Climate Change and Sentinel Monitoring Workgroup Meeting Summary
Wednesday, May 17, 2023
Teams Meeting (Link in Meeting Invite)

Attendees

Samarra Scantlebury, NYSDEC (Co-Chair), Kathleen Knight, CTDEEP (Co-Chair), James Ammerman (NEIWPCC), Juliana Barrett (CT Seagrant), Jordan Bishop (NEIWPCC), Jonathan Clough (Warren Pinnacle Consulting, Inc.), Sarah Crosby (Norwalk Maritime Aquarium), Katerina Gonzales (EPA), Elizabeth Hornstein (NY Seagrant), Gavin Jackson (CT DEEP), Kristen Laccetti (EPA), Kevin O'Brien (CT DEEP), Matthew Pruden (Cornell), Jackie Motyka (NERACOOS), Esther Nelson (EPA),Sara Powell (NY Seagrant), Sarah Schaefer-Brown (NY Seagrant), Cayla Sullivan (EPA), Maria Tzortziou (CCNY, CUNY)

Introduction

Samarra Scantlebury called the meeting to order at approximately 10:00 AM. Samarra provided an overview of the CCSM purpose and a synopsis of the February 2023 meeting: web page revisions, summary of special meeting focused on SHARP, Update of CT NERR and Update on USGS Clearing House Project. Please see those meeting minutes on our workgroup webpage. If you have any revisions, please send those recommendations to Kathleen.Knight@ct.gov.

Update on LISS Funded Projects for FY23, Cayla Sullivan, EPA

Cayla presented on the projects to be funded in the coming fiscal year, per the April Management Committee Approvals that related to our workgroup. Process this year was a little different in that the supplemental projects came from workgroup workplans.

Base Proposals Include:

- LIS Water Quality Monitoring Program, CT DEEP
- LIS Western Basin Water Quality Monitoring Program, IEC
- Unified Quality Monitoring Program, Save the Sound
- Coastal Acidification Monitoring, CT DEEP, UCONN, USGS, IEC
- Major Tributary Monitoring, USGS
- Upper Connecticut Monitoring, USGS

Supplemental Proposals Include:

- Climate Change Website Updates, NEIWPCC
- Alkalinity Analysis Intercalibration, CT DEEP
- Eel Grass Suitability Index Model Update, NEIWPCC
- Eel Grass 2024 Aerial Survey and Intercomparison, USGS and USFWS
- Unified Water Study Additions: Eel Grass, Save the Sound
- Eel Grass Collaborative, NERR
- Monitoring lower CT River, Norwalk, Northfield, Oyster Bay and Flax Pond, USGS

EPA's Arc-X Tool, Katerina Gonzales Special Advisor, Climate Adaptation of EPA's Office of Policy
https://www.epa.gov/arc-x

Katerina shared the intent of the tool, to streamline climate change and adaptation resources tailored to a community's needs by providing a series of selection options. Community feedback is what shaped the development of this tool.

To use Arc-X you can choose to select the geographic region and area(s) of interest this will produce the tailored list of resources. Resources include: funding opportunities, guidance, and case studies.

Joel and Katerina are seeking case studies to add to the tool. If members have any to offer, please email Katerina: Gonzales.Katerina@ct.gov

Sea Level Affecting Marshes Model- Connecticut, Kevin O'Brien and Gavin Jackson, CT DEEP
https://maps.cteco.uconn.edu/projects/slamm/

Kevin shared the purpose and how the SLAMM works.

- The SLAMM allows you to evaluate what sea level rise might do to your land covers beyond standard inundation.
- The tool allows you to evaluate a variety of scenarios at the local level. The projection includes the recommended planning horizon set by CIRCA, 2050.
- How it works: Uses elevation, sedimentation\erosion rates, land cover, Wetlands data, SLR estimates.
- Provides a range of uncertainty at certain points of time, these uncertainty values have value in their own right to provide range of possibilities at certain point in time.

Gavin Jackson shared examples of projects:

- First rendition was completed in 2015, then 2016 and most recently in 2022.
- In 2016 update determined the High-Medium scenario most closely aligned with 2050 planning horizon.
- Data is available in CT ECO
- A demonstration of the tool showed the workgroup members how you can evaluate an areas potential change with the various SLR scenarios. Within this demo it was highlighted significant areas are likely to be new marsh.
- In 2015 we estimated 50-97% marsh loss by 2100. However, low marsh is expected to increase as high marsh becomes submerged.
- We learned that this tool was not only useful for marsh impacts but where flooding impacts are expected to be observed (ie roads etc).
- Therefore road segments were assigned flooding attributes and evaluated for flooding freq.
- 2022 will take the next step on "new marsh" to evaluate tidal connectivity.

Marsh Viewer- NY, Jonathan Clough, Warren Pinnacle
https://warrenpinnacle.com/LIMaps/
Jonathan presented the overview and planning aspects of the tool.

- Developed online light weight viewer by tax parcel basis (to help landowners make decisions too)
- Planning workshops with communities in near future too.
- Similar to SLAMM just presented based on same data.
- In recent years working with SAV data to integrate vegetation such as seagrass. This had successful calibration in Chesapeake Bay, so hopeful it can be used locally here.
- Also, in NY looking at uncertainty to tell us a little more. SLR dominated the uncertainty of all the parameters.
- Included in model are fact sheets: these also note wetland loss estimates and the caution that these may be optimistic because it is not considering any pressures other than SLR (ie development, water quality etc)

- Jonathan then presented a demo with the tool. The tool has two maps probability map, likelihood it will be inundated and Type map which represents the best guess of what wetland type it will be with SLR (similar to CT map scenario controlled by user).

Open Discussion and Q&A -Members
Kathleen Knight opened the floor with reminder of the workgroups new equity discussion rules and introduced the first volunteer discussion leader, Jamie Vaudrey of UCONN.

Jamie Vaudrey, UCONN, NERRS, opened the discussion/questions sharing her recent experience with Great Island. Great Island is eroding on southern end of the island (specifically on a sandy spit), and they held a meeting to address this. There was a proposal to allow erosion of Great Island's sandy spit to create additional beach habitat that is needed by some birds, this was a new approach. Can we utilize these models to think about not just protecting the marsh but what does habitat change look like? As we are committee charged with developing model what should we be looking for?

Jonathan Clough, SLAMM model does try to account for what is happening with erosion on high energy shoreline, islands and spits through looking at fetch and wave energy. But it is not the strength of the model. So looking at it in granularity may not give you accurate results for specific location. Wave model would be more accurate, but very expensive and limited results. Therefore, these models could give you potential for these kind of habitat changes. But remember there are a lot of external factors at local level that alter those results.

Kevin O'Brien, If you take a system level approach you can get a sense of what can be changing and where. This could be informative for what type of monitoring and thereby what kinds of solutions you might want to consider. Kevin concurs letting it go is interesting option.

Kate asked if the uncertainty of the model could leverage monitoring for change ahead of new marsh formation.

Jonathan Clough, Indicated he thinks the uncertainty could be useful to help prioritize locations for monitoring.

Kevin O'Brien, David Kozak (DEEP retiree) indicated one of the key pieces of information that helps us evaluate actions rather than just framing with in best and worst case scenarios.

Jamie Vaudrey, asked about uncertainty to model we could go in two directions? We could target greatest uncertainty to improve the model? Or as sentinel sites are we looking to monitoring greater unknown areas (more uncertainty) or areas we have greater certainty?

Kevin O'Brien, Biggest amount of the uncertainty in the model is SLR so for the first question monitoring sea level rise at local level would be biggest bang for buck. For second part of your question if you want to utilize to evaluate over time and will be fairly certain it will still be around you could use high certainty and if you wanted to measure a hyper local change you might use uncertainty that way.

Jonathan Clough, Agreed hyper local data with gages would be helpful. Because model uses past erosion rates to predict further erosion rates, local erosion rates can also be helpful.

Samarra Scantlebury, shared Juliana Barrette's comment in chat have the sea elevation tables been crossed referenced with the model.

Jonathan Clough, Yes this is key input to the model. This parameter is great parameter to monitor, but it cannot be used to test the model because it drives the model. It takes at least 15 yrs. of data to use it to drive projections.

Samarra Scantlebury, Katerina could you share how one would share success stories or tools to add to the ARcX?

Katerina Gonzales, Yes please email me and we do have a template for success stories. However, the biggest help will be to participate in survey coming later this spring.

Samarra Scantlebury, Is there anything we could contribute to the SLAMM efforts that would be helpful as well?

Jonathan Clough, One thing Dave Kozak did before he left was by reviewing local scale model we found a few locations it didn't work which led to improving model. If anyone finds locations it doesn't work when you get into local monitoring that is helpful. I am also looking for case studies to put into the tool.

Kevin O'Brien, There is presence on LIS website for a lot of SLAMM related material and we are at the point were we will be posting this new material. So now is the time to be thinking about what we want to have posted and how we want to communicate it.

Meeting Close Out\Next Steps

Next meeting August 15th we anticipate putting together 1-Yr workplan and anticipate we will be discussing this then.

Fall meeting is scheduled for November 15th

We will be rescheduling the NERACOOS presentation of the strategy so that we can consider this in our own strategy update.

Stay tuned for agendas and meeting updates.

Meeting Adjourned at 12:00

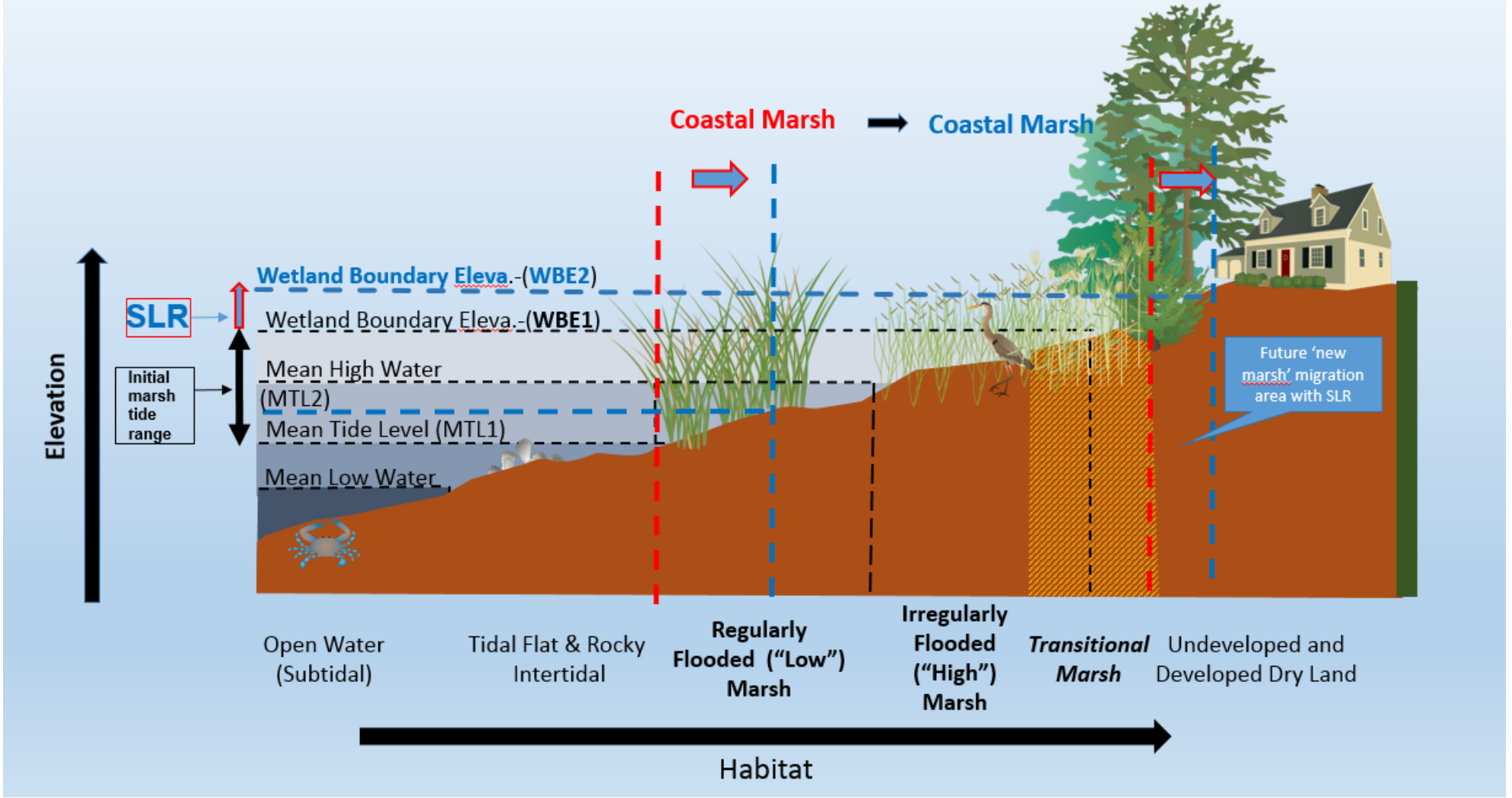
SEA LEVEL AFFECTING MARSHES MODEL (SLAMM) IN CONNECTICUT

Presented by: Kevin O'Brien & Gavin Jackson
Land & Water Resources Division

WHAT IS SLAMM?

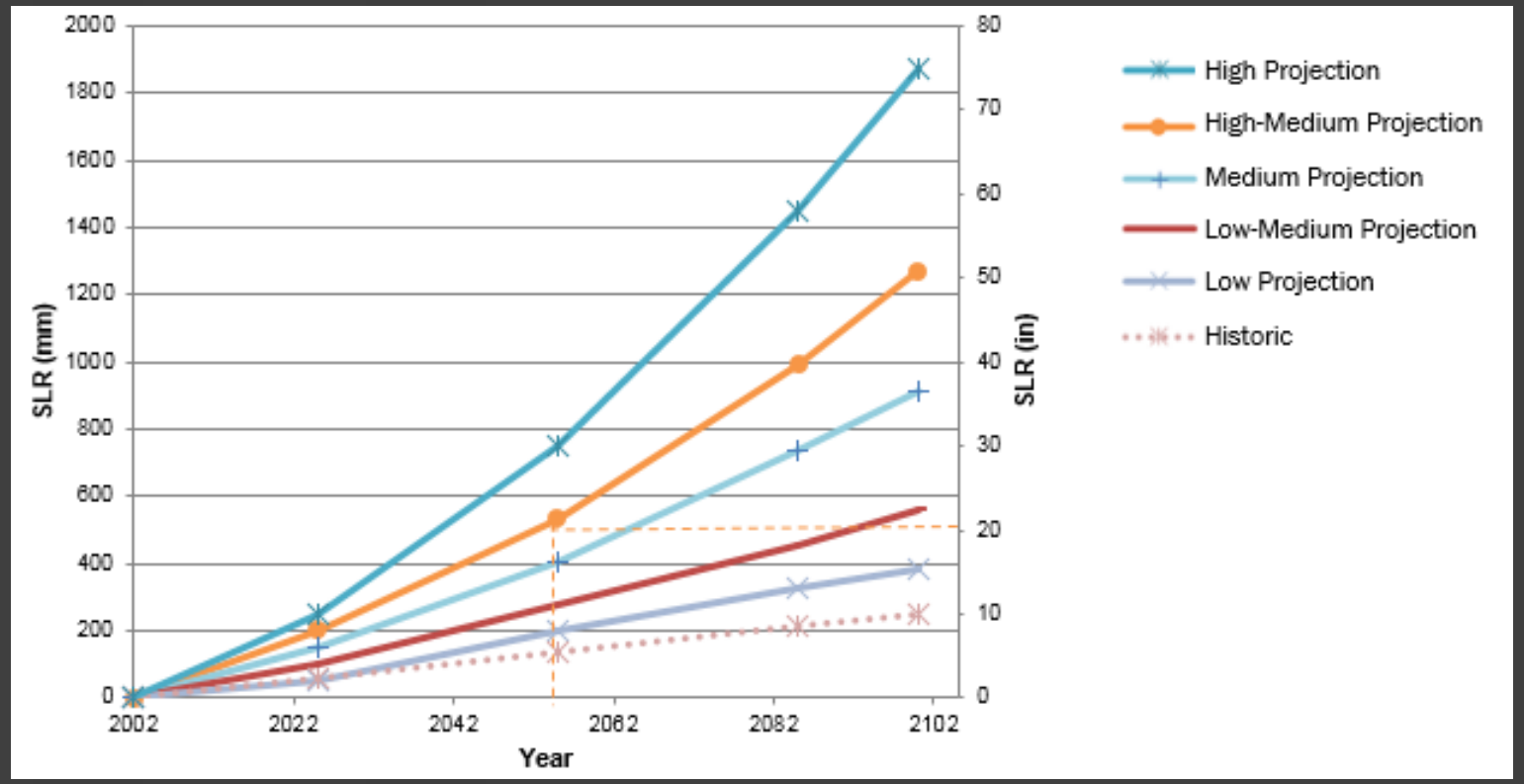
- Stands for **SEA LEVEL AFFECTING MARSHES MODEL**
- SLAMM is a widely adopted 2D computer model that projects long term change in shoreline habitats and flooding frequencies as a function of initial conditions land elevation, tide range, marsh surface accretion rates, sea level rise (SLR), and other environmental factors.
- Among the variables listed above, SLR is believed to have the greatest influence over modelled shoreline habitat change results.

SLAMM Shoreline Habitat Boundaries' Response to SLR



WOW! SLAMM SOUNDS COOL HOW DOES IT WORK?

SLAMM Sea Level Rise Scenarios



New York City Panel on Climate Change, 2015 Report Chapter 2, in *Annals of New York Academy of Sciences* 13326 (2015) 36-44 (2015)

WOW! SLAMM SOUNDS COOL HOW DOES IT WORK?

- SLAMM uses high resolution elevation, land cover, and NWI wetland data.
- Using key variables such as SLR Scenarios and tidal datum elevations marsh change is estimated over time through two different types of analyses.
- SLAMM can show where marsh types change, where marshes may get inundated or migrate.

DETERMINISTIC & UNCERTAINTY MODELING

- SLAMM is capable of producing results in two primary formats
- Deterministic approach uses specific model input values at a given time. This approach generates simulations on a scenario-by-scenario basis
- Uncertainty approach accounts for the potential ambiguity of input values. Model inputs here are assigned a range of possible values and ran through the model multiple times with the results summarized by the potential likelihood of that result to occur.

DETERMINISTIC & UNCERTAINTY MODELING

- All model realizations are assembled into probability distributions of reflecting the effect of input data/model uncertainties on predicting results.
- The more likely the result, the more confident we are that the model is accurately predicting a future condition.
- These deterministic and uncertainty results can be shared via several different data types including tables, charts/graphs, and spatial data files useable in a variety of desktop geographic information system (GIS) environments.

CONNECTICUT & SLAMM

Using SLAMM help to inform how SLR impacts coastal ecosystems and related infrastructure

THE PATH OF SLAMM IN CONNECTICUT

SLAMM has been the primary tool in Connecticut for understanding and communicating marsh response to SLR. There have been three iterations of SLAMM projects in Connecticut. The first being completed in 2015, the second in 2016 and the third in 2022. All iterations of the modeling were completed by Warren Pinnacle Consulting (WPC). Major objectives of all three SLAMM projects include:

1. Illustrating how CT's coastal marshes will change.

2. Determining where marsh migration areas could occur.

3. Projecting how the extent and frequency of road flooding will change over time.

4. Projecting how road flooding depth will change over time.

5. Identifying and Illustrating potential areas that can support tidal wetlands if connectivity can be restored.

THE PATH OF SLAMM IN CONNECTICUT

The 2015 project titled *Application of SLAMM to Coastal Connecticut* sought to provide numerical and map-based projections (in both deterministic and uncertainty formats) of the potential effects of SLR scenarios on Connecticut's coastal wetlands and surrounding infrastructure.

Table 1: 2015 SLR Scenarios (in mm) for each timestep relative to base year 2002

Time Step	General Climate Model Maximum	1m by 2100	Rapid Ice melt Minimum	Rapid Ice Melt Maximum
2025	127	129	727	254
2055	305	431	483	737
2085	584	807	1041	1397
2100	718	1000	1327	1721

The SLR scenarios used in each were taken from localized estimates for Long Island Sound developed by the New York State Energy Research and Development Authority (NYSERDA).

THE PATH OF SLAMM IN CONNECTICUT

The 2016 project titled *Advancing Existing Assessment of Connecticut Marshes' Response to SLR* uses the initial set of SLR scenarios as the 2015 project. However adding updated information to include additional scenarios.

Table 2: 2016 SLR Scenarios (in mm) for each timestep relative to base year 2002

Time Step	Low	Low-Medium	Medium	High-Medium	High
2025	51	102	152	203	254
2055	203	279	406	533	762
2085	330	457	737	991	1473
2100	381	559	914	1270	1905

In the 2016 project the High-Medium scenario for 2055 closely aligns with a recommended planning estimate of 50cm of SLR by 2050 from the CT Institute for Resilience and Climate Adaptation (CIRCA). As such, deterministic results from this scenario are particularly relevant.

THE PATH OF SLAMM IN CONNECTICUT

The 2015 effort provided results broadly across the coastal Connecticut study area; the 2016 effort provided a revision to those results based on updated SLR scenario data as noted in the previous slide as well as improvements to LiDAR elevation and tidal elevation data.

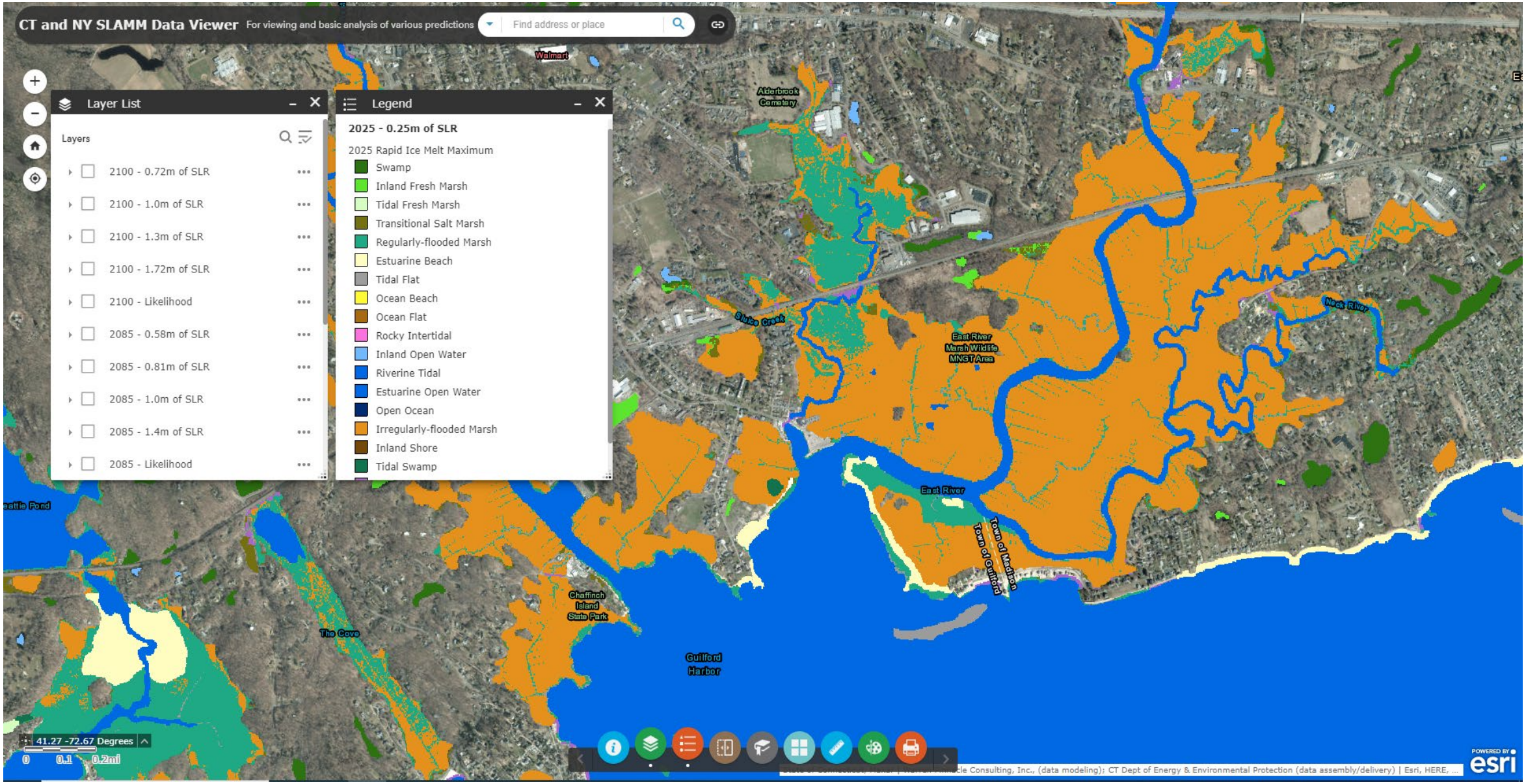
Additionally, it also considered impacts from a variety of storm scenarios ranging from 30-day, 60-day, and 90-day inundation as well as storm surge from both 10-year and 100-year storms.

RESULTS PLATFORM AND VIEWER

Results from the 2015 project were combined with those from concurrent and complementary projects conducted in New York and are available via the Long Island Sound Study website (Sea Level Affecting Marshes Modeling - Long Island Sound Study).

A derivation of the 2016 results with respect to road inundation across coastal Connecticut and including a focused look at the state's 21 largest marsh systems can be found at UConn Center for Landuse Education and Research (CLEAR) (Geocortex Viewer for HTML5 (uconn.edu)).

In addition to the data viewer the CT ECO website also contains supplementary information about the SLAMM projects in Connecticut. Information such as: data limitations, data layer information and aerial photography can be accessed through the website at http://cteco.uconn.edu/projects/SLAMM/


CT and NY SLAMM Data Viewer
For viewing and basic analysis of various predictions
Find address or place
Layer List
Layers
2100 - 0.72m of SLR
2100 - 1.0m of SLR
2100 - 1.3m of SLR
2100 - 1.72m of SLR
2100 - Likelihood
2085 - 0.58m of SLR
2085 - 0.81m of SLR
2085 - 1.0m of SLR
2085 - 1.4m of SLR
2085 - Likelihood
Legend
2025 - 0.25m of SLR
2025 Rapid Ice Melt Maximum
Swamp
Inland Fresh Marsh
Tidal Fresh Marsh
Transitional Salt Marsh
Regularly-flooded Marsh
Estuarine Beach
Tidal Flat
Ocean Beach
Ocean Flat
Rocky Intertidal
Inland Open Water
Riverine Tidal
Estuarine Open Water
Open Ocean
Irregularly-flooded Marsh
Inland Shore
Tidal Swamp
Walmart
Alderbrook Cemetery
Sluice Creek
East River Marsh Wildlife MNGT Area
Neck River
East River
Town of Madison
Town of Guilford
Chaffinch Island State Park
The Cove
Guilford Harbor
41.27 -72.67 Degrees
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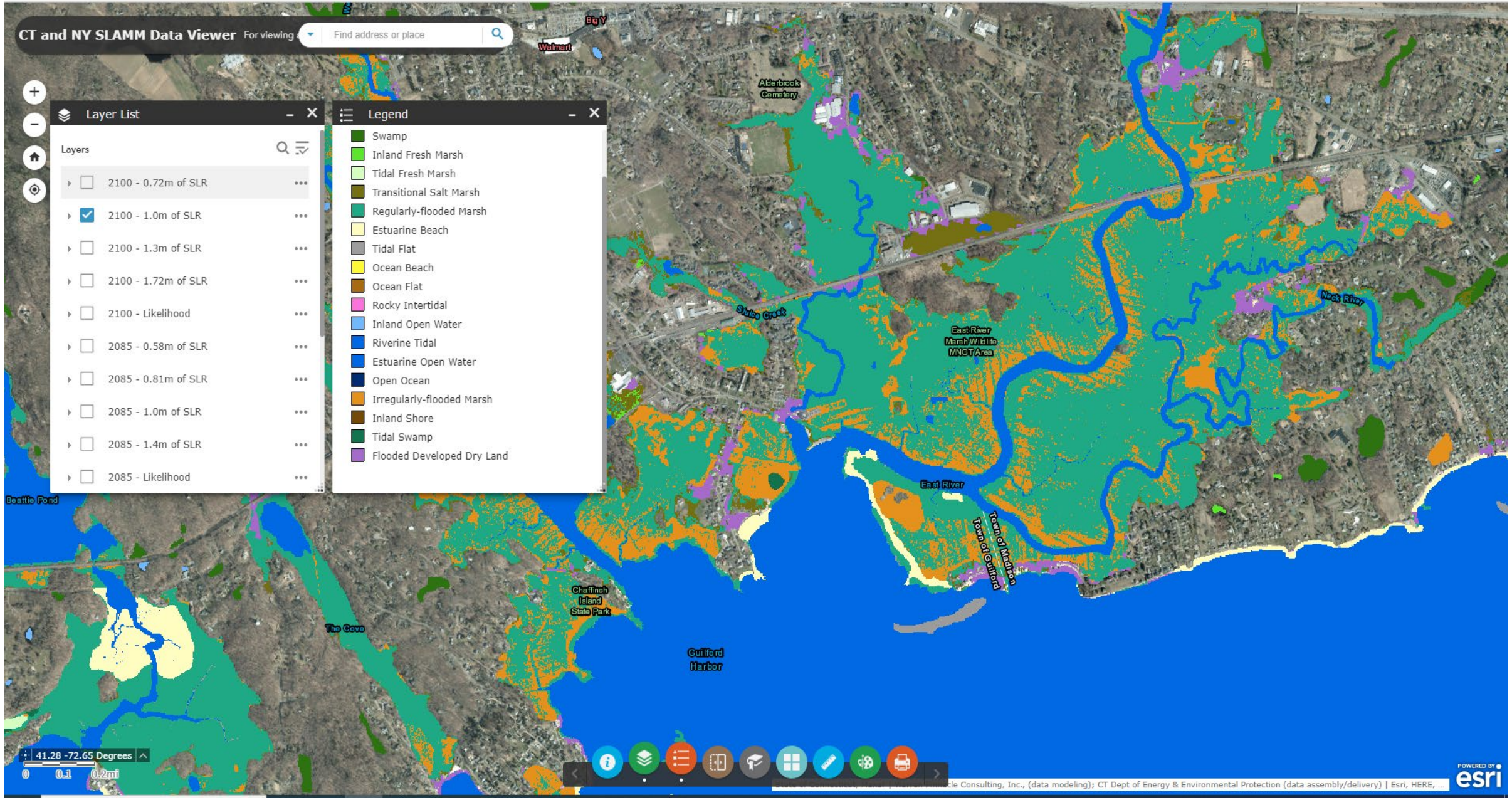
CT and NY SLAMM Data Viewer
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Tidal Flat
Ocean Beach
Ocean Flat
Rocky Intertidal
Inland Open Water
Riverine Tidal
Estuarine Open Water
Open Ocean
Irregularly-flooded Marsh
Inland Shore
Tidal Swamp
Flooded Developed Dry Land
Big Y
Walmart
Alderbrook Cemetery
Stuka Creek
East River Marsh Wildlife MNGT Area
Neck River
East River
Town of Madison
Town of Guilford
Beattie Pond
Chaffinch Island State Park
The Cove
Guilford Harbor
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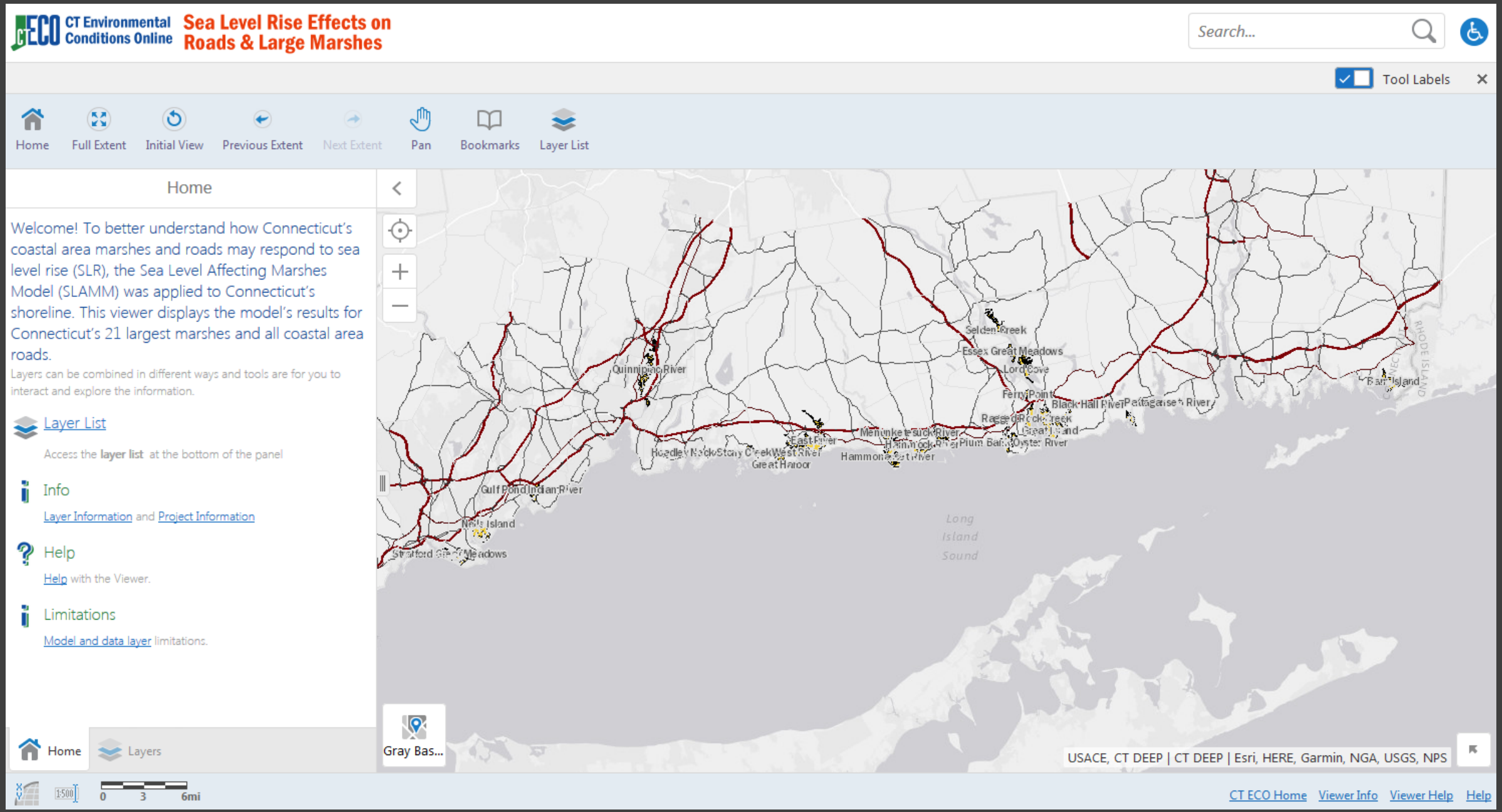

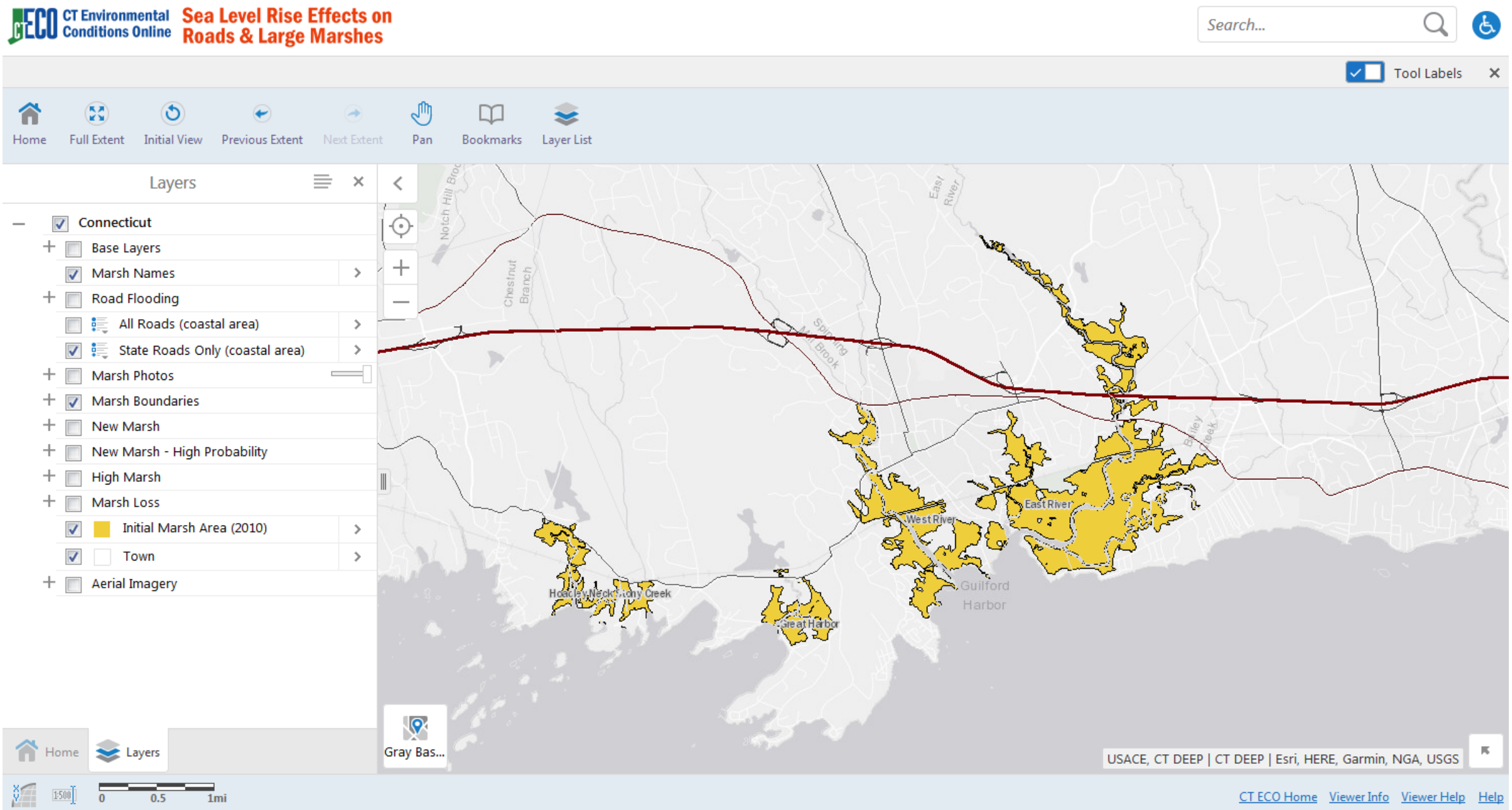
CT Environmental Conditions Online
Sea Level Rise Effects on Roads & Large Marshes
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Tool Labels
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Full Extent
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Layer List
Layers
Connecticut
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Road Flooding
All Roads (coastal area)
State Roads Only (coastal area)
Marsh Photos
Marsh Boundaries
New Marsh
New Marsh - High Probability
High Marsh
Marsh Loss
Initial Marsh Area (2010)
Town
Aerial Imagery
Notch Hill Brook
Chestnut Branch
Spring Hill Brook
East River
Bailey Creek
West River
East River
Guilford Harbor
Great Harbor
Hoadley Neck
Stony Creek
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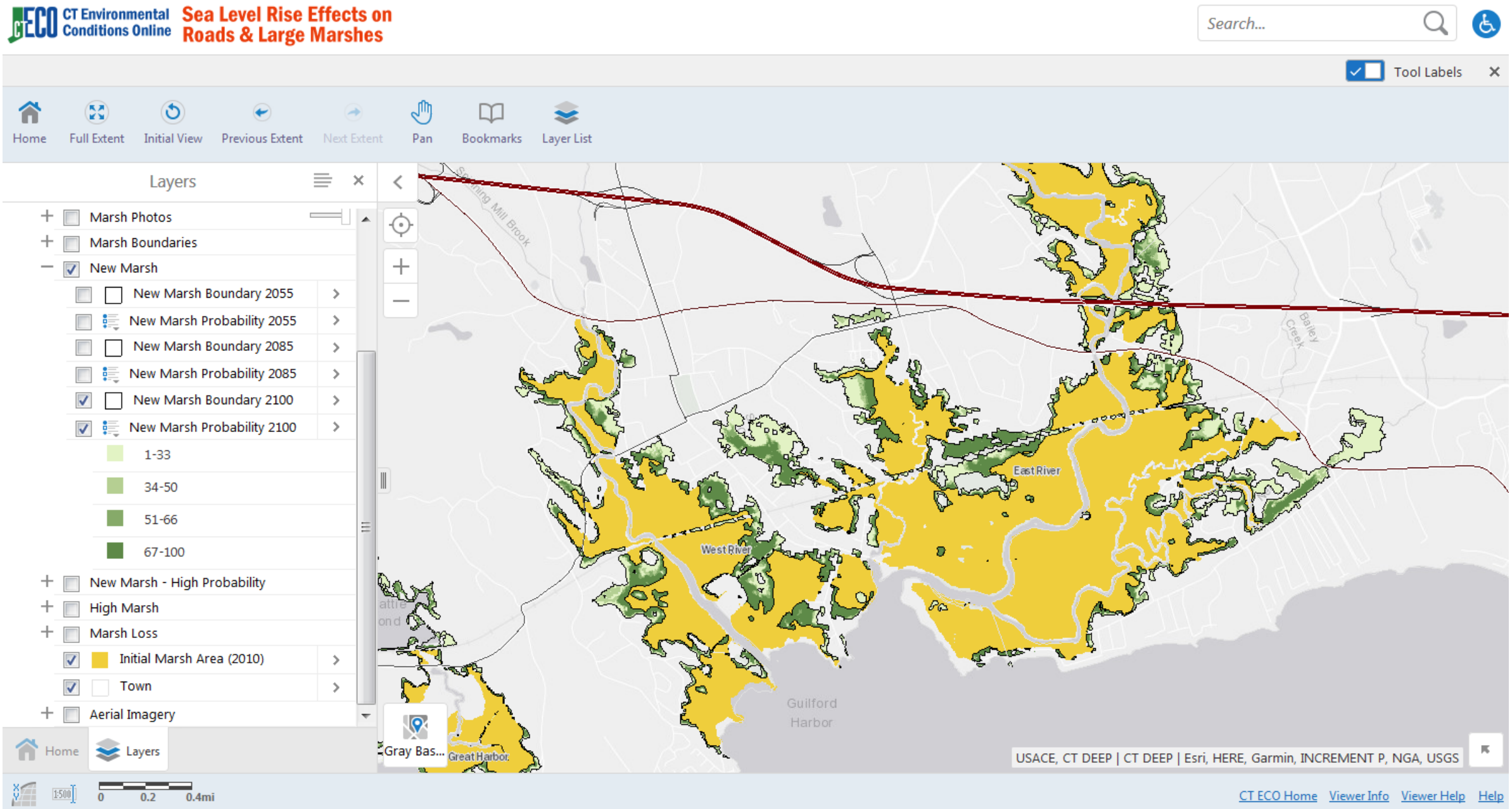
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Marsh Boundaries
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New Marsh Boundary 2055
New Marsh Probability 2055
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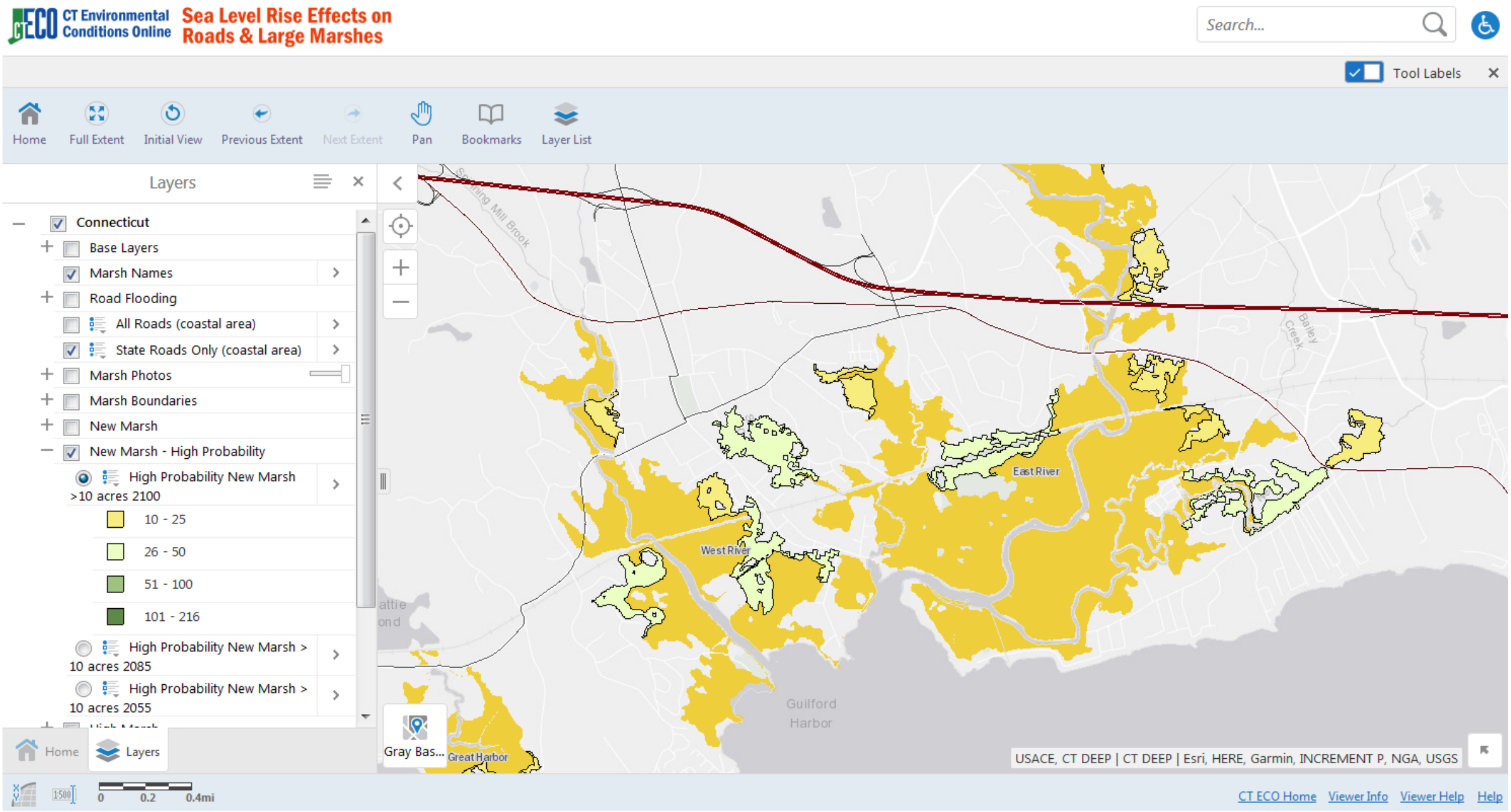
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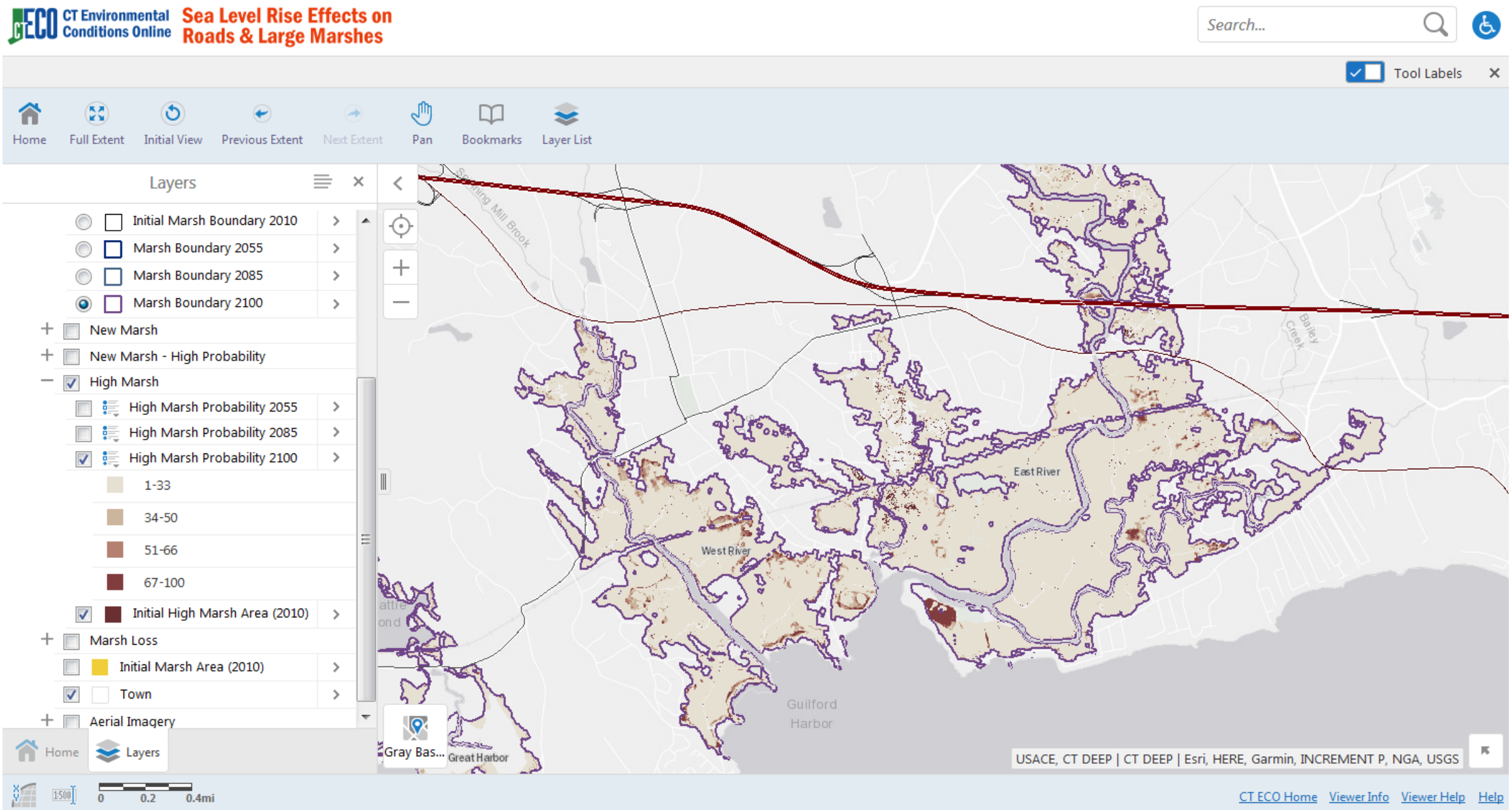
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WHAT WE LEARNED IN 2015

- High marshes (irregularly-flooded marshes) are the most vulnerable category to sea-level rise, with predicted losses ranging from 50% to 97% by 2100. However, as there is uncertainty in model predictions between high marshes and “transitional salt marshes,” some irregularly-flooded marsh loss may be offset by increases predicted in the transitional salt marsh category (occupying previous upland areas).

- Conversely, low marshes (regularly-flooded marshes) are predicted to make substantial gains under all SLR scenarios by occupying areas previously covered by high marsh and by other land types becoming regularly flooded over time.

- In addition to wetland losses, up to 9.5% of developed dry land in the study area is also predicted to become regularly flooded.

WHAT WE LEARNED IN 2016

- A precise water-inundation map is a key input to predict the fate of current marsh systems and the colonization of future marsh areas. Therefore, efforts should not only be devoted to reducing SLR-scenario uncertainty, but also to describing current and future hydraulic conditions and hydraulic pathways.

- Tide ranges and tidal muting does make a difference in model results. Low-tide-range and muted-tide marshes are more vulnerable to future SLR.

- Properly accounting for marsh collapse had local effects, but did not significantly affect landscape-level model predictions. This seems to be because high marshes that collapse are subject to higher sedimentation rates which partially make up for the elevation-capital loss.

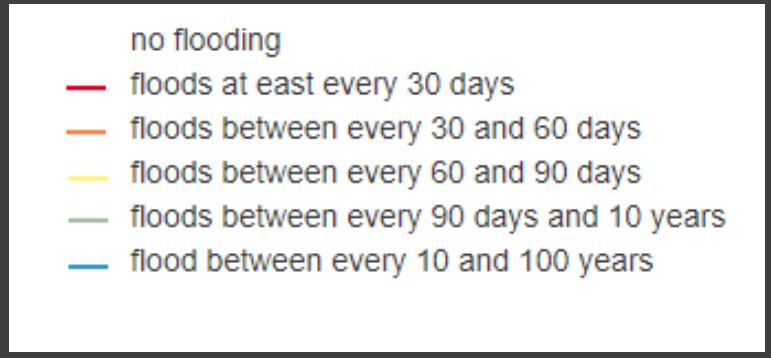
SLAMM DATA VIEWER MARSH RESULTS

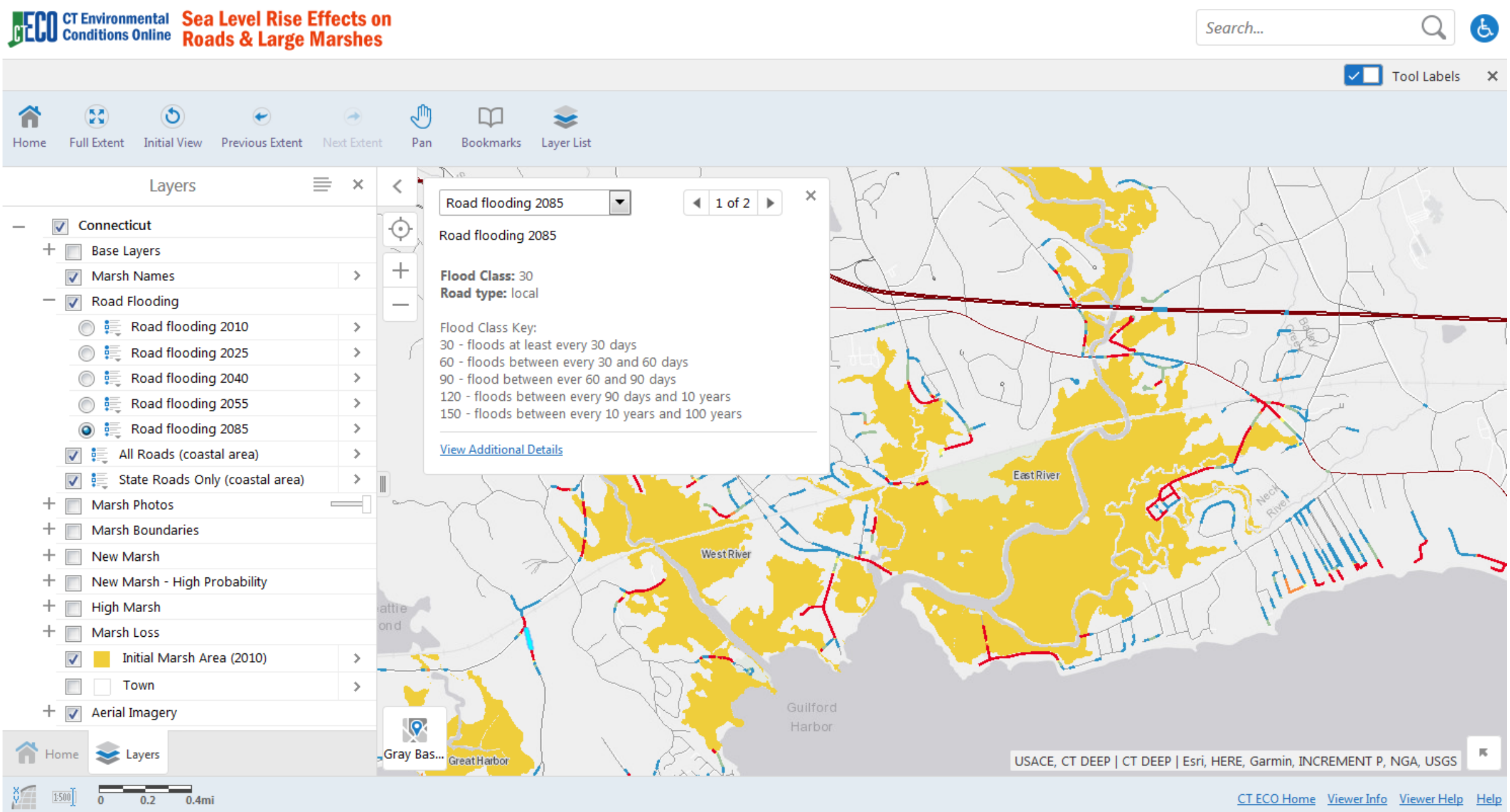
SLAMM brought state-wide visual and analytic awareness that SLR can have significant implications to not only the fate of coastal marshes, but also to the impacts of road flooding along coastal Connecticut.

The 2015 and 2016 iterations showed *where* flooding is likely to happen and which roads and critical infrastructure would be impacted by flood waters, whether tidal or storms.

SLAMM DATA VIEWER ROAD FLOODING RESULTS

- The starting roads layer was provided by the Connecticut Department of Emergency Services and Public Protection (DESPP).
- Each road was divided into 5 meter segments.
- Each road segment was assigned attributes for flooding frequency class for the years 2010, 2025, 2040, 2055 and 2085.

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Aerial Imagery
Road flooding 2085
1 of 2
Road flooding 2085
Flood Class: 30
Road type: local
Flood Class Key:
30 - floods at least every 30 days
60 - floods between every 30 and 60 days
90 - flood between ever 60 and 90 days
120 - floods between every 90 days and 10 years
150 - floods between every 10 years and 100 years
View Additional Details
East River
West River
Guilford Harbor
Great Harbor
Gray Bas...
USACE, CT DEEP | CT DEEP | Esri, HERE, Garmin, INCREMENT P, NGA, USGS
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CONNECTICUT & SLAMM IN 2022

With over five years since the last investigation this third project was well needed. There was a lot of updated data that needed to be incorporated.

- The 2016 project highlighted many road flooding hotspots and showed how the frequency of road flooding would have changed over time. However, there wasn't a definitive idea of how flooded these roads were going to be. Therefore, road flooding depth & inundation levels were a primary focus.

- Additionally, areas were previously identified where SLR would create new marsh areas however these areas are not currently showing any tidal connectivity. This project allows for further analysis of these areas to evaluate their potential to become new marsh if reconnected to tidal waters

CONNECTICUT & SLAMM IN 2022

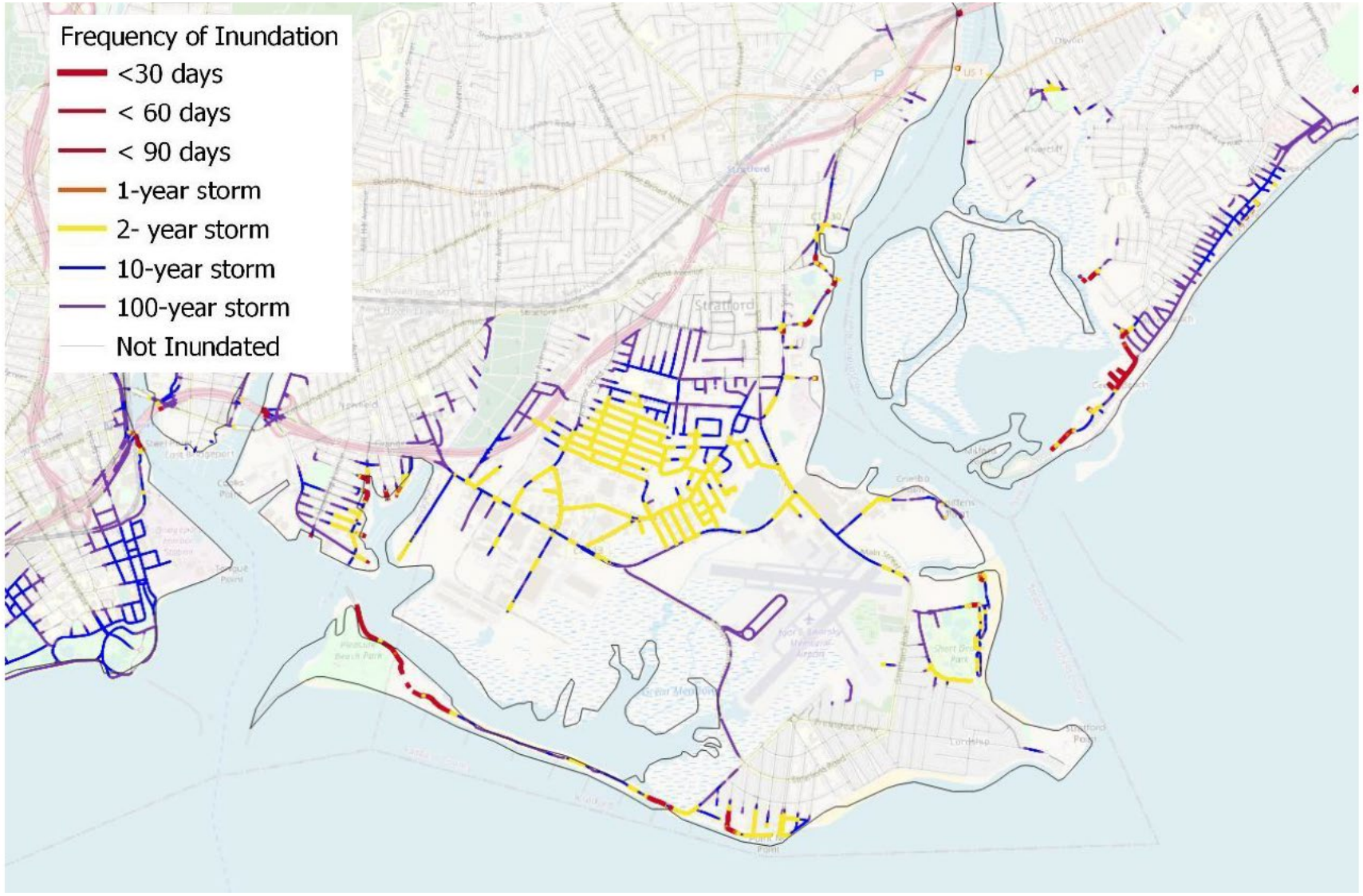
The third SLAMM project in 2022 titled *Investigation of the Effects of Sea-Level Rise on Connecticut Coastal Road Flooding* was done to mainly address the gap in data which provided an understanding of road depth during inundation.

Similar to the previous projects all five SLR scenarios were identified however only the high medium projection was used as the primary planning scenario.

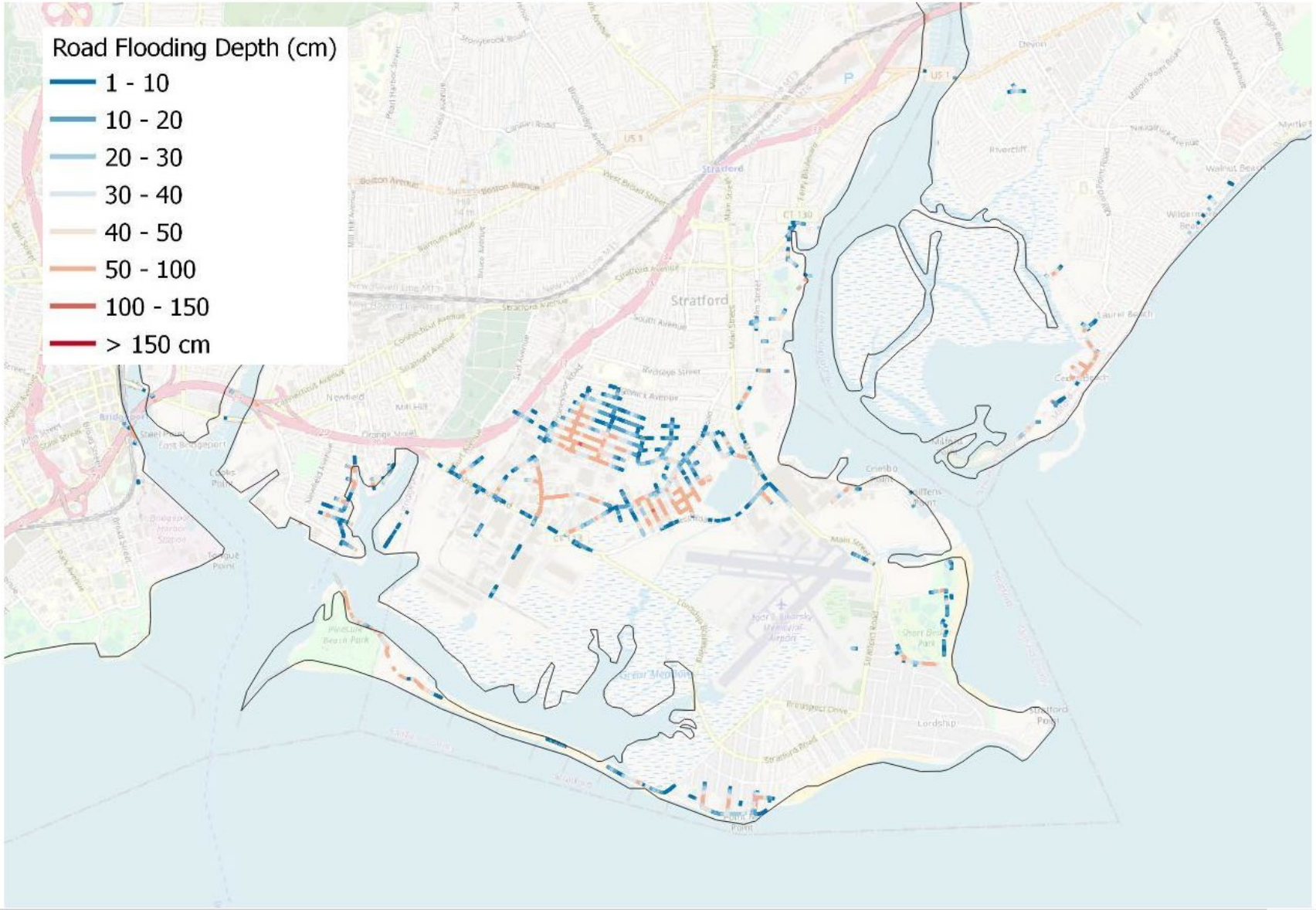
Table 3: Deliverables provided from the SLAMM coastal road flooding project 2022

Quality Assurance Project Plan	**Refined accounting of tidal muting with added data layers**
Input GEOTIFFs & Metadata	GIS shapefile output of road flood depth analysis
Updated input LiDAR	Final report and webinar

PREDICTED FREQUENCY OF INUNDATION IN STRATFORD CT IN 2040 UNDER A HIGH MEDIUM SLR SCENARIO



PREDICTED DEPTH OF INUNDATION IN STRATFORD, CT UNDER A 2040 2-YEAR STORM UNDER A HIGH-MEDIUM SLR SCENARIO



TIDALLY UNCONNECTED AREAS

Newly developed Connecticut land cover data is going to be used to refine existing SLAMM predictions for tidal marshes under future SLR scenarios. The final chapter of the 2022 SLAMM project incorporates the improved analysis of previously identified tidally-unconnected areas.

- The goal of this is to expand information on these areas using alternative SLR scenarios.
- With this information we can access where along the state's infrastructure can we improve tidal connectivity to assist in marsh restoration efforts or the creation of future marshes.
- This newly revised data can help resource managers and planners identify areas that can offset projected losses in coastal areas especially high marsh.


Tidally-unconnected inland wetland/ upland = future tidal marsh with culvert modification
tidal
non-tidal
direction of culverts image
invert elevation restricts tidal flow to north side of road?
West River Marsh
Future marsh?
West River Marsh
146
Future road reconstruction requiring TW fill?

THE FUTURE OF SLAMM IN CONNECTICUT

SLAMM has come a far way in Connecticut. SLR data is changing as the years go by as well as other important information needed for the model. As the information changes there might be a need to revisit the data obtained from the models correspondingly to ensure that results are being accurately portrayed in the time that it is being done.

- Current SLAMM data will be used in an updated online viewer.
- Future projects can be undertaken to refine what is already existing.
- Smaller scale SLAMM modelling can be done compared to state-wide modelling done in the past.
- Data gaps that may be present in the future can be addressed without starting from scratch.
- SLAMM data will continue being a tool to inform planning decisions with ***infrastructure***, ***marsh migration***, and ***marsh restoration*** in the future.

APPRECIATED EFFORT

A special thank you to Mr. Dave Kozak and Jonathan Clough from Warren Pinnacle Consulting who have been with the SLAMM effort in Connecticut since its inception and whose contributions have made the various SLAMM projects in Connecticut possible.

Developing Conservation Plans for New York's Long Island Sound Marsh Complexes

Presentation of marsh viewer: May 17, 2023

NE IW PCC

Long Island Sound Study

warren pinnacle consulting, inc.

NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

Disclaimer

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The contents of this document do not necessarily reflect the views and policies of NEIWPCC, LISS or the EPA, nor does NEIWPCC, LISS or the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Project team introduction

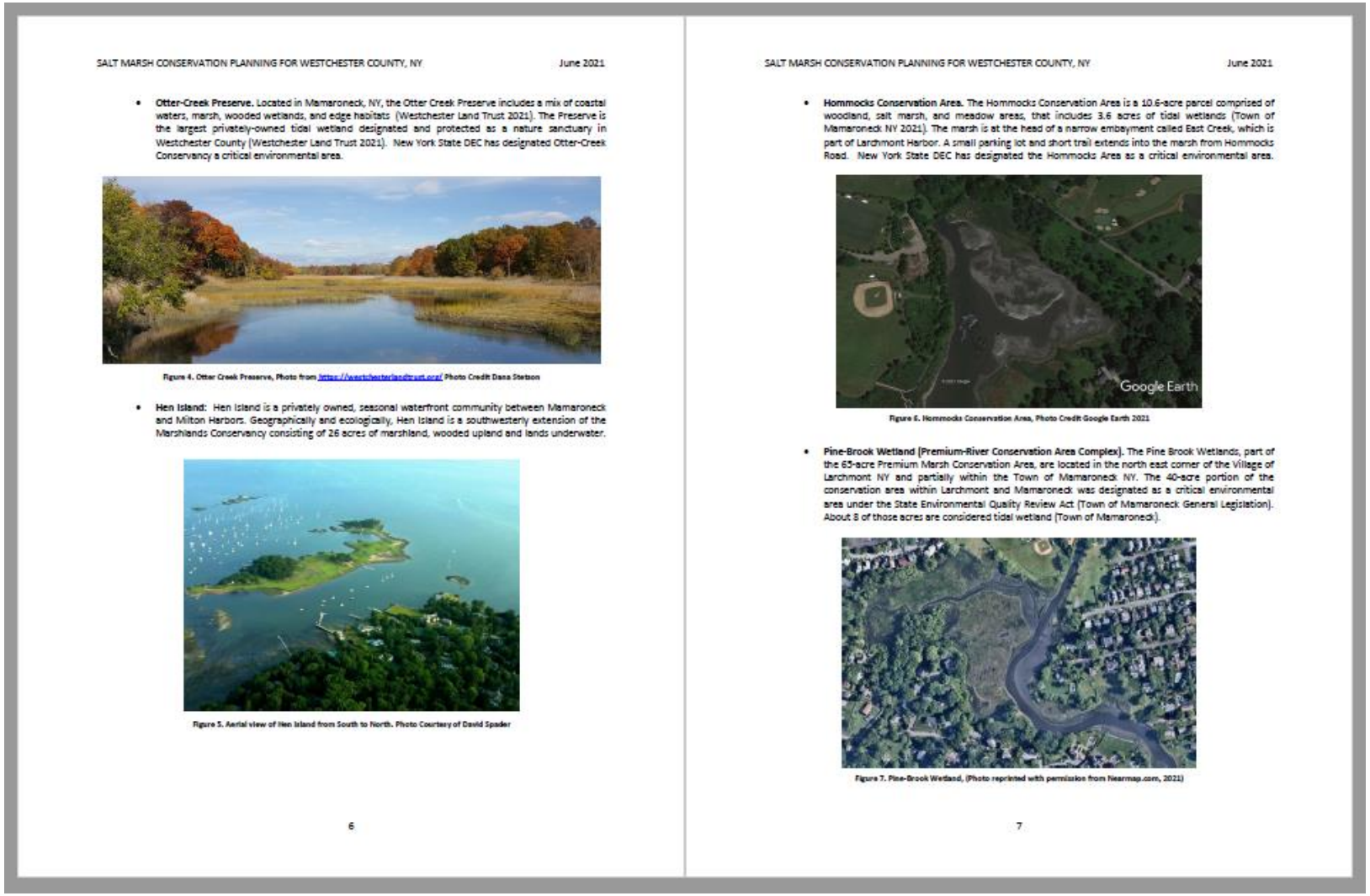
- Jonathan Clough – Warren Pinnacle Consulting, Inc.
  - Environmental Consultant primarily to EPA clients since 1995
  - Working with SLAMM model since 1998

- Victoria O'Neill
  - NEIWPCC Environmental Analyst
  - Long Island Sound Study Habitat Restoration and Stewardship Coordinator

- LISS Sustainable and Resilient Communities Extension Professionals for Long Island (Elizabeth Hornstein, Sarah Schaefer-Brown, Sara Powell)

Project Purpose

- **Provide information for LISS municipalities and/or marsh conservation groups to develop marsh conservation plans designed to increase coastal resiliency**



SALT MARSH CONSERVATION PLANNING FOR WESTCHESTER COUNTY, NY June 2021

- **Otter Creek Preserve.** Located in Mamaroneck, NY, the Otter Creek Preserve includes a mix of coastal waters, marsh, wooded wetlands, and edge habitats (Westchester Land Trust 2021). The Preserve is the largest privately-owned tidal wetland designated and protected as a nature sanctuary in Westchester County (Westchester Land Trust 2021). New York State DEC has designated Otter Creek Conservancy a critical environmental area.

Figure 4. Otter Creek Preserve, Photo from https://westchesterlandtrust.org/ Photo Credit Dana Stetson

- **Hen Island:** Hen Island is a privately owned, seasonal waterfront community between Mamaroneck and Milton Harbors. Geographically and ecologically, Hen Island is a southwesterly extension of the Marshlands Conservancy consisting of 26 acres of marshland, wooded upland and lands underwater.

Figure 5. Aerial view of Hen Island from South to North. Photo Courtesy of David Spader

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SALT MARSH CONSERVATION PLANNING FOR WESTCHESTER COUNTY, NY June 2021

- **Hommocks Conservation Area.** The Hommocks Conservation Area is a 10.6-acre parcel comprised of woodland, salt marsh, and meadow areas, that includes 3.6 acres of tidal wetlands (Town of Mamaroneck NY 2021). The marsh is at the head of a narrow embayment called East Creek, which is part of Larchmont Harbor. A small parking lot and short trail extends into the marsh from Hommocks Road. New York State DEC has designated the Hommocks Area as a critical environmental area.

Figure 6. Hommocks Conservation Area, Photo Credit Google Earth 2021

- **Pine-Brook Wetland (Premium-River Conservation Area Complex).** The Pine Brook Wetlands, part of the 65-acre Premium Marsh Conservation Area, are located in the north east corner of the Village of Larchmont NY and partially within the Town of Mamaroneck NY. The 40-acre portion of the conservation area within Larchmont and Mamaroneck was designated as a critical environmental area under the State Environmental Quality Review Act (Town of Mamaroneck General Legislation). About 8 of those acres are considered tidal wetland (Town of Mamaroneck).

Figure 7. Pine-Brook Wetland, (Photo reprinted with permission from Nearmap.com, 2021)

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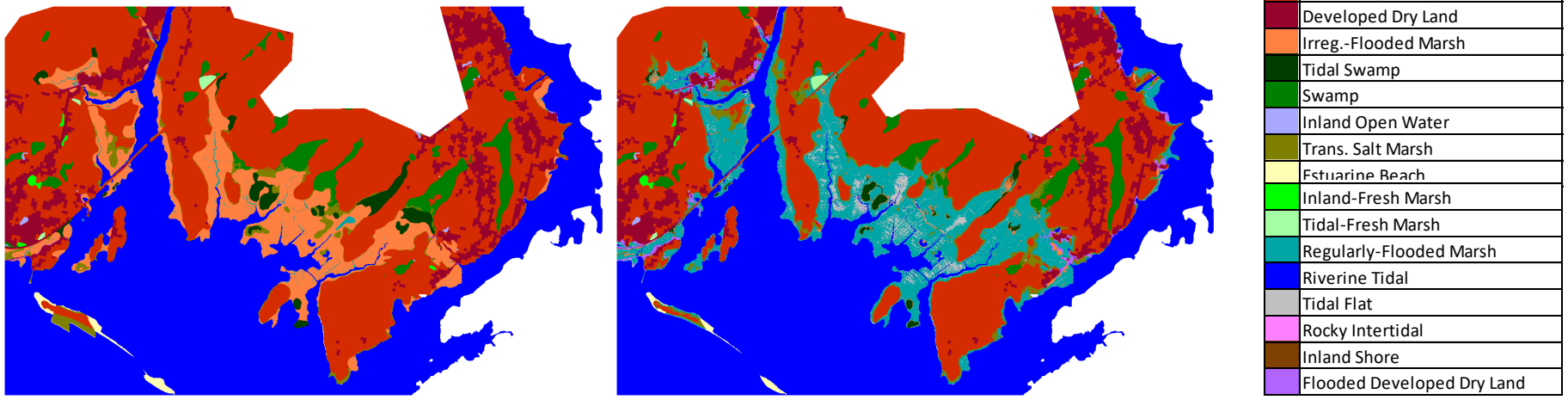
Project Stages

- Leverage existing SLAMM (Sea Level Affecting Marshes Model) projections for the entirety of coastal New York State
  - Develop light-weight on-line viewer that incorporates land-ownership data
  - Data analysis that examines marsh fate predictions on a tax-parcel basis
  - Present viewer and data-analysis results

- Develop marsh conservation plans
  - Via cooperative agreement with municipalities or other marsh conservation stakeholder groups *(Through September 2023)*
- Participate in community workshops to roll-out conservation plans
  - Revise based on community feedback *(September 2023)*

SLAMM - Sea Level Affecting Marshes Model

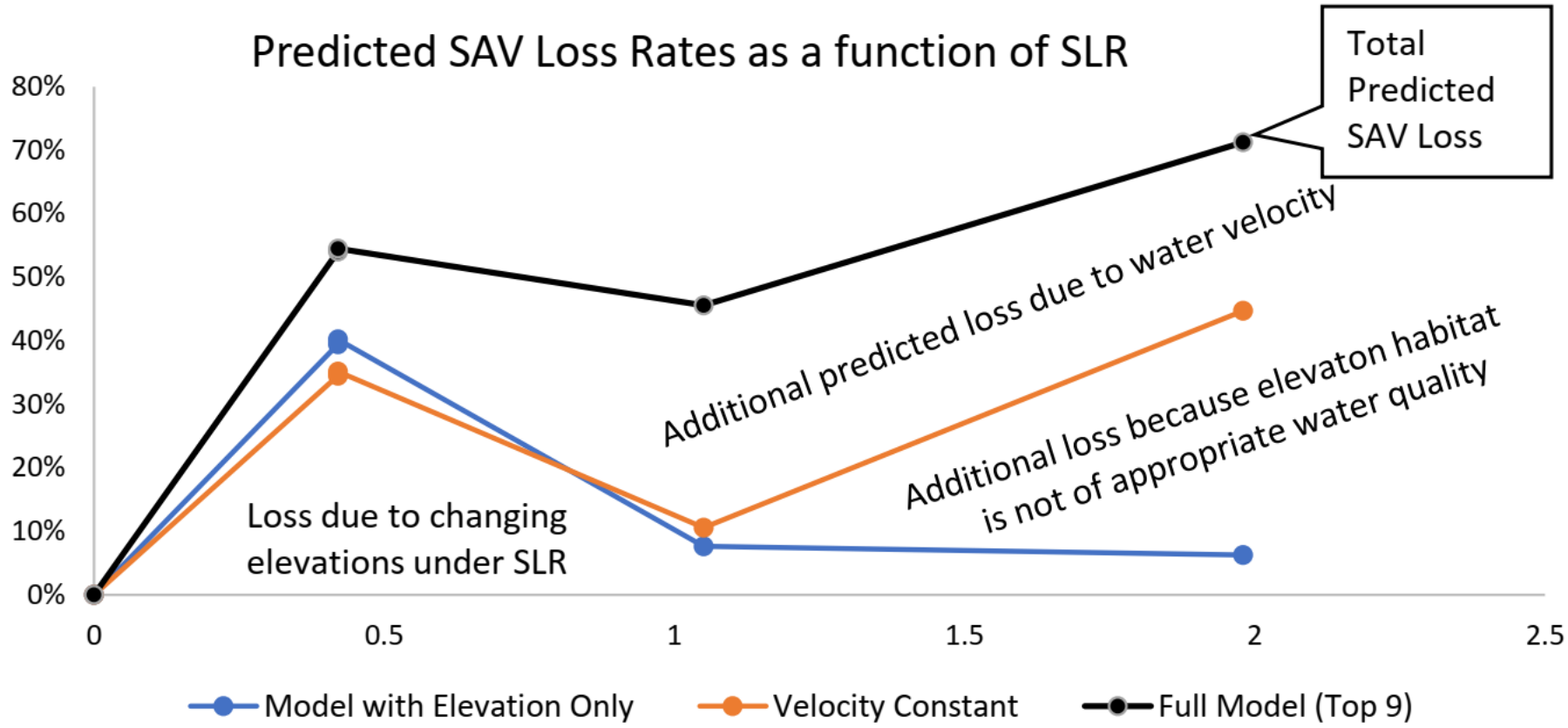
- Simulates the dominant processes in wetland conversions under SLR
  - inundation, erosion, accretion, soil saturation and barrier island overwash
- 26 land cover types
- Uses a complex decision tree to represent transfers among land cover classes
- Provides numerical and map-based output
- Integrated parameter sensitivity and stochastic uncertainty modules
- Users have included US EPA, USGS, The Nature Conservancy, National Wildlife Federation, and the U.S. Fish & Wildlife Service, among others



2010 2100, 1 m SLR

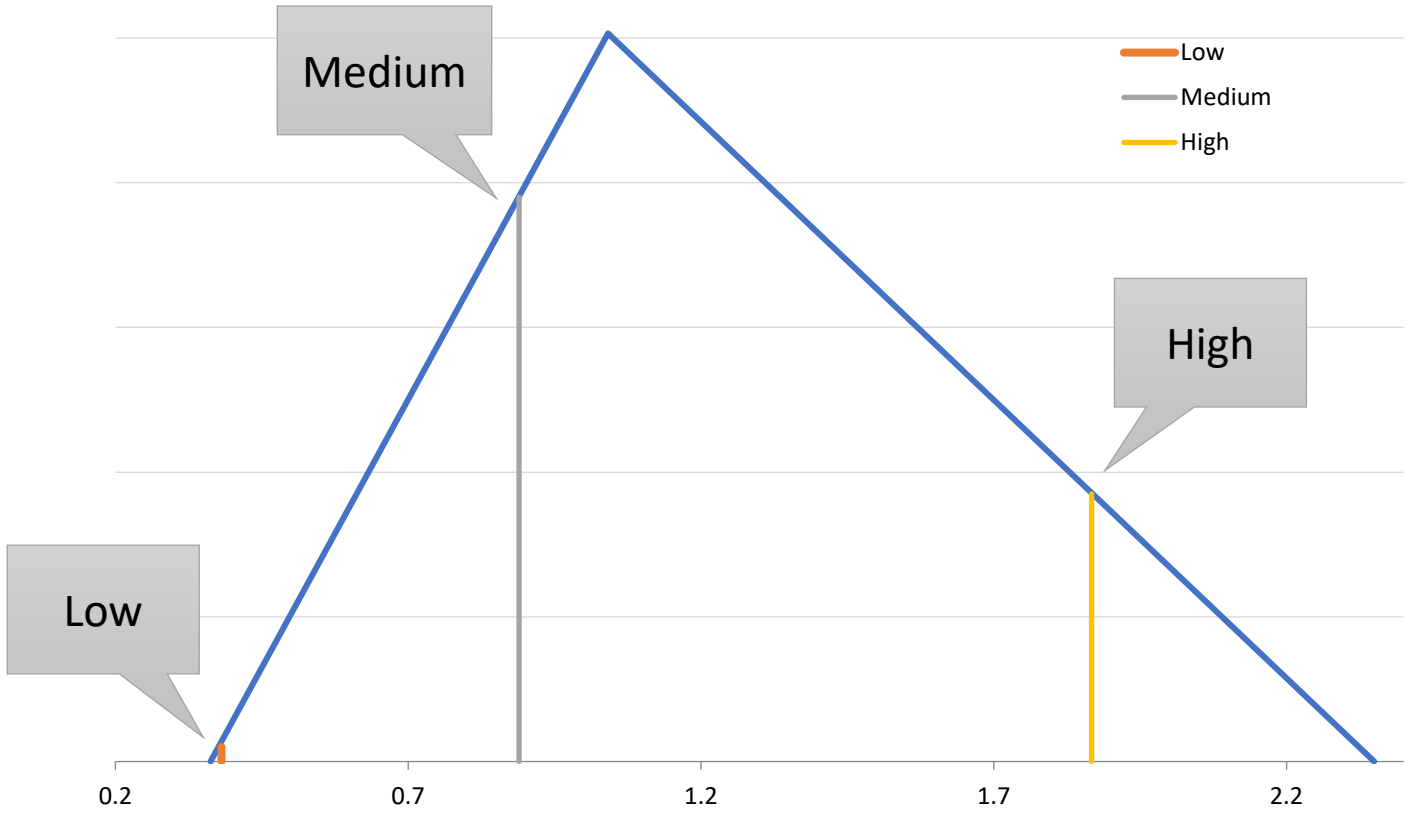
SLAMM and SAV

- Empirical model developed in OR with USGS and USEPA in 2014
- Calibrated/validated to Chesapeake Bay with EESLR funding in 2021
- https://tinyurl.com/SLAMMSAV



SLR Uncertainty

SLR in meters by 2100 compared with 2016 NYC Governor's SLR Scenarios

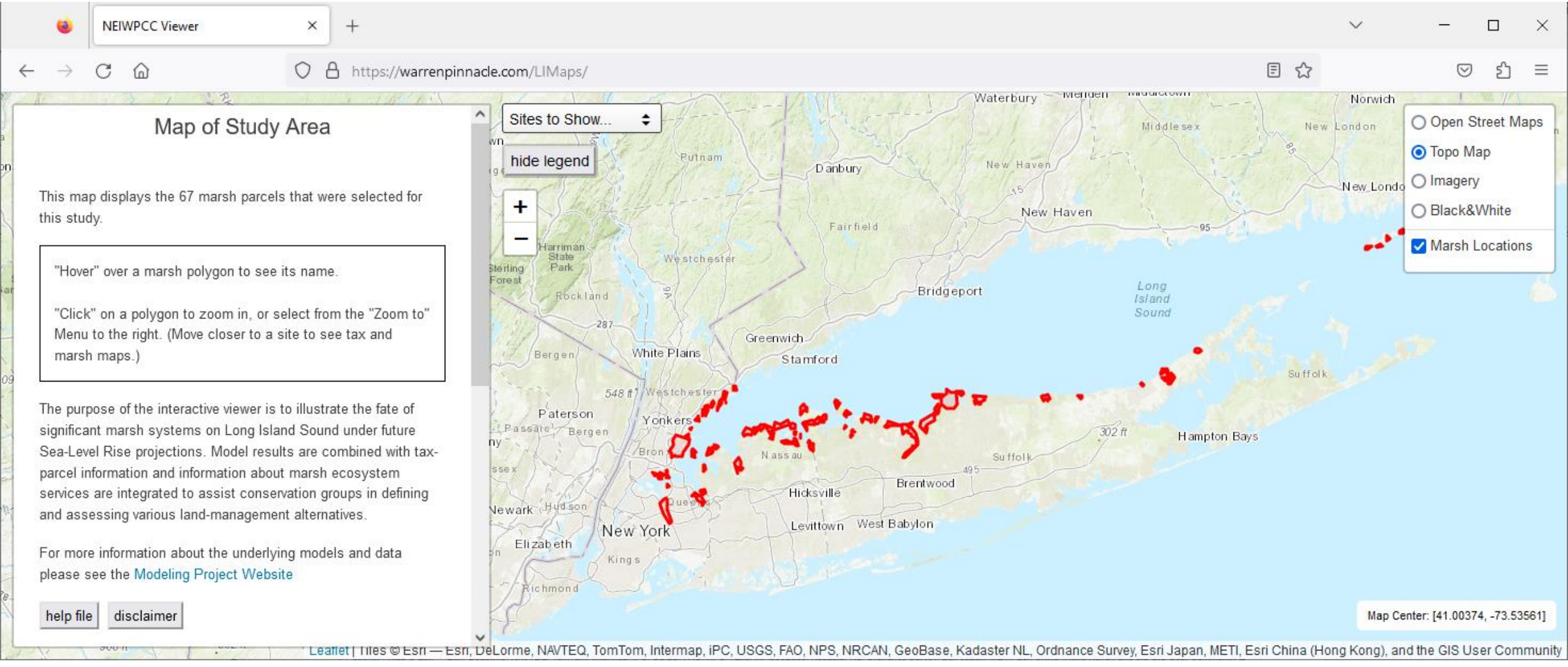


Sea level by 2100 between 0.35 m and 2.35 m by 2100; most-likely value of approximately 1 m.

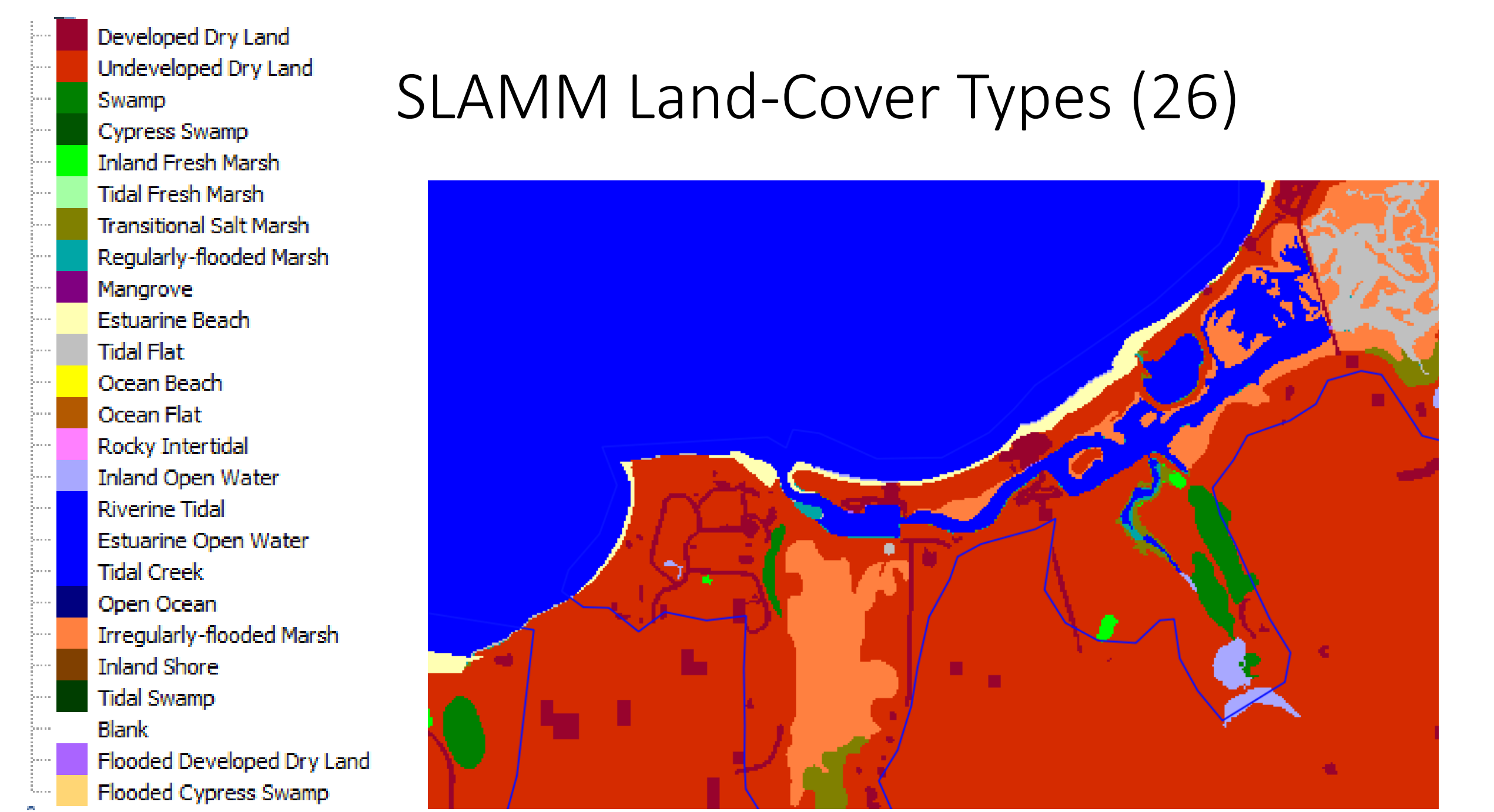
Derived by considering the NYC Panel on Climate Change (NPCC2) report (Rosenzweig and Solecki 2013) and the ClimAID report (Rosenzweig et al. 2011).

Marsh Interactive Fate Viewer

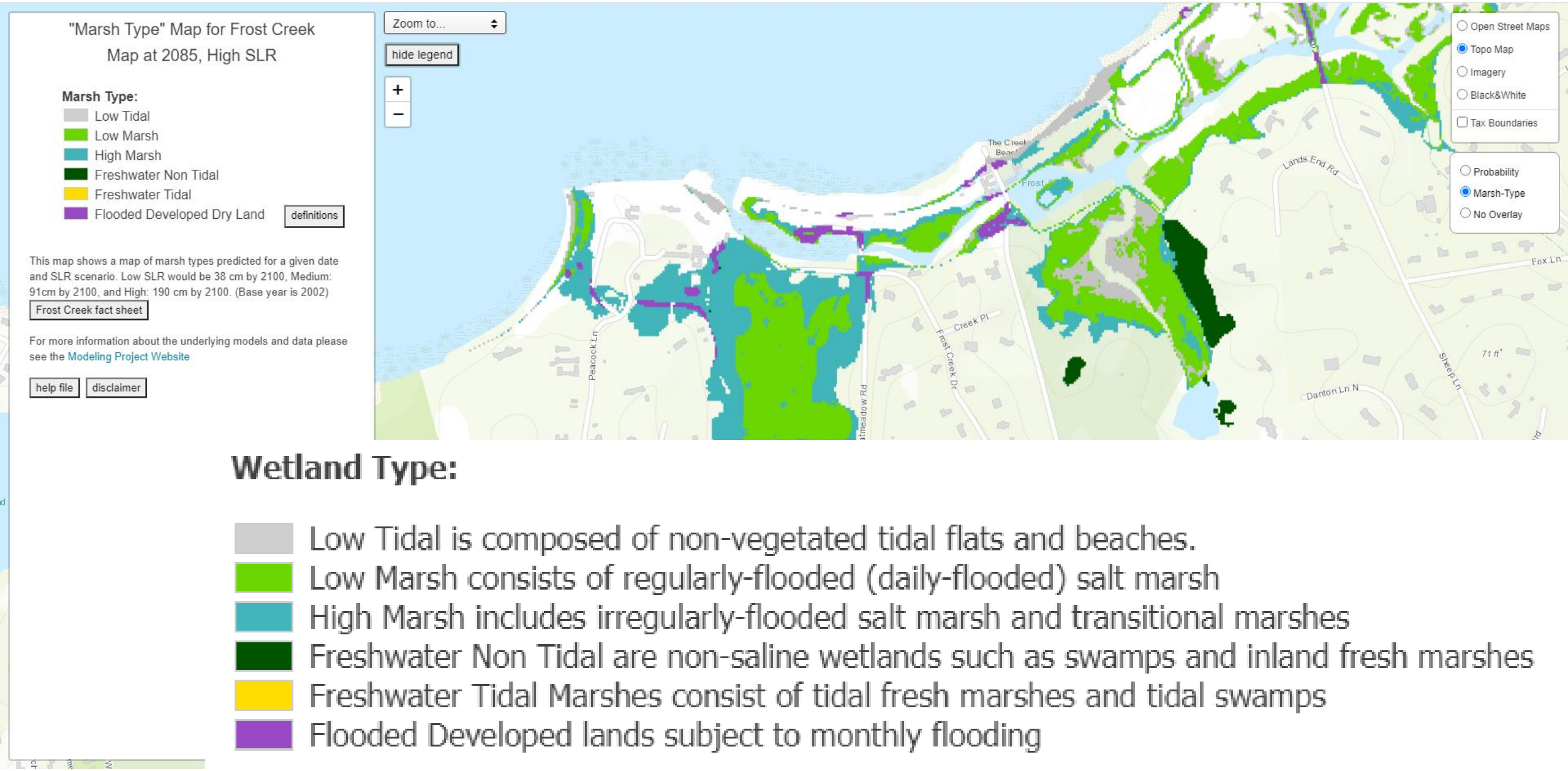
http://warrenpinnacle.com/LIMaps/



SLAMM Land-Cover Types (26)



Simplified Land-Cover Types

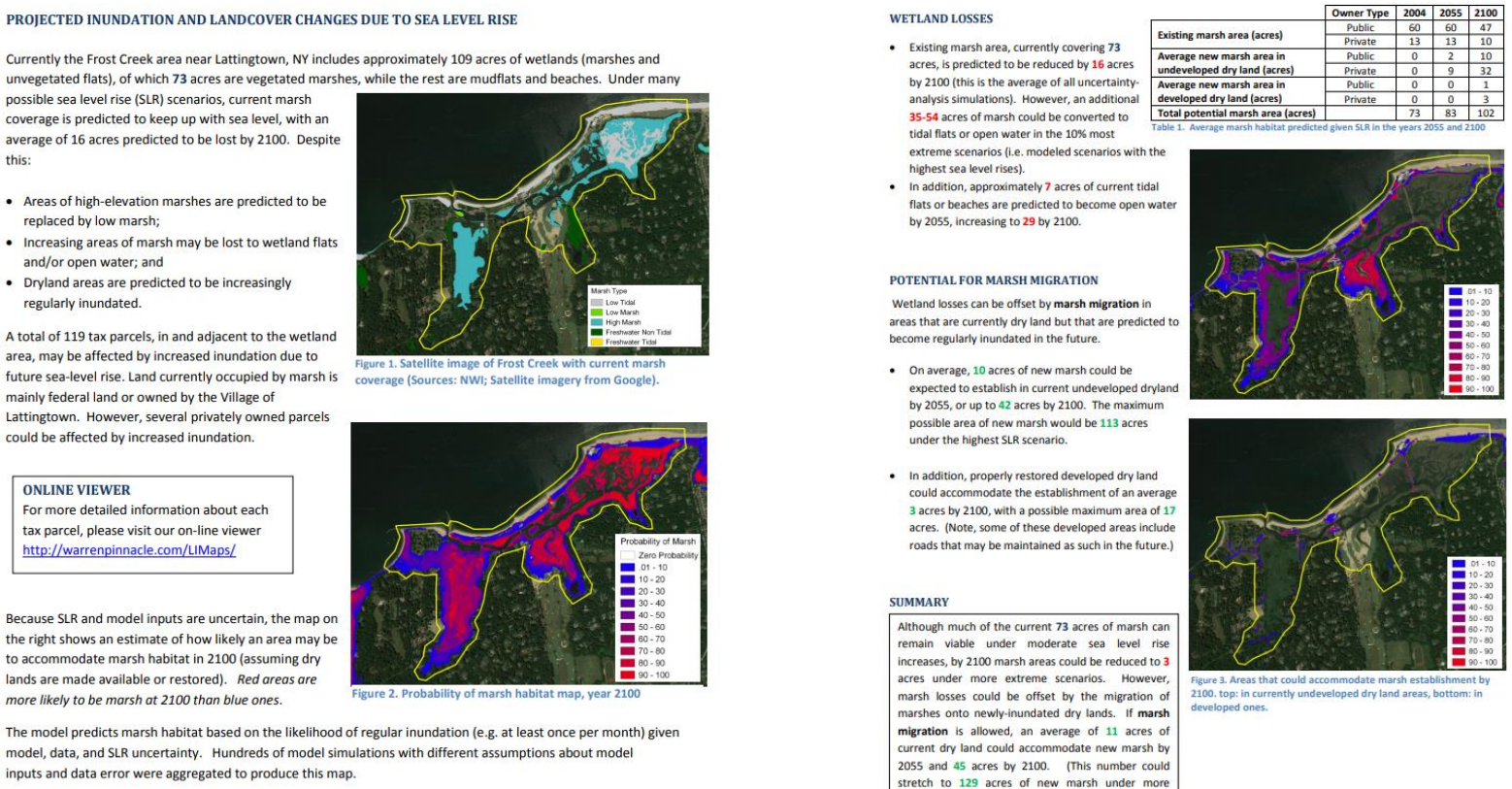


Wetland Type:

- Low Tidal is composed of non-vegetated tidal flats and beaches.
- Low Marsh consists of regularly-flooded (daily-flooded) salt marsh
- High Marsh includes irregularly-flooded salt marsh and transitional marshes
- Freshwater Non Tidal are non-saline wetlands such as swamps and inland fresh marshes
- Freshwater Tidal Marshes consist of tidal fresh marshes and tidal swamps
- Flooded Developed lands subject to monthly flooding

Fact Sheets

- Designed to provide an overview of its site in terms of current marsh habitat, its predicted resilience to sea-level rise, and potential future marsh habitat under sea-level rise



PROJECTED INUNDATION AND LANDCOVER CHANGES DUE TO SEA LEVEL RISE

Currently the Frost Creek area near Lattingtown, NY includes approximately 109 acres of wetlands (marshes and unvegetated flats), of which **73** acres are vegetated marshes, while the rest are mudflats and beaches. Under many possible sea level rise (SLR) scenarios, current marsh coverage is predicted to keep up with sea level, with an average of 16 acres predicted to be lost by 2100. Despite this:

- Areas of high-elevation marshes are predicted to be replaced by low marsh;
- Increasing areas of marsh may be lost to wetland flats and/or open water; and
- Dryland areas are predicted to be increasingly regularly inundated.

A total of 119 tax parcels, in and adjacent to the wetland area, may be affected by increased inundation due to future sea-level rise. Land currently occupied by marsh is mainly federal land or owned by the Village of Lattingtown. However, several privately owned parcels could be affected by increased inundation.

ONLINE VIEWER
For more detailed information about each tax parcel, please visit our on-line viewer
http://warrenpinnacle.com/LIMaps/

Figure 1. Satellite image of Frost Creek with current marsh coverage (Sources: NWI; Satellite imagery from Google).

Figure 2. Probability of marsh habitat map, year 2100

Because SLR and model inputs are uncertain, the map on the right shows an estimate of how likely an area may be to accommodate marsh habitat in 2100 (assuming dry lands are made available or restored). *Red areas are more likely to be marsh at 2100 than blue ones.*

The model predicts marsh habitat based on the likelihood of regular inundation (e.g. at least once per month) given model, data, and SLR uncertainty. Hundreds of model simulations with different assumptions about model inputs and data error were aggregated to produce this map.

WETLAND LOSSES

	Owner Type	2004	2055	2100
Existing marsh area (acres)	Public	60	60	47
	Private	13	13	10
Average new marsh area in undeveloped dry land (acres)	Public	0	2	10
	Private	0	9	32
Average new marsh area in developed dry land (acres)	Public	0	0	1
	Private	0	0	3
Total potential marsh area (acres)		73	83	102

Table 1. Average marsh habitat predicted given SLR in the years 2055 and 2100

- Existing marsh area, currently covering **73** acres, is predicted to be reduced by **16** acres by 2100 (this is the average of all uncertainty-analysis simulations). However, an additional **35-54** acres of marsh could be converted to tidal flats or open water in the 10% most extreme scenarios (i.e. modeled scenarios with the highest sea level rises).
- In addition, approximately **7** acres of current tidal flats or beaches are predicted to become open water by 2055, increasing to **29** by 2100.

POTENTIAL FOR MARSH MIGRATION

Wetland losses can be offset by **marsh migration** in areas that are currently dry land but that are predicted to become regularly inundated in the future.

- On average, **10** acres of new marsh could be expected to establish in current undeveloped dryland by 2055, or up to **42** acres by 2100. The maximum possible area of new marsh would be **113** acres under the highest SLR scenario.
- In addition, properly restored developed dry land could accommodate the establishment of an average **3** acres by 2100, with a possible maximum area of **17** acres. (Note, some of these developed areas include roads that may be maintained as such in the future.)

SUMMARY

Although much of the current **73** acres of marsh can remain viable under moderate sea level rise increases, by 2100 marsh areas could be reduced to **3** acres under more extreme scenarios. However, marsh losses could be offset by the migration of marshes onto newly-inundated dry lands. If **marsh migration** is allowed, an average of **11** acres of current dry land could accommodate new marsh by 2055 and **45** acres by 2100. (This number could stretch to **129** acres of new marsh under more extreme SLR scenarios).

Figure 3. Areas that could accommodate marsh establishment by 2100. top: in currently undeveloped dry land areas, bottom: in developed ones.