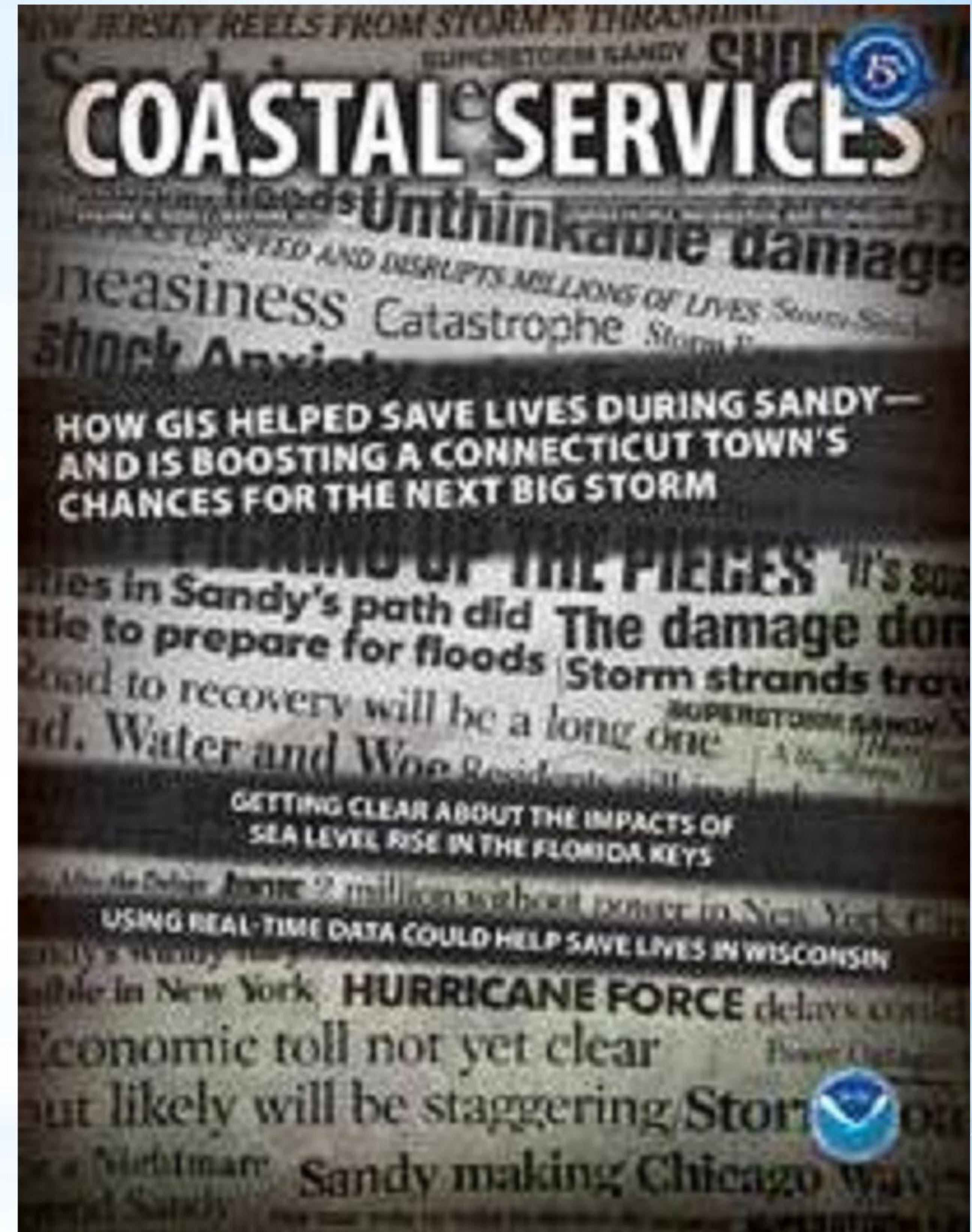


On the Front Line: Using GIS, LIDAR, and Real Time Data for Emergency Response and Resiliency Planning at the Local Level

Presented by:

Denise Savageau
Conservation Director
Town of Greenwich



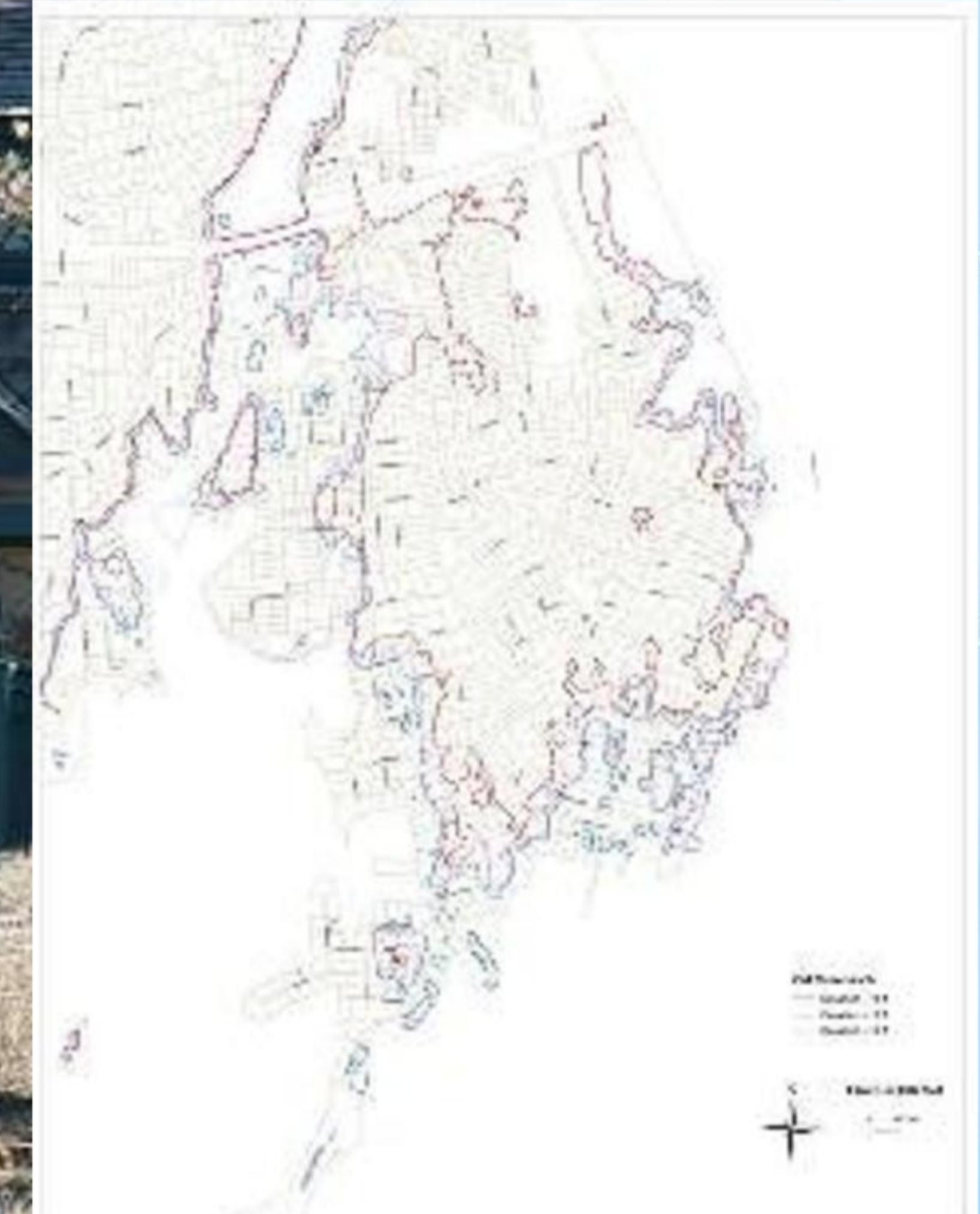
Municipalities are on the front lines when it comes to Climate Change Adaptation and Community Resiliency

- **Emergency Preparedness** – traditionally the domain of our First Responders focused on storm response and short term recovery
- **Land Use Planning** – traditionally Planning and Zoning, Inland Wetlands and Watercourse Commissions, Conservation Commissions with focus on flood plain regulations
- **Long Term Recovery** – not on the radar for most Towns until Sandy



The Challenge for Municipalities: Thinking Out of the Box

1. Expanding roles of land use planners in Emergency Preparedness and Response including Emergency Operation Centers
2. Involving First Responders in Land Use Planning
3. Creating GIS layers that can be used for both planning and emergency response
4. Include long term recovery in planning and preparedness efforts
5. **Maintaining sense of place and community**

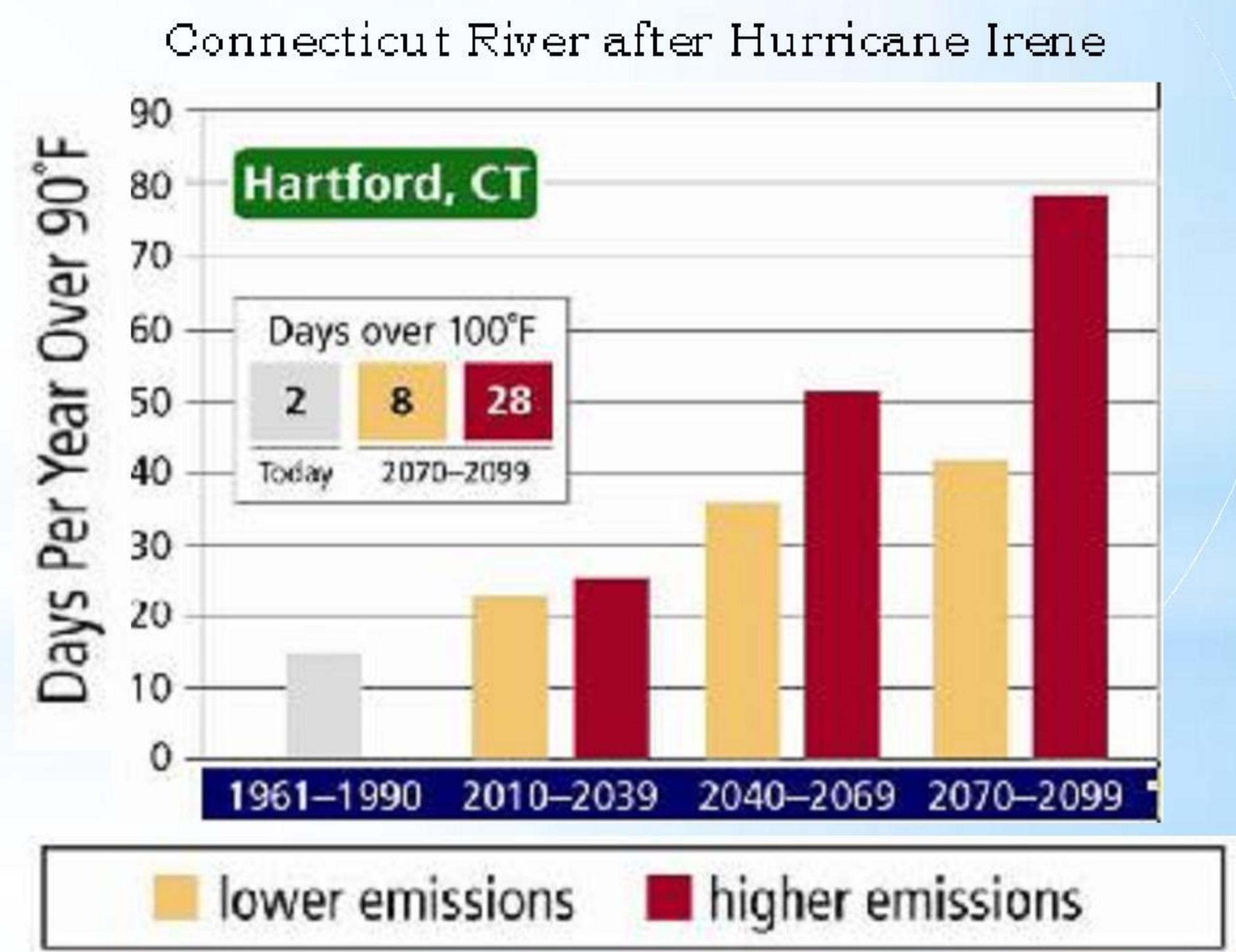
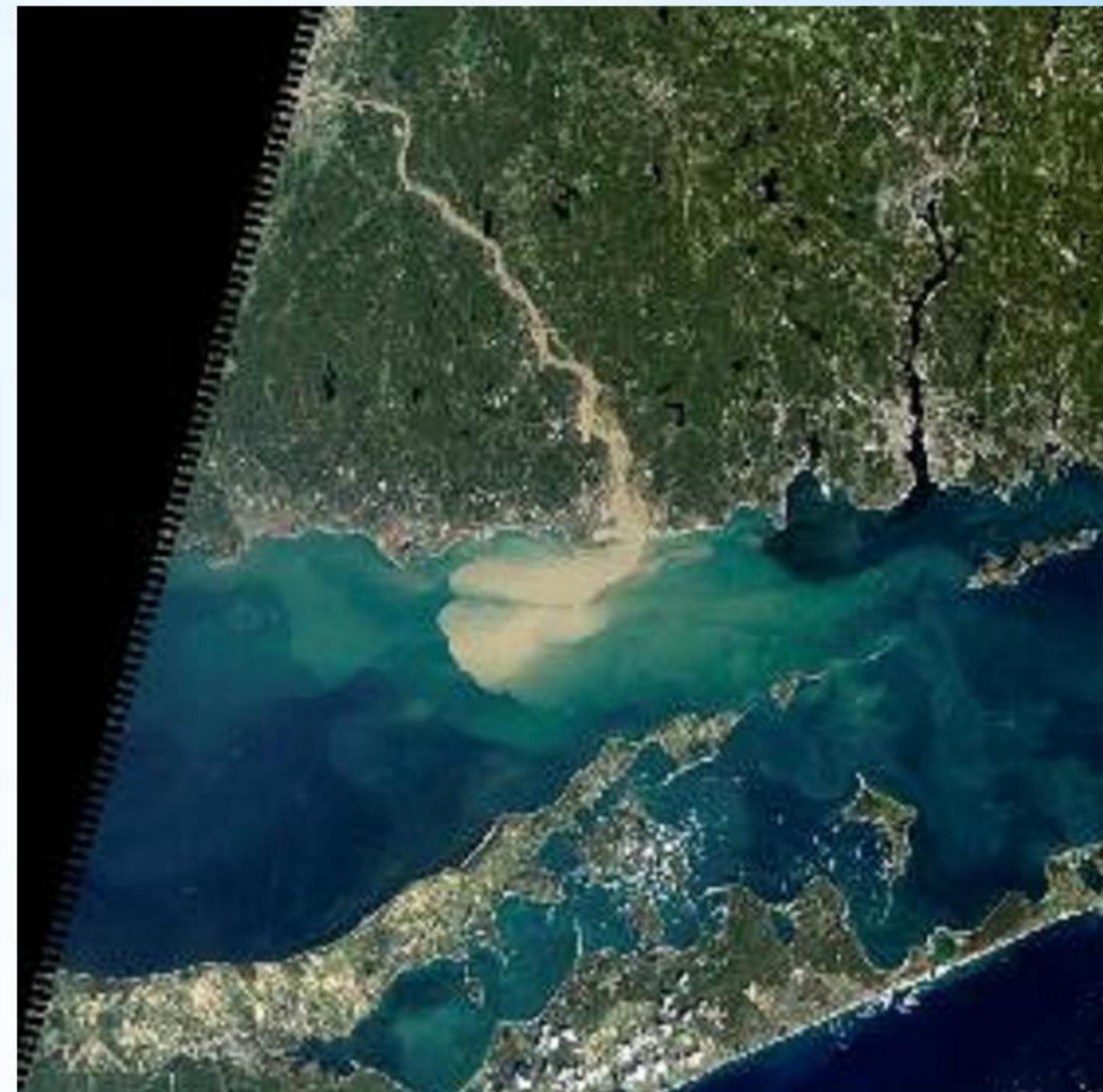


One of the biggest challenges ...

... a public that is on a huge learning curve about basic science relating to natural hazards

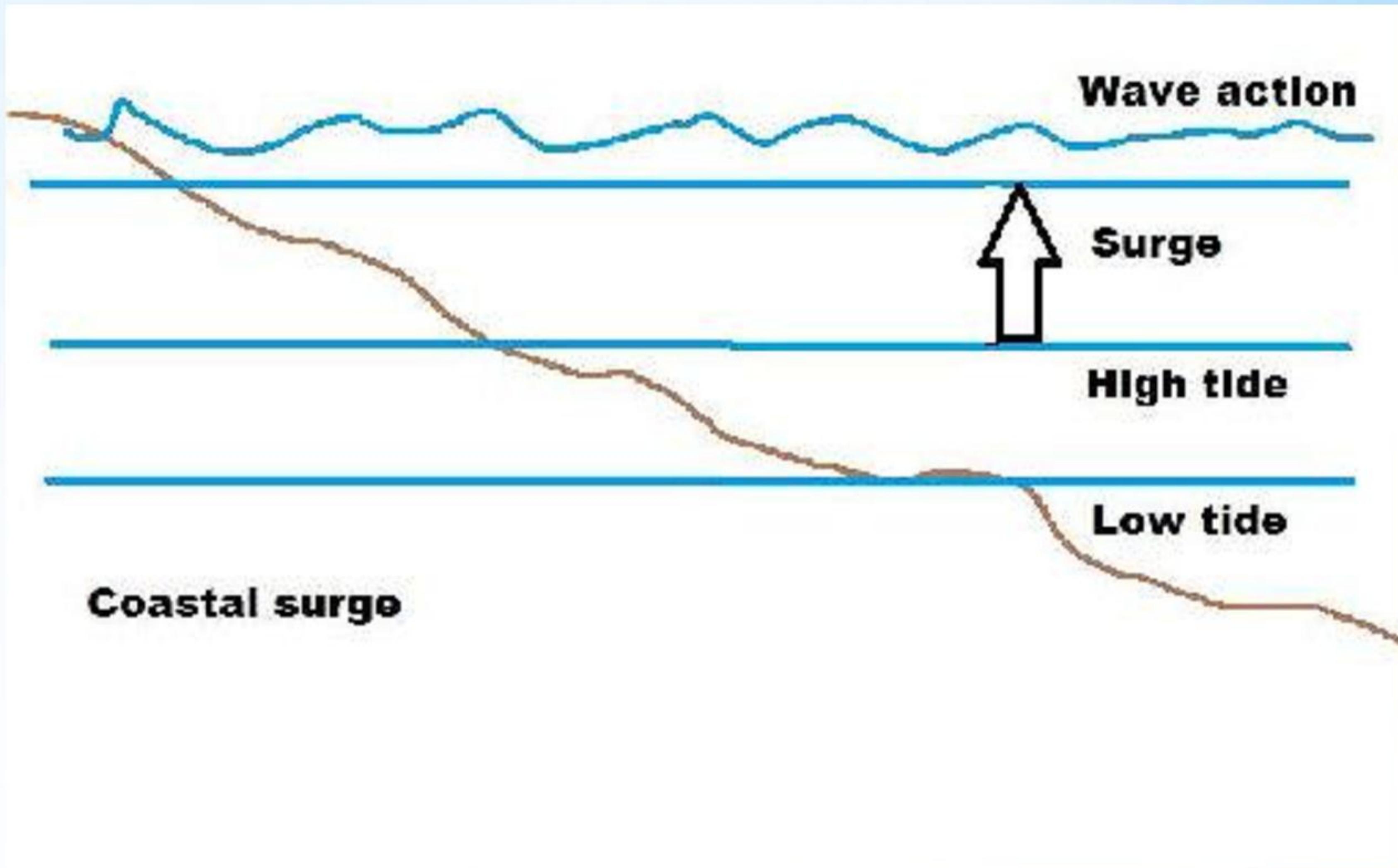
- Hydrology – very little understanding of water resources whether it is flooding or drought or other extreme event
- Coastal flooding versus riverine flooding
- Storm surge versus water elevation
- Surface water versus ground water

Any discussion on Climate Change – without this basic understanding - leads to confusion and inertia.



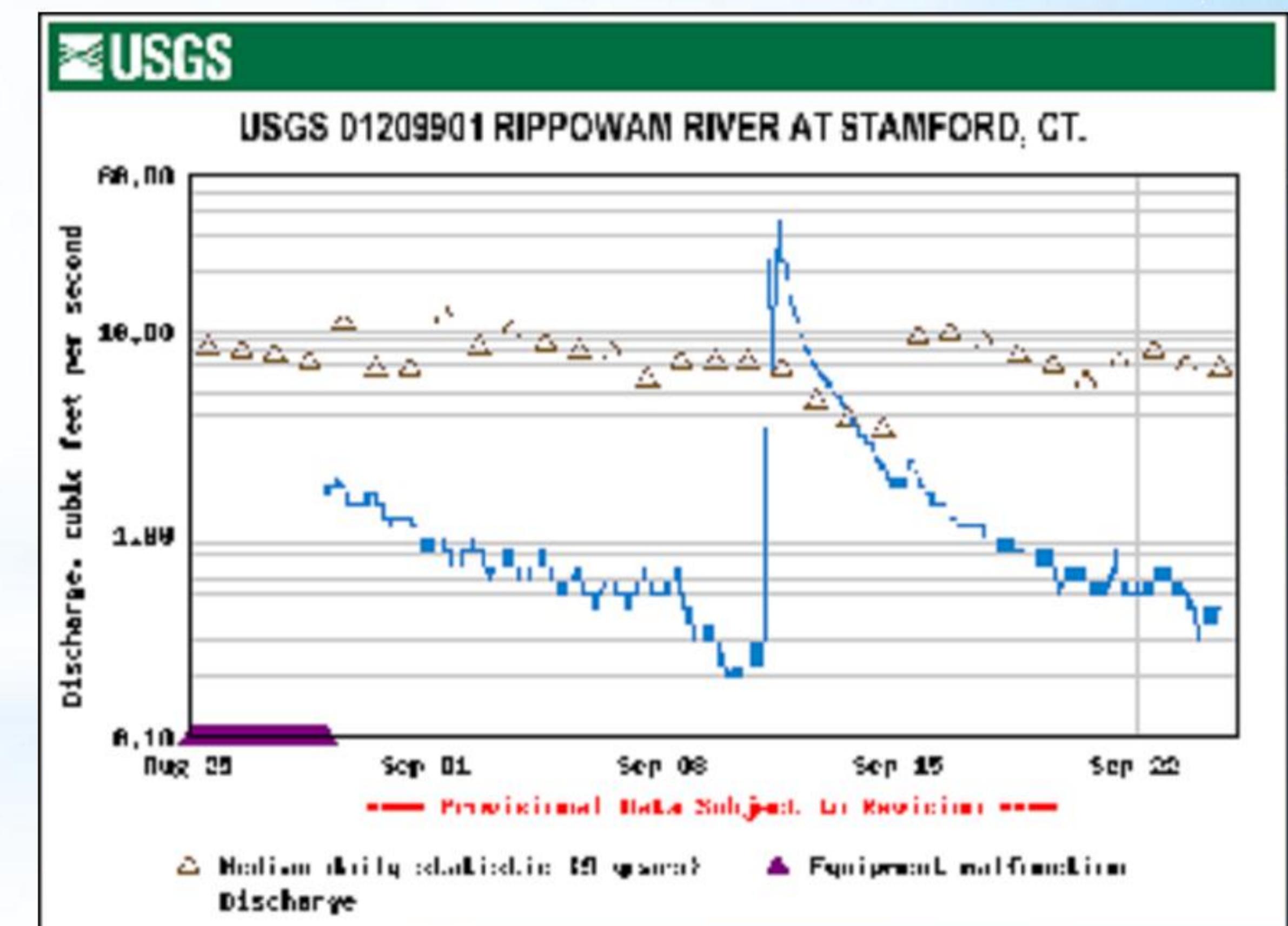
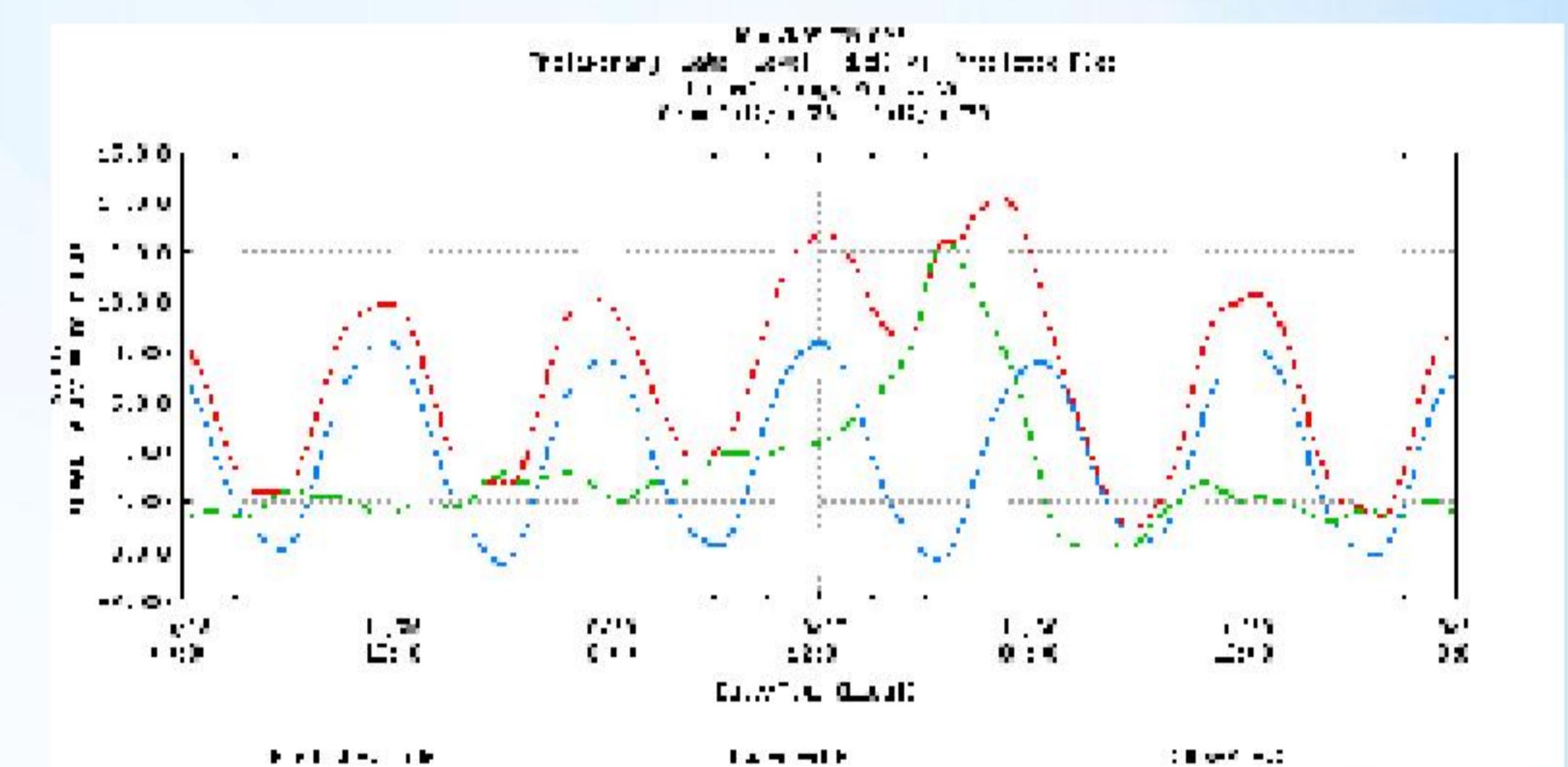
Understanding Storm Surge

- The storm surge is the difference between the actual recorded water elevation and the predicted water elevation (predicted tide).
- Surge heights are measured at still water and do not take wave action (surf) into account.
- A storm surge is NOT a big wave or tsunami-type event.



- During a storm event, the highest water elevation recorded does not necessarily occur when the surge is the highest. It depends on the timing of the surge in relationship to the tidal cycle.

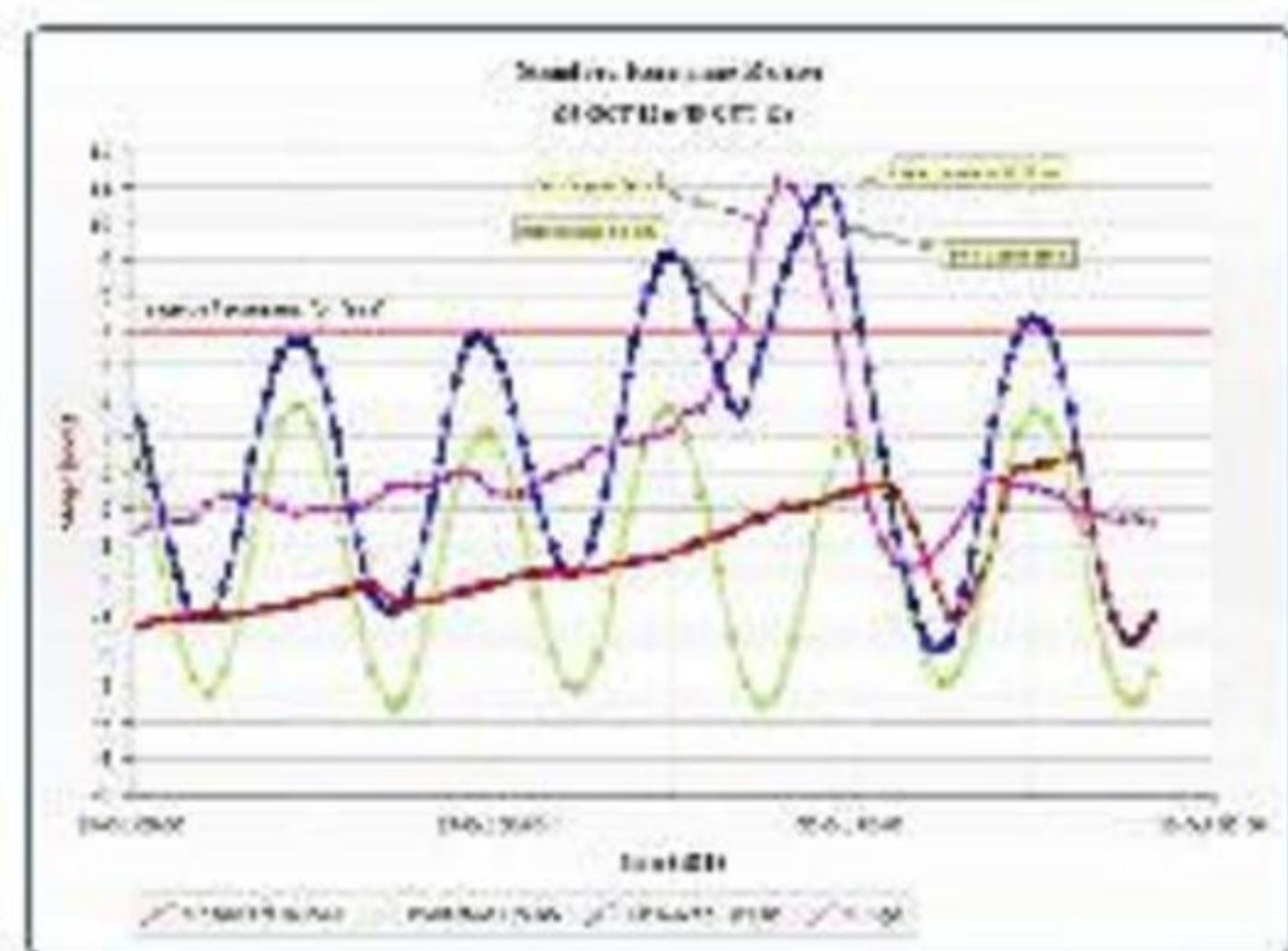
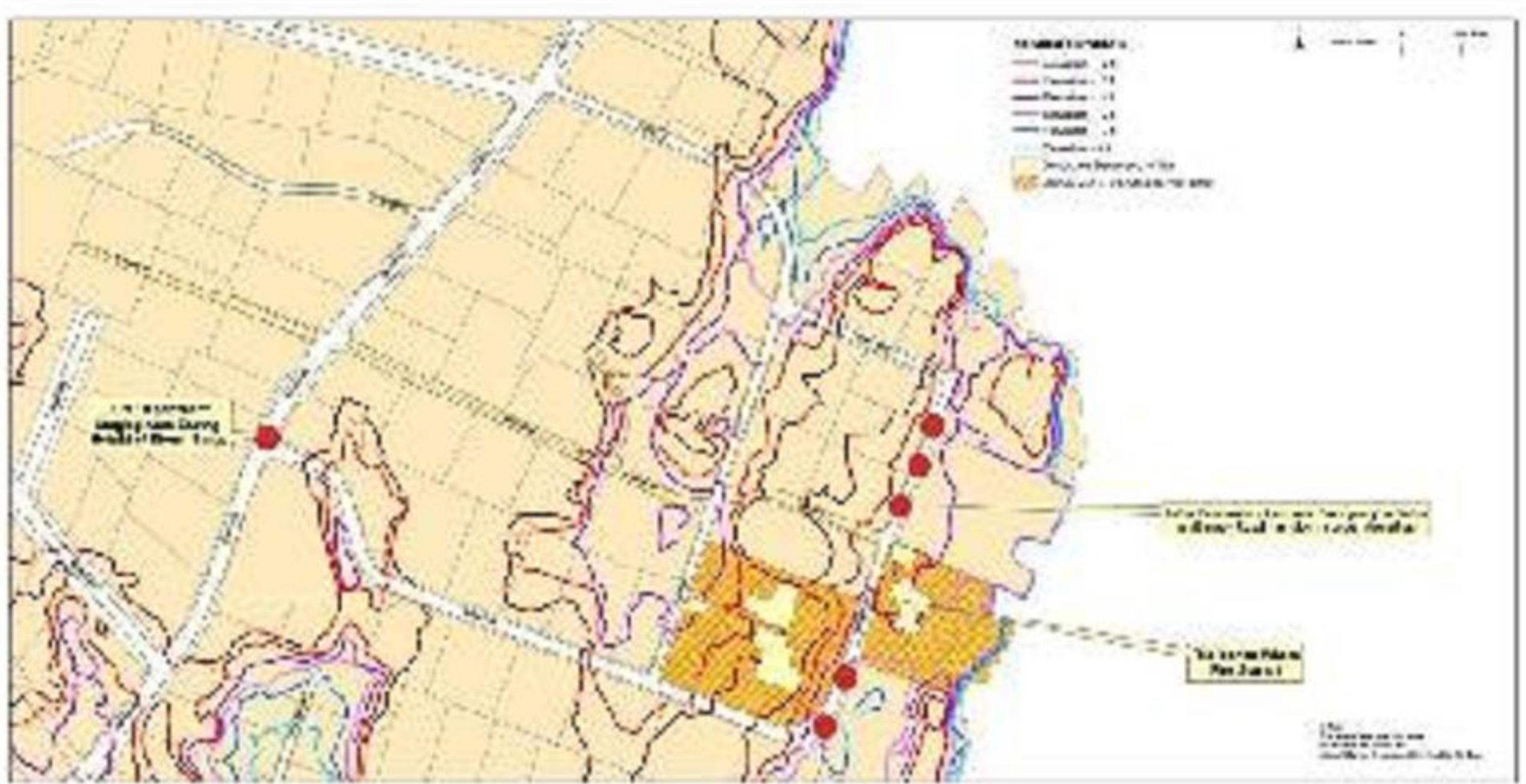
New tools are available to help local governments do a better job of planning, monitoring real time weather events, and educating the public.



Town of Greenwich is working on several different initiatives all aimed at making the Town more resilient. Many of the tools are being used both for emergency response AND planning purposes.

- Creation of database of certificate of elevation for homes in flood prone areas.
- Elevation of homes through Hazard Mitigation Grant Program
- Creating elevation layers on GIS at 1 ft intervals for better planning and use during flood events.
- Using LIDAR to refine catch basin rim elevations in coastal areas.
- Using the GIS with local data for education on sea level rise and severe weather events.
- Installation of stream gage on Byram River for flood and drought monitoring.
- Use of real time gages (USGS, NOAA, etc.) with GIS in the Emergency Operation Center.
- Adoption of new FIRM maps at Base Flood Elevation plus 1'
- Climate Change Adaptation in the Plan of Conservation and Development
- Beginning of inventory of vital infrastructure in our community

Hurricane Sandy - October 29, 2012
Binney Lane Fire - Old Greenwich
Staging Emergency Response



On Monday, October 29, 2012, the Greenwich Fire Department responded to a house fire at 45 Binney Lane in Old Greenwich. The water levels of 4.8 feet just off the height of Binney Lane. Waves were gusting between 7-8 ft high and the storm surge had reached over 6 ft and was continuing. The wave was expected to engulf the coastal buildings over within less than 6 p.m.

At the same time the wave began, the town's emergency operations center (shelters, 12 horses and 2 gages) The fire responded soon followed by staging the associated response teams, crews and power line blocking trucks, and 33 vehicles and two excavators became. The Town used its G-5 Sand Barrier made from the AGC's Seawall Hurricane Barrier to stabilize in the best evacuation route, and an staging area for emergency personnel for the inundated. The town authorities for example, a pump truck to help further to prevent flooding surges out of the older surge.

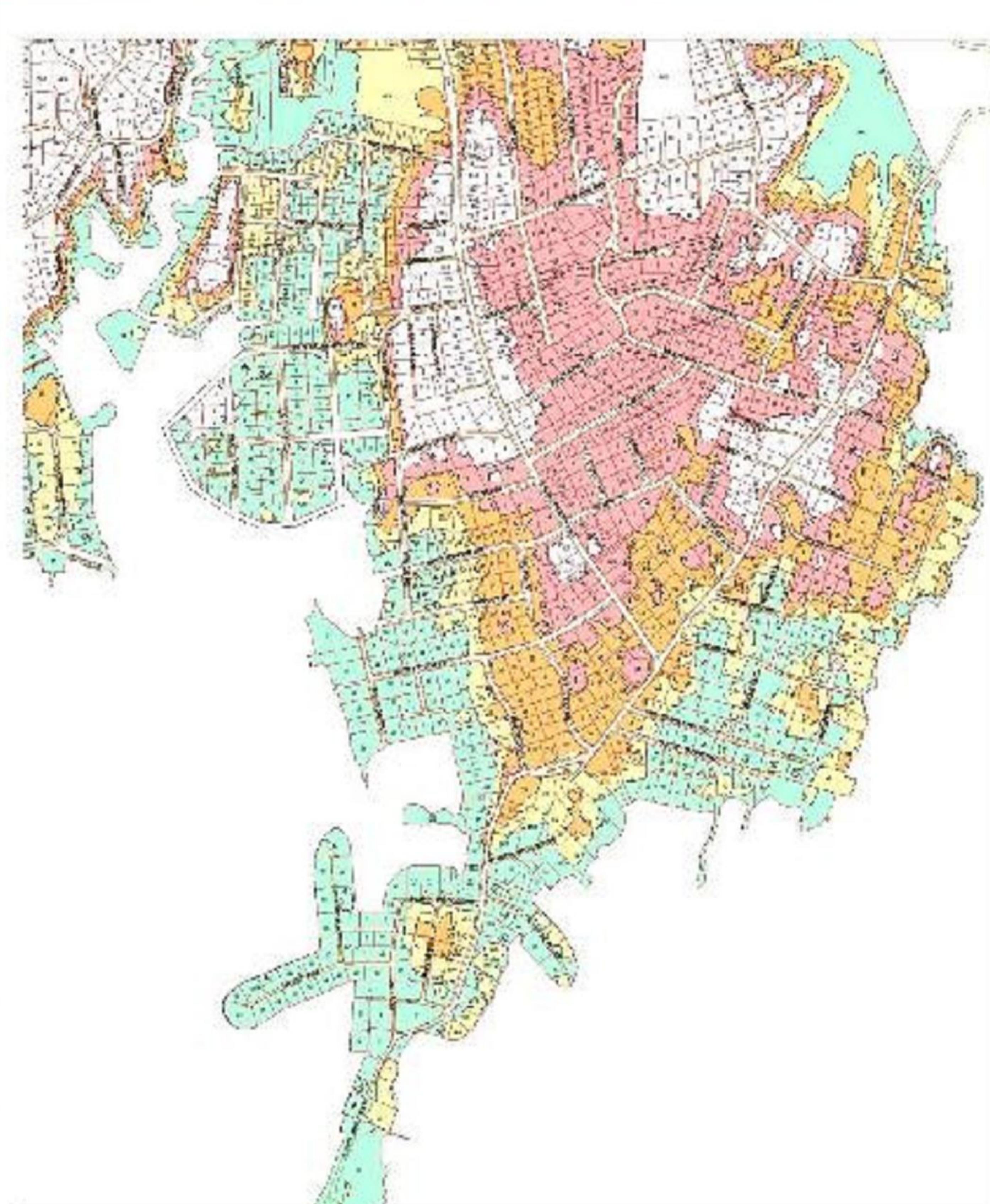
The Town has 24 continuous fire and solid wood elevation system for elevations to 20 ft. This way we could just move the elevators needed to the flooding the entire map. Using this system with information from the storm movement tracking, Emergency Operations Center staff were able to direct the evacuation in different locations. Additionally, historic storm surge data was combined to allow elevations to allow fire personnel to move quickly immediately once the surge and water elevations began flooding.

References:
1. The New York City Seawall Project. 2008. "Tsunami and Hurricane Surge Protection System for the New York City Area." Final Report. New York City Mayor's Office of Emergency Management.
2. USGS. 2012. "Hurricane Sandy: A Preliminary Assessment of Coastal Erosion and Beach Recovery." USGS Open-File Report 2012-1070. Reston, VA: U.S. Geological Survey.

GIS and tidal gages used to direct fire crews during Sandy.

Same GIS layers were used to provide building department officials with water elevations to conduct post-storm audit of properties.

Same GIS used for planning purposes, infrastructure assessment, and to better understand FIRM maps and prepare evacuations maps for future events.

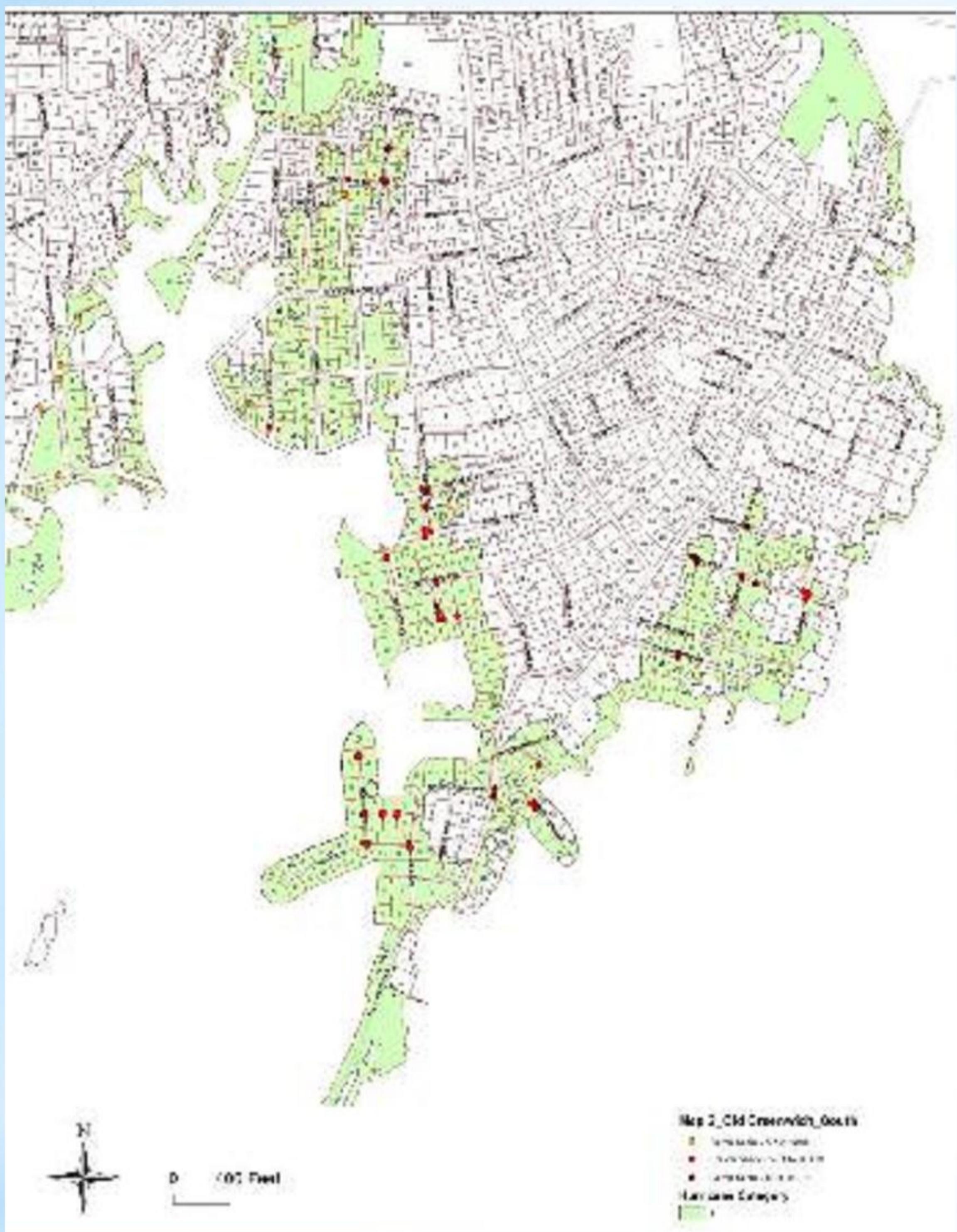


0 400 Feet



HOUSENO	UNIT	STREET	zip_ciy	zipcode	HURR_CAT
2		ARMONK STREET	GREENWICH	06830	1
3		ARMONK STREET	GREENWICH	06830	1
4		ARMONK STREET	GREENWICH	06830	1
0		BAYSIDE TERRACE	RIVERSIDE	06878	1
35		BINNEY LANE	OLD GREENWICH	06870	1
12		RYON ROAD	OLD GREENWICH	06870	1
17		RYON ROAD	OLD GREENWICH	06870	1
32		BUXTON LANDING	RIVERSIDE	06878	1

HOUSENO	STREET	zip_ciy	zipcode	FLOOD_ZONE	HURR_CAT
35	ANDERSON DRVE	GREENWICH	06830		4
35	ANDERSON DRVE	GREENWICH	06830		3
34	ANDERSON ROAD	GREENWICH	06830		3
34	ANDERSON ROAD	GREENWICH	06830		4
34	ANDERSON ROAD	GREENWICH	06830		3
20	ANN STREET	OLD GREENWICH	06870	AE12	3
20	ANN STREET	OLD GREENWICH	06870	AE12	4
20	ANN STREET	OLD GREENWICH	06870	AE12	2
20	ANN STREET	OLD GREENWICH	06870	AE12	4
12	ANN STREET	OLD GREENWICH	06870		3
12	ANN STREET	OLD GREENWICH	06870		2
12	ANN STREET	OLD GREENWICH	06870		4
41	ARCADIA ROAD	OLD GREENWICH	06870		4
41	ARCADIA ROAD	OLD GREENWICH	06870		3
43	ARCADIA ROAD	OLD GREENWICH	06870		3
0	ARCADIA ROAD	OLD GREENWICH	06870		4
0	ARCADIA ROAD	OLD GREENWICH	06870		3
0	ARCADIA ROAD	OLD GREENWICH	06870		4
0	ARCADIA ROAD	OLD GREENWICH	06870		3
0	ARCADIA ROAD	OLD GREENWICH	06870		4

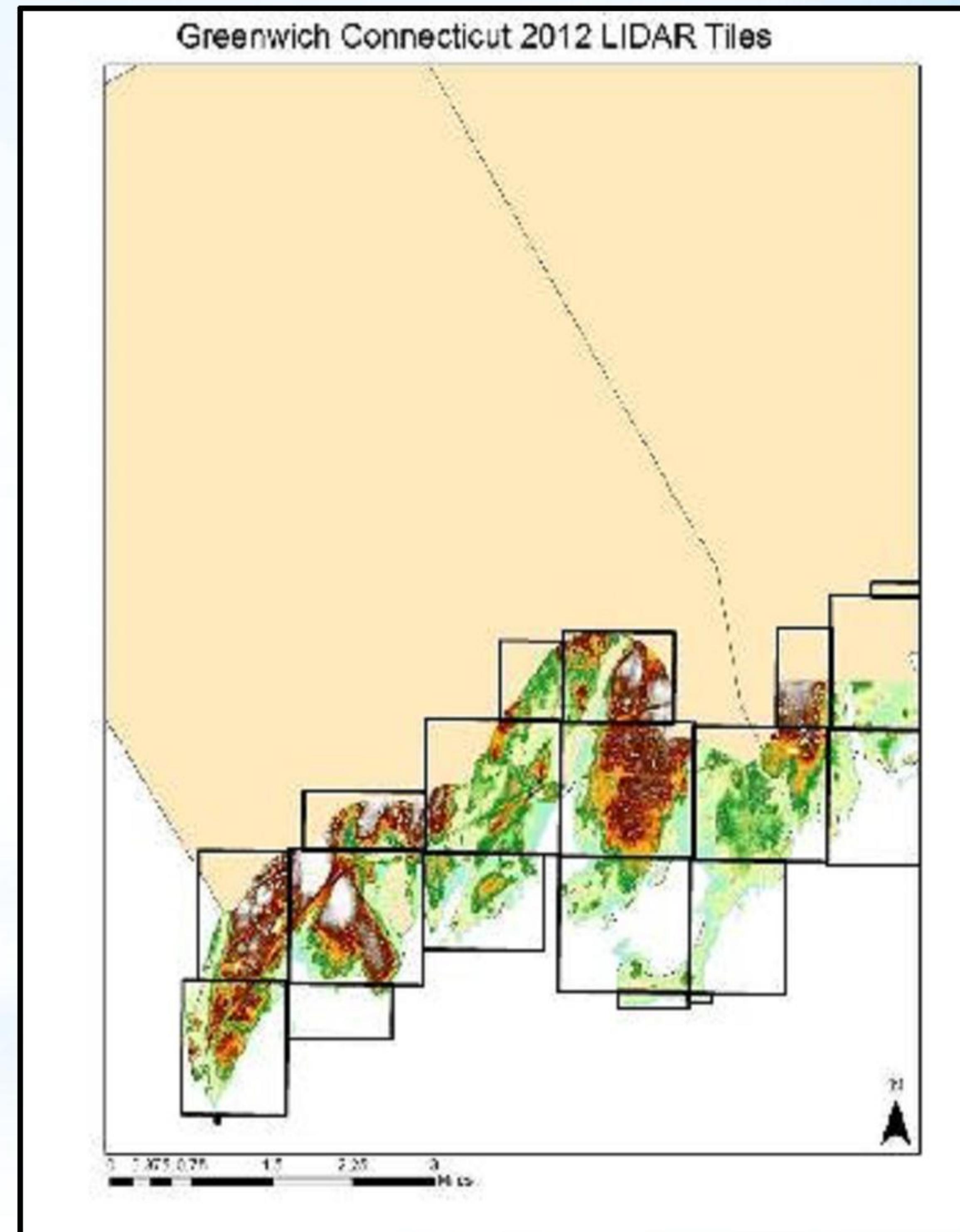


Using the New LIDAR

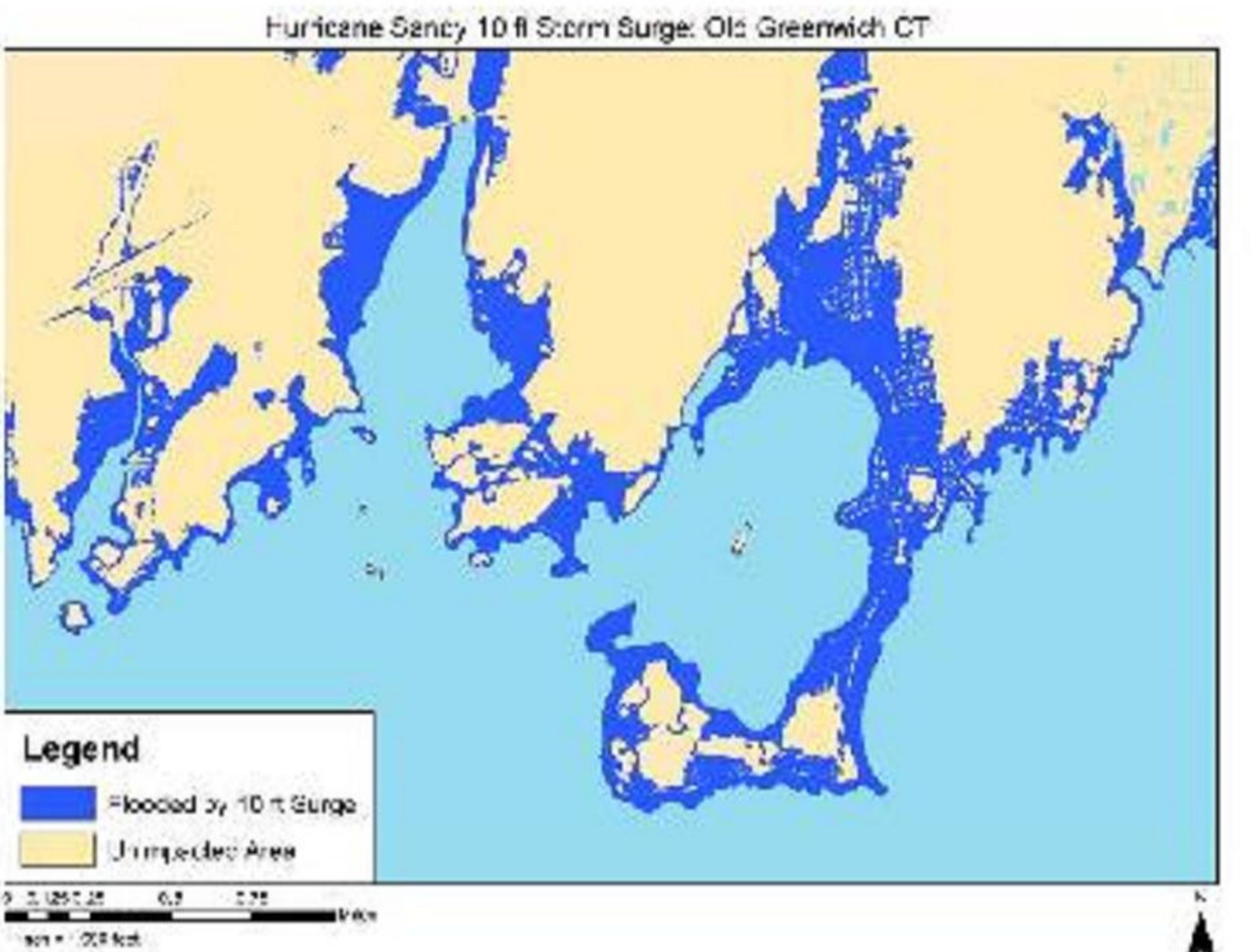
- Free download from:
NOAA Digital Coast website.
- Covers the entire CT coastline.
- Surveys were taken following
Sandy from Nov to Dec 2012
- Data in tiles due to large file
sizes
- Combine tiles into single
coverage: Mosaic tool



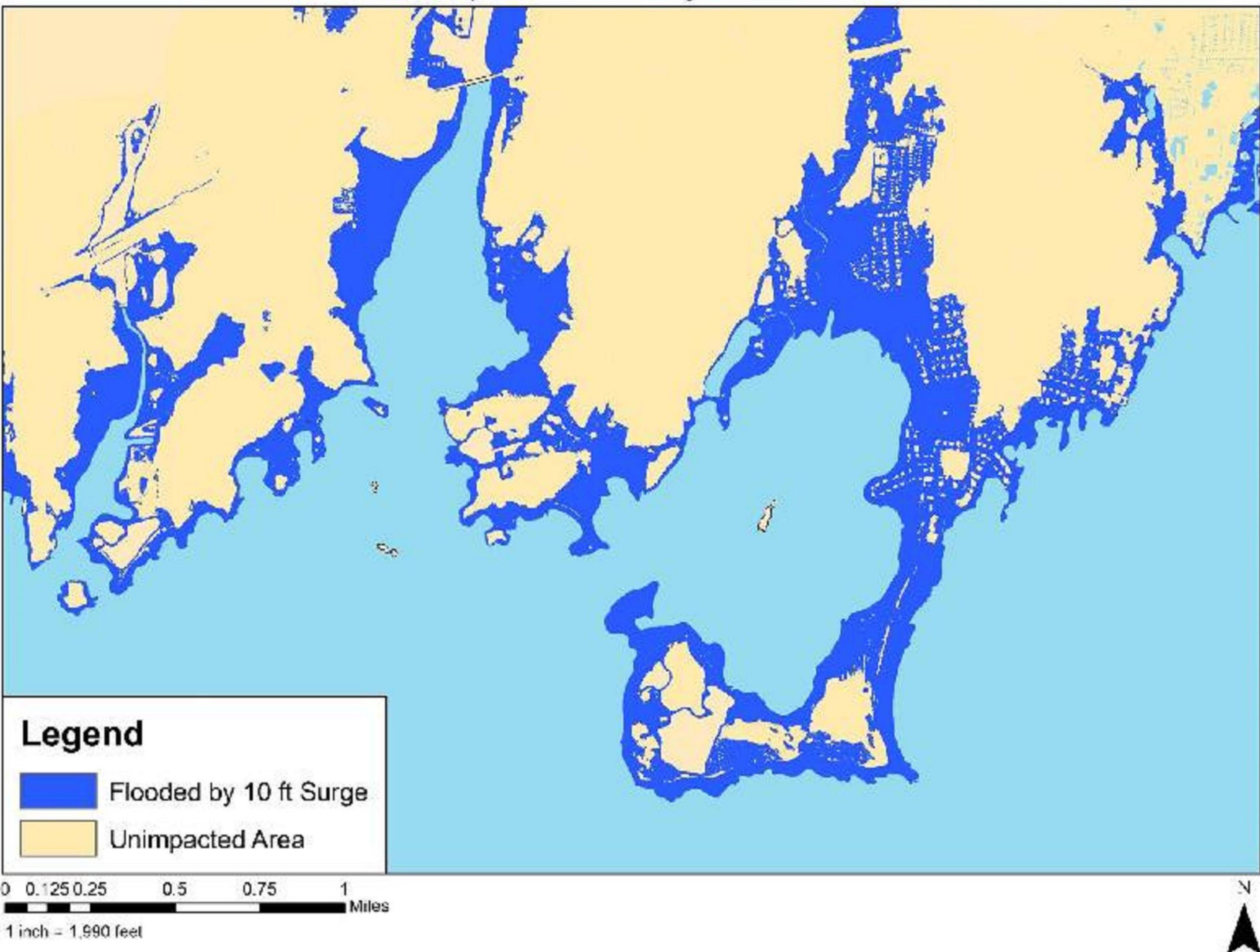
DIGITAL COAST
NOAA COASTAL SERVICES CENTER



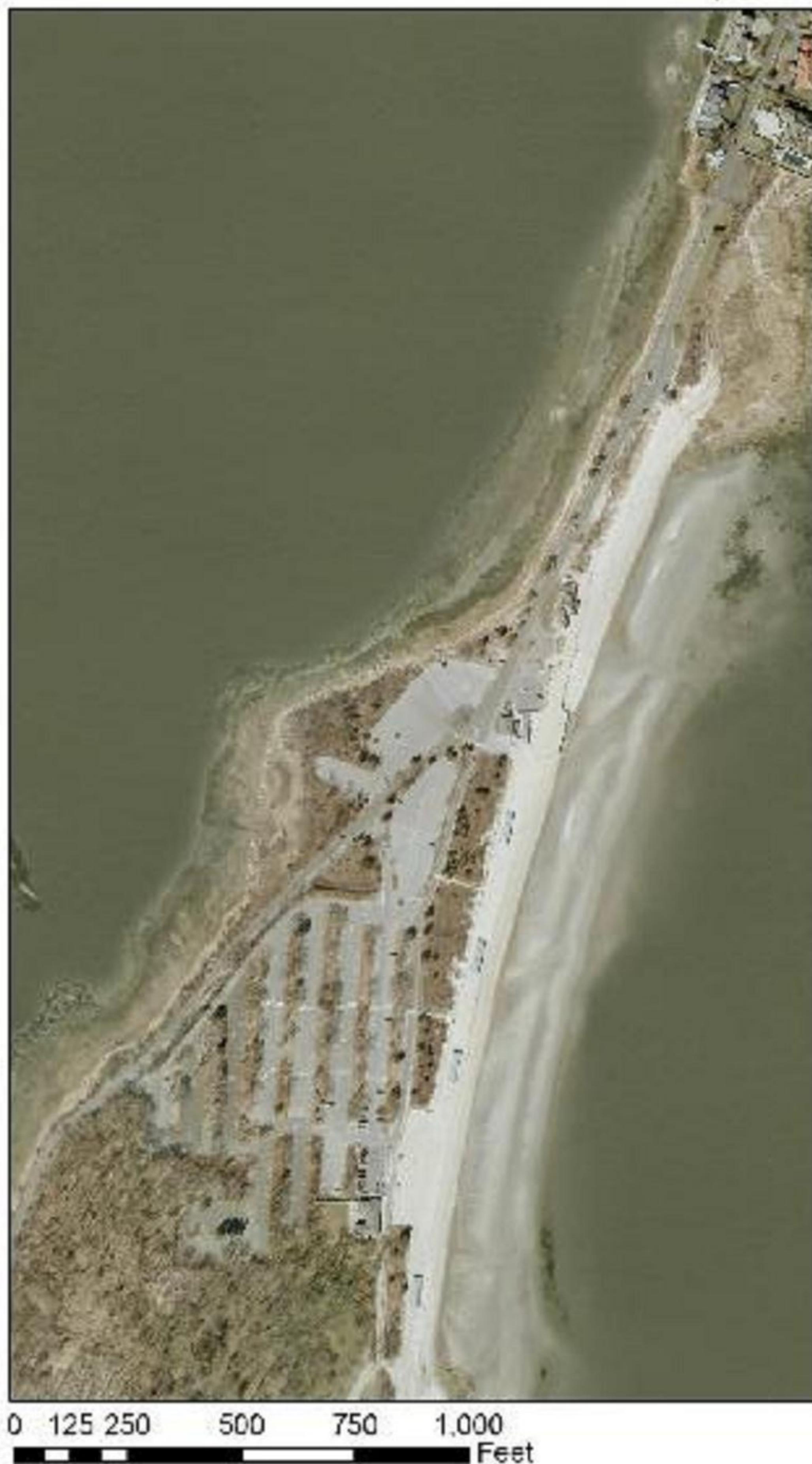
- High resolution: 2ft cell size
- TOG's current DEM: 25ft cell size
- Buildings are omitted:
Shown as No Data
- Allows better visualization of coastal flooding
- Elevation data reflects infrastructure and buildings



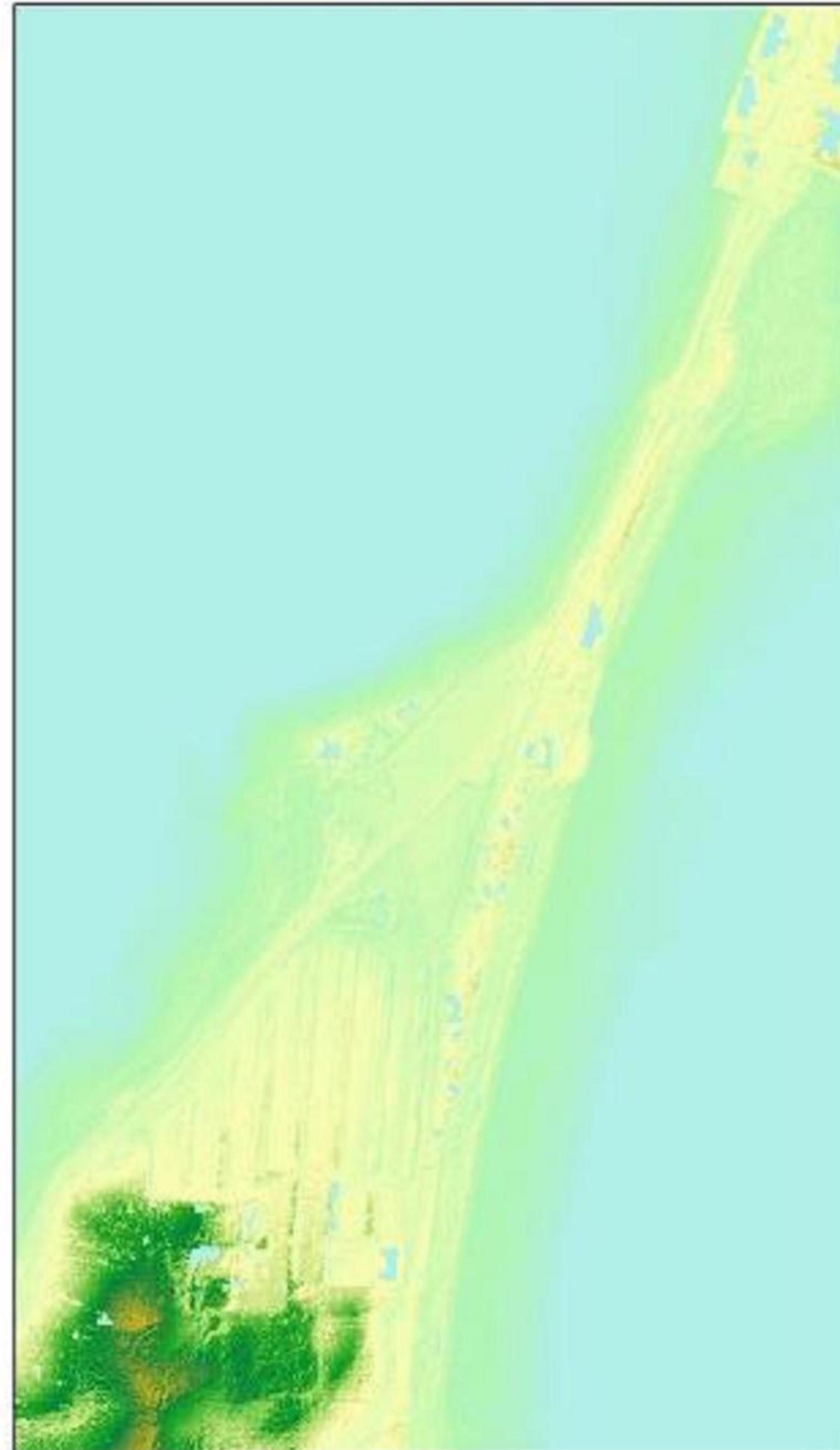
Hurricane Sandy 10 ft Storm Surge: Old Greenwich CT



LIDAR Comparison Greenwich Point Greenwich CT



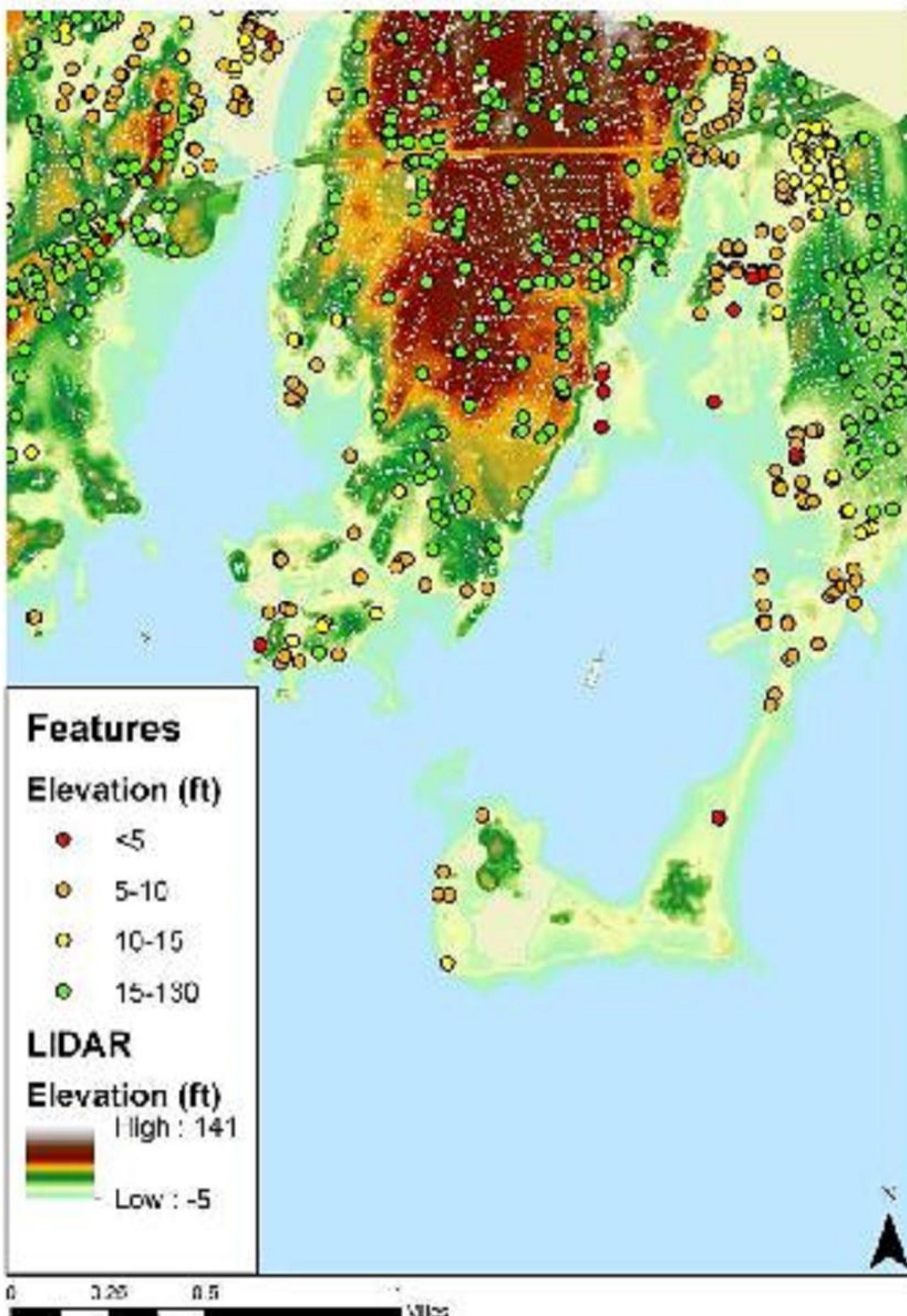
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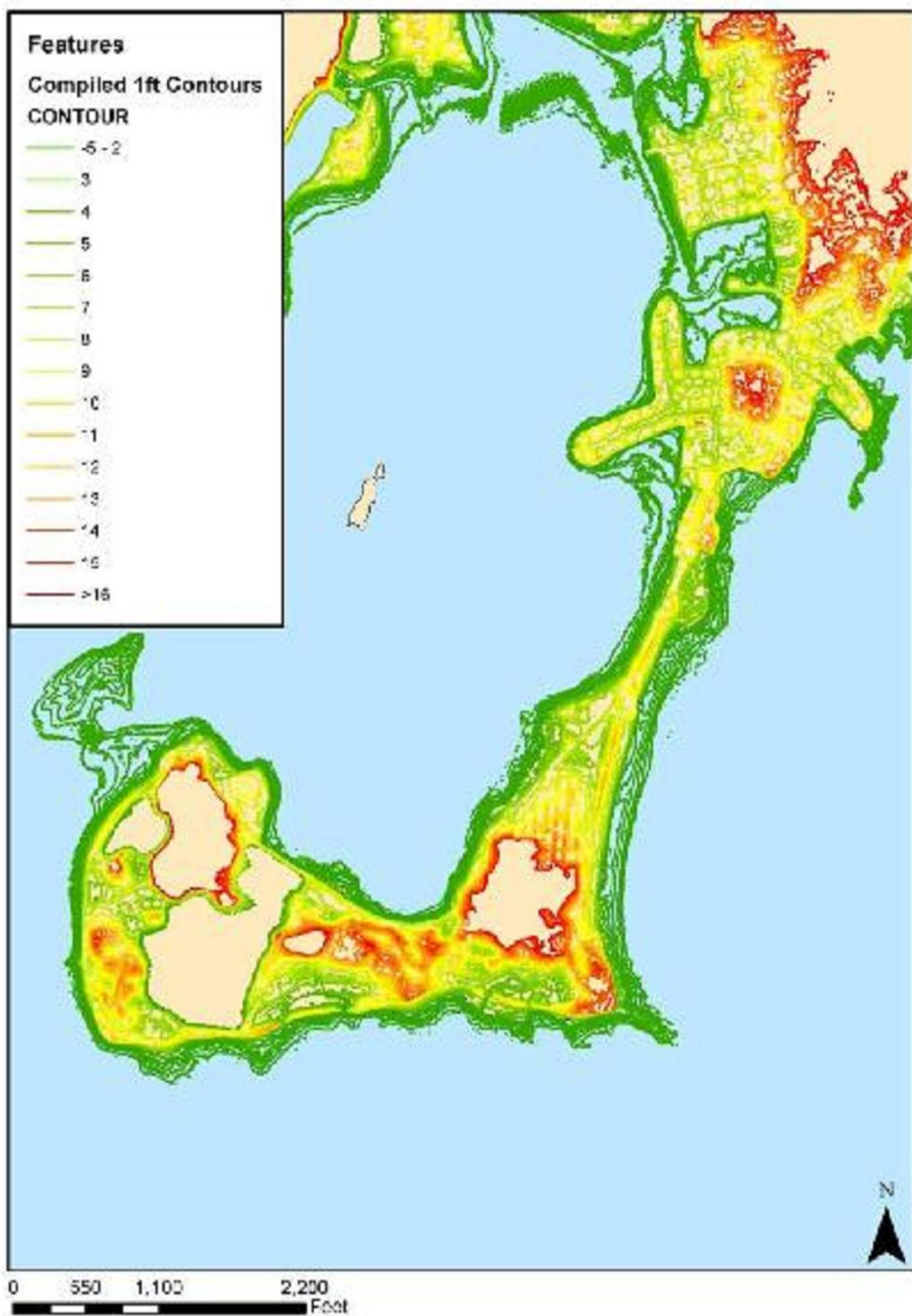
Legend
LIDAR Elevation
Elevation (ft)
High : 141.404
Low : -5.1725

- Generate 1 ft contour lines
- Refine visualization of flooding impacts:
 - Visualize impacts based on real time gauge data
 - Aids in Emergency Planning/Response
- Estimate elevation of infrastructure based on GPS coordinates:
 - Extract value by points tool
 - Catch basins
 - Buildings
 - Roads

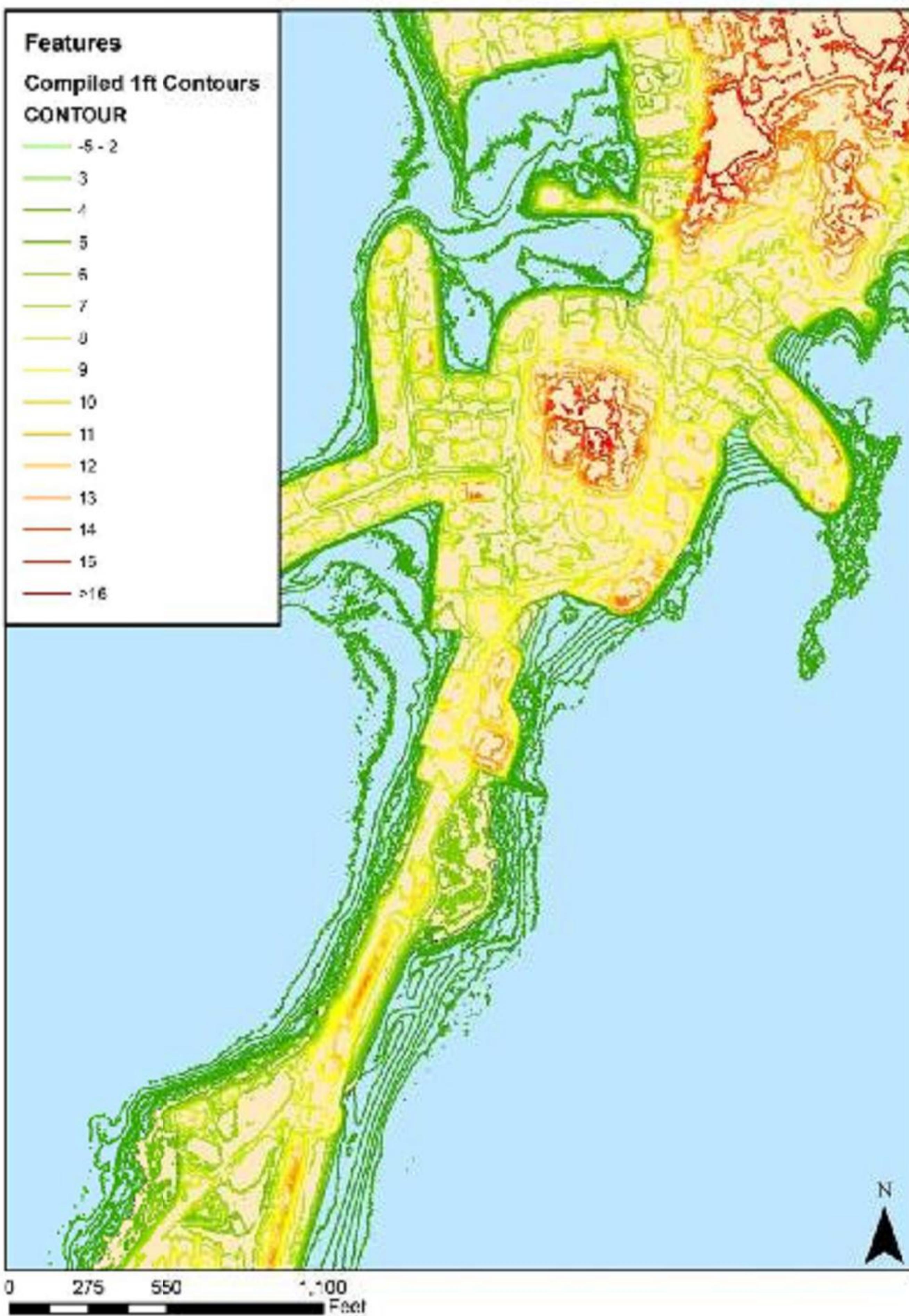
Catch Basins: Old Greenwich and Riverside CT



1 ft Contours Greenwich Point: Greenwich CT



1 ft Contours Greenwich Point: Greenwich CT





0
1
750 feet

■ 1934 Connecticut Aerial Photography

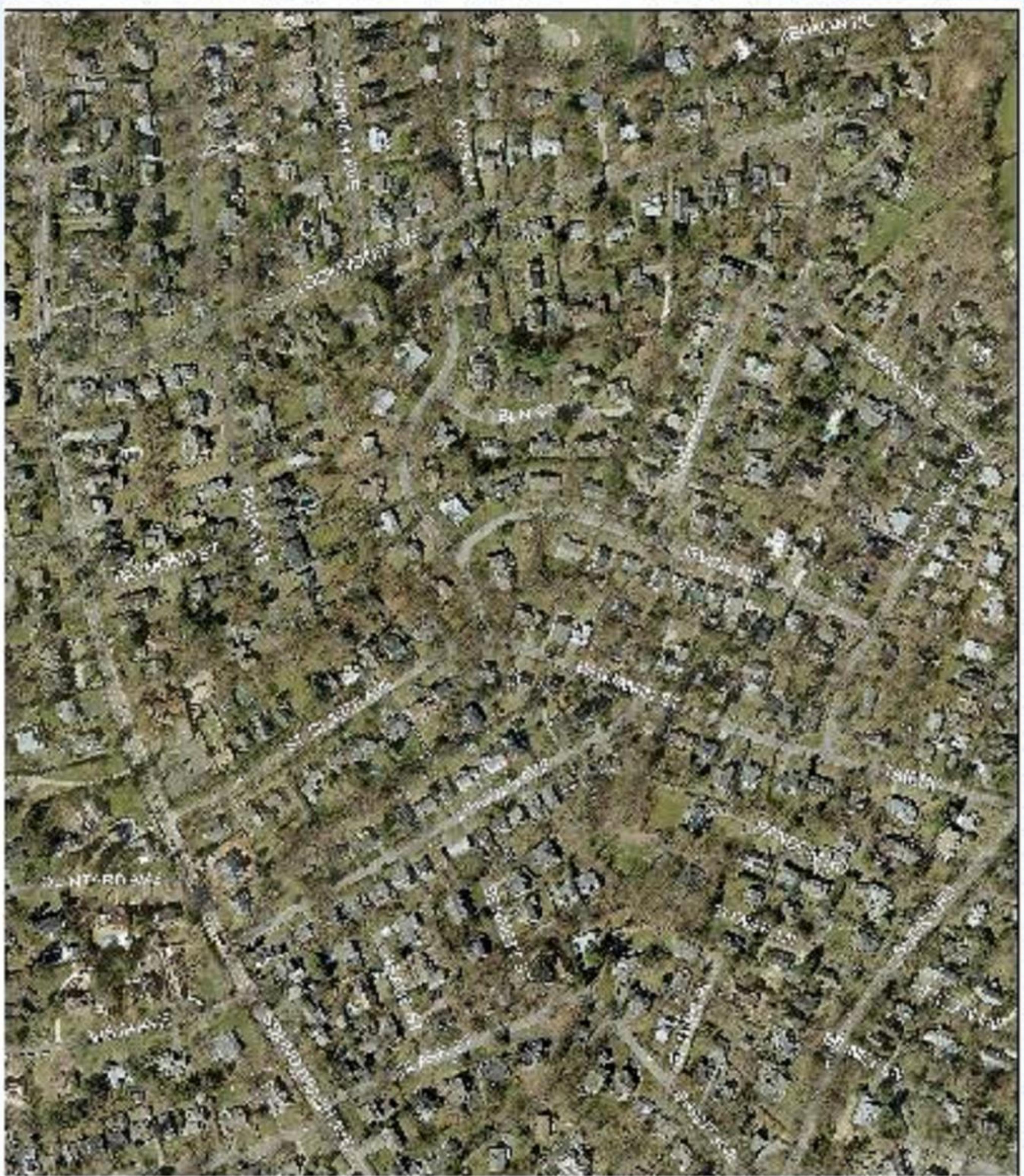


0
1
750 feet

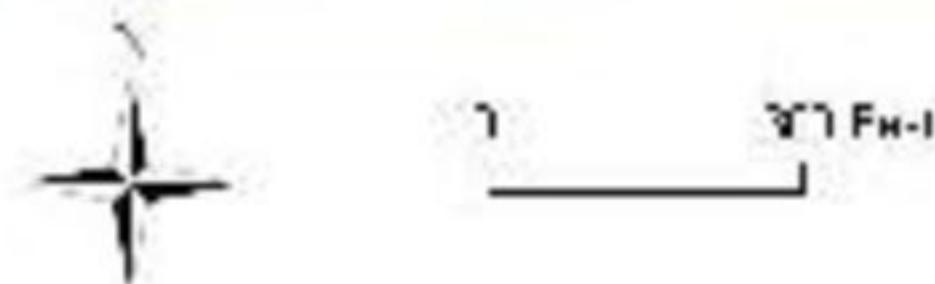
Old Greenwich 2008



1934 Aerial of
Section of Old Greenwich



2008 Aerial of
Section of Old Greenwich



Note drainage ditches in wetlands in 1934 aerial. 2008 photo indicates area is now developed.

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