TOWN OF STRATFORD

offering more from forest to shore

..... Building Coastal Resiliency

Project Team

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Consultants:

- GZA GeoEnvironmental, Inc.
- Jamie Caplan Consulting LLC
- The Cecil Group

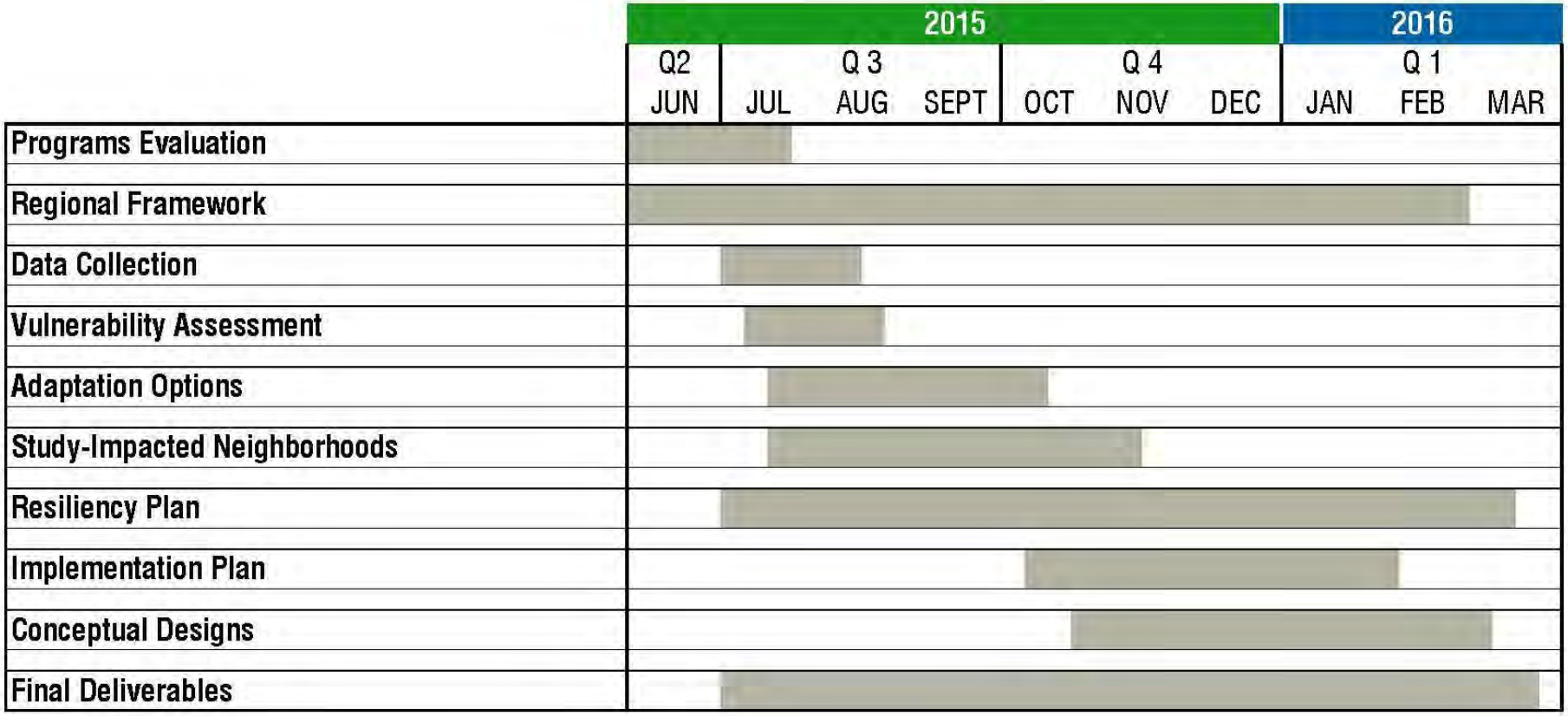
Connecticut Metropolitan Council of Governments

METROCOG

Connecticut Metropolitan Council of Governments

Post-Sandy Project funded by a HUD CDBG-Disaster Recovery Grant

Coastal Resilience Plan Timeline



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GZA

Public Meetings

- ✓ First Public Meeting: Stratford Town Hall (7/14/2015)
- ✓ Second Public Meeting: Birdseye Municipal Complex (11/5/2015)
- ✓ Today's Meeting
  - Project Overview
  - Resiliency Recommendations
  - Next Steps

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Development of the Community Coastal Resilience Plan

Goals:

- ✓ Plan for social, economic and ecological resilience to coastal flooding and sea level rise
- ✓ Create resilience plan model for other communities

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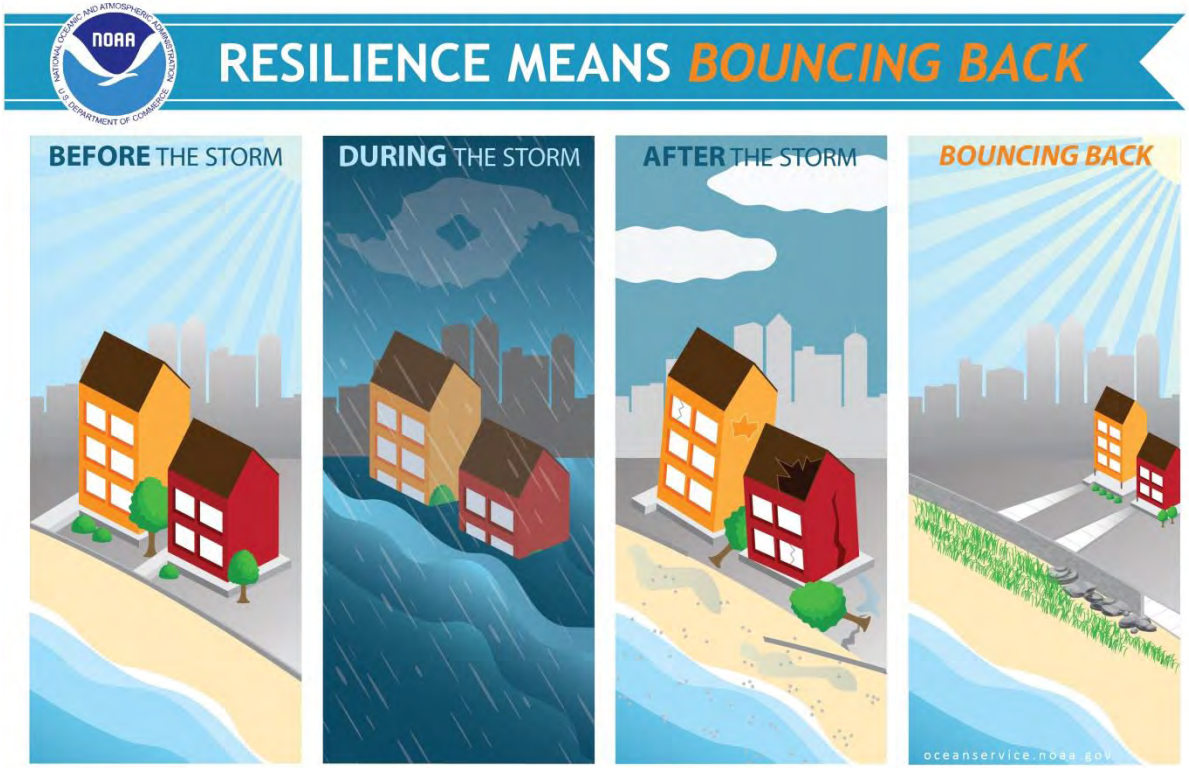
What is coastal resilience?

Coastal resilience means building the ability of a community to "bounce back" after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts. (*NOAA*)



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Why does coastal resiliency matter?

- ✓ Property Value
- ✓ Community Costs - Taxes
- ✓ Flood Insurance
- ✓ Sustaining and attracting new business
- ✓ Recreational assets and natural resources
- ✓ Long term Town viability

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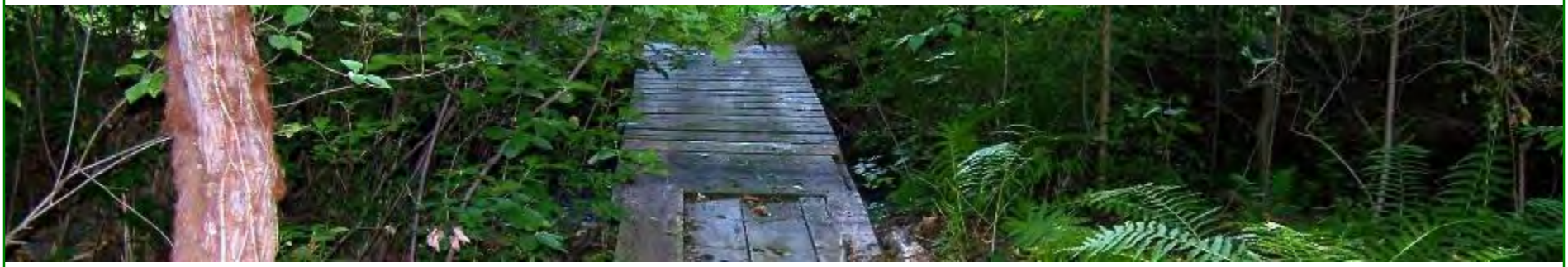
Coastal Resilience Plan Challenges



1. What are the risks?
2. What can be done to create resiliency?
3. How should these measures be implemented?

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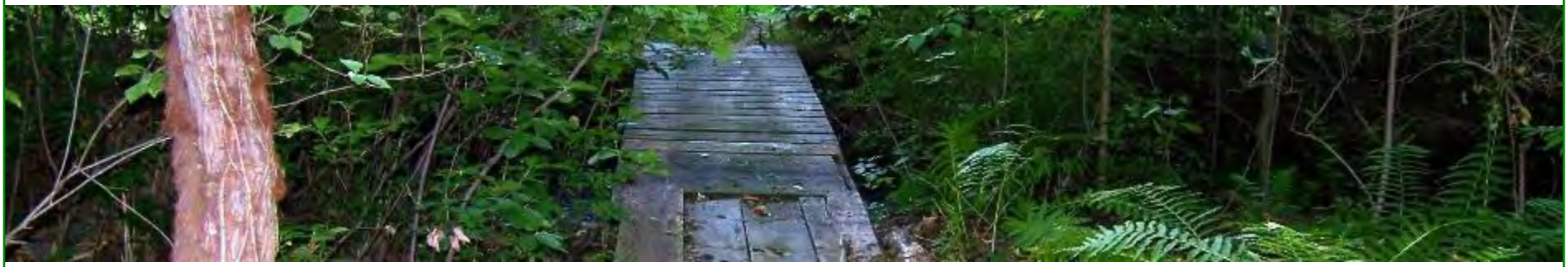
Coastal Resilience Plan Approach



1. What are the risks? **Hazard Vulnerability and Risk Assessment**

2. What can be done to create resiliency? **Retreat, Accommodate and/or Protect**

3. How can these measures be implemented? **Integrate resiliency planning and goals into all existing Town policies and programs.**

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Coastal Hazard Vulnerability/Risk Assessment

Long Beach West after the 1938 Hurricane (Ref. Town of Stratford)

Hurricane Sandy (2011)

Take Away 1

Use "Risk-Informed Decision Making"

Risk = An event x probability of occurrence x resulting consequences

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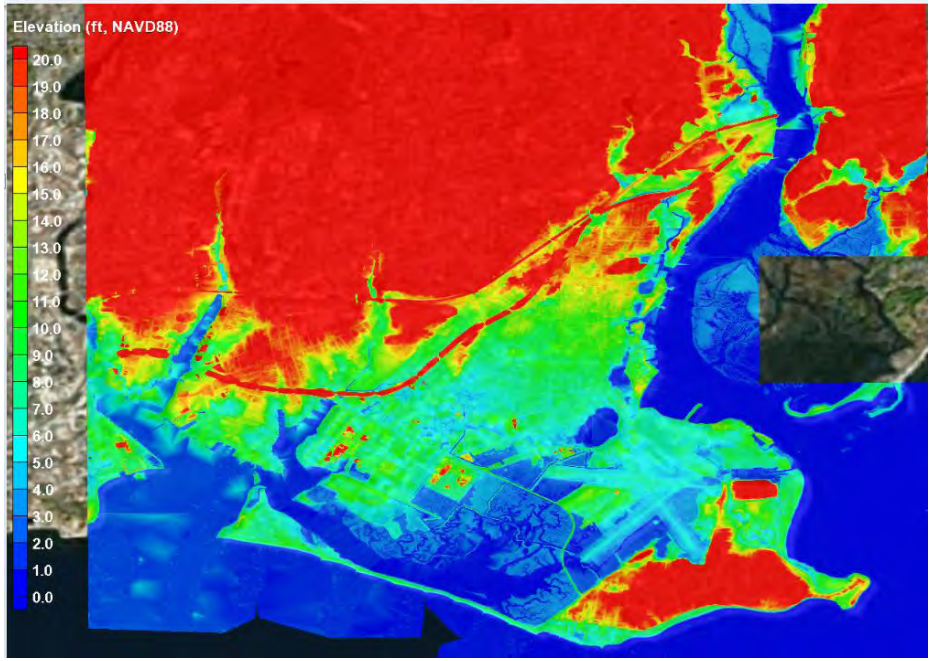
Coastal Hazard Vulnerability/Risk Assessment

Step 1 – Define Coastal Setting:

- ✓ topography/bathymetry
- ✓ shoreline features
- ✓ land cover
- ✓ geology
- ✓ natural resources
- ✓ ecology
- ✓ socioeconomic data



Take Away 2

Manage information using GIS (e.g., GZA GeoTool©)

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Example: Topography

GIS Layer DEM (2013 LiDAR)

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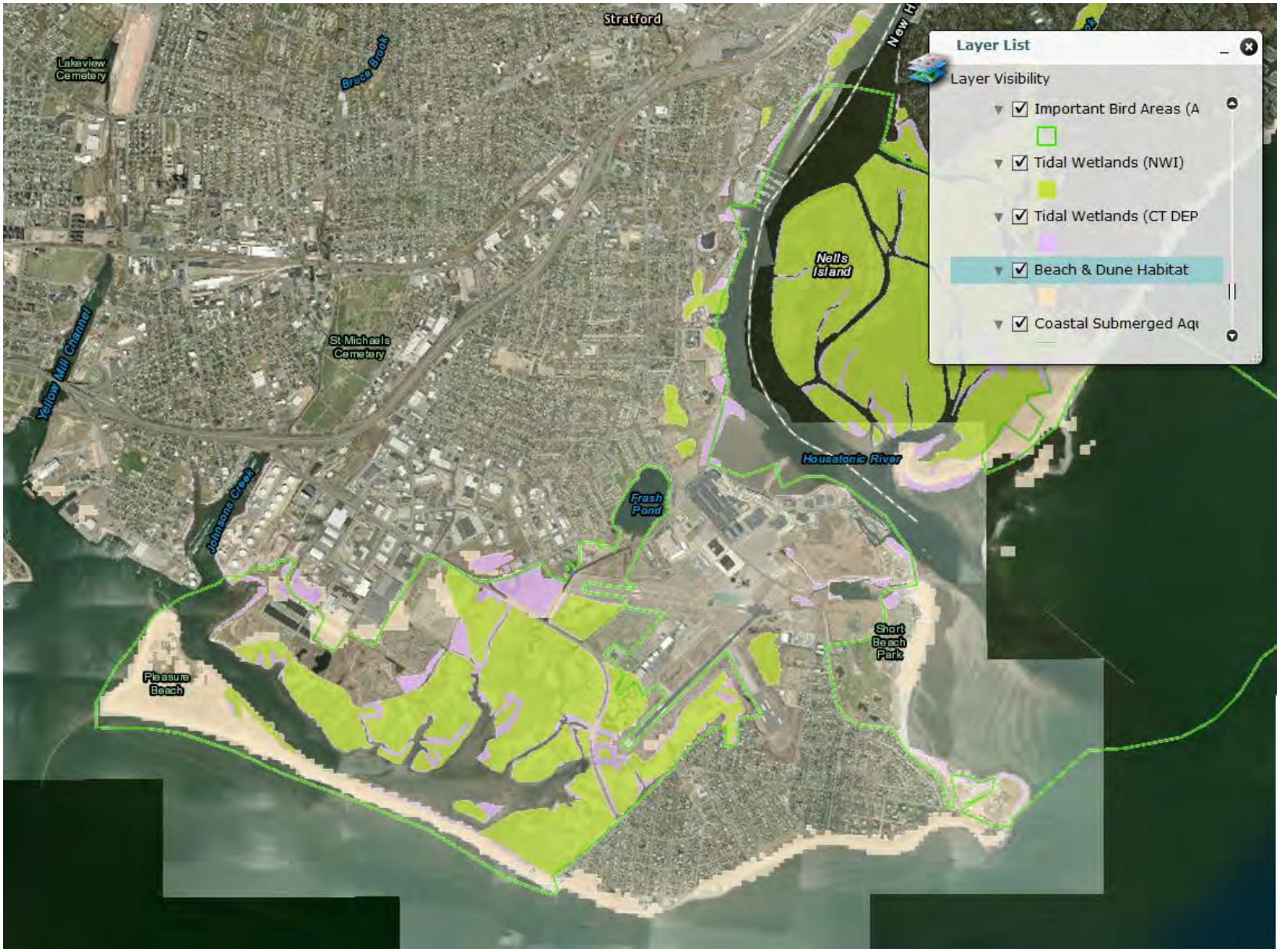
Example: Coastal Shoreline Types

GIS Layer: USACE North Atlantic Coast Comprehensive Study

Example: Coastal Wetlands and Habitat

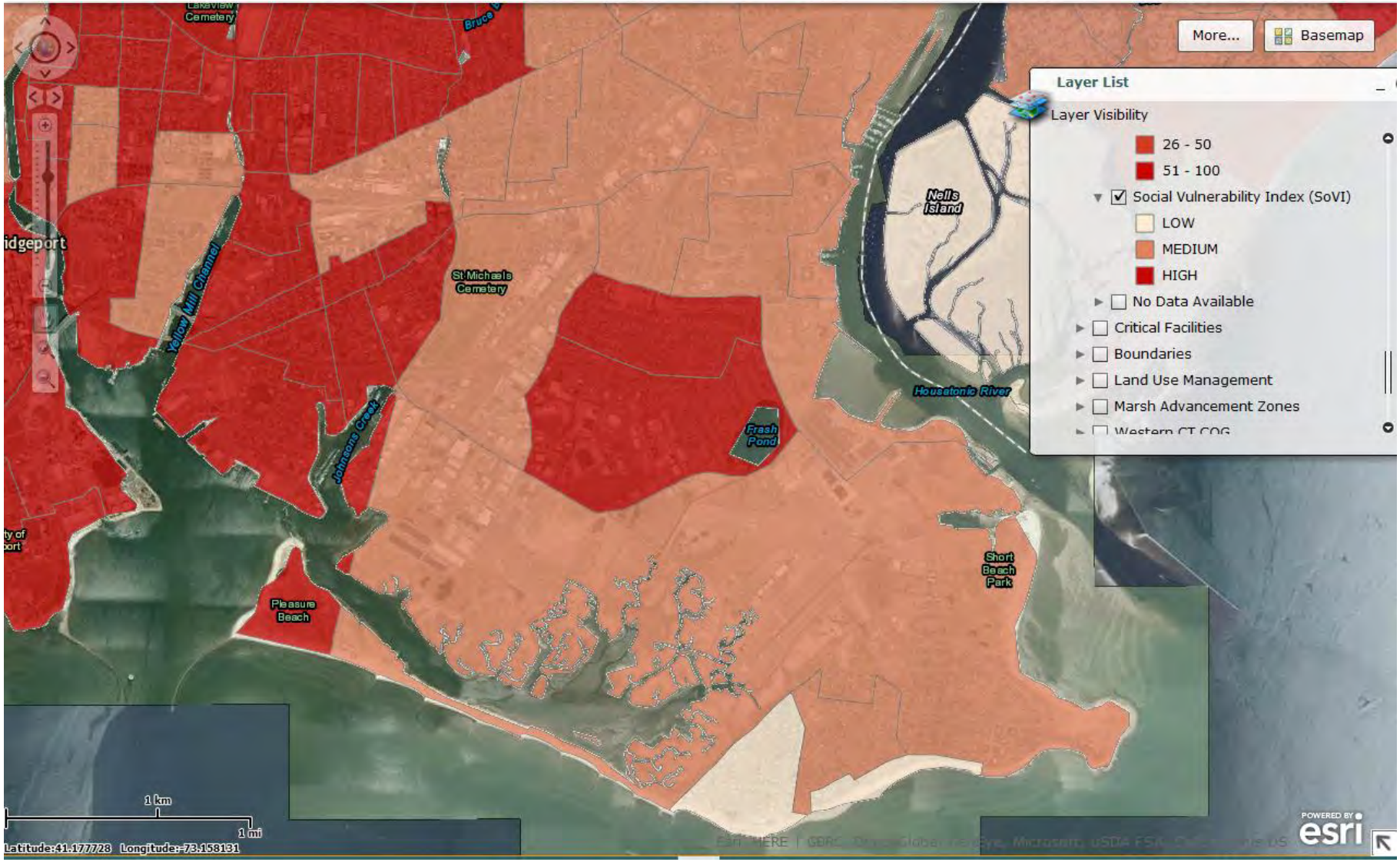


GIS Layer: The Nature Conservatory (TNC) Coastal Resilience

Example: Economic (Property Value)

GIS Layer: The Nature Conservatory (TNC) Coastal Resilience

Social (Vulnerability Index)



GIS Layer: The Nature Conservatory (TNC) Coastal Resilience

Coastal Hazard Vulnerability/Risk Assessment

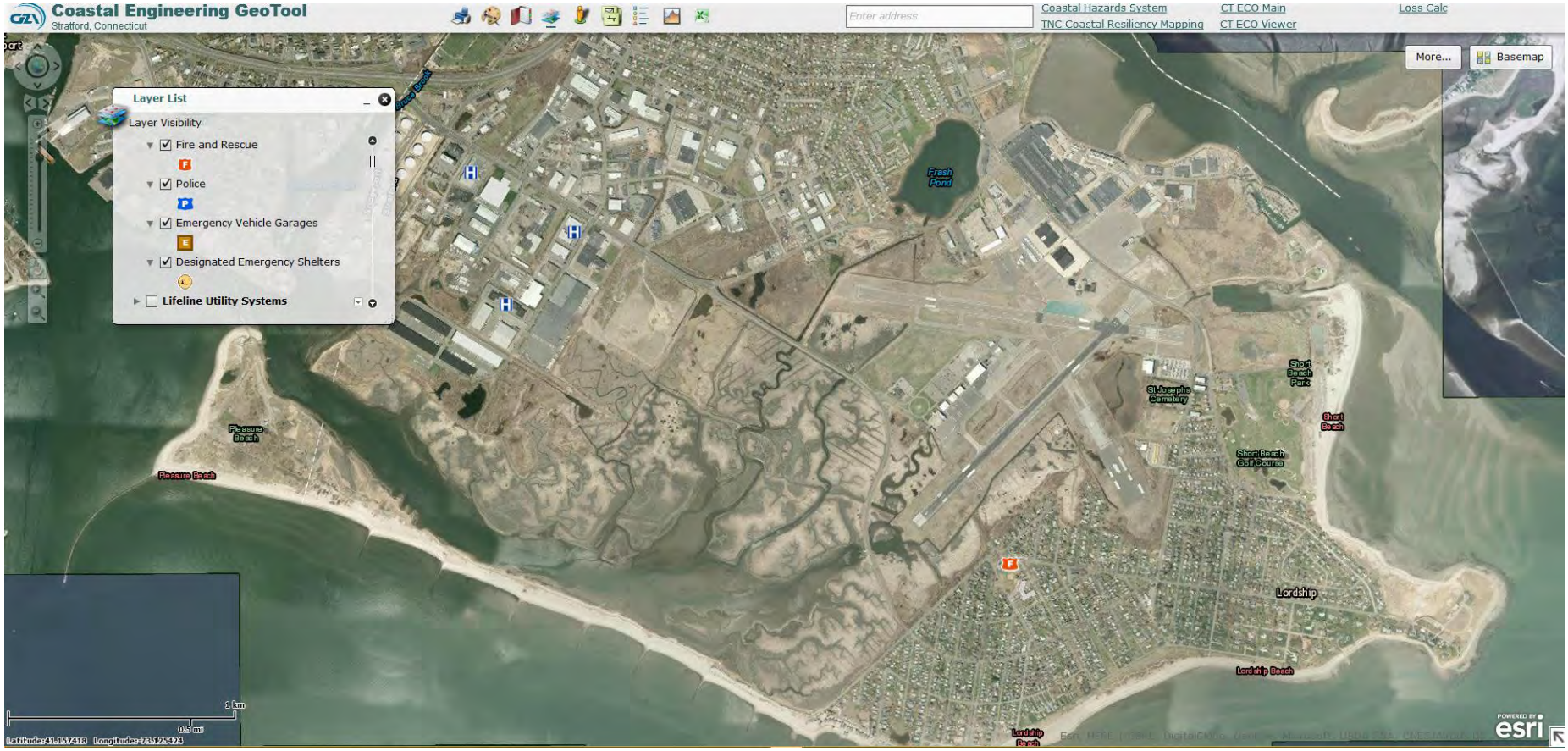
Step 2 – Inventory Town Assets:

- ✓ Essential Facilities
- ✓ Lifeline Utilities
- ✓ Transportation
- ✓ High Potential Loss Facilities
- ✓ Hazardous Material Facilities
- ✓ High Occupancy/Vulnerable Population Facilities
- ✓ Private and commercial property
- ✓ Natural Resources

Fire Department Company 1 - Ref. Momo4

Emergency Shelter - Stratford High School

Example: Essential Facilities



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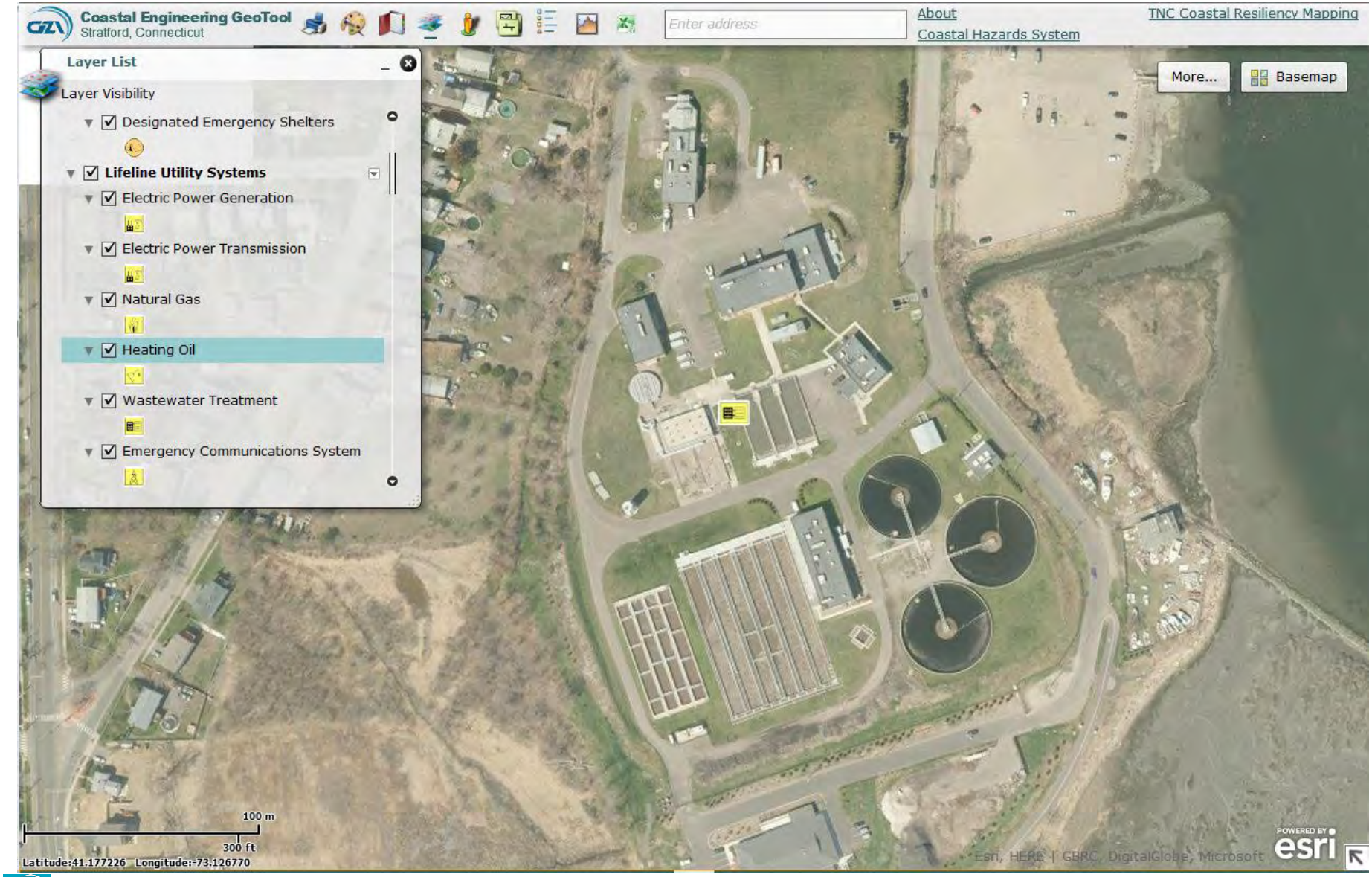
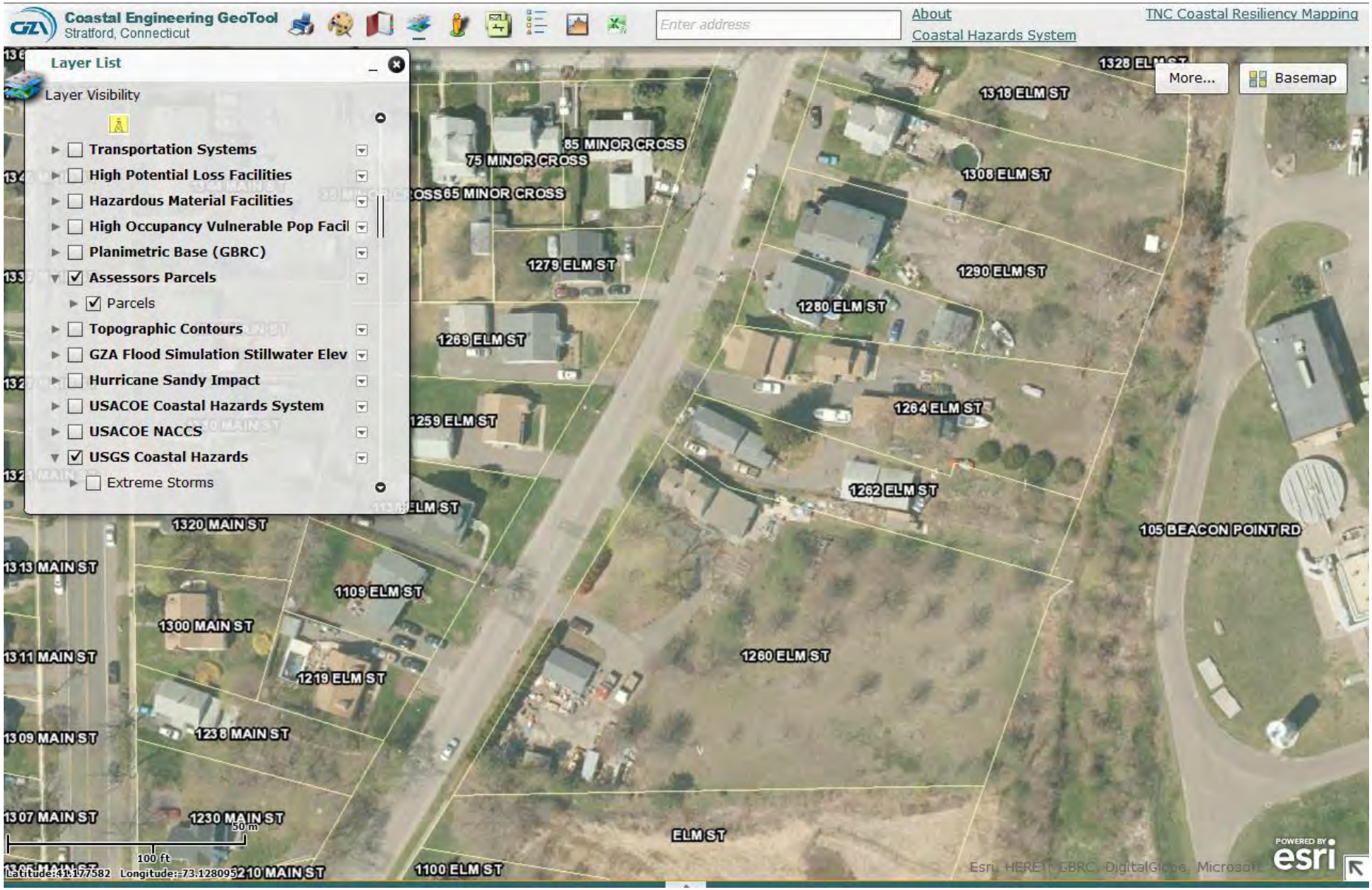
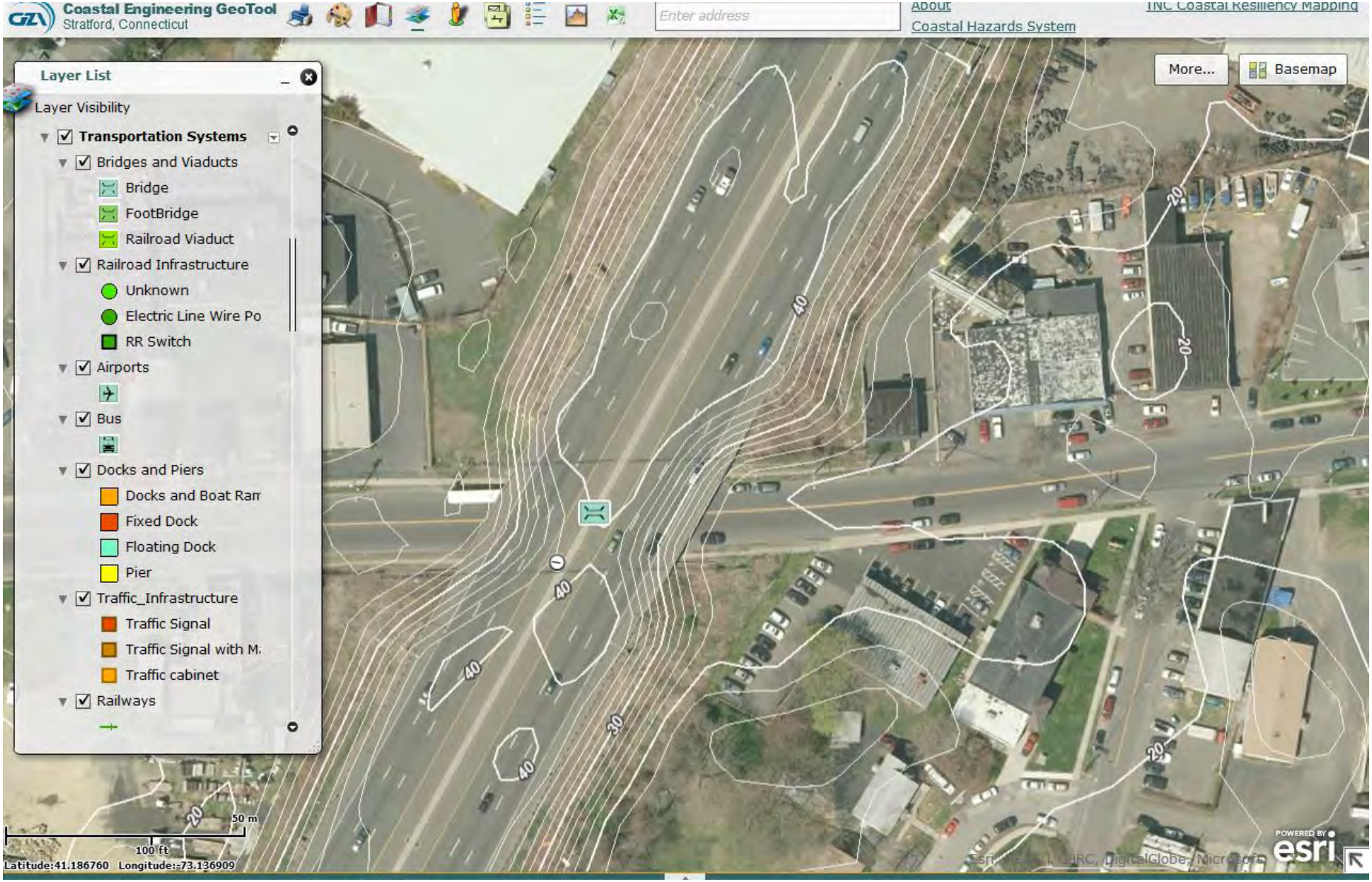
Example: Lifeline Utilities



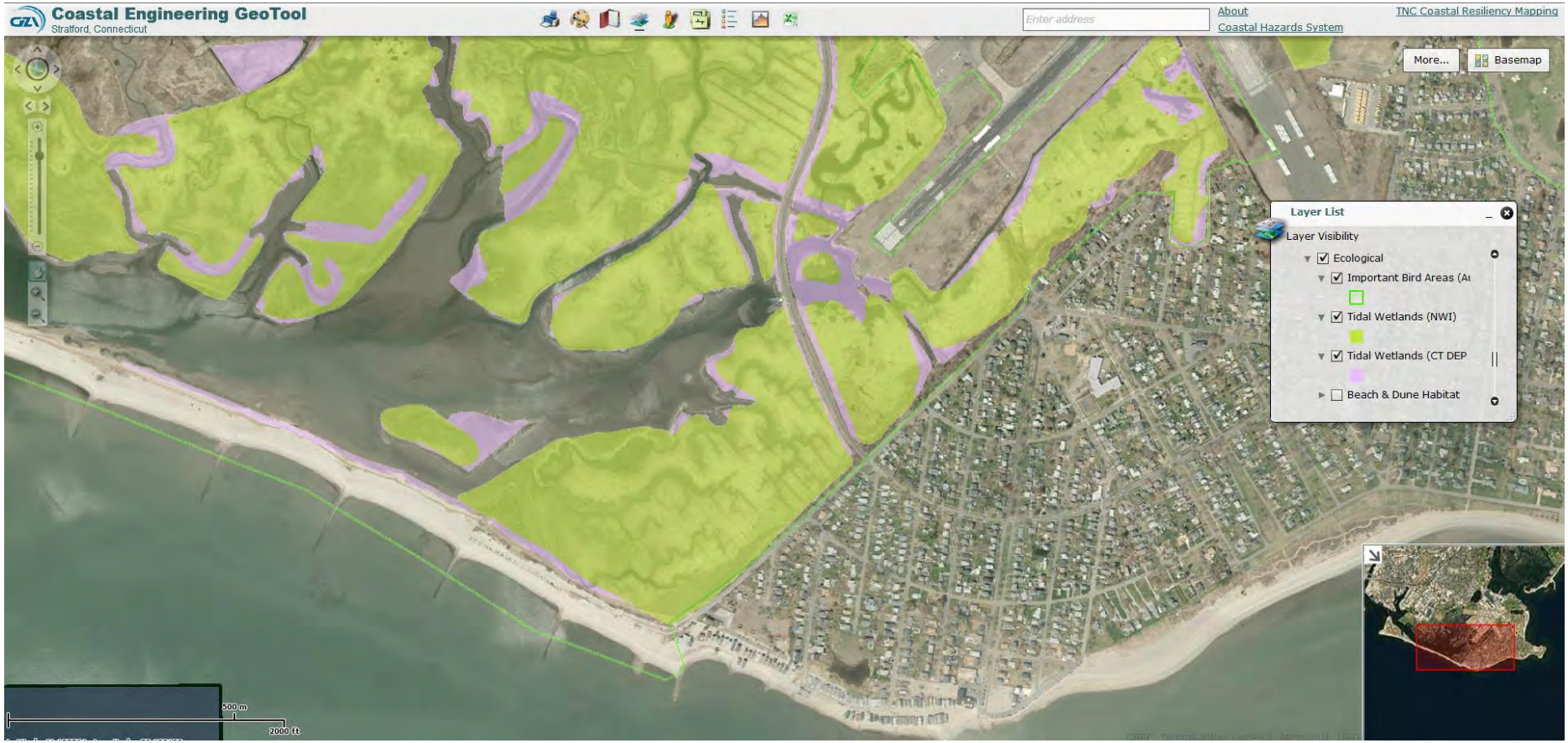
Example: Property (Assessor Data)



Example: Transportation



Example: Natural/Ecological Resources



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Coastal Hazard Vulnerability/Risk Assessment

Step 3 – Characterize Coastal Hazards:

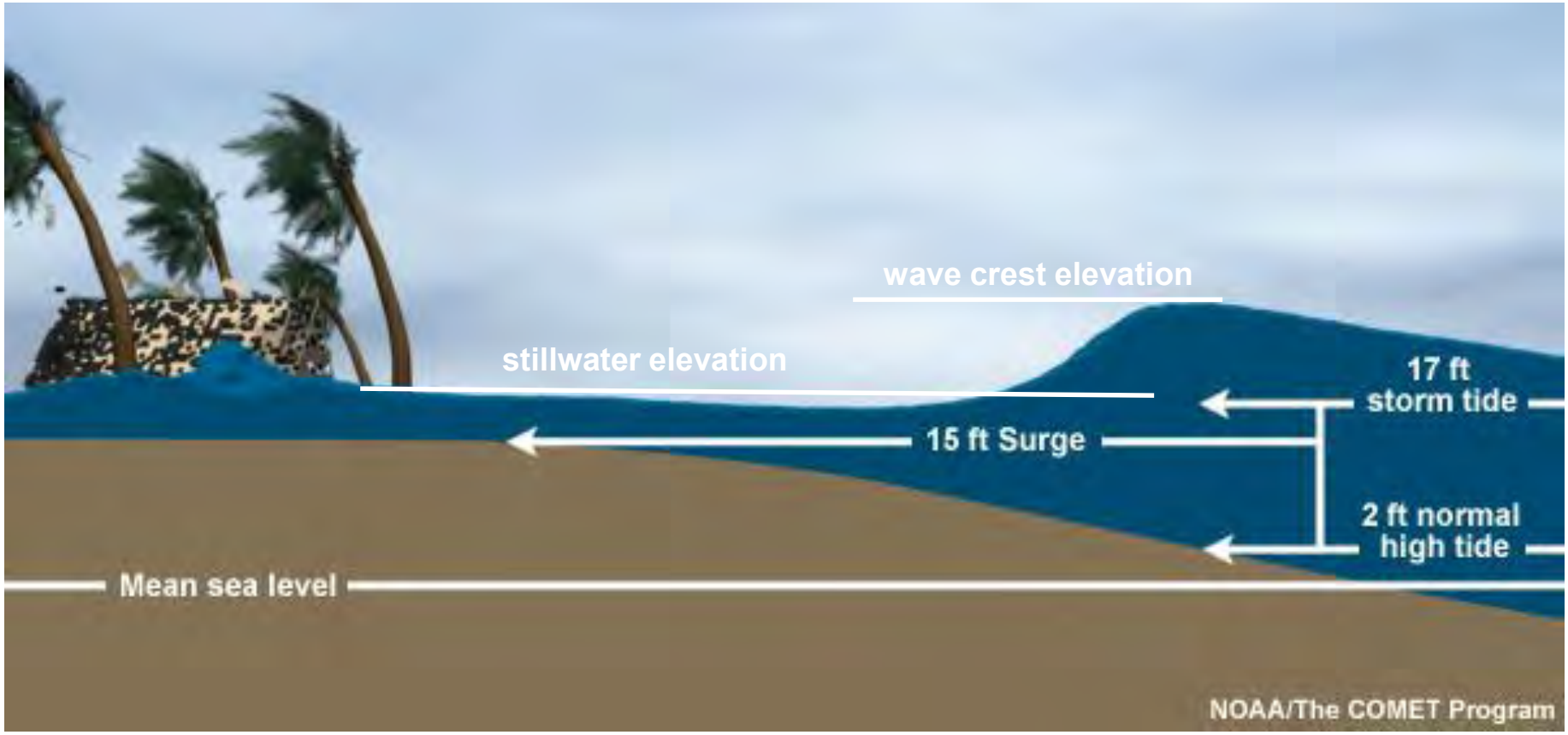
- ✓ Coastal flooding:
  - tides
  - storm surge
  - waves
- ✓ Salt Water and Spray
- ✓ Coastal erosion/sediment transport
- ✓ Precipitation (river flood, stormwater, building damage)
- ✓ High wind
- ✓ Effects of climate change

Take Away 3

Accurate, scientifically sound and probabilistic characterization of coastal hazards is important

Flooding in Lordship neighborhood during Hurricane Sandy (ctpost.com)

Coastal Flooding



GEOGRAPHICAL FACTORS

STORM FACTORS

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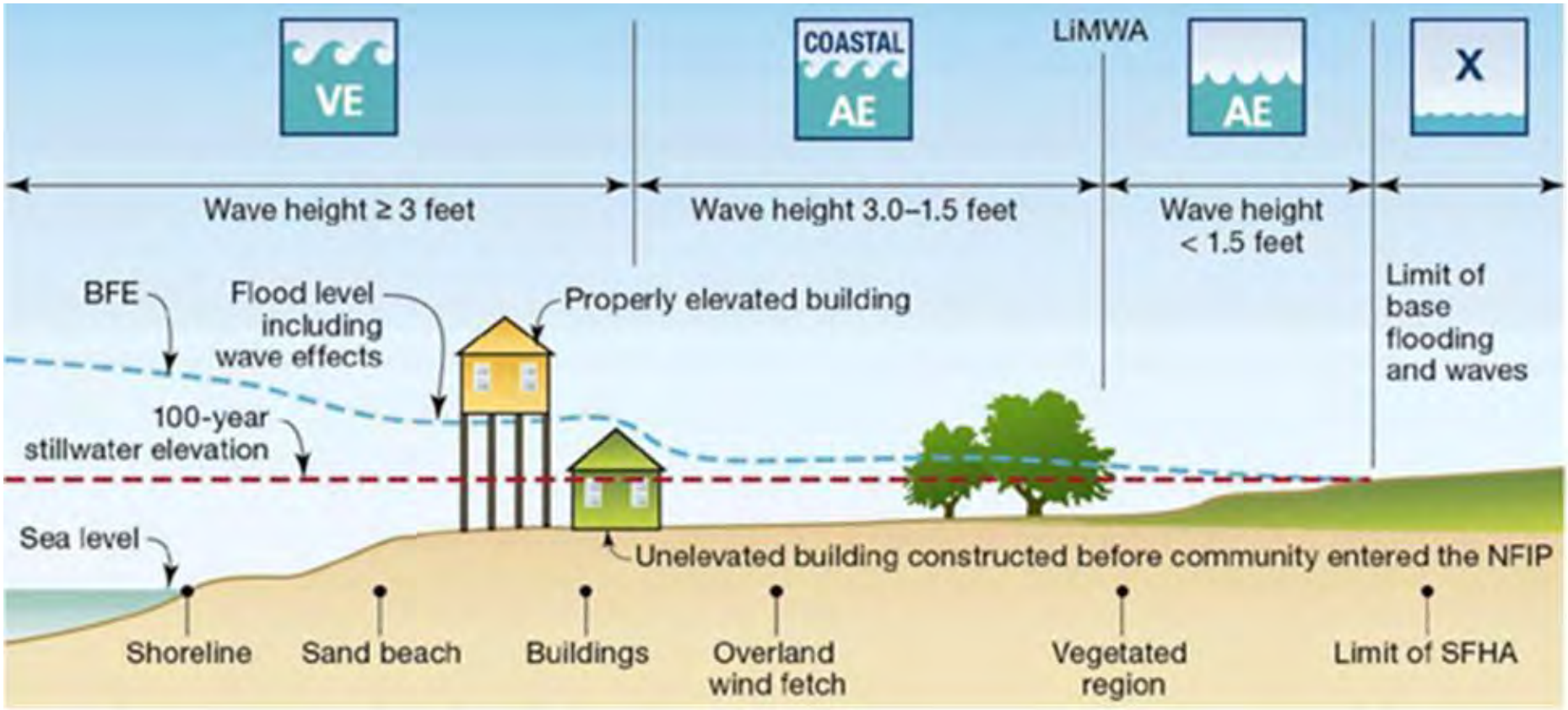
FEMA Flood Hazard Zones



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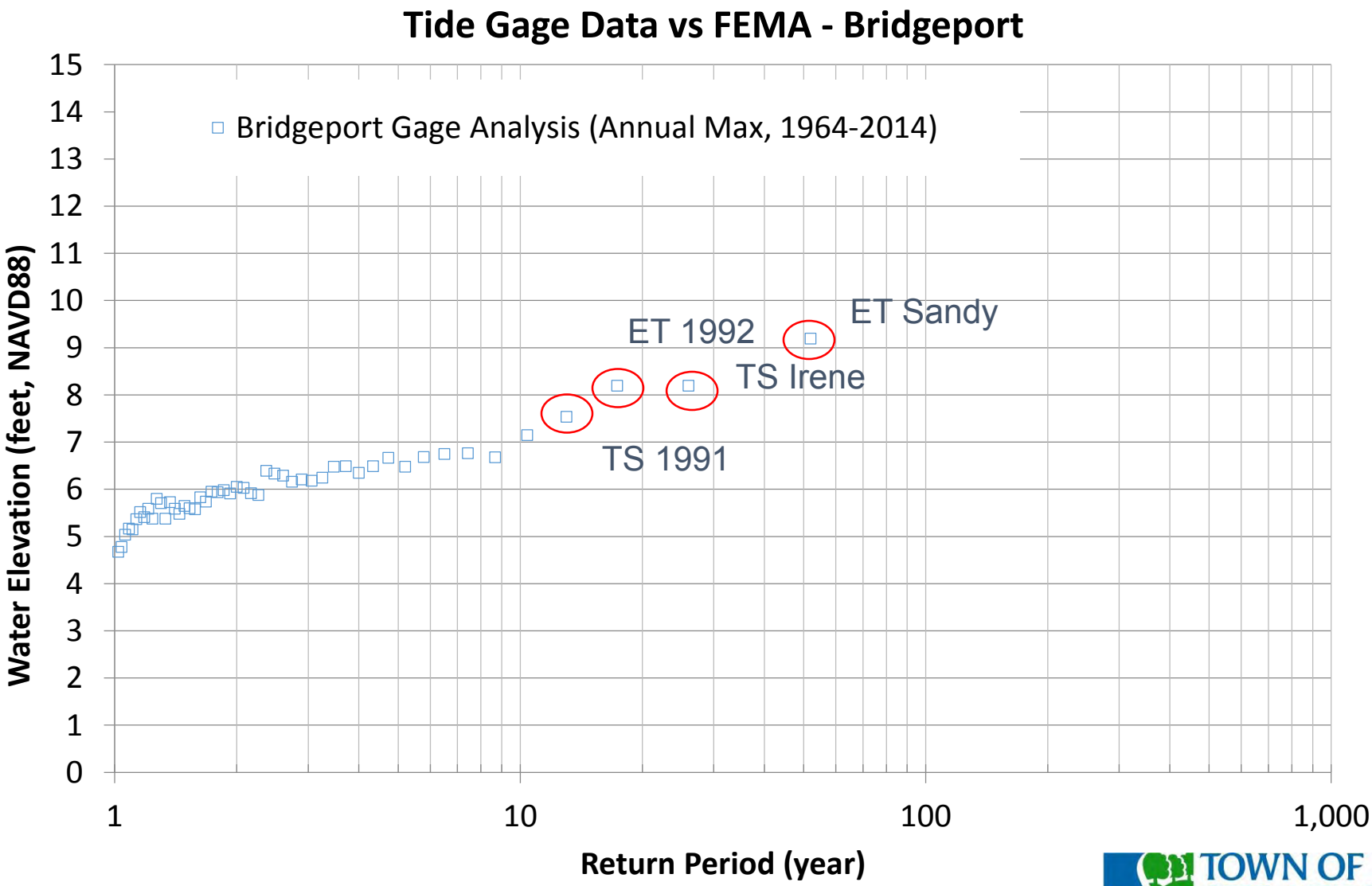
Historical Storms



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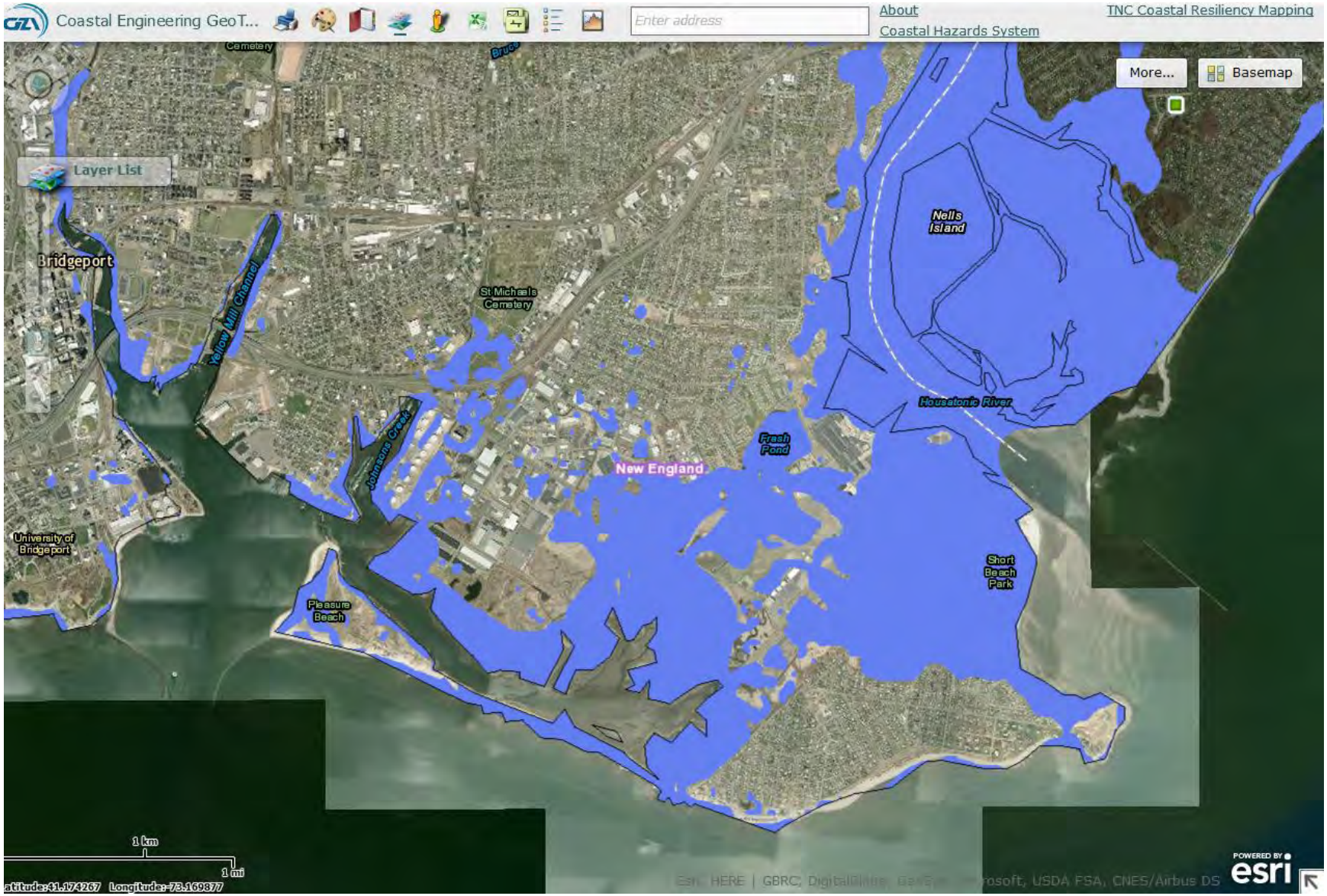
Observed Hurricane Sandy Flood Inundation



GZA High Resolution Model – Hydrodynamic Modeling

Presentation Copyrighted by GZA

FEMA Flood Insurance Rate Map: Base Flood Elevation

Coastal Engineering GeoTool
For Stratford CT
TNC Coastal Resiliency
GZA Loss Calc
Esri World Geocoder
Roosevelt Forest
Beaver Dam Lake
Oronoque Country Club
Sikorsky Aircraft
Twin Brooks Park
Unity Park
Boothe Memorial Park
Mill River Country Club
Wooster Park
Beardsley Zoo
Milford
Milford Cemetery
Wilcox Park
Gulf Pond
Merritt Pky
Merritt Pky CT-15 N
CT-15 S
CT-15 N Merritt Pky
Tavern Rock Rd
Broadbridge Rd
Trumbull Ave - Old Town Rd
Connors Ln
Second Hill Ln
Highland Ave
Main St
Plains Rd
Boston Post Rd
Bridgeport Ave
Schoolhouse Rd
Meadowside Rd
Newgatuck Ave
Fairfield
New Haven
Milford Pky
Wheelers Farms Rd
E Rutland Rd
W Rutland Rd
Governor John Davis Lodge Tpke
I-95 S
I-95 N
Hunting Ridge Rd
Shelton Rd
Unity Rd
Boothe Hill Rd
Hawley Ln
Perry Ave
Nichols Ave
Reservoir Ave
Chopsey Hill Rd
Huntington Pike
Huntington Rd
Cutspring Rd
River Rd
Elm St
Cherry St
Clark St
Bic Dr
Seaside Ave
Gulf St
Buckingham
Stony Plain Brook
Pequonnock River
Housatonic River
Beaver Creek
Pequonnock Creek
Stratford Creek
Bunnell Pond Brook
Pequonnock Creek
Pequonnock Creek
Pequonnock Creek

FEMA Flood Insurance Rate Map: Base Flood Elevation

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Predicted Sea Level Rise

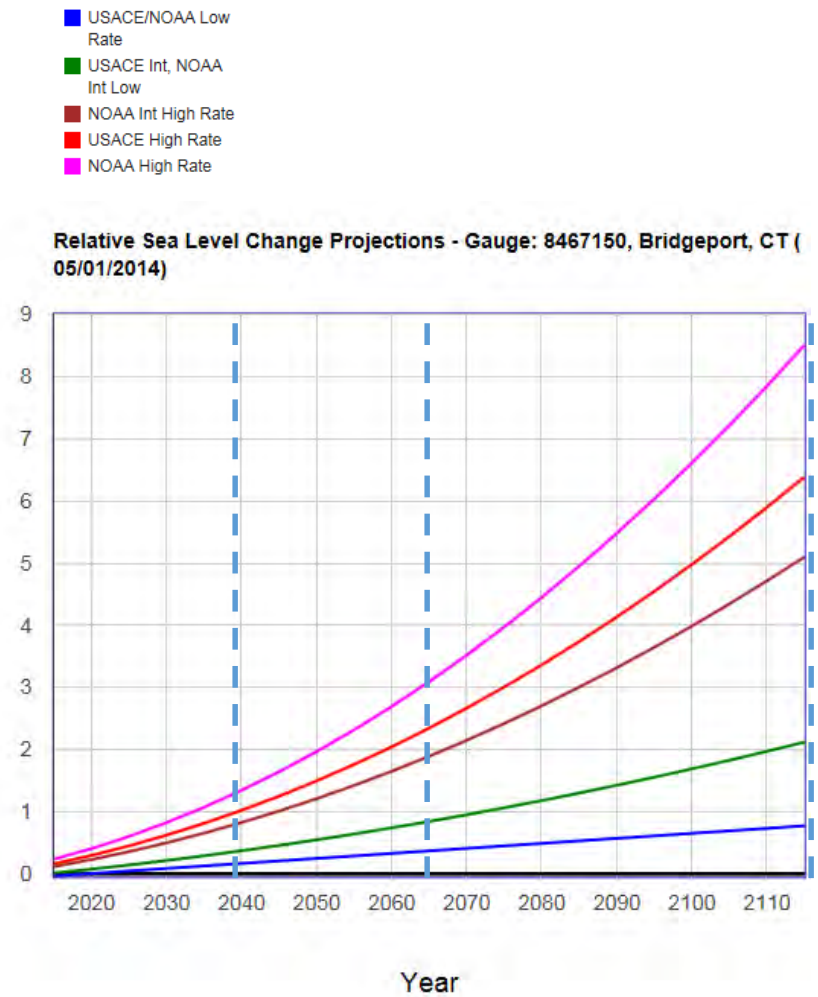
8467150, Bridgeport, CT
NOAA's Regional Rate: 0.00807 feet/yr
All values are expressed in feet relative to NAVD88

Year	USACE Low NOAA Low	USACE Int NOAA Int Low	NOAA Int High	USACE High	NOAA High
2015	-0.03	0.01	0.12	0.16	0.24
2020	0.01	0.08	0.23	0.30	0.41
2025	0.05	0.14	0.36	0.45	0.60
2030	0.09	0.22	0.50	0.62	0.82
2035	0.13	0.29	0.66	0.81	1.07
2040	0.17	0.37	0.83	1.02	1.34
2045	0.21	0.46	1.01	1.25	1.64
2050	0.25	0.55	1.21	1.50	1.97
2055	0.29	0.64	1.42	1.76	2.32
2060	0.33	0.74	1.65	2.04	2.69
2065	0.37	0.84	1.89	2.35	3.09
2070	0.41	0.95	2.15	2.67	3.52
2075	0.45	1.06	2.42	3.00	3.97
2080	0.49	1.18	2.70	3.36	4.45
2085	0.53	1.30	3.00	3.74	4.95
2090	0.57	1.43	3.32	4.13	5.48
2095	0.61	1.56	3.64	4.54	6.03
2100	0.65	1.69	3.99	4.98	6.61
2105	0.69	1.83	4.34	5.43	7.22
2110	0.73	1.97	4.71	5.89	7.85
2115	0.77	2.12	5.10	6.38	8.50

25 yrs
50 yrs
100 yrs

RSLC in feet (NAVD88)

Sea Level Rise Scenarios



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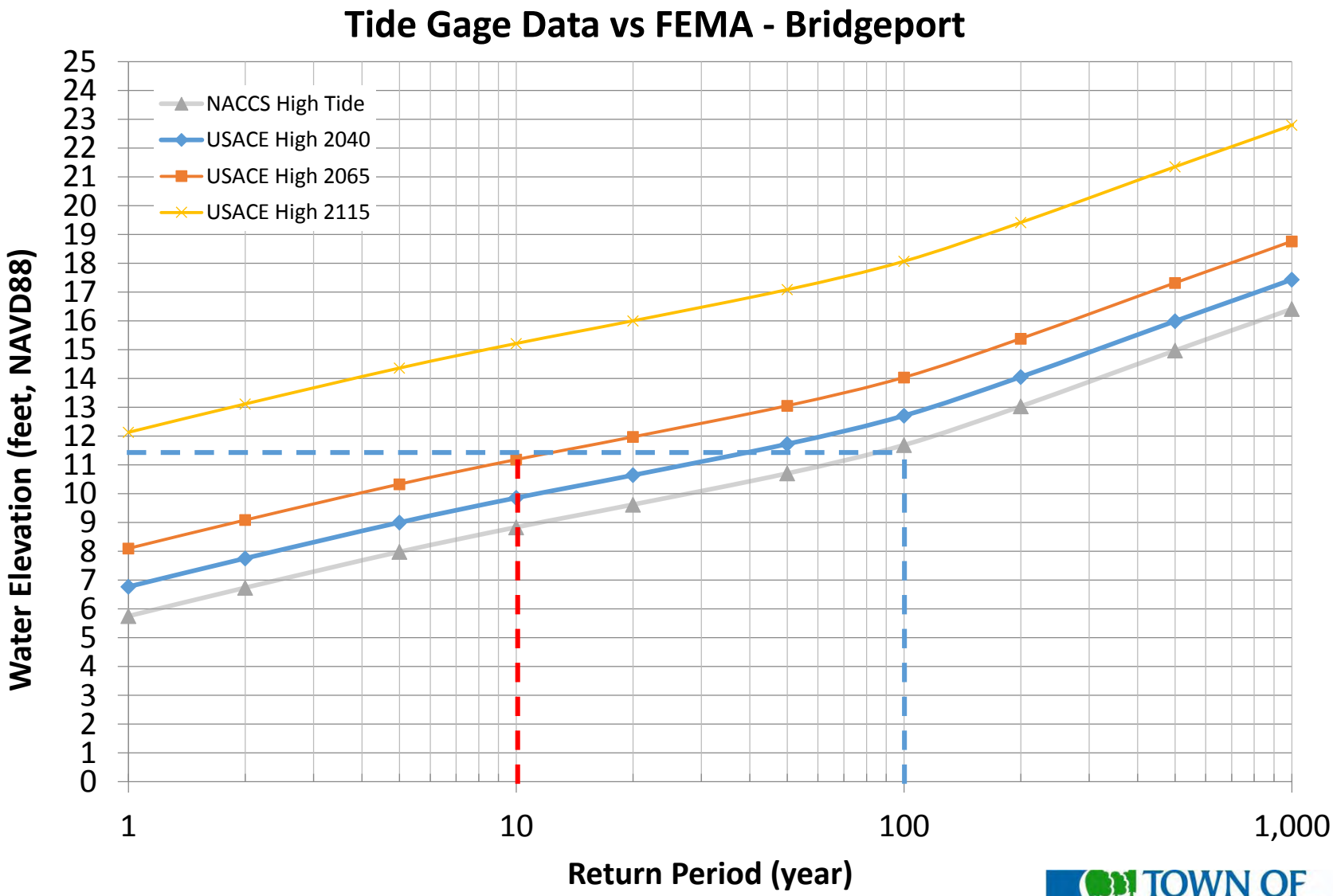
Predicted Sea Level Rise



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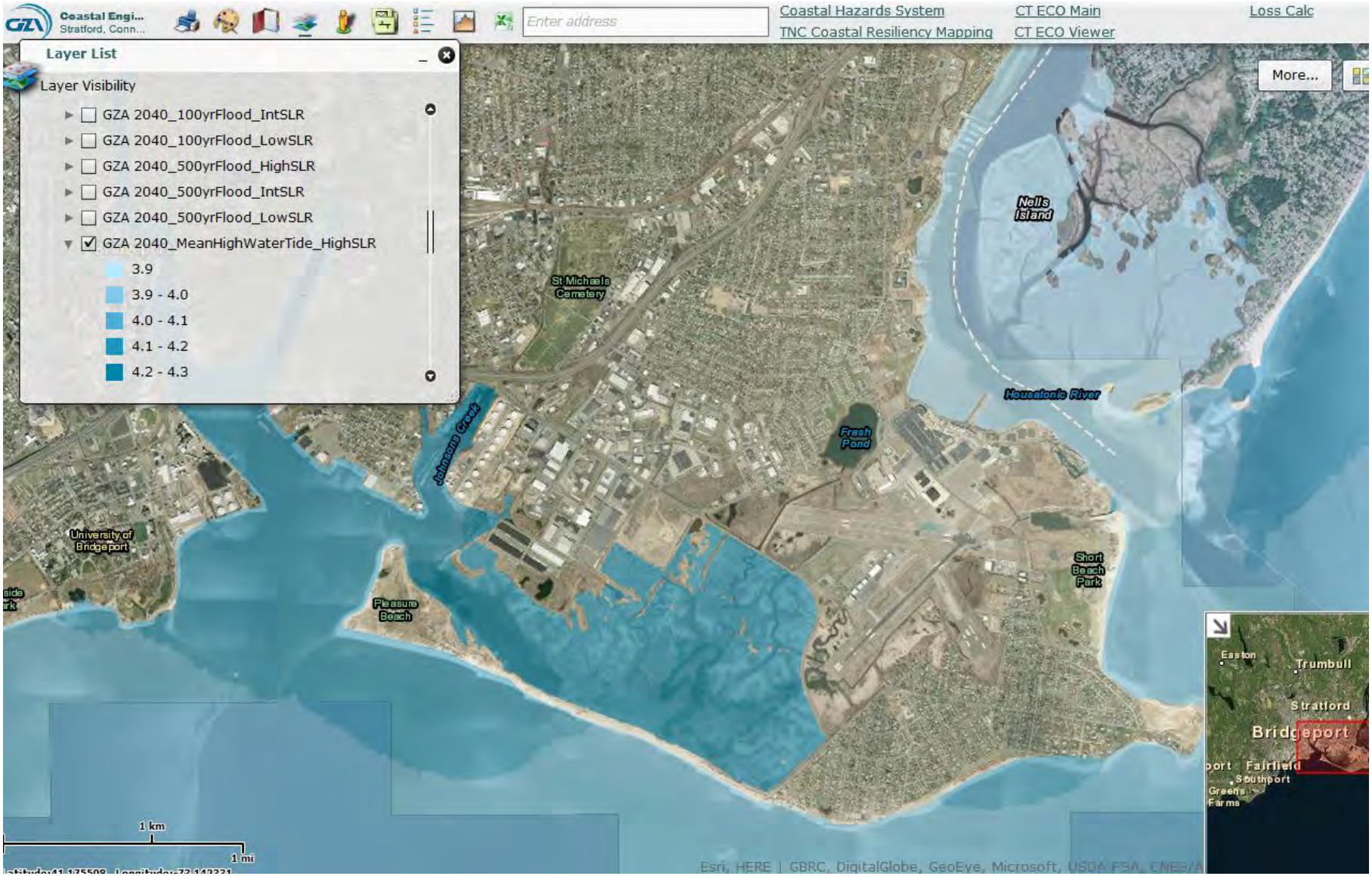
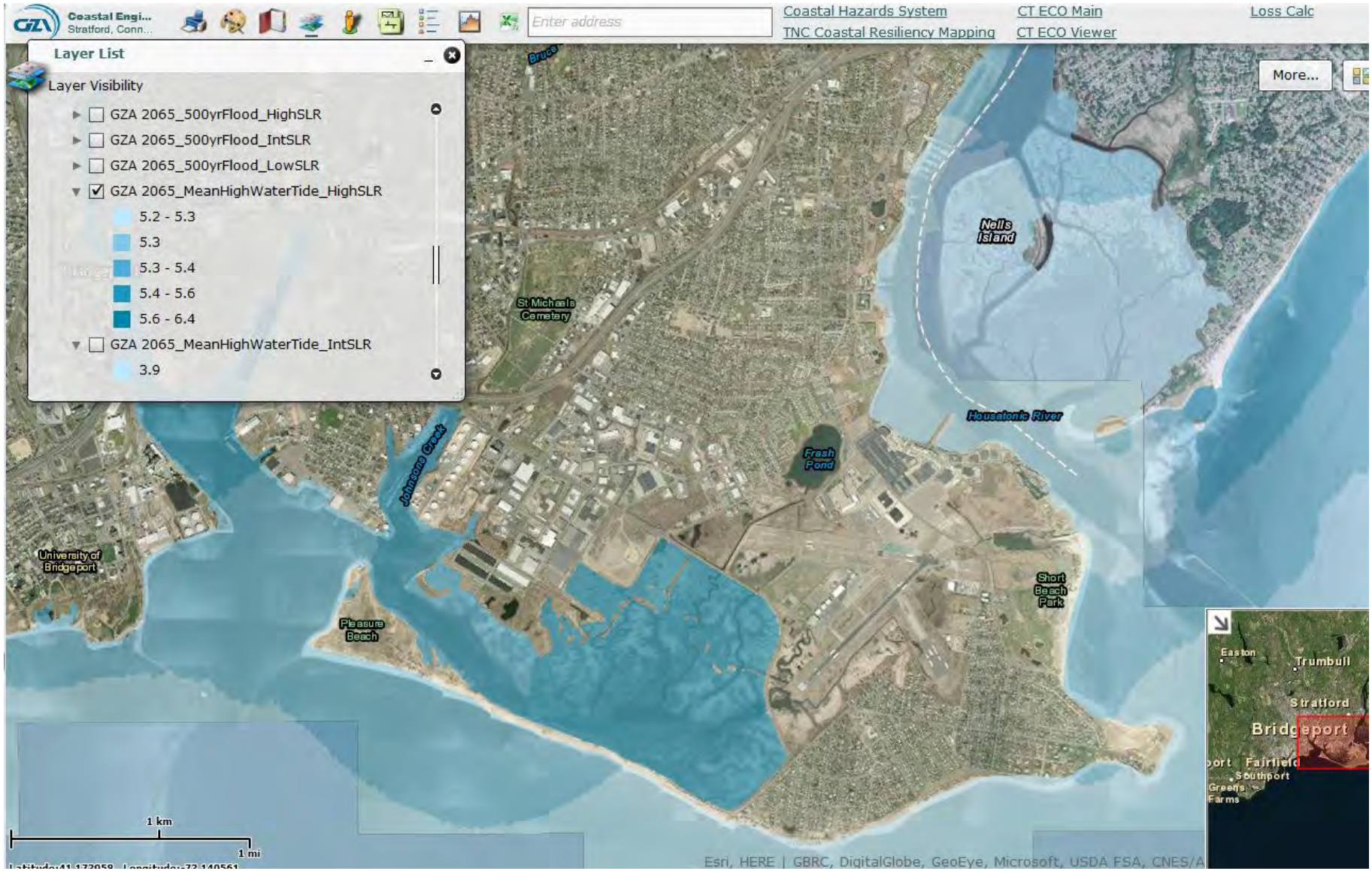
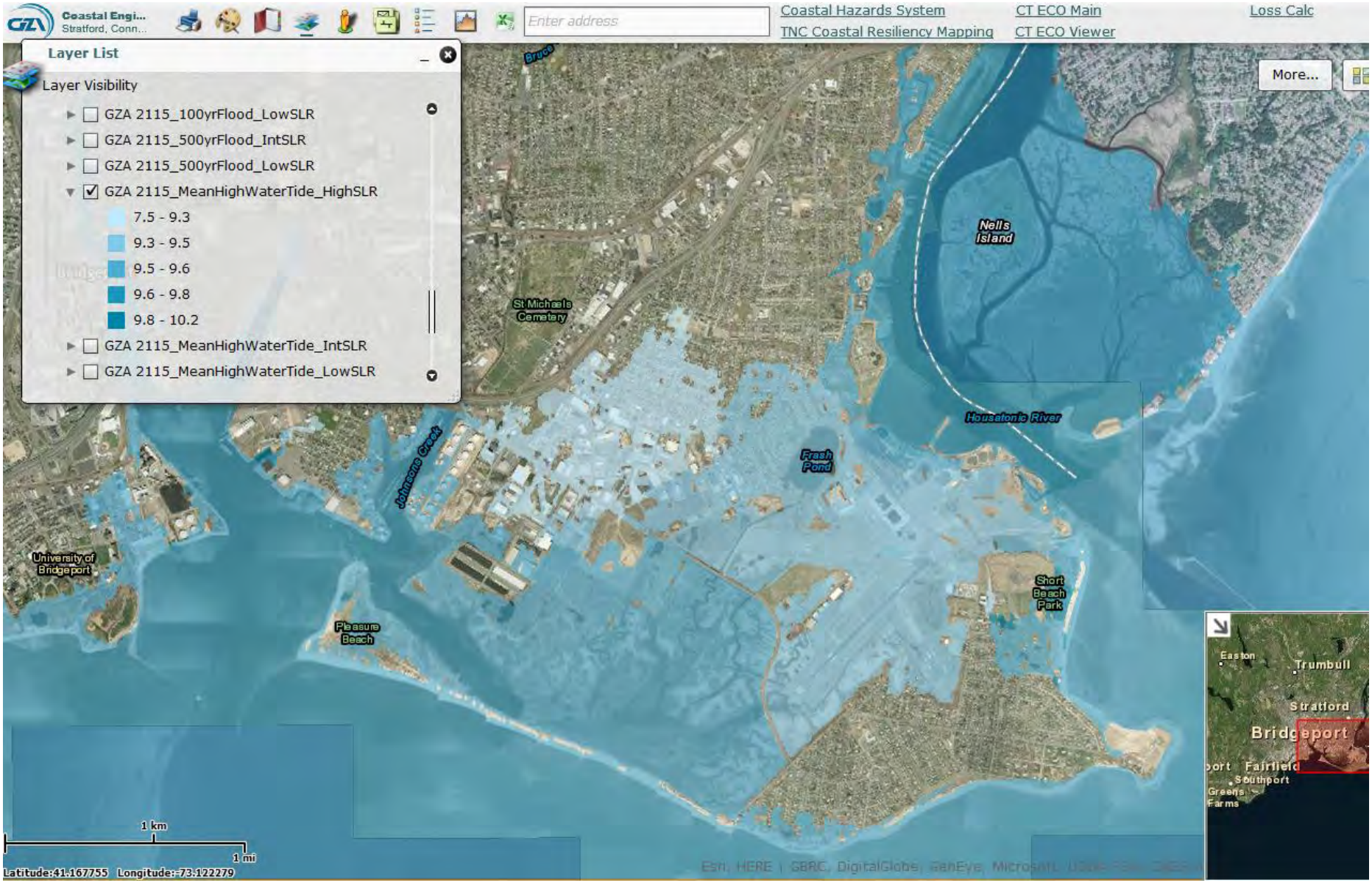
Mean High Tide: 2040 High SLR



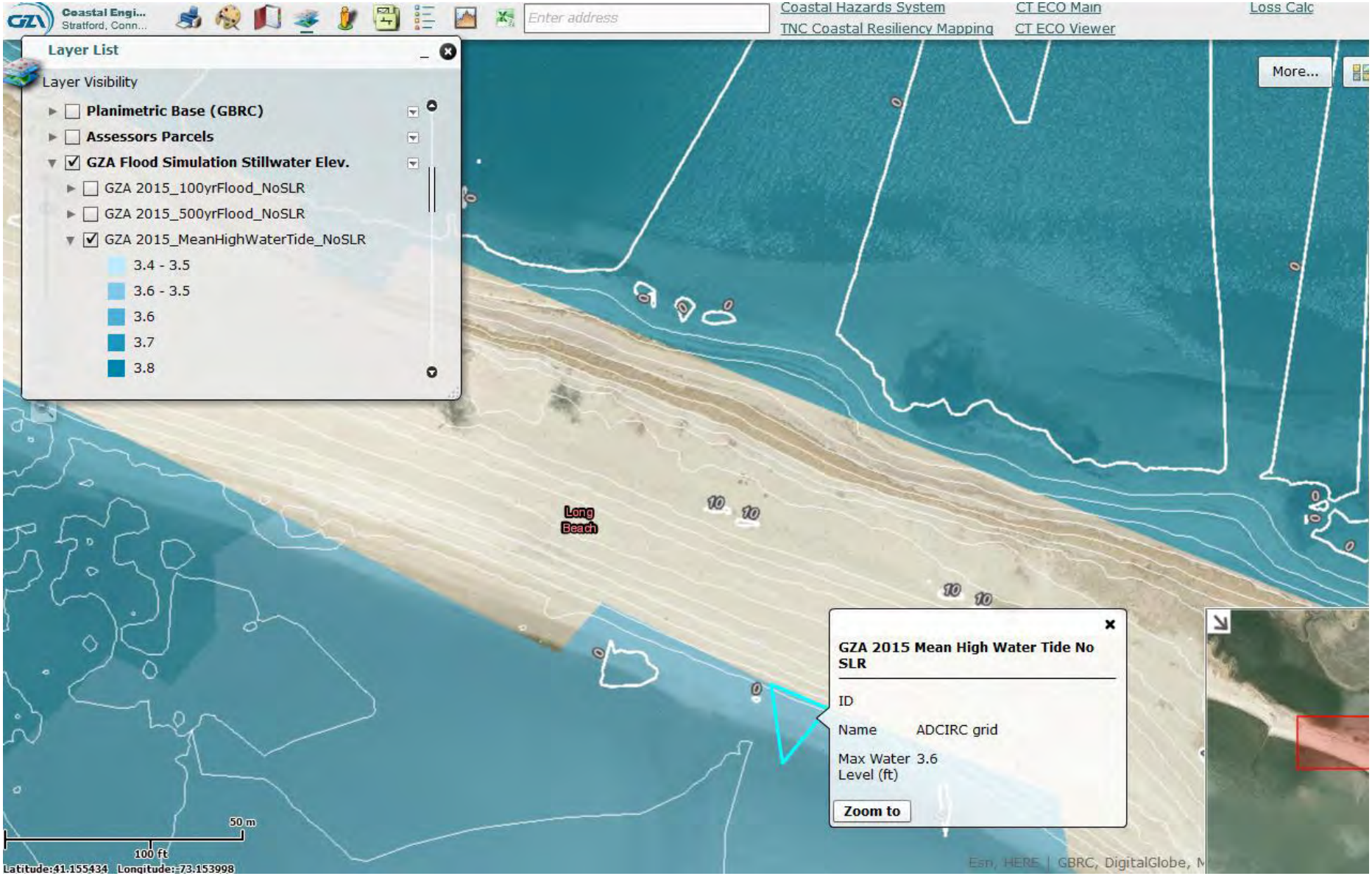
Mean High Tide: 2065 High SLR



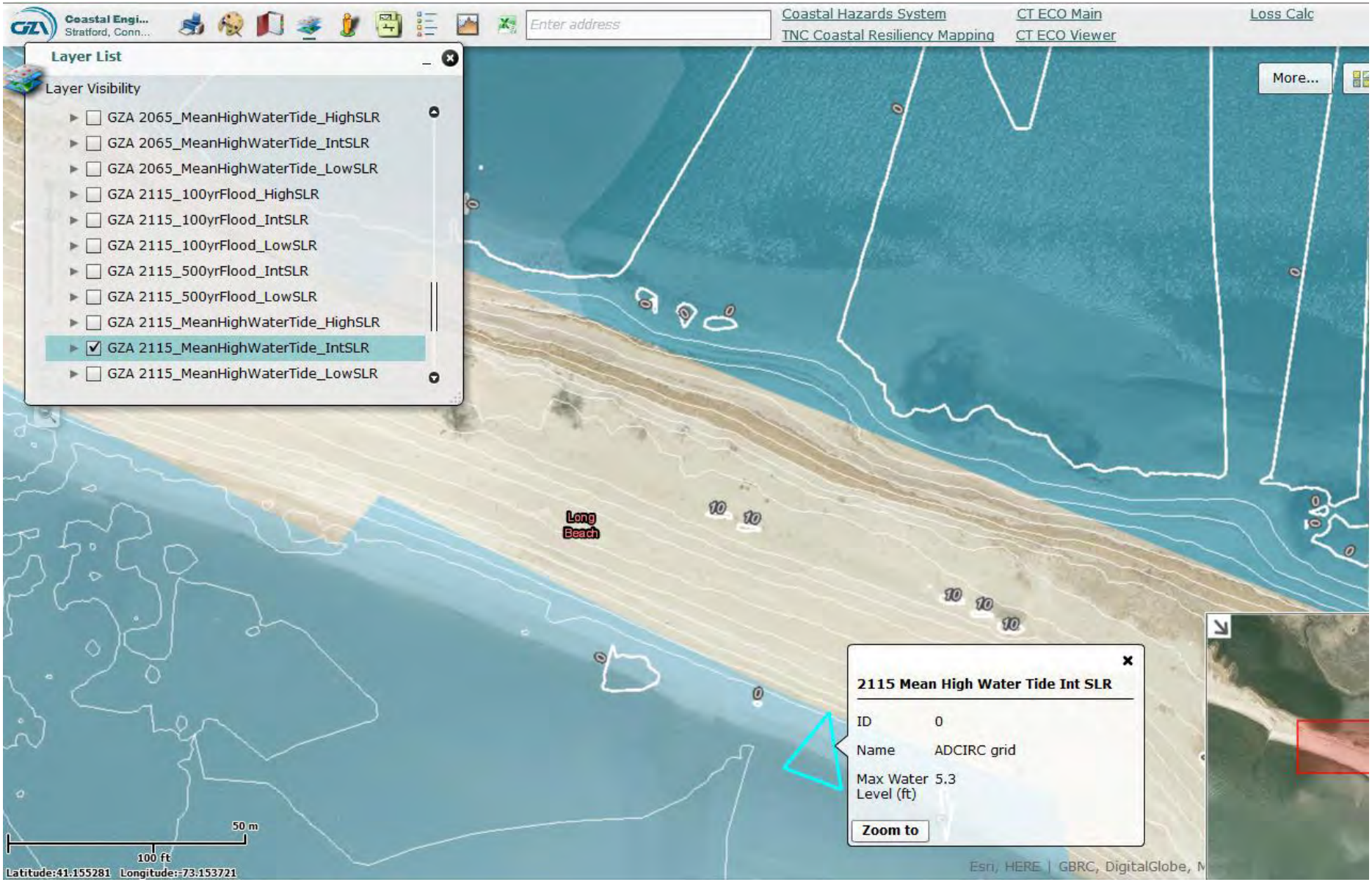
Mean High Tide: 2115 High SLR



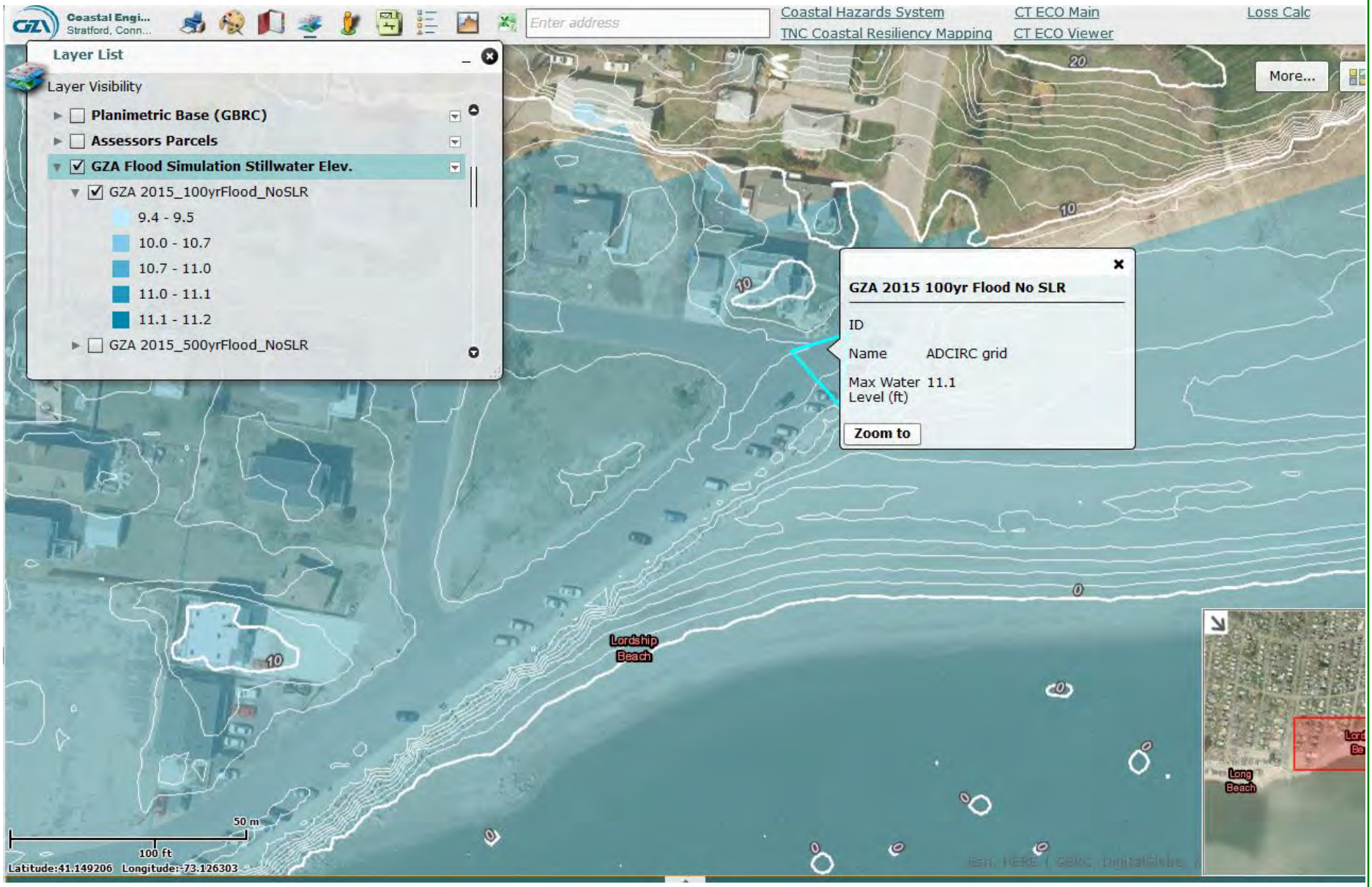
Mean High Tide: 2015



Mean High Tide: 2115 Int SLR

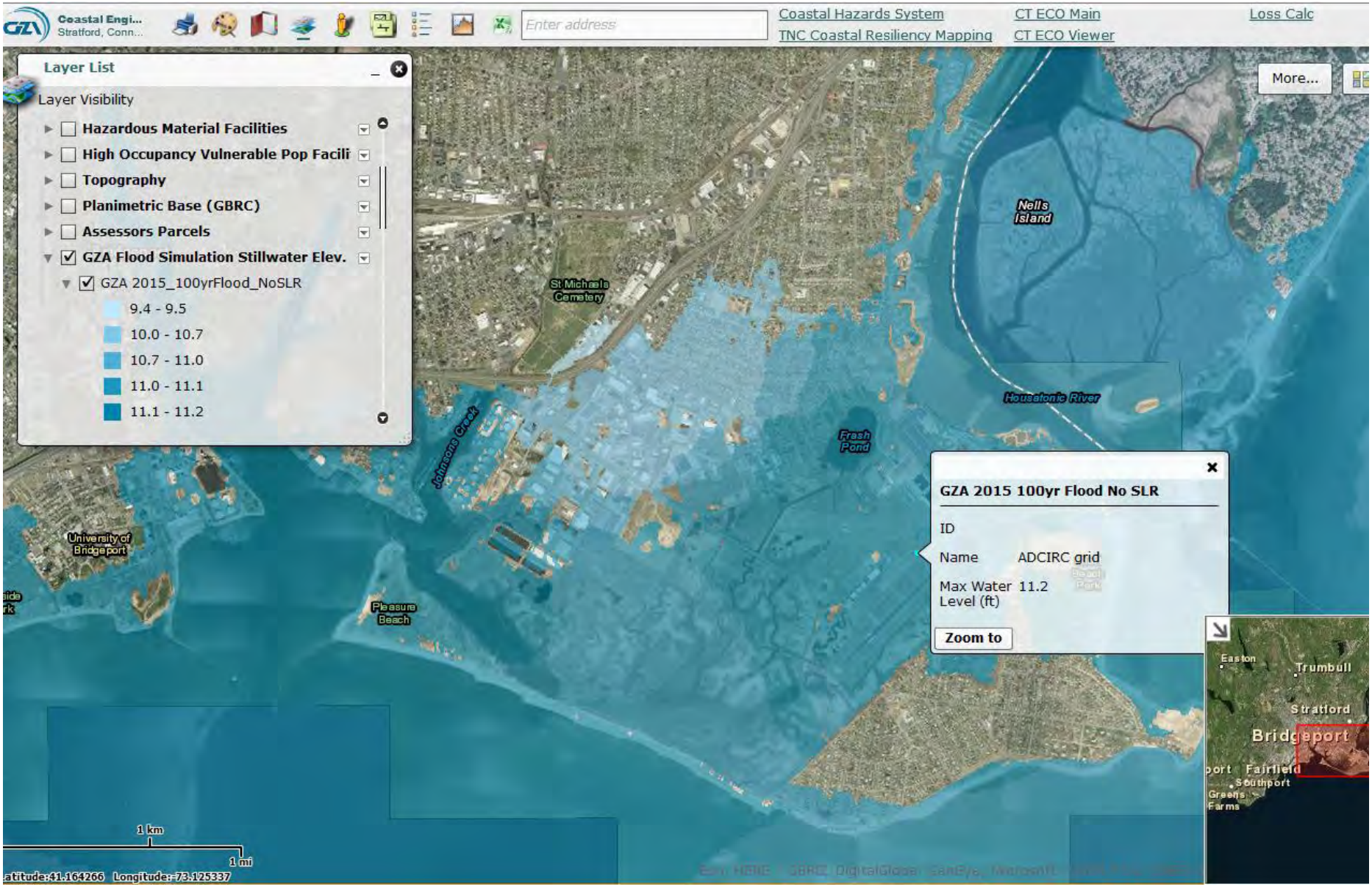


2015 100-year Flood Elevation (Stillwater)



Street flooding in Lordship section following Sandy
image from ctpost.com

2015 100-year Flood Elevation (Stillwater)



Damaged fuel station at Sikorsky Airport after Sandy
image from ctpost.com

Coastal Hazard Vulnerability/Risk Assessment

Step 4 – Characterize Vulnerability/Impacts:

- ✓ Essential Facilities
- ✓ Lifeline Utilities
- ✓ Transportation
- ✓ High Potential Loss Facilities
- ✓ Hazardous Material Facilities
- ✓ Neighborhoods
- ✓ High Occupancy/Vulnerable Population Facilities
- ✓ Private and commercial property
- ✓ Natural Resources

Hangar damage at Sikorsky Airport after Sandy
image from ctpost.com

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Quantify Loss: Cumulative Community Assets

HAZUS MH
EARTHQUAKE • WIND • FLOOD

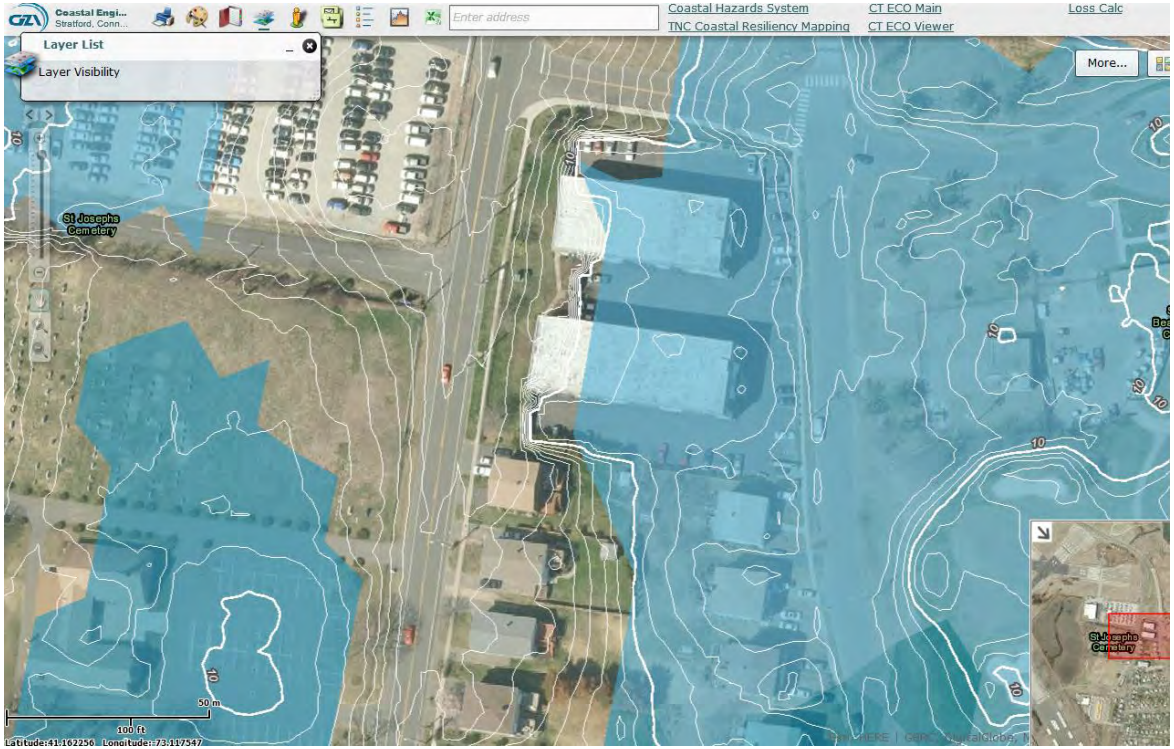
POTENTIAL LOSS ESTIMATES ANALYZED IN HAZUS :

✓ **DIRECT COSTS**

- **Physical damage** to critical facilities and infrastructure.

✓ **CONSEQUENTIAL COSTS**

- **Economic loss** including lost jobs, business interruptions, repair and reconstruction costs;
- **Social impacts**, including estimates of shelter requirements and displaced households
- **Environmental impacts**, including loss of wetlands, riparian and open space.



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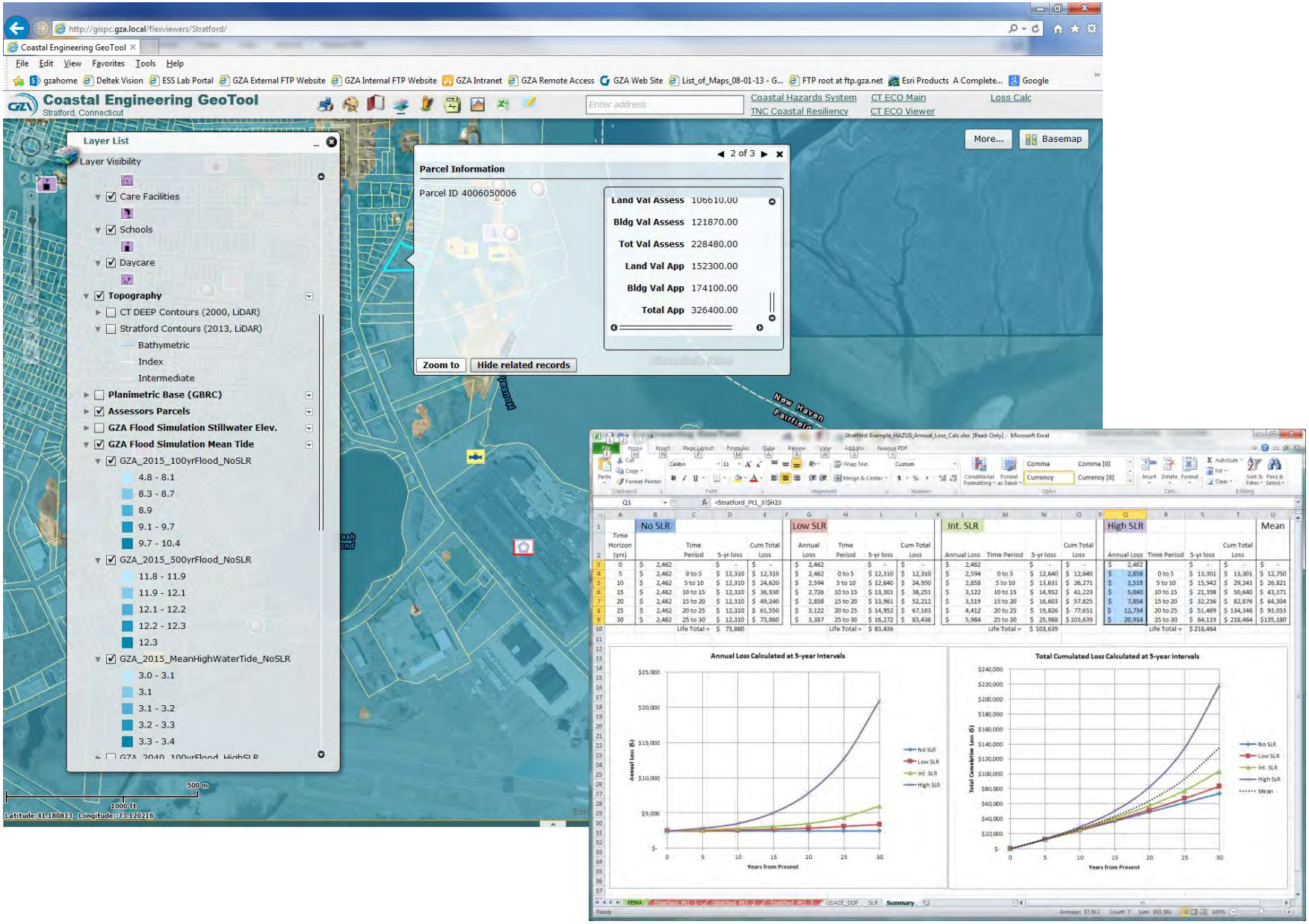
Quantify Loss: Individual Asset Loss



Building Damage

Damage to beach homes in Lordship neighborhood from Sandy
image from ctpost.com

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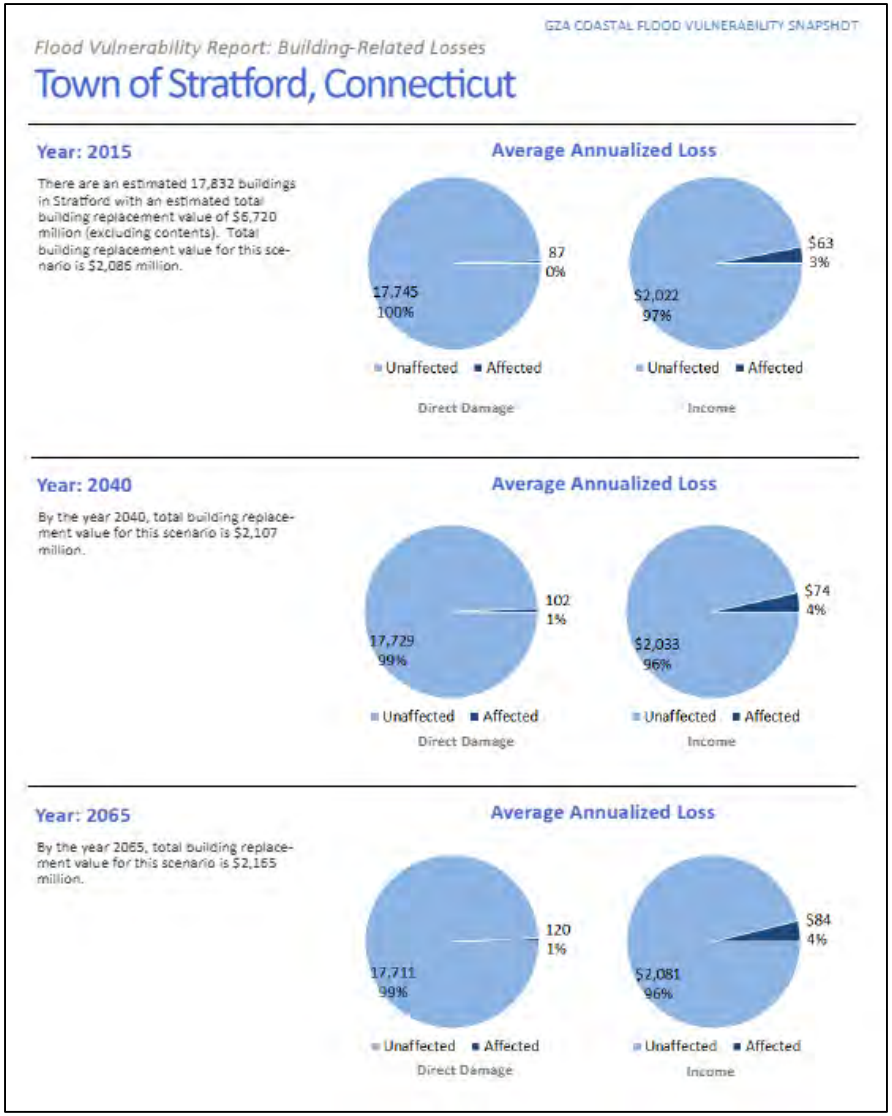
Stratford Building Economic Loss Exposure

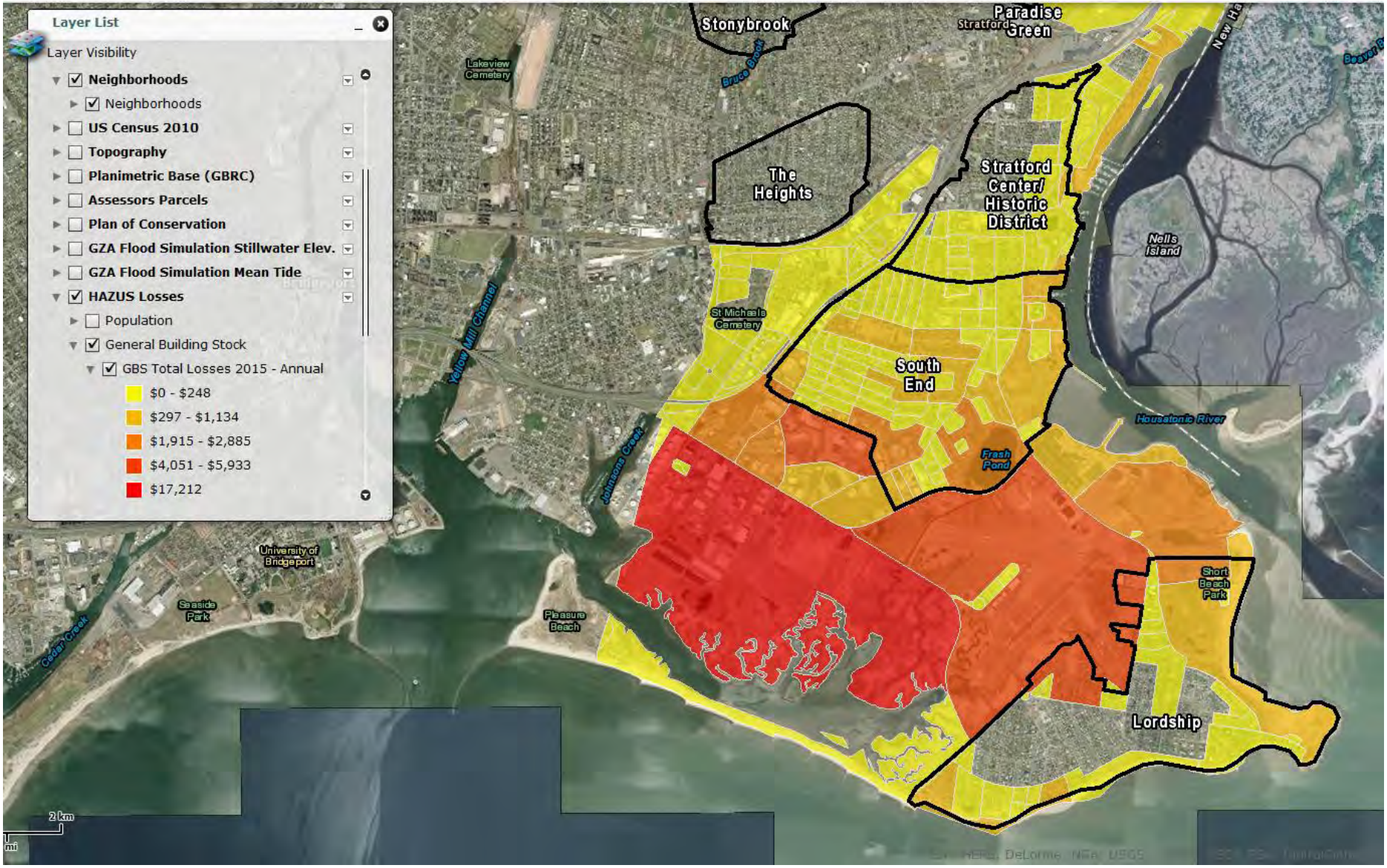
Occupancy	Loss Exposure ($1000)	Percent of Total
Residential	4,804,160	71.5%
Commercial	1,184,257	17.6%
Industrial	517,257	7.7%
Agricultural	14,010	0.2%
Religion	102,683	1.5%
Government	33,465	.5%
Education	64,294	1%
Total	**6,720,103**	**100%**



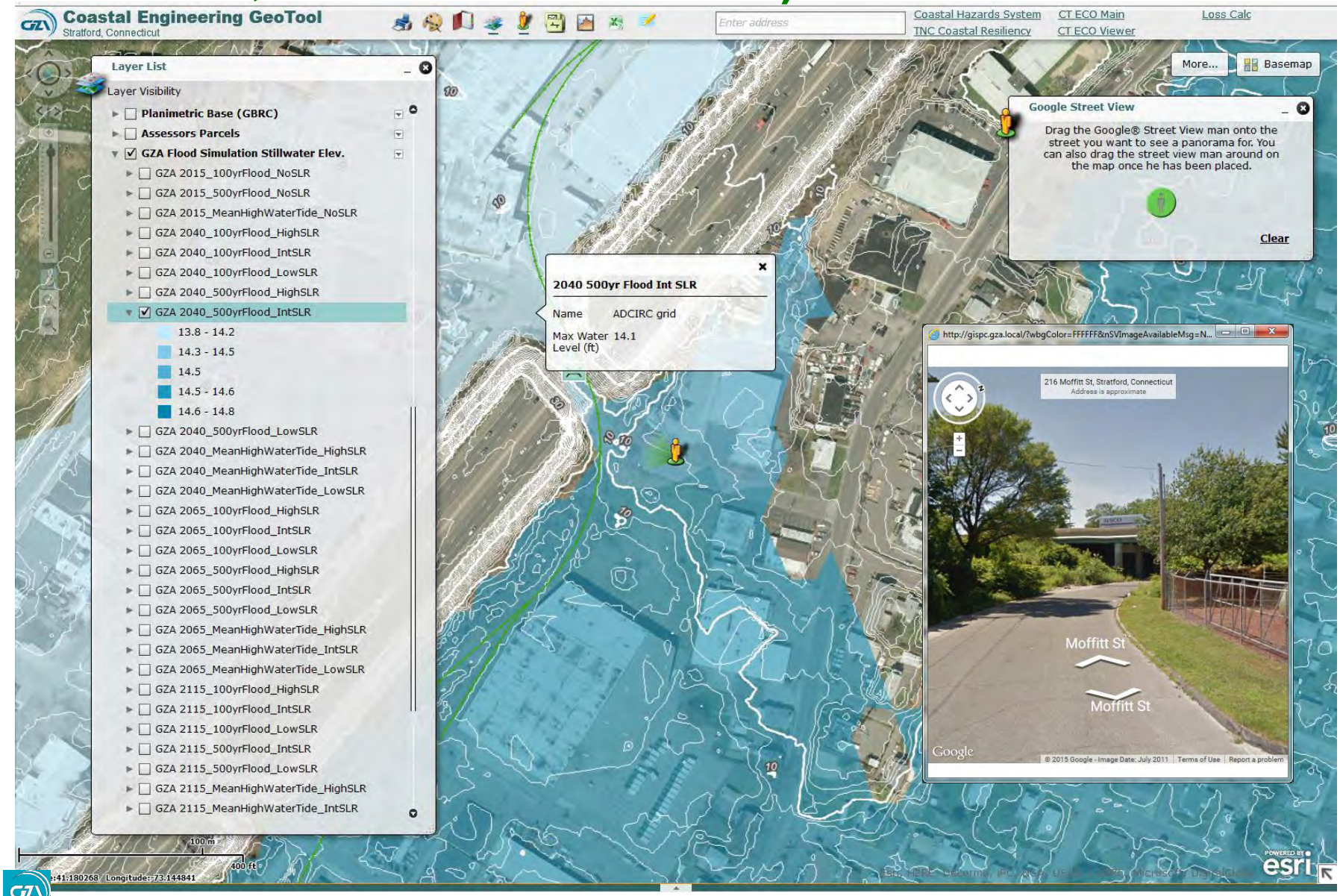
Take Away 4

Accurate characterization of prevented losses is necessary for evaluating the benefits of proposed resiliency measures

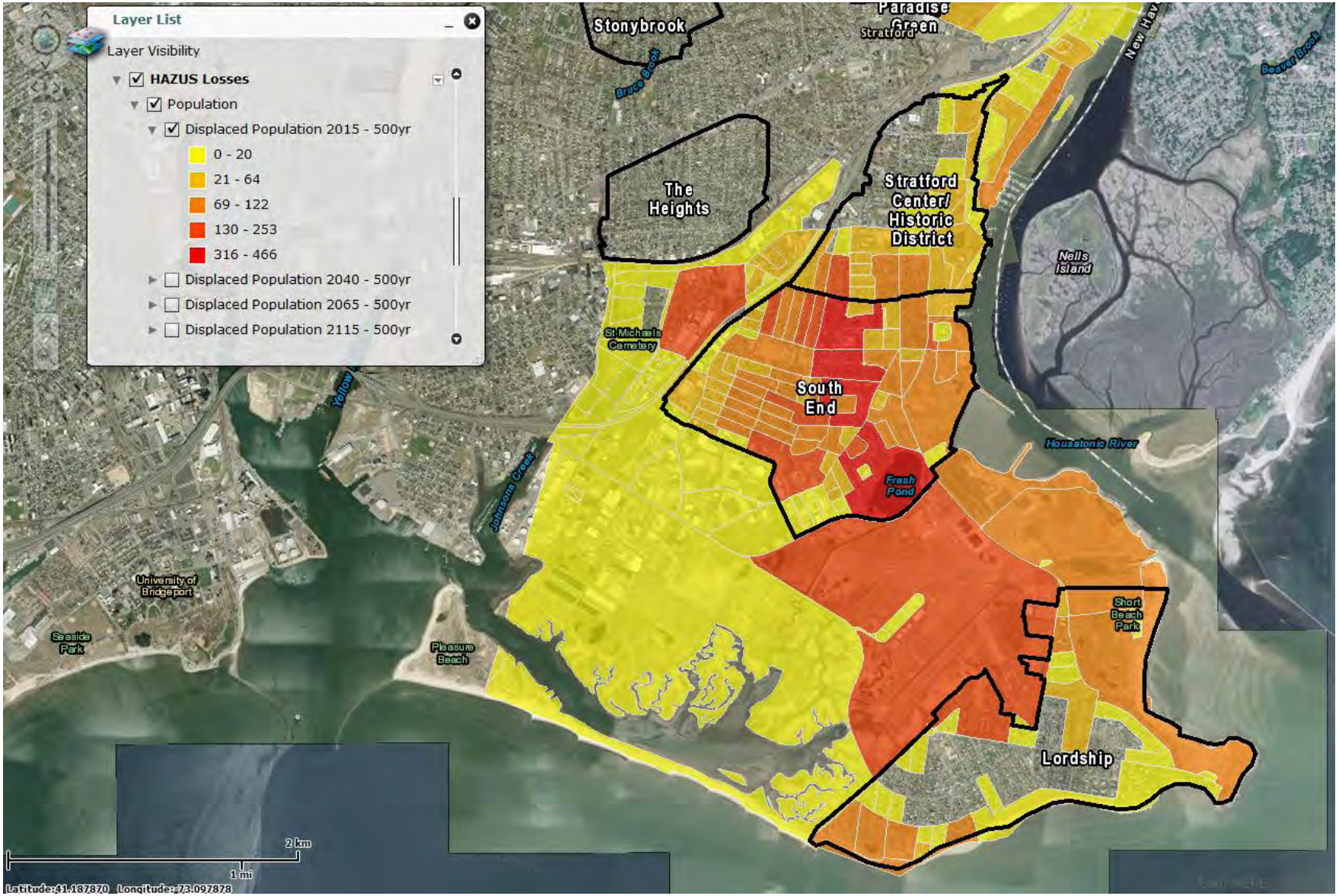
Economic Impacts – Building and Content Damage



Public Property (e.g. Infrastructure, Lifeline Facilities, Essential Facilities)



Social Impacts – People Displaced



Ecological Impacts

GIS Layer: The Nature Conservatory (TNC) Coastal Resilience

Resiliency Actions and Recommendations

Long Beach West after the 1938 Hurricane (Ref. Town of Stratford)

Hurricane Sandy (2011)

Take Away 5

Integrated approach using structural, non-structural and natural and nature-based features

Resiliency Strategies:

- Retreat
- Protect
- Accommodate

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Incorporate Town Values

- **Economic**
  - Prevent financial loss to the community
  - Reduction in the cost of NFIP insurance
  - Maintain the tax base
- **Social**
  - Protect public health, safety and welfare
- **Environmental**
  - Protect natural resources and the environment

Salt Marsh in Stratford- Ref. Karl Kristianssen

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Stratford Vision Plan

- **Waterfront**
  - Shoreline presents 13 Miles of Opportunity
  - Enhance Access to the Waterfront
- **Economic Vitality**
  - Redevelop the Stratford Army Engine Plant
  - Regional Collaboration
- **Environmental**
  - Minimize Impacts to natural landscapes, habitats and watercourses

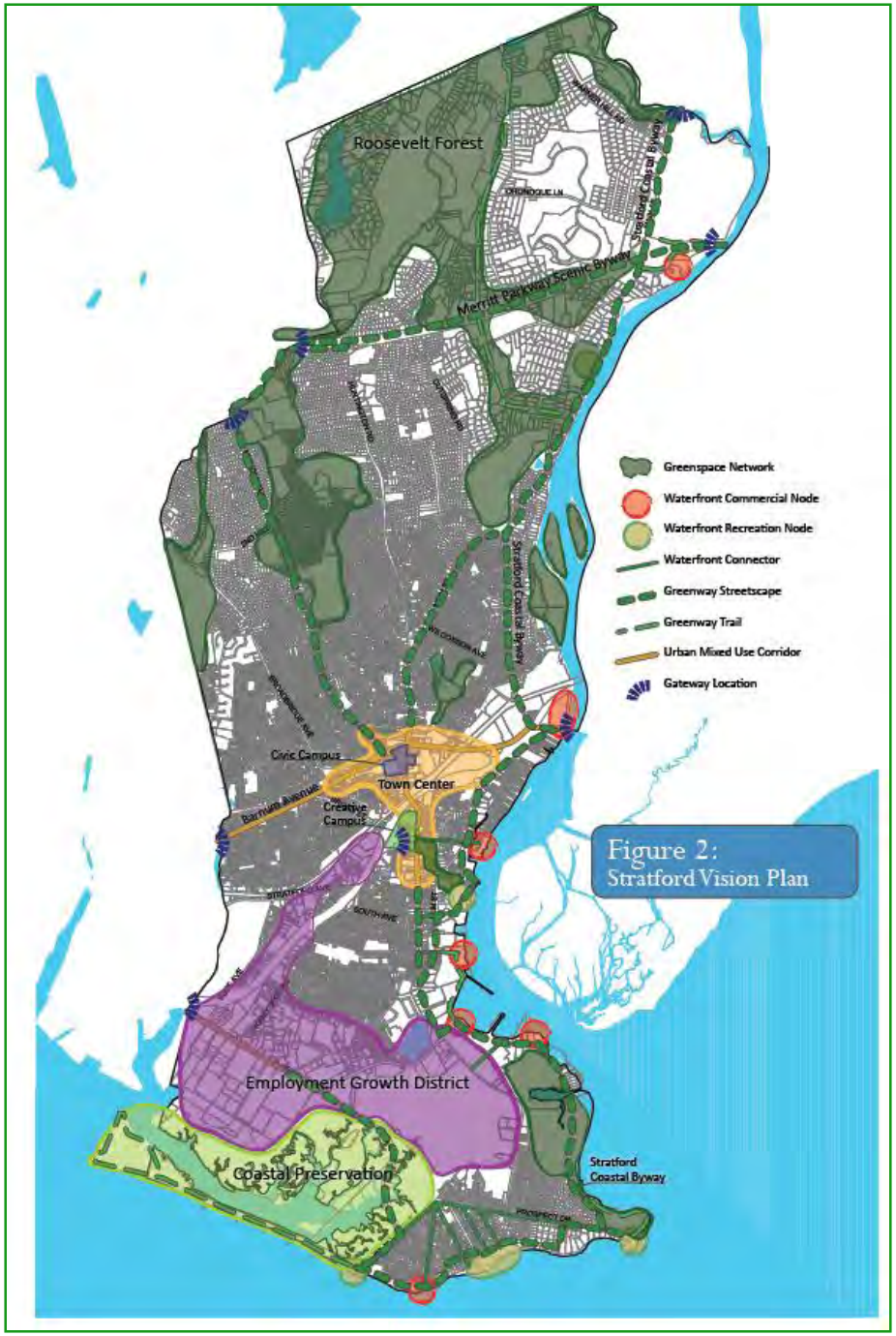
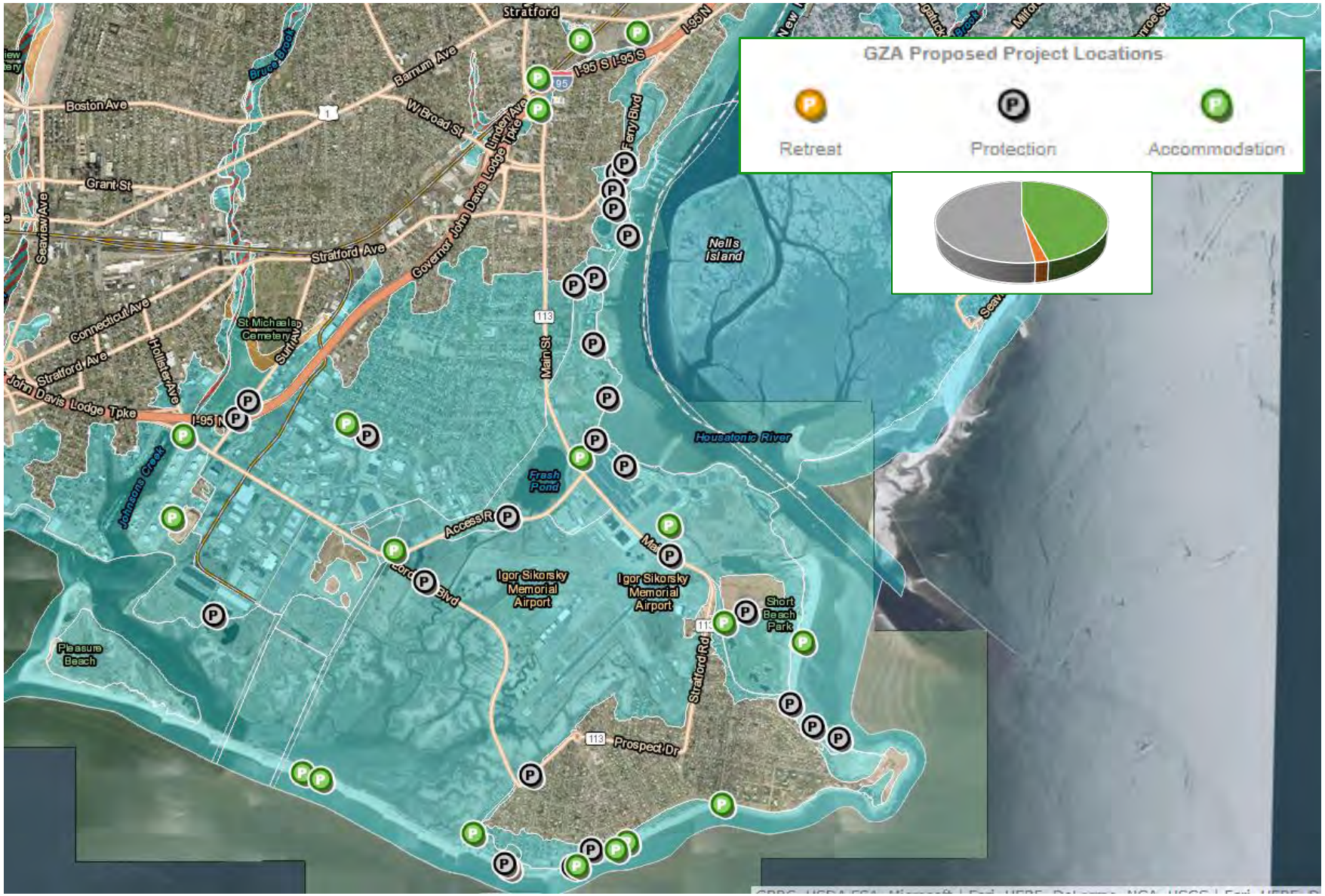


Figure 2: Stratford Vision Plan

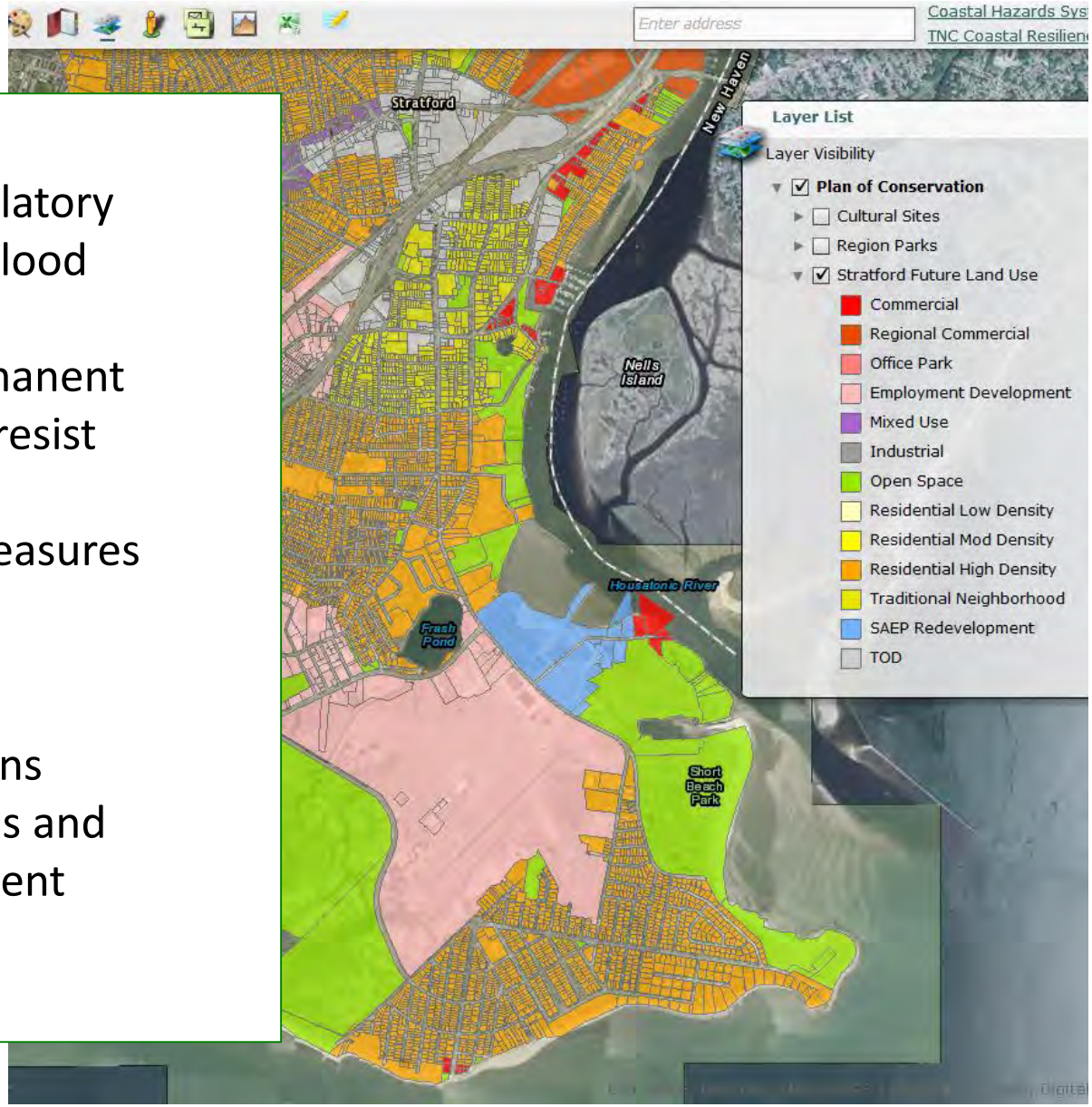
Proposed Projects – Integrated Coastal Resiliency Strategies



Accommodation - Risk Reduction Measures

Measures:

- Policy, planning and regulatory
- Overlay Zones – Design Flood Elevation (DFE)
- FEMA Compliance - permanent building modification to resist flooding
- Temporary protection measures
  - Temporary flood wall
  - Temporary flood gate
  - Backflow preventer
- Emergency Response Plans
- Beach Management Plans and periodic beach nourishment
- Stakeholder Outreach
- Adaptive land use



Accommodation – FEMA Compliance

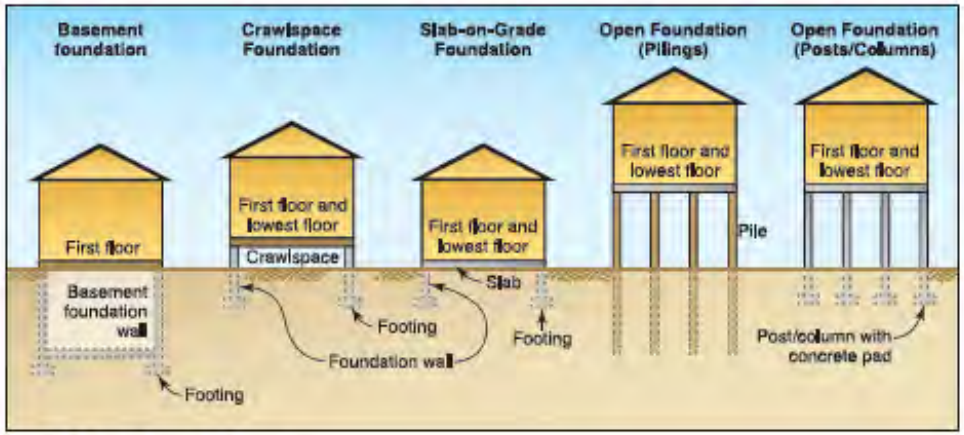


Figure 3-5. Home foundation types.

Issues:

- +/- 1,100 homes located below high hazard flood zone based on current FEMA FIRM
- Cost to Comply - $35M - $60M
- Compliance by raising homes not feasible on a large scale
- Possible for repetitive loss sites

Retreat - Risk Reduction Measures

Measures:

- Property Acquisition
- Property Condemnation
- Adaptive Land Use
- Stakeholder Outreach

Retreat - Risk Reduction Measures

Issues:

- Growing VE and AE Zone in the future
- 35%+ increase in Repetitive Loss Properties since Sandy (from 64 to 77)
- Need for extensive education and outreach to interested homeowners

Findings:

✓ Can serve as a "Win-Win" for all parties in the long term in highly vulnerable areas

Protection – Structural Risk Reduction Measures

Structural Measures:

- Flood Wall
- Storm Surge Barrier
- Tide Gates
- Breakwaters
- Detached Breakwaters
- Revetments
- Groins

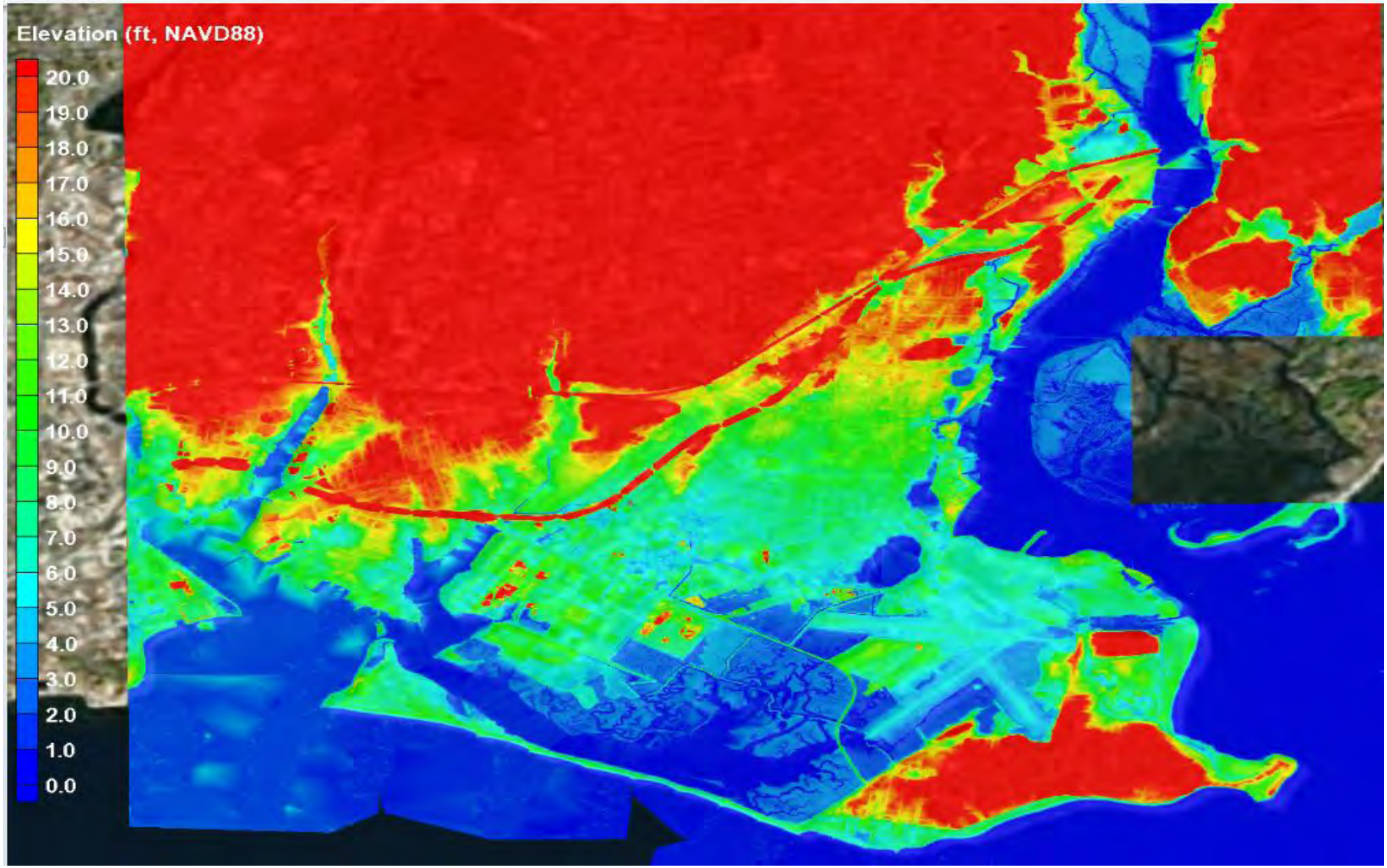
Long Beach West - Morgan Kaolian 2011

Protection – Natural Risk Reduction Measures

Natural and Nature Based:

- Dunes and beaches
- Vegetated features (Marshes and wetlands)
- Oyster and coral reefs
- Barrier Islands
- Maritime forests/shrub communities

Protection – Perimeter Levees and Flood Walls



Protection – Perimeter Levees and Flood Walls

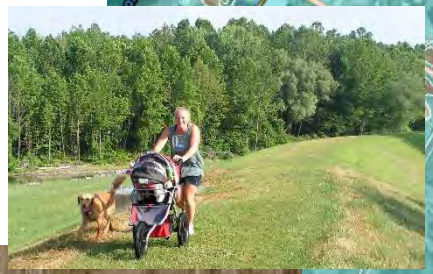
Protection – Perimeter Levees and Flood Walls

Protection – Perimeter Levees and Flood Walls

Protection – Perimeter Levees and Flood Walls

Coastal Review Online

Connecticut Audubon



Implementation

Long Beach West after the 1938 Hurricane (Ref. Town of Stratford)

Hurricane Sandy (2011)

Take Away 6

Adopt the Plan

Integrate with existing goals, plans and policies

Include Resiliency into Future Capital Projects

Apply for Future Grants (FEMA, USACE, HUD, FHWA)

FEMA: Community Rating System; LOMR

Management Plans & Permitting (Beach, Dredging, Stormwater)

Thank you for attending!

Questions? Comments?

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TOWN OF STRATFORD

offering more from forest to shore