Advancing Community Resilience to Lake-Level Flooding in Wayne County, New York

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New York Wayne County At the core of opportunity

After catastrophic flooding events in 2017 and 2019, waterfront property owners and community leaders in Wayne County are restoring damaged property and preparing for future inundation. But, residents and community leaders need decision-support tools to accurately determine the risks future floods pose to property and livelihoods—especially information on economic impacts and flood risk. Initiatives such as New York State's Lake Ontario Resiliency and Economic Development Initiative (REDI), and the Coastal Lake Economy and Resiliency (CLEAR) initiative have made major strides in developing projects to sustainably rebuild New York's Lake Ontario shoreline, including a $325 million-dollar investment in public projects and at-risk infrastructure. Even with these investments, Wayne County communities still need the best available tools to learn about potential flood and financial risks to property owners and communities.

Led by Syracuse University Environmental Finance Center, New York Sea Grant, and Cornell University, the Advancing Community-Level Resilience project was established in 2019 to fill these critical information gaps while supporting ongoing efforts of state and regional groups to plan for the future. The project received funding from the National Oceanic and Atmospheric Administration's Climate and Societal Interactions Division of the Climate Program Office.

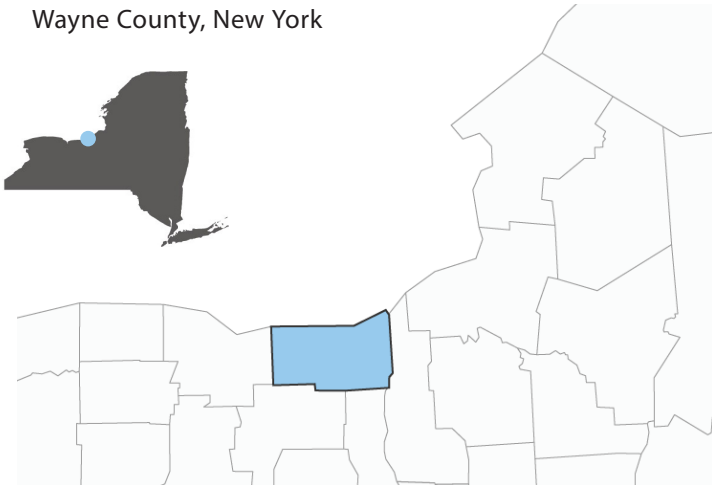
Project Goals

1. Identify economic vulnerabilities of flooding for shoreline communities with parcel-level analysis
2. In collaboration with Wayne County communities and existing planning efforts, develop recommended actions and policies.
3. Develop strategies to communicate recommended actions, policies, and tools effectively.

Project Context and Scope

This project is intended to build upon and support existing regional efforts. Many components of this project evolved alongside the Wayne County Coastal Lakeshore Economy and Resiliency (CLEAR) initiative, which developed a strategic plan to increase long-term resiliency to future flooding and storm events in Wayne County's lakeshore communities, and to pursue new, more resilient paths for community growth. The CLEAR initiative was led by the New York Department of State, along with a steering committee made up of elected officials, regional planning experts, and other community leaders in the County. New York Sea Grant and The Genesee-Finger Lakes Regional Planning Council participated in CLEAR Initiative in addition to their roles in this project.

This project differs from other planning initiatives, including the CLEAR initiative, in several important ways. It prioritizes the synthesis of new and locally scaled data, informed by an innovative and predictive inundation model, described in this report under "Component 1". Emerging research themes drove project focal areas for subsequent project components-



specifically, results of the mapping analysis highlighted risks of inundation for residential septic systems as well as residential structures. Consequently, focusing on on-site septic solutions and structural resilience was the major focus of most community engagement. The project did not focus on solutions for shoreline erosion, which is a major concern for many shoreline stakeholders - this was addressed in other regional plans.

Project Team Members

- Syracuse University Environmental Finance Center (SU-EFC)
- Cornell University
- Syracuse University Maxwell Center for Environmental Policy and Administration (SU-CEPA)
- New York Sea Grant (NYSG)
- Great Lakes Integrated Sciences and Assessments (GLISA)
- Wayne County Planning
- Syracuse University Maxwell X-Lab (X-LAB)

Project Leadership

- Khristopher Dodson, Syracuse University Environmental FInance Center
- Mary Austerman, Great Lakes Coastal Community Specialist, New York Sea Grant
- Dr. Scott Steinschneider, Cornell University Department of Biological and Environmental Engineering
- Ora Rothfuss, Wayne County Planning
- Dr. Richard Rood, Climate and Space Sciences and Engineering at University of Michigan, Great Lakes Integrated Sciences + Assessments

Project Approach

This project offers a multi-disciplinary approach to understanding and supporting economic vitality in coastal

communities wrestling with what flood resiliency means for them. Through phased components of the project, depicted below, the team gathered and synthesized parcel-level economic information and predicted inundation risk, which informed a suite of community-based planning activities. These activities included: engaging stakeholders in lake-level scenario planning, investigating local land use planning through a series of meetings with decision-makers, hosting information sessions on results of research and emerging solutions, and finally working with a team of experts on message testing.

Figure 1: Advancing Community Resilience to Lake-Level Flooding Project Components

1. Economic Analysis and Heat Mapping
- Parcel-level flood inundation analysis
- Mapping characteristics of economic vulnerability and flood hazard

2. Scenario Development
- Summarizing historic and projected climate change for Wayne County communities
- Developing lake level scenarios with local water resource managers
- Play-out the lake level scenarios to identify climate impacts
- Use the scenarios to generate management recommendations

3. Vulnerability Assessment
- Two public workshops to identify community assets and gather public input
- Implementation of the NY Great Lakes Coastal Resilience Index with each community

4. Local Plan and Policy Review
- Review and synthesis of municipal plans
- Development of model policies and land use guidance

5. Resiliency Recommendations
- Compiling results and sharing final maps, scenarios, and sets of recommendations

6. Message Testing
- Development and testing of messages and communication strategies to promote recommended actions
- Presentation of resiliency recommendations

Get to Know Wayne County: Flood Recovery and the Road to Resilience

Wayne County boasts over 35 miles of coveted shoreline along Lake Ontario, the easternmost and lowest lake in the Great Lakes system and 13th largest lake in the world. Living on the shoreline of one the world's largest freshwater lakes has never been without risks, but for shoreline communities in Wayne County, climate-related flooding and fluctuating water-levels are becoming a part of daily decision-making.

The Great Lakes were formed anywhere from 7,000 to 32,000 years ago, experiencing centuries of changing geological and climatological regimes before federal agencies in the U.S. and Canada began recording water levels in 1918. Long before European settlers arrived, Native peoples, including the Seneca and Cayuga, cultivated the land surrounding the southeast coast of Lake Ontario and fished its waters. Since the early 1700s, communities like Sodus Point, Wolcott, and Huron have experienced a rich history of boating, fishing, and tourism, all supported by Lake Ontario and the resources it provides.

Although shoreline flooding is nothing new, in recent years record-breaking, high-water levels have spurred a number of new and innovative community projects in Wayne County. The chronology below offers a snapshot of the positive steps the county, its communities, stakeholder groups and supporting institutions have taken to prepare for a changing climate beyond the efforts undertaken for this project.

- *Spring 2017:* Extremely wet winter and spring conditions overwhelm the Great Lakes system and contribute to record-breaking high-water levels on Lake Ontario. Rising water levels and flooding lead to beach closures, business closures and widespread damage to businesses, infrastructure, and property in Wayne County, causing summer tourism to grind to a halt.
- *Fall 2017*: Community members rally around flood recovery efforts, establishing citizen groups like Save our Sodus (SOS) to push elected leaders to support new investments in resiliency. NYSG and Cornell University release the results of the 2017 Lake Ontario High Water Level Impact Survey documenting the parcel-level impacts of the event on waterfront properties, which is later presented at New York state Senate hearings in October and November.
- *Fall 2018:* NYSG's coastal community development specialist Mary Austerman partners with Jayme Thomann, formerly of the Genesee-Finger Lakes Regional Planning Commission, to host a Post-Flood Recovery Workshop in Sodus Point. As a result of the workshop, several projects are identified as priorities for the county, including creating a circulation, accessibility, and parking (CAP) study, and seeking funding for a Coastal Hazard Erosion Zone designation.
- *Spring 2019:* Water levels once again rise, breaking

the record set in 2017. Communities still recovering from the devasting impacts of 2017 are faced with conditions that are the same or worse than before, leading to more damage, more closures, and more financial losses.

- *May 30, 2019:* The state of New York declares an emergency for the eight counties, including Wayne County, situated along the Lake Ontario shoreline.
- *May 2019:* The Governor's Office announces the Resiliency & Economic Development Initiative (REDI) to increase the resilience of shoreline communities and bolster economic development in the region. To identify projects, a REDI commission, led by New York Department of Environmental Conservation (NYSDEC), brought local leaders together for over 15 planning meeting and received and evaluated more than 500 proposed projects.
- *September 2019:* Work begins on the Advancing Community Resiliency to Lake-Level Flooding Project led by SU-EFC, NYSG, and Cornell University.
- *October 2019:* New York state commits $300 million to new resiliency projects across the eight counties impacted by flooding, including several flagship projects in Wayne County.
- *February 2020*: Building off the REDI process, the New York Department of State launches the Coastal Lakeshore Economy and Resiliency (CLEAR) Initiative to engage lakeshore stakeholders in a forward-thinking, long-term planning process to increase climate adaptation around Lake Ontario.
- *October 2021:* Final designs are completed for a living shoreline restoration of Wayne County's Crescent Beach, which will support increasing resiliency to erosion and future flood damage.
- *March 2022:* The New York Department of State and regional partners, including Wayne County, complete the Wayne County CLEAR Initiative Plan. According to the New York Department of State, the plan implementation strategy and proposed projects are under active review.
- *June 2022:* Construction is completed on a major repair of a critical sanitary sewer line in Sodus Point. The Lakestones Drive Flood Resiliency Project rebuilt a sanitary sewer main further back from the lakeshore and stabilized the eroding shoreline with rock.

Although the County still faces multiple complex threats, many positive advancements in resilience spearheaded by passionate community members and practitioners begin to chart a way forward for communities on the front lines of coastal flooding.

Community Solutions for Wayne County: Quick Guide

Outcomes from each project component informed the development of recommendations. The project identifies solutions in three key areas: Septic Vulnerability, Homes and Structures Vulnerability, and Regional Coordination and Collaboration. Discussion of these recommendations, and how they emerged over the course project, are discussed later in this report and summarized in Figure 3.

Figure 2: High Water Levels on Wayne County Beach. Photo by Mary Austerman, NYSG

Component 1: Re-Imagining Flood Vulnerability in Wayne County

Local Flood Risk Modeling

Decision-makers and homeowners rely on flood risk models to understand when and how flooding will affect shoreline property in Wayne County. Flood Insurance Rate maps from the Federal Emergency Management Agency (FEMA) are widely used, especially in Wayne County, but do not take into account flood events that happened since 1977. To quantify and organize flood risk information and support residents and decision-makers in Wayne County, the project team, led by Cornell University, developed a novel flood risk model to reflect current conditions in Wayne County. This effort was led by Scott Steinschneider, Cornell University Department of Biological and Environmental Engineering, and is a

Flood model development considered three major factors: water supply scenarios, water level management response and local flood dynamics. The water supply scenarios are the quantification and understanding of how water enters Lake Ontario. The main water sources to Lake Ontario include the: Lake Erie outflow, Lake Ontario net basin supply, Ottawa

Figure 3: Solutions Quick Guide Table

Vulnerability	Potential Solution
Septic	Establish a septic inspection and replacement program to encourage appropriate siting, replacement, and maintenance of on-site systems, enhance water quality, and reduce vulnerability of shoreline septic to flooding.
Structures	Update local zoning to reflect a resilient community vision; consider waterfront overlay districts where zoning is present encourage the development of resilient structures.
	Develop and digitize a map of the floodplain, including breakwalls, to assist the shoreline municipalities in implementing local laws and protections.
	Update and refine existing local plans, especially comprehensive plans, local waterfront revitalization plans, and hazard mitigation plans to account for growing resilience needs.
Regional Collaboration and Coordination	Establish a resiliency coordinator to increase intermunicipal collaboration
	Replicate successful models of intermunicipal collaboration, such as the Cayuga Lake Intermunicipal Organization to increase outreach, education, and community involvement

River flows and ice conditions on St. Lawrence River. The water level management response component quantifies how water supplies are mitigated and the resulting change to lake levels. In Lake Ontario, the water level management adhered to Plan 2014. Plan 2014 outlines the rules that control how much and when water is released from the Moses Saunders Dam, which significantly influences static water levels of Lake Ontario, though not enough to counteract extremes. Local flood dynamics includes wind events and high-water level frequency and was determined using a modeling framework that incorporates surge as defined by hourly levels collected from long-term gages and monitors static levels averaged across the lake

Cornell's modeling framework determines quantification of flood risk for total still water levels for the Wayne County shoreline. Based on modeling, one can determine for different probability of flooding in any given year the corresponding water level that would occur with that frequency. Thereby, the flood risk model outlines the different frequencies of which one can expect different degrees of flooding. This modeling effort was integral to SU-CEPA's parcel-level flood inundation analysis and informed the interactive Lake-Level Flooding Risk Map described below. Data for the flood model is available to interested residents, practitioners, or members of public via request.

Parcel-level Mapping and Social Analysis

To complete project goal #2, The SU-CEPA team worked to identify economic vulnerabilities and barriers to flood resiliency through property-level flood inundation analysis, census and property value data and mapping characteristics of economic vulnerability and flood hazards. This work culminated in the development of an interactive Lake-Level Flooding Risk Map available on the project website.

The SU-CEPA team started by collecting data from five different sources as displayed in Figure 4. Three-dimensional models of each property were constructed to feature both geographic attributes (parcel boundaries, building perimeters and elevations throughout) and structural and legal attributes (i.e., land use class, year built, type of wastewater system, assessed value, etc.). Three elevation values were determined for each property, including minimum elevation for the parcel, minimum elevation for lowest building, minimum elevation for largest building on the parcel, thereby, giving three aspects of the property that are potentially at risk for flooding.

The project team used a flood model of water levels and storm surge developed for this project by Cornell University to calculate three probabilities for each property: 1.) chance of water on the parcel (meaning the septic system is potentially at risk), 2.) chance of water flooding the lowest building and 3.) the probability of flooding of the largest building. Residents and practitioners can explore the risk and vulnerability of shoreline properties on the interactive Lake-Level Flooding Risk Map.

Findings across mapping, analysis, and modelling activities demonstrate the need for more effective risk communication. The following research highlights are especially notable for Wayne County:

- The conventional way a 100-year flood plain map is used in public discussions understates risk in two ways. In Wayne County, the risk of flooding varies greatly within the flood plain. The 1% risk only pertains to properties at the highest elevation: properties at lower elevations are at greater risk. Moreover, the 1% figure is only for a single year, and the compound risk of being flooded at least once over a longer period is considerably higher. For example, the chance of being flooded at least once over the life of a typical mortgage (30 years) is 26%.
- The total value of property with an annual risk of flooding of at least 1% was $60 million but many of

those properties had an annual risk of 10% or more (i.e., up to 10 times the 1% risk defining the flood plain). The total value of property with a 1% risk of flooding at least once over the course of a 30-year mortgage is estimated to be $70 million (i.e., slightly larger due to the inclusion of properties with annual risks slightly below 1% because they lie just outside the 1% flood plain).

This research is captured in a GIS StoryMap highlighting Wayne County properties that have an annual 1% risk or greater of lake level flooding. To support ongoing access to project data and tools, the project team created an interactive Lake-Level Flooding Risk Map, that provides specific elevation values and flood probabilities for Wayne County coast parcels, as well as considerable detail about the structural and legal characteristics of those parcels and the principal buildings they contain. This tool was presented to community members and policy makers in Wayne County and remains available for their use (see Component 3, Community Exchange for details).

Figure 4. Mapping Data Sources

Data	Source	Date	Use
LiDAR	FEMA	2014	Elevation of property (resolution to 1 m^2)
Model of Water Levels and Storm Surge	Cornell University	2021	Flood risk probabilities for properties
Tax Parcels	Wayne County	2019	Property boundaries, use, ownership, value, etc.
Tax Parcel Centroids	New York State	2019	Additional property attributes (e.g., sewer type and year built)
Building Footprints	Wayne County	2018	Structure, perimeter, location, and ownership

Component 2: Scenario Planning

Scenario Planning is a decision-making framework used to incorporate uncertainty into decision making in order to identify measures to ensure future resiliency by considering multiple futures. This project engaged a scenario planning approach that brings together local stakeholders and practitioners, who need science-based information about the future, and experts, who can translate and communicate available relevant science. Scenarios developed with multi-disciplinary input represent plausible, but alternate, future conditions of a system of interest. As such, they can provide a means of understanding potential future impacts, such as those related to climate change, and can help develop local, adaptive decision making to reduce the severity of those impacts. The project team, led by GLISA and NYSG, developed scenarios to help plan for a future with lake levels that will likely look different than what has been experienced in the past, specifically related to future climate changes and lake level conditions.The scenario development was informed by a combination of observational Lake Ontario water level data from the NOAA Great Lakes Environmental Research Laboratory, and results of a modeling study that used dynamically downscaled climate models to project future Great Lakes water levels (Notaro et al. 2015).

Stakeholder-based scenario-planning took place over a three-day virtual workshop on July 14th, 15th and 16th, 2021. The project team invited local decision-makers, water resource managers, and practitioners from Wayne County to attend. The first day covered introductions, an overview of the project and a Wayne County Climate and Lake Levels summary. Day 2 was the first day of scenario planning, during which the group reviewed focus areas of concern and an overview of scenarios. The first activity on Day 2 consisted of a discussion of boundary conditions of group scenarios and how the conditions stress outlined goals and activities, this activity was followed by a discussion on how to still meet those goals and activities given the boundary conditions. Day 3, opened with an activity where participants were instructed to choose an event (listed below) to build into the scenario and discuss how this further challenges the goals and activities discussed on Day 2. The groups were then prompted to consider low lake conditions and regrouped to share their findings.

Over the course of three days, groups engaged with scenario-based planning excerises informed by climate and lake-level projections, historical trends, and the physical properties of the Great Lakes system. Each group was asked to identify common goals or vision with respect to a given scenario. On the third and final day of the workshop, all breakout groups summarized the outcomes from the activities and recommended actions. A full summary of the workshop outcomes is included in Appendix A. Participants frequently noted challenges related to limited awareness and understanding of watershed impacts, as well as funding and finance limitations. Some examples include:

- Offer cost-share opportunities for local septic system maintenance or replacement
- Require new homeowners to attend a one-time standard septic maintenance education class
- Develop improved guidance for structural design levels and financial incentives to make those improvements
- Support or establish programs that train and certify individuals that could help with design and permitting activities in towns

- Create an inventory of residential structures including information about where the structures were built in relation to the shoreline, whether they are up to code, if they were impacted by flooding events of 2017 and 2019

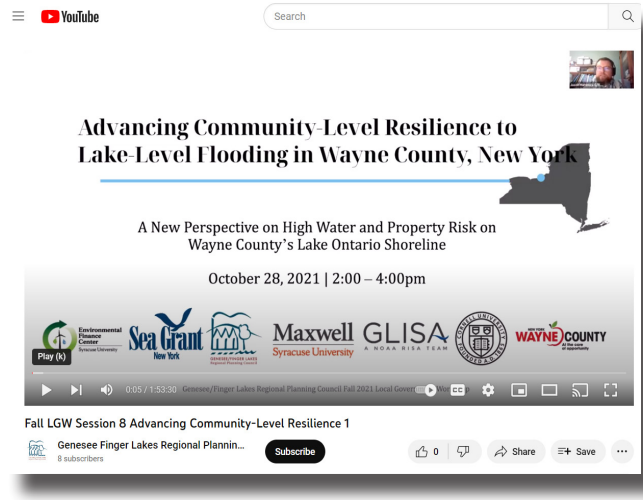
Workshop outcomes reinforced the importance of taking a Regional Approach to climate adaptation planning. Encouraging property owners and municipalities to consider approaching flood adaptation in groupings that make sense for the situation and geography could streamline workflows, reducing cost and staff commitments. Additionally, Municipalities have come to rely on Regional Practitioners (i.e., Wayne County Soil & Water Conservation District, NYSG, Wayne County Cooperative Extension, etc.) to help overcome barriers such as capacity, lack of technical expertise, awareness of funding programs and criteria, communication with and across state and federal agencies, and general transfer of knowledge about issues/solutions from outside the immediate Wayne County region. In reflecting about the workshop, moderators and workshop leaders discussed the need for greater awareness and education on regionally appropriate climate solutions, including innovative and alternative septic systems, land use planning models, and case studies of communities that have gone through a managed retreat process or property-buyout process.

Component 3: Community Exchange

In Fall 2021, the SU-EFC and NYSG hosted a 3-session workshop at the Genesee-Finger Lakes Regional Planning Council's biannual Local Government Workshop. These sessions were developed with multiple purposes in mind: first, to communicate results of mapping and modeling efforts completed earlier in the project (See Component 1), and to encourage solutions-based dialogue and information exchange with experts in two emerging areas of need: septic system program and technology and flood-resilient land use policies. Based on results from the Scenario Planning Workshop, project team members recognized that community members lacked information about potential policy and technical solutions, although they had strong visions and goals for reducing vulnerability to lake-level flooding.

In session 1 on October 28th, attendees were introduced to innovative modeling illustrating waterfront properties at-risk to extreme water levels. In session 2 on November 4th, attendees were presented with the challenges of at-risk sewer and septic systems and ways to make them more resilient. In the final session on November 9th, attendees learned from experts about policy tools and options to increase one's community resilience to extreme water levels. These sessions are available on for residents, practitioners, and other interested members of the public to view on YouTube and promotional materials about the events with additional details are included in the appendices.

Figure 5. YouTube Thumbnails & Links



Component 4: Local Plan Review

A strategic review of existing local planning mechanisms and policies was completed in May 2022 by project team members at G-FLRPC and SU-EFC. Review methodology included researching and reviewing available local policies and plans within the six waterfront municipalities, as well as a series of interviews conducted from May 9-15, 2022, with the municipal officials. Emergent themes from prior project activities informed guiding questions for the review, including the extent to which communities engaged septic/sewer regulations, the role and application of the Local Waterfront Revitalization Plan (LWRP), and floodplain management policies and practices withing County. In New York State, LWRPs are one of the most robust planning instruments for coastal communities, as they allow competitive funding for planning and implementation. Review findings include:

- The Village of Sodus Point and the Town of Huron are the gold standard for septic/sewer regulations. The Village of Sodus does not allow septic or sump pumps in the floodplain and the sewer infrastructure covers the full jurisdiction of the Village and beyond. The Town of Huron's local law surpasses all state and county laws.
- LWRPs vary widely across the County. While several communities have an LWRP, they are used very differently in pursuit of climate adaptation goals. The Town of Huron uses their LWRP on every permit that is issued, and the Town's Zoning Board of Appeals (ZBA) uses the LWRP. The Town of Wolcott references their LWRP as guidance for comprehensive plan situations. The Village of Sodus Point has a LWRP, but it does not work well with the current zoning law.
- Local officials indicate that mapping the floodplain and breakwalls in Wayne County having this will assist the municipalities in implementing local laws and protections.
- Support for Comprehensive Plan and Zoning Law updates is needed. Facilitating these updates will generate the documents, plans, and laws to support and protect the local resources and communities.
- A resiliency coordinator, working with all six municipalities, could streamline shared services and standardize laws and efforts across all six municipalities with the intention that shoreline communities work together and redistribute resources amongst themselves for the maximum benefit and protection. A final thought is for the waterfront to become its own state region.

A more detailed account of this review is available via request to any member of the public

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Component 5: Coastal Risk Message Testing

Led by the Syracuse University Maxwell X-Lab, message testing was conducted to understand how specific target audiences understand and assess flood risk and respond to policy solutions, with the goal of creating successful messages for Wayne County community leaders to use in educating the community on solutions. X-Lab conducted message testing from April-June 2022, after participating in public engagement events in 2021.

Preliminary outcomes from the project's parcel-level mapping and economic analyses (component 1) and feedback collected from regional decision-makers (component 4) offered new ways of describing flood risk and provided parcel-level risk assessments that quantified flood risk over the life of a mortgage (30 years), instead of offering flood risk in terms of the "100 year flood". A key question that this effort addresses is whether shoreline community residents are more willing to support resilience policies when faced with descriptions of the flood risk in terms of the 30-year "life" of a typical mortgage, rather than referring to the "100-year flood".

The results indicated that shoreline property owners had a very high level of support for a small tax-to-subsidy program that would defray the costs of septic system replacement. Additionally, results indicated that providing flood risk information on the probability of flooding at least once over the next year 30 years is potentially effective at increasing the likelihood of septic system replacement. A complete account of the results of this study is available in the appendices.

Figure 6. Shoreline residences with vulnerable septics. Photo by Aaron Vlasak, SU CEPA.

Community Solutions for Wayne County

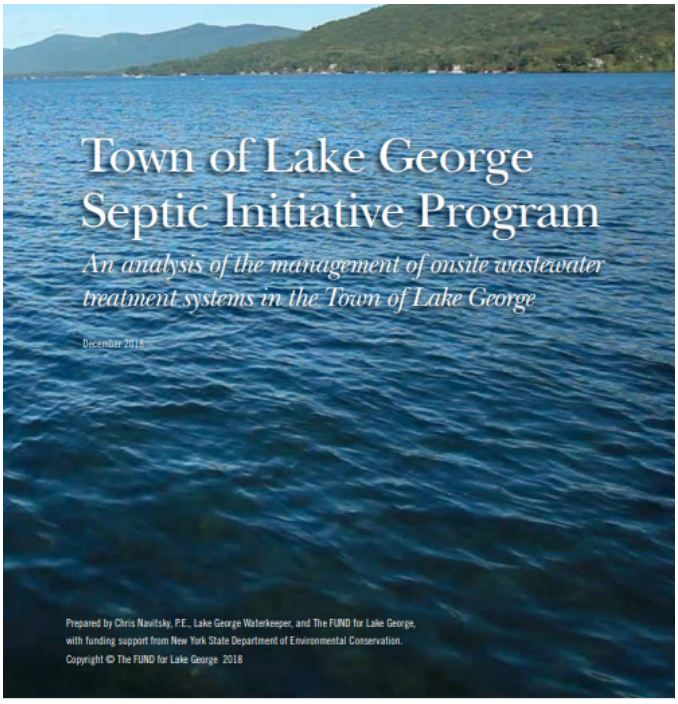
The project team evaluated outcomes from each project component to develop recommendations that cut across research findings, scenario planning outcomes, stakeholder input, and message testing results. The intended audience for these solutions is local decision-makers at the County and within each shoreline Town and Village.

1. Establish a working group or engage consultants to explore the financial benefits of establishing a county-wide septic inspection and improvement program. The program should explore fees and funding sources for homeowner cost-share opportunities or financial incentives to encourage appropriate siting, replacement, and maintenance of on-site systems, enhance water quality, and reduce vulnerability of shoreline septic to flooding.

The need for septic system improvements was identified early on in the project and echoed by stakeholders during workshops. Almost every shoreline septic system in Wayne County is at risk of inundation. Septic Inspection and Improvement programs emerged as a potential solution in July 2021, when residents, elected officials, and water resource experts attended the Lake-Level Scenario Planning workshop planned by NYSG. Workshop participants expressed that an essential part of a septic inspection program is community financing, to defray the costs to homeowners, especially costly system replacements. Building on the initial expression of community support at the Scenario Planning Workshop, the Maxwell X-lab's independent investigation found that shoreline property owners are supportive of tax-based septic improvement policies. Wayne County Soil and Water Conservation District administers a rebate program for Septic System replacement or maintenance through the State Septic System Replacement Fund, which may be expanded upon or broadened to service for households. Intermunicipal agreements are another tool that can be used to encourage a regional septic inspection and improvement effort. Although the Town of Huron and Village of Sodus have strong local septic system laws, other shoreline municipalities do not, and many residents would benefit from an additional funding and financing program. Septic Inspection and Improvement programs have been successful in other parts of the state, including Suffolk County and Lake George. In addition to exploring a county-wide option for septic system improvement, local officials as well as Wayne County departments can support septic system improvement through the following **communication actions**:

- Share educational content on the sources and the economic and environmental impacts of excess nutrients on water quality via town and county social media page

Figure 7. Report Cover, Town of Lake George Septic Initiative



- Highlight the potential consequences of taking no action to address septic system vulnerability, including property damage and delayed maintenance costs.
- Provide opportunities such as public workshops for residents to participate in visioning a septic system improvement program in their community
- Partner with extension services or technical assistance providers to host septic system education classes to new homeowners

2. Establish a resiliency coordinator to increase intermunicipal collaboration, streamline services, and encourage resource-sharing.

A strong theme from stakeholder-based activities throughout the project, including both the Lake-Level Scenario Planning Workshop (Component 3) and the Advancing Community-level Resilience Series (Component 4), is the value of regional practitioners. Because Wayne County is rural with small governments, municipalities have come to rely on regional practitioners to support collaboration and coordination at the watershed or subwatershed scale. Resiliency projects such as naturalizing shorelines, elevating structures, and installing green infrastructure often involve local, state, and federal jurisdictions and should be based on a clear regional vision. Existing regional practitioners include Wayne County Soil and Water Conservation District, New York Sea Grant, and Wayne County Cooperative Extension. Wayne County should consult with local municipalities to

gather input on appropriate placement opportunities for a coordinator. Options might include creating the position within a County Department or appointing a coordinator through the County Legislature; alternatively, the position could be based at an educational institution such as Wayne County Cooperative Extension. Opportunities to co-fund the position between participating municipalities and grants from the state or federal government should be considered. The following **communication actions** can support the County in advancing this recommendation:

- Convene local decision-makers from across Wayne County in an initial scoping conversation to discuss local needs.
- Request that Town and Village Boards add the topic of regional resilience coordinator to meeting agendas
- Share key messages with local decision-makers, residents, and technical assistance groups including:
- Climate change does not recognize town boundary lines or sector-based silos. All levels of government and stakeholders across various sectors must collaborate creatively for the future of the region and Wayne County.

3. Replicate successful models of intermunicipal, watershed-based collaboration to increase outreach, education, and community involvement.

In addition to a regional coordinator, Wayne County can increase local buy-in and community involvement in regional resilience planning by supporting a watershed-based group to work across municipal boundaries. Watershed groups, such as the Canandaigua Lake Watershed Association, use membership fees and volunteer services to leverage funding, procure grants, and hire a dedicated manager to oversee watershed protection and resiliency efforts. These groups can support outreach related to new projects and plans and lead voluntary programs for residents or homeowners. The following **communication actions** can support the County in advancing this recommendation:

- Invite intermunicipal watershed groups, including the Owasco Lake Watershed Council, Canandaigua Lake Watershed Association, and others to present on their organizational structure and mission at a local planning conference.
- As with recommendation 2, share key messages with local decision-makers, residents, and technical assistance groups including:
- Climate change does not recognize town boundary lines or sector-based silos. All levels of government and stakeholders across various sectors must collaborate creatively for the future of the region and Wayne County.

4. Update local zoning to reflect a resilient community vision and consider waterfront overlay districts where zoning is present to encourage the development of resilient structures.

Wayne County has participated in multiple efforts that have generated a robust community dialogue about resilience. The Sodus Point Post-Flood Recovery Workshop, New York State's Lake Ontario Resiliency and Economic Development Initiative (REDI), the Coastal Lake Economy and Resiliency (CLEAR) initiative, and the Scenario Planning Workshop in this project all introduced stakeholder-based goals and visions that can guide this process and have called for a re-evaluation of local zoning and codes. A zoning update process within Wayne County's shoreline municipalities should consider opportunities for: 1.) encouraging green infrastructure and nature-based solutions 2) adjusting area and bulk requirements to limit development in areas at high risk of flooding retrofits and 3) establishing overlay districts with more protective rules, such as a minimum elevation requirement for new structures. Zoning updates can be a time-consuming process for local boards and elected officials and can be confusing for local residents. To support transparency and build momentum around a zoning update change, local officials can employ the following **communication actions**:

- Engage a technical assistance group to facilitate a series of meetings with zoning and planning board members from across Wayne County's shoreline municipalities discuss aligning local codes with regional plans, discuss municipal capacity for enforcing codes, and brainstorm ways to augment local capacity if needed
- Emphasize the costs associated with no action (i.e., the cost of doing nothing) at local planning board meetings
- Centralize resources on a county website that highlight different zoning opportunities such as retrofits, overlay districts, and adaptation measures such as nature-based solutions

5. Update and refine existing local plans, especially comprehensive plans, local waterfront revitalization plans (LWRPs), and hazard mitigation plans to account for growing resilience needs

The local planning review completed for this project (Component 4) identified that several communities have opportunities to update local plans. Although almost all communities in Wayne County have a comprehensive plan, several have not been updated for 10 years or more. Updating these plans to account for growing resilience needs can serve as a justification for pursuing future grants and funding opportunities. Municipalities can also forecast staff and workforce needs during the planning process as it related to enforcing, coordinating, and planning for resiliency actions. LWRPs also present an opportunity to document needs, challenges, and project opportunities—and the LWRP

plan also opens the door to funding from the New York Department of State for both planning and implementation of LWRPs. Lastly, Wayne County updated its All-Hazard Multi-Jurisdictional Hazard Mitigation Plan in 2022, and towns and villages are currently in the process of the adopting the plan. This poses an opportunity for towns, villages, and the County to share resources, news related to the plan, and updates with residents and to demonstrate linkages to broader regional resilience efforts. Updating and developing plans takes considerable effort and can be burdensome for small communities. To support this process, shoreline decision-makers should take advantage of regional planners and technical assistance groups such as the Genesee-Finger Lakes Regional Planning Council. **Communication actions** to support these efforts include:

- Centralize news and resources about the planning process on a municipality website
- Present high-level information about the plans, including the funding opportunities (if LWRP) to civic groups, "friends of" groups, and other organized community groups in addition to town meetings
- Emphasize key messages that drive home the "why" behind the plan: 1.) High cost of taking no action on climate-related threats ; 2.) Climate change does not recognize town boundary lines or sector-based silos. All levels of government and stakeholders across various sectors must collaborate and plan for the future of the region and Wayne County

6. Develop and digitize a map of the floodplain, including breakwalls, to assist the shoreline municipalities in implementing local laws and protections.

Findings from the planning review (component 4), which involved interviews with several local officials indicate that a user-friendly map of the shoreline is needed to serve as the basis for ongoing planning. Although several projects have advanced mapping efforts for Wayne County, including the parcel-level analysis provided in this project and multiple shoreline risk profiles created for the CLEAR process, a single, user-friendly interface can directly support local officials. This mapping resource must be accessible online and demonstrate the presence and absence of breakwalls, and, to the extent possible, contain more detailed information about structures (for example, whether the structure is currently up to code). This kind of interface would be an additional support for communities exploring land-use policies and overlay district options. Communications actions that can enhance this effort include:

- Ensure the mapping resource is available online and provide local planning board members with training on how to use any special features
- Work with state agencies like New York Department of State, New York Department of Conservation, and New York Sea Grant to ensure that there is no duplication of effort and to integrate existing resources

Moving Ahead and Suggestions for Future Study

Building resilience takes time. In Wayne County, shoreline communities still need support in the form of education and awareness-building activities to inspire behavior change build public support for climate adaptation practices and policies. Continued investment and grant funding is needed to take recommendations from this project as well as the CLEAR and REDI process to the next phase of development. Capacity and leadership are needed at the local level to manage and acquire funds.

Future studies and areas of research that can support Wayne County and other coastal municipalities include:

- Sensitivity analyses that identify acceptable costs, fees, or taxes for septic replacement and improvement programs in rural areas
- Qualitative and quantitative studies that identify residents' level of support for local land use policies as well as any concerns or perceived barriers
- Additional message testing to further illuminate how communicating flood risk in terms of a 30-year "life" of a typical mortgage, rather than referring to the "100-year flood", can increase willingness to support or engage with resilience actions.

Funds for this project are provided through the Climate and Societal Interactions COCA/SARP competition by the National Oceanic and Atmospheric Administration Climate Program Office. To request additional information or access data referenced in this report, you may contact:

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Appendices

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Lake Level Scenario Planning Workshop

July 13-15, 2021
Summary Report

Authors:

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Great Lakes Integrated Sciences + Assessments

Mary Austerman,
New York Sea Grant

Table of Contents

Introduction and Overview of Scenario Planning and Process

Authors:
Kim Channell (Great Lakes Integrated Sciences + Assessments)
+
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Project Background

After catastrophic flooding events in 2017 and 2019, waterfront property owners and community leaders in Wayne County are restoring damaged property and preparing for future inundation. Residents and community leaders need decision-support tools to accurately determine the risks future floods pose to property and livelihoods. Initiatives such as New York State's Lake Ontario Resiliency and Economic Development Initiative (REDI) have made major strides in developing projects to sustainably rebuild New York's Lake Ontario shoreline, including a $325 million-dollar investment in public projects and at-risk infrastructure. Even with these investments, Wayne County communities still need the best available tools to learn about potential flood and financial risks to property owners and communities.

Using a multi-pronged approach, the project team will:

- Identify economic vulnerabilities of flooding to: individual community members and businesses, and residential and commercial properties.
- In collaboration with Wayne County communities, develop recommended actions and policies.
- Develop strategies to communicate recommended actions, policies, and tools effectively.

One component of the project is scenario planning, which was led by the Great Lakes Integrated Sciences and Assessments (GLISA) and New York Sea Grant (NYSG). This report will summarize the outcomes of that workshop.

Scenario Planning

Scenario planning is a method to describe and incorporate uncertainty into decision making. The goal is to account for uncertainty by developing a framework to consider several novel situations, not just what may be expected based on the past. Planning for multiple plausible futures, including extremes, can increase the robustness of management practices and preparedness for climate change impacts.

GLISA's scenario planning approach brings together practitioners, who need science-based information about the future, and experts, who can translate and communicate available relevant science. The goal of this workshop was to develop scenarios to help plan for a future with lake levels that will likely look different than what has been experienced in the past. After the workshop, participants should:

1. Have a better understanding of scenario planning
2. More clearly be able to picture how their focus area activities are impacted by lake levels and weather/climate
3. Have created a set of recommendations based on lake level scenarios tailored to focus area needs

Past GLISA scenario planning experiences have shown that a few key elements are necessary for a successful scenario planning workshop. First, the scenarios and solution strategies must be collaboratively created by representatives of all relevant stakeholders. Project partners and workshop facilitators worked to ensure that a diverse group of stakeholders from different sectors and backgrounds were represented in the participant

Figure 1: Sodus Point lighthouse in Wayne County, NY. Photograph by Mary Austerman

list. Second, focus area goals must be clearly defined from the beginning of the process, because the development of the scenarios and actionable recommendations depends on the definition of goals and challenges that the scenarios are intended to address.

The following handouts were mailed to the participants ahead of the virtual workshop (all included in the Appendix).

1. Project description 1-pager
2. Workshop agenda
3. Wayne County climate and lake level fact sheet
4. Lake level scenarios description
5. Scenario planning activities

On day 1 of the workshop, participants were given an overview of the project, an explanation of scenario planning and goals for the week, and a local climate and lake level summary for Wayne County. On day 2, participants were split into 4 breakout groups to complete the scenario planning exercises. Each group was assigned a focus area and a scenario, with no two groups having the same combination. This allowed for each group to build their own unique scenarios out of the lake level scenarios they were provided with.

Focus Areas of this Workshop

Lake Ontario experienced record-high, catastrophic flooding that lasted for months in both 2017 and 2019. As a result, a number of efforts focus to improve flood resilience for waterfront communities such as Governor Cuomo's Lake Ontario REDI, New York Department of State's Coastal Lakeshore Economy and Resiliency (CLEAR) Initiative, this NOAA funded project and more. The combination of these efforts and the expertise of the NOAA project team afford the opportunity to focus efforts in the areas of septic systems and structures (i.e., homes, outbuildings, etc.) at risk of inundation. The following data was generated for this project by Syracuse University Center for Environmental Policy and Administration identified numbers of septic and structures most at risk of flooding.

Septic systems: Households that are not served by public sewers usually depend on septic systems to treat and dispose of wastewater. The purpose of a septic system is to store, distribute, and treat liquid wastes from your house on your property while preventing contamination of groundwater, drinking wells, and nearby lakes and streams. When a septic system is properly located, designed, installed, and maintained, it serves as an effective, economical, and safe on-site wastewater treatment system. Being a rural county, many homes rely on septic systems. In fact, along Lake Ontario and its embayments, there are 1,096 residential properties on septic that are below 249.3 feet (76 meters) elevation, which approximates the 100-year floodplain.

Structures: In general, structures (i.e., homes, garages, outbuildings, etc.) located closer to Lake Ontario and its embayments are at higher risk of flooding than those at higher elevations. In response to the 2017 and 2019 flooding events, state funding was made available to some waterfront property owners, to mitigate damage from inundation. There are 1,892 residential waterfront properties and their total assessed value is $393 million. There are 31,507 residential properties in the county as a whole, with a combined assessment value of $3.914 Billion. Although 6% of those residential properties are located on the Wayne County waterfront, they account for approximately 10% of the total county assessment value. As a result, policy and land use planning, particularly along our shorelines, will improve community resilience.

Figure 2: Flooding in Ellisburg, 2017. Photo credit: Coastal Flooding Survey Project, Cornell University and New York Sea Grant.

Figure 3 (right): Flooding in Hamilin, 2017. Photo credit: Coastal Flooding Survey Project, Cornell University and New York Sea Grant.

Lake Level Scenarios

Since this project is focused on flood risk from high lake levels, GLISA developed a set of 3 physically plausible scenarios for the workshop around high lake level conditions. The groups also briefly considered low lake level conditions, but it was not the focus of the scenario planning exercises. The scenarios below are informed by climate and lake level projections, historical trends, and the physical properties of the Great Lakes system (see appendix for more information).

1. Cold Air Outbreak Scenario
2. Excess Precipitation Scenario
3. Extremes Scenario

During days 2 and 3, the breakout groups worked through the following scenario planning exercises together to build upon the GLISA scenarios and discuss the potential actions they would take in response (see appendix for more detailed description).

1. Describe specific issues and goals related to your group's focus area (i.e., septic at risk of flooding, or structures at risk of flooding). These issues should be specific to Wayne County's waterfront communities
2. Discuss the boundary conditions of your scenario and how those impact the community goals for your focus area identified in activity 1.
3. Using the goals identified in Activity 2, think about which can be met easily, with additional effort, or not at all. Focusing on the difficult to achieve and unattainable goals from activity 2, talk about how you can still meet those goals given the boundary conditions. Of the goals that cannot be met, what will you do to get to those goals still?
4. Choose an event to build into the scenario and discuss how this further challenges focus area goals/activities. If time permits, discuss multiple events.
5. Briefly consider how low lake levels impact the goals/issues related to your focus area. Use an abbreviated version of all previous steps to do so.

Breakout Group Summaries

Figure 4:
Flooding in Greece, 2017. Photo credit: Coastal Flooding Survey Project, Cornell University and New York Sea Grant.

At the end of day 3, all breakout groups summarized the outcomes from the activities and recommended actions. This provided participants with a chance to learn about all scenarios and focus areas, beyond their own breakouts, and share their thoughts in a group discussion.

Group A: cold air outbreak scenario for septic systems with coastal erosion event

GOAL #1: Ensure septic systems are working properly by 2031

GOAL #2: Ensure access to community financial fund for cost share

Group A focused on septic systems under the cold air outbreak scenario (#1). In this scenario, water levels are already above average. Then, a cold air outbreak associated with arctic oscillation occurs, causing very cold temperatures. The lakes freeze, evaporation shuts off, and the ground is frozen with snow cover. Water levels that were already above average become extremely high. Group A chose to add a coastal erosion event to this scenario as they discussed goals and actions. Currently, there are some measures in place to mitigate erosion through the REDI project and by homeowners, but septic systems are at high risk of being lost to erosion if the conditions of this scenario occur. Group members focused on two main goals: 1) ensuring that septic systems are working properly by 2031, and 2) ensuring access to a community financial fund for cost sharing. Some of the challenges of achieving these goals under this scenario are coordination between federal, local, and state agencies; funding; and the urgency needed to get work done quickly. To achieve goal #1, the group recommended an integrated strategy to inventory and assess septic systems' risk of inundation. The strategy would

include a regional coastal plan and participation from all agencies in order to reduce barriers in coordination. Under such a strategy, properties will be audited and assessed, with municipalities and inspection agents performing a coordinated inspection and audit. Code enforcement officers should also perform stress test on new home purchases. In some cases of septics along eroded shorelines, houses may not be livable. In these worst-case scenarios, houses would require a state or federally funded buyout.

To achieve goal #2, the group recommended federal investment in pilot programs for relocation and house buybacks; replication and adoption of model local septic laws to demonstrate seriousness and local commitment to federal and state agencies; and finding integrated local/state/federal funding solutions to erosion that may require federal investment in buyouts. The group noted that communities face significant challenges of revenue loss from lost value of tax assessments and recommended that buy out programs evaluate negative impacts to municipalities and allow for ample examination and public input before implementation. Such federal programs also often emphasize primary homes only, while many homes on Lake Ontario are secondary vacation homes that need to be considered in these programs as well.

Figure 5:
Wayne County Flooding in Sodus Point, 2017. Photo credit: Coastal Flooding Survey Project, Cornell University and New York Sea Grant.

Group B: extremes scenario for septic systems with unusually wet season event

GOAL #1: Ensure 100% of high-risk systems are protected from flooding by 2025

GOAL #2: Ensure 100% of septic systems are up to UPP standard by 2025

Group B focused on septic systems under the extremes scenario (#3). In this scenario, global teleconnection patterns cause shifts in the location of storm tracks. This contributes to rapid fluctuations between extreme high and low lake levels. As a result, floods are bigger and droughts are longer. The event Group B chose to add to this scenario was an unusually wet season over the basin that leads to further flooding and water inundation. They deemed that such conditions become hazardous within 3-4 days. Group members focused on two main goals: 1) ensure that 100% of high risk systems are protected from flooding by 2025, and 2) ensure that 100% of septic systems throughout lakeshore towns are up to Uniform Procedures Program (UPP) standard by 2025.

To achieve goal #1, the group recommended that 60% of new homeowners attend a one-time standard septic maintenance education class, that lakeshore homeowners know the location of their septic systems with 100% certainty, and that lakeshore community leadership identify and develop funding mechanisms to help offset the costs of failing septic systems.

To achieve goal #2, the group recommended the creation of a landowner decision making tool or app and a municipal decision making tool to address community areas that may need to convert from septic systems to sewer systems, and consider the challenges that come with that. The group noted that switching to municipal sewer systems comes with financial and geographic challenges related to flow problems, pump stations, and weather conditions. Regulatory challenges can also arise between the time mismatch of construction season and permitting and design requirements needed to make such construction happen. The group recommended creating a program that would increase personnel and technical assistance by training and certifying individuals that could help with design and permitting activities in towns.

Group C: extremes scenario for structures with ice and high wind event

GOAL #1: Develop an immediate response plan to high or low water level events

GOAL #2: Ensure 100% of residential structures are resilient to low and high levels

Group C focused on structures at risk under the extremes scenario (#3). In this scenario, global teleconnection patterns cause shifts in the location of storm tracks. This contributes to rapid fluctuations between extreme high and low lake levels. As a result, floods are bigger and droughts are longer. Group C chose to add an ice and high wind event that contributes to even higher water levels. This can cause flood damage to properties and protective structures. Group members focused on two main goals: 1) develop an immediate response plan to high or low water level events, and 2) ensure that 100% of residential structures are resilient to both low and high water levels.

To achieve goal #1, the group recommended developing a priority contact list and prioritizing where resources are coming from for communication purposes. Such a contact list would include neighboring municipalities across the county and other agencies and organizations. This would allow for coastal communities to contact subject

Figure 6:
Flooding in Hamlin, 2017. Photo credit: Coastal Flooding Survey Project, Cornell University and New York Sea Grant.

matter experts and have an extra layer of knowledge for environmental considerations for the structures under different hazard and response plans.

To achieve goal #2, the group recommended creating an inventory of residential structures, including information about where the structures were built in relation to the shoreline, whether they are up to code, if they were impacted by flooding events of 2017 and 2019 and how protected or at risk they are. Then come up with adaptive strategies based on the inventory, and determine thresholds for buyouts and relocation. This is particularly important for communities with a large portion of older building stock that may not be viable to rebuild, elevate, or retrofit.

Group D: excess precipitation scenario for structures with prolonged seiche event

GOAL #1: All residents outside 100-year floodplain remain safely in their homes

GOAL #2: No municipal/publicly owned roadways are unpassable

GOAL #3: 100% of properties the municipality provides water to will maintain service

Group D focused on structures at risk under the excess precipitation scenario (#2). In this scenario, water levels are already above average. Then, excess precipitation falls in Spring and early Summer. A continual source of water into the lake system leaves the basin saturated. Upstream, downstream, and lake shoreline flooding occur. Water levels that were above average become extremely high. Group D chose to add a prolonged seiche/wind event to this scenario, which they deemed could create unmanageable conditions after 3 days with potential loss of barrier beach protection for the shoreline under high water levels. Group members focused on three main goals: 1) all residents living outside of 100-year floodplain can remain safely in their homes through the duration of a high water event, 2) no municipal or publicly owned roads would be impassable during a high water event, and 3) 100% of properties being serviced by municipal water and wastewater services would maintain some kind of function throughout the duration of a high water event.

To achieve these three goals, the group recommended improved forecasts for short-term (e.g. wind events) and long-term (weekly/monthly water levels) timescales as well as proper communication of those forecasts to everyone who needs them (what the implications are for those specific impact areas). Currently, a lot of infrastructure is being built and homeowners are trying to make improvements to shore protections for their homes, but no one feels they have guidance as to what level they should be designing to, so the group also recommended improved guidance for design levels and financial incentives to make those improvements (e.g. federal funding to private homeowners). The group also recommended creating risk assessment tools to show who and what is being threatened by hazardous conditions, enforcing code more rigorously, and putting valves on drains with a backup system of pumps in extreme wet conditions.

Big Picture Takeaways

At the end of day 3, we reserved time to discuss larger concepts and actions to move identified goals forward. These following concepts/actions are from that discussion.

Regional Approach

Water, wave energy, etc. don't follow property lines or even municipal boundaries. The group discussed the idea of encouraging property owners and municipalities to consider approaching flood adaptation in groupings that make sense for the situation and geography. For instance, in shoreline management practices, looking at the shoreline system as a whole for a road or tract, rather than a parcel-by-parcel basis, may be more effective and efficient. Similarly, municipalities both inside and outside Wayne County might consider a like minded strategy to better coordinate resilience efforts. This regional concept could streamline the work, given that many of the same people are involved in numerous projects related to flooding, water levels, coastal resilience, etc. In the long run, a regional approach to these efforts could streamline workflows, reducing cost and staff commitments.

Regional Practitioners

The value of regional practitioners was discussed. Because Wayne County is rural with small governments, municipalities have come to rely on regional practitioners (i.e., Wayne County Soil & Water Conservation District, NYSG, Wayne County Cooperative Extension, etc.) to help overcome barriers such as capacity, lack of technical expertise, awareness of funding programs and criteria, communication with and across state and federal agencies, and general transfer of knowledge about issues/solutions from outside the immediate Wayne County region. Although the collective of practitioners have developed areas of expertise, the group discussed the need for this network of entities as well as expertise to grow. One way is to look at models from outside the region to see what elements might be applicable and transferable to Wayne County. This concept is closely linked to Regional Approach, particularly because of the varying coverage area of each entity.

Funds for this project are provided through the Climate and Societal Interactions COCA/SARP competition by the National Oceanic and Atmospheric Administration Climate Program Office.

Project partners include the Environmental Finance center at Syracuse University, New York Sea Grant, Great Lakes Integrated Sciences and Assessments, Cornell University, Maxwell Lab at Syracuse University, and Wayne County Department of Planning and Economic Development.

Appendix

Handout 1

Project Description

Page 1

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Powerful wind gusts of up to 50mph were recently observed in March 2020, at Sodus Point Beach Park and Lighthouse.
Photo: Mary Austerman, New York Sea Grant

About this project

After catastrophic flooding events in 2017 and 2019, waterfront property owners and community leaders in Wayne County are restoring damaged property and preparing for future inundation. But, residents and community leaders need decision-support tools to accurately determine the risks future floods pose to property and livelihoods. Initiatives such as New York State's Lake Ontario Resiliency and Economic Development Initiative (REDI) have made major strides in developing projects to sustainably rebuild New York's Lake Ontario shoreline, including a $325 million-dollar investment in public projects and at-risk infrastructure. Even with these investments, Wayne County communities still need the best available tools to learn about potential flood and financial risks to property owners and communities.

Goals

- Identify economic vulnerabilities of flooding to: individual community members and businesses, and residential and commercial properties.
- In collaboration with Wayne County communities, develop recommended actions and policies.
- Develop strategies to communicate recommended actions, policies, and tools effectively.

Contact

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Project trajectory

Economic Analysis and Heat Mapping

- Parcel-level flood inundation analysis
- Mapping characteristics of economic vulnerability and flood hazard

Scenario Development

- Summarizing historic and projected climate change for Wayne County communities
- Developing climate scenarios with local water resource managers
- Play-out the climate change scenarios to identify climate impacts
- Use the scenarios to generate management recommendations

Vulnerability Assessment

- Two public workshops to identify community assets and gather public input
- Implementation of the NY Great Lakes Coastal Resilience Index with each community

Local Plan and Policy Review

- Review and synthesis of municipal plans
- Development of model policies and land use guidance

Resiliency Recommendations

- Compiling results and sharing final maps, scenarios, and sets of recommendations

Message Testing

- Development and testing of messages and communication strategies to promote recommended actions
- Presentation of resiliency recommendations

Funds for this project are provided through the Climate and Societal Interactions COCA/SARP competition by the National Oceanic and Atmospheric Administration Climate Program Office.

Handout 2

Scenario Planning
Workshop Agenda

Page 1

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Scenario Planning Workshop Agenda

Day 1	**July 13th, 10am-12pm**: Introductions and presentations	
	Introductions and overview of project	20 min
	Wayne County Climate and Lake Levels Summary + Q&A	45 mins
	Break	10 min
	Scenario planning overview + summary of pre-workshop activities	15 min
	Discussion + Q&A time	30 min
Day 2	**July 14th, 10am-12pm**: Scenario planning part I	
	Activity 1 - Focus areas of concern	25 min
	Overview of scenarios	10 min
	Break	10 min
	Activity 2 - Discuss boundary conditions of your group's scenario and how these stress your goals/activities	30 min
	Activity 3 - Discuss how you can still meet your goals given the boundary conditions	30 min
	What to expect next time + what weather events could cause disruptions	15 min
Day 3	**July 15th, 10am-12pm**: Scenario planning part II	
	Activity 4 - Choose event from menu to build into scenario and discuss how this further challengers goals/activities	30 min
	Activity 5 - Consider low lake level conditions	10 min
	Activity 6 - Regroup with everyone to share and discuss	30 min
	Break	10 mins
	Next steps: discussion on what to do with this information	30 mins
	Closing Remarks	10 mins

Handout 3

Climate and Lake Levels Fact Sheet for Wayne County, NY

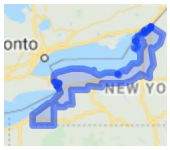
Page 1

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Climate and Lake Levels Fact Sheet for Wayne County, NY

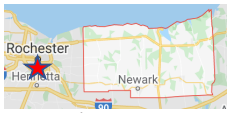
Description of the Data

Local climate data displayed in the tables below are derived from either NOAA U.S. Climate Division 9, NY data (Figure 1), or from the GHCN Rochester station data (Figure 2). Climate division data is used to identify seasonal and annual trends at the multi-county scale, while station data represents more local climate conditions.



Climate Division NY- 9

Six dynamically downscaled global climate models are used to assess future changes. Projections are reported as a change from the historical reference period of 1980-1999 and all use Climate Division 9, NY as a geographical boundary. Changes are reported as a range from the lowest model projection to the highest model projection rather than using an average of the six models. All projections assume a high emissions scenario (RCP 8.5).



Rochester Station near Wayne County

Temperature and Precipitation

- Average air temperature has increased 2.1°F with winter and spring warming the fastest
- Average air temperature is projected to rise between 3.2°F and 5.1°F by the mid-21st century with summer and fall showing the largest possible increases. Late-century can see as much as 6.5°F to 9.9°F of warming
- Total annual precipitation has increased 5.9in. with summer and fall increases being more than double those of winter and spring
- The future of precipitation is more uncertain than temperature. Annually, Climate Division 9, NY could experience a decrease of 0.9in up to an increase of 4.5in. by mid-century. Models show the largest uncertainty in spring precipitation.

	Historical Average (1981-2010)	Historical Change (1950 – 2019)	Projected Change (Mid-Century, 2040-2059)	Projected Change (Late Century, 2080-2099)
Temperature (°F)	Annual: 46.7 Winter: 25.1 Spring: 44.4 Summer: 67.6 Fall: 49.9	Annual: 2.1 Winter: 3 Spring: 2.3 Summer: 1.6 Fall: 1.5	Annual: 3.2 – 5.1 Winter: 1.5 – 4.5 Spring: 2 – 5.2 Summer: 3.7 – 5.9 Fall: 3 – 5.8	Annual: 6.5 – 9.9 Winter: 4.9 – 8.76 Spring: 4.9 – 10.8 Summer: 8.3 – 11.8 Fall: 6.9 – 10.8
Precipitation Totals (in)	Annual: 40 Winter: 8.5 Spring: 9.2 Summer: 10.8 Fall: 11.5	Annual: 5.9 (15.4%) Winter: 0.7 (7.8%) Spring: 0.5 (5.4%) Summer: 2.4 (24.2%) Fall: 2.2 (21.6%)	Annual: -0.9 – 4.5 Winter: -0.2 – 2.3 Spring: -1.7 – 2.3 Summer: -1.9 – (-0.1) Fall: -0.4 – 0.9	Annual: 1.3 – 6.9 Winter: 0.2 – 3.4 Spring: -0.9 – 2.6 Summer: -1.6 – 0.3 Fall: -0.3 – 1.7

Table 1: Temperature and precipitation trends for climate division NY-9.

GLISA
A NOAA RISA TEAM

Fact sheet created by GLISA in June, 2021

Extremes and Snowfall

- Wayne County, NY can expect more extreme heat days in the future with an increase as much as 6.8 to 24.5 days by mid-century
- Extreme precipitation days have increased by 2.1 days and days with even higher precipitation can be expected to increase in the future
- The projected change in snowfall is more uncertain for mid-century as seen by the range of -32.3 to 2.13in., but as temperatures keep rising into the late-21st century, dramatic declines in snowfall can be expected

	Historical Average (1981-2010)	Historical Change (1950 - 2019)	Projected Change (Mid-Century, 2040-2059)	Projected Change (Late-Century, 2080-2099)
Days Over 90°F	5.23 days	-2.1 days	6.8 – 24.5 days	20.7 – 51.9 days
Extreme Precipitation (in)	2.4 days (> 1.25in. precip)	2.1 days (> 1.25in. precip)	0.2 – 1 days (> 2in. precip)	0.8 – 1.6 days (> 2in. precip)
Snowfall Totals (in)	98.9	11.3	-12.7 - 0.8	-23.5 – (-13.7)

Table 2: Trends in temperature extremes, precipitation extremes, and snowfall. Historic analysis based on Rochester, NY station data (GHCN). Future analysis based on projections (UW-RegCM4) for climate division NY-9.

Lake Ontario Water Levels

- Seasonally, water levels rise into the summer season then decrease into the fall and winter
- The lowest water level ever recorded was 241.93ft. and this occurred during the winter of 1934
- The highest water level ever recorded was 249.05ft. and this occurred during the summer of 2019

	Long-term Average	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)
Average (ft)	245.31	244.65	245.63	246.03	244.85
Record High (ft)	249.05 [2019]	246.95	248.69	249.05	247.41
Record Low (ft)	241.93 [1934]	241.93	242.59	242.78	241.96

Table 3: Long-term average and seasonal Lake Ontario levels based on monthly data from 1918-2019.

Data Sources

- **Climate Division Data**: National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Climate Division Data. glisa.umich.edu/division/great-lakes/
- **Climate Station Data**: NOAA NCEI Global Historical Climatology Network Station Observations (GHCN). Rochester INTL AP Station. glisa.umich.edu/station/rochester-gtr-intl-ap/
- **Future Projection Data**: Dynamical Downscaling for the Midwest and Great Lakes Basin (UW-RegCM4). nelson.wisc.edu/ccr/resources/dynamical-downscaling/index.php.
- **Water Level Data**: NOAA Great Lakes Environmental Research Laboratory. glerl.noaa.gov/data/dashboard/data/levels/1918_PRES/

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A NOAA RISA TEAM

Fact sheet created by GLISA in June, 2021

Handout 4

Lake Level Scenarios

Page 1

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Lake Level Scenarios

General Characteristics of High Lake Level Conditions

The overarching characteristics of high lake level conditions that apply to all individual scenarios below are defined by moderate increases in annual temperatures and large increases in annual precipitation and intensity, particularly in late winter and early spring. Annual evapotranspiration also increases, but more modestly, and not enough to offset the large precipitation increases. The lakes also experience a moderate surface warming, particularly in the spring months. Ice cover declines, particularly in February and March. There are declines in snowpack in the winter and early spring months that contribute to a decline in soil moisture, but the overall increase in annual precipitation still leads to increased overall runoff. The increases in evapotranspiration are dominated by substantial increases in precipitation and runoff, which lead to increases in lakes net basin supply (NBS), particularly in the winter months. The combination of these factors leads to lake level increases*

Air Temperature	Precipitation	Extreme Precipitation	Evaporation	Runoff	Ice Cover	Snowmelt	Net Basin Supply	Lake Levels
↑	↑↑	↑↑	↑	↑↑	↓	↓	↑	↑

*This description is based on results of a modeling study that used two dynamically downscaled climate models to project future Great Lakes water levels:

Notaro, M., V. Bennington, B. Lofgren, 2015: Dynamical downscaling–based projections of Great Lakes water levels. Journal of Climate, 28 (24), 9712-9745, doi: 10.1175/JCLI-D-14-00847.1

Lake Level Scenarios for Workshop

These scenarios build upon the description of high lake level conditions above. Each participant will work with one of the following scenarios in a breakout group.

1. **Cold Air Outbreak Scenario**
   - Water levels are already above average
   - A cold air outbreak associated with the arctic oscillation occurs, causing very cold temperatures
   - The lakes freeze, evaporation shuts off, and the ground is frozen with snow cover
   - Water levels that were above average become extremely high
2. **Excess Precipitation Scenario**
   - Water levels are already above average
   - Excess precipitation falls in Spring and early Summer
   - A continual source of water into the lake system leaves the basin saturated

- Upstream, downstream, and lake shoreline flooding occur
- Water levels that were above average become extremely high

3. **Extremes Scenario**
   - Global teleconnection patterns cause shifts in the location of storm tracks
   - Rapid fluctuations between extreme high and low lake levels
   - Floods are bigger
   - Droughts are longer

Handout 5

Lake Level Scenario Planning Activities

Page 1

Advancing Community-Level Resilience to Lake-Level Flooding in Wayne County, New York

Lake Level Scenario Planning Activities

These scenario planning activities will occur over the course of the 3-day workshop. Please keep this handout for your reference.

Activity #1 (25 minutes): *Get to know each other, your roles/expertise, and what each of you see as water level related issues and associated goals for your focus area. Identify the report out person for day 3 (this should not be the facilitator or notetaker).*

Directions: Describe specific issues and goals related to your group's focus area (i.e., septic at risk of flooding, or structures at risk of flooding). These issues should be specific to Wayne County's waterfront communities. Once you have a list of these issues and goals, prioritize them and work through them as time allows. The goals identified here will inform the rest of the scenario planning activities.

Discussion Questions

- How is your focus area impacted by water levels?
  - High water impacts:
  - Low water impacts:
  - Variable water level impacts:
    - You might consider recent years of highs (2017 or 2019) and lows (2021).
- What goals are in place to maintain normal operating function for your focus area?
- What goals are in place to address focus area-specific impacts associated with water levels?

Outcome: List of **goals** and impacts for your focus area that relate to water levels. Name of report out person.

Activity #2 (30 minutes): *Identify which goals are most impacted by the boundary conditions of your scenario, and how they are affected.*

Directions: Discuss the boundary conditions of your scenario and how those impact the community goals for your focus area identified in activity 1.

Discussion Questions:

- What are the additional impacts on your focus area from the boundary conditions of your scenario?
- At present, are you already preparing for conditions like these?
- Which goals can be met under these conditions? Do assets function under these conditions?
- Which goals will be more difficult to meet under these conditions? What are the functional deficiencies or vulnerabilities?
- Which goals cannot be met under these conditions? These are needed for the next activity.

Outcome: A list of goals that are difficult to achieve or not attainable given the boundary conditions and why (what are the stressors/impacts).

Activity #3 (30 minutes): *Identify what actions need to happen to make unattainable goals achievable. Identify new goals that may be needed to address the issues identified for your focus area.*

Directions: Using the goals identified in Activity 2, think about which ones can be met easily, with additional effort, or not at all. **Focusing on the difficult to achieve and unattainable goals from activity 2**, talk about how you can still meet those goals given the boundary conditions. Of the goals that cannot be met, what will you do to get to those goals still?

Discussion Questions:

- Which of the goals identified stay the same?
- Which ones need modification to be achieved?
    - How/what modifications are needed?
    - What is the effort/cost of these modifications?
- Are there new goals that should be considered? Is there something you need to do that you aren't doing now, based on this scenario?

Outcomes: A list of actions/modifications needed to make unattainable goals achievable again, and new goals needed for the conditions of the scenario.

Activity #4 (30 minutes): *Participants will use an event from the menu to explore vulnerabilities of goals related to their focus area.*

Directions: Choose an event from the menu to build into the scenario and discuss how this further challenges focus area goals/activities. If time permits, discuss multiple events.

Events Menu (subject to change):

- Shift in the timing of the annual water level cycle (e.g., earlier highs)
- Low/High ice cover winters
- Do ice cover characteristics during a winter matter? thin/thick ice; continual versus intermittent coverage
- Storm event leading to large debris washing up on shore/damming inlets
- Coastal landslide/erosion event
- Water contamination event
- Prolonged seiche/wind event
- Earlier ice on/off dates
- Unusually wet season (user can define the timing) over the basin that leads to further water inundation/flooding
- Extreme rain event over the basin causing flash flooding
- ["perfect storm"] Combination of wet + retainment of flows

Discussion Questions:

- Would you have to further modify your goals/activities?
  - If so, how? What actions would be needed to modify?
- At present, are you already preparing for events like these or do you wait and respond to events like these?
  - What is the tipping point that leads to these decisions, what are you using to inform these decisions?
- At what point, if ever, do these conditions become unmanageable? What time scale?
- How easy/costly is it to prepare for an event like this, even if it doesn't happen?
- What are the challenges of preparing for events like this?
- How may you plan differently if you knew this event was coming versus if you didn't know it was coming?

Outcomes:

List of additional actions to help the communities achieve focus area related goals, considering the selected event/s. List of challenges related to the addition of the selected event/s.

3

Activity #5 (10 minutes): *As a wind-down, and to collect some of the low water concerns that have likely been discussed already, identify how low water impacts the goals related to their focus area and actions to improve those goals. This exercise is helpful to consider how goals hold up under conditions of varying lake levels.*

Directions: Now briefly consider how low lake level impact the goals/issues related to your focus area. Use an abbreviated version of all previous steps to do so.

Outcome: A list of low water specific goals, issues, and related actions.

Activity #6 (30 minutes): *During this time, we will re-group to learn about discussions from the other groups.*

Directions: Have the report out person from each group summarize outcomes from Activity 1-4 and recommended actions, including whether there is communication/infrastructure in place to meet goals (3-4 minutes each). Have a full-group discussion on each scenario.

Participant List by Breakout Group

Groups A & B

Group A		
Meredith	Perreault	Facilitator
Tess	Clark	Notetaker
Jeff	Simonet	Town of Huron
Philip	Eygnor	Huron Supervisor
Brian	Pincelli	Wayne County
Beth	Claypoole	CCE Wayne
Lynn	Chatfield	Town of Wolcott
Nancy	Martel	NYS Dept. of State
William	Werick	IJC GLAM Committee
Group B		
Katie	Graziano	Facilitator
Jes	Eckerlin	Notetaker
Roger	Gallant	Town of Huron
Anthony	Verno	Town of Williamson
Ora	Rothfuss	Wayne County
Lindsey	Gerstenslager	Wayne County SWCD

Groups C & D

Group C		
Kyla	Semmendinger	Facilitator
Megan	Kocher	Notetaker
Brienna	Wirley	NYSDEC
Dave	McDowell	Village of Sodus Point
Grace	Costello	U.S. Army Corps of Engineers
Jayme	Thomann	Bergmann
Josh	Cerra	Cornell University
Karen	Catcher	NYS Department of State
Roy	Widrig	NY Sea Grant
Group D		
Kathy	Bunting-Howarth	Facilitator
Nikki	Hart	Notetaker
Shannon	Dougherty	NYSDEC
Kevin	Rooney	Wayne Co DPW
Kevin	Druschel	Village of Sodus Point
Mike	Shantz	IJC GLAM Committee
David	Scudder	WCWSA
Robert	Call	NYSDEC
Scott	Steinschneider	Cornell University

Breakout Group Summaries:
Goals and Recommended Actions

Group A: cold air outbreak scenario for septic systems with coastal erosion event

GOAL #1: Ensure septic systems are working properly by 2031

- An integrated strategy to inventory and assess septic systems' risk of inundation, including a regional coastal plan and participation from all agencies in order to reduce barriers in coordination.
  - Properties will be audited and assessed, with municipalities and inspection agents performing a coordinated inspection and audit.
- Code enforcement officers should perform stress test on new home purchases. In some cases of septics along eroded shorelines, houses may not be livable.
  - In these worst-case scenarios, houses would require a state or federally funded buyout.

GOAL #2: Ensure access to community financial fund for cost share

- Federal investment in pilot programs for relocation and house buybacks
- Replicate and adopt model local septic laws to demonstrate seriousness and local commitment to federal and state agencies
- Find integrated local/state/federal funding solutions to erosion that may require federal investment in buyouts.

Group B: extremes scenario for septic systems with unusually wet season event

GOAL #1: Ensure 100% of high risk systems are protected from flooding by 2025

- 60% of new homeowners attend a one-time standard septic maintenance education class
- Lakeshore homeowners know the location of their septic systems with 100% certainty,
- Lakeshore community leadership identify and develop funding mechanisms to help offset the costs of failing septic systems.

GOAL #2: Ensure 100% of septic systems are up to UPP standard by 2025

- Create a landowner decision making tool or app and a municipal decision making tool to address community areas that may need to convert from septic systems to sewer systems and consider the challenges that come with that.
- Create a program that would increase personnel and technical assistance by training and certifying individuals that could help with design and permitting activities in towns.

Group C: extremes scenario for structures with ice and high wind event

GOAL #1: Develop an immediate response plan to high or low water level events

- Develop a priority contact list and prioritizing where resources are coming from for communication purposes. Such a contact list would include neighboring municipalities across the county and other agencies and organizations.
    - This would allow for coastal communities to contact subject matter experts and have an extra layer of knowledge for environmental considerations for the structures under different hazard and response plans.

GOAL #2: Ensure 100% of residential structures are resilient to low and high levels.

- Create an inventory of residential structures, including information about where the structures were built in relation to the shoreline, whether they are up to code, if they were impacted by flooding events of 2017 and 2019 and how protected or at risk they are.
    - Come up with adaptive strategies based on the inventory, and determine thresholds for buyouts and relocation.

Group D: excess precipitation scenario for structures with prolonged seiche event

GOAL #1: Develop an immediate response plan to high or low water level events

- Create risk assessment tools to show who and what is being threatened by hazardous conditions
- Enforce code more rigorously
- Put valves on drains with a backup system of pumps in extreme wet conditions.

GOAL #2: No municipal/publicly owned roadways are unpassable

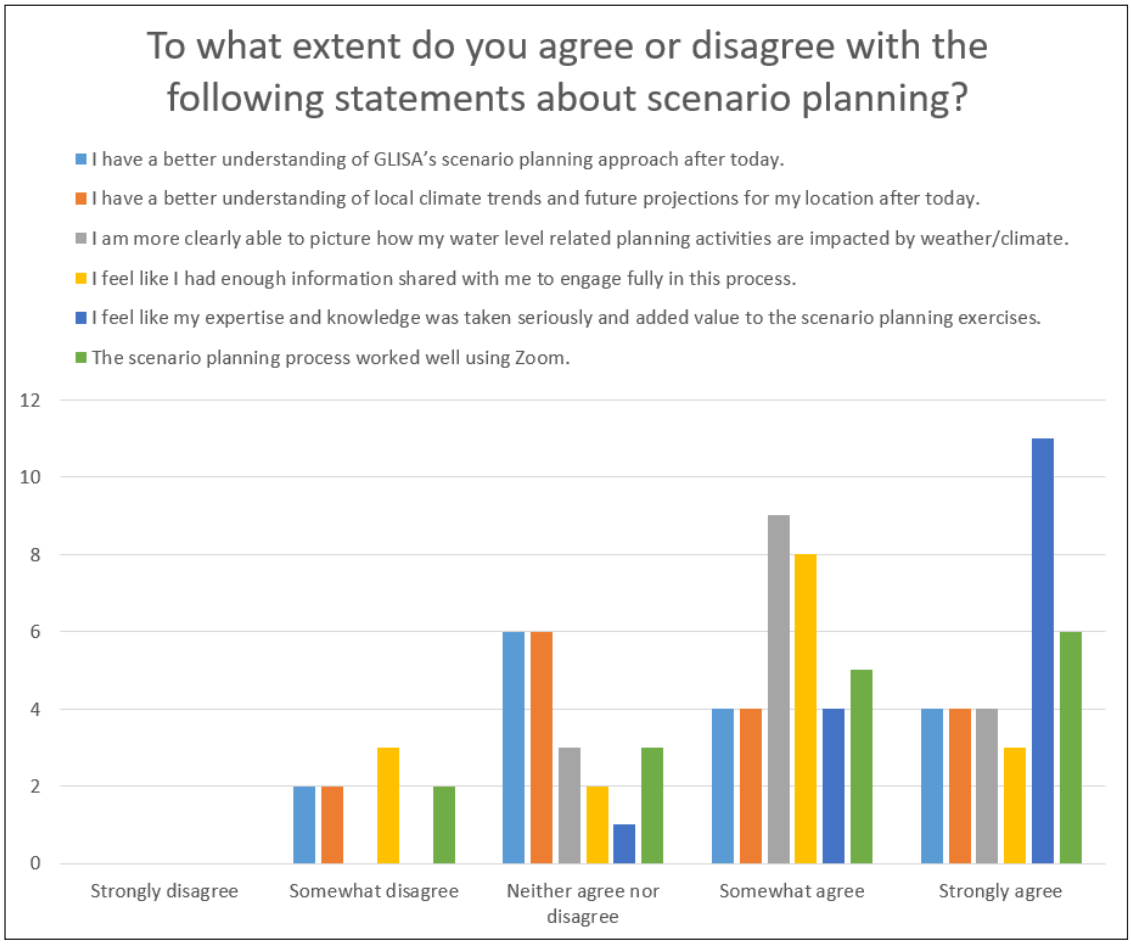
- Improve forecasts for short-term (e.g. wind events) and long-term (weekly/monthly water levels) timescales as well as proper communication of those forecasts to everyone who needs them (what the implications are for those specific impact areas).
- Improve guidance for design levels and financial incentives to make improvements (e.g. federal funding to private homeowners).

GOAL #3: 100% of properties the municipality provides water to will maintain service

- Create risk assessment tools to show who and what is being threatened by hazardous conditions
- Enforcing code more rigorously
- Putting valves on drains with a backup system of pumps in extreme wet conditions.

Survey:
Summary of Evaluation Results

After the workshop, participants were asked to anonymously respond to a multiple choice and short answer survey. Below is a summary of their responses.



Recommended Improvements for Future Workshops

This workshop was the first virtual scenario planning workshop GLISA has held. The following are recommended improvements to consider for future scenario planning workshops of this nature.

- Have a better explanation of what the scenario planning process is and what it's like. It's abstract (swirly) and will feel a bit strange - get out of your comfort zone. Meant to start the conversation - bring some ideas back with you to your higher-ups or people with decision making abilities.
- Carve out more time to discuss the scenarios and push to think about integrated effects beyond water levels (ice, etc.). Although the fine elements (i.e., reduction of winter evaporation, rapid fluctuations between high and low water levels, etc.) of each scenario were presented by GLISA, and shared in workshop materials, participants seemed to focus solely on the fact that the water was and then higher. This is not necessarily bad, possibly a result of having experienced catastrophic flooding events in recent years, paired with the various initiatives underway that are focusing at least in part on improving resilience to high water levels.
- Have scenario planning activities for only one group at a time: one group per day with the main facilitation team, instead of concurrent breakout rooms. All groups would join the final day for report out and group discussion. If this is not possible, build in considerable time for moving people in and out of breakout rooms.
- Have the climate 101 presentation be a recorded lecture ahead of time and start with asking for any questions.
- Clearly define the difference between goals and actions. Tie goals to impacts. Build in time to prioritize and rank goals to focus on top 2-4.
- Push people to think big picture things that they might think aren't possible/push beyond comfort level.
- Keep groups to 4 people or less.
- Provide more guidance to report out person.
- Clearer workbook to take facilitation notes in that is more interactive with participants.
- Allow more time for each activity, provide more time warnings.
- Add discussion to activity 1 for a local narrative about why each of those focus areas are important.
- Balance outsider and local knowledge.

Advancing Community-Level Resilience: 3-Session Virtual Track

2pm-4pm on 10/28, 11/4 & 11/9 | Register via Eventbrite

Please join the Syracuse University Environmental Finance Center and New York Sea Grant for a special track at the Genesee Finger Lakes Regional Planning Council's Fall Local Government Workshop. The Local Government Workshop is a signature event of G/FLRPC. This workshop is held twice a year and has provided a forum for training and information sharing since 1996.

October 28, 2021, 2:00 - 4:00pm
Session 8: Advancing Community-Level Resilience 1: A New Perspective on High Water and Property Risk on Wayne County's Lake Ontario Shoreline
Join experts from Cornell University and Syracuse University to hear about innovative modeling that illustrates at-risk waterfront properties vulnerable to flooding in Wayne County.

November 4, 2021, 2:00 - 4:00pm
Session 11: Advancing Community-Level Resilience 2: Sewer and Septic Opportunities for Action
Tune in to hear from experts from the Syracuse University Environmental Finance Center on the challenges of at-risk sewer and septic systems and initiatives to makes those systems more flood resilient.

November 9, 2021, 2:00 - 4:00pm
Session 13: Advancing Community-Level Resilience 3: Adopting Local Models of Flood Resiliency and Barriers to Implementation
Join experts from the Genesee-Finger Lakes Regional Planning Council and NY Department of State to learn about policy tools and options that can increase your community resiliency.

Learn more about the G/FLRPC's Local Government Workshop and download the full program HERE

Environmental Finance Center, Syracuse University | Sea Grant New York | Genesee/Finger Lakes Regional Planning Council | Maxwell Syracuse University | GLISA A NOAA RISA TEAM | Cornell University Founded A.D. 1865 | New York Wayne County

Coastal Risk Message and Septic Tank Replacement Survey Results

Survey Design

This survey aimed to understand how homeowners who are 18 years of age or older, who live near a body of water, and who own a septic tank assess flood risk. All four of these conditions had to be met to remain in the study. Each survey respondent was randomly assigned to one of three groups:

1. Control (n=160)
2. Treatment group 1 - given information on the likelihood of a 100-year flood over the life of a 30-year mortgage (n=158)
3. Treatment group 2 - given information on the depth of water inundation conditions for property with a 100-year flood (n=159).

The survey was administered virtually using Syracuse University's Qualtrics software. The survey was distributed starting June 14th, 2022. The last day data were collected was June 23rd, 2022.

Survey Questions

The survey consists of thirteen items across three different categories: screener questions, demographic information, and experimental outcomes. See the Appendix for the complete survey. Screening questions ensured all participants were homeowners, had a septic system, lived in a coastal area, and were 18 years of age or older. We then asked demographic questions, including age, sex, race, income, education, and property type.

For the experiment, all respondents were given information about the consequences of floods for those with septic systems and provided pictures of homes damaged by flooding (see the Appendix for the information and the pictures). Each treatment group was then asked to consider their property when reading a vignette and to answer questions afterward. See the box below for the actual content of the vignette. The control group was not given a vignette.

Treatment 1	*Treatment 2*
A commonly misunderstood term is the one-hundred-year flood plain because people in these areas can experience severe flooding more often than once every 100 years. A local government agency recently completed an analysis of flood risk for your home. They assessed the likelihood that your property will be flooded at least once over the next 30 years is 85%.	A local government agency recently completed an analysis of flood risk for your home. They estimate that a one-hundred-year flood will create a water level about 10 inches higher than the lowest point on your property.

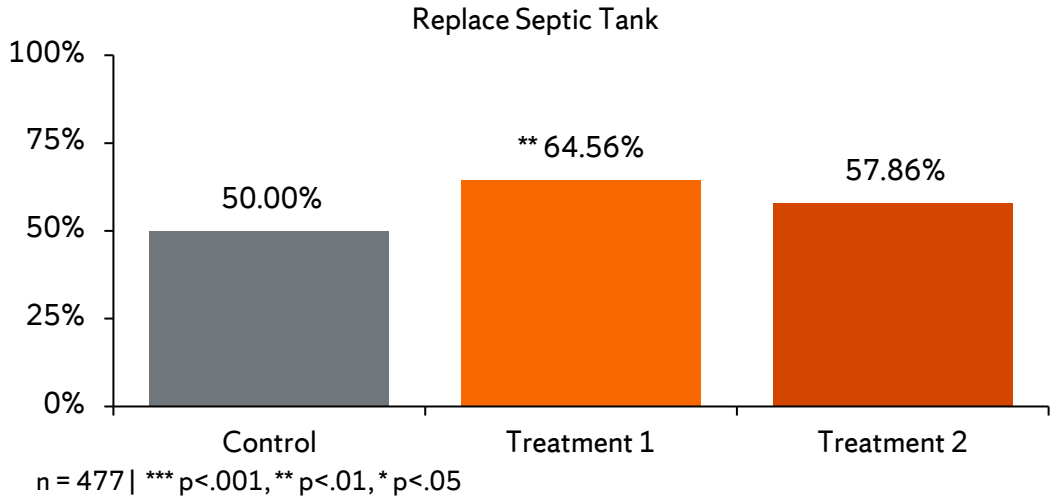
All respondents were then asked to answer (yes or no) the following two questions:

1. A new septic system, which can withstand severe flooding, costs approximately $16,000. Are you considering replacing your septic system in the next year?
2. Imagine the local government offers to subsidize septic tank replacement in your community. If this program would increase your annual property taxes by $75-100, would you support it?

Results

The survey experiment suggests that respondents in both treatment groups were more likely to report that they are considering replacing their septic tank relative to the control group. Figure 1 shows that those in treatment 1 group were almost 15 percentage points more likely to respond that they are considering replacing their septic system in the next year compared to the control group.

Figure 1.

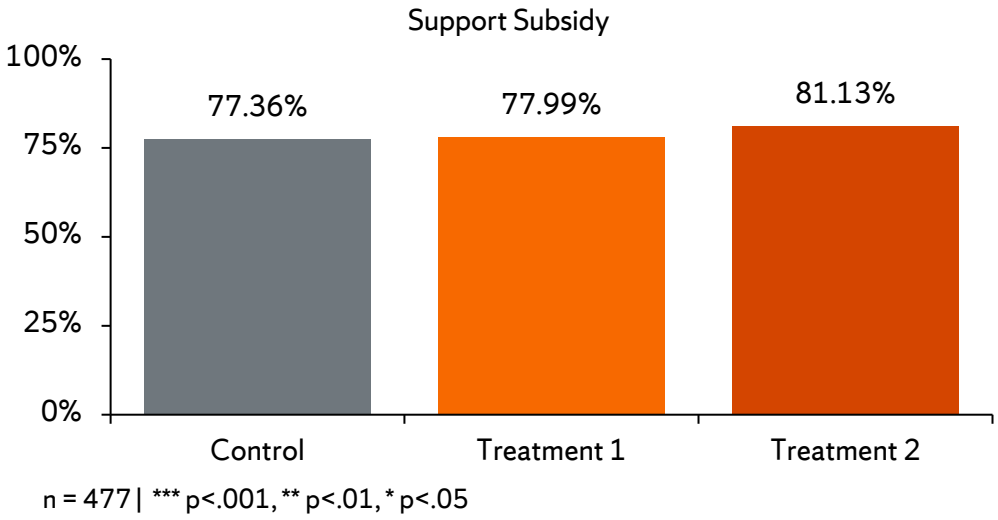


Treatment group 2 also reported a higher likelihood of replacing their septic system, about eight percentage points, but that difference was not statistically different from the control group.[1]

Figure 2 shows responses for the experimental groups to the question asking about subsidy support. Importantly, over three-quarters of all respondents supported such a program. Further, there is little variation in the response among the control and treatment groups. Treatment group 1 had a nearly identical proportion supporting the proposal. Treatment group 2 respondents were about four percentage points more likely to support the subsidy, but this difference is not statistically significant.

[1] We also ran tests to compare the coefficients on the two treatment groups, and none were statistically significant.

Figure 2.



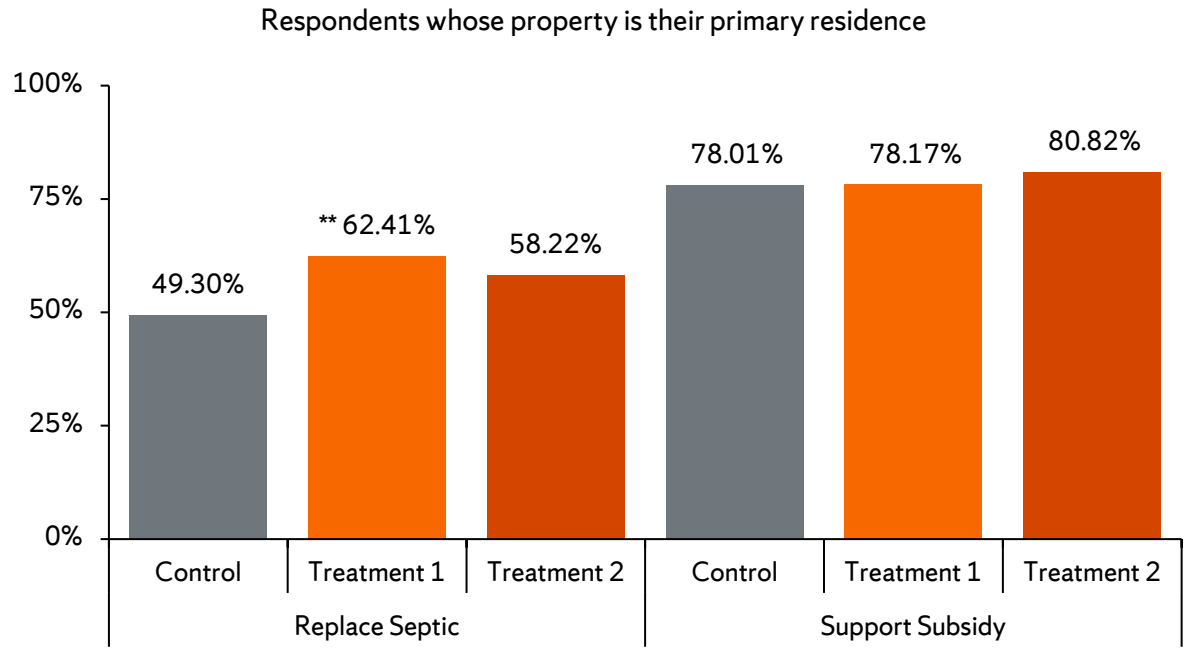
In addition to the models run for the pooled sample reported above, we also partitioned the results by property type and income level.

Property Type

Figure 3 shows the variation in the experimental outcomes for respondents who reported their property was their primary residence (90 percent of the sample).[2] Similar to the full sample, treatment group 1 was more likely to say they would replace their septic tank relative to control by around 13 percentage points. Those in treatment group 2 were also more supportive, but that difference was not statistically significant. Again, there is broad support for the subsidy program and little variation across the control and treatment groups.

[2] We do not report the results by property types for vacation homes (eight percent of the sample) and investment properties (two percent of the sample) because the sample sizes were too small.

Figure 3.



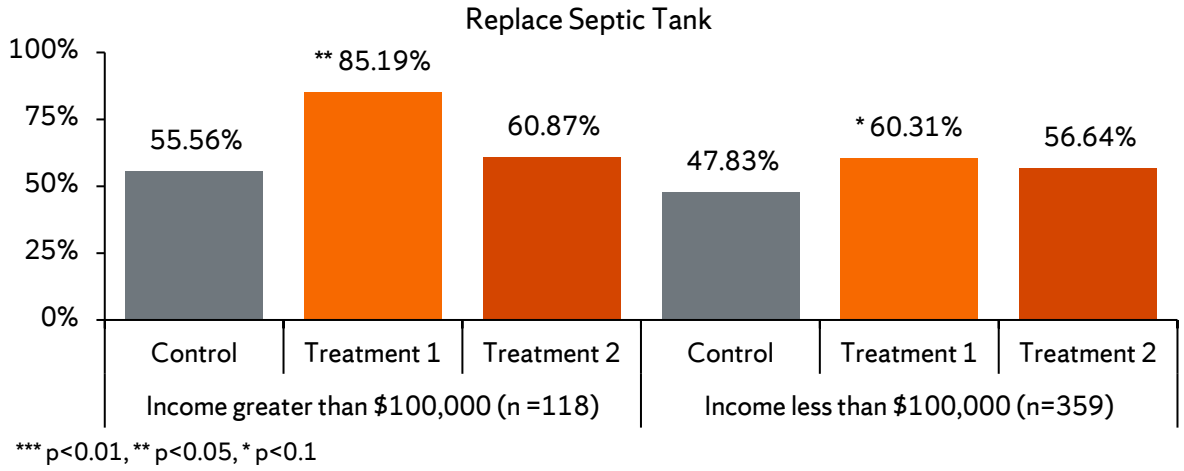
n = 429 | *** p<0.001, ** p<0.01, * p<0.05.

Income

Outcomes varied somewhat across respondents in different income groups. Figure 4 shows responses regarding the likelihood of replacing their septic tank in the next year for two groups: those with incomes over $100,000 (the highest income category) and the rest of the sample. Perhaps unsurprisingly, the more affluent homeowners were more likely to report that they intended to replace their septic tank in the next year relative to the less affluent group. Based on groups means, 56 percent of those with incomes over $100,000 reported that they were likely to replace their septic systems compared to 48 percent of those with incomes below $100,000. Further among the affluent group, those in treatment group 1 were nearly 30 percentage points more likely to say yes to replacing their septic tank than the control group. For those with income less than $100,000, treatment group 1 was about 12.5 percentage points higher than the control group. For respondents in treatment 2, there was a five percentage point increase relative to control for the more affluent homeowners and a nine percentage point increase for the less affluent homeowners relative to control. Neither result for treatment 2 was statistically significant, however.

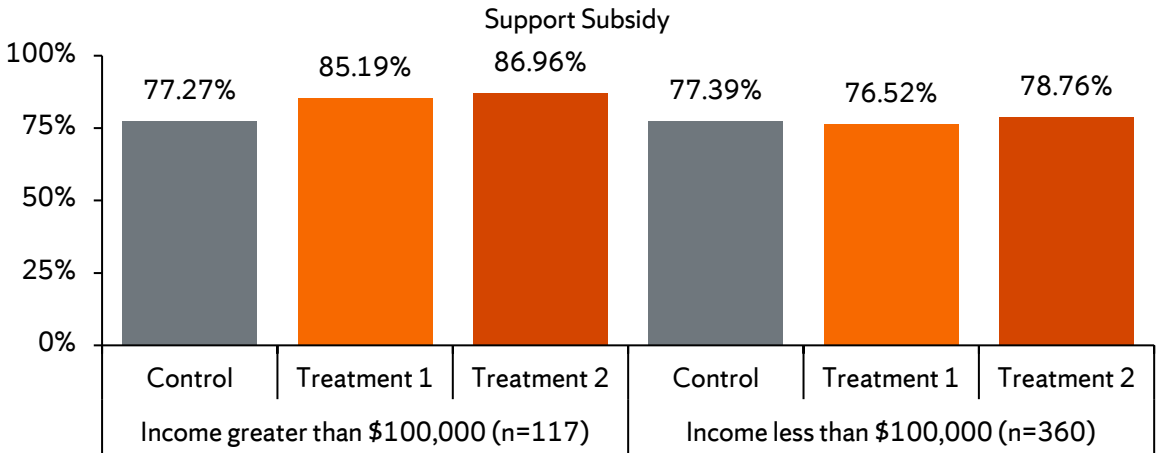
Figure 5 shows responses for the septic tank replacement subsidy by income group. Again, there is strong support for this type of program across the experimental groups. Relative to the control group, however, there is little difference in support for the treatment groups.

Figure 4.



*** p<0.01, ** p<0.05, * p<0.1

Figure 5.



*** p<.001, ** p<.01, * p<.05

Findings

This study was designed to estimate the importance of flooding messages to homeowners who had residential property near a body of water. It is unclear how much the priming that was done in the introduction to the survey - the information on the consequences of flooding for those with septic tanks and the photographs - affected the baseline levels reported (i.e., the control group's responses). Because all experimental groups were given this information, the baseline levels reported may have been higher than would have been the case without the priming information. Future studies might investigate this issue. With respect to the messaging, a couple of findings surfaced.

1. Around half of the control group reported being likely to replace their septic systems in the next year. Messages (treatment 1) that provided information on the probability of flooding at least once over the next year 30 years appear to be particularly effective at increasing the likelihood of septic system replacement. Reporting the height of the flood also seems to increase the reported likelihood of septic system replacement, but the differences relative to the control for this outcome were never statistically significant.
2. There seems to be high support for the tax and subsidy program among all respondents. Messaging did not appear to affect their level of support.

Appendix.

Coastal Flooding: Risk Assessment Testing

Start of Block: Intro

My name is Leonard Lopoo, and I am the Director of the Maxwell X Lab at Syracuse University. My team and I are conducting a short survey to improve our understanding of concerns about flooding in residential communities near lakes, rivers, creeks, and oceans. The survey should last around 5 minutes and will ask you several basic demographic questions. In addition, we provide some information on flooding and ask your opinion about it as it relates to your property. Your individual responses will remain completely anonymous. Thank you again; we really appreciate your help!

End of Block: Intro

Start of Block: Screener

Q1. Are you a homeowner?

- Yes (1)
- No (2) [If no, drop]

Q2. Do you live near a body of water (a lake, river, or ocean)?

- Yes (1)
- No (2) [If no, drop]

Q3. Do you have a septic system?

- Yes (1)
- No (2) [If no, drop]

Q4. Are you 18 years of age or older?

- Yes (1)
- No (2) [If no, drop]

Q5. For this research project, careful attention to survey questions is critical! To show that you are paying attention, please select "I have a question."

- I understand (1)
- I do not understand (2)
- I have a question. (3)

[If incorrect]

Q6.You didn't select the correct answer to our last question. Your attention to the survey questions is very important to our research, so we'd like to give you another chance to respond. To show that you are paying attention, please select "I have a question."

- I understand (1)
- I do not understand (2)
- I have a question. (3)

[If incorrect]
Q7. You have answered our questions incorrectly. We can only accept surveys from people who are paying attention so we are ending this survey.

[If correct]

End of Block: Screener

Start of Block: Demographic Questions

Q8. What is your age?

- Under 18 (1)
- 18 - 24 (2)
- 25 - 34 (3)
- 35 - 44 (4)
- 45 - 54 (5)
- 55 - 64 (6)
- 65 - 74 (7)
- 75 - 84 (8)
- 85 or older (9)

Q9. What is your race? You can select multiple.

- Hispanic or Latino (1)
- White (2)
- Black or African American (3)
- Native Hawaiian or Other Pacific Islander (4)
- Asian (5)
- Native American or Alaska Native (6)
- Other (7) _____

Q10. What is your sex?

- Male (1)
- Female (2)
- Intersex (3)
- Prefer not to say (4)

Q11. Please check your highest level of education completed.

- No high school (1)
- High school diploma (2)
- Associate degree (3)
- Bachelor's degree (4)
- Master's degree (5)
- Professional degree (6)
- Doctorate degree (7)

Q12. Please check the most appropriate category for your coastal property.

- Primary residence (1)
- Vacation home (secondary home) (2)
- Investment property (property you rent for additional income) (3)

Q13. What was your total household income last year?

- Less than $25,000 (1)
- $25,000-$50,000 (2)
- $50,001-$75,000 (3)
- $75,001-$100,000 (4)
- Greater than $100,000

End of Block: Demographic Questions

Start of Block: Survey Experiment Introduction

Properly maintained septic systems have little to no effect on nearby waterbodies and groundwater. However, a significant flood can affect the nutrients in wastewater leading to algae blooms and aquatic plant growth. Further, these pollutants can affect drinking water supplies making them unsafe. In addition, residential plumbing systems can become overwhelmed making lavatories inoperable for extended periods of time and potentially leading to raw sewage backflows into the home.

End of Block: Survey Experiment Introduction

Start of Block: Survey Experiment

[Control group]

Q14. A new septic system, which can withstand severe flooding, costs approximately $16,000. Are you considering replacing your septic system in the next year?

- Yes (1)
- No (2)

Q15. Imagine the local government offers to subsidize septic tank replacement in your community. If this program would increase your annual property taxes by $75-100, would you support it?

- Yes (1)
- No (2)

[Treatment group 1]

Imagine you were given the following information about your property. Please read it and answer the following two questions:

> A commonly misunderstood term is the one-hundred-year flood plain because people in these areas can experience severe flooding more often than once every 100 years. A local government agency recently completed an analysis of flood risk for your home. They assessed the likelihood that your property will be flooded at least once over the next 30 years is 85%.

Q16. A new septic system, which can withstand severe flooding, costs approximately $16,000. Would you consider replacing your septic system in the next year?

- Yes (1)
- No (2)

Q17. Imagine the local government offers to subsidize septic tank replacement in your community. If this program would increase your annual property taxes by $75-100, would you support it?

- Yes (1)
- No (2)

[Treatment group 2]

Imagine you were given the following information about your property. Please read it and answer the following two questions:

> A local government agency recently completed an analysis of flood risk for your home. They estimate that a one-hundred-year flood will create a water level about 10 inches higher than the lowest point on your property.

Q18. A new septic system, which can withstand severe flooding, costs approximately $16,000. Would you consider replacing your septic system in the next year?

- Yes (1)
- No (2)

Q19. Imagine the local government offers to subsidize septic tank replacement in your community. If this program would increase your annual property taxes by $75-100, would you support it?

- Yes (1)
- No (2)

End of Block: Survey Experiment