8. **OLD BUSINESS**

a. Water Quality Issues
   2. Staff Reports
      i. Staff update on final scope of work for isotope tracing of nutrients in the Sanibel River

The Sanibel River and The Impaired Waters Rule: How Stable Nitrogen Isotopes and Phytoplankton Community Analyses Can Indicate Nutrient Sources and Evaluate Nutrient Reduction Efforts

Scope of Work

Submitted to:

Natural Resources Department
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Environmental Center, Inc.

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The Sanibel River and The Impaired Waters Rule:
How Stable Nitrogen Isotopes and Phytoplankton Community Analyses
Can Indicate Nutrient Sources and Evaluate Nutrient Reduction Efforts

Scope of Work

1.0 Project Rationale

Due to high nutrient and phytoplankton abundance, water quality in the Sanibel River does not meet State of Florida standards for Class III surface waters, for which designated uses described as "recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife" are expected. The goal of this project is to investigate the utility of stable nitrogen isotope analyses and phytoplankton community description in linking potential sources of nutrients on Sanibel Island to nutrient concentrations and phytoplankton community characteristics in the Sanibel River. The results of this project may be used to identify sources of nutrients in the Sanibel River, to evaluate the effectiveness of nutrient reduction actions, and to guide future water quality data analyses and monitoring programs.

2.0 Project Description

The Sanibel River is currently listed as impaired under the Impaired Waters Rule (IWR, F.A.C. 62-303) for Trophic State Index, an aggregate of phosphorus (nutrient) concentration, phytoplankton (algae) abundance, and water clarity. The Trophic State Index (TSI) was developed to assess the health of freshwater ecosystems, where phosphorus is generally the nutrient that limits algae production. In these types of systems, addition of phosphorus generally results in increased algae abundance. In contrast, marine systems are generally thought to be limited by nitrogen – an increase in nitrogen availability, as either ammonia or nitrate, generally leads to an increase in phytoplankton production. Algae in brackish or estuarine systems, such as the Sanibel River and San Carlos Bay, may be limited by nitrogen or phosphorus.

The City of Sanibel has initiated several management practices to reduce nutrients in the Sanibel River; among them are the purchase of conservation easements, increased development setbacks from wetlands, removal of on-site septic systems, and the adoption of a fertilizer ordinance. However, it is difficult to differentiate between "non-point" sources of nutrients in surface waters, or to evaluate the effectiveness of specific nutrient reduction practices using conventional water quality data (e.g. concentration of ammonia, mg/l NH_4) alone. Furthermore, although chlorophyll abundance is a useful index of ecosystem production, it represents a collection of all groups of phytoplankton in a system, each of which may react to changes in their environment (e.g. nutrient availability, salinity) in different ways; ways that may be difficult to distinguish by looking at chlorophyll abundance alone. A clearer picture of the reaction of phytoplankton to environmental changes, whether natural or due to environmental management

decisions, would help evaluate the effectiveness of management efforts intended to resolve the water quality issues identified by the IWR.

The following project includes the use of two complementary analyses, natural abundance of stable isotopes and phytoplankton community composition, that may be used in conjunction with existing Sanibel-Natural Resources Department (NRD) water quality sampling program to (1) identify the land-based sources of nutrients in the Sanibel River, and (2) describe the relationship between land-based nutrient sources and chlorophyll/phytoplankton in the Sanibel River.

3.0 Project Tasks and Deliverables

3.1 Nutrient source sampling. We expect to work closely with Sanibel-NRD staff and property owners to determine the best times and locations for sampling potential nutrient sources. Up to eight samples will be collected between 28 – 31 July, 2008, in conjunction with routine surface water sampling along Sanibel River. These will include wastewater treatment plant effluent/ leachate, irrigation water from golf courses (may include either/both reclaimed water and chemical/industrial fertilizer), residential properties using chemical/industrial fertilizer, and other potential sources as advised by Sanibel-NRD and SCCF-Marine Lab.

Aqueous samples will be prepared for analysis of stable nitrogen isotope ratios in ammonium and nitrate according to Sigman et al (1999) and Sebilo et al (2004). Solid samples (e.g. pellet fertilizer) will first be prepared by dissolving approximately 10 g of sample per liter of purified water, measuring ambient nutrient concentration, then further processed following Sigman et al (1999) and Sebilo et al. (2004). Analyses of sample stable nitrogen isotope ratio will be sub-contracted to the Center for Isotope Geoscience, Department of Geological Sciences, University of Florida.

3.2 Surface water sampling for nutrients and SPOM. We will coordinate our surface water sampling event with Sanibel-NRD routine water quality sampling for July, 2008, at six regularly visited locations and three extra locations. The three extra stations are intended to include surface waters flowing through conservation or undeveloped areas. At each location, whole water samples will be filtered at each location. Filtrate will be prepared for analysis of stable nitrogen isotope ratios in ammonium and nitrate according to Sigman et al. (1997) and Sebilo et al (2004). Filters will be prepared for stable nitrogen isotope analysis of suspended particulate organic matter (SPOM), which includes phytoplankton and bacteria-rich organic floc. As above, analysis of stable nitrogen isotope ratios in ammonia, nitrate, and SPOM samples will be sub-contracted to the Center for Isotope Geoscience, Department of Geological Sciences, University of Florida.

3.3 Surface water sampling for phytoplankton community. High performance liquid chromatography (HPLC) and the CHEMTAX analytical method are used together to identify and quantify broad taxonomic groups within a phytoplankton community. HPLC

separates and quantifies the wide range of photopigments (e.g. chlorophylls, carotinoids) from mixed algal samples (Wright et al. 1991), while CHEMTAX is a computational/ mathematical method designed to calculate taxonomic class abundances from HPLC data (Mackey et al 1996).

Samples for phytoplankton community analysis will be collected at the same times and locations as for water quality and stable isotope analyses. Whole water samples will be filtered on-site with GF/F filters (0.7 um pore size). These filters will be frozen for immediate transport to Mote Marine Laboratory in Sarasota. HPLC-CHEMTAX analyses will be sub-contracted to Mr. B. Pederson, Phytoplankton Ecology Group, Mote Marine Laboratory.

3.4 Data Analysis and Report Preparation. Data deliverables will include all stable isotope and HPLC/phytoplankton community data. Reporting deliverables will include complete statistics analysis of project data, and discussion of these methods and results in the context of the existing Sanibel-NRD water quality sampling program; general land use patterns within the City of Sanibel; and recommendations for future nutrient management and water quality sampling efforts. Reporting deliverables will also include a presentation to City Council. Dr. Emily Hall and Mr. Brad Pederson (Mote Marine Laboratory), and Dr. Eric Milbrandt (Sanibel Captiva Conservation Foundation – Marine Lab) will provide technical contributions and expert review of the final report.

Please note that these analyses must be made in the context of ambient water quality conditions, including nutrient concentration and other conventional water quality data. Therefore, a request for water quality monitoring data from the July, 2008, sampling event will be made to Sanibel-NRD or Johnson Engineering, as appropriate.

4.0 Project Budget and Costs

Total project invoicing will not exceed **$ 11,590**. The following sections contain estimated costs associated with each project task described in Section 3.0. Specific project and invoicing milestone dates will be coordinated with Sanibel-NRD.

4.1 Nutrient Source Sampling: $ 1,120. Samples from eight potential nutrient sources will be collected and prepared by CHEC staff. Laboratory analysis services will be sub-contracted to Department Geological Sciences, University of Florida, in Gainesville, Florida.

4.2 Surface Water Sampling for Nutrients and SPOM: $ 1,620. Samples of surface water from nine locations along the Sanibel River will be collected and prepared by CHEC staff. Laboratory analysis services will be sub-contracted to Department of Geological Sciences, University of Florida, in Gainesville, Florida.

4.3 Surface Water Sampling for Phytoplankton Community: $ 1,350. Samples from nine locations along the Sanibel River will be collected and prepared for HPLC analysis

by CHEC staff. Laboratory analysis services will be sub-contracted to Mote Marine Laboratory, in Sarasota, Florida.

4.4 Data Analysis and Report Preparation: $ 7,500. Primary data analyses and report writing will be done by the Project Lead, Jason Hale, of CHEC. Drs. Emily Hall and Brad Pederson (Mote Marine Laboratory), and Dr. Eric Milbrandt (Sanibel Captiva Conservation Foundation – Marine Lab) will provide technical contributions and expert review of the final report.

5.0 Anticipated Project Timeline and Milestones

Week of 28 July 2008: Sample collection.

August – October 2008: sample prep and laboratory analysis; data request to Sanibel-NRD or Johnson Engineering for July, 2008, water quality monitoring data.

15 November 2008: Draft Report Due. Invoice 50% total.

15 December 2008: Final Report Due. Invoice 50% total.

6.0 Project Contacts

The **Charlotte Harbor Environmental Center, Inc.,** will be the sole contractor responsible for the professional quality, technical accuracy, timely completion and coordination of the tasks described in this Scope of Work.

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7.0 References

Mackey, M.D., D.J. Mackey, H.W. Higgins, and S.W. Wright. 1996. CHEMTAX – a program for estimating class abundances from chemical markers: application of HPLC measurements of phytoplankton. Marine Ecology Progress Series 144: 265-283.

Sigman, D.M., M.A. Altabet, R. Michener, D.C. McCorkle, B. Fry, and R.M. Holmes. 1997. Natural abundance-level measurement of the nitrogen isotopic composition of oceanic nitrate: an adaptation of the ammonia diffusion method. Marine Chemistry 57(1997): 227-242.

Sebilo, Matheiu, B. Mayer, M. Grably, D. Billiou, and A. Mariotti. 2004. The use of the 'ammonium diffusion' method for del15N-NH4 and del15N-NO3 measurements: comparison with other techniques. Environmental Chemistry 2004(1): 99-103.

Wright, S. W., Jeffrey, S., Mantoura, R., Llewellyn, C., Bjornland, C., Repeta, D. and Welschmeyer, N., 1991: An improved HPLC method for the analysis of chlorophylls and carotenoids from marine phytoplankton. Marine Ecology Progress Series 77: 183-196.