Coastal Vulnerability Assessment

Planning & Community Development Department
800 Seminole Road
Atlantic Beach, FL 32233

Revised

May 2021

Table of Contents

List of Tables

List of Figures

Appendices

Executive Summary

Sea levels have risen measurably over the years in Atlantic Beach. The question is how will this rate of sea level rise change in the future and how will it affect us as a City?

To help answer these questions, the City embarked on a study to evaluate the vulnerability of the City with respect to nuisance flooding and storm induced flooding from sea level rise in the 25-, 50- and 100-year timeframe. This report details the methodology utilized to develop a statistically based approach to vulnerability from sea level rise and assessed the vulnerability of critical facilities and infrastructure. The assessment also included an evaluation of the potential impact to all properties and structures within the city limits.

The results of this effort are series of maps that are essentially future versions of the FEMA Flood Insurance Rate Maps utilized for planning and building requirements today. The analysis reveals that there may be significant future impacts from sea level rise in the not so distant future that will have to be taken into account with respect to planning, development and redevelopment.

This report forms the basis for the next step in planning for the impacts of sea level rise through development of an adaptation plan. The adaptation plan will consider policies, planning measures, future projects, etc. to help adapt to and mitigate for impacts to vulnerable areas of the City.

This project was made possible by a Resiliency Planning Grant provided by the Florida Department of Environmental Protection's Resilient Coastlines program. Special thanks to Whitney Grey and Angel Baratta for their assistance.

The following City of Atlantic Beach staff provided content:

Shane Corbin; AICP, Director of Planning
Steve Swann; P.E., City Engineer
Amanda Askew; AICP, Principle Planner
Brian Broedell; AICP, Planner

1.0 Introduction

1.1 Overview

The City of Atlantic Beach is one of three small coastal communities in northeast Florida that make up the "Beaches" of Jacksonville. The City consists of three square miles with a population of approximately 14,000, is located between two miles of Atlantic Ocean beachfront on the east and the expansive marsh and estuarine environment of the San Pablo Creek / Atlantic Intracoastal Waterway (AICW) on the west. Atlantic Beach is a near fully-developed municipality where the predominant land use is residential consisting of stable and well-established neighborhoods.

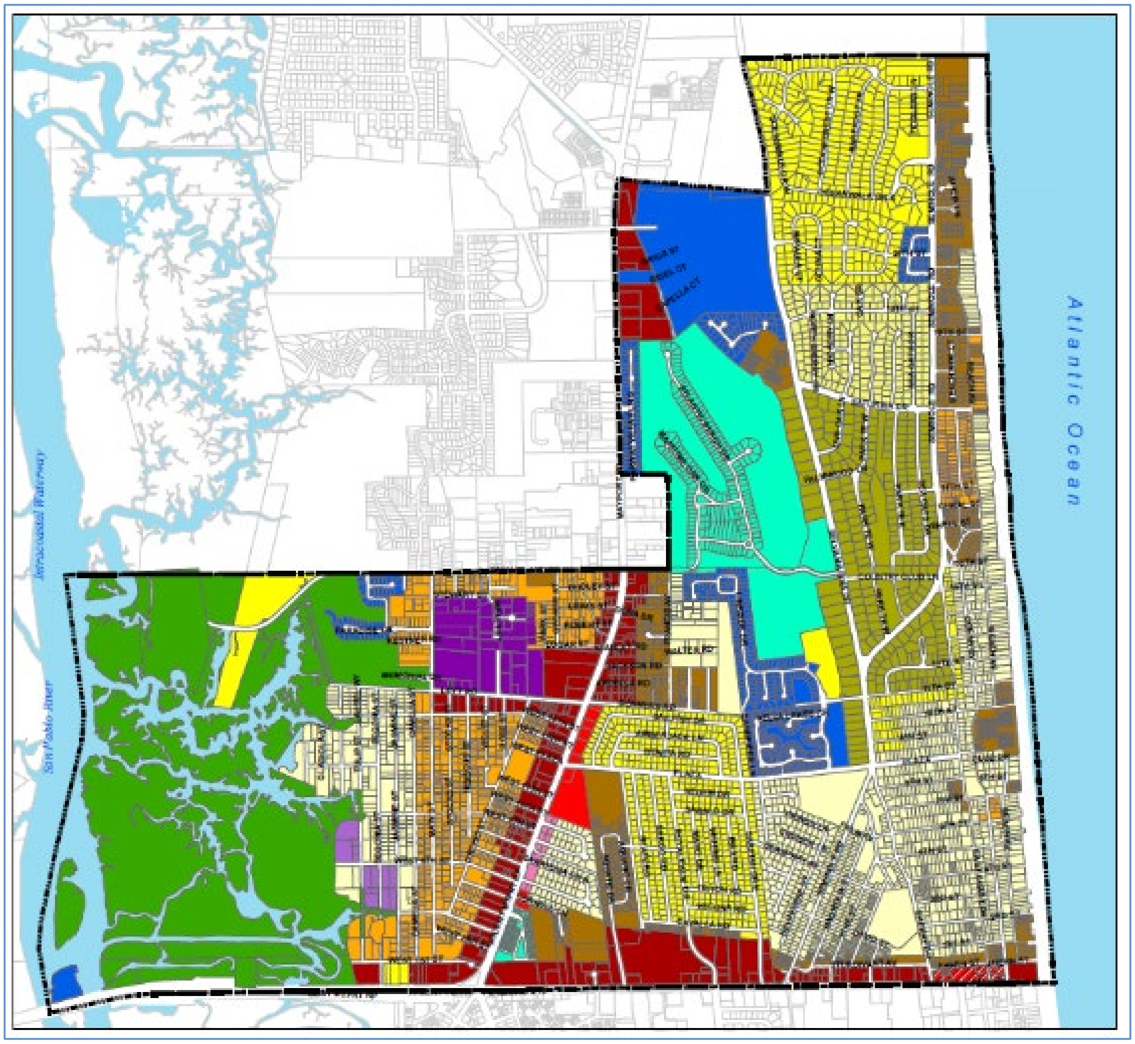


Figure 1-1 – Atlantic Beach Zoning Map

Atlantic Beach contains two commercial corridors: the north side of Atlantic Boulevard (SR10) extending from the ocean westerly to the AICW, and Mayport Road (SR A1A), extending from Atlantic Boulevard northerly to the municipal limits of the City at Dutton Island Road.

The City possesses a unique character and "personality" where a high quality of life, diverse recreational activities, preservation of community character and protection of natural resources are priorities to both residents and elected officials. Since the City is near full build out, current development consists of redevelopment and scattered infill. In 2019, City staff began observing the development of lots that were historically untouched primarily due to low lying topography and proximity to the 100-year floodplain. This trend is likely due to a lack of undeveloped land and the continued attractiveness of the area.

1.2 Coastal Resiliency Planning in Florida

Scientists from around the world have been studying climate change and the resulting sea level rise impacts for decades. Today, multiple sources of data are available to predict realistic scenarios of future sea levels and their impacts on coastal communities. Some cities, such as Miami, are already seeing impacts from sea level changes prompting immediate adaptation measures.

The state of Florida began their first organized adaptation planning efforts in 2009 which led to the Community Planning Act (CPA) in 2011. The CPA gave local governments the option to create adaptation plans. However, the state did not require municipalities to address sea level rise until 2015 when the "Peril of Flood" statute was passed which forced municipalities to address sea level rise in their comprehensive plans. Atlantic Beach incorporated "Peril of Flood" amendments in to its comprehensive plan in 2019.

In 2018, recognizing the need for coastal communities to assess potential impacts from sea level rise, the Florida Department of Environmental Protection's Resilient Coastlines Program awarded its 16 resiliency planning grants to coastal communities including Atlantic Beach. The purpose of Atlantic Beach's grant is to provide funding for planning purposes to help prepare our community for current and future effects of rising sea levels, initially through the preparation of this Vulnerability Assessment.

1.3 About this Project

On average globally, the sea level has risen by about 8 inches since scientific record keeping began in 1880. This rate has increased in recent decades to a little more than an inch per decade. Global average sea level has risen by about 7–8 inches (about 16–21 cm) since 1900, with about 3 of those inches occurring since 1993. In addition to the global average sea level rise, local sea level rise – sometimes called "relative sea level rise" – happens at different rates in different places. Local sea level rise is affected by the global sea level rise, but also by local land motions, and the effects of tides, currents, and winds.

Figure 1-2 shows an increase in global average sea level since 1880, in inches. Note that the blue line, tide gauge data, becomes steeper in more recent decades. This indicates an increasing rate of change. The surrounding light blue-shaded area shows upper and lower 95% confidence intervals and the orange line shows sea level as measured by satellites for comparison (1993-2016). *(U.S. Global Change Research Program, 2017)*

As sea levels have risen, the incidence of nuisance flooding or "sunny day" flooding during spring tide events at certain times of the year have increased five to ten fold since the 1960s in several U.S. coastal cities and rates of increase are accelerating in over 25 Atlantic and Gulf Coast cities. In Atlantic Beach, nuisance flooding resulting in overtopped roads is occurring now in areas of Atlantic Beach such as Dutton Island Road and West Plaza.

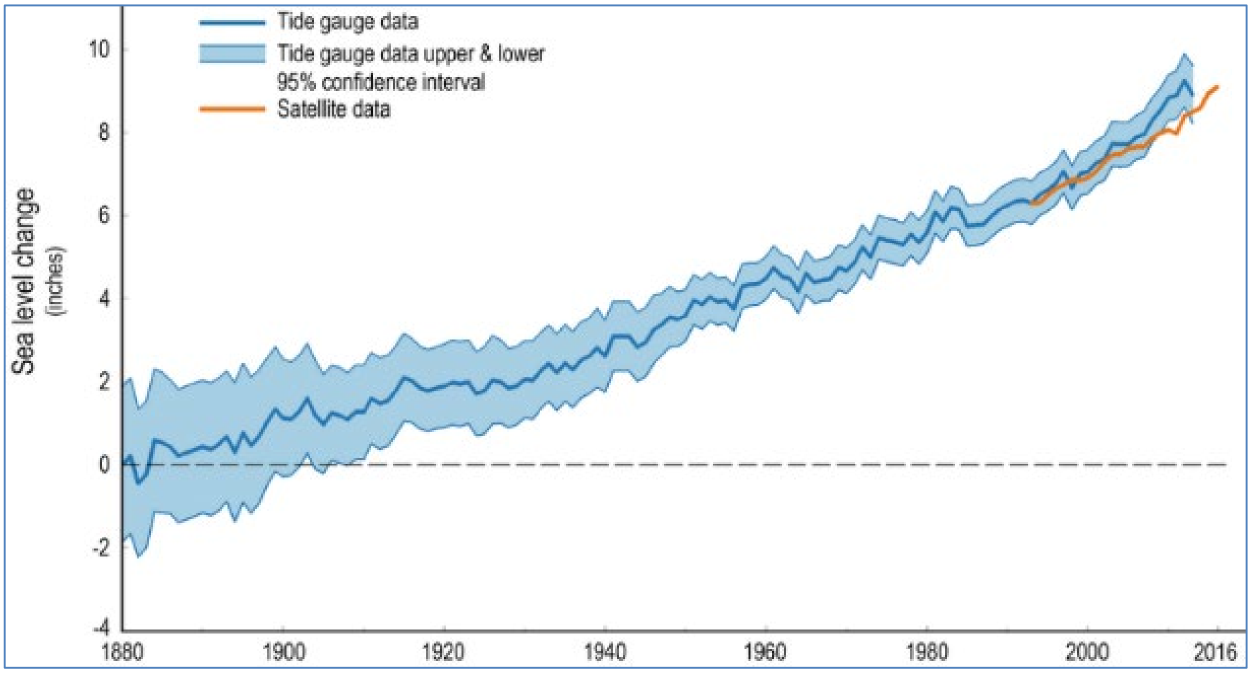


Figure 1-2 – Global Average Sea Level Change (US Global Change Research Program)

The closest National Oceanic and Atmospheric Association (NOAA) primary tidal gauge to Atlantic Beach is located at the Mayport Bar Pilot's Dock (NOAA tide gauge No. 8720218) near the ferry slip. Figure 1-3 depicts the relative change is sea level at the Mayport Bar Pilot's Dock over the 90-year history of this station. The current local rate of sea level change is approximately one-inch every decade. *(https://tidesandcurrents.noaa.gov/sltrends/)*

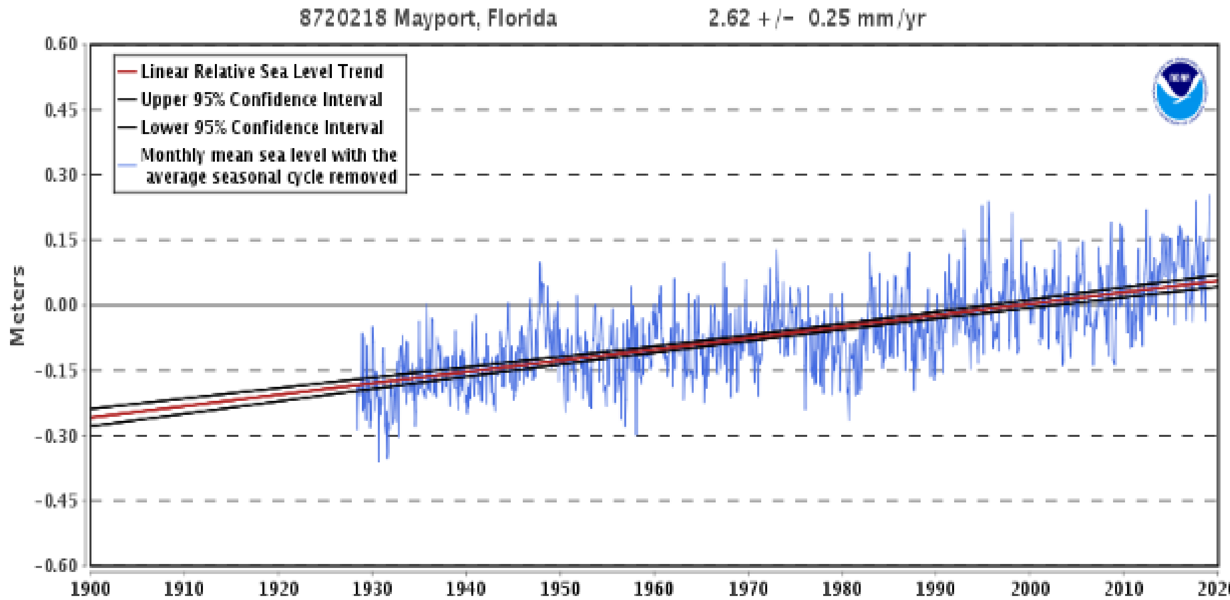


Figure 1-3 – Relative Sea Level Rise – Mayport Bar Pilot's Dock (NOAA)

Although there is uncertainty relating to the change in rate of sea level rise, there is no uncertainty that sea level is rising in our area. As sea levels rise, incidents of nuisance flooding will increase and flooding due to severe weather events will affect larger areas of the City. To aid in both planning and assessing the City's potential vulnerability under future scenarios with higher sea levels, the City conducted a rigorous technical analysis to determine just what those effects may be and how they will impact residents and critical infrastructure.

1.4 Scope of the Vulnerability Assessment

The vulnerability assessment is focused on providing a quantitative analysis of property, infrastructure and habitats within the City's municipal boundaries under future predicted sea level scenarios using widely accepted scientific analyses.

To complete the analyses required to make these predictions, the City selected two engineering consulting firms, Jones Edmunds & Associates and Applied Technology & Management, Inc. (ATM). Both firms have many years of local experience as well as experience conducting similar analyses throughout the coastal areas of the Southeast United States. Their task was to perform an analysis of potential future flood risks under projected sea level rise, storm surge and rainfall induced flooding scenarios to provide geographic information systems (GIS) based predictive flood risk map layers for years 2044, 2069 and 2119. City staff then utilized these GIS maps to perform a vulnerability assessment of sea level rise within its municipal boundaries for 2044 and 2069. Only years 2044 and 2069 are used for the vulnerability assessment due to the level of uncertainty beyond 50 years. In addition, most infrastructure and many buildings only have a life span of 50 years.

The technical analyses that form the basis of the vulnerability assessment began with the current Federal Emergency Management Association (FEMA) Flood Insurance Rate Maps (FIRMs) as the baseline condition and utilized NOAA 2017 Intermediate-High Sea Level Rise (SLR) scenarios for predicted 2044, 2069 and 2119 conditions as follows:

- Mean Higher High Water (MHHW) modeling to predict frequency of nuisance flooding
- Storm surge modeling to predict coastal flooding
- Stormwater modeling to predict upland rain induced flooding
- Composite coastal flooding and upland rain induced flood mapping to delineate future flood hazard areas
- Assessment of property, infrastructure and habitat impacted within flood zones of composite future flood mapping

MHHW is the higher of the two daily tides averaged over a 19-year tidal epoch. The methodology is summarized in Section 2 and the results of these analyses are presented in Sections 3 & 4 of this report. A more detailed description of the methodology is attached in Appendices A & B.

2.0 Methodology

2.1 General Methodology

For this vulnerability assessment, the baseline is the existing mean higher high water (MHHW) level and the current FEMA FIRMs for the City. The MHHW level, which is the average of the higher of each of the two daily high tides, provides an indication of the frequency of sunny day flooding occurrences due to normal tidal cycles and does not include storm events.

The FIRMs for the City of Atlantic Beach provide a prediction of what the 100-year flood event water levels will be. While FEMA does not consider sea level rise (SLR) in the development of a FIRM, they do conduct a rigorous analysis of storm surge flooding and flooding due to upland inundation from rainfall. FIRMs are currently used to map properties with respect to the 100-year flood event to set flood insurance premiums as well as to determine where stricter building and development standards apply for flood protection.

Given the common use of FIRMs for regulatory purposes and general familiarity many people have with these maps, this vulnerability assessment utilizes the FEMA methodology to predict the extents of a 100-year flood event in the future considering the effects of SLR. The technical analyses that serve as the foundation for this vulnerability assessment resulted in essentially producing maps of what the FIRM may look like in 25, 50 and 100 years considering sea level rise. The analyses also incorporated the loss of soil storage that may result from rising sea levels as well as predicted future build-out conditions within the city boundaries.

Surge analyses were conducted for both the Atlantic Ocean side of the City and the Intracoastal Waterway side of the City utilizing the same methodology FEMA used to develop the FIRMs for this area. It is important to note that as water depth increase with SLR, there is a corresponding increase wave heights and wave runup. Hence, the surge analyses being specifically analyzed with future water level conditions and not just added to the predicted increased sea level height.

Upland rainfall induced flooding was analyzed using the Interconnected Pond Routing (ICPR) model developed for the City's 2018 Stormwater Master Plan Update for every drainage basin within the City. This was a necessary step given the flat topography of the City and impacts of tide height on the performance of the drainage systems.

Both analyses utilized current conditions as a reference check and used the intermediate-high NOAA 2017 SLR projections. Surge analyses were conducted for the 25-, 50- and 100-year planning horizons to develop future 100-yr storm event predictions. Upland flooding analyses utilized the same planning horizon to develop associated flood risks from the 10-, 25- and 100-year return period storm events for each time period. The future storm surge flood risk maps that were produced were then combined with the rainfall-induced flood risk for the 100-year return period storm to produce a spatial estimate of future flood risks. MHHW mapping over the same planning horizons were also produced to assess areas where increased sunny day nuisance flooding might be expected.

2.2 Sea Level Rise Projections

A comparison review regarding the projected local sea level rise was performed at the Mayport Bar Pilot's Dock NOAA tide gauge No. 8720218 which is the closest gauge to the City. The projected local sea-level-rise estimates examined were for years 2044, 2069, and 2119 (i.e., the 25-, 50-, and 100-year scenarios). Several studies have published projected SLR estimates at this gauge and are presented graphically in Figure 2-1 and in tabular form in Table 2-1.

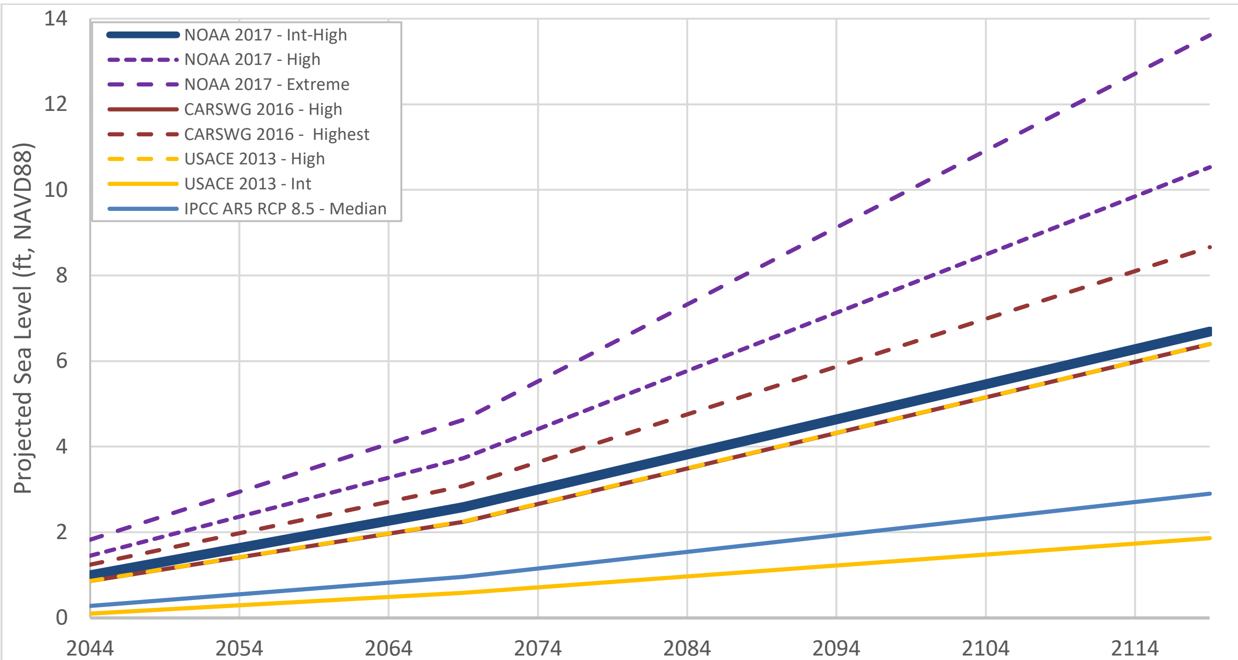


Figure 2-1 – Comparison of Projected Sea Level Rise Data Sets

Table 2-1 - Projected Future Mean Sea Levels - Mayport Bar Pilot's Dock (ft - NAVD88)

Year	USACE 2013		NOAA 2012		CARSWG 2016			NOAA 2017				IPCC AR5 RCP 8.5
	Int	High	Int-High	High	Medium	High	Highest	Int	Int-High	High	Extreme	Median
2044	0.1	0.86	0.63	1.24	0.48	0.86	1.24	0.54	**1.00**	1.45	1.83	0.28
2069	0.58	2.25	1.74	3.08	1.41	2.24	3.08	1.53	**2.58**	3.73	4.63	0.96
2119	1.86	6.4	5.03	8.66	4.13	6.4	8.66	3.77	**6.69**	10.53	13.62	2.90

The NOAA 2017 intermediate-high data was chosen for this effort due to its general acceptance as a moderate estimate of future sea level conditions and its use in other communities throughout Florida. The NOAA 2017 SLR curves are based on a Year 2000 start date. The SLR curve values was adjusted for a baseline start date of 2013, the date the effective FEMA FIS and mapping were completed and represent existing sea level conditions at that time. As a result, the curve values were adjusted for the three time-horizon scenarios by subtracting the projected SLR value of 0.39 foot for the year 2013 from the projected 2044, 2069, and 2119 values. Table 2-2 summarizes the selected sea level rise scenarios utilized in this vulnerability assessment.

Table 2-2 – Projected Sea Level Rise – NOAA Intermediate High 2017

Scenario	Projected Sea Level Rise (Feet)	Tidal Boundary Stage* (Feet NAVD 1988)
2019	0	2.00
2044	1.26	3.26
2069	2.85	4.85
2119	6.95	8.95

* Predicted future mean higher high water (MHHW) level

For comparison, water elevations recorded during Hurricane Matthew in October 2016 and Hurricane Irma in September 2017 are presented below. The highest water level recorded during Hurricane Matthew was 5.23 feet NAVD88 and was 5.58 feet NAVD88 during Hurricane Irma. Figure 2-4 compares estimated future sea levels with the highest tides from these two events.

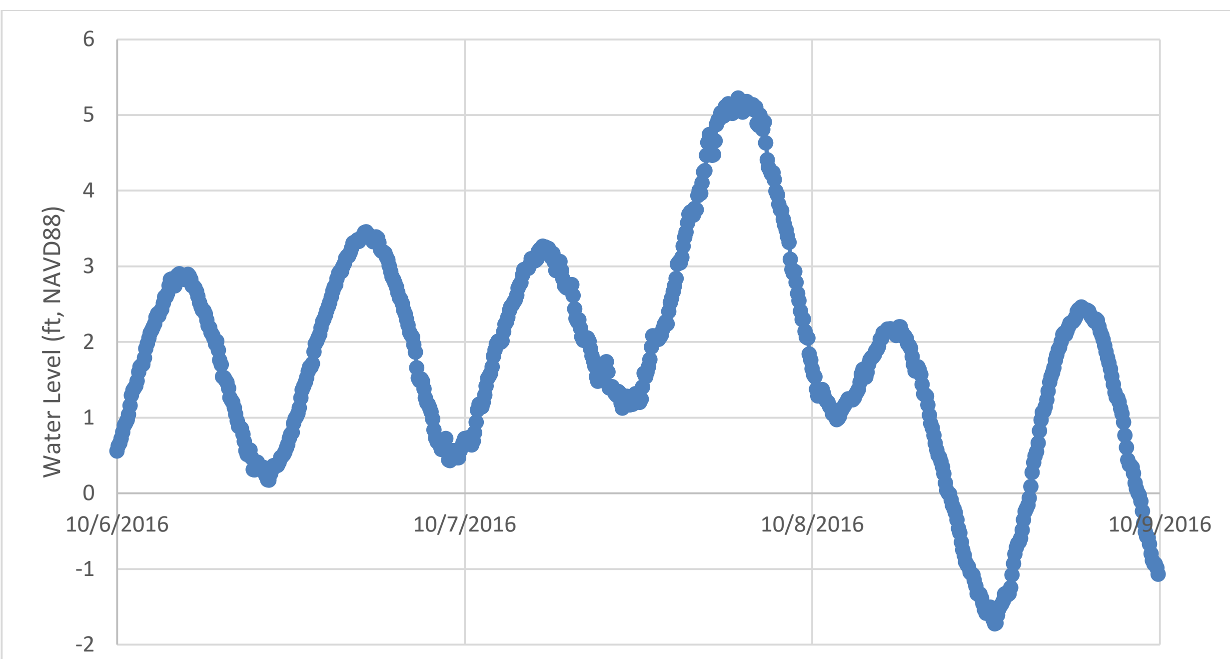


Figure 2-2 – Hurricane Matthew Water Levels - October 2016 at Mayport Bar Pilot's Dock

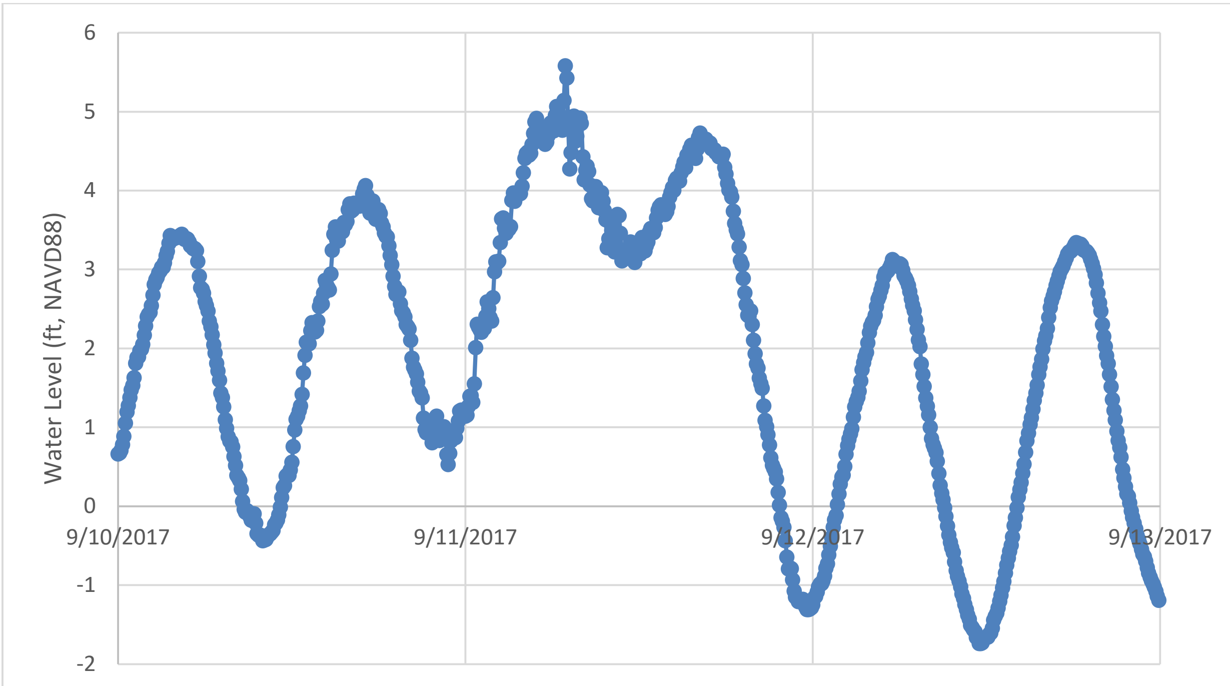


Figure 2-3 – Hurricane Irma Water Levels - September 2017 at Mayport Bar Pilot's Dock

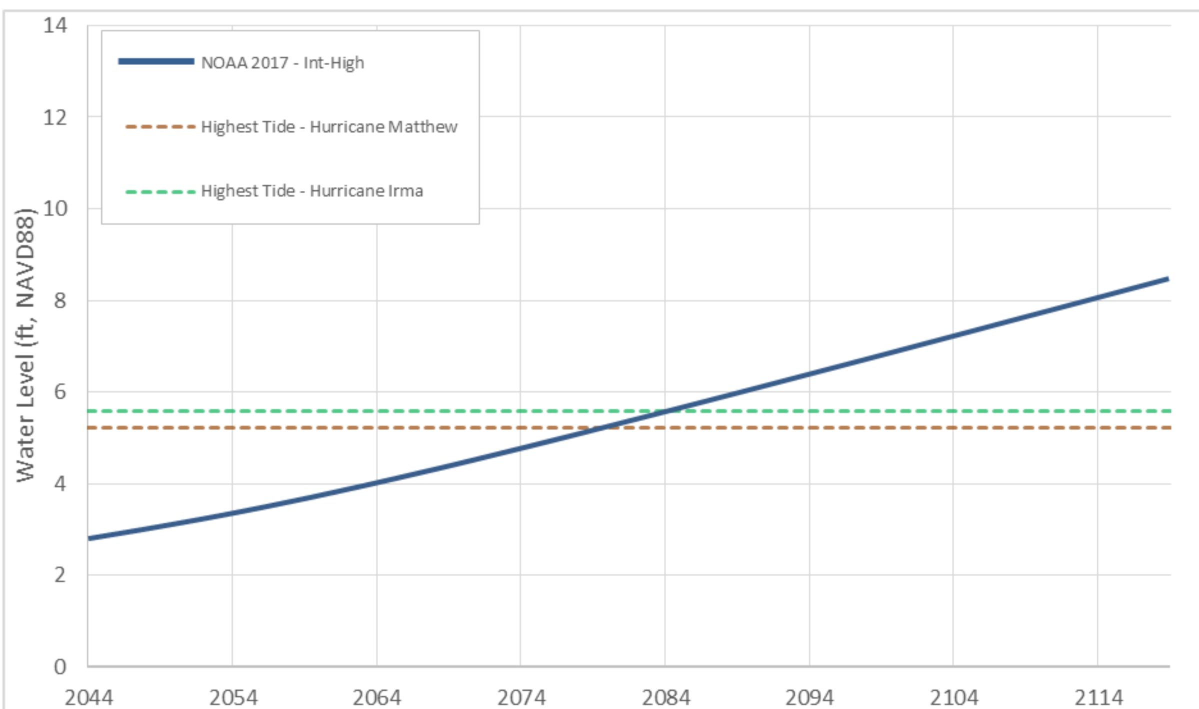


Figure 2-4 – Comparison of Matthew and Irma Water Levels with Projected Mean SLR

2.3 Nuisance Flooding

Nuisance flooding, sometimes referred to as "sunny day" flooding, is flooding that leads to public inconveniences such as road closures. The City currently experiences a limited degree of nuisance flooding in several locations. As sea levels continue to rise, nuisance flooding will become more prevalent and extensive.

For this effort, nuisance flooding is considered to be occurring when the tide level is approximately one foot greater than the Mean Higher High Water (MHHW) level at Mayport. This occurs at least once every year as can be seen in the statistical summary presented in Figure 2-5. This chart indicates that there is 99% probability of water levels exceeding MHHW by at least 1’ (0.3 m) on an annual basis. Similarly, there is a 50% probability of tidal levels exceeding MHHW by 1.5’ (0.45 m) in any given year and a 10% probability of tidal levels exceeding MMHW by 2’ (0.6 m) in any given year.

The current MHHW level in our area is at elevation 2’, and based on observations, nuisance flooding can start to occur when water levels exceed 3’. Areas of the City that are at or below 3’ elevation include the Dutton Island access road and portions of West Plaza, both areas that currently experience nuisance flooding. Given that there is a 99% probability of water levels of at least 1’ above MHHW occurring on annual basis as shown on Figure 2-5, nuisance flooding in portions of Atlantic Beach is expected to occur at least once every year at a minimum.

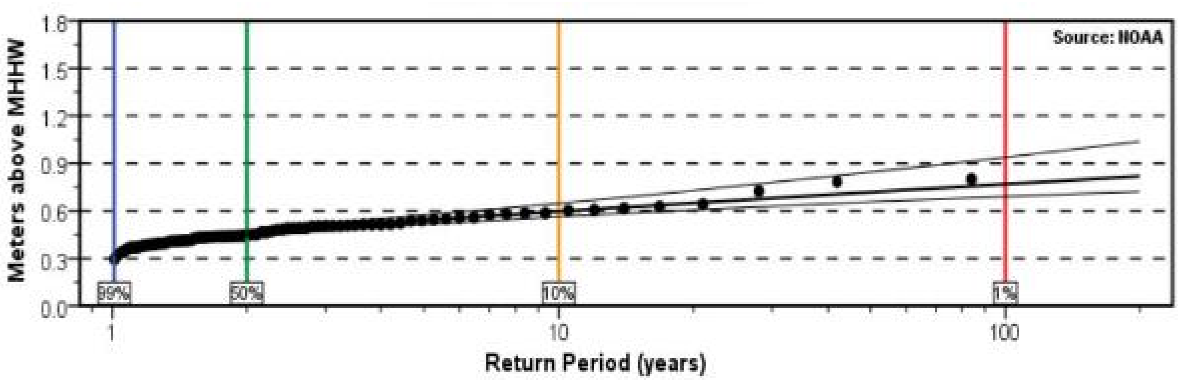


Figure 2-5 – Annual Exceedance Probability Curve – Mayport Bar Pilot’s Dock (NOAA)

To estimate nuisance flooding in the future, NOAA’s Digital Coast tools were utilized to overlay one foot of water level on top of the predicted sea level rise over the planning period. As updated digital elevation models become available, the City will undertake a more rigorous analysis of the future frequency and extent of nuisance flooding will update the Vulnerability Assessment as necessary.

2.4 Future Flood Risk

As sea levels rise there will generally be an increase in flood risk. This increased risk is not reflected in the current FEMA Flood Insurance Rate Maps (FIRMs) for the City. Estimating the extent of future risk requires updating the FIRMs to account for impacts in both storm surge and rainfall induced flooding under higher sea level conditions. The following sections describe the methodology utilized to develop the information required to assess the future flood risk for the City.

2.4.1 Storm Surge Modeling

Rising sea level will result in increased storm surge levels and wave heights as well as exacerbate nuisance flooding from extreme high tides. The combination of a higher sea level with a storm surge can result in larger storm impacts and coastal vulnerability from a flooding perspective than are currently experienced.

FIRMs are updated on a regular basis (typically every 10 years) and FEMA only considers the existing mean sea level at the time of the update and does not account for SLR. For the vulnerability assessment, an analysis based on the FEMA flood mapping protocol was conducted to evaluate coastal flooding and wave risks under projected SLR scenarios for 25, 50 and 100 years.

The storm surge modeling utilized existing FEMA stillwater elevation (SWEL) results (that don't include waves) for a 100-year event and increased the elevations to account for the projected increase in sea levels in the future. The next step required updating wave transect modeling on top of the increased SWEL elevations to predict 100-year base flood elevations under future higher sea levels. Figure 2-6 depicts a typical FIRM cross-section and the concept of SWEL and wave setup on top of the SWEL. Appendix A contains a detailed description of this approach.

Note that wave modeling is very sensitive to water depth and increased future sea levels will allow larger waves to travel further inland during storms because there is more area inundated with higher future SWEL. This is illustrated in Figure 2-7. The result of these analyses were FIRM type flood maps for future higher sea level scenarios.

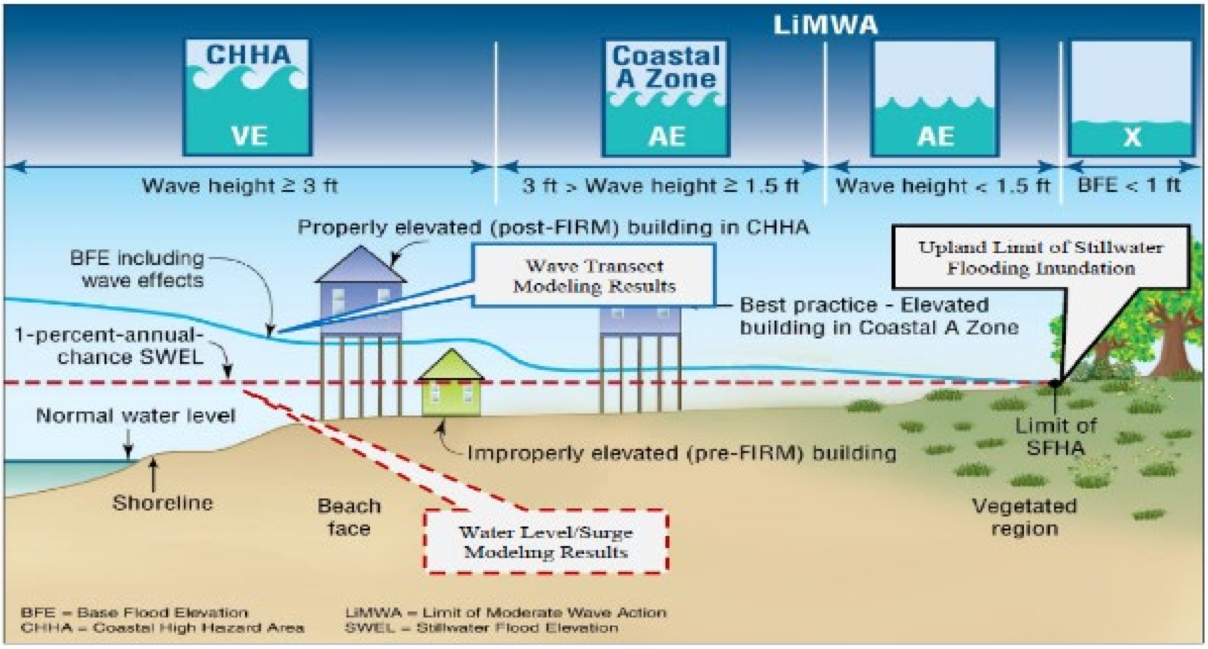


Figure 2-6 – Illustration of a Coastal Wave Transect

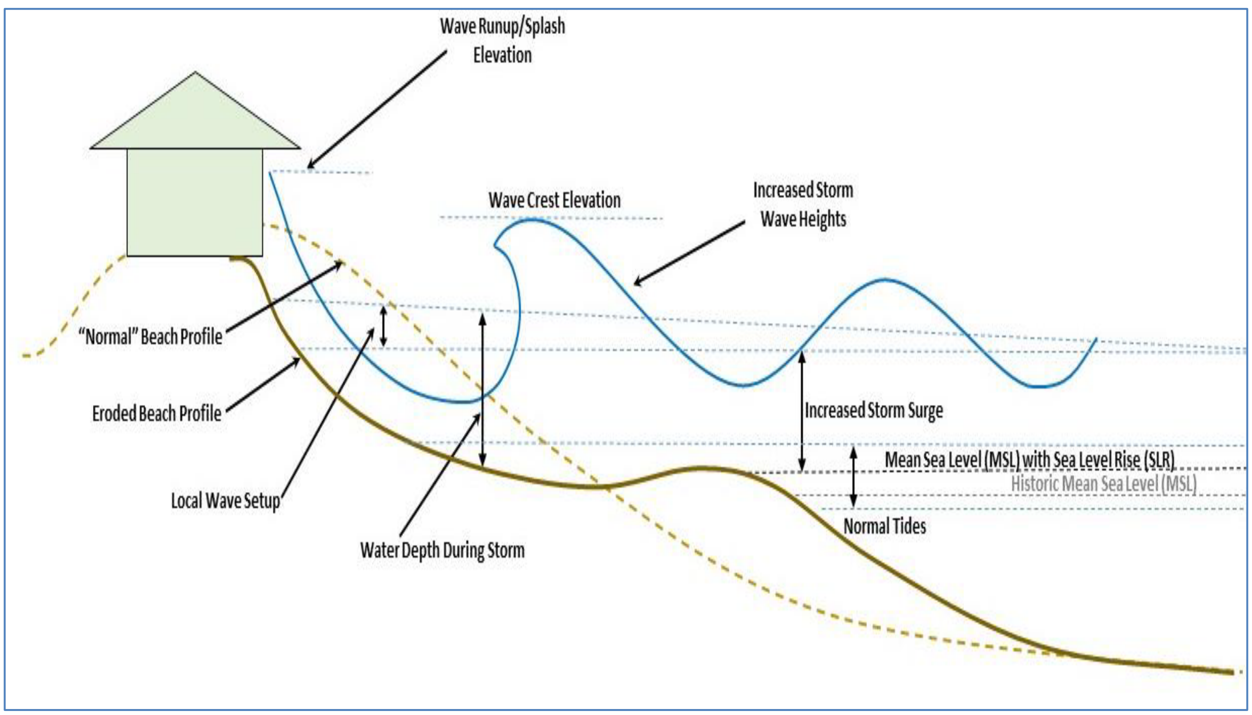
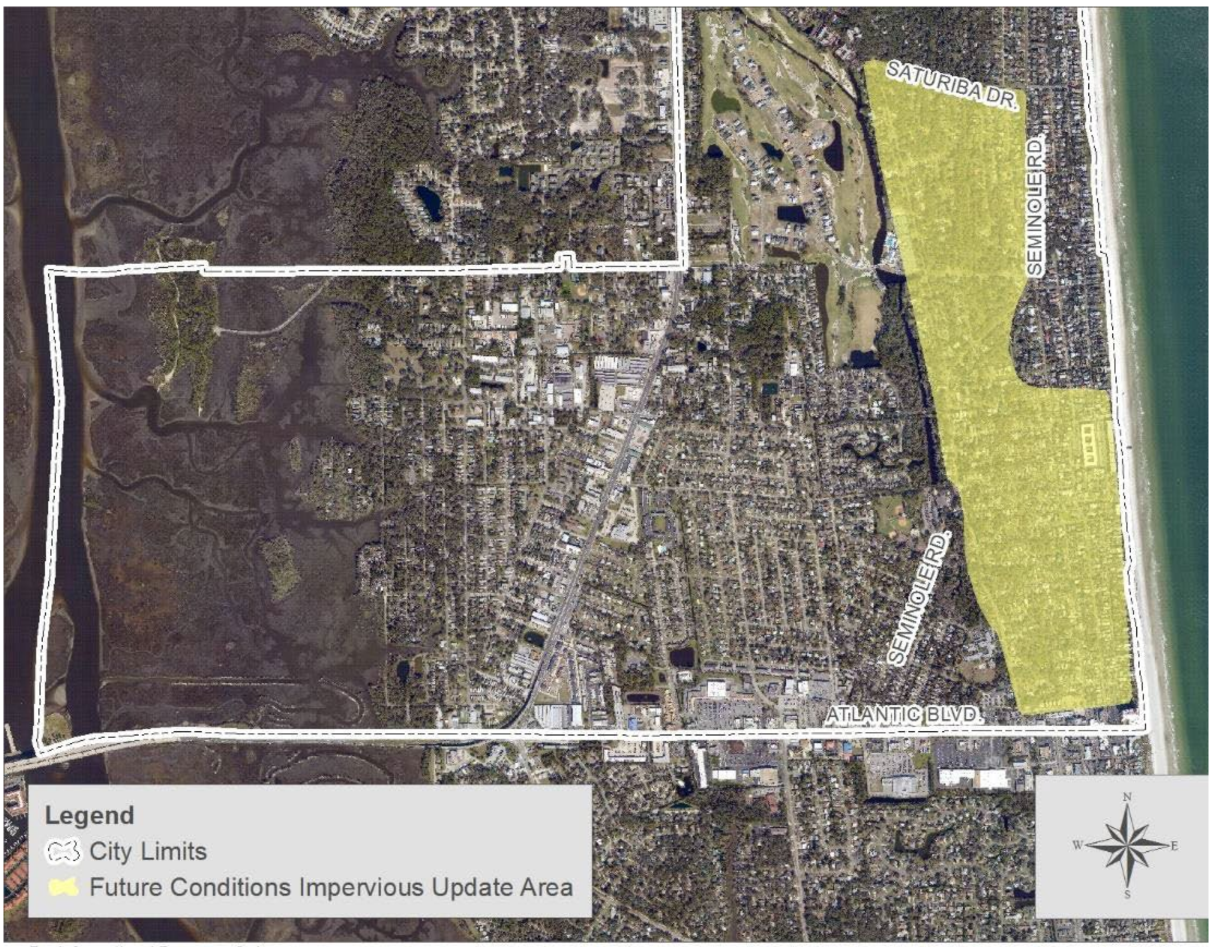


Figure 2-7 – Illustration of Modeling Effects of Sea Level Rise

2.4.2 Stormwater Inundation Modeling

To determine how rainfall-induced flooding may be impacted by sea level rise and new development within the City, the hydrologic and hydraulic parameters in the Interconnected Pond Routing (ICPR) Version 4 models that were developed during the City's 2018 Stormwater Master Plan update were adjusted to reflect projected increases in impervious area from future development, increased boundary conditions and node initial conditions from rising sea levels, and reduced soil storage from rising sea levels.

The rates of future development that were developed for the City's 2018 Stormwater Master Plan update were used to estimate the impervious area in the City in 2044, 2069 and 2119. The estimated future impervious values were applied to the already modeled stormwater drainage basins so that modeled runoff accurately reflects future conditions. The areas updated for future increases in impervious area for the 2044, 2069 and 2119 conditions are shown in Figure 2-8.



For Informational Purposes Only K:\08505 Atlantic Beach\8505.03_2017SWMPU\Design\MXD\Report\FutureConditionsImperviousUpdateArea.mxd

Figure 2-8 – Future Conditions Impervious Update Area

The ground water table is also expected to rise with rising sea levels because of consistently higher tides. This increase in ground water levels will reduce the amount of soil storage available for rainfall to infiltrate and will increase the volume of runoff during storm events. The decrease in soil storage will be more marked in areas directly adjacent to the coastline and will be reduced further inland. To account for these projected changes, the basin criteria in the stormwater model were adjusted to decrease soil storage capacity in conjunction with expected future sea level elevations.

Peak stage results from the future drainage conditions models were used to map the predicted rainfall-induced flood risk in the City in 2044, 2069 and 2119 for a series of 24-hour rain events including the 100-year return period rainfall events The results were then mapped using the 5-foot-by-5-foot digital elevation model (DEM) generated from the 2007 City of Jacksonville Light Detection and Ranging (LiDAR) data. Note that this does not account for grading changes that have occurred since the LiDAR was collected, including the grading changes at the Atlantic Beach Country Club. The models will be updated if necessary when newer data is available, expected late 2019. See Appendix B for a detailed description of this modeling approach.

2.4.3 Combined Inundation

The future storm surge flood risk maps were then combined with the rainfall induced inundation maps for the 100-year return period storm for 2044, 2069 and 2119. These maps are attached as Appendix C separately. Where there was overlap between the flood risk mapping, the higher inundation estimate from the two mapping efforts was selected. These maps provide for a spatial estimate of future flood risk that will serve as the basis for the vulnerability assessment.

Note that rainfall induced flood risk and coastal surge flood risk are usually evaluated relatively independently because the two forms of flood risk are neither fully dependent nor fully independent. Therefore, traditional statistical approaches are not applicable and the standard procedure to deal with this is to evaluate the two independently using common sea level rise scenarios and then take the higher of the combined identified risk at each location.

3.0 Future Conditions with Sea Level Rise

3.1 Projected Mean Higher High Water Levels

Figure 3-1 depicts the extent of Mean Higher High Water (MHHW) levels, the average of the higher of the daily high tides over a 19 year tidal epoch for NOAA's intermediate-High sea level rise projections for years 2044, 2069 and 2119 in Atlantic Beach. This is also referred to as a "bathtub model" because the higher water levels are just mapped to fill in areas of the City below the projected MHHW level. This model does not incorporate rainfall induced flooding or storm surge. The boundaries shown in this figure project where the future shoreline may be located absent any adaptive measures.

3.2 Projected Extents of Nuisance Flooding

Figure 3-2 depicts nuisance, or sunny day, flooding that the City may experience based on anticipated sea level rise. The mapped extent of projected nuisance flooding is based on the annual probability of experiencing tide levels of at least 1 foot greater than the MHHW.

Future nuisance flooding is predicted to increase substantially on the western side of the City adjacent to the Intracoastal Waterway and along Sherman Creek and the Aquatic Gardens neighborhood. Nuisance flooding seaward of the mapped extents are expected to be more frequent than an annual event.

3.3 Projected 100-Year Event Storm Surge

Figure 3-3 illustrates the projected extent of the storm surge expected from a 100-year storm event in Atlantic Beach in 2044, 2069 and 2119. This map builds on the previous "bathtub model" by predicting the potential extent of future storm surge resulting from increased sea levels during a 100-year storm event. Note that sea level projections for 2119 have a very high degree of uncertainty and is shown here for illustrative purposes only.

3.4 Projected Rainfall Induced Flooding

Figure 3-4 illustrates the projected rainfall induced flooding from a 100 year storm in Atlantic Beach for years 2044, 2069 and 2119. This map reflects future conditions with increased impervious surface from development. In addition, stormwater infrastructure is inhibited and the water table is elevated due to sea level rise projections. This map is combined with the projected previous storm surge map to create the projected 100 Year Future Flood Zones used in the vulnerability assessment.

3.5 Projected 100-Year Storm Event Flood

Figure 3-5 illustrates the extent of a projected 100-year storm event for years 2044, 2069 and 2119 by combining the previous 2 maps (Figure 3-4 and Figure 3-5). This map was developed using the same process FEMA utilized to create current Flood Insurance Rate Maps that depict the current extent of flooding expected from a 100-Year storm event. The extent of flooding from a 100-year storm event associated with projected sea levels in 2119 are provided for illustrative purposes only. The 2044 and 2069 scenarios are used for the Vulnerability Assessment due to the high level of uncertainty in sea level rise projections beyond 50 years.

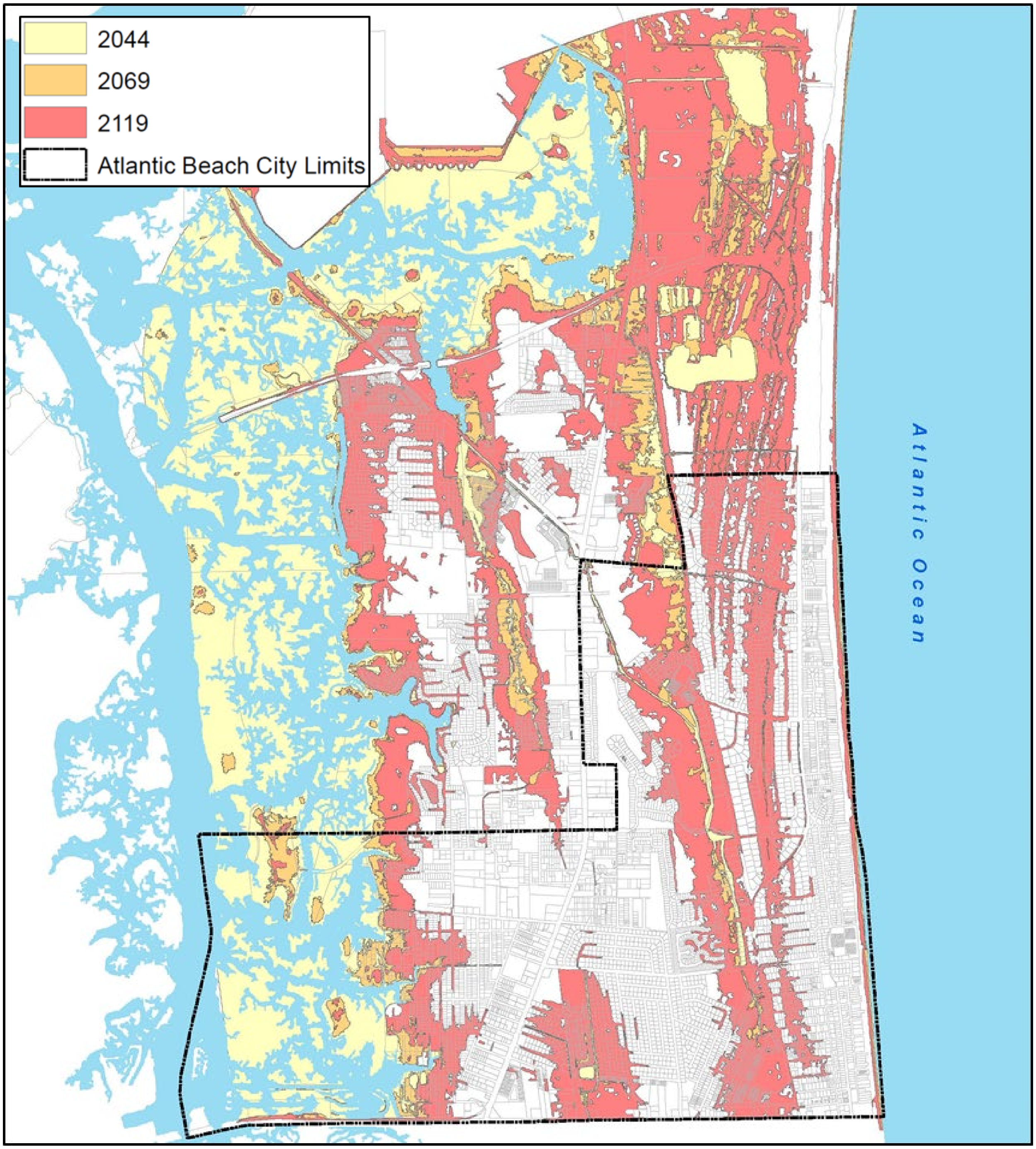


Figure 3-1– NOAA 2017 Intermediate-High Projected SLR for 2044, 2069 and 2119

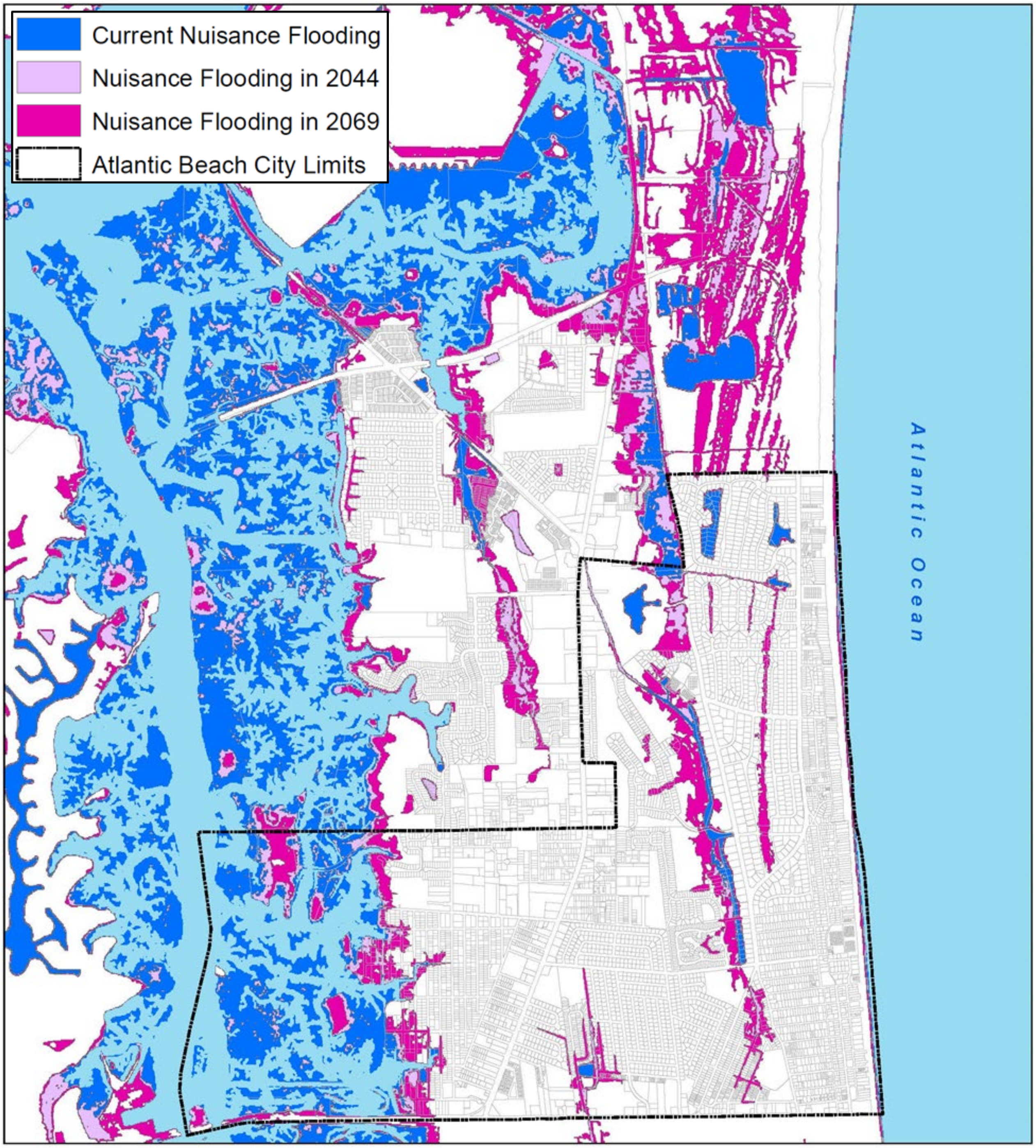


Figure 3-2 – Projected Nuisance Flooding Due to SLR

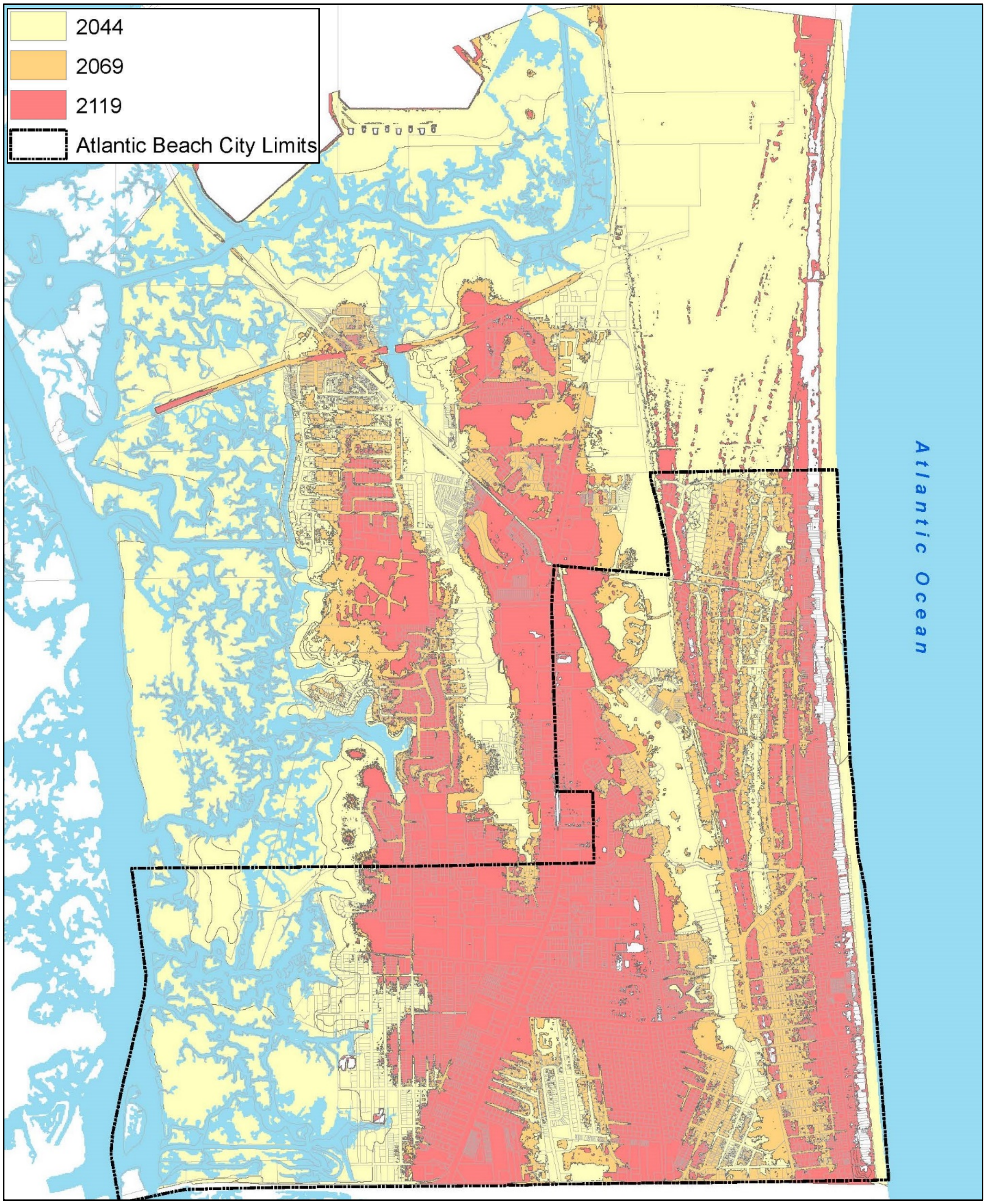


Figure 3-3 – Projected 100-Year Event Storm Surge

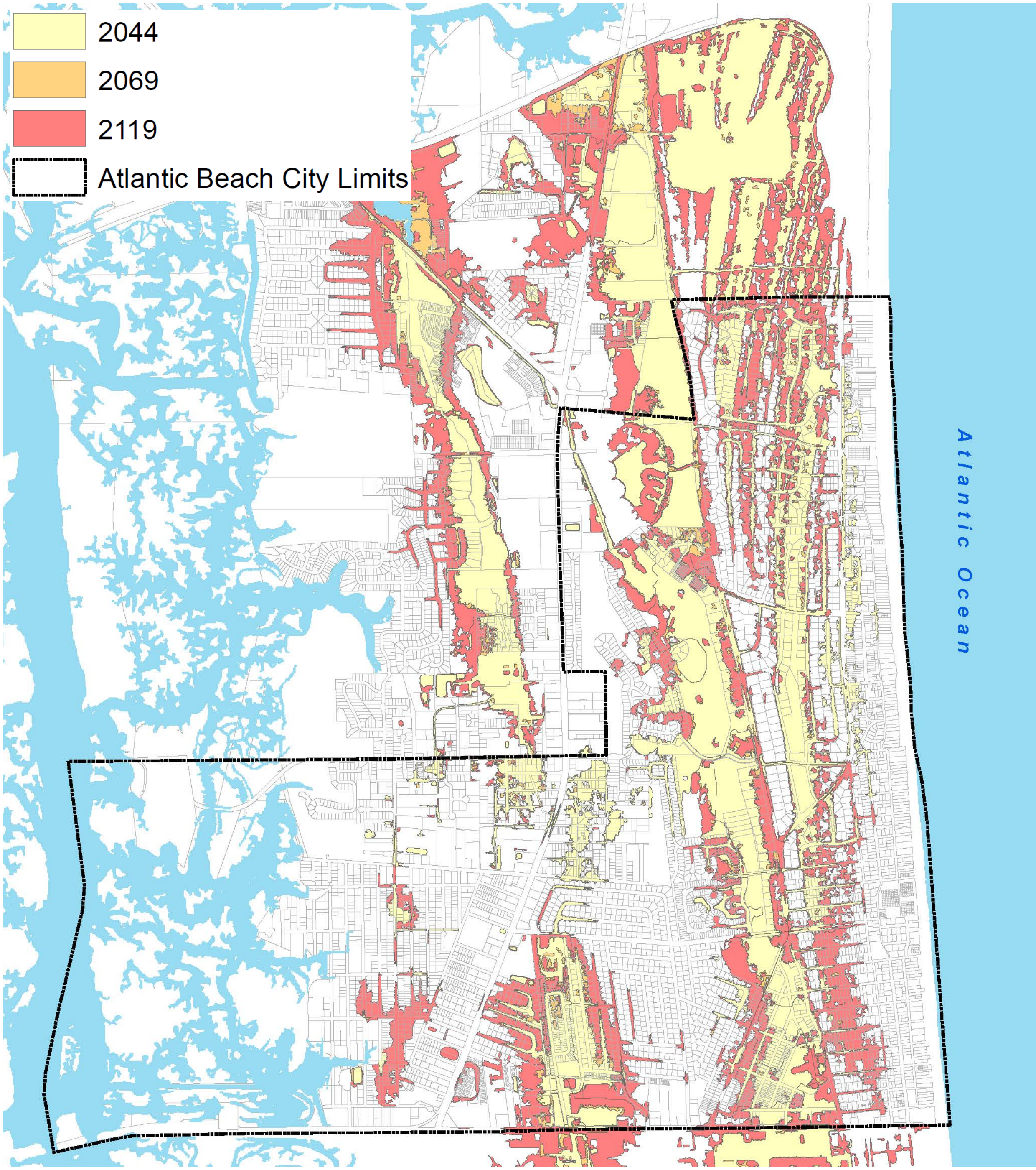


Figure 3-4 – Projected 100-Year Storm Event Rainfall Induced Flooding

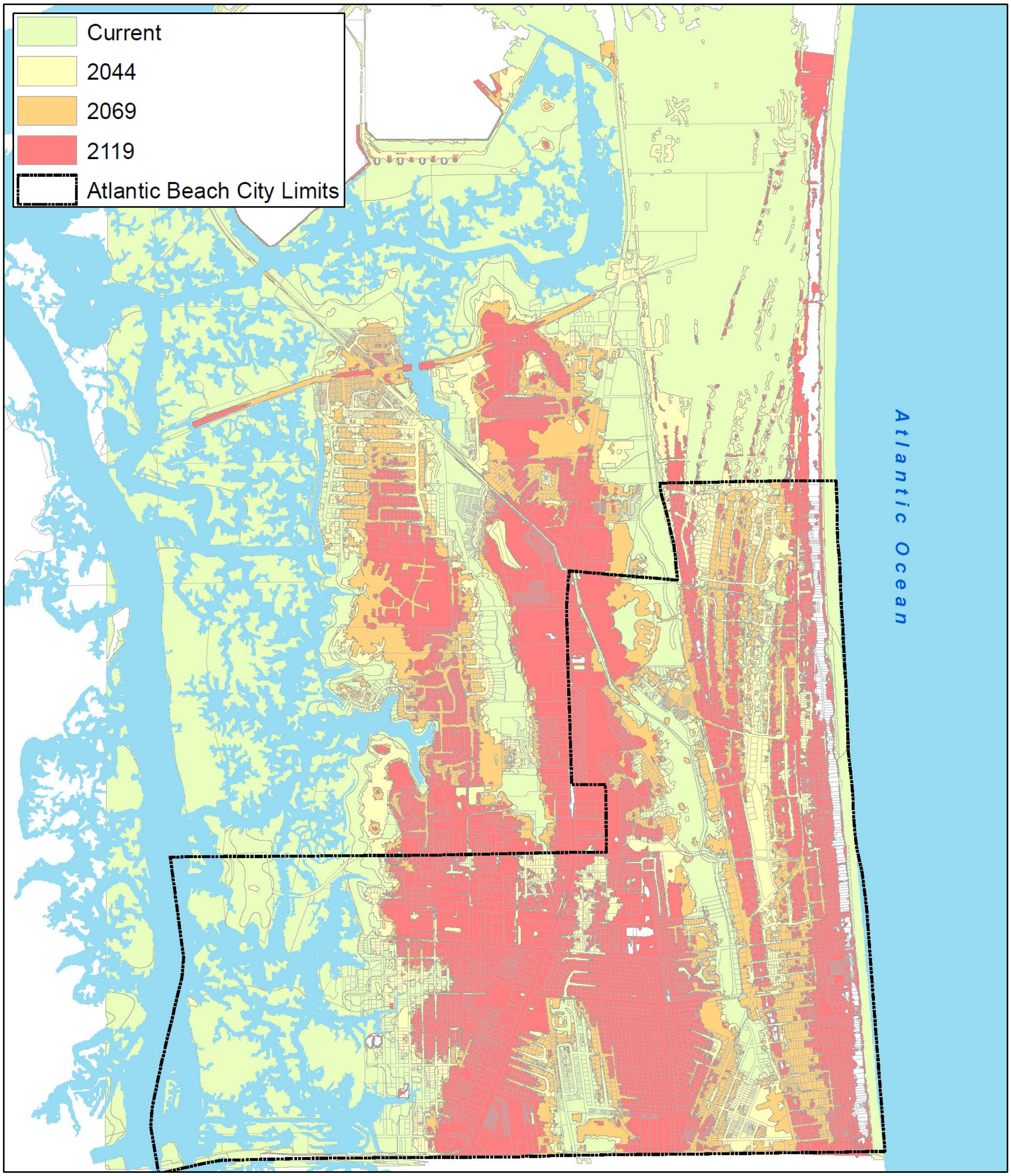


Figure 3-5 – Projected 100-Year Storm Event Flood

4.0 Vulnerability Assessment

4.1 Properties and Buildings

Based on the projected impacts of sea level rise, there will likely be additional properties in the future that will be subject to both nuisance flooding and located within a Special Flood Hazard Area (SFHA, which is the area inundated by flood waters from a 100-year storm event). Table 4-1 illustrates the total value of land and buildings impacted for the bathtub model, nuisance flooding and projected 100 year flood risk maps for 2044 and 2069. For the 100 year flood risk assessment, parcels were only counted if water was projected to reach their center. Counting every parcel touched would have included beach front parcels which are actually at higher elevations and typically have higher assessed values. All values are provided in today's dollar.

Table 4-1 - Vulnerability of Property

2044 Scenarios	Number of Parcels Impacted (% of All Parcels)	Number of Buildings on Impacted Parcels	Land Value of Impacted Parcels	Building Value of Impacted Parcels	Taxable Value of Impacted Parcels
SLR Only	262 (4%)	391	$38,694,000	$87,283,000	$106,065,000
Nuisance Flooding	249 (4%)	372	$33,564,000	$90,416,000	$111,556,000
100-Yr Flood Risk	1,035 (17%)	1,085	$100,693,000	$191,439,000	$233,842,000

2069 Scenarios	Number of Parcels Impacted (% of All Parcels)	Number of Buildings on Impacted Parcels	Land Value of Impacted Parcels	Building Value of Impacted Parcels	Taxable Value of Impacted Parcels
SLR Only	391 (6%)	509	$48,602,000	$108,385,000	$134,427,000
2069 Nuisance Flooding	797 (13%)	910	$82,899,000	$191,360,000	$241,443,000
2069 100-Yr Flood Risk	2,191 (35%)	2,248	$246,921,000	$424,598,000	$576,235,000

Nuisance flooding totals are important because they reflect what is likely to happen at least once annually. By 2069, nuisance flooding is predicted to impact 13% of properties in Atlantic Beach totaling $241,443,000 in taxable value. In 2069, 35% of properties will fall within the projected 100 year flood risk map totaling $576,235,000 in taxable value.

Existing development standards in place will help mitigate the impacts from sea level rise on property up to a certain point. These standards relate to the required minimum finished floor elevation (FFE) for all new construction that creates a buffer between flood water and living areas. The City currently requires a minimum finished floor elevation of 7.5 feet above mean sea level or 2.5 feet above the 100- year flood elevation or base flood elevation (BFE) per Chapter 24, Sec. 24-251(c) of the Land Development Code. However, the buffer provided by FFE standards that apply today to properties located in a SFHA will be reduced in the future as sea levels rise. Note that many structures currently located in a SFHA were built before these standards were required and will experience higher risk unless they are elevated.

4.2 Critical Facilities

4.2.1 Critical Facilities and Sea Level Rise - 2044 and 2069

The impact of SLR with respect to the vulnerability of critical facilities and infrastructure within the City is important with respect to planning. Critical facilities and infrastructure within the city limits located within areas subject to future inundation were picked up in the assessment as well as critical water and wastewater utility infrastructure owned and operated by the City outside of the city limits, see Figure 4-1. The assessment showed no direct impacts from the projected sea level in 2044 and direct impact to one wastewater lift station from the 2069 projection. However, one additional lift station, the City Hall and sections of five of the nine critical roadways are located within just twenty feet of the projected 2069 sea level.

4.2.2 Critical Facilities and Nuisance Flooding - 2044 and 2069

An assessment of critical facilities and infrastructure within the city was also completed for projected nuisance flooding in years 25 and 50, Figure 4-2. The results show two lift stations projected to be impacted by nuisance flooding in 2044 and seven lift stations projected to be impacted in 2069. Further, the models show City Hall, the City Hall parking lot and various sections of critical roadways may be prone to nuisance flooding by 2069.

4.2.3 Critical Facilities and Future Flood Risk Maps for 2044 and 2069

Using the projected 100-year flood zones in 2044 and 2069, an assessment of critical facilities and infrastructure within the city limits was completed, Figure 4-3. In both scenarios, critical facilities including the Police and Fire Station, City Hall, the Gail Baker Community Center and Atlantic Beach Elementary School are located within the projected flood zones. In addition, two potable water plants, four potable water wells and sections of all nine identified critical roadways are within both flood zone scenarios.

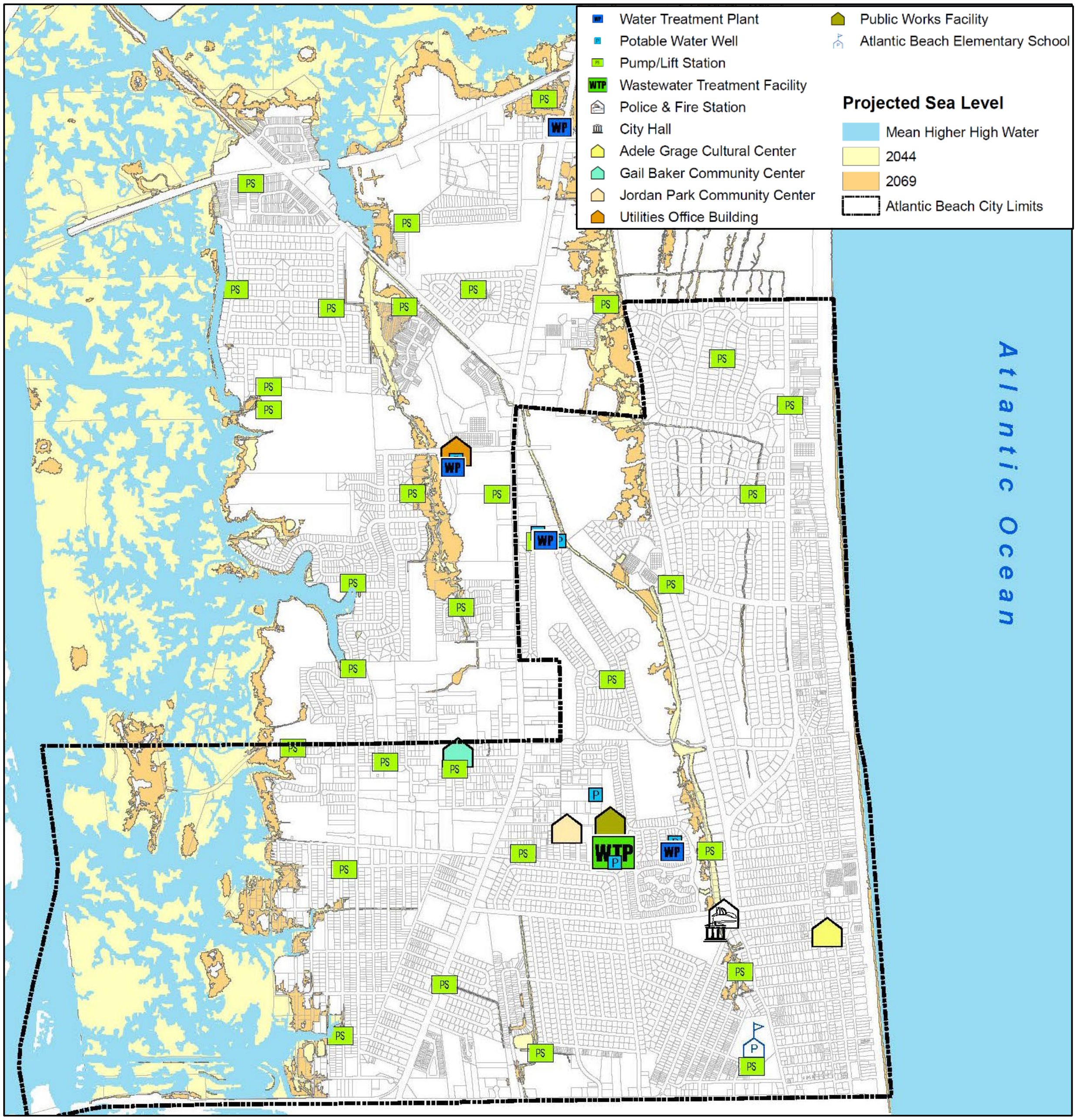


Figure 4-1 – Location of Critical Facilities in Proximity to SLR for 2044 and 2069

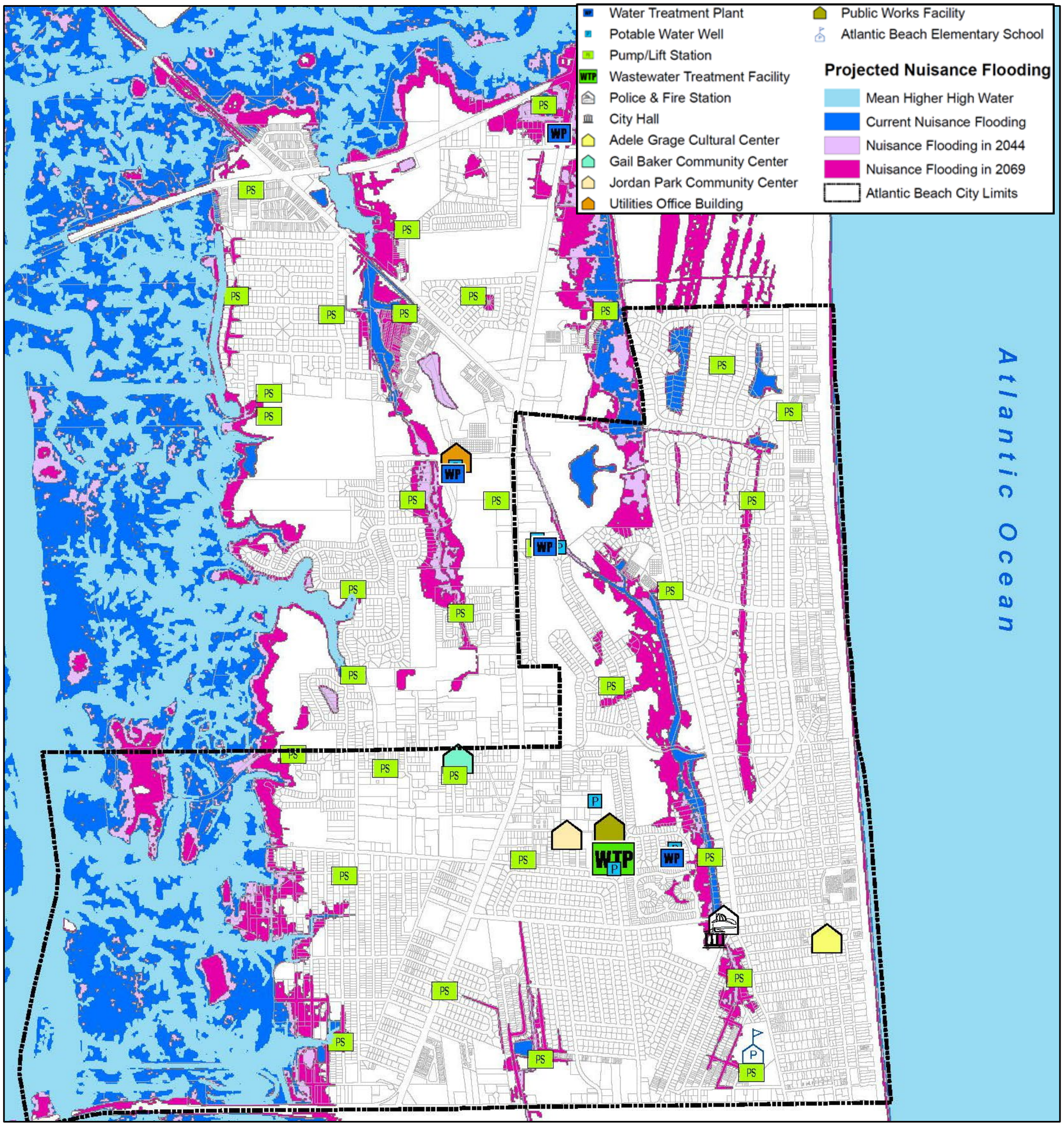


Figure 4-2 – Location of Critical Facilities in Proximity to Nuisance Flooding

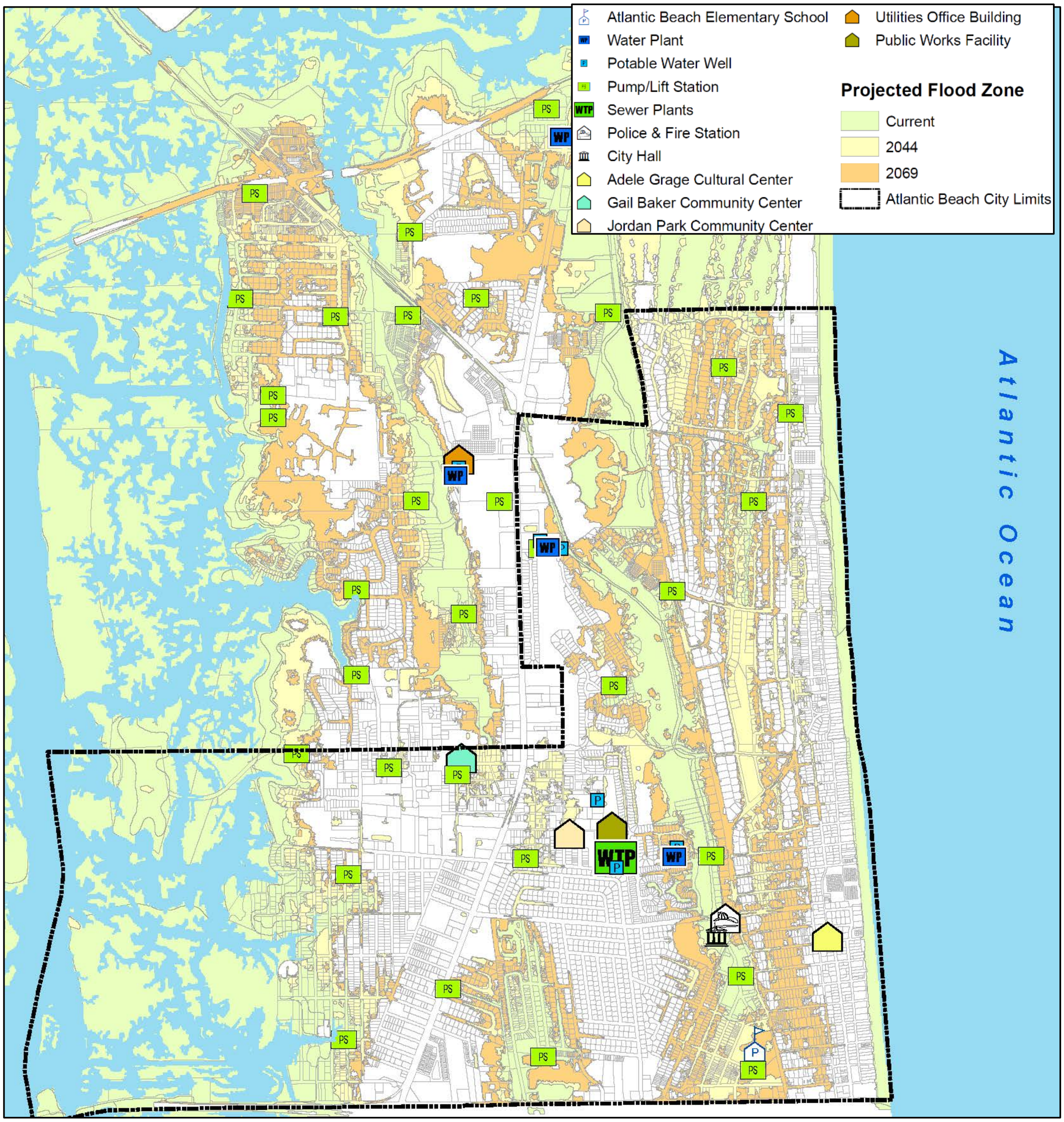


Figure 4-3 – Critical Facilities and Future Flood Risk Maps for 2044 and 2069

4.2.4 Summary of Critical Facilities Vulnerability

Table 4-2 summarizes the projected vulnerability of critical facilities for Atlantic Beach for the 25- and 50-year scenarios (2044 and 2069). As depicted in this table, sea level rise alone is not projected to become problematic for critical facilities until 2069. However, nuisance flooding in conjunction with sea level rise begins to impact critical city infrastructure by 2069.

Table 4-2 – Summary Critical Facilities Vulnerability by Scenario

2044 Scenarios	Critical Roads	City Hall, Police & Fire Station	Public Utilities Facility	Public Works Facility	Lift Stations (#)	Potable Water Wells (#)	Potable Water Plants (#)	Waste-water Facility	Atlantic Beach Elem. School	Adele Grage Center	Gail Baker Center	Jordan Park Center
SLR Only	N	N	N	N	N	N	N	N	N	N	N	N
Nuisance Flooding	N	N	N	N	Y (2)	N	N	N	N	N	N	N
100-Yr Flood Risk	Y (9)*	Y	N	N	Y (18)	Y (2)	Y (1)	N	Y	N	Y	N

* Portions of Atlantic Blvd, Seminole Rd, Mayport Rd, Sherry Dr, Dutton Island Rd, Levy Rd, Plaza, Main St & Selva Marina Dr

2069 Scenarios	Critical Roads	City Hall, Police & Fire Station	Public Utilities Facility	Public Works Facility	Lift Stations (#)	Potable Water Wells (#)	Potable Water Plants (#)	Waste-water Facility	Atlantic Beach Elem. School	Adele Grage Center	Gail Baker Center	Jordan Park Center
SLR Only	N	N	N	N	Y (1)	N	N	N	N	N	N	N
Nuisance Flooding	Y (3)**	N	N	N	Y (7)	Y (2)	Y (1)	N	N	N	N	N
100-Yr Flood	Y (9)*	Y	N	N	Y (23)	Y (4)	Y (2)	N	Y	N	Y	N

* Portions of Atlantic Blvd, Seminole Rd, Mayport Rd, Sherry Dr, Dutton Island Rd, Levy Rd, Plaza, Main St & Selva Marina Dr

** Portions of Seminole Rd, Levy Rd, & Selva Marina Dr

Table 4-3 –Critical Facilities Exposure Summary

2044		**2069**	
The two lift stations projected to be impacted by nuisance flooding in 2044 are located at 425 11th Street and 739 Renault Drive. The two wells projected to within the 100 year flood risk in 2044 are "1N" and "2S" both located at Plant #4. The water plant projected to within the 100 year flood risk in 2044 is Plant #4.	The eighteen (18) lift stations projected to be within the 100 year flood risk in 2044 are: 1. 302 Camelia St 2. 858 Cavalla Rd 3. 458 David St 4. 460 Palm Ave 5. 425 11th St 6. 69 Donner Rd 7. 1799 Selva Marina Dr 8. 404 20th St 9. 2277 Seminole Rd 10. 1030 Mimosa Cove 11. 1045 Monmouth Ct 12. 2567 West End St 13. 2632 SR A1A 14. 995 Gavagan Rd 15. 2595 Americas Cup Cr E 16. Dutton Island Rd W 17. 739 Renault Dr 18. 2200 Fairway Villas	The lift station projected to be impacted by sea level in 2069 is located at 739 Renault Drive. The seven (7) lift stations projected to be impacted by nuisance flooding in 2069 are: 1. 858 Cavalla Rd 2. 460 Palm Ave 3. 425 11th St 4. 404 20th St 5. 1030 Mimosa Cove 6. 2595 Amercias Cup Cr E 7. 739 Renault Dr The two wells projected to be impacted by nuisance flooding in 2069 are "1N" and "2S" at Plant #4.	The water plant projected to be impacted by nuisance flooding in 2069 is Plant #4. The four wells projected to be within the 100 year flood risk in 2069 are "1N" and "2S" at Plant #4; "3W" at Plant #3; and "1" at Plant #1. The two water plants projected to be within the 100 year flood risk in 2069 are Plant #1 and Plant #4. The (23) lift stations projected to be within the 100 year flood risk in 2069 include those 18 within the 2044 flood risk as well as: 1. 2318 Barefoot Tr 2. 2210 Aspin Ridge Dr 3. 2885 Wonderwood Ln 4. 914 Schooners Bay Dr 5. 1082 Ticonderoga St

The projected 100-year floodplain in 2044 and 2069 is expected to significantly encroach on critical facilities. This projected encroachment has implications for critical facility planning as discussed in Section 5.0.

5.0 Next Steps

5.1 Adaptation Planning

There is good news. The City of Atlantic Beach has time plan for the future and minimize the negative impacts associated with SLR. The next step is for the City to begin an adaptation planning process. The adaptation planning process would engage stakeholders to evaluate SLR predictions and consider what actions, if any, should be taken. The Florida Department of Economic Development (DEO) has resources available to assist local governments in this process and multiple communities have already completed their adaptation plans.

DEO describes the following 5 strategies for adaptation planning:

1. **Protection** - Protection strategies involve "hard" and "soft" structurally defensive measures to mitigate the impacts of current and future flooding, such as seawalls or beach renourishment, in order to maintain existing development.

2. **Accommodation -** Accommodation strategies do not act as a barrier to inundation but rather alter the design, construction, and use of structures to handle periodic flooding. Examples include elevating structures and stormwater retrofits that improve drainage or use natural areas to soak up or store water and runoff (i.e., green infrastructure).

3. **Strategic Relocation** - Strategic relocation involves the possible relocation of existing development to safer areas through voluntary or incentivized measures in populated, hazard prone areas that reduce the intensity of development and/or gradually increase setbacks over time. Such options usually involve the transition of vulnerable land from private to public ownership, but may also include other strategies such as transfer of development rights, purchase of development rights, and rolling easements.

4. **Avoidance** - Avoidance involves anticipatory actions taken to direct new development away from vulnerable lands to safer areas. Examples include land conservation, conservation easements, transfer of development rights, and increased coastal setbacks.

5. **Procedural -** Procedural strategies aim to generate vulnerability and adaptation information, increase awareness of vulnerabilities and adaptation options, or incorporate such information into plans or policies. Examples include vulnerability assessments, community outreach and education activities, new comprehensive plan language addressing sea level rise, and real estate disclosures.

6.0 References

2015 Unified Sea Level Rise Projection for Southeast Florida, Southeast Florida Regional Climate Change Compact Sea Level Rise Work Group, 2015

Climate Science Special Report: Fourth National Climate Assessment, U.S. Global Change Research Program, 2017

Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) Climate Change 2014: Synthesis Report, 2014

Adaptation Planning – Florida Department of Economic Opportunity (http://www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/adaptation-planning)

Global and Regional Sea Level Rise Scenarios for the U.S., NOAA Technical Report NOS CO-OPS 083, 2017

Global Sea Level Rise Scenarios for the United States, NOAA Technical Report OAR CPO-1 National Climate Assessment, 2012

Incorporating Sea Level Changes in Civil Works Programs, USACE Engineer Regulation (ER) 1100-2-8162, 2013

NOAA Tides & Currents – Water Levels (https://tidesandcurrents.noaa.gov/sltrends/)

Regional Sea Level Scenarios for Coastal Risk Management Report, Coastal Assessment Regional Scenario Working Group (CARSWG) 2016