St. Lawrence River Shoreline Resiliency Study

From BCA Architects & Engineers and Rootz, LLC

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Executive Summary:

New York State has an increased risk of flooding from the effects of climate change and associated extreme weather events. Human and natural communities in coastal environments are most vulnerable to shoreline flooding and subsequent erosion. Low-lying areas and impermeable surfaces are particularly at risk for flooding as a result of runoff. With climate change predicted to increase the frequency, intensity, and duration of precipitation events and coastal flooding (Horton et. al 2014), areas susceptible to flooding must be addressed.

Spring 2017 delivered intense rainfall and wind action in northern New York, causing record high water levels and flooding in the Lake Ontario – St. Lawrence River System. Emergency response measures included sandbag installation, weighting down stationary docks, pumping water out of flooded basements, and establishing "no wake" zones. The results of this flooding included shoreline property damage, floating debris, estimated 75% reduction in recreational boat traffic, and economic impacts for the shoreline communities. Homes were flooded; docks, marinas, and boat garages suffered damage and collapse. Docks and marinas hold a significant source of livelihood along the shoreline; the flood damage has slowed these vibrant communities and impeded economic growth.

In the wake of the storm damage in 2017, St. Lawrence County, in partnership with the City of Ogdensburg, and the Town and Village of Morristown, applied for and were awarded $25,000 through the Great Lakes Basin Small Grants Program to conduct a study titled "Enhancing Shoreline Resilience Along the St. Lawrence River in St. Lawrence County."

The goal of this study is to assess ecosystem vulnerability and identify resilience measures to enhance shore resilience along the Upper St. Lawrence River (approximately 40 miles of shore upstream from the Iroquois control dam, extending from the Towns of Hammond to Lisbon), that can be incorporated into local planning for riverfront communities.

A proposed Floodplain Protection Overlay District is an area of flood risk that was created from overlapping spatial and temporal data, with the purpose of identifying vulnerable areas to introduce adaptive mitigation measures. The collective data utilized include historical water levels, wetland, zoning, infrastructure, land use, Letters of Map Amendment, flood damage, and other environmental and societal factors.

By utilizing GIS software to compare the various data sets, in conjunction with consistent flood elevations provided in LOMAs, a picture of the flood risk area was developed. Utilizing the guidance found in the NYS Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act prepared by NYS DEC, a proposed 'Flood Plain Protection Overlay District' was overlaid over the entire study area. Base Flood Elevation was estimated to be approximately 248.6 ft AMSL using the LOMA data, but for the purposes of this study, the final flood elevation range is stated as 246-252 ft AMSL to account for wind and wave action.

The data analyzed indicated that the shoreline is naturally resilient. Specifically, the geology and geography of this area play a protective role against shoreline erosion. In addition, most of the critical infrastructure (e.g., hospitals, schools, etc.) are located outside of the proposed Floodplain Protection Overlay District. However, most of the built infrastructure at-risk of flooding occupy space within the floodplain of the River or its associated tributaries. As a result, flooding of residential and commercial property has occurred during flood events. As a result, waterfront residents and businesses have suffered from the economic impacts associated with flooding. These vulnerable areas are at-risk of flooding and require adaptive mitigative strategies in order to create more resilient shoreline communities, such as: local planning and regulations, built environment protection, and natural environment protection.

Natural variations in water levels typically benefit coastal wetlands and support healthy aquatic ecosystems. However, large variations in water levels can exacerbate shoreline vulnerability and detract from boating and water recreation. It is necessary for shoreline communities to prepare for the historical and projected highs and lows. Hence, vulnerabilities must be addressed in order to introduce adaptive mitigation strategies and improve shoreline resiliency through the full range of possible water levels.

Specific actions recommended as a result of this study are: report be made available to all subject municipalities; an intermunicipal work group should be formed to focus on improving resiliency; a formal process should be created to train municipal leaders and educate the public on this matter; and an intermunicipal floodplain protection overlay district should be adopted. Floodplain and/or flood damage protection regulations should be adopted or strengthened. The natural environment should be prioritized and protected, including green infrastructure, wetlands, and floodplain management. Further, new topographic surveys should be conducted for the most vulnerable areas, and a more detailed assessment of flood-prone tributaries should be completed, including critical culverts and bridges.

St. Lawrence County

St. Lawrence River Shoreline Resiliency Study

BCA Project No. 2018-112

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Acronyms and Key Terms:

Adaptive Mitigation – In contrast to emergency response for flooding, adaptive mitigation is strategic planning to reduce the impact of future flood events in a changing environment. This can involve policy, as well as engineering and survey measures.

AMSL – Above Mean Sea Level, a standard measure of elevation or altitude used by engineers in order to determine risk zones for flood events (USDA).

BFE – Base Flood Elevation, the elevation of a flood with a one percent chance of being equaled or exceeded in any given year (USDA).

Buffer Zone/ Buffer Area – Vegetative areas and wetlands which serve as buffers to flood waters, by slowing runoff and absorbing excess water, and in effect protect shorelines from erosion. These areas also support wildlife habitat and improve water quality (USDA).

Built Environment – Any human-constructed investments or related structures.

CRRA – Community Risk and Resiliency Act, a New York State government Act that provides guidance and requirements for determining areas of vulnerability and how to implement necessary changes in such areas (NYS Governor).

Critical Infrastructure – Built or natural features that are vital to health, safety/security, welfare, or economy of a community. If such infrastructure were damaged or destroyed, the community would suffer serious widespread detriments (DEC).

DEC – Department of Environmental Conservation, a New York State government department that regulates conservation and improvement of New York's natural resources and environment (DEC).

EPA – Environmental Protection Agency, an agency of the United States federal government that serves to protect human and environmental health (EPA).

FEMA – Federal Emergency Management Agency, an agency of the United States Department of Homeland Security which coordinates national disaster response (FEMA).

FIRM – Flood Insurance Rate Map, a map with Special Flood Hazard Area delineation and risk premium zones in a community (FEMA).

GIS – Geographical Information Systems, a network of gathering, managing, and analyzing data with reference to geography and spatial location (DEC).

GLAA – Great Lakes Action Agenda, a guide to foster protection of natural resources, environmental quality, and long-term community resilience, focused in New York State's Great Lakes basin (NYS Governor).

IJC – International Joint Commission, a cooperative organization consisting of representatives from the United States and Canadian governments. This Commission serves to prevent and resolve disputes involving boundary waters, as well as advising on water resource use and quality agreements (IJC).

LOMA – Letter of Map Amendment, an amendment issued by FEMA for a current FEMA map of a community, establishing that a property is not located in a SFHA (FEMA).

Natural Environment – Any natural area, ecosystem, or feature with scenic, recreational, or economic value (DEC).

NFIP – National Flood Insurance Program, a program that regulates flood insurance coverage and floodplain management as part of a federal Act (FEMA).

Noncritical Infrastructure – Built or natural features that the damage or destruction of would not impact vital community function; examples include residential docks and garages along the shoreline (DEC).

POD - Floodplain Protection Overlay District, the culmination of water levels, wetland, zoning, infrastructure, land use, LOMA, flood damage, and other environmental and societal factors to produce overlapping regions of high flood risk within the project area. This serves to identify areas of vulnerability based on the study, or areas in need of protection by adaptive mitigation measures to create future resiliency.

SFHA – Special Flood Hazard Area, an area with particular flooding or erosion concerns shown on a FIRM or a Flood Hazard Boundary Map (FEMA).

Shoreline Resilience – The ability of a region to sustain limited damage, as well as efficiently recover, from a hazardous storm or flooding event. The long-term ability of an area to successfully maintain itself and adapt throughout changing environmental conditions and events.

Shoreline Vulnerability – The characteristics of an area which make it susceptible to significant damage and loss as a result of a hazardous storm or flooding event.

Section 1.0 Project Description

1.1 Basis of Need

Throughout New York State, heavy rainfall can lead to flooding in all seasons. In much of northern New York State, flooding is most frequent in the spring, when rapid snowmelt and heavy rainfall lead to increased runoff. Coastal environments are particularly vulnerable to flooding that places both human and natural communities at risk. Urban areas, consisting of impermeable surfaces and low-lying areas, are especially vulnerable. As the 21st century progresses, our climate is projected to change, including large increases in the frequency, intensity, and duration of both extreme precipitation events and coastal flooding (Horton et. al 2014).

In spring 2017, extreme weather patterns (i.e., rainfall intensity and frequency) and resulting record high water levels experienced in Lake Ontario-St. Lawrence River System caused much damage to shoreline property and triggered a region-wide emergency response. Emergency response measures, as shown in Figures 1.11 and 1.12, included the distribution of sandbags; weighting down stationary docks; pumping water out of flooded basements; stabilizing damaged or eroded shore areas and establishing a “no wake” zone within 600 feet of the shoreline. High water levels and flood conditions in 2017 brought new attention to hazards faced by shore communities along the St. Lawrence River, as detailed in this video from the IJC: https://youtu.be/IkLh4UVkms0 .

Figure 1.11 – Governor Cuomo Deploys National Guard to stack sandbags, protecting shoreline property (Image courtesy of NYS Governor)

Figure 1.12 – No wake zones are established in residential areas to avoid damages (Image courtesy of North Country Newzjunky)

Although riverine flooding is a natural phenomenon essential to maintaining ecosystems, flooding in areas of human inhabitance often causes significant economic loss and compromises water quality. While our global community focuses on addressing the causes of climate change, our local communities must proactively develop and implement adaptive mitigation strategies to enhance resilience of vulnerable assets and related economy. Implementing adaptive mitigation strategies will make the 'at-risk' communities more resilient to flooding.

Shoreline Resiliency- The ability of an area to sustain limited damage, as well as efficiently recover, from a hazardous storm or flooding event. The long-term ability of an area to successfully maintain itself and adapt throughout changing environmental conditions and events.

1.2 Project Description

In the wake of the storm damage in 2017, St. Lawrence County, in partnership with the City of Ogdensburg, and the Town and Village of Morristown, applied for and were awarded $25,000 through the Great Lakes Basin Small Grants Program to conduct a study titled "Enhancing Shoreline Resilience Along the St. Lawrence River in St. Lawrence County." The grant is administered by the New York Sea Grant and New York State Department of Conservation.

The St. Lawrence River is the outflow of the entire Great Lakes system, beginning at Lake Ontario and running 800 miles east through Quebec, where it empties into the Atlantic Ocean. For this study, the project area comprised approximately 40 miles of shore upstream of the Iroquois control dam, including the Towns of Hammond, Morristown, Oswegatchie, and Lisbon, as shown in Figure 1.21. This stretch is commonly referred to as the Upper St. Lawrence River.

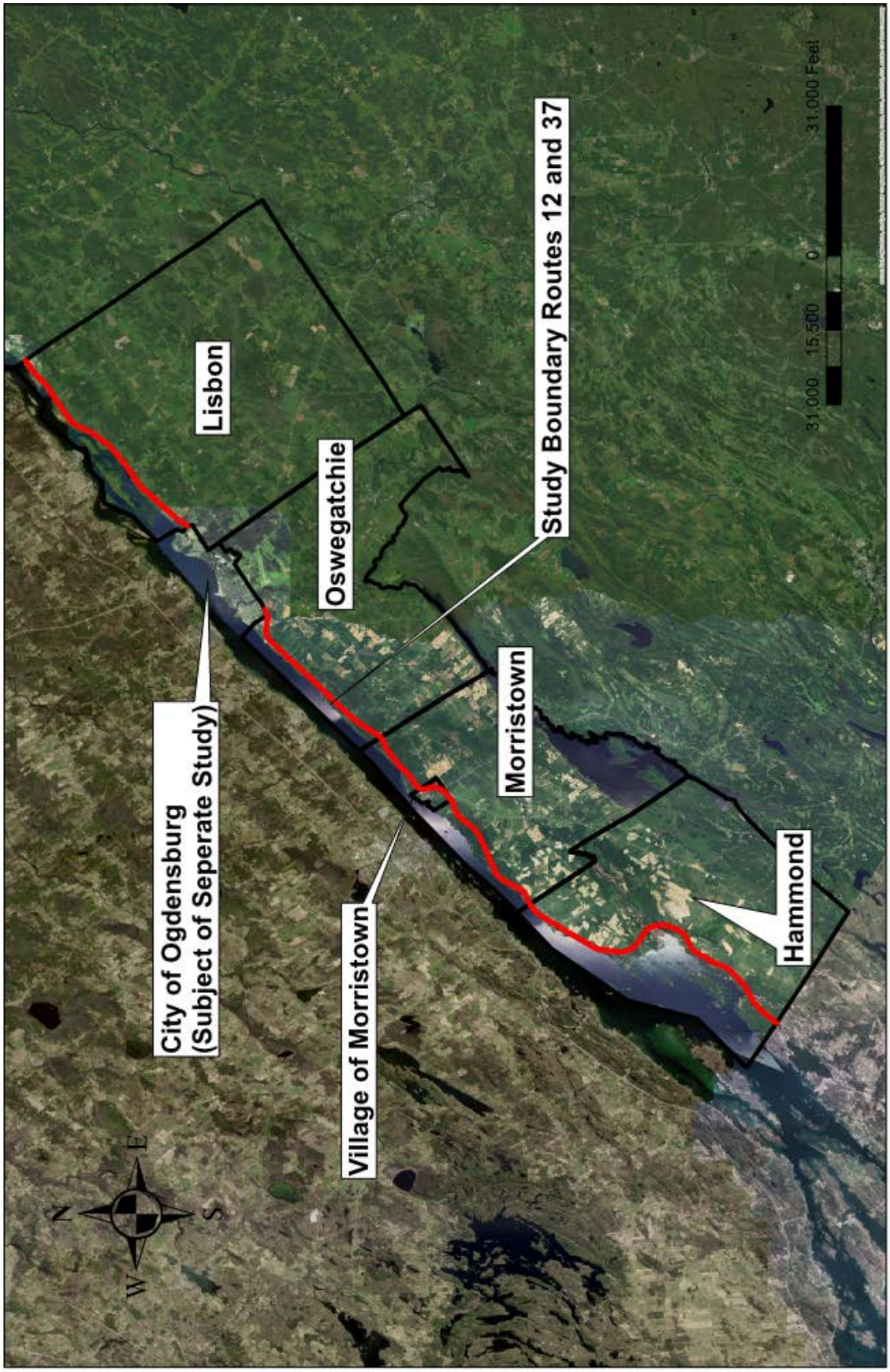

Figure 1.21 – Study Area Map

The goals of this study are, as part of a stakeholder-driven planning project, to assess ecosystem vulnerability and identify adaptive measures to enhance shore resilience along the Upper St. Lawrence River that can be incorporated into local planning for riverfront communities. The project goals adhere to Great Lakes Action Agenda (GLAA) Goal #7: "Enhance community resilience and ecosystem integrity through restoration, protection, and improved resource management." The objective(s) established to achieve the goal included conducting a preliminary study of community assets (i.e., built infrastructure and natural features) and land use practices in the shore areas to support developing recommendations to:

- protect critical infrastructure;
- enhance capacity of natural features to buffer storm/high water events; and
- improve parks and recreational opportunities.

The project scope, which aimed at accomplishing the goals and objectives presented above, was organized into four main tasks (Tasks 0100 – 0400) as follows:

Task 0100: Project Initiation & Site Reconnaissance

A project initiation meeting was held in County's office to "kick-off" the project and discuss the scope, schedule, budget, and other key elements associated with this Project. At a later date, key project team members conducted a focused site reconnaissance along the upper St. Lawrence River to observe and discuss shore characteristics within a portion of the project area; see Appendix B for details. The site reconnaissance was hosted by the Thousand Island Land Trust.

Task 0200: Vulnerability Assessment

A Vulnerability Assessment was conducted to establish an understanding of the people and places susceptible to flooding- an important first step towards identifying exposure to flood-related hazards and developing adaptive strategies associated with flood risk.

The vulnerability assessment primarily consisted of data collection and mapping. Publicly available literature (i.e., demographic data, land use regulations, flood records) and geographic information system (i.e., spatial and topographic data) was compiled, synthesized and assessed to characterize the relationship between high water levels and the natural and built environments along the shore zone, including:

• critical infrastructure in each community;

• existing patterns of land use on or near the shoreline in each community;

• areas of significant environmental value (e.g., conservation easements, wildlife management units, preserves, etc.);

• parks and recreational areas and opportunities;

• areas of potential environmental value (e.g., wetlands and floodplains) and other topographical features that can act as buffer areas to buffer flood events; and

• hydrodynamic data, such as historical water levels and high-risk flood zones.

The vulnerability assessment laid the foundation for developing recommendations related to an adaptive resilience strategy. The results of the vulnerability assessment and adaptive flood mitigation strategies are presented in Sections 2.0 and 3.0 of this Report, respectively.

Task 0300: Focus Group Meetings

Central to a successful planning effort is a well-crafted plan to educate, engage, and involve stakeholders. Stakeholders include individuals who can effect change, have relevant knowledge or skills, represent the interests of particular groups and/or will be affected by extreme weather and high-water conditions within the project area.

The Project Team prepared for and participated at two focus group meetings. The first focus group meeting was held at the Dobisky Center in Ogdensburg, New York on February 5, 2019. The objective of this meeting was to introduce the goals, objectives and scope of this resiliency study and solicit input from community representatives.

Following preparation of the draft Resiliency Report (Task 0400 below), a second focus group meeting was held at Chippewa Bay Fish and Game Club in Hammond, New York on May 8, 2019. The objective of this meeting was to present the results of the vulnerability assessment and garner input on the vulnerable assets- based on local knowledge about past flood events and exposure scenarios. Meeting participants partook in a vulnerability assessment aimed at identifying historical and potential consequences to the built environment (i.e., buildings, utilities, and transportation), natural environment, social environment and economy.

Participants in attendance at each focus group meeting are listed in Appendix F.

Task 0400: Prepare Draft/Final Flood Resiliency Report

This draft Flood Resiliency Study Report was prepared following completion of project initiation and site reconnaissance (Task 0100), vulnerability assessment (Task 0200) and the first of two focus group meetings (Task 0300). This draft Report includes maps of the land use patterns, vulnerability of natural and built assets based on ‘at-risk’ flood prone areas, and preliminary recommendations to enhance shoreline resiliency along the St. Lawrence River.

Following completion of the second Focus Group Meeting (Task 0300), the draft Flood Resiliency Study Report was revised incorporating input gathered from stakeholders. This Final report presents compiled data in tabular and figure format and provides a series of recommendations to protect critical infrastructure, reduce shoreline vulnerability to extreme weather events, and adapt to threats caused by extreme weather and high-water events within the project area communities.

1.3 Project Team

Planning is a consensus-building exercise that requires a variety of skills and expertise. St. Lawrence County’s Planning Office solicited the scope of services of a qualified consultant. St. Lawrence County selected a multi-disciplinary consultant team consisting of BCA Architects & Engineers and Rootz, LLC. BCA brought professional engineering experience related to the built environment, such as infrastructure, while Rootz brought specialized expertise in the natural environment, such as natural and nature-based design to promote flood resilience. Key project team members and contributing partners are as follows:

Key Project Team Members

- Keith Zimmerman, St. Lawrence County's Planning Office
- John Tenbusch, St. Lawrence County's Planning Office
- Matthew Biondolillo, Rootz, LLC -Environmental & Ecological Consultant
- Michael Altieri and Amanda Gaebel, BCA Architects & Engineers

Contributing Partners

- New York State Department of Environmental Conservation
- Department Authority of North Country
- St. Regis Mohawk Tribe
- Thousand Island Land Trust
- Save the River
- Focus Group Participants

Section 2.0 Vulnerability Assessment

2.1 Summary of Data Sources

This study examined available data sets and previous studies to perform the vulnerability assessment. It should be noted that no new data was generated as a part of this study. The following tables summarize the data sets collected and evaluated, providing a citation of the source and any special notes particular to each set.

Table 2.1.1 – Data Sets

Type	Source	Description	Comments
Contour/Topographic Data	GIS.NY.GOV	USGS 2-Foot Contours	
'Large' Culvert Data	GIS.NY.GOV	NYS DOT Culvert Inventory	
Bridge Data	GIS.NY.GOV	NYS DOT Bridge Inventory	
Tax Map Data	St. Lawrence County Planning Office	Real property data organized by SWIS Municipality Code	Tax map data was not provided for the Town of Hammond
NYS Wetland Dataset	St. Lawrence County Planning Office	State defined wetland areas with 100-foot protection zone	
Federal Wetland Data	St. Lawrence County Planning Office	Federally classified wetlands and waterbodies	
FIRM Maps and Letters of Map Amendment	FEMA.gov	100-year flood maps prepared for each subject community and LOMAs	Towns of Hammond and Lisbon do not participate in NFIP, so FIRM maps are not available
Zoning/Land Classification Data	St. Lawrence County Planning Office	Zoning maps classified by land use	Morristown is the only Town in this study with zoning regulations

Hydropower and Gauge Data	NOAA	Water level data compiled for gauges from Cape Vincent to the Saunders headwater
Flood Damage Reports	FEMA and NYS Department of Homeland Security and Emergency Services	Compiled flood damage reports from 2017 flood event
Flood Damage Maps	St. Lawrence County Planning Office	Mapping with locations of reported flood damages classified by type of property damaged
Nautical Seaway Trail Maps	St. Lawrence County Planning Office	Navigation charts of the St. Lawrence River Seaway

Figure 2.11 depicts a GIS overlay using a cross-section of the various data sets described in Table 2.1.1 utilizing the Village of Morristown as an example. By layering these seemingly disparate data sets together it is possible to see a pattern develop that references topographic information with reports of flood damage and Letters of Map Amendment cases throughout this stretch of shoreline. This appears to already be in a state of development from a planning perspective for the Village of Morristown. This municipality has an established ‘Flood Hazard Overlay District’ as outlined by the pink border on the map. The pattern that these data sets appear to establish from a shoreline flooding perspective will be discussed in subsequent sections of this report.

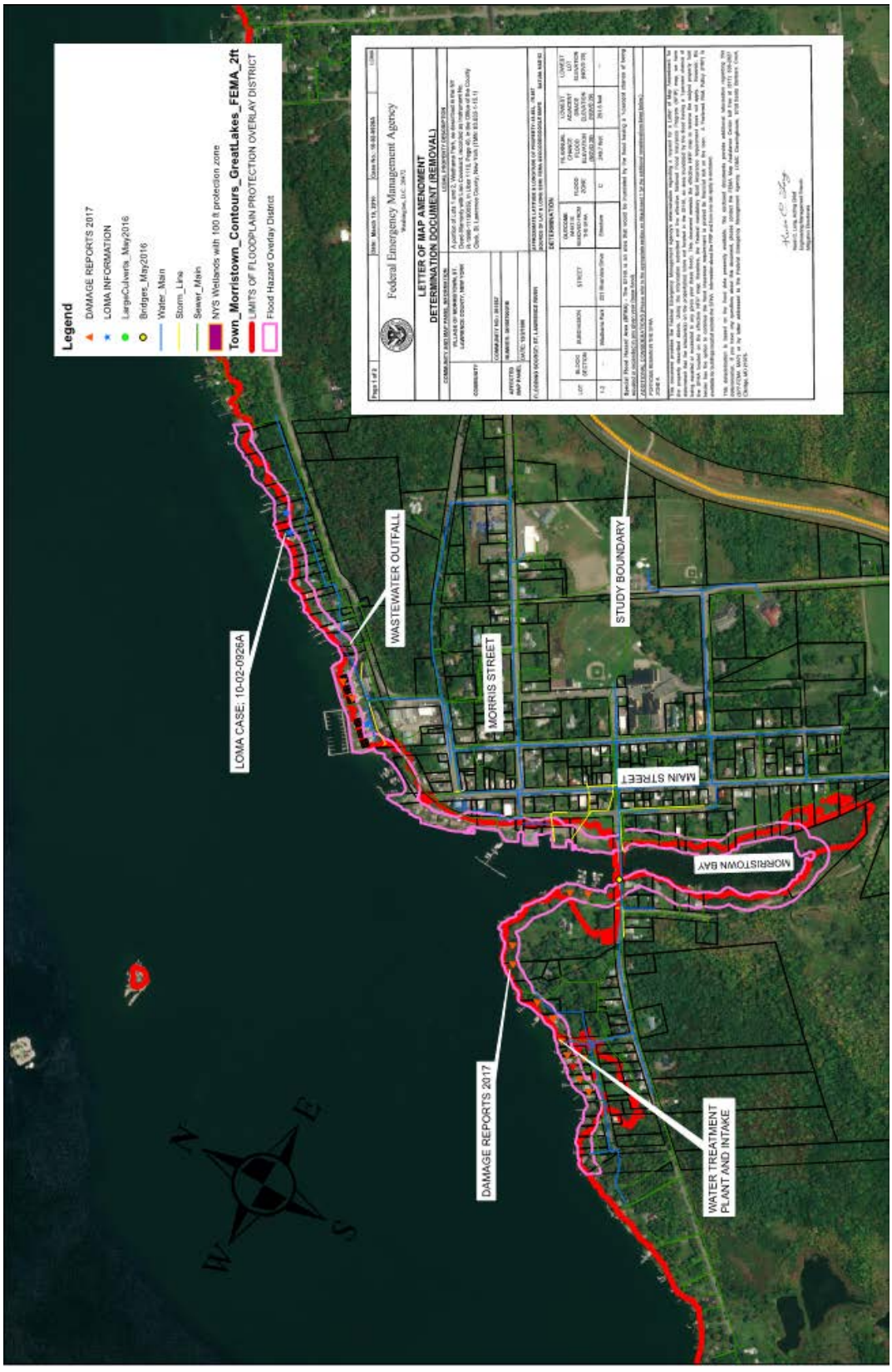

Figure 2.11 – Data Overlay Map

There were several studies examined as a part of this project that provide hydrological and hydraulic data as well as guidance for flood hazard management for communities. These studies are listed in Table 2.1.2 below.

Table 2.1.2 – Studies and Guidance Documents

Title	Organization	Description
Observed Conditions and Regulated Outflows in 2017	International Lake Ontario – St. Lawrence River Board	A report describing the causes of the record high water levels in 2017
Regulation Plan 2014 for the Lake Ontario and the St. Lawrence River	International Joint Commission	The primary regulatory document used to establish outflows and hydraulic control at the Moses-Saunders Dam
NYS Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act	NYS Department of Environmental Conservation	A guidance document for agencies to use to balance flood risks and strategies
Flood Smart Action Plan – Town of Greece, Town of Parma and the Village of Hilton	Various	A guidance document describing the 'Flood Smart Communities Approach'

2.2 Demographic Profiles

Extensive census and population data were gathered for this area by the Saint Lawrence County Planning Office that provide a very detailed description of the demographic and socio-economic characteristics of the study area. For further details, see https://www.stlawco.org/About/CensusDemoProfiles.

"From the scenic wonder of the St. Lawrence River to the reflective solitude of the Adirondack wilderness, the diverse geography of St. Lawrence County provides recreation enthusiasts and their families a paradise of year-round adventure. Five colleges and universities enroll over 10,000 students, including three colleges operated by the State University System. The Massena-Cornwall International Bridge and the Ogdensburg-Prescott International Bridge each afford a spectacular view of the St. Lawrence River and provide easy passage between the United States and Canada. Eighteen museums and art galleries, including the world-renown Frederick Remington Art Museum, an excellent library system, an established crafts community, and professionally and locally produced theater are just some of the reasons why St. Lawrence County has earned its reputation as an important cultural center."

-St. Lawrence County Industrial Development Agency

2.3 Land Use and Zoning

The predominant land use classifications within the study area were found to be agricultural, residential and vacant lands - see Figure 2.31. Seasonal housing and tourism contribute to much of the vacant and commercial land.

The Town of Hammond has a substantial amount of conservation and park land as compared to the other communities in the study area, particularly along the shoreline proper. Other land uses found within the study area included commercial, recreation/entertainment, community services, industrial and public services. Mapping depicting the land use classifications for each Town and Village within the study area can be found in Appendix C.

With the exception of the Village of Morristown, the Towns within the study area do not have specific policies, zoning or regulations regarding development in floodplain areas or areas prone to flooding. These regulations would apply specifically to local laws, State and Federal guidelines for these areas would still apply. The Village of Morristown does have a Flood Hazard Overlay District. This zoning designation specifically regulates site plan developments for properties located in this district from the perspective of flooding and flood risk.

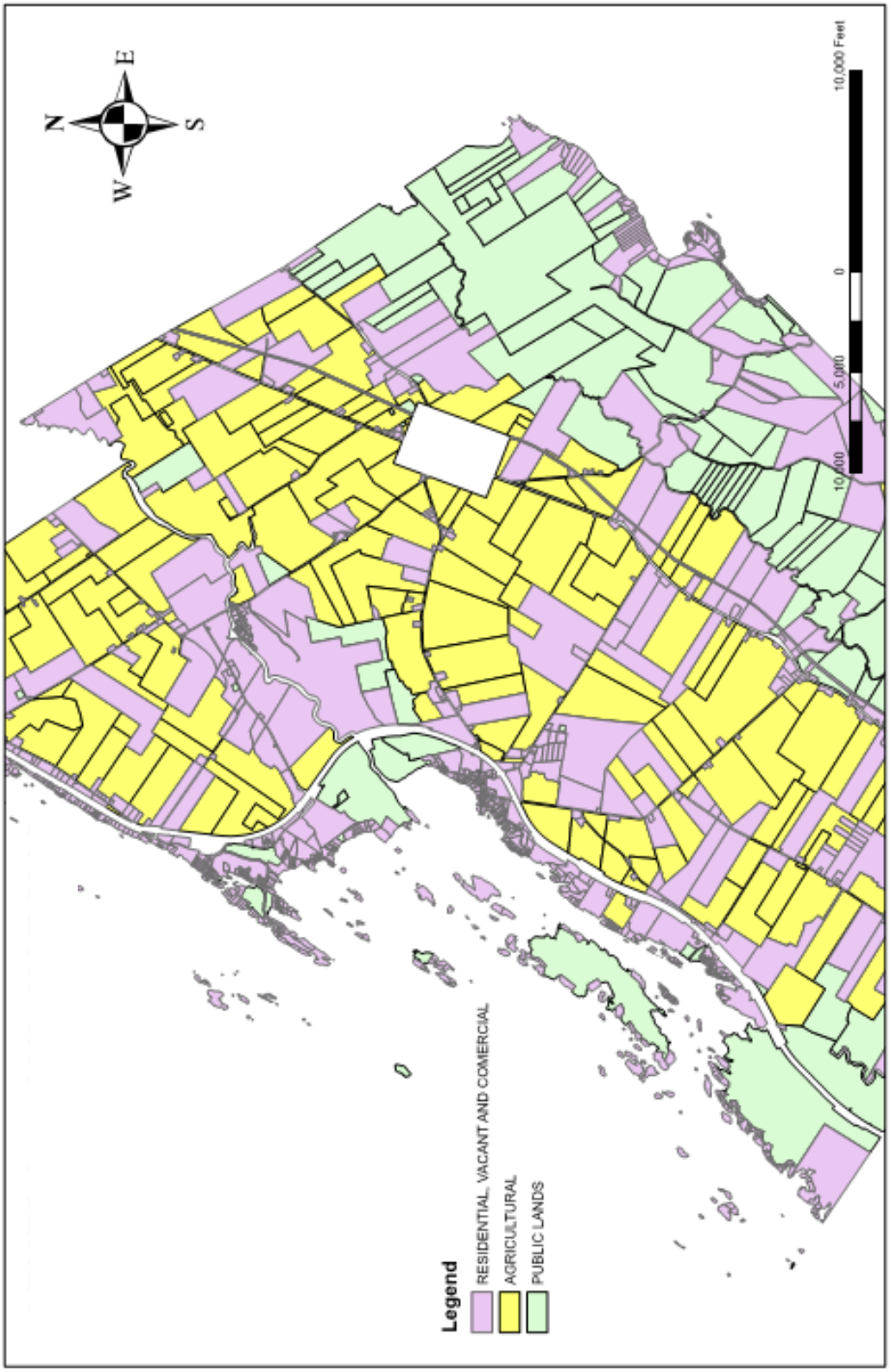

Figure 2.31 – General Land Use Map for the Project Area (Courtesy of St. Lawrence County Planning Office)

2.4 Flood Damage Assessment

Flood damage reports were compiled by FEMA and the NYS Department of Homeland Security and Emergency Services in the aftermath of the 2017 flood event. Docks and marinas were the highest reported damaged property from this data set. See Figures 2.41 and 2.42 for examples of dock damage report maps. Other reported damages included buildings, boathouses, septic systems, seawalls, water intakes, decks and shoreline erosion. Some examples of shoreline damage can be seen in Figures 2.43 and 2.44. The Lake Ontario and St. Lawrence River System – Detailed Damage Assessment data set can be found in Appendix A.

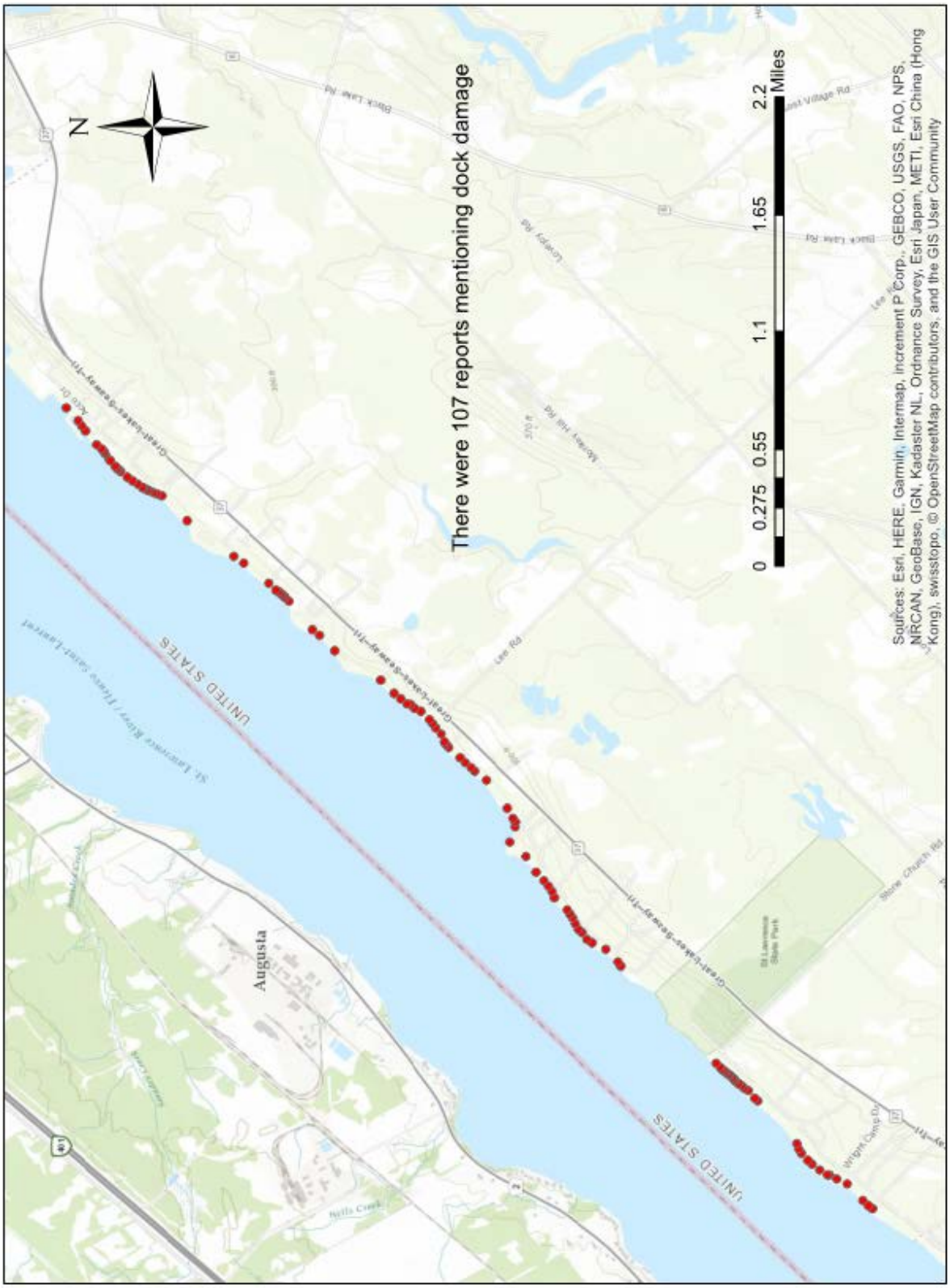

Figure 2.41 – Reported Dock Damage Map for Town of Oswegatchie (Courtesy of St. Lawrence County Planning Office)

Figure 2.42 – Reported Dock Damage Map for Town of Morristown (Courtesy of St. Lawrence County Planning Office)

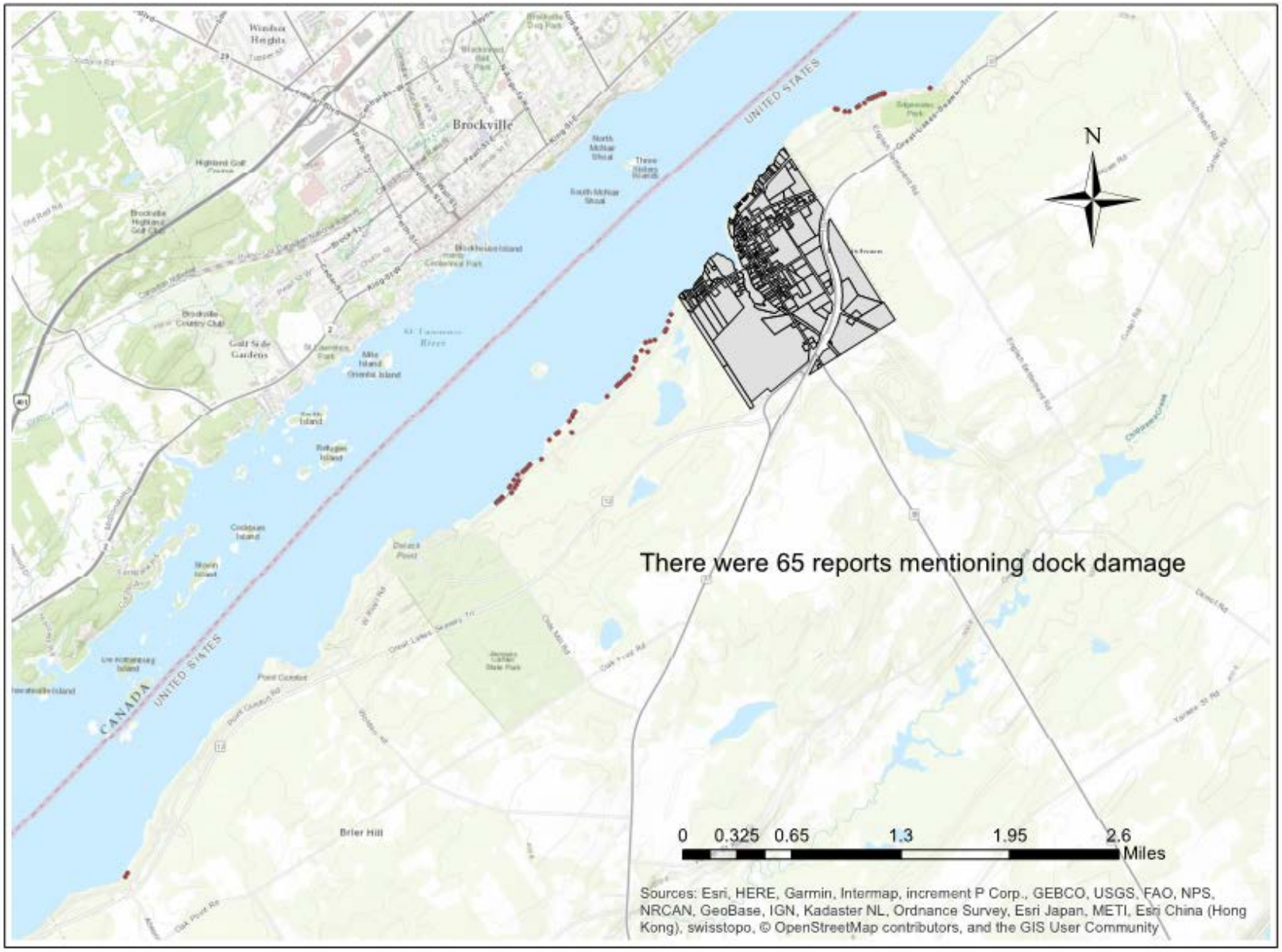

Figure 2.43 - Buildings in the Town of Hammond, Hamlet of Chippewa Bay, are inundated by flood water. This can lead to flooded basements, loss of property, and physical damage to concrete foundations over time

Figure 2.44 – A residential dock crumbles

2.5 Built Environment

The built assets within the study area follow a pattern that is very similar to the land use and zoning. The predominant built asset in the area are residential homes and related accessory structures, including docks, seawalls, boathouses, garages, sheds, private drives, parking areas and porches. An example of a typical built asset found within the study area is shown in Figure 2.51. As discussed in section 2.4, these assets were the primary reported structures damaged during the 2017 flooding event.

Figure 2.51 – Water recreation and water travel are very important to shoreline communities; watercraft-related assets, such as boat garages and docks, are a significant part of the built environment

While land use maps suggested agricultural built assets would predominate the area of study, this does not appear to be the case. Relatively little agricultural land is part of the built environment, with the primary land use coming in the forms of crop production and livestock grazing. Incidences of agriculturally related built assets include grain silos (see Figure 2.52), livestock pens and barns.

Figure 2.52 – Agricultural built assets along Morristown shoreline

Commercial built assets can also be found within the study area. These include noncritical infrastructure such as marinas, campgrounds, hotels, restaurants and small retail/supply/convenience stores. The primary concentration of commercial activity can be found in the Village of Morristown. The Village is also home to several institutional/public built assets, including Morristown Central School, the US Postal Service, public library, churches, banks, Town/Village/Court offices and the fire department. The Hamlet of Chippewa Bay holds a concentration of commercial built assets, especially in the form of marinas, stores and motels; such assets are also spread throughout Schermerhorn Landing, Allens Point, Chippewa Point, Blind Bay, and Oak Point.

The primary municipal infrastructure can be found at the Village of Morristown. This infrastructure includes potable water distribution mains, sanitary sewerage collection mains, stormwater collection piping, a raw water intake, potable water treatment plant and a wastewater treatment plant with a discharge to the St. Lawrence River. Utility lines, including electric and communication lines, are maintained throughout the area.

Transportation built assets also prevail in the study area, some of which are shown in Figure 2.53. These include bridges, culverts and traffic control devices in addition to the actual roadway structures. These assets come under a variety of jurisdictions, from Town, Village, County and the New York State Department of Transportation.

Figure 2.53 – Town of Hammond flooding over roadways and public docks (Image courtesy of Del Hamilton)

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Critical infrastructure identified was primarily centered around the municipal infrastructure at the Village of Morristown, particularly the water and wastewater treatment works. There are also several critical bridges and culverts that are located within the flood protection area maintained by Town, County and NYS DOT highway departments; some are shown in Figures 2.54 and 2.55. Built asset and critical infrastructure maps can be found in Appendix E.

Critical Infrastructure- Built or natural features that are vital to the health, safety/security, welfare, or economy of a community. If such infrastructure were damaged or destroyed, the community would suffer serious widespread detriments (DEC)

Figure 2.54 – Town of Hammond, Chippewa Bay critical culverts

Figure 2.55 – Town of Hammond, Chippewa Bay critical bridge

Some classes of built assets are considered vulnerable infrastructure, examples of which are shown in Figures 2.56 through 2.58. Assets not designed to withstand flooding conditions, or those which are part of a non-resilient shoreline, create vulnerability and are often subject to damage when a flood event occurs.

Figure 2.56 – A building constructed directly on the waterfront suffers damage and collapse

Figure 2.57 – A vulnerable boat garage and shed, juxtaposed with a greatly elevated residential structure

Figure 2.58 – A generator sits on the shoreline, just feet away from high water

2.6 Natural Environment

Natural assets found in the study area include wetlands, parks, undisturbed agricultural lands, vacant lands, conservation areas, creeks and bays. The wetland areas, shown in Figures 2.61 and 2.62, are primarily concentrated around the Chippewa Bay and Village of Morristown Areas with minor areas north of the City of Ogdensburg near the area of Red Mills. There is also a substantial amount of conservation land around the Chippewa Bay area in public and private holding. Parklands can be found along the entire stretch of shoreline, including Jacques Cartier State Park in the Town of Morristown, and St. Lawrence Park in the Town of Oswegatchie.

Figure 2.61 – Blind Bay wetland and undisturbed forest area

Figure 2.62 – A healthy shoreline supports valuable ecosystem diversity

2.7 Proposed Floodplain Protection Overlay District

A Floodplain Protection Overlay District is an area of flood risk created from overlapping regions of data, with the purpose of identifying vulnerable areas to introduce adaptive mitigation measures. The collective data utilized include water levels, wetland, zoning, infrastructure, land use, LOMA, flood damage, and other environmental and societal factors.

As discussed in Section 2.1, by utilizing GIS software to compare the various data sets, a picture of the flood risk area began to form. In addition, the Letters of Map Amendment available within the study area were reviewed as part of the data analysis to determine Base Flood Elevation– see Figure 2.71 for an example. The LOMAs showed a fairly consistent elevation for the 100-year flood or 1% annual chance flood elevation, 248.6 feet AMSL to 248.7 feet AMSL. The terms “100-year storm” or “100-year flood” are commonly used in the United States, but these terms can be confusing because they do not adequately convey that they are probabilities of a particular rain of flood event occurring. These probabilities are based on statistical methods that analyze storm or flood frequency using historical data. Rather than indicating that a particular storm event will only occur once per century, these terms mean that a particular storm event has one in one-hundred (1%) chance of occurring each year – so a 100-year storm could happen two years in a row or five times in a century and therefore could occur in consecutive years.

Page 1 of 2		Date: May 25, 2010	Case No.: 10-02-1282A	LOMA

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP AMENDMENT
DETERMINATION DOCUMENT (REMOVAL)

COMMUNITY AND MAP PANEL INFORMATION		LEGAL PROPERTY DESCRIPTION
COMMUNITY	TOWN OF OSWEGATCHIE, ST. LAWRENCE COUNTY, NEW YORK	
	COMMUNITY NO.: 360708	
AFFECTED MAP PANEL	NUMBER: 3607080025C	
	DATE: 5/1/1985	
FLOODING SOURCE: ST. LAWRENCE RIVER		APPROXIMATE LATITUDE & LONGITUDE OF PROPERTY: SOURCE OF LAT & LONG: ESRI: FEMA GEOCODE/GOOGLE MAPS DATUM: NAD 83

DETERMINATION

LOT	BLOCK/ SECTION	SUBDIVISION	STREET	OUTCOME WHAT IS REMOVED FROM THE SFHA	FLOOD ZONE	1% ANNUAL CHANCE FLOOD ELEVATION (NGVD 29)	LOWEST ADJACENT GRADE ELEVATION (NGVD 29)	LOWEST LOT ELEVATION (NGVD 29)
	--			Structure (Residence)	C	248.7 feet	252.1 feet	--

Special Flood Hazard Area (SFHA) - The SFHA is an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

ADDITIONAL CONSIDERATIONS (Please refer to the appropriate section on Attachment 1 for the additional considerations listed below.)

PORTIONS REMAIN IN THE SFHA
ZONE A

This document provides the Federal Emergency Management Agency's determination regarding a request for a Letter of Map Amendment for the property described above. Using the information submitted and the effective National Flood Insurance Program (NFIP) map, we have determined that the structure(s) on the property(ies) is/are not located in the SFHA, an area inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood). This document amends the effective NFIP map to remove the subject property from the SFHA located on the effective NFIP map; therefore, the Federal mandatory flood insurance requirement does not apply. However, the lender has the option to continue the flood insurance requirement to protect its financial risk on the loan. A Preferred Risk Policy (PRP) is available for buildings located outside the SFHA. Information about the PRP and how one can apply is enclosed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or by letter addressed to the Federal Emergency Management Agency, LOMC Clearinghouse, 6730 Santa Barbara Court, Elkridge, MD 21075.

Kevin C. Long

Kevin C. Long, Acting Chief
Engineering Management Branch
Mitigation Directorate

Figure 2.71 – Sample Letter of Map Amendment (Courtesy of FEMA)

The LOMAs provide the following definition for Special Flood Hazard Area (SFHA) – “The SFHA is an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).”

The data found in the LOMAs tracks fairly closely to gauge readings along the St. Lawrence Seaway. Gauges upstream of this section of shoreline registered maximum water levels in the range of 248.26 feet AMSL to 248.79 feet AMSL over a 36-year period. These upstream gauge stations include Cape Vincent, Alexandria Bay and Kingston. The gauge station at Ogdensburg recorded a daily maximum of 247.74 AMSL. Figure 2.72 depicts water level data for various gauges upstream, within and downstream of the studied stretch of shoreline. Detailed water level data can be found in Appendix D.

Figure 2.72 – Water Levels

	Daily Data (1960-2018)				
	Max		Min		
GAUGE	(m, IGLD-85)	(ft)	(m, IGLD-85)	(ft)	Agencies
Kingston	75.85	248.79	73.73	241.83	OPG & CHS
Ogdensburg	75.53	247.74	73.41	240.78	NYPA & NOAA
Cardinal	75.08	246.26	73.02	239.51	OPG
Iroquois HW	75.23	246.75	72.51	237.83	OPG
Iroquois TW	75.23	246.75	72.44	237.60	OPG & CHS
Waddington	74.35	243.87	71.73	235.27	NYPA
Morrisburg	74.37	243.93	71.60	234.85	OPG
Long Sault SS	74.25	243.54	71.07	233.11	NYPA
Moses HW	74.21	243.41	70.89	232.52	NYPA
Saunders HW	74.21	243.41	70.91	232.58	OPG
Moses TW	49.25	161.54	47.20	154.82	NYPA
Saunders TW	49.01	160.75	47.07	154.39	OPG
International TW	49.20	161.38	47.17	154.72	OPG

OPG = Ontario Power Generation

CHS = Canadian Hydrographic Service

NYPA = New York Power Authority

NOAA = National Oceanic & Atmospheric Administration

HW = headwater

TW = tailwater

*NYPA's value

Canadian gauges

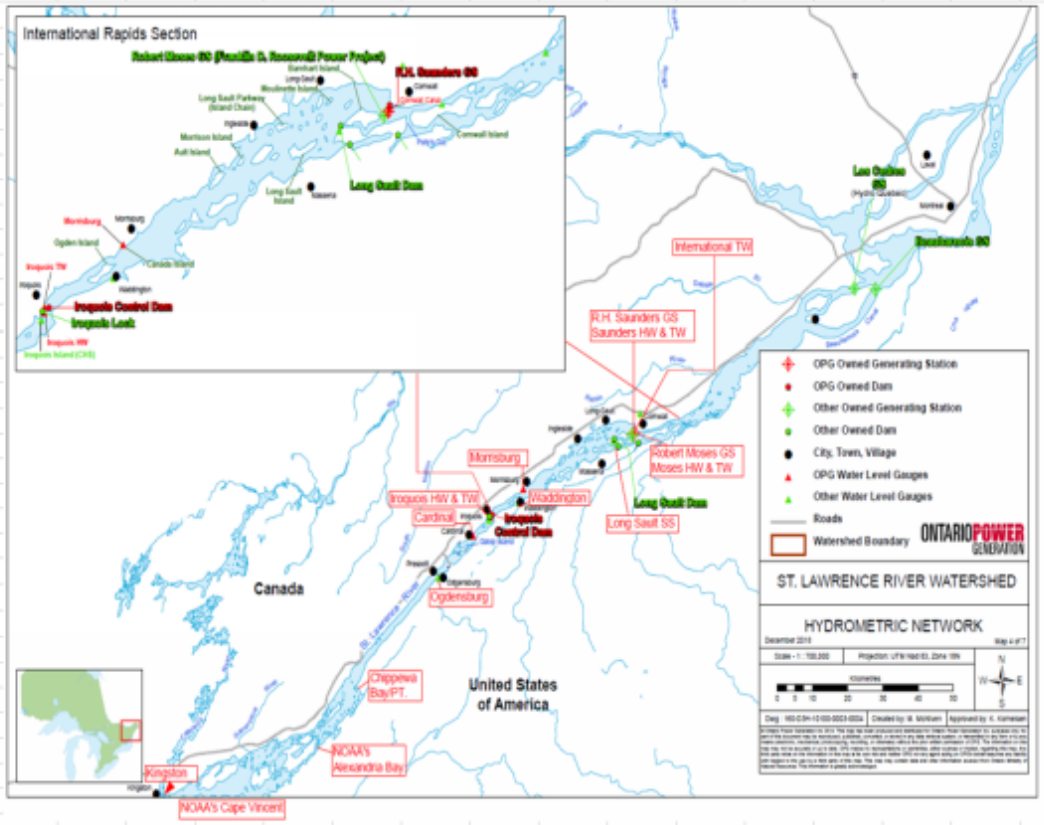
U.S. Gauges

	Daily Data (POR varies-see below)				
	Max		Min		
NOAA's GAUGE	(m, IGLD-85)		(m, IGLD-85)		Agency
Cape Vincent	75.85 (1 Jun 2017)	248.79	74.15 (14 Jan 1999)	243.21	NOAA
Alexandria Bay	75.69 (15 May 2017)	248.26	74.02 (30 Nov 2012)	242.79	NOAA
Ogdensburg	75.59 (9 Jun 1952)**	247.94	73.41 (4 Dec 1964)	240.78	NOAA

** 75.54 (8 May 2017)

For NOAA's gauge:	Periods of Record (POR)
Cape Vincent	14-May-1982 through 30-Nov-2018
Alexandria Bay	1-Jun-1983 through 30-Nov-2018
Ogdensburg	1-Jun-1914 through 30-Nov-2018***

***(data unavailable from 1-Nov-1914 through 31-May-1934)



Piecing this data together and utilizing the guidance found in the Draft NYS Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act (NYS DEC 2018), a proposed 'Flood Plain Protection Overlay District' was overlaid over the entire study area. BFE was determined in the study to be 248.6 ft AMSL based on the 2.0-foot contour data. Per NYS DEC guidance, the approximate limits of the proposed Floodplain Protection Overlay District are 246-252 ft AMSL, based on "the vertical flood elevation and corresponding horizontal floodplain that result from adding two feet (three feet for critical facilities) of freeboard to the base flood elevation and extending this level to its intersection with the ground" (NYSDEC 2018). The overlay for the project area is presented in Figure 2.73. See Figures 2.74 through 2.78 for Floodplain Protection Overlay District maps for individual subject municipalities. Separate datums were combined to create the 2.0-foot contour data used in this study; see the following link for an explanation of how the data was derived: http://gis.ny.gov/elevation/contours/contours-stlawrence.htm.

Figure 2.73 – Floodplain Protection Overlay District for project area

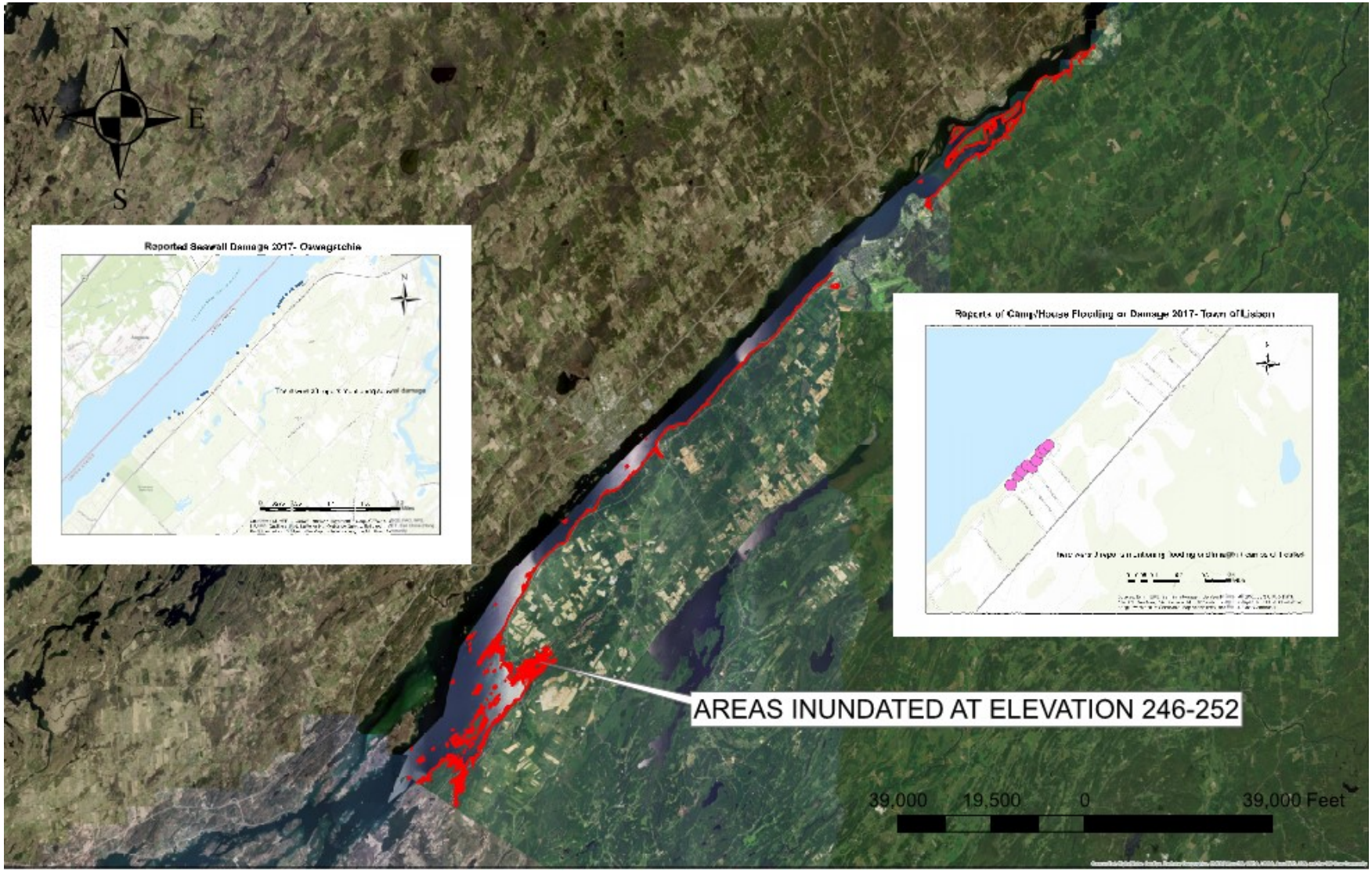
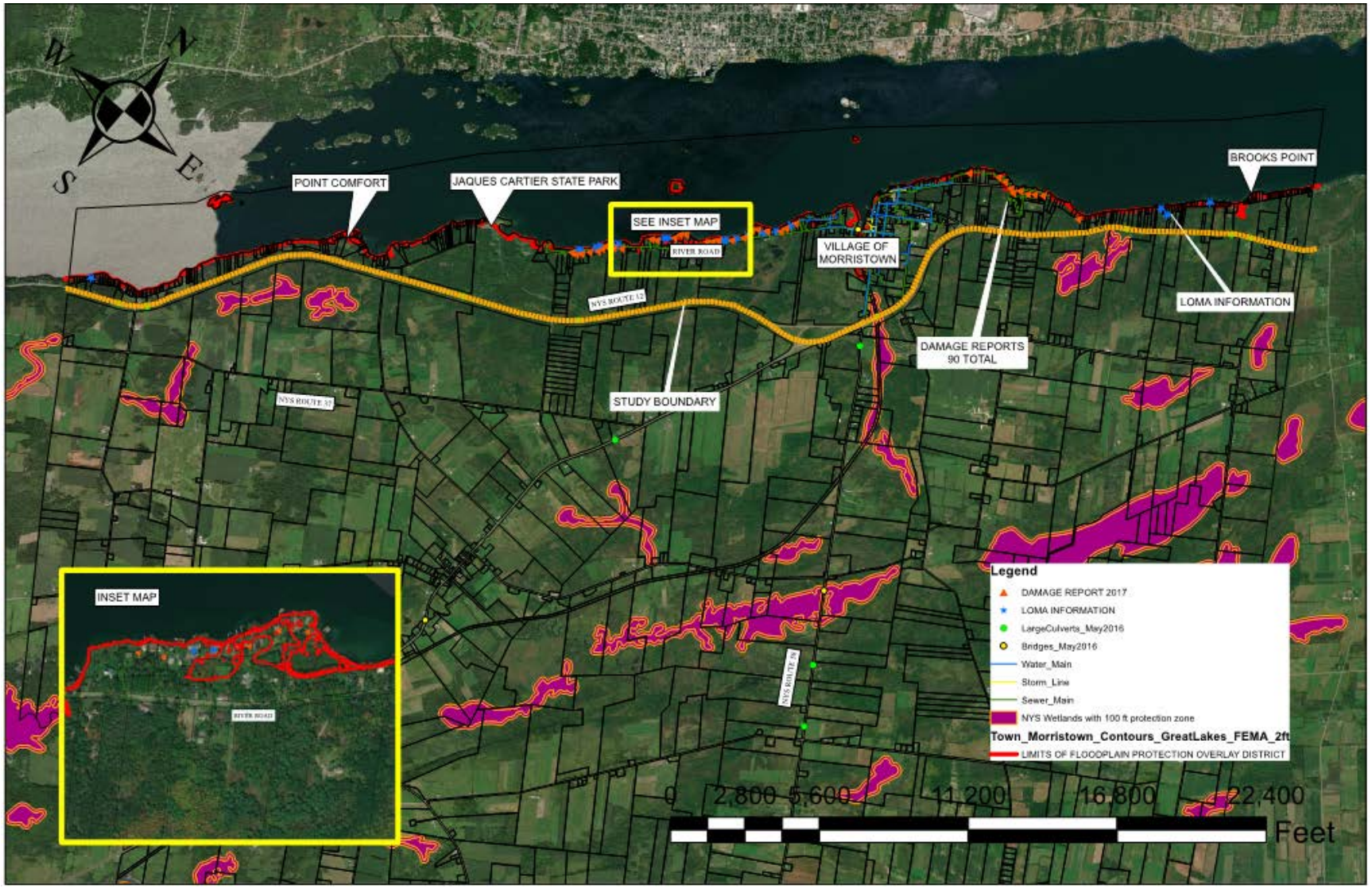


Figure 2.74 – Town of Morristown Floodplain Protection Overlay District



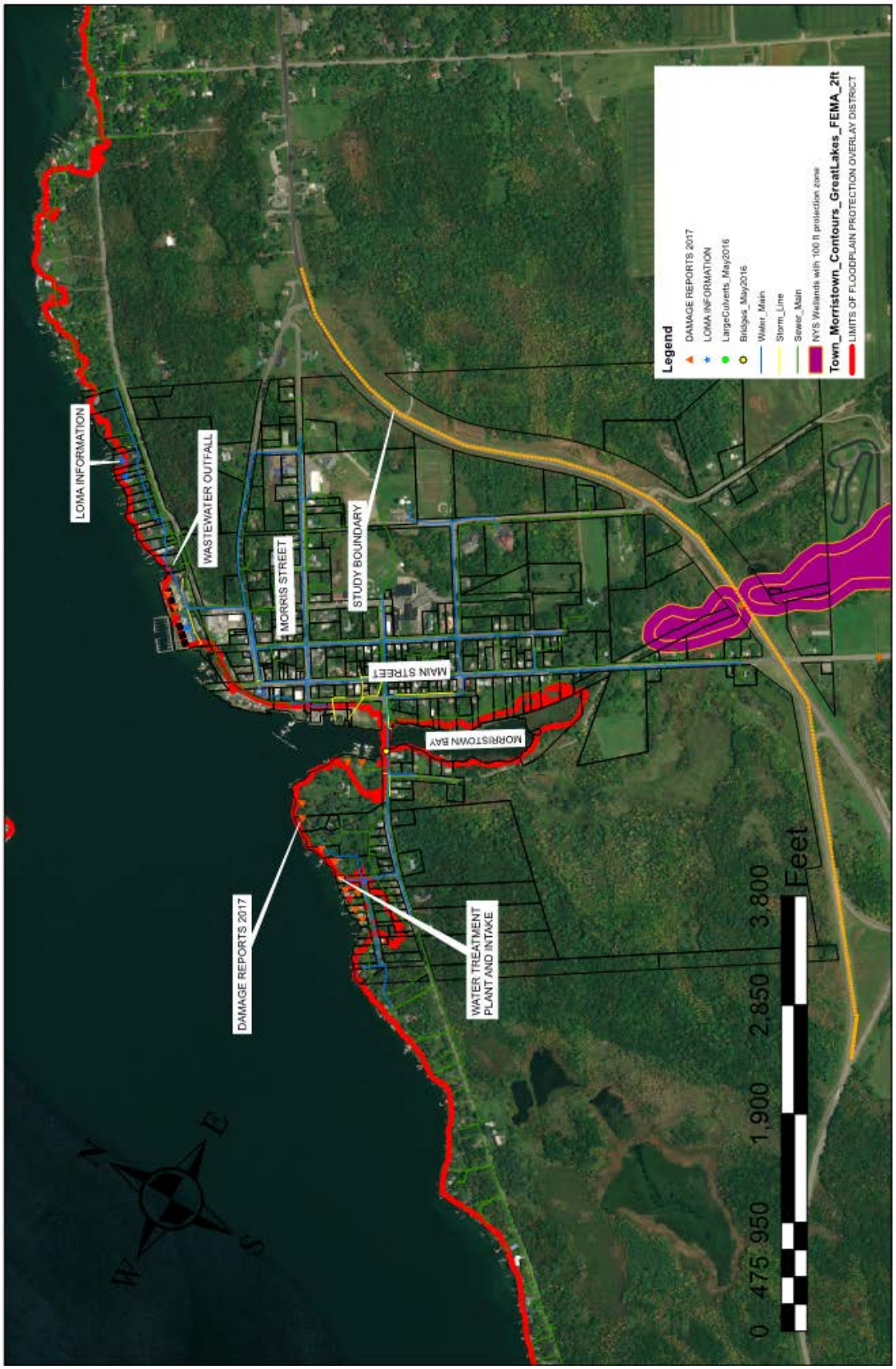
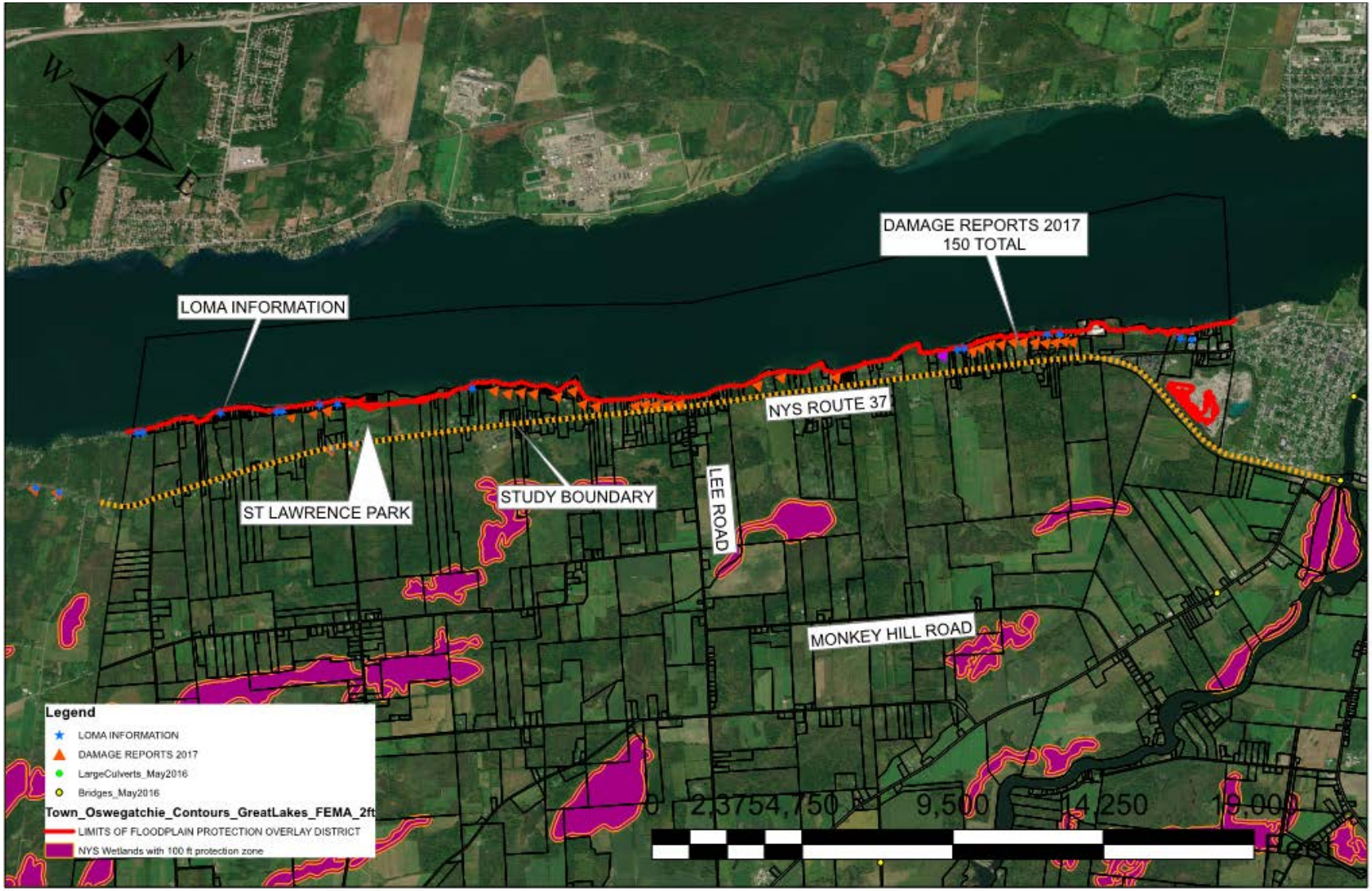


Figure 2.75 – Village of Morristown Floodplain Protection Overlay District

Figure 2.76 – Town of Oswegatchie Floodplain Protection Overlay District



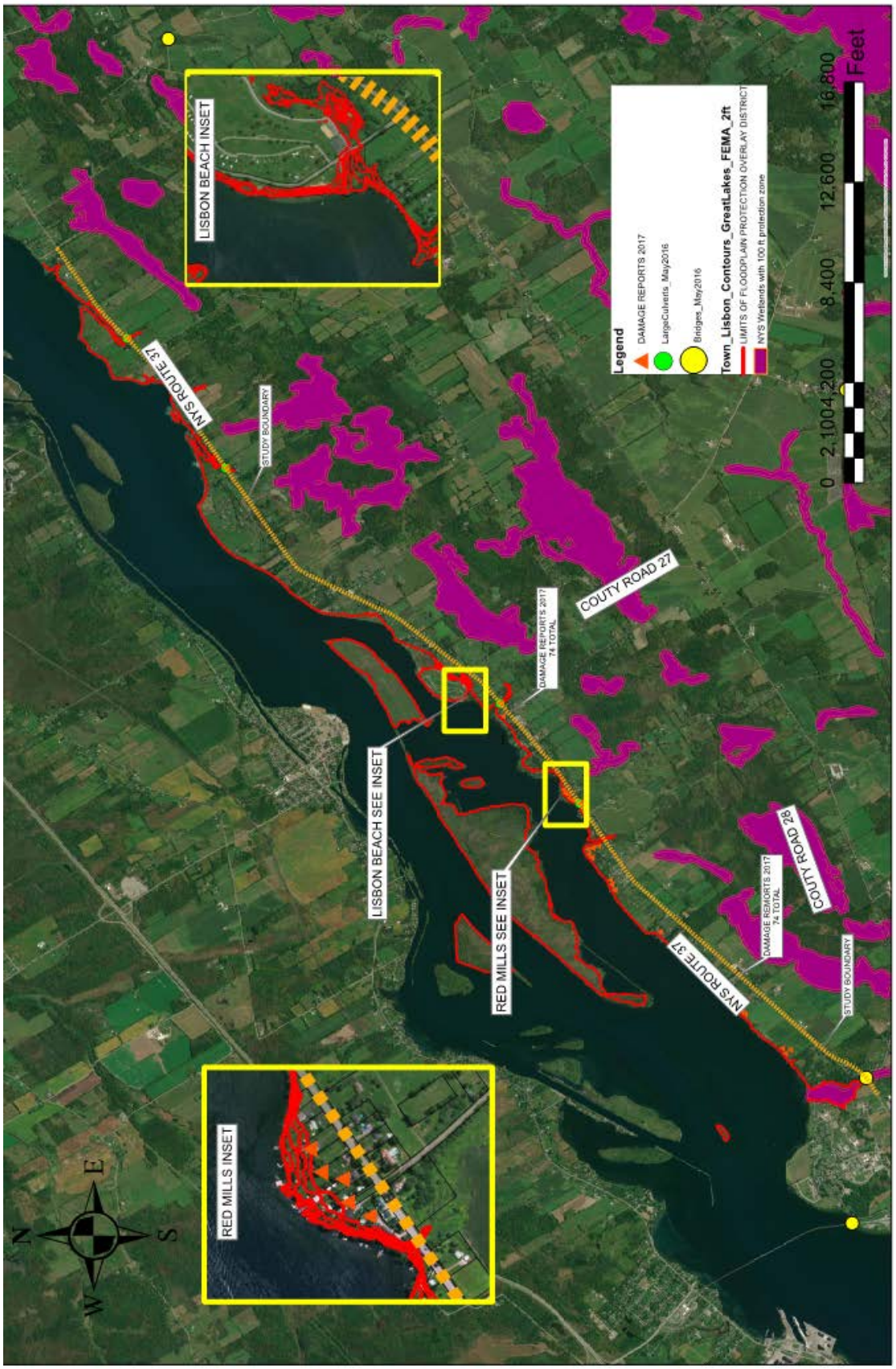
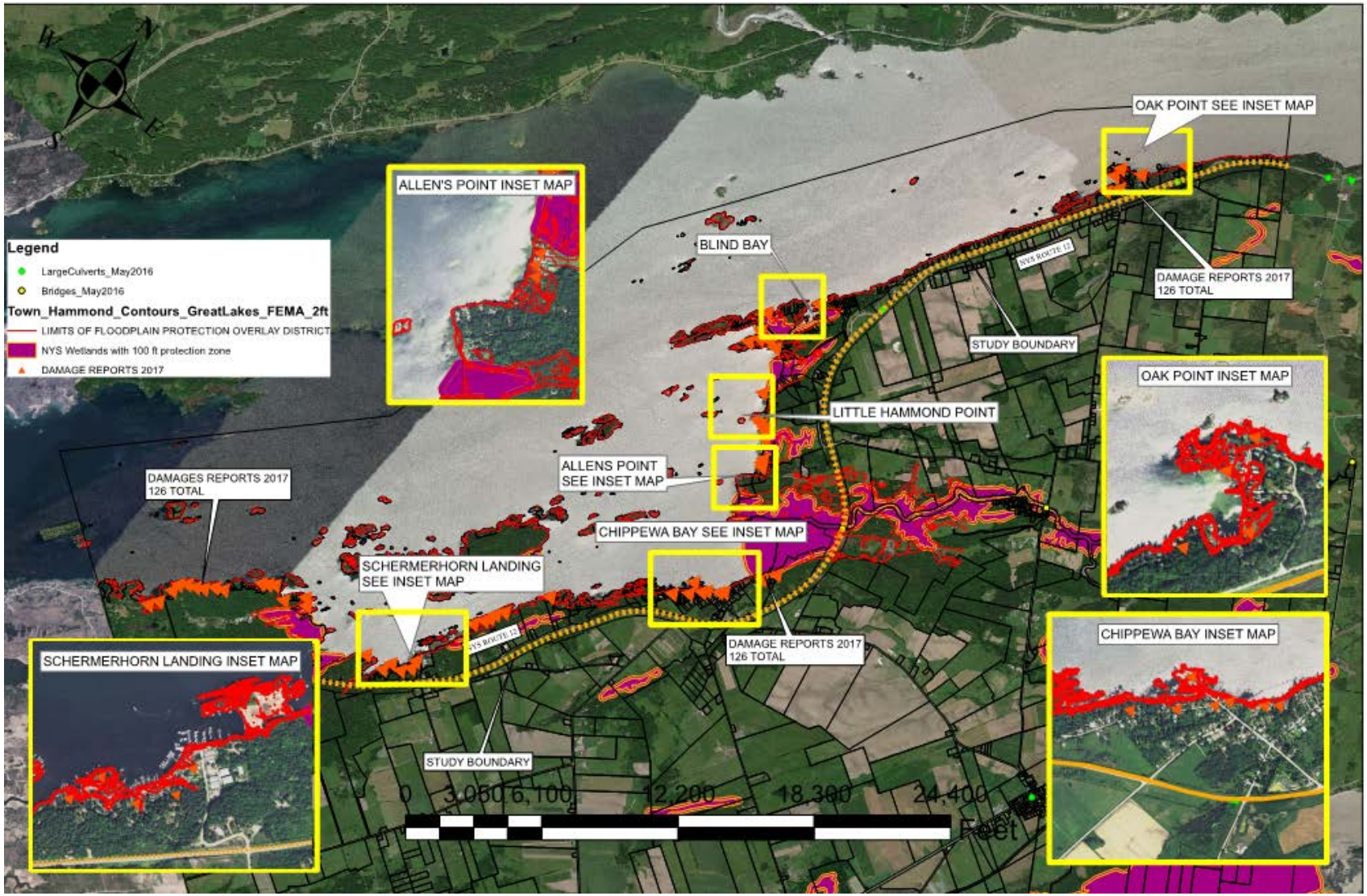


Figure 2.77 – Town of Lisbon Floodplain Protection Overlay District

Figure 2.78 – Town of Hammond Floodplain Protection Overlay District



2.8 Data Gaps

While this study does effectively identify shoreline vulnerability within the project area, there are points to improve upon which would make the results more comprehensive. Utility system data such as fiber optic and electrical lines would be valuable information in future studies, as communication and power distribution impact the quality of life in shoreline communities. The topographic data used was specific to 2.0-foot contours, so there is some uncertainty involved in the necessary extrapolation of the data. Additionally, tributaries in the project area were not explored, but surveying work and an inventory of critical culverts and bridges would be helpful in generating a more comprehensive view of the flood impacts and risk areas.

Section 3.0 Adaptive Flood Mitigation Strategies

The project team developed a range of adaptive mitigation strategies to reduce flooding vulnerability and enhance resilience within the project area. Based on findings of the vulnerability assessment, the project team developed draft mitigation strategies for discussion with the stakeholder group. A stakeholder meeting was held on May 8, 2019, whereby the project team discussed the results of the vulnerability assessment; identified data gaps and discussed flood mitigation strategies. The following flood mitigation strategies were identified and organized into the following three categories:

- Local Planning and Regulations
- Built Environment Protection
- Natural Environment Protection

3.1 Local Planning and Regulations

1. Form Partnerships to Support Floodplain Management

Partnerships between federal, state, and regional entities help expand resources and improve coordination. Consider the following actions:

- Coordinating with the International Joint Commission regarding regulated outflows and adaptive flood management strategies in a changing climate and environment.
- Collaborating with State- and County-level Department of Transportation regarding hydrological influences of flooding in connection with flow constrictions, such as culverts, bridges and roadways.
- Fostering partnerships with State government to support more resilient shoreline communities that can respond to and recover from climate change and future flood events. New York State's Resiliency and Economic Development Initiative (REDI) is described in Section 4.4.
- Working together with the regional watershed council (i.e., St. Lawrence River Watershed Partnership) to unify resources for comprehensive analysis, planning, decision-making and cooperation for advancing watershed-based planning initiatives.
- Forming an intermunicipal work group and/or retaining a resiliency director to help communities improve flood preparedness and resilience through planning and implementing adaptive mitigation strategies.
- Implementing and monitoring progress on advancing local mitigation actions to address flood hazards.

2. Incorporate Flood Mitigation into Local Planning

Comprehensive planning and floodplain management can mitigate flooding by influencing development. Recommended strategies include:

- Developing new maps and flood data.

- Adopting flood damage protection and floodplain protection overlay district into local code. This study proposed the limits of a floodplain protection overlay district.
- Providing the flood data to the community(s).
- Providing information to the community(s) to support tracking water levels (i.e., real-time and forecasts) within the River. For example, the IJC's Great Lakes boards use new modeling tools (https://ijc.org/en/advancements-great-lakes-water-level-forecasting) developed by US Corps of Engineers for application to seasonal water supply and water level forecasts throughout the Great Lakes. Another example is the NY Sea Grant's new inundation mapping tool for the public: https://seagrant.sunysb.edu/articles/t/coastal-community-development-program-resources-tools-coastal-resilience-index .
- Educating property owners that are at-risk of flooding.
- Developing training requirements or programs for municipal boards.
- Determining and enforcing acceptable land uses and development practices to alleviate the risk of damage by limiting exposure in flood risk areas. Local governments may benefit from new guidance per the DOS and DEC in the form of model local laws. New model local laws and tools to enhance resiliency can be found at https://www.dos.ny.gov/opd/programs/resilience/index.html.
- Mitigating hazards during infrastructure planning. For example, decisions to install or extend utilities or roadways to an area may increase exposure to flood hazards.
- Establishing a green infrastructure program to link, manage, and expand existing parks, preserves, greenways, etc.
- Adopting a post-disaster recovery ordinance based on a plan to regulate repair activities. For example, decisions to 'harden' a shoreline with structural measures (i.e., vertical walls- see Figure 3.11) may increase exposure to future erosion and flood hazards.

Figure 3.11 – An example of a hardened shoreline which may provide more hazards than benefits in the long term; erosion above the wall may be exacerbated during flooding

3. Improve Flood Risk Assessment

A heightened awareness of flood risk areas is recommended using the following methods:

- Using topographic survey, hydrological assessments and GIS mapping to further refine areas at risk of flooding along the St. Lawrence River and its tributaries. Information can be shared with community members using an interactive flood mapping tool.
- Incorporating the procedures for tracking high water elevations following a response into hazard mitigation and/or emergency response plans.
- Maintaining a database to track community exposure to flood risk.
- Conducting a verification study of FEMA's repetitive loss inventory and developing an associated tracking database.
- Revising and updating regulatory floodplain maps.

4. Limit or Restrict Development in Floodplain Areas

Flooding can be mitigated by limiting or restricting how development occurs in floodplain areas through actions such as:

- Prohibiting or limiting (future) development within the floodplain through regulatory measures.
- Limiting the density of development and/or percentage of allowable impervious surface in the floodplain and/or watershed.

- Developing a shore buffer ordinance to protect water resources and limit flood impacts.
- Prohibiting fill in floodplain areas.

5. Adopt and Enforce Building Codes and Development Standards for New Development
The use of building codes and development standards can promote infrastructures ability to withstand flooding. Potential actions include:

- Adopting the International Building Code® (ASCE, 2015) and International Residential Code® (ASCE, 2015).
- Adopting American Society of Civil Engineers (ASCE) 24-14, Flood Resistant Design and Construction. ASCE 24 is a references standard in the International Building Code® that specifies minimum requirements and expected performance for the design and construction of buildings and structures in flood hazard areas to make them more resilient to flood loads and damage.
- Adding or increasing "freeboard" requirements (e.g., feet above base flood elevation) in the flood ordinance.
- Using design standards to require elevation data collection during planning and to have buildable space on lots above the base flood elevation. See Figure 3.12 for an example of a structure in a strategic lot.
- Requiring standard tie-downs for temporary structures, such as docks and fuel tanks.

Figure 3.12 – Use of a naturally elevated and hard shoreline, showing strategic development

6. Adopt Policies to Improve Stormwater Management Planning

Rainwater and snowmelt can cause flooding and erosion in developed areas. Stormwater management practices include:

- Linking flood hazard mitigation objectives with EPA's stormwater initiatives.
- Completing a stormwater drainage study for known problem areas.
- Preparing and adopting a stormwater drainage plan and ordinance.
- Encouraging the use of Low Impact Development and Green Infrastructure techniques, such as porous pavement, vegetative buffers and bioswales, to name a few. See Figure 3.13.
- Adopting erosion and sedimentation control regulations for development and agriculture.

Figure 3.13 – Incorporating more pervious surface systems like this rain garden -or other Green Infrastructure- is a sustainable and Low Impact Development practice

7. Participate in the Community Rating System

The National Flood Insurance Program's (NFIP) Community Rating System is a voluntary incentive program that recognizes communities for enforcing floodplain management activities that exceed minimum NFIP requirements. There are many advantages to proactive floodplain management such as improved public safety, property loss reduction, open space and natural resource protection, and enhanced post-disaster recovery. Proactive floodplain measures include:

- Taking action to minimize the effects of flooding on people and property through measures including flood resilience and emergency response planning, flood warning, and evacuation planning.
- Advising the public about the flood hazard area and flood protection measures.
- Implementing property damage reduction measures for existing buildings such as acquisition, relocation, retrofitting, and other flood mitigation measures.
- Enacting and enforcing regulations that exceed NFIP minimum standards for new development.

3.2 Built Environment Protection

Regarding the built environment, planning and strategic engineering decisions are crucial to protecting both critical and noncritical infrastructure. Implementing resilient design, shown in Figures 3.21 through 3.23, can mitigate flooding-related damage during an event. If measures are not taken to protect existing or new structures, failures can occur due to structural limitations and outdated design, as shown in Figure 3.24. Examples of protection actions are as follows:

1. Reduce flood losses to existing development
2. Remove Existing Structures from Flood Hazard Areas
3. Improve Stormwater Drainage System Capacity
4. Conduct Regular Maintenance for Drainage Systems and Flood Control Structures

Figure 3.21 – Use of riprap and structural shore walls, as well as natural vegetative features

Figure 3.22 – Emergency response measures (e.g., Aquadam and supersack installation) may be warranted to protect properties that are not resilient

Figure 3.23 – Hard and soft mitigation combined, using limestone blocks and natural vegetation to create a resilient shoreline

Figure 3.24 – A concrete seawall less than 50 years old becoming ineffective, due to changing conditions and limitations of material properties in design

5. Elevate or Retrofit Structures and Utilities

    a. Elevating structures so that the lowest floor, including the basement, is raised above the base flood elevation
    b. Raising utilities or other mechanical devices, such as electric generators, above expected flood levels. See Figure 3.25.
    c. Wet floodproofing in a basement, which may be preferable to attempting to keep water out completely because it allows for controlled flooding to balance exterior and interior wall forces and deters structural collapse.
    d. Dry floodproofing buildings by strengthening walls, sealing openings (e.g., doors), or using waterproof compounds to keep water out. See Figures 3.26 and 3.27 for examples.

6. Protect Critical and Non-Critical Infrastructure

Figure 3.25 – Two workers elevate condenser units on a platform above BFE (Image courtesy of FEMA)

Figure 3.26 – Residential flood gates are used to protect openings (Image courtesy of Stormguard Floodplan)

Figure 3.27 – Waterproof membrane used to protect concrete foundation (Image courtesy of SUPERSEAL Construction Projects)

3.3 Natural Environment Protection

Natural resources and open space provide floodplain protection and other ecosystem services that mitigate flooding. It's important to preserve and protect such functionality using the following:

1. Conserve, Protect and Restore Natural Features, Floodplains and Open Space
    - Protecting and enhancing ecological landforms (i.e., stream channels, wetlands, etc.) that provide natural floodplain functions.
    - Developing an open space acquisition, reuse, and preservation plan targeting floodplain areas.
    - Preserving or restoring vegetative management, such as vegetative buffers, along streams, lakes, and other water resources, as shown in Figure 3.31.
    - Retaining natural vegetative beds in stormwater channels
    - Using Green Infrastructure (e.g., rain gardens and bioswales), natural (e.g., wetlands) and nature-based features (e.g., living shorelines and created wetlands) to capture, store, and treat stormwater runoff, as shown in figures 3.32 and 3.33.

Figure 3.31 – Natural vegetative buffer along the St. Lawrence River

Figure 3.32 – Porous asphalt pavement and low-lying vegetation and retention pond: parking lot system

Figure 3.33 – Porous asphalt pavement and recharge bed for water infiltration

- Using green solutions to shoreline management, such as living shorelines, shown in Figure 3.34, will help humans and natural resources coexist on our coasts in a changing climate. Living shorelines are sometimes called nature-based shorelines because they incorporate vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g., boulders or rock sills) for added stability. Living shorelines maintain continuity of the natural land-water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

Figure 3.34 – An example of Sustainable Shoreline design (Image courtesy of Hudson River National Estuarine Research Reserve)

- Flooding should be considered in the design of open space areas to promote stormwater and floodwater retention based on changes in land elevation. Managing floodwater in an urban or suburban area has a lot to do with the amount of permeable land that is available for water to move to, stay on, and percolate through. Improvement of the amount of function of permeable land in a built environment, as in Figure 3.35 and Figure 3.36, will reduce flood impacts. Parklands and urban open spaces can be designed specifically to accept excess rainwater. After a heavy rain, the open space may be flooded and not usable by people. But, after the water subsides, the area will again be usable as parkland for people and wildlife.

Figure 3.35 – Porous asphalt pavement and bioretention cell to reduce impervious surfaces and make a parking lot area more sustainable

Figure 3.36 – Bioretention area for efficient use of the land and effective runoff collection

Section 4.0 Funding Programs for Flood Mitigation

Communities share the understanding that flood risk doesn't stop at municipal boundaries and that solutions are best addressed holistically across geographic boundaries. Today's approaches work toward collaborating and integrating resiliency measures into the community and societal fabric to achieve broader sustainability goals. Increasingly, funding for local climate adaptation and resilience projects must draw on a range of public and private financing. For instance, eligible participants may apply for federal and state grant funding, work through public/private partnerships, and/or fund projects through local taxes.

A grant is a way the government funds your ideas and projects to provide public services and stimulate the economy. Grants support critical recovery initiatives, innovative research, and many other programs. In the United States, a range of government entities offer financial and technical resources to advance local adaptation and mitigation efforts. For your convenience, we've listed some of them here. See links below for funding sources.

4.1 United States Environmental Protection Agency (U.S. EPA)

The U.S. EPA's Office of Sustainable Communities occasionally offers Smart Growth grants to support activities that improve the quality of development and protect human health and the environment. See the following website for details https://www.epa.gov/grants .

4.2 Federal Emergency Management Agency (FEMA)

FEMA provides state and local governments with preparedness (non-disaster) grant programs to enhance the capacity of their emergency responders to prevent, respond to, and recover from a range of hazards; see https://www.fema.gov/grants . FEMA's Hazard Mitigation Assistance grant programs provide funding to protect life and property from future natural disasters. Example programs are as follows:

- Hazard Mitigation Grant Program assists in implementing long-term hazard mitigation measures following a major disaster.
- Pre-Disaster Mitigation provides funds for hazard mitigation planning and projects on an annual basis.

- Flood Mitigation Assistance provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.

4.3 U.S. Department of Agriculture

The USDA's Natural Resources Conservation Service (NRCS) offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources in a sustainable manner. See https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?&cid=stelprdb1048817 for details. Programs include:

- The Agricultural Management Assistance Program helps agricultural producers use conservation to manage risk and address natural resource issues through natural resources conservation.
- Conservation Innovation Grants offer funding opportunities at the state level to stimulate the development and adoption of innovative conservation approaches and technologies that leverage federal investment in environmental enhancement and protection.
- The Conservation Stewardship Program helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns.
- The Environmental Quality Incentives Program provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits, such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation, or improved or created wildlife habitat.

4.4 New York State – Multiple Agencies

New York State's Consolidated Funding Application (CFA) has been created to streamline and expedite the grant application process. The CFA provides multiple economic development opportunities, such as green infrastructure, waterfront revitalization, municipal parks, wastewater infrastructure, and more through a single application - see https://apps.cio.ny.gov/apps/cfa/ . For your convenience, we've listed some of them here.

- The New York Great Lakes Basin Small Grant Program supports local stakeholder-driven projects that apply holistic approaches to meet pressing problems and opportunities for protecting our natural resources, environmental quality, and economic development of New York's Great Lakes Basin. Eligible projects must use a complete ecosystem-based approach rather than a single issue or single species focus, incorporate stakeholder participation, and address key priorities in the New York Great Lakes Action Agenda to enhance community resiliency and ecosystem integrity through restoration, protection, and improved resource management. This Small Grant Program is administered by New York Sea Grant in partnership with NYS Department of Environmental Conservation (DEC).
- The Climate Smart Communities (CSC) Program helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Project type examples are as follows: climate adaptation and mitigation projects related to flood risk reduction, and extreme event preparation. The CSC program is jointly sponsored by the following six New York State agencies: Department of Environmental Conservation; Energy Research and Development Authority (NYSERDA); Department of Public Service; Department of State; Department of Transportation; and Department of Health.
- The Green Innovation Grant Program (GIGP) supports projects across New York State that utilize unique stormwater infrastructure design and create cutting-edge green technologies. GIGP provides grants on a competitive basis to projects that improve water quality and demonstrate green stormwater infrastructure in New York. Green infrastructure practices treat rainwater as a valuable resource to be harvested and used on site, and/or filtered and allowed to soak back into the ground, recharging aquifers, rivers, and streams. GIGP is administered by the New York State Environmental Facilities Corporation.

- The Water Quality Improvement Project (WQIP) grant program funds projects that directly address documented water quality impairments. Examples of eligible project types include: municipal wastewater treatment, nonagricultural nonpoint source abatement control, land acquisition for source water protection, salt storage, aquatic and riparian habitat restoration, nature-based shoreline restoration, and municipal separate storm sewer systems. WQIP is administered by the NYS Department of Environmental Conservation.
- A Local Waterfront Revitalization Program consists of a planning document prepared by a community, and the program established to implement the plan. An LWRP may be comprehensive and address all issues that affect a community's entire waterfront, or it may address the most critical issues facing a significant portion of its waterfront. LWRP is administered by the New York State, Department of State, Office of Planning and Development.
- The Trees for 'Tribs' Grant Program supports efforts to reforest New York's tributaries, or small creeks and streams, which flow into and feed larger rivers and lakes. The goal of the program is to support communities in planting trees and shrubs along stream corridors, also known as riparian areas, to prevent erosion, increase flood water retention, improve wildlife and stream habitat, as well as protect water quality. This program is administered by the NYS DEC.
- The Environmental Protection Fund (EPF) Grant Program supports the acquisition, planning, development, and improvement of parks, historic properties and heritage areas. From historic preservation efforts to playgrounds and trail development, EPF grants support a variety of projects that promote recreation, preserve our historic and natural resources and generally improve the quality of life in communities throughout the state. The EPF program is administered by the NYS Parks, Recreation and Historic Preservation.

In the wake of high waters and state of emergency in 2019, New York State Governor Andrew Cuomo announced a unique opportunity for communities affected by the Lake Ontario and St. Lawrence River shoreline flooding, as part of the new Lake Ontario Resiliency and Economic Development Initiative, or REDI commission. Referencing the extensive property damage and shoreline erosion caused by the 2017 flood event, Governor Cuomo explained that there is a need not only for rebuilding, but also for change in shoreline community planning and infrastructure. The REDI commission

serves to support more resilient shoreline communities that can withstand climate change and future flood events. A need was emphasized to protect sources of tourism and economic development along with residential investment. In effect, the commission will ultimately lead to more vibrant communities that can thrive in a changing environment, while fostering cooperation between state and local government. See https://www.ny.gov/lake-ontario-flooding/lake-ontario-flooding-preparation-resources#redi-commission for details.

Section 5.0 Conclusions and Recommendations

The data analyzed in this study showed that the majority of the shoreline within the project area is naturally resilient, with the exception of a few low-lying areas. These areas include Chippewa Bay, Schermerhorn Landing, Oak Point, Blind Bay, Little Hammond Point, and Allens Point. Specifically, the geology and geography of this area play a protective role against shoreline erosion. In addition, most of the critical infrastructure (e.g., hospitals, schools, etc.) are located outside of the proposed Floodplain Protection Overlay District. However, most of the built infrastructure at-risk of flooding occupy space within the floodplain of the River or its associated tributaries. As a result, flooding of residential and commercial built assets has occurred during flood events. While flooding has damaged the physical integrity of waterfront infrastructure; it has also contributed to negative impacts associated with the social environment and economy- particularly in waterfront communities that are dependent upon water-related tourism.

While natural variations in water levels are important for healthy riverine and lake environments, significant changes in water level highs and lows can make shoreline structures more susceptible to flooding and damage. As a result, vulnerable shoreline communities must plan for water level variation, as they are at-risk of flooding and require adaptive mitigative strategies to improve resiliency. The following are specific action items for the communities which will promote long-term shoreline resiliency.

1. **Make this study available to all subject municipalities for dissemination.**
   Flooding information is collected by each municipality and has been gathered for this study. Compiling this information and making it available to the public will enable multiple stakeholder groups to utilize that information in decision making.
2. **Organize an intermunicipal work group focused on improving resiliency.**
   Establishing a group that is responsible for implementing adaptive mitigation strategies and tracking progress towards becoming more resilient is essential to its success. This group will provide the additional and needed benefits of building and maintaining partnership and collaboration between municipalities and any other stakeholders that would like to join.
3. **Create a formal process to train municipal leaders and educate the public, particularly at-risk property owners, on this matter.**
   Understanding risk can help property owners, emergency responders, planning and zoning boards, insurance and mortgage companies, and other stakeholders make

decisions that will help themselves and their community better prepare for and recover from flooding—to be more resilient.

4. **Adopt an intermunicipal floodplain protection overlay district.**

New York State governs by Home Rule. Home rule gives local governments the authority to regulate land use. A floodplain protection overlay district that requires additional and intermunicipal review of site plans for building permits will go a long way in managing floodplains in a way that acknowledges the upstream-downstream connection of communities.

5. **Adopt or strengthen floodplain and/or flood damage protection regulations**

By strengthening local law for flood damage protection, communities will commit to higher standards that will better protect people and assets.

6. **Prioritize and protect the natural environment**

The natural environment, such as wetlands and floodplains, helps reduce impacts of flood events by storing water and releasing it more slowly to the stream network and groundwater. The natural environment and open space should be protected so they continue to provide flood attenuation services. Environmental Protection Overlay Districts are a good way to protect these lands.

7. **Update topographic survey for most vulnerable areas.**

In order to protect the most vulnerable shoreline communities, the most accurate and up-to-date survey data must be used. Clear topographic data shows which areas are naturally resilient, as well as those that are more susceptible to flooding and shoreline erosion. Preferably, new topographic survey data would be specific to 1.0-foot contours, as opposed to 2.0-foot, in order to provide more precision in the study results.

8. **Perform a detailed assessment of flood-prone tributaries, including critical culverts and bridges.**

Studying local tributaries could give a more holistic view of the St. Lawrence River flooding, and further identify areas at risk, especially critical infrastructure such as culverts and bridges. This would help subject municipalities identify areas in need of resiliency and help better prepare them for future flooding events.

It is recommended that a progress tracking table is created from these action items, which will include date ranges for necessary completion and a place for a County official to sign off on each completed item.

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