



Climate Summary

Working toward Climate Resilience

A Summary Prepared for the Town of Germantown, NY

Date: December, 2013

This summary was completed to provide information for land-use planning and decision-making as requested by the Town of Germantown. It identifies historic climate trends and introduces future projections and strategies to address the climate hazards most likely to affect Hudson Valley communities. This summary is based on information currently available to the New York State Department of Environmental Conservation (NYSDEC) and its partners.

New York's changing climate presents new challenges and opportunities for communities in the state. It is vital for local decision-makers to understand their community's vulnerability to a changing climate and take steps to increase their climate resilience.

Central to the information in this document is the concept of **Climate Resilience**: the ability to manage climate risks, respond productively as climate changes and recover quickly from extreme events. Our climate resiliency can be greatly enhanced by protecting and augmenting natural systems, like green and natural infrastructure.

To further support land-use and conservation planning efforts in the Town of Germantown, this summary can be supplemented by complementary summaries of water resources and natural areas and habitats, also available from the Estuary Program by request.



Cornell University



This document was created by the New York State Department of Environmental Conservation's Hudson River Estuary Program and Cornell University's Water Resources Institute in collaboration with DEC's Office of Climate Change.

The Hudson River Estuary Program (<http://www.dec.ny.gov/lands/4920.html>) protects and improves the natural and scenic Hudson River watershed for all its residents. The program was created in 1987 and extends from the Troy dam to upper New York Harbor.

The core mission of Estuary Program is to:

- Ensure clean water
- Protect and restore fish, wildlife and their habitats
- Provide water recreation and river access
- Adapt to climate change
- Conserve world-famous scenery

The Estuary Program is funded by the New York State Environmental Protection Fund. The New York State [Water Resources Institute](#) at Cornell University seeks to foster an understanding of the critical connections between people and the state's waters. It also seeks to empower communities to make informed decisions about land use that minimize impacts to water resources, including drinking water supplies, floodplains, and aquatic habitats.

The New York State Office of Climate Change was created to lead development, in concert with other DEC programs and New York State agencies, of programs and policies that mitigate greenhouse gas (GHG) emissions and help New York communities and individuals adapt when changes in climate cannot be avoided.

The information provided in this document is taken from the following:

The NYS 2100 Commission Report (<http://goo.gl/K9ohoi>)

Responding to Climate Change in New York (<http://gg.gl/vuf9M>)

The DEC Climate Smart Communities Program (<http://www.dec.ny.gov/energy/50845.html>)

Additional information about climate change in the Hudson Valley can be found on NYSDEC's webpages, starting with <http://www.dec.ny.gov/lands/39786.html>.

For more information about this summary or the Estuary Program, please contact:
Libby Murphy, Climate Outreach Specialist, ecmurphy@gw.dec.state.ny.us

New York State Department of Environmental Conservation
Hudson River Estuary Program
21 South Putts Corners Road
New Paltz, NY 12561
Phone: 845-256-3016 • Fax: 845-255-3649
Website: <http://www.dec.ny.gov/lands/4920.html>
Sign up for our Climate Resiliency in the Hudson Estuary Newsletter: <http://goo.gl/GYvVs2>

Introduction

Hudson Valley communities could benefit from improved planning, response and recovery regarding climate events, as highlighted by the impacts suffered by Hurricanes Sandy (2012) and Irene (2011) and Tropical Storm Lee (2011). Germantown has formally acknowledged the need for local action on climate change in its Comprehensive Plan in 2007. One way that communities like Germantown can prepare for a more prosperous future is to better understand and prepare for the risks and opportunities they face under a changing climate system. This document presents Germantown's primary climate hazards and the risks and opportunities they present, using the latest studies coming



What does climate resilience mean to you and your community? (C. Bowser)

from New York State.

Climate Hazards in New York State

Three significant climate hazards are expected to affect New York State residents during the 21st century: *increasing temperatures, rising sea level, and changing precipitation patterns.*

Increasing Temperatures

Annual average temperatures have been steadily increasing in New York State, posing new challenges to many of our industries, including agriculture, snow sports and more. Since 1970, they have been increasing at a rate of 0.6 degrees Fahrenheit (F) per decade. In winter months, this warming effect is even greater, at 1.1 degrees F per decade.



Climate change could pose a threat to industries reliant on winter weather. Belleayre Mountain Ski Center in Shandaken, NY

Since 1970, temperature increases in New York have surpassed national and global averages:

- Global annual average temperature up nearly **1°F**
- U.S. annual average temperature up **1.8°F**
- New York annual average temperature up nearly **2°F**
- New York winter temperatures up almost **5°F**

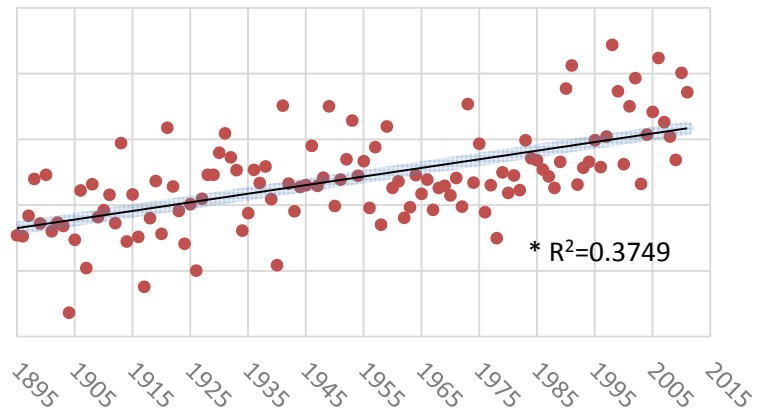
AIR TEMPERATURE PROJECTIONS FOR EAST OF THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
Annual average air temperature	50°F	51.5 - 53°F	53 - 55.5°F	54 - 58°F	54.5 - 59.5°F
Increase in annual average	-	1.5 - 3.0°F	3.0 - 5.5°F	4.0 - 8.0°F	4.0 - 9.5°F

Local evidence from Poughkeepsie's water treatment plant illustrates the two-degree increase in the area's annual average temperature (see chart to the right).

Models project an additional 3 to 5.5 degrees F will be added to the annual average temperature by 2050 in counties east of the Hudson estuary, including the Town of Germantown; 4 to 9.5 degrees by 2100.

Annual Average Temp. in Poughkeepsie (F)



Rising Sea Level

Global sea level is rising due to various factors, including thermal expansion from warmer water temperatures and melting of land-based ice. The Hudson River is connected to and influenced by the sea; therefore, it experiences tides and contains saltwater in its lower reaches. This is why the river south of the federal dam at Troy is considered an estuary. It is also the reason why the Hudson River's water level is rising with global sea level. Sea level rise along New York's coastline is greater than the global average due to readjustment of the Earth's crust from the last ice age and other local factors. Since 1900, sea level in the lower Hudson has risen one foot.



Flooding in Kingston, NY from Hurricane Irene (2012).

Since 1900, sea level in the lower Hudson has risen one foot. **Sea level in New York harbor has risen 15 inches in the last 150 years.** It is projected to increase another five inches, to a foot by 2050. It is possible that Hudson riverfront communities could

experience as much as six feet of sea level rise by the end of the 21st century. In addition to the serious implications of sea level rise for riverfront communities and infrastructure, coastal and shoreline habitats in the Hudson River estuary may be displaced as sea level rises unless they are able to migrate into undeveloped shoreline areas over time. See the accompanying Habitat Summary for a map and description of coastal and shoreline habitats and information on the rare species they support.

SEA LEVEL RISE PROJECTIONS FOR EAST OF THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
Low estimate of Sea Level Rise¹	-	2" - 5"	7" - 12"	12" - 23"	11" - 26"
High estimate of Sea Level Rise²	-	5" - 10"	19" - 29"	41" - 55"	52" - 68"

¹ Shown is the central range of values from global climate model-based probabilities rounded to the nearest inch.

²The rapid-ice melt scenario is based on acceleration of recent rates of ice melt in the Greenland and West Antarctic Ice sheets and paleoclimate studies.

Changing Precipitation Patterns

Precipitation has become more variable and extreme, whereas total rainfall has changed only marginally. **Heavy downpour events increased 74% between the periods of 1950-1979 and 1980-2009.** Projections indicate total annual precipitation should increase only slightly. Overall, we can expect more dry periods intermixed with heavy rain events and decreased snow cover in winter. In the future, Germantown can expect more dry periods intermixed with heavy rain events and decreased snow cover in winter.

PRECIPITATION PROJECTIONS FOR EAST OF THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
Total annual precipitation	51"	51" - 53.5"	51" - 53.5"	53.5" - 56"	51" to 56"
% Increase in annual precipitation	-	0 - 5%	0 - 5%	5% - 10%	0 - 10%
# Days with precipitation > 1"	10	10 - 11	10 - 11	10 - 12	*
# Days with precipitation > 2"	1	1 - 2	1 - 2	1 - 2	*

*No data available

Climate Risks and Opportunities for Germantown

Increasing temperatures, rising sea levels, and changing precipitation will lead to climate risks that Germantown can start preparing for now. Building climate resiliency presents opportunities

for adapting infrastructure, institutions, and communities to manage climate risks so that your town can respond productively as climate changes and recover quickly from extreme events. Resilience to climate change also depends upon maintaining or enhancing natural systems and the vital benefits they provide communities, including clean air and water, wildlife habitat, and natural flood protection. Effective conservation of natural areas contributing to climate resiliency occurs across property and political boundaries and requires a broader view of natural landscapes. Conducting a natural resource inventory is a first step toward identifying important natural areas in a town and considering them in local planning processes. See the accompanying Habitat Summary and Water Resource Summary for more discussion on managing and conserving important habitats and water resources. This section introduces major climate risks and opportunities for action in Germantown. Opportunities listed are taken from the DEC Climate Smart Communities guidelines. For more information and guidance on taking action, refer to the list of resources at the end of this document.

RISK: Heat Waves

Increasing annual temperatures will lead to more frequent, intense, and long-lasting heat waves during the summer, posing a serious threat to human health. The number of days above 95 degrees is expected to more than triple by 2050 in communities east of the Hudson and rise dramatically by 2080, while days below freezing will steadily decrease.

HEAT WAVE PROJECTIONS FOR EAST OF THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
# Days per year above 90°F	10	14 - 20	20 - 35	26 - 60	*
# Days per year above 95°F	1	2 - 4	3 - 10	6 - 25	*
# Heat waves per year	2	2 - 3	3 - 5	4 - 8	*
Average # days of each heat wave	4	4 - 5	4 - 5	5 - 6	*
# Days per year ≤ 32°F	134	128 - 139	111 - 127	90 - 120	*

*No data available

OPPORTUNITIES

Develop and implement a community heat emergency plan for your municipality or in collaboration with neighboring municipalities. This plan will identify vulnerable populations and existing resources and networks, and outline a course of action during a high-heat event.

Increase shading in public spaces with trees and other structures. During times of extreme heat, public spaces should provide relief for residents and animals, especially those that do not have access to air conditioning.

Expand cooling centers. To reduce hospitalization rates and deaths associated with heat waves, make sure a community has sufficient cooling centers, with multiple modes of transit to and from these locations.

RISK: Short-term Drought

Soil moisture will likely decrease with warmer, less snowy winters, fewer steady rainfall events, and higher evaporation from increased temperatures. This could lead to more frequent and intense periods of short-term drought, threatening local drinking water supplies and agricultural production. Drought may be of particular concern for Germantown given its lack of a large aquifer and abundance of clay soils that limit water infiltration.

OPPORTUNITIES

Implement a water conservation and reuse program. Outline and implement best practices and technologies to decrease water use and increase rainwater harvesting. Encourage xeriscaping: landscaping that requires little or no irrigation.

Maintain existing natural infrastructure. Protecting existing forested areas and wetland will contribute to groundwater infiltration, which can decrease the extent of drought.



Local students learning about our vital ecosystem for the 2013 Day in the Life of the Hudson River (C. Bowser)

Implement a source-water protection program. Identify, map and strategically protect local water supply sources and their watersheds or recharge areas.

RISK: Flooding

Increased sea level rise and intense precipitation events could lead to more frequent flooding along the Hudson and Roeliff Jansen Kill in Germantown, threatening waterfront assets such as homes, businesses, sewage infrastructure, roads and more. Stormwater runoff is of particular importance in Germantown, where 30 of its 57 soil types are poorly drained. Currently, little development is predicted to be at high risk of tidal flooding in Germantown. However, the town's sewage treatment plant borders the projected 100-year flood area if sea level rise reaches 72". The town could consider projected sea level rise and flooding in future development proposals to manage flood risk over time.

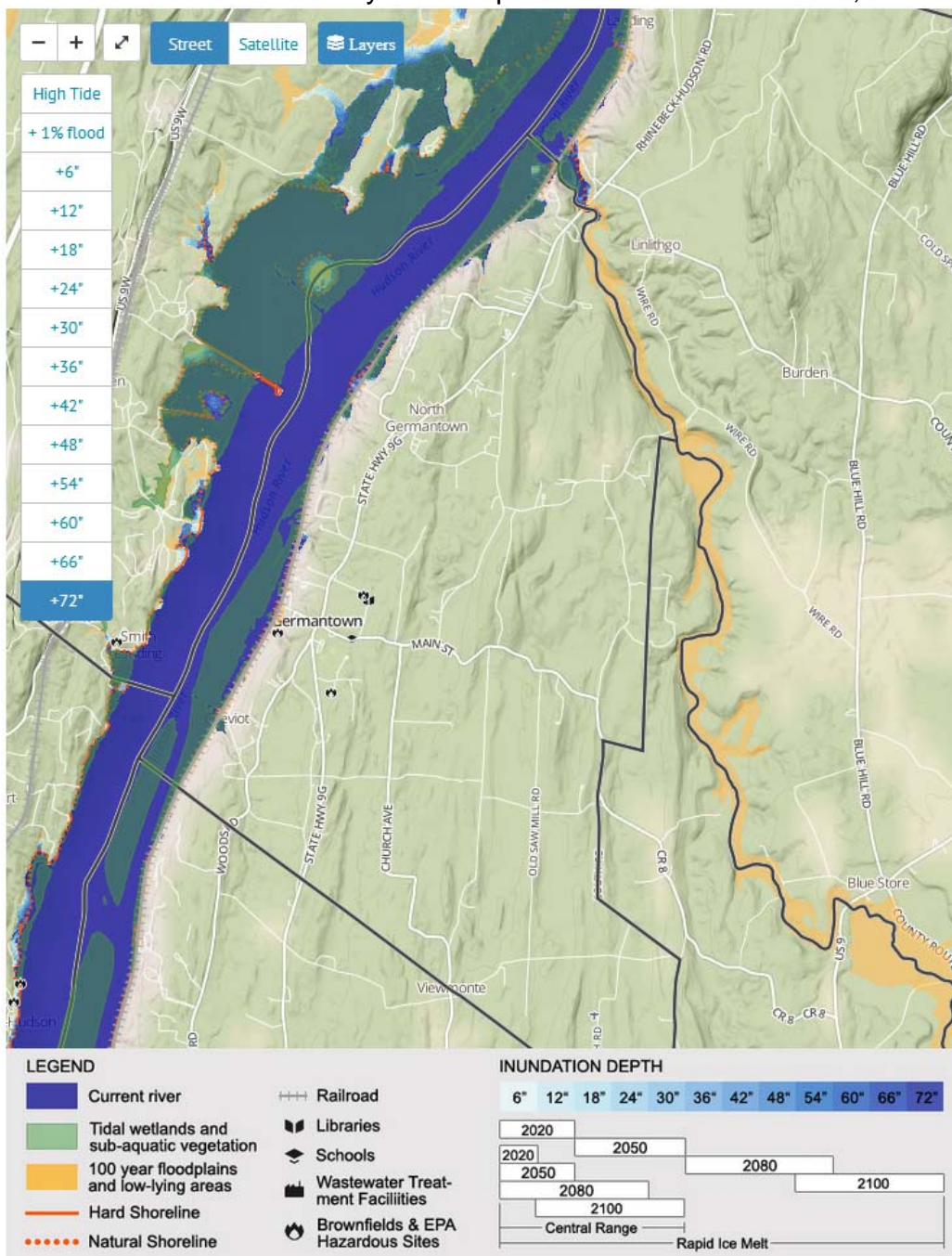


Summer high school students measuring future sea level rise at Marist College (C. Bowser)

There is a very strong relationship between land use and flooding that is essential to addressing increased flood risk from climate

change along streams. Healthy watersheds, including both land and water resources, can reduce erosion and flooding impacts, minimize public infrastructure costs, and be more resilient to climate change—all ecosystem services that directly benefit our communities and cost less than the alternatives. For more information on natural systems contributing to stormwater management and flood protection in Germantown, see the accompanying Water Resource and Habitat Summaries.

Projected 72" of sea level rise and 100-year floodplains around Germantown, NY



Source: Scenic Hudson's SL Mapper: <http://www.scenichudson.org/slr/mapper>

Closeup of Main Street, Germantown, NY. With 72" of sea level rise during a 100-year flood, the light blue areas will be submerged permanently and yellow areas submerged indefinitely.

Note the sewage treatment plant abuts the new 100-year floodplain, also the projected submergence of the Amtrak railroad.



To explore these maps in more detail, visit Scenic Hudson's Sea Level Rise Mapper at <http://www.scenichudson.org/slr/mapper>

OPPORTUNITIES

Incorporate future sea level rise and flooding into municipal planning. Adopt a floodplain protection or management ordinance, and require waterfront development to consider sea level rise and stronger storms over the lifespan of projects.

Use natural vegetated buffers to protect assets from flood risk. Enhance or create natural vegetated shoreline and stream buffers to protect natural areas for wildlife migration and flood mitigation. Consider facilitating a managed retreat from flood-prone areas over the long term and allowing for the migration of tidal and shoreline habitats as sea level rises.

Right size culverts. Many communities rely on culverts that are undersized, especially given the trend of more intense precipitation. Culverts should be inspected and re-sized to adequately handle water flows and reduce flooding.

Integrate changes to flooding risk into emergency planning. Incorporate flood and sea level rise risk and strategies to manage this risk into your county's multi-hazard mitigation plan.

Promote best practices and technologies to address flooding. Promote flood prevention strategies, such as minimizing impervious surface area and promoting the use of green infrastructure practices or natural features that help manage stormwater. See the associated Water Resource Summary for a discussion of post-construction stormwater management and green infrastructure.

Identify and conserve natural areas contributing to stormwater management. In addition to natural vegetated stream buffers, forests, wetlands, and other natural areas play a critical role in managing stormwater on the landscape by intercepting rain and snowfall, reducing and slowing the rate of runoff, and contributing to groundwater recharge. See the associated Water Resource and Habitat Summaries for more information on the role of natural areas in contributing to stormwater management and flood protection and maps of streams, floodplains, riparian forests, large forests, and wetlands in Germantown.

What Next?

Become a Climate Smart Community. Germantown has the opportunity to receive state assistance and resources to reduce greenhouse gas emissions, save energy and improve climate resiliency.

To take the Climate Smart Pledge, visit the website (<http://www.dec.ny.gov/energy/53013.html>) and contact:

Angela Vincent
VHB Engineering, Inc.
e-mail: climatesmart@vhb.com
Phone: 617-924-1770 x1287

Stay in touch with the Hudson River Estuary Program by visiting our Climate Resilience webpage (<http://www.dec.ny.gov/lands/39786.html>) and subscribing to our Climate Resiliency in the Hudson Estuary Newsletter (<http://goo.gl/GYvVs2>).

For more information on the topics discussed in this summary, please see the following sources:

NYSDEC Office of Climate Change: <http://www.dec.ny.gov/energy/44992.html>
Scenic Hudson Sea Level Rise Mapper: <http://www.scenicudson.org/slr/mapper>
NYC's Climate Resilience Planning: <http://goo.gl/jFTsbA>
Revitalizing Hudson Riverfronts: <http://goo.gl/aXFsbB>
Conserving Natural Areas and Wildlife in Your Community:
<http://www.dec.ny.gov/lands/50083.html>