Weathering the Storm:
Adaptation and Resiliency

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Observed and Projected Climate Change in New York State: An Overview

Developed for the Community Risk and Resiliency Act (CRRA) Drafting Teams

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Background

In January 2015, Governor Cuomo released his 2015 Opportunity Agenda, which included goals for a "Climate Smart NY." The programs and initiatives outlined in Climate Smart NY advance implementation of the Community Risk and Resiliency Act (CRRA), which requires State agencies to incorporate consideration of future physical climate risks caused by storm surges, sea-level rise, and flooding in certain permitting, funding, and regulatory decisions.

Based on the most current information on observed and projected climate change for New York State, the Department of Environmental Conservation (DEC), Department of State (DOS) and its partner agencies (including Department of Agriculture and Markets (DAM); Department of Transportation (DOT); Office of Parks, Recreation and Historic Preservation (OPRHP); Department of Health (DOH); Energy Research and Development Authority (NYSDERA); Environmental Facilities Corporation (EFC); and Dormitory Authority (DASNY)) have developed implementation guidance describing application requirements for applicants in programs covered by CRRA, and review procedures for agency staff.

This document provides a summary of observed and projected climatic conditions, and potential effects of changes in these conditions, for New York State. This information is primarily derived from "ClimAID: the Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State," published in 2011 by NYSERDA. In 2014, the ClimAID assessment was updated using new datasets, improved baseline scenarios, and the latest generation of climate models and emissions projections. The 2014 update provides the latest observations and projections for changes in climate in New York through 2100, while the full 2011 report articulates, by sector, the likely impacts these kinds of changes will have across the state.[1] This information is consistent with, and builds upon, the observations of observed climate change reported for the northeastern United States in the Third National Climate Assessment.[2]

As noted in the ClimAID reports, climate projections have uncertainty embedded within them. The projections are derived by downscaling global climate models, and it is possible that climate sensitivity could exceed or fall below the range in the models used. For New York in

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[1] Rosenzweig, C., W. Solecki, A. DeGaetano, M. O'Grady, S. Hassol, P. Grabhorn (Eds.). 2011. Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation. Technical Report. New York State Energy Research and Development Authority (NYSERDA), Albany, New York; Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W.Solecki. 2014(a). Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information. New York State Energy Research and Development Authority (NYSERDA), Albany, New York. Both reports available at http://www.nyserda.ny.gov/climaid.

[2] Horton, R., G. Yohe, W. Easterling, R Kates, M. Ruth, E. Sussman, A. Whelchel, D. Wolfe, and F. Lipschultz, 2014(b): Ch. 16: Northeast. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 16-1-nn. (http://nca2014.globalchange.gov/report/regions/northeast); Horton et al., 2012. Climate Change in the Northeast: A Sourcebook. Draft Technical Input Report prepared for the U.S. National Climate Assessment (http://data.globalchange.gov/file/390430f9-9cbf-4710-ba43-2ffa762754dc).

particular more research is needed on climate variability in the future, as well as on how microclimates may differ from regional projections.

Climate Change in New York State

Historically, New York State's climate can be described as humid continental. The average annual temperature varies from about 40ºF in the Adirondacks to about 55ºF in the New York City metropolitan area. The wettest parts of the state – including parts of the Adirondacks and Catskills, the Tug Hill Plateau, and portions of the New York City metropolitan area – average approximately 50 inches of precipitation per year. Mountain effects produce localized amounts of precipitation in excess of 60 inches at inland locations.[3] Parts of western New York are relatively dry, averaging about 30 inches of precipitation per year. In all regions, precipitation is relatively consistent in all seasons, although droughts and floods are not uncommon.

Observed Climate Change[4,5]

Changes from the historical climate have already been observed across New York State, mirroring observations for the northeastern United States as a whole.

Temperature
The annual average temperature statewide has risen about 1.3° C (2.4 °F) since 1970, with winter warming exceeding 2.4° C (4.4 °F); New York has warmed at an average rate of 0.14° C (0.25 °F)/decade since 1900. Annual average temperatures increased in all regions.

Precipitation
All seven stations used for the trend analysis in the 2014 ClimAID update show increasing average annual precipitation since 1900. In addition to increased mean annual precipitation across New York State, year-to-year (and multiyear) variability of precipitation has become more pronounced.[6] The pattern of precipitation has changed with increased precipitation in the winter and decreased precipitation in the summer, raising the risk of drought while adversely affecting drinking water supply.[7]

The northeastern United States has experienced a greater recent increase in extreme precipitation than any other region in the United States; between 1958 and 2010, the northeast saw more than a 70% increase in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events).[8]

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[3] Horton et al., 2014(b) and Horton et al., 2012.
[4] Rosenzweig et al., 2011; Horton et al., 2014(a).
[5] Horton, R. et al., 2014(b); Horton et al., 2012.
[6] Horton et al., 2014(a).
[7] NYS 2100 Commission, 2013. http://www.governor.ny.gov/sites/governor.ny.gov/files/archive/assets/documents/NYS2100.pdf
[8] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

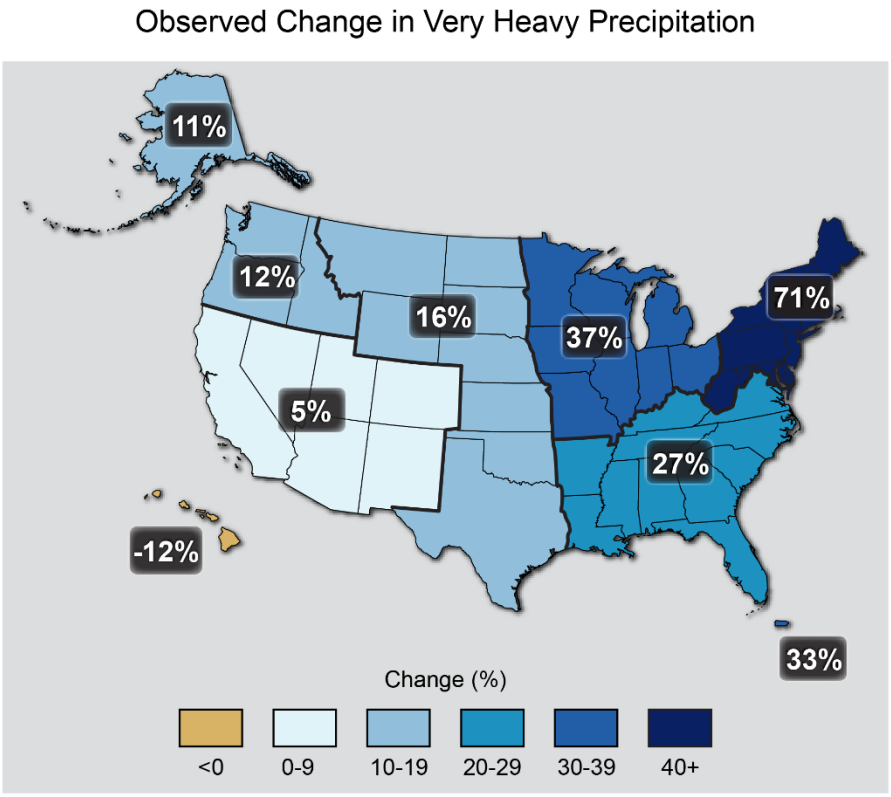

Figure 1. Observed increase in precipitation 1958-2010.[9]

New York State averages more than 40 inches per year of snow, varying regionally depending on topography and the proximity to large lakes and the Atlantic Ocean. The warming influence of the Atlantic Ocean keeps snow in the New York metropolitan region and Long Island below 36 inches per year, but snowfall amounts occasionally exceed 20 inches during nor'easters.

In addition to increased mean annual precipitation, year-to-year (and multiyear) variability of precipitation has become more pronounced. For all ClimAID stations, the standard deviation of annual precipitation (a measure of variability) was greater over the 1956 to 2012 period compared to 1900 to 1955.

Lake-Effect Snow

Lake-effect snows are an extreme precipitation phenomenon affecting areas adjacent to Lakes Ontario and Erie (and, to a lesser extent, the Finger Lakes). Arctic air masses moving over the relatively warm eastern Great Lakes are warmed, humidified, and destabilized, often leading to intense bands of heavy snowfall, generating as much as 48 inches of snow in a single storm. These events can last anywhere from an hour to a few days. Maximum seasonal snowfall in the state is more than 175 inches in parts of the Adirondacks and Tug Hill Plateau. Lake-

[9] The changes shown in this figure are calculated from the beginning and end points of the trends for 1958 to 2012. Figure source: updated from Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.), 2009. Global Climate Change Impacts in the United States. Cambridge University Press. Taken from Melillo, J.M. et al., 2014.

enhanced snowfall is localized; areas within miles of each other can experience large differences in snowfall totals.

There is also evidence of an increase in lake-effect snowfall along and near the southern and eastern shores of the Great Lakes since 1950.[10] Lake-effect snow is produced by the strong flow of cold air across large areas of relatively warmer ice-free water. As the climate has warmed, ice coverage on the Great Lakes has fallen. The maximum seasonal coverage of Great Lakes ice decreased at a rate of about 8 percent per decade from 1973 through 2008, amounting to a roughly 30 percent decrease in ice coverage.[11]

Extreme Precipitation and Coastal Storms
From 1851-2014, 12 hurricanes struck New York State.[12] The frequency, intensity, and duration of extreme precipitation events and coastal storms and flooding are increasing, exemplified by the pattern of extreme weather in 2011 (Hurricane Irene and Tropical Storm Lee), 2012 (Hurricane Sandy), 2013 (Niagara County and Mohawk Valley flooding), and 2014 (Long Island flooding).

Sea-level Rise[13]
Sea level along New York's ocean coast and in the Hudson River has risen by more than one foot since 1900, or about 1.2 in/decade. CRRA directed DEC to adopt science-based sea-level rise projections and to provide guidance to help State agencies apply these projections. The projections should be used as the basis for State adaptation decisions and are available for use by all decision makers. The projections allow decision makers to consider the probability that specified levels of sea-level rise will be exceeded as well as the consequences of the exceedance and the costs of preparing for it.

To comply with CRRA, DEC has adopted 6 NYCRR Part 490, Projected Sea-level Rise. Part 490 is applicable in three regions of New York State - the tidal coast of Long Island; New York City and the Lower Hudson River upstream to Kingston; and the Mid-Hudson River from Kingston, NY upstream to the federal dam in Troy, NY (see Figure XX). All three regions exhibit small differences in relative sea-level rise due to local conditions. Five projections are provided for each of the three regions, *i.e.*, low (L), low-medium (L-M), medium (M), high-medium (H-M) and high (H), qualitative terms referring to the rate of rise and not to ultimate water level itself.[14] Warming of the Earth to date has already locked us in to at least six feet of global sea-level rise above current levels;[15] we simply do not know the precise rate at which this rise will occur. Finally, each of these projections is presented for four different time

[10] Cook, E.R., P.J. Bartlein, N. Diffenbaugh, R. Seager, B.N. Shuman, R.S. Webb, J.W. Williams, and C. Woodhouse, 2008: Hydrological variability and change. In: Abrupt Climate Change. Synthesis and Assessment Product 3.4. U.S. Geological Survey, Reston, VA, pp. 143-257.
[11] Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.), 2009. Global Climate Change Impacts in the United States. Cambridge University Press.
[12] National Weather Service, National Hurricane Center, Miami, FL; Chronological List of all Hurricanes: 1851-2014. Revised May 2015. NOAA Atlantic Oceanographic and Meteorological Laboratory Hurricane Research Division (http://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html).
[13] NYS Sea-level Rise Projections, 6 NYCRR Part 490
[14] **L** = Low projection, the amount of sea-level rise that is very likely (the 10th percentile of ClimAID model outputs) to be exceeded by the specified time interval. **L-M** = Low-medium projection, the amount of sea-level rise that is likely (the 25th percentile of ClimAID model outputs) to be exceeded by the specified time interval. **M** = Medium projection, the amount of sea-level rise that is about as likely as not (the mean of the 25th and 75th percentiles of ClimAID model outputs) to be exceeded by the specified time interval. **H-M** = High-medium projection, the amount of sea-level rise that is unlikely (the 75th percentile of ClimAID model outputs) to be exceeded by the specified time interval. **H** = High projection, the amount of sea-level rise that is very unlikely (the 90th percentile of ClimAID model outputs) to be exceeded by the specified time interval.
[15] Strauss, B.H., 2013. Rapid accumulation of committed sea-level rise from global warming. Proceedings of the National Academy of Sciences, vol. 110 no. 34, pp. 13699–13700. (www.pnas.org/cgi/doi/10.1073/pnas.1312464110)

periods: the 2020s, 2050s, 2080s, and the year 2100 (see Table 1).[16] As shown, along the seacoast and tidal portion of the Hudson River (to the Federal Dam at Troy), sea-level rise could be up to 30 inches by the 2050s, up to four feet by the 2080s, and up to six feet by 2100.

Table 1. New York State Sea-level Rise Projections, 6 NYCRR Part 490

Region	Long Island					NYC/Lower Hudson					Mid-Hudson				
Descriptor	L	L-M	M	H-M	H	L	L-M	M	H-M	H	L	L-M	M	H-M	H
2020s	2	4	6	8	10	2	4	6	8	10	1	3	5	7	9
2050s	8	11	16	21	30	8	11	16	21	30	5	9	14	19	27
2080s	13	18	29	39	58	13	18	29	39	58	10	14	25	36	54
2100	15	21	34	47	72	15	22	36	50	75	11	18	32	46	71

Values represent inches of rise over baseline level, which is defined as the average level of the surface of marine or tidal water over the years 2000 through 2004.

Projected Climate (see Tables 2-9)

Without a dramatic decrease in the global generation of greenhouse gases like carbon dioxide, critical changes can be expected in New York's climate over the next century:

- **Annual average temperatures** in New York State are projected to rise 2.2° C to 5° C (4° F to 9° F) by the 2080s.[17]
- The number and duration of **extreme heat events** are likely to increase.
- **Short-term droughts** are anticipated to become more frequent.
- **Average precipitation** is projected to increase five to 15 percent by the 2080s, with most of the increase occurring in winter. Intense downpours will likely become more frequent.
- **Extreme weather events** are predicted to occur with increasing frequency as a result of the changing climate.
- The probability of **extreme lake-effect snows**, such as affected western New York in 2014, is likely to increase in the near future.

Given these trends and projections of future changes, past climate will likely be a less consistent predictor of future climate, and, in turn, past climate records may not suffice as benchmarks for forecasting.

Temperature

New Yorkers can expect an increase in average temperature ranging from 4 to 10°F by 2100, primarily in the form of warmer winters. Climate change modeling predicts that the anticipated increases in temperature will not be uniform across New York State and some areas may be more affected by these changes than others. By 2100, the greatest warming is projected in the northern parts of the state. Summers will become warmer and winters milder. Climate change

[16] Consistent with ClimAID, all parameters except sea-level rise throughout are presented for 30-year timeslices. For sea-level rise, the multidecadal approach is not necessary due to lower interannual variability; the 2020s timeslice for sea level (for example) therefore refers to the period from 2020–2029.

[17] Consistent with ClimAID, all parameters except sea-level rise throughout are presented for 30-year timeslices centered on the 2020s, 2050s, and 2080s. For example, the 2080s timeslice refers to the period from 2070 to 2099. For sea-level rise, the multidecadal approach is not necessary due to lower interannual variability; the 2020s timeslice for sea level (for example) therefore refers to the period from 2020–2029.

will extend growing seasons for species where temperature predominates growth, with photoperiod-controlled species being less affected by warming.

Precipitation

Projected changes in precipitation show variation across New York State. The greatest increases in precipitation are projected in the northern parts of the state, with much of this additional precipitation anticipated to occur during winter but increasingly as rain rather than snow.

Precipitation intensity is projected to increase everywhere, with the largest increases projected to occur in areas in which average precipitation increases the most (such as the northeastern United States). The northeast (and, therefore, New York State) is expected to experience the largest increases in heavy precipitation events.[18]

If intensity of sub-daily rainfall[19] (particularly in periods of less than an hour) is considered, there is evidence from historical data and regional climate modeling to suggest that the intensity of sub-daily rainfall events will increase as temperatures increase. Short, intense precipitation events can often exceed the absorption rate or ability of rainwater to infiltrate into the ground, which can dramatically increase runoff and the potential for flooding.

There also is a strong correlation between increased rainfall amounts and increases in air temperature. Warmer air is able to hold more moisture and if the atmosphere is able to hold more water, rainfall amounts would be expected to increase, particularly for the sub-daily rainfall events. According to a recent study,[20] one-hour rainfall amounts increased 7% for every degree Fahrenheit of air temperature increase.

Lake-Effect Snow

Models suggest the decreasing trend in ice cover on the Great Lakes will lead to increased lake-effect snow in the next several decades through greater moisture availability. In the longer term, lake-effect snows are likely to decrease as temperatures continue to rise, with the precipitation then falling as rain.[21]

Extreme Weather Events and Coastal Storms

Extreme weather events, ranging from heat waves to extreme precipitation events, are forecast to increase in both frequency and intensity.

The total number of hot days per year in New York State is expected to increase as the century progresses. The frequency and duration of heat waves, defined as three or more consecutive days with maximum temperatures at or above 90ºF, are also expected to increase. Extreme cold events, defined both as the number of days per year with minimum temperature at or below 32ºF, and those at or below 0ºF, are expected to decrease.

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[18] Karl et al., 2009.

[19] Measured precipitation for a period of time shorter than 24 hours.

[20] Lenderink, G. and E. Van Meijgarrd, 2008. Increase in hourly precipitation extremes beyond expectations from temperature changes. Nature Geoscience 1, 511 – 514.

[21] Karl et al., 2009; Rosenzweig et al., 2011; Kunkel, K.E., N.E. Westcott, and D.A.R. Knistovich, 2002: Assessment of potential effects of climate changes on heavy lake-effect snowstorms near Lake Erie. Journal of Great Lakes Research, 28(4), 521-536; Burnett, A.W., M.E. Kirby, H.T. Mullins, and W.P. Patterson, 2003: Increasing Great Lake-effect snowfall during the twentieth century: a regional response to global warming? Journal of Climate, 16(21), 3535-3542.

By the end of the century, the number of droughts is likely to increase, as the effect of higher temperatures on evaporation is likely to outweigh the increase in precipitation, especially during the warm months.

By the end of this century, sea-level rise alone may contribute to a significant increase in large coastal floods; coastal flood levels that currently occur once per decade on average may occur once every one to three years, and flooding at the level currently associated with the 100-year flood may occur about four times as often by the end of the century.

Climate change predictions indicate that precipitation from storms is likely to dramatically increase. The 1% annual chance storm event or "100-year storm" is expected to increase by 0.2 inches of rainfall and is likely to become more frequent, meaning larger storms are expected more often. Intense mid-latitude, cold-season storms, including nor'easters, are projected to become more frequent and take a more northerly track.[22]

Effects of Climate Change in New York

Climate change will continue to impose new risks to New Yorkers and to New York's economy and infrastructure. Without preemptive action, projected climatic changes will have deleterious effects on New York's transportation, water and energy infrastructure, and on sectors on which New York's economy depends, including agriculture, ecosystems, tourism, and water resources. These projected effects combine to threaten the livability and economic vitality of many of New York's communities, as well as the health and safety of the residents of these communities.

Rising sea levels will have major consequences for New York's coastal communities including but not limited to[23]

- Magnification of dangerous storm surges caused by high winds and tides, which increase the risk of flooding, beach erosion, and damage to infrastructure in low-lying areas;
- Increased areas of coastal inundation during regular tidal cycles;
- Regular inundation of coastal wastewater infrastructure and the direct transmission of pathogen and nitrogen pollution to ground and surface waters; and
- Increased salinity of the drinking water supply in communities along the Hudson due to saltwater intrusion.

Given projections of sea-level rise, by 2050, the number of New York City residents living within the 100-year floodplain (using current data) would increase from approximately 400,000 to 800,000 people.[24]

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[22] Kunkel, K.E., P.D. Bromirski, H.E. Brooks, T. Cavazos, A.V. Douglas, D.R. Easterling, K.A. Emanuel, P.Ya. Groisman, G.J. Holland, T.R. Knutson, J.P. Kossin, P.D. Komar, D.H. Levinson, and R.L. Smith. 2008. "Observed changes in weather and climate extremes." In Weather and Climate Extremes in a Changing Climate: Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands, edited by Karl, T.R., G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray, 35-80. Synthesis and Assessment Product 3.3. U.S. Climate Change Science Program, Washington, DC.

[23] NYS 2100 Commission, 2013.

[24] NYC Special Initiative for Rebuilding and Resiliency, 2013. A Stronger, More Resilient New York. Chapter 2: Climate Analysis. (http://www.nyc.gov/html/sirr/downloads/pdf/final_report/Ch_2_ClimateAnalysis_FINAL_singles.pdf)

Other consequences of warming and changes in precipitation include northward expansion of certain invasive species and parasites that threaten native plants, ecosystems, and human beings. Warming also potentially creates significant adverse effects on key New York regional economic activities, including winter sports; and maple syrup, apple, and dairy production. Sustained heavy downpours of rain heighten the risk of localized flash flooding and erosion. Heat waves, defined as three consecutive days with maximum temperatures above 90°F, are associated with heat-related illnesses, which disproportionately affect the elderly and children. Droughts, in addition to having agricultural impacts, also affect water resources. Water-use restrictions, and in some cases, water rationing, occur during drought periods in metropolitan and suburban areas.

The 2011 ClimAID report provides a table[25] of sector-specific climate change vulnerabilities that should be consulted for additional detail on the projected impacts of climate change in New York State.

[25] Table 12.2, pp. 444-453 in Roszensweig et al., 2011.

Figure 2. The seven ClimAID regions.

Table 2. Baseline climate and mean annual changes for the seven ClimAID regions of New York State.

Regions		Baseline	2020s	2050s	2080s
1 Rochester	Temperature Precipitation	47.7°F 34 in	+1.8 to 4.0°F 0 to +8%	+3.7 to 7.3°F +2 to +12%	+4.2 to 12.0°F +1 to +17%
2 Port Jervis	Temperature Precipitation	50°F 46 in	+1.6 to 3.5°F -1 to +10%	+3.1 to 6.9°F +1 to +14%	+4.0 to 10.7°F +2 to +18%
3 Elmira	Temperature Precipitation	47.5°F 35 in	+1.8 to 3.8°F -4 to +9%	+3.6 to 7.1°F +2 to +15%	+4.2 to 11.6°F +3 to +16%
4 New York City	Temperature Precipitation	54.6°F 49.7 in	+1.5 to 3.2°F -1 to +10%	+3.1 to 6.6°F +1 to +13%	+3.8 to 10.3°F +2 to +19%
5 Saratoga	Temperature Precipitation	47.6°F 38.6 in	+1.7 to 3.7°F -1 to +10%	+3.5 to 7.1°F +2 to +15%	+4.1 to 11.4°F +3 to +17%
6 Watertown	Temperature Precipitation	45.4°F 42.6 in	+1.9 to 3.9°F 0 to +8%	+3.7 to 7.2°F +2 to +13%	+4.3 to 11.8°F +3 to +15%
7 Indian Lake	Temperature Precipitation	39.9°F 40.8 in	+1.8 to 3.8°F 0 to +9%	+3.7 to 7.4°F +2 to +15%	+4.2 to 11.8°F +3 to +17%

Baseline data are for the 1971 to 2000 base period and are from the NOAA National Climatic Data Center (NCDC). Based on 35 GCMs and two Representative Concentration Pathways. Shown is the range between the low-estimate (10th percentile) and the high-estimate (90th percentile).

Tables 3-9. Baseline and projected changes in frequency of severe weather events in seven ClimAID regions of New York State.

3. Rochester (Region 1). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	8	12 (14 to 17) 19	18 (22 to 34) 42	22 (27 to 57) 73
	95°F	0.8	0.9 (2 to 4) 6	2 (3 to 9) 17	3 (6 to 22) 38
	Number of heat waves per year	0.7	2 (2 to 2) 2	2 (3 to 4) 5	3 (3 to 8) 8
	average duration	4	4 (4 to 4) 4	4 (4 to 5) 5	4 (5 to 6) 6
	Number of days per year with min. temp. ≤ 32°F	133	99 (103 to 111) 116	78 (84 to 96) 102	59 (68 to 88) 97
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	5	4 (5 to 5) 6	4 (5 to 5) 6	4 (5 to 6) 7
	2 inches	0.6	0.6 (0.6 to 0.7) 0.8	0.5 (0.6 to 0.8) 0.9	0.5 (0.6 to 0.9) 1

4. Port Jervis (Region 2). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	12	16 (19 to 25) 27	24 (31 to 47) 56	31 (38 to 77) 85
	95°F	2	2 (2 to 5) 10	3 (5 to12) 20	4 (7 to 28) 39
	Number of heat waves per year	1	2 (3 to 3) 4	3 (4 to 6) 8	4 (5 to 9) 9
	average duration	4	4 (5 to 5) 5	5 (5 to 6) 6	5 (5 to 7) 8
	Number of days per year with min. temp. ≤ 32°F	138	106 (108 to 116) 120	79 (86 to 100) 108	59 (65 to 89) 101
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	12	11 (12 to 13) 14	12 (13 to 14) 15	12 (13 to 15) 16
	2 inches	2	2 (2 to 2) 3	2 (2 to 3) 3	1 (2 to 3) 3

5. Elmira (Region 3). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	10	15 (17 to 21) 23	22 (26 to 41) 47	28 (33 to 67) 79
	95°F	1	2 (2 to 4) 7	2 (4 to10) 18	4 (7 to 24) 38
	Number of heat waves per year	1	2 (2 to 3) 3	3 (3 to 6) 6	3 (4 to 9) 9
	average duration	4	4 (4 to 5) 5	5 (5 to 5) 5	5 (5 to 6) 7
	Number of days per year with min. temp. ≤ 32°F	152	119 (122 to 130) 134	94 (100 to 114) 120	72 (79 to 103) 116
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	6	6 (6 to 7) 7	6 (6 to 7) 8	6 (7 to 8) 8
	2 inches	0.6	0.6 (0.7 to 0.9) 1	0.7 (0.8 to 1) 1	0.7 (0.8 to 1) 1

6. New York City (Region 4). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	18	24 (26 to 31) 33	32 (39 to 52) 57	38 (44 to 76) 87
	95°F	4	4 (9 to 18) 28	6 (9 to18) 28	9 (12 to 32) 47
	Number of heat waves per year	2	3 (3 to 4) 4	4 (5 to 7) 7	5 (6 to 9) 9
	average duration	4	5 (5 to 5) 5	5 (5 to 6) 6	5 (5 to 7) 8
	Number of days per year with min. temp. ≤ 32°F	71	50 (52 to 58) 60	37 (42 to 48) 52	25 (30 to 42) 49
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	13	13 (14 to 15) 16	13 (14 to 16) 17	14 (15 to 17) 18
	2 inches	3	3 (3 to 4) 5	3 (4 to 4) 5	2 (4 to 5) 5

7. Saratoga Springs (Region 5). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	10	14 (17 to 22) 23	22 (27 to 41) 50	27 (35 to 70) 82
	95°F	1	1 (2 to 4) 7	3 (3 to10) 18	3 (6 to 25) 42
	Number of heat waves per year	1	2 (2 to 3) 4	3 (4 to 6) 7	4 (5 to 8) 9
	average duration	4	4 (5 to 5) 5	5 (5 to 6) 6	5 (5 to 7) 9
	Number of days per year with min. temp. ≤ 32°F	155	123 (127 to 136) 139	98 (104 to 119) 125	77 (84 to 109) 120
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	10	10 (10 to 11) 12	10 (11 to 12) 13	10 (11 to 13) 14
	2 inches	1	1 (1 to 2) 2	1 (1 to 2) 2	1 (1 to 2) 2

8. Watertown (Region 6). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	3	5 (6 to 8) 10	9 (12 to 21) 26	12 (17 to 44) 57
	95°F	0	0 (0.1 to 0.9) 2	0.2 (0.6 to3) 7	0.8 (2 to 11) 23
	Number of heat waves per year	0.2	0.6 (0.8 to 0.9) 1	1 (1 to 3) 3	1 (2 to 6) 7
	average duration	4	3 (4 to 4) 4	4 (4 to 4) 5	4 (4 to 6) 6
	Number of days per year with min. temp. ≤ 32°F	147	116 (119 to 126) 130	96 (102 to 113) 119	78 (85 to 104) 114
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	6	6 (7 to 8) 8	7 (7 to 8) 9	7 (7 to 9) 10
	2 inches	0.8	0.6 (0.7 to 1) 1	0.7 (0.7 to1) 1	0.7 (0.8 to 1) 1

9. Indian Lake (Region 7). Full range of changes in extreme events: Low Estimate (10th Percentile), Middle Range (25th – 75th Percentile), High Estimate (90th Percentile).

	Extreme event	Baseline	2020s	2050s	2080s
Heat Waves & Cold Events	Number of days per year with maximum temperature exceeding				
	90°F	0.3	0.5 (0.8 to 2) 2	2 (3 to 6) 10	3 (5 to 19) 27
	95°F	0	0 (0 to 0.1) 0.2	0.1 (0.1 to 0.3) 0.6	0.1 (0.2 to 2) 6
	Number of heat waves per year	0	0 (0.1 to 0.2) 0.2	0.2 (0.3 to 0.7) 1	0.2 (0.5 to 2) 3
	average duration	3	3 (3 to 4) 4	3 (3 to 4) 4	4 (4 to 4) 5
	Number of days per year with min. temp. ≤ 32°F	193	159 (162 to 172) 177	131 (138 to 154) 161	107 (118 to 143) 156
Intense Precipitation	Number of days per year with rainfall exceeding				
	1 inch	7	7 (7 to 8) 9	7 (8 to 9) 10	8 (8 to 10) 11
	2 inches	0.8	0.7 (0.8 to 1) 1	0.8 (0.9 to 1) 1	0.8 (0.9 to 1) 1

Projections for temperature and precipitation are based on 33 GCMs and 2 RCPs. Baseline data are for the 1971 to 2000 base period and are from the NOAA National Climatic Data Center (NCDC). Shown are the low-estimate (10th percentile), middle range (25th to 75th percentile), and high-estimate (90th percentile) 30-year mean values from model-based outcomes. Decimal places are shown for values less than one, although this does not indicate higher precision/certainty. Heat waves are defined as three or more consecutive days with maximum temperatures at or above 90°F.

Glossary

Adaptation - The process of adjustment to actual or expected climate and its physical, social, or economic effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects. (IPCC/ClimAID)

Adaptive capacity - The ability of systems, institutions, humans and other organisms to adjust to potential stress or damage, to take advantage of opportunities, or to respond to consequences. (IPCC, derived from previous IPCC reports and MEA, 2005/ClimAID)

Climate - Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The typical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. (IPCC)

Critical Facilities - In the context of floodplain management, critical facilities are defined as facilities designed for bulk storage of chemicals, petrochemicals, hazardous or toxic substances or floatable materials; hospitals, rest homes, correctional facilities, dormitories, patient care facilities; major power generation, transmission or substation facilities, except for hydroelectric facilities; major communications centers, such as civil defense centers; or major emergency service facilities, such as central fire and police stations. (6 NYCRR Part 502.4(a)(17))

Ecosystem - An ecosystem is a functional unit consisting of living organisms, their non-living environment and the interactions within and between them. The components included in a given ecosystem and its spatial boundaries depend on the purpose for which the ecosystem is defined: in some cases they are relatively sharp, while in others they are diffuse. Ecosystem boundaries can change over time. Ecosystems are nested within other ecosystems and their scale can range from very small to the entire biosphere. In the current era, most ecosystems either contain people as key organisms, or are influenced by the effects of human activities in their environment. (IPCC)

Exposure - The degree to which elements of a climate-sensitive system are in direct contact with climate variables and/or may be affected by long-term changes in climate conditions or by changes in climate variability, including the magnitude and frequency of extreme events. (ClimAID)

Flood - The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods and glacial lake outburst floods. (IPCC)

Hazard - The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage

and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. (IPCC)

Impacts (consequences, outcomes) - Effects on natural and human systems. Effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. (IPCC)

Mean sea level - Sea level measured by a tide gauge with respect to the land upon which it is situated. Mean sea level is normally defined as the average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides. See Sea-level change. (IPCC SREX)

Percentile - One of the values of a variable that divides the distribution of the variable into 100 groups having equal frequencies, *e.g.*, ninety percent of the values lie at or below the ninetieth percentile, ten percent above it.

Representative Concentration Pathways (RCPs) – Scenarios developed by the IPCC that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover. RCPs usually refer to the portion of the pathway extending to 2100. Four RCPs were selected from the published literature and are used in the present IPCC Assessment as a basis for the climate predictions and projections presented in the AR5. (IPCC, based on Moss et al., 2008 and Moss et al., 2010)

Resilience - The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation. (IPCC, derived from Arctic Council, 2013)

Risk - The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure. (IPCC)

Sea-level rise - Increases in sea level, globally or locally, due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass and distribution of water and land ice, (iii) changes in water density, and (iv) changes in ocean circulation. Sea-level changes induced by changes in water density are called steric. Density changes induced by temperature changes only are called thermosteric, while density changes induced by salinity changes are called halosteric. See also Mean sea level. (IPCC SREX)

Sensitivity - The degree to which a system will respond to a change in climate, either beneficially or detrimentally. (ClimAID)

Storm surge - The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. (IPCC)

Storm water - Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage. (NPDES 40 CFR 122.26(b)(13))

Sustainability – A dynamic process that guarantees the persistence of natural and human systems in an equitable manner. (IPCC)

Vulnerability - The propensity to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. (IPCC)

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Presentation Title: **Water Level Control on Lake Ontario and Plan 2014**
Presenter: **Frank Sciremammano, Jr, PhD, PE**

Outline

I. Great Lakes and Lake Ontario Hydrology
II. Outflow and water level control on Lake Ontario
III. Plan 2014
IV. Coastal Resiliency planning and funding

Summary

Implementation in January 2107 of a change in the regulation of outflows from Lake Ontario will result in more frequent, extreme high and low water levels than under the previous regulation regime. This change is projected to result in an annual average $2.5 million in damages to lakeshore property owners alone as well as additional damages to businesses and communities along the New York shoreline. Flooding that occurred along the Lake in 2017 highlighted the need for more resilient shoreline protection and public infrastructure. Several financial and regulatory hurdles must be overcome before this can be achieved.

I. Great Lakes and Lake Ontario Hydrology

The upper Great Lakes and surrounding watershed, consisting of Lakes Superior, Michigan, Huron and Erie, all drain to Lake Ontario. Lake Ontario, in turn, drains through the St. Lawrence River to the Atlantic Ocean. As a result of this cascading of flows down through the system, the outflows and water levels on Lake Ontario vary the most within the system, as illustrated in the following table:

	Water Level (in feet above mean sea level)	**Outflow** (in thousands of cubic feet per second)
Lake Superior		
Maximum	603.4	132
Average	601.7	74
Minimum	599.5	41
Range (feet)	3.9	91
Lake Michigan-Huron		
Maximum	582.3	238
Average	578.8	183
Minimum	576.0	106
Range (feet)	6.3	132
Lake Erie		
Maximum	574.3	280
Average	571.3	210
Minimum	568.2	118
Range (feet)	6.1	162
Lake Ontario		
Maximum	248.6	353
Average	245.2	245
Minimum	241.9	154
Range (feet)	6.6	200

Within each of the lakes, the hydrologic water balance is made up of inputs from precipitation on the lake surface, runoff and groundwater flows from the surrounding basin and inflow from the upstream lake while outflows consist of evaporation from the lake surface and outflow to the downstream lake through connecting rivers. All of these processes are highly variable and with very limited predictability. As a result, the water level on each of the lakes varies with both an annual cycle and longer term, larger amplitude fluctuations. The average annual fluctuation for Lake Ontario is approximately 1.8 feet.

Superimposed on the annual fluctuations are long-term, usually ten to twenty year, cycles of increased precipitation or drought that affect the entire Great Lakes basin. These long-term cycles generally result in much larger changes in water levels, as illustrated in the 6.6-foot historical range for Lake Ontario.

II. Outflow and water level control on Lake Ontario

The primary inflow to Lake Ontario comes from the upper Great Lakes via the Niagara River connecting Lake Erie to Lake Ontario and passing over Niagara Falls. This represents, on average, approximately 85% of the water supply to Lake Ontario with the remainder from the local drainage basin. Neither component of the net water supply is controlled and the total is highly variable on both short and long term time scales.

The outflow from Lake Ontario is through the St. Lawrence River. Originating at the northeastern end of Lake Ontario in the Thousand Islands area of northern New York, it flows just under 200 miles to Montreal and its confluence with the Ottawa River. It then continues for another approximately 850 miles to the Gulf of St. Lawrence in the Atlantic Ocean.

For over 300 years, there was the desire to by-pass or eliminate the large set of rapids in the St. Lawrence in northern New York in order to open up the Great Lakes to commercial navigation from the Atlantic Ocean. This became a reality in 1960 with the construction of the Moses-Saunders dam near Massena, New York and the locks and channels of the St. Lawrence Seaway.

Construction of this bi-national project was approved by the International Joint Commission or IJC. The IJC was created by the 1906 Boundary Waters Treaty between the US and Canada. Its charge is to review, approve and manage projects affecting the waters on or flowing across the border between the US and Canada. The Commission has six members, three US and three Canadian. On the US side, the commissioners are presidential appointees and generally turn over with changes in administration. To carry out its charge, the IJC has approximately 40 appointed boards dealing with boundary waters from Alaska to Maine.

The construction of the St. Lawrence power and seaway project allowed for the control of the outflow from Lake Ontario through the St. Lawrence, with much higher or lower flows possible than under the natural conditions with the rapids. Through outflow adjustments, the water level fluctuations on Lake Ontario could also be at least partially controlled.

In the 1956 Order of Approval for the project, the IJC specifically included goals for regulating the outflow. These goals, termed Criteria in the Order, included provisions to protect downstream Montreal, provide safe flows for navigation, provide adequate flows for power production and to try to avoid extreme high or low water levels on Lake Ontario. Specifically, the Criteria set a goal of limiting the Lake Ontario water level fluctuations to a four foot range with a maximum level of 247.3 feet and a minimum level

of 243.3 feet, both relative to mean sea level. The intent, as also stated, was regulate the flows "for the benefit of property owners on the shores of Lake Ontario in the United States and Canada so as to reduce extremes of stage…".

The Order of Approval for the St. Lawrence power and navigation project also created a "Board of Engineers", now called the International Lake Ontario-St. Lawrence River Board. Its original charge was to develop an operating plan for the outflows to meet the Criteria and other conditions of the Order of Approval. The Board is now charged with managing the system, again in accordance with the operating plan and the other provisions of the Order. The operating plan developed was called Plan 1958D and it was implemented in 1962. Later, the IJC granted the Board the authority to deviate from the outflows determined by the Plan in order to provide a benefit or benefits to some as long as it did not unduly harm any other interests.

The Board's ten appointed members, five from the US and five from Canada, managed the system in accordance with Plan 1958D and its deviation authority for approximately 55 years until Plan 1958D was replaced with Plan 2014 in January 2017. Operations under Plan 1958D were generally successful in keeping the Lake water level to within its four foot range goal except during a few extreme supply conditions, particularly those in the early 1960's, in 1973 and in 1993. As a result, the monthly average lake level had a total range of 6.2 feet over the regulation period.

III. Plan 2014

Within a few years of implementation of Plan 1958D various interests were calling for changes that would better serve their particular desires. Many times these changes would conflict with each other such as the desire for generally higher water levels for recreational boating, especially in the fall, and the call to lower the lake in the fall to protect riparian property owners from high late winter and spring high water. In addition, with each occurrence of extreme supplies and levels, high or low, there were calls to alter the plan to better deal with the fluctuating supplies. In the late 1980's and 1990's, environmental activists and agencies called for alterations in the operating plan to allow for more extreme water levels on the Lake, both high and low, with the goal of achieving better diversity in the wetlands bordering the Lake and the upper River.

In 1999 the IJC obtained funding from the US and Canadian governments to study whether and how the system could be better managed to balance the current demands of all the interests. With funding in hand, the IJC appointed a Study Board to examine the whole issue of outflow control on the St. Lawrence River. This Study acted in a transparent, open, and public way to develop guidelines and to come up with recommendations to the IJC, which were contained in a report delivered in March of 2006.

The Study recommended consideration of three plans:

Plan A+ - " The Economic Plan", which maximized economic benefits.
Plan B+ - "The Environmental Plan", which maximized environmental benefits

and

Plan D+ - "The Balanced Plan", which as the name implies, was balanced.

With completion of the study, the IJC announced a proposed new Order and Plan that consisted of a revised Plan D+ from Study (the balanced plan), renamed Plan 2008. The IJC stated at that time that:

> "Plan *(2008)* is an improvement with respect to environmental and overall economic benefits, and takes a more balanced approach to all interests."

The IJC further stated that:

> The environmental benefits of Plan B+ (environmental plan) are desirable, but implementation of Plan B+ is not possible "without unduly reducing the benefits and protections currently accorded to other interests."

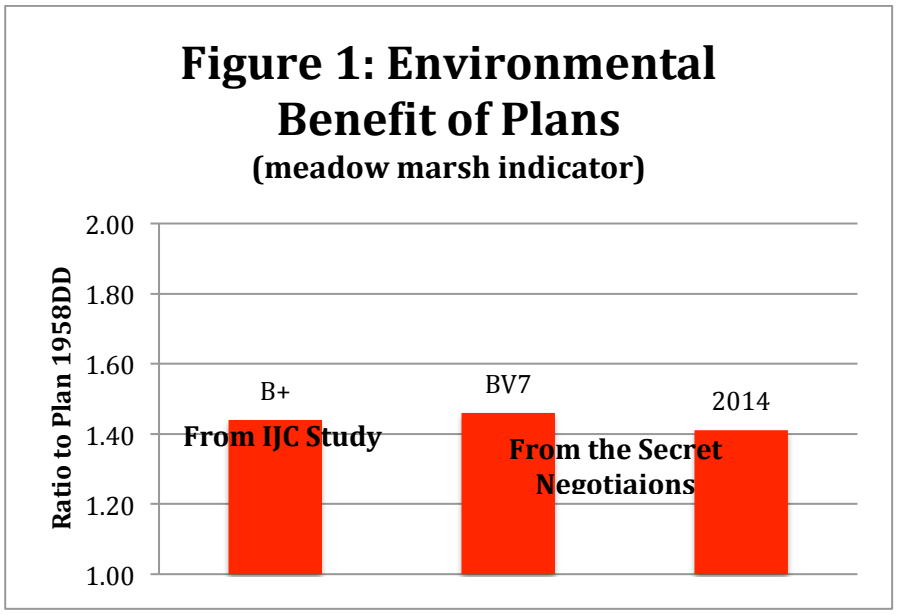
After holding public hearings, and facing demands from environmental groups and the NYS DEC that only the environmental plan would be acceptable to them, the IJC withdrew its proposal and formed a new, secret "Working Group" of government representatives only. Working in secret, this group recommended a new version of Plan B+, the environmental plan, which was termed Plan Bv7 for Plan B, version 7. After another round of public meetings by the IJC and further secret negotiations, the Working Group came up with Plan 2014, which is Plan Bv7 with a slight modification that added some protection against extreme water levels.

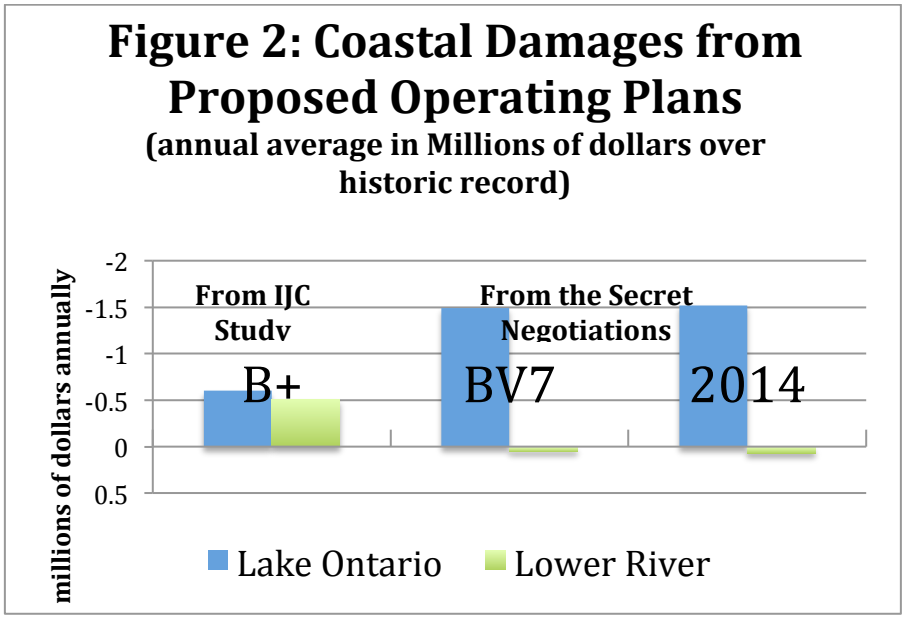
It is clear that Plan 2014 and its basis, Plan Bv7, are not one of the recommended plans from the IJC Study and, in fact, they violate three of the principle guidelines of the IJC Study.

Those guidelines stated that if damages result from any plan, they should not fall disproportionately on any one geographic area or interest group. Almost all the damages from Plan 2014 fall to the Lake Ontario shoreline. All other geographic areas and interests are held harmless or benefit. The guidelines also state that if damages are anticipated, mitigation and compensation measures should be in place prior to implementation. Plan 2014 has none. Finally, the guidelines state that any plan should be developed in an open process with wide public participation. Plan 2014 was developed in secret by a group that only consulted with environmental advocates.

When examining Plans Bv7 and Plan 2014, it is found that the environmental benefits are almost the same as the original Plan B+. However, the damages to the coastal areas of Lake Ontario are greatly increased. This resulted from the fact that the Province of Quebec stood by its commitment that its citizens in downstream areas of the St. Lawrence River should receive no less protection under any new plan than under the

previous plan of operation (Plan 1958D). As a result, all the damages were shifted to the Lake and, in particular, to the south shore bordering western New York. Apparently, the NYS government representatives, in particular the NYS DEC, participating as members of the secret Working Group were fine with this shift. The shift is clearly illustrated in the graphs in Figures 1 and 2. The environmental benefits remained the same during the secret negotiations while the damages to the Lake Ontario shoreline increased dramatically and those to the lower St. Lawrence River were eliminated.





With full knowledge of the damages to be expected, the IJC recommended approval of Plan 2014. With concurrence of the Canadian and US governments, the IJC adopted a new Order of Approval in December 2016 and implemented Plan 2014 in January 2017.

While the debate over Plan 2014 continues, it has been implemented and it will be very difficult to alter anytime soon.

IV. Coastal Resiliency planning and funding

As noted earlier, Plan 2014 allows for a much wider range in water level fluctuations on Lake Ontario, increasing the former four-foot target range to over seven feet including raising the maximum target level by over one foot compared to the previous target (248.46 feet versus 247.3 feet). It is also clear that Plan 2014 will not protect from even more extreme water levels, as promised by the IJC in promoting the Plan, as was clearly demonstrated several months after its implementation when the lake level reached an elevation a shade below 249. feet at the end of May 2017.

Thus, it is clear that operations under Plan 2014 will result in more extreme water levels, both higher and lower, than have been planned for or experienced in the past. And while no funding for compensation or mitigation was included in the Plan, the need to provide more resilience for lakeshore properties, waterfront businesses and lakeshore communities' infrastructure is evident. The high water event of 2017 alone is expected to result in damages in excess of $100 million.

Improvements to provide better resiliency should include better shoreline protection structures, redesign and replacement of recreational boat launches, replacement of fixed docks at marinas with floating dock systems, sealing and/or moving sewer and water utilities and support structures and buying out and relocating residences located in particularly vulnerable locations. These measures apply equally well to the Lake Ontario communities and downstream areas of the St. Lawrence River.

Other measures could include navigational dredging in critical sections of the St. Lawrence Seaway and downstream near the Montreal Harbor, increased capacity to handle high flow rates through or around the various hydroelectric plants along the St. Lawrence River, and the relocation of water intakes and sewage outfalls in the St. Lawrence River.

The obstacles to these potential changes are both financial and regulatory. As an example, one of the best ways to provide better shoreline protection along the Lake is to replace existing, undersized vertical gabion or concrete structures with sloped, rip-rap revetments. The cost of this can easily exceed one thousand dollars per linear foot of shoreline and the regulatory hurdles can be formidable. The regulatory hurdles result from the fact that the combination of desired maximum height and slope will often result in a structure that extends well beyond the regulatory mean high water line, established as elevation 247.3 feet by both New York State and Federal agencies. The NYS DEC and the Army Corps of Engineers, both with approval authority for lakeshore protection structures, have severe limits on the occupation or placement of fill in areas beyond the mean high water line for two reasons. Such placement removes bottom habitat along the shoreline and also results in the occupation and use of public underwater land by an

adjacent riparian owner. These are both discouraged and/or prohibited by current regulation and policy.

Similar regulatory and financial hurdles apply to the other measures that could be utilized to make the entire system more resilient and better prepared to handle future extreme conditions.

As for now, New York State is providing limited grants and compensation to both businesses and individuals that suffered damages due to the 2017 flooding along the Lake Ontario and St. Lawrence shorelines. However, there is no stipulation that this funding be used to provide improved resiliency and not just a replacement in kind of what was damaged in the first place.

Hopefully, the damages from the 2017 flooding will not just result in more debate about Plan 2014, but will move both the New York state and Federal governments toward providing solutions to better prepare for the inevitable extreme water levels that will come in the future.

SEA LEVEL RISE & RESILIENCY

Local Land Use Responses

Jessica A. Bacher
Executive Director
Land Use Law Center at
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LAND USE TOOLS

- Community Resilience: Implementation and Strategic Enhancements Local Assessment Tool
  - Helps approach hazards and risks comprehensively
  - Assess and refine your laws and policies to improve resilience
  - Achieve desired community outcomes
- NY State Resiliency Model Laws
- Malibu, California Example

Community Resilience: Implementation and Strategic Enhancements Local Assessment Tool

- Goal 1: Ensure Comprehensive Understanding of Known Hazards and their Potential Effects
- Goal 2: Conserve Land in Critical Coastal Areas
- Goal 3: Reduce Risk to People, Buildings and Facilities in Vulnerable Areas
- Goal 4: Plan for and Encourage Development in Safer Areas
- Goal 5: Implement Comprehensive Stormwater Management Techniques
- Goal 6: Improve the Community Capacity Needed to Enhance Resilience
- Goal 7: Build Support for Improving Community Resilience and Remove Barriers to Implementation

GOAL 3: Reduce Risk to People, Buildings, And Facilities in Vulnerable Areas

- Your community's economic, social, and cultural assets may be in vulnerable areas or residents may dwell or construct buildings in vulnerable areas despite known risks.
- If so, there are steps that can reduce (though not eliminate) future risk and enhance resilience.
- A resilient community recognizes the risk facing people and assets in vulnerable areas and takes steps to reduce that risk through a combination of proactive and protective land use laws, building codes, and planning policies.

GOAL 3: Reduce Risk to People, Buildings, And Facilities in Vulnerable Areas

LOCAL POLICIES INVENTORY REVIEW

- The strategies in the assessment identify a community's current capacity to reduce risk to people, buildings, and facilities in vulnerable areas.

GOAL 3: Reduce Risk to People, Buildings, And Facilities in Vulnerable Areas

UNDERSTANDING KEY CHALLENGES

- How would you characterize your community's approach/attitude towards risk and vulnerability? Are there populations or places in your community that bear a disproportionate share of risk or vulnerability resulting from potential hazards?
- How has the community responded to proposals or new regulations to reduce risk? What about incentives?
- Are there specific challenges you've faced in reducing risk to people, buildings, and facilities in vulnerable areas?

Assessment

- **STRATEGY CURRENTLY HAVE/USE? (Y/N)**
- **WOULD LIKE TO HAVE/IMPROVE? (Y/N)**
- **YOUR LOCAL LINKS & RESOURCES**

- **Overlay zoning** districts (e.g. limited development districts, hazard zoning districts, waterfront overlay districts, etc.) are used in hazard areas to limit allowable uses, provide for adequate setbacks, and apply additional standards
- **Elevation** requirements are available with design guidelines for streets and infrastructure
- **Steep slope ordinance** is modified to account for slopes exposed to increased moisture due to projected increases in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)
- The **substantial improvement/damage threshold** has been lowered below the minimum requirement of 50%
- Regulations prohibit the use of **fill** for the elevation of structures, and/or require floodplain storage compensation at an appropriate site when fill is used

GOAL 3: Practical Applications

- **Planning for Rising Waters:** Report of Kingston Tidal Waterfront Flooding Task Force evaluating the present and future vulnerability to flooding, storm surge, and sea level rise along the Rondout-Hudson waterfront.
- **Town of Watertown, CT, Subdivision Regulations:** Land subject to flooding, as identified on the Federal Administration Flood Insurance Rate Map (FIRM) shall not be subdivided unless certain conditions are met.
- **Town of Hornby, NY, Subdivision Regulations:** Determines allowable density based on net acreage once unsafe areas (e.g., steep slopes, floodplains) are subtracted from gross acreage
- **City of Roseville, CA, General Plan - Safety Element:** Implemented a series of tools to reduce risk in vulnerable areas including future conditions floodplains, compensatory storage requirements, two feet of freeboard, and stormwater provisions

Model Local Law Publication in Development

CRRA requires DOS, in cooperation with DEC, to prepare model local laws that include consideration of future physical climate risk due to:

- sea level rise
- storm surges
- flooding

A Variety of Models Will be Provided

- Risks, Challenges, & Landscapes Vary
- Regulatory Culture Differs
- Administrative Capacity Varies

Model Local Categories

- Basic Tools (Zoning, Subdivision, Roads, Etc.)
- Management of Floodplain Development
- Coastal Shoreline Protection
- Stormwater Control Measures
- Watercourse & Wetlands

BASIC TOOL

Elevated Buildings Provisions

- Provide an alternative way to measure height when an existing building in the 100-year floodplain is being elevated
- Allow elevation of existing homes even where it would create a non-compliance to height and setback (no variances), grant them Legal Non-Complying Status to allow future additions
- Require visual mitigation involving porches, stairs, raised front yards, or landscaping
- Require Non-Conversion Agreements

BASIC TOOL

Phased Reconstruction Moratorium

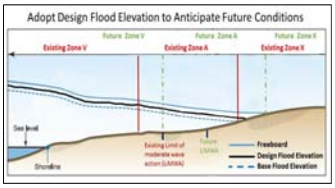
- Proactively sets priorities for Building Department services post-disaster
  - Building Permits & Inspections
  - Processing of land use applications (beware default approvals)
- Adopt now, activated by events
  - Disaster declaration
  - # structures damaged

Breezy Point

FLOOD

Establish Design Flood Elevation (DFE)

- Current freeboard (2 ft.) based on BFE
- DFE can be higher than BFE



Examples of basis for DFE:

- 500-yr flood elevation
- Extra height added to BFE
- Historical deficiencies
- Predicted changes in sea level
- Future conditions hydrology

COASTAL

Shoreline Stabilization

Shoreline Stabilization techniques generally fall into three categories:

1. Natural
2. Nature-based
3. Structural

Shoreline protection alternatives analysis can promote the use of natural or nature-based methods through the site plan or special use permits process

STORMWATER

Stormwater Management and Erosion & Sediment Control

- Updated Sample Local Law for stormwater management and erosion & sediment control
  - Base Version: General Permit updates, green infrastructure practices from NYS SWDM. Will be required for MS4 Operators
  - Resiliency Version: Additional provisions that allow municipalities to require a more detailed green infrastructure site planning process & consider riparian buffers, etc.
- http://www.dec.ny.gov/chemical/41392.html

Not all Solutions need to be Regulatory

- Acquisition of property
- Zoning incentives
- Local home elevation programs
- Community Rating System
- Green infrastructure
- Public education

Green roof at Logan Gardens, a senior housing apartment building in Manhattan.

Local Initiatives

Municipalities across the country have taken concrete action in response to sea level rise and storm hazards. These actions include:

- Establishing Policy
- Creation of a Task Force, Conducting Studies, and Information Gathering
- Comprehensive Planning
- Post-Disaster Planning
- Adoption of a Post-Disaster Moratorium
- Implementation of No-Build Zones
- Increasing Coastal Setbacks and Buffers
- Adoption of Coastal Erosion Overlay Zone
- Limiting Shoreline Protective Structures
- Requiring Building Elevations
- Requiring Sea Level Rise Impact Analysis for Shoreline Development
- Implementation of Wetlands Regulations
- Floodplain and storm water management
- Building code amendments for mitigation and hazard reduction

City of Malibu, California

City of Malibu, California: Coastal Zone Shoreline and Bluff Ordinance

- Development standards expressly require the consideration of sea level rise and mandate setbacks of a sufficient distance landward and elevations to a sufficient finished floor height, which will "eliminate or minimize to the maximum extent feasible hazards associated with anticipated sea level rise over the expected 100 year economic life of the structure."

Deed Restriction

- Ordinance requires deed restrictions against properties that can be sited and designed to not require a shoreline protection structure as part of the proposed development or at any time during the life of the development.
- The restrictions ensure that "no shoreline protection structure shall be proposed or constructed to protect the development approved."

Source: Georgetown Law
http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/hip/sea-level-rise.cfm

Legal Issues Facing Local Initiatives to Address Storms & Sea Level Rise

- **Regulatory Takings –**
  - Lucas v. South Carolina Coastal Council (1992) – total deprivation
  - Lingle v. Chevron (2005) – if no physical invasion or total deprivation, balancing test of Penn Central
- **Substantive Due Process**
- **Public Trust & Rolling Easements**
- **Accretion, Avulsion and Erosion**

Resources

- NOAA Climate Data, Modeling and Mapping: http://www.ncdc.noaa.gov/cdo-web/
- IPCC Reports
  - Fifth Assessment Report: http://www.ipcc.ch/report/ar5/
  - Climate Change 2014 Synthesis Report: Summary for Policymakers (Nov. 2014): http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_SPM.pdf
- White House reports and resources:
  - Building community resilience by strengthening America's natural resources and supporting green infrastructure (Oct. 2014): http://www.whitehouse.gov/sites/default/files/docs/enhancing_climate_resilience_of_americas_natural_resources.pdf
  - Fact sheet: http://www.whitehouse.gov/administration/eop/ceq/Press_Releases/October_8_2014
- NY DEC Climate Smart Communities Certification Manual: http://www.dec.ny.gov/energy/96511.html
- The Nature Conservancy's Coastal Resiliency Mapping Tool: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/connecticut/explore/coastal-resilience-tool.xml

Resources

- Sarah J. Adams-Schoen, *Sink or Swim: In Search of a Model for Coastal City Climate Resiliency*, forthcoming in Columbia Envt'l L. Rev. (2015).
- Sarah J. Adams-Schoen, *On the Waterfront: New York City's Climate Change Adaptation and Mitigation Challenge* (Parts 1 and 2), 25 Envtl. L. in N.Y. 81 and 101 (April and May 2014), *available at* http://ssrn.com/abstract=2439367 and http://ssrn.com/abstract=2416438.
- Yonn Dierwechter, *Metropolitan Geographies of US Climate Action: Cities, Suburbs, and the Local Divide in Global Responsibilities*, 12 J. Envtl. Pol'y & Plan. 59, 79 (2010).
- Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 Cornell L. Rev. 1153 (2009).
- Jessica A. Bacher & John R. Nolon, *Climate Change, Zoning and Transportation Planning: Urbanization as a Response to Carbon Loading*, 36 Real Estate L. J. 211, (2007), *available at* http://ssrn.com/abstract=1345397.

Resources

- John R. Nolon, *Land Use and Climate Change Bubbles: Resilience, Retreat, and Due Diligence*, forthcoming in William & Mary Envt'l L. & Policy Rev. (2015), *available at* http://ssrn.com/abstract=2459579.
- John R. Nolon & Patricia Salkin, *Integrating Sustainable Development Planning and Climate Change Management: A Challenge to Planners and Land Use Attorneys*, 63 Planning & Envt'l L. 3 (March 2011), *available at* http://ssrn.com/abstract=1774013.
- John R. Nolan, *Disaster Mitigation Through Land Use Strategies*, 23 Pace Envtl. L. Rev. 959 (2006), *available at* http://ssrn.com/abstract=1345395.
- Patricia E. Salkin, *Sustainability and Land Use Planning: Greening State and Local Land Use Plans and Regulations to Address Climate Change Challenges and Preserve Resources for Future Generations*, *34* William & Mary Envt'l L. & Policy Rev. 121 (2009), *available at* http://ssrn.com/abstract=1503379.
- Patricia E. Salkin, *Sustainability at the Edge: The Opportunity and Responsibility of Local Governments to Most Effectively Plan for Natural Disaster Mitigation*, 38 Envtl. L. Rep. News & Analysis 10158 (2008), available at http://ssrn.com/abstract=1157153.

Zoning and Land Use Planning

JESSICA A. BACHER*

YIELDING TO THE RISING SEA:

THE LAND USE CHALLENGE

Under *Lucas v. South Carolina Coastal Council*,[1] a government regulation that leaves no economic value is a regulatory taking. What if a local land use regulation prevents the reconstruction of a property destroyed by a natural disaster that is likely to reoccur, or prohibits new construction in a coastal zone that will be inundated by projected sea level rise? This is a novel case and raises one of many serious issues that are being addressed by the coastal state and local governments.

As the scientific certainty regarding sea level rise strengthens, local land use regulators are reconsidering planning, zoning, land management, and infrastructure. Various state, local, and private entities have begun to address the problem and institute adaptive measures. This article begins with an overview of a number of these state and local initiatives. Drawing on these efforts, the article concludes with a proposed ten step process for local governments to follow in adapting to sea level rise and storm hazards.

Rising sea levels in the United States will erode beaches; drown marshes and wetlands; damage barrier islands, habitat, and ecological processes; and cause saline intrusion into freshwater ecosystems and groundwater, flooding or inundation of low-lying areas, and damage to private and public property and infrastructure.

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The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (2007)[2] finds that sea level has been rising by 9 to 15 inches per century since 1993, and predicts that global average sea level will rise by 7.2 to 23.6 inches during this century. However, because the IPCC study did not consider increased melt water contributions from Greenland and Antarctica, these estimates are considered conservative. A recent report from the U.S. Climate Change Science Program notes that ''thoughtful precaution suggests that a global sea-level rise of 1 [meter] to the year 2100 should be considered for future planning and policy discussions.''[3]

Miami-Dade County, Florida: Climate Change Advisory Task Force

''Developed Miami-Dade County as we know it will significantly change with a 3-4 foot sea level rise. Spring high tides would be at about +7 to 8 feet; freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating; landfill sites would be exposed to erosion contaminating marine and coastal environments.''[4]

In 2006, the Miami Dade Climate Change Advisory Task Force was created to provide technical assistance and advice to the Board of County Commissioners concerning mitigation and adaptation measures in response to the impacts of global climate change.[5] The Science and Technology Committee of the Task Force published, in 2007, a statement documenting the ''very real threat'' posed by accelerated sea level rise. The report noted that South Florida's relative sea level rise over the last 70 years was about eight times greater than the rise over the previous 2,500 years[6] and projected a rise of at least 1.5 feet in the next 50 years and three to five feet by 2100.[7]

The Committee report emphasized the urgency ''of reconsidering nearly every aspect of the county's management, zoning, infrastructure, and planning,'' and recommended establishing sea level rise scenarios reflecting future rise to help determine what must be done to preserve habitability and what infrastructure will ''need to yield to the rising sea.''[8] The report called for detailed docu-

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mentation of infrastructure elevations, areas susceptible to erosion and pollution, drainage and storm-surge risks, and water supplies from across the county's various departments. The data and subsequent modeling of different sea level rise scenarios has been compiled in the Committee's ''Climate Change Briefing Book,'' which discusses the County's vulnerability to sea level rise and catalogs specific adaptive steps.

INDIVIDUAL STATE RESPONSES TO SEA LEVEL RISE

The following states have taken varying levels of action to deal with the impacts of accelerated sea level rise:

Florida: Although Florida is among the states most vulnerable to sea level rise, it has been slow to develop strategies to adapt to sea level rise.''[9] In July 2007, the Governor's Action Team on Energy and Climate Change was established and tasked with creating a comprehensive Florida Energy and Climate Change Action Plan. On October 15, 2008, the Action Team submitted the report containing initial ideas for adaptation strategies to combat adverse impacts to society, public health, the economy, and natural communities in Florida.[10]

Florida's regional planning councils have conducted a number of surveys on sea level rise. As part of a program sponsored by the EPA in 2002, the Southwest Florida Regional Planning Council coordinated a statewide study of sea level rise. The report of the Treasure Coast Regional Planning Council (2005) surveyed existing state and local shoreline initiatives in the area and urged that local governments consider sea level rise in all land use amendments in coastal areas of less than 10 feet in elevation; that topographic maps show one-foot contours in the coastal zone to aid local planning; and that planners consider long-term implications of sea level rise, instead of adopting a ten or twenty year time frame.[11]

Maine: Maine has incorporated sea level rise into its planning and regulations for more than a decade. The state's Natural Resources Protection Act acknowledges the fragile and dynamic nature of dune systems and the uncertainty of the extent of future change in sea level.[12] The Act requires a permit for activities in a coastal sand dune system. The Depart-

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ment of Environmental Protection in its corresponding Coastal Sand Dune Rules ''anticipates that sea level will rise approximately two feet in the next 100 years,'' and concludes that ''[u]nder any scenario of increasing sea level, the extensive development of sand dune areas and the construction of structures increase the risk of harm, to both the coastal sand dune system and the structures themselves.''[13] Standards for All Projects require that a project may not be permitted if ''it is likely to be severely damaged'' by the two-foot rise in sea level over 100 years.

Maryland: Maryland has been among the most advanced states in planning for sea level rise. Since 2000, the state Department of Natural Resources (DNR) has encouraged policies for responding to a rise of two to three feet in this century. In 2007, the governor established the state Commission on Climate Change, which includes an adaptation and response working group. In August of 2008, the Commission released its Climate Action Plan that contains an Adaptation and Response Toolbox designed to ''give state and local governments the right tools to anticipate and plan for sea-level rise and climate change.''[14] Maryland's ''Living Shorelines'' program presents management options that ''allow for natural coastal processes to remain through the strategic placement of plants, stone, sand fill, and other structural and organic materials.''[15]

Maryland has also undertaken coastal protection initiatives with the neighboring states. On November 12, 2008, the Metropolitan Washington Council of Governments Board approved the National Capital Region Climate Report, which identifies areas vulnerable to sea level rise in the Washington, DC Metropolitan area and includes recommendations to help area leaders and citizens adapt.[16]

In 2008, under revisions to its Critical Areas legislation, Maryland expanded buffer requirements from 100' to 200' for new subdivisions in Resource Conservation Areas and for projects requiring site plan approval and involving a change in land use. The revisions replace impervious surface limits with ''lot coverage limits,'' which include gravel, stone, shell . . . permeable pavement, or any man-made material'' in total coverage. The revisions require nonstruc-

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tural shoreline stabilization except where it can be proved to the Department of Natural Resources that soft stabilization is not feasible.[17]

New York: In 2007, the State Legislature established a Sea Level Rise Task Force within the Department of Environmental Conservation (DEC). The Task Force is charged with making recommendations to the Governor by the end of 2009 to protect New York's coastal ecosystems and natural habitats, and to increase coastal community resilience in the face of sea level rise.

The Legal Advisory Group of the Task Force, is responsible for reporting on existing laws and policies of the state that will likely be affected by the recommendations, existing and proposed methods used by the federal government, other states and their municipalities, and other countries to respond to sea level rise, and how recommendations may be affected by constitutional and common law concepts. Finally, the Group is evaluating to what extent affected property owners may have claims against planning agencies in the future if the government does nothing or otherwise fails to properly plan for sea level rise.

In addition to the Task Force and Working Group, the state created the Office of Climate Change, also within the DEC, to take the lead in the development of programs and policies to mitigate greenhouse gas emissions and to help communities and residents adapt to the effects of climate change.[18]

In 2008, the New York State Energy Research and Development Agency (NYSERDA) initiated a climate impact assessment project focusing on six sectors vulnerable to climate change, which include coastal zones, agriculture and ecosystems, energy and related infrastructure, transportation and communications infrastructure, public health, and water resources and related infrastructure. Currently workgroups for each sector are organizing stakeholder meetings to determine what the information needs are, what data is available, and to define the state's vulnerabilities. After the information is gathered, using modeling and case studies, potential adaptation strategies will be developed.[19]

NYSERDA also supports research relating to the reduction of CO_2 emissions associated with energy production as well as in projects researching adap-

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tive measures in response to climate change impacts. These projects include:

- Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State, a study that will identify impacts and needs specific to New York.[20]
- The Hudson River National Estuarine Research Reserve, a partnership of the National Oceanic and Atmospheric Administration (NOAA) and coastal states to explore options for protecting shoreline, tidal wetlands, and vegetated shallows in the Hudson River from the impacts of sea level rise.
- A study of the impact of climate change and land use patterns on water storage capacity and storm water management practices in the Hudson Valley.[21]

North Carolina: North Carolina's Coastal Areas Management Act (CAMA) of 1974 aims to encourage cooperative land use planning between state and local governments. All coastal communities must adopt land use plans in conformance with CAMA. It is the policy of the state that ''adequate plans for post-disaster reconstruction should be prepared by and coordinated between all levels of government prior to the advent of a disaster.''[22]

NOAA's summary of Coastal Programs sea level rise initiatives points out that although CAMA and the state's administrative regulations do not mention sea level rise, they recognize that shorelines are constantly changing.[23] CAMA bans hardened oceanfront structures. Oceanfront setbacks are tied to erosion rates: ''By their very nature, setbacks tied to long-term erosion rates take sea level rise into account, as it is one of the drivers of shoreline change from which erosion rates are determined.''[24] Setbacks for new development on public trust shorelines must be set back 30 feet landward from the normal high water line (as opposed to the mean high tide line); this ''is the ordinary extent of high tide based on site conditions such as the presence and location of vegetation, which has its distribution influenced by tidal action, and the location of the apparent high tide line.''

South Carolina: South Carolina's Office of Ocean and Coastal Resource Management (OCRM) has declared in a statement of policy:

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> It has been clearly demonstrated that erosion problems of this State are caused by a persistent rise in sea level, a lack of comprehensive beach management planning, and poorly planned oceanfront development, including construction of hard erosion control structures, which encroach upon the beach/dune system. Sea level rise in this century is a scientifically documented fact. Our shoreline is suffering from its effects today. It must be accepted that regardless of attempts to forestall the process, the Atlantic Ocean, as a result of sea level rise and periodic storms, is ultimately going to force those who have built too near the beachfront to retreat.[25]

OCRM concluded that ''the long-range public good is the same as the long-range private good. If the dry sand beaches of this State disappear because of the failure of its people and governmental natural resource managers to protect the beach/dune system, future generations will never have the opportunity to use and enjoy this valuable resource.''[26] The state's Coastal Zone Management Act of 1977 adopted retreat and re-nourishment as basic state policies for beach preservation and restoration.

Texas: The Texas Open Beaches Act of 1959 codified the public's common-law right of access to dry beach above mean high tide. Amendments to the Act in 1991 authorized the commissioner of the Government Land Office (GLO) to promulgate Beach/Dune rules. In a 2006 report, the GLO commissioner found that the state's rolling easement is never fixed, but migrates landward according to natural coastal processes.[27]

Local Sea Level Rise Initiatives

In addition to Miami-Dade, municipalities across the country have taken concrete action in response to sea level rise and storm hazard mitigation. These actions include:

- Comprehensive Planning
- Creation of a Task Force
- Adoption of a Post-Disaster Moratorium
- Post-Disaster Planning
- Implementation of No-Build Zones
- Increasing Coastal Setbacks and Buffers
- Adoption of Coastal Erosion Overlay Zone
- Limiting Shoreline Protective Structures
- Requiring Building Elevations
- Requiring Sea Level Rise Impact Analysis for Shoreline Development
- Implementation of Wetlands Regulations

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City of Bainbridge Island, Washington: Environment Element

The City of Bainbridge Island has explicitly addressed the potential for sea level rise in the Environment element of its comprehensive plan. Adopted in 2004, the plan recognizes that Bainbridge Island is potentially subject to sea level related impacts including flooding and erosion. The overall goal of the element is to avoid adverse impacts where possible; to minimize, reduce, or eliminate impacts over time; and to compensate for unavoidable impacts.[28] The plan outlines protections for critical areas including transfer of and purchase of development rights; provides for the use of the City's Shoreline Management Master Program to address and protect marine fish and marine shoreline habitat; mandates no net loss of the city's remaining regulated aquatic resources; requires the maintenance of vegetated buffers between proposed development and aquatic resources; calls for the preservation of stream courses; and the protection or restoration of natural functions of riparian habitat.[29]

The Frequently Flooded Areas component of the Element specifically recommends mitigating measures, which include a limitation on development and the alteration of natural floodplains; preservation of stream channels and natural protective barriers; revision of the flood insurance rate map to reflect the natural migration of frequently flooded areas; and implementation of nonstructural protective methods such as setbacks and the use of natural vegetation.[30]

Town of Duck, North Carolina: Moratorium on Rebuilding and Reconstruction

North Carolina's Coastal Areas Management Act of 1974 encourages cooperative land use planning between state and local governments[31] and it is the State's policy that ''adequate plans for post-disaster reconstruction should be prepared by and coordinated between all levels of government prior to the advent of a disaster.''[32] The State Design and Construction Guidelines for local hazard mitigation plans further provide that coastal communities should ''outline a post-disaster permitting process that facilitates repairs but remains steadfast to the need to mitigate against future disasters.''[33] One

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way to accomplish this is to create a short-term building moratorium to allow the community time to assess damage and consider mitigation measures.

The Town of Duck, on North Carolina's Outer Banks, is a coastal community that has adopted local regulations implementing these state coastal policies.[34] The Code Chapter on Rebuilding and Reconstruction sets out procedures for assessing damage, declaring a building moratorium, and defining types of moratoriums that may be declared in the aftermath of a damaging storm.[35] The ordinance is intended to ensure that rebuilding occurs ''in an orderly manner,'' and with the opportunity to identify ''appropriate areas for post-storm change and innovation.''[36]

East Hampton, New York: Local Waterfront Revitalization Plan

The Town of East Hampton on Long Island has been planning and regulating for sea level rise for years and has made specific reference to sea level rise in its comprehensive plan. Adopting its Local Waterfront Revitalization Program as the Coastal Management Component of its comprehensive plan, the town states: ''Future planning efforts should examine the likely effects of global warming, including increasing sea level rise and storm and hurricane activity on the Town's coastline. Beginning to plan for these effects, assessing potential damage to public resources and infrastructure, and evaluating methods of protection and associated costs are vital for future coastal management.''[37] East Hampton has also adopted coastal setbacks as much as 150' and no-build zones in high hazard floodplains.[38] East Hampton's coastal erosion overlay zone regulates the construction and alteration of shoreline protective structures.[39] To protect the natural shoreline, the town severely limits the construction of coastal erosion structures.

New York City Initiatives

New York City has also taken significant steps to address the threat of sea level rise around the metropolitan region. There is a citywide strategic planning process for climate change adaptation, including adaptation to sea level rise.[40] In 2008, Mayor Bloomberg launched the Climate Change Adaptation

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Task Force and the New York City Panel on Climate Change to develop adaptation strategies to secure the City's infrastructure from the effects of climate change.[41] The Task Force is one of the 127 initiatives proposed in PlaNYC, the City's long-term sustainability plan.[42]

The Task Force will inventory ''existing infrastructure that may be at-risk from the effects of climate change; develop coordinated adaptation plans to secure these assets based on New York City-specific climate change projections; draft design guidelines for new infrastructure that take into account anticipated climate change impacts; and identify adaptation strategies for further study that are beyond the scope of individual stakeholders.''[43]

The New York City Panel on Climate Change, modeled on the Intergovernmental Panel on Climate Change (IPCC), will advise the Task Force. The Panel will develop a unified set of climate change projections; draft protection levels to guide the design of new infrastructure; and produce a technical report on the localized effects of climate change on the City.[44]

The Task Force and the Panel will build on the climate adaptation plan the New York City Department of Environmental Protection (DEP) issued for its assets in May 2008.[45] The plan outlines possible approaches to coastal flooding as a result of sea level rise. DEP recommendations include raising the elevations of key facilities above projected flood heights and the promotion of gradual retreat from the most at-risk areas or different use of these areas, such as for park land.[46]

Other Municipalities

There are a number of other innovative methods developed by local governments. The Resource Protection chapter of Collier County's Land Development Code requires a mandatory sea level rise impact analysis for shoreline development.[47] The analysis must show that the development will remain fully functional for its intended use after a six inch rise in sea level.[48]

The Town of Falmouth, Massachusetts also explicitly addresses the impacts of accelerated sea level rise through extensive wetlands regulations.[49] The wetland ordinance and regulations identify specific resource areas for protection, including coastal wetlands, beaches, dunes, and

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marshes; land subject to tidal action, flooding, inundation, or coastal storm flowage; and any land within 100' of the protected resource areas.[50] The regulations require special protection for coastal floodplains immediately landward of salt marshes, coastal beaches, dunes, banks, and barrier beaches. Any buildings in theses areas should be designed to incorporate a relative sea level rise of at least one foot per 100 years in FEMA designated A-zones and at least two feet per 100 years in FEMA designated V-zones.[51]

LOCAL PLANNING AND REGULATORY STRATEGIES

Drawing on the local initiatives detailed above, this part contains an organized comprehensive approach for municipalities looking to adopt sea level rise adaptation and storm hazard mitigation strategies to follow. The approach is organized into ten steps starting with policies for local government to adopt. It then discusses approaches to local studies and citizen participation, follows with information regarding development moratorium, planning, and concludes with illustrative regulations and intermunicipal cooperation.

I. ADOPT POLICY RESOLUTION OR MAYORAL PROCLAMATION

The local chief elected officer or legislature can set the stage for sea level rise planning and the implementation of regulatory approaches through resolutions, proclamations, policy statements, or executive orders. These policy tools represent methods of initiating local action on sea level rise and assigning responsibilities to local boards and officers.

Policy statements can take notice of certain facts and create the foundation for a strategic blueprint for locality-wide climate change adaptation.[52] Documents may incorporate sea level rise projections and lay out the need to track this data. They can also establish the economic life of buildings (50-100 years), establish time lines for one and two foot sea level rise, provide for 10-year adjustments, and establish the need to assess infrastructure viability and emergency response. They can state the municipality's intention to proceed with certain specified actions to respond to sea level rise and storm hazards, including initiating a review of the comprehensive plan or the in-

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tent to consider sea level rise issues when updating zoning and land use regulations. The policy can establish plans to seek loans and/or grants for sea level rise planning and intent to lobby the state legislature in support of key sea level rise initiatives.

A policy statement can set the stage for further action by creating a Task Force of public and private actors to conduct studies, research, and lay out goals for land use training and education. The Task Force can also be charged with preparing an action plan and to work with each of the municipality's departments to formulate work programs and budgets.

II. APPOINT TASK FORCE AND AUTHORIZE STUDIES

To further the policy declaration a Task Force can be created and charged with determining threats posed by sea level rise and storm hazards, determining adequacy of current local laws and programs, and considering possibility of amending the comprehensive plan and zoning and land use laws.

a. Creating the Task Force and Charging it to Conduct a Study.

The community may create a Sea Level Rise Task Force by legislative action and instruct it to retain consultants, conduct surveys, gather data, study the results, build citizen awareness of local problems, and work with experts to develop an effective strategy for adaptation. The Task Force should determine the adequacy of current local laws and consider the possibility of amending the comprehensive plan to reflect the hazards of sea level rise and storms and adjusting local land use law accordingly.

In order to enable the community to determine sea level rise risks and mitigation measures, the Task Force may commission a formal sea level rise study. The Task Force can discover and incorporate studies that have been completed with regard to projections and inundation by reputable organizations and collect any maps that may exist for their municipality. The Task Force may hire consultants to gather available data at the regional and local level and supplement that data as new information becomes available. It may also commission a citizen survey to identify the critical issues facing the community, ensuring that the survey is distributed broadly to

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local citizens and supplemented by community meetings. Surveys not only gather information, but serve to educate constituents and build support. The study may document infrastructure elevations, areas susceptible to erosion and pollution, drainage and storm-surge risk areas, and the vulnerability of water supplies. It may also establish sea level rise scenarios reflecting future rise to help determine what must be done to preserve and protect property, the environment, and public infrastructure.

b. The Task Force should be composed of stakeholders representing all relevant constituencies.

The Task Force should include those whose support is necessary to implement sea level rise adaptation plans and regulations and those who will be affected by these changes.[53] These groups and individuals may include elected officials, members of the planning board and zoning board of appeals, the administrative enforcement officer, the municipal assessor, the highway superintendent, the park and recreation commissioner, members of the Conservation Advisory Council, a local historian, the sewer/water superintendent, developers, representatives of local utilities, business groups, civic groups, neighborhood associations, members of the school board, and local environmental organizations. Representation from key stakeholder groups on the Task Force helps to avoid the risk that the studies and surveys will not discuss and consider valuable data and views necessary for future planning. In turn, failure to address important considerations may ultimately generate opposition.

c. The Task Force should take measures to ensure sufficient citizen participation.

Involving key community leaders in addressing the critical issues identified through sea level rise studies equips them with the knowledge to educate other local citizens and land use officials. Consensus building among local leaders and citizens of the community is a vital element to successfully implementing a mitigation and adaptation plan. Knowledgeable leaders aided by professional staff and consultants may guide local discussion toward consensus among community

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stakeholder groups, build consensus among them, and achieve the best possible sea level rise and storm hazard mitigation strategies for the area.[54]

In order to gather all available ideas and secure the support of the entire community, meetings may be conducted on a communitywide basis, in neighborhoods, over long weekends, or in a series. Meetings with representatives of the media can be held; updates on the process of the study development or early drafts may be placed in local papers; and special mailings may be sent to all local postal addresses. Efforts should be made to identify divergent groups and views within the community, and to involve key representatives in the preparation of the study. Such representatives may be appointed to the Task Force or may be invited to join one or more special issue committees to assist in preparation of the study.

A critical issue is whether and how to provide training and education to the citizens and land use officials of the community. It may be necessary to not only involve key citizen leaders in the development of the policy document and studies, but to conduct broader outreach, training, and educational programs.

III. ADOPT A MORATORIUM, IF CALLED FOR, TO ALLOW TIME FOR PLANNING AND ADOPTING NEW REGULATIONS

Assuming that the study phase reveals that sea level rise measures must be adopted and that existing land use regulations are insufficient, the local legislature may adopt a moratorium that suspends the right of developers and land owners in sea level rise vulnerable areas to obtain development approvals and building permits while the community prepares a plan and implementing regulations. In coastal areas this can give communities dealing with destructive sea level rise impacts including extensive storm damage, erosion or flooding, time to rethink their land use plan and local laws and adopt smarter approaches that more properly manage growth.

A moratorium preserves the status quo for a reasonable time while the municipality develops a land use strategy to respond to new problems and prevents developers and property owners from rushing to

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develop their land under current land use rules that the community wishes to change. Moratoriums may be issued prior to the adoption of a local overlay zone, a new subdivision law, the designation of a critical environmental area, or the adoption of an environmental constraints ordinance. The moratorium will forestall additional negative impacts from the type of development that the new law or regulation is designed to prevent or mitigate.

IV. DECIDE WHETHER THE COMPREHENSIVE PLAN NEEDS TO BE AMENDED, BASED ON STEPS I & II, AND, IF SO, USE THE SEA LEVEL RISE TASK FORCE TO PREPARE IT

Taking Steps I-III allows the municipality to build political and factual support and decide whether it is worth adding a sea level rise component to its comprehensive plan amendment process. It is appropriate to adopt a comprehensive plan amendment for a portion of the community, such as a coastal hazards zone, where changes are happening and special circumstances exist.

V. ADOPT A COMPREHENSIVE PLAN SEA LEVEL RISE COMPONENT

A sea level rise component may recognize the susceptibility of a locality to flooding, erosion, sea level rise, and severe storm events. It may include information concerning the negative consequences to the community posed by these threats and will call the public's attention to the issue. A detailed sea level component can include information about the topography that will be affected by sea level rise including impacts on dunes, tidal wetlands, and environmental functions of groundwater. The level of detail is such that the plan can be the basis for certain regulatory approaches that will be discussed later.

New land use regulations will be needed to adapt to sea level rise. In most states, all local land use regulations must conform to the community's comprehensive plan.

A comprehensive plan amendment can be used to integrate planning for other programs, qualify the municipality for additional funding, and provide for coordinated implementa-

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tion of related plans. A FEMA approved all-hazard mitigation plan is required for municipalities to be eligible for its Hazard Mitigation Grant Program.[55] If the municipality has an existing all-hazard mitigation plan, then that plan can be incorporated by reference in the new sea level rise component in the comprehensive plan.

VI. ADOPT EXPANDING OVERLAY ZONE FOR SEA LEVEL RISE VULNERABLE AREAS IN THE COMMUNITY

Once a community completes the planning process, it can adopt an expanding overlay zone for the sea level rise vulnerable areas identified in the sea level rise component of the amended plan.[56] The provisions of the overlay ordinance are applied in addition to those in the underlying zoning regulations. All as of right and specially permitted uses allowed under the existing zoning are still permitted, except that the uses must meet the standards established in the overlay zone. The zoning resolution adopting this new zone may specify that it will ''expand'' as sea level rise projections change, by referencing a reliable source of information and providing that as the source changes projections, those new projections are incorporated automatically into the overlay zone's definition.

The overlay zoning provisions can state that all as-of-right uses in the underlying zones require a special permit and that such permits can be issued only if the proposed uses meet the standards articulated in the overlay zone. The planning board should be authorized to impose conditions on the issuance of special permits to ensure that these standards are met. Step VII outlines the application requirements and possible conditions for the special use permit.

An overlay zone should contain the following provisions:

a. Define Expanding Overlay Zone

i. Identify location of area vulnerable to sea level rise and storm hazards.

b. Describe and map the environmental characteristics in the overlay district, including for example:

i. General environmental characteristics of the zone,

ii. Areas subject to inundation upon seal level rise,

iii. Inundation Buffers,

iv. Habitats,

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v. Slopes,

vi. Dunes,

vii. Erosion Prone Areas, etc.

c. Standards Established for Each Identified Characteristic by Science and Engineering

i. For example: If an area is prone to flooding, then the standard could be an elevation requirement. If it contains critical habitat, those should be avoided by development.

ii. Option: Low impact development standards

d. Option: Add additional uses that are permitted in the overlay zone, such as those uses consistent with coastal ecosystem protection.

e. Option: Alternatively the community may choose to repeal the underlying zoning and to make the vulnerable area a new zoning district. This requires prescribing new and appropriate as-of-right uses and adopting prescriptive standards, like set backs and others such as those listed above. Conditional uses can be very limited or of an intermediate intensity and the municipality can establish standards for governing these conditional uses.

i. WARNING: There are a number of difficulties and disadvantages associated with this approach. Rezoning significantly alters the current expectations of the landowners and will result in political opposition. In addition, environmental conditions within the sea level rise area are not consistent throughout the district.

VII. APPLICATION REQUIREMENTS AND STANDARDS FOR SPECIAL USE PERMITS

The overlay zone suggested above converts all as-of-right uses to specially permitted uses and, perhaps, adds a few low impact uses that are compatible with the preservation of coastal ecosystems and sea level rise. Either in the overlay zone itself or in the special permit section of the community's zoning ordinance, there must be added special use application requirements to allow the local staff and planning board to receive the information needed and to impose conditions on special use permits to carry out the objectives of the overlay zone.

Application requirements: In addition to the information and material required to be submitted with other special use permit applications, an applicant for a special permit in the overlay zone must be required to submit detailed maps showing all relevant environmental conditions on the site subject to the application.[57] A base map must be submitted at an appropriate scale and on that map must be

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added the location of all conditions relevant to the enforcement of the overlay zones standards such as slopes, vulnerable soils, special vegetation, wetlands, habitats, surface waters, etc.

Applicants should be required to submit a sea level rise analysis for various levels of sea level rise.[58]

Conditions Imposed: The planning board must be authorized in this section of the law to impose conditions necessary to accomplish the objectives of the overlay zone. Examples of the types of conditions that may be imposed include:

- No-build and limited-build buffers & shoreline setbacks[59]
- Elevation requirements for permitted building[60]
- Limits on impervious surface
- Required storm water retention and management practices
- Mandatory clustering—requires clustering away from sensitive areas[61]
- Require applicant to prove compliance with sensitive area protections[62]
- Prohibit shoreline protective structures (hard/soft solutions)[63]
- Require Deed Restrictions/Conservation Easements before property is inundated[64]
- Require deed restrictions on building on all but small portion of the site
- Subject developers/landowners to development agreements governing future assurances.[65]

VIII. AMEND SITE PLAN AND SUBDIVISION REGULATIONS TO CROSS REFERENCE SPECIAL PERMIT REQUIREMENTS CREATED IN STEP VII

Many of the standards and techniques listed above for the special permit may be cross referenced or added to the community's subdivision and site plan regulations. In subdividing land or specifying development on an individual site, the details of the proposed development may be more clearly articulated and the planning board should be authorized to require the same information specified in the special permit section above and to impose further conditions of the type listed above in approving a subsequent subdivision or site plan proposal. Alternatively, the application for the subdivision or site plan approval can be simultaneous with the application for the special use permit, which

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will require that the applicant comply with all regular subdivision and site plan submission requirements as well as those contained in the special use permit requirements in the overlay zone.

IX. PLACE LIMITATION ON REBUILDING IN OVERLAY ZONE IF SUBSTANTIAL DESTRUCTION

The municipality can include a provision that requires the landowner to meet the standards in the new expanding overlay zone if a building is substantially destroyed. The municipality can define substantially destroyed (i.e. 50%). The landowner would have to apply for the special use permit and would be subject to the standards of the overlay zone, application requirements, and the imposition of conditions.

X. ESTABLISH MORATORIUM FOLLOWING FUTURE STORM EVENTS (POST DISASTER MORATORIA) OPTION

A municipality can adopt a post disaster moratorium that puts into effect a moratorium on all development upon the occurrence of specified storm events. The municipality can choose to:

> f. Limit all building pending a post-storm damage survey within a fixed time.[66]
>
> g. Limit all building not connected with required infrastructure.[67]
>
> h. Adjust zones and regulations to the post storm landscape.
>
> i. Regulate all post storm rebuilding according to changes in land and the landscape.

Additional Considerations and Tasks

In addition to these ten steps, there are a number of other considerations and tasks a municipality should consider.

Both the rate and impact of sea level rise and storm hazards challenge the capabilities of local, volunteer decision makers. If the techniques recommended above are adopted a new set of complicated responsibilities will be added to the responsibilities of planning board members. Against the weight of these pressures, the local land use decision makers need to understand the scope of their responsibility and authority under law, and need to be armed with the tools for land and other resource protection, as well as,

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consensus building and decision-making tools and techniques. It is important to involve them in the formulation of these new standards, procedures, and techniques and to ensure that they are trained in their use.

After adopting an overlay zone and other special permit, site plan, and subdivision provisions, a municipality can adopt enforcement mechanisms to ensure compliance with its new sea level rise zoning. In addition, municipalities can enter into Intermunicipal Agreements to regulate shared coastal resources and/or shared risk prevention and mitigation. There are numerous things a municipality can choose to do with adjacent communities.

With the risks of sea level rise and storm hazards comes state and federal technical assistance and grants. The municipality can charge its Task Force, if it created one, or other relevant board or staff to monitor these opportunities and apply for such assistance and funding when available.

OTHER TOOLS AND TECHNIQUES

Many states allow municipalities to establish transfer of development rights programs that concentrate development in receiving districts and provide for the transfer of development rights from sending districts. In smart growth terms, the receiving district is the designated growth area and the sending area is a conservation or natural resource protection area.

Public acquisition of private land is sometimes necessary to achieve the resource preservation and environmental protection objectives of local governments.[68] A municipality can purchase the owner's entire fee interest in the property, development rights, or a conservation easement. The state or federal government may provide funding for local acquisition through a variety of devices. There are also several methods that local governments may use to raise the funds needed for land acquisition, where authorized by state statute.

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[1]Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 112 S. Ct. 2886, 120 L. Ed. 2d 798, 34 Env't. Rep. Cas. (BNA) 1897, 22 Envtl. L. Rep. 21104 (1992).

[2]IPCC, Climate Change 2007: Physical Science Basis; Summary for Policymakers (February 2007).

[3]''Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region,'' U.S. Climate Change Sci-

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ence Program, available at http://www.climatescience.gov/Library/sap/sap4-1/final-report/default.htm (Jan. 15, 2009).

[4]Science and Technology Committee, *Statement on Sea Level in the Coming Century*, in SECOND REPORT AND INITIAL RECOMMENDATIONS MIAMI-DADE COUNTY CLIMATE CHANGE TASK FORCE, Presented to the Miami-Dade Board of County Commissioners (Apr. 2008), available at http://www.miamidade.gov/derm/library/08-10-04_CCATF_BCC_Package.pdf.

[5]MIAMI-DADE COUNTY, FLA., CODE, art. CXXVI, §§ 2-1941 to 1946 (2008), available at http://www.miamidade.gov/govaction/matter.asp?matter=061152&file=true&yearFolder=Y2006.

[6]MIAMI-DADE COUNTY, FLA., CODE, art. CXXVI, §§ 2-1941 to 1946, at 1 (2008), available at http://www.miamidade.gov/govaction/matter.asp?matter=061152&file=true&yearFolder=Y2006.

[7]MIAMI-DADE COUNTY, FLA., CODE, art. CXXVI, §§ 2-1941 to 1946, at 3-4 (2008), available at http://www.miamidade.gov/govaction/matter.asp?matter=061152&file=true&yearFolder=Y2006.

[8]MIAMI-DADE COUNTY, FLA., CODE, art. CXXVI, §§ 2-1941 to 1946, at 4 (2008), available at http://www.miamidade.gov/govaction/matter.asp?matter=061152&file=true&yearFolder=Y2006.

[9]S. Mulkey, *Climate Change and Land Use: Report to the Century Commission* (June 2007).

[10]Governor's Action Team on Energy and Climate Change, Florida Action Team Final Report (Oct. 2008), available at http://www.flclimatechange.us/documents.cfm.

[11]*See* The Treasure Coast Regional Planning Council, *Sea Level Rise in the Treasure Coast Region* (December 5, 2005), available at http://www.tcrpc.org/special_projects/TCRPC%20SLR%20Report%2012-05-05.pdf.

[12]MAINE NATURAL RESOURCES PROTECTION ACT, 38 M.R.S.A. § 480-A (2009).

[13]Maine Department of Environmental Protection Rules Ch. 355(1), available at http://www.maine.gov/sos/cec/rules/06/chaps06.htm.

[14]Maryland Commission on Climate Change, Climate Action Plan, Phase I: Sea-level rise and coastal storms 25 (Aug. 2008), available at http://www.mde.state.md.us/Air/climatechange/index.asp.

[15]Maryland Commission on Climate Change, Climate Action Plan, Phase I: Sea-level rise and coastal storms 22 (Aug. 2008), available at http://www.mde.state.md.us/Air/climatechange/index.asp.

[16]*See* The Metropolitan Washington Council of Governments, *National Capital Region: Climate Change Report* (Nov. 2008), available at http://www.mwcog.org/uploads/pub-documents/zldXXg20081203113034.pdf.

[17]*See* Critical Area Commission, Maryland House Bill 1253, Overview of 2008 Legislation (May 20, 2008).

[18]New York State Department of Environmental Conservation, Office of Climate Change, http://www.dec.ny.gov/about/43166.html.

[19]*See* Summary of the Sea Level Rise Task Force Steering Committee Meeting Summary, November 24, 2008 (on file with the author). *See also* New York State Energy Research and Development (NYSERDA), http://www.nyserda.

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org/programs/environment/emep/home.asp.

[20]Columbia University Center for Climate Systems Research (CCSR) is currently developing estimates of sea level rise for New York City and the NYSERDA Integrated Assessment for Effective Climate Change Adaptation Strategies, will use CCSR expertise to refine these estimates for coastal New York State and the Hudson River north to the Federal Dam in Troy. *See* Sea Level Rise Task Force Steering Committee Recommendations for Sea Level Rise Planning, November 14, 2008 (on file with the author).

[21]*See* New York State Energy Research and Development (NYSERDA), State Level Initiatives to Study Greenhouse Gas Emission, available at http://www.nyserda.org/programs/environment/emep/home.asp.

[22]North Carolina General Policy Guidelines for the Coastal Area, 5A NCAC 07M.0501.

[23]NOAA/Rhode Island Sea Grant/University of Rhode Island, *Summary of Coastal Program Initiatives that Address Sea Level Rise as a Result of Global Climate Change*, at 42 (February 2008).

[24]NOAA/Rhode Island Sea Grant/University of Rhode Island, *Summary of Coastal Program Initiatives that Address Sea Level Rise as a Result of Global Climate Change*, at 42 (February 2008).

[25]S.C. CODE OF REGULATIONS, Ch. 30, § 30-1(C)(4).

[26]S.C. CODE OF REGULATIONS, Ch. 30, § 30-1(C)(7).

[27]*See* Eddie R. Fisher & Angela R. Sunley, *A Line in the Sand: Balancing the Texas Open Beaches Act and Coastal Development*, Proceedings of Coastal Zone 07, Portland, OR (July 2007).

[28]*See* The City of Bainbridge Island Comprehensive Plan, Environmental Element, available at http://www.ci.bainbridge-isl.wa.us/comprehensive_plan.aspx.

[29]*See* The City of Bainbridge Island Comprehensive Plan, Environmental Element, available at http://www.ci.bainbridge-isl.wa.us/comprehensive_plan.aspx.

[30]*See* The City of Bainbridge Island Comprehensive Plan, Environmental Element, at 8, available at http://www.ci.bainbridge-isl.wa.us/comprehensive_plan.aspx.

[31]The North Carolina Coastal Area Management Act of 1974, N.C. GEN STAT. §§ 1131-100 to 134.3 (2009), available at http://dcm2.enr.state.nc.us/rules/cama.htm.

[32]15A N.C. ADMIN. CODE § 07M. 0501 (2008), available at http://www.nccoastalmanagement.net/Rules/Text/t15a-07m.0500.pdf.

[33]North Carolina Design and Construction Guidelines 15, available at http://149.168.212.15/mitigation/Library/Full_Tools_and_Tech.pdf.

[34]In 2005, Duck adopted, and the State of North Carolina certified, the town's CAMA CORE Land Use Plan, which calls for sea level rise mitigation planning. *See* TOWN OF DUCK, N.C., CAMA Core Land Use Plan (2005), available at http://www.townofduck.com/pzi.landuseplan.pdf.

[35]TOWN OF DUCK, N.C., CODE, ch. 152 (2008).

[36]TOWN OF DUCK, N.C., CODE, ch. § 152.03 (2008).

[37]Town of East Hampton, N.Y., Comprehensive Plan: Coastal Management Component at C-5 to C-6.

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[38]TOWN OF EAST HAMPTON, N.Y., CODE § 255-4-40.

[39]TOWN OF EAST HAMPTON, N.Y., CODE, Ch. 255: Zoning § 255-3-80.

[40]Climate Change Report, available at http://www.nyc.gov/html/planyc2030/downloads/pdf/report_climate_change.pdf.

[41]Press Release, *Mayor Bloomberg Launches Task Force to Adapt Critical Infrastructure to Environmental Effects of Climate Change*, August 12, 2008, available at http://www.rockfound.org/about_us/press_releases/2008/081208cc_nyc.shtml.

[42]PlaNYC, available at http://www.nyc.gov/html/planyc2030/html/home/home.shtml.

[43]Press Release, *Mayor Bloomberg Launches Task Force to Adapt Critical Infrastructure to Environmental Effects of Climate Change*, August 12, 2008, available at http://www.rockfound.org/about_us/press_releases/2008/081208cc_nyc.shtml.

[44]Press Release, *Mayor Bloomberg Launches Task Force to Adapt Critical Infrastructure to Environmental Effects of Climate Change*, August 12, 2008, available at http://www.rockfound.org/about_us/press_releases/2008/081208cc_nyc.shtml.

[45]Press Release, *Mayor Bloomberg Launches Task Force to Adapt Critical Infrastructure to Environmental Effects of Climate Change*, August 12, 2008, available at http://www.rockfound.org/about_us/press_releases/2008/081208cc_nyc.shtml.

[46]*Potential Adaptation Strategies For DEP*, *in* THE NYC DEP CLIMATE CHANGE PROGRAM ASSESSMENT AND ACTION PLAN: A REPORT BASED ON THE ONGOING WORK OF THE DEP CLIMATE CHANGE TASK FORCE 55 (May 2008), available at http://www.nyc.gov/html/dep/html/news/climate_change_report_05-08.shtml.

[47]COLLIER COUNTY, FLA., LAND DEVELOPMENT CODE, § 3.03.05 (2008).

[48]COLLIER COUNTY, FLA., LAND DEVELOPMENT CODE, § 3.03.05 (2008).

[49]FALMOUTH, MASS., CODE, ch. 235 (2008); Falmouth Wetlands Regulations, FWR § 10.00 (2008).

[50]Falmouth Wetlands Regulations, FWR § 10.02.

[51]Falmouth Wetlands Regulations, FWR § 10.38. FEMA flood zone designations available at http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtm.

[52]New York City, PlaNYC, http://www.nyc.gov/html/planyc2030/html/home/home.shtml; PlaNYC Report on Climate Change, available at http://www.nyc.gov/html/planyc2030/downloads/pdf/full_report.pdf.

[53]The Miami-Dade County, Florida's Climate Change Task Force consists of twenty-five appointed members representing various sectors of the Miami-Dade community including government agencies and educational institutions. See The Second Report and Initial Recommendations Miami-Dade County Climate Change Task Force, Presented to the Miami-Dade Board of County Commissioners (Apr. 2008), available at http://www.miamidade.gov/derm/library/08-10-04_CCATF_BCC_Package.pdf.

[54]The City of Olympia's Comprehensive Plan stresses community involvement. The City recognized that ''citizens will not give grudging support to (land use) actions if they do not understand the reasons for them,''

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and created *Olympia's Plan to Grow Smart*. Through this plan, the City conducts an aggressive education program for citizens of all ages, and encourages their participation in environmental issues. The plan helps to create a sense of community and creates locally approved goals for the city's land use planners based on community feedback. *See* Olympia's Plan to Grow Smart, http://search.mrsc.org/Subjects/Governance/trust/o46-41.pdf.

[55]Federal Disaster Mitigation Act of 2000, 44 CFR Part 201.6 (2008), calls upon states to plan for disasters by developing a mitigation plan that outlines processes for identifying the natural hazards, risks, and vulnerabilities of the area under the jurisdiction of the government to be approved by the government. Preparation and adoption of a jurisdiction wide natural hazard mitigation plan is a condition of receiving project grant funds under the Hazard Mitigation Grant Program. An enhanced plan that demonstrates that the state is committed to a comprehensive state mitigation program by engaging local governments qualifies for more grant money than a standard plan.

[56]*See* Tillamook County, OR, Land Use Ordinance, § 3.085, Beach and Dune Overlay District. Tillamook County, Oregon is highly vulnerable to ongoing coastal erosion, landslides, and sand inundation of permitted structures in the fore-dune areas of the coast. The county code incorporates a Beach and Dune (BD) Overlay Zone that prohibits development in active dune areas subject to flooding and other natural hazards; requires erosion and groundwater drawdown be minimized in coastal areas; and provides that only properties developed before a certain date may obtain permits for beachfront protective structures.

[57]*See* TOWN OF SOUTH KENSINGTON, R.I., CODE § 601, High Hazard Overlay. Special use permits for construction behind the fore-dune zone may be granted and may require additional information including a detailed map with extensive environmental information such as high and low tide levels, soil type, dunes and other natural protective barriers, existing flood and erosion control methods, and current drainage elevations and contours, as well as a detailed plan which lays out the proposed uses for the lot.

[58]*See* COLLIER COUNTY, FLA., COMPREHENSIVE PLAN, Policy 10. 3.4, Coastal Zone Management; Sea Level Rise Analysis. The Resource Protection chapter of the County's Land Development Code requires a mandatory sea-level-rise impact analysis for shoreline development, which must demonstrate that the development will remain fully functional for its intended use after a six (6) inch rise in sea level and if the applicant cannot meet this requirement, a list shall be provided by the applicant of the changes necessary in order for the development to meet the standard.

[59]*See* Town of East Hampton, NY: Code § 255-4-30, Coastal and Wetland setbacks and buffers. Wetland setbacks are provided for all areas of the town. Construction is prohibited within a wetland; sewage disposal devices must be set back 150 feet from the upland boundary of a wetland; turf may not be established nearer the upward boundary than 50 feet; and coastal setbacks of 100 to 150 feet, from bluff lines or dune crests, are created in addition to primary and secondary setbacks, feet are established. Where multiple setbacks may affect a property, compliance with

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each setback is required, unless nonfeasibility can be shown by the landowner.

[60]*See* CITY OF MALIBU, CAL., CODE §§ 10.4(A),(B),(O),(Q); 10.6(C), Coastal Zone Shoreline and Bluff Ordinance. Development standards expressly require the consideration of sea level rise and mandate setbacks of a sufficient distance landward and elevations to a sufficient finished floor height, which will ''eliminate or minimize to the maximum extent feasible hazards associated with anticipated sea level rise over the expected 100 year economic life of the structure.''

[61]*See* Escambia County, Fla., Comprehensive Plan, Chapter 11, Coastal Conservation and Management Element. Where development in sensitive areas is permitted, adverse impacts must be minimized through the use of clustering, variance of the county lot and setback requirements, a reduction in construction ''footprints,'' modified or innovative construction techniques, and land use and development techniques which minimize negative environmental impacts or results.

[62]*See* Maine Department of Environmental Protection, Rules Ch. 355(1), Coastal Sand Dune Rules. Standards for all projects in sand dune areas provide that a project may not be permitted if ''it is likely to be severely damaged'' by a two-foot rise in sea level over the next 100 years.

[63]*See* TOWN OF EAST HAMPTON, NY, CODE, Ch. 255: Zoning § 255-3-80, Coastal Erosion Overlay District. East Hampton's coastal erosion overlay regulates the construction and alteration of shoreline protective structures. The zoning establishes four coastal erosion zones to protect the natural shoreline, where the construction of new coastal erosion structures is prohibited or require a special permit.

[64]*See* CITY OF MALIBU, CAL.: CODE §§ 10.4(A),(B),(O),(Q); 10.6(C), Coastal Zone Shoreline and Bluff Ordinance. Ordinance requires deed restrictions against properties that can be sited and designed to not require a shoreline protection structure as part of the proposed development or at any time during the life of the development. The restrictions ensure that ''no shoreline protection structure shall be proposed or constructed to protect the development approved.''

[65]*See* BARNSTABLE, MASS., CODE, Ch. 168, Regulatory Agreements Ordinance. The ordinance allows the Town and/or the Cape Cod Commission to enter into a development agreement with a qualified applicant for land use approvals within a mapped district.

[66]*See* TOWN OF DUCK, N.C., CODE, ch. 152 (2008). Damage assessment team assesses property damage immediately following a storm and makes recommendations to the town's Building Inspector, who then inspects and categorizes structures according to the degree of damage. When a building moratorium is declared in the Town of Duck, North Carolina, an ''initial moratorium'' extends for 48 hours, during which no building permits may be issued. A ''destroyed structure moratorium'' extends for 30 days following the expiration of the initial moratorium and during this period, no permit for replacement of a destroyed structure will be issued. In order to receive building permits, all replacement building and repairs following moratoriums must meet applicable town zoning and other code requirements. A major ''damaged structure morato-

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rium'' also extends for 7 days following the initial moratorium and a ''minor damaged structure moratorium'' coincides with the 48-hour initial moratorium.

[67]*See* TOWN OF NAGS HEAD, N.C., CODE, §§ 48-741 to 48-744, General Use Standards for Redevelopment in Ocean Hazard Areas. After the close of a building moratorium destroyed or major damaged structures may not be reconstructed unless an on-site inspection of the lot by zoning administrator is performed, a septic improvements permit is granted, the water is restorable at the street frontage of the lot, the electrical service is restorable to building site, and there is direct, uninterrupted approved vehicular access to the lot.

[68]''Land Preservation,'' Ch. 3, *Environmental Law Practice Guide: State and Federal Law* (Michael B. Gerrard, ed., 2003).

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COMMUNITY RESILIENCE: IMPLEMENTATION AND STRATEGIC ENHANCEMENTS

DRAFT LOCAL ASSESSEMENT TOOL

(Not a yet final and approved product from EPA or FEMA)

EPA FEMA

August 2017

Table of Contents

GLOSSARY OF TERMS

1% Annual Chance of Flood (formerly 100-year flood)	A flood that has a 1 percent chance of being equaled or exceeded in any single year. [1]
.2% Annual Chance of Flood or (formerly 500-year flood)	A flood that has a 0.2 percent (1 in 500) chance of being equaled or exceeded in any single year.[2]
Capacity building	Activities and improved access to knowledge and tools that provide individuals and organizations with the skills necessary to function at the highest possible level.
Critical infrastructure	A community's essential systems and networks; includes transportation, utilities, health care, water, wastewater, etc.
Dry floodproofing	A structure is made watertight below the level that needs flood protection to prevent floodwaters from entering; requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete.[3]
Economic vulnerability	The level of risk faced by a local economy or to an individual's ability to earn income. For example, local economies that are highly dependent on a single employer or producer face a higher level of economic vulnerability than does a more diversified local economy.
Environmental justice	The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.[4]
Floodplain	The flat or nearly flat land adjacent to a stream or river that experiences occasional flooding; includes the floodway (consists of the stream channel and adjacent areas that carry flood flows) and the flood fringe (areas covered by the flood, but which do not experience a strong current).[5] Floodplain maps typically indicate the 100-year and 500-year flood areas.
Green infrastructure	Vegetation, soils, and other elements and practices that reduce and treat stormwater at its source while delivering environmental, social, and economic benefits.[6]
Living shoreline	A variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, oyster reefs, coir fiber logs, sand fill, and stone utilized to provide shoreline protection and maintain valuable habitat.[7]
Low impact design/development	Systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater to protect water quality and associated aquatic habitat.[8]

[1] msc.fema.gov/portal
[2] msc.fema.gov/portal
[3] www.fema.gov/media-library-data/20130726-1608-20490-9182/fema_551_ch_07.pdf
[4] www.epa.gov/environmentaljustice
[5] www.sciencedaily.com/terms/floodplain.htm
[6] www.epa.gov/green-infrastructure/what-green-infrastructure
[7] www.habitat.noaa.gov/restoration/techniques/livingshorelines.html
[8] www.epa.gov/nps/urban-runoff-low-impact-development

National Flood Insurance Program	A program that aims to reduce the impact of flooding on private and public structures by providing affordable insurance to property owners and by encouraging communities to adopt and enforce floodplain management regulations.[9]
Non-conforming uses/structures/lots	A use of property, a structure, or a lot size that was allowed under the zoning regulations at the time the use was established, the structure was erected, or the lot was platted, but which, because of subsequent changes in those regulations, is no longer a permitted use/structure/lot.[10]
Smart growth practices	A range of development and conservation strategies that help protect health and the natural environment and make communities more attractive, economically stronger, and more socially diverse.[11]
Social vulnerability/ socially vulnerable populations	Socioeconomic and demographic factors (age, income and poverty, education, housing, race, disability, social isolation, and more) that may affect an individual's ability to respond to hazard events.
Special Flood Hazard Area	The land area covered by the floodwaters of the base flood as identified on a National Flood Insurance Program map; the area where the National Flood Insurance Program's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.[12]
Substantial improvement	Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage," regardless of the actual repair work performed.[13]
Substantial damage	Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.[14]
Vulnerability assessment	A study characterizing the physical location of hazards and identifying the social, environmental, and economic assets which may be impacted
Watershed	A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel.[15]
Wet floodproofing	Permanent or contingent measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area.[16]

[9] *www.fema.gov/national-flood-insurance-program*
[10] *mrsc.org/Home/Explore-Topics/Planning/Development-Regulations/Nonconforming-Uses-Structures-and-Lots-Regulatio.aspx*
[11] *www.epa.gov/smartgrowth/about-smart-growth*
[12] *www.fema.gov/special-flood-hazard-area*
[13] *www.fema.gov/floodplain-management-old/substantial-improvement#0*
[14] *www.fema.gov/floodplain-management-old/substantial-improvement#0*
[15] *water.usgs.gov/edu/watershed.html*
[16] *www.fema.gov/wet-floodproofing*

COMMON ACRONYMS

BFE: Base Flood Elevation

BMP: Best Management Practice (stormwater)

CFM: Certified Floodplain Manager

CIP: Capital improvement plan

CRS: Community Rating System

FAR: Floor area ratio

FEMA: Federal Emergency Management Agency

FIRM: Flood Insurance Rate Map

GI: Green infrastructure

GIS: Geographic Information Systems

LEED: Leadership in Energy and Environmental Design

LID: Low-impact design

LiMWA: Limit of Moderate Wave Action

NFIP: National Flood Insurance Program

NPDES: National Pollution Discharge Elimination System

PDR: Purchase of Development Rights

RCD: Resource Conservation District

RL: Repetitive loss properties

SBA: Small Business Administration

SD: Substantial damage

SFHA: Special Flood Hazard Area

SI: Substantial improvement

SLAMM: Sea Level Affecting Marshes Model

SLOSH maps: Sea, Lake and Overland Surge from Hurricanes flood maps

SRL: Severe repetitive loss properties

TDR: Transfer of Development Rights

INTRODUCTION

What does it mean to be resilient? Climate-resilient communities understand their potential environmental hazards and are prepared and able to adapt when faced with change or unexpected circumstances. These communities can offer greater protection to the lives and property of residents and recognize that building resilience requires both hard and soft measures, from infrastructure enhancements to policies and governance, at the local and regional levels, and beyond.

In response to recent disasters and hazard-related events, more communities are working towards building resilience. But even motivated communities often find that challenges stand in the way – particularly when it comes to implementation. There might be political barriers or objections to resilience-building efforts in the community, such as an unwillingness to confront future problems, concerns about private property rights, or an expectation of high costs. Some communities may not prioritize resilience, choosing to focus their resources on other issues such as attracting business and jobs, or stimulating housing development. However, with some foresight and the help of model strategies, resilience can be effectively incorporated into a broad spectrum of community planning efforts and policies, allowing communities to avoid an "either/or" choice.

The **Community Resilience: Implementation and Strategic Enhancements (C-RISE) Local Assessment Tool** helps you approach hazards and risks comprehensively; and assess and refine your laws and policies in a way that improves resilience and helps achieve desired community outcomes. The tool works by assessing two critical elements of building resilience:

- the "how" – once identified, resilience-enhancing measures can be successfully integrated into existing land use laws, building codes, and planning policies; and
- the "what" – gaps in policies and regulations that support resilience.

It does so by walking communities through the following Resilience Goal Areas:

1. Ensure comprehensive understanding of known hazards and their potential effects (physical, economic, social)
2. Conserve land in critical coastal areas, river corridors, and other hazard-prone environments
3. Reduce risk to people, buildings, and facilities in vulnerable areas
4. Plan for and encourage development in safer areas
5. Implement comprehensive stormwater management techniques
6. Improve the community capacity needed to enhance resilience
7. Build community support for improving resilience and remove barriers to implementation

Once you have completed the assessment, you will have a more comprehensive understanding of how your community is currently addressing resilience and working towards community goals of enhancing resilience. While the assessment won't prescribe a solution for your community, it allows you to see your successes and strengths, and your gaps and challenges. In addition, it connects these factors to specific and applicable strategies for improving resilience, including applicable land use codes and tools.

WHO WILL BENEFIT FROM USING THIS TOOL?

This tool specifically addresses the challenges that face communities affected by coastal or riverine hazards, but can be used by any community that desires to enhance its resilience. To focus on implementation more directly, **this tool presumes that your community has done some preliminary work on developing a community vision or goals focused on resilience**. While there is an emphasis on land use laws, codes, and zoning regulations, the assessment extends beyond regulatory issues to help your community also take stock of local initiatives, strategies, and plans.

GETTING READY TO COMPLETE THE TOOL

Who Can Help Fill This Out?

The assessment is often most effective when communities approach it collaboratively, with a variety of expertise present at the table. Forming a steering committee or review group is an efficient way to ensure that the necessary information can be accessed and interpreted. Additionally, forming a group to assess resilience may help to cultivate buy in from officials with the authority to make decisions and allocate funding. A well-functioning group generally consists of three to six (or more) people who are sources of key community information as well as individuals who are willing to be on-going champions of building resilience.

Working through this type of tool can bring communities together in unexpected ways and can lead to long-lasting partnerships. New connections are critical when moving into the implementation phase. Remember that some of these potential partners may be in your applicable state and federal agencies/offices.

What Will I Need to Complete the Tool?

Successfully working through the assessment tool also requires access to key information and documents. It helps to have certain baseline information on hand or know where you can find the information you need (or who can help you find it).

Every community is different and has different needs and staffing structures. Table 1 provides suggestions to help get you started, recommends options for steering committee members, and provides examples of documents, plans, policies, and ordinances that may be useful to you as you work through the tool.

Table 1. Preparing to Complete the Tool – Useful Resources

PERSON/ AGENCY/ ORGANIZATION	RELEVANT RESLIENCE GOAL AREA(S)	CAN ALSO HELP PROVIDE	STEERING COMMITTEE
Certified floodplain manager	All goal areas	• Hazard/flood insurance rate maps (FIRM) • Hazard mitigation plan • Emergency operations plan • Post-disaster recovery plans and studies	X

		• Municipal zoning code	
Chief Resilience Officer	All goal areas	• Hazard mitigation plan • Post-disaster recovery plans and studies • Context-appropriate environmental codes/regulations (for example, a coastal area plan)	X
City or land use attorney	Goal 2 Goal 7	• Municipal zoning code	
Coastal zone manager/planner	Goal 1 Goal 2 Goal 6 Goal 7	• Hazard/flood insurance rate maps (FIRM) • Hazard mitigation plan • Post-disaster recovery plans and studies • Context-appropriate environmental codes/regulations (for example, a coastal area plan)	X
Code enforcement officer	Goal 3 Goal 5 Goal 6	• Municipal zoning code • Municipal building code	
Community and economic development staff	Goal 4 Goal 6 Goal 7	• Comprehensive/master plan • Municipal zoning code	X
Developer liaison(s)	Goal 3 Goal 4 Goal 6 Goal 7	• Comprehensive/ master plan • Municipal zoning code • Municipal building code • Subdivision regulations	
Emergency manager/ planner	All goal areas	• Hazard/flood insurance rate maps (FIRM) • Hazard mitigation plan • Emergency operations plan • Post-disaster recovery plans and studies	X
Land use planner	All goal areas	• Comprehensive/master plan • Municipal zoning code • Subdivision regulations	X
Local environmental organizations	Goal 2 Goal 7	• Context-appropriate environmental codes/regulations	
Natural resources planner or department	Goal 1 Goal 2 Goal 4 Goal 5 Goal 6 Goal 7	• Subdivision regulations • Context-appropriate environmental codes/regulations (for example, a coastal area plan)	
Parks and recreation staff	Goal 1 Goal 2 Goal 5 Goal 7	• Parks/ open space master plan	
Public works	Goal 1 Goal 3 Goal 5	• Emergency operations plan • Capital improvements plan	X

	Goal 6		
Relevant municipal board members (including volunteer) or elected officials	Goal 1 Goal 6 Goal 7	• Municipal zoning code • Subdivision regulations • Comprehensive/master plan	X
Stormwater manager/utility	Goal 1 Goal 5 Goal 6	• Stormwater management plan • Subdivision regulations • Context-appropriate environmental codes/regulations	X
Sustainability planner	All goal areas	• Comprehensive/master plan • Municipal zoning code • Municipal building code • Subdivision regulations • Context-appropriate environmental codes/regulations (for example, a coastal area plan)	
Transportation planner and engineer	Goal 1 Goal 3 Goal 5	• Comprehensive transportation plan • Road conditions reports	
Zoning administrator	Goal 2 Goal 3 Goal 4 Goal 5	• Municipal zoning code • Subdivision regulations	X

Potential Challenges

The U.S. EPA report "Smart Growth Fixes for Climate Adaptation and Resilience" presents a selection of potential challenges that a community might face when working to implement strategies to improve resilience.[17] Table 2 provides a summary of example challenges that might be encountered. These are helpful to think about when completing the Assessment. Often a solution will emerge from a more comprehensive view of a problem.

Table 2. Potential Challenges to Implementing Resilience Strategies

BARRIERS	EXAMPLES
Regulatory and Policy	• Allowing development in floodplains • Outdated flood maps • Conflicting regulations • Policy/regulations not guided by data/projections
Fiscal	• Perceptions of high cost • Inefficient public spending
Uncertainty	• Absence of reliable data about resilience risks • Perceptions of data complexity
Societal Disparities	• Areas most at risk affect those most vulnerable • Conflicting priorities/needs
Timeframe of impacts	• Discounting future impacts

[17] Resource material for this section was sourced from the publication "Smart Growth Fixes for Climate Adaptation and Resilience," U.S. EPA, Office of Sustainable Communities, 2017. https://www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience

	• "It won't affect me"
Legal issues	• Authority to legislate (Home Rule states versus Dillon's Rule states) • Conflicts with existing state or local law • Regulatory "takings"
Community Consensus	• "Not in My Back Yard" opposition

TOOL STRUCTURE

The **C-RISE Local Assessment Tool** is organized by the seven Resilience Goal Areas identified above, each broken into four activity types and collectively containing over 130 specific local land use and policy strategies. Within the tool, each goal is described, including how it helps build resilience. Practical applications offer information about communities that illustrate these goals in action. To dig deeper into the "how" and "what," you are asked to answer a few context-setting questions and to work through a checklist of strategies to consider how you currently (or could): 1) study, adopt plans, and educate; 2) remove barriers and build partnerships; 3) adopt incentives; and 4) enact policies and supportive regulations. Each goal includes targeted resources for these strategies that are included to both inform and inspire. These resources are examples of approaches that different communities have used to improve their resilience and, in the process, improve their economies, environment, health, and quality of life. The tool concludes with prioritization guidance and an action planning exercise to help synthesize what's been learned.

Tool Navigation

To ensure usefulness to a wide variety of communities, it was necessary to incorporate many resilience-building goals and strategies. However, it is recognized that not all the goals will apply to every community attempting to enhance their resilience. For example, a city that is in the floodplain and fully built out may not find Goal Area 4 - *Plan for and encourage development in safer areas* - to be highly relevant to their community. Answering the questions in the Worksheet on page 52 and tabulating the results will help direct you to the most applicable and relevant resilience goal areas for your community.

GOAL 1: Ensure Comprehensive Understanding of Known Hazards and Their Potential Effects (Physical, Economic, and Social)

This goal area addresses the importance of recognizing the hazards that could affect your community and the people and places that are most at risk. Although this tool is geared towards communities that have already wrestled with resilience issues, it does not mean that all information pertaining to hazards and risk is complete and up-to-date. This goal ensures comprehensive understanding of key issues. A resilient community has a thorough understanding of the hazards it can expect to face, the potential range in severity of those hazards, and where they are most likely to occur. Potential impacts are investigated, mapped, and recognized. A resilient community recognizes that vulnerabilities are not limited to physical structures, and that social and economic vulnerability are equally important to address.

PRACTICAL APPLICATIONS

***New York Rising Community Reconstruction Program*:** A recovery and resilience initiative to assist 124 communities severely affected by Superstorm Sandy, Hurricane Irene, and Tropical Storm Lee. The program directly engages residents and business owners through planning committees and public engagement events. At such meetings, community members coordinate with the state to develop reconstruction plans and identify projects to strengthen resilience. Thus far, 66 plans have been created. Each plan includes a thorough accounting of hazards, risks, and vulnerabilities. In most cases, projects will be implemented by local stakeholders, with support and technical assistance provided by the Governor's Office of Storm Recovery, which allocated over $700 million in federal funds to support the planning and implementation of such community-developed projects. *stormrecovery.ny.gov/community-reconstruction-program*

Louisiana Coastal Protection and Restoration Authority (CPRA) 2017 Coastal Master Plan: Updated every five years, the Coastal Master Plan is designed to respond to the loss of coastal land and the threats from storm surge events by identifying, funding, and completing projects that build or maintain land, reduce risk, and improve resilience. Since CPRA was created and the first Coastal Master Plan was released in 2007, it has completed or funded 135 projects, resulting in over 36,000 acres of land benefits, 282 miles of levee improvements, and over 60 miles of barrier islands and berms. In addition, the plan provides individual fact sheets for 24 parishes, detailing hazards and risks, the projected impacts of future land use change and flood depths, as well as the 2017 Coastal Master Plan projects for each parish. *coastal.la.gov/our-plan/2017-coastal-master-plan/overview/*

Understanding Key Challenges

- To what natural hazard events is your community most susceptible? What were the primary physical, economic, and social impacts of recent hazard events?

- Has your community been involved in the development of a Multi-Jurisdictional Hazard Mitigation Plan approved by the Federal Emergency Management Agency (FEMA)? Did you develop your own hazard mitigation plan? Document its name, date of plan, and URL, if available.

- Are there specific challenges you've faced in identifying your community's hazards and related community impacts?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess your community's current capacity for comprehensive understanding of known hazards and their potential physical, economic and social effects. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
1.1	Comprehensive plan has a hazard mitigation or resilience chapter/section			
1.2	Location of socially vulnerable populations (e.g. age, income and poverty, education, housing, race, disability, social isolation) is identified in comprehensive plan, relative to hazards/hazard-prone areas			
1.3	Waste facilities identified in hazard-prone areas			
1.4	Up-to-date flood hazard maps adopted. If "Yes", please provide the date maps were created/adopted in the "Links/Resources" column.			
1.5	Flood maps consider both historical events and projected flood lines and coastlines			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
1.6	Flood-prone areas (i.e. river corridor hazard areas and shallow, sheet flow flooding areas, or urban flooding areas) are identified in comprehensive plans/land use maps			
1.7	V130/VE zone areas[18] or Limit of Moderate Wave Action (LiMWA)[19] identified in comprehensive plans (if applicable)			
1.8	Erosion studies exist for vulnerable coastal areas			
1.9	Erosion-prone areas (i.e. fluvial (riverine) erosion hazard areas; beach, dune, cliff and bluff erosion/accretion areas; inlet movement; and oyster reef and coral reef sedimentation zones) identified in comprehensive plans			
1.10	Future flood-prone or erosion-prone areas have been identified by considering an increase in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)			
1.11	A current inventory of structures located in floodplains and their current elevation status is maintained			
1.12	A current inventory of repetitive loss properties (RL)[20] and severe repetitive loss properties (SRL)[21] is maintained			
1.13	A current inventory of National Flood Insurance Program (NFIP) claims (and amounts) that have been paid out is maintained			
1.14	A current inventory of critical community facilities (e.g., fire stations, town hall, hospitals, emergency shelters, utilities, schools, etc.) located within the SFHA (or the 1%/100-year floodplain) is maintained			

[18] National Flood Insurance Program flood zone classifications. V130 means coastal flood with velocity hazard (wave action) and BFEs have not been determined. VE means an area inundated by 1% annual chance flooding with velocity hazard (wave action); where base flood elevations have been determined, and flood elevation includes wave heights equal to or greater than 3 feet. *www.fema.gov/zone-ve-and-v1-30*

[19] A FEMA mapping standard for Flood Insurance rate maps; the inland limit of the area expected to receive 1.5-foot or greater breaking waves during the 1-percent-annual-chance flood event; may be included on more recent Flood Insurance Rate Maps. *www.fema.gov/vi/media-library/assets/documents/96413*

[20] A property for which two or more flood insurance claims of more than $1,000 have been paid by the National Flood Insurance Program within any 10-year period since 1978. *crsresources.org/files/500/mapping_repetitive_loss_areas.pdf*

[21] A 1–4 family property that has had four or more claims of more than $5,000 or two to three claims that cumulatively exceed the building's value; for the Community Rating System, non-residential buildings that meet those same criteria are also considered severe repetitive loss properties. *crsresources.org/files/500/mapping_repetitive_loss_areas.pdf*

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
1.15	A current inventory of public infrastructure (e.g., bridges, roads, power and communication lines, etc.) located within the SFHA (or the 1%/100-year floodplain) is maintained			
1.16	Locations where floods or high tides can infiltrate the water, sewer, or stormwater system(s) have been identified			
1.17	A high-water mark campaign that records high water elevations following flood events to validate existing mapping and map hazards[22] is used			
	Remove Barriers & Build Partnerships			
1.18	County or regional planning efforts for hazard mitigation and/or disaster recovery have been joined or initiated			
	Adopt Incentives			
1.19	Pre-disaster assistance and information is offered to businesses using Small Business Administration (SBA) and FEMA resources for developing Business Recovery Plans			
	Enact Policies & Supportive Regulations			
1.20	Cross-referencing of plans (e.g. comprehensive plan, hazard mitigation plan, disaster recovery plans, coastal management plan, etc.) is required prior to plan adoption			
1.21	Coastal setbacks reflect erosion rates, as established through erosion studies			
1.22	Annexation policies consider an increase in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)			

[22] A community-based awareness program that increases local communities' awareness of flood risk and encourages action to mitigate that risk using signs and high-profile launch events. www.fema.gov/high-water-mark-initiative

Targeted Resources

STRATEGY	Study, Adopt Plans, and Educate
1.1	**Integrating Hazard Mitigation into the Local Comprehensive Plan**: A fact sheet from FEMA with a link to a guidebook from the American Planning Association. https://www.fema.gov/media-library-data/20130726-1908-25045-9918/factsheet1.pdf
1.2	**Community Based Vulnerability Assessment: A Guide to Engaging Communities in Understanding Social and Physical Vulnerability to Disasters**: A step-by-step guide from to conducting a social vulnerability hazard assessment, by MDC and sponsored by FEMA. *http://www.mdcinc.org/sites/default/files/resources/Community%20Based%20Vulnerability%20Assessment.pdf* **Social Vulnerability Index**: Tool developed by the CDC analyzes a variety of risk factors at a census block level. *https://svi.cdc.gov/*
1.3	**Fort Worth, Texas Floodplain Management Plan**: Waste Water Facilities are part of the critical facilities hazard map *http://fortworthtexas.gov/files/FMP%202016-06-17.pdf*
1.4	**Adoption of Flood Insurance Rate Maps fact sheet**: FEMA explains the flood insurance program, availability of maps, and more. https://www.fema.gov/media-library/assets/documents/30451
1.5	**Fort Worth, Texas Floodplain Management Plan, "Open Channel Studies"**: *http://fortworthtexas.gov/files/FMP%202016-06-17.pdf* **FEMA Flood Insurance Study data**: *https://www.fema.gov/flood-insurance-study*
1.7	**Limit of Moderate Wave Action (LiMWA) Fact Sheet**: *https://www.fema.gov/media-library/assets/documents/96413*
1.8	**Manasota Key North Beach Erosion Study Update**: *https://www.charlottecountyfl.gov/projects/Project%20Documents/Manasota-Key-North-Beach-Erosion-Study-Update.pdf* **Florida Critical Erosion Reports**: Conducted by county by the Florida Department of Environmental Protection: *http://www.dep.state.fl.us/beaches/publications/tech-rpt.htm#Critical_Erosion_Reports* **North Carolina Coastal Erosion Study**: *https://ncdenr.s3.amazonaws.com/s3fs-public/Coastal%20Management/documents/PDF/North%20Carolina%20Beach%20Erosion%20Study%20DRAFTvMASTER%2020150211.pdf*
1.11 – 1.15	**Fort Worth, Texas Floodplain Management Plan**: *http://fortworthtexas.gov/files/FMP%202016-06-17.pdf*

1.17	**FEMA High Water Mark Initiative**: A community-based awareness program for recognizing flood risk and encouraging action to mitigate that risk. *www.fema.gov/high-water-mark-initiative*
	Remove Barriers and Build Partnerships
1.18	**General guidance on multi-jurisdictional mitigation planning**: *https://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf* **Governors' South Atlantic Alliance:** Governors of North Carolina, South Carolina, Georgia and Florida spearhead collaboration around ocean and coastal challenges and opportunities, including environmental sustainability and disaster preparedness. *southatlanticalliance.org* **Other regional collaboration examples:** *www.beachapedia.org/State_of_the_Beach/Model_Programs/Regional_Planning*
	Adopt Incentives
1.19	**Federal resources:** **U.S. SBA's Prepare My Business**: */www.preparemybusiness.org/* **FEMA Emergency Preparedness Resources for Business:** *https://www.fema.gov/media-library/collections/357* ***State examples:*** **Hawaii Natural Disaster Economic Recovery Strategy:** *files.hawaii.gov/dbedt/op/spb/2014_nders_final.pdf* **Florida Division of Emergency Management's Get a Plan!**: *www.floridadisaster.org/getaplan/business.aspx*
	Enact Policies & Supportive Regulations
1.21	**Rhode Island General Laws, Title 46 Chapter 23** - Rhode Island Coastal Resources Management Program, Section 140: Regulations specify that setbacks should be calculated from regularly updated erosion rates. *www.crmc.ri.gov/regulations/RICRMP.pdf*

GOAL 2: Conserve Land in Critical Coastal Areas, River Corridors, And Other Flood-Prone Environments

Encouraging development outside of these areas allows land to perform natural flood-reducing functions and reduces the risk that might be faced by people or structures located in flood-prone locations in your community. A resilient community protects lands in critical, flood-prone areas so that nature can perform its flood-reducing functions. Resilient communities encourage growth away from these sensitive environments to preserve the land and reduce risk to people and structures that might locate in dangerous flood-prone areas.

PRACTICAL APPLICATIONS

Lancaster County Pennsylvania Growth Management Planning: Establishes a framework for future land use and provides tools to assist municipalities in achieving growth management goals. Lancaster County provides two zoning tools to help municipalities incorporate natural resource identification and protection into subdivision and development proposals through site specific performance standards. *conservationtools.org/library_items/924-Model-Conservation-Zoning-District-and-Natural-Resource-Protection-Standards*

***Portland, OR Conservation Easements and Buyouts*:** The City of Portland, OR has placed conservation easements along critical watercourses designated as Environmental protections zones (Title 33, Chapter 33.430). The purpose of these zones is to protect resources and functional values that have been identified by the city as providing benefits to the public. The environmental regulations encourage flexibility and innovation in site planning and provide for development that is carefully designed to be sensitive to the site's protected resources. *www.portlandoregon.gov/bps/article/158539*

***Charles City, IA Floodplains as Amenities*:** After decades of fighting against the often-flooded Cedar River, Charles City transformed it into an asset. Using land acquired through FEMA flood buyouts, Charles City created a vibrant, inviting riverfront park with a whitewater course. Capitalizing on the river's natural features to help prevent future flooding, Charles City turned the river from an obstacle into an ecological and social benefit. *www.epa.gov/sites/production/files/2014-02/documents/sg_awards_2013.pdf*

Understanding Key Challenges

- Has your community been successful in conserving open space and natural areas in the past?

  a) If yes, what has worked?

  b) What, if anything, has been a challenge to conservation efforts?

- Are there key partners you need to help you conserve open space and natural areas? Are you working with them now or do you need help making connections?

- Are there concerns that your community's efforts to conserve land in critical coastal areas, river corridors, and other flood-prone environments may result in a regulatory "taking" of private property?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess a community's current capacity to identify, acquire, and conserve land in critical coastal areas, river corridors and other flood-prone environments. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
2.1	Identify and designate important natural resource areas, including current and future open space and natural areas/features for conservation, in local plan(s)			
2.2	Land conservation is considered when planning/designing capital improvements			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
2.3	A long-term tree canopy and/or open space goal has been established, and street trees are identified as critical infrastructure in comprehensive plan			
2.4	A strategic plan for acquiring priority open space/critical conservation areas exists			
	Remove Barriers & Build Partnerships			
2.5	A plan or program to acquire (through purchase or donation) conservation easements on property with sensitive natural features to ensure long-term protection is in place			
	Adopt Incentives			
2.6	Dedicated funding sources are available for open space acquisition and management (e.g. bonds, sales taxes, or transfer taxes)			
2.7	Incentives (e.g. tax abatements, fee waivers, expedited permitting, etc.) are provided for voluntary conservation/restoration of riparian buffers, open space, and/or wetland restoration			
2.8	Wetland mitigation banking program[23] is available			
2.9	Incentives are provided to preserve open land, such as a Purchase of Development Rights (PDR)[24] program			
2.10	Critical open space and natural resources are conserved through participation in a land banking program[25]			
	Enact Policies & Supportive Regulations			
2.11	Mandatory consistency reviews are performed to ensure that zoning districts are compatible with identified natural resource areas			

[23] The creation, restoration, or under certain circumstances the increased protection, of an area of functioning wetland in advance of, and to offset anticipated wetland impacts within the same ecoregion. *www.water.ncsu.edu/watershedss/info/wetlands/mitbank.html*

[24] A way to financially compensate willing landowners for not developing their land; an easement is purchased from the landowner that (usually) permanently restricts (all or certain types of) development on the land. The landowner retains ownership of the land and can use or sell it for purposes specified in the easement. *plannersweb.com/2004/01/purchase-of-development-rights-preserving-farmland-and-open-space/*

[25] Governmental entities or nonprofit corporations that acquire title to land, to conserve open space and natural resources.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
2.12	Open space and natural features (e.g., water body buffer zone; source water protection zone) are conserved using overlay zoning districts			
2.13	Open space and natural features are conserved through cluster/conservation requirements in subdivision regulations			
2.14	Subdivision regulations restrict some/all tree/vegetation clearance			
2.15	Subdivision regulations use Buildable Land Calculations[26] to remove vulnerable lands from development consideration			
2.16	"Transition zones" near tidal marshes are designated and protected.			
2.17	Future projections are considered when determining regulatory setbacks for land adjacent to tidal waters.			
2.18	Density standards[27] are established to conserve open space and natural areas by regulating the size and dimensions of lots and structures within sensitive areas			

Targeted Resources

STRATEGY	Study, Adopt Plans, Educate
2.1	**City of Raleigh, N.C., Greenprint Plan**: Adopted as part of the city's comprehensive plan, the Green Print Map and Plan highlight and connect environmentally sensitive areas throughout the city. *www.raleighnc.gov/cp*
2.2	**Rye, NH:** *http://town.rye.nh.us/Pages/RyeNH_BComm/CIP/approved_2016_CIP.pdf*
2.3	**City of Phoenix Comprehensive Plan**: The Plan establishes a goal of 25% tree canopy coverage of the city by 2030. *www.phoenix.gov/parkssite/MediaAssets/PhoenixAZ_CanopyProgressMap-PlanningVillages_2015-07-08.pdf*
2.4	**City of Durham, N.C., Third Fork Creek Watershed Management**: This plan prioritizes important natural areas to preserve in the Third Fork Creek Watershed and assesses the land acquisition cost compared to potential pollution reduction/prevention in selecting sites. It also prioritizes

[26] Land that is deemed not suitable for development (subject to flooding, erosion, improper drainage, and more) is not included in adequate building site calculations. This includes area such as steep slopes, floodplains, wetlands, stream corridors, riparian areas, and other important natural features.
[27] The permissible number of units (houses, square feet, people) in each area; typically measured in dwelling units per acre (residential) or by floor area ratio (FAR) for non-residential uses.

	sites that connect existing green space areas and provide "green gems" in the more urbanized landscape. *durhamnc.gov/970/Third-Fork-Creek-Watershed-Improvement-P* **Pennsylvania Municipal Planning Code Quick Guide to Official Maps**: Provides a guide for municipalities to implement an official map which can be used as a conservation tool by designating conservation areas, stormwater areas, open space reservations etc. *conservationtools.org/library_items/605-MPC-Quick-Guide-Official-Map* **State of Washington Growth Management Act**: Requires the identification and regulation of "critical areas", which include frequently flooded areas as well as ecologically sensitive areas. The critical area regulations establish buffers and setbacks for identified critical areas. *www.ecy.wa.gov/programs/sea/wetlands/bas/vol2final/Chapter%202_Volume%202_.pdf*
	Remove Barriers & Build Partnerships
2.5	**Orange County, N.C., Land Legacy Program**: The county works with other local governments, non-profits, state and federal agencies to acquire high priority land legacy sites. It also works successfully with landowners on estate planning and compact development design so they or their heirs may continue to use the land while dedicating a portion to conservation. *www.orangecountync.gov/departments/deapr/lands_legacy_program.php*
	Adopt Incentives
2.6	**Suffolk County, N.Y., Peconic Bay Region Community Preservation Fund**: A conservation program to preserve open space and farmland in five Long Island townships; the fund is financed by a 2% tax on real estate sales. *www.peconiclandtrust.org/community.html* **King County, Wash., Conservation Futures Program**: For more than 30 years, government and nonprofit groups across King County have used the Conservation Futures Tax (CFT) to protect from development 111,000 acres of land, forests, shorelines, greenways and trails. Funding has supported such diverse projects as Seattle's Duwamish Head Greenbelt, development rights on the Snoqualmie Forest and Puget Sound shoreline in Burien. *www.kingcounty.gov/services/environment/stewardship/conservation-futures.aspx*
2.7	**Virginia Land Preservation Tax Credit**: Allows an income tax credit for 40% of the value of donated land or conservation easements. *www.dcr.virginia.gov/* **Portland, Ore., Offsite Mitigation**: This report summarizes the issues and feedback received to date regarding the feasibility of a program that would allow mitigation for the environmental impacts of development to occur off-site rather than on the site where the impacts occur. Off-site mitigation could be one component of a natural resource management program that enhances watershed health while allowing industry to thrive along the North Reach of the Willamette River. *www.portlandoregon.gov/bps/article/158539*
2.8	**King County, Wash., Wetland Banking Program**: King County has adopted administrative rules that establish criteria governing the creation and use of wetland mitigation banks in King County in accordance with the Metropolitan King County Council's directive codified at King County Code (KCC) 21A.24.345. *www.kingcounty.gov/services/environment/water-and-land/wetlands/mitigation-banking.aspx*
2.9	**Suffolk County, N.Y., Farmland Program:** Initiated in 1974, the first Purchase of Development Rights (PDR) program to preserve farmland in the United States. The Suffolk County Farmland program has acquired 10,500 acres into the program to date. *www.suffolkcountyny.gov/Departments/Planning/Divisions/OpenSpaceandFarmland/FarmlandPreservation.aspx*

2.10	**The Nantucket Land Bank**: The oldest land bank in the nation created to acquire, hold, and manage important open spaces, resources and endangered landscapes for the use and enjoyment of the public. To date, nearly half of Nantucket is forever-protected open space. *www.nantucketlandbank.org/* **Orange County, N.C., Land Legacy Program**: The Lands Legacy Program uses leveraged local funds with State and Federal dollars to protect highly important natural and cultural resource lands via outright purchase and through donated or purchased conservation easements. *www.orangecountync.gov/departments/deapr/lands_legacy_program.php*
2.11	**Rye, NH Master Plan** (page 22): *http://www.town.rye.nh.us/Pages/RyeNH_Planning/2013_Master_Plan.pdf* **Deerfield, New Hampshire**: *http://www.townofdeerfieldnh.com/Pages/DeerfieldNH_BComm/Planning/wildlifehabitat.pdf*
	Enact Policies & Supportive Regulations
2.12	**Town of Chapel Hill, N.C., Resource Conservation District (RCD) Ordinance**: The Town's RCD overlay district ordinance requires natural vegetated buffers along all water bodies, including 150 buffers along each side of perennial streams and 50-foot buffers along each side of intermittent streams. *www.municode.com/library/nc/chapel_hill/codes/code_of_ordinances?nodeId=CO_APXALAUSMA_ART3ZODIUSDIST_3.6OVDI*
2.13	**City of Saratoga Springs, N.Y., Municipal Code**: Chapter 241 Subdivision Regulations, Article IV Conservation Subdivision Regulations. Addresses conservation subdivisions and cluster development with cluster development applied in more densely developed areas. *www.saratoga-springs.org/DocumentCenter/Home/View/2613*
2.14	**City of New Rochelle, N.Y., Municipal Code:** Chapter 178: Impervious Surfaces. For development over a certain threshold a permit is required specifying the allowed amount of impervious surface and the required environmental mitigation. *ecode360.com/6735551*
2.15	**City of Redmond, Wash., Municipal Code**: Section 20C.30.25 Site Requirements for Residential Zones (Net Buildable Area Calculation), *www.codepublishing.com/WA/Redmond/CDG/RCDG20C/RCDG20C3025.html*
2.18	**City of Redmond, Wash., Municipal Code**: Section 20C.30.25 Site Requirements for Residential Zones. Establishes several density standards including Net Buildable Area Calculation, maximum lot coverage, minimum open space. *www.codepublishing.com/WA/Redmond/CDG/RCDG20C/RCDG20C3025.html?_sm_au_=iVVWDb01FwrkW5kH* **Town of Islip, N.Y., Municipal Code:** Chapter 68 Zoning, Article 1 General Provisions, Section 68-3. Amended zoning to relax height restrictions on dwellings located in FEMA-designated Special Flood Hazard Areas to accommodate elevations to increase flood protection. *ecode360.com/7703256*

GOAL 3: Reduce Risk to People, Buildings, And Facilities in Vulnerable Areas

Your community's economic, social, and cultural assets may be in vulnerable areas or residents may dwell or construct buildings in vulnerable areas despite known risks. If so, there are steps that can reduce (though not eliminate) future risk and enhance resilience. A resilient community recognizes the risk facing people and assets in vulnerable areas and takes steps to reduce that risk through a combination of proactive and protective land use laws, building codes, and planning policies.

PRACTICAL APPLICATIONS

Alquist Priolo Earthquake Fault Zoning Act California: The main purpose of this policy is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. *http://www.conservation.ca.gov/cgs/rghm/ap/Pages/main.aspx*

***Planning for Rising Waters*:** Final Report of the City of Kingston Tidal Waterfront Flooding Task Force: Report of Task Force charged with evaluating the present and future vulnerability to flooding, storm surge, and sea level rise along the Rondout-Hudson waterfront. *http://kingston-ny.gov/filestorage/8463/8511/8682/8690/Kingston_Tidal_Waterfront_Flooding_Task_Force_-_Final_Report_September_2013.pdf*

***Town of Watertown, CT, Subdivision Regulations, Section 5 Design Standards, 5.16 Requirements Regarding Flooding*:** Land subject to flooding, as identified on the Federal Administration Flood Insurance Rate Map (FIRM) on file with the Town Clerk and Planning and Zoning Office, shall not be subdivided unless certain conditions are met. *http://www.watertownct.org/filestorage/10298/4365/8433/11272/Subdivision-Regulations031309.pdf*

Town of Hornby, NY, Subdivision Regulations, Section 1.5 General Policy for Subdivision Design and Review (BLE): Determines allowable density based on net acreage once unsafe areas (e.g., steep slopes, floodplains) are subtracted from gross acreage. *http://localaws.dos.ny.gov/sites/default/files/drop_laws_here/ECMMDIS_appid_DOS20150218075529_21/Content/0902134380038c8e.pdf*

***City of Roseville, CA, General Plan - Safety Element*:** Implemented a series of tools to reduce risk in vulnerable areas including future conditions floodplains, compensatory storage requirements, two feet of freeboard, and stormwater provisions that assume total blockage of flow paths for setting pad elevations everywhere in the city. *http://www.roseville.ca.us/civicax/filebank/blobdload.aspx?blobid=2556*

Understanding Key Challenges

- How would you characterize your community's approach/attitude towards risk and vulnerability? Are there populations or places in your community that bear a disproportionate share of risk or vulnerability resulting from potential hazards?

- How has the community responded to proposals or new regulations to reduce risk? What about incentives?

- Are there specific challenges you've faced in reducing risk to people, buildings, and facilities in vulnerable areas?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess a community's current capacity to reduce risk to people, buildings, and facilities in vulnerable areas. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
3.1	An up to date vulnerability assessment identifies current and projected vulnerable areas and associated risks to life and property			
3.2	Vulnerability assessment results are incorporated into relevant plans (e.g. comprehensive plan, hazard mitigation plan, land use plans, etc.)			
3.3	The public is educated about the risks of developing in environmentally sensitive areas			
3.4	Current and future flooding risks to critical infrastructure (such as water supply or wastewater treatment plants) have been assessed			
3.5	Development incentives are regularly evaluated to ensure they do not encourage development in vulnerable areas			
3.6	Capital improvement planning accounts for current and future hazards (i.e. bridges and culverts are designed to accommodate 1% annual chance flood events)			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Remove Barriers & Build Partnerships			
3.7	A "seller's disclosure" provision has been adopted, requiring any seller and/or their agent of real property within the regulated floodplain to disclose to the prospective buyer that the property is in a regulated floodplain, and whether the property has suffered damages from flooding			
	Adopt Incentives			
3.8	Participation in the NFIP Community Rating System (CRS) (provide current rating, if applicable) is established			
3.9	Historic districts or preservation requirements to slow reconstruction post disaster are in place			
3.10	A plan to increase points under the NFIP CRS to reduce insurance rates (if applicable) has been developed			
3.11	Incentives (e.g. tax abatements, fee waivers, insurance premium discounts, expedited permitting, etc.) are provided for first floor elevations and elevated systems (in the SFHA) above minimum NFIP standards			
3.12	Land swaps[28] are coordinated to relocate development from hazard areas to safer areas			
3.13	Incentives (e.g. tax abatements, fee waivers, insurance premium discounts, expedited permitting, etc.) are provided for wet or dry floodproofing of private structures			
3.14	A plan or program is in place for strategic acquisition (buyout) of repetitive loss properties in hazard areas and their re-use as open space and/or green infrastructure			
3.15	Alternative parking requirements are in place that encourage efficient land use and preservation of trees (i.e. parking, payment in-lieu of parking, reduced minimum parking requirements)			

[28] An exchange of municipally-owned land for privately owned land, used to strategically assemble and re-purpose large areas to increase resilience through open space, green infrastructure, and more.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Enact Policies & Supportive Regulations			
3.16	A Green Area Ratio[29] is used to determine the required amount of green space/green cover for new development			
3.17	Development code requires a minimum tree canopy coverage for building sites (25% to 40% for residential development and 10% to 15% for non-residential development)			
3.18	Overlay zoning districts (e.g. limited development districts, hazard zoning districts, waterfront overlay districts, etc.) are used in hazard areas to limit allowable uses, provide for adequate setbacks, and apply additional standards			
3.19	Flood damage prevention law is in place			
3.20	Special use permit procedures include a review for conformance with special standards in hazard areas			
3.21	Design flood elevation[30] expands regulations applying to floodplains into adjacent areas that are vulnerable to flooding but not designated floodplains on the 100-year Flood Insurance Rate Map (FIRM)			
3.22	Elevation requirements are available with design guidelines for streets and infrastructure			
3.23	New commercial or industrial facilities are required to have dry land[31] access to ensure emergency personnel and employees can reach facilities in the event of a flood			
3.24	Subdivision/ land development/ site plan review ordinances prohibit development in flood prone areas and/or require that any regulatory floodplain in a subdivision be set aside as open space (i.e. used as drainage/flowage easements or back yards)			

[29] A zoning regulation that sets standards for landscape and site design to help reduce stormwater runoff, improve air quality, and mitigate urban heat islands by dedicating a certain proportion of a building site to landscaping and/or permeable surfaces. *doee.dc.gov/GAR*

[30] The NFIP refers to the Base Flood Elevation (BFE) for lowest floor elevation requirements, while the International Codes (I-Codes) and ASCE 24 refer to the Design Flood Elevation (DFE). The DFE will always be the BFE or higher. *www.fema.gov/media.../fema_quick_ref_guide_flood_areas_022713_508.pdf*

[31] A vehicular access route that is above the base flood elevation and which connects land located in the floodplain to land outside the floodplain. *www.municode.com/library/wi/whitewater/codes/code_of_ordinances?nodeId=TIT19ZO_CH19.09DE_19.09.195DRAC*

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
3.25	Development review process requires fiscal impact analyses that includes costs related to projected increases in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)			
3.26	Subdivision/land development/site plan review ordinances require inclusion of Base Flood Elevations (BFE) and notation of structures in relation to the SFHA with preliminary and final plat submissions[32]			
3.27	Steep slope ordinance is modified to account for slopes exposed to increased moisture due to projected increases in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)			
3.28	Regulations state that, to the extent possible, if a lot in a new subdivision does not have a buildable site out of the regulatory floodplain, all new structures, pavement, and other development must be sited where they have the least impact on habitat			
3.29	Building code and/or design guidelines contain regulations/restrictions for development in the Special Flood Hazard Area (SFHA)			
3.30	Building code requires elevation of the first floor of a structure in the SFHA above BFE			
3.31	Building code requires first floor elevations and elevated building systems in the SFHA above and beyond the minimum NFIP standards (i.e. increase the requirement from 1' above BFE to 2-3' above BFE)			
3.32	Building code requires elevation of essential systems (i.e. heating, ventilation, and air conditioning) above the BFE			
3.33	Design requirements for elevated structures include provisions for the height, scale, aesthetic, and materials for elevated buildings			
3.34	Non-conversion agreements[33] are required to permanently restrict the use of spaces below first floors in elevated homes			
3.35	Policies are in place to address non-conforming uses, structures, and/or lots[34]			

[32] Base flood elevations are the computed elevations to which floodwater is anticipated to rise during the base flood; shown on FIRMS and flood profiles; the regulatory requirement for the elevation or floodproofing of structures. *www.fema.gov/base-flood-elevation*

[33] A legal document that requires property owners to agree to refrain from altering their buildings in ways that would not meet the standards of local laws and regulations for flood damage prevention. *www.kdhnc.com/523/Non-Conversion-Agreement*

[34] Policies may cover the allowable re-building of non-conforming structures following hazard damage as well as non-conforming uses or lots created because of zoning ordinance changes.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
3.36	A pre-event law is adopted, enabling local land use moratoriums that suspend certain development activities within defined areas to allow a municipality time to develop new studies, plans, or land-use laws			
3.37	Substantial improvement/damage provision in the flood damage prevention ordinance is amended to require cumulatively tracked improvements and repairs to structures within the regulated floodplain over a specified timeframe			
3.38	The substantial improvement/damage threshold has been lowered below the minimum requirement of 50%			
3.39	Regulations prohibit the use of fill for the elevation of structures, and/or require floodplain storage compensation at an appropriate site when fill is used			

Targeted Resources

STRATEGY	Study, Adopt Plans, Educate
3.3	**Hazus**: Hazus uses Geographic Information Systems (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. *www.fema.gov/hazus*
3.5	**Salem and Keene, NH (page 271), compensatory storage ordinance:** *https://www.nh.gov/oep/resource-library/planning/documents/innovative-land-use-planning-techniques-2008.pdf*
3.6	**King County, Wash., Basin Planning Program**: Basin plans were developed using future conditions hydrology to assure the design of capital facilities have sufficient capacity for projected future conditions. *www.kingcounty.gov/services/environment/wastewater/csi/updates-history/2004.aspx*
	Remove Barriers & Build Partnerships
3.7	**City of Novato, Calif., Residential Resale Program**: Code Enforcement Resale Inspectors research properties prior to inspections, noting permits issued, permit status and pending code violations. All residential properties are required to set appointments for inspection prior to sale and only the property owner or the listing agent may order a resale inspection. *novato.org/government/community-development/code-enforcement-resale-inspection/residential-resale*
	Adopt Incentives
3.8	**FEMA Community Rating System (CRS):** A voluntary incentive program that promotes and rewards community floodplain management activities exceeding the minimum National Flood Insurance Program requirements. Website providing resources, guidance and sample programs to support the development and enhancement of Community's CRS programs. *www.fema.gov/national-flood-insurance-program-community-rating-system*

3.10	**FEMA Community Rating System (CRS) Website:** Provides resources, guidance and sample programs to support the enhancement of Community's CRS programs. *crsresources.org/*
3.14	**City of Portland, Ore., Johnson Creek Willing Seller Program**: In 1997, Environmental Services developed the Johnson Creek Willing Seller Land Acquisition Program. The program helps move people and property out of areas that frequently flood. Restoration projects on land acquired through the program increase flood storage, improve fish and wildlife habitat, restore wetlands and create passive recreational activities for city residents. *www.portlandoregon.gov/bes/article/106234*
3.15	**Greensboro, N.C., Tree Preservation and Landscape Manual:** To allow a new development to preserve trees within or adjacent to a parking lot, a specified number of required off-street parking spaces may be reduced by the City Urban Forester or Environmental Officer by up to 10%. *www.greensboro-nc.gov/modules/showdocument.aspx?documentid=7532* **Cary, N.C., Town Development Ordinance Section 7.2.10.A.2:** Up to a 20% reduction in the number of parking spaces required in the site is allowed, to the extent that the reduction in the amount of required pavement will preserve existing healthy trees in an undisturbed, natural condition. *www.amlegal.com/wp-content/uploads/2015/05/LDO_Ch07.pdf* **Phoenix City Code Incentive for Tree Preservation:** To increase tree preservation, reduce heat island effect, provide more shading for pedestrians and buildings, the following provision was added to the city code: Minimum parking may be reduced by one parking space for each tree 12" in diameter or larger that is preserved. A maximum of 2 parking spaces or 10% of the total required may be reduced, whichever is greater. *www.codepublishing.com/AZ/Phoenix/*
	Enact Policies & Supportive Regulations
3.16	**Seattle Green Factor**: A score-based code that is designed to improve the quantity and quality of urban landscaping through zoning based requirements. Each zoning district has a green factor score that must be achieved. *www.seattle.gov/dpd/cityplanning/completeprojectslist/greenfactor/whatwhy/* **Washington, D.C., Green Area Ratio**: An environmental sustainability zoning regulation that sets standards for landscape and site design to help reduce stormwater runoff, improve air quality, and keep the city cooler. It is similar in design to the Seattle Green Factor (see above). *doee.dc.gov/GAR*
3.17	**Chapel Hill, N.C., Minimum Tree Canopy Requirements**: The Town's regulations require a minimum tree canopy coverage of 30% for multifamily and commercial development, and 40% canopy coverage for all other development. *www.municode.com/library/nc/chapel_hill/codes/code_of_ordinances?nodeId=CO_APXALAUSMA_ART5DEDEST_5.7TRPR*
3.18	**Town of Perinton, N.Y., Municipal Code, Chapter 208, Article VIII, Limited Development District**: Establishes a limited development district to ensure appropriate development is required to preserve water and air quality, preserve fish, wildlife and plant habitat, prevent the irretrievable loss of natural resources and maintain the aesthetic character of the community. *ecode360.com/6741928* **Town of Coxsackie, N.Y., Municipal Code**: Chapter 201 Zoning, Article III Districts, Boundaries and Regulations, Section 201-10, Waterfront Residential District, establishes a waterfront residential district to protect the waterfront, maintain the existing residential character and allow for low impact water-dependent and water-related recreational uses appropriate for the community and the river. *ecode360.com/13876045*
3.23	**City of Whitewater, Wis., Code of Ordinances**: Title 19 – ZONING, Chapter 19.09 DEFINITIONS, 19.09.195 - Dryland access, *www.municode.com/library/wi/whitewater/codes/code_of_ordinances?nodeId=TIT19ZO_CH19.09DE_19.09.195DRAC*

3.24	**Town of Pendleton, N.Y., Municipal Code**: Chapter 220 Subdivision of Land, Article V General Requirements and Design Standards for Major Subdivision, Section 220-27 Drainage improvements. Prevents land subject to flooding from being platted for residential occupancy or any other uses that may increase danger to health, life or property or aggravate the flood hazard. *www.ecode360.com/5124353?highlight=flooding,flood&_sm_au_=iVVkkMLvJS5085Tq* **Town of Watertown, Conn., Subdivision Regulations**: Section 5 Design Standards, 5.16 Requirements Regarding Flooding. Restricts sub-divisions in the SFHA to ensure that development is reasonably safe from flooding. *www.watertownct.org/filestorage/10298/4365/8433/11272/051311_Subdivision_Regulations_-_MASTER.pdf* **CRS Coordinators Manual**: Section 422.e, page 420-20. Credit criteria and example language is provided for regulations that set aside all the regulatory floodplain in a subdivision as open space (such as drainage or flowage easements or back yards) or otherwise keep them free from development, *crsresources.org/manual/*
3.26	**King County, Wash., Title 21A.24.170: Notice of Critical Areas**: County Critical Areas ordinance requires notice on title and final plans of the presence of identified critical areas; provision is pursuant to mandates under the WA State Growth Management Act. *www.kingcounty.gov/council/legislation/kc_code/24_30_Title_21A.aspx*
3.28	**CRS Coordinators Manual**: Section 422.e, page 420-20. Credit criteria and examples are provided for regulations require that each lot in a new subdivision provide a building site that is on natural high ground, out of the regulatory floodplain, *crsresources.org/manual/*
3.30	**New Hampshire model ordinance language (page 281):** *https://www.nh.gov/oep/resource-library/planning/documents/innovative-land-use-planning-techniques-2008.pdf*
3.31	**City of Roseville, Calif., Drainage Improvement Standards**: Provides design engineers and contractors a reference to the city's requirements for the design and construction of civil improvement projects within the City of Roseville. It is the responsibility of the design engineers and contractors to be familiar with these standards; includes regulations/restrictions for development in the city's regulated floodplain under the drainage section of the standards (section 10), *www.roseville.ca.us/gov/development_services/engineering_land_development/design_construction_standards.asp*
3.33	**Elevated Residential Structures, FEMA 54** (1984): a manual for designers, developers, builders, and others who wish to build elevated residential structures in flood-prone areas **Elevation Design Guidelines for Historic Homes**: Provides guidelines for protecting historic resources through structural elevation. *www.nj.gov/dep/hpo/hrrcn_sandy_pdf%20files/mississippi.pdf*
3.34	**City of Roseville, Calif., Deed Restriction Requirements**: Chapter 9.80, section 160.C.1 of the Roseville Municipal Code requires a formal restriction on the deed that restricts the allowed uses of the spaces below elevates floors for structures in the regulated floodplain. *qcode.us/codes/roseville/* **Higher Floodplain Development Standards Recommendations for the Town of Horseheads**: Regulates the use of space in elevated structures below the elevated living space. *www.stcplanning.org/usr/Program_Areas/Flood_Mitigation/Floodplain%20Management/THorseheads_Proposed_FP_Standards.pdf*. **CRS Resources guidance for higher regulatory standards**: *crsresources.org/400-2/*

3.35	**City of Utica, N.Y., Municipal Code**: Chapter 2-29, Zoning, Article IV District Regulations, Division 6 Land Conservation District, Section 2-29-255 Uses and/or Structures Rendered Nonconforming by the Adoption, Provides regulations for non-conforming uses, *ecode360.com/14014360#14014360*
3.36	**James A. Coon Local Government Technical Series**: Land Use Moratoria (2015), guidance on post-disaster land use moratoria which suspends a landowner's right to obtain development approvals. *www.dos.ny.gov/lg/publications/Land_Use_Moratoria.pdf*
3.37	**CRS Coordinators Manual:** Section 432.d, page 430-18. Provides credit criteria and example language for the cumulative substantial improvements element. *crsresources.org/manual/* **CRS Coordinators Manual:** Section 432.e, page 430-19. Provides credit criteria and example language for the lower substantial damage threshold element. *crsresources.org/manual/* **City of Roseville, Calif., Cumulative Substantial Improvement Requirements**: The city has adopted regulatory standards in its flood damage prevention ordinance that will track the cumulative improvements and repairs to structures in its regulated floodplain, for a period of 10-years. This requirement can be found in section 9.80.040 of the Roseville Municipal code. *qcode.us/codes/roseville/*
3.38	**CRS guidance for higher regulatory standards**: *crsresources.org/400-2/*
3.39	**Pierce County, Wash., Municipal Code**: Title 18E.70.40.C.4a requires new excavated storage volume be provided that is equivalent to the storage volume lost by the placement of fill or grading of a parcel within the designated floodplain. *www.codepublishing.com/WA/PierceCounty/html/PierceCounty18E/PierceCounty18E70.html#18E.70*

GOAL 4: Plan for and Encourage Development in Safer Areas

By proactively determining where growth can safely be accommodated now and in the future, your community can provide incentives for development in these locations to contribute to enhanced community resilience. A resilient community accommodates new growth while still protecting residents and assets, and reducing hazard risks. New development is guided by principles that help to further enhance the community's ability to withstand hazards and unexpected events.

PRACTICAL APPLICATIONS

***Pinelands Development Credit Program*:** The Pinelands Development Credit (PDC) Program is a regional transfer of development rights program that preserves important agricultural and ecological land. PDCs are allocated by the commission to landowners in the Preservation Area District, Special Agricultural Production Area and Agricultural Production Area, which are the sending areas. These credits can be purchased by property owners and developers who are interested in developing land in Pinelands Regional Growth Areas, which serve as the receiving areas. Typically, PDCs are used to increase residential densities in Regional Growth Areas. They may also be used in association with municipal variances in Regional Growth Areas, Pinelands Villages and Pinelands Towns, as well as for waivers of strict compliance approved by the Commission in any Pinelands management area. *www.nj.gov/pinelands/landuse/perm/pdc/*

***City of Snoqualmie, Wash.: Guiding Safe Growth*:** The City of Snoqualmie made a conscious decision to guide new growth out of the floodplain and direct it towards safer areas. This created two distinct divisions within the City: the historic core, which contains development in or near floodplains and Snoqualmie Ridge which is where all the new planned unit development occurred. By planning for growth in safer areas they successfully reduced flood risk for new development.
www.ci.snoqualmie.wa.us/Departments/PlanningDepartment/ComprehensivePlan/tabid/274/Default.aspx

Understanding Key Challenges

- Is encouraging development in safer areas a priority for your community? If not, what issues tend to stand in the way?

- Are there key partners you need to help you encourage development in safer areas? Are you working with them now or do you need help making connections?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess a community's current capacity to plan for and encourage development in safer areas. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
4.1	Safe development areas have been identified and designated as targeted growth areas in local comprehensive plan; a safe growth audit has been conducted			
4.2	Current hazard information and future projections have been incorporated into capital improvement planning and Infrastructure investments in safer growth areas are prioritized			
4.3	Data is used to identify safe growth areas, inform hazards analysis, and develop future projections			
	Remove Barriers & Build Partnerships			
4.4	Community has planned for managed retreat			
	Adopt Incentives			
4.5	Incentives are provided for infill development in areas with existing development and infrastructure, directing development away from designated conservation areas			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
4.6	"Receiving" areas of Transfer of Development Rights (TDR) program are targeted the community's safe growth areas			
4.7	Incentives are provided (e.g. height or density bonuses, tax abatement, expedited permitting, fee waivers, etc.) for development in safer growth areas			
	Enact Policies & Supportive Regulations			
4.8	Flexible zoning, such as dynamic zoning or floating zones, to encourage development in safer areas has been adopted			
4.9	Regulations state that, to the extent possible, each lot in a new subdivision must provide a building site that is on natural high ground, out of the regulatory floodplain			
4.10	New municipal buildings are required to be constructed in well-connected, safe areas			

Targeted Resources

STRATEGY	Study, Adopt Plans, Educate
4.3	**New York State Community Risk and Resiliency Act, State Generated Sea Level Rise projections:** Data helps identify safe growth areas, inform hazard analysis, and develop future projections *www.dec.ny.gov/energy/102559.html*
	Remove Barriers & Build Partnerships
	Adopt Incentives
4.6	**New York Department of State Transfer of Development Rights (TDR)**: Technical guidance for New York municipalities to implement a Transfer of Development Rights program as a resource preservation tool. *www.dos.ny.gov/lg/publications/Transfer_of_Development_Rights.pdf* **Lancaster County, Pa., TDR Practitioner's Handbook**: A detailed guide to TDR programs. *www.lancastercountyplanning.org/DocumentCenter/Home/View/162* **Transfer of Development Rights American Farmland Trust**: An overview of the history, purpose, benefits and potential drawbacks of a TDR program. *http://www.farmlandinfo.org/sites/default/files/TDR_04-2008_1.pdf* **Pennsylvania Land Trust Association Transfer of Development Rights Guide**: Provides an overview and guide to implementing a TDR program in Pennsylvania. *conservationtools.org/guides/12-transfer-of-development-rights*

	Fact Sheet: Transfer of Development Rights American Farmland Trust: (2001), Provides an overview of the history, purpose, benefits and potential drawbacks of a TDR program. *http://conservationtools-production.s3.amazonaws.com/library_item_files/64/57/FS_TDR_1-01.pdf?AWSAccessKeyId=AKIAIQFJLILYGVDR4AMQ&Expires=1486050770&Signature=cOUXtwlamFCt%2BFto75Pekt%2BngB0%3D* **PA Land Trust Association** Transfer of Development Rights Guide: Provides an overview and guide to implementing a TDR program in Pennsylvania. *http://conservationtools.org/guides/12-transfer-of-development-rights*
4.7	**CRS Coordinator's Manual**: Section 422.e- page 420-20. Provides credit criteria and examples for local requirements and incentives that relocates development from flood-prone portions of property *crsresources.org/manual/*
	Enact Policies & Supportive Regulations
4.9	**CRS Coordinator's Manual**: Section 422.e, page 420-20. Credit criteria and examples are provided for regulations require that each lot in a new subdivision provide a building site that is on natural high ground, out of the regulatory floodplain. *crsresources.org/manual/*

GOAL 5: Implement Comprehensive Stormwater Management Techniques

Effectively managed stormwater flow slows and spreads out, allowing time for the water to infiltrate the ground instead of running off into water bodies or storm drains. This is as important in developed areas where urban flash flooding occurs as it is in rural areas where river or stream flooding occurs. A resilient community recognizes that stormwater does not stop at municipal boundaries and that mitigation is best approached at the regional, watershed level. A resilient community employs multiple systems that share the mitigation workload rather than relying on a single system to carry excess water away.

PRACTICAL APPLICATIONS

Portland, Ore., Stormwater Management Plan and Program: Specifies that BMPs, including sustainable stormwater management systems, will be implemented to reduce pollutants in stormwater and the volume of runoff. To ensure that private property owners implement the BMP requirements, the city amended its codes governing new and redevelopment to remove barriers and create incentives for green infrastructure. A key feature of the program includes Green Streets. Another notable element is the Ecoroof Program, which provides an incentive in Central City for eco-roof installation by providing a floor area bonus. The Green Streets and Ecoroofs have generated significant city- and nation-wide interest, and self-guided walking and biking tours are available, connecting the green sites.
www.werf.org/liveablecommunities/studies_port_or.htm

Hoboken, N.J., Green Infrastructure Strategic Plan: Between July 2002 and July 2012, the city recorded 26 dates with greater than 2 inches of precipitation and tides of 4 feet or higher. During these storm events, Hoboken's sewer infrastructure is severely overtaxed. This plan identifies the most cost-effective, place-based green infrastructure projects to address current and anticipated stormwater management and flooding issues. It considers city assets most important to protect and evaluates how the measures can improve transit resiliency as well.
www.hobokennj.org/docs/communitydev/Hoboken-Green-Infrastructure-Strategic-Plan.pdf

Understanding Key Challenges

- Does your community have experience with green infrastructure/low-impact design?

- How has green infrastructure been received by the community? Are people interested, or is there a feeling that it will be too expensive/not effective?

- Do your community's codes and ordinances provide for the protection of natural features with stormwater management benefits (e.g., trees, open space, riparian areas, etc.), or do you typically rely on structural stormwater management methods?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess a community's current capacity to think about stormwater at a regional scale and manage it effectively. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
5.1	Goal(s) within comprehensive plan encourages green infrastructure (GI) in new development			
5.2	A municipal stormwater design manual that illustrates context-appropriate green infrastructure is available			
5.3	A watershed management plan for stream restoration or protection has been adopted			
5.4	Regional source water supply protection plan or strategy is in place			
	Remove Barriers & Build Partnerships			
5.5	A green infrastructure cost share or fee credit program is available			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
5.6	Green infrastructure is featured in a sustainable-streetscapes program			
5.7	Green infrastructure techniques and/or other integrated stormwater management methods are required in capital improvement plan (CIP)			
5.8	A stormwater utility is used as a funding source for green infrastructure and other stormwater management activities			
5.9	County or regional efforts to discuss managing stormwater at the watershed level have been joined or initiated			
	Adopt Incentives			
5.10	Incentives (e.g. tax abatements, fee waivers, development intensity bonus, expedited permitting, etc.) are provided for green infrastructure			
5.11	Incentives (e.g. tax abatements, fee waivers, development intensity bonus, expedited permitting, etc.) are provided for on-site stormwater retention/management			
	Enact Policies & Supportive Regulations			
5.12	Submission and approval of a stormwater site design plan is required during site plan review			
5.13	Stormwater performance standards are required for new development or redevelopment sites (e.g. capture and infiltrate the first 1-1.5 inches of rain using green infrastructure)			
5.14	Site plan requirement that requires development to retain all stormwater on site has been adopted			
5.15	Interference with proper stormwater drainage is prohibited in zoning ordinance regulations			
5.16	Clean Water Act Section 402 National Pollution Discharge Elimination System (NPDES) permits have been updated to consider projected increases in extreme weather events (i.e. changing precipitation patterns, changing or alternative coastlines, etc.)			
5.17	Green- and complete-streets design standards have been adopted			
5.18	Local building code requires check valves on wastewater pipes to prevent sewage from backflowing into basements			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
5.19	Density standards are in place to improve stormwater management, limit development in vulnerable areas, and reduce future damages			
5.20	Natural storm and flood mitigation strategies are implemented (e.g. restoring natural ('living') shorelines, mangrove planting, natural or artificial reefs, and/or dune restoration)			

Targeted Resources

STRATEGY	Study, Adopt Plans, Educate
5.1	**Imagine Austin (Texas) Comprehensive Plan**: Has several key themes, including compact and connected growth; green infrastructure (integrating nature into the city); and sustainable management of water resources. *www.austintexas.gov/department/imagine-austin* **City of Raleigh, N.C., 2030 Comprehensive Plan**: Policies and strategies encourage use of green infrastructure in new development and redevelopment. *www.raleighnc.gov/cp*
5.3	**Handbook for Developing Watershed Plans to Restore and Protect Our Waters**: Helps communities develop and implement watershed plans to meet water quality standards and protect water resources, *www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters* **Athens-Clarke County, Ga., Watershed Management Program**: Describes process for assessing the conditions of watersheds and developing plans to protect, restore, and improve them. *www.athensclarkecounty.com/4517/Watershed-Management-Plans* **Third Fork Creek Watershed Management Plan, Durham, N.C.:** Helped the city prioritize and implement projects to clean up and revitalize Third Fork Creek. *durhamnc.gov/970/Third-Fork-Creek-Watershed-Improvement-P* **Agua Hedionda Watershed Management Plan, Vista, Calif.**: A regional, comprehensive plan for preserving, restoring, and enhancing watershed functions and minimizing future degradation in this urbanizing watershed. *nrs.ucsd.edu/_files/agua-hedionda-watershed-management-plan.pdf*
5.4	**Beaver Lake Watershed Protection Strategy, Northwest Arkansas**: A regional, multi-jurisdictional strategy for protecting a high-quality drinking water supply and recreation area and for restoring impaired streams. *www.beaverwatershedalliance.org* **Lake Maumelle Watershed Management Plan, Central Arkansas**: A comprehensive, regional plan for protecting high-quality drinking water supply. *www.carkw/wp-content/uploads/2011/09/Lake_Maumelle_Watershed_Mgmt_Plan_May 07_reduced.pdf*

	Remove Barriers & Build Partnerships
5.5	**City of Durham, N.C., Rain Catchers Project, Ellerbee Creek Watershed**: A residential incentive program including outreach to homeowners; a reverse auction; selection of participants; and city funding of design, and installation of green infrastructure BMPs. *durhamnc.gov/949/Rain-Catchers* **Washington, D.C., River Smart Homes Program**: A residential green infrastructure incentive program in which the city performs audits and installs the BMPs for interested property owners. In turn, the property owner typically provides about a 10% cost-share and signs a maintenance agreement. *doee.dc.gov/riversmarthomes* **Philadelphia, Pa., Rain Check Program and Stormwater Incentive Program**: A homeowner education program for cost-sharing and installing green infrastructure BMPs with individual homeowners; also targets non-residential sites most impacted by stormwater fees and provides grants up to $100,000 per impervious acre managed. *www.phillywatersheds.org/whats_in_it_for_you/residents/raincheck ; www.phila.gov/water/wu/stormwater/Pages/Grants.aspx* **City of Raleigh, N.C., Stormwater BMP Cost-Share**: Provides cost share funds for green infrastructure BMPs for new and existing developments going beyond the city's stormwater management requirements. For priority watershed areas, the cost share is 90% of design and installation of the BMP; developments in non-priority watersheds receive 75% cost share. *www.raleighnc.gov/services/content/PWksStormwater/Articles/StormwaterQualityCostShareProgram.html* **Portland, Ore., Green Streets Program**: Supports green infrastructure retrofits of streets in residential, commercial, and industrial areas to capture the storm peak and reduce combined sewer overflows *www.werf.org/liveablecommunities/studies_port_or.htm*
5.7	**Nashville, Tenn., Integrated Ordinance**: An ordinance directing coordination among four city departments in developing an annual list of priority green infrastructure projects to fund in the city's CIP. *www.nashville.gov/Portals/0/SiteContent/WaterServices/Stormwater/docs/reports/GreenInfrastructureRpt101120.pdf* **Austin, Texas, Integrated Mission Project Selection**: An adopted city protocol that requires maximizing multi-benefits across city divisions in selecting CIP projects. *www.austintexas.gov/sites/default/files/files/Watershed/swtreat_mipcip.pdf*
	Adopt Incentives
5.10	**The Stormwater Calculator - Identifying Green Infrastructure Solutions:** EPA's desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States. *www.epa.gov/water-research/stormwater-calculator-identifying-green-infrastructure-solutions* **Water Quality Scorecard: Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scale** (2009): Guides local government staff through a review of relevant local codes and ordinances across multiple departments ensuring that codes work together to support a green infrastructure. *www.epa.gov/smartgrowth/water-quality-scorecard* **Seattle Floor Area Ratio (FAR) Bonus**: The green building FAR incentive in the Low-Rise zones increases FAR by 0.2 for green building. The greatest bonus is for apartment uses in zone LR3 inside the urban centers and urban villages: increase from base FAR of 1.5 to 2.0 for green building. *www.seattle.gov/environment/buildings-and-energy/incentives-and-rebates*

	Austin, Texas, Density Bonus: The city's Green Roof Density Bonus gives a density bonus of up to seven square feet for every square foot of green roof installed. Projects incorporating Green Stormwater Quality Infrastructure (biofiltration, rainwater harvesting, and other GI water quality controls) may receive additional credit if including green roofs in the project design. *www.austintexas.gov/sites/default/files/files/Sustainability/GR_Existing_Credit_Fact_Sheet_Revised_2014.pdf* **Raleigh, N.C.**: Actions to advance green infrastructure on a voluntary basis include a new expedited review process, code revisions to remove barriers, green street design templates, educational factsheets to use in the early phases of concept plan review, an enhanced green infrastructure cost-sharing program, and more *gsa.raleighnc.gov/smb/ptlprdapp1/PTLPRD/BoardsCommissions/Documents/CityCouncil/Archive/WorkSessions/WorkSession20161011.pdf* **City of Philadelphia Expedited Post-Construction Stormwater Plan Review**: Two types of expedited review for applicants proposing green infrastructure strategies: Disconnection Green Review (applicable to redevelopments exempt from city's channel protection requirements that meet 95% stormwater disconnection criteria) and Surface Green Review (applicable to all new development and redevelopment that meet 100% disconnection criteria). *www.pwdplanreview.org/manual/chapter-2/2.4-expedited-pcsmp-reviews* **Minneapolis, MN Stormwater Fee Credit**: New development and redevelopment are eligible for a stormwater fee credit if they install a BMP that goes beyond the stormwater requirements, *http://www.minneapolismn.gov/publicworks/stormwater/fee/stormwater_fee_stormwater_mngmnt_feecredits*
5.11	**Expedited Review Programs:** **Seattle Priority Green**: A prerequisite for the city's expedited review program, Priority Green, is the Green Stormwater Infrastructure Calculator showing 100% green infrastructure or all flat surfaces outside of building footprint as permeable pavement. *www.seattle.gov/dpd/permits/greenbuildingincentives/prioritygreenexpedited/default.htm* **Chicago Green Elements Permit**: Two-tiered approach to green permitting. Tier 1 is high number of green elements and LEED certified. Tier 2 includes one or more green elements—including green infrastructure—from an approved menu. *www.cityofchicago.org/city/en/depts/bldgs/provdrs/green_permit.html* **Building Intensity Bonus Ordinances**: **Durham, N.C., Building Height Bonus**: Offers incentives for the development applicant to provide desired amenities on the development site including 15 to 25 additional feet of building height for sustainable stormwater management. *durhamnc.gov/DocumentCenter/Home/View/6823*
	Enact Policies & Supportive Regulations
5.12	**New York State Stormwater Management Design Manual**: Provides designers with a general overview on how to size, design, select, and locate stormwater management practices at a development site to comply with state stormwater performance standards. *www.dec.ny.gov/chemical/29072.html* **Village of Voorheesville, N.Y., Zoning Law**: Article XIX Special Regulations, Site Plan Review. Establishes requirements for stormwater site design practices. *www.villageofvoorheesville.com/DocumentCenter/Home/View/128*
5.13	**Town of Chapel Hill, N.C., Stormwater Performance Standard**: Includes a volume requirement encouraging the use of green infrastructure: "runoff volume leaving the site post-development shall not exceed the stormwater runoff volume leaving the site pre-development (existing

	conditions) for the local 2-year frequency, 24-hour duration storm event." *www.municode.com/library/nc/chapel_hill/codes/code_of_ordinances?nodeId=CO_APXALAUSMA_ART5DEDEST_5.4STMA* **City of Phoenix, Ariz., Stormwater Performance Standards**: All developments shall not increase the 100-year, 2-hour peak runoff, change the time of the peak, nor increase the total runoff from its predevelopment values; all new developments must make provisions to retain the stormwater runoff from a 100-year, 2-hour duration storm (translating to a 2.5-inch storm event); standard used for water quality, channel protection and flood control. *www.phoenix.gov/pdd/devcode* **Washington, D.C., Stormwater Standard:** Requires development to retain the 90th percentile storm (1.2 inches of rainfall). At least 50% of the rainfall must be retained on site; up to 50% may be retained off site. The city operates a retention trading program so development can achieve the retention goal cost-effectively. *doee.dc.gov/release/district-establishes-new-river-protecting-stormwater-management-standards* **Georgia Stormwater Management Manual**: The 2016 edition has a runoff reduction standard that requires development to retain the first 1.0 inch of rainfall on the site to the maximum extent practicable. *www.atlantaregional.com/environment/georgia-stormwater-manual*
5.15	**Reducing Damage from Localized Flooding: A Guide for Communities**: Intended to help local offices in cities, towns, villages, and counties understand what they can do to reduce the damage, disruption, and public and private costs that result from localized flooding. *www.fema.gov/media-library-data/20130726-1446-20490-0539/FEMA511-complete.pdf*

GOAL 6: Improve the Community Capacity Needed to Enhance Resilience

To enhance resilience, your community can investigate and understand its barriers to success and identify possible solutions. A resilient community has the capacity, resources, and tools necessary to prepare for, withstand, and respond to system shocks and unexpected events.

CASE STUDY

Palm Beach County, Fla. - Comprehensive Planning for Resilience: Palm Beach County has taken a proactive and inclusive approach to planning and implementing resilience building strategies. This has been accomplished through the development of three separate plans that have been cross-checked for conflicts and integrated to take advantage of conflicts. Palm Beach County has a widely recognized comprehensive plan with a vision for the future that guides the county's growth and development. This comprehensive plan contains a robust coastal management element, as required by Florida law. They have also developed a hazard mitigation plan and a post-disaster redevelopment plan (PDRP). Instead of trying to make decisions in the hectic days following a disaster, the PDRP builds resilience by planning and developing goals for recovery and redevelopment. The plan also contains actions that can be taken before a disaster occurs, to support the capacity of residents, businesses, and other community stakeholders. Examples include: identifying sites for post-disaster temporary office space, maintaining inventories of land or vacant buildings that can be used for temporary housing, assisting small businesses with business continuity planning, facilitating mutual aid agreements (both public and private), and more.
discover.pbcgov.org/publicsafety/dem/Sections/Planning-Post-Disaster-Redevelopment.aspx

Understanding Key Challenges

- Does your community have a post-disaster recovery plan? If yes, when was this plan created and was it a successful process? If no, has your community considered developing a pre-disaster recovery plan?

- Do you feel your staff has the expertise necessary to address resilience challenges? Does your community encourage or provide incentives for advanced training or certifications for staff members that could support greater capacity for community resilience (such as the trainings provided by the Association of Climate Change Officials)?

- What is the source of your community's authority to legislate (ex. Home Rule state or Dillon's Rule state)?

- What are some tools your community could use to help address resilience challenges?

- Are there specific challenges you've faced in building the capacity needed to enhance community resilience?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess a community's current capacity to handle system shocks. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
6.1	Staff is trained in long term flood resilience planning and/or implementation, including: • GIS and GIS-based scenario planning tools • Sea, Lake and Overland Surge from Hurricanes (SLOSH) flood maps • Sea Level Affecting Marshes Model (SLAMM) • FIRM			
6.2	A program to build technical capacity among local developers to support resilient development practices has been implemented			
	Remove Barriers & Build Partnerships			
6.3	A Certified Floodplain Manager (CFM) is on staff			
6.4	Local government emergency response personnel, flood plain manager, department of public works personnel, hazard mitigation planner, and/or marine resources agent (or the like) is involved in developing/updating the community's comprehensive plan			
6.5	The local government planner or zoning administrator is involved in developing/updating the community's hazard mitigation plan			
6.6	Groups such as local businesses, schools, hospitals/medical facilities, agricultural landowners, water and wastewater utilities, and others who could be affected by floods are involved in the hazard mitigation plan drafting process			
6.7	Small businesses are assisted with continuity planning and mutual aid agreements			
6.8	Partnerships are developed to help local businesses evaluate their exposure to natural events and take steps to reduce exposure			
6.9	Public-private partnerships are developed to promote renewable energy			
	Adopt Incentives			
6.10	Resources are devoted to promoting commercial/residential mitigation activities that can reduce flood insurance rates			

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
6.11	Financial incentive packages are available to assist businesses remaining in the community following a disaster			

Targeted Resources

STRATEGY	Study, Adopt Plans, and Educate
6.1	**NOAA Office for Coastal Management Digital Coast Academy:** Offers a variety of methods and mediums of information, including: classroom, instructor-led; online, instructor-led; self-guided resources; case studies; publications; quick references; and videos and webinars. *coast.noaa.gov/digitalcoast/training/*
	Remove Barriers & Build Partnerships
6.3	**Association of State Floodplain Managers**: To become a CFM, must pass Association of State Floodplain Manager's (ASFPM) Certified Floodplain Manager exam. *www.floods.org/index.asp?menuid=426* **FEMA Floodplain Management Requirements:** Desk reference to reinforce understanding of government officials administering and enforcing local floodplain management regulations. *www.fema.gov/floodplain-management-requirements*
6.5	**Local Mitigation Planning Handbook, Task 2 – Build the Planning Team:** Identifies planning/community development department as important partner with authority to regulate development and involved in hazard mitigation activities, thus critical to the planning team. *www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf*
6.6	**Local Mitigation Planning Handbook, Task 3 – Create an Outreach Strategy:** Identifies stakeholders and how to engage them. Stakeholders listed include businesses, academia, non-profit and for-profit institutions, and local and regional agencies involved in hazard mitigation activities. Emphasizes the importance of stakeholder input to the planning process. *www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf*
6.7	**FEMA Business Continuity of Operations Plan template:** Continuity planning improves resiliency by identifying key products and services. *www.fema.gov/media-library/assets/documents/89510*
	Adopt Incentives
6.10	**Mississippi Development Authority Disaster Recovery Division, Homeowner Elevation Grant Program:** Program awards $30,000 grants to approved applicants in targeted counties to offset costs of elevating homes to FEMA elevation requirements to reduce flood insurance rates. *www.msdisasterrecovery.com/housing/elevation-grant*
6.11	**U.S. Department of Commerce Economic Development Administration's Public Works and Economic Adjustment Assistance Program:** Grant program to "leverage existing regional assets and support the implementation of economic development strategies that advance new ideas and creative approaches to advance economic prosperity in distressed communities". Can be used to support economic recovery, specifically

	aimed at job creation or retention projects and initiatives to keep employers from leaving a disaster area. *www.eda.gov/funding-opportunities/previous/*

GOAL 7: Build Support for Improving Community Resilience and Remove Barriers to Implementation

It is important to inform and engage a range of community groups to improve your chances of earning their "buy-in." Proactively identifying and overcoming challenges and barriers to strategy implementation is key to moving your efforts forward. A resilient community builds support through frequent, innovative, and robust engagement with citizens, stakeholders, and elected officials who are representative of the whole community.

PRACTICAL APPLICATIONS

Norfolk, Va., City Manager's Office of Resilience: As a part of the Rockefeller Foundation's 100 Resilient Cities program, the City of Norfolk developed "Norfolk Resilient City," a resilience strategy and action plan aimed at improving the resiliency of individuals, systems and neighborhoods. The actionable recommendations from the strategy can all be characterized as "collective and coordinated action to build resilience." The Office of Resilience supports the implementation of these actionable recommendations by 1) defining and translating a resilient Norfolk, 2) coordinating the city and its partners to support this vision of resiliency, and 3) fostering an environment for business innovation and economic growth. The Office also provides updates on the steps the City has taken to implement the strategy's actionable recommendations. *www.nfkresilientcity.org/*

New Orleans Mayor's Office of Resilience and Sustainability: As a part of the Rockefeller Foundation's 100 Resilient Cities program, the City of New Orleans developed "Resilient NOLA", a resilience strategy to meet urgent threats, amend their history of inequity and risk, adapt to a shifting natural environment, invest in equity, develop flexible and reliable systems, and prepare for the future. The Mayor's Office of Resilience and Sustainability and the Chief Resilience Officer, in coordination with the City Planning Commission and Hazard Mitigation Office, are responsible for implementing the strategy, integrating it into existing policies and procedures, and assessing the regional implications of policy changes. *www.nola.gov/resilience/*

Understanding Key Challenges [35]

- What concerns do residents have about planning for resilience?
- Are there political impediments or community objections to resilience-building efforts in your community (ex. an unwillingness to confront future problems, concerns about protecting private property, perception of high costs for improving resilience or reducing vulnerability to hazards)?
- Do your community's efforts meet or exceed existing state or federal laws?
- Are there specific challenges you've faced in building the capacity needed to enhance community resilience?

Inventory Your Local Programs, Policies, and Codes

The strategies below assess how a community handles potential barriers to implementation of resilience-enhancing strategies. The targeted examples at the end of this goal area provide more information about specific strategies. To inventory your policies, please read through the strategies described below and indicate if you are **currently using** this strategy, if you would **like to use** or implement this strategy, and provide any available local links or resources available to provide more information.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Study, Adopt Plans, Educate			
7.1	A website or regularly mailed bulletin informs the public about upcoming/ongoing/complete community resilience efforts			
7.2	Multilingual outreach is conducted to inform the public about upcoming/ongoing/complete community resilience efforts			
7.3	An annual plan of actions is produced, prioritizing the year's resilience building projects and efforts			
7.4	A post-disaster recovery/redevelopment plan is created			

[35] Questions adapted from Beatley, Timothy, *Planning for Coastal Resilience: Best Practices for Calamitous Times*. Island Press, Washington: DC, 2009.

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
7.5	A post-disaster redevelopment ordinance is adopted			
	Remove Barriers & Build Partnerships			
7.6	Hazard mitigation plan identifies projects that could be included in pre-disaster grant applications			
7.7	A dedicated Resilience Officer or Office of Resilience is established to plan and coordinate resilience building efforts and to identify funding opportunities for resilience projects			
7.8	Development review for resilience requirements and permitting activities is conducted from a centralized location that streamlines processes and eliminates inefficiencies			
7.9	A developer liaison is available to assist developers in meeting resilience goals			
7.10	State and regional agency financial support for public infrastructure that supports resilience has been sought/identified			
7.11	Special assessment districts[36] are created to fund resilient infrastructure improvements			
7.12	A capital reserve fund is created to save for resilient infrastructure improvements			
7.13	The current inventory of non-conforming structures located in the regulatory floodplain is maintained and frequently updated to prevent rebuilding in hazard areas, in the event of significant damage			
	Adopt Incentives			
7.14	Expedited development review/permitting is available for proposals that improve resilience in high hazard areas or for proposals located outside of high hazard areas			
7.15	A voluntary incentive program is available for strengthening buildings beyond code requirements			

[36] A flexible tool that can be used to channel property tax revenue increases for extraordinary needs (such as flood mitigation or resilience strategies); typically apply only in defined districts that will benefit from the project(s) being funded. *urbanland.uli.org/infrastructure-transit/using-special-assessments-to-fund-transit-investments/*

	STRATEGY	CURRENTLY HAVE/USE? (Y/N)	WOULD LIKE TO HAVE/IMPROVE? (Y/N)	YOUR LOCAL LINKS & RESOURCES
	Enact Policies & Supportive Regulations			
7.16	Zoning and building codes are reviewed every five years and updated, if needed			
7.17	Code is amended or ordinances adopted to allow renewable energy on individual properties and in communal installations (microgrids)[37]			

Targeted Resources

STRATEGY	Study, Adopt Plans, and Educate
7.1	**Public outreach websites:** **King County, Wash., Flood Information website**: *www.kingcounty.gov/services/environment/water-and-land/flooding.aspx* **City of Roseville, Calif., Floodplain Management website**: *www.roseville.ca.us/pw/engineering/floodplain_management/default.asp* **Pierce County, Wash., Flood Information website:** *www.co.pierce.wa.us/index.aspx?NID=3945*
7.2	**National Resource Center on Advancing Emergency Preparedness for Culturally Diverse Communities ("Diversity Preparedness")**: A web-based library of resources and information on disaster preparedness for culturally diverse communities and other at-risk populations. The planning tools, fact sheets, trainings, and other materials available through this site have been developed by academic centers, government agencies, and non-profit organizations from across the United States. They are geared for public health, healthcare, emergency management, and social service providers who work with diverse and high-risk communities. *diversitypreparedness.org/*
7.4	**Post Disaster Redevelopment Plan for Leon County, Fla.:** *www.leoncountyfl.gov/pdrp/* **Chatham County Redevelopment Plan, Chatham County, Ga.:** Post-disaster recovery/redevelopment plan. *www.chathamemergency.org/2016EMDocs/Chatham%20County%20Redevelopment%20Plan_2.1.16.pdf*
	Remove Barriers & Build Partnerships
7.7	**City of New Orleans Chief Resilience Officer:** Oversees the implementation of the nation's first Comprehensive Resilience Strategy, development of the city's climate action plan and sea level rise and climate adaptation strategies. *www.nola.gov/mayor/executive-staff/*

[37] A microgrid is an energy system capable of operating in parallel with, or independently from, the main power grid. The primary purpose is to ensure local, reliable, and affordable energy security. www.generalmicrogrids.com/about-microgrids

7.10	**Delta Regional Authority Community Infrastructure Fund:** As a complement to the SEDAP investments, the DRA created the Community Infrastructure Fund (CIF) to target physical infrastructure projects that help build safer, more resilient communities in the Delta region. CIF investments can be used for projects that address flood control, basic infrastructure development, and transportation improvements. *dra.gov/funding-programs/investing-in-the-delta/* **Clean Water State Revolving Fund (CWSRF):** The U.S Environmental Protection Agency's (EPA) Clean Water State Revolving Fund (CWSRF) program is the largest public source of water quality financing in the country. Each CWSRF program has a priority system that evaluates and ranks projects. Ranking criteria primarily focus on public health and water quality, but can also address other concerns including infrastructure resiliency. States may encourage projects promoting system resiliency through targeted rating criteria, such as offering priority points, and funding incentives, such as reduced interest rates and waiver of fees. *www.epa.gov/sites/production/files/2016-11/documents/funding_resilient_infrastructure_with_the_clean_water_state_revolving_fund.pdf*
7.13	**FEMA guidance for hazard mitigation planning**: Assists with creating an inventory of non-conforming structures located in the floodplain. *www.fema.gov/hazard-mitigation-planning*
	Adopt Incentives
7.15	**Going Beyond Code: A Guide to Creating Effective Green Building Programs for Energy-Efficient and Sustainable Communities:** Designed to help state and local governments design and implement successful "beyond code" programs for new commercial and residential buildings. While focuses on energy efficiency and green building standards, recommends a voluntary incentive program, among other financing strategies. *www.energycodes.gov/sites/default/files/documents/GoingBeyondCode.pdf*
	Enact Policies & Supportive Regulations
7.17	**Delaware Valley Regional Planning Commission Renewable Energy Ordinance Framework for Solar PV**: A resource for municipalities as they develop and update zoning ordinances to govern the siting of small-scale solar PV energy systems in their community. *www.dvrpc.org/EnergyClimate/ModelOrdinance/Solar/pdf/2016_DVRPC_Solar_REOF_Reformatted_Final.pdf*

PRIORITIZATION, ACTION PLANNING, AND IMPLEMENTATION WORKSHEETS

Use the results of the Resilience Goal prioritization; the inventory of local programs, policies, and codes; and the targeted examples to help set your action agenda for next steps. Fill in the following worksheets to get started.

Resilience Goal Prioritization Questions

Answer the following questions to help prioritize resilience goal areas and focus staff time and resources. Mark the number of topics you are interested in for each goal area in the tabulation table.

TOPIC QUESTION	Y/N	CONSIDER COMPLETING:
Does my community have a thorough understanding of the hazards it can expect to face, the potential range in severity of those hazards, and where they are most likely to occur?		Goal Area 1
Is information pertaining to coastal hazards and risk in my community (maps, plans, risk assessments) up to date?		
Does my community understand and consider our social and economic vulnerabilities?[38]		
Does my community protect lands in critical, flood-prone areas so that nature can perform its flood-reducing functions?		Goal Area 2
Does my community have dedicated funding sources for open space acquisition and management (for example bonds, sales taxes, or transfer taxes)?		
Does my community encourage growth away from sensitive environments to preserve land and reduce risk to people and structures that might locate in dangerous flood-prone areas?		
Has my community taken steps to reduce risk through a combination of proactive and protective land use laws, building codes, and planning policies?		Goal Area 3
Are there populations and/or places in my community that bear a disproportionate share of risk or vulnerability resulting from potential hazards?		
Has my community conducted a vulnerability assessment to identify current and projected vulnerable areas and associated risks to life and property and has it incorporated the results of that assessment into relevant plans (e.g. comprehensive plan, hazard mitigation plan, land use plans, etc.)?		
Has my community identified where growth can safely be accommodated now and in the future?		Goal Area 4
Does my community provide incentives for development in safe growth locations to enhance community resilience?		

[38] Social vulnerability refers to the increased burden of hazard impacts on certain populations within the community, based on race, income, education, language spoken and more; economic vulnerability refers to the local or regional economy's ability to recover following an unexpected shock to the system.

Is new development guided by smart growth principles helping to further enhance my community's ability to withstand hazards and unexpected events in my community?		
Does my community manage stormwater using a wide variety of measures spreading the burden of mitigation instead of relying on a single system to carry excess water away?		Goal Area 5
Does my community have experience with/uses/requires green infrastructure/low-impact design?		
Does my community coordinate with neighboring jurisdictions to explore watershed-based approaches to floodplain management, stormwater management, and green infrastructure?		
Do my community's codes and ordinances provide for the protection of natural features with stormwater management benefits (e.g., trees, open space, riparian areas etc.)?		
Does my community encourage and/or provide incentives for advanced training or certifications for staff members to support greater capacity for building community resilience (such as the trainings provided by the Association of Climate Change Officials, requiring CFMS for staff, or participating in the Community Rating System)?		Goal Area 6
Has my community considered/developed a post-disaster recovery plan?		
Do my community's resilience efforts meet and/or exceed existing state or federal laws?		
Does my community's staff have the range of expertise necessary to address resilience challenges?		
Has my community identified and involved anchor institutions (hospitals, colleges, other major employers) that can support the community's vision for greater resilience?		Goal Area 7
Does my community have a community champion/group who is advancing resilience efforts and building coalitions?		
Does my community have forward-thinking community leaders who understand the long-term challenges of building resilience?		
Does my community prioritize spending for hazard mitigation, disaster recovery, and improved resilience?		

GOAL	TOPICS OF INTEREST (#)	IDENTIFIED PRIORITY? Y/N
Goal 1. Ensure comprehensive understanding of known hazards and vulnerabilities (physical, economic, and social)		
Goal 2. Conserve land in critical coastal areas, river corridors, and other flood-prone environments		
Goal 3. Reduce risk to people, buildings, and facilities in vulnerable areas		
Goal 4. Plan for and encourage development in safer areas		

Goal 5. Implement comprehensive stormwater management techniques		
Goal 6. Build capacity and develop tools to enhance resilience		
Goal 7. Build support for improving community resilience and remove barriers to implementation		

Identify Priority Strategies

For each of the goal areas you responded to in the tool, identify up to five priority strategies that you would like to implement or explore further.

GOAL:

STRATEGIES

GOAL:

STRATEGIES

GOAL:

STRATEGIES

Develop Action Agenda

The following matrix will help you to clarify, prioritize, and define roles and responsibilities for moving forward for each of the resilience strategies that you have identified as a priority. For each strategy, identify the following:

- **Lead role**: The individual, agency, office, or organization who will champion this resilience strategy
- **Supporting cast**: Other individuals, offices, organizations, etc. who can help move the strategy further towards implementation or assist once the strategy has been implemented
- **Timeframe**: The amount of time estimated to complete the strategy or action being discussed; typically described as short term (0-6 months), mid-term (6 months- 1 year), or long-term (beyond one year)
- **Next Steps**: Actions that can be taken in the next 90 days to move the strategy towards implementation
- **Resources**: Time, funding, and/or materials – anything you will need to fully implement the action

A sample strategy has been filled out to show how the action agenda can be used.

RESILIENCE STRATEGY	LEAD ROLE	SUPPORTING CAST	TIMEFRAME	NEXT STEPS	RESOURCES NEEDED
***Example**: A green infrastructure cost share or fee credit program is made available*	*Office of Stormwater Management*	*Planning Dept.* *Public Works* *Public Affairs* *Local environmental Groups*	*Mid-term: 6 months – 1 year*	*Research existing cost share/fee credit programs and produce a feasibility study* *Identify likely users or residents/ businesses who would be most interested* *Investigate funding support resources*	*Staff time to research best practices and determine feasibility* *Funds to support cost sharing/ fee credits*

RESILIENCE STRATEGY	LEAD ROLE	SUPPORTING CAST	TIMEFRAME	NEXT STEPS	RESOURCES NEEDED

ADDITIONAL RESOURCES

The **National Flood Insurance Program's Community Rating System** is a comprehensive resource for strategies that may help reduce risk to hazards and build community resilience.

www.fema.gov/national-flood-insurance-program-community-rating-system

US EPA's **Smart Growth Fixes for Climate Adaptation and Resilience** is a publication that aims to help communities address some of the expenses and political challenges of preparing for and adapting to climate change.

www.epa.gov/sites/.../smart_growth_fixes_climate_adaptation_resilience.pdf

Community Risk and Resiliency Act (CRRA), **Projected Sea Level Rise** for New York

www.dec.ny.gov/energy/102559.html