CONNECTICUT GEOSPATIAL INFORMATION SYSTEMS COUNCIL

Storm Response and Recovery Assessment Group

FINDINGS REPORT
March 28, 2012

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Table of Contents

INTRODUCTION 1

FINDINGS 8

RECOMMENDATIONS 9

BEST PRACTICES 11

List of Figures

Figure 1 Tropical Storm Irene Precipitation Amounts 2

Figure 2 Tropical Storm Irene Surge Extent 3

Figure 3 Tropical Storm Irene Wind Gusts 4

Figure 4 Nor'easter Snow Amounts 5

Figure 5 Power Outage Figure (State EOC) 1

Appendices

Appendix A: Questionnaire Responses

Appendix B: Examples of Maps and Figures Used During Storm Events

Abbreviations

CL&P	Connecticut Light & Power
COG	Council of Governments
CRCOG	Connecticut Capitol Region Council of Governments
CT DAS	Connecticut Department of Administrative Services
CT DEEP	Connecticut Department of Energy and Environmental Protection
CT DESPP	Connecticut Department of Emergency Services and Public Protection
CT OPM	Connecticut Office of Policy Management
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
GIS	Geographical Information Systems
HIFLD	Homeland Infrastructure Foundation-Level Working Group
RPA	Regional Planning Agencies
USGS	United States Geological Survey

INTRODUCTION

The fall of 2011 will enter the history books of Yankee lore as proof of the old adage, if you don't like the weather in New England wait five minutes. Connecticut was struck by Tropical Storm Irene on August 27, 2011 and on October 29, 2011, a devastating Nor'easter blanketed the state in snow.

Despite Hurricane Irene being downgraded to a tropical storm prior to reaching Connecticut, the north central and western portions of the state received significant rainfall (Figure 1) and wind that caused wide spread flooding and damage to electric grid systems. In addition, coastal communities and shorelines were just as devastated due to coastal storm surges (Figure 2) and 50+ mph winds (Figure 3). Extensive power outages occurred and in total, approximately 800,000 customers were without power for days and in some cases over a week.

The October Nor'easter snow storm covered the entire state with snow ranging from one inch to over a foot and a half (Figure 4). Due to the timing of the storm, much of Connecticut's deciduous trees still had leaves and had not gone dormant for the winter; this combination created significant broken limbs, including complete uprooting of large trees. These effects severely impacted electric utility lines and poles, equipment, and caused numerous road blockages. The power outages caused by the October storm affected approximately 830,000 customers (Figure 5), more than Irene, and in some cases customers were without power for nearly two weeks.

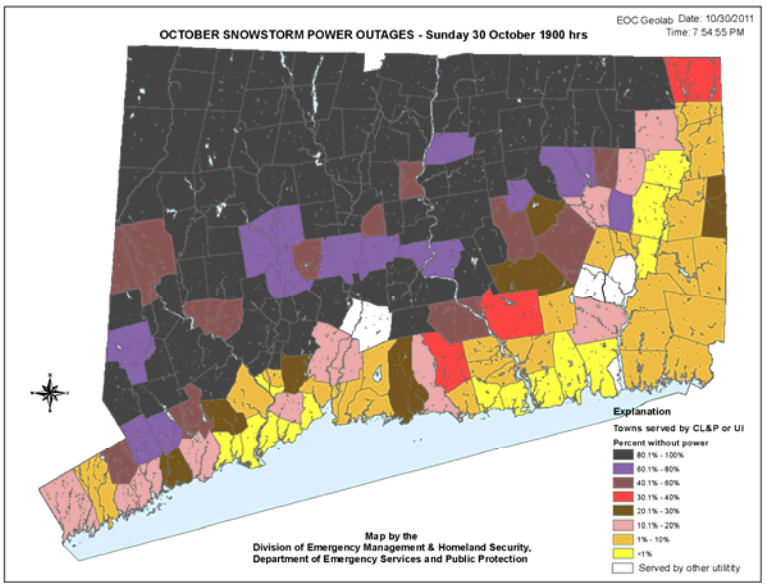
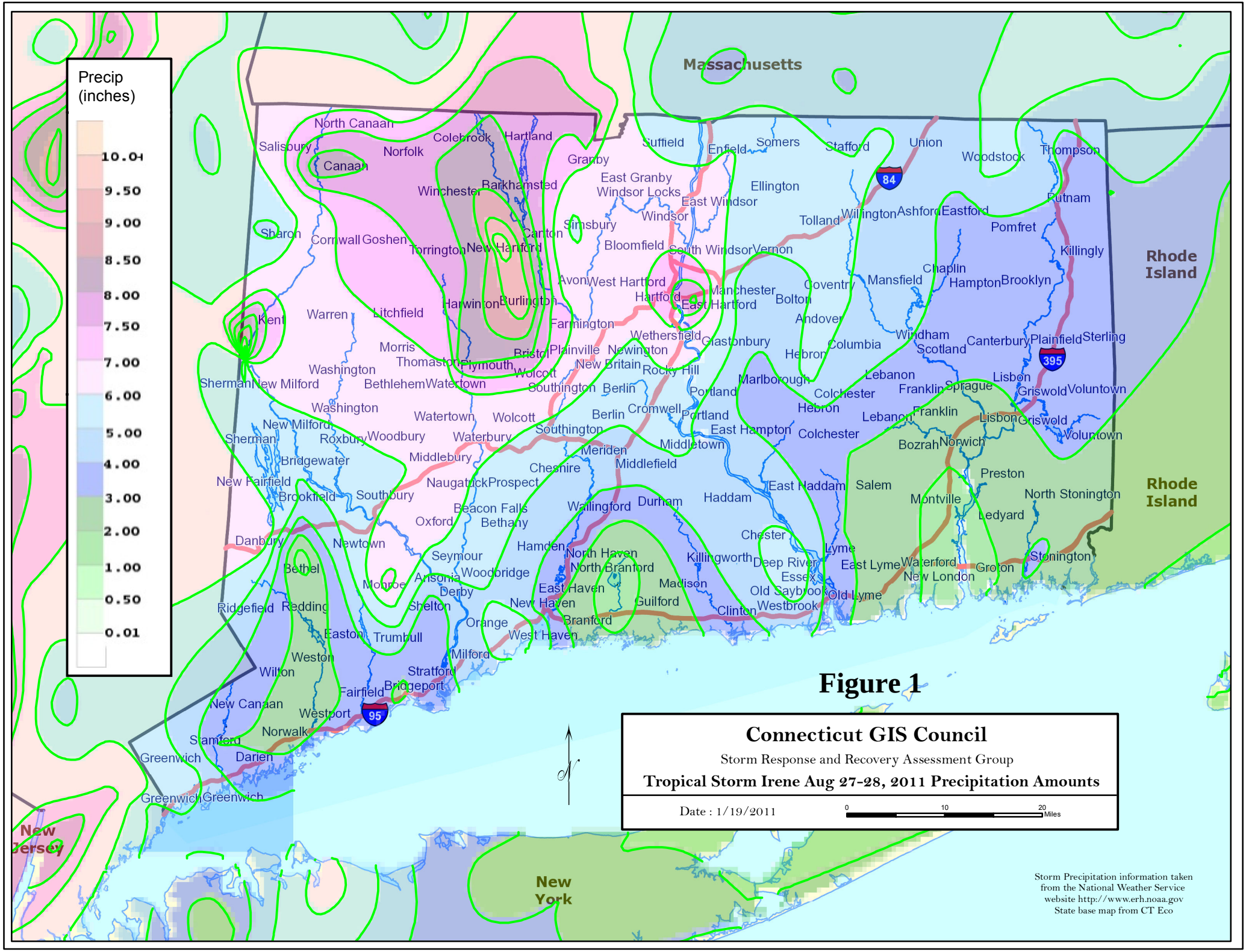
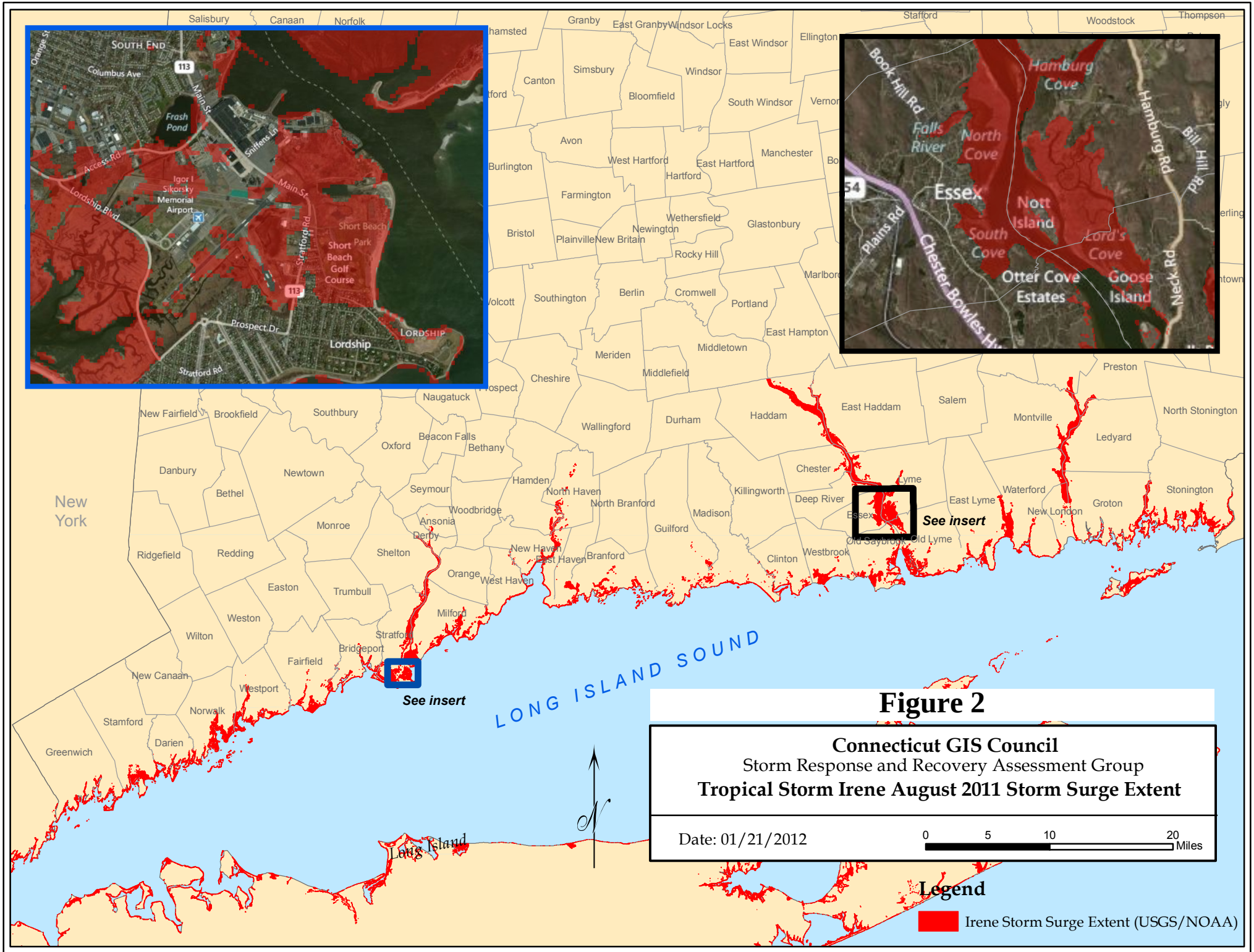


Figure 5*:* Power Outage Figure (State EOC)

During both storms' response and recovery efforts, the use of geographical information systems (GIS) served as an important decision making tool for those who used it. While there was and is general understanding of GIS and its benefit to emergency management, in the aftermath of both major natural events, anecdotal evidence began to


Precip
(inches)
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.50
0.01
Massachusetts
Rhode Island
Rhode Island
New York
New Jersey
North Canaan
Salisbury
Canaan
Norfolk
Colebrook
Hartland
Granby
Suffield
Enfield
Somers
Stafford
Union
Woodstock
Thompson
Putnam
Pomfret
Killingly
Winchester
Barkhamsted
East Granby
Windsor Locks
East Windsor
Windsor
Ellington
Tolland
Willington
Ashford
Eastford
Sharon
Cornwall
Goshen
Torrington
New Hartford
Simsbury
Canton
Bloomfield
South Windsor
Vernon
Avon
West Hartford
Hartford
East Hartford
Manchester
Bolton
Coventry
Mansfield
Chaplin
Hampton
Brooklyn
Kent
Warren
Litchfield
Harwinton
Burlington
Farmington
Wethersfield
Glastonbury
Andover
Hebron
Columbia
Windham
Scotland
Canterbury
Plainfield
Sterling
Morris
Thomaston
Plymouth
Bristol
Plainville
Newington
New Britain
Rocky Hill
Washington
Sherman
New Milford
Bethlehem
Watertown
Wolcott
Southington
Berlin
Portland
Marlborough
Lebanon
Franklin
Sprague
Lisbon
Griswold
Voluntown
Colchester
Hebron
Cromwell
Middletown
East Hampton
Bozrah
Norwich
Preston
Salem
Montville
North Stonington
Ledyard
Meriden
Middlefield
Chesire
Middlebury
Waterbury
Woodbury
Roxbury
New Fairfield
Brookfield
Southbury
Naugatuck
Prospect
Beacon Falls
Oxford
Bethany
Wallingford
Durham
Haddam
East Haddam
Danbury
Newtown
Seymour
Hamden
North Haven
North Branford
Killingworth
Deep River
East Lyme
Waterford
New London
Groton
Stonington
Chester
Lyme
Essex
Old Saybrook
Old Lyme
Westbrook
Clinton
Madison
Guilford
East Haven
New Haven
Branford
West Haven
Orange
Derby
Ansonia
Woodbridge
Monroe
Bethel
Ridgefield
Redding
Shelton
Easton
Trumbull
Weston
Wilton
Milford
Stratford
Fairfield
Bridgeport
New Canaan
Westport
Norwalk
Stamford
Darien
Greenwich
Greenwich
Greenwich
84
95
395
N
Figure 1
Connecticut GIS Council
Storm Response and Recovery Assessment Group
Tropical Storm Irene Aug 27-28, 2011 Precipitation Amounts
Date : 1/19/2011
0
10
20
Miles
Storm Precipitation information taken
from the National Weather Service
website http://www.erh.noaa.gov
State base map from CT Eco


Salisbury
Canaan
Norfolk
Granby
East Granby
Windsor Locks
East Windsor
Ellington
Stafford
Woodstock
Thompson
Simsbury
Canton
Bloomfield
Windsor
South Windsor
Avon
West Hartford
East Hartford
Hartford
Manchester
Burlington
Farmington
Bristol
Plainville
New Britain
Newington
Wethersfield
Glastonbury
Rocky Hill
Southington
Berlin
Cromwell
Portland
Meriden
Middletown
East Hampton
Middlefield
Cheshire
Naugatuck
New Fairfield
Brookfield
Southbury
Oxford
Beacon Falls
Bethany
Wallingford
Durham
Haddam
East Haddam
Salem
Montville
Preston
North Stonington
Ledyard
Danbury
Newtown
Bethel
Seymour
Hamden
North Haven
North Branford
Chester
Lyme
Killingworth
Deep River
Waterford
East Lyme
Groton
Stonington
New London
Woodbridge
Ansonia
Derby
Monroe
Madison
Guilford
Essex
Old Saybrook
Old Lyme
Ridgefield
Redding
Shelton
New Haven
East Haven
Branford
Clinton
Westbrook
Orange
West Haven
Easton
Trumbull
Milford
Weston
Wilton
Stratford
Bridgeport
Fairfield
New Canaan
Westport
Norwalk
Stamford
Darien
Greenwich
New York
LONG ISLAND SOUND
Long Island
See insert
See insert
SOUTH END
Columbus Ave
Orange St
Main St
Frash Pond
Sniffens Ln
Access Rd
Igor I Sikorsky Memorial Airport
Lordship Blvd
Stratford Rd
Short Beach
Short Beach Park
Golf Course
Prospect Dr
Lordship
LORDSHIP
Book Hill Rd
Hamburg Cove
Hamburg Rd
Bill Hill Rd
Falls River
North Cove
Essex
Nott Island
South Cove
Lord's Cove
Plains Rd
Chester-Bowles H
Otter Cove Estates
Goose Island
Neck Rd
54
Figure 2
Connecticut GIS Council
Storm Response and Recovery Assessment Group
Tropical Storm Irene August 2011 Storm Surge Extent
Date: 01/21/2012
0 5 10 20
Miles
Legend
Irene Storm Surge Extent (USGS/NOAA)

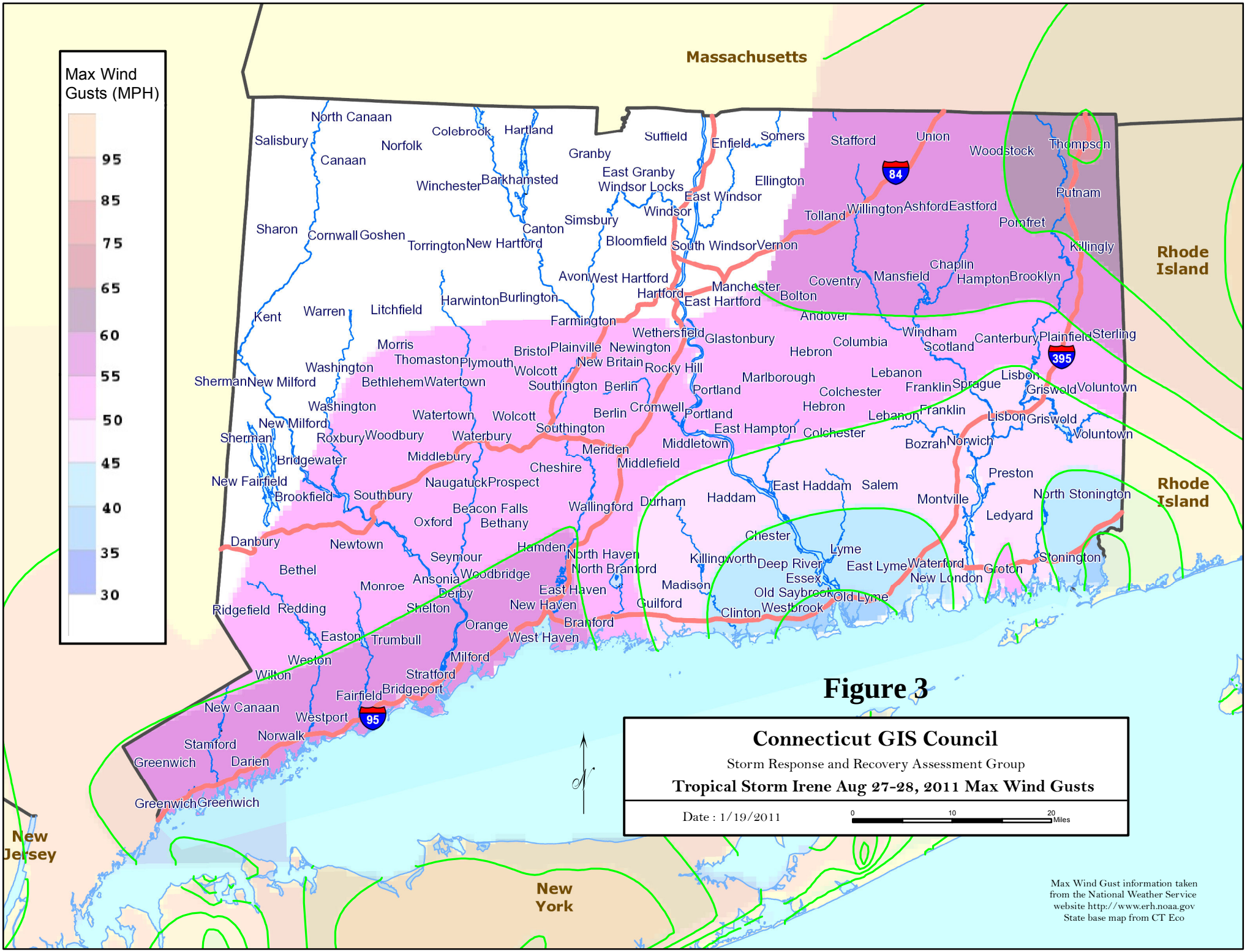


Figure 3

Connecticut GIS Council

Storm Response and Recovery Assessment Group

Tropical Storm Irene Aug 27-28, 2011 Max Wind Gusts

Date : 1/19/2011

0 10 20 Miles

Max Wind Gust information taken from the National Weather Service website http://www.erh.noaa.gov
State base map from CT Eco

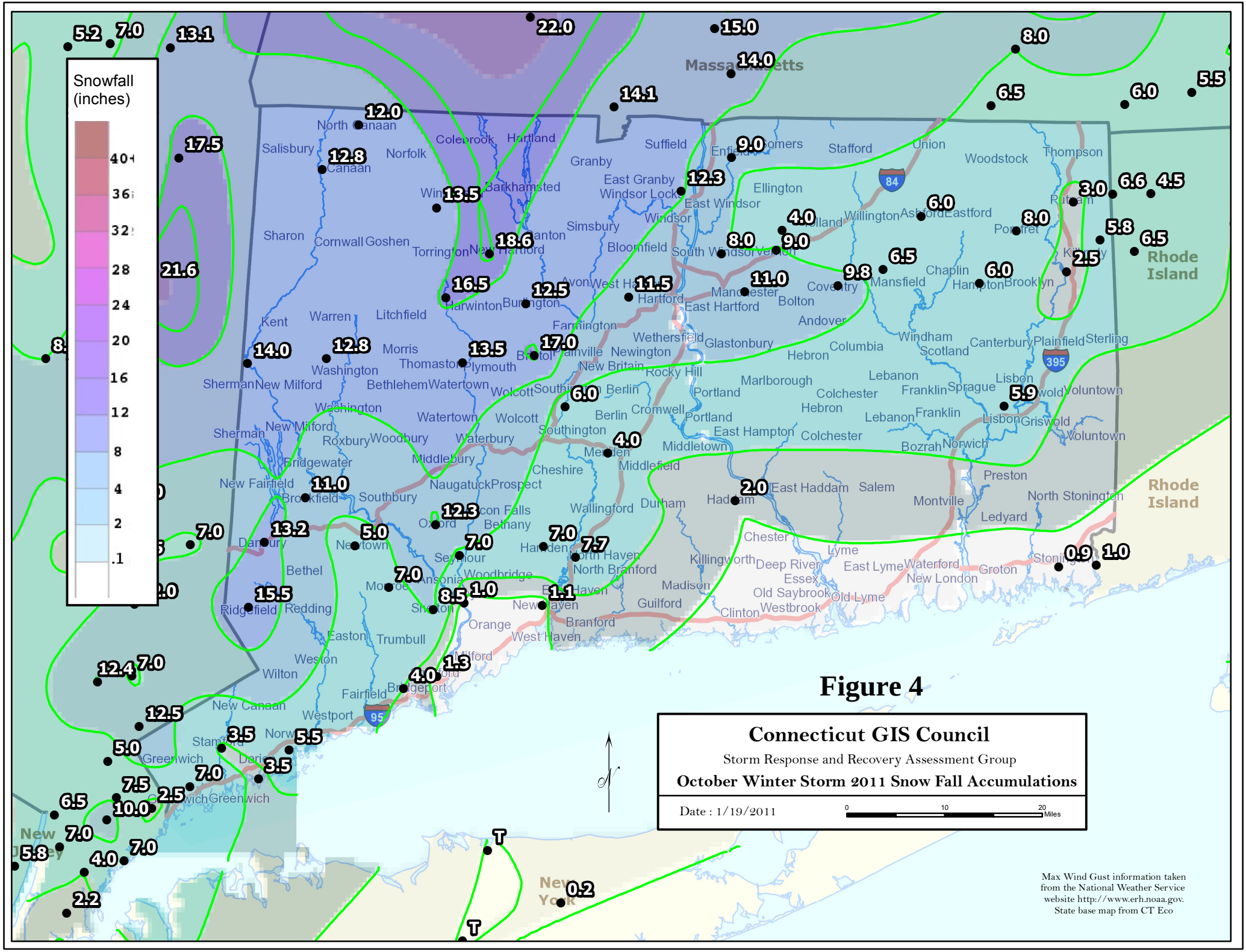

Snowfall (inches)
40
36
32
28
24
20
16
12
8
4
2
.1
Massachusetts
Rhode Island
Connecticut GIS Council
Storm Response and Recovery Assessment Group
October Winter Storm 2011 Snow Fall Accumulations
Date : 1/19/2011
0
10
20
Miles
Max Wind Gust information taken from the National Weather Service website http://www.erh.noaa.gov.
State base map from CT Eco

Figure 4

surface about missed opportunities to utilize GIS in an effective and efficient way. In particular, issues surrounding data sharing and coordination between municipalities and utility companies, as well as other GIS issues, became topics on the CT GIS List Serv.

In response to these issues, the Connecticut Geospatial Information Systems Council on November 17, 2011, voted unanimously to establish a Storm Response and Recovery Assessment Group ("Assessment Group"). The Assessment Group's purpose was to focus on various aspects of how GIS was used for pre-storm, storm, and post-storm response and recovery efforts at the local, regional, utility, state, and federal levels. The Assessment Group's effort ran parallel to and in some cases went deeper into the findings of what the Governor's Two STORM Panel had identified. *(For specific GIS findings and recommendations see Chapter Six of the Two STORM Panel report, dated January 9, 2012.)*

The Assessment Group engaged the Connecticut GIS community by utilizing list servs (CT GIS; Northeast Arc Users Group; and CT Planning Professionals) and started out by asking GIS users to fill out a contact form and asked "Did your office engage in storm pre-planning, response or recovery efforts?" Out of 101 responses the answers were as follows:

Did your office engage in storm pre-planning, response or recovery efforts?	
58	Yes
26	Not Applicable
17	We could have but weren't utilized
101	**TOTAL**

Next, the Assessment Group created and sent out a questionnaire to the Connecticut GIS community to solicit more detailed information and recommendations (see Appendix A for the responses received). The survey was broken down into three sections:

PART I Did your Emergency Operations Center (EOC) engage GIS resources? Explain.

PART II Describe how GIS was used for each applicable phase of the storm(s). Include details on maps and technologies used (printed maps, software, applications, etc.), in addition to barriers to success. Barriers can pertain to data, staffing issues, communication, software, technological limitation, etc. Please attach any map products as applicable.

Describe: 1. GIS Actions or Activities; 2. Barriers; and 3. Other activities for the following:

A) Pre-storm
B) During the storm
C) Post-storm

PART III

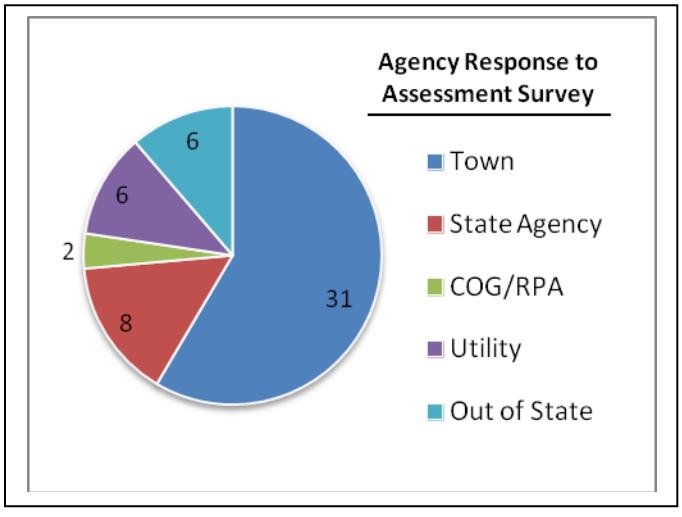
A) List your "Best Practices" that helped in the storm response and/or recovery efforts:
B) List any Recommendations on how GIS can/should be used during a local, regional, or statewide disaster:
C) Other comments:

The responses and reviews were grouped into four categories:

- Regional Planning Agencies and Councils of Government;
- 88 inland towns likely to have been more affected by the Nor'easter;
- 81 coastal towns likely to have been more affected by Tropical Storm Irene; and
- Connecticut and neighboring state agencies, utilities and the federal government.

When looking at the responses to the survey and the responses to the GIS Contact list we got the following results:

Entity Type	Number
Municipality	31
State Agency	8
COG/RPA	2
Utility	6
Out of State	6
TOTAL	**53**



FINDINGS

The results of the questionnaire and subsequent phone conversations are generalized in this section of the report. Since there were many overlaps in the responses, the barriers and recommendations are synthesized or "boiled-down" versions of the individual responses located in the Appendix A. In order to understand the recommendations, it is important to highlight the typical barriers to success. The following are some of the barriers identified:

Highlighted Barriers to Success:

- Lack of awareness or disconnect of GIS by upper management and decision makers was commonly cited on all levels.
- Lack of integration of GIS with Emergency Operation Centers (EOC).
- A lack of knowledge about what GIS data is available and how it can be used to mitigate hazards and serve as a simple communication tool.
- Where GIS is available, the lack of staffing and training becomes an issue when an event spans several days. Many EOCs were in operation for days on end making it difficult for many to have a GIS expert available at all times. This also led to on the spot GIS training to EOC operators, which is time consuming and in some cases an inefficient use of resources.
- Hardware and software limitations (older computers, slow processing speeds, networking issues, proper printing devices [plotters], and number of authorized software licenses).
- Loss of power and an inability for staff to make it into the office.
- Lack of or breakdown in communication prevented utility companies from providing any mapping data or hardcopies to EOCs and municipal GIS staff.
- Bureaucratic barriers that inhibit or discourage proactive communication/coordination between technical GIS staff and utility personnel/technical GIS staff.
- Field workers not having the tools to communicate their locations and actions back to the EOC prevented their efforts from being mapped and cataloged.

RECOMMENDATIONS

The Assessment Group identified key recommendations from the responses and interviews that best addressed the above barriers. The Assessment Group provided a draft copy of the recommendations at the February 2012 Council Meeting. These recommendations were also categorized into potential timeframes for when the recommendation could reasonably be put into place. In addition, potential entities have been identified that would need to be active participants in order to make these recommendations, or variations of them, reality. Many of these recommendations require broad support from the Connecticut GIS community and require inclusion versus exclusion; therefore even though an entity is not listed it does not mean others should proactively participate and be asked to participate. It must be noted that the Assessment Group did not tackle how each of these recommendations could be implemented nor identify which entity should take the lead. It is the hope of the Assessment Group that the GIS Council would quickly work through these issues to begin implementing some of the critical and less challenging recommendations.

RECOMMENDED IMPLEMENTATION SCHEDULE KEY

0 - 6 months	6 - 12 months	1+ years

RECOMMENDATIONS	POTENTIALLY AFFECTED ENTITIES
1. Create a State GIS Emergency Response Team to be activated during a storm event and create a disaster plan to work with municipal GIS staff.	CT DESPP, State GeoLab, GIS Council, Utilities, Regional and Local Governments, HIFLD, FEMA, USGS, CT DEEP
2. Explore the use and application of the FEMA Region 1 Geospatial Working Group – New England Geospatial Emergency Response Procedures Manual.	CT DESPP, State GeoLab, GIS Council, Local Governments, HIFLD, FEMA, USGS
3. Establish a working group to address and create a conduit for utility companies, state and local governments to exchange and improve data, specifically critical infrastructure, in a way that is compliant with the Freedom of Information Act and addresses security risks.	CT DESPP, CT DEEP, Utilities, CT DAS, GIS Council, CT OPM, CT Siting Council, Regional and Local Governments

4. Create a GIS volunteer network (similar to GIS Corps)	GIS Council, CT DESPP
5. The State should make available two statewide GIS web applications (using ArcGIS Server), one public-facing and one secured with sensitive-critical data layers with a focus on disaster planning and response.	GIS Council, CT DESPP, CT DAS, CT OPM
6. Fully integrate GIS into the EOC response and recovery efforts by embedding trained-technical GIS staff in all EOC (state and local) briefings and strategy meetings.	CT DESPP, State GeoLab, EOC Directors, Utilities, Regional and Local Governments
7. Identification of critical customers for each town and the State of Connecticut (migrate from paper based systems in the field to real-time data collection system).	CT DESPP, Utilities, Local Governments
8. Promote and establish awareness of GIS availability from the top down in an organization so that decision makers and managers are communicating with their GIS staff and that all departments within an organization can access and participate in the advancement and use of GIS technologies.	GIS Council (Education Committee), CT DESPP, Utilities, Regional and Local Governments
9. Develop support for RPAs/COGs to facilitate GIS resource-sharing among member towns, especially towns with no GIS. Explore free GIS resources (ArcReader, ArcGIS Online, etc).	CT DESPP, GIS Council, CTOPM, Utilities, Regional and Local Governments
10. Conduct training sessions for GIS staff (state, regional, local, utilities) and EOC managers to expand the understanding of available GIS data, discuss strategies, forecasting-predictability modeling, post-event assessments, and GIS analysis relating to potential natural and human disasters.	CT DESPP, GIS Council (Education Committee), CT OPM, Utilities, Regional and Local Governments, CT GIS User 2 User Group
11. Identify, at a local level, fragile or sensitive utility infrastructure that could benefit from extra protection – tree trimming across the street, sand bagging, placement of jersey barriers.	Local Governments, Utilities
12. Establish a State GIS Coordinator that processes multidiscipline skills, is competent in GIS, and knowledgeable of diverse datasets to manage the data collection and distribution of GIS information.	GIS Council, CT DESPP, CT DAS, CT OPM

13. Create a fully documented library that catalogs all the available GIS resources and how to obtain them.	GIS Council, Regional and Local Governments
14. Have a method to incorporate citizen provided information on damage reporting at a local, regional and state level.	CT DESPP, GIS Council and Local Governments
15. Ensure that every town in Connecticut has access to GIS software and hardware, the resources to develop data and the training to implement it's use.	GIS Council, CT OPM, Regional and Local Governments
16. Establish controls to prevent taxpayers funding the duplication of acquisition efforts by utilities, local and state government.	GIS Council, Legislature, Regional and Local Governments, CT OPM, Utilities
17. Matching of electronic data to manual paper process to make repairs and report corrective measures taken (post-storm).	Utilities, CT DEEP, CT Siting Council
18. Interstate GIS coordination and sharing of data (server).	CT DESPP (GeoLab)
19. Create a State GIS Department/Office to manage the hardware, software and logistics of creating a GIS repository.	Governor's Office and Legislature
20. Standardize data formats so that information can easily be shared across agencies and departments.	GIS Council, Regional and Local Governments

BEST PRACTICES

A number of entities created innovative solutions and tools to facilitate planning, response and recovery. To capture these solutions, the Assessment Group's questionnaire asked for best practices with the purpose to share them across the GIS community with the hope they can be replicated and benefit others. In addition, while the best practices listed below are just a snap shot in time, Recommendations #1 and #2 above would provide a means to further expand, coordinate, and document best practices that should be made available to the GIS community prior to events.

- **Utilizing the most current data layers available**. In advance of pending storms or season, GIS staff should review their key data layers to determine if any updates may have occurred, especially if using mapservice links. When possible, have metadata easily accessible.

- **Distribute necessary information before the event occurs**. Distribute necessary information using multiple methods so it is available from multiple sources should some not be available during/after an event. Have maps preprinted and ready in advance.

- **Set up map templates before the event.** Customize map templates based on event type; make sure proper map notations and data layers are part of the template. Have base maps (templates) with the commonly used layers already created saves time and leaves mainly creating/editing event-specific data.

- **Automate data collection process as much as possible.** During non-event times review and assess where processes or steps can be automated; reach out to others in the GIS community for tricks and tips.

- **Track and display citizen request calls by category type** (e.g. downed tree, power lines, traffic light outages, etc.).

- **Establish formal agreements with other entities for operational GIS assistance.** Some entities may require formal agreements for GIS data sharing or support whether it's between states, municipalities, or regional governments, efforts should be made prior to events.

- **Fully-functional GIS network in case of loss of Internet.** As the two storm events showed, utility lines and communications lines can seriously effect internet connections and GIS staff need to anticipate this loss and plan ahead to ensure key data sets are stored locally.

- **Pre-established GIS "call list" to staff the event.** Whether at the local level or state level GIS call lists are important to be established prior to events and reviewed on quarterly bases or as relevant.

- **Handing town maps to utility workers** (especially out of state workers) showing downed trees, power lines, traffic light outages, etc.

- **Mapping incidents in the field.** Explore the use of mobile device applications that record and send X Y coordinates of problems spots back to the EOC/GIS staff. Explore training key field staff.

- **Identify residents on well water to make power restoration a priority in those areas.** This type of analysis should be conducted during non-event times and the resulting data layer be incorporated into map templates. Identify other similar unique situations or concerns that should be addressed prior to events.

- **Create and manage evacuation and sheltering options.** While shelter and evacuation routes may change depending on the type of event, working with emergency management personnel ahead of time and at least identify main routes will save time during an event.

- **Make GIS staff part of the EOC**. Reach out to EOC managers, Chief of Police or Fire, social services, etc. and ask to participate in pre-planning activities or exercises.
- **Using National Hurricane Sea, Lake and Overland Surges from Hurricanes (SLOSH) data to anticipate flooding scenarios.** In addition, when possible after a surge event, record and identify inundated areas in order to compare the SLOSH or flood data to actual events.
- **Inter-departmental and inter-agency coordination to prevent map making repetition.**
- **Streaming live weather data from Hurrevac and NOAA.**