

# Captiva water monitoring project

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March 2009

## **Project description:**

Initiate Year Two of a two-year overall water quality monitoring and assessment project of the waters surrounding Captiva Island to develop a comprehensive survey of various island ecosystems including the beaches, identifying pollutants and possible sources. The final result will be extensive data on island water conditions; a final report based on the research; ongoing coordination with similar studies; updates to the community and officials; and recommendations on options to lessen pollution impacts on the island's waters, beaches and shoreline to enhance these ecosystems and reduce the chances of beach closures and similar episodes in the future.

## **Overall context:**

Captiva Island is renowned for its subtropical beaches and abundant natural habitat and resources such as mangroves, birds, shells and marine life – the main attraction for visitors and residents alike. Thousands flock to its Gulf beaches and the Pine Island Sound Aquatic Preserve every year, drawn by clean water, warm sun and myriad marine recreational opportunities such as fishing, boating, and eco-tourism, all together making water quality a critical issue for residents and visitors alike.

Development on Captiva consists of single-family homes, estate-zoned properties, some condominiums and three luxury destination resorts or hotels. The single-family homes are primarily served by on-site treatment and disposal systems (OSTDS or septic systems) of varying ages and efficiencies, while the resorts have self-contained package treatment systems.

In 2007, degraded water quality was observed during several years of above-average rainfall, all resulting in the degradation of the aquatic preserve and the Caloosahatchee River watershed. Beach closures plagued Sanibel and Captiva Islands, along with significant Gulf and bay water quality problems.

Beach closures, as well as declining water quality and associated impacts on critical habitats used by economically (as well as ecologically) important species who are sought after by recreational fishermen as well as non-consumptive users of water such as kayakers, generated interest in determining areas contributing to water quality problems. Therefore, a detailed survey of water conditions surrounding Captiva Island should identify potential problem areas, potential source information and recommendations for correcting these issues. The sampling may also help identify sources of storm-water runoff and sewage effluent that negatively impacts the island's beaches and shoreline.

Critical for Lee County tourism is the protection of Captiva and its natural resources. Clear, clean water and vital coastal ecosystems are the island's most essential resources to attract and retain visitors.

This project is undertaken by the Captiva Community Panel in conjunction with the Sanibel-Captiva Conservation Foundation Marine Laboratory. (See brief summaries of both entities attached.)

## Relationship to beach/shoreline:

A beach's health and vitality is directly related to the quality of the waters that wash over it. Not only does degraded water quality mean beach closures – a direct impact on recreational and environmental value – but unhealthy waters quickly lead to unhealthy beaches and marine ecosystems — blooms of micro- and macro-algae, nutrient overload, degraded critical estuarine and marine habitats, fish kills and more — leading to a deterioration in shoreline ecosystems that is difficult to reverse.

## Impact on tourism:

This project is driven by the 2007 beach closures on Captiva and Sanibel due to unhealthy water quality, which directly impacted island tourism at that time, as well as delivering a negative longer-term message about tourism-related conditions thanks to news reports of the closures. We are working to identify possible pollution for the pollution that prompted such closures, and to develop potential solutions and alternatives to prevent a recurrence of such problems and future ecosystem degradation.

Captiva is a significant tourism destination and generator of TDC bed tax revenues, with South Seas Island Resort, Teen Waters Inn, Captiva Island Inn, Jensens Twin Palms Resort/Jensens on the Gulf and numerous private vacation rental units providing a sizeable inventory (estimated at perhaps 200,000 annual room nights) of vacation options crucial to the county's tourism industry. Those rooms are consistently filled thanks to Captiva's long reputation as a world-class beach-and-bay destination resort, and that reputation (and the consequent tourism it generates) could be seriously affected should water quality problems recur and further beach closures and habitat losses result.

## Project timeline:

Testing began in October 2008, to continue at least through September 2010 (extensions may be requested if conditions are not conducive to valid testing). Collected data will be analyzed in coordination with other studies as described in the background materials, and a mid-term analysis will allow for corrections to the monitoring. Updates to the community and officials will be offered throughout the project, and a final report will summarize findings and make recommendations on corrective actions to lessen pollution impact on the island's waters, beaches and shorelines to enhance these ecosystems and reduce the chances of beach closures and similar episodes in the future.

## Budget information:

Categories	Year 1 Projected	Year 2 Proposed	Years 1 & 2 Total
Total salaries and fringe	\$79,672	\$58,054	\$137,726
Contractual analysis	\$29,175	\$26,000	\$55,175
Supplies and materials	\$3,000	\$4,000	\$7,000
Mileage and boat time	\$3,078	\$3,240	\$6,318
Comm. Panel administration	\$8,000	\$8,000	\$16,000
<b>Total</b>	<b>\$122,925</b>	<b>\$99,294</b>	<b>\$222,219</b>

**NOTE:** Our Year Two request has been reduced by approx. 25% from the request proposed in the funding application for FY 2008-2009.

# Captiva water monitoring project: Background materials

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March 2009

## Captiva Community Panel

The Captiva Community Panel was established by the nonprofit Captiva Property Owners Association, working in conjunction with Lee County. The panel, formed by the county in 2002, serves as an advisory board to the Lee County Board of County Commissioners on planning and other community issues on Captiva. The panel, which is made up of concerned islanders representing a cross-section of Captiva neighborhoods and thought, is funded by county funds, private donations and grants, and other funding sources. It is sponsored by the Captiva Property Owners Association Inc., a 501c3 nonprofit association.

**Mission:** To serve Captiva by maintaining the historic pattern of development on this barrier island. Such historical growth has consisted of unobtrusive, low-density residential use coupled with limited commercial development and vehicular traffic. Sensitive to such common concerns, Captiva community planning is to be maintained in consideration of an environment consisting of clean offshore waters, diverse and healthy marine life and robust native vegetation.

## Sanibel-Captiva Conservation Foundation

The Sanibel-Captiva Conservation Foundation Marine Laboratory is an independent marine laboratory funded through private donations, and local, state, and federal granting agencies. The laboratory currently has nine full-time staff members, four of which are Ph.D. level research scientists.

Research currently conducted by laboratory scientists includes: (1) studies of marine, estuarine and near freshwater submerged aquatic vegetation (SAV) and mangrove populations, including their restoration and functioning; (2) red drift macroalgal coverage; (3) water quality remote sensing using River Estuary Coastal Observing Network (RECON), an instrument array composed of eight near real-time sensors deployed at locations within the Caloosahatchee estuary.

Research conducted at the laboratory is driven by critical management questions concerning water quality, estuary health, and the restoration of these resources. Data collected by the laboratory is used to better understand the current state of the waters surrounding Sanibel and Captiva and to make more informed decisions regarding the future of the estuary.

**Mission:** To investigate status and trends of area habitats and associated faunas and floras within the waters on and around the barrier islands of Sanibel-Captiva and adjacent localities.

# **CAPTIVA WATER QUALITY ASSESSMENT PROJECT**

## ***Background report prepared by the Sanibel-Captiva Conservation Foundation Marine Lab***

### **I. Project Summary**

This is a request to continue with Year Two of a previously funded two-year study whose overall aims were to: (1) summarize historical regional water quality data, (2) characterize current near-shore water quality around Captiva Island during wet and dry seasons and low and high population periods using sentinel, event and beach sampling approaches, and (3) use several approaches to track identified problems to the source(s). The work in this final year will focus on determination of pollutant sources and resource mapping.

### **II. Project Abstract**

#### **A. Project Description**

During the first year of this study, we collected and combined all existing water quality data for the study area into a geodatabase (> 500,000 records). We analyzed these existing data and determined:

- (1) Where data gaps exist;
- (2) What pollutant parameters are of greatest concern; and
- (3) Where potential pollution problems may be occurring, especially nearshore.

Next, a water quality monitoring plan was developed which had three major components:

- (A) Collection of water quality data for six major storm events, three in the dry (November-April) and three in the wet (May-October) seasons at our previously selected "storm event" sites (Figure 1);
- (B) Collection of water quality data at 12 "sentinel" sites chosen based upon identified potential pollution sources as in item 1. These sites have been or will be sampled during late "spring" (moon is full or new with tides very high or very low) ebb tide events in an effort to maximize the influence of nearshore pollution sources; and
- (C) Collection of bacteriological samples at four beach sites, analyzing nearshore and interstitial water and sands for Fecal Indicator Bacteria (or FIBs).

It is important to note that the timing of our sampling events with tides and rainfall is critical to the success of this project's two-year goals and why the bulk of our sampling for Year One occurs during April-October 2009, when appropriate tides and significant rainfall events occur. Historically greater pollutant concentrations occur during these wetter months. To date we have collected about 25% of the samples called for in our monitoring plan (300 of an estimated 1,200 analyses). The data collected to date (March 2009) are not sufficient to determine if problem areas exist and provide a scientifically valid basis for developing a focused sampling plan for potential problem areas. Additionally, the opening of Blind Pass slated for spring 2009 may have a significant impact on current patterns and processes. By the end of the first year of this project (Oct 2009) we should have enough information to adapt or current monitoring effort to a more problem-focused approach.

In Year Two we will continue to sample water quality as outlined above with sentinel, event and beach sampling. As we receive and analyze data, we will adapt the above monitoring plan to concentrate our efforts on sites which have elevated bacteria levels, nutrients, sediments or degraded critical habitats. We will also relate our monitoring results to the opening of Blind Pass which is predicted to drastically change (and potentially improve) local conditions.

#### *Pollutants and source tracking*

One of the main problems associated with determining the cause(s) and prevention of FIB contamination is our inability to determine a source of the human or non-human contamination. Using FIBs (more specifically, *E. coli*) as an indicator of pollution is currently the sole basis for many beach and shellfish closures. Additionally, many areas have high levels of naturally occurring *E. coli* (for example, from waterfowl).

In Year Two of the Captiva Water Quality Assessment Project, we will identify sources of bacteriological beach contamination by using a combination of techniques recommended by state and federal agencies. The Environmental Protection Agency's Beach Sanitary Survey (EPA 2008) methods are currently being employed to assess beaches and identify probable influences which are related to elevated levels of FIBs. We are currently using these methods to evaluate existing data collected through our monitoring program and data collected by the Florida Department of Health, among others.

In Year Two of the project, we will continue to use these EPA methods to monitor FIBs in nearshore waters in and around Captiva's beaches. We will combine our tide-based sampling results with the Department of Health's routine weekly sampling results and assess the conditions which are associated with high levels of bacteriological contamination. Our sampling will become more focused on beaches identified to have consistently elevated bacterial contamination levels. After a relationship between environmental factors and elevated bacteria levels is established, we will use the FIBs (*Enterococcus* and *E. coli*) analyses performed at Lee County's Environmental Lab to screen for probable high concentrations of these FIBs.

Upon determination of elevated FIBs levels, a separate certified molecular and genetic microbial source tracking lab will be used to perform DNA-based analyses to identify whether the elevated bacterial concentrations are of human origin (e.g., Source Molecular Corp. Miami, FL). Sampling will cover an adequate spatial and temporal period to be able to come to conclude this. During Year two, we will run as many as 15 samples (@\$750/site for Human Bacteroidetes ID™ and Enterococcus ID™) when high FIBs concentrations are detected. If early genetic analyses indicate that human origin is likely, a more robust spatial assessment using groundwater, surface water and run-off sampling will be conducted.

One new technique that is cost-effective and can aid in identifying sources of pollution from human versus animals is using spectrofluorometry. Detergents are used in very large quantities, and may be present in significant concentrations in aquatic environments. Fluorescent whitening agents ("FWAs" or optical brightening agents) are used in most detergents to improve or restore "whiteness" during washing. FWAs do not readily break down in the environment, remaining either in solution or slowly adsorbing onto sediment particles. The FWAs are readily detected using new methods currently being developed (E. Cioffi, University of South Alabama, 2001-present). We plan to include the tracking of FWAs studying the near shore environment as one tool to indicate presence of human inputs. Elevated levels of boron (also from detergents) in near shore waters may also be indicative of human waste contamination. We will use strategic

sampling for boron in conjunction with other source-tracking techniques to help form a better image of human influences.

#### *Nutrient hot spots and sediment*

In Year Two, we will adapt our original monitoring plan to better evaluate areas which were identified as having elevated nutrient concentrations or high turbidity during the first year of the study. We will use a more focused sampling effort around these areas to characterize when elevated loadings are occurring and related potential sources. Samples will be analyzed for nitrogen species using U.S. EPA-approved methods. Turbidity is sampled *in situ* using calibrated probes and laboratory turbidity instrumentation. Most nutrient hot spots and elevated turbidities will likely be associated with run-off from rainfall events which are incorporated into our sampling design. We will sample progressively further upstream in each area (or watershed) found to have a problem to identify sources. Using GIS (geographical information systems) and on-the-ground surveys, a thorough analysis of land use components will be undertaken in each of these watersheds to determine estimated loading rates. The information collected will then be presented with best management practices (BMPs) and potential solutions as problem areas are detected.

In Year Two, we estimate an additional 300-500 analyses will be performed as in year 1, including DNA testing to determine whether bacteria present are of human origin. Samples will be collected also from 15-80 sites depending on the needs of our adaptive monitoring program (targeted groundwater, surface water and run-off sampling). Sampling will be initiated during proper environmental conditions and at appropriate locations to assure highest probability to detect any potential pollution.

#### *Association with other monitoring efforts*

SCCF is using data collected in this project, along with more focused monitoring/research studies near Sanibel-Captiva assessing scallop populations, seagrasses and mangroves to generate information on the status of key habitats and associated species. Additional studies examining drift macroalgae distribution, associated river and estuarine/Gulf nutrient sources and sinks and associated modeling efforts with Florida Gulf Coast University (FGCU) and others are also currently under way. We are also using our real-time observing River, Estuary, and Coastal Observing Network (or RECON, see <http://www.recon.sccf.org>), an array of six autonomous sensor arrays spanning over 90 miles of the Caloosahatchee watershed and ranging from fresh to full seawater. This network measures water properties every hour using state-of-the-art optical sensors for numerous parameters, including chlorophyll *a*, turbidity, colored dissolved organic matter (CDOM), nitrate, dissolved oxygen, salinity, temperature, and water depth (tidal information).

Two of these six sensors are in waters adjacent to Captiva; one is near Blind Pass, a low-volume inlet that separates Sanibel and Captiva Islands, periodically connecting Pine Island Sound to the Gulf of Mexico, but currently closed by sand deposition. The second site, Redfish Pass, is north of Blind Pass and is a deep-water inlet that connects the Gulf of Mexico with Pine Island Sound, a shallow body of water that is an aquatic preserve protected by the barrier island chain. Blind Pass is currently being dredged, with the pass slated to open between the Gulf and Pine Island Sound sometime in spring 2009.

A study focusing on changes in water and habitat quality around Blind Pass associated with the opening later this year is currently under way. A mobile RECON unit is being deployed to link the stationary RECON units at Blind Pass and Redfish Pass to data collected in the nearshore. These data include monitoring associated with this TDC-supported project. By establishing this association between the stationary RECONS and our near shore sampling efforts in this project, we will be better able to assess the regional component of any water quality degradation compared to local inputs.

Combining the results accomplished in Year Two of this study with existing data, we hope to provide a synthesis of all data which can lead to conclusions regarding sources of bacterial contamination on Captiva beaches and determine if and where sources of elevated nutrient inputs are occurring in Captiva watersheds. We will summarize the possible impacts of these findings on local aquatic habitats and resources. We will relate these findings to other studies which are being undertaken in the area.

#### B. Overall Context

As described above, this project will draw information from other projects ongoing in the area to derive more conclusive results. This proposal is Year Two of a planned two-year project.

#### C. Relationship to Beach/Shoreline

The protection of Captiva and its coastal resources is critical for Lee County tourism. Clear, clean water is the island's most essential resource. This project is focused on determining the extent of near shore water quality problems now perceived to be present on Captiva. The goal is to find specific sources of pollution if elevated levels are found during Year One. The results will help answer questions concerning beach closures, habitat degradation and algae blooms.

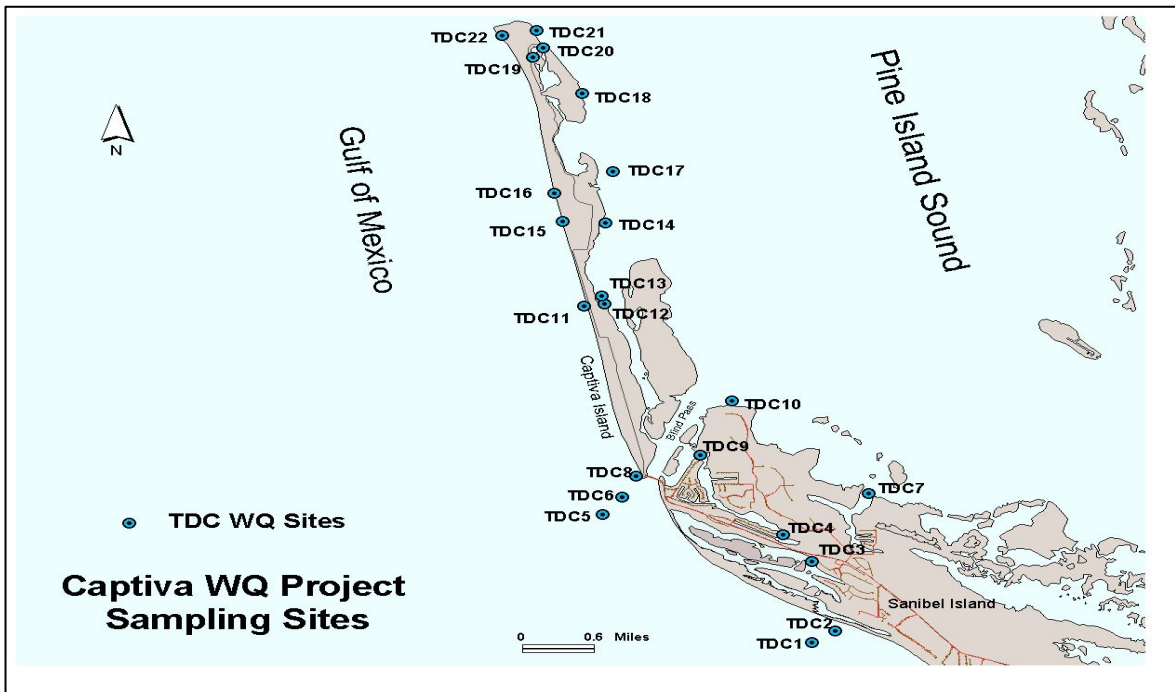
#### D. Impact on Tourism

The results provided by this effort will deliver information vital to managing coastal resources. Better management of coastal resources now will pay off in the future by providing the quality of resources which attract all tourists to Florida.

E. Project Timeline

Activity	2009		2010	
WQ Sampling	X	X	X	X
Habitat Surveys		X		
Event Sampling	X	X	X	X
Data Work-up			X	X
Maps Generated				X
Reports				Final

**III. Maps**



**IV. Budget Information**

A. Budget for the Project

**TDC Budget Detail and Justification for funding requested:**

Salaries and fringe (37%) for GIS and field/lab personnel	\$58,054.00
Supplies for sampling, workup, shipping and analyses	\$4,000.00
Collaboration with Dr. Cioffi (Univ. of South Alabama) for FWA monitoring	\$1,000.00
Mileage (1,800 miles) and boat time (15 days)	\$3,240.00
Subcontracting of a portion of nutrients, bacterial and DNA analyses (Lee Co. Env. Lab, Source Molec. Corp.)	\$25,000.00
<b>Total Requested Dollars:</b>	<b>\$91,294.00</b>

**SCCF match for overall effort:**

Salaries and fringe (37%) for dedicated staff (4.5 man mo.)	\$33,104.00
Indirect not charged on requested TDC funding (31%)	\$38,273.00
<b>Total Match:</b>	<b>\$71,377.00</b>

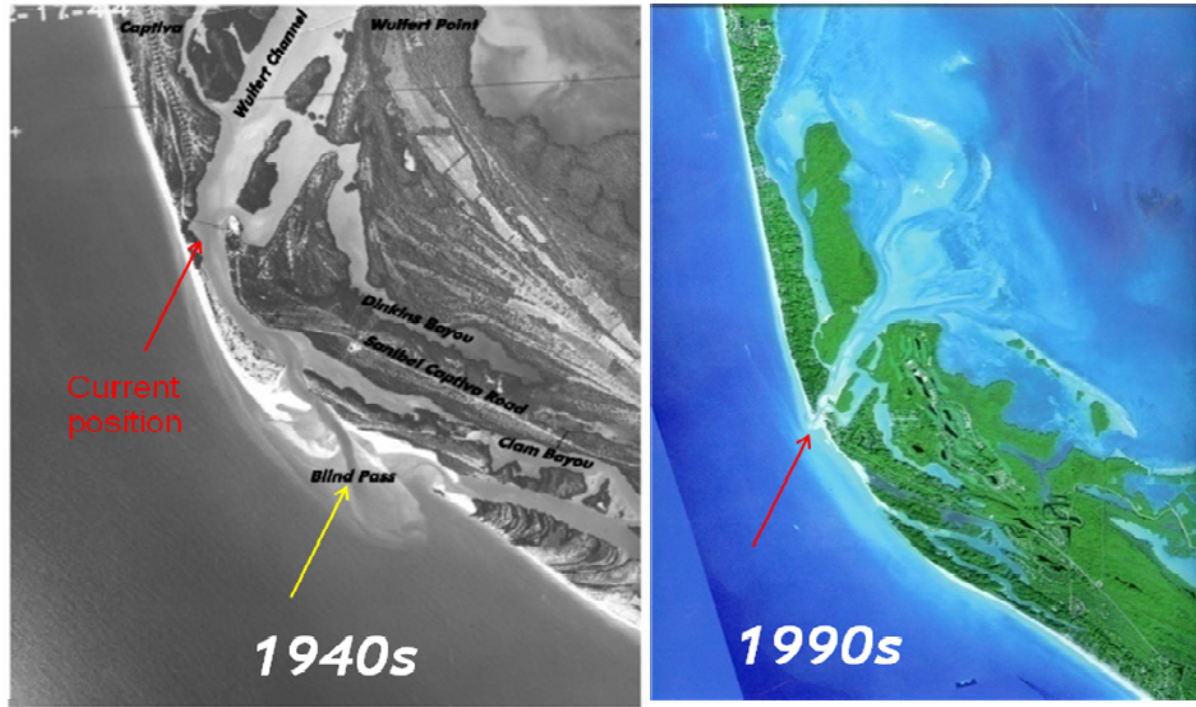
Budget Details and Justification

We are requesting support for a 13.5 man months to oversee and conduct all sampling and work-up, GIS and related database creation and maintenance. Boat use is requested for 15 days/year at \$150/day. Supplies, costs as included for expendables, disposable materials for water quality sampling. Mileage (@\$.55/mile is also included for travel to and from ramps and sampling sites (often without boat use for sampling from land) and to transport samples to the Lee County Environmental Lab through the chain of custody process. We are also including \$750/sample for 15 DNA-based sample analyses (for bacteria) at Source Molecular, Inc., and costs for standard analytical charges at the Lee County Environmental Lab for FIBs and nutrients (@\$30/sample x 150 samples for FIBs, \$50/sample for 150 nutrient analyses). We are also requesting supply costs for disposables, including bottles (required by Lee Co.) and chemical and laboratory supply costs for analyses we can run at SCCF's Marine Lab (chlorophyll *a*, turbidity, and CDOM). We will also be collaborating with Dr. Eugene Cioffi at the University of South Alabama (<http://www.gulfbase.org/person/view.php?uid=gcioffi>), who is currently completing development of a cost-effective approach to using fluorescent whitening agents as facile human-derived pollution markers. A small amount of funding is requested for his involvement with our efforts.

## Appendices



Sampling water quality at nearshore sites, beaches (sand, overlying and interstitial water), and using the Lab's RECON real-time water quality system.



Opening of Blind Pass, 2009. This effort will potentially change the water quality surrounding Captiva and northern Sanibel islands. Originally, this project was to be completed in 2008 or early 2009. It is now slated for summer 2009. Below, current status of effort as of March 4, 2009, and before November 2008.

Blind Pass Restoration  
Weekly Progress Report  
Feb. 15<sup>th</sup> thru Feb. 28<sup>th</sup>

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Friday, November 07, 2008  
View of Wulfert Channel (landward of Blind Pass Bridge) Prior to Construction



Wednesday, March 04, 2009  
View of Wulfert Channel (landward of Blind Pass Bridge) During Construction.