South Florida Water Management District

Lake Okeechobee Sediment Management Feasibility Study

PUBLIC / INTERAGENCY MEETING # 3

MEETING MINUTES

April 4, 2002

6:30 – 8:00 PM
Doyle Connor Agricultural Center
Moore Haven, FL

In Attendance

Robert Akre, Terra Kinetics Engineering Company
Bill Baker, MacVicar, Federico & Lamb, Inc.
Ann & Ross Bennett, Citizens and Lake Okeechobee Business Owners and Supporters (LOBOS)
Brion Blackwelder, Nova Southeastern University, Shepard Broad Law Center, ELULC, Inc.
Jerry Brooks, Florida Department of Environmental Protection
Allen Dupont, Case O'Bourke Engineering, Inc.
Mitch Flinchum, University of Florida, IFAS
C.S. Fry, Citizen
Paul Gray, Ph.D., Audubon of Florida
Sam Griffin, Fisherman's Heaven
Robert G. Harris, City of Moore Haven
Ernest James Hewett, III, Ph.D., University of Florida
Clyde Hopple, U.S. Army Corps of Engineers, Jacksonville
Tom James, Ph.D., South Florida Water Management District
Craig Jones, Terra Kinetics Engineering Company
Anwar Khan, EA Engineering, Science and Technology, Inc.
Cynthia Laramore, A.C.T.I.O.N.
Pepe Lopez, U.S. Sugar Corporation
Kathy Lukasiewicz, Blasland, Bouck & Lee, Inc.
Dan McCall, Florida Fish and Wildlife Conservation Commission
Katharine Murray, Environmental Quality, Inc.
Travis Murray, Lockhart Agricultural Technologies
Jim Owens, U.S. Army Corps of Engineers, Clewiston
Jorge Patino, P.E., South Florida Water Management District
Ryan Peck, U.S. Army Corps of Engineers, Clewiston
Ken Schenck, City of Pahokee
Kimberly Shugar, Florida Department of Environmental Protection
K. Thomas, City of South Bay
Ken Todd, P.E., Palm Beach County
Alvin Ward, Commissioner, Glades County, FL
Curt Pollman, Ph.D., Tetra Tech, Inc. (via teleconference)

Introduction/Purpose of the Meeting

On behalf of the South Florida Water Management District (District), Kathy Lukasiewicz, P.G., of Blasland, Bouck & Lee, Inc. (BBL) welcomed the meeting attendees, thanking all in attendance for their interest and participation in the Lake Okeechobee Sediment Management Feasibility Study (Feasibility Study). Ms. Lukasiewicz began the meeting with introductions District staff members, including Mr. Jorge Patino (Project Manager) and Dr. Tom James.

Ms. Lukasiewicz informed the attendees that this is the third public meeting designed to gather input from the public and agencies on the Feasibility Study. Ms. Lukasiewicz explained that during this meeting, the project team will discuss the status of the Feasibility Study and the draft Work Plan for the Evaluation of Alternatives (Work Plan). The Work Plan summarizes the tools and methods that will be used to evaluate the expected performance of the proposed sediment management alternatives relative to the study's goals and performance measures.

Ms. Lukasiewicz explained that public and interagency participation is an integral component of the Feasibility Study and all interested parties are encouraged to participate and provide input. Methods of participation throughout the Feasibility Study include discussions during public meetings, discussion with project team members or the Project Manager, Jorge Patino, and written comments sent to Mr. Patino. The District has also undertaken a variety of outreach efforts to inform and involve interested parties. Mr. Patino can be reached via telephone at 561-682-2731 at the District or e-mail (jpatino@sfwmd.gov). The attendees were also encouraged to fill out and submit Comment Cards located on the sign-in tables if attendees preferred writing their comments instead of speaking at the meeting.

Feasibility Study Overview

Based on the meeting agenda (attached), Ms. Lukasiewicz began a brief presentation to summarize the project and its status. The Feasibility Study is a three-year desktop study conducted by the District through a contract with BBL. The project was initiated in the fall of 2000 to address internal phosphorus loading in Lake Okeechobee.

The objective of the Feasibility Study is to evaluate a variety of sediment management alternatives to address internal phosphorus loading in Lake Okeechobee, improve water quality in the lake, decrease turbidity and decrease the occurrence of blue-green algae blooms.

Ms. Lukasiewicz generally discussed the difference between internal and external phosphorus loading in the lake. Internal loading occurs when phosphorus entrained in the sediments are introduced into the water column predominately through wind and wave induced resuspension of sediment particles containing high concentrations of phosphorus. External loading pertains to phosphorus that comes into the lake from external sources, including tributaries from throughout the Lake Okeechobee watershed that flow into the lake.

Ms. Lukasiewicz addressed the question "Why is this study needed?" by noting that there are an estimated 51,000 metric tons of phosphorus in the mud sediments within Lake Okeechobee, so much so that the internal phosphorus loads are now equal to the external phosphorus loads entering the lake from the watershed. Due to the extreme internal phosphorus loading

conditions, the lake may not respond as quickly to external reductions in phosphorus loading without measures taken to manage the internal inputs.

The Feasibility Study is required by the Lake Okeechobee Protection Act (Florida Statute 373.495(3)(f)). The information gained throughout this Feasibility Study will provide support for management decisions, which will be made in the future by the District's Governing Board (with further public and interagency input).

Water-column phosphorus levels in the lake's pelagic zone have more than doubled since the 1970s to currently exceed 100 parts per billion (ppb). The present external phosphorus loads are in excess of 600 metric tons per year. This excessive external loading has essentially used up the phosphorus storage capacity of the lake (Harvey & Havens, 1999).

This Feasibility Study focuses on the sediments in the pelagic zone of Lake Okeechobee, including an estimated 193 million cubic meters of phosphorus-rich fluid sediments that range in depth from a few centimeters at the edge to more than 75 centimeters in the center. The phosphorus concentrations in the pelagic zone range from 200 to 2,000 milligrams per kilogram (mg/kg); with the average phosphorus concentration in the upper 10 cm of sediment equaling approximately 1200 mg/kg. The average concentration in the upper 30 cm of sediment layer reaches as high as 990 mg/kg.

There are five major tasks in the Feasibility Study:

- Task 1 - Development of Goals & Performance Measures
  - Public/Interagency Outreach Meeting held in January 2001
  - Goals and Performance Measures Report finalized in June 2001
- Task 2 - Development of Alternatives
  - Public/Interagency Outreach Meeting held in July 2001
  - Development of Alternatives Report finalized in October 2001
- Task 3 - Work Plan for Evaluation of Alternatives
  - Public/Interagency Outreach Meeting held on April 4, 2002
- Task 4 - Evaluation of Alternatives
  - Public/Interagency Outreach Meeting planned for early 2003
- Task 5 - Stakeholder Prioritization of Alternatives
  - Public/Interagency Outreach Meeting to be determined

The sediment management goals developed during Task 1 of the Feasibility Study are:

- Maximize water quality improvements;
- Maximize engineering feasibility and implementability;
- Maximize cost effectiveness;
- Maximize environmental benefits; and
- Maximize socioeconomic benefits.

These goals and associated 26 performance measures developed in Task 1 are the result of a collaborative effort of the District; BBL (including Tetra-Tech, Inc. and other project team members); scientists and engineers from several federal, state, and local agencies; various interested organizations and the public.

Task 2 focused on development of sediment management alternatives, and was completed in October 2001. The project team (with input from the public, interested parties and governmental agencies) developed a set of sediment management alternatives using a three step process:

Step 1: Identify potentially applicable technologies and process options
(36 technologies were identified)
Step 2: Determine potential feasibility of technologies selected in Step 1
(14 options were retained after screening)
Step 3: Combine retained technologies into alternatives
(7 alternatives were developed for further evaluation)

The seven sediment management alternatives developed for further evaluation are:

Alternative 1 – No in-lake action
Alternative 2 – In-lake chemical treatment (single application)
Alternative 3 – Long term periodic in-lake chemical treatment
Alternative 4 – Dredging
Alternative 5 – In-lake chemical treatment followed by dredging
Alternative 6 – Dredging followed by in-lake chemical treatment
Alternative 7 – Long-term periodic dredging from in-lake sumps with or without follow-up in-lake chemical treatment

Ms. Lukasiewicz explained that the task currently underway is Task 3, development of the Work Plan for Evaluation of Alternatives. The draft Work Plan is available from the District and may be obtained through Jorge Patino, the District website, or by filling out a document request form available on the meeting sign-in tables. The Work Plan addresses the question of how the alternatives will be evaluated and essentially lays out the process for Task 4 - Evaluation of Alternatives.

The Work Plan describes how the alternatives will be evaluated, and specifically describes the targets, tools, critical data/input, methods, scoring process, interrelationships with other performance measures, and uncertainty considerations that will be used during evaluation of alternatives against the pre-established goals and performance measures.

Examples of tools that will be used in the evaluation process are water quality models (LOWQM), sediment resuspension models (LOHTM), chemical equilibrium models (MINEQL+), a correlation matrix to analyze socio-economic impacts and qualitative ecological assessments.

A broad spectrum of methods will be used to evaluate the alternatives including, for example, water quality modeling, case study evaluation and comparison, engineering analyses/estimates, socioeconomic assessments, qualitative assessments, collaboration with regulatory and wildlife agencies, and public input. The project team will be working closely with other governmental agencies including, but not limited to, the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), the Florida Department of Environmental Protection (DEP), U.S. Coast Guard, Florida Fish and Wildlife Conservation Commission (FWCC), lakeside counties and municipalities, and other stakeholders.

Status of Related Lake Okeechobee Studies

Mr. Patino explained that there are two other District-managed studies currently underway that will provide data and information which to be integrated into the Feasibility Study. One such study is the Pilot Dredging Project, which is being led by EA Engineering, Science and Technology, Inc. (Mr. Patino introduced Mr. Anwar Khan, the Project Manager EA Engineering). The second District-sponsored project is a laboratory study by the University of Florida titled: Potential Impacts of Sediment Dredging on Internal Phosphorus Load in lake Okeechobee (Dr. Tom James is the District's Project Manager).

Pilot Dredging Project

The main purpose of the pilot dredging project is to assess the viability of removing the phosphorus-laden, extremely fluid mud layer without removing a great deal of water in the process (sediments contain approximately 12% solids). The project has been successfully coordinated with multiple agencies including DEP, USACE, FWCC, USFWS and Martin County. It was necessary to obtain a construction permit from Martin County in order to construct a Confined Disposal Facility (CDF) within the county.

The dredge area is a 425-foot by 425-foot area within Lake Okeechobee; approximately 5 miles southeast of Port Mayaca. The CDF, a constructed holding facility where the dredged material will be transported (by barge), dried and tested is located approximately ¼ mile east of Port Mayaca, on the north side of the St. Lucie Canal. The CDF is lined to ensure containment of all dredged materials and consists of cells which will be utilized for each stage of processing. Various treatment methods will be used to test dewatering techniques and reducing the phosphorus level in the water to 40 ppb. The water will be treated and returned to the CDF. The sediments will be dried by evaporation and stored in the CDF. The District is currently working with DEP to determine where the dried sediments will eventually be deposited.

There will be 10 days of dredging within the pilot study area in Lake Okeechobee, where sediments are approximately 30 cm deep.

The dredge, designed by EA Engineering specifically for this project, is a hydraulic dredge that will move above the fluid mud layer at varying speeds during the project. Intake sizes will also be adjusted and monitored to gain as much technical information as possible. During the study, samples will be collected and analyzed for multiple parameters, including turbidity and other water quality measures.

Questions and Discussion Regarding the Pilot Dredging Project:

Ms. Laramore asked:
How far out from the actual dredging site will the contractors be monitoring water quality?

> *Mr. Patino responded:*
> Monitoring will be ongoing and extensive. The monitoring program is two-fold, and will include both equipment performance and regulatory/environmental parameters.

Mr. Kahn added:
The pilot dredging is a demonstration project that is designed to gather data and information regarding the dredging process involving this substrate. Monitoring will be continuous, incorporating pre-dredge, during dredging, and post-dredging operations. The extensive monitoring program will also include data collection on changes in substrate during dredging. The project will try to answer as many questions as possible.

We will specifically monitor turbidity and water quality; conduct bathymetric surveys; collect data on intake opening sizes, dredging speed, and the thickness of the layers removed from the bottom. The project will attempt to gather information on the pressing question of what happens to the surrounding mud when a portion of the fluid mud is removed. This and other information will be valuable for future projects.

Mr. Bennett asked:
Will the underwater visibility go to zero, therefore not allow the contractor an ability to monitor the dredging process by video?

Mr. Patino responded:
The District and EA Engineering are currently exploring techniques to ensure visible access during dredging. Suggestions from the public and agencies are welcome.

Mr. Bennett expressed:
There is value in seeing what is happening around the intake opening of the dredge.

Mr. Khan responded:
EA Engineering will video monitor the auger. Also, the fluid mud is so light in weight that any movement in the water disrupts the sediments and creates decreased visibility. One challenge of the project is to create as little disruption to the water column as possible. Even the dragline deploying the dredge creates turbidity in the water column.

Mr. Patino added:
The dredging area will be limited each day by the volume capacity of the barge.

Mr. Schenck asked:
When will the results of the pilot project be available? Mr. Schenck explained that he is the City Manager of the City of Pahokee, and they are currently working with the District on a project to dredge portions of the Pahokee Marina. Information gathered during the pilot project will be beneficial in understanding the behavior of the sediment and may assist in determining options as they proceed with the marina dredging project.

Mr. Khan responded:
The draft report is expected to be available in 30 to 60 days after dredging.

Mr. Patino added:

The District is interested in working with the City of Pahokee on this issue and in sharing information gained during the pilot project. An exchange of contact information after the meeting was suggested.

Mr. Patino noted that the CDF was constructed 2 to 3 weeks ago. The liner will be installed on April 5, 2002. The CDF is located on the north side of the St. Lucie Canal nearly ¼ mile east of the lake.

Ms. Laramore asked:
Will the pilot project incorporate any chemical treatment during the dredging process?

Mr. Patino responded:
The project will not include any chemical application; it is strictly a dredging project.

University of Florida Laboratory Study
Mr. Patino began discussions on the University of Florida study on the "Potential Impacts of Sediment Dredging on Internal Phosphorus Load in Lake Okeechobee," which is often referred to as the "Reddy Study" because Dr. Ramesh Reddy is the study's Principal Investigator. The study hopes to answer two very important questions (among others):

1) What is the present capacity of mud sediments in the lake to assimilate phosphorus, and how would this capacity change if the sediments were dredged to various depths (including complete removal of mud down to underlying substrate)?

2) What is the present rate of internal loading of phosphorus from the sediments to the water column (by diffusion and resuspension) and how would this rate change if sediments were dredged to various depths (including complete removal of mud down to underlying substrate)?

The laboratory study will address these questions by examining sediment core samples collected from Lake Okeechobee and analyzing the different layers of sediments under different controlled conditions. The study will address how much phosphorus will diffuse out of the sediments and what impacts will occur as different and increased layers are removed at 0, 50, 75 and 100 percent (thereby simulating removal via dredging). The study will also assess the flux of phosphorus from sediments into the water column, under experimental laboratory conditions.

A draft report on the study is expected to be available within a few weeks.

Mr. Patino asked if there were any further questions. No additional questions were raised.

<u>Additional Comments, Questions, and Discussion</u>
Ms. Lukasiewicz continued the presentation noting that the Lake Okeechobee Sediment Management Feasibility Study will incorporate the results of both the University of Florida study and the pilot dredging study into the engineering evaluation of the sediment management alternatives. She reiterated that the final Feasibility Study report will combine the engineering cost estimates, scientific evaluation, water quality modeling information, and other data in raw form for presentation to the District. The District will then further involve the public and other

agencies to weight the relative importance of each performance measure, and finally perform prioritization and decision analyses to develop a reasonable course of action.

Below is a summary of the additional discussion that followed:

Mr. Bennett asked:
How long has this problem been in existence?

> *Ms. Lukasiewicz responded:*
> As a clarification, Ms. Lukasiewicz asked if the problem being referenced is the accumulation of phosphorus in the sediments of the lake. After affirmation, in response Ms. Lukasiewicz noted that studies show that there has been significant deterioration of the lake's health due to internal phosphorus loading at least since the 1970s.
>
> *Dr. James added:*
> A study from the late 1980s estimated that the majority of impact on the lake dates back as far as 1910, followed by a steady increase in phosphorus loading. Since then, based on the yearly nutrient budgets for phosphorus (going in and coming out) over time and the fact that the phosphorus levels in the water column have doubled, the District has been able to determine that the assimilation capacity for the lake has been decreasing. This has given scientists the sense that in the last 30 to 40 years, phosphorus levels and lake conditions have really come to an historically significant level.

Mr. Bennett commented:
The local commercial fishermen have reported over the past numerous years, that while using fishing nets in certain parts of the lake, they have seen an increase in the amount of sediment in the water column. The perception of the local fishermen is that loading of the phosphorus in the lake, particularly in the shallow areas, is due to the shallow depth combined with wind-wave action. The sediment problem is not new.

Further, many local residents think the bottom sediment phosphorus loading problem is caused by exotic vegetation spraying. Why is that issue not being addressed?

> *Dr. James responded:*
> The District has analyzed the constituents in sediment samples and has not found evidence of plant materials that lead the District to believe that spraying of aquatic plants and the decaying process are the source of phosphorus in the sediments. The mud sediments are flocculent in nature and do not show this type of plant material. Some phosphorus may be contained in the algae (phytoplankton) within the sediments. The influx of solids from tributary canals, not from vegetation in the marsh zones, which have been sprayed for exotic species control purposes, appear to be the source of phosphorus.

Commissioner Ward asked:
Is the concentration in the north eastern portion of the lake, as shown in a display map at the meeting, due to a high concentration of phosphorus in a collection basin?

Ms. Lukasiewicz responded:
The map indicates sediment thickness, showing that as you move to the center of the pelagic zone located in the northeast portion of the lake, there is an increase in the accumulation of sediments. Another map at the meeting was referenced, showing phosphorus concentrations in the lake. Ms. Lukasiewicz noted that most of the higher concentrations are occurring in the deeper, pelagic zone. The lake has natural circulation patterns, resulting in higher deposition of sediments in the pelagic zones. Sustained wind directions within seasonal timeframes will continue to create this deposition process in the pelagic zones.

Ms. Laramore asked:
Is there any relationship between the concentration of phosphorus-rich sediments and the water depth in the lake?

Ms. Lukasiewicz responded:
Sediments appear to be accumulating in the deepest portion of the lake.

Dr. Gray asked:
What are the characteristic fluid properties of the mud in relation to the thickness through the layers?

Mr. Khan responded:
The system is very dynamic. With slight gradation, the flocculent throughout the layers becomes thicker as you move lower, with an increase in density towards the bottom. The upper layers are the most fluid, making in-situ dredging particularly problematic. The system changes from day to day, due to wind currents and boat traffic. It often takes 24 hours for the flocculent to settle again after disruption before analyses can recommence.

The goal of the pilot dredging project is to trap the top layer in-situ for collection and analyses. Because the system is so dynamic and easily disturbed, the team will dredge predominately in the morning to allow a settling time of flocculent mud layers.

Dr. Gray asked:
If the lower layers have the greatest density, why are the top layers so problematic in relation to phosphorus?

Ms. Lukasiewicz responded:
Scientists believe that the majority of the phosphorus is occurring within the top 30 cm of the mud layer. The phosphorus concentration tends to reduce as you reach the lower, more consolidated materials in the sediment layer. The laboratory sediment core study will provide additional information as to the characteristic properties of the mud in the different layers (e.g., 10cm, 30cm, 45cm, 55cm), all the way down to the native sand. The study will also evaluate what happens if only the native sand is left, considering the continuing flux in the system. With each new layer, analyses will determine the characteristics of the resulting substrate and the resulting conditions in the water column.

Commissioner Ward asked:
Will the pilot dredging project pump everything (water and slurry) into a barge?

Ms. Lukasiewicz responded:
All of the dredged material will be pumped onto a barge and transported to a CDF where it will be stored. A CDF is a confined, contained area that has been designed and constructed to safely contain all of the dredged material. The dredged material will first be allowed to settle in the CDF. The materials will then be tested and returned to the CDF. Decanted water from the CDF will be analyzed for phosphorus.

Mr. Khan added:
The CDF is to be located on the north side of the St. Lucie Canal ¼ mile east of the mouth of the canal, on District owned land.

Commissioner Ward asked:
Will there be different types of chemical treatment used during the pilot dredging project to determine how the sediment reacts?

Mr. Khan continued:
No chemical treatment will take place at the site. After an extensive laboratory process, the scientists have come to the conclusion that the water should first be settled out. The decanted water will then be treated in the laboratory with two different methodologies. One process involves a polymer, another involves a new technology that binds phosphorus.

Dredging will take place for approximately two weeks, 2-3 hours per day. The purpose of the project is demonstration in nature, showing how the dredging process works in this environment. Only 6,000 cubic yards will be dredged during the pilot project. If dredging is finally the alternative of choice, duration and rate of dredging will be determined at that time.

Commissioner Ward commented:
This dredging alternative seems like it could last for years, and years, and years.

Ms. Lukasiewicz added:
Using, in part, the information gained during the pilot project, the Feasibility Study will attempt to predict the magnitude of dredging that will be required to achieve the desired results of reduced internal phosphorus loading in the lake. Potentially, considering the size of the water body, and the magnitude of the project, if dredging is determined to be a viable option, dredging could last nearly 15 to 20 years, non-stop. This is why the methodical approach and Feasibility Study are so important.

Dredging of a lake of this magnitude would be a huge infrastructure intensive project the likes of which has never been attempted yet anywhere else in the world (assuming the entire pelagic zone is targeted). Commissioner Ward is correct. Using dredging, this problem will not be solved within a five-year period.

Mr. Khan added:
Often, with large-scale projects such as this, multiple dredges are used, depending on the scale of the project.

Mr. Harris asked:
Considering chemical treatment again, what happens to the phosphorus after the chemical treatment, and to the mud itself? Will we end up with the same turbidity that we have now, even after the chemical treatment?

Ms. Lukasiewicz responded:
The success that has occurred with chemical treatment has occurred when aluminum sulfate has been mixed with another buffering material such as sodium aluminate. Theoretically, the chemical mixture would be loaded onto a barge and released into the water column as slurry. As it moves through the water column, the slurry essentially inactivates and binds the phosphorus in the water column. As it reaches the bottom sediments, it continues to inactivate phosphorus. It is very important not to lower the pH of the water during this process. Aluminum sulfate alone has the potential to lower the pH of the system, so monitoring and management of the pH is a critical aspect of chemical treatment.

Lake Okeechobee has a fairly neutral pH of approximately 7. If the pH is closely managed during application, studies show that chemical treatment can remain effective for as many as 20 years, in some cases. Thus, chemical treatment can be a very effective method of inactivating the phosphorus within the system.

Theoretically, if you inactivate the phosphorus, there will be a decrease in the amount of blue-green algae and a decrease in turbidity. Also, theoretically, if the phosphorus is taken out of the system, the overall water quality improves. In cases where chemical treatment has been utilized successfully, the goals of the project have been to reduce blue-green algae, decrease turbidity, and increase overall water quality by decreasing the phosphorus levels. But, the sediments (mud) remain.

Ms. Laramore asked:
How will the Feasibility Study take the information gained during the pilot dredging project (6,000 cubic yards) to scale, making it applicable to the whole lake (200 million cubic meters)?

Ms. Lukasiewicz responded:
The magnitude of problem within Lake Okeechobee presents one of the challenges of the Feasibility Study. Taking the small scale of the pilot project to the large scale of actual dredging will necessitate a combination of data collection and case-study applications. There are data from a number of other very large-scale case study sites that will be incorporated into the Feasibility Study along with the data from the pilot project. Further, one of the goals for the pilot project is to evaluate how to scale this demonstration project up to the magnitude of the lake. At each phase of the

demonstration project, the contractors will consider how the pilot project can be scaled up. The final report will include an analysis of scalability.

Mr. Khan added:
One of the reasons for using this specially designed, innovative dredge technology is so that the pilot project can demonstrate its capability to dredge the flocculent material in-situ. Most conventional dredges require extensive intake of water during the dredging process. The pilot project will identify each stage and component of the project that is scalable.

Mr. Bennett asked:
What will be done with the dredged material?

Ms. Lukasiewicz responded:
The Feasibility Study will include a number of options for disposal of dredged material. Some of the options include:

- Confined disposal within the lake; using the dredged material to build islands within the lake
- Constructing a confined disposal facility outside the lake
- Dewatering the material and using the dried material as a blended soil, top soil, or agricultural mix.

For every alternative that includes sediment removal, there are a series of process options that will be considered as possible, or practical to address reuse or disposal of the dredged sediments. An example of reuse would involve taking the solids remaining after the dewatering process and mixing them with other materials for sale as beneficial materials such as compost/top soil. The study will consider the market for an organic, phosphorus-rich soil amendment.

Mr. Bennett asked:
Have you considered using the dredged material as a fuel for a natural gas power plant?

Members of the community previously approached the government with the idea of removing materials from the lake and spreading the sludge/sediments on agricultural fields. The suggestion was not acted upon due to the probability that the newly spread material would run back into the lake following rainfall.

Ms. Lukasiewicz responded:
Sufficient confinement and monitoring of the dredged material within a designated area is extremely important to ensure avoiding run-off into the lake and tributaries.

Mr. Fry asked:
Lake Apopka may be a good place to actually test some of the chemical application because Lake Apopka is considered by some as already "dead." Lake Trafford may also benefit from the Feasibility Study. Will there be sharing of applicable information?

Ms. Lukasiewicz responded:
Yes, the information will be shared. The USACE is currently studying Lake Trafford, and there are many similarities between Lake Trafford and Lake Okeechobee.

Scientists studying Lake Apopka have seen some increase in water quality due to decreased external loads entering the lake. There are also efforts to use biomanipulation in Lake Apopka to change the habitat. A group of fishermen have been contracted to remove the fish known as the "Gizzard Shad" from the lake in an effort to improve water quality.

Dr. James added:
Another effort to improve the water quality involves removing water from the lake, running the water through a marsh, and finally returning the water to the lake. This vegetative treatment, although slow acting, has improved the water quality.

Ms. Lukasiewicz added:
The District is also using alum in designated stormwater treatment areas to treat water prior to its entering the lake.

Mr. Thomas asked:
Will there be a detrimental effect to the environment caused by the use of alum? Water treatment plants have an MCL for aluminum that must be monitored regularly. The addition of alum to the municipal water storage area for the City of South Bay (Lake Okeechobee) may impact the water treatment facility's operations.

Ms. Lukasiewicz responded:
The application of aluminum sulfate, if properly managed, will not create a problem. If the pH in the lake system is not properly managed, the aluminum sulfate can cause toxicity for fish. Understanding the pH in the system is extremely important when considering chemical treatment.

One of the performance measures that will be used while evaluating each of the alternatives is that the alternative cannot impact the water quality to the point that it negatively affects users. Performance Measure 5D states "No impacts on water supply and operations." Each alternative will be evaluated against this and all other performance measures. If the alternative does not score well relative to the performance measure, the overall scoring of that alternative will be lowered.

Ms. Laramore asked:
What is the probability that the lake will require dredging more than once? How will chemically treating the water and dredging the sediments affect the water storage capacity of the lake/reservoir and the use of the lake's water for Aquifer Storage and Recovery (ASR)?

Ms. Lukasiewicz responded:
Studies preliminarily show that it may be necessary to dredge more than once. Studies also indicate that after dredging, due to wind currents and other factors, the sediments

may again accumulate in the pelagic zone. There is a strong likelihood that the pelagic zone would have to be redredged in 10 years.

Dr. James added:
The plans under consideration by the District now indicate that the water for the ASR wells will not come from Lake Okeechobee. The water for the ASR wells will come from the Stormwater Treatment Areas after the rainy season. On the other hand, during dry periods, the water from the ASR wells could be pumped into the lake, providing an additional source of water for the lake. This process may actually change the chemistry of the water in the lake. This may be good and this may be bad. One of the projects under ASR research will be to determine, by modeling, given the quality of water from the ASR wells, what the impacts will be to the receiving water bodies.

Ms. Laramore added:
One concern is that given the uncertainty of all of the projects around Lake Okeechobee, there is little integration of planning, information, and data. At what point will these activities become integrated?

Ms. Lukasiewicz responded:
In relation to this Feasibility Study, the performance measures for each alternative will be evaluated for minimum impact on the other projects.

Mr. Hopple added:
Many of the Comprehensive Everglades Restoration Plan (CERP) projects and pilots will begin within the next two to three years. Many of the questions that are being asked and answered through the Feasibility Study and the pilot dredging project will provide information that will be integrated into other projects. We hope to see correlation between the various projects.

Mr. Schenck asked:
How is the restoration of the Kissimmee River coming along?

Dr. Gray responded:
Phase I of the Kissimmee River Restoration has been successfully completed. Land acquisition is necessary and underway for the remaining portions of the project. The project is on schedule.

Mr. Bennett asked:
There have been two articles in the Florida Sportsman Magazine that point to wells as having a detrimental effect on the reef systems in the ocean. How is this related to the Feasibility Study?

Ms. Lukasiewicz responded:
There are at least two types of wells under study and discussion. One, the ASR wells, store water in the aquifer for future use. Another type of well, called deep injection well, pumps water into a much lower geologic layer.

Mr. Brooks added:
One researcher has reported his findings indicating the wells have a negative impact on the reef systems. Other researchers are also looking at that data. Ultimately, the data need further study to prove or disprove the theory suggested.

Commissioner Ward asked:
Why not, during the pilot project, just remove all of the phosphorus-laden layers in the lake? Instead of just taking the top layers, bring the soils down to the clean, native sand.

Ms. Lukasiewicz responded:
The purpose of the two concurrent studies is not to actually remove sediment to lower the phosphorus levels in the lake, but to collect scientific and technical information that will be incorporated into the Feasibility Study and future projects.

The current in-field pilot dredging project will demonstrate dredging and treatment technologies to determine if, and how, the fluid mud can be collected. The scope of work involves collecting the flocculent material up to 30cm deep in the sediment layer and is on a much smaller scale than the entire lake.

The University of Florida laboratory study will analyze cores collected from throughout the lake. The analyses will include an assessment of the quality of sediment and the quality of water at each successive layer of sediment removed until all flocculent layers are removed and the sandy bottom is reached. However, the analyses will take place in the laboratory, not the field.

The feasibility study process, by incorporating all the available data, technology, and information, will determine if it is actually most beneficial to remove all layers of flocculent sediments and leave only the sandy bottom.

Ms. Hewett asked:
How long has it been since the lake has been in a pristine condition?

Dr. James responded:
Studies looking at sediment cores using isotope dating technology that can trace sediments back to the 1800s found an increase in the amount of sediment coming into the lake after about 1910.

Mr. Khan added:
There is no interest in removing uncontaminated sediment.

Commissioner Ward asked:
Has the project team looked into an earlier idea that divided the lake into four equal, separate segments? The idea is to physically divide the lake into four cells, cleaning each one of the four cells independently. Theoretically, the plan would remove the water and contaminated sediments from one cell at a time, and proceed on to the next cell. The increased water quality that results from cleaning one section of the lake would help to stabilize the other three quarters

of the lake. The scenario would correspond with the wet and dry seasons for optimum results. Although this idea seemed a bit far fetched, it now looks more realistic and may be a feasible alternative to addressing the problem.

Ms. Lukasiewicz responded:
In-situ dredging is one of the alternatives that will be evaluated in the Feasibility Study. One of the process options linked with dredging includes dealing with the sediment from the lake in cells. This option includes creating isolated (contained) areas in the lake. Dredging would commence and the dredged materials would be pumped into the cell, creating islands. After the dredged material is settled and dewatered, the remaining water would be pumped back into the lake. To date, studies evaluating the process of dewatering the lake by means of sheet piling the entire lake and pumping water out indicate the process as cost prohibitive.

Commissioner Ward added:
Yes, the cost of sheet piling and dewatering in 10-mile segments would be high, but it appears that the cost of any alternative is also going to be extremely high.

Ms. Lukasiewicz responded:
Agreed.

Dr. Gray asked:
My understanding is that alum becomes toxic when the system is acidic. Is that correct?

Ms. Lukasiewicz responded:
The alum becomes "bioavailable" when the system is acidic. Under acidic conditions, if the alum is ingested, it may become toxic to the fish. The potential for toxicity in fish, as a result of an imbalance in the pH level in the lake, is of critical importance when using alum as a chemical treatment.

Dr. Gray commented:
The water collected near agricultural fields during limnology studies indicates an acidic pH of 3, 4, and 5 in the littoral zone partially due to rainfall.

We at Audubon are hoping dredging is going to work. Phosphorus in the mud is the cause of the problem in the water column. Dredging would remove the mud. Chemical treating the mud may affect benthic organisms within the substrate ecosystem. Audubon is supportive of the pilot project and the Feasibility Study. This issue must be approached scientifically.

Further, part of the Everglades Restoration Plan includes sending water from Lake Okeechobee that currently goes into the Caloosahatchee and St. Lucie Rivers south, to the Everglades. Unfortunately, demucking the lake is not part of CERP. If we send water from the lake as it is now, the Everglades would suffer. We must clean the lake water up prior to sending it to the south. We must clean the lake water up to make it available for the Everglades restoration efforts.

Commissioner Ward added:
Why not build settling areas in the area between Lake Okeechobee and the Everglades to treat raw water in the marsh areas, send the surface water to the Everglades, and treat the sediments in the marsh areas during the dry season?

> *Dr. Gray responded:*
> The District and USCAE are currently building filter marshes to cleanse the water. The phosphorus levels input into the filter marshes is approximately 70 ppb and the resultant treated water is nearly 10 ppb. Lake Okeechobee has a phosphorus level much higher (100-130 ppb), creating difficulty in completely treating the water.
>
> *Ms. Lukasiewicz added:*
> The areas Dr. Gray is referring to are called Stormwater Treatment Areas (STAs) that are constructed wetlands designed and constructed to treat the water using vegetation.

Commissioner Ward commented:
When I was a boy, the water was clear as gin. Back then, the lake had the capability to circulate and flush naturally. Commercial fishermen would use their bottom nets and stir up the sediments in the lake. Historically, the sediment-laden lake water could flow to the south and out the Caloosahatchee and St. Lucie Rivers, thus allowing some of the sediment to leave the lake. The problem began when the water was physically dammed so that it would not flush naturally.

One alternative to solving the problem would be to stir up the sediments in the lake and allow that water to flow into treatment areas.

> *Ms. Lukasiewicz responded:*
> Yes, the watershed's natural dynamics changed when the lake was physically restricted.
>
> *Dr. James added:*
> Some parts of the lake are becoming very clean.

Mr. Bennett commented:
The historical method of removing vegetation, grass and hyacinths (water lettuce) was a natural phenomenon. The plants cleared the water. During a hurricane, the wind would push all of the plants to the shore and clear the lake of the weeds. They would grow back over time and begin the cleansing process again.

No one here can argue that the 0% tolerance to hyacinths rule is important. Our concern is the practice of spraying the vegetation and dropping it to the bottom in the shallow portions of the lake. We are now working to encourage more projects like the north shore project where the water levels were low in the littoral zone, and the layers of phosphorus rich sediments were removed. Some of the best fishing in the lake right now is on the north shore. This is in part due to the recent sediment scraping and removal project. Vista Boca has great fishing these days.

Mr. Harris commented:

We are fortunate to have the combination of intellect and science combined in the Feasibility Study's project team. Ideally, the study would combine science with the experience of the local population knowledgeable about the everyday and historical aspects of Lake Okeechobee. The solution to this problem is going to come together when we combine technology with common passions of the people who know the pulse of the lake. The most important thing is to find a solution for the sake of the lake.

> *Ms. Lukasiewicz responded:*
> There is no substitute for the passion and knowledge of the local population. We encourage continued participation by the public and agency staff. The solution to the problem is going to come from a group of people with a passion for working together toward a solution.
>
> It is vitally important that the public and agency staff participate in this process. An additional opportunity for public participation is through a brainstorming session on beneficial sediment reuse, which Mr. Patino is organizing. The purpose of the brainstorming session is to gain ideas for beneficial reuse of the dredged sediments.

Mr. Bennett added:
Beneficial reuse of the sediments will be a key factor in finding a solution to the problem. Enterprise should be sought to cover the cost of the cleanup measures involved in this project.

With no further comments or questions, Ms. Lukasiewicz thanked the public and agency representatives for attending the meeting and participating in such an engaging manner.

The meeting was adjourned at 8:45 p.m.