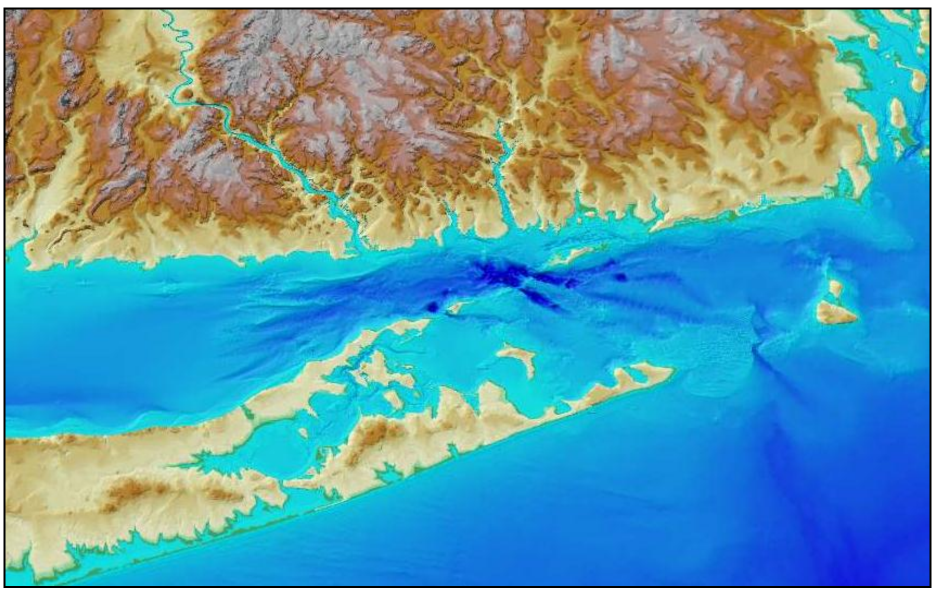
Supplemental Environmental Impact Statement for the Designation of Dredged Material Disposal Sites in Eastern Long Island Sound, Connecticut and New York

Report of Public Meetings 5 (Riverhead, NY) and 6 (New London, CT)



Prepared for: **United States Environmental Protection Agency**

Sponsored by: **Connecticut Department of Transportation**

Prepared by: **Louis Berger**
(under contract to the University of Connecticut)

March 2015

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Supplemental Environmental Impact Statement for the Designation of Dredged Material Disposal Sites in Eastern Long Island Sound, Connecticut and New York

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REPORT OF PUBLIC MEETINGS 5 (RIVERHEAD, NY) AND 6 (NEW LONDON, CT)

Held on December 8 (Riverhead) and December 9 (New London), 2014

EPA QA Tracking Number RFA 13063

Prepared for:
United States Environmental Protection Agency
5 Post Office Square, Suite 100
Boston, MA 02109

Sponsored by:
Connecticut Department of Transportation
Waterways Administration
2800 Berlin Turnpike
Newington, CT 06131-7546

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March 9, 2015

Document Control Number: LI009

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Table of Content

EXECUTIVE SUMMARY

This report provides a summary of the fifth and sixth public meetings as part of the Supplemental Environmental Impact Statement (SEIS) process for the designation of dredged material disposal sites in the Eastern Long Island Sound region. The SEIS will supplement the Environmental Impact Statement (EIS) for the designation of dredged material disposal sites in the Western and Central Long Island Sound, completed in 2004. The SEIS is prepared for the U.S. Environmental Protection Agency (USEPA), and supported by the Connecticut Department of Transportation (CTDOT). The study is being conducted in consultation with other federal and state agencies of New York State and Connecticut, as well as with consultation of the public.

The two public meetings were held in Riverhead (NY) and in New London (CT) on December 8 and 9, 2014, respectively. The primary purpose of these meetings was to present an overview of the approach and findings of the physical oceanography study conducted in the Eastern Long Island Sound region in support of the SEIS.

1. Introduction

In 2005, the USEPA designated the Western and Central Long Island Sound dredged material disposal sites, following the preparation of an EIS. The two disposal sites in the Eastern Long Island Sound, Cornfield Shoals and New London, are scheduled to close in December 2016. The EPA is in the process of preparing a Supplemental EIS (SEIS) for the potential designation of one or more disposal sites needed to serve the Eastern Long Island Sound region. The SEIS is being prepared in accordance with Section 102(c) of the Marine Protection Research and Sanctuaries Act (MPRSA; also referred to as Ocean Dumping Act [ODA]) of 1972. The USEPA has the responsibility of designating sites under Section 102(c) of the Act and 40 CFR Part 228.4 of its regulations. The SEIS is supported by the State of Connecticut through the Connecticut Department of Transportation (CTDOT).

2. Public Meetings

In accordance with USEPA's voluntary NEPA policy, the USEPA is conducting an extensive public involvement program throughout the development of the SEIS. Public scoping meetings were held on November 14, 2012 (Groton, CT) and January 9 (Riverhead, NY). Public meetings were also held on June 25 (Riverhead, NY) and June 26 (New London, CT), 2014; these meetings discussed the process and first results of the screening of the Eastern Long Island Sound project area (referred to as the 'Zone of Siting Feasibility' or ZSF) for potential dredged material disposal sites.

The objective of Public Meetings 5 and 6 was to present the approach and findings of the Physical Oceanography (PO) study, conducted by the University of Connecticut (UCONN) in the ZSF in support of the SEIS (Figure 1). The meeting was informational. Comments and questions were invited during the meeting. There was no official comment period following the meetings. Meetings were held on the following dates and locations:

- December 8, 2014 Suffolk County Community College, Riverhead, New York
- December 9, 2014 Fort Trumbull, New London, Connecticut

Both meetings were held between 3pm and 5pm. The format and agenda for each meeting were identical.

Time	Agenda Item	
2:00 pm	*Registration*	
3:00 pm	*Ground Rules/Logistics*	Facilitator, Bernward Hay, Louis Berger
3:05 pm	*Welcome/Project Update*	Jean Brochi, Project Manager, Ocean and Coastal Protection Unit, EPA Region 1
3:15 pm	*Physical Oceanography Study*	Frank Bohlen and Grant McCardell, UCONN
4:05 pm	*Discussion*	Bernward Hay, Louis Berger
5:00 pm	*Adjourn*	

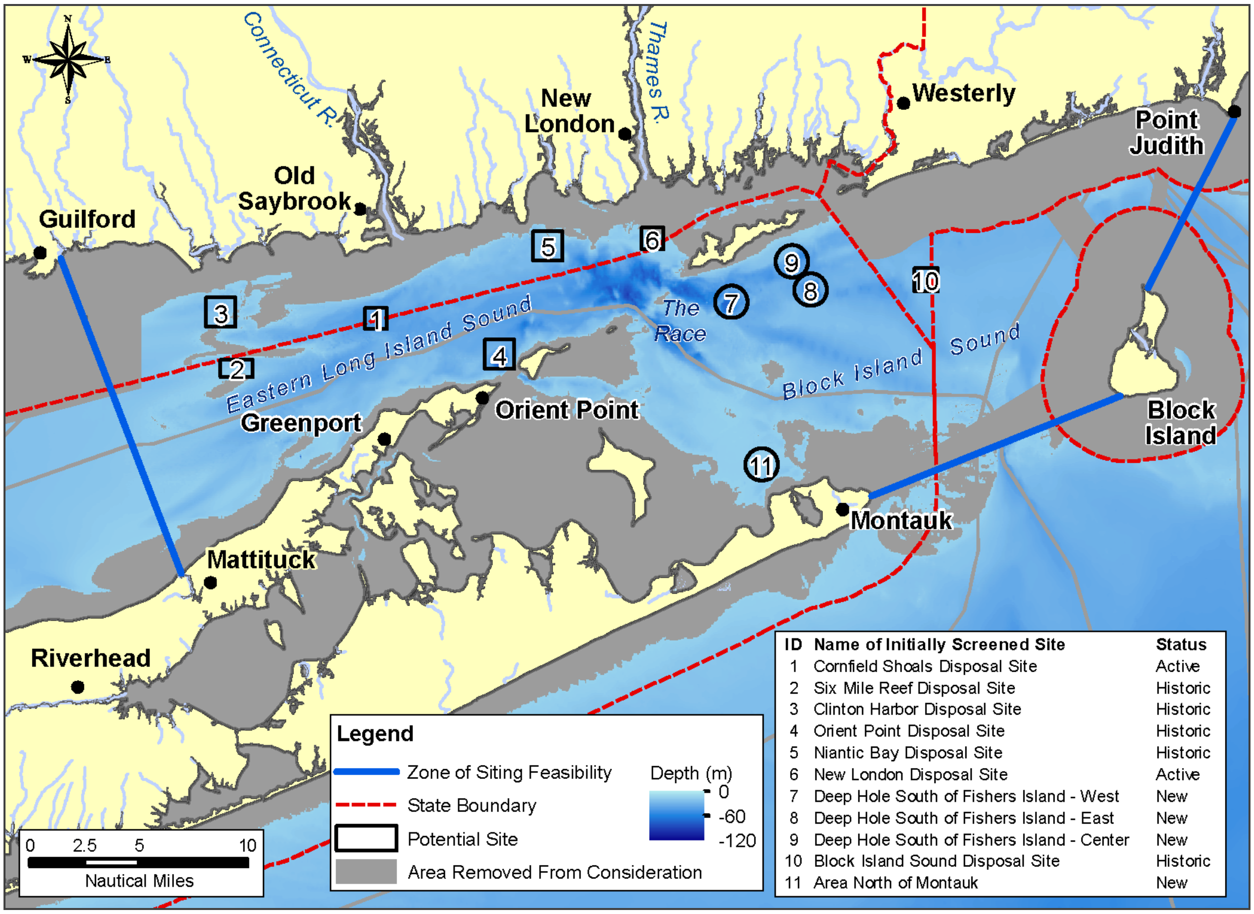

Figure 1: Zone of Siting Feasibility, which was the project area for the Physical Oceanography study. Also listed are eleven initially screened potential alternative disposal sites.

3. Meeting Summary

Scoping is part of the NEPA process through which federal agencies discuss the purpose of and need for the proposed action; the projected area extent and range of potential impacts resulting from the proposed action; and the studies necessary to determine the extent of potential impacts resulting from these actions. Public Meetings 5 and 6 presented the findings of the physical oceanography study.

The lists of Attendees and Commenters/Speakers from the Public are provided in Attachment 2. Presentations given by Ms. Jean Brochi (USEPA) and Drs. Frank Bohlen and Grant McCardell (UCONN, Department of Marine Sciences) are provided in Attachment 3. Transcripts, required for both meetings, were prepared by Mr. Robert Pollack from Alliance Reporting Service, Inc. (Riverhead meeting) and by Ms. Jackie McCauley from Brandon Huseby Reporting & Video (New London meeting); their transcripts are enclosed as Attachments 4 and 5, respectively.

Following is a summary of the two meetings:

- **Attendees:** A total of 27 attendees signed in at the Riverhead meeting; a total of 34 attendees signed in at the New London meeting. Attendees at both meetings included members from the Public, non-profit organizations, private companies, state and federal agency representatives, and representatives of government officials. Specifically, agency representatives included the USEPA, U.S. Army Corps of Engineers, U.S. Navy, CTDOT, Connecticut Department of Energy and Environmental Protection, New York State Department of State, and New York State Department of Environmental Conservation.
- **Commenters:** After the presentations, four individuals commented or asked questions at the Riverhead meeting; eight individuals commented or asked questions at the New London meeting.

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Attachment 1

MEETING ANNOUNCEMENT

From: Grimaldi, Alicia [mailto:Grimaldi.Alicia@epa.gov]
Sent: Tuesday, November 18, 2014 4:18 PM
To: ELIS
Cc: Brochi, Jean; Grimaldi, Alicia
Subject: NOTICE OF PUBLIC MEETINGS re: Eastern Long Island Sound Supplemental Environmental Impact Statement

The Environmental Protection Agency will be hosting another set of public meetings in Riverhead, NY and New London, CT to discuss the Supplemental Environmental Impact Statement (SEIS) to evaluate the potential designation of one or more dredged material disposal sites in eastern Long Island Sound. The purpose of this meeting is to present the status of the site screening process, the results of the physical oceanography study, and the next steps for releasing the draft SEIS and proposed rulemaking. The information for these public meetings is below.

MONDAY, DECEMBER 8, 2014
3:00 – 5:00 p.m. (registration begins at 2:30)
Suffolk County Community College, Culinary Arts & Hospitality Center
20 East Main Street
Riverhead, NY 11901
Directions: http://department.sunysuffolk.edu/CulinaryArts_E/3232.asp

TUESDAY, DECEMBER 9, 2014
3:00 – 5:00 p.m. (registration begins at 2:30)
Fort Trumbull
90 Walbach Street
New London, CT 06320
Directions: http://www.fortfriends.org/info.htm

For additional information, please visit:
http://www.epa.gov/region1/eco/lisdreg/elis.html.

Please consider forwarding this message to any parties who may be interested in attending. If you wish to be removed from this e-mail list or if you have any questions, please e-mail ELIS@epa.gov. Thank you!

Alicia Grimaldi
Ocean & Coastal Protection
Environmental Protection Agency, Region 1
5 Post Office Square, Suite 100
Mail Code: OEP06-01
Boston, MA 02109
Tel: (617)918-1806
Fax: (617)918-0806

Attachment 2

LISTS OF ATTENDEES AND COMMENTERS FROM THE PUBLIC

- Riverhead, NY December 8, 2014
- New London, CT December 9, 2014

Note: Addresses and contact information was provided on the original Sign-in sheets but not listed here for privacy reasons. Spelling of names and organizations was verified, if needed, using the internet. Names are listed in the order shown on the Sign-in sheets.

Riverhead, NY, December 8, 2014

ATTENDEE SIGN-IN

NAME	ORGANIZATION	QUESTIONS / COMMENTS?
Doug Pabst	U.S. Environmental Protection Agency, Region 2	
Mel Coté	U.S. Environmental Protection Agency, Region 1	
Patricia Pechko	U.S. Environmental Protection Agency, Region 2	
Mark Haubner	North Fork Audubon Society	
Nancy Brighton	U.S. Army Corps of Engineers, New York District	
Mark Habel	U.S. Army Corps of Engineers, New England District	
David Bergen	Southold Town Trustee	
Mike Zimmerman	New York State Department of State	
Dan Gulizio	Peconic Baykeeper	
Kari Gathen	New York State Department of State	
Kevin McAllister	Defend H_2O	Yes
Jennifer Street	New York State Department of State	
William Gash	Connecticut Maritime Coalition	Yes
Charles de Quillfeldt	New York State Department of Environmental Conservation	
Gwynn Schroeder	Office of Legislator Al Krupski	
Maureen Murphy	Citizens Campaign for the Environment	
Adrienne Esposito	Citizens Campaign for the Environment	Yes
Frank Bohlen	University of Connecticut	
Alicia Grimaldi	U.S. Environmental Protection Agency, Region 1	
Marie Domeneci	Suffolk County	
Bernward Hay	The Louis Berger Group, Inc.	
Jean Brochi	U.S. Environmental Protection Agency, Region 1	
Mark Woolley		
Joe Salvatore	Connecticut Department of Transportation	
George Wisker	Connecticut Department of Energy and Environmental Protection	
Marguerite Purnell	Fishers Island Conservancy	Yes
Grant McCardell	University of Connecticut	

New London, CT, December 9, 2014

ATTENDEE SIGN-IN

NAME	ORGANIZATION	QUESTIONS / COMMENTS?
Joseph Salvatore	Connecticut Department of Transportation	
Mark Habel	U.S. Army Corps of Engineers, New England District	
Bernward Hay	Louis Berger	
Lisa Lefkovitz	Battelle	
Stacy Pala	Battelle	
Alan Stevens	Connecticut Department of Transportation	
Todd Randall	U.S. Army Corps of Engineers, New England District	
Frank Bohlen	University of Connecticut	
Bill Spicer	Spicer’s Marinas	Yes
Lou Allyn	Mystic Harbor Management	
Andrew Ahrens	Fishers Island Conservancy	
Bob Evans	Fishers Island Conservancy	
John Johnson	Connecticut Marine Trades Association	Yes
Ron Helbig	Noank Village Boatyard	Yes
Shauna Lake	Americas Styrenics	
David Boomer	The Kowalski Group	
Brian Thompson	Connecticut Department of Energy and Environmental Protection	
Christian McGugan	Gwenmor Marina and Gwenmor Marine Contracting	Yes
Kris Shapiro	Cedar Island Marina	
Jeff Shapiro	Cedar Island Marina	Yes
Tracey McKenzie	U.S. Navy	Yes
Mike Zimmerman	New York State Department of State	
Judy Benson	The Day	
Jean Brochi	U.S. Environmental Protection Agency, Region 1	
Bill Gardiner	Spicer’s Marina	
John Gardiner	Spicer’s Marina	
Kathleen Burns	Connecticut Marine Trades Association	
Abbie McAllister	Saybrook Point Marina	Yes
Ayanti Grant	Congressman Joe Courtney	
Grant McCardell	University of Connecticut	
Matt LeBeau	Office of Senator Blumenthal	
George Wisker	Connecticut Department of Energy and Environmental Protection	
Peter Francis	Connecticut Department of Energy and Environmental Protection	
Drew Carey	CoastalVision	Yes

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Attachment 3

PRESENTATIONS

- **Jean Brochi, Project Manager, Ocean and Coastal Protection Unit, EPA Region 1:** ***Project Update*** (Slides 1 to 13)

- **Frank Bohlen and Grant McCardell, University of Connecticut:** ***Physical Oceanography Study*** (Slides 14 to 60)

Note: Presentation slides were identical at each meeting.

Eastern Long Island Sound Supplemental Environmental Impact Statement

Public meetings in Riverhead, NY and New London, CT

U.S. EPA Region 1

December 8 & 9, 2014

Agenda

2:30 pm	*Registration*
3:00 pm	*Ground Rules/Logistics* Mr. Bernward Hay, Louis Berger
3:05 pm	*Welcome/ELIS SEIS update* Jean Brochi, Ocean and Coastal Protection Unit, EPA Region 1
3:15 pm	Physical Oceanography Study Frank Bohlen and Grant McCardell, UCONN
4:05 pm	Discussion Mr. Bernward Hay, Louis Berger
5:00	Adjourn

EPA-USACE Share Responsibility

- Marine Protection, Research, and Sanctuaries Act (MPRSA, aka Ocean Dumping Act)
  - Section 102: EPA Designates Sites
  - Section 103: USACE Selects Sites subject to EPA concurrence
- Dredged material disposal at these sites must meet criteria in Ocean Dumping Regulations (40 CFR Parts 220-229)
- Clean Water Act (CWA)
  - Section 404: USACE issues permits subject to EPA concurrence
  - Section 404(c): EPA has veto authority

Long Island Sound
Dredged Material Disposal Sites

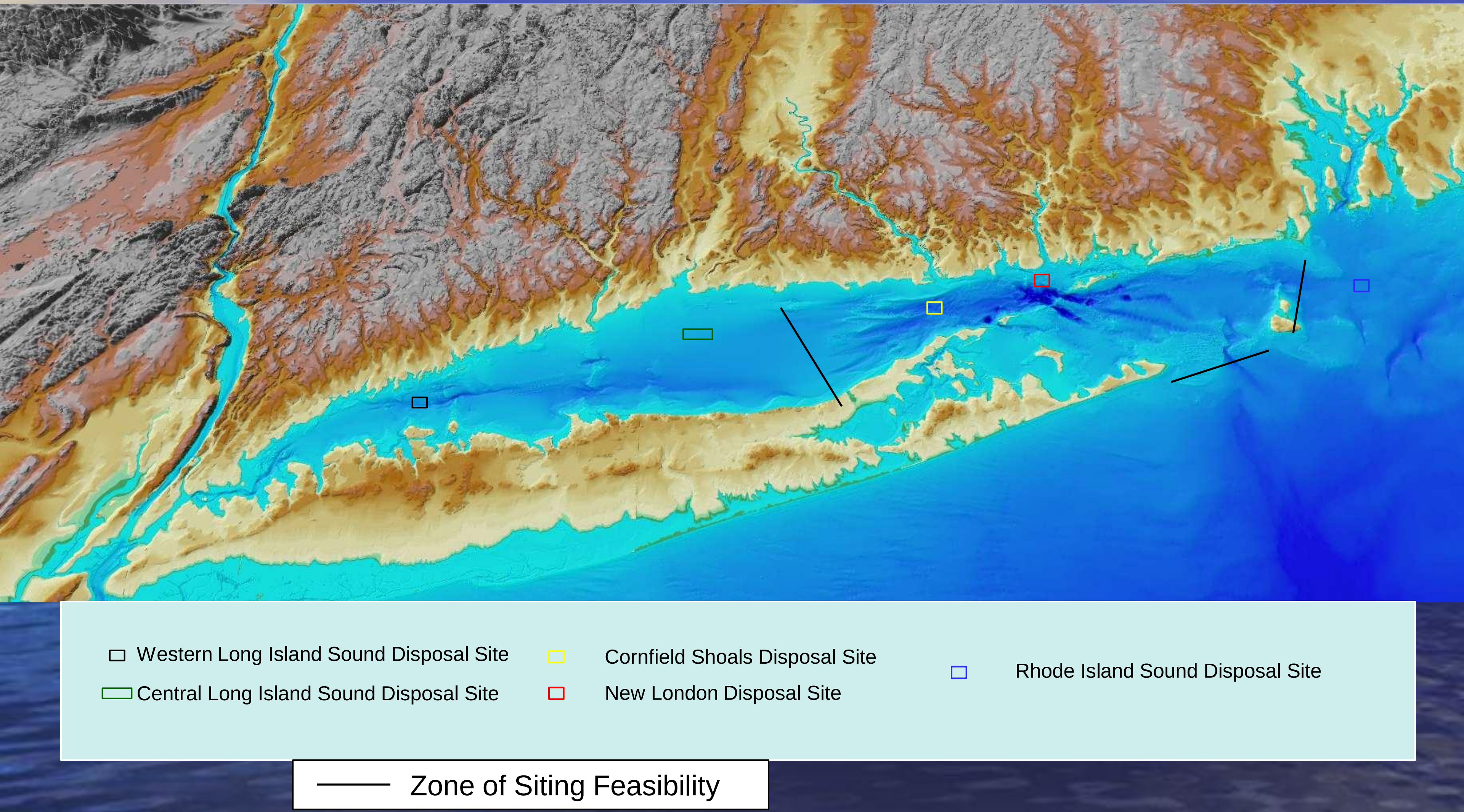
Designated by EPA in July 2005:

- Western Long Island Sound
- Central Long Island Sound

Selected by Corps in 1990s, scheduled to close December 2016:

- Cornfield Shoals
- New London

ELIS SEIS Process



EPA's Role in Dredging

- Designate ocean dredged material disposal sites for long-term use (following EPA's voluntary NEPA policy to prepare an EIS)
- Promulgate regulations and criteria for disposal site selection and permitting discharges
- Review USACE dredging projects and permits
- Develop site monitoring/management plans (SMMP)
- Monitor disposal sites jointly with Corps

Approach to Screening

- Screening Criteria for ocean dredged material site designation -

  Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA):

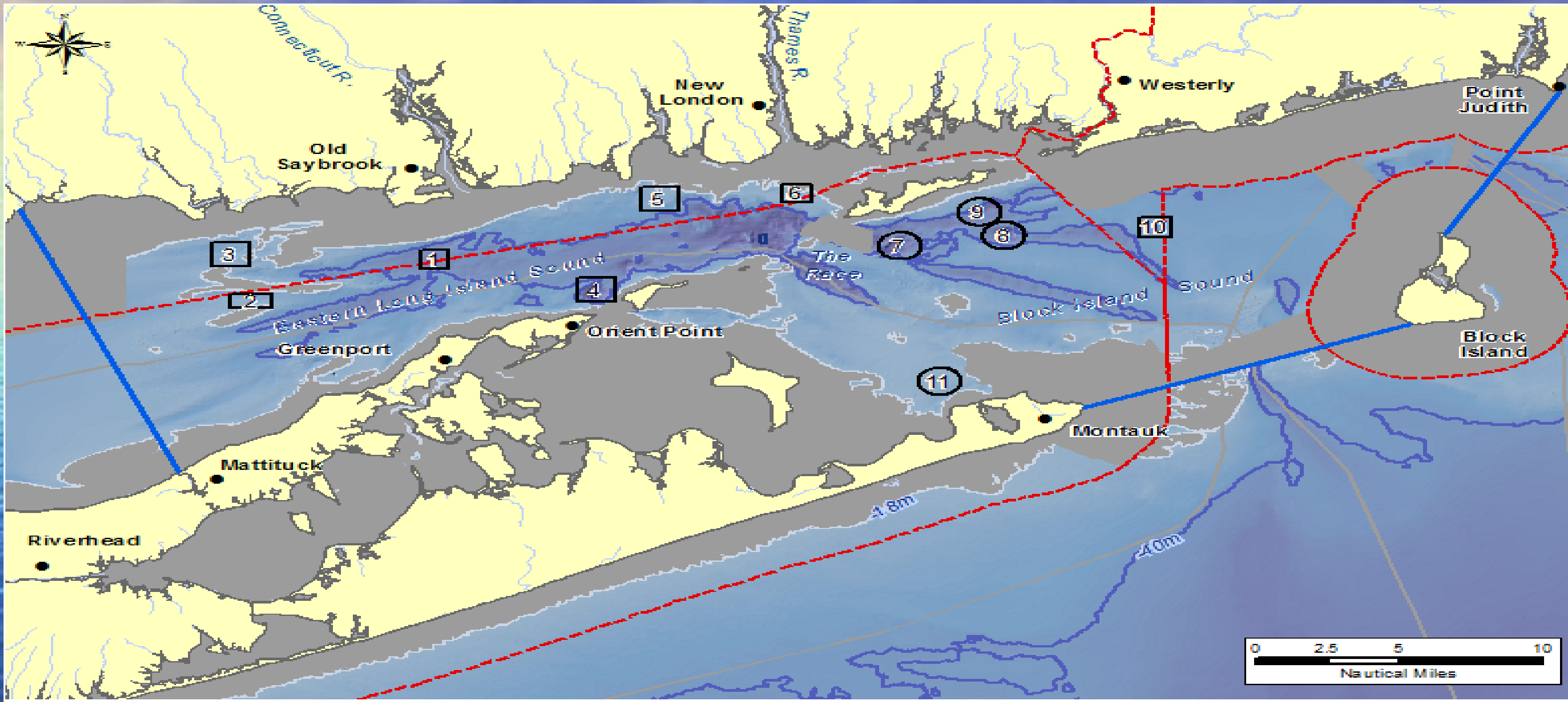
   5 general criteria (40 CFR 228.5)

  11 specific criteria (40 CFR 228.6)

Site Screening - Examples

- Sedimentary Environment
  - Bathymetry
  - Currents and Waves; Bottom Stress
  - Sediment Texture (resuspension potential; habitat)
- Areas of Conflicting uses
  - Infrastructure (cables, pipelines)
  - Navigation (shipping lanes, anchoring areas)
  - Recreation (areas and navigation)
  - Conservation Areas (sanctuaries, wildlife refuges, National Seashores, parks, artificial reefs, etc.)
  - Cultural and Archaeological Resources
- Biological Resources
  - Shellfish Beds
  - Benthic Community
  - Fish Habitat, Fish Concentrations, and Fishing Areas
  - Breeding, Spawning, Nursery, Feeding, and Passage Areas

ELIS SEIS – 11 sites for screening process



Legend

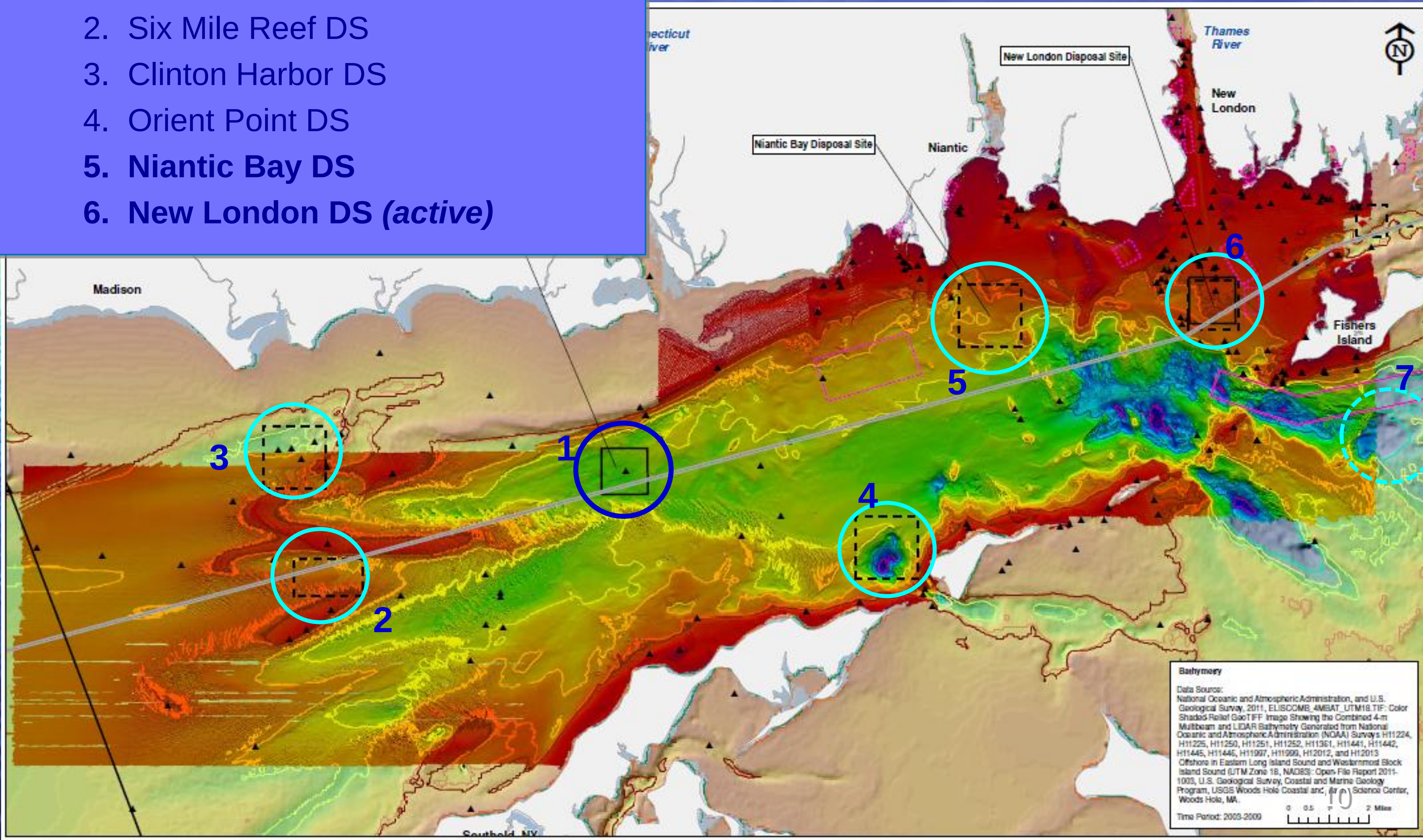
- Zone of Siting Feasibility
- State Boundary
- Potential Site
- Area Removed From Consideration

Depth (m): 0, -60, -120

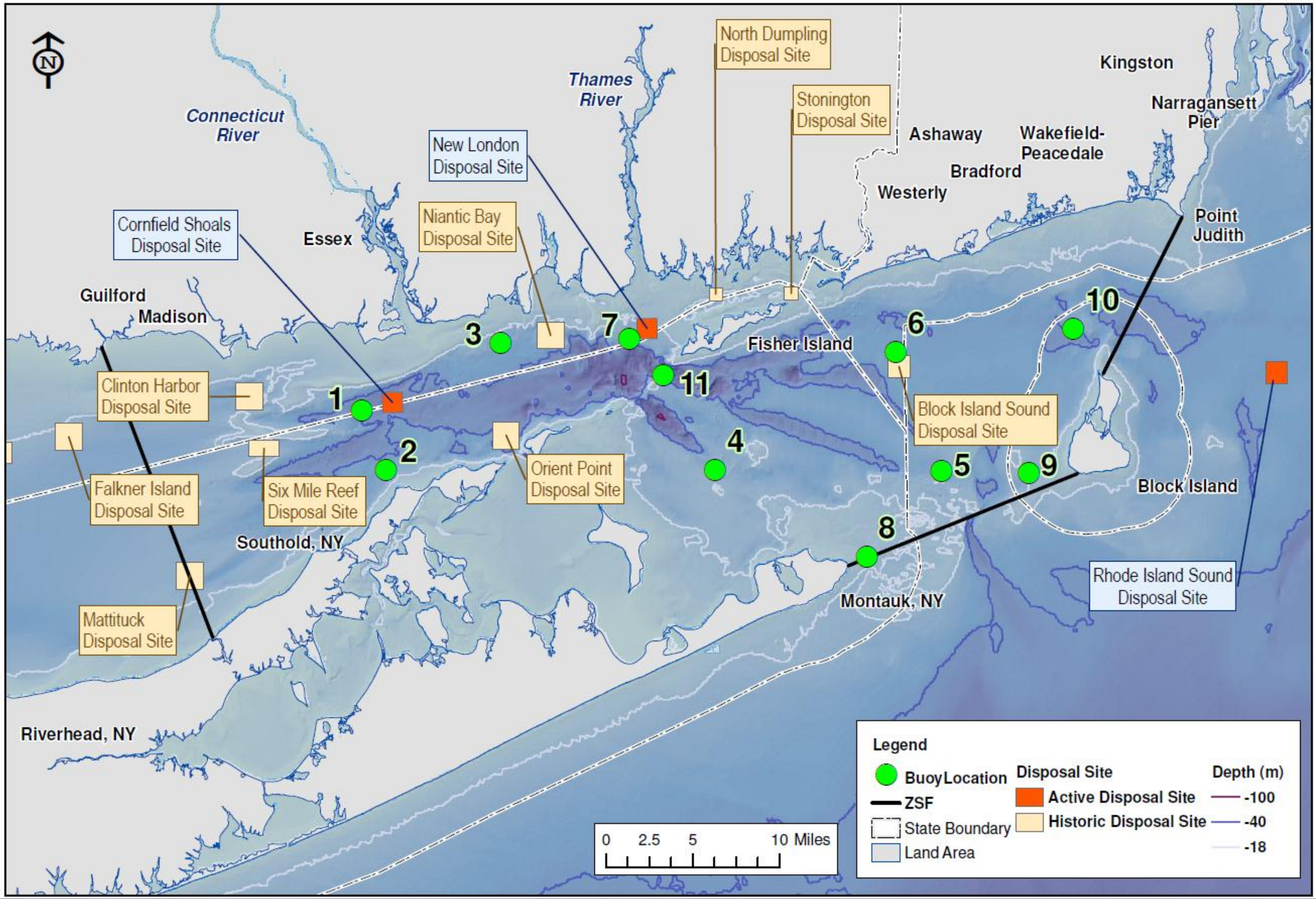
ID	Name of Initially Screened Site	Status
1	Cornfield Shoals Disposal Site	Active
2	Six Mile Reef Disposal Site	Historic
3	Clinton Harbor Disposal Site	Historic
4	Orient Point Disposal Site	Historic
5	Niantic Bay Disposal Site	Historic
6	New London Disposal Site	Active
7	Deep Hole South of Fishers Island - West	New
8	Deep Hole South of Fishers Island - East	New
9	Deep Hole South of Fishers Island - Center	New
10	Block Island Sound Disposal Site	Historic
11	Area North of Montauk	New

ELIS SEIS Process

1. **Cornfield Shoals DS (*active*)**
2. Six Mile Reef DS
3. Clinton Harbor DS
4. Orient Point DS
5. **Niantic Bay DS**
6. **New London DS (*active*)**



Physical Oceanography Study – Buoy Locations



ELIS SEIS Process

- Notice of Intent: published October 16, 2012.
- Cooperating agency and Public meetings in 2012 and 2013.
- EPA website revised: http://www.epa.gov/region1/eco/lisdreg/elis.html
- Email notification system, contact:

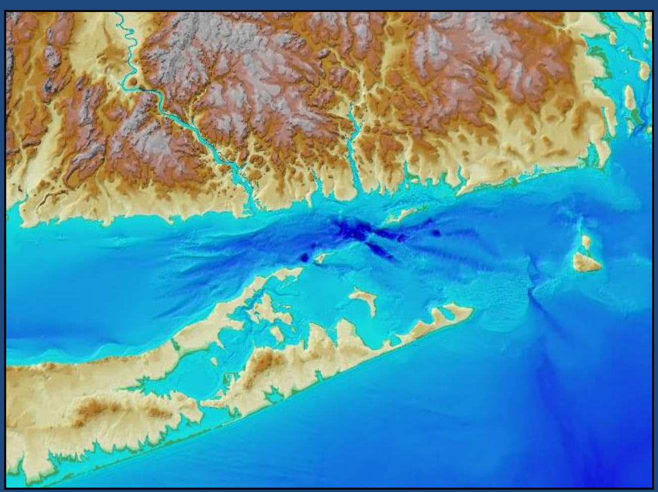
  ELIS@epa.gov if you would like to be added to the email distribution list.

Next Steps

- Draft ELIS SEIS/rulemaking - Spring 2015
- Public meetings – Spring 2015
- If SEIS recommends designation of one or more sites, publish final SEIS and rulemaking by December 2016.

Supplemental Environmental Impact Statement for the Designation of Dredged Material Disposal Site(s) in Eastern Long Island Sound, Connecticut and New York

Physical Oceanography of Eastern Long Island Sound Region



Prepared for: **U.S. Environmental Protection Agency**

Sponsored by: **Connecticut Department of Transportation**

Prepared by: **University of Connecticut**

with support from: **Louis Berger**

Public Meetings 5+6 (December 8+9, 2014)

Outline

1. Physical Oceanography in the ZSF – Purpose
2. Model: *Configure and test*
3. Evaluation of Simulations
   - Field Program: *Collect data (currents and stress etc.) at a set of stations that are expected to exhibit a wide range of conditions*
   - Model Performance: *Evaluate predictions of model with new data*
4. Analysis
5. Summary

Physical Oceanography

- Physical oceanography is the science that explains the patterns of ocean circulation and the distribution of properties such as temperature and salinity. Elements of physical oceanography include tides, currents, waves, and sediment transport.

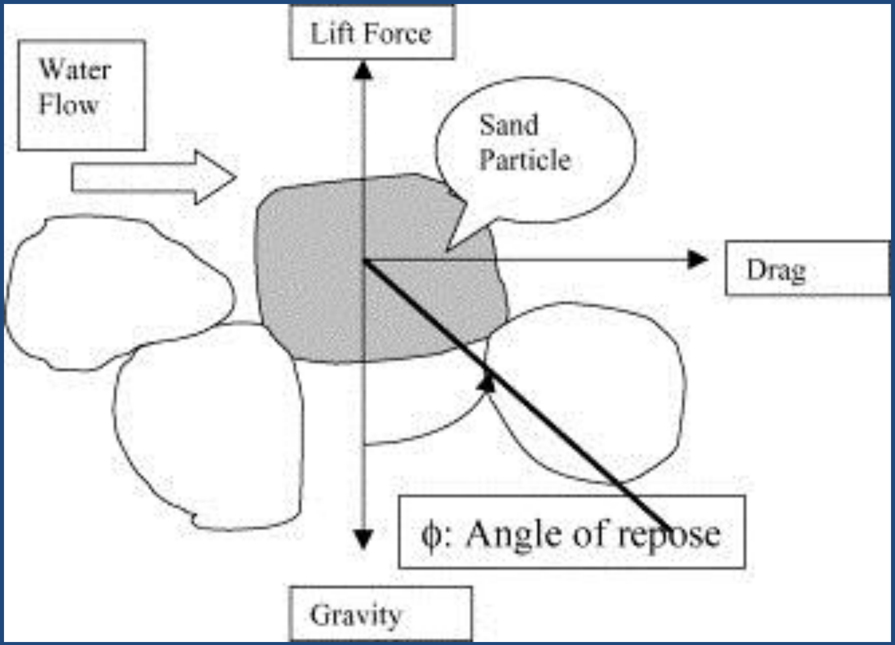
Of particular importance within this study are the factors governing boundary shear stress

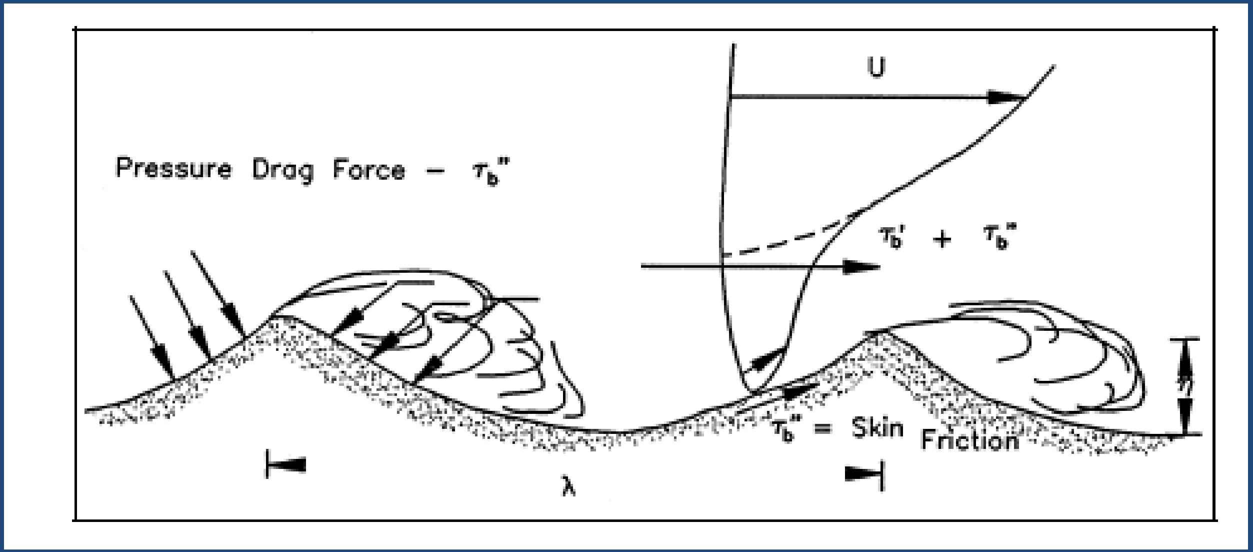
Sediment Transport

For sediment resuspension the lift force due to the flow around it must exceed the gravity force.

The lift and drag forces slow the water and this effective force per unit area is called the **shear stress**.

Bedforms have a similar effect on the flow… they slow it down.





Critical Erosion Stress

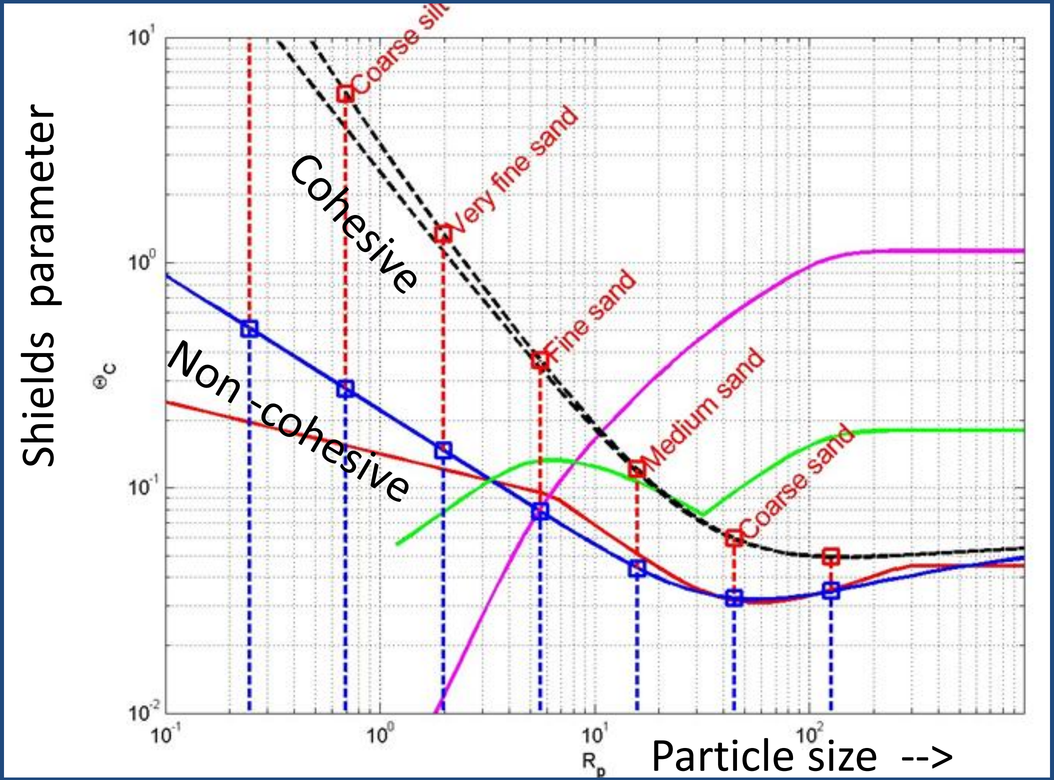


Figure 34. A graphical representation of the relationship between sediment particle size for cohesive and non-cohesive particles.

The red and blue solid lines are analytical representations of the critical Shields parameter, $\Theta_{c0} = \tau_{c0}/\rho_w sgd$, for non-cohesive sediments as a function of the particle Reynolds number. The black dashed lines show the influence of cohesion and adhesion on the critical value for the onset of particle motion.

The green and magenta lines show the critical values for the onset of sediment suspension as predicted by Bagnold (1966) and van Rijn (1984), respectively. The lower boundaries of the particle Reynolds numbers for traditional sediment classes (see Table 7) are shown by the blue dashed lines.

Particle Size and Critical Stress for Cohesive and Non-cohesive Sediments

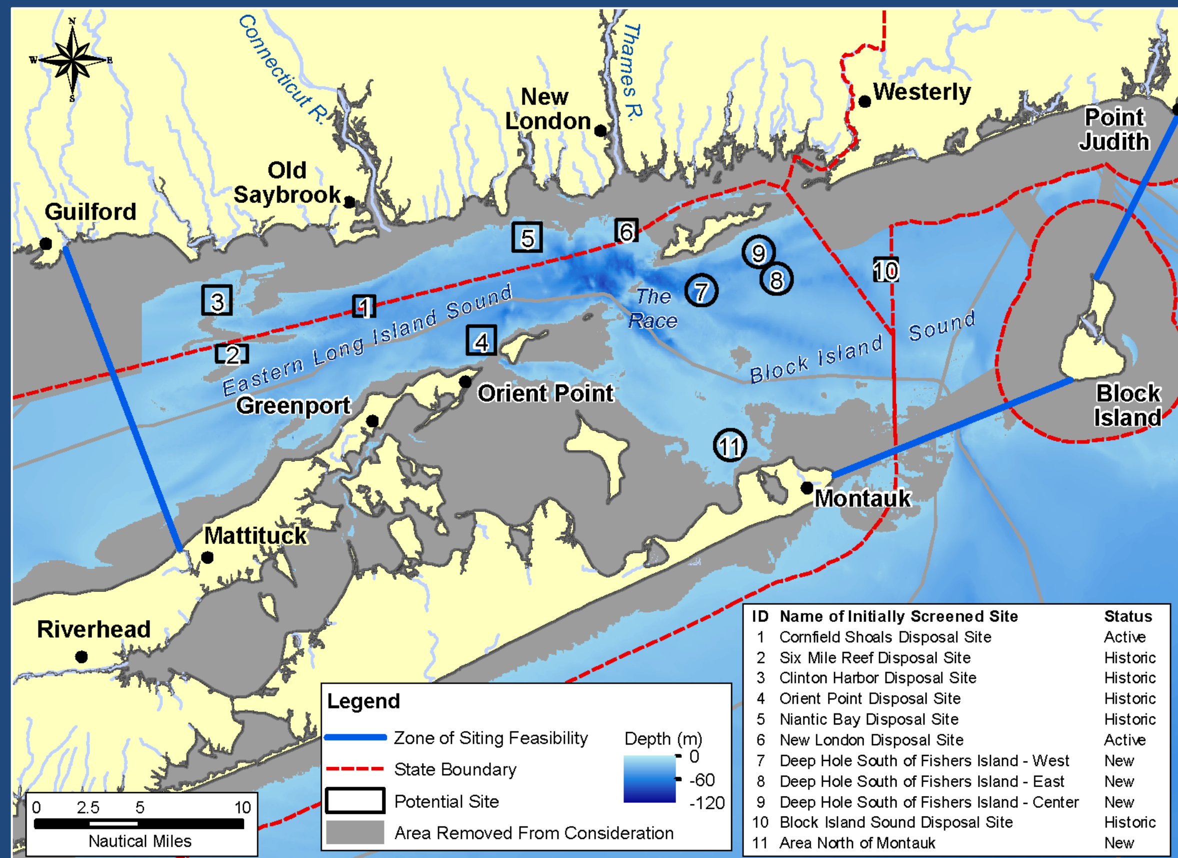
Size				Non-Cohesive Sediments			Cohesive Sediments		
	Particle Size		Reynolds Number	Critical Shields Parameter	Critical Stress	Critical Velocity	Critical Shields Parameter	Stress at the Initiation of Motion	Critical Velocity
Classification	Phi	d (mm)	R_p	Θ_{c0}	τ_{c0} (Pa)	$u_{1,0}$ (m/s)	Θ_c	τ_c (Pa)	u_1 (m/s)
Column No.	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Coarse sand	1-0	0.50	44.96	0.03	0.26	0.32	0.06	0.48	0.44
Medium sand	2-1	0.25	15.90	0.04	0.18	0.27	0.12	0.49	0.44
Fine sand	3-2	0.13	5.62	0.08	0.16	0.25	0.37	0.74	0.54
Very fine sand	4-3	0.06	1.99	0.15	0.15	0.24	1.33	1.35	0.73
Coarse silt	5-4	0.03	0.69	0.27	0.14	0.23	5.62	2.81	1.06
Medium silt	6-5	0.02	0.25	0.51	0.13	0.23	26.33	6.64	1.63
Fine silt	7-6	0.01	0.09	0.95	0.12	0.22	143.41	18.09	2.69

Notes: Columns 5 to 7 provide example magnitudes of the critical shields parameter, Θ_{c0}, for non-cohesive sediments and the stress τ_{c0} at the initiation of motion for the lower bounds for specific particle size classes listed on the left. An estimate of the magnitude of the required current at 1m above the sea floor required to create the critical stress for non-cohesive sediments is provided as $u_{1,0} = \sqrt{\tau_{c0} / \rho C_d}$ where $C_d = 2.5 \times 10^{-3}$ is assumed. Analogous estimates for cohesive sediments are provided Columns 8 to 10 based on the theory presented by Righetti and Lucarelli (2007). Values shaded in blue are extrapolations beyond the range of particle sizes used in parameterization.

Objective of PO Study

Support evaluation and selection of potential dredged material disposal sites within the Zone of Siting Feasibility (ZSF)

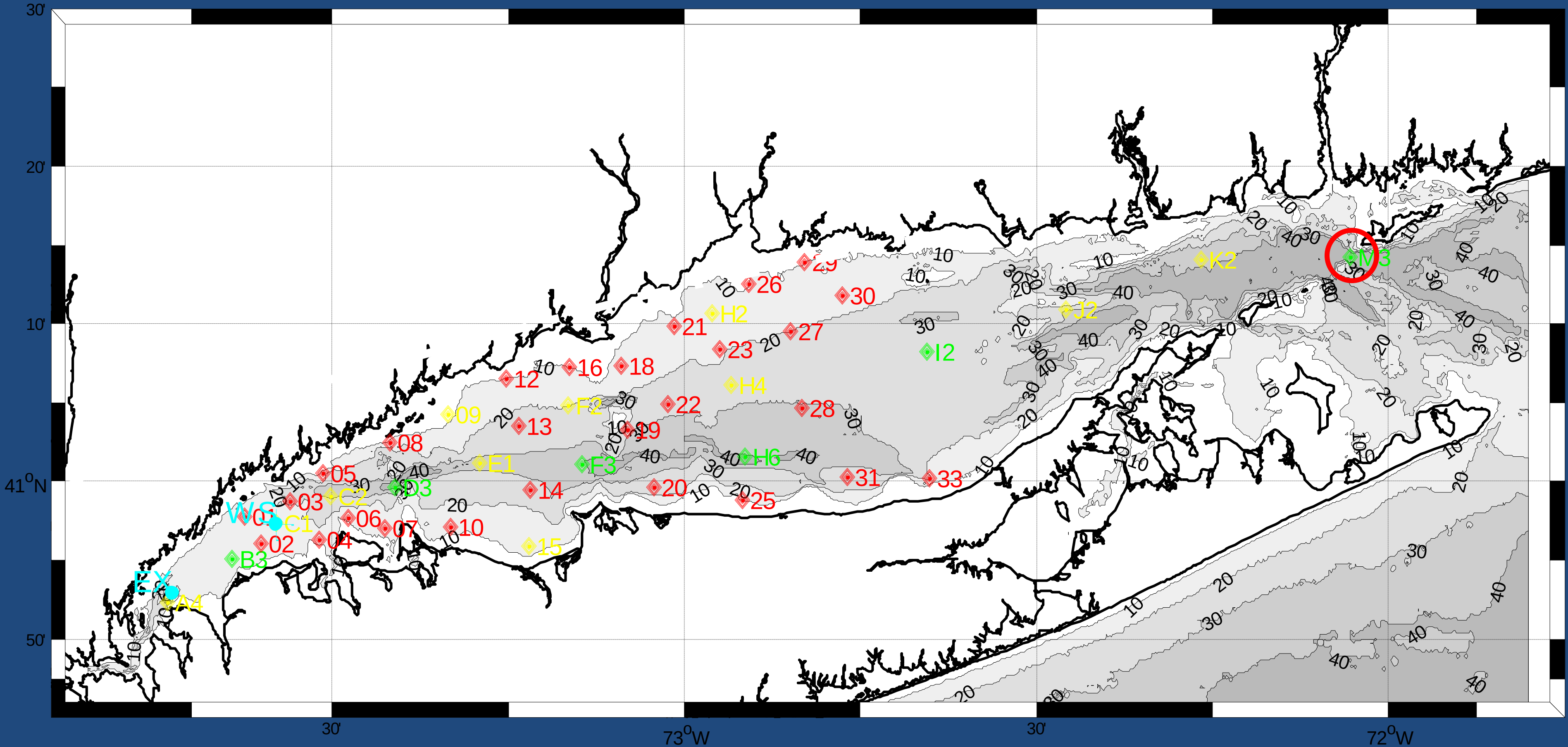
- Describe distribution of maximum bottom stress magnitudes expected in the ZSF including 'Superstorm Sandy' conditions (100-year storm)
- Characterize circulation in the ZSF to support assessment of potential off-site effects
- Acquire physical oceanography data to support future modeling of sediment transport at potential dredged material disposal sites



Zone of Siting Feasibility (ZSF). Initial screening identified (1) areas not suitable for locating dredged material disposal sites due to various constraints (gray zone), and (2) 11 sites for further investigation as potential disposal sites; these sites include two active and five historic disposal sites, and six 'new' sites not previously used for dredged material disposal. The background represents water depth.

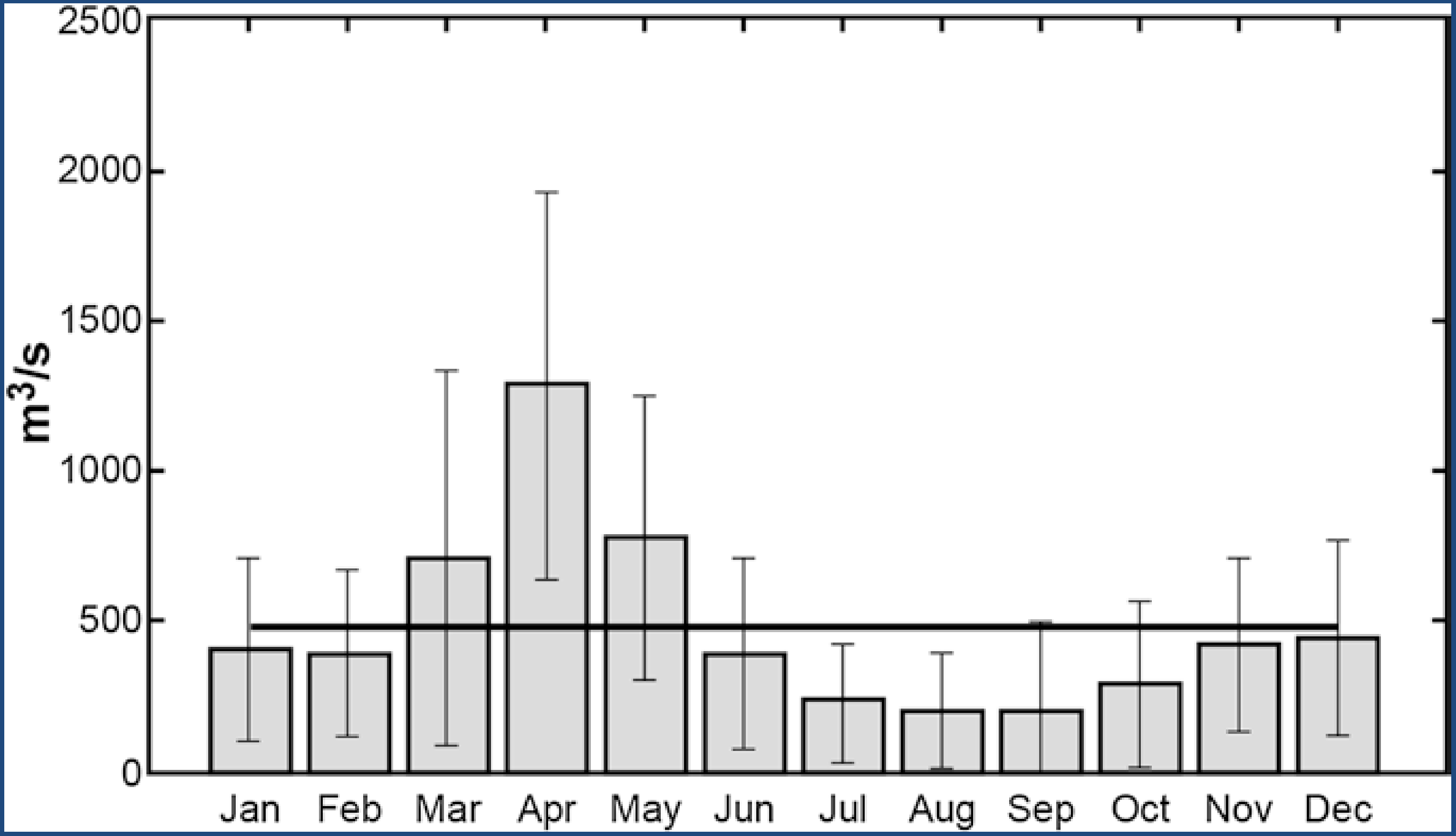
Regional Temperature and Salinity

CTDEEP – EPA Long Island Sound Study Ship Survey Stations

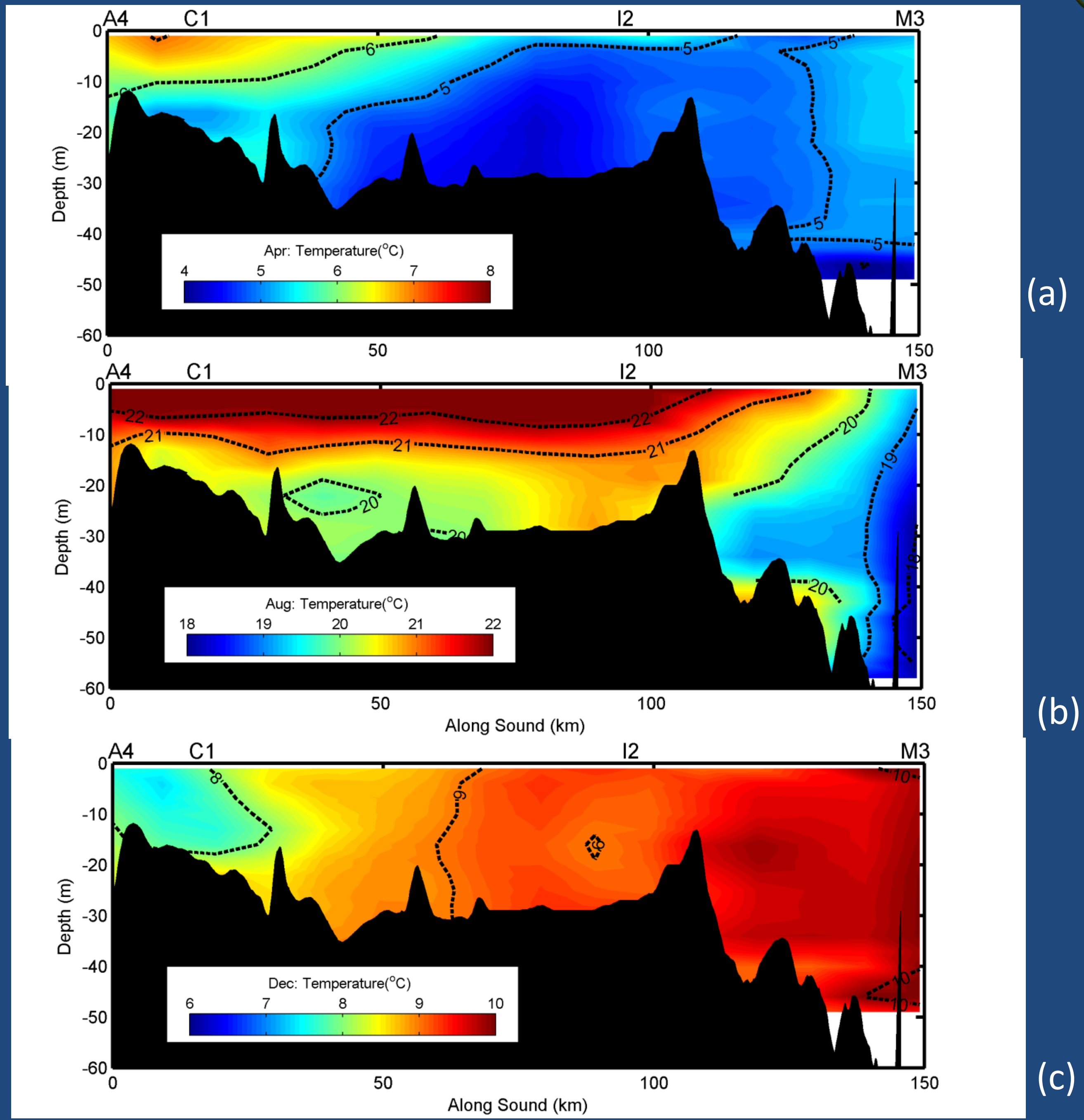


River Inflow

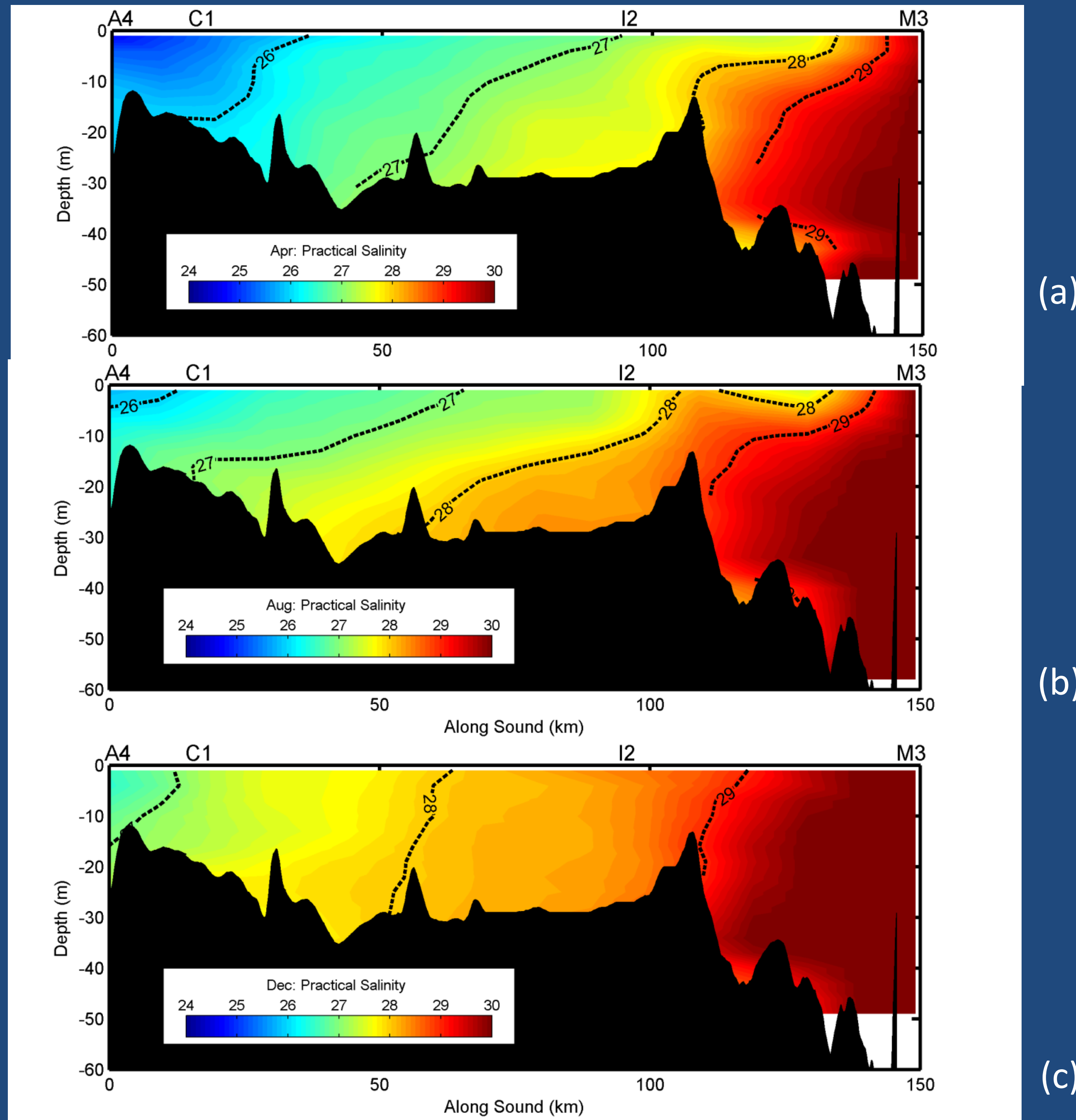
Monthly Discharge of Connecticut Rivers (~80% of total inflow to Long Island Sound)



Water Tempe-rature



Salinity



A4
C1
I2
M3
Depth (m)
0
-10
-20
-30
-40
-50
-60
0
50
100
150
26
27
28
29
Apr: Practical Salinity
24 25 26 27 28 29 30
(a)
A4
C1
I2
M3
Depth (m)
Aug: Practical Salinity
24 25 26 27 28 29 30
Along Sound (km)
(b)
A4
C1
I2
M3
Depth (m)
Dec: Practical Salinity
24 25 26 27 28 29 30
Along Sound (km)
(c)

Tidal Current Oscillations

- 00:00 AM

Tidal Current Oscillations

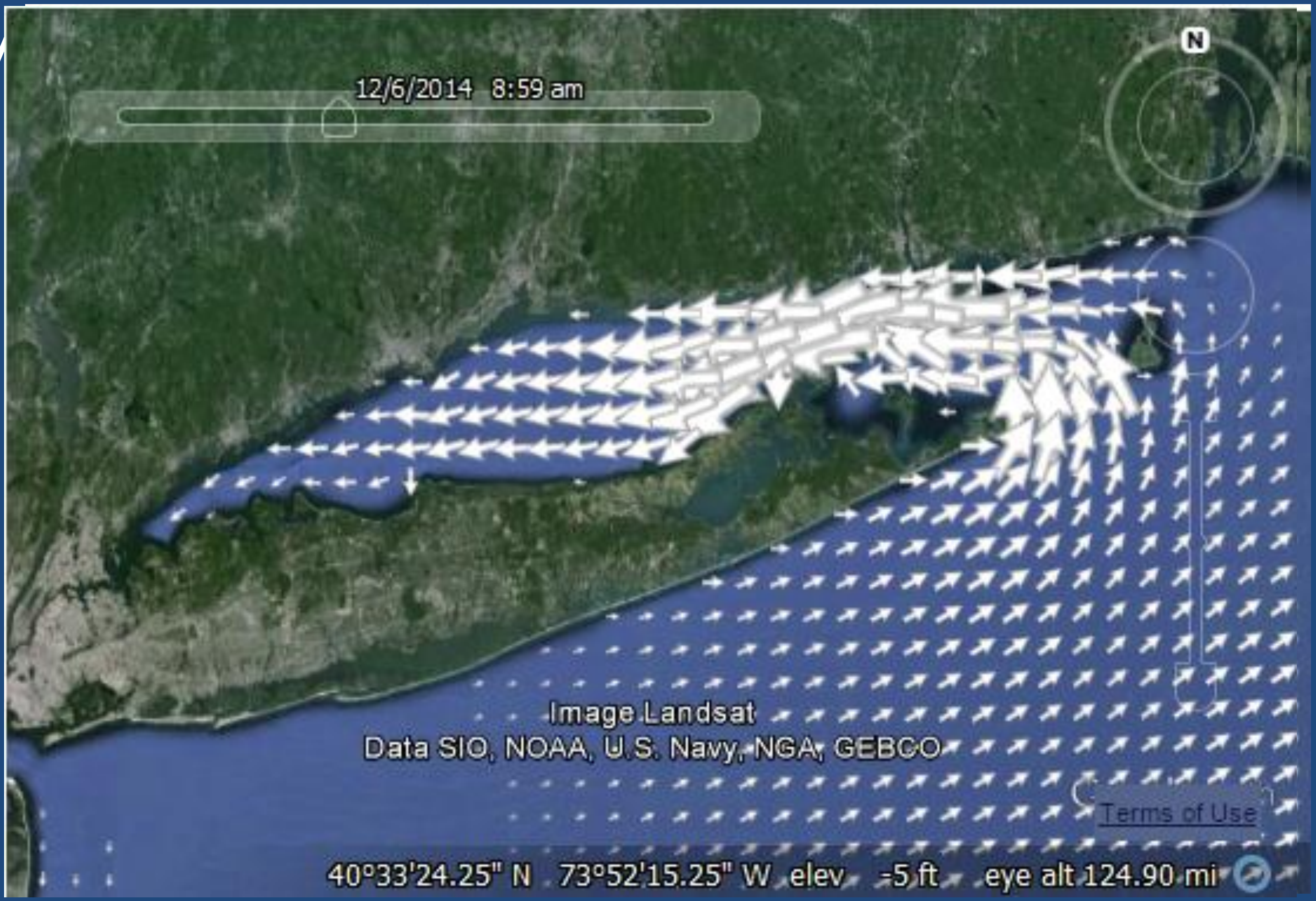
- 03:00 AM

Tidal Current Oscillations

- 06:00 AM

Tidal Current Oscillations

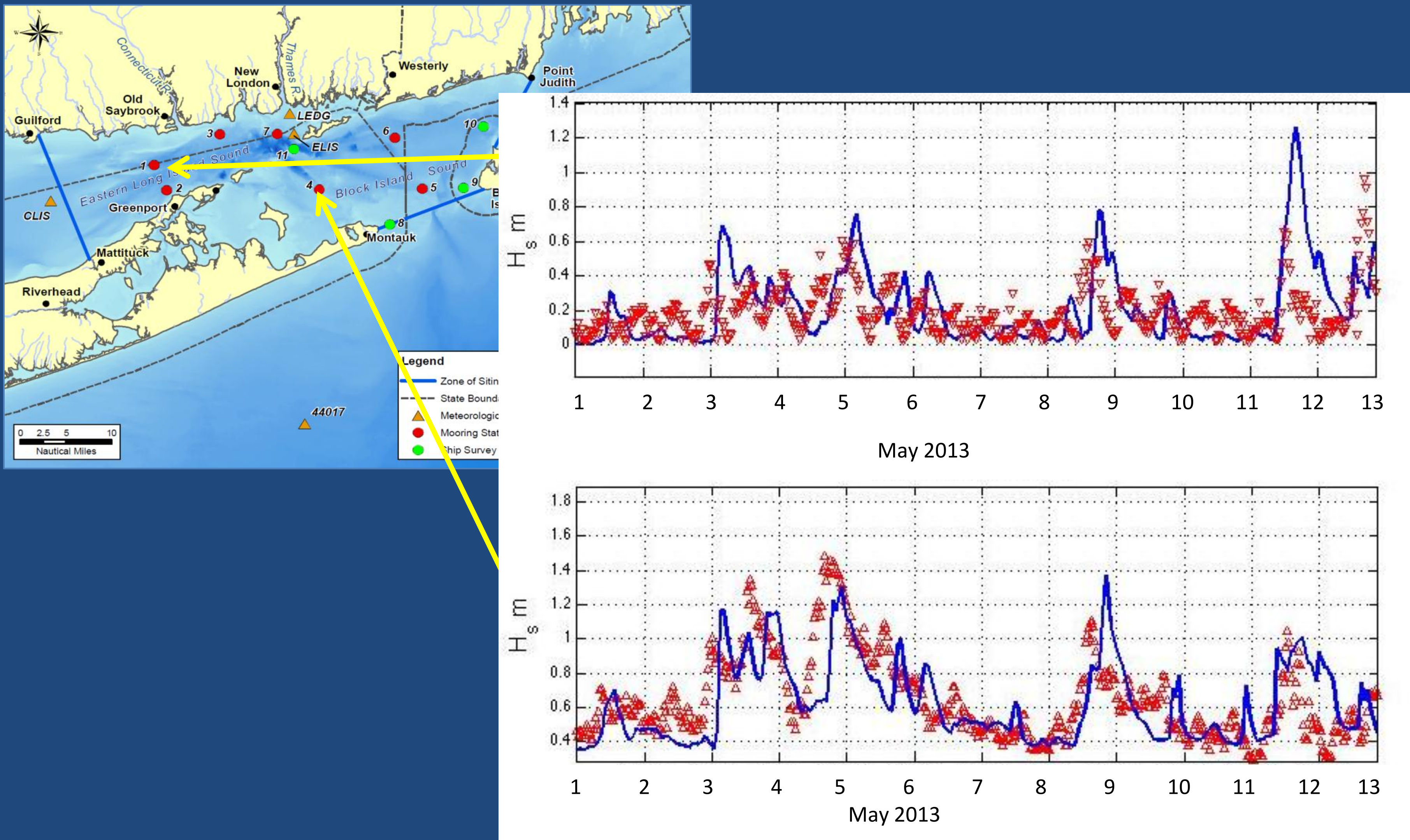
- 09:00 AM



Tidal Current Oscillations

- 12:00 AM

Significant Wave Height Observations *(red)*



Comparison of model and observed significant wave height at Stations DOT1 (upper panel) and DOT4 (lower panel) during May 2013.

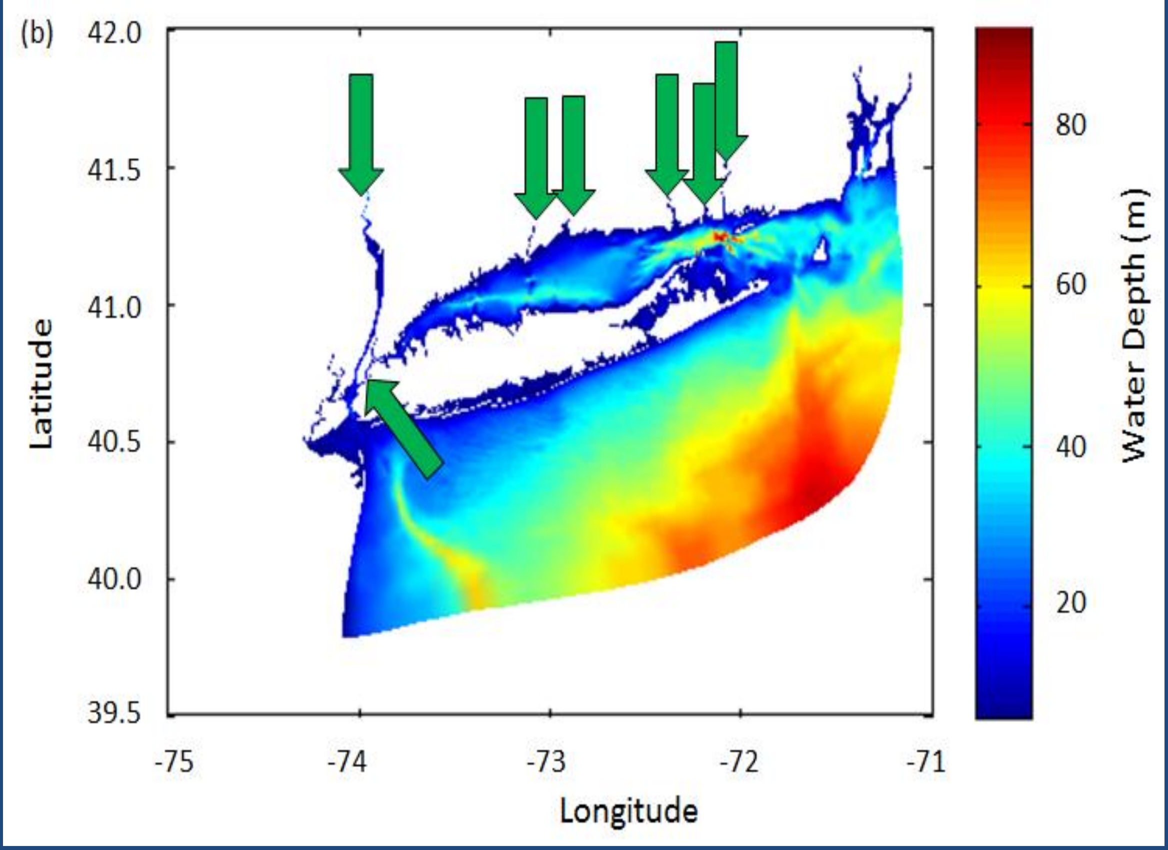
2. Model – Questions for Study

- What is the distribution and spatial variation in the bottom stress?
- Where are the regions in which the maximum stresses are smallest?
- Where does material in the water at potential sites go?

2. Model

FVCOM - Finite Volume Community Ocean Model

- Developed by Prof. Chen, Univ. of Massachusetts, adapted for Long Island Sound
- Nested within NECOFS (Northeast Coastal Ocean Forecast System)
- Forced by:
  - Tides
  - Observed River flow and wind
  - Climatology for surface heat exchange
  - Climatology for initial conditions



Bathymetry of the LIS model subdomain with the locations of freshwater sources (green arrows; from left to right: Hudson River, New York City wastewater treatment plants , Housatonic River, Quinnipiac River, Connecticut River, Niantic River, and Thames River).

2. Model *(cont.)*

An Unstructured Grid, Finite-Volume, Three-Dimensional, Primitive Equations Ocean Model: Application to Coastal Ocean and Estuaries

CHANGSHENG CHEN AND HEDONG LIU

School for Marine Science and Technology, University of Massachusetts–Dartmouth, New Bedford, Massachusetts

ROBERT C. BEARDSLEY

Department of Physical Oceanography, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

The “Model” is based on Newton’s laws.

It predicts the water velocity, level, temperature and salinity.

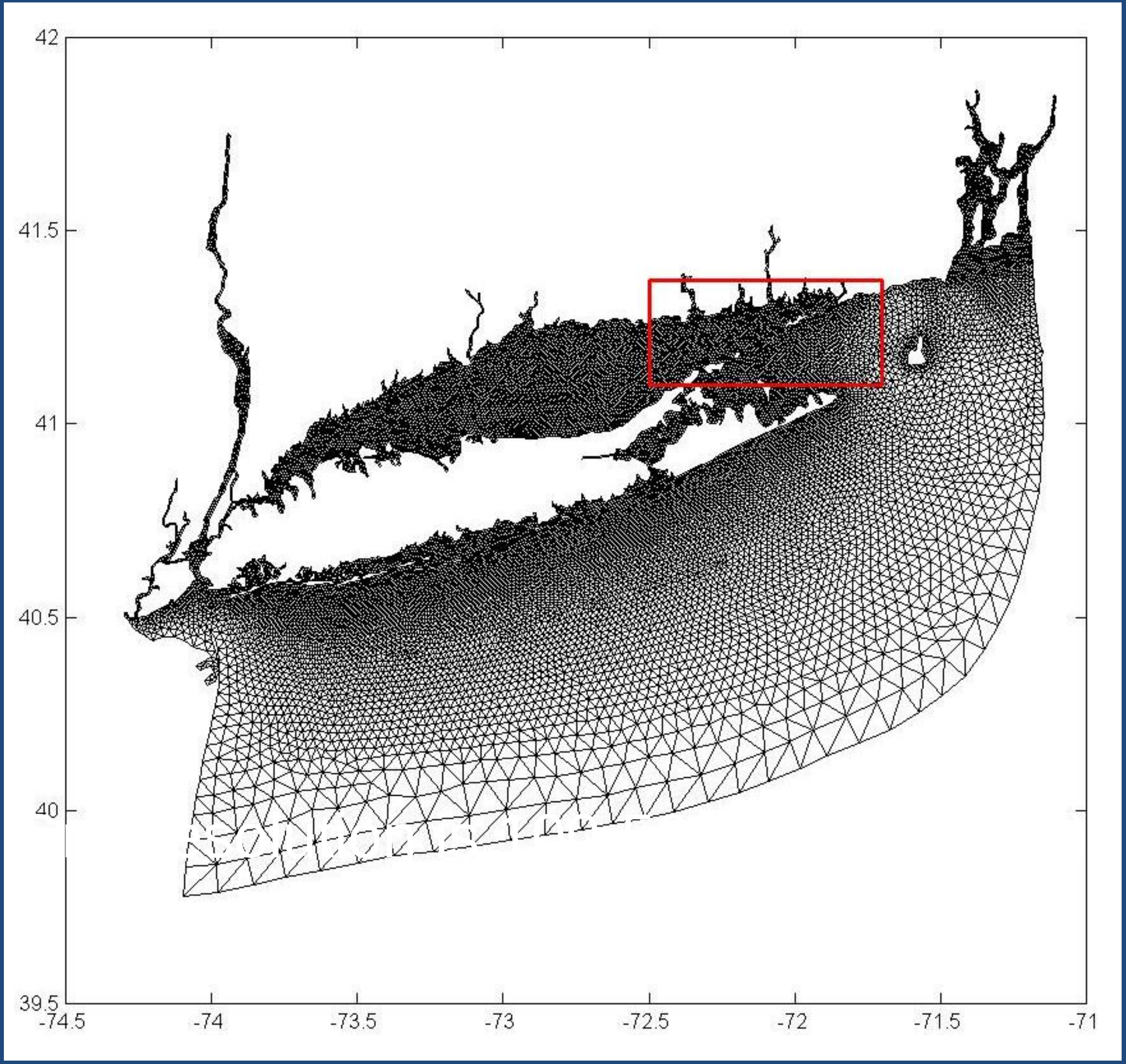
The bottom stress magnitude is computed from the formula

$$\tau = \rho C_D (u^2 + v^2)$$

Where the coefficient $C_{D,}$ is called the DRAG COEFFICIENT.

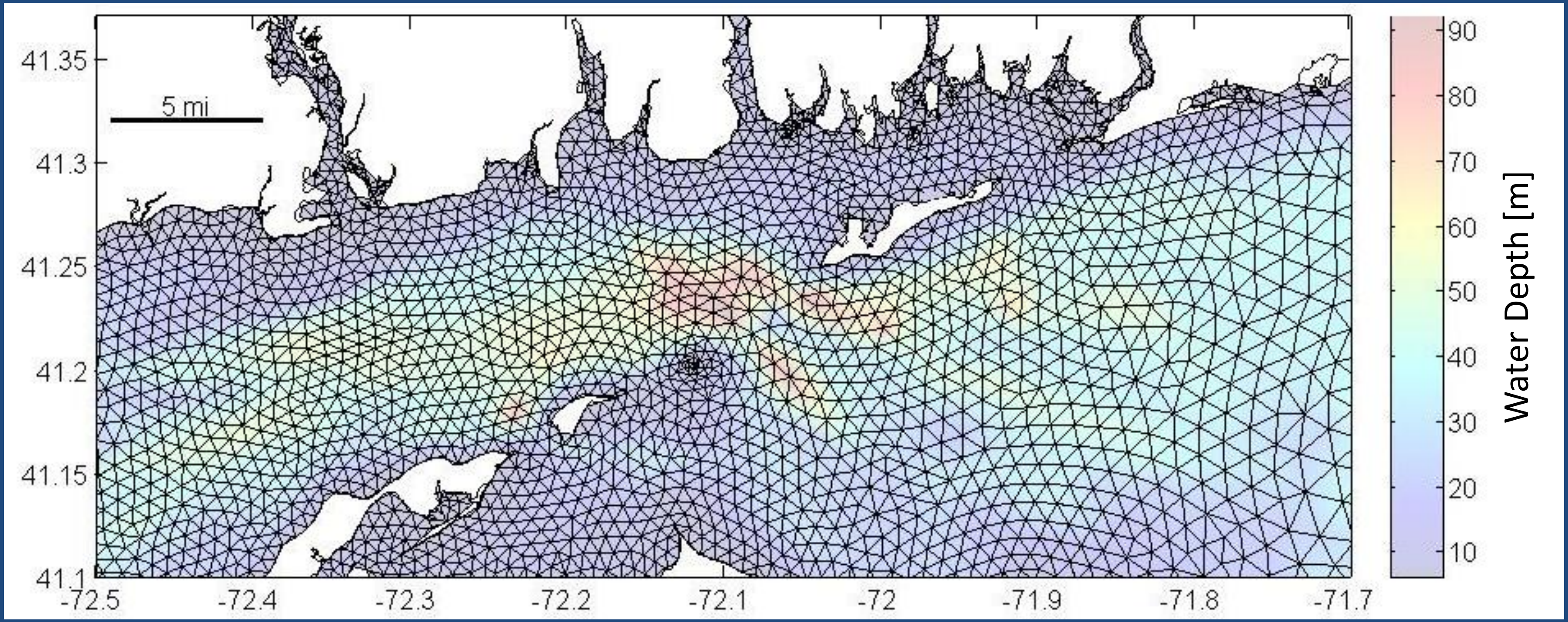
2. Model *(cont.)*

FVCOM runs on an unstructured triangular grid (mesh)



2. Model *(cont.)*

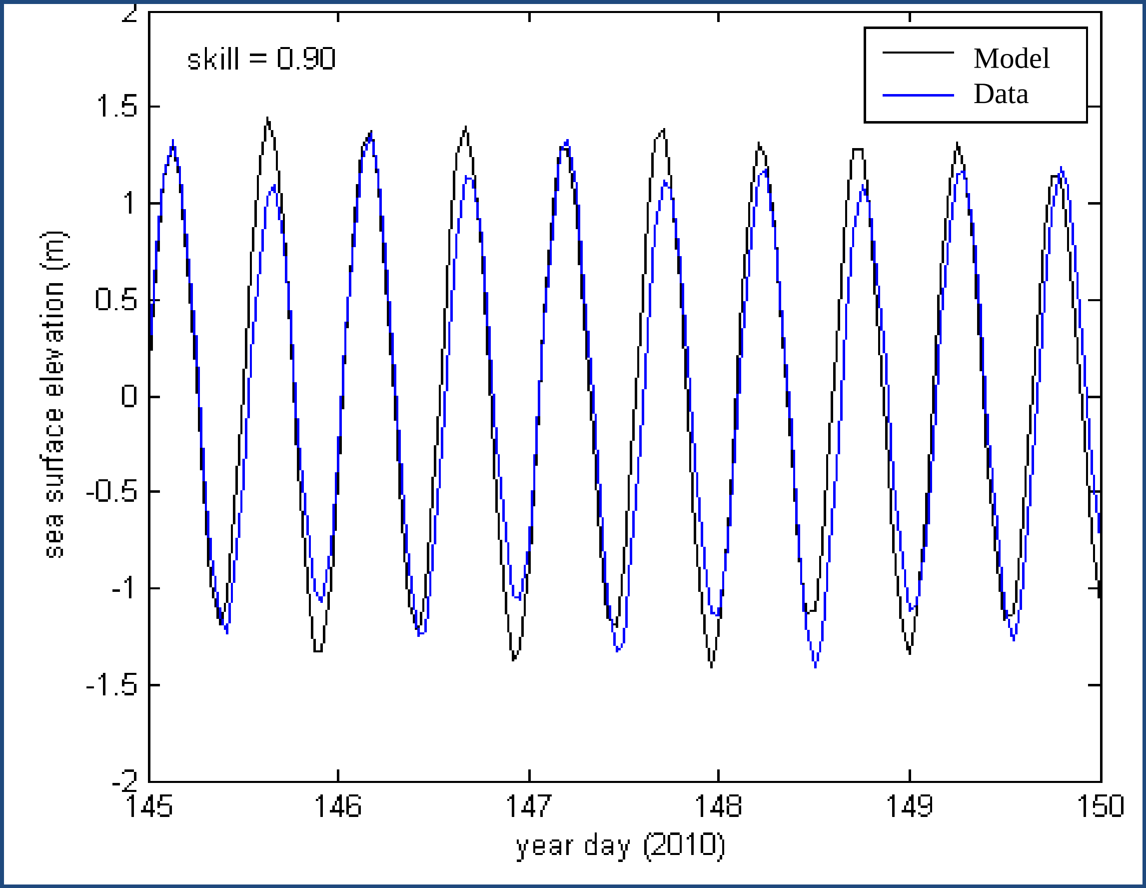
FVCOM runs on an unstructured triangular grid (mesh)



Grid resolution is 100-500 m (~ ¼ mile)

2. Model Calibration

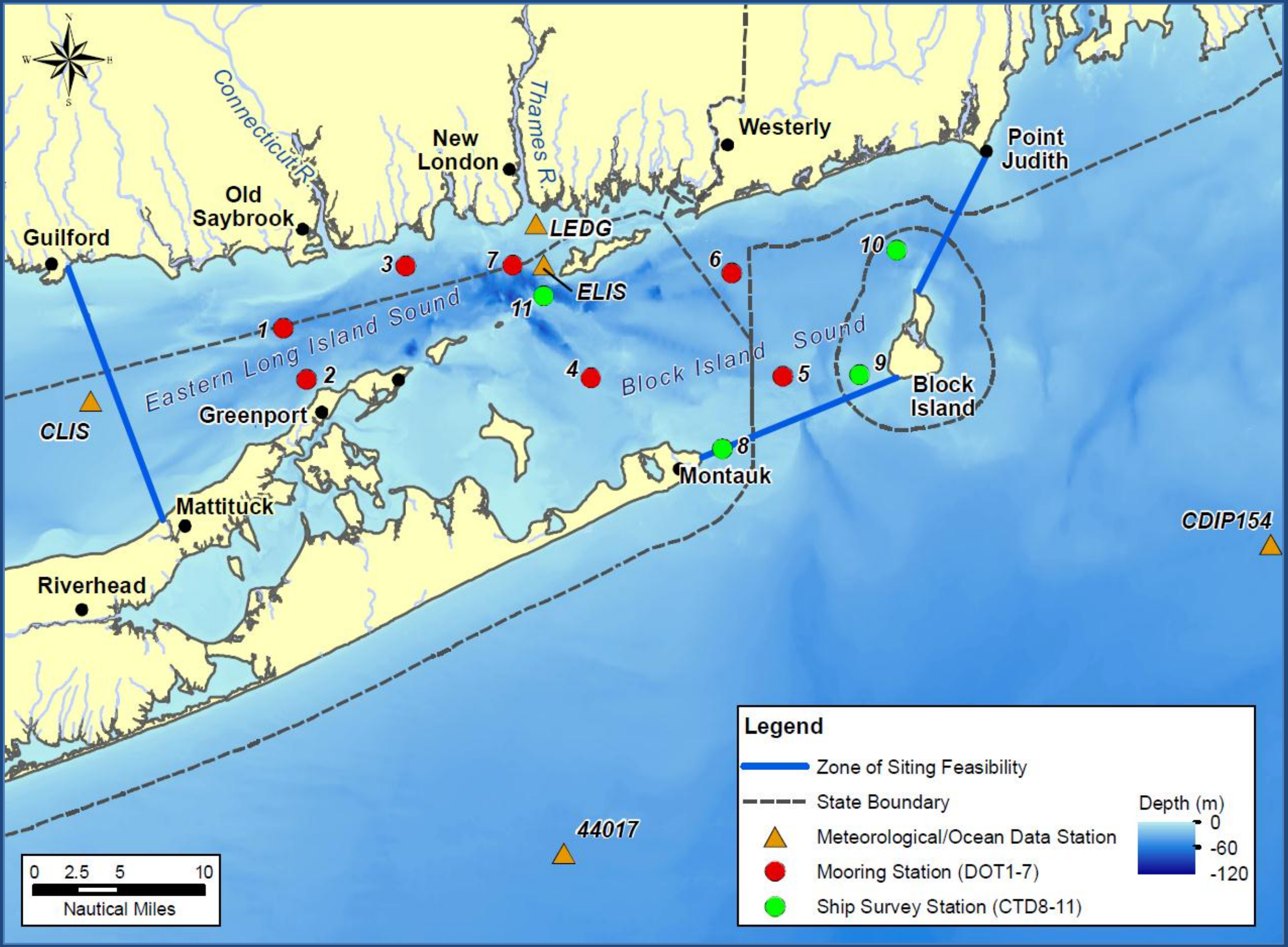
- Optimize the simulation of sea level, temperature, and salinity compared to observations
- Determine the Skill (variance in data explained/variance in data) to be 90%



Comparison of tidal heights at the NOAA Bridgeport tidal height gauge (BDR, blue) compared to those predicted by the FVCOM model (black) after iteratively calibrating the model using the 2010 NOAA data . Note that year day 1 is January 1, 2010.

3. Evaluation – Field Program

- Deploy instruments on 7 bottom tripods for 3 two-month observation campaigns to observe spring, fall winter conditions at locations having differing stresses etc
- Conduct 6 cruises with water column measurements at the 7 tripod stations and 4 additional stations



Survey stations in the ZSF, as well as meteorological/ocean stations. The background represents water depth.

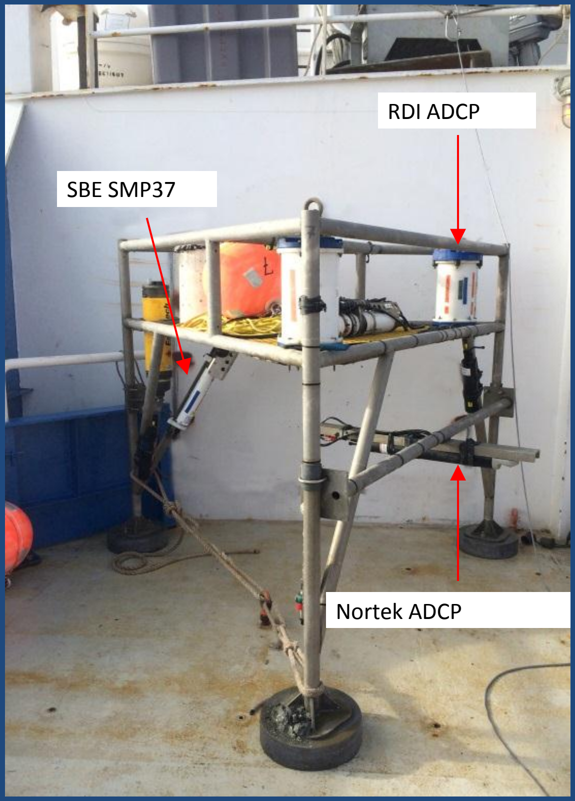
Survey periods

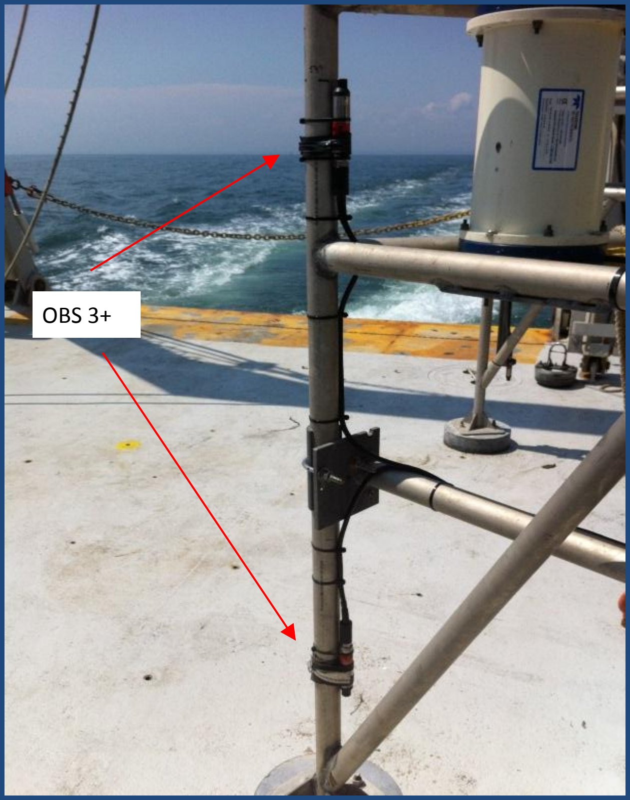
Campaign	Period	Interval	Conditions
1	Spring	March 12 - May 17, 2013 *(66 days)*	High river flow High wind
2	Summer	June 11 – Aug. 8, 2013 *(58 days)*	Low river flow, Low wind
3	Winter	Nov. 20, 2013 – Jan. 16, 2014 *(57 days)*	Low river flow, High wind

Moored Instruments

Sensors:

- Water column currents and waves
  (upward looking RDI ADCP)
- Currents near Seafloor - Stress
  (downward looking Nortek ADCP)
- Suspended sediment concentration
  (2 optical backscatter OBS3+)
- Salinity and temperature
  (CTD SBE SMP37)

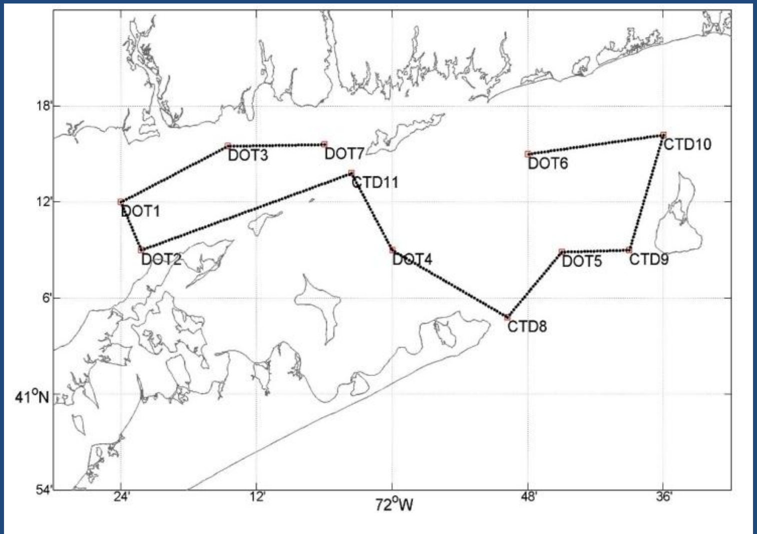




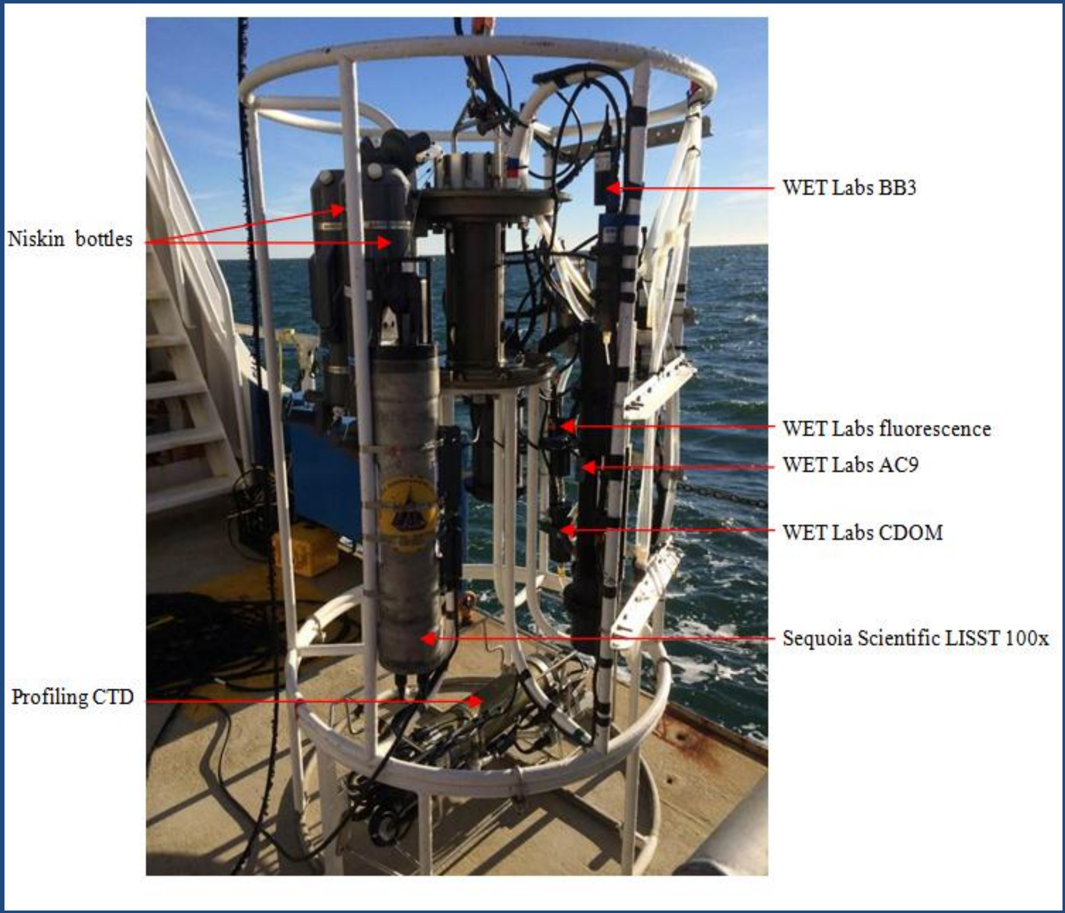
Left: Location of instruments in moored tripod frame
Right: Close-up of the OBS3+ mounts

Ship Surveys

- Temperature and salinity
  (Profiling CTD)
- Suspended sediment
  (WET Labs sensors)
- Water sampling
- Sediment Sampling

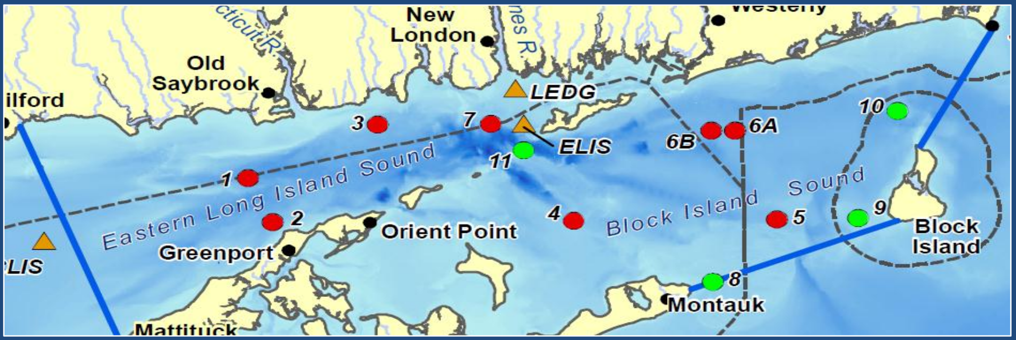


Example of a cruise track for ship surveys. The track varied for each cruise due to weather conditions and sea state.



Rosette sampler, equipped with a profiling CTD, Water samplers, and various optical sensors and particle analyzers.

Data Recovery



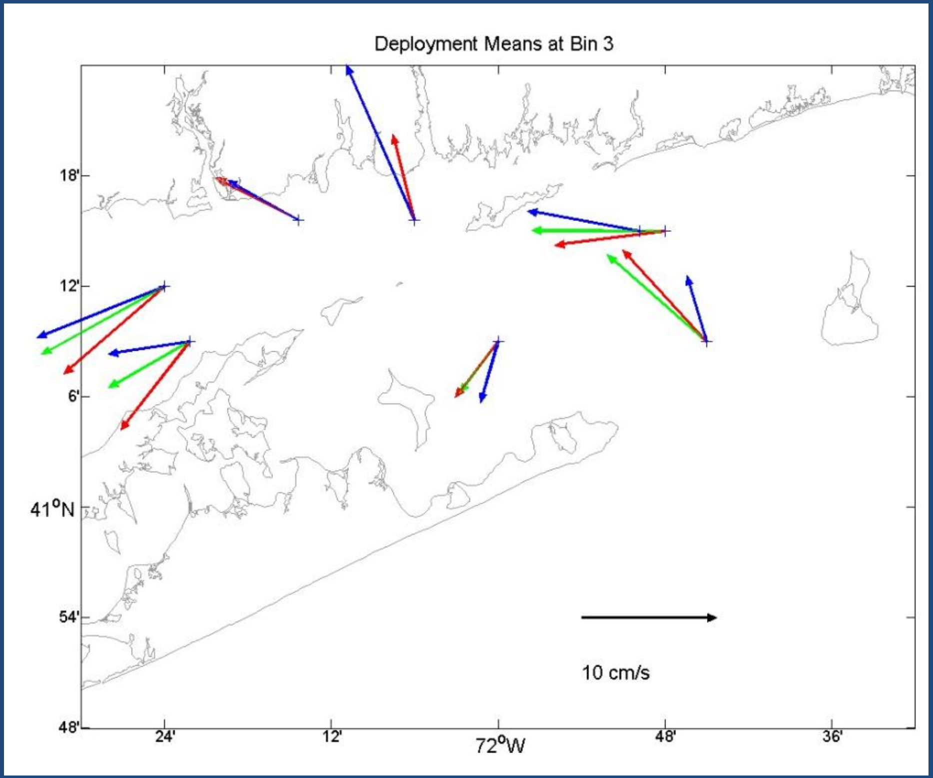
For Moored Stations

Parameters	Temperature and Salinity near the Seafloor				Currents and Suspended Sediment near the Seafloor				Waves and Currents in the Water Column			
Sensor	*CTD (SBE SMP37)*				*Nortek ADCP & OBS3+ sensor*				*RDI ADCP*			
Mooring Stn	Campaign			Total	Campaign			Total	Campaign			Total
	1	2	3		1	2	3		1	2	3	
	days				days				days			
DOT1	66	58	57	181	25	29	54	108	66	58	57	181
DOT2	66	58	57	181	25	27	54	106	66	58	57	181
DOT3	66	58	57	181	24	32	53	110	0	58	57	115
DOT4	66	58	57	181	27	34	56	117	66	58	57	181
DOT5	66	58	57	181	27	30	57	114	66	58	57	181
DOT6 A/B	66	58	43	167	25	16	44	86	28	16	43	87
DOT7	49	58	57	164	28	34	27	89	0	58	57	115
Max Days	*66*	*58*	*57*	*181*	*66*	*58*	*57*	*181*	*66*	*58*	*57*	*181*

Full or near-full data (>90%)
About half or more data (45 - 90%)
About one quarter or more data (22.5 - 45%)
No data

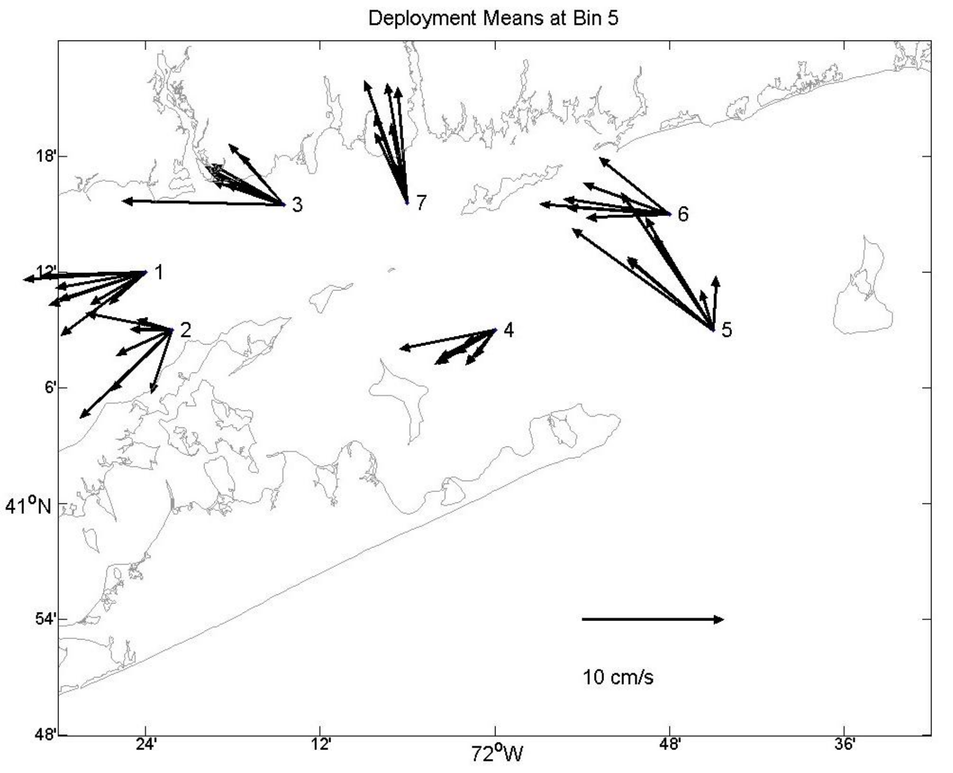
Example of Observations – mean flow near the bottom

RDI ADCP means at ~3m from seafloor



Mean currents at Bin 3 of the RDI ADCP measurements during Campaigns 1 (green), 2 (red), and 3 (blue).

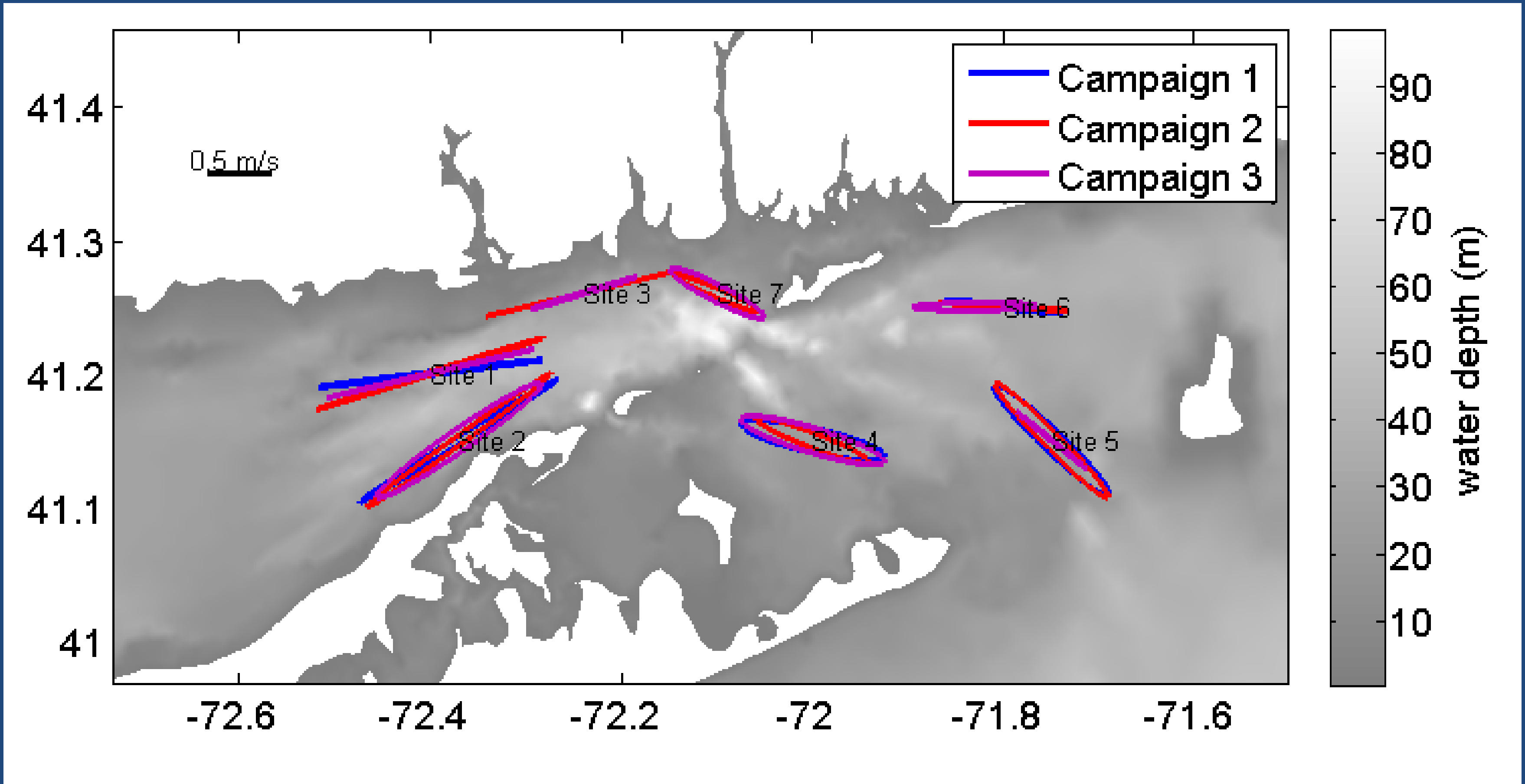
Nortek ADCP means at ~0.6m from seafloor



Mean velocity vectors at each moored station from the Nortek ADCP near the seafloor. The velocity scale is shown on graphic.

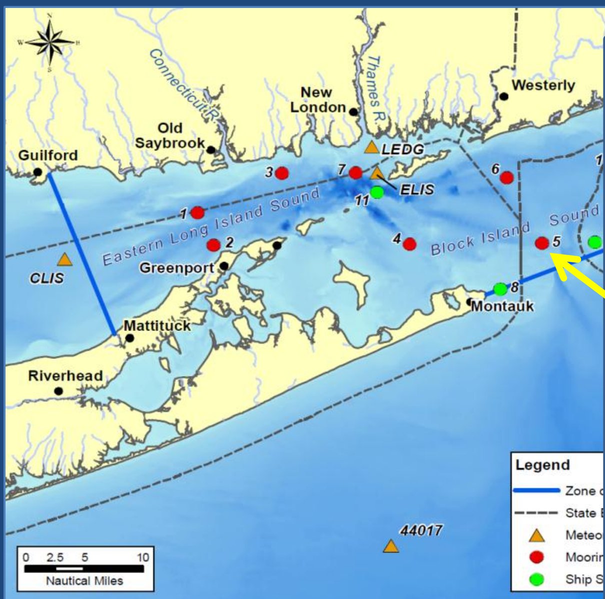
Tidal Current (M2) Amplitudes

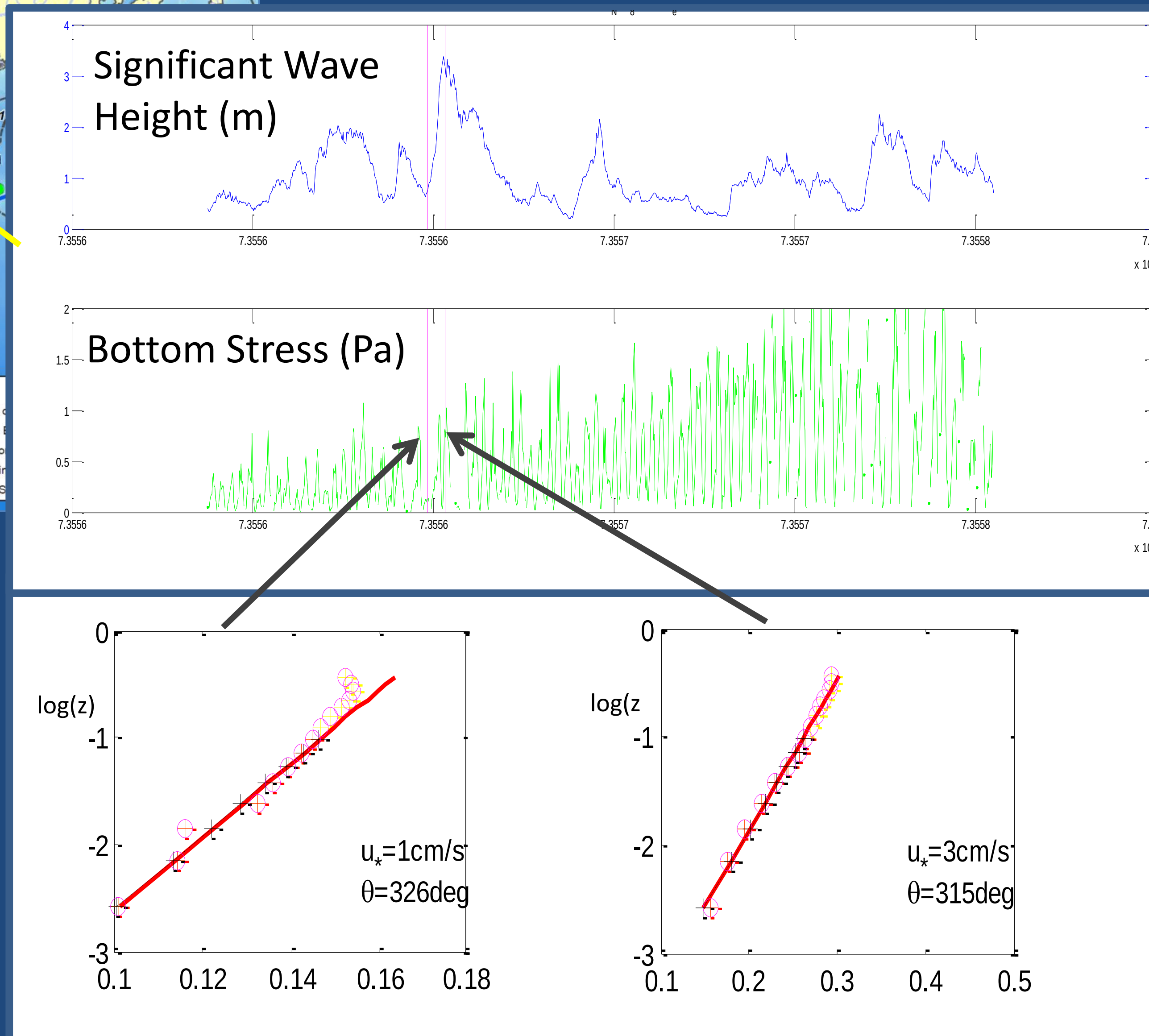
M2 Tidal Constituents



M2 ellipses for depth-average velocities from RDI ADCP measurements from the three campaigns (colors) and for FVCOM model (black) at all seven DOT stations. The grey shading represents mean water depth.

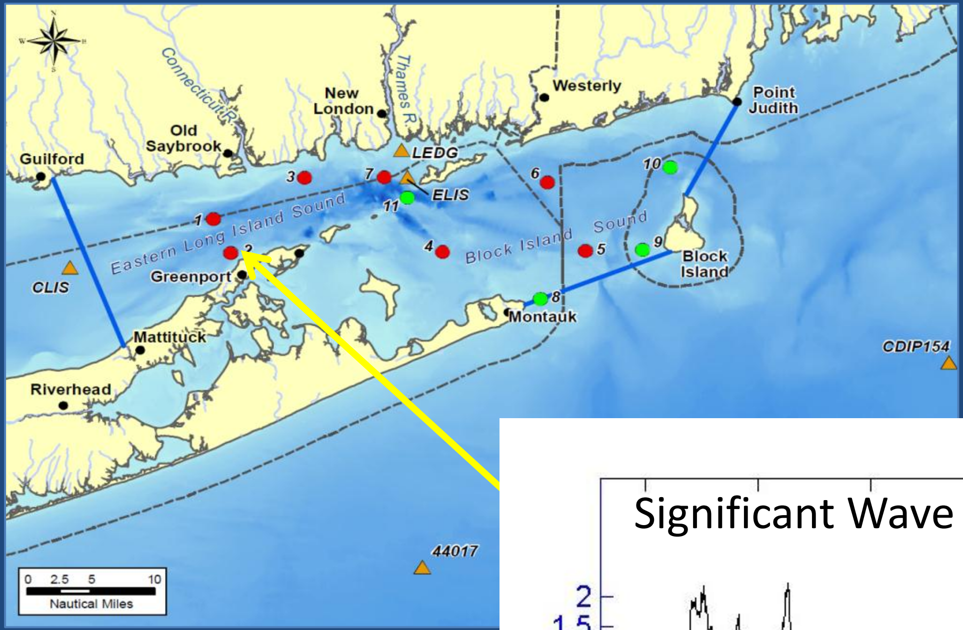
Wave and Stress Measurements

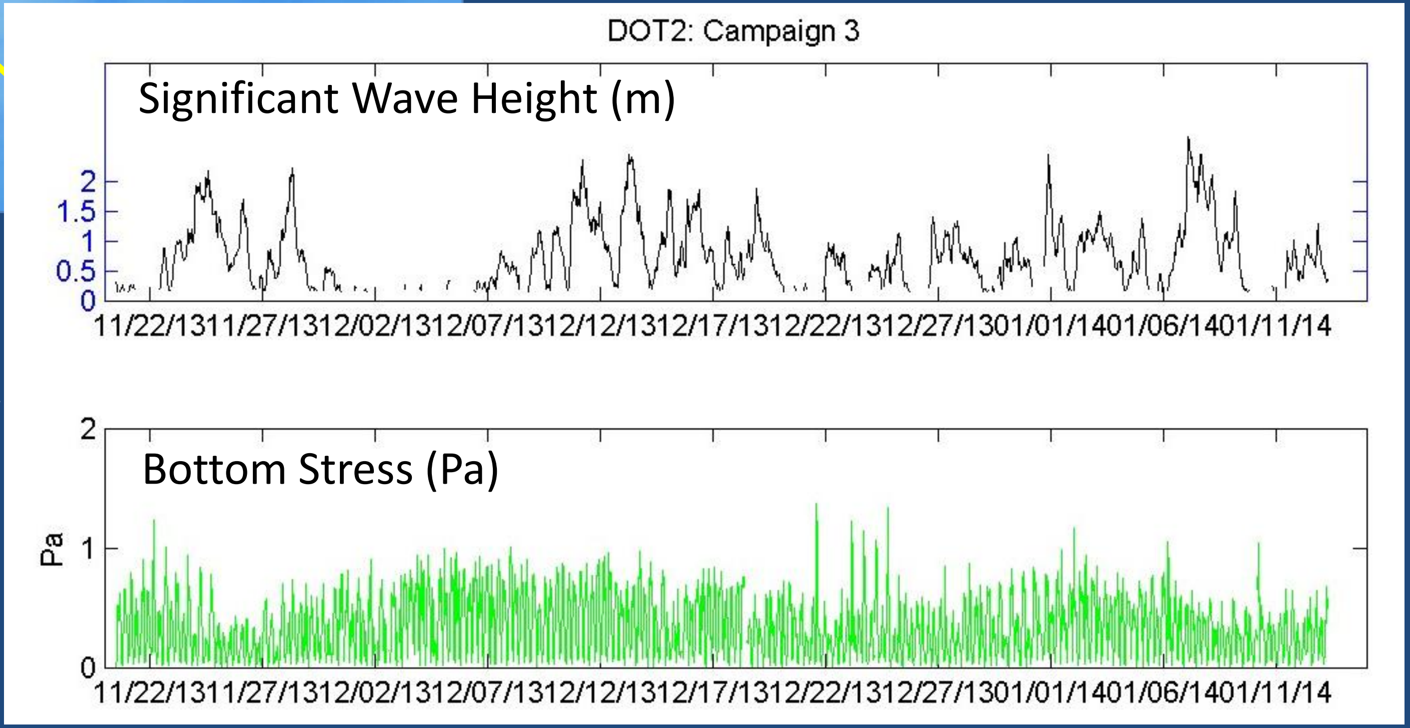




The variation of u(z) with log(z) for ensembles 297 and 317

Wave and Stress Measurements

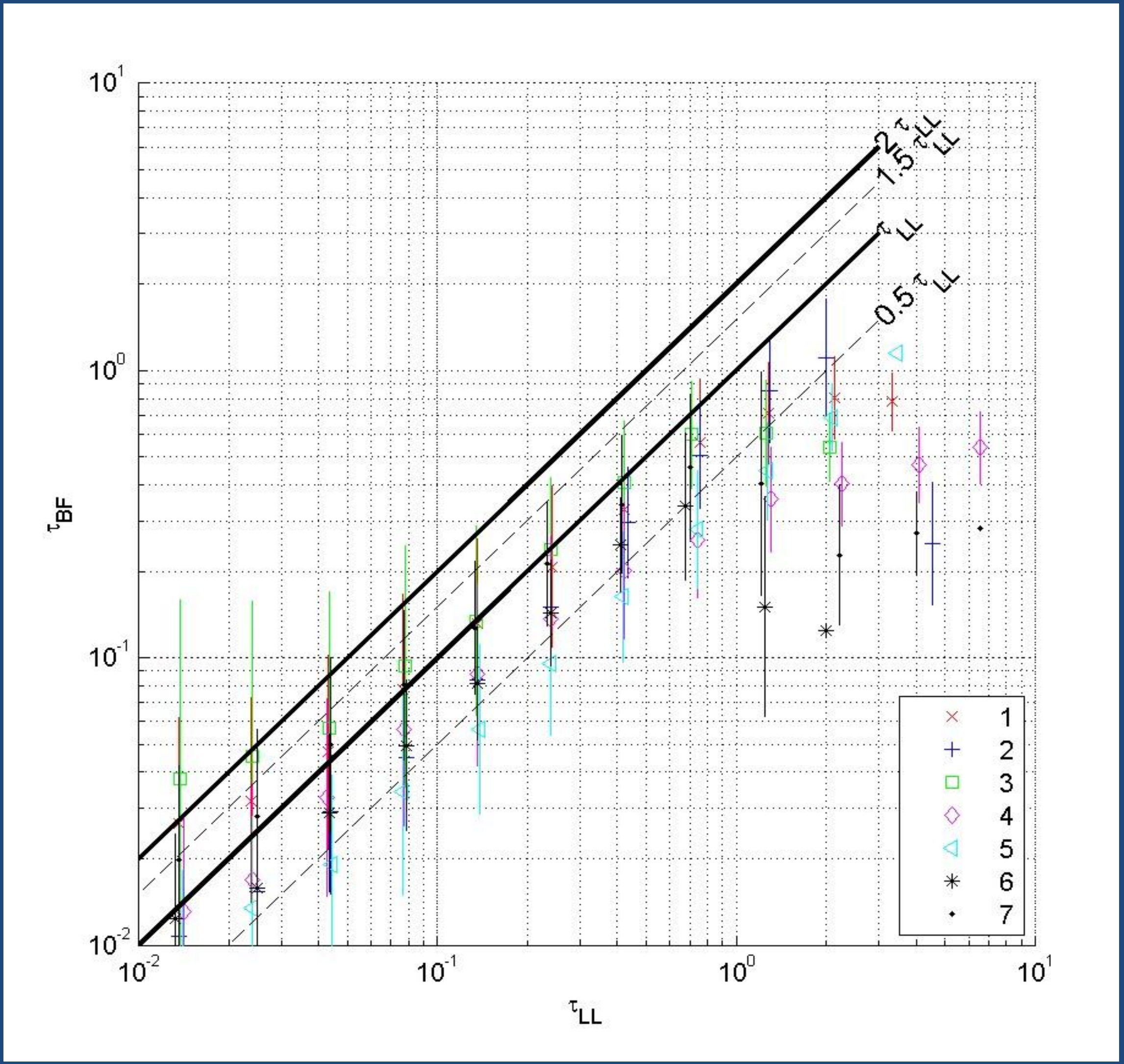




Characteristics at Station DOT2 during Campaign 3:
Top: Significant wave height (in m).
Bottom Stress.

Bottom Stress Drag Coefficient Evaluation

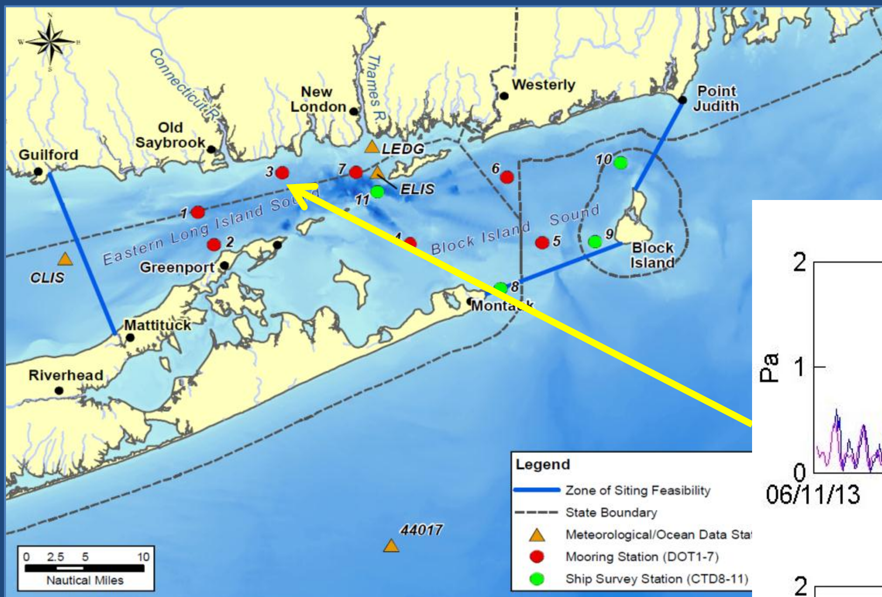
Measurements using the Log Law method (LL) support the use of Bulk Formula (BF) with C_d =0.0025.

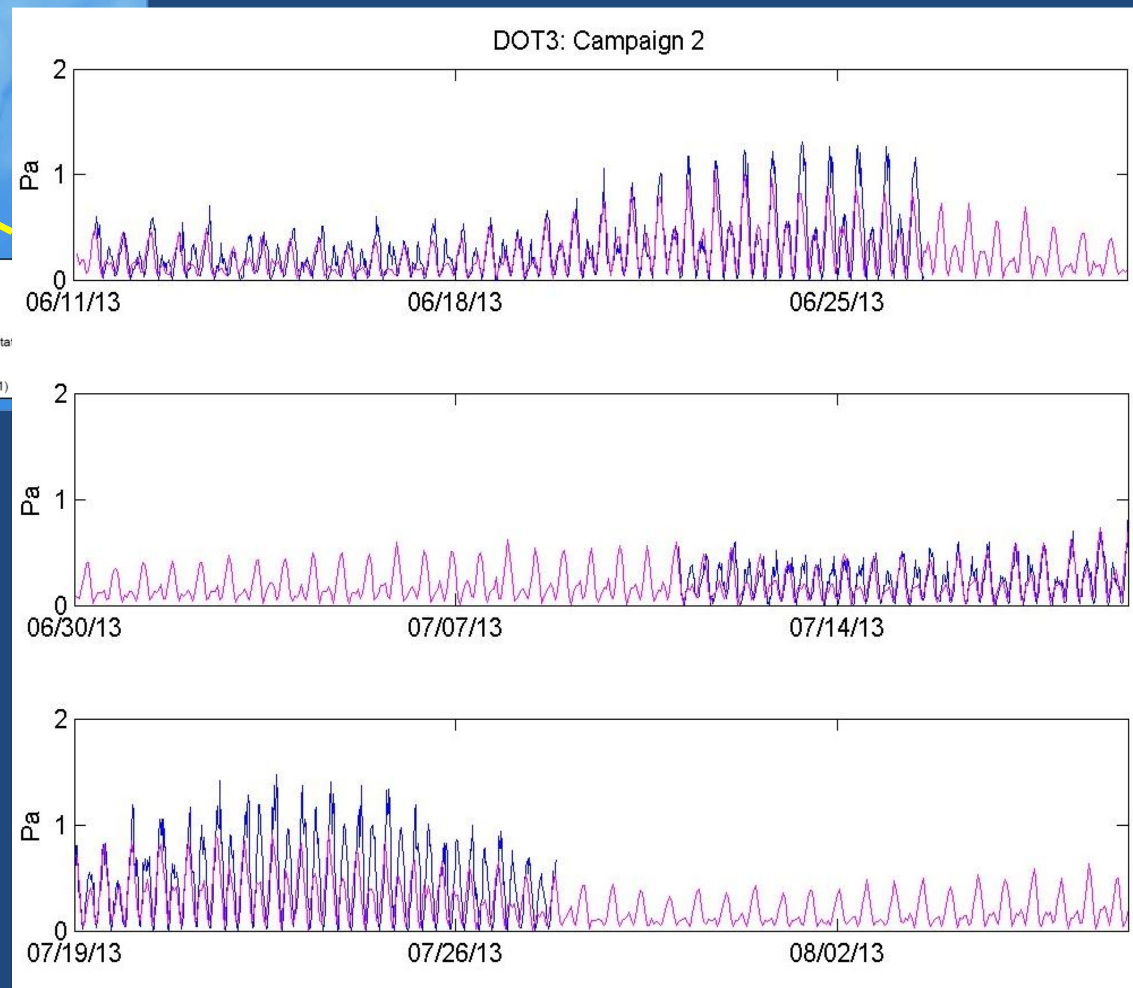


Summary of stress magnitude measurements using the log law and the bulk formula with C_d=0.0025. To suppress the noise inherent in turbulent quantities, measurements were bin-averaged. The key shows the stations numbers.

3. Evaluation of Bottom Stress in Model

Model simulations reproduce tidal and the spring-neap variations on observed stress

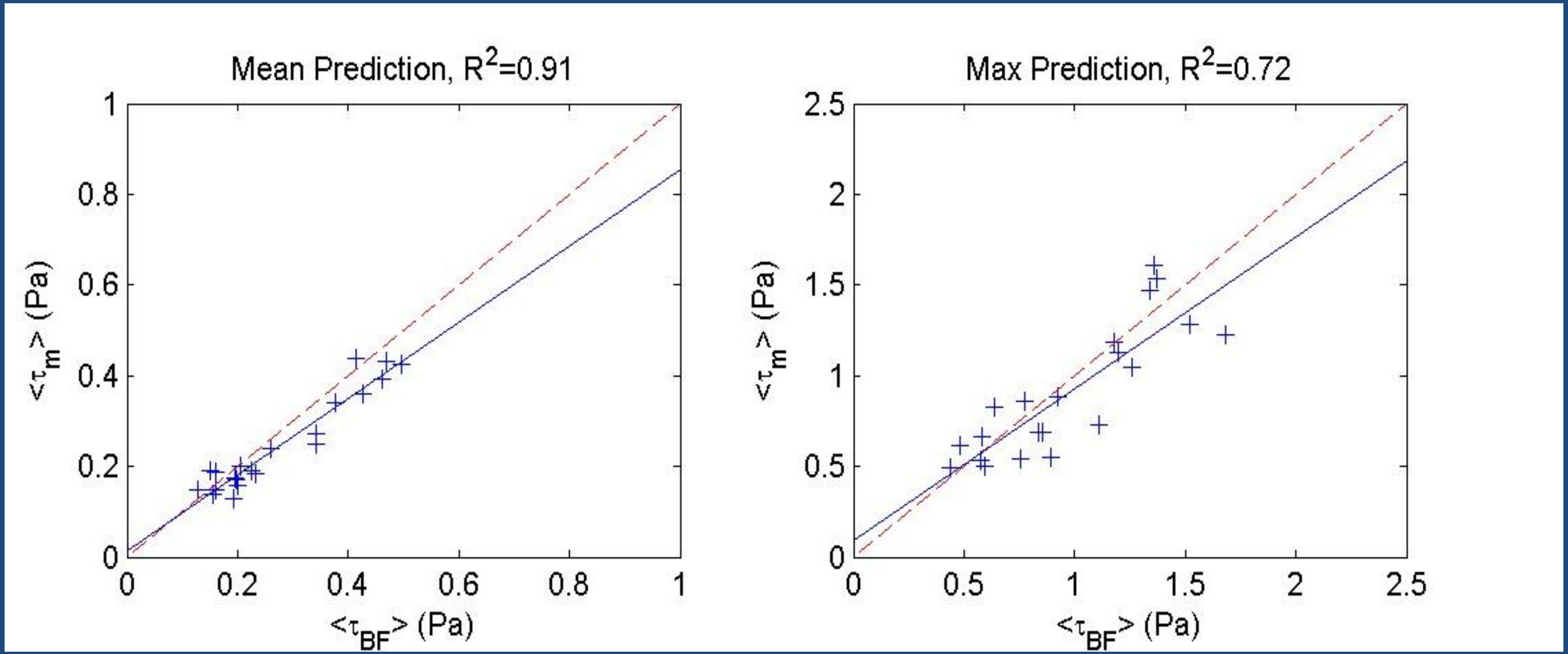




Model-predicted bottom stress at Station DOT3 during Campaign 2 in the summer of 2013 (magenta line). The blue line shows the measured stress using the bulk formula.

3. Evaluation

- Model and observations agree on the campaign mean and maximum stress magnitudes.
- Model can effectively discriminate between places where the maximum measured stresses are large (>1 Pa) and those where they are smaller (<1Pa).



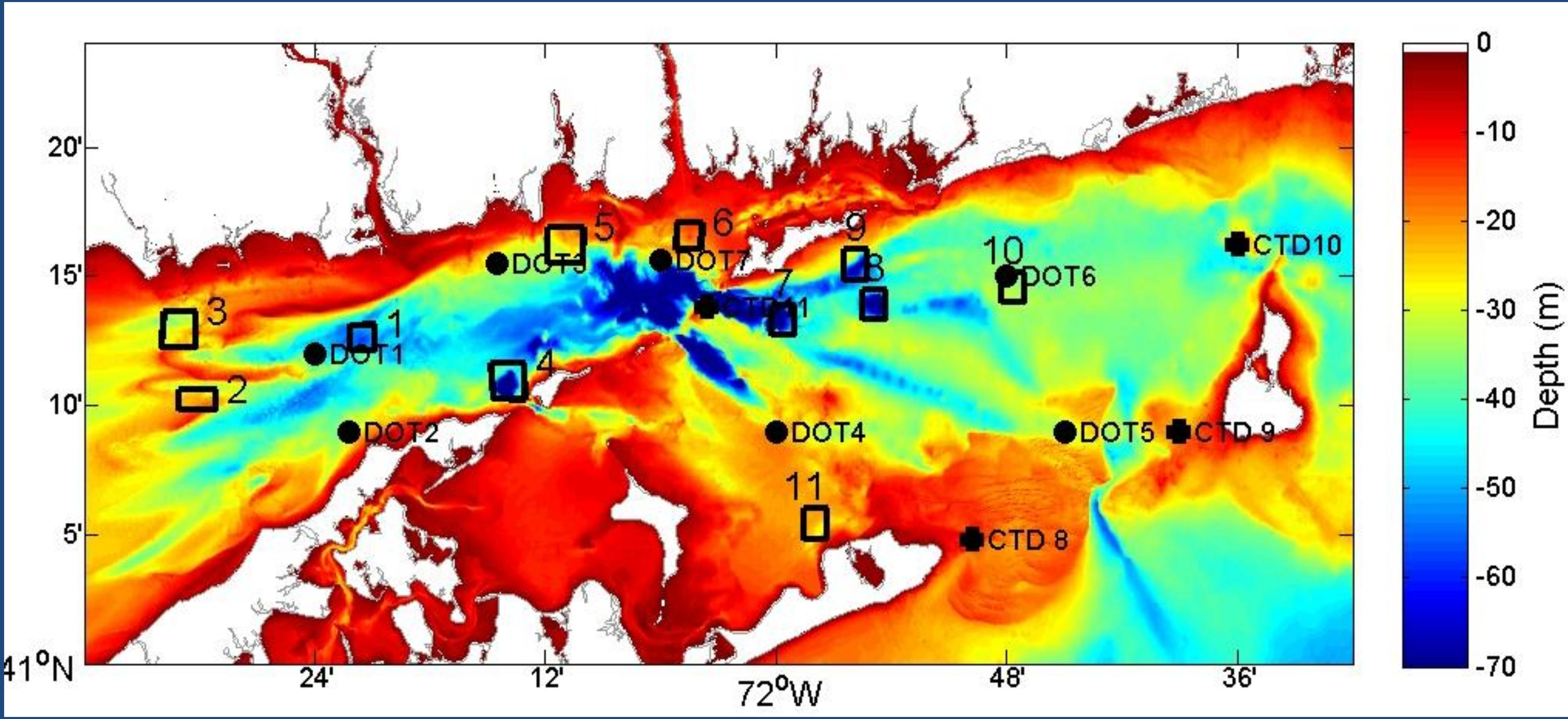
Left: Comparison of model predicted bottom stress magnitudes and mean bottom stress observed during the three campaigns. Points would all lie on the red dashed line if the model and data were in perfect agreement. The blue solid line shows the ordinary least-squares regression line which has a correlation coefficient of 0.91.
Right: Comparison of the predicted and observed maximum stress magnitudes. The correlation coefficient was 0.72.

4. Analysis

- Find maximum bottom stress magnitude at each point in the ZSF in the three Campaigns
- Compare values at sites identified in the screening process
- Simulate period of a severe storm (Superstorm Sandy) and compare maximum stress magnitudes

4. Analysis *(cont.)*

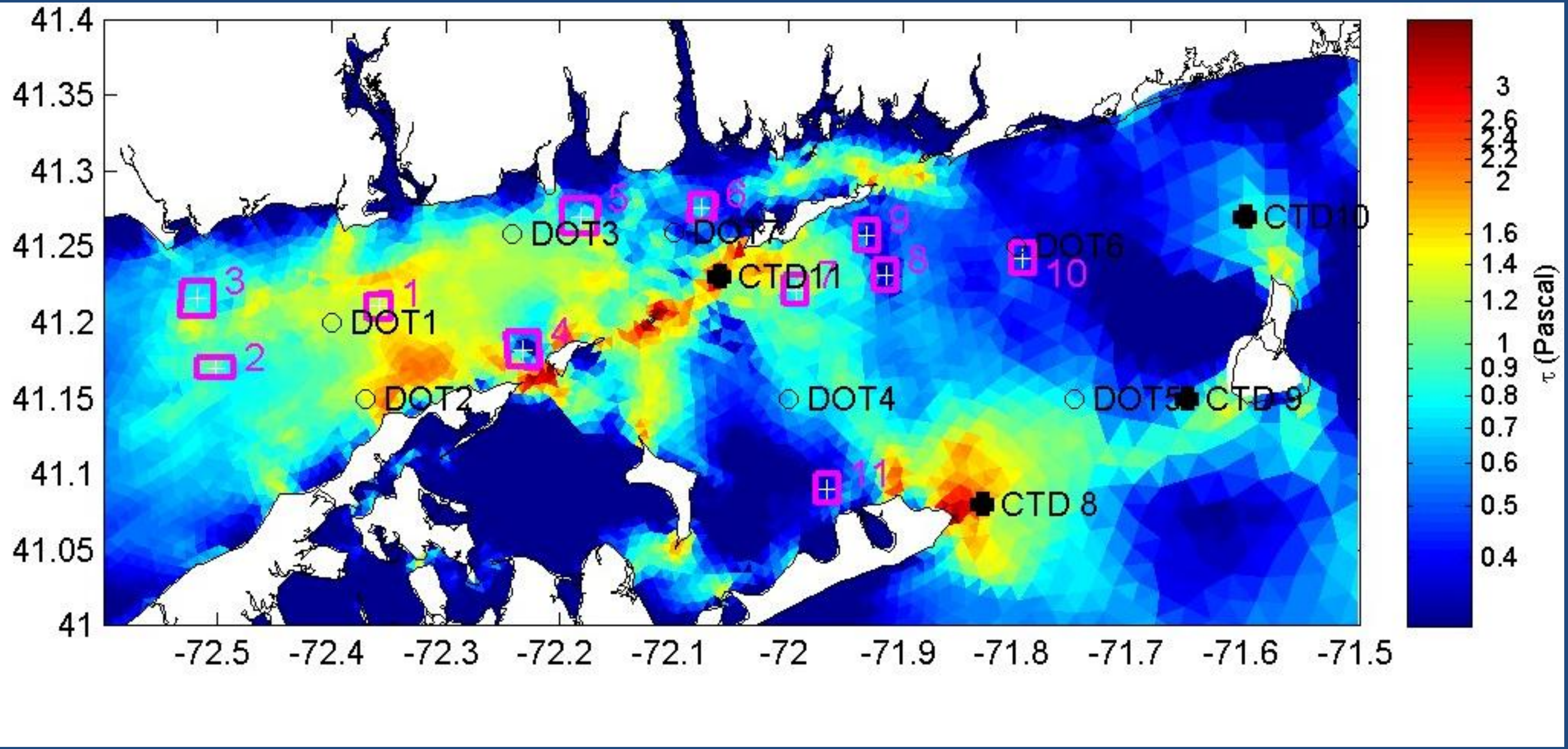
Bathymetry and locations of potential sites



Water depth and 11 potential dredged material disposal sites (open boxes) as identified during the initial screening process. Sites 1 and 6 are the active disposal sites (CSDS and NLDS, respectively). The seven mooring stations ('DOT') are identified by full circles; the four additional ship survey stations ('CTD') are identified by crosses.

4. Analysis *(cont.)*

- Spatial differences are much larger than seasonal variations
- Stress is high in much of ZSF



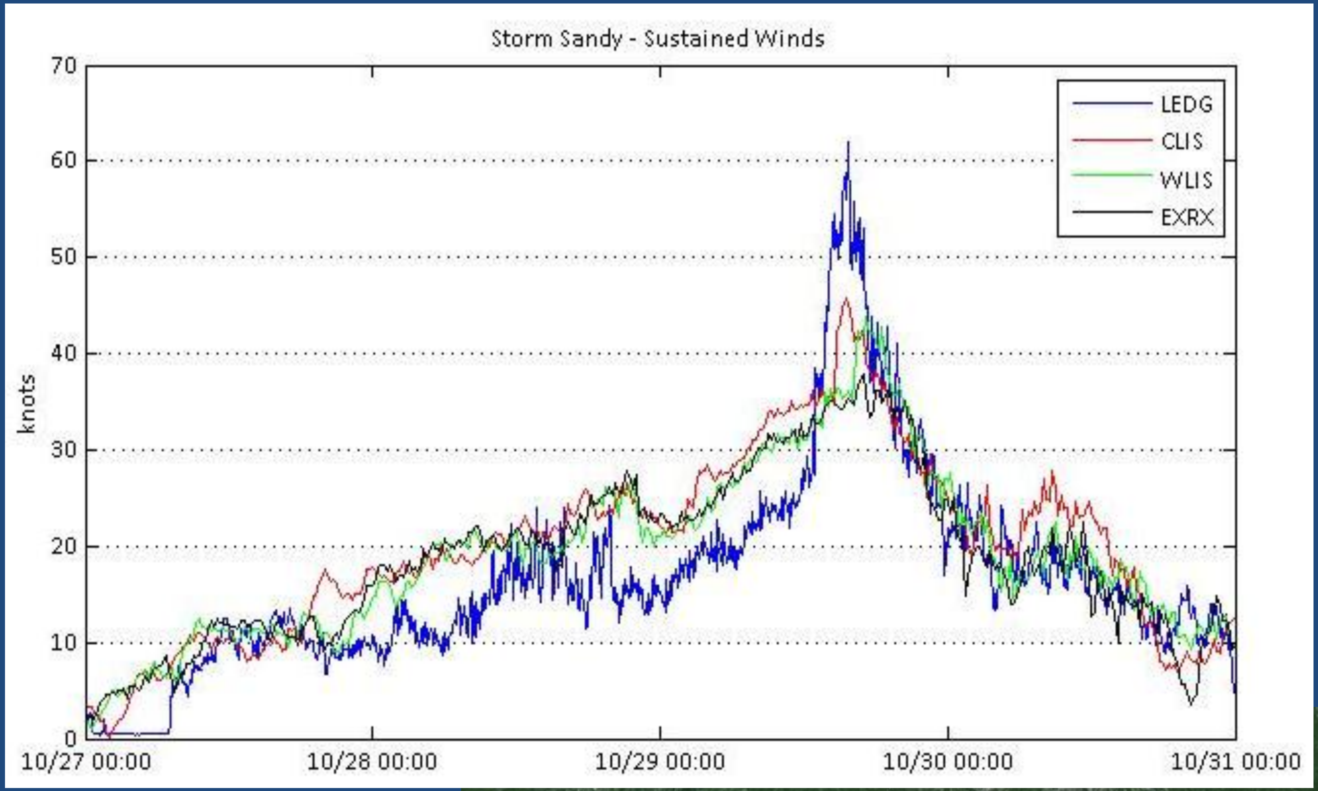
Maximum bottom stress during Campaign 3 (November 20, 2013, to January 16, 2014) for storm conditions (i.e., due to the principal tidal current constituents and the seasonal mean flow, as well as wind).

4. Analysis *(cont.)*

Maximum Bottom Stress (Pa) during Storm Conditions at Potential Dredged Material Disposal Sites

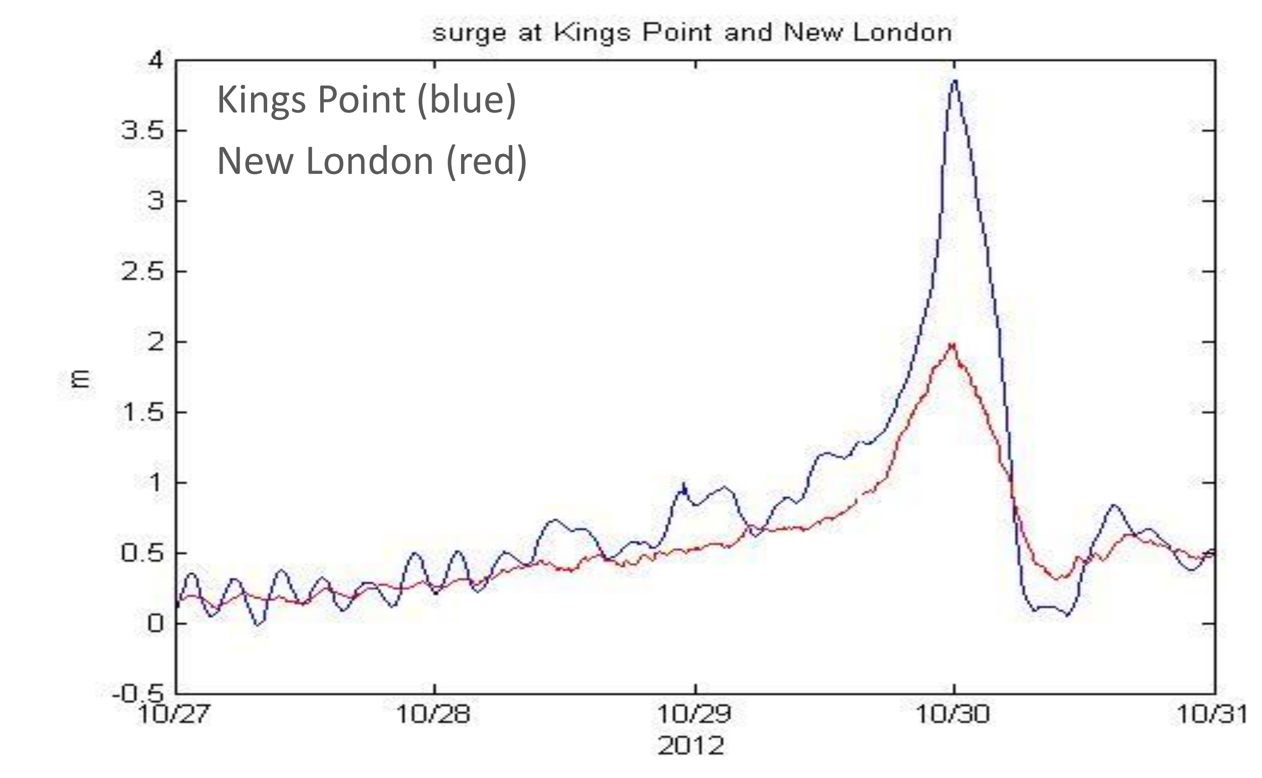
Potential Disposal Site			Maximum Bottom Stress (Pa)		
			1. (spring)	**2. (summer)**	**3. (winter)**
ELIS	1	Cornfield Shoals Disposal Site	1.17	1.31	1.24
	2	Six Mile Reef Disposal Site	0.92	1.09	1.00
	3	Clinton Harbor Disposal Site	0.72	0.71	0.81
	4	Orient Point Disposal Site	0.52	0.61	0.48
	5	Niantic Bay Disposal Site	0.73	0.97	0.84
	6	New London Disposal Site	0.60	0.70	0.69
BIS	7	Fishers Island-west	0.79	0.91	0.86
	8	Fishers Island-east	0.49	0.51	0.39
	9	Fishers Island-center	0.39	0.50	0.38
	10	Block Island Sound Disposal Site	0.49	0.63	0.44
	11	North of Montauk	0.31	0.31	0.34

4. Analysis *(cont.)*

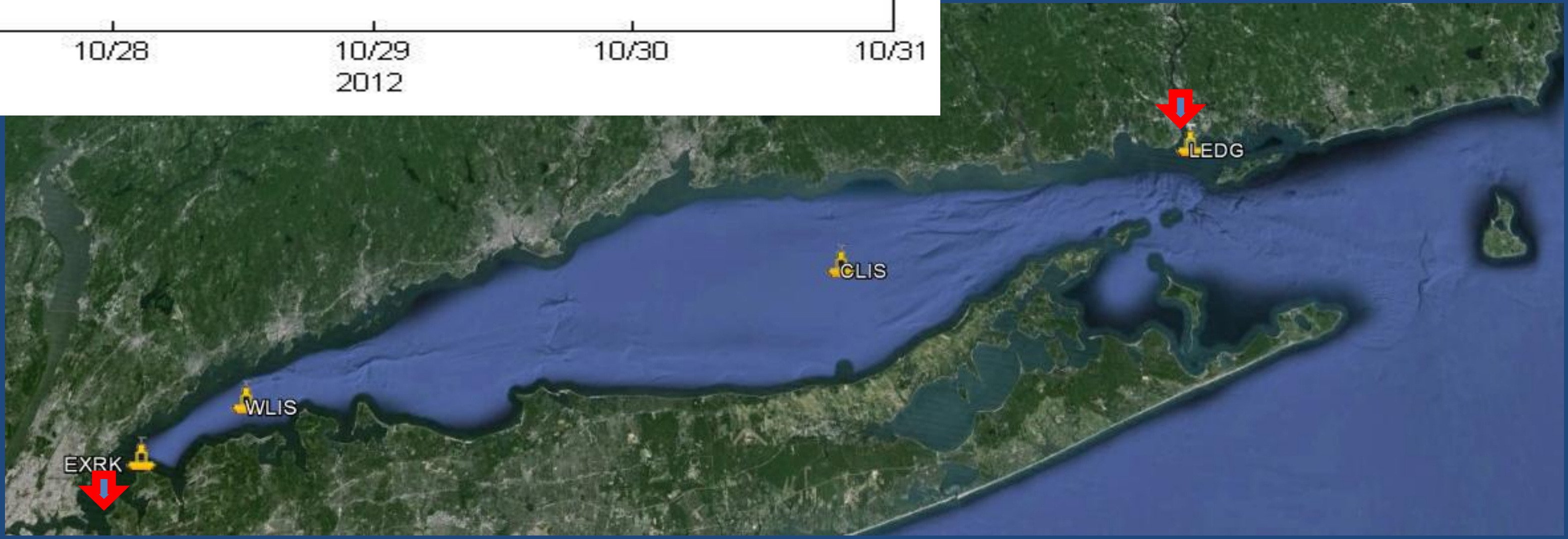


Superstorm Sandy: Sustained Winds

4. Analysis *(cont.)*

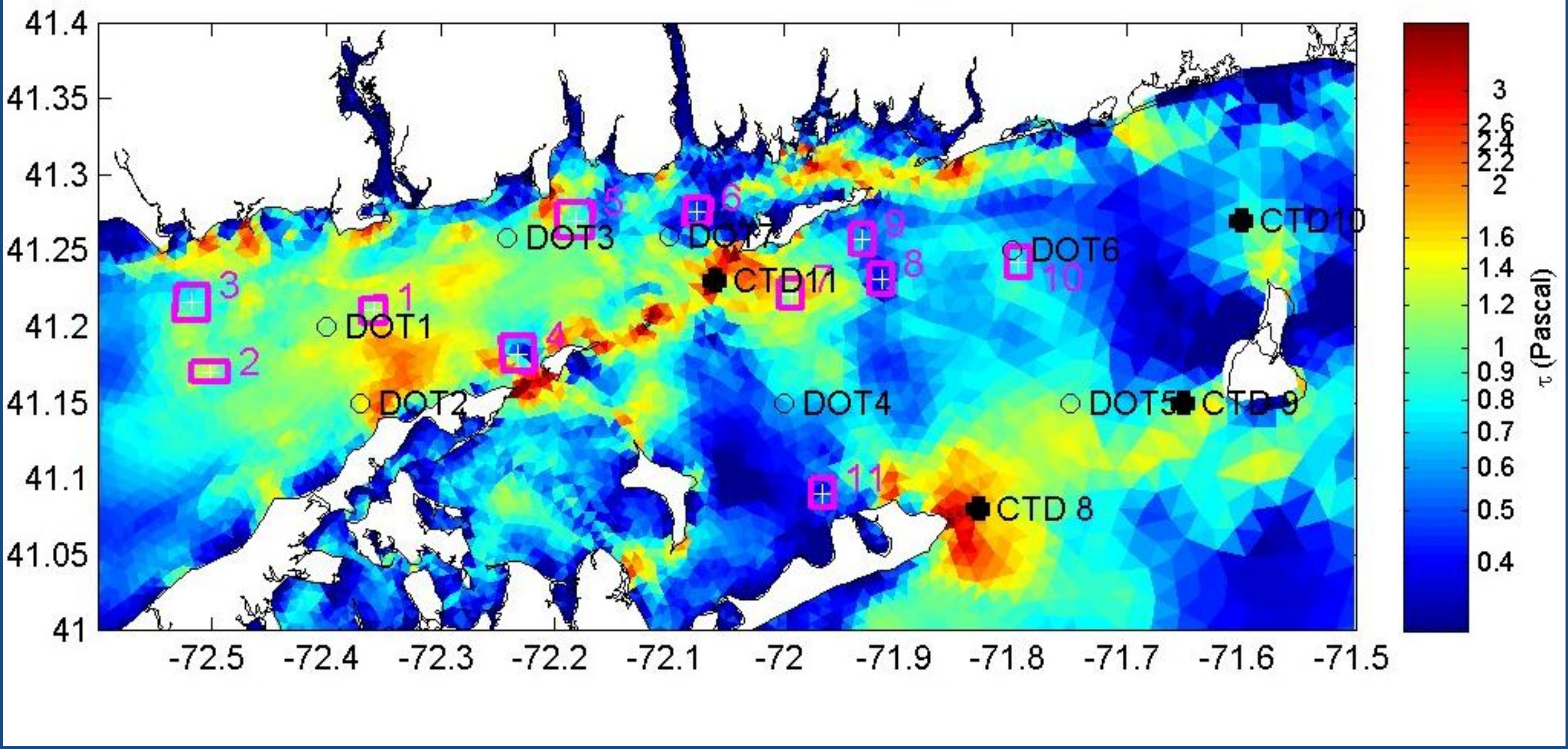


Superstorm Sandy: Storm Surge



4. Analysis *(cont.)*

Superstorm Sandy created higher maximum bottom stresses in some areas



Maximum bottom stress simulated for the period October 28 to 31, 2012 when Superstorm Sandy passed over New England.

4. Analysis *(cont.)*

Potential Disposal Site			Superstorm Sandy Conditions: Bottom Stress (Pa)
ELIS	1	Cornfield Shoals Disposal Site	1.16
ELIS	2	Six Mile Reef Disposal Site	1.26
ELIS	3	Clinton Harbor Disposal Site	0.87
ELIS	4	Orient Point Disposal Site	0.53
ELIS	5	Niantic Bay Disposal Site	0.99
ELIS	6	New London Disposal Site	0.48
BIS	7	Fishers Island-west	1.17
BIS	8	Fishers Island-east	0.46
BIS	9	Fishers Island-center	0.55
BIS	10	Block Island Sound Disposal Site	0.73
BIS	11	North of Montauk	0.39

4. Analysis *(cont.)*

Stress Threshold for Erosion on Seafloor:

- Defined as the level of stress at which dredged material in a disposal area will be mobilized
- Depends upon sediment grain size, fraction of clay, volume fraction, level cohesiveness
- Based on a review of the literature, we choose 0.75 Pa as the design threshold

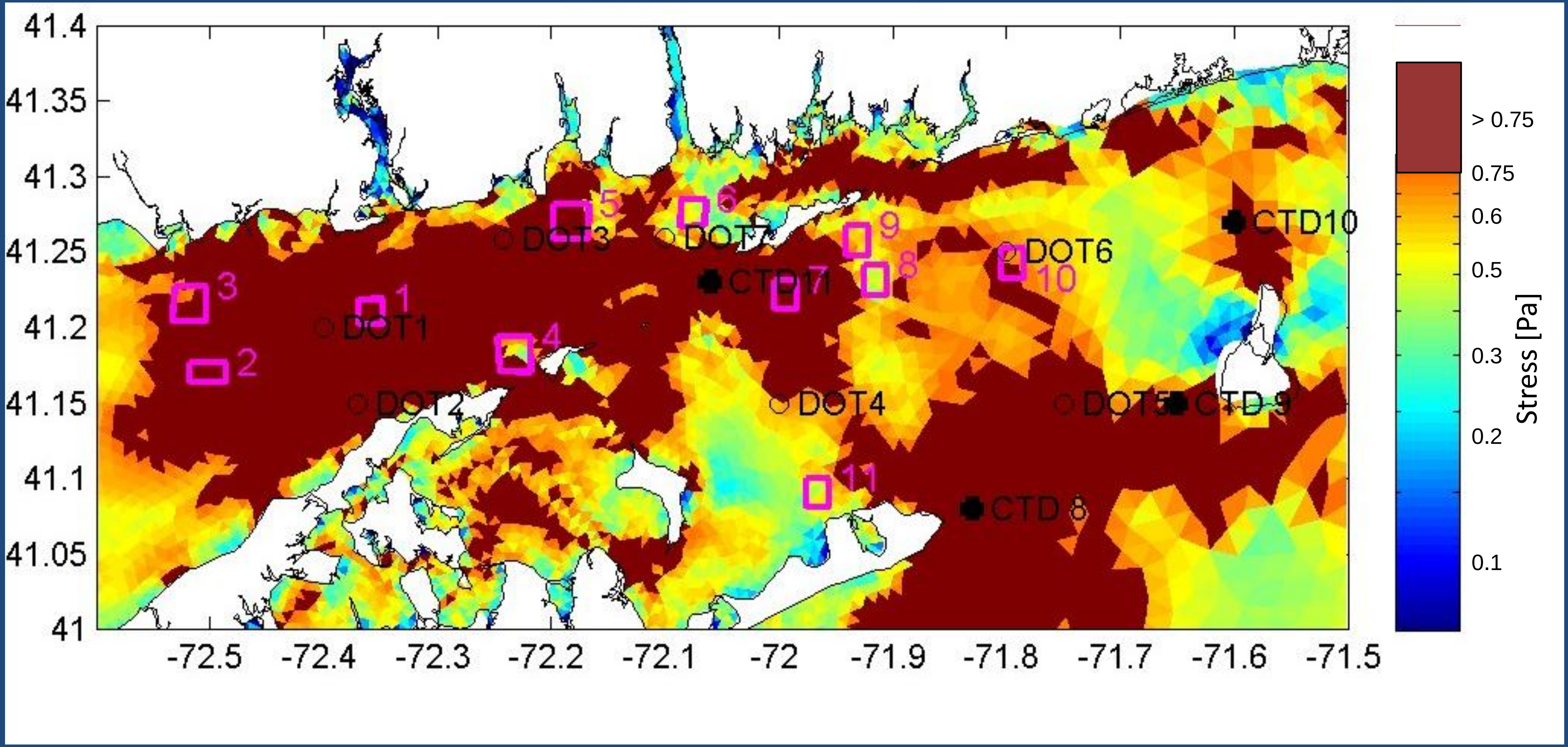
4. Analysis *(cont.)*

Comparison of Maximum Bottom Stress (Pa) for Potential Dredged Material Disposal Sites in the simulations of the three Observation Campaigns and Superstorm Sandy.

Potential Disposal Site				Maximum Stress in Simulations (Pa)	
ELIS	BIS	No.	Site Name	Group	Highest Value
●		1	Cornfield Shoals Disposal Site	>1	1.31
●		2	Six Mile Reef Disposal Site		1.26
	●	7	Fishers Island-west Disposal Site		1.17
●		5	Niantic Bay Disposal Site	0.75-1.0	0.99
●		3	Clinton Harbor Disposal Site		0.87
	●	10	Block Island Sound Disposal Site	<0.75	0.73
●		6	New London Disposal Site		0.69
	●	9	Fishers Island-center		0.55
●		4	Orient Point Disposal Site		0.53
	●	8	Fishers Island-east		0.46
	●	11	North of Montauk		0.39

5. Summary

Areas with maximum bottom stress exceeding the 0.75 Pa threshold during the simulation of Superstorm Sandy (screened as a uniform brown layer). Areas with bottom stress below 0.75 Pa are scaled (see color key on the right).



5. Summary (cont)

Sites 1, 2, and 7
(Cornfield Shoals, Six Mile Reef, and Fishers Island - west) have high maximum stresses.

Sites 4 and 10
(Orient Point DS and Block Island Sound DS) show maximum stress below the 0.75 Pa threshold at the center of the site, but have values in excess of 0.75 Pa within the boundary.

Sites 5 and 3
(Niantic Bay and Clinton Harbor) show maximum stresses exceeding 0.75 Pa but less than 1 Pa.

Site 6
(New London DS) is the only site in Eastern Long Island Sound with maximum bottom stress below the 0.75 Pa threshold.

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Attachment 4

TRANSCRIPTS OF PUBLIC MEETINGS, RIVERHEAD, NEW YORK DECEMBER 8, 2014

SUPPLEMENTAL ENVIRONMENTAL
IMPACT STATEMENT

Suffolk Community College
20 East Main Street
Riverhead, New York
3:00 p.m.
December 8, 2014

S P E A K E R S:

BERNWARD J. HAY, PH.D, LOUIS BERGER
JEAN BROCHI, Project Manager, EPA, Region 1
FRANK BOHLEN, University of Connecticut
GRANT MCCARDELL, University of Connecticut
A U D I E N C E S P E A K E R S:
ADRIENNE ESPOSITO, Citizens Campaign for the Environment
MARGUERITE PURNELL, Fishers Island
BILL GASH, Connecticut Maritime Coalition
KEVIN MCALLISTER, Defend H2O

DR. HAY: I think we are ready to start. Welcome to this public meeting. Good afternoon. Before we start, a couple of housekeeping items. The sign-up sheet is outside. I hope everyone has had a chance to sign in at this point. The public rest rooms are on the right side down the corridor, both ladies' room and men's room. Also, please turn off your cell phones or put them on vibrate.

My name is Bernward Hay. I am with the Louis Berger Group. We are under contract with the University of Connecticut, which is under contract to the Connecticut Department of Transportation. We have been assisting the Connecticut Department of Transportation and the EPA to prepare a Supplemental Environmental Impact Statement for the potential designation of one or more dredged material disposal sites in open waters. The EPA is the federal lead agency for this project. In addition to this public meeting, there will be another one tomorrow, which will be held in New London, Connecticut.

Today's meeting is designed to present findings of the physical oceanography

study that was conducted as part of the Environmental Impact Statement. This meeting will be informational, and there will be a presentation. Therefore, there is no comment period, but we do have time for questions and comments at the end of the presentation as well.

Ms. Jean Brochi is the project manager of the Ocean and Coastal Protection Unit of the EPA. She will open the meeting, and will give you a project update. Then this will be followed by the physical oceanography presentation by Frank Bohlen and Grant McCardell from the University of Connecticut Marine Science Department. Again, then we will have some time for questions and for comments.

The meeting is recorded by a stenographer, and also on audio devices, and the transcript will be available, after the meeting at some point, it will be made available to the public on their web site, at the EPA's web site. With this, Ms. Brochi will open the meeting.

MS. BROCHI: The other speakers probably won't need a microphone, but I do. Even with the microphone, if you can't hear me, please

just raise your hand or ask me to repeat something.

Anyway, thank you all for coming out this afternoon on this wonderful winter day. If you haven't been to a meeting before, this is an EPA meeting, and it is a combined EPA Region 1 and Region 2. We have several EPA representatives here. I am Jeanie Brochi, as Bernward said. Mel Cote, my manager is here. Doug Pabst and Pat Pechko from Region 2, and Alicia Grimaldi, who you met when you first signed in, is also from our office in Region 1.

This is for a Supplemental Environmental Impact Statement for Eastern Long Island Sound. The last set of public meetings that we had in this facility, actually, was in June, June 25th and 26th. Again, the primary focus of this meeting is for the physical oceanographic study, and Frank Bohlen will start that off.

Again, under the Marine Protection and Research Sanctuaries Act and the Clean Water Act, EPA and the Corps of Engineers share responsibility for dredged material management.

Several Corps of Engineers personnel are here today. Under Section 102 of the Marine Protection and Sanctuaries Act, EPA has the authority to designate disposal sites for dredged material.

The Long Island Sound Dredge Materials Disposal Site designation was officially, the final designation was in July of 2005, and that was for the western and central disposal sites. The Corp has the authority to select sites on a temporary basis. So Cornfield Shoals and New London disposal sites, which are in the eastern part of the Sound, were selected by the Corps of Engineers, and expire in 2016.

Here are the disposal sites. You can see the Western, Central and this meeting is focusing on the Eastern sites. Again, our role is to designate disposal sites. In doing so, we develop a site management and monitoring plan. EPA also has a shared role in reviewing dredging permits, but an applicant would apply to the Corp of Engineers for a federal permit.

We initially write the Environmental Impact Statement looking at site

screening, and there were site screening criteria both general and specific in the Marine Protection and Sanctuaries Act, which we follow. I didn't go into detail here, but I do have the presentation that went into detail from June.

Initially, we had the 11 sites in Eastern Long Island Sound. Now we are focusing on six sites, which include Cornfield, New London, Niantic, Orient Point, Clinton and Six Mile Reef. The physical oceanography study that you are going to listen to the result of and the analyses today initiated, the study initiated with some additional buoy locations, and the green shows the buoy locations, the labels show the historic sites, and the labels that are not in yellow show the dredged material disposal sites.

This process kicked off with a Notice of Intent in October of 2012. We have had several cooperating agency and public meetings, as I mentioned. One of the last public meetings, Sarah Anker's office recommended that EPA and the Corp start educational webinars to talk about

dredging, the process of dredging and some dredge material equipment. We held one webinar so far, and it was on April 3rd, and it was well attended. So we want to thank any representatives, if you are here. Thank you. Thank her for us, because that was very well attended.

If you didn't sign in, please do so. But if you did, and you want to comment after this meeting, or you have questions, feel free to send it to the ELIS at EPA.gov E-mail system. If you are not on our notification system about upcoming meetings, please feel free to sign up for that. We also have the minutes from the meetings, and we will have all the documents posted on our EPA Region 1 web site. The address is listed up there.

The next step in this process is to further evaluate the sites, draft rule making, and a draft supplemental Environmental Impact Statement by spring 2015. We will hold additional public meetings at that time, and those will be official comment periods on the draft, and the draft rule making.

Assuming that the SEIS recommends designation on one or more sites, then we will move forward with the final SEIS and rule making. That would be no later than December 2016.

With that, I am going to introduce Frank for the physo discussion.

DR. BOHLEN: Good afternoon. Can you hear me? If you can't, speak up. I am Frank Bohlen. I am a physical oceanographer at the University of Connecticut Department of Marine Sciences. I have been working on sediment and sediment transport for 45 years. A fair amount of that work has been done around dredged material disposal sites, dredging and dredged material disposal sites.

We have seen the evolution of information over the past 45 years, and there has been, believe it or not, a substantial evolution. I want to emphasize that we are going to be talking about the physical oceanography, physical oceanography of Long Island Sound, as in physics. Not the biological, not the chemical, geochemical nor the political. Physical oceanography.

We are going to be talking about

the physical oceanography in the Zone of Siting Feasibility. We will try to define that. By the way, if at any time you don't understand the language, don't be afraid to speak up, because we often tend to speak our own language. It is taken for granted that everybody knows where Staten Island is, sort of thing. Then you come out after the talk, and you find out that nobody knows where Staten Island is. Holy Christmas. So that doesn't work. Don't be afraid to ask the question if you don't understand the language.

Physical oceanography in the Zone of Siting Feasibility. Why? Because one of the first questions that is often asked is, is the stuff going to stay put, and under what circumstances might it not stay put, and if it doesn't stay put, where is it going to go. So it makes sense to begin with the physics. Besides the fact that it is the queen of the sciences, so the remaining sciences are only the handmaidens of the queen.

We are going to speak about the model that is being developed and being used. Why four? We can't measure all we need to know

at every point through the Zone of Siting Feasibility. We can measure characteristics at a number of discreet points, carefully selected discrete points, and then use that to build a model that will allow us to really assess on a much finer spatial scale than we could ever hope to do by measuring.

A model is important today in practically everything we do. We wake up in the morning and we look at the weather forecast, it's a model. We are going to be using a model, a numerical model. Then we are going to evaluate the model. How good are the simulations presented by the model. It will give you some indication of what the results indicate, and provide you with a summary.

The science that explains the patterns of ocean circulation and the distribution of properties such as temperature and salinity. That is where we all started. Nansen, Fridtjof Nansen back in 1900 when physical oceanography really started, the Norwegian school. Somebody tried to figure out what it means in terms of circulation, and what

all that means in terms of herring. But we go beyond that right now, and we look at currents, circulation of the water, waves, and the effects of those flows on the movement of sediments.

Of particular importance within this study, because you are asking me where the stuff is going to go, is why this stuff going to go. It is going to go because you are exerting a certain force on it. We measure that force in terms of force per unit area, which we call stress. We are all stressed at some point. This is stress. Again, capisce? Go back to our friend Sister Sarsaparilla in the fifth grade or so, and she was telling you about forces, or flow going over a surface. A change in velocity occurs as you approach the surface because you are beginning to exert force on the boundary, and as you do, you might drag it along, and you may disaggregate it, and you may break it down. So you are going to hear a lot about boundary shear stress, because the boundary is where we are working, and the shear stress is the force that may affect the form and shape of the boundary.

This is a little primer I studied

in the past that really doesn't work, but it is one you will see in all the texts. So it is up there for you to take a look at. It really was designed for the next set of terms you are going to hear a lot, namely noncohesive sediments. The general class of noncohesive sediment which I believe we are all familiar with is beach sand, discrete, granular material, with very little binding beyond gravity. I will take questions on it later.

The materials that we deal with are for the most part cohesive. They may be fairly coarse grained, and you can get sand, but they are stuck together by other stuff than simply gravity. It may be the technical term snot, at the interface, a mucilaginous matrix associated with biological activities along the boundary. You can actually stick sand together and cause it to be cohesive. But more typically what we are looking at is finer grain materials than sand. We get down well below the millimeters. We get down to the microns. 63 micron, the breakover between silt and sand. Then you get down to about 4 microns or so and you get into the clays.

When you get down to the really fine grains, you not only have the possibility of having a mucilaginous matrix, but you also have electrochemical binding, differences in charge of the particles. Those little magnets, they stick together.

When you get down to that scale, and an awful lot of the material we are dredging tends to be fine grained silts and clays that are very cohesive, what you are looking at, in distinction from this picture that you have up here, where it is showing off an individual grain sitting up on top here, as you would with sand, really what you have is a matrix. It is all sort of glued together, and the stress tends to break down the bulk. It doesn't go off grain by grain. It tends to sit there until it was breaks down in bulk failure.

Another thing to consider when you are taking a look at the boundary is the effect of the boundary on the velocity field above the boundary, (language). The boundary affects the velocity field, the flow right over that boundary. You can believe there is something up

here. As we get closer down to the boundary, we get closer to more and more friction, the flow is going to slow down. That gradient in velocity as we get down closer to the boundary is the stress we are talking about. There are a variety of factors that are affecting it. That is all they are trying to show you here, and you have got a rather complex velocity field. That is the vertical. Here is the velocity coming down to the boundary. You see it over here, (there were two screens along the front of the room), the velocity coming down to the boundary is rather complex because of some effects of the boundary on the flow. Another whole class to deal with that.

We sometimes have panels, and this is the famous Shields diagram showing something about particle characteristics against critical erosion velocity. The only thing you can take from this is there is a significant difference between the gluey, sticky cohesive stuff and the more granular noncohesive stuff. That is really all you need to get off this. We will see more of it as we go along.

A table summarizing some results, laboratory and field, shows you that as you go from course sands up through progressively finer materials, getting more and more cohesive, you have got a significant change in critical shear stress values. We are looking out here at the stress, at the initiation, it is called the initiation of motion, first motion. We are getting into this in terms of Pascals. You are familiar with pounds per square inch, probably. You may have heard of millibars. That is pressure. We usually hear pounds per square inch in terms of atmospheric pressure. That tends to be a vertical pressure.

This is the same sort of thing, except it is horizontal. Pounds per square inch, force per unit area. We can put it out in a variety of units, but one of the most common units is Pascals. You can Google it up and see what it means. If you care for Dynes per square centimeter, you will find it at the back, and you can convert that to pounds per square inch.

But the game today, we are going to be playing mainly with Pascal, and the thing I

want to call your attention to for part of the discussion at least later, is an interesting variation in this critical shear stress, Tau sub C, from point 48 up to a very high value, 18. This guy is circled out at about three quarters of a Pascal for something like fine sand. As you get finer and finer material, more and more cohesive, the critical stress goes up.

That is sort of counterintuitive. You believe in a kitchen if I have a pile of sand sitting on a counter and I blew on it, not much might move. But if I had a pile of flour sitting on the counter and I blew on it, a fair amount might move.

So she says why is it that the coarse grained stuff actually takes less force than the fine grained stuff. The answer is cohesion, it is stuck together. If you wet up that flour, and if you have played with flour, you know you have got to sometimes scrub your hands pretty good to get rid of it, you will find that it is more difficult to move. So that is a bit counterintuitive, but it is also one of the reasons why you see so much dredged material sticking around.

MR. GASH: Are you taking questions now, or do you want us to wait?

DR. BOHLEN: Questions later. If there is something not clear up here, please. We have a selected critical value here, something like three quarters of a Pascal and it goes up. So there are some interesting responses that you can play with.

The objective of the physical oceanography study. The first thing is the Zone of Siting Feasibility, understand, is this blue guy right here.

It sort of goes from Guilford over to Mattituck, right out here. You have got Long Sand Shoal and a fair piece of the Eastern Sound in here. Montauk to Block, Block to Port Judith is the Zone of Siting Feasibility, ZSF, for this study. The Environmental Impact Statement is built around that.

This slide is hard to read on either side. It shows you a number of the potential dredged material disposal areas. A couple of the active ones, the Cornfield and New

London. You have got here a number of the historic ones. There are about six historic ones sitting in there, and there are about four new ones in there. You can see that down in the panel on the side here.

The purpose, stress. Describe the distribution of maximum bottom stress magnitude expected in the zone. Characterize the circulation. Mind you, boundary shear stress is what gets this stuff moving. Then the circulation over the vertical is what transports it away from the initial point of introduction. Also recognizing that some amount of material is going to be entrained in the water column when you dispose of the material. There will be a bit of a cloud. You care about the vertical circulation as well as the boundary shear stress. Acquire physical oceanography data sufficient to calibrate, verify the model. Clear, more or less?

Everybody knows where you are, right? Staten Island. You probably have some sense of the circulation in Long Island Sound, right? If I tell you that it is tidally

dominated, that is probably not too much of a surprise, I would hope. This is a set of stations that were occupied over the course of the Long Island Sound study. It started about 1988 and ran intensively in the early 1990s, and it has been going on. A fair number of stations are still monitored by DEEP, and to some extent, DEC. The only one I want to call your attention to is this guy up here, which you can't read, and in fact, I couldn't read. I put a magnifying glass on it to determine that is M3 at the Race, East River to the Race.

You recognize that one of the factors affecting circulation in the Sound is fresh water inflows, that there is a regular seasonality to your fresh water inflows. This, (pointing to next slide), comes from the Connecticut River, which represents something in excess of 70 to 80 percent of the fresh water inflow to the Sound. So you get a feeling for the seasonality, peak in April/May, typically, due to snow melt up north. That is the assumption that there is a snow melt, but that is fairly typical, and a lull in the mid summer.

You see that I have got a tidal influence, and I can believe that we can make this may display a monthly variation, and I have got a river influence, and it may display some seasonal variations. We have got some temporal variations in the circulation of the Sound. They show up in water temperature. This is a set of slides that shows you the April, August and December temperature profiles. At the end, here is the East River, more or less, Throgs Neck over here. You get an idea that there is a deep seasonality in the temperature profile.

Again, it is all pretty much common sense. You have got to believe there may be a little bit of a time lag, but this afternoon, we are cooling down the water in the Sound. If you wait a while, it is going to get pretty cool out there. Then you are going to warm up Riverhead pretty quick. Coming through Long Island summers, you are going to warm quite fast. You are going to have a big reservoir of heat sitting out there, or cold, or absence of that.

Temperature, Salinity, that change of fresh water inflow is going to show up in the salinity structures. Temperature-salinity characteristics affect the density of the water column. Just like the density of the air affects atmospheric circulation, the wind, the density of the water column will affect the circulation of the water column. Now we have tides and we have got this density field operating. This is just a picture of the tidal circulation from a model on the web. If you want to Google it up, you can take a look at this guy. A little hard to see, but what is important here is the spatial variations. Much lower velocities in the western sound versus the eastern sound. We have got a lot of velocity flow through The Race. That is what you are seeing right up to here, and you can see fairly low velocities down here.

If I run through a tidal cycle, you can get an idea that it is coming and going. Move it back one, that is coming in. Still pretty strong flows in the eastern Sound in the flood, and here is another flood, and here we go turning into the ebb. A little stronger on the ebb. Fair amount of spatial variation, fair amount of temporal, time, relatively short time

scale, six to twelve hours, and then we drag that out to the monthly cycle.

Let's take a look at a little film. We will stop here for a second. This is not to impress you with the graphics, but here is the study area, right. If you look up on top, you will see a date. This is surface salinity that you are looking at.

MS. ESPOSITO: Is that this year, October 22nd this year? I can't read it.

DR. BOHLEN: This is October 22, 2012, for a period, but the detail is not as important as the nature of the enemy. You are dealing with a system. That is what is going on.

MS. ESPOSITO: Frank, is that just the surface?

DR. BOHLEN: That is the surface, that is surface salinity. Of course you can see the Connecticut River coming out here, and the ebb and the flood sweeping it around. You can see the variation from higher salinities off shore to progressively lower salinities as we come in. The typical salinity variation east and west in the Long Island Sound is about four parts

per thousand. These guys are in units of tens of percent, tens. We call it 35 parts per thousand. You might call that 3 and a half percent. Salinities are normally marked out in parts per thousand. On this guy here, you will see it goes 32, 31, 30, that is 3 percent salt. Oceanographers always deal with 4 decimal points within a 31.4450.

That is the system we are dealing with, sort of on average. If we keep running it long enough, actually, and it would take half an hour to tell you about how the system responded to Sandy, because October 29th was Sandy. We just walked by Sandy. Go back to the slide.

This just gives you an idea that not only are we worrying about spatial variations in temperature salinity, and some of the temporal variations that go along with them, but we also have to care about the waves. Surface waves have a velocity associated with them that interacts with the tidal and the density driven velocity field. So we have to worry about that, and this is just showing you two areas, one a little north of Montauk here, and the other sitting over here

by Orient Point, and some of the wave characteristics as we wander down here. That is all you are looking at here. The significance of the blue and the red in this, we are not talking about that right now. That is actually a model run to compare, observed to a model. But what you are getting out of this is that there is some significant spatial variability in wave heights, as you start marching into the Sound. Again, not terribly surprising because of the sheltering and because of the shallows.

What is the distribution and spatial variations in the bottom stress, where are the regions in which the maximum stress are the smallest, and where, if the stuff does get stirred up, does it go. Sort of pretty fundamental questions. The model, Grant McCardell.

DR. MCCARDELL: Hello, everybody. I am Grant McCardell, also from the University of Connecticut. I am going to be talking some about the model we have developed to look at distribution of the stresses.

You saw an example of the model

output just a few moments ago with that movie of the surface salinity. The reason we run models, as Dr. Bohlen stated, is because we are unable to go out there and make measurements over every single space at every single time. So we make some measurements at certain times, at certain locations, and we use those to be able to what we call tune a model. We then have to hope that the model is replicating reality, at least to a certain extent, in order to use the model to make predictions about what might or might not be the current during more extreme events, and in other locations. That is where we have areas.

The model that we are using is nested within a bigger model. It is nested within a model of the northeast coast and the northwest Atlantic. It is forced by tides, it is forced by observed flows, so we go and we get historic data, or get the model run from USGS stations.

It is forced by climatology, and by "climatology" here, what I am referring to is "what are the average conditions at a given space and date?" So the climatology for Riverhead, New

York for today's date might be that the average temperature is 35 degrees, and that is what we were using. So that is what we mean by climatology terms.

We also use climatology for the initial conditions. When you run a model, you have got to start somewhere, when we run this model long enough before the study period that is we are using the conditions for that actual period.

What is a model? The model that we use is called a primitive equation model. By primitive equation, we mean that it is based on first principles, it is based on Newton's laws that were developed in the 17th Century by Sir Isaac Newton. Those laws were further expanded to fluid dynamics in the 19th Century. It is a set of equations called the Navier-Stokes equations. Those are very well thought to represent fluid flow. They even model turbulence and all sorts of things. They are very rich sets of equations.

They are a rich set of equations that lend themselves to computer models. They

did not lend themselves very well to analytic solutions in the 19th Century, but they have lent themselves very well to be able to use high speed numerical computers to represent these equations, and then simulate the motion of fluids. The same sets of equations are used in ocean models. They are also used in atmospheric models. So when you looked at the weather forecast this morning, it is because someone had run a primitive equation model on the current conditions from yesterday, and extended that to be able to tell you what tomorrow is likely to be like.

In the model, the bottom stress magnitude -- which is what we are interested in here for the purposes of this study -- is computed according to the formula that you see down here. It is Tau equals Rho -- Rho is the water density -- times Cd. Cd is just a constant. We normally take it to be point zero zero two five. It varies somewhat, but spatially, different studies vary. Then that is times the square of the water velocity. So in other words, if I double the water velocity, I increase the stress four fold. This also makes

bottom friction non linear, which means that these models behave in a non linear fashion, which means that the models really are a pretty complex source of behavior.

Here is what our grid looks like to the bottom of your right. Again, this is nested within a bigger model that covers the rest of the shelf out here and then up to the northwest Atlantic, and this is our model. It contains about 30,000 triangular elements, each one of which contains 15 depth elements. So we have got a total of about 500,000 volume elements running this model.

In red right there, what I am showing is the area of our study. So red is the area of the study, and here it is to that red area. You can see that this model is made of discrete triangular mesh. It is important to realize that the resolution of this mesh is also the resolution of the output of this model. It is certainly much better than any survey we could ever do. We could not take a ship and survey every single one of those little triangles, nor could we go put buoys in every single one of those little triangles. But it is nevertheless of limited resolution. If we want even higher resolution than that because you want to know what is happening at Point Judith right at the pier, we can nest even finer triangles within this mesh. But it is impractical to use finer scale triangles over this domain, and we need to get the flow right over this domain to able to get the flows right at a finer scale.

So the current resolution is about one to five hundred meters, which is about a quarter of a mile, which is a fine enough resolution to distinguish between potential dredge sites, but it is not a fine enough scale to talk about moving the boundary 100 feet east or west.

We wonder how well does the model work. We have calibrated it. We have calibrated it using sea level heights, and we use sea level heights throughout Long Island Sound and New York Harbor. We also calibrated it using records of temperatures that we have, records of salinity that we have. As far as how well the model does, it really does quite well. I would call it

state of the art in terms of oceanography readings. We have got skills of 90 percent or better for sea level height, water currents, temperature and salinity.

With that, we are going to talk more now about evaluating our model compared to stress. Dr. Bohlen is going to talk more about that.

DR. BOHLEN: So you are a skeptic about this model stuff. We all are. We live with skepticism. A little bit of cynicism but a lot of skepticism. So we are going to go back out and we are going to measure at a discrete number of points. Deploy instruments, and the instruments are mounted on bottom frames. You will see them in a minute. We did talk about buoys, the buoy floats. There may be a little lobster pot to help us sort of find it, but the measurements that we are taking are using bottom mounted arrays.

Here they are. Seven bottom mounted tripods, three two-month observation Campaigns to try to get a feeling for some of this time variation that we were seeing earlier.

We know that we are never quite where we want to be. It used to get to be a curse if they see us walking down the dock and know there is a storm coming.

You would like to have it out there for a fair range of conditions, and you can believe that the conditions in the summer are somewhat different than the conditions in the winter, or the conditions during the seasonal transition, spring and fall seasonal transition are going to be different than the winter.

So we tried to pick three periods where a variety of conditions are going to be seen time wise. Then we are going to try site these seven stations that you see here in red at a number of locations where we might expect to see spatial differences in bottom shear stress. So we get a range of conditions, gather up that data and come back and use them to verify, evaluate the accuracy of the model. Clear?

Here are the periods. Our spring period is March through May. About each one of these is on the order of 60 days, you see everything. The spring period you saw on that

river discharge chart is a time when you expect to see elevated river discharge, and it might be windy as well. For those of us that live on the water, the spring can be pretty windy around here. Then the summer, lower river flow, and again for those guys that are sailors, you know when it gets nice and warm, the wind dies. Generally lower energy. Come winter, lower river flow, but with high wind. So three Campaigns. You will see this Campaign number one, two and three.

Here are the frames. Pretty standard stuff today, with the exception of this little guy that sits down here that says Nortek, which is the manufacturer of acoustic Doppler current profiler, ADCP. That is what you are going to hear a lot about in this study, but more and more, you are going to hear about it when people talk about measuring currents. We don't put a single current meter out any more. We actually have a single current meter at the bottom that allows us to take measurements of the whole of the vertical, or at the surface and take measurements over the whole of the vertical.

Very, very useful tool.

This Nortek I said was a little bit revolutionary in the game. It is what they call a pulse coherent acoustic Doppler current profiler, meaning that you can make very small measurements. The RDI that sits up on top of the ADCP, that is the upper looking guy, that is measuring about once every meter over the vertical. The Nortek measures centimeters over the bottom three quarters of a meter. So really fine slicing down to the boundary, which is what we care about. Remember? We really want to get those measurements down to the bottom. Grant showed you the equation, the square of the velocities, the east west velocity and the north south velocity. We are really able to measure those accurately right down to the bone, and we can with the Nortek. This thing, (the frame), also has a temperature salinity sensor sitting over here, and a couple of probes along here, and another one here that says OBS, Optical Back Scatter, so we can measure the concentration of stuff in the water column.

This will sample, burst sample

maybe four times an hour a whole array for a couple of thousand samples. So you can get a lot of data on the structure of the flow both over the vertical, we are looking for far field effects over the vertical, and in terms of resuspension, the boundary shear stress at these points. They are discrete points, and that is what you are measuring; water column currents and waves, currents near the sea floor, stress, suspended sediment concentration and temperature and salinity. That frame stands about 6 feet high or so, and about 8, 10 feet triangular.

When we were out there working on the frames, changing batteries and so forth, we had to get out there, so you run a ship out from Avery Point to the stations. Along the way, you take temperature and salinity measurements at a number of points. This is a conductivity temperature depth profiler, profiling conductivity temperature depth, CTD, along with a series of bottles in here. So as you are lowering it down, you can take discrete water samples over the vertical, and bring those samples back. That allows you to calibrate your

instruments. The OBS is an optical sensor looking at what is in suspension. How do you know that it really is telling you the truth? You draw some water samples, filter them down, compare them with the OBS. That is what the water samples allow you to do. You get your temperature and salinity from that as well .

Sediment samples. For each station that we are doing the CTD Cast, we will also get a sediment grab. We will get an idea of the distribution of the sediment in the study area as well.

This is just showing you some of the ship's track. It doesn't really mean very much because yesterday, the track didn't look like that, and tomorrow, it probably won't look like that again. You get from station to station, depending on how the weather goes.

The data recovery. This is an interesting slide. The data recovery is pretty good. You have three Campaigns, one, two, three in each of these boxes. The first guy shows you temperature salinity, and it shows you pretty much blue, which says full or near full data

recovery, greater than 50 percent. You have got a lot of temperature salinity there. You go out here and you say currents and suspended sediments near the sea floor. That is that Nortek ADCP. The pulse coherent guy that is looking at the bottom 75 centimeters or so. You see the blues are in the middle guy, lighter blue here and yellow.

The first time we put this guy out, the manufacturer had claimed a certain life of the batteries. So we figured we would go out once at the beginning and once at the end of the deployment period, change up the batteries. We went out there after about a week or two to check things out, and the batteries were bad. So that is why the Campaign One data recovery rate is somewhat lower than it was in the other Campaigns.

Same thing goes for the two zeroes down here for ADCP's. This is now just telling you some of the problems of doing this kind of measurement. These two instruments were sent back to the manufacturer for refurbishment, and sent back all refurbished, ready to go with the wrong firmware. You put it in the field, and you get no data, that sort of thing. But overall when you are taking a look through this, you say the data recovery rates are well in excess of 50 percent, and probably bordering on 80 percent for a lot of the sensors.

DR. MCCARDELL: We did not expect to have that percent. 50 percent was what was anticipated.

DR. BOHLEN: A few years ago, if you got 10 or 20 percent, you would really be feeling good. Just some examples of the observations. This is mean flow, an average, near the bottom. This is the RDI, the ADCP that is looking up. You are 3 meters off the sea floor here, and this is the long term net drift. This is not an instantaneous measurement, it is an average over many tidal cycles.

You can see it here, if you look carefully at these, you will see they are three different colors in every one of these. You can see in general, the near bottom flow will generally drift into the Sound. It is a characteristic estuarine flow.

You have the higher density, saltier water at the bottom, and it tends to migrate into the estuary, as opposed to the characteristic fresher, lighter surface waters that tend to migrate out. The waters of Long Island Sound are not getting fresher and fresher as the Connecticut River water comes in, so where is it going? Out. You have got a characteristic in at the bottom under the surface, and that is what you are looking at here.

This is now at a particular level, and we are going to come all the way up for you. It is just that they picked 3 meters here. This is the Nortek now, about a half a meter from the sea floor. It is the same sort of thing. You get an idea of the magnitude. The magnitude is shown in here on the order of 10 centimeters a second once again. Capisce? 10 centimeters a second? Are you comfortable with 10 centimeters a second? You don't have to lie to me.

A nautical mile per hour, one knot, nautical mile per hour, 50 centimeters a second. Does that give you a feeling for what 10 cm/sec is? Better? That is a mile per hour, sort of

like in a car, a little bit more, 6,080 feet, instead of 5,000 and some. So just to give you an idea, 10 centimeters a second as the average drift, pretty slow. 30 centimeters a second is a foot per second. So that is the drift, that is the average drift. You stir this stuff up and it is going to go back and forth, back and forth, back and forth, and it is going to keep marching out at the surface. At the bottom, back and forth, back and forth, back and forth, marching in. On average, about 10 centimeters a second, the average flow rate. Clear?

This is just showing a little bit about the tidal amplitudes in that these are tidal ellipses for each of the Campaigns. Again, what you are seeing roughly, this is now over the vertical. The M2 is the principal lunar component of the tide. You will see that generally things are acting along the axis of the system, which is about what you would expect. You can get some idea of the magnitude on this whole thing. This is a graphic. That is about a half a meter per second over here. So you get an idea that you have on the order of a knot or so

max flows down in here. As you get down further out in here, the velocities go down, which is what you are seeing ad nauseam. You saw it in the first model, you saw it in the project model.

With the wave statistics, one of the things we are looking at here is the extent to which the waves are influencing bottom shear stress. One of the questions is always sensitive to areas that are going to be influenced by the waves. To make a long story short here, what these data are showing, there is a difference. In our bottom stress profiles in here, we are looking at time against the magnitude of the bottom stress. You will see this is the spring/neap monthly cycle, the stress as you are looking at moving up here. Up here is time, and this is wave amplitude varying over the period. What you would like to see, if there was a neat correlation between the two, is the influence of the wave on the bottom stress.

To make a long story short here, probably not surprisingly, there isn't much of a correlation, because the stations are, for the most part, outside of "the wave base," the area that you expect to be influenced by waves. Which makes sense because you want to set a site for disposal of materials that tends to have as few influences to move this stuff around as possible.

The guy on the bottom is showing you a relationship between velocity and the distance over the vertical, and it is just showing you there is a difference at the two sites as we are coming in here, at the two times as you are coming in here. This is another site looking at the same thing, and probably the same answer.

One of the things I didn't point out, and you may have missed on the very first slide that had the Zone of Siting Feasibility, is around the margin of it was a gray border. That has been defined by the Army Corp and EPA as the area where you are too close to shore, and you may be more likely subject to wave influence. So that is looking pretty good so far from these data.

DR. MCCARDELL: Because it is shallower.

DR. BOHLEN: Because it is

shallower. I thought that went without saying, right. Closer to shore is shallower.

MS. PURNELL: Is that set at 14 feet? Is the boundary set at 14 feet?

DR. BOHLEN: I don't know.

DR. HAY: 18 meters.

DR. BOHLEN: 17, 18 meters.

MS. PURNELL: Thank you.

DR. BOHLEN: We can argue about the 17 or 18, but it is not going to affect it. This gets a little esoteric for you. This is the plot that Grant, when he was talking about the model formulation, he said he was going to be using a formula that had a drag coefficient in it, and he mentioned just sort of off hand, our drag coefficient, C sub d, is generally on the order of . 0025. This was a plot to check out whether that made any sense or not. What we are taking a look at here is a log plot sitting along here. There is a log law down in here, and there is a bulk formula on here. If everything on the vertical bulk formula, on the horizontal log law, if everything was fine, it would be laying along a single line, a log law.

It looks pretty good on this, laying along a single line until you get up in the vicinity of about a Pascal. When you get up to a Pascal or so, that begins to break down a little bit. This is where the complications come in. Why for? Because all sorts of things at this point start influencing the characteristic of the near bottom velocity field, the velocity over the vertical, the boundary layer when you get down to there. When you begin to stir up sediment into the water column, you begin to change the relationships that govern the distribution of the velocity over the vertical, the friction characteristics of the flow change. You can also change the pressure distributions at the bottom as they affect the flow field.

That is being verified here really as you see, you get up here pretty well, and you begin to break off somewhere around, if you can see it, right around here. Then you get off and say how many things are going on. But the long and short of this one is that the measurements using the log law support the use of the bulk formula with a drag coefficient of about .0025,

up to at least one Pascal.

I thought this was hard to see, and it may be that I am getting color blind as my age passes, but one of the things this is showing you is that model simulations reproduce tidal and the spring neap variations on the observed stress very well. You have got a neap, spring neap variation. Do you understand spring neap? Is that all right?

The monthly variations, twice monthly variations. We are near full moon tide right now. You drive down Route 25 this morning, this afternoon, and high water is pretty near the road. That is not counting what is going to happen when it is going to blow for the next day and a half. We get off the full moon, and the tidal excursion (range) is somewhat reduced. We get back on the new moon, and it is increased. That is the spring/neap cycle. That spring has got nothing to do with May June either.

What you are seeing here is a variation over the course of about 14 days or so of a spring neap cycle. You can see, if you can see it, if the blues and the purples weren't so close together, that the model is doing an excellent job of reproducing the stress that is measured from the array.

DR. MCCARDELL: The model is in red, and the data are in blue.

DR. BOHLEN: You can see it down at the end in the blue. That is why they dove off the end down in here. There is no data out there. So we got a pretty good feeling for that.

Here, we are looking at a comparison between the measured and observed again. This is now the model, modeled and observed or modeled and measured. This is the model and this is the observed, and you can see if there was a perfect fit, a one to one fit, everything would be laying on this line right here. So it is just a slight variation for the means, these are the mean velocities now. Then for the max in here, it is a little coarser. The R squared is about point 7 in here (the maximum value). It is something over point 9 in the case of the means. But in the world of modeling versus measuring, those correlations are excellent. That is a high correlation. You are

very happy with how well your model can do for you when you are talking about those kinds of values.

MS. PURNELL: Again, that data and the prior slide's data, that averages over all seven of those arrays? Is that how you came to that?

DR. BOHLEN: I had forgotten what I had on this one. Yes, it is.

DR. MCCARDELL: Yes, it covers the stress during the entire Campaign.

DR. BOHLEN: For all seven arrays.

DR. MCCARDELL: The maximum amount of stress during the entire Campaign.

DR. BOHLEN: Right. One of them, I had just one Campaign. Here is the analysis. Find the maximum bottom stress magnitude at each point in the Zone of Siting Feasibility in the three Campaigns, compare the values at sites identified in the screening process. That is the sites considered potential disposal areas. To simulate the period and the characteristics that you might expect during a storm, Sandy came to mind.

Here is the Bathymetry, water depths through the study area, and these are the stations, DOTs, groups, and the sites. You get an idea of what the water depths look like through the system. Are you comfortable with that? Pretty deep in the vicinity of the arrays. Montauk, - shallow is here. Is that okay?

Stress values. Here are your stresses in Pascals. Reds are three, and that number that we were playing with in that panel before, point 75 or so, is somewhere down in the blues, down in here. So if we say that a fair amount of the area in the Zone of Siting Feasibility has got fairly high stress, that is what that guy is saying.

The one thing that is interesting is that the spatial differences, if we run this now for each of the Campaigns, and we can go beyond the Campaigns now that we have a model, we can run it every month if we care to, you are going to find that the spatial differences are much larger than the seasonal variations.

Which sort of makes sense because you figure that wind and wind waves are probably

the primary factor affecting the turbulence over the vertical. We were seeing before that wind and wind waves have relatively little effect on bottom shear stress in the area that we are picking. You have got to get much closer to the beach to find that.

So to give you a sense of what the stresses look like, you are within a one and a half Pascals sort of range up in there. You get up into Fishers Island Sound or close to Fishers Island Sound, you are getting down to your point 7 or so. You get out into here, you get down around Montauk, you are up around 2 and behind Montauk.

Maximum bottom stress during storm conditions we observed through each of the Campaigns; one two and three. You can see this, we are allowed to go through this now and pick out different seasons, different locations. Cornfield is fairly high. That starts dropping down. This is Eastern Long Island Sound, Six Mile Reef, Clinton, Orient Point, New London.

Then we go Block Long Island Sound, outside of Eastern Long Island Sound, however you want to divide it. Fishers, this is the south side of Fishers near the deep hole for Fishers. Values similar to Clinton. You can sit and play with this. This is the kind of information that you will have to play with as you go through. That just summarizes some of the sites against that plot you had before.

Sandy. This should come as no surprise, the results from the Sandy analysis if you lived here during Sandy. You had some winds. This is now Ledge Light, tip of Long Island Sound, west of Long Island Sound and the Bronx. You have got some winds at Ledge Light that might get up to 60 miles an hour. Is that a lot of wind? It is not an afternoon sailing breeze, not around here, but it is a fair amount of wind. But this is not the 100 year storm event, wind wise. It is just sort of a husky afternoon sailing breeze. You can get a 50 knot blow nearly every year, every other year.

MS. ESPOSITO: We are supposed to get 50 mile per hour winds tomorrow.

DR. BOHLEN: We might get 50 mile per hour winds tomorrow, so there you are, call

me a liar. Again, any time you look at these things, you sort of scale them out, what do they look like, what do they feel like. Again, the impressive thing about Sandy that made it memorable was the surge, and the impressive thing about Sandy that made it memorable was the surge down towards New York. In this case, this is Kings Point, this is in Long Island Sound. In Kings Point, there is a surge up here on the order of 4 meters. We get down to the eastern end of things, on the order of one and a half to 2 meters.

So we have a pretty good surge down at our end. It has got a recurrence on the order of 30 to 40 years sort of a thing. When you get down to the western end of Long Island Sound and New York Harbor, you have got a recurrence interval of once every 1,000 to hundreds of years or so. That is what got the attention, besides 8 million people, to Sandy.

Superstorm Sandy, our analysis of that, running it in, created higher maximum amount of stresses in some areas, and most of those areas were closer to shore, sitting in

here. If you ran this guy against the slide I showed you earlier, which was the results of the model that is running through every year, and no Sandy in that, you won't see an awful lot of difference. You will some spatial variability in areas where you would expect to see more reds up along the shallows. It makes sense.

Sandy was, for the most part, a southeasterly storm here. It went northeasterly as it got close. Southeast, this way, east this way. That's when you have got your good winds and you have got some good waves and you have got some good stresses acting against, you all know what, residual flows. You stuff a lot of water down at the western end of the Sound, and it has got to go somewhere. It comes back out. It is the interaction of the tidal wave with the outflow of water that produces some interesting turbulence, and increases the chance of change in boundary shear stress. So the picture here is fairly complicated, but it didn't turn everything red at all, is the moral of this story. But I suppose you could find me a higher energy storm. Start looking around for it.

This is now the Superstorm Sandy conditions, and again, you are running these up against what we had before, and you see New London along on the eastern Sound and Cornfield, Six Mile. Six Mile is out in the water a little bit more, a little bit higher. These numbers aren't terribly much different than what we saw before. In fact, in some areas, you might see the stresses a little bit lower because of the complexity of the interaction of the flow.

We define a stress level based on historical data and literature. Based on a review, we chose point 75 Pascal as something of a design threshold. You can make it higher, you can make it a little bit lower, you can sit and argue about it but this is a work in progress. But you have the data to progress, to do that sort of testing. The model is looking pretty good. The results of the model are impressive.

Critical shear stress, if you listened to what I told you before, the manner of setting up a critical shear stress for cohesive materials is complicated. It depends on grain size fraction at play, volume fraction, how many burrowing organisms you have working that are at the sediment mound, how long the sediment has been down for consolidation. All of that affects bulk density, affects erodibility, and bulk density is very important in here.

The comparison of the maximum amount of stress for potential dredged material disposal site simulation in the three observing Campaigns and Sandy, throwing in Sandy, came out with this set of numbers. Cornfield one. Six Mile was next. Fishers Island west, this is south of Fishers Island near the deep hole, was next. Then Niantic Bay and Clinton Harbor. You run down this guy, the New London disposal site is point 69. All of these guys here; Block Island, New London, Fishers Island Center, Orient, Fishers Island East and North of Montauk are less than the defined critical threshold, point 75.

What this guy is, is just a graph of areas where the maximum amount of stress exceeds point 75. To give you an idea that it covers a fair number of the sites in the Eastern

Sound, it covers a fair number of sites in the Eastern Sound, with the exception of the Fishers Island site down here. This is the kind of information that is coming in, that we can bring into the site selection designation.

So, sites one, two and seven, Cornfield Shoals, Six Mile and Fishers Island. Everybody knows where they are, and Fishers Island west, have high maximum stress. Four and ten, this is Orient Point and Block Island, the Block Island Sound site. Maximum stress is below at the center of the site, but have values in excess of point 75 Pascals at the boundary. So there is a spatial variation on the scale of a mile or so. Grant already told you that the resolution of the model might be on the order of a quarter of a mile or so.

Sites three and five, Niantic Bay and Clinton Harbor, maximum stresses, but less than one. The stresses are above point 75, but less than one. If you want to really hold me to point 75, you can make your one, you can argue about a quarter of a Dyne or so, a quarter of a Pascal or so, the issue gets interesting. The

New London disposal is the only site in the Eastern Sound with a maximum stress level below point 75. We saw that. Thank you. Questions?

DR. HAY: Before you have any questions, state your name, please, for the record, and also your affiliation.

MR. GASH: I am Bill Gash, Connecticut Maritime Coalition. Referencing back to one of your earlier slides when you were talking about shear out there, I have a letter from the State of New York objecting to consistency certification for dredge projects taking place in Mystic.

I just want to be clear on something. They state in their letter that sediments associated with that project were comprised almost entirely of fine grained, very small silty particles. I would imagine those are the same fines that you are talking about.

DR. BOHLEN: What fines?

MR. GASH: That all stick together, they are all glued together.

DR. BOHLEN: Yes, yes.

MR. GASH: They said given the high

current velocities and unstable nature of sediments at and in the vicinity of NLDS, and the placement of the material from this proposal that contains large volumes of that very fine silt, adverse effects are anticipated at the site, adjacent areas as a result of the dredge material disposal activities. Can you comment on that at all? From what I am seeing from your presentation with the Pascals and the disposals, once the material has fallen, there is going to be some dispersion as they are falling. But as they get near bottom, everything pretty much settles down to less than point 75 shear in Pascals.

DR. BOHLEN: I really can't comment on it because I don't have the sediment data to look at. But seemingly the statement, at least the first part of the statement that you read, flies in the face of what I said about the erodibility of the materials that are progressively more cohesive. As you get down into the silt range of sediments, below 63 microns, the sediment, a sediment mass is very, very cohesive, and tends to get probably more cohesive, will get more cohesive as you add more clay particles.

The problem with any one of these about diagrams is they show you a single grain size. If I picked up that stuff out of my bucket and I said we did sediment grabs, full-on grabs at each of the stations that we were doing CTD casts at, it would be shmuck on the deck. It would be quite cohesive and clay like. When you get an analysis, you find there is a range of particle sizes. So you might say the mean grain size is 50 microns. But you have got a lot of stuff that is down to two, and you may have a little bit of stuff, because we do the grain size, distribution by mass, so a few big particles can skew the mean a lot.

Most of the sediments that we are familiar with in Mystic River are exceedingly cohesive. This is all I can tell you. As far as the barge goes, that is another whole story. 45 years ago had us diving on the New London disposal site. The sea story in that is that this was material that was being dredged from the Thames River for the channel up to the submarine

base, the channel from the mouth of the river up to the submarine base. If you look, it is being put into dredge by clamshell dredge and put into 2,000 cubic yard hopper barges. The barge would go out and they would open the bottom door and down goes the stuff.

We would go down after a while, I am not going into going down, but we would go down after a while for a swim. Any number of pieces of that stuff on the bottom retained the teeth marks from the clamshell bucket. When you drop that stuff in the water, there is a gravity flow. It goes down like a brick, vertically, and it retains its cohesive character until lobsters drill holes in it. That is another story.

DR. HAY: Any other comments, any questions?

MS. PURNELL: Marguerite Purnell.

DR. HAY: Do you want to state your affiliation.

MS. PURNELL: Fishers Island. The information that is presented today, is it on the web site yet?

DR. BOHLEN: No.

MS. PURNELL: Will it be posted on the web site as one of our presentations?

MS. BROCHI: It will, and when we post information, we are going to send an E-mail notification so everybody knows that it will be available.

MS. PURNELL: Because there is just a lot of material. I could ask you 40,000 questions and it is not really productive for the other people who are here.

DR. BOHLEN: You could try one.

MS. BROCHI: She already asked one.

DR. BOHLEN: That is okay. She can ask one other question.

MS. PURNELL: I appreciate the physical oceanography component to it, and there is a lot of meat in there to really think about. Have you made any effort to correlate that with the prior physical oceanography that was done in the prior designation for Western Long Island Sound and Central Long Island Sound since there were data points in the Eastern Long Island Sound for the siting feasibility as well. I was just

wondering whether or not you have looked at the consistency of the data and the findings as of yet.

DR. BOHLEN: I am not exactly sure what you are asking. Because as I showed you, I think, you are going to expect a fair amount of difference in the transporter regime in the central and western Sound, where we have worked before, but not on the siting study. Me, not on the siting study.

I have worked on other parts of the Sound, so there is a significant difference in the transport system in the Central Sound, Western Sound versus the Eastern Sound.

MS. PURNELL: I concur.

DR. BOHLEN: You can believe it just from an energetic standpoint, you saw all of those arrows, the blue arrows, the white arrows we showed you on the model. Then of course there is the matter of it being open to the world ocean out there from the southeast. It is a much more energetic system. The comparison between the two I am not so sure is germane to this question.

MS. PURNELL: The comparison is

germane in the sense that there was a large chunk of data in the physical oceanography report that dealt with the Eastern Long Island Sound. I apologize if that did not come across in my question.

DR. BOHLEN: Anything that dealt with the Eastern Long Island Sound we have seen. Of course, the other thing is we did the report that is in the Long Island Sound volume on the physical oceanography of Long Island Sound. We saw some of the slides from that report up here. So we are looking at all of that, and that will all be brought together. I think the thing that is impressive on this from the standpoint, again, from the history of disposal in the Sound is you have got more site specific measurements in this study than you had in any other study area.

There were seven frames out there, and the effort to tie all that together, and verify, calibrate and redesign the model has been substantial, leaving you with a very powerful tool to be used for any use out there, really. It is a substantial foundation to resolve the issue.

MS. PURNELL: The data point that was closest to the New London dump site, you based some of your findings on that. Where is that related to the position of the current outline of the dump site? Is it in it or is it to the northwest or is it to the southwest? Given the resolution of the slide, it is hard to figure.

DR. BOHLEN: Why don't we look on here as to exactly where it is. I will put the slide up and show you.

DR. MCCARDELL: I should add that the seven sites that we used for the surveys were chosen to represent the maximum variability that we would see within this entire domain as an attempt to get the model as good as we could. They were not chosen to represent any specific site, because we are legislated to be able to consider all possible sites. If we give undue credence to one site, we would have measurements at one site and not others.

MS. PURNELL: Thank you.

DR. MCCARDELL: I hope that explains a little bit.

MS. PURNELL: Thank you.

DR. HAY: Thank you. Other questions?

MR. MCALLISTER: Kevin McAllister, Defend H2O. That was very thorough. Thank you, Doctor. Forgive me if I am missing something, but this component with the physical oceanography, we are really focusing on dispersal, the biological implications as defined, I guess, at least in part with the environmental consequences. Was that another part? Am I missing something?

DR. BOHLEN: No biology.

MR. MCALLISTER: No biology. Of course, certainly I understand that part, but where is the biology?

MS. BROCHI: This is one part of the site screening. This is the physo component. There is a biological component as well. Biological characterization will be done combined with this physo model to model sediment transport as well.

MR. MCALLISTER: Will you be back in town to share this information with us?

MS. BROCHI: We will share the information, but we don't know the dates. Again, whenever anything is posted on the web site, we will notify you ahead of time. While this physo presentation is fresh in your mind, we will have it available probably next week. We will send out notification and have the presentation up, so yes. It is a multi faceted process, so it has many components going on, and we have contractors putting it together as we speak.

MR. MCALLISTER: As I understand, if I am not mistaken, was it the environmental consequences document that seems to be the bulk of the biology? That is at least what I saw so far as being represented. Is that correct?

MS. BROCHI: I am not sure what you mean by "environmental consequences."

DR. HAY: Do you mean the SEIS, the Supplemental Environmental Impact Study?

MR. MCALLISTER: No, there was another document that I had viewed, environmental consequences document.

MS. BROCHI: I am not familiar with the environmental consequences document, but

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if you remember it or you can reference it, send an E-mail to any of us, actually, or ELIS@EPA.gov e-mail, and we can get back to you.

DR. HAY: The environmental consequences document will be part of the SEIS.

MR. MCALLISTER: Chapter five, environmental consequences.

MS. BROCHI: All right. I thought you were looking at something.

MR. MCALLISTER: Thank you.

MS. BROCHI: There is also a no action alternative as part of this effort. So it is looking at sites, but is also looking at what happens if there is no site.

DR. HAY: Okay then. Other questions, comments?

DR. BOHLEN: We are pretty easy to find. BOHLEN@UCONN.EDU, or you can just take a look at the University of Connecticut and see the faces in here. If there are questions, we are happy to answer them.

MR. MCALLISTER: May I make a request with respect to our sign in? Would it be possible to provide some contact information to

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the attendees here via E-mail?

MS. BROCHI: Sure.

MR. MCALLISTER: Because a couple of those slides that were identified went by very quickly.

DR. BOHLEN: I'm sorry, a couple of the slides --

MR. MCALLISTER: A couple of the slides that identified the presenters and who was being represented today, that went very quickly. I didn't get names and contact information.

MS. BROCHI: Sure, we will get that out. We will do that in the notification when we post the information on the web site.

MR. MCALLISTER: Thank you.

DR. HAY: The names of the presenters is also on the agenda.

A SPEAKER: Just an anonymous question. Who is responding to the ELIS@EPA.gov address?

MS. BROCHI: Several of us at the Region 1 office.

DR. HAY: Thank you. Other questions?

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MS. ESPOSITO: Adrienne Esposito, Citizens Campaign for the Environment. Just for clarity, the University of Connecticut is contracted out by the EPA to do this work?

DR. BOHLEN: No.

MS. BROCHI: They are contracted for the project, and the contract is through Connecticut DOT, not directly to the EPA.

MS. ESPOSITO: Okay, but contracted for this effort.

MS. BROCHI: Yes.

MS. ESPOSITO: I understand.

DR. BOHLEN: You heard about a whole bunch of other things, and we may or may not involved in those.

DR. HAY: Other questions? Going once, twice? Last chance? I will adjourn the meeting now.

(TIME NOTED: 4:25 P.M.)

CERTIFICATION

I, Robert J. Pollack, a Notary Public in and for the State of New York, do hereby certify:

THAT the foregoing is a true and accurate transcript of my stenographic notes.

IN WITNESS WHEREOF, I have hereunto set my hand this 13th day of December 2014.

____

ROBERT J. POLLACK

SEIS MEETING 12-8-2014

CERTIFICATION

I, Robert J. Pollack, a Notary Public in and for the State of New York, do hereby certify:

THAT the foregoing is a true and accurate transcript of my stenographic notes.

IN WITNESS WHEREOF, I have hereunto set my hand this 8th day of January 2014.

Robert J. Pollack

ROBERT J. POLLACK

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Attachment 5

TRANSCRIPTS OF PUBLIC MEETINGS, NEW LONDON, CONNECTICUT DECEMBER 9, 2014

SUPPLEMENTAL ENVIRONMENTAL IMPACT
STATEMENT(SEIS) TO EVALUATE THE POTENTIAL
DESIGNATION OF ONE OR MORE DREDGED
MATERIAL DISPOSAL SITE(S) IN EASTERN
LONG ISLAND SOUND

DECEMBER 9, 2014
3:08 P.M.

FORT TRUMBULL
90 WALBACH STREET
NEW LONDON, CONNECTICUT

BRANDON HUSEBY REPORTING & VIDEO
Reporter: JACQUELINE V. McCauley, RPR, CSR
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(The hearing commenced at 3:08 p.m.)

DR. HAY: Welcome to this public meeting. Thanks for coming out on this lovely balmy afternoon here. So before we start, a couple of housekeeping measures. We don't have a microphone so if you have difficulty hearing, please move to the front. There are lots of seats up in the front.

Secondly, the bathrooms are outside just outside the hallway. Not outside the building. The sign-in sheet, I hope everybody had a chance to sign in. Also, if you want to make a comment at the end of this presentation, please also sign in. There is a sign-in sheet there, although there will be an opportunity to ask questions that you may not anticipate at this point.

Finally, please turn off your cellphones or any other kind of audio devices so that we don't get interrupted or put them on vibrate. My name is Bernward Hay. I'm with The Louis Berger Group. We're under contract to the University of Connecticut, which is under contract with the Connecticut Department of Transportation, and we're working together for the DOT and the EPA for the evaluation of potential dredged material disposal sites in open waters in the Eastern Long Island Sound

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region. So the EPA is the lead agency from the Federal side for this project.

Parallel to this meeting there was another meeting yesterday in Riverhead in New York, and today's meeting will focus on the findings of a physical oceanography study that was conducted for this Environmental Impact Statement. This will be presented by the University of Connecticut, Frank Bohlen and Grant McCardell, and it will be an informational meeting. So as a result, there won't be any specific comments or any specific comment period.

The meeting will be introduced by Ms. Jean Brochi. She's the project manager with EPA for the Ocean and Coastal Protection Unit, and she will provide a project status to see where we are in this process, and we have a 50-minute presentation by Frank and Grant, and after this the floor will be open for questions and comments.

The meeting will be recorded by a stenographer and also an audio recording device, and the transcript of the meeting will be made available to the public later on EPA's Web site. So with that, Jean?

MS. BROCHI: Thanks, Bernward. I probably need a mic. So of all of the speakers you

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will hear today I am probably the one that needs a mic. So if I talk too fast or you can't hear me, just raise your hand. I will repeat or I will stop.

Again, I'm Jean Brochi from EPA Region One, and I just wanted to introduce a few folks that are in the room as well with me. They're members of our cooperative agency group, and it includes Brian Thompson, George Wisker from DEEP. Joe Salvatore from Connecticut DOT in the back. We've got Todd Randall from the Corps of Engineers, Mark Habel from the Corps of Engineers New England. We have New York DEC and DOS representatives as well as EPA Region Two folks that came to last night's meeting in Riverhead, New York.

So you're here, because you are interested in the Eastern Long Island Sound Supplemental Environmental Impact Statement, and, again, I'm representing EPA Region One. So Bernward already went through the agenda. We will have Frank Bohlen and Grant McCardell show results of a physical oceanographic study.

So if you haven't been to previous meetings, we had a few introductory meetings on this process, and this has been going on since 2012. This meeting is going to be a summary of some of our

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responsibility and really just an update on the process, and then I'm going to give it to the University of Connecticut folks.

So EPA and the Corps of Engineers share responsibility for dredged material. EPA through the Marine Protection Sanctuary, Research and Sanctuaries Act, Section 102, has the authority to designate dredged material disposal sites. The Corps has, under the Ocean Dumping Act, Section 404 has the authority to select disposal sites.

There's a difference. The designation that EPA would use for dredged material sites is long term. We both manage and monitor sites. EPA, when we designate a site, we issue a site management monitoring plan, and that's also a shared responsibility that we partner with the Corps on.

Now, for permits, as you know, that's directly to the Corps of Engineers, and EPA has authority for the testing, to review the testing and make determinations on suitability. So the history -- a little history of the disposal sites.

You know that in 2005 EPA entered into an Environmental Impact Statement and designated Western and Central Long Island Sound. This is a supplemental for the eastern part of The Sound only,

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and the sites that are part of this effort include the Cornfield Shoals site and New London site, and both of those sites were selected by the Corps of Engineers. And the two sites, Cornfield and New London, expire December 2016, and here are the sites.

So you have Central and Western and then the focus here is for Eastern, New London and Cornfield. So, again, EPA's role in dredging is to review the permits, designate disposal sites. We promulgate the regulations. We develop site management monitoring plans, and then we manage the sites with the Corps of Engineers. So the initial approach to this effort was to look at site screening, and we looked at five general criteria and 11 specific, and all will lead to what we had done in the first EIS.

These are site selection criteria that are in the Marine Protection, Research and Sanctuaries Act, and so what we cover for some of this information is biological resources. We will be looking at conflicting use. We will be looking at sediment environment as well as physical conditions, and one of the aspects that was so most interesting to EPA and what you will hear more about later on is the physical conditions and the sediment transport at

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sites such as New London and Cornfield where they are so different in characteristics.

So the initial screening process started with 11 sites, and of those sites they included some historic disposal sites and the active disposal sites. For the historic sites those were sites that we knew had some dredged material disposal at some point in time. Most of them were in the 40s, and that was what the Corps of Engineers gave us for their official record.

So the 11 sites we initially screened, and they're listed on the bottom here. Active sites are included in that, and then from that group we narrowed it down to Cornfield Shoals disposal site, Six Mile Reef, Clinton Harbor, Orient Point, Niantic and New London, and those sites are still being evaluated.

So for the physical oceanography study you can see -- in the yellow block you will see the names of some of the historic sites and then -- it would be great if this worked, but -- there we go.

DR. BOHLEN: No, here.

MS. BROCHI: Thank you.

DR. BOHLEN: That's me.(referring to a laser pointer)

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MS. BROCHI: Listen. Don't take my steam. You are coming up next. There we go. So the yellow is historic, and the bluish white are the active sites, and what you are looking at is the disposal sites in red, and then for the green are the buoys that were placed for this physical oceanographic study that was conducted by UConn, and these black lines right here, I think Frank will go into more detail, is the zone of siting feasibility, which was established for the Environmental Impact Statement.

It's a busy slide so I will keep it up for a minute. So the process again, we started out the process October 16, 2012 with the Notice of Intent. Several folks had come to that meeting. We had an official comment period for that Notice of Intent, and since then we have had several public meetings as well as cooperating agency meetings.

At one of the June meetings, it was June 25 and 26, a representative from Sarah Anker's office requested that we try to reach out and do some more education. So EPA Region One and Region Two hosted a webinar on dredging, dredged material, dredged material equipment, and that was April 3, and that was well attended. I'm not sure if some of you folks were in there. I haven't looked at the sign-in sheet.

So if you are new to the process or you are interested and you haven't received notifications, please, again, you can e-mail me directly, I'm Jean Brochi, or you can e-mail the elis@epa.gov e-mail address, and we will add you to the distribution list, and we will also send out notifications whenever we're going to have a meeting, whenever we're going to post something on the EPA Web site.

The EPA Web site address is right here, and the minutes from the meetings, the documents, the studies will all be uploaded onto that Web site. There are people writing. I'll just leave this on for a few minutes.

Okay. So the next step draft, environmental, Supplemental Impact Statement, and rulemaking in the spring of 2015. We will at that point have additional public meetings for an official comment period on that document. And then if the SEIS recommends a designation of one more or sites, we will issue a final SEIS and rulemaking by December 2016. That's all I have. Thank you for coming and Frank is up next. I will give you back your laser.

DR. BOHLEN: Good afternoon. I'm

Frank Bohlen. I'm a physical oceanographer on the staff at the University of Connecticut Department of Marine Sciences. Physical oceanographer. I ain't no biologist. That's what that means. The physics of the ocean. And I'm here to talk about the study of the physical oceanography of the zone of siting feasibility.

It's important to realize what the talk is not. We're talking about the physical oceanography, circulation, currents, waves, and the factors that affect the movement of materials. You are going to hear a lot about boundary shear stress. We hear a lot about stress these days. This is boundary shear stress, the force that's going to be exerted on the bottom. And if the material fails, the material, because of that force loading, may be transported. So that's the physics of the process that we're going to be looking at.

Physical oceanography of the zone of siting feasibility I just told you the why of it. The how of it. We just can't go out and measure everything we want to know about every point in the field. That's a fair amount of area. You saw it on the earlier slide. So the best way to do that is to build a numerical model of the system. And we're all

very familiar with models. We wake up to the results of models on your weather forecasts. We live with models, and they're modeling everything from your voting preferences to what you eat and what you don't eat sort of a thing.

So you understand models at least in concept. The model is just that, one man's view of what the system is, how it functions, and that can be less than perfect. So what we try to do is, to the extent possible, to verify the results of the model, and to do that we take a series of measurements. Not as many as we might like to get, not as long as we like to get them. You talk to scientists. You guys are always cursing the scientists. They're saying, damn it, we always want more data.

But we get a fairly representative set of data and use it to calibrate a model. That will give us information on a much smaller, spatial scale, time temporal scale, than we could ever hope to do by taking direct measurements. That's the model.

We will talk to you a little bit about how we go about evaluating, the instruments that we're going to be using, and then what the results look like, what the model tells us about the currents that may affect the dispersion of materials that are

in the water column either resuspended from the bottom or entrained when you dispose of a couple of cubic yards of material in a dump, okay?

And then the boundary shear stress. If the stuff gets to the bottom and sits there under normal circumstances, under what condition might that stuff start to move around, okay? And then we will summarize the results.

Let's start out with a little bit of the physical oceanography. I told the gang yesterday that it's only right that we start with the physics of the system, because physics is, after all, the queen of the sciences, and everything else is simply handmaiden to the queen, okay? So physical oceanography, the science that explains the paths of ocean circulation, distribution of a property, blah, blah, blah. You can read it.

But of particular importance within this study are the factors governing boundary shear stress. Boundary shear stress. If we had a better rug, we could get the rug moving, okay? The force that's exerted, a horizontal force that's exerted on the bottom because of a gradient in the velocity as we approach the bottom. We have some wind movement over this floor here. If you can believe it's moving here

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pretty uninterrupted, and as it gets closer down to the floor, the flow is more and more influenced by the floor.

So there is some frictional drag on the velocity as it gets down to the bottom. That gradient and velocity from the free stream value to the boundary value produces a force on the bottom, horizontal force, a force per unit area, and the units we're going to be talking about are Pascals. You can go out and look it up, Pascals. You are familiar with pounds per square inch. You may have heard of Dynes in your physics class way back when. This is just another version of that force. And then we have a force per unit area, a shear, a horizontal force.

You hear of pounds per square inch, and as a vertical force through the atmospheric pressure. This is just a horizontal version of that same sort of thing. By the way, we speak our own language. We tend to speak our own language, and sometimes we take for granted that everybody knows what that word means.

But on occasion we find -- on more than one occasion we find that's not so. Don't be afraid to say wait a minute. There are no silly questions. So don't be afraid to say wait, wait,

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wait, wait, wait a minute on that for clarification. For substantive response we have to wait till the end of it.

So of particular importance within this study are the factors governing boundary shear stress, because it might affect the movement of sediment. This is a very simple picture (slide) that's not entirely appropriate, but it's one you often see in the textbooks when they talk about the forces acting on a sediment particle.

Now, why isn't it entirely appropriate? Because they're showing you discrete particles sitting here. Here is a sand particle sitting in the presence of a number of other sand particles. A bunch of billiard balls laying on each other, marbles, right? Got Bee-Bees? Pick a size. Got it? Not entirely appropriate, because the sediments that we deal with tend to be in structure quite a bit more complicated.

They're not simply one particle or another particle held together by gravity. They tend to be one particle, another particle quite small held together by lots of different gluing factors, gluing factors such as electrochemical binding. The magnetic attraction between the particles, or a biological

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film, mucilaginous matrix that's on the bottom. Kind of gooey-looking stuff. You can see it. On shellfish it's not uncommon at all, okay?

So what we tend to deal with is an assemblage of particles that we class as being cohesive. This sort of picture, simple picture you have back here really applies to the class of sediments that you are all familiar with in terms of beach sand. That's a good example of sediment. But it's okay when you start talking about drag on the bottom, and drag, of course, retards the flow, builds up that force that we were just talking about, the shear stress that particles can be moved.

The bottom also influences the near bottom velocity in a variety of different ways. In this case they're showing you how a sand wave field, nice, rhythmic sand waves, you have seen them off the beach maybe when you're laying-floating, you're facing down in the water and you are sort of hanging there, you can see the waves coming and building little sand waves, ripples in the bottom.

The velocity gets quite complicated over a structure like this, and you will see a number of instances in the study of the velocity field that we're looking at. We're interested in that, because

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that's what's going to affect the boundary shear stress displays quite complex characteristics.

The famous diagram, the Shields diagram, the only reason I put this up here is to show you that there is a class of sediments that is cohesive, a class of sediments that is noncohesive, and they're going to display different response characteristics to a given velocity field, and it's going to vary as a function of particle size. The velocity of the shear stress is buried in this parameter, okay?

So you can see there's a difference between cohesive, and maybe it's clearer when you look at something like this in tabular form where I'm only going to emphasize this -- what does that say? I can't quite see it. Stress at the initiation of motion. Stress at the initiation of motion. The stress that it's going to take just to get that particle to start rolling along.

And you can see here this is in Pascals, as I said. That if you are dealing with course sand, you may have a value of 0.48, and it's interesting. It's counterintuitive that as the grain size goes down so medium, fine, very fine, course silt, medium silt, fine silt, and beyond that would be

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clay, and you can see here in terms of grain size, the diameter in millimeters, you are starting about a half millimeter.

You ever calibrate the sand? You sit on a beach, you know, what you feel good about. There are people that do that. If you sit on a beach in England -- of course, if you are a Brit, you can sit on golf balls, and they figure that's a very nice afternoon on the beach, okay, the cobble, the typical British cobble beaches. But around over here if it gets too fine, you stand up and you sort of have all the sand stuck to your back. You don't like that either.

So it's about quarter of a millimeter or a half millimeter sand. It's what you see on a lot of beaches, and there are a variety of sands when you go along Fisher Island Sound's coast beaches. You will see a variety of sand sizes. That's just to give you -- you've got to develop a feel for this stuff, okay? You got to -- it's cohesive like bring it in here and slop it on the table.

Counterintuitive, he says. What's that mean? Most folks tend to think of transport in terms of grain sizes simply. So they have this idea

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that since it's more difficult for me to blow sand off the table than it is to blow flour off the table, right? Can't you see it? Flour, okay? Makes a hell of a mess. That if we have fine grained sediment, that stuff must move more easily than if we have coarse grain sediment, not true, and it's not true for a variety of reasons.

But to begin with, and the simplest one for you to understand is, wet that flour. On your countertop make a mess for mom. Wet the flour. You got a nice gooey mass of stuff. You got to wash it off your hands, okay? When that stuff gets wet, it's cohesive, extremely cohesive. And when I go (blow sounds), I get it on the floor before I get that stuff to move, okay.

So that's what they're trying to get through to you is that the simple relationships between grain size and transportability you got to revise -- a lot of people have to revise their thinking, okay?

Now, out of this the only reason we put a red box around this we sort of picked a range in the three quarters of a Pascal, you will see more of this later, as the level that we're looking at is sort of the critical level. The material we're playing

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with, there's some field data to back that up. But I want to show you this again to reinforce this cohesive component when you begin to think about how these mounds of sediments are affected by a flow.

Okay. Here we are. The objective of the physical oceanography study is to take a look at the distribution of maximum bottom shear stress through the zone of siting feasibility. It runs from Guilford, western boundary, Montauk to Block, Block to Point Judith, pretty good patch of water, and, you know it to be, I know most of you that are out there, a moderately dynamic patch of water.

I'll show you some depths in a couple minutes. These are the stations that are being looked at, okay? You just heard about them, and there is a variety of them sitting up here. There are only two active, the Cornfield and the Fishers Island, the Eastern Long Island Sound, sorry, New London site and Cornfield.

There are a number of historic sites, and there are 3 or 4 -- I think there are the 1, 2, 3, 4 new sites that are on there I picked out, okay? To characterize the circulation, that's the water column characteristics, we're looking at how the water column moves, and acquire enough physical

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oceanography data to support the verification of this numerical model that we're going to be using really to look at transport characteristics in detail, the study will.

That's a mess (referring to a slide). The only reason I show you, Long Island Sound, these are the old DEP stations over the years since the early '90s, and I wanted to point out M3. It's important down here. You can't read M3, but it's in The Race just off Fishers Island, because -- in a minute it will show up.

You recognize that there are a number of factors that govern circulation in Long Island Sound. Most of us think of the tides. Comes to no surprise there, right? Take a look out the window, and you got a fair idea of tides going. You go for a sail, and you are influenced by the tides. Your front yard is influenced by the tide today if you took a look there, okay?

But there is also the matter of fresh water inflows. Fresh water inflow show this regular seasonal variability with a peak discharge value typically in April/May. So we can expect to see some amount of seasonality in fresh water inflow. The fresh water inflow in combination with the temperature can affect water column densities, and the water column density, just like the atmospheric the air density that influence high and low pressures and influence winds, will influence circulation in the waters.

So now you have tides coming and going, yin and yang, and you have possibly some density-driven components as well associated with temperature and salinity. It shows the seasonality. The seasonality result looks something like this. These are three profiles along the axis of The Sound. Here is M3 sitting down in here, okay? You start down at the end at Throgs Neck, more or less, and you can see, if we look at April, August and December, that there is, in terms of water temperature, some evident differences in the vertical structure.

You see much more stratification in the summer. Surface waters are warmer. Bottom waters are significantly cooler. That makes for some differences in terms of vertical exchange, and you have heard about it in terms of hypoxia and the like, but you can also believe that the seasonality that you are looking at here from April, August and December, the differences in temperature -- go out there right now, the water temperatures are less than they were in

the summer. Go out there yesterday, they were less than they were last weekend sort of thing. It's cooling down. It might influence the density.

We go along and take a look at salinity, it's a little more subtle. But, again, you are going to see this is higher salinity waters, okay, the shelf waters, and you are going to see some differences in the extent of intrusion when it starts coming in.

This guy is April. We got a lot of fresh water coming out so The Sound, greater body of The Sound is somewhat fresher. You come into the summertime, and this guy in here, this will vary not only seasonally but year to year depending on what the wind condition looks like.

Just real quick. You know this. This is on our Web site (referring to a series of slides). You can take a look at this. If you want to play with it, you can just run the cursor. But I only show you this to impress you with the fact that there is a significant spatial variability in the velocity field in Long Island Sound, and, again, most of you know it.

You don't see much in the way of currents in the western Sound. You see a fair amount

of currents in the eastern Sound. The Race area is moderately energetic, okay? That guy's on the ebb. It's decided not to like us (slide show malfunction). I don't know. Well, if it was working, we turn it around and show it going the other way, okay, and you are going to see a significant amount of spatial variation in it, and it will -- if it doesn't -- there you go, okay? You can plug that in and play with it, get an idea that there is a significant spatial component to the tide. There is a significant time component to the tide, okay?

Now, just to impress you with all of that, can we impress you with the technology that's possible today or not. Can we shut it down? (set to run a video showing surface salinity distributions from a computer model)

(Whereupon, there was a discussion off the record.)

DR. BOHLEN: It's nothing you don't know. That's the other thing that's sort of frightening about school and education, right? If you just stop for a minute and think about it, you heard it in kindergarten or somewhere. You just sort of brighten this up.

So what I'm telling you about

circulation in Long Island Sound in general characteristics you probably know pretty well. Speak.

MR. ALLYN: You don't have --

COURT REPORTER: Sir, what's your name?

MR. ALLYN: Lou Allyn. Do you have a slide that in the future maybe you can talk about how many people you have working on this project with you, what the organization of the staff is?

DR. BOHLEN: Yeah. Jim O'Donnell is the principal investigator, he's not here today, myself, Grant, we have another post-Doctoral investigator, and we have two technicians who are on the project.

Video beings to run

This is a model run if you look up in the top, it says 10/21, and it's just real quick running through a tidal cycle and higher salinity water out here, okay? Lower salinity water back in here. Outflow of the Connecticut River, okay.

And if you keep running this, and we could run this, but we don't have enough time to run it -- I saw they gave us a deadline of time -- you could run this right on through Sandy, which was 10/29. This is 2012, okay, and beyond, because the

Sandy effects in the system, you pulse it, and then the system responds over the course of four or five days.

So the storm occurred on the 29th, and you might look to see what was going on on the 31st or so. But just to give you an idea -- and, again, some of you have seen this, the plume coming out on the ebb, casting waters that come down. Sometimes when there is a larger discharge, you will see the discharge right into the, down into The Race and into Plum Gut.

But you will generally always see a nice frontal zone in the vicinity of the Connecticut River. You may not see as much as in the case of the Thames. But if we ran this a little bit longer, we get a good rainfall after Sandy. You will see this guy coming out and getting very close over to Fishers.

So we're dealing with a spatially and temporally variant system, and the problem -- the question, the project goal is to assess what that means in terms of circulation and boundary shear stress, okay? Let's go back to the slide.

Well, you saw it. Again, this is just sort of a summary slide. We're really ahead of ourselves here. We are showing you some model results

in the blue, but the red or green observations are a couple places in the study area, and you have to look at this carefully to realize there's a difference in scale here, but you are seeing waves down in this area that might have a significant wave height of about one and a half meters, 1.4 meters.

We get further in, Six Mile Reef down in here, you will see waves that very seldom get over about one meter or so. This down in here is just about a meter. So there is some spatial variation as you would suspect, okay? An area a little more sheltered, an area a little more prone to the wind effect, because the water depth and the like there and some other spatial variations. We will see more of this when we get into the results of the model, okay?

So just the background of the physical oceanography of Eastern Long Island Sound, which I hope just reinforces what you already know. Next one (slide). So Grant will tell us a little bit about the model.

DR. MCCARDELL: So what we want to use the model for, as Frank was just telling us, is to be able to sort of fill in all the gaps for what we cannot measure both in space and in time. We can go out there. We can put something on the bottom. We

can deploy it till the batteries run out. We can get a month or even 60 days worth of data, and we can do that at one location with a broad-reaching study like this. We can even do it at seven locations, but we can't do it everywhere, and we can't do it through all time.

So what we want to do is we want to answer the question of what's the spatial distribution of stress throughout this entire study area. So how do we do that? We are going to run this model, and we're going to be able to then answer the questions about where the regions are where the stresses are the largest and the stresses are the smallest, and then the other question that we will be able to answer at some point is where does the material in the water go. If it does get eroded, where will it go?

And to do this we're using a model called FV-COM, which is the Finite Volume Community Ocean Model. It's been developed by UMass up in New Bedford and we're nesting it -- this is our model domain here extending out onto the shelf. At the shelf boundary here we are driving it using this larger model, which covers the entire northwest Atlantic.

Our model is forced by tides along

this outer boundary. The water goes up and down, which forces the water in and out in an appropriate manner. We're forcing it with observed river flow, these green arrows, and we're getting that from USGS gauge data. So for any given day we're replicating what was the actual river flow in the Connecticut River at that day.

In terms of the warming and the cooling for the heat, we're using climatology, and by the word "climatology" here what I'm talking about is "what are typical conditions at a given date and location." In other words, the climatology for Fort Trumbull here for today is probably that it's 35 degrees and overcast, and temperature, yeah, we're pretty close to climatology today. In terms of precipitation we're probably not very close to climatology.

Think of climatology as sort of like the Farmer's Almanac of what are the typical conditions for a typical location for a particular week or month, and so that's what we use for the surface heat exchange. So we're not modeling individual years for the surface heat exchange, and we're also not modeling individual years for how we start this up, but we do run it for long enough that we then are able to model individual years. Next slide.

So how does this whole thing work? Well, this works on an unstructured grid. It's finite volume. I'll show you what that means in a minute. It's a primitive equations model. What that means is it works according to first principles. It works according to Newton's laws by F equals MA. So it starts from the very, very basics, and it solves the equations that were derived from Newton's laws by Navier and Stokes in the early Nineteenth Century, and they derived these equations, but they were unable to solve them.

But fortunately we can approximate numerical solutions to these equations with computers. And so what we get from the model is we get the water velocity; get the sea surface height; get temperature and salinity, and then the model iterates itself. It says "okay, here I am. What's going to happen next?" and the model runs on a time step of 6 seconds.

So every 6 seconds of real world time we do this calculation, and then what we're interested in getting out of the model for this study is the stress. That's tau, the Greek letter tau we use to represent the stress, and that's the product of

the water density times rho. (That's the thing that looks like a P) there times this C sub D, which is the drag coefficient -- Frank will talk to you a little bit about that afterwards -- times the square of the water velocity. U is the east-west velocity. V is the north-south velocity.

You can think of it (pointing to u-squared plus v-squared) as just the square of the magnitude of the velocity, and it's important to realize that it's the square of the velocity. What that means is that a small change in the water velocity will equal a bigger change in stress. If I double the water velocity, I will quadruple the stress, and this is the way the model calculates stress, and this is also the way, as you will see, that we have determined to be one of the more robust methods to calculate stress out in the field as well. Next slide.

So here is our entire model domain again, and like I say it runs on these little triangles. So for every single one of these little triangles we're solving the full equations of motion, and our model domain right now has about 30,000 triangles, and it does this at 15 different depths. So we're modeling about a half a million discrete

finite volume fluid elements, and we're solving these equations at a real world time of every 6 seconds across this domain.

So needless to say 10 or 20 years ago we couldn't do this. You need state-of-the-art computing equipment to be able to run this sort of model. Now our study area here is this red box. Next slide.

And you can see the little triangles here, and so here is The Race. There is the Connecticut River, Niantic, I'm sorry, Niantic Bay, the Thames, Connecticut River over here, and these little triangles are what the model is running on. So the resolution of our model is those little triangles.

And it's important to note that this is the resolution of our grid; it's about 100 to 500 meters, which is about a quarter of a mile so we're resolving down to a quarter mile. So we're resolving the individual dump sites, but we're not resolving whether or not we cut off a little corner of one of the dump sites or whether we move the border of one of the dump sites by 100 feet. Next slide.

So how well does this model do this? Well, this is sea level that's coming from the model (being forced at the boundary like I said) compared to

data at the Bridgeport gauge, and it's doing pretty well. The model is in blue. The data is in black, and it also does very well for temperature and salinity as well, and this is throughout the entire domain.

And we determine something called a Skill is, and what the Skill is, is what's the error in the model from 100 percent. So if the model was perfect, it would have a Skill of 100 percent. A Skill of 90 percent means that the model is staying within about 90 percent of the data. In other words, there is about a 10 percent error in the model. That's about a 10 percent error in velocity as well.

So if I square that 90 percent Skill, because the velocity is square, I come up with a Skill for the stress of about 80 percent. So, in other words, these stress values you probably can take as being plus or minus 20 percent, and spatially it's probably even better than that.

So our model is working very well in the world of physical oceanography and ocean models -- and atmospheric models, for that matter. I should add that atmospheric models work on this exact same set of equations. They model fluid flow whether it be air or water. And in terms of model skills our model is

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doing very, very well. These are very, very good numbers. Next. And how good is the stress and what's the stress? Well, that's why we had the field program.

DR. BOHLEN: So we're going to go out and gather up some data to verify all of that and, again, within the zone of site feasibility, and we selected seven sites, and it says deployed instruments on 7 bottom tripods on two, sorry, three two-month observation campaigns, you will see the three campaigns, to observe spring, fall and winter conditions at locations having different stresses.

How did you pick out these seven sites? They're not coincident with any of those boxes you saw before. They're close on some cases, but that wasn't the issue. We have run stress models before in this area, and we were looking to get data at a variety of locations that would give us a variety of conditions.

So don't put all your instruments within a quarter mile of each other. Pick out a number of locations that are going to give you a range of answers. So what you have the seven sites here going from roughly Six Mile or so down in here out close to Block.

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We conducted three campaigns -- you will see it in a minute -- three campaigns, and during each of those campaigns there was also a survey, shipboard surveys. We went out to service the array so we did measurements along the transects. So there is a variety of data gathered up during these campaigns, six cruises with water column measurements at the seven tripod locations plus four additional stations in between, okay? Next.

Here are the campaign periods we had, spring, summer and winter. Conditions you are familiar with, the seasonality. You saw at least in stream flow, that there was a clear seasonality. You saw, I hope, in the temperature and salinity that there was something of seasonality, and you can probably believe that if we looked at the wind field, there is something of seasonality in the wind field.

We generally believe that the highest winds are during the transition periods in the spring and in the winter, sorry, spring and in the fall, okay? And so we have a spring campaign that's March to May, 66-day -- all around 60-day campaigns. When we had high river flow, you saw that April typically, generally high winds. Summer, low everything. Sailors know that all too well, right?

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And then winter was November through January where we had low river flow and a fairly energetic wind field, okay?

So we put out these arrays. This is a triangular array (referring to slide). We can get an idea of what it looks like here, stands about 6 feet or so tall, okay, and it has a variety of instruments, and I can spend all afternoon talking about the instruments to you. So if there are questions, we can do this later.

But to begin with you had an acoustic Doppler current profiler. You are going to hear a lot about ADCPs if you start playing with oceanography these days. That's how we measure currents these days. In the old days you put out a current meter at a discrete point, maybe a number of them over the vertical. So you had this array of instruments sitting over the vertical.

Now we have a single instrument at the bottom that can project an acoustic beam through the water column. And if we segment up the reflection, if you will, of that acoustic beam back to the sensor package, I can tell you what the currents look like at layers through the water column. In this case this is an RDI acoustic Doppler current profiler,

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and it's looking up, and it's giving us one meter slices through the water column to the surface through the bottom, okay?

We have another instrument sitting on here. This is a Nortek acoustic Doppler current profiler, same ADCP but very different instrument. This is what they call a pulse coherent instrument, which allows you to make very fine measurements. This thing is mounted about three-quarters of a meter above the bed, and it's measuring currents every centimeter down to the bed. So we're really slicing up that portion of the boundary layer that's coming down right onto the bed that I told you was important in terms of boundary shear stress.

Now, that current is very, very -- as it gets down at the bottom is very important. We're measuring it. We can measure it. We can take a look at it. We can also see that Grant, in his model, the values for the velocity in that profile.

There is also a temperature salinity sensor over here, that's what the SBE is, and then there are two optical sensors here looking at suspended material concentrations. These are optical back scattering probes, OBS, that measure the concentration of suspended materials at a couple of points over the vertical. The rest of it has to do with the recovery.

So we get water column currents and waves from the ADCP, RDI. We get currents and stress at the bottom. That's the Nortek. We get suspended material concentrations. We get temperature and salinity. We put this thing out for 66 days. It samples once every 15 minutes and it bursts samples. That means that it runs for a period of time every 15 minutes. Sample rates are typically on the order of one sample a second, maybe two to four samples a second, depending on the instrument, for minutes, every 15 minutes. You can imagine you are bringing back a fair block of data.

The shipboard surveys made use of this guy. This is a profiling conductivity temperature depth sensor right here, CTD. It also has a series of bottles on it. So as I send this down to measure temperature salinity over the vertical, I can draw water samples. You can bring the water samples back and use them to calibrate the other instruments.

I actually have a sample of water now with some amount of suspended material in it. I can filter it down, and I can see what the OBS is telling me and where it's right or wrong. The optical

back scattering probes, okay?

At each of the stations where we stop to use the CTD we got water samples, but we also got sediment samples, grabs, bring them back and take a look at what the sediments are at those stations. There are much, much more extensive sediment maps out there. These are supplementary measurements to the sediment maps.

The U.S. Geological Survey has done an extensive high-resolution survey of sediments in this area. We know the sediments in Eastern Long Island Sound very well, okay? (next slide) This is the data recovery for temperature and salinity. That was that CTD probe that was on the frame, currents and suspended sediments, that's Nortek and the OBS, and this is waves. That's the RDI. And we start off with different campaigns. These are coming down running through this.

To make a long story short the data recovery was something in excess of 50 percent depending on what you happen to look at, and in some areas, sometimes it was 100 percent. But in some times this guy gave us 66 days, and we were out there for 66 days so it worked all the time, but this guy gave us nothing. That was courtesy of the

manufacturer.

This was an instrument that was sent back to the manufacturer for refurbishment before being put out, and they put the wrong firmware in it. It came back brand new, well paid for, no work, okay? You will also notice this 6A/B here. That we get out here campaign one, the Nortek, 25 of the 66 days, here 28 of the 66 days.

There were two things going on here, the main one being that the frame got tipped over. It got tipped over one and a half times, and then we were smart enough to move it after that. We generally try to pass the word out among the fishermen so that they know where the gear is, and it's been a very successful approach over the years, but somehow this guy managed to get bumped.

The other thing it was that in the first campaign you see this all 25 of 66. This was a learning curve on the batteries and what the batteries could do, and we expected them to last for the 60 days. They didn't last for the 30 days. That's why you got 25 days of recovery.

But overall if you look through this, the data return is very, very good and certainly provides us with more than enough data remembering how

we're bursting and frequency that we're sampling during the burst to calibrate the model. Let's take a look at some of the results. This is the RDI ADCP mean velocity. You are going back, You are going forth, you are going back, You are going forth, you are going back, You are going forth, and every little bit you get a little bit further along.

There is a mean in the velocity field. It ain't just sloshing back and forth. Some of that temperature salinity effects, some of the wind effects give us a net, and that shows up in the means, okay? So the stuff will go up as you saw in the movie the way the plume was moving back and forth.

If you take a look at it, in my case when I'm not tied to the river, I might be moving one way or the other. In this case what the data are showing you is that if you set it at this point, the net transport would be to the northwest. Here it is slightly more west of north, and here it is more like southwest, southwest, southwest, well, west, call it northwest, got it, with the three different colors being the three different campaigns.

The net drift near bottom, what this is saying the net drift near bottom water column, we are 3 meters off the sea floor, is into The Sound. A typical estuarine pattern you expect bottom waters in the estuary to be moving in. Fresh water on top is a little bit lighter, a little bit less dense. Sitting on top, it runs out. So if it's running out, it's got to be running back in to keep the water in The Sound. Typical transport.

If you get down closer to the bed, this is a Nortek matter, (pointing to another slide) looking at that three-quarters of a meter to the bed, same sort of thing roughly. You know, if you take a look in a little more detail, there are now going to be six arrows, because we went out and recovered data twice during each campaign -- these on the bottom, okay? Basically the same sort of a pattern.

The main thing, the message to take home here it is a typical estuarine flow coming in at the bottom, and a magnitude, how about that one? These little arrows are worth 10 centimeters a second if they're about that long. Capish? 10 centimeters a second? Nah. Come on. You don't have to lie to me. 10 centimeters a second, fast or slow?

MR. JOHNSON: Fast.

DR. BOHLEN: I got a fast. One knot, one nautical mile per hour 6,080 feet per hour, okay? 50 centimeters a second, 5-0, one knot. You

can call me a liar if you want to (inaudible). One knot, 50 centimeters a second, so 10 centimeters a second is not all that fast, but it's persistent. It's persistent, okay?

Again, back to that, we get a feel for this thing, you know, what's sticking, what's not sticking, what's fast, what's slow. It's important. Okay. So you are looking at net drifts that run on the order of 10 centimeters a second, 5 to 10 centimeters a second, and you can figure out what that means in terms of net transport over the course of a day.

This is probably not entirely necessary, (next slide) but this is the tidal ellipse over the vertical. This is the average over the whole of the vertical, and it just shows you that if we were tracking the tide the way this thing goes and it's on the flood, it would be going that way, and then we wait six hours or so, and little by little the tide starts to drop off in speed, but it changes direction. With me?

Little by little over the course of a half an hour or so it's dropping in speed and changing in direction before it goes back onto flood. That's what you are looking at here, the so called

tidal ellipse. The major axis of the tidal ellipse going off here to the southwest, more to the west of southwest, okay? Here a little bit more northwest, northwest, and the magnitudes running in here on the order of half a meter per -- 50 centimeters a second, a knot.

So you got that guy there, I don't know, call it from here out, maybe a knot and a half in that neck of the woods as the major axis, okay? So, again, you pretty well have that in mind, and you saw it pretty well in the movie going back and forth, this magnitude, and this shows you there really wasn't much difference for all of the seasonality that we were looking for in terms of the behavior of the system from campaign 1, 2 and 3, not all that much difference in terms of the tidal ellipse. Okay.

Real quick what this is showing we were looking here at the wave conditions, significant wave height at the station off Montauk, okay? Block Island, Montauk sitting here, this guy in here, and we're looking to see what the effect of the waves are on the bottom shear stress, and to make a long story short what these data are showing, despite the fact there is a significant difference here in wave characteristics, there isn't that much difference in

bottom stress, okay, as you come along in this.

It's an interesting curve in the tracking. We can get into this later whether its tracking logarithmically over the vertical or not. Next slide. Now that makes sense. One thing I didn't tell you, when I showed you that slide of the zone of siting feasibility, there was around the perimeter a gray area. That's an exclusion area. That's thought to be more or less coincident with the areas that are going to be influenced by waves. So its variously estimated at being something like 17 meters.

DR. HAY: 18 meters.

DR. BOHLEN: How many.

DR. HAY: 18 meters.

A. 18 meters, he says. We were arguing yesterday about 17 or 18, 18 meters. So it ends up around 60 feet or so, alright? So it's not terribly surprising when all of our instruments are outside of that that the response to the system, to the waves, is not all that great, okay?

This just shows another area -- to show you that we've got a real spring neap cycle in the boundary shear out here, okay, that we don't see a lot of kick up in the shear as we change the waves, and we're getting up to 2 meter waves here,

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significant wave height. That's a significant wave height. The average of the one-third highest waves, that's not the maximum wave, so you can get almost twice as much. The maximum heights are almost twice as much as that.

So, again, you pick up the spring neap cycle pretty well in this, but it doesn't show up very much in terms of wave response, okay? (next slide) This is a comparison between two methods to calculate the boundary shear stress, and the one you saw was the so called bulk formulation. That we take the drag coefficient times the square of the velocities. That's the bulk formulation.

There is another way to do it, and you argue whether it's better or not so good, and that's the log in here. And if there was a perfect fit between the two, it would be on this one-to-one line down here. Well, you see that we're coming along calculating the stress levels using the two techniques, and they're pretty close, you might slide that over a little bit, until we get up to a stress level of about one Pascal, and at one Pascal it starts to dive off.

We could sit here and argue with you about why it's diving off. It would take another half

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an hour to explain the differences in the change of the flow field, what happens when you get up here, why the velocity profile may not be logarithmic at that level. But suffice it to say what we're using this little calculation for is to demonstrate at least to us the adequacy of the drag coefficient of 0.0025, which was the selected drag coefficient that was used in the formulation you saw earlier.

So the data do a pretty good job of verifying that selection until you get up to a point where nobody is surprised that it doesn't work, to put it in plain language, okay? So this is a very valuable set of data. If you take a look at this, you don't often get a chance to really get down into the nuts and bolts of the flow field.

MR. ALLYN: So the coefficient gives the best fit between the two models. Is that how you have the coefficient?

DR. BOHLEN: The coefficient was a selected value. Well, there is a lot of data to say it ought to be that value, and then the question is does it make any sense.

MR. ALLYN: Yeah.

DR. BOHLEN: And now you are comparing the results of a bulk formulation that uses

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that coefficient against a different way of calculating the stress, okay? Alright. So here we go. The rubber hitting the road. The model simulation says here we reproduce tidal and spring neap variations on the observed stress. Now, you saw some of the spring neap variation -- spring neap, do you understand that? Twice monthly variation in the tide, right?

We're just off the full moon. We're in the spring portion of the monthly tide. It has nothing to do with April, May, March, whatever it is, okay? This is twice a month. You got a new moon, and you got a full moon, and you have maximum tide during the new moon, maximum tidal range during the full moon, and in between smaller range -- neap, okay?

So you are looking at the spring neap cycles here coming along this guy, and then you are looking at a comparison, and I realize it's a little difficult to see here between the field observations the calculated values and the model values. And to make a long story short on this one we argue, using these sorts of data, that the model is doing a pretty good job of reproducing the measured results, which is what, of course, we were trying to verify. And next time we will have a different color

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for you. The blues and reds and pinks and purples are hard to see. Okay, next.

This is very good here. This is another comparison between the two. This is your bulk formulation again, that equation, okay, and these are the field observations.

DR. MCCARDELL: No.

DR. BOHLEN: I'm sorry. The other way around. These are the field observations and that's the model. We have it upsidedown and that's the model, and this is the mean of the boundary shears, okay? And then if they were identical, they would lay on the one-to-one lineup here, and what you are looking at this is now mean values over the period.

Correlation coefficient of about 0.91, which is very high. When you start looking at the maximum predictions, this gets a little more scattered in there, but it's still pretty close to the one-to-one. In this case it gets down to a 0.7 -- 70 percent. So you put that together with Grant was saying about the accuracy of the model, the accuracy of the comparison of the two, and it's looking like we've got a pretty good handle on the boundary shear stress in the model, okay?

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What's it all mean? So we want to find the maximum bottom -- so we're now using the model, because the model gives us information on all those little triangles, every quarter mile a little square, okay, over the whole of the field. Compare the value of the sites identified in the screening process and simulate a period of a severe storm. We picked Sandy. Go ahead.

The bathymetry. You know it, right? Fairly deep in The Race, not so deep near shore. You got the net depth coming back up. Six Mile on the end (west). I don't think you need to see anymore. These guys know this by heart, okay? So here you are in terms of stress distribution. This is Pascals. Red is high, on the order of 3 or maybe down in here, okay? Montauk not terribly surprising. Some places in the vicinity of The Race, some reds, fair amount of yellow, and some amount of blue, low.

As far as the zone of siting feasibility goes, remember where that is going, come back over to see Block Island, okay? You got your Point Judith sitting over in here. It says that there is a fairly high stress level particularly in the Eastern Sound through much of the zone of siting feasibility, okay? You are up in here.

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Remember we were cutting things off looking at values something like 0.75 as being something of a critical value for some of the sediments we might be playing with in terms of dredged material. The -- one of the things that's interesting here is that as we run this through the different campaigns, that the spatial differences we see between -- here's an area, you know, Long Sand Shoal at the mouth of the Connecticut River and Block Island Sound, you look at the spread, it's quite a spread in stress values. That spread is much larger than you will see seasonally, much larger than you will see seasonally.

So that says that, to me that the tidal field is important, and that the differences we're seeing are down in the subtle -- you will see some of the subtle things in a minute -- but subtle as in changing mean flow characteristics. That little 10 centimeters a second interacting with the mean flow of a knot or knot and a half, may be substantial -- may have a substantial effect.

So snapshot picture of the whole thing. This is maximum bottom stresses during campaign 3. We picked campaign 3, because that's the supposed to be the highest energy winds in winter, and

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then we picked our storm conditions, okay? Next.

Here are some of the numbers. We broke it down by Eastern Long Island Sound and Block Island Sound, and you see the Cornfield Shoals site generally has the highest stress. Probably not terribly surprising. For those of you who have played down there you know it's mostly sands, and that from a management standpoint over the years we counted it as a dispersal site, and there is good reason for it when you take a look at the stress values.

Look at the range as you go through Six Mile, Clinton, Orient Point, back to Orient Point, Niantic Bay, and here is New London, okay? All values below 0.75. Get out, Fishers Island, east-west and center. This is south of Fishers Island around what I call the deep hole, okay? So there are values in there. Fishers Island center it looks pretty low, okay? Might even get east looking low relative to what we see in The Sound. Block Island yet lower. North of Montauk, low. North of Montauk is really Montauk Harbor, really in there. It's in the shelter. Okay, next.

So we took a look at Sandy, see what we could do with it. Sandy was a fairly interesting event, right? Blew a little bit. These are our

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MYSOUND buoys out there, Ledge, Central Long Island Sound, Western Long Island Sound, Execution Rocks, and not surprising the Ledge shows the highest, about 60 knots or so, okay? Very short period.

So it was a wind event, short lived. We know that. What you don't know, what this thing doesn't show you one of the unique things about Sandy of course is that it may not have blown all that much max, but it blew a lot for a long time, and that is significant duration, unusually long duration, and a lot of that was from the southeast, which made for interesting conditions through a number of our areas, right?

And if you take a look at the fetch, the over-water distance in which the wind can act, for Eastern Long Island Sound southeast is favorite. East nearly, northeast not so much; but certainly southeast has the potential for influencing what's going on down here.

So it was good from that standpoint, fairly reasonable winds and significant duration, and a storm surge which increased water depths through the whole system, right? This guy is Kings Point (pointing to a slide). This guy is New London. So there is New London. You had a surge of something

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under 2 meters, about 1.5 meters - 5 to 6 feet, a surge down here, which has a recurrence interval of every 10 to 30 years. You know, we will see it again, that kind of a thing.

You get down the western Sound, oh my goodness, look at the western Sound. Four meters down at Kings Point, and, you know, in New York Harbor it was even more. Occurrence intervals down there are hundreds of years. We won't get into an argument about how many hundreds of years. In fact, we discussed that, but it's very, very low probability.

What should you care? Because you stuffed a lot of water down my Sound, okay? You piled up a lot of water down the western end of The Sound and that water's got to get out. That water coming back then has the potential to influence the velocity field in the eastern Sound, and from that standpoint that much water heading back out this way makes Sandy an unusual event, and we're very fortunate to be able to take a look at some of the numbers on it, okay?

It may be that there is a lot of subtle influences. It may be that it was the wind field does more to that data. We will see. We will take a look at it. But people talk about the frequency of occurrence of Sandy down here just in

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terms of wind and maybe storm surge. That's one way to think about it. But we're out in The Sound now, and what we care about is the amount of water that was produced in this and where it went and what it is going to do to us if it starts going back out. Okay.

So to make a long story short, if I showed you that earlier slide with the yellows and blues on stress, and I showed you this guy here now, this is Sandy's effect. About the only difference you are going to see it says created higher maximum bottom stresses in some areas. Well, now it turns out if you looked at the absolute numbers on the table -- I'll show it to you in a minute. I don't expect you to memorize the last table.

I'm telling you what we're looking at is, for the most part, each one changed a little bit. Some fair number of them went up a little bit. But in terms of the deeper water effects they weren't as great as you might expect. Most of the effects we're looking at higher stress in the shallow areas near shore, which given the wind field, you know, you don't need a model to tell you that probably. Okay, next.

So here we are. About the same distribution of stress. And if you went down and

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compared this set of numbers with the earlier set of numbers, you'd see just what I told you. You still got Cornfield Shoals as the winner, New London as the lowest end on the Eastern Long Island Sound sites. And if you run down this guy here, about the same. Now you are getting down Fishers Island center, Fishers Island east, it's still below your 0.75. This guy went up quite a bit, the west, as you might expect. The same thing for the Block Island Sound site. It went up. Next?

So it's defined as a level of stress that's got to be mobilized, and I figured that we were using a cutoff for the sake of screening of about 0.75 Pascals. That's going to vary depending on the stuff you are playing with. The more cohesive it's going to take more stress. The sandier, if you bring me out a beach sand, it's going to take less, okay, and a variety of other factors, too.

If you just get me in talking about the biological effects. Okay. Those damn bios messed up the texture of my sediment. They burrowed into the sediment, and so the physical oceanographer has to be sensitive to the biology, but that's affecting the uppermost layer of the sediment column, and it has been shown over the years to be a relatively minor

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effect. They build themselves little cocoons to stay put, okay? Next.

If you do that -- why don't we -- This is the comparison. Basically what you are looking at here we just split up what you just saw into areas that were greater than one Pascal, 0.75 to 1 Pascal and less than 1 Pascal, and you got Block Island Sound, New London, Fishers, Orient Point, Fishers Island east and north of Montauk as the sites that are below 0.75. The remainder were above 0.75. Okay.

MR. JOHNSON: Are you going to talk about capacity in any of these sites?

DR. BOHLEN: No capacity. Just -- with the exception of depth that is included in the model, what's out there is what's out there.

COURT REPORTER: Sir, can I have your name, please?

MR. JOHNSON: John Johnson.

COURT REPORTER: Thank you.

DR. BOHLEN: So before I gave you different shadings from the reds to the blues, right, browns to the blues. Here we just -- everything that's above 0.75 is in brown, and you can see this is maximum bottom stress exceeding during the simulation of Storm Sandy, okay? What are you looking at is Sandy. And as I said, if we did this for the non-Sandy, you're not going to see all that much of a change. You are going see some change but not all that much of a change.

What impresses you here is that there is a lot of brown. That's fine. What does it all mean to us? This guy. It says sites 1, 2 and 7, Cornfield Shoals, Six Mile and Fishers Island. Fishers Island - West, that's south of the island, have high maximum stresses. You saw that. Orient Point, that's Orient Point, Block Island Sound show maximum stress levels below at the center of the site but have values in excess of 0.75 within the boundary.

So there is some variation maybe the way the triangles were placed. We can argue about it. Niantic Bay and Clinton Harbor show maximum stresses exceeding 0.75 but less than one. We can sit and tune this later, but that's what the model is showing you right now the way it's laid out. New London disposal site is the only site in the Eastern Sound with a maximum bottom stress below 0.75. That's what we did, that's how we did it, and that's what we found. Questions?

DR. HAY: So we have 35 minutes or

so for questions and comments. Please speak up, and also please mention your name and any affiliation up front.

MR. CAREY: Drew Carey. Frank, the sediments on the bottom are obviously going to integrate the shear stress over time, and you didn't see a lot of effect from the wave climate in general because of the water depth.

DR. BOHLEN: Yeah.

MR. CAREY: So really the tidal prism and the bathymetry is what's driving a lot of the distribution of this shear stress, I would guess. Do you expect to see pretty reasonable correlation between those model shear stresses and the kinds of sediments that will be seen on the sea floor in different locations?

DR. BOHLEN: In a general sense, yes. That is to say if I was to draw you that stress diagram from Central Long Island Sound to Montauk, you would see that in general the stresses are lower in the western part of that down toward Central Long Island Sound than in the east.

And if you look at the sediments in general, once you get across Mattituck Sill, you tend to find softer sediments that have accumulated. Out

in the Eastern Sound, it may be somewhat coarser on the bottom on average. So a simple correlation might be there except for the fact that I can also bring you to a number of locations in the Eastern Sound right in The Race where you have very fine grained deposits that are quite stable. And when you go down and you put your flippers into it, you are amazed that because you are dragging along trying to stay there that this stuff stays put.

The sediments there are classes of fine grained sediments, and the majority shows this behavior when stress can really build up resistance to movement. So the simple correlation is very often hard to realize. You will find high energy flows and fine grained deposits out there. Is that what you are looking for?

MR. CAREY: Yeah, and so a little follow-up is that presumably based on characterization of dredged material you chose fine sand as kind of the driver that gave us this 0.75 Pascal.

DR. BOHLEN: Right.

MR. CAREY: If you shift down to say very fine sand or a slightly more complicated mix of grain sizes, you could get those materials to the bottom, get them to stay in place in slightly higher

shear than necessarily this.

DR. BOHLEN: Absolutely. What we're looking at here, this is the conservative.

MR. CAREY: Right.

DR. BOHLEN: I don't know how you class the conservative anymore, but --

MR. CAREY: Go ahead. Call me a conservative.

DR. BOHLEN: Now, what we have up here, 0.75, you can probably find that same material staying put in stresses in excess of one. I would say we really want to have that stuff -- we would be sure that that stuff is going to stay. That's use 0.75. I don't know whether that's liberal or conservative.

DR. HAY: Any questions? Comments?

MR. ALLYN: Compliments to you and your staff. That was amazing.

DR. HAY: Thank you.

DR. BOHLEN: I want to emphasize two things. This continues to be a work in progress, because the next step on this whole thing is to quantify the sediment transport. So we got a pretty good understanding of the velocity field and the shear that's associated with it.

Now we want to try for the sediment

transport model so we give you some ideas of the probability of movement, and then again what he said, Grant said about where the stuff is going to go so we're not finished yet. And then for those who haven't asked the question, I asked the question about when I heard about it.

The next step in this whole business is so you have established some background for exposure. The swimmer is down there, and there is some mud that's looking at going by. What about the effects, the biologicals, where the movement of the mud and the movement of the mud where the constituents may be impacting the benthic community or the water column. So the biological study has also yet to be done so it's very much a work in progress.

MS. MCKENZIE: Tracey McKenzie. I'm curious as to what your schedule is for your next sediment transport modeling.

DR. BOHLEN: You want to answer that.

DR. HAY: Well, the sediment transport modeling is -- there are two elements that are still being worked on. One is an LTFATE, long-term sediment transport model and a short-term sediment transport model. Maybe Grant, you want to

elaborate on that quickly.

DR. MCCARDELL: I have to refer you to Professor O'Donnell who is out of town as far as that's concerned. We're working on both of those projects.

DR. BOHLEN: The reason that I laugh is soon is all we ever hear. So I can't tell you that it's December 16 or whatever, but all of this I think as you saw in the schedule is going to have to be quickly addressed to get things finished off by next spring.

DR. HAY: In other words, there is still modeling that is taking place at this time.

DR. BOHLEN: Right.

MR. JOHNSON: John Johnson. Is this --

DR. HAY: Do you have an affiliation.

MR. JOHNSON: Yeah, I'm sorry, CMTA. Is this the only input that's going to determine the relocation sites and sediment dump sites? We take offense in the Marine industry to calling them dump sites. I think they should be called property relocation sites.

That all being said the question is

does -- what other additional information is going to be inputted to those people who are going to, you know, designate some other sites?

DR. BOHLEN: Jean.

MS. BROCHI: Again, I can take that and I can answer the capacity question as well. So the capacity of the potential disposal sites, the dredged material disposal sites, potential sites, not dumping sites, the capacity and dredging needs is part of the Environmental Impact Statement as well as biological characterization, the physo (physical oceanography), sediment, economics.

And all of that will be pulled together in an environmental consequences. It will be evaluated along with no alternative, which means what happens if we don't -- there are no sites that are available.

MR. JOHNSON: How far along are you in the studies of those other factors?

MS. BROCHI: This is one of the major studies that we just completed. That's why we're having this public meeting. Biological resources we have some information. We have a literature search on, the dredging needs capacity. We have the Corps of Engineering finalizing that report

right now, and it all will be compiled into the document, which will be the draft.

MR. JOHNSON: And your deadline is December of next year.

MS. BROCHI: 2016 for the final.

MR. JOHNSON: January 1, 2016?

MS. BROCHI: December 2016 is the final, rulemaking and --

MR. JOHNSON: That's two years.

MS. BROCHI: Yes. We're coming out in the spring with the draft so that's probably the date that you will hear from us, and we will have a public meeting.

DR. HAY: Next up is -- next up is Bill, actually, sorry.

MR. SPICER: Bill Spicer, Spicer's Marinas. Also a member of the Connecticut Marine Trades and a member of the Stakeholders Commission who is supposed to comment on the DMMP. I noticed a couple, three things. All of us have been looking at the NY DOS failure of consistency for some of our dredging permits. Mine has been out for eight years, since 2006, and continuously renewed very faithfully and is in force.

But it recently was declared, after

208 days, to be nonvalid. That it was not consistent with what New York had. It's very interesting the site 6 tests out very, very nicely when you're putting real scientific data out with real oceanographic studies and real oceanography running, and it shows that the NLDS is doing very well.

Now, I know we're in here, because we're supposed to be designating one or more sites in Long Island Sound, which is kind of interesting, because in some of the NY DOS claims where they are claiming inconsistency, they have located NLDS as northeast of the basin of Long Island Sound.

Now, what that would mean The Race runs out in two deep valleys that kind of make a V. The eastern one runs in through past Race Rock and between there and Fadden and comes out to about where Bartlett's Reef is and swings west. The other one is further west over by Little Gull Island, between there and Fadden.

Now, I contended in a bound paper that I submitted to Mike Keegan very early in this that the NLDS was in Fishers Island Sound. It's not down in the valleys and canyons. It's up on the top of the plateau, and it's not subject to Ambro. It's subject to 404 waters and regular Army Corps of

Engineers analyses the same way as is occurring in every other estuary in the country.

But we got singled out in 1980 by an amendment slipped through Congress by Representative Ambro of New York aided by -- out of the guy's own mouth, because he was bragging at a Holiday Inn in New London in 2006 that he aided Ambro in doing it, and his name was all over the coastal zone management sheet, and he happens to be employed by NY DOS, and both of these were sneak attacks without any particular notice to Connecticut's waterfront stakeholders.

And I also have a document from NOAA that says that they were very surprised that Connecticut didn't object to New York's -- or it seemed that way to me -- coastal zone management. But you know what? There weren't any comments against that being extended. You know why? We didn't know about it, because I believe that rumor has it, and the best information I can get was they're supposed to notify the Army Corps of Engineers.

What Army Corps of Engineers did they notify? New England? No. It's believed they sent it to New York. I can't prove that, but I sure know that there wasn't anything that I can find that's

here in New England except that when I -- I found out about it in the afternoon, and I went to DEP the next morning to challenge it, because I was furious.

We have been opposing Ambro for 32 of 36 municipalities to have water go up and down in Connecticut, tidal water, 32 of 36 opposed Ambro in print and wanted it repealed.

MS. BROCHI: Okay. So I am going to -- you bring up two good points I did want to mention, actually. So Mike Keegan -- you sent something to Mike Keegan. He's working for the Corps of Engineers on -- he's joining us on this effort, but that's the Dredge Material Management Plan, which is a separate effort, which I didn't mention tonight, and I think most of you are familiar with that.

They will also be having public meetings coming out with the programmatic EIS and documentation for that.

MR. SPICER: For the record I submitted that timely with a request for that. I think it was in December of '06. It was undated on the actual document. It was about that thick with white covers and spiral bound.

MS. BROCHI: Okay.

MR. SPICER: I can provide more

copies.

MS. BROCHI: I mean, we can talk --

MR. SPICER: That's okay, continue, continue. You're doing fine.

DR. BOHLEN: As far as our designation of the site, I mean what we classed as Eastern Long Island Sound versus outside of Eastern Long Island Sound had nothing to do with political jurisdictions and boundaries.

MR. SPICER: The Corps put $7 million of signs in by 2005 and then got a political decision where something was rammed down our throat here in Connecticut, and people weren't happy, and during the midst of this NOAA was kind of surprised. It seemed to me that nobody objected.

But when I got to DEP, I found that Gina McCarthy knew all about it, and she did find a way on one of the other things to shut me up. There was a letter from her deputy, Amy Marella, that told me to -- you know, I kind of got stabbed in the back about Ambro, and she had a way of shutting me up that was interesting. She looked me in the eye --

MS. BROCHI: I apologize on behalf of the agency --

MR. SPICER: Wait a minute. She

looked me in the eye and she said I wrote it. That's I, Gina McCarthy, wrote it. So I shut up. If it was a man, I'd address her in spades. A woman, I shut it up and turned around and decided that I had been really stabbed in the back --

MS. BROCHI: So --

MR. SPICER: -- and I haven't shut up since.

MS. BROCHI: So one other point that you made was about the DOS coastal zone consistency, and so they do have that authority. If anything is abutting, they can make comments on projects. Project specific review happens within the regulatory agencies and the Corps and EPA will handle that separately. This meeting is about the SEIS, do you have any questions specifically about this effort?

MR. SPICER: Yep, I do have it --

MS. BROCHI: -- process --

MR. SPICER: -- specific with NY DOS.

MS. BROCHI: Okay.

MR. SPICER: They're inconsistent. Did they say where in New London NLDS is? NLDS is in Fishers Island Sound.

MS. BROCHI: We --

MR. SPICER: Some others have made some errors, but that one may be crucial.

MS. BROCHI: Okay. So we do have a representative as part of our cooperating agency group here today. Mike Zimmerman is here. Can you speak to any of this or should they -- is there somebody else you can refer them to?

MR. ZIMMERMAN: Well, is there a specific question, I guess?

MR. SPICER: There is a statement that they have made contentions that are incorrect.

MS. BROCHI: So that --

MR. SPICER: They have had plenty of practice at making incorrect ones, and I have corrected them on numerous occasions, and I think we need to put it on record here that NLDS is in Fishers Island Sound and is 404 waters, and they have admitted it, and I call it if it was legal, it's an admission against interest. Where they have admitted, it's northeast of the eastern basin of Long Island Sound.

MS. BROCHI: Okay. So, Mike, would it be appropriate for Jennifer to receive something then?

MR. ZIMMERMAN: I'm sure she would be happy to.

MS. BROCHI: So if you want to submit official comments to DOS, Jennifer Street would be the contact.

MR. SPICER: At the moment I have cooperated, because I am being threatened standing on my air hose and I'm a diver. That I would go to Central this time, but that doesn't mean that they don't come in here and be honest with the folks.

MS. BROCHI: Right.

MR. SPICER: You got to tell them. In short, we have been jocked a couple times.

MS. BROCHI: Thank you.

DR. BOHLEN: Susan.

DR. HAY: I want to get some more comments, though.

MS. BURNS: Kathleen Burns, CMTA. I just wanted to follow-up on JJ's point when you were discussing impacts that would be weighted, the impacts that you are or not impacts, I apologize, but the different, the various studies that will be entered into this impact study. Are those weighted?

MS. BROCHI: Sorry, could you just say your affiliation?

MS. BURNS: Oh, I'm sorry, Connecticut Marine Trades Association. So there is

the physical. There is the biological. You had mentioned economic. What else is weighed in there?

DR. HAY: Archaeological.

MS. BROCHI: Archeological, cultural, economic. Then --

MR. JOHNSON: Capacities.

MS. BROCHI: Capacities is part of the development. It's not really weighted.

MS. BURNS: Are these weighted in any sort of fashion?

MS. BROCHI: No. The data is all collected. The site screening process is what we go through, evaluating where the sites are. So that's -- it's not weighted. It's more of a screening tool that we use. The final document will evaluate all of those equally.

DR. BOHLEN: But -- I don't know anything about evaluating documents. I'm saying if you came in here and you said a site that you are going to use is already full, that makes that classification pretty way up.

DR. HAY: Similarly if you had a site that's on a shellfish bed, that would be --

MS. BROCHI: Right. That's part of the screening, too.

MR. HELBIG: Jean, Frank, Ron Helbig.

COURT REPORTER: I'm sorry, sir, your name again?

MR. HELBIG: Ron Helbig, Connecticut Marine Trade Association, and the whole discussion has been about physics and about the stress on the bottom and site 6. Can either one of you talk to the effect that why is site 6 not considered a very good site based on all the data that you have here and the lack of stress that's on that site and speak to the fact that why that shouldn't continue to be a designated site?

MS. BROCHI: So I will take that, if you don't mind.

DR. BOHLEN: Yeah.

MS. BROCHI: So, again, so the part of the effort is to look at all of the sites, and what I had presented originally is we had started, you know, just eastern, open wide. We decided to go to historic sites, because we really weren't familiar with what had gone on there, and the Corps of Engineers had helped us.

So we included historic sites. We included active sites, which includes the currently,

currently used sites. And so part of the investigation is to look at all of the data. This is the first big chunk of data, and so we narrowed it down to the six sites, and so all of those six are going to be evaluated. So we're in the process of collecting data on all of those.

MR. HELBIG: My only question to you is just here tonight can you say from an educated opinion that the site 6 is something that we should be strongly fighting for because of the temperament of the currents on the bottom and the ability for the material to stay in that location?

MS. BROCHI: So what I can -- I don't -- I can't prejudge, and we have to evaluate all of the data as it comes in so -- but what I can say is based on the physical stress and what we set out in the Notice of Intent to look at is a containment site for the type of sediment that's in Long Island Sound and based on the dredging needs report that the Corps of Engineers produced in 2009.

Based on that report we determined, when we came out with the Notice of Intent, that we would look for a containment site. Cornfield Shoals is clearly -- and this proves it -- a dispersive site. So we're -- we need a containment site, and we're

looking at all of them, and we won't make a decision until we evaluate all of --

MR. HELBIG: But you don't want to share an opinion at least or --

MS. BROCHI: I do not want to share an opinion.

MR. HELBIG: Okay. I get that.

MS. BROCHI: Sorry.

DR. HAY: Sir, go ahead.

MR. SHAPIRO: My name is Jeffrey Shapiro. I'm from Cedar Island Marina. My concern is with the grade size used for your modeling, as the gentleman back here spoke about, was a sandy material, and in my experience almost all of the material that I see that goes out of waterfront facilities in Connecticut is a lot siltier material. Siltier material is going to be much more stable then the way you were talking, much more stable on the bottom than a sandier material.

So my only concern is with some of the evaluations you have done that you might tend to come to a conclusion that the material is going to move when in fact if you had used siltier material for your examples, you might come to a different conclusion, the conclusion that the material is not

going to move.

DR. BOHLEN: Okay.

MR. SHAPIRO: Like I said in Connecticut most of the material I see going out is a lot siltier, because if somebody has a waterfront facility and they have sand that needs to be removed, they're probably not going to be putting it in the barge and dumping it out to sea. They're going to be selling it to somebody. So that's my comment is that maybe --

DR. BOHLEN: I guess my response to that is don't get ahead of yourself.

MR. SHAPIRO: Okay.

DR. BOHLEN: And hear what was said. This is the study of the physics of the field and the development of a model that allows us to evaluate transport. You did a straw man evaluation. You went and picked a number. It ain't 10 and it ain't 0. How about 0.75? Where did 0.75 come from?

Joe Germano did some work down in a site down in Long Island Sound, and his numbers come up looking like 0.75. There is a study in the North Sea that -- the numbers come up looking like 0.75. It's not 1 and it's not 0.25. Okay. So we used it for screening. If it was this absolutely, what would we be seeing? It's the beginning of the process.

The next step in this whole thing is to refine it, and that's where the model starts coming in where you really do take a look at how the sediment is responding. You give me a much more complete set of data than grain size. I want both density, bulk density, I want sediment characteristics that go beyond simple grain size, and I can then talk to you about not this particle-by-particle movement that you were looking at in this first slide, which is unrealistic given all of the sediments I have seen in Long Island Sound but on the beach. If I'm off the beach, I got gooey stuff even if it's sandy, okay?

We build that into the model, and we come up with a much more accurate and quantitative evaluation of the transport potential. What you are looking at right now is just the beginning, screening. It's the beginning.

MS. BROCHI: And I'm going to add to that a little bit. So this effort is to designate one or more or none disposal sites, right, dredged material disposal sites. It doesn't mean automatically that dredging will happen, that projects will go out there. That happens from the regulatory agencies on a project-by-project basis all the time so

we're very familiar. The Corps of Engineers are back there, the EPA. I review the projects. We're very familiar with the type of sediment in Long Island Sound and the dredging needs.

Now, one thing I had mentioned earlier is the DMMP effort, which is separate from this. Well, as part of that effort they collected information on dredging needs. They looked at upland disposal and other beneficial uses and alternatives. Those documents are also going to be used in this evaluation. And so whenever they're, you know -- the object is to try to use sandy materials beneficially wherever, whenever possible.

DR. HAY: Okay.

MR. SHAPIRO: Not too often.

MS. MCALLISTER: Abbie McAllister, Saybrook Point Marina. We're basing -- the people who are going to be basing their decisions on things like Cornfield Shoals based on your model that you completed when it seems with all the data you have we have specific data on what type of sediment has been disposed at Cornfield Shoals for the last, I don't know, 20 years --

DR. BOHLEN: Sure.

MS. MCALLISTER: -- because we have

all had to have that tested specifically. Couldn't you plug those exact numbers into your model so that we would get a more realistic idea of what's being put into Cornfield Shoals rather than judging it as sand? I know I'm not putting sand in Cornfield Shoal. It's a fine sediment, and that's on record with the DEP.

DR. BOHLEN: I'm sorry, you're not putting sand in Cornfield Shoal.

MS. MCALLISTER: It's a fine sediment, because we have to have it tested every time we dump there.

DR. BOHLEN: Well, you can get --

MS. MCALLISTER: Every two years we dredge.

DR. BOHLEN: What's the use of the Cornfield Shoals area? George?

MR. WISKER: Cornfield is a dispersive site.

DR. BOHLEN: And what's the major source of the material that goes into Cornfield Shoals historically?

MR. WISKER: Connecticut River.

DR. BOHLEN: Connecticut River sediment.

MS. MCALLISTER: We're not putting

sand --

DR. BOHLEN: I know you are not putting sand, George.

MR. WISKER: It's not always sand.

MS. MCALLISTER: We know exactly what has been put there. Couldn't we use those (inaudible)? Wouldn't that give us a better idea of just --

DR. BOHLEN: And we can also look at the mounds at New London the same way and the mounds at central Long Island Sound the same.

MS. MCALLISTER: We have done so much research it would seem that it would be easy to pull that into this whole thing.

DR. BOHLEN: I forgot to tell you 45 years. Did I tell you that?

MS. MCALLISTER: I believe it. I'm just saying it seems like you have taken such detail with everything else that it would be not that much more difficult to use what's been approved for that in the past.

DR. BOHLEN: And we are and we are.

DR. HAY: Yes?

MR. MCGUGAN: Hi, Christian McGugan, Gwenmor Marina and Gwenmor Marine Contracting. One thing I was wondering -- I think this kind of speaks to what Bill Spicer was talking about -- are any of these proposed sites outside, because I don't even know what the delineation is between a coastal zone management area and a non-coastal zone management area?

And the reason I ask are any of these sites outside of the coastal zone management, because I think the fear is that the recent trend of DOS objecting to all the projects in southeastern Connecticut, because Bill's was the first, and we have heard the storms coming, and it seemed like it's coming. They used to just sit on their comment for 180 days and then Army Corps would assume consistency issue of the permit.

Well, things they seem to have changed starting with Bill, and like I said we have heard the rumblings that this is coming. So effectively what they have done for private projects is shut down the New London dump site, okay? Now, I'm a dredge contractor. I have projects on the Connecticut River including Abbie's.

I was telling her today next time she dredges, Saybrook Point Inn dredges, you probably are going to have to go to Central, because New York

is going to object. So I guess the fear is that you guys do all this hard work and come up with this new site or these new sites, and we say hooray. We have a place to go.

We apply for our permits to dredge, and New York can still just object, and that sets off an appeal process and a legal process that no small marina operator can bear, and no small marina operator can bear to go to central Long Island with their spoils, and I have been to some of those dredge management meetings, but I can barely stomach it as a dredge contractor, which I'm sure Jeff knows as well.

When they talk about alternative disposal methods, I mean, there is electric cars invented in the '50s, but we're still filling up with gasoline. That's the best analogy I can make. So as far as the affordability of getting rid of dredge spoils in these other crazy ways that I have heard, it's just not reality.

So anyway, I think that's the fear. So are any of the proposed sites -- is there anyone in this room from Army Corps? Are they all going to be within the coastal zone management, and this could all just be --

MS. BROCHI: So the zone site of

feasibility includes those sites. The 11 sites are all within the coastal zone management consistency and that's Connecticut and New York. So either Mike or George, if you have any specific information? To my knowledge there is no -- you know, there is no yardage or mileage that, you know, gives you preference to being able to object or not. It's whether it's abutting and whether it's in danger.

MR. WISKER: I think what we're getting is within Long Island Sound it's either, you know, they're all territorial waters of one or the other state. Boundary lines match. An example of where you might be outside of the coastal zone is say Rhode Island where you got far enough off into the territorial seas beyond the state territorial limits. Then -- and that may be where it would apply. You would have to go quite a ways off shore, open water.

MR. CAREY: You have to get away from Rhode Island's territory.

MR. WISKER: That's what I'm saying. You have to go out and hang a right. So that would be the one way you would avoid, because under the Federal consistency laws the two states within Long Island Sound if there is a reasonable, foreseeable effect of a project in one state on another, that other state

has the right to remove that for consistency with that program.

MS. BROCHI: Thank you.

MS. MCKENZIE: Tracey McKenzie again. Just to follow up the question with you, George, because the New London disposal site now, a corner of it, the boundary of New York and Connecticut goes right through, I think, like the lower third corner of --

MR. WISKER: Southeastern.

MS. MCKENZIE: Southeastern corner of it. If the site was shifted so it's not on the boundary line, New York would still be able to comment on the coastal action that Connecticut DEEP takes.

MR. WISKER: Right.

MS. MCKENZIE: I just want -- that's all.

DR. HAY: Tracey, what is your affiliation.

MS. MCKENZIE: U.S. Navy Subbase, New London.

MS. BROCHI: Does that answer your question?

MR. MCGUGAN: Just for the record,

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to go to New London for Bill Spicer, the cost for him to try to go to Central with the same material, because I was his dredge contractor, and I'm not here because I'm sore about not dredging this job. It's a much bigger issue to me. The difference between going to New London or going to Central with this stuff is more than double the cost for a marina operator.

So it's going to be a huge burden on the marinas in southeastern Connecticut, and the Connecticut River is like coming. So I guess somehow --

DR. BOHLEN: When you say cost, you are including all factors in the cost. It isn't just dollars.

MR. MCGUGAN: Right. Well, I have actually done --

DR. BOHLEN: Is that right --

MR. MCGUGAN: We have done trips. Ron, he couldn't because (inaudible) is too shallow. So we did a couple loads and tried to be as nice as I could, but, man, it's a long trip. It's 24, 26-hour cycle to get out to New Haven and back. So it's just -- that's the economics of it. It's just like, you know, you are digging with a wheelbarrow in your yard. You are going right there, and you are going to your

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neighbor's house. It's just --

MS. BROCHI: All of the regulatory agencies and cooperative agencies understand the economic impact, but the State doesn't.

MR. MCGUGAN: Well, I think New York and Connecticut needs to get along or -- maybe Connecticut needs to understand what is acceptable.

DR. HAY: So it's 5 o'clock. We started five minutes late so let's allow for five more minutes, so maybe two more comments that are burning. Sir?

MR. SHAPIRO: My name is Chris Shapiro from Cedar Island Marina. Is just hasn't -- maybe there is an answer to this, but it hasn't been entirely clear to me. You say, you know, in the calculations, you know, there is going to be a lot of variables, you know, such as economic, you know, commercial, that type of thing. Who on your team is going to be considering those variables?

MS. BROCHI: Well, there is individual people at EPA as well as the Corps of Engineers and all --

MR. SHAPIRO: Well, you guys are scientists. Who from the business side is going to be considering this? I mean, surely, you know, I'm not

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going to get up here, you know, and talk about, you know, the displacement or anything like that. So how can you guys talk about business?

MS. BROCHI: You will have an opportunity to comment about --

MR. SHAPIRO: No, no. Who on your who is actually putting together the actual recommendations?

MS. BROCHI: Yeah, well, so the recommendations come from the agency and the cooperative agencies, but the working group that was set up for the DMMP has nonregulatory and nonagency specific focus on it that we're going to tap into as well.

MR. SHAPIRO: So there are people from the business side, too.

MS. BROCHI: Yeah.

MR. SHAPIRO: Obviously this is very important, you know, but there obviously needs to be some professionals, you know, that understand, you know, the economic, you know, impacts. I know that you guys are probably very smart, but there needs to be professionals, you know.

DR. HAY: We have an economist on board as well.

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MR. SHAPIRO: Can you give me their names?

COURT REPORTER: I'm sorry?

DR. HAY: Ben Lieberman.

MR. SHAPIRO: Ben Lieberman?

MS. BROCHI: So on the working group, Mark, do you know when the next working group of the DMMP would be established or --

MR. HABEL: Probably about the time we publish the draft of the DMMP.

MS. BROCHI: So Mike Keegan would be the contact.

MR. SHAPIRO: Okay. I'd just like to ask --

DR. BOHLEN: Did I hear -- Jean, you said after the DMMP or after --

MS. BROCHI: No, the Dredge Material Management Plan.

DR. BOHLEN: What's the date for the release of the Dredge Material Management Plan?

MR. HABEL: It will be sometime in the spring.

MR. JOHNSON: Of 2015?

MR. HABEL: Yes.

DR. BOHLEN: I know there was some

questions on that that had been circulating.

DR. HAY: One final question? Comments? Okay. Thank you all for coming. Have a great afternoon.

(Whereupon, this hearing was concluded at 5:10 p.m.)

CERTIFICATE OF REPORTER

I, Jacqueline V. McCauley, a Notary Public duly commissioned and qualified in and for the State of Connecticut, do hereby certify that the Supplemental Environmental Impact Statement(SEIS) to Evaluate the Potential Designation of One or More Dredged Material Disposal Site(s) in Eastern Long Island Sound hearing was taken on December 9, 2014 at 3:08 p.m., and reduced to writing under my supervision; that this hearing is a true record of the testimony given during the hearing.

I further certify that I am neither attorney nor counsel for, nor related to, nor employed by any of the parties to the action in which this hearing is taken, and further, that I am not a relative or employee of any attorney or counsel employed by the parties hereto, or financially interested in the action.

IN WITNESS HEREOF, I have hereunto set my hand and affixed my seal this 18th day of December, 2014.

Jacqueline V. McCauley
Notary Public

My Commission expires: 12/31/2017

END OF REPORT.