Increasing Resilience in Coastal Communities

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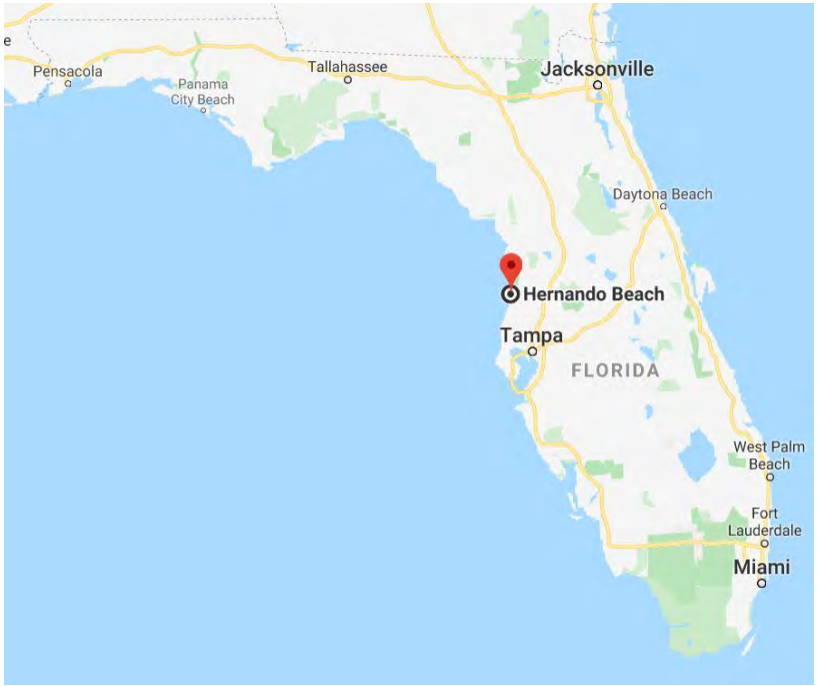
The Problem

Background

Selected Community: Hernando Beach, Fl

- Population: 2,299 people (2010 census)
- Located in SW Hernando County

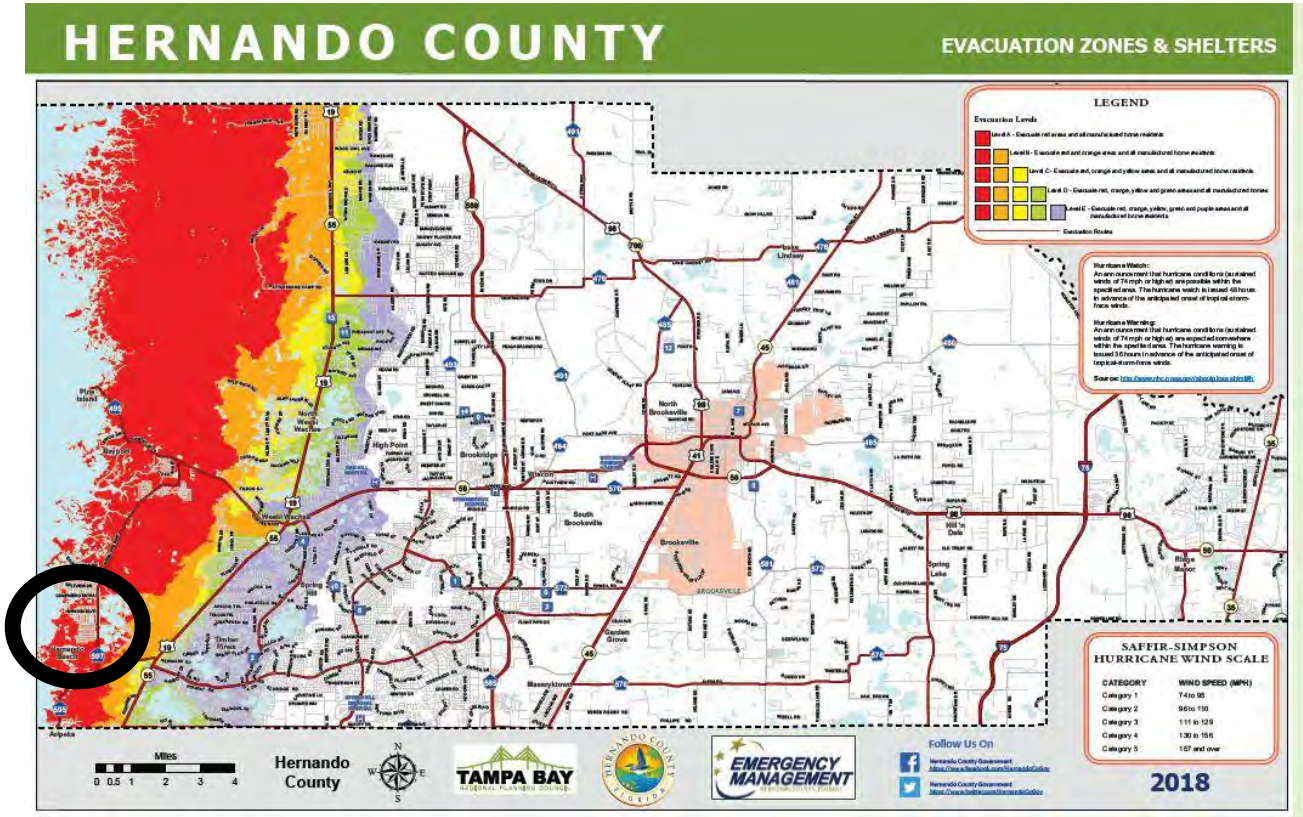


(google.com/maps)

Residential Properties

- Last man-made waterfront community (1959)
- Over 1000 homes at risk to water levels rising

Roads, Evacuation Routes, and Utilities



(hernandocounty.us)

Natural Resources

- Second largest sea grass bed in North America
- Estuaries
- 11,206 acre Weeki Wachee Nature Preserve

(tripstodiscover.com)

Stressors

DECLINE IN SWAMP

INCREASE IN SALT AND TRANSITIONAL SALT MARSHES

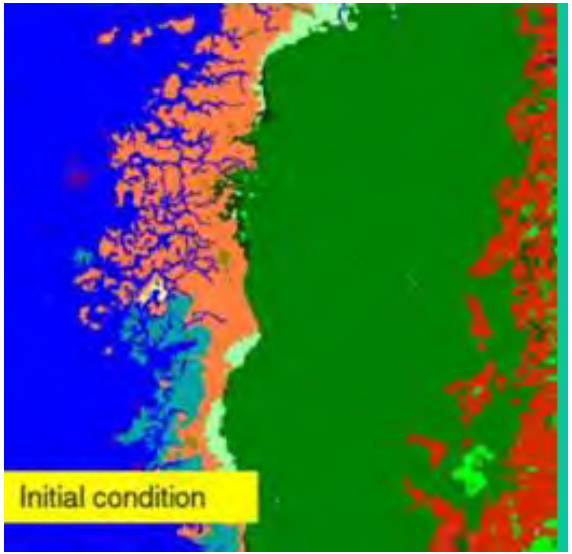
DECLINE IN UNIQUE SPECIES

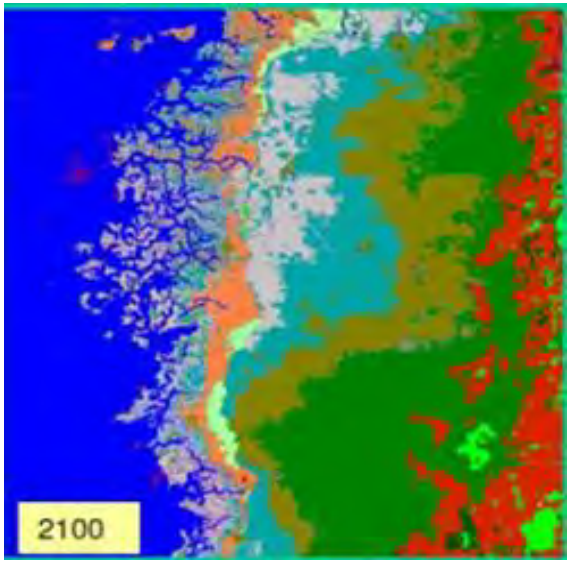
INCREASED FLOOD RISK

SEA LEVEL RISE

Decline in Swamps/Increase in Salt Marshes

- Decline in swamps (50%)
- Increase in salt (370%) and transitional salt marshes (1800%)





http://www.fl-conservationscience.org/pdfs/Geselbracht%20et%20al.pdf

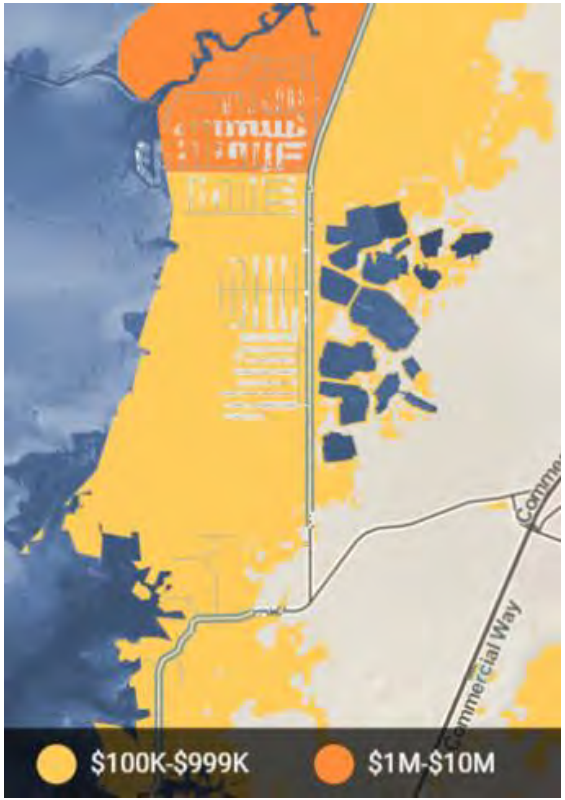
Decline in Unique Species

- Bald eagle
- Gulf salt marsh mink
- Whooping crane
- Chassahowitzka black bear

https://www.naturecoaster.com/chassahowitzka-chazz-bears-ok/

Increase in Flood Risk Damage

- Above a 50% chance that by the year 2050 there will be a flood of more than 5 feet
- Risk of $120 million in residential property damage



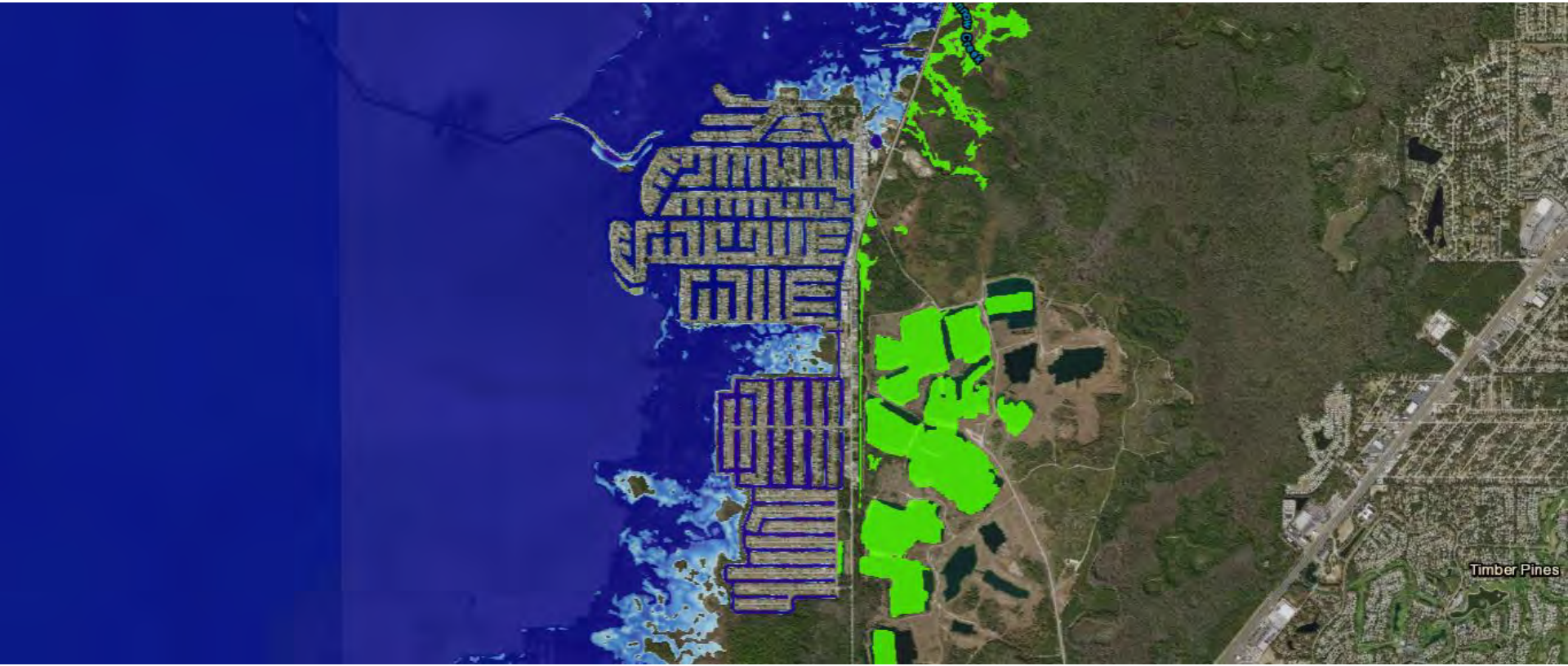
https://ss2.climatecentral.org/#13/28.4701/-82.6498?show=property&projections=0-K14_RCP85-SLR&level=5&unit=feet&pois=hide

Rise in Sea Level

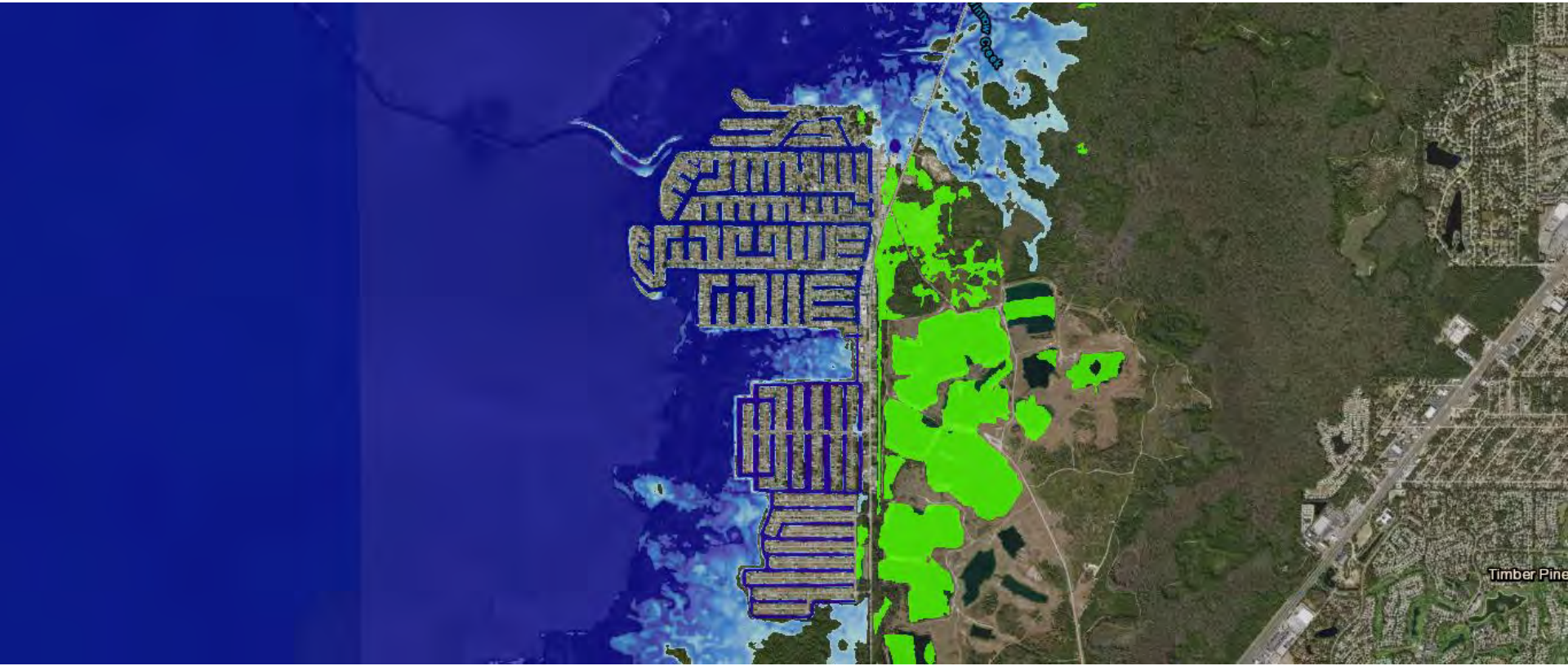
Henryk Sadura *Getty Images*

Sea Level Rise - Current MHHW

Sea Level Rise - 1 foot



Sea Level Rise - 2 feet



Sea Level Rise - 4 feet

Proposed Solutions

Solution 1: Risk MAP

- A technological tool provided by the Federal Emergency Management Agency (FEMA)
- Purpose: increase public awareness

https://www.fema.gov/risk-mapping-assessment-and-planning-risk-map#wcm-survey-target-id

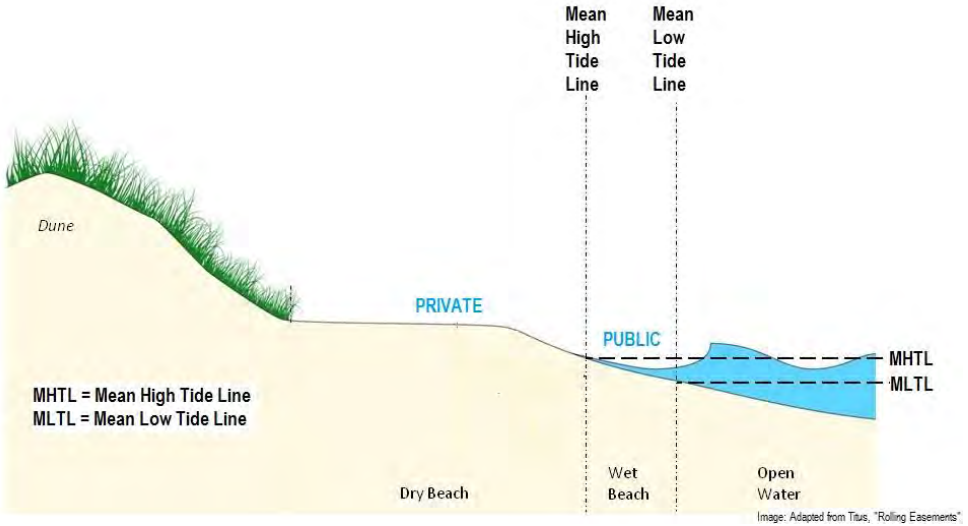
Solution 2: Rebuilding Restrictions

- A regulatory tool which limits a property owner's ability to rebuild
- Purpose: phase out high risk properties over time

(google.com/maps)

Solution 3: Rolling Easement Statutes

- A regulatory tool encompassing many land-use policies based on a defined natural feature (usually the tide line)
- Purpose: to allow land-use policies to change with the sea level



https://www.flseagrant.org/wateraccess/common-law-statutes/

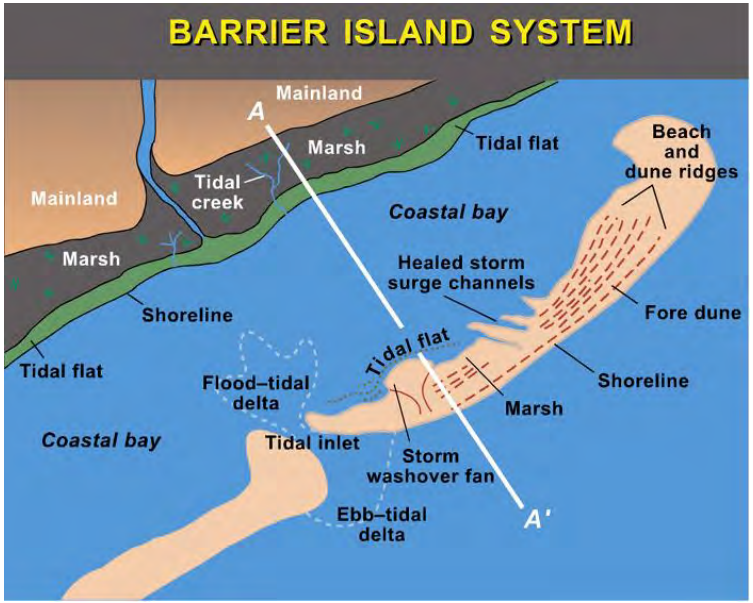
Solution 4: Structural Elevation

- Can involve raising the foundation or simply moving essential equipment
- Purpose: prevent or lessen damage in the case of a flood

https://theconstructor.org/building/flood-resistant-building-structures/21187/

Solution 5: Barrier Islands

- A ridge made of sand, found parallel to the main coast with a lagoon or a bay separating the two
- Purpose: protect coastlines, which in turn buffer shores



https://blog.geogarage.com/2011/04/657-new-islands-discovered-worldwide.html?m=0

Solution 6: Mangrove Restoration

- Maintaining the coastline
- Reducing erosion
- Purpose: reduce excess area of salt marshes and transitional salt marshes and help reduce sea level rise

http://theconversation.com/mangrove-forests-can-rebound-thanks-to-climate-change-its-an-opportunity-we-must-take-102823

https://www.britannica.com/story/amazing-mangroves

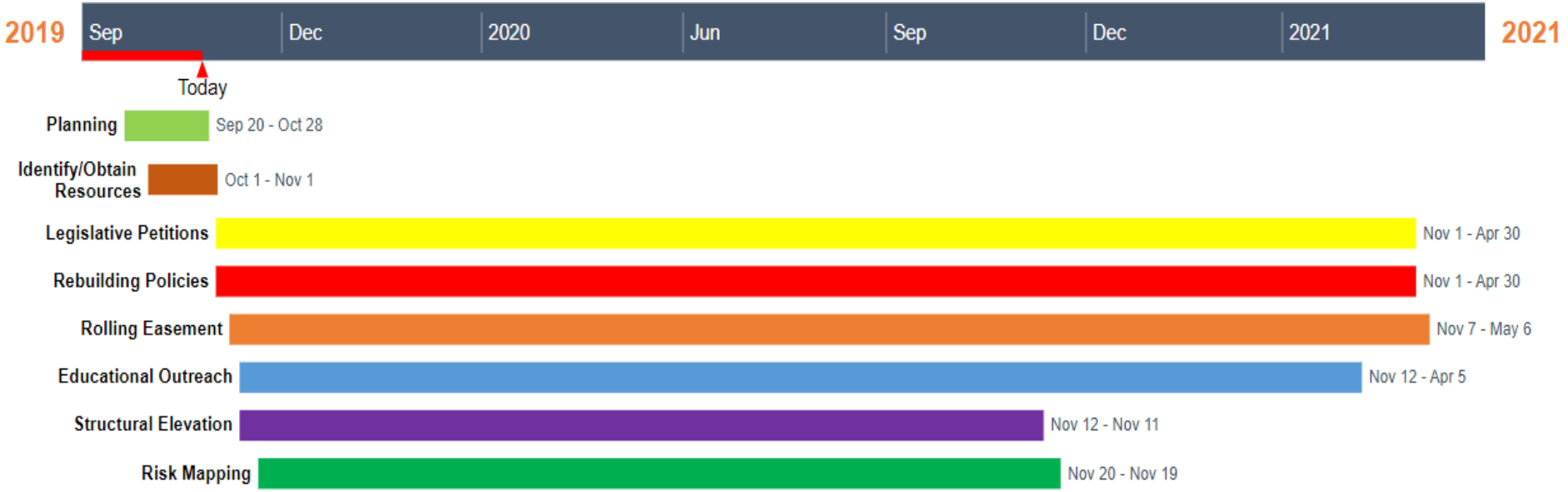
Solution 7: Artificial Coral Reef Expansion

- Man-made structures that replicate a natural coral reef
- Purpose: Improve coastal protection from storms and sea level rise, and provide a base for coral recovery

https://morefundiving.com/artificial-coral-reefs/

Methods, Resources, and Implementation

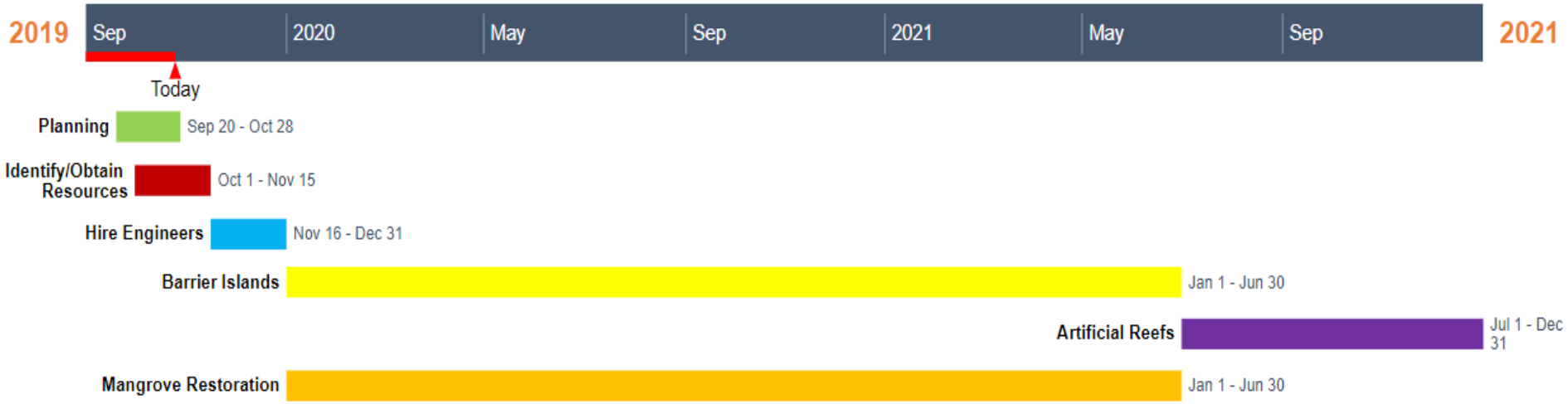
Phase 1: Legislative and Educational Outreach



Phase 1

Strategy	Budget	Resources	Timescale
Rebuilding Restrictions	$10,000	Legislative Petitions	6-18 months
Rolling Easement	$20,000	Legislative Petitions	18 months
Elevation/ Flood-Proofing	$10,000	Educational Outreach	6-12 months
Risk Mapping	$10,000	Educational Outreach	6-12 months

Phase 2: Living Shoreline Strategies



Phase 2

Strategy	Budget	Resources	Timescale
Barrier Islands	$1,000,000	Expert civil and environmental engineers, concrete, sediment	18 months
Artificial Coral Reefs	$450,000	Expert civil and environmental engineers, concrete, large structures	6 months
Mangrove Restoration	$500,000	Expert environmental and ecological engineers, appropriate flora	18 months

Conclusions

The Resiliency of Navarre Beach

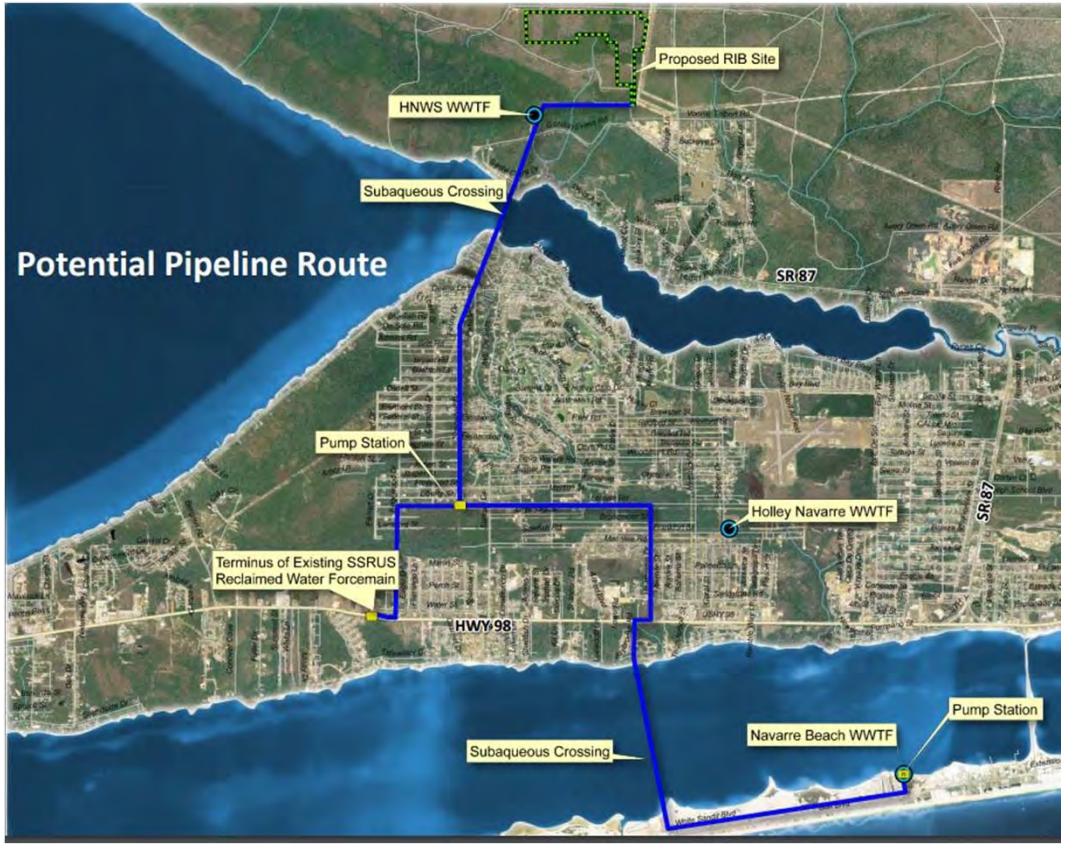
A Case Study on the Wastewater Treatment Facility

Fonda DeSantos, Kelly Dunn, Emily Harmon, Jasmine Pena, and Jennifer Rosas

“Florida’s Most Relaxing Place!”

- Navarre Beach is a coastal community within Florida’s panhandle.
- Low lying area that is susceptible to flood events and sea-level rise (SLR). Highest point: 16 ft (4.87 m)
- Home to a population of 995, Navarre Beach is a common tourist attraction.
- Navarre Beach has suffered from eroded shorelines in response to hurricanes making landfall.
- The last restoration projects took place in 2006 and then again in 2016.

Navarre's Wastewater Treatment Facility



- Built in 1974
- Waters considered state regulated.
- Effluent has been pouring into the Santa Rosa sound for ~ 45 years (Escobedo, 2019)
- Up to 600,000 gallons of effluent a day. (Blanks, 2019)
- The alternative: to dump the treated water into 200 acres of leased property on Eglin Air Force Base (Blanks, 2019)

Stressors to Navarre Beach

Photo credit: Northwest FL Daily News

Climate Impact

Sea level rise

Habitat alteration

Marsh migration

Recurrance Intervals

Inundation

High tide flooding

Natural & Anthropogenic Stressors

Water and Sewage treatment facility

Producing signs for Navarre Beach to raise awareness

Development

Land Use, Land Change (LULC)

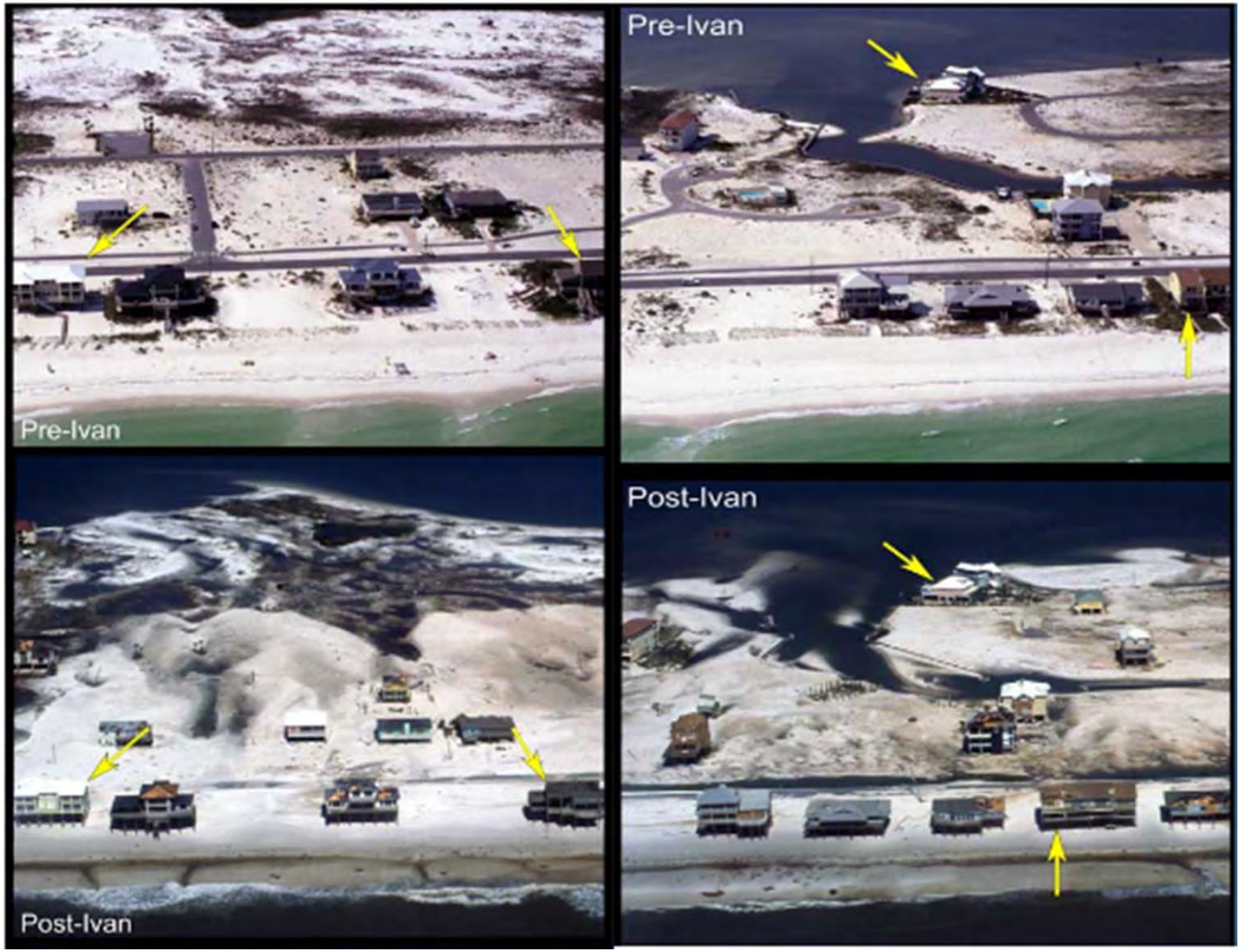
Economics

Biodiversity Loss

Shorebirds & Turtles
Seagrasses

Climate Impact

- SLR at Navarre Beach has risen approximately 8 inches in the last 90 years.
- In 2012, NOAA scientists predicted a SLR range of 8 inches to 6.6 feet by 2100.
- In 2018, NASA Climate Scientists predicted a SLR of 26 inches by 2100.
- Navarre Beach is highly susceptible to coastal flooding from storm surges, often leading to extensive rehabilitation after these events.
- Navarre experiences 1 flood event a year and ~ 1 hurricane every 3 years.


Pre-Ivan
Pre-Ivan
Post-Ivan
Post-Ivan

Recurrence Intervals

Inundation

Photo Credit: NorthEscambia.com

Flooding

- By 2100, more than 80% of Navarre Beach below 7 feet in sea level will experience recurring flooding.
- At a 10-foot level, 97.8% of the total population in Navarre and $435 million properties will be exposed to flooding by 2100
- High prediction of flooding within the next 80 years

High Tide

- When storms hit, flooding exacerbated
- Designated as a critical erosion area
- Residents are facing the challenges and dangers of recurring floods due to high tides during storms/ hurricanes

Natural and Anthropogenic Tourism

- As populations in coastal communities increase, there is an increase in resource use and rapid development.
- **Increase** in tourism often leads to an **increase** in:
  - use of resources
  - urbanization
  - pressure on ecosystem carrying capacity
  - environmental degradation
- However, Santa Rosa County's economic stimulation is sourced primarily from Navarre Beach.
- 2016-2017: $2.8 million in bed taxes.
- October 2018 - July 2019: $3.25 million in bed taxes.

Development & Biodiversity Loss

- Development is still occurring in response to increased tourism and economic stimulation.
- To prevent further degradation, proposals have been made for signage.
- Plant operates at 40% capacity
- Mainland about to pass carrying capacity

- Seagrasses are a keystone species
- Effluent can promote the growth of algal blooms, ultimately leading to ecosystem degradation

Economics

- Navarre Beach has undergone various Restoration Projects.
- Past projects have been funded through the community
  - **Coastal Tech Engineers**
    - Land surveys
  - **Dune Doctors**
    - Vegetation Planting
  - **Santa Rosa County Engineers**
    - Dredging management

- Each restoration project has continuously been under budget.

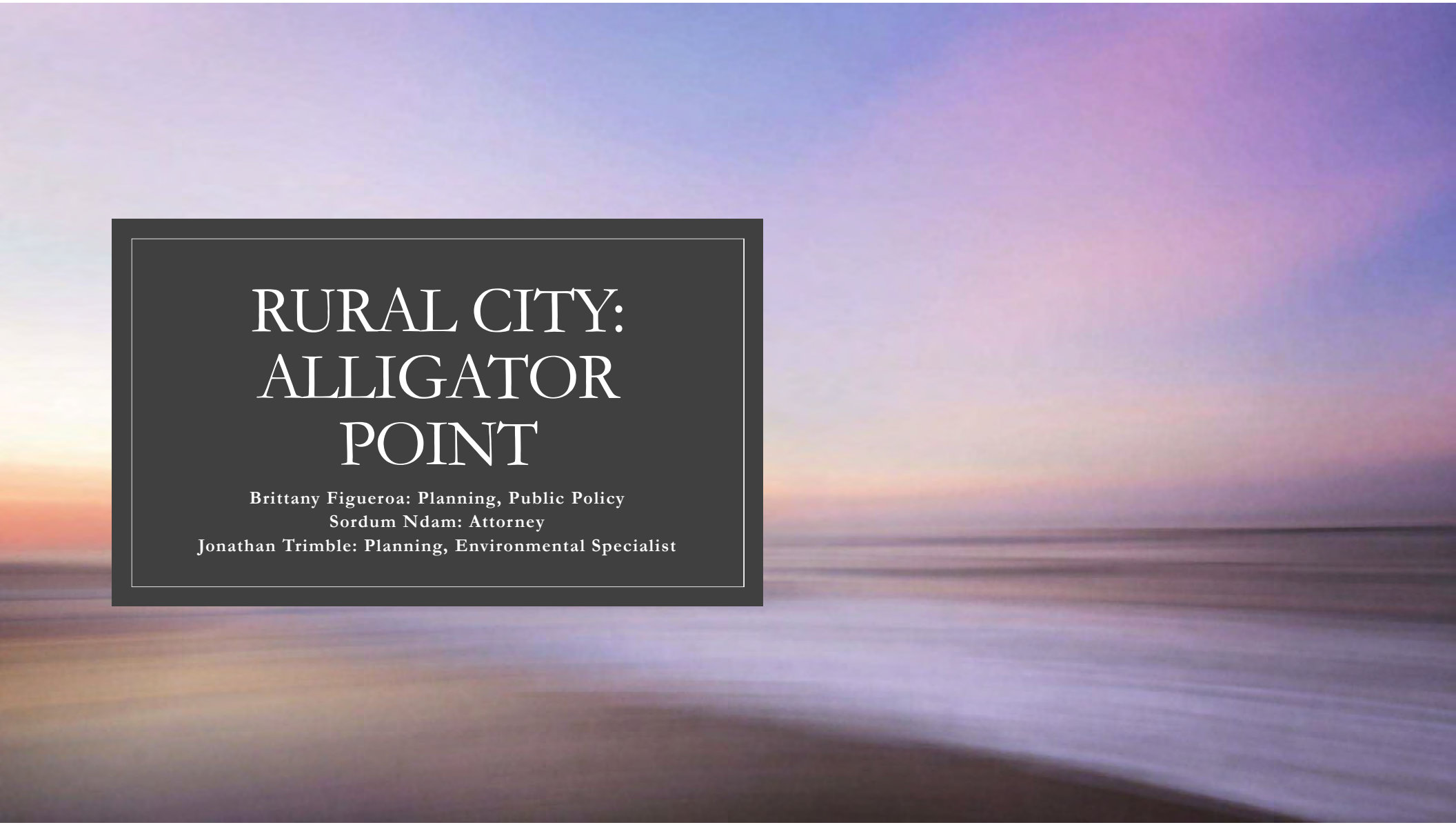
Projected Outcome and Mitigation Efforts

1. Long term, the option to move the Wastewater Treatment Facility is feasible.
2. Instead of dumping the water into the 200 acres of Eglin, the water could be used to irrigate Navarre proper after the first subaqueous pipeline.
3. Implementation of marshlands and living shoreline along and within the Santa Rosa Sound.
4. Construct wetlands
5. Implementation of clean energy technology for pipeline pumps

Conclusion

- Since sea level rise and extreme climate events cannot be avoided, the most promising approach would be proactive measures.
- Construct wetlands that not only filter waste-water but also add stability and protect land areas from storm events.
- Implementing measures to capture biogas from wastewater that can be used for electricity and heating.
- Limit development and ensure that at risk residential areas are not rented or sold.
- Use of kinetic energy pumps along the highway to move wastewater from Navarre beach to the sink at Eglin.

Thank you! Questions?



RURAL CITY: ALLIGATOR POINT

Brittany Figueroa: Planning, Public Policy
Sordum Ndam: Attorney
Jonathan Trimble: Planning, Environmental Specialist

Background

- Population: 447 as of 2012
- Median household income: $28,875
- “Florida’s Forgotten Coast”
- The nature lover’s rural beach getaway
- Known for fishing, sailing, Phipps Preserve, Bald Point State Park (a 5,000-acre protected wildlife area)

http://www.alligatorpoint.org/images/APandMarinaBig.jpg

Problem Statement

- Global sea levels have been rising and falling throughout our planetary history
- Last interglacial period ~125,000 years ago sea levels were 4-6 meters (13-20ft) above current levels (Gornitz, 2007)
- Factors of SLR: Melting land ice, thermal expansion, land subsidence, slowing gulf stream
- Recent acceleration of rise
- Global mean sea level has risen by 7-8 inches since 1900, 3 of those inches since 1993 (Sweet et al. 2017)
- Best case scenarios put sea level rise at .3 m (1ft) worst case at 2.5m (8ft) by 2100
- Intermediate projection and most likely scenario is around 3 ft
- One of the biggest unknows for future projections is greenhouse gas concentration and its effect on temperature

Problem Statement

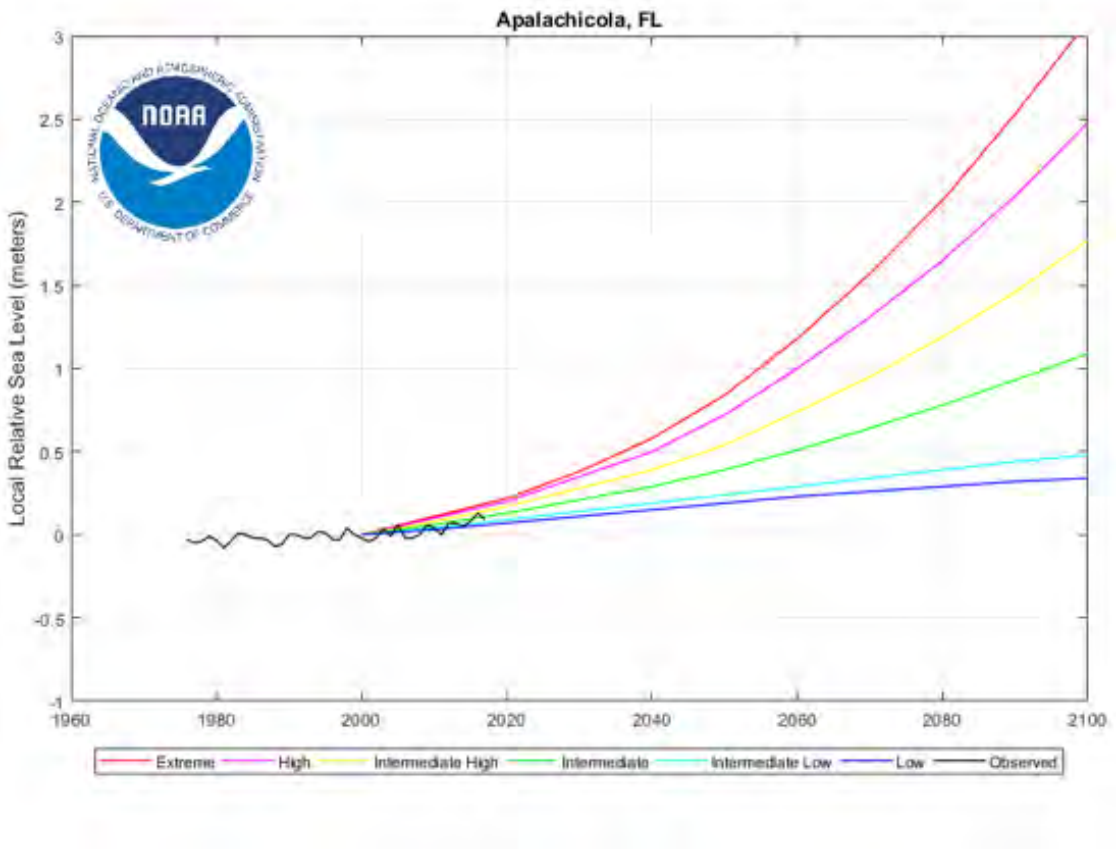
GMSL Scenario (meters)	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Low	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.30
Intermediate- Low	0.04	0.08	0.13	0.18	0.24	0.29	0.35	0.4	0.45	0.50
Intermediate	0.04	0.10	0.16	0.25	0.34	0.45	0.57	0.71	0.85	1.0
Intermediate-High	0.05	0.10	0.19	0.30	0.44	0.60	0.79	1.0	1.2	1.5
High	0.05	0.11	0.21	0.36	0.54	0.77	1.0	1.3	1.7	2.0
Extreme	0.04	0.11	0.24	0.41	0.63	0.90	1.2	1.6	2.0	2.5

Source: Global Mean Sea-Level Scenarios Source NOAA, 2017

Sea-Level Projections

Relative Sea Level Rise Projections
Apalachicola

Intermediate Projection 1.1m
(~3.5 ft)

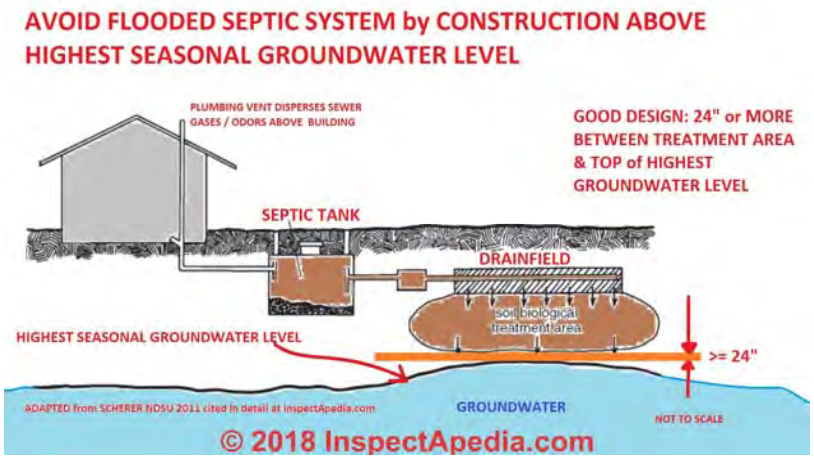


5 Stressors

- Promoting the economy, which primarily consists of tourism
- Taking care of those tourists, which means preventing and mitigating beach injuries
- Protecting infrastructure
- Mitigating natural and human disasters
- Maintaining the commercial industry, which notably features shellfish harvesting

Buildings & Infrastructure

- Roads: 5 mile main thoroughfare, 5 miles of feeder roads
- Water utilities including water tower
- Electric utilities
- Septic tanks
- Single family residences
- Condominiums
- Marina



Impacts

- Roads vulnerable to flooding events
- Electric utilities vulnerable to storm events
- Water utilities vulnerable to flooding and salt water intrusion
- Many older houses vulnerable from lesser building codes
- Some houses build at grade and many others below current base flood elevations
- Septic tanks vulnerability to rising water tables and flooding events
- Septic backups and discharge into flood waters pose health and environmental risks
- SLR changing dynamics of freshwater flows and salinity balance endangering fisheries

TIMELINE

- 5-year project including 3 phases
- July 2020 to June 2025
- FDEP portion: July 2020 to June 2021
- Partner organizations continue with additional phases

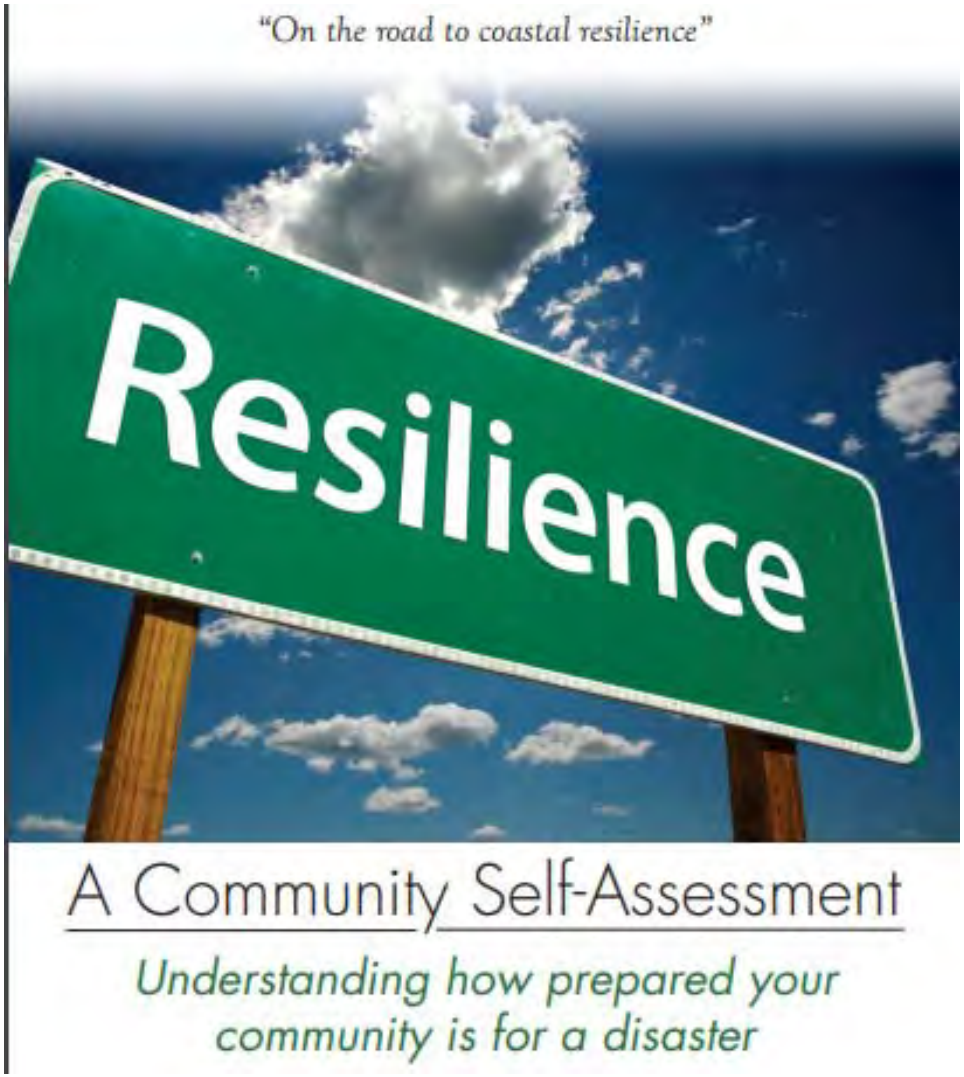
Task/ Deliverable No.	Task or Deliverable Title	Task Start Date	Task End Date	Deliverable Due Date
1	Summary Background Information – Sea Level Rise, Coastal Erosion, Flooding	Upon Execution	7/30/2020	8/10/2020
2	Coastal Resilience Index and Financial Assessment	8/11/2020	10/31/2020	11/10/2020
3	In-kind Services and Volunteer Resource Plan Development	8/11/2020	10/31/2020	11/10/2020
4	In-kind Services and Volunteer Resource Plan Implementation	11/01/2020	03/15/2021	03/31/2021
5	Land Conservation Plan Design	11/11/2020	12/31/2020	01/10/2021
6	Stakeholder Engagement toward Land Conservation Policy Creation	11/11/2020	12/31/2020	01/10/2021
7	Critical Infrastructure Retrofitting and Relocation Plan Design	11/11/2020	12/31/2020	01/10/2021
8	Stakeholder Engagement toward Infrastructure Retrofitting and Relocation Policy Creation	11/11/2020	12/31/2020	01/10/2021
9	Creation of Development Restrictions Policy	01/02/2021	03/31/2021	04/05/2021
10	Establish Private Land Conservation Easements	01/11/2021	03/01/2021	03/05/2021
11	Phase I Living Shoreline Study and Design	03/01/2021	04/10/2021	04/15/2021
12	Model Coastal Management Element GOPs for the county	03/01/2021	03/31/2021	04/01/2021
13	Acquire Permits and Finalize Impact Assessments for Infrastructure and Natural Resources	03/01/2021	05/01/2021	05/05/2021
14	Development Restrictions Comprehensive Plan Implemented	04/01/2021	04/01/2021	04/05/2021
15	Begin Phase I Infrastructure Retrofitting and Living Shoreline Construction	04/01/2021	05/01/2021	05/20/2021
16	Stakeholder Engagement Strategy and Regional Compact Designs	03/01/2021	05/05/2021	05/15/2021
17	Stakeholder Engagement toward Regional Compact	03/01/2021	05/05/2021	05/15/2021
18	Complete Phase I Infrastructure Retrofitting and Living Shoreline Construction	06/20/2021	06/20/2021	06/30/2021
19	Phase I Project Completion with FDEP Grant Funds	06/30/2021	06/30/2021	06/30/2021

BUDGET

- **FDEP funds to assist with Phase I**
- **Partner Organizations:** Franklin County, Apalachee Regional Planning Council, APSTA, local businesses, Friends of Franklin County State Parks, The Land Trust Alliance, The Nature Conservancy, Resiliency Florida, Mississippi-Alabama Sea Grant Consortium, Audubon, FDEP, FWC, FDEM, FEMA, USFWS, USDA, USACE, EPA, EDA, universities

Categories	Subtotal by Task
In-kind Services and Volunteer Resource Plan	$1,500.00
Land Conservation Plan	$0.00 (In-kind)
Infrastructure Retrofitting and Relocation Plan Design	$7,000.00
Living Shoreline Study and Design	$7,000.00
Stakeholder Engagement	$2,500.00
Comprehensive Plan Implemented	$5,000.00
Phase I Infrastructure Retrofitting and Living Shoreline Construction	$50,000.00
Deliverables	$2,000.00
Total by Category	**$75,000.00**

7 PROPOSED SOLUTIONS & STRATEGIES



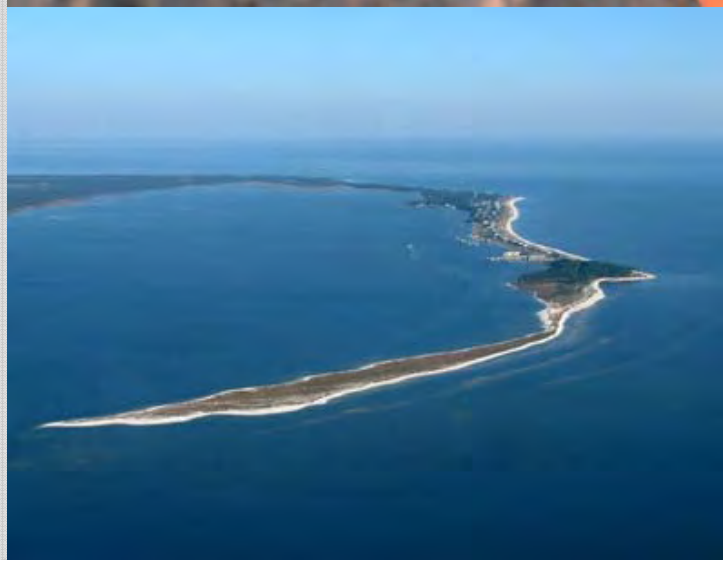
1. Conduct a Community Self-Assessment & Financial Assessment

- Assess community vulnerabilities and risks with a Coastal Resilience Index
- Financial assessment: financial ratios, internal and external benchmarks, and peer comparisons
- Determine budget stressors, project employee needs, and areas requiring external financial assistance

2. Implement a Land Conservation Program

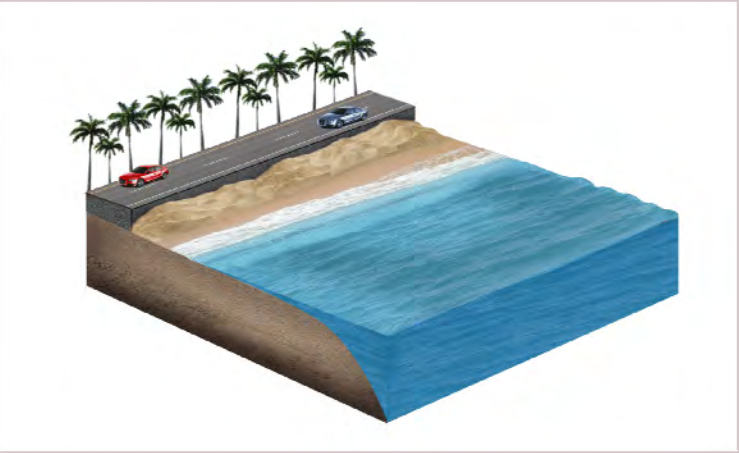
- Reverting properties to natural space to ensure citizen and wildlife safety and well-being.
- Discuss conservation and financial assistance options with the Land Trust Alliance.
- Preserve ecological resources, maintain limited quantities of residential properties, and conservation tax-incentives
- 3 techniques: conservation easements, buy-outs, and transfer of development rights.
- Research additional budget leverage sources and private developers who need additional development density.

www.facebook.com/AlligatorPointSeaTurtlePatrol

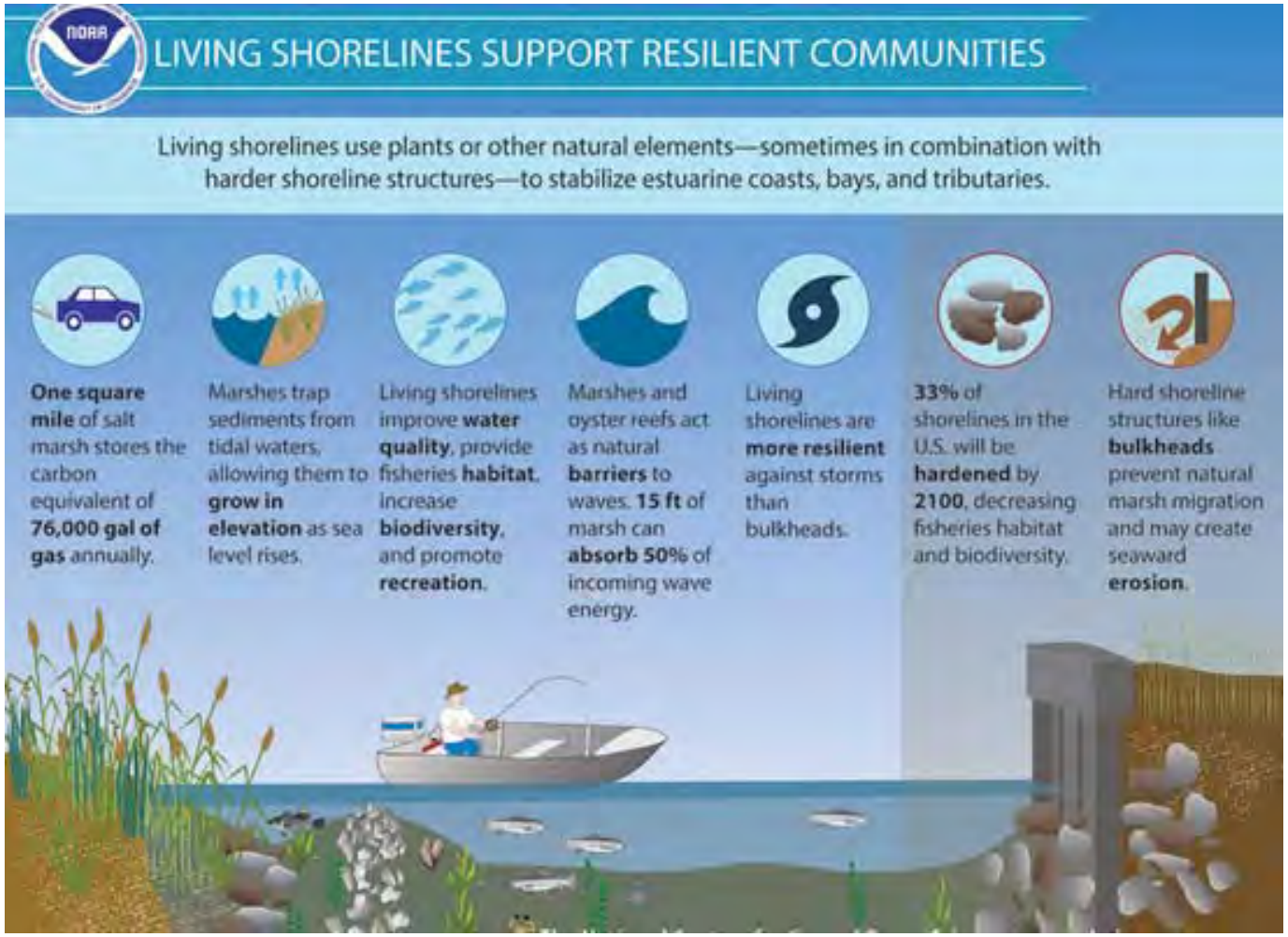


3. Implement an Infrastructure Retrofit Program

- The Alligator Point Water Resources District, the Alligator Point Volunteer Fire Department, Alligator Drive, and stormwater drainage systems require infrastructure retrofitting and relocation.
- SLR, coastal erosion, and flooding place significant risk on these community amenities.
- Immediate action to avert saltwater intrusion into the water table aquifer and elevated coastal water tables
- Alligator Drive has repeatedly been damaged by storm surge and will continue to disintegrate by flooding events and natural disasters; relocate to higher ground.
- Water Resources District should retrofit underground pipes of properties that are contained within the land conservation plan to protect water supplies.



Sealevelrise.org



4. Implement Living Shorelines

- Purpose: create coastal resilience and protect and restore coastal systems
- Techniques: applying native coastal vegetation and breakwaters consisting of oyster shells
- Benefits: cost savings to taxpayers, public engagement, recycling natural resources, natural protection measure, improving coastal ecosystem for wildlife.

5. Implement a Community Involvement Strategy and a Regional Compact

- Property owners' opinions and concerns should be incorporated into all community projects
- Workshops and citizen advisory boards on a continuous basis to inform, educate, and learn from residents.
- Forums to facilitate trust amongst stakeholders while solidifying working relationships. Sustainability: Incorporate equity, environment, and economy.
- Regional Compact: Uniting Gulf Counties to progress and coordinate on climate change mitigation and adaptation strategies. Strength in numbers approach.
- Oyster shell collections along the coast by fisherman and seafood businesses to voluntary supply oyster reef shells.

Joe Rondone/Democrat
https://www.floridastateparks.org/get-involved

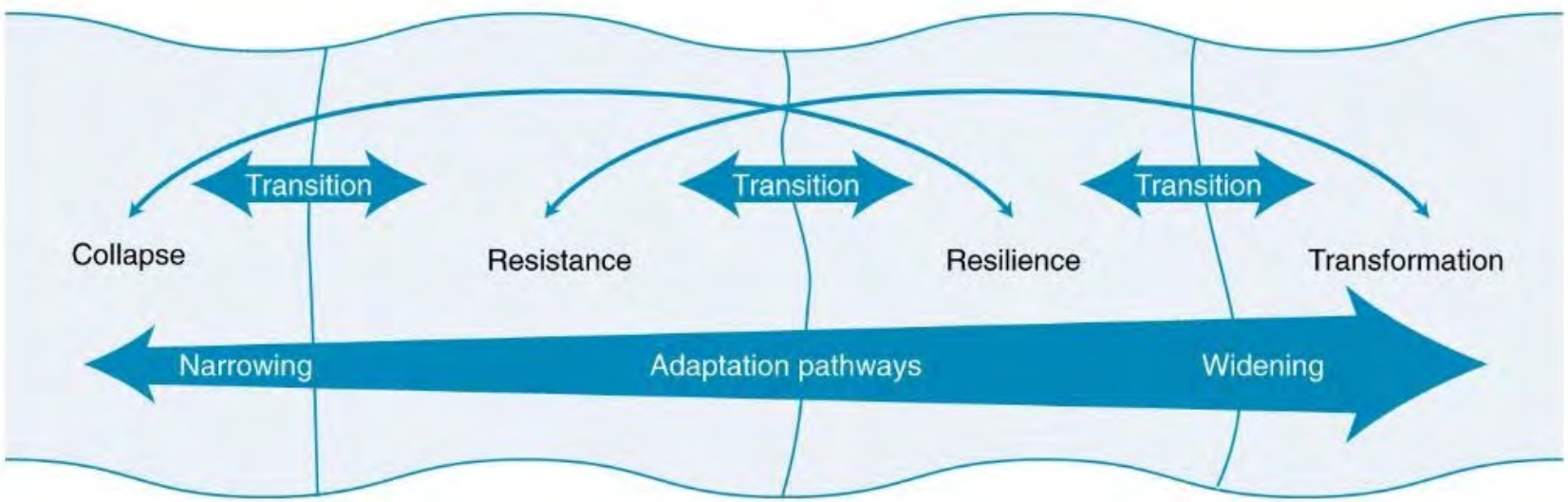
6. Designate Volunteers and Organizations to Assist with Grant Resources

- Voluntary "labor" to reach the project's goal of community resilience.
- Facilitate cooperation efforts with businesses, non-profits, and the public for assistance with applying for additional funding sources.
- Acquire in-kind services for project design and implementation elements.
- Several "public lands weeks" to help with planting native vegetation and outdoor labor.

Maisie Thomas/Nome Nugget

7. Implement Development Restrictions

- Saves residents money in the grand scheme.
- SLR, coastal erosion, and flooding are inevitable on Alligator Point. Hurricanes and storm events exacerbate these negative externalities.
- Remaining residents should abide by development restrictions for the public common well-being.
- Elevation, retrofitting, relocation, and new construction recovery activities are extremely expensive for individual property owners and the public at large.
- Benefits: beach and wetland migration, prohibiting development in hazard zones, and constructing infrastructure outside of hazard zones (Deyle, 2015).



Adaptation Transition Pathways

7 Proposed Solutions & Strategies

(Rosenzweig & Solecki, 2018)

Conclusions

- Alligator Point is a strategically placed town with much potential
- Its size makes it difficult to meet challenges such as rising sea levels
- Alligator Point is a rural haven worth protecting
- Florida benefits from Alligator Point; in turn, Florida should work to benefit Alligator Point