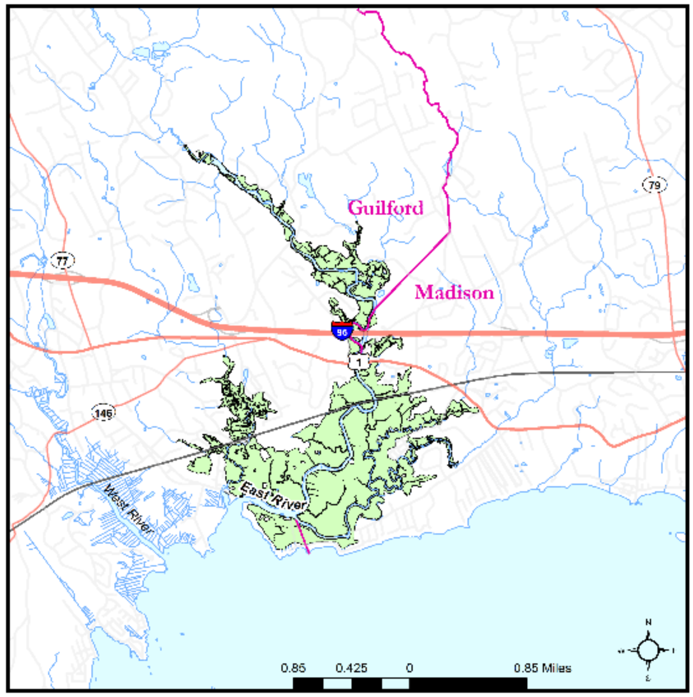
East River Marsh Resilience Assessment

Guilford & Madison, CT

Background

The East River Marsh (ERM) complex includes more than 800 acres of tidal wetlands and at least as much associated coastal woodlands, streams, inland wetlands, vernal pools, and grasslands. It provides critical *ecosystem services* such as nursery, nesting, feeding, and shelter habitat for many migratory and resident fish and wildlife, including marsh-dependent and forest interior-dependent birds and shellfish beds. The marsh filters pollutants, stores greenhouse gases and moderates flooding and shoreline erosion, protecting coastal communities' shoreline infrastructure and homes during storms. The marsh and adjacent uplands also offer significant recreational and aesthetic resources and include sites of historical significance.

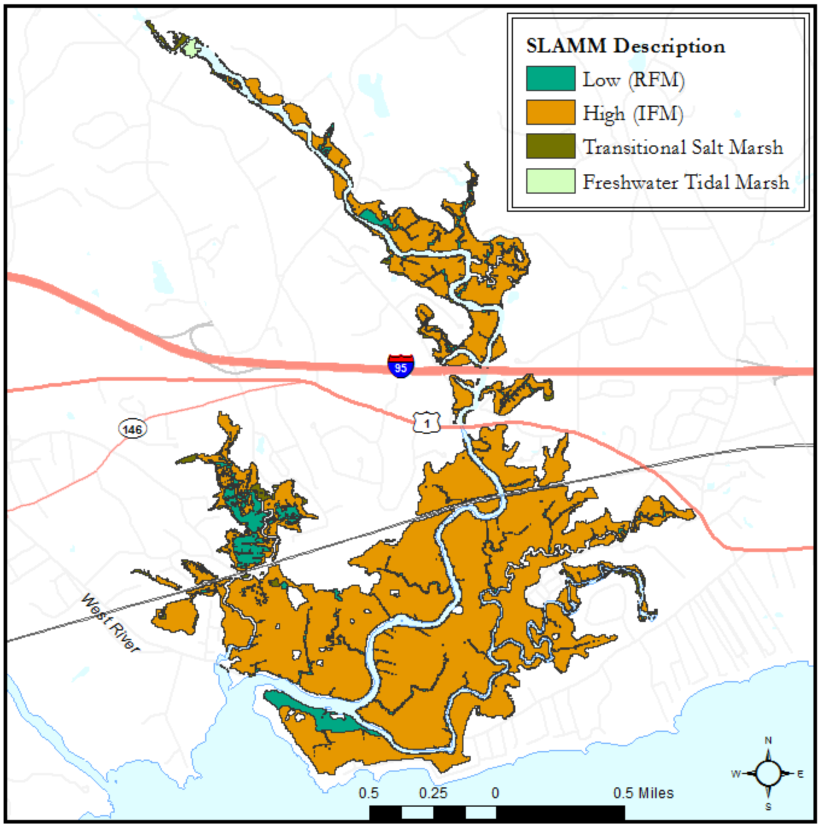
Figure 1
East River Marsh (2010)



Over the past century, parts of the ERM have been filled, dredged, or otherwise altered through the construction of roads, railroads, mosquito ditches and marsh-front development. Although among Connecticut's most productive ecosystems, coastal marshes like the ERM are also the most vulnerable to a more a recently recognized threat – accelerating rates of long term sea-level-rise (SLR). This assessment of the resilience of the ERM to SLR provides a 'blueprint' for developing a strategy to address these threats.

Altered marshes, already experiencing loss in ecosystem services, may also be the most susceptible to the adverse effects of SLR. To better understand how Connecticut's coastal marshes and roads may respond to sea level rise, the **Sea Level Affecting Marshes Model** (SLAMM) [1] was applied to Connecticut's shoreline. Model results indicate that a rising sea could significantly change Connecticut's coastal marshes and increase coastal area road flooding frequencies, potentially prompting road flood-proofing reconstruction projects that could further alter coastal marshes. A summary of the model's results can be accessed through the *Sea Level Rise Effects on Roads and Large Marshes Data Viewer* results page[2] available through Connecticut Environmental Conditions Online (CT ECO) at https://cteco.uconn.edu/viewers/.

Figure 2
Existing East River Marsh Types



Existing Conditions

- The ERM's 886 acres of salt, brackish, transitional, and freshwater tidal wetlands, and associated mud flats, creeks, and pools/ponds comprise the largest high-marsh dominated coastal wetland on Long Island Sound.

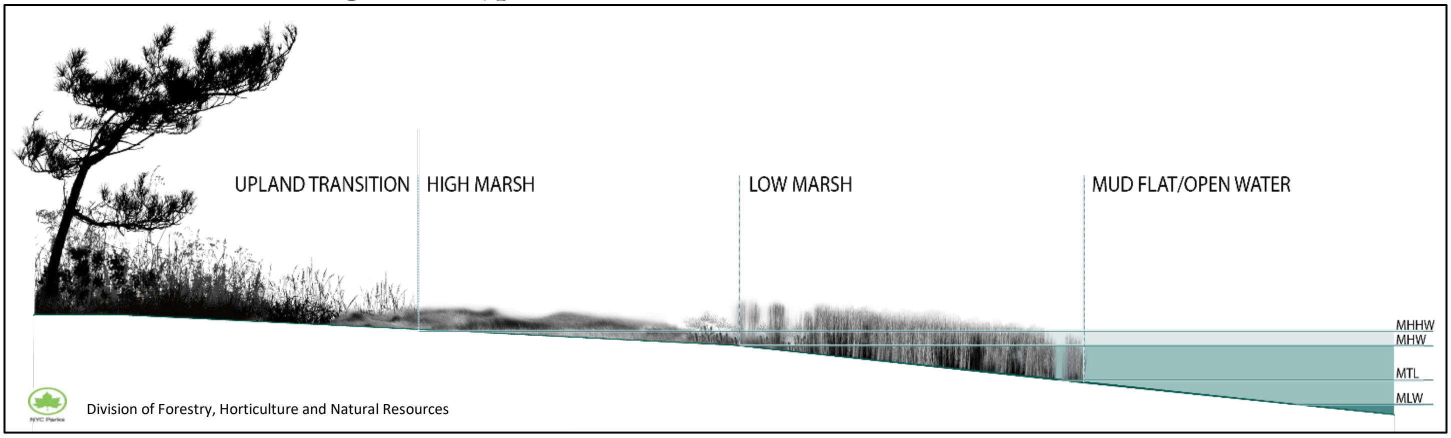
- Due to the large proportion of high marsh habitat, the ERM supports one of the largest breeding populations in Southern New England of the saltmarsh sparrow, a species of global conservation concern. Numerous federal- and state-listed plants, birds, mammals, amphibians, and invertebrates also reside or forage within the ERM.

-A tide gate on Sluice Creek near the Guilford Town Marina has altered the marsh's hydrology resulting in the displacement of native high marsh grasses with non-native invasive common reed, or *Phragmites australis.*

- Roads and the Amtrak rail line that cross and border the marsh alter its hydrology and sediment transport, and limit its ability to migrate landward. Approximately 20 sections of road intersecting or bordering the marsh flood at least every 90 days flood from regular non-storm influenced tidal flooding.

Existing Conditions (2010) ERM Marsh Types		
Marsh Type Zones	**Description**	**Area (acres)**
Low	- Floods daily - Dominant plant: tall form saltwater cordgrass - Dominant birds: Seaside Sparrow, Great Egret	75
High	- Floods monthly - Dominant plants: saltmeadow cordgrass, black rush, spike grass; wet depressions on marsh platform support highly salt tolerant plants such as stunted saltwater cordgrass, sea lavender, and glasswort - Dominant birds: Saltmarsh Sparrow, Clapper Rail	778
Transitional/ Upper Border	- Upland border habitat between high marsh and upland floods a few times a year - Highest elevation area of marsh also referred to as the upland marsh border - Dominant plants: black rush, and woody/non-woody shrubs - Dominant birds: Red-winged Blackbird	31
Freshwater Tidal	- Limited to extreme upper reaches of marsh near Guilford East River Preserve	2

Figure 3 – Typical Marsh Zones of a Connecticut Saltmarsh



MHHW-mean higher high water (highest tides of month); MHW-mean high water; MTL-mean tide level (average of all tides): MLW-mean low water

Projected Future East River Marsh Conditions

SLAMM is capable of generating projected marsh response to SLR results in two ways. The first uses specific model input values. The second employs an uncertainty module that projects the extent and type of marsh based upon their probability or likelihood of occurring in the future using multiple alternative model input values. For example, one key model input is SLR. Instead of selecting a specific SLR scenario value, SLAMM's uncertainty module generates results that considers all five possible scenarios. Because there is greater confidence in mid-range SLR values, the exert greater influence over model results than other values.

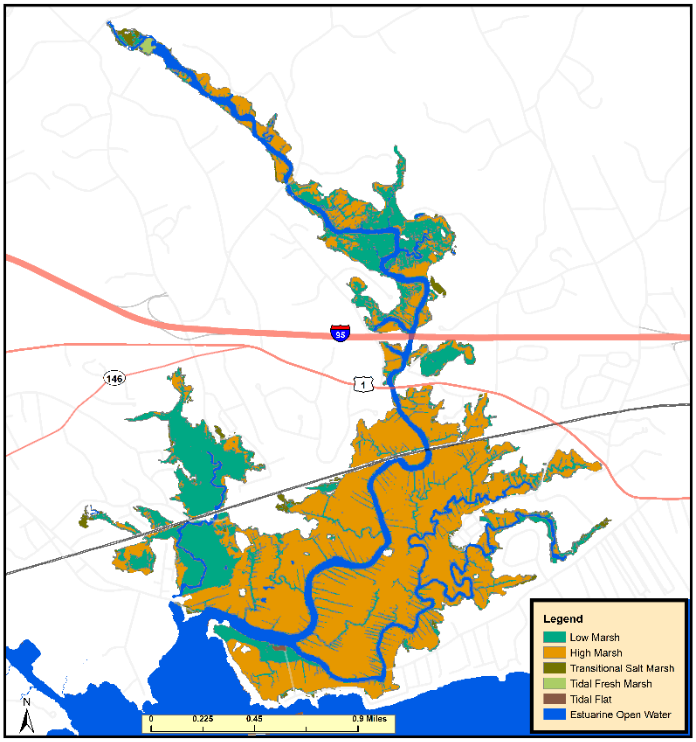
Results Based on Two SLR Scenarios:

ERM Change Based on Two Alternative Sea Level Rise Scenarios (acres) **					
Marsh Type	**2010** Initial Conditions	**2055** High-Medium SLR	**2055** High SLR	**2100** High-Medium SLR	**2100** High SLR
Low	75	297	765	972	238
High	778	606	157	19	5
Transitional	31	33	49	48	73
Tidal Freshwater	2	2	2	1	0
Total	**886**	**938**	**973**	**1040**	**316**

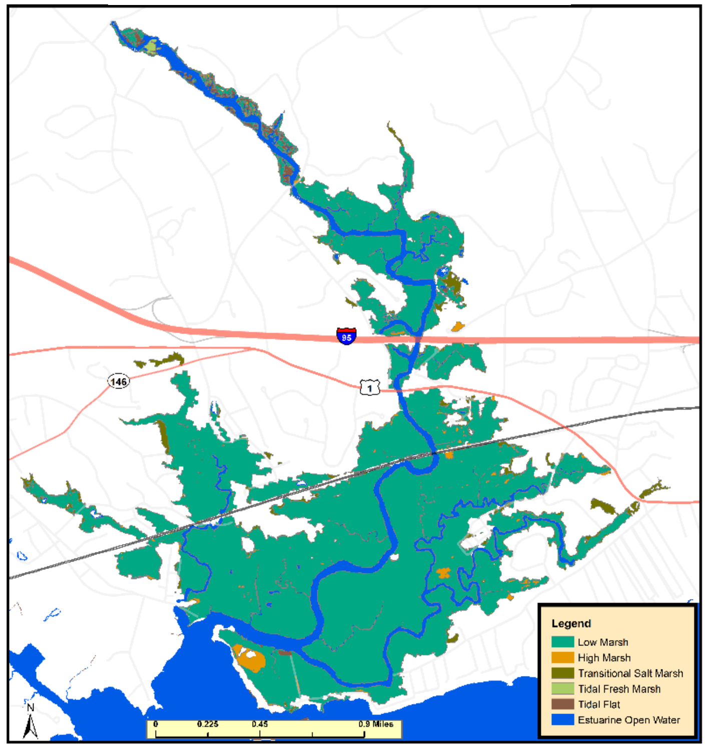
** SLAMM uses 5 SLR scenarios with a base year of 2010: Low, Low-Medium, Medium, High-Medium, and High. The High-Medium scenario of 18 inches by 2055 (~4 feet by 2100), approximates the 20 inches of SLR scenario by mid-century adopted by the State of CT as an upper bound for coastal resilience planning. The High SLR scenario is approximately 2 feet by 2055 and 6 feet by 2100.

Figure 4 - Changing East River Marsh Habitats- Two SLR Scenarios

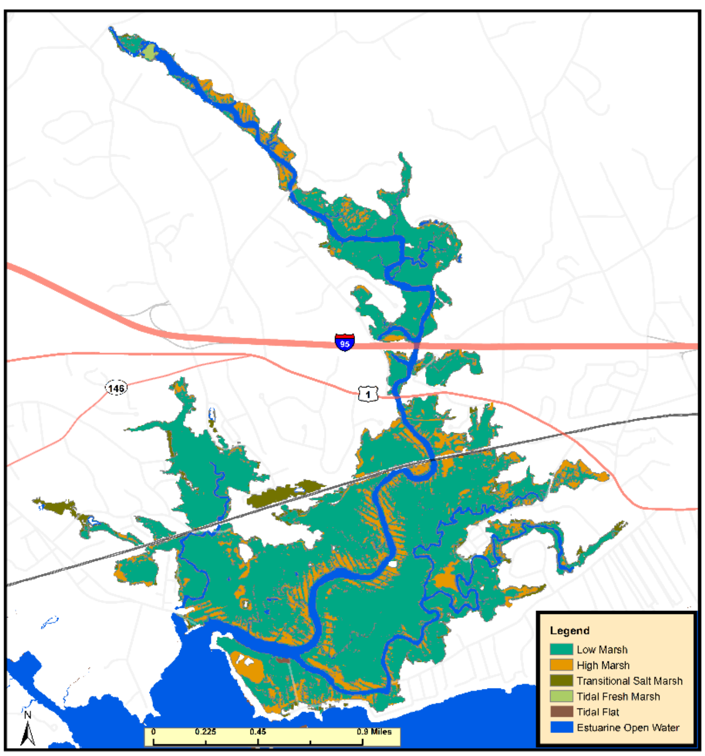
(a.) Medium – High SLR 2055



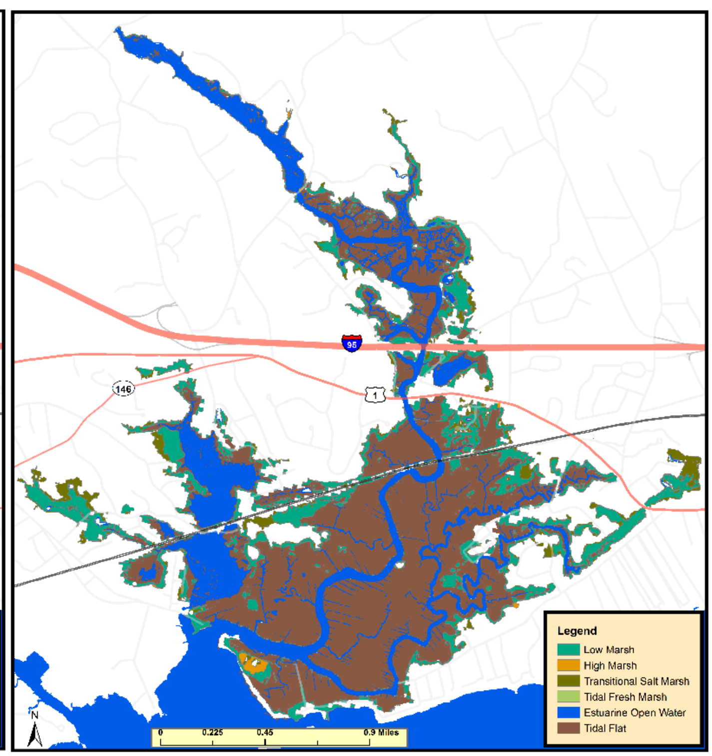
(b.) Medium – High SLR 2100



(c.) High SLR 2055



(d.) High SLR 2100

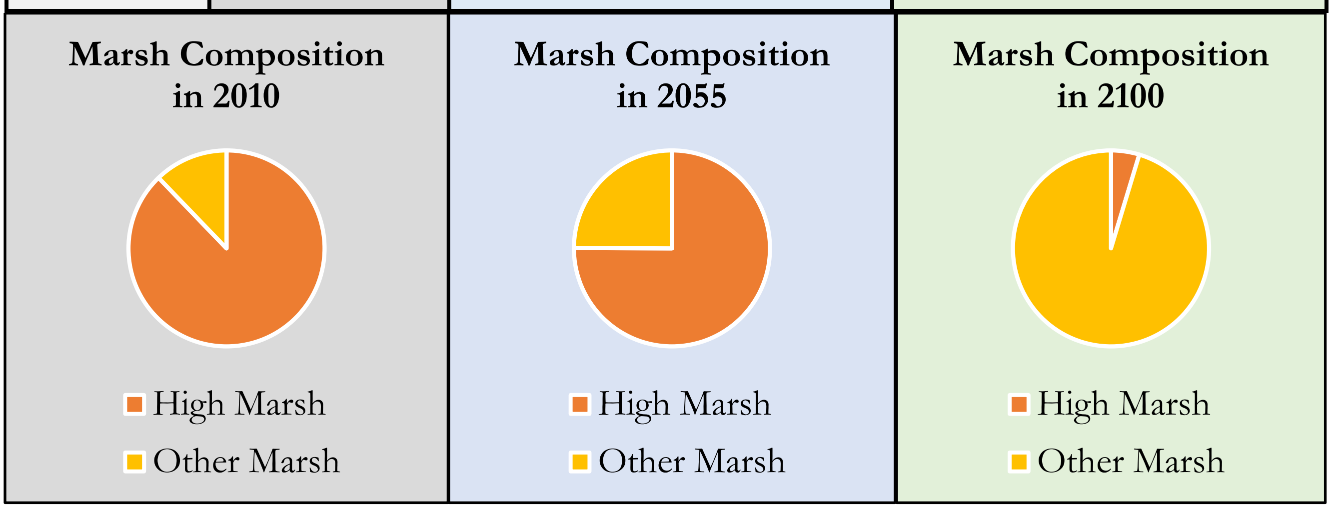


Probability-Based Results:

SLAMM results indicate that the total area of marsh and different marsh habitat types will likely change by the end of the century in response to SLR. Much of the existing high marsh will likely convert to other marsh types, principally low marsh, which early scientific evidence suggests may not offer the same ecosystem services as high marsh. Total area of marsh will increase as shown below <u>only if undeveloped land remains undeveloped to accommodate marsh migration</u> and existing tidal flow pathways are maintained. Because some marsh migration areas will likely be developed or disconnected from tidal water flow pathways in the future, these results likely overestimate the amount of future marsh.

Figure 5

East River Marsh Change (acres)			
	2010	**2055 ***	**2100 ***
Total Marsh	886	950	1071
High Marsh	778	713	50



* Includes only marsh with at least 33% probability of occurring by that date (with assumptions described above)

2010
Total Marsh
886 acres

2055
Total Marsh
950 acres

2100
Total Marsh
1071 acres

DRAFT

Threats to the Marsh

Threat	Effect
Sea level rise (SLR)	- Where surface elevation of high marsh can't keep pace with SLR, it may 'drown' converting to mudflat, or low marsh, resulting in the loss of critical habitat needed by birds nesting exclusively in high marsh.
Upland development	- May impact water quality and lead to forest habitat fragmentation and loss of marsh migration areas.
Invasive plant species	- *Phragmites australis*, often located in areas associated with freshwater drainage ditches and land disturbance may increase. - Small populations of *Lythrum salicaria* (purple loosestrife) in brackish to fresh water wetlands. may expand.
Tide gates/Culverts	Tide gates and culverts can restrict the flow of saltwater into and out of the marsh, altering marsh hydrology and the plant communities.

As shown in Figure 3, each marsh zone exists within a relatively narrow range of elevation; with only a few inches of elevation separating each zone.

- Threats to the ERM are largely driven by SLR combined with incompatible adjacent land uses that increase the flow of pollutants into the marsh and illegal placement of fill in the marsh that elevates the marsh surface above the range of the tides.

- As the rate of SLR outpaces a marsh's ability to increase its surface elevation, frequently flooded low marsh becomes too wet for marsh plants to survive, as shown on the map in the lower right in Figure on page 4. Such conditions result in conversion of marsh to tidal mud flats or open water, marsh types less effective in buffering coastal communities from shoreline erosion and flooding from storms.

- SLR results in more frequent flooding of high marsh surface eventually converting it to low marsh, changing the marsh plant community and potentially marsh ecosystem services.

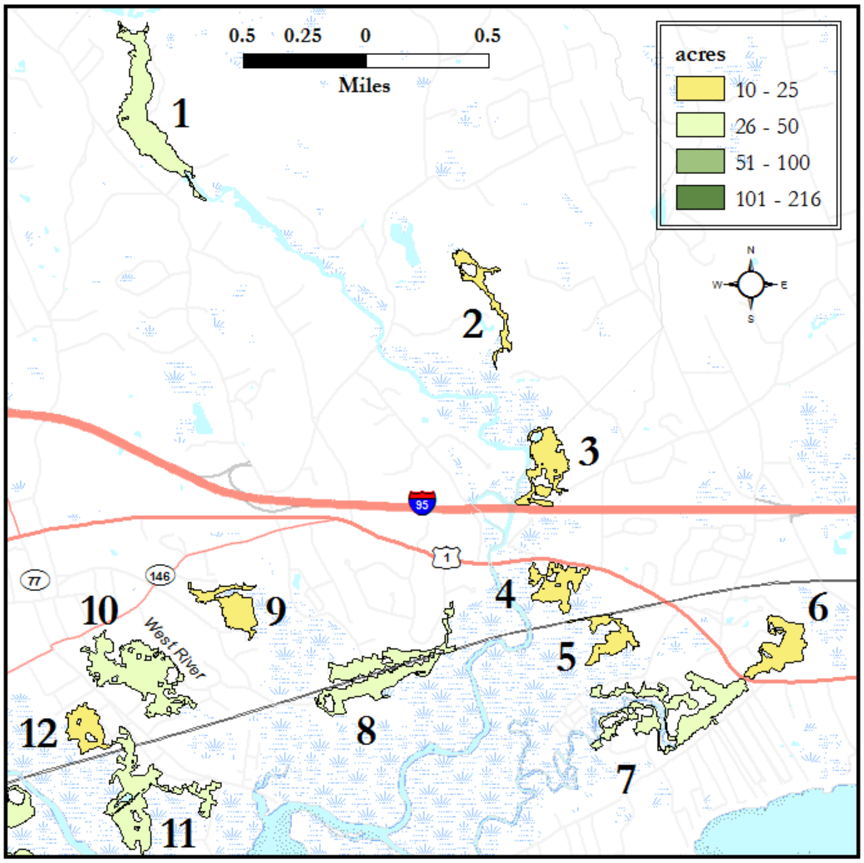
- In some cases, as sea level rises, undeveloped areas along the upland marsh border—the transition marsh or upland border areas—become high marsh and previously dry upland becomes transitional marsh. However, such areas are capable of supporting the upland migration of the marsh only for as long as they remain undeveloped and are not fortified to prevent tidal water inundation through the construction of seawalls, the placement of fill or other barriers to the natural upland movement of the marsh. **The SLAMM results optimistically but unrealistically assumes such conditions will persist in the future, likely overstating the amount of future marsh.**

Planning for Marsh Migration, Creation and Restoration

Marsh Migration:

SLAMM identified large (>10 acres) marsh migration areas with greater than 33% chance of supporting future new marsh by 2100. These areas, identified in the following graphic, warrant further investigation to more fully evaluate their capacity to support marsh in the future and to evaluate options to conserve such areas to ensure that they remain undeveloped and available to accommodate marsh migration.

Figure 6 - East River Marsh in 2100-Large High Probability New Marsh



- These 12 marsh migration areas were identified based on size and likelihood of future marsh. Each 'new marsh area' is ≥ 10 acres with at least some part of each area having a ≥ 33% likelihood of new marsh by 2100.

- Although SLAMM identified all these areas as potentially significant migration areas, field investigation is needed to confirm absence of barriers to migration.

- With a few exceptions, the marsh migration areas identified here are privately owned unprotected land potentially subject to future development.

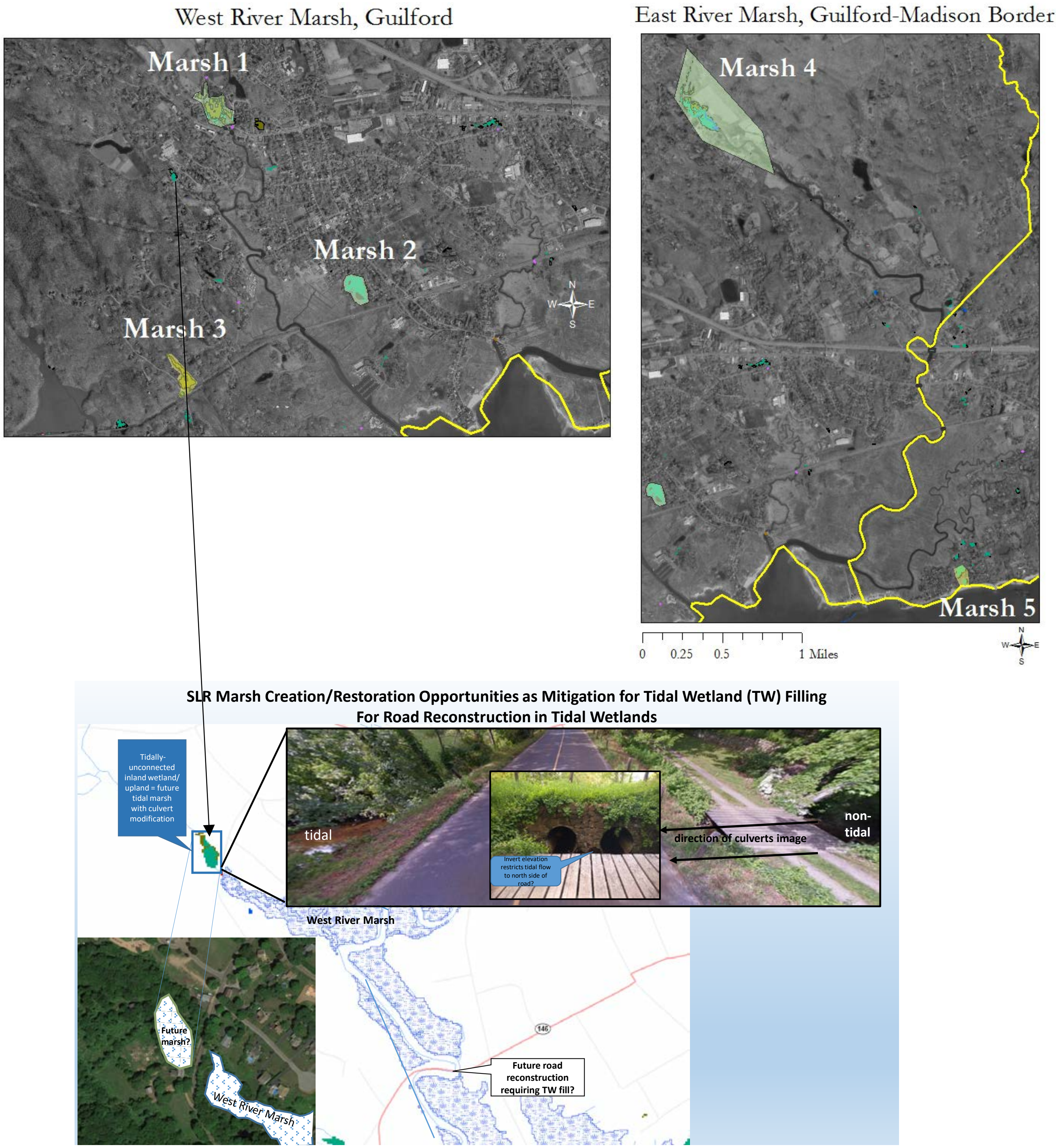
Marsh Creation:

In addition to future marsh migration areas with existing tidal connections, other areas potentially capable of supporting tidal marsh in the future with SLR will only be able to support future new marsh if existing barriers to tidal flow are removed. Such areas, referred to as **tidally-unconnected areas (TUAs)**, exist at elevations suitable to accommodate new marsh in the future with SLR if they can be (re)connected to tidal waters. Of particular interest are those TUAs proximate to existing tidal waterbodies that, with minimal modifications to the landscape, could be connected to tidal water to support marsh in the future. Such areas could provide marsh restoration or creation opportunities that can compensate for the loss of existing marsh that is expected to transition to mudflats or open water, or be subject to other types of degradation, such as filling associated with the reconstruction of roads that cross marshes. An analysis of marsh size, coastal structures, existing hydraulic pathways, and wetland type was completed for the West and East River Marsh areas in Madison and Guilford. Significant TUAs were defined as ≥ 2 acres and connected or proximate to an existing hydraulic pathway to tidal wetlands. They are identified here for further analysis to gauge their potential to support tidal marsh in the future if (re)connected to a tidal waterbody.

Tidally Unconnected Areas (TUAs)			
	ID	**Location**	**Acres**
West River Marsh	1	Guilford	7.1
	2	Guilford	4.5
	3	Guilford	3.8
East River Marsh	4	Guilford	13.2
	5	Madison	2.4

The figures on the following pages identify the location of these TUAs, including an example of twin road culverts on Four Mile Course Road, Guilford that prevents tidal water from flowing into TUA Marsh 1.

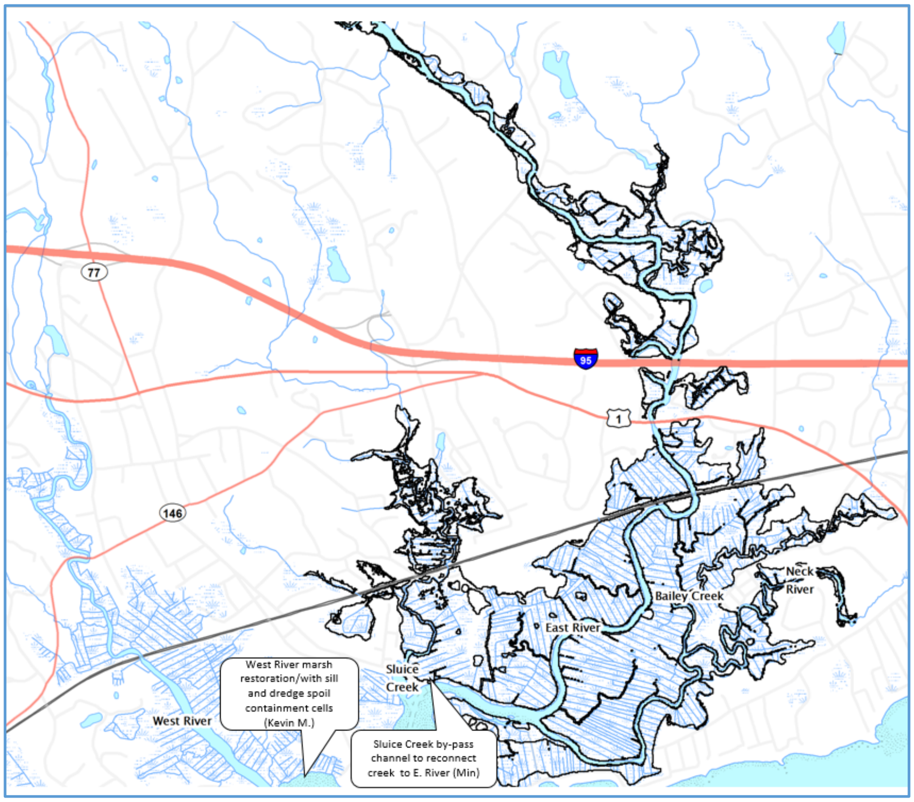
Figure 7 - Tidally Unconnected Areas Potentially Capable of Supporting Future New Marsh



Marsh Restoration:

Protection of large marsh migration corridors and connecting TUA to tidal wetlands are two strategies for ensuring that the ERM, and in particular high marsh, continues to exist into the future. Another strategy involves restoring sections of the ERM that are currently degraded. Marsh degradation may be the result of limited tidal exchange, high erosion rates, or invasive plants replacing native vegetation. Marsh restoration projects that increase the health of degraded marshes may help them more readily adapt to SLR.

Figure 8 Potential Marsh Restoration Project Areas



Possible ERM restoration projects requiring additional investigation and funding:

1. *Sluice Creek*: Proposed by-pass channel to restore degraded marsh area with limited tidal exchange resulting from tide gate being managed to accommodate Guilford Town Marina operations.

2. *Restoration of Eroded West River Marsh at Chaffinch Island Park*: Proposed marsh restoration through the placement of dredge material in containment cells.

Objectives and Next Steps

Addressing threats to ERM will require developing strategies based on the following objectives:

1. Increase awareness of the value of and threats to the ERM by beginning dialogues between conservation organizations and marsh-front property owners;
2. Conserve the largest upland areas most likely to support future new marsh, especially high marsh;
3. Identify potential marsh restoration/creation sites that might be incorporated into future road flood-proofing reconstruction projects potentially affecting the ERM.

Next Steps

- Verify existing protected open space (POS) data to confirm targeted new marsh/migration areas require protection
- Field-visit sites to capture ground imagery to identify potential barriers to migration
- Identify migration area landowners and initiate contact to gauge interest in conservation
- Update CT DEEP marsh migration area landowner database
- Identify cooperating organizations to continue field investigations
- Identify technical assistance needs and potential partners
- Link efforts to Menunkatuck Audubon Society's citizen science program to establish transects within the ERM to monitor changes in vegetation and salinity and to Audubon Connecticut's bird survey data for its Guilford Saltmeadow Sanctuary
- Initiate a public engagement program emphasizing the importance of conserving high priority marsh migration areas will be critical for building support for other coastal resilience initiatives
- Further investigate/rank marsh creation areas, including identifying additional information needed to complete preliminary assessment
- Re-assess previous/currently proposed ERM restoration projects' feasibility/design/construction funding needs and apply for funding as needed
- Work with Audubon Connecticut contractors to survey threats and restoration opportunities within the East and West River Marshes
- Include descriptions of future road flooding frequencies in vicinity of East (and West?) River Marsh?
- Host a gathering of marsh-front landowners to assess their SLR concerns and interest in marsh migration area land conservation

[1] For an overview of the Sea Level Affecting Marshes Model, see http://cteco.uconn.edu/projects/SLAMM/ .

[2] See http://cteco.uconn.edu/projects/SLAMM/results.htm#slamm. Data describing existing marsh and projected marsh change for the 21 marshes are available at http://s.uconn.edu/slammviewer (select 'Layer List' and pan/zoom to East River Marsh for a more complete description of how SLR may affect the ERM).