A joint meeting of the Citizen's Advisory Committee (CAC) and the Science and Technical Advisory Committee (STAC) of the Long Island Sound Study (LISS) was held on Thursday, June 14th, at the Norwalk Maritime Aquarium. The meeting commenced at 9:43 with a CAC/STAC business meeting.

CAC Meeting: 9:43-10:10 am

Sandy Breslin [Audubon CT], CT Chair of the Policy and Legislative Committee gave a legislative update and encouraged attendees to join the CAC and others who will be visiting Washington, DC on Wednesday, June 27th to lobby for the Long Island Sound Study. CAC priorities include 1) reauthorization and 2) fiscal years 2013 and 2014 budgets and 3) SRF budget. This is an important trip for stakeholders and an opportunity to meet EPA leadership, Congressional members and their DC staff. Sandy reported that the Natural Resources Conservation Service (NRCS) designation of LIS and its watershed as a "multi-state partnership priority area" has been approved, with the support of the CAC and others and that over $400,000 has already come to Connecticut through this program. This is a big gain for Long Island Sound.

Adrienne Esposito [Citizen's Campaign for the Environment] and a NY Chair of the CAC Policy and Legislative Committee reported on the sewage pollution right-to-know legislation that mandates that the public be notified when raw or partially treated sewage is released. The General Assembly of CT has passed this legislation with support from the Ct DEEP; New York has yet to adopt it.

CT CAC co-chair Curt Johnson [CT Fund for the Environment] introduced Jennifer Sappells from the Long Island North Shore Heritage Area, who has requested to join the CAC. Curt reported that the membership committee of CAC has recommended that the North Shore Heritage Area be added as a member of the CAC with Jennifer as its representative and Avrum Golum, MD JD, as her alternate. Jennifer gave a brief overview of the organization. The CAC voted and the motion passed unanimously. Curt welcomed Jennifer to the CAC.

Curt briefly described a letter from The Nature Conservancy (TNC) urging support for a bill going to the governor of New York to establish management areas for seagrass. Chantal Collier [TNC] provided background information. Maureen Dolan-Murphy [Citizen's Campaign for the Environment] recommended that the CAC send a separate letter of support on letterhead. All agreed, and Curt agreed to draft and circulate such a letter for a 24 hour review and comment.

Joint CAC and STAC Meeting: 10:11 AM

A total of 53 people attended the meeting: 21 CAC (quorum), 20 STAC (quorum), 8 staff, and 4 guests. Curt Johnson introduced and welcomed Jennifer Herring, CAC representative from the Norwalk Maritime Aquarium and host for the day's meeting. Jennifer gave an overview of the recent transformation of the museum and emphasis on LIS, and encouraged all meeting participants to visit in the afternoon

after the meeting. Jennifer also spoke of a new research vessel, the first of its kind in the country, to be unveiled soon at the Aquarium.

The joint meeting began with an introduction by Curt Johnson about the day's schedule. STAC co-chair Jim O'Donnell [University of Connecticut, Department of Marine Sciences] introduced the day's activities as identifying agreement areas, gaps, and roadblocks in the Synthesis Book and the Soundvision Plan emphasizing that the objective is not to revise the body of the book, *Long Island Sound: The Urban Sea Revisited*, or Soundvision but rather to provoke questions and link science to management priorities.

Jim Latimer [US Environmental Protection Agency] proceeded to give an overview of the six technical chapters of the *Long Island Sound: The Urban Sea Revisited* book. His presentation provided key insights and science gaps for each chapter. Mark Tedesco [EPA Long Island Sound Office] provided an overview of the management chapter (chapter 7), with emphasis on how to use the technical information for ecosystem based management applications. Mark underscored the importance of adaptive management and uncertainty that is inherent in natural ecosystems. A summary of Jim Latimer's technical chapter overview, as well as Mark Tedesco's management presentation, was handed out at the meeting. [**Appendix A**].

Long Island Sound: The Urban Sea Revisited Overview:
Chapter 1. The social history chapter covers the past 500 years of social and economic changes.
Chapter 2. The geology chapter makes a connection about how the geology of the Sound ties into the current environmental conditions such as circulation and mixing and how these factors might change with climate change and sea level rise.
Chapter 3. The physical oceanography chapter highlights the effects that wind and temperature have on stratification and how this information can be used to create more accurate management models.
Chapter 4. The geochemical chapter focuses on the chemical changes in the sediment, chemical fluxes, and cycles, and how these factors change by basin.
Chapter 5. The pollutant chapter focuses on the magnitudes, sources, and effects of different pollutants, the historical records, and current hot spots of pollutants.
Chapter 6. The biology and ecology chapter focuses on habitats, flora, plankton, deep water benthos, fish, shellfish, and wildlife, and also examines cross-cutting topics such as the effects of hypoxia, climate change, and invasive species on the biology and ecology of the Sound.
Chapter 7. The management chapter focuses on how each of the technical chapters link to management.

Approximately 70 people have been involved with the book in total, with over 12 institutions contributing. Mark Tedesco mentioned that national experts, outside of LISS, were reviewing all chapters. Five chapters have been through the external review process; one chapter is being revised, and chapter six has gone out for review. The *Long Island Sound: The Urban Sea Revisited* book will be more than 500

pages, with the largest chapter on biology and ecology. The expected timeframe for the published book is likely in early 2013.

CAC co-chairs Nancy Seligson [Town of Mamaroneck] and Curt Johnson introduced and provided an overview of the Sound Vision document. Nancy pointed out the fortuitous timing of having the longer, more comprehensive 10 year plan, as well as the shorter action oriented two year version plan of Sound Vision for LIS and how this work is directly related to revising the Comprehensive Conservation and Management Plan (CCMP). Nancy gave a brief recap of the history of the document's creation, citing the focus groups, the longtime drafting, and rolling out the document through multiple venues, including partnering with SoundWaters to link elected officials with the rollout at six ports of call around Long Island Sound. The LIS Citizens Summit provided another opportunity for public input. Curt Johnson acknowledged Leah Schmalz [Connecticut Fund for the Environment] for her hard work and leadership in facilitating the SoundVision planning effort, and the New York Community Trust and Long Island Sound Study for financial support. The full document, as well as the two-year SoundVision action plan, were both formally adopted in June of 2011 by a unanimous vote of the CAC. The Sound Vision documents can be found at http://LISoundvision.org.

A handout [**Appendix B**] was provided to the attendees identifying the large extent of overlap between the CAC SoundVision priorities and the management recommendations that Mark identified as flowing from the science synthesis. Overlap areas included:

- The use of green infrastructure, low impact development for clean water;
- Continuing key clean water investments: both sewage treatment upgrades and stormwater solutions;
- Engage public in clean water stewardship though a major social marketing campaign
- Protect key coastal sites for wildlife and people, including Plum Island
- Restore and improve important coastal habitat types and reopen rivers
- Support the use of natural biological feedback systems for restoring clean water, including: restoring wetlands; expanded sustainable shellfish and algae production and protection (bio extraction); expanding submerged aquatic vegetation (sea-grass);
- Integrate climate change across programs and watershed planning: do not "stovepipe" climate change adaption from nutrient/pathogen BMPs, habitat protection and restoration.

- Gaps, or priority CAC management recommendations that were less emphasized in science synthesis included:
  - The importance of controlling pathogen pollution because it greatly limits people's enjoyment of the Sound;
  - Engage people in exploring, understanding and protecting the Sound:

- As a complement in messaging the biological feedback system concepts we overlap on, naturally functioning dunes, beaches, marshes and forested riverfronts protect our human neighborhoods and lives from increasing flood risks
- Engage and coordinate citizen-based science monitoring of our harbors and embayments to better understand water quality and wildlife status – in the areas where most of the public interacts with our LIS urban sea.
- Partner with tourism and economic development in a "come to the Sound" campaign;

o Implement sustainable dredge management to maintain recreational boating access**.**

Curt noted with some concurrence that perhaps some of these issues (like pathogen contamination and dredge management) might be of little interest to research scientists, they are of great interest to LIS users and citizens. Thus, he suggested that the *Long Island Sound: The Urban Sea Revisited* recommendations at least note this disparity.

Comments included the importance of making connections for people to the Sound, and the difficulty of getting the general public interested in the open waters of the Sound (as opposed to the local shoreline). Dredging for recreational boating was a topic of considerable interest; Nancy Seligson pointed out the *Long Island Sound: The Urban Sea Revisited* book quote referring to the "lack of long term ecological effects from dredge disposal activities". STAC co-chair Larry Swanson [Stony Brook University] expressed concern about the impacts of deepening harbor channels for recreational boats, citing Smithtown Bay, NY, and emphasized the need to look at and understand the interaction of bays with the greater LIS before we deepen areas for recreational boats.

After lunch, Larry Swanson offered the following observations/questions: How are we going to react to sea level rise; are we going to fight or let nature take its course? This is a technical and management issue. Secondly, we will see regional reversal of progress in anthropogenic disturbances in the next century due to climate change; citing changes in peak flows of the Hudson River that might have a profound impact on phytoplankton and other components of the ecosystem. Curt Johnson responded that SoundVision identifies lands at risk, and asked if we have the science and historical information that we need to support the idea of sea level rise? Johan Varekamp [Wesleyan University, Department of Earth & Environmental Science] remarked that sedimentation rates have increased four to five times in the last century. Brian Thompson [CT Department of Energy and Environmental Protection] noted that we need to understand the sources of that sediment. A number of opinions were expressed regarding the issue of sea level rise, including the need to assess tidal wetland loss, the uncertainty in estimating the differences from sea level rise and marsh loss and the particular impacts of sea level rise to structures located on barrier beaches. Jim O'Donnell remarked that a gap in information about sediment transport exists. Marty Garrell [Adelphi University] remarked that it is the

bigger and more frequent storms associated with climate change that will be/are more damaging than sea level rise, particularly winter nor'easters. Johan Varekamp noted the tremendous sediment load that Tropical Storm Irene produced, but that historically the big floods (e.g., 1936, 1948) contained more damaging floodwaters to Connecticut and New York fresh water river systems.

Other science questions that emerged included Sandy Breslin's remark that we don't have good avian (bird distribution, breeding and migration) information; there have been changes since the last data collections/surveys were conducted. Carmella Cuomo [University of New Haven] pointed out the localized impacts that create (for example) shifts in prey populations that birds feed on because of sediment changes that result from benthic faunal changes that ultimately impact birds and economically hurt the state through the loss of hunting. Brett Branco [Brooklyn College] pointed out the importance of having the right people making management decisions, citing the location of bird refuges next to airports. Curt Johnson added to this a similar issue at Jamaica Bay Refuge on Long Island, where rebuilding /restoring islands as habitat could create a problem of too many birds in close proximity to JFK airport – but in this case the islands appeared to be supporting rarer species of conservation value and few high nuisance bird populations.

Penny Howell [CTDEEP, Marine Fisheries Unit] pointed out the important role of citizen science through the Project Limulus program, where data collected lead to the protection of three regions where it is now illegal to take horseshoe crabs. This comment is reflected in the high priority the CAC gives support for citizen monitoring of embayments.

Questions were raised about the fate and impact of pharmaceuticals in LIS; Joop Varekamp commented about the link to a greater number of female fish in LIS. John Mullaney [US Geological Survey – Connecticut] cited a study done on the Quinnipiac River that showed that 80% of the base flow in the summer is sewage. Larry Swanson suggested that in the long term we might need to stop using water as a transport mechanism for sewage to LIS.

Curt Johnson returned to the science questions that need answers for a better understanding of the impacts of dredging. Are there hydrologic questions, such as the benthic community response to dredge spoils? The need to have realistic dredge windows was brought up by Grant Westerson [Connecticut Marine Trades Association] because the existing short windows (time frames) cannot sustain the livelihoods of dredging contractors. Charlie Yarrish [University of Connecticut at Stamford, Department of Ecology and Evolutionary Biology] pointed out that the contaminant issue in the food chain is still not well understood in LIS: not all sites are the same and there are changes seasonally and spatially. Curt Johnson pointed out the important role of marine spatial planning in assessing areas with the greatest potential for dredging and management in general. Brett Branco noted that models are built for general circulation; there is a need to understand local

dynamics. John Mullaney pointed out the uniqueness of all embayments – whether they are surface or not surface fed, etc.

Curt Johnson asked for feedback about the role for citizen groups collecting data, assessing sites and doing management of LIS sites, and the fundamental issue of what to do with citizen science data. Leah Schmalz noted the successful national weather service citizen's monitoring program.

Other comments included the lack of information on embayments, despite being some of the most heavily used real estate in LIS, and the lack of understanding about the terrestrial carbon flux in relation to LIS.

A list of key issues and science gaps were recorded [**Appendix C and D**].

Curt Johnson wrapped the meeting up by acknowledging and thanking Jim Latimer for his work on *Long Island Sound: The Urban Sea Revisited*, and asked everyone who had been involved to please stand (to applause). Nancy Seligson noted the importance of sharing notes from the day, and keeping the conversation alive. Curt suggested that there be a confluence once a year between the CAC and STAC. Mark Tedesco noted that there had been inspired discussion at the days meeting, and that *Long Island Sound: The Urban Sea Revisited* would be at the final editorial stage at the end of July, and completed shortly thereafter.

The meeting adjourned at 2:43 p.m.

Appendix A: *Long Island Sound: The Urban Sea Revisited* overview technical chapters 1-6, management chapter 7 (meeting handout)
Appendix B: Overlapping Long Island Sound Management Recommendations: *Long Island Sound: The Urban Sea Revisited* Chapter 7 and CAC SoundVision (2011-2020)
Appendix C: **Discussion: What management issues are limited by science?** A list of key issues recorded during meeting
Appendix D: Science Gaps identified at meeting

Appendix A: *Long Island Sound: The Urban Sea Revisited* overview technical chapters 1-6, management chapter 7 (meeting handout)

The following is a priority list for each of the six technical chapters of the 1) key insights and implications for management, 2) major gaps and key research needs to support management, and 3) the resulting recommendations for ecosystem based management of Long Island Sound. Chapter authors were asked to consider these questions in reviewing the list:

- Are the key insights outlined in 1 and the gaps in knowledge and research needs outlined in 2 represented accurately and fairly?
- Are there key points missing from outline 1 and gaps in knowledge and research needs from outline 2 that should be included?
- Would you recommend any additional, specific management actions to the list outlined in 3?

The final list will be used by the Chapter 7 authors as a "cheat sheet" to highlight and integrate the information from the prior six technical chapters into the management chapter.

1. Emphasize key insights and implications for management from technical chapters 1-6
    a. History
        i. Explains many examples of current conditions for water quality, habitat, and living resources through: shipping, fishing, and watershed development.
    b. Geology
        i. Character of the basin underpins physical oceanography.
        ii. CT portion of the watershed is greatly shaped by north-south tributaries.
        iii. NY portion of the watershed (Long Island) is shaped by glacial forces.
    c. Physical Oceanography
        i. Dissimilar morphological and topographical features of the lands bordering the Sound play an important role in its physical oceanographic processes.
        ii. Lateral wind fields have changed over time and affect seasonal DO trends.
        iii. Changes in basin from historical engineering have modified water properties, e.g. decrease in salinity in WLIS.
        iv. The driving forces to its physical functioning are quite variable and consequently the responses to these forces fluctuate considerably as well.

d. Geochemistry
    i. Biogeochemical processes in the sediments affect the sources, fates, and effects of chemical species which in turn affect benthic organisms.
    ii. WLIS and embayments are strongly reducing (which limits deep benthic reworking by organisms); ELIS is strongly oxidizing (which promotes deep benthic reworking by organisms), CLIS is a transition zone between the two and may serve as a harbinger of future sediment-organism change.
e. Pollution
    i. Sediment core data show the trajectory of contamination, peaking in the 1960s-1970s and declining since for many contaminants, due to regulation/management.
    ii. Legacy of contaminants remains and levels are high in WLIS/CLIS and in some embayments, with potential for toxicity.
    iii. Tributary and WWTF nutrient inputs have decreased over time even in the face of increased watershed development due to effects of regulatory/management actions.
f. Ecology/Biology
    i. Littoral zone
    ii. Intertidal and subtidal
        1. Tidal wetlands: Decline of 30% from historical extent of tidal wetlands
        2. Seagrass: under current K_d conditions, eelgrass is unlikely to survive in WLIS and is marginal in CLIS.
    iii. Plankton
        1. West-East gradients in decreasing nitrogen, chlorophyll a, zooplankton is not gradual but dominated by condition at extreme ends.
        2. Nutrient and chlorophyll a levels have not changed in open Sound over 60 years.
    iv. Deep water benthos
        1. In WLIS and CLIS, tidal resuspension of sediment dominates net long-term influx of sediment.
        2. Foram fauna has changed between *Elphidium* and *Ammonia* but causes not clear; decrease in diatom productivity, invasive crytospecies of Ammonia, or hypoxic tolerances.
    v. Fish, Shellfish, Wildlife
        1. These resources provide import ecosystem services to the region.
        2. Historic changes in menhaden, oysters, and anadromous fish may have alerted the ecosystem.
        3. Finfish trawl survey since 1984

a. Overall abundance is stable with decrease in spring (decrease in epibenthic species: winter flounder, windowpane flounder, increase in demersal species: butterfish, scup) and increase in fall (butterfish, scup, weakfish).
b. Cold-adapted species have declined in abundance, particularly in spring, while warm-adapted have increased.

vi. Cross cutting issues
1. Inorganic nutrient loadings and photosynthetic production fuel the biological respiration that drives the system to hypoxia.
2. Planktonic community respiration dominates benthic oxygen demand and rates can deplete DO in days if not for physical ventilation.
3. Human mediated invasions of species have likely been occurring for more than 500 years, but may be increasing due to globalism. Temperature increases may increase the survival of some introduced species and extend the range into LIS of other species.

2. Identify gaps to understanding and identify key research needs <u>to support management</u>
a. History
b. Geology
i. Uncertainty to groundwater flow and discharges from Long Island.
ii. Ambiguity on the nature and timing of marine incursions to the Sound.
c. Physical Oceanography
i. Local overwater wind observations will be required to understand short time scale meteorological events.
ii. Need to better characterize lateral structure.
iii. Additional measurements and modeling to estimate boundary fluxes.
iv. Local effects of global climate change remain uncertain.
v. High resolution sampling and aligned bathymetry and topography to support predictions of coastal hazards and flooding from storms/sea level rise.
d. Geochemistry
i. Changes in CLIS and embayments will be sensitive to changes in system and should be emphasis for monitoring/studies.
ii. Understand the relationship between embayments and LIS proper.
iii. Better characterize the role of sediment processes in the sources, transport and fate of nutrients and other compounds.
e. Pollution

i. Studies of pH and dissolved inorganic carbon.
ii. Continue periodic sampling of sediments (e.g. NCA).
iii. Emerging contaminants need to be characterized.
iv. Continue to monitor nutrient inputs.

f. Ecology/Biology
   i. Littoral zone
      1. Little quantitative data on spatial and temporal features; as a result what has been lost and how to restore it is unknown.
   ii. Intertidal and subtidal
      1. Tidal Wetlands
      2. Seagrass: continue monitoring of spatial and temporal variability and research response to stress.
      3. Seaweeds: little monitoring of species type, distribution, and abundance is performed.
   iii. Plankton
      1. Fate of primary production and linkages to hypoxia need to be better understood: uncertainty to sinking and horizontal export of primary production, and imbalances between sources and sinks of carbon in WLIS.
   iv. Deep water benthos
      1. Seasonal and year-to-year temporal dynamics are not well studied or understood (particularly for coarse grain sediment successional dynamics, response to infrastructure disturbance, succession in hypoxic areas).
      2. Spatial dynamics and relationships to differernt stressor/pressures (including characterization in embayments) are not well understood
      3. Sparse biomass, productivity, and community measurements for incorporation into food web models.
   v. Fish, Shellfish, Wildlife
      1. Ecosystem modeling would help relate trends in harvest and survey abundances to the biology of natural resources.
      2. The mechanisms involving important variables such as loss of keystone species, fishing pressure, temperature, habitat alternation need to be better understood.
   vi. Cross-cutting Issues
      1. Remineralization of organic carbon and nitrification of ammonium from sewage treatment plant discharges can contribute to hypoxia, but direct measurements using 15N tracer and other methods will be needed to assess their importance.

2. Food web dynamics are relatively poorly known; need to better understand trophic linkages between production apex predators
3. Changes in climate can affect timing and fate of primary production but little is known of the consequences of these changes.
4. Gaps in monitoring components of the biological community, e.g. seaweeds, benthic animals.

3. Identify management priorities for EBM of LIS
    a. Embrace sustainability
        i. LID and sustainable redevelopment
            1. Lower cost compared to post development remediation.
        ii. Prioritize management of existing pollution sources and impairments
            1. Wastewater treatment plant upgrades
            2. Onsite wastewater treatment
            3. Stormwater runoff
            4. Agriculture
            5. Individual stewardship
        iii. Adaptation to coastal hazards
            1. Shoreline hardening versus soft solutions and retreat.
    b. Establish baselines of historical condition and magnitudes of change
        i. Focus on protecting/restoring ecosystem services rather than "pristine" conditions.
            1. Preserve, restore, enhance natural features that support desired services.
    c. Integrate climate change across programs.
        i. Integrated watershed management (don't stovepipe climate change adaption from nutrient/pathogen BMPs and habitat protection and restoration.
    d. Enhance positive feedback loops.
        i. Restore wetlands, shellfish, SAV, and enhance bioextraction.
    e. Improve eutrophication and ecological modeling and monitoring.
        i. Develop more mechanistic understanding of the interplay among nutrient discharges and physical and biological variables promoting hypoxia.
    f. Design adaptive management framework.
    g. Conduct marine spatial planning.
        i. Integrate regulation and management of resource usage (fisheries, CZM).
    h. Improve data management and interpretation.
    i. Reconnect people to the Sound.

i. Support for access and public use.
ii. Recognize social and economic benefits to past and ongoing management.
iii. Engage the public, providing science-based information.

Appendix B: Overlapping Long Island Sound Management Recommendations: *Long Island Sound: The Urban Sea Revisited* Chapter 7 and CAC SoundVision (2011-2020) Sources: Tedesco and Latimer, *LIS: The Urban Sea Revisited* draft outline for Synthesis Chapter 7. Citizens Advisory Committee, *SoundVision: An Action Plan for Long Island Sound*, 2011-2020 (2011), on the web at LISoundvision.org

Note: Highlighted items are among the top SoundVision management actions prioritized and voted on at September 8, 2011 CAC meeting

Clean Water for a Healthy Sound

1. Create green infrastructure retrofits and Low Impact Development rules for new construction and redevelopment as a cost-effective measure for controlling our massive stormwater problem
2. Manage existing pollution sources, from:
    a. Wastewater sewage treatment plants (meeting reduction targets for hypoxia; ensure general permits support improved water quality);
    b. Control and reduce impacts of stormwater pollution: strong state-based low impact development standards and MS4 (municipal) permits;
3. Engage public in clean water stewardship though a major social marketing campaign; expand storm-drain stenciling, create incentives for residential green infrastructure and public education.
4. Support the use of natural biological feedback "filter" systems for clean water, including: restoring wetlands; expanded sustainable shellfish and algae production and protection (bio extraction); expanding submerged aquatic vegetation (sea-grass).

Protecting all LIS Living Creatures

1. Protect key coastal sites for wildlife and people, including Plum Island
2. Restore and improve important coastal habitat types, reopen rivers
    a. with particular focus on urban habitats;
    b. Support positive feedback loops associated with habitat improvements of wetlands; shellfish; submerged aquatic vegetation associated with clean water, biological functioning and economic co-benefits;
3. Identify lands at risk from coastal hazards and sea level rise and support adaptation to coastal hazards though shoreline softening and retreat.

4. Conduct marine spatial planning, including management of resource usage.

Cross-Cutting Issue: Integrate climate change across programs and watershed planning: do not "stovepipe" climate change adaption from nutrient/pathogen BMPs, habitat protection and restoration.

Gaps: High Priority LIS Management Recommendations
From CAC SoundVision plan, not mentioned in the Synthesis outline

Observation: The Synthesis management priorities outline is focused on natural functions of the ecosystem. It misses some critical human, social and economic components of the Sound. These components include:

1. **The importance of limiting pathogen pollution because it greatly limits people's enjoyment of the Sound** (swimming and shellfishing). **Economics:** LIS beach swimming is estimated to provide $660 million/annually to the NY and CT economies in 1990 dollars. Shellfishing is estimated to provide $100 million/annually to both state's economies in 1990 dollars. (Source for all economic estimates herein: Altobello, Marilyn A., University of Connecticut, *The Economic Importance of Long Island Sound's Water Quality dependent Activities,* US EPA, Region I, January 6, 1992, pp. 4-21.)
SoundVision Management Recommendations: Eliminate raw sewage and bacteria impacts; reduce beach closings by 50% in five years using a variety of strategies, including assuring that combined sewer overflows are eliminated through a combination of green and gray technologies.

2. **Engage people in exploring, understanding and protecting the Sound:**
a. Naturally functioning dunes, beaches, marshes and forested riverfronts protect our human neighborhoods and lives from increasing flood risks AND clean our water as well as provide wildlife places to live. This should be the focus of a major educational campaign.
b. Engage and coordinate citizen-based science monitoring of our harbors and embayments to better understand water quality and wildlife status – in the areas where most of the public interacts with our LIS urban sea.
c. Partner with tourism and economic development in a "come to the Sound" campaign.

3. **Implement sustainable dredge management to maintain recreational boating access.**
Economics/social: The Altobello economic report estimates that the recreational boating industry around the Sound provides $3.2 billion in 1990 dollars of economic benefits to Connecticut and New York. Recreational boating is the public access to the Sound for hundreds of thousands of New York and CT citizens.
Science: The synthesis outline states, "There is a lack of observable long-term ecological effects from (dredge?) disposal activities. There is no evidence of changes

to benthic processes or habitat apart from those resulting from introduction of sediment of different grain sizes or changes in seabed elevation". This raises important additional dredge management issues and merits a "deeper" look.

4. **Invest in the Restoration of the Sound:**
   - **a.** Maintain and increase current federal investment in the Sound;
   - b. Advocate for CT and NY capital investments in the Sound.

Appendix C: Discussion: What management issues are limited by science? A list of key issues recorded during meeting.

Discussion: What management issues are limited by science?

- Are the management objectives in Sound Vision supported by the science?
- Where should the science be strengthened to better support the management objectives?
- Do the Urban Sea management priorities reflect the general priorities of Sound Vision? If not, how do they differ?
- Are there examples of where science has clearly resulted in applications of management that have improved water quality or the health or abundance of living resources?
- What are the top science and management priorities for LIS?

MG What level do the decisions get made at and how involve the public?
CC Inherent conflicts in what public wants. Ex. Dredging can damage the very resources public wants to protect. Have to show the whole picture; explain big picture. Take what the scientists have said to create management recommendations. There's a disconnect.
JO Reason for meeting today. Move management forward effectively. Require substantial resources and people. Need to articulate in simple and clear way.
SB Always that tension. Emphasis of CAC on communication, education and outreach; marry science with efforts to engage public.
JK It's on agenda to engage public
JO Management has to progress regardless
PH Ecosystem services; work with the system. Dredging perfect example. Not done with just one effort. Good marketing effort needed. Message.
NS How do we craft that message? Let's understand what can be dredged and where there are problems so that we can engage the public
AE Dredging overseen by Army Corp. Example dredging – one for ecosystem, one for navigation.
JO Need for funding for science; coordination – two different issues.
NS Coordination of agencies key. Need to participate in process.

LS Management in context of political realities. Everyone driven by need for economic recovery. Need to convince political leaders importance of ecosystem-based decisions. Beach nourishment good example; impact to ecosystem vs beachfront real estate protection.
GW Dredging: public funding will not come w/o understanding of public need for dredging.
CC Science Gaps that affect ability to manage not addressed.
MG Science often inconclusive. If manager – public wants work to get done. Dedicated managers say buck stops here; I have to act.
NS Need to move forward, incrementally.
JO What management issues are limited by science? Need to identify.
BB Unintended consequences; incomplete understanding of ecosystems. Boating/dredging and habitat protection /restoration.
MW Hypoxia. N control heavily invested. What are science gaps to know if this has been effective? Gaps of understanding of role of other nutrients, primary productivity, meteorological events. Looking at central management issue. Nutrient control and hypoxia mitigation – science needs.
JO Missing alternative management opportunities.
GW Data gaps re cycling; movement of materials and energy within ecosystem. Biology, chemistry and meteorology.
AC Hypoxia critical; won't need to dredge because no one will want to go to the sound.
NF Agencies/silos. Coastal and marine spatial planning key; bringing in stakeholders. Merge science and users. Need to understand ecologically important areas in LIS. Need more biological data, esp. coastal.
AG Hypoxia. What has improved? We're starving the Sound. Need referee.
JK If any part of the chain is weak, it's all weak. We have an incomplete understanding of primary productivity.
BT From a manager: working on dredge plan for LIS. We should understand where sediment coming from. NPS/sediment control. Can't quantify (yet?) sediment and contaminant load. State agency to regulate? DEEP and local = regulation of nps. More than CT/NY problem (Irene – VT).
MT Missing from Sound Vision. Importance of maintaining/funding science. There will be strong threats to maintaining science & observation programs. Critical importance; need to go forward with management (NS).
JV Disconnect Sound Vision and Scientific views . Need to marry two views.
SD Gaps to inform management. Look at last 10 years; ways science has influenced management (and decisions). Wind influence hypoxia, good example.
VB What is the real value of healthy Sound? (MT) rfp in 2012 to revisit Altobello rpt. Need to know how money has been spent and what it has leveraged. Use examples from other programs.

Discussion notes from white board:
Coordinate management agencies
Make economics of LIS more about economic recovery and connect to public (adds public pressure) Bring to stakeholders.
Gap – What's happening on the bottom of LIS?
Sometimes do not realize unexpected consequences of our conservation goals.
Management issues focused on nutrient control and hypoxia
Need a better understanding of cycling of nutrients and energy.
Need an outside, independent review (starting point: synthesis book?).
Water quality – hypoxia. Need more info on the nonlinear relationship.
Need sediment and contaminant load data and about source.
Missing from Sound Vision – advocate for maintaining research and observation programs. Get public buy-in.
Value of past work and resources in general (rfp out soon) and include leverage/return on investment.

Appendix D: Science Gaps identified at meeting.

- Sources of Sediment
- Climate change and sea level rise (mapping)
    - Collect data e.g. tidal wetlands loss, new wetlands
    - Shoreline changes (CTSG & CTDEEP project)
    - Erosion of land i.e. barrier beaches – gap
    - Catastrophic events – winds and hurricanes and nor'easters (included in book)
    - Ecological significance
- Protecting key coastal sites
    - Need avian data –distribution of breeding & migrating birds
    - More than just protecting sites – linkages re: benthic fauna (food web) and chemical fluxes
    - Realize unexpected consequences and relationship to human use
    - Data to predict recovery – LISS partners moving in this direction
- Pharmaceuticals in LIS & impacts on wildlife
- Dredging and biological impacts
    - Open vs. capped – DDMP addressed
    - Windows – scientific basis?
    - Used to restore habitats (e.g. wetlands) – site specific – need scoping study
    - Disposal of dredged materials – needs to be viable
- Enhancing feedback loops
    - Bio-extraction – shellfish and algae (included in regs for STPs?)
    - Tidal wetlands & SAV's

    - Site specific spatially and seasonally; need to assess potential of sites & scale of project
    - Use citizen-monitoring programs? Need to define goals and parameters
- Carbon flux – varies seasonally
- Freshwater input re climate change