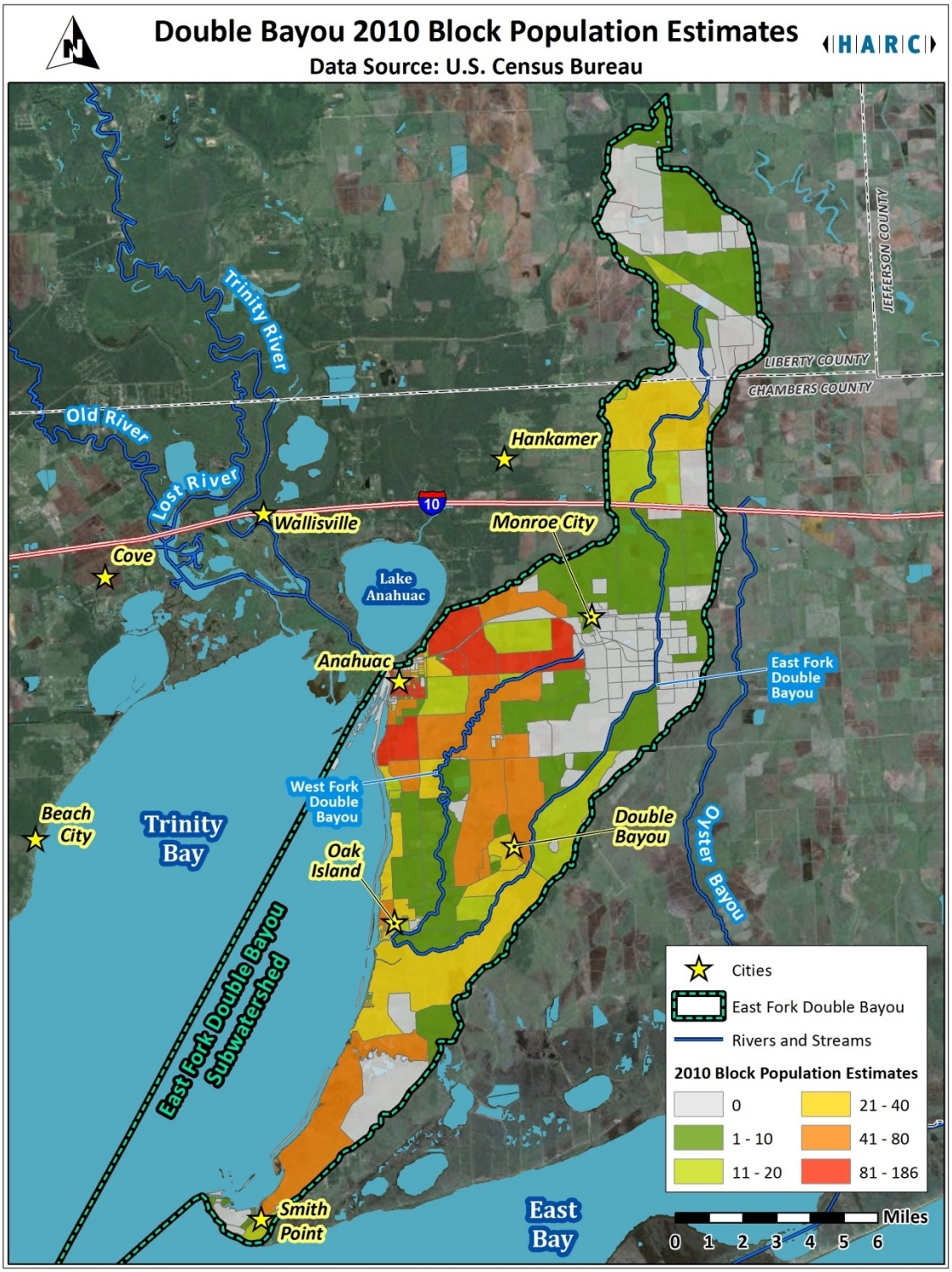
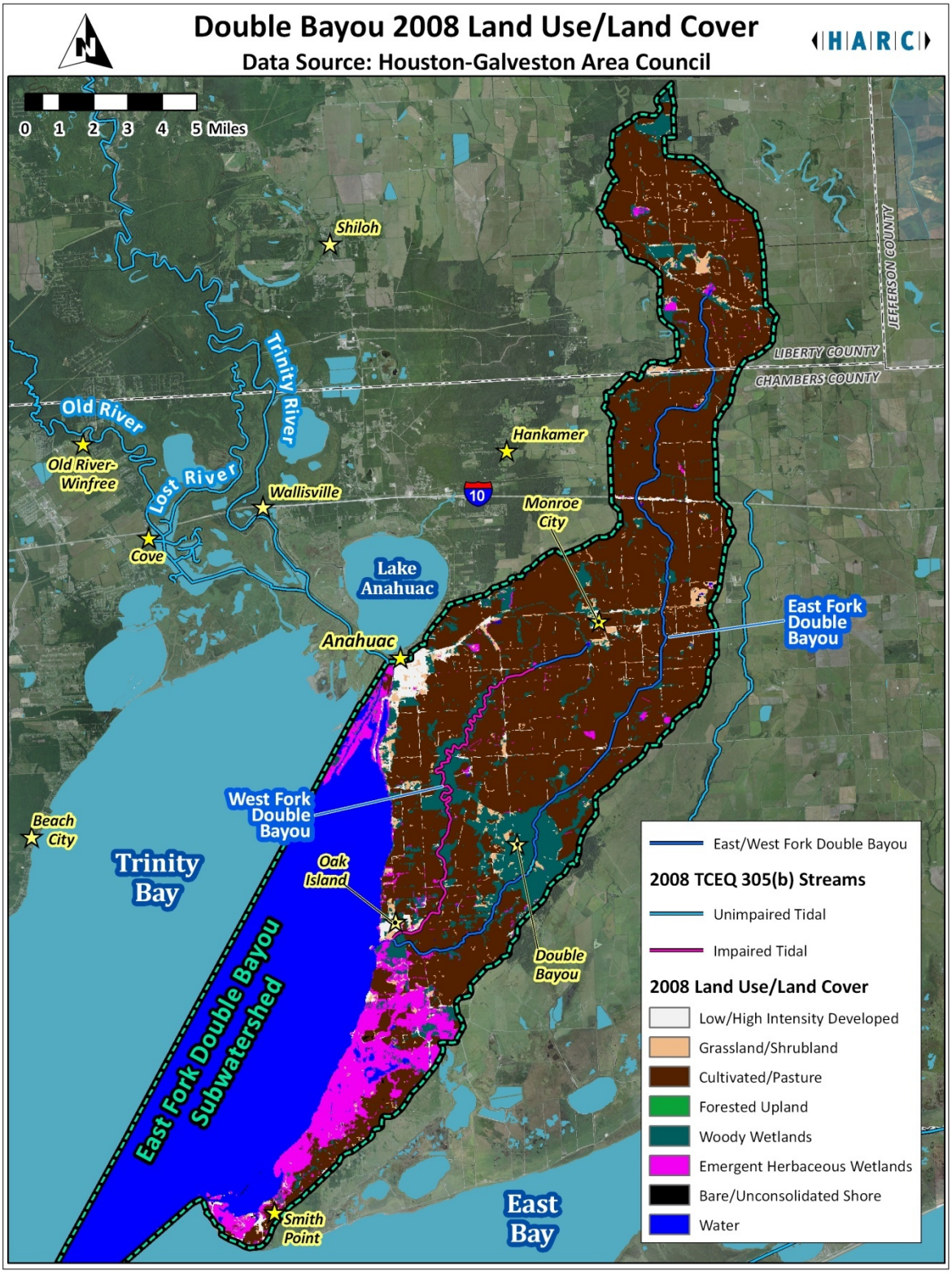
Appendix A. Additional Parameter Analysis

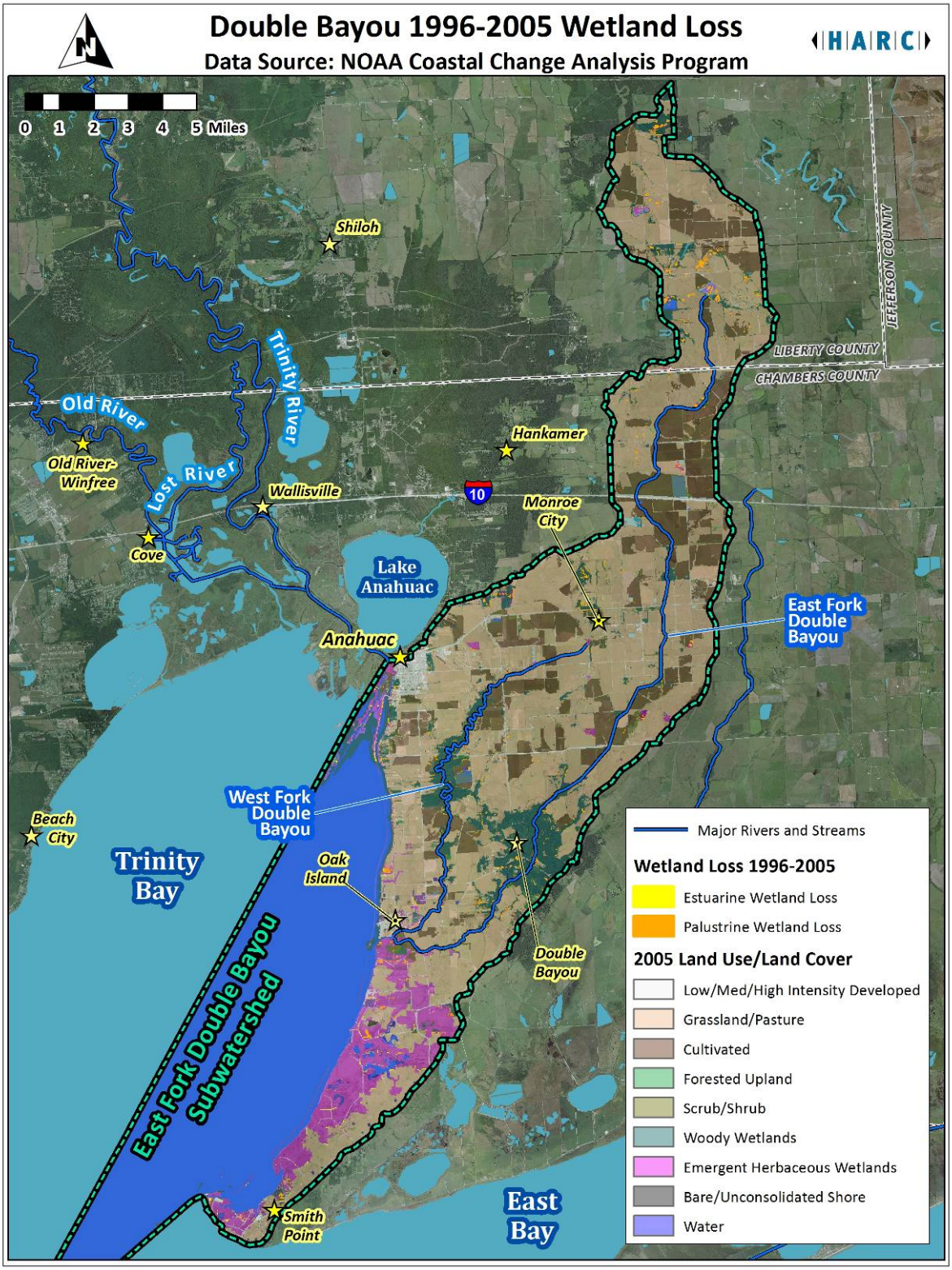
Double Bayou – Spatial Analysis of 2010 Census Data



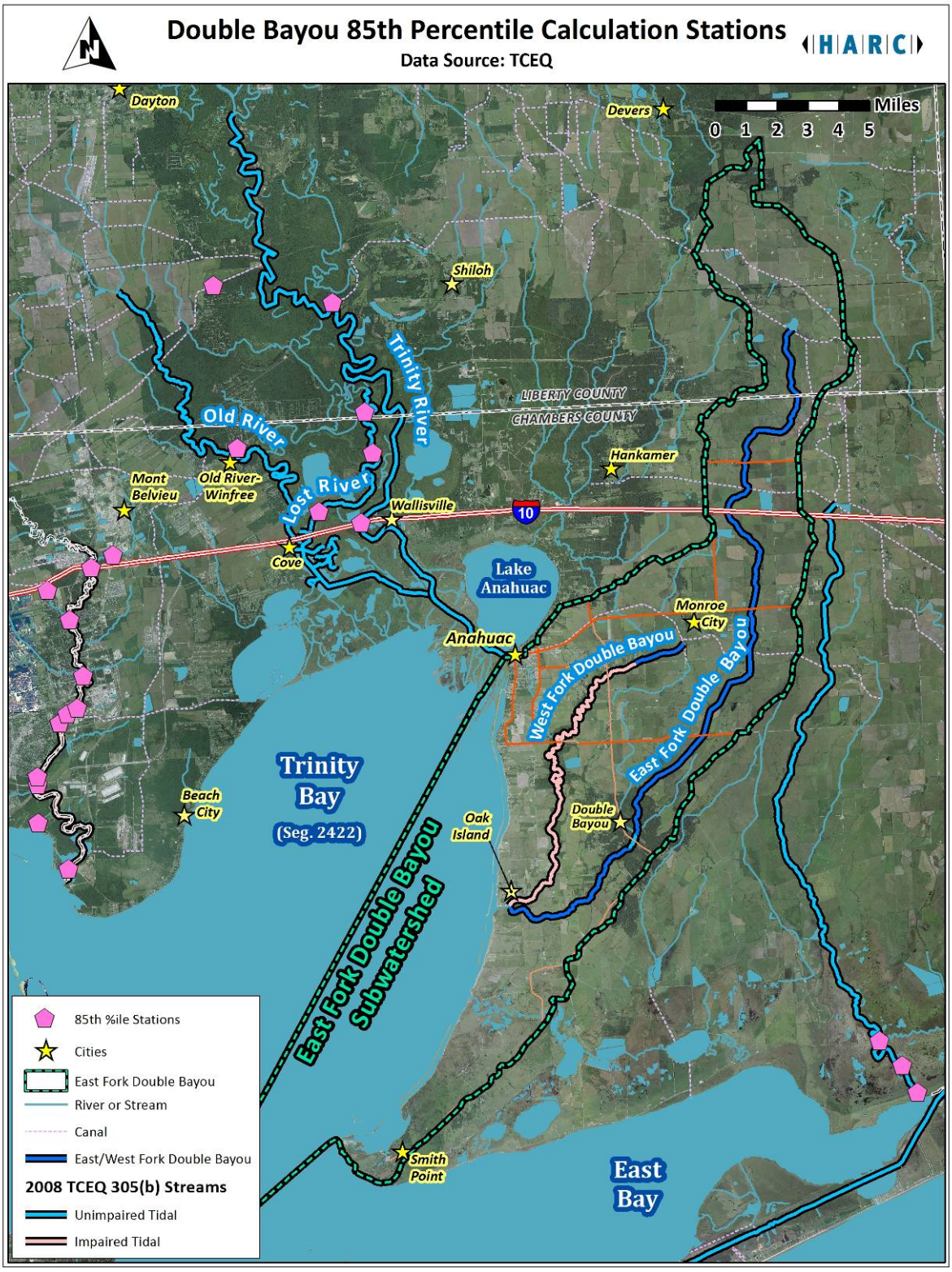
Double Bayou – Spatial Analysis of 2008 Land Use/Land Cover data



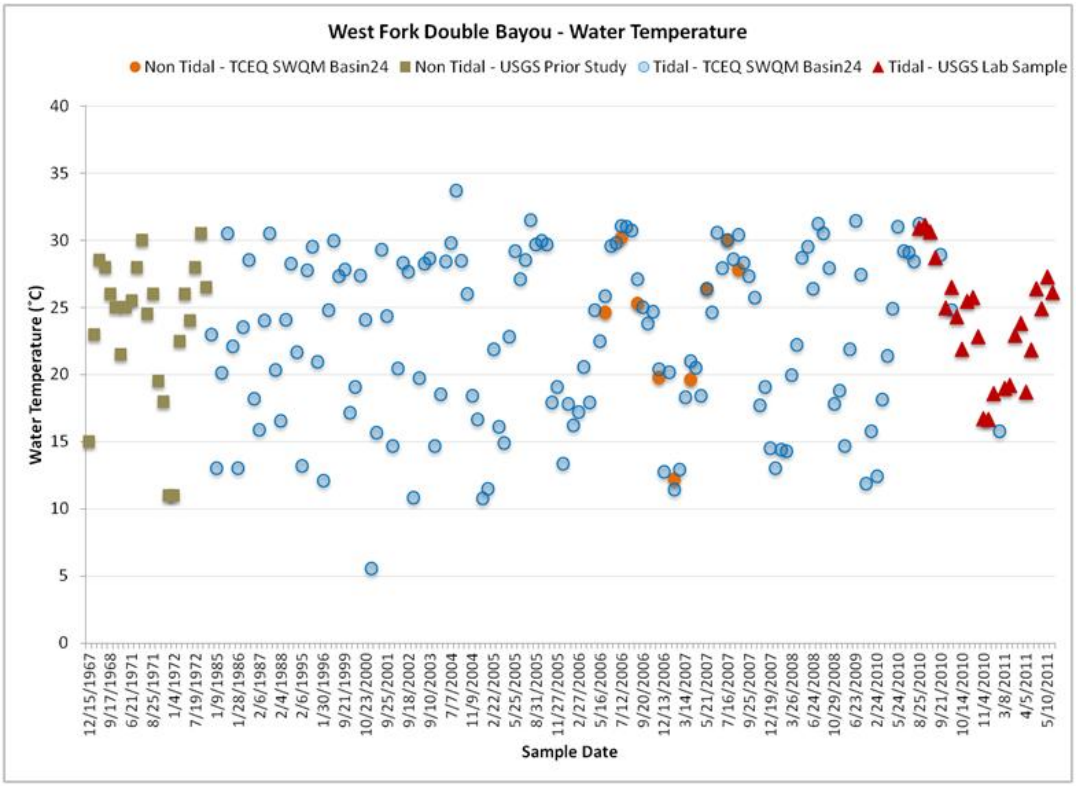
Double Bayou – Spatial Analysis of comparing 1996 land cover to 2005 land cover to analyze wetland loss



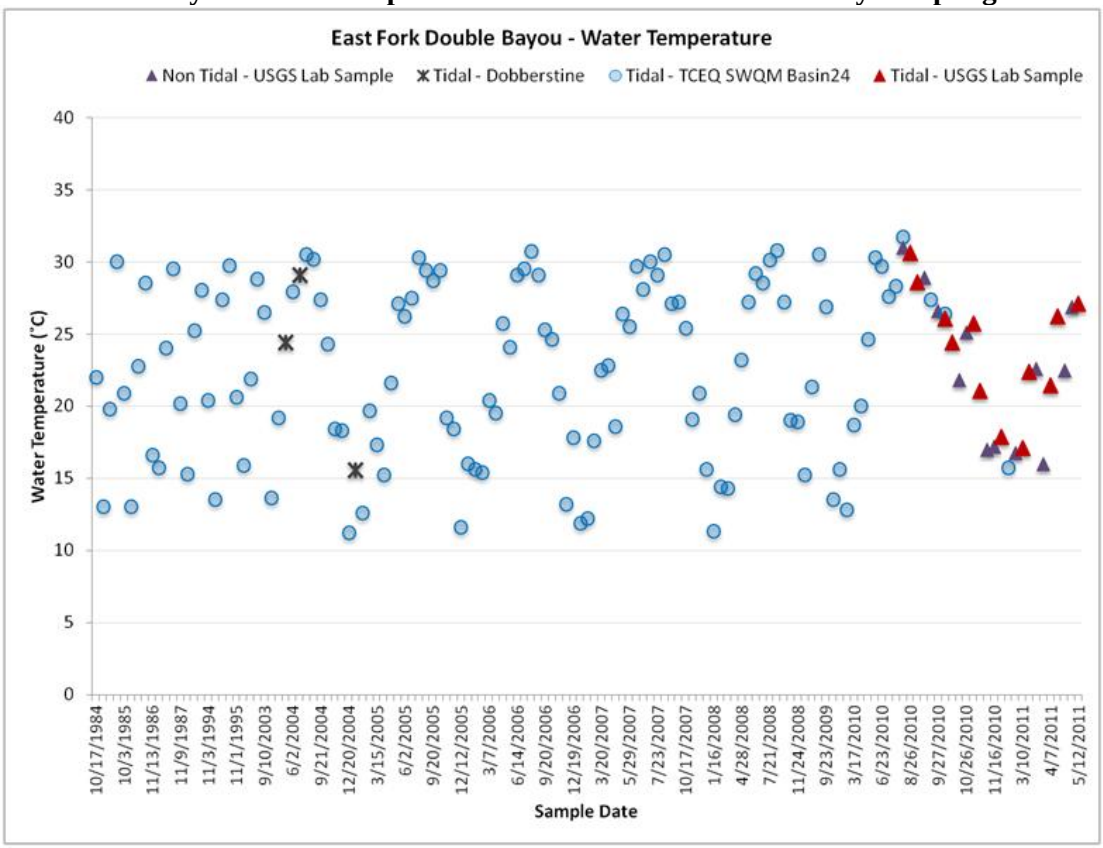
Stations used in 85th percentile criteria calculations



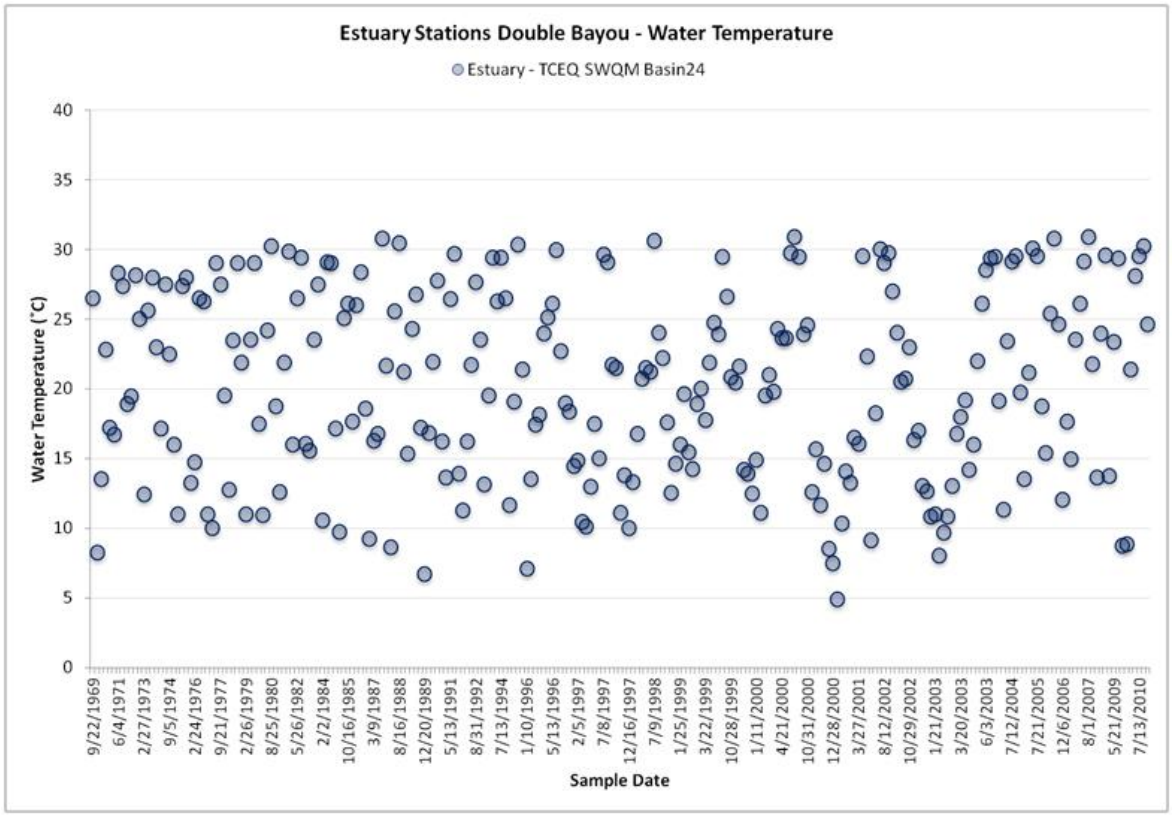
West Fork Double Bayou Water Temp – Baseline Dataset and current study Sampling Dataset



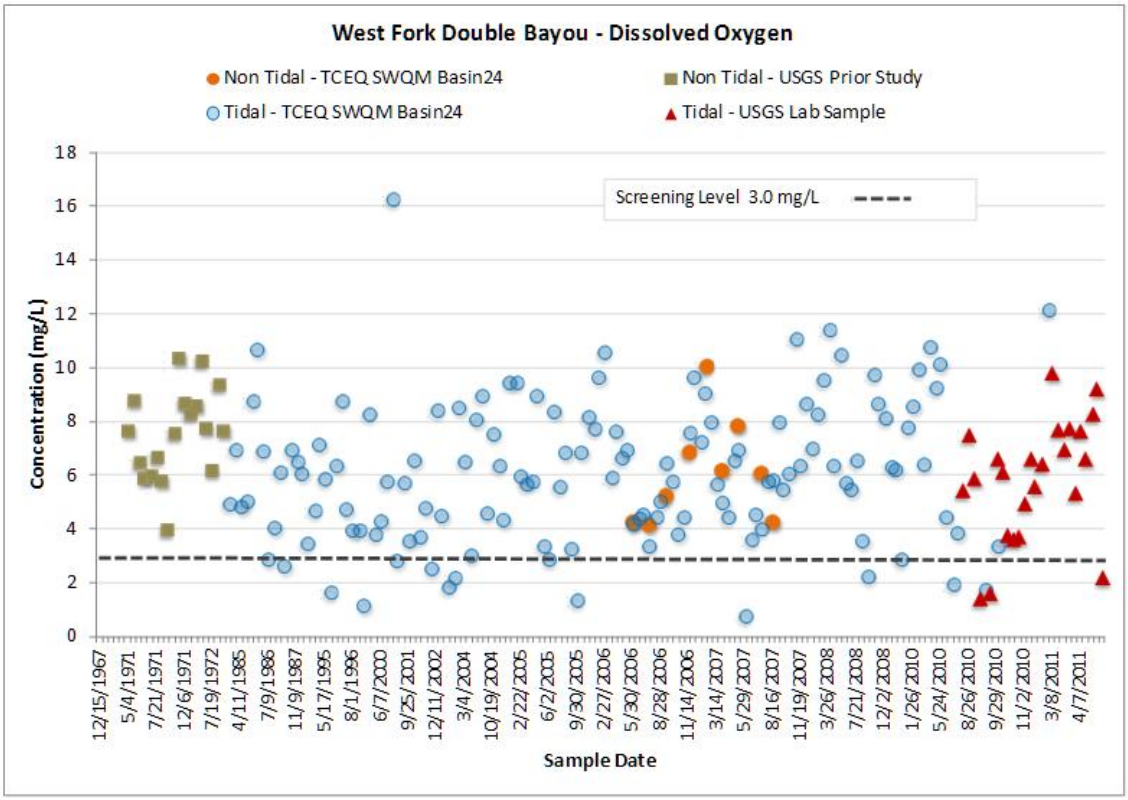
East Fork Double Bayou Water Temp – Baseline Dataset and current study Sampling Dataset



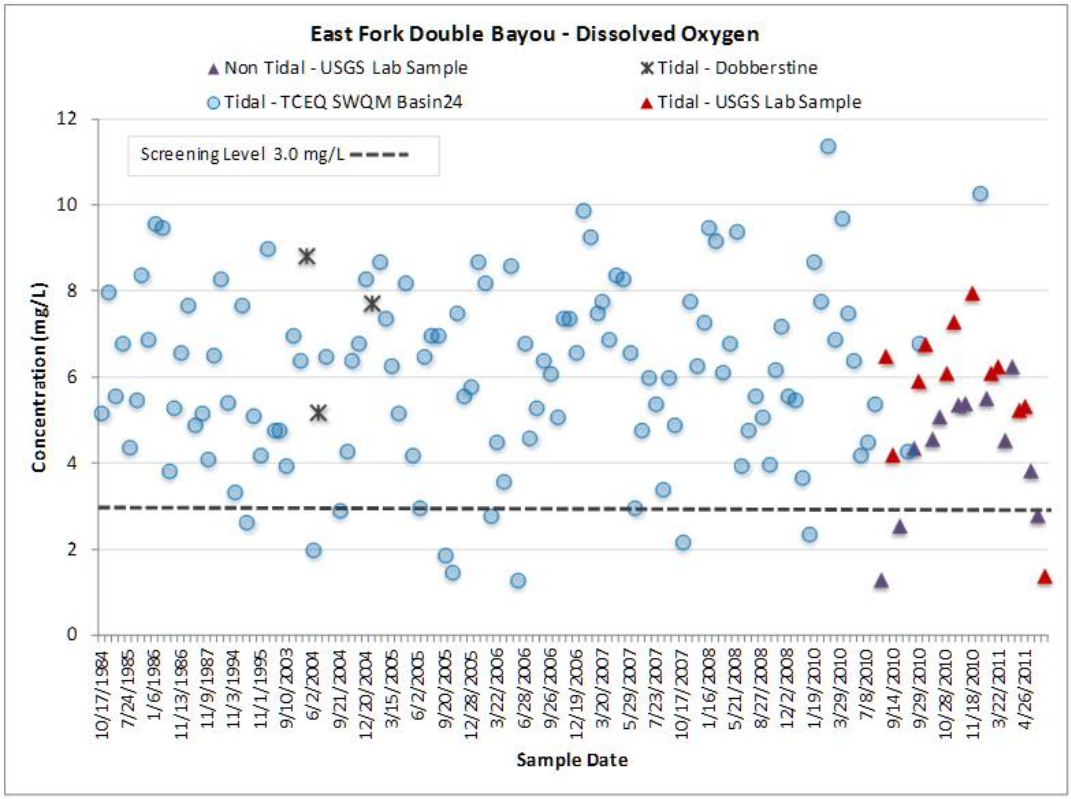
Estuary Double Bayou Water Temp – Baseline Dataset and current study Sampling Dataset



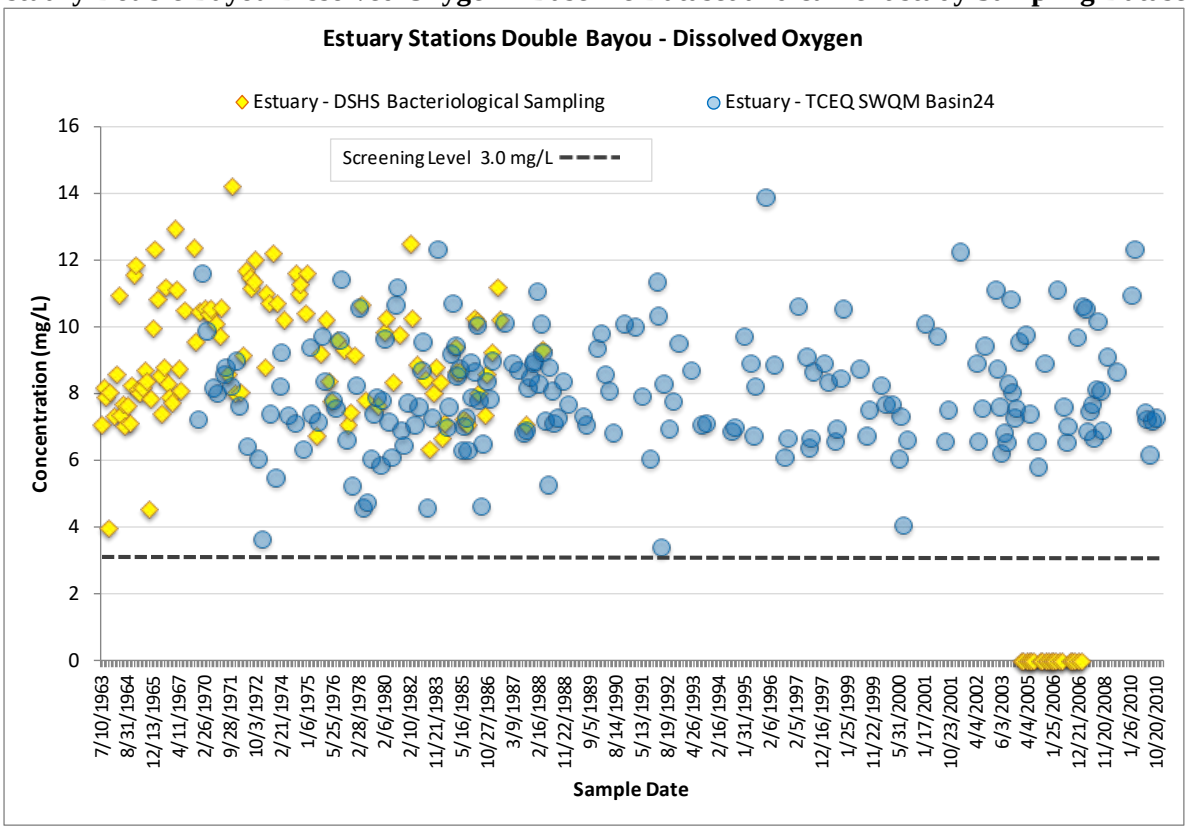
West Fork Double Bayou Dissolved Oxygen – Baseline Dataset and current study Sampling Dataset



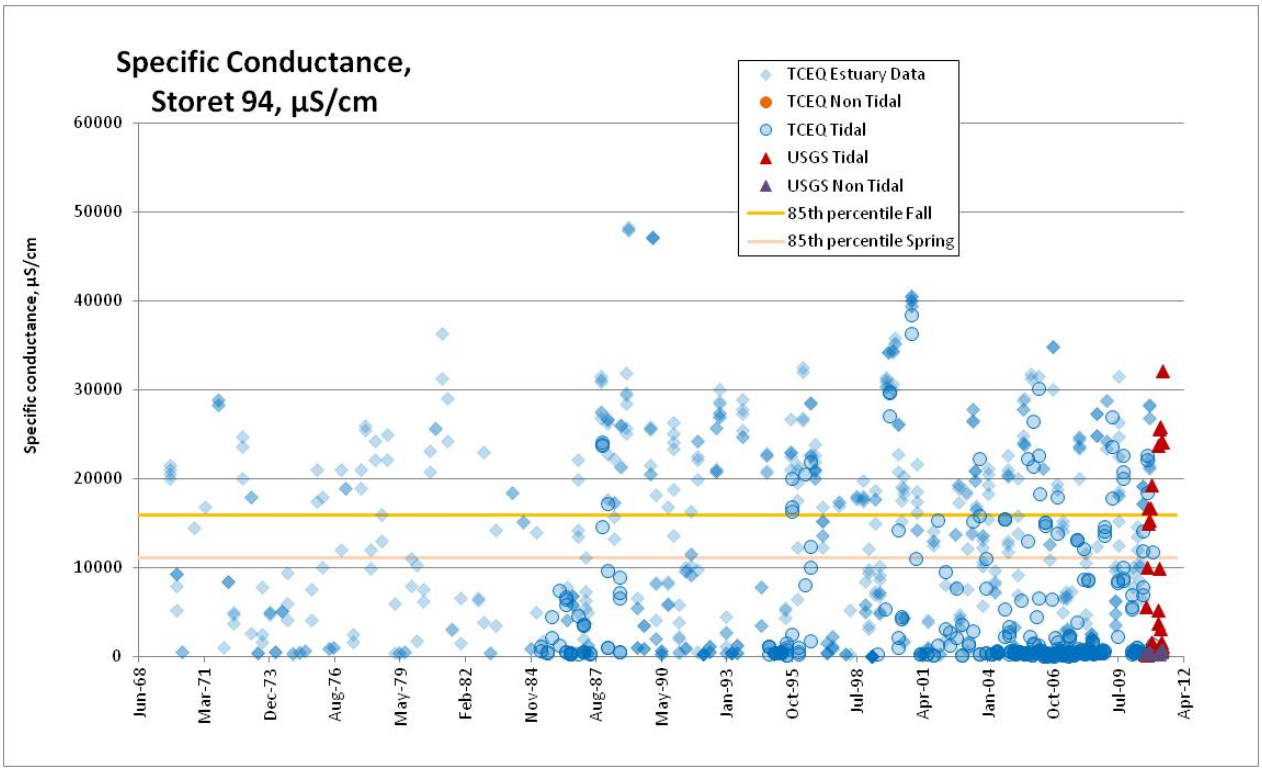
East Fork Double Bayou Dissolved Oxygen – Baseline Dataset and current study Sampling Dataset



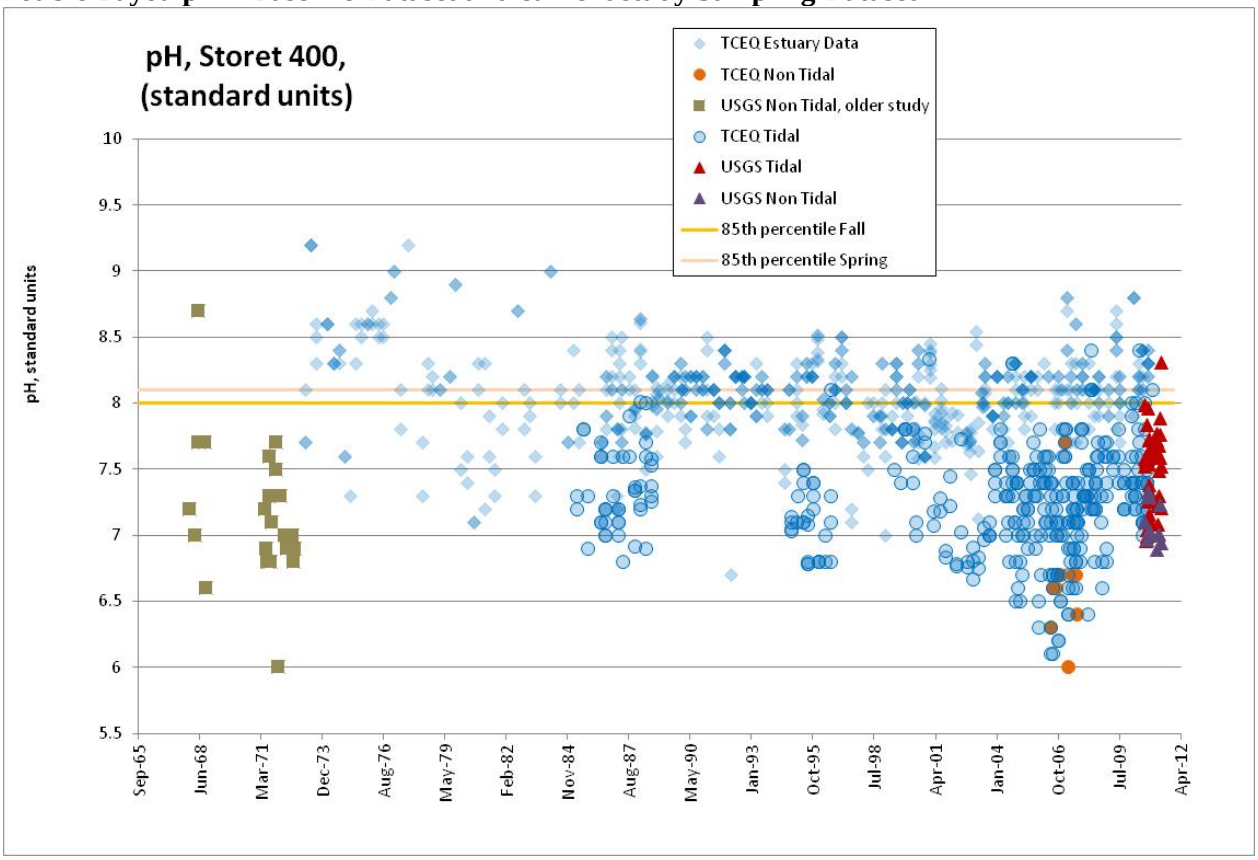
Estuary Double Bayou Dissolved Oxygen – Baseline Dataset and current study Sampling Dataset



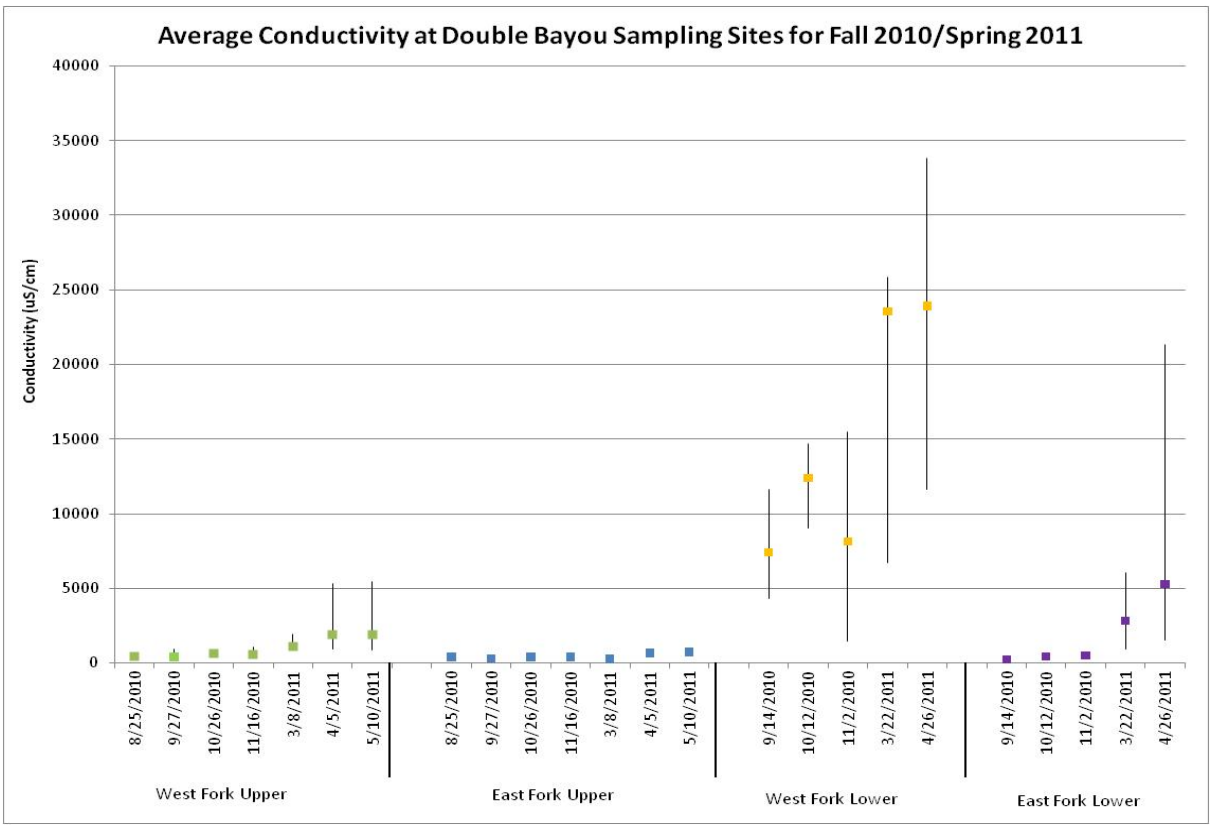
Double Bayou Specific Conductance – Baseline Dataset and current study Sampling Dataset



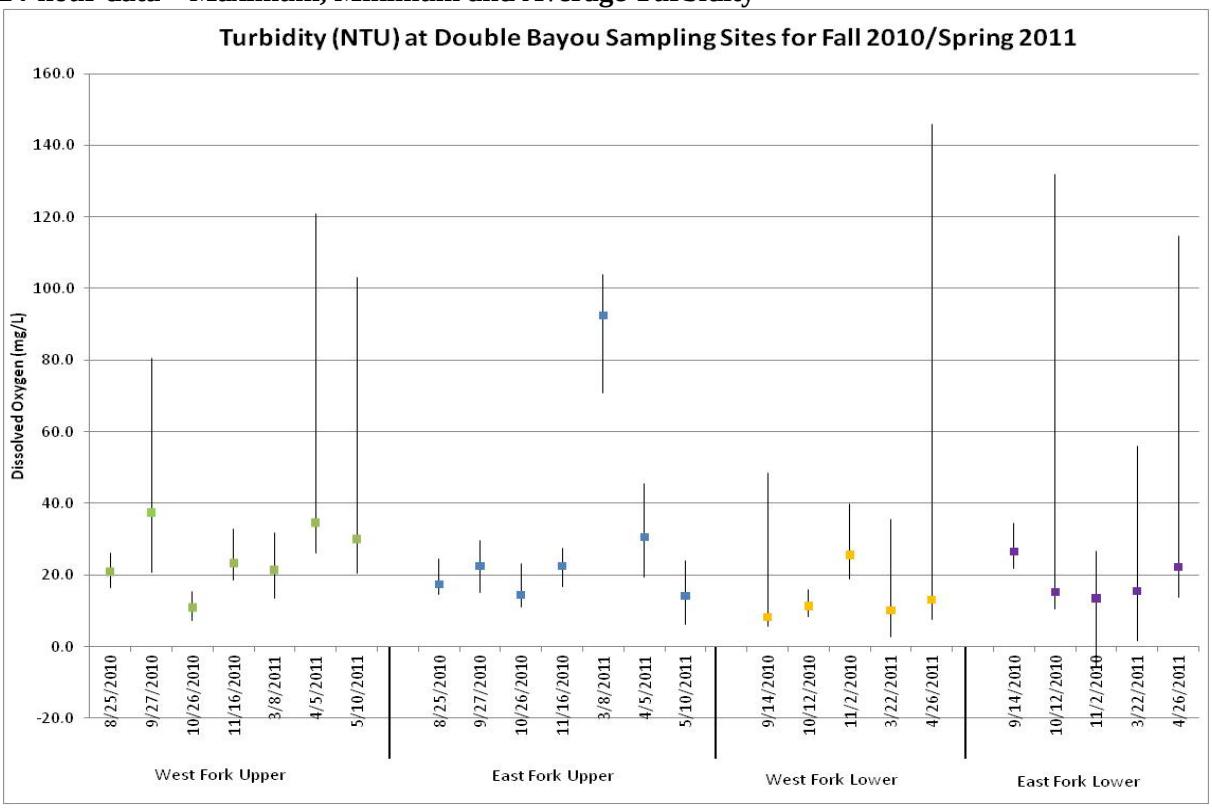
Double Bayou pH – Baseline Dataset and current study Sampling Dataset



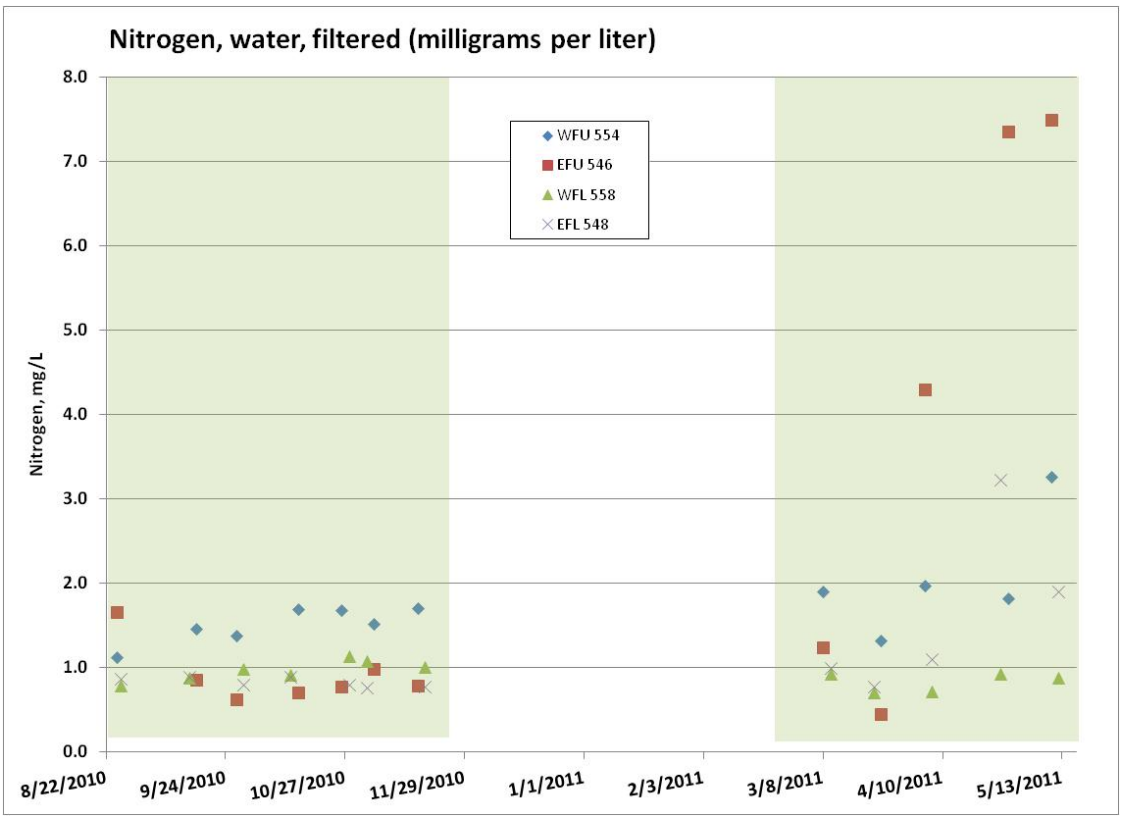
24-hour data – Maximum, Minimum and Average Conductivity



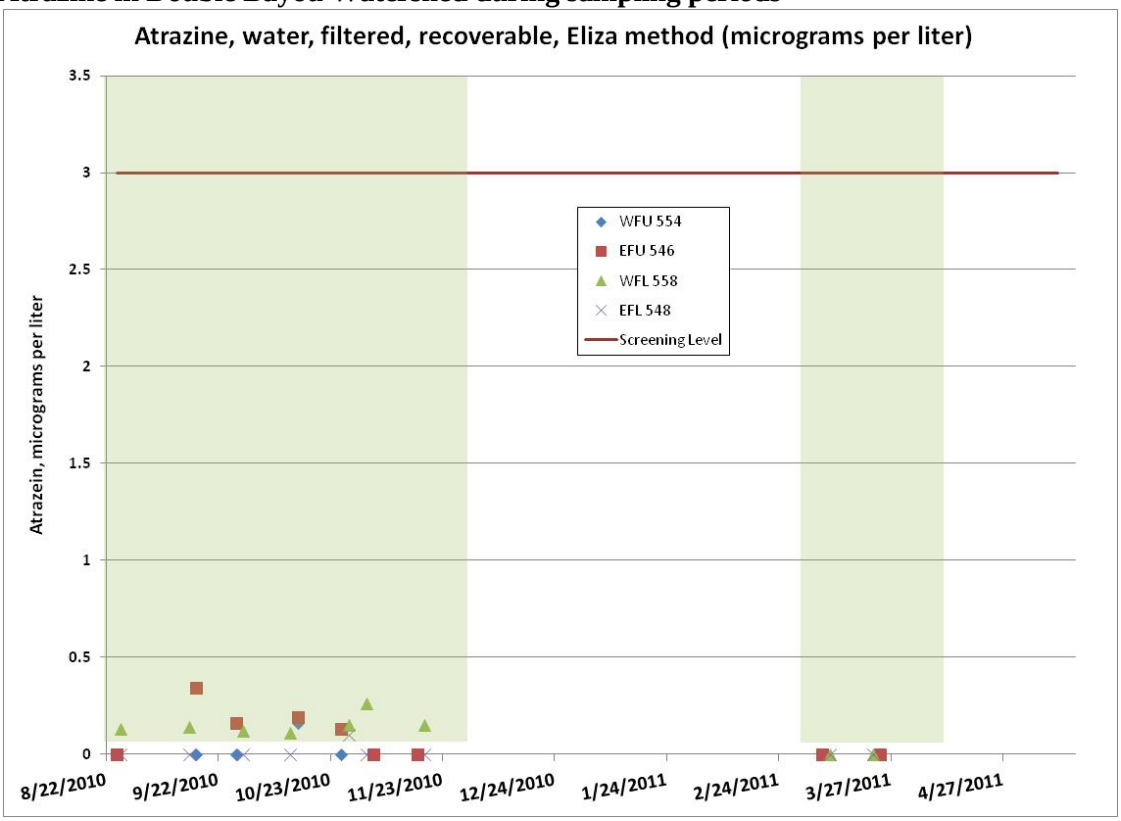
24-hour data – Maximum, Minimum and Average Turbidity



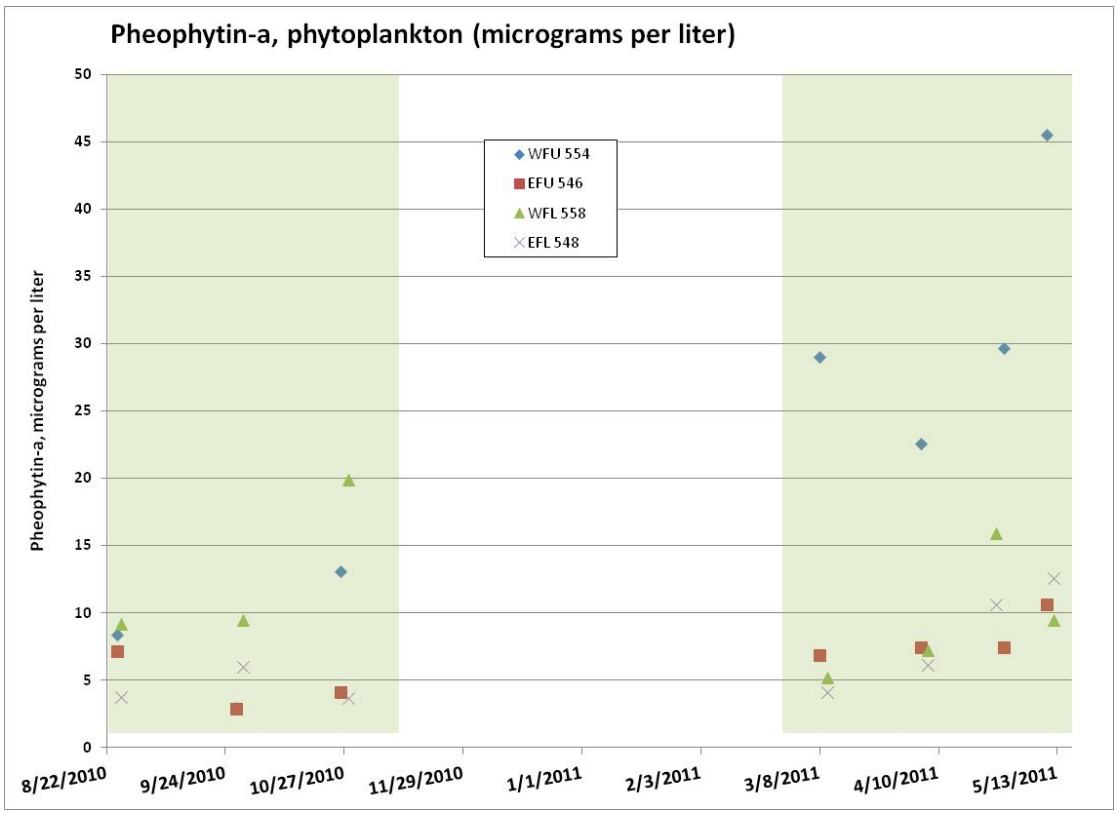
Nitrogen in Double Bayou Watershed during sampling periods



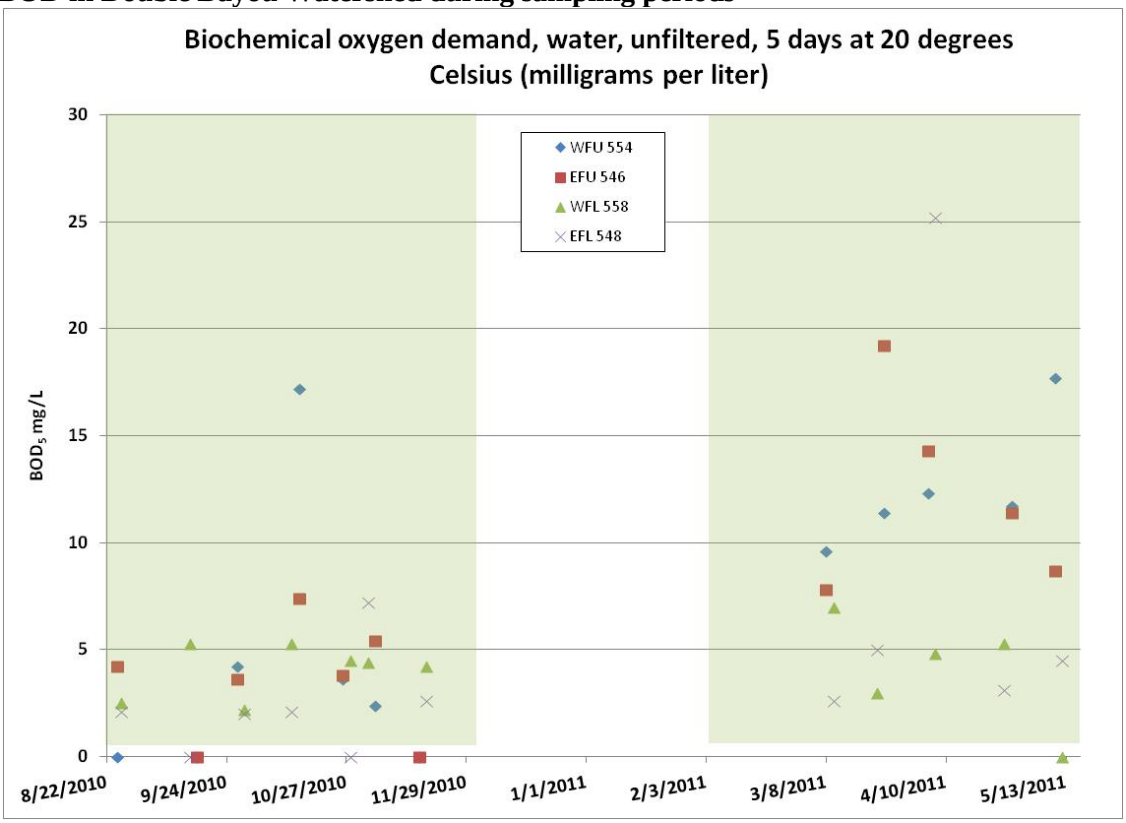
Atrazine in Double Bayou Watershed during sampling periods



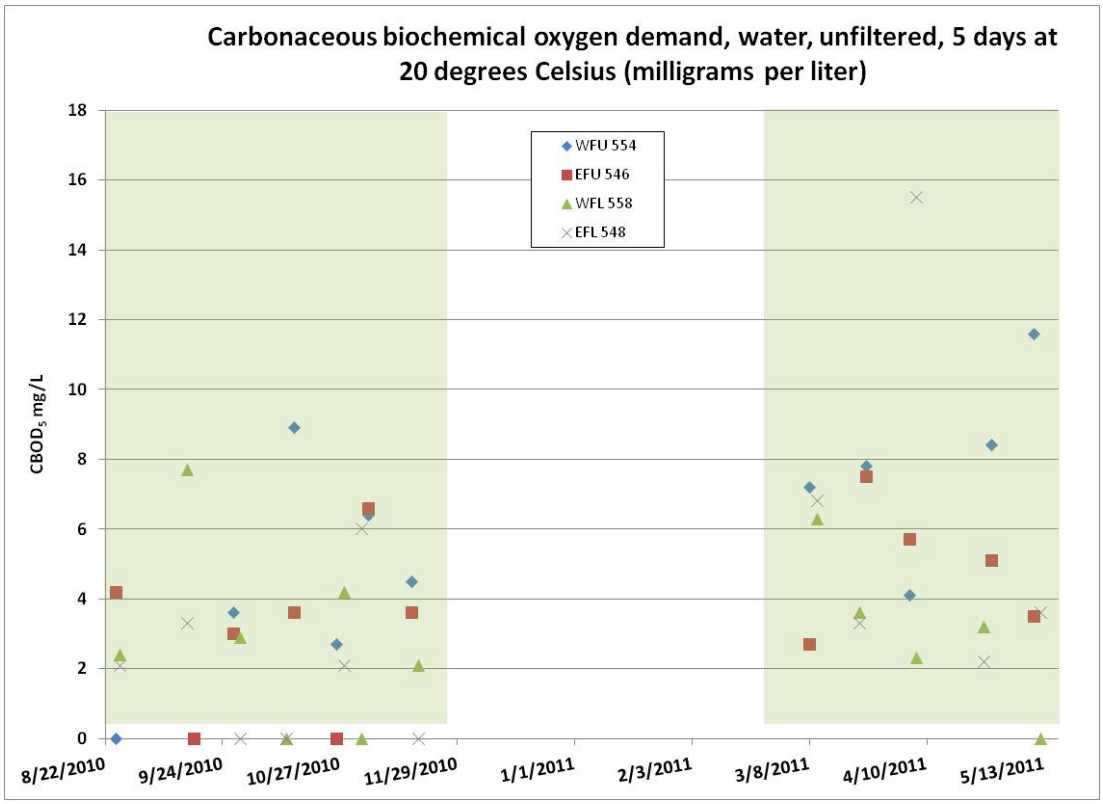
Pheophytin-a in Double Bayou Watershed during sampling periods



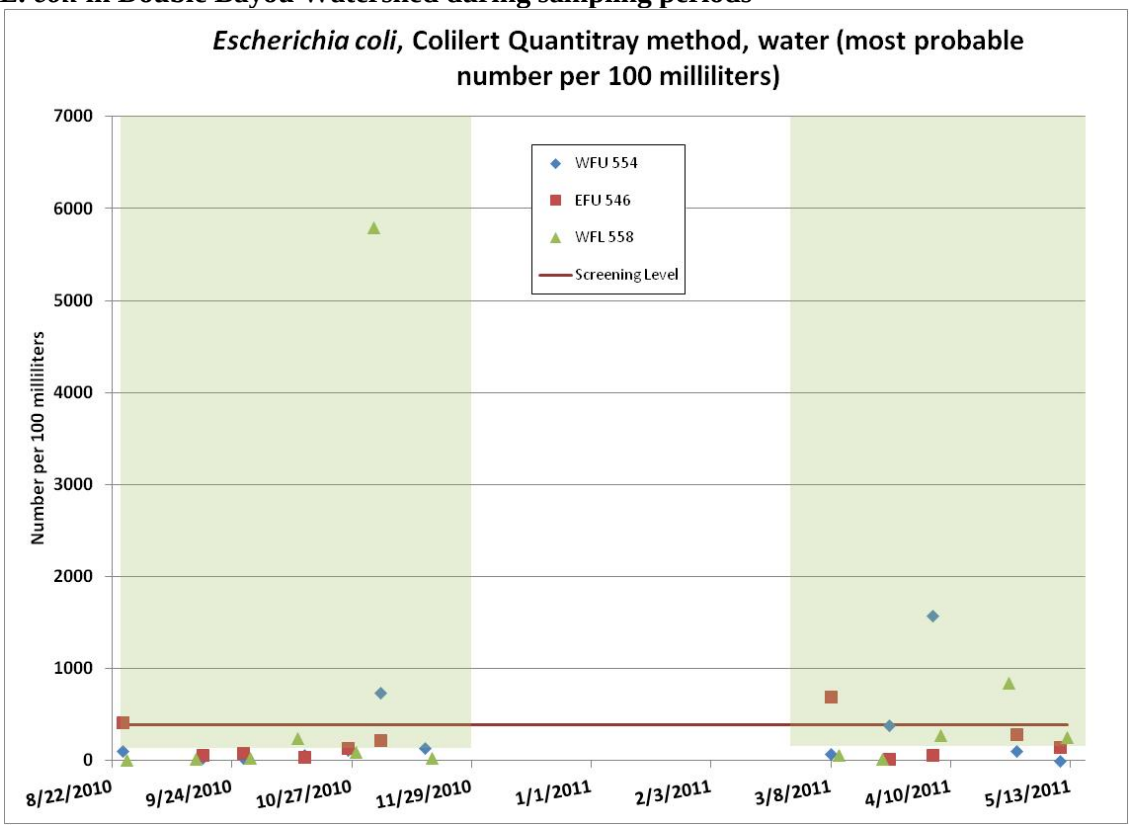
BOD in Double Bayou Watershed during sampling periods



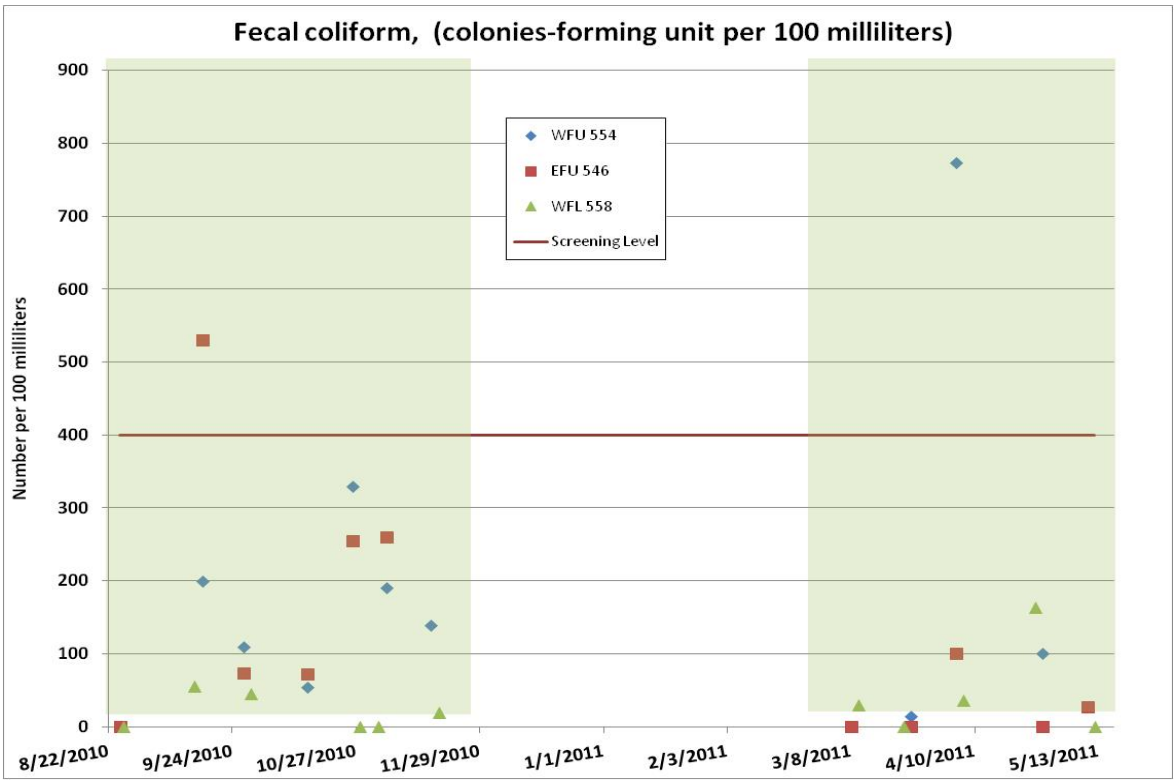
CBOD in Double Bayou Watershed during sampling periods



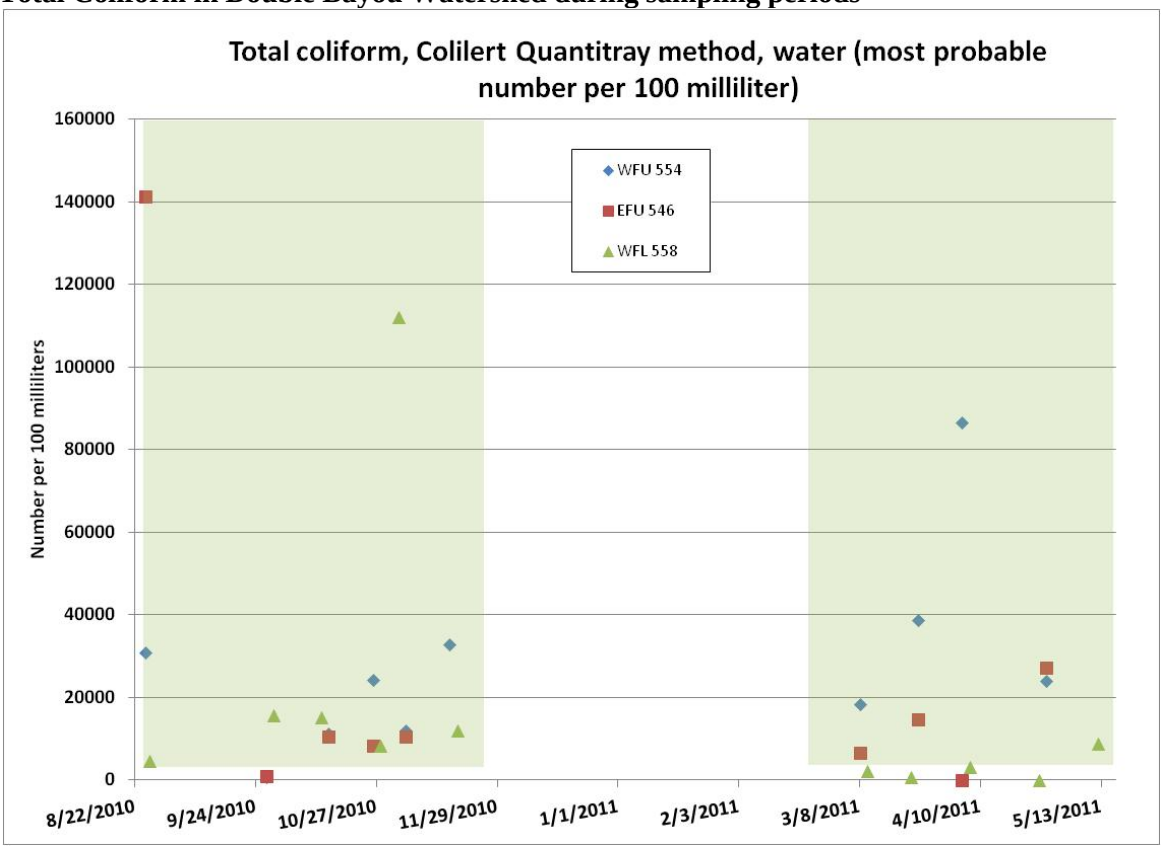
***E. coli* in Double Bayou Watershed during sampling periods**



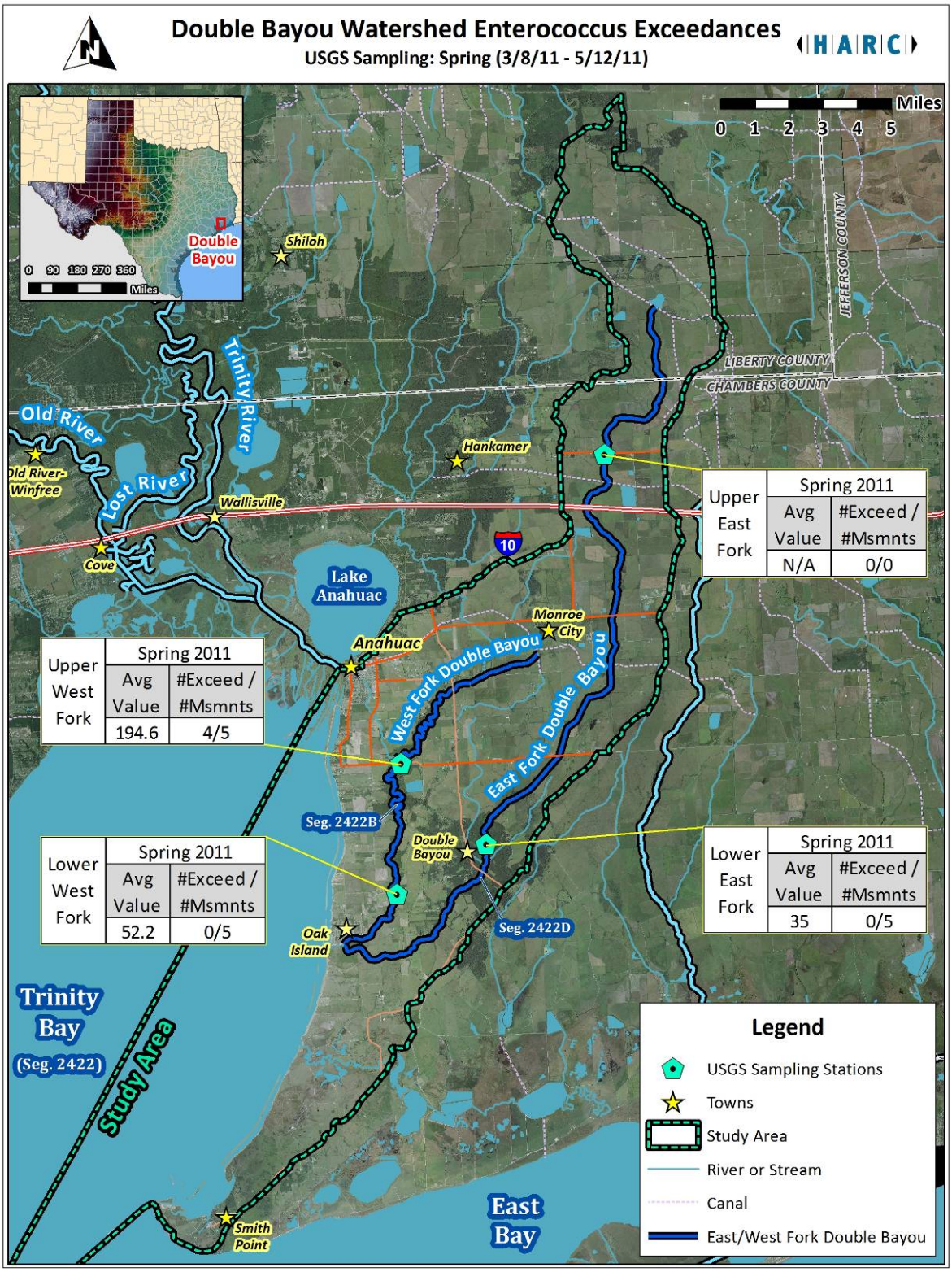
Fecal Coliform in Double Bayou Watershed during sampling periods



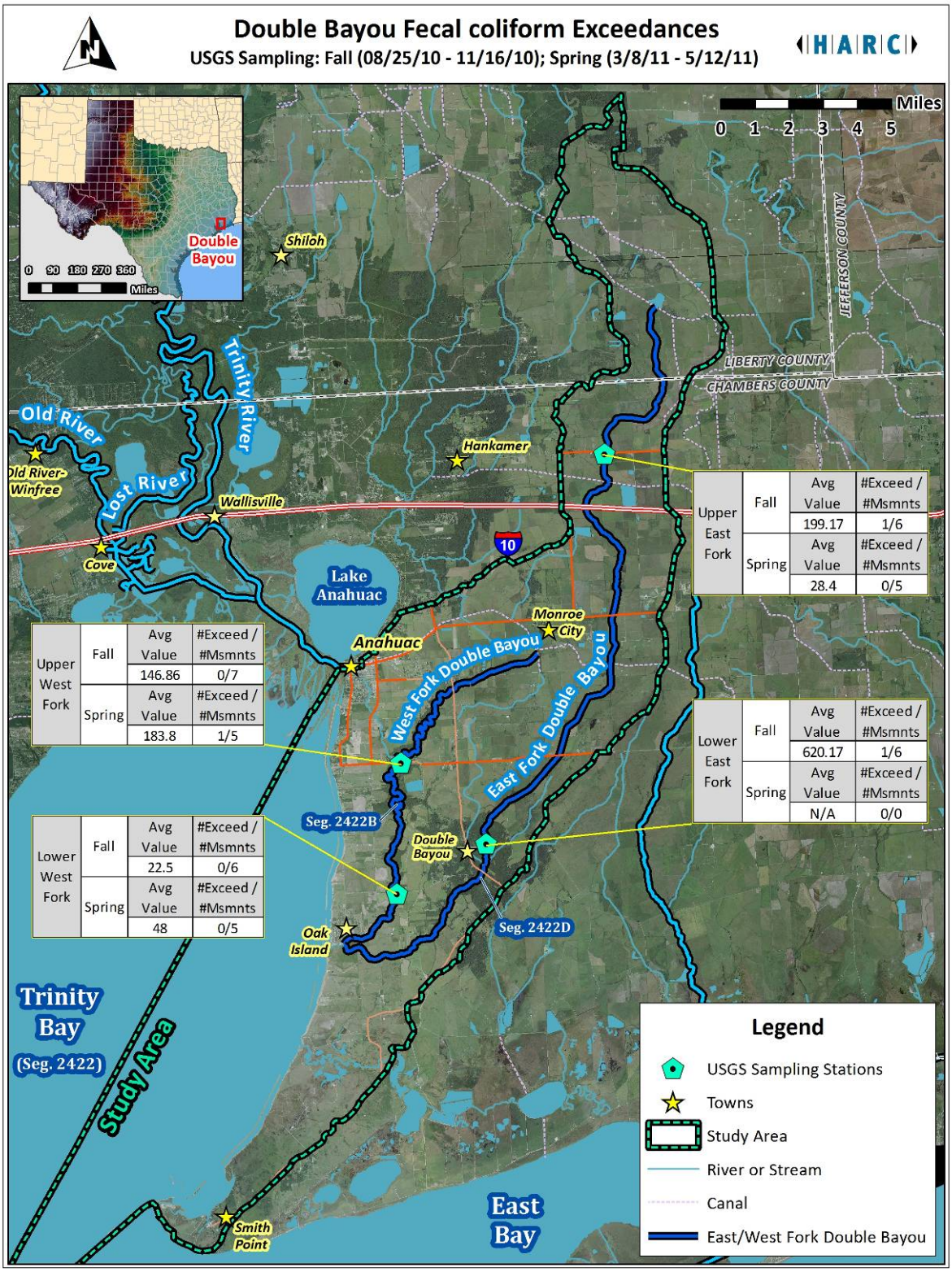
Total Coliform in Double Bayou Watershed during sampling periods



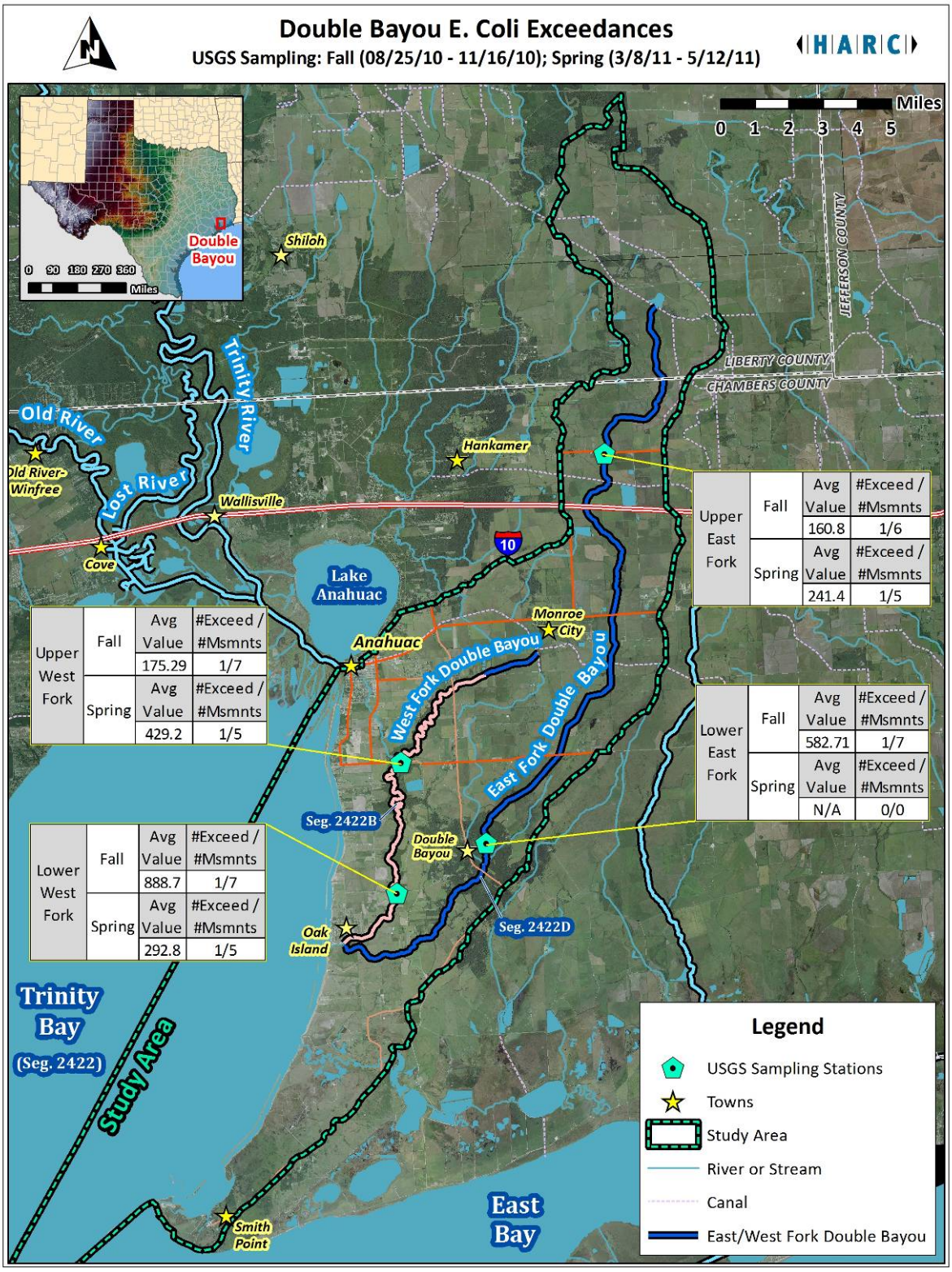
Spatial Analysis of Enterococcus in Double Bayou Watershed during sampling periods



Spatial Analysis of Fecal Coliform in Double Bayou Watershed during sampling periods



Spatial Analysis of *E. coli* in Double Bayou Watershed during sampling periods


Double Bayou E. Coli Exceedances
USGS Sampling: Fall (08/25/10 - 11/16/10); Spring (3/8/11 - 5/12/11)
HARC
Miles
0 1 2 3 4 5
0 90 180 270 360
Miles
Double Bayou
Shiloh
Trinity River
Old River
Old River-Winfree
Lost River
Wallisville
Cove
Hankamer
JEFFERSON COUNTY
LIBERTY COUNTY
CHAMBERS COUNTY
10
Lake Anahuac
Anahuac
Monroe City
West Fork Double Bayou
East Fork Double Bayou
Seg. 2422B
Seg. 2422D
Double Bayou
Oak Island
Trinity Bay (Seg. 2422)
Study Area
East Bay
Smith Point
Upper West Fork
Fall: Avg Value 175.29; #Exceed / #Msmnts 1/7
Spring: Avg Value 429.2; #Exceed / #Msmnts 1/5
Upper East Fork
Fall: Avg Value 160.8; #Exceed / #Msmnts 1/6
Spring: Avg Value 241.4; #Exceed / #Msmnts 1/5
Lower West Fork
Fall: Avg Value 888.7; #Exceed / #Msmnts 1/7
Spring: Avg Value 292.8; #Exceed / #Msmnts 1/5
Lower East Fork
Fall: Avg Value 582.71; #Exceed / #Msmnts 1/7
Spring: Avg Value N/A; #Exceed / #Msmnts 0/0
Legend
USGS Sampling Stations
Towns
Study Area
River or Stream
Canal
East/West Fork Double Bayou

Appendix B: Stakeholder and Outreach

DOUBLE BAYOU STAKEHOLDER CANDIDATE CATEGORIES

Chambers County
- County Judge
- Commissioner, Pct. 2
- Commissioner, Pct. 1
- County Engineer

Anahuac, City of
- Mayor
- Alderman, Pos. 1
- Alderman, Pos. 2
- Alderman, Pos. 3
- Alderman, Pos. 4
- Alderman, Pos. 5
- city staff

Liberty County
- County Judge
- Commissioner, Pct. 1
- county staff

Local Agencies (TBCD & CLCND)
- CLCND Gen. Mgr.
- Ret. CLCND Mgr.
- CLCND Board Member
- TBCD Acting Gen. Mgr.
- TBCD Board, Pct. 4
- TBCD Board, Pct. 1

Federal & State Agencies
- AgriLife Extension
- Trinity Bay SWCD
- Lib/Ch Farm Service Agency
- USFWS
- TPWD
- NRCS

NGOs
- Waterborne Education Center
- Galveston Bay Foundation
- Ducks Unlimited

Landowners
- Upper East Fork
- Lower East Fork
- West Fork
- Liberty County
- Monroe City

Oak Island Community
- Channel Marker 17
- Oak Island Lodge
- Kiva Construction
- new resident
- long-time resident

Smith Point Community
- seafood industry
- fisherman
- new resident
- long-time resident

STAKEHOLDER INTERVIEWEES

Round 1, Spring 2011

Honorable Bubba Abernathy, Chambers County Commissioner, Pct. 1
Don Brandon, Chambers County Engineer
Sidney Lewis, Chambers County Environmental Officer

Artie Presley, Owner – Oak Island Lodge, Oak Island Motel, Oak Island Market, Hurricane Restaurant and Club
Lee Simon, Kiva Construction, Oak Island

Terry Haltom, Chair, Chambers-Liberty Counties Navigation District Board
Tommy Myzell, Vice Chair, CLCND board
Allen Herrington, Secretary, CLCND board
Ken Coleman, CLCND board
Ken Mitchell CLCND board
Mary Beth Stengler, General Manager, CLCND

Hon. Sue Hawthorne, Mayor, City of Anahuac
Dan Irby, Public Works Director, City of Anahuac

Jerry Shadden, General Manager, Trinity Bay Conservation District
John Finn, Utility Superintendent, TBCD

John Jenkins, rice farmer, board member, Trinity River Authority

Tyler Fitzgerald, AgriLife County Extension Agent

Terrie Looey, AgriLife Marine Extension Agent

David Manthei, NRCS District Conservationist, Anahuac
Phillip Stewart, NRCS District Conservationist, Liberty

Winston Denton, Coastal Fisheries Biologist, Texas Parks & Wildlife Dept.

Lisa Miller-Marshall, Oyster TMDL Coordinator, Galveston Bay Foundation

STAKEHOLDER INTERVIEWEES
Round 2, Summer 2011

Honorable Bubba Abernathy, Chambers County Commissioner, Pct. 1
Bobby Hall, Chambers County Engineer
Sidney Lewis, Chambers County Environmental Officer

Bobby Hall, Chambers County Engineer

David Manthei, NRCS District Conservationist, Anahuac

Hon. Sue Hawthorne, Mayor, City of Anahuac
Lance Naumann, City Manager

Winston Denton, Coastal Fisheries Biologist, Texas Parks & Wildlife Dept.

Tyler Fitzgerald, AgriLife County Extension Agent
Terrie Looey, AgriLife Marine Extension Agent

George ("Pudge") Willcox, retired General Manager, CLCND

Guy Robert Jackson, owner, Chambers County Abstract Co.; chair, Chambers Recovery Team

George Turner, rancher
Clint Fancher, rancher
Tyler Fitzgerald, AgriLife County Extension Agent

Jeffrey Jenkins, Pres., Pct. 3, Trinity Bay Conservation District
Dorothy Hamilton, Sec., Pct. 5, TBCD
Greg Turner, Pct. 4, TBCD
Guy Goodson, Board Attorney, TBCD
Tommy Gilbert, Pct. 1, TBCD
Jerry Shadden, General Manager, TBCD
John Finn, Utility Superintendent, TBCD

Darlene McPherson-Pagels, Oak Island Citizen

Terry Haltom, Chair, Chambers-Liberty Counties Navigation District (CLCND) Board
Tommy Myzell, Vice Chair, Allen Herrington, Secretary, Ken Coleman, Ken Mitchell, Mary Beth Stengler, General Manager (all CLCND board

Alan Bernstein, paddler on Sierra Club trip on East Fork of Double Bayou
Joe Coker, paddler on Sierra Club trip on East Fork of Double Bayou
Tom Douglas, trip leader on Sierra Club paddle trip on East Fork of Double Bayou
Debbie King, paddler on Sierra Club trip on East Fork of Double Bayou
Chris Krohn, paddler on Sierra Club trip on East Fork of Double Bayou

Yes, I want to learn more about Double Bayou and its watershed!

Open House, 10/13/2011

Please sign me up to receive updates!

Name	Address	City	Zip Code	Phone	Email
DAVID BOYD	136 TEAL P.O.BOX 1384	ANAHUAC	77814	281-495-8004	DBOYDRETARED@SBCGLOBAL.NET
LEROY EZER	Rt2 Box 724	"	"	409-252332[illegible]	CANADARANCH@hughes.N
Ollie Mayer	Rt2 Box 706			409.252445	
Norma Eze	R.2 Box 724	"	77514	409-252-3327	canadaranch@hughes.net
Ruth Millsaps	PO Box 166 Wallisville, TX 77597			409-267-4488	Ruth.A.Millsaps@usace.army.mil
Jean Abshier Forrest Randy Forrest	POB 2362	ANAhuac	77514		FDoubleBayou@aol.com
John BRITT	5130 Cotton Lake Dr Cove, TX 77523	Cove	77523	281-703-7825	JBritt@leeed.o
TERRY BINGHAM	P.O Box 2134 ANAHUAC TX 77514	ANAHUAC	77514	409 267 6757	TERRYBING@

Yes, I want to learn more about Double Bayou and its watershed!

Please sign me up to receive updates!

10/13/2011

Name	Address	City	Zip Code	Phone	Email
BUBBA DAVID ABERNATHY		ANAHUAC			
BRIAN HOLT	1120 Hodges Lane	Wharton	77488	979-532-3496	bjack@tsslc.state.texas.gov
Kenny Hoffpauir	229 Bob White Lane	Anahuac	77514	469-348-8267	hoffpak@yahoo.com kennyha@eastchambers.net
Mayor Sue Heathcock	PO 354	Anahuac	77514	409-277-9114	S.heathcock@anahuac.tx
René Hoffpauir	229 Bob White Ln	Anahuac	77514	214-727-4352	txgrandma@yahoo.net *
(Pagels) Darlene McPherson	PO Box 2398 4415 W. Bayshore Rd	Anahuac	77514	(281-331-2145) 409-267-2258	dmcpherson@mdptechinc.com
SANDRA & TOM BUMGARNER	POBox 1521 502 SCHERER	ANAHUAC	77514	281-732-6033 409-267-4498	Tomb101@aol.com
Chip Young	RC 2 Box 714A Anahuac Tx 77514			9072527342 7135687094	

Yes, I want to learn more about Double Bayou and its watershed!

Please sign me up to receive updates!

10/13/2011

Name	Address	City	Zip Code	Phone	Email
[signature]	535 Scherer Rd PO Box 86 ~~Anahuac~~	Anahuac	77514	409 267 3417	bscherer-86 @ Yahoo.com

Double Bayou Watershed Protection Overview

What is a Watershed?

"A watershed is the area of land that catches rain and drains into a marsh, bayou, creek, river, lake, or bay. It functions similar to a bowl: Water dropped inside the bowl works its way to the bottom of the basin – draining to a common outlet."[1]

Where is the Watershed of Double Bayou?

The Double Bayou watershed starts in southern Liberty County and drains to the East and West Forks of Double Bayou, which join at the southern part of the watershed and discharge into Trinity Bay at Oak Island.

The Watershed Study Area includes the lands that drain to the East and West forks of Double Bayou, plus other drainages in the vicinity that drain into Trinity Bay, such as irrigation canals, surface water runoff, and storm sewers (all of which are included in the regulatory / administrative definition of the watershed). The total Watershed Study Area is 88,562 acres, which is approximately 7.7 % of the combined area of Liberty and Chambers counties.

TCEQ/EPA 303(d) List Process

- Clean Water Act of 1972 requires that water quality standards be set to meet designated uses of stream segments.
- Amendments of 1987, Section 303(d): require a water quality inventory to determine which streams are impaired, and then to establish limits that would reduce the pollution load enough to bring the waters into compliance with the standards. These "impaired waters" = 303(d) list.
- "Impaired Waters" = those not meeting water quality standards for the designated use.
- TMDL = Total Maximum Daily Load; "maximum amount of any pollutant, contaminant, or impairment that can enter a body of water before the quality of the water is deemed unfit to for its designated uses."[2] TMDL also refers to the process of defining the limits, attributing allowable loads to sources, and developing a plan to achieve improvements that then meet water quality standards.
- TCEQ has delegated authority from EPA for enforcing provisions of the Clean Water Act.
- Point Source Pollution = contamination that enters the water in a specific, identifiable location – primarily wastewater treatment plant outfalls.
- Nonpoint Source Pollution = pollution that enters the water from many diverse sources – primarily runoff from residential areas, city streets, or agriculture.

[1] Armand Bayou Watershed Partnership. 2004. *Armand Bayou Watershed Plan.* p. 6.
[2] http://waterquality.montana.edu/docs/watermonitoring/tmdl_intro.shtml, accessed 2/2/2010.

Current Status of Double Bayou in TCEQ Process

Designated use for Double Bayou: Primary Recreation/Swimming & Aquatic Life

Listing date and parameters: West Fork of Double Bayou, 303(d), 2008
Dissolved Oxygen (too low) and Bacteria (too high)

Current standards: Dissolved Oxygen (D.O.), 3.0 mg/L (grab sample)
Bacteria, *E. coli* in freshwater, 394 colonies/100 mL
Bacteria, *Enterococcus* in tidal and estuarine waters, 89 colonies/100 mL
Bacteria, fecal coliform in freshwater, tidal & estuarine waters, 400 colonies/100 mL

Past exceedances:

- Average levels of bacteria were consistently too high at three key monitoring stations: one on the East Fork (not on the 303(d) List) and two on the West Fork (on the 303(d) List).
- Individual samples for dissolved oxygen at those same stations were too low anywhere from 6% to 18% of the time, although the long-term averages met standards.

Current Project

The current project for Double Bayou is characterizing water quality for the watershed of the Study Area. The project is being implemented by the Geotechnology Research Institute/Houston Advanced Research Center (HARC), and funded by the Recovery Act, through TCEQ and EPA, and with additional monitoring support from USGS.

The project is establishing a baseline dataset, identifying gaps in monitoring data, implementing additional monitoring, analyzing the data, drafting a watershed characterization report, and informing key stakeholders about the project and its results. The information will be necessary for any future watershed protection planning efforts conducted in the Double Bayou watershed.

Needs and Benefits of the Project

- Clarify any existing water quality issues in the Double Bayou watershed.
- Identify water quality trends in the watershed.
- Provide a basis for developing a Watershed Protection Plan, which would address water quality issues before increasing population and developed land use make it more difficult to do so.

Planning Alternatives to Address Water Quality Issues

When a water body has water quality issues, stakeholders in the watershed have two basic choices for methods to address the impairment if agency support and funding for improvements are to be accessed: a Watershed Protection Plan (WPP) or an Implementation Plan (I-Plan).

- Watershed Protection Plans must include nine key elements to be acceptable by state and federal agencies (TCEQ and EPA). WPPs are proactive and strictly voluntary. WPPs may address more than just water quality issues. (See attached for summary requirements.)
- I-Plans must include the nine elements, plus additional features that provide more guarantees that water quality standards will be met – with a "hammer," primarily through the permitting process.

Project Timeline Summary and Role of Stakeholders

Winter 2009-10	Data gap analysis and data monitoring plan
Fall/Winter 2010	First new data collection and analysis
Spring 2011	Stakeholder interviews, Round I
Spring/Summer 2011	Second new data collection and analysis
Summer 2011	Stakeholder interviews, Round II
Early Fall 2011	Public open house

Stakeholder Presentation Materials: Glossary

Double Bayou Watershed Planning
Glossary

Chlorophyll-a – a substance found in green plants, including algae, that enables plants to make food, through photosynthesis. High levels of chlorophyll-a in water can indicate that there is too much algae in the water for it to be healthy for fish and other aquatic life. The algae can reduce light penetration needed by other plants during the day, and also use up oxygen during their normal nighttime functions.

Dissolved Oxygen (DO) – oxygen dissolved in water and freely available for use by fish and other aquatic life. Specific minimum levels of DO in water are necessary for different kinds of aquatic life.

E. coli – a species of bacteria that is found in the intestines and waste of humans and other warm-blooded animals. The presence of *E. coli* in freshwater is the currently accepted indicator that human pathogens could also be present.

Enterococcus – a type of bacteria that is found in the intestines and waste of humans and other warm-blooded animals. The presence of *Enterococcus* in brackish or tidal waters is the currently accepted indicator that human pathogens could also be present.

EPA – Environmental Protection Agency, the federal agency which has responsibility for maintaining and regulating water quality in the nation's waters under the Clean Water Act.

Fecal Coliform – bacteria found in the intestinal tracts of humans and other warm-blooded animals. Fecal coliform bacteria used to be the standard indicator for pathogens, but they were determined to be less reliable as an indicator of human pathogens than *E. coli* and Enterococcus.

Nonpoint Source (NPS) Pollution – pollution in water that comes from scattered sources on land (rather than one specific location), and which is generally transported to a water body by rainfall runoff. Examples of nonpoint sources are yards, roads, parking lots, and agricultural lands.

Nutrients – substances used by living things to promote growth. Examples of nutrients in water include nitrogen or phosphorus compounds. High nutrient levels in water can result in too much plant growth, such as algae blooms.

Pathogen – a disease-causing microorganism.

pH – a measure of how acidic or basic a water solution is. pH is measured on a scale of 0 to 14, with 7 being neutral, below 7 being acidic, and above 7 being basic. White vinegar is acidic with a pH of 2.4, and Milk of Magnesia is basic with a pH of about 10.

Point Source Pollution – pollution that enters the water from a single identifiable point, such as a pipe. An example would be an outfall pipe from a wastewater treatment plant.

TCEQ – Texas Commission on Environmental Quality, the state agency which has responsibility for maintaining and regulating water quality in Texas streams, lakes, and estuaries.

TMDL – Total Maximum Daily Load, or the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. TMDL also refers to a regulatory process used to determine allowable pollutant concentrations in surface waters.

Turbidity – cloudiness in water caused by suspended material, such as silt or organic matter.

Water Quality Criteria – the limits set for substances found in water that are either the minimum or maximum for maintaining a particular use of a water body. For example, an aquatic life use would require a minimum concentration of dissolved oxygen for fish to live, while a recreational use would require that a concentration of indicator bacteria be below a given maximum in order for the water to be safe for human contact.

Water Quality Standards – a combination of: designated uses for a water body, the specific criteria needed to protect those uses, and an anti-degradation policy to prevent actions that would allow the water quality to deteriorate.

Watershed – an area of land that drains to a stream, river, or other body of water. Watershed boundaries are determined by analyzing where any drop of rain falling on the land area would flow.

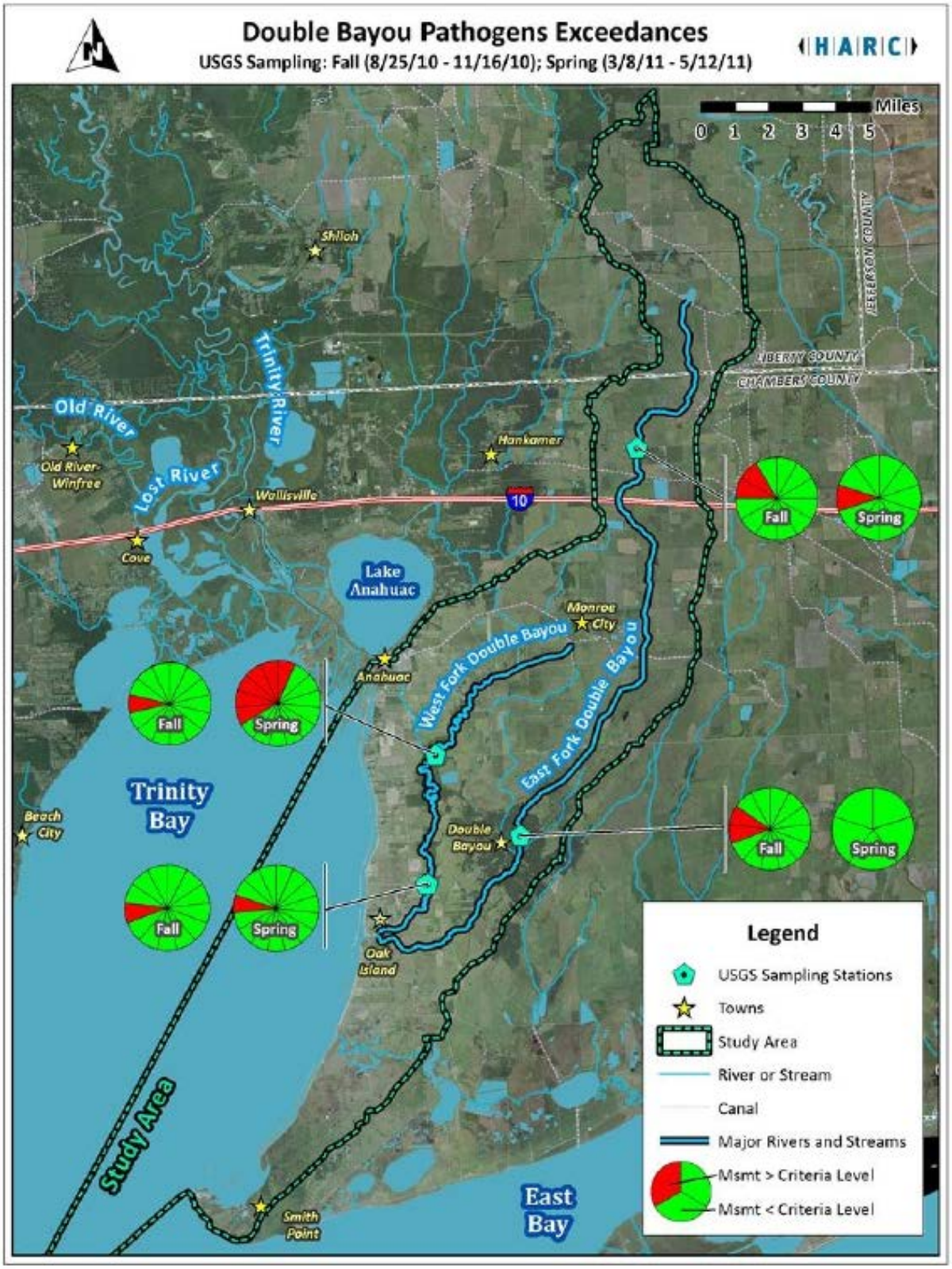
Stakeholder Presentation Materials: EPA 9 Elements

Watershed Protection Plans
EPA 9 Elements

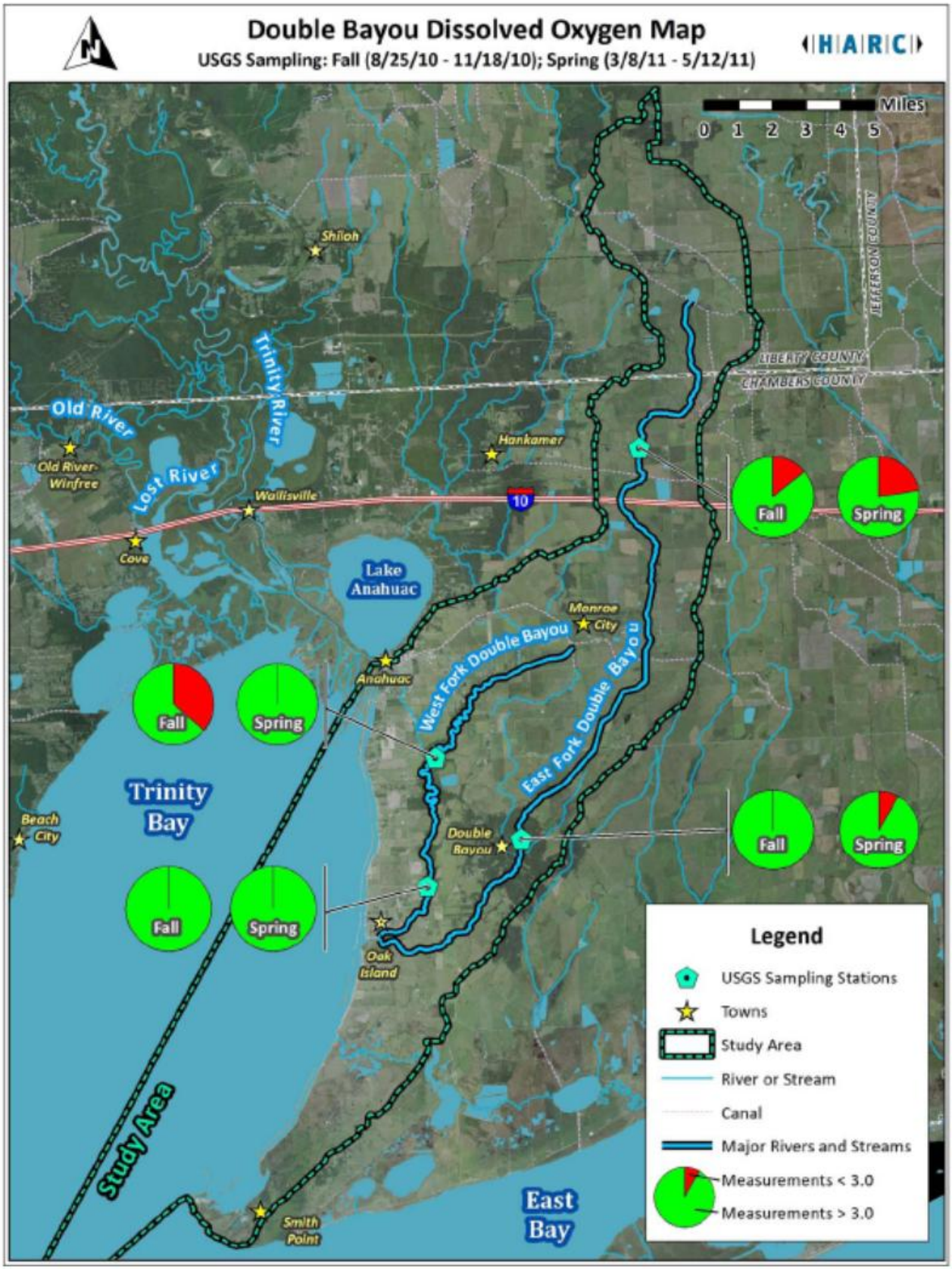
a. Identification of the causes & sources.
b. Estimate of the needed load reductions.
c. Description of management measures.
d. Estimate of technical and financial assistance.
e. Strategy for Information /education.
f. Schedule for implementation.
g. Description of interim, measurable milestones.
h. Criteria to determine if load reductions are achieved.
i. Monitoring component to evaluate effectiveness.

Stakeholder Presentation Materials: Map, Watershed Study Area

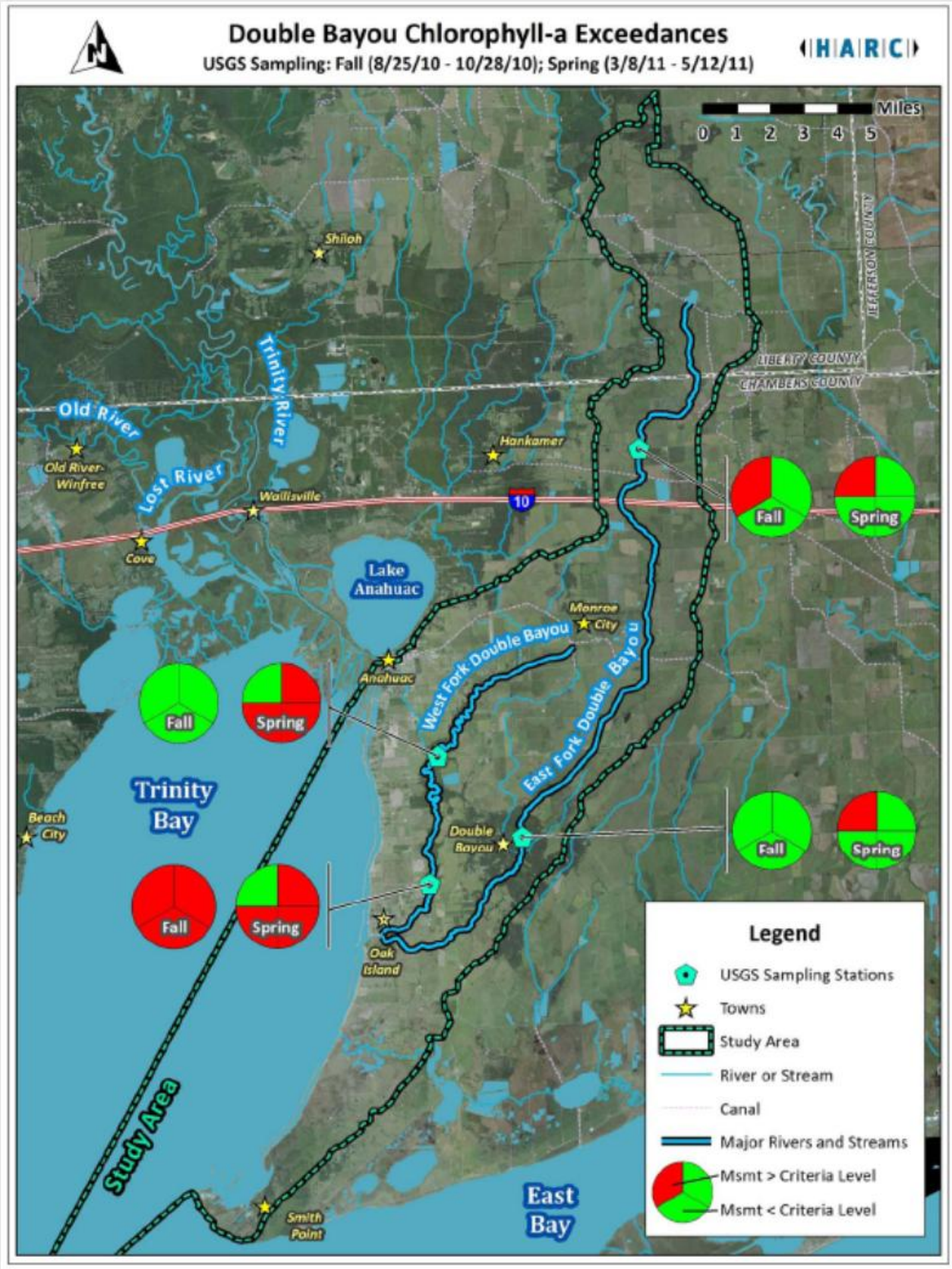
Stakeholder Presentation Materials: Maps, Pathogens



Stakeholder Presentation Materials: Maps, Dissolved Oxygen



Stakeholder Presentation Materials: Maps, Chlorophyll-a



Stakeholder Presentation Materials: Presentation, Final

Double Bayou Watershed Protection

Characterization Study and Stakeholder Involvement

Summer 2011

What is a Watershed?

An area of land that catches rain and drains into a marsh, bayou, creek, river, lake or bay.

Where is the Watershed of Double Bayou?

- Watershed - from southern Liberty County to Trinity Bay at Oak Island
- Study Area - Double Bayou watershed, *plus* associated drainages into Trinity Bay = 88,562 acres (138 sq. mi.)

What Are Water Quality Standards?

What are the Goals?
(from the Clean Water Act)

- Protect Human Health
- Protect Aquatic Life

Who Determines the Standards?

- TCEQ, with...
- EPA approval

What Makes Up the Standards?

- Designated Uses
  - Aquatic life
  - Aquatic recreation
  - Drinking water supply
- General & Numerical Criteria
  - to meet the uses
- Anti-degradation Policies

What are the Bayous' Designated Uses?

TCEQ has listed 2 Designated Uses for Double Bayou:

- Primary Recreation / Swimming

And

- Aquatic Life

What Are the Bayous' Criteria?

Recreation / Swimming

- Fecal Coliform (former standard): < 400 colonies / 100 mL
- *E. coli*, for freshwater: < 394 colonies / 100 mL
- *Enterococcus* , for saltwater: < 89 colonies / 100 mL

Aquatic Life

- Dissolved Oxygen: > 3.0 mg/L

What is the Characterization Study…?

- Research and gathering of baseline data
- Identification of gaps in baseline data set
- Data monitoring to fill gaps
- Analysis of data, for differences across the watershed and over time

…What is the Characterization Study?

- Analysis and recommendations of a water quality model for the watershed
- Introduction of study results to stakeholders in the watershed
- Final report

Indicator Bacteria Results, Spring 2011

Indicator Bacteria Results, Spring 2011

Indicator Bacteria in the West Fork

Designated Use	Water Quality Criteria	Too High at FM 2936	Too High at Eagle Ferry Rd
Recreation / Swimming	Fecal Coliform: < 400 colonies / 100 mL	Fall: 0 of 7 Spring: 1 of 5	Fall: 0 of 7 Spring: 0 of 5
	E. coli: < 394 colonies / 100 mL	Fall: 1 of 7 Spring: 1 of 5 (429 avg)	Fall: 1 of 8 (785 avg) Spring: 1 of 5
	Enterococcus : < 89 colonies / 100 mL	Fall: N/A Spring : 4 of 5 (195 avg)	Fall: N/A Spring: 0 of 5

Indicator Bacteria in the East Fork

Designated Use	Water Quality Criteria	Too High at FM 1663	Too High at Carrington Rd
Recreation / Swimming	Fecal Coliform: < 400 colonies / 100 mL	Fall: 1 of 7 Spring: 0 of 5	Fall: 1 of 6 (620 avg) Spring: N/A
	E. coli: < 394 colonies / 100 mL	Fall: 1 of 7 Spring: 1 of 5	Fall: 1 of 7 (583 avg) Spring: N/A
	Enterococcus : < 89 colonies / 100 mL	Fall: N/A Spring: N/A	Fall: N/A Spring: 0 of 5

Summary of Fall/Spring Bacteria Results:

- Upper West Fork site had exceedances for all indicators.
- Lower West Fork site only had exceedances for *E. coli*.
- Upper East Fork site had exceedances for *E. coli* and fecal coliform, and no *Enterococcus* measurements.
- Lower East Fork site had exceedances *E. coli* and fecal coliform, and none for *Enterococcus*.

Potential Implications of Bacteria Results

In other words...

Bacteria levels could be too high to support primary recreation in the bayous, and could be a problem for oysters in the bay.

Dissolved Oxygen Results, Spring 2011

Dissolved Oxygen in the West Fork

Designated Use	Water Quality Criteria	Too Low at FM 2936	Too Low at Eagle Ferry Rd
Aquatic Life	Dissolved Oxygen: > 3.0 mg/L	Fall: 247 of 680 Spring: 0 of 576	Fall: 0 of 538 Spring: 0 of 384

Dissolved Oxygen in the East Fork

Designated Use	Water Quality Criteria	Too Low at FM 1663	Too Low at Carrington Rd
Aquatic Life	Dissolved Oxygen: > 3.0 mg/L	Fall: 95 of 671 Spring: 129 of 576	Fall: 0 of 537 Spring: 31 of 383

Potential Implications of Dissolved Oxygen Results

In other words...

Dissolved oxygen levels could be too low to support healthy aquatic life in the East Fork.

Chlorophyll-a results, Spring 2011

Chlorophyll-a in the West Fork

Designated Use	Screening Level	Too High at FM 2936	Too High at Eagle Ferry Rd
Aquatic Life	Chl-a, Tidal: <21.0 µg/L	Fall: 0 of 3 Spring: 3 of 4	Fall: 3 of 3 Spring: 3 of 4

Chlorophyll-a in the East Fork

Designated Use	Screening Level	Too High at FM 1663	Too High at Carrington Rd
Aquatic Life ??	Chl-a, Tidal: <21.0 µg/L		Fall: 0 of 3 Spring: 1 of 4
	Chl-a, Non-Tidal: <14.1 µg/L	Fall: 1 of 3 Spring: 1 of 4	

Potential Implications of Chlorophyll-a Results

In other words...

Chlorophyll-a levels indicate the possibility of too many nutrients in both forks.

What happens when a water is impaired?

1. Impaired waters are added to the *"303(d) list."*
2. Impaired waters enter the process for a Total Maximum Daily Load (*TMDL*) – a pollutant *budget* for a stream to meet criteria.
3. Texas requires a *plan* to be developed to reduce the pollutant to levels that meet the criteria.

There are 2 choices for plans:

Implementation Plan (I-Plan)	Watershed Protection Plan (WPP)
EPA's 9 elements	EPA's 9 elements
Specific requirements to meet standards, usually through the permitting process.	Voluntary
May only address specific water quality issues, and not others.	May address other issues of concern to stakeholders.
TCEQ workload results in 5-12 year delay before planning and implementation.	Grants are available to start planning and implementation in fall 2011.

One example for watershed protection

- Damaged Riparian Areas can cause many problems for a stream.
- Only some of the problems are directly related to water quality standards.

What is a Riparian Area?

- The band of vegetation that occurs adjacent to the stream bank
- Transitional zone between the wetlands and upland areas.

Slide courtesy of Melissa Parker, TPWD

Why watershed protection?

- Impaired Riparian Areas can:
  - Diminish water quality
  - Reduce wildlife habitat
  - Increase flooding events
  - Contribute to bank erosion
  - Reduce aesthetic value
- Watershed Protection Plans can address all of these issues.

Characteristics of a Healthy Riparian Area

- Diverse collection of native vegetation in close association with water.
- Many of these plants have deep roots that:
  - Bind the soils of the streambank
  - Protect against erosion

Slide text courtesy of Melissa Parker, TPWD

Benefits of Healthy Riparian Areas

- Improve water quality
  - Filter & catch sediment
  - Assimilate pollutants
  - Reduce bacteria in runoff
- Provide important habitat for wildlife and fish
  - Food, shelter, shading, travel corridors
- Stabilize streambanks
  - Reduce velocity of floodwater
  - Protect banks from erosion

Slide text courtesy Melissa Parker, TPWD

Benefits of Healthy Riparian Areas

- Important recreational resource:
  - Anglers
  - Hunters
  - Paddlers
  - Hikers
  - Birdwatchers
  - Fishers

Slide text courtesy of Melissa Parker, TPWD

How could a WPP help riparian health?

- Identify appropriate native vegetation.
- Develop plans for "living shorelines."
- Identify strategies for healthy land management.
- Recruit partners for implementation.

Next Steps:

- Present results to community open house.
- Review and make recommendations for a water quality model.
- Develop recommendations and plan for community outreach.
- Prepare and submit Final Report.
- Secure funding for Watershed Protection Plan.

Thank you!

TCEQ

HARC

USGS

6

Stakeholder Presentation Materials: Brochure, Final

What's Next for Double Bayou?

- ⇒ Finalize report on water sampling results, with recommendations for watershed protection planning.
- ⇒ Identify and involve stakeholders in the watershed planning process.
- ⇒ Begin Watershed Protection Plan.

We all live in a watershed!

With thanks to our sponsors and partners:

TCEQ

Galveston Bay Estuary Program

H A R C

USGS science for a changing world

Stead Conservation Solutions

The WATER in DOUBLE BAYOU

Is it healthy for fish?

Is it safe for people to swim and boat?

Is it worth improving?

If you are interested in the answers to these questions, you will want to read this…

Stakeholder Presentation Materials: Open House Flyer

What's a Watershed?

A watershed is an area of land that catches rain and drains into a marsh, bayou, creek, river, lake, or bay. *All* land is part of a watershed.

Where is the Double Bayou Watershed?

From southern Liberty County to Trinity Bay at Oak Island:

How's the Water?

Researchers collected and analyzed water samples in fall 2010 and spring 2011, in both the West and East forks of Double Bayou. They tested for substances that determine the health of the streams:

For PEOPLE:
Bacteria levels are sometimes too high to support contact recreation in the bayous, and could be a problem for oysters in the bay.

For FISH:
Dissolved oxygen levels are sometimes too low to support healthy aquatic life.

For GENERAL USE:
Chlorophyll levels– indicating the presence of algae—suggest too many nutrients and/or not enough shade over the water. High levels have been found, but especially in the West Fork. Too much algae leads to other problems, such as fish kills.

Double Bayou water quality is not beyond repair, and action now could avoid more costly problems later.

Why a Watershed Protection Plan?

- What happens on the land affects the streams that run through it.
- Watersheds cross political boundaries and authorities.
- A Watershed Protection Plan (WPP) defines a "pollutant budget."
- Stakeholders contribute important local knowledge on their watershed.
- A WPP combines local and expert knowledge on voluntary strategies to meet the pollutant budget.
- Successful voluntary measures can avoid the need for regulatory requirements.

How Can You Have a Say?

- Learn about your watershed!
- Attend stakeholder meetings!
- Participate in the Watershed Plan!

Double Bayou Characterization Study

Stead Conservation Solutions

For more information, contact:
Linda Stead
linda.stead@steadconservation.com

Stakeholder Presentation Materials: Open House Press Release, Final

DOUBLE BAYOU

How's the Water?

- Is it healthy for fish?
- Is it safe for people to swim and boat?
- Is it worth improving?

If you are interested in the answers to these questions, you will want to ...

Learn:

- What's in the water
- How you can have a say
- How you can be part of the solution

Attend the

Double Bayou Open House

Thursday, October 13, 2011

4:00 p.m. to 7:00 p.m.

Chambers County Library

202 Cummings St., Anahuac

Refreshments

For questions or RSVP, 713-703-1123 or linda.shead@sheadconservation.com

Stakeholder Presentation Materials: Newspaper Article, *The Progress*

4800 Research Forest Drive | The Woodlands, TX 77381
T 281-364-4059 | F 281-363-7935 | www.harc.edu

NEWS RELEASE

For Immediate Release:
October 5, 2011

How's the Water in Double Bayou?

By Linda Shead
Shead Conservation Solutions

The Houston Advanced Research Center invites residents of the Double Bayou watershed to attend an Open House and learn about the state of their bayou. The event is Thursday, October 13, 2011 from 4:00 p.m. to 7:00 p.m. at the public library in Anahuac.

"This is an opportunity for citizens to hear the results of recent water quality studies conducted in the east and west forks of Double Bayou, and provide us feedback on how we use local strategies to improve the bayou's water," said Steven Johnston, water and sediment quality coordinator with the Galveston Bay Estuary Program.

In 2004, the West Fork of Double Bayou was placed on a state list for low levels of oxygen. The levels were too low to maintain healthy fish and other aquatic life. In 2006, the State listed the tributary for high levels of bacteria – unsafe for recreational contact. At the time of those listings, there were not enough data for the East Fork. However, the recent studies indicate some water quality problems in both forks.

When a stream does not meet the standards set for its safe use – by people or fish – it becomes eligible for planning and/or requirements for improvements. Local, state, and federal resources can be made available to help local stakeholders develop and implement a watershed protection plan. A watershed is an area of land that catches rain and drains into a marsh, bayou, creek, river, lake, or bay. Action now could avoid more costly problems later.

The current water quality project is being conducted by the Houston Advanced Research Center, in conjunction with the U.S. Geological Survey and Shead Conservation Solutions. The project is funded by the American Recovery and Reinvestment Act through the Galveston Bay Estuary Program of the Texas Commission on Environmental Quality.

The Open House will be held at Chambers County Library, 202 Cummings St. in Anahuac, from 4:00 p.m. to 7:00 p.m. on October 13. Refreshments will be provided. For more information, contact Linda Shead, 713-703-1123, or linda.shead@sheadconservation.com.

Stakeholder Presentation Materials: Newspaper Ad, *The Progress*

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Bayou?

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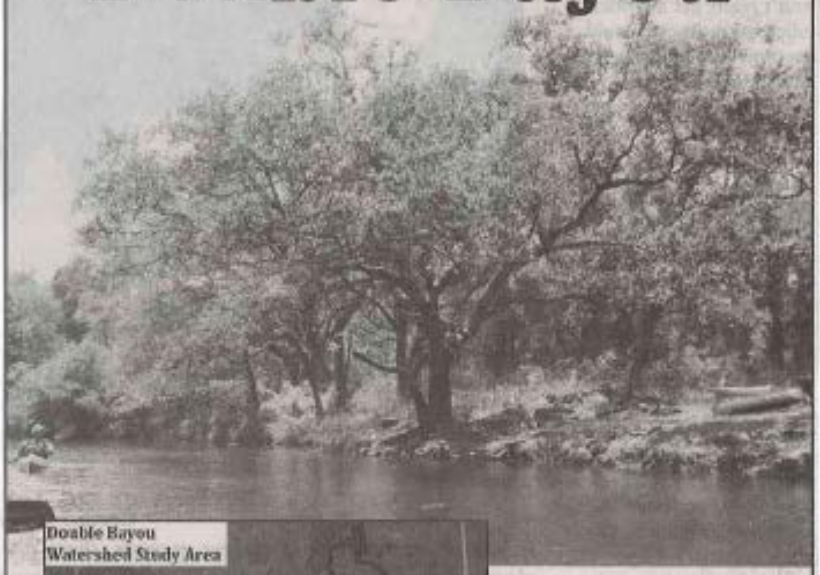
Double Bayou



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- Is it healthy for fish?
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Learn

- What's in the water
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