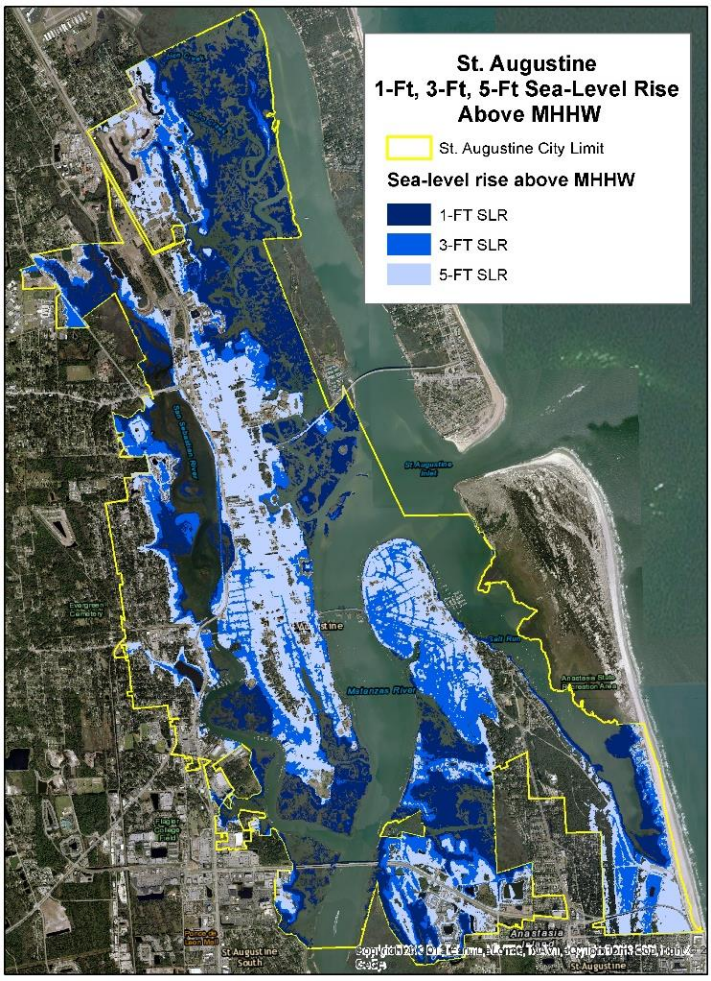
Adapting to Rising Tides

Coastal Resilience in St. Augustine: Baseline of Our Past, Beacon for Our Future

STUDY APPENDICES

April 2016



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Appendix 1. Sea Level Rise (SLR) Projection and Inundation Methodology

1.1 Northeast Florida Relative Sea Level Rise Projections

Sea level trends, which are based on historical local observations, are used with models of future scenarios to estimate what sea levels might be at a given point in the future. Because of the uncertainty in the factors driving sea level rise (e.g. greenhouse gas emissions, global temperature increases, glacial and ice sheet melt), it is prudent to consider a range of possible future scenarios. In this paper, two sets of future sea level projections were evaluated and mapped: one set from the U.S. Army Corps of Engineers (USACE) and the other set from the National Climate Assessment, commonly referred to as the NOAA projections. It is important to note that these values were expressed in feet relative to LMSL and have not yet been converted to NAVD88.

1.2 U.S. Army Corps of Engineers Relative Sea Level Rise (SLR) Projections

The USACE utilizes three sea level rise (SLR) projections or "curves" for evaluating the effects of potential relative SLR on their coastal projects. Each of the three curves represents a future scenario of sea level change, resulting in global sea level rise values of 8 inches (0.2 meter)s, 1.6 feet (0.5 meters), and 5 feet (1.5 meters) by 2100. These curves were adapted from the National Research Council's report, *Responding to Changes in Sea Level: Engineering Implications,*[1] and can be explained as excerpted from the USACE and summarized below:

- **USACE Low Curve (8 inches or 0.2 meters by 2100):** The historic rate of sea-level change based on observed local sea level measurements. The USACE Low and NOAA Low are equivalent.
- **USACE Intermediate Curve (1.6 feet or 0.5 meters by 2100):** Computed from the modified NRC Curve I considering both the most recent Intergovernmental Panel on Climate Change (IPCC) projections and modified NRC projections with the local rate of vertical land movement added. The USACE Intermediate and NOAA Intermediate Low are equivalent.
- **USACE High Curve (5 feet or 1.5 meters by 2100):** Computed from the modified NRC Curve III considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added. "This 'high' rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate the potential rapid loss of ice from Antarctica and Greenland, but it is within the range of values published in peer-reviewed articles since that time." The USACE High is below the NOAA High.

1.3 NOAA Global Mean Sea Level Rise (SLR) Projections

Under the Global Change Research Act of 1990, the United States National Climate Assessment (NCA) is commissioned by U.S. Congress every four years to consider future sea level rise trends and synthesize current scientific literature on global mean SLR. The NCA is a multi-agency effort, led by NOAA, and provides four global mean SLR scenarios which can be used for assessing potential impacts. These four scenarios estimate that mean global sea level will rise at least 0.2 meters (8 inches) and no more than

[1] For more information on the U.S. Army Corps of Engineers Sea Level Change Methods, see: http://www.corpsclimate.us/ccaceslcurves.cfm

2.0 meters (6.6. feet) by 2100.[2] Each of the scenarios incorporates different amounts of thermal expansion from ocean warming and ice sheet loss, resulting in a range of projected global mean SLR amounts as excerpted from the NOAA report and summarized below.

1. **NOAA Low Curve (8 inches or 0.2 meters by 2100):** This is a linear extrapolation of the historic SLR rate of 1.7 mm/yr. The NOAA Low and USACE Low are equivalent.
2. **NOAA Intermediate Low Curve (1.6 feet or 0.5 meters by 2100): "**Based on upper end of the IPCC Fourth Assessment Report (AR4) global SLR projections resulting from climate models using the B1 emissions scenario." The NOAA Intermediate Low and USACE Intermediate are equivalent.
3. **NOAA Intermediate-High Curve (3.9 feet or 1.2 meters by 2100):** "Based on an average of the high end of semi-empirical, global SLR projections. Semi-empirical projections utilize statistical relationships between observed global sea level change, including recent ice sheet loss, and air temperature." The NOAA Intermediate High is below the USACE High curve.
4. **NOAA High Curve (6.6 feet or 2.0 meters by 2100):** "The greatest uncertainty surrounding estimates of future global SLR is the rate and magnitude of ice sheet loss, primarily from Greenland and West Antarctica" High rate "…derived from a combination of estimated ocean warming from IPCC Fourth Assessment Report (AR4) global SLR projections and a calculation of the maximum possible glacier and ice sheet loss by the end of the century." The NOAA High is above the USACE High curve.

1.4 Other Sea Level Rise (SLR) Projections

While this paper utilizes sea level rise (SLR) projections from USACE and NOAA, it is pertinent to mention two (2) other sets of projections for context of the ranges of estimated future sea level. First, the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) provides four (4) scenarios of future sea level rise based on predicted greenhouse gas emissions. These scenarios result in estimates of 10 inches (0.26 meters) to 32 inches (0.82 meters) of SLR by 2100.

Additionally, the Southeast Florida Climate Compact recently adopted three (3) relative SLR scenarios for the southeast region to utilize in analysis of potential vulnerabilities and development of adaptation strategies: (1) NOAA High Curve; (2) USACE High Curve; and (3) a curve representing the mean of the IPCC AR5 RCP8.5 scenario. These three (3) scenarios result in estimates of 31 inches (0.79 meters) to 61 inches (1.55 meters) by 2100.

[2] For more information on the National Oceanic and Atmospheric Administration (NOAA) Sea Level Change Methods, see: NOAA. (December 6, 2012). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. Climate Program Office (CPO) – NOAA Technical Report OAR CPO-1. http://cpo.noaa.gov/AboutCPO/AllNews/TabId/315/ArtMID/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx

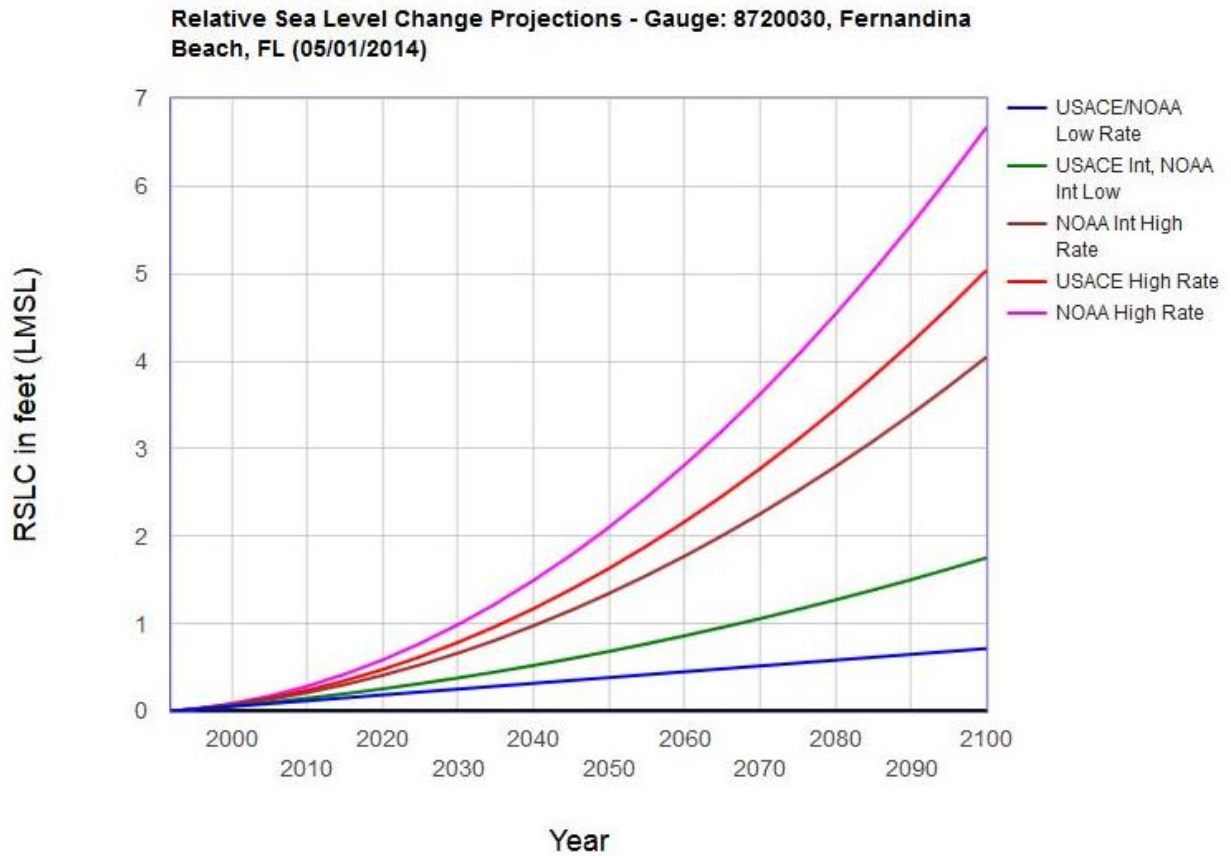

Figure 1. USACE and NOAA relative sea level change projections (in feet), Fernandina Beach, Florida.

1.5 Relative SLR Inundation Mapping Methodology

The relative SLR projections are expressed relative to mean sea level (MSL). In order to utilize these projections for the determination and analysis of potential impacts to coastal and terrestrial features, the values must be translated to the North American Vertical Datum of 1988 (NAVD88), which is the vertical datum of the Digital Elevation Model (DEM) used in this paper. This correction value (to convert from MSL to NAVD88) is unique for each tide station and varies throughout the state's coastal areas. SLR amounts were converted to NAVD88 for terrestrial inundation mapping using correction values from the St. Augustine tide station # 8720576.

Additionally, the relative SLR scenarios were mapped on top of Mean Higher High Water (MHHW) tidal datum. Many locations on the U.S. east coast experience two high tides and two low tides a day. MHHW represents the average of the higher of those two high tides. This value is based on actual water level observations gathered at each tide station over a 19-year period. Because this represents the current observed high tide, it is common and recommended practice to map relative SLR amounts on top of high tide (in this case MHHW). This analysis uses MHHW tidal datum values from the St. Augustine tide station # 8720576, which is located in close proximity to the City, and represents tidal variation in the Intracoastal waterways surrounding much of the City.

"Bathtub" inundation models for each relative SLR scenario were then mapped using a Digital Elevation Model (DEM) compiled by the University of Florida GeoPlan Center. This DEM was created by

mosaicking data from four different sources, including the best available LiDAR data from the Coastal LiDAR collection coordinated by the Florida Division of Emergency Management and NOAA. The bathtub inundation models were then evaluated for hydrologic connectivity and isolated areas not connected to the ocean, intracoastal, or adjoining waterway were removed from the GIS layers of inundation.

Appendix 2. Adaptation Tools

2.1 Overview

Common relative SLR adaptation tools to investigate and implement include the following: (1) coordination, cooperation, collaboration, and decision support; (2) planning; (3) regulatory; (4) financial: government spending; and (5) financial: taxes, trusts, and market-based.[3]

At the regional and local levels in Florida it is important to build upon the work done by others and to thoroughly examine the specific impacts of SLR in each locale. The State of Florida does not currently have a comprehensive statewide strategy to adapt to SLR. However, much work has been done at the federal level, and in other states and cities, that can be applied to Northeast Florida. In addition, organizations such as the Florida Department of Economic Opportunity (DEO), the St. Johns River Water Management District (SJRWMD), and the Army Corps of Engineers (ACE) have adopted or implemented guidelines that assist in creating local strategies. The materials included within this section of the paper are excerpted and adapted from the following resources.

Adaptation Action Areas: A Planning Guidebook for Florida's Local Governments
http://www.floridajobs.org/docs/default-source/2015-community-development/community-planning/crdp/aaaguidebook2015.pdf?sfvrsn=2

Florida Department of Economic Opportunity (DEO) – Adaptation Funding Resources
http://www.floridajobs.org/docs/default-source/2015-community-development/community-planning/crdp/adaptationfundingopportunities.pdf?sfvrsn=2

Georgetown Climate Center - Adaptation Tool Kit: Sea Level Rise and Coastal Land Use
http://www.georgetownclimate.org/resources/adaptation-tool-kit-sea-level-rise-and-coastal-land-use

Protecting Florida's Communities: Land Use Planning Strategies and Best Development Practices for Minimizing Vulnerability to Flooding and Coastal Storms (Florida DCA, 2005)
http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/449/Florida_Community_Protection_-_DCA_2005.pdf

The Georgetown Climate Center – Adaptation Tool Kit is especially useful as it uses the following approach to providing local government decision support.

> *"We analyze each tool by (1) the type of power exercised to implement it (planning, regulatory, spending, or tax and market-based tools); (2) the policy objective that it facilitates (protection, accommodation, planned retreat, or preservation); and (3) the type of existing or potential land uses that the tool can be used to adapt (critical infrastructure, existing development, developable lands, and undevelopable lands. Finally, we provide a top-level analysis of the trade-offs between tools – the economic, environmental, and social costs and benefits, and the legal and administrative feasibility of implementing each tool."*

[3] Adapted from SFRPC AAA Guidebook, SFRPC AAA Policy Options, GCC Adaptation Tool Kit

2.2 Intergovernmental Coordination, Cooperation, and Collaboration

Policies, procedures, and jurisdictional boundaries vary. Regardless, no governmental entity is an island unto itself. The City is inextricably part of a larger web of local, regional, state, federal and global actors and agencies. We cannot overemphasize the fact that tools to address complex national and natural security challenges like SLR require continuous and mindful intergovernmental coordination, cooperation, and collaboration.

The State of Florida comprehensive plan regulations provided in Section 163.3177(6)(h), F.S. 2015 require an Intergovernmental Coordination Element to clearly identify interacting governmental units and coordinating mechanisms to address any potential inter-jurisdictional impacts from urban development. The scope and scale of the relative SLR threat and successful adaptation suggest that the City voluntarily revise the existing comprehensive plan elements, as appropriate, or alternatively, implement a stand-alone element with specific goals, objectives, policies, and strategies to establish a clear and comprehensive community-wide approach to relative SLR. Once adopted, this element, or provisions in appropriate elements, will provide the basis and rationale for prioritized implementation through the City's Capital Improvement Plan (CIP) and land development regulations. ***Table 1*** provides a useful matrix identifying important intergovernmental roles and agents.

Table 1. Possible coordination roles and collaborative agents working toward SLR and coastal hazard mitigation and adaptation within Florida local governments.[4]

	Emergency Management				Growth Management, Planning, & Building				Public Works		Environmental Protection		Administrative & Elective		
SLR / Hazard Mitigation & Adaptation Role	*SLR & coastal hazard data analyst(s)*	*Recovery operations expert(s)*	*Mitigation operations expert(s)*	*Evaluation & shelter expert(s)*	*Planning & zoning official(s)*	*Growth management planner(s)*	*Community development planner(s)*	*Building code official(s)*	*Electric & gas utility official(s)*	*Public works official(s)*	*Natural resource manager(s)*	*Hazardous waste manager(s)*	*City/County manager*	*City/County attorney*	*Budget & finance chief*
Prepare, review, & update LMS hazards identification & vulnerability assessment	✓			✓					✓		✓	✓			
Prepare, review, & update CEMP hazards analysis	✓			✓							✓	✓			
Assess natural hazard constraints in FLUE land suitability analysis	✓				✓	✓			✓	✓	✓	✓			
Analyze proposed dev/redevelopment in hazard areas for FLUE review & update any proposed FLUM amendments	✓			✓	✓	✓	✓				✓	✓			
Re-evaluate community exposure & vulnerability after disasters	✓			✓	✓			✓	✓	✓					
Review & update SLR / hazard mitigation policies in LMS, PDRP, AAA, & Comprehensive Plan	✓		✓	✓	✓	✓	✓	✓			✓	✓			
Review & update SLR / hazard mitigation structural projects in LMS, AAA, & CIE	✓		✓	✓	✓				✓	✓	✓	✓			
Review & update hazard redevelopment policies in LMS, PDRP, AAA, & Comprehensive Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Review & update PDRP operations policies and procedures		✓			✓		✓	✓	✓	✓			✓	✓	✓
Participate as member of Recovery Task Force	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓

[4] Excerpted and adapted from *Protecting Florida's Communities: Land Use Planning Strategies and Best Development Practices for Minimizing Vulnerability to Flooding and Coastal Storms*. Florida Department of Community Affairs. 2005. p 48. http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/449/Florida_Community_Protection_-_DCA_2005.pdf

2.3 Decision Support Tools

Many decision support tools exist at local, state, and national scales. Climate Central, "an independent organization of leading scientists and journalists researching and reporting the facts about our changing climate and its impact on the public," has developed two *Surging Seas* interactive tools for evaluating SLR and coastal flood risk: the Risk Finder (***Figure 2***) and the Risk Zone Map (***Figure 3***). While these are unlikely to offer the resolution necessary to make definitive policy and program decisions, they do provide a relative snapshot of risk thresholds across 10 SLR scenarios over approximately 50 impact variables.

As the City of St. Augustine iteratively adapts to SLR, striking the optimal balance of analyzing the past, considering the present, and projecting into the future will be crucial to the success of the path(s) chosen by the City and will require sufficient decision support tools. A sampling of freely available tools, from agencies such as the National Oceanic and Atmospheric Administration (NOAA), is summarized below.

Climate Central: Surging Seas
http://sealevel.climatecentral.org/

NOAA Digital Coast: Tool Repository
https://coast.noaa.gov/digitalcoast/tools/list

NOAA Digital Coast: Social Vulnerability Index (SoVI) 2010 Census Tracts
https://coast.noaa.gov/dataregistry/search/collection/info/sovi

StormSmart Connect: A Local Government Networking Tool
http://stormsmart.org/

University of Florida GeoPlan Center: Florida Sea Level Scenario Sketch Planning Tool
http://sls.geoplan.ufl.edu/

U.S. Climate Resilience Toolkit – Coastal Resilience Index (CRI): A Self-Assessment Tool
https://toolkit.climate.gov/tool/coastal-resilience-index

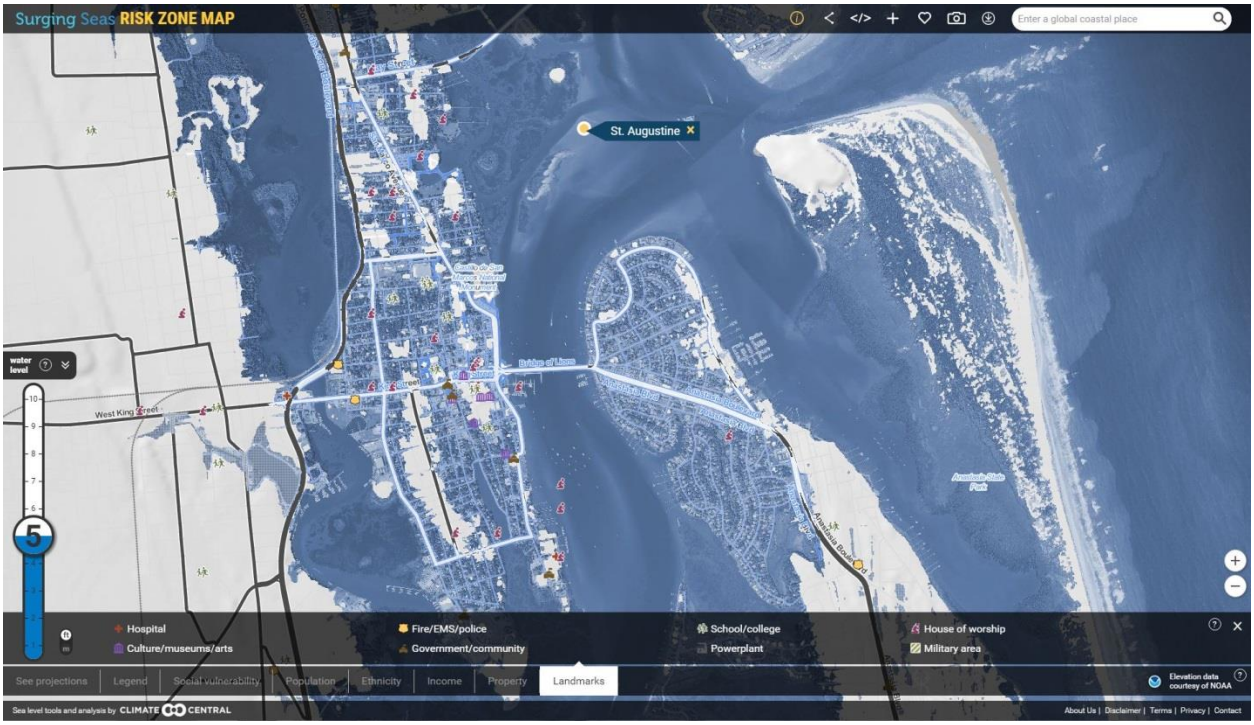

Figure 2. Climate Central – Surging Seas: Interactive Risk Finder Tool.

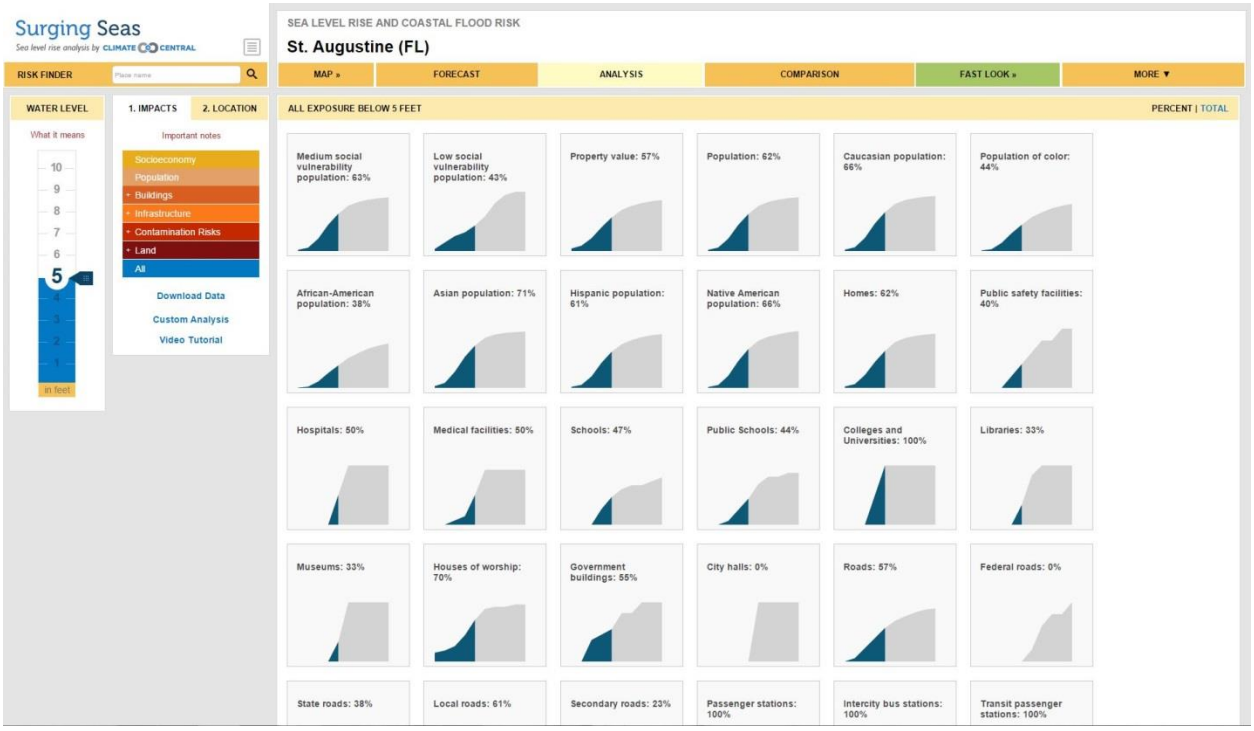

Figure 3. Climate Central – Surging Seas: Interactive Risk Zone Map.

2.4 Planning Tools

The State of Florida's legislative oversight of local governmental planning and growth management has been in flux in recent decades. However, three recent legislative enablers to the Florida comprehensive planning process (one active, two inactive) provide a strong foundation from which the City of St. Augustine might guide SLR adaptation. A summary of these planning elements and additional resources are shared in the next sections.

2.4.1 Coastal Management Element (Required): Post-Disaster Recovery Plan (PDRP)

The State of Florida comprehensive plan regulations Section 163.3177(7)(l), F.S. 2008 and Section 163.3178(2), F.S. 2008 (both since amended to remove the original language) and Rule 9J-5.012(3)(b)(8), F.A.C. (repealed June 02, 2011) required a hazard mitigation / post-disaster redevelopment plan (PDRP) within the coast management element and encouraged all non-coastal local governments to adopt a PDRP. At a minimum a PDRP should, "establish long-term policies regarding redevelopment, infrastructure, densities, nonconforming uses, and future land use patterns." The current Section 163.3178(2)(f), F.S. 2015 still requires "a redevelopment component that outlines the principles that must be used to eliminate inappropriate and unsafe development in the coastal areas when opportunities arise." Though no longer mandated by the State to the same level of specificity, the previous requirements provide valuable guidelines that may assist the City in addressing local concerns.

For more information on the PDRP purpose, policies, process, pilot plans (i.e., five counties and one city), guidebooks (e.g., best practices, vulnerability analysis methodology, funding), and implementation training, visit the Florida State Emergency Response Team (SERT) resources web page for PDRPs.

Florida Division of Emergency Management – Post-Disaster Redevelopment Plan
http://www.floridadisaster.org/Recovery/IndividualAssistance/pdredevelopmentplan/Index.htm

Florida Department of Economic Opportunity (DEO) – Post-Disaster Redevelopment Plan Links Toolkit
http://www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/post-disaster-redevelopment-planning/toolkit

2.4.2 Coastal Management Element (Optional): Adaptation Action Area (AAA)

The State of Florida comprehensive plan regulations Section 163.3164(1), F.S. 2015 and Section 163.3177(6)(g)(10), F.S. 2015 allows for the optional development of an Adaptation Action Area (AAA) designation to integrate "policies within the coastal management element to improve resilience to coastal flooding resulting from high-tide events, storm surge, flash floods, stormwater runoff, and related impacts of sea-level rise (SLR)." Designated AAAs are analytically defined as highly vulnerable to coastal impacts and receive "prioritized funding for infrastructure needs and adaptation planning." The designation of AAAs is an early step in the comprehensive planning process to address relative SLR and the City is highly encouraged to utilize this planning tool. For more information on the AAA purpose, policies, process, description of relationships with conventional hazard mitigation coastal high-hazard areas, and implementation into the Coastal Management Element of the comprehensive plan, visit the Florida Department of Economic Opportunity (DEO) resources web page for AAAs.

Florida Department of Economic Opportunity (DEO) – Adaptation Planning: Planning for Coastal Flooding and Sea Level Rise
http://www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/adaptation-planning

2.4.3 Relative SLR Mitigation (Optional): Greenhouse Gas (GHG) Emissions Reductions and Energy Efficiency

Florida Growth Management Act / HB 697 (signed June 17, 2008, but since repealed) and Section 163.3177 F.S. 2008 added energy conservation and greenhouse gas (GHG) emissions reduction language to several mandatory comprehensive plan elements. Though this language is no longer currently active within the required and optional elements of comprehensive plans, it may still offer guidance as to how a local government may manage urban development to assist with global mitigation of GHG emissions and SLR. Language that addressed the GHG emissions related to relative SLR included:

- *Future Land Use Plan Element:* Incorporate strategies to reduce GHG emissions, encourage energy efficient land use patterns and electric utility infrastructure and service, discourage urban sprawl, and map energy conservation
- *Traffic Circulation Element:* Incorporate strategies to reduce GHG emissions from the transportation sector
- *Conservation Element:* Incorporate factors that affect energy conservation
- *Housing Element:* Incorporate standards, plans, and principles to address energy efficiency and renewable energy generation within the design and construction of new housing

Additionally, Section 20. Section 553.9061, F.S. 2008 established scheduled increases in thermal efficiency standards as set forth below. While these scheduled increases were repealed in the year 2011, the purpose for their proposal remains important because of the long-term implications of a more energy efficient built environment on a state, national, and global scale. Furthermore, the best practices described may be worth voluntary consideration by Florida local governments.

- *Florida Energy Efficiency Code for Building Construction:* Progressively increase the energy performance of new buildings relative to the 2007 Florida Building Code by at least 20% (2010 Edition), 30% (2013 Edition), 40% (2016 Edition), and 50% (2019 Edition)
- *Florida Building Commission:* Identify specific building options and elements likely to contribute to energy performance goals, such as:
    - Solar water heating
    - Energy efficient appliances
    - Energy efficient windows, doors, and skylights
    - Energy Star “cool roofs”
    - Enhanced ceiling and wall insulation
    - Reduced-leak duct systems
    - Programmable thermostats
    - Energy efficient lighting systems
    - Cost effectiveness testing

For more information on the type of residential sector best practices to reduce greenhouse gas emissions, improve energy efficiency, and conserve water, visit the Florida Department of Agriculture and Consumer Services (FDACS) resources web page for interactive home energy auditing and education (***Figure 4***). Additional resources on integrating energy efficiency into urban planning are included below.

Florida Department of Agriculture and Consumer Services (FDACS) – My Florida Home Energy
http://www.myfloridahomeenergy.com/

International Code Council (ICC) – International Green Construction Code:
http://www.iccsafe.org/cs/IGCC/Pages/default.aspx

Energy Cities (Europe) – 30 Proposals for the Energy Transition of Cities and Towns
http://www.energy-cities.eu/-Contents-

California Energy Commission (CEC) – Sustainable Urban Energy Planning: A Roadmap for Research and Funding (June 2005)
http://www.energy.ca.gov/2005publications/CEC-500-2005-102/CEC-500-2005-102.PDF

International Energy Agency (IEA) – Promoting Energy Efficiency Best Practices in Cities: A Pilot Study (May 2008)
https://www.iea.org/publications/freepublications/publication/cities_bpp.pdf

United Nations (UN) Habitat Program and ICLEI Local Governments for Sustainability – Sustainable Urban Energy Planning: A Handbook for Cities and Towns in Developing Countries
http://www.unep.org/urban_environment/PDFs/Sustainable_Energy_Handbook.pdf

Figure 4. Home page for My Florida Home Energy, a statewide consumer interactive self-audit and home improvement decision support tool.

2.4.5 Cultural Heritage: Projecting Impacts, Preserving History

Given the City of St. Augustine's national historic value, it is imperative that planning strategies and tools pay special attention to protecting the community's cultural heritage. Most often, people emphasize the importance of preserving material goods and physical infrastructure. However, the uncertainties surrounding relative SLR and coastal change necessitate that due diligence be given to preserving the services and spirit of our social heritage as some structures may be lost to changing tides. Below are two particularly useful resources for planning and mitigating disaster impacts to historic resources.

Disaster Planning for Florida's Historic Resources (Florida DS/DHR/DEM/DCA/1000 Friends of Florida)
http://www.floridadisaster.org/Mitigation/Documents/Disaster_Planning_for_Historic_Resources.pdf

Disaster Mitigation for Historic Structures: Protection Strategies (Florida DS/DHR/DEM/1000 Friends of Florida)
http://www.1000friendsofflorida.org/wp-content/themes/1000freinds/formpop/form-pop.php?q=disaster-mitigation

2.5 Regulatory Tools

2.5.1 Zoning and Overlay Zones

A necessary complement to the relative SLR adaptation planning tools, zoning regulations may need to account for coastal risk and vulnerability insights and may offer strategic overlays aligned with the five common major SLR adaptation strategies (protection, accommodation, retreat, avoidance, and procedural).

2.5.2 Floodplain Regulations

Adaption to relative SLR may require additional local land use and/or building design restrictions beyond the minimum National Flood Insurance Program (NFIP) minimums for new development and/or redevelopment within AAAs and other high risk coastal zones.

2.5.3 Building Codes and Resilient Design

As a post-disaster redevelopment initiative in response to Hurricane Andrew in the year 1992, Miami-Dade County implemented the most stringent windstorm hardening building code criteria within the State of Florida. As we adapt to relative SLR and embark on creating more resilient communities, other local governments may need to integrate similar local augmentation to statewide building codes to improve the performance and hazard mitigation of their high risk properties.

2.5.4 Setbacks and Buffers

Some native Florida coastal ecosystems, such as the three (3) types of mangroves, provide protective and beneficial ecosystem services. Land development codes, environmental permitting, and zoning criteria may need to evaluate the environmental, social, and economic opportunities and constraints to various coastal setback and buffer regimes (e.g., mandatory minimums, tiered permitting based on property use and/or building use classifications).

2.5.5 Conditional Development and Exactions

When coastal risks become too high for specific properties, local governments may choose to impose special conditions upon issuance of permits. These conditions may include restrictions on property use rights, require disaster hardening improvements or removal of existing high risk structures, implement

new coastal buffers, impact fees to cover the costs for the five adaptation strategies or disaster response, and related actions.

2.5.6 Rebuilding Restrictions

Similar to the special conditions that may limit specific activities and property uses, local governments may restrict rebuilding, in part or overall, when the horizontal or vertical infrastructure on high risk properties have been compromised or destroyed. Resilient and adaptive redesign and construction best practices may become criteria for properties where redevelopment is not precluded altogether.

2.5.7 Subdivision and Cluster Development

In recent years it has become common for local governments to incentivize the preservation of open space through clustered development, in exchange for allowances of density increases. These practices may complement relative SLR adaptation strategies by generating flexible spaces for flood buffering and stormwater drainage.

2.5.8 Armoring Permits (Hard and Soft)

Hard armoring uses are structurally engineered infrastructure to provide services such as flood and erosion control. Soft armoring restores, replenishes, or otherwise augments the natural ecosystems that buffer developed uplands from the impacts of inundation and erosion from SLR and storm surge.

2.5.9 Rolling Coastal Management / Rolling Easement Statutes

Mixing relative SLR adaptive tools, such as rolling management and easements, may place restrictions or otherwise regulate high risk property uses based on evolving thresholds of actual or projected scenarios of coastal impacts. These tools inherently uses an adaptive regulatory structure of benchmarks and baselines to justify milestones of policy and procedural changes aimed to protect high risk natural and built environments.

2.6 Financial Tools: Government Spending

2.6.1 Capital Improvement Programs (CIPs)

The CIP process is one of the most powerful tools available to local governments in adapting to relative SLR. Strategic scenario planning and funding of CIPs may use projections of relative SLR to relocate, retrofit, or alter maintenance regimes for existing infrastructure or to locate new public works in zones deemed spatially safe within predefined time spans. Also, the CIP sets forth the funding priorities over a relatively short planning horizon and is updated annually to adjust priorities and adapt to unforeseen events.

2.6.2 Potable Water, Wastewater, and Stormwater Utilities

Rates and fees associated with the local water utilities may offer opportunities to generate revenue to fund capital improvements. Stormwater infrastructure may need improvements to mitigate and attenuate increased surface and sub-surface water volumes due to flood and relative SLR. Potable water and wastewater infrastructure may need improvements to mitigate saltwater intrusion to maintain drinking water quality and to avoid compromising wastewater biological treatment processes.

2.6.3 Acquisition and Buyout Programs

Local governments may need to add or strategically expand floodplain buyout programs for high risk properties and structures. The primary reasons for acquisition may include: (1) the maintenance of suitable flood buffers between rising tides and urban infrastructure; (2) the creation of ecological corridors for extant or migrating beaches, wetlands, and their associated plant and animal species; and/or (3) setting aside land in certain areas to act as "urban sponges."

2.6.4 Conservation Easements

For stable ecological corridors where local government acquisition may be undesirable or unfeasible, conservation easements may offer a flexible mechanism for permanent public sector influenced flood buffering on privately owned properties in exchange for direct compensation and/or tax benefits. These easements may apply to all, or just a portion, of a strategic property with significant conservation and flood buffering value.

2.6.5 Rolling Conservation Easements

For ecological corridors in flux due to the coastal erosion and restructuring associated with relative SLR, rolling conservation easements may be necessary to coordinate private property preservation for flood buffering. These easements often maintain land use rights on upland areas of a property while enabling conservation restrictions on shifting floodplain areas as they roll landward.

2.7 Financial Tools: Taxes, Trusts, and Market-Based

2.7.1 Impact Fees

Through the assessment of impact fees, private land developers pay their proportionate share of the long-term infrastructure servicing costs associated with land use changes and urban development. Given sufficient decision support, calculation methodology, and SLR scenario planning, this tool may be used to assess an Adaptation Action Area (AAA) impact fee for adaptation infrastructure implementation as an additional "service cost."

2.7.2 Special Assessments

Special Adaptation Action Area (AAA) assessments, such as a capital project assessment, may be embedded within ad valorem and non-ad valorem taxes on local property tax bills to fund one or more of the five (5) types of relative SLR adaptation strategies.

2.7.3 Tax Incentives

Complete tax abatements, one-time tax credits, and/or lower revolving tax rates, are all potential tax incentives available to local governments for preferential relative SLR adaptation strategies, such as the creation of conservation areas, the relocation or retrofit of high risk properties, and the consolidation of urban dwelling units and services into upland infill areas.

2.7.4 Transfer of Development Rights (TDR)

Transfer of development rights (TDR) programs are a tool that enables a sending area property owner to give a portion, or all, of their urban development rights to a receiving area property owner in exchange for fair compensation. Ideally, receiving areas would be existing, low risk, urban infill land uses that would benefit from increased density or intensity rights during redevelopment. One potential synergistic benefit of TDR programs is the ability to keep urban infrastructure and services confined to

smaller, more dense, areas where other Adaptation Action Area (AAA) capital improvements are scheduled, thus optimizing the use and outcomes of CIP funds.

2.7.5 Land Readjustment (LR) Strategies[5]

Land readjustment (LR) allows a group of landowners to cooperate and pool ownership of their properties into a collective holding that is subsequently reallocated through sub-divisions back to the original individual landowners. This reallocation is typically done after a portion of their original individual properties are used for joint infrastructure and the benefits typically come from increased land value despite decreased land area. This may be a strategic tool to create both space and funding for SLR adaptation related capital improvements.

2.7.6 Real Estate Disclosures

When some types of investment risks are known for a real estate property (e.g., radon, lead-based paint), then disclosures empower potential buyers to account, and properly price, for the risk. As relative SLR trends, projections, and vulnerability assessments mature, local governments may require sellers to disclose flood risk, relative SLR inundation potential, erosion potential, and/or statutory buffer restrictions.

2.7.7 Public-Private Partnerships (PPP)[6]

While most local government capital improvement projects use "pay-as-you-go" financing, public-private partnerships (PPPs) share some costs and risks with private investors. This financing tool may lower both construction costs and overall lifecycle costs by spreading them over the full lifetime of the asset. The State of Florida Department of Transportation (FDOT) has already undertaken several transportation PPP projects, including a performance-based "available payment" model to build and operate toll facilities near Fort Lauderdale.[7]

2.7.8 Coastal Land Acquisition Programs and Land Trusts

The Adaptation Action Area (AAA) element within a comprehensive plan may offer a policy home for the criteria used to find and fund the acquisition of high risk coastal properties. Public and/or private funds may finance these strategic acquisitions and land trusts, potentially including: (a) federal or state programs; (b) special taxes; (c) special permit fees; and (d) tax or cash incentives for land trades or donations.

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[5] Sorensen, Andre. (1999). Land Readjustment, Urban Planning and Urban Sprawl in the Tokyo Metropolitan Area. *Urban Studies.* Vol. 36, No. 13, 2333-2360. http://dx.doi.org/10.1080/0042098992458

[6] Closing America's Infrastructure Gap: The Role of Public-Private Partnerships. *A Deloitte Research Study*. https://www.cdfifund.gov/Documents/Public-Private_Partnerships.pdf

[7] Closing State Infrastructure Gaps – Chapter 4: Rebuilding America's Crumbling Infrastructure. *A Deloitte Research Study*. p. 67. http://www2.deloitte.com/content/dam/Deloitte/us/Documents/public-sector/us-state-chapter4-closing-state-infrastructure-gaps-012915.pdf

Appendix 3. Additional Annotated Resources and Implementation Examples

3.1 City Government Scale

This section synthesizes and provides links to several relevant adaptation plans that may be of interest to the City.

3.1.1 City of Fort Lauderdale – Adaptation Action Areas (AAA)

"In 2015, the City's Community Investment Plan included a new AAA section which includes the identification of the first 16 AAAs and 38 projects identified for funding within those AAAs." See pages 419-426 for the AAA section of the CIP.

Adaptation Action Area Homepage: http://gyr.fortlauderdale.gov/greener-government/climate-resiliency/innovative-pilot-projects/adaptation-action-areas

3.1.2 City of Punta Gorda – Adaptation Plan

"This report identifies the alternative adaptations that could be undertaken to address the identified climate change vulnerabilities for the City of Punta Gorda. These adaptations are presented in the order of prioritized agreement from the public meetings. Only the highest agreement adaptation in each vulnerability area is fully developed for potential implementation. One of the utilities of this approach is that it provides a variety of adaptation options, which the City could select for implementation, adaptive management, and subsequent monitoring."

Adaptation Plan: http://www.ci.punta-gorda.fl.us/userdata/growthmgmt/PuntaGordaAdapatationPlan8-14-09.pdf

3.1.3 City of Satellite Beach – Sea-Level Rise Comprehensive Plan Recommendations

In 2009, the City of Satellite Beach, Florida, authorized a pilot project designed to assess municipal vulnerability to rising sea level and initiate the planning process to properly mitigate impacts. To implement the pilot project, the City hired a geologist to develop a science-based assessment of the impacts and timing of relative SLR, and the Satellite Beach Comprehensive Planning Advisory Board (CPAB) formed a Sea Level Rise Subcommittee to use the assessment to determine strategies and policies to be incorporated into the City's Comprehensive Plan. The pilot project generated both a technical report based on the best scientific data available and policy recommendations based on that data.

Initiative Overview: http://www.georgetownclimate.org/resources/satellite-beach-sea-level-rise-comprehensive-plan-recommendations

Sample Ordinance, Policy Recommendations, and Comprehensive Plan Modifications: http://www.satellitebeachfl.org/Documents/Sea%20Level%20Rise%20-%20CRE%20Report%2007-18-10.pdf

PowerPoint Presentation About Policies and Process: http://www.floridaplanning.org/wp-content/uploads/2015/09/Satellite-Beach-Community-Based-Planning-for-Coastal-Resiliency-Tara-McCue.pdf

3.2 County Government Scale

3.2.1 Broward County – Comprehensive Plan: Climate Change Element

The Comprehensive Plan policies adopted by Broward County on 2/12/2013 (Ordinance No. 2013-02) are an extension of the 126 recommendations detailed in "Broward's Climate Change Action Plan – Addressing our Changing Climate", as developed by the Broward County Climate Change Task Force and approved by the Board of County Commissioners on May 4, 2010. The Broward County Climate Change Element provides a framework for integrating the economic, environmental, and social factors of climate change. A county-wide strategy, based on local vulnerability and consistent with regional efforts, the Element aims to mitigate the causes, and address the local implications, of global climate change. In doing so, the county has moved one step closer to building a sustainable, climate resilient community.

Climate Change Element Language:
http://www.broward.org/PlanningAndRedevelopment/ComprehensivePlanning/Documents/ClimateChangeElement.pdf

3.2.2 Flagler County – Army Corps of Engineers (ACE) – Hurricane and Storm Damage Reduction Project

In 2014, the ACE completed a Hurricane and Storm Damage Reduction Project for Flagler County, Florida. This study included an appendix which addressed the impact of relative SLR on the shoreline. ***Figure 5*** shows the estimate of the long-term erosion rates attributable to relative SLR for Flagler County. However, the procedure used by ACE is applicable to long straight sandy beaches with an uninterrupted supply of sand (ACE Report Appendix, p. A-15). "Little is known about the rate at which profiles respond to changes in water level; therefore, this procedure should only be used for estimating long-term changes" (ACE Report Appendix, p. A-15).

Main Report:
http://www.saj.usace.army.mil/Portals/44/docs/Planning/EnvironmentalBranch/EnvironmentalDocs/FlaglerCoSPP_FinalMainSep2014.pdf

Appendix:
http://www.saj.usace.army.mil/Portals/44/docs/Planning/EnvironmentalBranch/EnvironmentalDocs/FlaglerCoSPP_FinalAppendixA_EngineeringSep2014.pdf

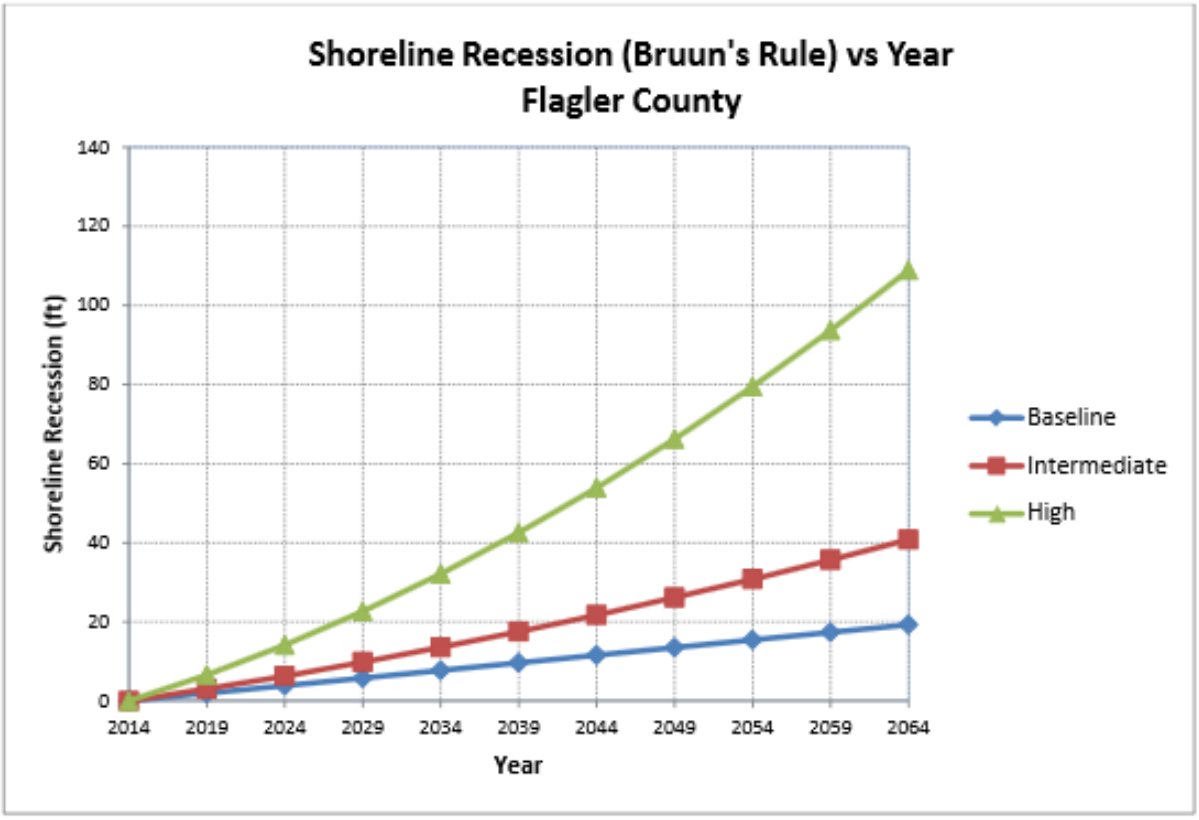


Figure 5. Shoreline recession by year. (Source: Army Corps of Engineers).

3.2.3 Lee County – Climate Change Resiliency Strategy (CCRS)

Lee County contracted with the Southwest Florida Regional Planning Council (SWFRPC) to develop a Climate Change Vulnerability Assessment (CCVA) in January 2010. The project included an assessment of potential effects of climate change on the human and native ecosystems in the unincorporated portions of the county. In follow-up, a second part of the contract was to develop the Lee County Climate Change Resiliency Strategy (CCRS). The CCRS includes a process for identifying potential climate change resiliency strategies through coordination and consultation with local government leadership. The CCRS is a toolbox that contains a wide variety of ideas and opportunities for the County to employ in climate change planning, energy savings, and cost savings. This strategy includes approaches to mitigate and adapt to the effects of climate change while positioning the County to take advantage of potential economic development opportunities associated with climate change.

CCRS Report (SWFRPC, October 06, 2010):
http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/447/Beever%20et%20al.%202010.%20Lee%20County%20CC%20Resiliency%20Strategy.pdf

3.2.4 Levy County – Planning for Coastal Change

The Planning for Coastal Change in Levy County project initiated planning for coastal change, with a focus on the current and potential impacts of future relative SLR, in Levy County, Florida, and its coastal communities. The final 206-page findings report recounts the project's planning methods, provides

information, numeric data, and maps regarding vulnerabilities to sea level rise and other coastal changes, summarizes community member feedback from project workshops, discusses local adaptive capacities, and offers recommendations for adaptation strategies and ongoing planning.

Initiative Homepage: http://changinglevycoast.org/

Preliminary Report: http://www.levycounty.org/myJSSImages/file/sealevelrise_planning.pdf

3.3 Regional Scale

3.3.1 Land Vulnerable to Rising Sea Level: Northeast Florida[8]

This assessment includes six (6) counties and consists of all lands below the 10-foot contour, which includes approximately 321 square miles of uplands, 254 square miles of wetlands, and accounts for 14 percent of the total land area within Northeast Florida. The study determined that conservation make up the single largest land use affected by sea rise in Northeast Florida and that wetlands likely to migrate inland account for 56 square miles or 18 percent of the study area.

Likelihood of Shore Protection – Northeast Florida (Excerpt Page): http://risingsea.net/ERL/FL_Northeast.html

Likelihood of Shore Protection – Northeast Florida (Full Report): http://risingsea.net/ERL/shore-protection-retreat-sea-level-rise-Northeast-Florida.pdf

Table 2. Northeast Florida Future Land Use Subject to Sea Level Rise (Acres)[9]

FLU Category	County Land Use Area (Acres)						GTM Study Area	
	Nassau	*Duval*	*St. Johns*	*Flagler*	*Clay*	*Putnam*	*(%)*	*(Sq. Miles)*
Agriculture	2,150	32,139	22,011	6,909	618	22,106	23	134
Commercial	976	4,708	3,628	224	1,285	164	3	17
Conservation	8,325	17,839	47,061	9,556	7,041	27,632	38	183
Industrial	436	3,453	85	28	184	1,070	2	8
Public / Recreational	2,648	9,485	10,079	752	4,496	11	8	42
Residential	10,460	38,386	18,918	4,511	13,901	6,740	26	145

[8] Postal, M., K. Joiner, and T. Lilly. (2010). "Northeast Florida." In James G. Titus, Daniel L. Trescott, and Daniel E. Hudgens (editors). The Likelihood of Shore Protection along the Atlantic Coast of the United States. Volume 2: New England and the Southeast. Report to the U.S. Environmental Protection Agency. Washington, D.C. http://risingsea.net/ERL/FL.html

[9] http://risingsea.net/ERL/FL_Northeast.html

Table 3. Northeast Florida Future Land Use Subject to Sea Level Rise (All Land)[10]

Likelihood Category	County Land Use Area (Acres)						GTM Study Area	
	Nassau	*Duval*	*St. Johns*	*Flagler*	*Clay*	*Putnam*	*(%)*	*(Sq. Miles)*
Protection Almost Certain	18,160	42,036	21,433	10,519	12,661	8,431	30	176
Protection Likely	2,336	4,973	31,004	4,753	7,226	6,796	14	89
Protection Unlikely	1,628	5,603	4,628	147	5,821	9,368	7	42
No Protection	5,687	1,585	1,162	225	436	164	2	14
Wetlands	33,041	41,993	43,555	9,380	1,763	33,024	47	254

Table 4. Northeast Florida Future Land Use Subject to Sea Level Rise (Dry Land)[11]

Likelihood Category	County Land Use Area (%)						Regional Area (%)
	Nassau	*Duval*	*St. Johns*	*Flagler*	*Clay*	*Putnam*	*Northeast Florida*
Protection Almost Certain	65.3	77.6	36.8	67.2	48.4	34.1	54.8
Protection Likely	8.4	9.2	53.2	30.4	27.6	27.4	27.7
Protection Unlikely	5.9	10.3	7.9	0.9	22.3	37.8	13.1
No Protection	20.4	2.9	2	1.4	1.7	0.7	4.4

Excerpt from the study:

> *The ultimate net loss of wetlands will depend both on landward migration and on the ability of wetlands to keep pace with sea level rise. Nevertheless, in the very long run, existing tidal wetlands would be submerged by a large rise in sea level and thus their continued existence depends on new wetlands forming inland. Viewed in that light, existing policies are almost certain to eliminate about 55 percent the wetlands that might otherwise be sustained as sea level rises and to protect 4 percent of those wetlands. We are less certain about the other 41percent. There appears to be a good chance that wetlands will migrate inland another 13 percent of the region, and wetland migration is possible albeit unlikely in 28 percent of the region. Planners need guidance from both scientists and policy makers about the importance of ensuring that wetlands survive in the areas our maps depict in blue and red, compared with the benefits of preventing wetlands from taking over these areas.*

3.3.2 RCI / NEFRC – Summary and Regional Action Plan: A Report of the Emergency Preparedness Committee on Sea Level Rise

"In August 2012, NEFRC [Northeast Florida Reginal Council] assigned sea level rise as a policy issue to the RCI [Regional Community Institute of Northeast Florida, Inc.]."

Summary and Regional Action Plan: http://www.nefrc.org/pdfs/Regional%20Action%20Plan.pdf

[10] http://risingsea.net/ERL/FL_Northeast.html
[11] http://risingsea.net/ERL/FL_Northeast.html

3.3.3 Regional Action Plan

In August 2012, the Northeast Florida Regional Council (NEFRC) assigned SLR to the Regional Community Institute of Northeast Florida, Inc. (RCI), a nonprofit organization created by the NEFRC to consider policy issues. RCI undertook a twelve month effort that included determining whether the region encompassed by the NEFRC is vulnerable to relative SLR. If they determined the region vulnerable, the RCI was to review information and make assumptions regarding the range of water rise and the planning horizon. They were then to work with coastal governments on community resiliency assessments, using the assumptions. Their final task was to take the best practices and lessons learned from local governments and make policy recommendations to the NEFRC.

In October 2013, the RCI decided that Northeast Florida *is* vulnerable to sea level rise and the region should consider the potential for impacts of 6-inch, 1-foot, 3-foot and 6-foot of rise. In doing so, the RCI developed the following five (5) recommended actions:

- Create a clearinghouse on understanding risk
- Engage the community
- Save money
- Collaborate and leverage success
- Engage the business sector in long term resiliency (NEFRC 2013)

Regional Action Plan: http://www.nefrc.org/pdfs/Regional%20Action%20Plan.pdf.

3.3.4 Regional Planning Councils

Six coastal planning councils in Florida have prepared sea level rise studies regarding their particular regions. The reports range from preliminary to the most recent published report by the Southeast Florida Regional Climate Change Compact, which contains 110 recommendations for four counties in Southeast Florida. The information published by the Compact is the most current report that addresses SLR issues mundane to coastal communities in Florida.

Summary of Six Regional Reports: http://risingsea.net/ERL/FL.html

Southeast Florida Regional Compact Climate Change Documents:
http://www.southeastfloridaclimatecompact.org/compact-documents/

3.3.5 St. Johns River Water Management District (SJRWMD) Strategic Plan

The SJRWMD Strategic Plan (FY2015-2019) identifies SLR as a strategic priority (see ***Figure 6***) and their intent to investigate water supply implications, estuarine water quality and coastal wetlands impacts associated with sea level rise. This information, when available, will assist local governments with strategies related to the protection of natural resources in the region.

Strategic Plan (FY2015-2019): http://floridaswater.com/StrategicPlan.pdf

District Strategic Plan (FY 2015–FY 2019)

Sea Level Rise

Investigate water supply implications, estuarine water quality and coastal wetlands impacts associated with sea level rise. (Concludes after FY2017-2018.)

Strategy	Milestones/Deliverables				
	FY 14–15	FY 15–16	FY 16–17	FY 17–18	FY 18–19
Sea Level Rise Impact Assessment	Formulation of team and team chair	Inventory and analysis of current District efforts	Inventory and analysis of current District efforts	Strategy report with recommendation	Strategic Priority concludes

Success Indicators: To be developed.

Figure 6. Excerpt from the SJRWMD Strategic Plan (FY2015-2019), page 25, delineating their timeline for taking an inventory and developing a strategy to mitigate and adapt to sea level rise. (Source: SJRWMD)

3.4 National Scale

3.4.1 National Flood Insurance Program (NFIP): Community Rating System (CRS)

The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed National Flood Insurance Programs (NFIP) requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from meeting the goals of the CRS:

1. Reduce flood damage to insurable property,
2. Strengthen and support the insurance aspects of the NFIP, and
3. Encourage a comprehensive approach to floodplain management.

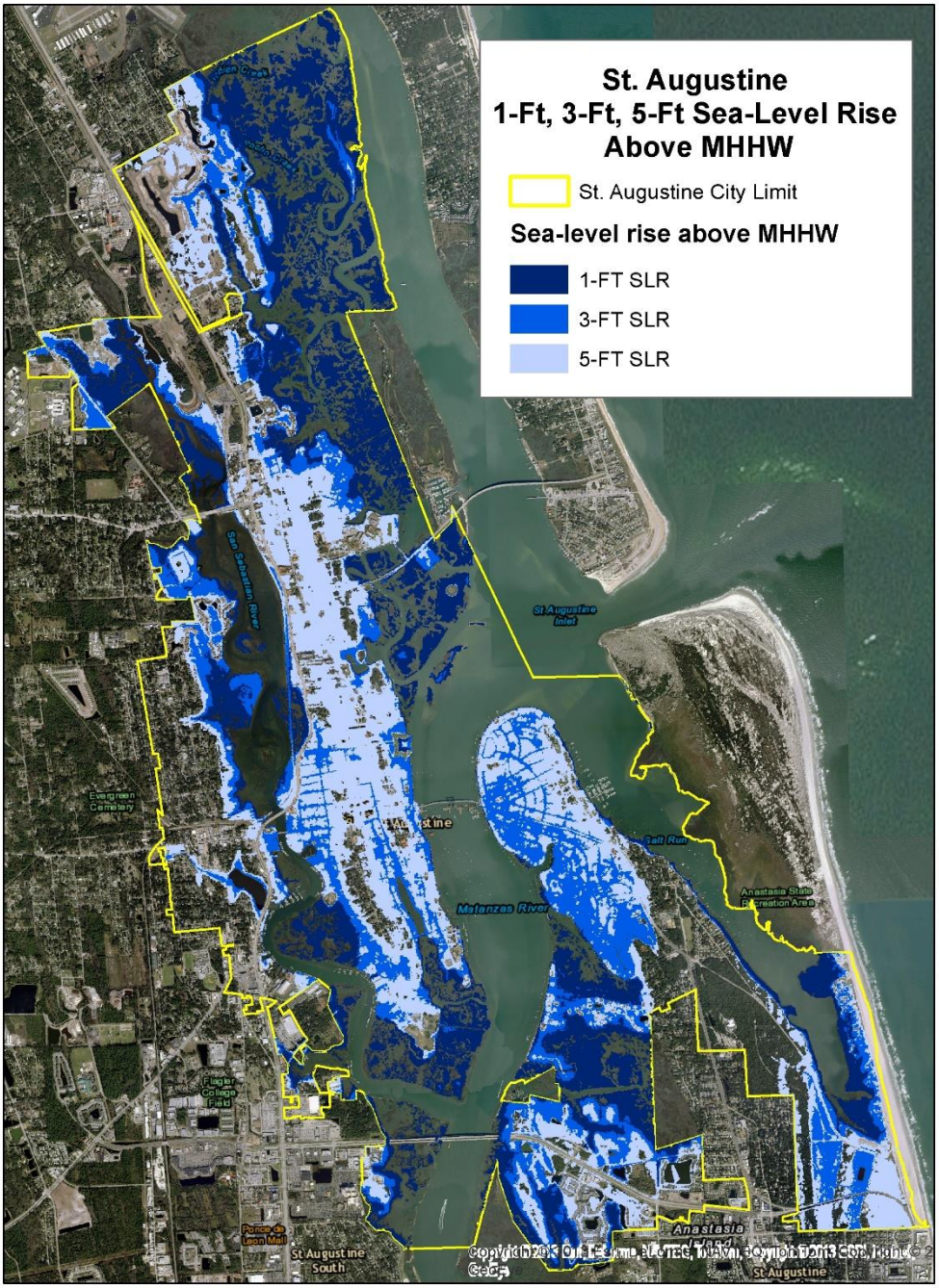
The Florida Division of Emergency Management (FDEM) is moving forward with the Florida CRS Initiative, designed to assist communities to better their CRS rating. At present, the CRS program is the only option available for residents to receive a flood insurance premium reduction. More about the program can be found here: http://www.fema.gov/national-flood-insurance-program-community-rating-system and here: http://www.floridadisaster.org/mitigation/CRS/.

3.4.2 National Landmarks at Risk

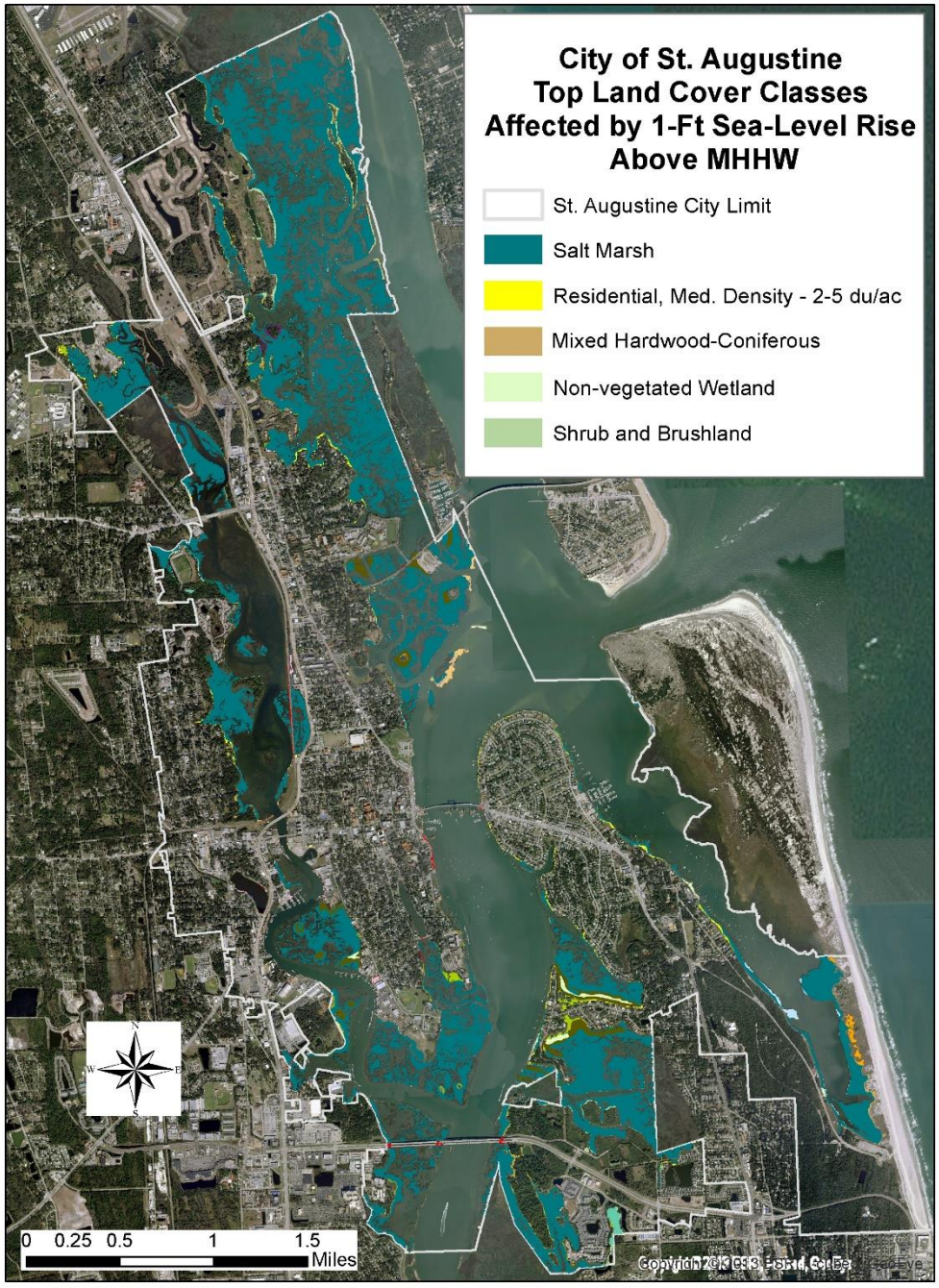
This report is a selection of case studies that were chosen to highlight the urgency of sea level rise on the nation's most cherished monuments and historic sites. St. Augustine was naturally included because of its rich and diverse representation of the American experience. The Castillo de San Marcos, North America's oldest masonry fort, is threatened by rising seas and is featured on the cover of the report. The report references the "living seawall" completed by the National Park Service in 2011 adjacent to the Castillo de San Marcos and other issues facing the historic district. The fact that St. Augustine is included in the report highlights the fact that the well-being of the city is recognized at the highest level in the federal government and that the city is the steward of some of the nation's finest treasures.

Holtz, Debra, Adam Markham, Kate Cell, and Brenda Ekwurzel. (May 2014). *National Landmarks at Risk - How Rising Seas, Floods, and Wildfires Are Threatening the United States' Most Cherished Historic Sites*. Union of Concerned Scientists.
http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/National-Landmarks-at-Risk-Full-Report.pdf

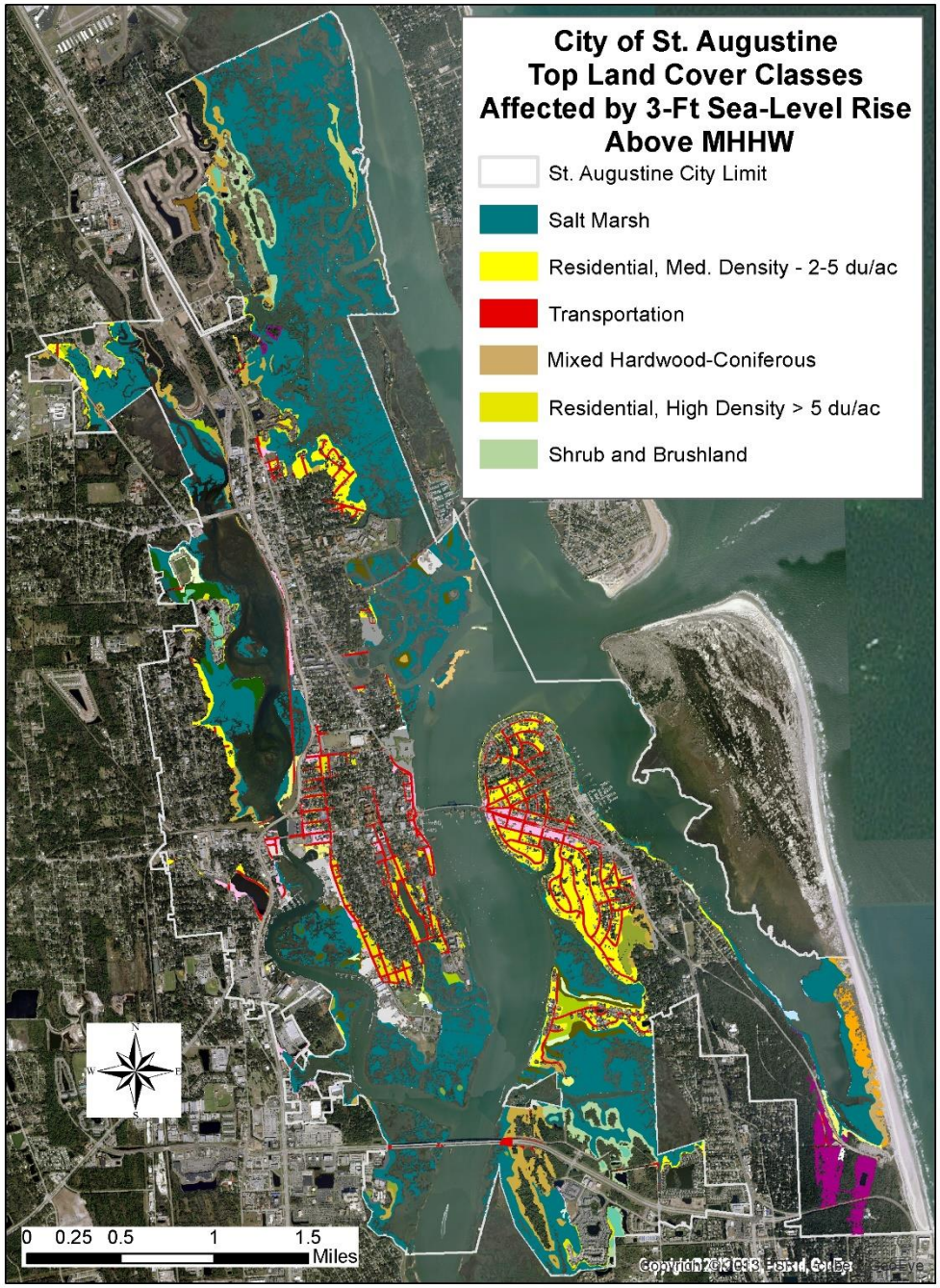
Appendix 4. Inundation Map: Affected Areas @ 1-Foot, 3-Foot, and 5-Foot Relative SLR



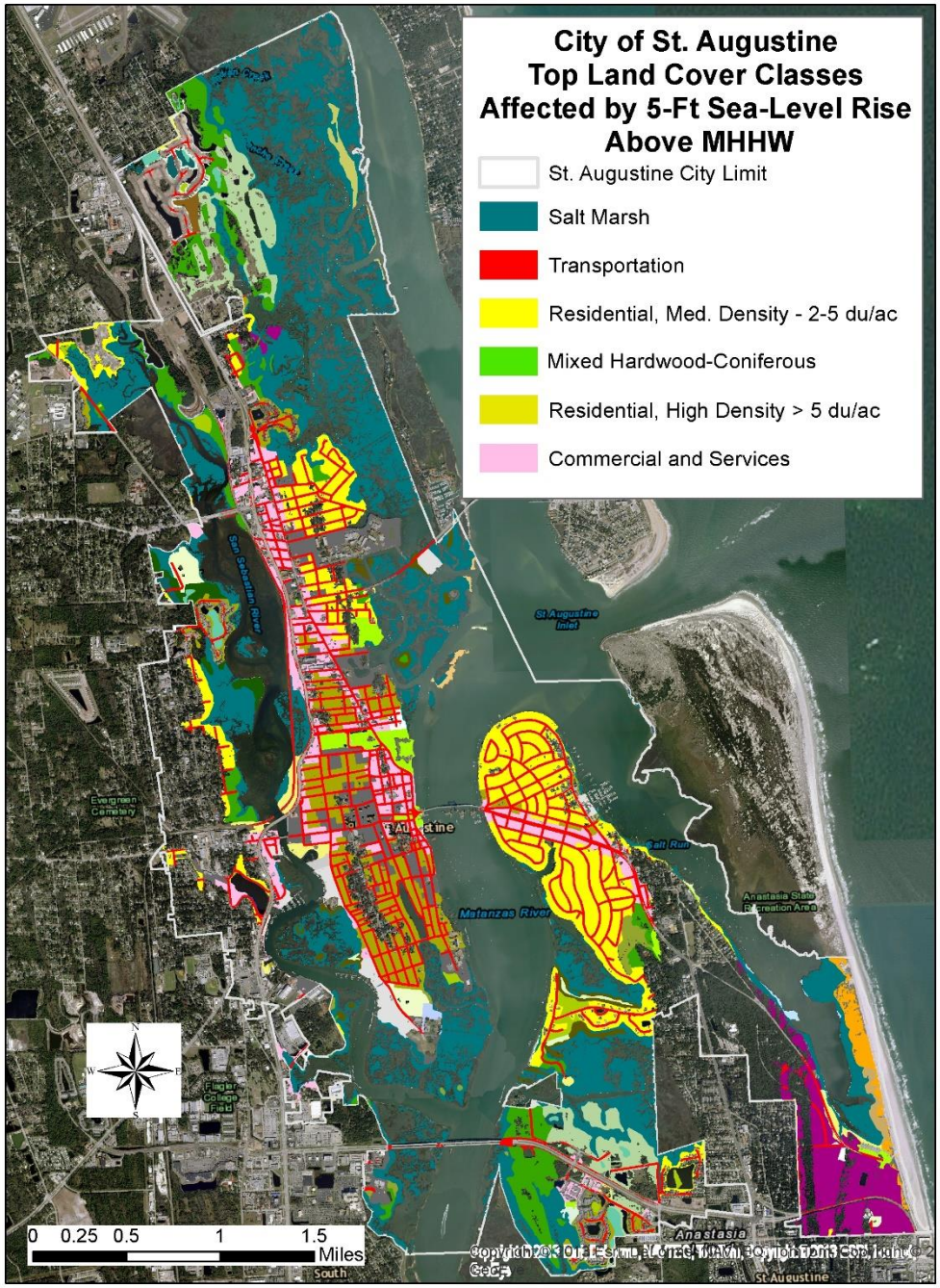
Appendix 5. Impact Map:
Top Land Cover Classes @ 1-Foot Relative SLR



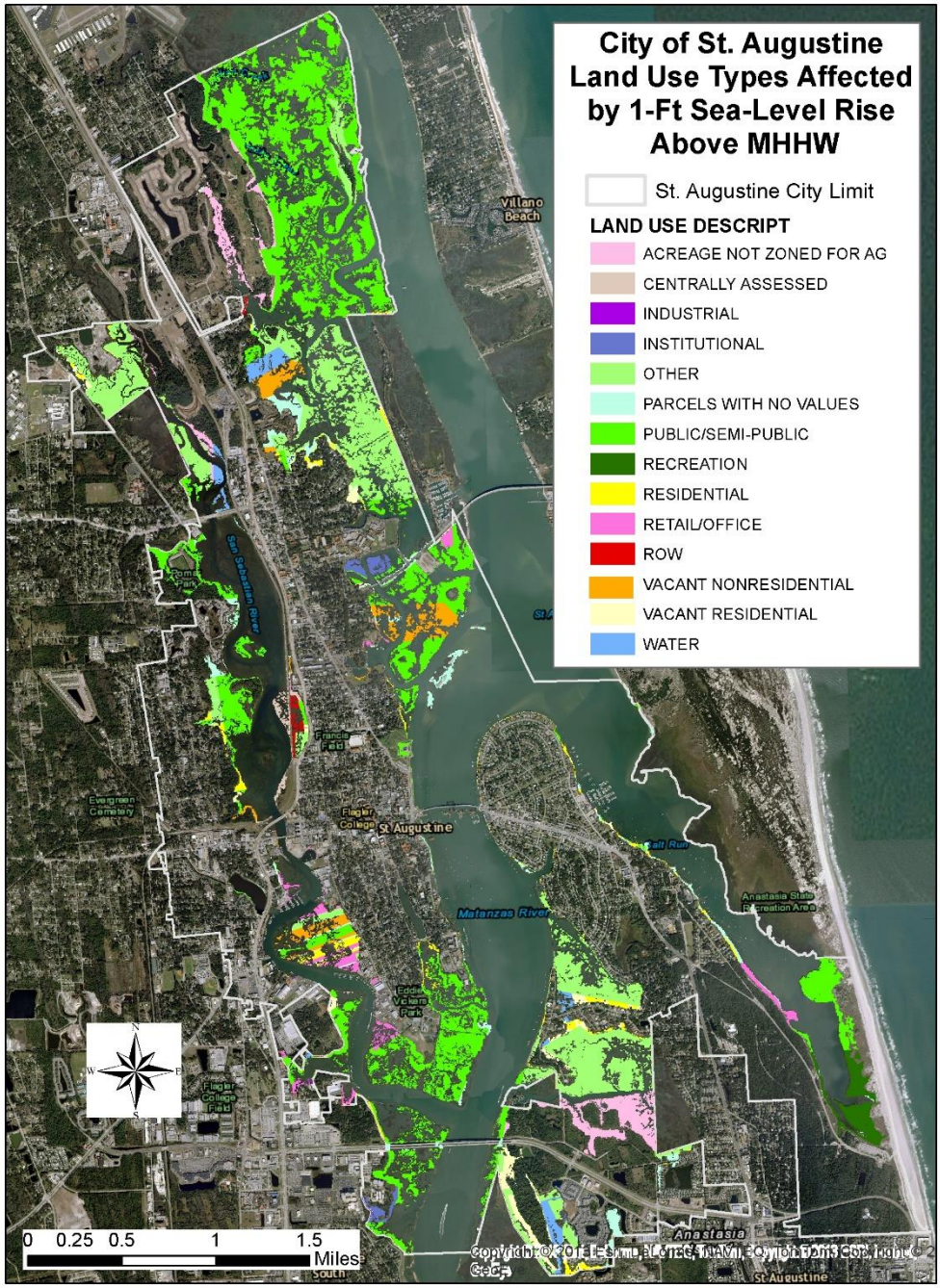
Appendix 6. Impact Map: Top Land Cover Classes @ 3-Foot Relative SLR



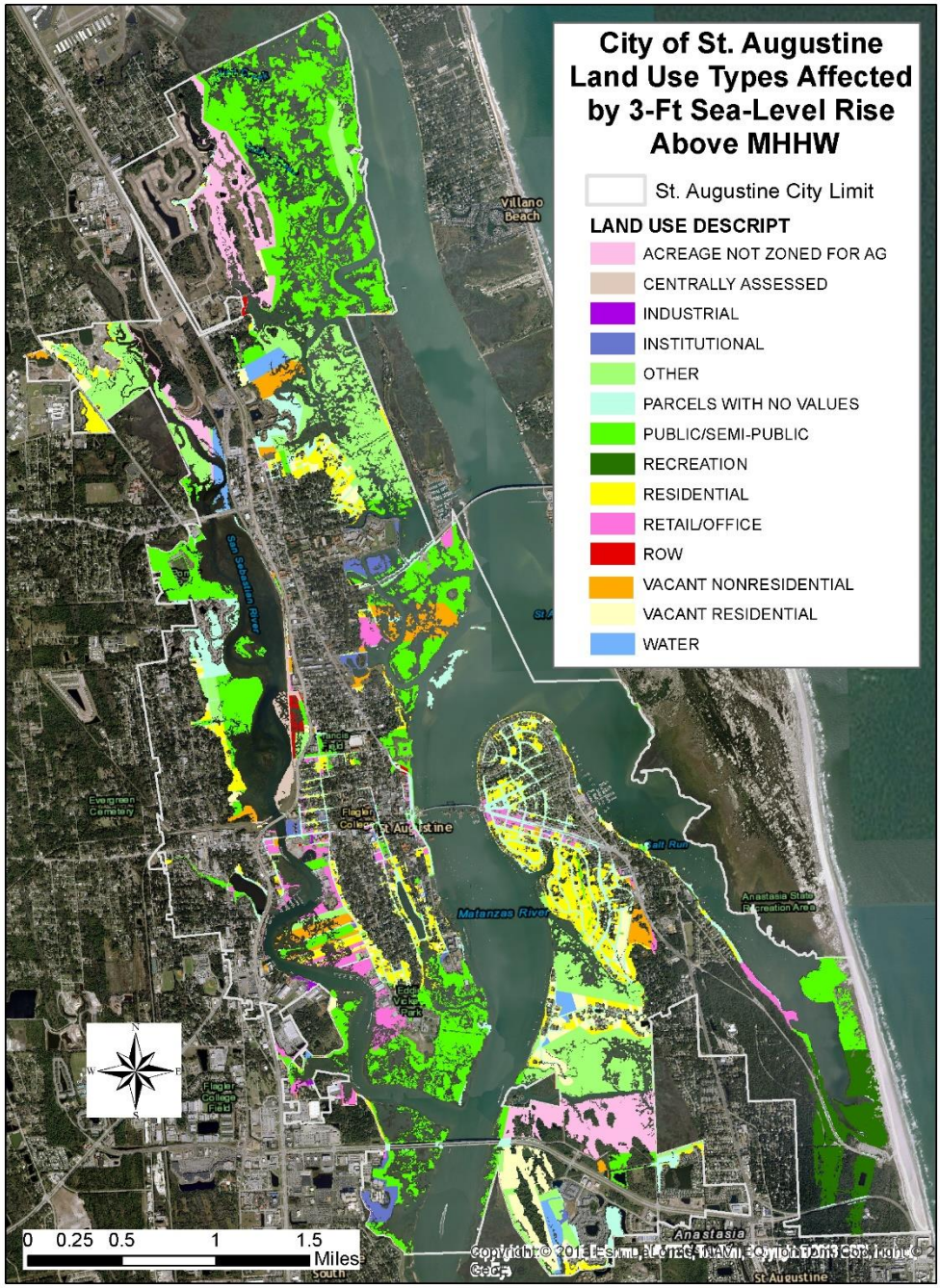
Appendix 7. Impact Map: Top Land Cover Classes @ 5-Foot Relative SLR



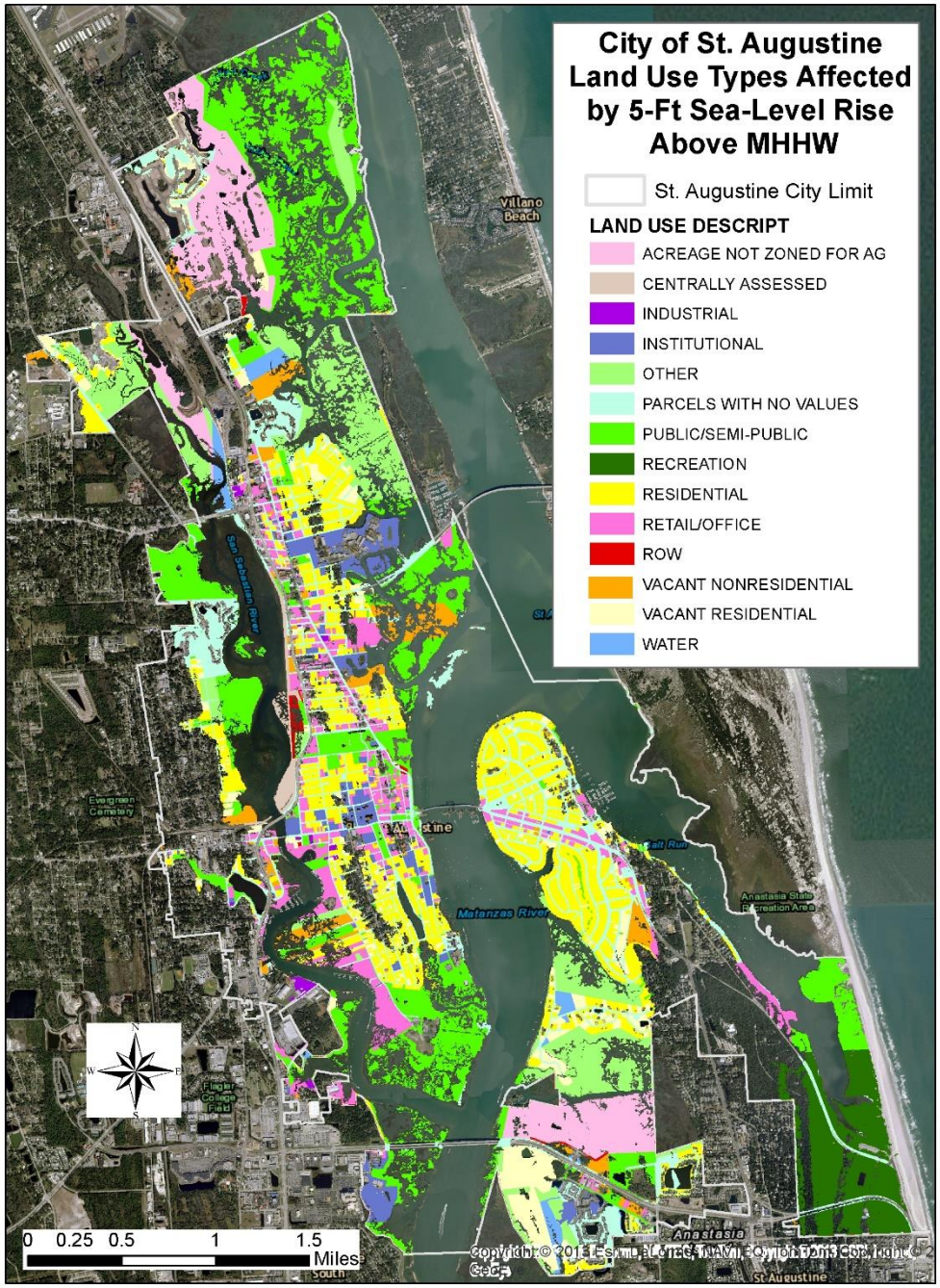
Appendix 8. Impact Map: Top Land Use Classes @ 1-Foot Relative SLR



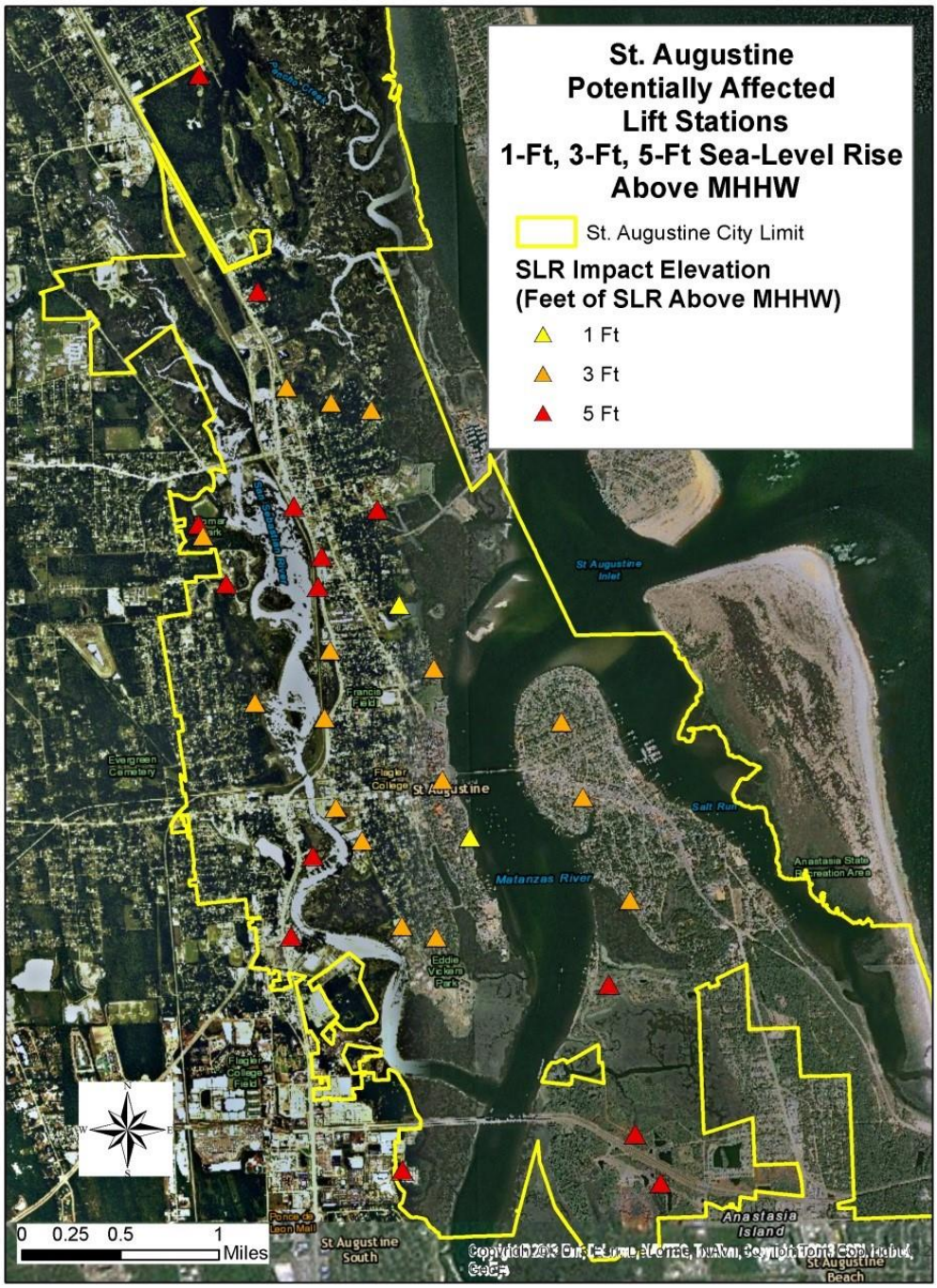
Appendix 9. Impact Map: Top Land Use Classes @ 3-Foot Relative SLR



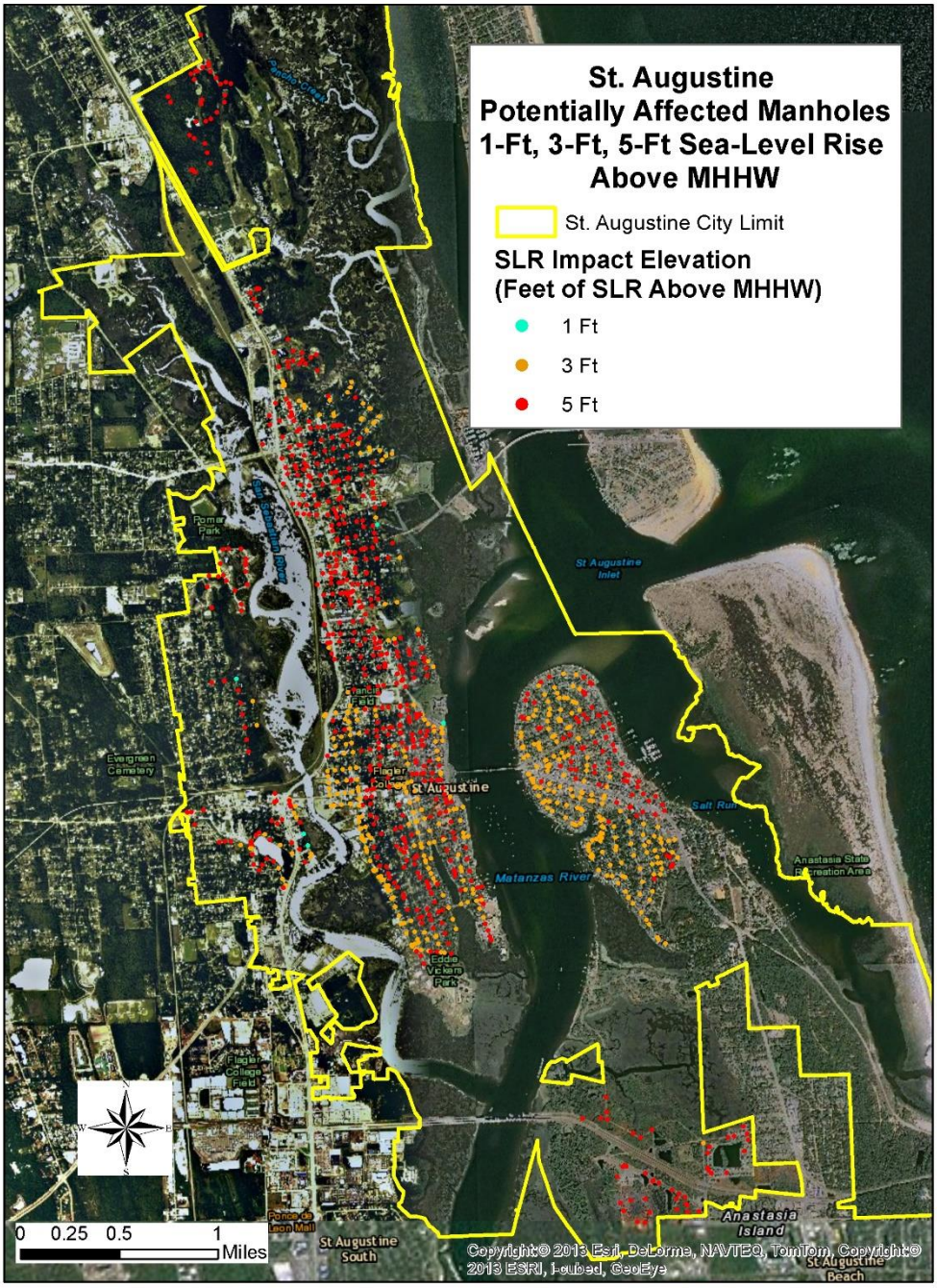
Appendix 10. Impact Map: Top Land Use Classes @ 5-Foot Relative SLR



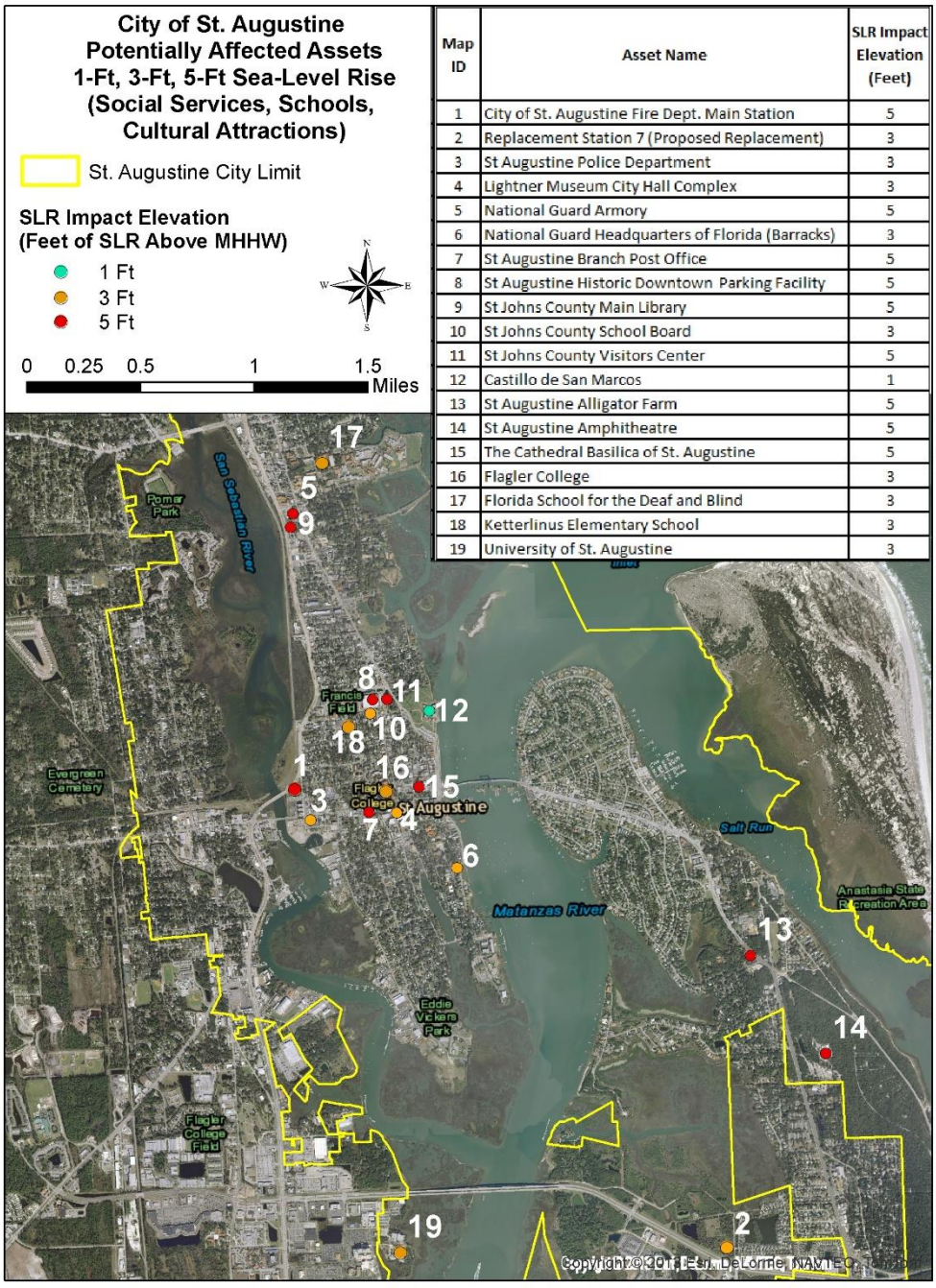
Appendix 11. Impact Map:
Stormwater Lift Stations @ 1-Foot, 3-Foot, & 5-Foot Relative SLR



Appendix 12. Impact Map: Stormwater Manholes @ 1-Foot, 3-Foot, & 5-Foot Relative SLR

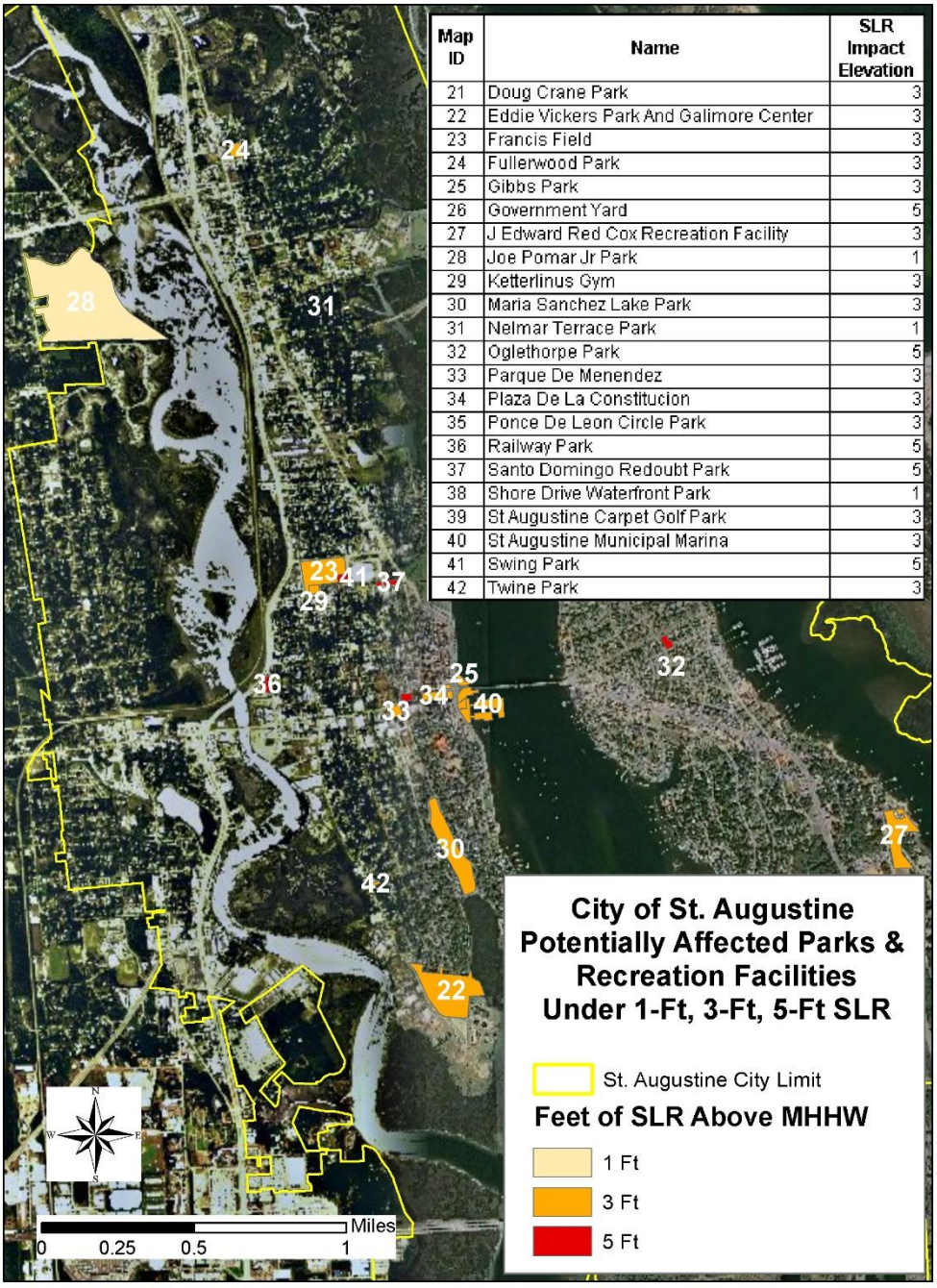


Appendix 13. Impact Map:
City Building Assets @ 1-Foot, 3-Foot, & 5-Foot Relative SLR



Map ID	Asset Name	SLR Impact Elevation (Feet)
1	City of St. Augustine Fire Dept. Main Station	5
2	Replacement Station 7 (Proposed Replacement)	3
3	St Augustine Police Department	3
4	Lightner Museum City Hall Complex	3
5	National Guard Armory	5
6	National Guard Headquarters of Florida (Barracks)	3
7	St Augustine Branch Post Office	5
8	St Augustine Historic Downtown Parking Facility	5
9	St Johns County Main Library	5
10	St Johns County School Board	3
11	St Johns County Visitors Center	5
12	Castillo de San Marcos	1
13	St Augustine Alligator Farm	5
14	St Augustine Amphitheatre	5
15	The Cathedral Basilica of St. Augustine	5
16	Flagler College	3
17	Florida School for the Deaf and Blind	3
18	Ketterlinus Elementary School	3
19	University of St. Augustine	3

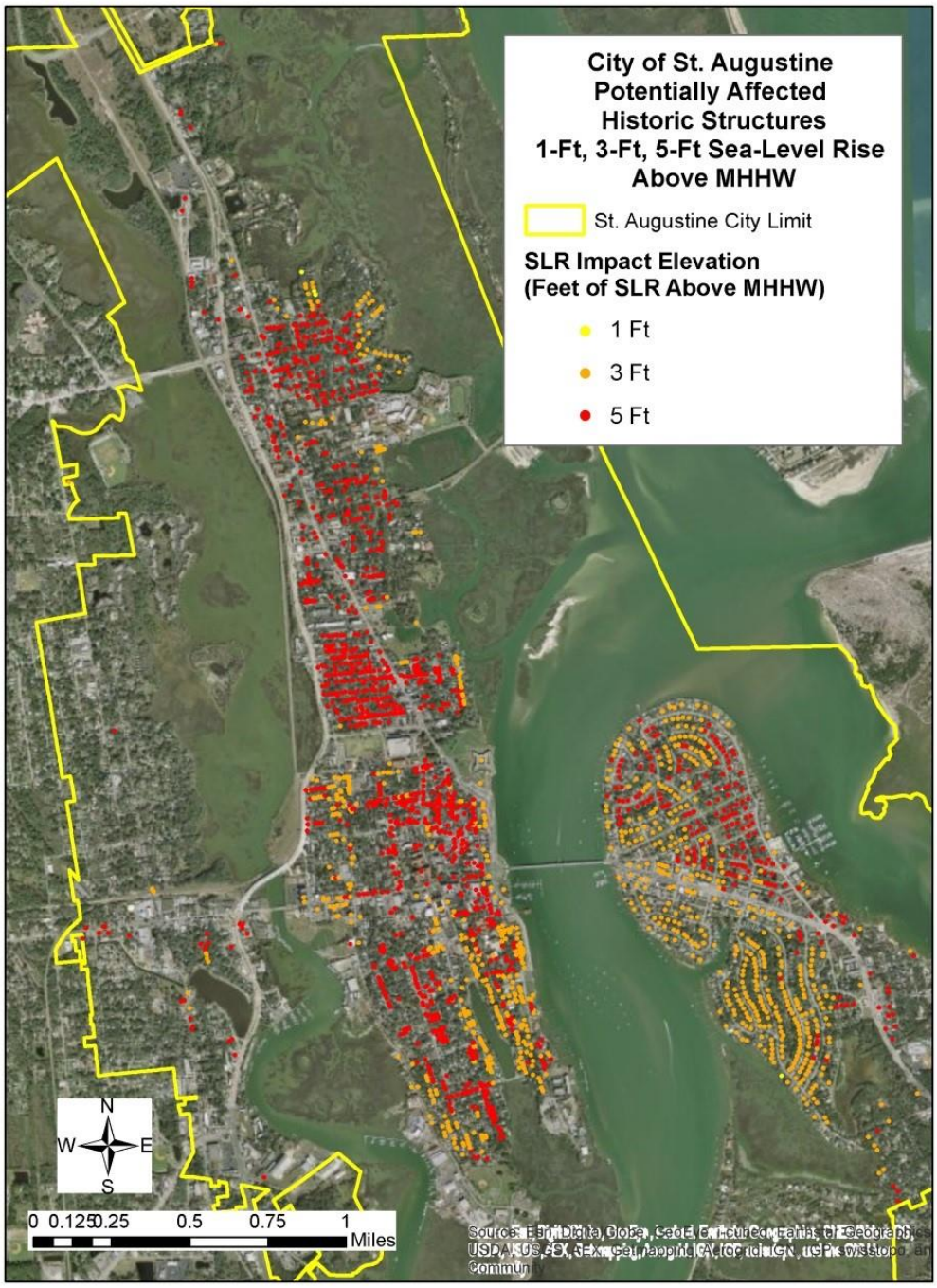
Appendix 14. Impact Map:
City Parks and Recreation Assets @ 1-Foot, 3-Foot, & 5-Foot Relative SLR



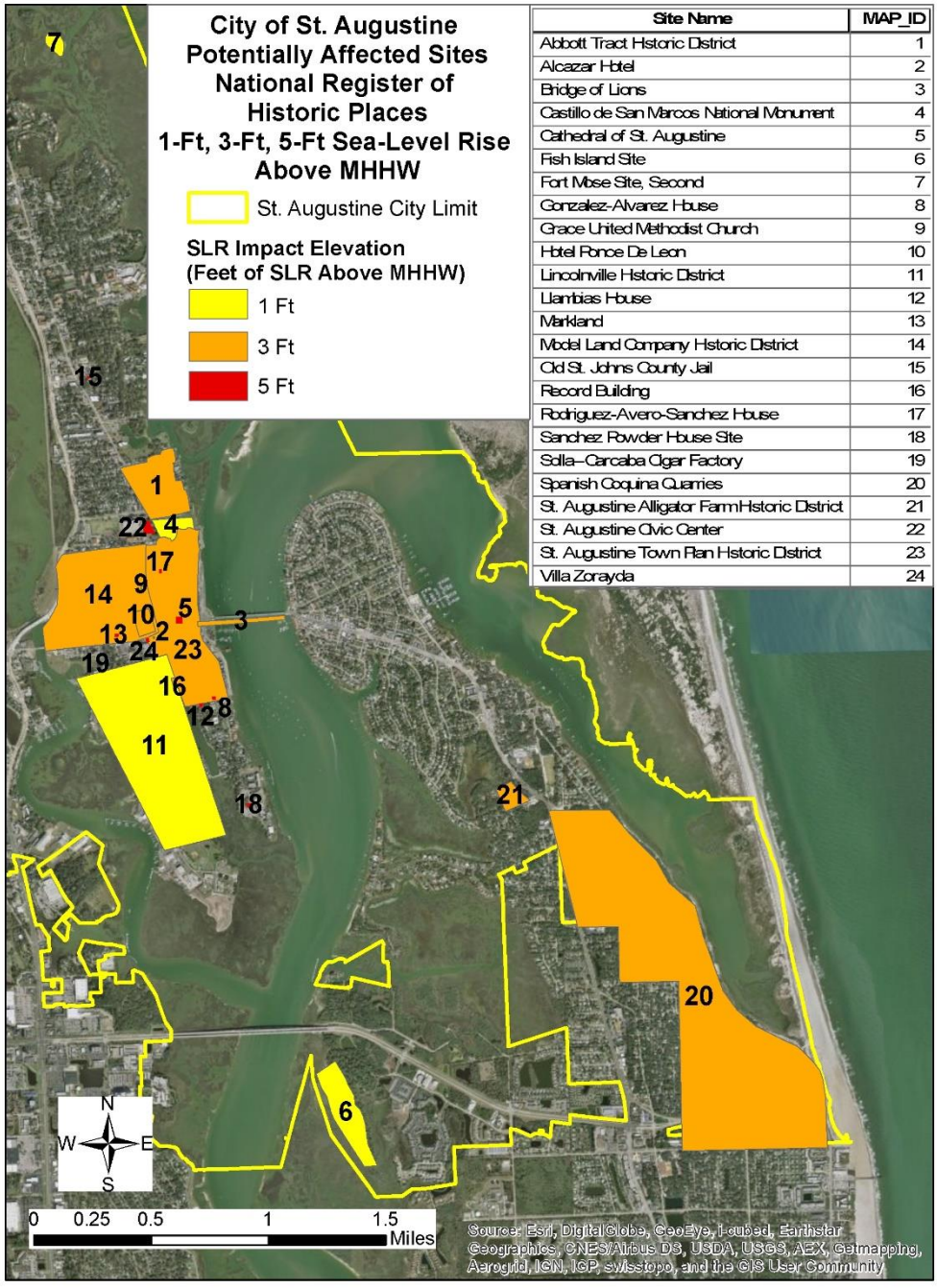
Map ID	Name	SLR Impact Elevation
21	Doug Crane Park	3
22	Eddie Vickers Park And Galimore Center	3
23	Francis Field	3
24	Fullerwood Park	3
25	Gibbs Park	3
26	Government Yard	5
27	J Edward Red Cox Recreation Facility	3
28	Joe Pomar Jr Park	1
29	Ketterlinus Gym	3
30	Maria Sanchez Lake Park	3
31	Nelmar Terrace Park	1
32	Oglethorpe Park	5
33	Parque De Menendez	3
34	Plaza De La Constitucion	3
35	Ponce De Leon Circle Park	3
36	Railway Park	5
37	Santo Domingo Redoubt Park	5
38	Shore Drive Waterfront Park	1
39	St Augustine Carpet Golf Park	3
40	St Augustine Municipal Marina	3
41	Swing Park	5
42	Twine Park	3

Appendix 15. Impact Map: Historic Cemeteries @ 1-Foot, 3-Foot, & 5-Foot Relative SLR

Appendix 16. Impact Map: Historic Structures @ 1-Foot, 3-Foot, & 5-Foot Relative SLR



Appendix 17. Impact Map:
National Register of Historic Places @ 1-Foot, 3-Foot, & 5-Foot Relative SLR



Site Name	MAP_ID
Abbott Tract Historic District	1
Alcazar Hotel	2
Bridge of Lions	3
Castillo de San Marcos National Monument	4
Cathedral of St. Augustine	5
Fish Island Site	6
Fort Mose Site, Second	7
Gonzalez-Alvarez House	8
Grace United Methodist Church	9
Hotel Ponce De Leon	10
Lincolnville Historic District	11
Llambias House	12
Markland	13
Model Land Company Historic District	14
Old St. Johns County Jail	15
Record Building	16
Rodriguez-Avero-Sanchez House	17
Sanchez Powder House Site	18
Solla–Carcaba Cigar Factory	19
Spanish Coquina Quarries	20
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