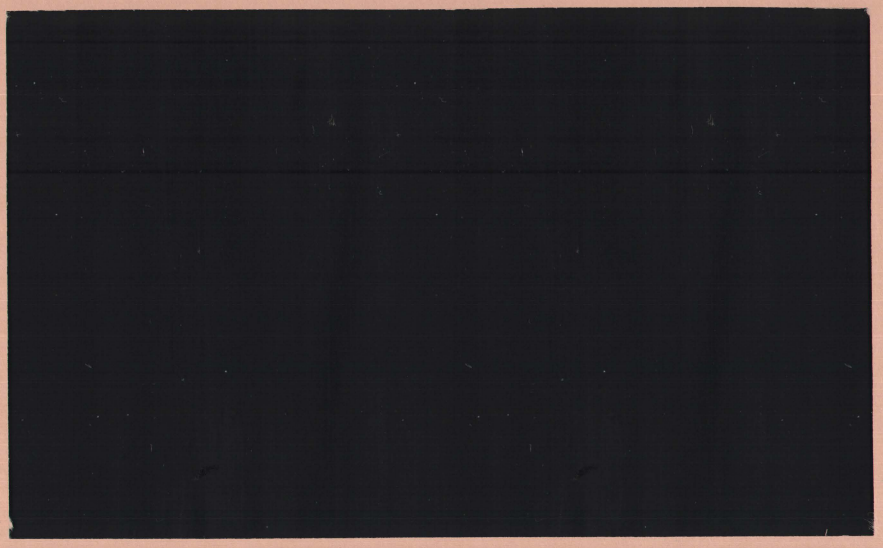
MARINE SCIENCES RESEARCH CENTER
STATE UNIVERSITY of NEW YORK
STONY BROOK, N.Y.

AN IDENTIFICATION AND PRELIMINARY ASSESSMENT OF ALTERNATIVES TO ENHANCED NUTRIENT REMOVAL AT SEWAGE TREATMENT PLANTS FOR ALLEVIATING HYPOXIA IN WESTERN LONG ISLAND SOUND

Report of a Workshop
21 August 1991



AN IDENTIFICATION AND PRELIMINARY ASSESSMENT OF ALTERNATIVES TO ENHANCED NUTRIENT REMOVAL AT SEWAGE TREATMENT PLANTS FOR ALLEVIATING HYPOXIA IN WESTERN LONG ISLAND SOUND

Report of a Workshop
21 August 1991

COAST Institute
of the
Marine Sciences Research Center

J.R. Schubel
Project Director

Working Paper 53
Reference No. 91-11

Approved for Distribution

J.R. Schubel
Dean and Director

WORKSHOP PARTICIPANTS*

Malcolm Bowman

Louis Carrio

Karen Chytalo

Arthur Glowka

Arthur Newell

D.W. Pritchard

J.R. Schubel

John P. St. John

R. Lawrence Swanson

Mark Tedesco

Peter Weyl

Robert Wilson

LIST OF OBSERVERS

Rafael Nino-Lopez

Jianguo Sun

Denise Veidt

Chongle Zhang

---

* See Appendix A for affiliations and addresses.

3/2/04 RL

INTRODUCTION

This workshop was conducted at the request of the U.S. Environmental Protection Agency, Long Island Sound Study. The background on the workshop is summarized briefly in the 16 August 1991 memo to participants which follows.

marine sciences research center

STATE UNIVERSITY OF NEW YORK, STONY BROOK, N.Y. 11794-5000 (516) 632-8700
FAX (516) 632-8820

MEMORANDUM

TO: Participants in Alternative "Technologies" Workshop

FROM: J.R. Schubel, Dean and Director

SUBJECT: Agenda for Meeting on 21 August 1991

DATE: August 16, 1991

We are looking forward to a lively and productive discussion on 21 August 1991. The objectives of this workshop -- as stated by EPA -- are reproduced below.

"The first phase brings together in August for a one-day meeting (1) to identify the most promising technologies to alleviate hypoxia in western LIS based upon an initial assessment by workshop participants of their advantages and disadvantages; (2) to identify aspects of the application of each technology to LIS that should be evaluated further with existing information to refine the assessment of its technical and economic potential for alleviating hypoxia in LIS, and (3) to identify individuals (and alternates) to prepare the evaluative white papers. J.R. Schubel will be responsible for convening this workshop and for preparing a report of the proceedings within one week of the workshop. Commissioned white papers are to be completed and distributed by the beginning of November. The stipend for preparation of each white paper shall not exceed $1,000."

We will start with a brainstorming session to develop a list of potential alternative approaches (alternative to upgrading sewage treatment) to alleviating hypoxia in western LIS. Once we have this list we will begin the evaluation phase.

We will begin promptly at 0930 and end by 1530 hours.

I look forward to seeing you on August 21st.

JRS/mf

RELIEVING HYPOXIA OF WESTERN LONG ISLAND:

A SEARCH FOR ALTERNATIVE APPROACHES

MARINE SCIENCES RESEARCH CENTER
COAST Institute Workshop
Endeavour Hall 139
21 August 1991
0930 - 1530

0930	**Statement of the Problem; Goals and Objectives of Workshop; Introductions**	**J. R. Schubel, Facilitator**
0945	**Identification of the Set of Alternative Approaches (Alternatives to Advanced Treatment at STPs): Brainstorming Session**	
1000	**An Evaluation of Alternatives**	
1200	**Catered Lunch**	
1245	**Evaluation Continued**	
1430	**Identification of Topics and Authors for White Papers on Most Promising Approaches**	
1500	**Summary & Conclusions**	
1530	**Adjourn**	

OBJECTIVES OF THE WORKSHOP

The following objectives were presented at the beginning of the workshop:

- To identify the alternative "technologies" -- as many as possible.
- To make a first pass at developing brief assessments of the advantages and disadvantages of each technology.
- To select the two to four most promising "technologies" which are deserving of greater attention through commissioned white papers.
- To identify potential authors of the white papers.

BRAINSTORMING SESSION

The Workshop was opened by brainstorming the following topic ***"in how many ways can we "gas-up" Western Long Island Sound?***

The Rules of Brainstorming

- Quantity is what counts; the more ideas the better.
- No value judgements are permitted.
- Look for connections between and among ideas.
- Wild ideas are encouraged.

With this as a topic and the rules as guidelines the group conducted a brainstorming session. The ideas that were presented are listed below in the order that they were presented and without modification.

The Ideas Generated

1. Re-route sewage treatment plant outfalls to the lower bay, to farther overshore in LIS, to New Jersey, to the open ocean.
2. Re-route some of the outfalls that now extend into the open Sound back closer to shore.
3. Re-route some nearshore outfalls to deeper water in the open Sound.
4. Add bubblers along the cable crossing.
5. Pump wastewater effluent to the Long Island shoreline of Long Island Sound.

6. Dredge out either the East River or the Mattituck Sill.
7. Create artificial wetlands.
8. Build floating seaweed plantations -- floating farms in Long Island Sound.
9 Enhance natural wetlands.
10. Construct tidal gates across the East River.
11. Make a big cut all the way through Long Island to improve flushing of the Sound.
12. Reduce the level of sewage treatment at New York City plants.
13. Shoot Canadian geese.
14. Add submerged "air" foils at critical points in the Sound or in the East River.
15. Construct a Long Island to Connecticut bridge to enhance vertical mixing because of the effects the bridge supports would have in creating turbulence.
16. Construct a series of vertical mixing structures at critical points in Long Island Sound.
17. Remove the larger particulates from wastewater effluent.
18. Divert more, or less, of the Hudson River flow by appropriate modifications.
19. Add diffusers to outfalls.
20. Construct tidal gates at both ends of Long Island Sound.
21. Decrease the population in the region.
22. Discharge wastewater effluent to the open ocean.
23. Discharge wastewater effluent from some plants directly to land.

24. Pulse the discharges of wastewater effluent; create storage to provide for selective releases to coincide with favorable tidal conditions.
25. Assign discharge quotas to plants, communities, counties, etc.
26. Recycle gray water.
27. Actively promote water conservation.
28. Create sumps in Connecticut similar to those we have on Long Island.
29 Change agricultural practices utilizing lessons learned from Chesapeake Bay and other areas.

The next step involved combining ideas generated during the brainstorming session into a smaller number of categories. The categories developed and the ideas included within those are summarized below.

A. RELOCATION OF OUTFALLS FROM SELECTED SEWAGE TREATMENT PLANTS

(1,2,3,5,22,23,24,27)

B. MODIFICATION OF THE BASIN GEOMETRY OF LONG ISLAND SOUND TO ALTER CIRCULATION AND FLUSHING

(6,11,18)

C. CONSTRUCTION OF STRUCTURES TO CHANGE THE CIRCULATION AND MIXING OF LONG ISLAND SOUND

(10,15,16,20)

D. THE SOFTER SOLUTIONS – CONSTRUCTION OF WETLANDS AND FLOATING FARMS

(7,8,9)

E. LOCALIZED VERTICAL TURBULENT GENERATORS

(4,14)

F. STRATEGIES TO REDUCE THE INFLUENTS TO SEWAGE TREATMENT PLANTS

(21,26,27)

G. STRATEGIES TO REDUCE THE EFFLUENTS (VOLUME, NUTRIENTS, AND THEIR IMPACTS) FROM SEWAGE TREATMENT PLANTS

(17,19,23,24,25,27)

H. REDUCE THE LEVEL OF TREATMENT AT NEW YORK CITY SEWAGE TREATMENT PLANTS

(12)

Following this grouping of ideas, the workshop used a modification of Edward DeBono's Six Hats Thinking to evaluate them. Participants concentrated on identifying the good points of each of the categories of strategies, then the bad points and finally they looked for creative ways of implementing the strategies.

EVALUATION OF THE CLASSES OF ALTERNATIVE TECHNOLOGIES

A. RELOCATION OF OUTFALLS FROM SELECTED SEWAGE TREATMENT PLANTS

The Good Points

- The solution to pollution is dilution.
- Relocation would remove sources from sensitive areas.
- Relocation would take advantage of natural processes.
- Relocation would reduce the need for increasing the level of treatment at STPs.
- Relocation would fertilize the ocean and enhance productivity.
- Relocation would have multiple advantages . . . it not only would reduce hypoxia in western Long Island Sound, but also improve the situation in the East River.
- A large tunnel which would carry the discharges from a number of sewage treatment plants could also pick up other discharges such as overflow from CSOs and industrial effluents.
- Relocation would decrease the input from toxics and reduce the amount of chlorine needed by sewage treatment plants.
- Relocation would enhance the likelihood of achieving swimmable, fishable goals.
- There are precedents for this approach e.g. Boston Harbor.
- Low operating costs.

- The strategy could be applied selectively . . . i.e. not all STPs would need to be included in an outfall relocation strategy.
- Relocation would alter the circulation -- presumably for the better.

The Bad Points

- Relocation could starve western Long Island Sound for nutrients and decrease the productivity.
- There could be a backlash from environmentalists.
- Relocation of outfalls would produce a negative environmental impact somewhere. If wastewater effluent were discharged to the inner shelf, it could exacerbate late spring blooms and the probability of hypoxic events on the inner shelf.
- The relative cost of piping versus the cost of STP upgrade need to be established.
- Relocation of discharges to the inner shelf could add undesirable loadings of nutrients and contaminants to the lower layer leading to a transport upstream into the harbor and river causing eutrophication problems there.
- Relocation could produce undesirable changes in salinity.
- Relocation is fraught with political and jurisdicational complications.

The Creative Approach

- The longer the pipe, the better . . . but beyond some limit, the environmental benefits may drop off rapidly. Research would be

required to select the optimum discharge strategy -- the region or regions to receive the outfalls.

- Select a strategy that would minimize the region closed to shellfishing.
- A large tunnel which collected the discharges of a number of STPs and CSOs would have great benefits to the region.
- The capital costs of a large project to combine and relocate outfalls need to be established and compared to costs of upgrading of STPs; the operating costs of relocation may be much less.
- The anticipated multiple benefits of this strategy need to be evaluated carefully and rigorously.

B. MODIFICATION OF THE BASIN GEOMETRY OF LONG ISLAND SOUND TO ALTER CIRCULATION AND FLUSHING

The Good Points

Dredging of the Mattituck Sill

- Bottom water renewal from the ocean would increase leading to recharging of the bottom layer with clean, oxygenated ocean water.
- It can't do any harm -- probably.
- The conservative approach is possible; dig a little, wait and see what happens. If the results are good, dig some more.
- It would provide a source of sand for beneficial uses such as aggregate and beach nourishment.

- The NOAA model shows the importance of deep water intrusion to the Sound over the Mattituck Sill.
- We understand the technology; we know how to dredge.

Dredging the East River

- It would increase the exchange of water between the Sound and the Harbor leading to a greater net flux westward. The result -- improvement in water quality of western LIS.
- We understand the technology; we know how to dredge.

The Bad Points

- Dredging would create disposal problems for the dredged material.
- It changes the sedimentary characteristics in the dredged and in the disposal areas and probably the benthic communities in both areas.
- It could have adverse effects on coastal erosion.
- It could enhance stratification and aggravate hypoxia in western LIS.
- There are large uncertainties in how dredging of Mattituck Sill would affect the Sound; a great deal of research would be needed.
- There would be public resistance.
- The cost would be high.
- The change in salinity in LIS could lead to a change in the ecology which could either be good or bad, but the results are uncertain.
- Dredging the Mattituck Sill would accentuate the effect of the eastern boundary influence on Long Island Sound.

The Creative Approach

- Reduce uncertainties through research; utilize mathematical models.
- Cut a channel through the Mattituck Sill near the North Shore of Long Island Sound (i.e. Connecticut) for maximum benefit.
- Use the dredged material for beneficial purposes such as beach nourishment, aggregate or for construction of an island.

C. CONSTRUCTION OF STRUCTURES TO CHANGE THE CIRCULATION AND MIXING OF LONG ISLAND SOUND

The Good Points

- Tide gates on the East River which are open only during the time when the tide is flowing from the Sound to the Harbor would enhance flushing of the East River and the Lower Bay. They would eliminate the source of nutrients from the East River (from everything west of the gate) to western Long Island Sound.
- The Shinnecock Canal is a precedent for the strategy.
- East River tide gates would tend to destratify western Long Island Sound thereby enhancing the recharging of bottom waters with dissolved oxygen from the upper layer and from the atmosphere.
- Tide gates on the East River would increase the probability of opening shellfish beds in Long Island Sound.

- Tide gates would reduce navigation hazards in the East River during those times when the tide gates are open.
- Tide gates are a better strategy for New York Harbor than pulse releases of STPs.
- Vertical columns enhance vertical mixing.
- Vertical structures such as sills are simple and have been constructed by the U.S. Army Corps of Engineers. They reduce vertical stratification, and enhance mixing. If you made a mistake, you can dismantle them and remove them.
- The new structures create new habitat.
- The Connecticut-Long Island Bridge would enhance economic development; the vertical supports would enhance vertical mixing.
- Long Island Sound Offices could be created at both ends of the bridge: one for Connecticut and one for New York -- the perfect political solution.
- The structures would enhance primary and secondary production.
- The structures would increase vertical circulation.

The Bad Points

- The effects of bridges, pillars and posts on mixing are very local in extent.
- Construction of a sill in western Long Island Sound would not be very effective in enhancing vertical mixing.

- Tide gates across the East River would result in delays for navigation, hazards to navigation, lost time, increases in the probability of spills, etc.
- The political ramifications of tide gates are enormous -- N.Y. would be exporting its unwanted wastes to New Jersey.
- The salinity would increase in New York Harbor . . . salinity intrusion in the Hudson could threaten freshwater supplies.
- Tide gates would diminish the tidal dispersion in New York Harbor.
- The uncertainties of constructing tide gates are large; a great deal of research would be needed.
- The pooling of sewage in the East River when the gates were closed would be objectionable because of aesthetic problems, including smell.
- The costs of constructing and maintaining tide gates on the East River would be high.

The Creative Approach

- Of the strategies mentioned in this section, only tide gates make sense.
- Combine tide gates with pulsing of discharge from STPS to reduce the adverse undesirable impacts in the East River.

D. THE SOFTER SOLUTIONS -- CONSTRUCTION OF WETLANDS AND FLOATING FARMS

The Good Points

- It would be a green solution.
- Material dredged from Mattituck Sill could be used to create new wetlands.
- Marketable products could be created from the floating farms: seaweed, drugs from the sea, alginate -- all good things for the low cholesterol, low fat diet so popular today.
- It would be a positive thing to do.
- It would be a partial solution; one of a mix of solutions.
- It would create new habitat.
- It would remove nutrients and would generate dissolved oxygen.
- Creation of wetlands would create a sink for toxics.
- Creation of wetlands would produce new recreational opportunities such as birdwatching and photographing.

The Bad Points

- Creation of floating farms would create hazards to navigation.
- Creation of wetlands would limit access to the shore.
- The area of wetland needed to have a measurable benefit on alleviating hypoxia of western LIS may be excessive.
- You would trade one habitat for another.
- Wetlands can produce undesirable odors and mosquitoes, and attract other vectors.

- There would be a conflict with developers.
- Trying to enhance wetlands could lead to the potential degradation of good natural wetlands.
- These soft solutions could be accepted as a total solution when they are not.
- Wetlands can be reservoirs for toxic materials.
- Floating farms can be both a sink and a source of floatables.

The Creative Approach

- A big green solution for the Big Apple.
- A green solution for a large metropolitan area using environmentally beneficial strategies has a great deal of public appeal.
- These could be components of a comprehensive regional solution.

E. LOCALIZED VERTICAL TURBULENT GENERATORS

The Good Points

- They would add DO directly to the water by adding air; they are a frontal assault on the primary symptom of the problem.
- They would contribute to breaking down the vertical stratification.
- They would be easily operated.
- They would have low capital costs -- maybe.
- Positive results have been demonstrated in small scale operations.
- They could be turned on and off as needed (seasonally, for example.)

- They would be well-suited to emergencies.
- It is a flexible technology that could be relocated to address problems where they occur.
- Adding DO is a direct approach to the symptom (hypoxia) of the illness (eutrophication.)

The Bad Points

- They would contribute to bubbles at the sea surface which would eject bacteria and viruses into the atmosphere enhancing the potential for the spread of airborne diseases.
- Bubbles could resuspend sediments.
- Bubble size is critical and difficult to control.
- The spatial scale for the strategy to work is all wrong for Long Island Sound as a DO transfer mechanism.
- The energy requirements would be intensive.
- The cost would be enormous.
- A submerged airfoil would have to be enormous in size to have a measurable effect.
- Bubbles could create a frothy, bubbly mass and mess in western Long Island Sound and on the shore.

The Creative Approach

- Use these strategies in harbors . . . in combination with sewage outfalls.
- Use windmills to drive the bubblers.

F. STRATEGIES TO REDUCE THE INFLUENT TO SEWAGE TREATMENT PLANTS

The Good Points

- It would be a green solution.
- There would be less water to treat; enhancing the capability of better treatment.
- It would reduce toxicants; for example, copper because there will be less dissolution of pipes since less water will be flowing through them.
- It would decrease the amount of nutrients being discharged by the plants.
- It would reduce vertical stratification of receiving waters because of decreased discharge of freshwater.
- It would promote more efficient and effective operation of STPs.
- The cost would be relatively low.
- It would increase the number of people that an STP could serve.
- It would reduce the bypassing of storm water and sewage during overflow events.
- It would reduce the CSO storage needed.
- It would reduce the capital costs of outfalls associated with strategy A.
- It would contribute to solving a resource problem: water is a scarce commodity and getting scarcer.

- It would reduce the amount of chlorine needed in sewage treatment.
- It is a solution to which everyone could contribute.

The Bad Points

- The concentration of nutrients might increase.
- Compliance would be hard to achieve.
- It would be only a partial solution.
- The lower flows to the STPs could result in an accumulation of particulate matter in the pipes.

The Creative Approach

- The strategy would be compatible with all other strategies listed.
- It would contribute to all of them!
- Develop strategies to promote local gray water use; for example, for large apartment complexes.
- Public education would be an essential ingredient.
- Economic incentives would increase the level of compliance; meters have been shown to decrease water consumption.
- It would reduce the amount of water withdrawn from the Hudson for industrial and domestic use.

G. STRATEGIES TO REDUCE THE EFFLUENTS FROM STPs (VOLUME OF WATER, MASS OF NUTRIENTS; AND THEIR IMPACTS ON THE RECEIVING WATERS)

The Good Points

- It would reduce the nutrient input to Long Island Sound.
- It would be a direct assault on the real problem.
- It would reduce the potential for population in the region because there would be less land for development.
- Discharge quotas are a community effort and can build community support.

The Bad Points

- It would put a limit on growth.
- It would promote illegal dumping.
- It would take land out of other uses.
- Spraying of wastewater effluent onto land could produce undesirable odors and bacterial contamination of the atmosphere.
- Spraying or piping onto land could lead to contamination of aquifers.
- Land is not available within New York City for this purpose.
- There are high costs of meeting discharge quotas.
- Equity issues would need to be addressed.

The Creative Approach

- It could be a component of a set of regional solutions.
- Diffusers on discharge pipes placed near the bottom in deep water could reduce stratification in certain areas; it may be good for local solutions in restricted areas.
- Tailor the solution to the specific characteristics of the local environment.

H. REDUCE THE LEVEL OF TREATMENT AT NEW YORK CITY SEWAGE TREATMENT PLANTS

The Good Points

- It might improve DO levels in western Long Island Sound i.e. alleviate hypoxia.
- It might improve fish and fisheries in western Long Island Sound.
- It would be the least expensive of all of the strategies.

The Bad Points

- It would be against the law.
- There's a large uncertainty as to what the outcome would be.
- It would degrade water quality in the East River and in New York Harbor.

The Creative Approach

- Conduct a decadal experiment to see if the hypothesis is correct.

VOTING FOR THE ALTERNATIVES

At this point, each participant in the Workshop was given three votes and instructed to cast the three votes for one, two, or three of the categories of solutions included within the strategies A-H. Workshop participants were told that the strategies that received the most votes would be those for which white papers would be commissioned. The white papers are to provide more detailed information for the November workshop. The results of the voting were:

STRATEGY	NUMBER OF VOTES
A.	9
B.	9
C.	6
D.	6
E.	1
F.	9
G.	1
H.	1

Based upon the balloting strategies A, B, C, D and F were selected for the commissioning of white papers. A discussion followed in which questions and issues were developed to provide the potential authors of the white

papers with some guidance as to the points to explore. These are summarized in the next section.

SOME TOPICS TO BE COVERED IN THE WHITE PAPERS

The following generic questions should be addressed in each white paper:

1. What is the anticipated impact of this technology on DO levels in WLIS and outside LIS?
2. What are the impacts on habitats and living marine resources within LIS and outside LIS?
3. What are the other environmental benefits that could be derived by utilizing this technology?
4. Is the technology available today? How successfully has it been employed in demonstration and in full scale projects?
5. What are the environmental site conditions required to successfully employ this technology?
6. What are the costs, short-term (development of technology, implementation) and long-term (maintenance), associated with this technology? How do these costs compare to STP nitrogen reduction through upgrading treatment?
7. What are the uncertainties associated with this technique?
8. What research questions need to be addressed prior to demonstration or implementation of this technology?
9. Does this technology have the potential of providing the whole solution or part of the solution to hypoxia problems in WLIS?

Could it be used in conjunction with STP nitrogen reduction or instead of it?

10. What are the major advantages and disadvantages of this technology relative to STP upgrading and to other alternative technologies?

Other questions and issues that are specific to the various alternative technologies that should be addressed by the authors of the white papers are listed for each technology.

A. RELOCATION OF OUTFALLS FROM SELECTED SEWAGE TREATMENT PLANTS

- How much volume (how many plants, numbers of pounds of nitrogen) reduction would it take to make a measurable and significant difference in hypoxia in the western Sound?
- What would the effects of ocean outfalls be on the South Shore beaches of Long Island and on New Jersey ocean beaches?
- What are the various outfall relocation options? What are the advantages and disadvantages of each option?
- Is the best strategy one mega-outfall? . . . or n smaller outfalls?
- What's the cost of relocating outfalls relative to the cost of upgrading of STPs? . . . both capital and operating costs?
- What is the relative gain of tackling the aggregate STPs of Connecticut and Westchester rather than New York City STPs? . . . In this analysis take the combined outfalls both to the ocean and to central Long Island Sound.

- How would this strategy of the relocation of outfalls fit in with other large regional efforts? . . . the New York-New Jersey Harbor Estuary Program, the Long Island Sound Study, the CSO Abatement Program, etc.?
- What are the advantages of pulsing of discharges from STPs in this relocation scenario?
- Clarify the influence of the East River on western Long Island Sound.

Potential Candidates for Author of the White Paper

Dominick DiToro

John St. John

Robert Thomann

B. MODIFICATIONS OF THE BASIN GEOMETRY OF LONG ISLAND SOUND TO ALTER CIRCULATION AND FLUSHING

- Survey the influence of basin geometry of Long Island Sound on the tidal circulation and the density-driven circulation.
- What is the influence of the circulation on the morphology of the basin; on the stability of the bottom?
- Is the East River dredgeable? . . . or would it take New York City's biggest "blast" to excavate it?
- How much material would need to be removed from the Mattituck Sill to make a difference? What would one do with it? What beneficial uses could it be put to? How frequently would maintenance dredging be required?

- How would dredging of the Mattituck Sill alter the salinity of the Sound? . . . what habitat modifications would result?
- How does the Mattituck Sill influence the inflow of ocean water in the late spring and early summer?
- What degree of improvement of hypoxia would be expected from dredging the Mattituck Sill under various dredging scenarios?

Potential Candidates for Authors of the White Paper

Henry Bokuniewicz

W. Frank Bohlen

Robert E. Wilson

C. STRUCTURES TO CHANGE THE CIRCULATION AND MIXING

- Track down the old plans for a cross Long Island Sound bridge and assess the extent of the benefit of this structure on vertical mixing.
- What are the impacts of vertical structures (for example, bridge piers, etc.) on vertical mixing?
- What are the costs of construction of tidal gates? . . . the in costs of operation and maintenance?
- Compare the benefits of tide gates with pulsing of sewage discharge from STPs under various pulsing scenarios.
- Would "dutch door" tidal gates in which only the upper part of the water column is gated make sense?

- Get the information from the Army Corps of Engineers studies and San Francisco Bay Estuary (Carquinez Straits) and extract any lessons for Long Island Sound.
- What are the potential biological impacts of salinity changes resulting from these strategies?
- What would the effects of East River tide gates be on the Jersey shore?
- What have the Japanese done in this general area of R & D in their ports and harbors? Are there any lessons to be learned?
- Get a copy of D.W Pritchard's paper on the Mississippi situation and the construction of the underwater barrier to prevent the penetration of saltwater from contaminating New Orleans' freshwater intakes.
- What hazards would tide gates on the East River pose to navigation? What would be the costs of delays in navigation?
- What costs would be associated with the maintenance of tide gates?

Potential Candidates as Authors of the White Paper

Alan Blumberg

Malcolm Bowman

Malcolm Spaulding

D. THE SOFTER SOLUTIONS -- CONSTRUCTION OF WETLANDS

- How much wetland area would it take to make a difference in reducing hypoxia in western LIS?
- Where are the candidate areas for creation or expansion of wetlands?

- What do present wetlands contribute in terms of removal of nutrients?
- Could dredged materials be used for wetland creation and enhancement? . . . What are the opportunities and problems?
- Assess the state-of-the-art of wetland creation (find out the status of the ongoing NRC Marine Board study).
- Assess wetland's as sinks for toxics.
- Don't limit the discussion to tidal wetlands . . . we're also interested in wetlands in upland areas.

D. THE SOFTER SOLUTIONS – <u>FLOATING SEAWEED FARMS</u>

- What hazards would they pose for navigation?
- Track down the old New York Sea Grant Institute/Gas Research Institute studies and extract the important lessons for this particular analysis.
- Assess the markets for products from floating seaweed farms in Long Island Sound. Assess the effects -- real and perceived -- of pathogens on the marketability of products.

<u>Candidate Authors for this White Paper</u>

Valerie Gerard

Ronald Roezsa

Charles Yarish

F. REDUCE THE INFLUENT TO SEWAGE TREATMENT PLANTS

- At what point does the percentage of volume reduction become a problem? . . . from the physical or biological perspective?
- What's the state-of-the-art in terms of what is achievable in water conservation? What are the State laws regarding water conservation (conversion to low flow toilets, for example in all new construction)? What impacts will these laws have?
- How important is leakage from the system in New York City?
- Explore the uses of gray water -- what's realistic?
- Look into what San Diego and Santa Barbara have achieved as well as other areas.
- What are the rules and regulations governing the use of gray water in this region?
- What laws would have to be changed to enhance the use of gray water?
- What's the potential for fiscal savings?
- How would different levels of water conservation affect sewage treatment plant performance? . . . efficiency, effectiveness and selected upgrade?
- What would the benefits be to Long Island of different levels of water reduction from sewage treatment plants resulting from water conservation?

Potential Candidates for the White Paper

Angelica Forndran

Charles Gunnerson

R.Lawrence Swanson

CLOSING COMMENTS

Following this discussion, several members of the Workshop asked to revisit topic H: Reducing the Level of Treatment at New York City's Treatment Plants. There was strong feeling on the part of some participants that this was the only technology of all those discussed where there was actually some record and that that record indicated that as the levels of treatment of New York City plants went up, the water quality of western Long Island Sound went down. They recommended that while it only received one vote as a candidate for more detailed analysis through a white paper, it was sufficiently important that we should recommend to the US EPA that a white paper be commissioned. The majority of the group agreed. Larry Swanson will take the lead in orchestrating the preparation of this white paper and will seek input from Tom Brosnan, Paul Stacey, Jeanette Semon and perhaps others.

SOME GENERAL GUIDANCE TO AUTHORS OF WHITE PAPERS

The white papers dealing with topics described earlier will be the major source of information to the follow-up workshop on alternative technologies. We offer the following general guidance to the authors of those papers. The white papers are background papers for the next workshop.

- Their primary purposes are (1) to summarize existing information, (2) to focus discussions on the questions and issues stated earlier, (3) to highlight scientific and technical areas of agreement and disagreement, and (4) to identify specific research needs to reduce the levels of uncertainty associated with the advantages and disadvantages of each technology.

- Each white paper should be long enough to cover the subject matter and short enough to retain the interest of the audience. We estimate the appropriate length to be between 20 and 30 double-spaced pages.

- Each white paper should have a selective bibliography.

- The white papers are not expected to be polished, rigorously documented manuscripts suitable for publication. They are expected to be imaginative, creative, exploratory examinations of the practicality and efficacy of applying the specific technologies instead of, or in addition to, advanced levels of sewage treatment to alleviate hypoxia in western Long Island Sound.

APPENDIX A:
WORKSHOP PARTICIPANTS

Dr. Malcolm Bowman
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Mr. Louis Carrio
New York City Department
of Environmental Protection
59-06 Horace Harding Expressway
Elmhurst, New York 11368

Ms. Karen Chytalo
New York State Department
of Environmental Conservation
Division of Marine Resources
Building 40
State University of New York
Stony Brook, New York 11790-2356

Mr. Art Glowka
Long Island Sound Task Force
Stamford Marine Center
185 Magee Avenue
Stamford, Connecticut 06902

Mr. Arthur Newell
New York State Department
of Environmental Conservation
Division of Marine Resources
Building 40
State University of New York
Stony Brook, New York 11790-2356

Dr. Donald W. Pritchard
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Dr. J.R. Schubel
Director
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Mr. John P. St. John
HydroQual, Inc.
One Lethbridge Plaza
Mahwah, New Jersey 07430

Dr. R. L. Swanson
Marine Sciences Research Center
Waste Management Institute
State University of New York
Stony Brook, New York 11794-5000

Mr. Mark Tedesco
EPA Region II
Jacob K. Javits Federal Building
26 Federal Plaza
New York, New York 10278

Dr. Peter Weyl
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Dr. Robert Wilson
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

LIST OF OBSERVERS

Mr. Rafael Nino-Lopez
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Mr. Jianguo Sun
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Ms. Denise Veidt
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000

Mr. Chongle Zhang
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794-5000