**In Attendance:**

**STAC Members:** Jim Ammerman, Carmela Cuomo, Sylvain De Guise, Michele Golden, Dianne Greenfield, Jim Hagy, David Hudson, Shauna Kamath, Jason Krumholz, Kamazima Lwiza (New York Co-chair), Robin Miller, Jim O'Donnell, Paul Stacey, Kelly Streich, Mark Tedesco, Craig Tobias, Maria Tzortziou, Jamie Vaudrey, Penny Vlahos (Connecticut Co-chair), Laura Wehrmann, Michael Whitney, Emily Wilson, Chester Zarnoch

**CAC Liaisons to STAC:** Sarah Crosby (The Maritime Aquarium)

**Others:** Danielle Alexander (NYCDEP),Robert Burg (LISS/NEIWPCC), Finnian Cashel (EPA), Nathan Chien (EPA), Margaret Cozens (U Conn), Emma Cross (SCSU), Naomi Detenbeck (EPA), Alex DuMont (NEIWPCC), Syma Ebbin (U Conn), Abdulai Fofanah (NYCDEP), Lillit Genovesi (NYSG), Anya Grondalski (LISS/NEIWPCC), Traci Lott (CTDEEP), Sharon Kahara (U New Haven), Kathleen Knight (CTDEEP), Chris Knightes (EPA), Alison Kocek (USFWS), Kristen Laccetti (EPA), Peter Linderoth (STS), Bill Lucey (STS), Cara Manning (U Conn), Emily Marquis (CTDEEP), Gio McClenachan (Stony Brook), Richard Moore (USGS), Jon Morrison (USGS), Esther Nelson (EPA), Anagha Payyambally (U Conn), Matthew Pruden (Cornell), Luciana Santoferrara (Hofstra), Judith Sarkodee-Adoo (NYCDEP), Nancy Seligson (CAC), Youngmi Shin (EPA ORISE), Lane Smith (NYSG), Cayla Sullivan (EPA), Elizabeth Tanzi (EPA), Kelsey Ward (U Conn), Gregory Wilkerson (NYCDEP), Kimarie Yap (IEC)

**Introductions, Updates:** Jim Ammerman started by asking Robert Burg, the LISS Communications Coordinator, to introduce our new communications staff member. Robert introduced Anya Grondalski who joined the communications team in January. She will be working on science-related articles as well as coordinating social media. Anya announced that she was working on a Women in Science celebratory social media post to feature some of the women involved in the LISS partnership. If you want to participate, the deadline to send in the form is today (March 1). She has also started a LISS LinkedIn account and posted on Instagram for World Seagrass day (today). Nancy Seligson asked if the Women in Science feature applied to those involved in the CAC and Anya replied that it applied to all women involved with the LISS. She also thanked the STAC members for giving her the chance to address them.

Jim Ammerman added two reminders about the deadlines for abstract submissions for the Long Island Sound Research Conference on March 15 (now March 22) and for pre-proposals for the LIS Research Competition on April 8. Penny Vlahos added her encouragement to submit both pre-proposals for the research competition and abstracts for the research conference. She noted that significant funds were available for the research competition, a comment seconded by Kamazima Lwiza who also encouraged participation. Penny also added that requests have been made for focused sessions at the research conference which would depend on the abstracts submitted. She also noted that the abstracts would be reviewed by the STAC co-chairs with the addition of Sylvain De Guise and Jim Ammerman. Penny introduced the first speaker Cara Manning from the University of Connecticut noting that she was another speaker in the STAC’s efforts to introduce faculty and researchers new to the Long Island Sound region.

**New Investigator Presentation: Studying coastal processes using dissolved gas measurements and other biogeochemical tracers:**  Cara Manning, UConn

Cara began by stating that her focus is on measuring gases and other tracers to study biogeochemical processes. She is excited to be giving this talk now that she has two data sets from LIS. She uses mobile gas analyzers, in situ sensors, and discrete samples and currently has two Ph.D. students working with her. Cara noted that she is a long-time fan of hypoxic zone research. She studied denitrification and oxygen cycling in a seasonally anoxic estuary, Saanich Inlet, in British Columbia, Canada.

The research questions that interest her include: 1. How do hypoxia and other changing environmental factors influence greenhouse gas emissions? 2. How do coastal ecosystems regulate nutrient cycling through denitrification and nitrogen fixation? 3. What are the rates of photosynthesis and respiration in coastal waters and sediments? 4. How do physical processes influence ecosystem productivity, respiration, and other biogeochemical fluxes?

Cara first addressed a study of hypoxia impacts on greenhouse gas emissions, as conducted by a Ph.D. student, Anagha Payyambally. They collected profiles of methane and nitrous oxide at seven stations in the western Sound in August and October 2023. Methane was highly supersaturated (up to 400 nmol/kg) and so was N2O, though much less so, at only about 10 nmol/kg. Since there were still low levels of oxygen in the water column, these gases were presumably released from the sediments. She asked whether there was interest in additional methane and nitrous oxide data and asked anyone with an interest or ship time in the western Sound to contact her. While her initial data presented here was from discrete samples, she is currently acquiring continuous instrumentation to monitor surface methane and nitrous oxide.

Cara’s lab also conducted a pilot study in an eelgrass meadow of the Niantic River, and found daily patterns of oxygen and nitrogen gas, maximum oxygen and minimum nitrogen during the day and the opposite at night. Bare sediment showed the same pattern but with lower production and respiration rates. She is also setting up instrumentation to measure three noble gases (neon, argon, and krypton) which will allow correction for the influence of physical effects (ebullition and temperature changes) on the bioactive gas measurements mentioned above.

She concluded by discussing the use of the Wirewalker, which can make a suite of both physical and biogeochemical measurements while continuously profiling up and down a wire. (It was also discussed at the November 2023 STAC meeting by Dr. Leonel Romero.) It is an excellent platform for high resolution profiles in a dynamic environment like LIS where you want to measure daily changes in oxygen. She hopes to use this instrument to measure how physical processes, air-sea exchange, and phytoplankton production all contribute to the development of hypoxia. They have received training on the Wirewalker and are currently seeking support to deploy it in the field. She finished by listing four challenges she has encountered as an early career researcher interested in conducting management-relevant research in LIS. 1. How do I find end users with the capacity to engage with my lab? 2. How do I frame research questions in a way that the answers will have management relevance and actionability? 3. How do I find identified research gaps that my lab can fill when some research results and ongoing work are not identifiable through literature searches.? 4. How do I find opportunities for my group members to get involved?

**Discussion:**

-Paul Stacey asked about what conditions in LIS would result in the greatest carbon sequestration. Cara responded that it was poorly understood and depends on the balance between production and respiration. It also depends on whether the carbon is respired as carbon dioxide or methane.

-Jim Hagy asked about the whether the equilibrium concentration of a gas is equivalent to the saturating concentration and Cara replied that it was, but both values are dependent on the atmospheric concentration of the gas.

**Characterizing the ecological and biogeochemical influences of nitrogen form and source on the Western Long Island Sound microbiome:** Dianne Greenfield, ASRC and Queens College, CUNY

Dianne began by characterizing LIS as an urban estuary impacted by nitrogen loading from a variety of different sources. While treatment plant upgrades have decreased the area of hypoxia, the impacts of eutrophication persist, such as hypoxia, harmful algal blooms (HABs), and other impairments, especially in the western Sound. Dianne’s research in LIS focuses on Theme 1 of the CCMP, clean waters and healthy watersheds, with an emphasis on phytoplankton as sentinels of change.

Phytoplankton are photosynthetic, take up carbon dioxide, and generate about half of the world’s oxygen. They are the base of aquatic foodwebs and influence regional and global biogeochemical cycling and climate. They also have a short life cycle and rapid division rates, and their productivity is regulated by environmental factors like light, temperature, and nutrients, and they respond rapidly to environmental changes and long-term perturbations. Her lab has sampled throughout LIS with a focus on the western Sound. They have conducted a series of analyses, including water quality, nutrients, phytoplankton, and bacteria, in both surface and bottom waters. They have also conducted specific rRNA targeted assays for the HAB dinoflagellate *Alexandrium catenella*, though that will not be discussed here.

Dianne’s study found that both the total chlorophyll *a* and the proportion of picoplankton declined when moving from west to east in LIS surface waters. This is coupled with a decrease in dinoflagellates and an increase in diatoms, particularly large diatoms, towards the east. This additionally coincides with a decrease in dissolved inorganic nitrogen (DIN), dissolved organic matter (DOM), and an increase in dissolved oxygen, salinity, and light. Focusing just on the western Sound, she found that nitrate concentrations were low in the spring and summer, and an increase in the fall coincided with diatom blooms. Ammonium concentrations and flagellate abundances rose in the summer, including HAB-forming species. In addition, silica was never limiting.

She noted that that the surface phytoplankton in the western Sound contributes to the flux of carbon and nitrogen to the deep water which becomes hypoxic in the mid-summer (July and August). However, the microbial populations and nitrogen transformations important to carbon and nitrogen cycling in the deep water are poorly understood. Bacterial abundances in western Sound bottom waters decreased during the onset of hypoxia but then increased during hypoxia. At the same time, the dominant form of nitrogen was ammonium prior to the onset of hypoxia, but switched to nitrite and nitrate during the onset of hypoxia suggesting that ammonium oxidation and ultimately nitrification were occurring. These results have been repeated multiple times and have implications for the influence of hypoxia on carbon and nitrogen cycling.

The COVID-19 pandemic lead to a natural experiment in nitrogen loading in the New York City region and elsewhere. Greatly decreased traffic at the beginning of the COVID-19 pandemic compared with previous years reduced atmospheric NOX emissions by 25-30%, improving air quality. Nitrogen loading from wastewater treatment plants along the Hudson River and serving lower Manhattan dropped precipitously at the start of the pandemic and gradually returned to previous levels, while the plants in residential areas of the outer boroughs, including the four plants at the eastern end of LIS, showed little or no declines. While turbidity and chlorophyll *a* declined in the Hudson River Estuary in March and April 2020, there was less change in the narrows of western LIS, though chlorophyll *a* increased.

To examine how post-COVID conditions coming from the landscape relate to water quality and phytoplankton, they sampled a series of shore locations moving from west to east, along an urban to suburban gradient, from Alley Creek (Queens, NY) to the Saugatuck River (Westport, CT). The pattern was different from stations in the central Sound, presumably due to terrestrial inputs, with diatoms most abundant in the spring and dinoflagellates in the summer. Picoplankton were the greatest contributor to phytoplankton biomass, and chlorophyll *a* was the highest in the summer. Ammonia was negatively correlated with chlorophyll *a*.

Nutrient addition experiments with a variety of nitrogen sources showed the greatest uptake of nitrate, except when ammonia was high. Nitrate favored diatoms but ammonia inhibited them, reduced forms of nitrogen favored flagellates, especially HAB forms. This has implications for LIS nitrogen management strategies. Additional projects underway include 16S and 18S rRNA analysis for prokaryotic and eukaryotic microbes which indicated many HAB species, including the brown tide organism, *Aureococcus anophagefferens*, which was widely distributed. There was also greater diversity near the shore as compared to the channel, suggesting that terrestrial influences were important. In summary, there were clear west to east gradients of nitrogen, phytoplankton, and chlorophyll *a* in the main channel of LIS, but they were less clear nearshore. Nitrate favored diatoms, but ammonia favored dinoflagellate HABs and euglenoids. Locations with wastewater treatment plant inputs had the highest concentration of ammonia, numbers of HAB species, and overall phytoplankton diversity.

**Discussion:**

-Paul Stacey noted that organic carbon sources from the landscape are poorly constrained, it takes time for ammonia from New York City (NYC) to be nitrified, and wastewater nitrogen during the pandemic probably stayed more in the suburbs because fewer people were commuting into NYC. He also wondered about potential silica limitation in the bioassays. Dianne replied that she has lots of dissolved organic carbon data and its association with bacteria. Nitrification of ammonia in the western Sound seems closely tied to hypoxia and the redox state. Silica seems to be abundant and not limiting and is detailed in the supplement to a recent *Marine Environmental Research* paper. She agreed that the wastewater was probably redistributed away from the city.

**Introduction to the Theme: Modeling of Long Island Sound Embayments and Tributaries:** Kate Knight, CT DEEP

Kate introduced the phased modeling effort that CT DEEP has been developing over several years with directly linked or coordinated models. Some of these models will be described in the following talks. The primary purpose of this effort is to identify nutrient management strategies for non-point sources that can be implemented at the local level. This effort began in 2019 with enhanced monitoring efforts in watersheds and embayments to support the modeling. Jon Morrison of USGS and Craig Tobias and Jamie Vaudrey of U Conn have been involved in the monitoring.

Following the establishment of sufficient monitoring data, CT DEEP entered a planning phase with an initial focus on the Pawcatuck Estuary funded by SNEP. They used the practical Pawcatuck experience to build out modeling plans and QAPPs for the other major watersheds in Connecticut. They also increased both parameter coverage and spatial coverage in the models. They are also using a Scenario Application Manager (SAM) to find the best scenarios and eventually get community buy-in and achieve actual results. The model is applicable to some subwatersheds immediately, but they have also developed a linking tool which can output the subwatershed data in any format desired and link it to others for running the best scenarios. CT DEEP has chosen six priority embayments which will be the immediate focus of the Second-Generation Nitrogen Strategy. They will also be talking to communities and making sure that their priorities are incorporated so that model results can be translated into real results. These models and simpler tools to be developed can be used by town planners.

**Discussion:**

-Penny Vlahos asked Kate if she was familiar with Mike Whitney’s model and suggested that they discuss possible synergies.

-Craig Tobias suggested that the modelers get together with the monitoring folks to provide updates on progress.

**Assessment of Hypoxia and Macroalgae Growth Using a 3D Water Quality Model (for the Pawcatuck Estuary):** Finnian Cashel, EPA

Finnian is modeling the Pawcatuck River Estuary (PRE) along with Chris Knightes of EPA. The Pawcatuck River is a shallow river (1-3 m) which runs 56 km and extends into Little Narragansett Bay at the eastern end of LIS. Its 283 km2 watershed is relatively undeveloped, draining largely forested and agricultural lands and small towns. There are two larger urban areas in the lower river which have wastewater treatment plants discharging into it.

He is working with data collected by a variety of different agencies from 2018 to 2020, primarily in the summer. This includes continuous sonde data (sampling every 15 min) as well as discrete samples, the latter comprises nutrient data as well as the hydrographic information collected by the sondes and extends the length of the river. Finnian is using the HSPF watershed model which feeds into both the EFDC hydrodynamic and WASP water quality models. HSPF provides inflow from the Pawcatuck River, tributaries, and groundwater to EFDC, and HSPF also provides upstream boundary conditions, and subwatershed and WWTP loads to WASP. In turn, EFDC provides WASP with water depth, velocity, salinity, and water temperature.

Their previous work simulated the Pawcatuck River Estuary (PRE) in one dimension which included 17 WASP water quality segments, 19 state variables with macroalgae and phytoplankton, and a sediment diagenesis submodule. (This study was just published in the as Cashel, F. S., et al., 2024; "Using monitoring and mechanistic modeling to improve understanding of eutrophication in a shallow New England estuary." J Environ Manage **355**: 120478.) Their current 3D model has increased spatial and ecological complexity and includes two size classes of phytoplankton. Adding state variables increases system process complexity which raises the important question of how much complexity is too little or too much. Their EFDC curvilinear grid has 186 two-dimensional cells comprising Little Narragansett Bay and the Pawcatuck River, many more that the 17 segments of their previous 1D model. They also have three vertical layers throughout the entire system. There were significant complications in the development of the model, including the limited availability of depth and elevation data which leads to the creation of unnatural “waterfall features”. The shallow nature of the system can also lead to numerical instability because of layer compression. The EFDC to WASP linkage time for a full five-year run of this complex model is lengthy (5-6 hours) and can create calibration issues. Another issue was how to apportion the loads to different model segments throughout the watershed.

Finnian summarized their hydrodynamic model results, noting that the model correctly predicts the decreasing salinity gradient moving upstream. Incorporating elevation was the key to limiting the salinity intrusion. The model also accurately simulated the stratified environment and the vertical layers also improved simulation of large, rapid swings. The model also captured seasonal variations in stratification, with the highest during spring runoff. Dissolved oxygen trends in down- and midstream areas were captured by the model, but upstream bottom oxygen values are currently overpredicted and include large variations. The previous 1D model had suggested the importance of Carbonaceous Biochemical Oxygen Demand (CBOD) decay, Sediment Oxygen Demand (SOD), and phytoplankton respiration as dissolved oxygen sinks, and the current model supports this. For phytoplankton, the model simulated the observed spatial trends, with peak concentrations in the midstream region and lower concentrations in Little Narragansett Bay. The model was unable to capture the large, rapid swings in concentrations and adding a second phytoplankton size class has made little difference so far. Finally, for macroalgae, the model shows a late spring bloom, mid-summer sag, and a fall bloom, with a decreasing gradient moving upstream. The macroalgae strongly limits light and nutrients available to the phytoplankton. The increased spatial resolution of this model should enable an assessment of locations favorable to eelgrass growth.

In summary, modeling of the PRE along with other embayments can inform LIS management through improving understanding of watershed loadings and highlight important eelgrass and nursery habitats. Monitoring in the Sound can also improve the characterization of downstream boundary conditions for embayment models. This work also improves our understanding of small, shallow estuaries which are rarely modeled. Future work will explore land use and climate change scenarios and continue to explore model complexity. In conclusion, the 3D model allowed for the simulation of stratification in the PRE, and confirmed the major ecosystem components controlling dissolved oxygen, including sediment oxygen demand, CBOD decay, phytoplankton and macroalgae. Macroalgae also had large impacts of water clarity and nutrient availability, affecting phytoplankton and eelgrass. Further calibration of several important parameters is needed.

**Discussion:**

-Jim O’Donnell suggested that two horizontal and three vertical layers is not sufficient for a 3D model, and the presumed benthic flux might not be necessary because there is too much vertical flux which is a common problem in such models. He stressed the impression of getting these fluxes right. Finnian responded that he is planning to conduct a sensitivity analysis with increasing numbers of vertical layers to see how it impacts the benthic fluxes.

-Jamie Vaudrey asked about the over prediction of bottom water oxygen in the most upstream areas. She is not aware of field data for sediment fluxes in that area and wondered if it might be getting into a freshwater regime while the model presented uses a saltwater benthic flux component. It might be a good place for some additional field work to measure the benthic fluxes. Finnian was not aware of any available field data either and said it made it difficult to calibrate along with the shallow depth of the water and the variation of the salinity front. They still believe that sediment oxygen demand is very important but further work is needed.

-Robin Miller reiterated the need for sensitivity analysis with several different vertical layers and asked if hydrodynamics was being calibrated to velocity and temperature as well as salinity. Finnian replied that he had little velocity data, but the temperature simulations are very accurate. Robin replied that oxygen should also be considered, especially in such a stratified system.

-Craig Tobias commented that perhaps some sediment flux measurements were needed to compare with the model and wondered if gas transfer was parameterized correctly. Finnian replied that he did the best he could with available data from similar estuaries but could always use more information.

**Building a Dynamic SPARROW model for the Long Island Sound Watershed:** Richard Moore, USGS

This presentation describes a multi-year project to build a dynamic SPARROW model for the Long Island Sound watershed, the model is currently nearing its initial results. The watershed is primarily in New England with a small area in New York. It uses the NHDPlus Version 2 dataset which includes 21,000 flow lines. Not all these flow lines may be used as there is a more detailed HSPF model in Connecticut. The plan is to publish results next year and provide them to Naomi Detenbeck and her River Basin Export Reduction Optimization Support Tool (RBEROST) which conducts simulations and will be described in the next talk.

The main part of the model is the data, and there is also a control file, which calls up the program itself, the SPARROW master code. In addition to the model structure, there are the dependent variables and the predictors. Sources include new predictors such as MODIS snow cover, the baseflow nitrogen estimate, and the population on septic which are all positive in terms of adding nitrogen. Delivery terms can be positive or negative in the model and attenuation terms are positive but remove various amounts of nitrogen.

Richard showed a map of the watershed which runs from the Sound all the way up to Maine and Canada. The project is a cooperative effort between USGS and US EPA and is modeling seasonal nitrogen loads to Long Island Sound. Previous SPARROW models just modeled the annual nitrogen loads, this model provides all four seasons for the years 2000 to 2020, for 84-time steps. The loads at monitoring sites for each year and season are dependent variables and include nitrogen, phosphorus, and suspended sediment. Loads were obtained using WRTDS or Fluxmaster programs, depending on the available information. SPARROW also includes a component for storage, which addresses time scales for loads. RBEROST then uses these results to optimize BMP magnitude and placement to achieve downstream load reduction targets. The deliverables of this project include: 1. A USGS data release of the Dynamic SPARROW model input and results, 2. A journal article or USGS report documenting Dynamic SPARROW modeling results, and 3. Public outreach which includes a website for examining Dynamic SPARROW results to make the data available and accessible to the public.

Why a dynamic SPARROW model? Previous SPARROW models were static, whereas this one has seasonal time steps, which is much more compatible with Connecticut’s HSPF models, which has an even finer time resolution. Dynamic SPARROW and RBEROST also have finer spatial resolutions than in the past. Past steady state models do not address how much time is needed to reach an expected model response. However, the Dynamic SPARROW model can do this and can also provide probabilities of exceeding loading targets. Richard showed the structure of the data file that the model is based on, the total data set has 1.76 million rows. He then reviewed progress for the dependent variables, stream network, and streamflow, noting that the current streamflows are seasonal averages, which could be improved in the future to provide specific years and seasons.

Municipal wastewater discharges are another predictor, and the larger ones provide more reliable data. The relative positions of outfalls and monitoring locations can sometimes require manipulation of model segments. Another predictor is atmospheric nitrogen deposition which uses Community Multiscale Air Quality model (CMAQ) data, the grid spacing is 12 km, so another data source is also under evaluation. Satellite (MODIS) derived snow cover data and the National Land Cover Database (NLCD) are additional predictors, the latter divided into urban, forested, and agricultural lands. The population on septic systems is another predictor, determined by the population **not** on sewers. Additionally, baseflow nitrogen, based on groundwater nitrogen concentrations and discharges, is also included. Agricultural and non-agricultural fertilizer use, and several seasonally relevant delivery variables are also included in the model. Additionally, nitrogen attenuation factors, both in stream and in reservoirs, are also included.

**Discussion:**

-Paul Stacey wondered if point and non-point sources could be separated over a long period of time, the better to manage land use in individual segments. Richard replied that the model is still under development and when completed will provide individual results for each source. Paul added that he would like to be able press on a particular point on a stream map and get the SPARROW estimate for that point, Richard agreed that they would like the same.

**Optimizing management practices to meet loading targets for the Long Island Sound Basin under variable climate:** Naomi Detenbeck, EPA

Naomi stated that the goal of this project is to demonstrate and refine a refine a regional optimization tool for the Long Island Sound Basin to allow stakeholders to find the least-cost solution to meet multiple nutrient loading targets, both for the main Sound and specific embayments. The River Basin Export Reduction Optimization Support Tool (RBEROST) is being refined as part of this project and coupled with the Watershed Management Optimization Support Tool (WMOST), for the HUC12-HUC10 scale. Users can include nutrient sources such as wastewater, stormwater, and agricultural runoff, as well as riparian management practices. Since it is coupled with the Dynamic SPARROW model it can consider how to best change management strategies with climate or seasonally and consider lags resulting from storage of nutrients. The model is extensible since it is built on national and regional datasets. It is also user-friendly, with R packages available for preparing inputs on a publicly available server.

The model can minimize or maximize different components, minimizing cost is a common objective. The user can place constraints on the solutions, such as downstream loading targets for the main Sound or an intermediate location like upstream lake or river TMDLs, or caps on specific solutions. Decision variables can also include a choice of management actions, the level of implementation, and the location of implementation. The type of management actions includes WWTP and/or septic upgrades and conversions, agricultural BMPs, urban stormwater BMPs, and riparian zone restoration.

The SPARROW model provides the incremental delivered load for each NHDPlus catchment calculated from the fraction delivered to water plus the fraction delivered through a reach or reservoir. RBEROST adds the fraction removed by management action plus the fraction retained by riparian buffers. Naomi then showed the schematic of the scaled-up optimization model framework. The previous RBEROST version included data inputs from the Upper Connecticut River Basin. The new version uses expanded 2000-2020 data sets which include the whole LIS basin. It also adds costs and efficiencies for wastewater and septic upgrades. Interim testing is being conducted with seasonal SPARROW model inputs, and completion awaits the final source loads from dynamic SPARROW. Updated RBEROST model code will include septic upgrades, septic to sewer conversions, and source loads from storage components. She detailed the way the model addresses storage, which is proportional to the previously delivered load. Sensitivity and uncertainty analyses will be conducted in the future.

There are current loading targets available for the major watersheds flowing into LIS, smaller watersheds will be added later. For the south shore of LIS, nitrogen loading model inputs will be required. Data sources for loads, costs, and efficiencies include Suffolk County septic upgrades, EPA stormwater BMP performance curves, USDA agriculture conservation load reductions, USGS regional SPARROW models, and others. Naomi showed a schematic flow chart of the optimization model that will be available to users and discussed the uncertainty analysis process. This analysis provides the probable costs to meet loading targets and can calculate the additional costs required for an added margin of safety and an improved likelihood of meeting loading targets. Current RBEROST code for the upper Connecticut River Basin can be found at the EPA GitHub site and parallel coding/optimization projects are underway for the Puget Sound and Upper Illinois River Basins.

The next steps include updating the code for sensitivity and uncertainty analysis for RBEROST v2 and testing the seasonal working version with outputs from the seasonal SPARROW model. This will be followed by incorporating the dynamic SPARROW output including source loads and attenuation coefficients into RBEROST v2. RBEROST v2 will then be tested and applied to major subwatersheds of LIS in wet, dry, and normal precipitation years; after which it will be extended to the south shore of LIS.

**Discussion:**

-Nancy Seligson thanked all the presenters today and especially those addressing important management issues. She suggested that the STAC consider which of today’s presentations are most important to bring forward to address management challenges. Kamazima Lwiza agreed and said some of the model presentations could have used more time.

-Mark Tedesco asked if conservation actions to prevent possible loading increases could be incorporated into RBEROST and Naomi replied that while they are not currently included, they probably could be. The model currently does include riparian restoration and does look retrospectively at land use changes over time. She said that she would consider it further and that they could talk later.

-Paul Stacey wondered how many of the effective BMPs would be implemented. Naomi replied that the model included both cost and effectiveness of BMPs so that highly effective but costly BMPs might not be applied. She also noted that both urban and agricultural BMPs were included and that they could be evaluated either retrospectively or prospectively.

-Mark Tedesco and Jim Ammerman thanked all the speakers and said it was good to see all the exciting model developments that were going on.