Living Shoreline Suitability Model

CITY OF JACKSONVILLE
SUMMER 2026

EXECUTIVE SUMMARY

Jacksonville's waterfronts play a defining role in the city's character and quality of life and are of significant economic, recreational, and cultural importance to its communities. The city's shoreline is complex, ranging from highly industrial to undisturbed salt marsh, all of which provide tremendous value. The city's 1,500 miles of beach, riverine, and intercoastal shoreline along the Atlantic Ocean, St. John's River, and its tributaries increase the city's susceptibility to coastal erosion, flooding, and sea level rise. Such forces can make waterfront assets vulnerable to damage, placing homes, businesses, and coastal infrastructure at a higher risk. Protecting coastal and riverine areas is paramount, which is why shoreline stabilization projects aimed at preventing erosion are vital.

Ensuring protection of Jacksonville's shorelines requires a range of strategies rather than a one-size-fits-all solution. Shoreline stabilization exists along a spectrum of approaches, from hardened gray infrastructure, such as seawalls and bulkheads, to nature-based green infrastructure, like salt marshes and oyster reefs, as well as green-gray hybrid solutions that combine the strengths of both.

Jacksonville's landscape requires a tailored, data-driven approach to shoreline management based on individual site conditions. In alignment with Jacksonville's *Resilient Jacksonville* strategy, the City has developed a Living Shoreline Suitability Model (LSSM) to evaluate a suite of different shoreline stabilization approaches within the St. John's River system to determine where they are most appropriate. The development of the city's LSSM was based on the Virginia Institute of Marine Science's Shoreline Suitability Model (SSM), which has been used to examine a variety of estuarine systems along the Atlantic and Gulf Coasts, from New York to Tampa Bay.

Approximately 308 miles of Jacksonville's shoreline was evaluated using the LSSM. Results show that about one-third of the study area is suitable for non-structural living shorelines. Another 11 percent of shorelines in the study area is recommended to be protected by marsh plantings with a sill, which is a structure placed parallel to the shoreline to reduce wave action. Gray infrastructure is recommended for 22 percent of shoreline, particularly along the main stem of the St. Johns River where bulkheads are already present.

The results of this analysis indicate that 22 percent of shoreline within the Jacksonville study area does not require shoreline stabilization, because these sites contain undeveloped marsh, which serves as a natural shoreline stabilizer, or the due to the presence of public boat ramps. Additional study is needed to determine the best shoreline stabilization approach for 12 percent of the study area due to challenging conditions, like high wave action from wind. Less than 1 percent of the study area was determined to be best protected through land use management, such as stormwater or vegetation management, as bank heights in these particular sites were in excess of 30 feet, making them unsuitable for hardening measures or living shorelines.

Moving forward, the City plans to use the LSSM to guide planning for shoreline stabilization projects. The findings of the LSSM will be used to inform the implementation of living shoreline projects across Jacksonville, including pilot projects in public parks along the St. Johns River and its tributaries. The successful execution of projects on public property are expected to inspire additional projects on private property in Jacksonville and beyond. Ultimately, the city's LSSM provides information necessary to advance shoreline management in Jacksonville, which will ultimately improve city resilience.

CONTENT

BACKGROUND

Located on the Atlantic Coast and the St. Johns River, Jacksonville is a city shaped by water. From its working waterfronts and bustling marinas to quiet creeks, tidal marshes, and riverfront neighborhoods, water is woven into the identity of the city and the daily lives of its residents. It supports commerce and tourism, provides opportunities for boating and fishing, and creates scenic character that defines many of Jacksonville's most treasured places. The city's waterways are not only an economic and recreational asset, but also an essential part of the natural systems that sustain Northeast Florida's environment and quality of life.

At the same time, Jacksonville's close relationship with the water brings significant challenges. With roughly 1,500 miles of shoreline, the city must continually respond to coastal erosion, flooding, and increasing pressures associated with storms and sea level rise. These issues are made more dynamic by the extraordinary complexity of Jacksonville's waterfront. No two stretches of shoreline function the same way, and each faces its own unique set of environmental and management needs.

Many urbanized portions of Jacksonville's riverfront have been hardened with seawalls, bulkheads, and rock revetments designed to protect infrastructure and private property from erosion and wave action. While these structures can effectively stabilize shorelines, they disconnect the land from the water and do not provide the same ecological benefits as natural systems.

In some areas, such as the Timucuan Ecological and Historic Preserve, expansive salt marshes and tidal wetlands provide a natural buffer against erosion while improving water quality and supporting fish and wildlife. These living shorelines are among the most productive ecosystems in Florida, helping sustain the ecological health of the St. Johns River and surrounding estuaries.

The future of the city's waterfront depends on thoughtful planning and management approaches that recognize the value of both resilient infrastructure and healthy natural systems. Protecting and restoring shorelines where possible, while adapting developed areas to changing environmental conditions, will be essential to preserving the character, function, and long-term resilience of Jacksonville's waterways.

SHORELINE STABILIZATION METHODS

There is no single solution for protecting Jacksonville's shorelines. Instead, shoreline stabilization exists along a continuum of approaches ranging from hardened gray infrastructure, such as seawalls and rock revetments, to nature-based green infrastructure, such as salt marsh and oyster reefs, and green-gray hybrid solutions.

Successful shoreline management will require careful evaluation of site conditions, environmental impacts, and community priorities. By strategically matching shoreline treatments to the conditions and needs of each location, Jacksonville can work toward a more resilient waterfront that protects both people and natural systems.

Living shorelines offer many compelling benefits compared to conventional shoreline hardening. Designed to mimic the function of natural coastal systems, living shorelines use features such as native salt marsh vegetation, oyster reefs, and other natural materials to stabilize vulnerable banks and reduce erosion. Rather than simply deflecting wave energy, these systems absorb and dissipate it. Living shorelines strengthen over time as vegetation becomes established, in contrast to hardened shorelines that weaken over time as materials degrade. In addition to protecting against erosion, living shorelines improve water quality, create habitat for fish and wildlife, and enhance the visual character of the waterfront.

Despite their many benefits, living shorelines are not appropriate everywhere. In areas exposed to intense wave action, heavy boat wakes, or highly developed urban conditions, more robust protection measures are required. In these locations, hybrid approaches that combine natural elements with structural reinforcement or gray hardening methods (e.g., seawalls and revetments) may provide the most effective and resilient solution.

Selecting the right approach requires a careful understanding of site conditions, goals, and long-term maintenance needs. By using the right strategy in the right place, Jacksonville can better protect its shoreline while preserving the ecological health and character of its waterways.

The use of both green and gray solutions to protect our shorelines is supported by the City of Jacksonville's *Resilient Jacksonville* strategy, which includes actions for making the city more resilient in the face of acute shocks and chronic stressors, like tropical storms and coastal erosion.

> ***"Action 16 | Invest strategically in hardened shorelines."***
>
> ***"Action 17 | Identify shorelines where nature and nature-based solutions can provide long-lasting ecosystem service benefits."***
>
> \- *Resilient Jacksonville* (2023)

DEVELOPMENT OF A LIVING SHORELINE MODEL FOR JACKSONVILLE

The City's Office of Resilience has developed a Living Shoreline Suitability Model (LSSM) for Jacksonville that determines sites where living shorelines may be appropriate and where hardening may be required. The City's LSSM was based on a Shoreline Management Model (SMM) that was developed by the Virginia Institute of Marine Science. The VIMS SMM has been adapted and applied to estuarine systems across the southeast, including several locations in Florida – most notably in Tampa Bay.

To complete an LSSM for Jacksonville, the City relied upon the VIMS' Shoreline Management Model version 5.1 Handbook. Jacksonville's LSSM uses a suite of data, including information on nearshore bathymetry, bank height, fetch, adjacent land use, and the position of existing marshes and shoreline protection structures (Appendix A). Together this information is used to evaluate whether segments of the shoreline are suitable for living shorelines or whether they require other shoreline stabilization measures, such as rock revetments or bulkheads.

The model outputs management recommendations for shorelines (Appendix B) based on the data provided (Appendix A). Specifically, the model recommends two different types of living shoreline solutions: 1) non-structural and 2) plant marsh with sill. The model also recommends two different types of hardening 1) revetment or 2) revetment / bulkhead toe revetment. Additionally, the model provides recommendations on whether no shoreline stabilization is needed, such as public boat ramps or where the shoreline contains an undeveloped marsh, which provides natural shoreline stabilization.

The model recommends additional study where special conditions warrant a more tailored approach to shoreline stabilization. The model recommends land use management as the best course of action in areas where bank heights exceed 30 feet, as tall banks limit intervention such as bulkheads, seawalls, and living shorelines. In these elevated areas, more appropriate actions include addressing stormwater, upland development, and vegetation management. The VIMS model also included beach nourishment, but this recommendation was removed from Jacksonville's LSSM as no extensive beaches are present in the study area.

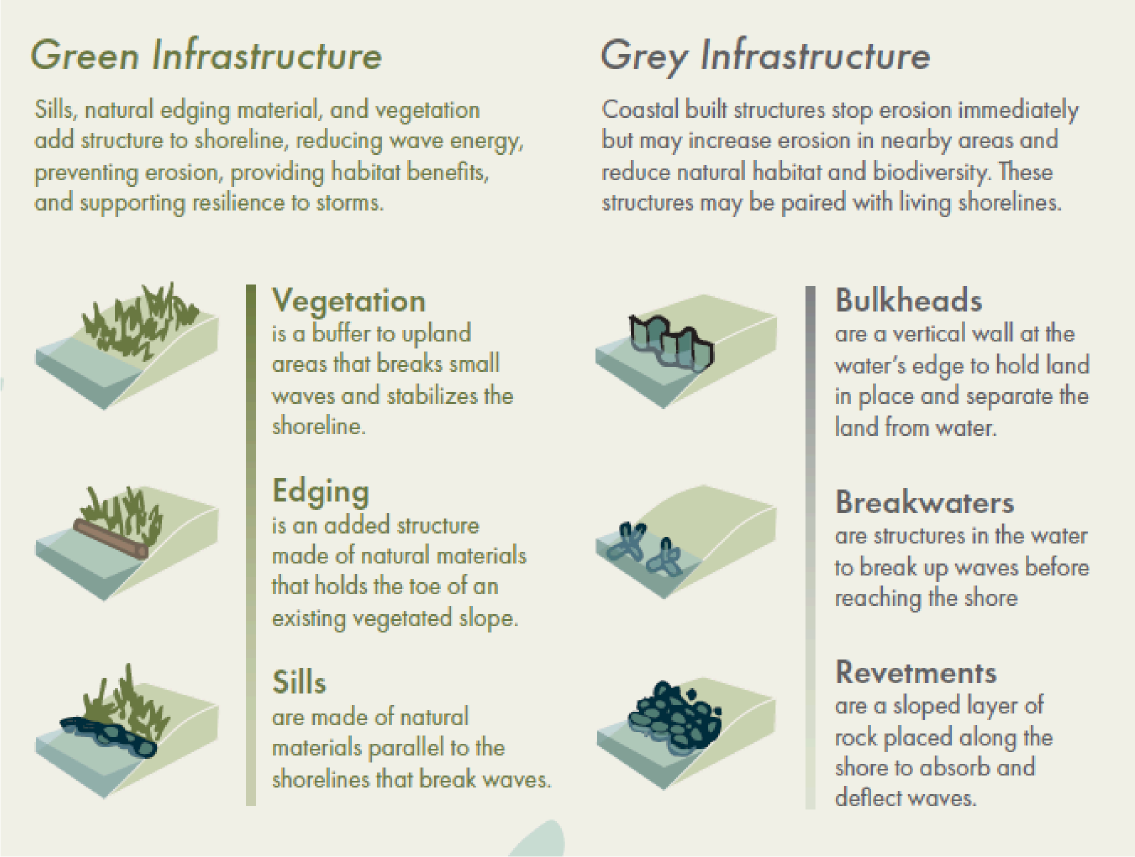

Figure 1: Illustration showing a continuum of solutions for shoreline stabilization from green to gray.

In total, the City of Jacksonville modeled approximately 308 miles of shoreline, including the main stem of the St. Johns River and many of its tributaries. Beaches were excluded from the analysis because the City already has a comprehensive beach nourishment project in place with the U.S. Army Corps of Engineers. Additionally, salt marsh dominated areas, like the Timucuan Ecological and Historical Preserve and Intercoastal Waterway, were excluded because the shorelines are already natural and relatively stable.

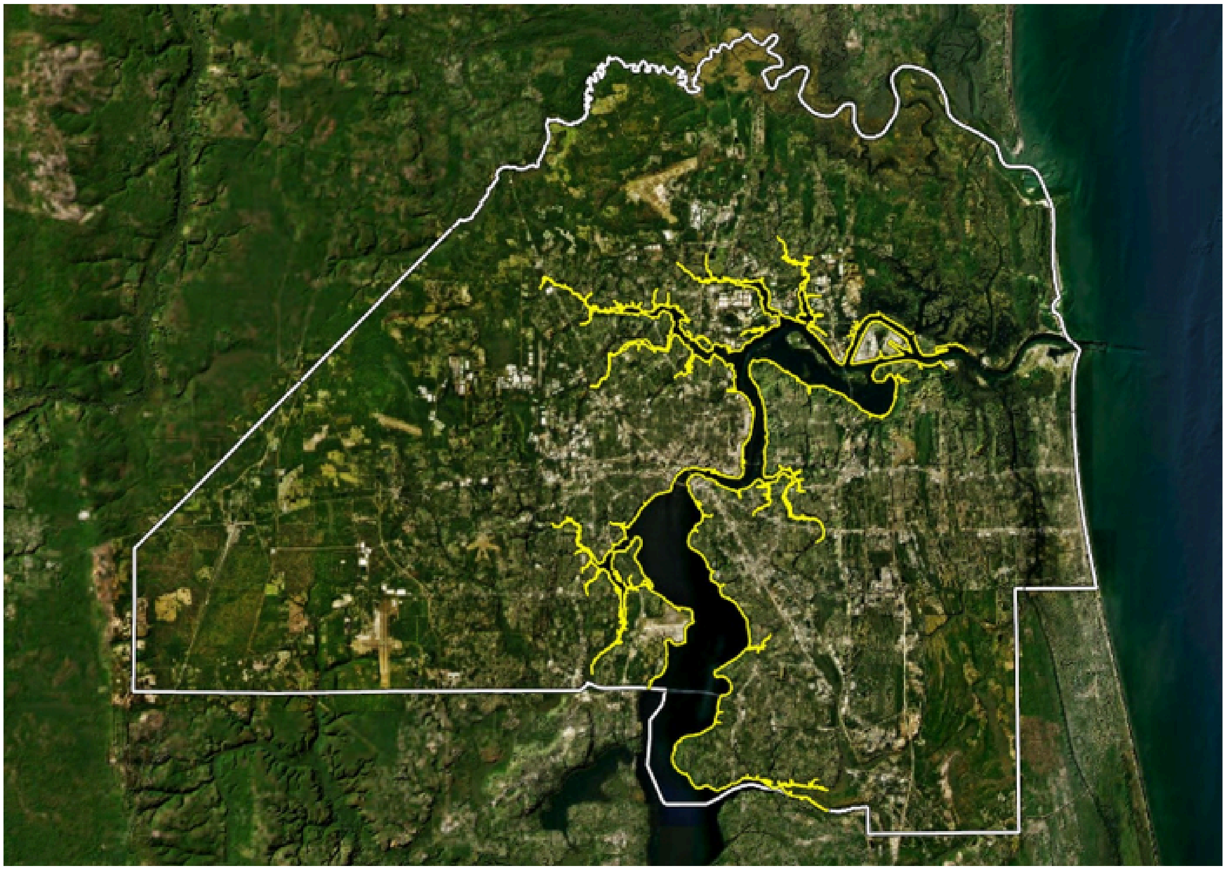

Figure 2: Extent of study area for Jacksonville's Living Shoreline Suitability Model.

In order to test the model, the City acquired a dataset from VIMS encompassing approximately 3 miles of shoreline in Virginia. The LSSM developed for Jacksonville was used to analyze the VIMS dataset, and the resulting recommendations were compared between the VIMS SMM v5.0 and the LSSM for Jacksonville (developed based on VIMS SMM v5.1). Overall, the model performed well with the vast majority of the VIMS SMM results matching those of the LSSM for Jacksonville. All discrepancies between the VIMS results and the LSSM for Jacksonville were able to be explained – demonstrating that the model performed as expected.

A few differences were due to the model versions (i.e., the VIMS dataset was analyzed using SMM v5.0, but the LSSM was developed based on the SMM v5.1; v5.0 did not contain a recommendation for breakwaters but v5.1 does contain breakwaters as a shoreline recommendation). Other differences were due to modifications made to the SMM v5.1 when developing the LSSM for Jacksonville to better suit conditions along the St. Johns River and its tributaries (i.e., removing beach nourishment from the list of recommendations). Overall, the results of the validation exercise strengthens the City's confidence in the LSSM.

Figure 3: Comparison of VIMS dataset (SMM v5.0) to the Jacksonville LSSM (based on VIMS SMM v5.1) showing general alignment except for beaches and bulkheads.

KEY FINDINGS

The results of the model are compelling. Approximately **one third** of the shoreline included in the model was determined to be suitable for non-structural living shoreline. Many of these areas are located along the tributaries of the St. Johns River. According to the model, tributaries such as Julington Creek, Ortega River, Ribault River, and Trout River may be good locations for living shorelines.

An additional **11%** of the modelled area is suitable for planting marsh with a sill for additional shoreline stabilization. For example – the shoreline of Reddie Point Preserve and the Jacksonville Zoo and Botanical Gardens were determined to be suitable for this type of shoreline stabilization technique, which is notable because the only living shoreline to be constructed in Jacksonville, to date, is at the Jacksonville Zoo and Botanical Gardens.

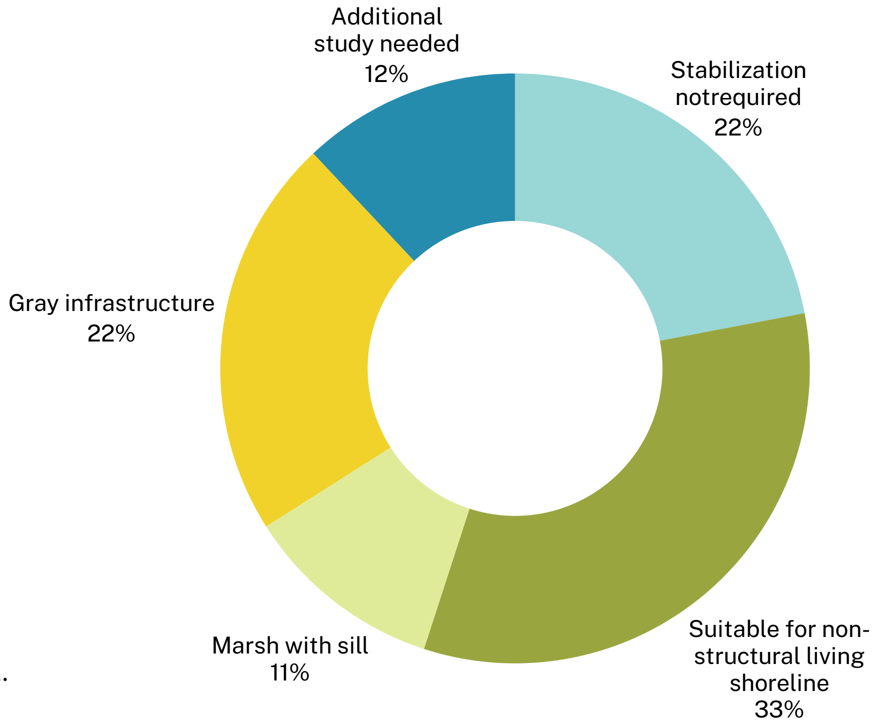

Figure 4. Chart displaying relative percentages of management recommendations in study are for Jacksonville's LSSM.

The model recommends that 22% of the shoreline be stabilized with gray infrastructure, such as bulkheads. This is true for much of the main stem of the St. Johns River south of downtown Jacksonville, much of which is already stabilized by bulkhead structures. Hardening along these areas is needed due to the high fetch – wind driven wave energy – that can cause chronic erosion.

The model indicates that additional work is needed to determine the best course of action for **12%** of the shoreline. It is recommended that additional studies be completed to identify the best possible solutions for these areas, which have high fetch, highly modified conditions, or unique riverine conditions. Some of these areas are likely not suitable for living shorelines; however, hybrid gray-green solutions may be applicable at some of these sites.

Land use management was recommended for less than **1%** of shoreline area, as few sections of the St. John's River have bank heights that exceed 30 feet. In these elevated areas, interventions such as bulkheads, seawalls, and living shorelines are not feasible, but actions to address stormwater runoff, upland development, and vegetation management have potential to provide positive benefits.

The model indicates that stabilization measures are not required along **22%** of the shoreline. The majority of these areas do not require stabilization because they contain saltmarsh vegetation, which naturally buffers the shoreline while providing beauty and undisturbed habitat for wildlife. In other sites, the model determined that some shorelines may not need stabilization is because they contain public boat ramps, which are hardened structures not prone to erosion.

Though much of Jacksonville's shoreline is privately owned, the City has the potential to enhance and protect shorelines and infrastructure within its vast park system, which is the largest in the contiguous United States. Of the total **58** parks contained within the study area, **twenty-eight** had a recommendation for non-structural living shoreline. **Fifteen** parks had a recommendation for a living shoreline with a sill. **Thirteen** of the parks were public boat ramp facilities and do not require stabilization.

SITE-SPECIFIC RECOMMENDATIONS

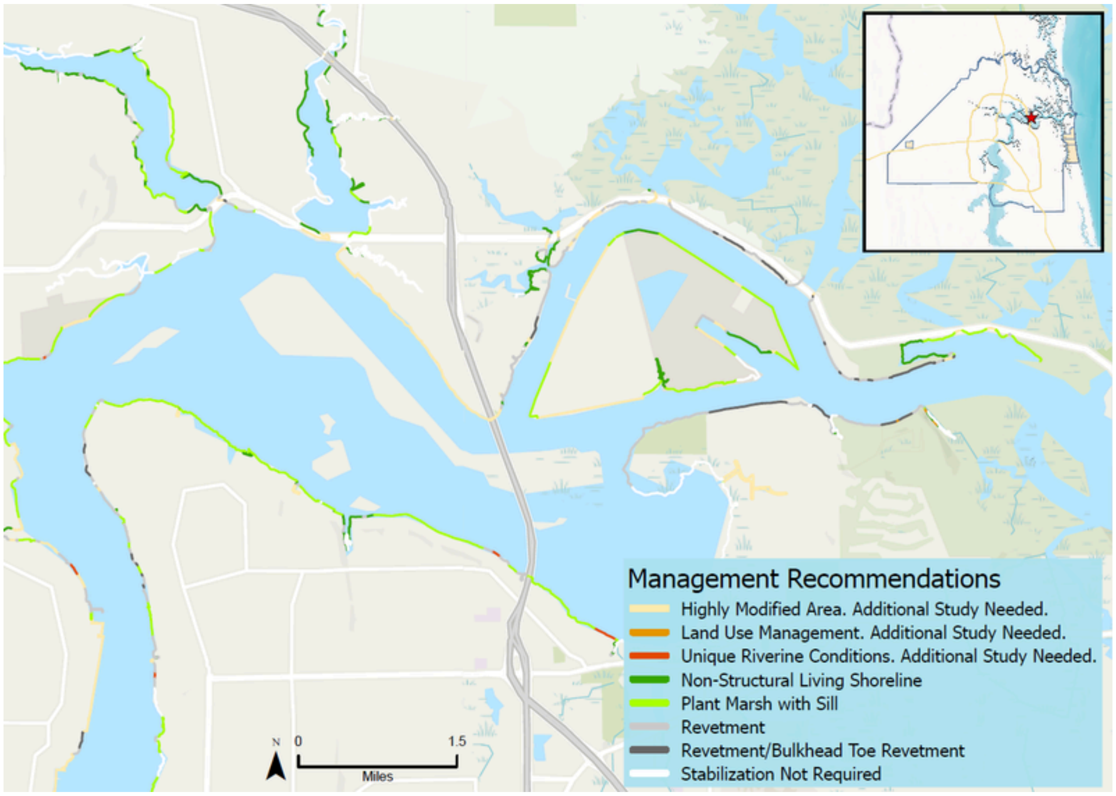

Figure 5: Map showing management recommendations for shorelines near Blount Island, including areas where living shorelines are suitable and other areas that require revetments and / or bulkheads.

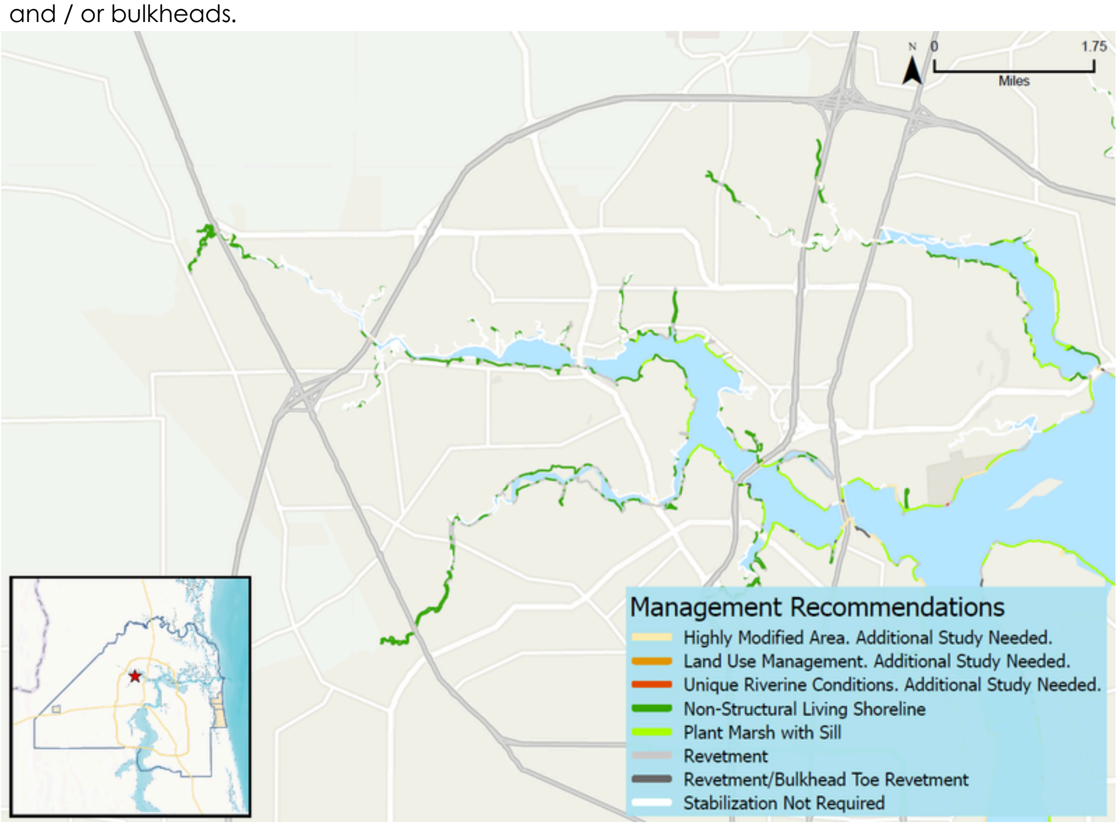

Figure 6: Map showing management recommendations for Ribault River and Trout River where most of the shorelines are suitable for living shorelines or where stabilization is not required.

Figure 7: Map showing management recommendations near Reddie Point, including the Jacksonville Zoo and Botanical Gardens – the location of Jacksonville's only living shoreline.

Figure 8: Map showing management recommendations for shorelines near Downtown, where much of the shoreline will require additional study.

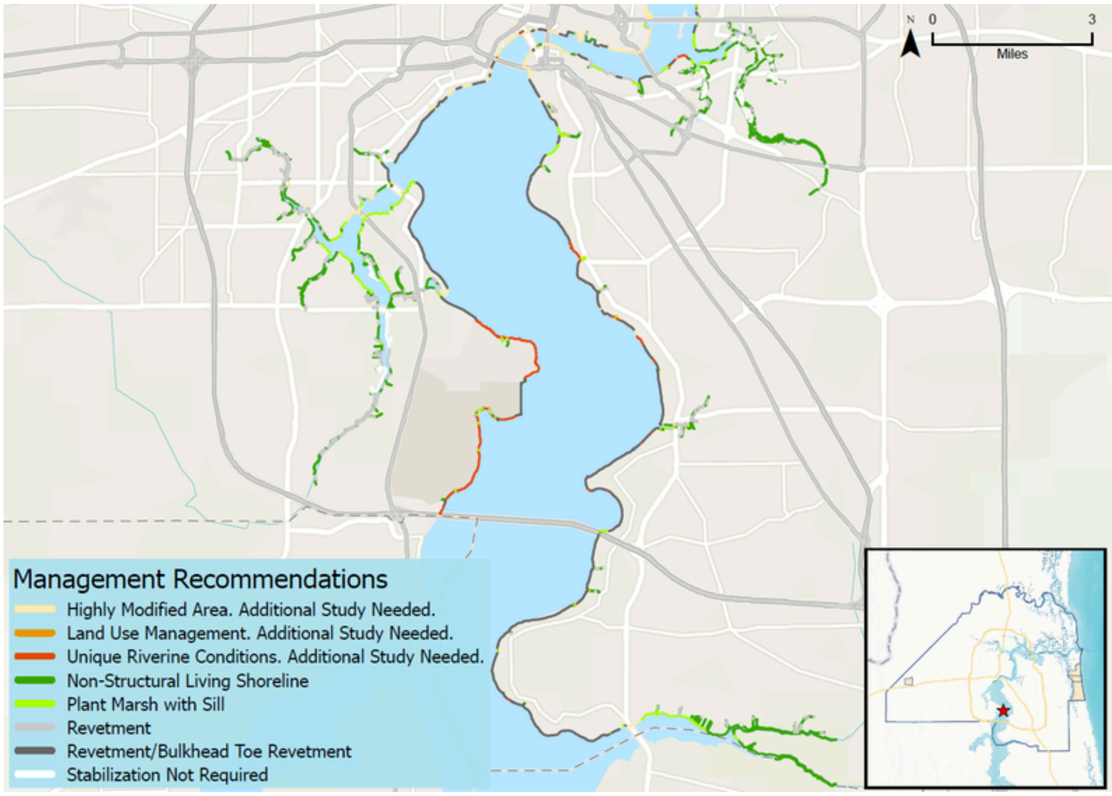

Figure 9: Map showing management recommendations for the main stem of the St. Johns River south of Downtown, where bulkheads are common features.

NEXT STEPS

Now that the model has been successfully applied to Jacksonville, the City is interested in using the results to inform shoreline stabilization projects, including the construction of living shorelines. For example, the results can be used to identify shorelines within City parks where living shorelines projects could be implemented to reduce erosion, improve aesthetics, and enhance wildlife habitat.

Many city parks already have natural shorelines and do not require stabilization; however, there are locations (e.g., Ribault River Preserve) where the addition of living shoreline could be used to enhance the function of the park's shoreline. In other cases, the addition of a sill or other natural structure, like oysters, could be used to enhance parks with natural shorelines (e.g., Riverview Park). At other locations, additional information will be needed before a shoreline solution can be implemented, but the LSSM provides a starting point for planning decisions.

Next steps include designing, permitting, and constructing living shorelines in suitable locations on public lands across Jacksonville. This will require finding dedicated funding sources for projects, including monitoring and long-term maintenance costs. The City is optimistic that the LSSM will help support grant applications for state and federal funding by demonstrating that living shoreline projects in Jacksonville will be implemented where they are most likely to be successful. The successful implementation of living shoreline projects on public lands will provide an opportunity for public outreach and education about shoreline stabilization techniques and could encourage similar projects on private properties across the city – thereby increasing the overall resilience of our shoreline while also improving water quality and enhancing habitat for wildlife.

APPENDIX A: REFERENCED DATA TYPES

Required Data Layer	Description	Source(s)
Shoreline	Base layer showing the position of the shoreline.	NOAA
Riparian Land Use/Land Cover	Land Use / Land Cover within 100 ft of shoreline.	2025 aerial imagery; COJ land use data
Bank Height	Vertical distance from toe to top of bank. Categorized as 0–5 ft, 5–30 ft, and >30 ft.	USGS 1ft contour data
Roads and Permanent Structures	Roadways or permanent upland structures located near the shoreline.	COJ building footprints; 2025 aerial imagery
Beach/Wide Beach	Persistent sandy shorelines that reduce wave energy.	2025 aerial imagery
Bathymetry	Nearshore water depth: distance from shoreline to the 1meter (3.28 ft) bathymetric contour.	NOAA / Geonex
Canals, Public Boat Ramps, and Sand Spits	Land features requiring additional review to determine preferred erosion control options.	2025 aerial imagery
Submerged Aquatic Vegetation (SAV) and Mangroves	Presence of SAV or mangroves within 30 ft of shoreline.	SAV and mangroves were assumed to be absent
Shoreline Protections Structures	Erosion control structures located on or off the shoreline.	NOAA; 2025 aerial imagery
Tidal Marshes	Marshes subject to tidal influence and persistent year round.	2025 aerial imagery
Fetch	Maximum averaged distance over water to the nearest shoreline based on 16 directions.	NOAA shoreline; Duval County boundary
Tributary Designation	Low energy tributaries where long fetch vectors may otherwise misclassify energy levels.	2025 aerial imagery

Table A1: Types of data included in LSSM along descriptions and sources.

APPENDIX B: MANAGEMENT RECOMMENDATIONS

Management Recommendation	Description
Non-structural living shoreline	Remove existing shoreline structure if present; grade bank if necessary and install a non-structural living shoreline which may include riparian buffer planting along the bank, and/or marsh plants, coir logs, or oyster reefs along the shoreline. Best choice for low energy environments.
Plant marsh with sill	In moderate energy environments a sill may be required to establish a living shoreline. Remove any existing shoreline structure if present and grade the bank if possible. Stabilize bank with riparian vegetation and plant a marsh with a sill. If the bank cannot be graded, repair existing shoreline structure with a minimal footprint and consider incorporating a marsh with a sill or some other shoreline enhancement (e.g. oyster castles).
Revetment	Remove existing failing or failed shoreline structure, if present. Construct new revetment as far landward as possible; grade the bank and plant vegetation buffers where possible. If grading is not possible, construct or repair existing revetment in the same alignment. A bulkhead should be considered only if previously present and the site is limited by navigation. Consider shoreline enhancement such as creation of vegetated wetlands and/or riparian buffer and/or sandy beach/dune above and immediately channelward of the structure.
Revetment/Bulkhead Toe Revetment	If grading is possible, remove the failed bulkhead and replace with a revetment landward of the current bulkhead. When grading not possible, (re)construct bulkhead in the same alignment and/or add a toe revetment. Consider a shoreline enhancement project such as creation of vegetated wetlands and/or riparian buffer and/or sandy beach/dune above and immediately channelward of the structure.
Land Use Management	Shorelines with tall banks greater than 30 feet limit possible solutions to address bank erosion. Forces other than tidal erosion, such as over-land runoff, upland development, and vegetation management are likely also having effect on bank conditions. Assessment of all factors and modifications to address causes for bank erosion are recommended. This may include changes to vegetation management, implementation of projects to address storm water, relocating buildings, utilities, and other infrastructure. All new construction should be located 100 feet or more from the top of bank. Actions may also include requesting zoning variances for relief from setback and other land use requirements or restrictions that may increase erosion risk. Seek expert advice to inform management options.
Stabilization Not Required	No specific management actions are suitable for shoreline protection, e.g. boat ramps, undeveloped marsh, and barrier islands.

Table B1: Management recommendations with descriptions

ACKNOWLEDGEMENTS

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