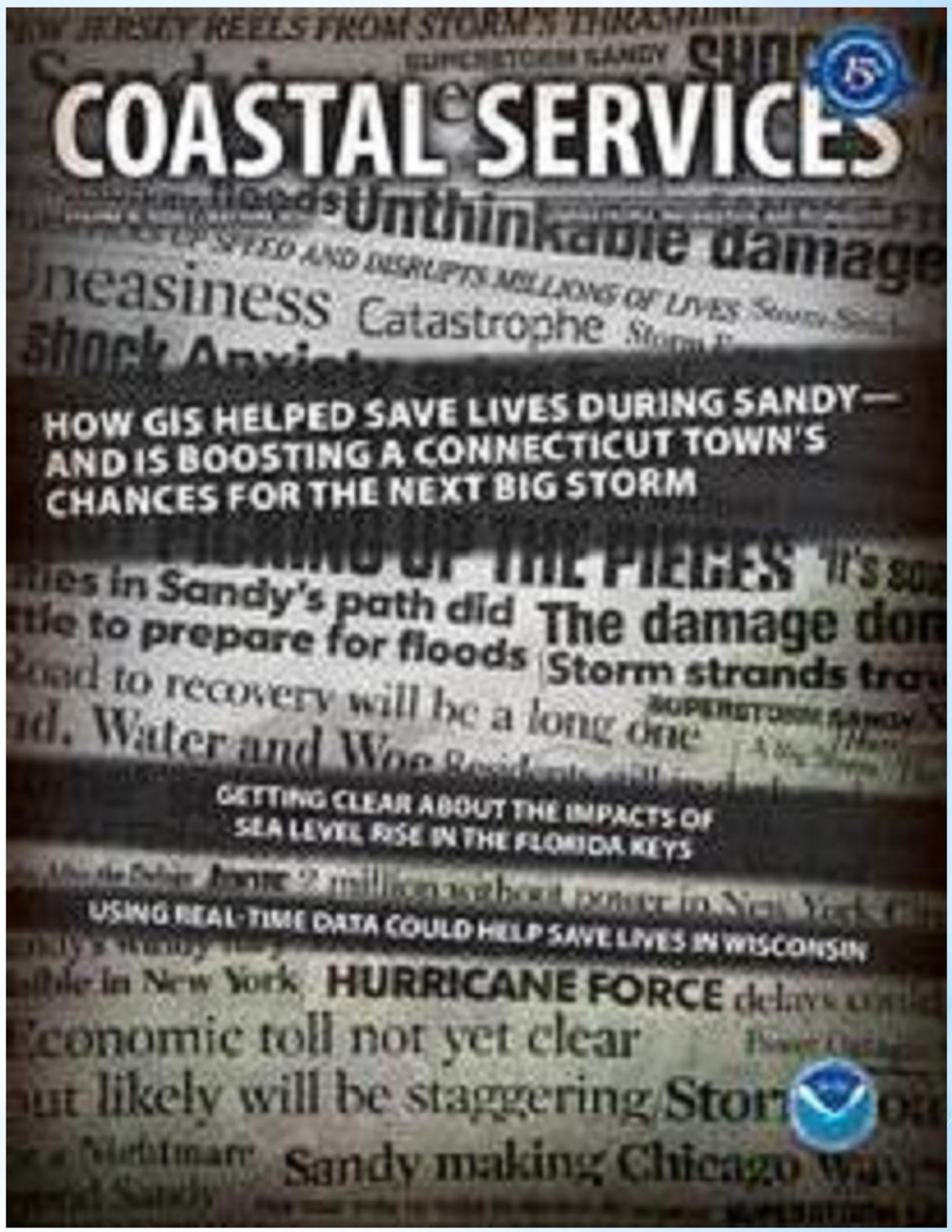
On the Front Line:

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



Presented by:

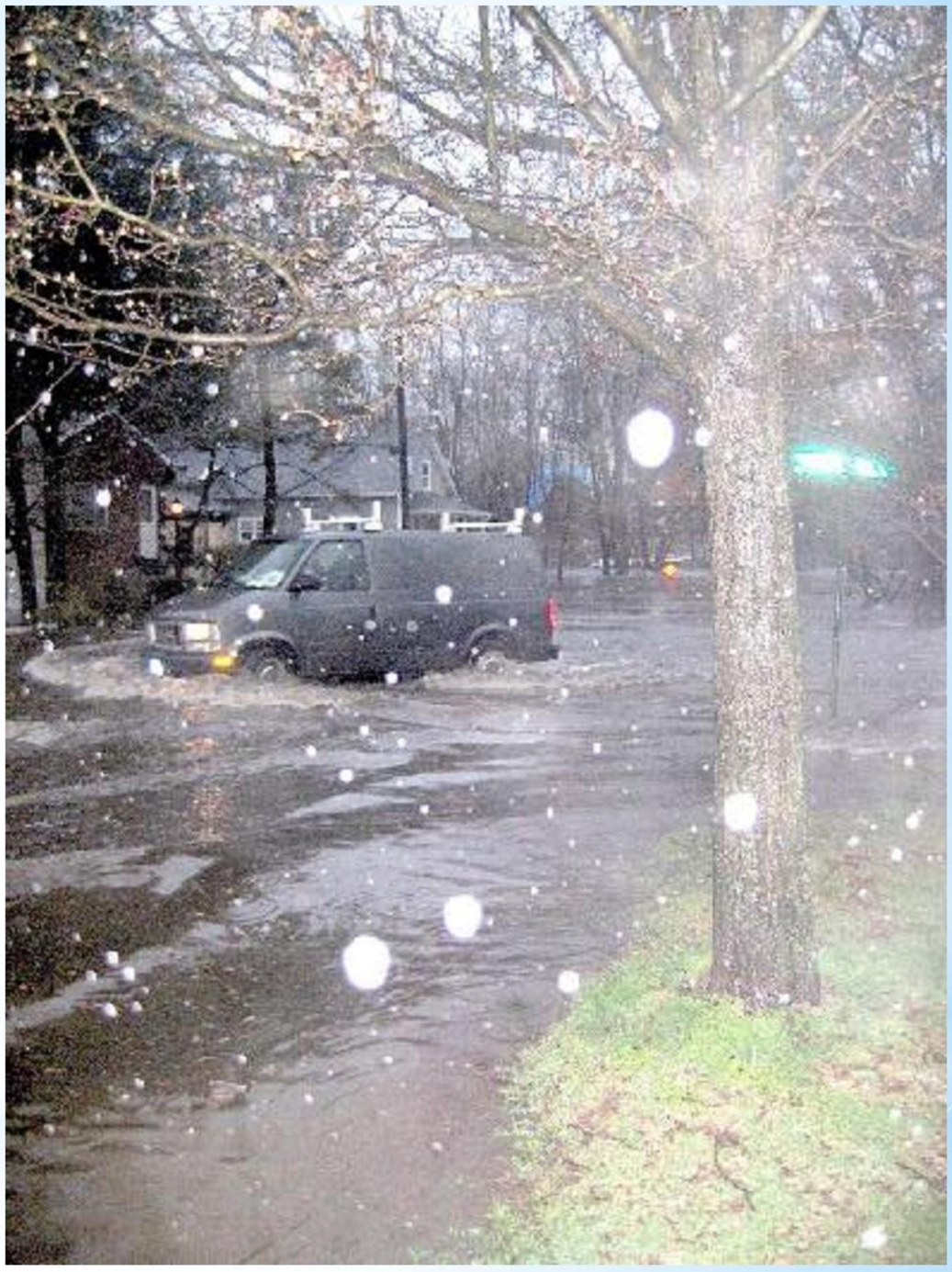
Denise Savageau
Conservation Director
Town of Greenwich

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

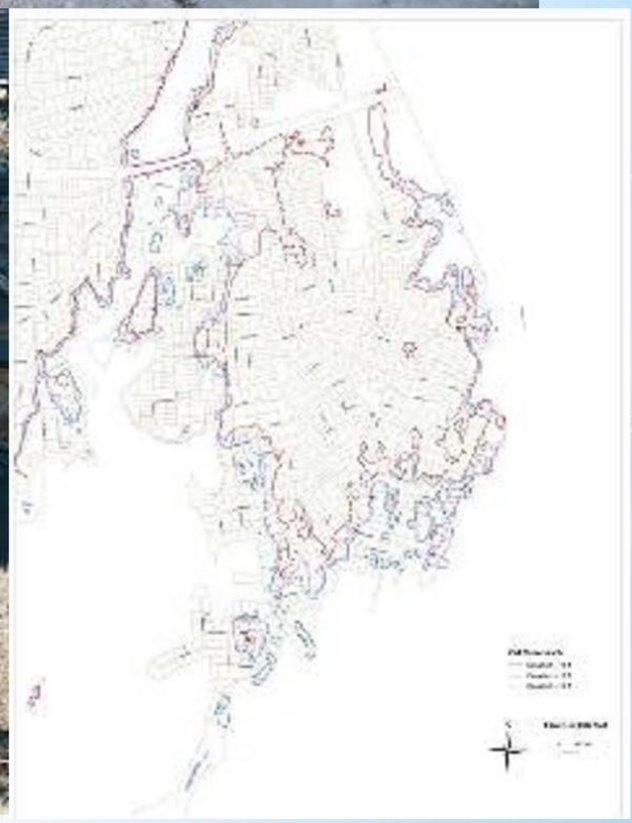
1. Expanding roles of land use planners in Emergency Preparedness and Response including Emergency Operation Centers

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**



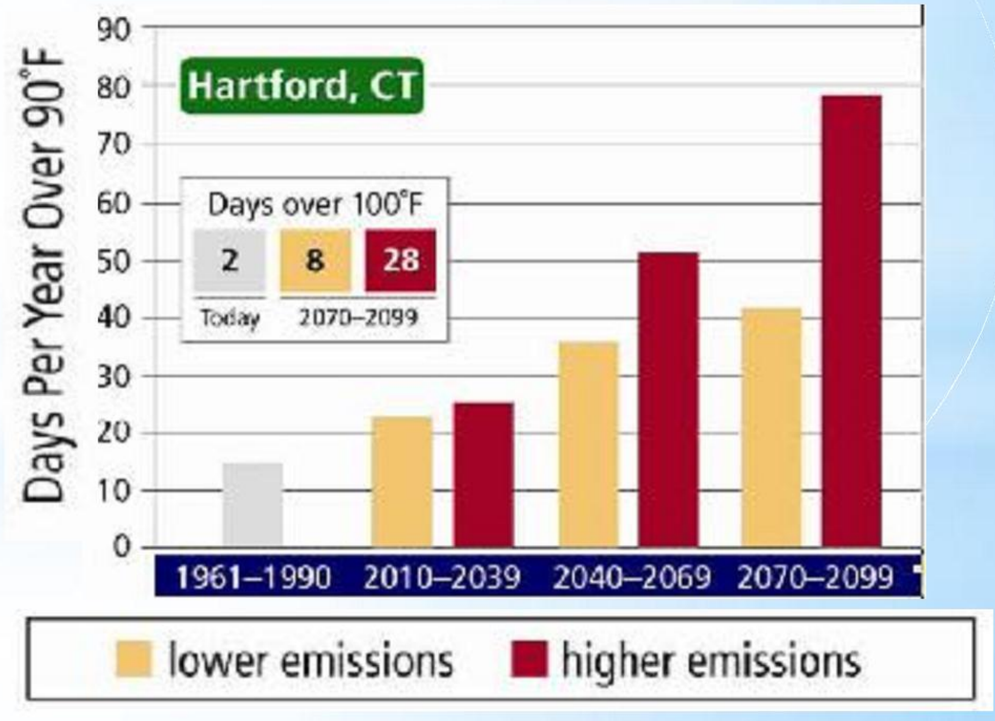
One of the biggest challenges …

… 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.

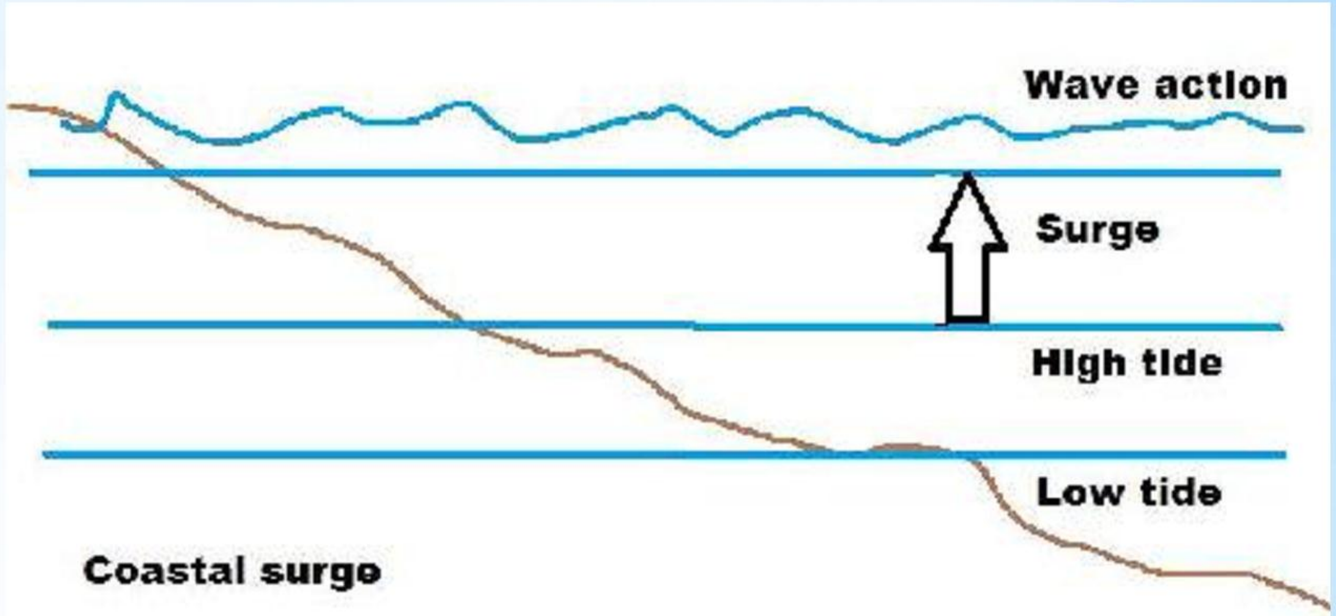
Connecticut River after Hurricane Irene



In Yohe and Cole 2007 Presentation of NECIA 2007 Data

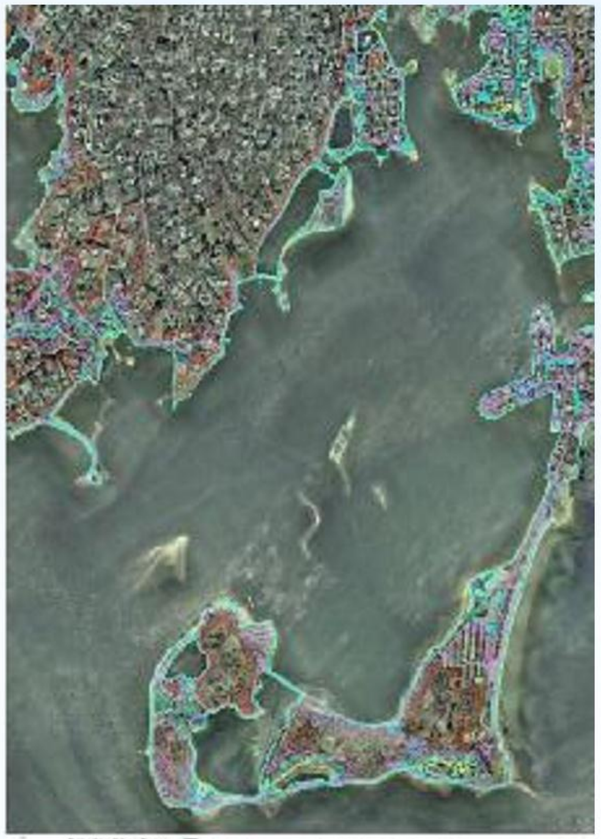
Understanding Storm Surge

- The storm surge is the difference between the actual recorded water elevation and the predicted water elevation (predicted tide).

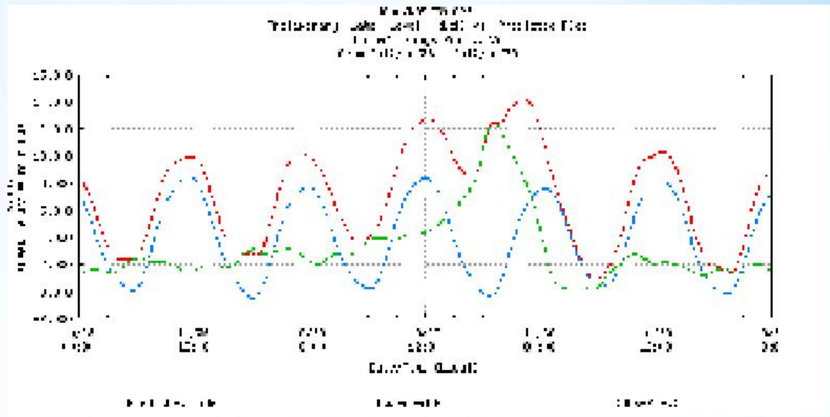


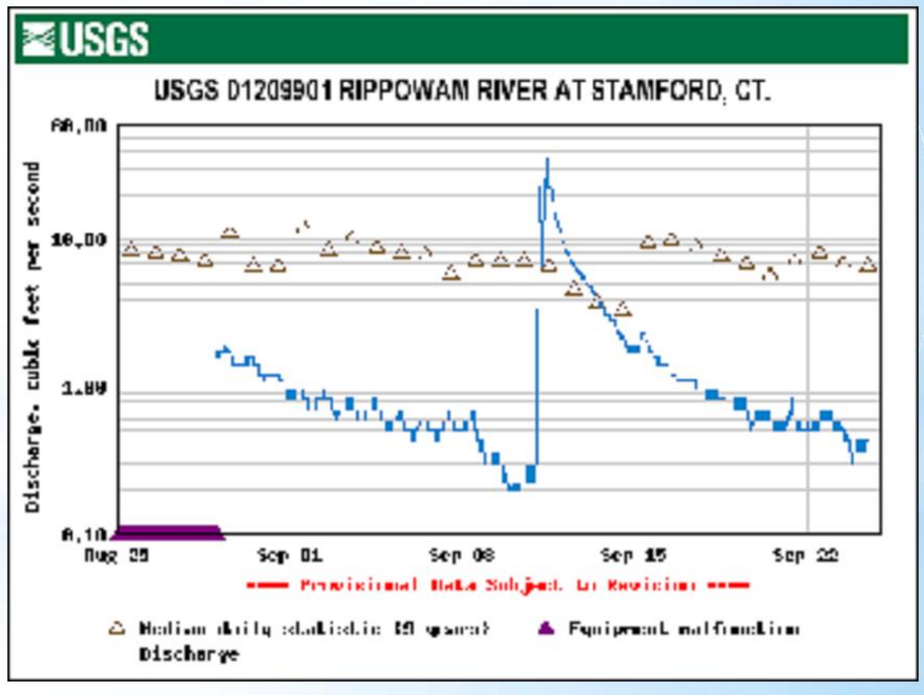
- Surge heights are measured at still water and do not take wave action (surf) into account.
- A storm surge is NOT a big wave or tsunami-type event.
- During a storm event, the highest water elevation recorded does not necessarily occur when the surge is the highest. It depends on the timing of the 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.



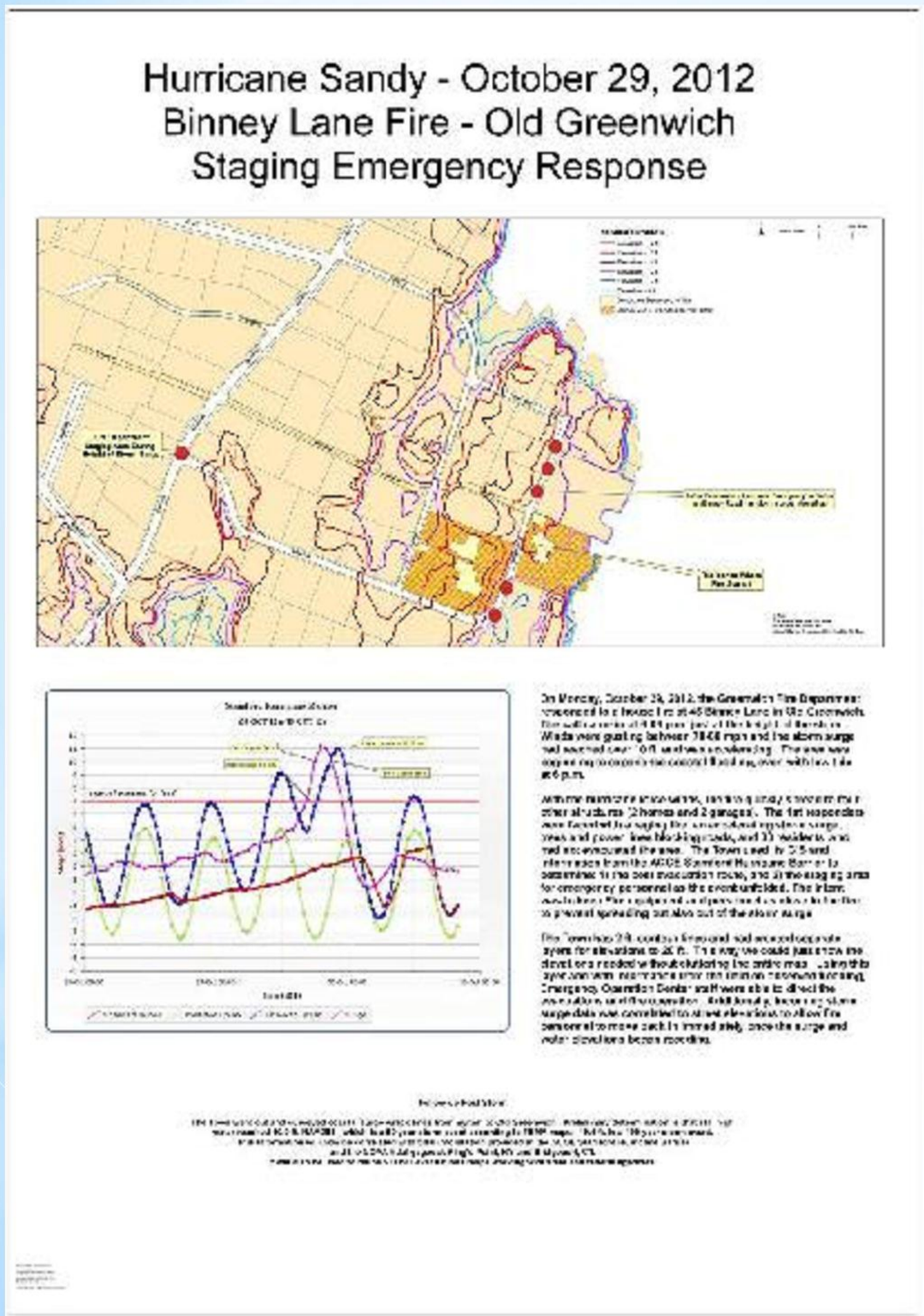
DIGITAL COAST
NOAA COASTAL SERVICES CENTER





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

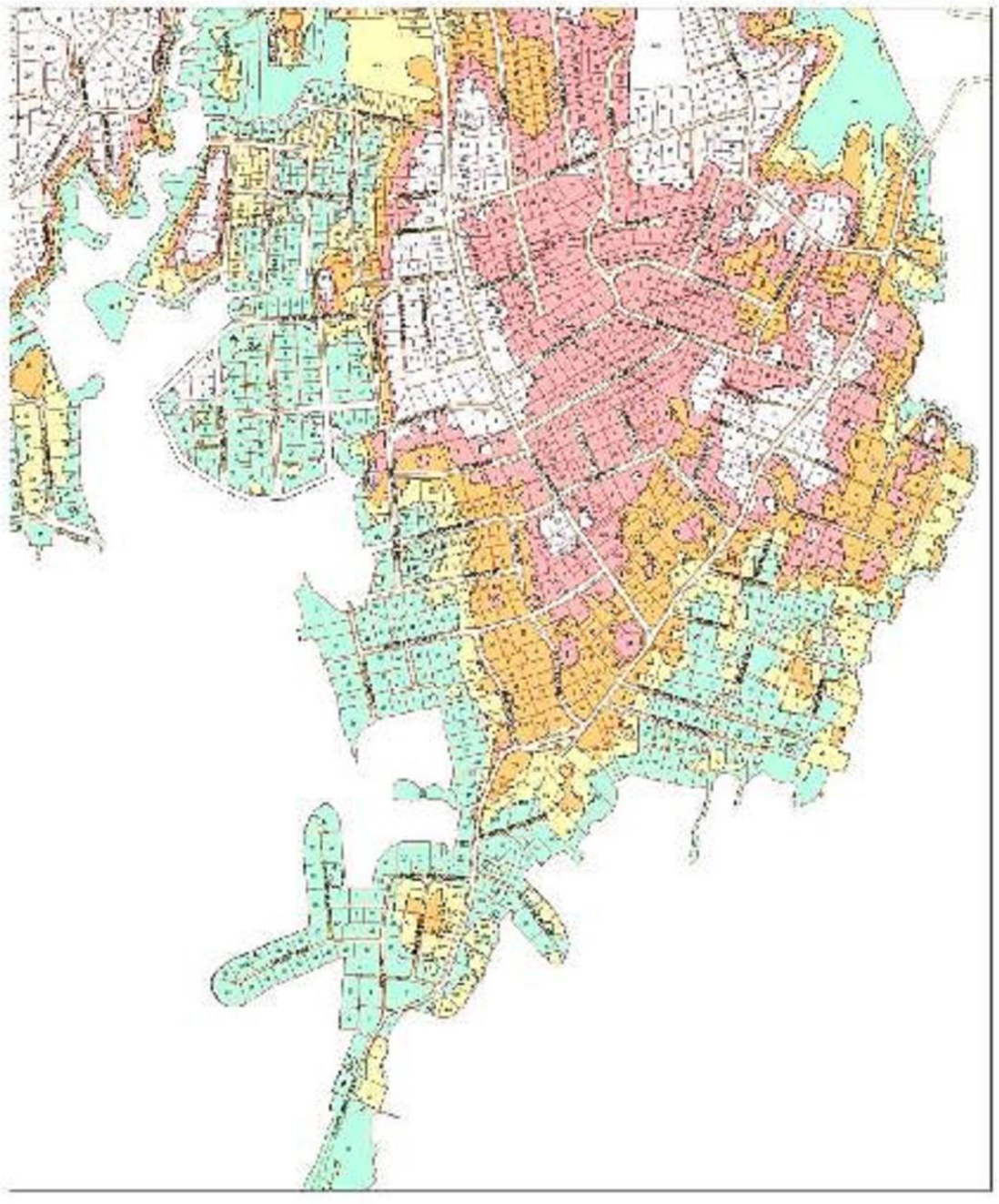
- Creation of database of certificate of elevation for homes in flood prone areas.
- Elevation of homes through Hazard Mitigation Grant Program
- Creating elevation layers on GIS at 1 ft intervals for better planning and use during flood events.
- Using LIDAR to refine catch basin rim elevations in coastal 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



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.



HOUSENO	UNIT	STREET	zip_city	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		BRYON ROAD	OLD GREENWICH	06870	1
17		BRYON ROAD	OLD GREENWICH	06870	1
32		BUXTON LANDING	RIVERSIDE	06878	1

HOUSENO	STREET	zip_city	zipcode	FLOOD_ZONE	HURR_CAT
35	ANDERSON DRIVE	GREENWICH	06830		4
35	ANDERSON DRIVE	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		4
43	ARCADIA ROAD	OLD GREENWICH	06870		4
0	ARCADIA ROAD	OLD GREENWICH	06870		4
0	ARCADIA ROAD	OLD GREENWICH	06870		4
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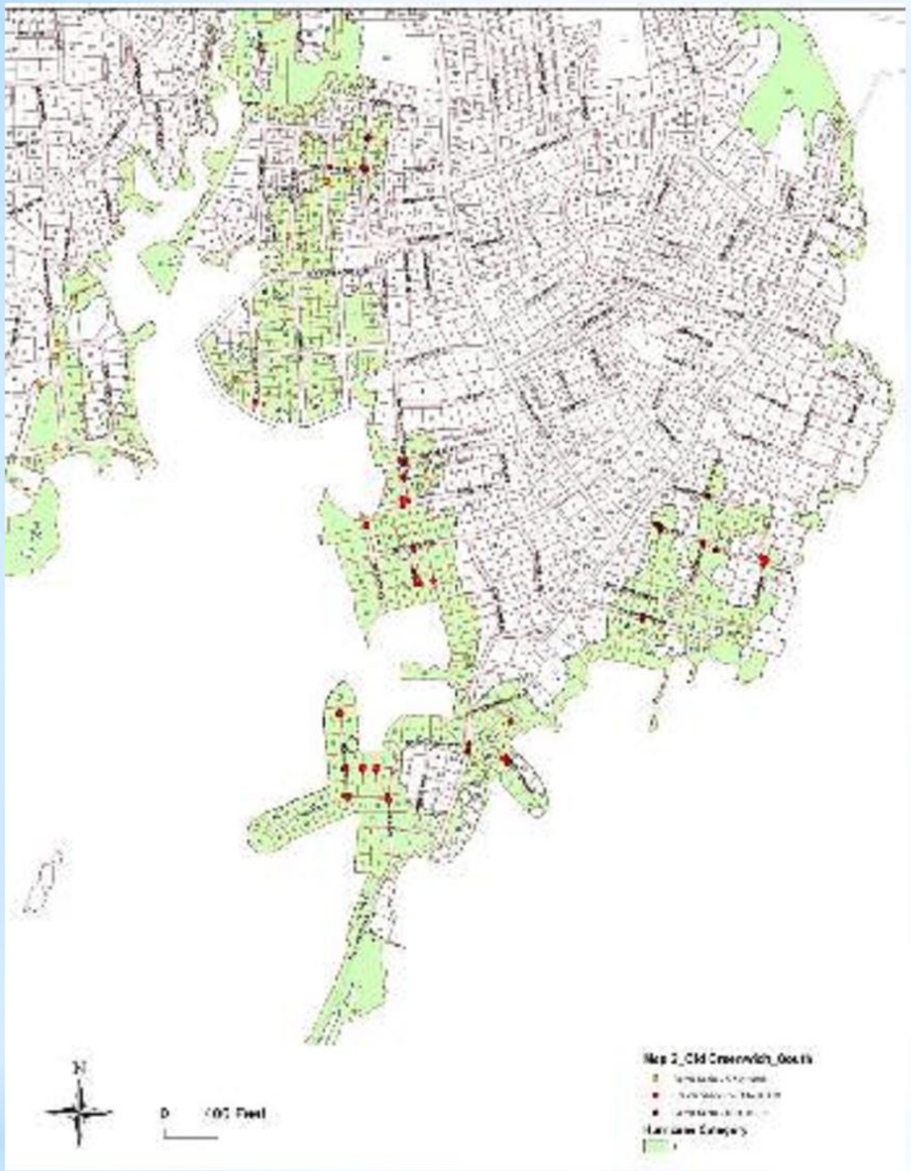
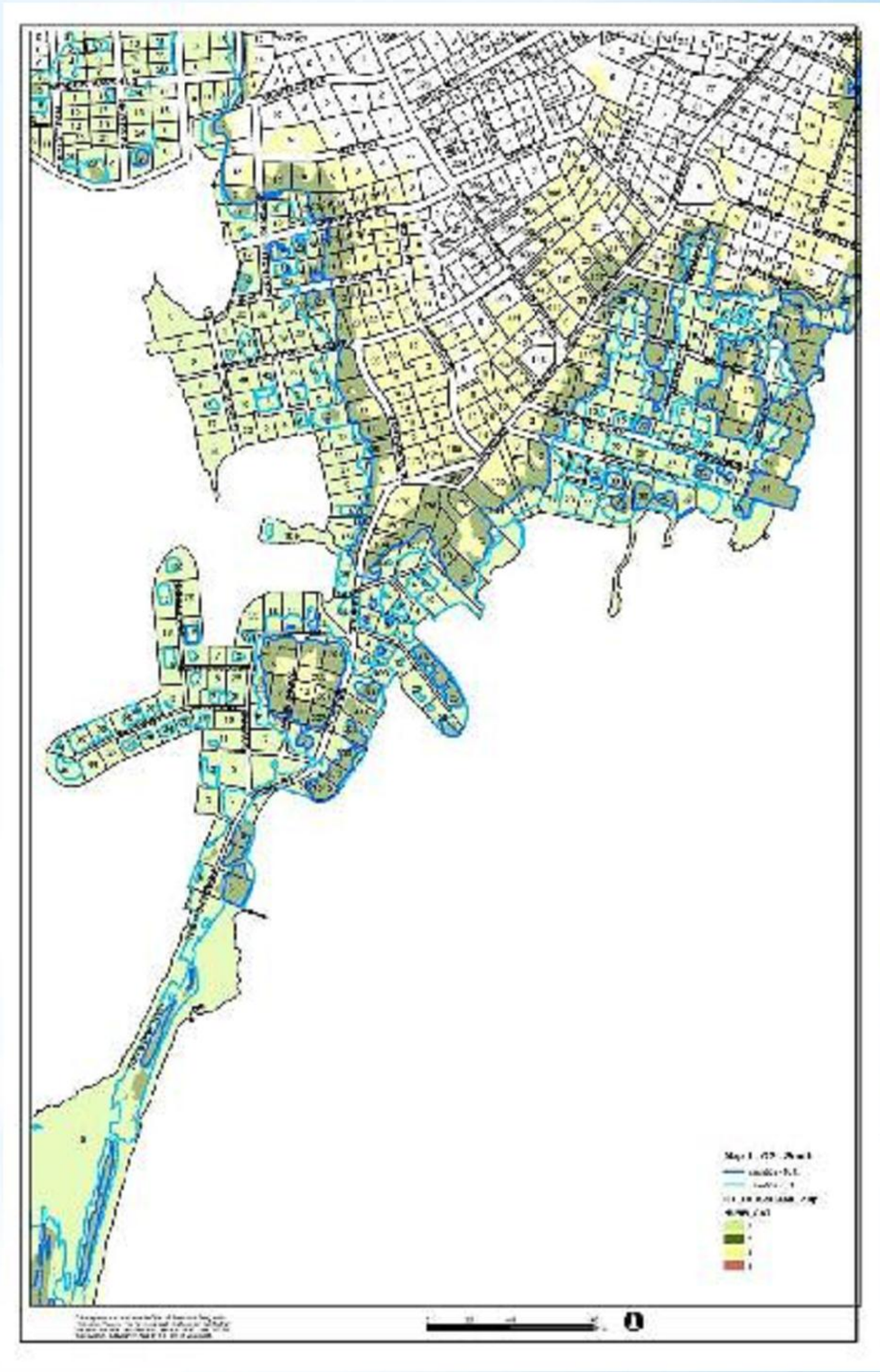


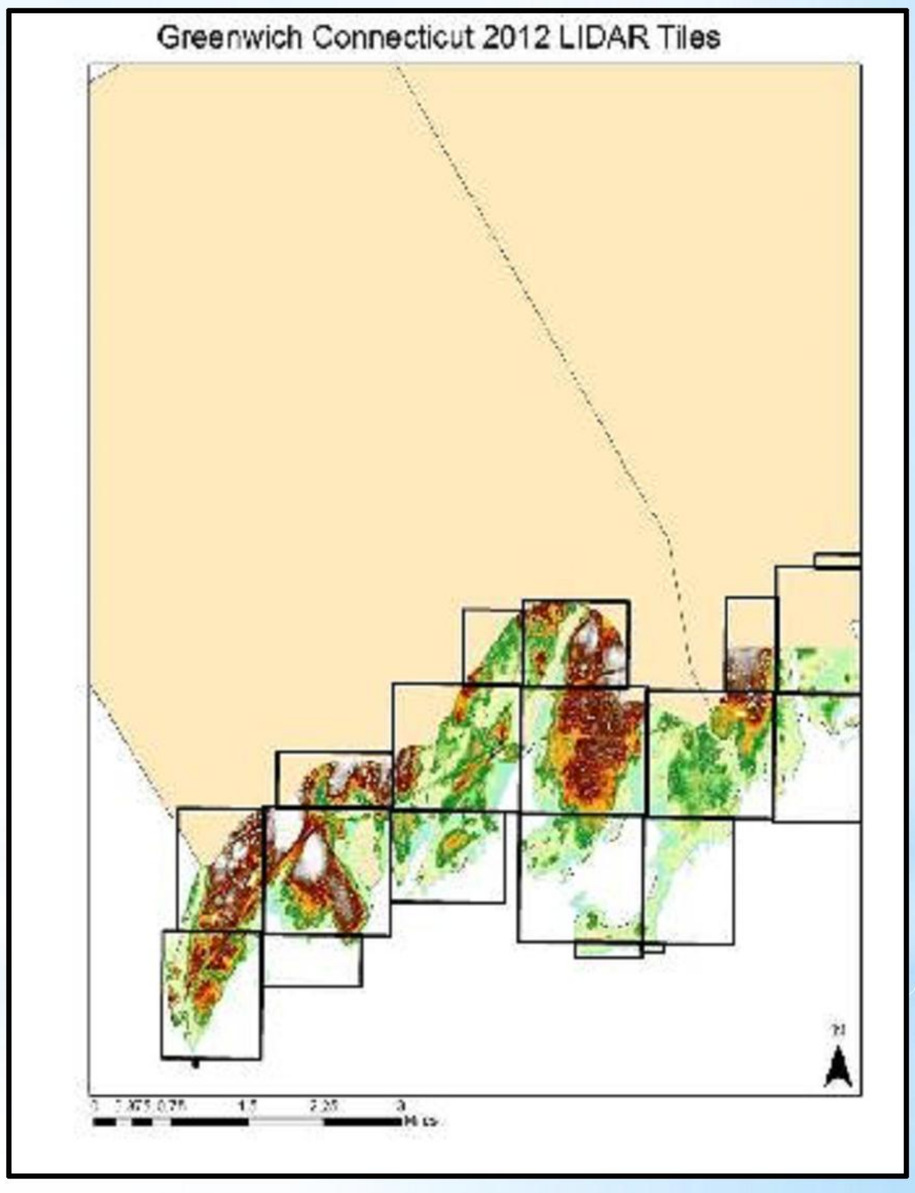


Date	High tide time	Predicted water elevation - NAVD
Wednesday, January 01, 2014	10:42 AM	4.7 ft
Wednesday, January 01, 2014	11:16 PM	3.8 ft
Thursday, January 02, 2014	11:35 AM	4.7 ft
Friday, January 03, 2014	12:08 AM	4.0 ft
Friday, January 03, 2014	12:26 PM	4.6 ft
Saturday, January 04, 2014	1:00 AM	4.1 ft

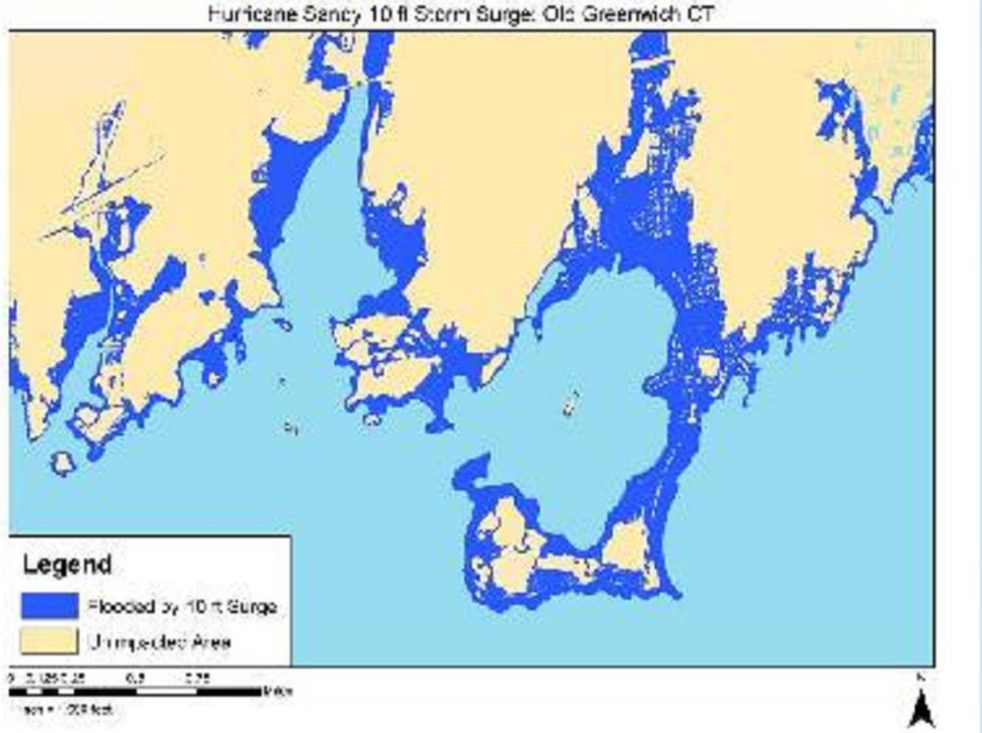
Using the New LIDAR

DIGITAL COAST
NOAA COASTAL SERVICES CENTER

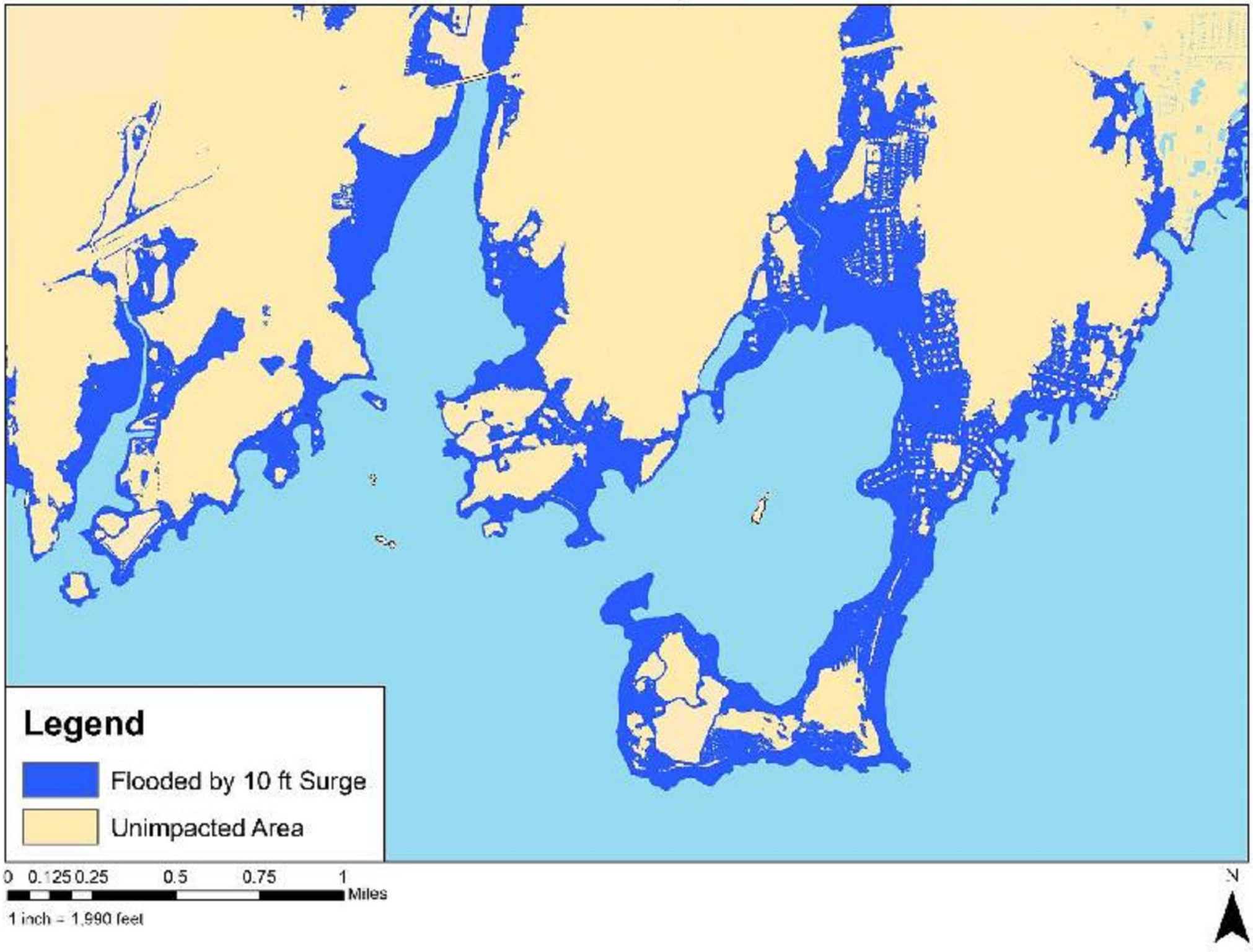
- Free download from: **NOAA Digital Coast website**.
- Covers the entire CT coastline.
- Surveys were taken following Sandy from Nov to Dec 2012
- Data in tiles due to large file sizes
- Combine tiles into single coverage: **Mosaic tool**



- 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

Legend

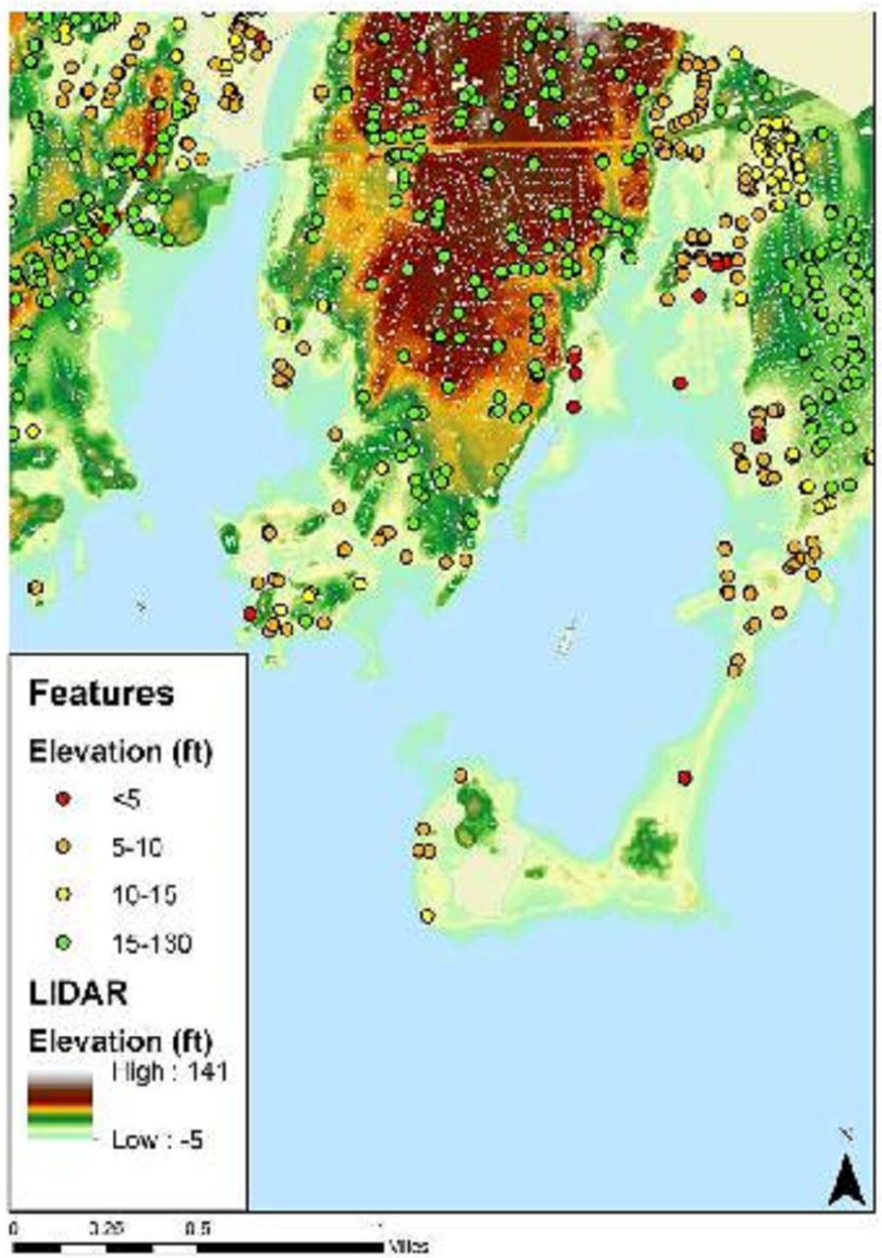
LIDAR Elevation

Elevation (ft)

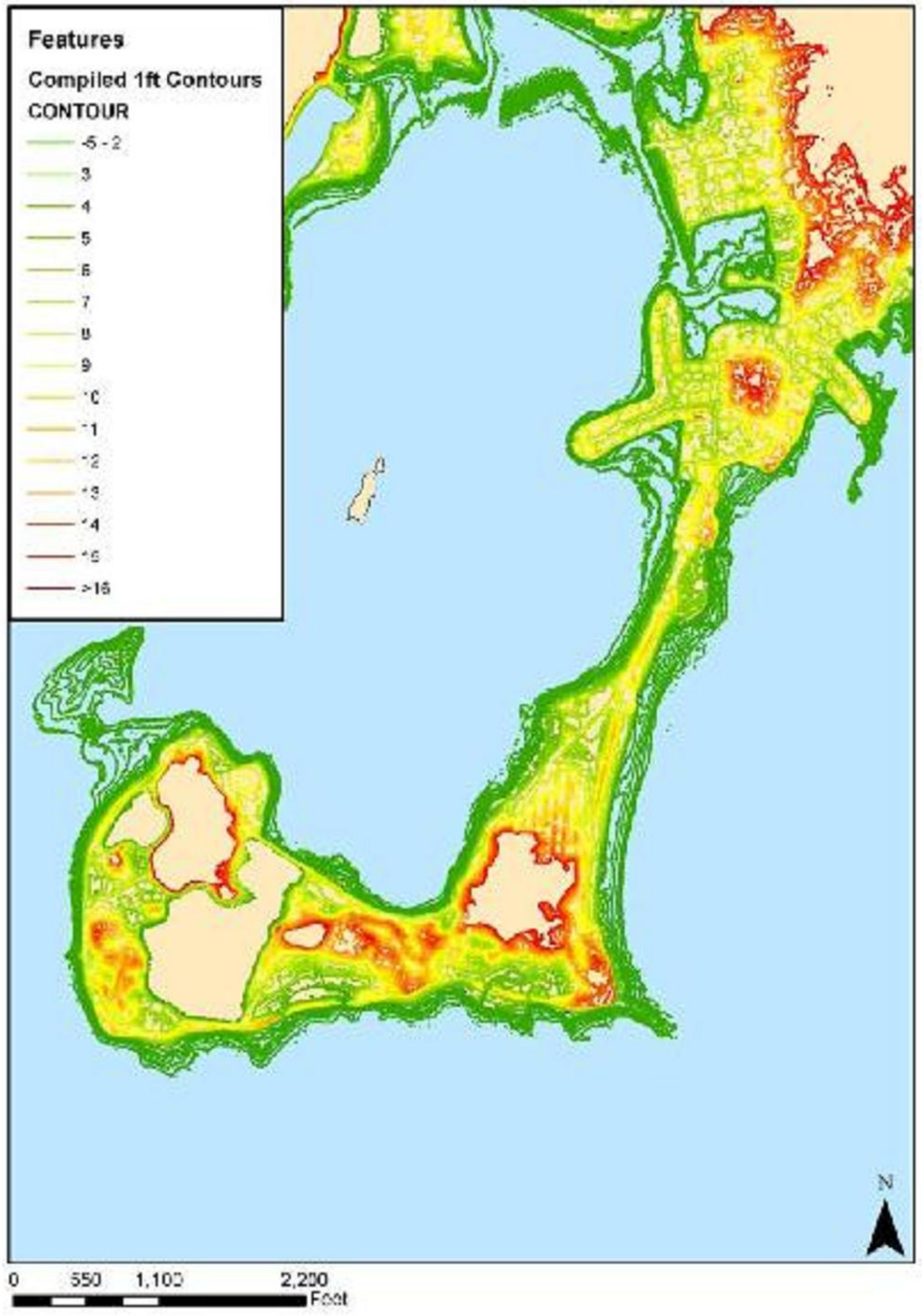
High : 141.404

Low : -5.1725

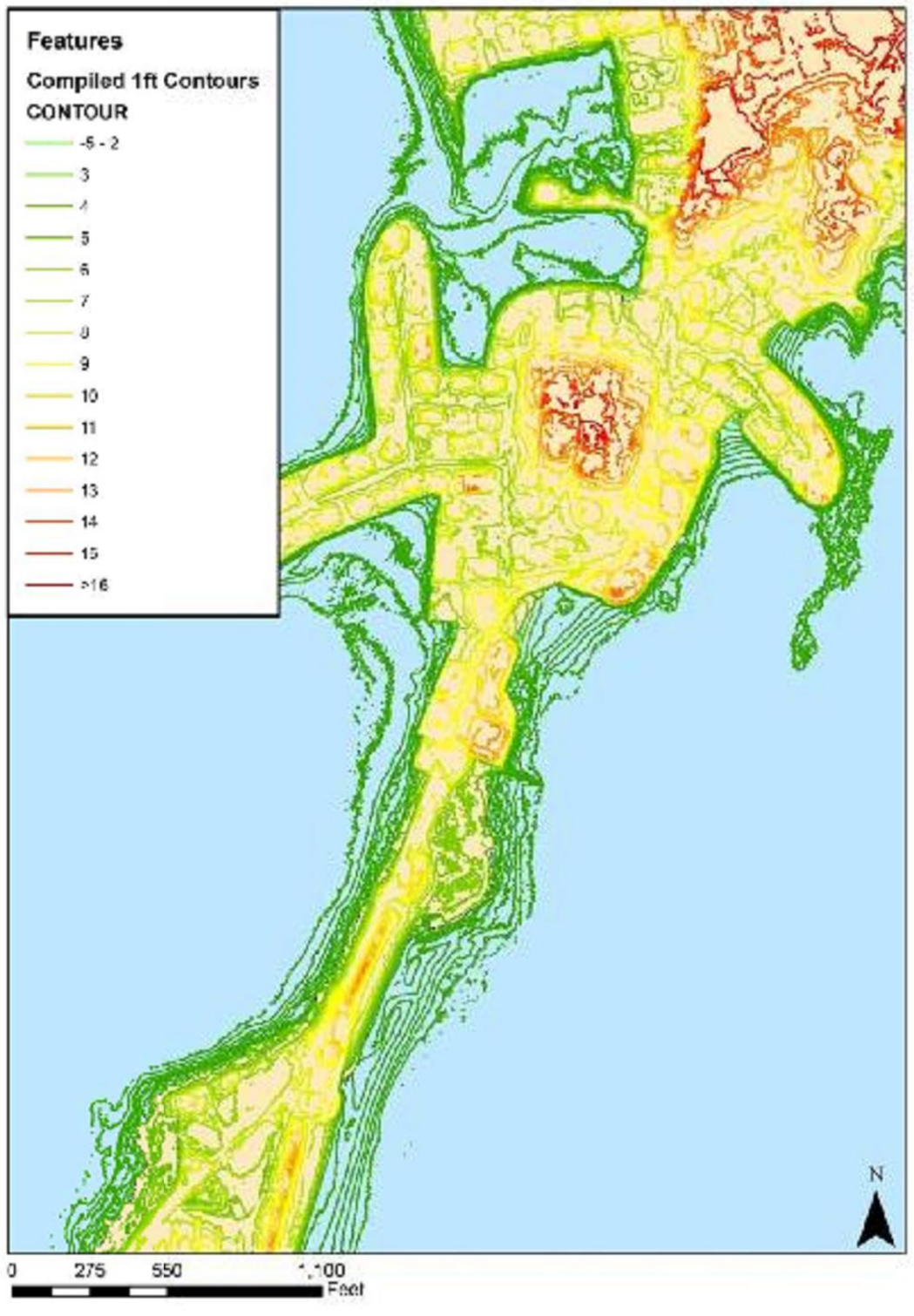
- Generate 1 ft contour lines
- Refine visualization of flooding impacts:
  - Visualize impacts based on real time gauge data
  - Aids in Emergency Planning/Response
- Estimate elevation of infrastructure based on GPS coordinates:
  - Extract value by points tool
  - Catch basins
  - Buildings
  - Roads



1 ft Contours Greenwich Point: Greenwich CT



1 ft Contours Greenwich Point: Greenwich CT



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1934 Connecticut Aerial Photography

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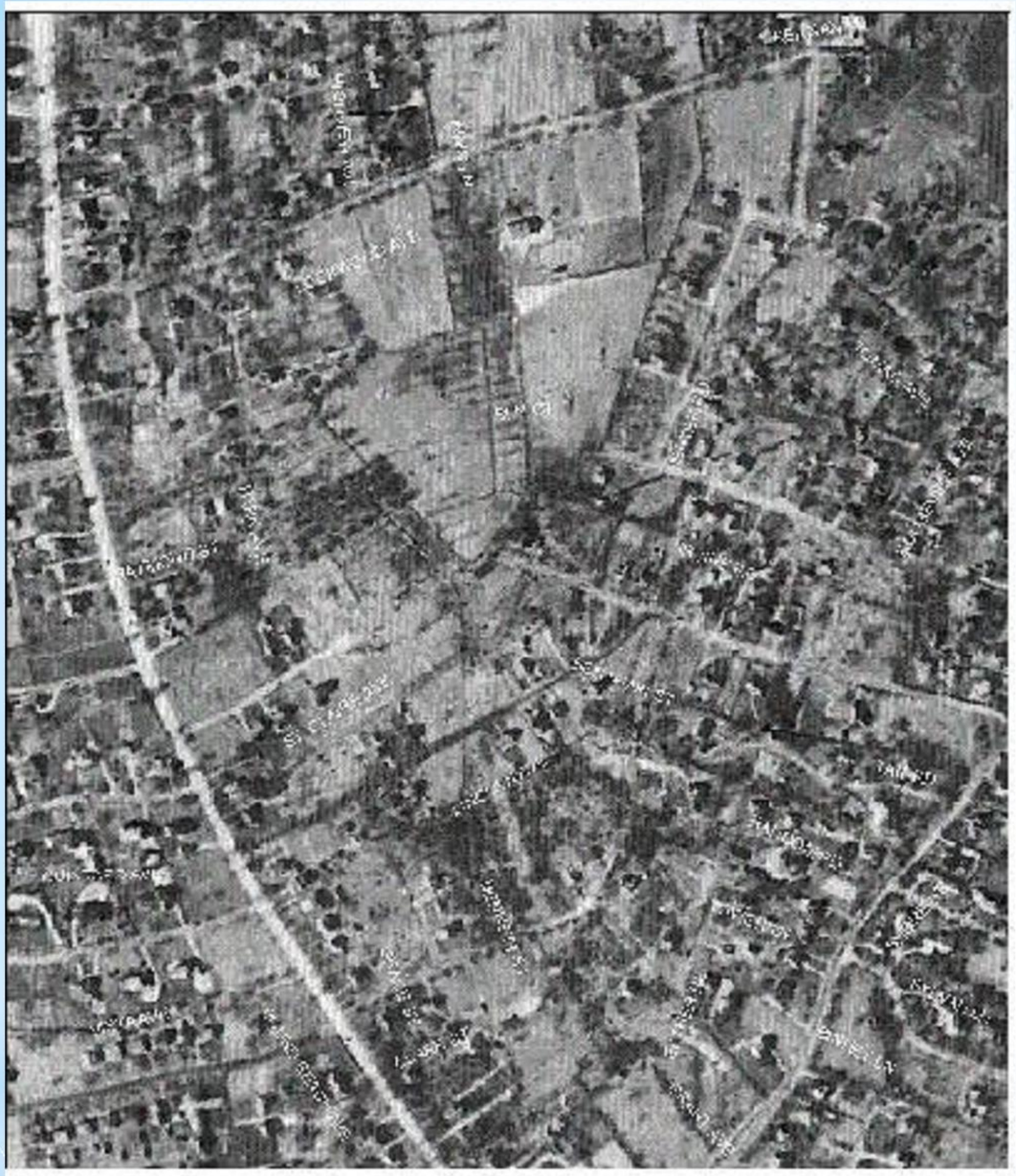
Old Greenwich 2008



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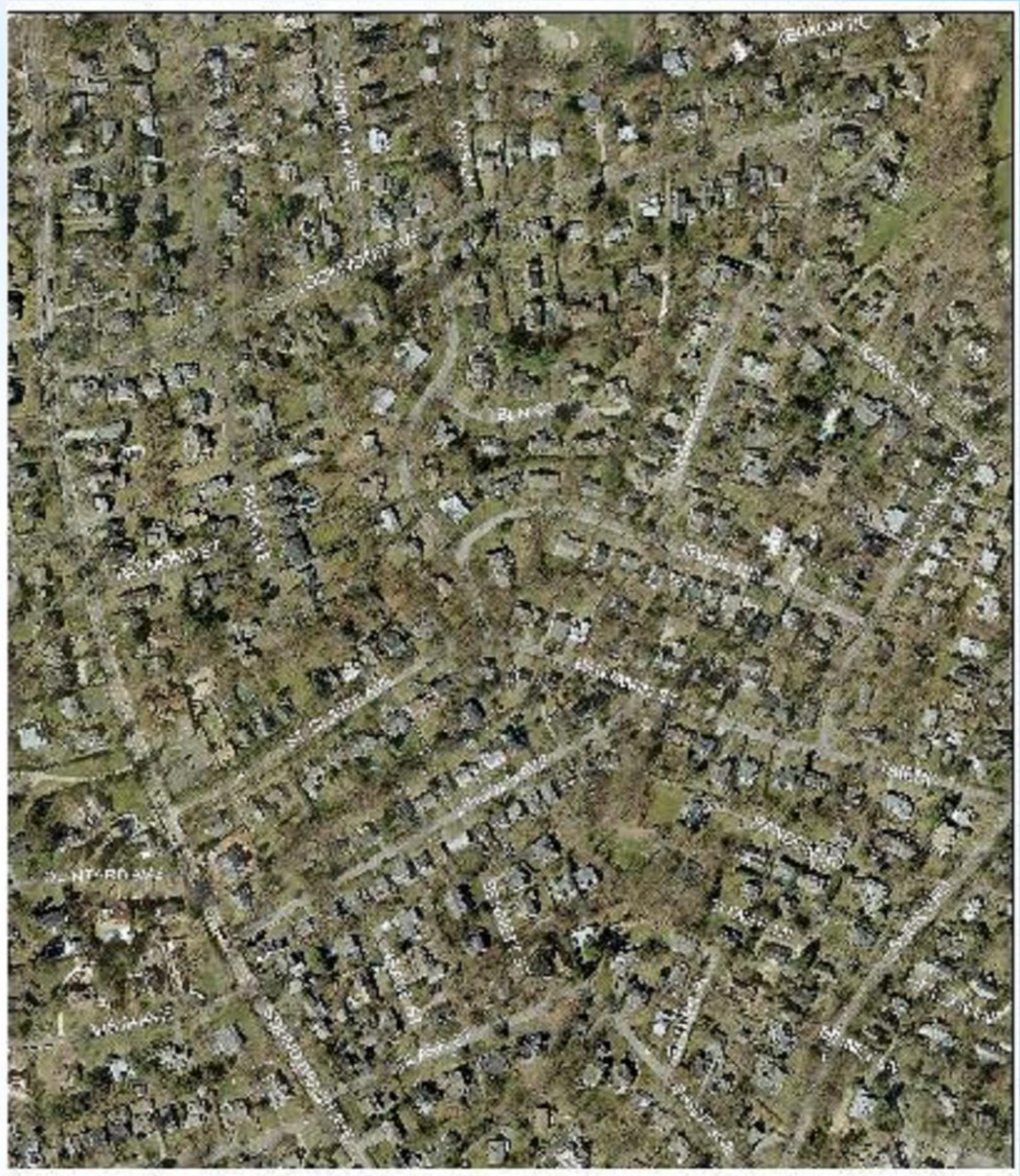
1934 Aerial of
Section of Old Greenwich



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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