGP, PDM, NY Rising Grant Funding	M
Join and participate in activities for the NFIP Community Rating System.	Department of Public Works	Local Staff Labor, HMGP Grant Funding	High (Joint)
Periodically review and update floodplain management program and monitoring activities.	Department of Public Works	Local Staff Labor; NFIP Grant Funding	High
Establish a Capital Improvements Plan to budget for long term improvements.	Town Board, Consulting Team	Local Staff Labor, CFA, NY Rising Grant Funding	L
TOWN OF WALLKILL – Public Awareness			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Expand awareness, outreach and sign-ups for the existing Public Safety Alert system in the Town of Wallkill. Coordinate with county 'code red' system.	Town Board	Local Funding; HMGP, PDM, NSF Grant Funding	High (Joint)
Educate public about emergency preparation and response actions.	Town Board	Local Funding; HMGP, PDM, NSF Grant Funding	L
Support disaster preparedness training for agencies serving vulnerable populations and the general public.	Town Board	Local Funding; HMGP, PDM, NSF Grant Funding	High
Inform local residents of the flooding problems associated with debris and brush located near the banks of waterways.	Town Board, Department of Public Works	Local Funding, Local Staff Labor; HMGP, PDM, NSF Grant Funding	High

Update flood hazard maps--in particular in densely settled areas and promote resident and business owners' awareness of the flood hazard locations.	Department of Public Works	Local Funding; HMGP, PDM, NSF Grant Funding	High
Adopt a Real Estate Disclosure code to inform property buyers of local hazards.	Town Board	Local Staff Labor	L
Develop community outreach program to private property owners to encourage cleanup of waterways on their property, or secure permission for the municipality to do it.	Town Board	Local Funding	L
TOWN OF WALLKILL – Natural Resource Protection			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Establish a system to create/protect undeveloped buffers around wetlands, streams and rivers. Encourage riparian vegetation.	Town Board, Consulting Team	Local Funding; EPA, NYSDEC/EPF, OPRHP/EPF, USDA-NRCS Grant Funding	High
Develop a plan that identifies local and regional flood mitigation capacity areas which could be used to mitigate large stormwater events in vulnerable areas of town.	Town Board, Consulting Team	Local Funding; NYSDEC/EPF, OPRHP/EPF, HMGP, PDM Grant Funding	M

ACTION ITEMS – City of Middletown**CITY OF MIDDLETOWN – Structural Projects**

Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Repair or replace drainageway channel concrete sidewalks along the rear portion of West Main Street in Middletown.	Department of Public Works	Local Staff Labor, Local Funding; HMGP, PDM, PA Grant Funding	High
Replace with increased capacity, culvert near Boyce Excavating property on east side of West Main Street.	Department of Public Works	Local Staff Labor, Local Funding; HMGP, PDM, PA Grant Funding	High
Repair or replace with increased capacity, concrete box culvert near Middletown City salt storage facility. [IN PROGRESS]	Department of Public Works	Local Staff Labor, Local Funding; HMGP, PDM, PA Grant Funding	M
Reinforce open channel waterways from erosion and scour within the City of Middletown.	Department of Public Works	Local Staff Labor	M
Cleanup of debris and trees upstream from enclosed waterway channel from Mill Street to city limits in Middletown.	Department of Public Works	Local Staff Labor	High (Joint)
Cleanup of debris, trees in waterways on private properties in collaboration with property owners. Develop letter of release / hold harmless agreement.	Department of Public Works	Local Staff Labor	M (Joint)
Replace or repair enclosed box culvert portion of waterway from Mill Street to Genung Street in Middletown.	Department of Public Works	Local Staff Labor, Local Funding; HMGP, PDM, PA Grant Funding	M
Increase culvert and channel capacity leaving the Middletown city area to the southeast to reduce bottlenecks. Coordinate efforts downstream with the Towns of Walkkill and Wawayanda to continue capacity and unrestricted flow of drainage.	Department of Public Works, Consulting Team	Local Staff Labor, Local Funding; HMGP, PDM Grant Funding	M (Joint)
Identify existing infrastructure repair projects as opportunities for mitigation improvements.	Department of Public Works, Consulting Team	Local Funding, HMGP, PDM Grant Funding	M
Inspect and repair damage to face of Mill Pond Dam. [IN PROGRESS]	Department of Public Works, Consulting Team	Local Funding, HMGP, PDM, PA Grant Funding	M

CITY OF MIDDLETOWN – Structural Projects (Cont)			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Develop study and design for construction of detention basin(s) to capture downstream flow from Monhegan Lake watershed area into City of Middletown.	City Council, Planning Board, Consulting Team	Local Funding; New York Rising, HMGP, PDM Grant Funding	High (Joint)
Work with O&R Utilites to identify critical power grid priority areas for "first repair" response. Develop plan to strengthen these priority and vulnerable grid components to reduce likelihood of future outages.	City Council, Orange County Planning, O&R, Consulting Team	Local Funding; O&R, HMGP, PDM Grant Funding	High
CITY OF MIDDLETOWN - Emergency Services			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Install emergency fuel storage tanks in or near the City of Middletown to reduce their dependency on the Town of Wallkill surplus.	City Council, Department of Public Works	HMGP, PDM, NY Rising Grant Funding	M (Joint)
Develop "Selective Reduction / Rationing Plan" for local emergency services fuel storage with tiered system for different levels of alert during fuel shortage.	City Council, Department of Public Works	Local Funding	High (Joint)
Provide backup power for key traffic signals in the event of widespread outages to reduce gridlock conditions from hampering emergency vehicle access.	City Council, Department of Public Works	NYSDOT, HMGP, PDM, NY Rising Grant Funding	M
Establish or expand access to public cooling centers.	City Council	HMGP Grant Funding	M
Review inundation map and practice the procedures for the Emergency Response Plan for Monhagen Lake Dam.	City Council, Emergency Services, Department of Public Works	Local Funding	High

CITY OF MIDDLETOWN – Inventory Protection			
Mitigation			Priority
Investigate structural improvements to protect wastewater treatment plant in flood plain along Dolson Ave from damage or loss of access due to flood.	[COMPLETED]	n/a	M
CITY OF MIDDLETOWN - Planning and Prevention			
Mitigation			Priority
Conduct vulnerability assessment of shelters and multi-family facilities, such as senior housing or large apartment complexes and review emergency backup power needs and solutions.	Department of Public Works, Consulting Team	HMGP, PDM Grant Funding	High
Get standing approval/agreement between City and Orange County to be able to clear debris from drainage crossings in County jurisdiction without regulatory approvals.	City Council, Orange County	Local Staff Labor	L
Investigate watershed and impervious area which is contributing to increased flooding south toward Wisner Ave / Draper Brook corridor	City Council, Consulting Team	Local Funding; HMGP, PDM, USDA-NRCS Grant Funding	High (Joint)
Adopt Walkkill/Middletown Hazard Mitigation Plan as an amendment to the larger Orange County Hazard Mitigation Plan so that they can work together.	City Council	Local Funding	M (Joint)
Have local Floodplain Administrator obtain certification.	Department of Public Works	Local Staff Labor, NFIP	L
Identify additional facilities outside of hazard prone areas for population shelters in case of widespread emergency.	City Council	Local Staff Labor, Local Funding; HMGP; PDM	High (Joint)
Update existing zoning code / building code requirements to provide stronger mitigation practices.	City Council, Planning Board, Consulting Team	Local Staff Labor, Local Funding; NY Rising, CFA Grant Funding	M

CITY OF MIDDLETOWN - Planning and Prevention (Cont.)			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Incorporate / adopt Wallkill/Middletown Hazard Mitigation Plan into City Comprehensive Plan.	City Council, Town Board	Local Staff Labor	M (Joint)
Update town, city and county hazard mapping information to include latest data.	Planning Department	Local Staff Labor	High (Joint)
Provide changes in development review process to evaluate future development projects with an eye toward hazard mitigation.	Planning Department, City Council	Local Staff Labor	High
Develop agreement with DEC to have ability cleanup Wallkill River waterway as needed for regular maintenance without normal regulatory approvals.	City Council, Department of Public Works	Local Staff Labor	High (Joint)
Provide planning review officials with access to continued training on enhanced stormwater management and low impact development techniques.	City Council, Planning Board	Local Staff Labor, Local Funds; NFIP, NSF Grant Funding	High
Revise zoning and site plan regulations to reduce impervious surface area and create larger riparian buffers along floodways / waterways	Planning Board, City Council	Local Staff Labor, Local Funds; USDA-NRCS, NYS DEC/EPF Grant Funding	High
Incorporate local law prohibiting the storage of debris, brush or similar clogging elements near the banks of waterways.	City Council, Planning Board, Consulting Team	Local Staff Labor, DEC Grant Funding	High
Join and participate in activities for the NFIP Community Rating System.	Department of Public Works	Local Staff labor, HMGP, NFIP Grant Funding	High (Joint)
Periodically review and update floodplain management program and monitoring activities.	Department of Public Works	Local Staff Labor, NFIP Grant Funding	High
Conduct bi-annual waterway inspections to identify properties which are violating debris storage restrictions along banks of waterways.	Department of Public Works, Consulting Team	Local Staff Labor; Local Funds	M

CITY OF MIDDLETOWN - Public Awareness			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Expand similar Public Safety Alert system used in Wallkill into City of Middletown.	City Council	Local Funding; HMGP, PDM, NY Rising Grant Funding	High (Joint)
Coordinate with school district and Time Warner Cable to have direct access to broadcast capability.	City Council	Local Funding; HMGP, NSF Grant Funding	High
Educate public about emergency preparation and response actions.	City Council	Local Funding, HMGP, NSF Grant Funding	L
Support disaster preparedness training for agencies serving vulnerable populations and the general public.	City Council	Local Funding, HMGP, PDM, NSF Grant Funding	High
Inform local residents of the flooding problems associated with debris and brush located near the banks of waterways.	City Council, Department of Public Works	Local Staff Labor, Local Funding; HMGP, NSF Grant Funding	High
Adopt a Real Estate Disclosure code to notify property buyers of potential hazards.	City Council	Local Staff Labor	L
CITY OF MIDDLETOWN - Natural Resource Protection			
Mitigation	Responsible Position, Department or Agency	Potential Funding Sources	Priority
Update flood hazard maps--in particular in densely settled areas and promote resident and business owners' awareness of the flood hazard locations.	Planning Department	Local Staff Labor, Local Funding; USDA-NRCS, HMGP, NFIP, NSF Grant Funding	High
Develop community outreach program to private property owners to encourage cleanup of waterways on their property, or secure permission for the municipality to do it.	City Council, Department of Public Works	Local Staff Labor, Local Funding; HMGP, NSF Grant Funding	L

Potential Funding Sources

FEMA – Hazard Mitigation Grant Program (HMGP) – Grant funding for planning and mitigation, directly in response to hazard mitigation plans and emergency or disaster events.

<http://www.fema.gov/hazard-mitigation-grant-program>

FEMA – Pre Disaster Mitigation (PDM) – Annual grant funding for planning and mitigation prior to hazard events. <http://www.fema.gov/pre-disaster-mitigation-grant-program>

FEMA – National Flood Insurance Program (NFIP) – Community Assistance Program. Grant funding to help comply with NFIP floodplain management requirements. <http://www.fema.gov/national-flood-insurance-program/>

FEMA – National Flood Insurance Program (NFIP) – Community Rating System. Community bonus program for participating in and improving local NFIP floodplain management strategies. <http://www.fema.gov/national-flood-insurance-program/>

FEMA/NYSOEM – Public Assistance Program (PA) – Public Assistance program. Grant funding for mitigation and repair of infrastructure and facilities after hazard events. <http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit>

FEMA – Flood Mitigation Assistance Program (FMA) – Unified HMA Program. Annual grant funding to reduce or eliminate flood damage to insured NFIP structures. <http://www.fema.gov/flood-mitigation-assistance-program>

FEMA – Repetitive Flood Claims Program (RFC) – Unified HMA Program. Annual grant funding to reduce or eliminate flood damage to insured NFIP structures which have experienced repetitive losses. *See also: Severe Repetitive Loss (SRL) program.* <http://www.fema.gov/repetitive-flood-claims-program>

US Dept. of Agriculture – National Resources Conservation (USDA-NRCS), Watersheds and Wetlands Division. Surveys and planning studies for water, wetland conservation and alternative development strategies. <http://www.nrcs.usda.gov>

US Dept. of Agriculture – National Resources Conservation (USDA-NRCS), Watershed Protection and Flood Prevention Program. Grant funding and technical assistance for improvements to watersheds under 250,000 acres. <http://www.nrcs.usda.gov>

US Dept. of Agriculture – National Resources Conservation (USDA-NRCS), Emergency Watershed Protection Program (EWP). Grant funding and technical assistance for relief from hazards in small watershed areas. <http://www.nrcs.usda.gov>

National Science Foundation (NSF) – Directorate for Engineering, Hazard Reduction Program. Grant funding for research and educational activities related to hazard reduction. <http://www.nsf.gov/funding/>

NYS Consolidated Funding Application (CFA) – Annual grant funding for a variety of planning and mitigation projects through different state and private entities. <https://apps.cio.ny.gov/apps/cfa/>

NYS Office of Storm Recovery - Community Reconstruction Program (NY Rising) – Funding program for rebuilding and identifying long-term community resiliency measures. <http://stormrecovery.ny.gov/>

NYS DOT – Consolidated Local Street & Highway Improvement Program (NYS DOT). Funding for construction or repair of highways, bridges, railroad crossings and other facilities not on the state highway system. <https://www.dot.ny.gov/programs/chips>

NYS OPRHP/EPF – Environmental Protection Fund (NYS OPRHP/EPF), Grant funding for planning and mitigation projects related to open space conservation and environmental improvements. <http://nysparks.com/grants/>

NYSDEC/EPF – Environmental Protection Fund (NYSDEC/EPF), Grant funding for construction or acquisition projects which enhance communities and protect the environment. <http://www.dec.ny.gov/>