I. Project Information*

Project Director	Savanna Barry
Project Title	Cedar Key ShOREs: Shoreline Options for Resilience and Equity
Project Location	Cedar Key, FL, USA
Project Summary	We leveraged previous community engagement to design nature-based solutions (NBS) around key public infrastructure. Recent collaborations on living shorelines between Cedar Key (CK) stakeholders and UF generated interest in further application of NBS for vulnerable public infrastructure threatened by sea level rise, frequent storms, and chronic erosion. CK was particularly vulnerable to storm surges and rising seas, and recent hurricanes caused extensive damage to shorelines and the community. Of particular concern was the highly exposed G and 1st Street neighborhood and adjacent low-lying areas. This focus area encompassed critical routes for emergency services, a popular shore fishing spot, and a public school in addition to private homes, local businesses, and failing stormwater infrastructure. CK has been unable to address climate hazards in the focus area due to the complex situation, let alone integrate NBS features. At the same time, multiple groups interact with the focus area and require continual engagement to ensure an equitable solution could be achieved. In Phase II, we built on Phase I outcomes to assist CK with the highly technical project design, advancing concepts toward permitting while incorporating input from the community. In both project phases, we deployed stakeholder-driven workshops and survey processes, conducted site visits to inform design possibilities and visualization, and integrated technical expertise with local preferences and infrastructure needs. Our team included experts in policy, ecology, civil and coastal engineering, community resilience, risk management, community engagement, and fisheries. Phase II products include designs for multiple stormwater and shoreline NBS projects and a case study that documents the process our team employed when working with the CK community.

II. Executive Summary

To support bridging knowledge to action, the GRP seeks to develop products that are widely accessible and useful to communities, academics, non-governmental organizations, and public and private decision-makers. GRP Executive Summaries are designed to communicate, in clear and non-technical language, what issues GRP has supported, what was done, and what was achieved.

Responses must be written in complete sentences rather than in bullet point.

1. What problem are you addressing, and why does it matter? (up to 100 words) *

Briefly describe the issue your project is tackling. Why is this problem significant to the Gulf region, its communities, ecosystems, or systems of practice?

Cedar Key is a small Gulf Coast community facing accelerating sea level rise, frequent storm surges, stormwater flooding, and chronic shoreline erosion. The G and 1st Street neighborhood is an area where critical transit routes, homes, fringing coastal habitats, and public spaces are at risk. Low city staff capacity limits proactive solutions, yet the town's economy, culture, and access to the Gulf depend on resilient shorelines and functional stormwater systems. Our project addressed these climate hazards by building capacity and co designing nature based solutions that blend scientific expertise with local knowledge to protect people, ways of life, and ecosystems.

2. What did you do? (up to 500 words) *

Summarize your key activities and outputs during this period (or planned for the project). Program activities are the actions a program takes (e.g., conducting field research, holding workshops, analyzing data, providing training, building partnerships), while outputs are the direct, tangible products or results of those actions (e.g., number of partnerships established, models created, workshops held, students trained).

We implemented a multi-phase, community-centered process to design nature-based solutions (NBS) for shoreline protection and green stormwater infrastructure (GSI) in Cedar Key. Our approach combined technical rigor with inclusive engagement to ensure designs reflected local priorities while meeting resilience goals.

Phase I (2023) focused on awareness and idea generation. We hosted three public workshops (Feb–Apr 2023) introducing NBS options such as bioswales, permeable pavement, tree-box filters, living shorelines, and a hybrid "Sea Groin" concept. These sessions featured mapping exercises, hands-on demonstrations, and facilitated discussions to capture community preferences. To broaden participation, we conducted a multi-mode intercept survey at fishing spots, the food pantry, aquaculture facilities, and other community hubs, thereby reaching end users often excluded from formal planning.

Phase II (2024–2025) advanced technical design and deepened engagement. We organized six targeted sessions: two shoreline property-owner focus groups (May 2024), an advanced GSI design workshop (April 2025), two shoreline design workshops (Nov 2024; Aug 2025), and a final open house (Oct 2025). These were complemented by 12 semi-structured resident interviews (Mar–May 2024) and outreach to shore-based anglers (Sept 2025) to refine Sea Groin features for public access and fishing needs. This iterative process ensured designs balanced ecological function, flood mitigation, and cultural priorities.

On the technical side, we advanced hydrodynamic and stormwater modeling to guide siting and evaluate expected performance. We produced formal engineering plans for GSI interventions (including tree-box filters, permeable pavement, and bioswales). For shoreline protection, we refined the Sea Groin concept into a 90% design that integrates habitat restoration and recreational access and developed homeowner-scale living shoreline templates to guide smaller scale interventions on private property.

Key outputs included:
- Community-vetted conceptual and refined engineering designs for the Sea Groin, homeowner living shoreline templates, and GSI suite.
- Modeling frameworks for wave/tide dynamics and stormwater performance, for a total of three new models.
- Visual renderings of proposed interventions to support decision-making.

- Workshop materials, summaries, and a comprehensive case study documenting inclusive engagement strategies (https://ufdc.ufl.edu/IR00012364/00001/pdf).
- A peer-reviewed journal article on community perceptions of NBS (https://doi.org/10.3389/fmars.2025.1639887)
- A co-authored book chapter featuring Cedar Key ShOREs as a case study (in review)
- Eight professional conference abstracts and presentations:
-- 2023: Coastal and Estuarine Research Federation
-- 2024: American Geophysical Union, Gulf of Mexico Conference, Symposium on Flooding Adaptation, Florida Resilience Conference
-- 2025: Center for Watershed Protection's National Watershed and Stormwater Conference, Council for Educators in Landscape Architecture, Natural Hazards Workshop
- An extension presentation to 58 stormwater practitioners Florida's panhandle region.
- Media engagement, including being featured on an episode of the Geotrek podcast (https://rss.com/podcasts/geotrek/1367947/) and a GRP feature story (https://www.nationalacademies.org/news/community-voices-and-scientific-insight-build-a-more-resilient-cedar-key), which amplified project visibility.

Through these activities, we not only delivered permit-ready NBS designs but also strengthened local capacity and built momentum to implement these NBS. Our outputs provide actionable tools—technical plans, templates, and engagement models—that can be replicated in other Gulf communities facing similar climate challenges.

3. What did you achieve? (up to 500 words) *

What were the outcomes or impacts of your work so far? What changed or advanced as a result of your activities—whether in knowledge, people, communities, policies, or systems? Outcomes and impacts are the changes that result from your work—such as increased knowledge, improved decision-making, strengthened community capacity, policy influence, or environmental improvements. For example, your work might lead to new coastal planning practices, or your engagement efforts might help communities better prepare for climate risks. Your education programs might have inspired students to pursue careers focused on Gulf issues or increased their commitment to staying and working in Gulf communities.

The project advanced Cedar Key's capacity and readiness to implement nature-based solutions (NBS) for climate resilience. One early success (the City's rapid installation of inline check valves during Phase I) reduced saltwater backflow and demonstrated the effectiveness of locally tailored recommendations. This visible improvement, as well as impressive performance of existing living shorelines during multiple hurricanes, built trust and momentum for larger shoreline and stormwater interventions.

We delivered permit-ready, community-supported designs for multiple NBS interventions along G and 1st Street, integrating hydrodynamic and stormwater models to ensure technical feasibility while preserving public access and ecological function. These designs represent a major step toward implementation, bridging the gap between conceptual ideas and actionable infrastructure projects.

Engagement outcomes were measurable and impactful. In the exit survey from the final workshop (n = 17), 94% of participants supported constructing the Sea Groin, 88% supported stormwater improvements, and 88% wanted homeowner template projects built in their community. Knowledge gains were also evident: 88% of participants reported learning new strategies, and many translated this knowledge into action—53% had already implemented property-level measures such as rain barrels or native plantings, and another 12% planned to do so. These findings indicate not only increased awareness but tangible behavioral change.

We broadened inclusion by engaging aquaculture workers, shore-based anglers, inland residents, and renters, groups often underrepresented in planning. Their input shaped design features, such as adding stairs to the Sea Groin to maintain uninterrupted fishing access, ensuring community member priorities were integrated with technical goals. This inclusive approach strengthened equity outcomes and fostered community ownership of resilience strategies.

Beyond local impacts, the project reinforced Cedar Key's long-standing partnership with UF and aligned with the city's adoption of a Shoreline Management Master Plan and was tied to their recent vulnerability/adaptation

planning process. By creating continuity from demonstration sites to neighborhood-scale resilience, our work supports systemic change in coastal planning practices. The co-design model we applied (see: https://ufdc.ufl.edu/IR00012364/00001/pdf) offers a replicable framework for other Gulf communities facing similar climate challenges.

Importantly, the City demonstrated its commitment to implementation by preparing a major funding proposal to construct the Sea Groin and associated stormwater improvements.
Although that proposal was not successful, it signals strong local intent to move forward with building NBS projects. Building on this momentum, the City is actively pursuing additional grant opportunities in collaboration with UF to secure resources for construction and long-term monitoring.

Finally, the project elevated Cedar Key's visibility in the resilience field. Outputs such as a peer-reviewed journal article, a forthcoming book chapter, and multiple conference presentations disseminate lessons learned to practitioners and researchers. Media coverage, including a GRP feature story and podcast episode, amplified awareness and positioned Cedar Key as a leader in equitable, nature-based adaptation.
In sum, the project achieved measurable knowledge gains, strengthened decision-making capacity, delivered permit-ready designs, catalyzed funding pursuits, and advanced inclusive engagement practices. The Cedar Key ShOREs project laid a strong foundation for implementation and provided a model for small coastal communities across the Gulf.

4. What's next? (up to 100 words) *

What are your next steps or priorities based on what you've learned? Share any anticipated shifts in direction, upcoming efforts, or recommendations for others working on similar issues.

We will use permit ready engineering designs and cost estimates for shoreline and GSI interventions to pursue construction funding and regulatory approvals to support the City's efforts to implement these NBS. We will support homeowners in applying living shoreline templates and use our models to guide monitoring and adaptive management. Pending permits and funding, we aim to construct the Sea Groin with integrated public access. We will also leverage related efforts (e.g., Gulf Futures AMERICA project) to sustain technical expertise and equitable engagement.

5. Activity Location *

Please fill out the following chart with the relevant locations for your project work using this form.

Progress__Annual_Report_Activity_Location.xlsx

Filename: Progress__Annual_Report_Activity_Location.xlsx.xlsx **Size:** 11.5 kB

6. Per your approved Data Management Plan, are you expected to submit data? *

Yes

Submit Data Management Project Personnel

Any project members who will be submitting data to GRIIDC must have their own account at GRIIDC that is linked to your current grant project. To facilitate GRIIDC account set-up and ensure you are prepared for the required Dataset Information Form (DIF) submission, the GRP will send the information in the below form to GRIIDC directly.

Key Personnel *

The project's Data Manager and any other key personnel who will be interacting with GRIIDC should be listed in the form below.

	Role of the Project Member	Full Name	Email	Organizational Affiliation
Key Personnel 1	Data Manager	Savanna Barry	savanna.barry@ufl.edu	University of Florida
Key Personnel 2	Data Submission	Mark Clark	clarkmw@ufl.edu	University of Florida
Key Personnel 3	Data Submission	Eban Bean	ezbean@ufl.edu	University of Florida

Accounts can be requested later for individuals who are not listed in the form, but they will not be able to edit or upload datasets until they have an account.

1. Set up your GRIIDC Account *

1. Each data management project member should first set up their account at this link. https://grp.griidc.org/account
2. Each user should have their own account and accounts should not be shared. If a user already has an account but has forgotten their password, they can reset it here: https://grp.griidc.org/account/reset-password

2. Submit Dataset Information Form (DIF) *

1. All grant projects that will produce data should submit a dataset information form (DIF) within 6 months of the start of funding, even if your data will be archived elsewhere. This assists the GRP with monitoring future submissions.
2. DIF submission can be found at: https://grp.griidc.org/dif
3. Please submit a DIF for every dataset you anticipate will result from your project. They do not have to be exact, as they can be edited or deleted later depending on the actual project results. Additional DIFs can also be submitted later if more or different datasets result from your project.

Review DIF and Data Uploads *

Please confirm that you have added or edited any Dataset Information Forms (DIF) as necessary on the GRIIDC website and/or uploaded any datasets that have been finalized since your last progress report. Datasets must be publicly accessible and linked to GRIIDC by the end date in your full grant Period of Performance.

Yes, I can confirm

III. Progress Report Questions

Please feel free to expand on your answers from the Executive Summary.

1. Please revisit your proposal and review your goals and the outcomes you were seeking to achieve through this grant. How successful were you in meeting your goals? Please assess your success against the criteria you set in your proposal and use any combination of anecdotes, stories, graphs, charts, visuals as well as data to explain your success. Upload supporting files if you choose.*

Our goals were to co design stormwater and shoreline NBS for the G and 1st Street neighborhoods; advance concepts with technical modeling toward permitting; and center end users through inclusive engagement. We met these goals by delivering a multi phase process that produced community vetted, fully engineered shoreline and GSI designs, hydrodynamic and stormwater models, and homeowner templates to accelerate implementation. We engaged residents via three Phase I workshops; six Phase II sessions; 12 semi structured interviews; a multi-mode intercept survey; and targeted outreach to shore based anglers. Early action—the City's installation of two in line check valves—validated the approach, and workshop surveys indicated strong support, knowledge gains, and initial property level adoption. While full construction lies beyond the grant's scope and requires permits/funding, the project achieved permit ready designs and strengthened readiness for implementation.

Our proposal set three primary objectives:
(1) Develop engineering design plans for green stormwater infrastructure (GSI) to reduce flooding and improve water quality;
(2) Design shoreline interventions that reduce erosion and flood impacts while enhancing ecological integrity and public access; and
(3) Apply and document a fully integrated co-design model prioritizing equity and stakeholder engagement.

We accomplished all three of these goals. For stormwater, we delivered formal design plans for tree-box filters, bioswales, permeable pavement, and pocket parks, supported by watershed analysis and hydrologic modeling. These plans are shovel-ready and include cost estimates and maintenance guidance. Communication with the Suwannee River Water Management District indicates that the projects are exempt from formal permitting, and therefore the City may implement them as funding becomes available. For shoreline, we advanced conceptual designs into refined plans for a NBS hybrid "Sea Groin" and homeowner-scale living shoreline templates, informed by hydrodynamic modeling (Delft3D and FUNWAVE), engineering expertise, and community feedback. These designs optimize wave attenuation, habitat restoration, and public access features.

For community engagement, we implemented the co-design model as promised: three Phase I workshops, six

Phase II workshops, 12 semi-structured interviews, and two targeted intercept surveys ensured inclusion of at-risk groups such as aquaculture workers, anglers, and inland residents. We financially compensated survey, interview, and workshop participants to reduce barriers to participation. We also used approachable visualizations at every step to facilitate dialogue. Feedback was continuously integrated into design revisions through integrating consultants into workshop processes and through the iterative engagement process.

While full construction lies beyond the grant scope, we delivered permit-ready shoreline designs, shovel-ready GSI designs, strengthened community readiness for NBS, and documented the process in a comprehensive case study for replication in other Gulf communities, exactly as envisioned in the proposal.

See the attached compilation of workshop summary reports that illustrate many of the concepts above in terms of the community engagement process. The technical design process is documented in the design deliverables submitted below.

Optional File Upload

Cedar Key ShOREs Phase II Workshop Summary Reports_ALL.pdf

Filename: Cedar Key ShOREs Phase II Workshop Summary Reports_ALL.pdf.pdf **Size:** 7.8 MB

2. How has your work benefited your organization, professional field, community, or other stakeholders? *

For Cedar Key, the project delivered tangible tools and immediate improvements that strengthened local resilience. Clear engineering designs and hydrodynamic/stormwater models gave the City actionable plans for shoreline and stormwater interventions, and the modeling tools will be relevant for years to come as the City plans other projects. The installation of inline check valves immediately resulted in benefits through reduced saltwater backflow and demonstrated the value of locally tailored recommendations. Residents were empowered with practical options, including homeowner-scale living shoreline templates and rain garden guidance, enabling property-level action to complement city-scale projects.

For UF and partners, the work deepened a cross-disciplinary collaboration spanning ecology, coastal engineering, law, landscape architecture, and community resilience. This integration refined a replicable co-design methodology that blends technical rigor with inclusive engagement. This is an approach that can inform other Gulf adaptation projects through the case study and the many conference presentations/media products that resulted. The project also generated scholarly outputs, including a peer-reviewed journal article, a forthcoming book chapter, and multiple conference abstracts, advancing academic discourse on equitable, nature-based adaptation. We also directly employed five undergraduate students, one master's student, and three post-doctoral researchers in Phases I and II, contributing to the early career development of future researchers and resilience practitioners.

For the professional field, the project demonstrated how inclusive and varied engagement strategies such as intercept surveys, stipends for participation, and targeted focus groups can improve technical designs, community member participation, and equity outcomes. By documenting this process in a comprehensive case study, we provided a practical framework for practitioners seeking to balance feasibility with community priorities. The modeling tools and design templates developed here are transferable to other small coastal communities facing similar climate hazards.

For end users including anglers, aquaculture workers, inland residents, and renters, the designs preserve cultural and economic priorities while enhancing resilience. Features such as integrated fishing access and golf cart parking in the Sea Groin design ensure that adaptation measures do not compromise traditional uses of the shoreline. Habitat restoration elements improve ecological integrity, while stormwater interventions reduce flooding risks, linking everyday concerns to long-term climate resilience.

Finally, the project elevated Cedar Key's visibility as a leader in community-driven adaptation. Media coverage, including a GRP feature story and a Geotrek podcast episode, amplified lessons learned and positioned the

community as a model for equitable resilience planning. These benefits extend beyond Cedar Key, offering insights and tools that can be scaled across the Gulf region.

3. Are there any other successes related more broadly to this project that you would like to share with us? *

The project sustained long term trust between UF and Cedar Key and aligned with concurrent initiatives (Operation TRAP: https://sites.google.com/ufl.edu/operationtrap, Plastic-free Restoration of Oyster Shorelines (PROS): https://sites.google.com/ufl.edu/pros/home, and Operation Spatfall) that reinforce nature based adaptation and plastic free restoration. The work also informed residential templates that can scale adoption beyond city projects, and workshop evaluations generally documented strong participant satisfaction and perceived incorporation of community feedback throughout the project (see attachment in section III.1).

4. What did you learn (positive or negative) as a result of this grant? What lessons would you share with other organizations or the field at large? *

We reinforced our prior learning that successful resilience planning requires a combination of technical rigor and genuine community engagement. Iterative co-design grounded in local knowledge, supported by high-quality visual materials and diverse engagement modes, consistently produces better designs that are more widely accepted by the community. This approach increases buy-in and ultimately improves the likelihood of implementation.

Early wins matter but trust requires sustained effort. Visible improvements and success stories such as small-scale demonstration projects or pilot implementation sites help build momentum. However, long-term trust depends on continuous engagement across multiple project cycles. Communities need to see progress and feel heard but also be confident that they will not be abandoned by outside collaborators when the grant ends.

Equity and inclusion demand intentionality. Engaging underserved groups such as renters, aquaculture workers, and shore-based anglers improved both equity and practicality of designs. Doing so required additional effort, tailored engagement strategies, and financial compensation to reduce barriers and combat workshop fatigue.

Balancing technical feasibility with community priorities is essential. Designs must meet engineering standards while reflecting local ways of life, traditional public space uses, and economic realities. Providing stipends, using approachable visuals, and integrating feedback iteratively helped achieve this balance.

Anticipate participant turnover. Leadership changes at the city level (election cycles) and resident turnover can disrupt continuity and slow progress if not addressed. We learned to provide background context at every stage so new participants feel included and can quickly begin contributing. We also learned to communicate directly with new city leaders to ensure the project direction continued to align with city priorities and would remain relevant. This practice helps maintain momentum and ensures that evolving groups remain aligned with project goals.

Plan for permitting and material complexity. Coastal permitting requirements and concerns about material sustainability were recurring challenges. Both issues can be addressed through early dialogue among community members, regulators, and legal/technical experts. Proactive communication builds trust, clarifies expectations/requirements, and reduces delays during design and implementation.

Adaptability during extreme events is essential. This project unfolded during a period when Cedar Key experienced two record-breaking storm surge events (Hurricanes Idalia, 2023 and Helene, 2024) as well as several smaller storms such as Tropical Storm Debby (2024). These events caused widespread damage and disrupted normal

routines, creating challenges for engagement and project timelines. We learned that remaining sensitive to community needs during times of crisis is critical. By listening to residents and adjusting expectations, we maintained trust and relevance. Flexibility in project management was key: we worked closely with GRP to adapt goals and deliverables to be more responsive to emerging needs in light of the devastation suffered by the community. This adaptability ensured that the project stayed on track despite significant disruptions and reinforced the importance of building contingency plans into resilience projects.

Plan for the long term. Monitoring and maintenance under evolving climate conditions require resources that small cities often lack. Long-term collaborations with universities or non-profits can fill this gap, but they demand careful planning and clear communication from the outset.

All of these lessons are directly transferable to other small coastal communities pursuing co-designed nature-based solutions.

5. How do you characterize your relationship with the GRP and what suggestions do you have for improvement? *

Our team's relationship with GRP has been extremely positive throughout both phases of the Cedar Key ShOREs project. As referenced above, we faced major challenges due to hurricane impacts in Cedar Key during the project period. GRP staff were supportive of ideas to adapt deliverables to make them more relevant to community needs and granted a no-cost extension to allow our team time to pivot and leave space for the community to heal before rushing into the next workshop. GRP staff were also very supportive in other ways such as being timely with fiscal tasks, highlighting the project through media coverage, promptly answering any questions related to grant administration and data management, and setting clear expectations for project performance. I do not have any suggestions for improvement by the GRP staff themselves. The only suggestion I have is that I would love the opportunity to have some sort of cohort learning from the other PIs and institutions who were involved in the same RFP (both Phases I and II). I feel there is a lot I could learn from the other teams – maybe some sort of speed talk webinar with time for discussion or close-out call would be a mechanism for this.

6. Please provide any other feedback or comments you have for the GRP. *

Thank you so much for all you do to provide relevant and responsive funding opportunities for Gulf communities. Your work is helping move the needle along so many dimensions of the Gulf, including health, resilience, ecosystem, and economy. I hope to be fortunate enough to receive future funding from the GRP and will continue to follow your work and outputs closely.

7. If applicable, please identify and describe the ways you or your organization leveraged GRP's grant (e.g., other funders, volunteers who worked on the program, in-kind donations etc.) Please specify the value and/or number/hours of volunteers if possible.

We estimate that we directly leveraged ~$33,685 and influenced a further $185,000 through this grant. For detailed calculations and justifications, see the excel file uploaded into the supplemental report materials section.

Briefly, leveraged funds mostly derive from in-kind donation of time as well as salaries, fringe, travel, and printing costs covered by other funding sources but directly benefitting the Cedar Key ShOREs project. Influenced funds refer to the integration of Cedar Key ShOREs outcomes and processes into the City of Cedar Key's concurrent resilience and adaptation planning process.

Please note that the amounts reported here are best estimates prepared by the project director and have not been reviewed or vetted by the University of Florida's grant administration team.

8. NBS Project Plan and Design

Please submit your NBS Project Plan and Design. For more details, please refer to the RFA (pages 4 and 5).

Cedar Key ShOREs Design Deliverable.zip

Filename: Cedar Key ShOREs Design Deliverable.zip.zip **Size:** 663.6 MB