Planning for Sea Level Rise in the Matanzas Basin

Appendix D:

Conservation Impacts and Priorities in the Matanzas Basin

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1. INTRODUCTION

This report describes the work completed by the Conservation Research Subgroup for the *Planning for Sea-level rise in the Matanzas Basin project,* led by University of Florida (UF) researcher Kathryn Frank, Department of Urban and Regional Planning in collaboration with the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM). The Conservation Subgroup included Dr. Tom Hoctor, Director of the UF Center for Landscape Conservation Planning, Michael Volk, Project Coordinator at the University of Florida, and Mingjian Zhu, PhD Candidate at the University of Florida. Florida Natural Areas Inventory (FNAI) staff also provided data and assistance. Funding for this work was provided by the NERR System Science Collaborative.

The Matanzas basin is particularly important for conservation for several reasons. First, it is one of the few locations on the Florida Atlantic coast that is fairly undeveloped with many opportunities remaining for land conservation and acquisition. Additionally there are many important and large tracts of silvicultural land, which provide opportunities for careful management while maintaining conservation values. There are significant existing conservation lands along the coast, but connections are needed inland towards the Ocala National Forest, Twelve Mile Swamp, and other existing conservation lands. In so doing, opportunities may be created for coastal to inland retreat of focal species and upland migration of natural communities as sea levels rise. Finally, the area is one of significant biodiversity, home to a variety of important focal species, including umbrella species such as the black bear and gopher tortoise, and a variety of wetland dependent and coastal species such as the American Oystercatcher. The GTM and other conservation entities currently have an opportunity to maintain these resources, but as sea levels rise and additional development occurs in the region, these opportunities will be reduced or lost.

2. METHODS

a. Summary

The overall goal of the research completed by the Conservation Subgroup was to assess the impacts from sea-level rise and future development on landscapes, natural communities, and focal species within the Matanzas basin, and to make recommendations for future conservation priorities.

Project Study Area

The project study area was identified by the overall project team based on the boundaries of the Matanzas River watershed, and included an additional 5 km buffer, necessary for inclusion of areas that may be important for habitat corridor modeling. The 5 km buffer was considered sufficient to address potential coastal to inland connectivity and relationships to the statewide Florida Ecological Greenways Network (FEGN) based on potential connections to inland conservation lands and higher priority areas within the FEGN. Additionally, GTM staff requested that we identify the Pringle Forest and Marsh View parcels in this project and assume that they were not part of existing conservation areas in order to assess their potential conservation value. The Pringle Forest parcel in particular is being considered for acquisition under the Florida Forever program, so they were interested to see how it compared with the conservation priorities identified for this project. Figure 1 shows the project study area, including the Pringle Forest and Marsh View parcels.

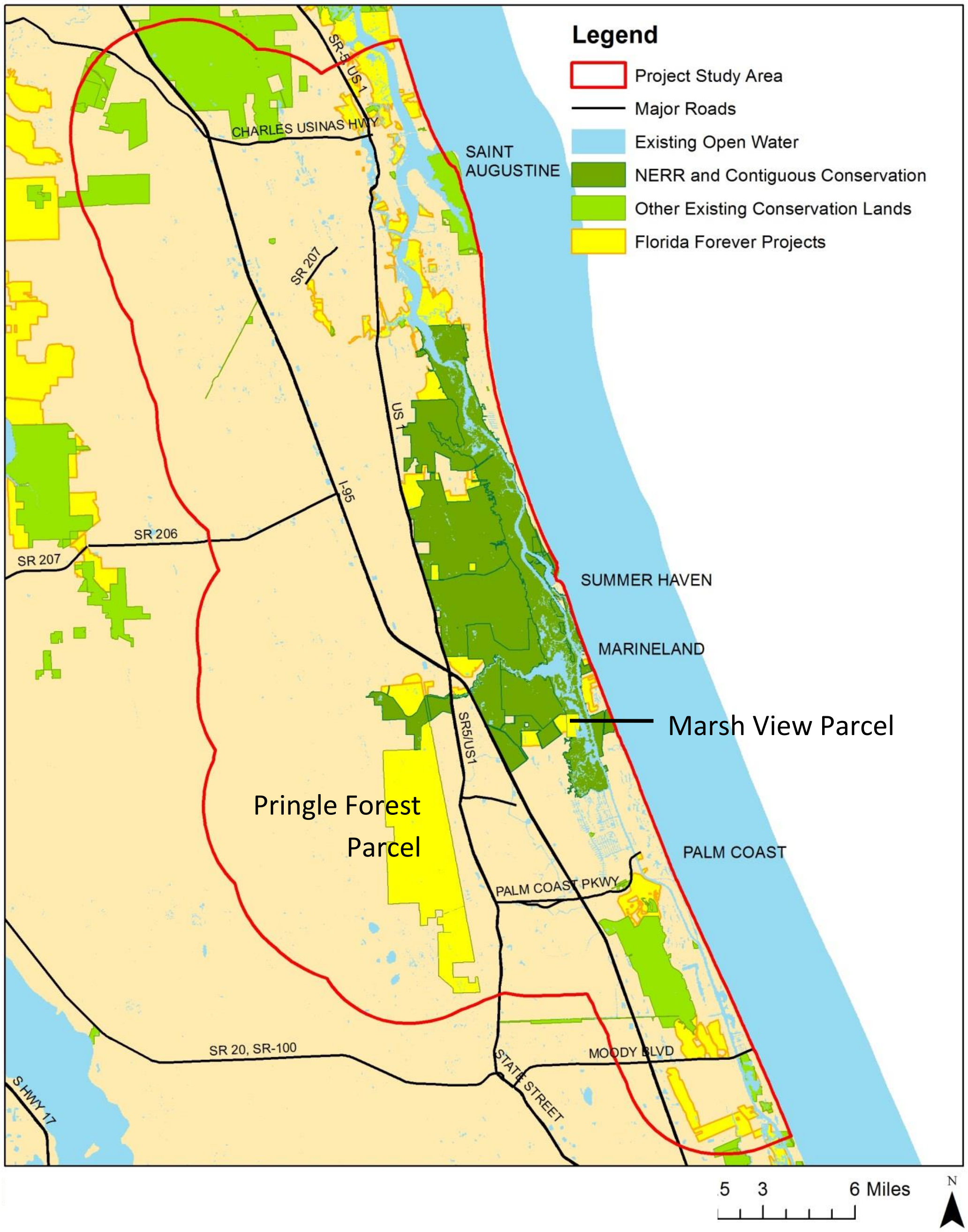

Figure 1: Project Study Area.

Current and Future Land Use/Land Cover Scenarios

Project team and steering committee members agreed that conservation analyses of impacts and priorities should be based on 1m and 2.5m sea level rise by 2100, and a future development scenario for 2060. A 1m sea level rise scenario was chosen because it is a fairly commonly accepted mid-range estimate of the amount of sea level rise likely to occur in Florida by 2100. A 2.5m sea level rise scenario was used to show impacts from a more extreme level of sea level rise. It is also valuable to compare 1m and 2.5m sea level rise conservation priorities to see whether 1m priorities remain relevant if sea levels rise further, enabling more advanced planning. As described elsewhere in the main report for this project, several future development scenarios were created for the project as a whole. For the analyses assessing impacts from future development on conservation priorities, we used a "trend" scenario for future development. This is based on current land use and development trends, with no attempt to change current development densities or patterns except to avoid areas inundated by sea level rise.

In short, the basic method used for all conservation impact assessments was to compare a current priority or land cover dataset with a future development or sea level rise scenario. In order to do this, we had to create current and future land cover datasets using the best available land use/land cover GIS data within the study area. The primary datasets and scenarios created are listed below, though for some analyses other datasets were also used.

- Current land use/land cover
- 1m sea level rise scenario
- 1m sea level rise scenario with future "trend" development
- 2.5m sea level rise scenario

A composite of several datasets was used to create these scenarios, while using data that was consistent to the greatest extent possible with that used by other researchers in this project. The primary datasets used for current land use scenarios included 2009 FLUCCS (Florida Land Use and Cover Classification System) data obtained from the St Johns River Water Management District, emergent vegetation data obtained from the GTM, and Cooperative Land Cover (CLC) data obtained from Florida Natural Areas Inventory (FNAI). Data used for future land use and development scenarios included SLAMM data provided by Associate Investigators Greg Kiker and Anna Linhoss, future development scenarios created by Associate Investigator Paul Zwick, and current FLUCCS and CLC data in upland areas unaffected by sea level rise. Table 1 below shows the combination of scenarios and data used, and the basic forms of analyses that were conducted for each.

Table 1. Sea Level Rise and Development Scenarios and Analyses

Sea Level Rise/Development Scenario	Conservation Analysis	Data Source
Current Sea Level	Identify existing species habitat and conservation priorities	Current land use/land cover (FLUCCS, CLC, other sources)
1m Sea Level Rise	Assess conservation impacts/priorities based on 1m sea level rise only	1m SLAMM + current land use in upland areas unaffected by SLR
1m Sea Level Rise + Future Development	Assess conservation impacts/priorities based on 1m sea level rise and future development	2060 "trend" 1m SLR development scenario + 1m SLAMM + current upland land use unaffected by SLR
2.5m Sea Level Rise	Assess conservation impacts/priorities based on 2.5m sea level rise only	2.5m SLAMM + current land use in upland areas unaffected by SLR

Conservation Impact and Priority Analyses

Using the data and scenarios described above, the team agreed on a number of conservation impact and priority analyses assessing various types of resources at various scales including focal species, natural communities, landscape connectivity, water resources, and others. The primary analyses, including which scenarios were used for each, are summarized in Table 2. Within the study area, analyses were conducted at one of four scales based on the type of analysis and what was determined to be most suitable:

1) Existing GTM Reserve and contiguous conservation areas
2) Existing reserve plus a one mile buffer
3) Project study area
4) St Johns and Flagler counties

Table 2. Conservation Impact and Priority Analyses

		Impact Analyses	**Conservation Priority Analyses**
1	Focal **Species**	Completed for 1m SLR, 2.5m SLR, and development impacts within the entire project study area, GTM lands only, and all conservation lands within the study area	Completed for 1m and 2.5m SLR within the GTM + 1 mile buffer
2	Priority **Natural Communities**	Completed for 1m SLR, 2.5m SLR, and development impacts within the study area	Used existing data
3	**Water Resource** Priorities	Same as # 2	Used existing data
4	**Biodiversity** Hotspots	Same as # 2	Used existing data
5	**Estuarine Habitat** Protection	Same as # 2	Completed for 1m SLR within project study area
6	Coastal to Inland **Connectivity** Priorities	N/A	Used existing data
7	**Reserve** Scale Conservation Priorities	N/A	Completed for 1m SLR within the GTM + 1 mile buffer
8	**Regional** Conservation Priorities	N/A	Completed within the two county study area

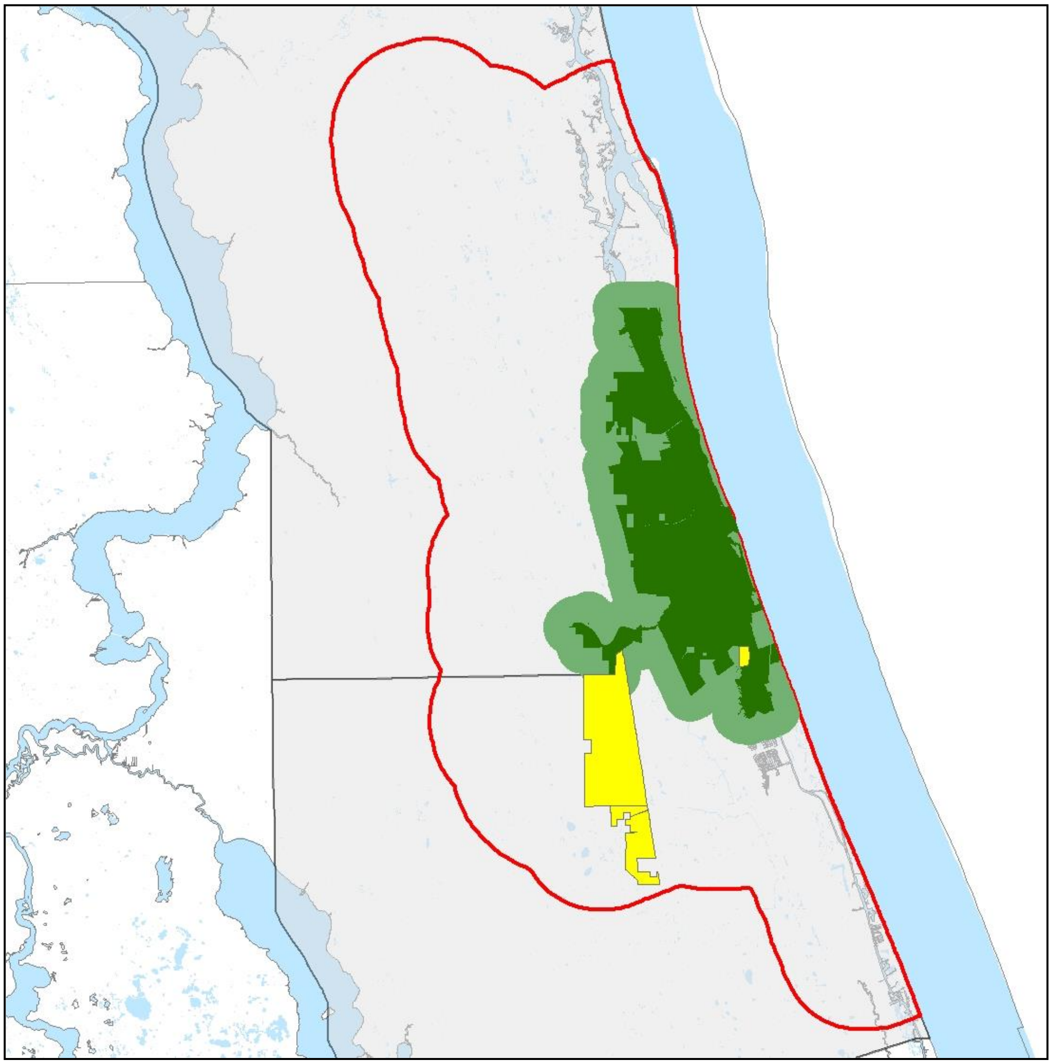

Figure 2. Scales of Assessment for Conservation Analyses. The Pringle Forest and Marsh View parcels are highlighted in yellow. 1) Existing GTM Reserve is in dark green, 2) Existing reserve plus 1 mile buffer is in medium green, 3) Project study area is outlined in red, 4) St Johns and Flagler counties are shown in gray.

b. Literature Review

In preparation for assessing impact and priority analyses for the project, we conducted a literature review of species and habitat vulnerability, adaptation capacity, and resilience to sea-level rise within the study area. To begin, we identified a list of species and natural communities that are either focal species/communities within the Matanzas basin, or are likely to be imperiled by sea-level rise or land use changes within the area using the Florida Natural Areas Inventory (FNAI) searchable tracking list (http://fnai.org/trackinglist.cfm). Input was also solicited from the staff at the GTM. The species and communities were reviewed in this literature review included:

Species

1) Sea turtles (loggerhead, green, leatherback, Kemps' Ridley)
2) Wading birds (great egret, little blue heron, snowy egret, tri-colored heron, white ibis, roseate spoonbill, glossy ibis, reddish egret, yellow-crowned night heron, black-crowned night heron)
3) Wood Stork
4) Shorebirds (Caspian tern, brown pelican, black skimmer, least tern, royal tern, sandwich tern)
5) Black rail
6) Painted bunting
7) Atlantic salt marsh mink
8) Anastasia and Pallid beach mice
9) Manatee

Coastal Natural Communities

1) Beach dune
2) Coastal strand
3) Marine consolidated substrate
4) Maritime hammock
5) Salt Marsh
6) Coastal interdunal swale
7) Coastal grassland
8) Mangrove

All species and communities types were queried by topic (TS) in Google Scholar using the species/community name together with sea-level rise. For example:

"loggerhead, sea-level rise"
"green turtle, sea-level rise"
"Caspian tern, sea-level rise"
"Mangrove, sea-level rise"

Based on the information found, we compiled a literature review, which includes citations and summaries for potentially relevant articles. Articles were selected to be included based on their relevance to sea-level rise or climate change and the species or natural community in question, particularly if relevant to adaptation, vulnerability, or resilience of that species or community to sea-level rise. In the results section of this report, we have summarized some of the information identified as potentially relevant to assessing vulnerability, adaptability, and resilience in natural communities and focal species.

c. Focal Species Impact and Priority Analyses

Focal species assessments were completed for a list of 37 species and species guilds. The initial list of species was drafted using the FNAI Inventory Tracking List, which provides a list of rare species for each Florida county. Rare and other species of conservation interest (focal species) were selected that are likely to occur in the study area, and for which habitat or occurrence data was likely to be available from either UF, FNAI, or the Florida Fish and Wildlife Conservation Commission (FWC). Also, based on input from GTM staff, additional species were added from the Faver-Dykes State Park and Matanzas State Forest Management Plans. The management plan for the GTM NERR was also referenced. A comparison between the focal species lists included in these three management plans, and the species that were analyzed in this project is included in Appendix A. Manatees were included in the original list of focal species, but ultimately excluded because of lack of occurrence/habitat data within the study area. In addition several species that occur just to the south or north of the GTM study area were selected to serve as additional indicators of the potential impacts of estuarine habitat change and to account for potential range shifts with climate change. These species were: Atlantic saltmarsh snake, Worthington's Marsh Wren, and MacGillivray's seaside sparrow. In addition these species habitat models were based on very similar species that occur on the Florida Gulf Coast given that these were the habitat models available; those Gulf coast "surrogate" species are included in the list below. Table 3 below includes the final list of species and sources of data used for focal species impact analyses. Data sources included habitat models generated by UF, FWC, or FNAI staff, as well as element occurrence data provided by FNAI. Habitat models are scripts that are run in ArcGIS to identify potential habitat for a given species based on land cover, proximity to other land covers/land uses, patch size, soils, and other physical characteristics in the landscape. Element occurrence data is GIS based data identifying specific locations where species occurrences have been documented.

Table 3. Focal species list and sources of data used for focal species assessments.

Common Name	Scientific Name	Current Habitat Data Used	Future Habitat Data Used
1. Gopher Tortoise	*Gopherus polyphemus*	UF script	UF script
2. Spotted Turtle	*Clemmys guttata*	UF script	UF script

Common Name	Scientific Name	Current Habitat Data Used	Future Habitat Data Used
3. Eastern Indigo Snake	*Drymarchon couperi*	UF script	UF script
4. Diamondback Rattlesnake	*Crotalus adamanteus*	UF script	UF script
5. Florida Kingsnake	*Lampropeltis getula floridana*	UF script	UF script
6. Florida Pine Snake	*Pituophis melanoleucus mugitus*	UF script	UF script
7. Sandhill Crane	*Grus canadensis pratensis*	UF script	UF script
8. Gopher Frog	*Rana capito*	UF script	UF script
9. Southeastern American Kestrel	*Falco sparverius paulus*	UF script	UF script
10. Neotropical Migrant Forest Bird Guild		UF script	UF script
11. Migratory (Wintering) Waterfowl		UF script	UF script
12. Wading bird Guild		UF script	UF script
13. Black Rail	*Laterallus jamaicensis*	UF script	UF script
14. Wood Stork	*Mycteria americana*	UF script	UF script
15. Swallow-tailed Kite	*Elanoides forficatus*	UF script	UF script
16. Bald Eagle	*Haliaeetus leucocephalus*	UF script	UF script

Common Name	Scientific Name	Current Habitat Data Used	Future Habitat Data Used
17. Limpkin	*Aramus guarauna*	UF script	UF script
18. Striped Newt	*Notophthalmus perstriatus*	UF script	UF script
19. American Oystercatcher	*Haematopus palliatus*	UF script combined with FNAI occurrence based polygon	UF script combined with FNAI occurrence based polygon
20. Bachman's Sparrow	*Peucaea aestivalis*	UF script	UF script
21. Round-tailed Muskrat	*Neofiber alleni*	UF script	UF script
22. Florida Mink	*Neovison vison*	UF script	UF script
23. River Otter	*Lontra canadensis*	UF script	UF script
24. Florida Mouse	*Podomys floridanus*	UF script	UF script
25. Sherman's Fox Squirrel	*Sciurus niger shermani*	UF script	UF script
26. Florida Black Bear	*Ursus americanus floridanus*	UF script	UF script
27. Sea Turtles		FNAI polygon	FNAI polygon combined with future open water
28. Open Water Foraging Shorebird Guild (i.e. Black skimmer, Least tern, pelicans)		UF script combined with FNAI occurrence	UF script combined with FNAI occurrence

Common Name	Scientific Name	Current Habitat Data Used	Future Habitat Data Used
		based polygon for Least Tern	based polygon for Least Tern
29. Sand Foraging Shorebird Guild (i.e. Plovers, sandpipers)		UF script combined with FNAI occurrence based polygon for Wilsons Plover	UF script combined with FNAI occurrence based polygon for Wilsons Plover
30. Painted Bunting	*Passerina ciris*	UF/FWC script	UF/FWC script
31. Anastasia Beach Mouse	*Peromyscus polionotus phasma*	FNAI polygon	FNAI polygon combined with future open water
32. Merlin	*Peromyscus polionotus phasma*	UF script	UF script
33. Mangrove Forest Bird Guild (Florida Prairie Warbler)		UF script	UF script
34. Ornate Diamondback Terrapin (for Diamondback Terrapin)	*Malaclemys terrapin macrospilota*	UF script	UF script
35. Gulf Saltmarsh Snake (for Atlantic Saltmarsh Snake)	*Nerodia clarkii clarkii*	UF script	UF script
36. Marian's Marsh Wren (for Worthington's Marsh Wren)	*Cistohorus palustris marianae*	UF script	UF script
37. Scott's Seaside Sparrow (for MacGillivray's seaside sparrow)	*Ammodramus maritimus peninsulae*	UF script	UF script

The focal species impact analyses that were completed are as follows:

I. 1m sea level rise impact assessment within the project study area
II. 2.5m sea level rise impact assessment the project study area
III. 2060 future development scenario impact assessment within the project study area
IV. Assessment of 1 and 2.5m sea level rise impacts within the GTM and contiguous conservation lands only, excluding the Pringle Forest parcel.
V. Assessment of 1 and 2.5m sea level rise impacts within all conservation lands in the project study area.

The species specific habitat priorities are intended to identify unprotected habitat near the GTM that could be added to the reserve to mitigate for habitat lost to sea level rise within (or near) the reserve. The first step of this process was to identify species that had a high degree of projected habitat loss from sea level rise (such as loss of 10% or more of the current protected habitat base) as well as species included in GTM related management plans. The list of species for which priority habitat analyses were conducted is included in the Results section. We then used the 1m sea level rise and 2.5m sea level rise habitat models of each of these species to identify remaining or new habitat for each species both within the GTM and within one mile of the GTM. These habitat priority layers can be used to identify specific blocks of habitat adjacent or near the reserve that could serve as priority additions to mitigate focal species habitat loss due to sea level rise.

d. Priority Natural Community Impact Analyses

Impacts to priority upland natural communities were assessed from 1m and 2.5m sea level rise and future development by comparing the current and future land use scenarios with the "trend" development scenario described earlier. In addition to solely natural communities, pine plantations and rangeland were also included in this assessment because of the number of acres of these uses that occur within the region and their value for conservation goals. These include providing valuable natural and semi-natural habitat for a variety of upland species that occur within the project area, such as black bear. For wetland natural communities we used the analyses provided by Drs. Kiker and Linhoss as part of the SLAMM analysis. Upland natural communities and land cover types included in this assessment are listed below.

1) Rangeland
2) Scrub
3) Pine flatwoods
4) Sandhill

5) Upland hardwood forest
6) Cabbage palm hammock
7) Mixed conifer-hardwood upland forest
8) Pine plantation

e. Water Resource Impact and Priority Analyses

These analyses are intended to be coarse indicators of water resource protection priorities (both surface water and groundwater) as well as potential restoration priorities for improving water quality and quantity. Except for the Riparian Network analysis these analyses use existing CLIP 3.0 or new CLIP data under development. The impact assessment was simply an overlay of the priority resources identified in the subsections below and both sea level rise inundation (1m and 2.5m) and the future development scenario. The analyses were:

<u>1) CLIP Significant Surface Waters Protection</u>

This data layer identifies areas that contribute water runoff to a surface water feature that has statewide significance, including: aquatic preserves, shellfish harvesting areas, seagrass beds, springs, public water supply sources, watersheds important for rare fish species, Outstanding Florida Waters, National Wild & Scenic Rivers, and National Estuaries. Highest priorities are immediately adjacent to significant surface waters, while lower priorities include all watersheds that contribute to significant surface waters.

<u>2) CLIP Aquifer Recharge Priorities</u>

This data layer identifies priorities for potential recharge to an underlying aquifer system (typically the Floridan aquifer, but could be intermediate or surficial aquifers in some portions of the state). The highest priorities indicate high potential for recharge to springs or public water supplies.

<u>3) CLIP Surface Water Restoration Priorities</u>

This data layer is a draft analysis of areas important for restoring impaired water bodies. Areas identified as high priorities are higher to moderate intensity land uses on soils with higher runoff potential and nearer to surface water features in or flowing to impaired water bodies. Areas identified as high priorities could either be restored to more natural land cover, institute best management practices including enhanced water quality buffers, remove or manage drainage features such as ditches and canals where feasible to allow for more natural water storage and treatment (dispersed water storage), or retrofit storm water drainage in urban and suburban areas to store more water (such as bioswales, etc.).

4) Riparian Network

This layer was created specifically for the Matanzas study area. It identifies functionally connected buffers around the Matanzas River and major creeks including all the wetlands and water bodies connected to them. Buffers are up to 1000 meters wide and include all connected natural and semi-natural land cover adjacent to the connected surface water network. Areas identified within the Riparian Network are more likely contributing to protecting water quality in the Matanzas watershed.

f. Biodiversity Hotspot Impact Analyses

Biodiversity priorities were identified for the study area using the CLIP biodiversity resource category dataset. The biodiversity resource category is intended to represent statewide biodiversity priorities based on a combination of several core data layers from the CLIP database. These include datasets representing Strategic Habitat Conservation Areas (SHCAs) and areas of potential habitat richness for vertebrates identified by the Florida Fish and Wildlife Conservation Commission; and rare species habitat conservation priorities and priority natural communities identified by the Florida Natural Areas Inventory.

The core data layers are combined to create an aggregated dataset ranked from Priority 1 to 5, with Priority 1 being representing lands that are most important for preserving biodiversity. Within the Matanzas project study area, lands representing all five levels of biodiversity priority are currently present. Existing lands within the GTM Research Reserve are a high priority for biodiversity, as well as patches of land along the coast and on the western edges of our study area.

Using the biodiversity resource category dataset, we assessed potential impacts on *terrestrial* biodiversity priorities from 1m and 2.5m sea level rise, as well as land use change using the 1m sea level rise future development scenario. Impacts from future development were identified by simply overlaying current biodiversity priorities with the trend 1m sea level rise future development scenario to identify areas where future development is projected to occur in an area currently identified as a biodiversity priority. Impacts from sea level rise were assessed by comparing the current, 1m, and 2.5m sea level rise land use datasets described earlier in this appendix to identify areas of land cover change. Biodiversity priorities considered impacted included those that converted to open water or wetlands in future scenarios. This could include current wetlands that convert to open water, and current uplands that convert to either wetlands or open water.

Although we are describing areas that convert to open water or wetlands with 1 or 2.5m sea level rise as being “impacted”, it could be argued that these areas may still have conservation and biodiversity value. However, the quality of habitat resulting from these land cover changes, and timeframe for the conversions is uncertain. Therefore it is conservative to note these areas as being impacted, with the understanding that they may still have conservation value. In particular, we demonstrate this possibility in the analysis of future estuarine habitat priorities elsewhere in this appendix.

h. Estuarine Habitat Impact and Priority Analyses

Estuarine habitat priorities and impacts were assessed within the Matanzas project study area based on 1m and 2.5m sea level rise scenarios. Potential impacts from future land use change were also assessed based on the trend 1m sea level rise scenario. Habitat categories included in this analysis are shown in Table 4.

Table 4. Estuarine Habitat Categories

FLUCCS Code	DESCRIPTION	Natural Community	Notes
6120	Mangrove swamps	Mangrove swamp	
6420	Saltwater marshes	Saltmarsh	
6460	Mixed scrub-shrub wetland	Shrub wetland	Only included when adjacent to other estuarine wetland types
6500	Non-vegetated wetland	Tidal flat	
6510	Tidal flats	Tidal flat	

FLUCCS code 6460, “Mixed scrub-shrub wetland” was included since it can sometimes be used to identify mangrove or other shrubby wetlands within estuarine areas. However most instances of this land cover classification are inland, so it was only included where adjacent to other estuarine wetland types.

To identify estuarine impacts and priorities, current and future land use scenarios were overlaid to locate 1) existing estuarine habitat lost to sea level rise, 2) existing estuarine habitat that remains after sea level rise, 3) existing uplands that convert to estuarine habitat as sea levels rise (i.e. future estuarine habitat), and 4) future estuarine habitat contiguous with areas of existing estuarine habitat projected to remain after sea level rise. Estuarine habitat lost to sea level rise included any of the land cover types listed in Table 4 that converted to open water in future scenarios.

Additional prioritization was then completed by identifying areas of future or existing estuarine habitat that remains after sea level rise that were 1) within the existing GTM, 2) outside of current GTM boundaries, but contiguous with the existing GTM, 3) within 1 mile from the GTM, 4) within the project study area but not contiguous with the GTM and further than 1 mile from existing GTM lands.

i. Reserve Scale Conservation Aggregated Priorities Analysis

"Reserve scale" conservation priorities were identified based on the aggregation of all primary habitat for all focal species included in this project. As described elsewhere, primary habitat was identified for focal species based on species characteristics and habitat requirements using GIS habitat model scripts and element occurrence data from FNAI. Any primary habitat for any focal species was maintained as a priority in the reserve scale priority analysis. However only priority habitat directly connected to the reserve and within a 1 mile buffer from the reserve boundaries was included. Gaps of less than or equal to one 10m cell were closed. Lands separated from the reserve by roads were also included, though an argument could be made that these should be a lower priority. Additionally, the initial selection of priority lands was compared to aerial photography, and some small patches were added that had clearly been excluded due to limitations in the study area mask. Finally, the priorities were compared to the CLIP Landscape Integrity dataset to verify that in general all met a minimum threshold of landscape integrity.

j. Regional Conservation Priority Analysis

Regional scale conservation priorities were developed for the study area to identify a regional conservation priority context for the GTM as well as to serve as a data resource for helping to guide conservation planning within the study area. These priorities were based on a variety of inputs, including the most recent updates of the Florida Ecological Greenways Network (FEGN) and the Critical Lands and Waters Identification Project (CLIP). This data aggregation is intended to provide regional context for our more specific corridor, species habitat, and natural community priorities for the GTM, and allowed us to incorporate data created through statewide analyses (such as CLIP and the FEGN) into broad priorities for the Matanzas basin. The following layers and priority levels were used to create the Regional Conservation Priorities:

- FEGN (all priority levels)
- Florida black bear priority habitat from FEGN analysis
- FEGN Coastal to Inland Connectivity areas
- FEGN Major River Buffers
- CLIP Landscape Integrity (Index levels 7-10)
- CLIP Aggregated Priorities (P1-P3)

Figure 3 shows the process and inputs used to create the regional conservation priorities.

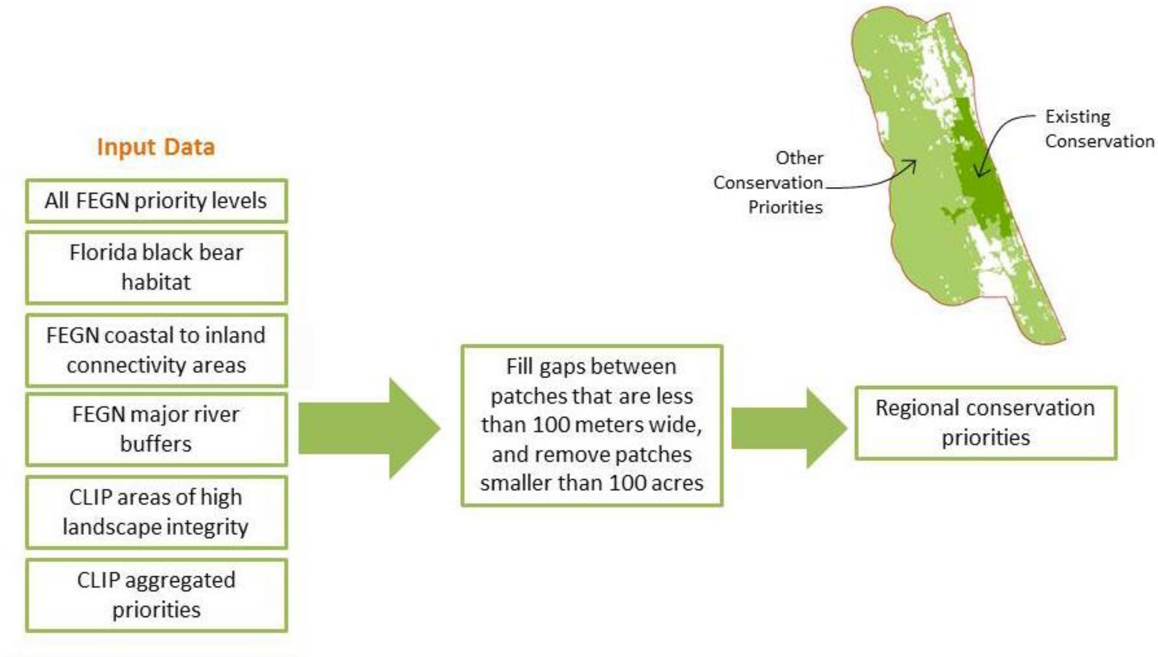

Figure 3. Regional Conservation Priority Process Diagram

k. GTM Coastal to Inland Connectivity Analysis

The GTM coastal to inland connectivity analysis is intended to augment state identified wildlife corridors (the FEGN) to ensure that opportunities for inland retreat from Matanzas River estuary are maintained and regional ecological connectivity is achieved to help facilitate the conservation of various focal species in an era of climate change. The Princess Place tract within the GTM reserve was used as a central location to serve as the source for all connectivity analyses. Three existing conservation land destinations were selected to represent north, west, and southern connectivity options and to represent a diverse, spatially expansive regional ecological network. The selected destinations were Twelve Mile Swamp to the north, the Ocala National Forest to the west, and the Relay Tract in Flagler County to the south. A cost surface to identify the best potential connectivity options was created by combining the Landuse Intensity data layer from CLIP (which is a component of the Landscape Integrity layer), intensive land use from WMD FLUCCS data (defined as existing residential, commercial, industrial, or utility land uses), and large open water bodies. The Landuse Intensity data layer ranks areas based on both local and landscape-scale intensity of existing land use. Areas that are dominated by large tracts of natural or semi-natural land cover have the highest rankings in the Landuse Intensity data layer and are also the areas most likely to support functional connectivity from a general landscape perspective. The top five ranks of the Landuse Intensity data layer (index values 10-5) were inverted to ranks of 1-6 (where 1 represents the areas with the highest potential connectivity suitability) to create the foundation of the cost surface. Then all lower suitability values in the Land Use intensity data layer and all intensive land uses in the WMD FLUCCS data were converted to No Data (which means that potential connectivity areas cannot be identified through such areas). Finally, larger water bodies (more than 100 meters wide) were identified and given a rank of 7, which means these areas are potentially suitable for connectivity but represent the highest cost/lowest suitability. We then ran ArcGIS Cost Distance and Cost Path functions to identify the Least Cost Paths (LCP) between the GTM and each of the three destinations. We then buffered each LCP by two miles total (1 mile on each side of the path) with suitable land cover and low intensity land uses to identify an opportunity swath that could accommodate a wide enough corridor to be potentially functional.

3. RESULTS

a. Literature Review

We searched the literature for information about several sea turtle species, including Loggerhead, Green, Leatherback, and Kemp's Ridley Turtles. The literature makes it clear that sea turtles are vulnerable to climate change and sea-level rise. Changes in beach profile and width resulting from sea-level rise or other disturbances such as hurricanes are likely to affect sea turtle nesting success (see for example Mmpb et al. 2010; Tony et al. 2011), with climate and temperature change having potential impacts on several portions of sea turtle life history such as hatchling gender and male to female sex ratios (Hawkes et al. 2007, Lucy et al. 2009). Resilience and adaptation to both climate change and sea-level rise will likely depend on active conservation intervention (Antonios et al. 2009; Mmpb et al. 2011), and Elvira et al. 2009 state:

> "Conservation recommendations to increase the capacity of marine turtle populations to adapt to climate change include increasing population resilience, for example by the use of turtle exclusion devices in fisheries, protection of nesting beaches from the viewpoints of both conservation and coastal management, and increased international conservation efforts to protect turtles in regions where there is high unregulated or illegal fisheries (including turtle harvesting). Increasing research efforts on the critical knowledge gaps of processes influencing population numbers, such as identifying ocean foraging hotspots or the processes that underlie the initiation of nesting migrations and selection of breeding areas, will inform adaptive management in a changing climate".

Lucy et al. 2009 state:

> "although it is too early to give detailed management recommendations, careful protection of coastlines along which turtles nest should be considered, as should the protection of beaches that produce male hatchlings, which may be of increased importance in the future. More active management approaches, for example translocation of eggs to suitable yet vacant nesting beaches, may be necessary to consider under worst-case scenarios".

Our review of avian vulnerability, adaptation, and resilience included wading and shorebird species in general as well as several specific avian species. Low-lying coastal and intertidal habitats that support shorebirds are likely to be at high risk of inundation and loss due to sea-level rise and anthropogenic factors such as sea walls, likely jeopardizing the ability of these areas to support current shorebird numbers (Galbraith et al. 2002). The effect of sea-level rise on the length of time for which intertidal food supplies are available is also a conservation issue for shorebird species (Sarah et al. 2006). In addition, extreme storm events could have negative impacts on avian biodiversity due to flooding and overwash especially regarding the many species that nest on sand substrates adjacent to coastal waterbodies including terns, skimmers, and plovers in Florida. Salt marsh restoration in low-lying areas may create potential ecological traps, due to the greater vulnerability of these areas to impacts from storms (Martijn 2010). In estuarine areas, Erwin et al. 1995 argue that, "for many species of waterbirds nesting in coastal estuaries, maintaining numerous small islands may be a more effective management strategy than maintaining larger islands or reserves". In their study, the nesting density of great white herons *Ardea herodias* was shown to be higher on small islands, which also attracted various other water bird species, yet small islands were also more vulnerable to erosion from watercraft, insufficient maintenance (with regard to dredge material islands), and sea-level rise.

Studies of Painted Buntings in Georgia indicated that this species is almost as dependent on saltmarsh vegetation as they are on shrub and forest vegetation (Ross 2009). For Buntings as well as several other avian species, habitat conservation efforts may need to include shrub habitat as well as nearby saltmarsh to provide not only the necessary food resources for shrub-associated species, but also for forest interior species during the breeding season. Tidal forests may serve as important refuges for closed-canopy species, such as Northern Parula and Acadian Flycatcher if their preferred oak and pine habitats are lost due to increased urban development; therefore these habitats should also be the focus of conservation efforts (Ross 2009, 2012). Such maritime and coastal forest are likely to be caught between a rising sea and coastal development, which will limit opportunities for spatial shifts in forest cover in response to sea-level rise.

Several sources were reviewed related to beach mice. A study of the effects of hurricane storm surge on Alabama beach mice found that they will likely be negatively affected by increased hurricane frequency and intensity. The Alabama beach mouse can survive future hurricanes, but may be vulnerable to extinction from a combination of multiple successive hurricanes, climate change, and greater than normal human disturbance (Alexandra 2011).

Coastal natural communities are uniquely at risk from sea-level rise, climate change, and human influences, and the scope of impact in many cases depends largely on local influences and conditions. Catriona et al. 2000 state that, “the best strategies to protect ecosystems from climatic changes may be those that reduce other stresses, thus increasing resilience to a variety of stresses.” Sea-level rise will increase the susceptibility of beach dune communities to erosion, but where the eroded sediment locates depends on a variety of factors (Carter 1991). Coastal armoring is expected to increase in response to the combination of increasing human populations, beach erosion, and sea-level rise. This will likely result in significant ecological impacts; reductions in beach width and avian species abundance have already been documented on armored shorelines (Jenifer et al. 2008, Galbraith et al. 2002). Building setback regulations, “have the potential to mitigate loss of beach area by providing a buffer zone which allows for the natural movement of beaches in response to perturbation” (Marianne et al. 2008). Response of dune vegetation to a warmer, wetter climate is also uncertain (Carter et al. 1991). “Most of the main temperate dune species are C3 plants which given favorable conditions would respond positively to CO^2 enhancement. However local factors may offset such potential gains (Carter et al. 1991)”. Simulations of sea-level rise demonstrated that beach erosion constrained spatially dependent dune plant communities to a narrow area, resulting in a breakdown of the successional process (Rusty et al. 2005).

Several sources were reviewed for information on coastal forest response to sea-level rise. Doyle et al. 2010 state that, “tidal freshwater forests in coastal regions of the southeastern United States are undergoing dieback and retreat from increasing tidal inundation and saltwater intrusion attributed to climate variability and sea-level rise”. In Florida, decline of freshwater coastal forest areas along the Gulf of Mexico has been documented from salinity stress due to increased tidal flooding, with likely replacement by tidal saltwater communities or open water (Desantis et al. 2007, Thomas et al. 2010). “Coastal forests with frequent tidal flooding are unable to support species-rich forests or support regeneration of the most salt-tolerant tree species over time. Given that rates of sea-level rise are predicted to increase and periodic droughts are expected to intensify in the future due to global climate change, coastal forest communities are in jeopardy if their inland retreat is restricted (Desantis et al. 2007)”.

Responses of tidal salt marshes to sea-level rise are in large part dependent on their ability to maintain surface elevations relative to mean sea level. Influential factors include local submergence and sedimentation rates, density and composition of flora, and type and intensity of anthropogenic influences (Morris et al. 2002, Richard et al. 1985). In addition, eutrophication has been shown to exacerbate marsh loss by increasing above ground leaf biomass, decreasing the biomass of shore stabilizing roots, and increasing microbial sedimentation resulting in creek-edge and bay-edge marshes evolving into mudflats and wider creeks (Deegan et al. 2012). To increase salt marsh resilience to sea-level rise, improving water quality inflows may have an important influence.

Mangrove forests are among those ecosystems most immediately threatened by projected increases in sea-level and hurricanes. Factors that influence mangrove resilience include accretion and sedimentation rates, the production rate of forests, shoreline erosion rates, and storm frequency (Joanna et al. 1991). In a study of mangrove forest migration along the southwest coast of Florida, Thomas et al. 2003 state that:

> "as hurricane intensity increases over the next century, model projections suggest that future mangrove forests are likely to be diminished in average height and will contain a higher proportion of red mangroves. Sea-level rise will allow mangrove encroachment into freshwater marsh and swamp environments of the interior Everglades system that with minimal coastal erosion will increase mangrove expanse and reduce freshwater marsh coverage. South Florida human population will likely continue to grow significantly and could indirectly affect freshwater flow and circulation that could exacerbate the rate and extent of sea-level rise. Mangrove systems of south Florida are already preserved in the public land trust of various U.S. government parks and refuges. Because they are fairly remote and insulated within large public land holdings, there is little threat from human impact of coastal development, nor are there any feasible coping strategies for abating mangrove migration into upland habitats from sea-level rise".

b. Focal Species Impact and Priority Analyses

<u>Species Impact Analyses</u>

Impact assessments to focal species indicated a broad range of impacts from sea level rise. The species losing the greatest amount of habitat to 1m sea level rise was the black rail, projected to lose up to 58% of its current habitat. However some wetland or open water dependent species actually are projected to gain habitat. In the most extreme example, American oystercatcher is projected to see a 167% gain in habitat. The majority of species on our list lost or gained between 0-10% of current habitat. If American oystercatcher is excluded, the change in habitat for all other species with 1m sea level rise was a loss of approximately 6%.

No species gained habitat as a result of future development, though some species were minimally affected, such as wetland dependent species where future development is less likely to occur. Upland species were the most significantly impacted by future development, with many species losing greater than 10% of current habitat, and several losing between 20-30% of current habitat. Gopher tortoise is an example, which is projected to lose a little over 20% of its habitat to future development. Complete statistics and maps for focal species impacts are included in Appendix B. A sample map is included below (Figure 4) showing impacts from 1m sea level rise and development for wood stork.

When changes from 1m sea level rise and future development were combined, impacts were compounded or reversed for some species. Striped newt for example, was projected to gain habitat with 1m sea level rise, but the net change in habitat reversed to a loss of over 22% of current habitat when future development and sea level rise statistics were combined.

Similar patterns of habitat change were seen with 2.5m sea level rise, with some wetland or open water dependent species gaining habitat, while upland species generally lost habitat. However in this case the average gain/loss across all species was over 12%- almost twice the average loss seen with 1m sea level rise. Again, American oystercatcher was excluded from this figure because the amount of habitat it gains would skew the statistic.

Finally, statistics were created to identify the amount of focal species habitat lost or gained within existing conservation areas. These statistics are valuable as an indicator of which species might be inadequately protected by current conservation lands as sea levels rise. In this case, again some species gain or lose habitat. Species losing the most habitat within the GTM reserve under 1m sea level rise include the black rail (-57%), Florida mink (-43%), and seaside sparrow (-43%), though several other species lose significant habitat as well. With 2.5m sea level rise, Florida pine snake loses 79% of existing habitat, neotropical migrant forest birds lose 55%, black rail loses 96%, and limpkins lose 57%. Other species lose similar amounts: Seaside sparrows (-83%), Marian's marsh wren (-76%), mangrove forest birds (-99%), Gulf saltmarsh snake (-66%), merlin (-69%), painted bunting (-41%), sand foraging shorebirds (-67%), and Florida mink (-83%).

A comparison of average loss/gain statistics for focal species within the GTM reserve, and separately within all conservation areas in the study area is below in Table 5. It indicates that there is a significant increase in habitat lost with 2.5m sea level rise, but that consideration of focal species habitat across all conservation lands in the study area (rather than just the GTM reserve) mitigates those impacts. Table 6 summarizes species impacts within the entire study area.

Table 5. Average loss/gain of focal species habitat in existing conservation areas

	1m sea level rise within the GTM and contiguous conservation lands	2.5m sea level rise within the GTM and contiguous conservation lands	1m sea level rise within all conservation lands in the study area	2.5m sea level rise within all conservation lands in the study area
Percent loss/gain of existing habitat for all focal species	-3.12%	-27.88%	-2.39%	-19.25%

Table 6. Habitat loss/gain for focal species across entire project study area

	Number of species losing habitat	Number of species gaining habitat
Focal species impacts from 1m sea level rise	27	10
Focal species impacts from future development	37	0
Focal species impacts from 1m sea level rise and development combined	33	4
Focal species impacts from 2.5m sea level rise	30	7

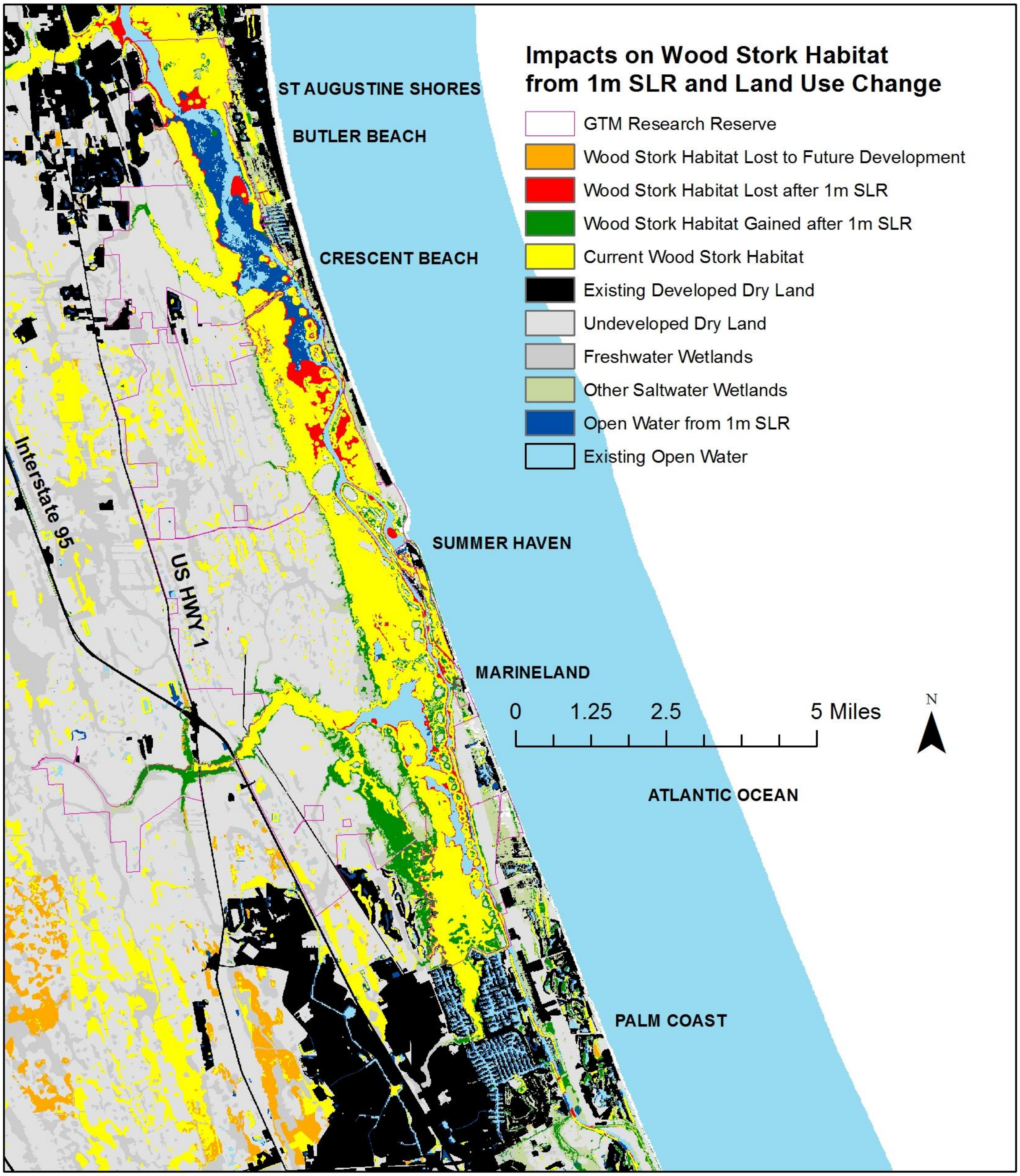

Figure 4. Wood stork impacts from 1m sea level rise and future development

Species Habitat Priority Analyses

Based on the results of the species impact analysis, we identified a subset of our focal species that had more projected habitat loss from sea level rise (such as loss of 10% or more of the current protected habitat base) as well as species included in GTM related management plans. We then identified priority habitat for each of those species within 1 mile of the GTM, where all higher priority classes of habitat from each species model was identified as potential priority. This was done for both the 1m sea level rise habitat model and the 2.5m habitat model for each species. It should be kept in mind that for most of our focal species (the ones with UF Hoctor models available) these 1m and 2.5m habitat models are rerun for each scenario so that habitat lost to fragmentation or habitat gained from natural community change due to sea level rise are reflected in the priority habitats identified for each of the two scenarios. The species selected for identifying priority habitat within 1 mile of the GTM included:

1) Gopher frog
2) Striped newt
3) Gopher tortoise
4) Sea turtles
5) Pine snake
6) Diamondback rattlesnake
7) Shorebird sand-foraging guild
8) Swallow-tailed kite
9) Wading bird guild
10) Black rail
11) Limpkin
12) Painted bunting
13) Anastasia beach mouse
14) Florida Mink
15) Black bear

The species specific habitat priorities are intended to identify unprotected habitat near the GTM that could be added to the reserve to mitigate for habitat lost to sea level rise within (or near) the reserve. These habitat priority layers can be used to identify specific blocks of habitat adjacent or near the reserve that could serve as priority additions to mitigate focal species habitat loss due to sea level rise. We present one example of these maps here (Figure 5) for wading birds, which indicates that though habitat will be lost as sea level rise progresses beyond 1m, there is potential priority habitat in all directions surrounding the GTM that could be added to the protected habitat base. The rest of the maps and discussion of species-specific habitat conservation priorities are in Appendix D. There are several major trends across these results for all fifteen species or guilds. Estuarine wetland dependent species will lose extensive existing available habitat but will also see potential gain of new habitat as sea level rise continues from 1m up to 2.5m. For those species with cumulative habitat loss within the GTM, other blocks of future marsh that may be available to mitigate losses include southeast of the GTM. Upland species will see progressive habitat loss within the GTM as sea level rise continues, but there are available areas of potential priority habitat exist west of the GTM including around Pellicer Creek. In addition, some upland species have potential priority habitat available outside the GTM on the barrier islands at 1m sea level rise, but virtually all of that habitat is unlikely to be available at 2.5m sea level rise. However, US1 and I-95 limit the potential for functional connectivity between some of these potential habitat additions and the GTM. Beach-related species have similar issues where available additional habitat priorities that could be protected will become much scarcer if sea level rise reaches 2.5m. However, it should be pointed out that beach dynamics are complicated to model, and our SLAMM-based habitat models may under-represent future beach and beach dune habitats.

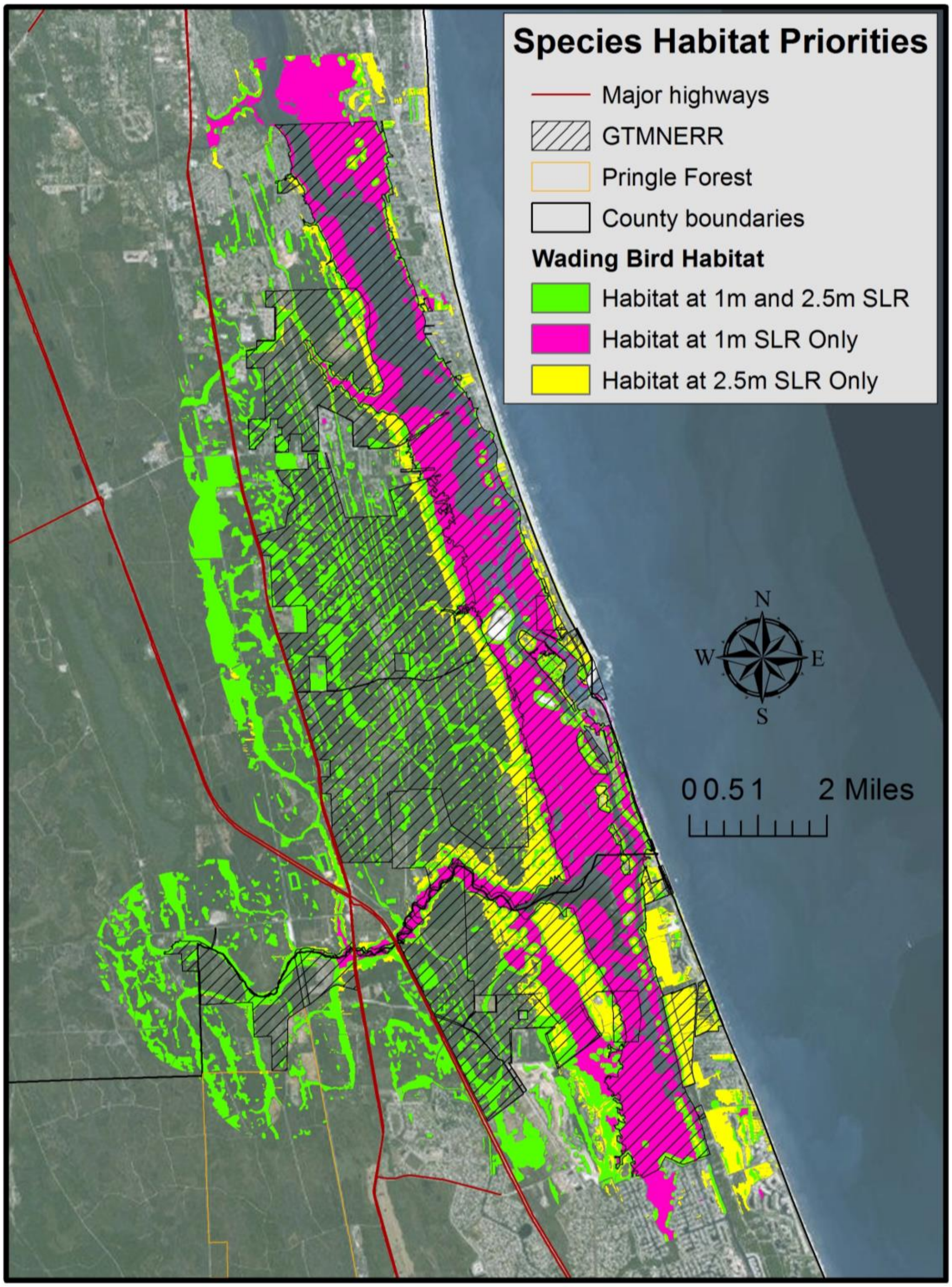

Figure 5. Wading bird guild potential habitat priorities at 1m sea level rise and 2.5m sea level rise within 1 mile of the GTM.

c. Priority Natural Community Impact Analyses

Results from the natural community and land cover impact analysis are shown below in Table 7, which is a combination of upland natural communities from FLUCCS and Cooperative Land Cover data and wetland natural communities from the SLAMM modeling. A more detailed version of Table 7 is included in Appendix E. This analysis indicates that nearly all upland land cover types will be impacted by future development. Impacts from sea level rise to upland land cover types are similar, with virtually all upland land cover included in this assessment experiencing a decline in acreage. The only exception is pine plantation, which is minimally impacted by sea level rise, with most acreage occurring further to the west of the estuary. Some, though not all wetland land cover types experience a net loss from sea level rise. Impact assessments of estuarine communities are more nuanced, since SLAMM analyses show that some wetland land cover types actually see a net gain in acreage as sea levels rise. Appendix E includes maps illustrating impacts from sea level rise and future development on the natural community/land cover types included in this analysis.

Table 7. Natural Community and Land Cover Impact Assessment Summary

Natural Community Type	Percent loss/gain to 1m SLR	Percent loss/gain to 2.5m SLR	Percent Loss to future development
Upland land cover impacts			
Rangeland	-5.5%	-20.1%	-31%
Scrub	-4.8%	-32.0%	-28%
Pine flatwoods	-2.6%	-9.0%	-20%
Sandhill	-1.1%	-4.5%	-36%
Upland hardwood forest	-16.6%	-79.6%	-6%
Cabbage palm hammock	-16.6%	-98.8%	-0%
Mixed conifer-hardwood upland forest	-8.1%	-34.7%	-21%
Pine plantation	-0.3%	-1.2%	-20%
Wetland land cover impacts based on SLAMM results			
Swamp	-2.5%	-7.9%	
Cypress swamp	-2.3%	-11.2%	
Inland Freshwater Marsh	-2.2%	-6.9%	
Transitional Saltmarsh	81.4%	15.6%	
Regularly Flooded Marsh	-31.0%	13.6%	

Mangrove	38.0%	-99.7%	
Estuarine Beach	100.0%	100.0%	
Tidal flat	49.0%	139.1%	
Ocean Beach	32.0%	136.6%	
Irregularly Flooded Marsh	34.0%	-99.4%	
Vegetated tidal flat	-14.7%	-100.0%	
Open water	56.9%	166.2%	

d. Water Resource Priority and Impact Analyses

Figures 6-9 represent the water resource priorities based on CLIP Surface Water Protection priorities, CLIP Groundwater Recharge priorities, draft CLIP Surface Water Restoration priorities, and the riparian network supporting water quality and quantity for the Matanzas River watershed. Collectively these four maps identify water resource conservation and restoration priorities near the GTM that could be targets for land acquisition, wetland mitigation, dispersed water storage, minimization of future development impacts, best management practices, and stormwater management improvements in current developed areas.

We have also provided basic impact statistics for each of these water resource data layers in Table 8. Draft CLIP Surface Water Restoration Priorities in the study area have a value range between 0-95 within the study area, with higher values representing higher priorities. For the statistics included in Table 8, priority values were grouped into sets of 10 (for example original values of 90-99 were given a new value of 9). This resulted in a reduced set of 9 priority values, of which statistics for the highest priority values 5-9 are shown below in Table 8. Results show greater impacts on water resource priority areas in a 2.5m sea level rise scenario compared to a 1m scenario. In both cases sea level rise impacts on areas identified as high priority for surface water protection are greatest. It is also clear that future development, if continued at current rates and densities, will greatly impact upland areas important for water resources, in most cases even more significantly than sea level rise. These analyses also do not take into account considerations of saltwater intrusion, stormwater runoff, and other secondary impacts from sea level rise and land use change that will impact water resources- above and beyond inundation or land conversion for development.

Table 8. Water Resource Priority Impacts from Sea Level Rise and Land Use Change

	Total areas(acres)	Inundated by 1m SLR (acres)	Percentage inundated by 1m SLR	Inundated by 2.5m SLR(acres)	Percentage inundated by 2.5m SLR	Acres impacted by trend 1m SLR development scenario	Percentage impacted by development
CLIP Groundwater recharge priorities							
1 - highest priority	78.1	0.0	0%	0.0	0%	3.83	5%
2	9638.4	145.6	2%	1,219.8	13%	1829.23	19%
3	28942.3	446.1	2%	2,530.8	9%	5826.42	20%
4	87067.5	1,253.9	1%	6,087.1	7%	17582.07	20%
5	58734.8	986.0	2%	3,772.5	6%	11155.89	19%
Totals	184,461.10	2,831.60	2%	13,610.20	7%	36,397.44	20%
Riparian network (RN) priorities							
Functional Upland Buffers in the RN	10897.9	1,209	11%	3,588	33%	8,119	75%
Wetlands in the RN	52324.6	4,265	8%	12,915	25%	5,478	10%
Totals	63,222.5	5,474	9%	16,503	26%	13,597	22%
CLIP Surface water protection priorities							
1 - highest priority	14801.4	3,540.8	24%	8,827.8	60%	121.20	1%
2	35973.6	3,279.4	9%	10,248.1	28%	3146.32	9%
3	10267.4	350.9	3%	1,148.6	11%	1885.52	18%
4	83192.0	468.1	1%	4,810.7	6%	14063.79	17%
5	16740.6	3.2	0%	0.0	0%	3205.48	19%
Totals	160,975.17	7,642.40	5%	25,035.22	16%	22,422.31	14%
Draft CLIP Surface water restoration priorities							
9 - highest priority	12031.6	244.6	2%	378.1	3%	2134.99	18%
8	21639.0	1,245.4	6%	1,645.7	8%	4292.22	20%
7	21283.2	222.4	1%	355.8	2%	4803.72	23%
6	39541.8	600.5	2%	934.1	2%	7806.05	20%
5	1490.0	0.0	0%	0.0	0%	444.78	30%
Totals	95,985.62	2,312.89	2%	3,313.67	3%	19,481.76	20%

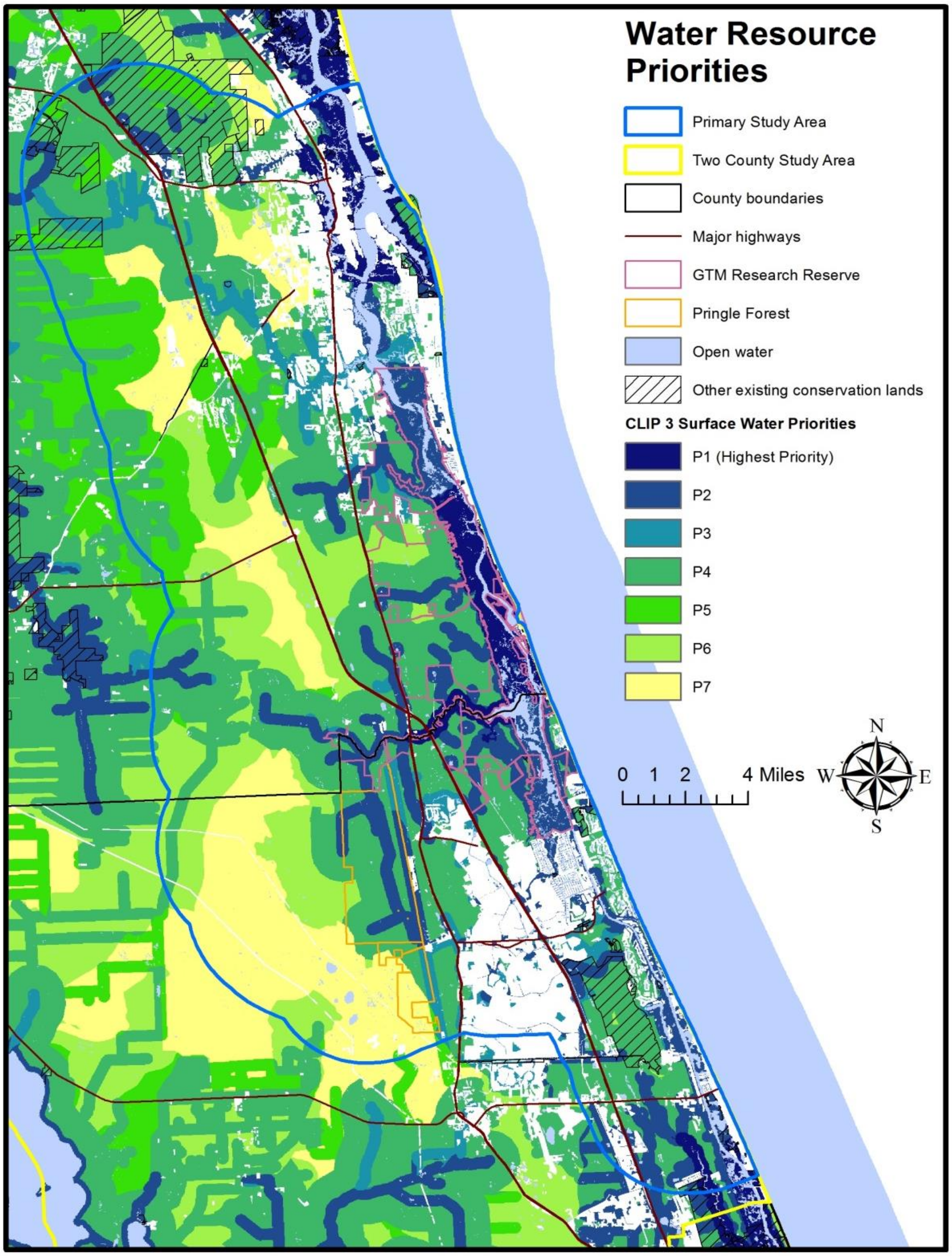

Figure 6. CLIP Surface water protection priorities, where the darkest blues represent the highest priorities.

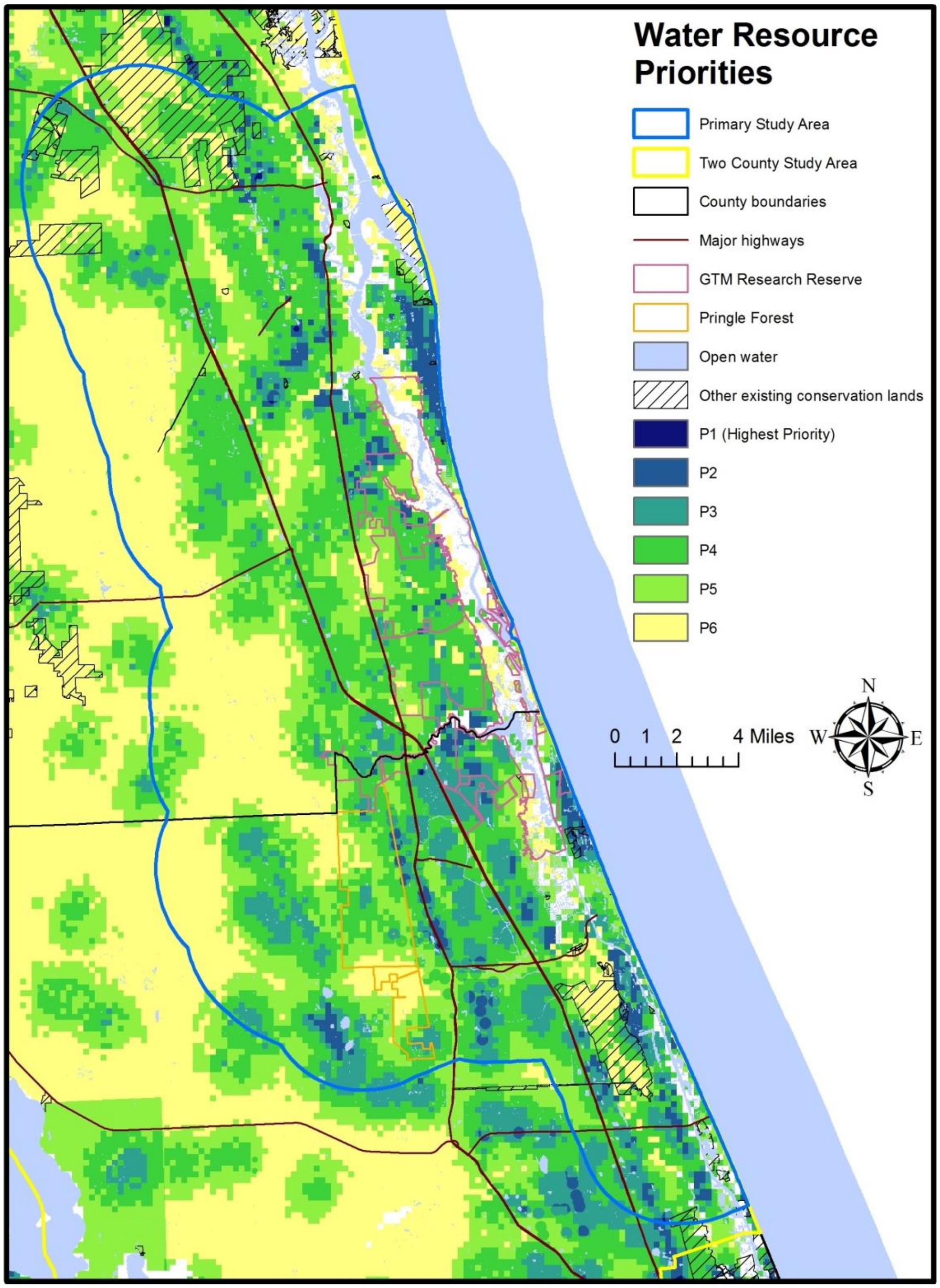

Figure 7. CLIP Groundwater recharge priorities, where the dark blues and blues represent the highest priorities and the greens represent moderate priorities.

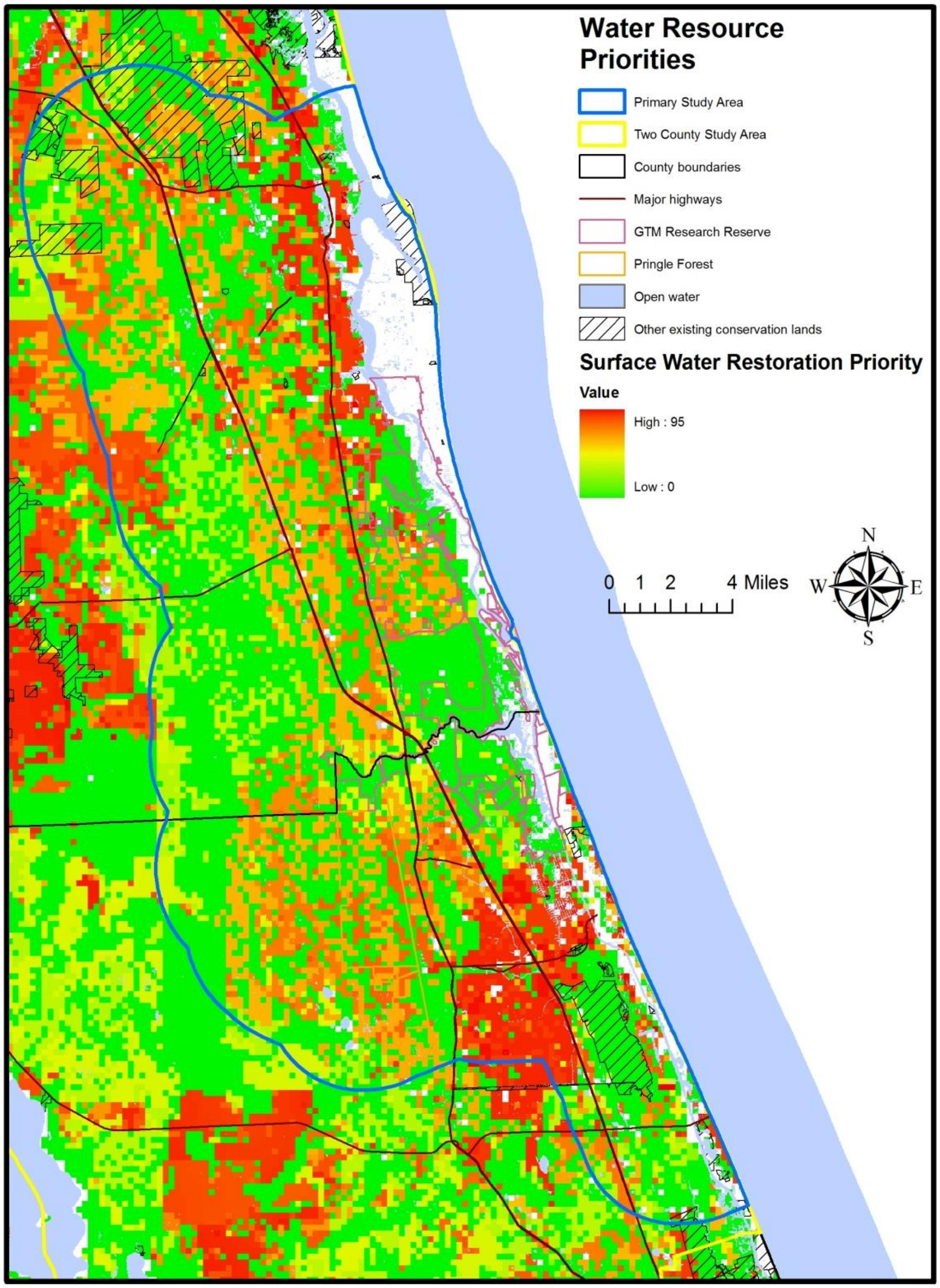

Figure 8. Surface water restoration priorities, where the reds and oranges represent areas where various types of restoration, retrofitting, best management, or other water management activities could significantly improve impaired water bodies.

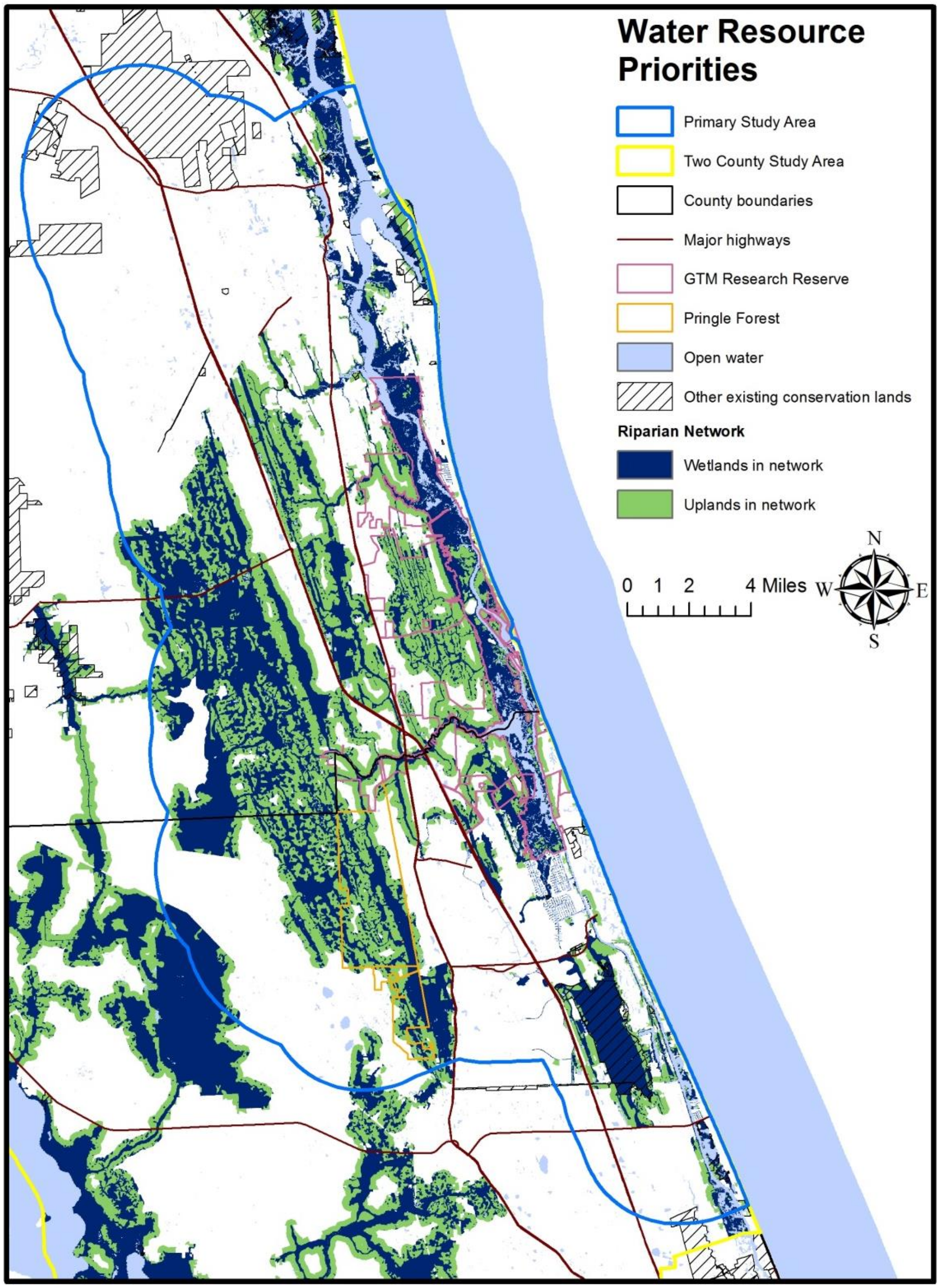

Figure 9. Riparian networks: all areas in dark blue or green are most important for protecting the integrity of the freshwater inflows to primarily the Matanzas River estuary (except for the portions of the network furthest to the west that flow into the St. Johns River). Maintaining or improving water flows with natural levels of nutrient (nitrogen and phosophorous) is critical for maintaining or improving the resistance and resilience of salt marshes to sea level rise.

e. Biodiversity Hotspot Impact Analyses

Analyses of the impacts from sea level rise and land use change indicate a moderate to high degree of impact. Under 1m sea level rise, coastal Priority 1 and 3 lands are most impacted, whereas under a 2.5m sea level rise scenario, coastal Priorities 1, 3, and 5 are most highly impacted. Again, "impacts" in this analysis refers to any biodiversity priority that changes to open water or wetlands under a sea level rise scenario. SLAMM analyses show that there actually may be significant conversions of upland areas to coastal wetlands in the areas shown to be "impacted" in this analysis, meaning that they may still support some level of biodiversity.

The total acreage of biodiversity priorities impacted by future development in this analysis under 1m and 2.5m sea level rise is fairly similar, probably reflecting the fact that inland development is responsible for the majority of the impacts. In both scenarios, Priority 3 and 4 lands are most greatly impacted by development. This occurs primarily in the upland areas west of Interstate 75, but also in the upland areas around Palm Coast and St. Augustine. Table 9 and Figures 10-12 illustrate these results. Figure 10 shows current biodiversity priorities identified by the CLIP 3.0 dataset.

Based on these analyses, future priorities for protecting biodiversity could be focused in several ways. One important recommendation is to manage existing lands important for biodiversity to maintain resiliency in the face of climate change. In terms of future conservation priorities, priority could also be place on upland areas adjacent to the GTM, which have less risk of being impacted by sea level rise, but are potentially at risk from future development. Other strategies include minimizing the impacts of any future development on the highest priority areas for biodiversity. We have good data for identifying these areas, but they are often ignored in the land use planning process at the local and regional scales.

Table 9. Impacts to Biodiversity Priorities from Sea Level Rise and Land Use Change

CLIP Biodiversity Value	Existing Acres	Acres Impacted by Sea Level Rise	Percent Impacted	Acres Impacted by Future Development	Percent Impacted	Total Acres Impacted	Total Percent Impacted
Impacts to Biodiversity Priorities from 1m Sea Level Rise							
Priority 5	2,604	87	3%	343	13%	430	17%
Priority 4	16,895	417	2%	3,466	21%	3,883	23%
Priority 3	35,992	2,102	6%	7,393	21%	9,495	26%
Priority 2	34,324	470	1%	4,228	12%	4,698	14%
Priority 1-Highest	3,966	300	8%	420	11%	720	18%
	93,781	**3,375**	**4%**	**15,850**	**17%**	**19,225**	**21%**
Impacts to Biodiversity Priorities from 2.5m Sea Level Rise							
Priority 5	2,604	264	10%	318	12%	582	22%
Priority 4	16,895	1,477	9%	3,365	20%	4,842	29%
Priority 3	35,992	5,364	15%	7,352	20%	12,716	35%
Priority 2	34,324	2,259	7%	4,194	12%	6,453	19%
Priority 1-Highest	3,966	1,324	33%	385	10%	1,709	43%
	93,781	**10,687**	**11%**	**15,614**	**17%**	**26,301**	**28%**

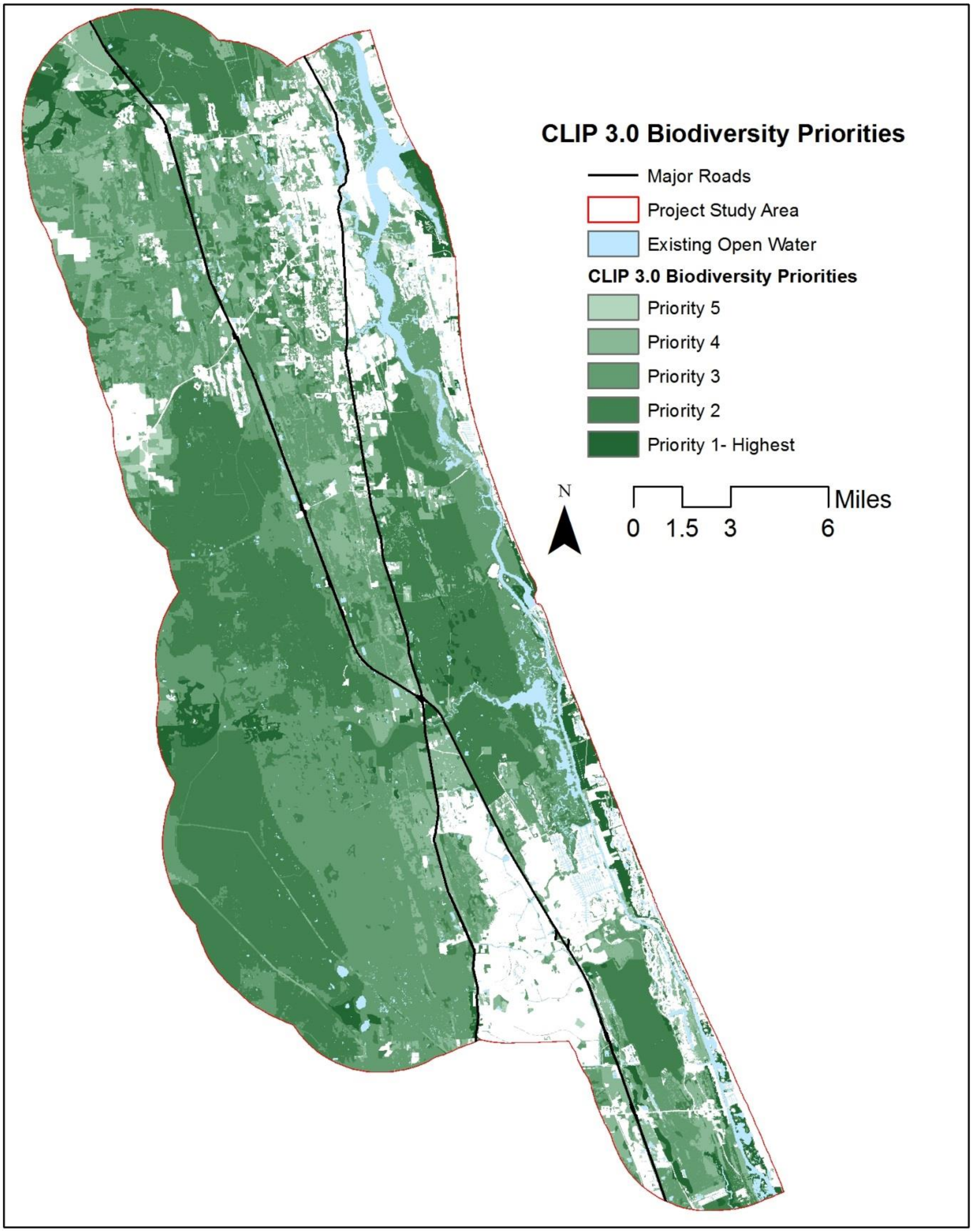

Figure 10. Current CLIP Biodiversity Priorities, where the darker the green, the higher the priority.

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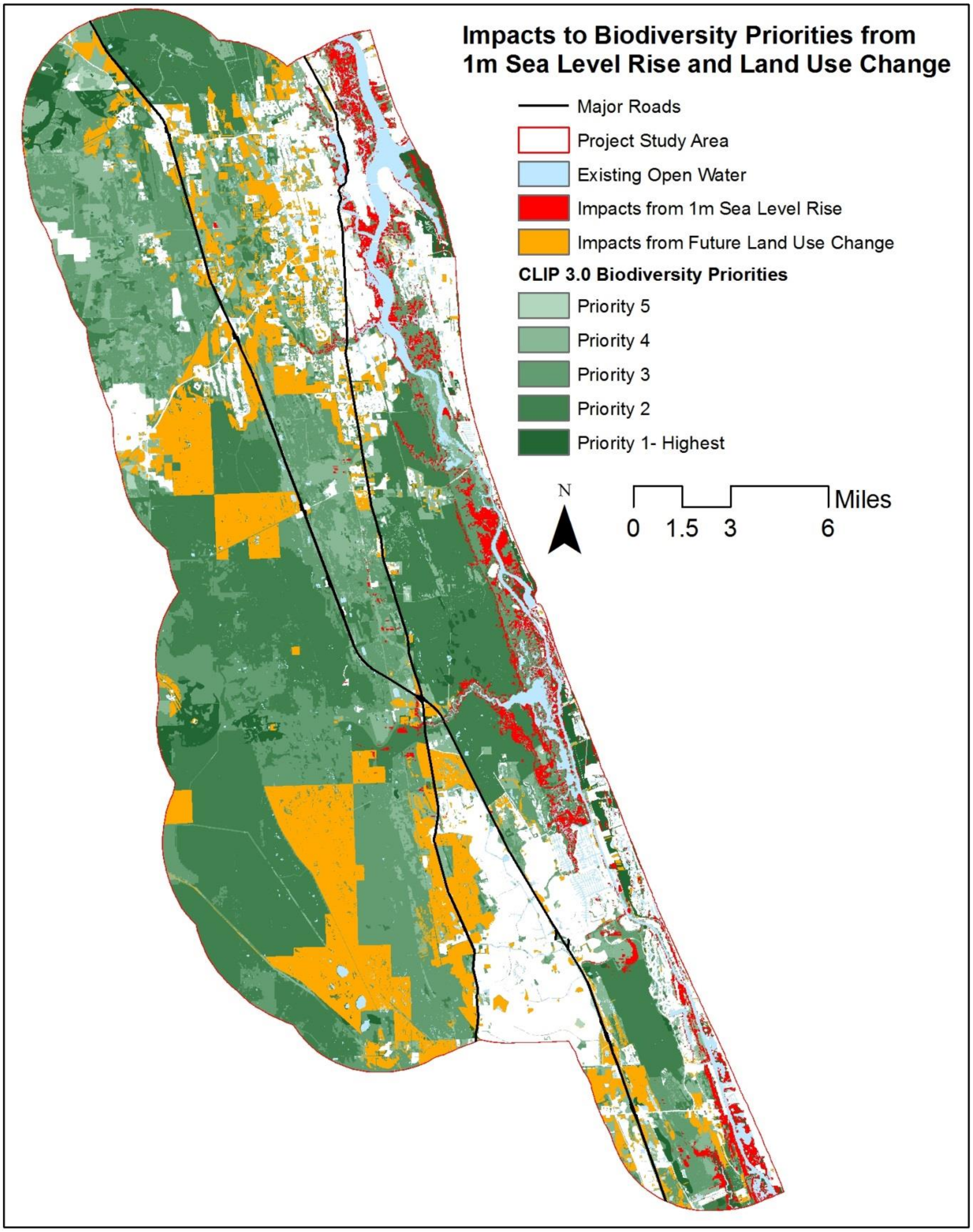

Figure 11. Impacts from 1m Sea Level Rise and Future Development on Biodiversity Priorities

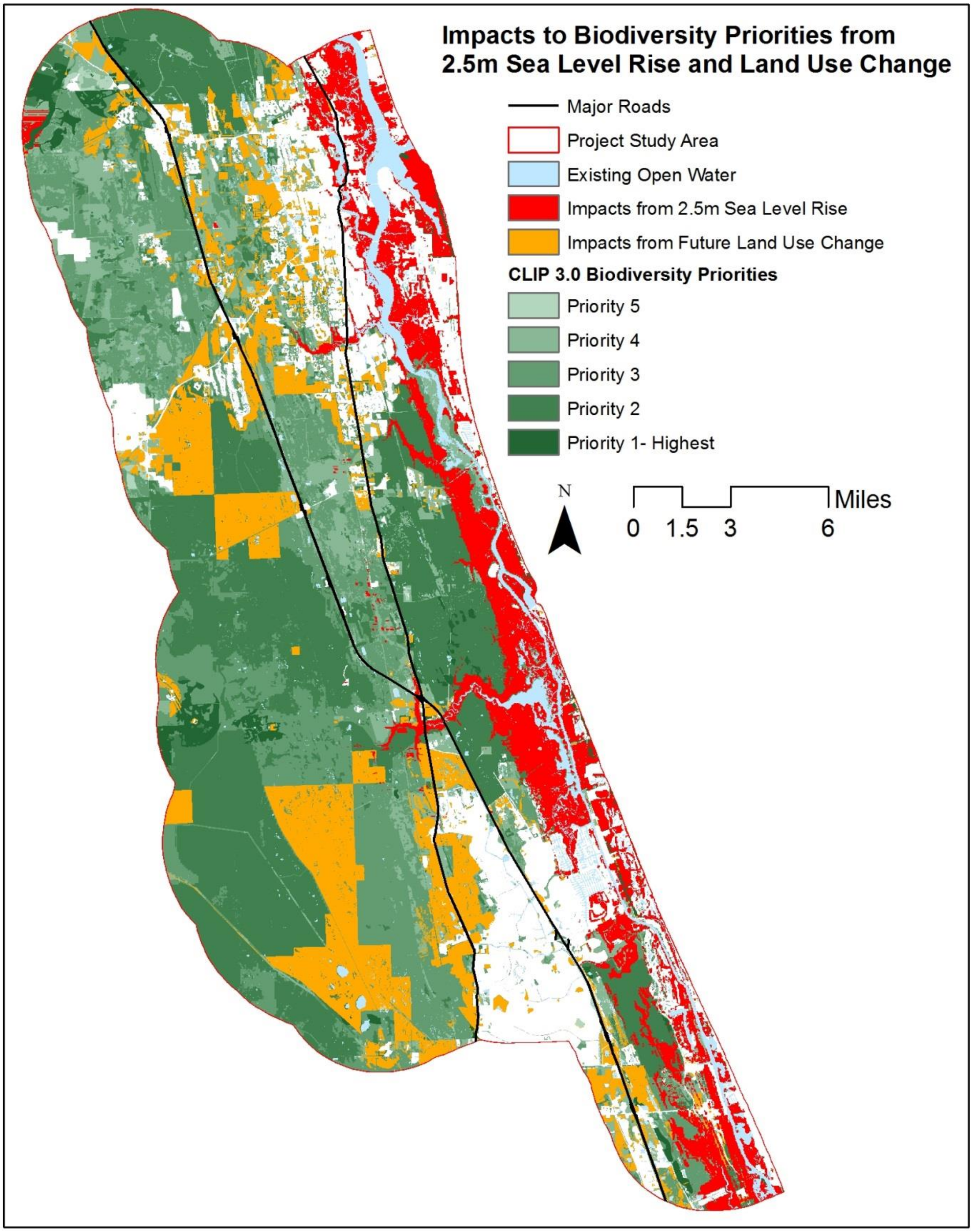

Figure 12. Impacts from 2.5m Sea Level Rise and Future Development on Biodiversity Priorities

e. Estuarine Habitat Impact and Priority Analyses

Figures 13-14 show various classifications of estuarine habitat resulting from 1m and 2.5m sea level rise including 1) existing estuarine habitat lost to sea level rise, 2) existing estuarine habitat that remains after sea level rise, 3) existing uplands that convert to estuarine habitat as sea levels rise (i.e. future estuarine habitat), and 4) future estuarine habitat contiguous with areas of existing estuarine habitat projected to remain after sea level rise.

Table 10 shows the overall acreage of each of the classifications described above within the project study area. Note that "N/A" is listed in the row identifying development impacts on existing habitat impacted by sea level rise, since it is assumed that areas impacted by sea level rise are not also impacted by development.

Table 10. Estuarine habitat resulting from sea level rise

Habitat Type	Total Acres Within Project Study Area	Acres Impacted by Future Development	Acres Within Existing Managed Lands
Estuarine Habitat after 1m Sea Level Rise			
Existing Estuarine Habitat Lost to SLR	3,751	N/A	1,661
Existing Estuarine Habitat that Remains	10,460	11	6,338
Future Estuarine Habitat Not Contiguous with Existing	898	27	190
Future Estuarine Habitat Contiguous with Existing	2,319	11	1,084
Estuarine Habitat after 2.5m Sea Level Rise			
Existing Estuarine Habitat Lost to SLR	13,726	N/A	7,818
Existing Estuarine Habitat that Remains	935	19	370
Future Estuarine Habitat Not Contiguous with Existing	4,227	461	812
Future Estuarine Habitat Contiguous with Existing	9,495	311	5,210

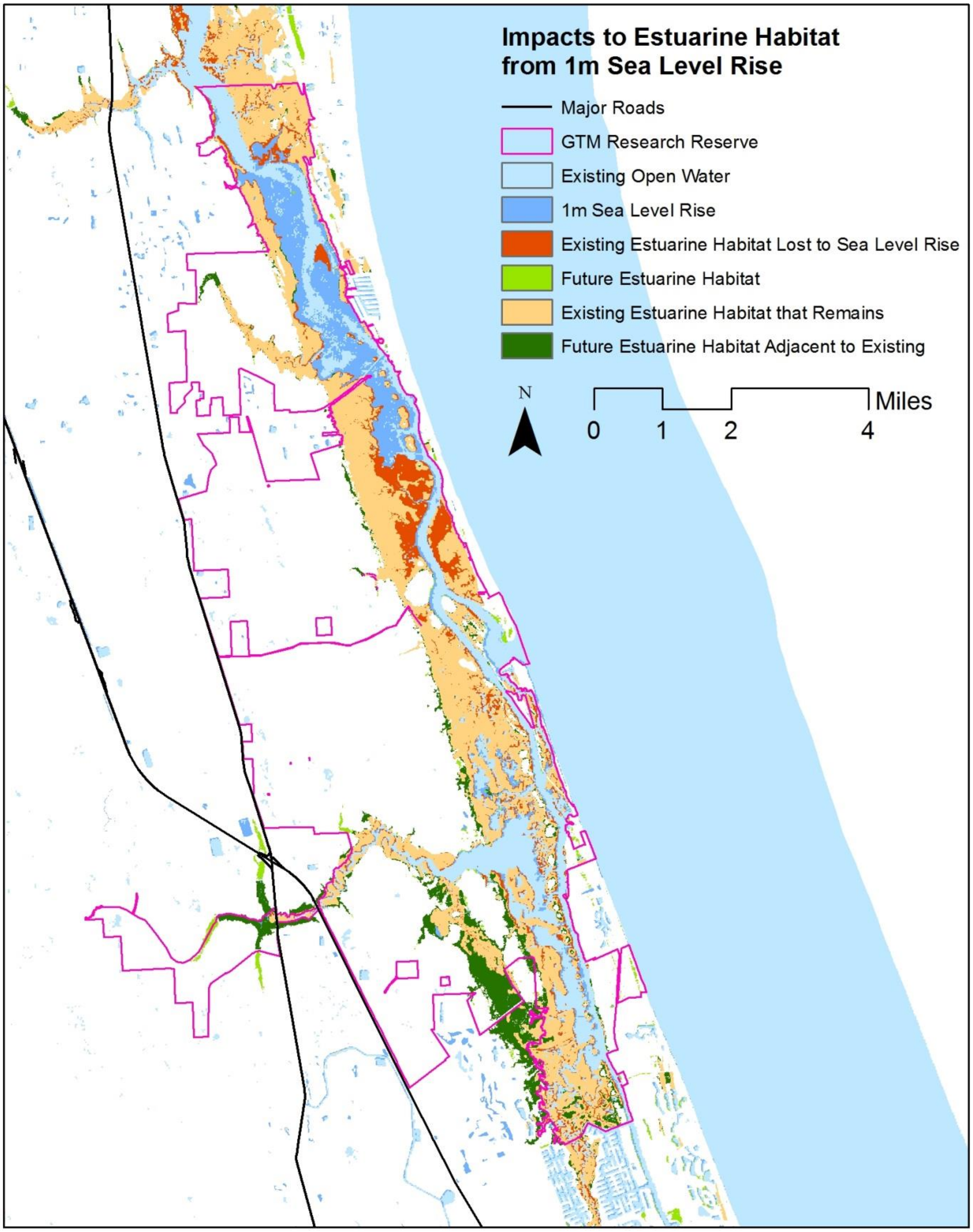

Figure 13. Estuarine Habitat Resulting from 1m Sea Level Rise

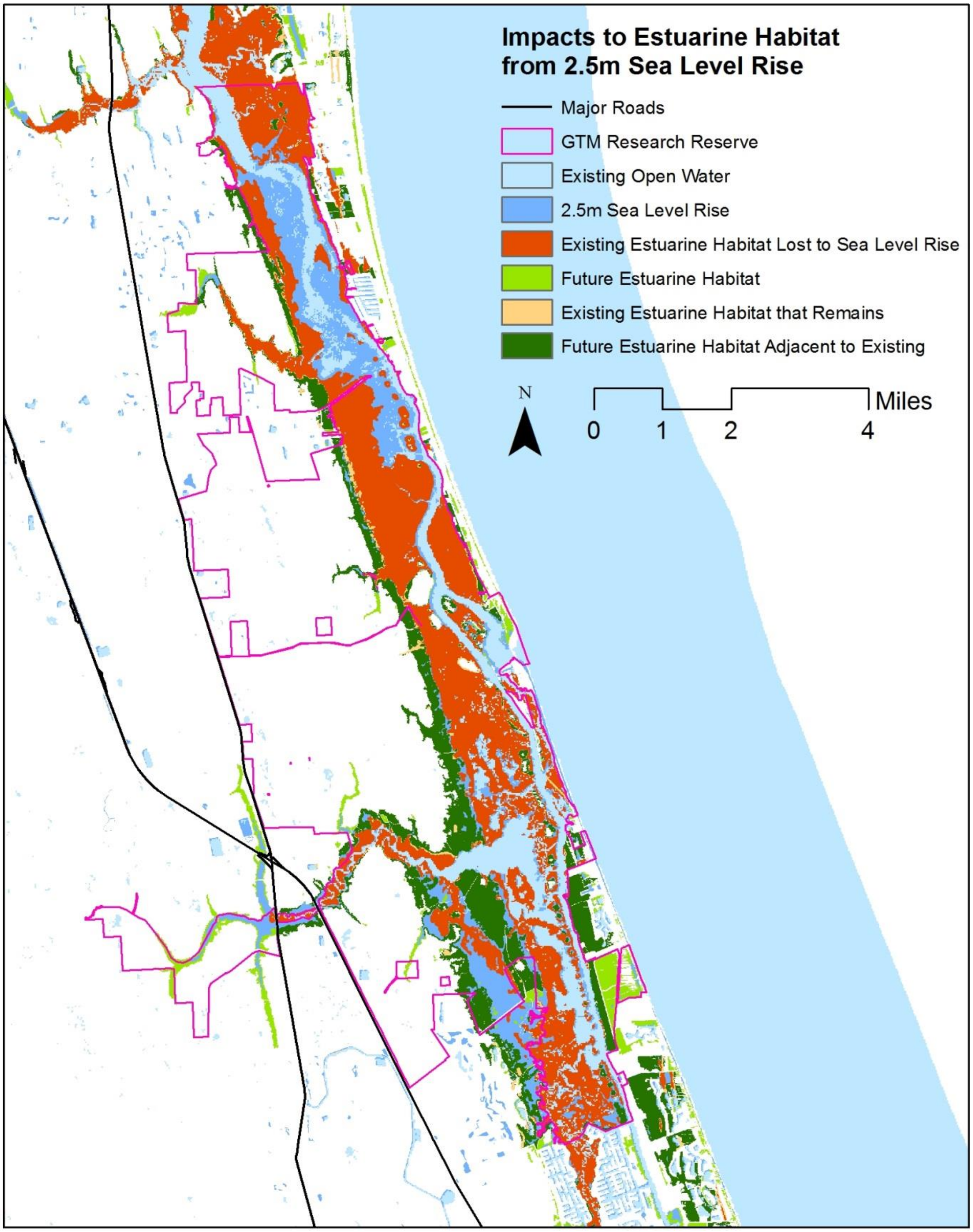

Figure 14. Estuarine Habitat Resulting from 2.5m Sea Level Rise. It should be clear from this map that at a 2.5m SLR there will be almost complete "turnover" in estuarine wetland habitat, which means that virtually all current habitat will be lost and potentially replaced by newly created habitat in areas that are currently uplands.

Based on these data, areas of future or existing estuarine habitat that remains after sea level rise were identified in the following categories: 1) within the existing GTM, 2) outside of current GTM boundaries, but contiguous with the existing GTM, 3) within 1 mile from the GTM, 4) within the project study area but not contiguous with the GTM and further than 1 mile from existing GTM lands. Figure 15 shows the results of this analysis in lands proximal to the GTM. The results show that existing GTM lands protect a large amount of the important future or existing estuarine habitat in the region. However there are several relatively large patches of future or existing habitat projected to remain after 1m sea level rise that are contiguous with existing GTM lands and unprotected by current conservation areas. These include a large patch of existing habitat that borders the north edge of the GTM, a smaller patch to the south of the GTM surrounded by developed lands, and a large patch that is projected to be future estuarine habitat on the southwest edge of the GTM. There is also at least one large area of existing or future estuarine habitat, which will no longer be contiguous with the GTM after sea levels rise and is beyond the 1 mile radius from the GTM, but could be important for protecting riparian habitat just to the west of St Augustine Shores. These areas are circled in red on Figure 15.

These results can be used to make decisions about estuarine habitat conservation priorities in several ways. For example, management of existing habitat that will be lost to sea level rise is important for maintaining resilient populations of focal species within estuarine habitat, as well as maintaining estuarine based ecosystem services to the greatest extent possible. Conservation of existing estuarine habitat that is projected to remain in place as sea levels rise is potentially the safest bet for maintaining these natural communities, since land cover changes in response to inundation, saltwater intrusion, and other coastal changes are difficult to predict and SLAMM model results are by any account only an approximation of what may occur. Conservation of future estuarine habitat and especially future estuarine habitat adjacent to existing habitat may provide coastal to inland retreat options for estuarine species and natural communities. However it should be noted that our identification of future estuarine habitat that is contiguous with existing habitat does not take into account the length of the border where these two habitat categories meet. For example, it may be possible to have a very large area of future estuarine habitat that is only tangentially connected to existing habitat in one small location. Therefore it may be important to also consider the length of the border shared between existing habitat and areas projected to be future habitat, and potentially to give higher priority to future habitat that has the longest edge in common with existing.

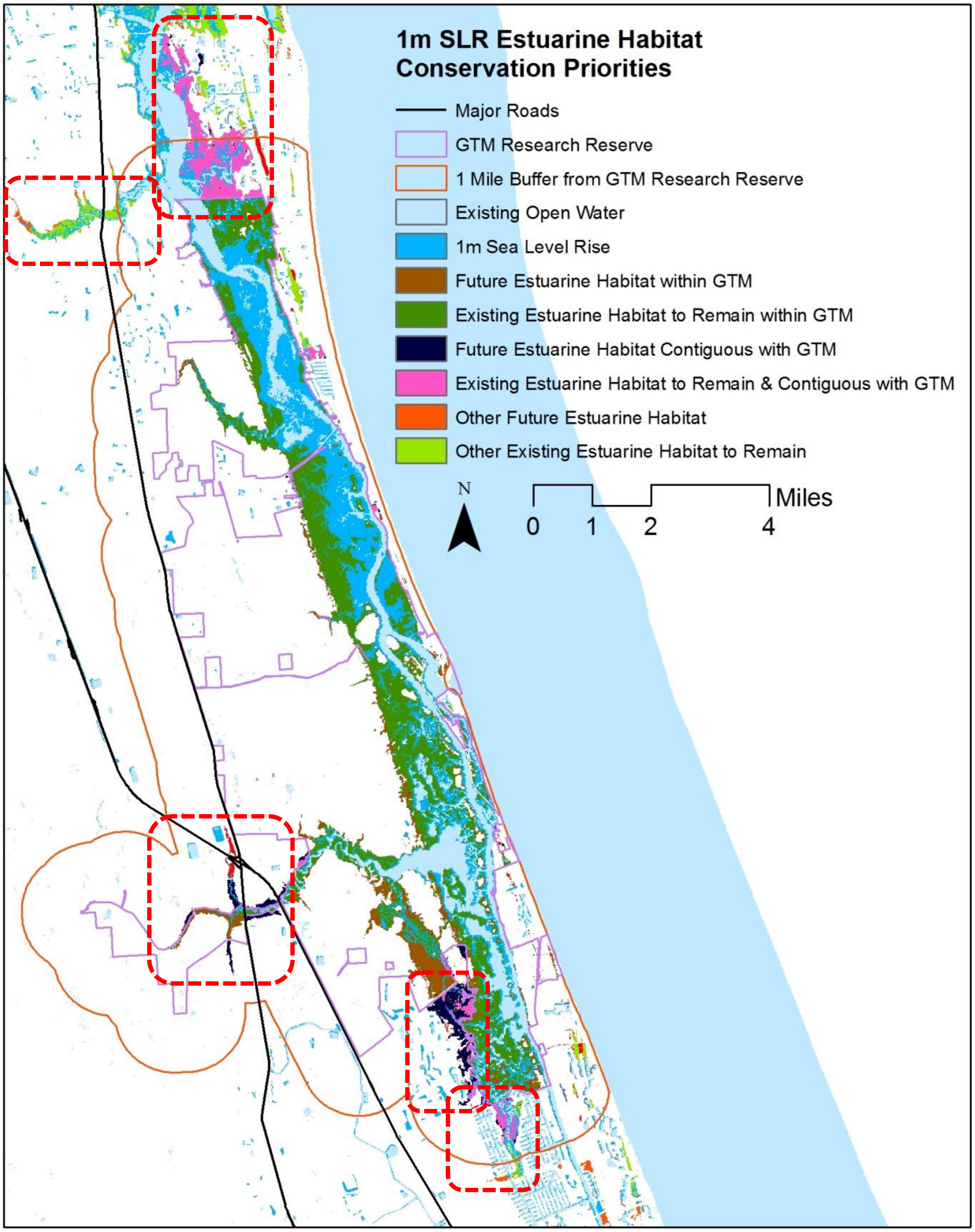

Figure 15. Estuarine Habitat Priorities Proximal to the GTM. *Areas circled in red are those described in the text as potential priorities.*

f. Reserve Scale Conservation Aggregated Priorities Analysis

Figures 16-17 show the reserve scale priorities that were developed based on the aggregation of all primary habitat for focal species directly connected to the reserve and within a 1 mile buffer from the reserve. The identification of areas directly connected to the GTM disregarded potential fragmentation by roads. However road fragmentation is an important consideration, and lands separated from the existing GTM by roads could potentially be considered a lower priority than those that are completely contiguous- particularly major roads such as Interstate 95 or US Highway 1. These results indicate that there are still ample opportunities to conserve focal species habitat around the current GTM to expand the current amount of protected habitat (and potentially increase focal species population size) or to mitigate the impact of SLR as current habitat is either lost to various focal species within the current GTM boundary.

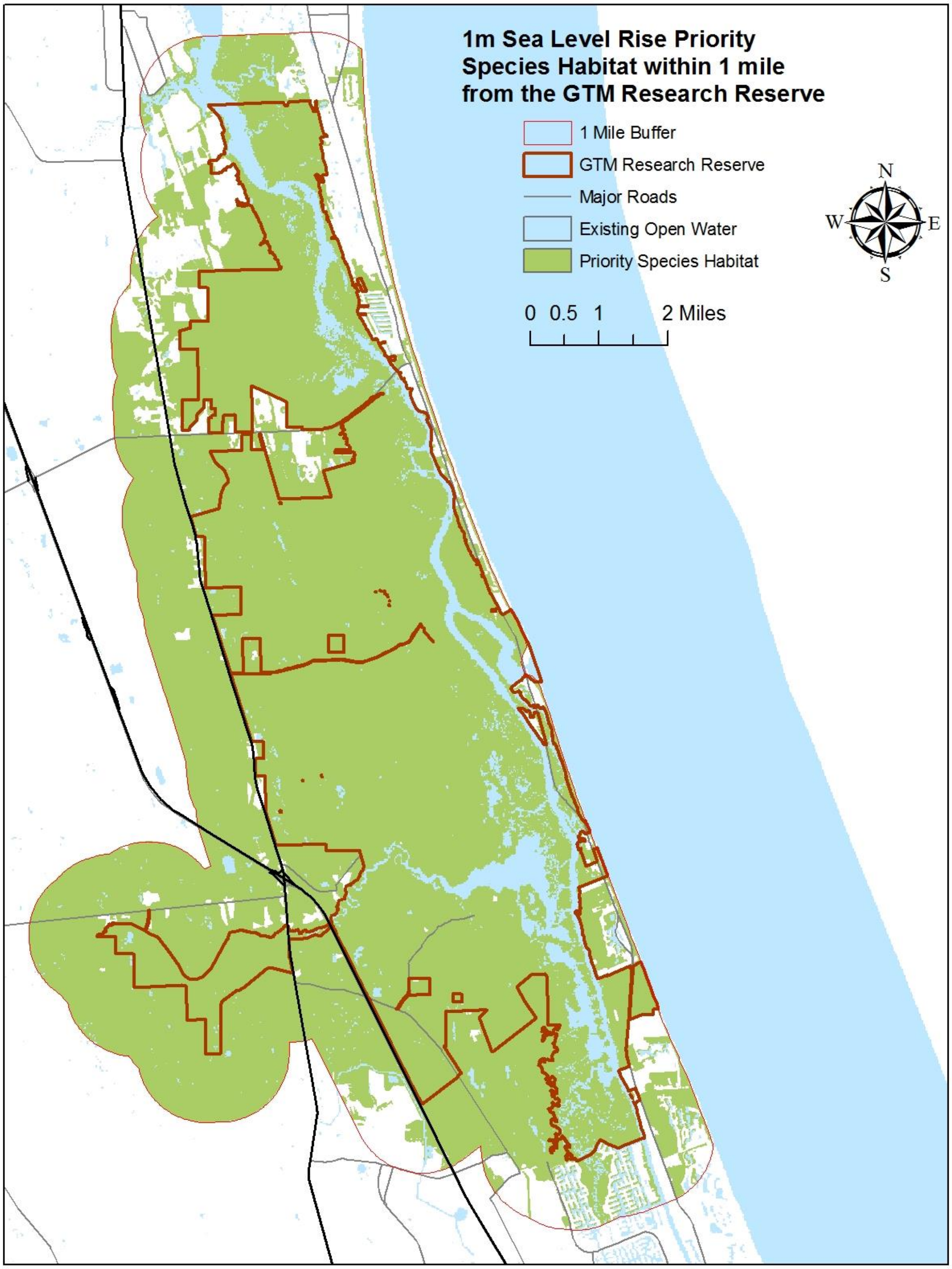

Figure 16. 1m Sea Level Rise Priority Species Habitat within 1 mile of the GTM Research Reserve

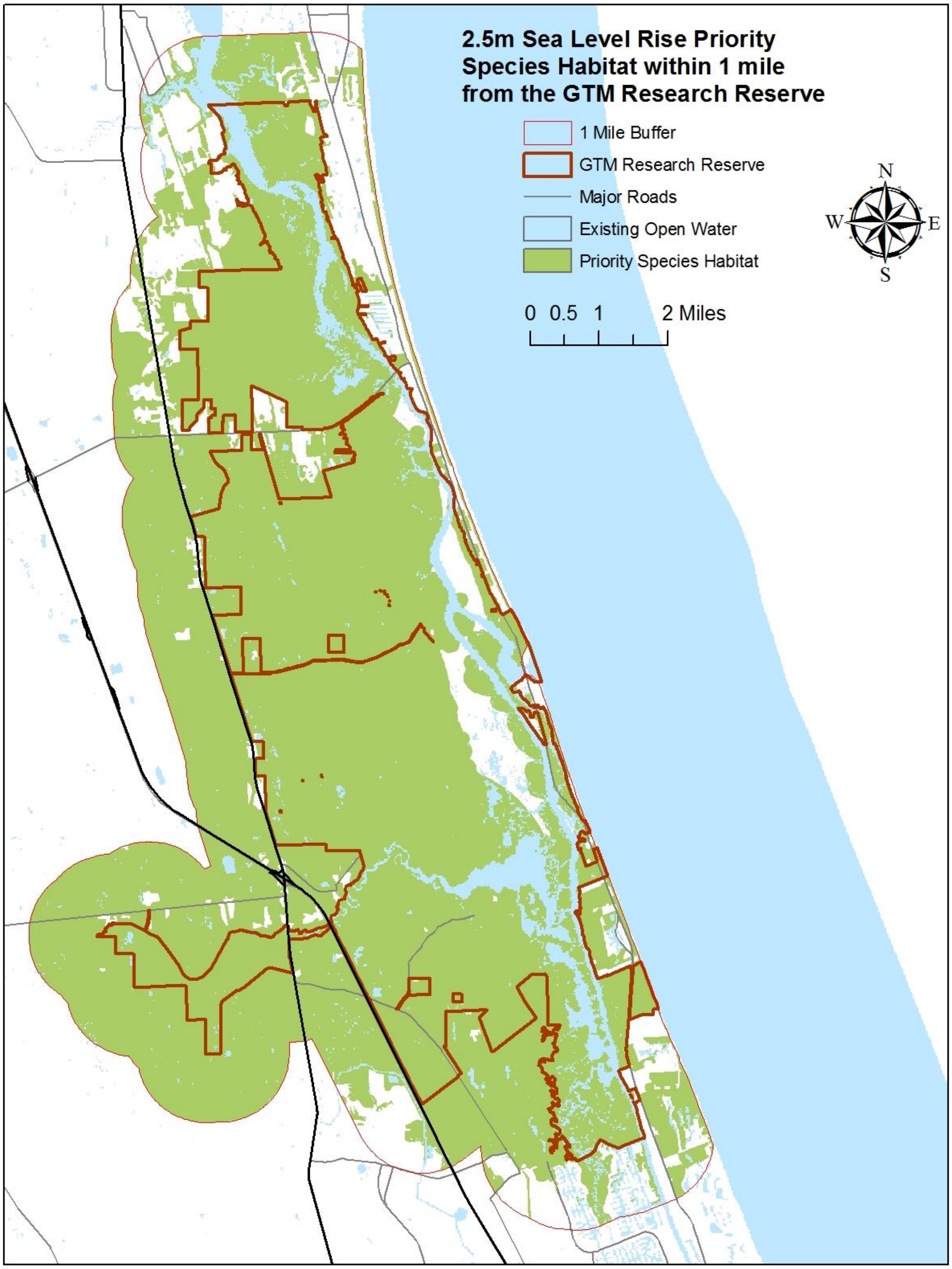

Figure 17. 2.5m Sea Level Rise Priority Species Habitat within 1 mile of the GTM Research Reserve

g. Regional Conservation Priority Analysis

Regional scale conservation priorities were developed for the study area to identify a regional conservation priority context for the GTM as well as to serve as a data resource for helping to guide conservation planning within the study area. We have provided maps of each of the individual data layers in Appendix F with the combination of all layers into the Regional Conservation Priority Aggregation provided in this section (Figures 18-19). The data aggregation is intended to provide regional context for our more specific corridor, species habitat, and natural community priorities for the GTM, and allowed us to incorporate data created through statewide analyses (such as CLIP and the FEGN) into broad priorities for the two county region including and surrounding the Matanzas basin. The aggregation makes clear that there are still areas of broad, landscape-scale conservation priorities in the study area despite significant development pressure in the region. This includes the opportunity to protect a functionally connected ecological network incorporating the GTM and other existing conservation lands from southeastern Duval County south to central Flagler County and west to the eastern edges of the St. Johns River as well as across the river to the Ocala National Forest. Though these data should only serve as a general guide to conservation and land use planning in the two county region, it indicates significant potential for development impacts in rapidly growing areas including north St. Johns County. These priorities could be used as a general guide to emphasize green infrastructure based planning to maximize protection of biodiversity and ecosystem services while accommodating future development in the areas with the least impact on these critical natural resources.

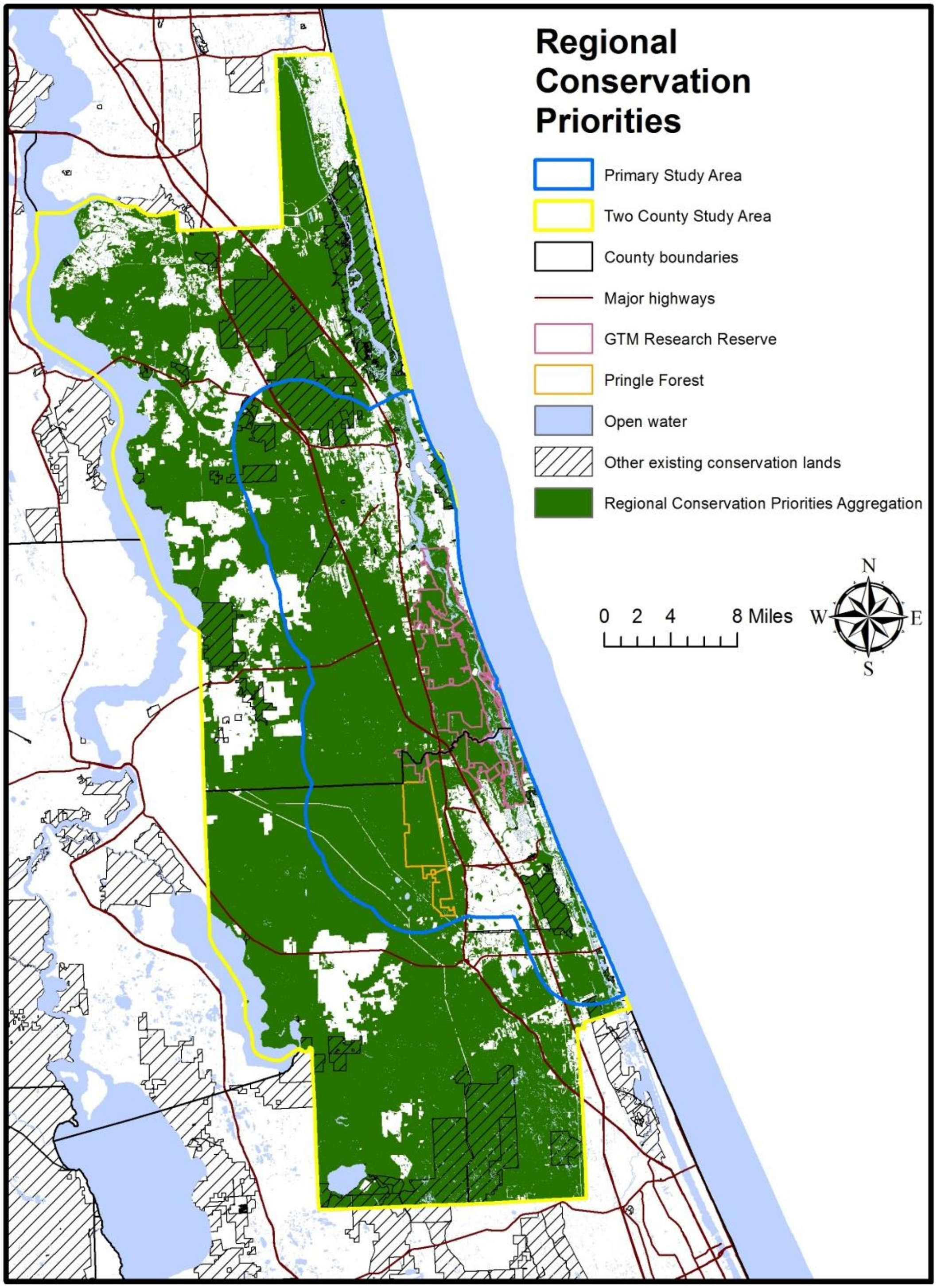

Figure 18. The two county regional conservation priorities based on various statewide data layers identifying biodiversity, wildlife corridor, and ecosystem service priorities. These results indicate that there is still an ample and very significant green infrastructure in the region, and these data should be used as a general guide for avoiding and minimizing the impact of future development on this important natural resources.

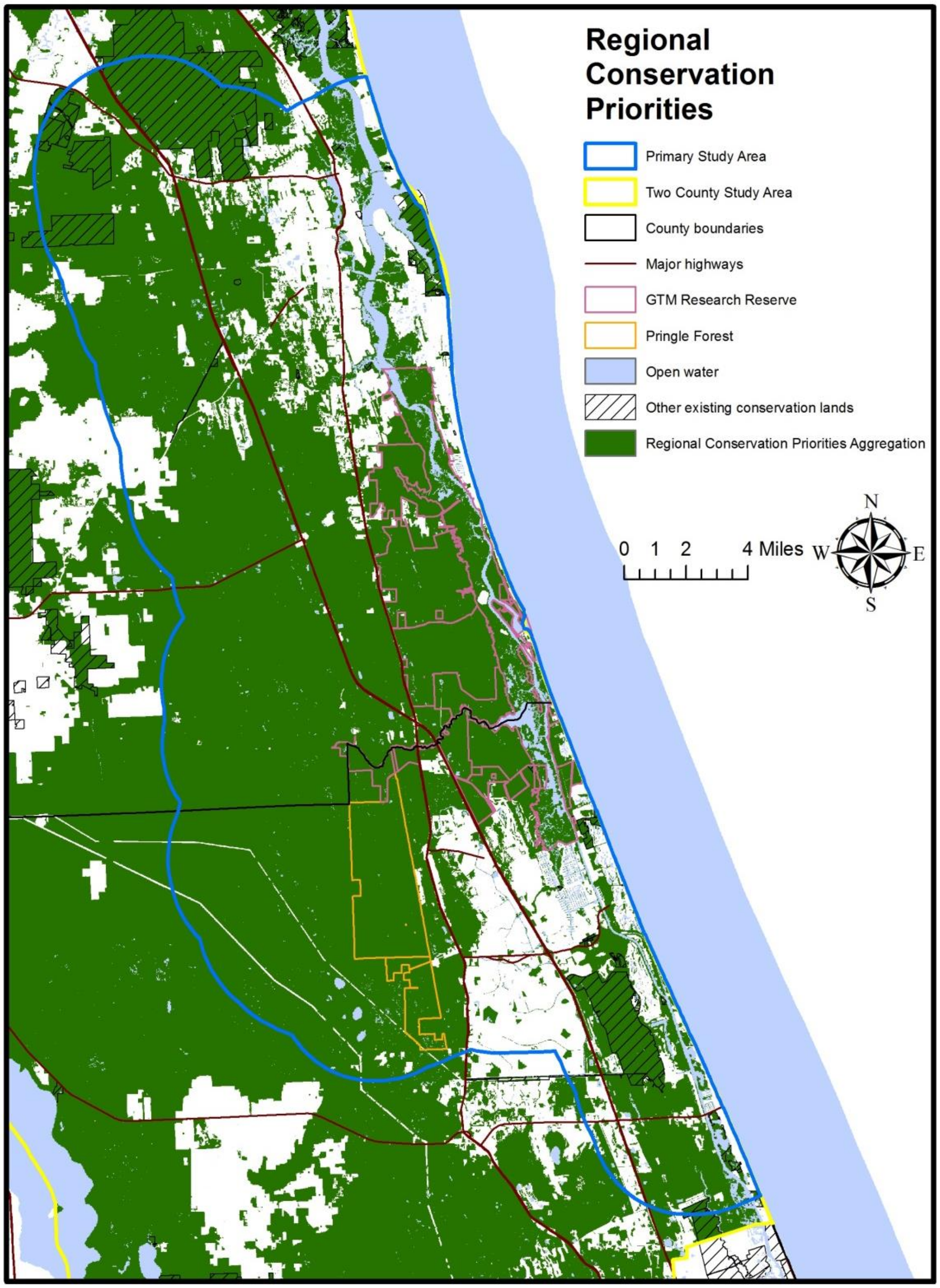

Figure 19. Regional conservation priorities zoomed to the Matanzas basin.

h. GTM Coastal to Inland Connectivity Analysis

The GTM coastal to inland connectivity analysis is intended to augment state identified wildlife corridors (the FEGN) to ensure that opportunities for inland retreat from Matanzas are maintained and regional ecological connectivity is achieved to help facilitate the conservation of various focal species in an era of climate change and ongoing development. The Princess Place tract within the GTM reserve was used as a central location to serve as the source for all connectivity analyses. Three existing conservation land destinations were selected to represent north, west, and southern connectivity options and to represent a diverse and spatially expansive regional ecological network. These destinations were Twelve Mile Swamp to the north, the Ocala National Forest to the west, and the Relay Tract in Flagler County to the south. The results of these corridor analyses are similar to the corridors within the Florida Ecological Greenways Network; however, they more specifically address ecological connectivity between the GTM and other existing conservation lands in the region (Figure 20-21). These opportunities are all currently still feasible; however the fast pace of growth and the minimal consideration of the importance of corridor in the northern portion of St. Johns County and southeastern Duval County threaten to fragment the remaining corridor opportunities, which would isolate what is currently the northernmost portion of the Ocala-St. Johns Florida black bear population still found in the Twelve Mile Swamp Conservation Area and remaining undeveloped lands connected to it. The corridor to the Relay Tract in Flagler County is threatened by DRIs and other potential future development west of I-95. The corridor to the Ocala National Forest is most threatened by low density development in the southeast corner of Putnam County on the east side of the St. Johns River.

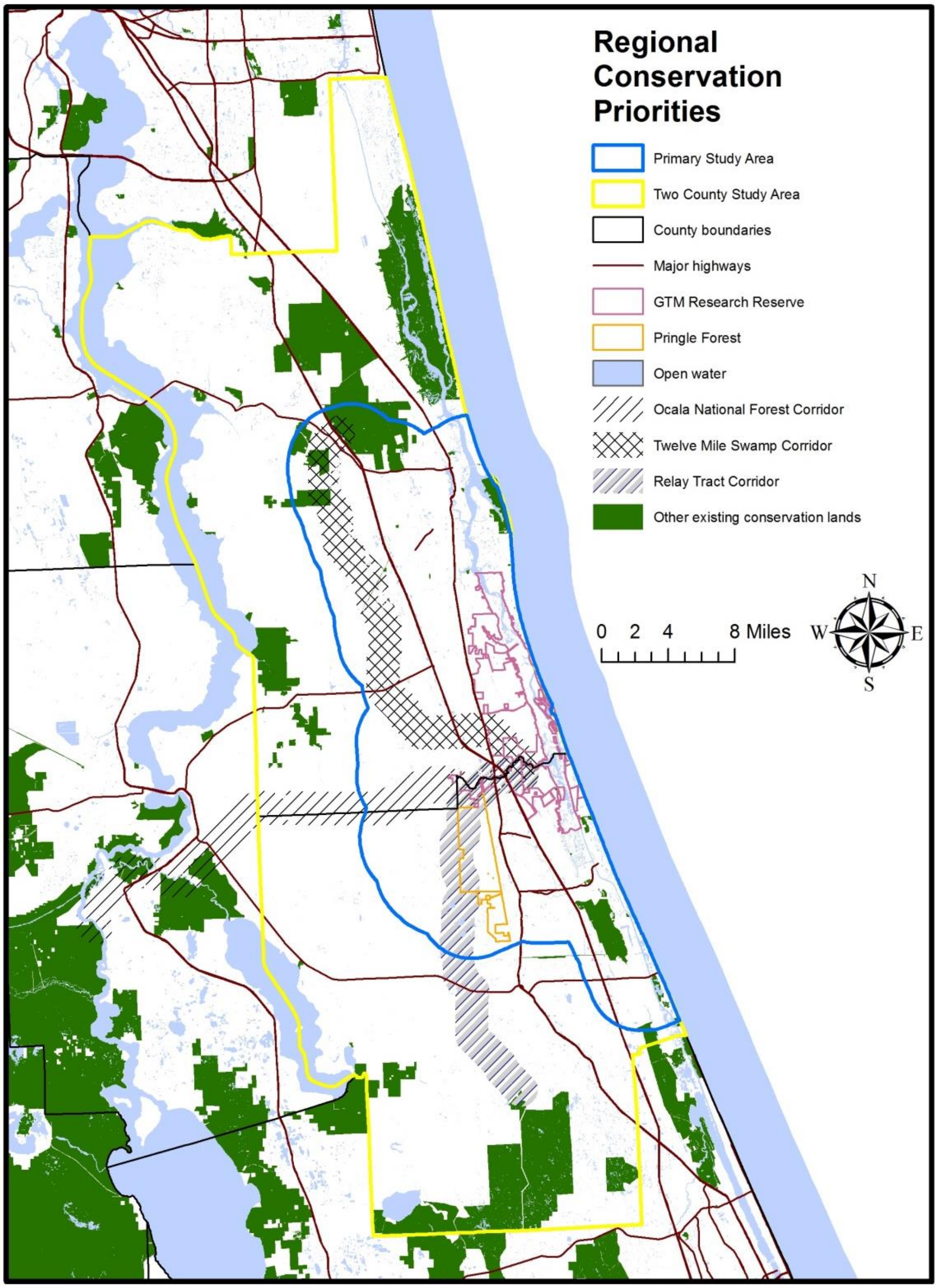

Figure 20. GTM coastal to inland connectivity analysis

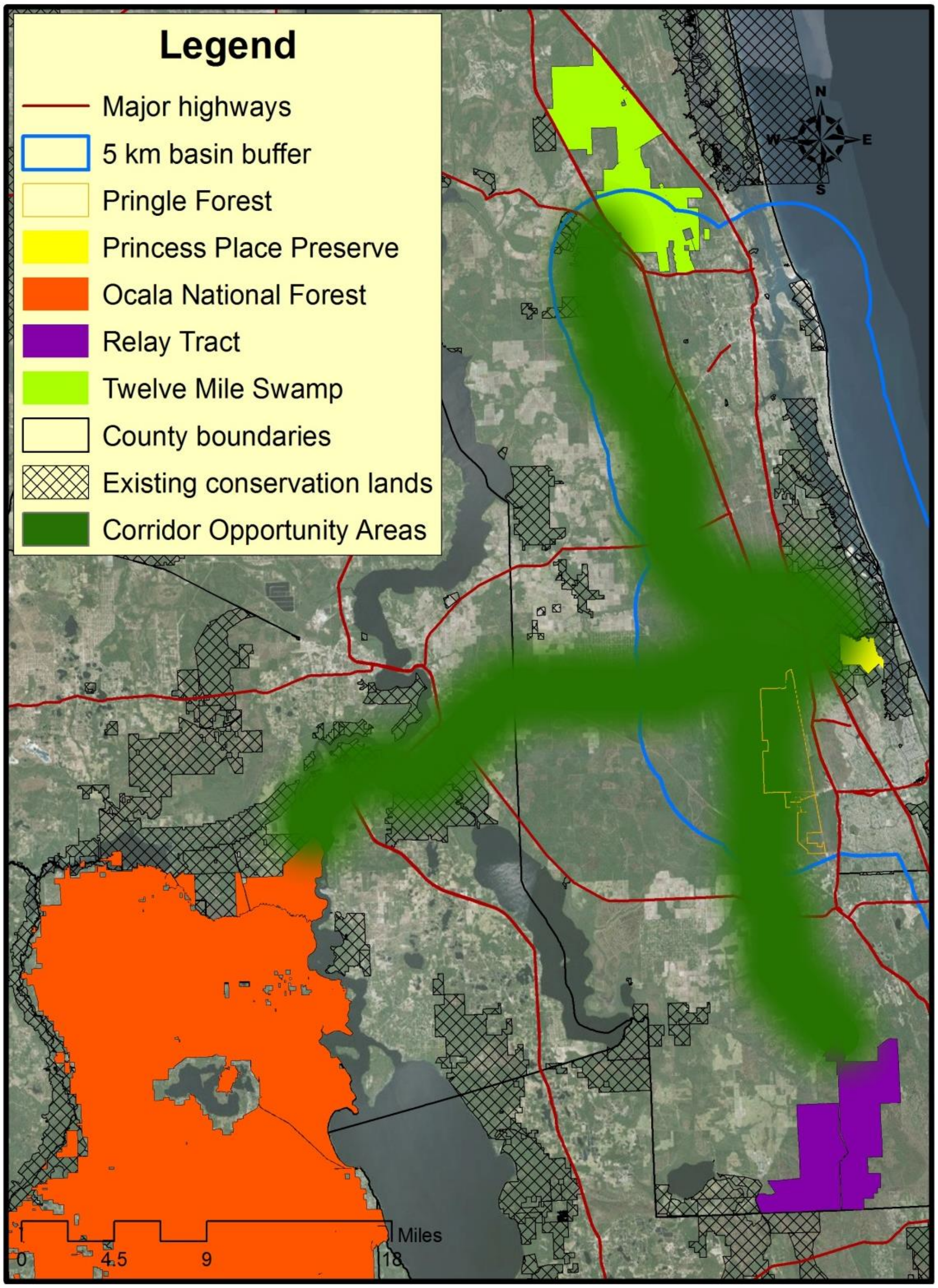

Figure 21. GTM coastal to inland connectivity analysis with less explicit corridor identification

4. DISCUSSION

This project provides assessments of impacts from 1m sea level rise, 2.5m sea level rise, and projected future development on focal species, natural communities, and water resource priority areas in the region surrounding the GTM. In addition, available state GIS data layers were used to identify regional conservation priorities to serve as a context for GTM conservation planning and management, and also to potentially guide land use planning in the region surrounding the reserve. We also developed focal species specific habitat priorities near the GTM to guide opportunities to mitigate the loss of focal species habitat from SLR within the reserve. Finally, we identified best potential opportunities to functionally connect the GTM with other existing conservation lands in the region. These analyses and GIS data layer products should serve as a strong foundation for future planning efforts to minimize and mitigate the impacts of sea level rise and potential future development on the focal species and ecological systems in and around the GTM to support the goal of facilitating adaptation to sea level rise and related land use change. These analyses should also serve as a guide for similar efforts in other coastal landscapes.

The scope of the species and ecological impact assessment and conservation analyses and recommendations evolved over the life of the project. This included adding more detailed species-specific information, natural community impacts, and ecosystem service measures in the form of water resource priority data to augment the original focus on potential impacts to, and opportunities to maintain or enhance, ecological connectivity from coastal ecosystems to inland ecosystems as sea level rise progresses. These analyses provide users of the report and database the ability to identify current conservation priorities for biodiversity and water resources, identify conservation priorities that will remain after sea level rise impacts, and additional conservation priorities for mitigating, or adapting to, the impacts of sea level rise. The results of our work make clear that there are very important opportunities to:

1) Protect ecological connectivity at the regional landscape scale from the GTM to inland conservation priorities west, southwest, and northwest of the GTM. Major potential obstacles for protecting (and restoring) these ecological connectivity opportunities include the barriers created by two major highways, US 1 and I-95, just west of the GTM and potential funding for protecting the large private tracts of land needed to complete functional corridors. However, future transportation retrofits and funds from both Amendment 1 (if this funding is allocated as it was supposed to be in future state of Florida annual budgets) and potentially expanded incentives-based conservation programs could significantly assist these efforts. Future development also threaten all of these corridors and especially the corridor between the GTM and Twelve Mile Swamp Conservation Area where rapid growth in northern St. Johns County and southeastern Duval County threaten to cut off Twelve Mile Swamp (and the northernmost portion of the Ocala-St. Johns Florida black bear population) from conservation lands and large private timber lands to the south.

2) Protect landscape scale connectivity of existing and future saltmarsh, other estuarine natural communities, and ecotonal uplands adjacent to the reserve. Opportunities currently are available to protect estuarine habitat contiguous with the reserve that is projected to remain even as sea levels rise. There are also opportunities to protect areas that SLAMM models identify as *future* estuarine habitat contiguous with the GTM. This is particularly true at the northern and southern ends of the GTM, but also along Pellicer Creek. These areas of future or existing estuarine habitat contiguous with the reserve provide opportunities for expansion of the GTM, while protecting “no-regrets” areas of existing habitat, and/or areas of future habitat where saltmarsh and other estuarine communities might try to expand or retreat as sea levels rise. Protecting these areas provide the best opportunities to maintain function estuarine habitat as SLR progresses.

3) Mitigate loss of species habitat within the GTM caused by sea level rise by protecting additional habitat for these species adjacent or very near the GTM. There is significant available habitat adjacent or near the GTM for all species selected for species-specific analyses so that it is possible to add enough habitat to at least achieve no net loss of available habitat if the GTM is expanded to include these additional areas. In addition, we created a reserve-scale aggregated priorities data layer that provides additional landscape conservation priority information combined with species priorities to further assist conservation planning decisions in areas adjacent or near the GTM.

4) Consider protection and restoration of water resource priorities inland of the GTM to restore and maintain the function of the freshwater tributaries of the Matanzas River. The CLIP Surface Water Protection priorities data layer shows important tributary buffers and watershed protection areas for maintaining the water quality and ecosystem function of the GTM and Matanzas River. The CLIP Groundwater Recharge data layer shows areas of important recharge and groundwater protection for the coastal surficial aquifer that likely provides seepage and other inflows to the freshwater tributaries of the GTM and Matanzas River as well as directly to the Matanzas River. The Riparian Network data layer identifies both wetland and upland buffers that are integral to maintaining hydrological processes (and habitat connectivity) in the watershed of each of the major freshwater tributaries of the Matanzas River. Finally, the draft CLIP Surface Water Restoration Priorities data layer shows more disturbed land use areas, including agricultural and developed land uses, where restoration of natural land cover, adoption of best management practices, or stormwater treatment retrofits (such as bioswales and low impact development practices) could have the most positive impact on improving water quality in impaired water bodies. All of these layers are relevant to efforts to protect or restore the water quality of inflows to saltmarsh ecosystems in and near the GTM, and research has shown that saltmarshes with higher quality freshwater inflows are less susceptible to degradation, likely resulting marshes that are more resistant to sea level rise than degraded ones (Deegan et. al 2012). Protection of all significant creeks into the Matanzas River also provides additional opportunities to allow for functional shifts in habitat from fresh to estuarine including functional connectivity for species moving along these gradients as SLR progresses.

Though these more detailed impact assessments and conservation recommendations do provide valuable information for future planning efforts in and around the GTM, there are limitations including:

1. Species analyses were only for terrestrial (and terrestrial nesting) species due to available data and focus on terrestrial connectivity. Therefore, though impacts to aquatic species could be significant as sea level rise progresses, assessment of these impacts was beyond the scope of this project. However, some of the potential impacts to estuarine and marine aquatic ecosystems can be inferred from our natural community impacts assessment, which indicate significant changes to estuarine wetlands that could impact both available habitat and energy/nutrient processes that will likely significantly change the structure and function of saltwater aquatic ecosystems in and around the GTM.

2. Potential habitat models used in this study are approximations of available habitat for selected focal species and can have significant errors of omission and commission. All habitat models used in this project have received significant vetting from species experts that should indicate that they can provide at least reasonable estimates of potential available habitat for all of our focal species. However, habitat maps and impact statistics are meant to only be a general guide to conservation and land use planning efforts, and do not replace more specific, field-based surveys and research of occupied habitat or habitat priority. If GTM staff moves forward with efforts to identify mitigation opportunities for specific focal species, data provided by this study needs to be augmented with field work before making land conservation decisions.

3. Though no net loss of protected focal species habitat is a legitimate measure for guiding future land conservation planning, it does not provide the same level or potential detail that would likely be provided by population viability assessments (PVAs). PVAs are data, time, and funding intensive, but they might be considered for a few appropriate focal species to determine what both the reserve-scale or regional landscape scale conservation priorities would be for ensuring that viable populations of focal species would be protected. As an example, though pursuing a no net loss of Florida black bear habitat within the GTM is a useful goal (if it is agreed that black bear habitat within the GTM is or likely could be relevant to Florida black bear conservation now or in the near future), protecting a viable population of bear will require the protection of large blocks of functionally-connected habitat in a multi-county area from southeastern Duval County to the north, Putnam County to the west, and Flagler County and Volusia County to the south.

4. A potentially major limitation of both the SLAMM analysis and the natural community and species impact assessments done in this project is a lack of consideration of conversion of saltmarsh ecosystems to mangrove ecosystems as global warming progresses. Field observations by GTM staff and others indicate that mangroves are increasing in areas south of the study area and within the study area itself. However, our results indicate changes in saltmarsh ecosystems based solely on the influence of sea level rise without considering potential conversion to mangroves as average air temperatures continue to rise. Therefore,

we may be significantly over-estimating the future extent of saltmarsh while significantly underestimating the future extent of mangroves. We have modeled potential habitat for various saltmarsh-dependent or saltmarsh-preferring species that might be significantly less common if mangrove habitat becomes much more common at the expense of saltmarsh. Therefore, a next step for both natural community and species-impact assessments would be to combine the results of the current project with future efforts to apply down-scaled climate models as well as improved or different process models (such as possibly an updated version of SLAMM) to consider both inundation and air temperature effects. This said, our models of estuarine habitat priorities adjacent to the reserve lump mangrove, salt marsh, and other estuarine natural community types into one group. Therefore these models should still be useful as indicators of general trends of estuarine habitat conversion, in spite of the lack of consideration of potential conversion of salt marsh to mangrove habitat within these areas.

5. An additional limitation of the SLAMM analyses is that it does not describe upland habitat type conversions, beyond showing uplands that convert to wetland habitat types or open water. Therefore as climate change occurs, upland ecosystem types could also change, affecting the suitability of these habitats for various focal species included in this project.

6. The Water Resource conservation priority data layers, except the Riparian Network data layer, are all based on fairly coarse, statewide models of surface and groundwater conservation priorities. Therefore, they likely lack the resolution to address specific hydrological protection and restoration that could provide a lot more detail about specific conservation actions to restore and maintain the Matanzas River watershed. One potential future research effort could include much more detailed hydrological process models to determine the most important intact and impaired inflows to the River and the areas where conservation or restoration would have the most impact on restoring ecological integrity. This could include a more resolute version of the CLIP Water Restoration priorities model run specifically for the GTM study area with more detailed input data and much smaller cell sizes. This could also include identification of specific wetland restoration/rehydration or dispersed water storage opportunities that would have the most impact on the level, timing, and quality of freshwater inflows to the River.

7. The regional conservation priorities developed for the study area were based on existing conservation data aggregation. To fully integrate sea level rise considerations in the planning process, a use of a reserve algorithm such as Zonation (Molianen et al., 2012) or Marxan (Possingham et al., 2000) to identify conservation priorities under sea level rise scenarios would be useful. Species habitat and natural community grids could be used as tools to identify areas of high ecological value. Future projected species habitat and natural communities under various sea level rise scenarios in the Matanzas study area could serve as inputs to identify conservation priorities in response to sea level rise and land use change. The conservation priorities identified based on reserve algorithms could be used to guide conservation land acquisition to facilitate adaptation of species and natural communities to sea level rise, as well as to augment existing conservation layers by

including spatially-explicit consideration of sea level rise. Doctoral student and graduate assistant for this project, Mingjian Zhu, UF Department of Landscape Architecture, completed his dissertation testing portions of this process (Zhu 2015). In this study, an integrated modeling process that incorporated a geomorphological model (SLAMM), habitat models (species habitat models) and spatial prioritization software (Zonation) was developed to identify conservation priorities in the face of landscape dynamics due to SLR and land use change. Comparisons of conservation priorities produced by Zonation with existing conservation areas and datasets in Florida suggest that existing conservation areas coupled with the protection of additional priorities identified in existing conservation datasets could protect a large proportion of conservation priorities in Florida necessary for adaptation to sea level rise. However, there are still some top priority areas excluded in the existing conservation areas and datasets that may be important to protect as sea level rises. Comparison of conservation priorities produced by Zonation with the Florida Ecological Greenways Network (FEGN) and the Critical Lands and Waters Identification Project (CLIP) show that the updated FEGN and CLIP could serve as a good foundation for future conservation decisions regarding SLR adaptation. Comparison of conservation priorities produced by Zonation with future development scenarios shows that some top conservation priorities important for adaptation to SLR will be threatened by future development. However, this situation could be avoided if growth patterns are changed through practices such as increased development densities.

8. Natural community and landscape scale priority analyses are solely based on ecological value assessments, such as importance for focal species habitat and landscape scale connectivity. Additional ecosystem service value assessments could be conducted to for example assess the economic value of various ecosystem types within and around the GTM, providing a stronger argument to the public for their current conservation. This could include assessment of storm protection priorities of existing and future natural habitats within and surrounding the GTM.

Although the conservation challenges stemming from future sea level rise and development pressures are great within the Matanzas basin, there are also tremendous opportunities still available for maintaining conservation priorities now and in the future. Assets within the region include the extensive areas already in conservation, the extensive and large tracts of silvicultural lands west of the reserve, and the strong organizational and outreach abilities of GTM staff within the region to advocate for future conservation. Continued work and action to maintain resilient ecosystems, acquire or protect new lands, avoid and minimize the impacts of future development, and implement best management practices in partnership with upland landowners, are all important and feasible strategies for protecting the values and assets that make the Matanzas River basin a unique and special place.

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Appendix A: Comparison between species listed in the GTM Research Reserve, Faver-Dykes State Park, and Matanzas State Forest Management Plans and species assessed in the Planning for Sea Level Rise in the Matanzas Basin project

Species listed below include:
Designated species from the Faver-Dykes Management Plan, Addendum 5
Endangered and threatened species from the Matanzas State Forest Plan, Section III.5
Endangered and threatened species from the GTM Research Reserve Plan, Appendix A.6

Fish and invertebrates were not included in focal species analyses due to difficulty modeling these species with available information. Plants were excluded from focal species analyses, but were addressed via separate analyses of impacts on natural communities. Fish, invertebrate, and plant species included in management plans are excluded from the list below.

Species Name	Faver-Dykes MP	Matanzas State Forest MP	GTM Research Reserve MP	Sea Level Rise Project Assessment List
AMPHIBIANS AND REPTILES				
Florida gopher frog *Rana capito*	Y		Y	Y
Striped newt *Notophthalmus perstriatus*	Y		Y	Y
American alligator *Alligator mississippiensis*	Y		Y	Not included, considered nearly ubiquitous in available habitats
Eastern diamondback rattlesnake *Crotalus adamanteus*	Y		Y	Y
Gopher tortoise *Gopherus Polyphemus*	Y	Y	Y	Y
Florida pine snake *Pituophis melanoleucus mugitus*	Y		Y	Y
Loggerhead, Green, Kemps Ridley, and Leatherback Turtles			Y	Yes, as part of a sea turtle guild
Eastern Indigo Snake *Drymarchon couperi*			Y	Y
Common Kingsnake *Lampropeltis getula*			Y	Not included. Florida Kingsnake included

Species Name	Faver-Dykes MP	Matanzas State Forest MP	GTM Research Reserve MP	Sea Level Rise Project Assessment List
BIRDS				
Roseate spoonbill *Ajaia ajaja*	Y		Y	Yes, as part of a wading bird guild
Great egret *Casmerodius albus*	Y		Y	Yes, as part of a wading bird guild
Little blue heron *Egretta caerulea*	Y		Y	Yes, as part of a wading bird guild
Snowy egret *Egretta thula*	Y		Y	Yes, as part of a wading bird guild
Tricolored heron *Egretta tricolor*	Y		Y	Yes, as part of a wading bird guild
American swallow-tailed kite *Elanoides forficatus*	Y		Y	Y
White ibis *Eudocimus albus*	Y		Y	Yes, as part of a wading bird guild
Merlin *Falco columbarius*	Y		Y	Yes, to be added with new habitat model script
Bald eagle *Haliaetus leucocephalus*	Y	Y	Y	Y
Wood stork *Mycteria americana*	Y	Y	Y	Y
Black-crowned night heron *Nycticorax nycticorax*	Y		Y	Yes, as part of a wading bird guild
Yellow-crowned night heron			Y	Yes, as part of a wading bird guild
Osprey *Pandion haliaetus*	Y		Y	Not included, common in available habitat and difficult to model suitable nesting habitat
Brown pelican *Pelecanus occidentalis*	Y		Y	Yes, considered part of the shorebird guild
Hairy woodpecker *Picoides villosus*	Y		Y	Not included, very rare species found in a variety of forested land cover types
American redstart *Setophaga ruticilla*	Y			Yes, as part of a neotropical migrant forest bird guild
Least tern *Sterna antillarum*	Y		Y	Yes, as part of the shorebird guild

Species Name	Faver-Dykes MP	Matanzas State Forest MP	GTM Research Reserve MP	Sea Level Rise Project Assessment List
Caspian tern *Sterna caspia*	Y		Y	Yes, as part of the shorebird guild
Royal tern *Sterna maxima*	Y		Y	Yes, as part of the shorebird guild
Sandwich tern *Sterna sandvicensis*			Y	Yes, as part of the shorebird guild
Bachman's sparrow *Aimophila aestivalis*			Y	Y
Piping Plover *Charadrius melodus*			Y	Yes, as part of the shorebird guild
Peregrine falcon *Falco peregrinus*			Y	Not included
Southeastern American kestrel *Falco sparverius paulus*			Y	Y
American oystercatcher *Haematopus palliates*			Y	Y
Least bittern *Ixobrychus exilis*			Y	Yes, as part of a wading bird guild
Painted bunting *Passerina ciris*			Y	Y
Glossy ibis *Plegadis falcinellus*			Y	Yes, as part of a wading bird guild
Black skimmer *Rynchops niger*			Y	Yes, as part of the shorebird guild
MAMMALS				
West Indian manatee *Trichechus manatus*	Y		Y	Not included. No data available for study area
Florida black bear *Ursus americanus floridanus*	Y		Y	Y
Southeastern weasel *Mustela frenata olivacea*			Y	Not included
Atlantic salt marsh mink *Neovison vison lutensis*			Y	Not included. Florida Mink included.
Anastasia beach mouse *Peromyscus polionotus Phasma*			Y	Y
Florida mouse *Podomys floridanus*			Y	Y
Sherman's fox squirrel *Sciurus niger shermani*			Y	Y

Appendix B: Focal Species Impact Assessment Statistics

The following section includes statistics describing impacts to focal species from 1m and 2.5m sea level rise and future development, both within the entire study area (Table 1), and within the GTM and existing conservation lands only (Table 2).

Table 1. Focal Species Impacts from Sea Level Rise and Future Development within the Matanzas Project Study Aera

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Gopher Tortoise	Gopherus polyphemus	G3	S3	13,346	-352	-2.60%	-2,771	-20.76%	-3,123	-23.40%	-3,072	-23.02%
Spotted Turtle	Clemmys guttata	G5	S3?	104,397	-2,125	-2.00%	-18,562	-17.78%	-20,687	-19.82%	-8,424	-8.07%
Eastern Indigo Snake	Drymarchon couperi	G3	S3	180,685	348	0.10%	-34,120	-18.88%	-33,772	-18.69%	-9,731	-5.39%
Diamondback Rattlesnake	Crotalus adamanteus	G4	S3	139,379	-316	-0.20%	-28,082	-20.15%	-28,398	-20.37%	-7,570	-5.43%
Florida Kingsnake	*Lampropeltis getula floridana*			42,407	347	0.80%	-7,549	-17.80%	-7,202	-16.98%	-6,780	-15.99%
Florida Pine Snake	Pituophis melanoleucus mugitus	G4T3	S3	12,587	-446	-3.50%	-2,654	-21.08%	-3,100	-24.63%	-3,258	-25.89%
Sandhill Crane	Grus canadensis pratensis	G5T2T3	S2S3	41,369	-1,129	-2.70%	-8,292	-20.04%	-9,421	-22.77%	3,610	8.73%

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Gopher Frog	Rana capito	G3	S3	68,501	-2,269	-3.30%	-14,003	-20.44%	-16,273	-23.76%	-7,009	-10.23%
Southeastern American Kestrel	Falco sparverius paulus	G5T4	S3	15,118	-1,800	-11.90%	-3,747	-24.79%	-5,547	-36.69%	-3,563	-23.57%
Neotropical Migrant Forest Bird Guild				36,180	-1,559	-4.30%	-5,207	-14.39%	-6,766	-18.70%	-7,731	-21.37%
Migratory (Wintering) Waterfowl				11,688	5,811	49.70%	-167	-1.43%	5,644	48.29%	18,621	159.32%
Wading bird Guild				94,427	678	0.70%	-12,295	-13.02%	-11,618	-12.30%	-3,340	-3.54%
Black Rail	*Laterallus jamaicensis*	G4	S2	1,601	-921	-58%	-5	-0.34%	-927	-57.90%	-995	-62.13%
Wood Stork	Mycteria americana	G4	S2	94,427	678	0.70%	-12,295	-13.02%	-11,618	-12.30%	-3,340	-3.54%
Swallow-tailed Kite	Elanoides forficatus	G5	S2	189,642	-3,509	-1.80%	-34,840	-18.37%	-38,349	-20.22%	-14,401	-7.59%
Bald Eagle	Haliaeetus leucocephalus	G5	S3	97,523	1,226	1.20%	-10,389	-10.65%	-9,163	-9.40%	5,869	6.02%
Limpkin	Aramus guarauna	G5	S3	6,002	-739	-12.30%	-468	-7.80%	-1,208	-20.12%	-1,746	-29.09%

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Striped Newt	Notophthalmus perstriatus	G2G3	S2S3	5,775	222	3.80%	-1,525	-26.41%	-1,304	-22.58%	535	9.27%
American Oystercatcher	Haematopus palliatus	G5	S2	3,444	5,777	167.73%	-41	-1.18%	5,737	166.55%	4,226	122.69%
Bachman's Sparrow	*Peucaea aestivalis*	G3	S3	51,105	-2,101	-4.10%	-9,224	-18.05%	-11,325	-22.16%	-4,130	-8.08%
Round-tailed Muskrat	Neofiber alleni	G3	S3	18,975	-359	-1.80%	-3,075	-16.21%	-3,435	-18.10%	-1,636	-8.62%
Florida Mink	*Neovison vison*	G5T3	S3	10,905	-4,948	-45.30%	-27	-0.25%	-4,975	-45.62%	-5,441	-49.90%
River Otter	*Lontra canadensis*			184,616	-8,317	-4.50%	-32,929	-17.84%	-41,246	-22.34%	-16,951	-9.18%
Florida Mouse	Podomys floridanus	G3	S3	6,830	-218	-3.10%	-1,363	-19.96%	-1,581	-23.15%	-1,308	-19.16%
Sherman's Fox Squirrel	Sciurus niger shermani	G5T3	S3	51,770	-4,404	-8.50%	-7,789	-15.05%	-12,193	-23.55%	-8,433	-16.29%

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Florida Black Bear	Ursus americanus floridanus	G5T2	S2	169,642	-1,459	-0.86%	-31,320	-18.46%	-32,779	-19.32%	-4,526	-2.67%
Sea Turtle Guild				731	-469	-64.22%	-10	-1.31%	-479	-65.53%	-529	-72.40%
Shorebird Guild- Open water foraging (i.e. Black skimmer, Least tern, pelicans)				22,239	5678	25.53%	-77	-0.35%	5,601	25.19%	17,522	78.79%
Shorebird Guild- Sand foraging (i.e. Plovers, sandpipers)				13,206	-1407	-10.65%	-66	-0.50%	-1,473	-11.15%	-2,345	-17.75%
Painted	*Passerina ciris*	G5	S3	9,463	-501	-5.29%	-2,818	-29.78%	-3,319	-35.07%	-2,152	-22.74%

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Bunting												
Anastasia Beach Mouse	Peromyscus polionotus phasma	G5T1	S1	1579	-683	-43.28%	-36	-2.27%	-719	-45.54%	-1,387	-87.84%
Merlin	*Peromyscus polionotus phasma*			11,846	-1,396	-11.70%	-40	-0.34%	-1,436	-12.12%	-1862.59	-15.72%
Gulf Saltmarsh Snake (for Atlantic Saltmarsh Snake)	*Nerodia clarkii clarkii*			15,377	-46	-0.20%	-43	-0.28%	-88	-0.58%	-2119	-13.78%
Mangrove Forest Bird Guild (Florida Prairie Warbler)				376	-9	-2.30%	-6	-1.55%	-15	-3.88%	-375	-99.76%
Marian's Marsh Wren (for Worthington's Marsh Wren)	*Cistohorus palustris marianae*			6792	-1241	-18.27%	-22	-0.33%	-1,263	-18.60%	-2268	-33.39%

Common Name	Scientific Name	Global Rank	State Rank	Current habitat (ACRES)	Net gain/loss to 1m SLR (ACRES)	Percent gain/loss to 1m SLR	Loss to Land Use Change (ACRES)	Percent Loss to Land Use Change	Combined gain/loss to 1m SLR and LU Change (ACRES)	Total Percent gain/Loss to 1m SLR and Land Use Change	Net gain/loss to 2.5m SLR (ACRES)	Percent gain/loss to 2.5m SLR
Ornate Diamondback Terrapin (for Diamondback Terrapin)	*Malaclemys terrapin macrospilota*			17,729	6,337	35.70%	-145	-0.82%	6,192	34.92%	7159	40.38%
Scott's Seaside Sparrow (for MacGillivray's seaside sparrow)	*Ammodramus maritimus peninsulae*			10,905	-4,948	-45.30%	-27	-0.25%	-4,975	-45.62%	-5441	-49.90%

Table 2. Impacts to Focal Species within the GTM Research Reserve and Other Conservation Lands

Common Name	**Scientific Name**	**Current habitat in the study area (ACRES)**	**Current habitat in the GTM & contiguous conservation lands (ACRES)**	**1m SLR Habitat net loss or gain**	**Percent**	**2.5m SLR Habitat net loss or gain**	**Percent**	**Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)**	**1m SLR Habitat net loss or gain**	**Percent**	**2.5m SLR Habitat net loss or gain**	**Percent**
Gopher Tortoise	Gopherus polyphemus	13,346	3,926	-77	-1.96%	-630	-16.05%	4,610	-103	-2.23%	-1,217	-26.40%
Spotted Turtle	Clemmys guttata	104,397	9,038	-813	-8.99%	-1,743	-19.28%	19,033	-858	-4.51%	-4,130	-21.70%

Common Name	Scientific Name	Current habitat in the study area (ACRES)	Current habitat in the GTM & contiguous conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent	Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent
Eastern Indigo Snake	Drymarchon couperi	180,685	17,455	842	4.82%	-2,477	-14.19%	31,786	823	2.59%	-4,551	-14.32%
Diamondback Rattlesnake	Crotalus adamanteus	139,379	16,968	109	0.64%	-3,054	-18.00%	25,732	28	0.11%	-3,934	-15.29%
Florida Kingsnake	*Lampropeltis getula floridana*	42,407	11,441	-267	-2.33%	-3,246	-28.37%	13,968	-26	-0.19%	-3,737	-26.75%
Florida Pine Snake	Pituophis melanoleucus mugitus	12,587	1,153	-109	-9.42%	-917	-79.50%	4,423	-153	-3.47%	-1,196	-27.04%
Sandhill Crane	Grus canadensis pratensis	41,369	2,680	-415	-15.49%	644	24.02%	4,256	-464	-10.90%	2,220	52.16%
Gopher Frog	Rana capito	68,501	14,527	-920	-6.33%	-2,596	-17.87%	17,690	-976	-5.52%	-2,934	-16.59%
Southeastern American Kestrel	Falco sparverius paulus	15,118	2,257	-405	-17.93%	-727	-32.24%	2,710	-461	-17.01%	-884	-32.61%
Neotropical Migrant Forest Bird Guild		36,180	4,226	-930	-21.99%	-2,334	-55.23%	9,586	-1,115	-11.63%	-4,506	-47.00%
Migratory (Wintering) Waterfowl		11,688	4,936	2,415	48.93%	8,152	165.17%	5,271	2,753	52.24%	9,667	183.41%
Wading bird Guild		94,427	12,105	46	0.38%	-4,745	-39.19%	20,763	162	0.78%	-4,277	-20.60%

Common Name	Scientific Name	Current habitat in the study area (ACRES)	Current habitat in the GTM & contiguous conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent	Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent
Black Rail	*Laterallus jamaicensis*	1,601	892	-507	-56.83%	-856	-96.04%	974	-538	-55.28%	-668	-68.66%
Wood Stork	Mycteria americana	94,427	12,106	46	0.38%	-4,745	-39.19%	20,763	162	0.78%	-4,277	-20.60%
Swallow-tailed Kite	Elanoides forficatus	189,642	18,447	-1,322	-7.16%	-3,985	-21.60%	33,203	-1,498	-4.51%	-6,205	-18.69%
Bald Eagle	Haliaeetus leucocephalus	97,523	23,143	247	1.07%	1,292	5.58%	32,013	664	2.07%	2,211	6.91%
Limpkin	Aramus guarauna	6,002	660	-198	-29.93%	-378	-57.18%	1,432	-259	-18.07%	-564	-39.39%
Striped Newt	Notophthalmus perstriatus	5,775	1,615	135	8.34%	264	16.35%	1,860	101	5.44%	241	12.94%
American Oystercatcher	Haematopus palliatus	3444	1855	2,696	145.33%	-83	-4.49%	2,454	2,812	114.60 %	331	13.47%
Bachman's Sparrow	*Peucaea aestivalis*	51,105	8,044	-721	-8.97%	-1,447	-17.99%	11,037	-757	-6.86%	-1,699	-15.39%
Round-tailed Muskrat	Neofiber alleni	18,975	4,245	-188	-4.43%	-471	-11.11%	4,921	-188	-3.82%	-472	-9.59%
Florida Mink	*Neovison vison*	10,905	5,370	-2,281	-42.47%	-4,444	-82.75%	5,959	-2,505	-42.03%	-3,375	-56.64%

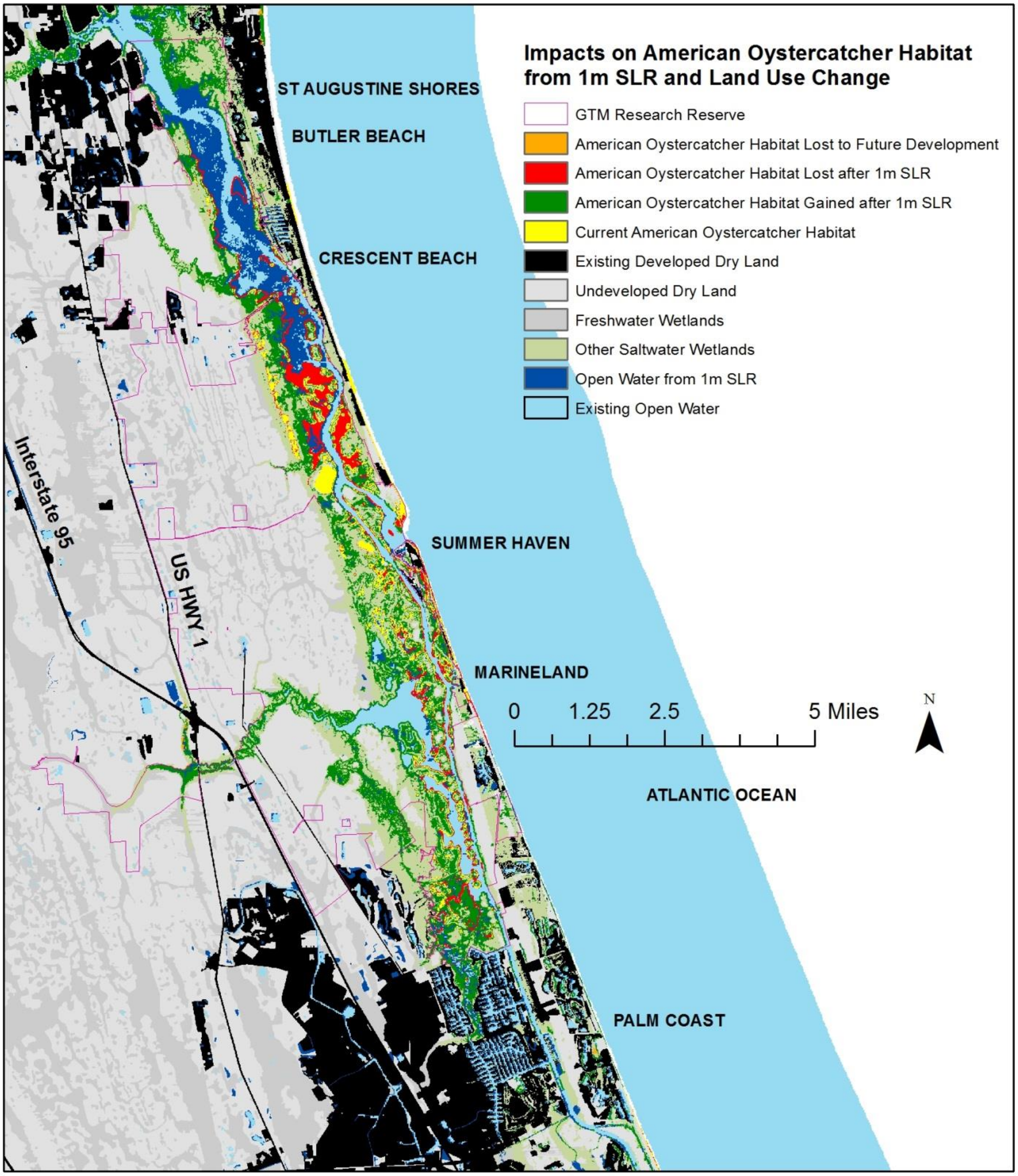
Common Name	Scientific Name	Current habitat in the study area (ACRES)	Current habitat in the GTM & contiguous conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent	Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent
River Otter	*Lontra canadensis*	184,616	15,552	-2,340	-15.04%	-4,785	-30.77%	29,515	-2,598	-8.80%	-6,554	-22.21%
Florida Mouse	Podomys floridanus	6,830	2,667	-61	-2.27%	-493	-18.48%	2,878	-68	-2.36%	-560	-19.46%
Sherman's Fox Squirrel	Sciurus niger shermani	51,770	13,876	1,291	9.30%	-1,712	-12.34%	16,603	1,082	6.51%	-1,951	-11.75%
Florida Black Bear	Ursus americanus floridanus	169,642	23,040	-728	-3.16%	-1,688	-7.33%	37,537	-807	-2.15%	-2,223	-5.92%
Sea Turtles		731	18	-3	-17.70%	-2	-12.07%	93	-12	-12.64%	-32	-34.18%
Shorebird Guild- Open water foraging (i.e. Black skimmer, Least tern, pelicans)		22,239	11,023	1,616	14.66%	4,057	36.81%	12,348	1,872	15.16%	6,898	55.86%
Shorebird Guild- Sand foraging (i.e. Plovers, sandpipers)		13,206	6,467	-742	-11.48%	-4,312	-66.67%	7,595	-866	-11.40%	-3,052	-40.18%

Common Name	Scientific Name	Current habitat in the study area (ACRES)	Current habitat in the GTM & contiguous conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent	Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent
Painted Bunting	*Passerina ciris*	9,463	1401	-206	-14.67%	-577	-41.15%	1,826	-242	-13.26%	-741	-40.56%
Anastasia Beach Mouse	Peromyscus polionotus phasma	1579	70	0	-0.04%	-2	-3.11%	631	-6	-0.89%	-446	-70.72%
Merlin	*Peromyscus polionotus phasma*	11,846	6,196	-843	-13.60%	-4,278	-69.05%	6,794	-859	-12.64%	-2,600	-38.27%
Gulf Saltmarsh Snake (for Atlantic Saltmarsh Snake)	*Nerodia clarkii clarkii*	15,377	7,993	122	1.53%	-5,257	-65.76%	8,749	1	0.01%	-3,354	-38.34%
Mangrove Forest Bird Guild (Florida Prairie Warbler)		376	239	14	5.95%	-238	-99.82%	243	10	4.30%	-242	-99.80%
Marian's Marsh Wren (for Worthington's Marsh Wren)	*Cistohorus palustris marianae*	6792	3691	-720	-20%	-2,794	-75.69%	4,003	-789	-20%	-2,069	-51.68%

Common Name	Scientific Name	Current habitat in the study area (ACRES)	Current habitat in the GTM & contiguous conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent	Current habitat in the GTM, contiguous conservation, and all other conservation lands (ACRES)	1m SLR Habitat net loss or gain	Percent	2.5m SLR Habitat net loss or gain	Percent
Ornate Diamondback Terrapin (for Diamondback Terrapin)	*Malaclemys terrapin macrospilota*	17,729	9,046	2,346	25.93%	-1,451	-16.04%	9,894	2,777	28.07%	457	4.62%
Scott's Seaside Sparrow (for MacGillivray's seaside sparrow)	*Ammodramus maritimus peninsulae*	10,905	5,371	-2,281	-42.47%	-4,444	-82.75%	5,959	-2,505	-42.03%	-3,375	-56.64%

Appendix C: Focal Species Impact Maps

The following section includes maps identifying impacts from sea level rise and future development on focal species. Maps are included for 1m sea level rise, 1m sea level rise and development, and 2.5m sea level rise. Development impacts were not included in the 2.5m sea level rise impact assessment because only a 1m sea level rise future development scenario was available, and development patterns under a 2.5m rise in sea levels were determined to be uncertain.


Impacts on American Oystercatcher Habitat from 1m SLR and Land Use Change
GTM Research Reserve
American Oystercatcher Habitat Lost to Future Development
American Oystercatcher Habitat Lost after 1m SLR
American Oystercatcher Habitat Gained after 1m SLR
Current American Oystercatcher Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
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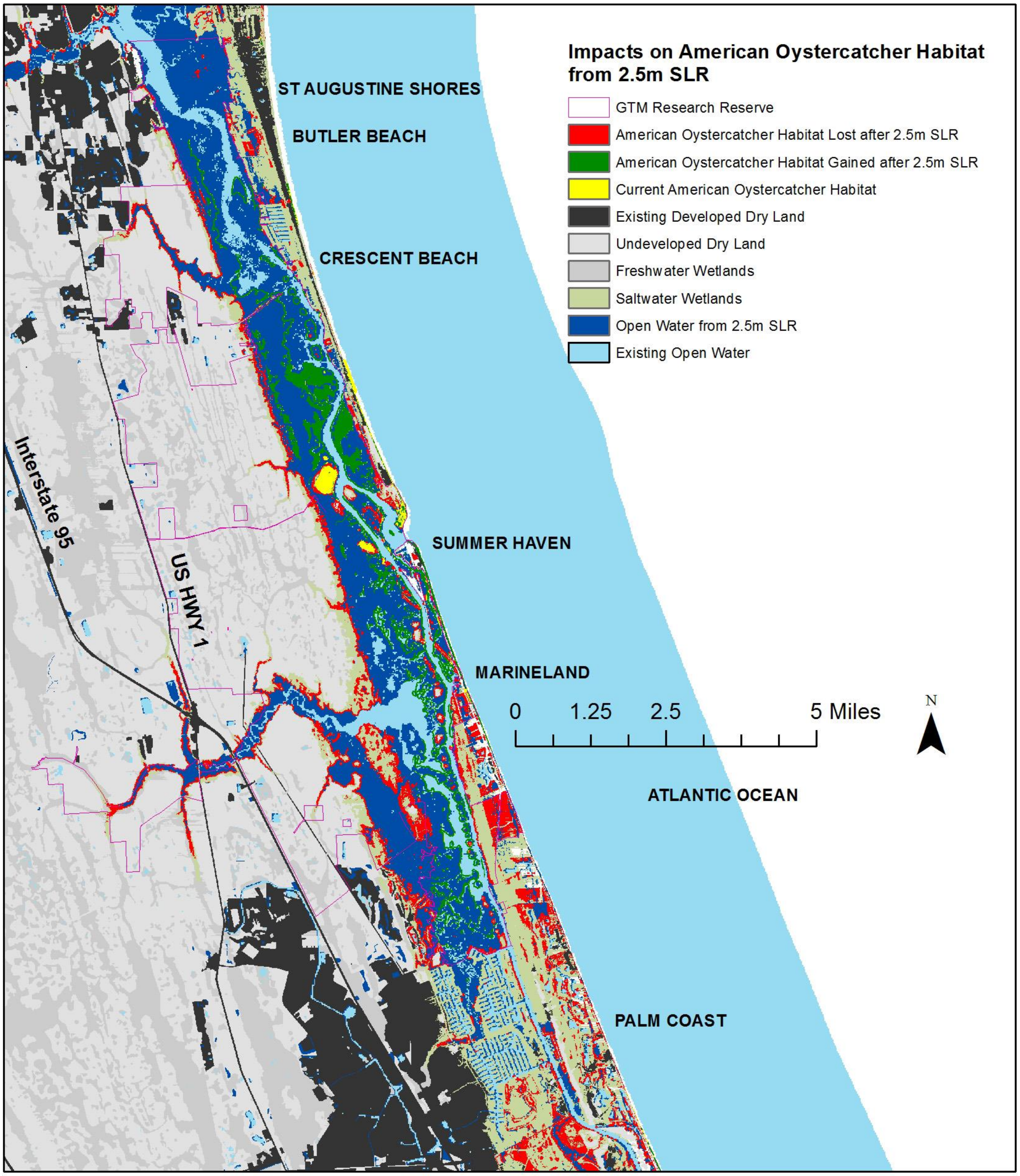
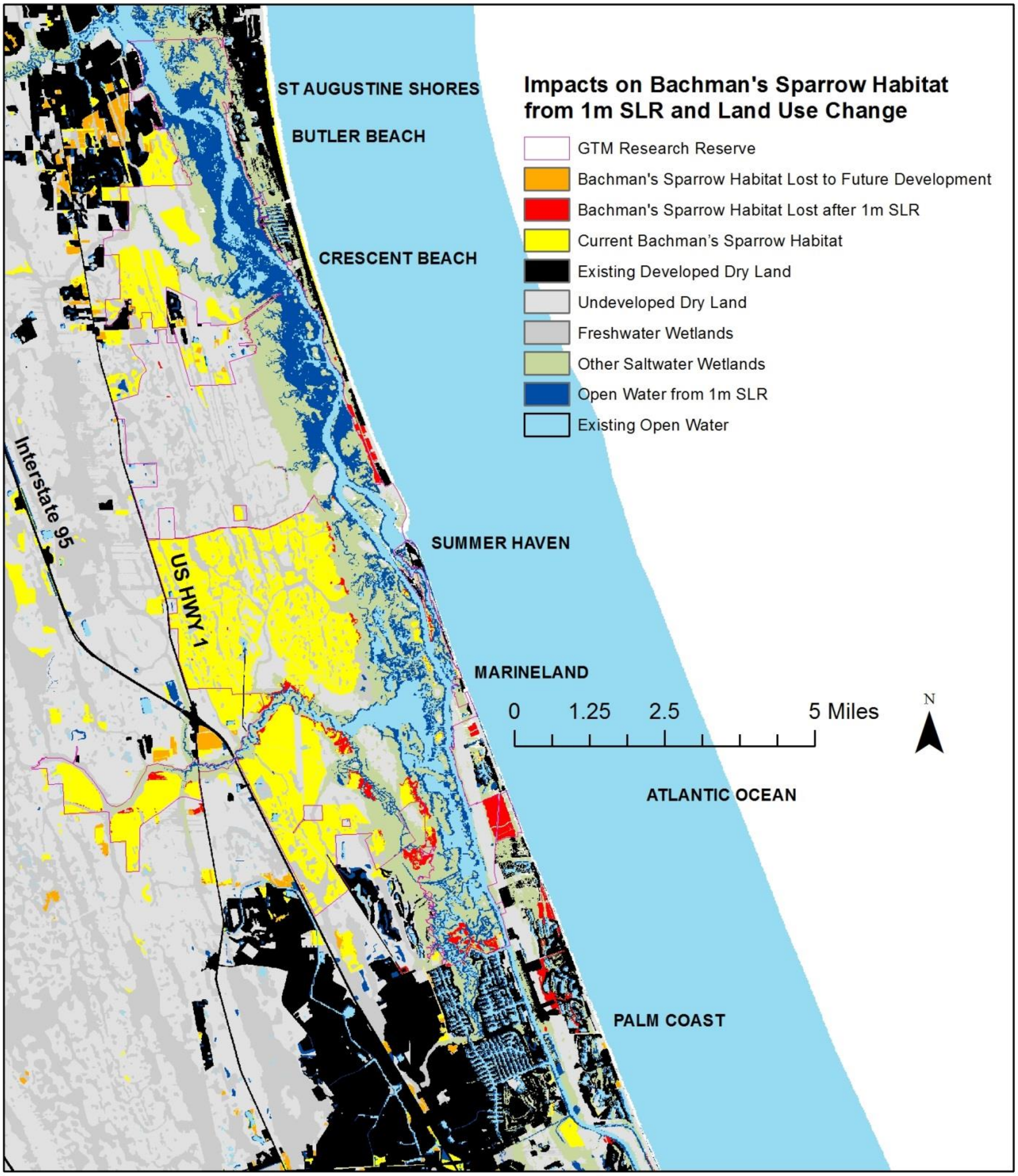
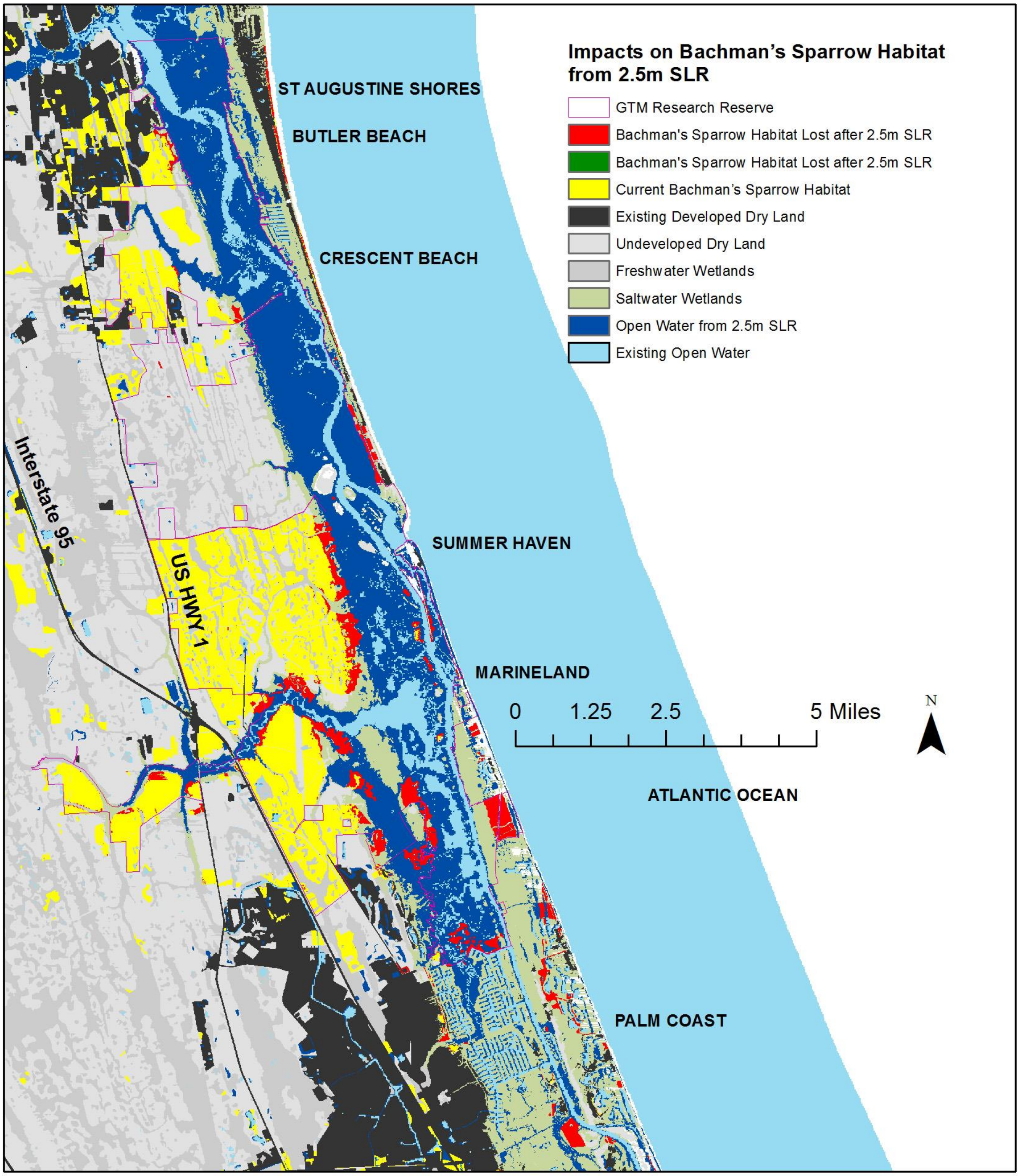
1.25
2.5
5 Miles
N

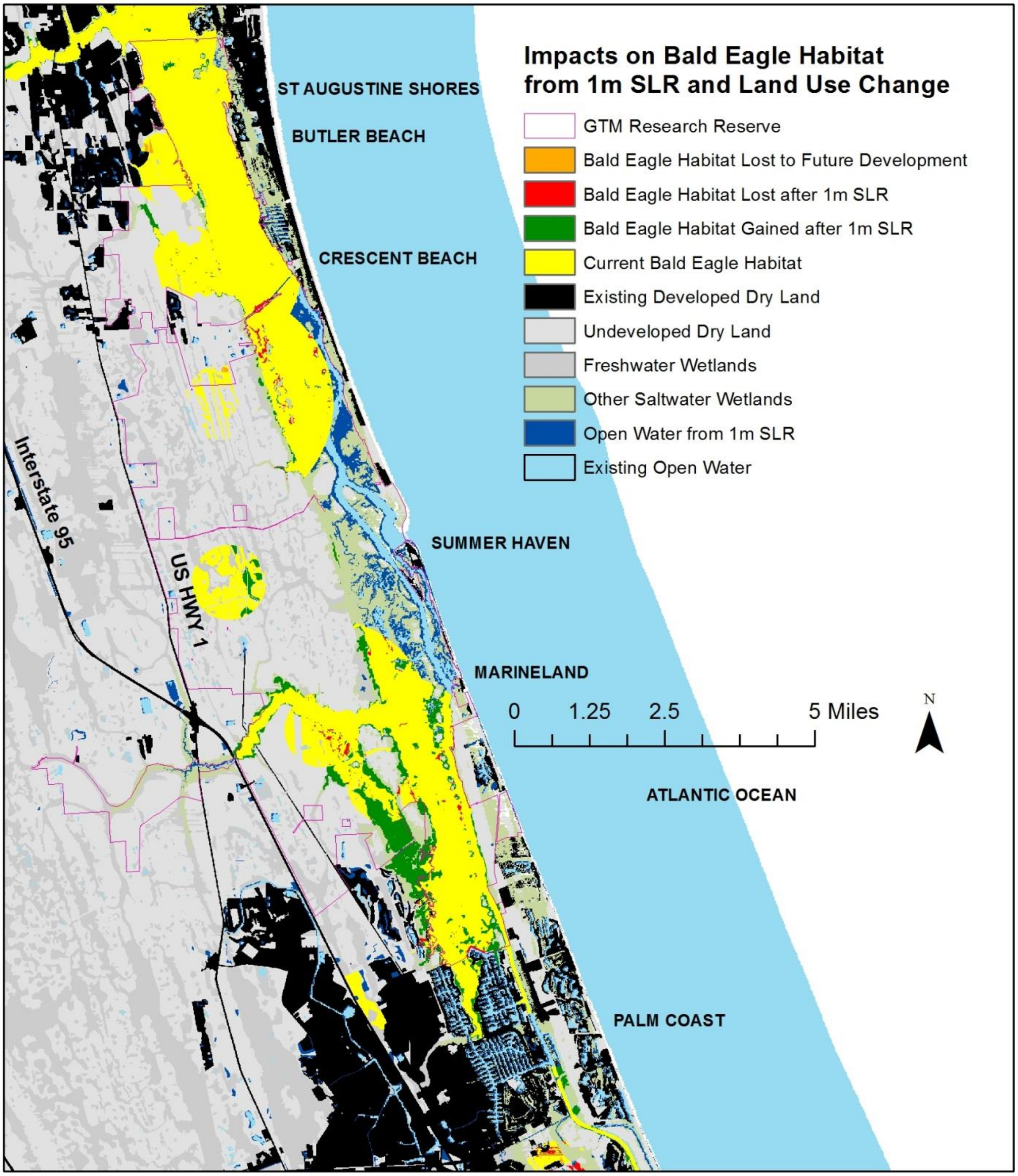


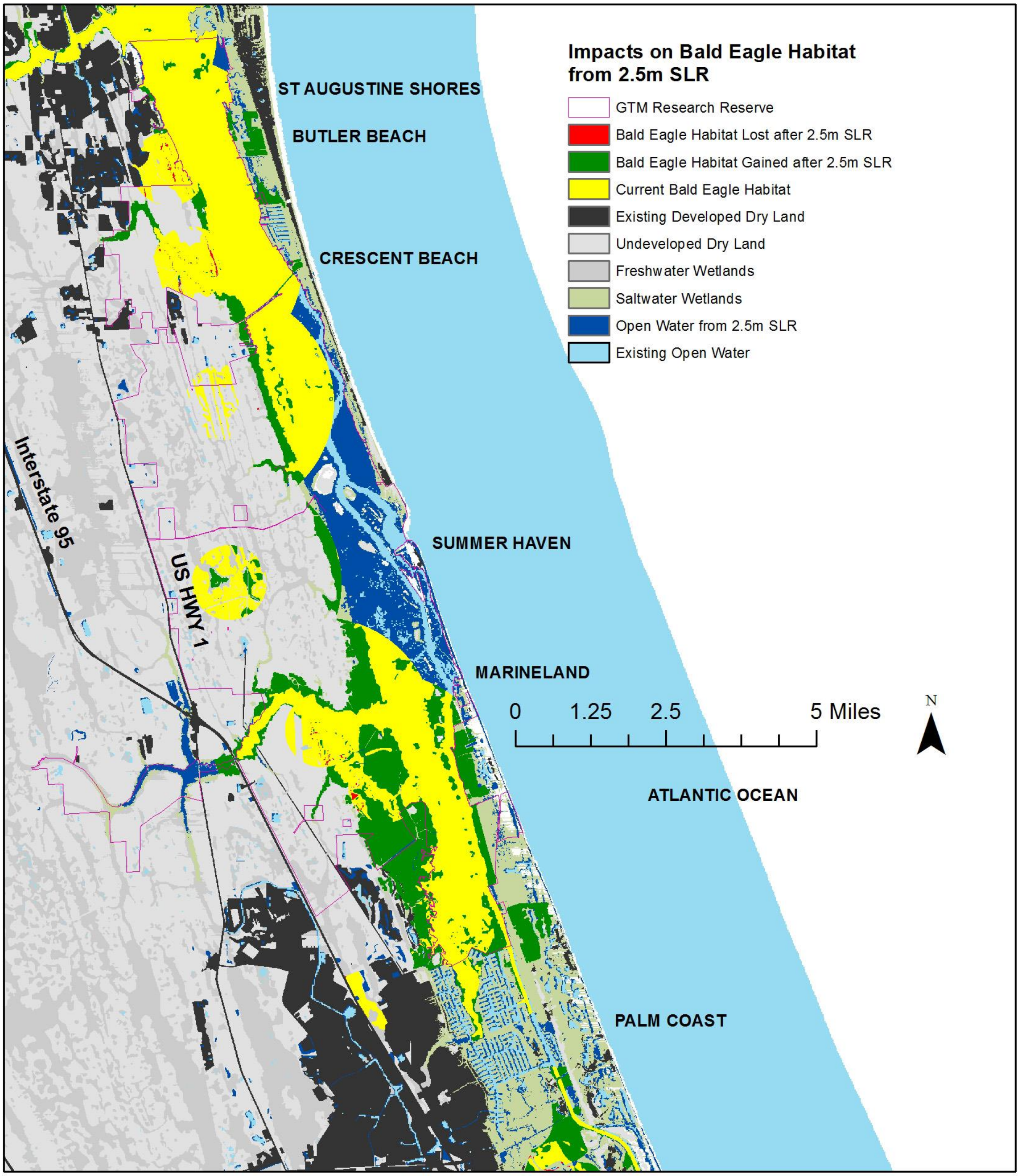
Impacts on American Oystercatcher Habitat from 2.5m SLR
GTM Research Reserve
American Oystercatcher Habitat Lost after 2.5m SLR
American Oystercatcher Habitat Gained after 2.5m SLR
Current American Oystercatcher Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
Interstate 95
US HWY 1
SUMMER HAVEN
MARINELAND
0 1.25 2.5 5 Miles
N
ATLANTIC OCEAN
PALM COAST

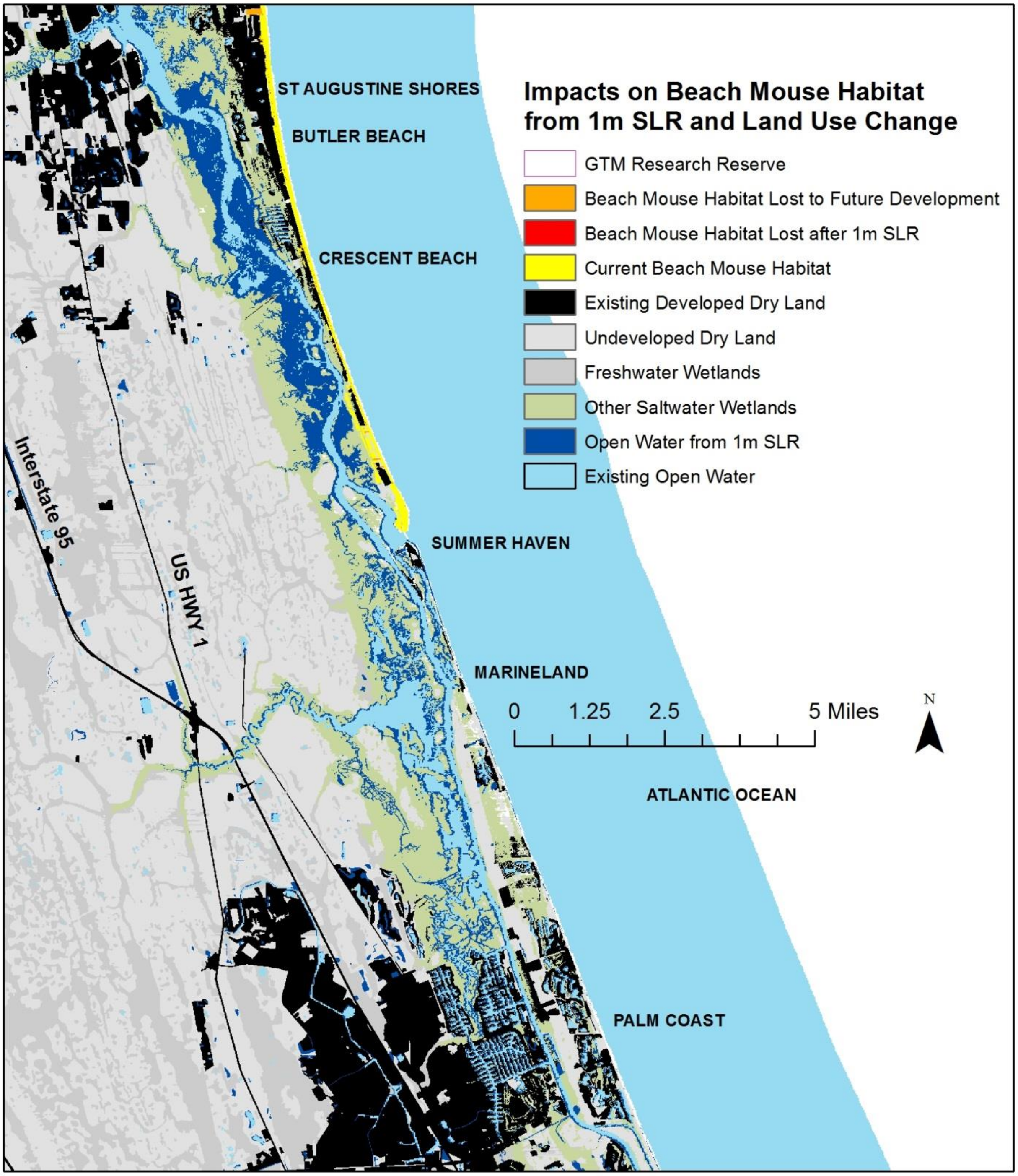


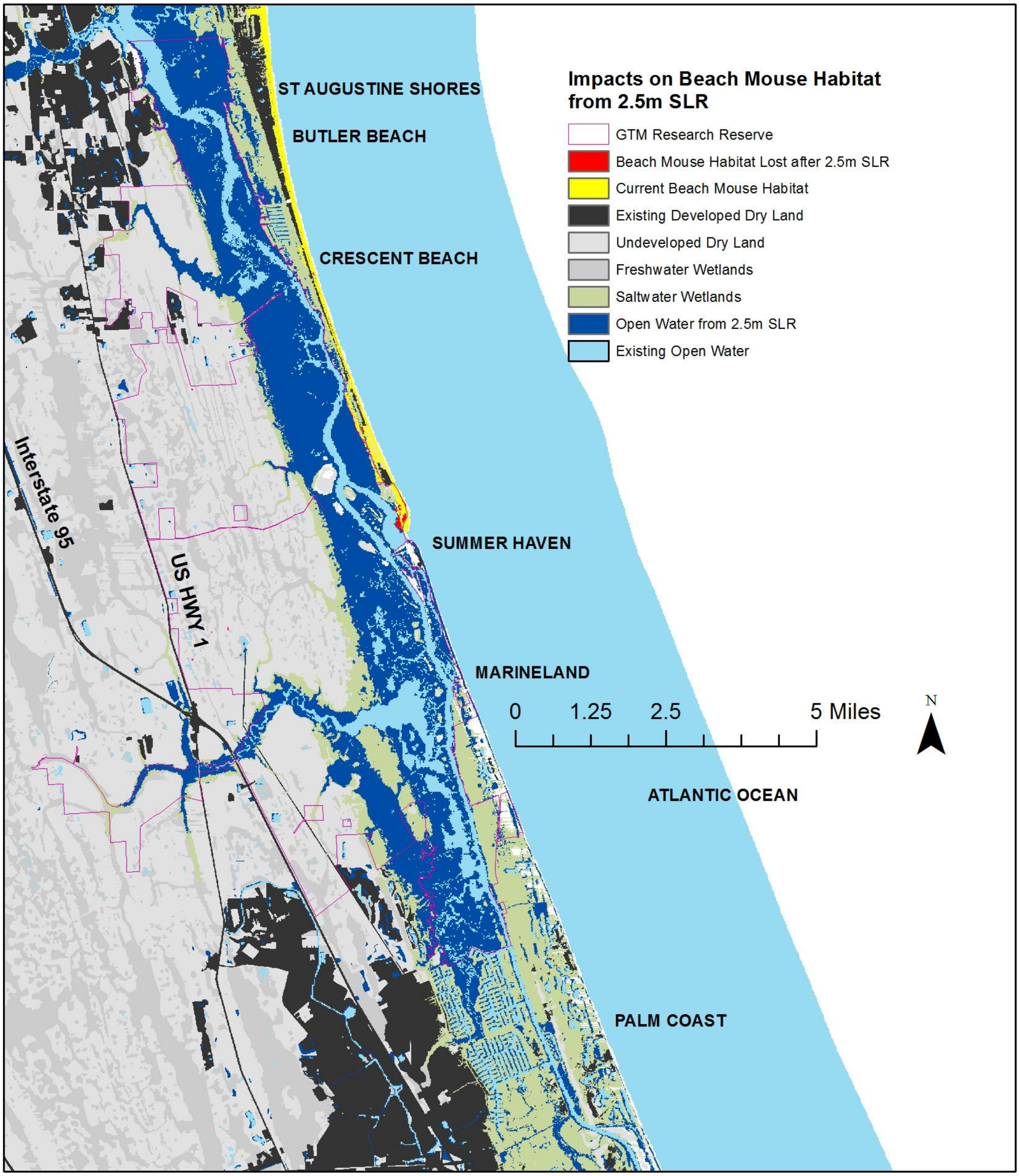
Impacts on Bachman's Sparrow Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Bachman's Sparrow Habitat Lost to Future Development
Bachman's Sparrow Habitat Lost after 1m SLR
Current Bachman's Sparrow Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

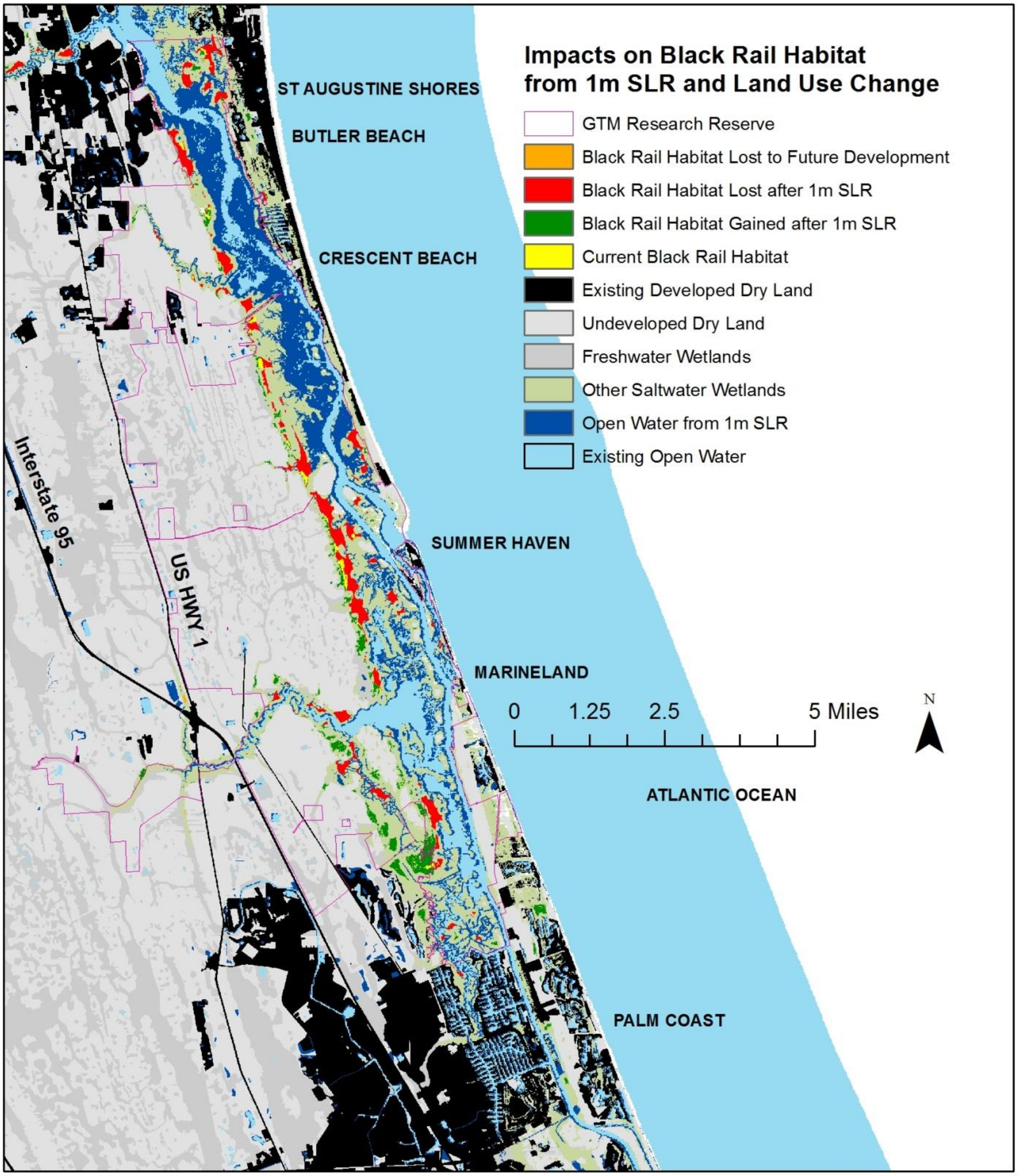

Impacts on Bachman's Sparrow Habitat from 2.5m SLR
GTM Research Reserve
Bachman's Sparrow Habitat Lost after 2.5m SLR
Bachman's Sparrow Habitat Lost after 2.5m SLR
Current Bachman's Sparrow Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Bald Eagle Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Bald Eagle Habitat Lost to Future Development
Bald Eagle Habitat Lost after 1m SLR
Bald Eagle Habitat Gained after 1m SLR
Current Bald Eagle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

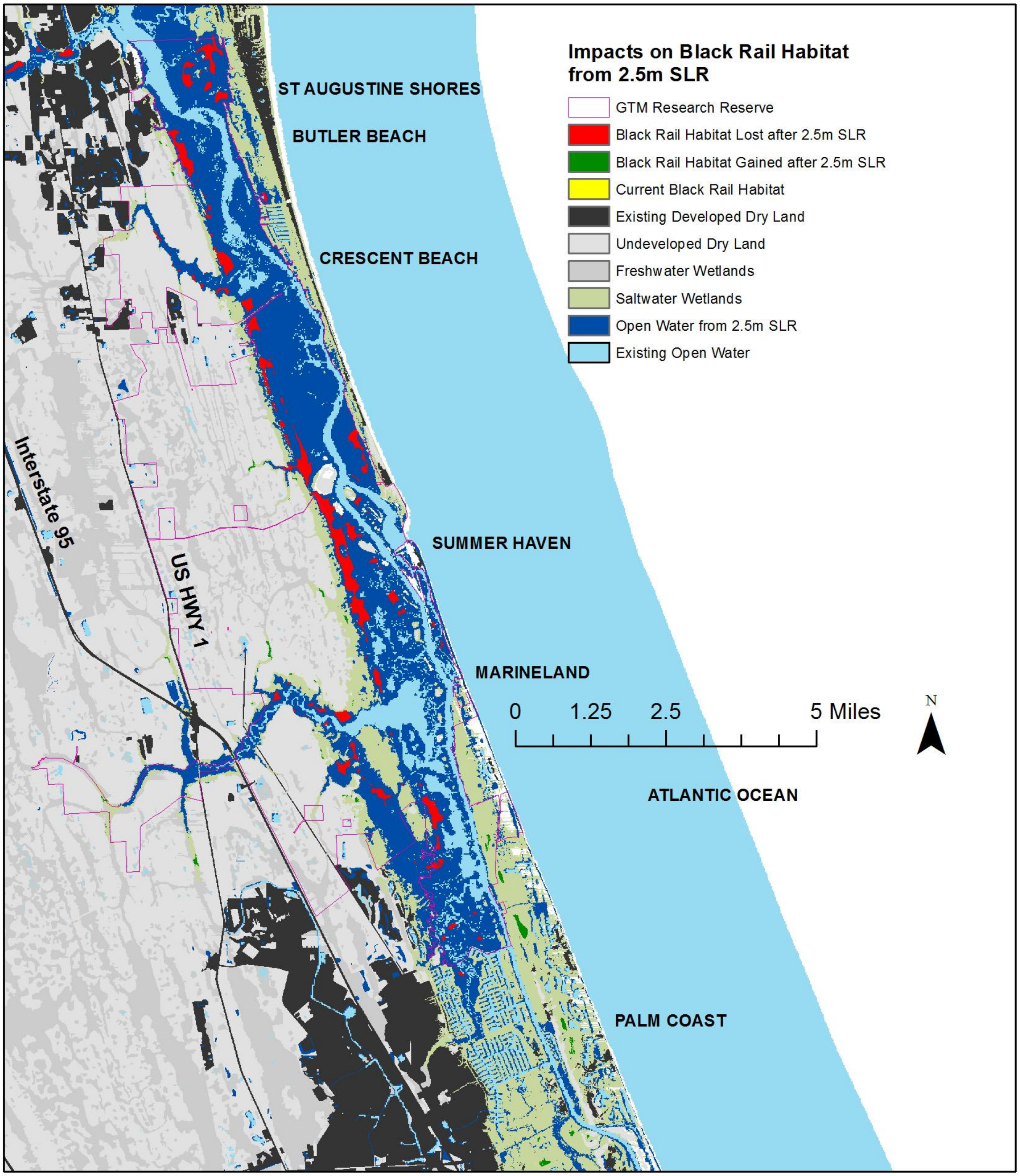

Impacts on Bald Eagle Habitat from 2.5m SLR
GTM Research Reserve
Bald Eagle Habitat Lost after 2.5m SLR
Bald Eagle Habitat Gained after 2.5m SLR
Current Bald Eagle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

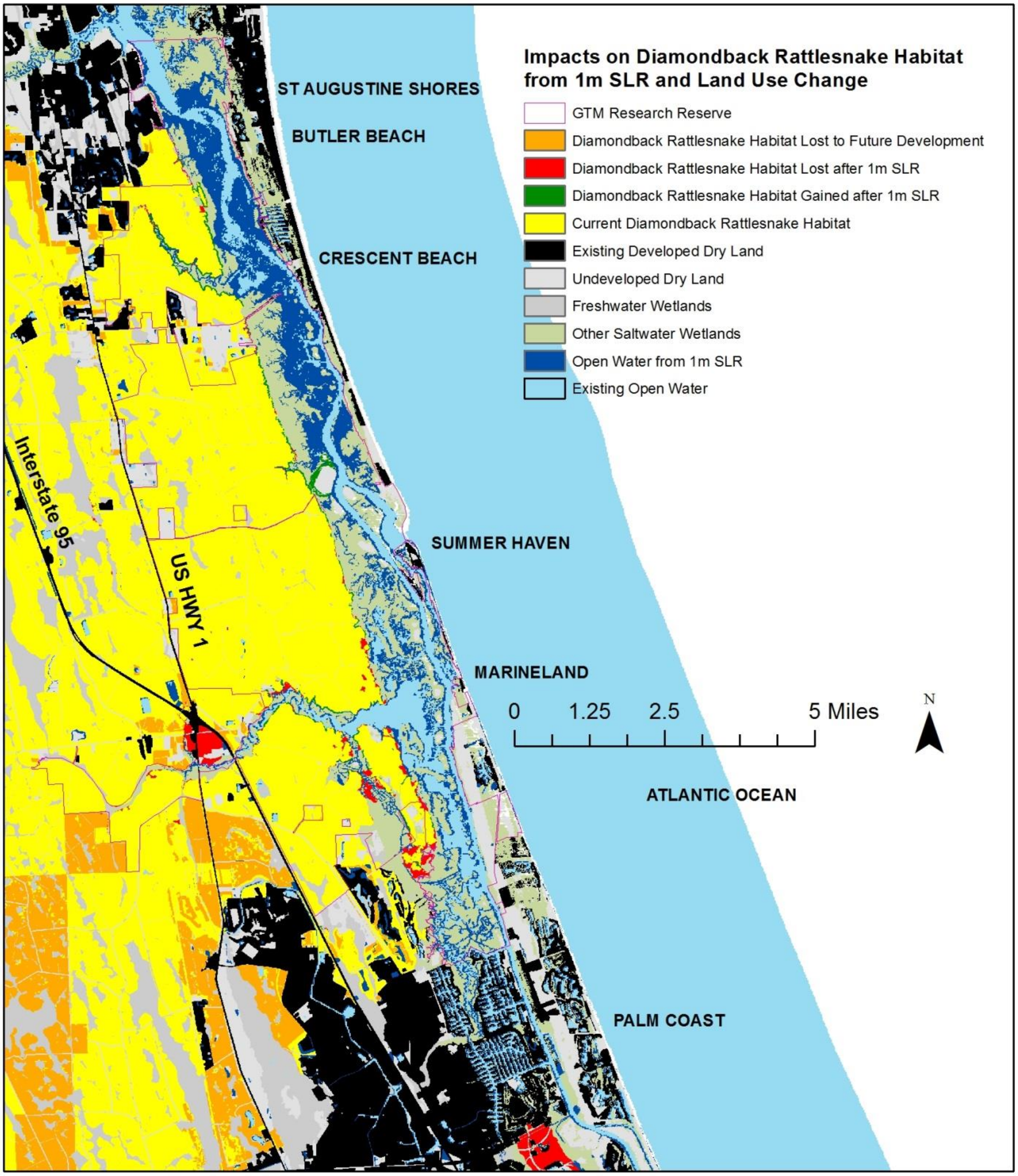

Impacts on Beach Mouse Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Beach Mouse Habitat Lost to Future Development
Beach Mouse Habitat Lost after 1m SLR
Current Beach Mouse Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

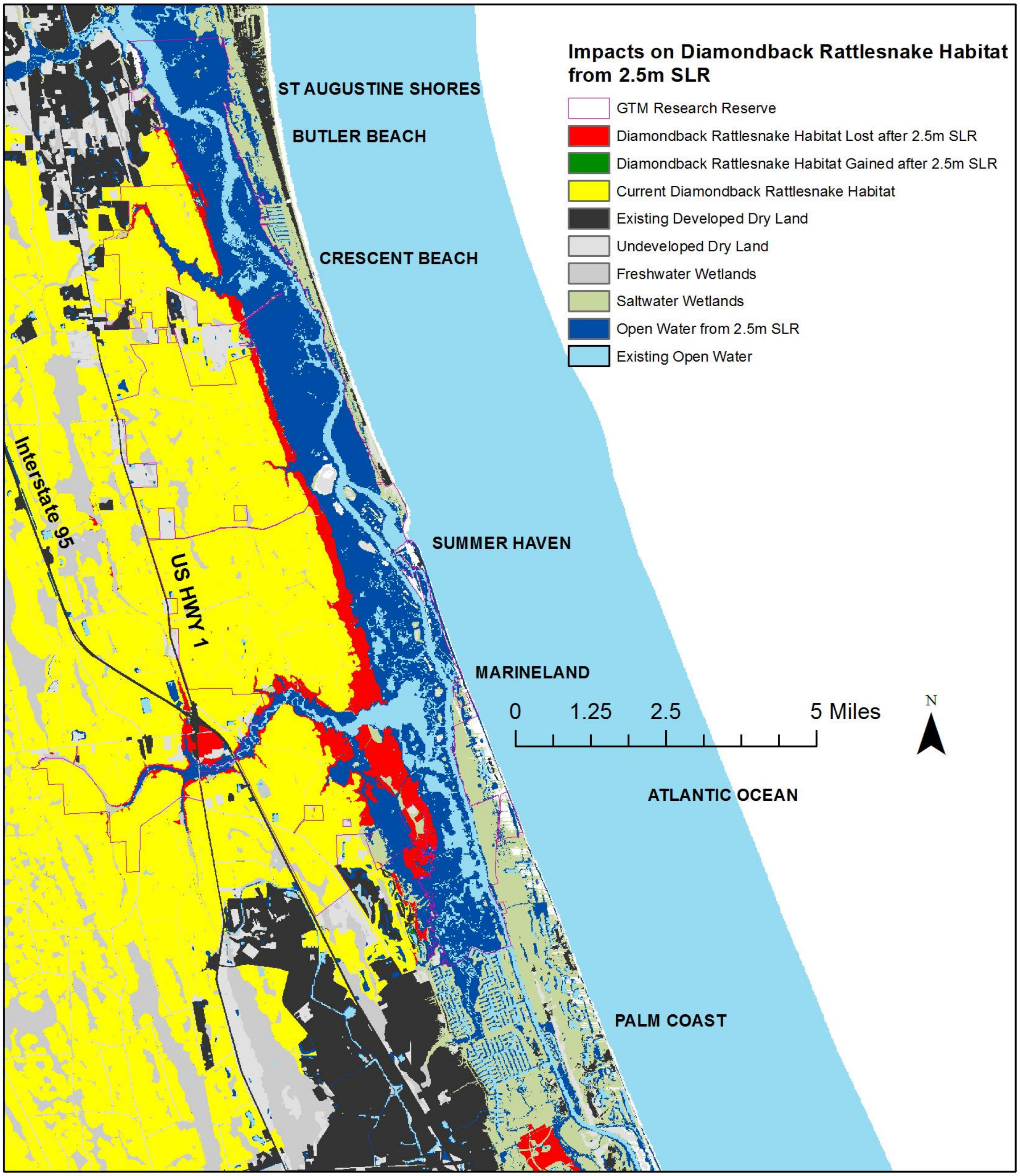

Impacts on Beach Mouse Habitat from 2.5m SLR
GTM Research Reserve
Beach Mouse Habitat Lost after 2.5m SLR
Current Beach Mouse Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

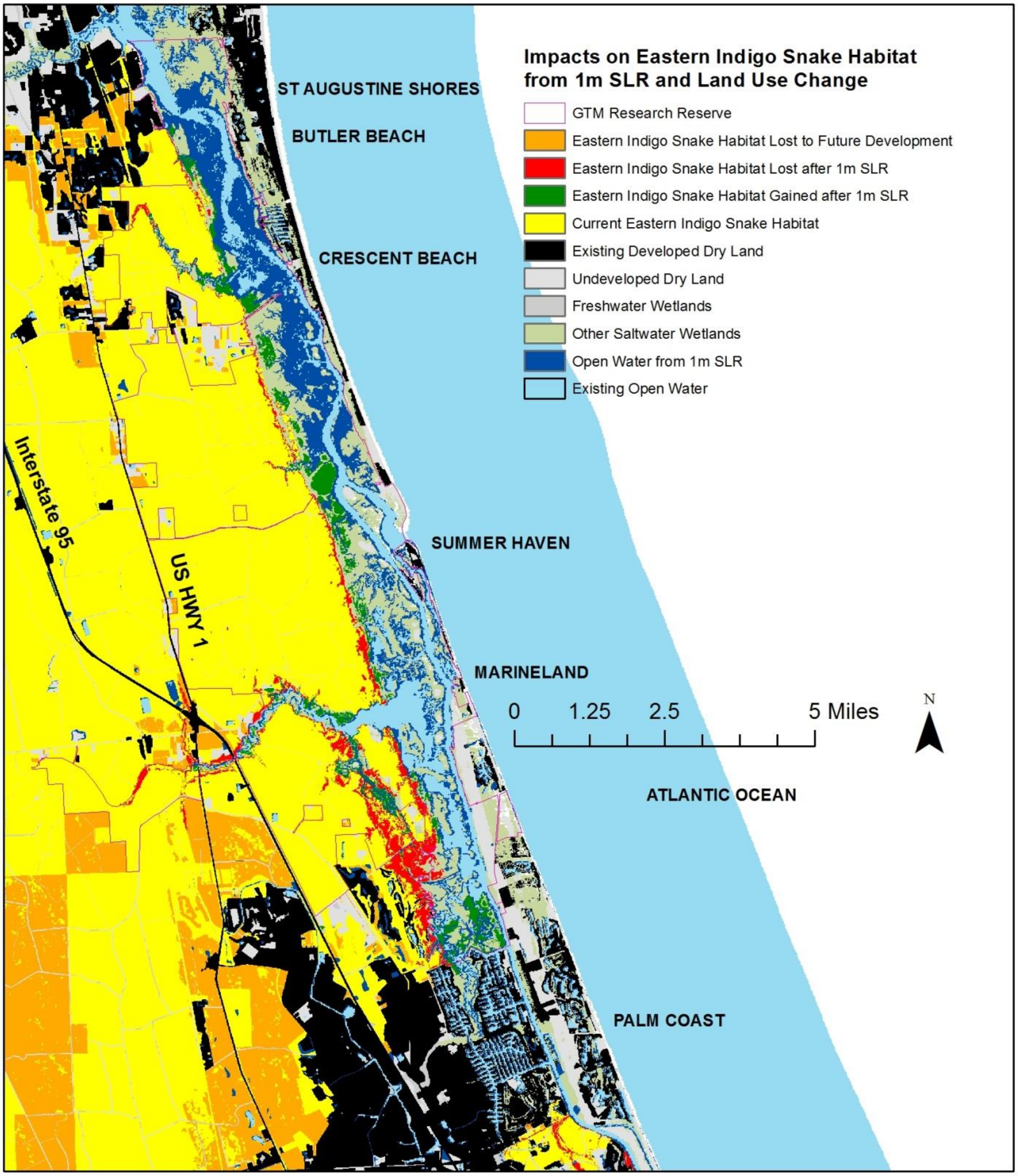


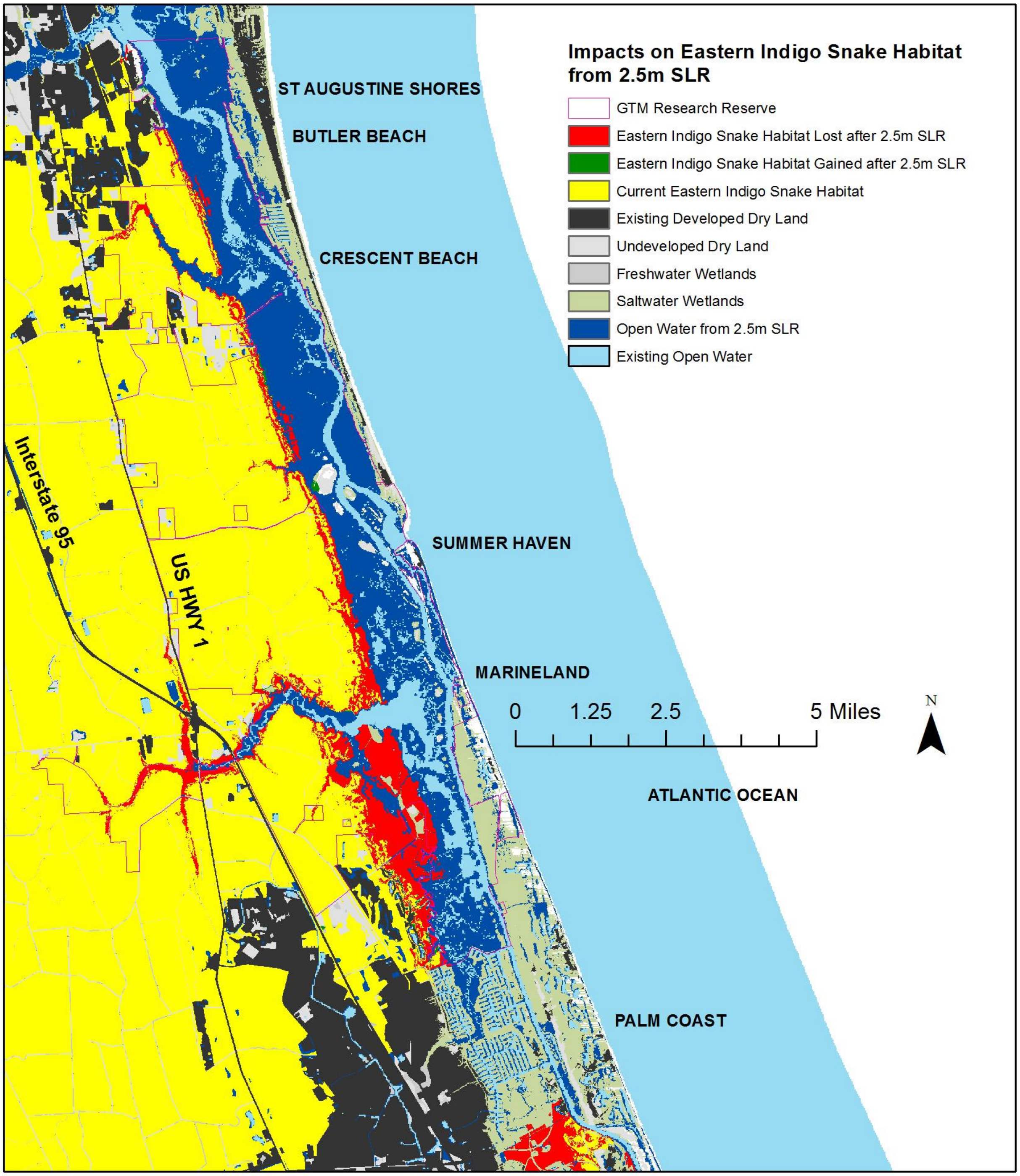
Impacts on Black Rail Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Black Rail Habitat Lost to Future Development
Black Rail Habitat Lost after 1m SLR
Black Rail Habitat Gained after 1m SLR
Current Black Rail Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

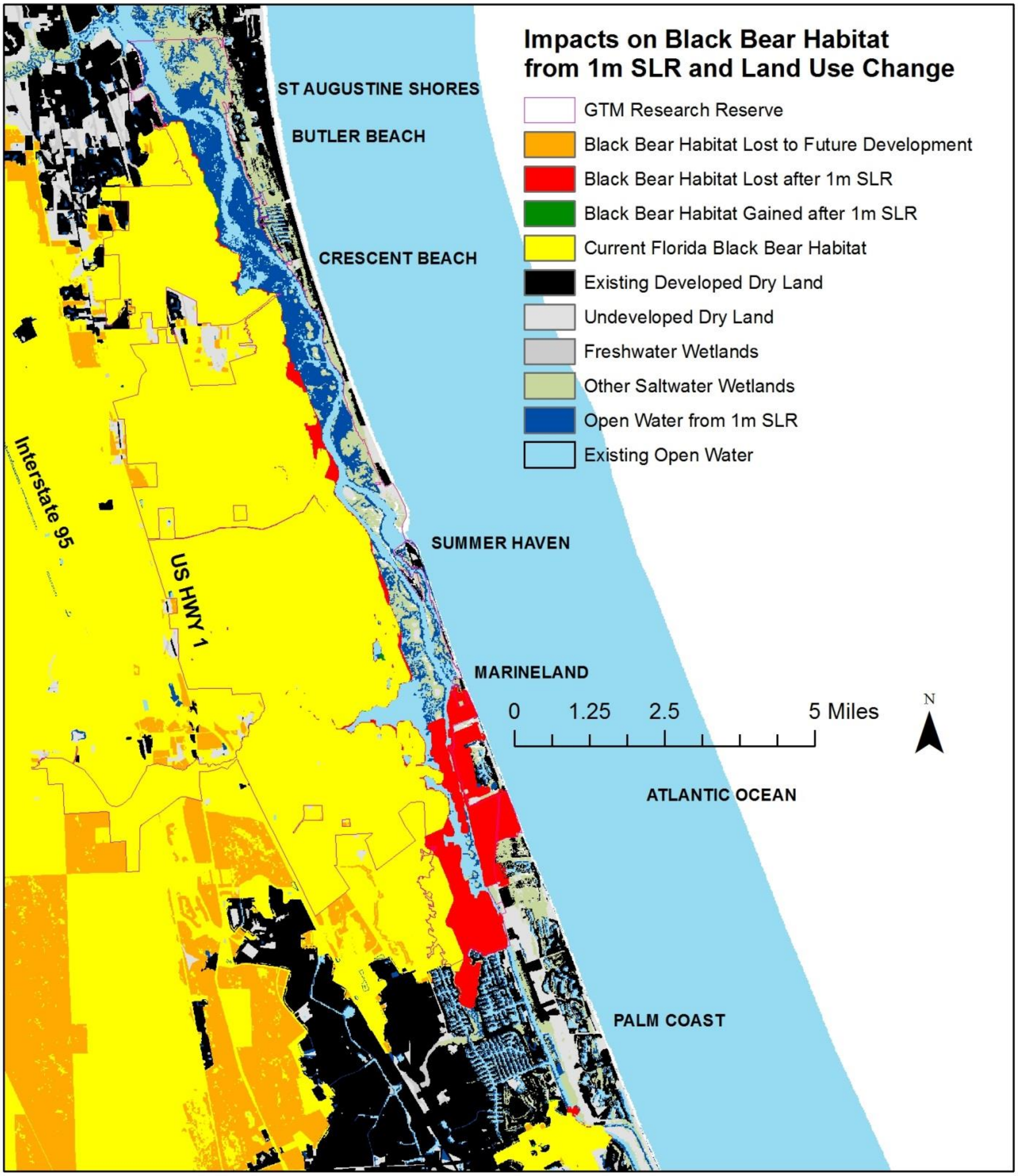

Impacts on Black Rail Habitat from 2.5m SLR
GTM Research Reserve
Black Rail Habitat Lost after 2.5m SLR
Black Rail Habitat Gained after 2.5m SLR
Current Black Rail Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on Diamondback Rattlesnake Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Diamondback Rattlesnake Habitat Lost to Future Development
Diamondback Rattlesnake Habitat Lost after 1m SLR
Diamondback Rattlesnake Habitat Gained after 1m SLR
Current Diamondback Rattlesnake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

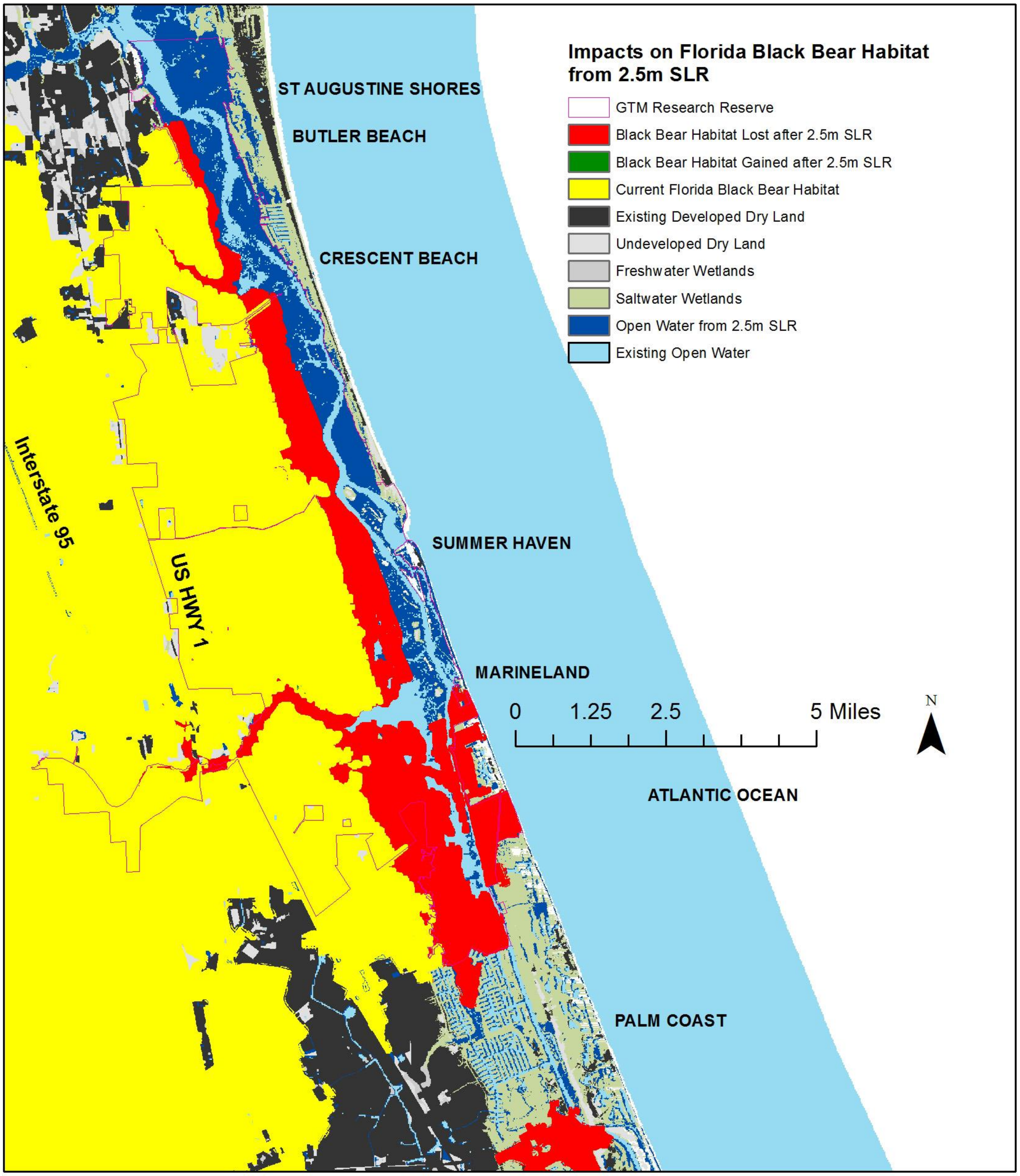

Impacts on Diamondback Rattlesnake Habitat from 2.5m SLR
GTM Research Reserve
Diamondback Rattlesnake Habitat Lost after 2.5m SLR
Diamondback Rattlesnake Habitat Gained after 2.5m SLR
Current Diamondback Rattlesnake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

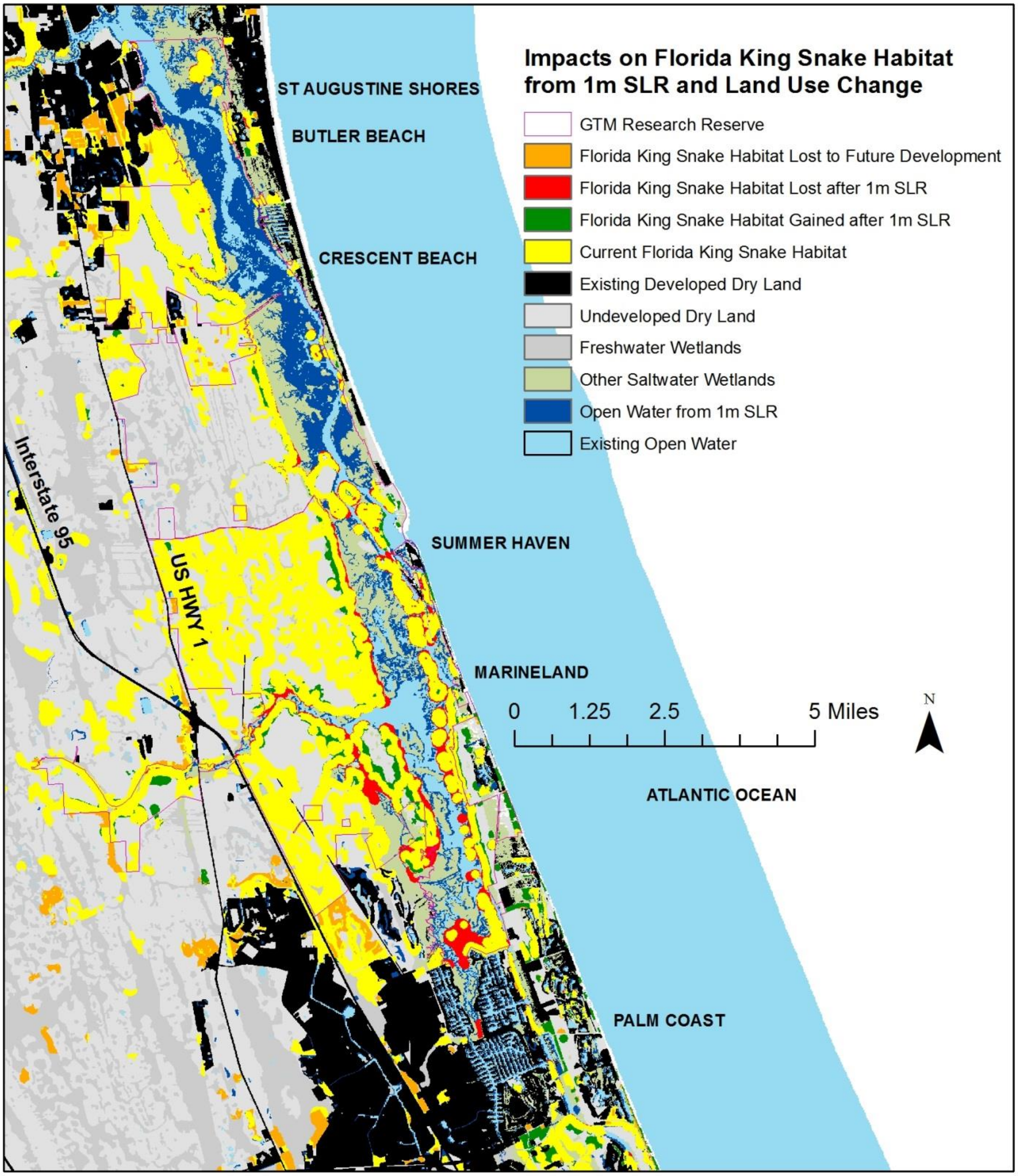

Impacts on Eastern Indigo Snake Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Eastern Indigo Snake Habitat Lost to Future Development
Eastern Indigo Snake Habitat Lost after 1m SLR
Eastern Indigo Snake Habitat Gained after 1m SLR
Current Eastern Indigo Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

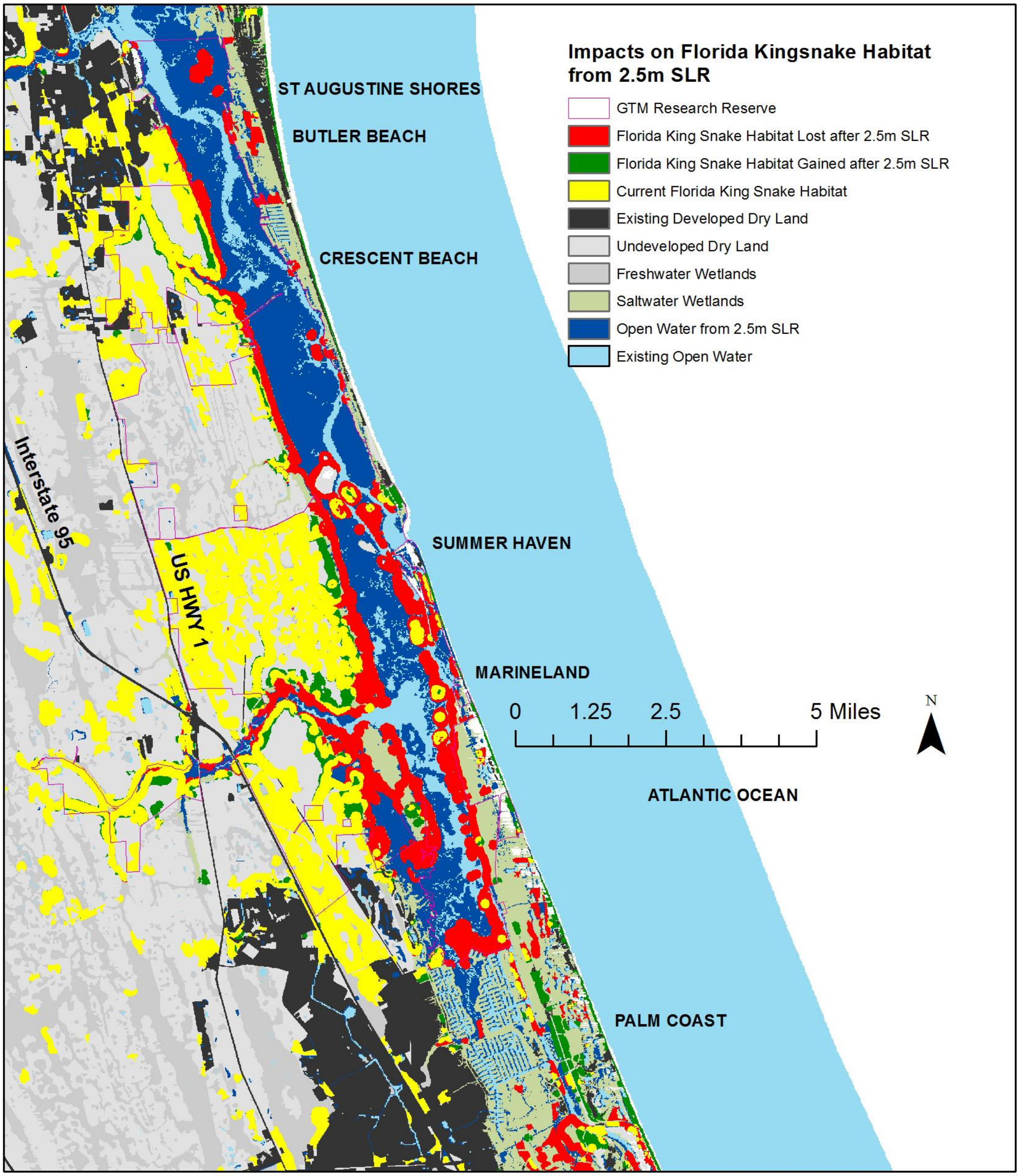

Impacts on Eastern Indigo Snake Habitat from 2.5m SLR
GTM Research Reserve
Eastern Indigo Snake Habitat Lost after 2.5m SLR
Eastern Indigo Snake Habitat Gained after 2.5m SLR
Current Eastern Indigo Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



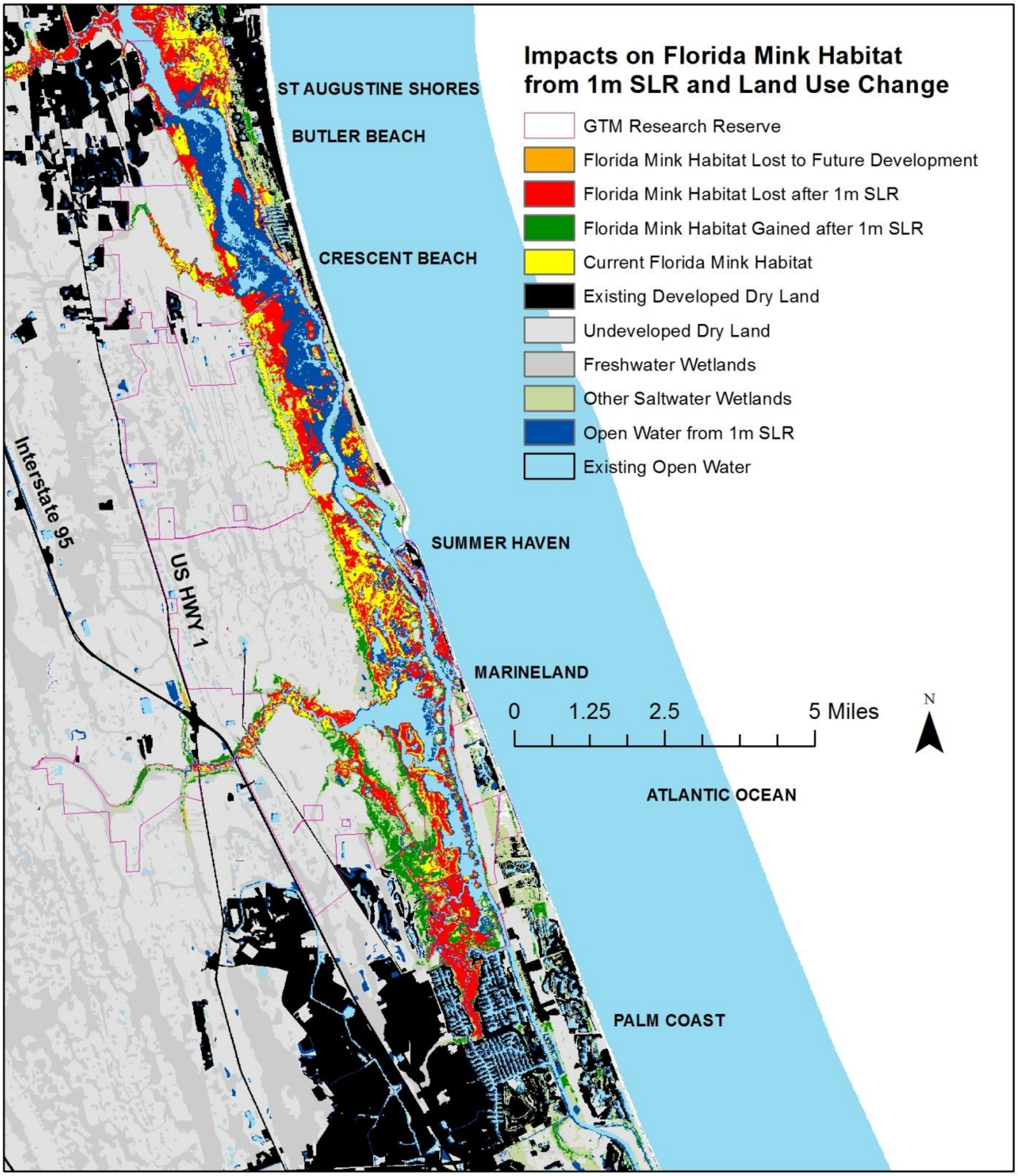
Impacts on Black Bear Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Black Bear Habitat Lost to Future Development
Black Bear Habitat Lost after 1m SLR
Black Bear Habitat Gained after 1m SLR
Current Florida Black Bear Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

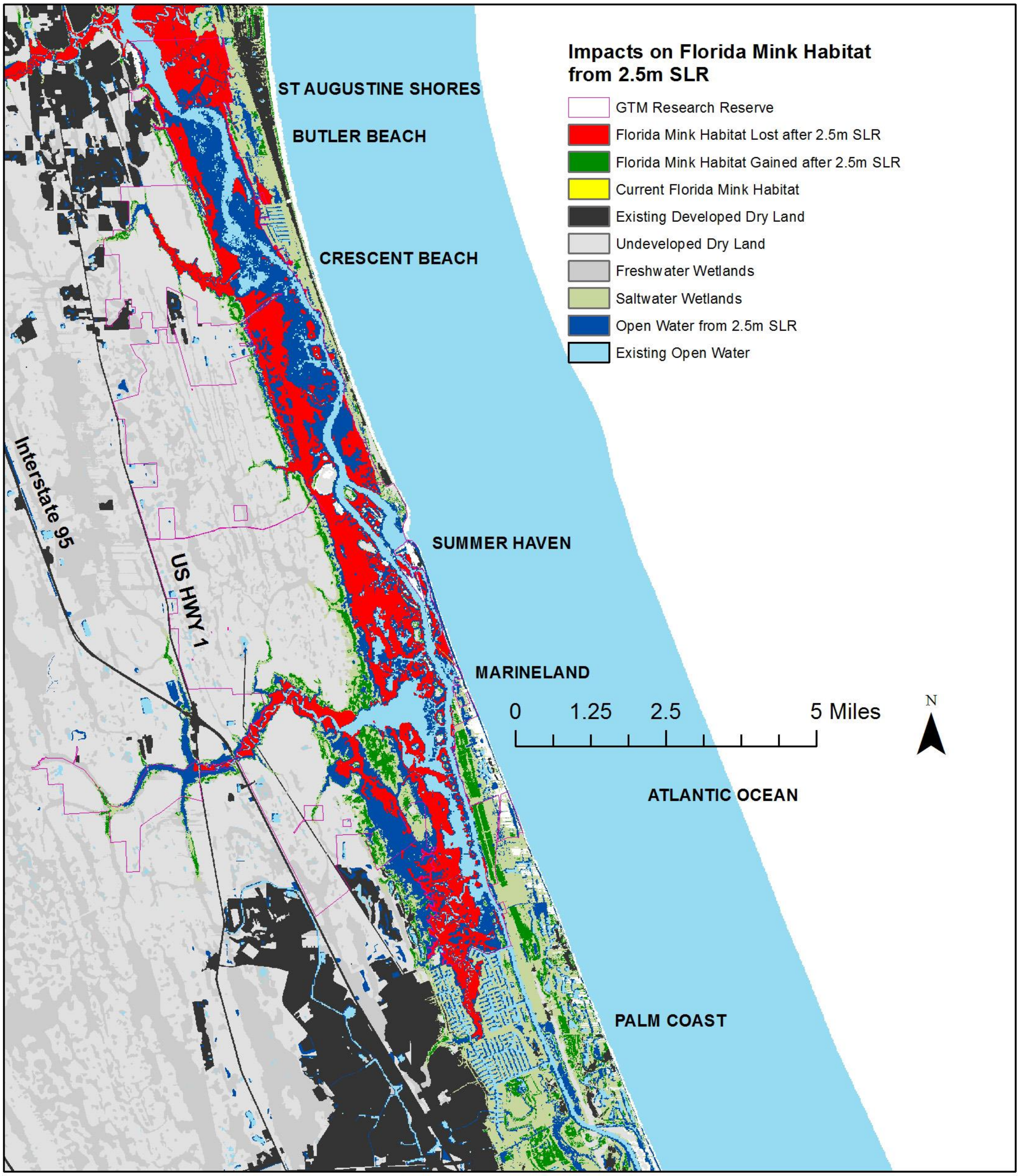

Impacts on Florida Black Bear Habitat from 2.5m SLR
GTM Research Reserve
Black Bear Habitat Lost after 2.5m SLR
Black Bear Habitat Gained after 2.5m SLR
Current Florida Black Bear Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

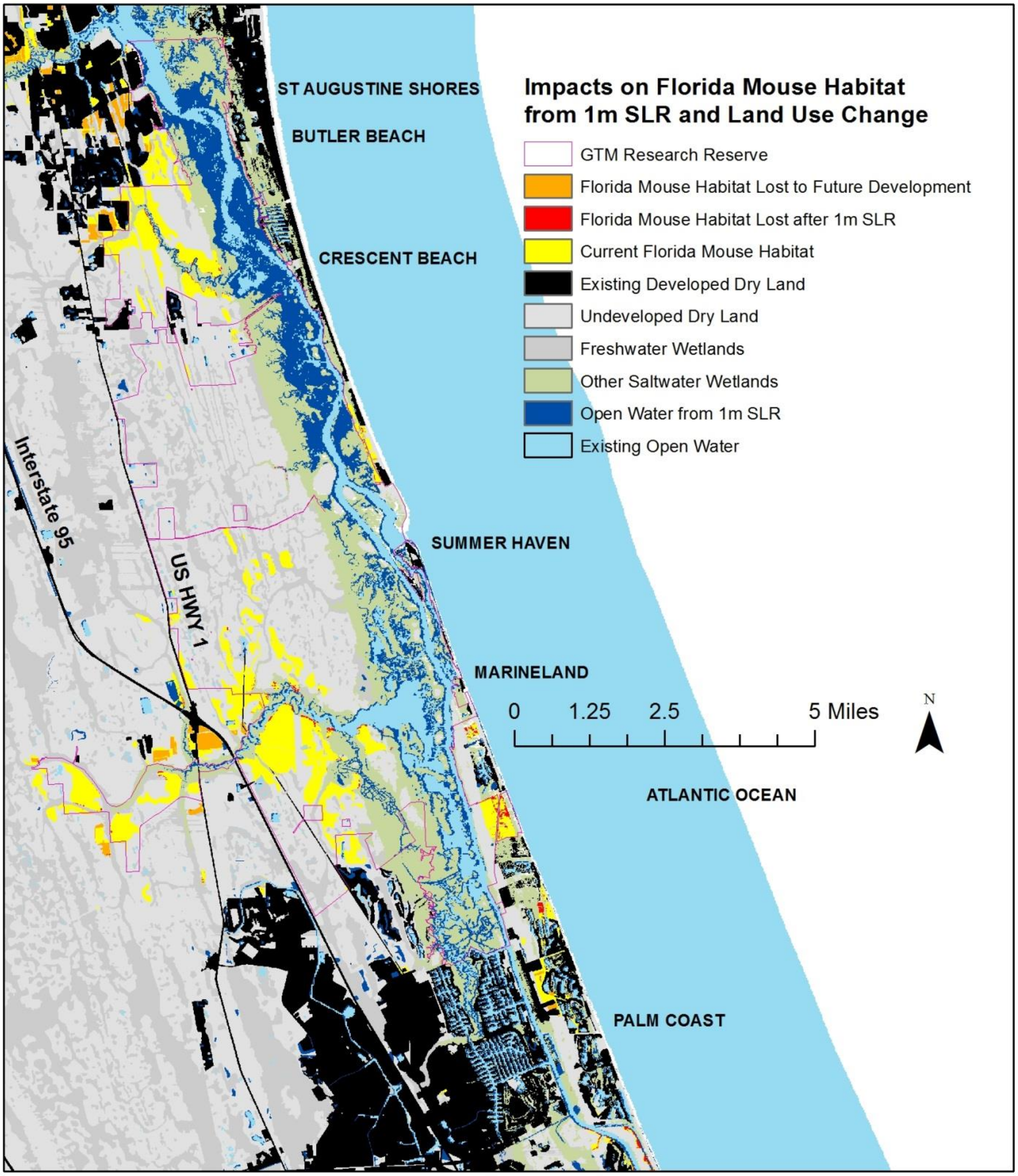

Impacts on Florida King Snake Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Florida King Snake Habitat Lost to Future Development
Florida King Snake Habitat Lost after 1m SLR
Florida King Snake Habitat Gained after 1m SLR
Current Florida King Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

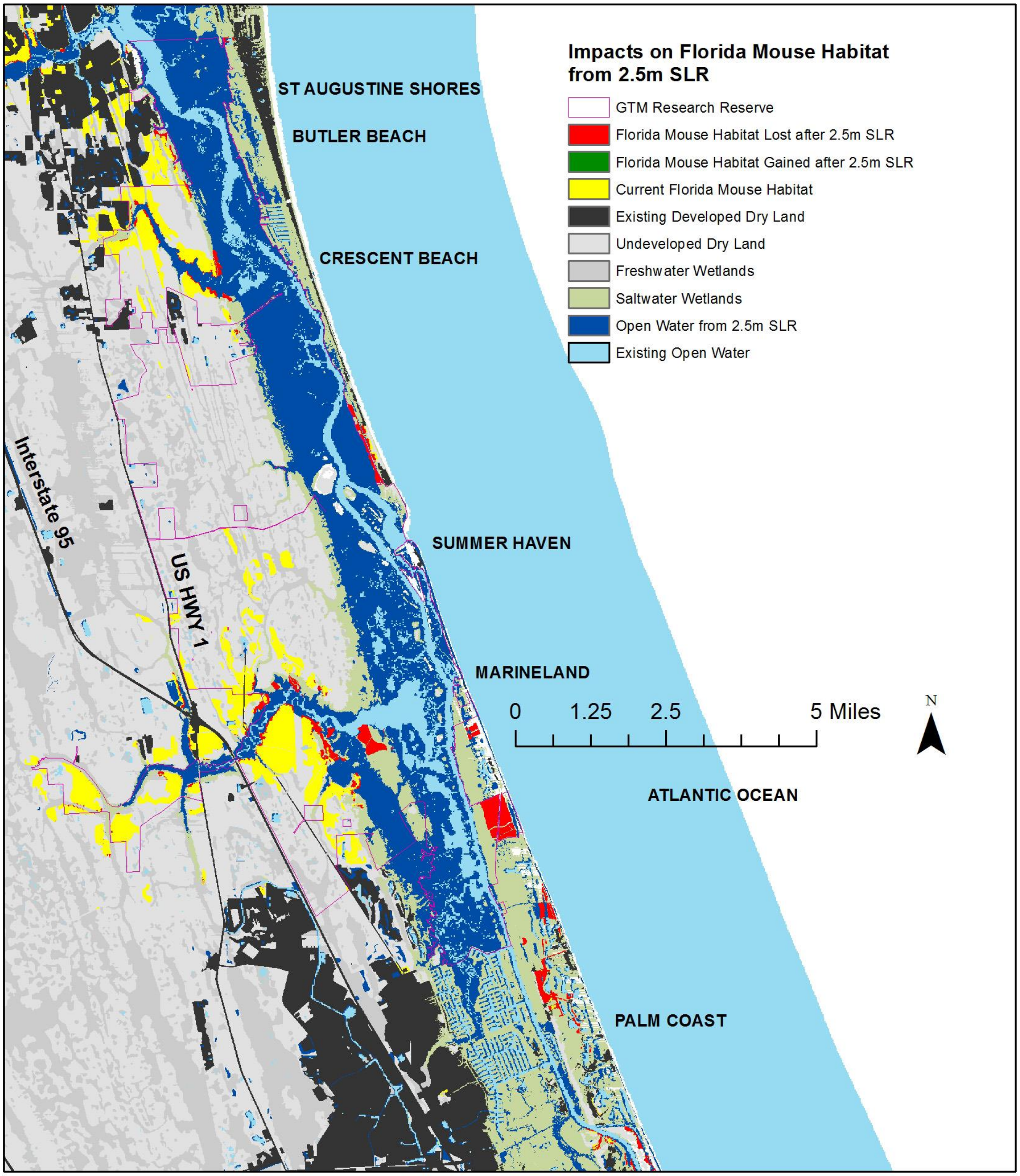


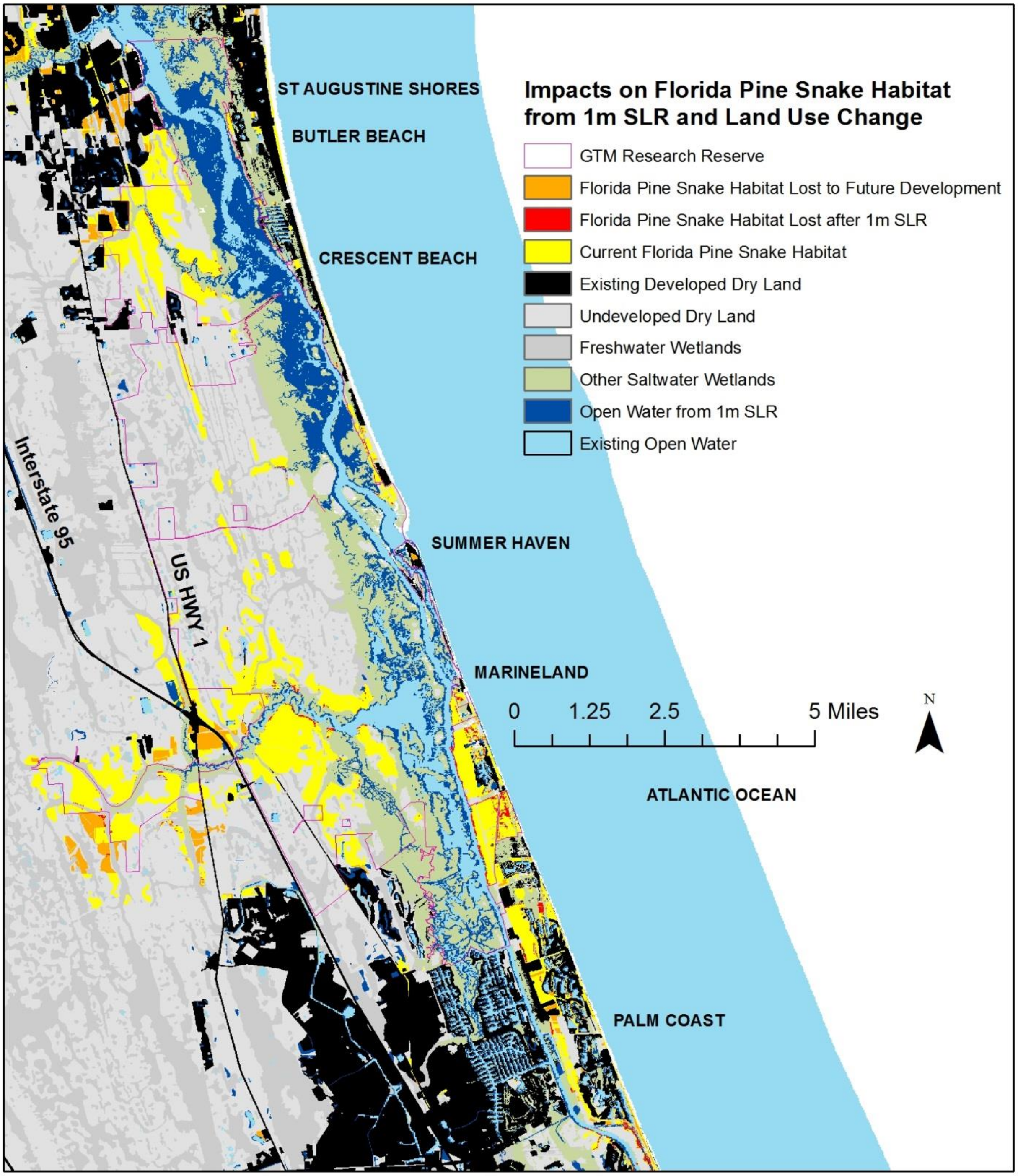
Impacts on Florida Kingsnake Habitat from 2.5m SLR
GTM Research Reserve
Florida King Snake Habitat Lost after 2.5m SLR
Florida King Snake Habitat Gained after 2.5m SLR
Current Florida King Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

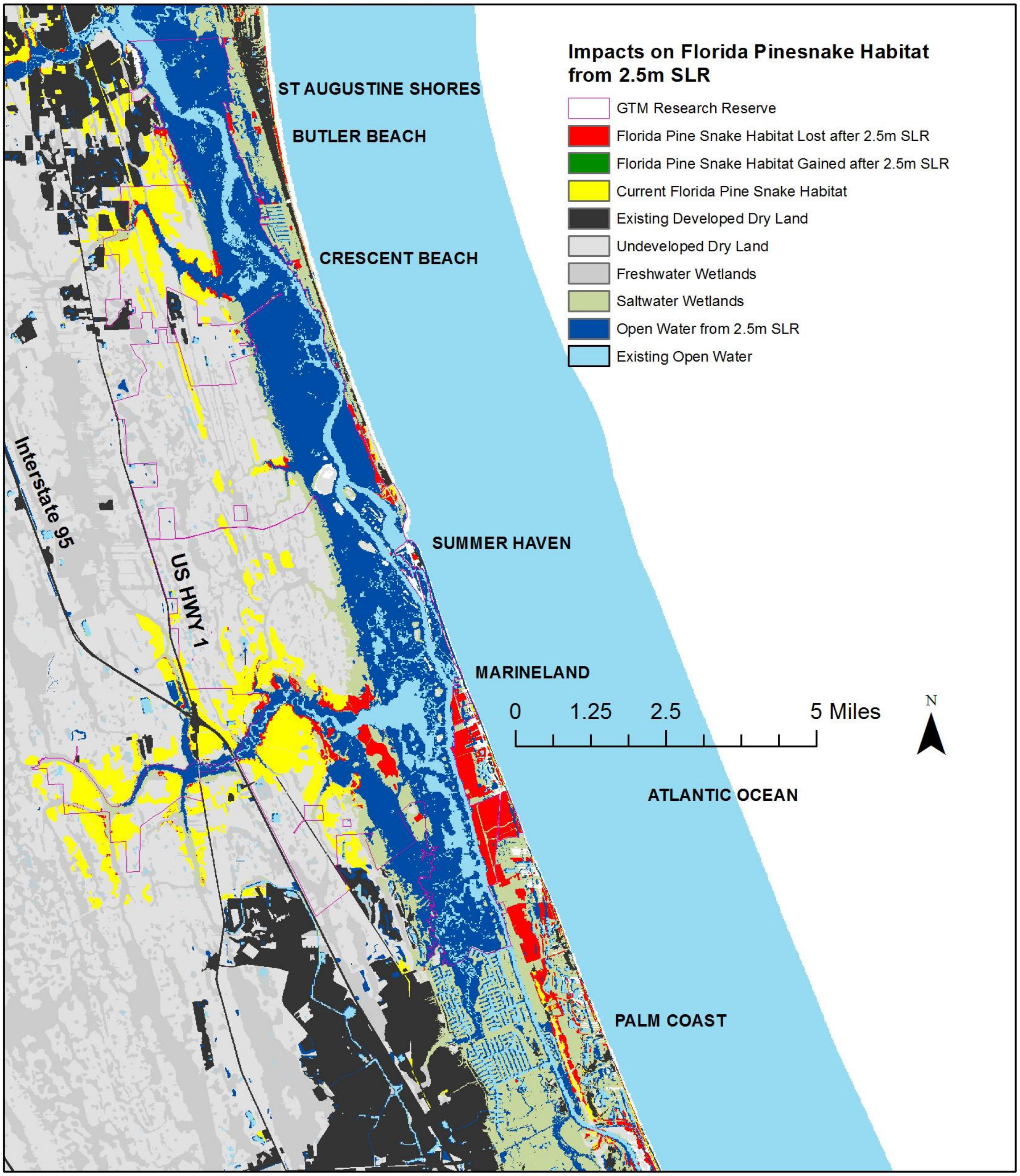

Impacts on Florida Mink Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Florida Mink Habitat Lost to Future Development
Florida Mink Habitat Lost after 1m SLR
Florida Mink Habitat Gained after 1m SLR
Current Florida Mink Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

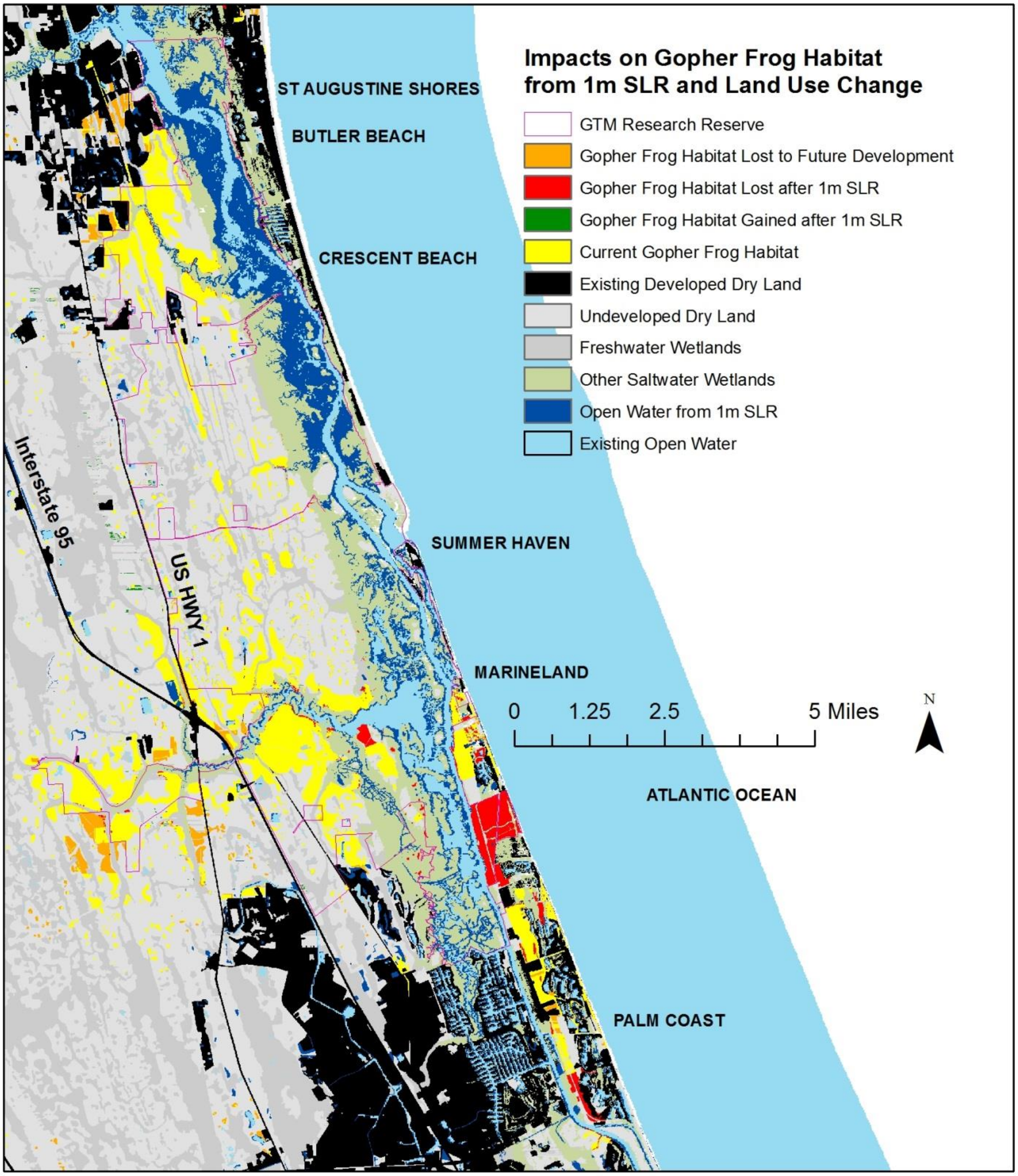

Impacts on Florida Mink Habitat from 2.5m SLR
GTM Research Reserve
Florida Mink Habitat Lost after 2.5m SLR
Florida Mink Habitat Gained after 2.5m SLR
Current Florida Mink Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

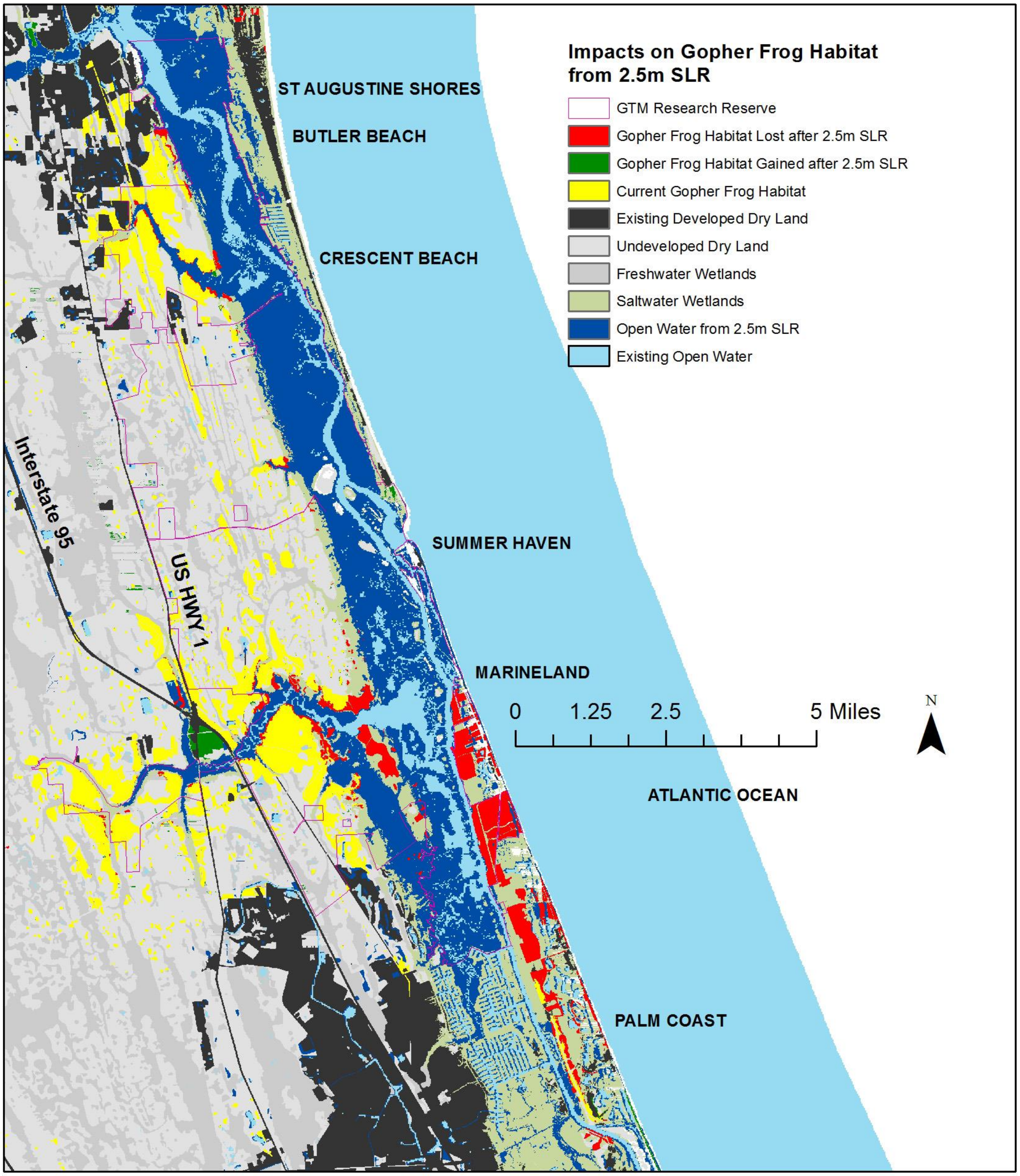

Impacts on Florida Mouse Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Florida Mouse Habitat Lost to Future Development
Florida Mouse Habitat Lost after 1m SLR
Current Florida Mouse Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

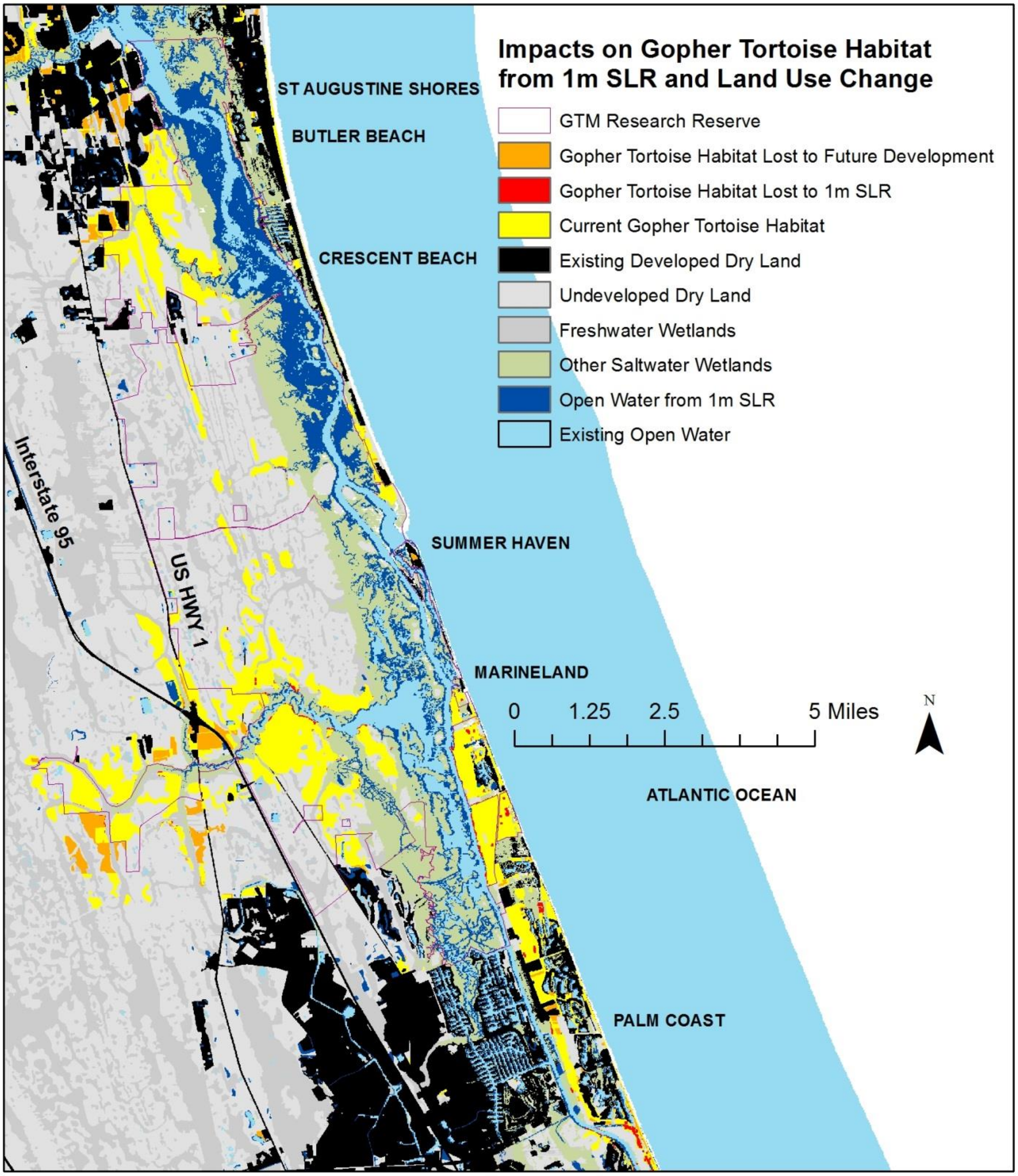

Impacts on Florida Mouse Habitat from 2.5m SLR
GTM Research Reserve
Florida Mouse Habitat Lost after 2.5m SLR
Florida Mouse Habitat Gained after 2.5m SLR
Current Florida Mouse Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

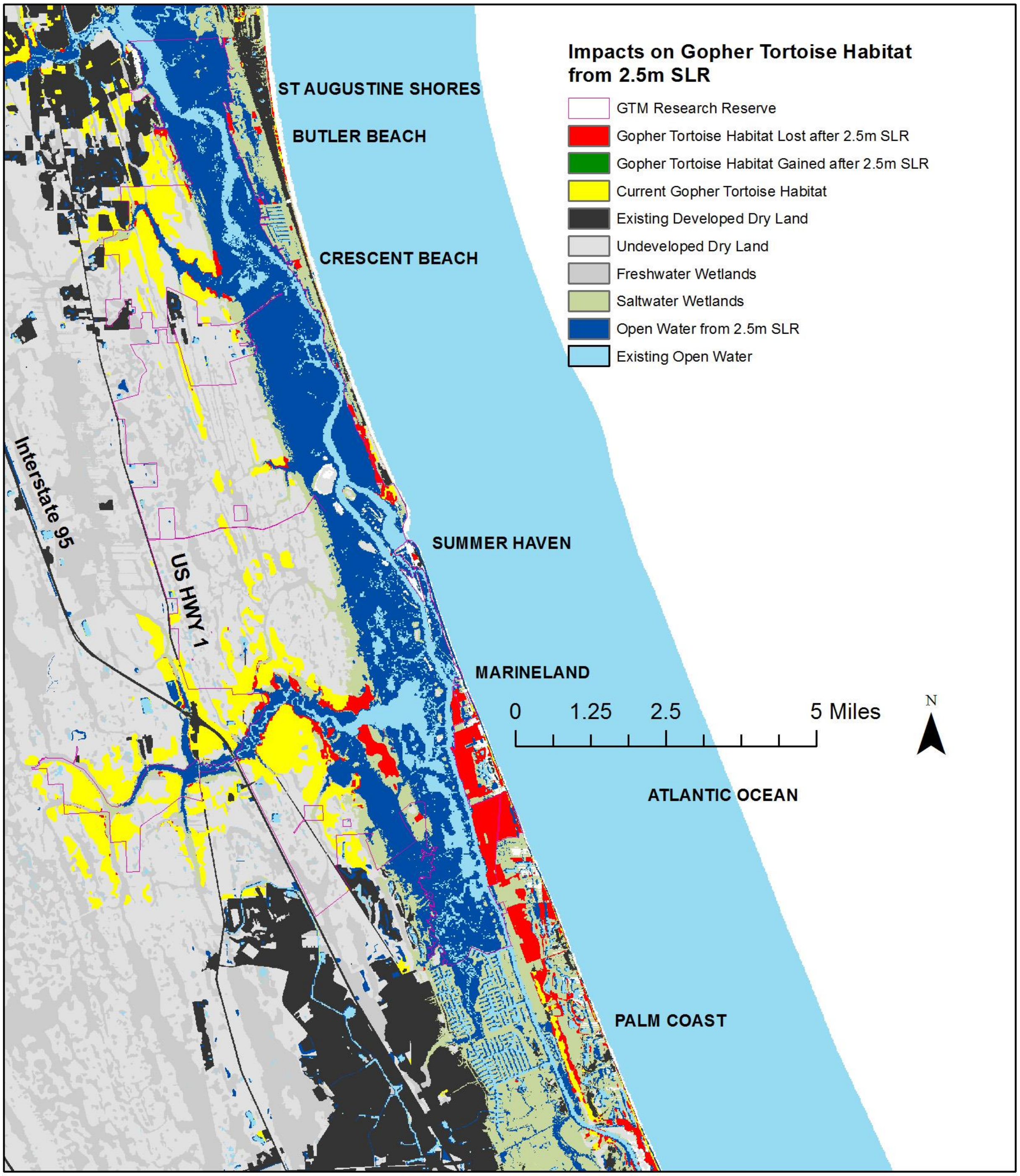

Impacts on Florida Pine Snake Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Florida Pine Snake Habitat Lost to Future Development
Florida Pine Snake Habitat Lost after 1m SLR
Current Florida Pine Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Florida Pinesnake Habitat from 2.5m SLR
GTM Research Reserve
Florida Pine Snake Habitat Lost after 2.5m SLR
Florida Pine Snake Habitat Gained after 2.5m SLR
Current Florida Pine Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

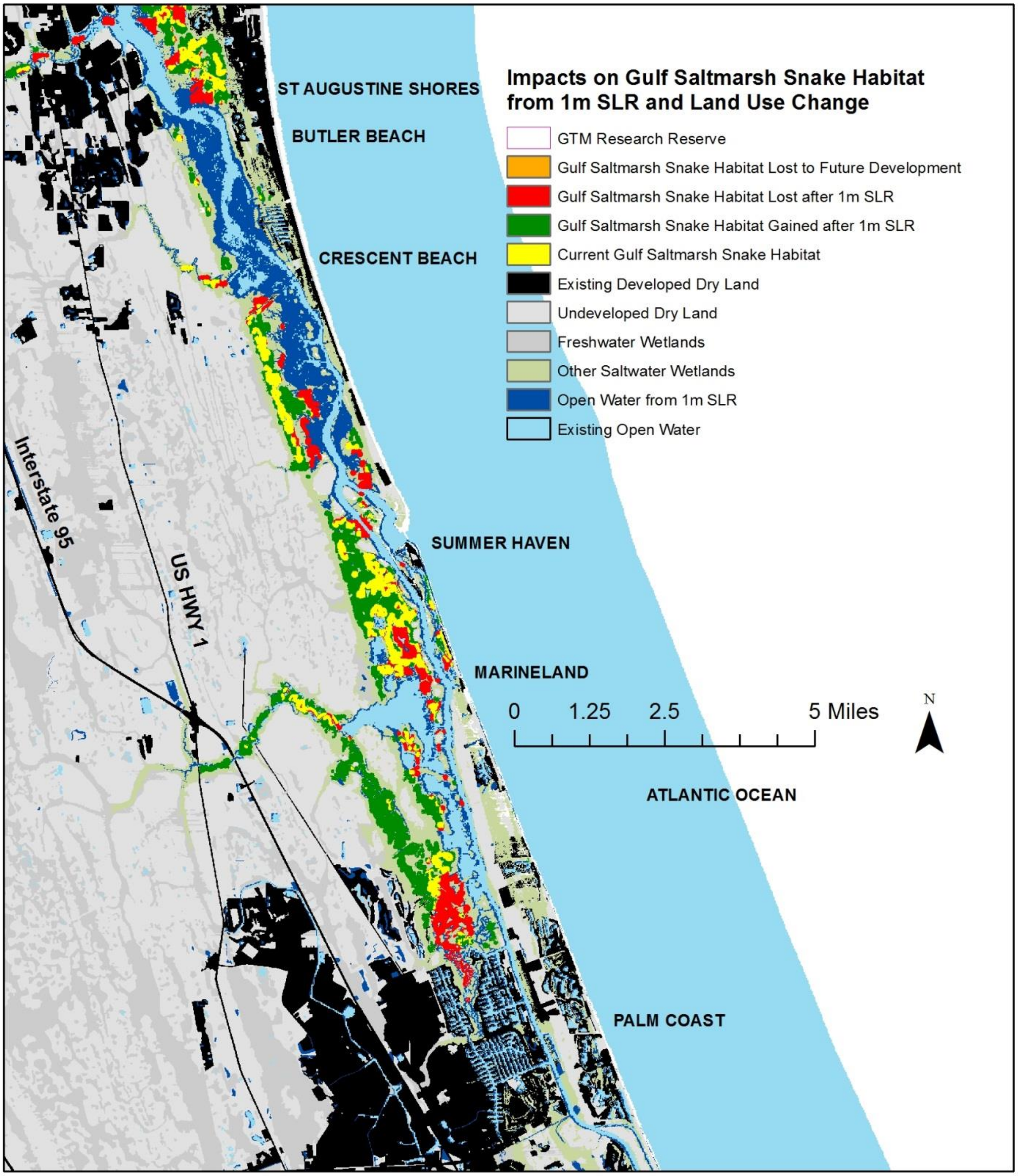

Impacts on Gopher Frog Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Gopher Frog Habitat Lost to Future Development
Gopher Frog Habitat Lost after 1m SLR
Gopher Frog Habitat Gained after 1m SLR
Current Gopher Frog Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Gopher Frog Habitat from 2.5m SLR
GTM Research Reserve
Gopher Frog Habitat Lost after 2.5m SLR
Gopher Frog Habitat Gained after 2.5m SLR
Current Gopher Frog Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Gopher Tortoise Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Gopher Tortoise Habitat Lost to Future Development
Gopher Tortoise Habitat Lost to 1m SLR
Current Gopher Tortoise Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Gopher Tortoise Habitat from 2.5m SLR
GTM Research Reserve
Gopher Tortoise Habitat Lost after 2.5m SLR
Gopher Tortoise Habitat Gained after 2.5m SLR
Current Gopher Tortoise Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Gulf Saltmarsh Snake Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Gulf Saltmarsh Snake Habitat Lost to Future Development
Gulf Saltmarsh Snake Habitat Lost after 1m SLR
Gulf Saltmarsh Snake Habitat Gained after 1m SLR
Current Gulf Saltmarsh Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
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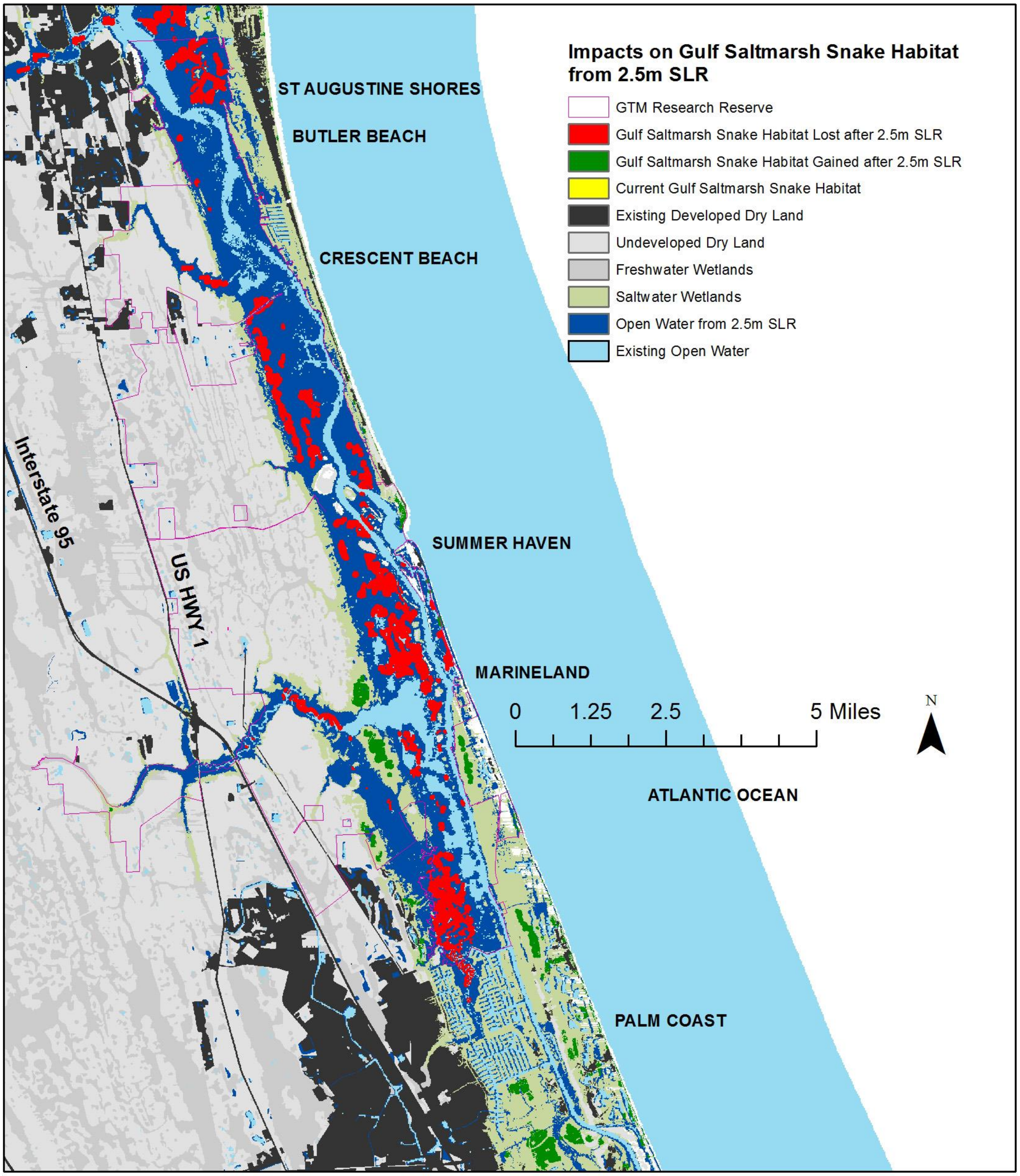
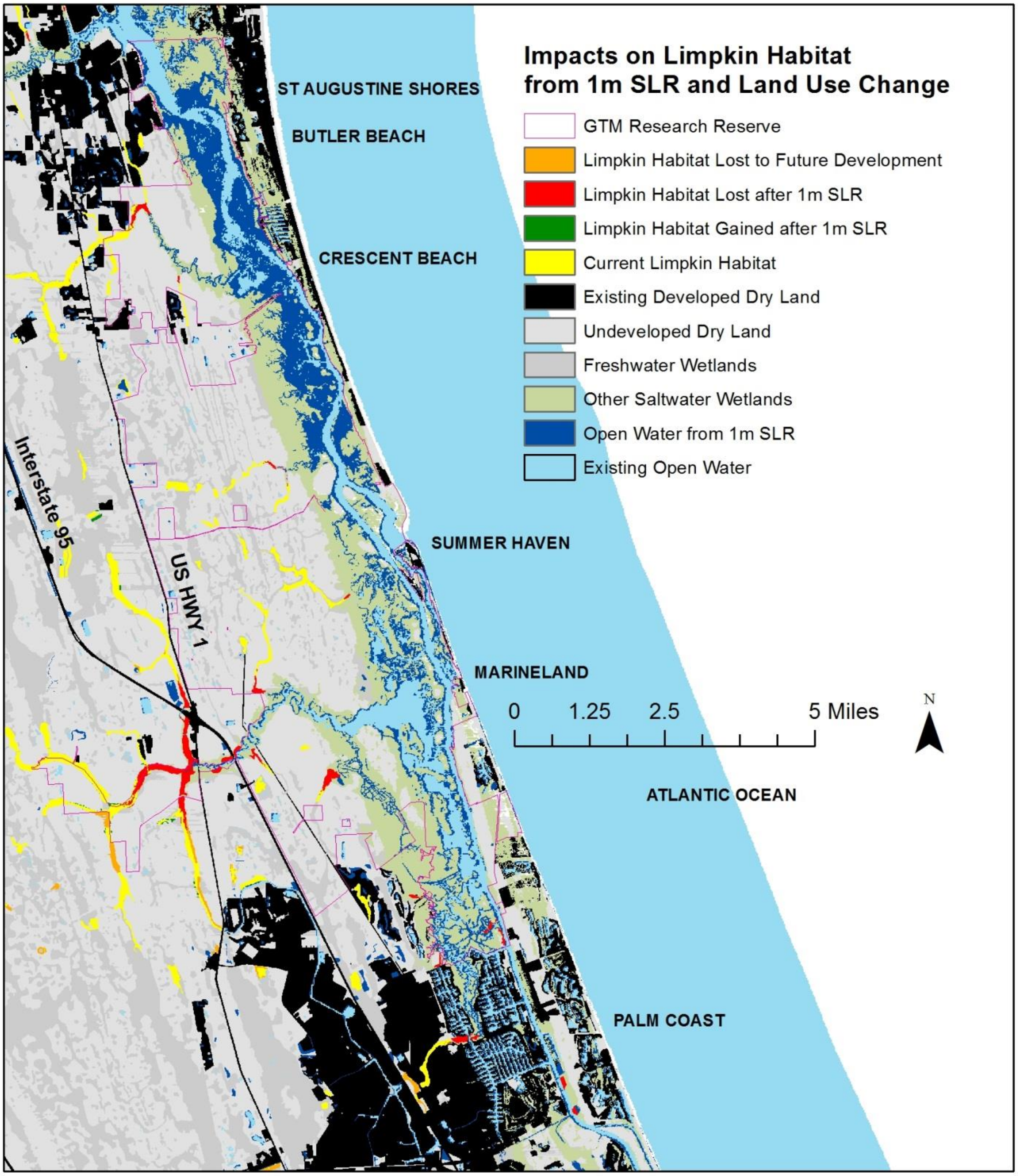
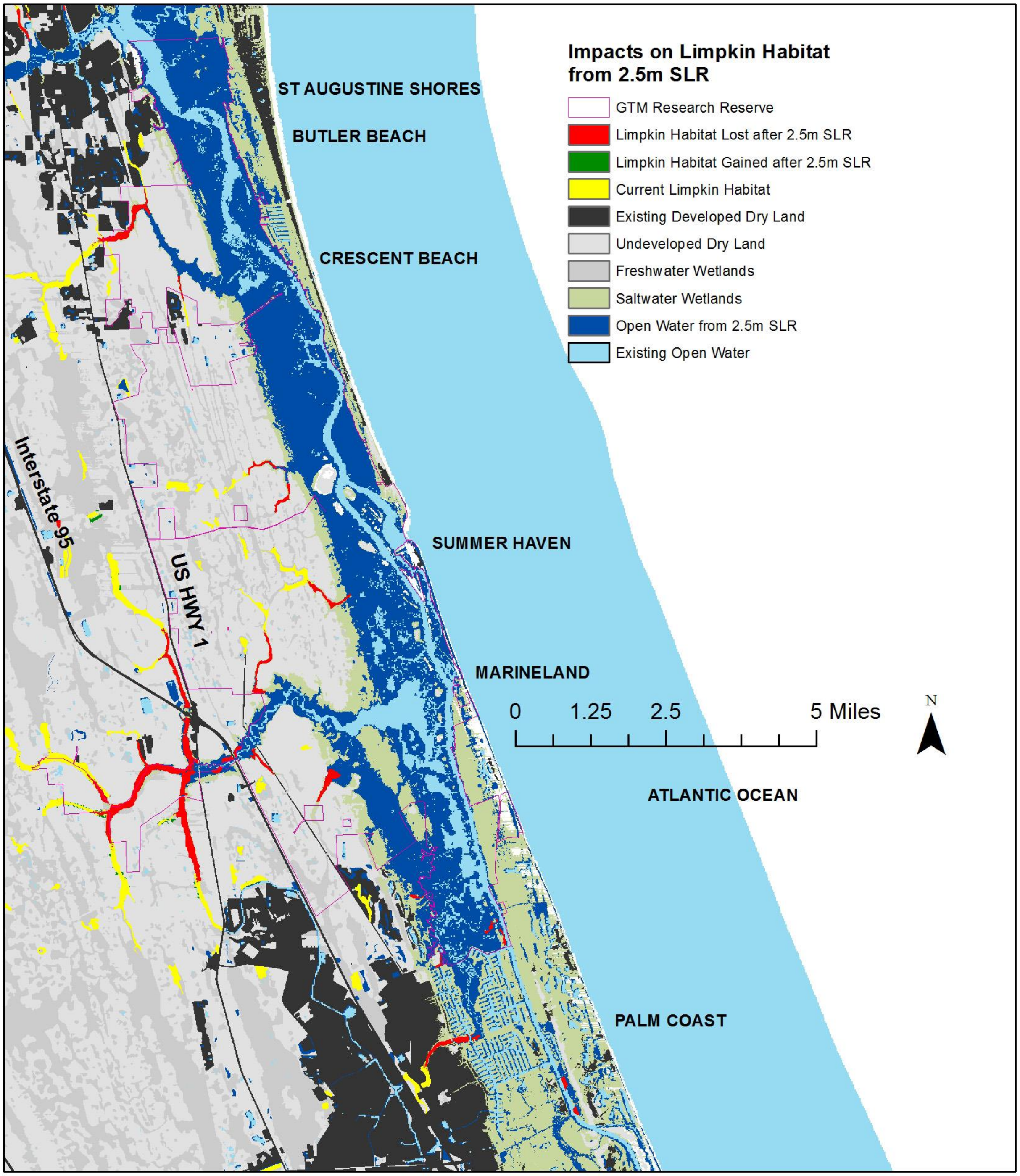
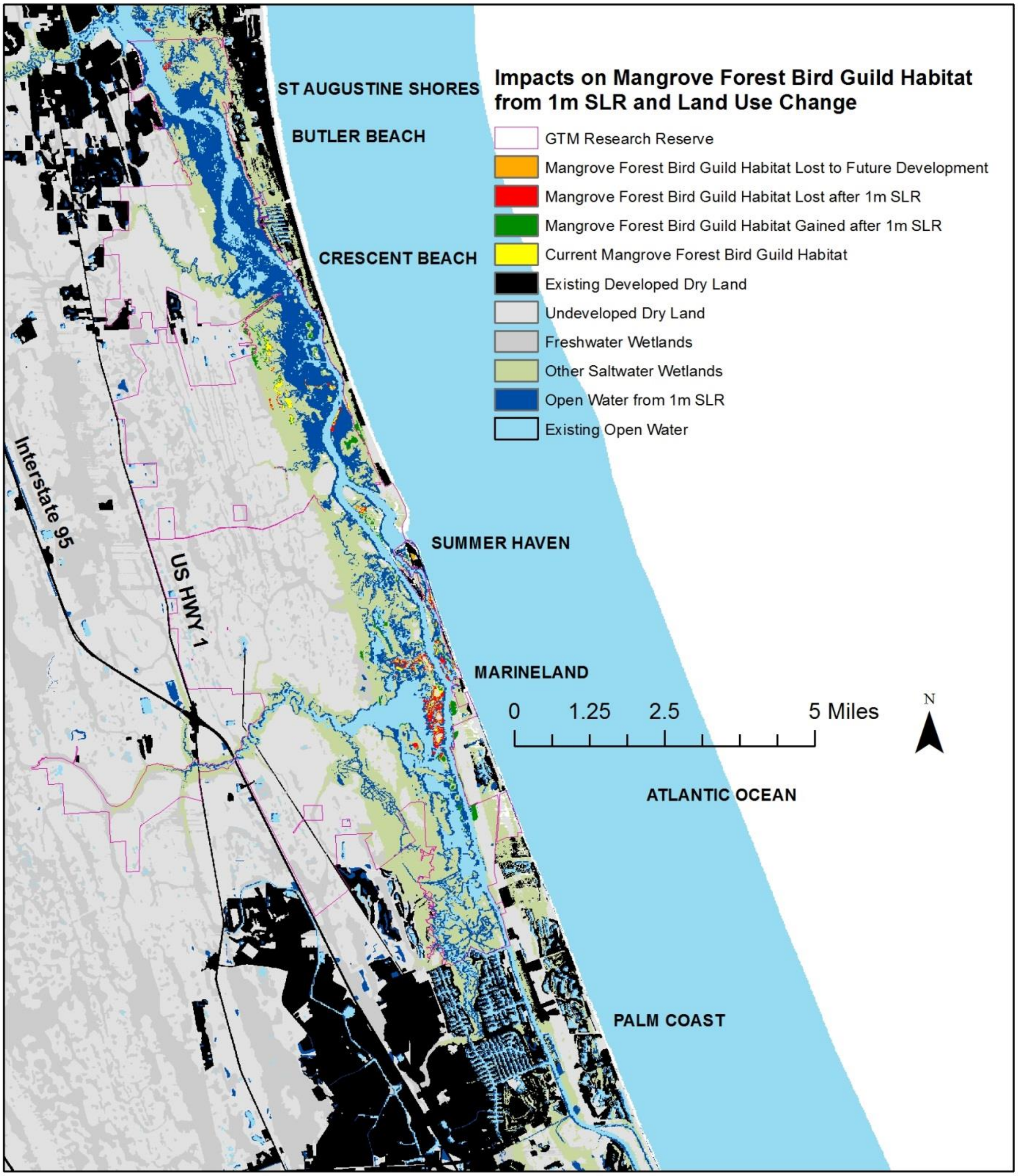
1.25
2.5
5 Miles
N

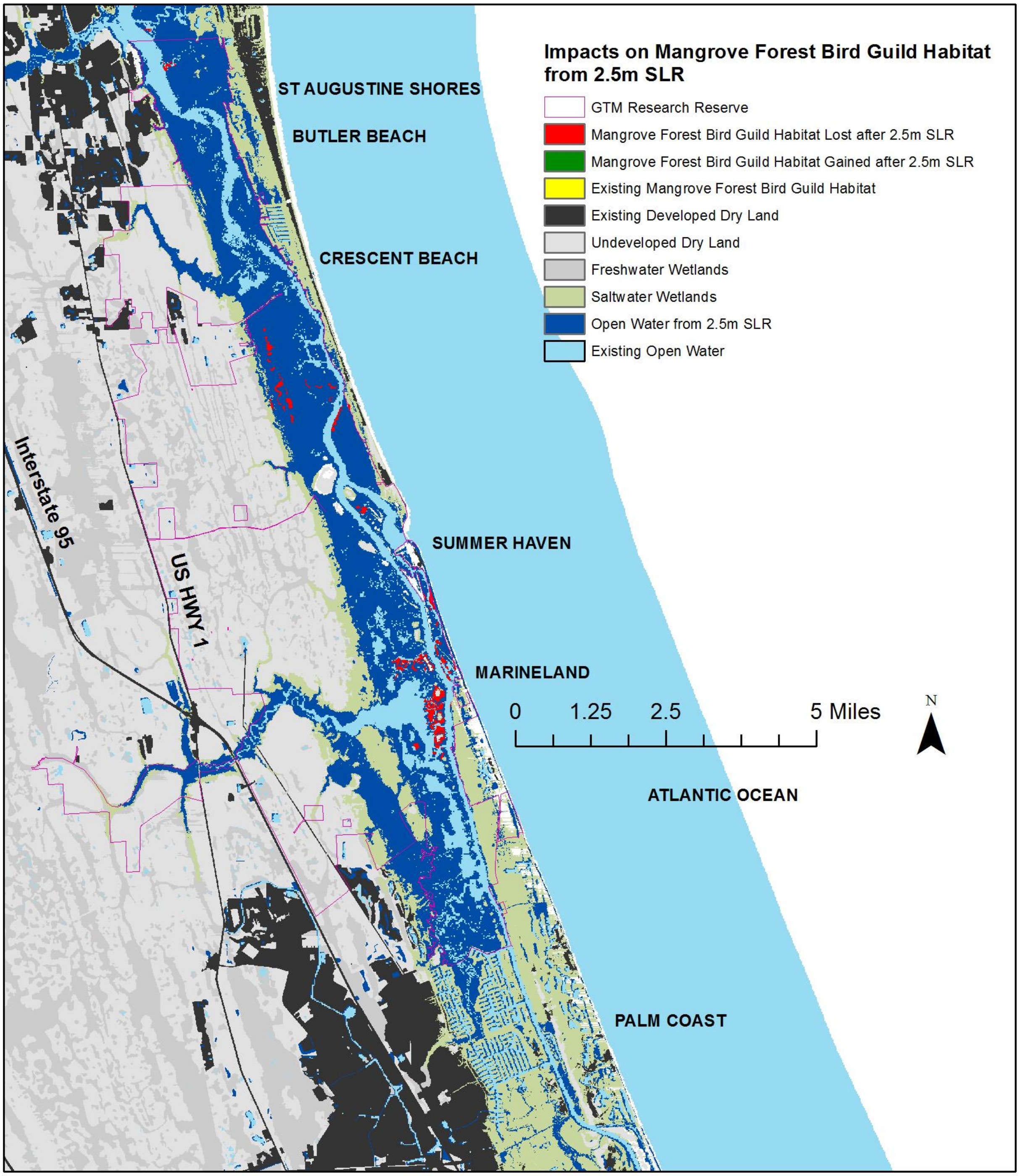

Impacts on Gulf Saltmarsh Snake Habitat from 2.5m SLR
GTM Research Reserve
Gulf Saltmarsh Snake Habitat Lost after 2.5m SLR
Gulf Saltmarsh Snake Habitat Gained after 2.5m SLR
Current Gulf Saltmarsh Snake Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

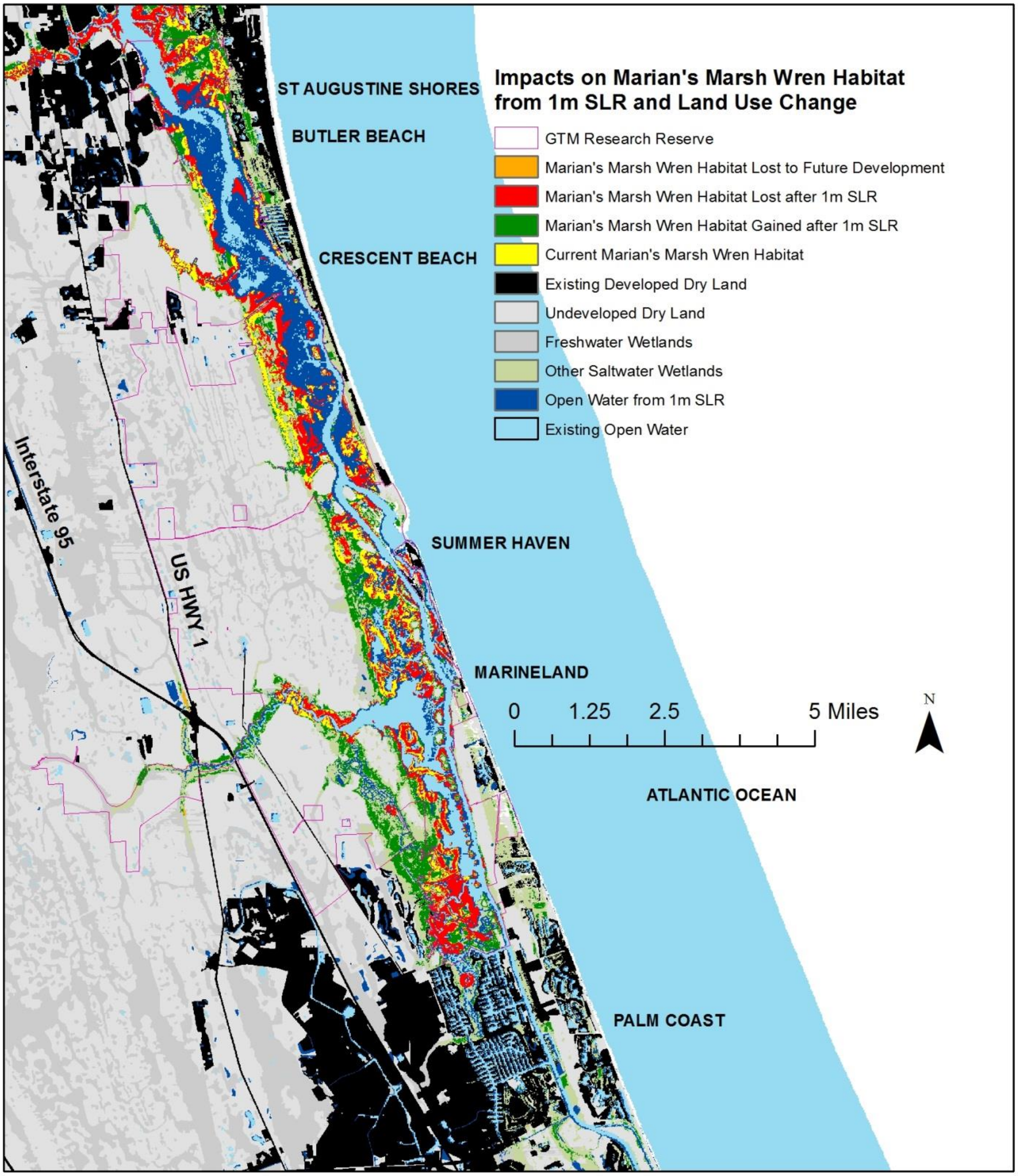

Impacts on Limpkin Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Limpkin Habitat Lost to Future Development
Limpkin Habitat Lost after 1m SLR
Limpkin Habitat Gained after 1m SLR
Current Limpkin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Limpkin Habitat from 2.5m SLR
GTM Research Reserve
Limpkin Habitat Lost after 2.5m SLR
Limpkin Habitat Gained after 2.5m SLR
Current Limpkin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Mangrove Forest Bird Guild Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Mangrove Forest Bird Guild Habitat Lost to Future Development
Mangrove Forest Bird Guild Habitat Lost after 1m SLR
Mangrove Forest Bird Guild Habitat Gained after 1m SLR
Current Mangrove Forest Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Mangrove Forest Bird Guild Habitat from 2.5m SLR
GTM Research Reserve
Mangrove Forest Bird Guild Habitat Lost after 2.5m SLR
Mangrove Forest Bird Guild Habitat Gained after 2.5m SLR
Existing Mangrove Forest Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Marian's Marsh Wren Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Marian's Marsh Wren Habitat Lost to Future Development
Marian's Marsh Wren Habitat Lost after 1m SLR
Marian's Marsh Wren Habitat Gained after 1m SLR
Current Marian's Marsh Wren Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
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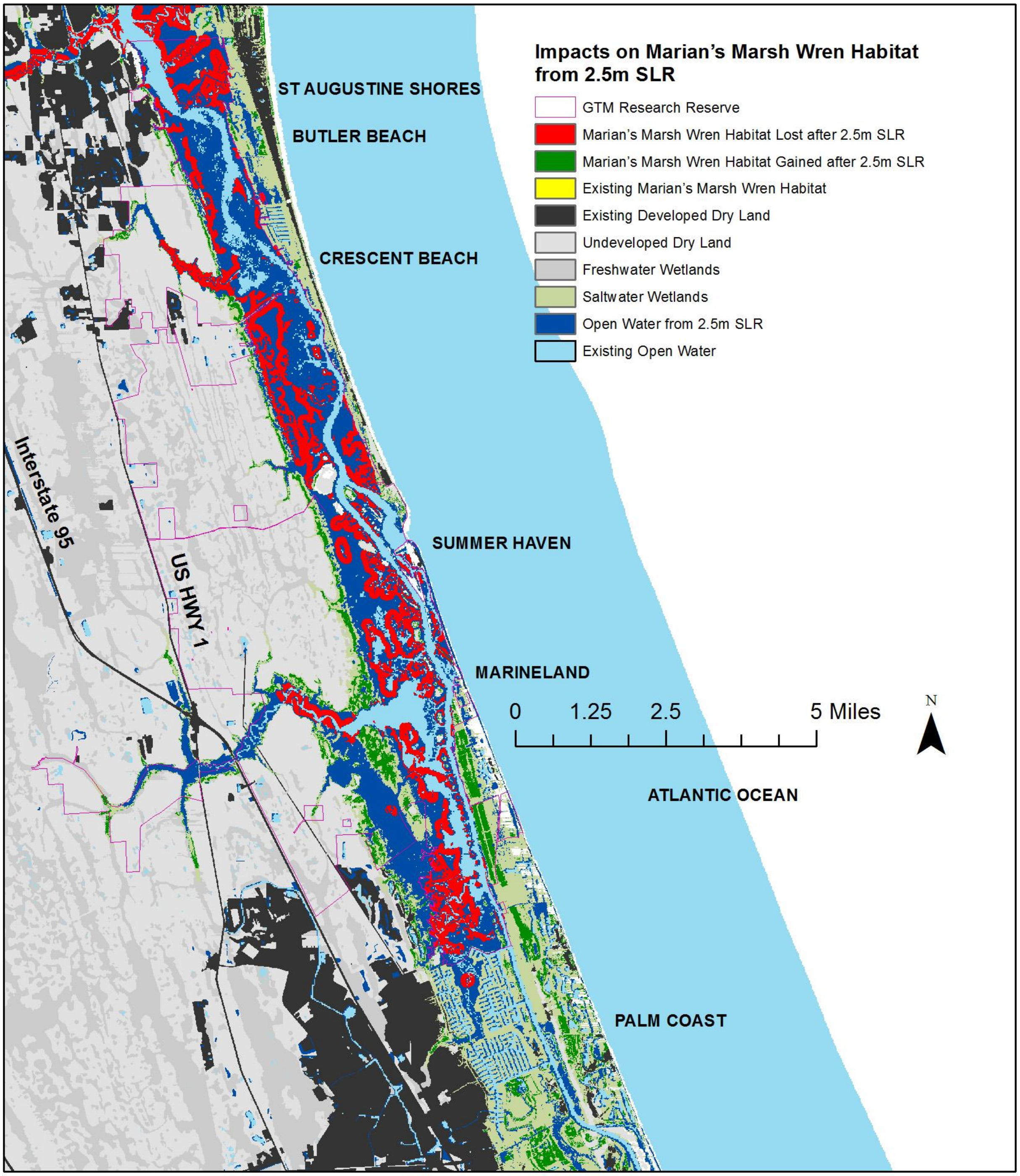
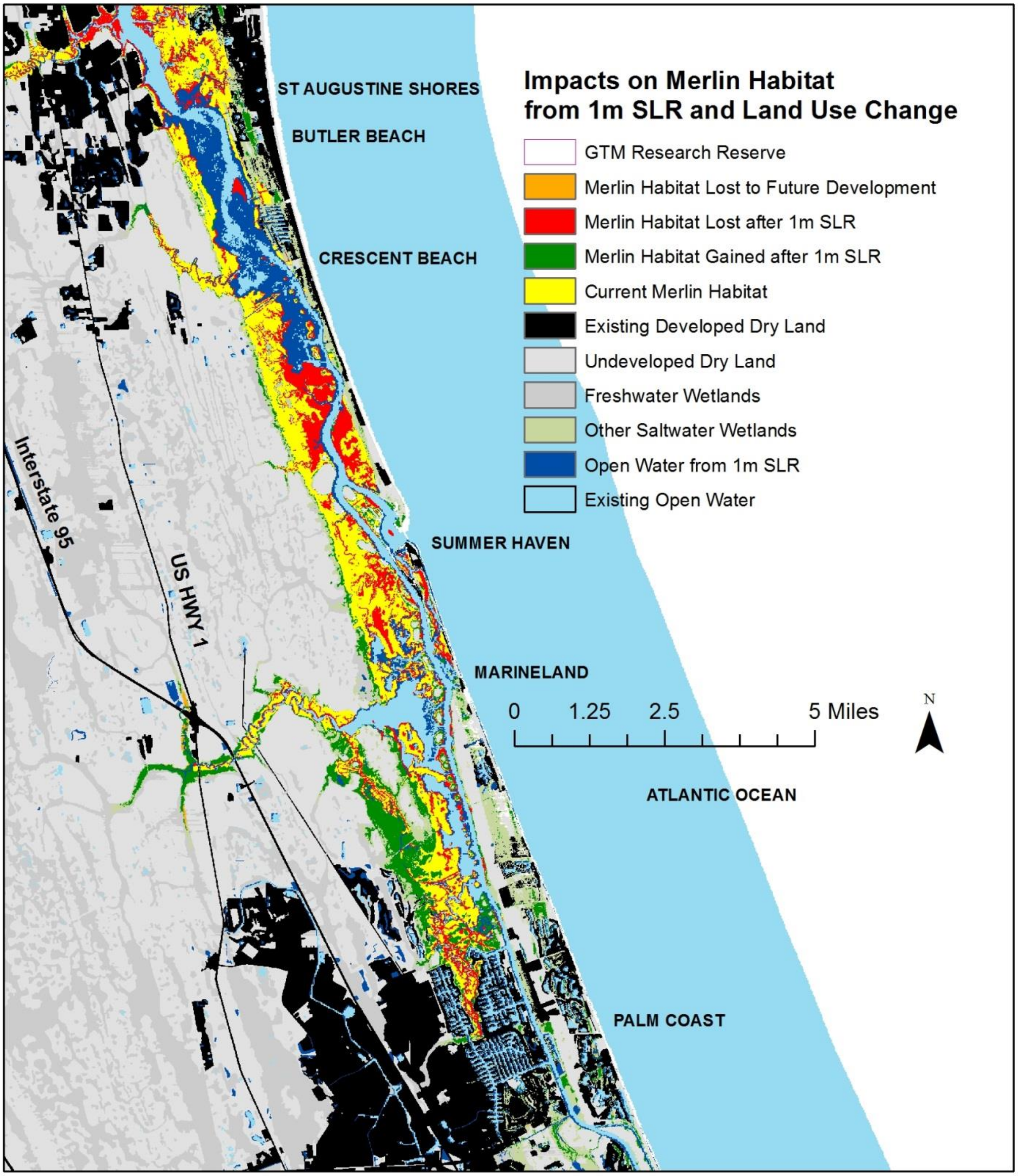
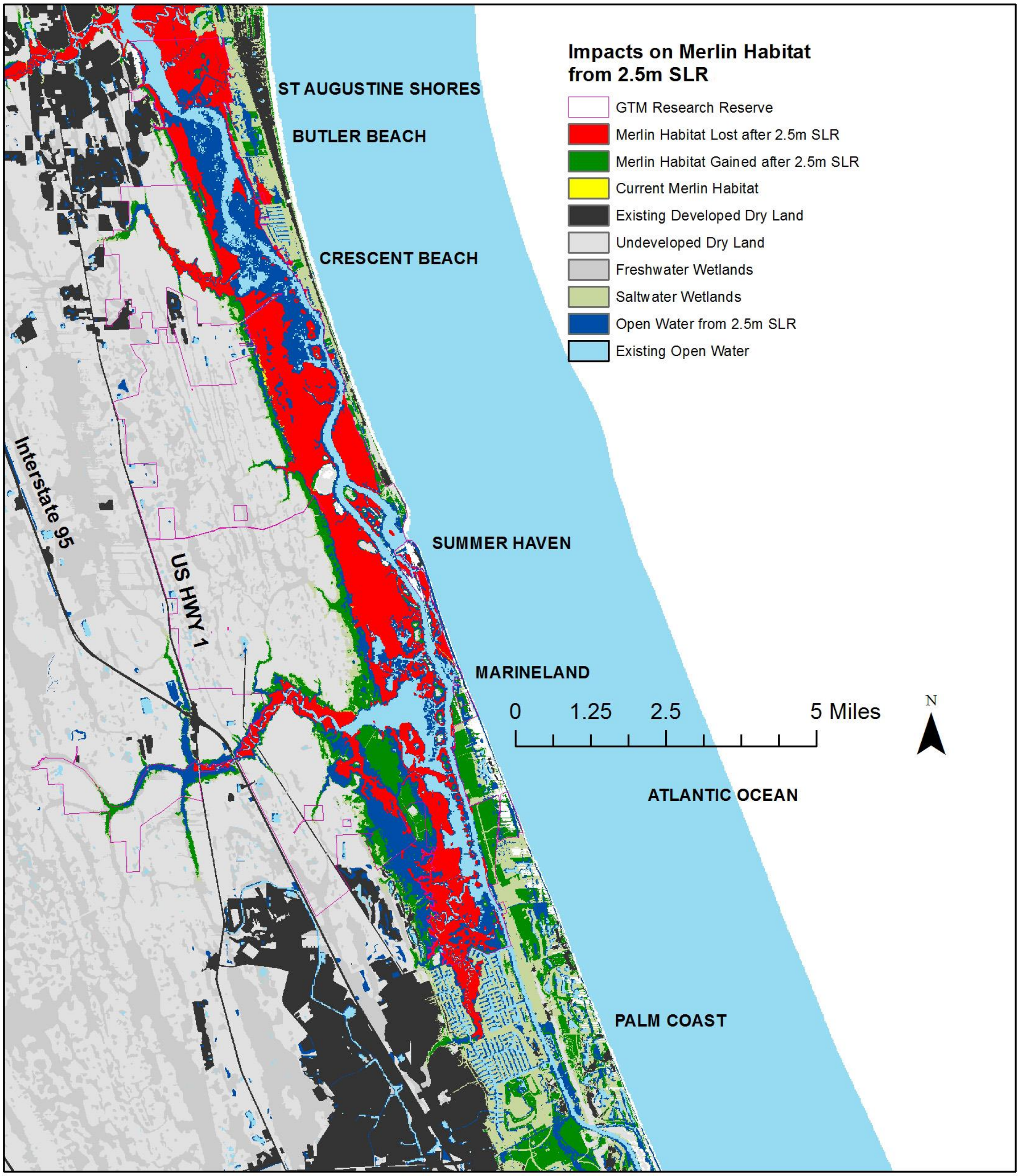
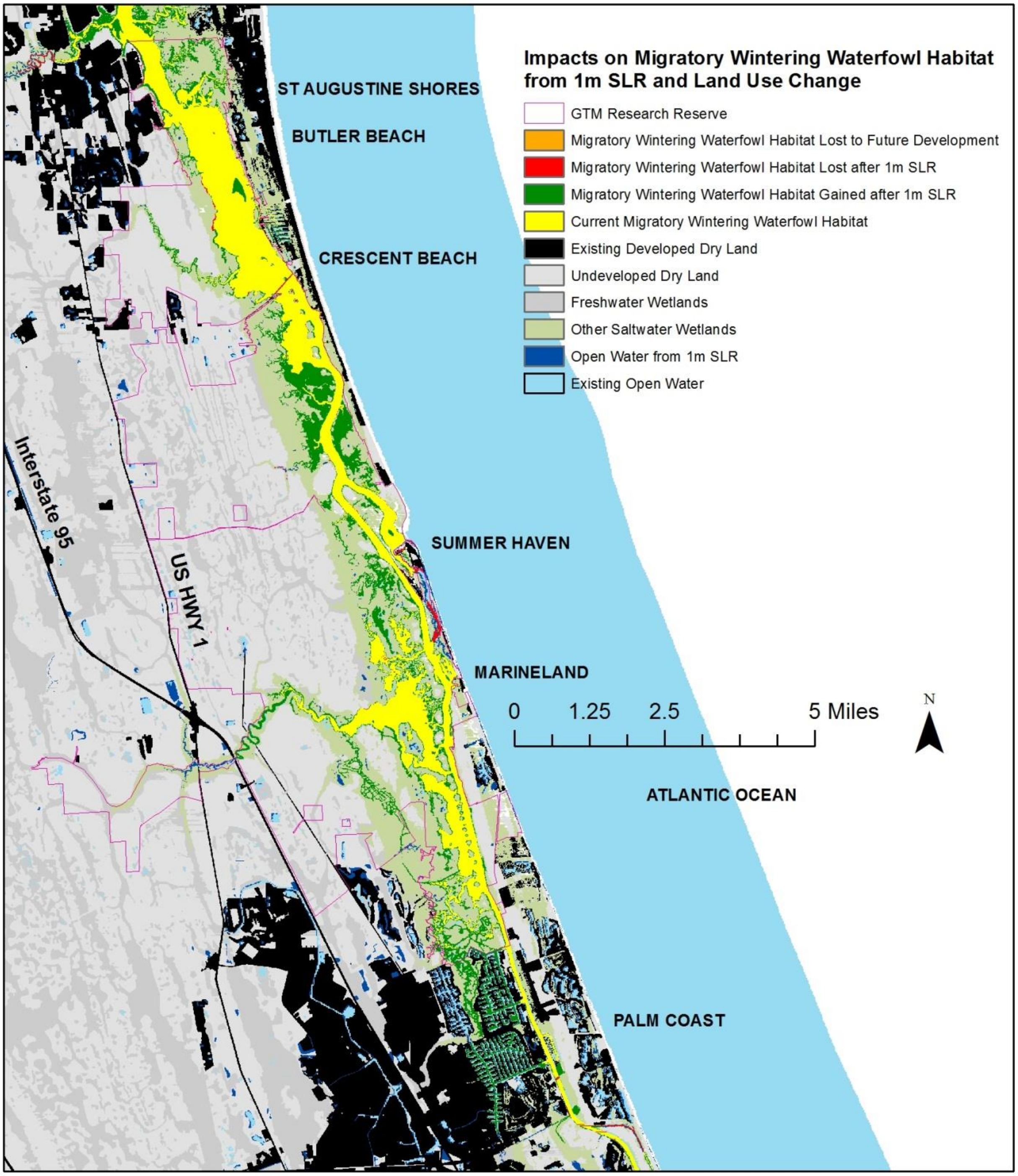
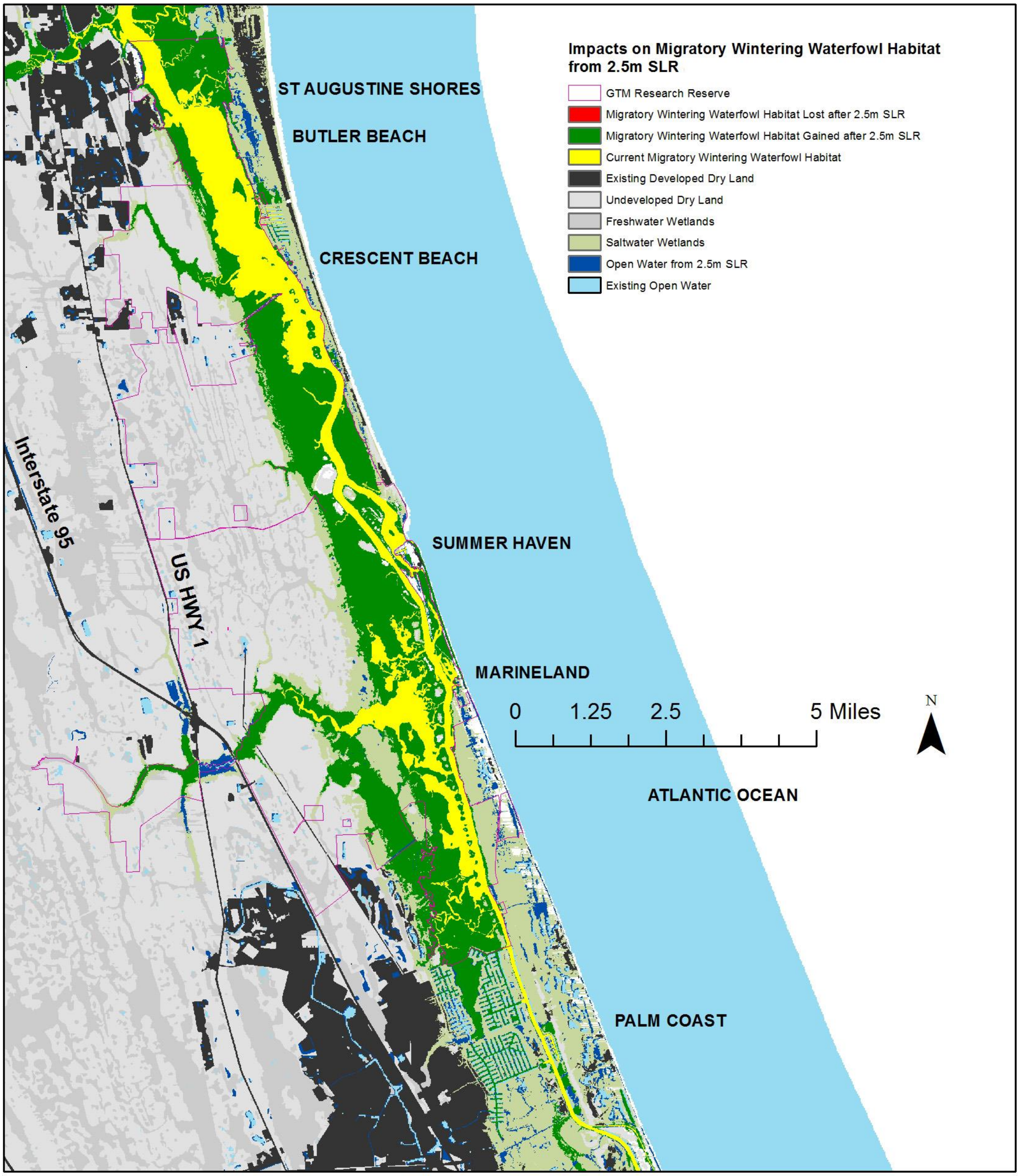
1.25
2.5
5 Miles
N

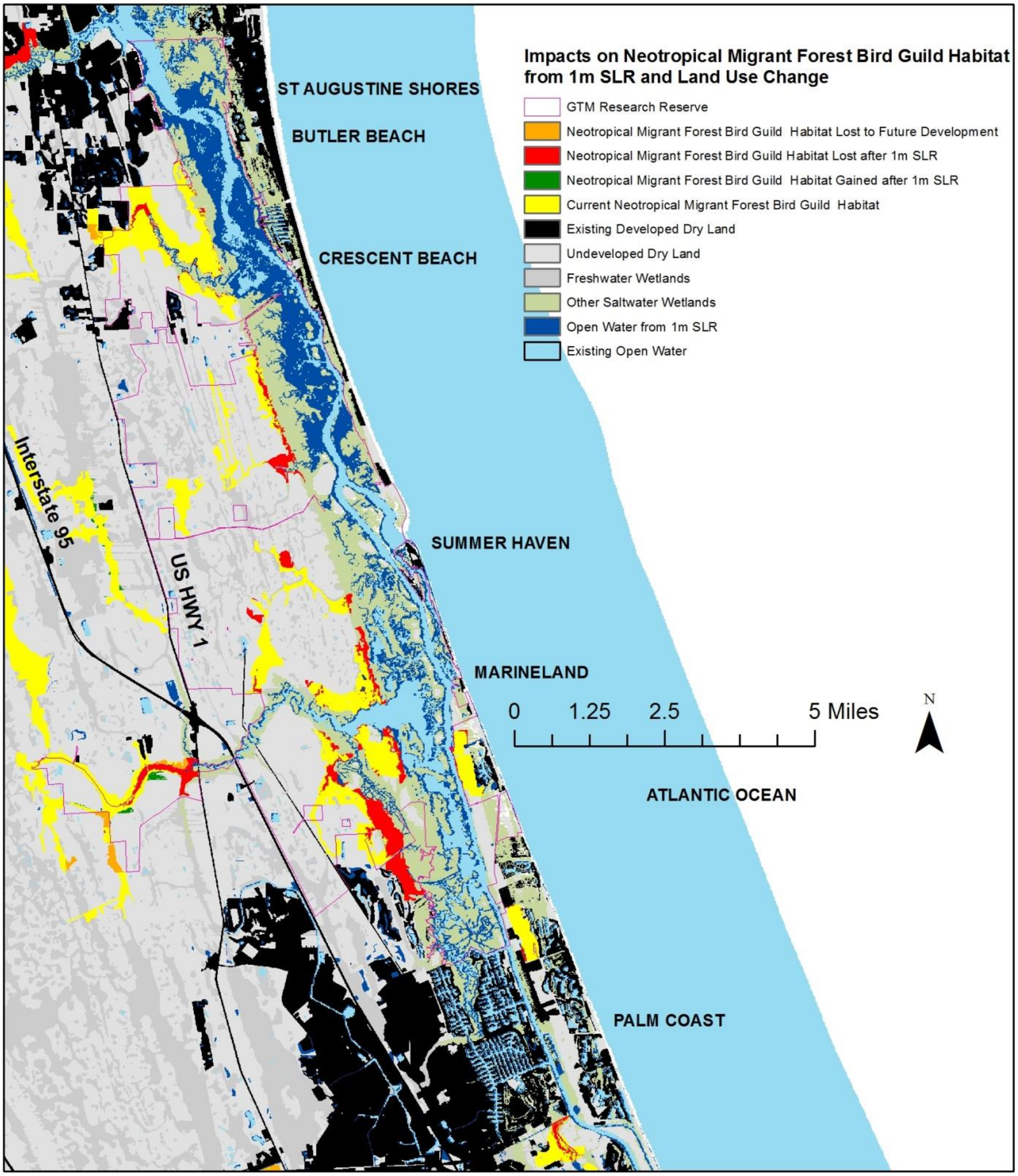

Impacts on Marian's Marsh Wren Habitat from 2.5m SLR
GTM Research Reserve
Marian's Marsh Wren Habitat Lost after 2.5m SLR
Marian's Marsh Wren Habitat Gained after 2.5m SLR
Existing Marian's Marsh Wren Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

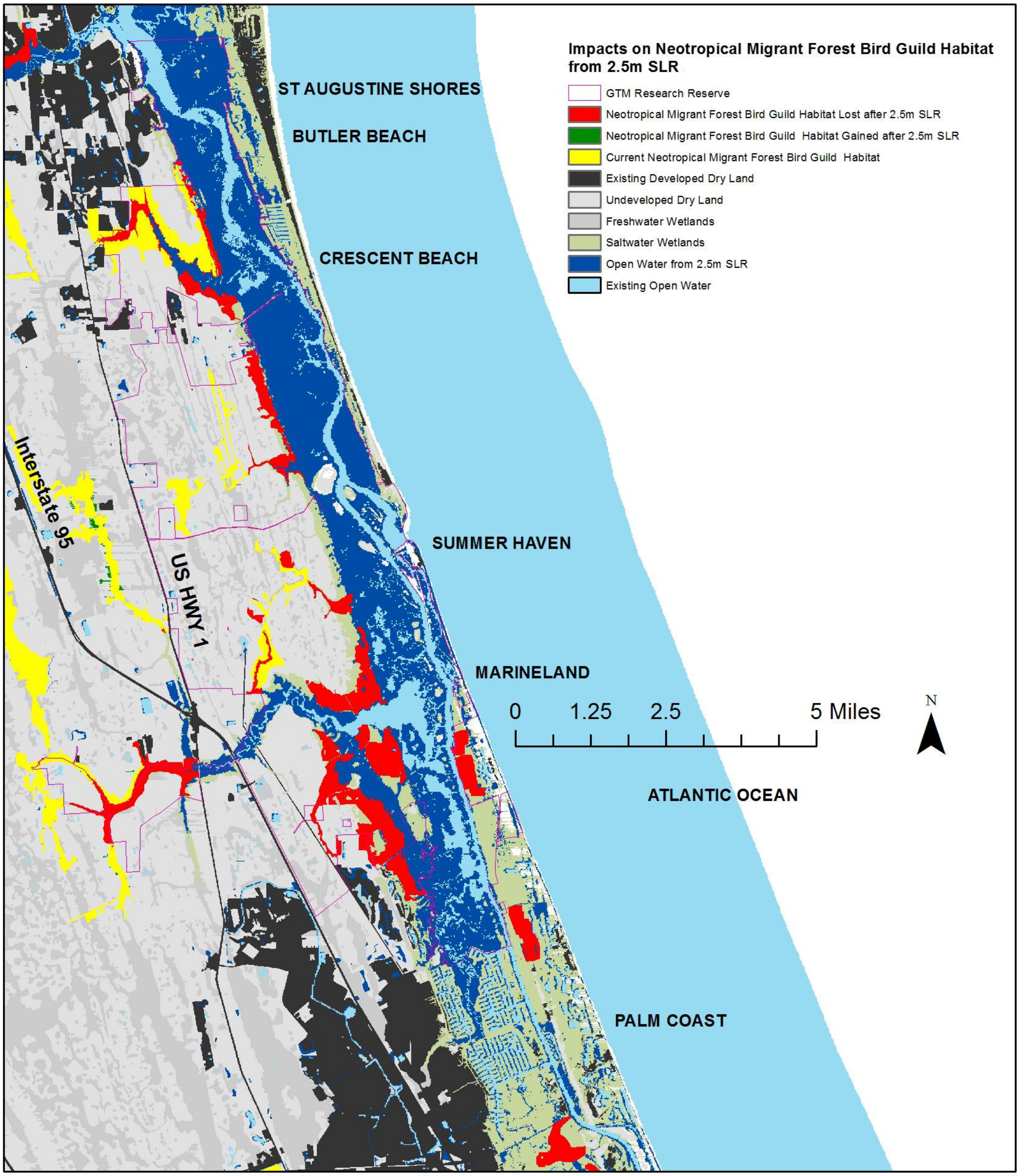

Impacts on Merlin Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Merlin Habitat Lost to Future Development
Merlin Habitat Lost after 1m SLR
Merlin Habitat Gained after 1m SLR
Current Merlin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

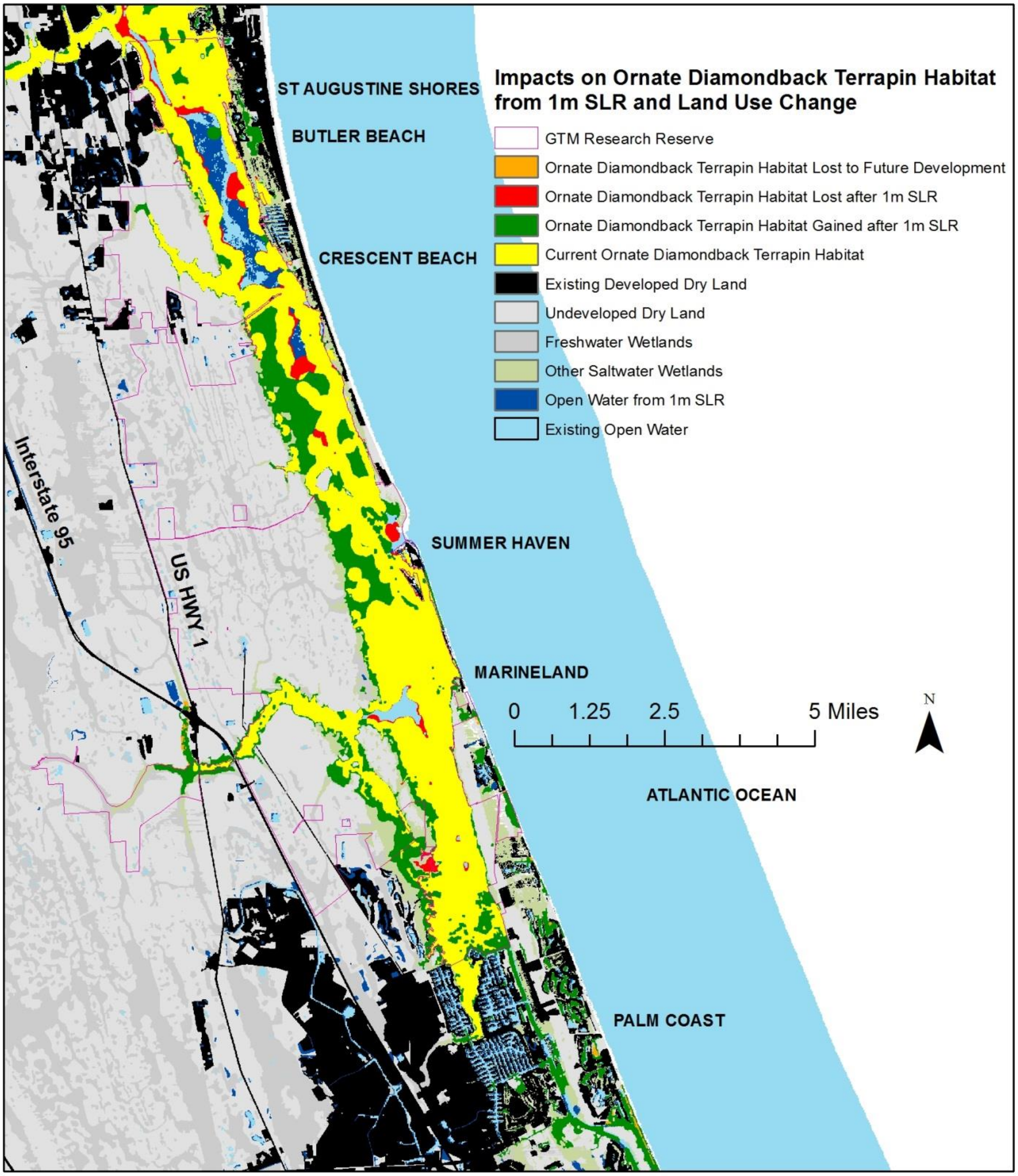

Impacts on Merlin Habitat
from 2.5m SLR
GTM Research Reserve
Merlin Habitat Lost after 2.5m SLR
Merlin Habitat Gained after 2.5m SLR
Current Merlin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

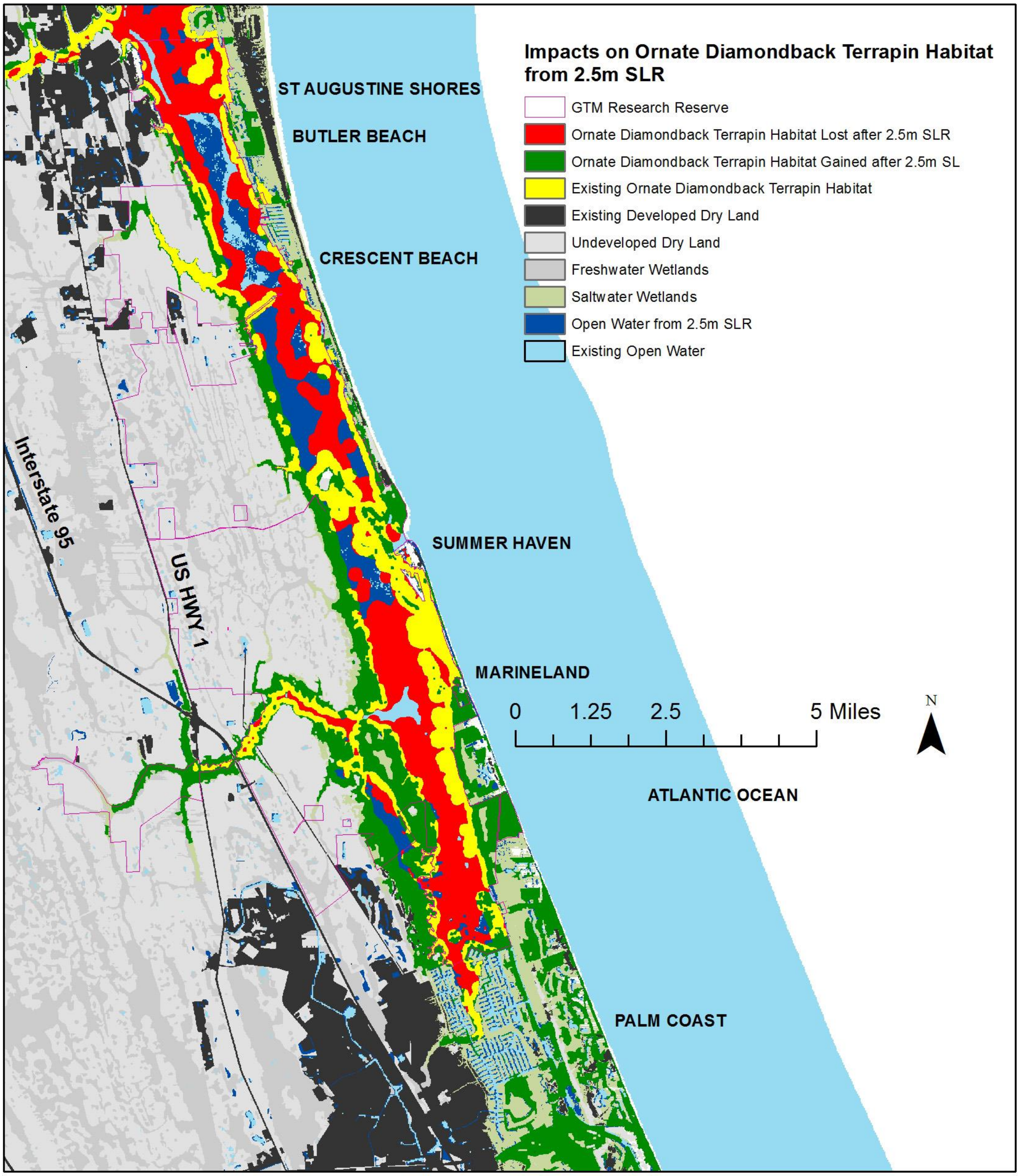

Impacts on Migratory Wintering Waterfowl Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Migratory Wintering Waterfowl Habitat Lost to Future Development
Migratory Wintering Waterfowl Habitat Lost after 1m SLR
Migratory Wintering Waterfowl Habitat Gained after 1m SLR
Current Migratory Wintering Waterfowl Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

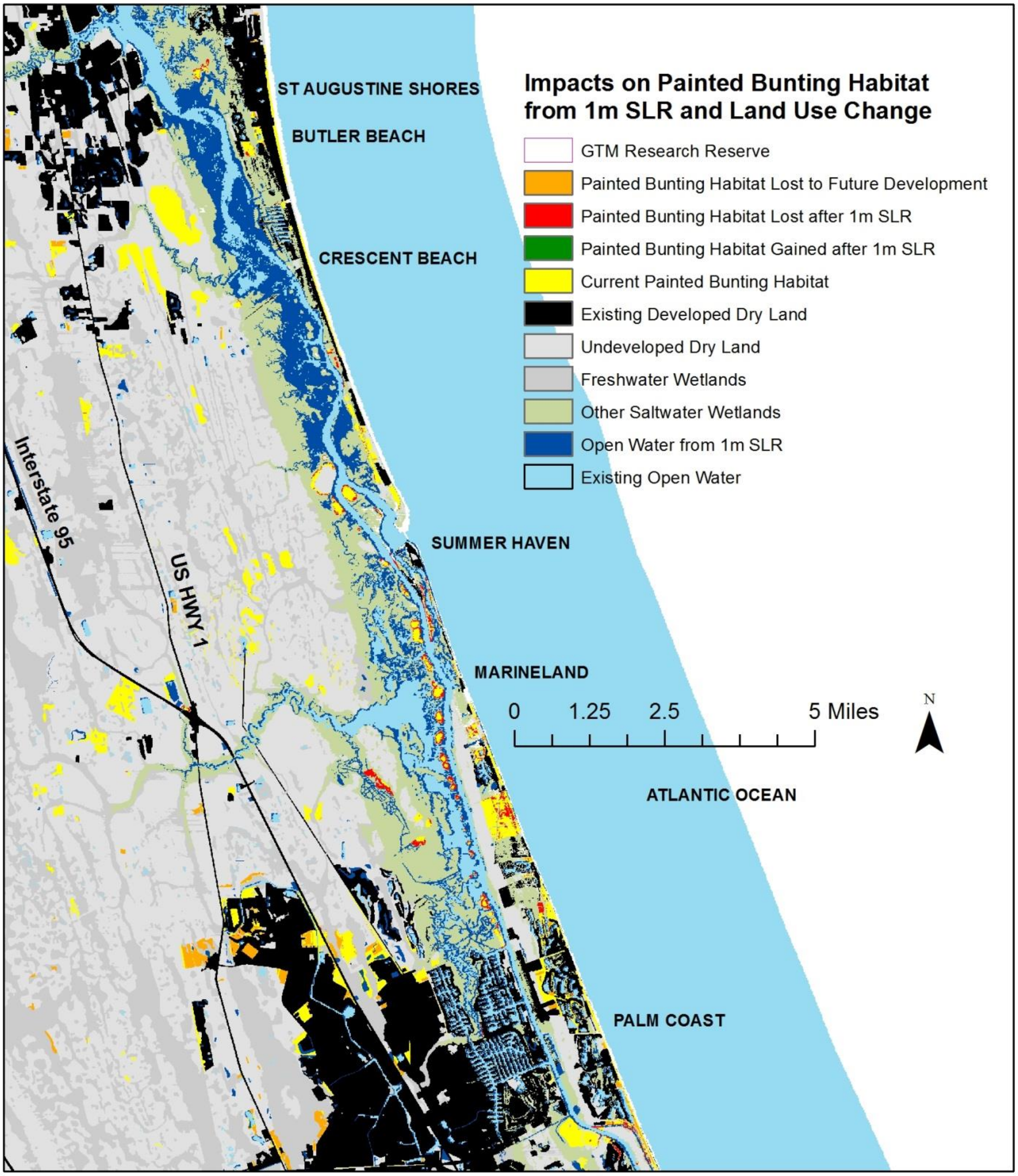

Impacts on Migratory Wintering Waterfowl Habitat from 2.5m SLR
GTM Research Reserve
Migratory Wintering Waterfowl Habitat Lost after 2.5m SLR
Migratory Wintering Waterfowl Habitat Gained after 2.5m SLR
Current Migratory Wintering Waterfowl Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

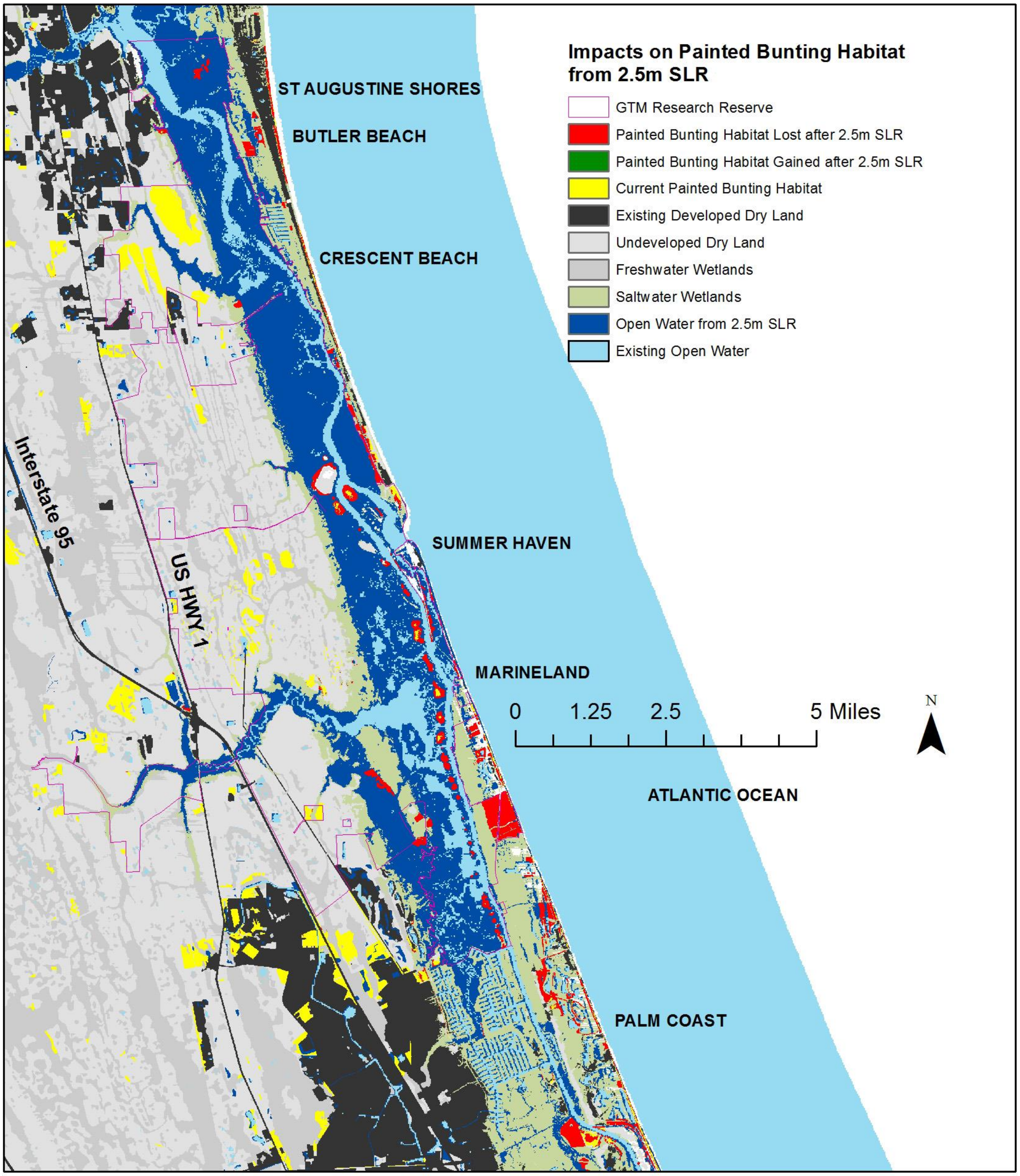

Impacts on Neotropical Migrant Forest Bird Guild Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Neotropical Migrant Forest Bird Guild Habitat Lost to Future Development
Neotropical Migrant Forest Bird Guild Habitat Lost after 1m SLR
Neotropical Migrant Forest Bird Guild Habitat Gained after 1m SLR
Current Neotropical Migrant Forest Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

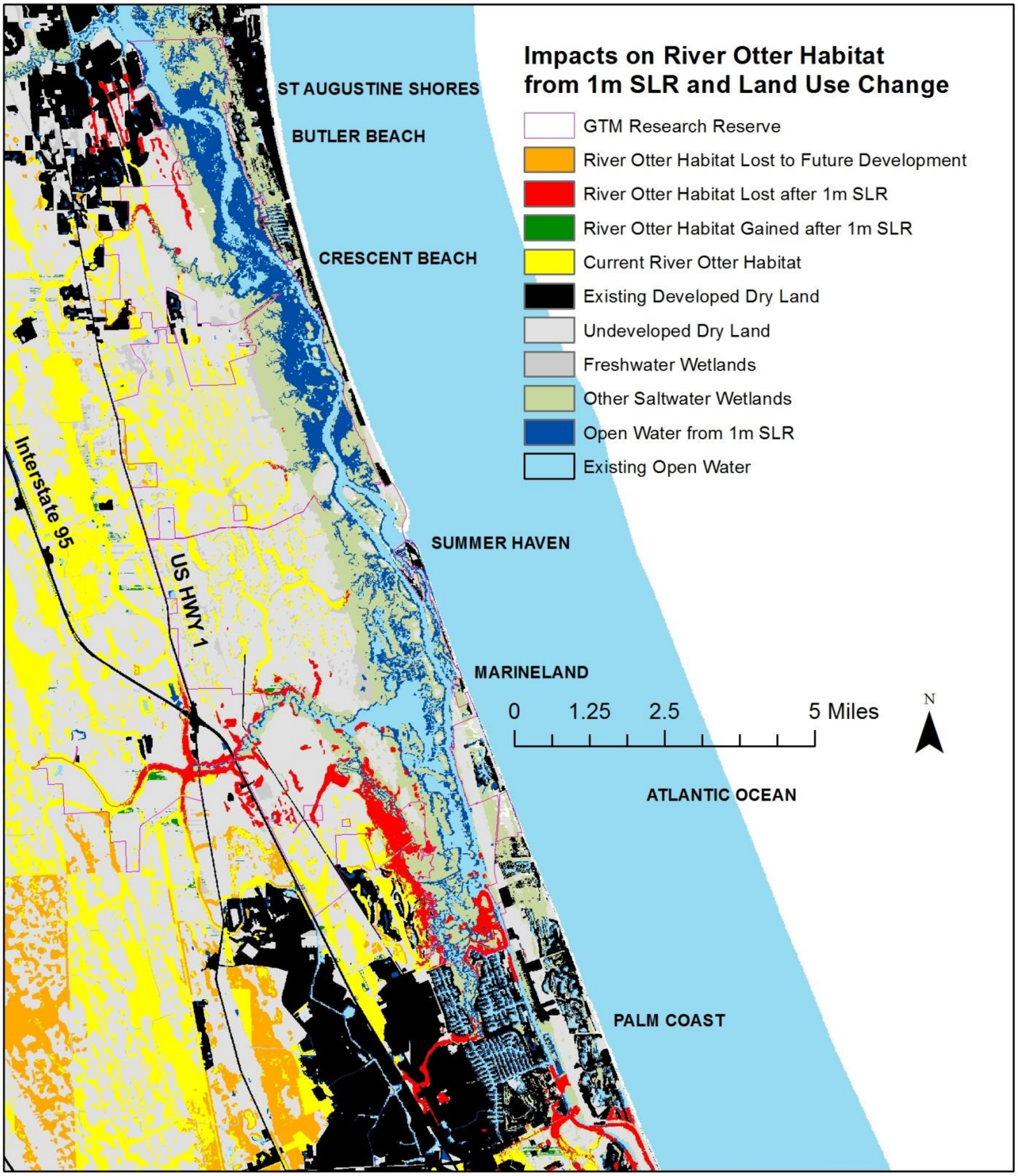

Impacts on Neotropical Migrant Forest Bird Guild Habitat from 2.5m SLR
GTM Research Reserve
Neotropical Migrant Forest Bird Guild Habitat Lost after 2.5m SLR
Neotropical Migrant Forest Bird Guild Habitat Gained after 2.5m SLR
Current Neotropical Migrant Forest Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

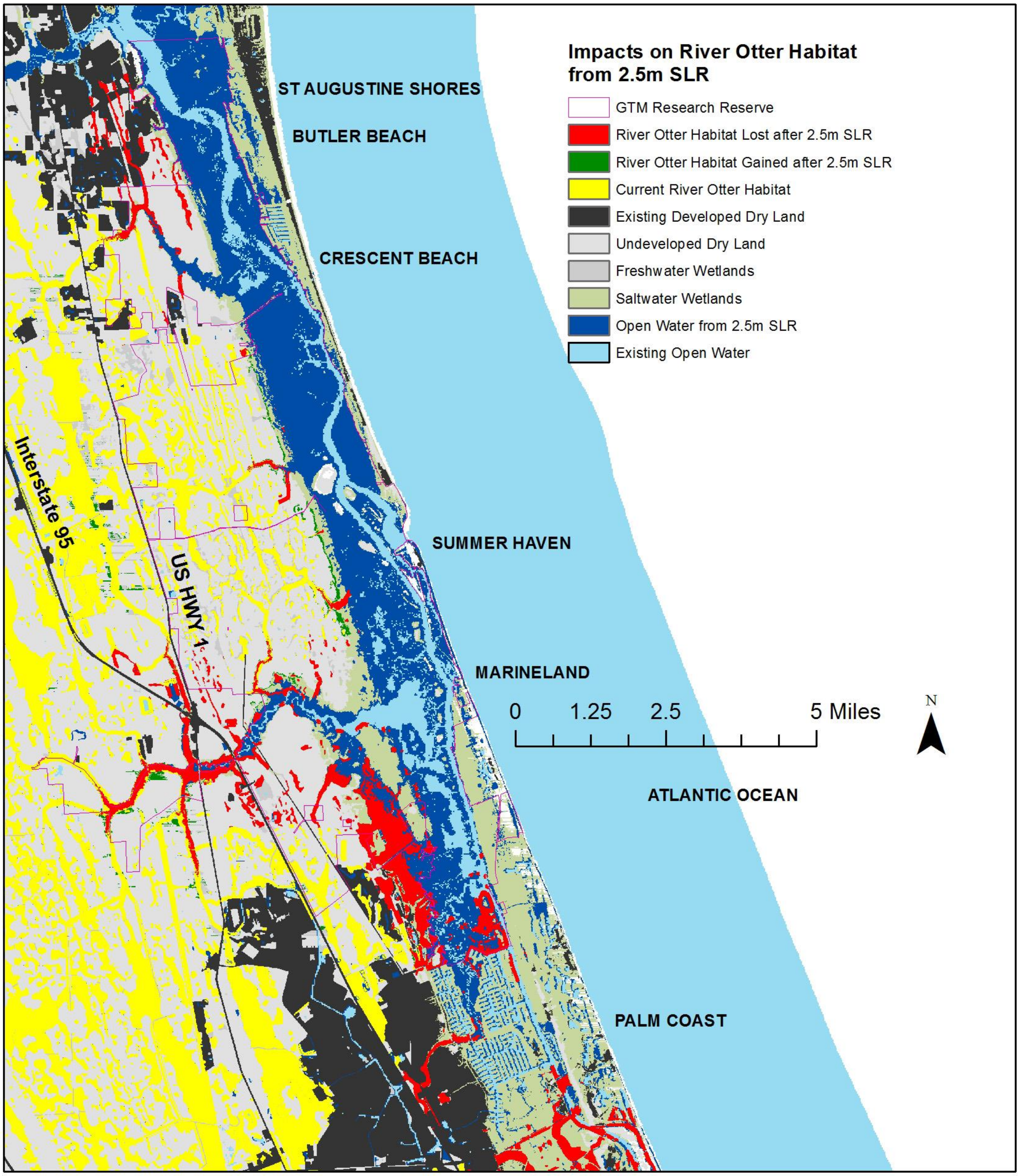

Impacts on Ornate Diamondback Terrapin Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Ornate Diamondback Terrapin Habitat Lost to Future Development
Ornate Diamondback Terrapin Habitat Lost after 1m SLR
Ornate Diamondback Terrapin Habitat Gained after 1m SLR
Current Ornate Diamondback Terrapin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

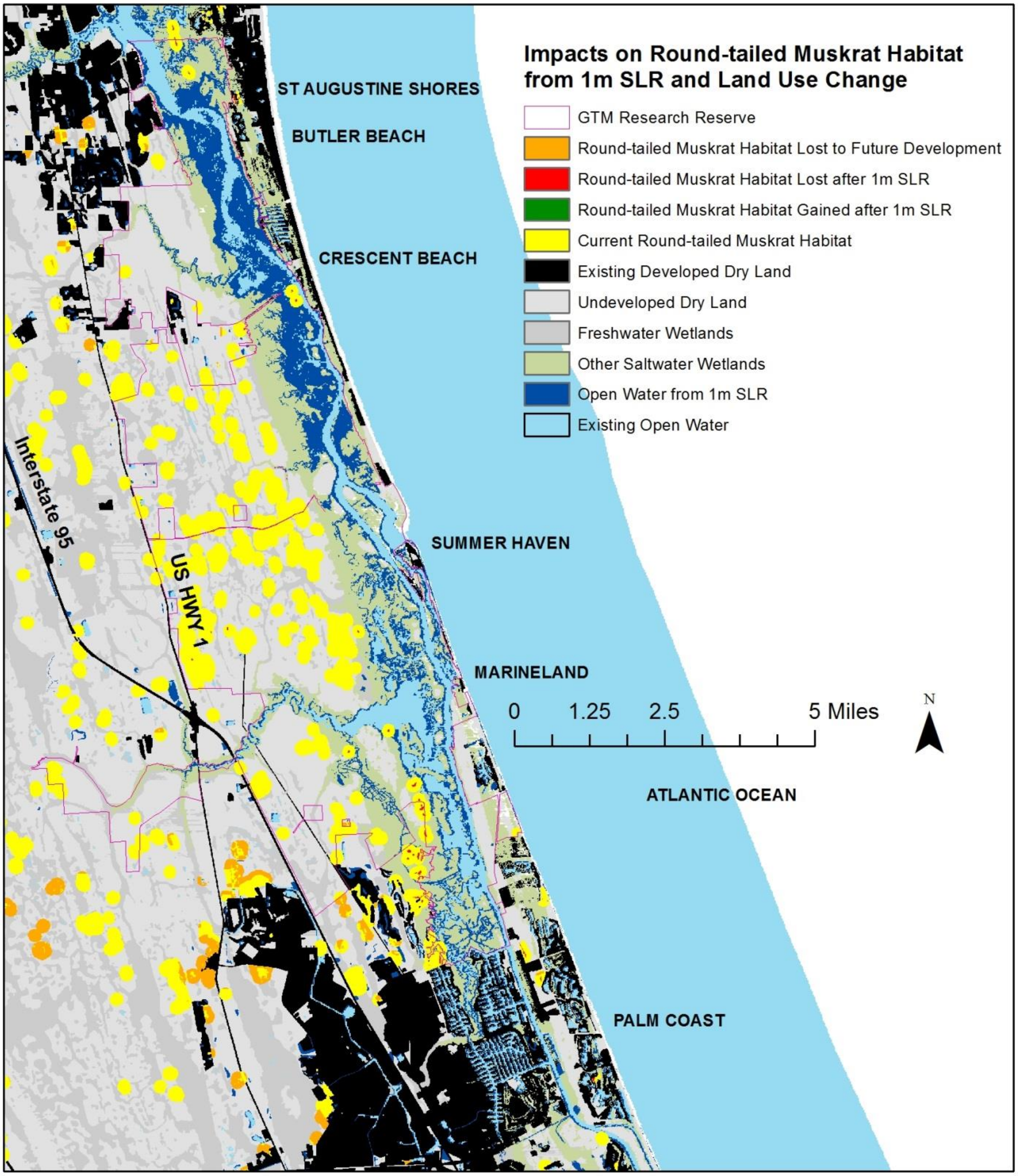

Impacts on Ornate Diamondback Terrapin Habitat from 2.5m SLR
GTM Research Reserve
Ornate Diamondback Terrapin Habitat Lost after 2.5m SLR
Ornate Diamondback Terrapin Habitat Gained after 2.5m SL
Existing Ornate Diamondback Terrapin Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

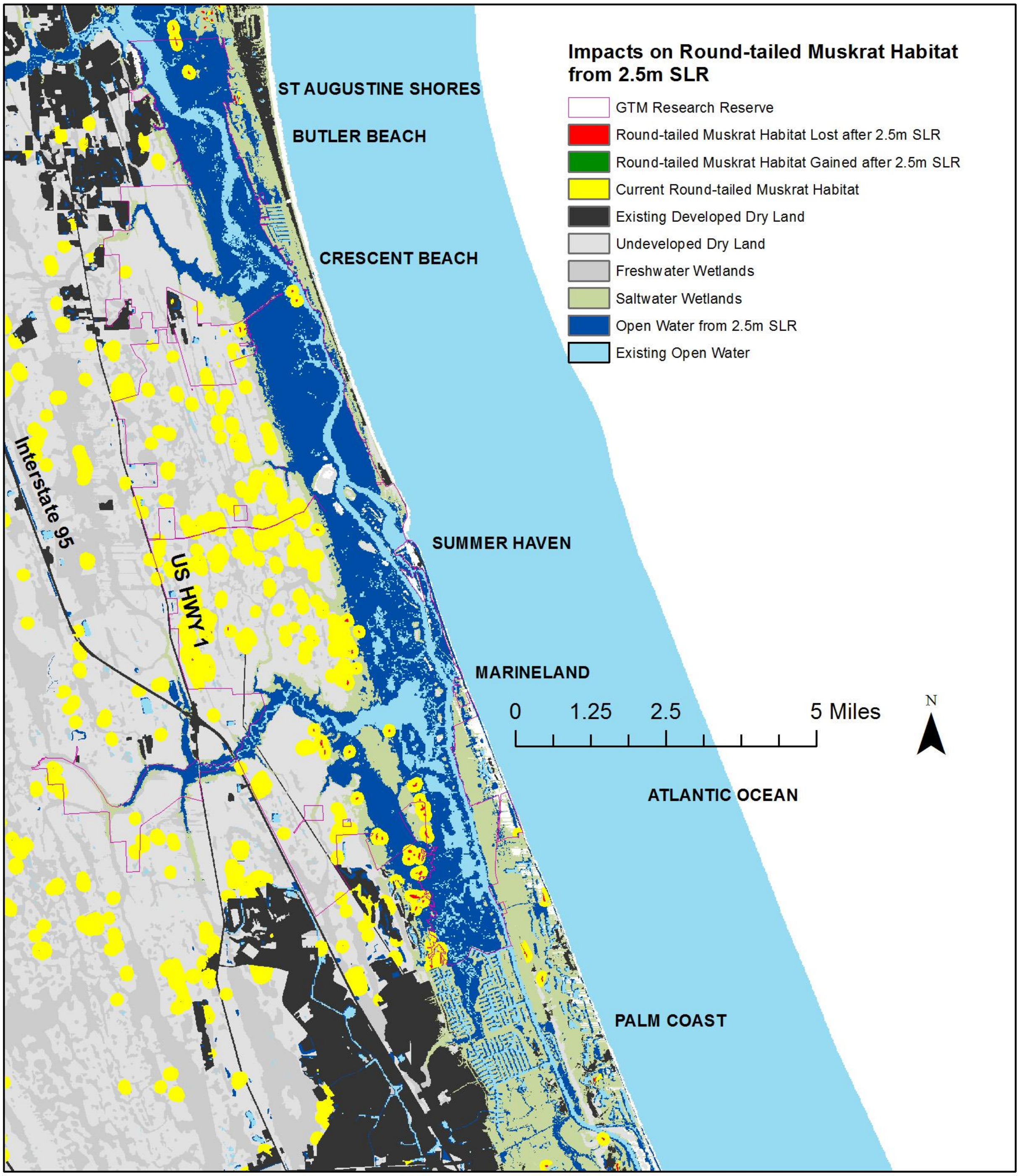

Impacts on Painted Bunting Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Painted Bunting Habitat Lost to Future Development
Painted Bunting Habitat Lost after 1m SLR
Painted Bunting Habitat Gained after 1m SLR
Current Painted Bunting Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

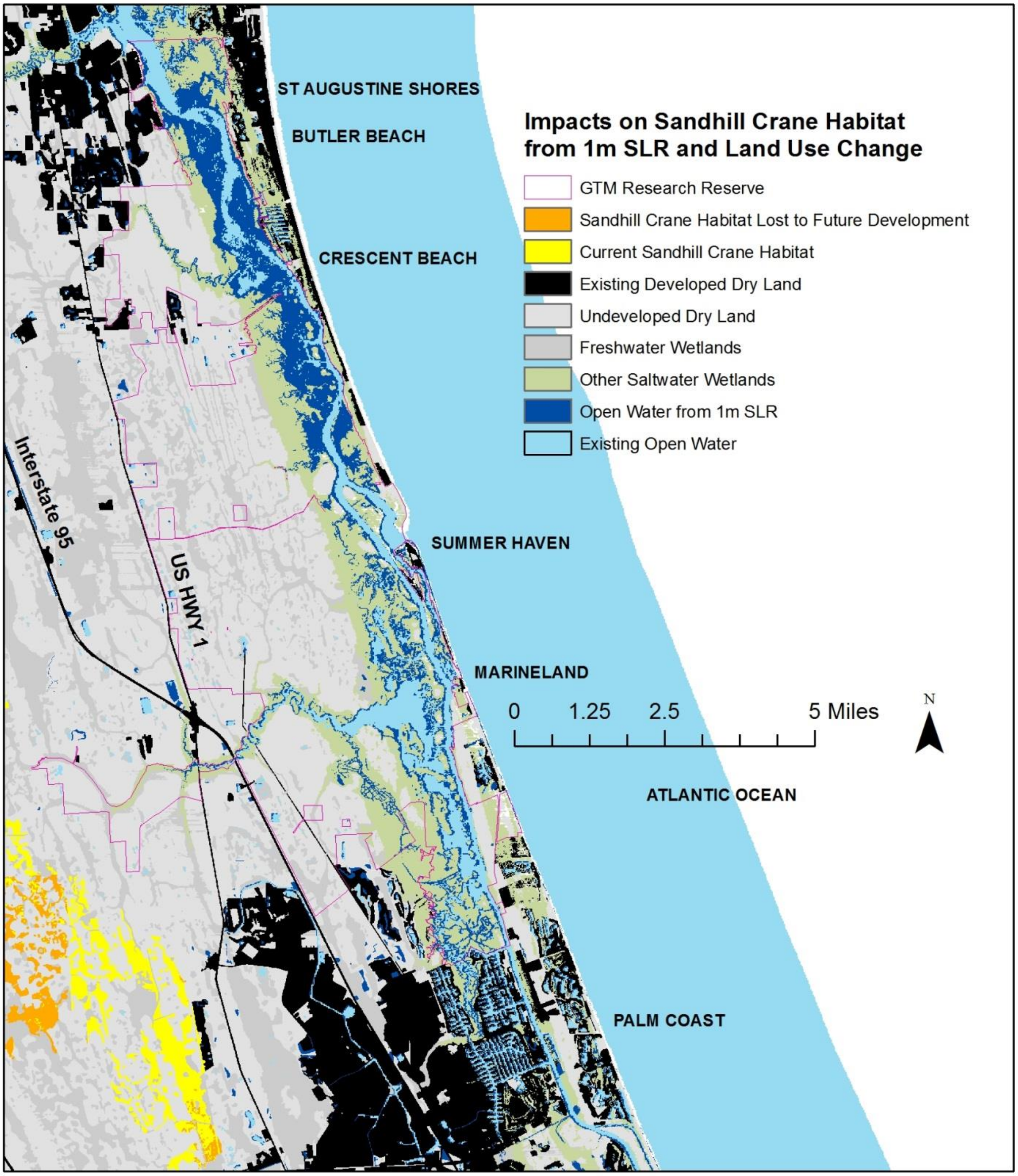

Impacts on Painted Bunting Habitat from 2.5m SLR
GTM Research Reserve
Painted Bunting Habitat Lost after 2.5m SLR
Painted Bunting Habitat Gained after 2.5m SLR
Current Painted Bunting Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on River Otter Habitat from 1m SLR and Land Use Change
GTM Research Reserve
River Otter Habitat Lost to Future Development
River Otter Habitat Lost after 1m SLR
River Otter Habitat Gained after 1m SLR
Current River Otter Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

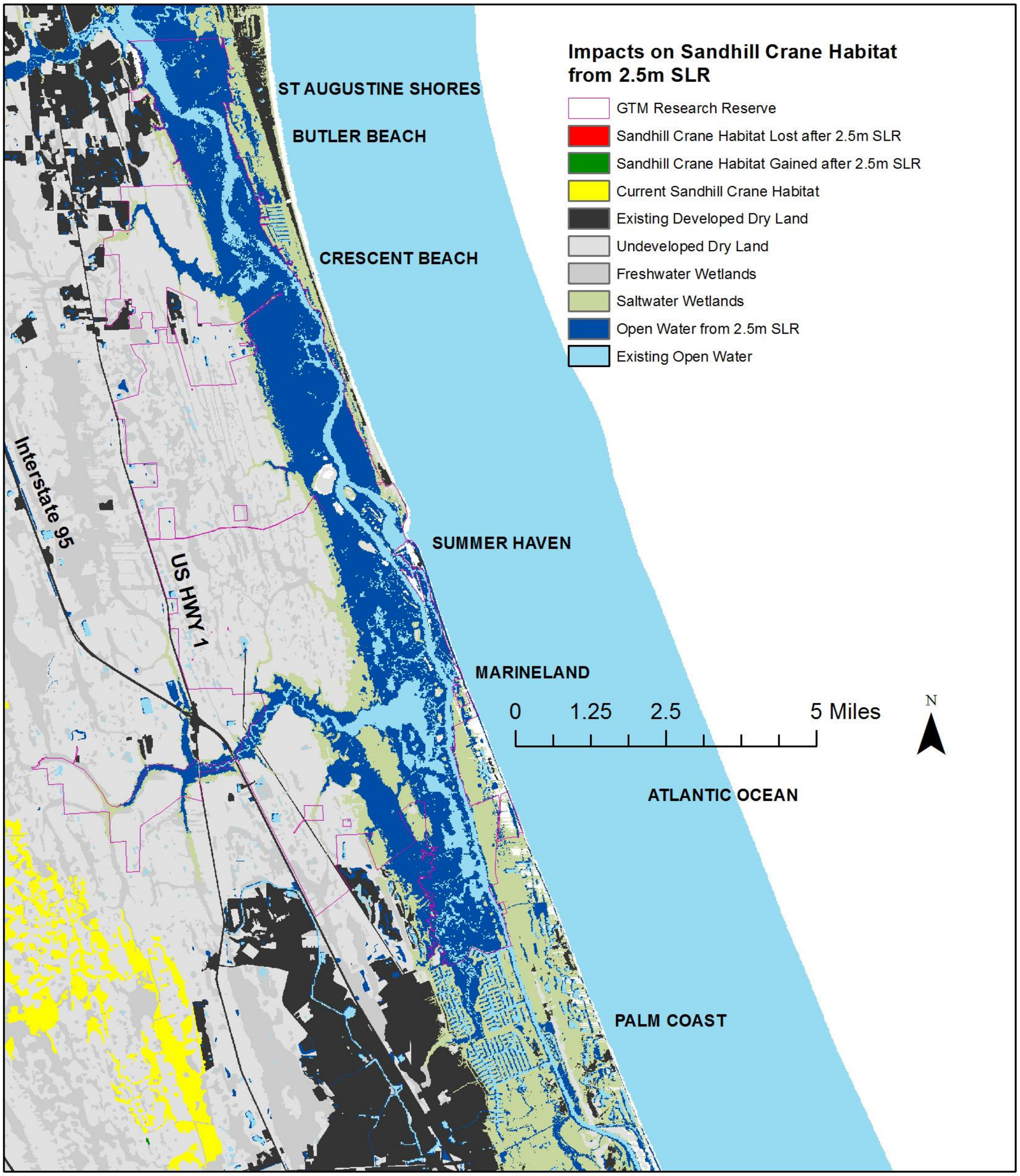

Impacts on River Otter Habitat from 2.5m SLR
GTM Research Reserve
River Otter Habitat Lost after 2.5m SLR
River Otter Habitat Gained after 2.5m SLR
Current River Otter Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

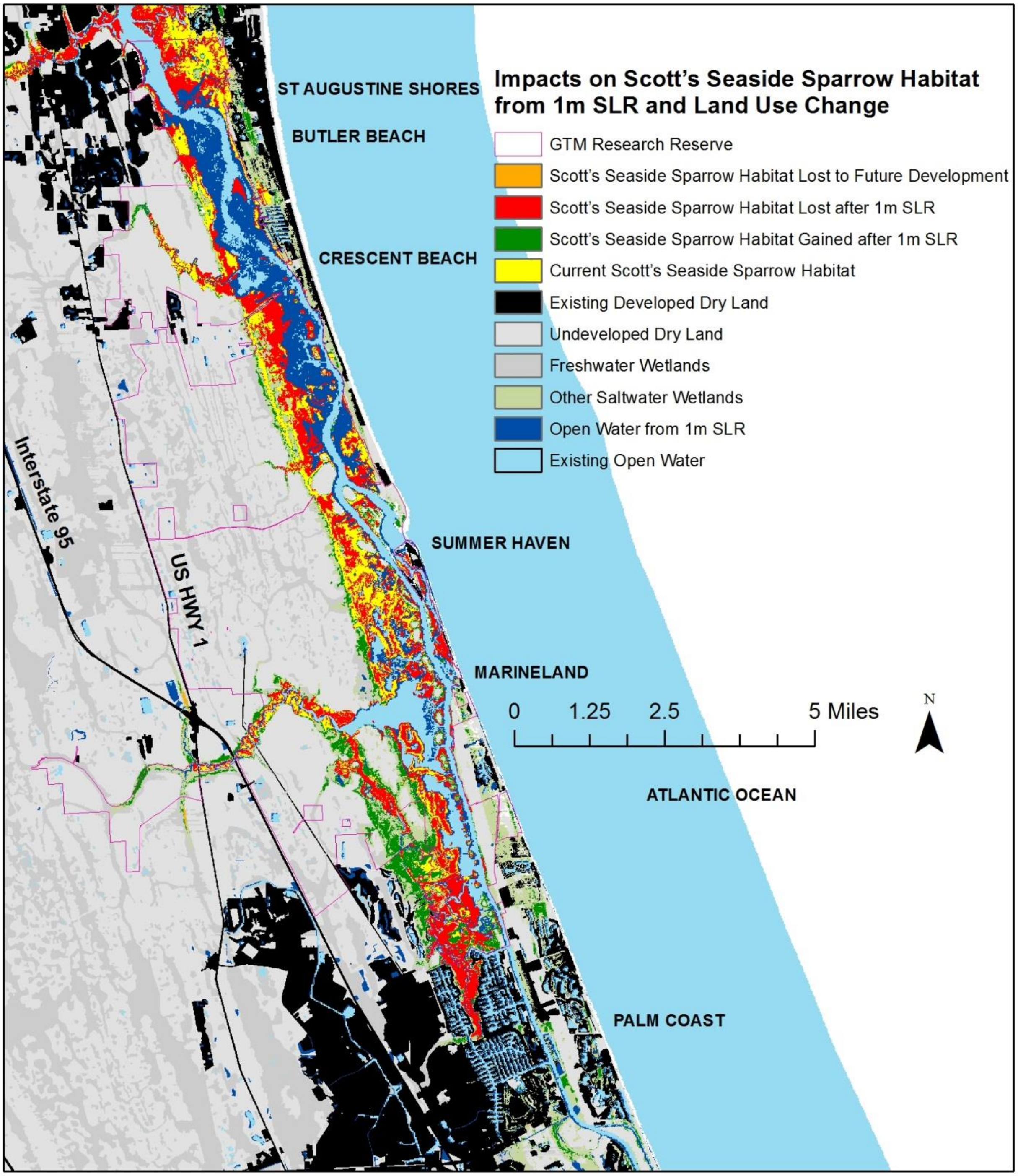

Impacts on Round-tailed Muskrat Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Round-tailed Muskrat Habitat Lost to Future Development
Round-tailed Muskrat Habitat Lost after 1m SLR
Round-tailed Muskrat Habitat Gained after 1m SLR
Current Round-tailed Muskrat Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

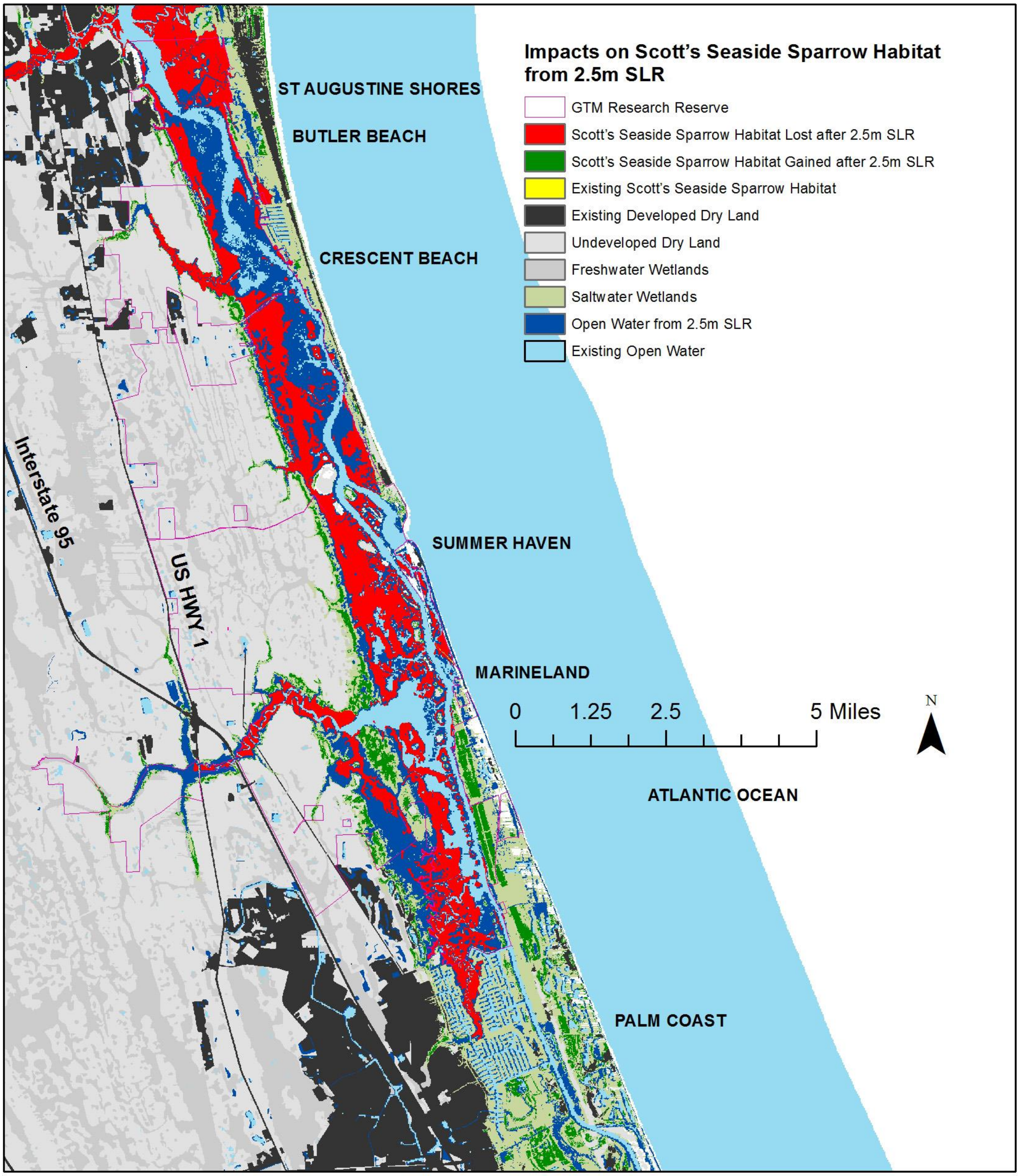

Impacts on Round-tailed Muskrat Habitat from 2.5m SLR
GTM Research Reserve
Round-tailed Muskrat Habitat Lost after 2.5m SLR
Round-tailed Muskrat Habitat Gained after 2.5m SLR
Current Round-tailed Muskrat Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



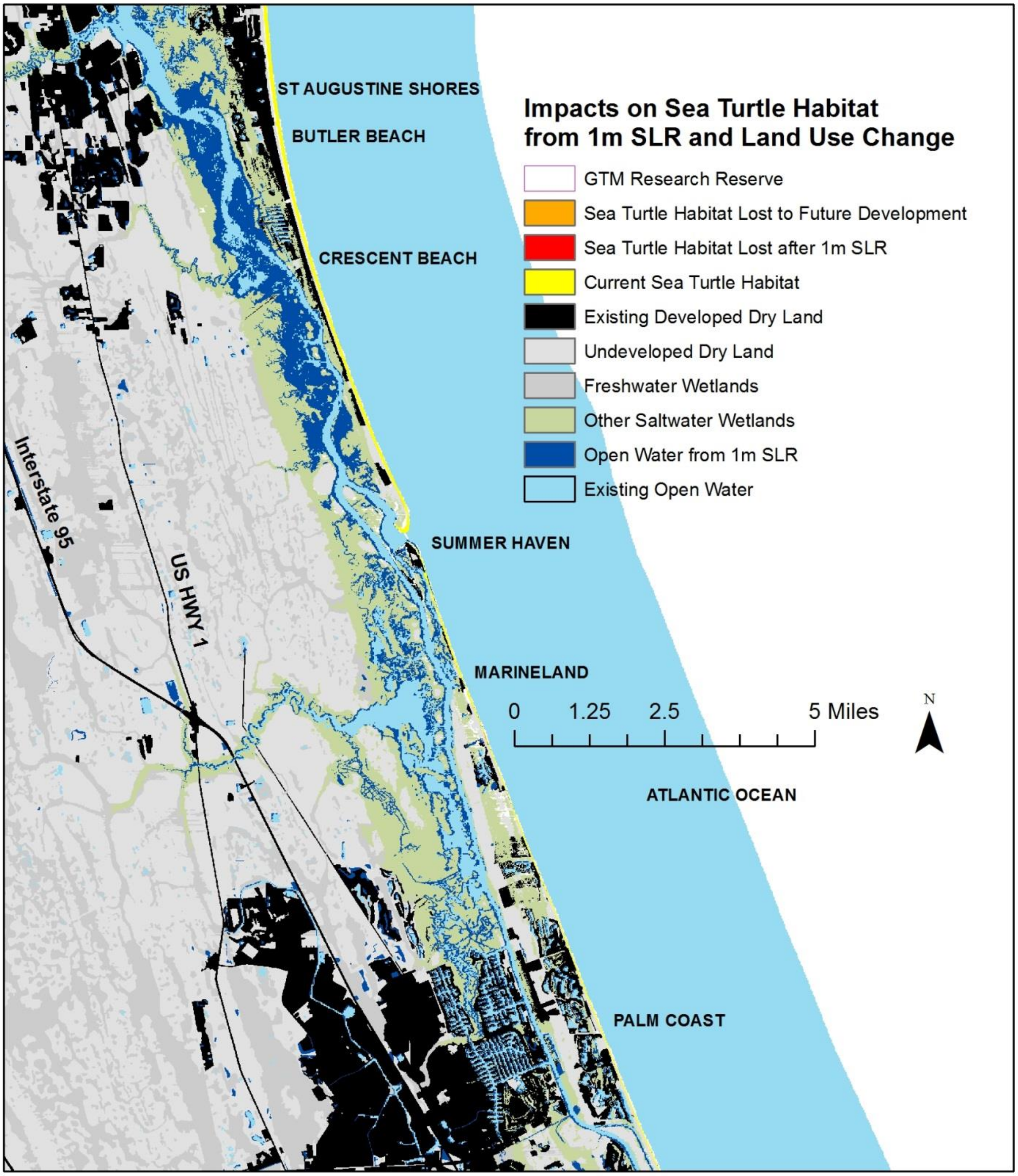
Impacts on Sandhill Crane Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Sandhill Crane Habitat Lost to Future Development
Current Sandhill Crane Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on Sandhill Crane Habitat from 2.5m SLR
GTM Research Reserve
Sandhill Crane Habitat Lost after 2.5m SLR
Sandhill Crane Habitat Gained after 2.5m SLR
Current Sandhill Crane Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

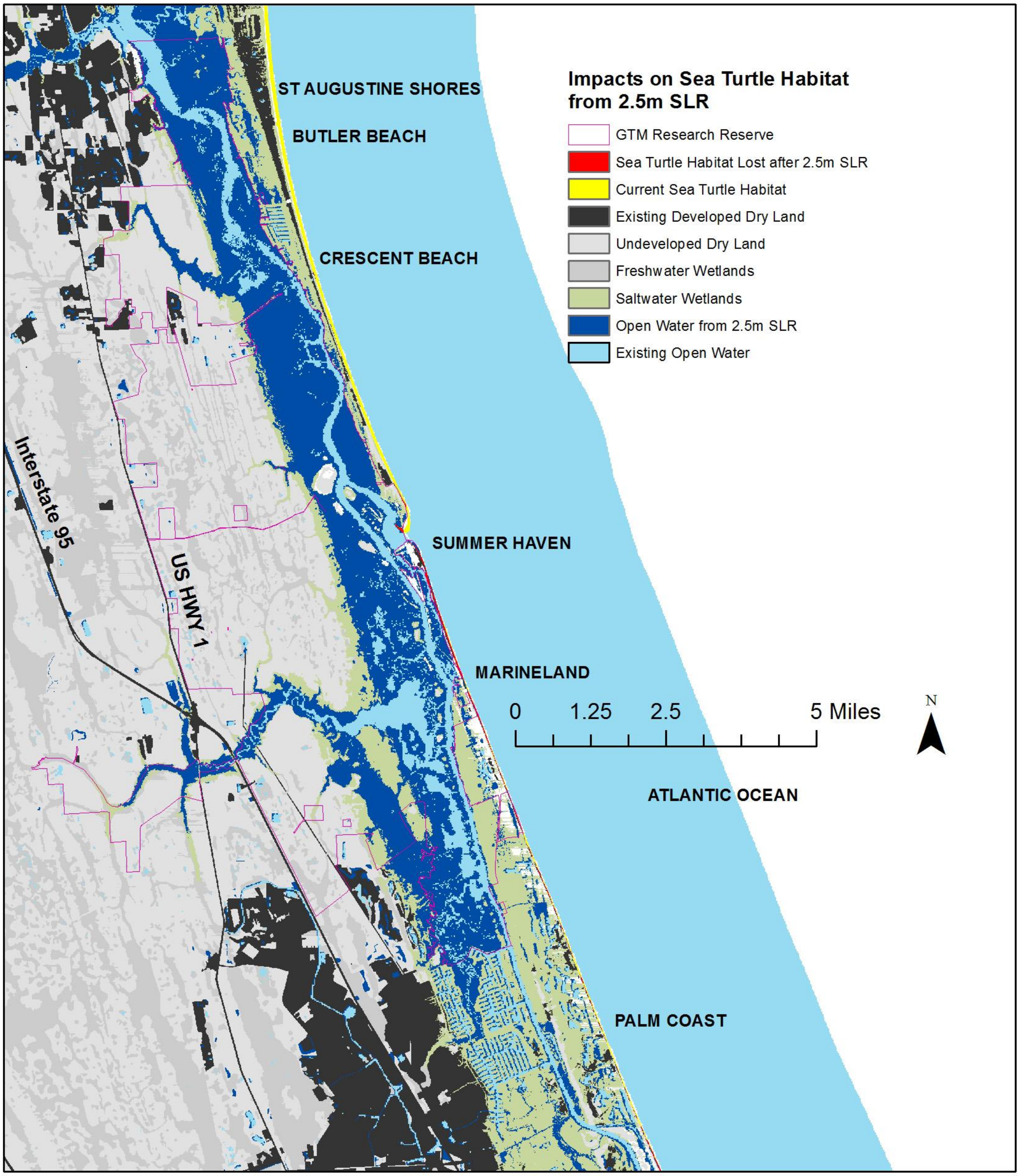

Impacts on Scott's Seaside Sparrow Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Scott's Seaside Sparrow Habitat Lost to Future Development
Scott's Seaside Sparrow Habitat Lost after 1m SLR
Scott's Seaside Sparrow Habitat Gained after 1m SLR
Current Scott's Seaside Sparrow Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



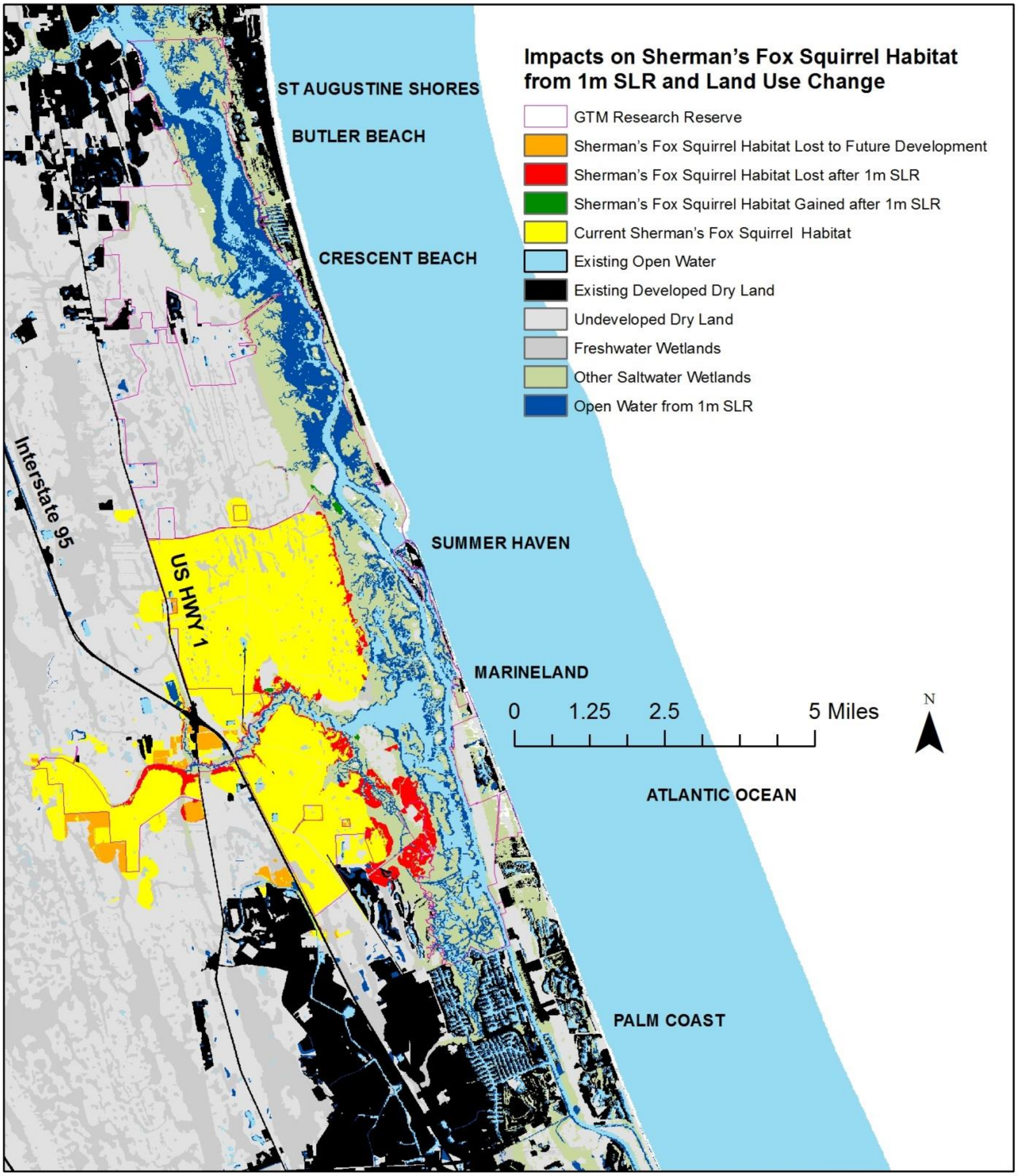
Impacts on Scott's Seaside Sparrow Habitat from 2.5m SLR
GTM Research Reserve
Scott's Seaside Sparrow Habitat Lost after 2.5m SLR
Scott's Seaside Sparrow Habitat Gained after 2.5m SLR
Existing Scott's Seaside Sparrow Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



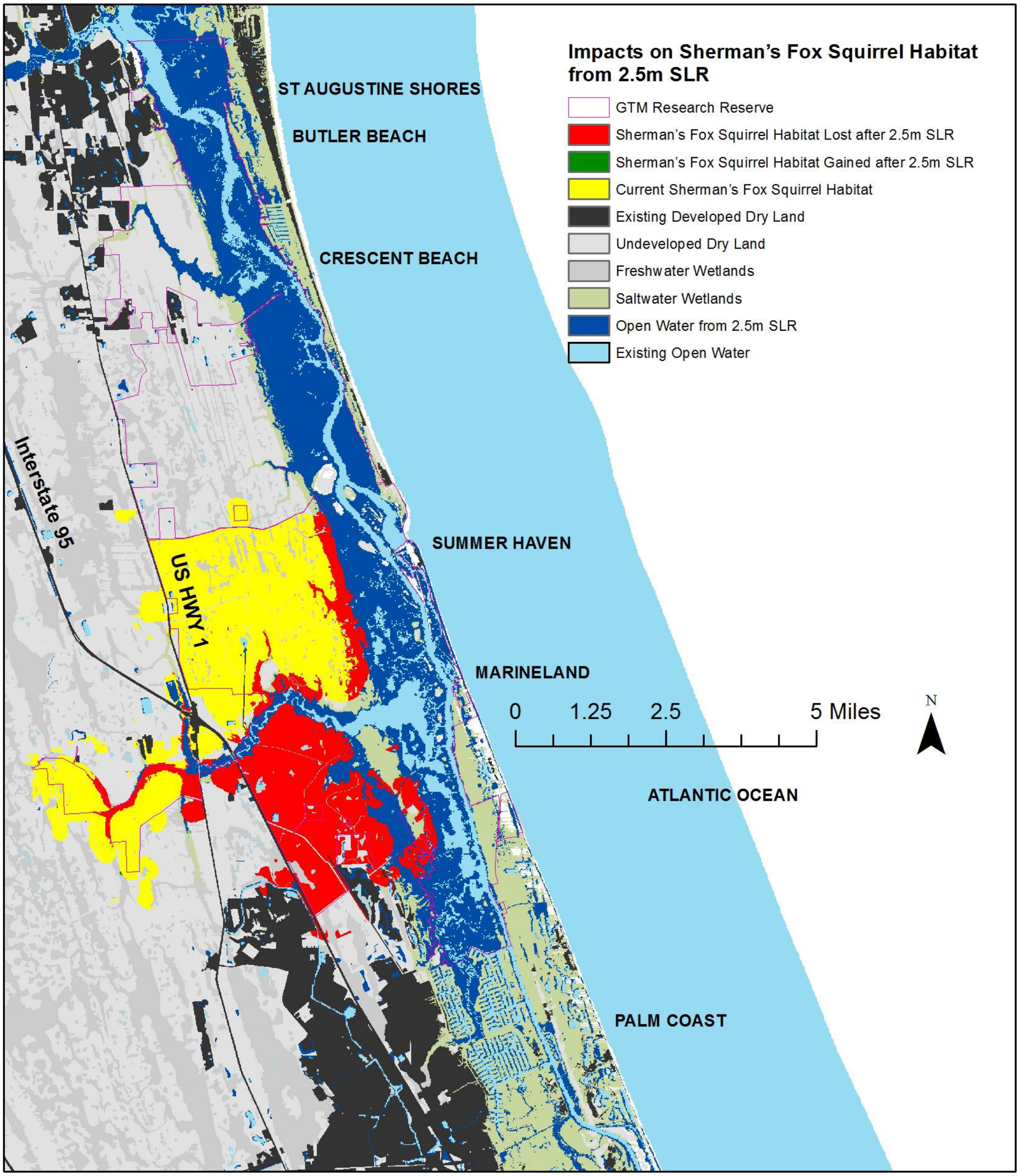
Impacts on Sea Turtle Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Sea Turtle Habitat Lost to Future Development
Sea Turtle Habitat Lost after 1m SLR
Current Sea Turtle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

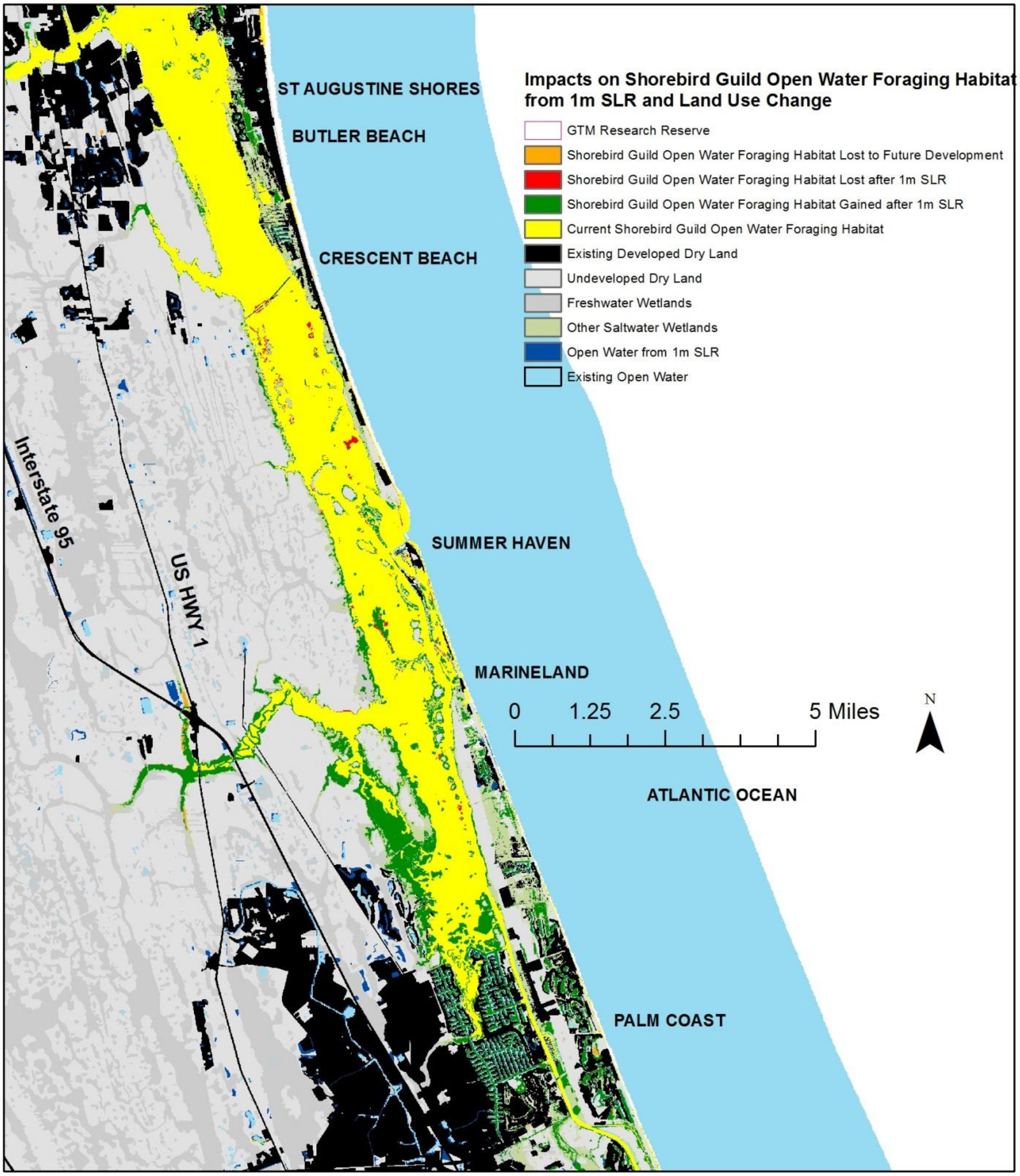


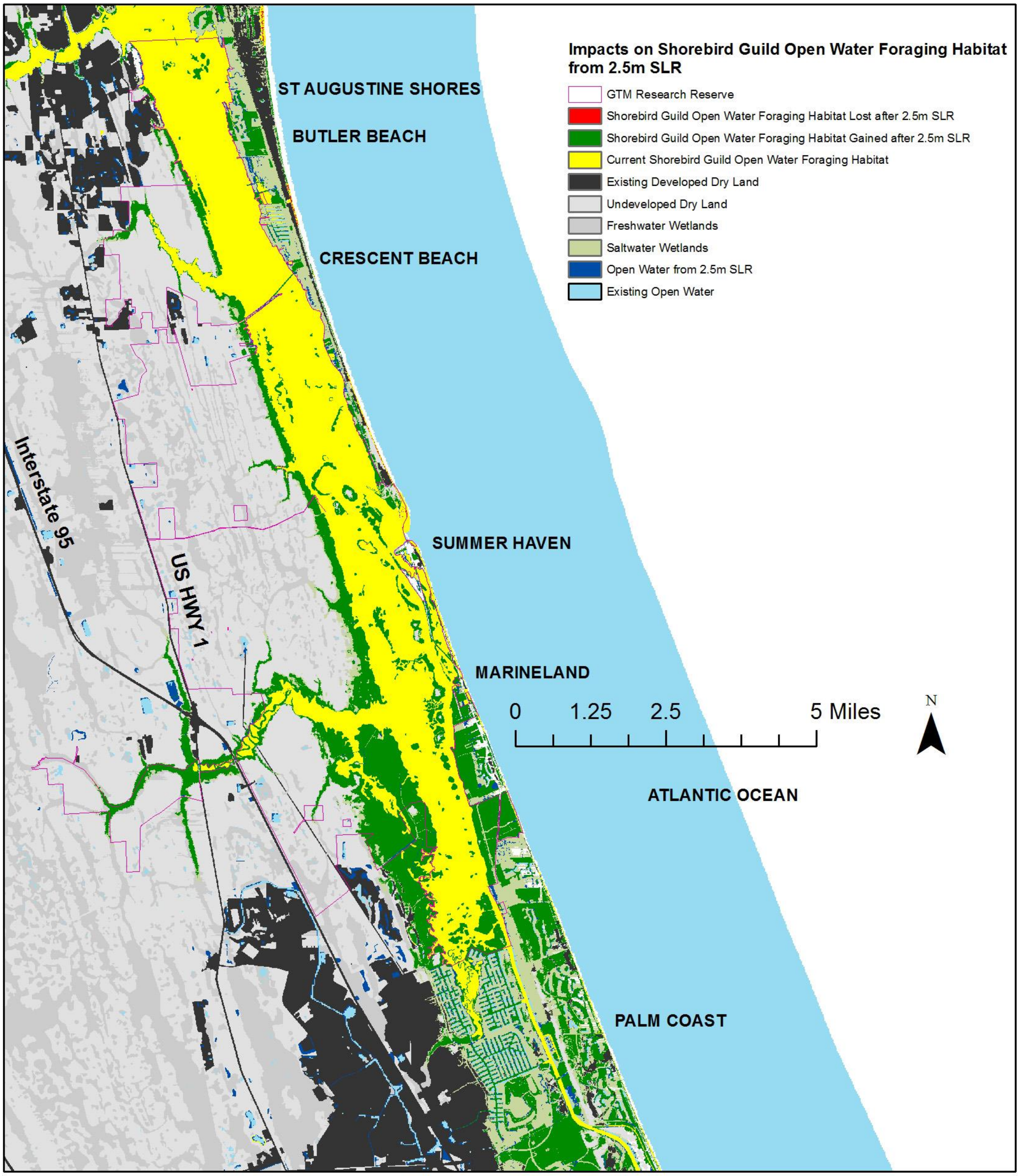
Impacts on Sea Turtle Habitat from 2.5m SLR
GTM Research Reserve
Sea Turtle Habitat Lost after 2.5m SLR
Current Sea Turtle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

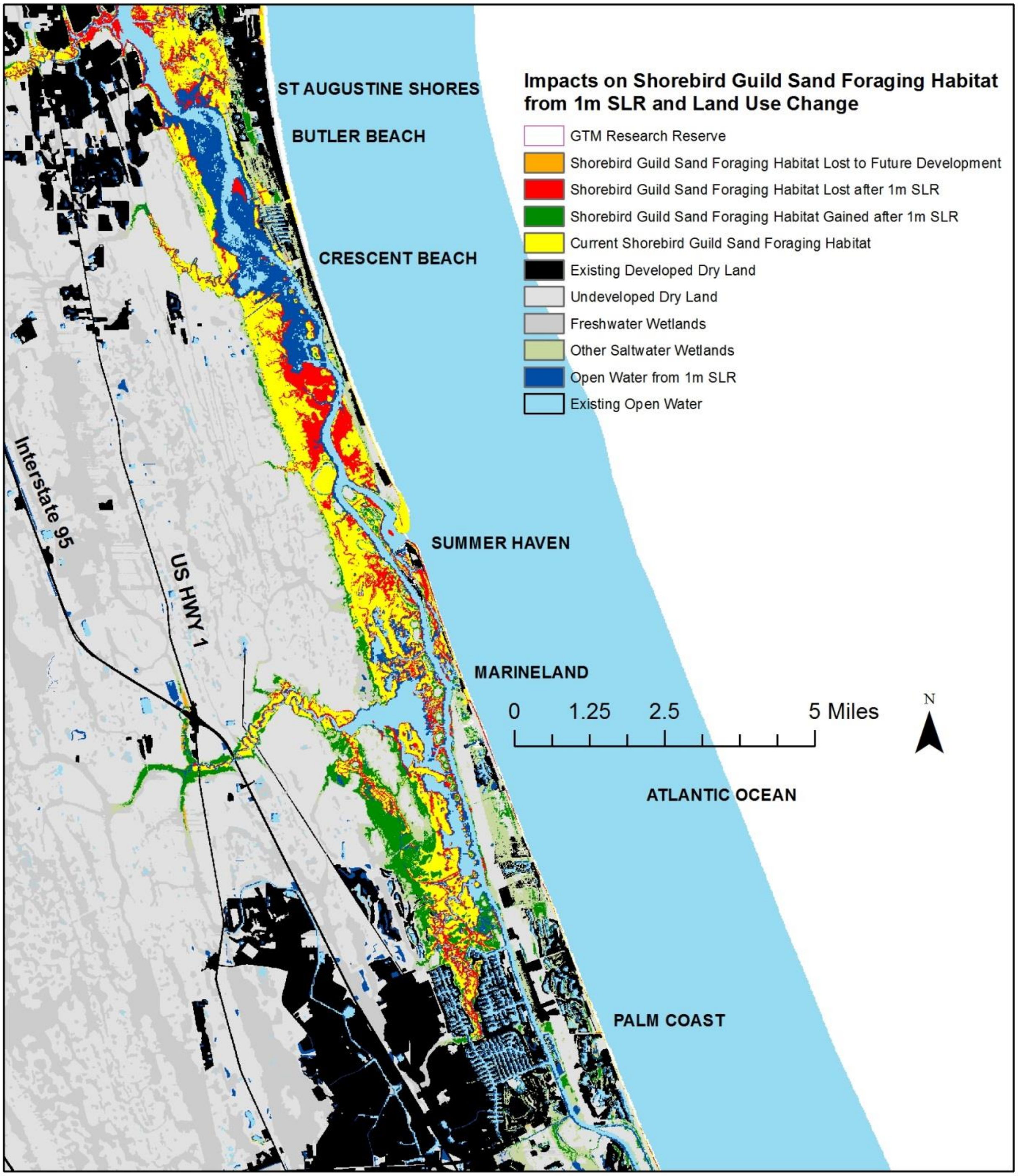


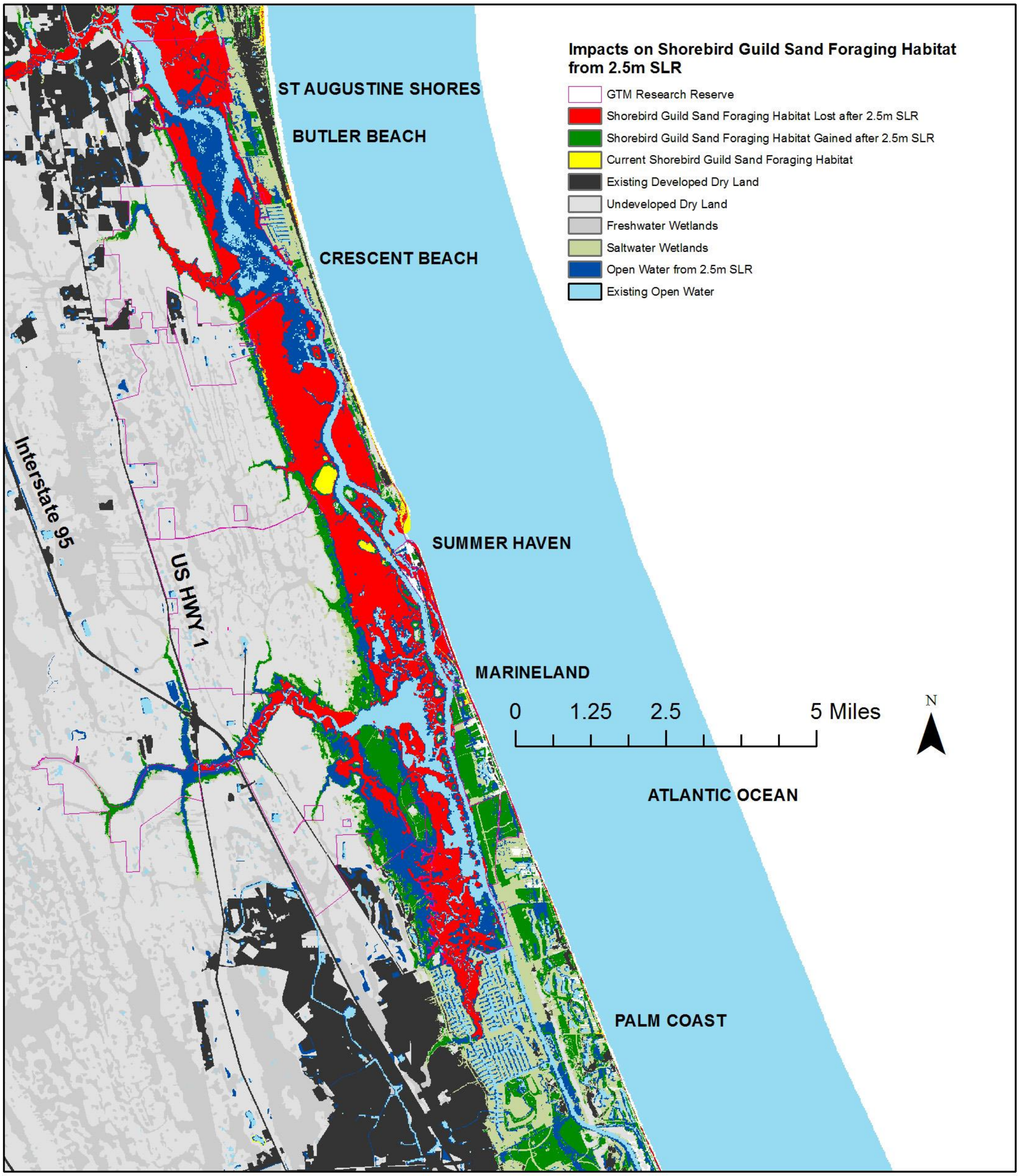
Impacts on Sherman's Fox Squirrel Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Sherman's Fox Squirrel Habitat Lost to Future Development
Sherman's Fox Squirrel Habitat Lost after 1m SLR
Sherman's Fox Squirrel Habitat Gained after 1m SLR
Current Sherman's Fox Squirrel Habitat
Existing Open Water
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on Sherman's Fox Squirrel Habitat from 2.5m SLR
GTM Research Reserve
Sherman's Fox Squirrel Habitat Lost after 2.5m SLR
Sherman's Fox Squirrel Habitat Gained after 2.5m SLR
Current Sherman's Fox Squirrel Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
Interstate 95
US HWY 1
SUMMER HAVEN
MARINELAND
0
1.25
2.5
5 Miles
N
ATLANTIC OCEAN
PALM COAST

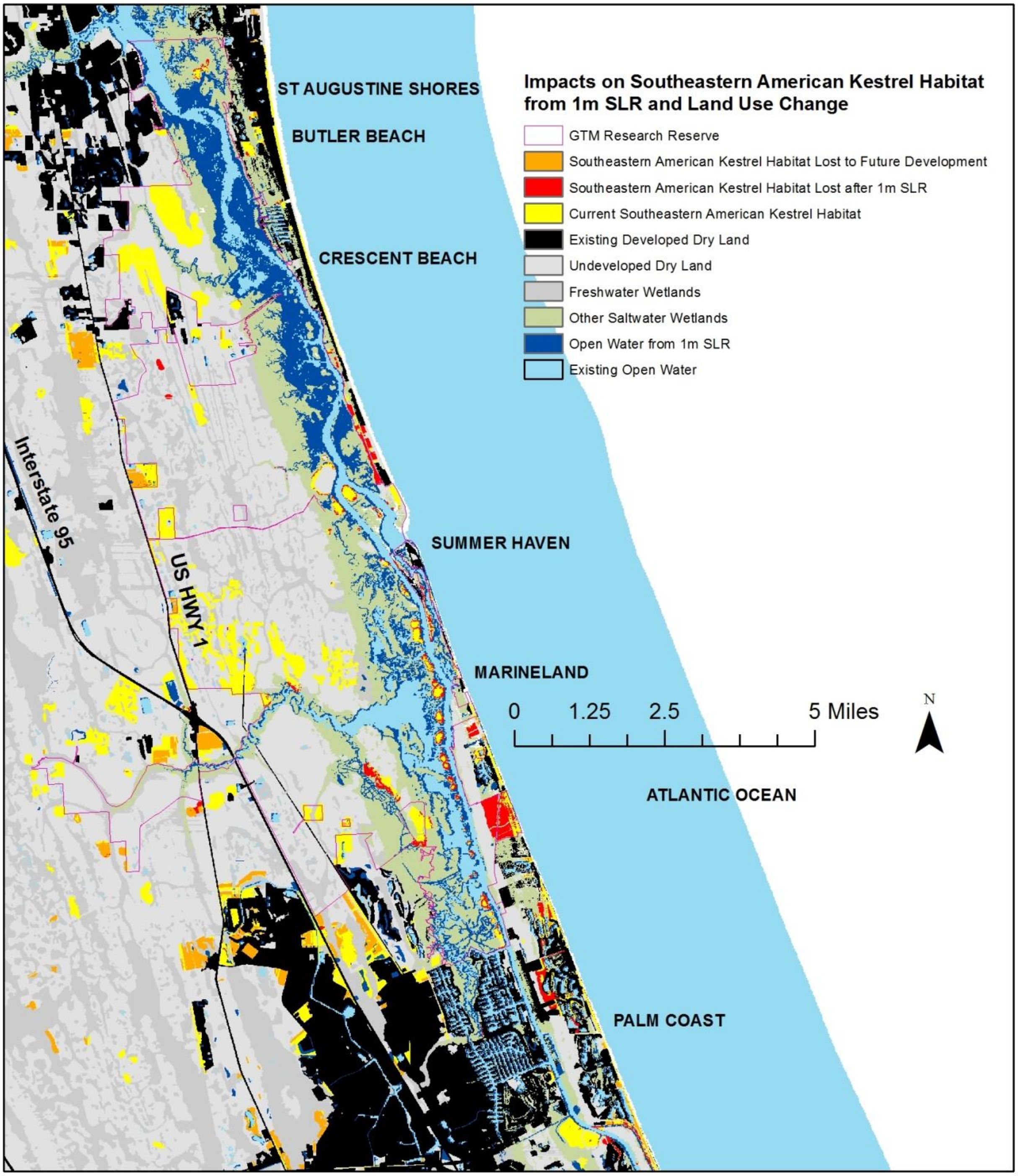

Impacts on Shorebird Guild Open Water Foraging Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Shorebird Guild Open Water Foraging Habitat Lost to Future Development
Shorebird Guild Open Water Foraging Habitat Lost after 1m SLR
Shorebird Guild Open Water Foraging Habitat Gained after 1m SLR
Current Shorebird Guild Open Water Foraging Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Shorebird Guild Open Water Foraging Habitat from 2.5m SLR
GTM Research Reserve
Shorebird Guild Open Water Foraging Habitat Lost after 2.5m SLR
Shorebird Guild Open Water Foraging Habitat Gained after 2.5m SLR
Current Shorebird Guild Open Water Foraging Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

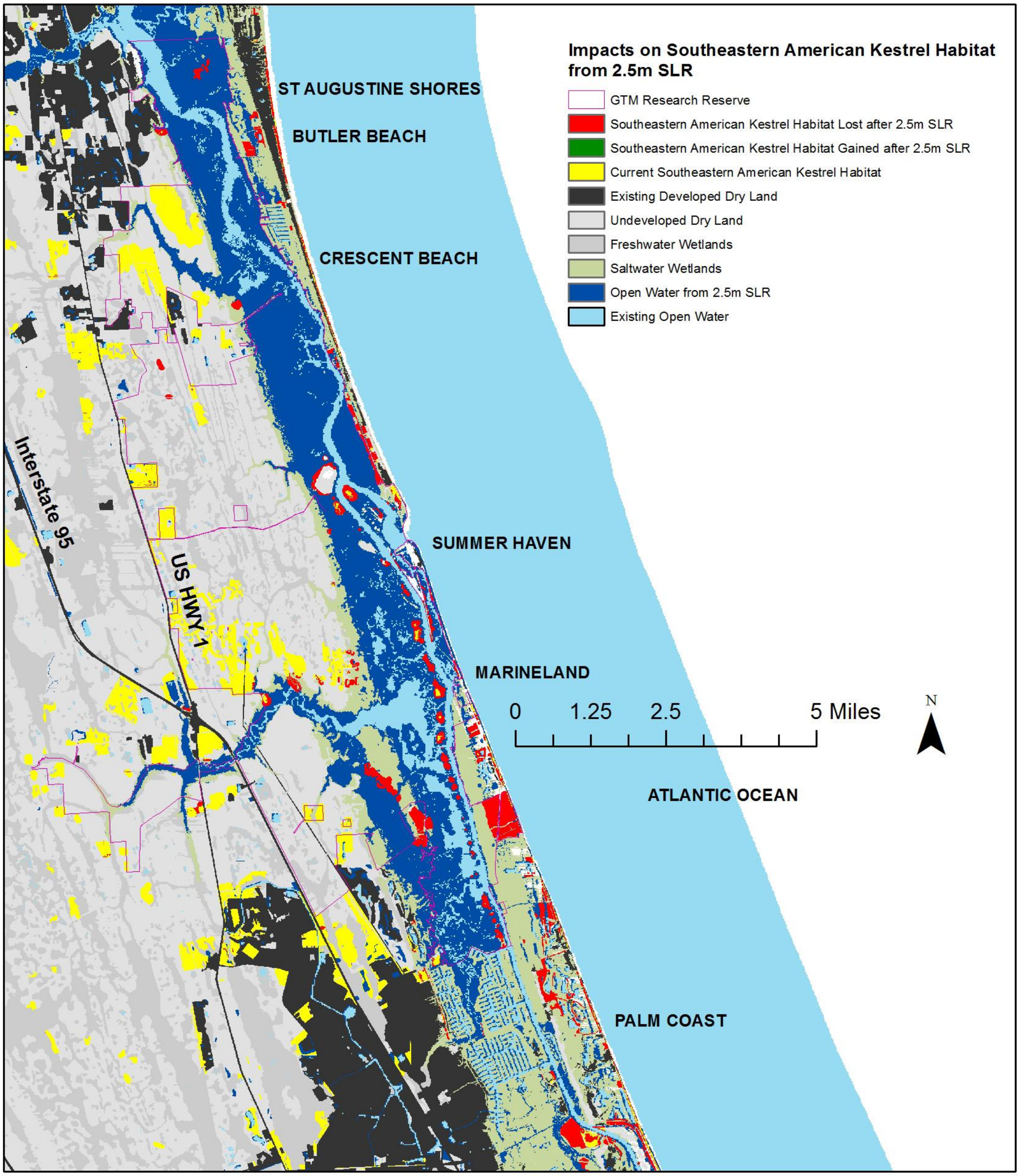

Impacts on Shorebird Guild Sand Foraging Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Shorebird Guild Sand Foraging Habitat Lost to Future Development
Shorebird Guild Sand Foraging Habitat Lost after 1m SLR
Shorebird Guild Sand Foraging Habitat Gained after 1m SLR
Current Shorebird Guild Sand Foraging Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



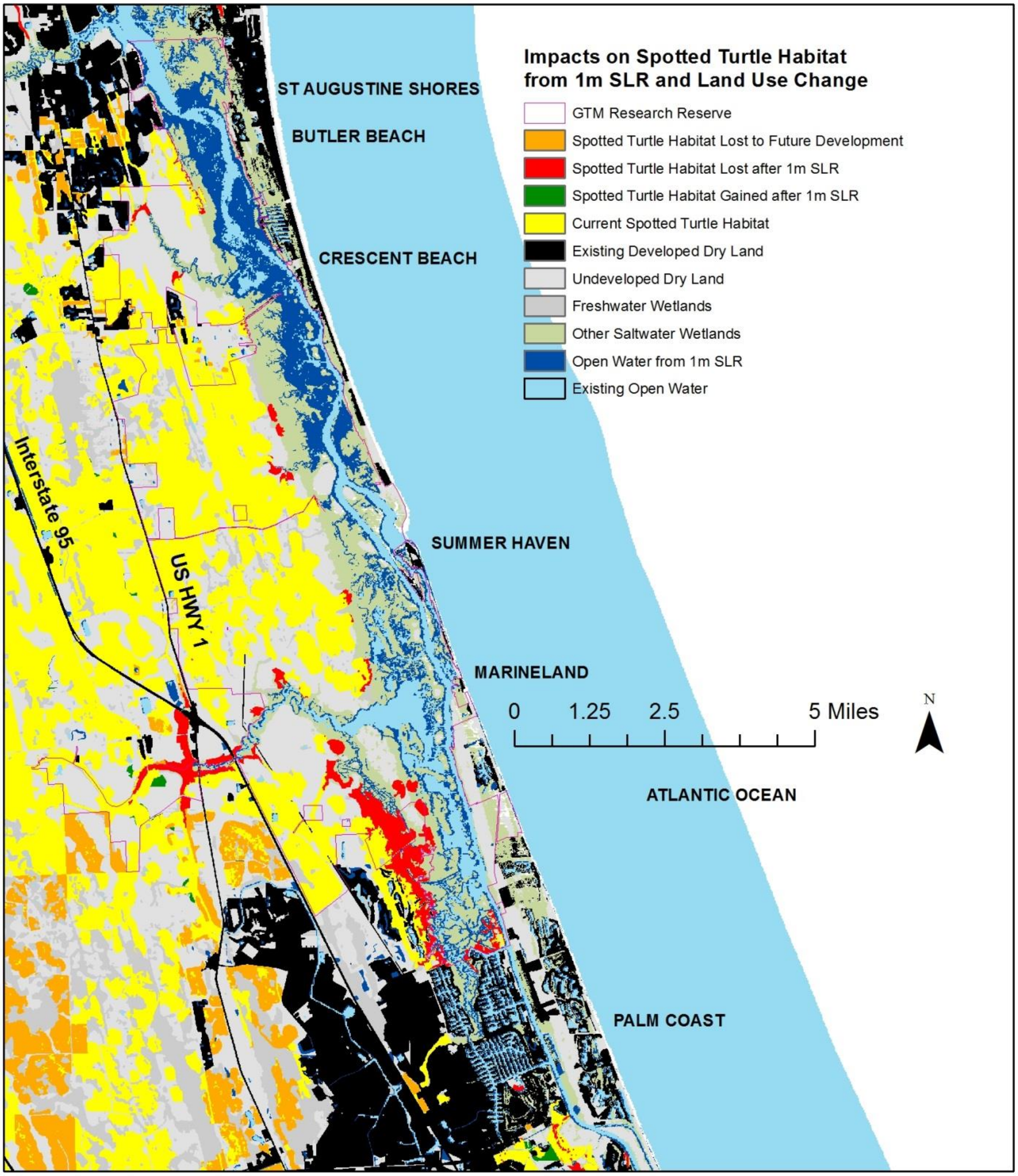
Impacts on Shorebird Guild Sand Foraging Habitat from 2.5m SLR
GTM Research Reserve
Shorebird Guild Sand Foraging Habitat Lost after 2.5m SLR
Shorebird Guild Sand Foraging Habitat Gained after 2.5m SLR
Current Shorebird Guild Sand Foraging Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Southeastern American Kestrel Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Southeastern American Kestrel Habitat Lost to Future Development
Southeastern American Kestrel Habitat Lost after 1m SLR
Current Southeastern American Kestrel Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Southeastern American Kestrel Habitat from 2.5m SLR
GTM Research Reserve
Southeastern American Kestrel Habitat Lost after 2.5m SLR
Southeastern American Kestrel Habitat Gained after 2.5m SLR
Current Southeastern American Kestrel Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Spotted Turtle Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Spotted Turtle Habitat Lost to Future Development
Spotted Turtle Habitat Lost after 1m SLR
Spotted Turtle Habitat Gained after 1m SLR
Current Spotted Turtle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
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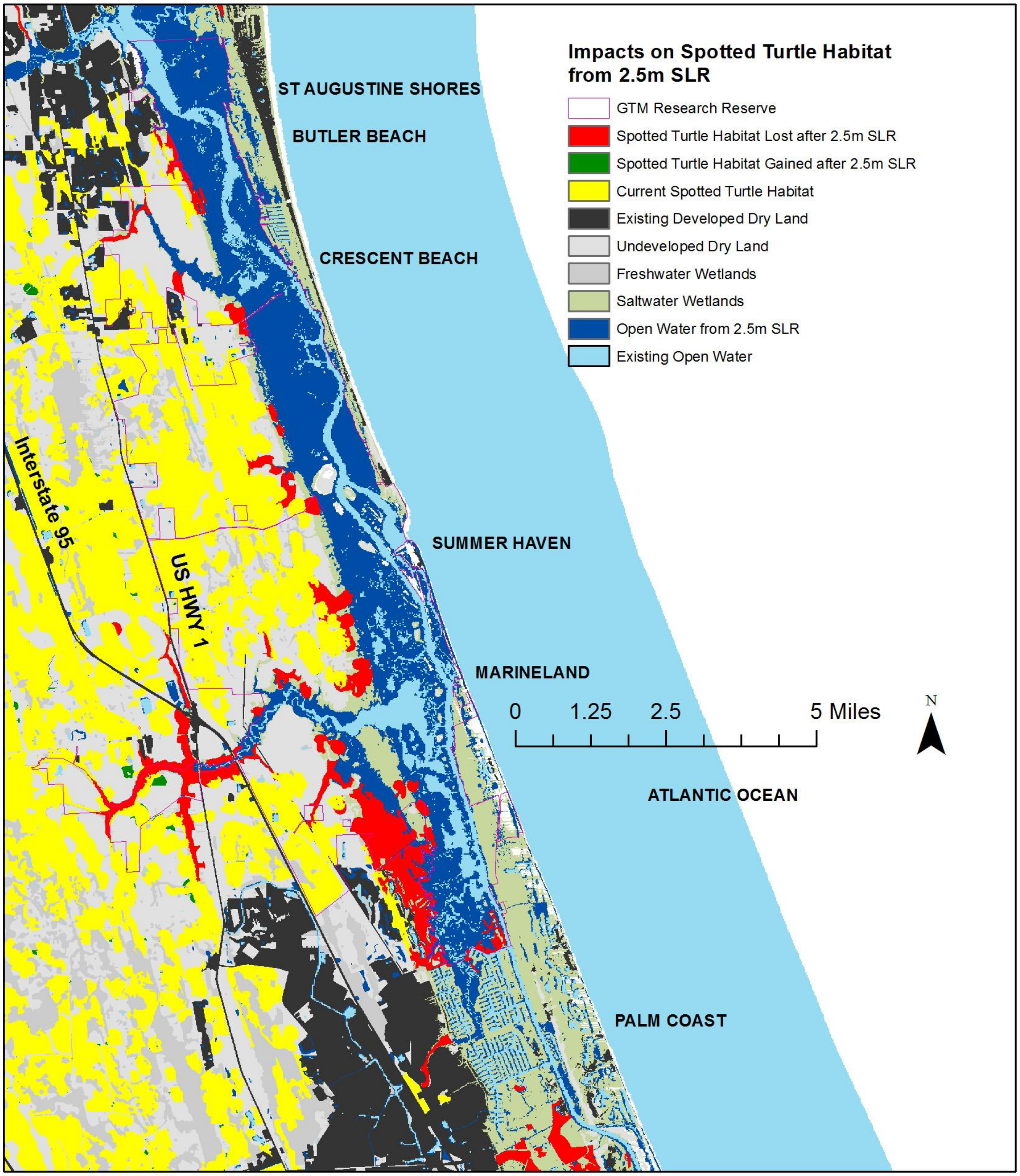
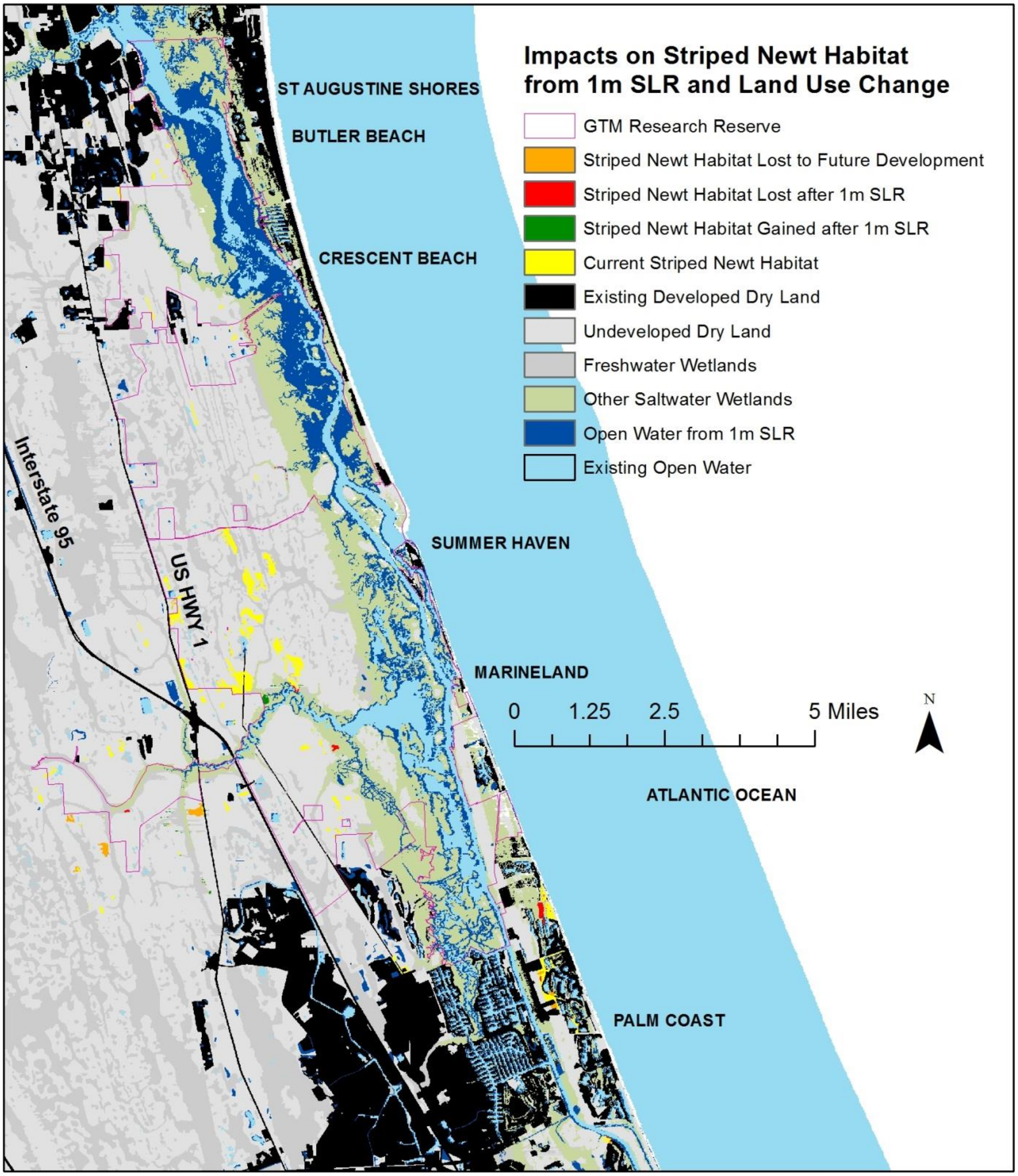
1.25
2.5
5 Miles
N


Impacts on Spotted Turtle Habitat from 2.5m SLR
GTM Research Reserve
Spotted Turtle Habitat Lost after 2.5m SLR
Spotted Turtle Habitat Gained after 2.5m SLR
Current Spotted Turtle Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Striped Newt Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Striped Newt Habitat Lost to Future Development
Striped Newt Habitat Lost after 1m SLR
Striped Newt Habitat Gained after 1m SLR
Current Striped Newt Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
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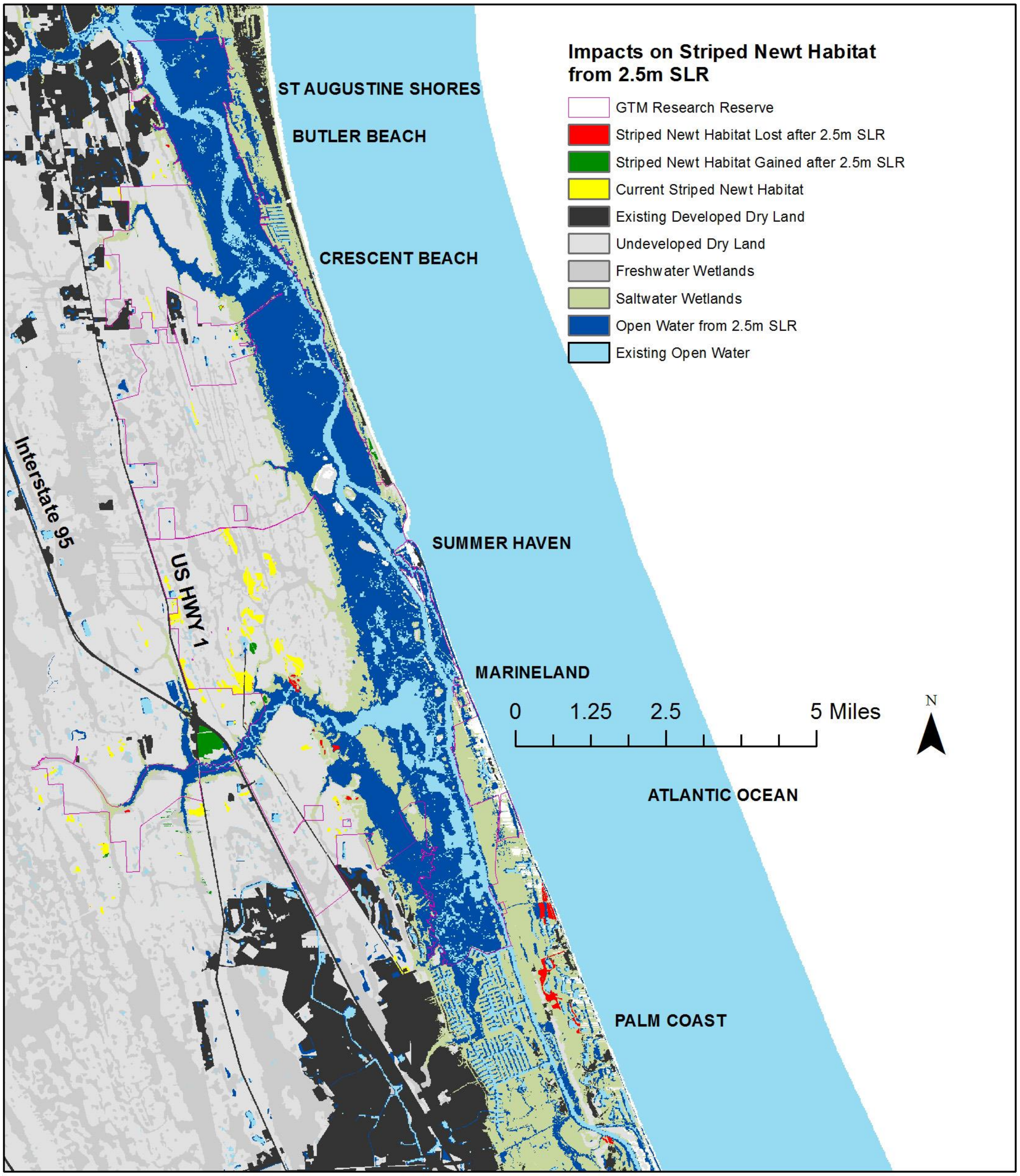
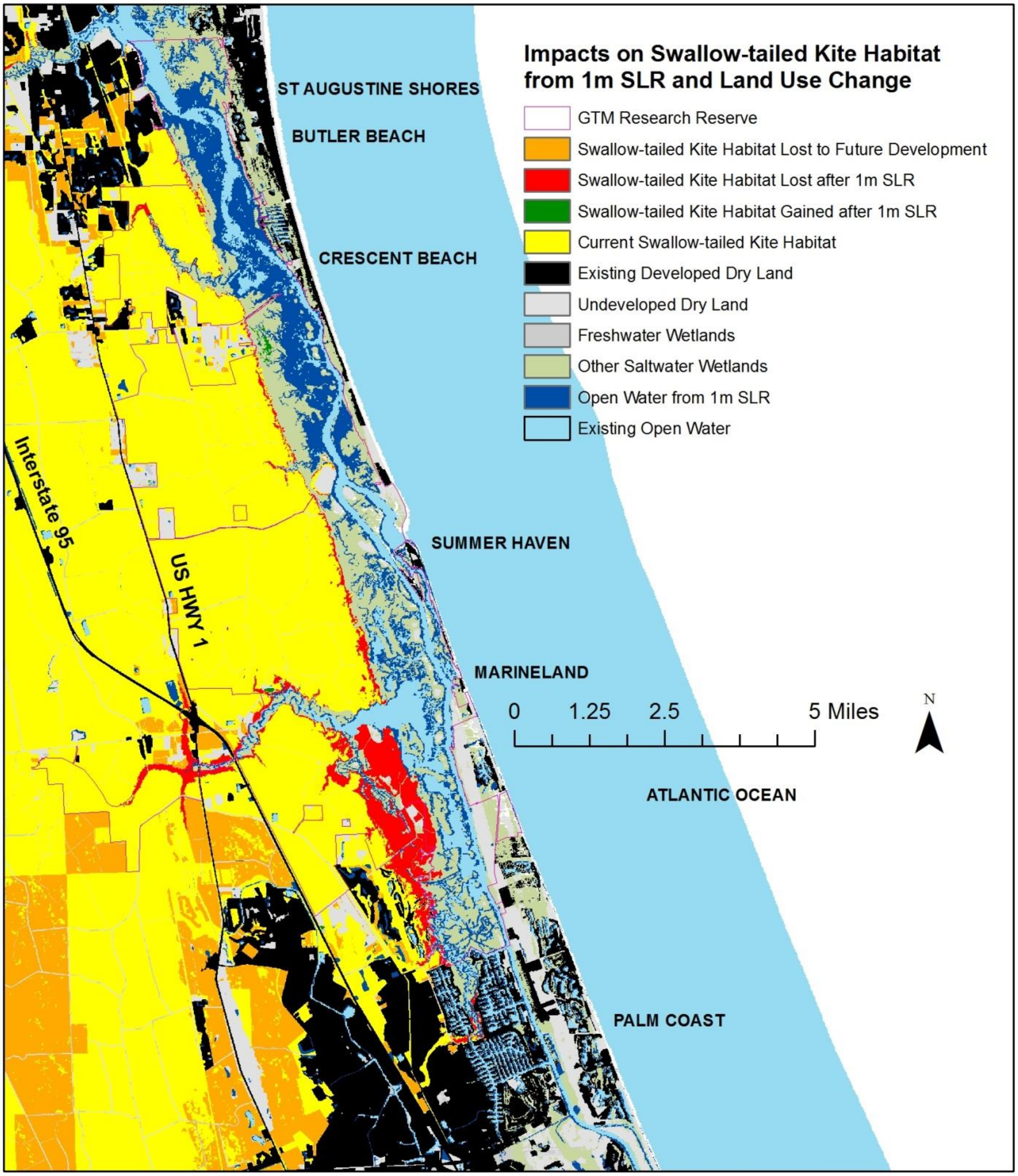
1.25
2.5
5 Miles
N


Impacts on Striped Newt Habitat
from 2.5m SLR
GTM Research Reserve
Striped Newt Habitat Lost after 2.5m SLR
Striped Newt Habitat Gained after 2.5m SLR
Current Striped Newt Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Swallow-tailed Kite Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Swallow-tailed Kite Habitat Lost to Future Development
Swallow-tailed Kite Habitat Lost after 1m SLR
Swallow-tailed Kite Habitat Gained after 1m SLR
Current Swallow-tailed Kite Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
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PALM COAST
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Interstate 95
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0 1.25 2.5 5 Miles
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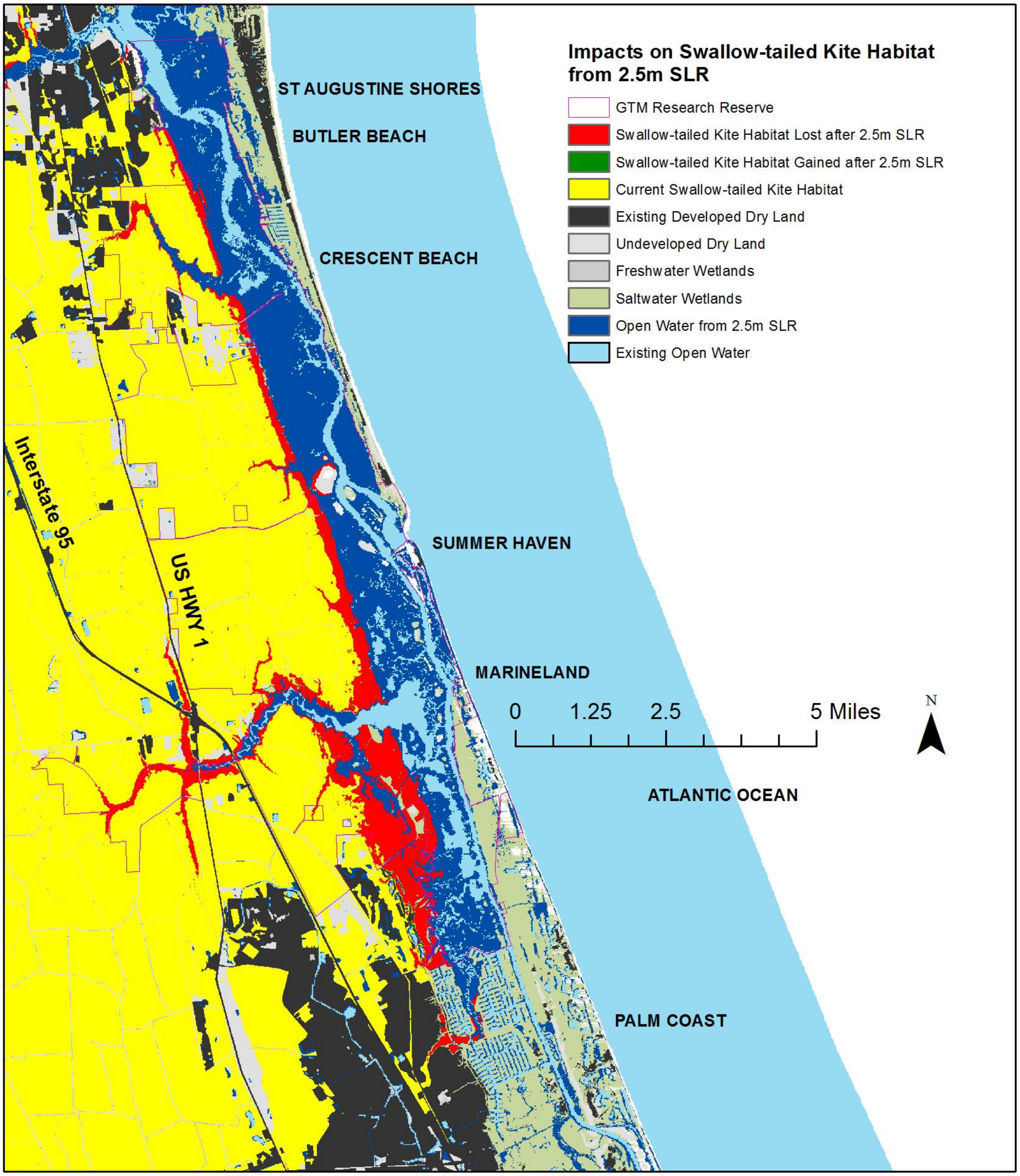
Impacts on Swallow-tailed Kite Habitat from 2.5m SLR
GTM Research Reserve
Swallow-tailed Kite Habitat Lost after 2.5m SLR
Swallow-tailed Kite Habitat Gained after 2.5m SLR
Current Swallow-tailed Kite Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
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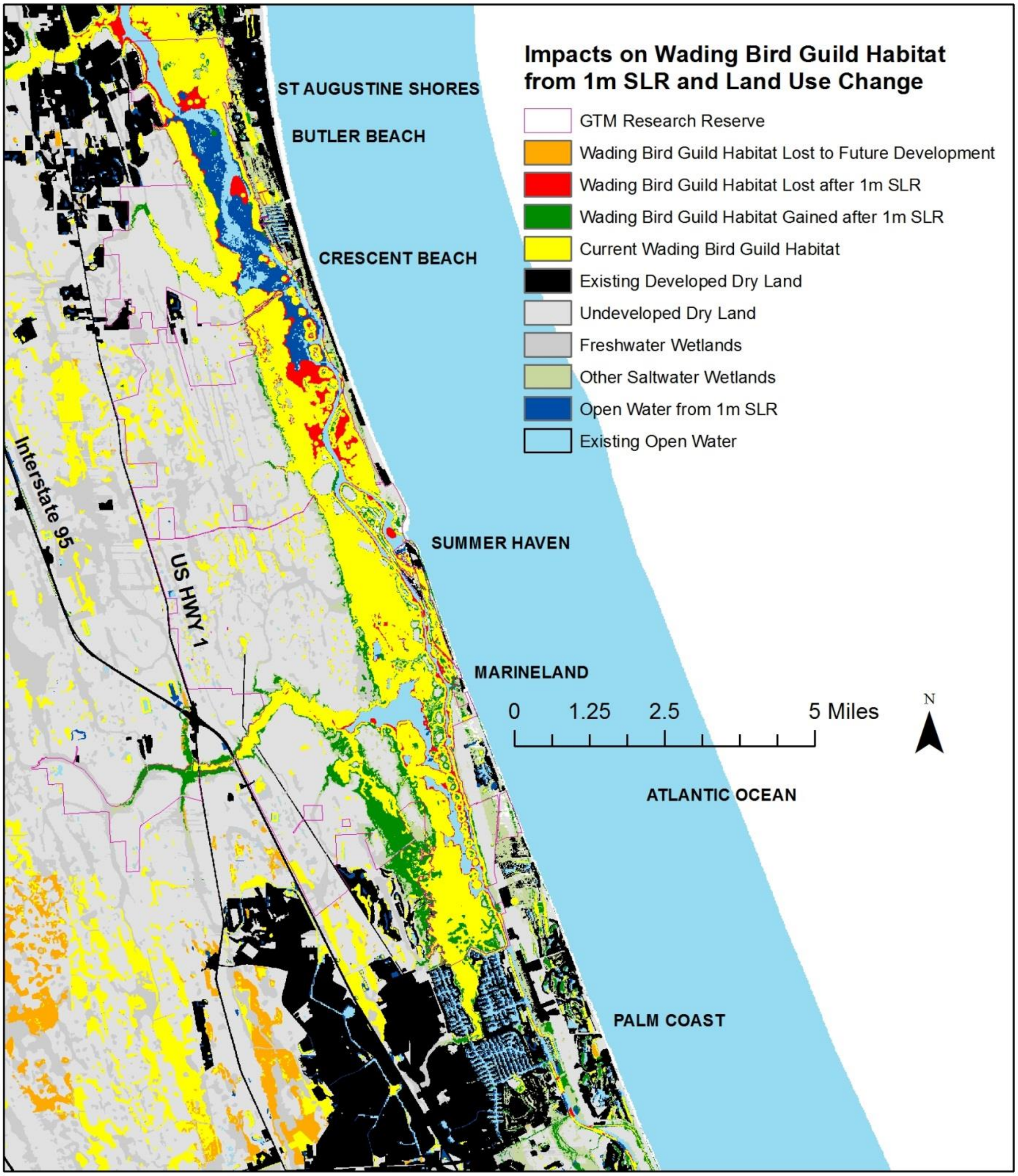
1.25
2.5
5 Miles
N



Impacts on Wading Bird Guild Habitat from 1m SLR and Land Use Change
GTM Research Reserve
Wading Bird Guild Habitat Lost to Future Development
Wading Bird Guild Habitat Lost after 1m SLR
Wading Bird Guild Habitat Gained after 1m SLR
Current Wading Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
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1.25
2.5
5 Miles
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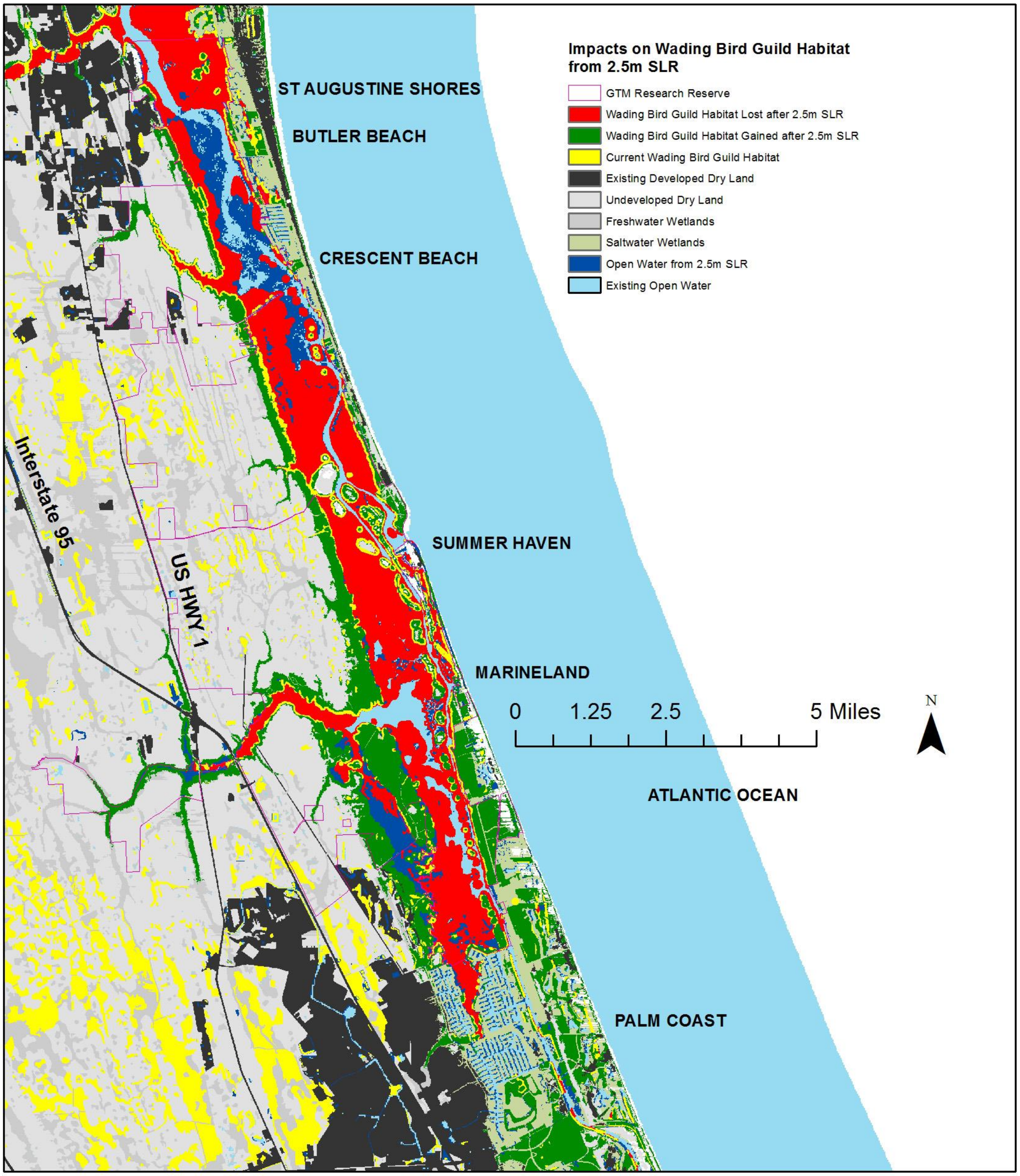
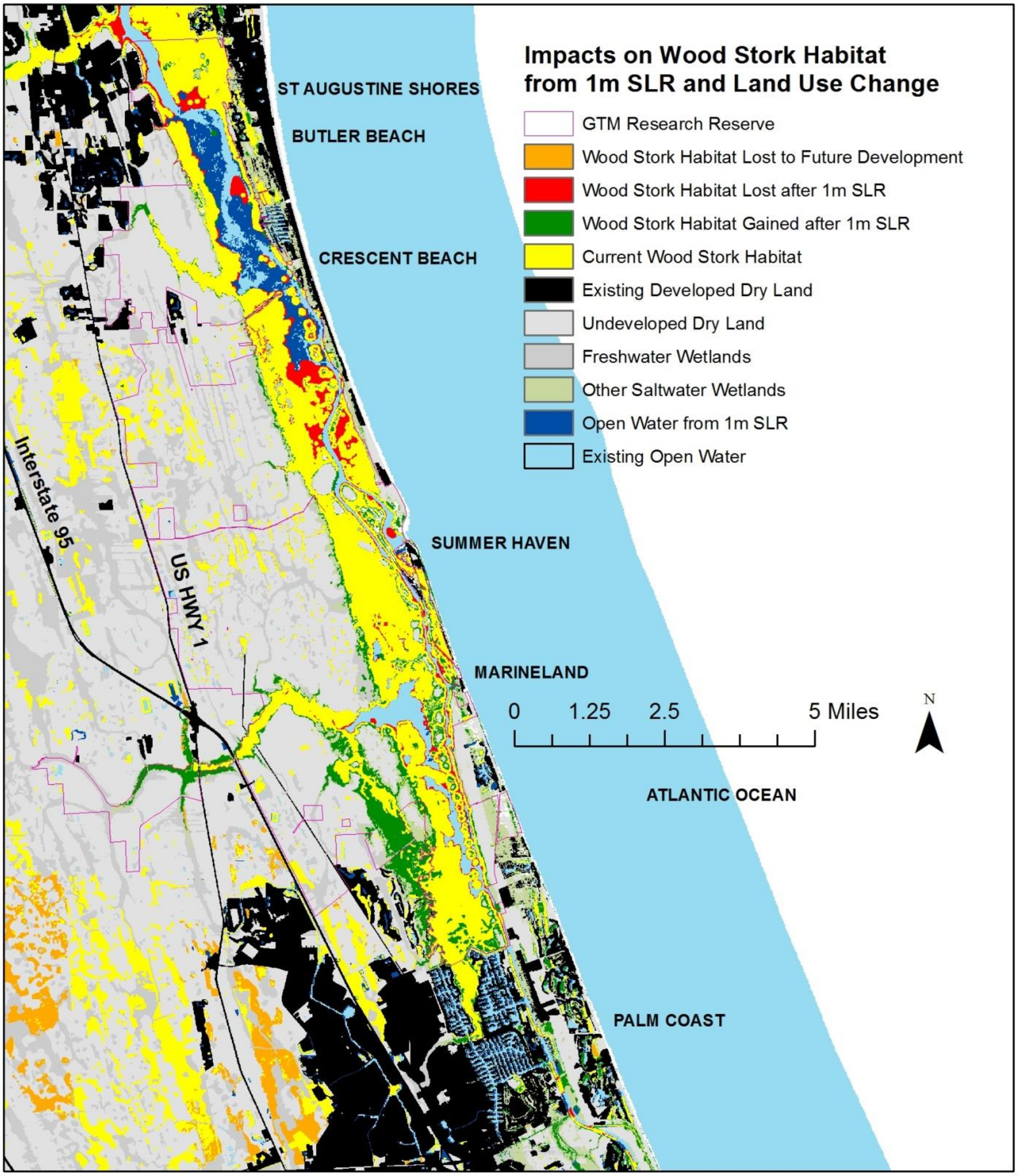
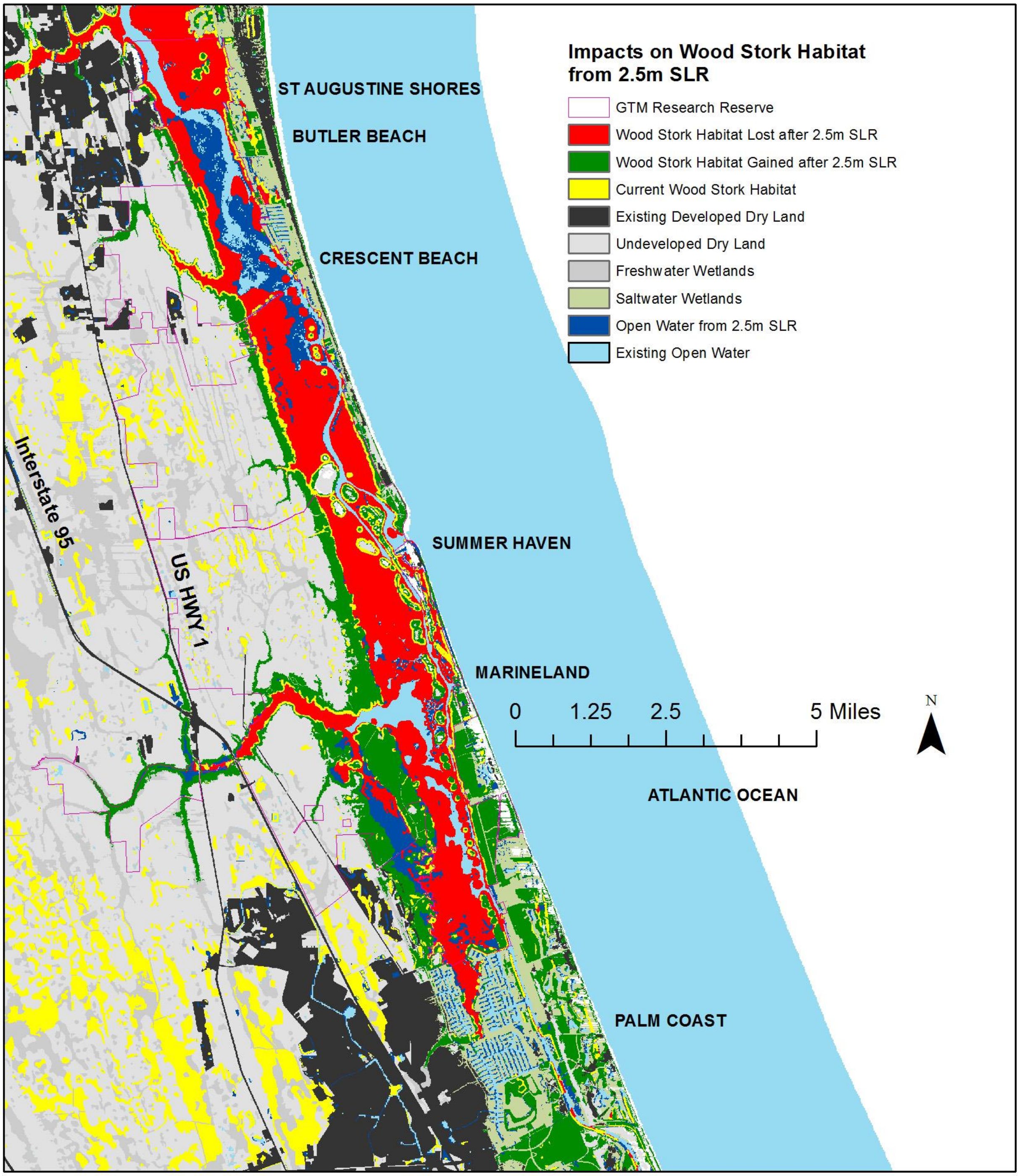

Impacts on Wading Bird Guild Habitat from 2.5m SLR
GTM Research Reserve
Wading Bird Guild Habitat Lost after 2.5m SLR
Wading Bird Guild Habitat Gained after 2.5m SLR
Current Wading Bird Guild Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Wood Stork Habitat
from 1m SLR and Land Use Change
GTM Research Reserve
Wood Stork Habitat Lost to Future Development
Wood Stork Habitat Lost after 1m SLR
Wood Stork Habitat Gained after 1m SLR
Current Wood Stork Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

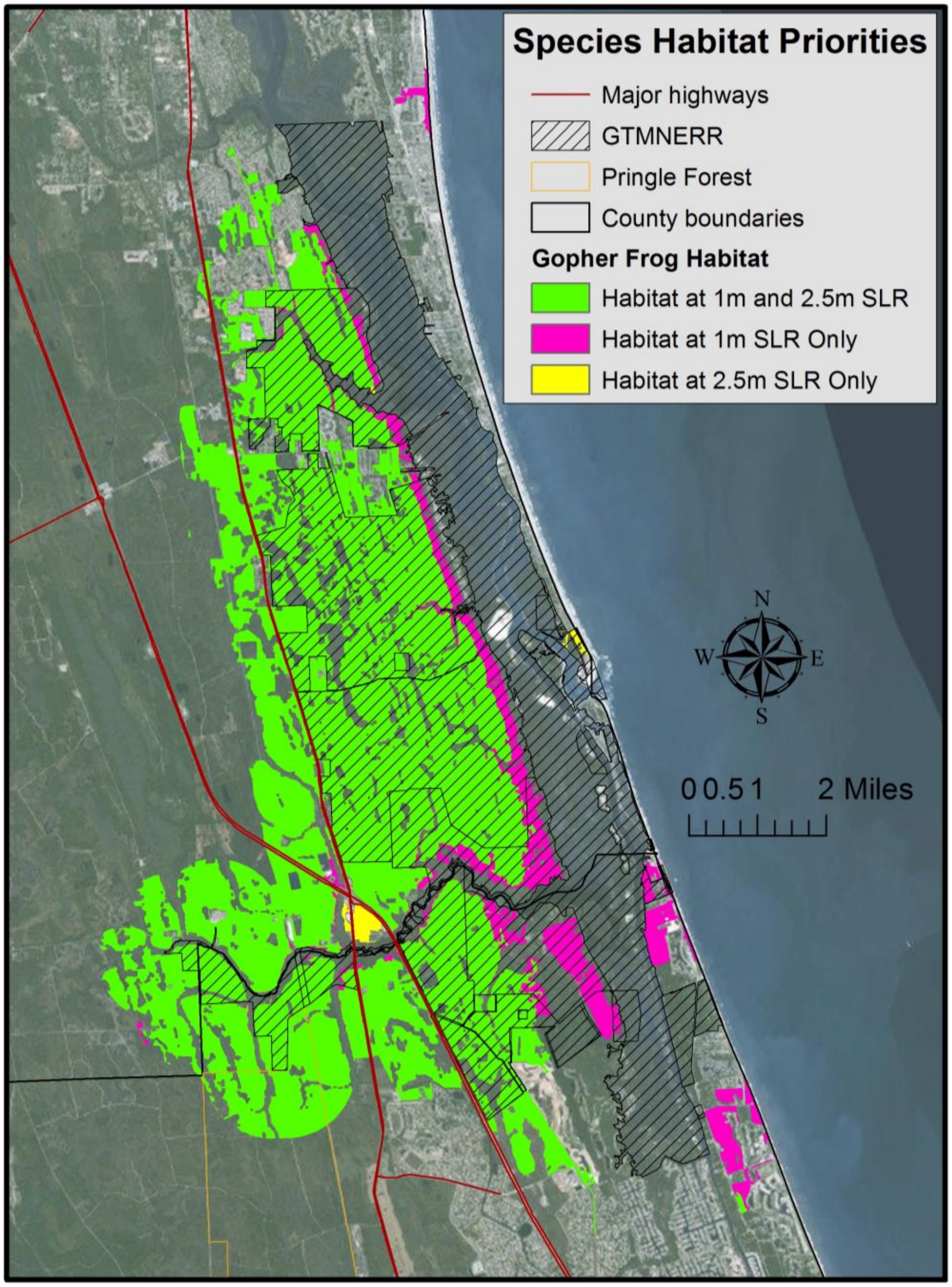

Impacts on Wood Stork Habitat from 2.5m SLR
GTM Research Reserve
Wood Stork Habitat Lost after 2.5m SLR
Wood Stork Habitat Gained after 2.5m SLR
Current Wood Stork Habitat
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

Appendix D: Focal Species Priority Maps

This Appendix includes maps and brief discussions of the potential opportunities to protect additional habitat near the GTM for the 15 focal species potentially most affected by SLR, as measured by the percentage of habitat loss within the GTM. There are several caveats that should be considered when using these habitat models for their intended purpose. All of these habitat models are considered potential habitat models, which means they are predictions of potentially occupied habitat but are not based on field evaluations of confirmed occupancy. Such habitat models are dependent on simplified rules based on land cover types, patch sizes, proximities of various land cover types, and other factors including water body locations, nesting sites, etc. depending on the specific species model. All of these models were developed with advice and review from at least one species specific expert for each species model. However, errors of commission are likely, meaning habitat is predicted to be potentially suitable but the focal species of interest may not occur at that site. In addition, errors of omission are also possible, which means that sites that are actually occupied may not be identified in the relevant model as potential habitat. All models are dependent on the accuracy of the land cover data used (which in this case was Water Management District land use data modified to include the natural communities in the Cooperative Land Cover Data version 2.0 and emergent vegetation natural communities from the GTM). Obviously, the future depictions of potential habitat represented by the maps in this Appendix are also dependent on the accuracy of the SLAMM model results for the 1m and 2.5m scenarios. However, regardless of these caveats, the potential habitat model scenarios for the 1m and 2.5m SLR scenarios are useful tools for determining where additional habitat could be protected adjacent or near the existing GTM to mitigate habitat loss within the GTM. All habitat identified in these models are limited to areas within 1 mile or the GTM in order to highlight the most proximal available habitat for mitigating impact of SLR. In addition, the maps allow users to visualize where habitat change will occur between the 1m and 2.5m SLR scenarios.

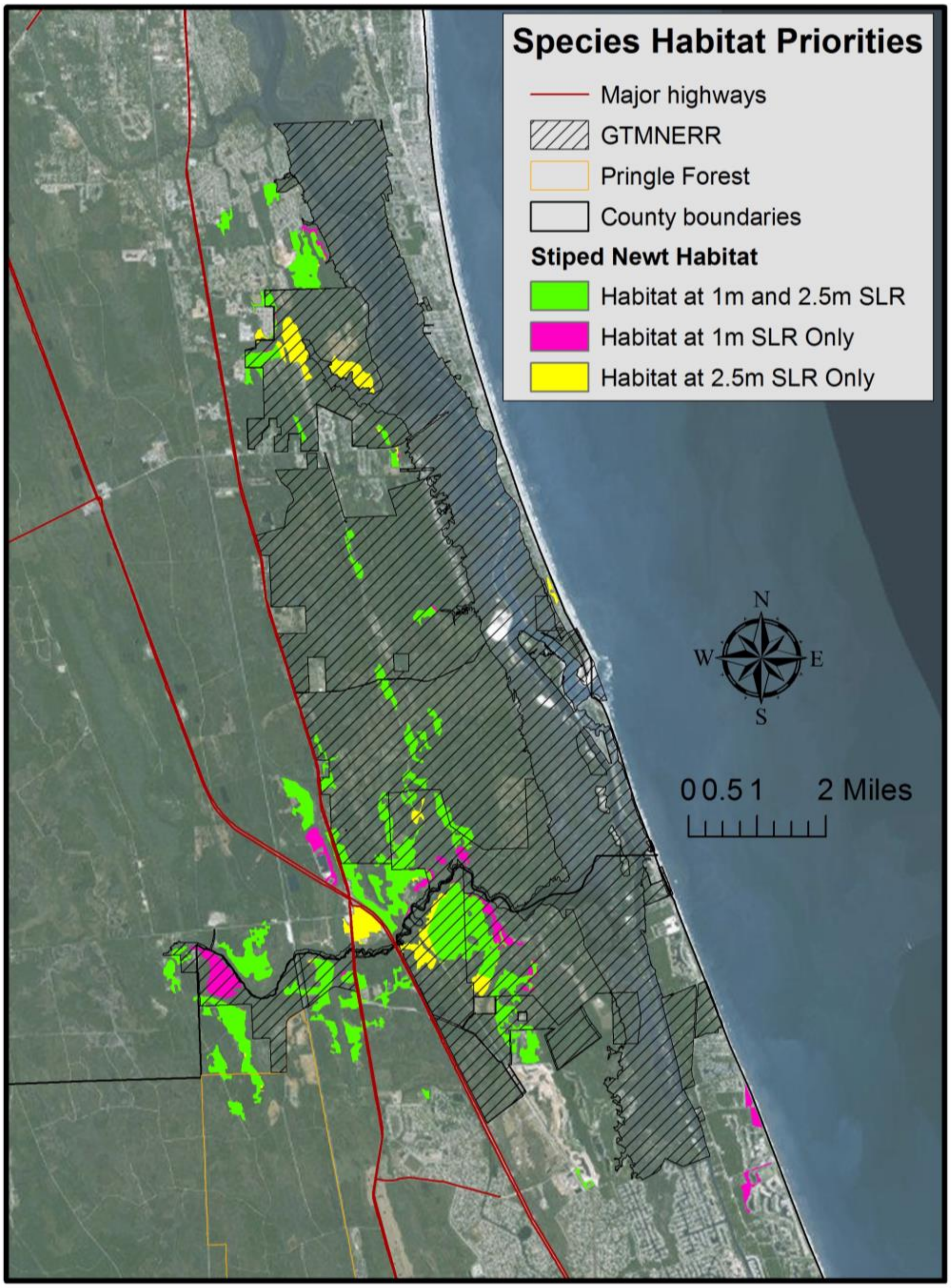
1) Gopher Frog

Gopher frogs require upland habitats that preferably also support gopher tortoises (gopher frogs frequently use gopher tortoise burrows) that are near potentially suitable ephemeral ponds. This model identified all freshwater wetlands less than 5 acres as potentially breeding habitat and any natural to semi-natural uplands with appropriate soils (more xeric) within 2000 meters of those wetlands and at least 10 acres in size as potential habitat. Overall, this model almost certainly identifies more habitat than is occupied, with identified habitat on the barrier island probably not actually suitable and some uplands on the mainland probably not appropriately dry enough. However, there is definitely potential habitat along Pellicer Creek that included currently unprotected land that could be added to the GTM to mitigate habitat loss to gopher frogs. This will be a common theme for other species, including even more xeric dependent, regarding the importance of habitat near Pellicer Creek.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Gopher Frog Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1 2 Miles

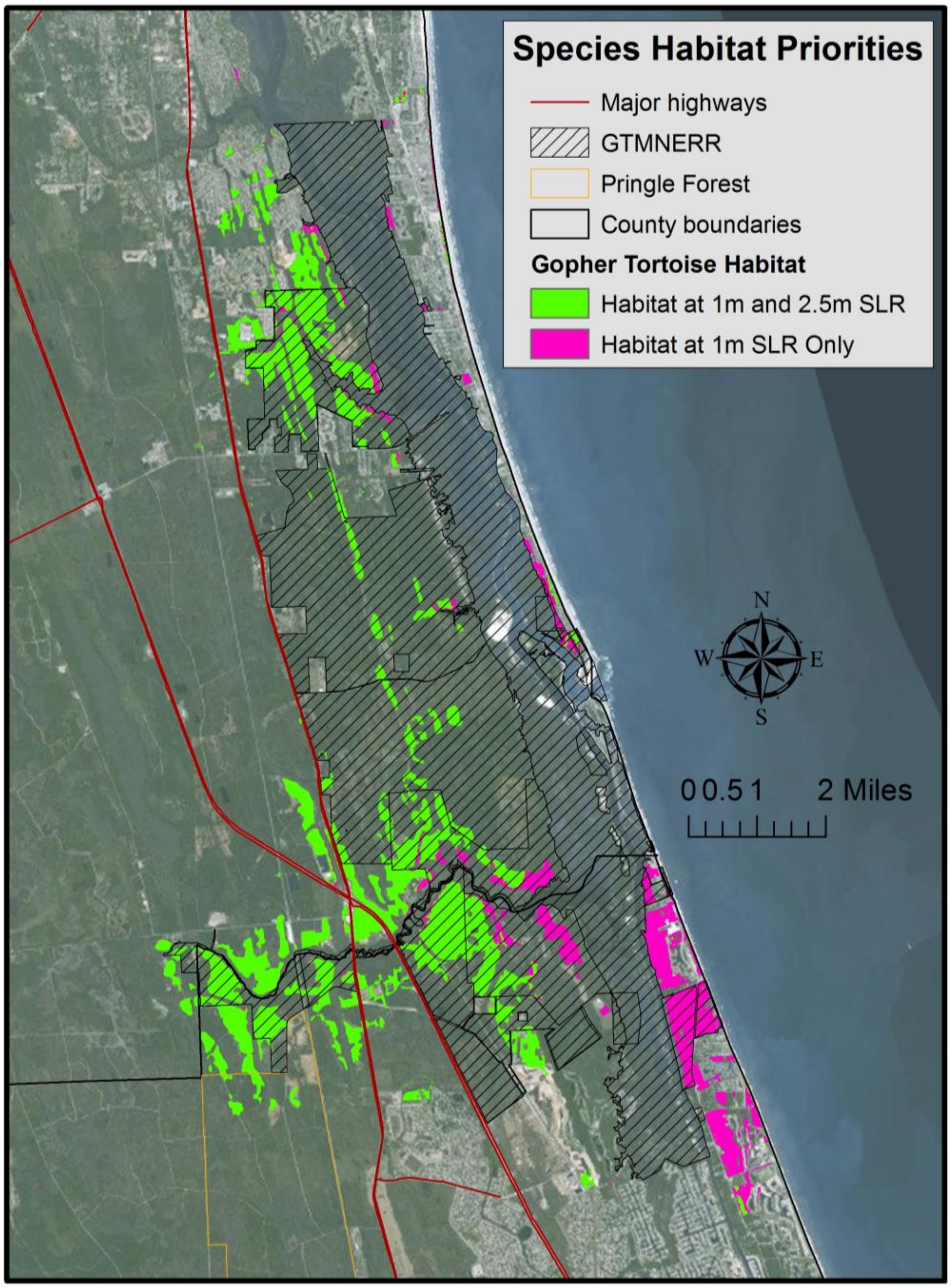
2) Striped newt

Striped newts have similar habitat requirements as gopher frogs with more dependence on xeric upland forest. In this model, all freshwater wetlands less than 7 acres and all appropriate xeric uplands within 1000 meters of such wetlands were identified as potential habitat. The models again show the importance of lands around Pellicer Creek. In addition, the loss and gain of habitat between the 1m SLR and 2.5m SLR scenarios is likely driven by loss of potentially appropriate freshwater wetlands for breeding due to conversion of freshwater wetlands to estuarine, and then the conversion of some uplands to potentially appropriate freshwater wetlands in the 2.5m scenario, which is depicted by the yellow habitat blocks on the map.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Stiped Newt Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1 2 Miles

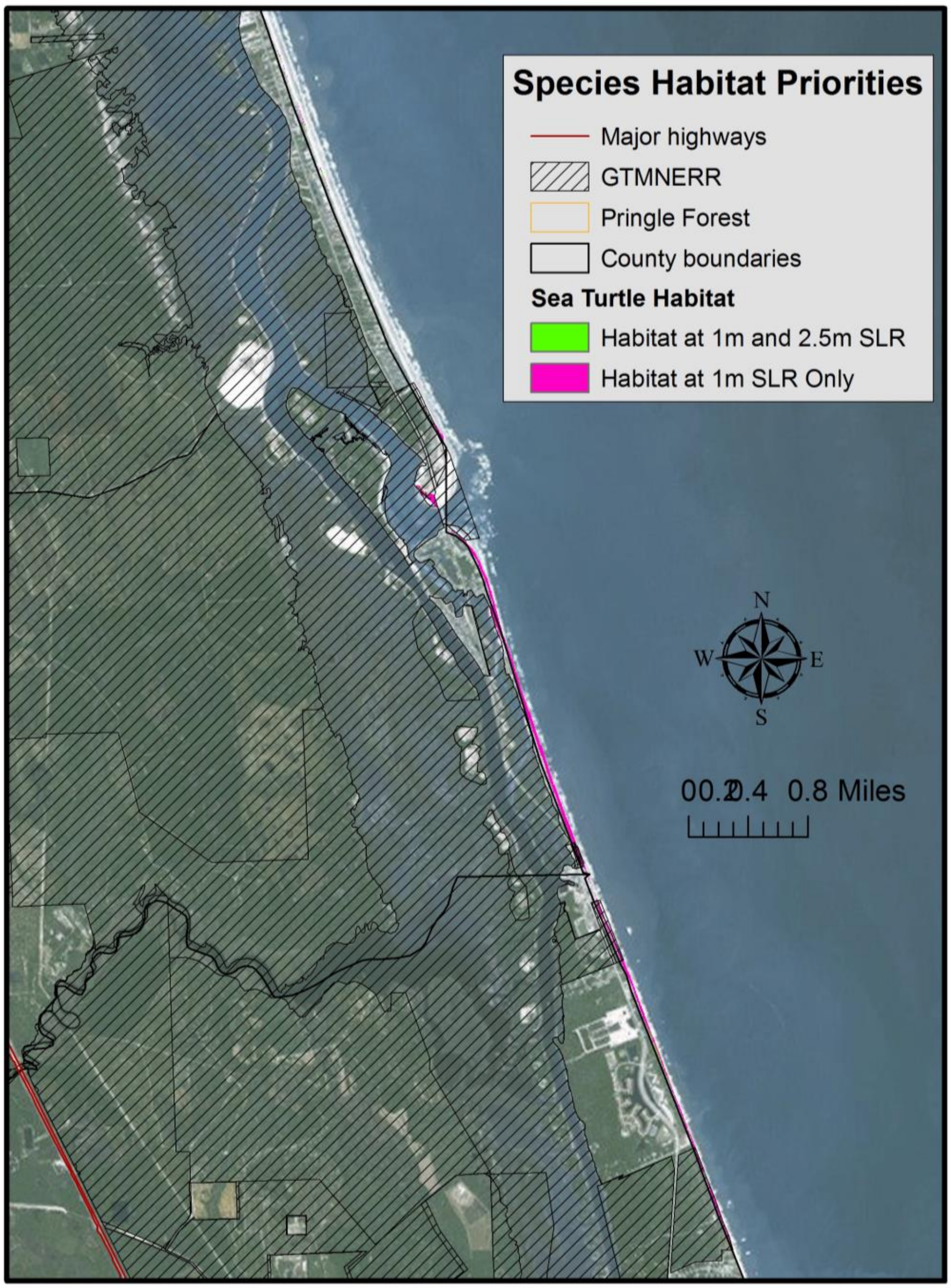
3) Gopher tortoise

Gopher tortoises are dependent on suitably xeric uplands and especially scrub, sandhill, and scrubby or more xeric flatwoods. The scenario models show the probable large scale habitat loss for gopher tortoises on the barrier island in the 1m scenario. The models also again show the importance of unprotected habitat near Pellicer Creek as well as a smaller block of potential habitat to the north of the GTM.



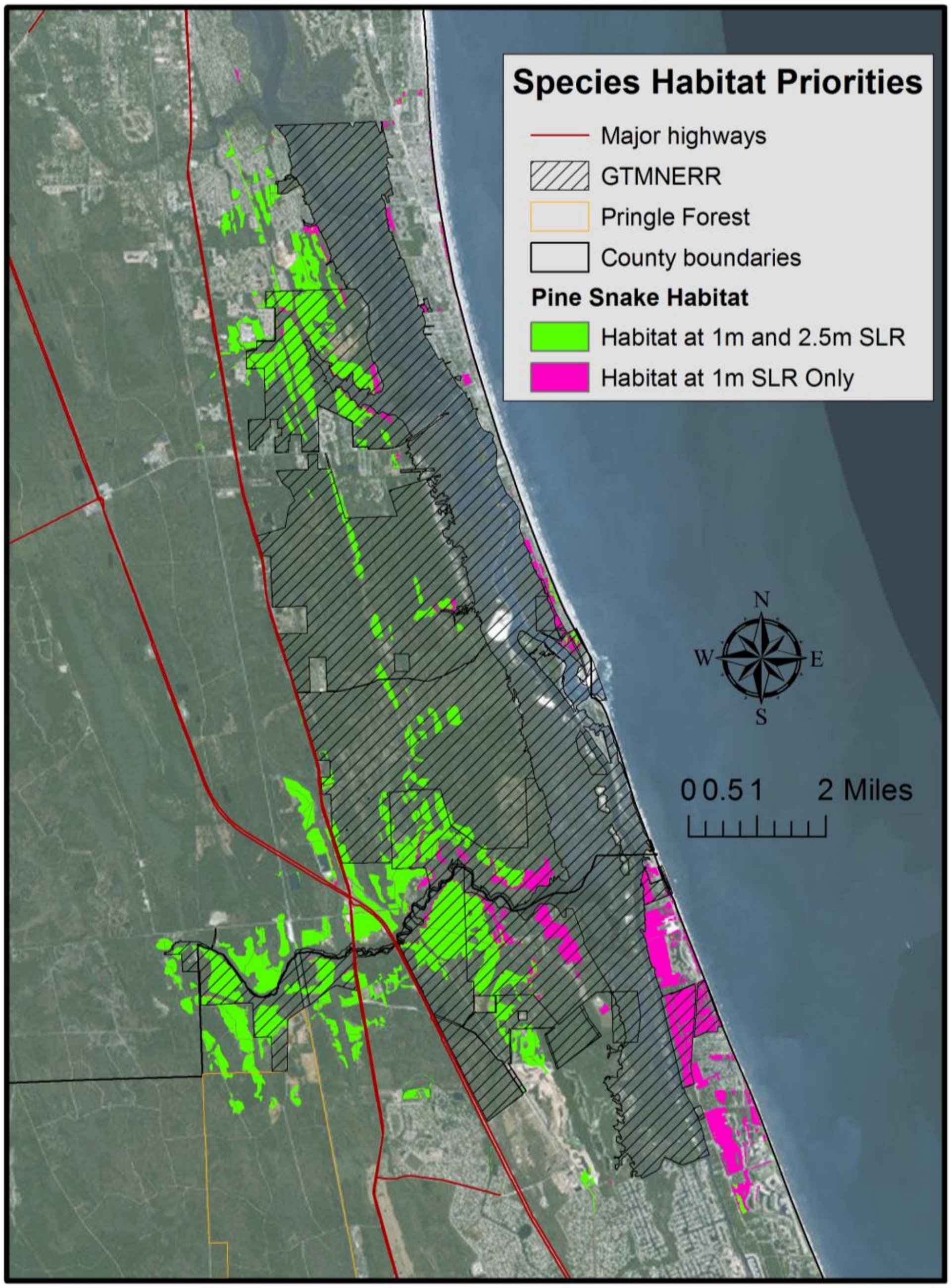
4) Sea turtles

Sea turtles are not well represented in the 1m and 2.5m scenarios since our models were dependent on a static nesting habitat layer from FNAI and the difficulty of identifying new beach habitat using SLAMM. However, sea turtle nesting habitat will clearly be highly threatened with a 1m or greater SLR and future habitat will be dependent on the development of at least somewhat stable beach and beach dune as SLR progresses.



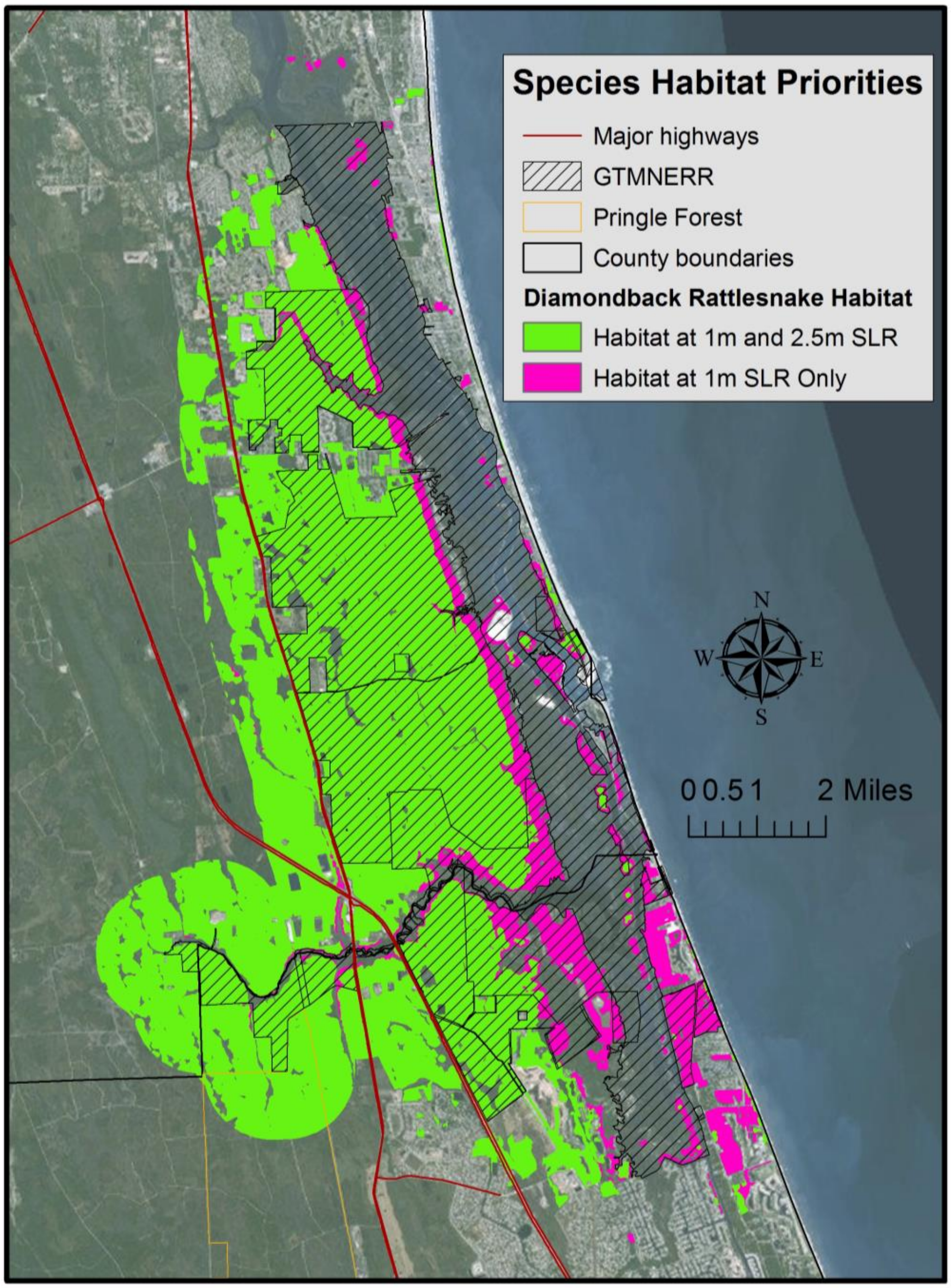
5) Pine snake

Pine snakes are dependent on dry, sandy soils with either forest or grassland cover. The model result very much mimics that for gopher tortoise, with the most important potential unprotected blocks of habitat occurring along Pellicer Creek and north of the GTM.



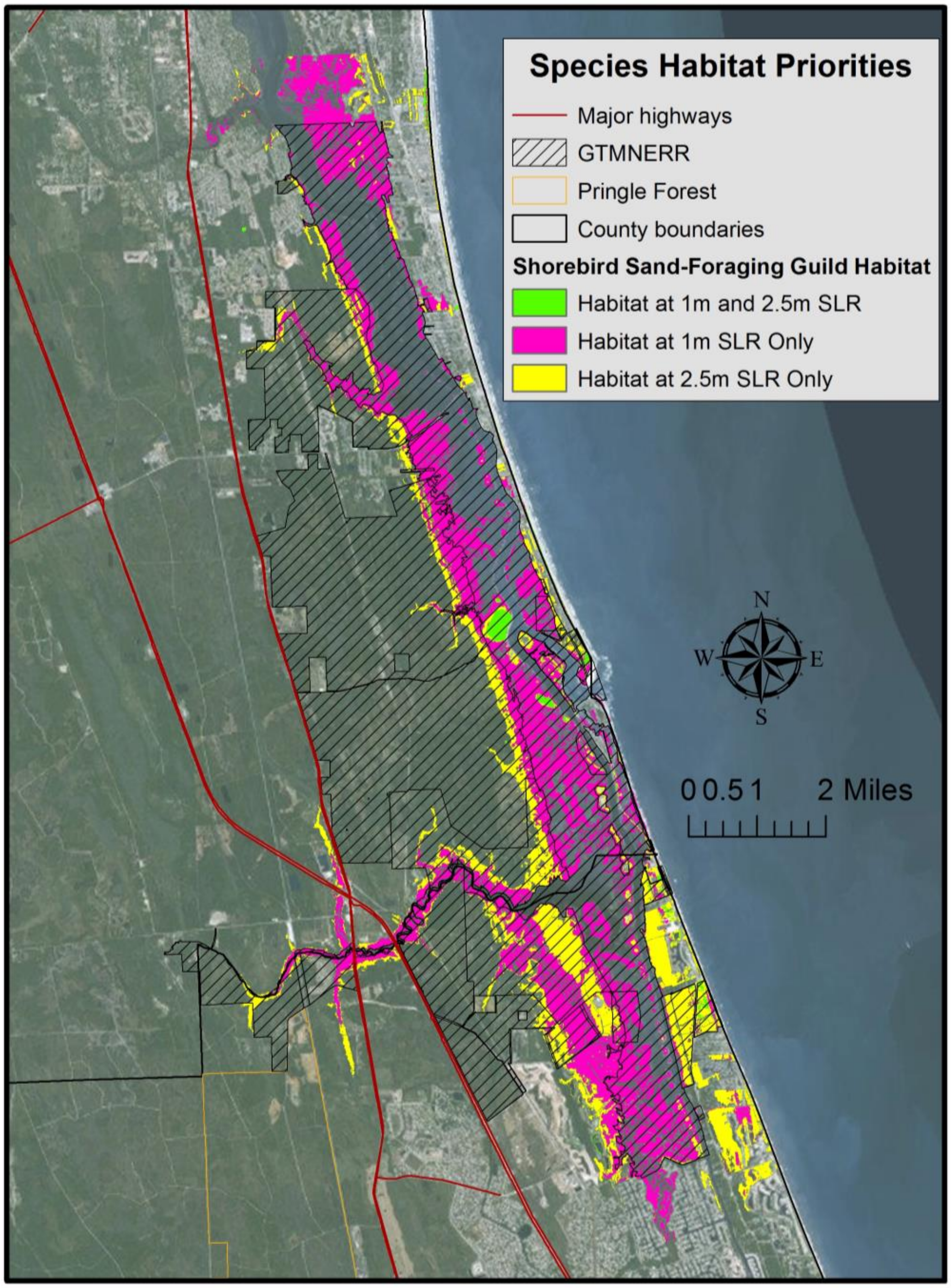
6) Diamondback rattlesnake

Eastern diamondback rattlesnakes use primarily flatwoods, sandhills, scrub, upland hammocks, and shrub and brush land covers. The map of the 1m and 2.5m scenarios indicate relatively extensive opportunities to protect additional habitat to mitigate loss within the GTM to SLR.



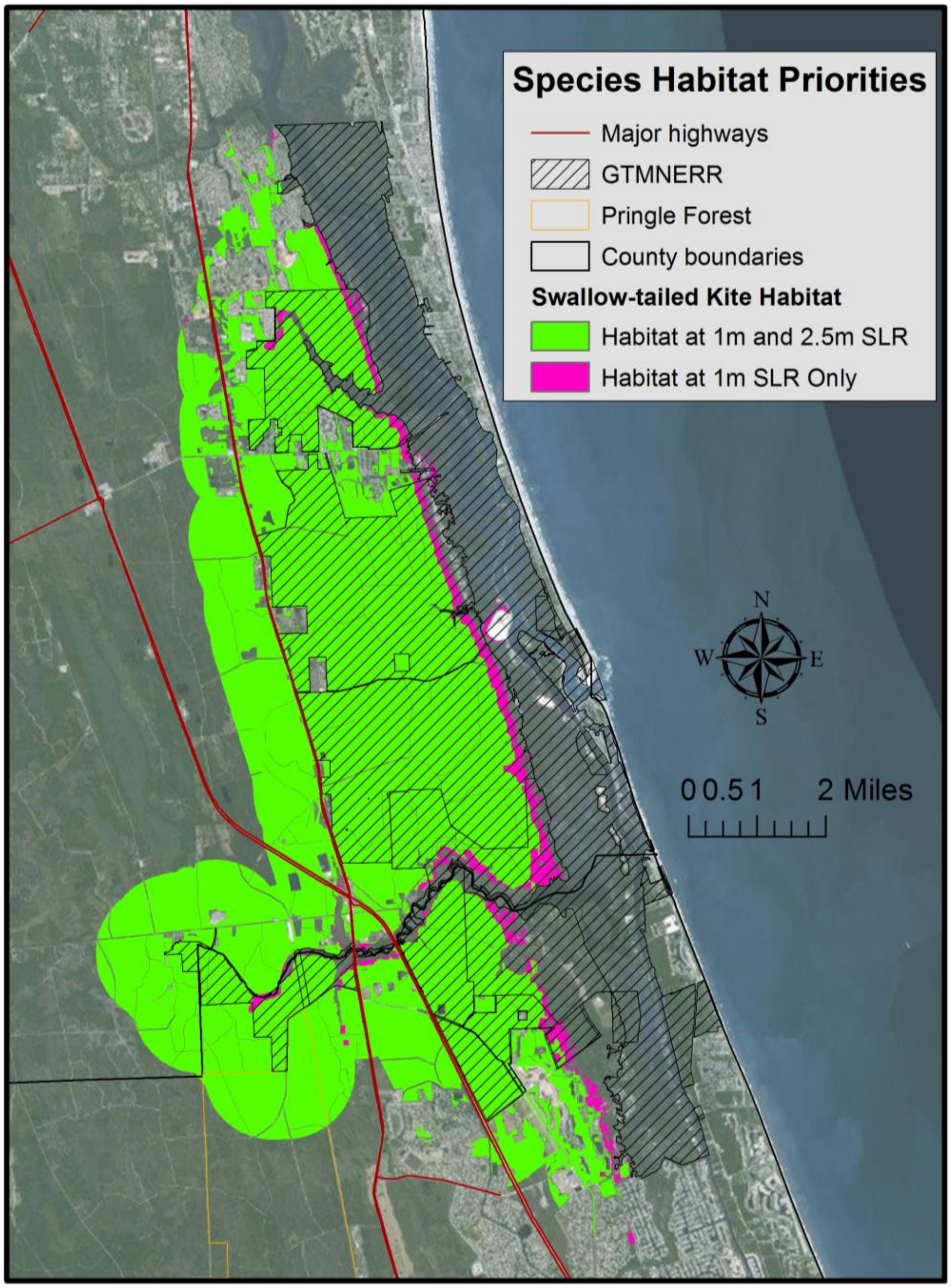
7) Shorebird sand-foraging guild

The shorebird sand-foraging guild includes plover, sandpipers and other smaller wading shorebirds primarily found foraging on intertidal shorelines included mudflats, oyster bars, sand edges, and beaches. Some of these species also nest on sand substrates above the mean high tide line. These species will be greatly affected by SLR as mean low and high tide lines shift as SLR progresses. Given current topography, these birds may see a habitat increase (at least regarding foraging habitat but appropriate nesting habitat is more complicated) but with significant reductions as SLR reaches 2.5m. The best opportunities to protect additional habitat up to 2.5m SLR appear to be southeast (on the current barrier island) and southwest on the mainland.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Shorebird Sand-Foraging Guild Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1 2 Miles

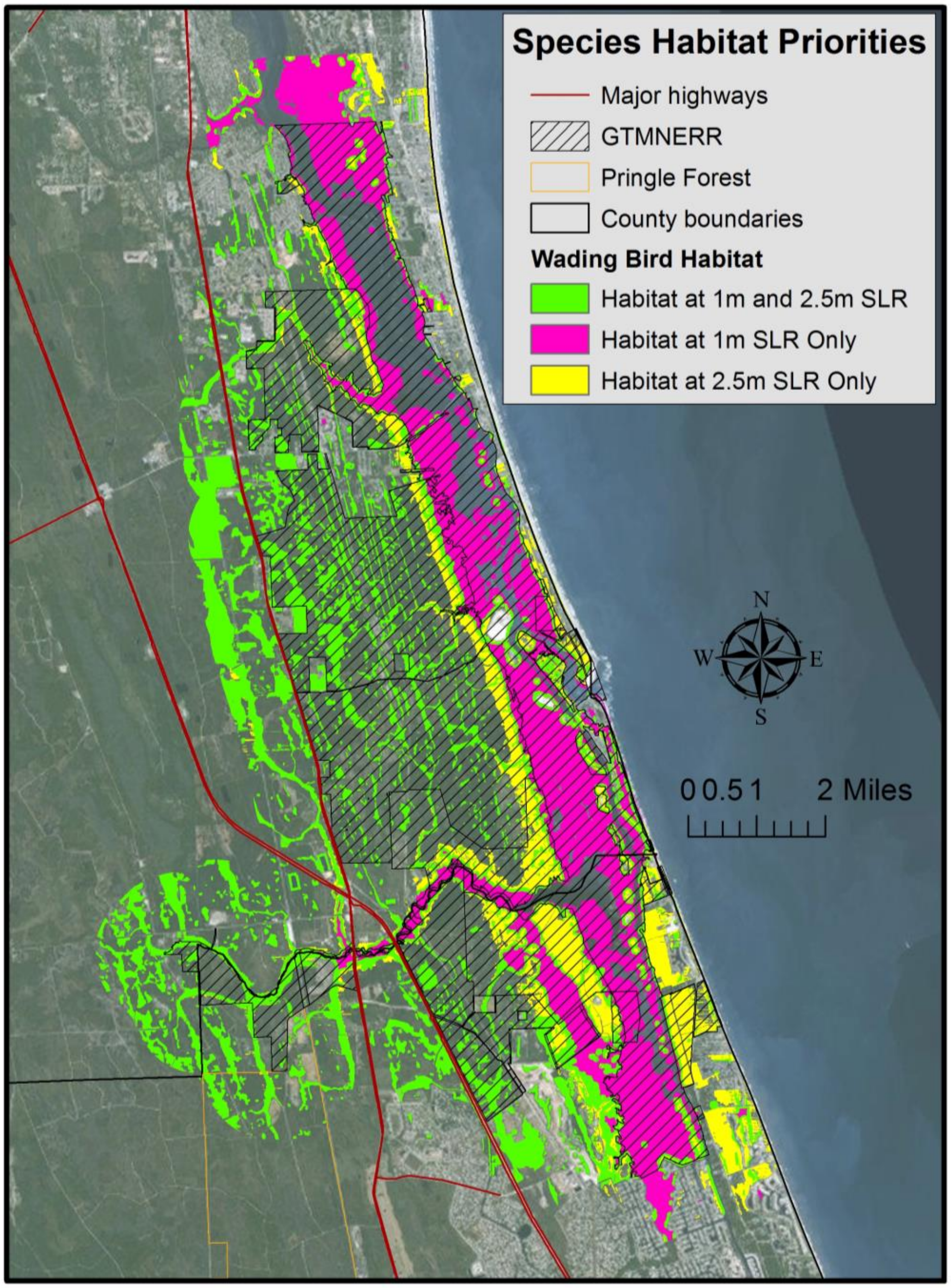
8) Swallow-tailed kite

Swallow-tailed kites prefer large rural landscape dominated by pinelands and forested wetlands while also using open upland and wetland habitats that occur in such landscapes. Large pines and cypress tend to be the most likely trees selected for nest sites. Similar to eastern diamondback rattlesnakes, there appear to be ample opportunities to protect additional habitat primarily west of the GTM to mitigate habitat loss from SLR. However, this is a wide-ranging, fragmentation sensitive species that requires larger, intact landscapes to support successful nesting territories and foraging habitat. Increased suburbanization north, south, and especially west of the GTM could significantly affect the functionality of the GTM as swallow-tailed kite habitat in the future.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Swallow-tailed Kite Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
N
W
E
S
0 0.5 1
2 Miles

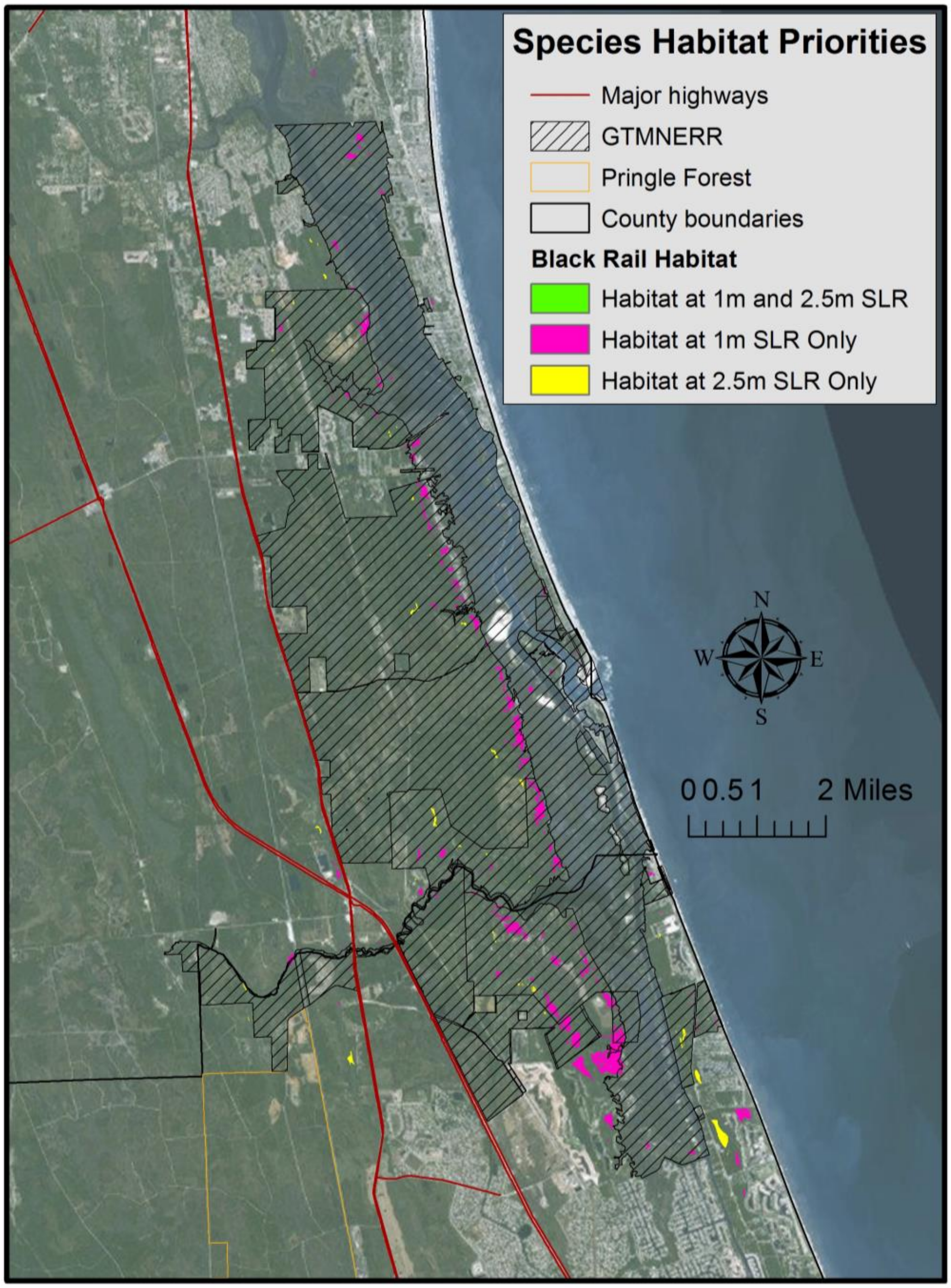
9) Wading bird guild

This guild includes a wading bird species such as herons, egrets, etc. They use a variety of fresh and salt water wetlands though in general herbaceous wetlands tend to be preferred or used more frequently by most species. Within the GTM and surrounding landscape that makes tidal estuarine marshes particularly important to this guild. Overall, habitat may be gained in the 1m SLR scenario but there will be less estuarine habitat in the 2.5m scenario. Some forested freshwater wetlands, both forested and non-forested, will convert to estuarine, which will in general maintain their function as habitat for these species. There are significant opportunities especially south of the GTM to protect additional blocks of habitat should be available through the transition from current sea level to 2.5m SLR.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Wading Bird Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1
2 Miles

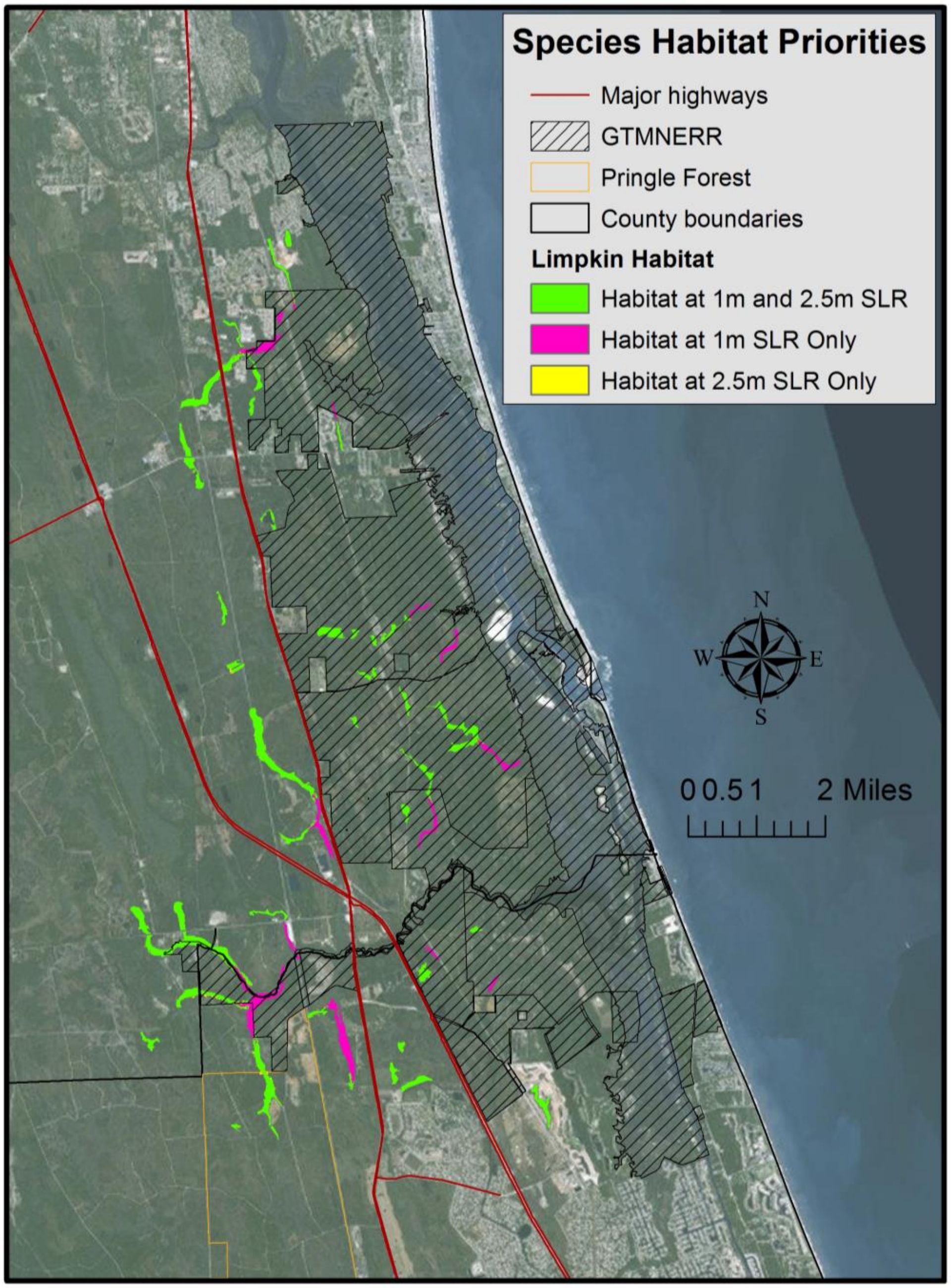
10) Black rail

Black rails are dependent on appropriately large salt marsh edges adjacent to natural or semi-natural upland cover types. This model likely under-represents potentially suitable habitat in the GTM landscape, but black rails are at least relatively rare and may not be found everywhere there are high salt marsh adjacent to undeveloped uplands. The 1m and 2.5m SLR scenarios suggest that much of the potential available habitat at 1m SLR will be inundated at a 2.5m SLR. Most of the additional unprotected habitat in both scenarios occurs south of the reserve.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Black Rail Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1 2 Miles

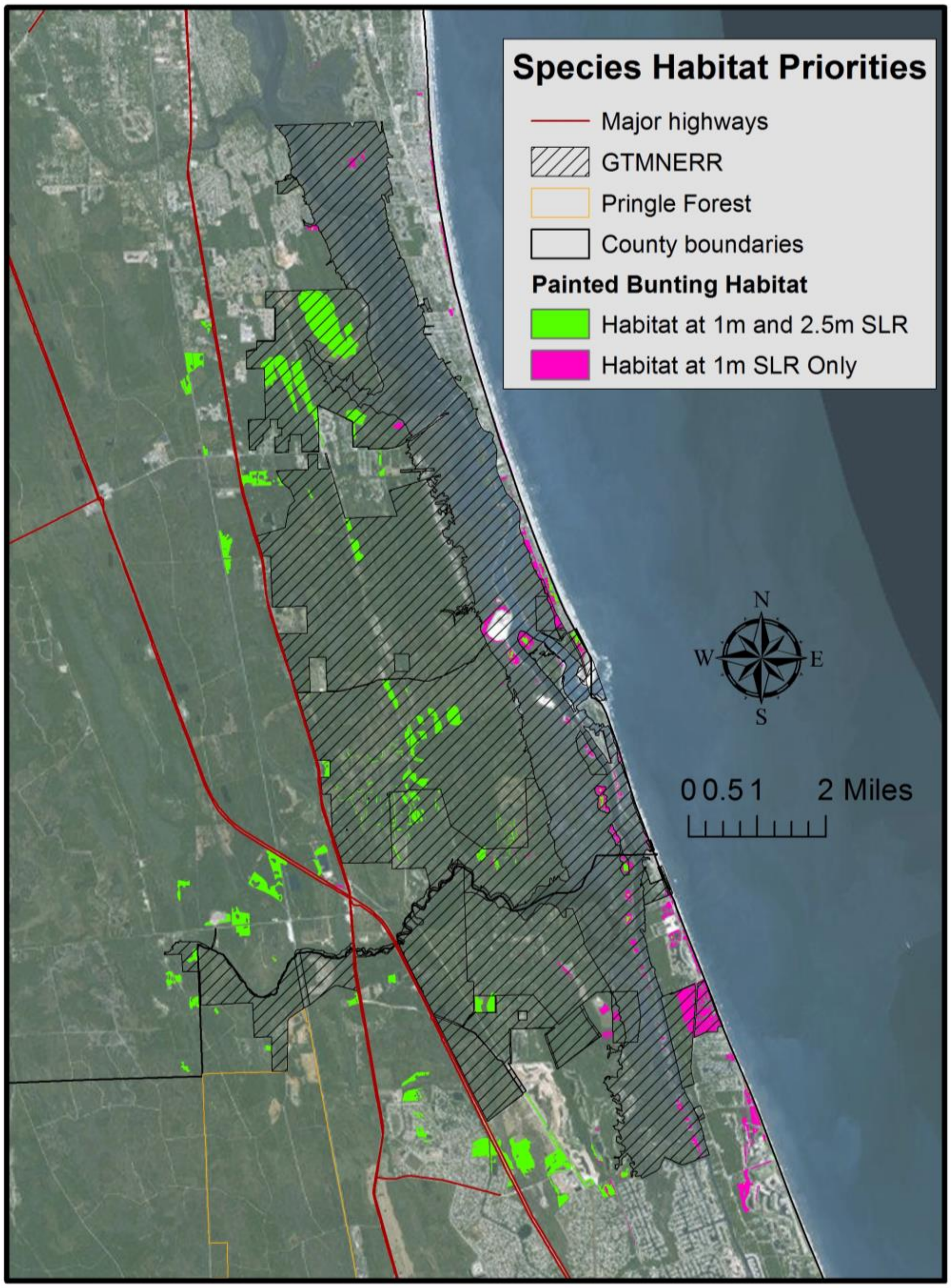
11) Limpkin

Limpkins can be found in a variety of freshwater wetlands and water bodies in Florida. Breeding habitat is generally determined by the occurrence of sufficient freshwater apple-snails, although bivalves and other snails supplement their diet. Limpkins are often found near lake, river and stream edges, wetlands associated with such open water, and herbaceous freshwater wetlands. Although limpkins may be found in other areas, this model limits identification of primary habitat to all freshwater wetlands adjacent to appropriate open water and all freshwater herbaceous wetlands. The habitat model scenarios for both 1m and 2.5m SLR suggest there are several creek systems including the upper parts of Pellicer Creek that are suitable habitat for limpkins that could be added to the GTM as habitat is lost to SLR.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Limpkin Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
Habitat at 2.5m SLR Only
N
W
E
S
0 0.5 1
2 Miles

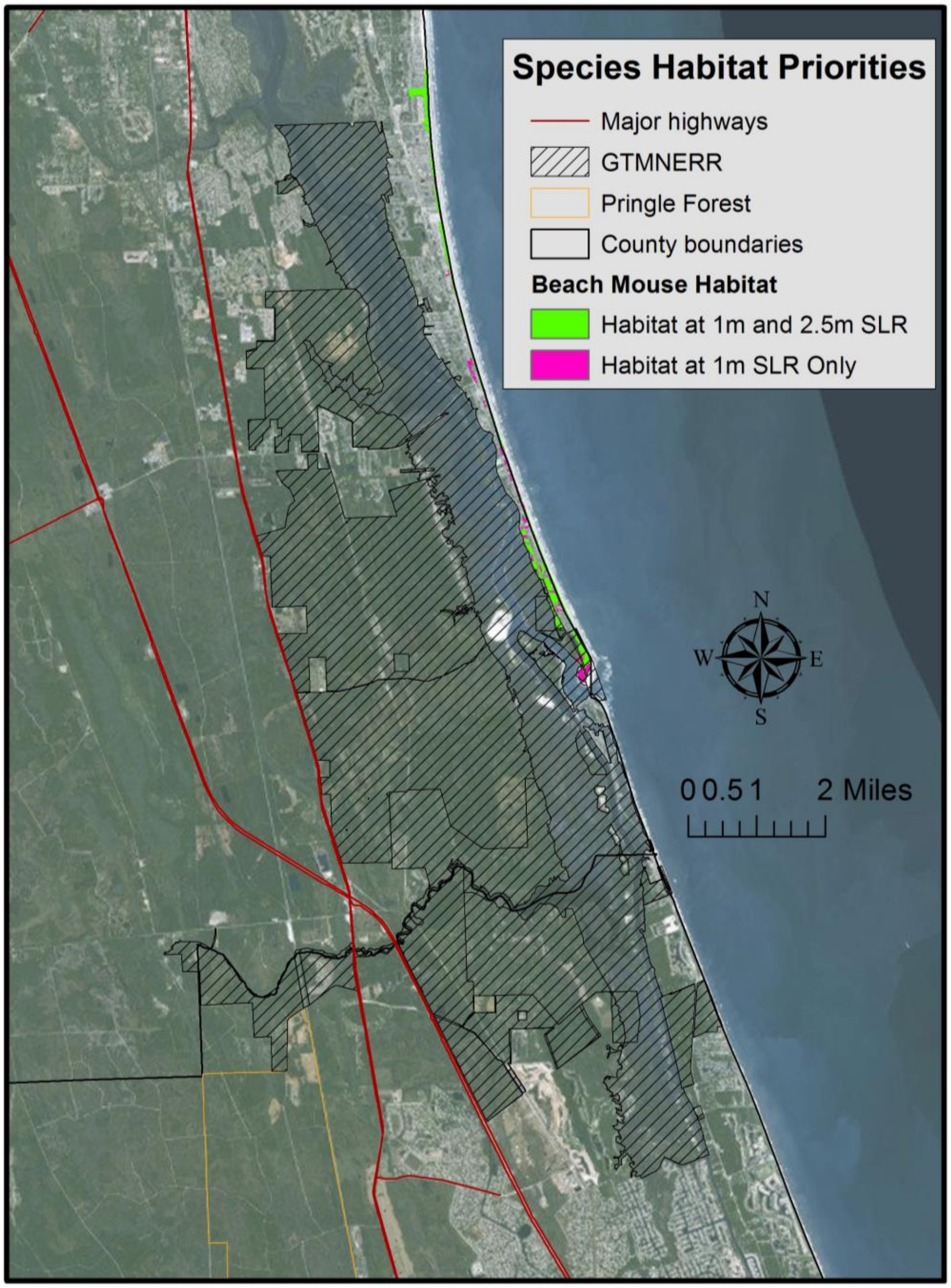
12) Painted bunting

Painted buntings nest in coastal habitats including xeric oak scrub, shrub and brushland, and associated hardwood hammocks and forest and cabbage palm–live oak hammocks that are usually located on well drained soils. This species is affected by coastal development that is more likely to occur on the drier sites preferred by painted buntings. Most potential habitat on the barrier island will be lost at a 2.5m SLR. Remaining blocks of potential habitat further inland are generally not well connected or extremely close to the GTM. If not already in progress, this is a species whose presence and habitat extent on and near the GTM should be monitored.


Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Painted Bunting Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
N
W
E
S
0 0.5 1 2 Miles

13) Anastasia beach mouse

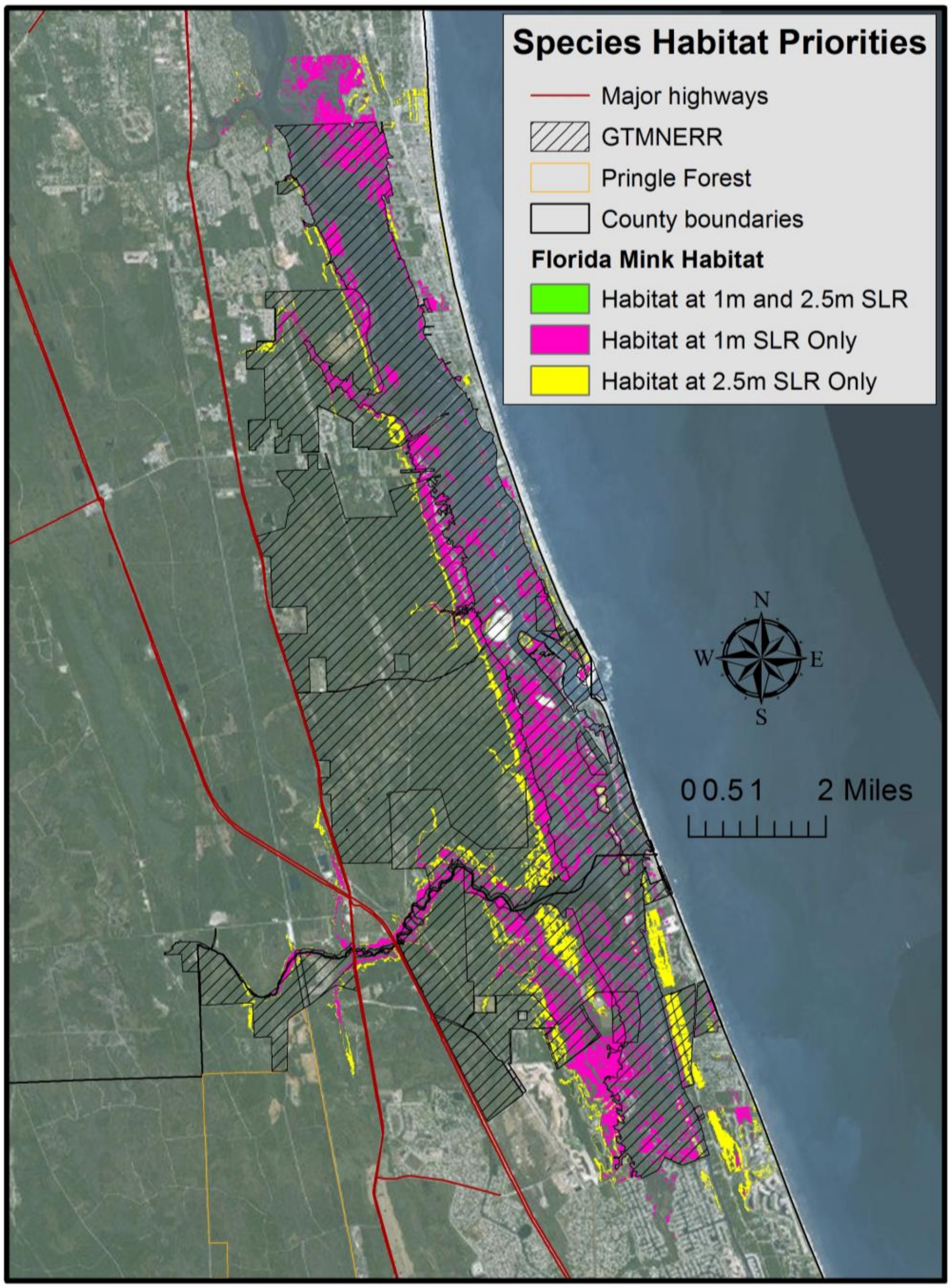
Anastasia beach mouse habitat is not well represented in the 1m and 2.5m scenarios since our models were dependent on a static habitat layer from FNAI and the difficulty of identifying new beach dune habitat using SLAMM. However, beach mouse habitat will clearly be highly threatened with a 1m or greater SLR and future habitat will be dependent on the development of at least somewhat stable beach and beach dune as SLR progresses. In addition, the models show that there are some stretches of habitat that may still exist at a 2.5m SLR adjacent to the GTM that would be worth considering for protection.



Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Beach Mouse Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
N
W
E
S
0 0.5 1 2 Miles

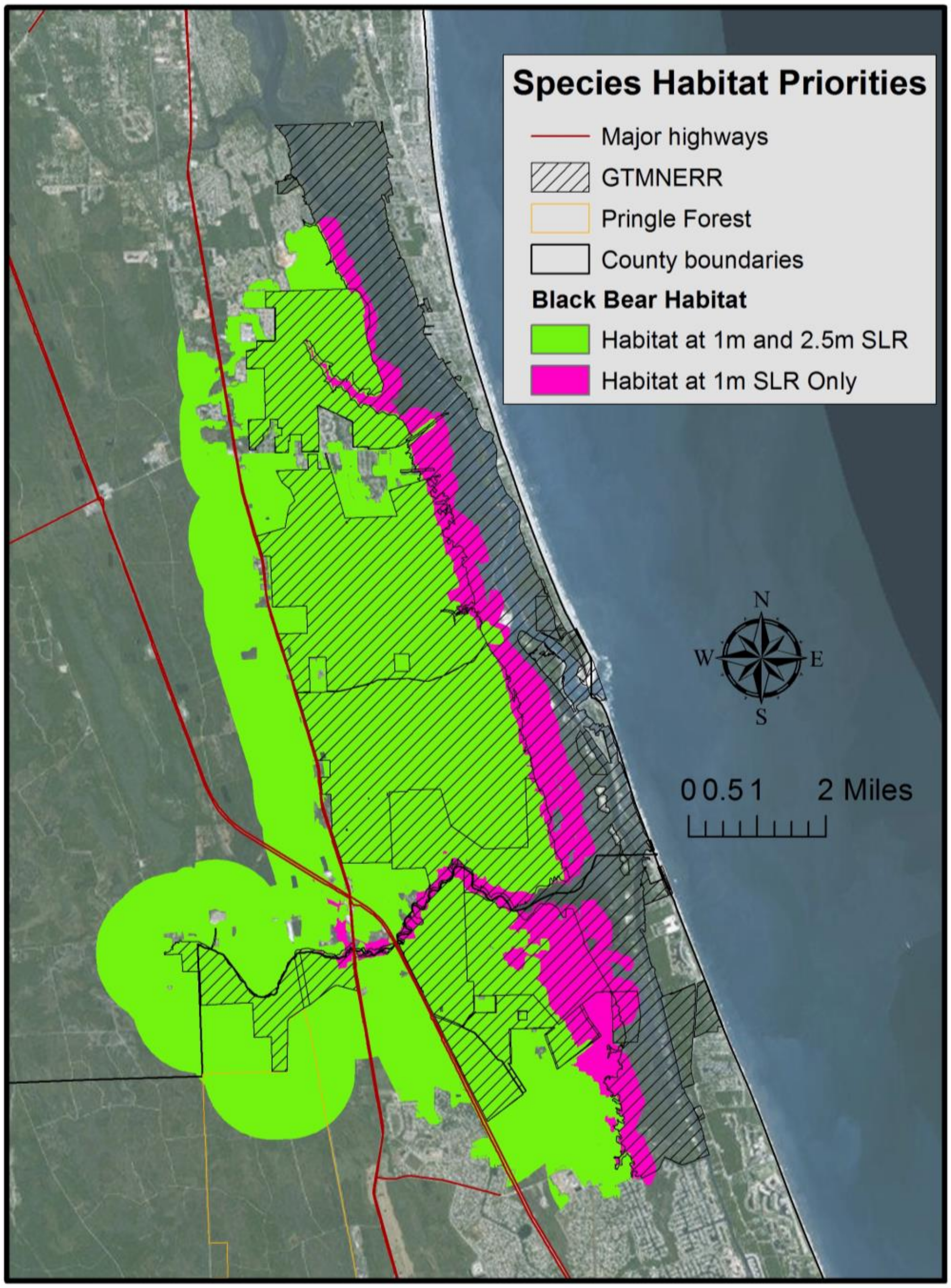
14) Florida mink

Florida mink are largely dependent on intact saltmarsh habitat. Much habitat that will be potentially available at a 1m SLR will be gone at a 2.5m SLR. The best opportunities to protected additional habitat up to a 2.5m SLR are south/southeast of the GTM.



15) Florida black bear

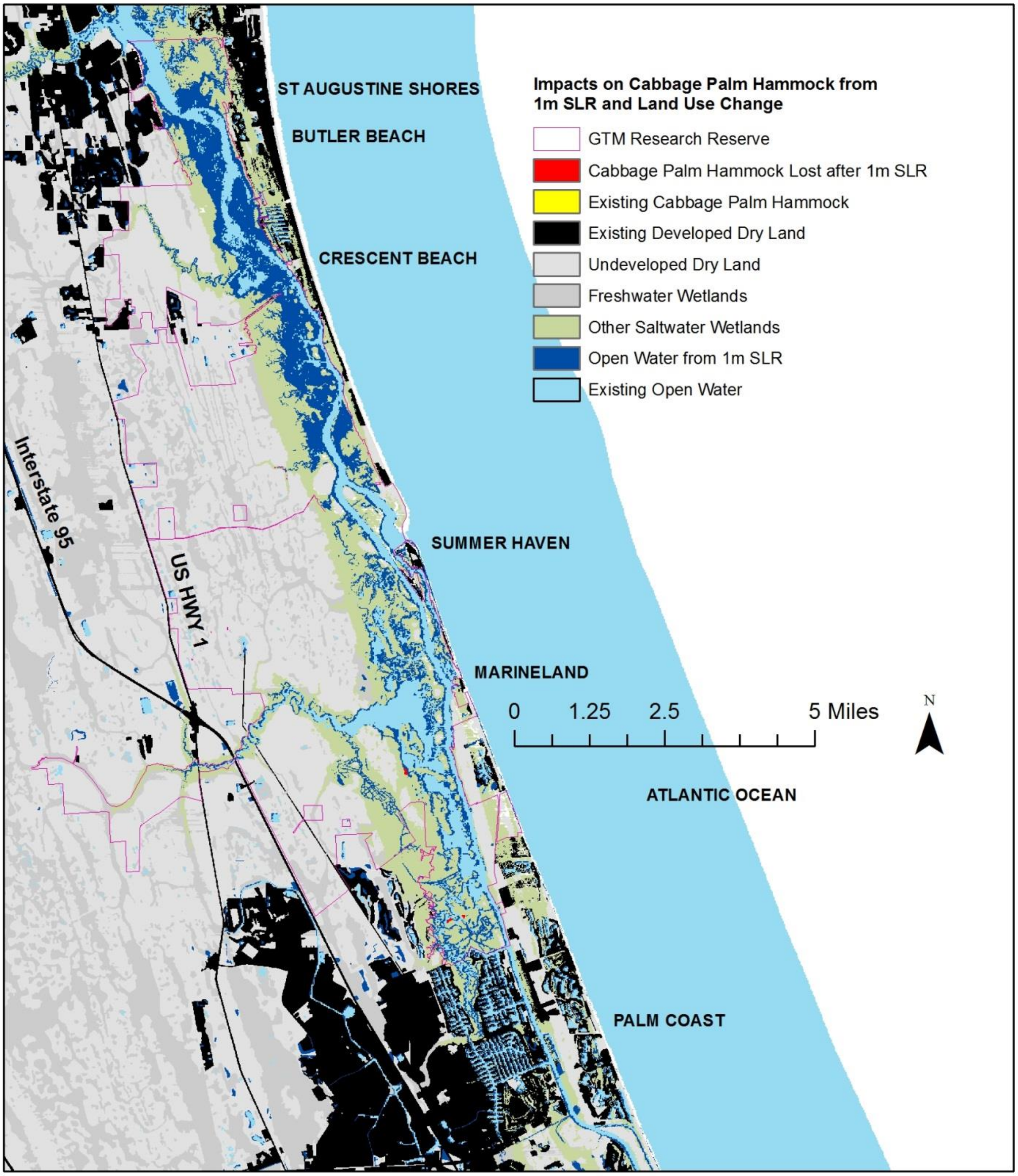
Florida black bear require large blocks of forested and uplands and associated herbaceous land covers to support functional home ranges and populations. Protection of existing large, suitable blocks of habitat from further fragmentation from development (including new or expanded roadways) will be critical for conserving a viable population of Florida black bear in the regional landscape surrounding the GTM. There appears to be plenty of potential habitat directly west of the GTM to mitigate the loss of habitat to SLR, but much of that habitat is separated from the GTM by I-95 and US 1.

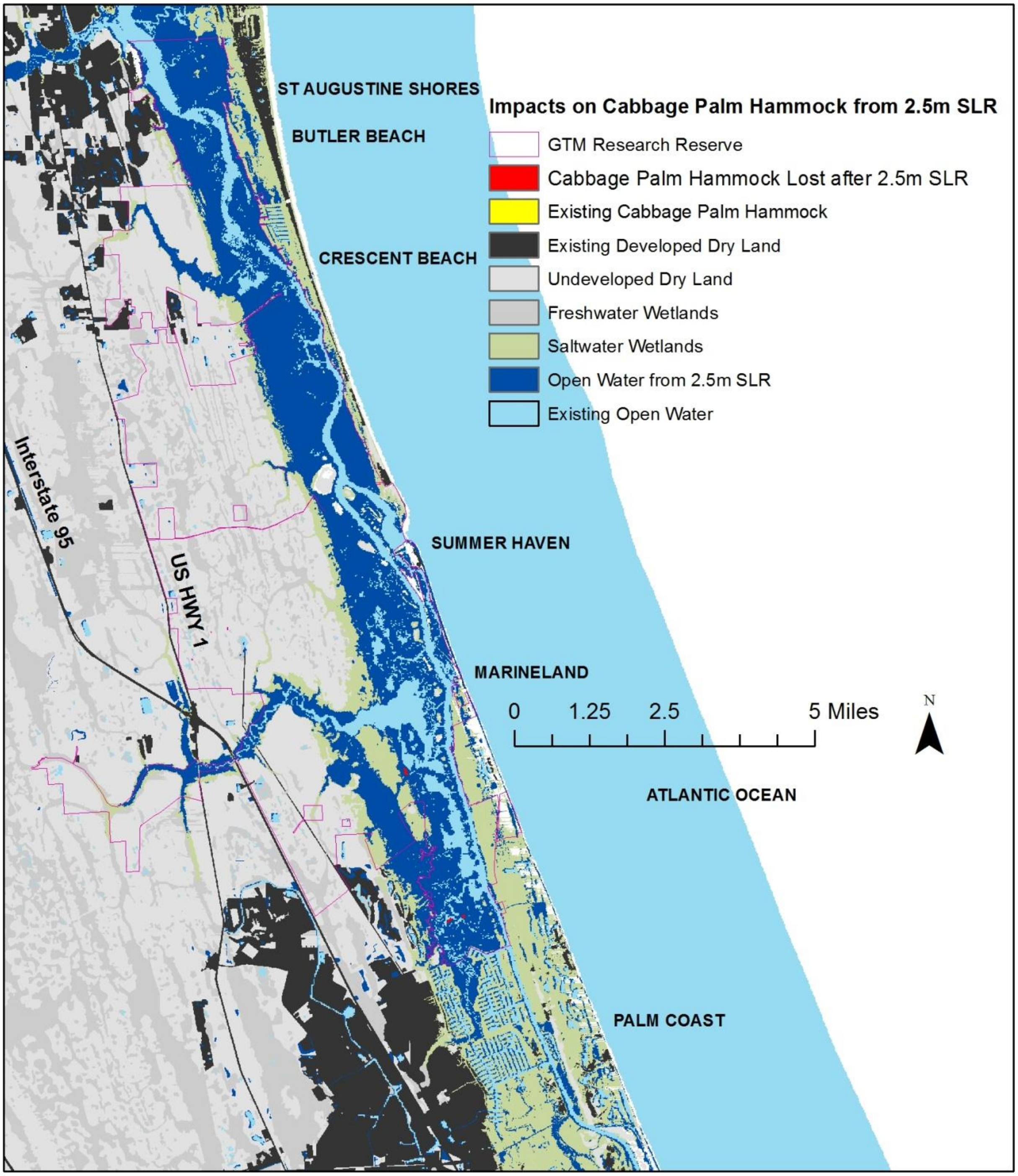


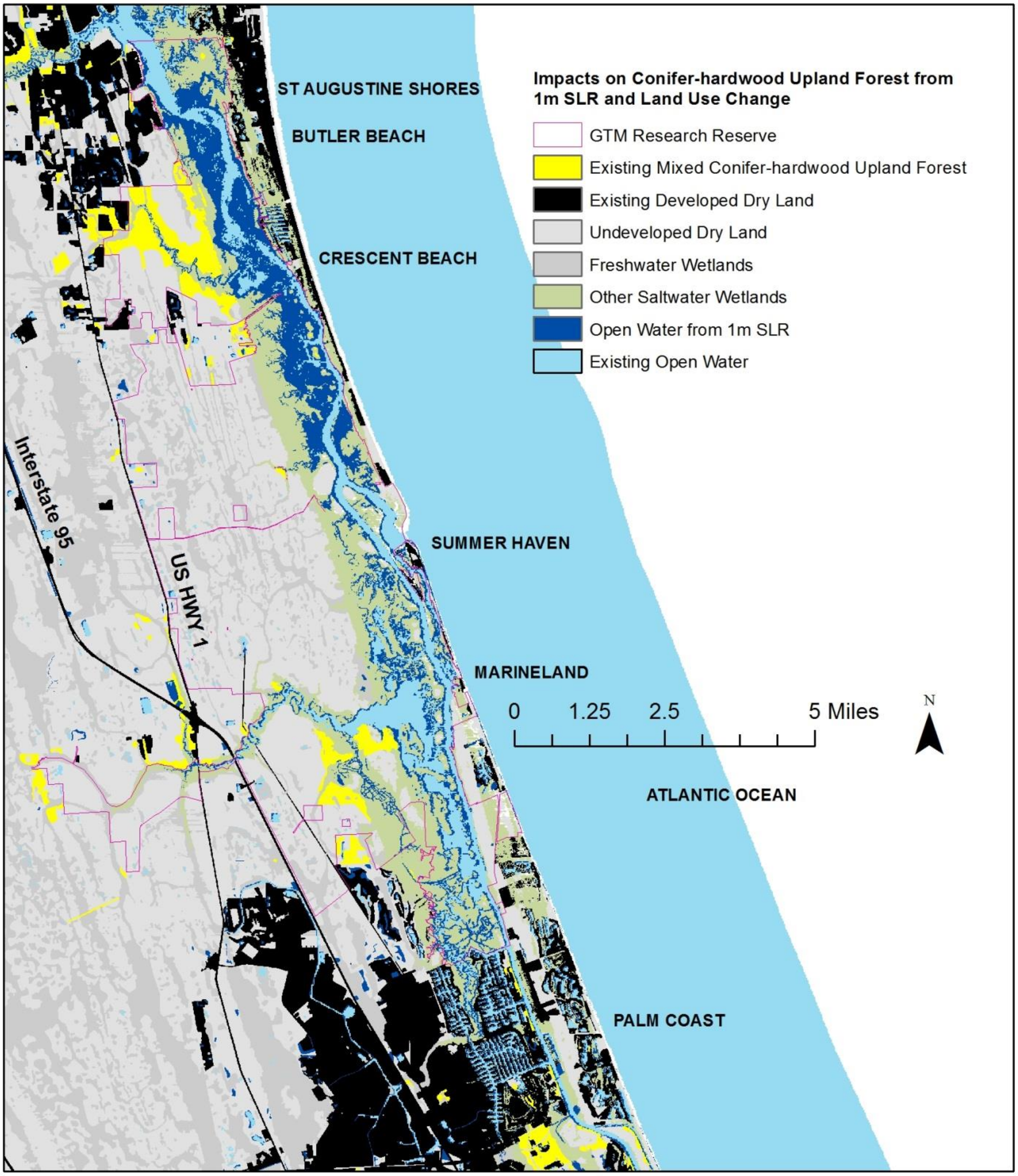
Species Habitat Priorities
Major highways
GTMNERR
Pringle Forest
County boundaries
Black Bear Habitat
Habitat at 1m and 2.5m SLR
Habitat at 1m SLR Only
N
W
E
S
0 0.5 1 2 Miles

Appendix E: Natural Community and Land Cover Impact Maps and Statistics

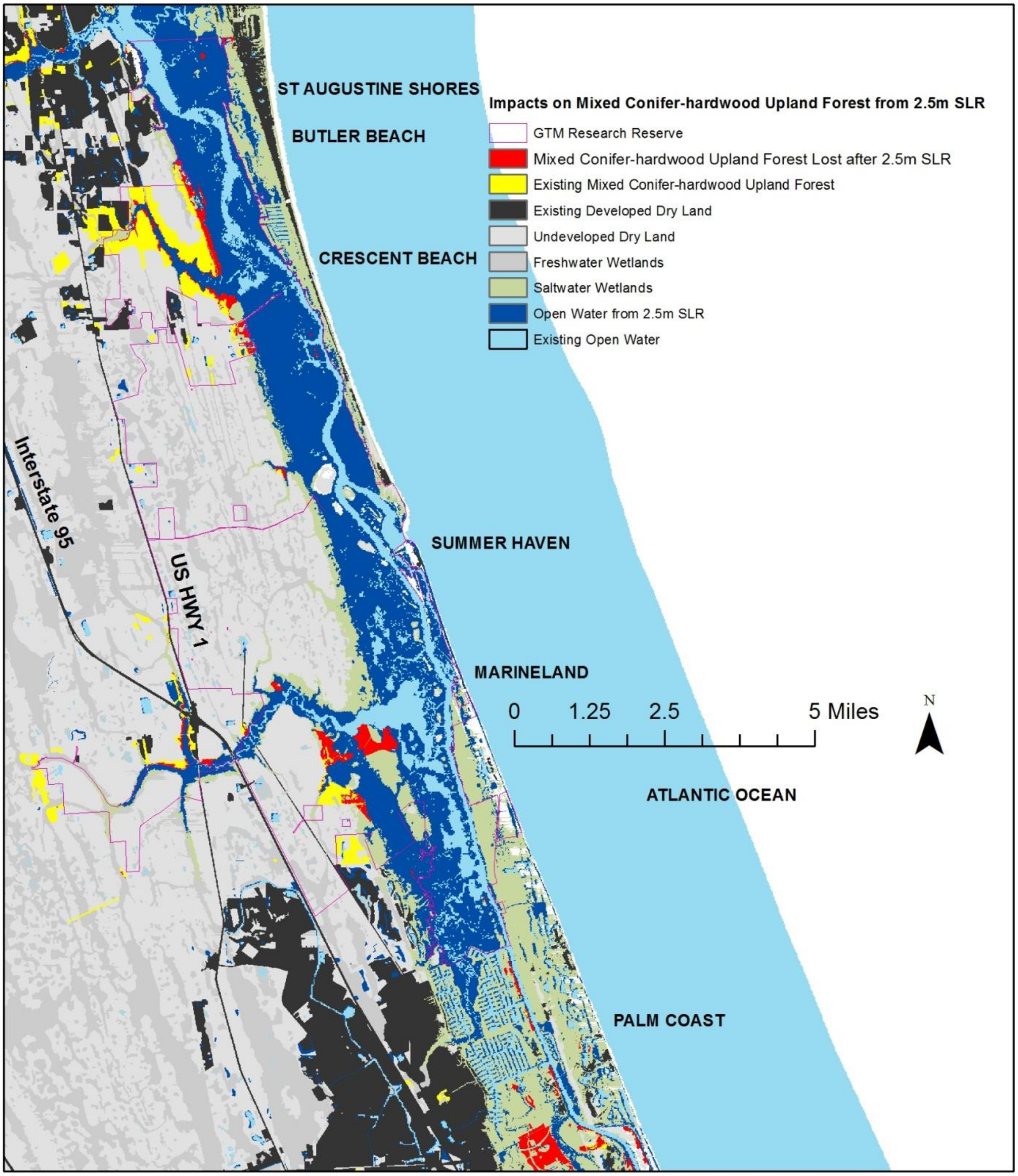
The following section includes the statistics and maps identifying impacts from sea level rise and future development on natural communities and natural/semi-natural upland and wetland land cover types. Maps and statistics are included for 1m sea level rise, 1m sea level rise and development, and 2.5m sea level rise.


Impacts on Cabbage Palm Hammock from 1m SLR and Land Use Change
GTM Research Reserve
Cabbage Palm Hammock Lost after 1m SLR
Existing Cabbage Palm Hammock
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

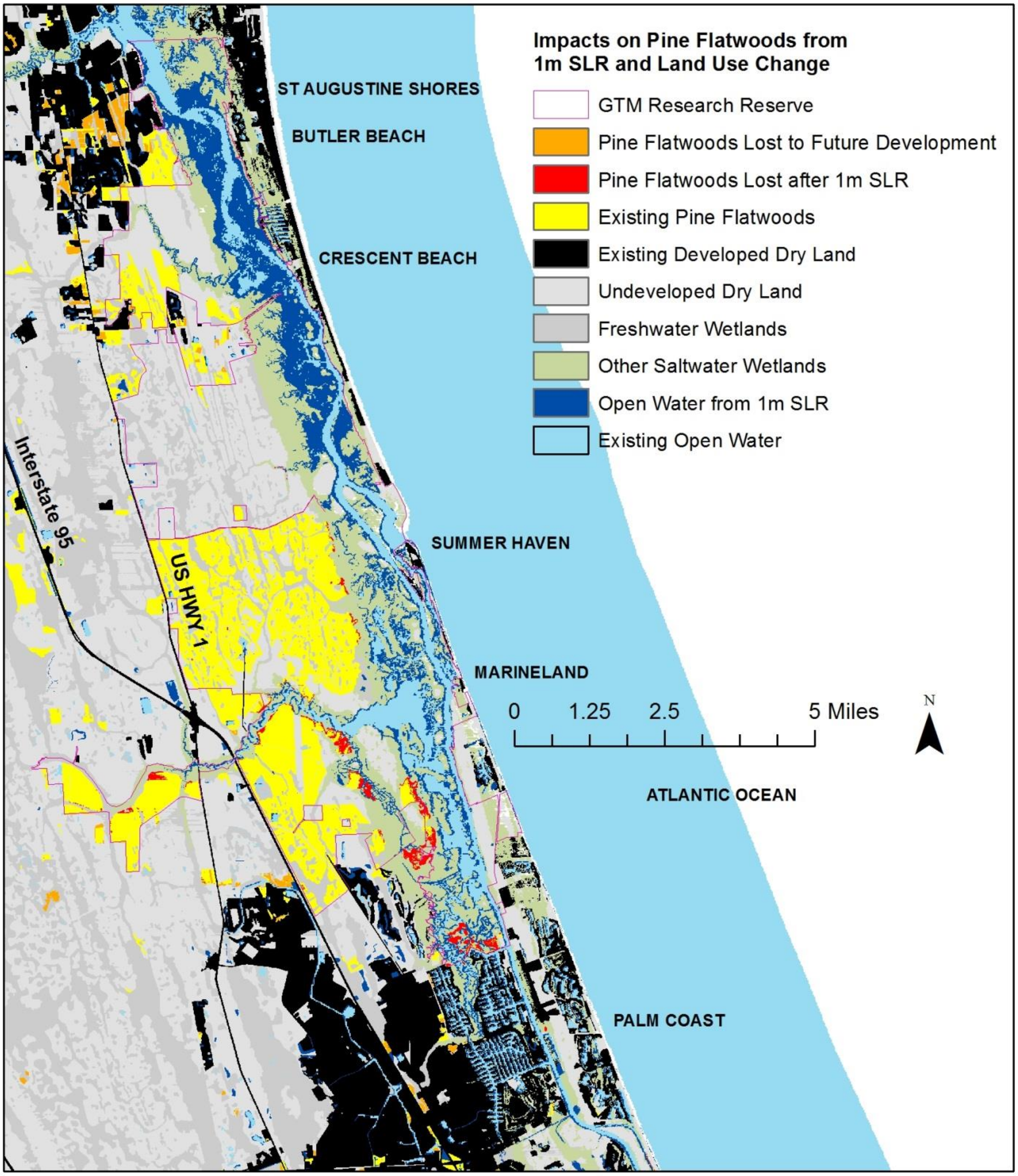

Impacts on Cabbage Palm Hammock from 2.5m SLR
GTM Research Reserve
Cabbage Palm Hammock Lost after 2.5m SLR
Existing Cabbage Palm Hammock
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

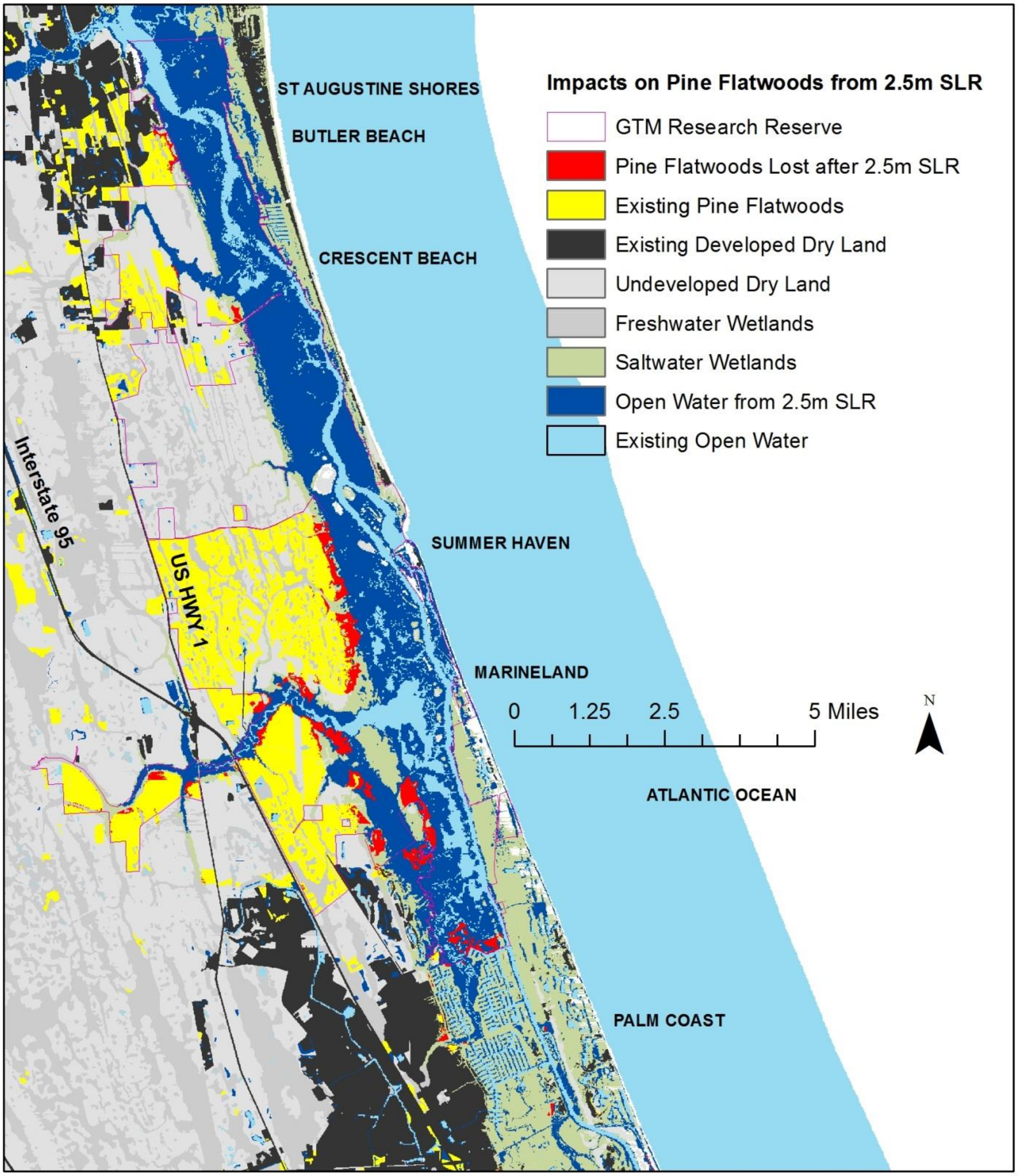


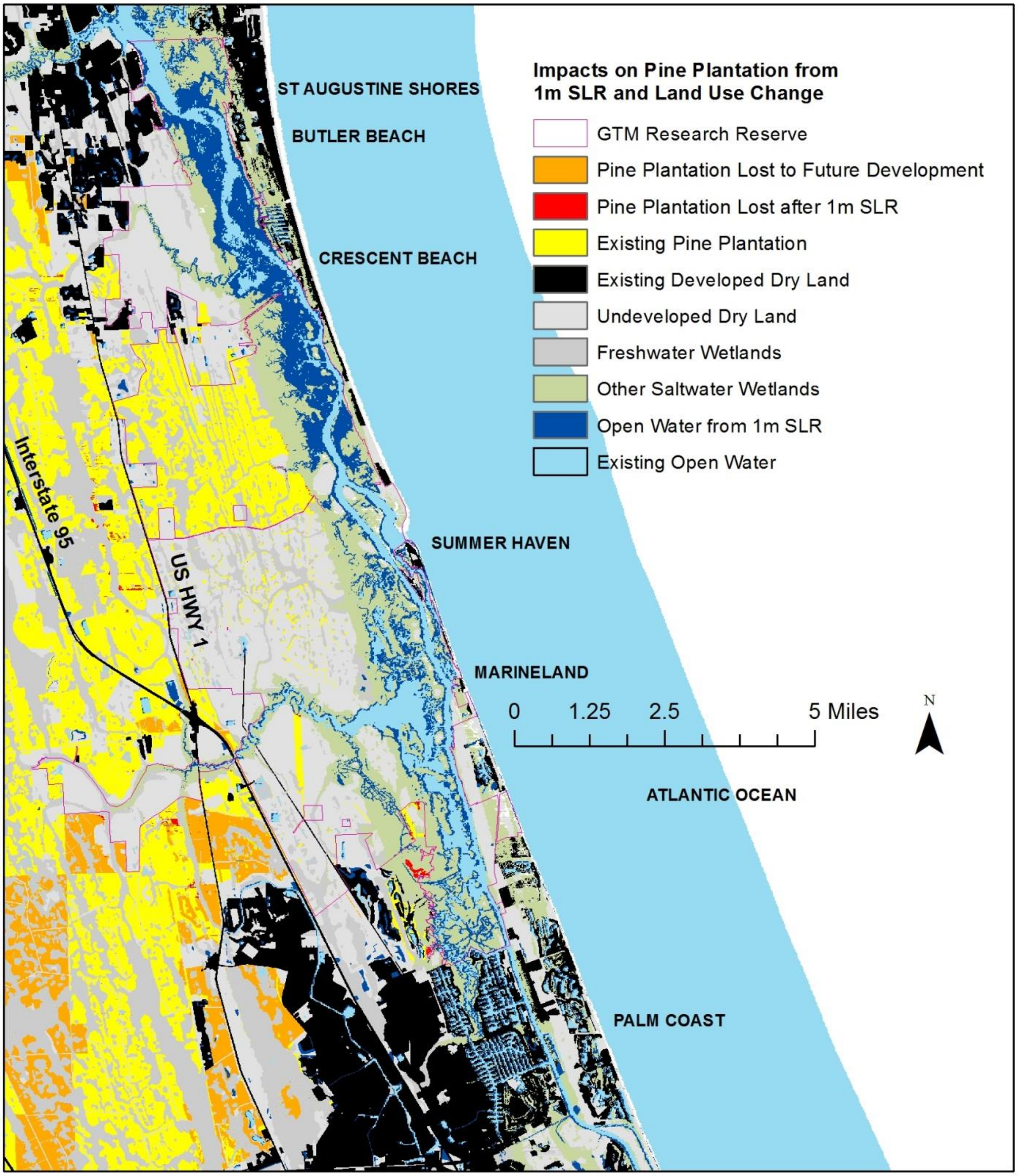
Impacts on Conifer-hardwood Upland Forest from 1m SLR and Land Use Change
GTM Research Reserve
Existing Mixed Conifer-hardwood Upland Forest
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

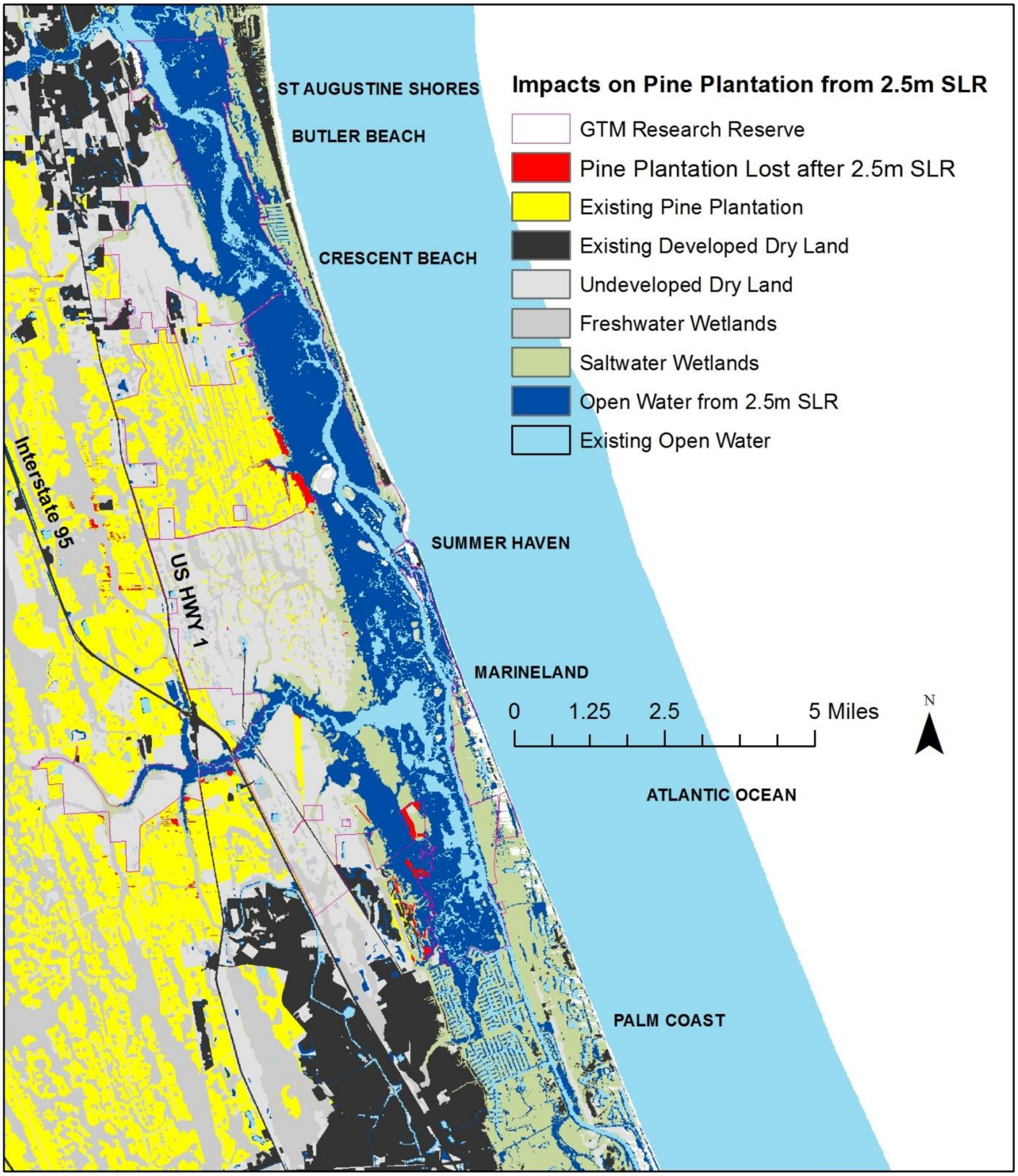


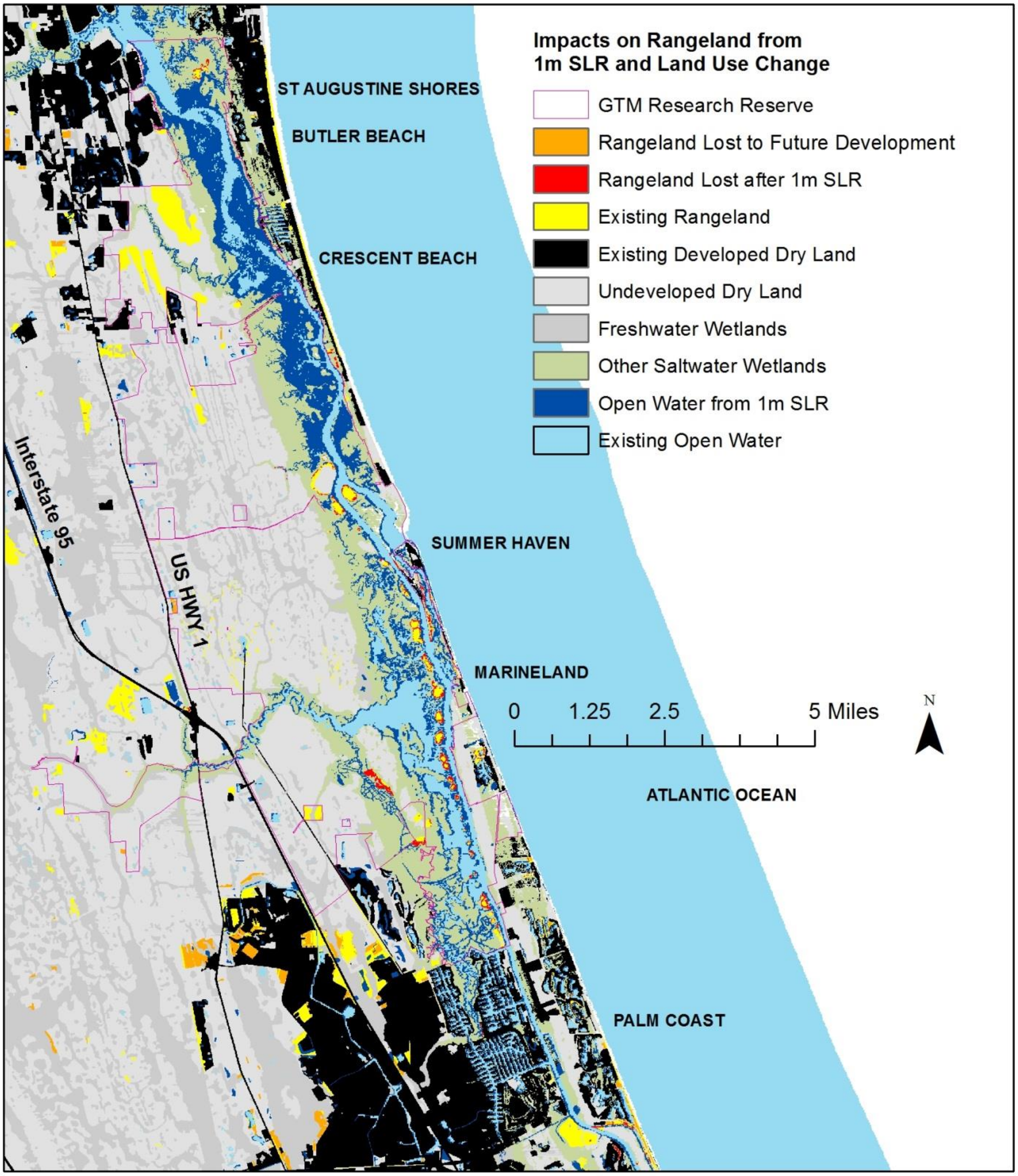
Impacts on Mixed Conifer-hardwood Upland Forest from 2.5m SLR
GTM Research Reserve
Mixed Conifer-hardwood Upland Forest Lost after 2.5m SLR
Existing Mixed Conifer-hardwood Upland Forest
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

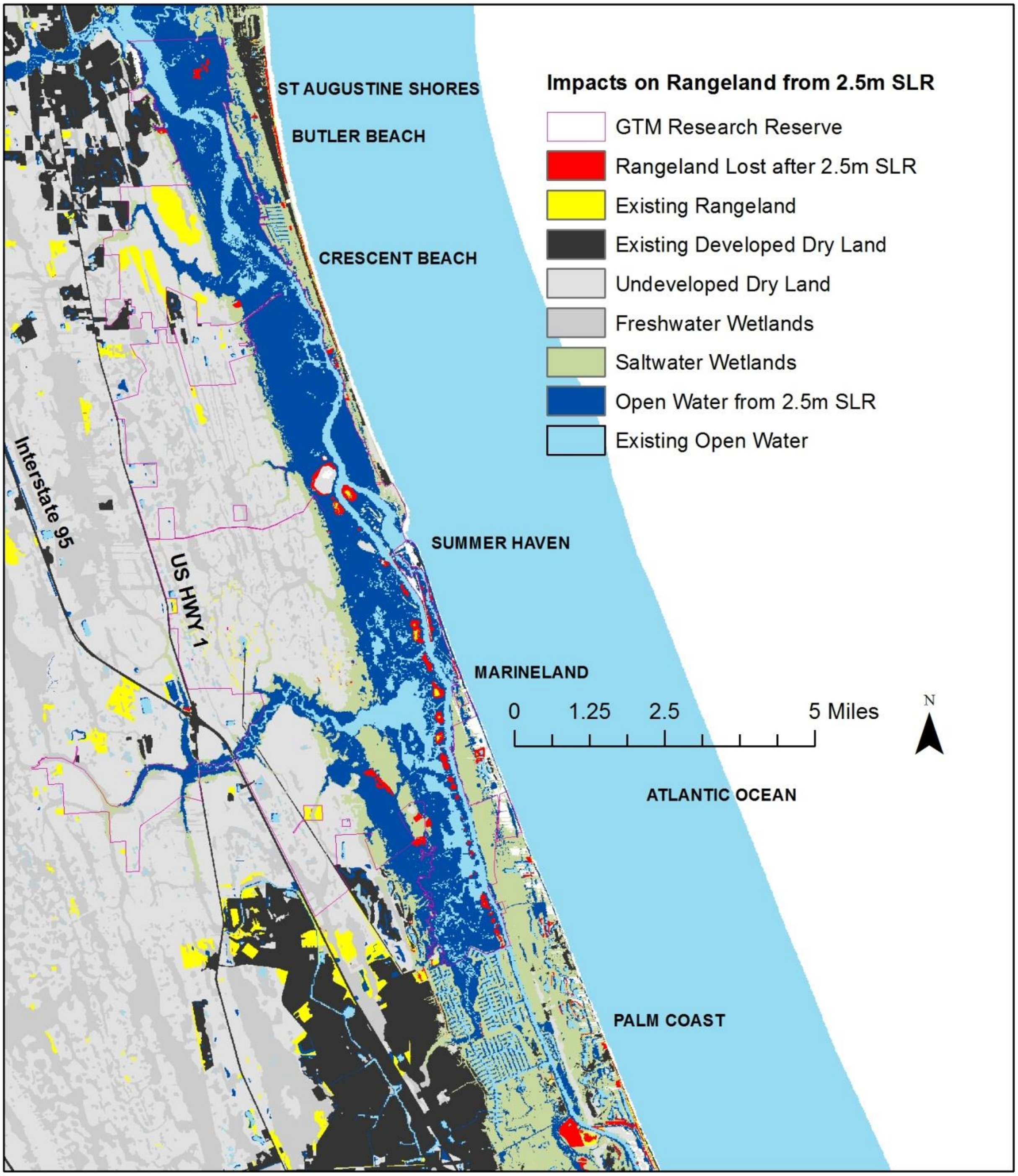

Impacts on Pine Flatwoods from
1m SLR and Land Use Change
GTM Research Reserve
Pine Flatwoods Lost to Future Development
Pine Flatwoods Lost after 1m SLR
Existing Pine Flatwoods
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

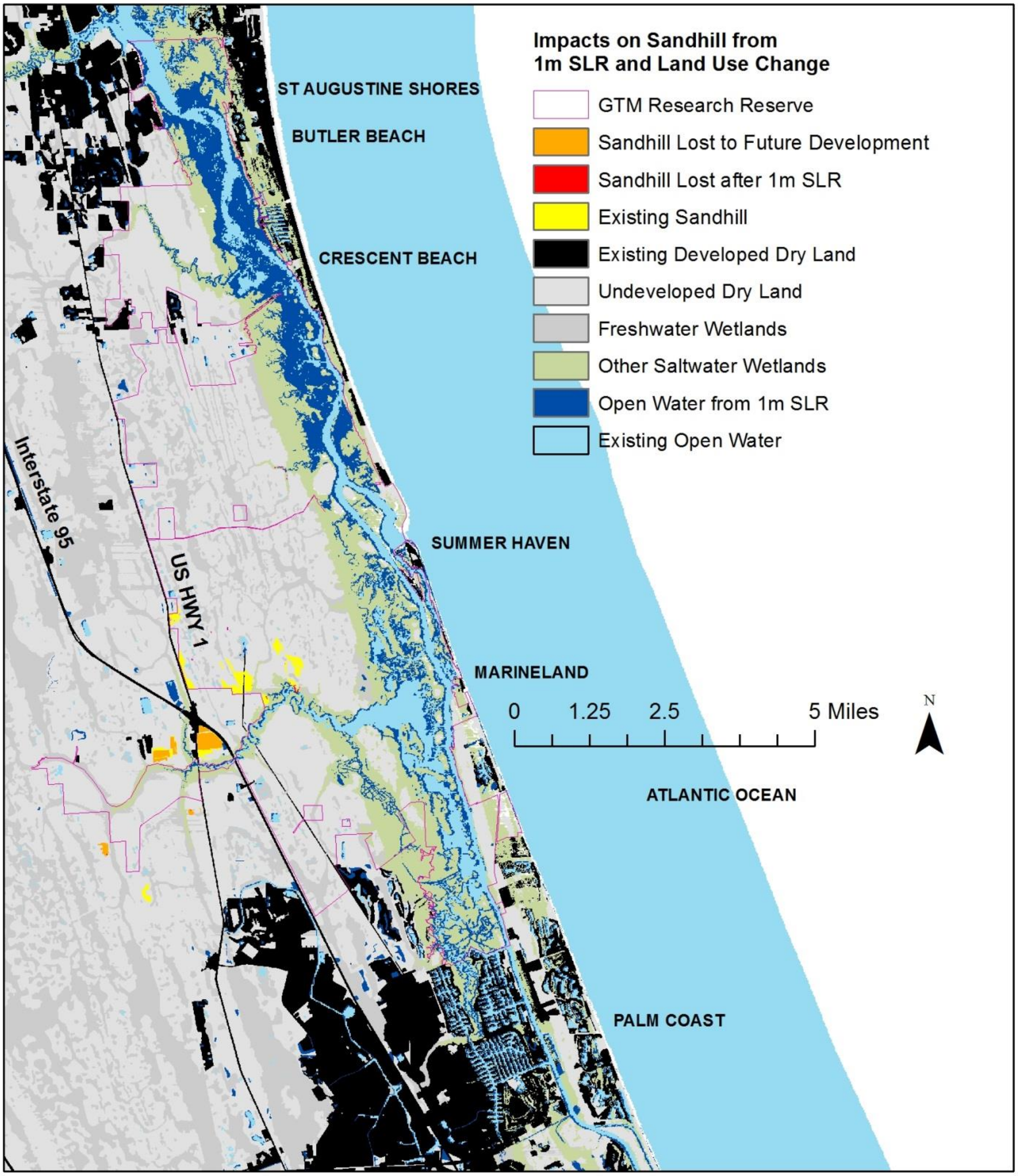

Impacts on Pine Flatwoods from 2.5m SLR
GTM Research Reserve
Pine Flatwoods Lost after 2.5m SLR
Existing Pine Flatwoods
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

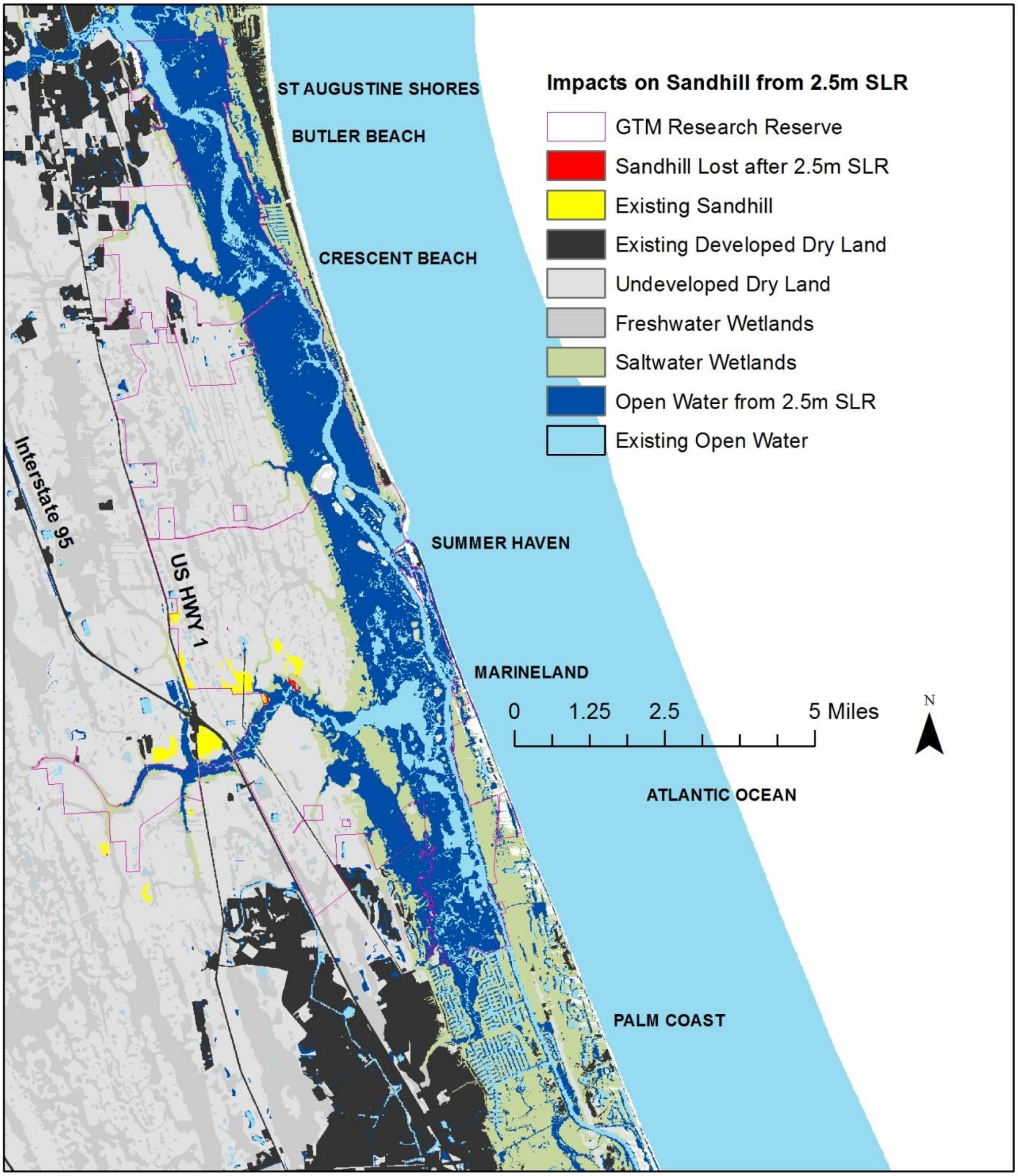

Impacts on Pine Plantation from
1m SLR and Land Use Change
GTM Research Reserve
Pine Plantation Lost to Future Development
Pine Plantation Lost after 1m SLR
Existing Pine Plantation
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N

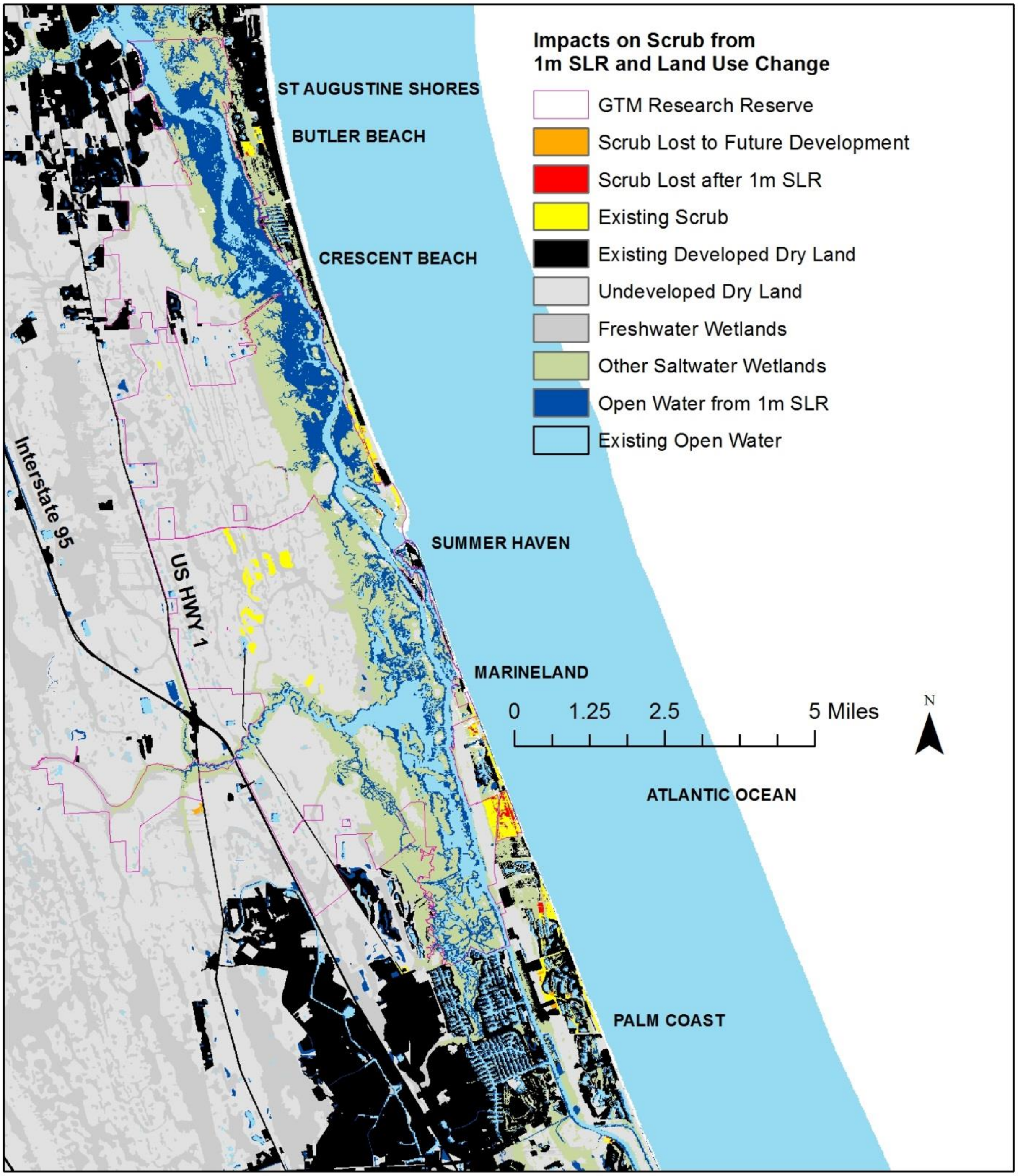

Impacts on Pine Plantation from 2.5m SLR
GTM Research Reserve
Pine Plantation Lost after 2.5m SLR
Existing Pine Plantation
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

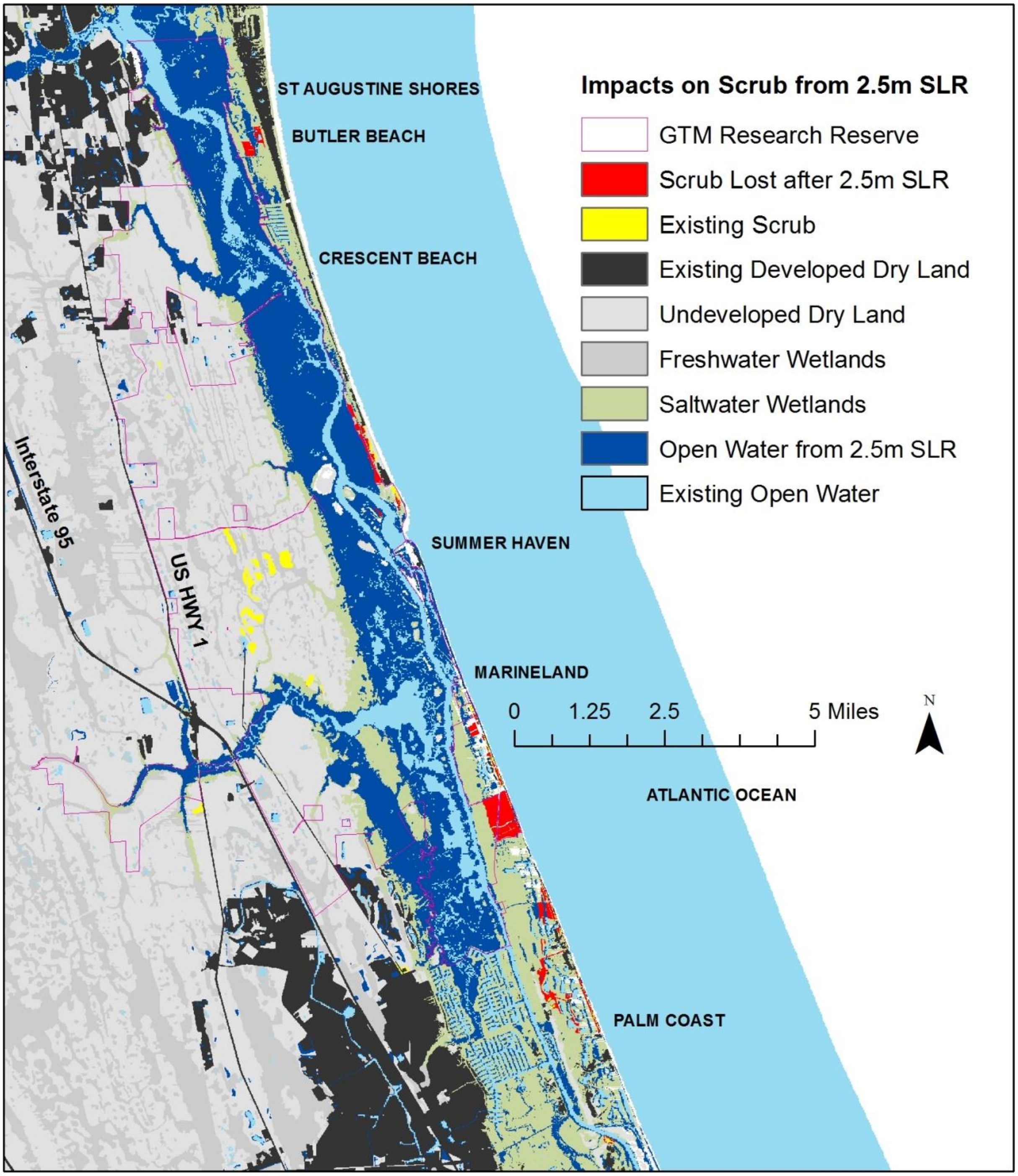

Impacts on Rangeland from
1m SLR and Land Use Change
GTM Research Reserve
Rangeland Lost to Future Development
Rangeland Lost after 1m SLR
Existing Rangeland
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

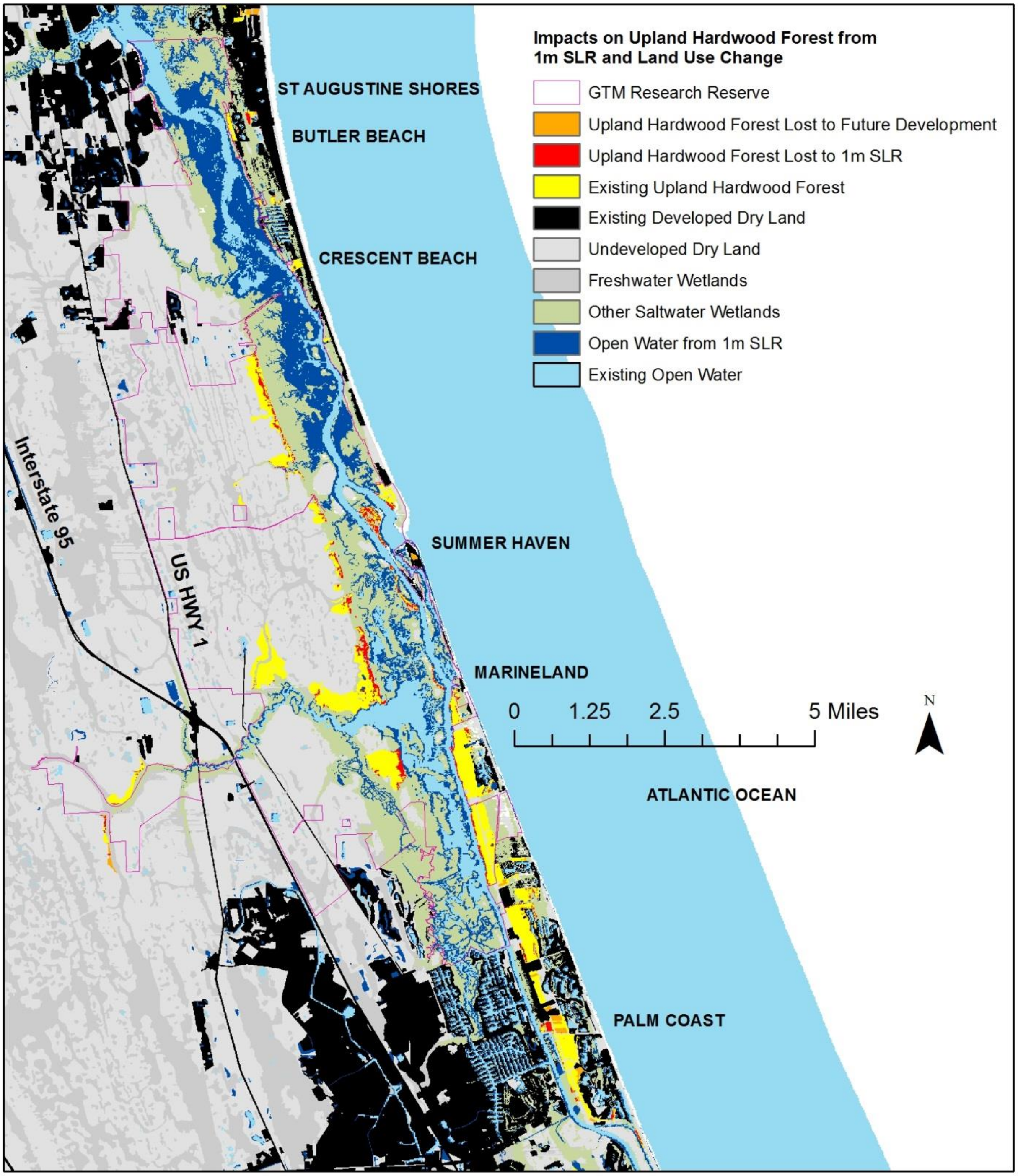

Impacts on Rangeland from 2.5m SLR
GTM Research Reserve
Rangeland Lost after 2.5m SLR
Existing Rangeland
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Sandhill from
1m SLR and Land Use Change
GTM Research Reserve
Sandhill Lost to Future Development
Sandhill Lost after 1m SLR
Existing Sandhill
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on Sandhill from 2.5m SLR
GTM Research Reserve
Sandhill Lost after 2.5m SLR
Existing Sandhill
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0 1.25 2.5 5 Miles
N


Impacts on Scrub from
1m SLR and Land Use Change
GTM Research Reserve
Scrub Lost to Future Development
Scrub Lost after 1m SLR
Existing Scrub
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N


Impacts on Scrub from 2.5m SLR
GTM Research Reserve
Scrub Lost after 2.5m SLR
Existing Scrub
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N



Impacts on Upland Hardwood Forest from
1m SLR and Land Use Change
GTM Research Reserve
Upland Hardwood Forest Lost to Future Development
Upland Hardwood Forest Lost to 1m SLR
Existing Upland Hardwood Forest
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Other Saltwater Wetlands
Open Water from 1m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
ATLANTIC OCEAN
PALM COAST
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

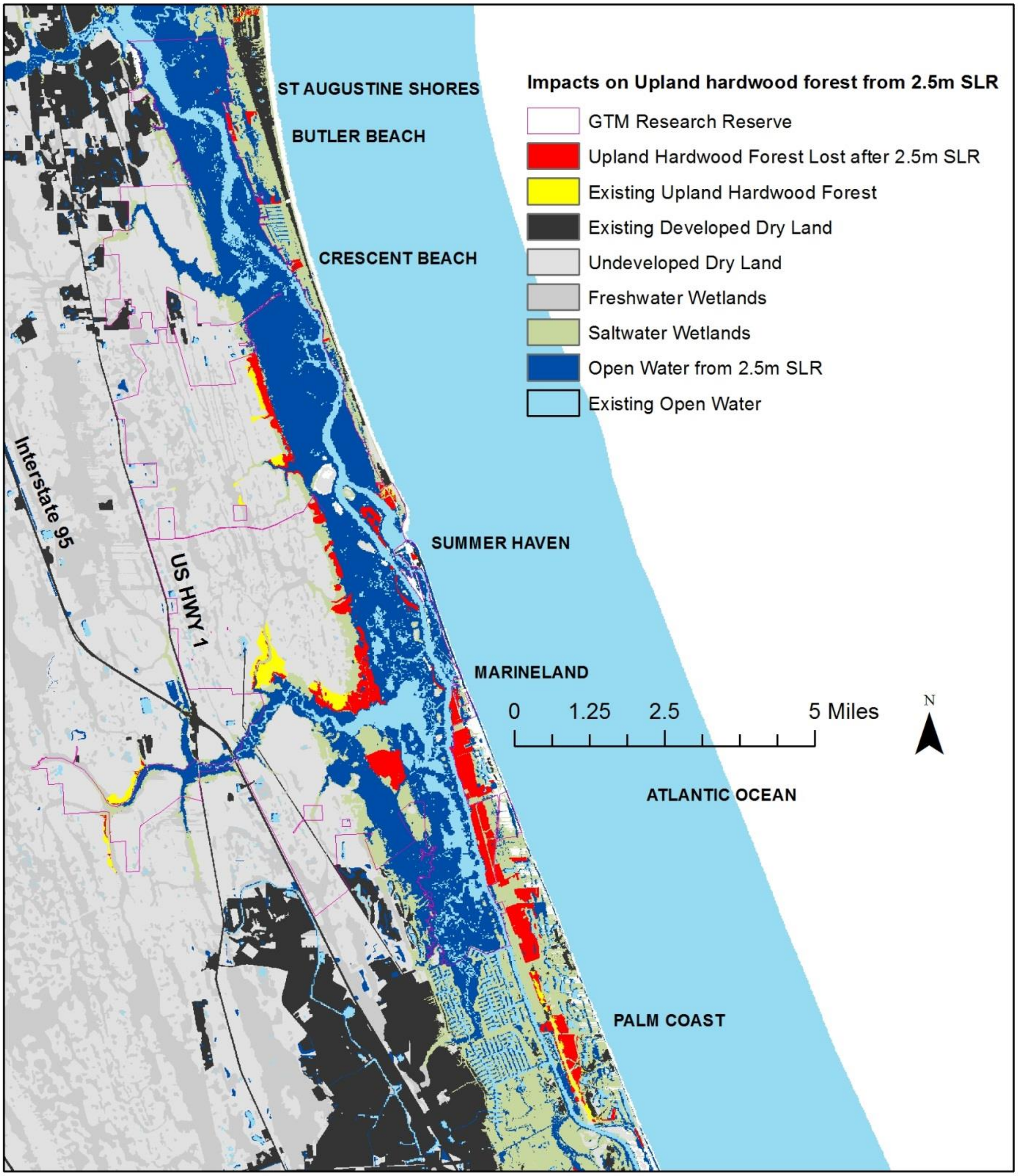

Impacts on Upland hardwood forest from 2.5m SLR
GTM Research Reserve
Upland Hardwood Forest Lost after 2.5m SLR
Existing Upland Hardwood Forest
Existing Developed Dry Land
Undeveloped Dry Land
Freshwater Wetlands
Saltwater Wetlands
Open Water from 2.5m SLR
Existing Open Water
ST AUGUSTINE SHORES
BUTLER BEACH
CRESCENT BEACH
SUMMER HAVEN
MARINELAND
PALM COAST
ATLANTIC OCEAN
Interstate 95
US HWY 1
0
1.25
2.5
5 Miles
N

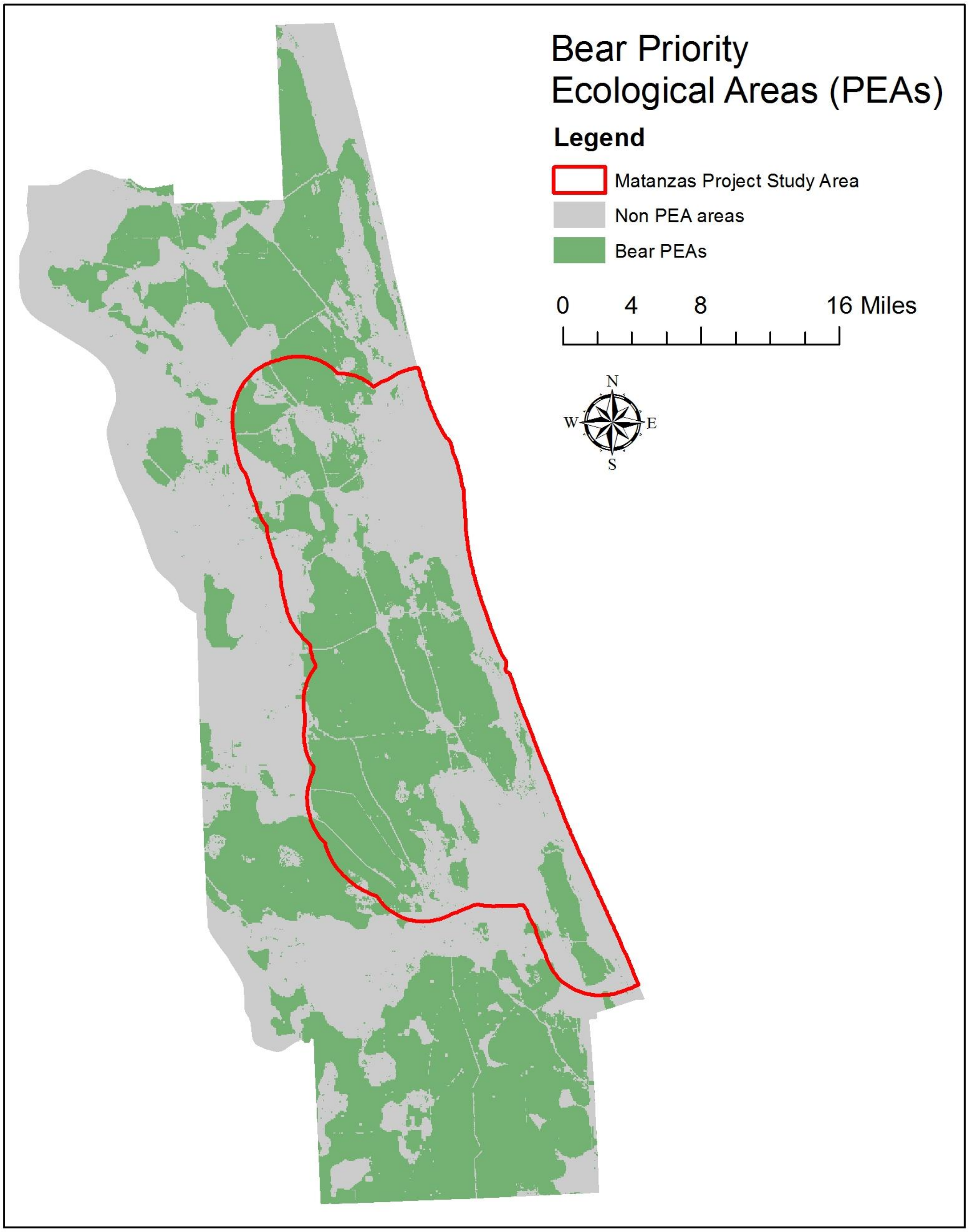
Table 1. Natural Community and Land Cover Change Statistics. Rows with no values are those for which the SLAMM analysis team did not provide detailed statistics.

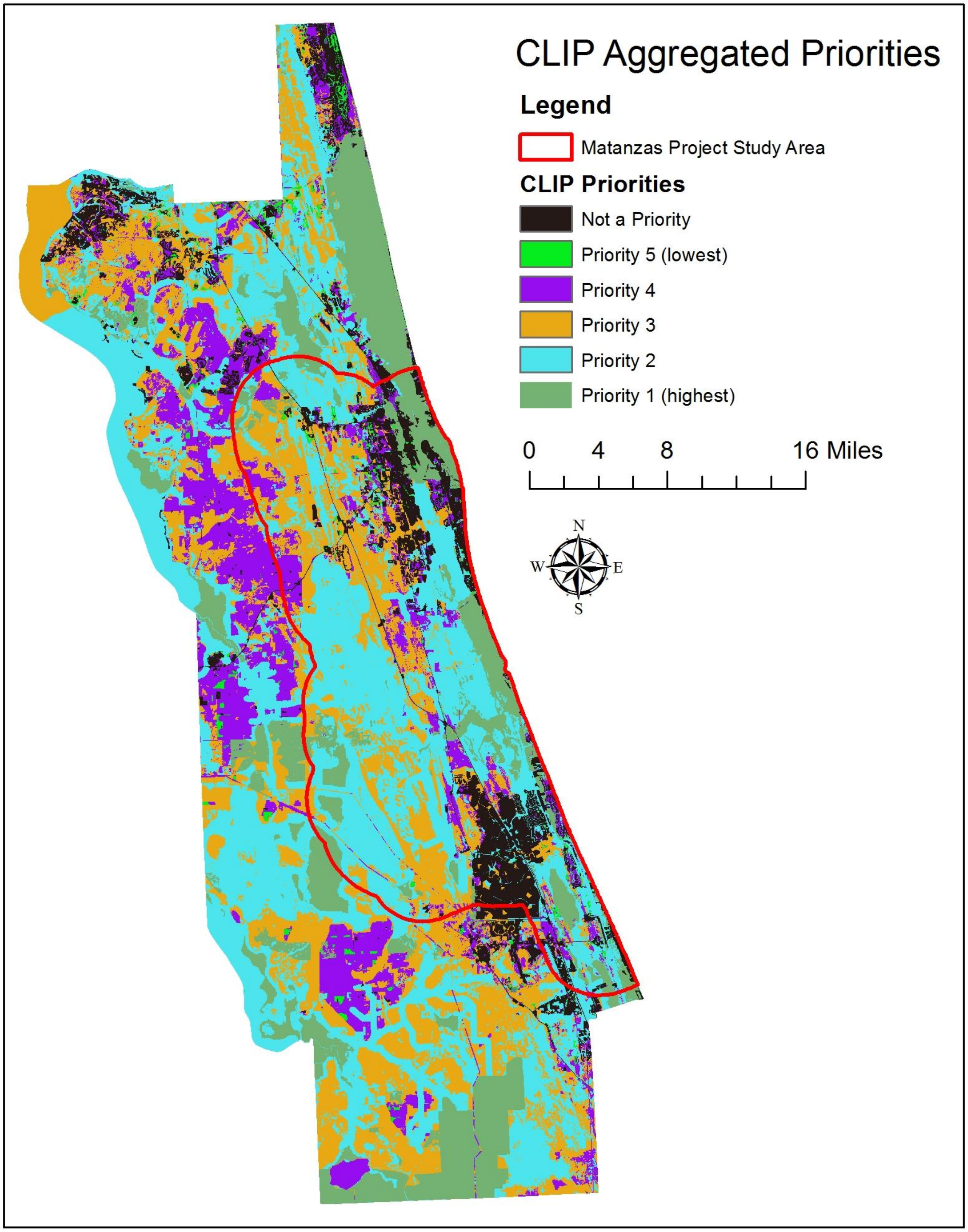
Natural Community Type	Current Area (ACRES)	Loss after 1m SLR (ACRES)	Gain after 1m SLR (ACRES)	Net gain or loss (ACRES)	Percent loss or gain after 1m SLR	Loss to 2.5m SLR (ACRES)	Gain after 2.5m SLR (ACRES)	Net gain or loss (ACRES)	Percent loss or gain to 2.5m SLR	Additional area lost to future development (ACRES)	Percent Loss to future development
Upland land cover impacts											
Rangeland	7,487	-414	-	-414	-5.5%	-1,505	-	-1,505	-20.1%	-2,301	-31%
Scrub	1,651	-80	-	-80	-4.8%	-528	-	-528	-32.0%	-462	-28%
Pine flatwoods	14,611	-378	-	-378	-2.6%	-1,310	-	-1,310	-9.0%	-2,863	-20%
Sandhill	375	-4	-	-4	-1.1%	-17	-	-17	-4.5%	-134	-36%
Upland hardwood forest	3,233	-537	-	-537	-16.6%	-2,573	-	-2,573	-79.6%	-183	-6%
Cabbage palm hammock	547	-91	-	-91	-16.6%	-540	-	-540	-98.8%	-	-0%
Mixed conifer-hardwood upland forest	7,141	-575	-	-575	-8.1%	-2,475	-	-2,475	-34.7%	-1,498	-21%
Pine plantation	66,830	-181	-	-181	-0.3%	-797	-	-797	-1.2%	-13,515	-20%
Wetland land cover impacts based on SLAMM model results											
Swamp	68,099			-1,705	-2.5%			-5,369	-7.9%		
Cypress swamp	5,270			-119	-2.3%			-589	-11.2%		
Inland Freshwater Marsh	2,065			-46	-2.2%			-142	-6.9%		
Transitional Saltmarsh	3,729			3,037	81.4%			582	15.6%		
Regularly Flooded Marsh	8,168			-2,536	-31.0%			1,110	13.6%		
Mangrove	360			-138	38.0%			-359	-99.7%		
Estuarine Beach	0			16	100.0%			80	100.0%		
Tidal flat	3,167			1,551	49.0%			4,406	139.1%		

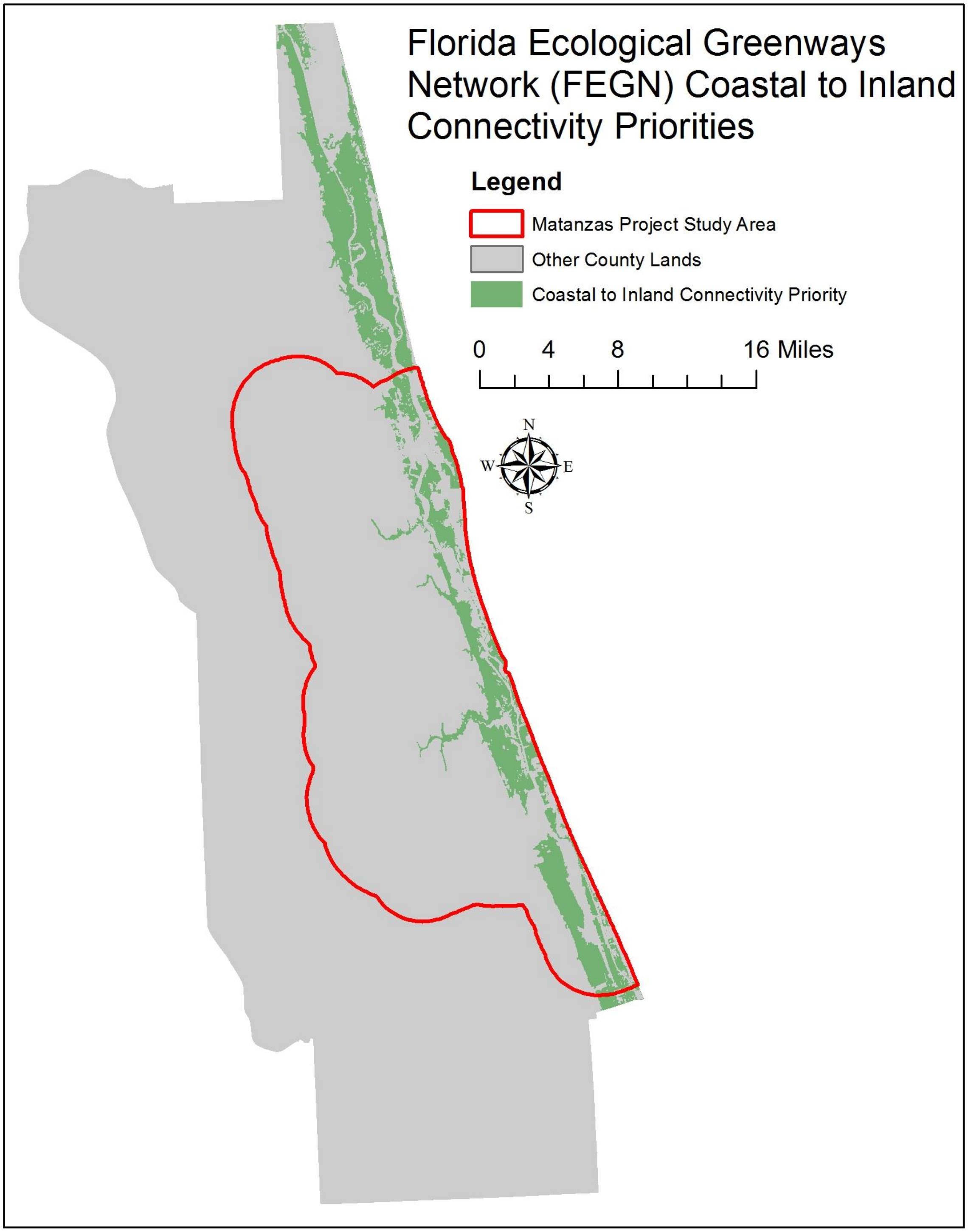
Natural Community Type	Current Area (ACRES)	Loss after 1m SLR (ACRES)	Gain after 1m SLR (ACRES)	Net gain or loss (ACRES)	Percent loss or gain after 1m SLR	Loss to 2.5m SLR (ACRES)	Gain after 2.5m SLR (ACRES)	Net gain or loss (ACRES)	Percent loss or gain to 2.5m SLR	Additional area lost to future development (ACRES)	Percent Loss to future development
Ocean Beach	504			162	32.0%			689	136.6%		
Irregularly Flooded Marsh	145			-49	34.0%			-144	-99.4%		
Vegetated tidal flat	1,365			-201	-14.7%			-1,365	-100.0%		
Open water	12,798			7,280	56.9%			21,266	166.2%		

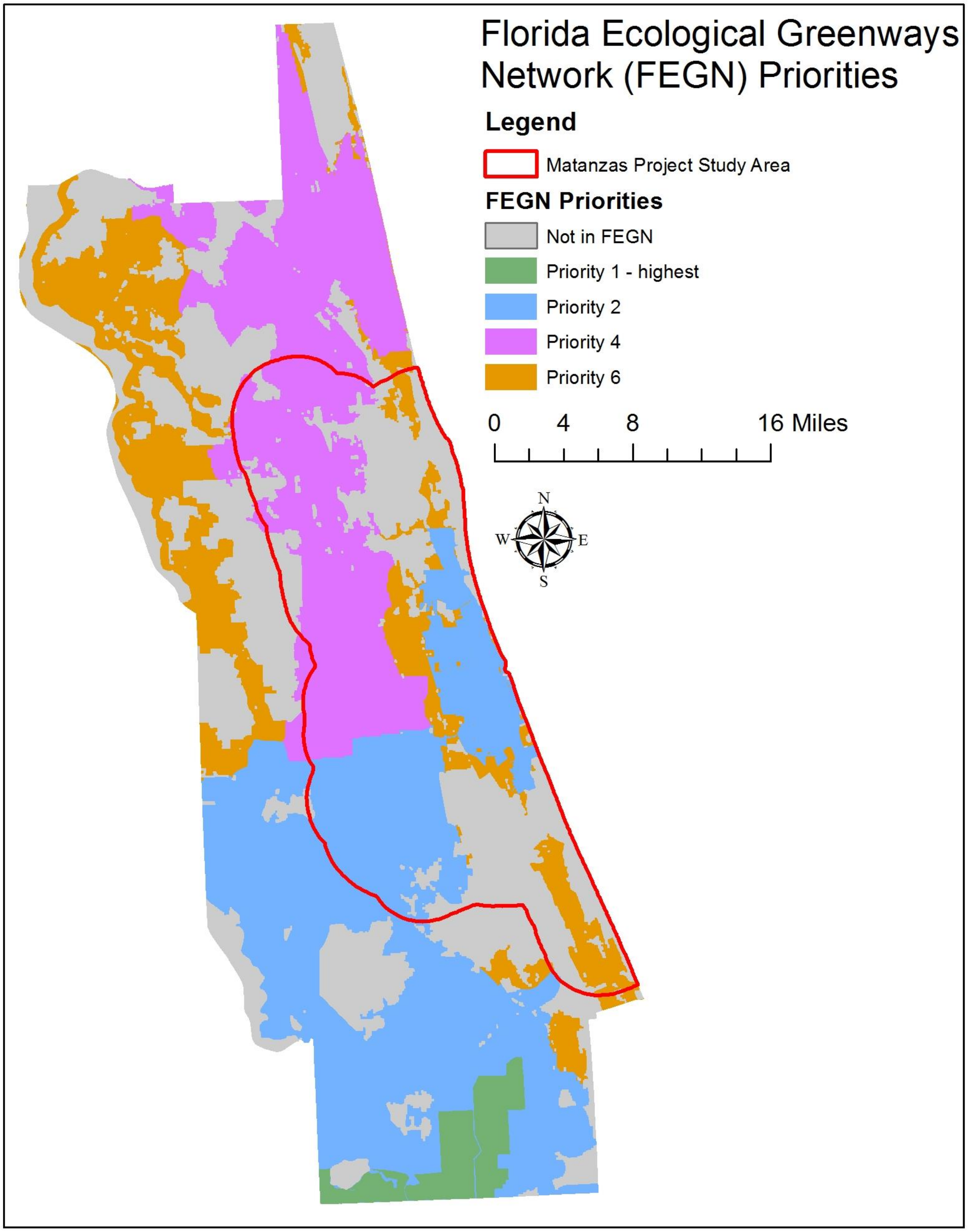
Appendix F: Regional Conservation Priority Map Layers

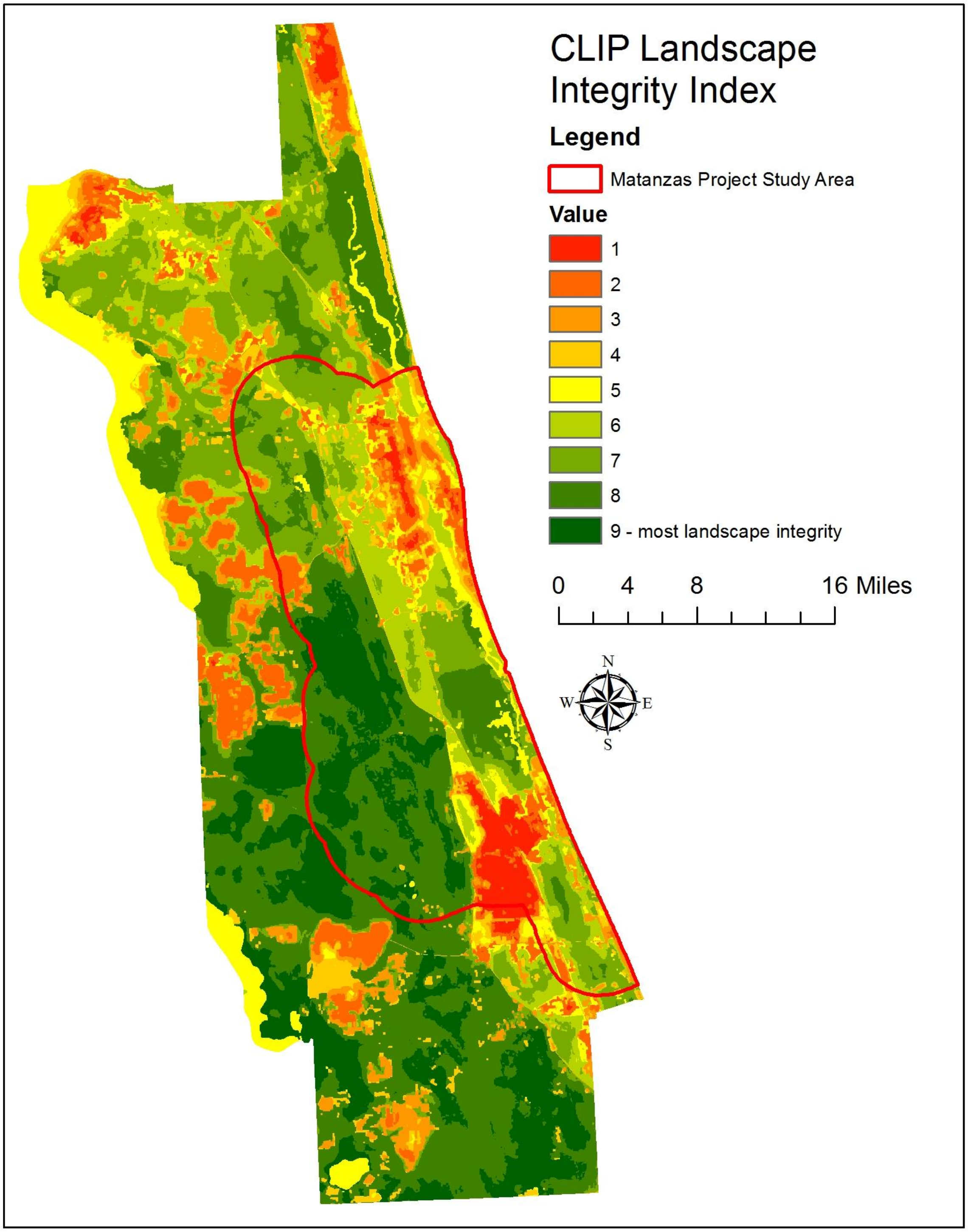
The following section includes maps illustrating the component layers included in the regional conservation priorities identified for the Matanzas project study area.

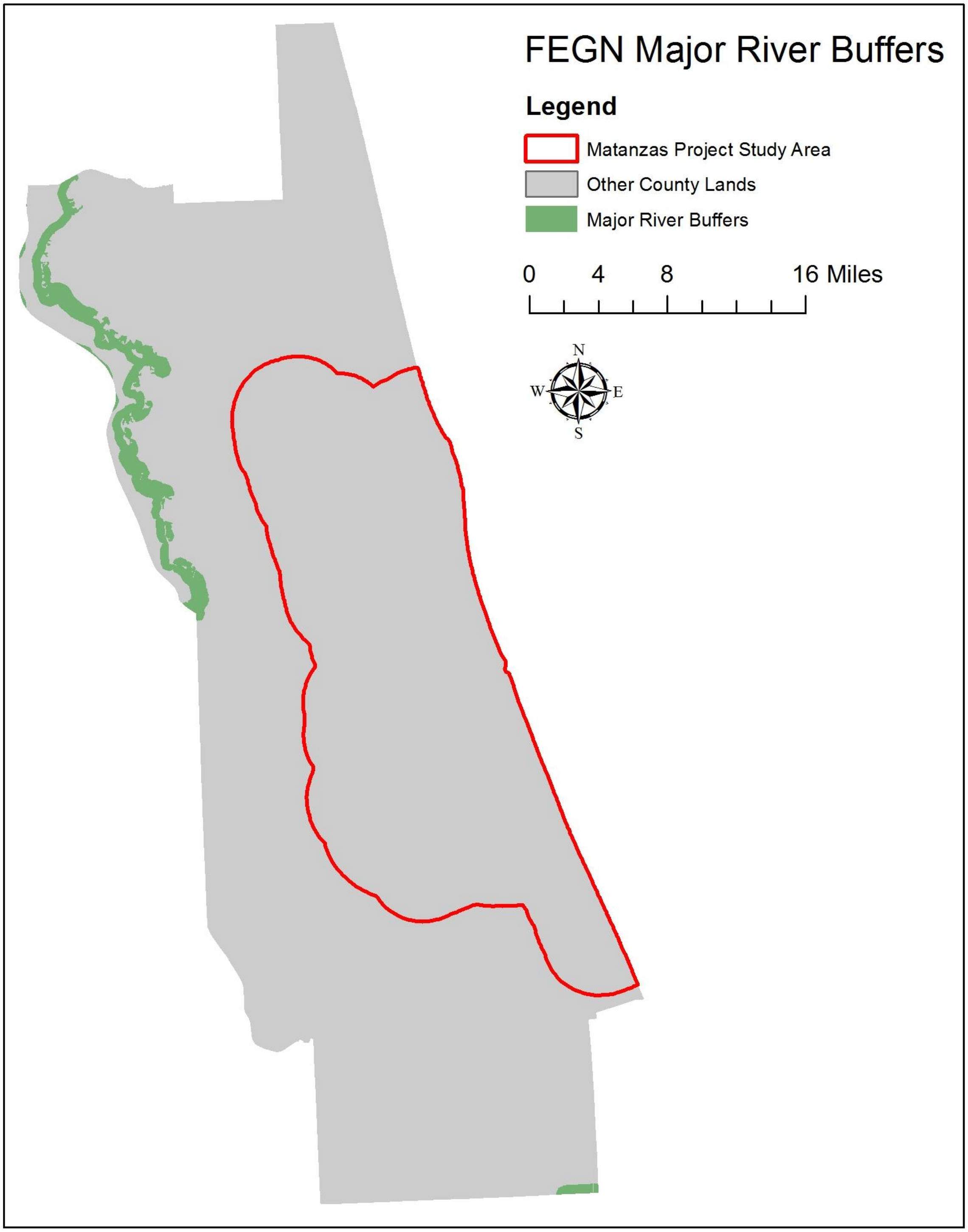

Bear Priority
Ecological Areas (PEAs)
Legend
Matanzas Project Study Area
Non PEA areas
Bear PEAs
0
4
8
16 Miles
N
W
E
S


CLIP Aggregated Priorities
Legend
Matanzas Project Study Area
CLIP Priorities
Not a Priority
Priority 5 (lowest)
Priority 4
Priority 3
Priority 2
Priority 1 (highest)
0 4 8 16 Miles
N
W
E
S


Florida Ecological Greenways Network (FEGN) Coastal to Inland Connectivity Priorities
Legend
Matanzas Project Study Area
Other County Lands
Coastal to Inland Connectivity Priority
0 4 8 16 Miles
N
W
E
S


Florida Ecological Greenways Network (FEGN) Priorities
Legend
Matanzas Project Study Area
FEGN Priorities
Not in FEGN
Priority 1 - highest
Priority 2
Priority 4
Priority 6
0
4
8
16 Miles
N
W
E
S


CLIP Landscape
Integrity Index
Legend
Matanzas Project Study Area
Value
1
2
3
4
5
6
7
8
9 - most landscape integrity
0
4
8
16 Miles
N
W
E
S


FEGN Major River Buffers
Legend
Matanzas Project Study Area
Other County Lands
Major River Buffers
0 4 8 16 Miles
N
W
E
S