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Watershed Influences and In-Lake Processes—A Regional-Scale Approach to Monitoring a Water-Supply Reservoir, Lake Houston near Houston, Texas

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In Cooperation with the City of Houston

U.S. Department of the Interior
U.S. Geological Survey

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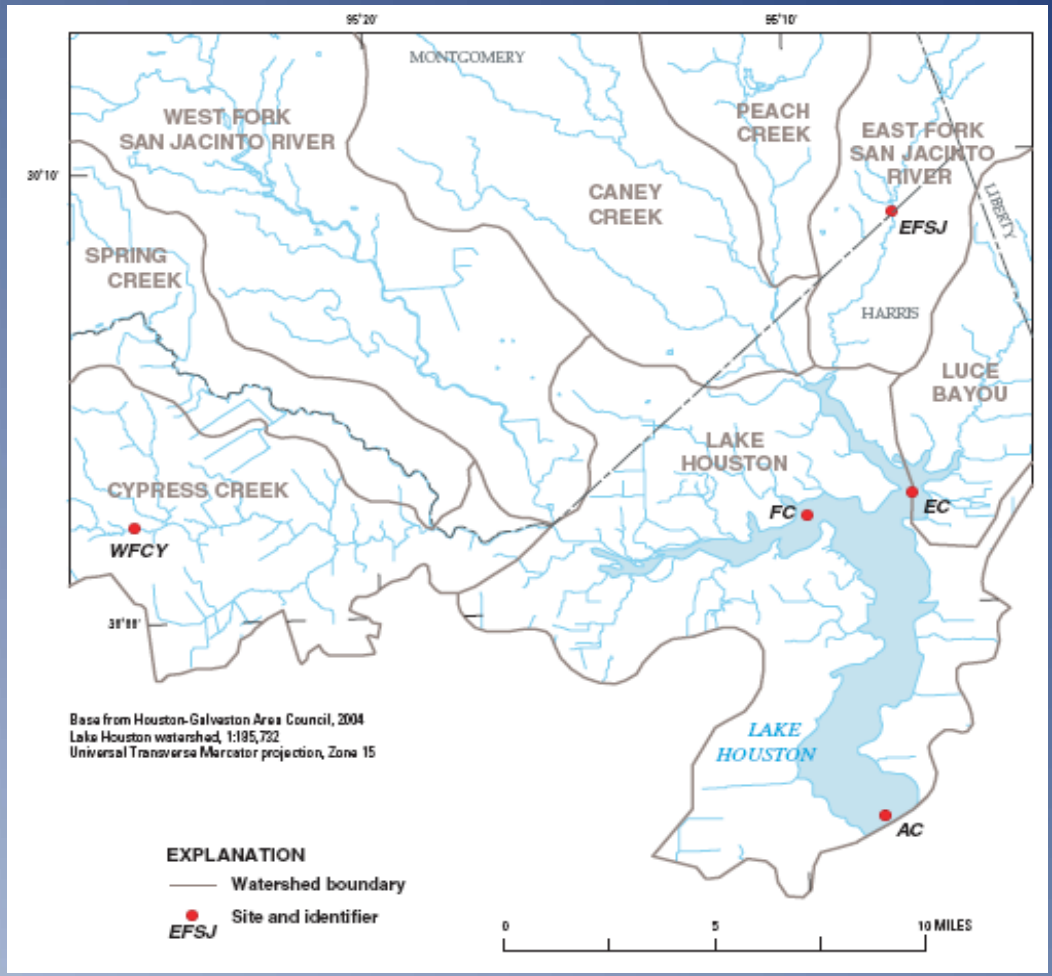
Introduction

- Description of study area
- Watershed monitoring
- In-Lake monitoring
- Preliminary evaluation

Study Area

- Lake Houston is northeast of downtown Houston, Texas
- Reservoir with “small” contributing watershed
- A major source of water for Houston (pop. 4.5 million)

Study Area



- Drainage area 2,835 mi^2
- Land use is rural, transitional, and urban
- Western subbasin predominately urban
- Eastern subbasin predominately rural

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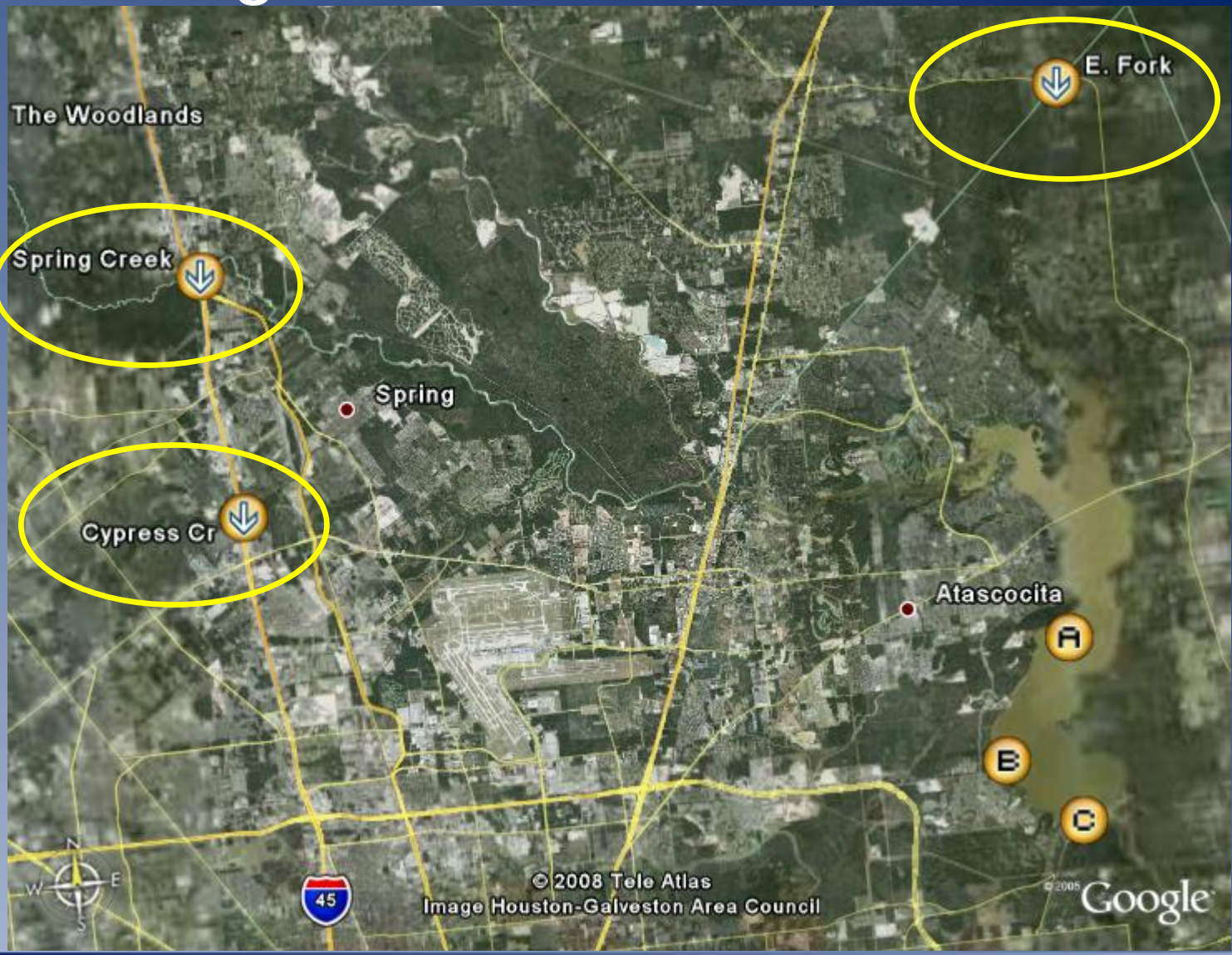
Figures from Sneck-Fahrer and others, 2005, USGS SIR 2005-5241

Monitoring Sites



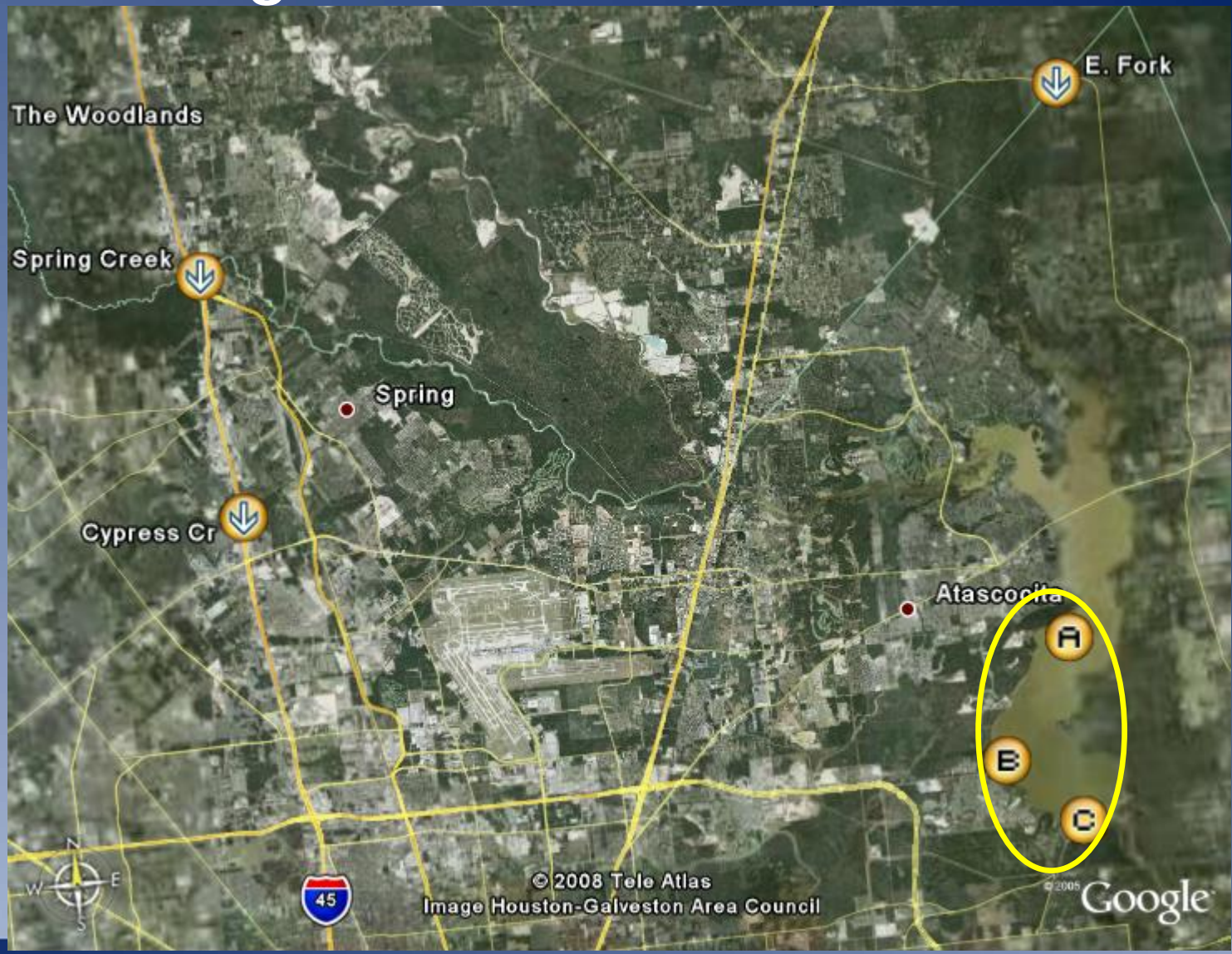
Watershed Monitoring

- Three sites selected above Lake Houston
  - 08068500 Spring Creek near Spring
    - Drainage area: 409 mi^2
    - Streamflow data: 1939-present
    - Water-quality data: 1999-present
  - 08070200 E. Fork San Jacinto River near New Caney
    - Drainage area: 388 mi^2
    - Streamflow data: 1984-present
    - Water-quality data: 1984-99; 2005-present
  - 08069000 Cypress Creek near Westfield
    - Drainage area: 285 mi^2
    - Streamflow data: 1944-present
    - Water-quality data: 1959-64; 1977-78; 1983-2004; 2008

Watershed Monitoring

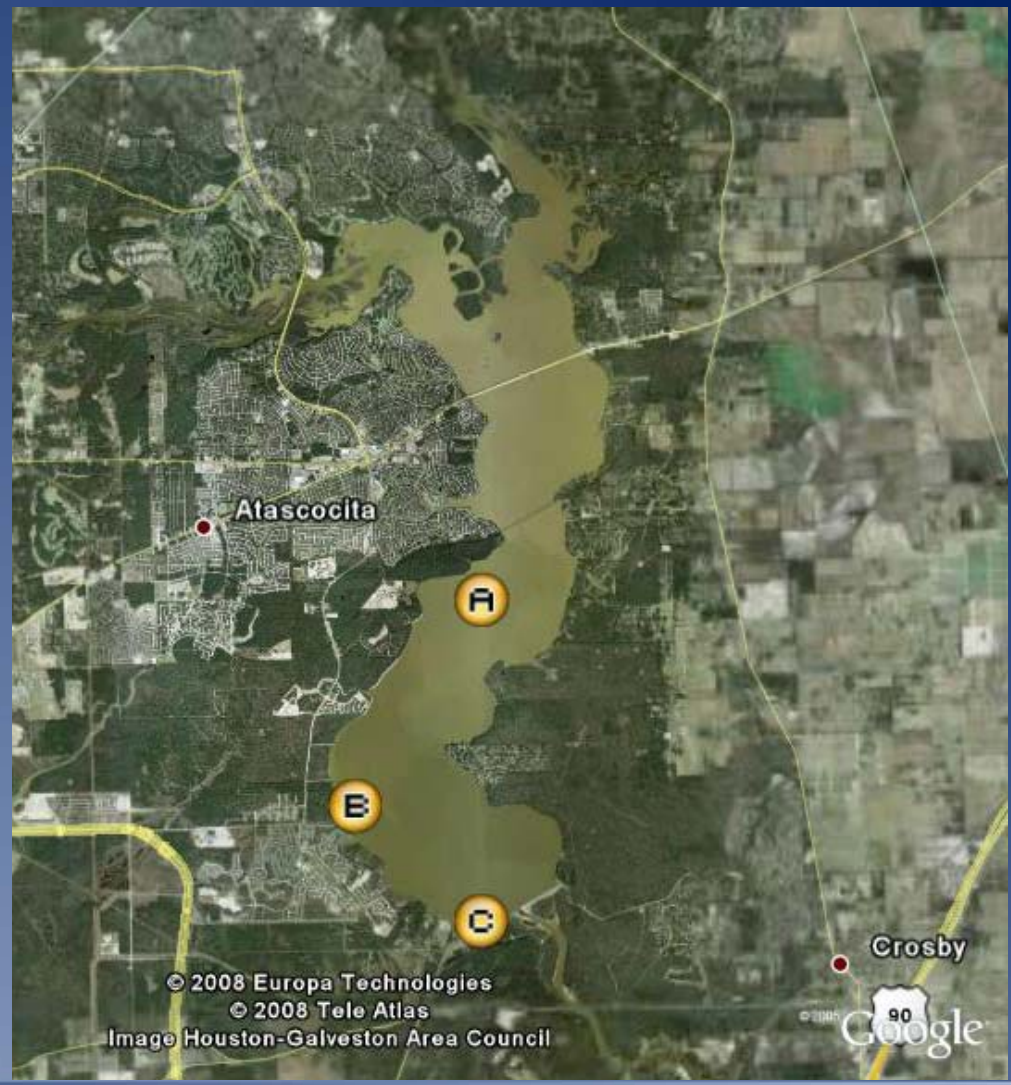
Watershed Monitoring

Monitoring Sites



In-Lake Monitoring

- 2 sites in southwestern quadrant of lake
- 1 site about mid-lake
- Site configuration provides information upstream and downstream from areas of source-water withdrawal



In-Lake Monitoring

In-Lake Monitoring

Auto-profiler monitoring mechanism

Watershed Monitoring Approach

- Continuous water-quality monitoring
  - Turbidity, dissolved oxygen, water temperature, specific conductance, and pH
- Discrete sampling
  - Nutrients, sediment, and others

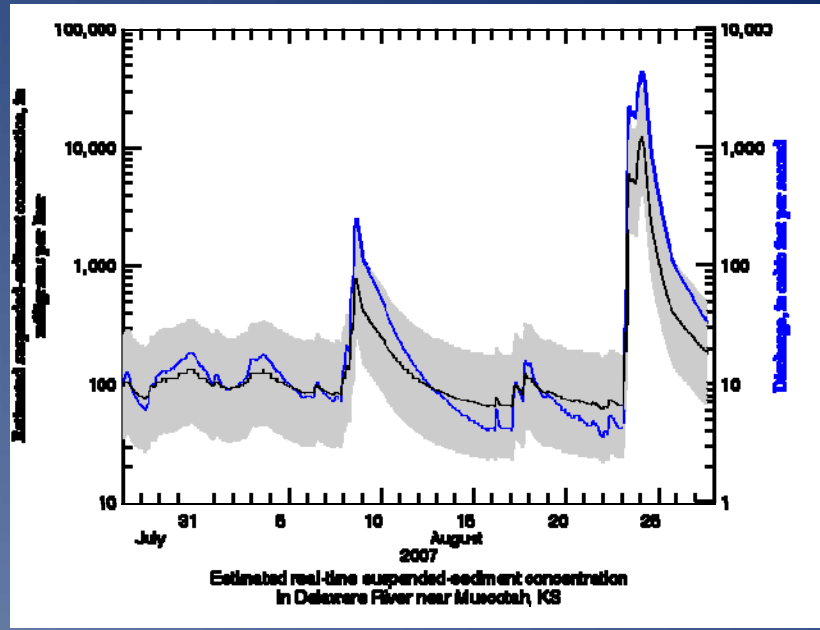
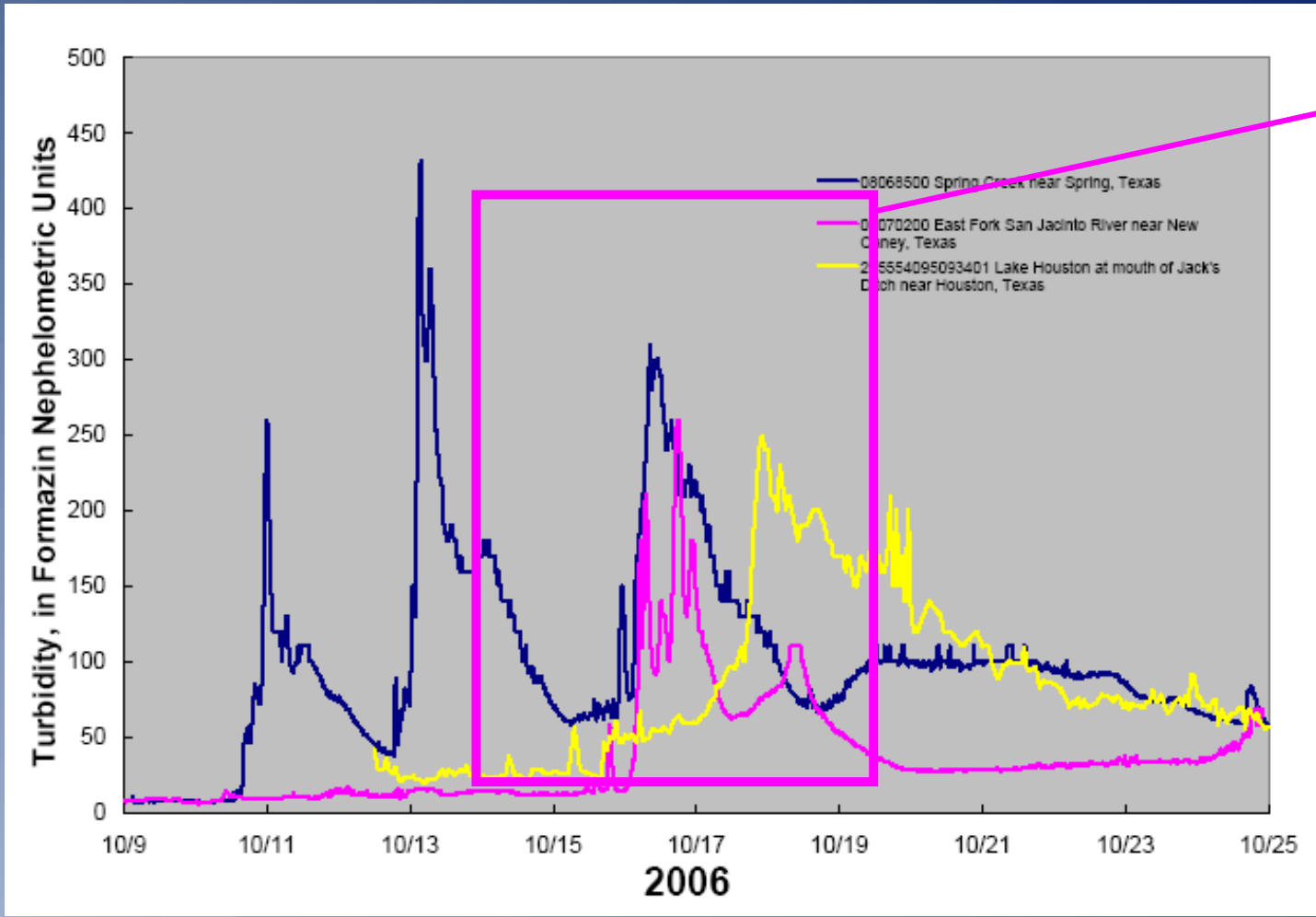


Figure from USGS estimated real-time data (Kansas)

In-Lake Monitoring Approach

- Continuous water-quality monitoring
  - Turbidity, dissolved oxygen, water temperature, specific conductance, pH, chlorophyll, blue-green algae, PAR
- Discrete sampling
  - Nutrients, Geosmin, MIB, phytoplankton (species), and others

Time of Travel Estimation



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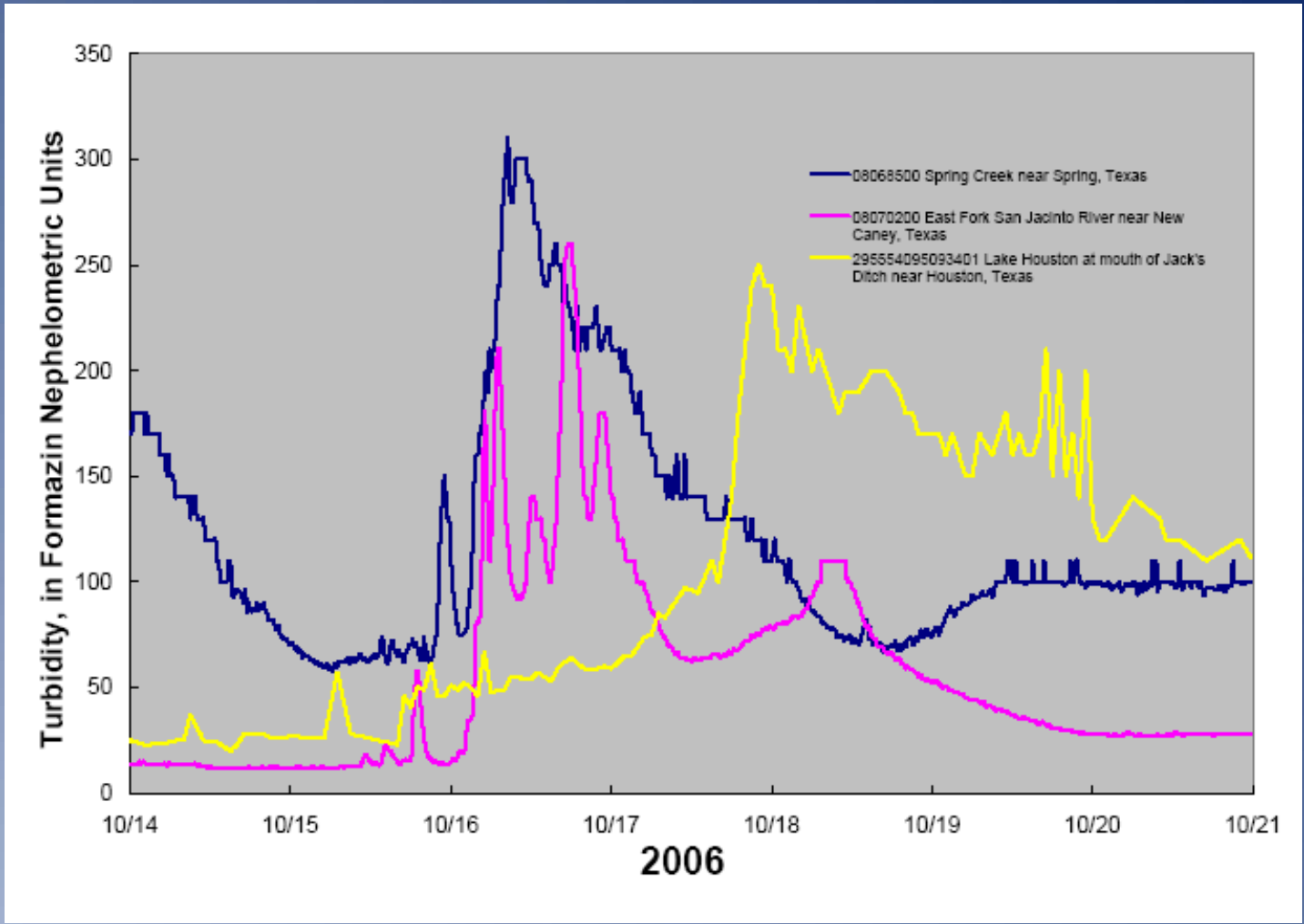
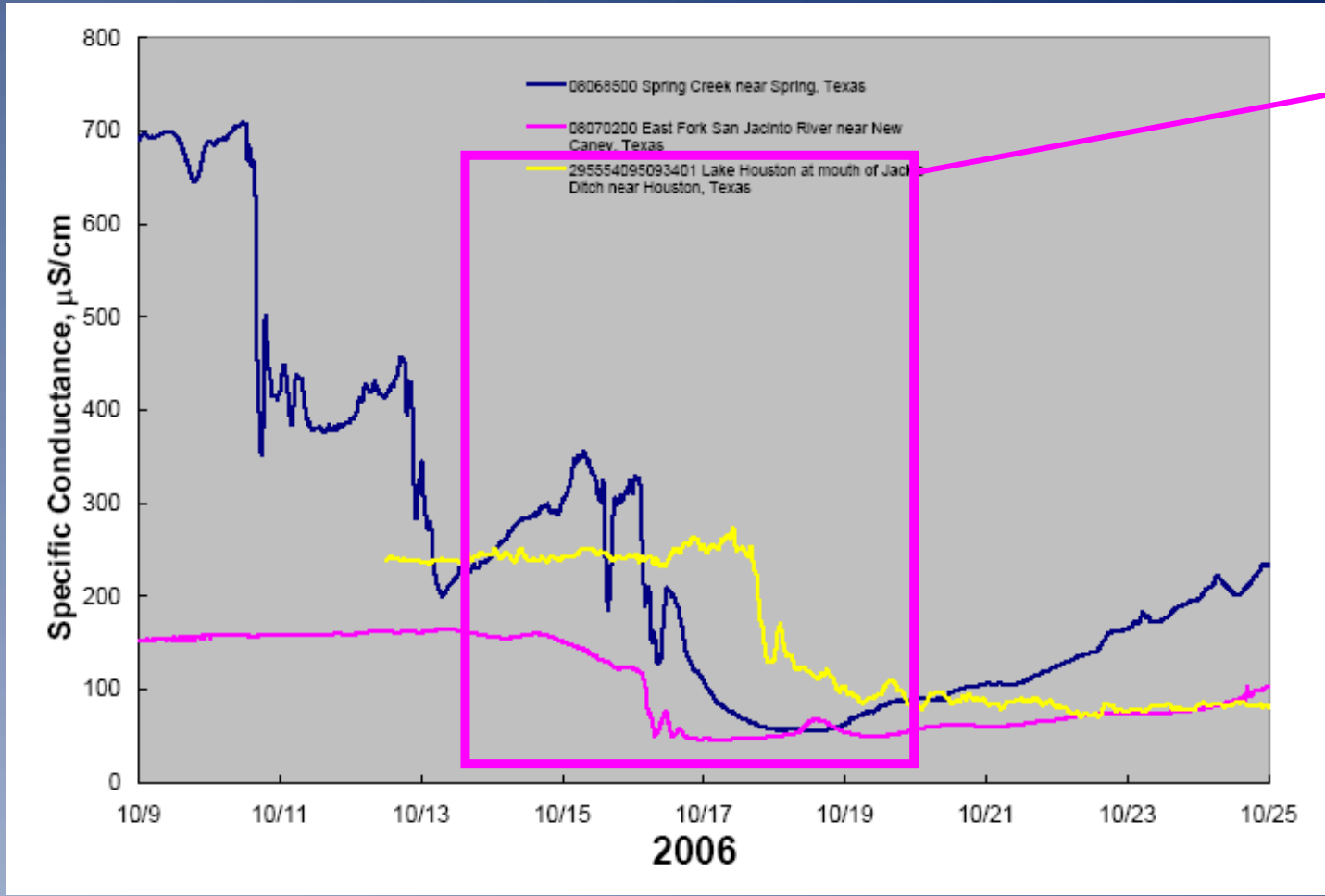
Lake Houston at Mouth of Jack's Ditch and inflow turbidity data

Time of Travel Estimation



Lake Houston at Mouth of Jack's Ditch and inflow turbidity data (zoom)

Time of Travel Estimation



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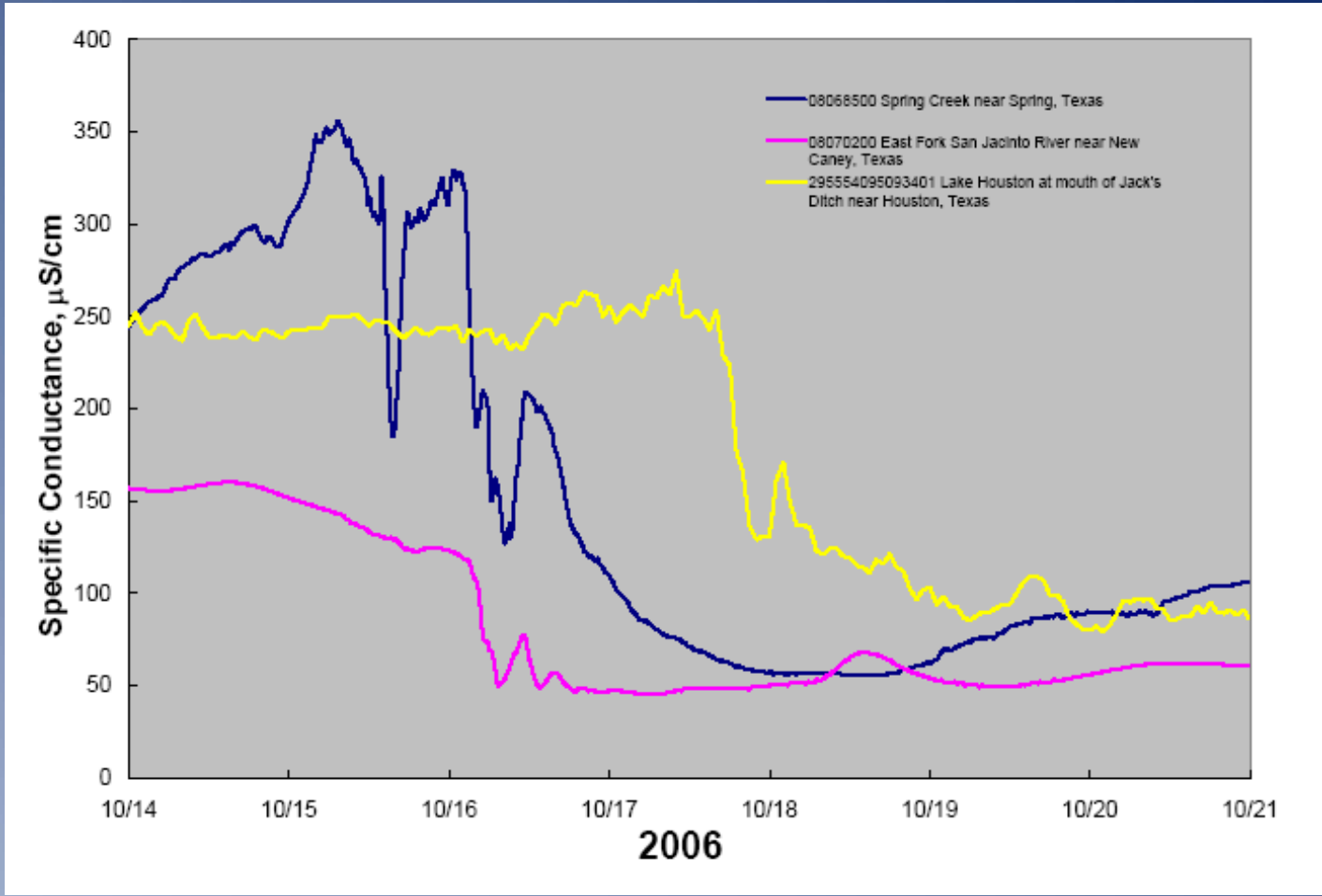
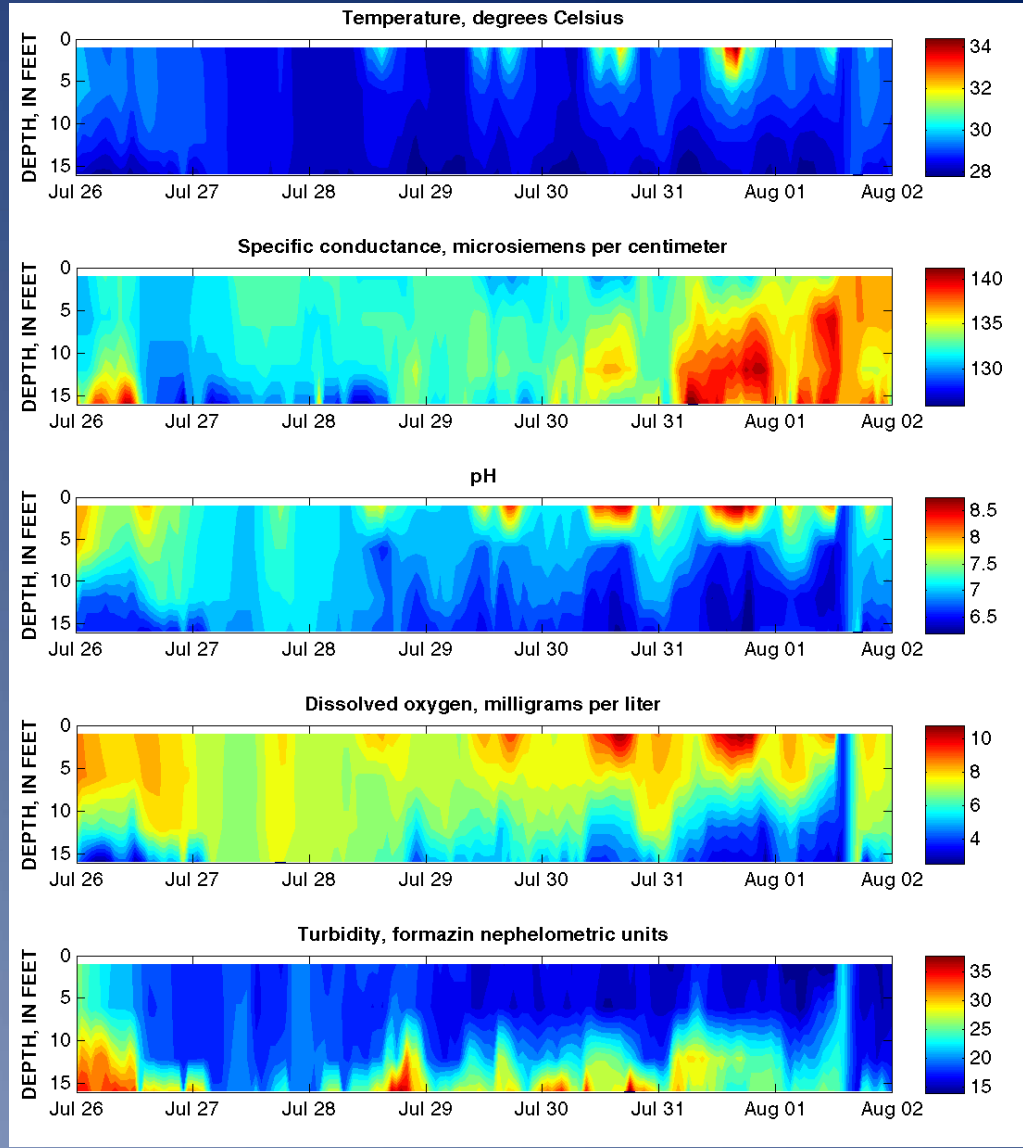
Time of Travel Estimation



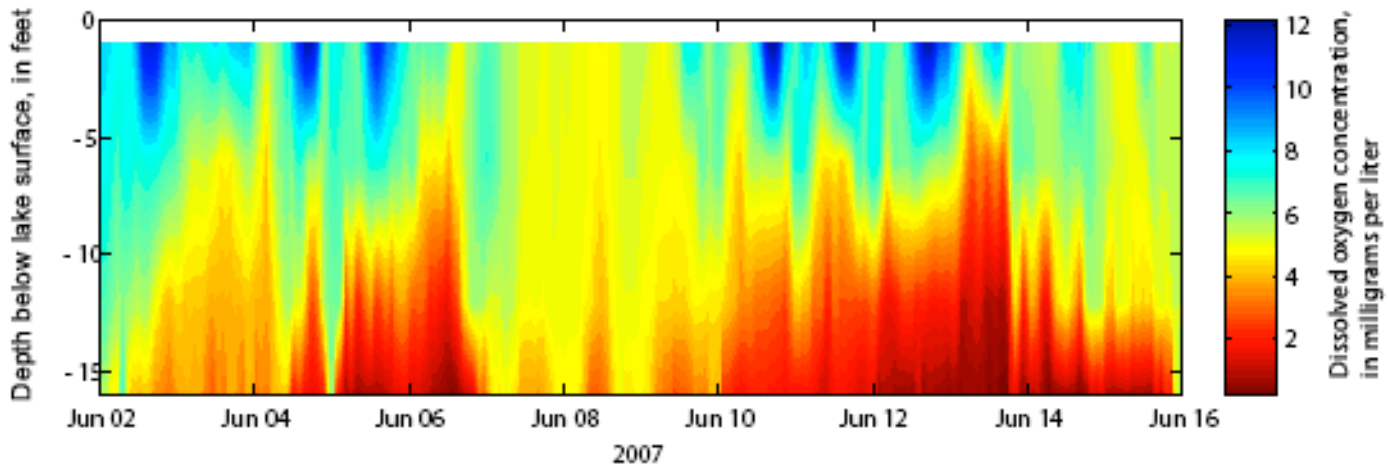
Lake Houston at Mouth of Jack's Ditch and inflow specific conductance data (zoom)

Preliminary Results In-Lake Processes

- Continuous vertical profile data
- Stratification
- Rapid mixing



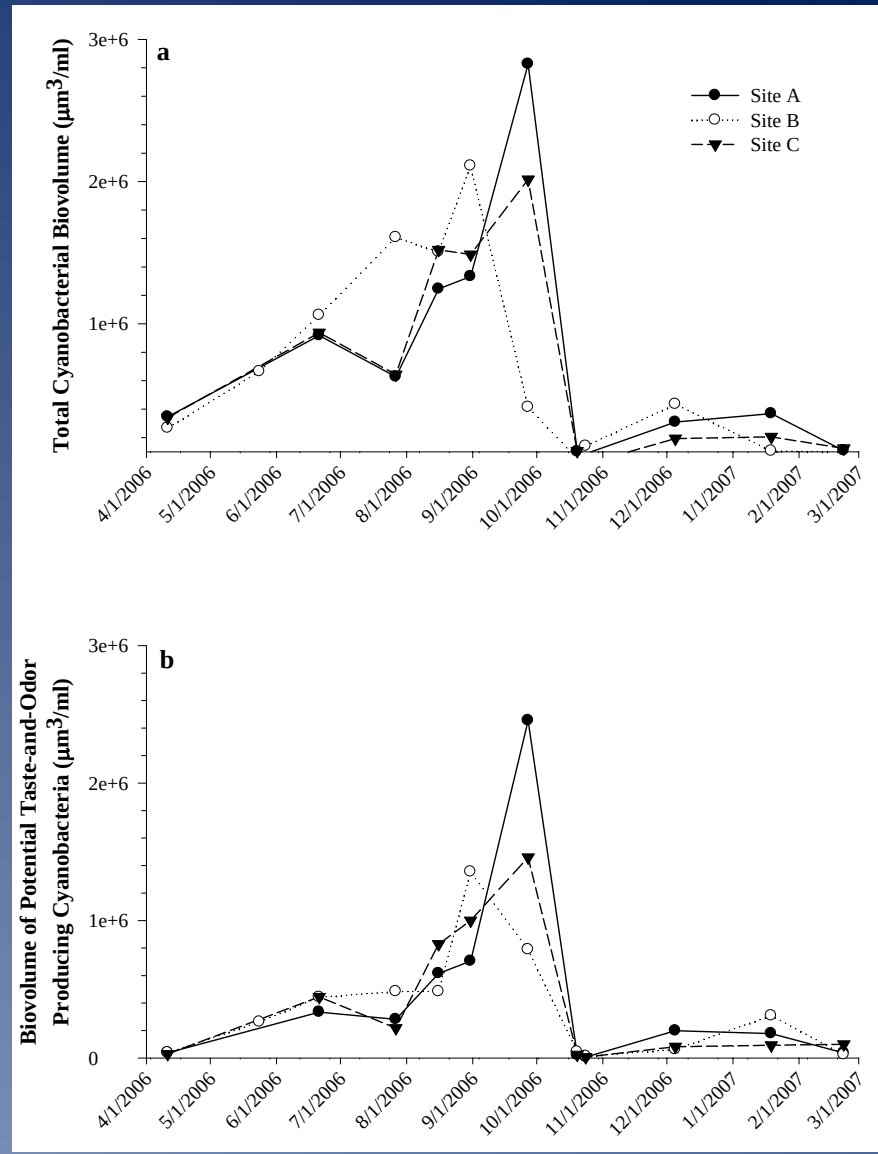
Preliminary Results In-Lake Processes



Lake Houston at Mouth of Jack's Ditch dissolved oxygen data

Phytoplankton Analysis

- Graph a—Seasonal patterns in cyanobacterial biovolume were similar among sites, although peak biovolume was observed in mid-August at Site B and late-September at sites A and C
- Graph b—Biovolume of potential taste-and-odor producers was significantly greater (ANOVA by site and date, p=.03; depths treated as replicates) at Site A than Site B during late September



Conclusions

- Mobile, multidepth lake water quality monitoring gages are a viable method for collecting and transmitting data

- When combined with watershed water-quality information, the effects of watershed influences on water-quality in the lake can be evaluated at multiple scales

Conclusions (continued)

- 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

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