

Coffee, Climate and Conversation: *“Resilience in Landscapes”*

A Roundtable hosted by:



ENVISION RESILIENCE
NANTUCKET



Coffee, Climate and Conversation

“Resilience in Landscapes”

Jennifer Karberg, PhD

Nantucket Conservation Foundation
Research Program Supervisor

jkarberg@nantucketconservation.org

Sarah Bois, PhD

Linda Loring Nature Foundation
Director of Research and Education

stb@lfnf.org

Emily Molden

Nantucket Land Council
Executive Director

emily@nantucketlandcouncil.org

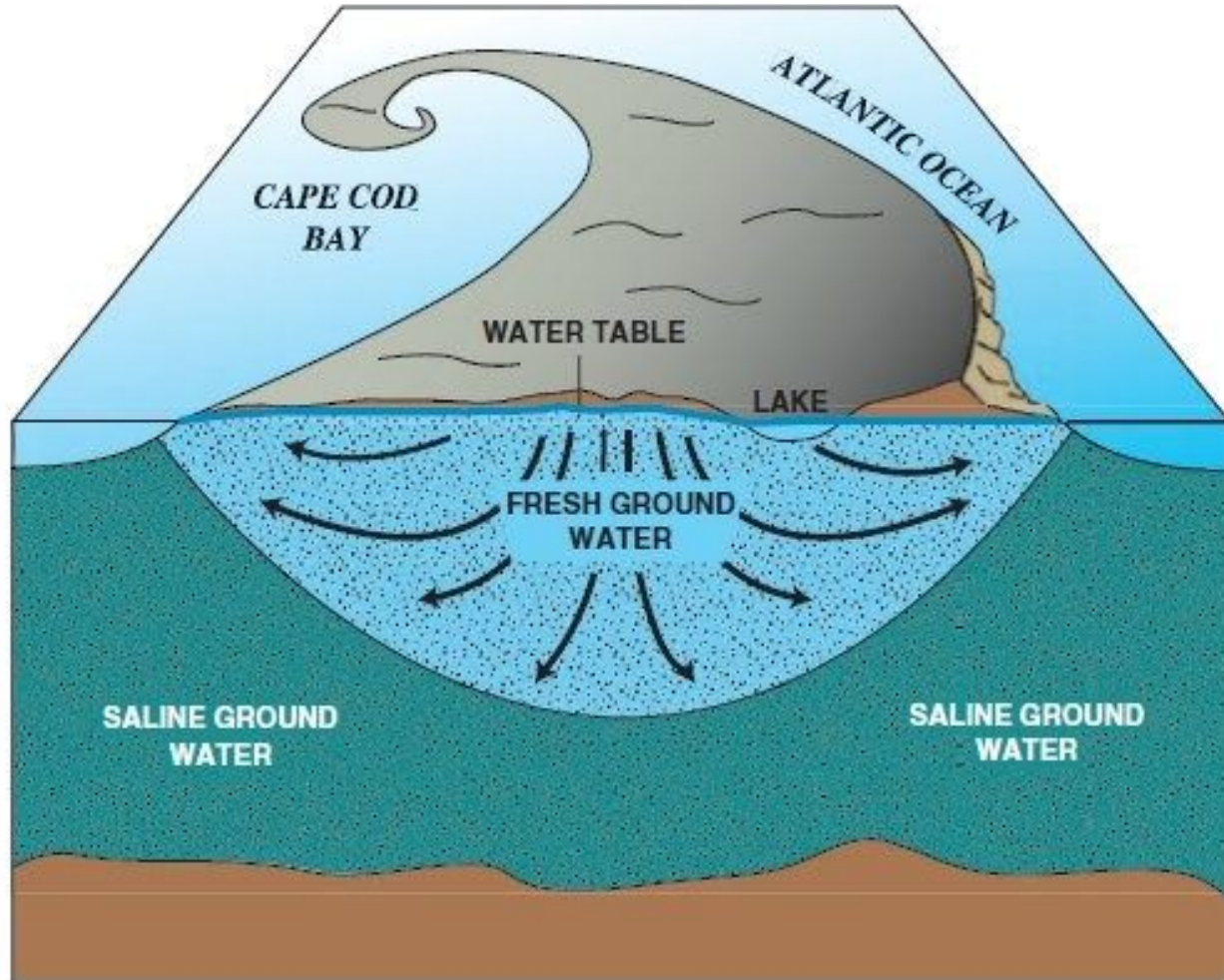
Today Emily, Sarah and I are going to talk about climate change on Nantucket but we aren't talking specifically about sea level rise or erosion.

We want to look at the other ways climate change will and already is impacting Nantucket.

Following is an introduction to climate change impacts that are less talked about. Once we introduce those, we circle back to talk about the Hope for Nantucket, the resilience already present in our open space, our conservation lands, our advocacy and education and our research on island.

Groundwater Impacts

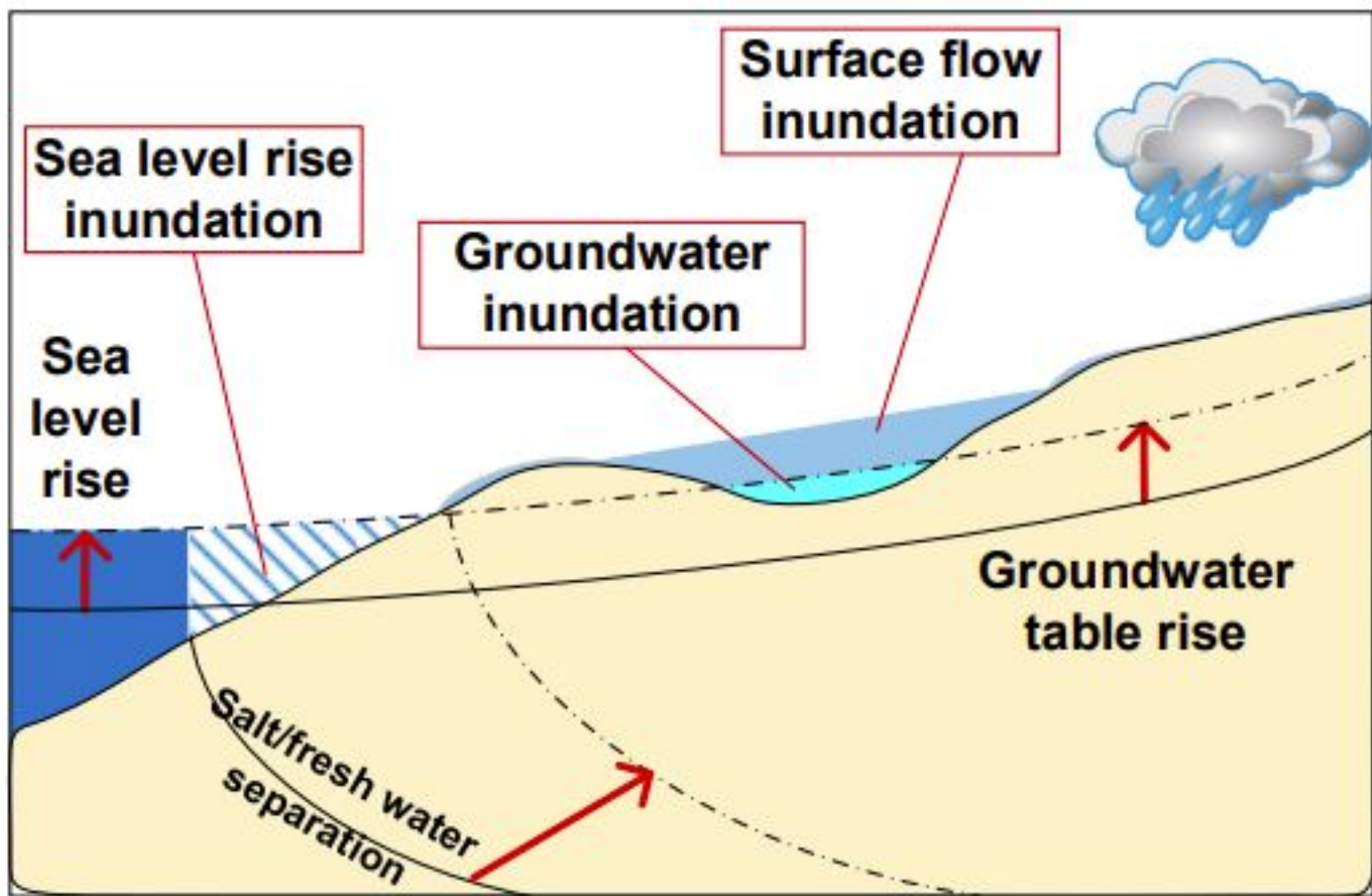
- Nantucket Island has a sole source aquifer similar to the one on Cape Cod.
- Freshwater underlies our island, serving as our freshwater source
- Water table: distance of groundwater below the soil surface
- Where the water table is higher than the soil, we get wetlands, ponds, lakes etc.
- The fresh groundwater and water table will be impacted by rising sea levels.



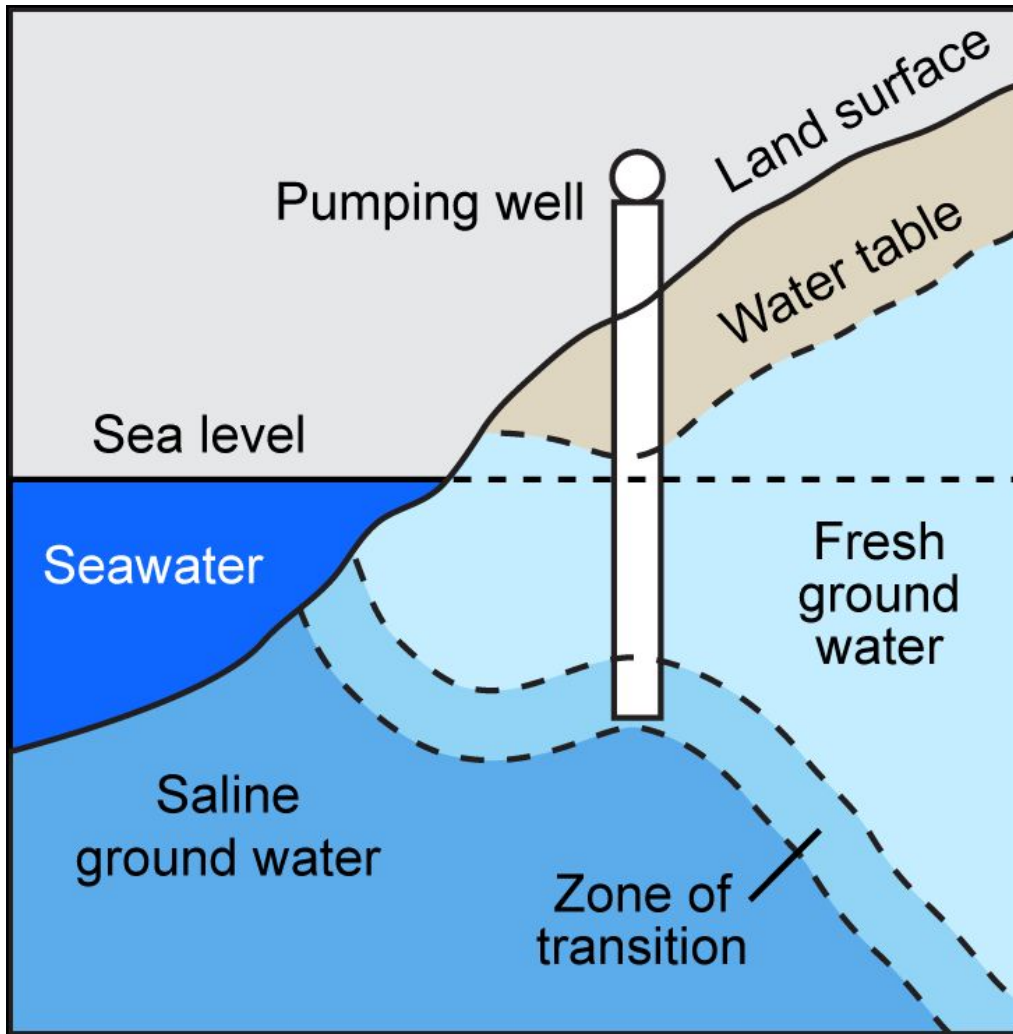
Source: USGS

As sea level rises, the salt/freshwater boundary will move farther inland, particularly on coastal shorelines.

This diagram shows that movement farther inland.



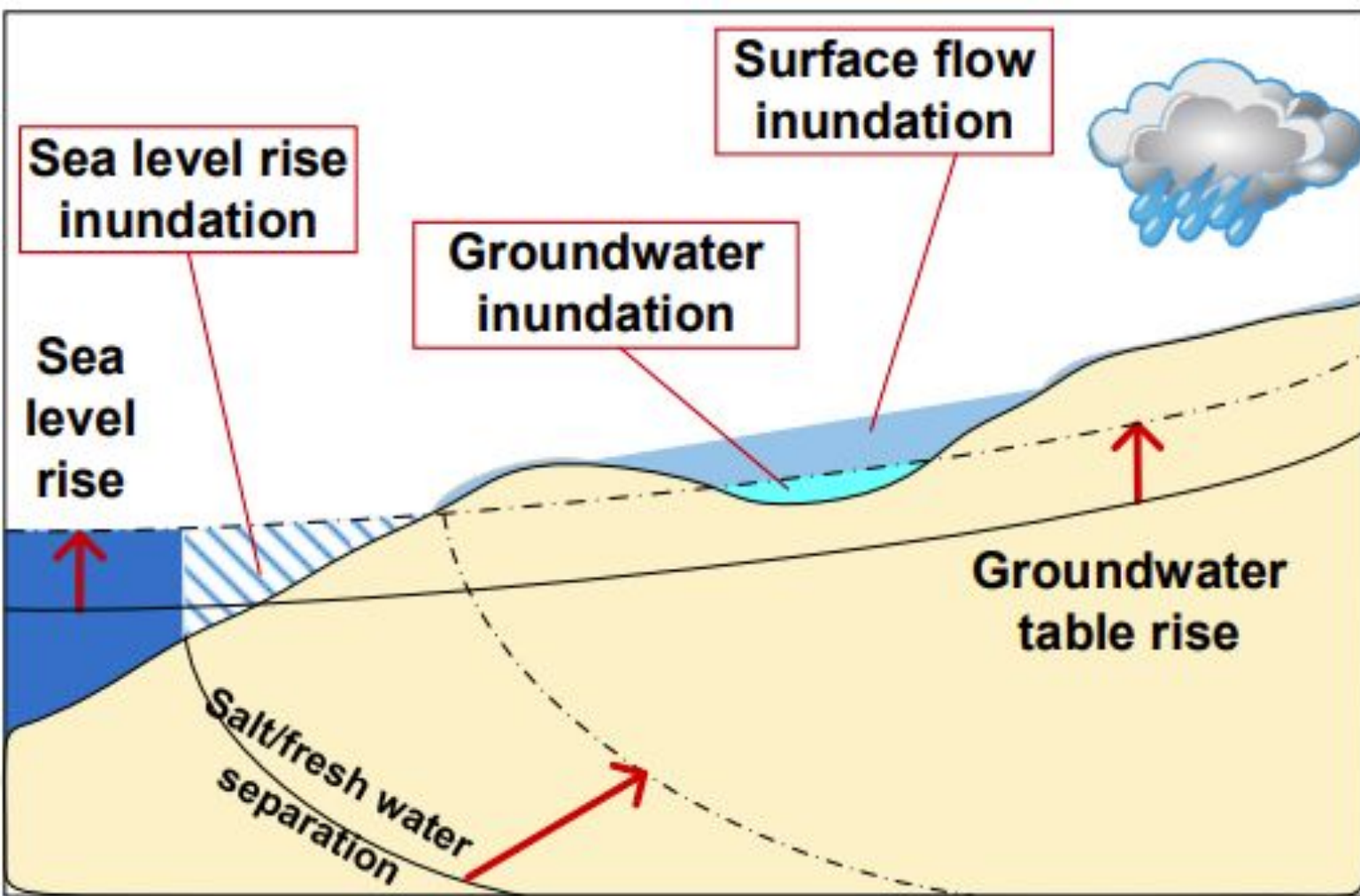
Salt water intrusion



As the salt/freshwater barrier gets pushed inland, the risk of salt water intrusion into drink wells and natural wetlands increases dramatically.

Some areas in Madaket already see brackish conditions in drinking water wells - this will increase as the groundwater levels are shifted by sea level rise.

source: US Environmental Protection Agency



Rising sea levels will also cause the water table to rise up, towards the soil surface.

Estimates by the USGS on Cape Cod predict 2ft of water table rise with a 6ft rise in sea level.

Rising water tables means less distance to wet soil or water below the soil surface.

Increase wetland areas, decreased distance between groundwater and septic systems, more water in basements, issues with buried electrical lines etc.



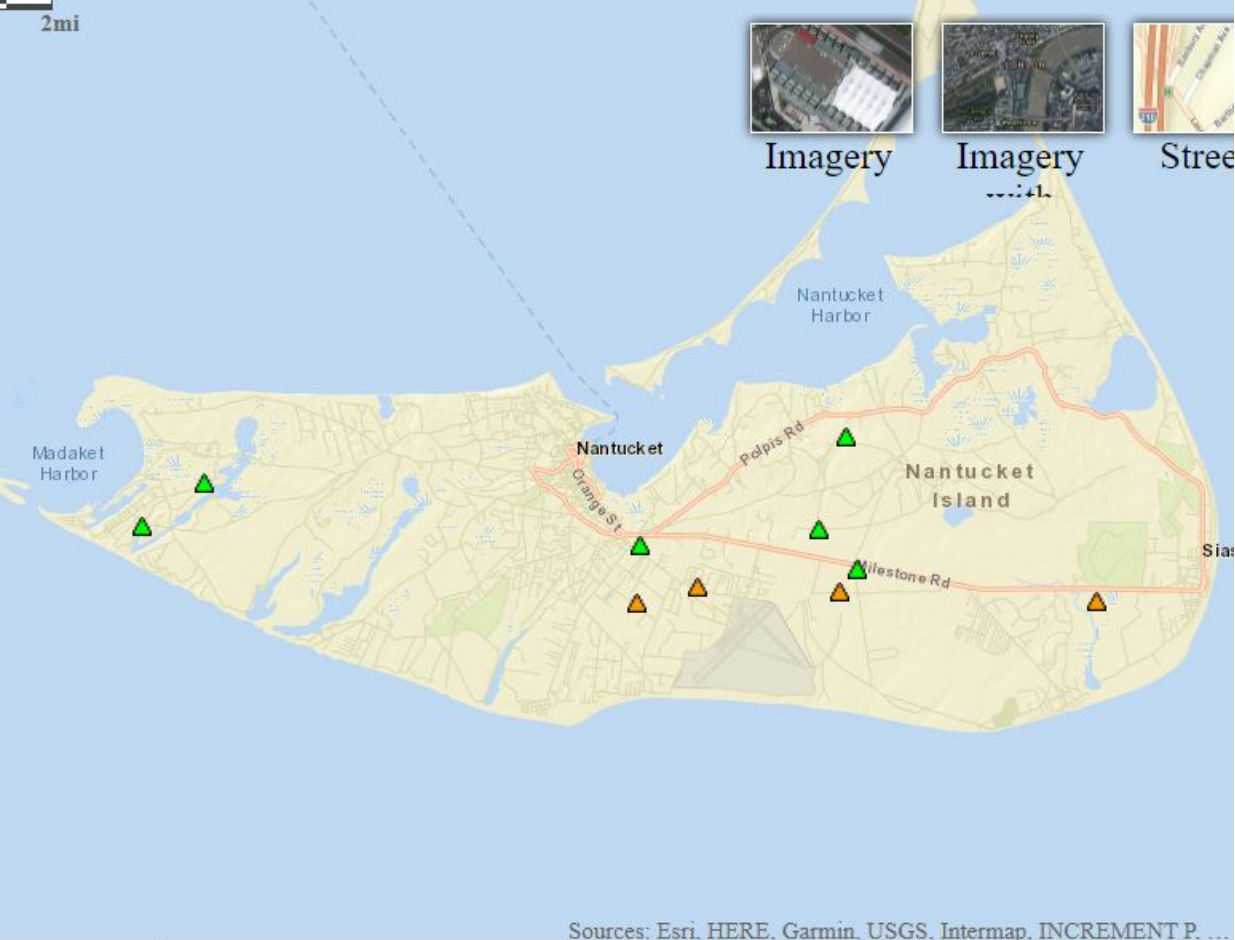
Imagery



Imagery



Street



We can make predictions on Nantucket: The USGS maintains 10 groundwater level sampling wells. These wells are sampling every month by the Nantucket Land Council for over 40 years.

Currently groundwater averages 6-12ft below our soil surface but can be much shallower in places.

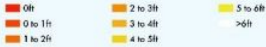
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, ...

Explanation - Percentile classes (symbol color based on most recent measurement)								Wells	Springs
●	●	●	●	●	●	●	●	○ Real-Time	■
Low	<10	10-24	25-75	76-90	>90	High	Not Ranked	□ Continuous	■
	Much Below Normal	Below Normal	Normal	Above Normal	Much Above Normal			△ Periodic Measurements	■

Present Depth to Groundwater

1:35,000

0 0.25 0.5 Miles

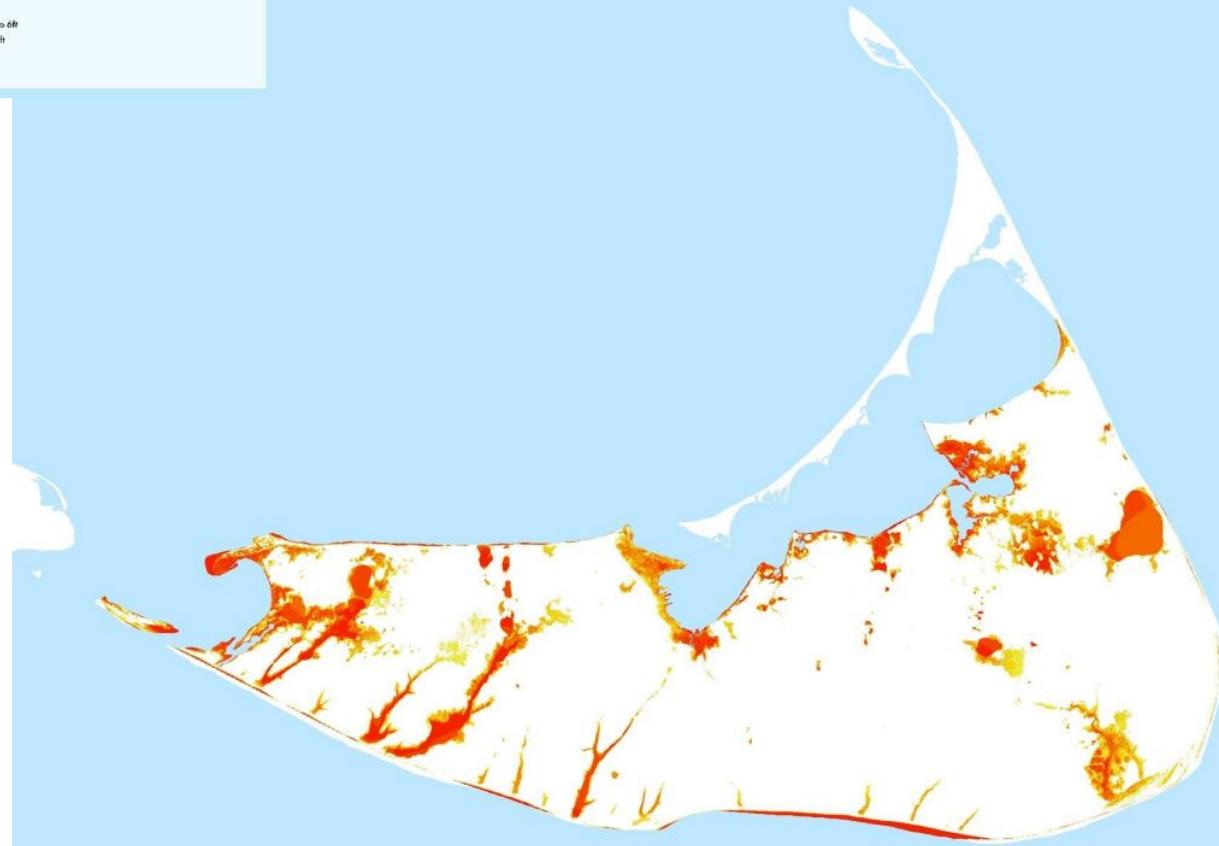


Red to orange colors indicate areas where current groundwater is 0-2ft below the soil surface. With predicted 2ft rise - we could see groundwater at the soil surface in more places in the next 30-50 years.

And these impacts will be seen farther away from the shore than sea level rise.

Groundwater rise is predicted to be seen up to 3 times farther inland than rising seas.

The data is available to begin making these predictions for Nantucket.



Source: Nantucket Draft Coastal Resilience Plan, Arcadis, 2021

Easton St



The circle at Easton St near Brant Point: this has been a mown grass park but the southwestern corner now has freshwater wetland plants.

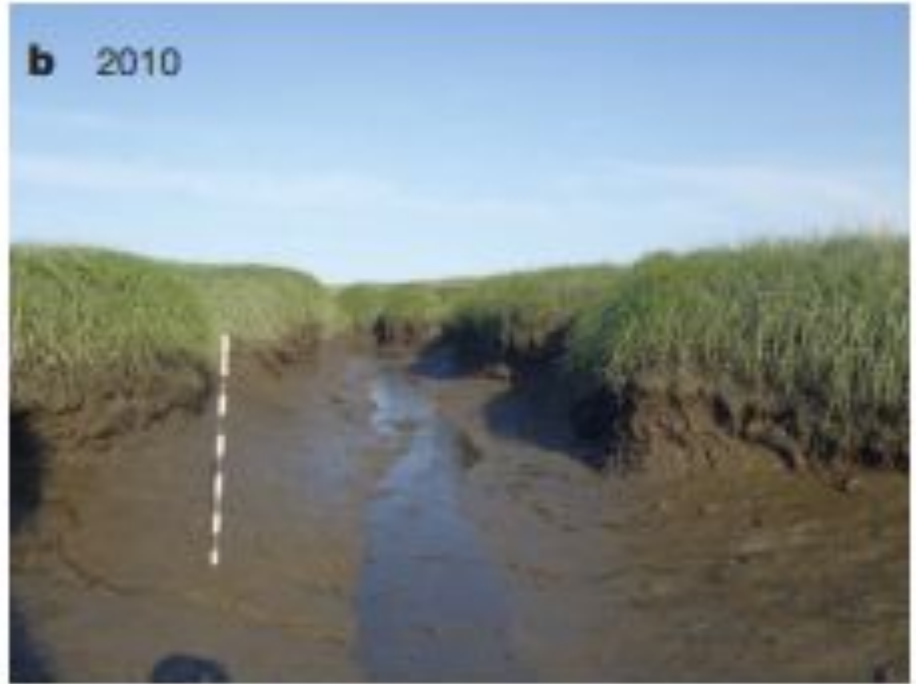
This shows an impact of more than just occasional storms - groundwater needs to be at the plant roots for greater than 75 days in the growing season to convert to wetland plants.

Salt Marshes and Sea Level Rise



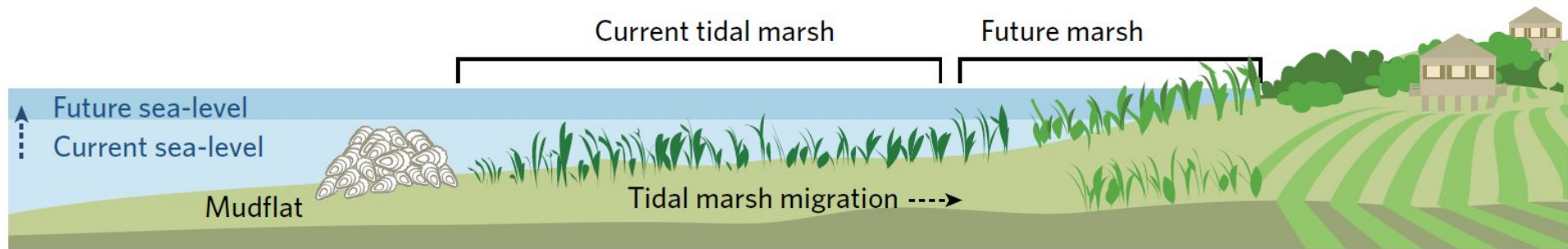
Switching gear to salt water wetlands: salt marshes are excellent at holding, storing and managing storm surge and floods. As long as they remain healthy....

Extra Nutrient input can harm salt marshes



Salt marshes naturally filter excess nitrogen and phosphorus that runs off uplands. But current research is seeing a tipping point, too much nutrient in the salt marshes is leading to salt marsh death. As the salt marsh dies and erodes away, it can no longer buffer uplands during storms.

Source: Johnson et al. 2016 Saltmarsh plant response to eutrophication. *Ecological Applications* 26:2649-2661



Salt marshes are designed to migrate naturally. As salt water moves up elevation, salt marsh plants move with. This process has happened slowly across the landscape for a long time. In general, Nantucket's salt marshes will keep up with sea level rise for the next 40-50 years....IF nothing gets in the way of migration.....

Folger's marsh during a high tide/storm surge

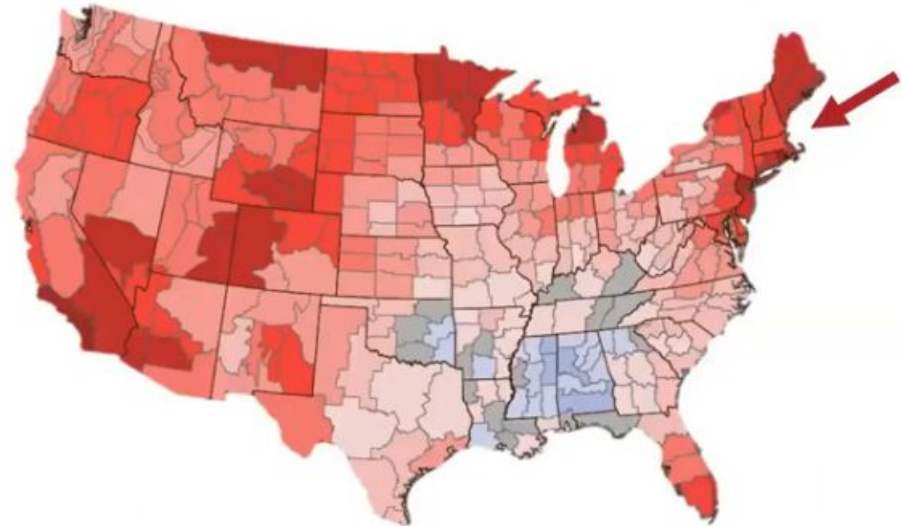
Many salt marsh areas on Nantucket contain barriers to migration from roads to lawns to houses to bulkheads. These restrictions create a serious impact to local salt marsh resilience.



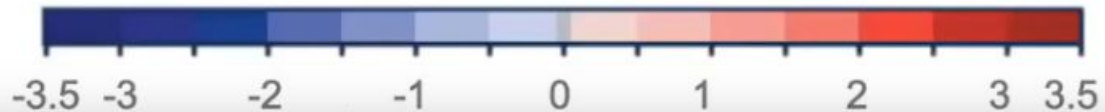


New England Warming

- New England air temperature has warmed by 1.7 °C (~ 3°F) since 1901



Rate of temperature change 1901-2015 (°F/100 years)

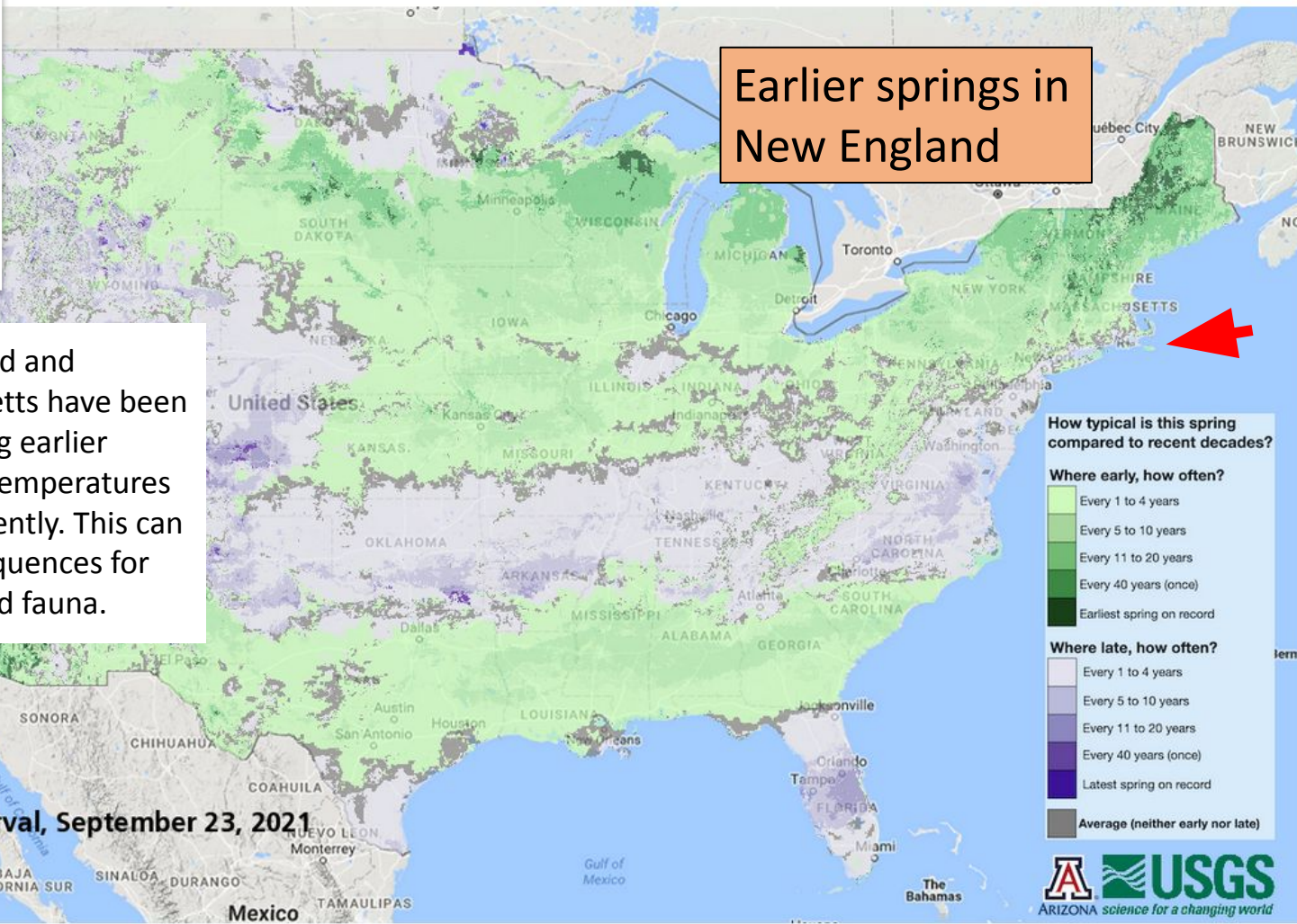


EPA 2016, Hayhoe et al.
2007



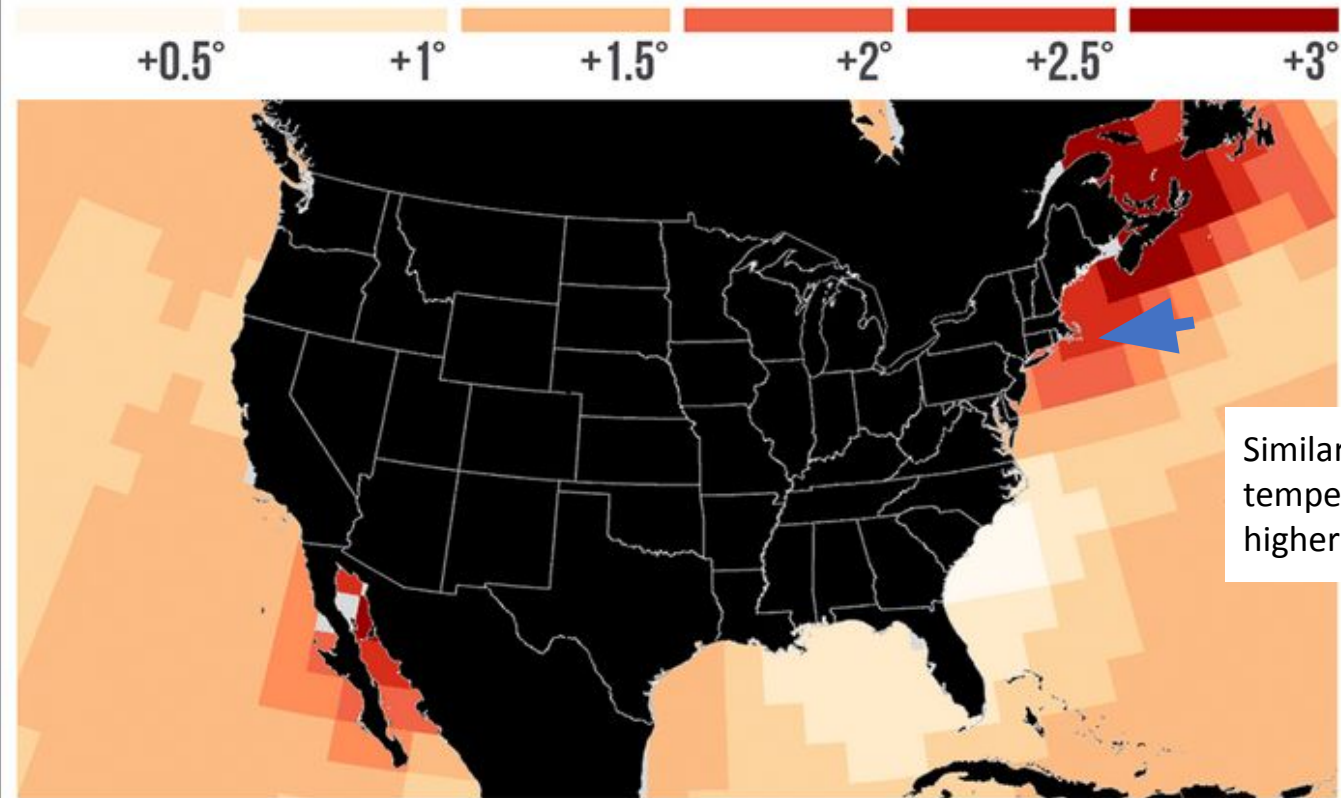
Earlier springs in New England

New England and Massachusetts have been experiencing earlier spring-like temperatures more frequently. This can have consequences for our flora and fauna.



Ocean Warming

Change in average ocean temperature since 1901



Similarly our sea surface temperatures are warming at higher rates in New England.

Change in annual sea surface temperatures (°F) 1901-2018. (gray indicates insufficient data)
Source: NOAA Extended Reconstructed Sea Surface Temperature (ERSST) V5 dataset

Ecological, economic, and cultural impacts

Migration



Invasive species



Eastern Tent Caterpillars



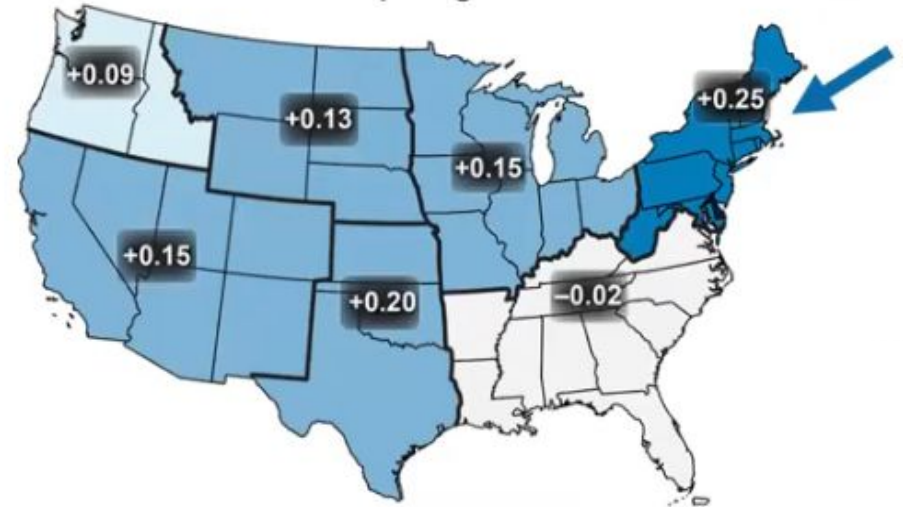
Native flowering and fruiting

Precipitation changes; Amount changes and timing is variable

- 10% increase in precipitation over the last 50 years in Massachusetts

Change in daily precipitation 1948-2015

Spring



Change (inches)



Increased erosion, flooding potential, and storm water runoff



Changes to precipitation can come in the form of more frequent storms or more heavy rain in episodic events leading to increases in erosion, potential flooding, and stormwater runoff.



Climate Change Impacts on Freshwater Ponds

An aerial photograph of a large, winding freshwater pond system. The water is a deep blue-grey color, reflecting the sky. The pond is surrounded by lush green vegetation, including grasses and trees. In the foreground, a wooden dock extends into the water. The background shows a residential area with houses and more greenery under a clear sky.

Increasing storm intensity with shorter periods of heavy rainfall results in greater surface run-off, “stormwater” as well as erosion of soil and sediments. This type of run-off carries more pollutants directly into water bodies without the filtration through soils and vegetation that we see with longer soaking rains.

Increasing Precipitation and Temperature



Increasing atmospheric temperatures and changes in the duration of our growing season results in warmer water for longer periods of time. These changes impact not only fish and faunal species but also aquatic vegetation AND algae. Changing conditions will allow blue-green algae to outcompete other species and ultimately result in an increased incidence in Harmful Algal Blooms (HABs).

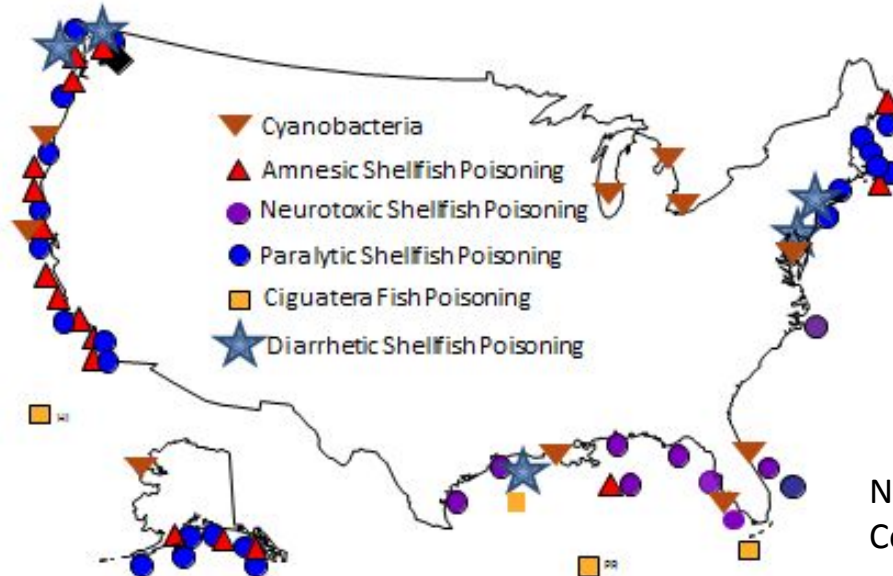
Climate Change Impacts on Marine Systems

An aerial photograph of a coastal region. A long, narrow, sandy island stretches across the middle of the frame, separating a large body of blue water on the left from a smaller bay on the right. The water is a vibrant blue, with some whitecaps visible. In the foreground on the right, there is a cluster of houses with grey roofs and white walls, surrounded by green grass and trees. The sky is a clear, light blue with a few wispy clouds near the horizon.

Higher intensity rain events will also contribute to increasing pollutant loads through more direct run-off to our marine environments and harbors.

Marine Harmful Algal Blooms

Coastal HABs causing public health problems



Changing conditions will also result in an increase in algal blooms in our harbors and nearshore environments.

NOAA's National Centers for Coastal Ocean Science (NCCOS)

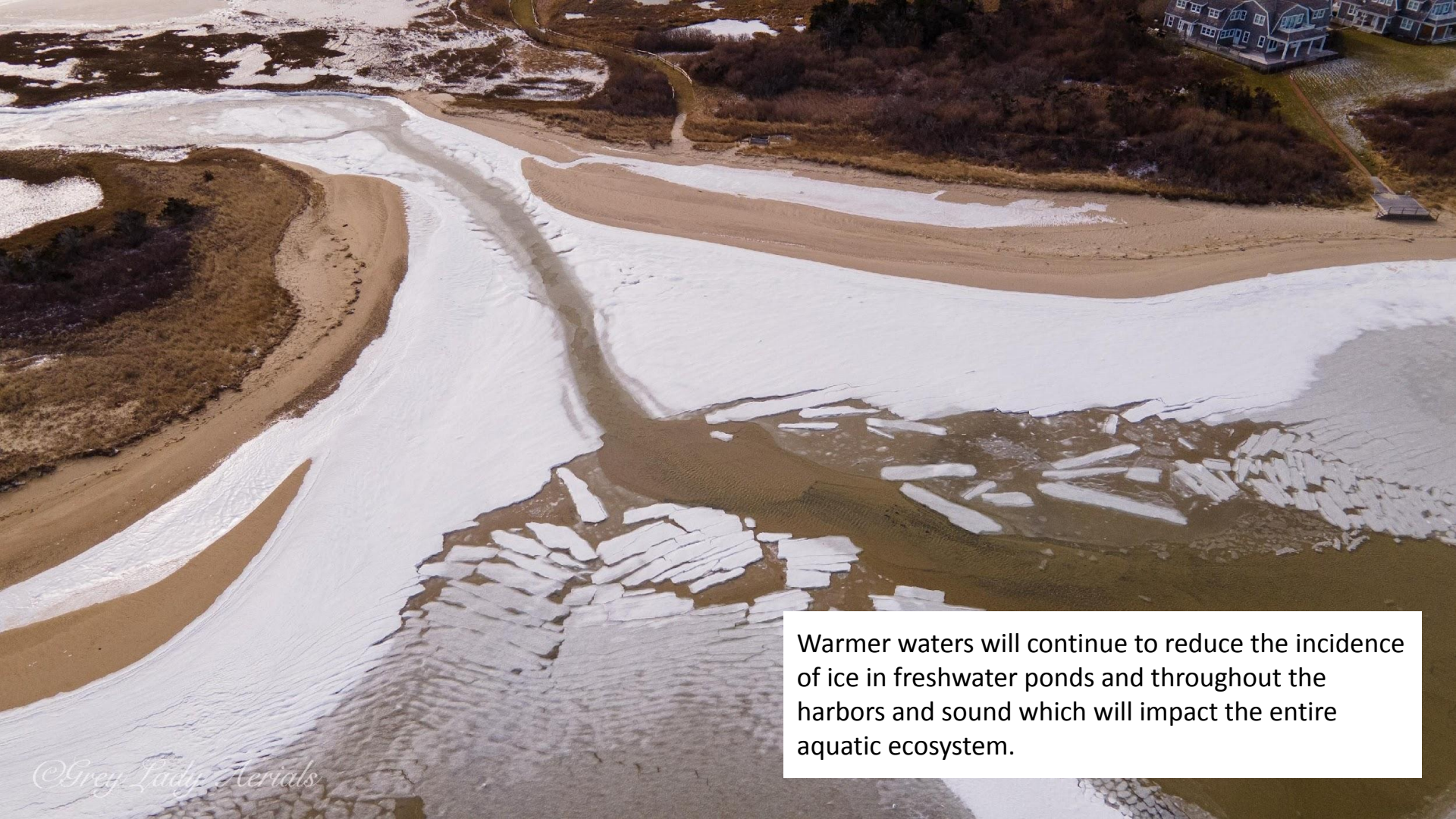


Water quality in Nantucket Harbor is hugely influenced by physical characteristics including shape and depth as it relates to overall circulation.

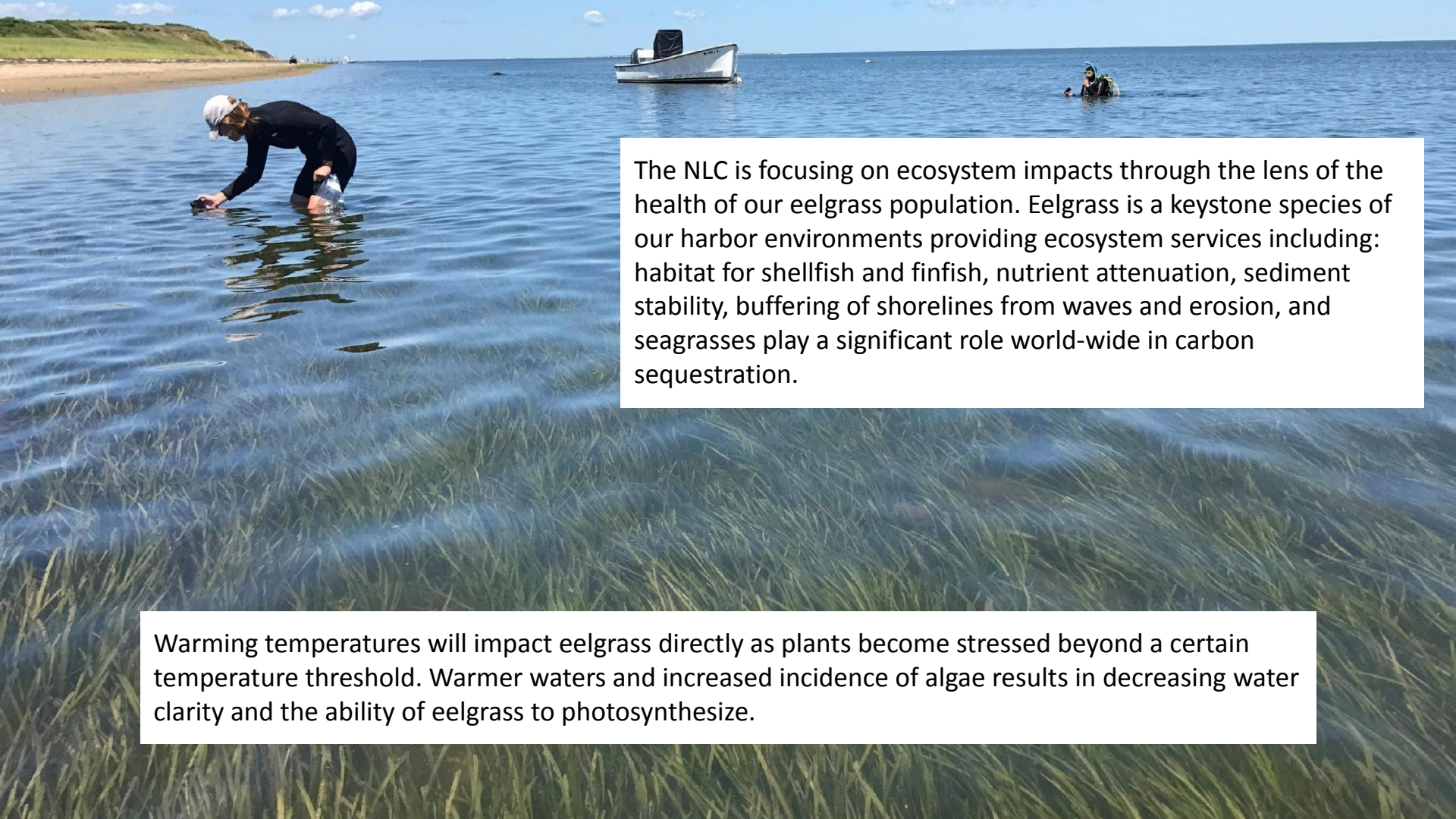
Erosion, Sand Movement, and Circulation



Factors like storm intensity, sea level rise and erosion will impact the shape and dynamics of circulation throughout the harbor in the future which may also impact flushing rates in unknown ways.



Warmer waters will continue to reduce the incidence of ice in freshwater ponds and throughout the harbors and sound which will impact the entire aquatic ecosystem.



The NLC is focusing on ecosystem impacts through the lens of the health of our eelgrass population. Eelgrass is a keystone species of our harbor environments providing ecosystem services including: habitat for shellfish and finfish, nutrient attenuation, sediment stability, buffering of shorelines from waves and erosion, and seagrasses play a significant role world-wide in carbon sequestration.

Warming temperatures will impact eelgrass directly as plants become stressed beyond a certain temperature threshold. Warmer waters and increased incidence of algae results in decreasing water clarity and the ability of eelgrass to photosynthesize.

Eelgrass Migration

Can eelgrass migrate in response to rising sea level? This will depend on the rate of change and whether or not it has anywhere to go.



Nantucket has HOPE for Climate Change



Grey Lady Aerials

slide created by: Jen Karberg

Nantucket's Inherent Resilience

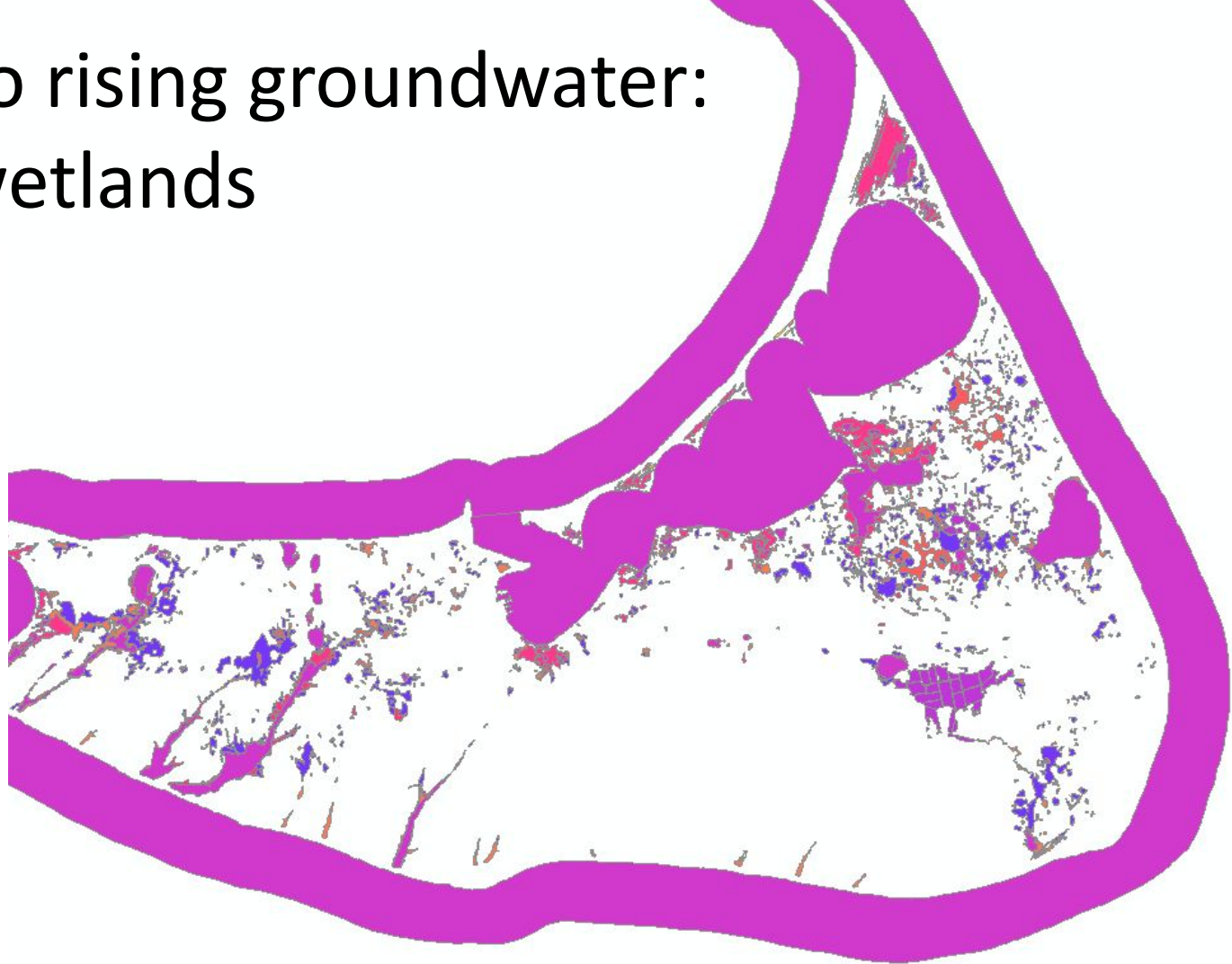
Resilience comes in many forms and while the impacts of climate change to Nantucket are many, so is hope in the form of our resilience.

Nantucket has many active conservation organizations conducting research, educating the community, advocating for resilience and simply protection resilience open space from conservation.

Resilience to rising groundwater: protected wetlands

State and local regulations protect wetlands and the buffers around these wetlands. Examining and potentially increasing those buffers may protect areas where groundwater will rise in the future.

Looking at the current extent of wetlands on island, we can predict where groundwater will rise and take active steps: conservation, reduce development and alter development that will be an issue.



Depth to Groundwater, 2050

Depth to groundwater mapping based on publicly available data from USGS groundwater wells. Data should be used for planning purposes on only.



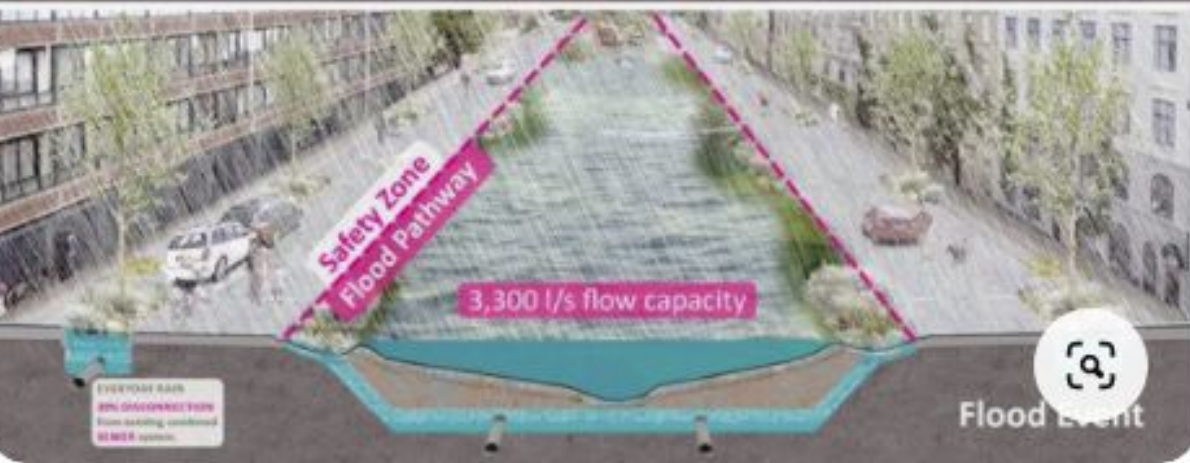
Predictions of groundwater depths in 2050.

Many areas will groundwater will rise, will already be impacted by sea level rise - and Nantucket is making plans to adapt already.

But inland areas will see more freshwater as well. Luckily - many of these areas are already conservation land. Management and protection of this resilient open space will help give the water a place to go.

Source: Nantucket Draft Coastal Resilience Plan, Arcadis, 2021

Rising Groundwater - give the water space



Salt marsh health can be protected through enhanced fertilizer regulation and active marsh management.

Of the ~1600 acres of salt marsh on Nantucket, the Nantucket Conservation Foundation owns ~1200 - giving a lot of protection.

We are examining our salt marshes to look for health as well as restrictions to migration.

The sand road to the north of Eel Point road was closed 2 years ago - already the salt marsh is moving into the road and migrating away from rising seas.





Polpis Rd represents a major restriction to Folger's marsh migration. It's also a human health and safety issue when Polpis rd becomes impassable during storm surge - it's a spot to improve both ecology and community function. While a bigger culvert will allow water to move under the road, we advocate for a bridge to increase salt marsh resilience.

Bridges over salt marshes, as seen here, allow the actual salt marsh, and all of it's value as a resilient habitat, to migrate under the road. Culverts tend to allow just water to move under the road.



image envisions returning Washington St. Extension back to a salt marsh while giving space for human use.





And the last option is to gain more salt marsh area, buy more time, by building the salt marsh out!

Oyster castles reefs like the one pictured here slow down harbor water and waves. Placed in front of a salt marsh, they reduce marsh erosion and loss.

They may also create a low energy wave area so that sediment accumulates and salt marshes build out towards the oyster reef. This can be passive or assisted migration and can help gain salt marsh area where migration is not possible.

NCF is piloting a similar project in Polpis Harbor starting 2021.

A completed array of oyster castles at Chincoteague NWR. Credit: TNC
slide created by: Jen Karberg

Open space as a coastal resiliency asset

An aerial photograph of a coastal wetland landscape. The scene features a large, irregularly shaped blue pond in the upper left quadrant, surrounded by vibrant green marshland. The marshes are interspersed with sandy and silty channels and smaller pools of water. In the background, the ocean stretches to the horizon under a clear sky. The overall impression is of a healthy, natural coastal ecosystem.

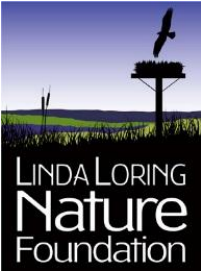
- Open space as space for mitigation strategies
- More resilient landscapes
- Reduce carbon emissions and improve air quality
- Maintain habitat health and connectivity

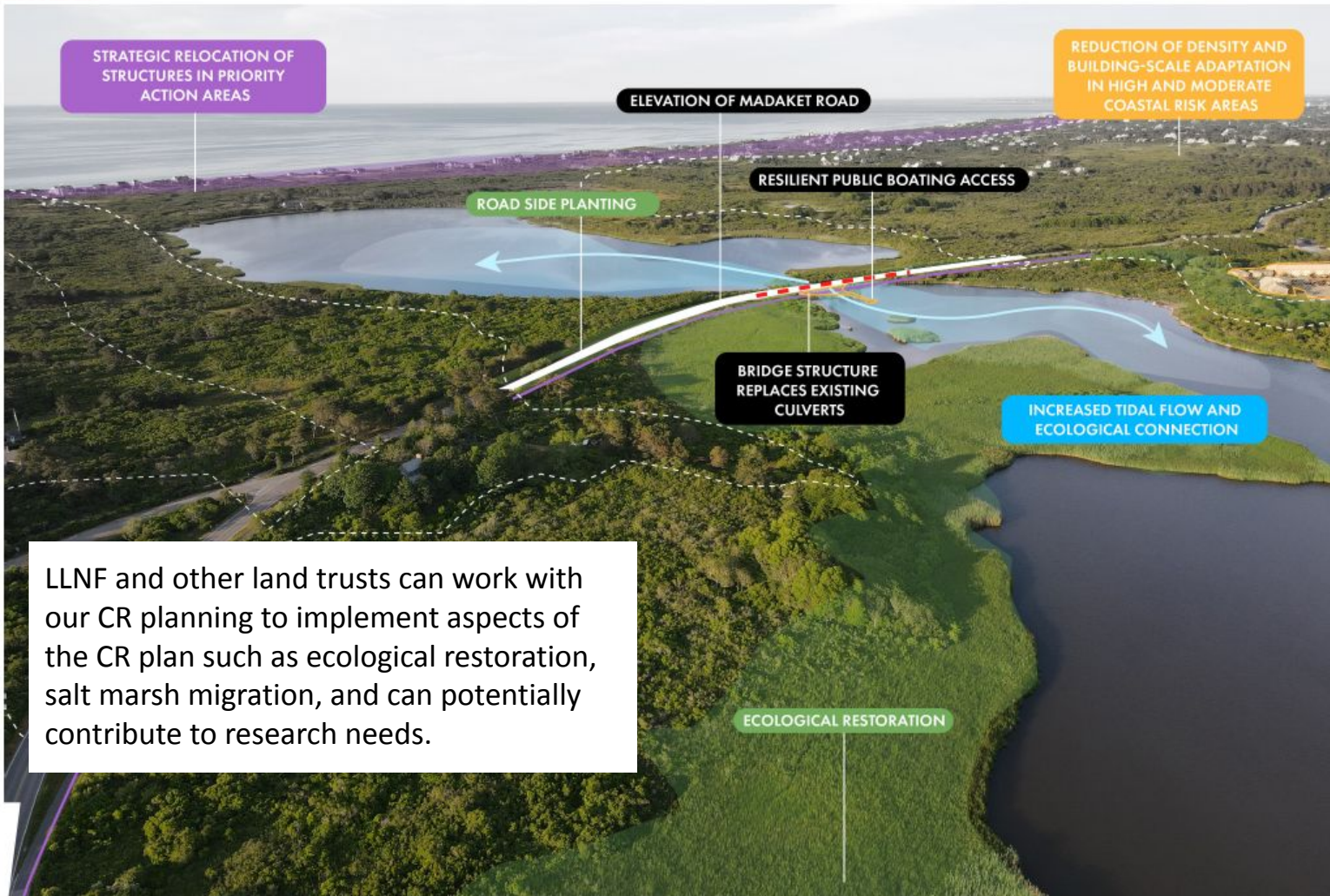
Observe, record, and communicate

At the Linda Loring Nature Foundation we research, record, and communicate about many different types of climate change impacts. Go to llnf.org to learn about all of these research and monitoring topics.



This map of the Linda Loring Nature Foundation at 3, 6, and 9ft sea level rise illustrates how the land can act as mitigation for climate change impacts.





STRATEGIC RELOCATION OF STRUCTURES IN PRIORITY ACTION AREAS

ELEVATION OF MADAKET ROAD

REDUCTION OF DENSITY AND BUILDING-SCALE ADAPTATION IN HIGH AND MODERATE COASTAL RISK AREAS

ROAD SIDE PLANTING

RESILIENT PUBLIC BOATING ACCESS

BRIDGE STRUCTURE REPLACES EXISTING CULVERTS

INCREASED TIDAL FLOW AND ECOLOGICAL CONNECTION

ECOLOGICAL RESTORATION

LLNF and other land trusts can work with our CR planning to implement aspects of the CR plan such as ecological restoration, salt marsh migration, and can potentially contribute to research needs.



COASTAL RESILIENCE ADVISORY COMMITTEE



STOSS

one architecture

THE CRAIG GROUP

Your partners in preservation, planning and policy

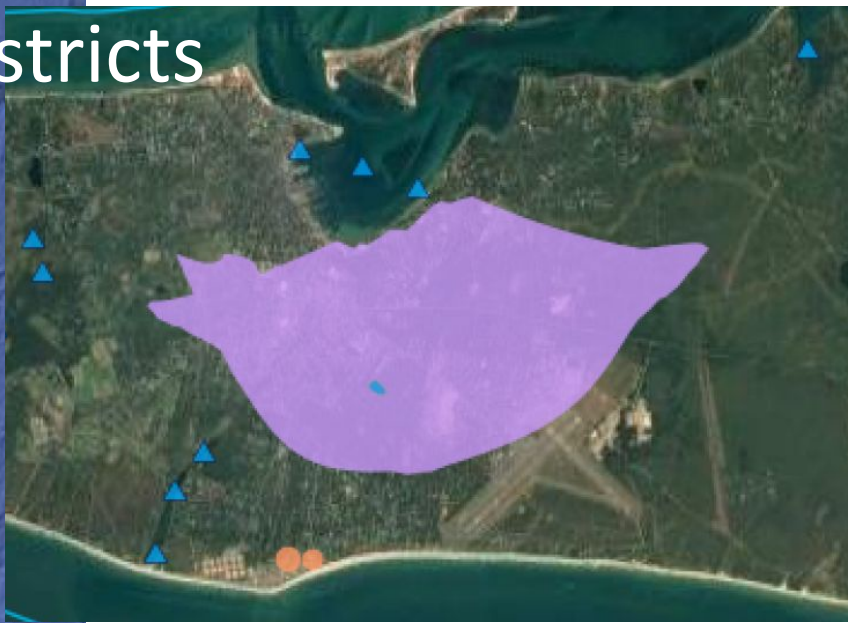


A biologically diverse landscape is a more resilient landscape



© 2024 Google

Wellhead Protection Districts



Resilient Landscapes on Nantucket are supported by the open space and habitat protection work that our community has championed for decades. The NLC's core advocacy work is all about facilitating small scale changes across private properties that contribute to a greater mission. Island wide policy and regulations are what guide the overall use and management of all land, and are equally as important as property specific stewardship. Regulations implemented in our wellhead protection districts protect the quality of our island water supply.

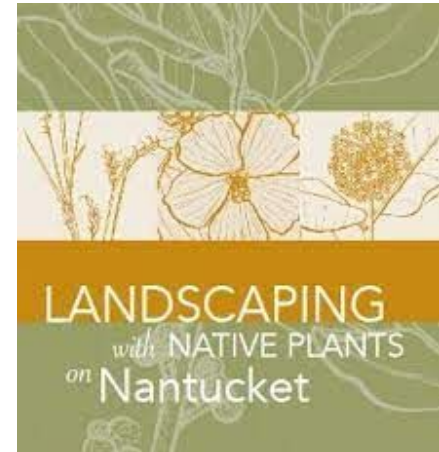
Fertilizer Management and Reduction

Best Management Practices for Landscape Fertilizer
Use on Nantucket Island

Prepared by the Article 68 Work Group
2010-2012



Guidelines for
Landscape Fertilizer
Use on
Nantucket Island



Fertilizer regulations require BMP's
to reduce impacts from nutrient
pollution on our waters.



Policy and Regulations...

We must continue to uphold and/or improve protection of our coastal resources via our wetlands bylaw and the standards of our local and critical wetland protection regulations, as well as general island wide policies and zoning specific changes that directly address how we continue to use and develop our properties.

"We cannot retreat until we stop advancing".

We must work as a community to "REIMAGINE" our policies based on our best projections about the future.

An aerial photograph of a large, irregularly shaped freshwater pond. The water is a murky greenish-brown color. The pond is surrounded by dense green vegetation, including grasses and shrubs. In the background, there are several houses and buildings, suggesting a residential area. The ocean is visible in the upper left corner, with a clear blue sky above it.

Freshwater Ecosystem Monitoring and Management

© Gretchen Gigi Callahan

Ongoing monitoring of island ponds and HABs help educate and communicate about local conditions as well as build the knowledge needed to determine the best ways to manage the systems in the future.



Create an Account - Increase your productivity, customize your experience, and engage in information you care about.

Sign In



Town & County of NANTUCKET, MA

- Coronavirus
- Government
- Services
- Business
- Community

Harmful Algal Blooms Monitoring Program

Nantucket Pond Coalition

Pond Openings

Sampling Sites & Watershed Protection District

Home > Community > Water Quality > Harbors & Ponds > Harmful Algal Blooms Monitoring Program

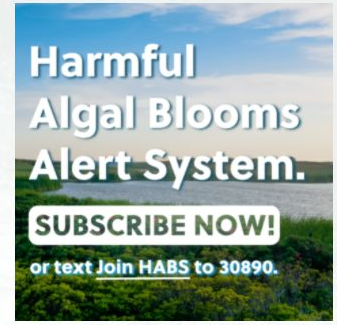
Harmful Algal Blooms Monitoring Program

The Town of Nantucket, in collaboration with Nantucket Land Council, Nantucket Conservation Foundation, Nantucket Land Bank, Linda Loring Nature Foundation, UMASS Boston, and Mass Audubon monitors the following ponds for harmful algal blooms (HABs) weekly from June through September: Long, North Head of Long, Miacomet, Sesachacha, Capaum, Gibbs, Hummock, Clark's Cove (West Hummock Pond), Maxcy, Washing, Tom Nevers, Stump, Almanac, Wigwam, Pout, and UMASS Boston's Nantucket Field Station (NFS) Ponds.

HAB Monitoring Sites Map

The Following Sites Have Blooms Occurring:

- [Gibbs Pond](#)
- [Head of Hummock Pond](#)
- [South Clark's Cove](#)
- [Sesachacha Beach \(Quidnet side\)](#)



Select Language

Eelgrass Health Assessments and Restoration



We have begun a long term monitoring program of the island's eelgrass beds in Nantucket and Madaket Harbors. These health assessments will continue to help us understand the stresses they face and some ways we can intervene from a restoration perspective. We are collecting long term light and temperature data to monitor changes as our climate warms.



We are continuing to pursue eelgrass transplanting off Monomoy and are gearing up to add a seeding program in collaboration with the Town NRD next year.



We continue to investigate additional variable impacting eelgrass including boat use and an increasing population of the invasive European green crabs.

Collaborations: Nantucket Biodiversity Initiative

“nearly 20 years promoting biodiversity”



Nantucket organizations collaborate on data collection and education about how to build a more resilient environment!



Nantucket Field Station

Nantucket Memorial Airport

The Trustees of Reservations



Collaborations: ACKlimate Nantucket

Promoting Climate Action Through Community Engagement



THANK YOU!

Questions and Conversation...



@Grey Lady Reports