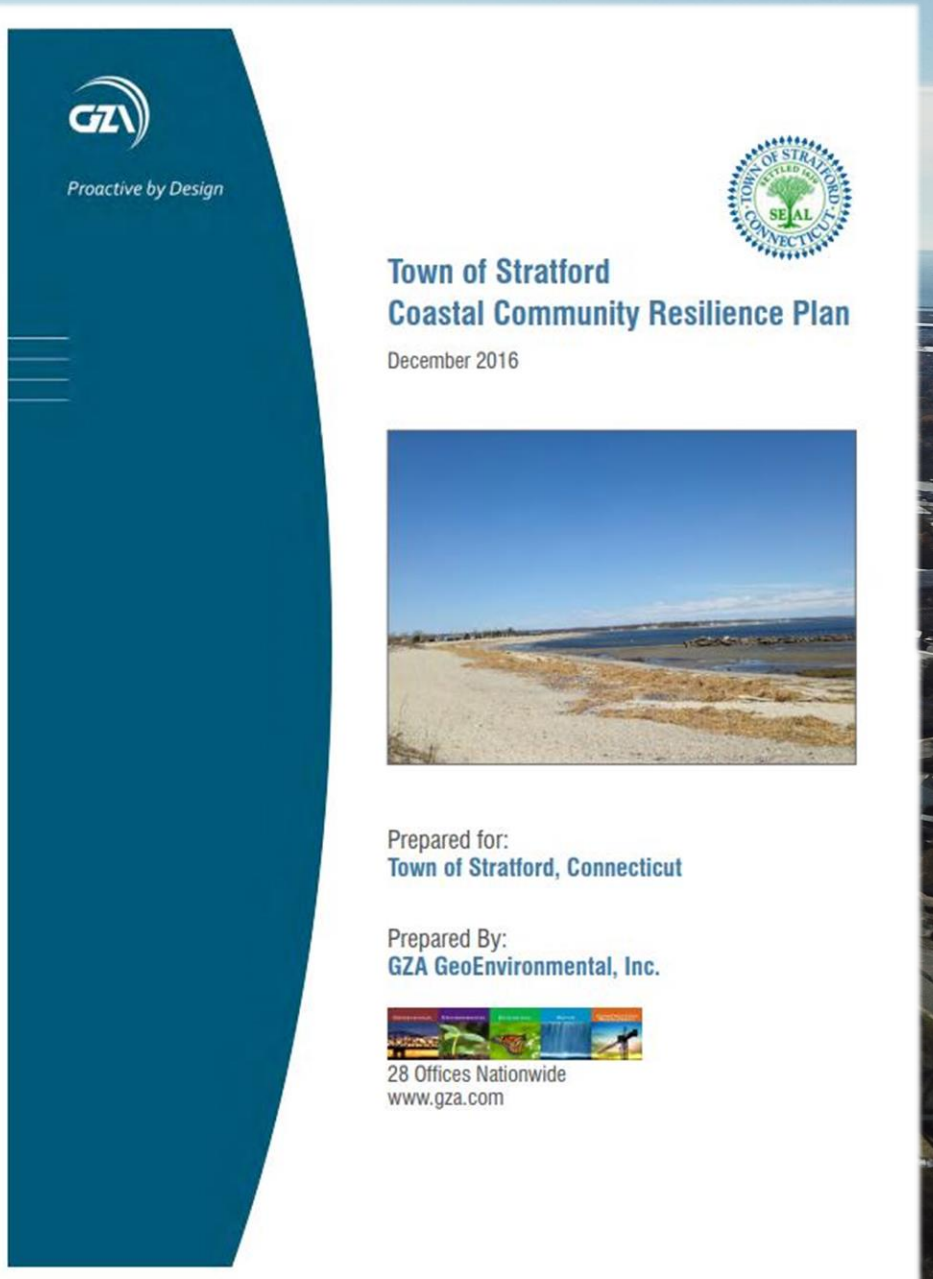
Planning for a more Resilient Stratford

Susmitha Attota, AICP – Town Planner
Dan Stapleton, P.E. – GZA

Stratford's Plan

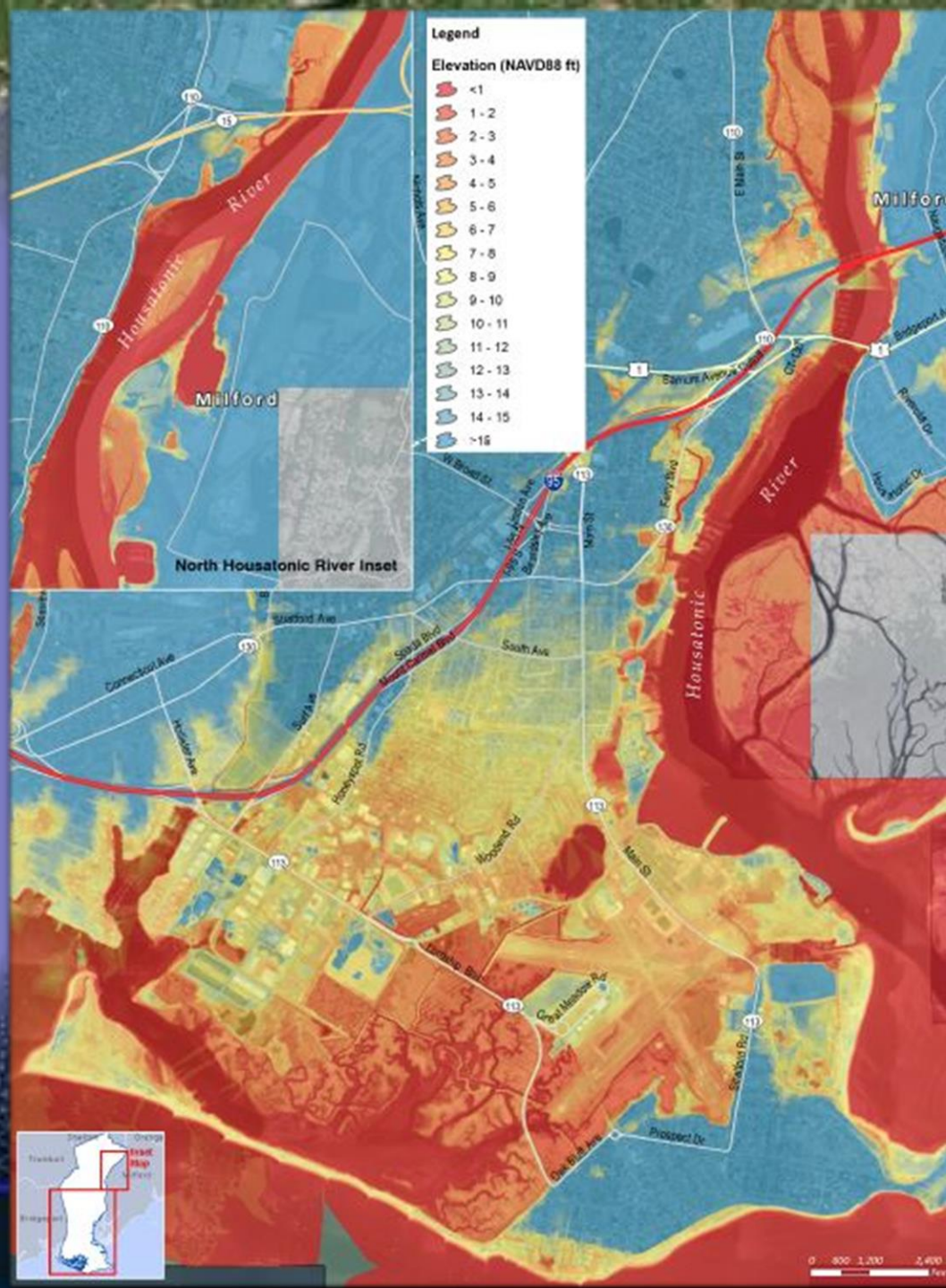
- Planning Began March 2015
- PLAN'S GOAL: Provide actionable coastal resilience roadmap for the Town
- Funded by Community Development Block Grant Disaster Recovery (CDBG-DR) grant

Stratford Coastal Community Resilience Plan



Analyses At A Glance

- Large Areas of Low-Lying Land Vulnerable to Flooding
- SLR Frequency & Elevation of Storm Surge Flooding
  - 2040
  - 2065 – SLR 0.4 – 2.2 feet
  - 2115 – SLR 0.8 – 6.2
- Stratford's Primary Exposure Risks
  - Most Socially Vulnerable Neighborhood (South I-95)
  - Airport Daily High Tide Flooding by 2065
  - Critical Facilities At Risk:
    - WPCA
    - Pump Stations
    - Airport
    - Schools
    - Transfer Station



Hurricane Sandy
Flood Inundation Simulation using ADCIRC
Model by GZA

Figure 3.10 GZA Computer Flood Simulations of Hurricane Sandy Time Step 1

Figure 3.11 GZA Computer Flood Simulations of Hurricane Sandy Time Step 2

Figure 3.12 GZA Computer Flood Simulations of Hurricane Sandy Time Step 3

Figure 3.13 GZA Computer Flood Simulations of Hurricane Sandy Time Step 4

Figure 3.14 GZA Computer Flood Simulations of Hurricane Sandy Time Step 5

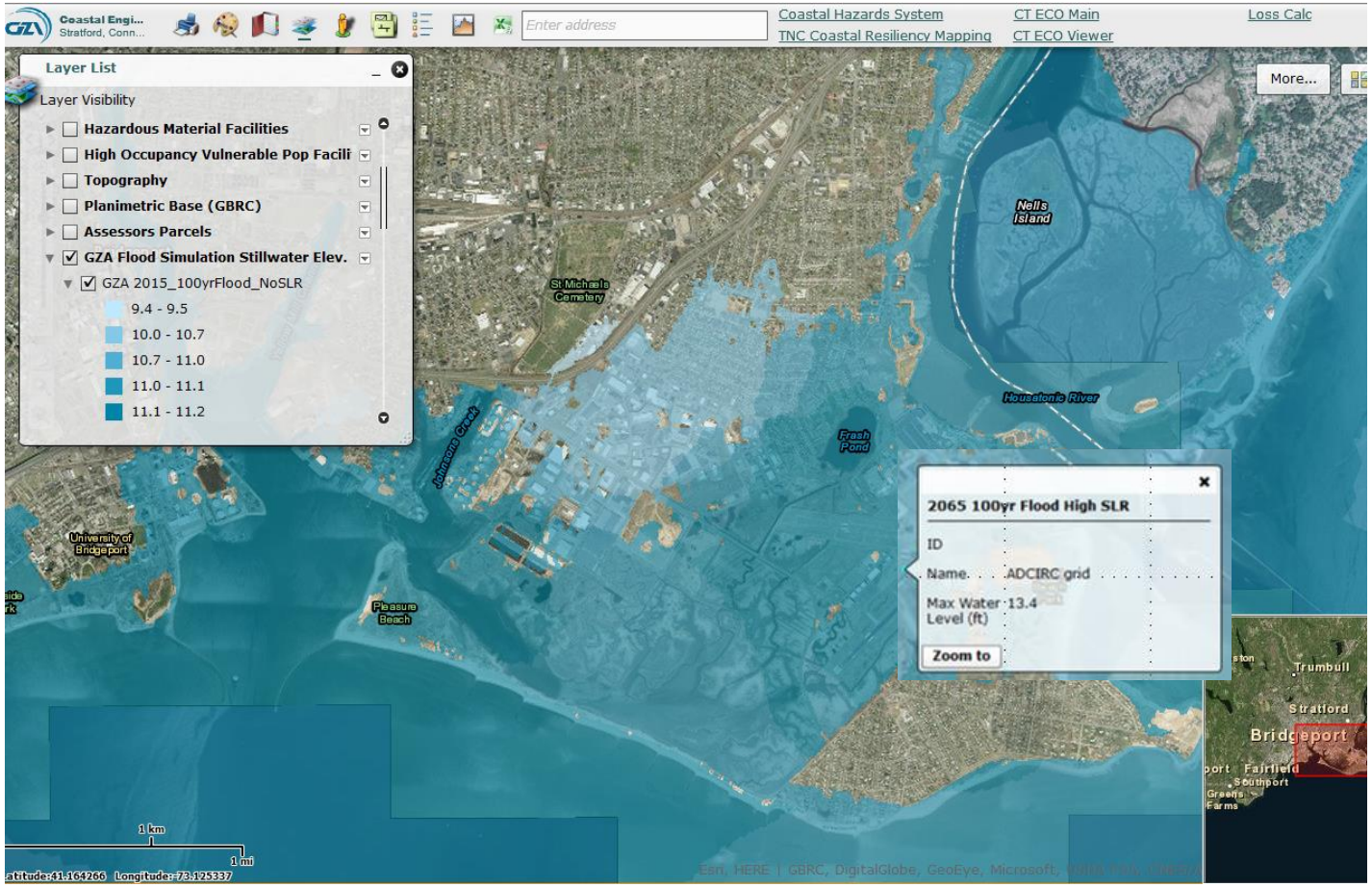
Figure 3.15 GZA Computer Flood Simulations of Hurricane Sandy Time Step 6

Figure 3.16 GZA Computer Flood Simulations of Hurricane Sandy Time Step 7

Figure 3.17 GZA Computer Flood Simulations of Hurricane Sandy Time Step 8

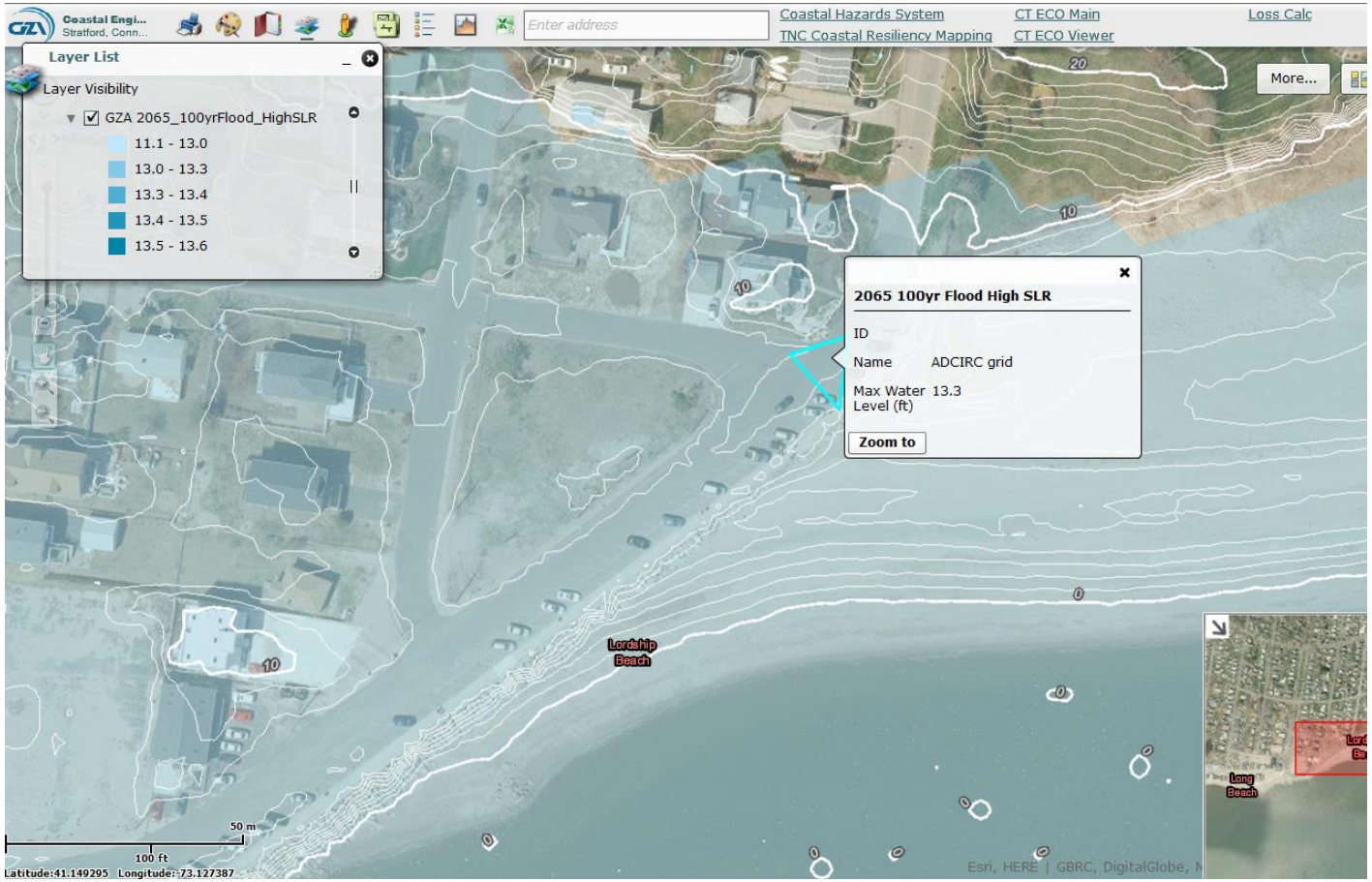
Superstorm Sandy

GZA Flood Inundation Simulation Model Results

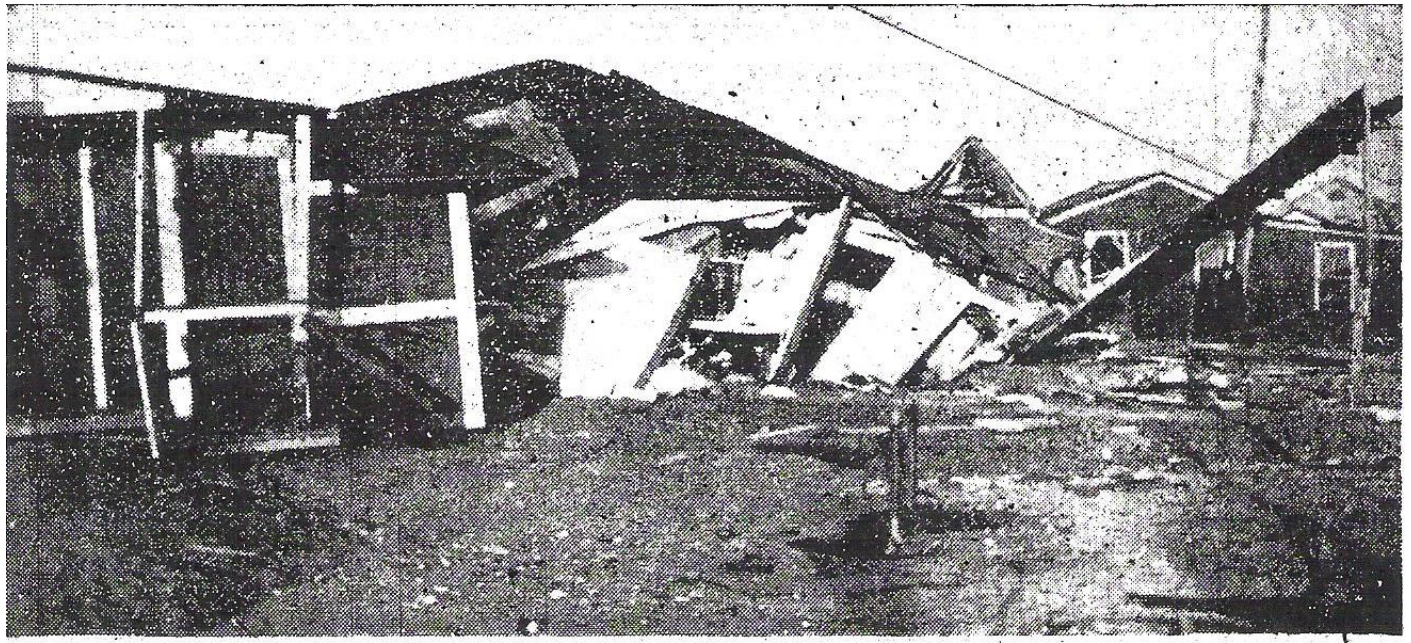


Superstorm Sandy

GZA Flood Inundation Simulation Model Results



Hurricane of ‘38



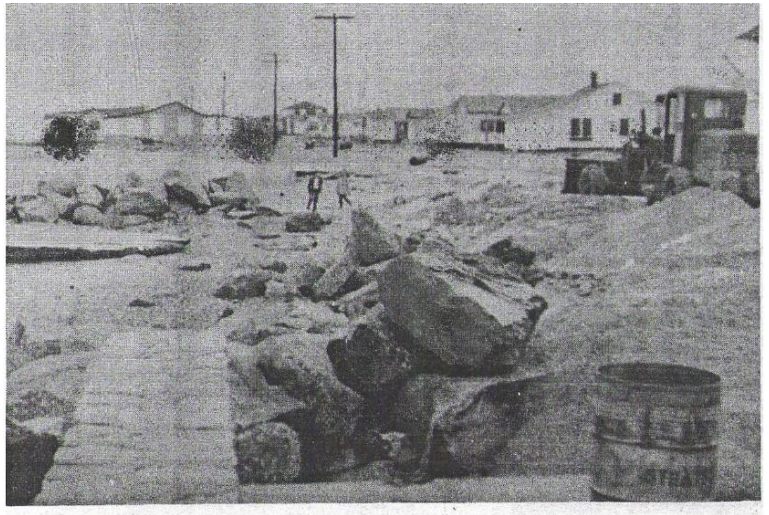
LORDSHIP COTTAGES SUFFER SIMILAR FATE—Here is one of more than 50 cottages demolished by the storm at Long Beach, Lordship, with damage estimated at more than $100,000.

Sunday Post Photo—Pitt

September 22, 1938

Damage from the Hurricane of 1938 at the cottages between Lordship and Long Beach. Courtesy of the Stratford Historical Society.

Damage from the Hurricane of 1938 at the cottages between Lordship and Long Beach. Courtesy of the Stratford Historical Society.

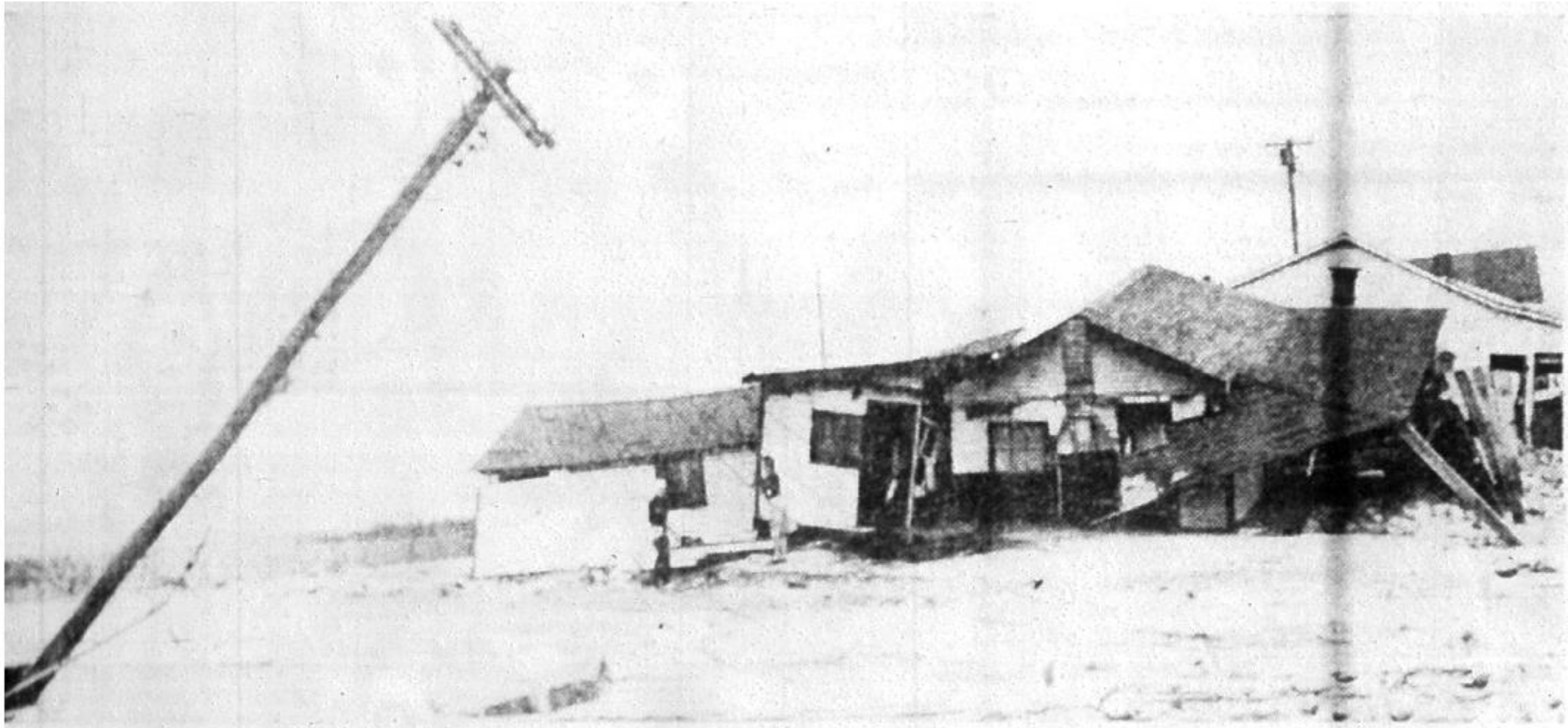


Stratford's Heritage: hurricane

Although it is most often a source of pleasure and recreation, the Stratford waterfront can also become a scene of desolation. This potograph was taken the day after a hurricane struck in 1955, wiping out the western end of the sea wall in Lordship and much of the adjoining sidewalk. (Collection of Mrs. F. Biebel, Sr.)

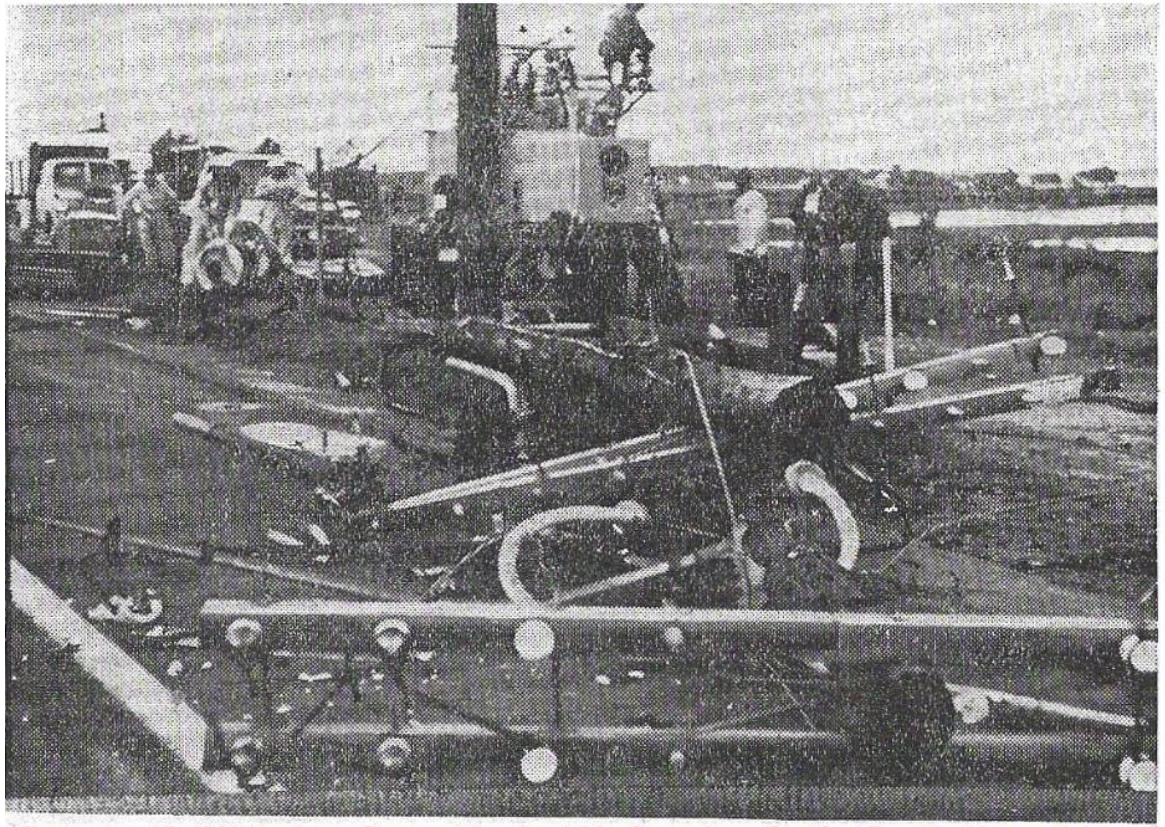
March 16, 1972

Hurricane of 1944



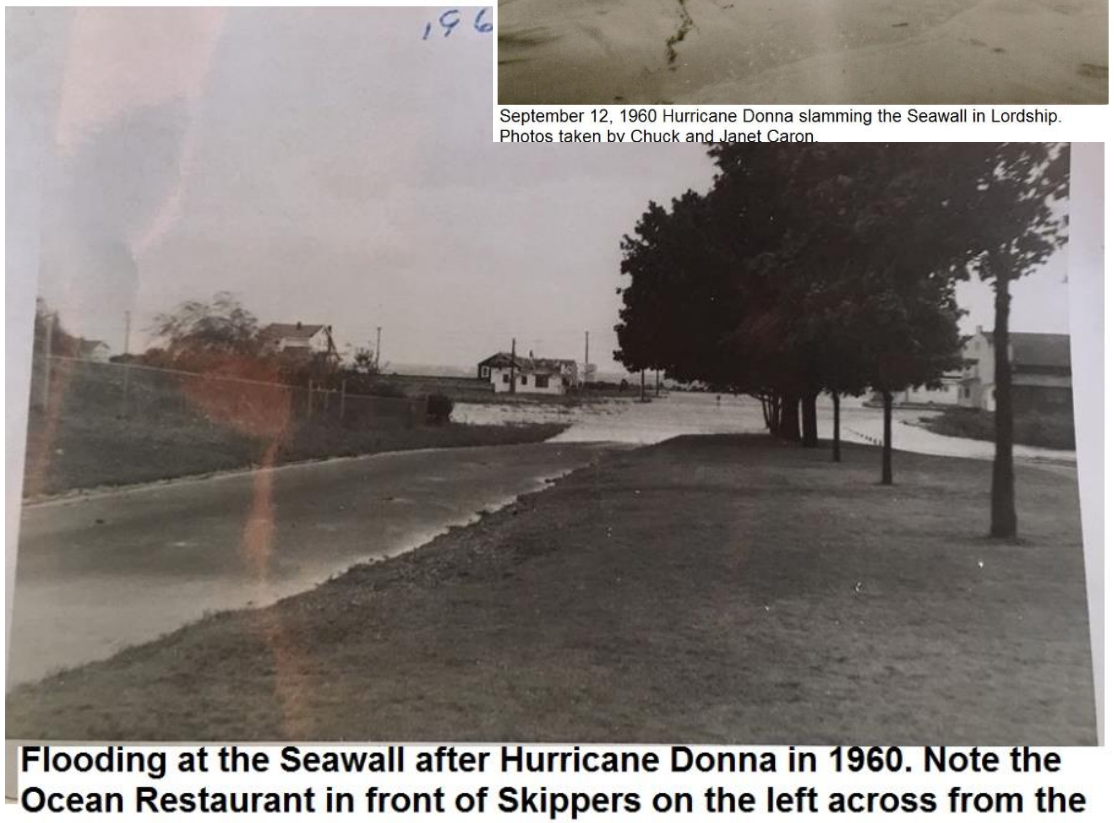
September 17, 1944: The Stratford Beach Head looked more like Anzio and Salerno after the Hurricane ripped houses apart, twisted telephone poles in their sockets and ripped power lines from their moorings. In this scene we have what is left of a group of cottages at Short Beach.

Hurricane Donna



September 15, 1960 Hurricane Donna strikes Lordship. Scene is on Stratford Road looking north in front of the Cemetery. Short Beach cottages and Housatonic River in background.

September 12, 1960 Hurricane Donna slamming the Seawall in Lordship. Photos taken by Chuck and Janet Caron.

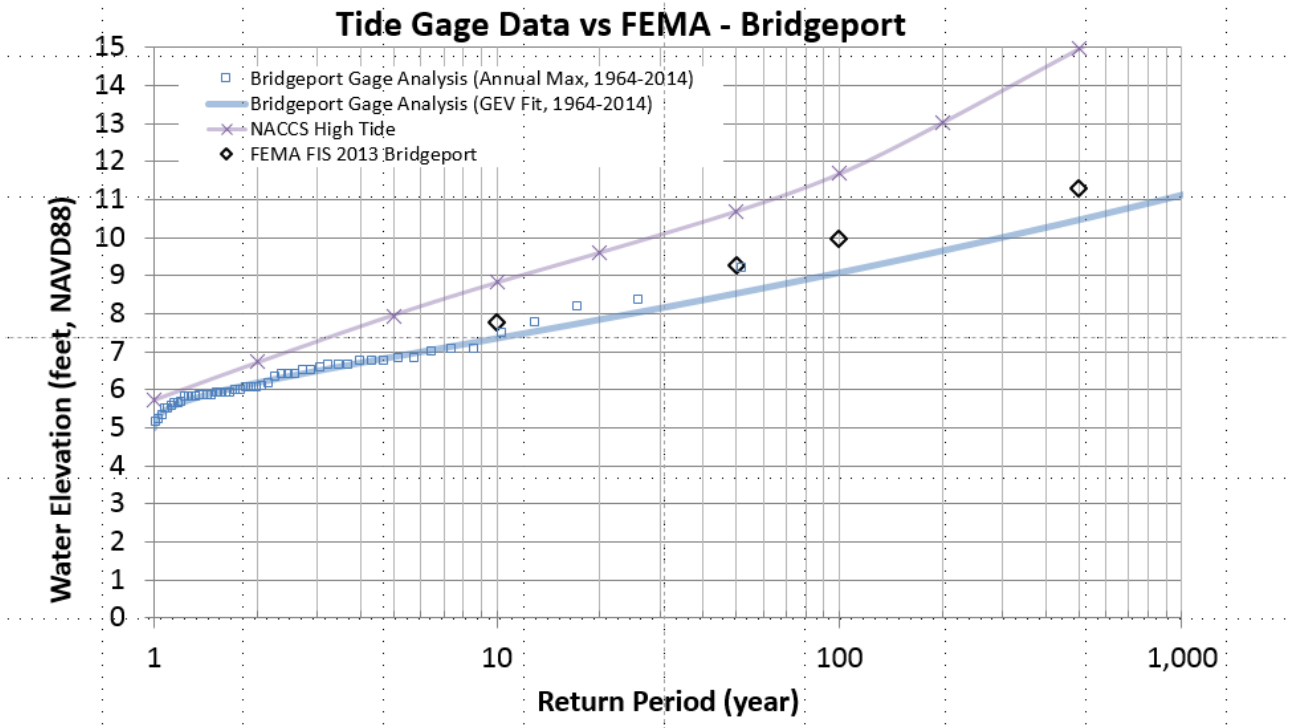


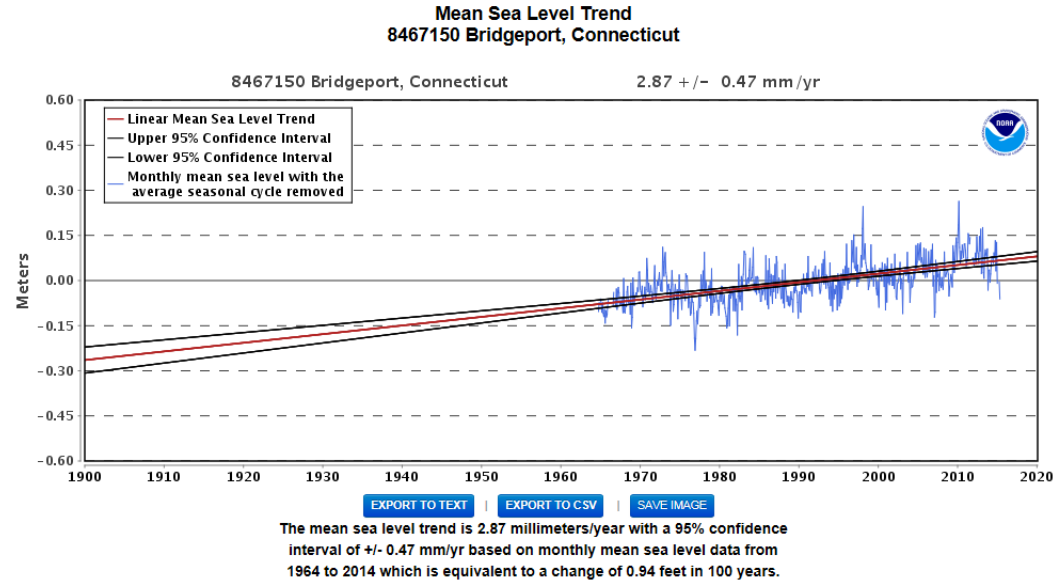
Flooding at the Seawall after Hurricane Donna in 1960. Note the Ocean Restaurant in front of Skippers on the left across from the skating rink.

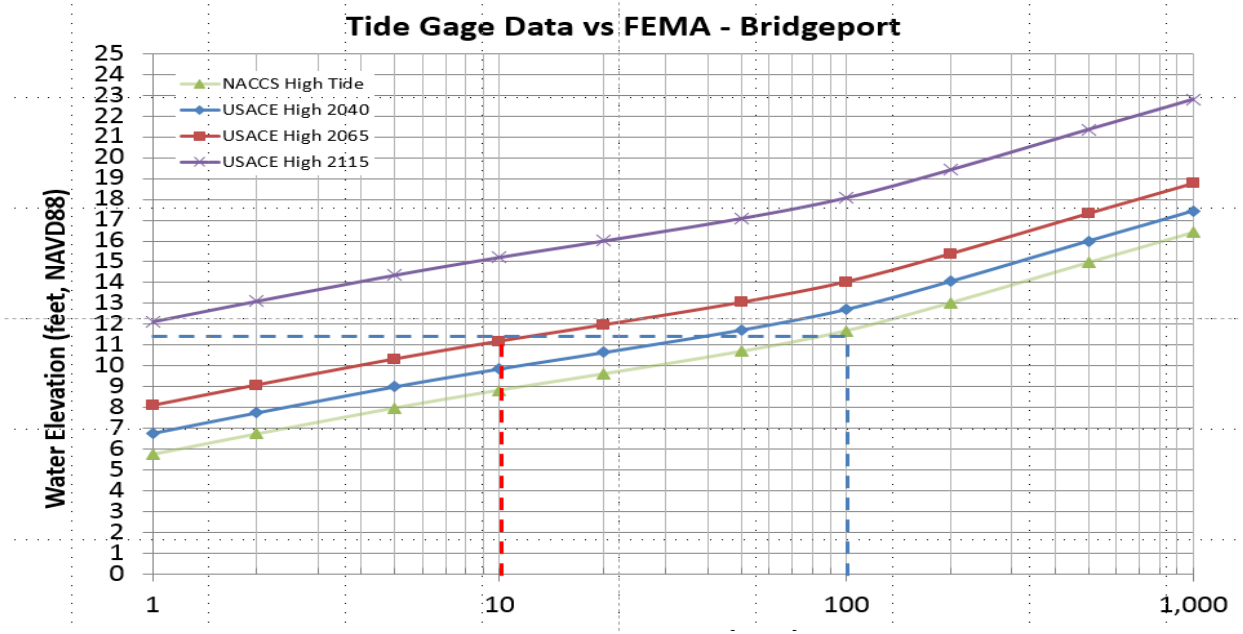
Courtesy of Karen Knowles Russett

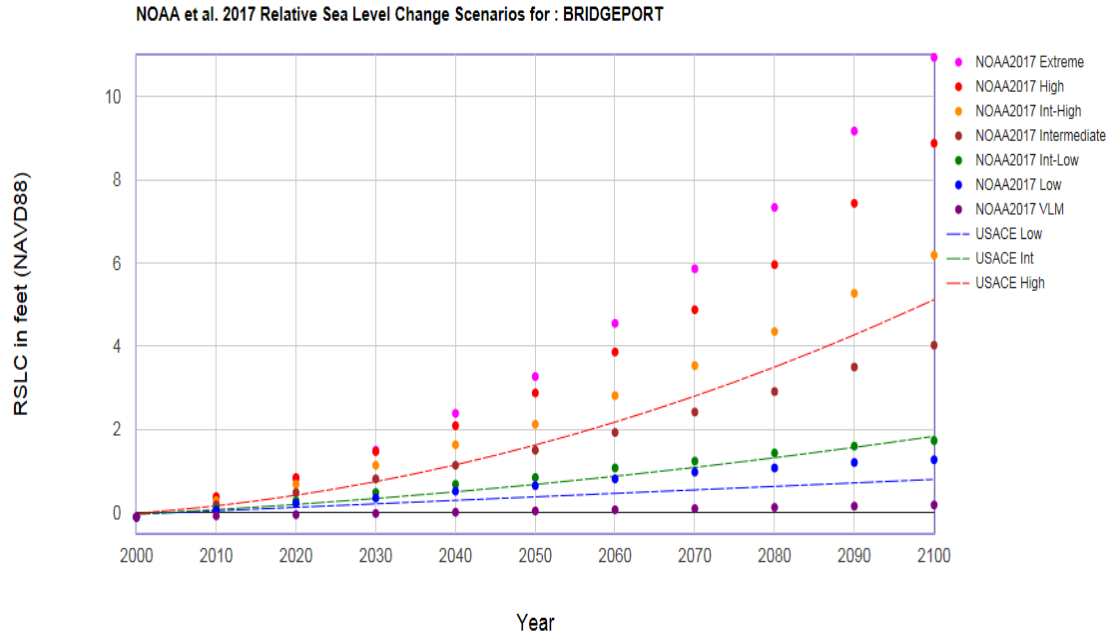
1965 Storm

1965 storm Lordship cottages now known as Shoreline Drive.
Photo property of the Biebel Family

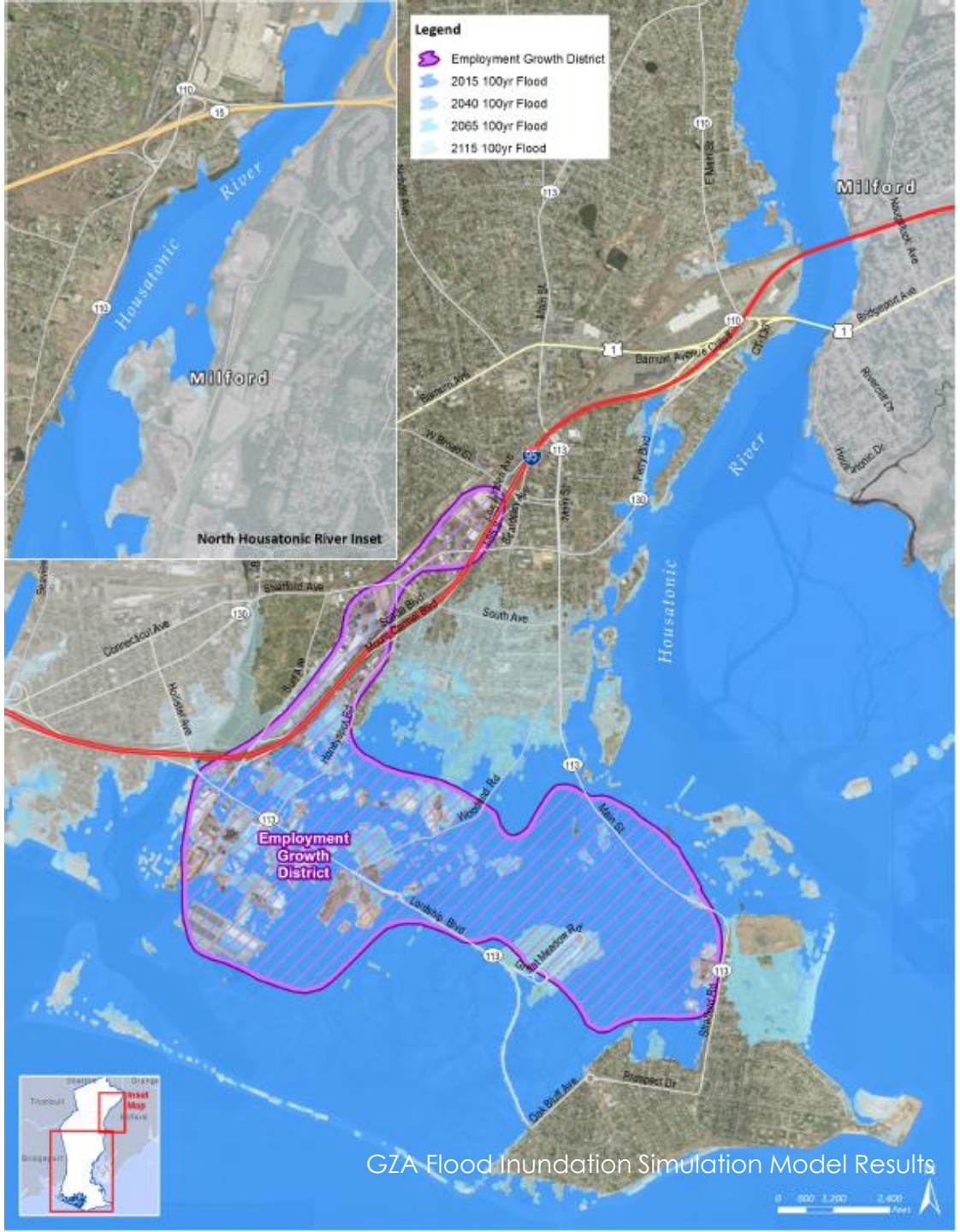

Tide Gage Data vs FEMA - Bridgeport
Bridgeport Gage Analysis (Annual Max, 1964-2014)
Bridgeport Gage Analysis (GEV Fit, 1964-2014)
NACCS High Tide
FEMA FIS 2013 Bridgeport
Water Elevation (feet, NAVD88)
Return Period (year)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1
10
100
1,000


Mean Sea Level Trend
8467150 Bridgeport, Connecticut
8467150 Bridgeport, Connecticut
2.87 +/- 0.47 mm/yr
Linear Mean Sea Level Trend
Upper 95% Confidence Interval
Lower 95% Confidence Interval
Monthly mean sea level with the average seasonal cycle removed
Meters
0.60
0.45
0.30
0.15
0.00
-0.15
-0.30
-0.45
-0.60
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
EXPORT TO TEXT
EXPORT TO CSV
SAVE IMAGE
The mean sea level trend is 2.87 millimeters/year with a 95% confidence interval of +/- 0.47 mm/yr based on monthly mean sea level data from 1964 to 2014 which is equivalent to a change of 0.94 feet in 100 years.


Tide Gage Data vs FEMA - Bridgeport
NACCS High Tide
USACE High 2040
USACE High 2065
USACE High 2115
Water Elevation (feet, NAVD88)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
1
10
100
1,000


NOAA et al. 2017 Relative Sea Level Change Scenarios for : BRIDGEPORT
RSLC in feet (NAVD88)
0
2
4
6
8
10
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year
NOAA2017 Extreme
NOAA2017 High
NOAA2017 Int-High
NOAA2017 Intermediate
NOAA2017 Int-Low
NOAA2017 Low
NOAA2017 VLM
USACE Low
USACE Int
USACE High

Asset-Based Vulnerability Assessment



Employment Growth District Flood Risk Profile

The POCD defines the Employment Growth District (EGD) as the mixed use employment corridor along Lordship Boulevard, including Sikorsky Airport, and along Honeyspot Road to Route 95. Table 4.1 presents an overview of the existing development EGD as well as the future development potential for commercial and industrial space and residential units.

	Commercial Space (sf)	Industrial Space (sf)	Residential Units (no. of units)
Existing	858,000	947,000	290
25% Build Out	925,000	4,725,000	610
Full Build Out	3,700,000	18,900,000	2,450

Table 4.1 Existing Development and Development Potential

The two key areas outlined in the POCD include are the Lordship Boulevard Employment Growth District and Sikorksy Airport.

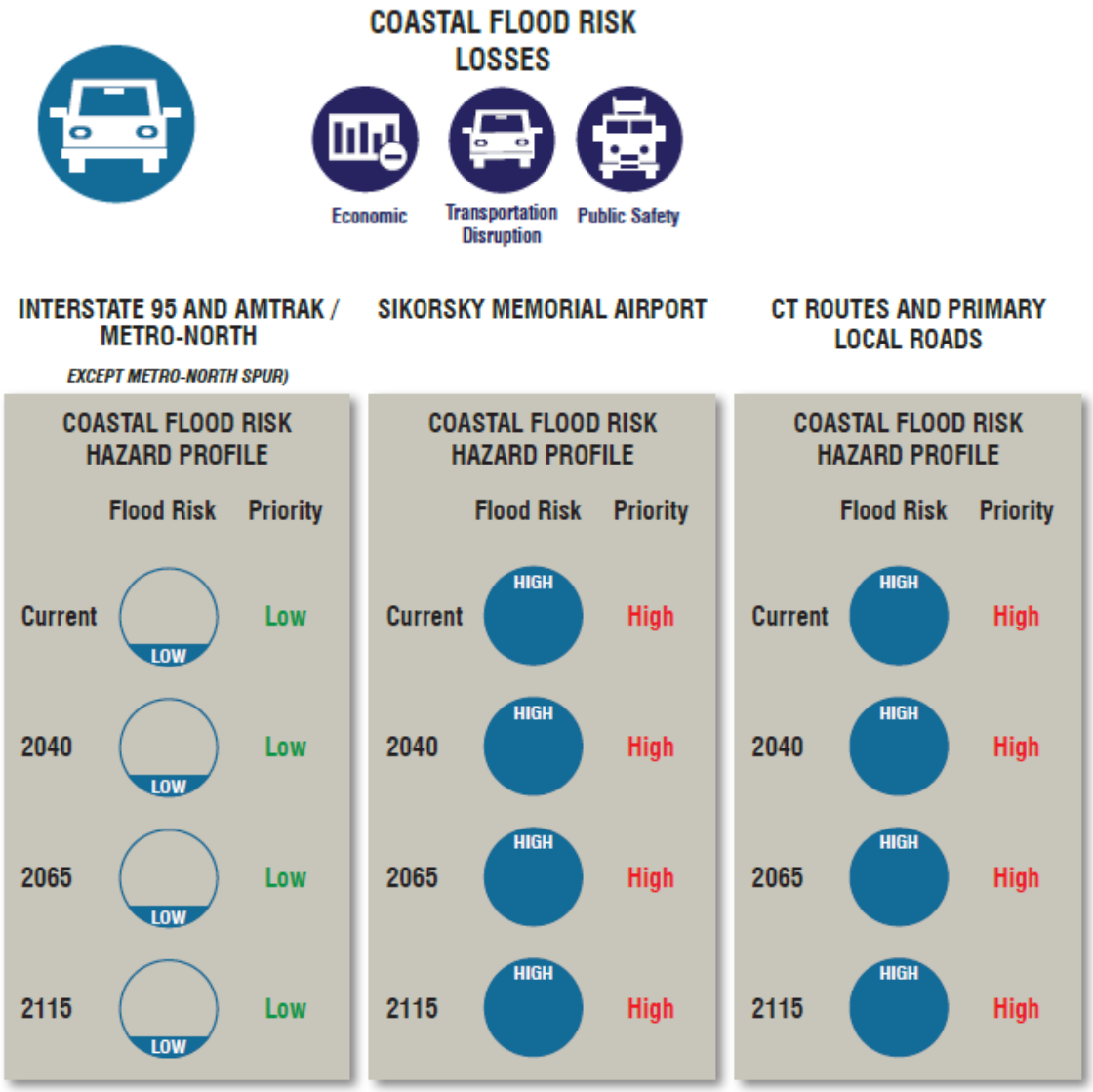
Portions of Lordship Boulevard and much of Sikorsky Airport were inundated during Hurricane Sandy. The vulnerability of the EGD was evaluated relative to the current FEMA FIRM Base Flood Elevation and the predicted 100-year recurrence interval coastal floods (stillwater elevation) through the year 2115 (see Figure 4.3). Lordship Boulevard and Sikorsky Airport are highly vulnerable to coastal flooding. Lordship Boulevard and Sikorsky Airport are currently within the effective FEMA Zone AE.

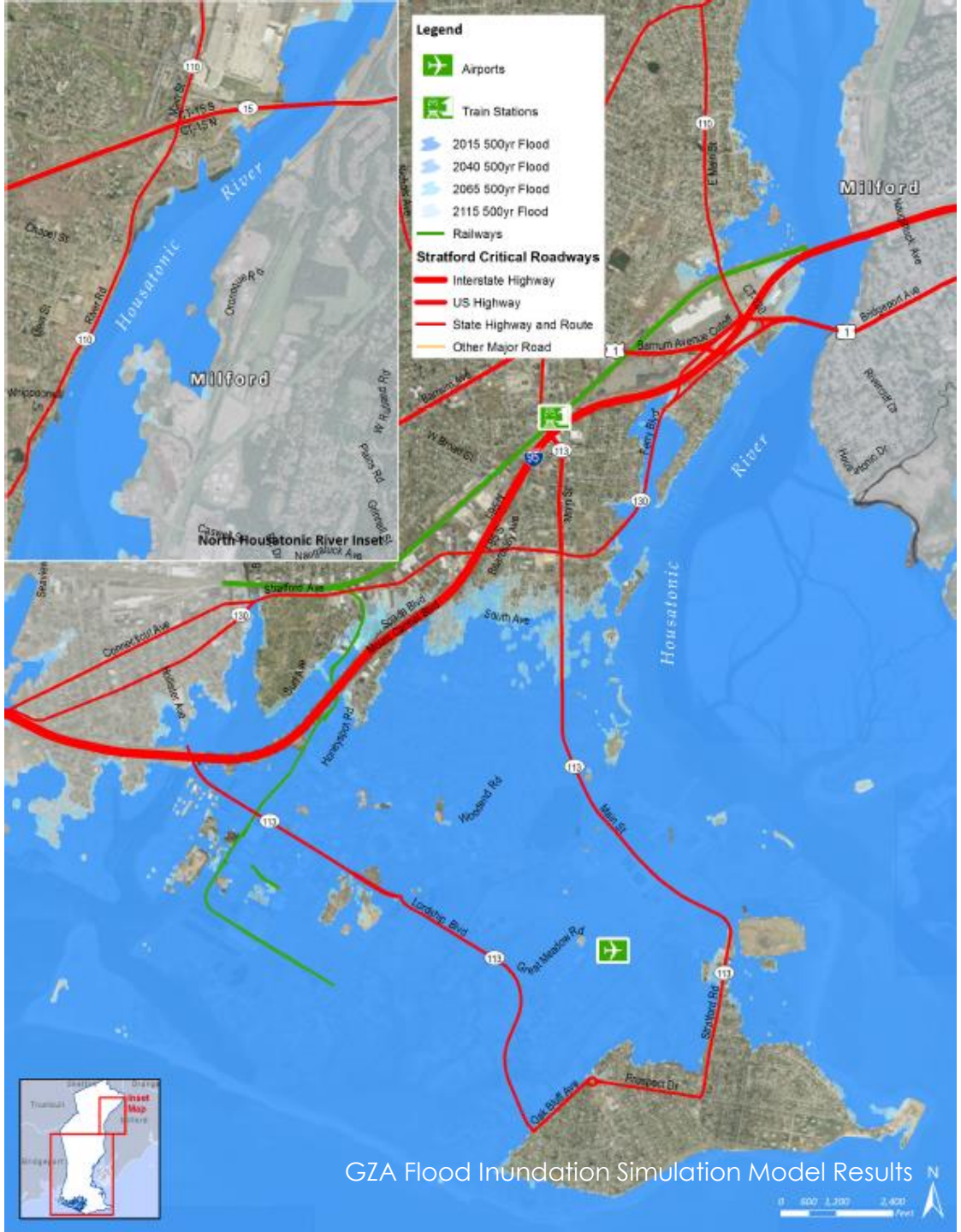
The flood vulnerability is due principally to: 1) flooding from Great Meadows with respect to Lordship Boulevard and 2) floodwaters entering into Sikorsky Airport via the Marine Basin. The effects of coastal flooding will increase due to sea level rise, resulting in increased damage potential especially in consideration of future development along Lordship Boulevard.

Potential losses to the EGD include: 1) direct costs due to existing and future EGD development and content damages; 2) direct costs to aircraft, facilities and content damages at Sikorsky Airport; and 3) indirect costs due to disruption of services. Sikorsky Airport also houses essential facility support such as the police helicopter.

Figure 4.3 Employment Growth District *(facing page)*

Transportation Vulnerability Assessment





Financial Vulnerability Assessment

AAL Per capita: $1,100 +/-

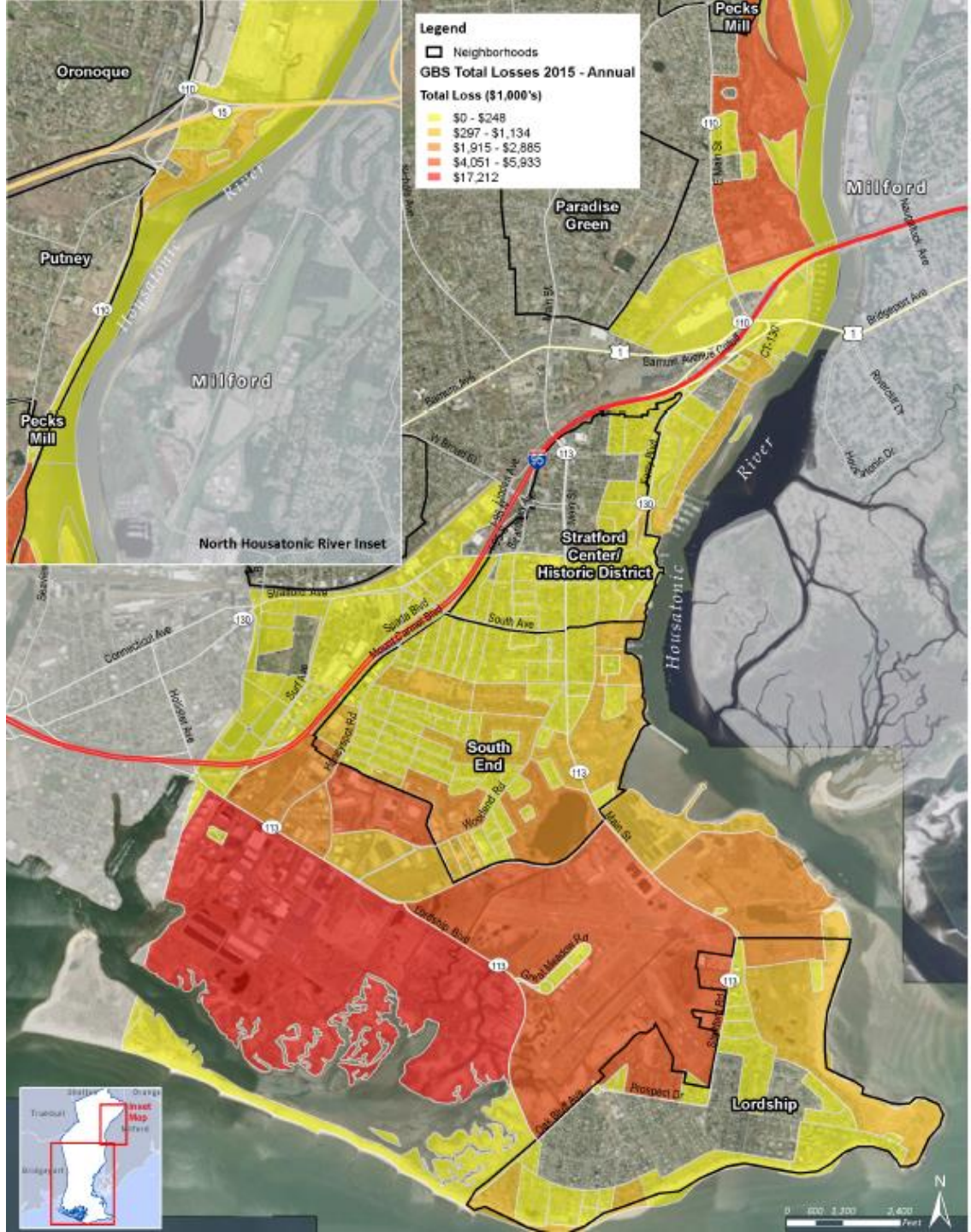
Occupancy	Exposure ($1,000)	Percent of Total
Residential	4,804,160	71.5%
Commercial	1,184,257	17.6%
Industrial	517,257	7.7%
Agricultural	14,010	0.2%
Religious	102,683	1.5%
Government	33,465	.5%
Education	64,294	1%
Total	**6,720,103**	**100%**

Table 4.2 Stratford Building Exposure and Occupancy Type

Category	10 yr	25 yr	50 yr	100 yr	500 yr	AAL
	(Shown in Millions of Dollars)					
Residential	$87	$110	$174	$244	$442	
Commercial	$160	$203	$286	$424	$551	
Industrial	$107	$135	$192	$272	$390	
Other	$13	$18	$24	$30	$47	
Total	**$367**	**$465**	**$675**	**$971**	**$1,430**	**$57**

Table 4.3 Estimated Flood-Related Building Losses - Stratford

GZA Flooding Loss Estimation Results

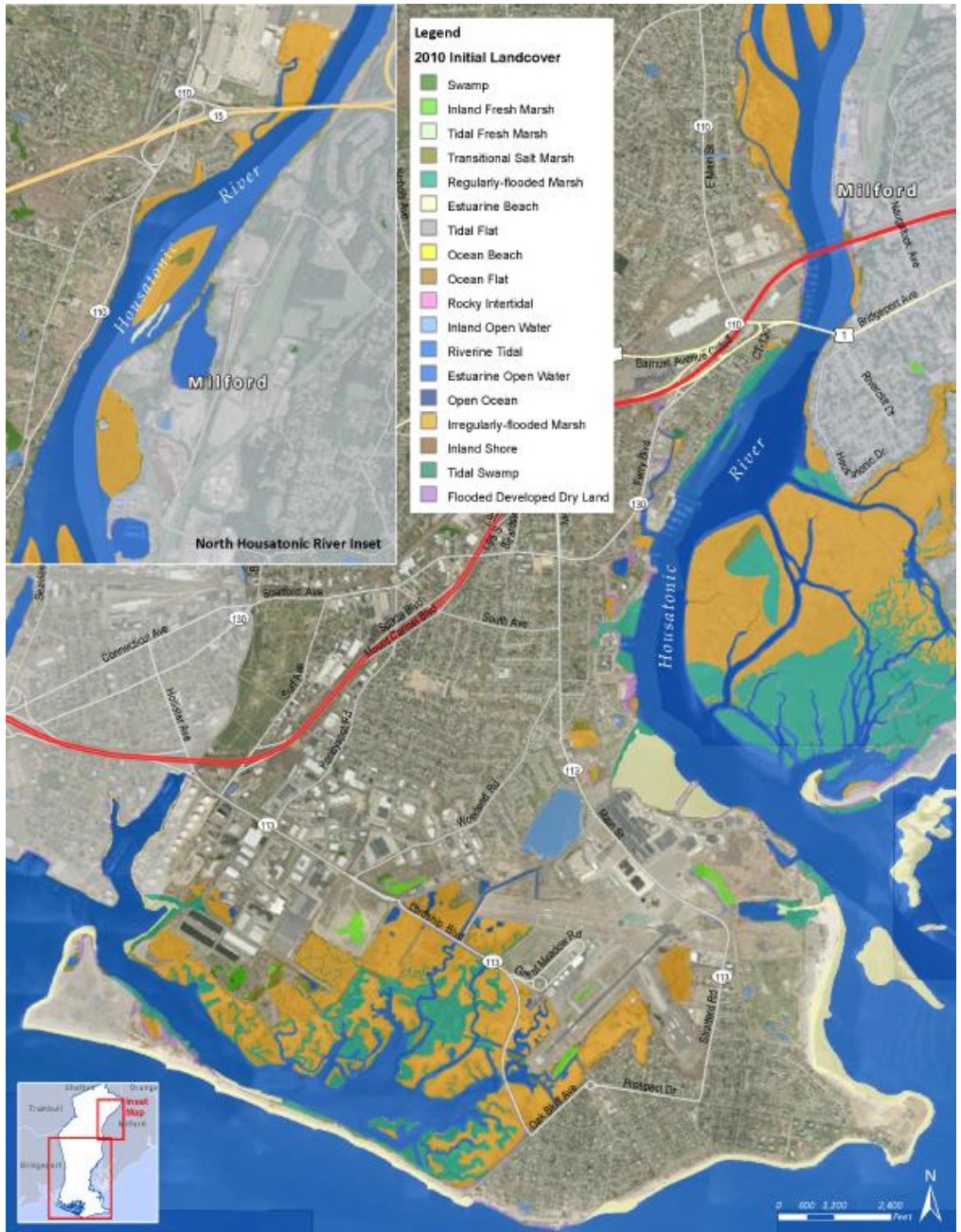


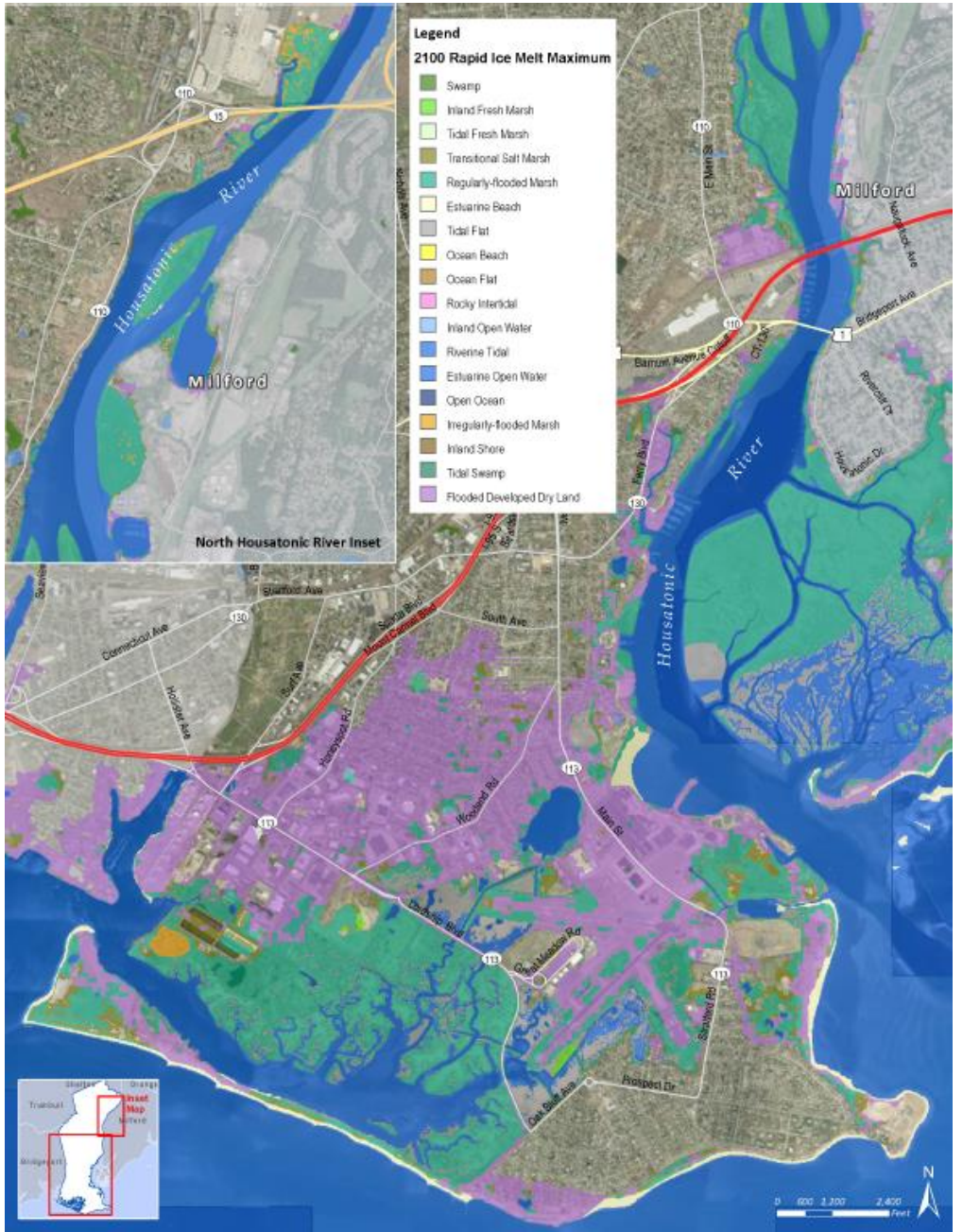
Natural Resource Vulnerability Assessment

COASTAL FLOOD RISK LOSSES

Loss of Natural Resources

Economic



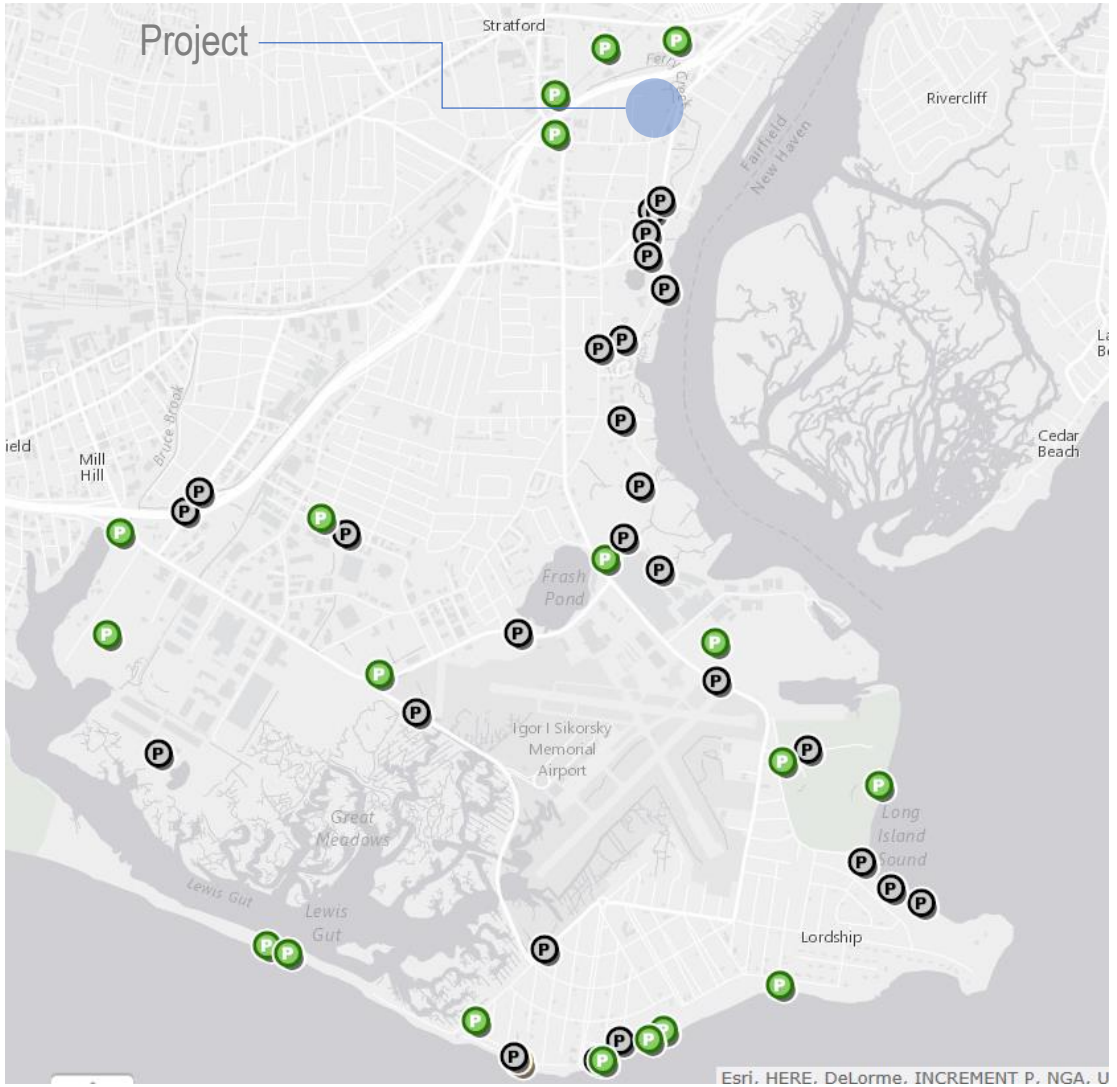


Three Strategy Approach

- RETREAT – Buy-Out Program, Acquisition/Demo, Beach Restoration
- PROTECT – Blend of Natural and Nature-Based Features and Structures; incorporating Elevated Greenway
- ACCOMMODATE – Zoning, Flood Proofing and Bldg Elevation, Beach Nourishment/Maintenance, Post-Storm Repair

Aligning Town Plans with Flood Risk

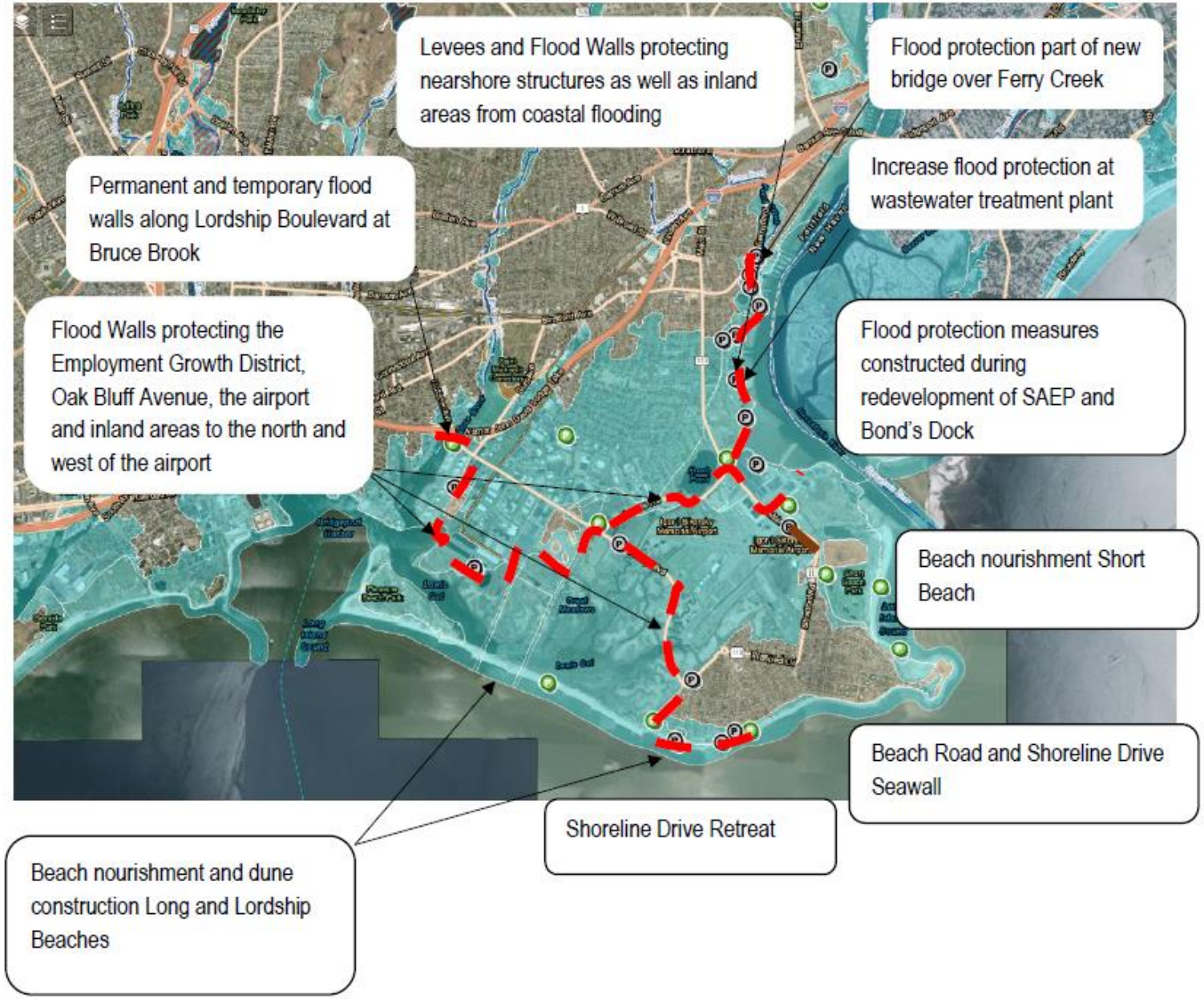
Perimeter Flood Protection Projects



Flood Mitigation Project Integration

Estimated Cost Summary of Town Resiliency Projects:

Estimated Construction Cost:	$181,853,400
Engineering, Design and Permitting (15%):	$ 27,278,010
Contingency (10%):	$ 20,913,141
Total Estimated Cost:	$230,000,000



GZA Flooding Loss Estimation Results

Value of Resiliency Investment: Prevented Building Losses and Benefit-Cost

Current AAL Per capita: $1,100 +/-

Protect to Elevation 10 feet NAVD88:

Category:	10 yr	25 yr	50 yr	100 yr	500 yr	AAL
Total	0	$465M	$675M	$971M	$1,430M	$46M
Per capita AAL						**$890**

Protect to Elevation 12 feet NAVD88:

Category:	10 yr	25 yr	50 yr	100 yr	500 yr	AAL
Total	0	0	0	0M	$1,430M	$9M
Per capita AAL						**$175**

Protect to Elevation 11 feet NAVD88:

Category:	10 yr	25 yr	50 yr	100 yr	500 yr	AAL
Total	0	0	0	$971M	$1,430M	$17M
Per capita AAL						**$330**

Stratford Living Shoreline Project

Sacred Heart UNIVERSITY
DEPARTMENT OF BIOLOGY

The Stratford Point Living Shoreline

AECOM Figure 3

PROJECT LOCATION MAP

COASTAL DUNE RESTORATION
LONG ISLAND SOUND COMMUNITIES
STRATFORD, CONNECTICUT
Project No.: 60481699 Date: 2017-02-20

Last saved by: JASON.JERRYTONE (2017-02-20) Last Plotted: 2017-02-20 Project Management Initials: Designer: JRJ Checked: CH Approved: CH ANSI A 8.5" x 11"
Filename: S:\PROJECTS\PRIVATE-SECTOR\DUPONT\DUP_LORDSHIP_PROJECTS\LIVING SHORELINE PILOT PROJECT\DESIGN SUPPORT\DUNE REHABILITATION\PROJECT LOCATION MAP.DWG

Resilience Plan Implementation Roadmap

Step 1:
Adopt Plan

Step 2:
Establish Coastal Resiliency Team

Step 3:
Prioritize Plan Projects

Step 4:
Create "Resiliency Project Funding Plan"

Step 5:
Create "Resiliency Permit Compliance Plan"

Step 6:
Evaluate Stratford's participation in the NFIP, including Community Rating System (CRS)

Step 7:
Incorporate findings and recommendations into the next update of the Plan of Conservation

Step 8:
Incorporate findings and recommendations into the next update of the Hazard Mitigation Plan

Step 9:
Review and Modify Zoning Regulations with Resiliency Policies

Step 10:
Review and Modify Stratford Building Codes with proposed State Building Code Modifications

Resilience Successes

- CRS CLASS 8
- Raised Community Awareness/Buy-In
- Project Integration Into HMP and POCD
- Complete Streets / Green Infrastructure
- Conceptual Design and Cost Estimate - WPCF
- Integration of flood mitigation into new bridge design
- Integration of flood mitigation into land development agreements
- Constructed Living Shoreline Pilot Project
- State & Federal Grant Applications
- Getting Noticed!

Future Planning Needs

Project Funding

Flood Erosion Control Board

Internal Staffing & Budget

Community Outreach

Advanced Planning Analysis

Please Contact Us With Any Questions:

Susmitha Attota, AICP
sattota@townofstratford.com