RHODE ISLAND SCHOOL OF DESIGN - UNITED STATES

IGC

Location

Adaptation of low-lying neighborhoods in Portsmouth, RI. USA.

This project addresses the question of effectively managing areas that are vulnerable to sea level rise but difficult or impossible defend due to their low elevation and exposure. It uses a community visualization survey to asses both concerns and possible responses to issues arising from storm surge and sea level rise in two neighborhoods in Portsmouth, Rhode Island, USA. The survey responses, together with information gathered from subject area experts and town officials, formed the basis for scenario development.

Background

The neighborhoods of Common Fence Point and Island Park are extremely vulnerable to sea level rise and storm surge. Major tropical cyclones in 1635, 1815, 1938, and 1954 washed over the lowest lying areas. Experiences from the 1938 and 1954 form a significant part of the local cultural memory. One respondent stated, "I have lived in Portsmouth all of my 66 years, 38 of them in Island Park and Common Fence Point. My parents and grandparents as well as other family members lived through and lost their homes in Island Park to Hurricane Carol."

Development has expanded in the years following 1954, increasing vulnerability to these hazards. Access and the needs of evacuation during storm events is a significant community concern due to the vulnerability of surface routes.

The effects of sea level rise and changing water tables are already evident. The Town Planner has noted that "at extreme high tides, I've seen fish and eels swim in the drain across from Flo's Clam Shack in Island Park. If that drain is full of water from the ocean, rainwater has no place to go." There have been continued problems with septic systems (small ground based sewage disposal). The failure of septic systems has led to nutrient pollution and algal blooms that result in the closure of beaches and areas used for shell fishing, an activity that is culturally and economically significant.

The Rhode Island School of Design (RISD), The University of Rhode Island Coastal Resources Center (CRC), The State of Rhode Island Division of Statewide Planning (SWP), and the Nature Conservancy (TNC) are engaged in a series of coordinated intersecting projects designed to address these issues.

Requirements and Assumptions

The innovations applied are constrained by what stakeholders and area experts deemed relevant and politically feasible in the study area. The team is committed to maintaining the perceived legitimacy of the stakeholder process by respecting this direction. This is a first step in trustbuilding for ongoing work.

Selected innovations reflect stakeholders' clear priorities that families be able to remain in their homes for as long as possible, and that marshes and beaches be protected. There is a strong desire to preserve the affordability of existing housing stock, and not to implement schemes that would spur development (e.g., adoption of an expensive public sewer system).

Major Innovations Employed

GRN 2035 16: Coastal Urban Resilience: Modeling for Risk Reduction. Sea Level Affecting Marsh Migration (SLAMM)[1] and ADCIRC (ADvanced CIRCulation) models are utilized.
GRN 2035 17: Green Infrastructure for Coastal Resilience.
GRN 2035/2050 8: Ecosystem Services of Green Infrastructure.
TLD: Use of "Thin Layer Deposition" to elevate marshes.
AWWT: Use of small scale alternative self-contained waste water treatement systems.

Existing 2020

Early Adopter 2035

Early Adopter 2050

Early Adopter

This scenario assumes that current engagement efforts are built upon, and that Common Fence Point and Island Park residents continue to expand their current preparedness efforts such as identifying persons in need of transportation assistance during evacuation and generator sharing. This community capacity is expanded into political support for projects that maximize benefits to the community such as improving and elevating Park Avenue, creating a second escape road from Common Fence Point, and supporting efforts at marsh elevation and protection.

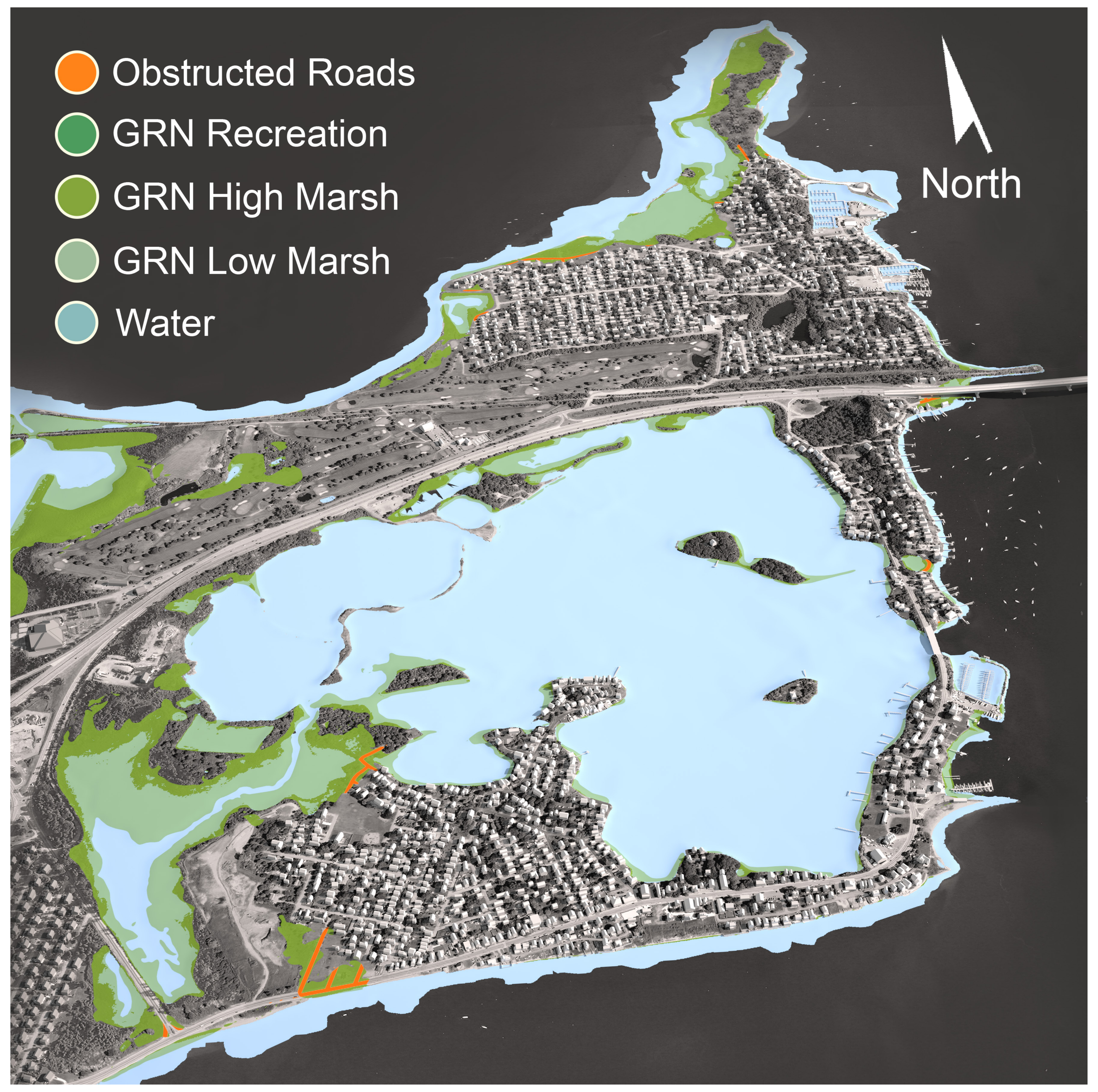
Key tasks include: 1) Relocating threatened community park facilities affected by marsh migration, 2) Developing an orderly process for abandonment of failed septic systems, and 3) supporting homeowners in obtaining buyout funds. Where sufficient protection and access from elevated roadways exists, properties may be elevated to defend against marsh encroachment.

The net result of these actions is to maximize natural storm buffers, nutrient filtration and water quality ensuring that the maximum number of families can remain while preserving the natural features that define the area and the local way of life.

Fall River Herald News, 1938

Works Progress Admin., 1938

Project Surroundings



Non and Late Adopter 2035

Late Adopter 2050

Late Adopter

The late adopter scenario assumes that current efforts stall and that serious efforts at building support for elevating Park Avenue and other critical routes such as Common Fence Point Boulevard do not occur until the roads are regularly blocked by tides. Under this scenario it's likely that some marsh loss will occur as will additional septic failures and disorderly abandonment. This will cause additional beach and shell fishing closures due to nutrient pollution. Time necessary for engineering, approvals, and funding appropriation is likely to delay and complicate the response, as is increased competition for resources from other communities facing similar problems.

Despite these negative effects in the short term, the focus brought about by access issues is likely to galvanize community resolve and support for undertaking adaptation measures. Significant marsh preservation is still possible as is road protection with benefits accruing to the remaining residents. The Park Avenue elevation is proposed in the same form as the Early Adopter scenario, the route of the Common Fence Point escape road is shortened. The extent to which roads can be elevated and reinforced will depend on when action occurs.

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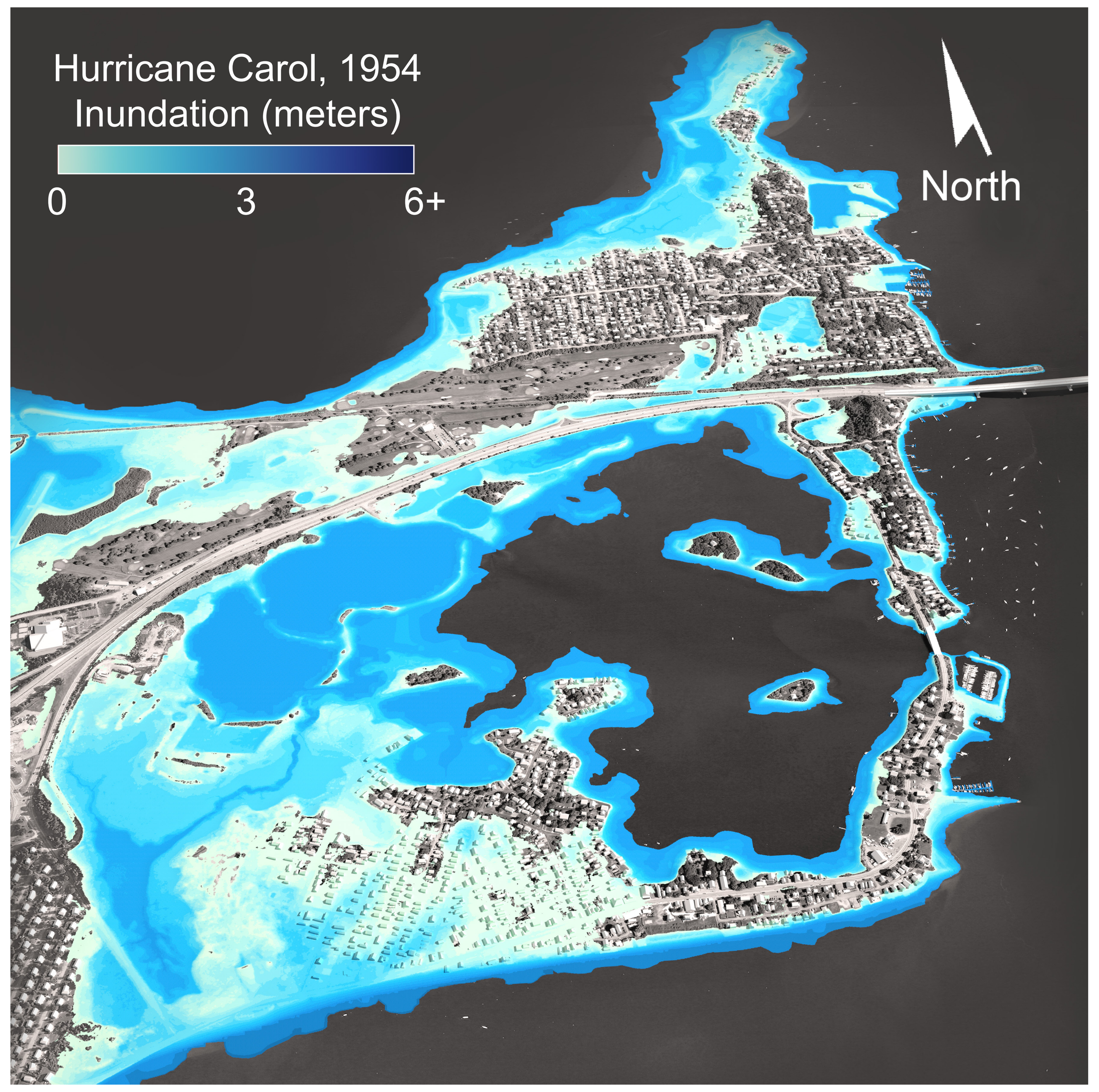


Non Adopter 2050

Non Adopter

Under the non-adopter scenario, it's likely that marshes will not keep up with sea level rise, significantly increasing the vulnerability of adjacent lands to inundation and erosion. In the absence of an orderly plan for communal protection or buyouts septic failures and disorderly abandonment will occur. This results in environmental impacts to Narragansett Bay, beach and shell fishing closures. Loss of connectivity under the non-adopter scenario greatly increases the risk to residents in an emergency and will undermine disaster response.

Even with adaptation, these areas remain highly vulnerable to tropical cyclones. Hurricane Carol, which caused significant damage in 1954, would over-wash virtually all of Island Park if it occurred at today's sea levels, Current climate models suggest that the probability of significant winds and storm surge will increase (See Ullman et. al. 2019). Failure to adapt and maintain buffers will thus increase the likelihood of total abandonment after a major tropical cyclone event.

All scenarios assume continued moderate coastal storms, but do not include a major (category 3 or 4) tropical cyclone.

Innovation: Thin Layer Deposition (TLD).

The future viability of salt marshes undergoing sea level rise depends on two factors: 1) The ability of marshes to move inland as sea levels rise (below left), and 2) the availability of sediment for deposition on existing marsh platforms [2]. Rhode Island Sea Grant, US Fish and Wildlife Service, and local non-governmental organizations such as Save the Bay are experimenting with elevation of marsh platforms using thin layer deposition. This is accomplished by spraying or manual placement of dredged sediment (below right). This is often accompanied by placement of mesh bags of oyster shells at the marsh edge to prevent erosion [3].

Marsh migration, M. Asciola.

Demo. site, RI Seagrant

Early adopter

Sustainable Development Goals	WAT	AGR	GRN	ENE	TRAN	IND	INST	RES	TLD	AWWT
1: No Poverty	0	0	0	0	0	0	0	0	0	0
2: Zero Hunger	0	0	0	0	0	0	0	0	0	0
3: Good Health and Well-being	0	0	1	0	0	0	0	0	1	0
4: Quality Education										
5: Gender Equality										
6: Clean Water and Sanitation	0	0	3	0	0	0	0	0	3	3
7: Affordable and Clean Energy	0	0	0	0	0	0	0	0	0	0
8: Decent Work and Economic Growth	0	0	0	0	0	0	0	0	0	1
9: Industry, Innovation and Infrastructure	0	0	0	0	0	0	0	0	0	1
10: Reduced Inequality										
11: Sustainable Cities and Communities	0	0	3	0	0	0	0	0	3	3
12: Responsible Consumption and Production	0	0	0	0	0	0	0	0	0	0
13: Climate Action	0	0	3	0	0	0	0	0	3	0
14: Life Below Water	0	0	3	0	0	0	0	0	3	3
15: Life on Land	0	0	1	0	0	0	0	0	1	0
16: Peace and Justice Strong Institutions										
17: Partnerships to achieve the Goal										
	0	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**14**	**11**

Most benefici	Bene-ficial	Neutral	Detri-mental	Most detrime
3	1	0	-1	-3

Late adopter

Sustainable Development Goals	WAT	AGR	GRN	ENE	TRAN	IND	INST	RES	TLD	AWWT
1: No Poverty	0	0	0	0	0	0	0	0	0	0
2: Zero Hunger	0	0	0	0	0	0	0	0	0	0
3: Good Health and Well-being	0	0	1	0	0	0	0	0	1	0
4: Quality Education										
5: Gender Equality										
6: Clean Water and Sanitation	0	0	1	0	0	0	0	0	1	3
7: Affordable and Clean Energy	0	0	0	0	0	0	0	0	0	0
8: Decent Work and Economic Growth	0	0	0	0	0	0	0	0	0	1
9: Industry, Innovation and Infrastructure	0	0	0	0	0	0	0	0	0	0
10: Reduced Inequality										
11: Sustainable Cities and Communities	0	0	1	0	0	0	0	0	1	3
12: Responsible Consumption and Production	0	0	0	0	0	0	0	0	0	0
13: Climate Action	0	0	1	0	0	0	0	0	1	0
14: Life Below Water	0	0	1	0	0	0	0	0	3	3
15: Life on Land	0	0	1	0	0	0	0	0	1	
16: Peace and Justice Strong Institutions										
17: Partnerships to achieve the Goal										
	0	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**8**	**10**

Non-adopter

Sustainable Development Goals	WAT	AGR	GRN	ENE	TRAN	IND	INST	RES	TLD	AWWT
1: No Poverty	0	0	0	0	0	0	0	0	0	0
2: Zero Hunger	0	0	0	0	0	0	0	0	0	0
3: Good Health and Well-being	0	0	-1	0	0	0	0	0	-3	0
4: Quality Education										
5: Gender Equality										
6: Clean Water and Sanitation	0	0	-3	0	0	0	0	0	-3	-3
7: Affordable and Clean Energy	0	0	0	0	0	0	0	0	0	0
8: Decent Work and Economic Growth	0	0	0	0	0	0	0	0	0	-1
9: Industry, Innovation and Infrastructure	0	0	0	0	0	0	0	0	0	-1
10: Reduced Inequality										
11: Sustainable Cities and Communities	0	0	-3	0	0	0	0	0	-3	-3
12: Responsible Consumption and Production	0	0	0	0	0	0	0	0	0	0
13: Climate Action	0	0	-3	0	0	0	0	0	-3	0
14: Life Below Water	0	0	-1	0	0	0	0	0	-3	-3
15: Life on Land	0	0	-1	0	0	0	0	0	-1	0
16: Peace and Justice Strong Institutions										
17: Partnerships to achieve the Goal										
	0	**0**	**-12**	**0**	**0**	**0**	**0**	**0**	**-16**	**-11**

3 GOOD HEALTH AND WELL-BEING
6 CLEAN WATER AND SANITATION
11 SUSTAINABLE CITIES AND COMMUNITIES
14 LIFE BELOW WATER
15 LIFE ON LAND
8 DECENT WORK AND ECONOMIC GROWTH
13 CLIMATE ACTION
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Sustainable Development Goals

Contributions to the UN sustainable development goals focus on maintaining, improving, and reinforcing green infrastructure managing sanitation, and the contributions of those strategies to improved livability and environmental quality. Sustainable Development Goals 14, Life Below Water, and 15, Life on Land, are envisioned to be direct effects. Contributions to Sustainable Development Goal 3, Good Health and Well Being, are considered based on the maintenance of sanitation, environmental quality, and the provision of recreation that fosters healthy living. Early use of alternative wastewater systems will have a modest stimulating effect on Goal 9, Industry, Innovation and Technology. Effects on Goal 8 are based on maintaining existing commerce in the study area.

The bottom-up approach used in this project includes supporting nascent efforts at organizing the community around storm resilience. This increased community capacity, combined with the maintenance of affordable housing stock, contributes to Sustainable Development Goal 11, Sustainable Cities and Communities. Similarly, collective action to maintain and improve green infrastructure will contribute both directly and indirectly to Sustainable Development Goal 13, Climate Action.

Survey Research

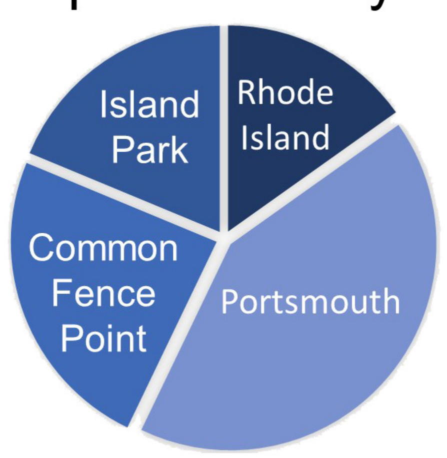
The scenario levels and innovations applied are based on survey research. A survey was developed in collaboration with the Town of Portsmouth and the Coastal Resources Center, and was approved by the Brown University Institutional Review Board. The survey was promoted through a press release by the town and was open to Rhode Island Residents over the age of 18. The survey included visualizations of existing conditions, storm surge, sea level rise, and marsh migration. These visualizations were based on models by the University of Rhode Island Graduate School of Oceanography.

In addition to describing their concerns about each visualized scenario, respondents were asked to share their perceptions of the likelihood and severity of storm consequences and when they expected different levels of sea level rise (SLR) to be realized. Open ended questions were explored by seven independent coders who identified themes that emerged from the responses. A shared comprehensive set of themes was developed and then applied independently. The application was validated by comparing agreement among independent coders regarding application.

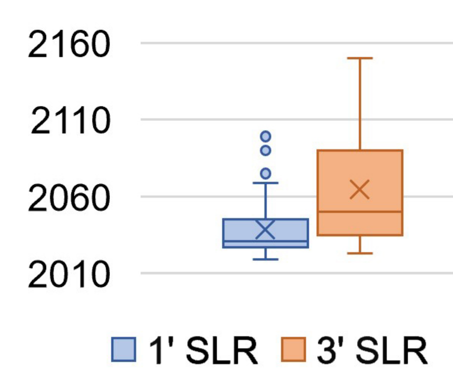
Results

Of the 115 respondents to the survey 21 respondents lived in Island Park, 27 respondents lived in Common Fence Point, and 47 respondents lived in other Portsmouth neighborhoods. The median expectation for realizing .33m (1') SLR and .9m (3') SLR were 2031 and 2050 respectively. The mean expectations were 2039 and 2063. These expectations were used as scenario levels for 2035 and 2050. In addition to identifying consequences, respondents rated the importance of criteria for evaluating the success of adaptation measures.

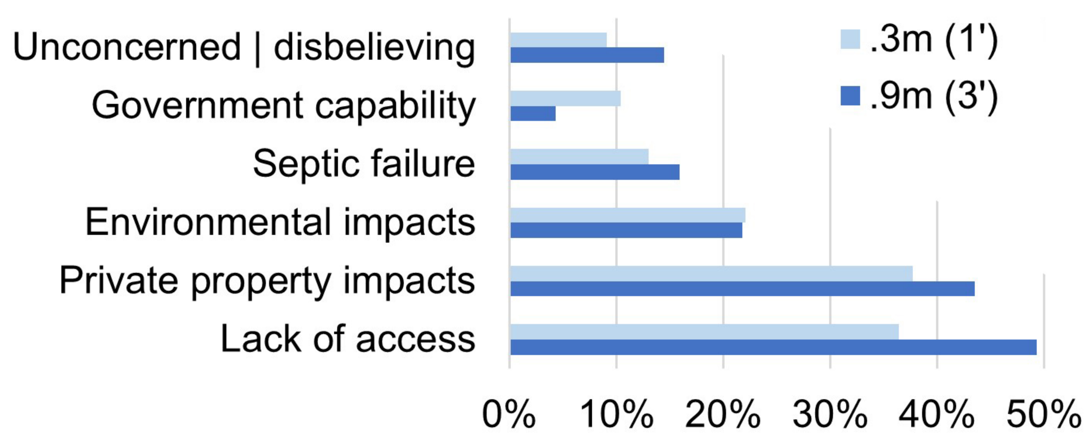
Resp. Residency



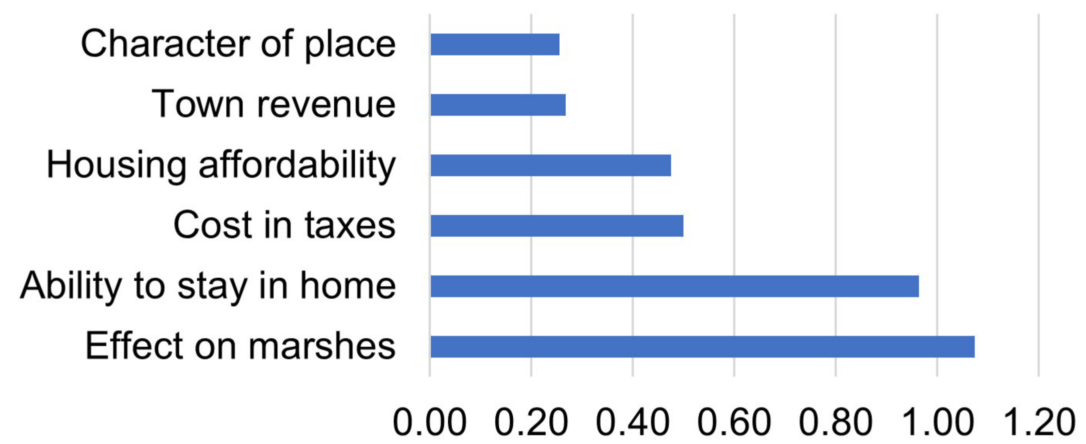
SLR Expectation



Community Concerns



Evaluation Criteria



Sources:

1. Boyd, J., et al., The Rhode Island Sea Level Affecting Marshes Model (SLAMM) Project. 2015, Rhode Island Coastal Resource Management Council: Wakefield RI. p. 30.
2. Kirwan, M.L., et al., Sea level driven marsh expansion in a coupled model of marsh erosion and migration. Geophysical Research Letters, 2016. 43(9): p. 4366-4373.
3. Elevating Drowning Salt Marshes | Rhode Island Sea Grant. 2020. https://seagrant.gso.uri.edu/elevating-drowning-salt-marshes/

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