



# Development of Sensor Assisted Water Quality Nowcasting and Forecasting Environment for Coastal Beaches



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- ❑ Partners/End-User Organizations
  - Louisiana Department of Health and Hospitals: Beach Monitoring Program
  - Louisiana Department of Environmental Quality: NPS Program

# Project Background



## Holly Beach, Louisiana

12/22/2009

## Calcasieu River Basin

SPOT-TM Merged  
Satellite Imagery



GIS Center

2000

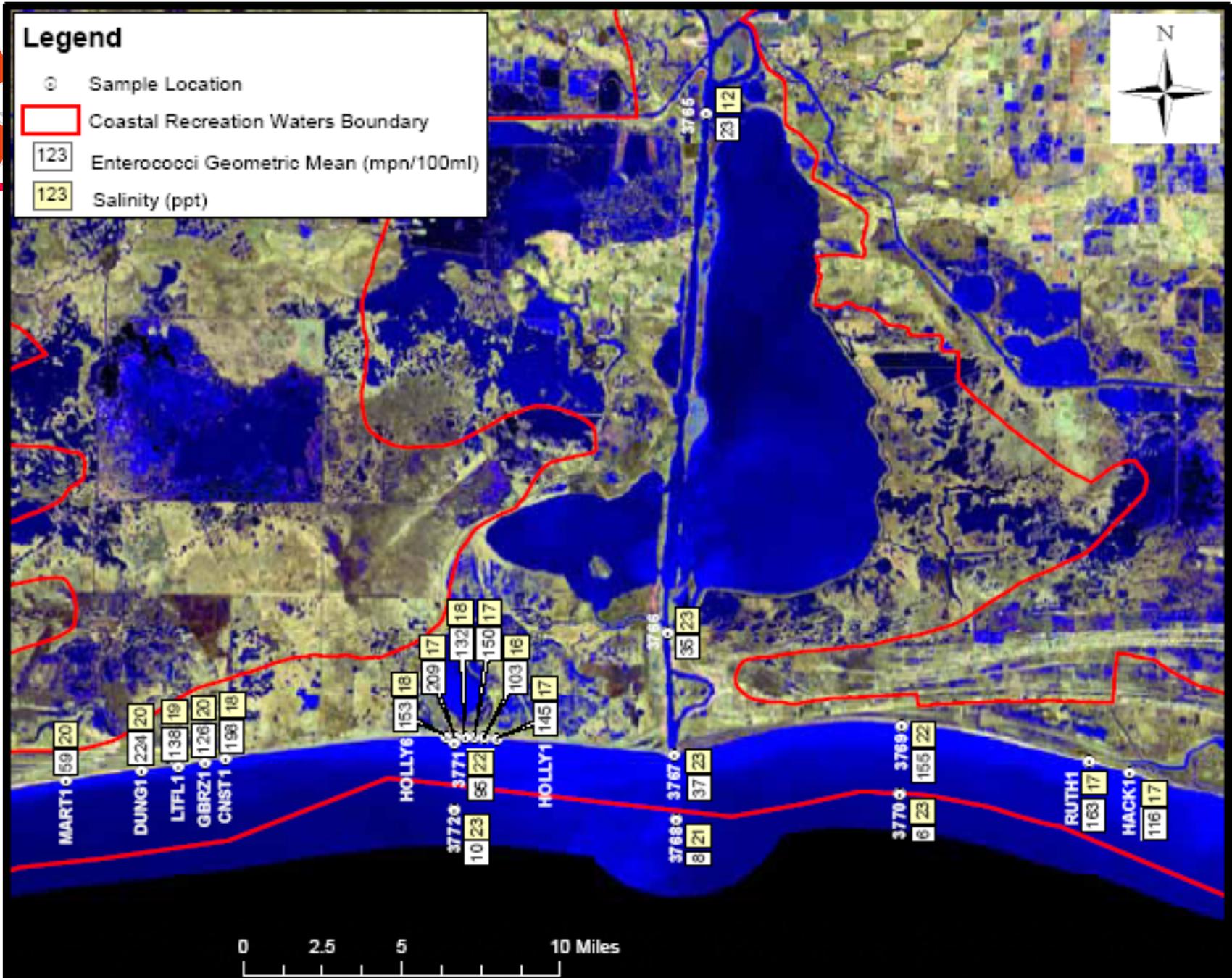
2000

Map date:  
12/15/98  
Map number:  
1998-01-308  
Map source:  
LDEQ SPOT-TM  
merged satellite  
imagery



# Legend

- Sample Location
- ▭ Coastal Recreation Waters Boundary
- 123 Enterococci Geometric Mean (mpn/100ml)
- 123 Salinity (ppt)



0 2.5 5 10 Miles

- ❑ Applying NASA MODIS Terra and Aqua data for bacterial source area-tracking at watershed-scale and for linking beach water quality parameters to MODIS surface reflectance
- ❑ Gathering water quality data using a wireless sensor station for continuous monitoring of surrogate water quality parameters
- ❑ Developing nowcasting and forecasting models for predicting fecal indicator bacterial concentrations using surrogate water quality parameters that are readily measurable using the sensor system
- ❑ Constructing web-enabled user-friendly GIS (Geographic Information System) platform .



# Development of a Sensor-Assisted Nowcasting Environment (SANE) for Beachgoers (SANE Beachgoers)



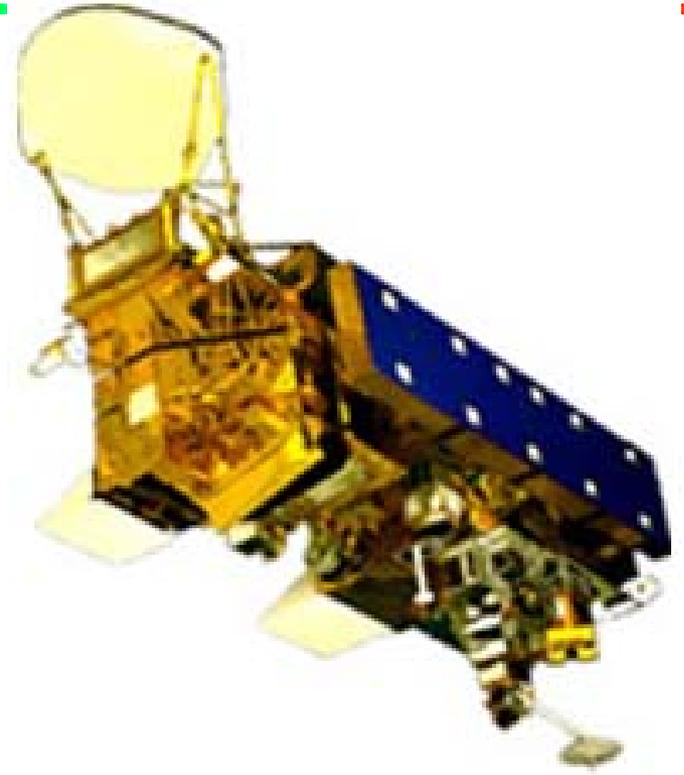
- ❑ **SANE Beachgoers** is a collection of datasets, in-situ water quality monitoring sensor station, statistical models, GIS platform, and internet/website which work together to provide current beach water quality and weather conditions for beachgoers.
- ❑ The **SANE Beachgoers** will reduce the decision-making time from 2 – 3 days to near real-time due to the support of statistical models, wireless water quality sensor station, and web-enabled GIS platform, significantly improving the decision-making in beach management and use. .

# Development of a Sensor-Assisted Forecasting Environment (SAFE) for Beaches (SAFE Beaches)



- ❑ **SAFE Beaches** is a collection of datasets including remote sensing imagery, in-situ water quality monitoring sensor station, mathematical models, GIS platform, and internet which work together to produce beach water quality forecasts in a probabilistic fashion like weather forecasts.
- ❑ The **SAFE Beaches** changes the decision-making time from 2 – 3 days behind to 1 – 3 days ahead of actual use of beaches due to the identification of priority source areas and mapping/modeling of watershed time of concentration and to the use of weather forecast information.
- ❑ An essential component of SAFE Beaches and this project is the priority source-area tracking of fecal indicator bacteria using the novel runoff fingerprinting (ROF) method.

# SAFE/SANE Components: Sensors on NASA Satellites (MODIS Terra and Aqua Data)



$$I(\theta) = \sum_{i=1}^N p(x_i|\theta) \left( \frac{\partial \ln p(x_i|\theta)}{\partial \theta} \right)^2 = \sum_{i=1}^N p(x_i|\theta) \left( \frac{\ln p(x_i)|_{PM}^{Aqua} - \ln p(x_i)|_{AM}^{Terra}}{\Delta \theta} \right)^2$$

## SAFE/SANE Components: Wireless Water Quality Monitoring Sensor Station

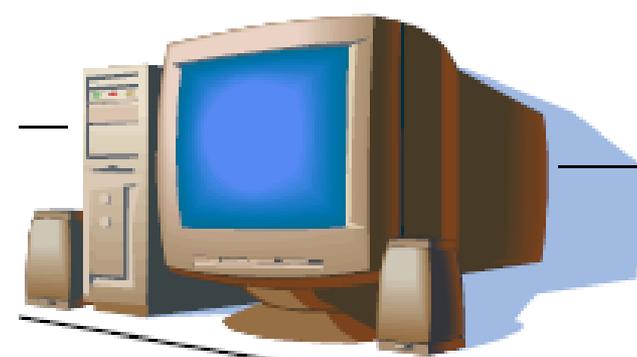


Verizon Wireless Static IP address:

# SAFE/SANE Components: Water Quality Monitoring Sensor Station



*Base Station*





# Wireless Water Quality Monitoring Sensor Station



- Temperature (Celsius)
- Specific Conductance/ Conductivity (mS/cm)
- Salinity (ppt)
- DO% and DO in mg/L
- Turbidity (in NTU's)
- Chlorophyll: ug/L and %RFU.
- pH
- Depth (in meters)

- ❑ Novel **runoff fingerprinting method**, based on NASA MODIS Aqua and Terra, for tracking priority source-area of fecal indicator bacteria
- ❑ **Sensor-Assisted Nowcasting Environment for Beachgoers (**SANE Beachgoers**)**
- ❑ **Sensor-Assisted Forecasting Environment for Beaches (**SAFE Beaches**).**
- ❑ Web-enabled and user-friendly **GIS platform** for linking the SANE Beachgoers and SAFE Beaches together to form an integrated decision support system for beach water quality management.



# November Sampling Results: Lab Data



Site	Replicate	MPN per 100 mL of Sample				Chlorophyll-a (mg/m <sup>3</sup> )
		Coliforms	Fecal Coliforms	E. Coli	Enterococci	
<i>Regulatory Standard (geometric mean)</i>		NA	200.0	NA	35.0	NA
Little Florida Beach	A	2.0	2.0	0.0	80.1	7.308
Little Florida Beach	B	0.0	0.0	0.0		7.140
Holly 6	A	2.0	0.0	0.0	73.8	4.554
Holly 6	B	0.0	0.0	0.0		4.410
Holly 2	A	7.8	0.0	0.0	62.7	6.380
Holly 2	B	7.8	0.0	0.0		7.400
LA-82	A	540.0	170.0	0.0	298.7	9.291
LA-82	B	NS	NS	NS		7.720
FD (Holly 2)	A	7.8	0.0	0.0	62.0	3.120
FD (Holly 2)	B	NS	NS	NS		4.068
FS-1 (LA-82)	A	NS	NS	NS	248.9	6.920
FS-2 (LA-82)	B	NS	NS	NS	298.7	6.498

NA = Not Applicable

NS = No Sample Analyzed due to lack of LT Broth

# Holly Beach, Louisiana

62.7 / 0.0

298.7 / 170.0

