Village of Catskill Inventory and Coastal Risk Assessment

For the Catskill Waterfront Resilience Task Force

January 2014

Overview

The New York State Department of State developed an asset inventory and risk assessment tool as part of its New York Rising Community Reconstruction Program. The tool is used to inventory and categorize all of the assets of a community's waterfront, and based on multiple factors to calculate a risk score for each. The resulting scores can be used to examine trends in coastal or riverine flooding risk, and to plan for risk reduction by geography or sector (e.g. critical facilities, vulnerable populations).

Risk scores are calculated according to the formula:

Risk Score = Exposure * Vulnerability * Hazard

Exposure = a sum of Risk Area and Landscape Attributes
Risk area = a score based on location of asset in relation to three modeled risk areas: Moderate (=0.5), High (=1), or Extreme (=2)
Landscape Attributes = an additive score based on six features of the landscape that lie between the assets and the source of flood waters (each feature contributes a score of 0.5 if its character contributes to flood risk, for a possible total range of 0-3).
Vulnerability = an assigned score representing the capacity of an asset to return to service after a storm, ranging from Insignificant (highest capacity, =1) to Major (lowest capacity, =5)
Hazard = a constant representing the likelihood and magnitude of future storm events (100 year storm = 3, 500 year storm = 4)

For a 100 year storm event (Hazard = 3), risk scores can be categorized as follows:

Risk category	Risk score	Consequences of flood
Residual	< 8	Minor or infrequent
Moderate	6 - 23	Moderate to serious
High	32 – 70	Significant
Extreme	> 70	Dangerous

Methods

As part of the Catskill Waterfront Resilience Task Force Initiative, project partners and task force members completed the Inventory and Coastal Risk Assessment created for the NY Rising Community Reconstruction Program. Assets were identified through remote analysis and input from Task Force members. They were categorized according to their class (e.g. Infrastructure Systems, Housing, Economic), class sub-category (e.g. Transportation, Single-Family Residence, Restaurant), importance to socially vulnerable populations, and critical facilities. Individual assets were grouped based on proximity and similar characteristics.

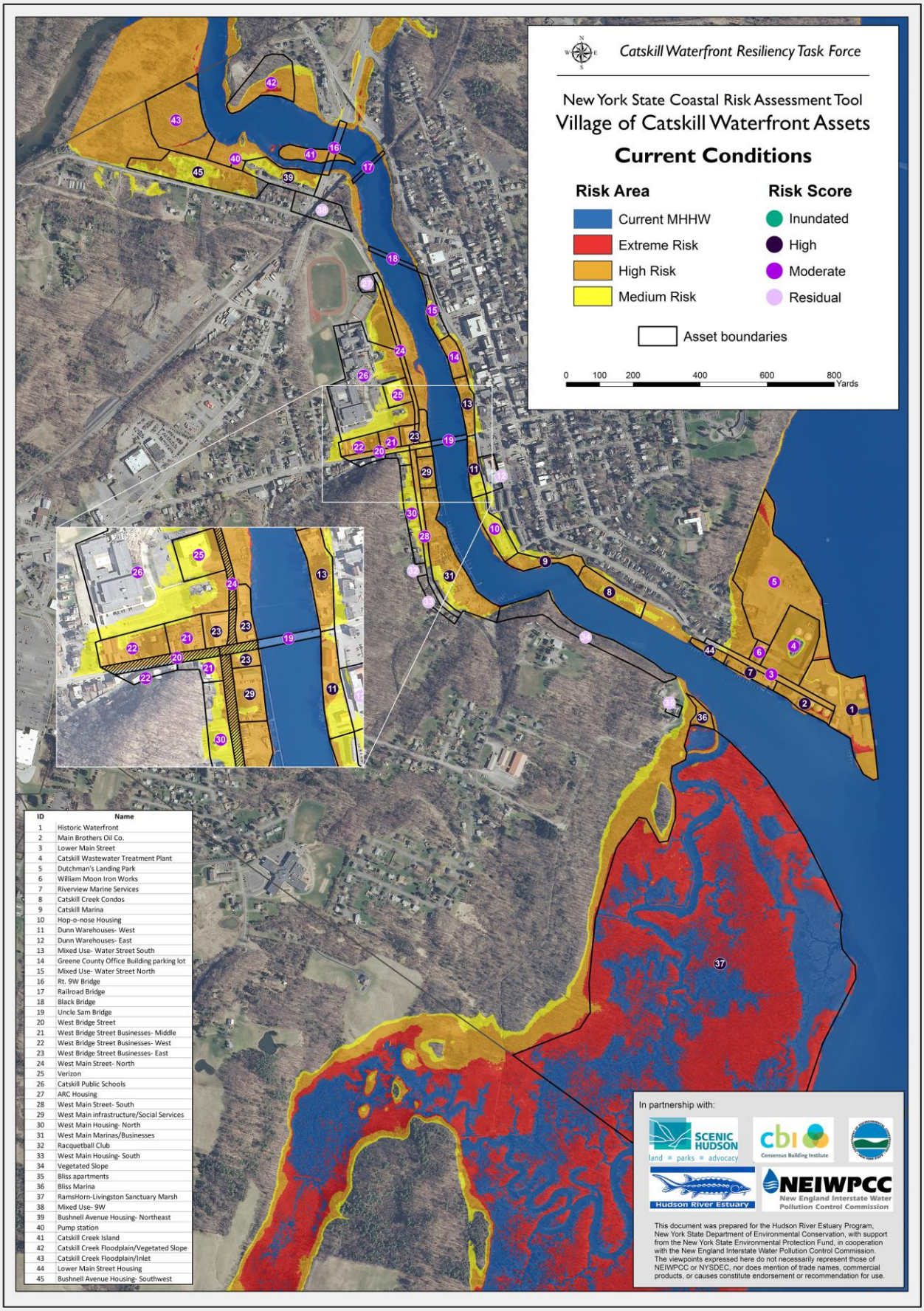
Current risk areas were modeled by Scenic Hudson (a project partner) using methods defined by the New York Rising Community Reconstruction Program, and the following data: a current working model of Hudson River elevation (a vertical datum modeled by New York Harbor Observing and Prediction System), LiDAR elevation data, and Base Flood Elevations[1]. Risk areas were also modeled for the 2020s, 2050s, and year 2100, using 6.5, 21.5, and 60 inches of sea level rise (SLR), respectively. These values represent the middle of ranges expected in these time frames under future rapid ice melt conditions. At the time of analysis the Task Force had not yet made a decision as to whether to use central range or rapid ice melt SLR predictions in analytical tools, so rapid ice melt predictions were somewhat moderated by using the middle of the ranges.

Landscape attribute values were scored based on the modeled risk areas, local knowledge, and remote analysis. Vulnerability scores, which represent the level of impairment or consequences that assets experience from a storm event, were developed in discussion with Task Force members based on their knowledge of the assets and recent storm events (Superstorm Sandy and Hurricane Irene, in particular). Vulnerabilities were estimated where a value was not provided.

Risk scores were calculated for a 100 year storm event (Hazard = 3) for current, 2020s, 2050s, and 2100 conditions.

Additional detail on methodology can be found in the document “Guidance for New York Rising Community Reconstruction Plans: A planning Toolkit for CR Planning Committees” and the associated Assets Inventory and Coastal Risk Assessment Tool, available from the New York Rising Community Reconstruction Program website: http://stormrecovery.ny.gov/community-reconstruction-program

[1] Three different Base Flood Elevations were used for three sections of the study area: 10.5’ between Catskill Point and Uncle Sam Bridge, 17’ between Uncle Sam Bridge and Route 9W Bridge, and 20’ upstream from Route 9W Bridge. The composite BFEs for the village were modeled by Scenic Hudson based on these elevations described by FEMA.



ID	Name
1	Historic Waterfront
2	Main Brothers Oil Co.
3	Lower Main Street
4	Catskill Wastewater Treatment Plant
5	Dutchman's Landing Park
6	William Moon Iron Works
7	Riverview Marine Services
8	Catskill Creek Condos
9	Catskill Marina
10	Hop-o-nose Housing
11	Dunn Warehouses- West
12	Dunn Warehouses- East
13	Mixed Use- Water Street South
14	Greene County Office Building parking lot
15	Mixed Use- Water Street North
16	Rt. 9W Bridge
17	Railroad Bridge
18	Black Bridge
19	Uncle Sam Bridge
20	West Bridge Street
21	West Bridge Street Businesses- Middle
22	West Bridge Street Businesses- West
23	West Bridge Street Businesses- East
24	West Main Street- North
25	Verizon
26	Catskill Public Schools
27	ARC Housing
28	West Main Street- South
29	West Main infrastructure/Social Services
30	West Main Housing- North
31	West Main Marinas/Businesses
32	Racquetball Club
33	West Main Housing- South
34	Vegetated Slope
35	Bliss apartments
36	Bliss Marina
37	RamsHorn-Livingston Sanctuary Marsh
38	Mixed Use- 9W
39	Bushnell Avenue Housing- Northeast
40	Pump station
41	Catskill Creek Island
42	Catskill Creek Floodplain/Vegetated Slope
43	Catskill Creek Floodplain/Inlet
44	Lower Main Street Housing
45	Bushnell Avenue Housing- Southwest

In partnership with:

SCENIC HUDSON land = parks = advocacy

cbi Consensus Building Institute

Hudson River Estuary

NEIWPCC New England Interstate Water Pollution Control Commission

This document was prepared for the Hudson River Estuary Program, New York State Department of Environmental Conservation, with support from the New York State Environmental Protection Fund, in cooperation with the New England Interstate Water Pollution Control Commission. The viewpoints expressed here do not necessarily represent those of NEIWPCC or NYSDEC, nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.

Results

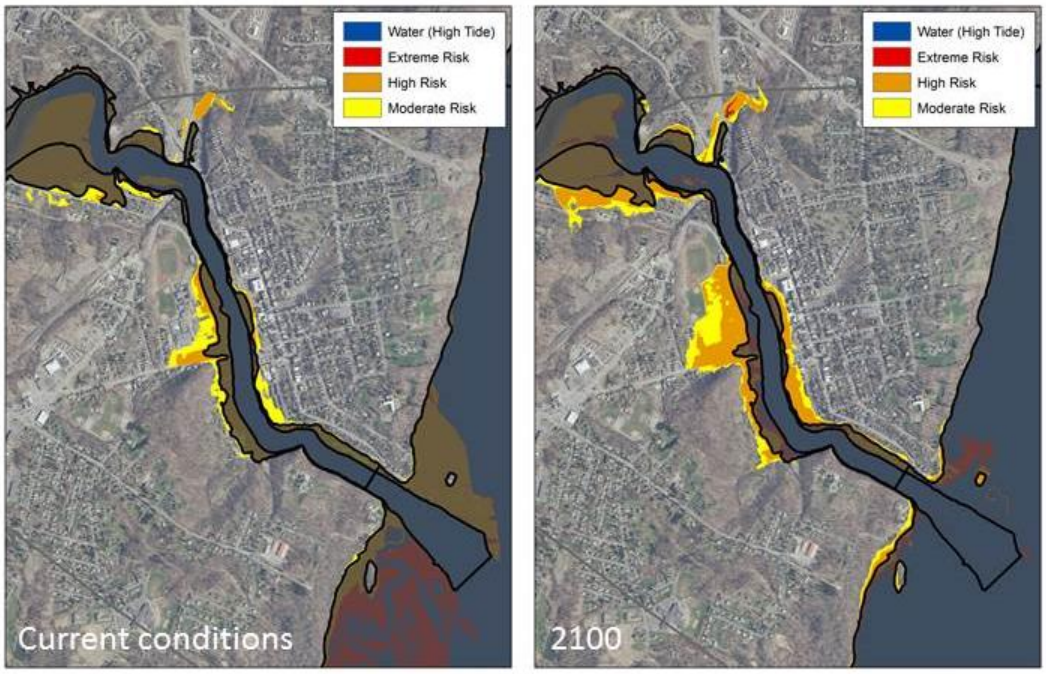
The results below are described for current, 2020s, 2050s and 2100 time frames (corresponding to predicted sea level rise of none, 6.5", 21.5", and 60", respectively). It is important to note that while in reality the time frames of these sea level rise projections may be different, the trends are likely to hold under most conditions. It is also important to note that changes described for these individual time frames in fact describe the range of time leading up to each of them; that is, changes described in the 2100 time frame could in fact occur between the 2050s and 2100 (between 21.5" and 60" SLR).

Risk Areas

The Village of Catskill has varied waterfront topography. Small floodplain areas along Catskill Creek are interspersed with stretches with steeper shoreline topography. At the confluence of the creek with the Hudson River are the low-lying Catskill Point area to the north, and the large tidal RamsHorn Marsh area to the south.

There is little predicted shift in risk areas with 6.5" SLR (2020s time frame). Three of the 45 mapped assets are predicted to advance to a higher risk area category: RamsHorn Marsh (may be considered inundated), Hop-o-nose Housing (increases from Moderate to High), and eastern Dunn Warehouses (will become within the Moderate risk area). A slightly larger, though still incremental shift in risk areas is predicted with 21.5" SLR (the 2050s timeframe). Portions of the Main Brothers Oil Co. will experience regular inundation, and 7 assets will advance into the Extreme risk area category (these assets are by and large found on Catskill Point). A much more pronounced advancement of risk areas is likely by 2100, with a total of 16 assets experiencing regular tidal inundation, including several farther upstream along Catskill Creek.

An examination of FEMA's Base Flood Elevations (BFEs) from Digital Flood Insurance Rate Maps indicates that they do not include all of the current risk areas (which use modeled BFEs based on FEMA flood height and high resolution LiDAR elevation data). Small areas along Bushnell Avenue and West Main Street west of Route 9W, north of West Bridge Street (in the business and school area), and on either side of the creek south of the Uncle Sam Bridge are the most notable examples. In future SLR conditions these areas expand even further beyond the FEMA mapped BFEs and additional small waterfront areas exhibit this trend. This information may be useful in future regulatory planning.

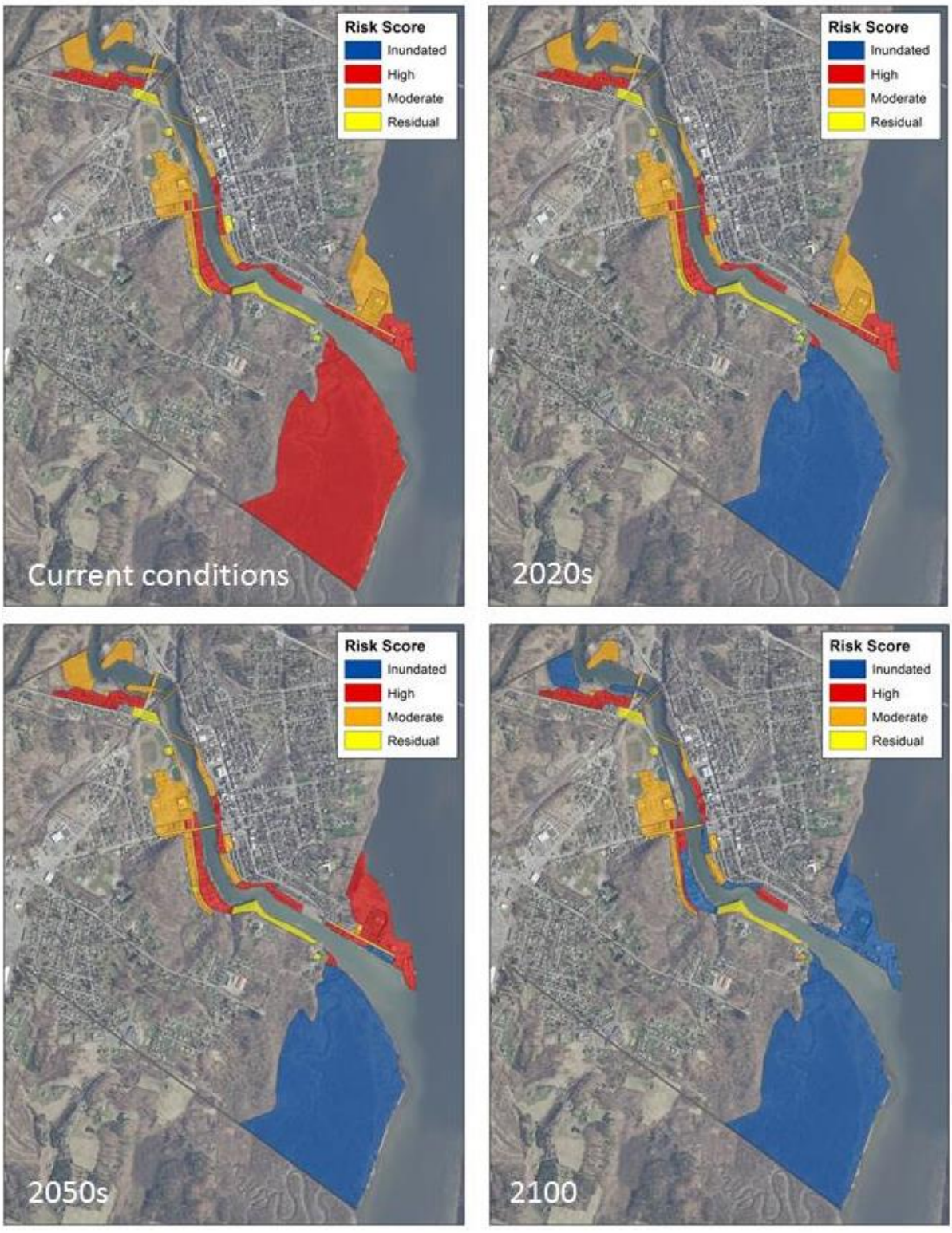


Current and modeled 2100 condition risk areas for Village of Catskill waterfront assets, shown with FEMA's BFEs (in gray overlay with black outlines).

Risk Scores

Risk scores in this analysis ranged from 0-48 (Residual to High). While no assets fell in the Extreme risk category, 16 of the 45 assets were projected to become regularly inundated by 2100 (that is they were in a permanent risk area which is not scored by this tool). Most assets were ranked relatively low for vulnerability, with none rated as a 5 (Major) and only 10 assets receiving a score of 4 (Significant). Since Vulnerability is one of the main factors in the calculation of risk score, these relatively low numbers combined with relatively confined Extreme risk areas to lead to the absence of Extreme risk scores.

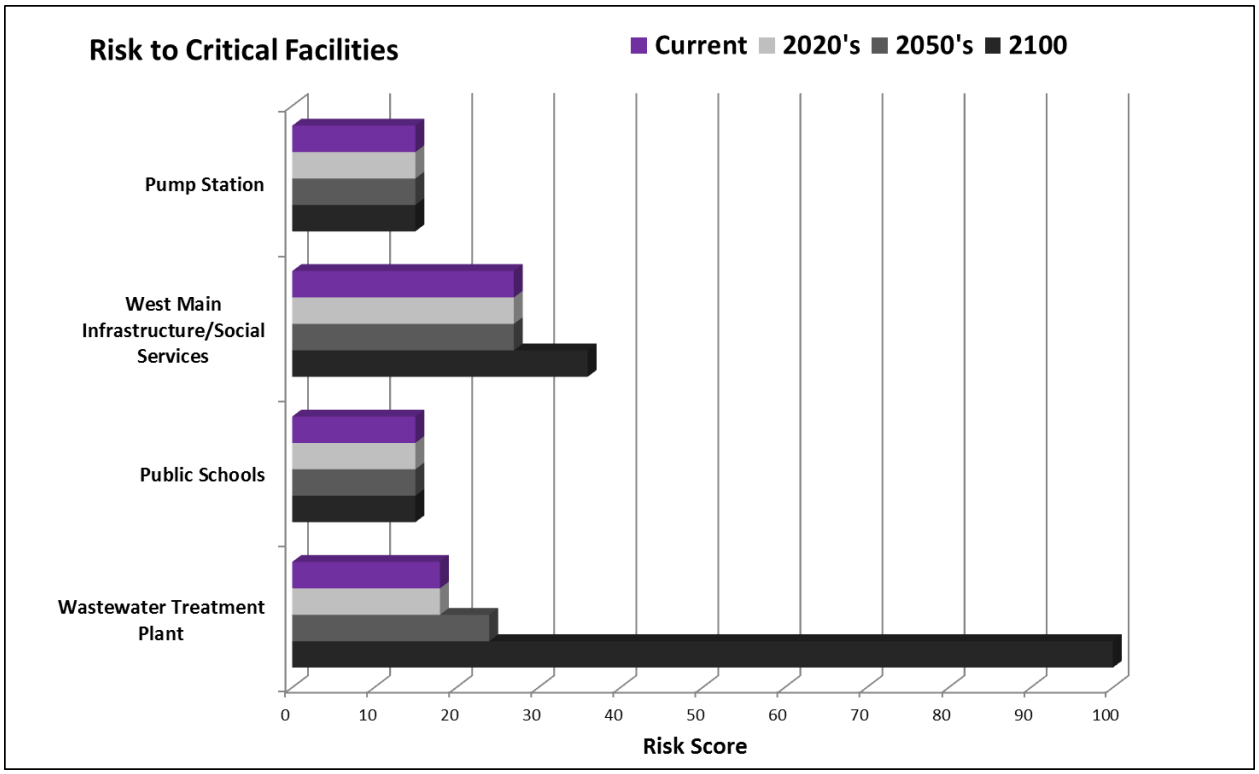
The overall pattern of risk scores is similar to that of the modeled risk areas, but the risk scores also take into account additional ground and situational conditions that are relevant to the overall risk of assets in the village. For instance, an asset in a High or Extreme risk area could have a relatively low risk score if the property has several protective landscape attributes and low vulnerability (due to a flood adapted building design, for example). Below are additional results as examined by components of risk score, various asset categories, and neighborhoods.



Risk scores under current, 2020s, 2050s, and 2100 conditions for Village of Catskill waterfront assets.

Critical facilities and transportation/access assets

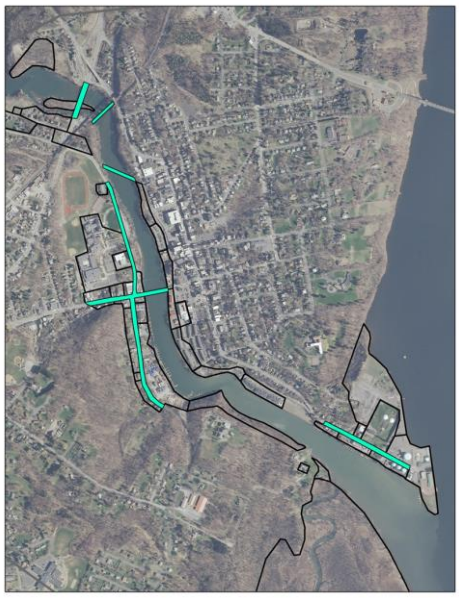
The analysis identified seven assets that are considered critical facilities according to FEMA's definition. Those at highest risk under current conditions are the Greene County Highway Department and a Pump Station (which were grouped along with an adjacent oil business into one asset called West Main Infrastructure/Social Services). While the risk to these two critical facilities is expected to increase with SLR above 21", it is the Wastewater Treatment Plant (located on Catskill Point) that is expected to first experience regular inundation, sometime in the latter half of the century. All other FEMA critical facilities are expected to remain at relatively low risk through the remainder of the century.



Risk scores of non-transportation related critical facilities in Catskill's waterfront. A score of 100 is used to represent assets that are predicted to experience regular inundation.

All of the 9 transportation/access assets included in the analysis are currently at relatively low risk, and most are expected to remain so for the timeframe of this assessment. The most notable exceptions are the stretch of West Main Street north of West Bridge Street and lower Main Street, which are both predicted to experience inundation in the second half of the century. The southern portion of West Main Street and the Greene County Office Building Parking lot are both also expected to become exposed to higher risk (though not become inundated) sometime after the 2050s. West Main Street

north of West Bridge Street provides important access to the Catskill public schools and other assets, and the village may wish to examine ways to extend its longevity. Lower Main Street provides access to Catskill Point, which is expected to experience widespread inundation and is discussed in greater detail below.



Catskill waterfront transportation/access assets included in the analysis (in blue).

Natural Assets

Natural areas along Catskill's waterfront include the large tidal marsh at RamsHorn-Livingston Sanctuary (which extends south beyond the village boundary), a steep vegetated slope on the south side of Catskill Creek near its mouth, and three vegetated floodplain and sloped areas upstream of the Route 9W bridge. The landscape attributes for natural assets, which contribute to the exposure score, were somewhat difficult to classify using this tool. For instance, RamsHorn Marsh is tidal, and by definition is already inundated regularly, and yet it is currently an important natural asset. Without adaptation it is likely that by the 2020s the increased inundation will negatively impact the marsh and the characteristics that may provide protection to other assets, and by the 2050s they will be considerably diminished. The longevity of the marsh and its protective services may be extended by marsh adaptation and/or migration, through natural or human assisted processes (e.g. assisted accretion). Upstream on the Catskill Creek the shore floodplains and island in the creek (known locally as Goat Island) are likely important for attenuating flood waters. They are expected to experience gradual increases in inundation driven by sea level rise.

High Vulnerability

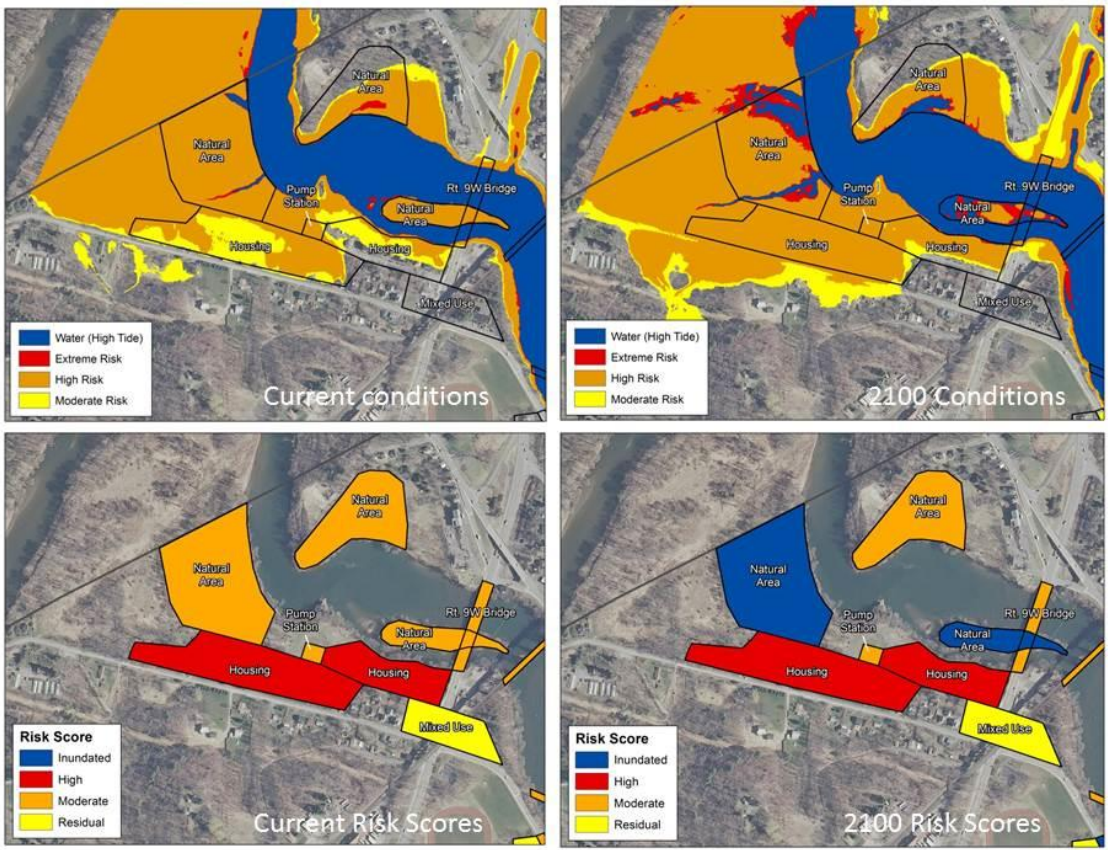
Ten assets were assigned the Significant vulnerability score (the highest score assigned in the village). The assets on this list include small businesses (including marinas), warehouses, mixed use areas, and single-family housing neighborhoods, none of which are considered FEMA critical facilities. All of these assets currently have high risk scores, and are expected to remain in this category into the 2050's. Beyond that time, those that are downstream from the Uncle Sam Bridge are expected to begin experiencing regular inundation. Examining the specific conditions that cause high vulnerability in assets (e.g. mechanicals in the basement) may present opportunities for effective adaptation actions. Most of the high vulnerability assets in Catskill had intermediate exposure scores, so their overall risk does not appear to be disproportionately driven by their vulnerability (i.e. they are both vulnerable and somewhat exposed).

Neighborhoods

Bushnell

The Bushnell waterfront neighborhood, west of Route 9W on the south side of Catskill Creek, includes approximately two dozen single-family homes[2] and a pump station located between the creek and the road. Most homes in the neighborhood, as well as the pump station, are in Moderate and High risk areas currently. Risk areas are expected to become higher without expanding their area significantly beyond their current location in this neighborhood; thus those homes that are outside of current risk areas are likely to remain so for the foreseeable future, while those already in risk areas will more uniformly experience High risk by the end of the century. Several assets on the south side of West Main Street in this part of the village (and which were not included in the description above) will begin experiencing risk by the middle of the century.

The homes, which collectively are considered socially vulnerable assets, demonstrated significant vulnerability during past flooding events, and are experiencing High overall risk. Due primarily to its lower vulnerability, the pump station is categorized as having Moderate risk score. The overall risk for



Bushnell neighborhood Risk Areas (top two images) and asset Risk Scores (bottom two images) under current and modeled 2100 conditions.

[2] This count includes homes between the creek and West Main Street.

the assets in this neighborhood (which are grouped together in this analysis) is not expected to change by the end of the century. However, it should be noted that increasing risk areas will mean increasing overall risk for individual homes, and it is also likely that the vulnerability of homes will increase with time- a factor which is not included in future risk scores. There are three nearby natural assets which may provide some attenuation of both stormwater stream flooding and tidal storm surge flooding. Two of these assets will experience at least partial inundation by the end of the century, which may reduce the efficacy of their protection.

West Bridge Street

A mixed use area centered on West Bridge Street is characterized by small businesses and the Catskill public schools. Most assets in this zone currently fall within the High risk area, though the majority of school buildings are still outside of any risk area. By the end of the century the school buildings are predicted to be in Moderate and High risk areas. Sometime in the second half of the century West Main Street north of West Bridge Street (an important access route) and the small businesses closest to the creek will move into Extreme risk or experience some regular inundation.

In terms of overall risk, most assets in this neighborhood are currently at Moderate risk, with the exception of businesses closest to the creek which are experiencing High risk. As with the Bushnell neighborhood, most assets are not expected to move into higher risk categories by the end of the century. The notable exception is West Main Street north of West Bridge Street, where a stretch of approximately 400 feet located in front of the Verizon building will be partially inundated by 2100.

Catskill Point

Located at the confluence of Catskill Creek and the Hudson River, Catskill point is a low-lying, relatively flat area that is central to the village's waterfront character. The assets identified at Catskill Point include the Catskill Wastewater Treatment Plant (a FEMA critical facility), the Historic Waterfront area, infrastructure assets such as Lower Main Street and an oil company, several small businesses, single-family housing, and Dutchman's Landing (a public waterfront park).

Small Portions of the Main Brothers Oil Company, the park, and the Historic Waterfront already fall within the Extreme risk area. The Oil Company, Historic Waterfront, Riverview Marine Services, and Lower Main Street Housing have High overall risk scores under current conditions for a 100 year event. A 500 year event elevates the risk to all Catskill Point assets but Lower Main Street to High. Risks areas are not expected to change dramatically by the 2020s, but by the 2050s the oil company will experience some inundation, and all but William Moon Iron Works will be in the Extreme risk area. By 2100 the entire Point is expected to experience regular inundation.

Preliminary Observations

The risk assessment indicates that most waterfront assets in the Village of Catskill will experience a relatively slow increase in overall risk in the near-term. This trend affords an opportunity to plan for targeted adaptation to the more dramatic increases in risk that are anticipated in the mid- and long-terms (particularly between 21.5 and 60 inches SLR). Along the Catskill Creek, a handful of assets that are expected to experience regular inundation by 2100 may be effectively protected using traditional fortification measures. A more transformational approach would be necessary to facilitate long-term adaptation for Hudson River waterfront areas, including Catskill Point and RamsHorn Marsh. A neighborhood approach to examining risk shows promise as a tool to analyze this assessment's results and translate them into planning. Future planning tools may be used in this neighborhood approach to address issues such as risk areas extending beyond the delineated FEMA Base Flood areas.

Risk assessment tool assumptions/limitations

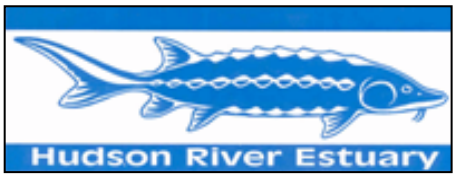
There are two versions of the risk assessment tool: coastal and riverine. The village of Catskill includes both Hudson River shore and frontage on the lower Catskill Creek, and as such is influenced differently depending on the type of storm event (e.g. Hurricane Irene, with stormwater and creek flooding vs. Superstorm Sandy, with coastal storm surge). Using the coastal version of the tool may not adequately capture the influence of surface stormwater and creek flooding, and some landscape attributes of this version are not applicable to estuarine environments (e.g. presence of dunes). However, using the riverine version would similarly fall short in capturing risk from tidal storm influences, and would fail to accurately quantify risk to the Village's Hudson River waterfront. The Project Team examined both tool versions with Catskill's assets and determined that risk scores would not substantially differ between the two. Since the risk areas were modeled using methodology described for the coastal tool (and not including a riverine stormwater flow component), the team ultimately selected and used the coastal version of the tool.

The vulnerability score of the tool is a major driver of the final risk score. The Project Team used Task Force member input on vulnerability scores whenever possible, but in some cases had to estimate vulnerability. In addition, future sea level rise conditions will change vulnerability scores, but the same vulnerability scores were used in all future models due to the difficulty in predicting how future vulnerability will change. Thus the change in *future* risk scores is driven disproportionately by exposure (a function of modeled risk area and landscape attributes).

Landscape attributes were relatively uniform in the Village of Catskill, with no assets considered to have adequate shore defenses or protective vegetation. The only attribute that changed in future SLR conditions was the waterline ("Beach Width"), and this attribute only changed for a small number of assets (6) in the 2100 SLR conditions; most assets that had a predicted change in this attribute scoring were already predicted to be inundated in 2100. Thus the risk area is the predominant driver of the exposure score in the analysis for Catskill.

An examination of risk changes in smaller time/SLR steps (particularly between 21.5 and 60 inches) would likely help clarify trends and prioritize adaptation planning for specific assets, but is outside of the current scope of the project.

Support and technical assistance for this project comes from NYS Department of Environmental Conservation Hudson River Estuary Program, the New England Interstate Water Pollution Control Commission, Scenic Hudson, the Consensus Building Institute, and the Lincoln Institute of Land Policy.



This document was prepared for the Hudson River Estuary program, New York State Department of Environmental Conservation, with support from the New York State Environmental Protection Fund, in cooperation with the New England Interstate Water Pollution Control Commission. The viewpoints expressed here do not necessarily represent those of NEIWPCC or NYSDEC, nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.

ID	Name	Class	Sub-class	FEMA critical facility	Socially vulnerable	Current Risk Area	6.5" SLR Risk Area	21.5" SLR Risk Area	60" SLR Risk Area
1	Historic Waterfront			No, Locally Significant	No	High	High	Extreme	Inundated
2	Main Brothers Oil Co.	Infrastructure_Systems	Liquid Fuels	No	No	Extreme	Extreme	Inundated	Inundated
3	Lower Main Street	Infrastructure_Systems	Transportation	No, Locally Significant	No	High	High	Extreme	Inundated
4	Catskill Wastewater Treatment Plant	Health_and_Social_Services	Public Works Facilities	Yes	No	High	High	Extreme	Inundated
5	Dutchman's Landing Park	Natural_and_Cultural_Resources	Parks and Recreation	No	No	High	High	Extreme	Inundated
6	William Moon Iron Works	Economic	Industrial, Warehousing and Manufacturing	No	No	High	High	High	Inundated
7	Riverview Marine Services	Economic	Marina/Water Based Business	No	No	High	High	Extreme	Inundated
8	Catskill Creek Condos	Housing	Multi-Family Residence	No	Yes	High	High	High	High
9	Catskill Marina	Economic	Marina/Water Based Business	No	No	High	High	Extreme	Inundated
10	Hop-o-nose Housing	Housing	Multi-Family Residence	No	Yes	Moderate	High	High	High
11	Dunn Warehouses- West	Economic	Industrial, Warehousing and Manufacturing	No	No	High	High	High	Inundated
12	Dunn Warehouses- East	Economic	Industrial, Warehousing and Manufacturing	No	No	N/A	Moderate	Moderate	High
13	Mixed Use- Water Street South	Economic	Downtown Center	No	No	High	High	High	High
14	Greene County Office Building parking lot	Infrastructure_Systems	Transportation	No	No	High	High	High	Extreme
15	Mixed Use- Water Street North			No	No	Moderate	Moderate	High	High
16	Rt. 9W Bridge	Infrastructure_Systems	Transportation	Yes	No	High	High	High	High
17	Railroad Bridge	Infrastructure_Systems	Transportation	No	No	High	High	High	High
18	Black Bridge	Infrastructure_Systems	Transportation	No	No	High	High	High	High
19	Uncle Sam Bridge	Infrastructure_Systems	Transportation	Yes	No	High	High	High	High
20	West Bridge Street	Infrastructure_Systems	Transportation	No, Locally Significant	No	High	High	High	High
21	West Bridge Street Businesses- Middle	Economic	Small Business	No	No	High	High	High	High
22	West Bridge Street Businesses- West	Economic	Small Business	No	No	High	High	High	High
23	West Bridge Street Businesses- East	Economic	Small Business	No	No	High	High	High	Extreme
24	West Main Street- North	Infrastructure_Systems	Transportation	No, Locally Significant	No	High	High	High	Inundated
25	Verizon	Infrastructure_Systems	Telecommunications	No	No	High	High	High	High
26	Catskill Public Schools	Health_and_Social_Services	Schools	Yes	Yes	High	High	High	High
27	ARC Housing	Housing	Supportive Housing	No, Locally Significant	Yes	N/A	N/A	N/A	N/A
28	West Main Street- South	Infrastructure_Systems	Transportation	No, Locally Significant	No	High	High	High	Extreme
29	West Main infrastructure/Social Services			Yes	No	High	High	High	Extreme
30	West Main Housing- North	Housing		No	Yes	Moderate	Moderate	High	High
31	West Main Marinas/Businesses	Economic		No	No	High	High	High	Inundated
32	Racquetball Club	Natural_and_Cultural_Resources	Parks and Recreation	No	No	N/A	N/A	N/A	High
33	West Main Housing- South	Housing	Single-Family Residence	No	No	N/A	N/A	Moderate	High
34	Vegetated Slope	Natural_and_Cultural_Resources	Natural Habitats	No	No	N/A	N/A	N/A	N/A
35	Bliss apartments	Housing	Multi-Family Residence	No	Yes	N/A	N/A	N/A	Moderate
36	Bliss Marina	Economic	Marina/Water Based Business	No	No	High	High	High	Inundated
37	RamsHorn-Livingston Sanctuary Marsh	Natural_and_Cultural_Resources	Parks and Recreation	No	No	Extreme	Inundated	Inundated	Inundated
38	Mixed Use- 9W			No	Yes	N/A	N/A	N/A	N/A
39	Bushnell Avenue Housing- Northeast	Housing	Single-Family Residence	No, Locally Significant	Yes	High	High	High	High
40	Pump station	Infrastructure_Systems	Water Supply	Yes	No	High	High	High	High
41	Catskill Creek Island	Natural_and_Cultural_Resources	Natural Habitats	No	No	High	High	High	Inundated
42	Catskill Creek Floodplain/Vegetated Slope	Natural_and_Cultural_Resources	Natural Habitats	No	No	High	High	High	Extreme
43	Catskill Creek Floodplain/Inlet	Natural_and_Cultural_Resources	Natural Habitats	No	No	High	High	High	Inundated
44	Lower Main Street Housing	Housing	Single-Family Residence	No	No	High	High	Extreme	Inundated
45	Bushnell Avenue Housing- Southwest	Housing	Single-Family Residence	No, Locally Significant	Yes	High	High	High	High

ID	Name	Current Landscape Attribute Score	6.5" SLR Landscape Attribute Score	21.5" SLR Landscape Attribute Score	60" SLR Landscape Attribute Score	Vulnerability	Current Exposure Score	6.5" SLR Exposure Score	21.5" SLR Exposure Score	60" SLR Exposure Score	Current Risk Score- 100 year event	6.5" SLR Risk Score	21.5" SLR Risk Score	60" SLR Risk Score
1	Historic Waterfront	2	2	2	2	4	3	3	4	Inundated	36	36	48	Inundated
2	Main Brothers Oil Co.	2	2	2	2	2	4	4	Inundated	Inundated	24	24	Inundated	Inundated
3	Lower Main Street	1.5	1.5	1.5	2	2	2.5	2.5	3.5	Inundated	15	15	21	Inundated
4	Catskill Wastewater Treatment Plant	2	2	2	2.5	2	3	3	4	Inundated	18	18	24	Inundated
5	Dutchman's Landing Park	2.5	2.5	2.5	2.5	2	3.5	3.5	4.5	Inundated	21	21	27	Inundated
6	William Moon Iron Works	1.5	1.5	1.5	2	3	2.5	2.5	2.5	Inundated	22	22	22	Inundated
7	Riverview Marine Services	2	2	2	2	4	3	3	4	Inundated	36	36	48	Inundated
8	Catskill Creek Condos	2	2	2	2	3	3	3	3	3	27	27	27	27
9	Catskill Marina	2	2	2	2	4	3	3	4	Inundated	36	36	48	Inundated
10	Hop-o-nose Housing	2	2	2	2	2	2.5	3	3	3	15	18	18	18
11	Dunn Warehouses- West	2	2	2	2	4	3	3	3	Inundated	36	36	36	Inundated
12	Dunn Warehouses- East	1.5	1.5	1.5	1.5	1	0	2	2	2.5	0	6	6	8
13	Mixed Use- Water Street South	2	2	2	2	4	3	3	3	3	36	36	36	36
14	Greene County Office Building parking lot	2	2	2	2	2	3	3	3	4	18	18	18	24
15	Mixed Use- Water Street North	2	2	2	2	1	2.5	2.5	3	3	8	8	9	9
16	Rt. 9W Bridge	2	2	2	2	1	3	3	3	3	9	9	9	9
17	Railroad Bridge	2	2	2	2	1	3	3	3	3	9	9	9	9
18	Black Bridge	2	2	2	2	1	3	3	3	3	9	9	9	9
19	Uncle Sam Bridge	2	2	2	2	2	3	3	3	3	18	18	18	18
20	West Bridge Street	1.5	1.5	1.5	1.5	1	2.5	2.5	2.5	2.5	8	8	8	8
21	West Bridge Street Businesses- Middle	1.5	1.5	1.5	1.5	1	2.5	2.5	2.5	2.5	8	8	8	8
22	West Bridge Street Businesses- West	1.5	1.5	1.5	1.5	1	2.5	2.5	2.5	2.5	8	8	8	8
23	West Bridge Street Businesses- East	2	2	2	2	4	3	3	3	4	36	36	36	48
24	West Main Street- North	1.5	1.5	1.5	2	2	2.5	2.5	2.5	Inundated	15	15	15	Inundated
25	Verizon	1.5	1.5	1.5	2	2	2.5	2.5	2.5	3	15	15	15	18
26	Catskill Public Schools	1.5	1.5	1.5	1.5	2	2.5	2.5	2.5	2.5	15	15	15	15
27	ARC Housing	1.5	1.5	1.5	1.5	1	N/A	N/A	N/A	N/A	0	0	0	0
28	West Main Street- South	1.5	1.5	1.5	2	2	2.5	2.5	2.5	4	15	15	15	24
29	West Main infrastructure/Social Services	2	2	2	2	3	3	3	3	4	27	27	27	36
30	West Main Housing- North	1.5	1.5	1.5	1.5	2	2	2	2.5	2.5	12	12	15	15
31	West Main Marinas/Businesses	2	2	2	2	4	3	3	3	Inundated	36	36	36	Inundated
32	Racquetball Club	1.5	1.5	1.5	1.5	1	N/A	N/A	N/A	2.5	0	0	0	8
33	West Main Housing- South	1.5	1.5	1.5	1.5	1	N/A	N/A	2	2.5	0	0	6	8
34	Vegetated Slope	2	2	2	2	1	N/A	N/A	N/A	N/A	0	0	0	0
35	Bliss apartments	1.5	1.5	1.5	1.5	1	N/A	N/A	N/A	2	0	0	0	6
36	Bliss Marina	2	2	2	2	4	3	3	3	Inundated	36	36	36	Inundated
37	RamsHorn-Livingston Sanctuary Marsh	2	2	2	2	3	4	Inundated	Inundated	Inundated	36	Inundated	Inundated	Inundated
38	Mixed Use- 9W	1.5	1.5	1.5	1.5	1	N/A	N/A	N/A	N/A	0	0	0	0
39	Bushnell Avenue Housing- Northeast	2	2	2	2	4	3	3	3	3	36	36	36	36
40	Pump station	1.5	1.5	1.5	1.5	2	2.5	2.5	2.5	2.5	15	15	15	15
41	Catskill Creek Island	2	2	2	2	1	3	3	3	Inundated	9	9	9	Inundated
42	Catskill Creek Floodplain/Vegetated Slope	2	2	2	2	1	3	3	3	4	9	9	9	12
43	Catskill Creek Floodplain/Inlet	2	2	2	2	1	3	3	3	Inundated	9	9	9	Inundated
44	Lower Main Street Housing	2	2	2	2	3	3	3	4	Inundated	27	27	36	Inundated
45	Bushnell Avenue Housing- Southwest	1.5	1.5	1.5	1.5	4	2.5	2.5	2.5	2.5	30	30	30	30

ID	Name	Notes
1	Historic Waterfront	Includes the Historic Catskill Point/Warehouse/Museum (Locally Significant), Ferro property, Frank Guido's Port of Call
2	Main Brothers Oil Co.	
3	Lower Main Street	
4	Catskill Wastewater Treatment Plant	
5	Dutchman's Landing Park	Includes concession stand (vulnerability=1)
6	William Moon Iron Works	
7	Riverview Marine Services	
8	Catskill Creek Condos	
9	Catskill Marina	Eastern area- former marina?
10	Hop-o-nose Housing	
11	Dunn Warehouses- West	
12	Dunn Warehouses- East	
13	Mixed Use- Water Street South	Includes Catskill Mill and mixed use building (w/ housing)
14	Greene County Office Building parking lot	
15	Mixed Use- Water Street North	Includes multi-family housing and commercial (?); vulnerability estimated
16	Rt. 9W Bridge	
17	Railroad Bridge	
18	Black Bridge	
19	Uncle Sam Bridge	
20	West Bridge Street	Vulnerability estimated
21	West Bridge Street Businesses- Middle	Includes Ellas Castle, Catskill Florist, West Side Salon, El Caribe (restaurant), Oils and soaps, Dimentions North (vulnerability=2), Captain Kidds (vulnerability=4)
22	West Bridge Street Businesses- West	Includes The Old Firehouse, J&E Air Systems, Homestead Funding Corp, Multi-family residence, Athens Aquatics, Tinman Heating & Cooling, and 2 vacant buildings (21 and 35 West Bridge St), Curtron building
23	West Bridge Street Businesses- East	Includes Mountain T-shirts, Rivertide Aikido (and dance studio?), Con-E Island, Kids Only, Henderson monuments
24	West Main Street- North	Vulnerability estimated
25	Verizon	
26	Catskill Public Schools	Includes middle and high schools
27	ARC Housing	
28	West Main Street- South	
29	West Main infrastructure/Social Services	Includes Greene Co. Hwy Dept (FEMA, vulnerability=4), Henderson Oil, Pump station (FEMA, vul=2)
30	West Main Housing- North	Includes Colonial Condos (multi-family residence, socially vulnerable)
31	West Main Marinas/Businesses	Includes Catskill Yacht Club, Hop-O-Nose Marina, Creekside Restaurant, vacant parcel (with economic potential)
32	Racquetball Club	
33	West Main Housing- South	
34	Vegetated Slope	
35	Bliss apartments	
36	Bliss Marina	
37	RamsHorn-Livingston Sanctuary Marsh	
38	Mixed Use- 9W	Includes apartments, car dealership, and Twin-County Rehab Center (healthcare facility, Locally Significant)
39	Bushnell Avenue Housing- Northeast	Includes Bushnell Ave (vulnerability=2)
40	Pump station	
41	Catskill Creek Island	
42	Catskill Creek Floodplain/Vegetated Slope	
43	Catskill Creek Floodplain/Inlet	
44	Lower Main Street Housing	Incldules 115-121 Main Street
45	Bushnell Avenue Housing- Southwest	Includes Bushnell Ave (vulnerability=2)