

Galilee

A Vision for a Resilient Port

2016 Interdisciplinary Studio
University of Rhode Island Landscape Architecture
Prepared for The Rhode Island Foundation

*Prepared by Mary-Kate Kane and Antone Almeida with
URI Professors William Green, ASLA and Austin Becker, Ph.D.*





Galilee

A Vision for a Resilient Port

This project has been a collaborative effort that benefited from contributions by members of Rhode Island coastal departments, stakeholders groups, and an interdisciplinary team of Landscape Architecture (LA), Master of Environmental Science Management (MESM), and Marine Affairs (MA).

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Executive Summary

Each year, URI's Senior Studio in Landscape Architecture assists a city, town, or government agency with a project that engages students in professional-level planning and design. This year the senior class joined graduate students from Marine Affairs and the Master of Environmental Science and Management Program on a special natural-hazard resilience project for the Port of Galilee, Rhode Island. Together, they developed a vision for a resilient and sustainable Galilee, the most important commercial fishing port in Rhode Island. The collaboration of students from different departments reflects how interdisciplinary problem-solving can address some of the most complex challenges society faces.

This report explains the process through which the students gathered information, engaged stakeholders, and developed a series of thematic design interventions that could enhance the functioning port, while addressing the impacts of sea level rise and intensifying storms and surges. The students evaluated the coastline, the landscape, and the land uses around this small State-owned port on the southwest end of land in the Town of Narragansett. While science cannot predict with any certainty the next hurricane for Rhode Island, recent devastating events in Florida, Louisiana, New York and New Jersey suggest that the scientific projections for more intense storms and rising seas must be considered by business owners and residents, officials and politicians, and designers and planners.

This port project grew from conversations between the Rhode Island Department of Environmental Management, the URI Foundation, RI Sea Grant and faculty in Landscape Architecture and Marine Affairs. Incorporating different disciplines into the studio afforded students the opportunity to experience the challenges of working with individuals of different backgrounds and skills. Following a standard design process, students collected existing information, reports and data; visited sites and explored the surrounding environs; analyzed existing conditions including regulatory, economic and physical conditions; and looked at coastal protection and adaptation strategies from around the globe, including recent resilience projects from the Rebuild By Design competition in the New York Metropolitan area. The students ran a public listening session in which they presented their analysis and facilitated purposeful discussions that engaged stakeholders and gathered opinions. Following the workshop, the students developed a list of priority concerns and issues as well as strategies that might be employed successfully in Galilee. These elements included a living breakwater and boardwalks over dunes and across marshland; improved circulation for pedestrians, bicyclists and motorists; a parking structure suitable for floodwater storage in times of coastal storms; a museum of the fishing industry and a completely redeveloped streetscape. Students created connections between the Block Island Ferry, the parking garage, beaches and a new museum, restaurants and shops. One student proposed a hurricane barrier across the mouth of the port refuge. Another student created an integrated system of rain gardens and bioswales to enhance stormwater handling and infiltration, while reducing street flooding. Through the museum and boardwalk kiosks students sought to highlight the important role that the fishing industry has played in the state and region. When viewed in its entirety, the project could enhance the environment of the port, contribute to a more functional village and raise awareness about the pending threats caused by climate change and sea level rise.

The students presented their final work to stakeholders and planning professionals at the URI Graduate School of Oceanography. By suggesting an approach and a vision with design interventions, the students were able to raise important questions and help facilitate a dialogue. While this report is not the final word, it illustrates options and suggests the importance of acting now before it is too late.

Will Green, Professor of Landscape Architecture, URI and Austin Becker, Assistant Professor Marine Affairs, URI



Hurricane Sandy Brings Climate Change to Reality

In October of 2012, Hurricane Sandy struck the East Coast with great force, leaving many coastal communities severely devastated. Rhode Island avoided the brunt of this storm, yet approximately 300,000 Rhode Island residents were affected, according to the State of Rhode Island Action Plan. Hurricane Sandy damaged many private properties as well as public facilities, roadways, businesses and infrastructure and thus had an impact on the well-being of Rhode Island’s residents and the state’s economy. Storms such as Hurricane Sandy have brought climate change to life in many coastal communities and conversations surrounding resiliency and preparedness have become more frequent and more urgent.

Impacts of Climate Change are Evident in Rhode Island

Coastal storms have, and will continue to crash onto Rhode Island’s shorelines, changing them forever. As a result of climate change, storms are becoming more frequent and severe. Rhode Island has also been experiencing rising sea levels, salt marsh migration, and an increased intensity of rainfall due to a changing climate. According to data collected at the Newport, RI tide station, sea levels have been rising an inch per decade since the 1930’s. The Coastal Resources Management Council (CRMC) predicts sea levels will rise 5 to 7 feet by 2100. The destructive combination of storm surge and sea level rise has the potential to wreak havoc in communities along the coast of Rhode Island. Many areas already experience nuisance flooding during high tides; with sea level rise, these floods will become the norm. Also, with the increasing severity of storms, storm surge inundation and flooding due to salt marsh migration may devastate properties, roadways and infrastructure. Careful planning and active implementation of adaptation strategies are needed to ensure the safety of residents as well as the environmental and economic well-being of the state. Collaboration between stakeholders, planners, designers and community members is necessary to protect coastal areas against imminent climate change hazards.



Hurricane Sandy Path



Hurricane Sandy Damage, Westerly, RI

Rhode Island's Strong Connection with the Coast Means Much is at Stake

Rhode Island is strongly tied to the sea. One of the state's most valuable assets is its coastline. 18 of the 39 municipalities in the state are located on the coast. The state’s economy relies heavily on the coastline; both tourism and fishing are vital industries to the state of Rhode Island. In fact, tourism is the 4th largest private sector employer in Rhode Island and it channels \$1.03 million annually to other industries. Additionally, the fishing industry in Rhode Island contributes about \$200 million in annual sales associated with fish landed by Rhode Island vessels. Nearly 7,000 people are employed in catching, processing, distributing and selling fish harvested by Rhode Island vessels. Also, saltwater recreational fishing generates a total of \$160 million to Rhode Island’s economy according to a study conducted by Ninigret Partners. As sea levels continue to rise, coastal properties, businesses, piers and critical infrastructure are

at risk, disturbing two very important economic sectors in the state. The livelihood and the well-being of many residents may be disrupted as homes, businesses, infrastructure and beaches are damaged as a result of flooding and erosion. Likewise, sea level rise may cause detrimental environmental impacts as well; for instance, salt marsh migration and the erosion of beaches and dune systems are results of sea level rise and coastal flooding in Rhode Island. Salt marshes provide many ecosystem services such as protection against flooding and erosion, wildlife habitat, and the filtration of runoff. As sea levels rise and wave action intensifies, beaches will be altered, affecting the habitats and buffers that they provide. Climate change and sea level rise will continue to impact Rhode Island’s residents, economy and natural environment.



"Sustainable Design Studio: A Planning, Policy and Design Studio on Storm Resilience for the Urban Waterfront"

At the University of Rhode Island, students tackled a challenge that many coastal communities now experience: How do we address sea level rise and storm surge in a highly trafficked, economically important, mixed-use area and propose adaptation strategies to make the area more resilient? Students addressed this challenge in a semester-long course entitled "Sustainable Design Studio: A Planning, Policy and Design Studio on Storm Resilience for the Urban Waterfront." The focus was the Port of Galilee, an economically and culturally important coastal community in Narragansett, Rhode Island. While the "Sustainable Design Studio" course was listed as a landscape architecture course, students from a range of backgrounds took part in the class in an attempt to tackle a complex, real-world challenge presented by a changing climate. Seniors from Landscape Architecture and Marine Affairs collaborated with graduate students from the Master of Environmental Science and Management program and the Master of Marine Affairs program. Students also sought the knowledge and expertise of professionals from a range of fields including the Narragansett town planner, the Department of Environmental Management's Galilee Port Manager, specialists from the Coastal Resource Center, professional landscape architects, staff from the Coastal Resources Management Council and leaders within Interstate Navigation. Throughout the semester, students gained an understanding of the critical importance of interdisciplinary collaboration when addressing climate change impacts and increasing resiliency in a community.

Climate Change Requires Thoughtful, Multi-faceted Planning

The coastal hazards brought forth by climate change, such as flooding, structural damages, and erosion, require planning and strategic action in order for communities to adapt to a changing coastline. Increasing the resiliency of a community--improving its ability to bounce back from a hazard or storm event--can provide ancillary benefits, making the community stronger overall. While sea level rise and storm surge events will likely affect everyone in some way, no single entity is solely responsible for making necessary changes. This lack of direct responsibility makes climate change a difficult issue to plan for. The challenges professionals face are multi-faceted and require the expertise from a variety of fields.



1. PRECEDENT STUDY

2. SITE ANALYSIS

3. DESIGN PROPOSALS

Under the direction of professors Austin Becker, Ph.D. and William Green, ASLA, the semester was divided into three sections: 1. precedent study, 2. site analysis and 3. design proposals.

Precedent Study During the precedent study portion, students examined how other coastal areas in the Northeast were adapting to sea level rise and working towards building more resilient communities. By researching innovative proposals from the recent “Rebuild by Design” competition, students were able to consider the components of several winning design interventions and learn about what made them exceptional.

Site Analysis Students were given a tour of the site by Dan Costa, the Rhode Island Department of Environmental Protection Port of Galilee Manager. Students visited the port in action and asked questions to gain a deeper understanding of the area. Students worked to create a site analysis of the Port of Galilee, examining the natural, built and economic aspects of the area. They presented their work at a listening session open to the public and stakeholders within Galilee. The listening session provided further insight that assisted students in moving onto the third phase: creating design interventions and strategies.

Design Proposals With the knowledge gained from the precedent study, site analysis and listening session, students began to design strategies and interventions to help the Port of Galilee adapt in the face of rising sea levels and potential coastal hazards. One group of students created a planning guide that would become a framework in which the design interventions would fit.

Course Recap

- Research “Rebuild by Design” proposals to create a greater understanding of real coastal resiliency projects.
- Form groups and select one winning RBD project to focus on. After looking at winning proposals, create illustration boards that explain the winning projects. This is an analysis of the winning projects. This tactic allows students to explore GIS mapping.
- At a planned community workshop, present student version of the RBD analysis. The goal is to speak with the community to see what design features could or could not work for the Port of Galilee.
- Keep in mind the successful design implications of RBD and take part in comprehensive site visit of Galilee with local officials. Take a detailed inventory of vulnerable areas throughout the port.
- Analysis stage of Galilee Project. These should reflect the RBD analysis style and form.
- After analysis, identify the major design implications that need to be addressed. Separate into groups of similar design preference.
- 7 groups: 3 addressing parking garages and connectivity, water management, breakwater rehabilitation, dune restoration, floating buildings, and most importantly a Resiliency planning guide that will link each project into one system.
- Participate in several critiques from various landscape architecture and planning professionals.
- Final presentation on December 18th showcasing design possibilities in front of an array of professionals from Sea Grant, RIDEM, Narragansett Planning Department, etc.





PENN Design + Olin



Sasaki Associates



SCAPE Studio

Precedent Study

Hurricane Sandy Brings Climate Change to Life

During the precedent study portion of the course, students analyzed the winning proposals from the renowned “Rebuild by Design” competition (RBD).

The Rebuild by Design competition, launched by the Hurricane Sandy Rebuilding Task Force sponsored by the United States Department of Housing and Urban Development (HUD) generated a wide array of creative ideas aimed at increasing resiliency in areas affected by Hurricane Sandy. Out of 41 proposals, each ranging in scope and scale, there were only six winning proposals and one finalist in the competition.

Students examined a variety of ideas and components of the winning proposals and looked at the geography, scale, demographics, culture and economics of the area to understand the context in which each design intervention was proposed. Students created maps using GIS to illustrate the spatial analysis, the hydrological aspects, the jurisdictional boundaries and the connectivity of each site. Ancillary benefits and aesthetics of the design interventions were also considered.



Bjarke Ingels Group (BIG)



Learning From Others: Precedent Study

The Port of Galilee faces many of the same problems that other coastal areas are currently confronting. By understanding the ways in which other coastal communities and ports are addressing the issues surrounding sea level rise, Galilee can begin to address its own specific concerns.

The Rebuild by Design competition proposals allowed students to understand what must be taken into consideration before implementing design interventions and strategies for achieving resilience.

While the scale is very different, designing for sea level rise and storm surge may not be all that different from one location to the next. For instance, Boston and New York City are implementing projects similar to successful strategies in the Netherlands. While the Port of Galilee may be a small port in relation to those in Boston and NYC, it is a major source of revenue for Rhode Island and a vital stop for vessels along the North East.



Public Engagement at the Listening Session

Following research on Galilee's natural, built, and economic features, a public meeting, or listening session, was held. Stakeholders included RIDEM, faculty from URI Graduate School of Oceanography, town planners and others. The purpose of the listening session was to share what was learned through the site analysis process and gain a deeper understanding of the local conditions and needs by engaging with the local stakeholders.



New Ideas through Precedent Study Projects

A powerpoint presentation, supplemented by boards set up around the perimeter of the room, highlighted the students' findings pertaining to the Port of Galilee. Attendees were divided into smaller groups so that they could view posters, created by the students and discuss key components of winning proposals from the Rebuild by Design competition.



Small Learning Groups to Facilitate Talking

The smaller groups rotated through each student-led group stopping for ten minutes at each RBD poster table. This facilitated dialogue and conversation about the RBD interventions and their potential suitability for the port. Students also had prepared questions to ask each group to acquire more information about the site, its needs as well as its limitations. The listening session allowed for an exchange of information, thoughts and concerns of community members, stakeholders and experts in the field.

Site Analysis





Galilee Overview

The Port of Galilee is a significant commercial fishing port, a transportation hub to Block Island, a seasonal tourist destination and a home to many year-round residents. Galilee has experienced flooding and damage to its piers and infrastructure from coastal storms, such as Hurricane Sandy.

The port community will continue to be at risk as sea levels continue to rise, which calls for proactive planning and adaptation to increase the area's resiliency. Increasing resiliency within the Port of Galilee would mean strengthening the community, economy, and infrastructure within Galilee by making wise land use decisions, understanding and adapting to the risks associated with climate change, and preparing the community to recover quickly after a hazardous event such as a hurricane, coastal storm, or flooding.



Surrounding Neighborhoods



Site Usage: Day + Night Throughout Year



Existing Problems



Vulnerability for Galilee + Block Island

Understanding the Area





History of the Site

Galilee has been an established commercial fishing port since the 1940's. It emerged as a fishing village in the 1800's as colonists displaced the Narragansett Native Americans and began using the area for fishing to supplement their farming enterprises. Over the next few decades, construction and infrastructure improvements helped to make Galilee one of the largest commercial fishing ports on the East Coast.

Beginning in 1890, the Army Corps of Engineers (USACE) constructed three miles of stone breakwaters to create the Point Judith Harbor of Refuge. During this construction, the breachway was dredged and stone jetties were installed, creating a channel that would make the area safer and more accessible to larger fishing vessels. The Harbor of Refuge construction project was completed in 1914. In the 1930's, a project to dredge an anchorage basin just inside the breachway began. Wharves and better docking facilities were also built to accommodate larger vessels at the port. By the 1940's, Galilee had become established as a vital commercial fishing port on the East Coast. In the mid-1900's, restaurants, inns, and beaches slowly emerged in the area adding a tourism element to the bustling port.

While the Port of Galilee serves as a Port of Refuge during major storms, the area has not been spared damages from hurricanes and other coastal storms. As sea levels rise and storm surge contributes to the erosion of shoreline, the Port of Galilee is expected to face an increasing threat of serious damage.



Modernistic Concept of Galilee (Mid 20th Century)



Small Town. Big Impact.



"Tuna Capital of the World"

Historic Timeline

1700	Colonists used the land for farming. The rich pastures, created by the melting of glaciers 10,000-12,000 years ago, supported the grasses to feed horses, cattle, and sheep.
1902	Galilee is named by Canadian fisherman Thomas Mann
1938	Great damage from the 1938 Hurricane
1954	During the 1954 hurricane, extreme flooding of Sand Hill Cove Road trapped residents of Great Island.
1956	The State Division of Public Works constructed the Galilee Escape Road to prevent trapping residents. This construction divided a previously continuous salt marsh, also eliminating about seven acres of valuable marsh habitat.
1991	RIDEM's Division of Fish and Wildlife became the lead agency in a multi-agency effort designed to restore the Galilee Bird Sanctuary and salt marsh.
1995	The Division of Fish and Wildlife acquired the bird sanctuary
1997	Construction was completed and tidal flow restored to the estuary in October
2010	The Block Island Ferry Headquarters moves to Galilee
2011	Hurricane Sandy damage to Galilee facilities and dock



Current Inner Harbor Refuge Conditions



Outlook of Project

South County Independent

URI Students Offer Climate Change Solutions for the Port of Galilee

By Elizabeth Rau

Michael DeLuca, Narragansett's community development director, said he is encouraged by the students' proposals. "These are all interesting and innovative projects... It's always great to see unique ideas come forward. The town and the state can learn a lot from the creative ideas of these young people."

Two years ago, the U.S. Economic Development Administration invested \$2.9 million in the port to make much-needed repairs of a major pier and a 925-foot stretch of bulkhead from Salty Brine Beach to State Pier 3. Federal and state officials gathered at the port Monday to celebrate completion of the work. ***The URI student projects illustrate the importance of continuing to explore ways to ensure that the port thrives in the face of severe storms like Hurricane Sandy.***



Sea Level Rise

*Most of Galilee Could be Underwater by 2100.
A Successful Comprehensive Plan is Crucial.*



How to Combat This Problem

According to coastal inundation modeling results from the 2015 North Atlantic Comprehensive Study (NACCS) completed by the U.S. Army Corps of Engineers (USACE), 5 feet of sea level rise is expected before the end of this century. The table to the right shows projections according to data collected at the Newport, Rhode Island tide gauge based on the National Oceanic and Atmospheric Administration's (NOAA) high rate sea level rise estimates.

SLR Scenario (feet)	Planning Horizon	Projected Year
0	Current	2015
1	20-year	2035
2	35-year	2050
3	50-year	2065
5	70-year	2085
7	85-year	2100

What are the Options?

The Port of Galilee is economically important to the State of Rhode Island. Much of the seafood found in Rhode Island goes through this valuable port. In addition to the fishing industry in Galilee, the Block Island Ferry headquarters and Interstate Navigation are located here. Galilee is a vital transportation hub for the residents of Block Island and design interventions must reflect that. 5 feet of sea level rise would leave Galilee 75% under water. Floating buildings? Elevated dunes? Elevated Roads? Students developed a variety of innovative design recommendations to enhance the conversation surrounding climate change impacts in the Port of Galilee. When choosing designs to consider implementing in the port, of course the most economical and efficient designs should take precedence.



5' SLR + 2' Contours

Contours and a 5' sea level rise map clearly helps emphasize the importance of a plan. 5' SLR is fairly certain, especially before the end of this century.

Designs

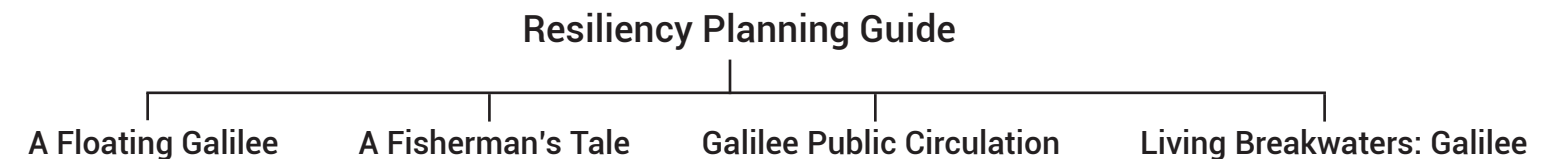


RESILIENCY PLANNING IS THE OBJECTIVE.



One Comprehensive Plan. Four Design Teams.

In the Sustainable Design Studio, students faced a modern day challenge that many coastal communities are experiencing. Through the process of examining precedent projects; performing a site analysis; engaging with the public, stakeholders and professionals in the field, the students were then prepared to create their own strategies and suggestions for the Port of Galilee. The strategies were not limited to landscape architecture design proposals alone. A resiliency guide titled, *A Guide for Resiliency Planning in the Port of Galilee*, was drafted to provide the groundwork for future planning in the area. 4 project titles are listed below.





A Resiliency Planning Guide

Collaboration between stakeholders, planners, designers and community members is necessary in order to facilitate a proactive approach to protecting coastal areas against imminent climate change hazards such as flooding, coastal erosion, and property damage. *The Guide to Resiliency Planning* outlines a three part approach to achieving increased resiliency within the Port of Galilee:

- Establish a Galilee Climate Resiliency Committee
- Develop a resiliency plan
- Monitor, evaluate, and update the established plan

The foundation of the guide is based on "Building Resilient States: A Framework for Agencies" by Smart Growth America. Smart Growth's document explained ways in which state leaders can make strategic decisions to align goals and enhance long-term resiliency in their state.



3 Approaches Resiliency Planning in the Port of Galilee

1. Establish a Galilee Climate Resiliency Committee

The Port of Galilee would benefit from the formation of a committee in charge of tackling the challenges facing Galilee brought forth by climate change. The committee would focus on developing and creating plans, policies, and priorities to effectively strengthen the area. For instance, responsibilities of the committee may include strengthening construction standards for waterfront businesses, providing tools and assistance to better integrate plans at the local level, retrofitting and upgrading existing infrastructure, or engaging public awareness by leading educational programs. The committee might also satisfy the following:

- **Create a comprehensive list** Create a comprehensive list of agencies and organizations within Galilee to understand the unique composition of the community and the variety of agendas.
- **Committee composition** Include a variety of stakeholders, governmental and non-governmental organizations, business leaders and community members in the make-up of the committee.
- **Foster collaboration** Use the committee as a way to strengthen partnerships and foster collaboration between groups.

2. Develop a Resiliency Plan for the Port of Galilee

A chief responsibility of the committee would be to create a cohesive, customized Resiliency Plan that would provide residents, stakeholders and planners with information about climate change impacts in the Port of Galilee. The proposed Resiliency Plan would outline goals and objectives specific to Galilee's resiliency, focusing on the climate change impacts that pose the greatest threat to the area. Suggested goals of the Resiliency Plan include:

- **Develop a risk assessment** of infrastructure and prioritize assets to protect.
- **Create an online database** of at-risk assets to provide a centralized source of information for residents, stakeholders and planners.
- **Encourage informed land use decisions** and create incentives to ensure that future development does not increase vulnerability.
- **Develop public outreach** and training programs to educate the public on the changing climate and impending impacts.
- **Establish sources of funding** in order to create a Resiliency Fund.

3. Develop a Process to Monitor, Measure and Report Progress

Another responsibility of the committee would be to measure the progress of the plan, review the plan's basic assumptions, update the plan, and share lessons learned with other communities. The committee would:

- **Create clear goals** and objectives for increasing resiliency in the Port of Galilee.
- **Measure preparedness** at different levels and with varying priorities.
- **Review the original assumptions** as natural, social, economic and political conditions change.
- **Update plans accordingly**, keeping in mind priority objectives.
- **Share lessons learned** to encourage support and involvement as well as to assist other communities tackling similar challenges.



Student Designs

Groups of students worked together on a series of thematic master plans incorporating design interventions identified in earlier phases of work. The plan on the facing page indicates the location of a few of the more important recommended improvements. The pages that follow illustrate designs for the Port of Galilee which combine improvements from the group work.

Enhancing the Dunes: Building Beach Resilience

Aims to rebuild the sandy dunes along Salty Brine Beach and reduce storm surge overflow with a series of interventions that will help slow Galilee's inevitable flooding and beach migration.

System Wide Approach Towards Filtration

Proposes a series of interconnecting retention ponds, detention basins and bioswales that will collect and filter storm-water runoff to increase filtration before depositing it into the Narragansett Bay.

Post Storm Clean Slate Plan

Proposes a strategy for responding to the destruction of the Port of Galilee after a major storm. The approach uses green design strategies to improve the function of the site, while preserving opportunities for fishing and recreation.

Floating Galilee

To prevent sea level rise from damaging homes and businesses along the western side of the port, this proposal suggests using floating buildings.

Living Breakwaters: Galilee

Implementing a living breakwater on top of the existing Point Judith breakwater will provide added strength to withstand a 100-year storm in addition to 5 feet of sea level rise.

Public Circulation Galilee

Through three interventions, this design proposal helps the port adapt to sea level rise through a new circulation plan.

A Fisherman's Tale: Bridging the Past, Present for the Future

This design proposes a museum celebrating the fishing industry along with a parking garage, and salt marsh trail



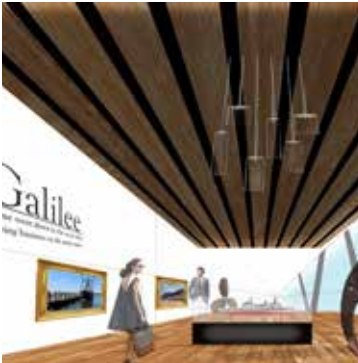
1 Living Breakwater



4 Smart Streets



2 Floating Buildings + Docks



5 Galilee Museum



3 Parking Garage



6 Salt Marsh Accessibility



Embracing Storms + Sea Level Rise

The Port of Galilee is one of the most important commercial fishing ports in New England. The port also serves the Block Island ferry which attracts thousands of tourists each year. Currently there are two beaches, several restaurants, a nightclub, and a few stores which all seem very much unconnected. While it is critical to create some separation between the tourism industry and the commercial fishing industry in the port for safety reasons, enhancing the circulation system within the area would benefit both enterprises.

Through three interventions, this design proposal helps the port adapt to sea level rise through a new circulation plan. The circulation plan includes the construction of a multi-use parking garage that can endure various levels of flooding. The parking garage would also provide rooftop use and storage during storms events. With new roads and sidewalks, the parking garage would connect to an elevated walkway allowing for access to the salt marsh. This elevated trail would provide educational opportunities through signage at several stops along the path. This proposal allows for stronger connectivity within the port while also allowing for occasional flooding. An additional benefit of this design intervention is the increase in parking spaces for the port with the construction of a parking garage.



5' Sea Level Rise



Rain Garden Use



5' Storm Surge

2100



5' Sea Level Rise



Connectivity Map

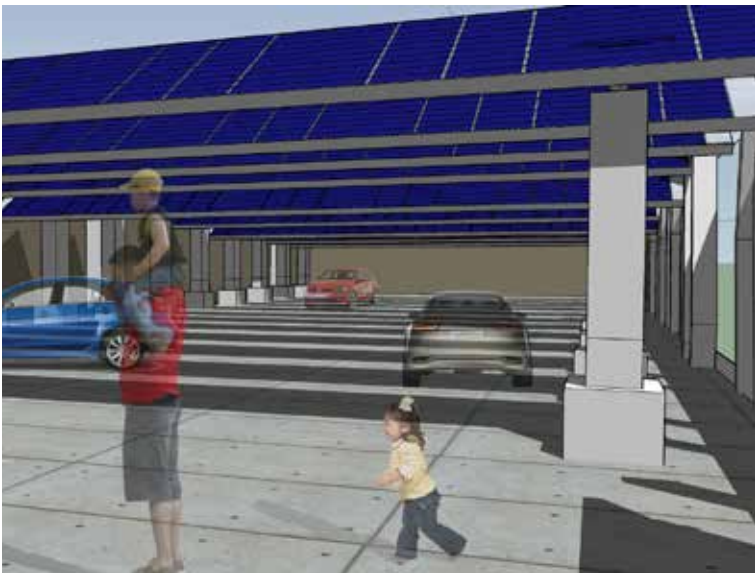
Elevated trail (white) does not affect the sensitive estuarine scrub shrub (teal). The trail connects the parking garage, Roger Wheeler Beach, and Galilee Escape Road for complete access to the salt marsh and bird sanctuary from points north.



Tackling the Parking Situation

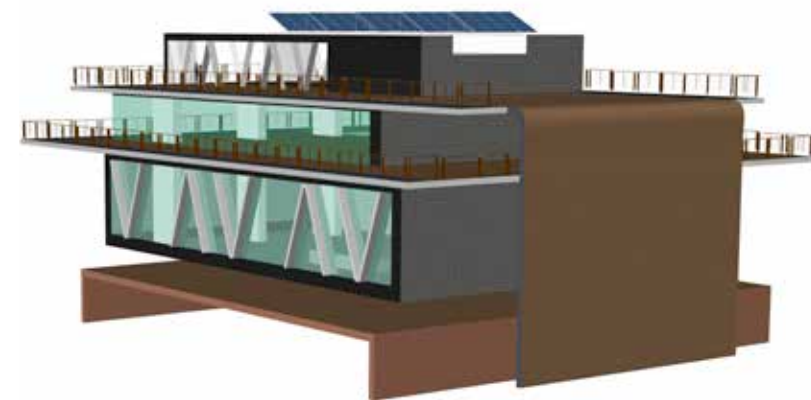
The parking complex is a 4-story structure that provides ample parking (1,200 spaces) to accommodate the influx of tourists during the peak seasons. The parking complex will be LEED certified and will support green infrastructure such as living walls and a green roof. The roof will also provide patio space and views of the bustling fishing port, the Salty Brine Beach and the ocean. Rooftop access for solar panels add shade to parked cars. The parking structure is designed to have a zero net system to collect all runoff on site. Storm water will be stored in a cistern system below the first story.

The parking structure serves another function: it acts as an emergency relief station in a storm event. Equipment can be stored in elevated sections of the parking structure. The ground level is designed to take in water while the remaining stories are protected from inundation. The parking complex meets the requirements of FEMA.





Incorporating a Sense of Place with a Town Center



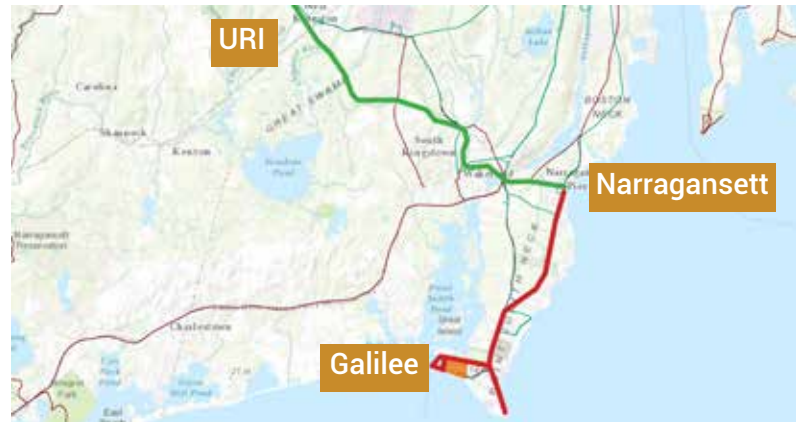
Creating a Sense of Place in Galilee

This design honors Galilee's history as a vital fishing port. The design for the museum was influenced by the shape of a catamaran. This design allows for inundation of 8 feet which allows the first floor to be flooded in the event of a coastal storm. This first floor has an open concept and serves as a reception and gathering space as well. The museum would engage the community and illustrate the importance of the port and fisheries has played for Rhode Island and the Northeast. The museum would engage the community and illustrate the importance of the port and the fishing industry in Rhode island and in the Northeast.



Eco-Tourism Destination

The salt marshes around Galilee are extensive and visible from the road. The design of a boardwalk across the marsh can provide for improved circulation and ecological education. These paths for pedestrians and bicyclists lead from the parking garage and incorporate a series of kiosks which display different qualities of the port and the ecological system without disturbing the fishing activities.



Bike + Trail Connectivity

Green follows existing bike path

Red represents proposed route towards an eco-tourism destination

Arbor Knot Trail: A Valuable Connection

The Arbor Knot Trail enhances connectivity through Galilee and will consist of a boardwalk that allows bikers to travel above the wetlands while connecting them to streets without biking along busy roadways. The boardwalk will also serve families by providing access to the salt marsh. While walking along the boardwalk, visitors can learn about significant events throughout Galilee's history by reading kiosks along the trail. The boardwalk will be 10-11 feet wide providing enough room for walkers and bikers to share, and will be built about 5 to 6 feet above the existing elevation of the wetland. The trail leads to the fishing museum and the kiosks act as windows offering glimpses into the fuller museum experience. These trial stops provide a fun way of gathering information. Scan codes on kiosks will give users instant access to websites that provide information related to sea level rise and related topics in Galilee and in Rhode Island.

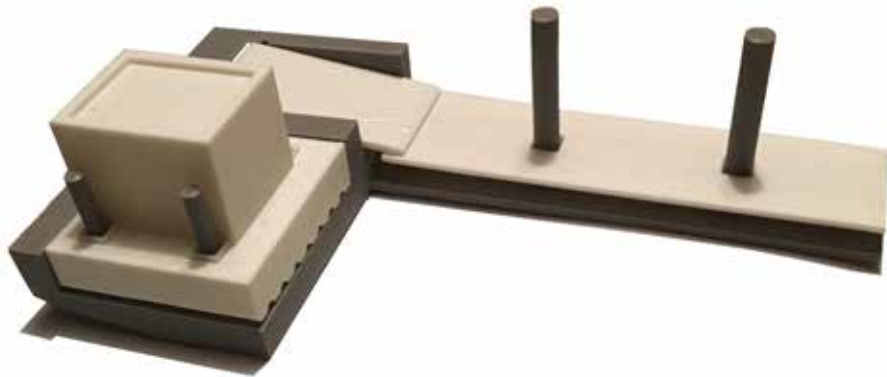




Setting a New Standard for Galilee Building Codes

To prevent sea level rise from damaging homes and businesses along the western side of the port, this proposal suggests using floating buildings and docks. Currently areas such as Taiwan and the Netherlands use floating buildings in areas of sea level rise and flooding.

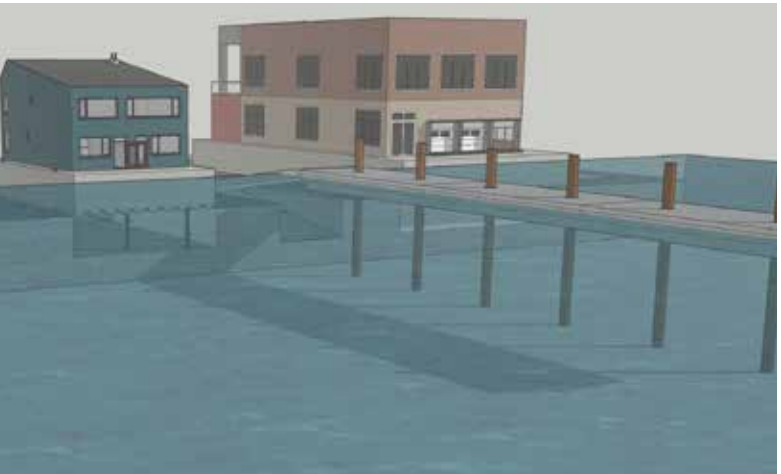
This design proposal is influenced by ports in Alaska that must sustain tidal changes of nearly 25 feet. These ports in Alaska were able to manage these tidal fluctuations with the use of floating docks. Galilee would benefit from both floating buildings and docks, especially those that are able to withstand the weight of many service vehicles.



This animated 3D model was created to illustrate the movement of structures would work during a storm surge. The dock can be moved along the posts to best demonstrate the dynamic design of this intervention at the final presentation.



Proposed Design Under Normal Conditions



Proposed Design Under Storm Surge Conditions



Resilient in a 100-Year Storm

The design proposes essential buildings along the edge are built to be semi-floating. Any new construction that is built (or homes/ businesses that are rebuilt), need to obey new laws which would require a water tight foundation that rests on a concrete pad that makes up the edge of the dock. Under normal circumstances, the building would remain stationary, resting on a pad at grade with the top of the bulkhead. During storm surges, these building designs would allow the structure to float secured by its pilings. As soon as water recedes, the building will settle back into usual position.

This building design allows for waterfront dependent businesses to maintain a connection to both the street and the boats. The dynamic nature of this two faceted system allows the edge environment to adapt to fluctuating water level as well as the apparent increase in storm frequency and severity up to and including current 1% storm projections.

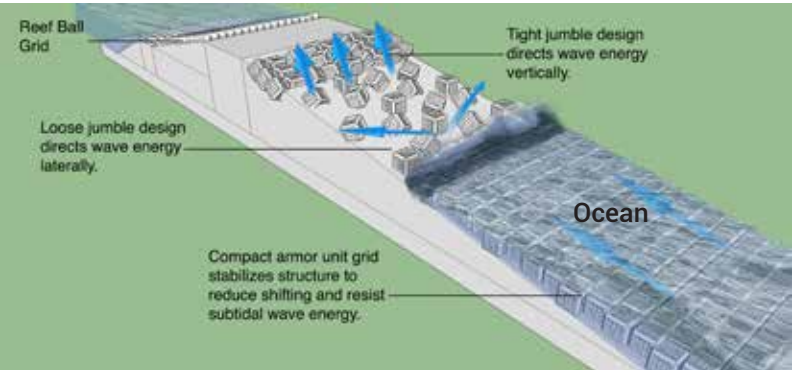


Multi-Faceted Approach to Resilience

Implementing a living breakwater on top of the existing Point Judith breakwater will provide the existing structure with the added endurance to withstand a 100-year storm in addition to 5 feet of sea level rise. Providing shoreline defenses with the improved breakwater would lessen the impacts on built infrastructure in the port; therefore the initial costs of installing the breakwater will prove to be cost effective in the long run.

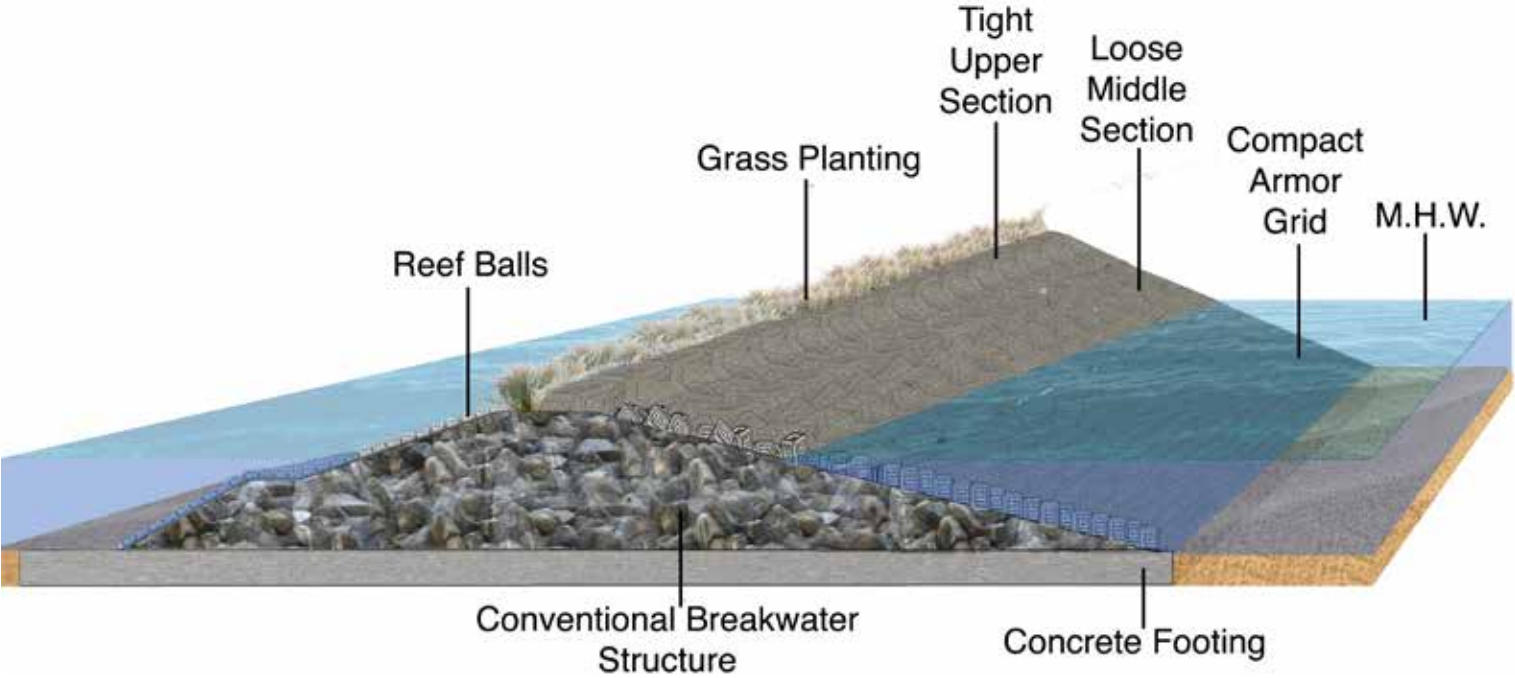
In the short term, all boats, docks, and utilities will have stronger defense against the more frequent, weaker storms and would improve the resilience of the entire port village area.

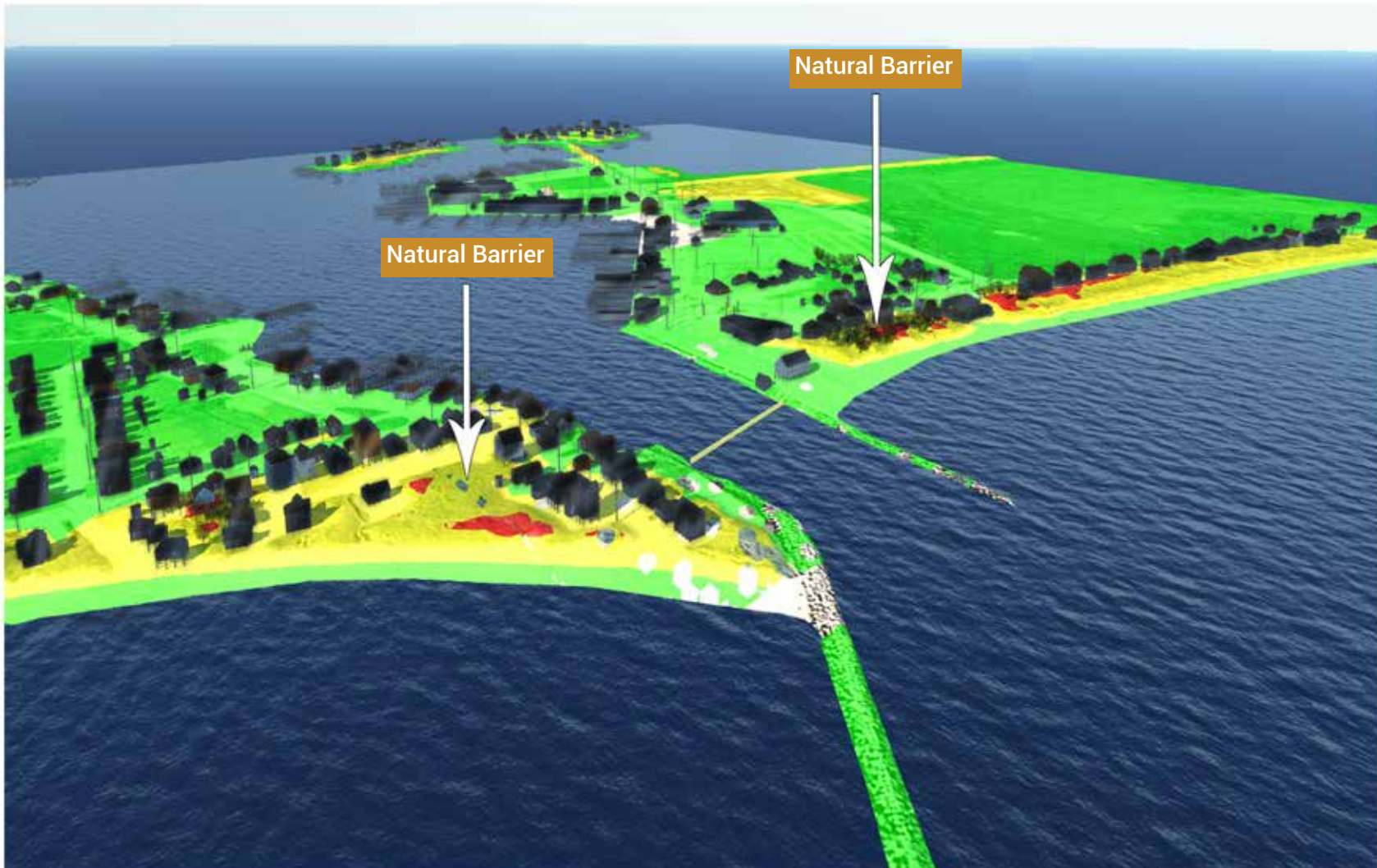
Also, by building a living breakwater which would support habitats, the natural ecology of the waters would be strengthened. Shellfish will help to filter polluted water of the heavily trafficked channel, boost the fishing industry, and encourage species diversity.



3 Part Design

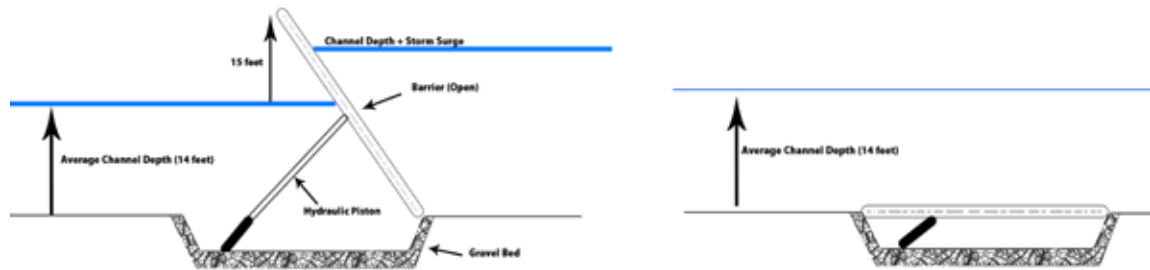
- Ocean-facing side, features a stacked grid lining the lowest section of the breakwater.
- The middle segment has a very loose grid of jumbled EConcrete armor units.
- The upper most segment has the same jumbled structure: the knit is closer together and will direct wave energy vertically.



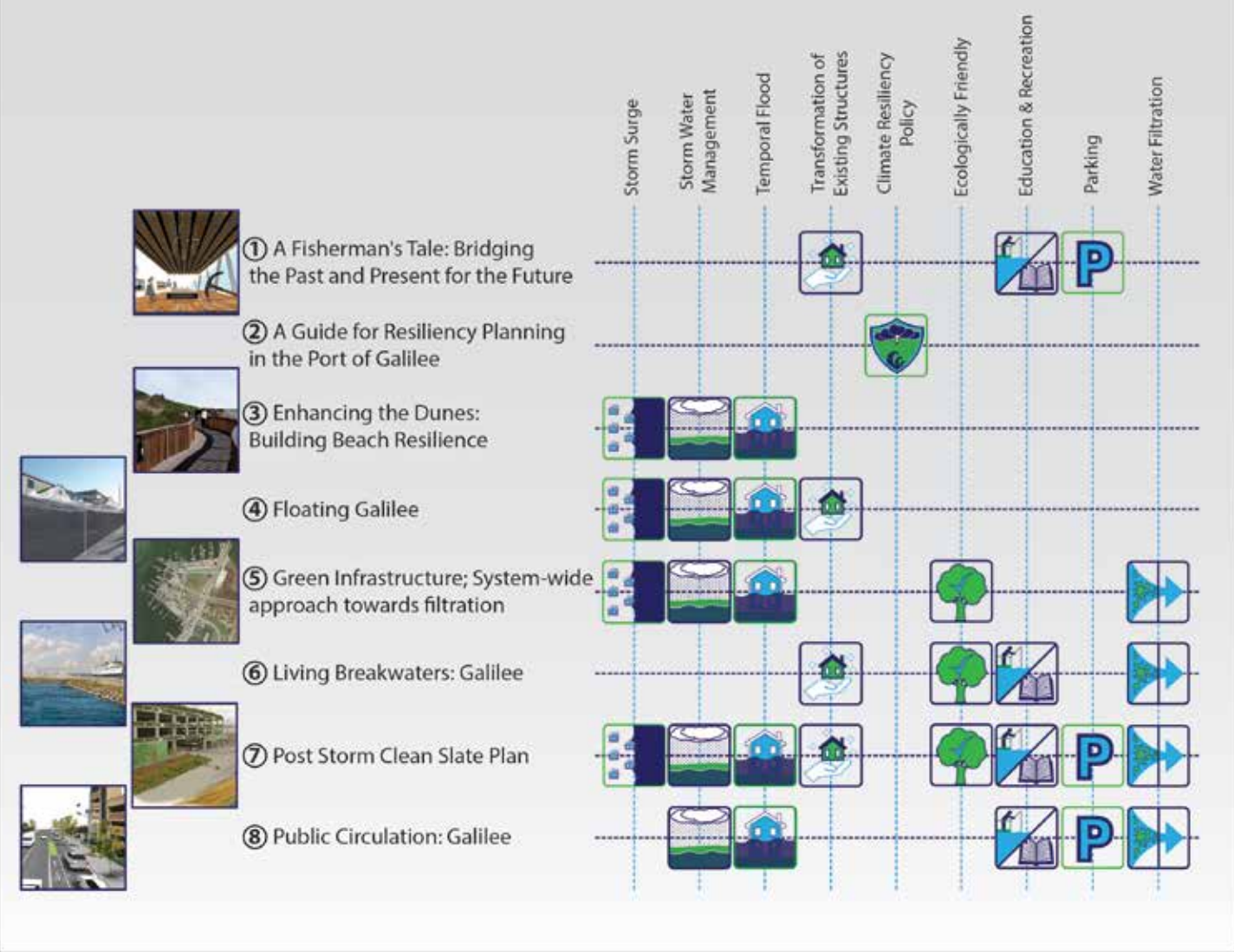


Storm Surge Barrier

The dune system provides a natural wall against the ocean with a maximum height of up to 24 feet. By stabilizing the dunes and constructing a barrier in the channel, the port may be sheltered from storm surge.

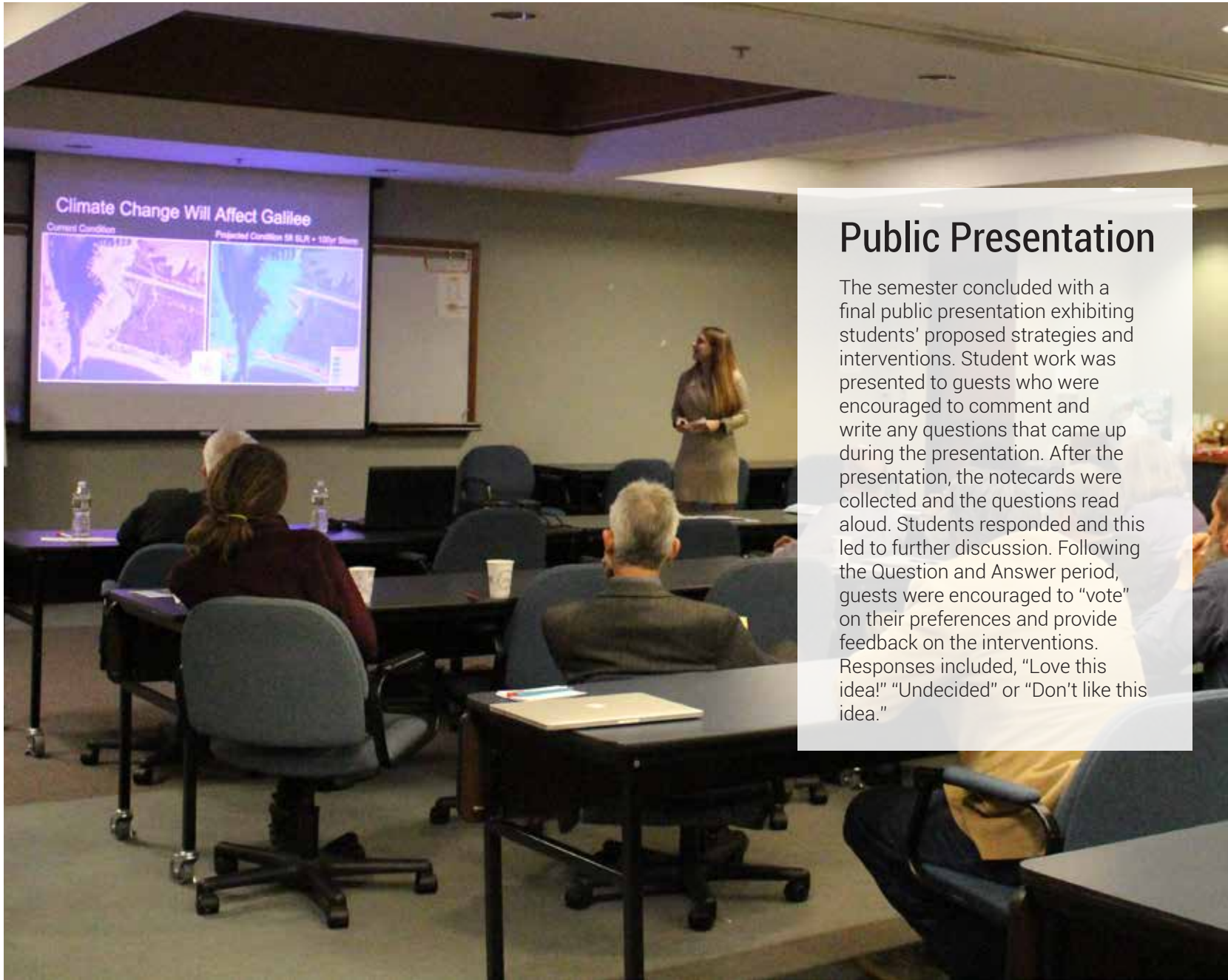


Summary of Project Conditions & Objectives



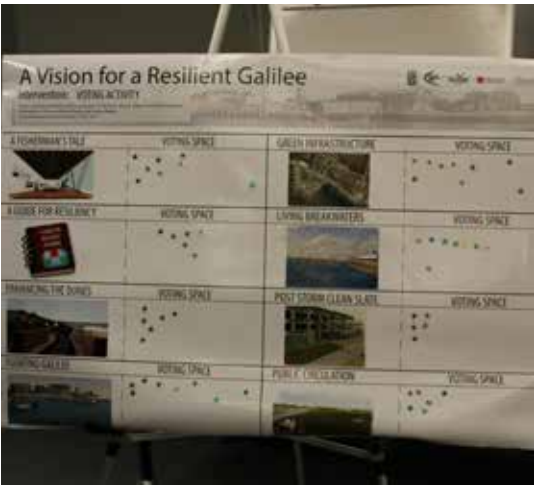
Final Presentation



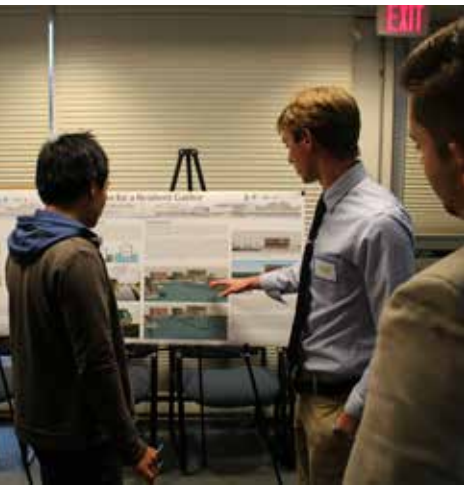


Public Presentation

The semester concluded with a final public presentation exhibiting students' proposed strategies and interventions. Student work was presented to guests who were encouraged to comment and write any questions that came up during the presentation. After the presentation, the notecards were collected and the questions read aloud. Students responded and this led to further discussion. Following the Question and Answer period, guests were encouraged to "vote" on their preferences and provide feedback on the interventions. Responses included, "Love this idea!" "Undecided" or "Don't like this idea."



(Left and Above) During the intermission, students had a chance to speak with small groups of professionals about their individual projects. Their comments or preferences were recorded in the stakeholder preferences chart.



(Above) A student describes his concept for floating buildings. He explains that a building code change will be necessary for a future buildings.



(Above) A voting activity was initiated at the end of the presentation. The voting was centered on " Could you see these projects implemented in Galilee?".



Lessons Learned and Next Steps

The Port of Galilee is already experiencing the effects of climate change and the impacts will become more severe as sea levels continue to rise. Careful planning must begin today to prepare for tomorrow.

While this one semester course only touched the surface of a complex situation in Galilee, it raised critical questions and sparked important conversations. The process employed in this service learning course taught students valuable lessons. Interdisciplinary collaboration, community engagement, and thoughtful background research are critical components when tackling complex issues surrounding climate change. While most of the resilience strategies proposed by students were visionary and far-reaching, they brought forth new ideas and an innovative menu of options for the future. By working with universities and exploring methods employed in other areas, communities can discover creative, practical solutions.

GIS, geodesign, and landscape architecture design are useful tools in planning for sea level rise and storm surge. Geographic coastal data must be shared while design interventions are developed to fit specific environments. While the traditional way of combating sea level rise is to retreat or to build a wall, they are not the only options. Adapting to changing conditions with select design and planning strategies can sometimes help to minimize damages. Other times, abandoning an area and rebuilding is the only option.

In future service learning courses, a wider range of students from different disciplines may bring forth even stronger solutions. For instance, in the Port of Galilee, bringing engineering students into the discussion may help to develop resilient dock designs and other infrastructure improvements to withstand strong storm surge. Also, developing smaller step-by-step improvements may be more implementable in the short-term. If the course were to extend to a second semester, a cost-benefit analysis would be particularly valuable since projects are generally limited by the availability of funds. Also, increasing the level of community engagement would strengthen design interventions and strategies. For instance, meeting with commercial fishermen at their place of work in Galilee would help students understand what they do and how the site works. Becoming immersed in a community strengthens the understanding of what the needs are of that community.

There is no easy fix for adapting to climate change. Every community must explore the data available and the relevant options before implementing resilience strategies. Collaboration and communication are key to this process.

Appendix + Citations



Page	Citation
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Executive Summary	
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Appendix + Citations

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21	• Photo: RIDEM
22	<ul style="list-style-type: none">• RIDEM Historical Galilee Concept• Galilee Postcard http://thesaltsailor.com/rhodeisland-philatelic/rhodeisland/postcard126.htm 1• 6th Annual United States Atlantic Tuna Tournament http://sos.ri.gov/virtualarchives/items/browse?tags=fishing• www.ricoasts.org (Discovery of Coastal Environments: Virtual Field Trips on the Internet by the URI Office of Marine Program)
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