The 18th Annual

Florida Lake Management Society Conference & the North American Lake Management Society Southeast Regional Conference

"Managing our Lakes, Reservoirs, and Rivers"

Naples Grande Resort & Club
Naples, Florida June 4 - 7, 2007

17th ANNUAL CONFERENCE OF THE FLORIDA LAKE MANAGEMENT SOCIETY & THE NORTH AMERICAN LAKE MANAGEMENT SOCIETY SOUTHEAST REGIONAL CONFERENCE

PROGRAM & PROCEEDINGS

"Managing our Lakes, Reservoirs, and Rivers"

June 4-7, 2007

Naples Grand Resort & Club
Naples, Florida

ABOUT THE ARTIST

Joanelle Mulrain grew up on the St. Johns River in Jacksonville, Florida and graduated with a Bachelors of Fine Arts and a Minor in Ceramics from Jacksonville University. Recently, her love of art and nature's seasons has been the focus of her work, resulting in the founding of Great Blue Heron Studios. She often paddles her blue kayak deep into the St. Johns' swamps and tributaries, studying patterns in natural light, air, and water that are central themes to her work. Her water-level portraits feature birds and nature, raw and alive, with peaceful vistas embellished with a broad palette of brilliant colors. Her connection to Florida lakes and rivers is evident as she asks the viewer to participate with her in this journey through nature on canvas and paper. Through her paintings and photography, Joanelle shares her deep understanding of the importance of sustaining our natural ecosystems and protecting and preserving our environment for generations to come. In 2006, Joanelle authored her first signed and limited edition book in a series of 12, "Re-Rooting: Life's Journey."

ABOUT THE COVER ART

Joanelle has donated to the Florida Lake Management Society (FLMS) one of her outstanding works of art - "Florida Cattails at Lochloosa." The opportunity to own this wonderful image (a 3' x 4' signed photo giclee) is available to all conference participants by purchase of a raffle ticket from FLMS conference staff. All proceeds from this raffle will be used by FLMS to help support and promote environmental education and other aspects of the Florida Lake Management Society's mission. Please visit with Joanelle, help support FLMS through a raffle ticket purchase, keep your fingers crossed that you win the art, and enjoy the conference!

MISSION STATEMENT

The mission of the Florida Lake Management Society
is to promote protection, enhancement, conservation,
restoration, and management of Florida's aquatic resources;
provide a form for education and information exchange;
and advocate environmentally sound and economically
feasible lake and aquatic resources management
for the citizens of Florida.

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Requests for additional copies of this program and information about the Society may be sent to the following address:

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AWARDS

The Florida Lake Management Society presents the following annual awards:

The Marjorie Carr Award is the Society's highest award and is given for lifetime work on behalf of Florida's aquatic resources. This award is named in honor of Marjorie Carr who, among other things, organized citizens and brought to an end the proposed Cross-Florida Barge Canal.

> Past recipients include: Hal Scott (1990), Vince Williams (1991), Cassie and David Gluckman (1993), Johnny Jones (1994), Richard Coleman (1995), Nat Reed (2000), Mike Kasha (2001), Everett Kelly (2002), Joe E. Hill (2003), Jake Stowers (2004), and Henry Dean (2005) – not awarded in 2006.

The Edward Deevey, Jr. Award is given to an individual for contributing to our scientific understanding of Florida's waterbodies. Edward Deevey was an internationally recognized limnologist and was affiliated with the State Museum of Florida at the time of his death.

> Past recipients include: William Beck (1990), Jim Hulbert (1991), Howard T. Odum (1993), Tom Crisman (1994), Marty Wanielista (1995), Karl Havens (1999), Claire Schelske (2000), and Betty Rushton (2003) – not awarded in 2004, 2005, or 2006.

The Scott Driver Award is given to an "activist" who has promoted the restoration, protection, and/or appreciation of Florida's aquatic resources. Scott was a well known activist on behalf of Lake Okeechobee and was a member of the steering committee that founded FLMS at the time of his death.

> Past recipients include: Helen Spivey (1990), Jim Hawley (1991), Wayne Nelson (1993), Jim Thomas (1994), Tom Reese (1995), Judith Hancock (1999), Carroll Head (2000), Mary Carter (2001), Al Cheatum (2002), Thomas E. Fortson (2003), Beverly Sidenstick (2004), Joanne Spurlino (2005) and Barbara Ketchum (2006).

The Richard Coleman Aquatic Resources Award is given to a professional who has worked to restore, protect, and/or advance our understanding of Florida's aquatic resources. This award is named in honor of Richard Coleman who was a founder and first president of FLMA and, prior to his death, worked tirelessly to protect and restore aquatic resources throughout the State of Florida.

> Past recipients include: Eric Livingston (1990), William Wegener (1991), Paul Shaffland (1993), Jeff Spence (1994), Sandy Fisher (1995), Kim Schildt (2000), Jess Van Dyke (2001), Patrick J. Lehman (2002), Lothian Ager (2003), Dr. Marty Kelly (2004), Dr. Harvey H. Harper, III (2005) and Dr. Edgar F. Lowe (2006).

The Marjorie Stoneman Douglas Award is given to individuals in the media who report on aquatic resource issues. This award is named in honor of Marjorie Stoneman Douglas who authored the book, "Everglades River of Grass", founded the Friends of the Everglades, and who has been environmentally active in South Florida.

> Past recipients include: John Morgan (2000), Georgia Davis (2001), Victor Hull (2002), Dave McDaniel (2003), Bob Hite (2004) and Ron Littlepage (2006).

The Bob Graham Award is given to persons elected to office who demonstrate a commitment to lake and aquatic resource conservation. Bob Graham is remembered for his support of many environmental initiatives, including the purchase for preservation of thousands of acres of Gulf Coast wetlands.

> Past recipients include: Robert B. Rackleff and Debbie Lightsey (2001), Shannon Staub (2002), Cliff Barnes (2003), Senator Ken Pruitt (2005) and John Delaney and Senator Jim King (2006).

The President's Award is given by the President of the Society to an individual for outstanding support of the work of the Society during the past year.

> Past recipients include: Nancy Page (1999), Julie McCrystal (2000), Erich Marzolf (2001), and Chuck Hanlon (2002), Chuck Hanlon (2003), Jim Griffin (2004), Erich Marzolf (2005) and John Burns and Michelle Jeansonne (2006).

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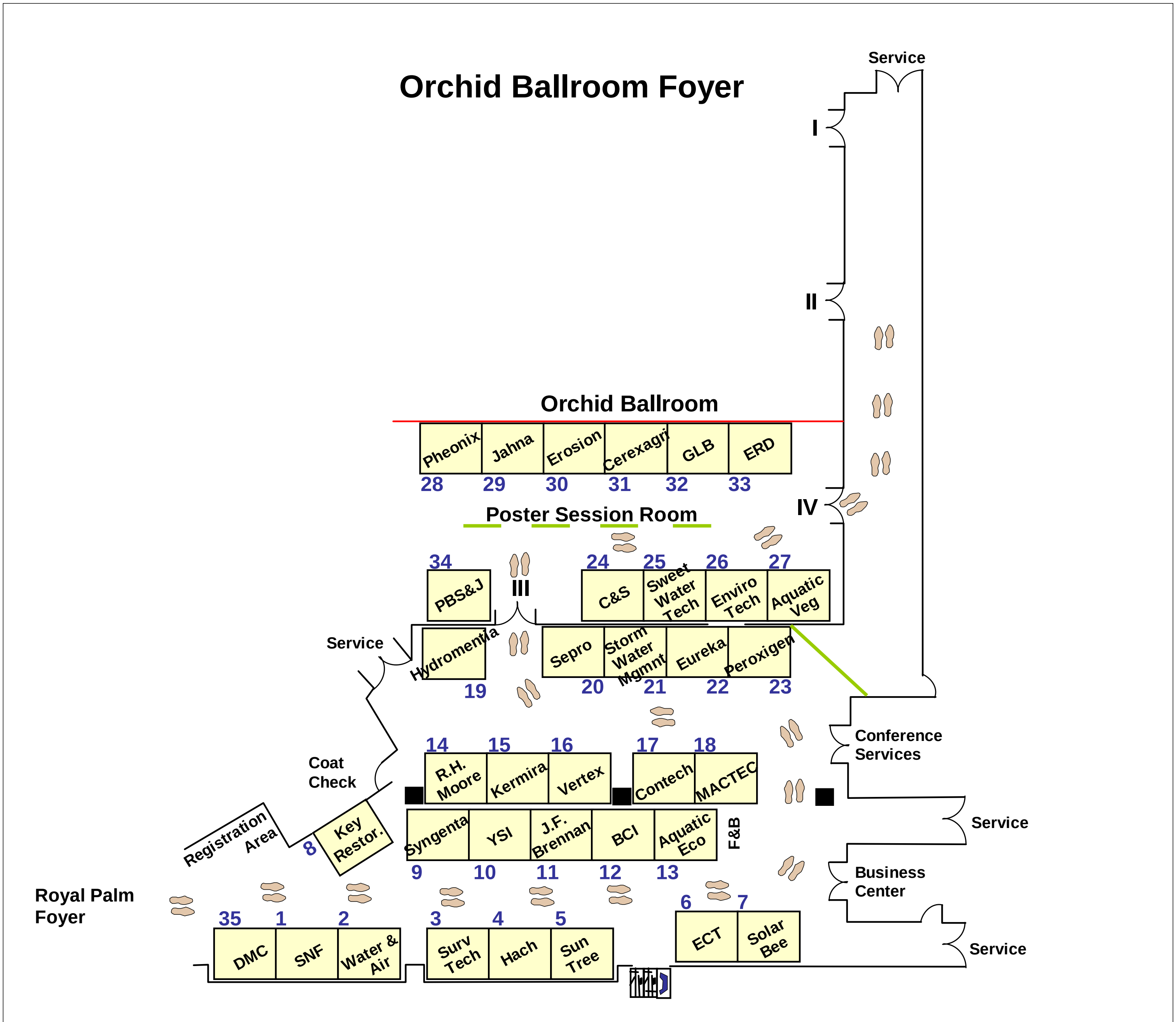

Naples Grande Resort & Club **Orchid Ballroom Foyer**

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Aquatic Eco-Systems, Inc.

Aquatic Eco-Systems, Inc., founded in 1978, is the largest lake aeration system, fountain and related product source worldwide. Our staff of fisheries biologists, lake specialists and technicians provides aeration system sizing, installation, product recommendations and repair/troubleshooting services. Get everything you need from one source: our 500-page print or online catalog. For your convenience we have sizing questionnaires, Tech Talks and a product search engine at aquaticeco.com.

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Aquatic Vegetation Control, Inc. (AVC)

Aquatic Vegetation Control, Inc. (AVC) is a nineteen year old Florida corporation offering vegetation management and general environmental consulting services throughout the southeast. Since its establishment as an exotic/nuisance vegetation management company specializing in the control of invasive wetland and upland species, AVC has broadened its scope of capabilities to include chemical mowing, certified lake management, re-vegetation, restoration services, roadside and utility vegetation management, and general environmental/ecological consulting.

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Arc Surveying & Mapping, Inc.

Arc Surveying & Mapping, Inc. is qualified as a Small Business Enterprise, and is comprised of a group of twelve innovative professional surveyors, computer mapping technicians and field survey personnel. The staff of Arc Surveying and Mapping, Inc. is dedicated to providing accurate, timely and cost-effective topographic and hydrographic surveying services to our clientele. For over twenty years Arc Surveying & Mapping, Inc. has provided a wide variety of private and governmental clients with specialized land surveying, hydrographic surveying and mapping services throughout the State of Florida, the Territory of Puerto Rico and the U. S. Virgin Islands. Arc Surveying & Mapping, Inc. is a technological leader among land surveying firms and has established its reputation by the acquisition and application of cutting edge technology to its surveying operations. By making a concerted corporate effort to acquire the professional competence, field experienced personnel, technical equipment and surveying skills necessary to meet client-driven schedules, Arc Surveying & Mapping, Inc. has earned it's reputation for meeting budgetary and time frame constraints for it's clientele while maintaining the necessary rigid quality control and accuracy requirements of the final product. Arc Surveying & Mapping, Inc. currently provides clients with multi-disciplined land and hydrographic surveying services, including, but not limited to, topographic and hydrographic surveys, boundary and right-of-way surveying and mapping, construction layout, dredge quantity measurement, and subsurface probing and demarcation of existing utility lines.

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BCI Engineers & Scientists, Inc.

BCI Engineers & Scientists is a multi-disciplinary environmental and engineering consulting firm that specializes in: Government, Land Development, Water Resources, Mining Services, Geotechnical and Investigative Engineering. With offices throughout Florida and highly qualified professional staff, BCI's focus is developing solutions to complex engineering and environmental challenges for our clients throughout the world. For over 25 years, BCI has maintained a reputation of listening to our clients, understanding their objectives and needs, and communicating frequently to accomplish our assignments professionally, timely and within budget.

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C&S Chemicals, Inc. is a direct manufacturer of water treatment chemicals, specifically Aluminum Sulfate and Sodium Aluminate. Family-owned and family-operated since 1980, C&S prides itself on being the low cost provider for its product line. Having been a leading supplier in the municipal water and wastewater market, C&S hopes to become the go-to chemical source for Lake Management. Centrally located in Bartow, C&S Chemicals has the capability to service the entire state of Florida.

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Cerexagri-Nisso LLC

Cerexagri-Nisso LLC, is a leader in the marketing and manufacturing of Aquatic Herbicides and Algaecides and has been involved in the development and sale of these products for over 40 years. The current product line includes various formulations of Aquathol, Hydrothol and AquaKleen. Committed to the Aquatic Plant Management Industry, Cerexagri supports aquatic research in cooperation with Universities , Federal and State Agencies. This research is dedicated to better Aquatic Plant Management techniques resulting in improved Aquatic Habitat and enhancing future use of Aquatic Resources.

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CONTECH Stormwater Solutions has one mission: to provide you with the best stormwater solution for your site. Our comprehensive line of treatment and detention /retention technologies means optimum choice and design flexibility—and each product comes backed by a dedicated, knowledgeable team of experts. Independently verified test results, extensive field monitoring, and straightforward technical information assure your stormwater requirements will be met. We are your one source for stormwater solutions.

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Dredging & Marine Consultants

Dredging & Marine Consultants, LLC (DMC) is an Engineering firm located in Port Orange, Florida. DMC offers environmental and engineering services with qualified and experienced professionals in the following disciplines:

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Environmental Consulting & Technology, Inc.

Environmental Consulting & Technology, Inc. (ECT), is a professional engineering and scientific services firm headquartered in Gainesville, Florida, with more than 210 personnel in 14 offices. These offices are located in Gainesville, New Smyrna Beach, Orlando, Jacksonville, Melbourne, Tampa, Fort Lauderdale, Tallahassee, and Fort Myers, Florida; Ann Arbor, Brighton, Detroit, and Clinton Township, Michigan; and New Castle, Delaware. ECT personnel have completed hundreds of water-related projects in Florida, which have resulted in a wealth of experience in all phases of engineering, sampling/monitoring, permitting, and planning. This experience has been gained from numerous projects involving studies of lakes, streams, spring and estuarine areas; evaluation of existing surface and stormwater systems and components; collection, analysis, and evaluation of water quality data; modeling and evaluation of urban and rural water resources using various in-house computer models; use of a GIS for mapping and cataloging of data; determination of basin and sub-basin watershed characteristics; development of pollutant loadings; wetland delineation and permitting, and design and development of mitigation systems; fishery studies; determination of water level impacts on ecological systems; identification of BMPs; evaluation of point and nonpoint sources; engineering evaluation and design of stormwater collection and distribution systems; implementation of comprehensive water quality monitoring systems; soil sampling; biological sampling; hydrologic/hydraulic modeling; hydric soil determinations; data management; development of TMDLs; preparation of grant applications and other documents to obtain funding for capital improvements; development of master stormwater plans for governmental agencies; and updating master stormwater plans on a continuing basis. ECT's key personnel have served as expert witnesses on many water resource engineering and permitting projects.

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Environmental Research & Design, Inc. (ERD)

Environmental Research & Design, Inc. (ERD) is an environmental engineering firm which specializes exclusively in projects related to lake management, water quality, and stormwater. Virtually all work efforts performed by ERD involve research projects or studies related to lake restoration, water quality, stormwater management, sediment characterization, and sediment-water column interactions. In addition to engineers, scientists, and design professionals, ERD also maintains a fully equipped research laboratory which is certified by the FDEP and NELAP. ERD owns a wide variety of field monitoring equipment for hydrologic, stormwater, surface water, groundwater, and sediment sampling and analysis. ERD has developed a reputation for a high quality and detailed product completed in a timely manner, and has received awards for technical excellence and innovative stormwater practices.

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EnviroTech Instruments, LLC

EnviroTech is based in Virginia and manufactures in-situ nutrient monitors, samplers and data acquisition systems. Our nutrient analyzers provide self-recorded and continuous real-time / on-line data. Products include single and multi-channel systems in submersible and non-submersible formats. Each unit is fully programmable - including the analysis methods. Parameters include nitrate, nitrite, phosphate, silicate, ammonia, urea and iron. Custom methods can be easily implemented by the user. Our products also host additional sensors to provide complete monitoring systems. We can implement telemetry and "water to web" infrastructure and custom design capabilities allow us to develop new solutions for specific applications.

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Great Lake Bio Systems, Inc. & MixAir Tech

Great Lakes Bio Systems, Inc. (GLB) is the manufacturer and supplier of Bacteria, Trace Minerals, broad based non-bacterial Enzymes and other products. GLB is at the forefront in providing environmentally safe solutions for the conscientious aquatic manager or private lake or pond owner. MixAir Technologies (MAT) is the manufacturer of the most efficient and economical line of small bubble diffusers on the market today. MAT has a diffuser to fit any performance or economic criteria for your lake or pond. The GLB and MAT product lines were designed to work together in order to create a healthy and friendly aquatic environment. No other company offers such a diverse line of environmentally friendly products to meet the needs of aquatic management.

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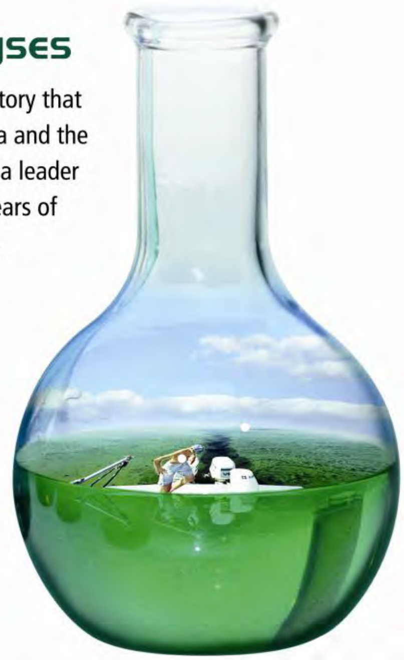
GreenWater laboratories **Cyano LAB**

Phytoplankton and Algal Toxin Analyses

GreenWater Laboratories/CyanoLab (est. 2001) is a private analytical laboratory that specializes in the identification and quantification of toxigenic cyanobacteria and the toxins they produce. GWL/CL is nationally and internationally recognized as a leader in the field of toxigenic cyanobacteria analyses. GWL/CL staff has over 50 years of cumulative experience in the fields of aquatic biology, limnology, phycology, aquatic toxicology, analytical chemistry, and cyanotoxin analyses.
The mission at GWL/CL is to provide timely and accurate information to lake managers to promote safe water quality for the ecology of freshwater systems as well as recreational and drinking water resources.



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Jahna Dredging Inc.

Jahna Dredging, Inc. is a contract, maintenance and environmental dredging company based in Lake Wales, Florida. Services include lake dredging: sediment processing and dewatering: and canal and water body dredging and restoration. Jahna Dredging, Inc. is a wholly owned subsidiary of E.R. Jahna Industries, Inc, an aggregates mining company with operations throughout the Southeast. Jahna has over 50 years of experience in hydraulic dredging and sediment processing, including materials such as organic muck, sand, clay, and mine tailings. Jahna works closely with Florida cities and county agencies on a variety of lake, canal and river restoration projects.

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JAHNA DREDGING INC.

J.F. Brennan Co.

J.F. Brennan Company has provided marine construction services for over 85 years. Over the past 15 years Brennan has focused on lake and waterways management services including integrated dredging and dewatering, erosion and scour protection as well as structural repairs to shorelines and dam structures. Recently, Brennan completed a muck removal project at Lake Osborne in Palm Beach County where we segregated the sand and fine grain muck and dewatered the materials. After dewatering, the dewatered materials were beneficially reused as organic fill on local golf courses. At the time of this FLMS Conference, using this same ID&D® Integrated Dredging and Dewatering System, Brennan is performing the same services on the C-51 Canal in Palm Beach County. Of particular interest on this project, Brennan is using the output of a high-tech sub-bottom survey performed by Hibbard Inshore to guide the dredge to remove only the muck material. The sub-bottom survey mapping system is extremely accurate and provides a signature and location of all sub-bottom sediment layers.

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HydroMentia Inc. is a water pollution control company specializing in Managed Aquatic Plant Systems (MAPS) for nutrient pollution control. The HydroMentia Team pioneered the development of Algal Turf Scrubber® (ATS™) and Water Hyacinth Scrubber (WHS™) treatment technologies. These proven water treatment methods optimize biological nutrient removal through engineered system design. HydroMentia staff, with nearly 75 years combined experience, includes several of the nation's leading experts in the development and operation of commercial scale MAPS.

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HydroMentia
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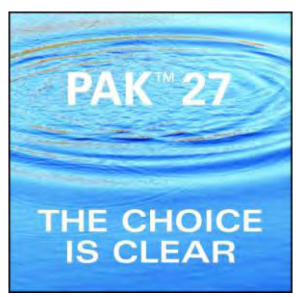

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Conference Theme:
Managing Our Lakes, Reservoirs, and Rivers

Naples Grande Resort and Club – Naples, Florida
June 4-7, 2007

FINAL PROGRAM

MONDAY - JUNE 4, 2007

7:00 am	Exhibitor Set-Up (Orchid 3, 4, & Foyer)
8:00 am-5:00 pm	Check-In and Registration (Royal Palm Foyer East)
8:00-11:45 am	**Workshop 1: It Takes A Community, The Public Side of Environmental Restoration Projects; and Speaking for Success: How to Prepare and Deliver A Clear Message to Your Audience (Royal Palm 7).** (Coordinators: Kelli Hammer Levy and Melissa Harrison, Pinellas Co. Dept. of Environmental Management and Russ Hoffman, Beautiful Ponds Co.)
8:00-11:45 am	**Workshop 2: Use of Alum in Lake Management (Royal Palm 8).** (Coordinator: Harvey H. Harper, Environmental Research & Design, Inc.)
8:00-11:45 am	**Workshop 3: Aquatic Plant Identification and Monitoring (Orchid 1).** (Coordinators: Ed Harris and Amy Giannotti, Florida Dept. of Environmental Protection)
8:00-11:45 am	**Workshop 4: Identifying and Managing Exotic Species in Aquatic Environments (Orchid 2)**. (Coordinator: Shannon Carter Wetzel, Seminole Co. Public Works)
9:30-10:00 am	MORNING REFRESHMENT BREAK
12:00-1:00 pm	LUNCH (provided with Workshop registration, Acacia 4, 5, 6)
1:15-4:00 pm	**Workshop 5: Identifying Common Freshwater Phytoplankton (Royal Palm 7).** (Coordinators: John Burns and Ann Shortelle, MACTEC Engineering and Consulting, Inc.)
1:15-4:00 pm	**Workshop 6: Using GIS and GPS as Part of a Low Budget Lake Assessment Approach (Royal Palm 8).** (Coordinators: Jim Griffin and Sara Koenig, University of South Florida – FCCDR)
1:15-4:00 pm	**Workshop 7: Using Florida's Water Birds to Monitor Wetland Restoration Success (Orchid 1).** (Coordinators: Jim Peterson, Pam Bowen and Erich Marzolf, St. Johns River Water Management District.)
1:15-4:00 pm	**Workshop 8: Lake Management Planning and Plans for Small Lakes (Orchid 2).** (Coordinators: Jason Mickel, Hillsborough Co. Public Works; and Anamarie Rivera and Amy Lambert, Pinellas Co. Environmental Management)
3:00-3:15 pm	AFTERNOON REFRESHMENT BREAK

TUESDAY - JUNE 5, 2007

8:00 am-4:00 pm	Check-In and Registration (Royal Palm Foyer East)	
8:00 am	Breakfast	
9:00-9:20 am	Opening Remarks: (Orchid 1 & 2)	John Burns – FLMS President Ken Wagner – NALMS President Chuck Hanlon/Todd Olson – FLMS Conference Chairs Mike Coveney - FLMS Program Chair

Session 1: Lake and Reservoir Management Part 1 (Orchid 1 & 2)
Moderator: Mike Coveney

9:20-9:40 am **Is This Lake Really Impaired?** – David Eilers, James C. Griffin, and Kimberly Koenig

9:40-10:00 am **Of Conspiracy Theories and Lakes: Careful, Some of Them Might Be True** – Clell J. Ford

10:00-10:20 am **The Keys To Successful Lake Management: An Irreverent Look at a Serious Topic** – Ken Wagner

10:20-10:40 am Discussion

10:40-11:10 am MORNING BREAK (Exhibit Hall, Orchid 1-2 Foyer)

Session 2: Lake and Reservoir Management Part 2 (Orchid 1 & 2)
Moderator: Mike Coveney

11:10-11:30 am **The Florida Atlas of Lakes: A New Tool for Managing Lakes in Florida** – Ron Chandler, Jim Griffin, Rich Hammond, Kevin Kerrigan, Shawn Landry, and Jason Scolaro

11:30-11:50 am **One of These Canals Is Not Like The Others: Unique Chemistry for a Lake Istokpoga Residential Canal** – Erin M. McCarta and Clell Ford

11:50-12:10 pm **A Comparative Analysis of Lake Alice and Lake Island Ford: Methods and Results of a Low-Cost Diagnostic Lake Assessment Protocol** – David Eilers, Jim Griffin, and Sarah Koenig

12:10-12:30 pm **Ken Wagner (NALMS President) – NALMS Status Update**

12:30-2:00 pm LUNCH (Sunset Deck)

TUESDAY – JUNE 5, 2007 (Continued)

Session 3: Fish, Plankton and Lake Food Webs (Orchid 1 & 2)
Moderator: Karl Havens

2:00-2:20 pm	**Hurricane Impacts on the Littoral Fish Community at Lake Okeechobee, Florida** – Mark Rogers and Micheal S. Allen
2:20-2:40 pm	**Long-Term Plankton Monitoring of Lake Okeechobee, Florida: Trends in Crustacean Zooplankton Populations and Comparison to Other Shallow Subtropical Lakes** – John R. Beaver, Karl E. Havens, and Therese L. East
2:40-3:00 pm	**Fish and Shellfish Impingement and Entrainment Patterns on the Florida Panhandle** – J.H. Neese, R.M. Markey, H.R. Hammers, J. Debicella, and A.B. Shortelle
3:00-3:20 pm	**Persistent Effects of a Severe Drought on Zooplankton in Lake Okeechobee, Florida** – Karl E. Havens, Therese L. East, and John R. Beaver
3:20-4:20 pm	AFTERNOON BREAK & POSTER SESSION (Orchid 1-2 Foyer, Orchid 3-4)

Session 4: Posters
Moderator: Ann Shortelle

Small Pond Management in the City of Winter Park, Florida – Timothy J. Egan

Taylor Creek Algal Turf Scrubber Nutrient Recovery Facility for Phosphorus and Nitrogen Control in Okeechobee, Florida – Mark J. Zivoinovich, E. Allen Stewart, Robinson Bazurto, and Kimberleigh Dinkins

An Experimental Analysis of Probability–Based Sampling Regimes – Todd Tietjen

The Water Atlas Adopt-A-Pond Component: A New Tool For Managing Stormwater Ponds in Florida – Ron Chandler, Jim Griffin, Rich Hammond, Kevin Kerrigan, Jason Scolaro, Karen Dufraine, and Shawn Landry

Habitat Management Through Spatial Database Design – Jim Griffin, Rich Hammond, Keven Kerrigan, Jason Scolaro, Karen Dufraine, Jessica Atwell, Greta Klungness, and Michelle McIntrye

An Innovative Approach to Database Management – Lori McCloud, Steve Richter, Dean Dobberful, Michelle Jeansonne, and Brian Sparks

Hydrilla Detection Device for Wetland Surveys in Dark Water – Mandy Livingston-Calley, Jennifer Tallerico, Lori Mccloud, and Pam Livingston

Identification of Common Phytoplankton in Florida Lakes – John Burns and Ann Shortelle

Reducing Phosphorus Loading From a Wetland Restoration Project With a Mobile Alum Injection System – V.R. Hoge, E.R. Marzolf, R. Naleway, T. Debusk, T. Auter, and F. Dierberg

TUESDAY – JUNE 5, 2007 (Continued)

Posters (continued)

Mercury and Index of Biological Integrity for Fish on the North Fork Holston River, VA and TN – E. Curtis, A. Shortelle, and H. Fogell

The Status of International Regulations and Guidelines for Human Exposure to Cyanobacteria – John Burns

4:20-5:00 pm	FLMS Chapter meeting and NALMS SE meeting (Orchid 1 & 2)
5:00-6:00 pm	NALMS 2007 Committee Meeting (Orchid 1 & 2)
6:00-7:30 pm	Exhibitors' Social (Orchid 3-4 Foyer)

Wednesday - June 6, 2007

8:00 am-3:00 pm Check-In and Registration (Royal Palm Foyer East)

7:30 am Breakfast

Session 5A: Nutrient Dynamics in Shallow, Eutrophic Lake Jesup, FL. (Orchid 1)
Moderator: Sherry Brandt-Williams

8:20-8:40 am **Hydrologic and Water Quality Modeling of the Lake Jesup Watershed Using Hydrological Simulation Program–Fortran (HSPF)** –Yanbing Jia

8:40-9:00 am **Watershed Loadings Into Lake Jesup Using the Event Mean Concentration (EMC) Based PBS&J Pollutant Loading Model** – Joe Walter

9:00-9:20 am **Water Quality Modeling of Lake Jesup Using Qual2K** – Scott A. Lowe

9:20-9:40 am **Measuring Sediment Nutrient Fluxes and Sediment Oxygen Demand In Lake Jesup** – Scott A. Lowe and Gloria Eby

9:40-10:00 am **Assessment of the Importance of Nitrogen Fixation on the Whole Lake Nitrogen Budget for Lake Jesup** – D.A. Tomasko, J.P. Montoya, and T.K. Frazer

10:00-10:20 am **Looking for Correlations in a Lake Without Limiting Nutrients** – Sherry Brandt-Williams

Session 5B: Integrated Watershed Management Part 1 (Orchid 2)
Moderator: Kelli Hammer Levy

8:20-8:40 am **Integrating Lake and Stormwater Management Programs for Maximum Water Quality Benefits** – Timothy J. Egan

8:40-9:00 am **Phosphorus Load Reduction Measures on Existing and Former Dairy Properties in the Lake Okeechobee Watershed** – James A. Laing

9:00-9:20 am **St. Paul Regional Water Services Reservoirs and Watershed Restoration Program** – David Schuler

9:20-9:40 am **Evaluation of Stormwater Reuse on a Typical Single Family Residential Parcel** – Jeffrey L. Herr

9:40-10:00 am **The Use of Conceptual Ecosystem Models In Determining the Effects of Future Land Development and In Developing Management Strategies to Decrease Impact on Natural Resources: Big Cypress Region, FL** – Nellie E. Morales

10:00-10:20 am **Irrigation with Recycled Wastewater – Good Intentions Gone Awry? –** Harvey H. Harper

10:20-10:50 am MORNING BREAK (Orchid 3-4 Foyer)

Session 6A: Vegetation Management and Restoration (Orchid 1)
Moderator: Dean Dobberfuhl

10:50-11:10 am	**Use of Biocontrol Insects to Control Invasive Aquatic Plants** – Charles E. Ashton
11:10-11:30 am	**The Impact of Fluridone on Target and Non-Target Plant Species: Data From Monitoring of Actual Lake Treatments** – Ken Wagner
11:30-11:50 am	**Vegetation Management on a Private Lake** – David Glicksberg, Jason Mickel, David Ellers, James Griffin, and Sarah Koenig
11:50-12:10 pm	**Vegetated Shorelines Promote Healthy Fisheries** – Matthew Kerkhof

Session 6B: Integrated Watershed Management Part 2 (Orchid 2)
Moderator: Harvey Harper

10:50-11:10 am	**A Reason Assurance Plan for Lake Seminole in Pinellas County Florida – An Alternative to a TMDL** – Kelli Hammer Levy, Doug Robison, Dave Tomasko, and Emily Hyfield
11:10-11:30 am	**Lake Josephine Aquatic Habitat Enhancement: Using the Tools in the Toolbox** – Beacham Furse and Larry Davis
11:30-11:50 am	**Lake Seminole – A Living Laboratory for Assessing the Effectiveness of Multiple Lake Management Actions** – Kelli Hammer Levy and Doug Robison
11:50-12:10 noon	**Butler Chain of Lakes Hydrologic/Nutrient Budgets & Lake Management Plan** – Harvey H. Harper and Sergio Duarte
12:10-2:10 pm	BANQUET LUNCH / FLMS Business Meeting (NALMS Discussion) Vista Dining Room

Session 7A: Dynamics of Submersed Aquatic Vegetation (Orchid 1)
Moderator: Dean Dobberfuhl

2:10-2:30 pm	**Using Hyperspectral Imagery to Detect Submerged Aquatic Vegetation in the St. Johns River** – Courtney Hart, Dean Dobberfuhl, and Jonathan Jordan
2:30-2:50 pm	**The Effects of Shading on Pistillate *Hydrilla Verticilla* (L.F.) Royle Transplants from Lake Okeechobee, Florida, USA** – H.J. Grimshaw
2:50-3:10 pm	**The Role of Sediments in the Post Hurricane Recovery of Lake Okeechobee** – R. Thomas James, Daniel R. Engstrom, and Shawn P. Schottler
3:10-3:30 pm	**The Influence of Water Depth and Vegetation Management Activities on Giant Bulrush in Lake Okeechobee** – Chuck Hanlon

Wednesday – June 6, 2007 (Continued)

Session 7B: Policy and Regulation (Orchid 2)
Moderator: Shannon Carter-Wetzel

2:10-2:30 pm	**Regulatory Considerations for Wetlands in the Southwest Florida Water Management District** – Jennifer Brunty
2:30-2:50 pm	**The Proposed Reclassification of Florida's Surface Waters: Scientific Basis and Policy Implications** – Edgar F. Lowe and A.B. Shortelle
2:50-3:10 pm	**Florida Game and Freshwater Fish Commission – New Funding Initiatives** – Bruce V. Jaggers
3:10-3:30 pm	**NPDES Phase II Permits – MS-4 and Construction Activity Summaries** – Patricia Tierney
3:30-4:00 pm	AFTERNOON BREAK (Orchid 1-2 Foyer)

Session 8A: Dredging for Lake Restoration (Orchid 1)
Moderator: Mike Perry

4:00-4:20 pm	**The Evolution of Sediment Removal Technology for Restoring Subtropical Lake Systems in Land-Limited Landscapes** – John Kiefer and Walter R. Reigner
4:20-4:40 pm	**Lake Hancock Sediment Removal Mesocosm Experiment - Preliminary Results** – Dave Tomasko, Emily Hyfield, and Doug Robison
4:40-5:00 pm	**Removal of Organic Bottom Sediments from Lake Maggiore Utilizing an Integrated High Capacity Hydraulic Dredging and Rapid Mechanical Dewatering System** – Gary Drake and Kirk Davis

Session 8B: Ground Water – Surface Water Interactions (Orchid 2)
Moderator: Sean McGlynn

4:00-4:20 pm	**Shallow Groundwater Nutrient Dynamics in the Lower St. Johns River Basin** – Ying Ouyang
4:20-4:40 pm	**Sources of Nitrate in the Wekiva River Basin** – W.A. Tucker, S.A. Rizzo, N.M. Goodwin and R. A. Mattson
4:40-5:00 pm	**Karst Lakes and Nutrient Loading to the Aquifer** – Sean McGlynn

THURSDAY- JUNE 7, 2007

7:30 am Breakfast

10:30 am-12:00 noon Exhibitor Breakdown

Session 9: Streams and Rivers (Orchid 1 & 2)
Moderator: Clell Ford

8:20-8:40 am **Invertebrate Community Patterns Associated with Land Use Influenced Changes in Organic Matter Loading in Tributaries of the Lower St. Johns River** - Dean R. Dobberfuhl, Michael A. Chadwick, Alex D. Hury and Arthur C. Benke

8:40-9:00 am **Environmental Challenges for a Sustainable Water and Energy Future** – Virgil Hobbs

9:00-9:20 am **Battle Bend Slough Restoration, Apalachicola River (Liberty County, FL)** – Michael J. Hill

9:20-9:40 am **Climatic Cycles and Their Effect on Florida Rainfall and River Flow** – Martin Kelly

9:40-10:10 am MORNING BREAK (Orchid 1-2 Foyer)

Session 10: Comprehensive Everglades Restoration Project (CERP) (Orchid 1 & 2)
Moderator: Bruce Sharfstein

10:10-10:30 am **CERP Adaptive Management: Sustainability of a Longterm Monitoring and Assessment Effort in the Comprehensive Everglades Restoration Plan** – Greg Graves

10:30-10:50 am **The Importance of Long-Term Monitoring Data in Developing and Assessing CERP Performance Measure Goals and Targets for Lake Okeechobee** – Andrew J. Rodusky

10:50-11:10 am **Balancing Sustainability with Scientific Rigor: An Example from the Greater Everglades Wetlands CERP Module** – Jana M. Newman and Greg Graves

11:10-11:30 am **Lake Worth Lagoon Salinity Variability and Its Remediation –** Miriam Barranco, Jason Moretz, and Jim Bolleter

11:30-11:45 am Concluding Remarks: Clell Ford – FLMS President 2007/08

11:45 am-12:45 pm FLMS Board Meeting (Orchid-1)

SESSION 1

LAKE & RESERVOIR MANAGEMENT
PART 1

IS THIS LAKE REALLY IMPAIRED?

David Eilers, James C. Griffin and Kimberly Koenig
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Tampa, FL
Jason M. Mickel
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Tampa, FL

Purpose and Scope

This paper presents results of lake assessments conducted between May and August of 2006 on twenty four Hillsborough County (County) Lakes and comments on the findings for lakes that are presently listed by the Clean Water Act Section 303 (d) Impaired Water's List (303(d).

Method and Approach

Both the University of Florida's LAKEWATCH program (UF) and the University of South Florida's Water Atlas Lake Assessment program (USF) conduct lake assessments that include lake morphology (bathymetry and shoreline mapping), biology (plant biology) and lake water chemistry (water column chemistry). Both programs have recently adopted procedures which allow a more rapid collection and analysis of these data. These new methods make it feasible to calculate the trophic state index (TSI) based on both lake water chemistry and lake water chemistry with the contribution of plant-bound nutrients. These calculations are based on earlier work by Canfield and Hoyer (2000). The USF program includes a summary of the results of the assessment in lake assessment reports which are published on the Hillsborough Water Atlas (www.hillsborough.wateratlas.org). The reports review trends in water quality with predictions of the trophic state index based on water column chemistry alone as well as with the potential contribution from existing plant biomass.

Between May 2006 and September 2006, USF conducted twenty-four assessments of lakes grouped by watersheds across the County. Our initial results demonstrate a large difference in lake water quality and plant diversity both between regions and within regions. These data also demonstrate that water column chemistry alone is not an adequate determinant of the health of a lake and that other factors that are allowed in the current Impaired Waters Rule (IWR) should be used for adding or removing a lake from the 303 (d) verified list.

Results and Discussion

Five lakes assessed in 2006 that were also listed in the 303 (d) verified list as impaired were selected for review. Table 1 lists these lakes. The questions asked in this review are: (1) would the overall assessment of the lake indicate impairment; (2) does the column water chemistry indicate impairment; (3) do submerged vegetation play a major role in maintaining nutrient balance and what is the estimated nutrient contribution and (4) given that the lake is impaired, what should be done. For question 1 we consider, based on our assessment, if the lake meets its intended use (Class III waters). Question 2 is solely based on water chemistry at the time of assessment; however, trend data is also included. Question 3 is based on the results of the vegetation assessment conducted as part of the lake assessment and includes the calculation of TSI based on water chemistry and submerged nutrient biomass. Question 4 is based on the assessment and other watershed and demographic factors. Table 2 provides the nutrient (including TSI and TSI adjusted for biomass) results of lake assessments on the six study lakes. These and other results from the lake assessments will be used to answer the four questions posed above. All the lakes are clear water lakes and by the current rule must have a TSI less than 40 to be not considered impaired (based on criteria established in F.A.C 62.303).

Table 1 Group 1 Basin Lake Assessed in 2006 that were listed as impaired

Lake	**IWR Basin Group**	**303 (d) Listed**	**Impairment**	**Concentration Causing Impairment**		Limiting Nutrient
				Nitrogen	**Phosphorus**	
Calm	1	x	Nutrient	0.33	0.01	N and P
Carroll	1	x	Nutrient	0.44	0.02	N and P
Crescent	1	x	Nutrient	0.65	0.01	N and P
Magdalene	1	x	Nutrient	0.67	0.01	N and P
Mound	1	x	Nutrient	0.45	0.01	N and P

The lake assessment nutrient chemistry results show single case impairment for two lakes and a potential for three lakes to become impaired by that criteria. Additional sampling for at least three of the lakes may provide adequate evidence to remove them from the 303(d) verified list. Lake Crescent should be a lake of concern for the County and consideration for restoration, especially restoration of submerged aquatic plant communities is recommended.

Table 2 Nutrient results from 2006 Lake Assessment for five impaired lakes

Lake	**IWR Basin Group**	**303 (d) Listed**	**Impairment**	**Concentration Causing Impairment**		Limiting Nutrient	**TSI**	**TSI Adj**
				Nitrogen	**Phosphorus**			
Calm	1	x	Nutrient	0.41	**0.022**	P	42.92	44.72
Carroll	1	x		0.45	**0.023**	P	35.92	38.04
Crescent	1	x		0.94	**0.035**	P	52.32	52.75
Magdalene	1	x		1.07	**0.014**	P	37.25	40.79
Mound	1	x		0.52	**0.02**	P	38.45	43.48

Conclusion

A lake assessment for lakes between 50 and 250 acres requires one day or less to accomplish while those between 250 and 1000 acres take between two and three days to complete using our current methods. The results can assist a County in make critical decisions concerning future management of their lakes.

References

Canfield and Hoyer, *J. Aquat. Plant Management*, 38: 2000.

OF CONSPIRACY THEORIES AND LAKES: CAREFUL, SOME OF THEM MIGHT BE TRUE

Clell J. Ford
Highlands County Natural Resources Department
Sebring, FL

Regionally, the Lake Wales Ridge is experiencing lower rainfall for 2006 – 2007 than have been seen in several years, in some cases lower than during the 2000 – 2001 drought. This has led to lower lake levels than experienced in the active tropical seasons of 2004 and 2005. A long held theory among locals is that the channelization of the Kissimmee River, completed in 1971, has resulted in lower lake levels throughout the southern Lake Wales Ridge. The Central and Southern Florida Flood Control Project converted 103 miles of meandering river prone to flooding its 48,000 acres of associated wetlands to a 56-mile long flood control canal. Since 1971, lake levels for several similar lakes on the southern Lake Wales ridge have been depressed from 0.1’ to 5.6’ on average compared with the period before 1971; in this rather crude analysis, lakes further north had the greatest deficit.

This presentation compares average annual lake fluctuations for 1940s-1970 with 1971-2006 for Crooked Lake and Lake Arbuckle in Polk County and lakes Lotela, Jackson, June-in-Winter and Placid in Highlands County. It also compares regional stream flows and regional rainfall records for these same time periods which bracket the channelization of the Kissimmee River. This analysis also considers factors including local hydrologic changes, and hemispheric hydrologic cycles that have influenced the hydrology of southern Lake Wales Ridge Lakes over the past 60 years. Whatever the cause water chemistry data for these lakes show that lakes with greater fluctuation ranges have healthier water quality.

NOTES

THE KEYS TO SUCCESSFUL LAKE MANAGEMENT: AN IRREVERENT LOOK AT A SERIOUS TOPIC

Ken Wagner, Ph.D
ENSR
Willington, CT

Lake management is a highly interdisciplinary field of endeavor; one must have a firm grasp of relevant science, economics and socio-political issues to achieve success. The "standard" approach to successful lake management can be summarized as follows:

- Set realistic goals
- Involve all relevant parties
- Apply sound science
- Prevention with any rehabilitation
- Organize, prepare, anticipate
- Focus and persevere
- Adequately fund actions
- Publicize and recognize
- Monitor and follow up

The above are all key steps, but make for a boring talk. This more humorous and hopefully more memorable presentation summarizes the key elements in terms of openness:

- Open process – inclusive, fair, comprehensive – everyone needs a seat at the table, no matter how incompatible they may seem with the desires of any other group. The process is educational as well as consensus-building, and all interested parties need to be involved. Illustrations are provided.
- Open minds – evaluate without prejudice; there is almost always more than one valid position on an issue, and more than one way to solve a problem. Clinging to a view with no consideration for alternatives is a huge stumbling block in most processes. Getting interested parties to see opposing points of view and seek rational compromise or even adopt previously opposed positions is a very daunting task, but is achievable within the right framework.
- Open lake – private property vs. public opportunity – a very controversial area, the tragedy of the commons is a highly applicable concept to lake management. Private ownership has issues as well, however, as water is not really amenable to treatment as a commodity; ownership is transient and invasive species and related issues make property lines irrelevant in many management contexts.
- Open checkbook – you get what you pay for, or less – first an most critically, spend the money to get useful and adequate data for making management decisions. Then follow the plan and don't cut corners to save a few dollars. Consider long-term costs, not just immediate capital outlay.
- Open ended management – no clear endpoint, follow-up needed – lake management is like landscape management; one-time actions rarely last, and refinement, upkeep, and adjustment are to be expected.

This talk lays out the premises of lake management within the context of “openness” as a theme in a humorous manner that will let you laugh at others and yourselves while coming to grips with the major factors that have to be addressed if we are to successfully manage lakes and their watersheds. Lake management is a process, not an endpoint, and requires multiple steps, applied iteratively and properly. A number of helpful tips are offered to assist practitioners in achieving success, in a short time and with enough imagery to help those who view it to remember it.

NOTES

Monitoring and Mitigating Cyanobacteria

James E. F. Morgan
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Cyanobacteria (blue-green algae) are unique, some say mysterious, primitive and troublesome organisms. They are difficult to monitor, difficult to predict, and even more difficult to eradicate. Understanding cyanobacteria ecology, dynamics of bloom formation, and mitigation techniques is critical to preventing unwanted blooms that cause taste, odor, and often toxin problems. A focus on monitoring and identifying algal species early is essential for ecologically safe treatment. Research confirms that we have no sure method to predict the severity and duration of blooms or the presence and concentration of cyanotoxins. Toxicity cannot be determined visually. Monitoring source water for cell count/ID, cyanotoxins, and phycocyanin fluorescence validates cyanobacteria presence. Monitoring for chlorophyll a, DO, pH, total phosphorous, and other criteria only suggests the presence of cyanobacteria. Establishing baseline data, using consistent real-time surveillance and early treatment are the keys to success. An environmentally safe approach using early treatments of PAK™27 algaecide to "prune the bloom" before they become problematic is a safe, ecologically sound way to mitigate cyanobacteria blooms and their toxins.

NOTES

Session 2

Lake & Reservoir Management
Part 2

The Florida Atlas of Lakes: A new Tool for Managing Lakes in Florida

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Florida Center for Community Design and Research (FCCDR), University of South Florida
Tampa, FL

Purpose and Scope

This paper presents the design of the soon to be implemented "Florida Atlas of Lakes" Water Atlas website. This project is a cooperative effort between USF-FCCDR, UF-LAKEWATCH and the Florida Lake Management Society. This new addition to the Water Atlas Portal (www.wateratlas.org) will provide spatially managed LAKEWATCH data for all LAKEWATCH lakes in Florida.

Design Methods and Approach

The Water Atlas Program at the University of South Florida provides spatially attributed water resource data via the World Wide Web to a nine county region stretching between Pinellas County on the west coast and Seminole County and, soon, Volusia County on the East Coast and Leon County in the Florida Panhandle. The extension of the benefits of the Water Atlas to all the citizens of Florida has always been a major goal of the Water Atlas program. However the program has not had the manpower, funding or technology to achieve this goal. A combination of new designs and new technologies has now made this goal possible. The first requirement was to replace the current multiple atlas-specific databases and code bases with a single spatial/nonspatial database and a single code base. This was achieved by the "One Atlas" design shown in Figure 1. The new technologies include Microsoft DotNet programming language, ArcIMS 9.2, the newest ESRI internet management system and new Google mapping technologies. The One Atlas approach will not only make the Water Atlas more efficient and effective, but it will reduce the time that individual staff must spend on a single project, thus increasing effective staff. This year we will make a small step in that direction with the Florida Atlas of Lakes. While this new statewide atlas will not have the full functionality of a county Water Atlas, it will, have the spatial reach and database functionality that are needed to effectively manage a statewide program like Florida LAKEWATCH.

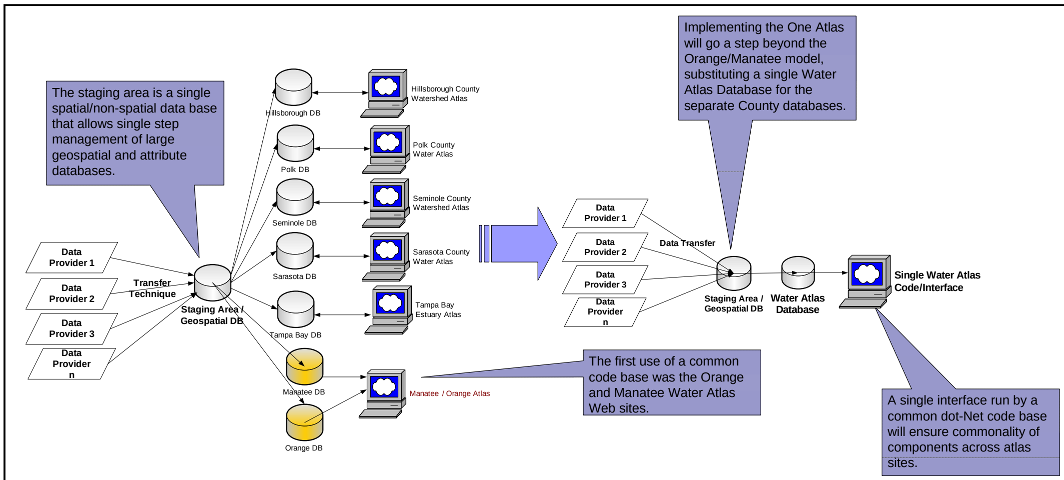

Figure 1. Existing (left) and future (right) Water Atlas conceptual designs.

Water Atlas projects manage and deliver all-source data through a map interface (spatially managed data). The key to this process is an accurate relationship between the data site and the waterbody with which the site is associated. LAKEWATCH sites are spatially matched to map themes based on the 1:24,000 scale National Hydrology Database (NHD). Additional map themes are then added to the base map to create the ArcIms map that is used to drive the spatial/nonspatial database. Figure 2 shows Water Atlas web-based map with the Florida Atlas of Lakes Themes added. Additional themes, including the 2004 aerials, will be added as the project matures.

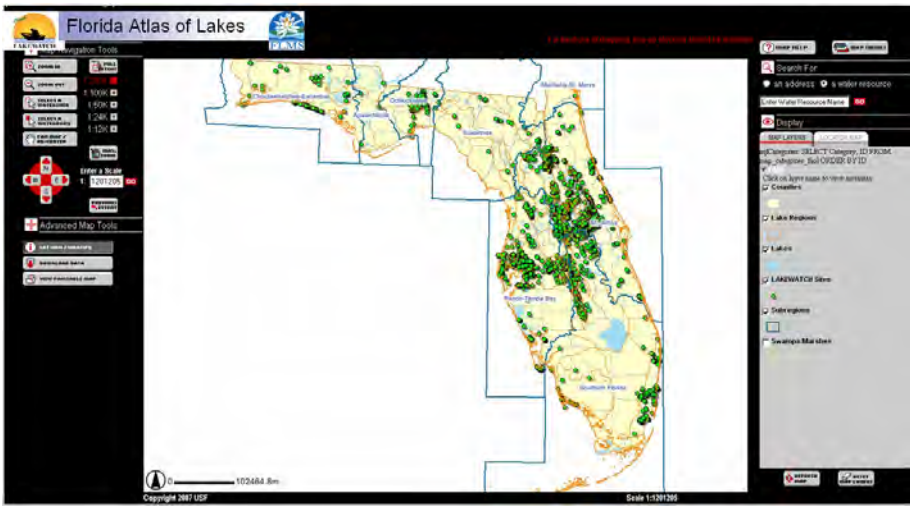

Figure 2. ArcIms map page showing site them, NHD lake and sub-region themes, Florida Lake Regions and Counties.

Data is managed and displayed on water resource pages. The Florida Atlas of Lakes web page structure will include over 600 resource pages and a main or program page (Figure 3). Both page types are managed through a web page administration function that will be used by volunteers and LAKEWATCH coordinators to personalize text and add photos and communicate via announcements and web-based forms.

Figure 3. Florida Atlas of Lakes program page.

Conclusion

When implemented in October 2007, the Florida Atlas of Lake will allow the citizens of Florida to better understand and appreciate the important work that is done on their behalf by the Florida LAKEWATCH volunteers.

ONE OF THESE CANALS IS NOT LIKE THE OTHERS: Unique Chemistry for a Lake Istokpoga Residential Canal

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Lake Istokpoga is the fifth largest lake in Florida, at an impressive 27,692 acres, and is considered the crown jewel of Highlands County. From April 2005 to February 2006, the South Florida Water Management District tasked Highlands County with conducting a year long intensive water quality investigation on Lake Istokpoga, for which a private contractor was chosen to complete the sampling and analysis.

The results of this study highlighted a few areas of concern as well as some unusual and unique outliers. A residential canal near the south end of the lake, the Rutledge Canal, has provided the most interesting data. The water in this particular canal has characteristics that are considerably different from all the other 41 sample sites, as well as from the other eight residential canal sites. Found at this site was the highest concentration of Total Phosphorus, the lowest concentrations of Sulfate, Magnesium, and Calcium, and field parameters that measured far outside what other similar sites were producing.

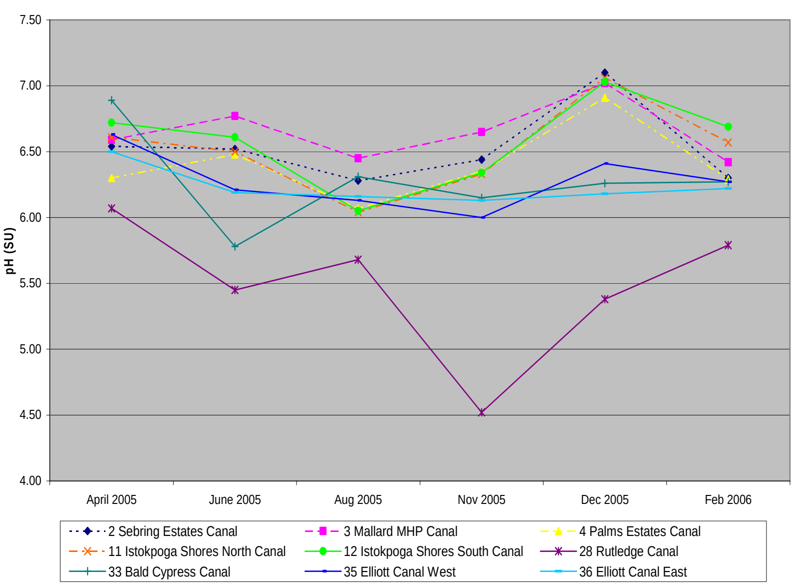
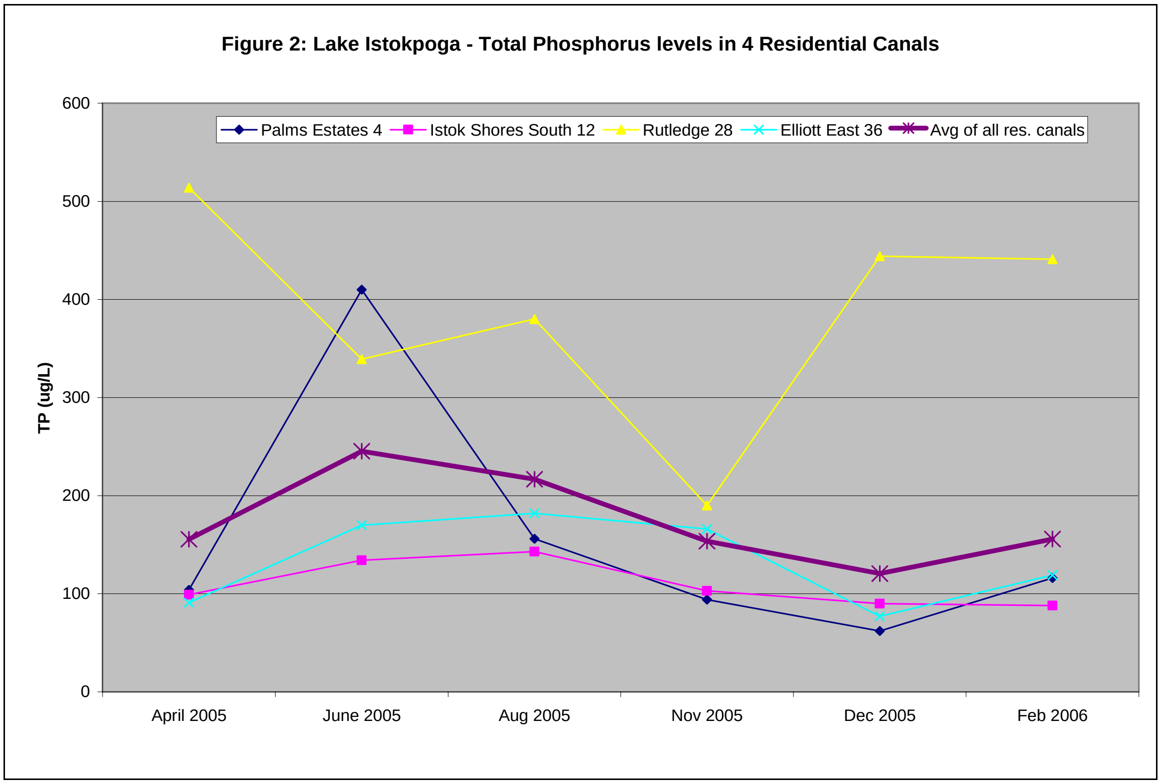


Figure 1: Lake Istokpoga - pH Value Comparison across one year for all residential canal sites

A comparison of pH values for all residential canal sites shows the Rutledge Canal site having values substantially lower than the others (Figure 1). The Rutledge Canal site also exhibits similar comparisons for the parameters of magnesium, calcium and sulfate. Another field parameter shown considerably lower at the Rutledge site compared to similar sites is specific conductivity.

Alternatively, total phosphorus concentrations at the Rutledge site is the parameter which is most times shown at levels higher than the average of all residential canals (Figure 2). Four of the nine residential canal sites, one in each quadrant of the lake, were chosen for this comparison. Total Phosphorus is a nutrient which is highly scrutinized in Lake Istokpoga due to its large contributions to waterbodies downstream, including Lake Okeechobee. Although the total phosphorus loading from the stream which feeds the Rutledge Canal is small in comparison to other contributors to Lake Istokpoga, it remains a curious activity.



Further investigation of these unusual results included collecting water quality samples within the stream that contributes flow to the canal. There has been no single source of water identified and no unusual activities occurring upstream that would explain the unique chemistry. It has not been proven that the chemical activity within this canal contributes substantially to Lake Istokpoga's overall health, but it may have localized impact to vegetation and fish.

NOTES

A COMPARATIVE ANALYSIS OF LAKE ALICE AND LAKE ISLAND FORD: METHODS AND RESULTS OF A LOW-COST DIAGNOSTIC LAKE ASSESSMENT PROTOCOL

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A five-year research effort is currently underway to conduct diagnostic assessments of 150 lakes located within Hillsborough County. The Florida Center for Community Design and Research (FCCDR), with support from the Hillsborough County and the Southwest Florida Water Management District, uses a revised approach to assess the ecological health and morphology of lakes. The primary goals of the lake assessments are: (1) to determine the current state of each lake in terms of trophic state, vegetative cover, and presence of nuisance vegetation and (2) to determine the potential for future changes to the trophic state from stormwater runoff and lake management practices. The data collected from these assessments are summarized in reports and made available to stakeholders at WaterAtlas.org.

The use of new, low-cost spatial technology allows for the diagnostic assessment of a lake with one day of field work and minimal pre- and post-processing. This paper examines this revised assessment approach and includes results from Lake Island Ford and Lake Alice. Lake Island Ford and Lake Alice are located in the Brooker Creek Watershed in the Keystone Lakes Region of Northwestern Hillsborough County. This region has experienced significant urbanization in recent years.

Bathymetric data is collected with a Lowrance LCX 26C HD Wide Area Augmentation System enabled Global Positioning System (WAAS-GPS) with fathometer (bottom sounder) to determine the boat's position and bottom depth in a single measurement. The advantages of this low-cost 'fish finder' include its ability to collect hard (bottom depth) and soft (vegetation) returns and a dual geographical / sonar display. This data is used to understand the morphology (perimeter, volume, bathymetry, etc.) of the lake and to determine the percent area covered (PAC) and percent of the available volume of the lake infested (PVI) with submerged vegetation. GIS is used both in the field and office to increase the effectiveness of data collection and reduce the post-processing of field-derived data. Additionally, shoreline vegetation is surveyed for species abundance and the presence of pest plants, a water column profile is conducted to determine changes in physicochemical parameters, and water column chemistry samples are collected.

Lake Island Ford and Lake Alice were assessed during the 2006 field season, the first year the revised approach was employed in Hillsborough County. The approach was successful, and Alice and Island Ford yielded differing results regarding their general health and primary concerns for lake management. Our water physicochemical survey supported the upward trend in Trophic State Index (TSI) values that can be seen in both lakes from the latest data from LAKEWATCH and other sources. The substantial increase in phosphorus and 85% PAC in Lake Alice is of primary concern. Moreover, the recent increase in phosphorous and high concentration of Chlorophyll a (8.80 ug/L) measured in Lake Island Ford attest the need for better lake management practices. FCCDR's adapted diagnostic lake assessment protocol is a low-cost method providing stakeholders with the data necessary to better manage our lakes and lake-centered watersheds.

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NOTES

SESSION 3

FISH, PLANKTON & LAKE FOOD WEBS

HURRICANE IMPACTS ON THE LITTORAL FISH COMMUNITY AT LAKE OKEECHOBEE, FLORIDA

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Aquatic habitat abundance and complexity influence fish community interactions, species diversity, and abundance (Benson and Magnuson 1992). Natural disturbances can result in changes to aquatic habitats that disrupt ecological processes and those changes may be magnified by anthropogenic modifications. In Florida, aquatic vegetation is a principle component of available habitat to littoral fish communities and interactions between natural disturbances and human modifications may result in large changes in aquatic habitats and fish communities. Lake Okeechobee, Florida, was impacted by catastrophic hurricanes during 2004-2005 that resulted in lake-wide changes to littoral habitats.

We sampled the littoral fish community at Lake Okeechobee during the summers of 2003 and 2004 (i.e., pre-hurricane) and again in summer 2006 (i.e., post-hurricane). Sampling was conducted in the northwest area of the lake and fish were collected using 10m x 10m (total area = 0.01 ha) block nets treated with rotenone (3 mg/L). Sample sites were selected to represent available habitat types (e.g., emergent vegetation, submerged vegetation) and sampling occurred in the same areas during each time period. Fish were collected by 4 individuals within each blocknet using dipnets. Collected fish were placed on ice and returned to the laboratory for identification. Total lengths (nearest mm) and weights (nearest g) were measured from subsamples of 50 fish per species and blocknet. Individual weights were used to extrapolate the total catch biomass for each species in each net.

We evaluated the following fish community metrics for each time period: total species richness, species diversity, species evenness, and total fish biomass. We also evaluated total biomass between time periods for species groups that are associated with littoral vegetation and/or open water habitats. Species groups were omnivore/obligate planktivores (i.e., brook silversides *Labidesthes sicculus*, inland silversides *Menidia beryllina*, gizzard shad *Dorosoma cepedianum*, and threadfin shad *D. petenense*), centrarchids (i.e., bluegill *Lepomis macrochirus*, dollar sunfish *L. marginatus*, warmouth *L. gulosus*, redear sunfish *L. microlophus*, redbreast sunfish *L. auritus*, spotted sunfish *L. punctatus*, bluespotted sunfish *Enneacanthus gloriosus*, black crappie *Pomoxis nigromaculatus*, and largemouth bass *Micropterus salmoides*). Community and family group metrics were estimated for each net during each period and bootstrap resampling was used to recreate expected distributions of average metric values for each period.

We found decreased species diversity, species richness, total biomass, and centrarchid biomass after hurricanes relative to pre-hurricane conditions. These decreases were likely due to loss of vegetated habitats and the forage resources and predation refuges they provide for many littoral fish species. Loss of complex vegetated littoral habitats also resulted in increased biomass of omnivore/obligates planktivore species, which are often found in degraded habitats (Vanni et al. 2005).

Hurricane effects on Lake Okeechobee's littoral fish community were likely magnified because of hydrologic modifications (i.e., Herbert Hoover levee and dike system) that held water levels within the levee during and after hurricanes. Prior to levee construction, connected wetlands would have provided for surface area expansion during storm events and attenuated wind and seiche effects (Havens 2005). Hydrologic modifications to Lake Okeechobee's watershed have also created trade-offs among potential management actions that will influence estuaries, recreational users, and other water needs.

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NOTES

LONG-TERM PLANKTON MONITORING OF LAKE OKEEECHOBEE, FLORIDA: TRENDS IN CRUSTACEAN ZOOPLANKTON POPULATIONS AND COMPARISON TO OTHER SHALLOW SUBTROPICAL LAKES

John R. Beaver
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Beachwood, OH
Karl E. Havens
University of Florida
Gainesville, FL
Therese L. East
South Florida Water Management District
West Palm Beach, FL

Long-term plankton monitoring of the plankton of Lake Okeechobee was conducted from 1994 to 2006 to examine relationships among zooplankton composition, phytoplankton composition, and potential controlling physical/chemical variables. The crustacean zooplankton assemblage of Lake Okeechobee was typical of other eutrophic Florida systems, being numerically dominated by the calanoid copepod *Diaptomus dorsalis*, which is considered to be more successful in productive Florida lakes because of both its higher population growth rate and its greater ability to avoid vertebrate predators than other crustaceans. Cyclopoid copepods were much less important, in terms of their relative abundance or biomass. Like other productive Florida lakes, cladocerans were less important than copepods and were dominated primarily by *Eubosmina tubicen* and to a much lesser extent by *Daphnia ambigua*. Abundance of both calanoid copepods and cladocerans generally decreased with decreasing water depth, perhaps indicating that deep-water stations provide a vertical refuge from predators that is not available in shallow near-shore locations. Despite several significant perturbations to Lake Okeechobee during the 12-year study (including a drawdown, drought, and four hurricanes), the crustacean zooplankton community remained taxonomically unaltered with similar densities and seasonality throughout the study with the exception of a decline in cladocerans after the drought. The abundance of crustacean zooplankton components was poorly correlated with variables related to food quantity/quality and physical/chemical variables. The similarity of the crustacean zooplankton community of Lake Okeechobee to other shallow lakes in Florida and the temperate zone will be discussed.

NOTES

FISH AND SHELLFISH IMPINGEMENT AND ENTRAINMENT PATTERNS ON THE FLORIDA PANHANDLE

J. H. Neese and R.M. Markey
Gulf Power Company, Pensacola, FL
H. R. Hammers, J. Debicella, and A. B. Shortelle, Ph.D.
MACTEC Engineering and Consulting Inc., Newberry, FL

The CWA requires USEPA to ensure that the location, design, construction and capacity of cooling water intake structures (CWIS) reflect the Best Technology Available (BTA) for minimizing adverse environmental impacts. Preparation of Comprehensive Demonstration Studies (CDS) in compliance with Section 316(b) of the federal Clean Water Act (CWA) was performed for three electrical power-generating facilities on the Florida panhandle. These facilities are located on diverse waterbodies: a freshwater river, an estuarine river, and an estuarine bay. Field studies have been conducted for over one year to evaluate the resources, and measure rates of impingement and entrainment at each facility. At the freshwater site, fish and shellfish impingement rates were low. Hogchoker and blue gill were the dominant fishes impinged. At the site on the tidally influenced river, fish and shellfish impingement rates were relatively low and episodic. Crabs and penaeid shrimp accounted for greater than 60 percent of the total impingement. The estuarine bayside facility impinged more species than the other two sites. Shellfish dominated both impingement and entrainment at this facility. Data were evaluated for seasonal and diel patterns, and to estimate annual rates. Additional studies are being conducted to estimate survival and the potential benefits of existing as-built CWIS configurations and operational measures coupled with new technologies at these facilities that minimize adverse impacts to fish and shellfish.

NOTES

PERSISTENT EFFECTS OF A SEVERE DROUGHT ON ZOOPLANKTON IN LAKE OKEECHOBEE, FLORIDA

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Gainesville, FL
Therese L. East
South Florida Water Management District
West Palm Beach, FL
John R. Beaver
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Data from 1997 to 2005 were used to examine impacts of a managed draw-down, subsequent drought and resulting historic low water levels (during 2000 and 2001) on the zooplankton of Lake Okeechobee. Prior to the drought the lake supported less than 150 ha of submerged vegetation. Following the drought, over 20,000 ha of submerged vegetation developed around the lake shore and there was substantially increased recruitment of age 0 fish. The zooplankton changed significantly from the pre- to post-drought period, including: (a) a near-complete loss of all dominant species of cladocerans and rotifers after the drought; and (b) an abrupt transition to a community with over 80% of total biomass comprised of the predation-resistant copepod *Diaptomus dorsalis*. These changes persisted for the entire five years of post-drought sampling. In contrast, there were no systematic changes in biomass of bacteria, phytoplankton, inedible cyanobacteria, algal cell size, suspended solids, or any other physical or chemical attributes known to affect zooplankton in shallow lakes. Evidence points towards an increase in predation by fish and/or invertebrates as a cause for the loss of all but the most predation resistant species from the lake's zooplankton community, and indicates a need for future research to link climate changes to shifts in predation pressure in this and other shallow lakes in Florida.

NOTES

SESSION 4

POSTER SESSION

SMALL POND MANAGEMENT IN THE CITY OF WINTER PARK, FLORIDA

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Introduction

The City of Winter Park manages 14 natural lakes and ponds under 20 acres in surface area. Water quality, and habitat management issues vary widely from pond to pond, and management activities and techniques must be site specific to maintain ecological integrity and pond aesthetics. Problems frequently encountered in small ponds include:

- turbidity
- low dissolved oxygen
- planktonic algae blooms
- filamentous algae blooms
- floating plant infestation
- exotic plant infestations of the littoral zone
- exotic animal introductions
- flooding/high water

Many ponds suffer from two or more of these conditions at any given time. These problems are usually caused, or exacerbated by, high nutrient, and organic material loads from storm water runoff. Public access to, and recreational opportunities provided by many small ponds are often limited, making them a low priority for capital expenditures. Even on the most limited access ponds, though, the adjacent property owners, and others that contribute runoff to the pond, pay into the city's storm water utility. The City of Winter Park is committed to providing the highest level of management practical for each pond regardless of size or accessibility.

Management Methods/Discussion

Management efforts for each pond are developed on a case-by-case basis. Factors considered when developing management plans include human health and safety, pond accessibility and neighborhood support/participation. The City of Winter Park has employed numerous management techniques to improve conditions in, and public enjoyment of its small ponds, including the following.

- Aeration systems have been used to reduce frequent floating plant and filamentous algae problems. The extent to which these undesirable conditions are controlled varies from lake to lake, but in all cases maintenance frequency and herbicide/algaecide use have been reduced.

- The maintenance of municipally owned shorelines and littoral zones using manual and chemical methods has been employed to minimize coverage of exotic species, and encourage native plant growth. This activity ties into wildlife management efforts by providing healthy littoral zones that promote use by native fauna.

- Leaf and debris traps and baffle box structures have been installed to reduce sediment and leaf loads. The intent of this effort is to reduce nutrient loads, thereby reducing planktonic algae growth, and/or to reduce turbidity.

- The City's public education efforts frequently touch on subjects that can severely affect small ponds including the proper use of fertilizers and pesticides, the release and feeding of exotic birds or other animals and the proper disposal of yard debris and pet waste.

- Flood control on many small ponds is accomplished by drainage wells that were drilled throughout Orange County in the 1950's and '60's. Winter Park has one storm water lift station on a small pond with no natural outfall. The facility was permitted and constructed in the interest of public safety to prevent roadway flooding during high water conditions.

As a result of Winter Park's management efforts, the city's small lakes and ponds provide numerous recreational opportunities for the surrounding neighborhoods, as well as providing safe, healthy urban wildlife habitat. The ponds add to the aesthetics and quality of life for many throughout the city.

NOTES

TAYLOR CREEK ALGAL TURF SCRUBBER® NUTRIENT RECOVERY FACILITY for PHOSPHORUS and NITROGEN CONTROL in OKEECHOBEE, FLORIDA

Mark J. Zivojnovich, E. Allen Stewart, P.E., Robinson Bazurto, and Kimberleigh Dinkins
HydroMentia, Inc.
Ocala, FL

The Algal Turf Scrubber® (ATS™) has been employed as a structural Best Management Practice (BMP) at Taylor Creek in the Lake Okeechobee Watershed, Florida. The project augments activities of the Lake Okeechobee Protection Program, and is expected to reduce phosphorus and nitrogen pollutant loading to the lake by 4,000 and 17,087 pounds per year, respectively based water quality data for the period 1989-2005,. The facility has a daily flow of 15 million gallons with a process area of approximately 3.6 acres.

The Algal Turf Scrubber® is a managed aquatic plant system, which utilizes cultured algae to remove pollutants from impaired waters. Targeted nutrients are removed from source water through direct plant uptake, chemical filtration and precipitation, and are managed through routine biomass recovery. The ATS™ consists of an inclined flow way, where water is introduced in pulsed flows via a distribution manifold. Algae are cultivated along the flow way and treated water collected within an effluent flume before being discharged to Taylor Creek. Biomass recovery through routine harvesting (7 – 21 day cycle) of the algae maintains the ATS™ in an accelerated growth phase, maximizing pollutant recovery rates.

The system began operation in January 2007 and has been funded by the Florida Department of Agriculture and Consumer Services (FDACS) in cooperation with the South Florida Water Management District (SFWMD). ATS™ design and first quarter nutrient load reduction results will be presented.

NOTES

AN EXPERIMENTAL ANALYSIS OF PROBABILITY-BASED SAMPLING REGIMES

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Abstract

Comprehensive sampling of water quality in regions with large numbers of aquatic systems can be extremely difficult given logistical and time constraints involved in sampling numerous, widespread and diverse bodies of water. One approach that attempts to overcome these difficulties is probability-based sampling. This sampling regime uses a randomly selected subset of the total population of lakes in order to develop a statistically based assessment of the water quality for an entire region/population. In natural systems it is impossible to assess the validity of the probabilistic approach to monitoring, as a complete set of data from the entire "population" of lakes cannot be obtained. Using the >70 aquaculture ponds on the Mississippi State University campus, I have developed an experimental test of this monitoring approach in order to test its performance in a population of lakes that by design are similar in size, shape, water source and geology. The water quality parameters temperature, dissolved oxygen, pH, specific conductance, in-vivo chlorophyll fluorescence and in-vivo phycocyanin were measured in each pond at daily to weekly intervals for 1 year. I will explore the variability encountered in these controlled systems in order to explore the level of confidence that can be obtained using different sample sizes and sampling intervals in order to facilitate better application of the approach to natural lakes.

Objectives

As monitoring efforts continue to be curtailed in order to control costs of environmental monitoring one approach that is growing in importance involves probability-based sampling. This approach derives from the basic statistical concept that a random sample can be used to assess the central tendency (mean) of a given parameter for a given population.
A simple example would be a "region" with 100 lakes to be sampled for temperature. Sampling constraints dictate that no more than 20 of the lakes will actually be sampled. By randomly selecting 20 lakes to be sampled a mean temperature along with a measure of variability can be calculated to describe the overall population of lakes.
The problem with this approach is that it is difficult to assess accuracy and precision of the sample. By using a collection of 70 ponds with similar geology, soils, environmental exposure, size, depth, and water source this study addresses the questions of how large of a sample is required, what level of precision can be obtained, and evaluates the overall approach.

Methods

Ponds were sampled from the ~2 m from shoreline, ~0.5 m below the surface between the hours of 10:00 and 14:00 at weekly intervals between May and December of 2006. Temperature, dissolved oxygen, pH, turbidity, and specific conductance were measured with a calibrated

Eureka Manta multiparameter system. *In vivo* chlorophyll and *in vivo* phycocyanin fluorescence were measured using a Turner Designs *Aqua*fluor fluorometer. For this study, data from August 3, 2006 are presented. Sub-samples of the total 70-pond data set were randomly selected representing 5, 10, and 20% of the total. Additionally, the data was ranked and the 5% of the ponds with the lowest and highest values were then non-randomly selected. Mean and 90% confidence intervals values for the sub-samples were calculated.

Results

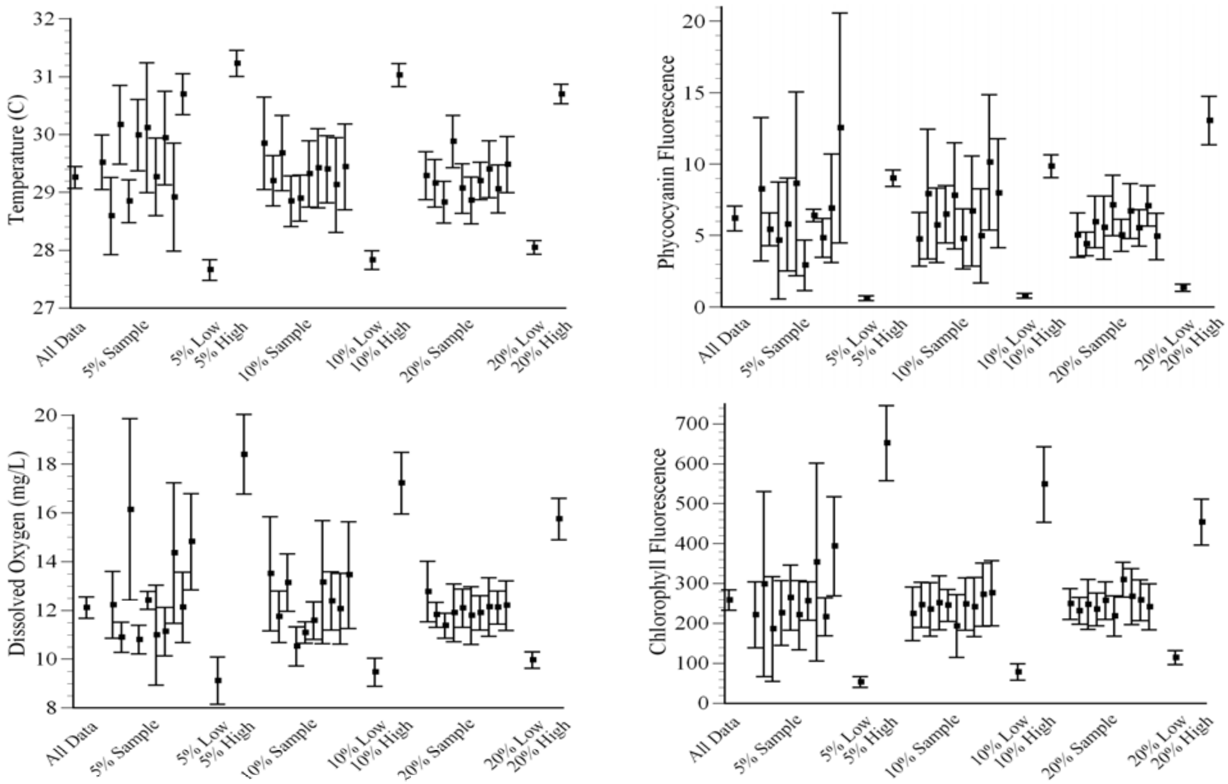

Figure 1. Means and 90% confidence intervals for temperature, dissolved oxygen, phycocyanin fluorescence, and chlorophyll fluorescence.

Conclusions

Overall the 5, 10, and 20% sub-samples generally did a good job of predicting the mean values of the entire population of lakes for all of the parameters. As would be predicted by statistical theory, the larger the sub-sample the better the agreement with the overall population measure. In general, the more biologically influenced the parameter, the less the contraction of the 90% confidence interval with increased sample size. Of the 120 sample:parameter combinations tested only 6 did not have confidence intervals that overlapped with the population mean. In the sub-samples that were intentionally selected to have all high or all low values, the confidence intervals never overlapped the population mean. While these extreme combinations will only occur once out of >22 million times, significant errors can arise when they do.

THE WATER ATLAS ADOPT-A-POND COMPONENT A NEW TOOL FOR MANAGING STORMWATER POND IN FLORIDA

Ron Chandler, *Jim. Griffin*, *Rich Hammond*, *Kevin Kerrigan*, *Jason Scolaro*, *Karen Dufraine* and *Shawn Landry*
USF-FCCDR
Tampa, FL

Purpose and Scope

This poster presentation is focused on the design of the new Adopt-A-Pond web component now being implemented on the Water Atlas. The Water Atlas Program at the University of South Florida provides spatially attributed water resource data via the web (www.wateratlas.usf.edu) to a nine county region stretching between Pinellas County on the west coast and Seminole County and, soon, Volusia County on the East Coast and Leon County in the Panhandle of Florida. The Water Atlas originally was designed as a lake, stream, watershed and estuary atlas; however, within the last five years, it has added ponds as a major water resource.

Design Methods and Approach

Stormwater ponds are a critical element in a stormwater system and the management of these water resources is essential for flood protection and water quality as well as to add natural beauty and a refuge for flora and fauna in urban areas. The goal for any water resource component on the Water Atlas is to provide an online source of educational materials as well as a platform for communication of resource management information and a means of data acquisition and management for water resource volunteers and managers (Figure 1).

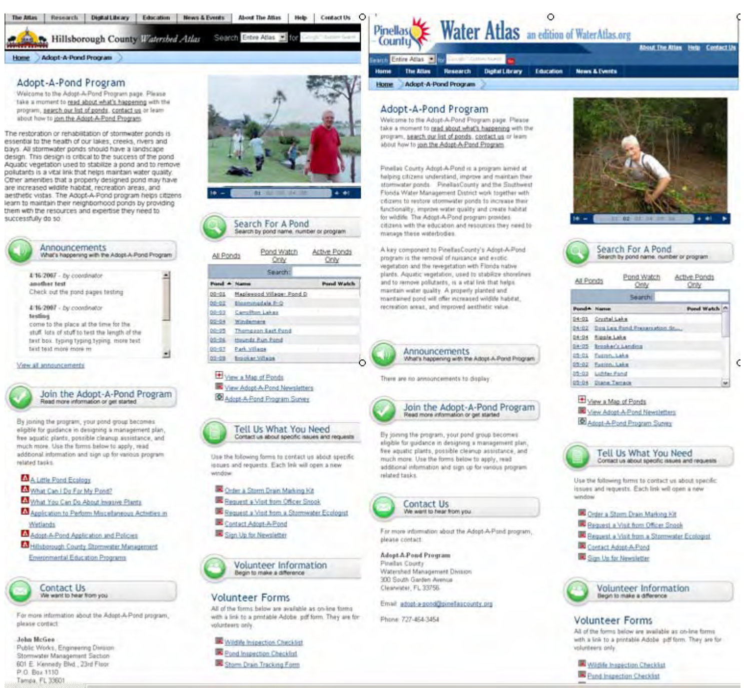

Figure 4. The Adopt -A-Pond Program page for Hillsborough and Pinellas Counties. Communicate with announcements and show of program with photo slide show and gather information with on-line forms.

The component has two sections, the web page displays which include a program page shown in Figure 1 and over 200 pond pages (not shown but detailed in poster presentation) and the web-admin section shown in Figure 2. The program page and pond pages both have interactive forms, photo slide shows and full page-to-page navigation. Each page is also connected to the Water Atlas map component to allow spatial analysis of the surrounding stormwater system, and watershed. The two County Adopt-A-Pond programs also conduct volunteer and professional water quality sampling of some of the ponds in the program. To support these efforts, the pond pages include a field data form and a quick view of all water quality data managed for the pond through the Water Atlas database. Full data download and graphing is provided through the Water Atlas data download system and advanced graphing features. A more detailed description of this functionality is provided in the poster presentation.

The web admin section pages include a status monitor to allow coordinators and program managers to view the program status and to determine what reports are waiting approval. This page automatically links to the report area that allows edit and approval of reports and photos as shown in Figure 2. Two important functions of the component are the management of volunteer activity which is communicated through the "Workday Report" functionality and the management of field data which is accomplished through the "PondWatch Monthly Sampling Reports" shown in Figure 2.

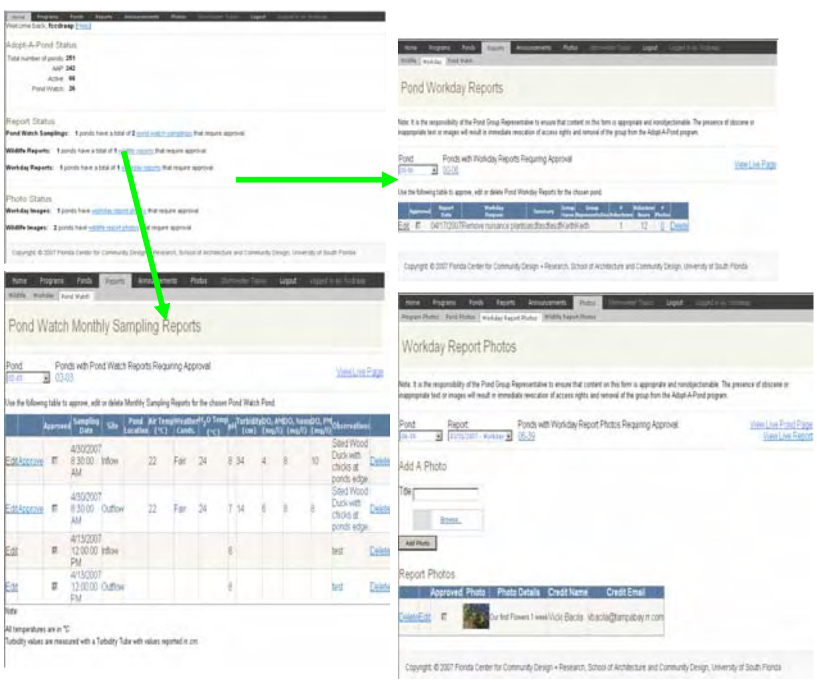

Figure 2. The Adopt-A-Pond Component has an on-line web-admin section that allows program managers and Adopt-A-Pond volunteer coordinators to customize and manage the site..

Conclusion

The new Adopt-A-Pond component provides a new dimension to the Water Atlas and is an example of the type of new .Net components that are now being designed for what will be a completely new Water Atlas in the years to come. The component not only allows more flexibility in page management it provides a means of managing data and information not yet seen in this type of application.

HABITAT MANAGEMENT THROUGH SPATIAL DATABASE DESIGN

Jim Griffin, *Rich Hammond, Kevin Kerrigan, Jason Scolaro, Karen Dufraine*
USF-FCCDR,
Jessica Atwell, Greta Klungness and Michelle McIntyre
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Tampa, FL

Purpose and Scope

This poster presentation is focused on the design and implementation of the new Habitat Restoration web component of the Tampa Bay Estuary Atlas. Two posters are presented. The first outlines the website design and its application and the second is focused on a parallel spatial database design project assigned to geography (GIS) graduate students at the University of South Florida.

Design Methods and Approach

The protection, restoration and management of wetland systems in Florida are critical to the future of the State. Emergent wetland loss in the Tampa Bay area alone is estimated at 18% between 1950 and 1982 (Hallard, 1989). The population change during that period for Hillsborough County was 49% and for Pinellas County 23%. The population change since 1985 for the two Counties is in excess of 24% and 10 % respectively (http://www.florida-business-data.com). Population pressures, rise in land value and other factors like growth in the tourism sector have made the management of these critical resources more problematic.

The Florida Center for Community Design and Research (FCCDR) completed the Tampa Shoreline Restoration Initiative (TSRI) management plan in concert with the Mayor's Beautification Program (MBP) and PBSJ in 2004/2005. This plan was published in hard copy and as a CD. Soon after that, the MBP requested that the plan's contents be provided as a web component to the Tampa Bay Estuary Programs (TBEP) Water Atlas site. Seeing the need for a more robust component to handle existing and future restoration site management requirements, FCCDR in partnership with TBEP and MBP designed, developed and implemented the current restoration component now live on Water Atlas (http://www.tampabay.wateratlas.org). Figure 1 shows the component on the TBE Atlas.

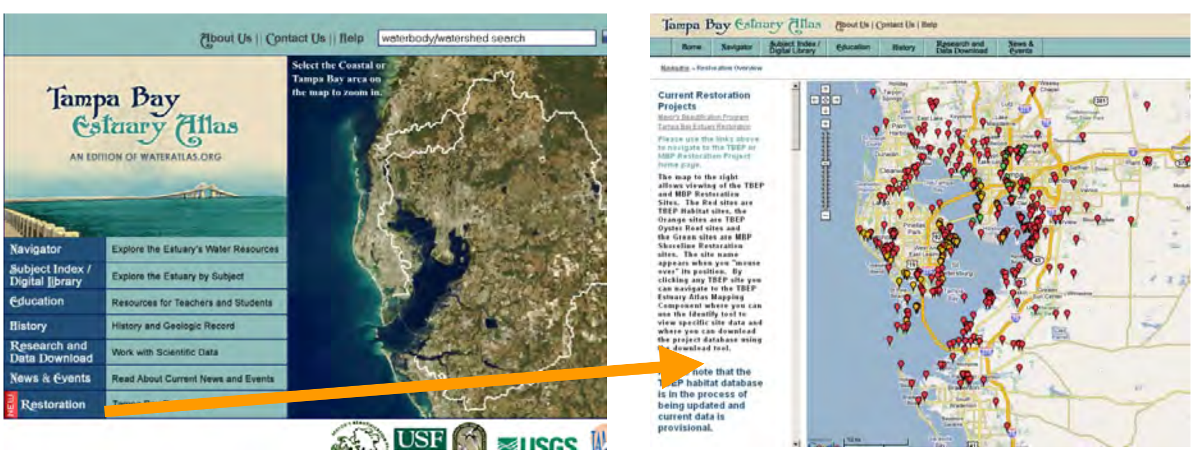
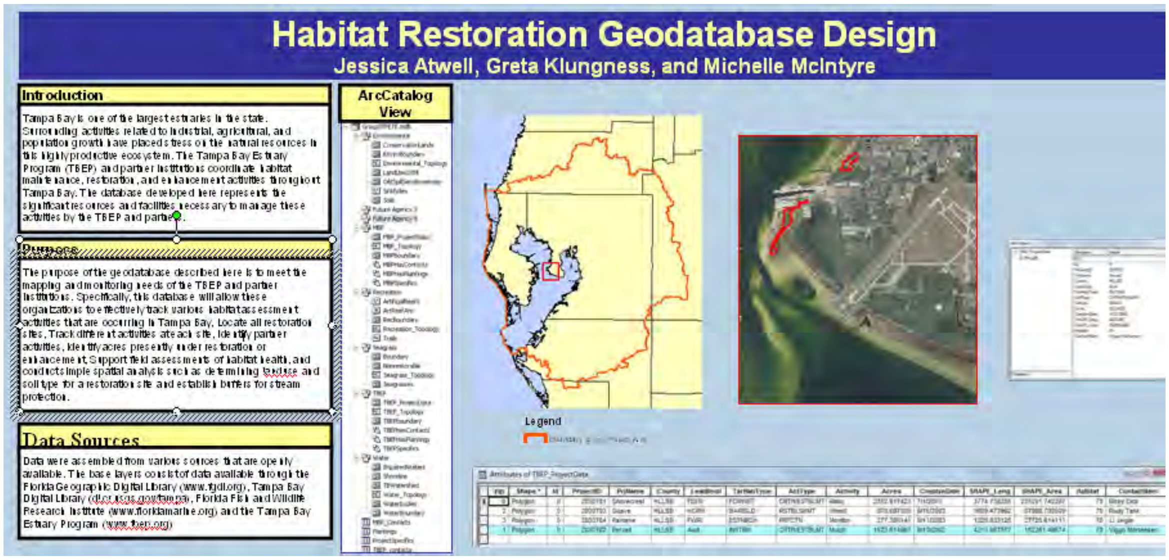


Figure 5. Tampa Bay Estuary Atlas front page and Restoration component project page.

One of the major challenges of the project was to develop a method to manage the huge quantities of data generated by various sources using no pre-determined schema and virtually without metadata. This challenge was solved using a combination of traditional and spatial database approaches. The problem was so interesting and had so many possible approaches that is was used as a class project in a graduate level spatial design class taught by the author. Only one team took this particular project although other graduate student teams took other similarly challenging projects. The second part of the poster presentation shows the results of this team's efforts. Their "geodatabase" design approached took the traditional conceptual, logical and physical database design approach. Part of their results is shown in Figure 2.



The poster presentation will provide an overview of the new Restoration component and a discussion of the GIS, database management and web design efforts that went into its design, development and implementation. The presentation will also provide some insights on the difficulties of developing a spatial database (geodatabase) for restoration site management. Similar project have been attempted (Gruber, 2006, NERI), and with the new capabilities offered by spatial databases these types of possible solutions to restoration site management should be more common in the future.

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AN INNOVATIVE APPROACH TO DATABASE MANAGEMENT

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Michelle Jeansonne and Brian Sparks
BCI
Lakeland, FL

Typical data collection within the St. Johns River Water Management District (SJRWMD) and other organizations often involves contracting sample analysis to consultants and receiving a "data-dump" of the results at the end of the contract period. Studies requiring organism identification that span several years may have multiple consultants involved in sample analysis, resulting in different data delivery formats. Furthermore, different consultants may use different naming conventions for organisms, causing the lowest level of identification to change based on the skill and experience of the analyst.

Data received at the end of the contract period usually need to be reorganized and formatted to fit the local database. This often invites transcription errors and introduces mistakes that require an enormous amount of staff time to correct. Since data collected during a study usually cannot be evaluated or examined until the initial data-dump is received at the end of the contract, trends in data and emerging issues often cannot be detected until months after the project is complete. This eliminates the possibility of altering the project to capture additional data as questions emerge. In an attempt to minimize data variability and conserve staff time, we developed a "real time" biological database utilizing a standardized naming convention, where consultants can actively enter data, perform quality assurance/quality control (QA/QC) functions, and load approved data in real-time to the District database.

The "real time" aspect of the database is implemented by using a Web-based interface called Citrix. This allows any user with Internet access to enter or access data in the database, which was created in Microsoft Access. Security is enforced both by the Citrix application and Microsoft Access with separate passwords.

The database tracks all samples from the time of collection to delivery of the final data, and will generate a Chain-of-Custody for sample shipment to the consultant. Nomenclature within the Integrated Taxonomic Information System (ITIS; http://www.itis.gov) was adopted as the standardized naming convention, and provides the entire taxonomy for each organism. Tables for each taxonomic level were created and linked by ITIS codes to adjacent tables. During data entry, the analyst needs only to specify the lowest level of identification (i.e. 'Sub-Species'), and the database automatically populates the entire taxonomic tree of that organism from its lowest-identified level up to Kingdom.

The QA/QC area of the database provides immediate feedback as data entry occurs. Invalid entries result in error messages that guide the user in correcting the entry. Duplication of records is prevented, and auto-filling of certain fields assists analysts in data entry. Organisms that do not exist in the database are stored in a separate area for additional review, ensuring data accuracy. All records must be reviewed prior to final approval to the database, and analysts are required to toggle a box indicating they have conducted the final review. These procedures help guarantee that data loaded to the database are accurate and reliable.

This database provides the opportunity for data entry and evaluation to occur "real time". Results from a study can be accessed as the project is ongoing, allowing for changes and/or additional data collection should unanticipated issues arise. Staff time will be greatly reduced as the need for data entry and/or reformatting has been eliminated, as well as the potential for transcription errors.

NOTES

HYDRILLA DETECTION DEVICE FOR POND SURVEYS IN DARK WATER

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BCI Engineering and Scientists Inc.
Lakeland, FL
Lori McCloud, Pam Livingston
SJRWMD
Palatka, FL

Background

In an effort to facilitate compliance of the Total Maximum Daily Loads for the lower St. Johns River, a Regional Stormwater Treatment Facility (RST) was constructed in the Tri-County Agricultural Area to treat agricultural runoff from a 1,196-acre watershed. The facility pumps water from an agricultural canal through a 15-acre wet detention pond, then into a 38-acre wetland. Water is then discharged from the wetland into Deep Creek, which empties into the lower St. Johns River. The presence of *Hydrilla verticillata*, and it's ability to out-compete native submerged aquatic vegetation (SAV), has caused recent concern that the plant may, over time, completely fill-in the volume of the pond, adversely affecting the pond's ability to improve water quality. Herbicide application, though effective in treating Hydrilla, would generate a large release of nutrients as the plants die, a result directly in opposition to the goals of the RST. Thick mats have been shown to hinder irrigation operations by reducing flow rates as much as 90% thereby impeding the operation of irrigation structures (Godfrey et al., 1996). The purpose of this project is to monitor the distribution and productivity of *Hydrilla verticillata* in the pond portion of the RST to evaluate how long it will take, if left untreated, for Hydrilla to completely fill-in the treatment pond.

Hydrilla can grow in almost any freshwater spring, lake, marsh, ditch, pond, river and tidal zone in water depths ranging from a few inches to 20 ft. Massive amounts of Hydrilla can alter dissolved oxygen, pH, and other water chemistry parameters (Smart and Barko, 1988). The dense mats that form from Hydrilla production interfere with fish and wildlife habitat. Hydrilla has many competitive advantages over other vegetation in that it can grow with less light and it is more efficient at taking up nutrients than other plants. Optimal reproduction temperatures have been reported to be between 68-81 degrees F with a maximum temperature of 86 degrees F (http://plants.ifas.ufl.edu/seagrant/hydver2.html). It has also been suggested that Hydrilla can grow in 1% of surface irradiance or less (www.mass.gov/dcr/waterSupply/lakepond/geir.htm). In order to validate literature values for optimal temperature and light with respect to growth and production for conditions existing in the RST treatment pond, we intend to measure light and temperature in this study, along with the distribution and productivity.

Methods

Traditional methods to monitor SAV such as SCUBA, underwater photography, and hydro-acoustics cannot be utilized in the RST pond, as water depth and high color preclude their use. The pond was divided into four sections and a power analysis was done to determine the number of transects required for sampling within each section. A petite ponar dredge will be used to measure the distribution of Hydrilla in the pond. A LI-COR datalogger with underwater quantum sensors will be used to measure the photosynthetically active radiation (PAR) irradiance data. A YSI meter will be used to measure the temperature at the sediment interface and through the water column. The LI-COR and YSI will be paired with the findings from the petite ponar to validate literature values. Average production will be calculated from the ponds inception and will be compared to reported production values for Hydrilla. If the values differ significantly, productivity cages will be deployed to monitor in situ production. Sampling will occur on a quarterly basis and will be ongoing for one year, to cover a full growing/dormant season for Hydrilla.

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Godfrey, K.E., and Anderson, L.W.J. (1996). "*Hydrilla pakistanae* as a Biological Control Agent of *Hydrilla verticillata*" L.B. (ed.). Biological Control Program Annual Summary, 1995 California Department of Food and Agriculture, Division of Plant Industry, Sacramento California, USA

NOTES

IDENTIFCATION OF COMMON PHYTOPLANKTON IN FLORIDA LAKES

John Burns and Ann Shortelle
MACTEC Engineering & Consulting, Inc.
Newberry, Florida

Identification of common freshwater algal taxa in lakes, rivers, ponds, and reservoirs is an important component of surface water management in Florida. Algal taxa are often used to help identify lake condition and to support biological assessments that determine if a water body meets its designated use and impairment status for 303(d) listing purposes. Algal data are also useful for developing Total Maximum Daily Loads (TMDL), Trophic Status, and as indicators of the overall condition of aquatic ecosystems.

Algae do not necessarily represent a formal taxonomic group of organisms and there is continued disagreement among phycologists over the exact number of algal divisions (~8-11). However, a loose collection of divisions or phyla distinguished by a combination of characteristics that include photosynthetic pigments, starch-like reserve products, cell covering, and other aspects of cellular organization are useful for classification. The number of freshwater algal genera reported in North America (>800) continues to increase and likely represent an underestimate of the region's diversity. As of April 12, 2007, over 3,500 algal taxa have been listed in the FDEP Florida Biological Database. State-wide, Cyanobacteria tend to be one of the most frequently reported algal groups inhabiting Florida lakes, including smaller picoplankton in some highly productive waters that may have been historically overlooked.

This paper will compliment the FLMS workshop on identification of common phytoplankton in Florida lakes and will discuss various techniques and standard operating procedures for algal identification, enumeration, quality assurance, and quality control. Algal taxa information will also be discussed in regards to the utility of algae as a tool for biological assessment of Florida lakes.

NOTES

REDUCING PHOSPHORUS LOADING FROM A WETLAND RESTORATION PROJECT WITH A MOBILE ALUM INJECTION SYSTEM

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Palatka, FL
T. DeBusk, T. Auter, and F. Dierberg
DB Environmental
Rockledge, FL

Introduction

Lake Apopka, the fourth largest lake in Florida, is one of the headwaters for the Ocklawaha Chain of Lakes. By the 1970s, Lake Apopka was considered the most severely polluted large Florida lake. To reduce nutrient loading to Lake Apopka, the St. Johns River Water Management District (SJRWMD) purchased 2,362 ha of farms west of the Apopka-Beauclair Canal between 1988 and 1992. Following the cessation of farming, the land was reflooded to encourage shallow marsh habitat. As a significant part of the restoration effort, the Marsh Flow-Way (MFW) was constructed to filter suspended solids and particulate phosphorus from Lake Apopka. The MFW consists of four independent cells capable of treating up to a total of 220 cfs.

The West Marsh properties comprise approximately 1,000 ha, located north of the MFW. Storm events during 2004, which included three major hurricanes, increased water levels in these parcels sufficiently to threaten adjacent properties and the integrity of project levees and pumps. The untreated discharge of six inches of water over the 1,000 ha would approximately equal the P loading SJRWMD has allocated to this property for a full year. Therefore, the objective of this project was to use liquid alum (aluminum sulfate) to treat discharge water at this site to significantly reduce phosphorus loading to Lake Apopka and the entire Ocklawaha system.

Methods

DB Environmental, Inc. in Rockledge, Florida was contracted to provide design and implementation assistance. Since the existing pump and retention pond layout built by the farmers was incompatible with an alum injection system, a temporary pump and the existing MFW system were reconfigured.

Due to the distance from existing electrical sources, a photovoltaic system was designed to power the alum-dosing pump. The initial pump used to move water over the existing levee was an axial flow diesel pump with a maximum capacity of 30 cfs. In order to mobilize the alum pump system at other sites rapidly on demand, the power and pump system was trailer mounted.

Discharge with alum dosing began on March 15, 2005 with the injection of approximately 18 mg Al/L (13 L/minute) into the intake side of the temporary pump. In response to lower total phosphorus within the West Marsh, dosing was reduced to 15 mg Al/L on March 30. Further reduction of dosing to 12 mg/L was implemented on November 1 to try to achieve higher flows and a shorter residence time. Following an initial drawdown, the system was shut down temporarily to install a culvert system to convert to a gravity flow system in June 2005.

Results

During 272 days of operation (ceasing December 12, 2005), approximately 684,000 gallons of liquid alum were consumed to treat 7,128 ac-ft of water. Approximately 1,599 kg of TP were removed at a cost of $195.67/kg TP ($88.74/lb). These values exclude the cost of constructing or operating the MFW or its acquisition cost. However, the initial fixed costs ($54,475 or 17% of the total) of the alum injection system will not be required during future use of the system. Without treatment, the annual P loading that the District has allocated to this property would have been exceeded by nearly six times.

Conclusions

By comparing the flow rates and water quality results some conclusions can be made as to the best way to operate this and other similar systems. The most important factor in achieving the best efficiencies appeared to be consistent flow and reduced residence times in the cells to reduce leaching of phosphorous from the soils. External factors that could not be controlled such as rainfall and power outages resulted in inefficiencies. However, procedures were also improved throughout the period of operation and the lowest levels of discharged phosphorous were measured during the last month of operation. Switching from pumped flow to gravity flow made it much easier to achieve a consistent flow. A decreased alum dosing during the last month of operation allowed for increased flow during this period and resulted in lower phosphorous discharge concentrations as a result of the shorter residence time.

The restoration of former agricultural lands is a complex and lengthy process. Portable alum injection systems can be used to cost-effectively reduce the influence of impacted areas on the surrounding ecosystem and shorten the restoration timeline while greatly improving management flexibility. The lessons learned have already been utilized on other District sites. For example, this particular portable system has already been mobilized to another site where it is operating off the electrical grid.

NOTES

MERCURY AND INDEX OF BIOLOGICAL INTEGRITY FOR FISH ON THE NORTH FORK HOLSTON RIVER, VA AND TN

E. Curtis, A. Shortelle, and H. Fogell
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The North Fork Holston River (NFHR), located in southwestern Virginia and northeastern Tennessee, is part of the Upper Tennessee River Basin. The NFHR originates in Bland County, Virginia and flows southwest approximately 112 river miles until its confluence with the South Fork Holston River (SFHR) in Tennessee to create the Holston River. A former chlorine plant (site) operated from 1950 to 1972 and contributed mercury to the river. The plant ceased operations in 1972. Mercury concentrations in surface water decreased significantly after the removal of sediment from a section of the NFHR in 1982 and again when outfall treatment commenced in 1994.

Fish Index of Biotic Integrity (IBI) collections were made in 1988, and the status of fish fauna were considered to be “poor” to “fair” (YMA 1989). In 2005, fish IBI collections were repeated in an effort to document changes over time. Fish collections were conducted in representative habitat types within a particular sampling reach to obtain a representative assemblage of fish species from each sampled area. Bulk sediment samples were collected for total mercury and methylmercury analysis in conjunction with the fish collections.

Total mercury in sediment was not detected at the upstream reference location (RM 85.4). Downstream total mercury concentrations ranged from a minimum of 0.0964 mg/kg at RM 48.9 to a maximum of 4.97 mg/kg at RM 81.4 (near the site). Detected results for total mercury at downstream locations were greater than the upstream reference location. The methylmercury concentration at the upstream reference location was 0.000034 mg/kg. Downstream methylmercury concentrations in the NFHR ranged from a minimum of 0.0002 mg/kg at RM 26.5 to a maximum of 0.000938 mg/kg at RM 8.7. Detected results for methylmercury were greater than the upstream reference location concentration except for two sampling locations (RM 39 and RM 17.5), which had methylmercury concentrations less than the concentrations detected at the upstream reference location.

Fish IBI scores calculated using the Ridge and Valley scoring system (TVA 2005) ranged from 46 to 54, representing classifications from “Fair/Good” to “Good/Excellent”. The 2005 IBI data was compared to historical IBI data presented from the 1988 YMA IBI study (YMA 1989). The 1988 IBI utilized the Blue Ridge scoring criteria instead of the recently developed Ridge and Valley scoring criteria, which is approximately 2 to 4 points lower than the Blue Ridge scoring system, and therefore, more stringent. Despite the use of a more stringent scoring system in the current study, there has been improvement in the fish communities in the NFHR at all downstream sampling locations except RM 61.5, which maintained a “Fair” classification for both time periods. Conversely, the IBI classification for the reference sampling location rated as “Good” in 1988 but declined to “Fair” in the 2005 study.

Single regression analyses were performed for the following data pairs: 1) fish IBI scores versus river mile; 2) fish IBI scores versus bulk sediment total mercury concentrations; and 3) fish IBI scores versus bulk sediment methylmercury concentrations. None of the fish IBI scores varied significantly by river mile. No slope change effect was noted for the fish IBI scores indicating scores upstream were equivalent to scores downstream. The fish IBI scores fluctuate within the NFHR without regard to the total mercury or methylmercury sediment concentrations.

There are several factors that may contribute or explain the minor variability in fish IBI scores. Natural salt brine discharges occur near the site, and pH was slightly elevated in the NFHR near the site, which could lead to a reduction in the fish IBI scores at the locations near the site. In addition, fish typically prefer larger rock outcrops, submerged aquatic vegetation, and variable water depths for both habitat and cover. The locations with lower IBI scores lacked these habitat elements, which could have adversely affected the fish IBI scores. Fish IBI scores did not vary significantly with river location, and mercury and methylmercury concentrations explained little of the observed variation in IBI scores. The IBI results indicate that fish communities in the NFHR appear to be sustained and are improving over time, and support conclusions of other studies that there has been a steady recovery of fish in the NFHR since the site closure in 1972.

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NOTES

THE STATUS OF INTERNATIONAL REGULATIONS AND GUIDELINES FOR HUMAN EXPOSURE TO CYANOBACTERIA

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Cyanobacteria and their toxins are an emerging issue for Florida lake managers and other surface water managers responsible for water quality, water supply, and human health. Since the first report of a toxic cyanobacterial bloom published in Nature (1878), wildlife mortality events and isolated reports of human illness following exposure to cyanobacteria are found throughout the scientific literature. Increases in the occurrence of cyanobacterial blooms, following accelerated eutrophication of water bodies, and the availability of analytical tools and techniques for elucidation of cyanotoxin groups, have contributed to the increased frequency of the reporting during the later half of the 21st century. Surface water managers and health professionals are now increasingly responding to cyanobacterial bloom events in public water supplies and recreational waters, but are often limited by the availability of algal toxin data, a clear understanding of potential ecological and human health risks, and guidelines necessary to protect human health.

The World Health Organization (WHO) has developed a provisional guideline for microcystin-LR in drinking water. Many other countries have developed their own guidelines and regulations based on the WHO guideline and have added additional toxins to their lists. Human health effects following recreational exposure to cyanobacteria is an additional concern. Recreational contact guidelines offered by the WHO are linked to the probability of health effects at three levels: 1) low (2-4 µg L^{-1} MCYST), 2) moderate (20 µg L^{-1} MCYST), and 3) high (scum formation). Australia and others have recommended a recreational contact standard of 20 µg L^{-1} for 'high risk' activities such as swimming to 100 µg per liter for 'low risk' activities such as fishing or boating.

Federal guidelines for drinking water and recreational exposure to cyanotoxins in the US are not available, but cyanobacterial toxins are listed on the USEPA Contaminated Candidate List. Several states have individually adopted cyanobacterial toxin guidelines to help protect human health in the absence of federal guidelines.

NOTES

SESSION 5A

NUTRIENT DYNAMICS IN SHALLOW, EUTROPHIC LAKE JESUP, FL

HYDROLOGIC AND WATER QUALITY MODELING OF THE LAKE JESUP WATERSHED USING HYDROLOGICAL SIMULATION PROGRAM – FORTRAN (HSPF)

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A Hydrological Simulation Program – Fortran (HSPF) model is developed in this study to simulate the hydrology and water quality in the Lake Jesup watershed, a high-urbanized watershed in central Florida. The HSPF model is calibrated for flow, water temperature, dissolved oxygen, sediment, and nutrients measured at several sites across the watershed for the simulation period from 10/1997 to 09/2003. The calibration results show a good agreement between the observed data and the simulated outputs. The average annual watershed loadings of TN and TP are 140.7 metric ton N/yr and 18.7 metric ton P/yr. There is significant variation between the watershed loadings in the three dry years (10/1998 – 09/2001) and those in the three wet years (10/1997 – 09/1998 and 10/2001 – 09/2003). The average dry year watershed loadings of flow, TN, and TP are 63,286.2 acre-ft water/yr, 95.5 metric ton N/yr, and 12.9 metric ton P/yr, respectively. The average wet year watershed loadings are 127,677.7 acre-ft water/yr, 185.8 metric ton N/yr, and 24.6 metric ton P/yr, which are approximately 2 times of the dry year watershed loadings. Using these loading estimates, a water and nutrient budget for Lake Jesup is developed.

The calibrated HSPF model is used to assess the impact of various management scenarios on the nutrient loadings to Lake Jesup. A general description of the simulated scenarios is given as follows:

1. Current – current (1997 – 2003) conditions;
2. Future – future land use with 100% Best Management Practice (BMP) implementation for future development (newly increased residential, industrial, and commercial areas);
3. Future + 25% BMP – future conditions + 25% BMP implementation for current land uses without BMPs (excluding forest, water, and wetland);
4. Future + 50% BMP – future conditions + 50% BMP implementation for current land uses without BMPs (excluding forest, water, and wetland);
5. Future + 75% BMP – future conditions + 75% BMP implementation for current land uses without BMPs (excluding forest, water, and wetland);
6. Pristine – all forested (except water and wetland) watershed.

Figure 1 compares the estimated TN and TP loadings to Lake Jesup under these six scenarios. The estimated TP loading under the future scenario is close to the current TP loading level, suggesting that the implementation of BMPs for all the future development and the decrease of the agriculture and pasture areas under the future conditions would effectively control the increase of TP loads. Because the removal efficiencies of BMPs for nitrogen are relatively low compared with those for phosphorus, the implementation of BMPs is less successful in controlling the increase of TN loading from the watershed. The projected future conditions have an 11% increase of TN loading from the current level. Additional reductions of watershed nutrient contributions can be achieved by implementing BMPs to the areas currently without receiving treatment. Implementing BMPs to 25%, 50%, and 75% of the current land uses without BMPs and 100% of future development could reduce nutrient loadings from the projected future levels by 3%, 6%, and 9% for TN and by 6%, 11%, and 17% for TP. Despite implementing BMPs to an extreme level (Future + 75% BMP), the resulting nutrient loadings will still be well above the estimated background loadings under the pristine scenario, which account for only 31% and 32% of the projected future TN and TP levels. To achieve greater nutrient reductions than those in the simulated BMP implementation scenarios, watershed management should focus on implementing nonstructural BMPs (such as better source control and stormwater reuse) to reduce nutrient loading rates from developed areas and using BMP treatment trains to improve nutrient removal efficiencies.

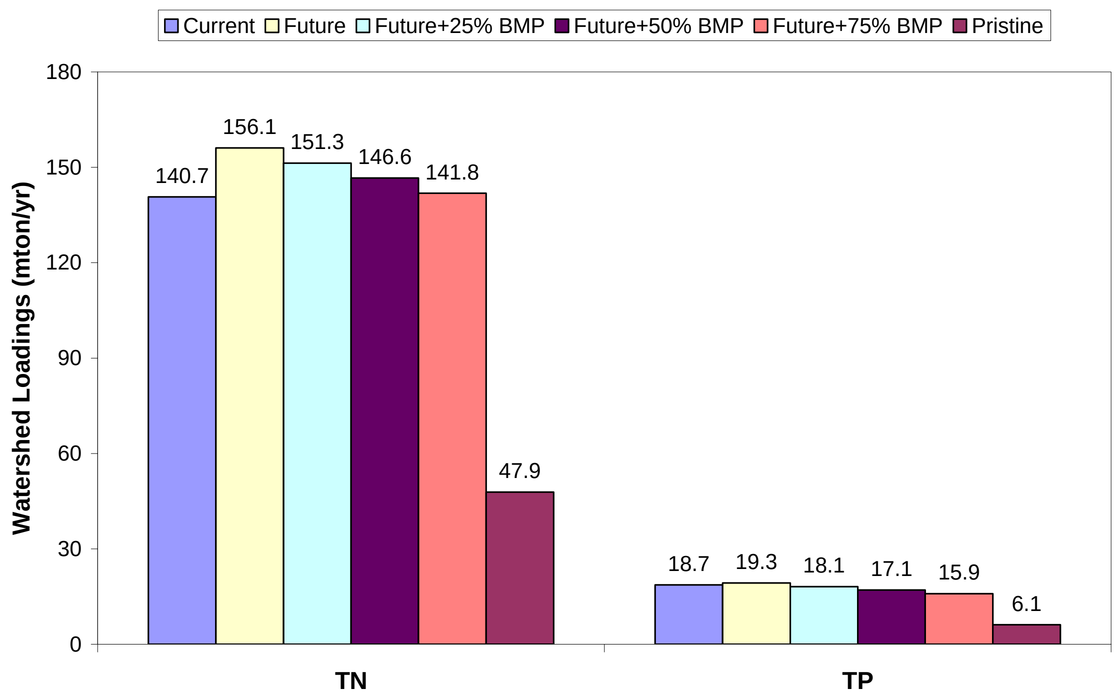

Figure 1. Comparison of average annual TN and TP loads to Lake Jesup for the six simulated scenarios.

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WATERSHED LOADINGS INTO LAKE JESUP USING THE EVENT MEAN CONCENTRATION (EMC) BASED PBS&J POLLUTANT LOADING MODEL

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This presentation is one component in a project managed by Seminole County to provide a more in depth grasp of the existing water quality inputs into Lake Jesup and the in-lake water quality processes. This presentation focuses on surface water quality loadings distributed both the spatially and temporally to the lake. This presentation will discuss the development of the inputs into the PBS&J Pollutant Loading Model, the derivation of seasonal runoff coefficients and the use of event sampling data to calibration event mean concentration values for different land uses.

NOTES

WATER QUALITY MODELING OF LAKE JESUP USING QUAL2K

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HDR|LMS Engineers

A QUAL2k water quality model of Lake Jesup was developed to help quantify the internal dynamics of the Lake. The model has been calibrated using an extensive, long term (15 years), field data set that is available for lake. Initial efforts at calibrating the model to reproduce the severely eutrophied state of lake were poor. There was not enough external nutrient loading to the lake to reproduce the internal conditions that were being measured. To increase the nutrient loadings internal loads were increased by increasing the sediment nutrient fluxes until a reasonable calibration was obtained. Based on these results a field sampling program was initiated to measure the actual sediment fluxes in the lake. Remarkably, the measured fluxes actually matched those predicted by the model reasonably well.

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MEASURING SEDIMENT NUTRIENT FLUXES AND SEDIMENT OXYGEN DEMAND IN LAKE JESUP

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As part of the ongoing effort to understand the eutrophication processes at work in Lake Jesup, two field efforts were mobilized. The first involved the measurement of sediment nutrient fluxes and sediment oxygen demand. The second involved the measurement of nitrogen fixation by algae. The results indicated that the internal sources of nutrients in Lake Jesup via these two mechanisms are significant. Sediment fluxes contribute an estimated 1573 MT/yr of TN and 739 MT/yr of TP. Nitrogen fixation adds another 357 MT/yr of TN. By comparison, external loads of TN and TP are estimated to contribute 220 MT/yr and 27 MT/yr respectively. In percentage terms 90% of the nitrogen load and 96% of the phosphorus load is generated internally. This presentation will discuss the field data collection efforts, results and implications. Sediment oxygen demand was also large, averaging almost 2 g $O2/m^2/d$.

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ASSESSMENT OF THE IMPORTANCE OF NITROGEN FIXATION ON THE WHOLE LAKE NITROGEN BUDGET FOR LAKE JESUP

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In the TMDL report for Lake Jesup (FDEP 2005), measured concentrations of TN were higher than could be modeled from typical loading sources. To address this discrepancy, estimated rates of nitrogen fixation were used to balance the in-lake TN values for Lake Jesup. These rates, however, were extrapolated from measures made on Lake George, which has much better water quality than Lake Jesup. As a consequence, Seminole County asked PBS&J for assistance in determining the potential importance of nitrogen fixation on Lake Jesup's nutrient budgets and water quality. In August 2006, preliminary measurements of N_2-fixation in Lake Jesup were made using a high-sensitivity stable isotope tracer method from 10 stations throughout the lake. At each station, water and sediments were sampled for isotopic characterization of suspended particles and surface sediments, respectively. Measurements were also made of N_2-fixation rates in water from each of these stations. On a volumetric basis, the mean rate of N_2-fixation for all stations was 45 ± 21 nmol N L^{-1} h^{-1} (mean ± SD, N=26). Based on these results, the "excess" TN that could not be accounted for from traditional loading sources could be produced within a period of time (122 days) less than the estimated turnover time of the lake. Results from this study support the premise that N_2-fixation is a potentially significant source of nitrogen input to Lake Jesup and provides a mechanism for balancing the nitrogen budget.

NOTES

LOOKING FOR CORRELATIONS IN A LAKE WITHOUT LIMITING NUTRIENTS

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When strong correlations exist between nutrient concentrations and biological responses or other physical parameters in aquatic ecosystems, the curve defining the relationship can be used to identify critical causative thresholds. Examples of these thresholds are the nitrogen to phosphorus ratio that triggers growth of nitrogen-fixing phytoplankton or the phosphorus concentration that corresponds with light intensity insufficient to sustain submerged aquatic vegetation. These correlations can then be used to define target concentrations for nutrients that would theoretically create conditions conducive to the water quality goals in lake restoration and management plans: e.g., water quality that allows optimum coverage of submerged aquatic vegetation, improving overall habitat. Ambient water quality data for many lakes exhibit significant relationships between key analytes and several biological responses. However, Lake Jesup, with nutrient concentrations typically well in excess of phytoplankton demand and a large seasonally inundated floodplain wetlands does not exhibit strong and persistent relationships to nutrients alone. The results of analyzing ten years of water quality and hydrology data demonstrate the need to consider both when setting nutrient criteria for meeting water quality restoration goals on Lake Jesup.

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SESSION 5B

INTEGRATED WATERSHED MANAGEMENT
PART 1

INTEGRATING LAKE AND STORMWATER MANAGEMENT PROGRAMS FOR MAXIMUM WATER QUALITY BENEFITS

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Introduction

The City of Winter Park, Florida has integrated all aspects of stormwater and lake management under one office, with a dedicated funding source, to increase the efficacy of stormwater retrofit efforts, and to accelerate water quality improvements. As with most lake management efforts, the Winter Park program has gone through several iterations as long-term problems became apparent, and as the research and knowledge base regarding the causes of these problems increased.

Winter Park's early efforts in lake management centered on control of the invasive, aquatic plant hydrilla (*Hydrilla verticillata*). Heavy infestation of the city's lakes in the 1960's lead to the formation of a citizens advisory board to work with staff and make recommendations to the City Commission. Although still a significant management issue, hydrilla was brought under maintenance level control by the mid 1970's. As hydrilla coverage decreased, residents became concerned by more frequent, and severe planktonic algae blooms. Documented declines in water quality during the 1970's led city staff, and the Lakes and Waterways Advisory Board (Lakes Board) to focus on stormwater runoff as a significant threat to the health of the city's lakes.

Program Implementation

In 1990, the city implemented a stormwater utility to help fund the construction and maintenance of stormwater retrofits. This revenue was used in addition to existing general fund allocations, rather than as a replacement for them. One of the first tasks accomplished was to partner with the U.S. Geological Survey to perform a detailed nutrient budget on the chain of lakes to help prioritize the retrofit program. Management of the stormwater utility, as well as other lake and stormwater operations still funded through the general fund was put under control of the Public Works Department, with oversight by the Lakes and Waterways Advisory Board. One office oversees all activities related to aquatic plant management, access management, water quality monitoring, development review (for stormwater requirements), shoreline permitting, street sweeping, public education, and flood control, as well as the planning, design, construction and maintenance of all stormwater retrofit systems.

This integrated approach to stormwater and lake management allows for maximum efficiency and flexibility in planning and executing elements of the program. Flexibility has proved critical in securing outside funding to augment the City's retrofit construction program. Having the ability work with the Lakes Board and the City Commission to restructure the capital project list has helped Winter Park to secure $1,340,000.00 in State and Federal grants over the past five years. These funds have helped the City to construct five major treatment systems on the chain of lakes. The efficiency of having all critical staff working out of a single office, allows the Public Works Director to rapidly act on advice from construction, engineering and limnological experts, related to changes in staff task assignments, project prioritization, maintenance frequency or other operational aspects of the program.

Results and Discussion

Monitoring data show average annual water clarity (Secchi disk transparency) within the Winter Park Chain of Lakes has increased between 50% and 130% in the past ten years. In 1998 the average annual Secchi disk transparency ranged from 1.0 to 1.5 meters on the four lakes in the Winter Park Chain. In 2006 all four lakes had average annual clarities above 2.0 meters. Trend analyses of data from this period, show a continuous, strong progression toward improving water clarity on each lake The City feels that these improvements have been in large part due to dedicated funding, heavy emphasis on maintenance and unified oversight of lake and stormwater management activities.

In 2006 the Lakes Board adopted a goal to achieve 3.0 meter average annual water clarity in all four lakes in the Winter Park Chain. To reach this ambitious goal, the City will need to continue actively constructing stormwater treatment facilities, as a significant portion of the stormwater conveyance system has yet to be retrofitted. As the retrofit program begins to reach completion (effective treatment on all outfalls where it is practical), a higher percentage of the stormwater utility revenue will be shifted to operation and maintenance activities to ensure that the maximum treatment potential of each facility is maintained. The City will also look to innovative in lake treatments to speed improvements on lakes where retrofit work is complete. Included in this effort is one project currently underway on Lake Virginia. A follow up study on the nutrient loading to the chain of lakes identified sediment recycling (internal loading) as a significant source of phosphorus to the lake. In 2006, grant money was obtained from the State of Florida to assist in the implementation of a sediment P deactivation project using aluminum sulfate. This project will be completed in July of 2007.

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PHOSPHORUS LOAD REDUCTION MEASURES ON EXISTING AND FORMER DAIRY PROPERTIES IN THE LAKE OKEECHOBEE WATERSHED

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The objective of the Dairy Best Available Technologies (BATs) Program was to identify, select, monitor and oversee implementation of BATs that would significantly reduce the export of phosphorus (P) from dairy operations into tributaries and Lake Okeechobee. Various alternatives were evaluated to determine the best comprehensive system of technologies to address the multiple dairy farm components (High Intensity Areas, waste management system, pastures, etc.). The goal of the program was achieved using an objective methodology that allowed for review and input by a multi-agency team (Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Services, United States Department of Agriculture – Natural Resource Conservation Service, University of Florida – Institute of Food and Agricultural Sciences, and the South Florida Water Management District) and stakeholders throughout the technology selection and implementation process. Implementation of the selected technology, edge of farm stormwater retention/detention and reuse followed by alum chemical treatment, has occurred at four distinct project sites in the Lake Okeechobee watershed. Monitoring and evaluation has been underway for three years and will be presented in detail. The objective of another initiative on former dairy sites was to implement one or more alternatives to minimize P discharges from the Lamb Island Dairy Remediation Project site. The implemented alternatives were chosen to minimize P discharges to the maximum extent practicable while taking into consideration cost effectiveness as well as the minimization of long term operation and maintenance requirements. The design and implementation of this project also received review and input from a multi-agency team. Monitoring and evaluation of this project site will also be presented in detail.

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St. Paul Regional Water Services Reservoirs and Watershed Restoration Program

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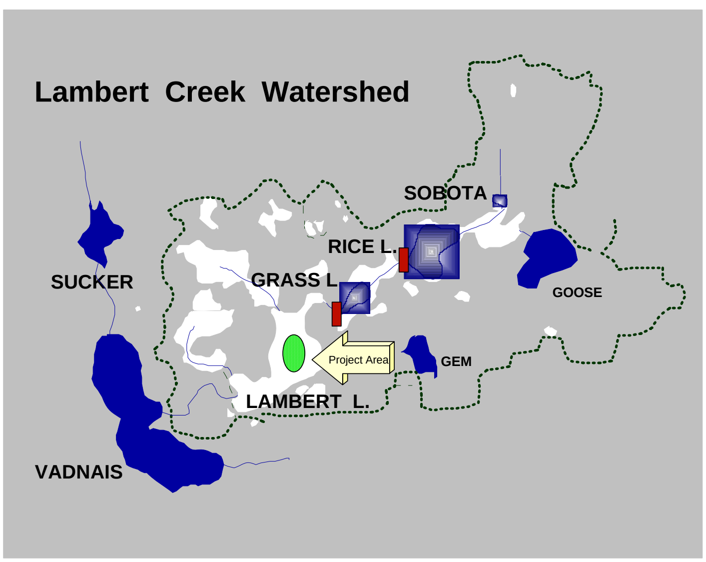
The Saint Paul Regional Water Services (SPRWS) provides potable water to the cities of St. Paul, Arden Hills, Falcon Heights, Lauderdale, Little Canada, Maplewood, Mendota, Mendota Heights, Roseville and West St. Paul. The SPRWS treatment facility receives source water from a chain of reservoirs, which includes Pleasant Lake, Sucker Lake and Vadnais Lake. These reservoirs are augmented with water from the Mississippi River and local watersheds.

The SPRWS has been plagued with severe taste and odor problems in the water supplied to the public. Most of these problems can be traced to the degraded water quality of the source water reservoirs brought on by excessive algal growth. In 1984 SPRWS initiated an intensive diagnostic study of the source water reservoir system and contributing watersheds. The results of the study indicated that nutrient enrichment, with phosphorus as a limiting nutrient, had produced abundant algal populations, which in turn produced taste and odor compounds. Identified sources of phosphorus loads into the reservoir system included the Mississippi River, internal loads from lake sediments and local watersheds – primarily Lambert Creek.

Phosphorus loadings from the Mississippi River source and reservoir sediments were addressed by capital projects funded by SPRWS. A Phase I CWP diagnostic study of Lambert Creek was conducted under the sponsorship of the Vadnais Lake Area Water Management Organization (VLAWMO) in 1991. This study revealed that wetlands along the course of Lambert Creek had high sediment phosphorus concentrations and release rates. The problem was further exacerbated by the fact the wetlands had been drained when Lambert Creek became a county drainage ditch in the early 1900's and the City of White Bear Lake had used the headwaters as a stabilization pond for the municipal wastewater effluents. The subsequent wet/dry cycling of the wetland via climatological conditions provided for periods of decomposition of detritus followed by flushing to Vadnais Lake. These findings were incorporated into the workplan, which called for "reconstruction" of the wetlands via man-made control structures on the outlets.



Management Measures

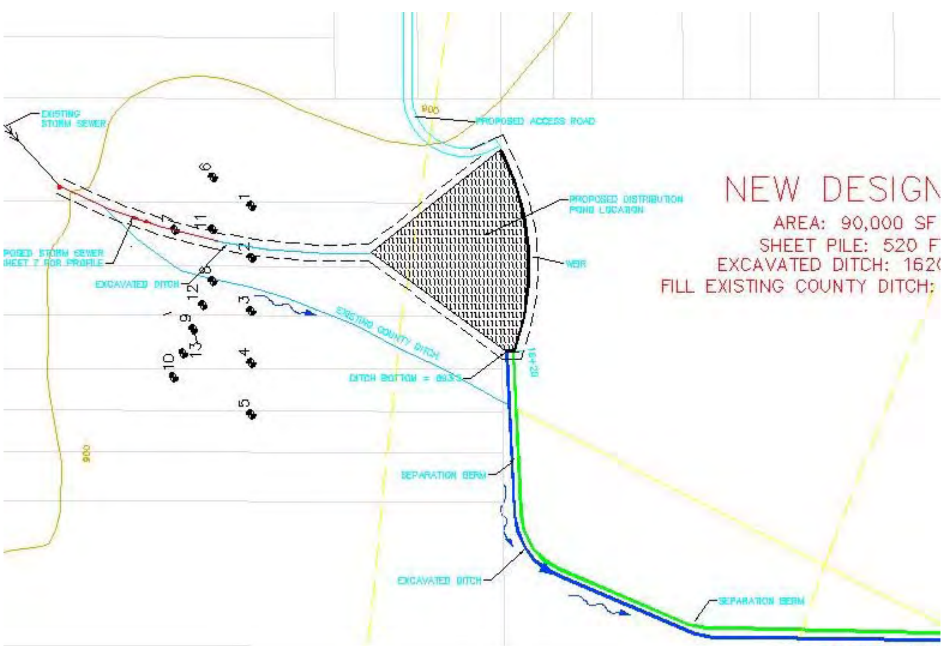
The primary focus of the work plan is to reduce the mass of phosphorus runoff to Vadnais Lake. Long term statistical analysis has indicated that in order to lower taste and odor episode frequencies to acceptable levels, total P values need to remain equal to or less than 25 micrograms per liter in mixed layer samples from April through September. This should reduce the frequency of chlorophyll A concentrations exceeding

20 micrograms per liter, which is the nuisance level at which taste and odor episodes are likely. In order to achieve the 25 ppb management goal, Lambert Creek P loads need to be reduced by as much as 50%.

The goals of the plan include:

- Purchasing easements
- Creating an alternative ditch route
- Abandoning the existing ditch by filling with excavation material
- Construction of a pond and distribution weir
- Construction of an emergency overflow weir
- Distribute the ditch water to the wetland
- Avoid any increase in flood levels
- Assess the performance of the weir in P removal and need for chemical addition

The construction plan consists of installing a 530-foot sheet pile weir with 45 adjustable weir openings. A 1.7-acre pond will be excavated to a depth of 4 feet to act as a stilling pool and the outflow will be dispersed into the greater wetland. The current ditch will be filled in for a reach of 2226 feet (County Ditch 14), and a 2226 foot emergency overflow ditch will be excavated to the east of the current ditch. The weir will be designed for dispersion only with minimal impoundment and head loss; about 0.1 feet of head. A pond outlet will be constructed at a proper elevation to direct flows greater than 20 cubic feet per second (cfs) to the emergency overflow route. The extensive flow record on County Ditch #14 shows that 20 cfs represents 94% of the flow regime and 96% of the total phosphorus entering Lambert Lake.



EVALUATION OF STORMWATER REUSE ON A TYPICAL SINGLE FAMILY RESIDENTIAL PARCEL

Jeffrey L. Herr, P.E., D.WRE
PBS&J
West Palm Beach, FL

Pollutant loadings from developed land are much higher than undeveloped land due to increased runoff volumes and the addition of anthropogenic pollutant sources such as fertilizers. Based on a study completed in the Leon County area of Florida (Harper, Herr and Baker 2000), pollutant loadings typically increase by more than one order of magnitude following development. Estimated pollutant removal efficiencies for typical stormwater treatment systems currently used in Florida remove 25-40% of the total nitrogen load, 30-70% of the total phosphorus load, 75-95% of the total suspended solids load and 25-60% of the biochemical oxygen demand. If pollutant loadings following development are an order of magnitude greater than pre-development loadings and currently used stormwater treatment systems remove only a fraction of the pollutants, additional pollutant loads are being discharged to our receiving waters every day. In addition, potable water supply sources are rapidly being depleted. Stormwater runoff should be considered a resource for alternate water supply and should not be lost to tide.

Low impact development (LID) is a method to reduce the impact of development on the environment. LID encompasses many elements and has many benefits. This presentation will consider the requirements and benefits of collecting, storing and reusing stormwater runoff from a typical single family residential lot contained within a typical curb and gutter residential subdivision. All storm water runoff for common rain events (<2-3 inches) from the lot and adjacent street will be collected and stored on-site and reused for irrigation, toilet flushing, and other water uses requiring a lesser water quality. The implementation of this concept would significantly reduce pollutant loads to the stormwater treatment system and downstream receiving waters and would significantly reduce the potable water use requirements for the home.

NOTES

THE USE OF CONCEPTUAL ECOSYSTEM MODELS IN DETERMINING THE EFFECTS OF FUTURE LAND DEVELOPMENT AND IN DEVELOPING MANAGEMENT STRATEGIES TO DECREASE IMPACT ON NATURAL RESOURCES: BIG CYPRESS REGION, FL.

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Purpose

Conceptual ecosystem models are non-quantitative planning tools that identify the major anthropogenic drivers and stressors on the ecosystem, the ecological effects of these stressors, and the most significant attributes or indicators of these ecological responses (Ogden, et. al., 2005) . As part of South Florida Restoration effort, a set of 12 conceptual ecological models (CEMs) was developed to provide a framework to evaluate the effects of the Comprehensive Everglades Restoration Plan (CERP) on ecosystem attributes or functions. However, these CEMs could also be used to evaluate the ecological effects of landuse changes on ecosystem attributes. One of these models, the Big Cypress Regional model (Duever, 2005; Roybal, 2006), was used to determine the effect of future land use plans on sub-basins within the Big Cypress Region. Furthermore, the model was utilized to develop management recommendations to decrease the impact of future urban development on the Big Cypress Basin attributes.

Methods

An assessment tool was developed to evaluate the potential impacts of landuse changes on environmental resources in the Big Cypress Basin (Morales, 2005). This tool was developed using the Big Cypress Basin CEM as a guideline. The Big Cypress Basin CEM presents a suite of assumptions that explain the hypothesized cause and effect linkages among environmental stressors and ecosystem functions in the Basin (Duever, 2005). In addition, the model lists the set of performance measures used as indicators of environmental conditions in the Basin that have been selected as targets for restoration.

The linkages presented in the Big Cypress Basin CEM were used in this study to identify the ecosystem functions future land use activities and restoration efforts would affect in the Big Cypress Basin. The hydrologic, ecological and water quality performance measures identified in the Basin CEM were used to identify the qualitative changes in ecosystem functions that would be expected to occur due to urban development; such as qualitative changes in water flow, number of wading bird nestings, plant community gradients, and turbidity increases.

Results

Future urban development plans in Estero Bay, Trafford, West Collier and East Collier sub-basins focus on converting selected tracts of farmland and undeveloped land to residential areas (Metcalf & Eddy, Inc., 2005). In these areas, sheet flow will be channelized, wetlands will be drained and upland forests will be removed, accordingly. These stressors could have detrimental effects on biological attributes such as drying of adjacent wetlands and upland forest, as well as decreasing of bird and wide-ranging mammal communities. In addition, hydrological and water quality attributes could be affected such as reversing water flow, creating unnatural flow delivery to wetlands, cutting hydrological connection among wetlands, increasing forest fires and increasing sedimentation in Lake Tafford.

Conclusions and Recommendations

In order to decrease the effects of proposed urban development, upland deforestation should be minimized, particularly in areas adjacent to wetlands. In addition, preserves for wildlife corridors should be developed to minimize habitat fragmentation. Consideration should be given to providing centralized sewage collection and treatment systems. Furthermore, special consideration should be given to the quantity and quality of storm water by implementing practical storm water runoff and agricultural best management practices.

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NOTES

IRRIGATION WITH RECYCLED WASTEWATER – GOOD ITENTIONS GONE AWRY?

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The use of recycled wastewater for irrigation is an increasingly popular practice within the State of Florida. Many new developments are required to use recycled wastewater, if available, and demand for this water has exceeded capacity in many areas of the State. Thousands of miles of pipelines have been installed to support this use. One of the largest users of reuse water is golf courses which provide a large open area where large volumes of reuse can be deposited. Irrigation with reuse water is an excellent water conservation technique, which has converted, treated wastewater from a liability into a coveted resource.

Although wastewater reuse has many conservation benefits, an increasing amount of evidence is pointing to reuse as a significant pollutant source to surface waters. Reuse water commonly has total phosphorus concentrations in excess of 1 mg/l and may exceed 5 mg/l, depending on the level of treatment. Phosphorus concentrations in this range are similar to concentrations in septic tank drain fields and are 5-25 times higher than commonly observed in untreated urban runoff. As a result, the phosphorus loading from reuse irrigation at a single-family home site may exceed the loading from the septic tank system. For example, a single-family irrigation system with four zones operating at 50 gpm for 30 minutes per zone twice each week would generate 12,000 gallons/week. A septic tank system, assuming a generation rate of 125 gpd/capita and four residents, would generate 3500 gal/week. Assuming similar concentrations in the reuse water and septic system leachate, the reuse water would have a total phosphorus loading which is 3.4 times greater than the septic tank system. The environmental impacts of the reuse water would be further increased as a result of direct runoff of the irrigation water onto impervious surfaces and waterways. Nitrogen concentrations in reuse water are commonly in the range of 5-10 mg/l, which also exceeds raw untreated runoff by a factor of 2-5. Recent water quality improvement projects conducted by ERD have implicated reuse water as a significant source of nutrient loadings to surface waters which negates the potential water quality improvements from nonpoint source reduction projects.

Reduction of the negative environmental impacts from reuse irrigation is essential to prevent reuse water from becoming an environmental catastrophe. First, it must be universally recognized that, although reuse water is an excellent conservation measure, steps must be taken to reduce or eliminate the potential environmental impacts. Next, the existing elevated nutrient concentrations must be reduced. One method of accomplishing this objective is to provide advanced wastewater treatment (AWT) for reuse water. When reuse water is used for subdivisions and golf courses, the primary source for irrigation water should be the on-site stormwater ponds with reuse used to supplement the pond levels. This will allow dilution of the reuse water with the pond water as well as provide any opportunity for additional nutrient removal within the pond. The overall objective of this program should be to minimize release of water from the ponds. Irrigation with reuse water should be carefully controlled to prevent direct discharges into waterways or stormsewer systems.

NOTES

SESSION 6A

VEGETATION MANAGEMENT & RESTORATION

USE OF BIOCONTROL INSECTS TO CONTROL INVASIVE AQUATIC PLANTS

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Alligatorweed (*Alternanthera philoxeroides*) was introduced into the United States from South America in the late 1800's and became problematic in the southeastern United States. This sprawling emergent plant formed dense floating mats which once grew across many narrow rivers and canals. In 1959, cooperative efforts on biological control of aquatic plants were initiated between the U. S. Army Corps of Engineers and the Agricultural Research Service, U. S. Department of Agriculture. Overseas searches began for potential biological control insects to control alligatorweed in the 1960's. These searches produced three insects, which have proven to be very successful in controlling alligatorweed in much of the southeastern U.S. All biological control insects go through an extensive screening and quarantine process before they can be released. The alligatorweed flea beetle (*Agasicles hygrophila*), the alligatorweed thrip (*Amynothrips andersonii*), and the alligatorweed stem borer ((*Vogtia*) *Arcola malloi*) were released in Florida in 1964, 1967 and 1971 respectively. These insects have been successfully established in most of the southeastern United States and successfully control alligatorweed. Three years after the introduction of the alligatorweed flea beetle in Florida, the U.S. Army Corps of Engineers Jacksonville District stopped herbicide spraying for alligatorweed in Florida. The insects have not eliminated alligatorweed but they have keep populations at a low level.

In 1980, a freeze in northern Florida depleted the alligatorweed flea beetle population to such an extent that alligatorweed populations began to be a problem again on the St. Johns River. Staff was sent to South Florida to collect and repopulate the St. Johns River with alligatorweed flea beetles. In a short time, the insects brought the problem weed back under control. Due to this successful effort, it was determined that it may be possible to expand alligatorweed biological control efforts into colder climates by introducing alligatorweed flea beetles in the spring. In 1981 a program was established to provide alligatorweed biocontrol insects to states where the insects did not over-winter. The collection and distribution of the alligatorweed flea beetles was the primary focus of the effort.

The adult alligatorweed flea beetles are black with yellow stripes. The adults have well developed flight muscles and travel to new areas in search of food. All life cycles feed on alligatorweed. A female can lay approximately 1000 eggs in her lifetime. The entire life cycle including adult, egg, larvae, pupae, and adult is completed within 30 days. In 1964, the beetles were released on the Ortega River in Jacksonville, Florida, and by 1965 the alligatorweed had been controlled. Unfortunately alligatorweed will grow further north than the biocontrol agents. The beetles will not survive freezing weather, so beetles do not over-winter in these climates.

Headquarters, U.S. Army Corps of Engineers, established the APCOSC located in the Corps of Engineers Jacksonville District to serve as the Corps-wide center of expertise in the operational aspects of aquatic plant management. As part of these services, the center provides alligatorweed biocontrol insects to public agencies that have alligatorweed problems. The U.S.

Army Corps of Engineers, Engineer Research and Development Center (ERDC) laboratory in Vicksburg, Mississippi, fund the project through the Federal Aquatic Plant Control Program. Currently the center holds permits from the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) to collect; ship, and field release these insects in Alabama, Georgia, Louisiana, Mississippi, North and South Carolina, Tennessee, Texas, Oklahoma, Arkansas and Puerto Rico. Our permits for the continental U.S. are issued for a period of 3 years and USDA-APHIS monitors the release of the insect. Permits for Puerto Rico are issued on a yearly basis.

The alligatorweed flea beetles are generally collected in May along the St. Johns River by staff utilizing sweep nets while running airboats through beds of alligatorweed. The insects are sorted from other bugs, packed in fish worm containers with alligatorweed, then packed in coolers with a small amount of ice to be air expressed to their destinations. State and county agencies, universities, and other federal agencies receive the shipments and utilize them on their properties or distribute them to other areas as needed. Most recipients of the flea beetle program indicate that they provide good control of alligatorweed.

The waterfern (*Salvinia minima*) is naturalized in Florida and has become problematic in certain slow moving water bodies and canal systems along the St. Johns River. Prior to funding reductions in 1996, the District controlled this species with herbicides. In 2000, it was noted that *Salvinia minima* populations seemed to cycle in some of these areas. Upon further examination, adult Salvinia weevils (*Cyrtobagous salviniae*) were collected from *Salvinia minima* samples from these areas. The weevil appears to contribute to the cycling of *Salvinia minima* populations.

Adult weevil populations were monitored monthly at four locations on the St. Johns River in north Florida. The sampling areas included two undeveloped natural creeks, one creek with residential development and one canal system surrounded by residential development where Salvinia had become a problem. The potential for augmenting weevil populations to assist in the control of *Salvinia minima* will be discussed.

NOTES

THE IMPACT OF FLURIDONE ON TARGET AND NON-TARGET PLANT SPECIES: DATA FROM MONITORING OF ACTUAL LAKE TREATMENTS

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Fluridone, the active ingredient in the herbicide SONAR, is a systemic compound that is less acutely toxic that most other herbicides. This creates some challenges for maintaining adequate exposure, but also creates opportunity for managing plants selectively. Use history can be described as:

- Fluridone, as Sonar, has been in use for up to 20 years in some states and a minimum of 10 years in others
- Four Sonar forms available: liquid (AS) and 3 pellets (SRP, PR, Q)
- Doses are typically 5-20 ppb AS, about 50 ppb for pellets
- Recommended exposure time varies by application, but >60 days is desired and >90 days is preferred at >2-4 ppb
- Measurement of in-lake concentrations is simple and common (FasTEST), with detection down to about 0.5 ppb
- Assessment of likely or actual impact by biochemical means is available (PlanTEST and EffecTEST)
- Greater knowledge of impacts on wider range of plant species, although most information has not been organized and systematically evaluated.

Creative use can be described as follows:

- Lower doses at longer exposure times
- Sequestered treatments (partial lake treatment)
- Choice of release rates for pelletized formulations
- Bump/drip treatments (sequential additions)
- Tracking of concentrations
- Evaluation of likely and actual impacts on plant species

Data from plant monitoring programs associated with field treatments have been used to evaluate the impact on individual plant species of each of four treatment classes based on initial dose and duration of exposure. Some species are more susceptible than others, some recover more rapidly, some are very opportunistic after treatment, and some respond with such variability that prediction of impact is difficult. Plants that decline under nearly all treatment conditions include Eurasian watermilfoil - *Myriophyllum spicatum*, Northern watermilfoil - *M. sibiricum*, Naiad – *Najas*, Waterweed – *Elodea*, Water marigold - *Bidens beckii*. Plants that are stable or increase after nearly all treatments include Stonewort – *Chara*, Nitella – *Nitella*, Water Stargrass – *Zosterella*, Bladderwort – *Utricularia*, Floating leaf pondweed - *Potamogeton natans*. Species that react differently at different concentrations often used in treatments include Water celery – *Vallisneria*, Yellow water lily – *Nuphar*, Water lily – *Nymphaea*, Fanwort – *Cabomba caroliniana*, Some pondweeds – *Potamogeton amplifolius*, *P. gramineus*, *P. zosteriformis*. Species that often appear after treatment when not present beforehand include

Naiad – *Najas*, Leafy pondweed - *Potamogeton foliosus*, Sago pondweed – *Stuckenia*, Waterweed – *Elodea*, Northern milfoil - *Myriophyllum sibiricum*, Aquatic mosses – *Drepanocladus*. Plants that show a wide response that suggests genotypic plasticity or perhaps adaptive capacity include Sago pondweed – *Stuckenii*, Coontail – *Ceratophyllum*, Water crowfoot – *Ranunculus*, Illinois pondweed - *Potamogeton illinoensis*, Curlyleaf pondweed - *Potamogeton crispus*.

Factors that govern the impact of fluridone on target and non-target plant species include dose, duration of exposure, reliance on carotene auxiliary pigments, method of propagation, depth of growth, and hydrologic features of the lake. Key features in plant recovery include:

- Dose and exposure during treatment - survival
- Immigration of plants
- Seed base and proximity of vegetative populations
- Weather
- Alternative stable states hypothesis

Treatment considerations essential to planning will be discussed. Foremost is knowledge of the plant community that allows an assessment of the likely progression of assemblage composition and density after treatment based on the field data now available. Continued collection of such data will be essential to improved understanding and treatment designs. Important considerations for treatment designs include:

- Where a lakewide treatment is desired, choice of dose will depend mainly on desirability of preserving the existing non-target plant assemblage and the length of recovery period that can be tolerated.
- As the portion of the lake to be treated becomes smaller, the importance of maintaining non-target vegetation decreases.
- Each case calls for site-specific planning and flexible execution, applying any of a number of treatment options to achieve the planned dose.
- Consecutive year treatments may be needed for eradication or at least control, given plant ecology and treatment variability. Follow-up controls are almost essential.

NOTES

VEGETATION MANAGEMENT ON A PRIVATE LAKE

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Purpose

This paper illustrates a lake management and restoration project on Lake Valrico in central Hillsborough County where the lake residents have been battling *Hydrilla verticillata* (hydrilla) for many years with limited success. Since 2005, the County has provided assistance to the lake community with this effort by developing and implementing a plan to reduce the hydrilla population without negatively impacting water quality. This paper will outline two years of planning, implementation, methods, data collection, citizen involvement, and lessons learned.

Background & Discussion

The Hillsborough County Lake Management Program is a cooperative program between Hillsborough County and the Southwest Florida Water Management District (SWFWMD). The program incorporates assistance, expertise, and resources from the University of Florida LAKEWATCH Program, the University of South Florida, and Hillsborough Community College as well as Hillsborough County Stormwater Management and Mosquito and Aquatic Weed Control. It is the goal of the Lake Management Program to assist citizen groups in achieving an understanding of each lake ecosystem through the best available science, education, and monitoring techniques.

Hillsborough County is uniquely challenged in our management effort in that most of our lakes (over 200) are private with no public access; thus, our capabilities are limited. However, many of these lakes are linked via natural or altered connections and ultimately flow into other water bodies, several of which are on the state's impaired waters list, including Lake Valrico. Many lakes also receive suburban stormwater runoff or have direct stormwater discharge as a result of a County or FDOT project. Typically, stormwater projects focused on moving and storing water to reduce flooding and water quality was usually an after thought. However, the County now considers water quality issues when designing new stormwater projects. The Stormwater Management Environmental Team will provide assistance to engineers during the design and review period. Also, when possible, the Lake Management Program will assist residents with restoration projects that improve water quality, increase native plant populations, remove invasive plants, and restore natural communities.

Lake Valrico is approximately 105 acres of open water with the actual lake area at 142 acres, based on the lake perimeter at ground level. The lake is presently listed by the Clean Water Act Section 303 (d) Impaired Water's List for nutrients under the Tampa Bay Tributaries Group 2 Basin Verified List. Nitrogen and phosphorus are limiting nutrients based on a TN/TP ratio median of 12.4 (107 values) in the planning period (1998) and 17.6 (164 values) during the verified period (2001). Annual average TSI, as measured by the Florida Department of Environmental Protection - Southwest District was greater than 60 in 1998 and 2001.

Following the installation of a stormwater pipe (2003) that drains a nearby intersection into a stormwater pond and ultimately, into Lake Valrico, the residents became extremely vocal and were successful in getting the County involved with addressing the hydrilla problem. In 2004, the County developed, fully funded, and implemented a plan to treat the lake with SONAR. The SONAR was effective and reduced the biomass of hydrilla nearly 100% but the hydrilla rapidly grew back the following spring. Therefore, a new approach was developed and implemented in 2006, which is the scope of this paper.

Methods

In early 2006, the County's Stormwater Management Section along with Mosquito and Aquatic Weed Control Unit developed a new plan to address the hydrilla population, which spread back to 100% PAC. This plan, which spanned one year, consisted of conducting two Lake Assessments (with USF), treating 6 acres with Aquathol Super K (endothall), releasing 875 triploid grass carp into the lake (~ 7/acre given a 20% mortality rate), conducting monthly inspections and collecting water quality data (Lakewatch and Stormwater), and obtaining vegetation removal permits, right-of-way permits, and triploid grass carp permits from the respective agencies.

The method for the Lake Assessments consisted of collecting water quality samples, and conducting lake bathymetric and vegetative analyses. A Lowrance WAAS GPS and "Fish-finder" fathometer system was used for the Lake Assessments. University of South Florida faculty and students worked in conjunction with the County Stormwater Management Section to complete fieldwork for the lake. All data from the field has been processed and bathymetric maps from this effort have been uploaded to the watershed atlas for display.

Results

Data from the 2006 Lake Assessment (before new management activities) indicate a lake totally inundated with vegetation with a large vegetative biomass load. The primary submerged vegetation included *Hydrilla verticillata* (Hydrilla) with a small population of *Ceratophyllum demersum* (Coontail). Observational inspections throughout the late fall and winter, indicated that the vegetation biomass was reduced but regenerated quickly in the early spring. In fact, according to the May 2007 Lake Assessment, the vegetative biomass has only been reduced slightly. Water quality data for this period remained relatively stable and consistent with seasonal variations.

Conclusions

The triploid grass carp need more time to control the hydrilla. A second treatment of Aquathol Super K will be considered to give the carp an opportunity to keep up with the growth rate.

VEGETATED SHORELINES PROMOTE HEALTHY FISHERIES

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Vegetated shorelines promote healthy fisheries compared to hard armor. Bioengineered shorelines are a form of soft revetment used to stabilize these sensitive areas. Soft revetment practices are designed to reintroducing native plant species along banks or shorelines using natural "soft" products to aid in the establishment of vegetation. These soft products usually include erosion control blankets (ECB's), live staking or natural stakes, coir or straw logs, and natural twine. Native seeding or plugs are used to reclaim the area. The native plants will completely take over the area becoming a single system entwining with the products and soil. These soft products will breakdown in years or even months leaving the native plants behind holding the soil. "Commonly available bio-engineered materials offer inherent resistance to shear stress on the order of 3 to 5 pounds per square foot", according to US EPA.

Hard armor systems are typically rip-rap "rif-raf", vinyl/metal seawalls, and concrete structures. These practices use "Hard" products to create the buffer between the water and shorelines. Riprap systems are designed to bury the existing soil and act as a buffer between the waves and the shore. Vinyl seawalls and concrete structures are often 3 feet or greater in depth taking the shoreline completely out of the equation. These systems create barren unproductive zones in the fisheries life chain.

Vegetated shorelines promote healthier fisheries by creating a buffer zone between the land and the water. The vegetation scrubs the water as it enters into the water body removing soil particles, absorbing fertilizer, and acts as a scrubber for pesticides and other man-made runoff.

Habitat created allows for an increase in macro invertebrates. The abundant food source in the surrounding plants fuels the web of life resulting in increased fishery productivity. The macro invertebrates feed the small fry, which now have a place to seek refuge along the roots and vegetation. These soft revetment systems create a food source and provide shelter for young fish. "Coir fiber logs or other soft revetment structures provide the crucial habitat needed for many macro invertebrate life cycles", according to Eric Spangler President Terra Vision LLC.

The Bio-Engineering Group was tasked by the Army Corps of Engineers to work on the Shelby Bottoms Greenway project located in Nashville TN. "Bioengineering Group staff developed a bioengineering design that was compatible with the existing hydrologic conditions, effectively stabilizes the eroding shoreline, utilize native plant materials, was extremely durable, and ultimately resulted in a cost effective and low maintenance solution." "This project produced a stable aesthetically pleasing shoreline that enhances the park experience while providing valuable habitat for the varied wildlife population that inhabits or uses the park."

A vegetated shoreline results in a healthier more productive fishery. The natural products used to create a vegetated shoreline and different nesting/living habitat structures all result in helping complete the web of life.

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SESSION 6B

INTEGRATED WATERSHED MANAGEMENT PART 2

A REASONABLE ASSURANCE PLAN FOR LAKE SEMINOLE IN PINELLAS COUNTY FLORIDA – AN ALTERNATIVE TO A TMDL

Kelli Hammer Levy
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PBS&J

Lake Seminole is currently listed by the Florida Department of Environmental Protection as an impaired waterbody pursuant to Section 303(d) of the federal Clean Water Act and is scheduled for Total Maximum Daily Load (TMDL) development in 2007. The primary pollutants associated with the lake's impairment are nutrients, which have resulted in hypereutrophic conditions.

The Clean Water Act regulations recognize that alternative pollution control requirements may obviate the need for a TMDL. Specifically, water bodies that would otherwise be listed as impaired are not required to be included on the Section 303(d) list if other pollution control mechanisms are demonstrated to be stringent enough to result in compliance with water quality standards within a reasonable period of time. These alternatives to TMDLs are referred to as Category 4b waters. Reasonable Assurance documentation is required for formal Category 4b demonstration by the U.S. Environmental Protection Agency (EPA). The EPA guidance on Category 4b demonstrations requires that the following elements be addressed:

1. The identification of the water body and a statement of problems causing the impairment;
2. A description of pollution controls and how they will achieve water quality standards;
3. An estimate or projection of the time when water quality standards will be met;
4. A schedule for implementing pollution controls;
5. A monitoring plan to track effectiveness of pollution controls; and
6. The commitment to revise pollution controls as necessary.

In addition to addressing the six elements listed above, the Reasonable Assurance plan for Lake Seminole will establish that 1.) Implementation of the major water quality projects set forth in the Lake Seminole Watershed Plan (2001) are sufficient to meet the established restoration goals; and 2.) That the restoration goals for Lake Seminole are appropriate given the unnatural origins of the lake, as well as the significant hydrologic and biological alternations that have taken place since the lake was first constructed.

This presentation will provide an overview of the Reasonable Assurance plan process; outline the County's progress towards developing a Reasonable Assurance plan for Lake Seminole; and will highlight key components of the Reasonable Assurance plan that will address improvements to water quality within the lake.

Reference

PBS&J. 2001. Lake Seminole Watershed Management Plan. Final task report submitted to the Pinellas County Board of County Commissioners.

NOTES

LAKE JOSEPHINE AQUATIC HABITAT ENHANCEMENT: USING THE TOOLS IN THE TOOLBOX

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Lake Josephine is a 500-hectare natural "transition" lake located in Highlands County. The lake consists of three lake basins ranging from 105 hectares to 255 hectares connected by shallow natural channels at the south end of each basin. Aquatic habitat problems on Lake Josephine have resulted from stabilized water levels and inadequate control of invasive aquatic plants. Prior to 1969, water levels fluctuated more than two feet each year, including frequent flood events, and provided an environment for dynamic littoral communities. Stabilized water levels created by construction of water control structures on Jackson Creek entering the lake and Josephine Creek exiting the lake allowed development and expansion of tussocks and invasive aquatic plants. The project goal for the Lake Josephine Aquatic Habitat Enhancement Project is management of the lake's aquatic habitat for the long-term benefit of fish and wildlife and the people who utilize those resources.

The primary objective of any FFWCC aquatic habitat enhancement project is to manage invasive aquatic plants and associated organic detrital material to create beneficial and functional aquatic habitat for fish, wildlife, and people as is feasible. To be "feasible", management must be cost effective, provide ecological benefits, be in the best public interest, and have the greatest potential for success as compared to other available methods. Hardship on riparian owners and other lake users must also be minimized to the extent practical and allowable under environmental permit conditions. In this project, we utilized three management strategies: mechanical removal of tussocks and associated organic sediments, management for diverse native aquatic plant communities through natural recolonization or revegetation, and management of future invasive aquatic plant problems through use of herbicides and aquatic harvesting.

Tussock removal was conducted using two water level scenarios: "extreme low management" (drawdown to 67.50/68.50 ft. NGVD) and "regulated high water" (71.50 ft. NGVD). After consideration of currently available methodologies, two methods were determined to best meet project objectives:

1. Aquatic weed harvesters to harvest tussock in the east basin under "regulated high" conditions (Phase I)
2. Temporary dams with pumps and earth-moving equipment in the central and west basins to remove tussock and organic detrital sediments under "extreme low management" (drawdown) conditions (Phase II). Installation of temporary dams across the swales between the basins allowed the pump-down of the west and central basins individually to desired levels.

The advantages of these strategies were two-fold. At least two basins were kept at full-pool through the project phases, thereby reducing the impact on recreational users. During the "harvester" project phase, work was conducted in all three basins under "high-water" conditions. During the drawdown project phase, work on the central basin, which receives the least fishing pressure and has no public boat ramp, was conducted in December and January when fishing pressure is highest. Work in the west basin was conducted in March and April as recreational use declines until summer. The east basin, which receives the greatest recreational use and has two public ramps, was kept high through the winter and spring. Secondly, basins adjacent to the dewatered basin were used to assist in basin refill after tussock removal is completed, thereby reducing refill time and dependence on rain for refill. However, drought conditions during and following the drawdown project contributed the partial dewatering of the east basin during refill of the west basin. Since 2002, the FFWCC, in coordination with Southwest Florida Water Management District (SWFWMD), Florida Department of Environment Protection Bureau of Invasive Plant Management, and Highlands County, have enhanced over 70 hectares, or about two-thirds, of the littoral habitat available in Lake Josephine through tussock and organic sediment removal.

Colonization and management of aquatic plants at enhanced sites has been monitored following each project phase. We have transplanted 500,000 aquatic plants (200,000 giant bulrush; 133,333 jointed spikerush; 100,000 Egyptian paspalidium; 66,667 maidencane) and 400 bald cypress trees. Invasive aquatic plants are also being controlled with aquatic herbicides to encourage recruitment of desirable plants. A long-term maintenance program has been implemented to maintain desirable vegetation communities and prevent formation of tussocks in enhanced areas. Although the program is being administered by the Highlands County Aquatic Weed Control Project, all work is coordinated between FFWCC, FDEP, SWFWMD, and Highlands County.

Expected benefits of aquatic habitat enhancement on Lake Josephine include:

1. Improvement of foraging, spawning, and protective habitat for invertebrate, fish, waterfowl, and wading bird populations;
2. Natural reestablishment of desirable native aquatic plant communities and increased diversity of plant species;
3. Improvement of water movement within littoral areas, allowing the flushing of accumulated detritus;
4. Improved access into littoral areas for recreational users (anglers, hunters, wildlife watchers, pleasure boaters, etc.);
5. Reduction of nutrient (phosphorus and nitrogen) loading into the lake through the removal and sequestering of organic material;
6. Increased aesthetic value for the lake.

NOTES

LAKE SEMINOLE – A LIVING LABORATORY FOR ASSESSING THE EFFECTIVENESS OF MULTIPLE LAKE MANAGEMENT ACTIONS

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Lake Seminole is a 684-acre freshwater lake located in west central Pinellas County, Florida. It was created by the impoundment of an arm of Long Bayou, an estuarine waterbody, in the 1940s. Water quality and sport fisheries began to decline during the late 1970s, the trend continued into the late 1990s. Since 1999, water quality conditions in the lake have degraded even further to the point where the trophic state index is now consistently greater than 78.

The *Lake Seminole Watershed Management Plan* identified and modeled the predicted improvement associated with numerous lake restoration and management projects and programs. Since the adoption of the Plan in 2004, the County has begun implementation of several major capital improvement projects including: 1) retrofitting of the five highest nutrient loading sub-basins with alum injection stormwater treatment systems; 2) alum treatment and diversion of flows from the Lake Seminole Bypass Canal into the lake; 3) excavation of nuisance shoreline vegetation and muck sediments followed by replanting with desirable native species; 4) lake level modification and 5) dredging of 1 million cubic yards of flocculent organic sediments. All projects and programs in the Plan are expected to be implemented or completed by 2012.

Pinellas County implemented a statistically robust water quality and biological monitoring program. Monitoring will allow for an opportunity to quantitatively and qualitatively assess the effectiveness of multiple lake management actions. This paper will present a brief history of Lake Seminole, a summary of the Plan, and an update on the observed and predicted improvements in lake water quality and biological communities.

NOTES

BUTLER CHAIN OF LAKES HYDROLOGIC/NUTRIENT BUDGETS & LAKE MANAGEMENT PLAN

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The Butler Chain of Lakes consists of 11 interconnected deep waterbodies in southwest Orange County with a combined surface area of over 5000 acres. The lakes in the Chain have historically exhibited oligotrophic characteristics and are renown for excellent water quality and good fishing. In 1987, the Chain was designated as an Outstanding Florida Water by the Florida Legislature. However, rapid residential growth in the basin has increased both the volume of stormwater runoff and mass loadings of nutrients into the Chain-of-Lakes. As a result, the Orange County Environmental Protection Division (EPD) contracted Environmental Research & Design, Inc. to perform a comprehensive loading assessment of the lake system. During 2005-2006, ERD evaluated historical water quality trends and conducted a 12-month field monitoring program to develop nutrient budgets for each of the 11 lakes. The study included evaluation of hydrologic inputs, nutrients loadings (bulk precipitation, groundwater seepage and stormwater runoff) and sediment interactions to develop hydrologic/nutrient budgets and a watershed/water quality model.

The study concluded that impacts from stormwater and baseflow are less significant than impacts from sources such as groundwater seepage, landscape and fertilization activities, and wetland contributions. Structural nutrient control systems such as retention ponds and alum treatment systems were evaluated for the upstream lakes of the Chain of Lakes. The impact of boating activities on lake water quality was studied and motorized boating restrictions were recommended on water depths of 10 ft. or less to reduce sediment resuspension. The retrofitting of dry detention systems to dry/wet retention was also recommended as a mean of increasing stormwater runoff treatment. Furthermore, changes to existing ordinances were recommended for rear yard berm/swale requirements, shoreline clearings, and sediment/erosion control and landscaping practices, along with requirements for the connection of future developments to the sanitary sewer system.

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SESSION 7A

DYNAMICS OF SUBMERSED AQUATIC VEGETATION

USING HYPERSPECTRAL IMAGERY TO DETECT SUBMERGED AQUATIC VEGETATION IN THE ST. JOHNS RIVER

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Airborne hyperspectral imagery has been used worldwide to successfully detect and identify submerged aquatic vegetation (SAV). This study describes the image-processing methodology that was developed for 2003 and 2006 airborne hyperspectral imagery to determine the extent of SAV in the lower basin of the St. Johns River. Results from the 2003 study and preliminary results from the 2006 imagery will be discussed.

Study area

The St. Johns River is a 500-km low-gradient, black water river in northeast Florida. The Lower St. Johns River basin (LSJRB) encompasses the final 170 km of the river and is subject to tidal exchange and reverse flow events. In the lower basin, the St. Johns is wide (ca. 3-5 km) and shallow (< 2 m), and there is a broad littoral shelf frequently supporting meadows of SAV. Imagery collected in both 2003 and 2006 covered the shoreline of the St. Johns River from downtown Jacksonville to south Palatka.

Methodology

Five hyperspectral images and their associated ground-truth data, along with reflectance data collected in the field, were used in the creation of a spectral library that was applied to the full collection of hyperspectral images acquired in 2003. This approach was utilized as a basin-wide SAV mapping tool that successfully mapped SAV. Classification results were comparable to SAV estimates made from independently collected transect data. Results from the 2003 data analysis provided guidance for selecting finer spatial resolution (pixel size) and more specific spectral resolution (narrower bandwidths) for the 2006 data collection. Hyperspectral data were again acquired in the spring of 2006 with the goal of not only identifying SAV, but potentially distinguishing specific SAV species. Substantially more groundtruthing was conducted for the 2006 imagery and produced a more accurate and diverse spectral library. Over 80 ground truthing plots were identified and delineated in the field using GPS to serve as training polygons for the subsequent image analysis. Groundtruthing was performed within two weeks of the image acquisition. The improved spectral library was applied to the 2006 images that coincided with the areas used in the creation of the 2003 spectral library.

Results

Preliminary results of the analysis of the 2006 data suggest increased classification accuracy for SAV mapping as a consequence of greater spatial and spectral resolution and an increase in ground-truthing conducted during imagery acquisition. Spectral signatures show significant between-class variation, which should lead to more robust image classification throughout all remaining images. Classified images from both the 2003 and 2006 data collection were also compared to groundtruthing transects that were conducted near the imagery collection date. Transect data were used to assess the accuracy of the supervised classification techniques applied to the remotely sensed data.

Conclusions

A methodology was developed for processing the 2003 airborne hyperspectral imagery and fieldwork reflectance data into a spectral library suitable for SAV identification. This same methodology was improved upon with the addition of higher resolution imagery collected in 2006. Hyperspectral imagery has proven to be very useful for SAV identification with the caveat that water depth and existing conditions (algal blooms, existing emergent vegetation, etc.) are influential factors. While the potential exists for distinguishing SAV species, health, or density, such projects require narrow, well-selected spectral bands from the imagery as well as very detailed and robust ground-truthing.

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NOTES

THE EFFECT OF SHADING ON PISTILLATE *HYDRILLA VERTICILLATA* (L. F.) ROYLE TRANSPLANTS FROM LAKE OKEECHOBEE, FLORIDA, USA

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Introduction

The effect of shading on morphometric and meristic characteristics of pistillate *Hydrilla verticillata* (L. f.) Royle was investigated in a large outdoor tank using water, sediment, and plants from Lake Okeechobee, Florida.

Methods

Plants were grown in peat sediment and lake water, under ambient temperature (27 – 31 ^{o}C) and photoperiod (13L : 11D). Treatments were established by differentially shading plants with varying numbers of layers of fiberglass window screen. Photon flux density (PFD) ranged from 8 to 154 mmole photons m^{-2} s^{-1}, or 1.1 to 21.6% of average incident photosynthetically active solar radiation (PAR), based on percent transmittance in the tank and averaged continuous daytime measurements from a mid-lake PAR sensor.

Results and Discussion

Plant characteristics examined included ash-free dry mass, total leaf, internode, shoot, and branch numbers, leaf area, and cumulative shoot length; all of which decreased linearly with decreasing PAR, and had statistically significant treatment effects. No statistically significant treatment effects were found, however, when leaf and branch numbers on the upper third of each shoot were expressed as a percentage of their totals, indicating canopy formation had not yet occurred.

The apparent photosynthetic PFD for no net growth of *H. verticillata*, measured approximately a quarter meter above the sediment surface, approximated zero, with an upper 95% confidence limit of 13 mmole photons m^{-2} s^{-1}, or 1.8% of mean incident PAR. These results suggest that *H. verticillata* can grow in very low light, which likely is an important adaptation given the poor light climate typical of this and many other culturally eutrophic water bodies.

NOTES

THE ROLE OF SEDIMENTS IN THE POST HURRICANE RECOVERY OF LAKE OKEECHOBEE

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Introduction

The eye walls of three hurricanes, Frances and Jeanne in September of 2004 and Wilma in October 2005 passed very close to the center of Lake Okeechobee--a large shallow eutrophic lake in south Florida. The high winds created large waves, large standing waves (seiches), and strong currents that led to resuspension and movement of large amounts of sediments. There was a dramatic increase in suspended solids, total and soluble phosphorus, and dissolved inorganic nitrogen concentrations that have not returned to pre hurricane values despite the storm free year of 2006. This presentation evaluates monitoring data taken before and after these hurricanes to determine potential mechanisms influencing the recovery of Lake Okeechobee.

Methods

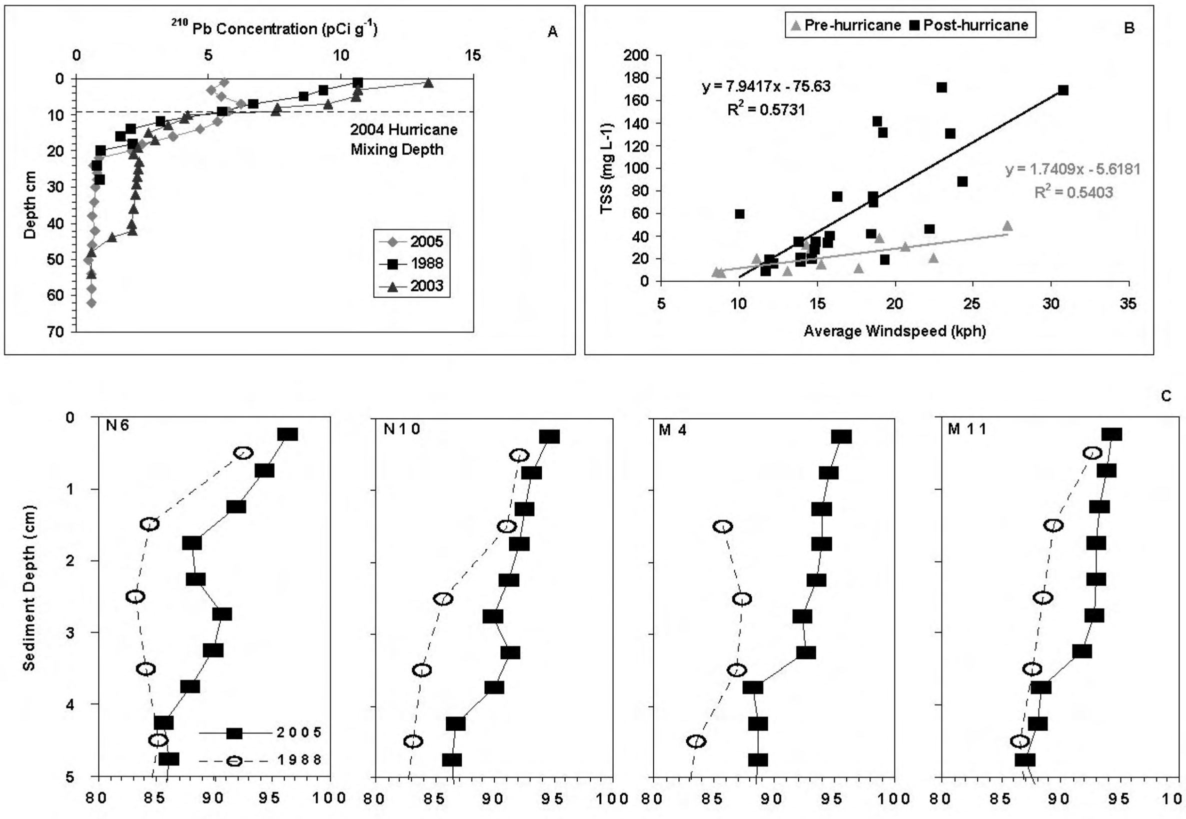
In-lake water quality was monitored on a monthly basis at 34 locations in the lake. Four of these locations included weather stations that measure wind speed. The monitoring program has been described by James et al. (1995). Secchi Disk depth, total suspended solids (TSS), total depth, chlorophyll *a*, nitrogen, and phosphorus species were measured.

Sediment cores were collected from the thirteen locations in Lake Okeechobee in 1988 (Brezonik and Engstrom 1998), three in 2003 (Schottler and Engstrom 2006) and eight in April 2005. Sediments were collected by piston corer, sectioned at 0.5-2 cm intervals in the field, and analyzed for water content; all 1988 and 2003 cores and two 2005 cores were also measured for ^{210}Pb as described in Schottler and Engstrom (2006).

Discussion

The high TSS and nutrient conditions persisted after the hurricanes despite reduced wind speed and water levels, both related to improved water quality conditions in Lake Okeechobee (James and Havens 2005, Maceina and Soballe 1990). We hypothesize that the hurricanes produced an increased layer of more easily resuspended unconsolidated surface sediments, which contributed to the persistent TSS and nutrient conditions afterward. Three lines of evidence are presented: 1) ^{210}Pb profiles in sediment cores taken before and after the storms show a marked change from an exponential decline with depth in the top 10 to 15 cm pre-hurricane to nearly homogeneous conditions after (Fig. 1A), 2) the slope of the relationship between wind speed and solids increased after the hurricanes (Fig. 1B), and 3) water content of surface sediments in four cores taken at the same locations before and after the hurricane was higher after the hurricanes than before (Fig 1C). As these sediments reconsolidate, water quality should improve in Lake Okeechobee.

Figure 1. Before and after hurricane comparisons for A) ^{210} PB profiles, B) Relationship between wind speed and TSS, C) Water content of surface sediments



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NOTES

THE INFLUENCE OF WATER DEPTH AND VEGETATION MANAGEMENT ACTIVITIES ON GIANT BULRUSH IN LAKE OKEECHOBEE

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Controlled pond and greenhouse studies were conducted to evaluate the influence of water depth-on giant bulrush (*Scirpus californicus*) seed germination and establishment and the impact of herbicide treatments on mature bulrush. Seed germination and establishment were tested under two inundation regimes using shaded and unshaded replicates. More than 2,400 seeds were either placed at depths of 0, 10, 25 or 50 cm immediately, or seed were allowed to germinate on exposed moist sediment before being inundated to test depth. Germination was observed predominantly in treatments with exposed substrate (0 cm). Only 3 seedlings were observed in the unshaded 10 cm treatment whereas no germination was observed at deeper inundations or the 10 cm shaded treatment. Bulrush stem density was greatest when substrate was exposed throughout the study. Plants inundated to 50 cm at the slow inundation rate had similar densities to those inundated to 10 and 25 cm, whereas plants inundated immediately to 50 cm produced the fewest density of stems. Plant biomass and inflorescence density was greatest for plants inundated to 0 cm and 10 cm. Exposure to the herbicide Diquat significantly reduced stem density, total plant biomass, stem height and the plants ability to produce seed. In the lake, long-term monitoring of stem density was used to further evaluate the effect water depth and herbicide treatments have on bulrush. Remote sensing also was used to quantify temporal changes in the areal coverage of bulrush along more than 30 km of shoreline. Similar to the controlled studies, stem density tended to decrease with increased water depth and plants treated with Diquat required nearly a year to recover to pre treatment densities. Results indicate that bulrush in Lake Okeechobee is stressed by high lake stage, high turbidity and exposure to herbicide treatments.

NOTES

SESSION 7B

POLICY & REGULATION

REGULATORY CONSIDERATIONS FOR WETLANDS IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

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The Southwest Florida Water Management District (District) has Statutory responsibilities to provide for management of water and related environmental resources; to promote the conservation, development and proper utilization of surface and groundwater; to provide water storage for beneficial purposes; to prevent damage from floods, soil erosion and excessive drainage; to manage stormwater and protect water quality; to protect wetlands, fish and wildlife, and other natural resources; and to promote recreational development. The District governs the regulation of water resources and wetlands, unless exempt by law, where land use consists of agriculture, commercial / residential / industrial developments, and certain mining operations. The District manages these waters through regulatory programs including Environmental Resource Permit (ERP) and Water Use Permit (WUP) applications, and compliance and enforcement activities. This presentation is an overview of some of the basic regulatory activities for wetlands and surface water regulations in the District.

Environmental Resource Permitting

Evaluation of ERP applications and associated compliance with regard to wetlands and surface waters first involves consideration of direct or secondary wetland and surface water impacts. Consideration is given to whether reasonable assurance has been provided that the proposed activity will not result in adverse secondary impacts to the quantity of water that reaches receiving waters (either too much or too little), the ability of surface waters to store or convey water, the value of functions provided to wildlife, the quality of receiving waters with respect to water quality standards, and the maintenance of Minimum Flows and Levels (MFLs). One of the primary issues considered here is whether a watershed of a lake (or wetland) has been altered, or rerouted, to accommodate the stormwater management system engineered for water quality treatment, at times without regard to the hydrologic needs of surface waters. Maintenance of hydroperiods required to maintain the habitat value of a wetland or other surface water is also considered with regard to seasonal water requirements of these waterbodies.

Evaluation of primary impacts to wetlands and other surface waters in the ERP process first considers whether all reasonable efforts have been made to reduce and eliminate impacts to the waters to begin with. This applies primarily to wetlands and to surface waters with significant habitat or water quality functions, rather than to upland cut ditches, or other waters with minimal habitat or water quality functions.

Once reduction and elimination has been addressed, remaining impacts are addressed through mitigation, and the amount of mitigation required is determined through the Uniform Mitigation and Assessment Method (UMAM). In addition, mitigation must be "type for type" – impacts to marshes cannot be mitigated though enhancement of a forested system, for example.

Water Use Permitting

Evaluation of WUP applications with respect the potential for adverse impacts to wetlands and surface waters primarily involves the potential for surficial water table drawdowns and/or excess irrigation runoff adversely impacting wetlands and surface waters. While many deep agricultural wells extending to the Floridan aquifer are not generally expected to impact surface waters, wells that extend only to the intermediate aquifer may very well cause adverse hydrologic impacts. Furthermore, depending on the amount of pumping and the geology of the wellfield area, public supply wellfields using large wells extending to the Floridan aquifer have been shown to have adverse hydrologic impacts on wetlands and other surface waters. The District and Tampa Bay Water have developed a program in recent years, the Wetland Assessment Procedure, to scientifically assess stress and changes in hydrology for isolated wetlands near wellfields. Potential impacts resulting from excess irrigation runoff are addressed through improved irrigation efficiency and management practices, including tailwater recovery systems and increased use of soil moisture sensors to "fine-tune" irrigation management.

Unauthorized Activities

Unauthorized activities in wetlands and surface waters that may result in compliance / enforcement action include both primary and secondary impacts. Among the more common and obvious impacts are the dredging and/or filling of wetlands and other surface waters. The District is responsible for compliance with regulations with regard to agriculture, commercial/industrial businesses, subdivisions, and non-phosphate mining operations and mining that does not involve sorting or grading; however, the District does issue and enforce the terms of WUPs for all mining operations.

NOTES

THE PROPOSED RECLASSIFICATION OF FLORIDA'S SURFACE WATERS: SCIENTIFIC BASIS AND POLICY IMPLICATIONS

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A.B. Shortelle, Ph.D.
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The Clean Water Act requires that water quality standards protect the designated uses of regulated waters. For many years, Florida's classification of surface waters has had five designated uses: I) Potable water supply, II) Shellfish propagation or harvesting, III) Recreation and propagation and maintenance of a healthy, well-balanced population of fish and wildlife, IV) Agricultural water supply, and V) Utility and Industrial use. There is concern that this simple classification is insufficient for the varied aquatic life and human uses associated with Florida's numerous rivers, lakes, streams, wetlands, and estuaries. Consequently, FDEP convened the Designated Uses and Classification Refinement Policy Advisory Committee. The committee has evaluated the current classification and potential refinements. Working with the committee, FDEP has a new classification based on four aquatic life uses and seven human uses. The proposed aquatic life uses form a gradient of decreasing similarity to the structure and function of biological communities of the natural background condition: from very high similarity (AL-1) to low similarity (AL-4). AL-2 is equivalent to Class III. Proposed human uses describe a gradient of decreasing recreational use and contact: potable water supply (HU-1), shellfish harvesting (HU-2), recreation and fish consumption (HU-3, HU-4, HU-5), irrigation (HU-6), and navigation and industrial uses (HU-7). The default classification for Class III waters would be (AL-2/HU-3). Water quality standards could be affected: most prominently, dissolved oxygen, nutrients, and bacteria. Proposals to lower an existing designated use would require a substantive, scientific justification in the form of a use attainability analysis.

NOTES

FLORIDA GAME AND FRESHWATER FISH COMMISSION – NEW FUNDING INITIATIVES

Bruce V. Jaggers
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As a result of a 1998 constitutional amendment the Florida Game and Fresh Water Fish Commission was reorganized into the Florida Fish and Wildlife Conservation Commission (FWC) on July 1, 1999. Internal reorganization has been ongoing since 1999 and as a part of that reorganization development of FWC projects is now focusing on teaming, multi-agency partnerships and stakeholder input. The focus of the teaming aspect is to create a multi-disciplinary approach to project planning which includes participation by multiple species guild representatives. An example of this process is an FWC multi-disciplinary team, the Kissimmee Chain of Lakes Standing Team (KCOL) which also participates in the Kissimmee Interagency Working Group. FWC funding initiatives have also been reorganized to reflect our focus. The former Lake Restoration Section is now known as the Aquatic Habitat Restoration and Enhancement Section (AHRES). An AHRES application process has been developed for funding approval for projects. A key component of this application process is species guild review. Priority funding is given to projects with multiple funding partners. Eligible projects are those that address restoration or enhancement of fresh water aquatic habitat. Projects must be on public lands and demonstrate benefits to fish and wildlife.

NOTES

NPDES PHASE II PERMITS – MS-4 AND CONSTRUCTION ACTIVITY SUMMARIES

Patricia Tierney, CPESC
Orlando, FL

The Clean Water Act was passed in 1972 with lofty goals of restoring the nation's waters to protect fish, wildlife and recreational use. Current permits (May 2003) resulting from that Act include the NPDES Generic Permit for Discharge of Stormwater from Phase II Municipal Separate Storm Sewer Systems and the Generic Permit for Stormwater Discharge from Large and Small Construction Activities. Both of these permits reach a large number of people in our State and allow cities, counties, contractors, developers, universities, Department of Transportation, military facilities, and Community Development Districts to discharge stormwater into Waters of the State and MS4s. At this time, there are approximately 128 Phase II MS-4 permittees and nearly 20,000 NPDES Generic Construction Permits in Florida.

These generic permits are designed to reduce the pollutant load and appear to be straightforward. However, implementing the permit in the field can be complex, as permittees deal with resources issues, lack of training and high turnover rates, economic constraints, low enforcement activities, and a number of other reasons that can result in non-compliance. This presentation summarizes permit information (for both permits), detailing requirements, as well as data from various NPDES Phase II permit holders around the State. This presentation briefly summarizes the NPDES permits as it relates to Phase II MS-4s and Small (and Large) Construction sites, for those who want to know what the smaller communities and developers/builders are required to do to reduce the pollutant load in their jurisdiction.

Online References

NPDES MS4 Phase II Rule, list of who's covered, permit options, FAQ, etc.
http://www.dep.state.fl.us/water/stormwater/npdes/MS4_1.htm

Customizable materials from EPA for MS4s
http://cfpub.epa.gov/npdes/stormwatermonth.cfm

MS4 Phase II permit, Notice Of Intent, Specific Guidance, List of BMPs, etc.
http://www.dep.state.fl.us/water/stormwater/npdes/MS4_5.htm

Permit Options and Requirements for Construction Activity (Permit, NOI, NOT, SWPPP template, etc.)
http://www.dep.state.fl.us/water/stormwater/npdes/construction3.htm

The Florida Stormwater, Erosion, and Sedimentation Control Inspector Training & Certification Program (scheduled classes, list of instructors, electronic copy of manual, etc.)
http://www.dep.state.fl.us/water/nonpoint/erosion.htm

FDEP Construction Brochure, Frequently Asked Questions
http://www.dep.state.fl.us/water/stormwater/npdes/construction1.htm

SESSION 8A

DREDGING FOR LAKE RESTORATION

The Evolution of Sediment Removal Technology for Restoring Subtropical Lake Systems in Land-Limited Landscapes

John Kiefer, PE and *Walter R. Reigner, PE*
BCI Engineers and Scientists, Inc.

Over the last twenty years, land has become an increasingly precious commodity in Florida, and the science associated with sediment removal in subtropical lake systems has necessarily matured in response to the decreasing availability of affordable land. The early "pump and dump" mentality has been increasingly replaced with sophisticated dewatering and water clarification/ treatment processes to greatly reduce land area requirements for sediment placement. Improvements in chemical effectiveness and enhancements in physical separation equipment combined with the adaptation of proven wastewater solids handling practices have even made it feasible to restore lake bottoms in highly urbanized watersheds. Without such innovation, urban lakes would be impractical to restore from a cost standpoint; thus resulting in the eventual loss of a valuable natural resource that is common to many of Florida's high growth areas and vital to the health of Florida's economy. Also, creative ideas have been developed to maximize the beneficial placement of dewatered sediment to improve the characteristics of altered terrestrial and aquatic landscapes. This includes capping contaminated soils, restoring grade at subsided muck farms, creating habitat islands in lakes, deflecting currents in open water bodies, and as organic soil amendments for wetland restoration or farming. This presentation will summarize and discuss the changes that have occurred to sediment removal and use over time and provide case studies that document the incremental advancements in the science of sediment dewatering as it relates to navigation improvements, water quality enhancement, and habitat enrichment.

NOTES

LAKE HANCOCK SEDIMENT REMOVAL MESOCOSM EXPERIMENT-PRELIMINARY RESULTS

Dave Tomasko, Emily Hyfield, and Doug Robison
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Lake Hancock, a 4,500-acre freshwater lake, is located in Polk County, Florida at the headwaters of the Peace River. Historically, this lake has experienced poor water quality for at least the past 40 years, and is currently listed (303(d)) as an impaired water body based on dissolved oxygen and nutrients (TSI>60). Under a contract with Polk County Natural Resources, PBS&J completed the first of two mesocosm experiments at three locations in the lake to assess the potential for water quality improvements based on sediment removal activities. The funding for this project was provided by Polk County and FDEP for the creation of the TMDL BMAP. The initial experiment was completed in Winter 2006; a second one will be repeated in Summer 2007. Three mesocosm conditions were sampled: Dredged, Undredged and Reference, at each of three locations. Samples were taken on four dates, two under natural conditions, and two under "mixed" or artificially induced windy conditions. A suite of physical, chemical and biological water quality parameters were analyzed. Preliminary results indicate a significant change in nutrient concentrations between the dredged and undredged mesocosms. Changes in nutrient concentrations indicate a shift in the Total Nitrogen:Total Phosphorus ratio which, if sustained, could reduce blue-green algal dominance. Based on BOD results and the relationship between Lake Hancock discharges and DO in the Peace River at Bartow, the potential benefit from dredging the lake could extend into the Upper Peace River as well.

NOTES

REMOVAL OF ORGANIC BOTTOM SEDIMENTS FROM LAKE MAGGIORE UTILIZING AN INTEGRATED HIGH CAPACITY HYDRAULIC DREDGING AND RAPID MECHANICAL DEWATERING SYSTEM

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Phoenix Process Equipment Company
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Kirk Davis, P.G.
Jahna Dredging, Inc.
Lake Wales, FL

Introduction

Lake Maggiore is a 380-acre freshwater lake in St. Petersburg, Florida. The lake was formerly connected to Tampa Bay via Salt Creek. In the 1940's a water control structure was built on the northwestern corner of the lake to control storm water and eliminate tidal influences. Like many Florida lakes, a thick accumulation of organic muck deposits had resulted in shallow lake conditions, declining water quality, poor water clarity, persistent algae blooms, and a reduction in recreational use of Lake Maggiore. In order to reverse these negative highly eutrophic conditions caused in part by the nutrient rich muck deposits, the City of St. Petersburg contracted for the removal of approximately 1.5 million in-situ cubic yards of lake bottom sediments.

Project feasibility studies evaluating numerous lake restoration options concluded that hydraulic dredging in conjunction with mechanical dewatering was the most economical approach based on available sediment disposal options. Jahna Dredging Inc. was awarded a contract for the sediment removal and dewatering which included modifying existing state and federal environmental permits to construct a commercial scale dewatering plant and to return clear plant effluent back into Lake Maggiore.

Purpose

The purpose of the presentation is to share specific project design information and valuable execution experience to assist lake managers plan restoration projects including:

1. Extensive pre-dredging sediment sampling and material characterization to determine mass balance, material throughput, and system flow diagrams.
2. Fine sediment dewaterability studies leading to equipment sizing and polymer selection.
3. Design, erection, and operation of a high capacity hydraulic cutterhead dredge integrated for continuous operation with a temporary mechanical dewatering facility.
4. Overview of production rates, dewatered material types, and haul volumes.
5. Water quality and environmental monitoring.
6. Sediment hauling and disposal limitations and considerations.
7. Estimated ranges in cost for sediment dredging, dewatering, and disposal.

Results and Conclusions

Results from the successful completion of the multi-year Lake Maggiore restoration project will be presented. During the project a total of approximately 500,000 dry tons of sediment (over 60,000 truck loads) were hydraulically removed from the lake, separated into sand and fine fractions by screening and hydrocycloning, thickened and dewatered using belt filter press technology to produce dry stackable materials ready for hauling off site to a distant disposal area. Return water was monitored and shown to be non-toxic, clear / non-turbid, and meeting background water quality. The conclusions support that hydraulic dredging integrated with mechanical sediment dewatering to be a technically, environmentally safe, and economically feasible approach to lake sediment removal, particularly in an urban setting where area development precludes traditional sediment disposal techniques, and open land for sediment processing is limited.

NOTES

SESSION 8B

GROUNDWATER – SURFACE WATER INTERACTIONS

Shallow Groundwater Nutrient Dynamics in the Lower St. Johns River Basin

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Characterization of shallow groundwater nutrient dynamics in the Lower St. Johns River Basin (LSJRB), Florida is crucial to evaluation of groundwater pollution and to understanding of its potential adverse environmental impacts upon the LSJR water quality. The objectives of this study were to: (1) evaluate shallow groundwater nutrient contamination status in the septic tank land use areas using field sampling data and US-EPA's water quality criteria; (2) determine the site and seasonal variations of the shallow groundwater nutrients; and (3) identify the relationships between the shallow groundwater nutrients and the land use conditions using Piper (e.g., trilinear) plots. Results and suggestions from this study will be presented and discussed.

NOTES

SOURCES OF NITRATE IN THE WEKIVA RIVER BASIN

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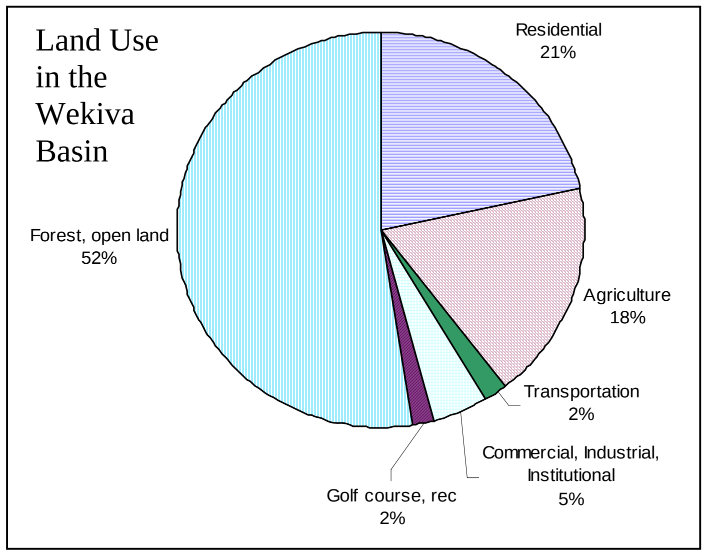
Central Florida's Wekiva River is a springfed system of regional, state and national significance. Several of the Basin's seven 2nd magnitude springs have impaired water quality due to nitrate contamination. The Basin, including its springshed, encompasses 415,000 acres within four counties (Lake, Orange, Seminole, and Marion).



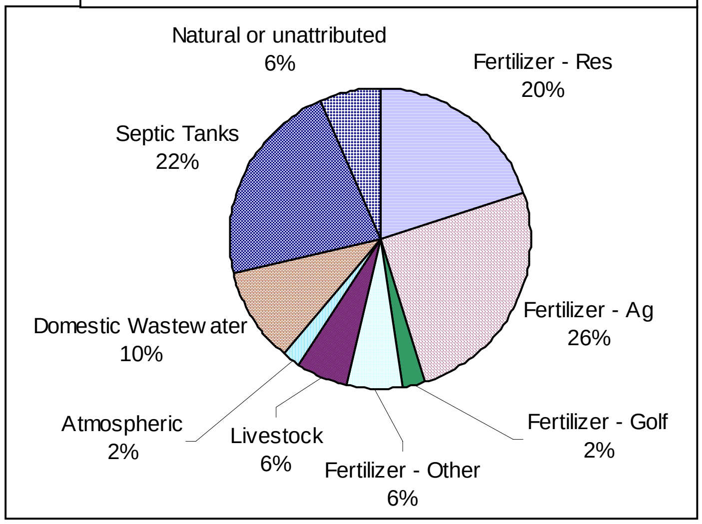
Sources of nitrate include fertilizer use, sewage (sewered systems and septic tanks) and atmospheric deposition. Inputs (e.g., fertilizer applied) from these sources were estimated. Transport mechanisms to waters of the Basin were defined, and nitrate loadings to surface water and groundwater were estimated.

UF/IFAS Extension Service recommendations were the primary source of fertilizer application rates, unless published evidence indicated that actual application rates differed from Extension recommendations. Acreage in various land uses were determined using ArcGIS™ from the St. Johns River Water Management District (SJRWMD) 2004 land use data. Florida Department of Environmental Protection permits were used to identify wastewater facilities discharging nitrate, and compliance monitoring data from 2004 through 2006 were used to estimate effluent loads. Septic tank information provided by FDOH was used to estimate the number of septic tanks in the basin.

Loadings to groundwater were estimated using ArcGIS™ by multiplying representative groundwater concentrations for each land use by groundwater recharge rates used in SJRWMD's E. Central Florida groundwater model. Representative groundwater concentrations for each land use were based on field scale monitoring studies from sites in Florida, if available, or studies from similar land uses elsewhere. Field scale monitoring studies were not identified that could be used to estimate groundwater concentrations in residential areas, and residential land use is a large and growing portion of the Wekiva Basin. Stormwater loadings were estimated by application of the Watershed Management Model (WMM) developed for the Wekiva Study Area Stormwater Master Plan.

The following pie chart shows that fertilizer use by agriculture and for residential turfgrass are major sources of nitrate to the Wekiva Basin (26 and 20 % of total loading, respectively), as are septic tanks (22% of total loading). Fertilizer use comprises about half of total loadings. Domestic wastewater is also a significant source at 10% of the total. Anthropogenic loadings are about 90% of the total.

Nitrate loadings to the Wekiva Basin, Partitioned by Source



Significant uncertainties are associated with these estimated loadings, and additional research is recommended to reduce these uncertainties. In particular, the portion of the Basin in residential land uses is growing rapidly, yet field data that can be used to estimate the groundwater loading that result from fertilizer use on residential turfgrass is quite limited. A broad scale monitoring effort is recommended to improve estimates of nitrate loading to groundwater from residential land uses.

Potential strategies for reducing loadings were identified and evaluated in a preliminary, qualitative manner. The St. Johns River Water Management District has established Provisional Pollutant Load Reduction Goals for waters of the Basin, finding that nitrate loadings in the Basin may need to be reduced as much as 85%. Fertilizer use by homeowners and farmers, and septic tank and domestic wastewater effluents contribute the bulk of the loadings. To achieve the Provisional Pollutant Load Reduction Goals, these source types would represent the primary targets for load reduction. Load reduction strategies evaluated included:

- More stringent requirements for domestic wastewater management as promulgated by Florida Department of Environmental Protection in 2006 as Florida Administrative Code 62-600.550; these requirements will be phased in during the next five years
- Replacement of conventional septic systems with advanced septic systems;
- Replacement of conventional septic systems by expanding the service areas of central sewer systems;
- Wider implementation of Best Management Practices for both fertilizer use and irrigation in residential and agricultural land uses.

Florida Department of Health recommended load reduction strategies for septic systems, as summarized above. Florida Department of Agriculture and Consumer Services and UF/IFAS Extension Service are involved in the development and implementation of Best Management Practices for fertilizer use and irrigation. A load reduction scenario was evaluated in which each of these strategies was assumed to be implemented, resulting in a 20% reduction in nitrate loading.

Karst Lakes and Nutrient Loading to the Aquifer

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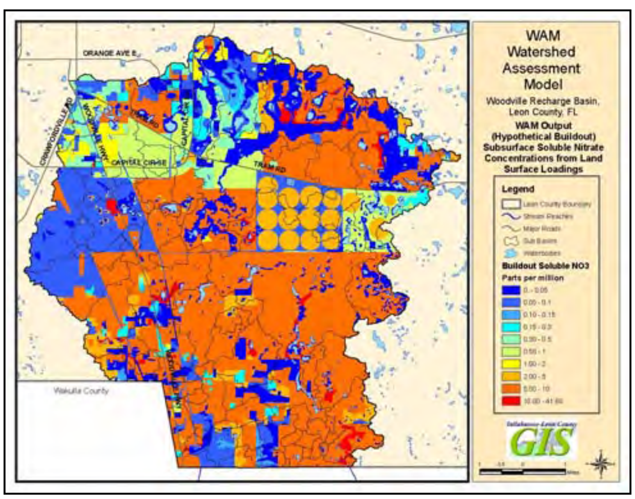
The Woodville Recharge Basin is a karst plane that includes several first order springs, numerous sinks and excellent examples of karst lakes (Lakes Jackson, Iamonia, Lafayette, Bradford and Munson). The Watershed Analysis and Management Model (WAMview) was used to assess nutrient loading from surface to ground water. Nitrogen loading was traced to wastewater sources. Phosphorus loading derived from direct surficial inputs into open karst features associated lakes and streams. Popular attention has focused on nitrogen loading but nutrient limitation results suggest that phosphorus loading may have a more serious effect on area springs.

Within the WRB karst lakes periodically disappear into sinkholes. Lost rivers dive into the ground only to reappear as springs. In some areas swaletts are common. These are shallow underground rivers that pop up on the surface for a few hundred feet only to disappear into a sink. Karst features and caves abound. All of these tend to conduct water through a dendritic cavern system to the numerous springs in the area. This study examined nutrient loading and impacts to springs as a result of Landuse.



Wakulla Springs is considered the world's deepest freshwater spring. Wakulla Springs has experienced significant nutrient enrichment over the past 10 years. Herbicides are now applied at the springshed annually as a drip treatment to keep the springs open. Harmful algae are proliferating. This summer 30 swimmers were treated for toxic shock (this occurred at Ichituknee Springs too) and 37,000 cubic yards of noxious muck washed up at Wakulla Beach.

The Woodville Recharge Basin (WRB) encompasses most of the springshed of Wakulla Springs and the St. Marks Rise. The Floridian Aquifer in the WRB is covered by 10 to 20 feet of sand and is vulnerable. The Floridian Aquifer is a limestone aquifer that transmits water through bedding planes, fractures, tunnels and caverns. The water flows into and out of the springs through the underground caverns of the Floridian Aquifer. The Woodville Recharge Basin (WRB) is experiencing rapid growth. Water quality in the aquifer is deteriorating.

Stormwater flows into Sinkholes and can pass directly to the aquifer without being attenuated. This is has been termed a short circuit to the aquifer. Many compounds like phosphorus, pesticides, herbicides and petroleum hydrocarbons are hydrophobic and are absorbed by soils. Compounds like Nitrate and Chloride behave differently, they are hydrophilic and percolate through the soils without attenuation.

Conclusions

- Atmospheric deposition studies indicate that oxidized nitrogen does not have a major effect on groundwater nitrate nutrient concentrations. Phosphate deposition was insignificant because the sandy soils contain enough clay for the soil water equilibrium concentrations of phosphate to dominate groundwater concentrations.
- Septic tank systems did not have dramatic effects on the surficial aquifer
- Mesocosm experiments indicate that approximately 50% of the nitrogen was attenuated and phosphorus was completely attenuated.
- Dye studies, some covering over 16 miles, showed that open karst features transport surface water directly into area springs.
- Background water comes from across the Georgia border.
- Extensive conduit systems in the central and western WRB carry nutrient rich water to Wakulla Springs. Nitrogen is largely derived from a wastewater sprayfield and phosphorus from sinking streams and lakes.
- Extensive conduit systems in the eastern WRB carry the waters that are low in nutrients to the St. Marks Rise. This area is relatively undeveloped.
- Stormwater flows into Sinkholes from Karst Lakes and Sinking Streams and passes directly to the aquifer without being attenuated.
- Deep wells indicate that groundwater flow may be facilitated in the WRB by a dipping impervious dolomite layer between 100 and 200 feet. A rubble zone above the dolomite behaves as a pseudo conduit.
- Saline waters were encountered at depths of 300 feet within the WRB.


Lake Jackson, May 2007

This Study was funded by the U.S. Environmental Protection Agency. Greg Mauldin (Tallahassee-Leon County GIS), Frank Lesesne, PG. (MACTEC) and Steve Reese, PE. (Ardaman) contributed to this report.

Notes:

SESSION 9

STREAMS & RIVERS

INVERTEBRATE COMMUNITY PATTERNS ASSOCIATED WITH LAND USE INFLUENCED CHANGES IN ORGANIC MATTER LOADING IN TRIBUTARIES OF THE LOWER ST. JOHNS RIVER.

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Introduction

Organic matter, primarily in the form of detritus, serves as the resource base for invertebrates in many small streams (Wallace et al. 1997). However, urban development reduces organic matter inputs and can potentially alter stream ecosystems through a suite of possible mechanisms (Meyer et al. 2005, Walsh et al. 2005). These changes have been shown to alter stream function in northeast Florida streams (Chadwick et al. 2006). One important finding was that increased urbanization changes the character of the organic matter loading by increasing the relative proportion of labile OC. It was hypothesized that increasing labile organic carbon in the system would improve detrital food quality and result in greater secondary productivity. A two-year study was undertaken to examine the effects of urbanization on low-order streams in the lower St. Johns River basin. The prediction that increased labile carbon would produce greater macroinvertebrate biomass was tested.

Methods

Eighteen watersheds were selected representing a range of total impervious area from 0-66%. Water quality samples were collected monthly from streams draining those watersheds and analyzed for standard field and chemical parameters. Macroinvertebrate samples were collected from a subset of seven streams, representing various levels of urbanization with 0-51% impervious surface. Macroinvertebrates were sampled quarterly or monthly in triplicate at five random sites within a 100-m reach. Samples were sorted, counted, and measured for biomass estimation. Analyses were performed using Systat®.

Results and Discussion

Sites were significantly different with respect to all measured forms of OM. Factor analysis indicated that most of the variance among sites was explained by differences in seston, labile OM, and refractory OM. There was no relationship between benthic organic matter (CPOM) or seston (FPOM) and total impervious area (TIA). The only apparent effect of impervious surface on OM constituents was an exponential decline in TOC and a significant increase in the relative proportion of labile TOC with increasing TIA. Thus, it appears that increasing TIA in watersheds (i.e., urbanizing) not only reduces the total loading of OM but also changes the potential nutritional availability of the OM entering the system. But do those changes affect secondary consumers?

While there was no relationship between total macroinvertebrate abundance or biomass and TIA, individual functional feeding guilds were affected. Canonical correlation analysis indicated that collector/gatherer and predator densities were positively related to labile forms of OM. Collector/gatherer, predator, filterer, and scraper densities were positively related to inorganic seston while collector/gatherer density was negatively related to organic seston. Therefore, the original prediction of increased macroinvertebrate biomass was not supported. However, the data do indicate that increasing TIA and concomitant increases in the proportion of labile TOC differentially increase the collector and predator feeding guilds. Since the total amount of seston was not affected by TIA, increased seston quality may explain the relative increase in the collector-feeding guild. Similarly, increased seston quality appeared to increase trophic efficiency, which was suggested by the relative increase in the predator-feeding guild.

Two other features were important determinants of macroinvertebrate community structure. Riparian structure determined the in-stream condition. First, open canopy streams were dominated by *Hydrilla verticillata*. Dominance of *H. verticillata* completely changed the resource base from terrestrial detritus to aquatic macrophytes. It also changes the diel DO pattern from relatively steady to extreme hypoxia/supersaturation oscillations. The second determinant was stream hydrology. Undeveloped low-order streams displayed ephemeral flow patterns. In contrast, urbanized streams displayed perennial flow patterns; although, this can be strongly influenced by stormwater controls in the watershed (Thiele et al. in review). Largely due to these changes in stream flow, macroinvertebrate biomass and density increased and peaked at intermediate levels of TIA, unlike many other urban systems (Paul and Meyer 2001, Walsh et al. 2005).

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NOTES

ENVIRONMENTAL CHALLENGES FOR A SUSTAINABLE WATER AND ENERGY FUTURE

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All industry is faced with meeting environmental challenges and standards. As the only reliable and environmentally friendly power generation mode, it is essential the Hydropower Community lead the field and actively pursues environmental enhancement opportunities. The U.S. Army Corps of Engineers has made great improvements to water quality downstream of federally owned, operated and maintained hydropower facilities in the Southeastern United States.

The majority of lakes in the Southeastern United States and other temperate regions of the world experience a phenomenon known as thermal stratification. In the summer months, as surface waters warm, the differences in density between the surface and bottom water restrict the vertical circulation of the lake. Reservoir-based hydroelectric water intakes are typically oriented such that they draw water from low in the water column. The lower portion of a thermally stratified lake is practically void of dissolved oxygen. Releasing low dissolved oxygen water into the tailrace can seriously impact downstream fish habitat. The U.S. Environmental Protection Agency (EPA) has published dissolved oxygen criteria indicating levels of less than 5 mg/l can severely impair fish development in early stages of life.

The U.S. Army Corps of Engineers operates and maintains 24% of the hydropower in the United States and is the nation's fifth largest electric power provider with almost 24 thousand megawatts of installed capacity. Three Corps facilities located in the upper Savannah River Basin have a combined capacity of 1,480 megawatts. In fiscal year 2006, these three Projects generated $66 million in revenue that was returned to the United States Treasury. All Corps Projects are designated multipurpose, balancing the demands of hydropower, navigation, recreation, flood damage reduction, water supply and environmental stewardship stakeholders.

Environmental stewardship is one of the U.S. Army Corps of Engineers' primary missions. Within our environmental operating principles, the Corps strives to avoid impact and whenever possible restore or improve ecosystems neighboring our facilities. Man-made impoundments are easy targets for environmental concern and criticism. Private industry hydroelectric installations are required by the U.S. Federal Energy Regulatory Commission (FERC) to address all environmental issues associated with their facility prior to relicensing. Federal government powerplants are not currently subject to FERC oversight but public scrutiny will eventually focus on these facilities. When that time arrives, the Corps of Engineers will be able to display numerous positive and proactive environmentally conscientious strides.

Hartwell Project is the northwestern most facility and origin of the Savannah River, which forms the State border between South Carolina and Georgia. The rocky channel below the dam combined with the cool generation release water temperatures have created an unusual geographic location for a “put and take” trout fishery, which is stocked by both the South Carolina and Georgia Departments of Natural Resources. Decreasing summertime dissolved oxygen levels in the lake due to thermal stratification have historically impaired this fragile downstream fishery when water is released during generation periods. Working with the Tennessee Valley Authority (TVA), plant staff modified turbines adding hub baffles and air passages to significantly improve downstream water quality. Before the installation of the hub baffles, less than 1 mg/L dissolved oxygen discharge was common in the tailrace during August and September. The turbine hub baffle modification increased release dissolved oxygen as much as 3 mg/L with a measured efficiency loss of 0.5% at maximum wicket gate opening.

Richard B. Russell Project is a pump storage facility and the middle Corps impoundment on the Savannah River. One of the environmental features installed during initial construction was a forebay hypolimnetic oxygen diffuser system to meet downstream water quality standards. Liquid oxygen is trucked to a local storage facility and a water bath vaporizer is used to gasify the oxygen before distribution into the lake. The original system consisted of a rigid pipe grid supplying oxygen to ceramic and rubber diffuser membranes. This system required periodic underwater cleaning and leveling to achieve better oxygen dispersion. TVA developed an improved efficiency replacement system which was installed at Richard B. Russell in 2002. The TVA-designed diffuser lines have controllable buoyancy, enabling surface inspection and maintenance, thus eliminating need for divers or remote operated vehicles. The improved oxygen transfer efficiency of this new system is yielding equivalent water column dissolved oxygen absorption while using only 60% of the liquid oxygen requirement of the previous diffusers.

J. Strom Thurmond Project is the oldest and southeastern most Corps hydropower facility on the Savannah River. In conjunction with the rehabilitation of the 50-year-old power plant, the Corps installed Auto-Venting Turbines (AVT) designed and manufactured by Voith Siemens Hydro. Unlike conventional Francis turbines, AVT blades are hollow with thicker leading and trailing edges. Air is channelized under the headcover to the hollow turbine blades. Air and water mix at the blade’s trailing edge that is machined with slots to facilitate air passage. The turbine efficiency impact of the AVT is only 0.2% with one air passage valve open improving discharge dissolved oxygen by 2 mg/l. At Thurmond, AVT has increased downstream dissolved oxygen as much as 4 mg/l. The AVT provides greater dissolved oxygen absorption with a wider distribution filling the draft tube cross section. This action earned the Corps and Voith Siemens the 2003 National Hydropower Association Hydro Achievement Award.

Over the next few years the Corps will automate dissolved oxygen systems, optimize multiple aeration systems, pursue real time turbine efficiency and water quality monitoring. The Corps is beginning installation of a new oxygen diffuser to mitigate for habitat loss and eliminate hydropower operational restrictions in the basin. These accomplishments and plans demonstrate only a fraction of the commitment with which the U.S. Army Corps of Engineers views the mission of environmental stewardship. The Savannah District is extremely proud of the ecological improvement successes realized within our region and look forward to meeting similar challenges in the future.

NOTES

BATTLE BEND SLOUGH RESTORATION
APALACHICOLA RIVER (LIBERTY COUNTY, FL)

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The Apalachicola River is located in the Florida Panhandle and is the largest river in Florida. It is home to many species of endangered mussels, anadromous striped bass (*Morone saxatilis*) and the endangered Gulf sturgeon (*Acipenser oxyrinchus destotoi*). Battle Bend is located at Navigational Mile 28.8 and was once part of the main channel of the river until the U. S. Army Corps of Engineers (USACE) excavated a cutoff in 1968 that bypassed this bend in the river. Over the next two decades, sediment deposition created a blockage in the lower arm of Battle Bend that restricted fish passage and angler access into the backwater pool of the severed bendway. Navigation maintenance activities (dredging) contributed to the entrenchment of the river channel that resulted in the loss of important floodplain habitat along the river corridor.

This purpose of this project was to re-establish a channel 200' wide by 1,000' long at the lower arm of Battle Bend. Sediment removal from Battle Bend was accomplished using excavators with spoil material loaded onto barges for transport. Reconnection of this old cutoff river channel will improve its water quality during low flow conditions and enhance its function as an important backwater habitat for spawning, feeding and/or nursery areas for many important Apalachicola River fishes. Material was transported by barge 14 miles downstream to Bloody Bluff, then, trucked 15 miles to the disposal site. Total material to be excavated was about 64,000 cubic yards at a total project cost of $1.94 million dollars.

NOTES

CLIMATIC CYCLES AND THEIR EFFECT ON FLORIDA RAINFALL AND RIVER FLOW

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A major step in developing legislatively mandated minimum flows for watercourses in Florida are the selection of an appropriate benchmark or baseline flow period. Although most appreciate that rainfall is the primary driving factor affecting river flows, it has been traditionally assumed with respect to hydrology that river flows are the consequence of a sequence of random independently and identically distributed random variables. Recently climatologists have suggested a link between multidecadal periods of warming and cooling of the Atlantic Ocean (the Atlantic Multidecadal Oscillation – AMO) and rainfall patterns across much of North America. Citing Enfield et al. (2001), Basso and Schultz (2003) noted that the AMO offered an apparent explanation for observed rainfall deficits throughout central Florida. The AMO suggests that a step trend should be expected in rainfall leading to multidecadal differences in rainfall. What is particularly interesting to those of us in Florida is that unlike most of the continental United States, Enfield et al. (2001) found for most of Florida a positive (rather than negative) correlation between rainfall and prolonged periods of North Atlantic Ocean sea surface warming (Enfield et al. 2001). While periods of warmer ocean temperature generally resulted in less rainfall over much of the United States, there are some areas, including peninsular Florida, where rainfall increased.

Since river flows are largely rainfall dependent, variation in rainfall should result in variations in river flows. While researchers often examine annual variation in stream flow in anticipation of monotonic trends affected by anthropogenic factors, river flow data were tested for a step change as well. Statistical evidence is presented demonstrating a step change in both rainfall (for sites in south-central Florida) and river flows that is consistent with a step in warming and cooling phases of the AMO. While this work does not suggest that monotonic trends and human induced changes in flow have not occurred; it is suggested that many of the observed decreasing or increasing flow trends reported for rivers in Florida are consistent with a step trend.

To be consistent with Enfield et al.'s (2001) conclusions regarding the AMO, it was reasoned that in Florida flows would be highest at stream flow gage sites when sea surface temperatures in the North Atlantic are in a warm period (i.e., positively correlated). At the same time most of the continental United States would be expected to be in a period of lower flows. Conversely, the majority of continental gage sites would be expected to exhibit higher flows during AMO cool periods and much of peninsular Florida would be expected to be in a period of low flows.

Based on these hypotheses, Kelly (2004) examined flow records for multidecadal periods corresponding to warming and cooling phases of the AMO for numerous gage sites within the District, the state, and the southeastern United States to discern if increases and decreases in river flows were consistent with AMO phases. It was concluded that flow decreases and increases in the northern part of the state and flow increases and decreases in peninsular Florida are consistent with AMO warm and cool phases and the reported relationship with rainfall. For example, when rivers in peninsular Florida were in a multidecadal period of higher flows (1940 to 1969), rivers in the north to northwestern part of the state were in a low flow period. Conversely rivers in peninsular Florida exhibited generally lower flows (1970 to 1994) when rivers in the northern portion of the state exhibited higher flows.

Relatively large decreases and increases in flow are attributable to rainfall differences between multidecadal periods. For example, differences in flow volumes between multidecadal periods averaged 30% in SRP rivers. These results challenge the often held assumption that rainfall and hence river flows are the consequence of a sequence of totally random events, and suggest that those involved with water management (e.g., lake management, water supply development and flood protection) may need to rethink their paradigm with respect to river flow analysis and allow for multidecadal variations in river flow volumes.

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NOTES

SESSION 10

COMPREHENSIVE EVERGLADES RESTORATION PROJECT (CERP)

CERP Adaptive Management: Sustainability of a Longterm Monitoring and Assessment Effort in the Comprehensive Everglades Restoration Plan

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The value of environmental monitoring data is almost invariably a function of the expanse of time addressed. Environmental processes are often slow, and recovery of systems being restored can be slower than the processes that resulted in their impairment. Changes may occur over years or decades. In addition, ecological datasets are notoriously variable. Variation may arise from the methods used to collect samples or observations, and from the timing and spatial coverage which are always fiscally driven limitations. Unusually wet or dry years and, as is particularly true in Florida, large storms can compound this variability.

In order to successfully detect change, the extent of change must exceed the natural variation. A dataset that precedes an activity that seeks to intentionally bring about a change in an environmental system must be of sufficient length to at least make estimates about how and why the thing being monitored behaves. The degree to which we must understand the thing being measured is a function of the scale of the change expected - a sufficiently large and abrupt change in condition could be easily detected. However, changes are often subtle and complex. As a rule, provided we are measuring the correct set of variables in the correct way at the correct frequency, the longer the dataset the better understood are the processes and dynamics of system, and the greater likelihood that changes will be detectable.

Historically, the success rate for maintaining the effort necessary to accomplish long-term monitoring efforts has been very low. Priorities change. What was an overarching issue today is of little concern tomorrow. Personnel change and as a result to pool of available expertise, abilities, and commitment may change as well. Datasets that develop large discontinuities as a result of programs sporadically coming on and offline may lose much of their value that they might otherwise have had if they were sustained.

The commitment to sustain monitoring equates with a commitment to expend money. Monitoring can be expensive. It therefore behooves all concerned that the correct suite of monitoring objectives is well defined and focused. Since there is no way to return to the past to correct the error of omission, failure to identify the critical pieces of the environmental puzzle may compromise not only the interpretation of the monitoring effort, but may also equate with the loss of large sums of money that might have otherwise been better spent elsewhere. Such scenarios must be avoided.

Comprehensive Everglades Restoration Program (CERP) is a complicated restoration project containing many uncertainties. Lead agencies have committed to use adaptive management to decrease uncertainty and to shape and guide the restoration effort. Expectations regarding what constitutes “restoration” differ. The realization of any interpretation of restoration, except perhaps the most minimalist vision of restoration, must be tempered by insurmountable realities of limited funds. Principal among these are irretrievably developed lands and a large burgeoning human population. Adaptive management is a defined strategy to work within a complex framework of uncertainty and to chart a course through conflicting goals and incompatible expectations.

The first system-wide Monitoring and Assessment Plan (MAP) was developed over a number of years and issued in 2004. In 2006 a pilot effort to produce a System Status Report was completed. These initial efforts to assess the monitoring data provided lessons learned that were to be some of the causative factors for modifying the 2004-monitoring plan. In addition, it was decided to move near-scale project-level ecological monitoring into the MAP, while maintaining existing funding levels if possible. The MAP needs to be able to evaluate predictions at both system-wide and project level scales, and to provide management input into changes to the construction and operation of the many varied pieces of the constructed elements of restoration. If expectations regarding a specific project are not realized or are not fully realized, the science afforded by prudently monitoring the outcomes is expected to provide answers to remedy problems encountered and/or to maximize benefits. Therefore, the monitoring effort must be sustainable and well focused in order to adequately describe baseline condition, and to detect ecological changes (both expected and potentially unexpected) that may in some cases take decades to be realized. These goals will be made possible by moving forward with monitoring implementation in accordance with the principles of adaptive management: the MAP will be periodically revised as knowledge and experience is gained through its implementation. The two overarching objectives of MAP revision remain its contribution to the overall CERP adaptive management program and sustainability of long-term monitoring efforts.

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NOTES

THE IMPORTANCE OF LONG-TERM MONITORING DATA IN DEVELOPING AND ASSESSING CERP PERFORMANCE MEASURE GOALS AND TARGETS FOR LAKE OKEECHOBEE

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As part of the Comprehensive Everglades Restoration Program (CERP), alternative water treatment projects such as filter marshes and excess water storage facilities such as reservoirs and regional aquifer storage recovery (ASR) wells are proposed for the Lake Okeechobee watershed. These projects are expected to result in reduced lake stage fluctuations and watershed nutrient loading, and are expected to improve in-lake environmental conditions. To assess the effectiveness of these projects, six revised performance measures (PM), and associated goals and targets will be used. These PMs cover hydrologic (lake stage), chemical (water quality) and biological (fish, macroinvertebrates, vegetation and diatom to cyanobacteria ratios) attributes. Pre-CERP project implementation monitoring programs are currently being conducted, to collect baseline data on the above attributes. For several of the monitoring programs, long-term data already exists, while sparse data exists for other monitoring programs. These data will serve as the baseline data, which will be compared to post-CERP implementation data, to assess the effectiveness of the CERP projects contributing to Lake Okeechobee restoration. Comparing pre- and post-CERP implementation data also will enable water managers to evaluate the effectiveness of CERP projects and employ adaptive management strategies where and when necessary. However, the effectiveness of adaptive management will depend on the reliability of the long-term monitoring data collected both prior to and after the CERP projects are on-line.

NOTES

BALANCING SUSTAINABILITY WITH SCIENTIFIC RIGOR: AN EXAMPLE FROM THE GREATER EVERGLADES WETLANDS CERP MODULE

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The long-term realization of the Comprehensive Everglades Restoration Plan (CERP) Monitoring and Assessment Plan (MAP) not only hinges upon the strong defensible science that underpins the plan, but also on the logistical and economic sustainability of the MAP over several decades as CERP projects come on line. As with any development of a large-scale monitoring program, the Monitoring and Assessment Plan (MAP) built upon several distinct components that provided the initial goals and targets, and through an evolution of thought and scientific discussion, the next level of product emerges. Unquestionably this is dynamic process that is responsive not only to new scientific insights and knowledge, but also to ever shifting political and monetary pressures. This presentation will illustrate the layers of products that became incorporated into the current Greater Everglades Wetlands module MAP and the future direction currently envisioned to ensure a scientifically and monetarily sustainable monitoring network.

NOTES

LAKE WORTH LAGOON SALINITY VARIABILITY AND ITS REMEDIATION

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Abstract

Lake Worth Lagoon (LWL), located in Palm Beach County, was originally a freshwater lake. By1927 it had been converted into a saltwater lagoon with two inlets at its northern and southern ends. The C-51 canal releases fresh water into the central portion of the LWL causing rapid and substantial changes in salinity and the accumulation of large amounts of anoxic sediment. The resulting conditions have caused substantial declines in oyster and seagrass populations by creating harmful salinity fluctuations, by reducing levels of light which inhibit seagrass growth and create substrate conditions that prohibit both oyster and seagrass colonization. As part of the Comprehensive Everglades Restoration Program (CERP), the South Florida Water Management District, United States Army Corp of Engineers and other various stakeholders have proposed a number of project alternatives and management measures designed to restore favorable ecological conditions to the lagoon. Currently a number of measures are being modeled that are aimed at reducing peak flows to the lagoon, reducing sediment loading and restoring substrate conditions conducive to oyster and seagrass colonization. This talk will review those measures and discuss the pros and cons of each.

NOTES

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