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Chapter 5: NORTHEAST FLORIDA

by

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INTRODUCTION

Regional Background

The northeastern region of Florida is one of varied natural, geographical, and topographical environments. The region is a part of the Atlantic Coastal Plain and contains an assorted mix of land cover types that span from coastal marshes to upland hammocks and scrub areas. Within these 5,096 square miles of land and water is a diverse network of natural resources, including commercial and natural forest areas, rivers and associated wetlands, springs, and other undeveloped lands, all of which provide economic, environmental, recreational, and aesthetic benefits to the residents and visitors of the region. Eighty-seven percent of the region is land area, and the remaining 13 percent is fresh water.[1]

All of these diverse environments, even inland, are tied to the region's large natural bodies of water in some manner. On the eastern edge of the zone lie the coastal areas of Flagler, St. Johns, Duval, and Nassau counties, along the Atlantic Ocean. Within these four counties, the coastal areas are highly diverse and cannot be depicted just as open-ocean shoreline. A strip of coastal ridges separating the Atlantic Ocean from a narrow lagoon system and the mainland characterizes Northeast Florida's major coastal area, the Upper East Coast Basin. The Intracoastal Waterway connects the lagoon system in the basin. The Tolomato River is one of the major lagoons in this system and runs from Jacksonville in Duval County to St. Augustine in St. Johns County. Another major lagoon is the Matanzas River, running from St. Augustine to the Matanzas Inlet. Running parallel and east of the Tolomato River is the Guana River, which is a separate lagoon from the Intracoastal Waterway.[2]

The other major coastal areas in the region are the St. Mary's River Basin and the Nassau River Basin, both of which are characterized by extensive marsh and wetland areas. The inland portion of Northeast Florida is dominated by the Lower St. Johns River Basin, which contains Duval, St. Johns, and two interior counties, Clay and Putnam.[3] The Atlantic Ocean's tidal effects influence the St. Johns River for 100 statute miles upriver, near the southern border of Putnam County.[4]

In no small part due to Northeast Florida's attractive aquatic amenities, the region has seen a steady increase in population growth over the last 30 years. The 2000 Census showed that population in the region had grown by 22 percent over the 1990 population compared to state and national averages of 23.5 and 13.1 percent, respectively.[5] Historically, the Northeast Florida region has not seen the development that other areas of the state have experienced. This has resulted in the present existence of large tracts of undeveloped and undisturbed native habitats within the region that are home to a wide variety of native flora and fauna. Because the region is still relatively undeveloped and has much available land left, however, projections indicate that

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[1]Northeast Florida Regional Planning Council. (1997). *Strategic Directions: A Strategic Regional Policy Plan for Northeast Florida* (p.79). Jacksonville, FL: Author.
[2]*Ibid.* at 83–84.
[3]*Ibid.* at 81–82.
[4]NOAA. (1999). Currents in the St. Johns River, Florida: Spring and Summer of 1998 (p. 3). Silver Spring, MD: Author.
[5]US Census (2000).

the region will begin to grow faster than the rest of the state, on a percentage basis, through 2010.[6]

Most of this expected population growth will occur in the coastal areas of Northeast Florida. Flagler County, at the southern boundary of the region, is the fifth fastest growing county in the country and ranks first in Florida in population growth. Flagler County grew by 73.6 percent during the 1990–2000 Census period. Another coastal county in Northeast Florida, St. Johns County, is the fifth-fastest growing county in the state. St. Johns County's growth rate from 1990 to 2000 was 46.9 percent. Inland areas are not immune from high growth, though. Clay County, which rests on the St. Johns River, has the eighth largest population growth of any county in the state.[7]

Purpose of this Study

Because of the high population growth rates of coastal and riverine areas, it is imperative that land use planners begin to prepare for the eventual rise of sea levels in these areas. The coastline is highly developed with residential, commercial, and recreational properties. Areas bordering Florida's rivers face similar kinds of development. As Florida's population grows, these properties will only grow more numerous. Almost 25,000 kilometers of Florida's coast is below 3.5 meters in elevation.[8] If sea levels continue to rise, much of this area can be expected to be flooded. Planners must begin to decide which land areas in their counties and municipalities will be protected, if any, against sea level rise and what the cost of holding back the sea will be. Although the sea is not expected to rise in any significant amount in the near future, it is wise to start anticipatory planning on shore protection strategies now.

The Northeast Florida Regional Council (NEFRC) has been contracted by the Southwest Florida Regional Planning Council (SWFRPC), through a grant from the U.S. Environmental Protection Agency (EPA), to participate in a nationwide project promoting planning for and awareness of sea level rise. The other regional planning council's along the Atlantic Coast (East Central Florida, Treasure Coast, and South Florida) are also participating in this study; and the cooperative agreement between EPA and SWFRPC contemplates extending the study to include the entire coast of Florida.

The Florida studies are part of a national effort by the EPA to encourage the long-term thinking required to deal with the impacts of sea level rise issues. With this project, the EPA hopes to ensure the long-term survival of coastal wetlands and to diminish losses to life and property from coastal hazards, such as erosion and inundation. The regional planning councils of Florida share these goals, as do other coastal states, including New Jersey, North Carolina, and Maryland, where similar research has been conducted.

This sea level rise project seeks to stimulate government planning for adaptation to the effects of rising sea levels on uplands and wetlands. This is to be accomplished by creating maps that

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[6]Northeast Florida Regional Planning Council. (1997). *Strategic Directions: A Strategic Regional Policy Plan for Northeast Florida* (p.80). Jacksonville, FL: Author.
[7]US Census (2000).
[8]Titus, G., & Richman, C. (2001). Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations along the U.S. Atlantic and Gulf Coasts. *Climate Research: 18 (3).*

demonstrate the expected responses of counties and municipalities to sea level rise, based on current land use designations and future planning policies. Governments can then use these created sea level rise maps as guides for future land use and zoning decisions in coastal areas and tide-affected river areas.

These maps are intended for two very different audiences:

- ***State and local planners and others concerned about long-term consequences.*** Whether one is trying to ensure that a small town survives, that coastal wetlands are able to migrate inland, or some mix of both, the most cost-effective means of preparing for sea level rise often requires implementation several decades before developed areas are threatened. EPA seeks to accelerate the process by which coastal governments and private organizations plan for sea level rise. The first step in preparing for sea level rise is to decide which areas will be elevated or protected with dikes, and which areas will be abandoned to the sea.

- ***Policy makers and citizens concerned about long-term climate change.*** Governments at all levels and many citizens are considering measures to reduce greenhouse gas emissions. The urgency of doing so depends in part on the consequences of climate change and sea level rise. Those consequences in turn depend to a large degree on the extent to which local coastal area governments will permit or undertake sea level rise protection efforts. In addition, the United Nations Framework Convention on Climate Change, signed by President Bush in 1992, commits the United States to taking appropriate measures to adapt to the consequences of global warming.

Approach

Based on research estimates of sea level rise in the next 200 years, the current 5-foot contour line was determined to be the mean sea level shoreline for mapping purposes. Although sea level may not rise exactly 5 feet, 5-foot contour line intervals on maps are common. More specific gradations of contour are not readily available on existing maps. Additionally, astronomical high tides must be accounted for, which means allowing for a few more feet of rise to be added to the 5-foot shoreline. Since only 5-feet interval contour lines are readily available, the 10-foot contour line must be used as the default sea level rise line for mapping purposes. Although such a large rise is unlikely any time soon, it is a mean estimate of the rise expected over the next two centuries, if global warming continues at its present pace.

To make assumptions about shore protection scenarios, determining future land use was necessary to define anticipated responses. To determine the protection scenarios of 0–10 foot upland areas, the generalized land uses were defined based on local government future land use maps. It is generally being assumed that protection is almost certain for existing developed areas and extensively used parks. Protection is assumed to be likely for less densely developed areas, moderately used parks, developed coastal areas, and agricultural areas. Undeveloped areas, coastal high hazard areas, and minimally used parks are assumed to be unlikely to be protected. Conservation lands, both privately and publicly owned, have generally been understood to be No Protection areas.

Table 1 lists areas of land vulnerable to sea level rise in Northeast Florida, and Figure 1 shows the lands vulnerable to sea level rise in the region. (We do not have a single map depicting the results of this study for the entire Northeast Florida Region.)

Table 1. Area of Land Close to Sea Level by County (square kilometers)

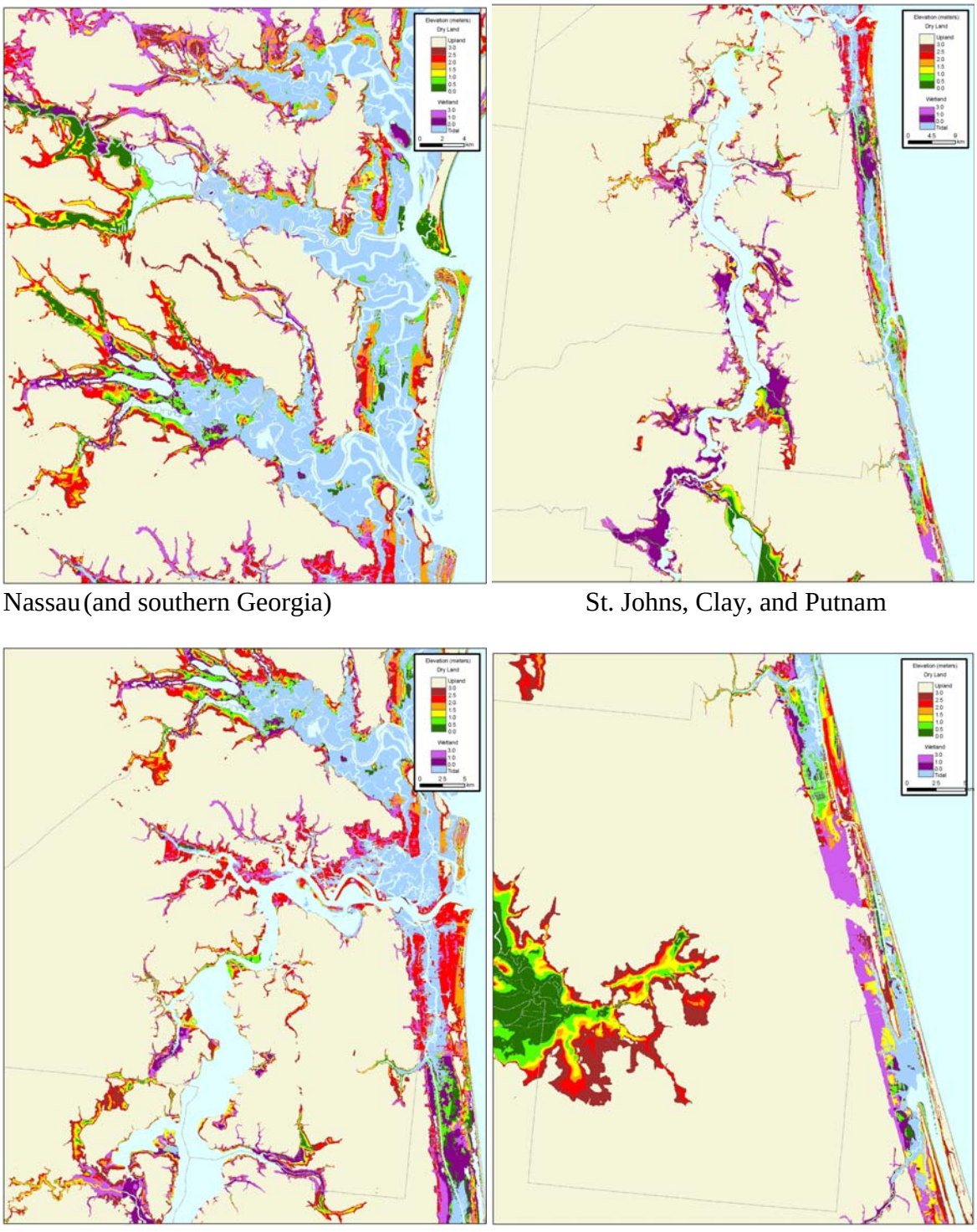
	Elevations (m) above spring high water									
County	**0.50**	**1.00**	**1.50**	**2.00**	**2.50**	**3.00**	**3.50**	**4.00**	**4.50**	**5.00**
Clay	13.4	27.5	45.5	57.9	71.2	94.3	108.5	120.9	143.3	1571
Duval	26.2	44.3	62.5	98.4	210.9	256.5	296.9	357.1	419.5	485.6
Flagler	56.6	80.7	112.8	134.4	165.3	228.8	261.2	312.2	401.4	441.3
Colleton	58.9	122.8	157.3	218.9	296.5	342.3	391.9	464.2	513.6	571.0
Nassau	66.9	98.2	126.8	157.2	208.8	238.5	309.4	3632	459.5	519.0
Putnam	88.4	160.8	198.6	217.5	236.6	274.9	299.2	324.4	374.7	405.5
St. Johns	64.0	134.4	170.7	201.7	247.5	290.5	330.6	386.2	446.2	485.4
Total	374	669	874	1086	1437	1726	1998	2328	2758	4479

Source: National Elevation Dataset and Titus J.G., and J. Wang. 2008. Maps of Lands Close to Sea Level along the Middle Atlantic Coast of the United States: An Elevation Data Set to Use While Waiting for LIDAR. Section 1.1 in: *Background Documents Supporting Climate Change Science Program Synthesis and Assessment Product 4.1*, J.G. Titus and E.M. Strange (eds.). EPA 430R07004. U.S. EPA, Washington, DC.

Report Outline

The following sections of this report discuss details on these subjects further:

- Sea level rise predictions for northeast Florida;
- Current federal, state, and local coastal management policies;
- The general methodology used for development of county sea level rise maps; and
- Analysis and summary of anticipated sea level rise response scenarios for each county, and sea level rise response maps for each county.



Nassau (and southern Georgia) St. Johns, Clay, and Putnam

Duval Flagler

Figure 1 Elevation maps of the Counties in Northeast Florida relative to spring high water.
Source: See Table 1.

ESTIMATES OF SEA LEVEL RISE

Causes and Indications of Sea Level Rise

Increasing concentrations of carbon dioxide and other gases in the atmosphere have been warming the globe since humans began to release them. This is the process commonly known as the greenhouse effect. The average surface temperature of the planet has risen by approximately 1° F (0.6°C) in the last 100 years, coinciding with the increase in concentration of greenhouse gases in the atmosphere. All of the warmest years on record have happened since 1980. Global warming is expected to raise surface temperatures by a few more degrees within the coming century.[9]

The EPA estimates that there will be a 50 percent chance of a 1°C change in temperature by 2050, and a 90 percent probability of a 0.31°C rise in temperature. There is a 5 percent cumulative probability that temperatures will rise by more than 2°C in 50 years. By 2100, there is a 90 percent chance that a change in temperature equal to last century's will occur (0.6°C). A rise of 2°C by 2100 has a 50 percent probability, while there is a 5 percent prospect of a 4.7%°C increase in global temperatures.[10]

The global change in temperature caused by the greenhouse effect is likely to have a number of consequences that will combine to cause sea levels to rise. As surface temperatures rise, added heat will penetrate the ocean and cause the layers of the ocean to warm and expand by 20 cm by 2100.[11] These warmer temperatures may melt portions of the Greenland Ice Sheet and small glaciers, which could contribute increases of 2.9 cm[12] and 8.7 cm,[13] respectively, to the 22nd century's sea level. The melting of Antarctic ice sheets, however, is not expected to contribute to global sea level rise until after 2100. This is because the Antarctic ice sheets are already floating in the ocean and displacing water. Only if the acceleration of Antarctic ice streams conveying ice into the ocean increases substantially will Antarctic contributions to sea level rise be substantive. This is unlikely, however, because the increased precipitation caused by warmer air temperatures will outpace an acceleration of ice streams.[14]

By 2050, there is a 50 percent probability of average global sea levels rising by 15 cm. There is a 90 percent likelihood that sea level will raise by at least 4.6 cm and a one-in-ten chance of a 28 cm rise. Research results for 2100 finds that the probable sea level rise will be 34 cm. Sea level rise for 2100 at the 90 percent probability is 10 cm, and there is a 10 percent chance of a 65 cm sea level rise. Two hundred years from now, there is a 50-50 likelihood that sea levels will raise by 81 cm. By 2200, there is nine-in-ten chance of a sea level rise of at least 22 cm and a 10

[9]Titus, G., & Narayanan, V. (1995). *The Probability of Sea Level Rise*. Washington, DC: U.S. Environmental Protection Agency.
[10]*Ibid*. at 50.
[11]*Ibid* at 124.
[12]*Ibid* at 82.
[13]*Ibid* at 119.
[14]*Ibid* at 125.

percent probability of 196 cm sea level rise. Although very unlikely, there is a 1 percent chance of sea levels rising 42 cm, 104 cm, and 409 cm in 2050, 2100, and 2200, respectively.[15]

Sea Level Rise Estimates in Northeast Florida

The EPA document, *The Probability of Sea Level Rise*, provides the recommended procedure for estimating sea level rise at a specific location. An estimation of sea level rise at a particular location can be found using the following formula: **local(t) = normalized(t) + (t-1990) * trend,** where (t) is sea level rise. This equation is simply the addition of the normalized sea level projection for a specific year to the current rate of sea level rise from 1990 onward to a specific year in the future. The normalized projections provided in Table 2 "estimate the extent to which future average global sea level rise will exceed what would have happened if current trends simply continued."[16] The current global rate of sea level rise is 1.8 mm/year,[17] while sea level in Northeast Florida (Mayport) is rising at 2.2 mm/year. A historical rise rate of more than 2.5 mm/year is common along much of the U.S. coast.[18] The historical rates of sea level rise at various locations in the United States can be found in Table 3.

As an example, to find the estimation of the 50 percent probability of sea level rise in Northeast Florida in 2100, the following steps would be taken. As noted previously, the historical rate of sea level rise in this region has been 2.2 mm/year. The historical rate of rise (2.2 mm) is multiplied by the number of years from 1990 to 2100 (110). At that rate, sea level can be expected to rise 24.2 cm by 2100. For 2100, Table 2 provides a normalized sea level projection of 25 cm for the 50 percent probability. The rate projected from the current rate of rise of 24.2 cm is added to the normalized projection of 25 cm. This results in a 2100 sea level rise estimate of 49.2 cm at the 50 percent probability. It is important to note the normalized projections provided by the EPA are estimates of future sea rise and not based on hard statistics.[19] Full results for estimates of sea level rise in 2025, 2050, 2075, 2100, 2150, and 2220 can be viewed in Table 4.

[15] *Ibid* at 128.
[16] *Ibid* 144.
[17] *Ibid*
[18] *Ibid.* at 145.
[19] *Ibid.* at 145–146.

TABLE 4
ESTIMATED SEA LEVEL RISE FOR NORTHEAST FLORIDA

Sea Level Rise Projection by Year, Above 1990 Levels

Probability (%)	2025		2050		2075		2100		2150		2200	
	cm	inches	cm	inches	cm	inches	cm	inches	cm	inches	cm	inches
90	6.7	2.6	12.2	4.8	18.7	7.4	25.2	9.9	38.2	15.0	51.2	20.2
80	8.7	3.4	16.2	6.4	24.7	9.7	34.2	13.5	51.2	20.2	69.2	27.2
70	10.7	4.2	19.2	7.6	28.7	11.3	40.2	15.8	61.2	24.1	83.2	32.8
60	11.7	4.6	21.2	8.3	32.7	12.9	44.2	17.4	70.2	27.6	97.2	38.3
50	12.7	5.0	23.2	9.1	35.7	14.1	49.2	19.4	78.2	30.8	110.2	43.4
40	13.7	5.4	26.2	10.3	39.7	15.6	54.2	21.3	88.2	34.7	124.2	48.9
30	15.7	6.2	28.2	11.1	42.7	16.8	60.2	23.7	100.2	39.4	144.2	56.8
20	16.7	6.6	31.2	12.3	47.7	18.8	68.2	26.9	115.2	45.4	171.2	67.4
10	19.7	7.8	36.2	14.3	55.7	21.9	79.2	31.2	141.2	55.6	220.2	86.7
5	21.7	8.5	40.2	15.8	61.7	24.3	90.2	35.5	169.2	66.6	277.2	109.1
2.5	24.7	9.7	44.2	17.4	68.7	27.0	102.2	40.2	202.2	79.6	342.2	134.7
1	26.7	10.5	48.2	19.0	75.7	29.8	116.2	45.7	245.2	96.5	448.2	176.5
Mean	12.7	5.0	24.2	9.5	36.7	14.4	51.2	20.2	86.2	33.9	127.2	50.1

TABLE 2 ESTIMATING SEA LEVEL RISE AT A SPECIFIC LOCATION
Normalized Sea Level Projections, Compared with 1990 Levels (cm)[20]

Sea Level Projection by Year

Cumulative Probability (%)	2025	2050	2075	2100	2150	2200
10	-1	-1	0	1	3	5
20	1	3	6	10	16	23
30	3	6	10	16	26	37
40	4	8	14	20	35	51
50	5	10	17	25	43	64
60	6	13	21	30	53	78
70	8	15	24	36	65	98
80	9	18	29	44	80	125
90	12	23	37	55	106	174
95	14	27	43	66	134	231
97.5	17	31	50	78	167	296
99	19	35	57	92	210	402
Mean	5	11	18	27	51	81

[20] *Ibid.* at 145.

TABLE 3
HISTORICAL RATE OF SEA LEVEL RISE AT VARIOUS LOCATIONS IN THE UNITED STATES (mm/yr)

Atlantic Coast

Eastport, ME 2.7
Portland, ME 2.2
Boston, MA 2.9
Woods Hole, MA 2.7
Newport, RI 2.7
New London, CT 2.1
Montauk, NY 1.9
New York, NY 2.7
Sandy Hook, NJ 4.1
Atlantic City, NJ 3.9
Philadelphia, PA 2.6
Lewes, DE 3.1
Annapolis, MD 3.6
Solomons Is., MD 3.3
Washington, DC 3.2
Hampton Rds., VA 4.3
Portsmouth, VA 3.7
Wilmington, NC 1.8
Charleston, SC 3.4
Ft. Pulaski, GA 3.0
Fernandina, FL 1.9
Mayport, FL 2.2
Miami Beach, FL 2.3

Gulf Coast

Key West, FL 2.2
St. Petersburg, FL 2.3
Pensacola, FL 2.4
Grand Isle, LA 10.5
Eugene Island, LA 9.7
Sabine Pass, TX 13.2
Galveston,TX 6.4
Freeport, TX 14.0
Padre Island, TX 5.1

Pacific Coast

Honolulu, HI 1.6
Hilo, HI 3.6
San Diego, CA 2.1
La Jolla, CA 2.0
Newport, CA 1.9
Los Angeles, CA 0.8
Santa Monica, CA 1.8
San Francisco, CA 1.3
Alameda, CA 1.0
Crescent City, CA –0.6
Astoria, OR –0.3
Seattle, WA 2.0
Neah Bay, WA –1.1
Sitka, AK –2.2
Juneau, AK –12

CURRENT POLICIES AND TRENDS IN COASTAL MANAGEMENT

Very few policies at any level of government were specifically designed to respond to the effects of sea level rise caused by global warming. Many coastal management, construction, and planning and zoning guidelines, however, can prepare citizens and governments for rising sea levels. The three basic categories of adaptive responses to sea level rise are retreat, accommodation, and protection.

Retreat[21] is the policy of abandoning lands and structures in coastal zones and allowing marine ecosystems to move inland. In this response, there is no effort to protect the land from sea level rise. Governments exercising the retreat option generally prevent development in prone areas, allow development with conditions for abandonment (e.g., rolling easements) and/or withdraw subsidies for construction in danger zones. Governments can restrict development in coastal areas through a variety of policies. These approaches usually include land acquisitions, setbacks, low densities, planning and zoning restrictions on coastal land use, and bans on redevelopment of damaged structures.

Accommodation[22] allows for land use and occupancy of vulnerable areas to continue, but with no attempts to prevent flooding or inundation. It is a hybrid of retreat and protection, because structures are protected while floodplains and shorelines advance farther inland. Governments favoring accommodation can strengthen flood preparations, prohibit activities that may destroy protective coastal resources, and/or deny government flood insurance coverage of inhabitants of vulnerable areas. Strengthened flood preparations may include countering rising seas and high winds through building code requirements, improvement of drainage, and education. Like retreat, accommodation requires advance planning by local governments. Local governments must also accept that valuable land may be lost to rising seas. Although accommodation is a common short-term response, it may be less useful in the long run. Although it may be practical in some circumstances to maintain habitable homes as wetlands advance onto people's yards, eventually the wetlands would become inundated and homes would be standing in the water.

Protection[23] involves using structural, defensive measures to protect the land from the sea so that land use can continue. Shores can be protected by hard structures such as seawalls, revetments, and dikes or by soft structural techniques like beach nourishment and elevation of land surfaces with fill. Unlike the first two options, protection has a dramatic impact on both the immediate environment and ecosystems beyond the immediate area. The costs to wetlands, unprotected uplands, and offshore fisheries must be assessed be protective measures are constructed.

Federal Policies

[21] IPCC Coastal Zone Management Subgroup. (1990) *Strategies for Adaption to Sea Level Rise.*
[22] *Ibid.*
[23] *Ibid.*

Although a few federal policies specifically deal with the problems of sea level rise, several policies address the same effects of sea level rise, such as flooding, erosion, and wetland loss. These policies are included in the Coastal Zone Management Act, the Coastal Barrier Resources Act, the Clean Water Act, the Rivers and Harbors Act, and National Flood Insurance Act.

The Coastal Zone Management Act of 1972[24] is the federal law that created and guides the nation's coastal management programs. Congress created the CZMA to deal with the threats to the country's coastal zone caused by increasing and competing demands on the land and water of the zone. The CZMA establishes the coastal management policy of the United States as preserving, protecting, developing, and, where possible, restoring or enhancing the resources of the nation's coastal zone by encouraging and assisting the states to exercise to develop and implement their own coastal management programs. Congress also specifically addressed the issue of sea level rise in the act:

> Because global warming may result in a substantial sea level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence.
>
> The Congress finds and declares that it is the national policy—the management of coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands.

The provisions of the CZMA are realized through the Coastal Zone Management Program (CZMP), which is administered by NOAA. The CZMP is a voluntary federal–state partnership that has provided cost-sharing grants to states to develop and implement their own coastal zone management plans. The CZMP has based eligibility for federal approval of state plans on several factors. Each state's plan is required to define boundaries of the state's coastal zone, identify uses within the area to be regulated by the state plan, the criteria for regulations such uses, and the guidelines for priorities of uses within the coastal zone. Subsequent to approval of the plan by NOAA, grants are awarded for implementation of the state's coastal management plan. In addition to providing financial assistance, the CZMP also supports states by offering mediation, technical services and information, and participation in priority state, regional, and local forums. Thirty-four states and territories with federally approved coastal management programs are participatories in the CZMP. Almost all of the nation's shoreline (99.9 percent) is currently managed by the CZMP. The main effect of the CZMA on the issue of sea level rise is to make state policymakers aware of the matter when they create their own coastal management plans.

Another piece of federal legislation that has a bearing on coastal management policies is the Coastal Barrier Resources Act (CoBRA),[25] enacted in 1982. CoBRA was designed to protect barrier islands along the nation's coast. Coastal barrier islands are located off of

[24]16 USC 1451-1464, Chapter 33; P.L. 92-583, October 27, 1972; 86 Stat. 1280.
[25]Public Law 97-348 (96 Stat. 1653; 16 U.S.C. 3501 et seq.) Coastal Barrier Resources Act (CoBRA).

the mainland coast and protect the mainland by receiving the majority of the ocean's energy contained in winds, waves, and tides. Coastal barriers also protect and maintain productive ecosystems that exist within this protective zone. In drafting the law, Congress found that certain actions and programs of the federal government subsidized and permitted development on coastal barriers and the result was the loss of barrier resources, threats to human life, health, and property, and the expenditure of millions of tax dollars each year.

CoBRA established a Coastal Barrier Resources System, which designated various undeveloped coastal barrier islands for inclusion in the system. The boundaries of the system are contained on maps kept on file by the Department of the Interior. CoBRA prohibits various federal actions and policies from occurring on islands within the system. The following areas in Northeast Florida are within the CoBRA system[26]:

Nassau County: Fort Clinch.

Duval County: Talbot Islands Complex (also in Nassau County).

St. Johns County: Guana River, Usinas Beach, and Conch Island.

Flagler County: Matanzas River (also in St. Johns County) and Washington Oaks Gardens.

The act places several restrictions on federal government spending on expenditures that encourage development or modification of a coastal barrier. No new expenditures or federal assistance can be used on coastal barrier islands for the following projects:

> (1) The construction or purchase of any structure, appurtenance, facility, or related infrastructure;
>
> (2) The construction or purchase of any road, airport, boat landing facility, or other facility on, or bridge or causeway to, any System unit; and
>
> (3) The carrying out of any project to prevent the erosion of, or to otherwise stabilize, any inlet, shoreline, or inshore area, except that such assistance and expenditures may be made available on (certain designated units) for purposes other than encouraging development and, in all units, in cases where an emergency threatens life, land, and property immediately adjacent to that unit.

Notwithstanding the previous restrictions, CoBRA does provide exceptions to limitations on a variety of expenditures with the barrier system. These include military and Coast Guard activities; maintenance of federal navigation channels; maintenance of certain publicly owned roads, structures, and facilities; scientific research; and nonstructural projects for shoreline stabilization that mimics, enhances, or restores a natural stabilization system. (Although shoreline stabilization may immediately bring beach

[26]Found at http://www.fws.gov/cep/cbrunits.html.

nourishment to mind, it is a more ecologically friendly process than simply dumping sand on a beach. Nonstructural shore erosion control projects usually use bioengineering to create protective vegetative buffers, stabilizing stream banks and shorelines and creating near-shore habitats for aquatic species and waterfowl.) Another feature of the act is the prohibition of national flood insurance or HUD assistance to any projects within the barrier system that facilitate an activity that is not consistent with CoBRA's provisions. CoBRA is a good start in the prevention of development in areas that will be most affected by the effects of sea level rise.

The National Flood Insurance Program (NFIP)[27] is another important component of federal coastal management policy. It is administered by the Federal Emergency Management Agency (FEMA), and its primary goals is to save lives and reduce future property losses from flooding. The NFIP is a voluntary program based on a mutual agreement or partnership between the federal government and local communities. This partnership provides that the federal government will make federally backed flood insurance available to home and business owners in communities that agree to adopt and enforce comprehensive floodplain management standards designed to reduce flood damages. NFIP transfers most of the costs of private property flood losses from the taxpayers to people who choose to live within floodplains through insurance premiums and increased construction standards.

Community response to this requirement involves the adoption of land use, zoning, and building code standards that, at a minimum, include the design and construction standards of the NFIP. The minimum NFIP design and construction standards are applicable to all new construction, substantial damages, and substantial improvements to existing structures located in Special Flood Hazard Areas or in Special Flood Hazard Areas that have not yet been identified by FEMA. The Special Flood Hazard Areas represent the statistical chance of a 100-year flood occurring in any given year. The 100-year flood has a 1 percent chance of occurring in any given year.

The NFIP imposes stricter requirements on communities in the V-Zones of Flood Insurance Rate Maps. These are locales in coastal high hazard areas located along coastlines that are subject to high water levels, wave action, and erosion from strong storms and hurricanes. The wind and resultant waves and tidal surges associated with these storms cause water of high velocity to sweep over nearby land. Generally, the V-Zone indicates the inland extent of a 3-foot breaking wave atop a storm surge. These areas are extremely hazardous to life and property.

The NFIP lists a number of building requirements for new construction or substantial improvements in coastal high hazard areas to be able to withstand wind and waves. New buildings and improvements must:

- Obtain and maintain the elevation of the bottom of the lowest horizontal structural member of the lowest floor.
- Be located landward of mean high tide and no new construction is allowed over water.

[27] 44 CFR 60.3

- Be elevated so that the bottom of the lowest horizontal structural member of the lowest floor is at or above the base flood elevation (BFE), on a pile or column foundation.
- Allow the space below the lowest elevated floor to be free of obstruction or must be enclosed with non-supporting breakaway walls, open lattice-work, or insect screening designed to collapse under wind and water loads without causing damage to structural supports or the elevated structure.
- Not use fill for structural support of buildings.
- Prohibit manmade alteration of sand dunes and mangrove stands that would increase potential flood damage.

As previously noted, CoBRA prohibits new NFIP coverage for new or substantially improved structures in any coastal barrier in the CoBRA system. More details on NFIP's influence on state and local policies can be found in following sections.

The Clean Water Act of 1972 is another federal law that has an effect on the health of our nation's coastal areas and wetlands. Section 404 of the Clean Water Act sets national policy for the discharge of dredged or fill material into the nation's navigable waters and adjacent wetlands. The act has even been interpreted to have authority over inland wetlands. Section 404 gives jurisdictional responsibility for issuing dredge permits to the U.S. Army Corps of Engineers (COE). EPA has responsibility for developing and interpreting the criteria used in permit issuances.

The Clean Water Act prohibits the discharge of dredged or fill material at a specific site if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem or if the discharge will cause or contribute to significant degradation of U.S. waters. Practicable alternatives, under the act, include activities that do not include a discharge into U.S. waters or discharges into waters other than the specific site requested. Degradation caused to U.S. waters is deemed to be significant adverse effects to human health or welfare, aquatic life stages and ecosystems, ecosystem diversity and productivity, and recreational, aesthetic, and economic values. Discharges from established and ongoing farming, ranching, and forestry activities are exempt from Section 404 provisions.

To receive a permit to discharge dredge materials, the applicant must prove to the COE that he or she has taken steps to avoid wetland impacts where practicable, minimized potential impacts to wetlands, and provided compensation for any remaining, unavoidable impacts through activities to restore or create wetlands. States also have a role in Section 404 decisions, through state program general permits, water quality certification, or program assumption.[28]

An additional federal law that gives the COE additional authority over construction in navigable waters and wetlands is the Rivers and Harbors Act (RHA).[29] Sections 9 and 10 of the act authorize the COE to regulate the construction of any structure or work within navigable waters of the United States. The types of structures the RHA allows the COE to

[28]40 CFR Part 230 – Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material.
[29](33 U.S.C. §§ 401 *et seq.*).

regulate include the following: wharves, breakwaters, or jetties; bank protection or stabilization projects; permanent mooring structures, vessels, or marinas; intake or outfall pipes; canals; boat ramps; aids to navigation; or other modifications affecting the course, location condition, or capacity of navigable waters.

When issuing permits for construction of the aforementioned structures, the COE must consider the following criteria: (1) the public and private need for the activity; (2) reasonable alternative locations and methods; and (3) the beneficial and detrimental effects on the public and private uses to which the area is suited. The COE is also required to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to protect and conserve wildlife resources.

State Policies

As with federal policies, few state policies specifically address the issue of sea level rise. State coastal guidelines that cover beach management policies can, however, be used to respond to sea level rise concerns. These policies are included in the Coastal Construction Control Line Program, the Beach Erosion Control Program, and Coastal Building Zone and Strategic Beach Management Plans.

The Florida Beach and Shore Preservation Act was enacted by Florida's legislature to preserve and protect Florida's beach and dune system. Beaches and dunes are the first line of defense against storms, acting as a buffer between the sea and coastal development. One of the programs authorized by the Beach and Shore Preservation Act to be an essential element in the protection effort is the Coastal Construction Control Line (CCCL) Program.[30]

The CCCL Program was designed to protect Florida's beach and dune system from irresponsible construction that could weaken, damage, or destroy the health of the dune system. Structures that are built too close to the sea can inhibit the beach and dune system from its natural recovery processes and can cause localized erosion. Improperly constructed structures are a threat to other nearby coastal structures should they be destroyed by storms. The CCCL Program gives the State the jurisdiction to apply stringent siting and design criteria to construction projects within the Control Line. It must be noted that the CCCL is not a setback line, but is rather a demarcation line of the state's authority.

The CCCL is marked at the landward limit of coastal areas that are subject to the effects of a 100-year storm surge. Although wind and flooding may intrude further inward than the 100-year storm surge area, effects landward of the CCCL are considerably less than those within the CCCL. Within the CCCL, the State prohibits the construction or siting of structures that would cause a significant adverse impact to the beach and dune system, result in the destabilization of the system, or destroy marine turtle habitat. To meet these requirements, structures are required to be located a sufficient distance from the beach and frontal dune and must also be sited in a way that does not remove or destroy natural

[30]Beach and Shore Preservation Act, Florida Statutes (s.) Chapter 161.

vegetation. The CCCL also requires all structures to be constructed to withstand the wind and water effects of a 100-year storm surge event. This involves creating structures that meet American Society Civil Engineering 7-88 Section 6 wind design standard for 110 mph winds and 115 mph for the Keys. Water standards include a foundation design to withstand a 100-year storm event—including the effects of surge, waves, and scouring. There is no prohibition against rebuilding under the CCCL Program. Because of highly erosional effects, the CCCL Program discourages the construction of rigid coastal armoring (seawalls) and instead encourages property owners' use of other protection methods such as foundation modification, structure relocation, and dune restoration.

Another similar endeavor to regulate coastal construction is the Coastal Building Zone (CBZ). The CBZ was established as part of the Coastal Protection Act of 1985 to protect coastal areas and to protect life and property. The CBZ is similar to the CCCL Program in that it is a regulatory jurisdiction rather than a setback line. The CBZ envelops land from the seasonal high water line to 1,500 feet landward of the CCCL. In those areas fronting on the ocean but not included within an established CCCL, the Coastal Building Zone includes the land area seaward of the most landward V-zone line, as established by NFIP's flood maps. The V-Zone is an area likely to experience a wave greater than 3 feet high with storm surge or areas within the 100-year storm event used by the CCCL Program. Local governments enforce the Coastal Building Zone, as a part of their building codes, rather than the state. The CCCL and CBZ are referenced in the building codes of Northeast Florida's coastal counties.

Within the CBZ, new construction is required to meet the Standard Building Code 1997 wind design standard of 110 mph, and 115 mph for the Keys. As for water standards, structures are required to meet NFIP requirements or local flood ordinance requirements, whichever are stricter. Foundations must also be designed to withstand a 100-year storm surge. CBZ construction standards are less stringent than CCCL standards. This is because NFIP flood maps have lower base flood elevations for 100-year storm events than do CCCL studies.

Another state effort to protect Florida's beaches, authorized by the Beach and Shore Preservation Act, is the Beach Erosion Control Program (BECP).[31] The BECP is the primary program that implements the Florida Department of Environmental Protection's beach management recommendations. The BECP was created to coordinate the efforts of local, state, and federal governments in protecting, preserving, and restoring Florida's coastal resources. One of the activities of this program is the offering of financial assistance to counties, local governments, and other special districts for shore protection and preservation efforts. The BECP will provide up to 50 percent of project costs. The mix between federal, state, and local funds is different for each project.

Beach management activities eligible for funding from the BECP include beach restoration and nourishment activities, project design and engineering studies, environmental studies and monitoring, inlet management planning, inlet sand transfer,

[31]Found at http://www.dep.state.fl.us/beaches/programs/bcherosn.htm.

dune restoration and protection activities, and other activities related to beach erosion prevention.

Another endeavor of the BECP is the development and maintenance of a Strategic Beach Management Plan (SBMP) for Florida. The SBMP is a multiyear repair and maintenance strategy to carry out the proper state responsibilities of a comprehensive, long-range, statewide program of beach erosion control; beach preservation, restoration, and nourishment; and storm and hurricane protection. The SBMP[32] is divided into specific beach management plans for Florida's coastal regions, including the Northeast Atlantic Coast Region. The Northeast Atlantic Coast Region encompasses the four coastal counties in this study: Nassau, Duval, St. Johns, and Flagler.

Within Northeast Florida, a number of beach restoration projects have been conducted and planned. In Nassau County, the St. Mary's River entrance is dredged annually and the gathered sand is used for beach nourishment projects at Fort Clinch and Fernandina Beach's shoreline. South Amelia Island and Nassau Sound are other areas of Nassau County with periodic beach nourishments. One of Duval County projects is the placement of sand from semi-annual dredging on the south shoreline of the St. Johns River entrance. Another periodic nourishment project includes Duval County's beaches from the mouth of the St. Johns River to the St. John's County line. In St. John's County, the Anastasia State Recreation Area, St. Augustine Beach, and the Matanzas Inlet are involved in recurring beach nourishments.

Florida also has one of the largest land and water (including wetlands) acquisition programs in the country called Florida Forever.[33] The revenue for this program is used for restoration, conservation, recreation, water resource development, historical preservation, and capital improvements on acquired conservation lands. Land acquisition is almost exclusively voluntary, because the State wishes to avoid using its power of eminent domain. The funding for this program comes from $3 billion in bond issues over a 10-year period, which is being paid back from an excise tax. Florida Forever Funds are distributed annually to various governmental agencies for land and water acquisition: Department of Environmental Protection (38 percent), Water Management Districts (35 percent), Florida Communities Trust (24 percent), Department of Agriculture/Forestry (1.5 percent), and the Fish and Wildlife Commission (1.5 percent). Since the program began in 1999, Florida Forever funds have been used to protect more than 270,000 acres of natural floodplains, nearly 500,000 acres of significant water bodies, more than 24,000 acres of fragile coastline, and more than 520,000 acres of functional wetlands.[34] Within northern Florida, the St. Johns River Water Management District (SJRWMD) uses its Florida Forever land acquisition funds primarily on water resource development and restoration projects and for nonstructural flood protection and conservation.

Local Government Policy

[32]Florida Department of Environmental Protection. (2000). *Strategic Beach Management Plan: Northeast Atlantic Coast Region.* Tallahassee, FL: Author.
[33]Found at http://edis.ifas.ufl.edu/FE331.
[34]Found at http://www.dep.state.fl.us/lands/acquisition/FloridaForever/default.htm.

Although no counties reference sea level rise in their building codes or comprehensive plans, all of Northeast Florida's coastal counties have coastal management or conservation elements in their comprehensive plans.

The Coastal Management Element[35] of Nassau County's Comprehensive Plan establishes dune protection as a priority for the county: "…the County shall protect, conserve and enhance the remaining coastal barrier dunes and establish construction standards to minimize the impact of man-made structures on the dunes and beaches.…" The comprehensive plan affirms a number of provisions for protection of the dune system, including site plan review for all beachfront construction, protection of hammock/dune interface areas, requirements for filling and revegetation of any breaches or blowouts in the dune system, prohibition of excavation of dunes (unless no other option exists) and requirements for developers to repair any unpermitted destruction of dunes. The Conservation Element establishes a 25-foot vegetative buffer between wetlands and upland development, or 100 feet within all 100-year floodplains as determined by FEMA.

The City of Jacksonville's (Consolidated Duval County) Comprehensive Plan Conservation/Coastal Management Element[36] states: "The ocean-fronting beaches and dunes within the City's jurisdiction shall be maintained predominantly in their natural state for conservation and recreational uses." The Jacksonville Comprehensive Plan prohibits all new construction seaward of the state's CCCL, except for passive recreation and access structures. It also forbids the construction of any new hardened shore protection structures or the reconstruction of any existing erosion control structures, except for navigation and emergency transportation corridors. Jacksonville's Comprehensive Plan also includes extensive provisions for protection of the city's remaining wetlands. Within saltwater marshes, only conservation and light residential uses, water-dependent port activities, and access to a permitted use are permitted. Septic tanks, drain-fields, and/or grey-water systems must be located outside of the saltwater marsh and not within 75 feet of any wetland or mean high water line.

The St. Johns County Comprehensive Plan's Conservation/Coastal Element[37] discourages the construction of seawalls and other shoreline modifications. Seawalls that are permitted must be set landward of the mean high water line. The Coastal Element also requires the County to minimize the disturbance of natural shoreline resources that provide shoreline stabilization and protect landward areas from the effects of storm events. St. Johns County seeks to have Land Development Regulations in place by 2007 that will address the relocation of habitable structures which have incurred damage from a natural disaster event, where damage is greater than 75 percent of their assessed value, to new locations that are outside the Coastal High Hazard Areas (CHHA), provided that sufficient land is available on the subject parcel for such relocation. Future policies will also address the utilization of improved construction site development practices during redevelopment, in a manner consistent with the land development regulations, to

[35]Nassau County Comprehensive Plan.
[36]Duval County Comprehensive Plan.
[37]St. Johns County 2015 EAR Based Comprehensive Plan Amendment (2000).

minimize the risk of recurrent damage. To protect wetlands, the St. Johns County Comprehensive Plan establishes a 25-foot vegetative upland buffer between wetlands and developments. Along the St. Johns, Matanzas, Guana, and Tolomato rivers, there is a 50-foot upland buffer.

Flagler County's Comprehensive Plan protects beaches and dunes through the coastal building code and the coquina rock protection ordinance. As with the other coastal counties' building codes, buildings are required to be sited so as not to interfere with the stability of the dune system and not to diminish the dunes' ability buffer against storms. The county's coquina ordinance prohibits the theft, vandalism, and destruction of coquina rock. Coquina rock is an essential part of the natural processes protecting the beach and dune system from erosion. The Coastal Management Element of the comprehensive plan places special emphasis on the beach within Flagler Beach's city limits for beach nourishment, given the city's higher level of development and lack of protective dune structure. Flagler County's floodplain ordinance requires structures within the CHHA to have the lowest supporting horizontal member to be located not lower than 1 foot above the base flood elevation level.

The two inland counties included in this study, Clay and Putnam, do not have coastal management elements in their comprehensive plans. They do have wetland protection and floodplain provisions, though. The Putnam County Comprehensive Plan[38] restricts development within FEMA-determined 100-year floodplains and floodways within the floodplain. Residential development is restricted to the lowest density of the future land use category that the land is located in. The only other uses permitted within 100-year floodplains are resource-based recreational facilities, water-dependent components of commercial development, general agriculture, silviculture and mining (with a 500-foot buffer). An average 25-foot, minimum 15-foot, upland vegetative upland buffer is required between jurisdictional wetlands and development.

The Clay County Comprehensive Plan[39] requires a setback of 50 feet landward of the ordinary high water line or mean high water line. The setback is increased to 100 feet for developments on aquatic preserves or Outstanding Florida Waters. A 25-foot vegetative buffer zone is required landward of the high water line. Development within FEMA 100-year floodplains must allow the maintenance of existing flood storage and the allowed development density must not create potential flood hazards or degrade the natural functioning of the floodplain.

[38]Putnam County Comprehensive Plan.
[39]Clay County Comprehensive Plan.

MAP DEVELOPMENT METHODOLOGY

Topographic Study Area

Similar to other sea level rise planning studies in Florida, this study considers all land below the 10-foot (NGVD) contour.[40] The selection of this study area does not imply that we are predicting—or even analyzing the consequences of—a 10-foot rise in sea level**.** Because tidal influence can extend almost to the 5-foot contour, the 10-foot contour is approximately the highest elevation that might be inundated by tides were sea level to rise 5 feet over the next few hundred years—but that is not the primary reason we used the 10-foot contour to delineate the study area.

During the original design of this study, EPA and SWFRPC sought to identify a study area that could be implemented throughout Florida and that would include all land that might be significantly affected by sea level rise during the next century. If possible, they also sought to include land that might be affected over a longer period of time, but that goal had to be balanced against the extra cost of studying a larger study area. All things being equal, it is better to make the study area over-inclusive rather than under-inclusive: If someone later needs a map depicting only land below the 8-foot contour, then it would be very easy to subdivide our data and only show shore protection for land below the 8-foot contour. By contrast, if someone needs a map that includes some areas inland of our original study area, they will have to repeat our study for these higher areas.

The quality of topographic information varies throughout Florida. Some counties have LIDAR, and some water management districts have 2-foot contours. Nevertheless, the best topographic maps for some portions of Florida have 5-foot contour intervals. Therefore, the only realistic choices for a statewide study area were the 5-, 10-, 15- and 20-foot contours.

Considering the criteria, EPA and SWFRPC decided that a 10-foot contour would probably be the most appropriate study area for Florida. Although the land below 5 feet is the most vulnerable, limiting the study area to such low land would exclude many areas that are potentially vulnerable to sea level rise during the next century. Statewide, most of the land between 5 and 10 feet is already below the base flood elevation for a 100-year storm, and hence will experience greater flooding as sea level rises. Finally, topographic contours are only estimates. Under the National Mapping Standards, up to 10 percent of the land can be higher or lower than the map indicates, by more than one-quarter of the contour interval. Thus a substantial amount of land depicted as between 5 and10 feet may in reality be between 3 and 4 feet; using the 10-foot contour to delineate the study area helps ensure that this very low land is considered.

[40]Until recently, most topographic maps provided contours that measured elevation above the National Geodetic Vertical Datum of 1929. That datum represented mean sea level for the tidal epoch that included 1929, at approximately 20 stations around the United States. The mean water level varied at other locations relative to NGVD, and inland tidal waters are often 3–6 inches above mean sea level from water draining toward the ocean through these rivers and bays. Because sea level has been rising, mean sea level is above NGVD29 almost everywhere along the U.S. Atlantic Coast.

The study area also includes all land within 1,000 feet of the shore, even if it is above the 10-foot contour, for two reasons. First, rising sea level and other coastal processes can cause beaches, dunes, bluffs, and other land to erode even though they may have sufficient elevation to avoid direct inundation by rising water levels. The 1,000-foot extension is somewhat arbitrary; we chose that distance primarily to be consistent with similar studies in other states. Second, extending the study area 1,000 feet inland also ensures that it is large enough to be seen along the entire shore on the county-scale maps produced by this study.

The NEFRC used elevation polygons from the St. Johns River Water Management District to determine the study area within this project.

Protection Scenarios

After all uplands from 0 to10 feet in elevation and lands within 1,000 feet of shore were determined, protection scenarios had to be assigned to the sections in the study area. The protection scenarios in the maps that accompany this study illustrate the areas that planners within this region expect will be protected, or not protected, from erosion and inundation in the future. Those expectations incorporate state policies and regulations, local concerns, land use data, and general planning judgment.

Generally, the first step in assigning a protection scenario is to determine the general land use categories of the uplands within the study area in a particular county. Land use layers were obtained from GIS information gathered at the NEFRC or from data attained from county planning agencies. Counties within Northeast Florida use different land use category classifications, but these categories can generally be summarized as including the following: agricultural, commercial, conservation, industrial, public/recreational, and residential. Generally, residential, commercial, recreational, and industrial lands were determined to be almost certain or likely to be protected. Conservation lands and land with no prospect for development were generally labeled as unlikely to be protected or not to be protected. The protection scenarios for agricultural land uses were based on whether there was a history of specifically protecting such farms or forests.

Three land use categories are typically designated as protection almost certain. The first is existing developed land within extensively developed areas or designated growth areas. The second category is future development within extensively developed areas or designated growth areas, including residential, office/commercial, and industrial uses. It is understood that every effort will be made to protect highly developed land from saltwater intrusion because of the economic value of these lands and the high population density. Another land use category that has been deemed as protection almost certain is parks that are extensively used for purposes other than conservation and have current protection or are surrounded by protected lands, for example, parks with highly used launching ramps or sports venues. Because these parks exist for primarily for recreational and not exclusively for conservation purposes, they are almost certain to be protected from sea rise.

Land uses that are within the scenario of protection likely will probably be protected, but there is a plausible reason to not expect protection. These land uses include less densely developed areas, future development outside of growth areas, extensively developed CoBRA coastal areas, and private beaches. Moderately used parks used for purposes other than conservation, future development where a park or refuge is also planned, agricultural areas with historical shore protection, and military lands where protection is not certain are also included in this approach. As with the previous scenario, it is easy to assume that these mostly privately owned areas are too valuable (whether for economic, recreational, or social reasons) to abandon. Because these areas are not extensively developed yet, however, they have not reached the point of critical mass where it would be inconceivable for policymakers and landowners to be allow them to retreat.

Areas unlikely to be protected are places where lands are probably going to retreat, but where there is no absolute policy against shore protection. Generally, these are areas where land values are low compared with the costs of shore protection. For privately owned nonconservation lands, protection would not be cost-effective compared to the value for the land. Lands expected to become part of a nature reserve, but not guaranteed, are also in this category. protection unlikely areas include undeveloped privately owned lands, unbridged barrier islands or lightly developed coastal high hazard areas, minimally used parks, undeveloped areas where most of the land will be part of wildlife refuge but where development is also planned, and conservation easements that preclude shore protection.

The final protection scenario is termed as no protection. This includes lands that are certain not to be protected because they are conservation lands where protection is absolutely prohibited. Private lands owned by conservation groups, conservation easements that preclude shore protection, wildlife refuges and parks with a policy preference for natural occurring processes, and public lands/parks with little or no prospect for public use are within this category. Also, farmlands and forested uplands have been deemed as no protection in Northeast Florida. The overwhelming majority of agricultural lands within the Northeast Florida study are primarily forested timberlands. The cost of importing pulpwood from Brazil is becoming more economical, thereby making much of Florida's timberlands worthless within the near future. Because of the decline of the timber industry in Northeast Florida, forested uplands would be cost-prohibitive to fortify.

Wetlands were also mapped in this project. Most authors have concluded that wetlands could not keep pace with a significant acceleration in sea level rise and, thus, that the area of wetlands converted to open water will be much greater than the area of dry land converted to wetlands. Moreover, in areas where dikes protect farmland or structures, all the wetlands could be lost.[41]

[41]Titus, J., et al. (1991). Greenhouse effect and sea level rise: The cost of holding back the sea. *Coastal Management: Volume 19.*

Although land use categories were the general determinants for assigning protection scenarios, other factors (such as local planner input and NFIP and CoBRA guidelines) were also authoritative. These factors are included in Table 5, as provided by the EPA and SWFRPC,[42] and modified for a regional approach by the NEFRC. Table 5 contains the matrix used by GIS staff to identify protection scenarios for the study area. County-specific differences in these decisions and site-specific departures from the statewide approach are discussed in the county-specific sections of this report; the results for sea level rise map for each county is included in the county sections.

Within the study area depicted on the maps, the following protection scenarios and accompanying colors were used:

- Protection almost certain: Brown
- Protection likely: Red
- Protection unlikely: Blue
- No protection: Light green
- Wetlands: Dark green.

Local Stakeholder Review

The contract for this project requires local government staff to review the draft sea level rise maps for each county. Local planners are the best authorities to identify whether specific areas of their regions will be protected, or not, against sea level rise. Table 5 recognizes instances where existing land use data formats may not be complete enough to be able to identify a protection scenario for a land area. Local planner input is particularly helpful in determining the future status of currently undeveloped areas. Whether an undeveloped area outside of a growth area will be developed in the future is a determinant of the protection status of the locale. Local planner information is also invaluable in determining whether park areas or conservation lands will, or should, be protected against sea level rise.

On June 22, 2004, the NEFRC held a workshop at the its offices in able to allow local planners to review draft sea level rise maps. The membership of the Local Mitigation Strategy (LMS) workgroups from Nassau, Duval, St. Johns, and Flagler counties were invited to attend the meeting. The LMS workgroups were determined to be the best forums for presenting the draft maps because of their constituencies. The workgroups contain representatives from local planning and emergency management agencies as well as members of nonprofit groups and industry, all in one body. Fifteen members of the workgroups from the four coastal counties attended the workshop. After a review of the project was provided to them, the LMS members were given the draft map from their specific county to review. Jim Titus, EPA, and Dan Trescott, SWFRPC, assisted the groups by conference call. Planners from the NEFRC facilitated each county's discussions and changes to the draft maps were recorded.

[42]Jim Titus of EPA prepared a summary of the approaches taken by other states and Dan Trescott of SWFRPC converted this summary into a table, and then adapted it for the situation in Florida.

Clay and Putnam Counties were included in the sea level rise study after the June 22, 2004, workshop. The NEFRC's GIS coordinator brought draft maps to the planning departments of these two counties for review, where changes were discussed and recorded.

Changes to the draft maps made by local planners are discussed in the county sections.

TABLE 5 REGIONAL APPROACH FOR IDENTIFYING LIKELIHOOD OF LAND USE PROTECTION[1]		
Likelihood of Protection[2]	**Land Use Category**	**Source Used to Identify Land Area**
Protection Almost Certain (brown)	Existing developed land (FLUCCS Level 1–100 Urban and Built-up) within extensively developed areas and/or designated growth areas.	Developed lands identified from water management districts (WMDs) existing Florida Land Use, Cover and Forms Classification System (FLUCCS) as defined by Florida Department of Transportation Handbook (January 1999); growth areas identified from planner input and local comprehensive plans.
	Future development within extensively developed areas and/or designated growth areas (residential/office/commercial/industrial).	Generalized Future Land Use Maps from local comprehensive plans, local planner input, and WMDs.
	Extensively used parks operated for purposes other than conservation and have current protection[3] or are surrounded by brown colored land uses.	County-owned, state-owned, and federally owned lands (based on local knowledge) or lands defined as 180 Recreational on the Level 1 FLUCCS, local planner input, and Florida Marine Research Info System (FMRIS) for current protection measures.
Protection Likely (red)	Existing development within less densely developed areas, outside of growth areas, mobile home development not anticipated to gentrify, not on central water and sewer, and within a coastal high hazard area.[4]	Developed lands identified from WMD existing FLUCCS; growth areas identified from local planner input, local comprehensive plans and current regional hurricane evacuation studies.
	Projected future development outside of growth areas could be estate land use on Future Land Use Map.	Local planner input.
	Moderately used parks operated for purposes other than conservation and have no current protection or are surrounded by red colored land uses.	County-owned, state-owned, and federally owned lands (based on local knowledge) or lands defined as 180 Recreational on the Level 1 FLUCCS, local planner input, and FMRIS.
	Coastal areas that are extensively developed but are ineligible for beach nourishment funding due to COBRA (or possibly private beaches unless case can be made that they will convert to public)	Flood Insurance Rate Maps for CoBRA, local knowledge for beach nourishment.
	Undeveloped areas where most of the land will be developed, but a park or refuge is also planned, and the boundaries have not yet been defined so we are unable to designate which areas are brown and which are green; so red is a compromise between	Local planner input.
	Agricultural areas where development is not expected, but where there is a history of erecting shore protection structures to protect farmland.	Local planner input.
	Military lands in areas where protection is not certain.	FLUCCS Level 173.

Protection Unlikely (blue)	Undeveloped privately owned that are in areas expected to remain sparsely developed (i.e., not in a designated growth area and not expected to be developed).	Undeveloped lands identified from WMD existing FLUCCS Level 1–160 mining , 700 barren land ; nongrowth areas identified from planner input, local comprehensive plans, Flood Insurance Rate Maps for CoBRA and current regional hurricane evacuation studies.
	Unbridged barrier island and CoBRA areas or within a coastal high hazard area that are not likely to become developed enough to justify private beach nourishment.	Flood Insurance Rate Maps for CoBRA, local knowledge for beach nourishment, and local planner input.
	Minimally used parks operated partly for conservation, have no current protection or are surrounded by blue colored land uses, but for which we can articulate a reason for expecting that the shore might be protected.	County-owned, state-owned, and federally owned lands (based on local knowledge) or lands defined as preserve on Future Land Use Map, local planner input, and FMRIS.
	Undeveloped areas where most of the land will be part of a wildlife reserve, but where some of it will probably be developed; and the boundaries have not yet been defined so we are unable to designate which areas are brown and which are green; so blue is a compromise between red and green.	Local planner input.
	Conservation easements (unless they preclude shore protection).	Local planner input.
No Protection (light green)	Private lands owned by conservation groups (when data available).	Private conservation lands.
	Conservation easements that preclude shore protection	Local planner input.
	Wildlife Refuges, portions of parks operated for conservation by agencies with a policy preference for allowing natural processes (e.g., National Park Service).	Local planner input.
	Publicly owned natural lands or parks with little or no prospect for access for public use.	County-owned, state-owned, and federally owned lands (based on local knowledge) defined as preserve on the Future Land Use Map and local planner input.
	Farms and forests with no history of erecting shore protection structures.	Undeveloped lands identified from WMD existing FLUCCS Level 1–200 Agriculture, 300 Rangeland, 400 Upland Forest, and local planner input.

1. These generalized land use categories describe typical decisions applied in the county studies. County-specific differences in these decisions and site-specific departures from this approach are discussed in the county-specific sections of this report.
2. Colored line file should be used in areas where less than 10 foot elevations exist within 1,000 feet of the rising sea or color cannot be seen on ledger paper map.
3. Current protection may include sea walls, rock revetments, beach renourishment, levees, spreader swales, or dikes.
4. Coastal High Hazard Area defined in Rule 9J-5 FAC as the Category 1 hurricane evacuation zone and/or storm surge zone.

COUNTY BY COUNTY MAPPING ANALYSIS

This sea level rise study includes six counties in the Northeast Florida region: Clay, Duval, Flagler, Nassau, Putnam, and St. Johns. The study area consists of approximately 321 square miles of uplands and 254 square miles of wetlands. A 10-foot rise in sea level would inundate about 575 square miles of the Northeast Florida region. The total amount of affected area accounts 14 percent of these six counties.

Table 6 illustrates the breakdown of the various land uses in the study area that are subject to sea level rise. Because Northeast Florida is still largely undeveloped, conservation lands make up the single largest land use that would be affected by sea rise. This category makes up 38 percent (183 square miles) of the upland study area. The next largest upland area subject to inundation is residential use, comprising 26 percent (145 square miles) of the study area. Agricultural use is the third largest category subject to sea rise. This land usage takes up 23 percent (134 square miles) of the affected area. Public/recreational, commercial, and industrial land use categories together encompass only 13 percent (67 square miles) of the area affected by rising seas.

The percentages and acreage of protection scenarios assigned to land uses in the study area can be found in Table 6. Predictably, wetlands make up almost half (47 percent) of the total study area (254 square miles). We estimate that protection is almost certain for about 55 miles (176 square miles) of the dry land within the study area. The Atlantic Coast of Florida continues to be developed, and it can be expected that residential areas will be protected. As a result, shore protection is likely for another 89 square miles (28 percent) of the dry land in the study area. Thus, under current policies, more than 80 percent of the dry land is likely to be protected from rising sea level.

The protection unlikely scenario covers 42 square miles of the total study area, about 13 percent of the dry land. Conservation lands and other areas designated as no protection account for 14 square miles, only 4.4 percent of the dry land in the study area. Thus, the areas where wetlands are likely to migrate inland account for only 18 percent of the study area (56 square miles). A clearer picture emerges if one compares these areas with the 254 square miles of wetlands. The total land that may be submerged, 310 square miles, accounts for approximately 56 percent of the low land in Northeast Florida.

The ultimate net loss of wetlands by any particular year 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 4percent of those wetlands. We are less certain about the other 41percent. There appears to be a good chance that wetlands will migrate land in another 13percent 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.

Table 6
Northeast Florida Future Land Use Subject To Sea Level Rise (Acres)

Acreage Per Land Use Category								
FUTURE LAND USE	NASSAU	DUVAL	ST. JOHNS	FLAGLER	CLAY	PUTNAM	SQUARE MILES	% OF STUDY AREA
Agriculture	2150	32139	22011	6909	618	22106	134	23%
Commercial	976	4708	3628	224	1285	164	17	3%
Conservation	8325	17839	47061	9556	7041	27632	183	38%
Industrial	436	3453	85	28	184	1070	8	2%
Public/Recreational	2648	9485	10079	752	4496	11	42	8%
Residential	10460	38386	18918	4511	13901	6740	145	26%

Acreage Per Protection Scenario								
SCENARIO	NASSAU	DUVAL	ST. JOHNS	FLAGLER	CLAY	PUTNAM	SQUARE MILES	% OF STUDY AREA
Protection Almost Certain	18160	42036	21433	10519	12661	8431	176	30%
Protection Likely	2336	4973	31004	4753	7226	6796	89	14%
Protection Unlikely	1628	5603	4628	147	5821	9368	42	7%
No Protection	5687	1585	1162	225	436	164	14	2%
Wetlands	33041	41993	43555	9380	1763	33024	254	47%

Percentage of Dry Land Protected							
SCENARIO	NASSAU	DUVAL	ST. JOHNS	FLAGLER	CLAY	PUTNAM	REGION
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

NASSAU COUNTY

Nassau County is included in the project because of its location on the Atlantic Ocean and the St. Mary's and Nassau rivers. The entire eastern border of the county is included because it is affected by the tidal influence of the ocean. The St. Mary's River defines the northern and western borders of the county, but it is tidally influenced upstream to the Highway 17 bridge.[43] Therefore, the remainder of the river west of the bridge was excluded from the study. The southern border of Nassau County is partially defined by the Nassau River. The Intracoastal Waterway runs parallel to the Atlantic coast, approximately 3 miles inland from the Nassau River to the St. Mary's River. These waterways combine to create approximately 117 linear miles of tidally influenced coastline in Nassau County.

Data Used for Study and Maps

The datasets used for the study of Nassau County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
Nassau County Future Land Use	Northeast Florida Regional Council
Street Centerlines	Unites States Census Bureau (TIGER)
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use: The future land use designations in the future land use layer for the Nassau County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines: The streets layer is used for reference purposes.

Existing Land Use: The St Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons: The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial

[43]Found at http://www.sjrwmd.com/programs/acq_restoration/s_water/stmarys/.

Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for Nassau County:

1. Created an Arc GIS map document for the project (slr_nassau_final.mxd).
2. Projected all layers to State plane Florida East Zone 0901, and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000 foot water buffer. This resulted in a shape file of the total area of interest for the project (slr_nassau_sea rise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_sea rise_nassau_draft.shp).
11. Created an attribute field in the draft layer named [SEA RISE]. Populated the sea rise field based on the criteria contained in Table 5.
12. Analyzed the protection scenarios for Nassau County to ensure that the scenarios adhered to the criteria set forth by the overall project standards.

The general approach findings were as follows:

Atlantic Coast (from the St. Mary's River to the Nassau River)

The landmass that sits between the Intracoastal Waterway and the Atlantic Ocean is Amelia Island. At the north end of the island is Ft. Clinch State Park. It has a future land use designation of recreation and is given the scenario of protection almost certain because of its historic significance and its extensive use by visitors. There is a great deal of forested uplands in the park, which future planners may decide to relinquish for wetlands migration, but they are currently designated protection almost certain. South of the Ft. Clinch State Park are the cities of Fernandina Beach and the area of American Beach. The majority of the land use for these two cities is designated as residential with some recreation, commercial, and industrial areas. The commercial areas extend

primarily along the A1A corridor. The commercial, industrial, and residential areas are assigned the scenario of protection almost certain. The recreational areas, which primarily consist of neighborhood parks and public beaches, have been assigned the scenario of protection likely. South of American Beach and extending to the south end of the island is the Amelia Island Plantation Resort. This area consists of high-end home sites as well as residential, commercial, conservation, and recreational (golf courses) future land use. The residential and commercial areas are designated protection almost certain and the conservation areas are designated protection unlikely because they may be allowed for wetlands migration.

Local Stakeholder Changes from Draft Maps
Because of the historical significance of the Fernandina Beach area as well and the fact that the remainder of the Amelia Island is a resort area, the local planners decided that the island should be assigned the scenario of protection almost certain, eliminating the necessity of designating areas bordered by protected areas as protection unlikely. Local planners have, however, designated areas on the island that directly border the wetlands and may be relinquished for wetlands migration as protection unlikely.

Intracoastal Waterway

The Intracoastal Waterway runs from the northern border of Nassau County (St. Mary's River) to its southern border (Nassau River). The majority of the lands along the west coast of the Intracoastal Waterway are residential with some minor areas of commercial. These areas are marked as protection almost certain because the residential sites are mostly high-end. There are some islands in the Intracoastal Waterway that have open space and some forested uplands and are designated as conservation. These areas are deemed as protection unlikely because they will most likely be left for wetlands migration. There were no changes from the draft map.

St. Mary's River

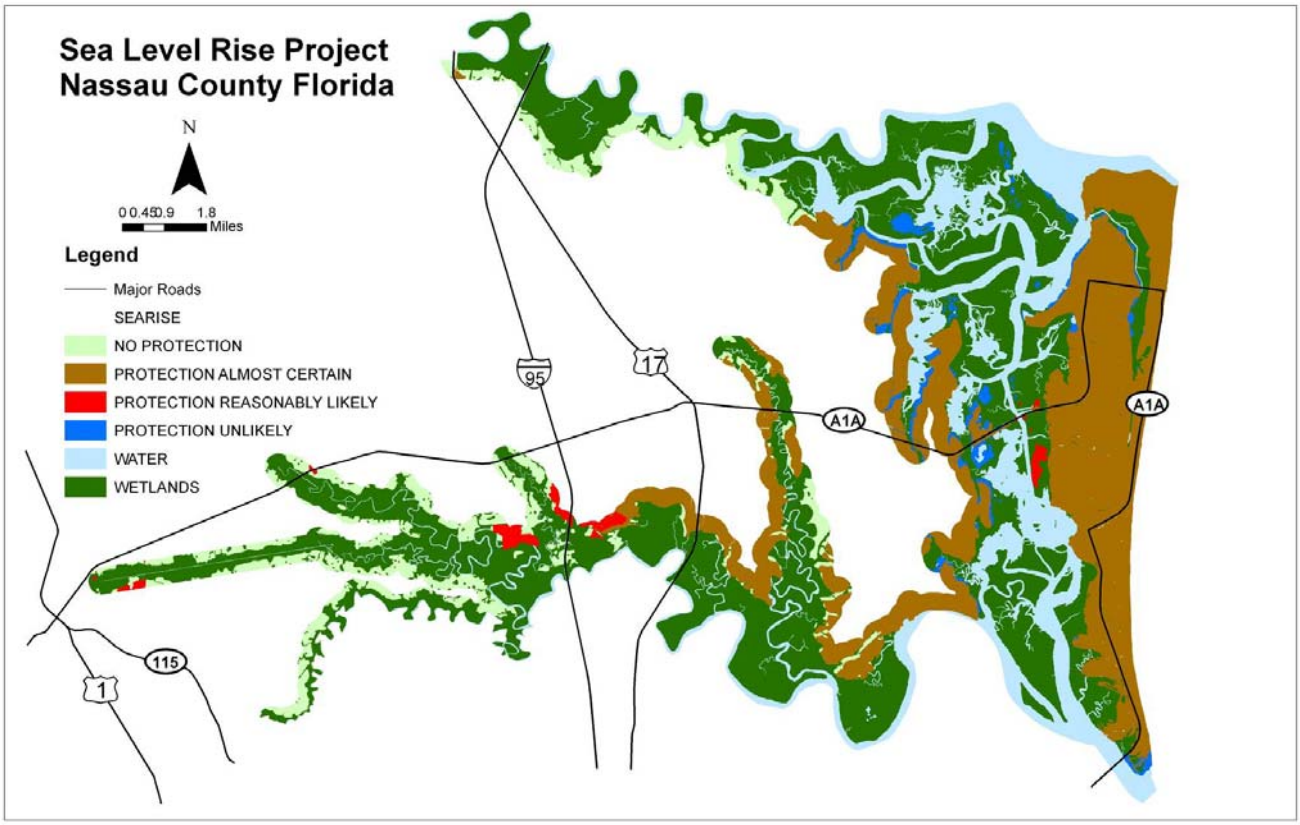
The entrance to the St. Mary's River is at the Atlantic Ocean. The overwhelming majority of the lands along the St. Mary's River are designated as conservation and agricultural with some areas of residential. The areas of residential are deemed as protection almost certain. The areas of conservation and agricultural are deemed as no protection because they will most likely be relinquished for wetlands migration. There were no changes from the draft map.

Nassau River

The Nassau River runs west from the Atlantic Ocean as a portion of Nassau County's southern border. The areas contiguous to this river are split between residential, conservation, and agricultural. The more highly developed residential areas are deemed as protection almost certain, although there are also less developed areas along the river. The conservation areas are deemed as no protection because they will most likely be

relinquished for wetlands migration. The agricultural areas have also been deemed as no protection because of their lack of existing current shore protection structures.

Local Stakeholder Changes from Draft Maps
Local planners recognized that some of the residential areas along parts of the Nassau River are less developed than others and therefore they were changed from protection almost certain to protection likely.
Map 1 shows the study results for Nassau County.



Map 1: Nassau County: Likelihood of Shore Protection.

DUVAL COUNTY

Duval County is included in the project because of its proximity to the Atlantic Ocean and the St. Johns River. The entire eastern border of the county is included because it is affected by the tidal influence of the ocean. The St. Johns River runs through the county from the Atlantic all the way to the county's south border. The St. Johns River, the Intracoastal Waterway, the Nassau River, Dunns Creek, the Broward River, the Trout River, the Ribault River, the Arlington River, Pottsburg Creek, the Ortega River, and Julington Creek combine to create approximately 210 linear miles of coastline influenced by tides. Add this to the 20 miles of beach along the Atlantic coast and Duval County has approximately 230 linear miles of coastline affected by tidal influence.

Data Used for Study and Maps

The datasets used for the study of Duval County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
COJ Future Land use	City of Jacksonville Planning Department
Neptune Beach Future Land Use	City of Neptune Beach Planning Department
Atlantic Beach Future Land Use	City of Atlantic Beach Planning Department
Jacksonville Beach Future Land Use	City of Jacksonville Beach
Street Centerlines	City of Jacksonville Sheriff's Office
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use – All of the future land use layers for the Duval County area of interest were merged together as a single layer. The future land use designations in the future land use layer for the Duval County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines – The streets layer was used for reference purposes.

Existing Land Use – The St Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial

Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for Duval County:

1. Created an Arc GIS map document for the project (slr_duval_final.mxd).
2. Projected all layers to State plane Florida East Zone 0901 and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000 foot water buffer. This resulted in a shape file of the total area of interest for the project (slr_duval_sea rise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_sea rise_duval_draft.shp).
11. Created an attribute field in the draft layer named [SEA RISE].
12. Analyzed the protection scenarios for Duval County to ensure that they followed the criteria set forth by the overall Sea Level Rise project standards.

The general approach findings were as follows:

Atlantic Coast (north of the St Johns River inlet to Nassau County)

The Atlantic Coastline land north of the St. Johns River inlet area is all part of the Little Talbot Island State Park. This entire area is assigned the scenario of protection likely because of its moderate use by visitors.

Intracoastal Waterway (north of the St. Johns River to the Nassau River)

The shorelines of the northern Intracoastal Waterway and Nassau Sound consist mostly of wetlands conservation and agricultural designations with some minor areas of residential. It is assumed that the agricultural and conservation areas will not be protected

and will be left alone for wetlands migration. The residential designation of this area is protection almost certain, because many of the properties are high end. The conservation designations in this area are deemed as no protection and will most likely be left to wetlands migration. The exceptions to this are the areas of conservation bordering the Little Talbot Island State Park. These areas may be given a future designation of protection almost certain because they border State Road A1A. If these areas are allowed to flood then SR A1A will also be flooded. It may be more feasible as well as cost-effective to fortify the land as opposed to fortifying SR A1A.

Local Stakeholder Changes from Draft Maps

Because of their moderate visitor usage, the above areas of conservation were originally assigned protection unlikely but the local planners suggested that they should be designated as no protection because they would be land for wetlands.

Atlantic Coast (south of the St Johns River inlet to St. Johns County)

The majority of the areas of land south of the St Johns River inlet to St. Johns County are improved beachfront and designated as residential, commercial, and industrial. This entire stretch of land has been assigned the scenario of protection almost certain. This stretch of coastline comprises the City of Atlantic Beach, the City of Neptune Beach, and the City of Jacksonville Beach.

Local Stakeholder Changes from Draft Maps

There are park/recreation parcels within this area that were originally assigned the scenario of protection unlikely, but these parcels are completely surrounded by commercial and residential parcels, so the local planners decided that by default these parks/recreation parcels should be assigned the scenario of protection almost certain.

Intracoastal Waterway (south of the St. Johns River to St. Johns County)

The Intracoastal shoreline from the St Johns River south to St. Johns County is bordered mostly by wetlands scattered with forested uplands (conservation), high-end residential, and agriculture. The areas of conservation and agriculture are designated as no protection because the majority of land along the Intracoastal is unimproved and these are the only areas for the wetlands to migrate.

Local Stakeholder Changes from Draft Maps

The areas of conservation above were originally assigned protection unlikely because some of it may be developed in the future, but the local planners suggested that they should be designated as land for wetlands migration so their scenario was changed to no protection.

St. Johns River Inlet Area to Sisters Creek

The St. Johns River inlet is bordered to the north by Huguenot State Park. This area is labeled protection likely because it is mainly a sandbar created by the stone embankment

erected to protect the channel from washout. There is an ongoing debate concerning what to do with the northern jetties because of the concentration of sand that is choking off the channel that feeds the Ft George Inlet. This area of the moderate-use park is labeled protection likely but may be changed in the future depending on the outcome of current studies. The south side of the St. Johns River inlet is property owned by the Mayport US Naval Base and is labeled as protection almost certain because it would be protected even if the base were to close and the land changed to other uses. West of the Naval Station is the Mayport Fishing Village. This area is almost all commercial and is designated as protection almost certain. The land to the east of Sisters Creek, Fort George Island, is designated as conservation and agricultural and is assigned the scenario of protection likely. The area of land south of Sisters Creek is known as the Timucuan Preserve and is given the scenario of protection unlikely because it will most likely be left alone for wetlands migration.

Local Stakeholder Changes from Draft Maps
The Ft. George Island area was originally assigned the scenario of protection unlikely, but the local planners decided that it should be deemed as protection reasonably likely because of the existence of a public golf course, Kingsley Plantation (Timucuan Preserve), and a few residential parcels.

St. Johns River (from Sisters Creek to the Trout River)

The large area of wetlands fed by water flowing from Sisters Creek, Cedar Point Creek, and Clapboard Creek is bordered to the north by improved areas designated as residential as well as areas designated as agriculture. These agriculture lands are assigned the scenario of protection unlikely and the improved lands are assigned the scenario of protection almost certain. Further west of the Timucuan Preserve is the Mill Cove area. Uplands in this area are designated as residential, conservation, and parks/recreation. All of these areas that are not wetlands are assigned the scenario of protection almost certain. The study area along the north side of the St. Johns River west of Clapboard Creek consists primarily of improved properties with commercial and residential designations and is assigned the scenario of protection almost certain. The study area along south side of the St. Johns River and west of the Timucuan Preserve is primarily residential with some smaller areas of conservation and recreation. The residential and recreational areas are assigned the scenario of protection almost certain and the conservation area is assigned the no protection scenario. Quarantine Island, which is located in the center of the St. Johns River, is assigned the scenario of protection almost certain because of its navigational necessity. Blount Island, also located in the St. Johns River, is assigned the scenario of protection almost certain because of its mostly industrial use.

Local Stakeholder Changes from Draft Maps
Quarantine Island was originally assigned the scenario of protection unlikely but the local planners decided that it is vital to the directional flow of the St. Johns River and that it should be changed to protection almost certain.

Trout, Ribault, and Broward Rivers and Dunns Creek

The land contiguous to these water bodies is primarily residential with some commercial (boat marinas) and recreation. All of the areas along the Trout River that are designated as residential or commercial are assigned the scenario of protection almost certain. The areas of recreational use are assigned the protection likely scenario.

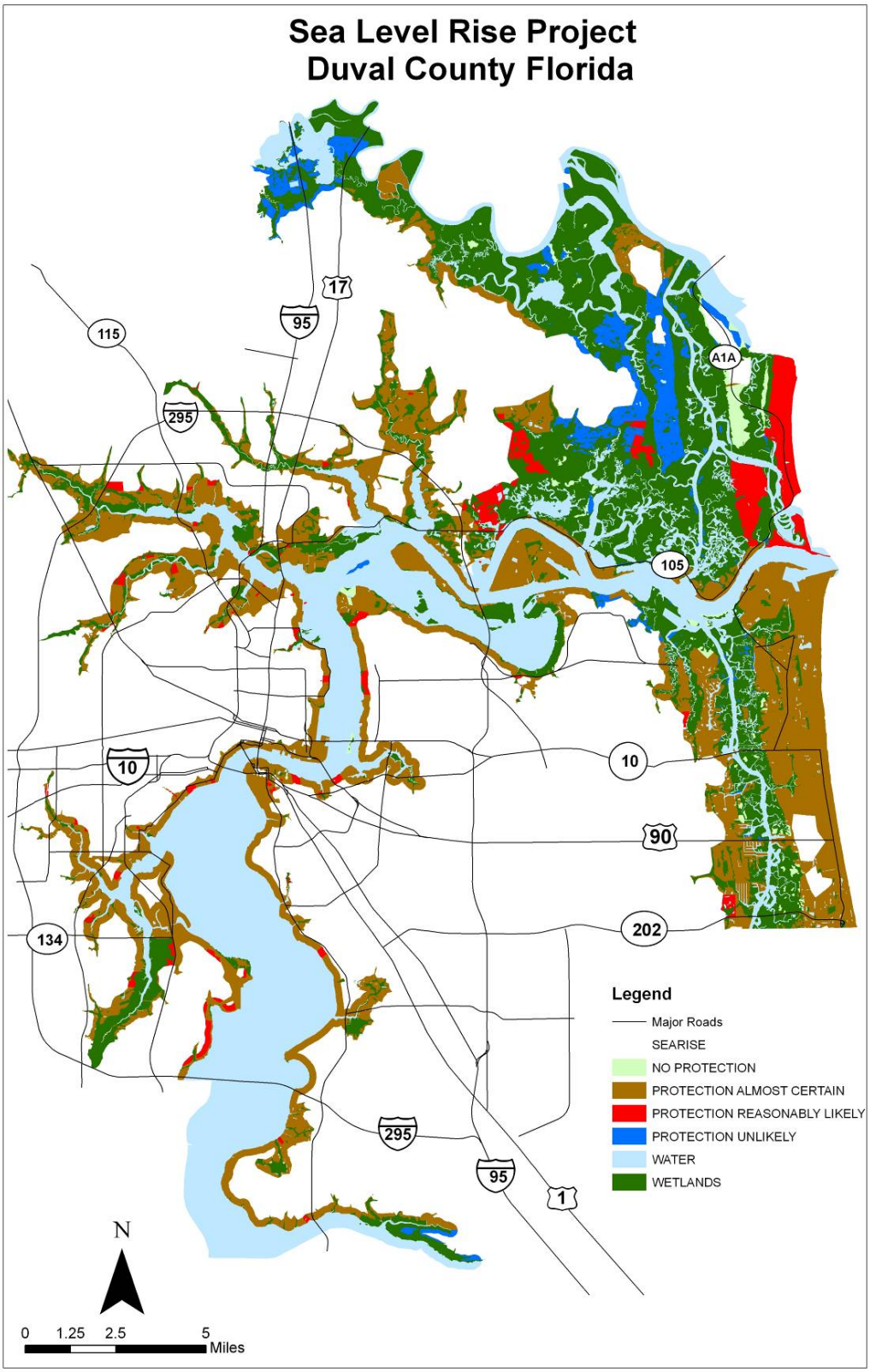
St. Johns River (from the Trout River south to the county border)

Areas of residential, commercial, industrial, public, recreational, and conservation land uses border the remainder of the St. Johns River. The residential areas, which consist of mostly high-end homes, and commercial, industrial, and public lands, including boat ramps and the Jacksonville Naval Air Station, are assigned the scenario of protection almost certain. The recreational areas are deemed as protection likely. The Exchange Club Island located under the Matthews Bridge is assigned the scenario of no protection, but this may need to be analyzed further if the island exists to divert the flow of water. The areas along the Arlington River and Pottsburg Creek are residential and will most likely be protected so they are assigned as protection almost certain. The Ortega River coastline consists mostly of high-end residential properties, and these lands are deemed as protection almost certain. The recreation areas along the Ortega River are deemed as protection likely. The conservation areas are assigned the scenario of no protection because retreat will be allowed for wetlands migration.

Julington Creek (from the St. Johns River to the end)

Julington Creek is bordered by areas of residential, public, and agricultural. The residential homes along the creek are medium to high end and will most likely be protected. Therefore, these areas are assigned the scenario of protection almost certain. The public lands (boat ramp) are deemed as protection likely. The remaining agricultural lands are assigned the protection unlikely scenario because it is believed that it will not be cost-effective to fortify them, thereby leaving them for wetlands migration.

Map 2 shows the study results for Duval County.



Map 2: Duval County: Likelihood of Shore Protection

ST. JOHNS COUNTY

St. Johns County is included in the project for Northeast Florida because of its location on the Atlantic Ocean and St. Johns River, which defines the eastern and western boundaries of the county. The Intracoastal Waterway and the Matanzas River both run parallel to the Atlantic coastline approximately 3 to 4 miles inland and are also included. All of these water bodies represent approximately 150 linear miles of tidally influenced coastline within the county.

Data Used for Study and Maps

The datasets used for the study of St. Johns County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
St. Johns County Future Land Use	St. Johns County GIS
Street Centerlines	St. Johns County GIS
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use –The future land use designations in the future land use layer for St. Johns County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines – The streets layer was used for reference purposes.

Existing Land Use – The St. Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for St. Johns County:

1. Created an Arc GIS map document for the project (slr_stjohns_final.mxd).
2. Projected all layers to State plane Florida East Zone 0901 and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000 foot water buffer. This resulted in a shape file of the total area of interest for the project (slr_stjohns_sea rise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_sea rise_stjohns_draft.shp).
11. Created an attribute field in the draft layer named [SEA RISE].
12. Analyzed the protection scenarios for St. Johns County to ensure that they followed the criteria set forth by the overall Sea Level Rise project standards.

The general approach findings were as follows:

Atlantic Coastline

The majority of the area of land along the Atlantic Ocean is high-end residential and recreational (golf courses, state parks, etc.) and is assigned the scenario of protection almost certain. “The Guana Tolomato Matanzas National Estuarine Research Reserve encompasses over 60,000 acres of salt marsh and mangrove tidal wetlands, oyster bars, estuarine lagoons, upland habitat and offshore seas in Northeast Florida. It contains the northern most extent of mangrove habitat on the east coast of the United States.”[44] The majority of the preserve is marked as protection almost certain because of its ecological importance. The open land areas within the preserve are marked as protection likely. Some of the open areas within the preserve that are contiguous to tidally influenced water bodies are marked as no protection. Most of the areas along the cities of St. Augustine and St. Augustine Beach are marked as protection almost certain. The open land areas in these cities contiguous to tidal influenced hydrology are marked as protection likely

[44] Found at http://www.dep.state.fl.us/coastal/sites/gtm/.

because there is a possibility that they may be protected to also protect areas farther inland.

Intracoastal Waterway and Matanzas River

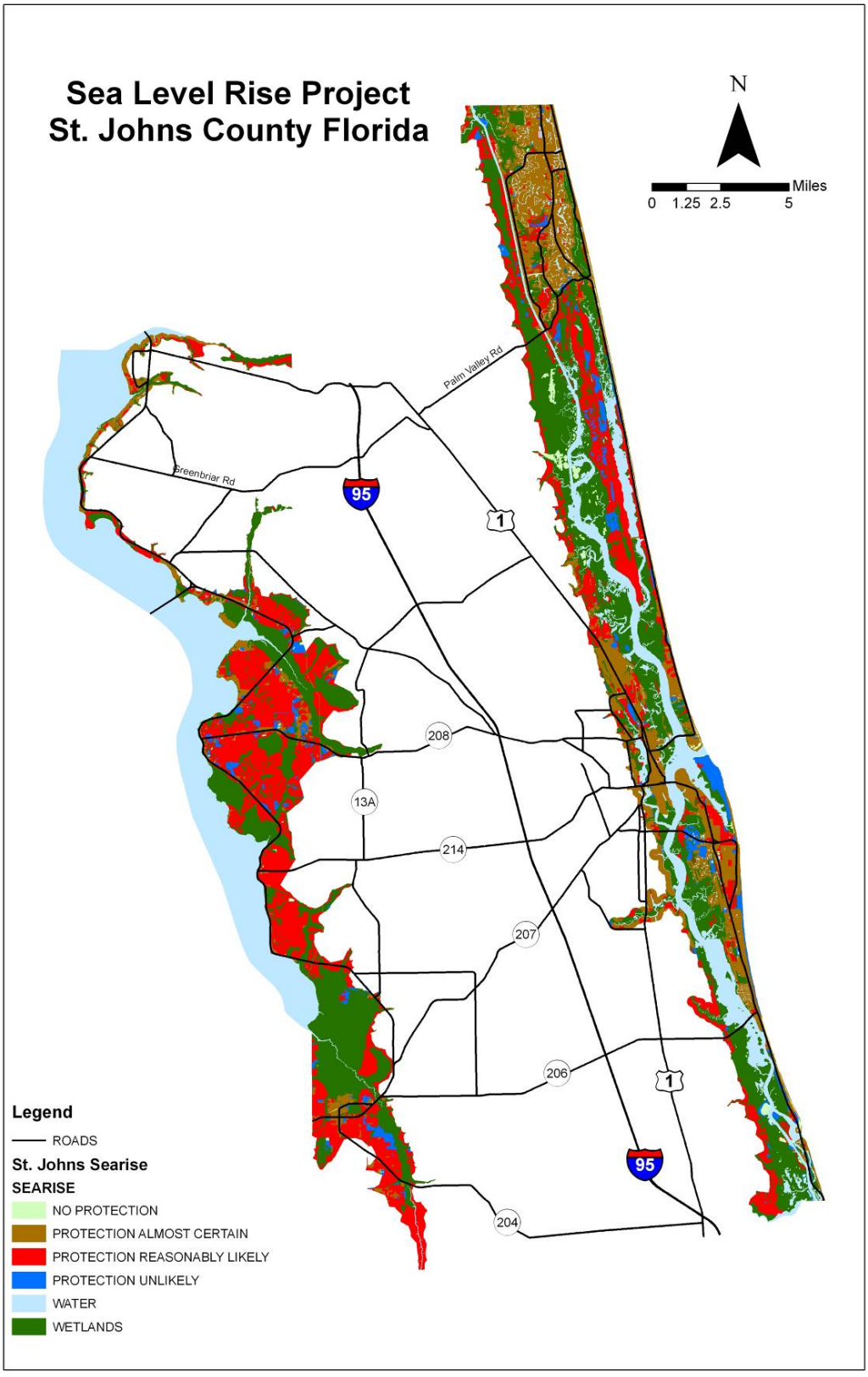
The areas of land around the Intracoastal Waterway consist mainly of agricultural lands. The areas of agricultural lands, either cropland or pasture lands, are deemed as protection likely. The forested areas of agricultural are deemed as protection unlikely. The residential areas near the Intracoastal are primarily high end and are all marked as protection almost certain. The commercial areas along the Intracoastal are also marked as protection almost certain.

Local Stakeholder Changes from Draft Maps
The above -forested and agricultural areas were originally marked as no protection, but the local planners specified that they should be marked as protection unlikely because they may be protected depending on the types of vegetation they contain.

Eastern Bank of St. Johns River

The land along the St. Johns River is largely designated as a mix of agricultural and residential and is identified as protection almost certain. The forested areas are marked as protection likely. Because these particular forested areas are so far inland, they are protected by default because the surrounding residential areas are being protected. Areas of high-end residential uses are marked as protection almost certain.

Map 3 shows the study results for St. Johns County.



Map 3: St. Johns County: Likelihood of Shore Protection

FLAGLER COUNTY

Flagler County is included in the project for Northeast Florida because of its location on the Atlantic Ocean, which defines the eastern boundary of the county. The Intracoastal Waterway runs parallel to the Atlantic coastline approximately 3 miles inland. Flagler County has approximately 63 miles of tidally influenced coastline included in the study.

Data Used for Study and Maps

The datasets used for the study of Flagler County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
Flagler County Future Land Use	Flagler County Planning / NEFRC
Street Centerlines	U.S. Census Bureau (TIGER)
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use –The future land use designations in the future land use layer for Flagler County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines – The streets layer was used for reference purposes.

Existing Land Use – The St. Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for Flagler County:

1. Created an Arc GIS map document for the project (slr_Flagler_final.mxd).

2. Projected all layers to State plane Florida East Zone 0901 and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000' water buffer. This resulted in a shape file of the total area of interest for the project (slr_Flagler_searise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_searise_Flagler.shp).
11. Created an attribute field in the draft layer named [SEA RISE].
12. Analyzed the protection scenarios for Flagler County to ensure that they followed the criteria set forth by the overall project standards.

The general approach findings were as follows:

Atlantic Coastline

The properties along the Atlantic Coastline consist of high-end residential, commercial, and recreational land use designations. All of the areas contiguous to the ocean, including open and forested lands, are marked as protection almost certain, including the golf courses. Some of these areas are undeveloped but if they were allowed to flood, Highway A1A would have to be fortified or relinquished to flood waters. It would be more cost-effective to fortify the properties rather than raise the highway. SR A1A has recently been designated a scenic highway, making it important to protect from flooding. The areas of recreation include beachfront parks and golf courses, all of which will most likely be fortified if necessary. The towns of Marineland, Beverly Beach, and Flagler Beach are all marked as protection almost certain.

Local Stakeholder Changes from Draft Maps
The local planners decided that the golf courses along the Atlantic Coastline should be marked as protection almost certain because of their popularity with the locals, as opposed to the original designation of protection likely.

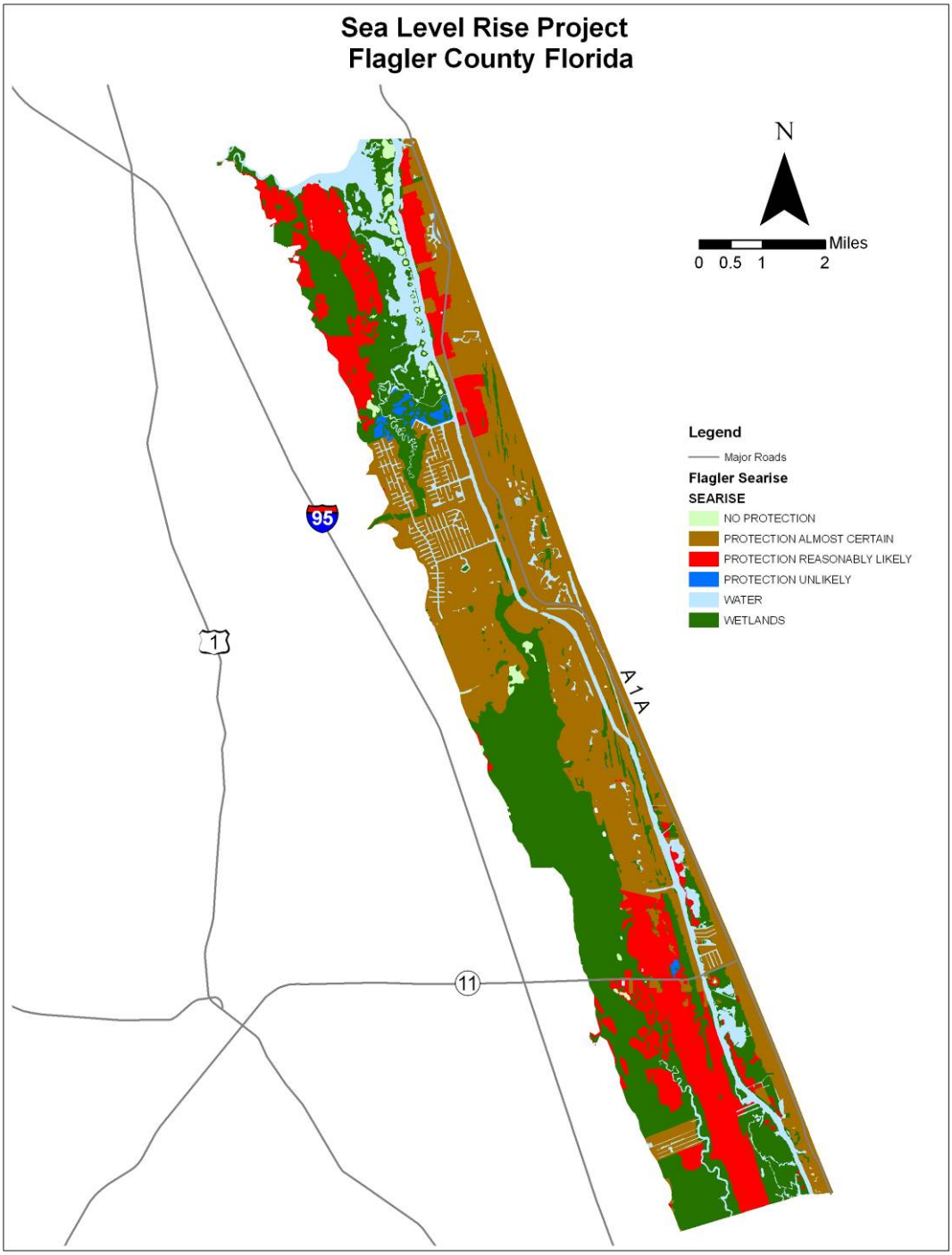
Intracoastal Waterway

There are study lands that border both coastlines of the Intracoastal Waterway. Many of these lands are agricultural and are marked as protection likely. Other areas along the

Intracoastal include commercial, recreational, and residential. The forested areas of parks and public land are marked as protection likely. The commercial, recreational (golf courses), and residential lands are marked as protection almost certain. There are some areas of open lands that are contiguous to developed areas that are marked as protection unlikely, while specific ones targeted by planners are designated as protection almost certain. Some of these areas are surrounded by marsh (wetlands), but they are close enough to developed lands that there may be a possibility for protection in the future. There are islands of open and forested lands along the Intracoastal Waterway that are marked as no protection because of their remoteness; they currently are accessible only via a boat.

Local Stakeholder Changes from Draft Maps
The local planners specified that there are specific forested areas along the Intracoastal that have been targeted for future development. These areas are marked as protection almost certain.

Map 4 shows the study results for Flagler County.



Map 4: Flagler County: Likelihood of Shore Protection

CLAY COUNTY

Clay County is included in the project for Northeast Florida because of its location on the St. Johns River. The St. Johns River is affected by the Atlantic Ocean's tides upstream to the border between Putnam County and Volusia County. The St. Johns River defines the eastern boundary of the county. Doctors Inlet is fed by the St. Johns and flows into a large area of wetlands and forested conservation uplands. Two creeks flow west from the St. Johns: Black Creek flows into the Black Creek Basin and Governors Creek flows west, north of the City of Green Cove Springs. Approximately 67 linear miles of tidally influenced coastline are included in the project for Clay County.

NOTE: The Black Creek Basin is the subject of an extensive study currently being conducted by the St. Johns River Water Management District and the State of Florida and has been excluded from this study.

Data Used for Study and Maps

The datasets used for the study of Clay County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
Clay County Future Land Use	Clay County Planning Department
Street Centerlines	Clay County Sheriff's Office
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use –The future land use designations in the future land use layer for Clay County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines – The streets layer was used for reference purposes.

Existing Land Use – The St Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for Clay County:

1. Created an Arc GIS map document for the project (slr_clay_final.mxd).
2. Projected all layers to State plane Florida East Zone 0901 and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000 foot water buffer. This resulted in a shape file of the total area of interest for the project (slr_clay_sea rise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_sea rise_clay_draft.shp).
11. Created an attribute field in the draft layer named [SEA RISE].
12. Analyzed the protection scenarios for Clay County to ensure that the scenarios adhered to the criteria set forth by the overall Sea Level Rise project standards.

The general approach findings were as follows:

St. Johns River (from the north county border to Doctors Inlet)

Seawalls fortify this entire 3.5-mile stretch of coastline along the St. Johns River in Clay County. These seawalls protect areas of high-end residential land use. For this reason these areas are deemed as protection almost certain.

St. Johns River (Doctors Inlet south to the county border)

The majority of the area along the St. Johns from Doctors Inlet to the Green Cove Springs city limits is marked as protection almost certain because many of the parcels are designated as residential and a good portion of those have existing seawalls. The Green Cove Springs area has some residential, commercial, and industrial areas, which have also been marked as protection almost certain. South of Green Cove Springs are areas that are mostly conservation with some rural residential. The conservation areas are

marked as protection unlikely and the residential are marked as protection likely because of possible future development.

Local Stakeholder Changes from Draft Maps:
The local planners changed the above conservation areas from no protection to protection unlikely because there may be a change in future protection.

Doctors Inlet

Doctors Inlet is completely surrounded by medium to high-end residential. Seawalls currently protect many of the homes around the inlet and those properties that aren't will most likely be protected in the future. For this reason, all of the area around the inlet is marked as protection almost certain. One parcel on the inlet has a future land use designation of commercial (restaurant) and it is completely protected by an existing seawall and is also marked as protection almost certain.

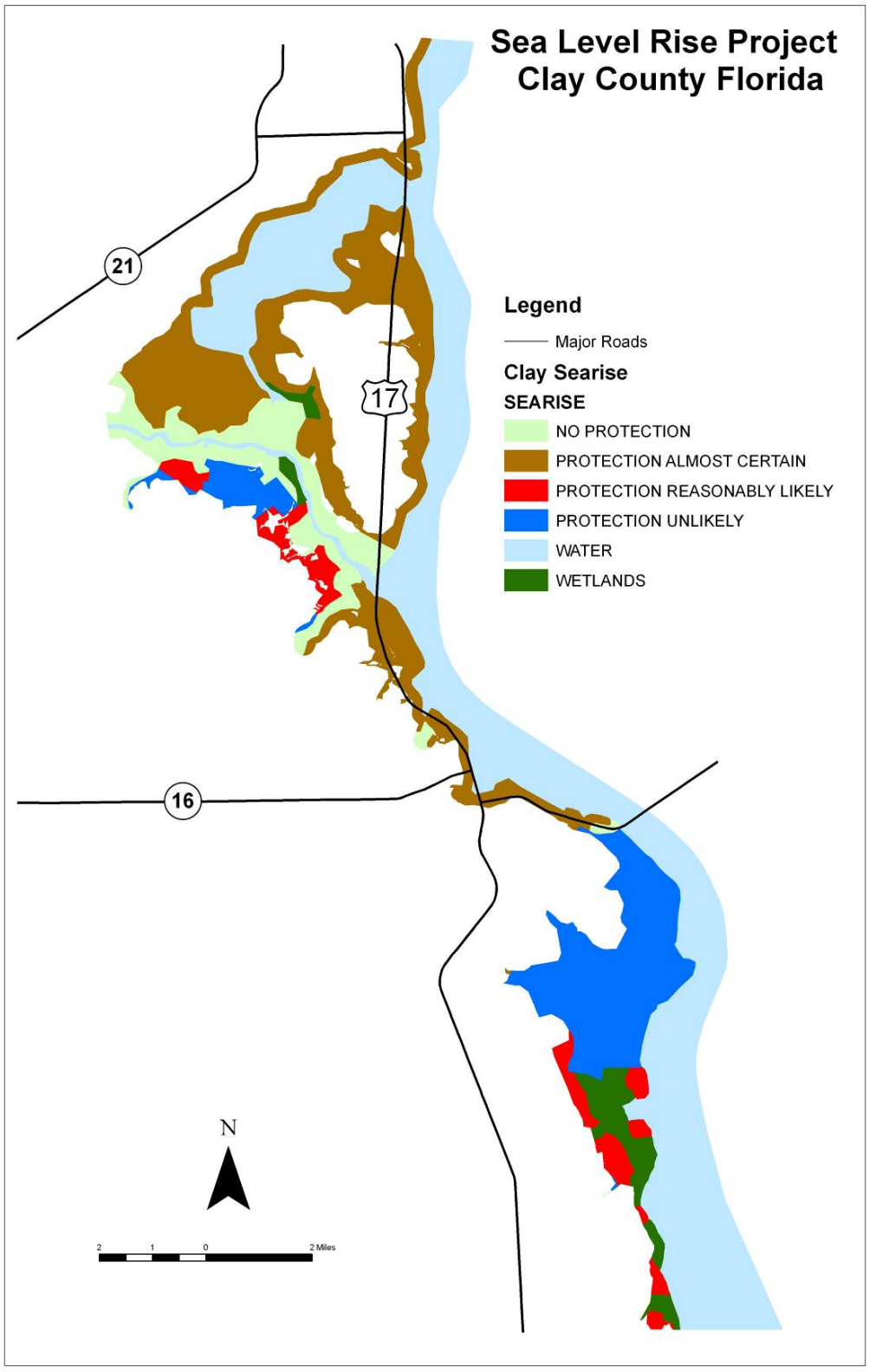
Black Creek

Black Creek extends west from the St. Johns River into the Black Creek basin. There is a considerable amount of conservation land in this area and it is marked as no protection and will most likely be relinquished for wetlands migration. The areas to the north of Black Creek are urban and rural residential. These areas are marked as protection almost certain because of planned future development. On the south side of Black Creek are mining, conservation, and residential areas. The residential areas are defined as protection likely because they are less densely developed but could possibly be protected for future growth. The mining area is abandoned so this area and the conservation areas are defined as no protection for wetlands migration.

Governors Creek

The Governors Creek area is mostly conservation surrounded by residential. The residential areas are marked as protection almost certain and the conservation areas are marked as no protection because they will most likely be allowed to flood.

Map 5 shows the study results for Clay County.



Map 5: Clay County: Likelihood of Shore Protection

PUTNAM COUNTY

Putnam County is included in the project for Northeast Florida because of its location on the St. Johns River. The St. Johns River is affected by the Atlantic Ocean's tides upstream to border between Putnam County and Volusia County. The river defines the eastern boundary of the county. The St. Johns River, along with Rice Creek, provides approximately 115 linear miles of tidally influenced coastline for the study.

Data Used for Study and Maps

The datasets used for the study of Putnam County were compiled from multiple sources. The maps and analysis were based on the following layers:

Layer	Source
Putnam County Future Land Use	Putnam County GIS
Street Centerlines	Putnam County GIS
Existing Land Use	St. Johns River Water Management District
Elevation Polygons	St. Johns River Water Management District
Digital Ortho Quarter Quads	St. Johns River Water Management District

Future Land Use –The future land use designations in the future land use layer for Putnam County were generalized into the following designations:

AGRICULTURE	RECREATION
COMMERCIAL	HIGH DENSITY RESIDENTIAL
CONSERVATION	MEDIUM DENSITY RESIDENTIAL
INDUSTRIAL	LOW DENSITY RESIDENTIAL
PUBLIC	WATER

Street Centerlines – The streets layer was used for reference purposes.

Existing Land Use – The St. Johns River Water Management District maintains this layer. This layer was used to differentiate uplands, wetlands, and water based on the FLUCCS field values.

Elevation Polygons The elevation polygons were compiled from the elevation contours maintained by the St. Johns River Water Management District. The Arc View 9 Spatial Analyst extension was used to convert the contour line file to a polygon layer based on the elevation field.

Mapping Procedures

The following procedures were performed to create the final layer and maps for Putnam County:

1. Created an Arc GIS map document for the project (slr_putnam_final.mxd).
2. Projected all layers to State plane Florida East Zone 0901 and 1983.
3. Selected the water polygons from the existing land use layer.
4. Buffered the water polygons with a distance of 1,000 feet.
5. Selected the elevation polygons from the elevation layer that were less than 10 feet and intersected the 1,000 foot water buffer polygon.
6. Exported the selected elevation polygons to a new shape file.
7. United the exported elevation polygons with the 1,000 foot water buffer. This resulted in a shape file of the total area of interest for the project (slr_putnam_sea rise_area_of_interest.shp).
8. Clipped the future land use shape file with the area of interest. This resulted in a layer of future land use that comprised polygons only in the area of interest for the project.
9. Clipped the existing land use shape file with the area of interest. This resulted in a layer of existing land use that comprised polygons only in the area of interest for the project.
10. United the clipped existing and future land use layers. This resulted in a layer containing attributes of future and existing land use attributes (slr_sea rise_putnam_draft.shp).
11. Created an attribute field in the draft layer named [SEA RISE].
12. Analyzed the protection scenarios for Putnam County to ensure that the scenarios adhered to the criteria set forth by the overall Sea Level Rise project standards.

The general approach findings were as follows:

St. Johns River (northern county border to the City of Palatka)

The lands along the St. Johns River are largely undeveloped, but these areas have been marked as protection almost certain. These lands are currently the only undeveloped lands that are contiguous to the St. Johns River, and they may be developed in the future. The forested areas are marked as protection likely because they also may be developed in the future. There are some areas of high-end as well as low-end residential that are marked as protection almost certain. Some of the residential areas that contain older, nonmaintained housing may be relinquished to flooding. These areas should be revisited in the future, and their protection scenario may change to protection likely. The Rice Creek area of the study has some agricultural lands that are marked as protection unlikely. There are also areas of conservation lands in the Rice Creek area that are marked as no protection because they are likely to be relinquished to wetlands migration. There are also publicly owned lands in the Rice Creek area that are marked as protection likely. The majority of the lands in the City of Palatka is residential, commercial, and recreation, and these lands are deemed as protection almost certain.

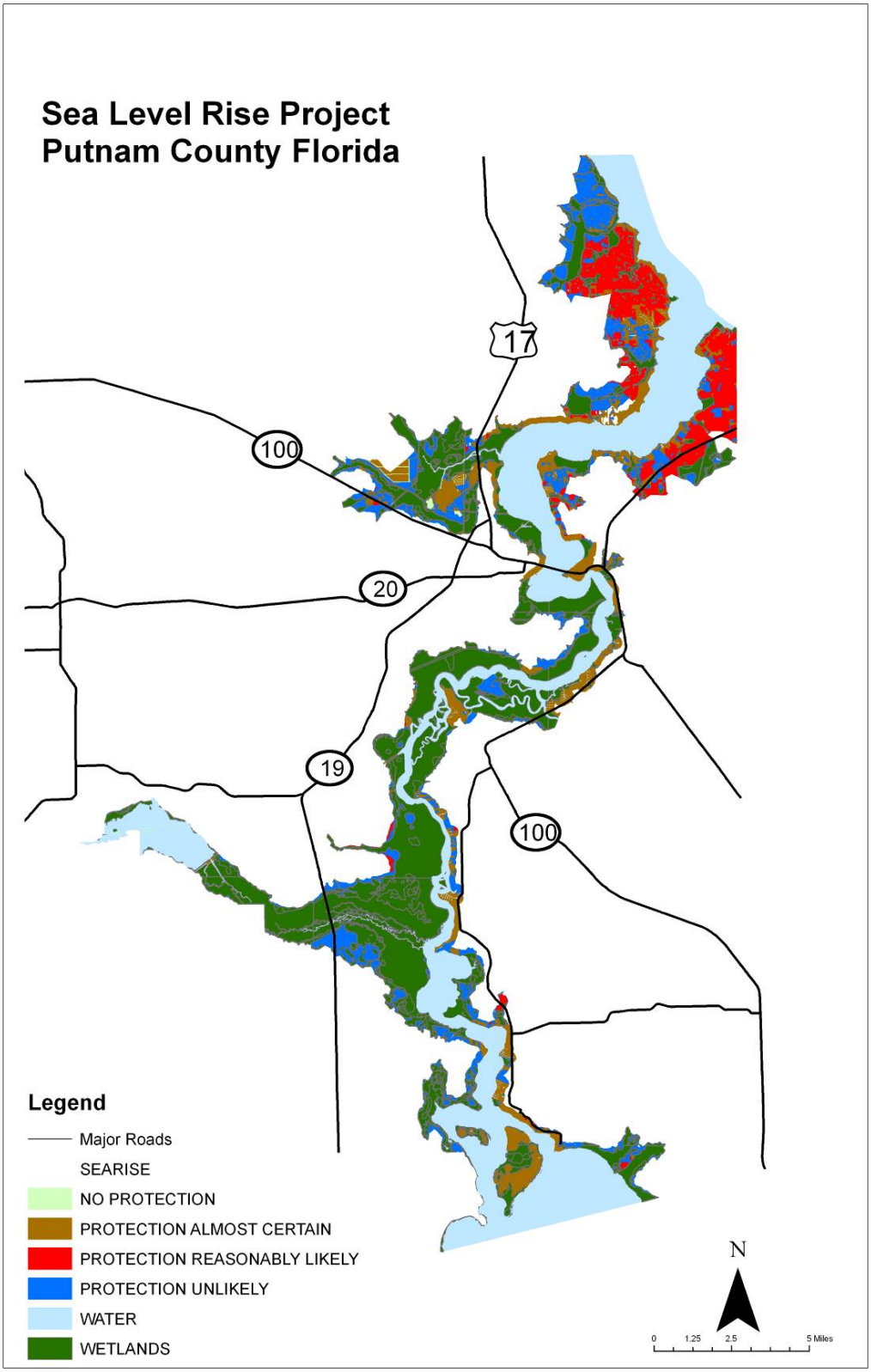
St. Johns River (south of Palatka to the county border)

There are open lands and croplands in this area that are deemed as protection unlikely. The residential areas are marked as protection almost certain. As with the north end of the St. Johns River, many of the residential parcels contain homes that may not be feasible to protect. These areas should be revisited in the future and possibly assigned a different scenario depending on the condition of the properties. The conservation and agricultural lands in this area are deemed as no protection because they will most likely be relinquished to wetlands migration. Some of the agricultural land has been designated as protection likely.

Local Stakeholder Changes from Draft Maps:

The local planners changed the Drayton and Hog Island scenarios from protection likely to protection almost certain because of their populations. They have also changed some of the agricultural lands from no protection to protection likely because of dense housing in some areas.

Map 6 shows study results for Putnam County.



Map 6: Putnam County: Likelihood of Shore Protection

CONCLUSION

This report and the accompanying maps depicting response scenarios are intended to stimulate local government planners and citizens to think about the problem of sea level rise. Although this project covers a timeframe of 200 years, it would be a mistake to assume that thinking about sea levels rising can be put off to a future time. The sea is already rising and some shores are already eroding. Moreover, an effective response may require a lead-time of many decades. If we develop areas where wetland migration is preferred in the long run, it might take a lead-time of 50–100 years to relocate the development. Even in areas that we protect, shore protection measures can take decades to plan and implement.

The relevance of planning for sea rise can also be seen by the events of 2004's hurricane season. As hurricanes headed toward this area, official forecasters predicted that storm surges in some areas would rise above the 10-foot contour mapped for this project. One need only look at areas of Northeast Florida, such as St. Augustine and Flagler Beach, to witness the erosional effects of rising seas. With strong hurricane seasons projected to continue into the future because of warmer ocean waters, the events of the 2004 hurricane season will repeat themselves. High storm surge and erosion are not effects that will wait until 2200. They are occurring now in our region.

The rate of development and the increase in population on the coast of Northeast Florida are other important factors in starting the preliminary stages of planning for sea level rise now. As sea levels continue to rise, much of the currently developed, increasingly populated area can be expected to be flooded. Planners must begin to decide which land areas in their counties and municipalities will be protected, if any, against sea level rise and what the cost of holding back the sea will be. Citizens living in these areas must also know the costs associated with protection against sea rise.

This project's creation of maps is only a depiction of the expected response scenarios to sea level rise, based on the best currently available knowledge. Local planners may decide in the future that it may be wise to retreat from lands currently deemed to be protected lands, due to costs and environmental considerations. It is important to repeat that this project is only a start to anticipatory planning for sea level rise. This is Year One of a 200-year project.