

Continuous Real-Time and Discrete Water-Quality Monitoring of Lake Houston, a Source-Water Reservoir, near Houston, Texas

-by Amy Beussink, Jennifer Graham, Tim Oden, Mike Turco, and many others



Prepared in Cooperation with the City of Houston

Texas Water Science Center

Web Ex

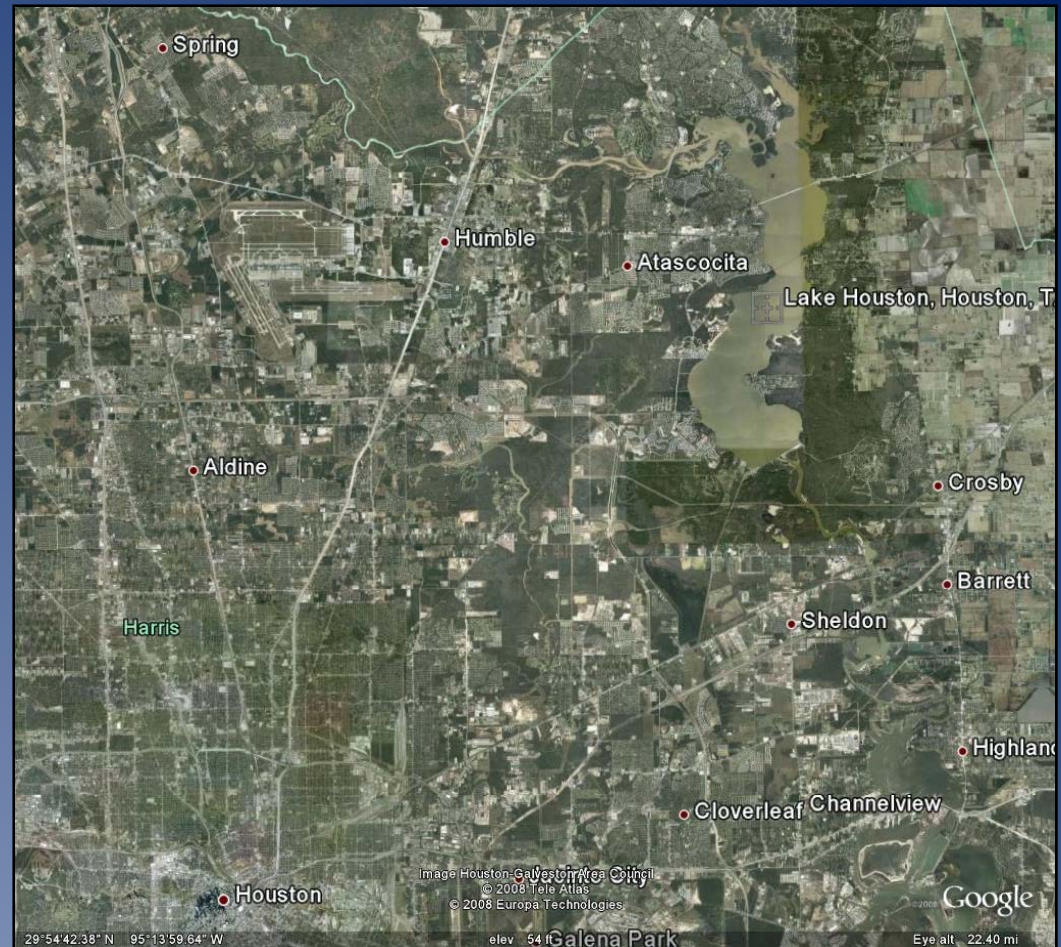
The Woodlands, TX, April 14, 2009

Outline

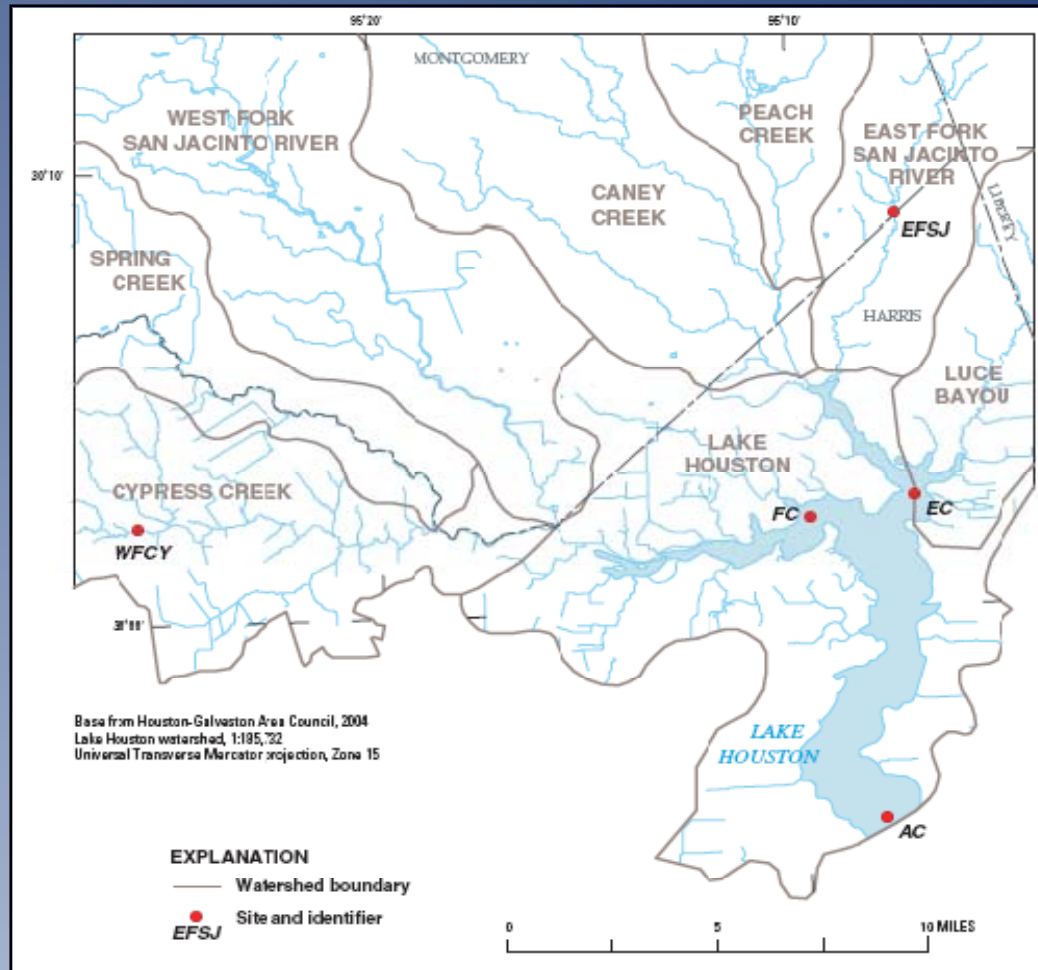
- **Study area**
- **Project overview**
- **Continuous monitoring and data**
- **Discrete sampling and data**

Study Area

- Lake Houston located ~17 miles northeast of downtown Houston, TX
- Shallow reservoir, maximum depth ~30 feet
- Long and narrow, ~8 miles by <2 miles
- Impounded in 1954
- Becoming significant source water for Houston (population 4.5 million)
 - New water treatment plant
 - Color, taste and odor complaints 2004 - 2006

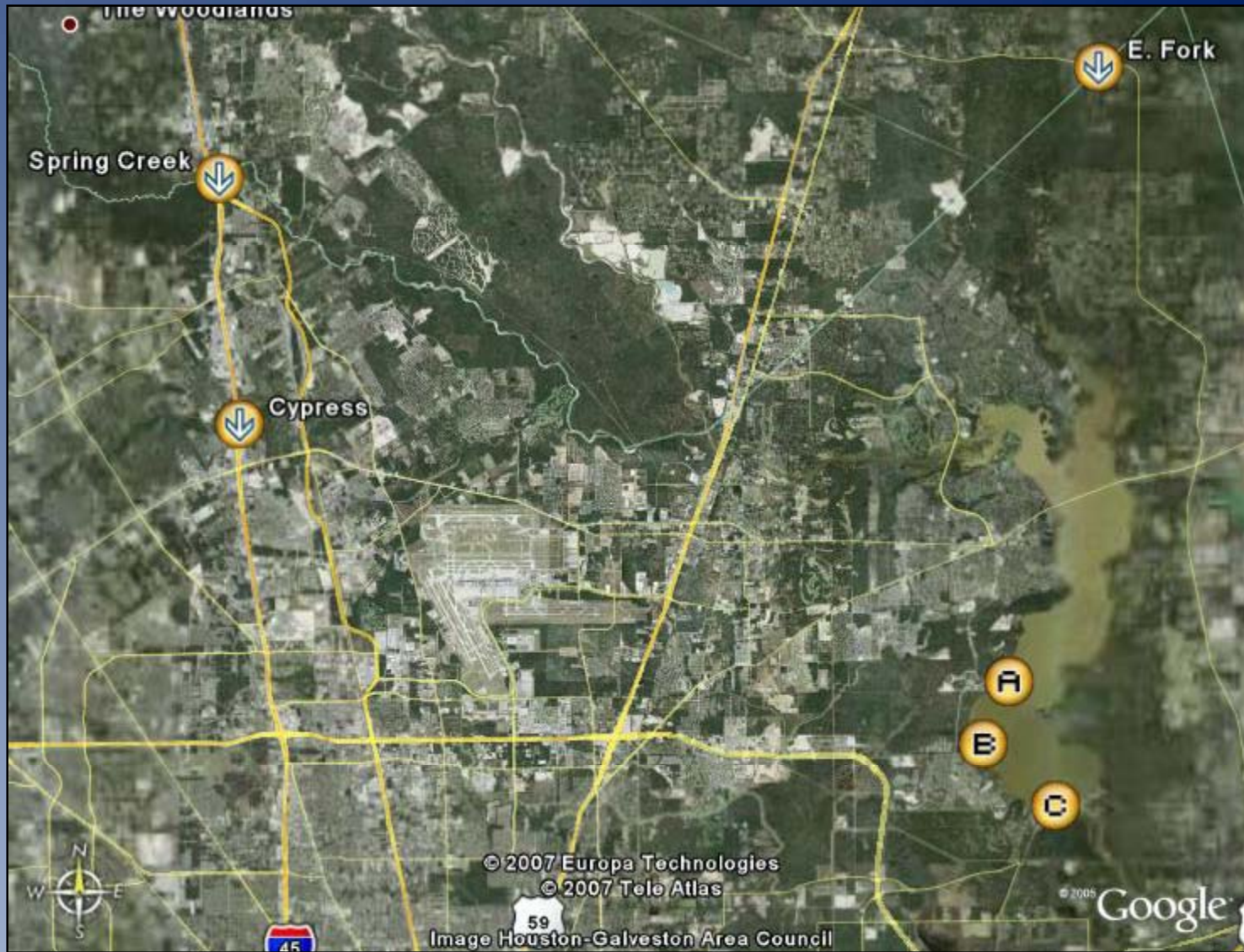


Study Area

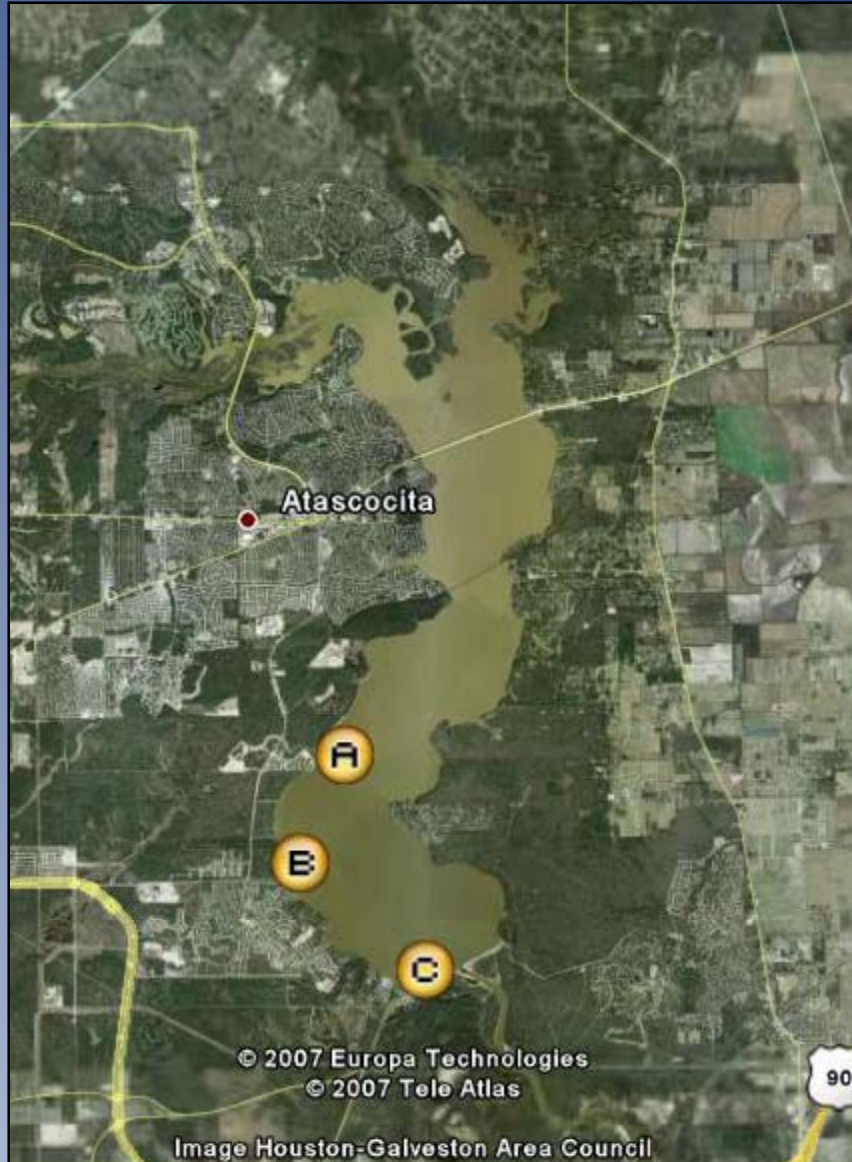


- Drainage area 2,835 mi²
- Land use is rural, transitional and urban
- West Fork predominately urban
- East Fork predominately rural

Monitoring Locations



In-lake Monitoring



- Three locations in southwestern quadrant of lake
- Nearby drinking water raw intake
- Riverine lake (WRT ~12 hours to ~200 days)
- Current design provides information at intake and upstream of intake
- Discrete sampling and continuous monitoring

Project Overview

Continuous In-lake Monitoring



- Turbidity
- Dissolved Oxygen
- Temperature
- Specific Conductance
- pH
- Chlorophyll fluorescence
- Phycocyanin fluorescence







10/12/2006





01.20.2009 13:39





00 00000001 0118 OFFLINE
05/08/2009 20:59:28 GMT

1	2	3	↑
4	5	6	↓
7	8	9	2ND
CLEAR	0	HELP	ENTER

Press ENTER or HELP for top-level menu, press ENTER to return to the previous screen. The ENTER key is also used to submit user input.

Some keys have secondary functions, which appear as a second color on the key. These are invoked by first pressing the "2nd" key.

The LEFT_ARROW (2nd + UP_ARROW) will clear the current screen.

The CLEAR key is used to backspace.

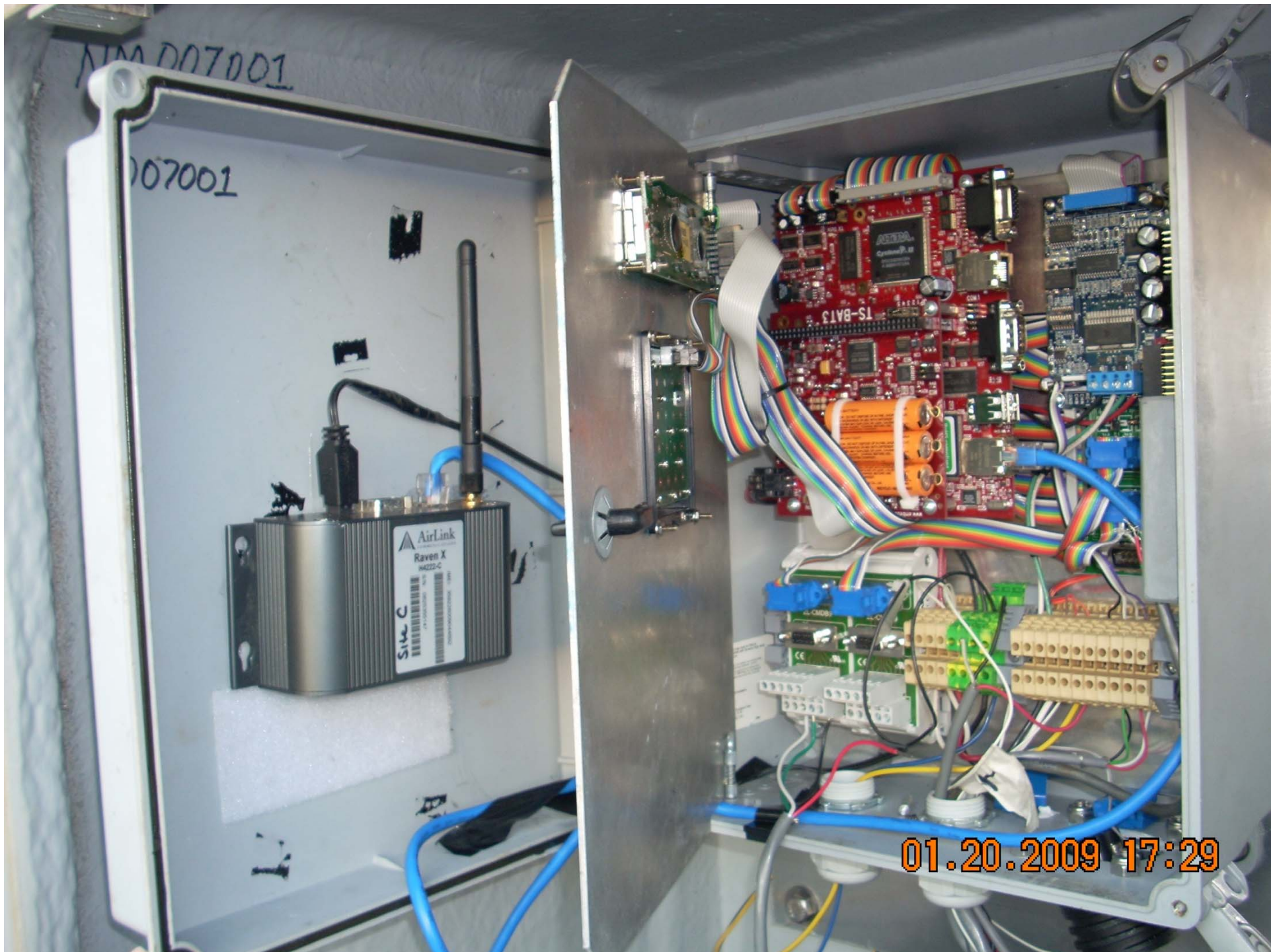
When performing numeric input, the following keys have secondary functions:

UP_ARROW	Enters a decimal point
DOWN_ARROW	Enters a minus sign

When using a screen that uses UP_ARROW, DOWN_ARROW, LEFT_ARROW, and RIGHT_ARROW, the following keys have secondary functions:

A (2nd + 1)	Enters a
B (2nd + 2)	Enters b
C (2nd + 3)	Enters c
D (2nd + 4)	Enters d
E (2nd + 5)	Enters e

ALUMI
BP367
SERIAL NUMBER
5122840



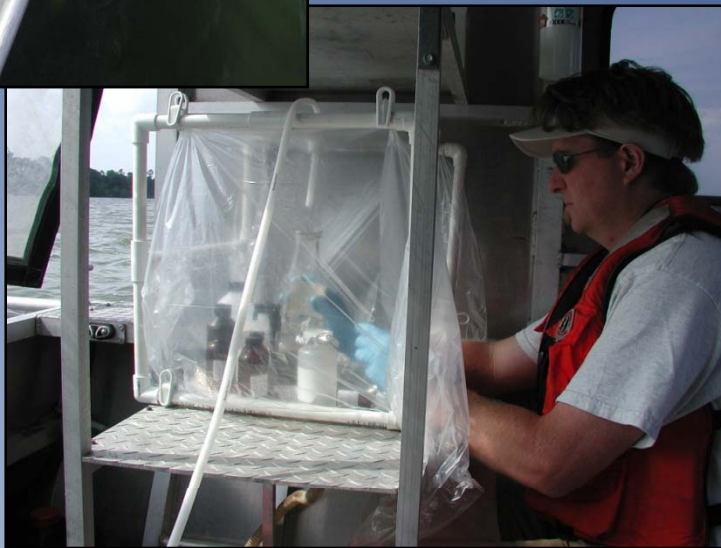


Continuous In-lake Monitoring



- Turbidity
- Dissolved Oxygen
- Temperature
- Specific Conductance
- pH
- Chlorophyll fluorescence
- Phycocyanin fluorescence

Discrete Sampling In-lake



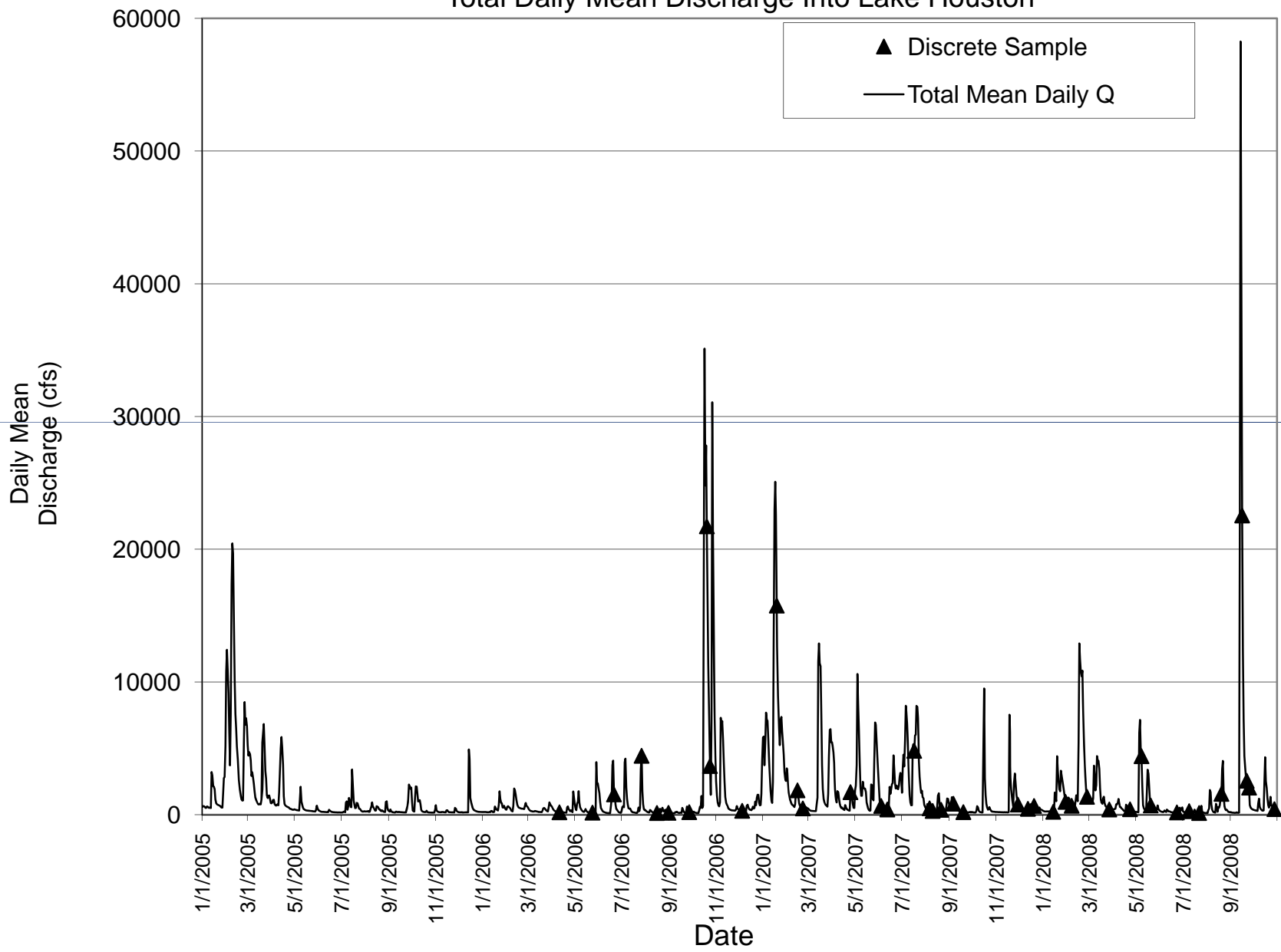
- Phytoplankton – Private MI lab
- Nutrients – COH lab & USGS NWQL CO
- Microcystin – USGS KS lab
- Geosmin and MIB – COH & USGS KS lab
- Actinomycetes – USGS OH lab
- Coliforms – USGS Houston lab
- Sediment (TSS) – USGS KY lab
- Manganese – COH lab & USGS NWQL CO

Project Timeline

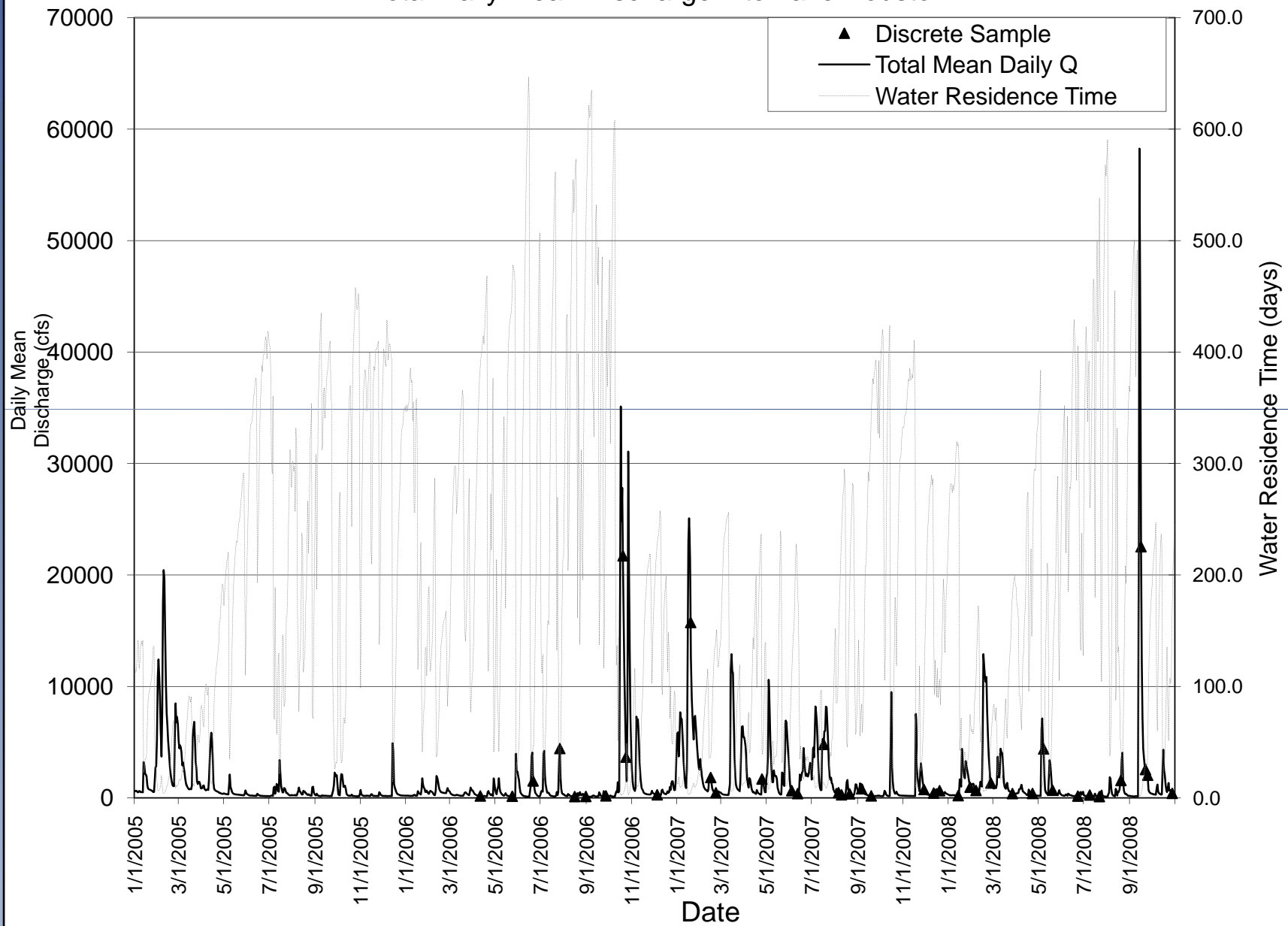
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	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Site A Alcoa				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site A RR																																				
Site B				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site C Deussen				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Site C CWA																																				

 Continuous monitoring
 Discrete sampling

Total Daily Mean Discharge Into Lake Houston



Total Daily Mean Discharge Into Lake Houston



Continuous Monitoring and Data

<http://tx.usgs.gov/>

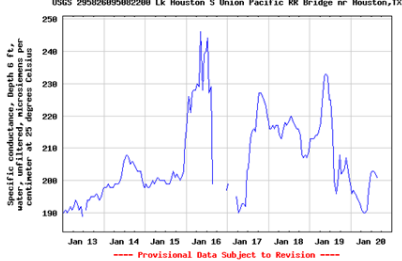
USGS Real-Time Water Data for USGS 295826095082200 Lk Houston S Union Pacific RR Bridge nr Houston, TX
http://waterdata.usgs.gov/bx/hwis/liv/?site_no=295826095082200&PARAmeter_cd=00010,00011,00012

Parameter 00010; DD 16

Specific conductance, Depth 1 ft, water, unfiltered, microsiemens per centimeter at 25 degree Celsius
 Most recent instantaneous value: 197 01-20-2009 15:15



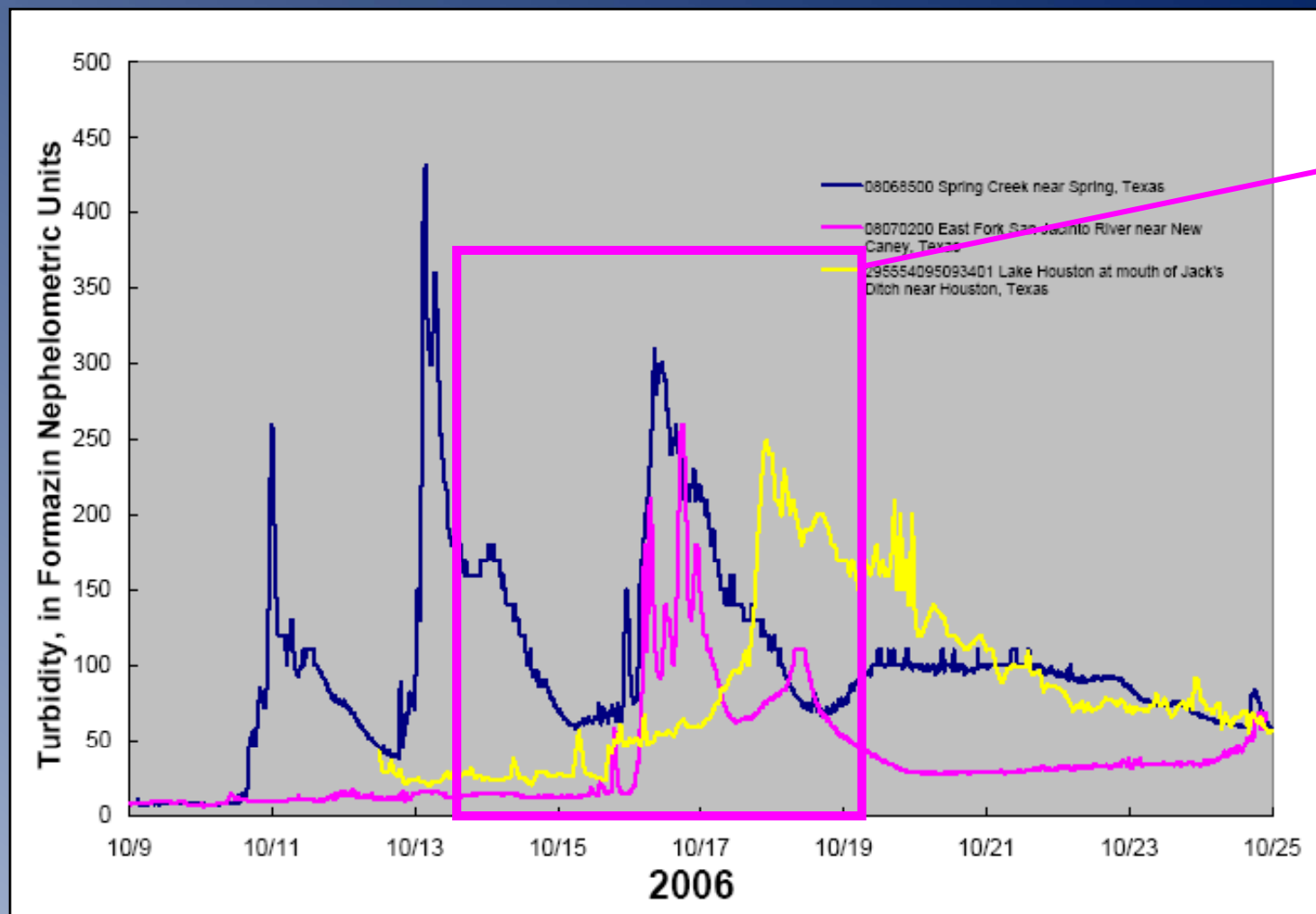
Specific conductance, Depth 6 ft, water, unfiltered, microsiemens per centimeter at 25 degree Celsius
 Most recent instantaneous value: 201 01-20-2009 15:30



USGS Real-Time Data for Texas_ Water Quality - Windows Internet Explorer									
http://waterdata.usgs.gov/bx/hwis/current/?type=quality&group%20key=basin%20cd									
USGS Real-Time Data for Texas_ Water Q...									
San Jacinto River Basin									
08067650	W Fk San Jacinto Rv bl Lk Conroe nr Conroe, TX	01/20 16:30	12.2	466	13.9	8.0			
08068000	W Fk San Jacinto Rv nr Conroe, TX	01/20 16:30	13.5	588	15.3	8.0			
08068275	Spring Ck nr Tomball, TX	01/20 14:30	10.8	326	18.0	7.0			
08068400	Panther Br at Gosling Rd, The Woodlands, TX	01/20 16:00	19.2	830	7.0	7.0			
08068500	Spring Ck nr Spring, TX	12/08 08:45	--	--	***	--			
		12/05 10:15	***	***	--	***			
08069000	Cypress Ck nr Westfield, TX	---	---	Eqp	Eqp	Eqp	Eqp	Eqp	Eqp
08070200	E Fk San Jacinto Rv nr New Caney, TX	01/20 16:00	11.6	248	11.2	7.0			
294728095200103	LJ-65-14-738 (Northeast Piezometer No. 4)	01/20 14:00	22.4	--	--	--			
295435095082201	Lk Houston at CWA Structure nr Houston, TX								
	Depth 1 ft	---	---	Dis	Dis	Dis	Dis	Dis	Dis
	Depth 6 ft	---	---	Dis	Dis	Dis	Dis	Dis	Dis
	Depth 12 ft	---	---	Dis	Dis	Dis	Dis	Dis	Dis
	Depth 16 ft	---	---	Dis	Dis	Dis	Dis	Dis	Dis
295554095093401	Lk Houston at mouth of Jack's Ditch nr Houston, TX								
	Depth 1 ft	01/20 15:15	12.6	171	10.3	7.0			
	Depth 6 ft	01/20 15:30	12.6	171	10.3	7.0			
	Depth 12 ft	01/20 15:45	12.6	172	10.2	7.0			
	Depth 16 ft	01/20 16:00	12.6	171	10.2	7.0			
295826095082200	Lk Houston S Union Pacific RR Bridge nr Houston, TX								
	Depth 1 ft	01/20 15:15	11.9	197	10.4	7.0			
	Depth 6 ft	01/20 15:30	11.9	201	10.4	7.0			
	Depth 12 ft	01/20 15:45	11.9	202	10.4	7.0			
	Depth 16 ft	01/20 16:00	11.8	203	10.3	7.0			
Brazos River Basin									
08086212	Hubbard Ck bl Albany, TX	01/20 16:00	Dry	--	--	--			
		12/17 11:30	--	Dry	--	--			
08086290	Big Sandy Ck abv Breckenridge, TX	01/20 16:00	9.3	15,000	--	--			

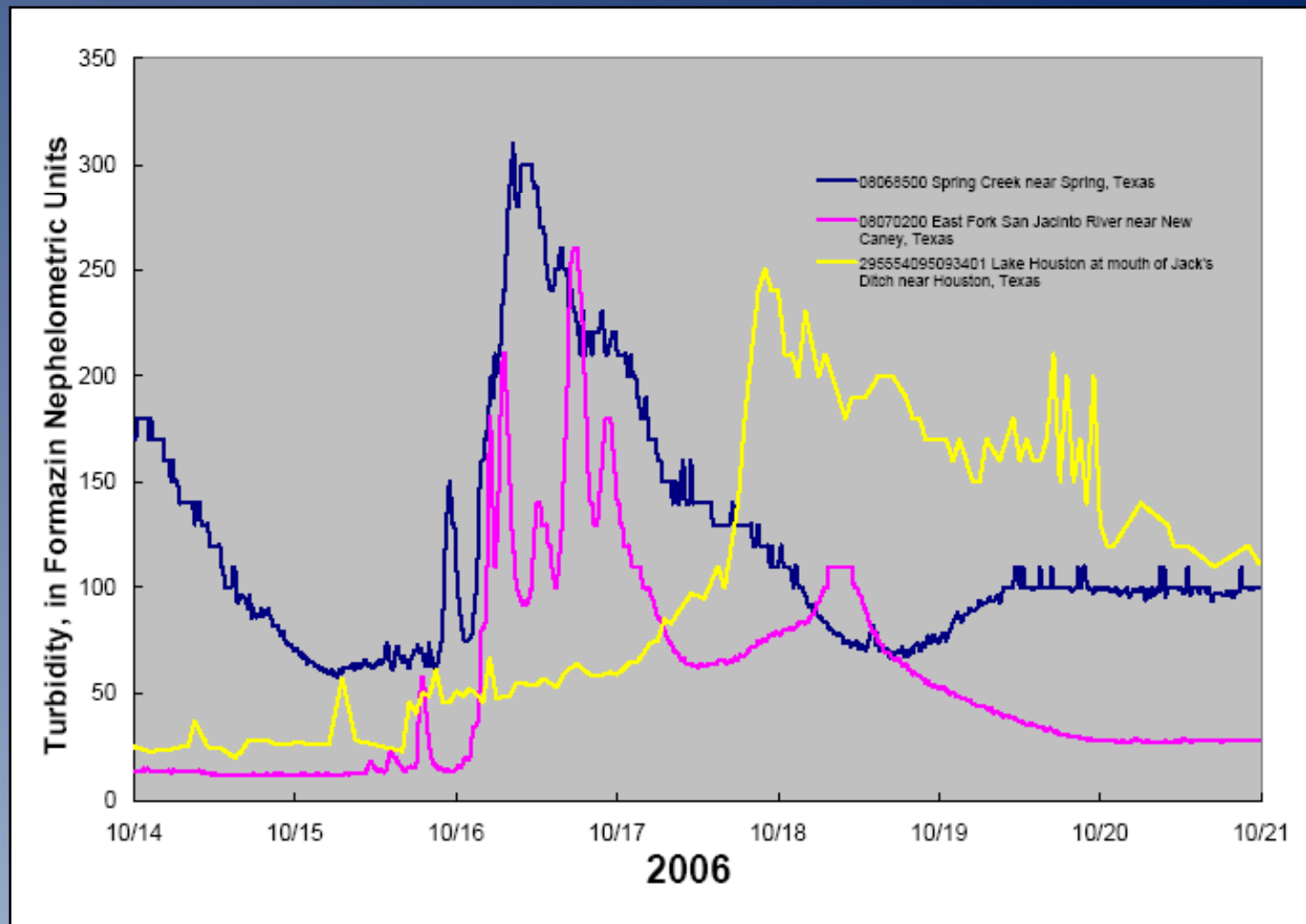


Time of Travel Estimation

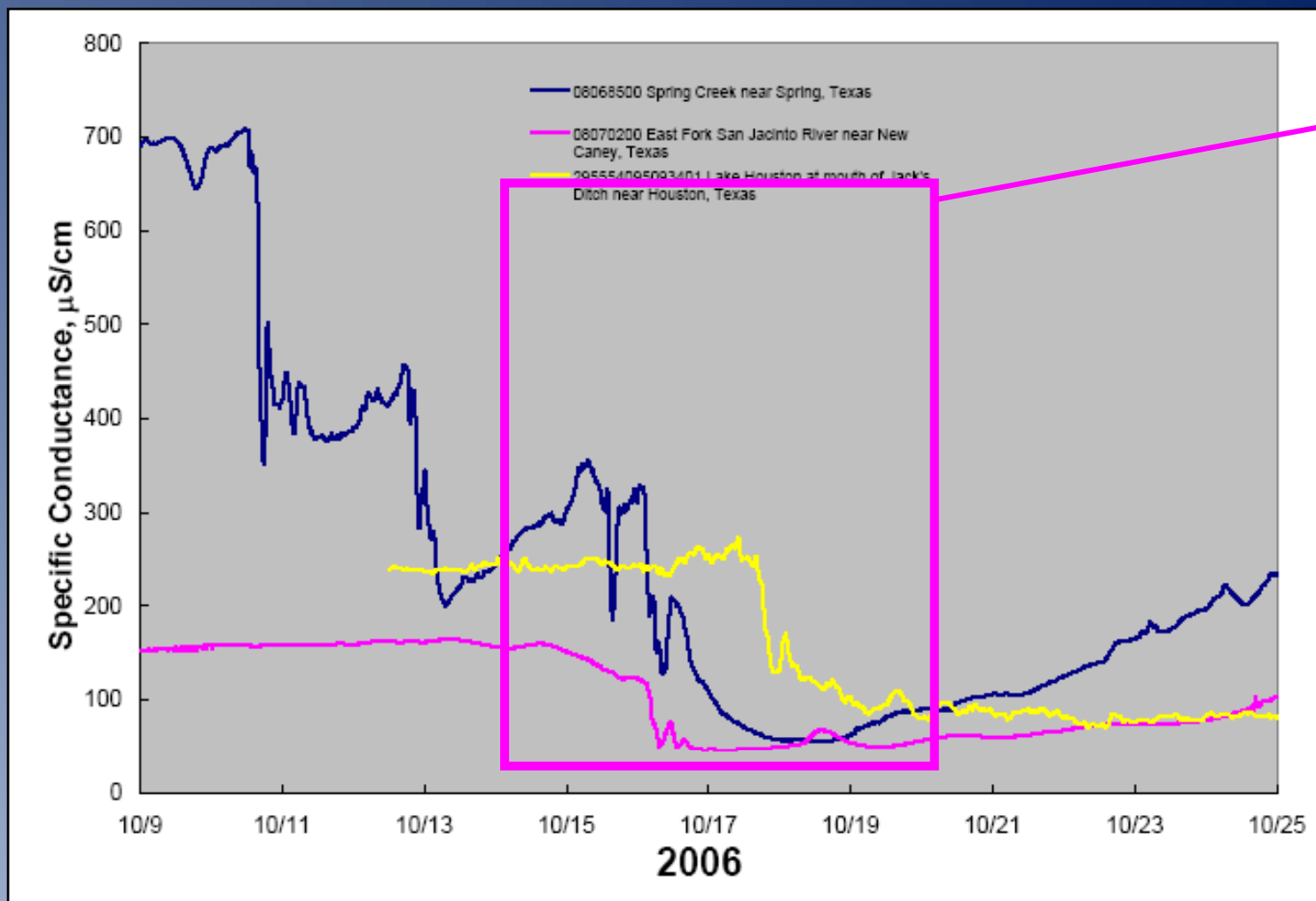


Next slide

Time of Travel Estimation

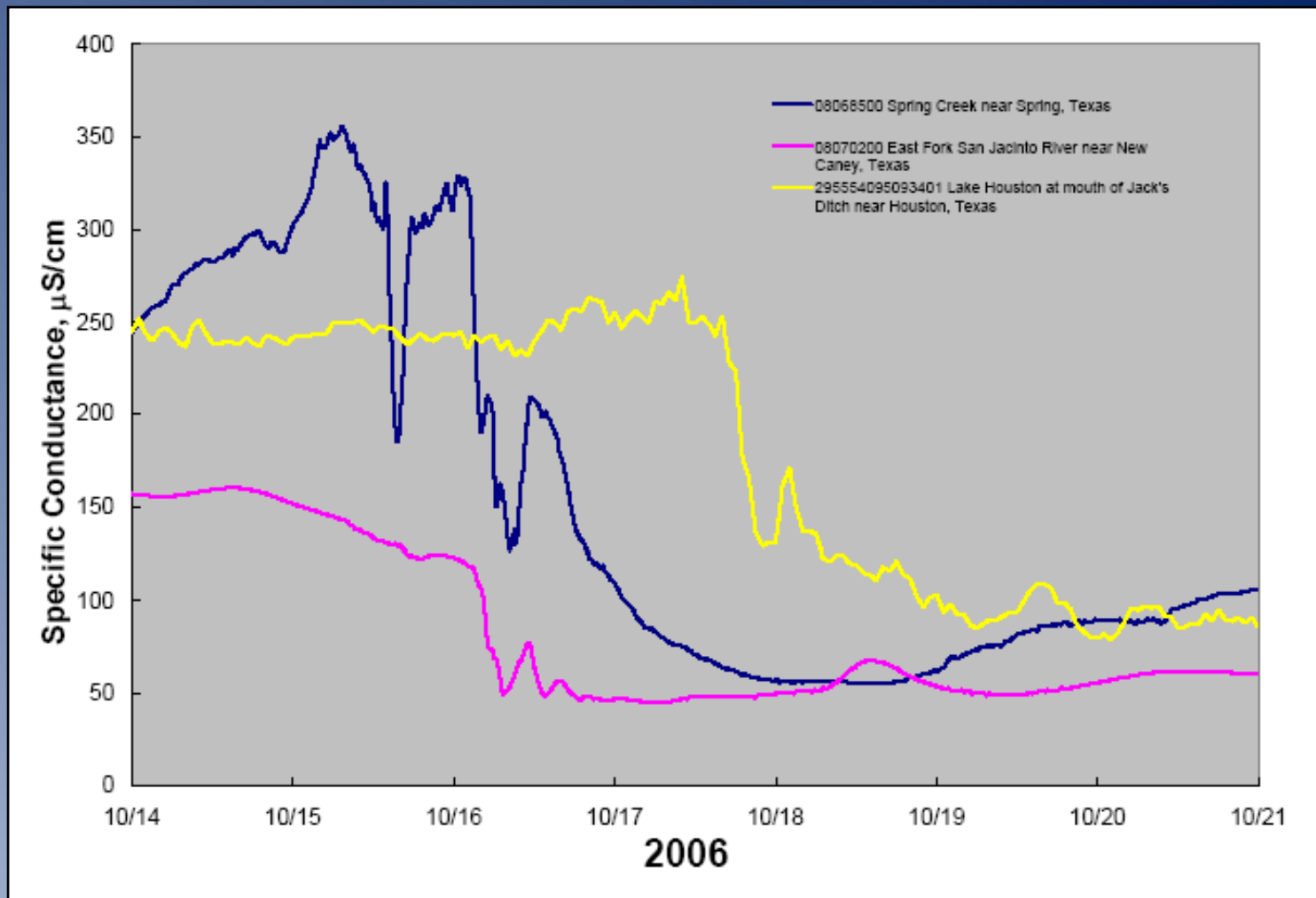


Time of Travel Estimation

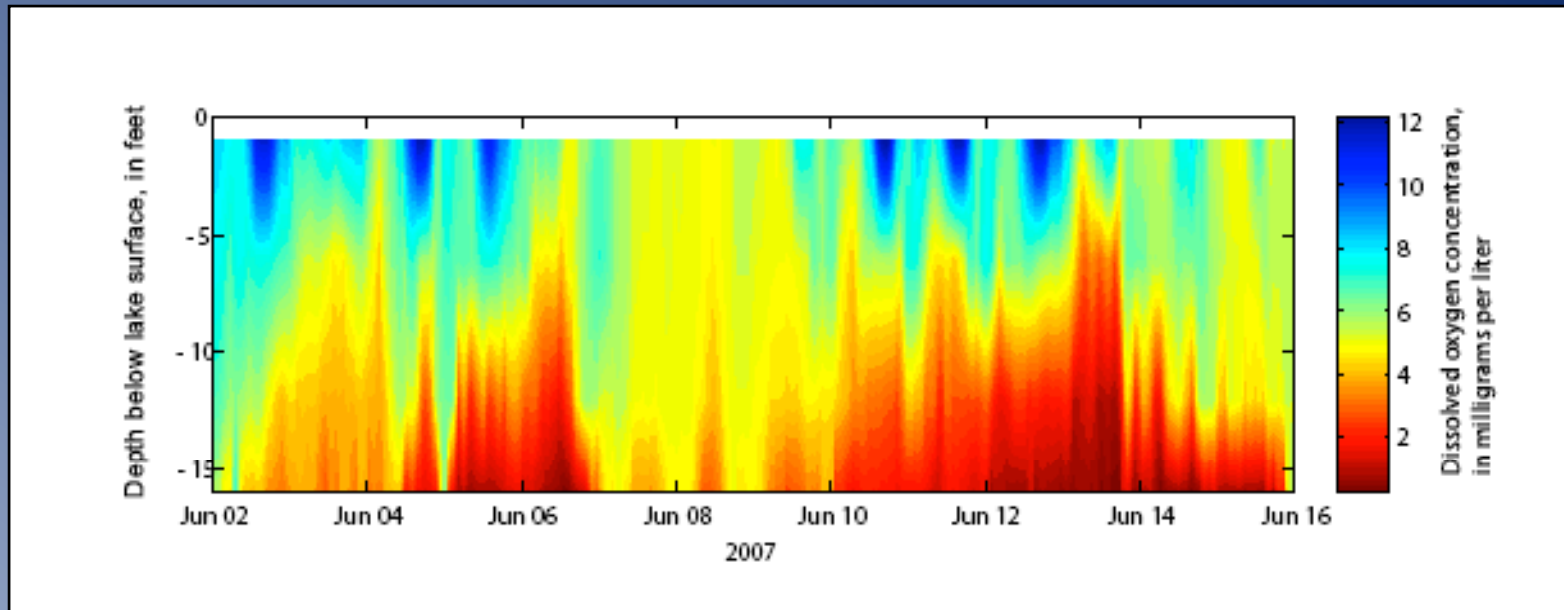


Next
slide

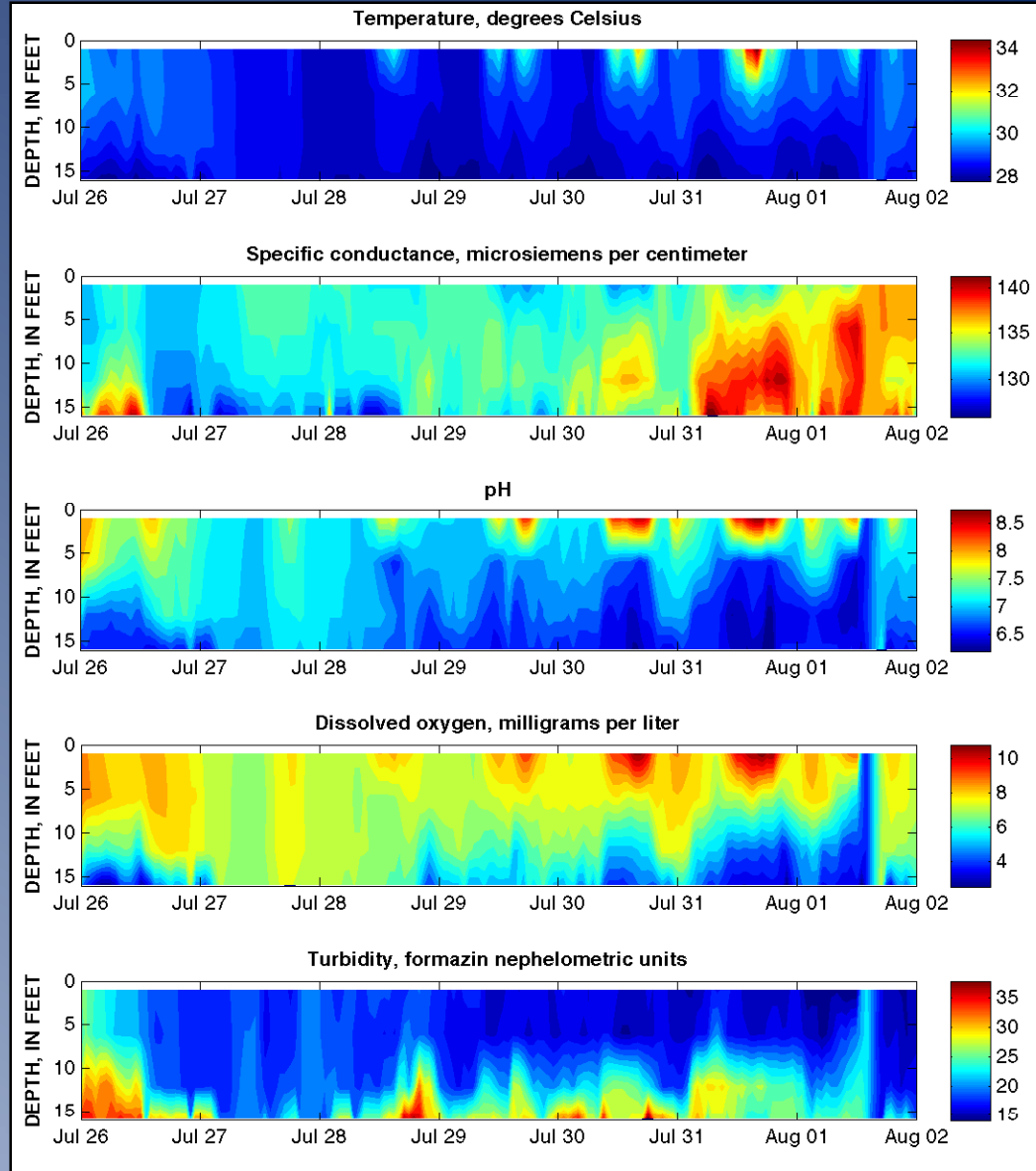
Time of Travel Estimation



Continuous Data Profiles

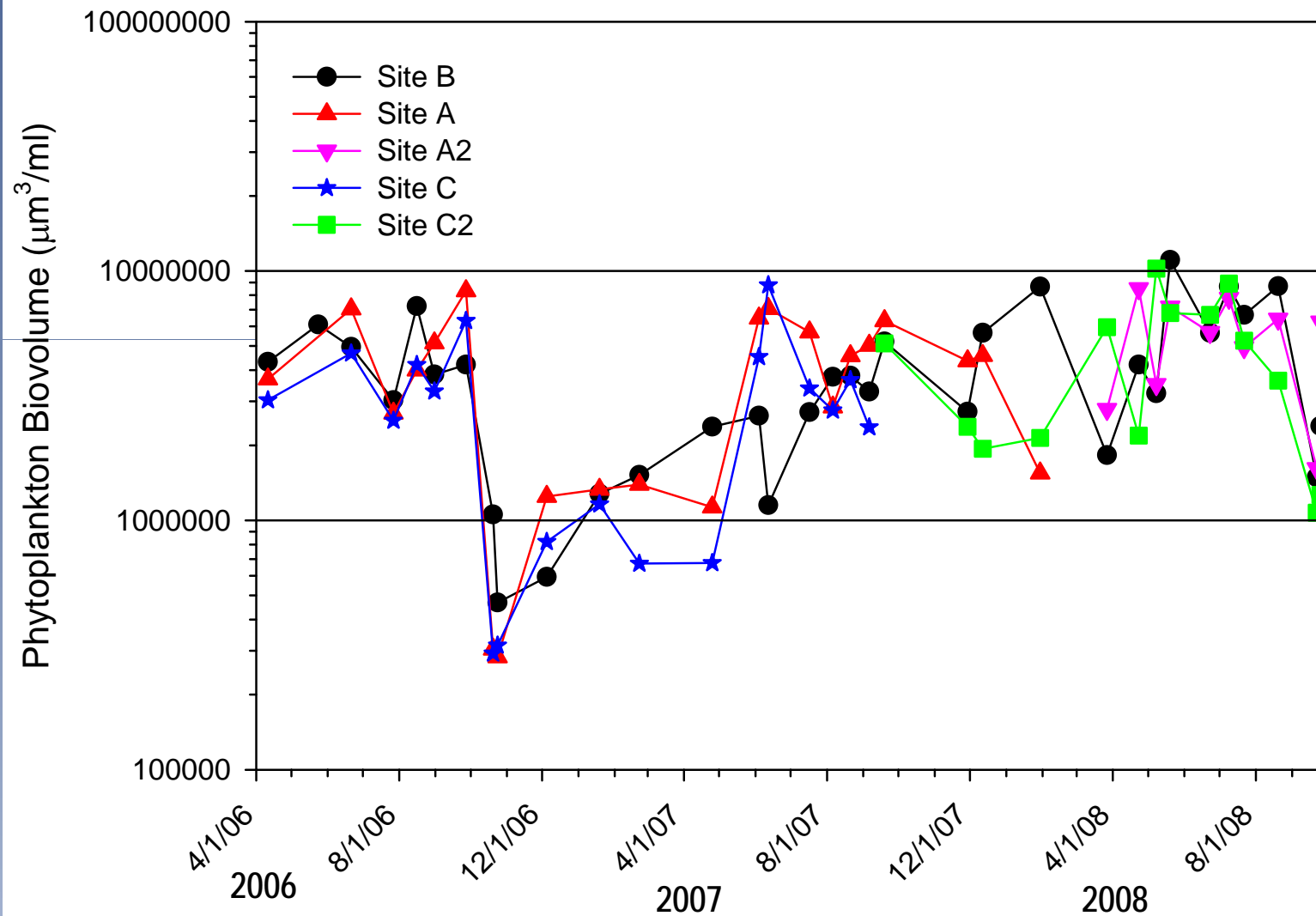


Continuous Data Profiles

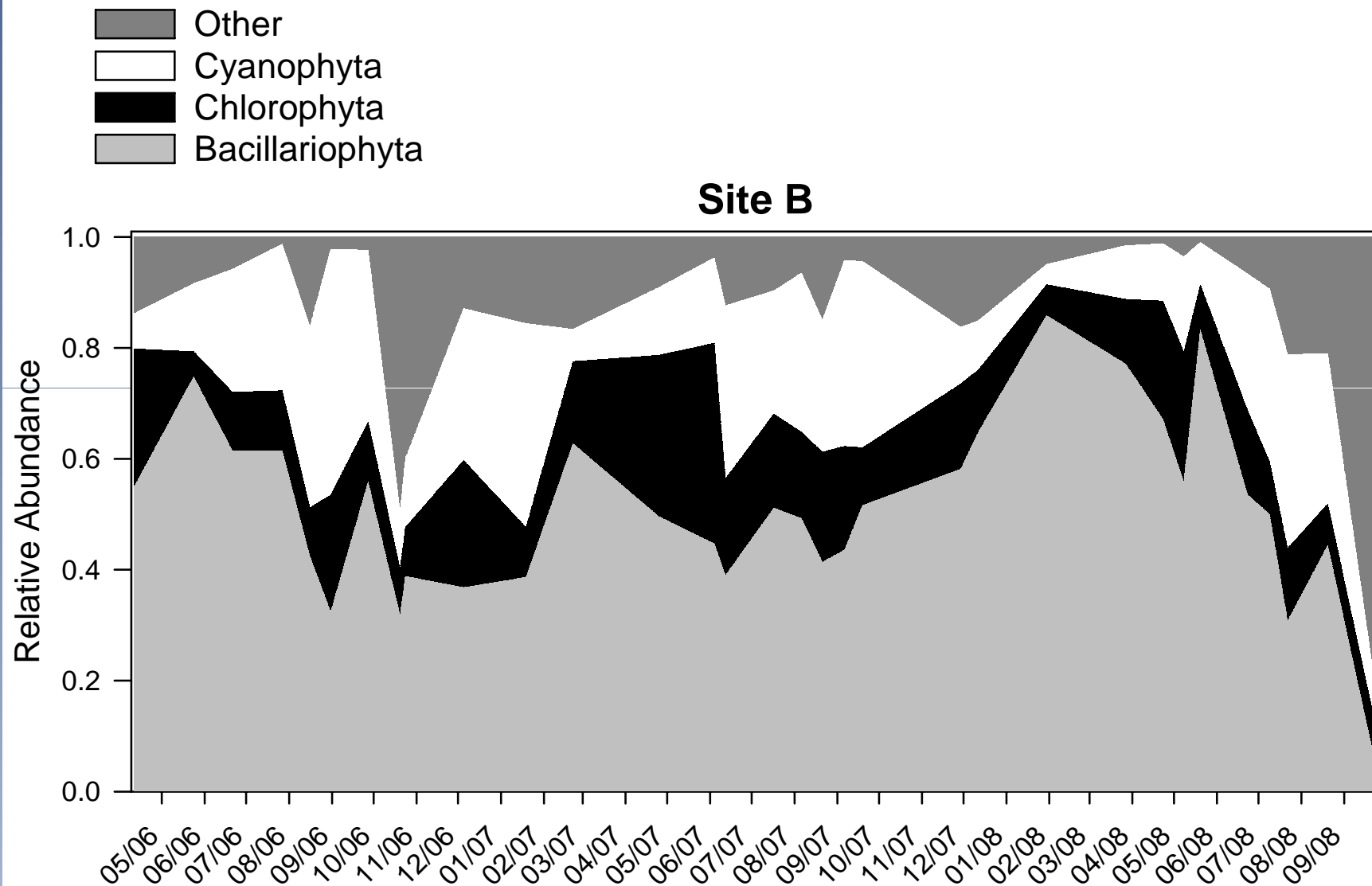


Discrete Sampling and Data

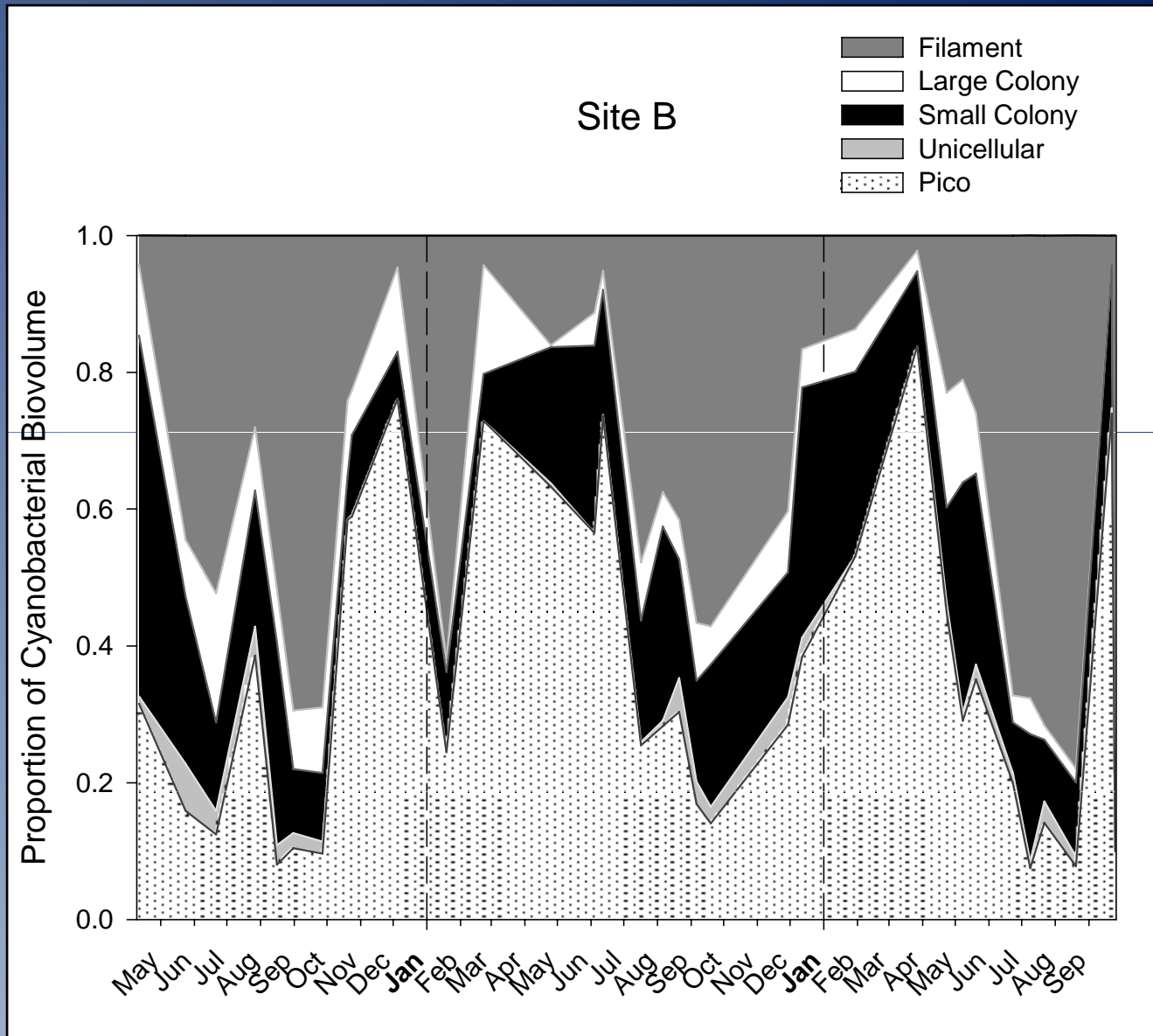
Phytoplankton - Biovolume



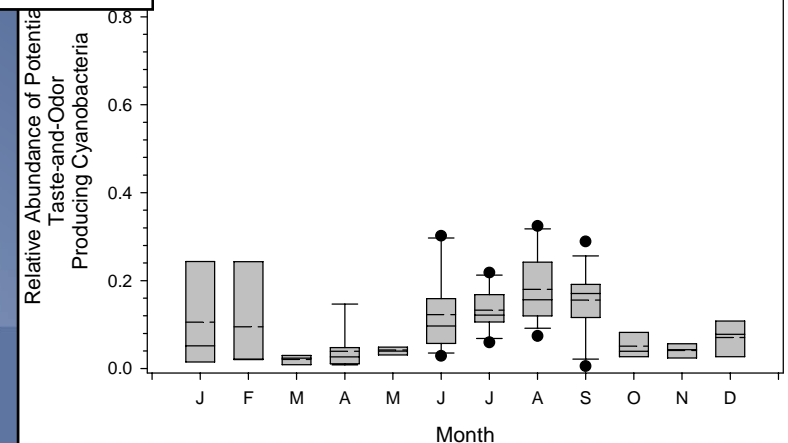
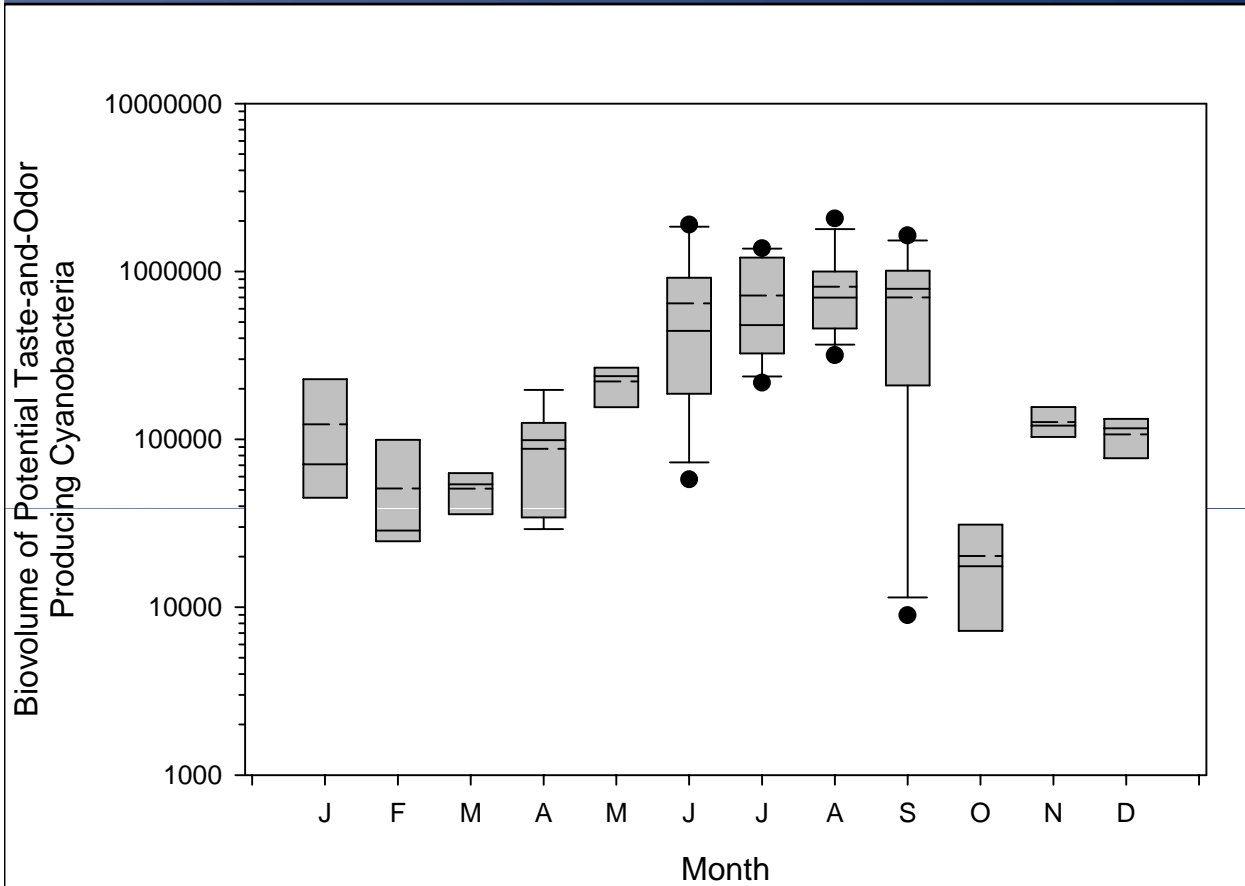
Phytoplankton – Community Composition



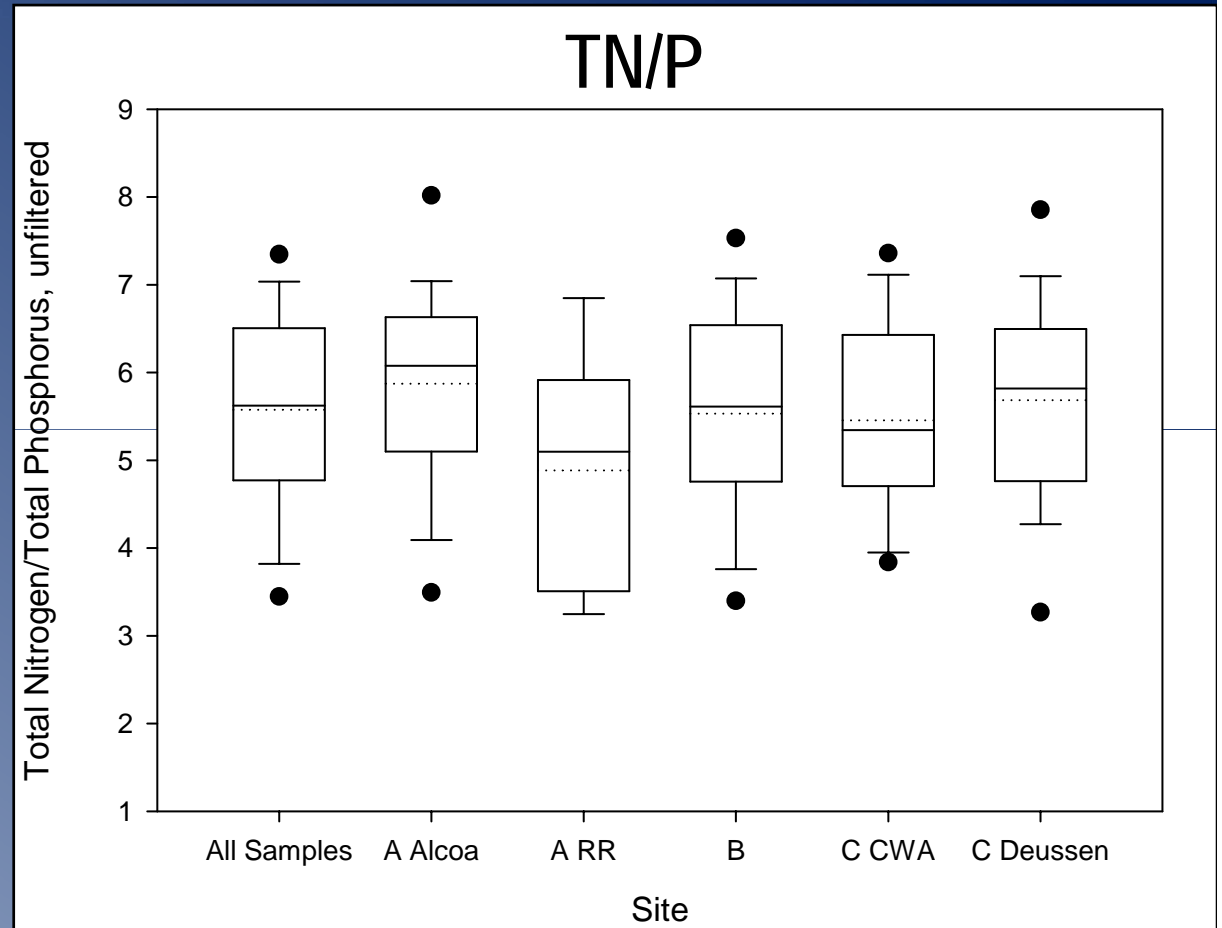
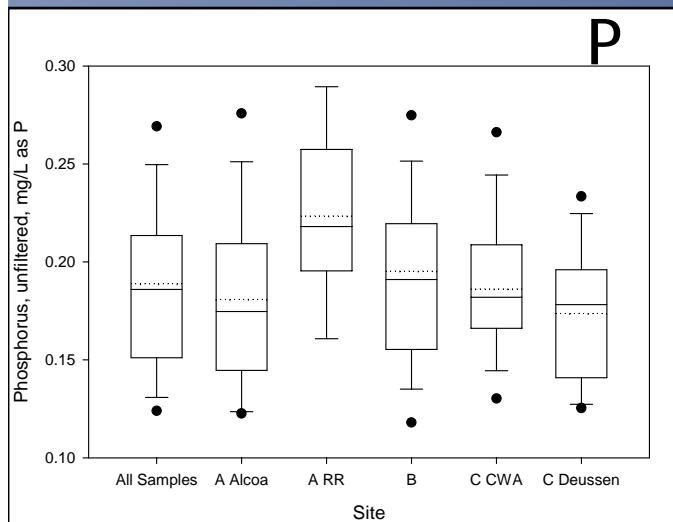
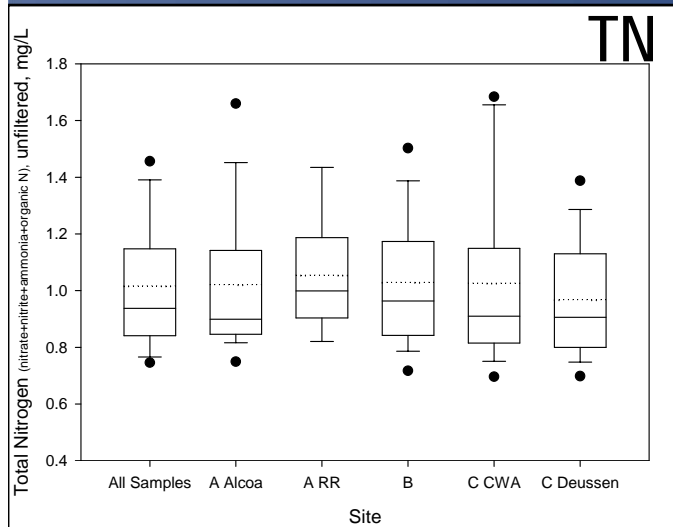
Phytoplankton - Morphology



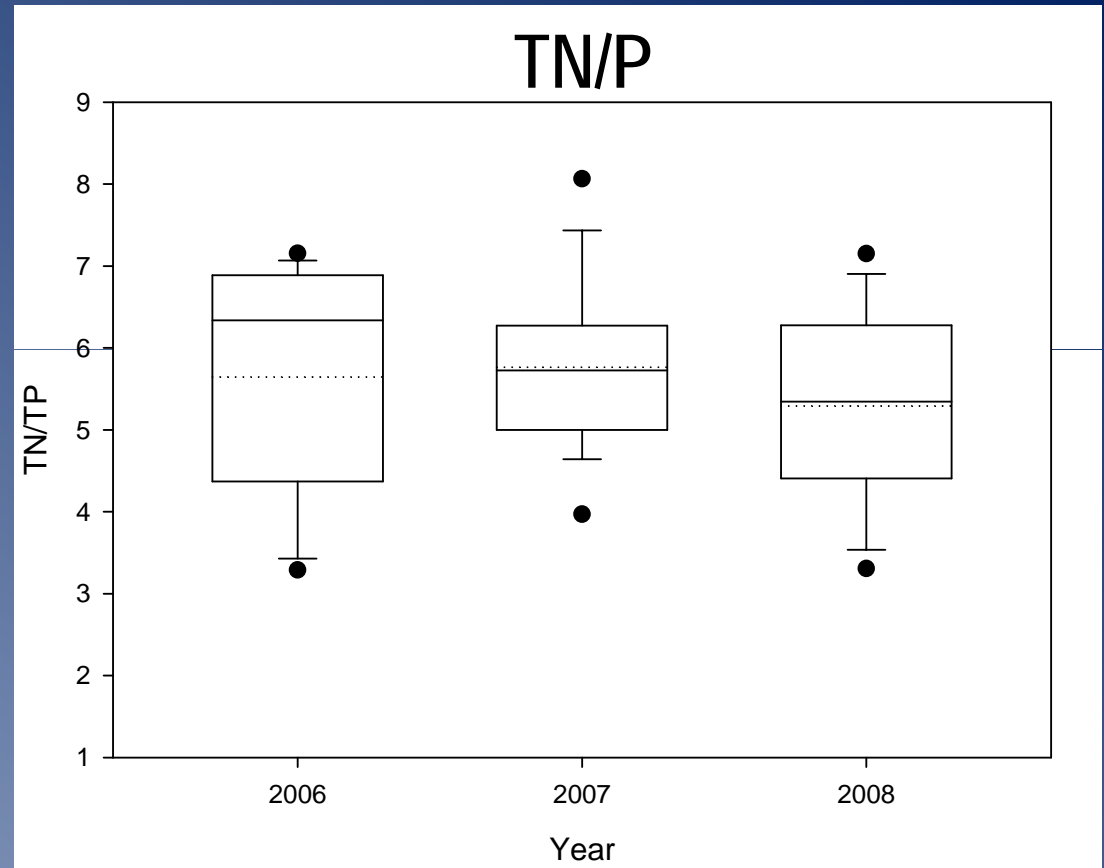
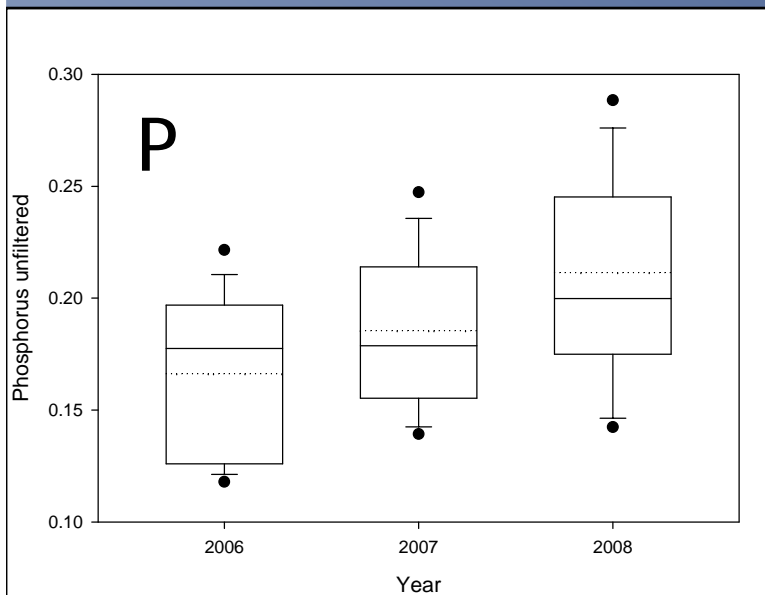
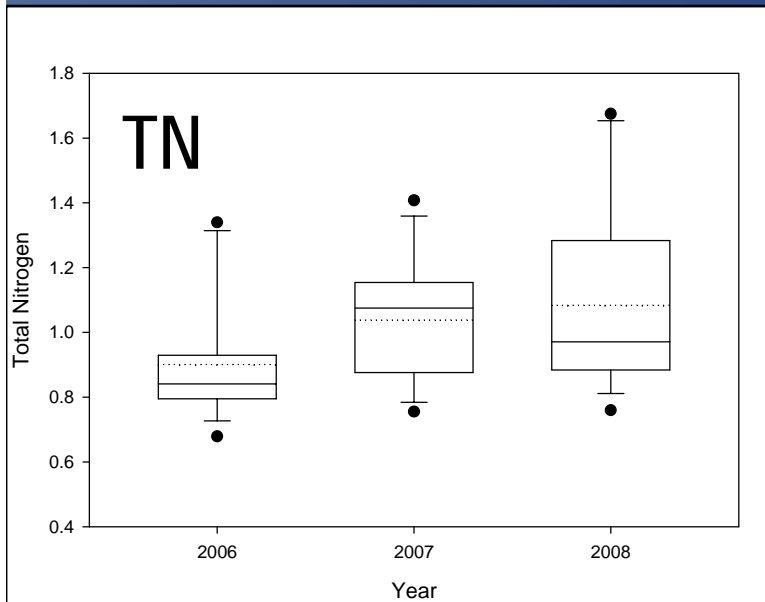
Taste-and-Odor Producing Cyanobacteria



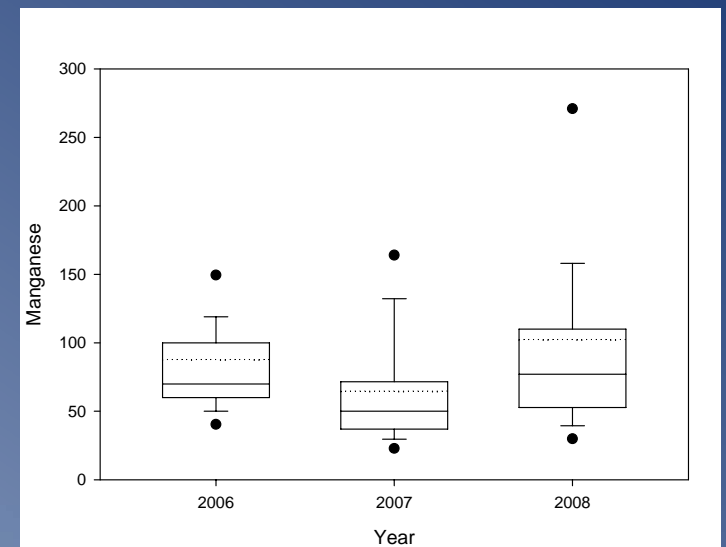
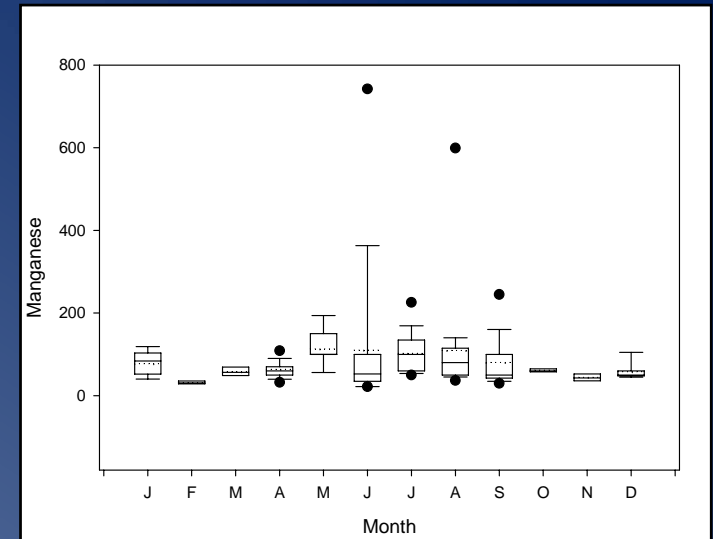
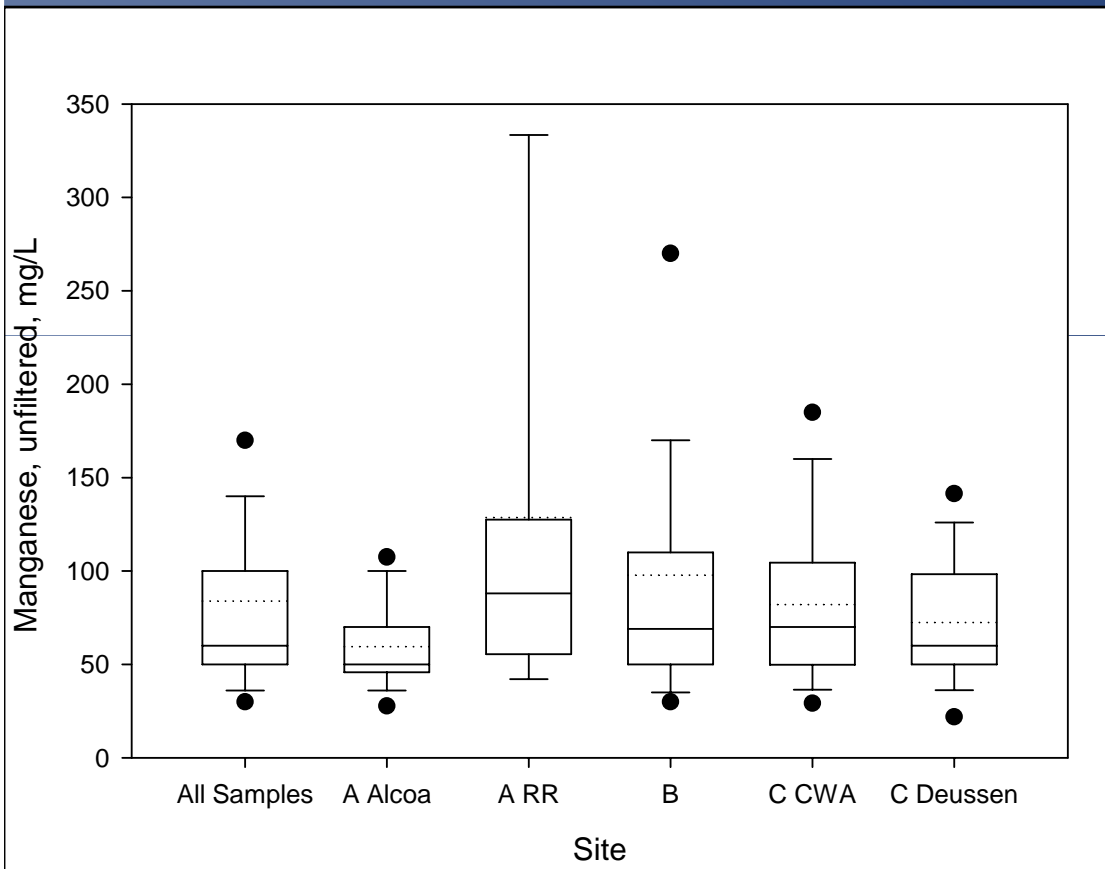
Nutrients



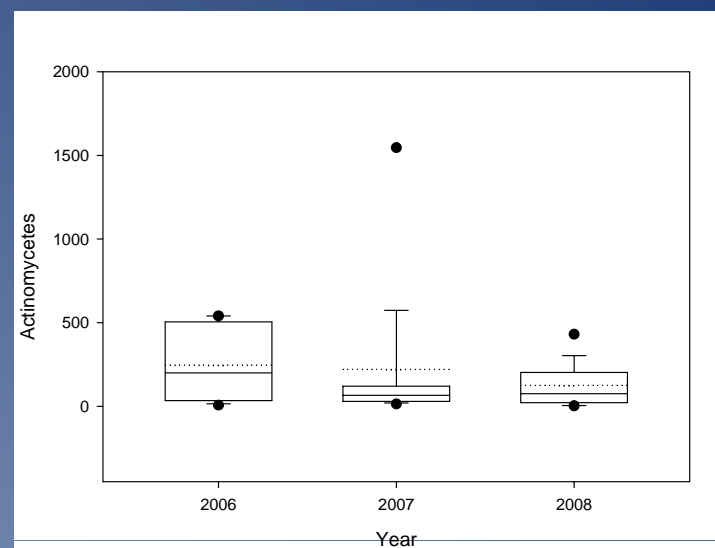
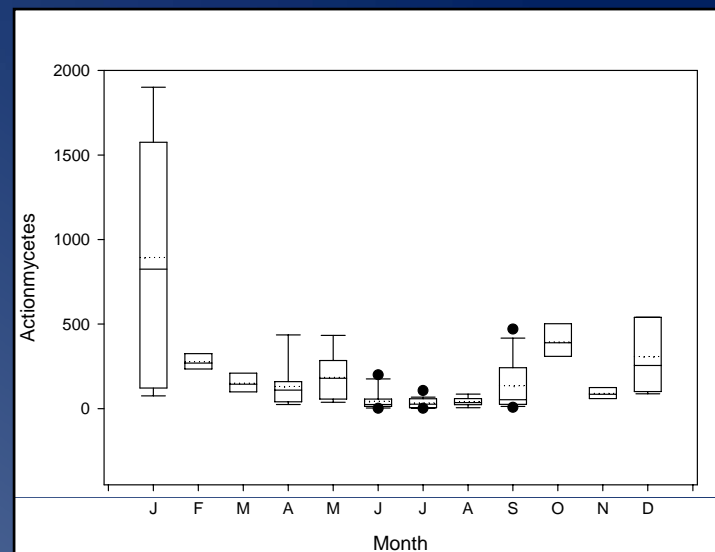
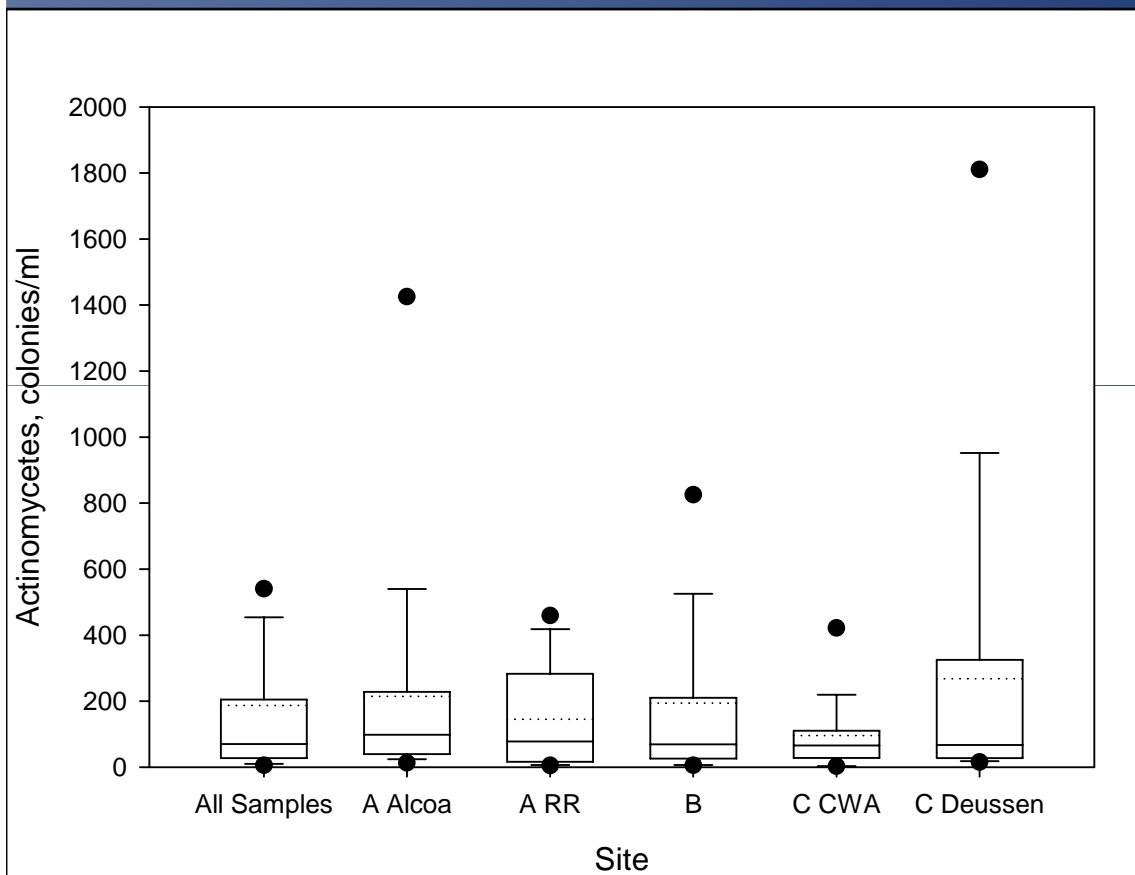
Nutrients



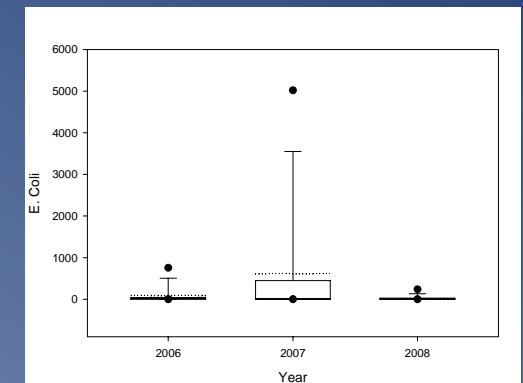
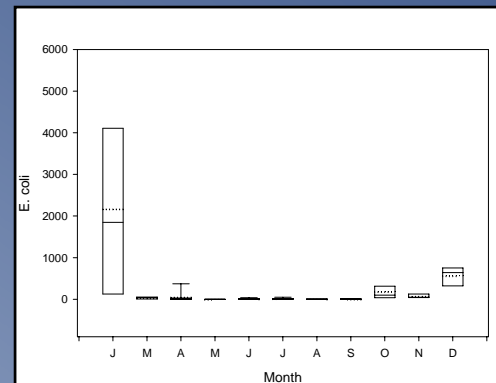
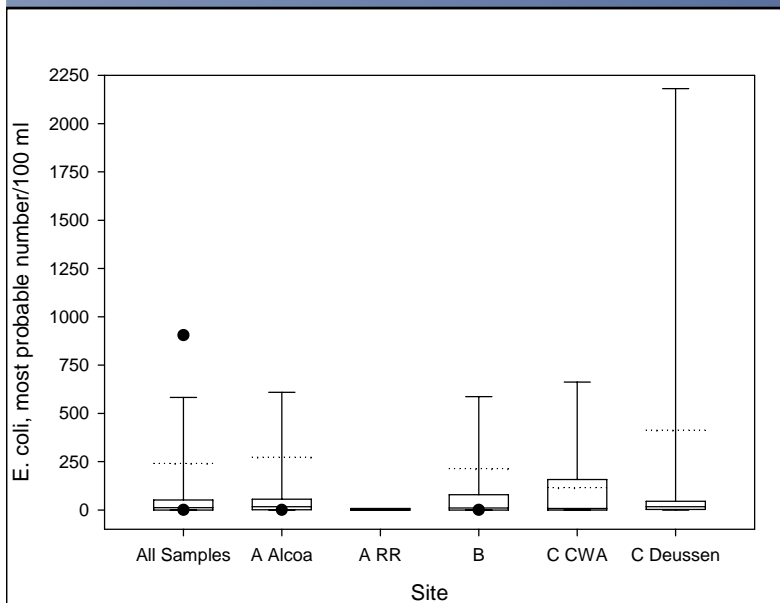
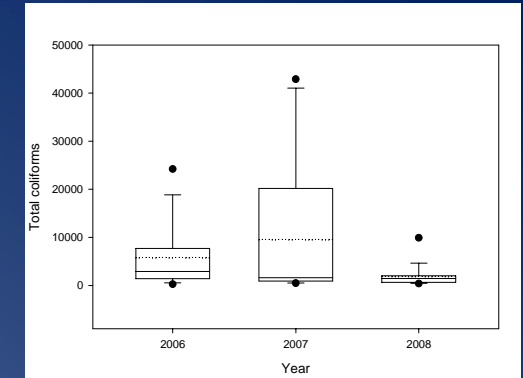
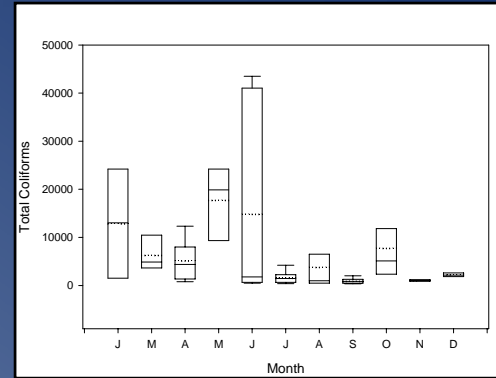
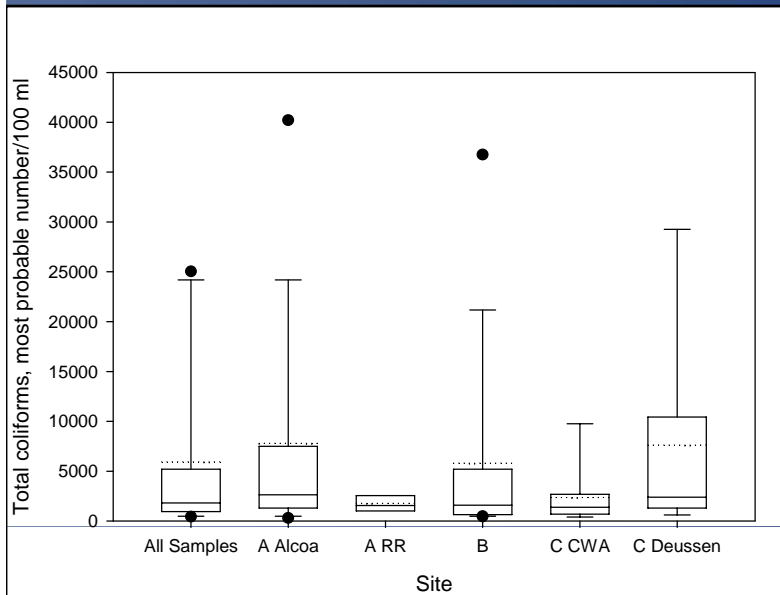
Manganese



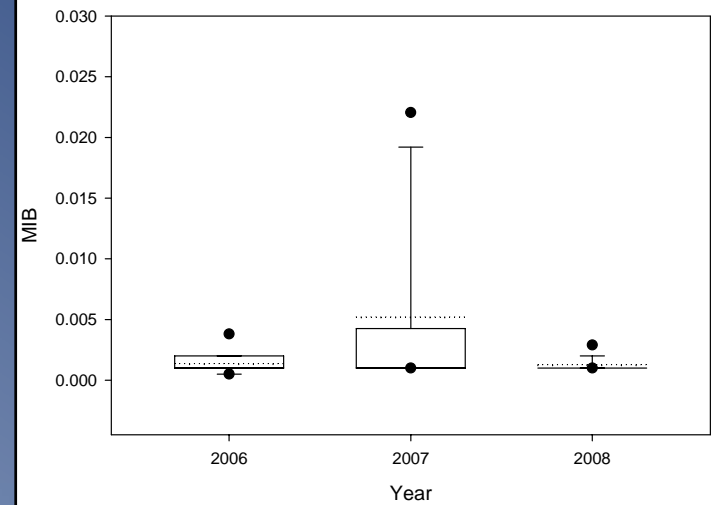
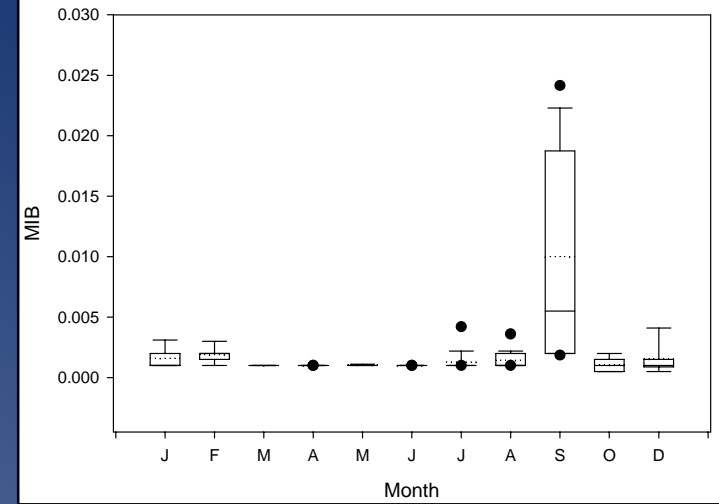
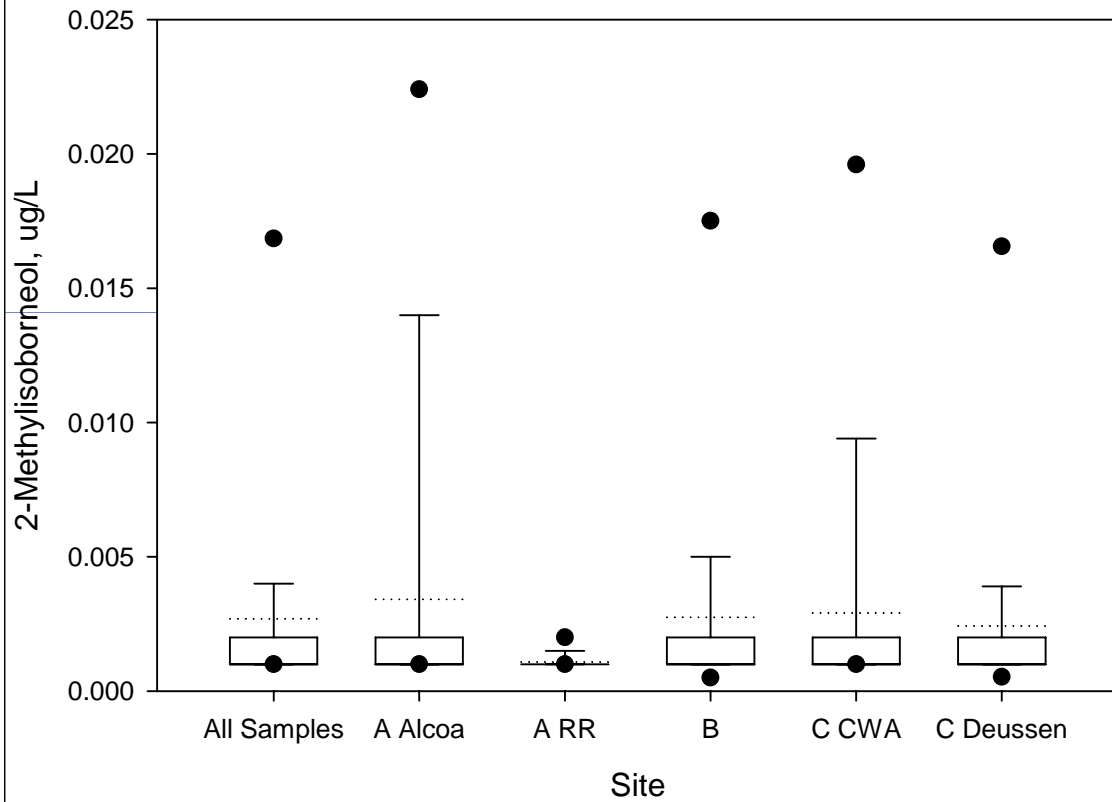
Actinomycetes – taste-and-odor bacteria



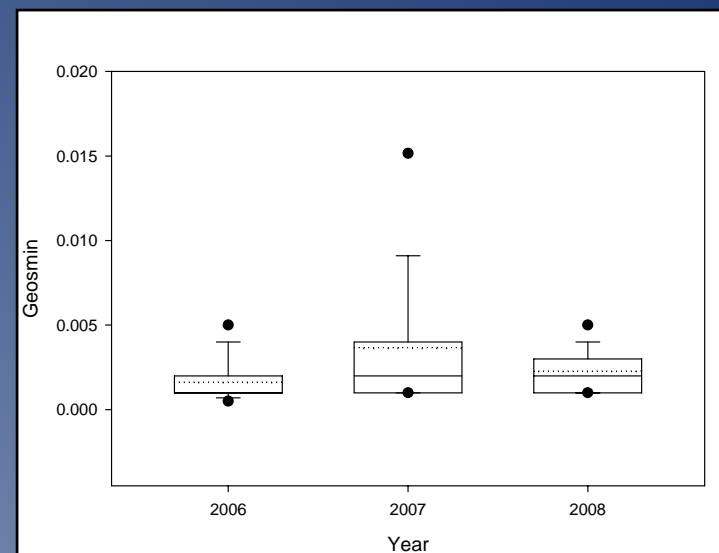
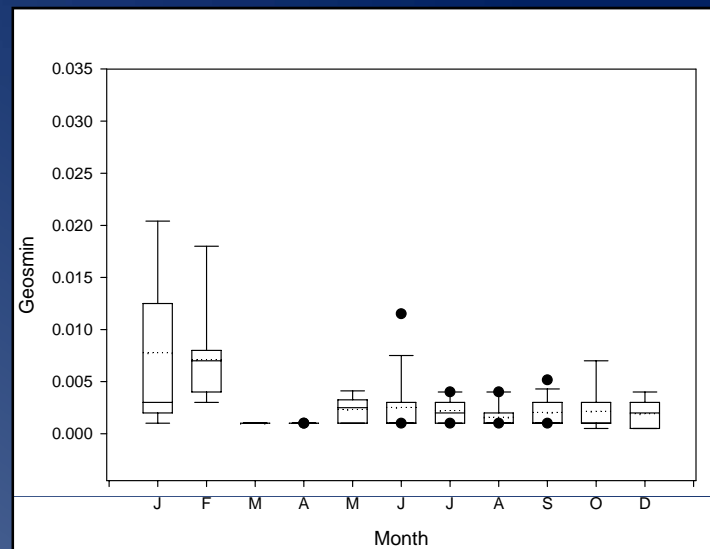
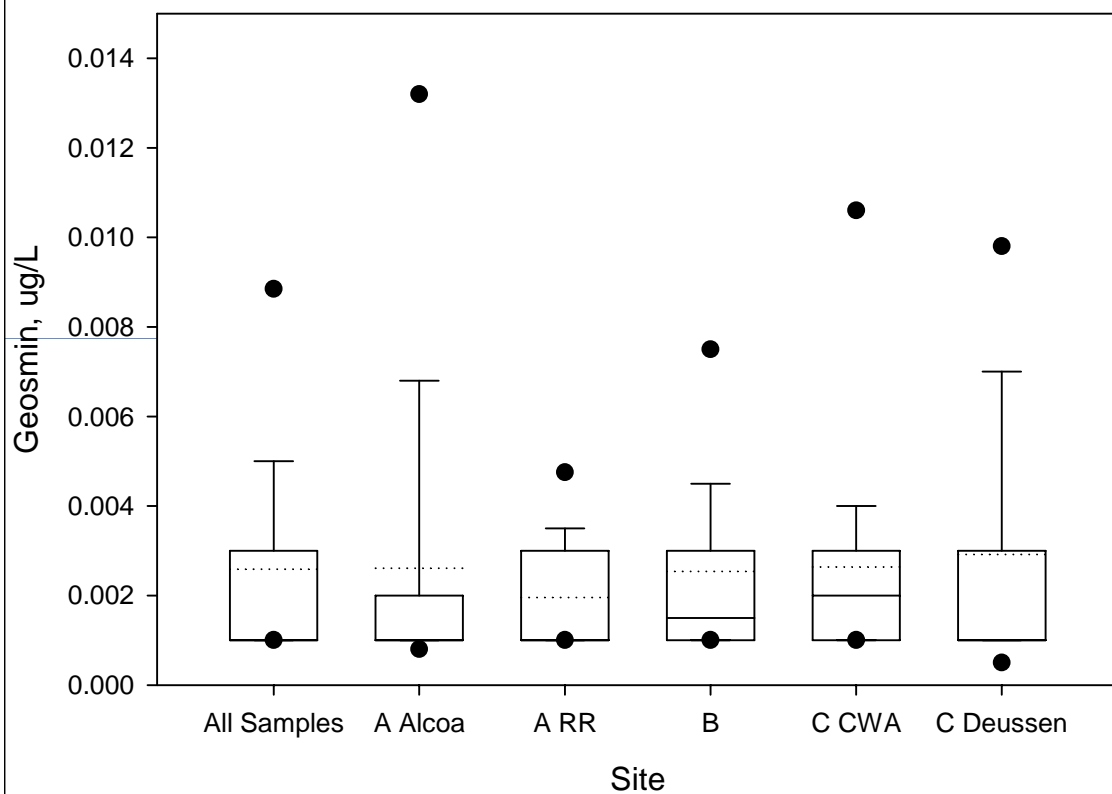
Coliforms



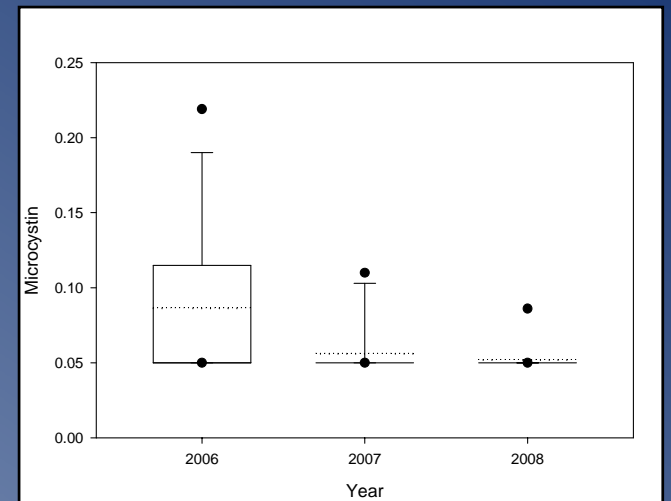
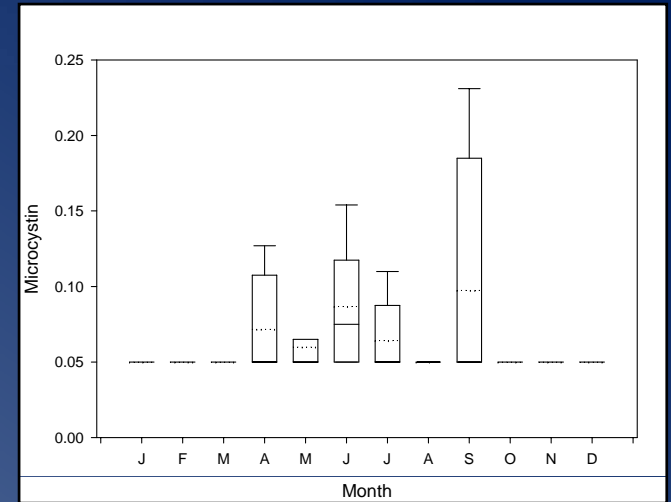
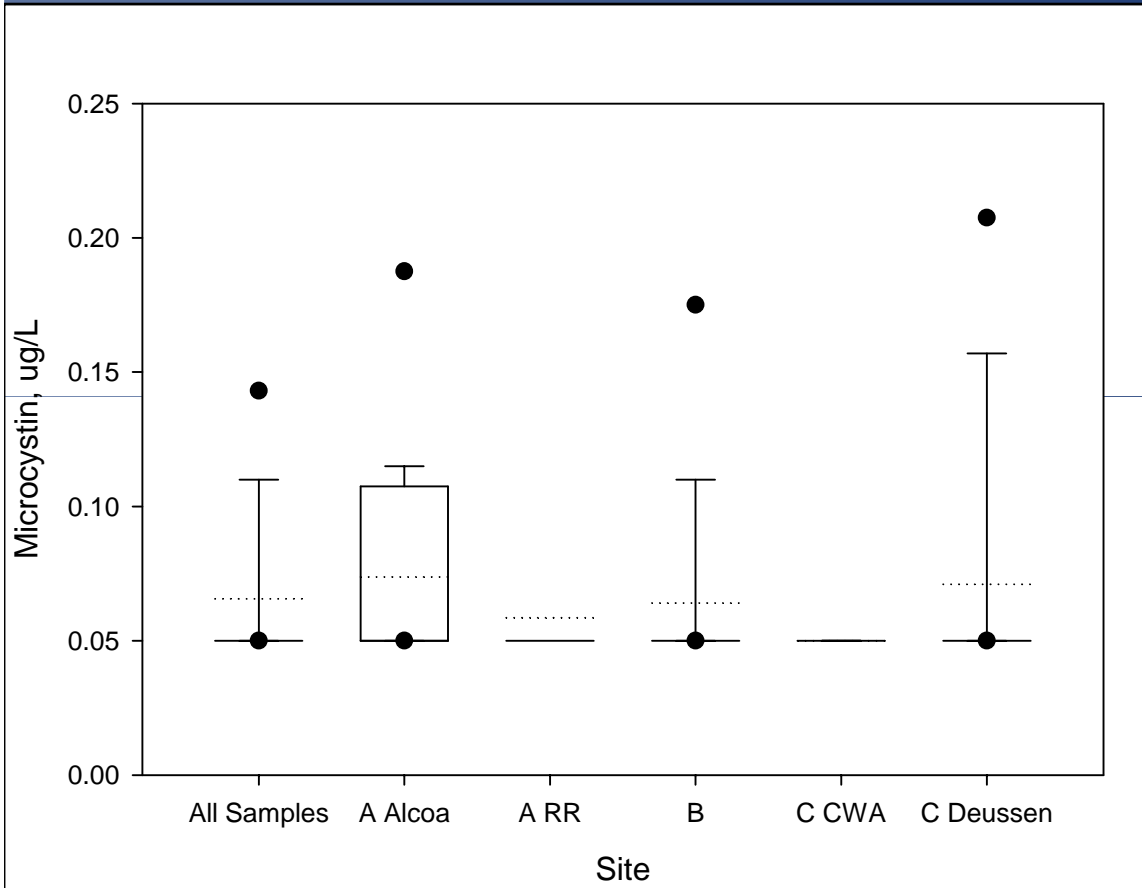
MIB



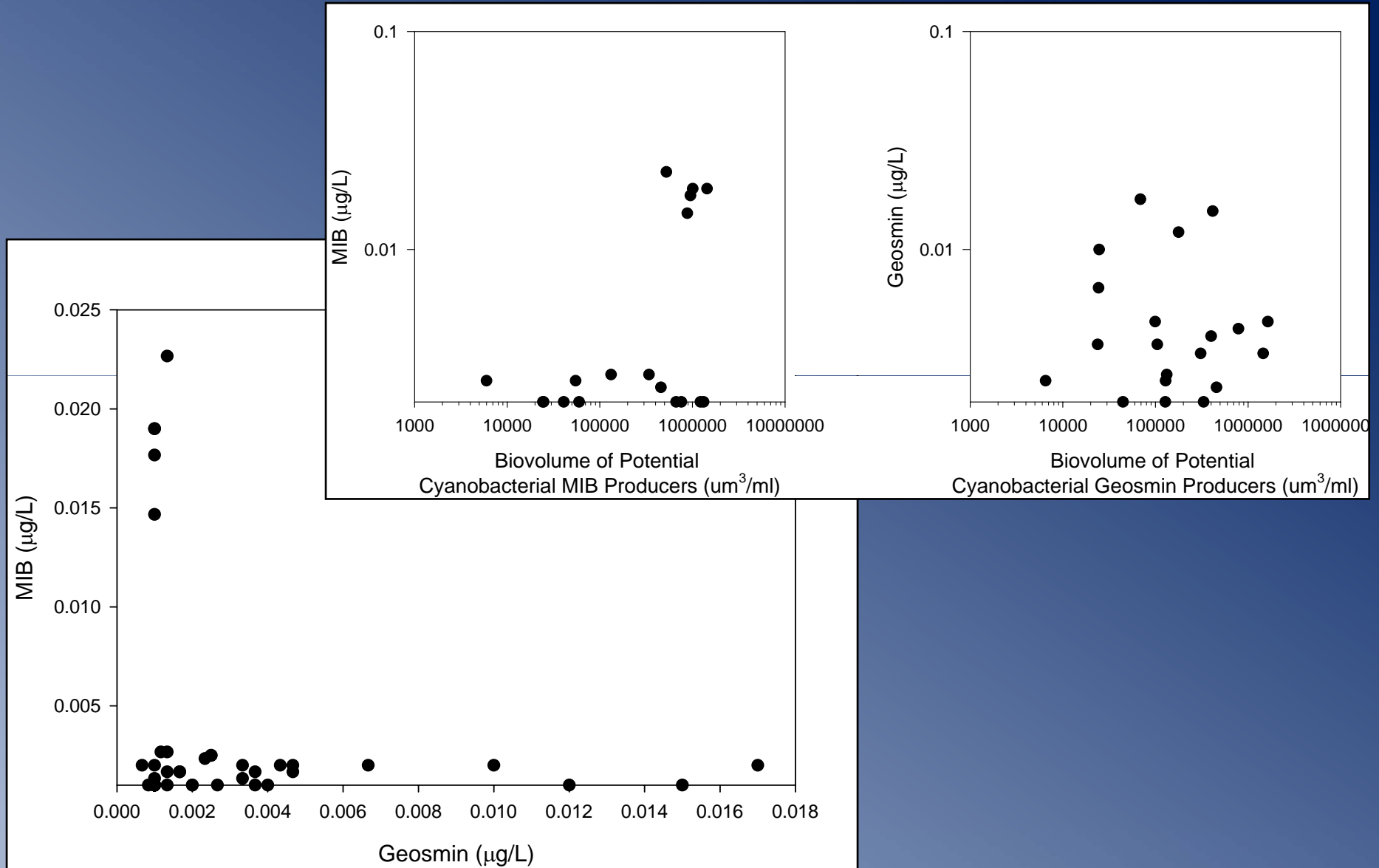
Geosmin



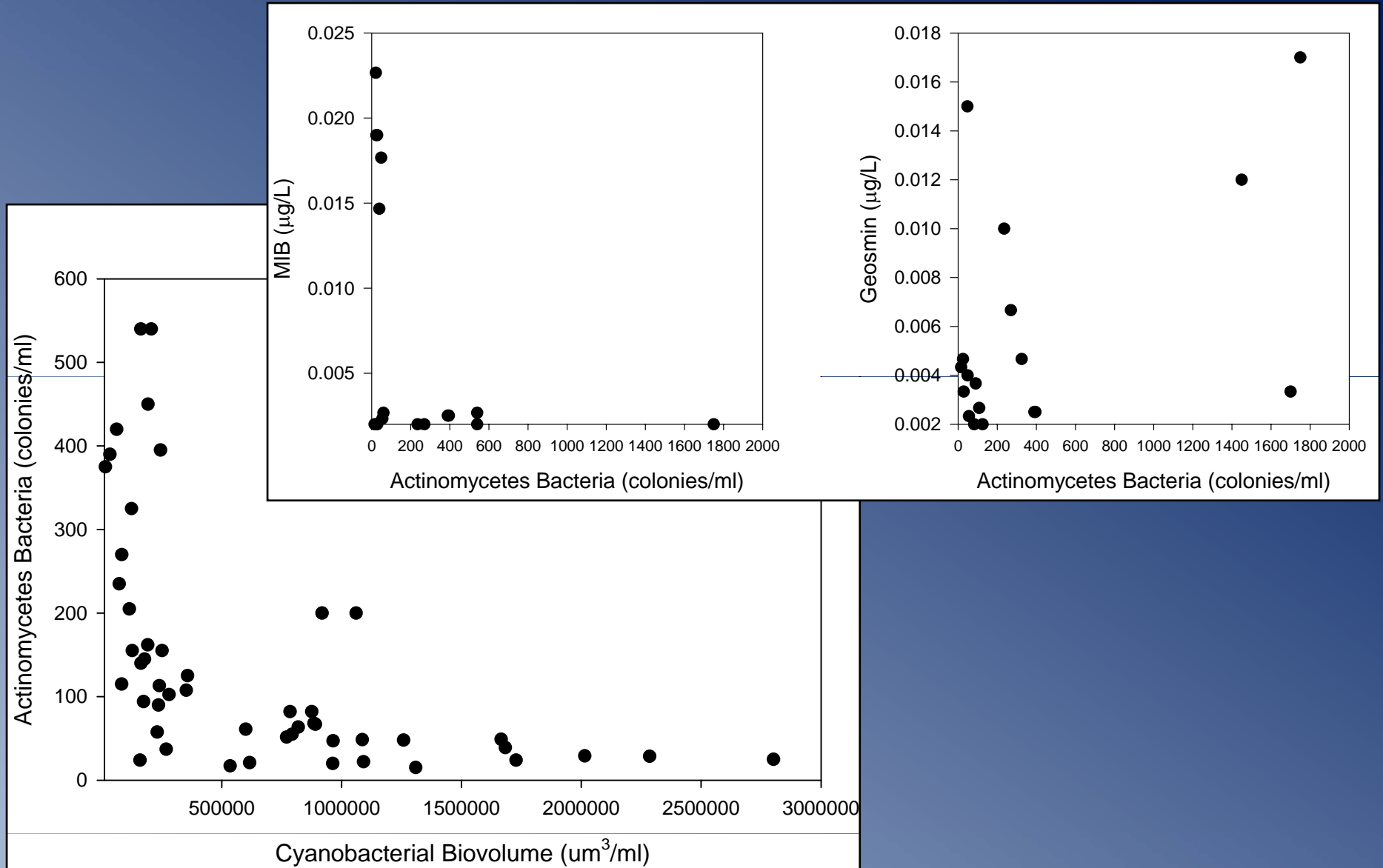
Microcystin



MIB, Geosmin, Cyanobacteria



MIB, Geosmin, Cyanobacteria, Actinomycetes



Continuing Investigations:

- Water residence time
- Water column mixing
- Hydrodynamic modeling
- Chlorophyll and phycocyanin fluorescence
- Other relationships

Conclusions

- Mobile, multi-depth lake water-quality monitoring gages are a viable method for collecting and transmitting continuous data in real-time
- When combined with tributary water-quality information, the effects of watershed influences on water-quality in the lake can be evaluated
- Discrete sampling for ancillary constituents can be used to develop methods to estimate loads and frequency of occurrence
- Water-quality techniques developed through this project can be scaled and modified to fit most project needs

QUESTIONS ?



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