Coastal CT's Roads and Marshes Response to Sea Level Rise

Using Sea Level Affecting (Roads) & Marshes Model SLA(R)MM to Identify Marsh & Flood Mgt. Priorities

> UCONN Climate Adaptation Academy , January, 25, 2019 David Kozak david.Kozak@ct.gov, CT DEEP-Coastal Mgt. Program

Tropical Storm ????, West Haven, CT (08/2011)

Marshes \rightarrow Coastal Flooding Pathways



Coastal Municipality Climate Change Concerns* HIGH PRIORITY :

Flooding & Erosion Impacts Infrastructure and Property

- Biggest Municipal Concern is Flooding: ranged from the need to raise roads recurring high tide flooding to protecting wastewater treatment plants and pump stations
- **Protect infrastructure: ID vulnerabilities** from neighborhood to site specific scale
- □ Municipal budgets force reactive responses rather than plan proactively
- **Protect private** residential and commercial **structures** ... **from coastal erosion**
- Potential loss of town tax base

* Municipal Issues & Needs for Addressing Climate Adaptation in Connecticut, UCONN CLEAR/CT Sea Grant (September 2017)

Coastal Municipality Climate Change Concerns

LOW PRIORITY?:

Environment

□ Impact on the environment received little mention

Impacts of salt on vegetation and salt water intrusion

Impacts SLR and storms on beaches, LIS water quality

Mid-Century Road Flooding Near Coastal Marshes



2055 Road Flooding

- Flooding at least every 30 days Flooding at least every 60 days
- Flooding at least every 90 days

SLAMM Investigation

1. How will CT's largest coastal marshes change?

- 2. Where will the most *significant* new marsh areas occur ?
- 3. How will extent and frequency of road flooding change?
- 4. How coordinate marsh & road flooding mgt.?

SLAMM Projected Sea Level Rise



4th National Climate Assessment SLR Scenarios for CT's Eastern Shoreline





How Will <u>ALL</u> of CT Marshes <u>Change</u> by 2100*

Marsh Classes	EXISTING 2010 (acres)	Marsh <u>Change</u> by 2100 (acres) Alternative SLR				
		Medium	High-Medium	High		
High-Marsh	10,413	-8,486	-9,815	-10,200		
Low-Marsh	1,969	11,320	10,097	6,215		
Transitional Marsh	1,366	971	1,112	1,086		
Tidal-Fresh Marsh	731	-138	-402	-665		
Total	14,479	3,667	992	-3,564		

* Additional SLAMM marsh change analyses focused on CT's 21 largest tidal marshes (~ 8,000 acres)

CT's High Marsh Dominated Coastal Wetlands



CT Coastal Marsh is . .



... a transition area between uplands and low energy coastal waters, where sediment accumulates at different elevations subject to ebb and flood of tides supporting salt tolerant plants

CT's Future Low Marsh Dominated Coastal Wetlands?

SLAMM's Shoreline Habitat Boundaries' Response to SLR

A *Typical* CT Coastal Marsh . . . (for now?)

East River Marsh, Guilford/Madison

How Does SLAMM Predict Marsh Response to SLR?

Sea-level Rise vs. Marsh Surface Elevation Change

Marsh surface elevation factors:

- Tide range
- Marsh surface elevation from LiDAR
- Marsh accretion/collapse
- Wetland to dry land boundary elev. (WBE)

✓ CONSIDERS UNCERTAINTY/ERROR USING PROBABILITY ANALYSIS

Coastal Marsh Response to SLR - #1

INCREASE IN MARSH SURFACE ELEVATION

Greater above-ground plant growth

More sediment trapped from water

Elevation gain via surface accretion

Elevation gain via sub-surface expansion

Organic carbon addition

Rising sea level

Less below-ground decay

Source: Make Way for Marshes (Northeast Regional Ocean Council)

Coastal Marsh Response to SLR - #2

Saltmarsh Migration in CT (Transitional Marsh)

Hammonasset Beach State Park, Madison, CT

A Saltmarsh with Nowhere to Go/Grow SLAMM Does NOT Consider Future New Development

A Saltmarsh with Nowhere to Go/Grow

21 Marshes - Total Area

(>33% probability)

Selected Marshes Composition - 2010-2085

(>33% probability high marsh)

High Marsh Loss

2010

High Marsh Loss

2055

High Marsh Loss

2085

Dual Coastal Marsh Management Strategies

1. Conserve *high-likelihood* marsh migration areas

2. Create/restore marsh by modifying/creating new tidal hydraulic connections

Identifying Priority Marsh Migration Conservation Opportunities

Modify Hydraulic Connections at Road Crossings

Using SLA(R)MM to Predict SLR Effects on Road Flooding

Sunny Day Flooding, Chaffinch Island Road, Guilford, CT (pre-reconstruction)

SLAMM Predicted Road Flooding Frequency Change

SLAMM Existing Road Flooding Conditions

Legend Existing Conditions Road Flooding

Floods at least every 30 days

- Floods btw. every 30-60 days
- Floods btw/ every 60-90 days
- Floods btw. every 90 days-10 yrs
- Floods btw. every 10-100 yrs

Legend - 2055 Road Flooding ~ 20" SLR Floods at least every 30 days Floods btw. 30-60 days

Floods btw. 60-90 days

- Floods btw. 90 days -10 years
- Floods btw. 10 years-100 years

Ground-truthing SLAMM's Existing Tidal Flooding Frequencies

- Floods btw/ every 60-90 days
- Floods btw. every 90 days-10 yrs
- Floods btw. every 10-100 yrs

CT Coastal Roads Tidal Flooding

(Medium-High SLR Scenario)

Statewide Road Flooding (miles)

	2010	2025	2040	2055	2070	2085	2100
30 days	0.0	6.3	24.3	53.6	107.6	173.4	242.2
60 days	2.5	5.4	9.7	12.3	20.0	16.3	16.8
90 days	3.2	4.8	8.4	13.5	17.4	13.9	12.6
Total	5.7	16.5	42.5	79.3	144.9	203.6	271.6

Single Access Road Flooding

Garnet Park Rd will flood at least every 30 days isolating neighborhood

Floods btw. 10 years-100 years Floods btw. 90 days -10 years

Single Access Road Flooding

Road Flooding Mgt. → Marsh Mgt. Modifying Roads to Restore/Create Marsh

SLAMM Viewer on CT ECO- All Roads & 21 Marshes

So What?!

Marshes:

- Flooding pathways (future role of tide gates?)
- High → Low Marsh shift before 2100 under moderate SLR
- Predicted $\widehat{\mathbf{t}}$ in area **total marsh unrealistically** optimistic
- Marsh loss minimal (role of tidal restriction structures)?

Roads:

- Tidal road flooding <u>much</u> more frequent & extensive (10x?)
- Neighborhoods near marshes often most vulnerable
- Road/infrastructure flood mgt. → marsh mgt.

Some Critical Outstanding Issues . . .

- How will marsh-front landowners respond to SLR/marsh migration/ erosion?
- Will <u>new</u> high marsh keep pace with loss of existing high marsh and what are implications of high marsh loss?
- What's appropriate mitigation for road reconstruction in marshes?
- Is marsh migration area land conservation acceptable wetland fill mitigation?
- Is risk of flooding on inland side of roads with modified hydraulics to create/restore marsh acceptable?
- Will tide gates/management become an increasingly important flood control tool?

Even More Critical Questions . . .

- What effect do existing shoreline structures have on capacity of marsh to migrate?
- What's needed to create a wetland mitigation banking system?
- What TW Act statutory amendments required to enable wetland mitigation banking system?
- What's an acceptable road flooding planning horizon?

Long Island Sound at Night

