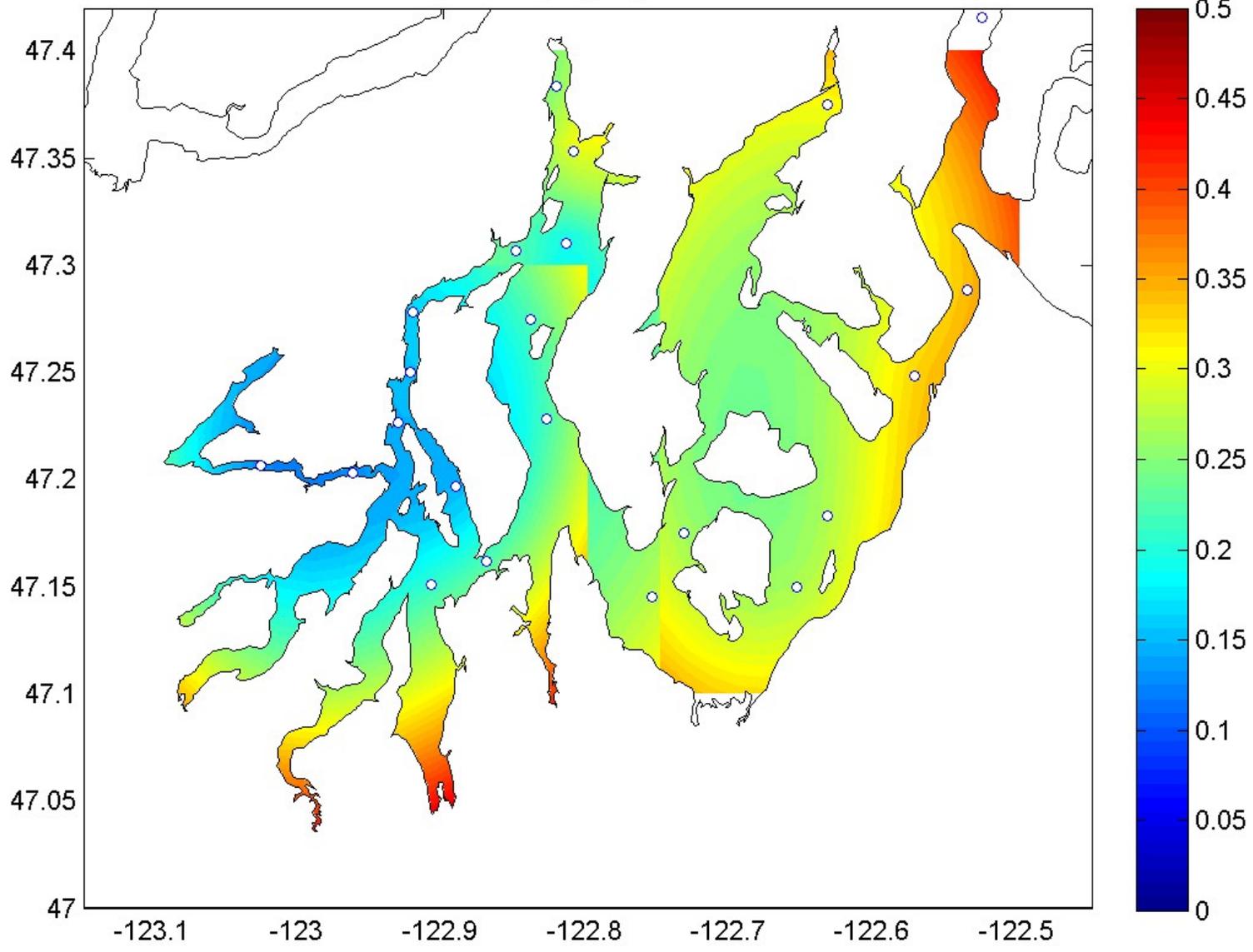


# South Puget Sound Monitoring and Modeling

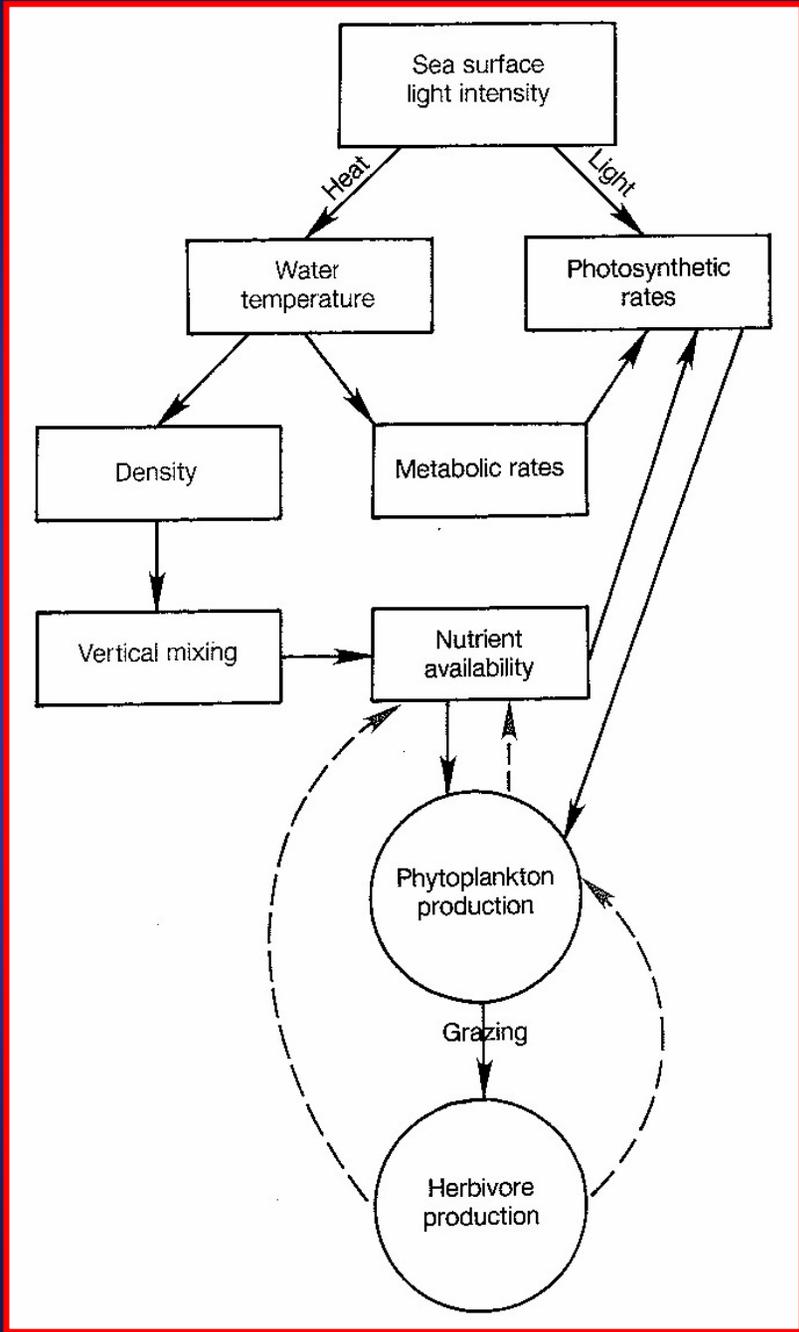
Mindy Roberts (project manager)  
Adrienne Stutes (marine ecologist)  
June 11, 2007

# Surface DIN(mg/L) - Cruise B2



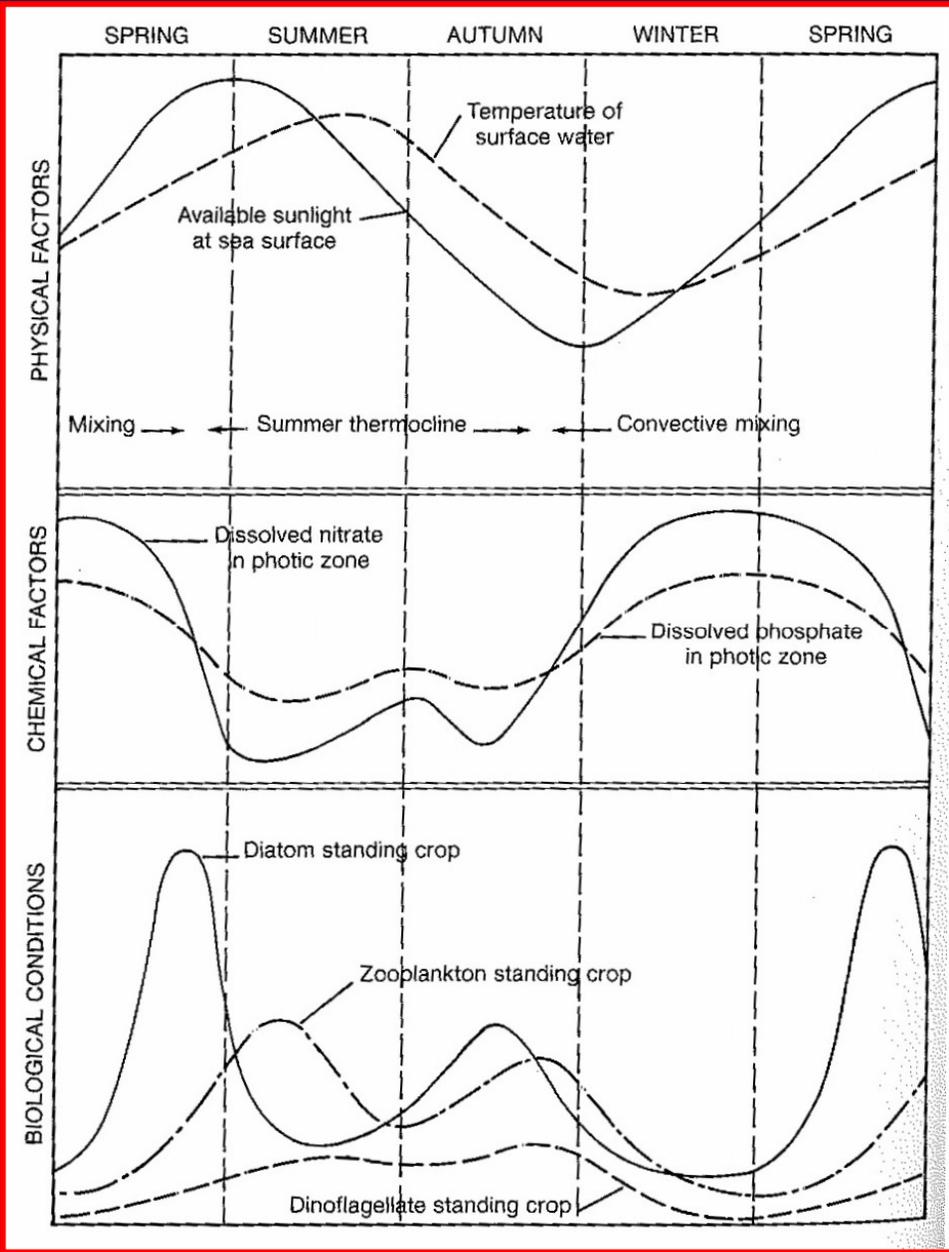
# Estuarine Circulation

- Estuaries are enriched by nutrients from land runoff
- High productivity is a result of nutrient inundation
- Less dense freshwater overlies heavier salt water
- Heavier salt water is mixed upward into the freshwater with the tides
- Serves to replenish nutrients and promote growth of primary producers



# Seasonal Aspects of Primary Productivity

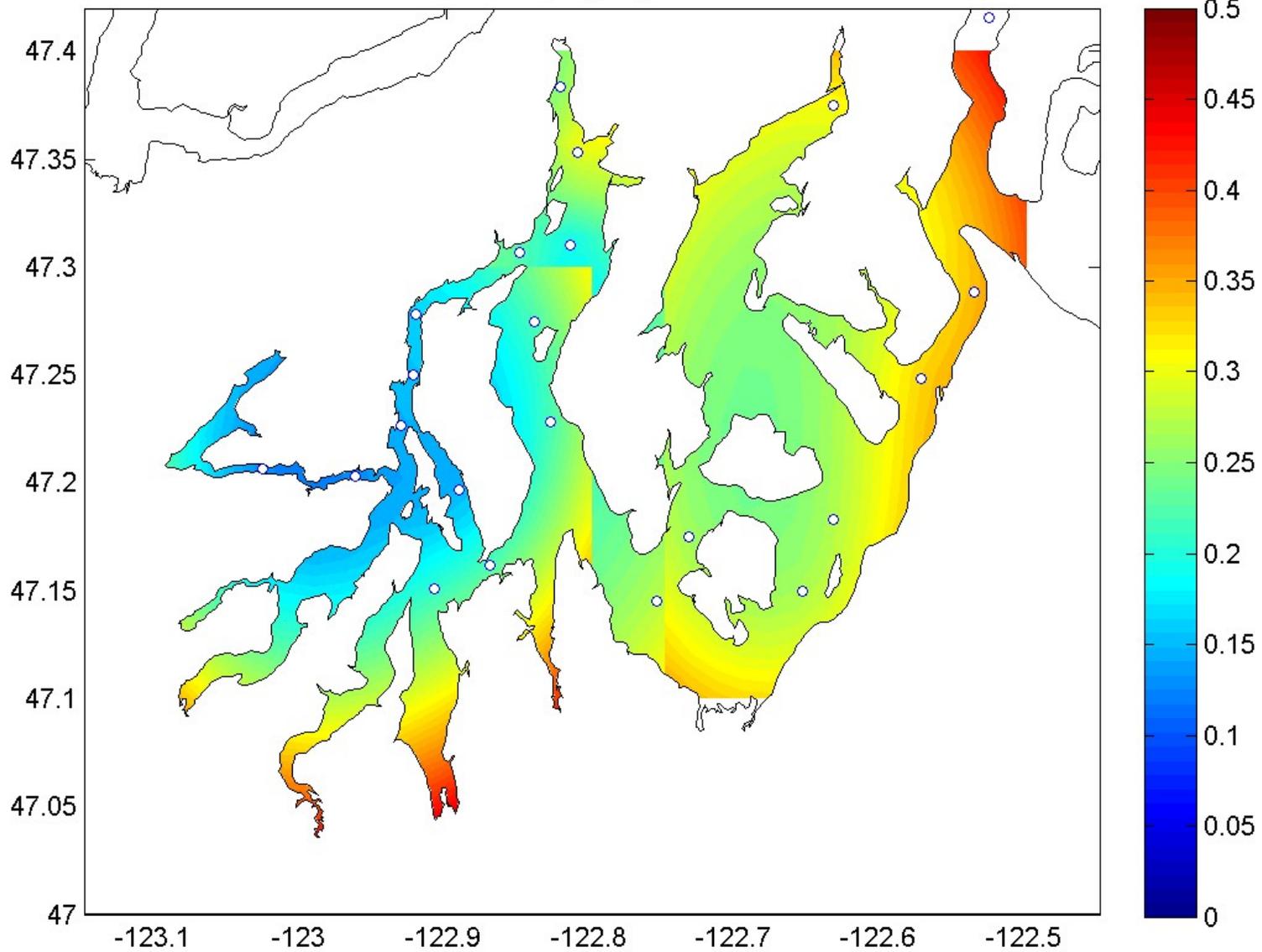
- Seasonal variations in phytoplankton abundances occur in response to:
  - Light intensity
  - Nutrient abundance
  - Grazing pressure (not to be discussed here)
  - Water temperature



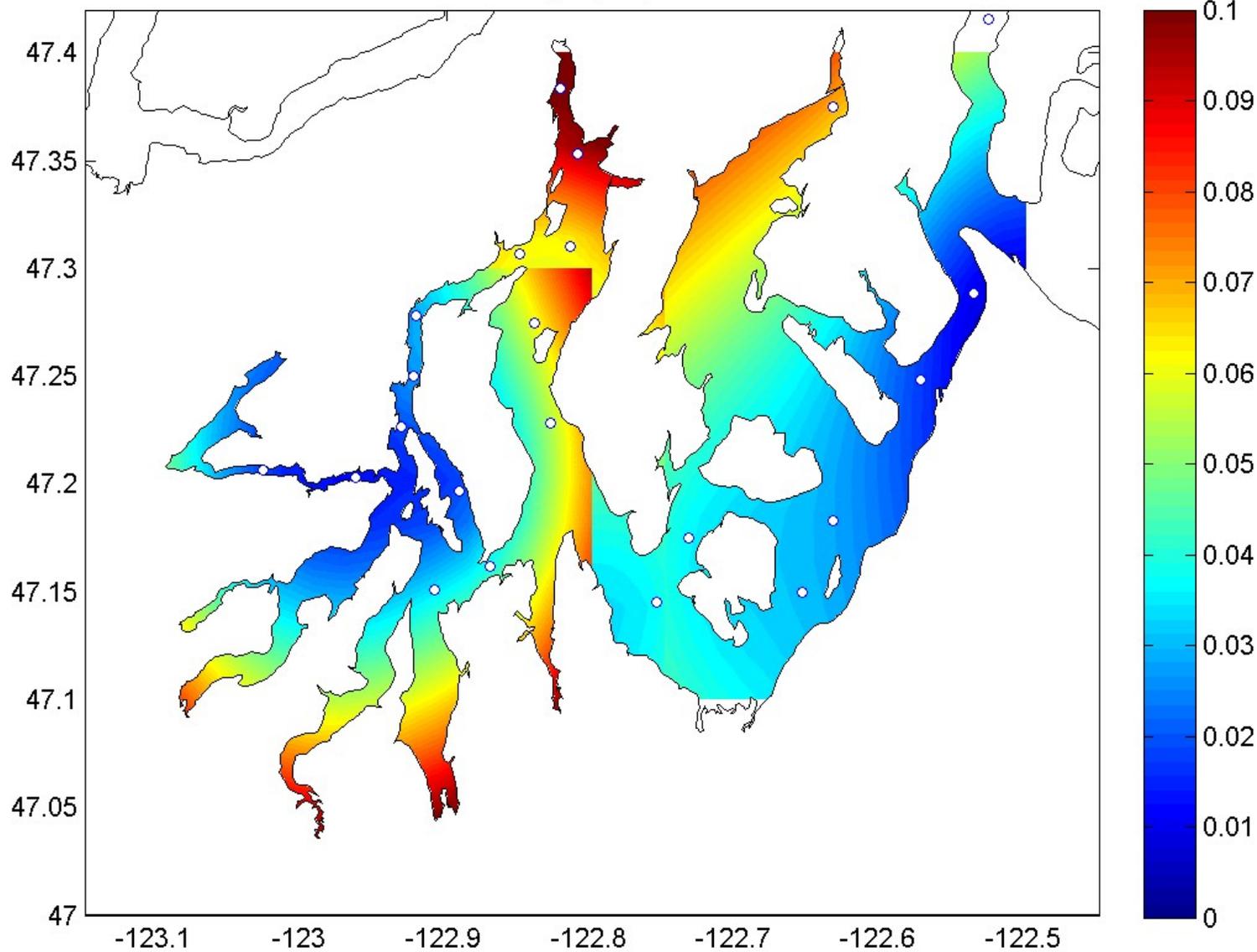
# Phytoplankton Blooms

- Large phytoplankton blooms can have both positive and negative effects
  - Positive – food source for zooplankton grazers
  - Negative – decreased oxygen concentrations due to respiration and die off
- As nutrients are used up, phytoplankton die off and sink down in the water column
- Decreases in dissolved oxygen concentrations in the water column, with lowest concentrations seen at depth
- Low dissolved oxygen concentrations are detrimental to fish and invertebrates who need oxygen to survive – can result in fish kills
- HABs

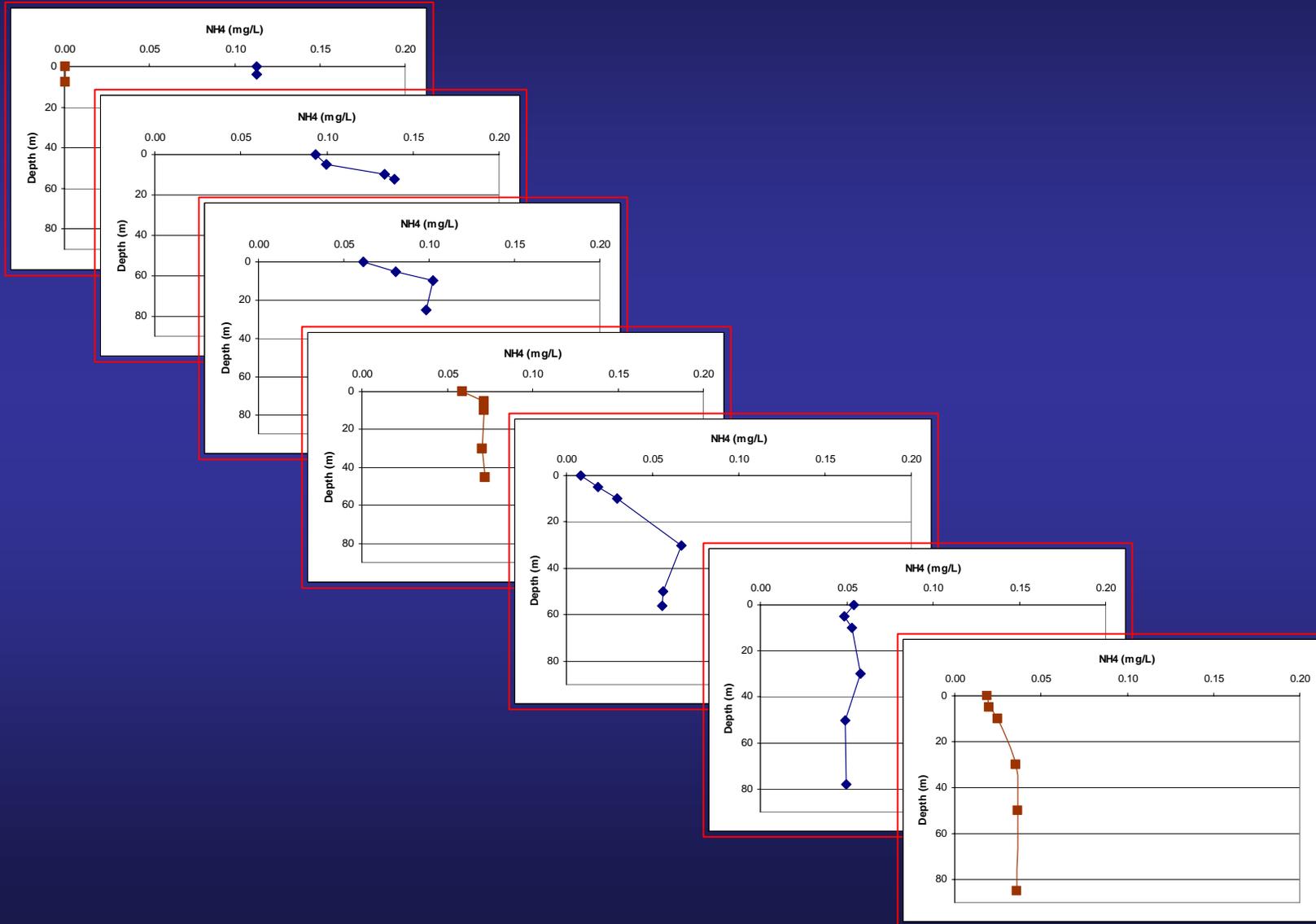
# Surface DIN(mg/L) - Cruise B2



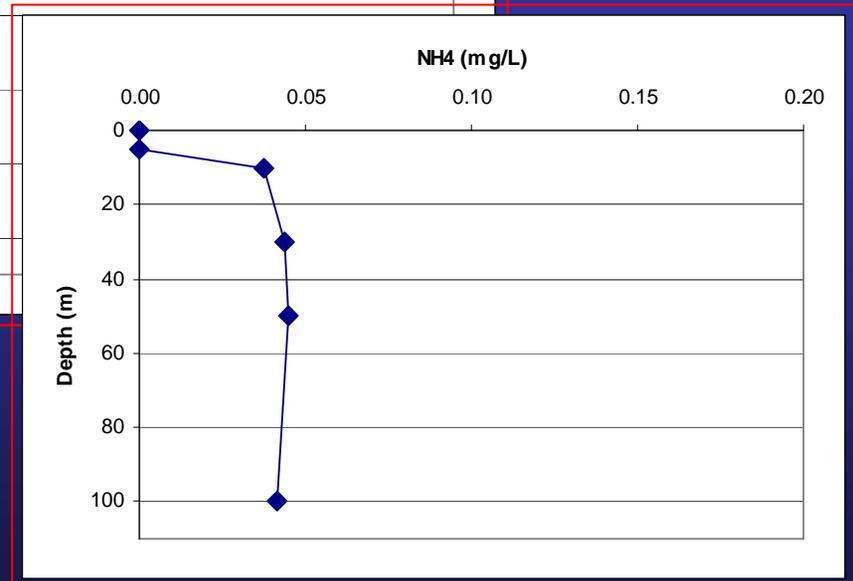
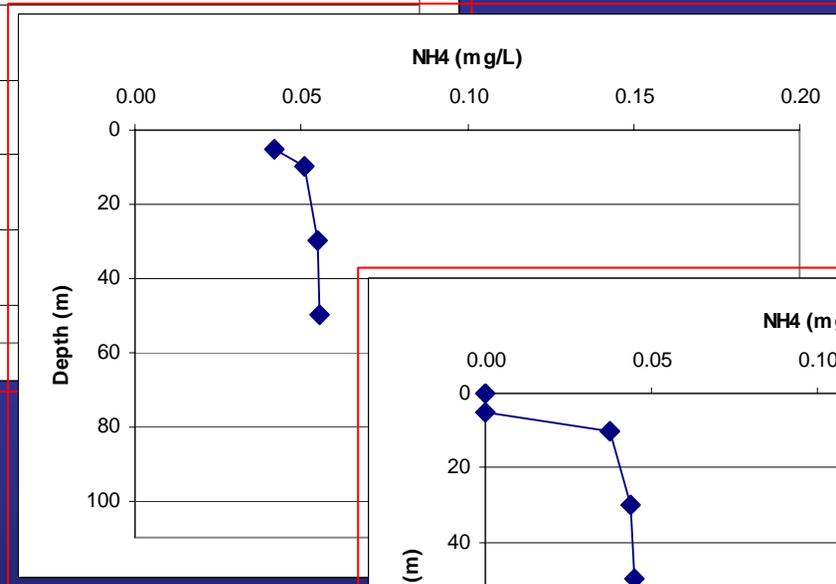
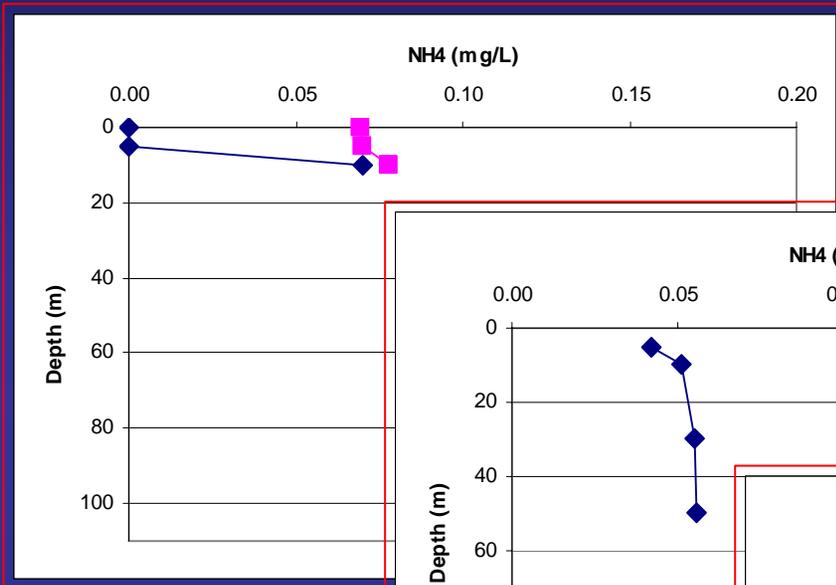
# Surface NH<sub>4</sub>(mg/L) - Cruise B2



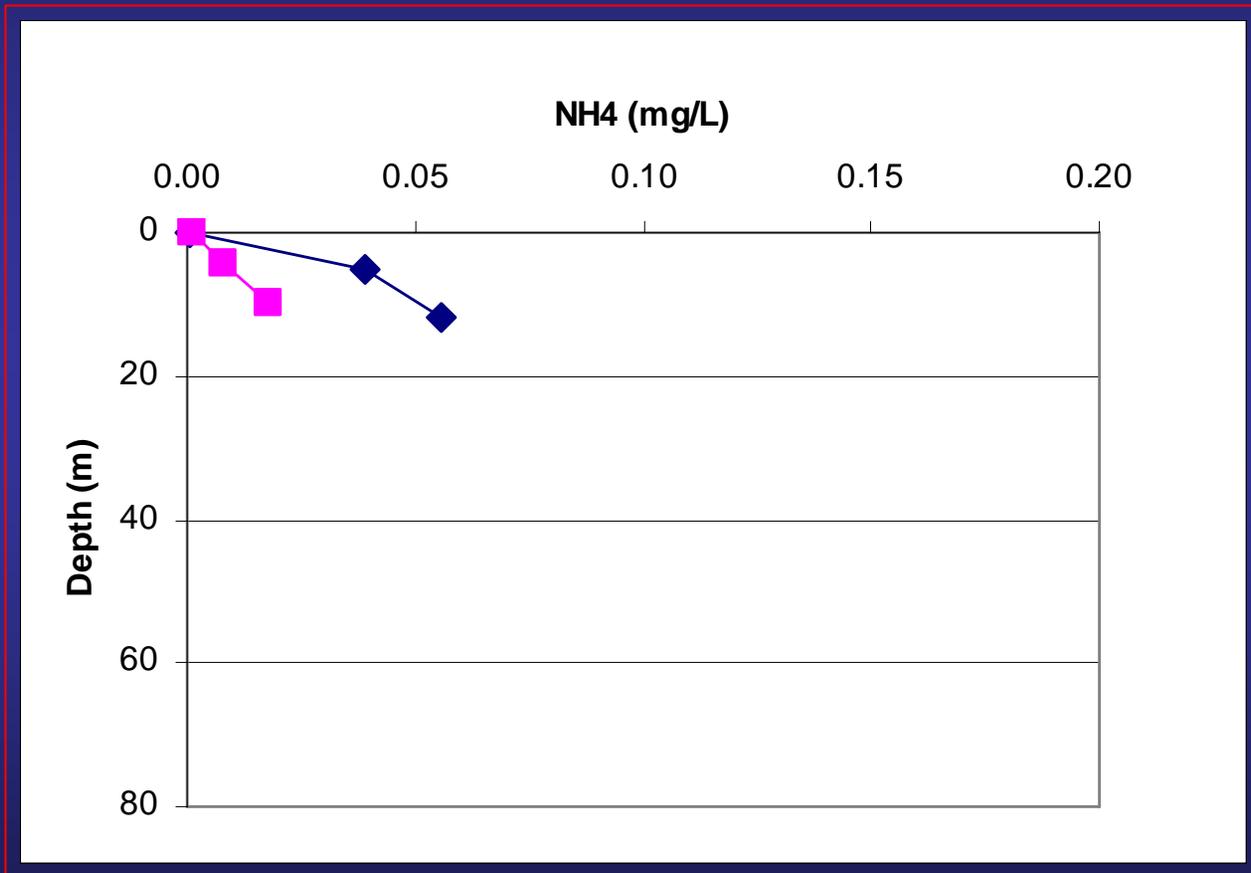
# Case Inlet NH4 Concentrations for August and September 2006



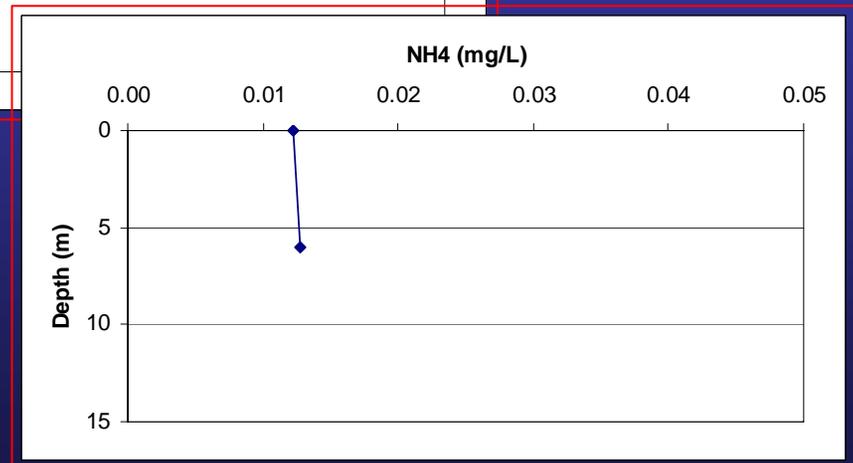
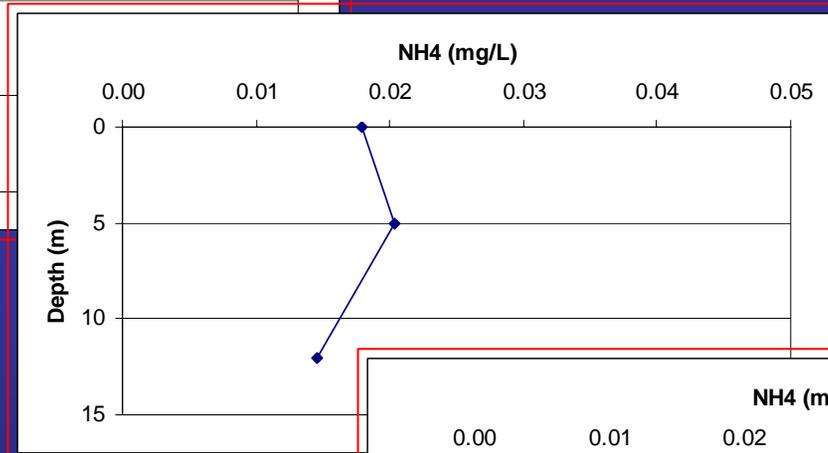
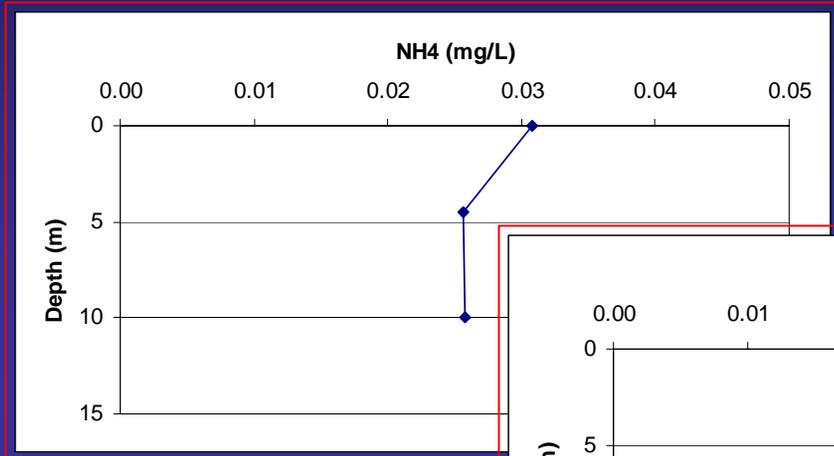
# Carr Inlet NH4 Concentrations for August and September 2006



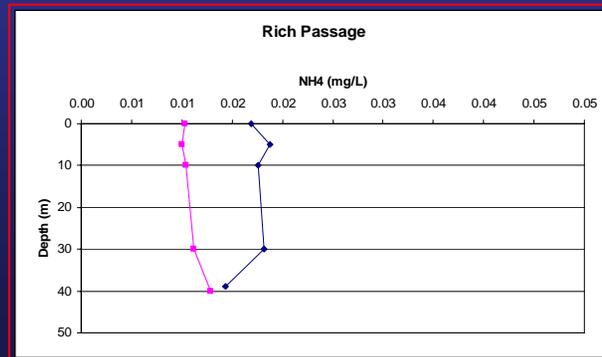
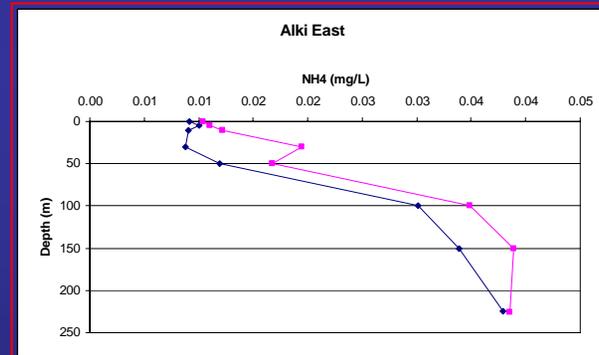
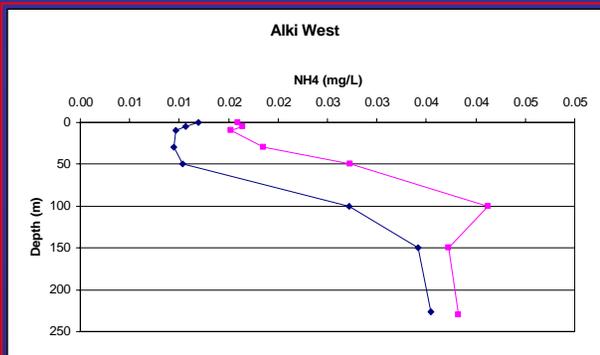
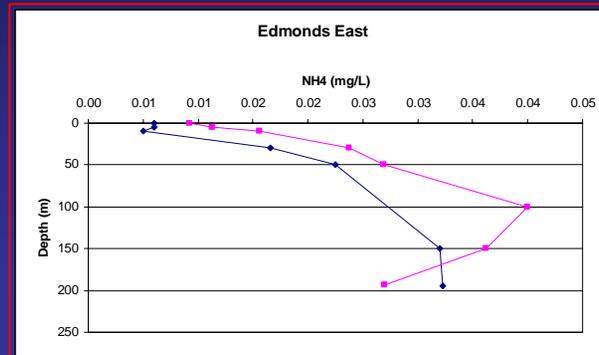
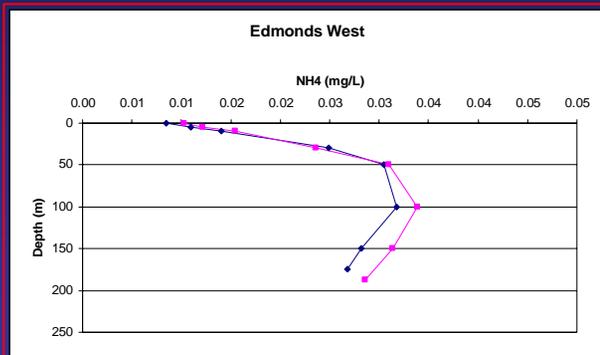
# Budd Inlet NH4 Concentrations for August and September 2006



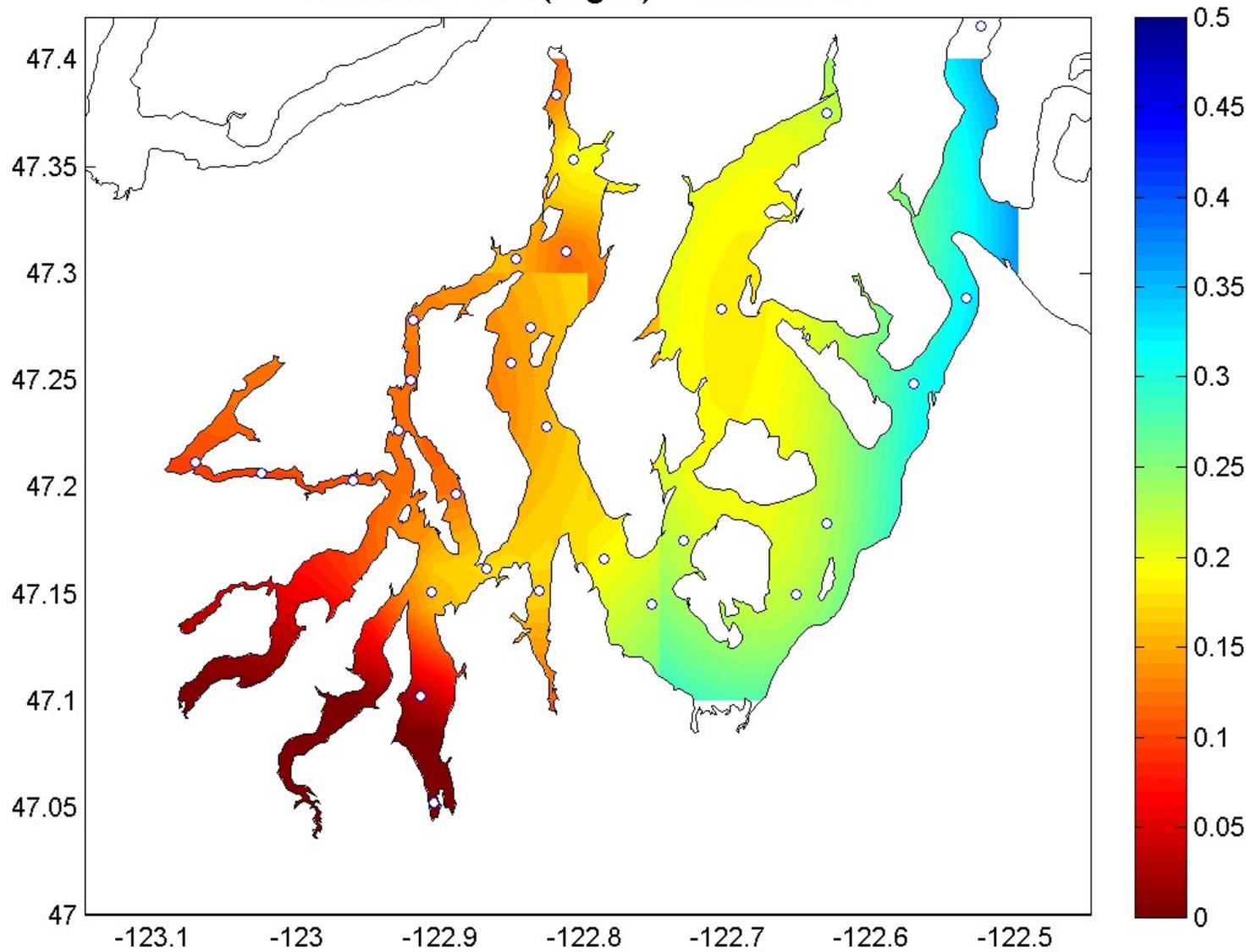
# Hammersley Inlet NH4 Concentrations for September 2006



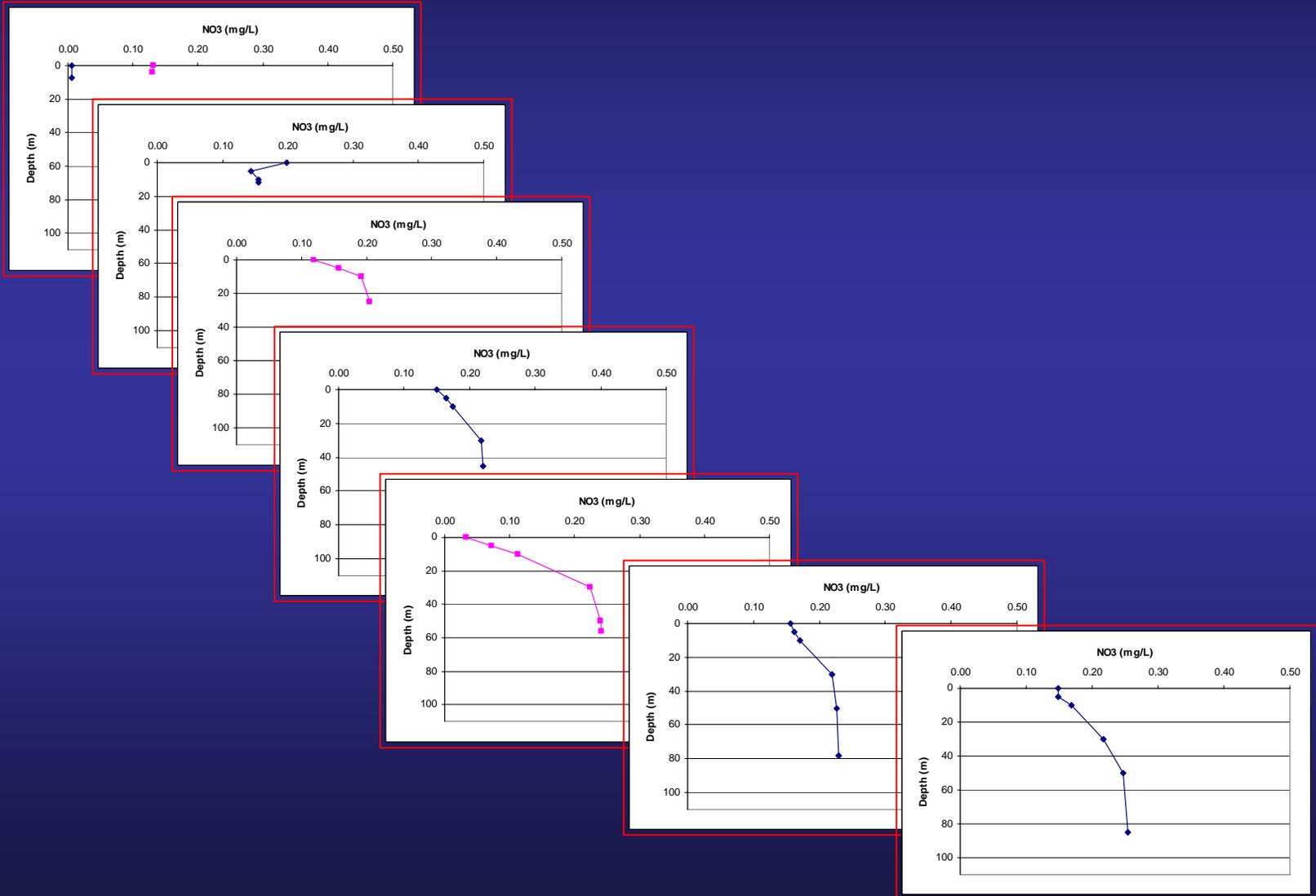
# Boundary Stations - NH4 Concentrations for August and September 2006



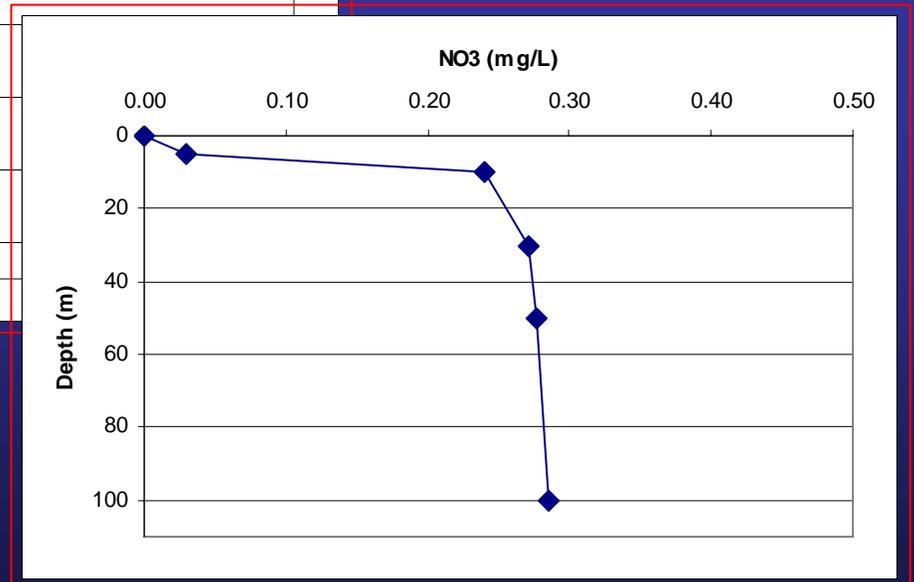
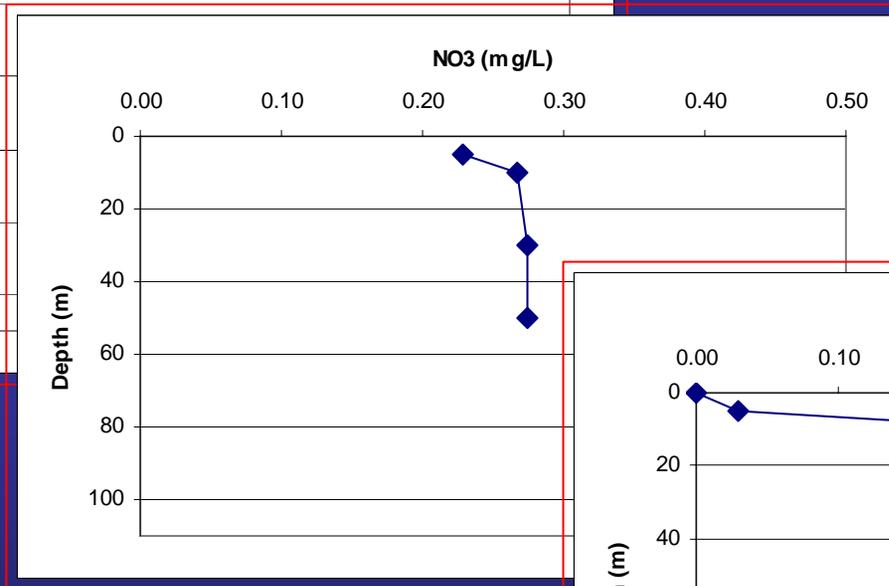
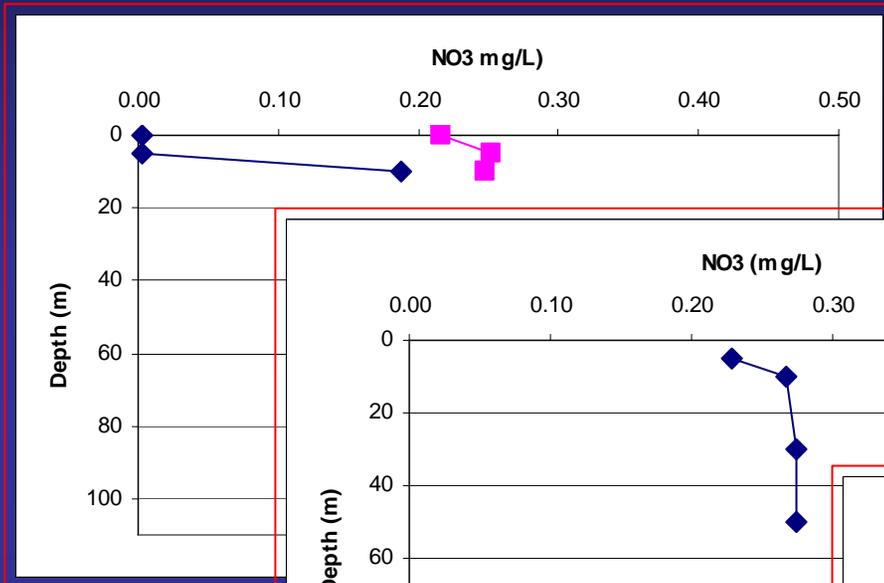
# Surface NO<sub>3</sub>(mg/L) - Cruise B2



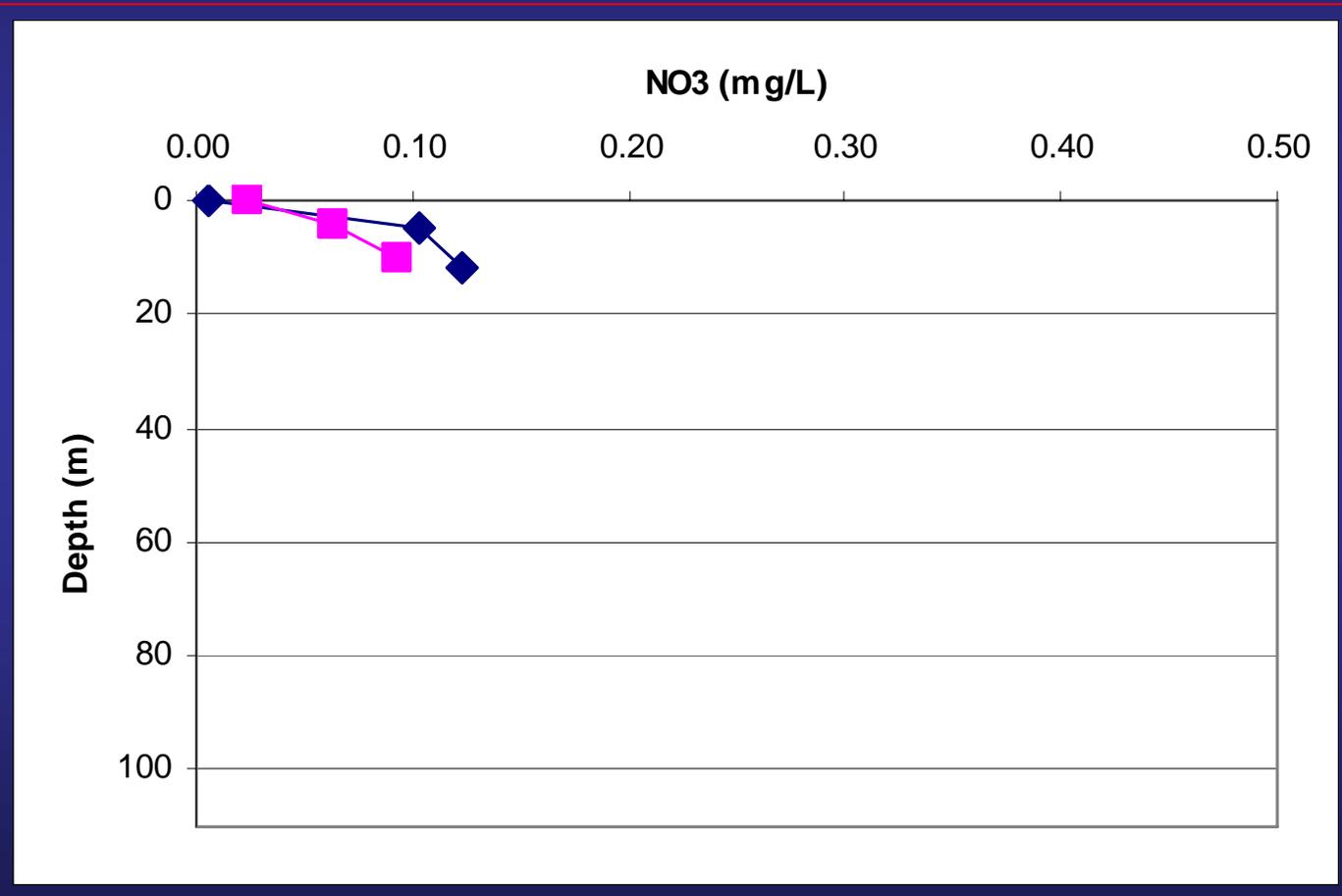
# Case Inlet NO3 Concentrations for August and September 2006



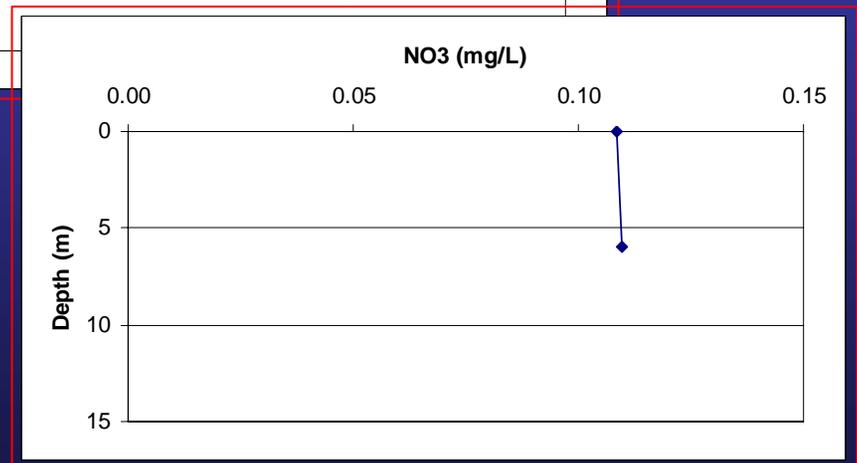
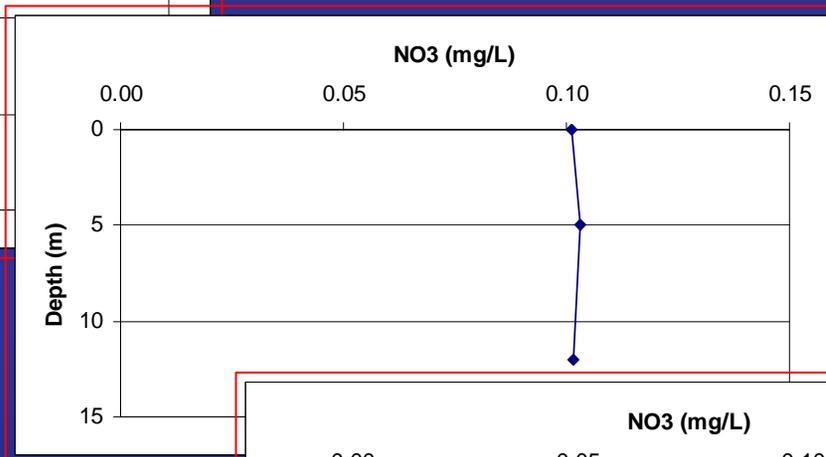
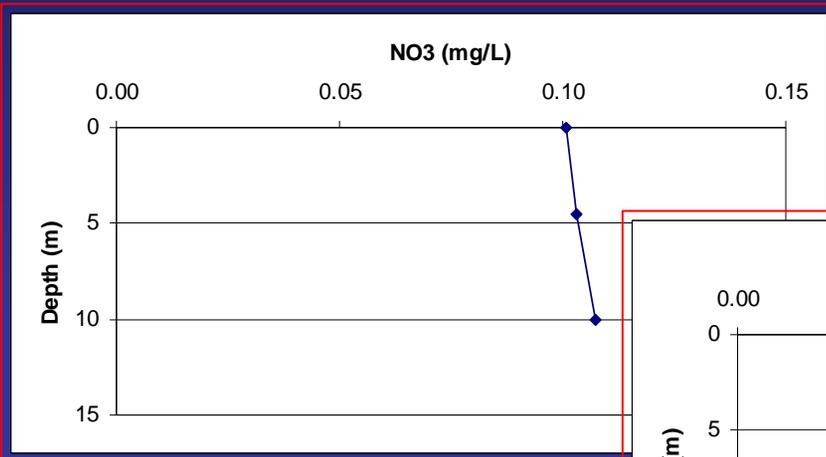
# Carr Inlet NO3 Concentrations for August and September 2006



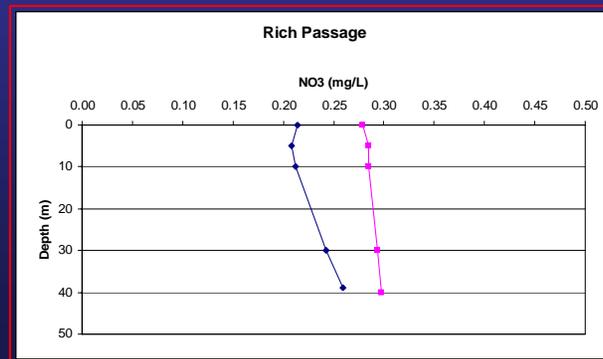
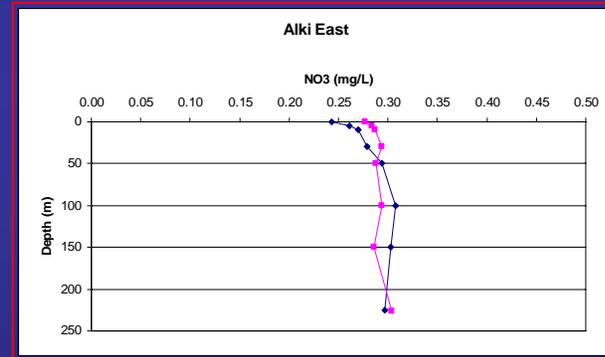
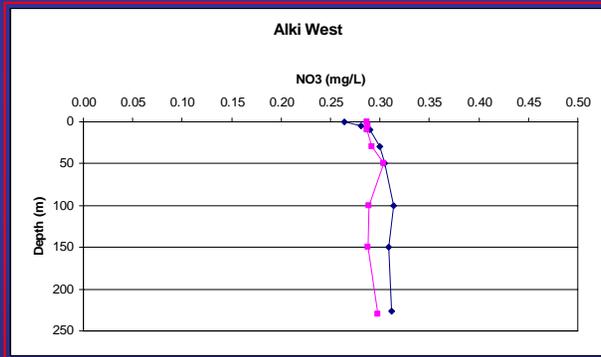
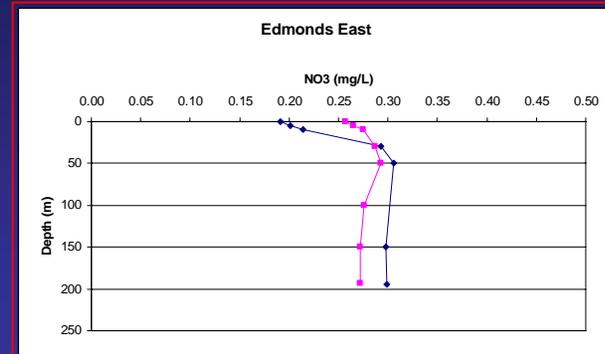
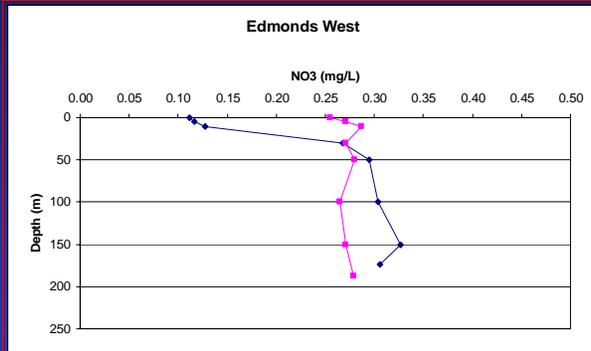
# Budd Inlet NO<sub>3</sub> Concentrations for August and September 2006



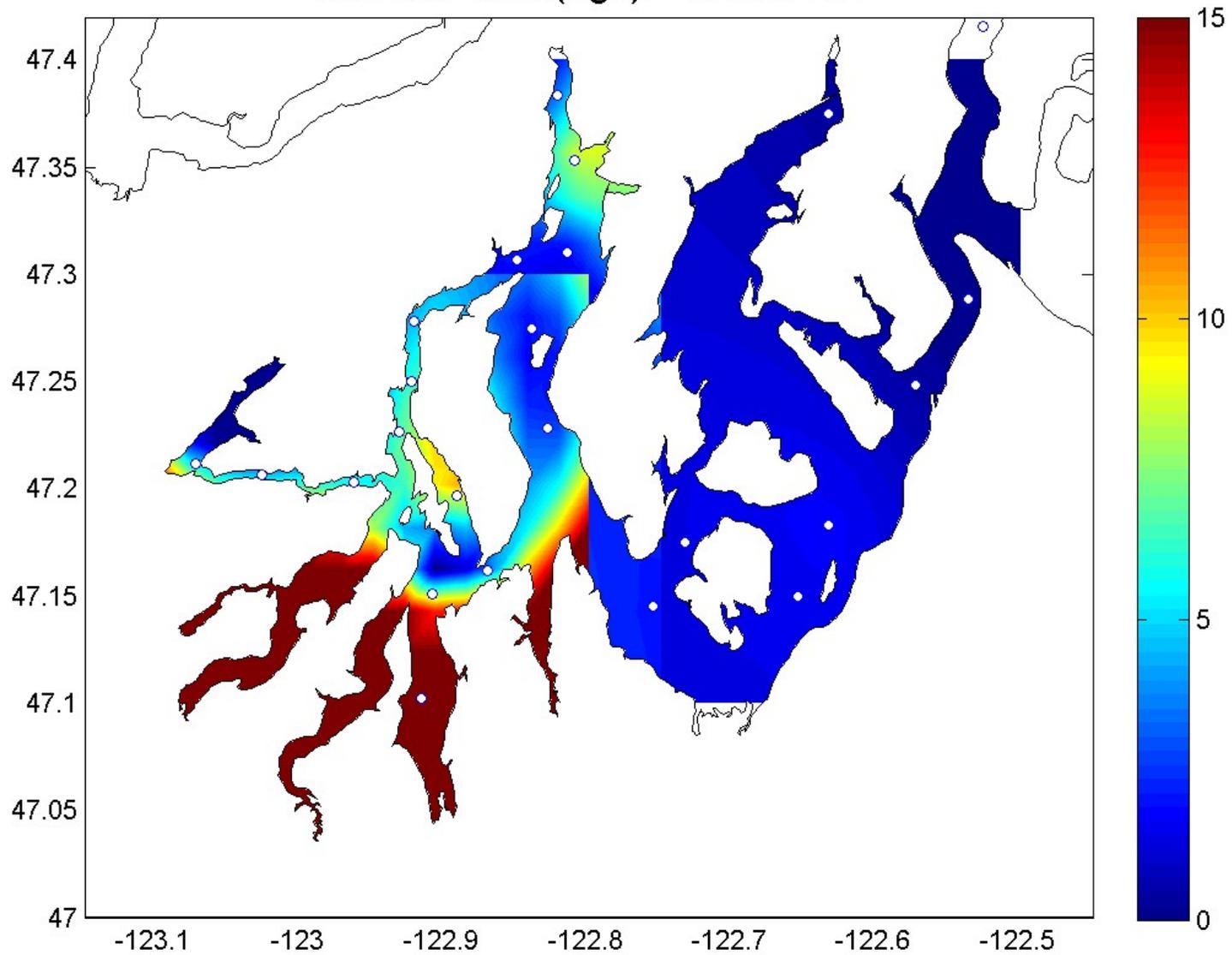
# Hammersley Inlet NO3 Concentrations for September 2006



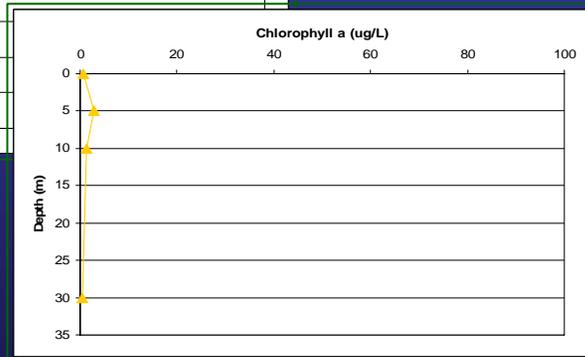
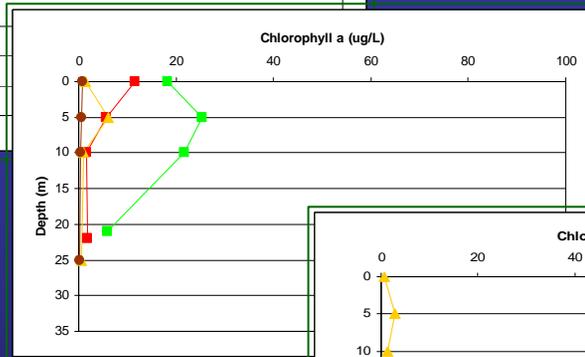
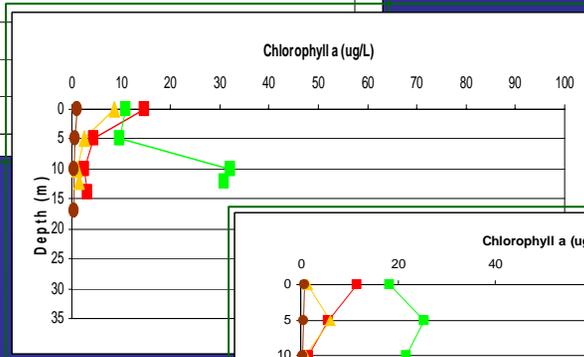
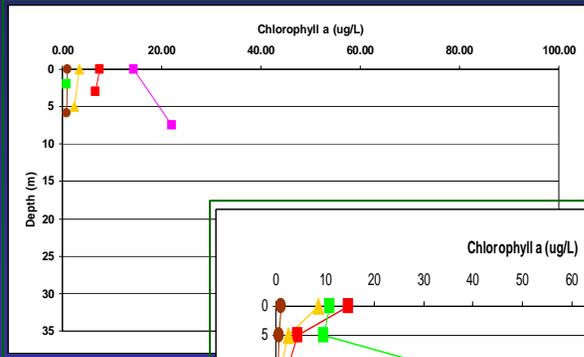
# Boundary Stations - NO3 Concentrations



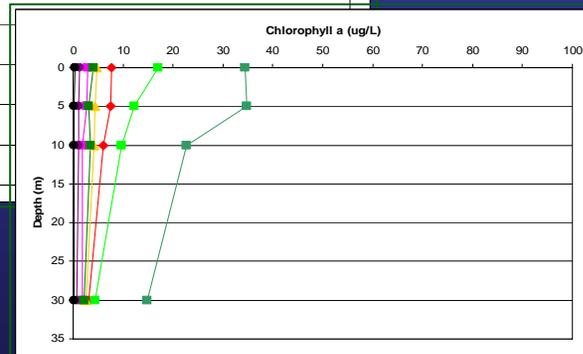
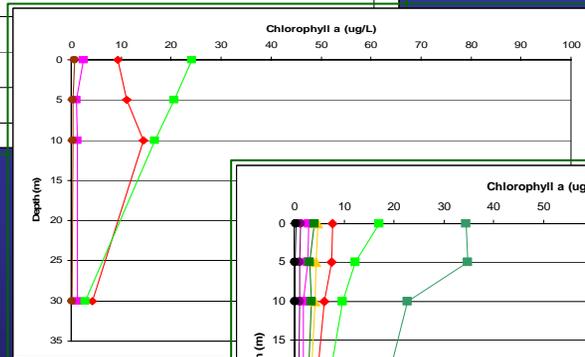
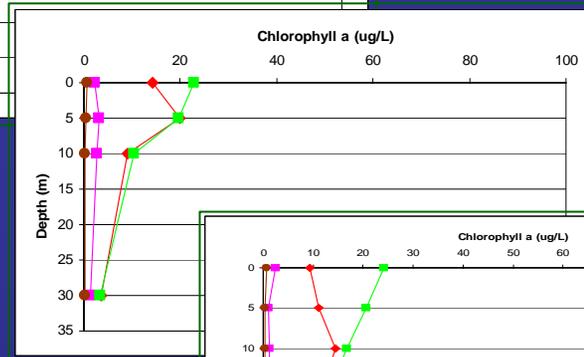
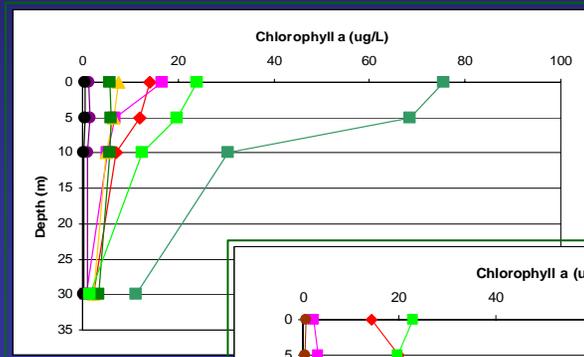
# Surface Chla(ug/l) - Cruise B2



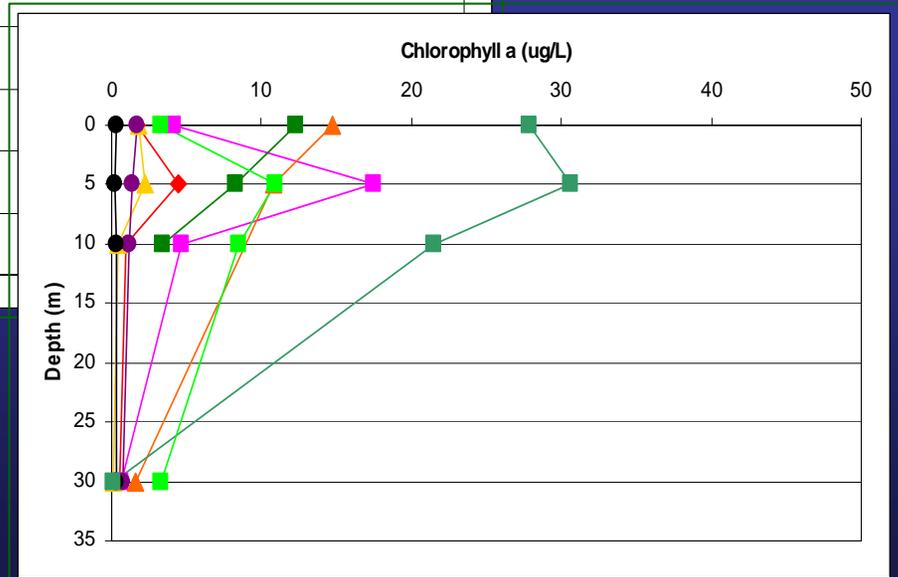
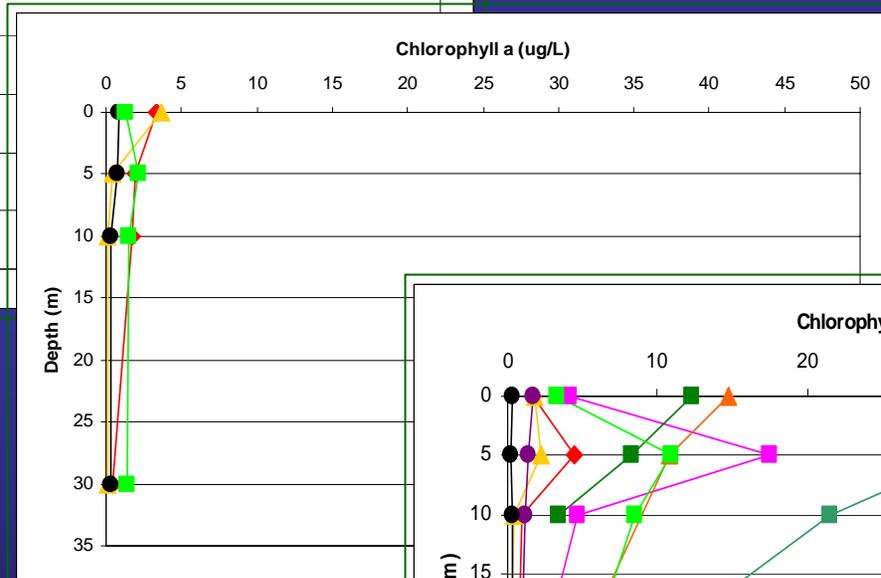
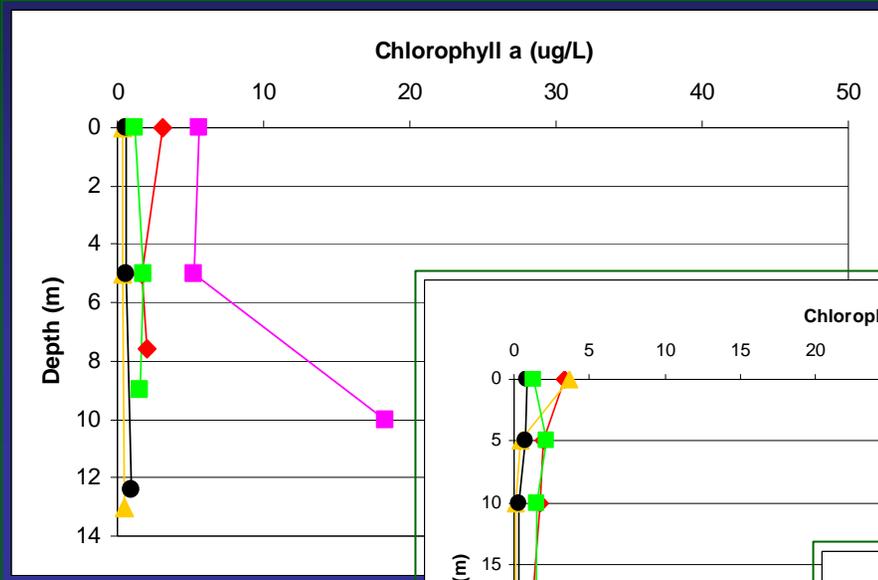
# Case Inlet – Chlorophyll a Concentrations



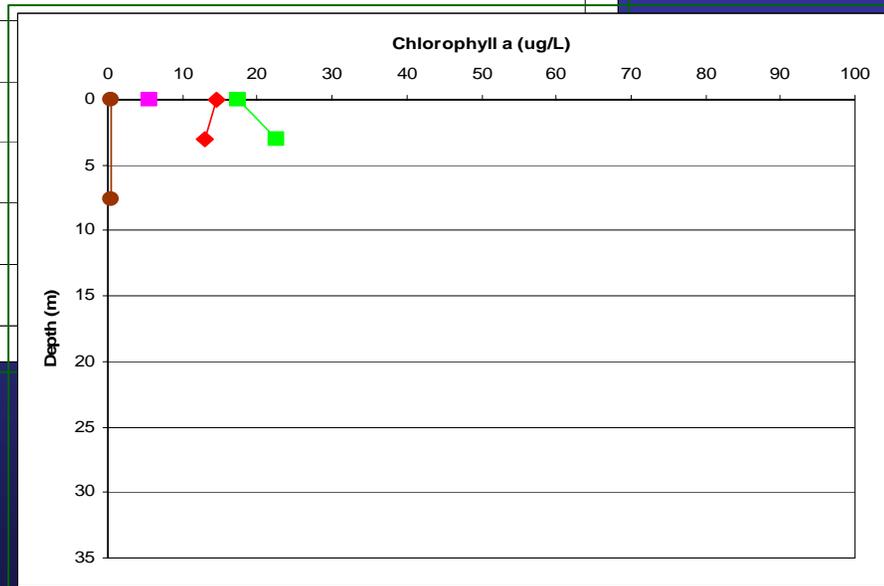
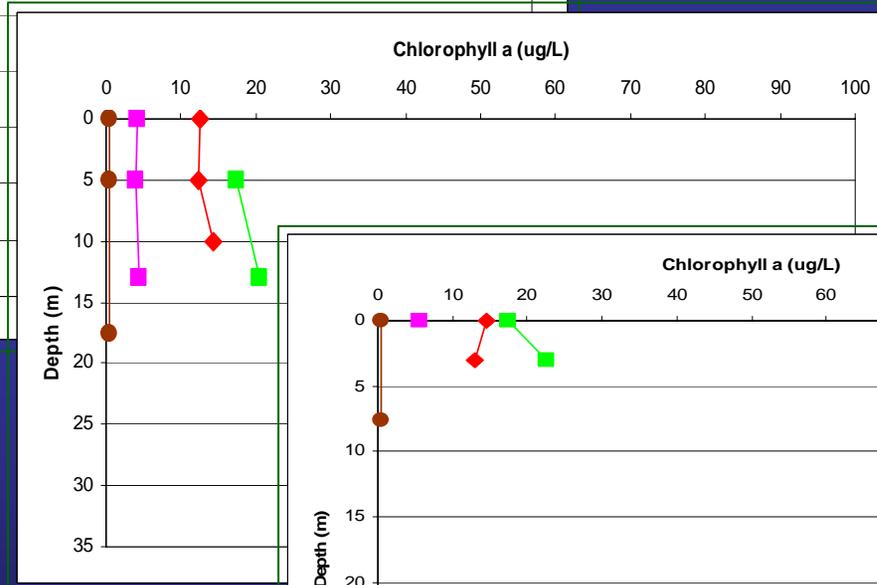
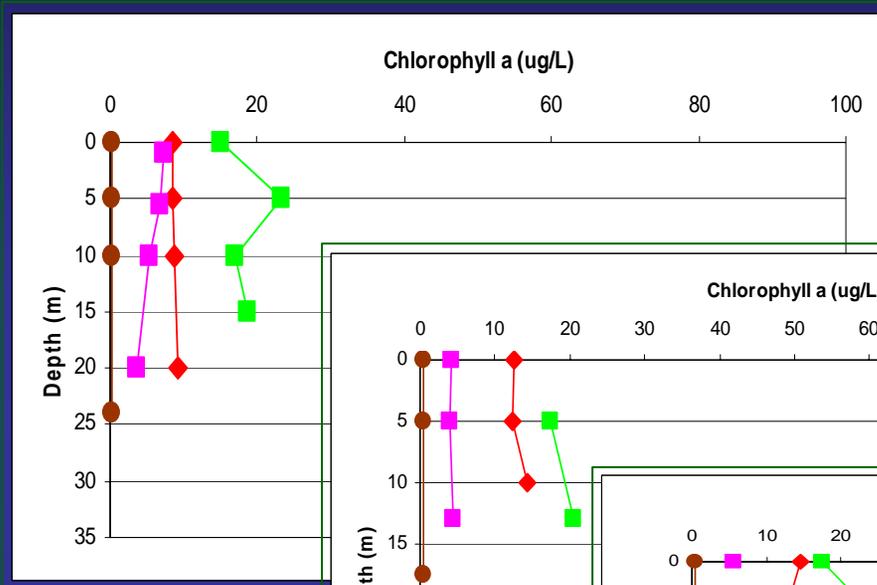
# Case Inlet – Chlorophyll a continued



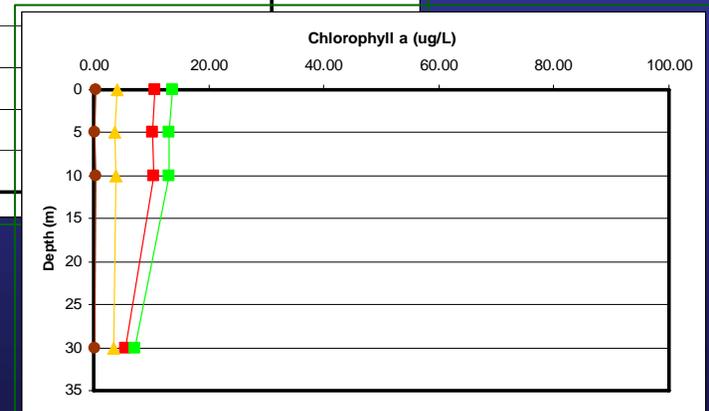
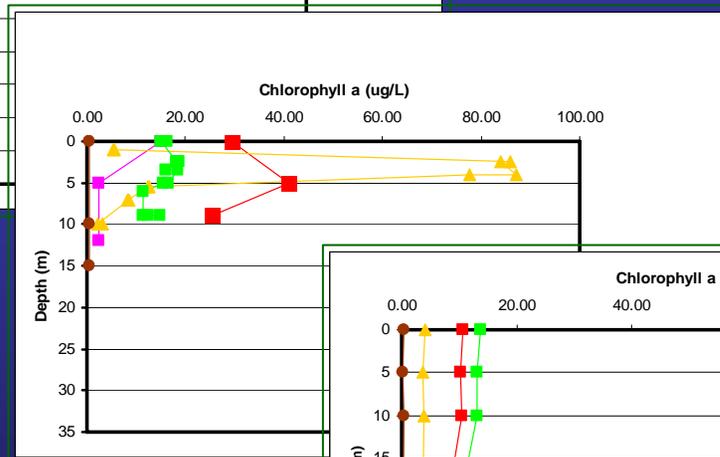
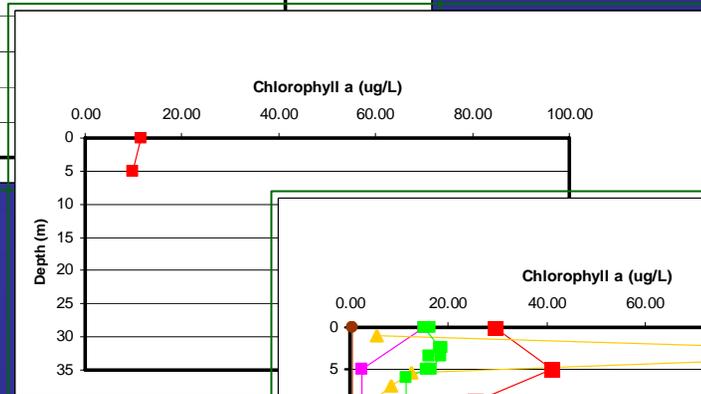
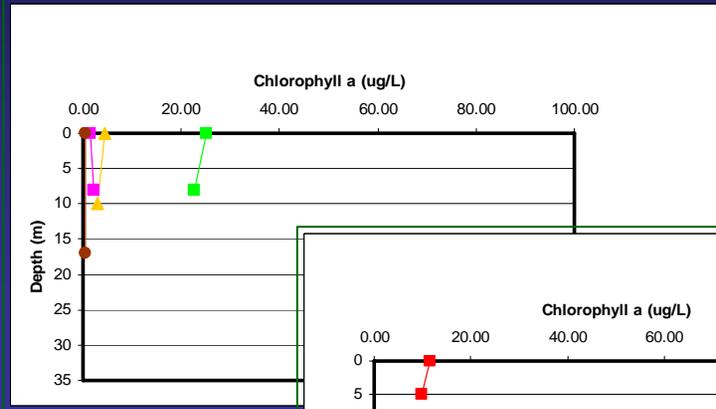
# Carr Inlet – Chlorophyll a Concentrations



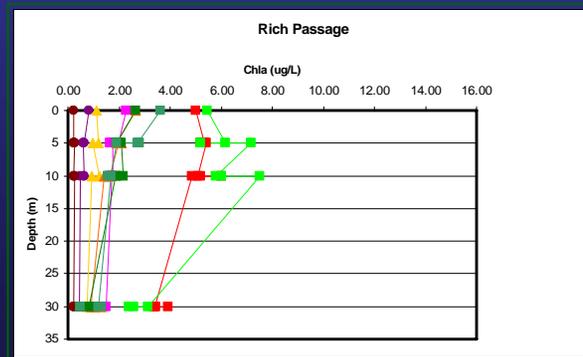
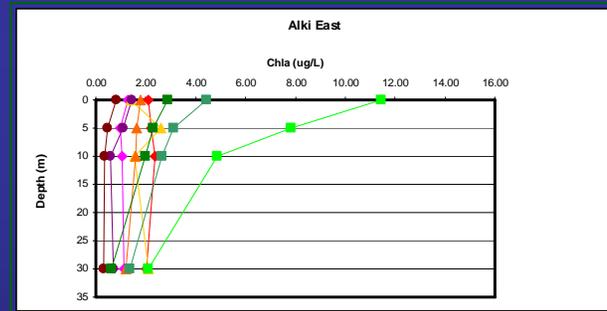
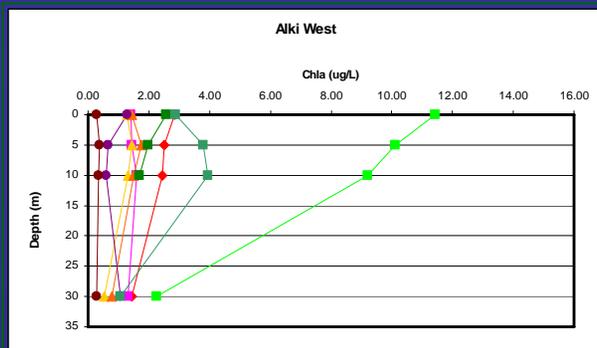
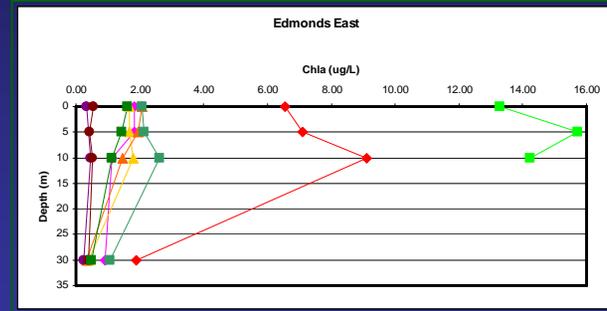
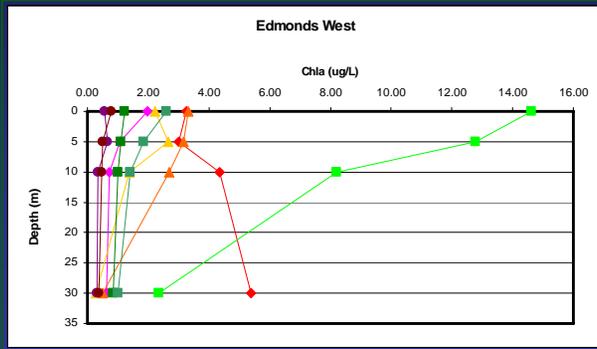
# Hammersley Inlet – Chlorophyll a Concentrations



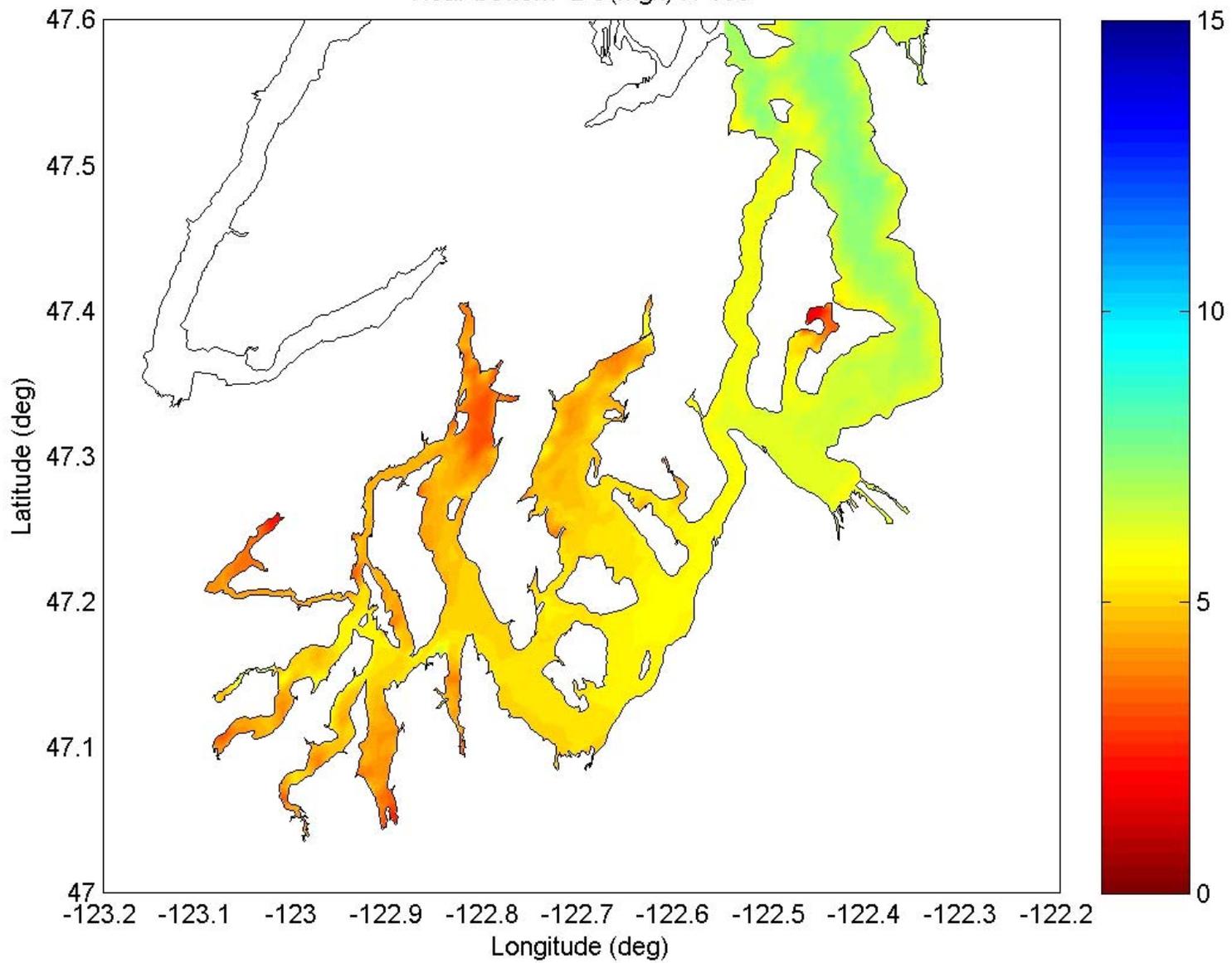
# Budd Inlet – Chlorophyll a Concentrations



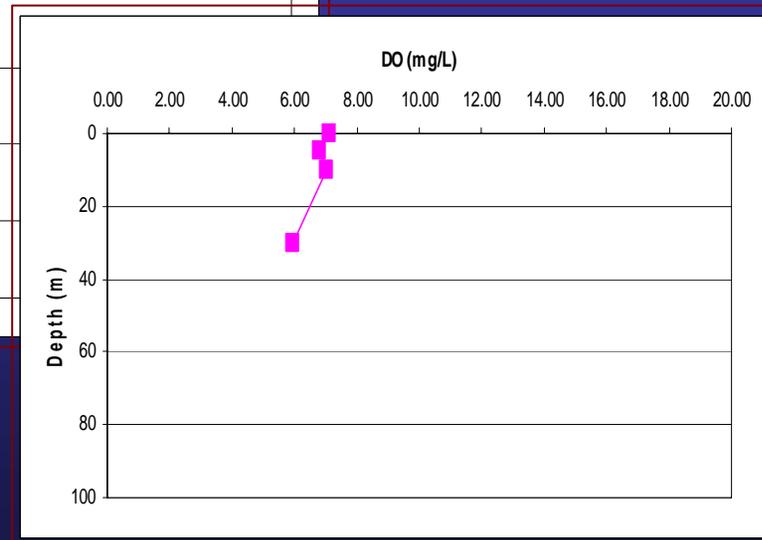
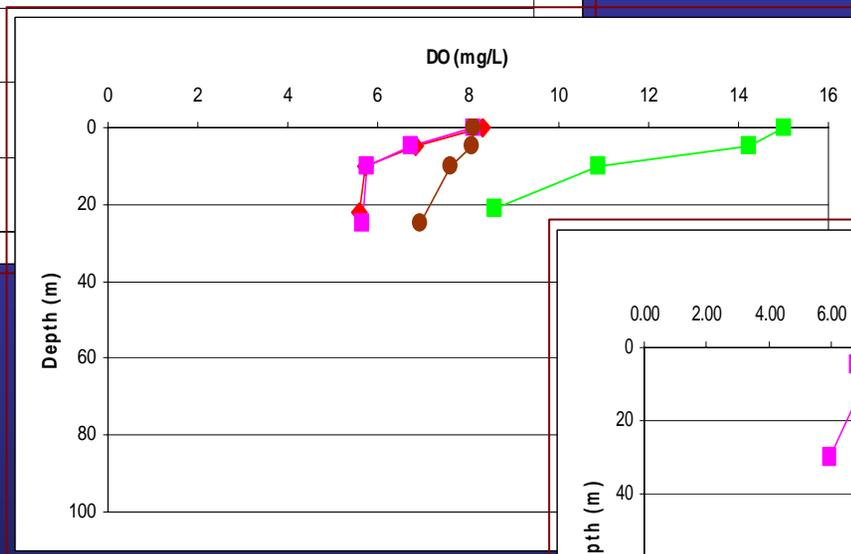
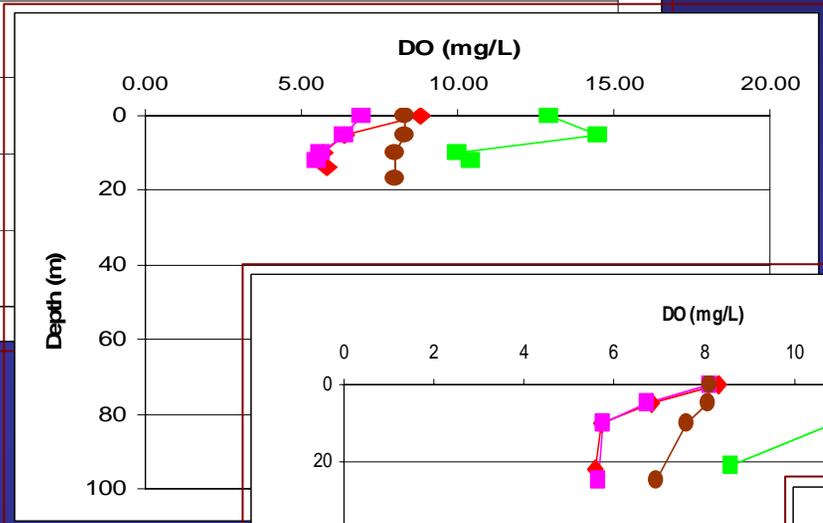
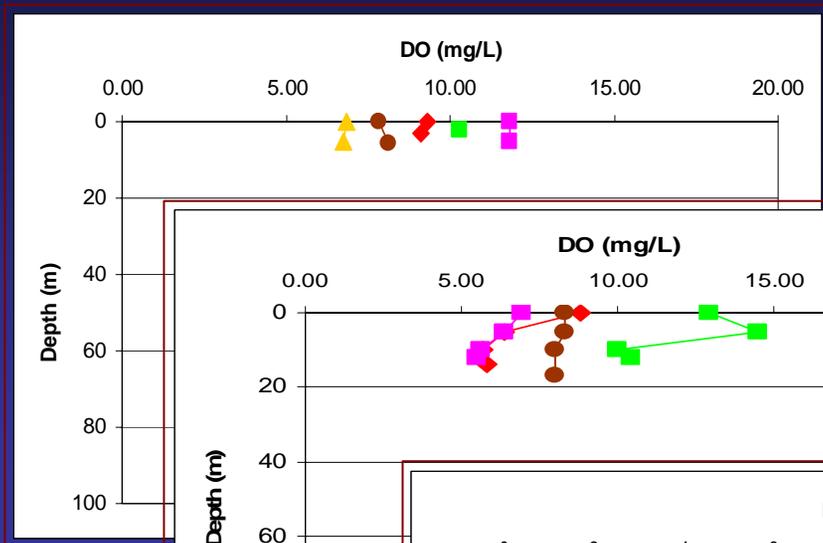
# Boundary Stations - Chlorophyll a Concentrations



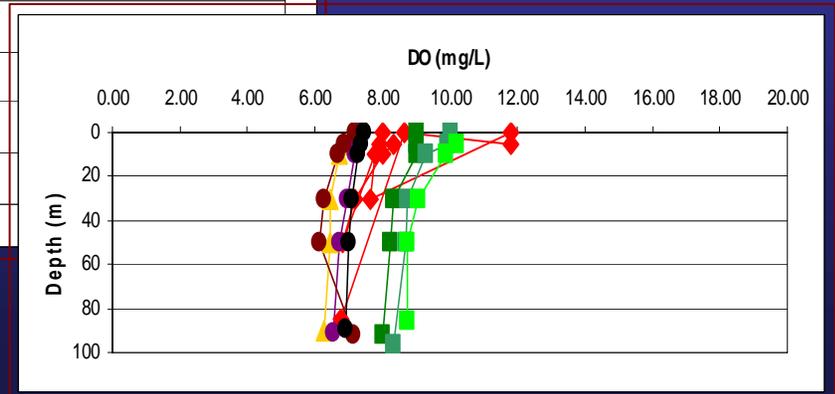
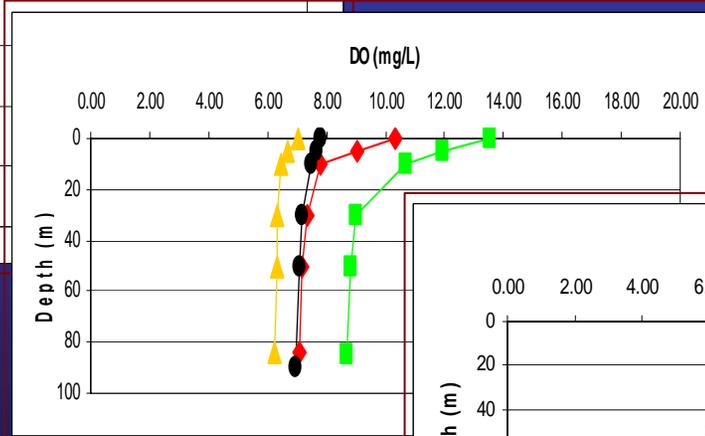
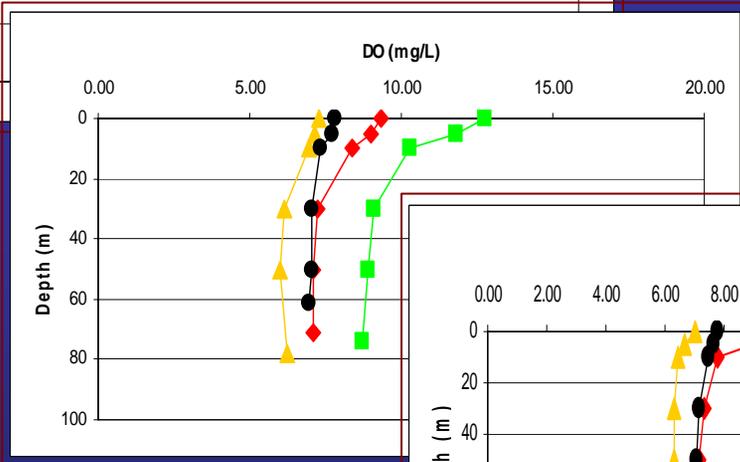
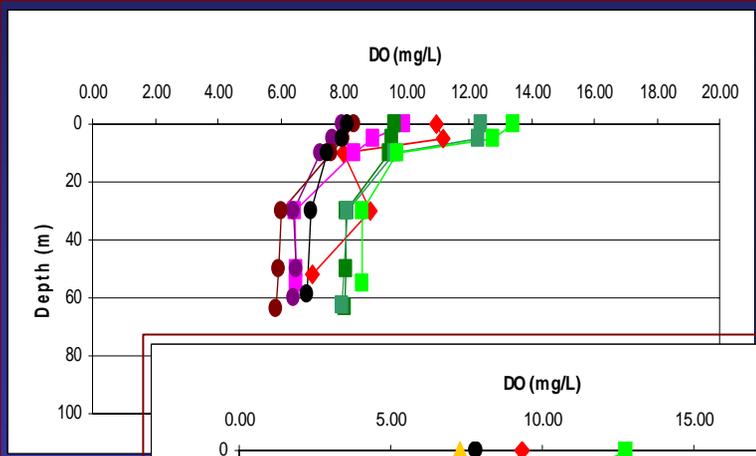
Near-bottom DO(mg/l) N-100



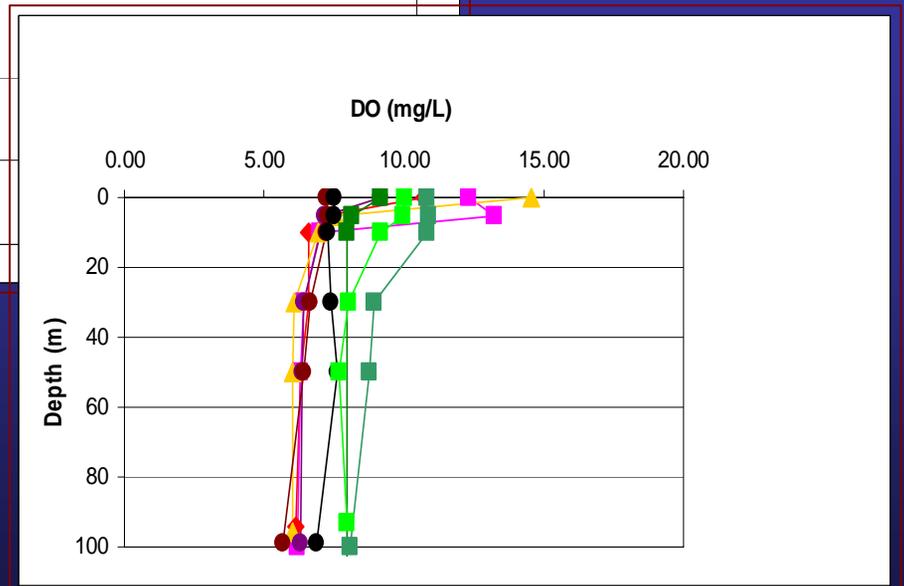
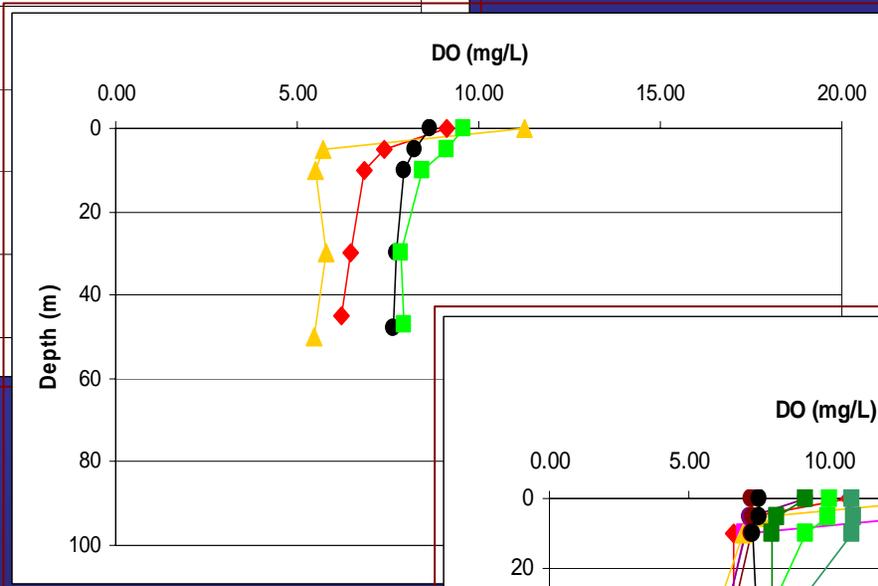
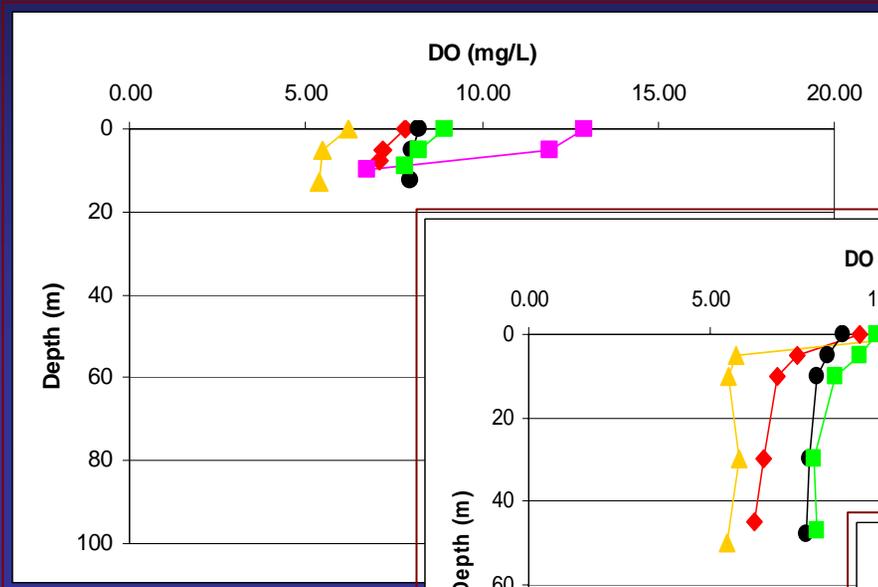
# Case Inlet - Dissolved Oxygen Concentrations



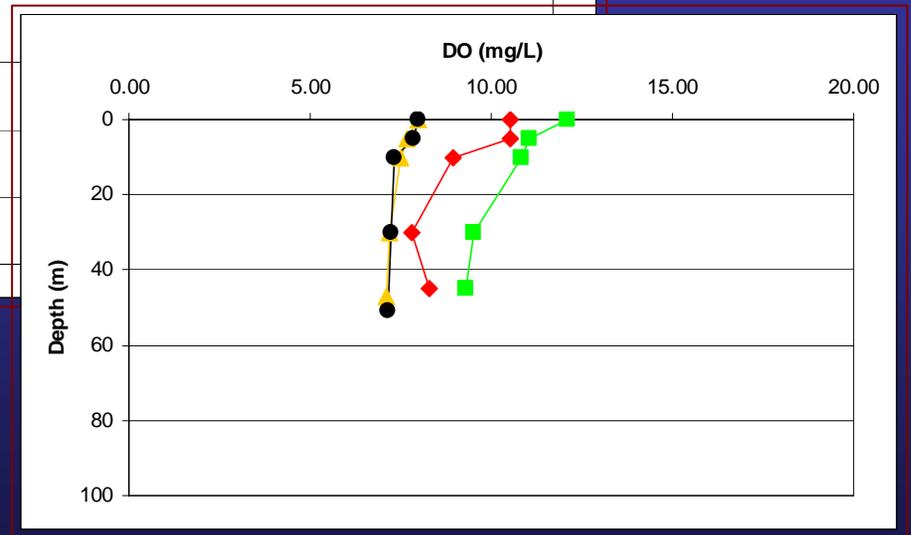
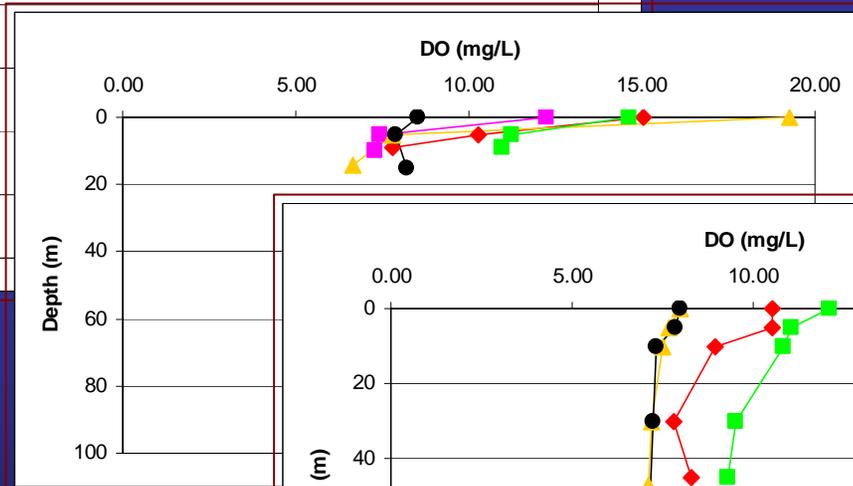
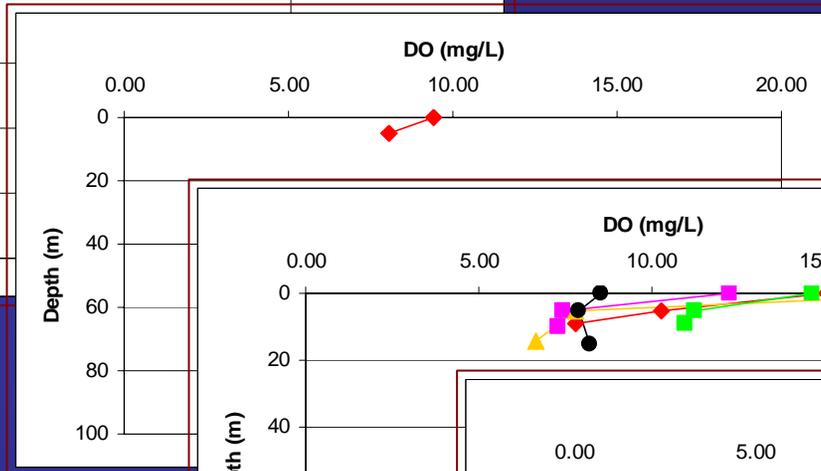
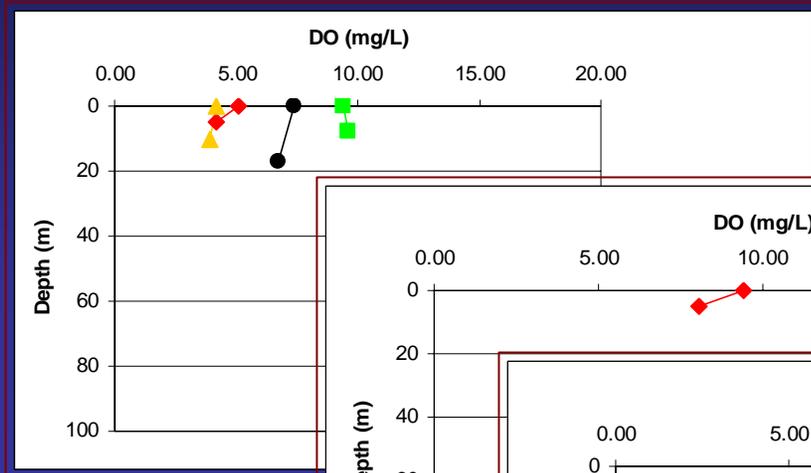
# Case Inlet – Dissolved Oxygen Concentrations continued



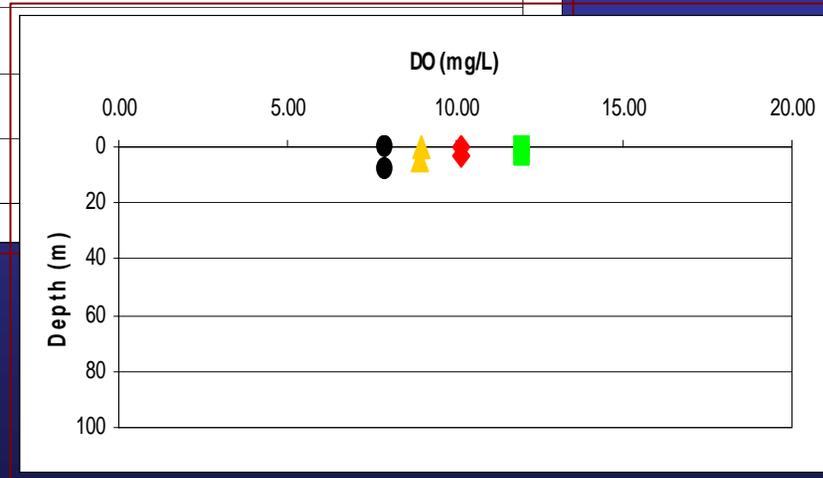
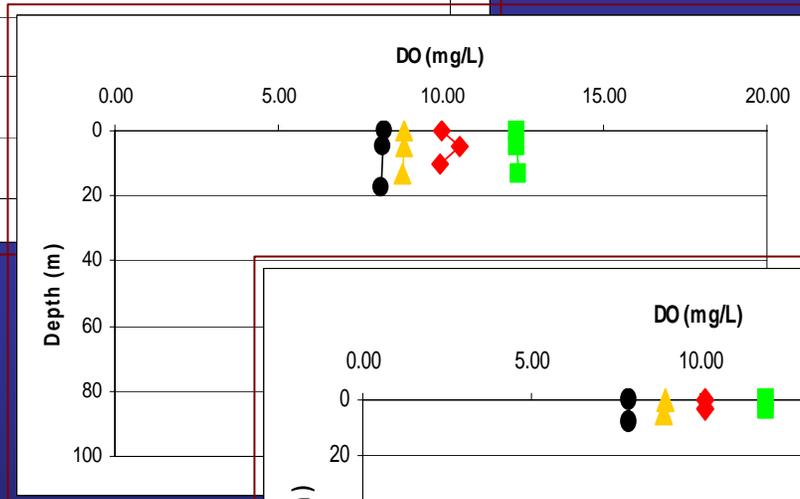
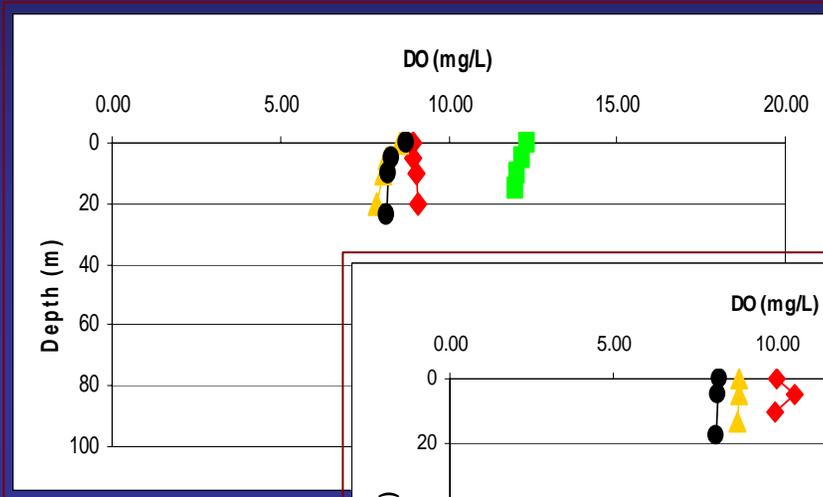
# Carr Inlet – Dissolved Oxygen Concentrations



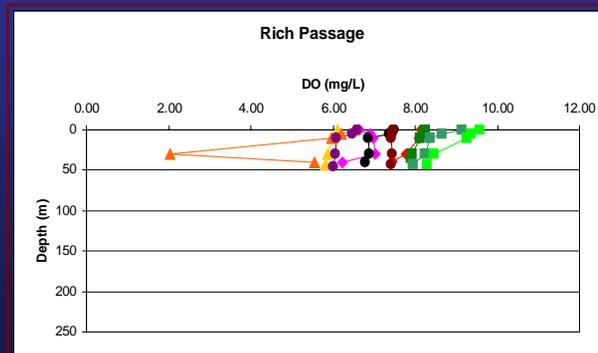
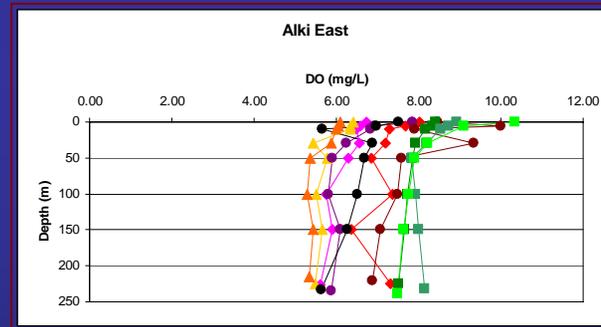
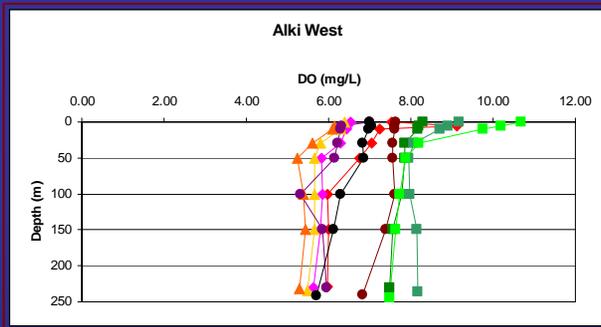
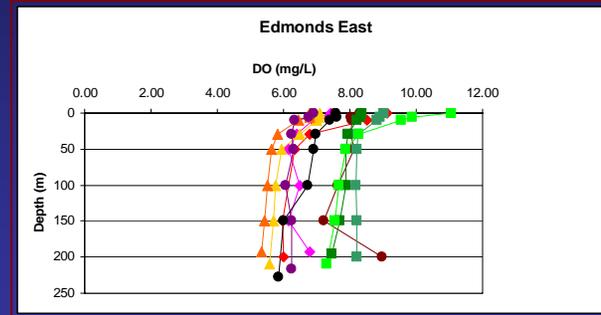
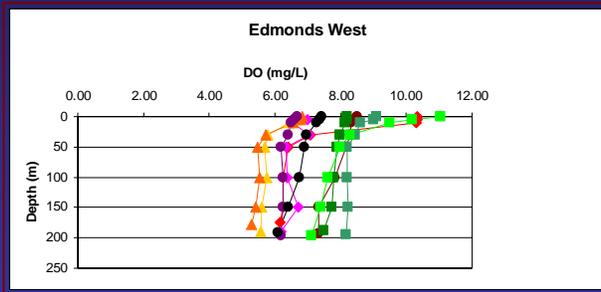
# Budd Inlet – Dissolved Oxygen Concentrations

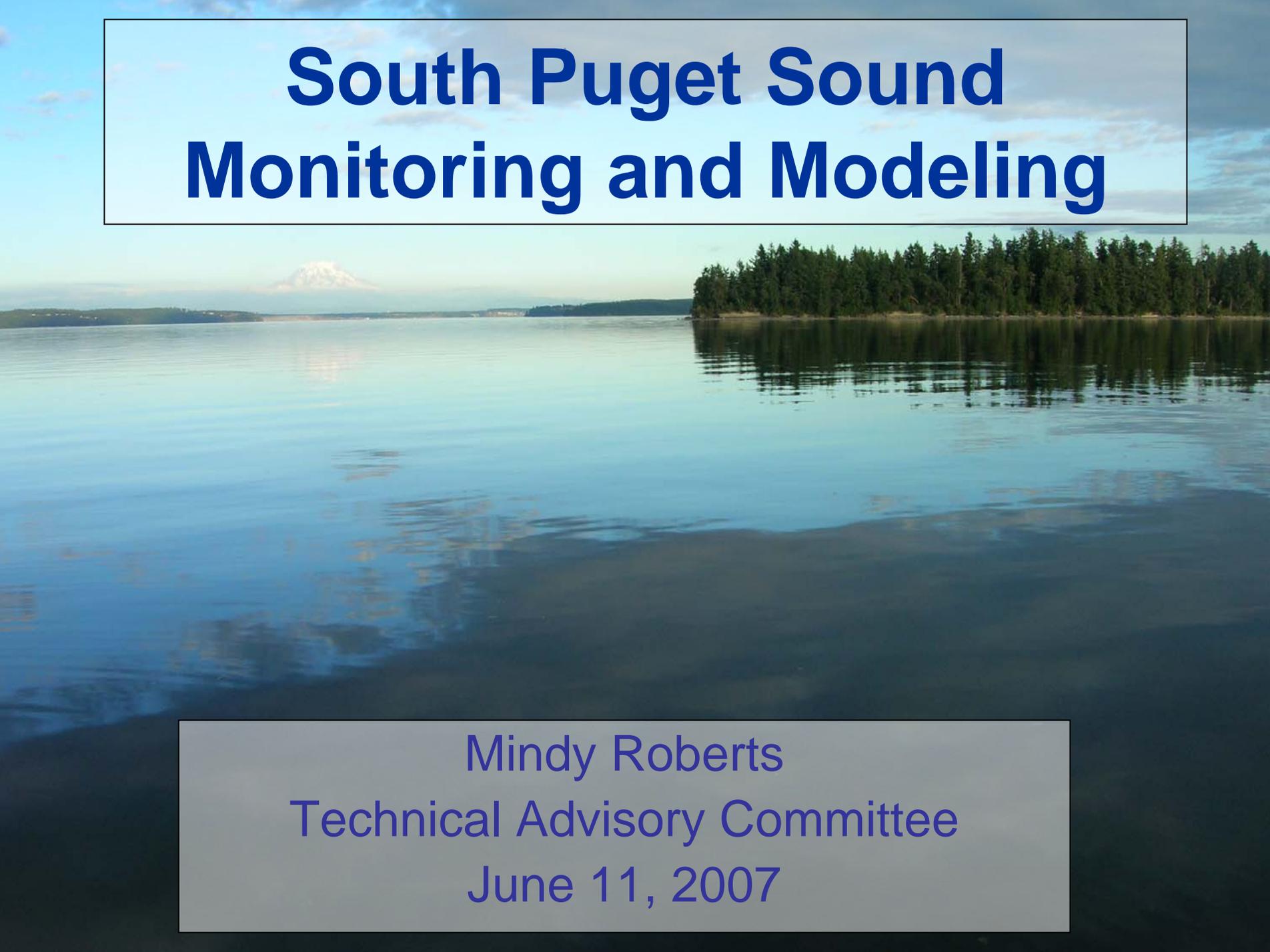


# Hammersley Inlet – Dissolved Oxygen Concentrations



# Boundary Stations - Dissolved Oxygen Concentrations





# South Puget Sound Monitoring and Modeling

Mindy Roberts  
Technical Advisory Committee  
June 11, 2007

# Presentation overview

- Monitoring results
  - WWTPs
  - Tributaries
- Other study components
  - Meteorological stations
  - Sediment flux study approach

# Results to date

- <http://www.ecy.wa.gov/eim/>
  - User Study ID
    - MROB0004 (fresh)
    - SPSMEM\_M (marine)
  - “get results”
  - Provisional only (until QA/QC complete)
  - Dissolved total phosphorus and nitrogen are not identified correctly

# WWTP monitoring

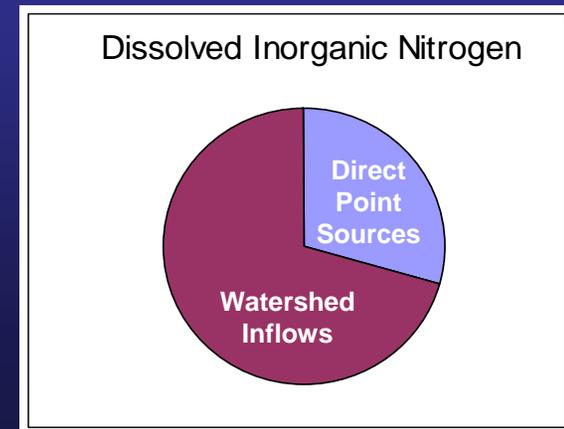
## Summary of WWTP Characteristics

South Puget Sound DO Study

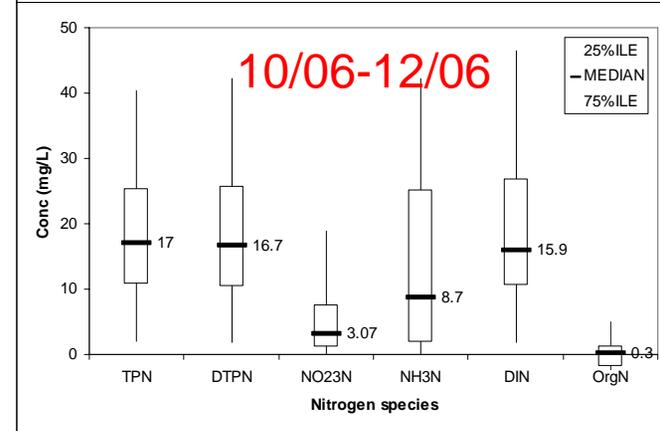
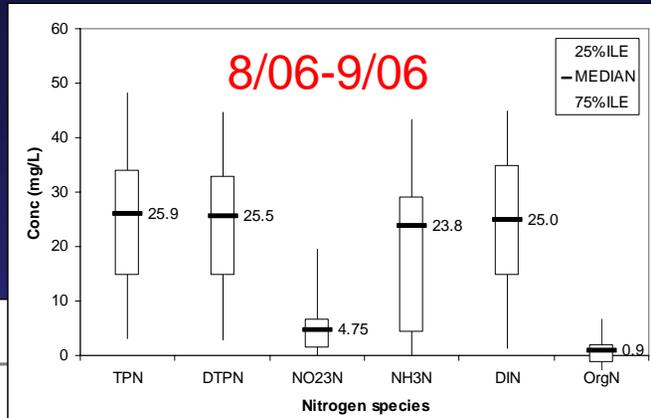
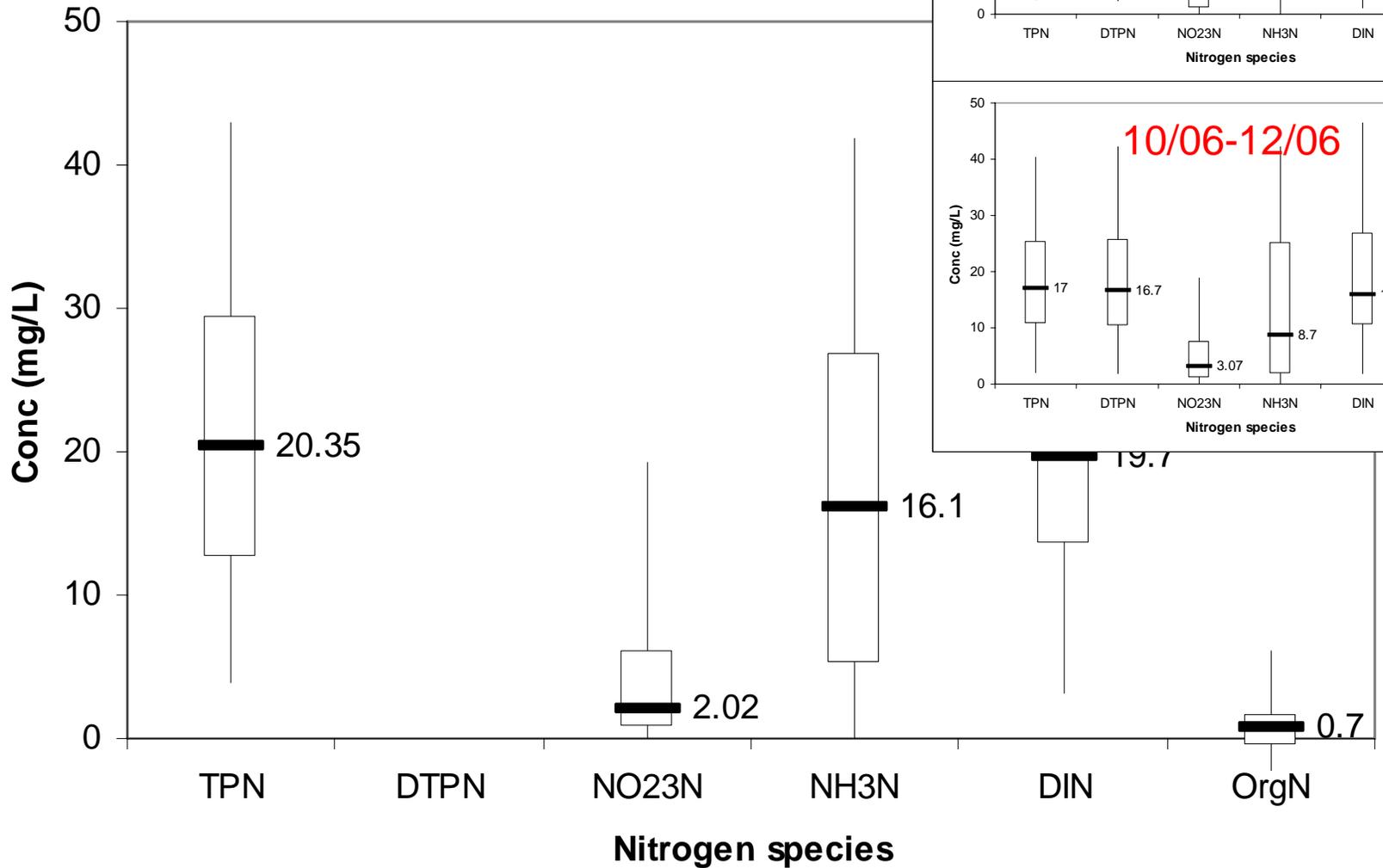
Plant Name	ongoing?	Region	Writer	Permit No.	Effective Date	Expires	Parameter limits	Reporting parameters	Design criteria
<b>MUNICIPAL WASTEWATER</b>									
Beverly Beach		SWRO	(Dave Dougherty)	<b>inactive; to Tamoshan</b>					
Blake Island/WA Parks		NWRO	(Bernard Jones)	<b>inactive</b>					
Boston Harbor	x	SWRO	Dave Dougherty	WA004029	7/1/2006	6/30/2011	BOD5, TSS, FC, pH	Q, BOD5, TSS, FC, NH3 (A), DO, pH, sludge (gal, %solids)	Q <sub>maxmo</sub> 0.054 mgd; popn 600
Bremerton	x	NWRO	Mike Dougherty	WA002928	10/1/2000	9/30/2011	BOD5, TSS, FC, pH, toxicity	Q, BOD5, TSS, FC, NH3 (H), DO, pH, toxicity, NO3N (I), TP (J), NO23N (I)	Q <sub>maxmo</sub> 10.1 mgd
Carlyon Beach		SWRO	Dave Dougherty	WA0037915	7/1/2007	6/30/2012	BOD5, TSS, FC, pH	Q, BOD5, TSS, FC, NH3 (H)	Q <sub>maxmo</sub> 0.060 mgd
Central Kitsap	x	NWRO	Mike Dougherty	WA003052	1/1/2007	12/31/2012	BOD5, TSS, FC, pH	Q, BOD5, TSS, FC, NH3 (H); DO, pH, toxicity, NO3N, NO23N, TP (J)	Q <sub>maxmo</sub> 6.0 mgd
Chambers Creek	x	SWRO	Glenn	WA0039624	1/1/2003	12/31/2007	BOD5, TSS, FC, pH, toxicity	Q, CBOD5, BOD5, TSS, PPM, Temp, FC, pH, chlorine, NH3 (B), DO	Q <sub>maxmo</sub> 28.7 mgd
Fort Lewis/Solo Point		EPA	Dave Ragsdale	WA0021954	12/30/2003	2/1/2009	CBOD5, TSS, FC, pH, Cl	Q, BOD5, TSS, pH, Cl, FC, TN (K)	<b>*not listed in permit*</b>

See handout

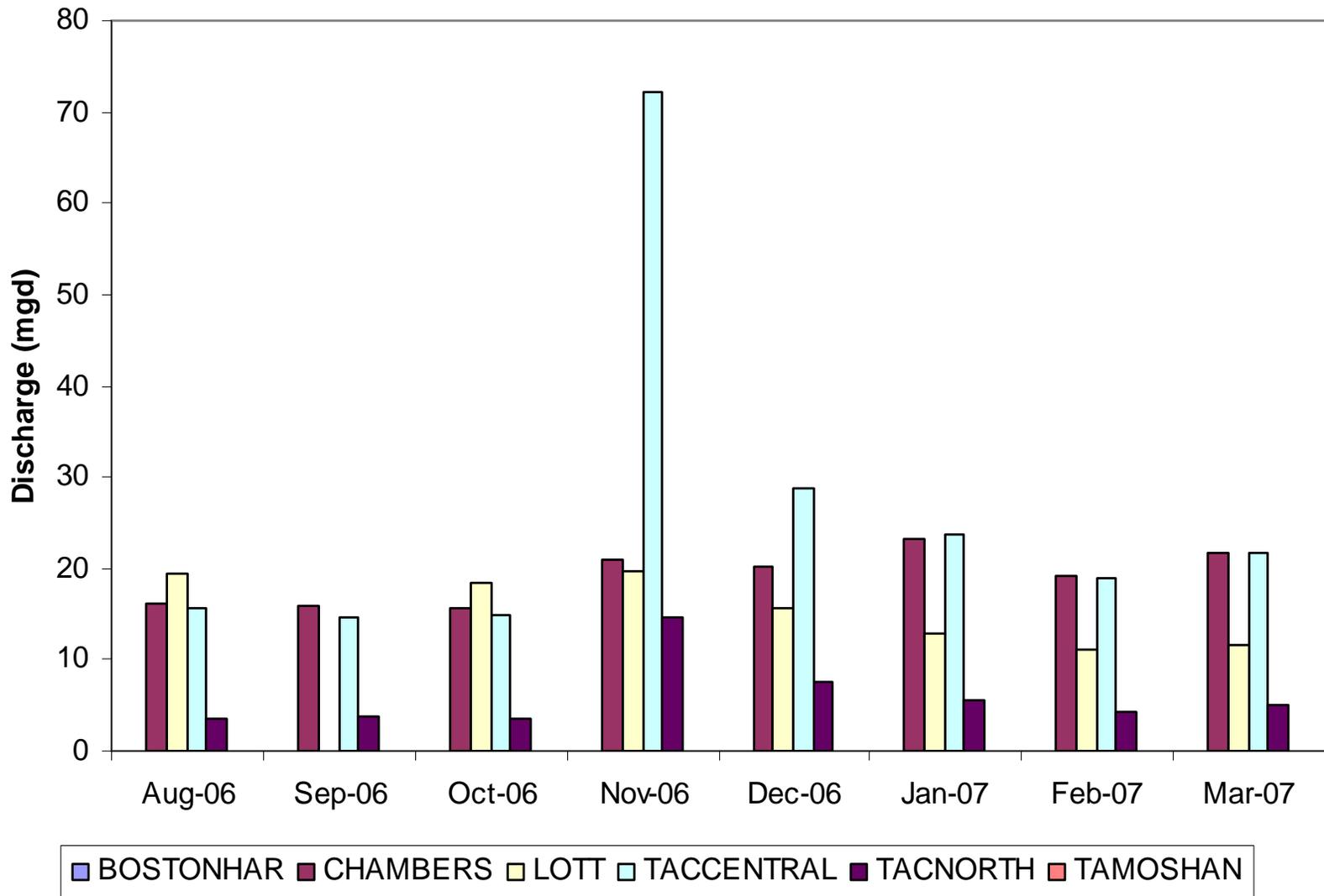
- *South Sound Phase 1 DIN loads:*
  - 4,200 kg/d (1,700 tons/yr)



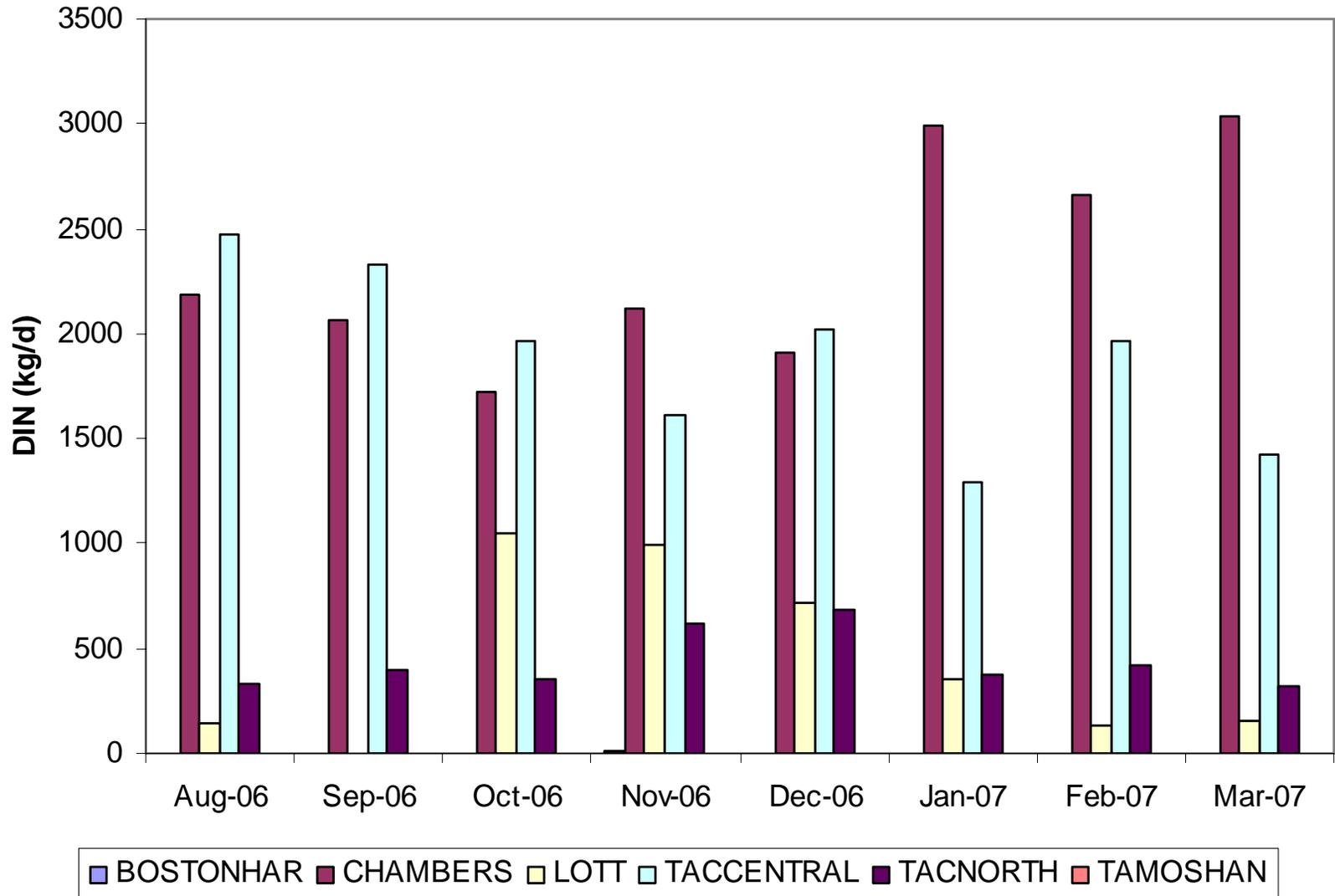
# Nitrogen (1/07-3/07)



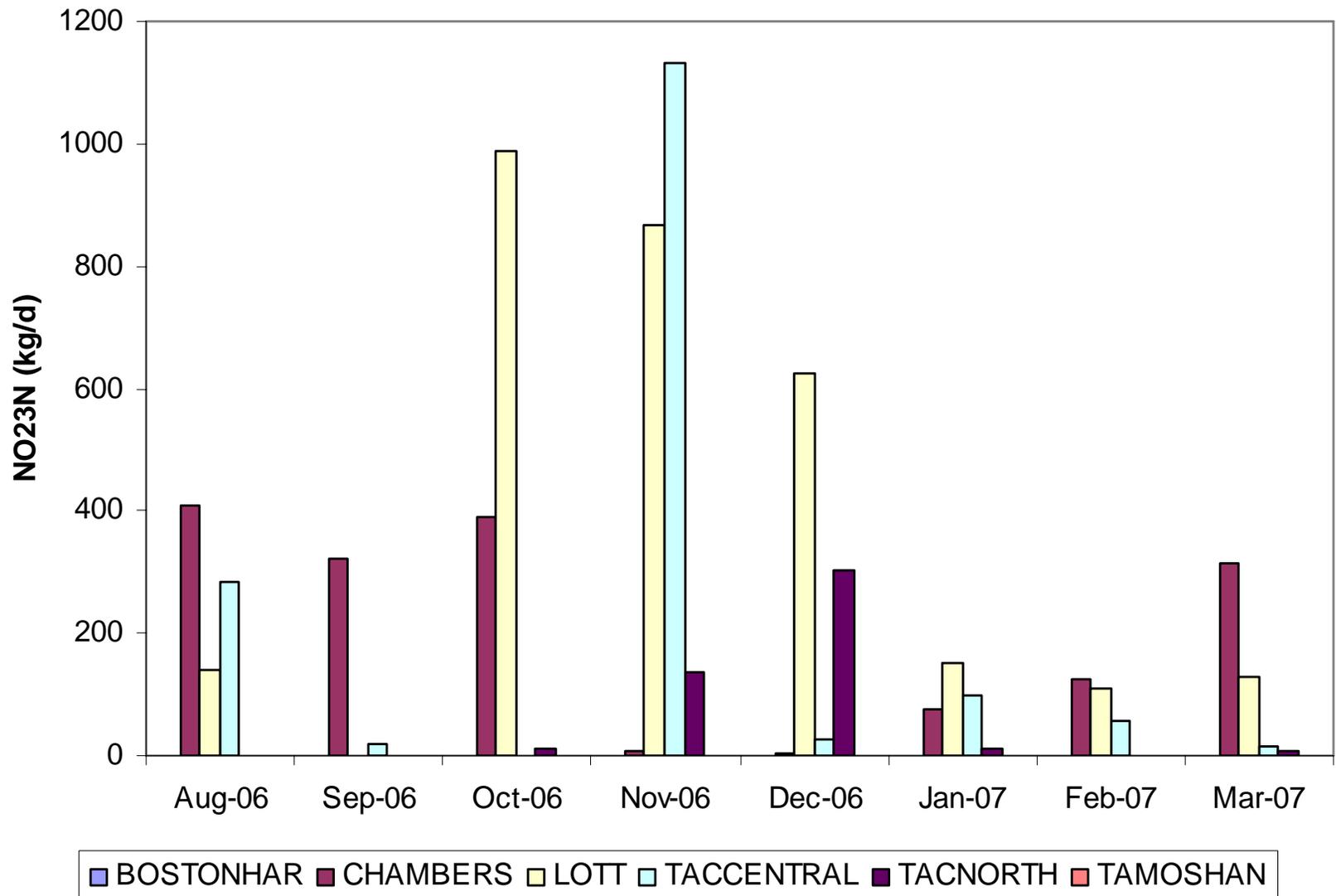
# WWTP Discharge



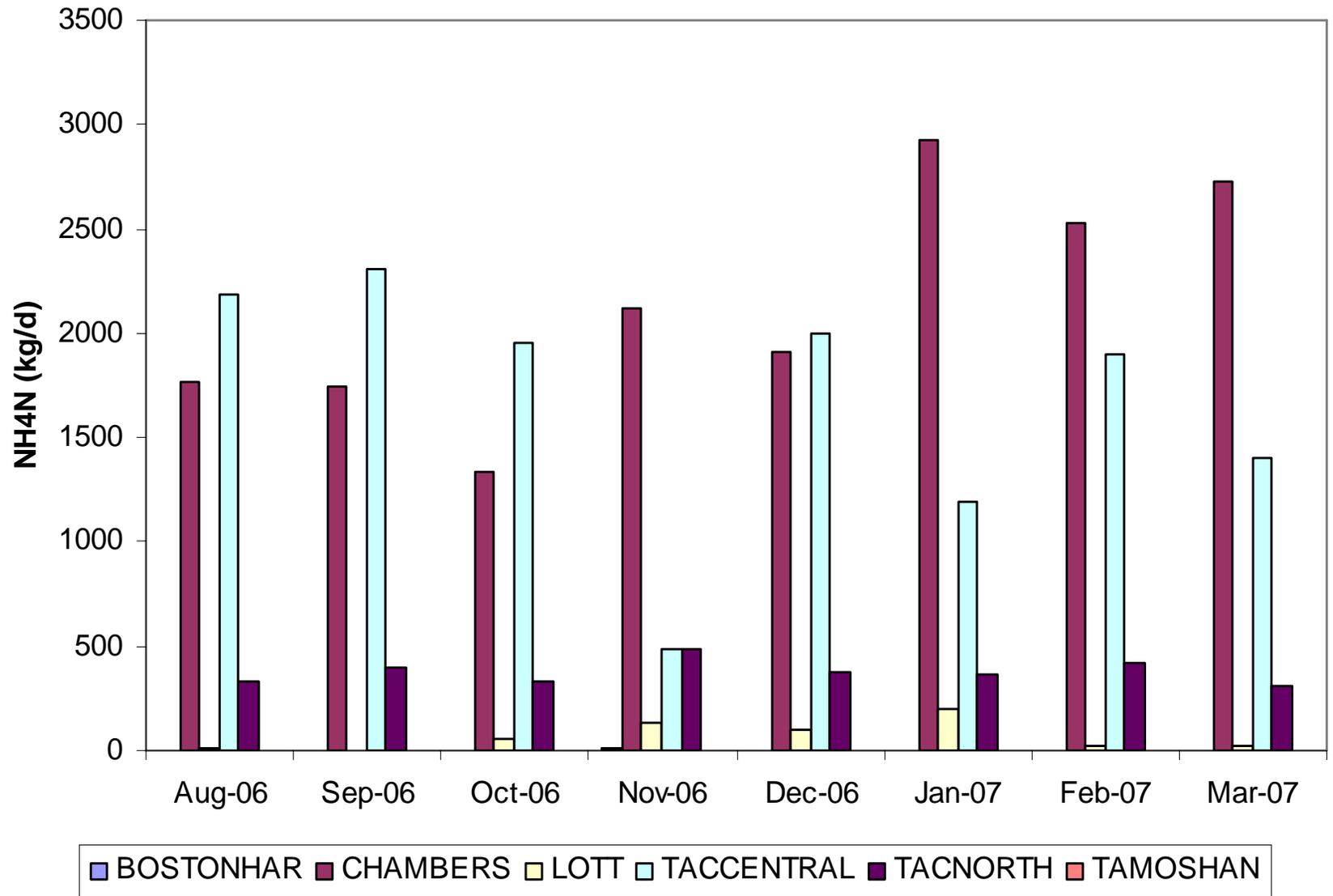
# WWTP DIN



# WWTP Nitrate + Nitrite

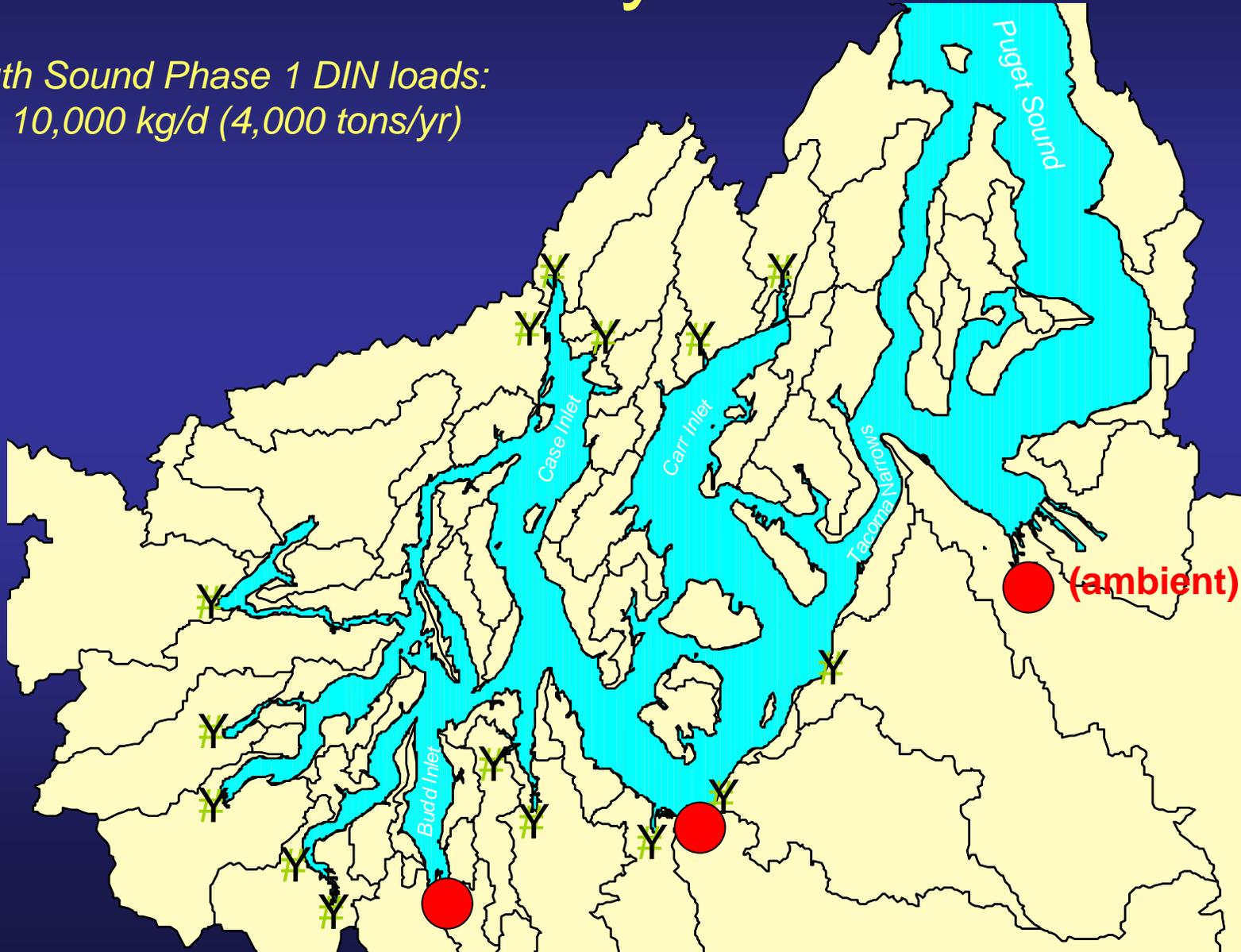


# WWTP Ammonium

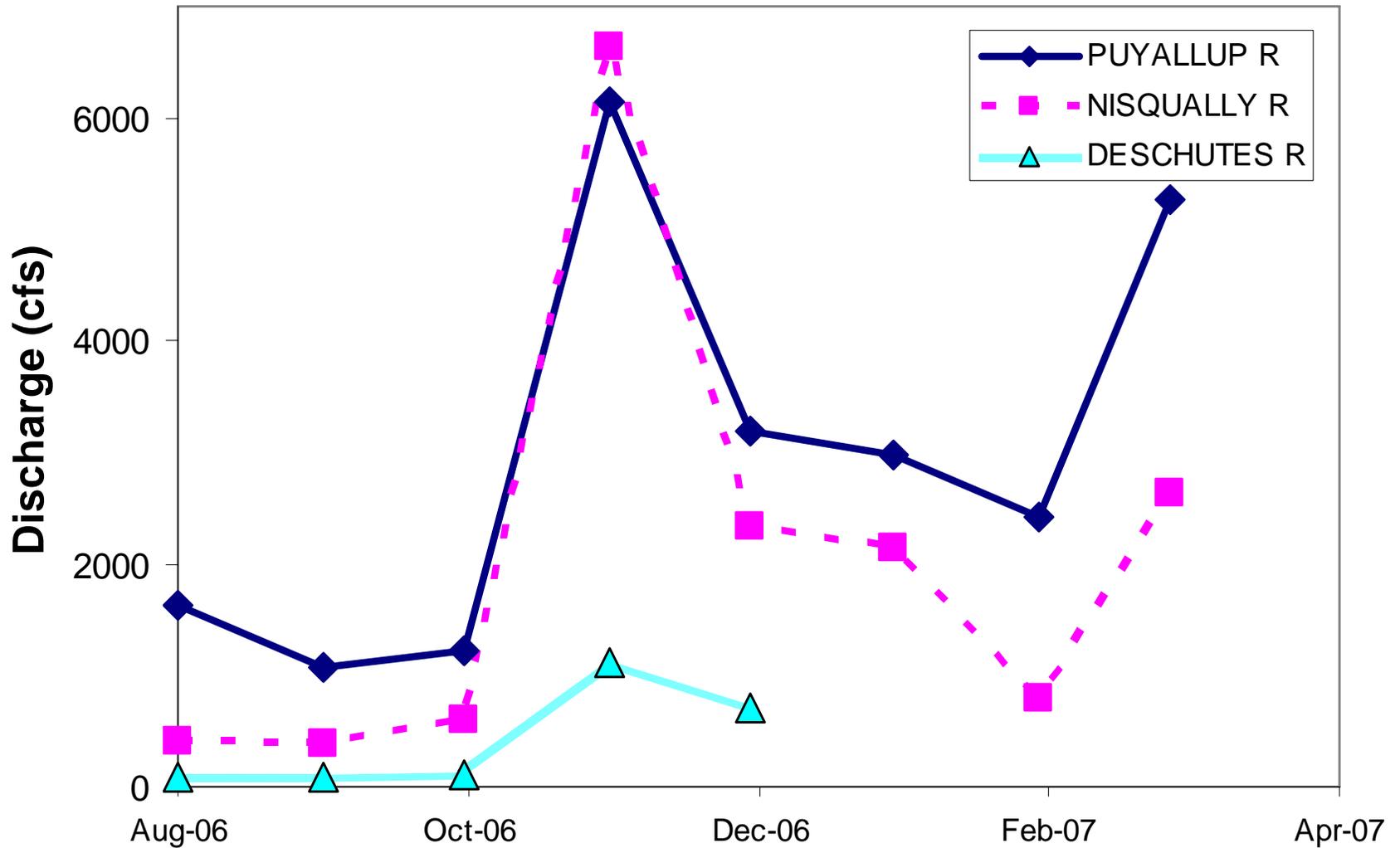


# Tributary inflows

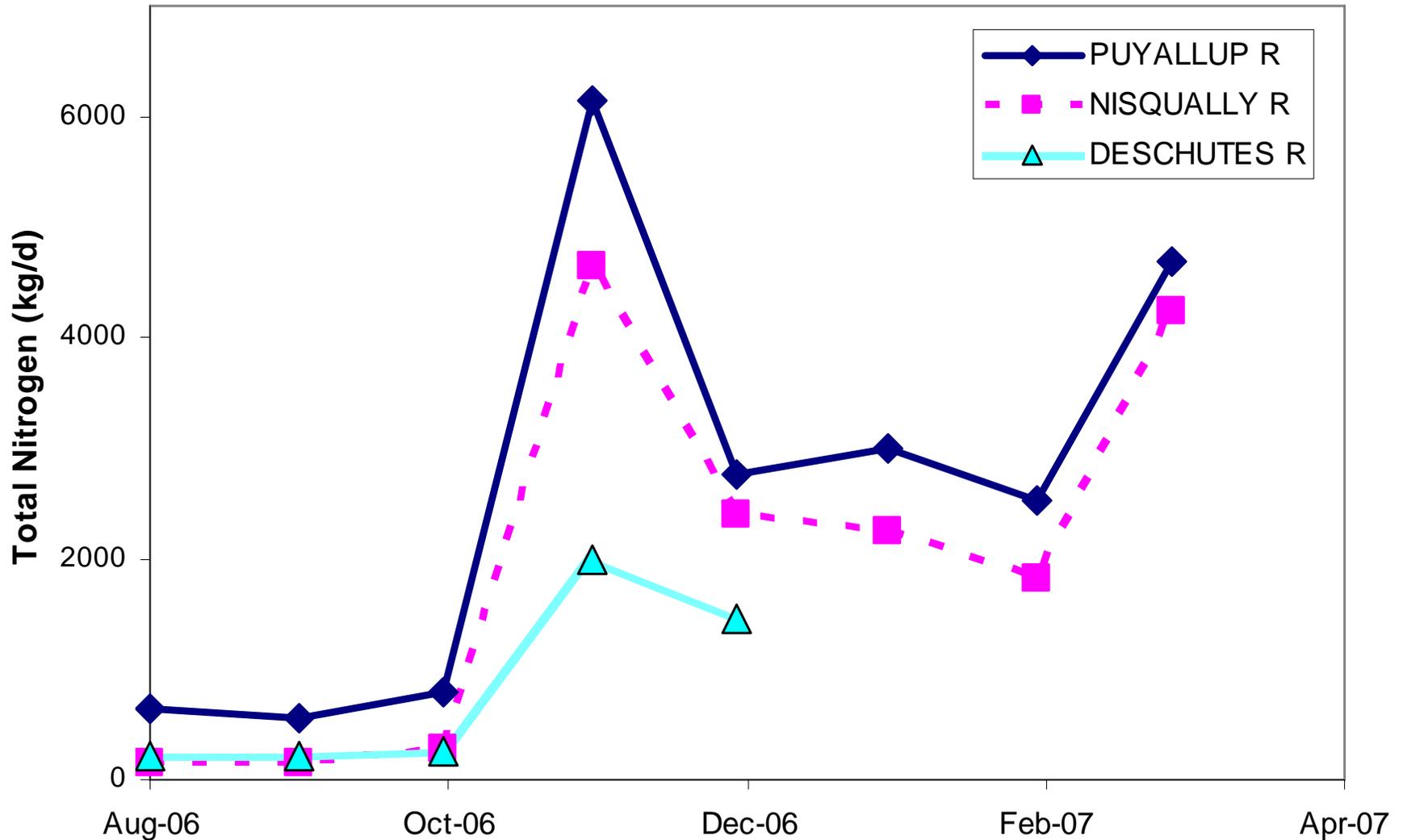
South Sound Phase 1 DIN loads:  
10,000 kg/d (4,000 tons/yr)



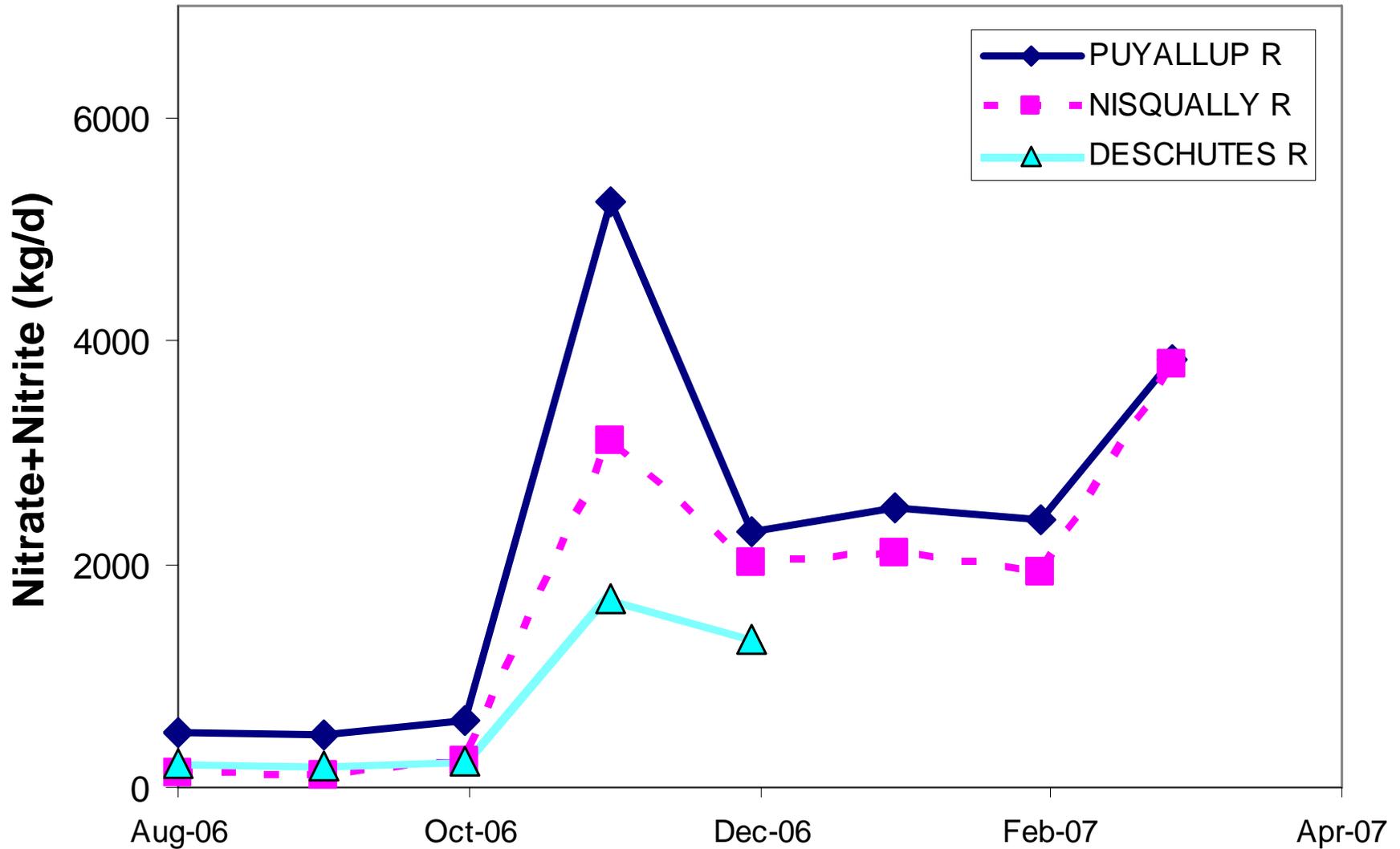
# Discharge



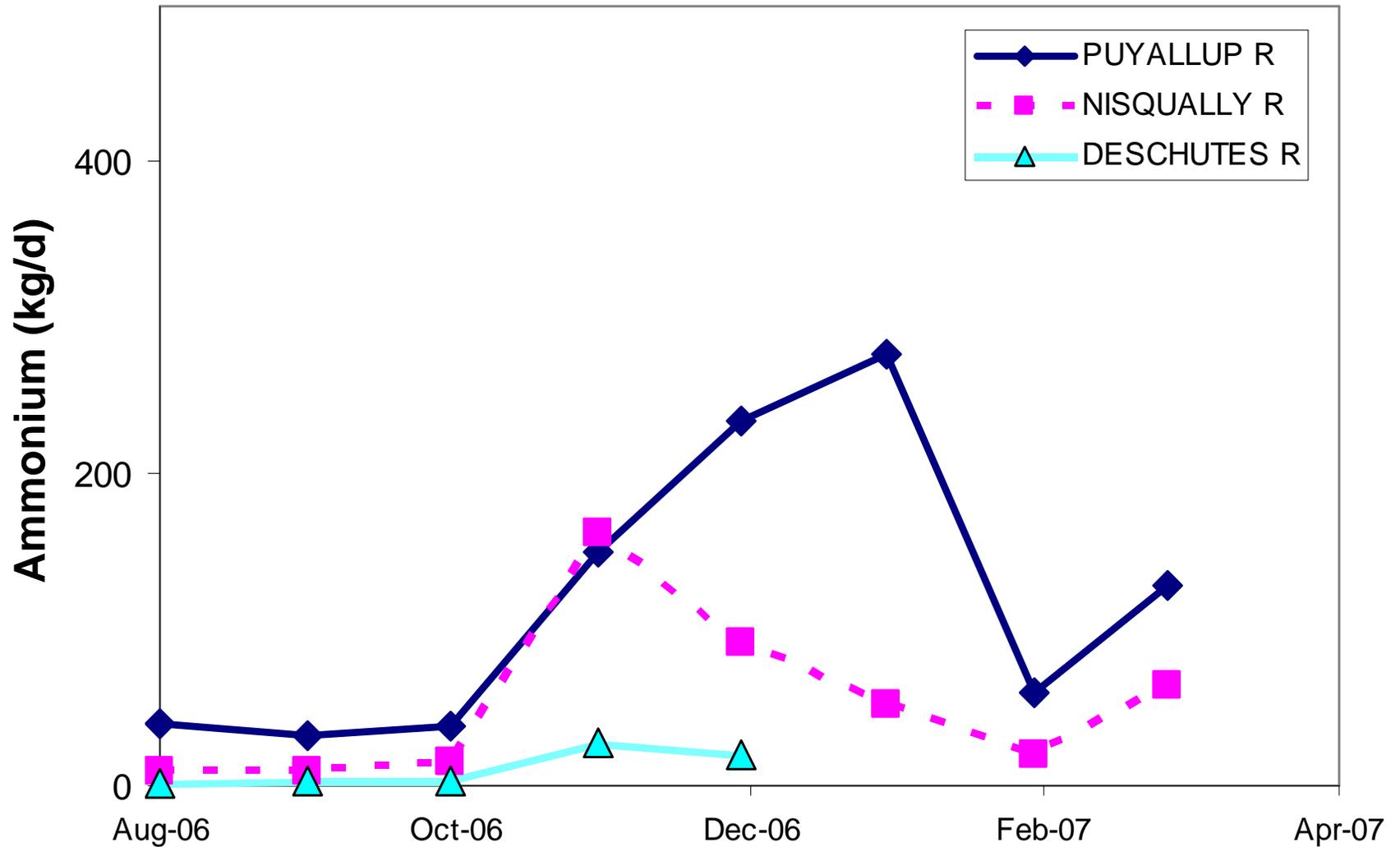
# River Total Nitrogen



# River Nitrate + Nitrite



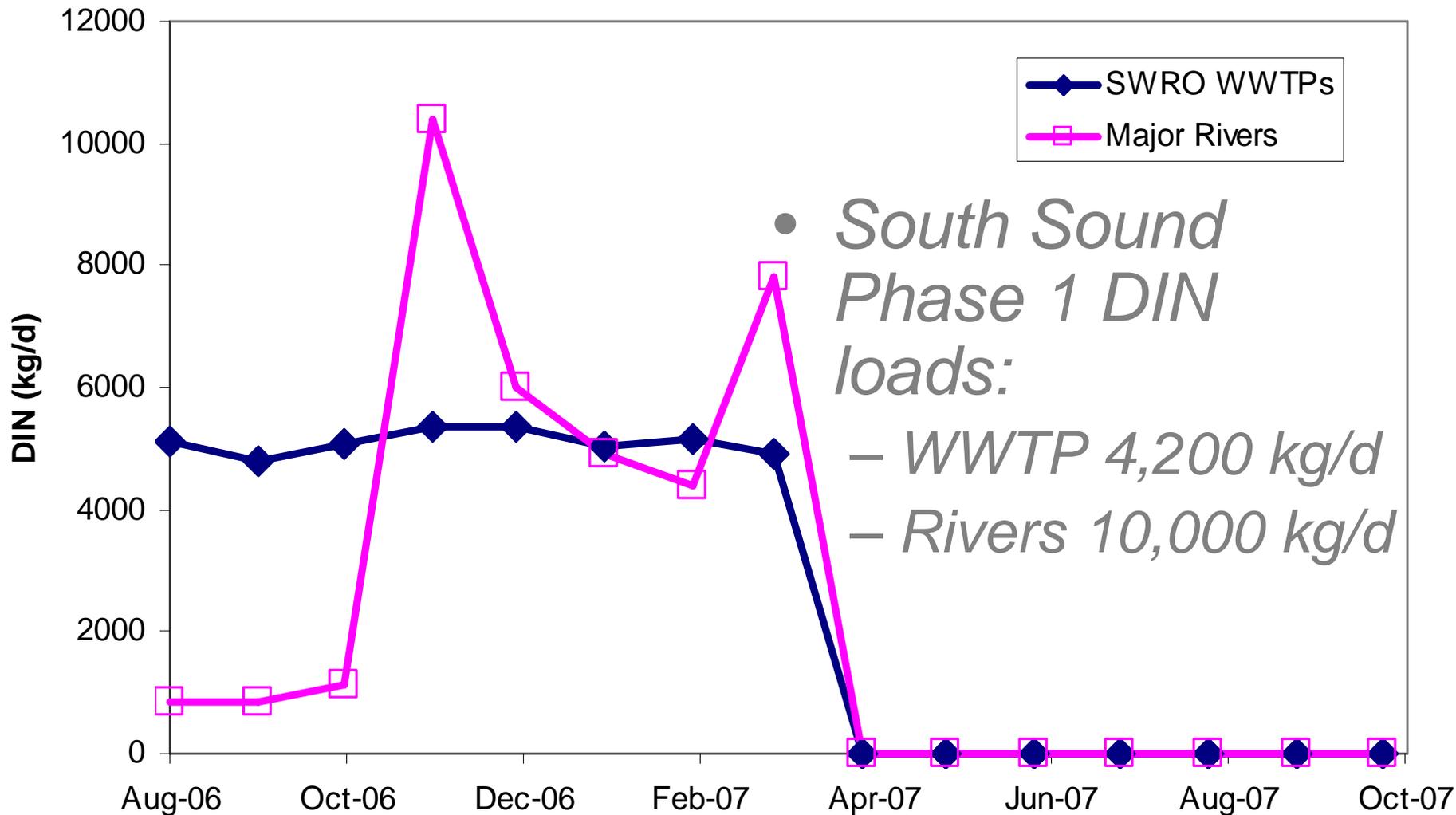
# River Ammonium



# Tributary results to date

- Concentration hot spots?
  - Puyallup, Deschutes, Burley, Chambers, McAllister, Woodard, Woodland
- Load hot spots?
  - Puyallup, Nisqually
- *Loads for remaining tribs will be estimated from flow and concentration*

# SWRO WWTPs vs. Major Rivers

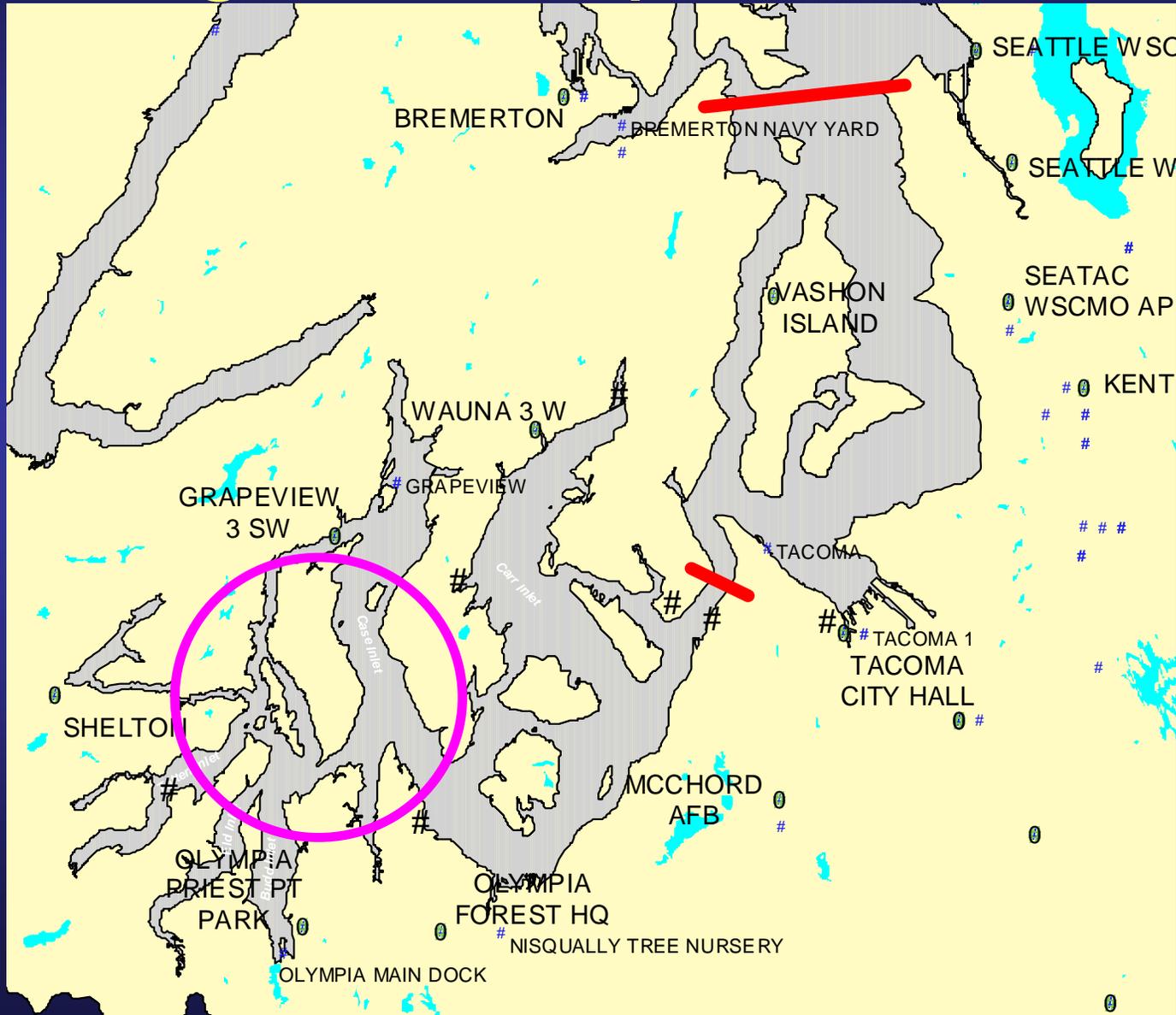


# Meteorological Stations

- Purchasing four stations
  - Campbell Scientific
  - Davis Instruments
- Sensors
  - Wind speed and direction
  - Temperature (air and dewpoint)
  - Precipitation
  - Relative humidity
  - Solar radiation

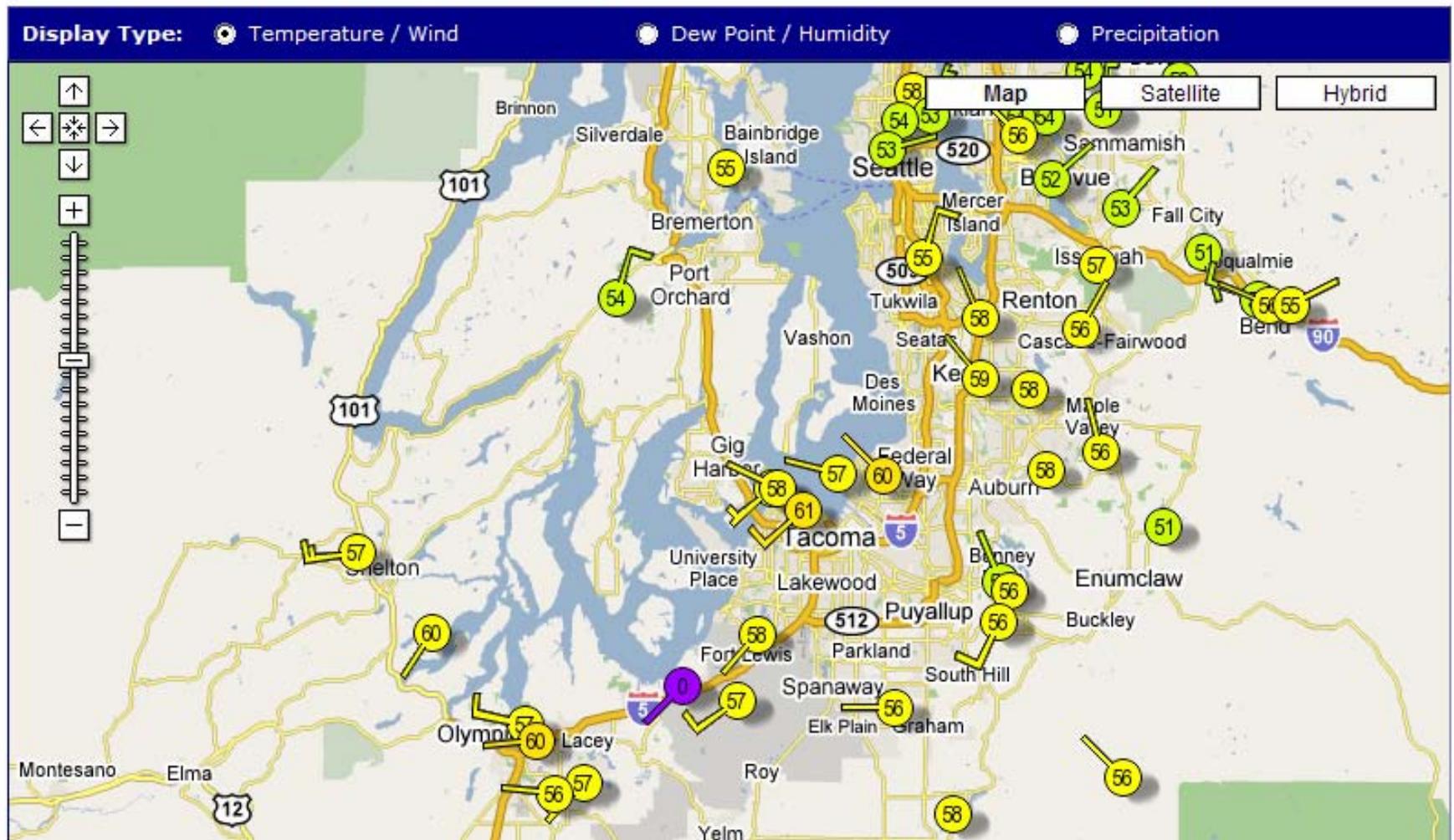


# Existing and Proposed Stations



# Other Networks

## Personal Weather Stations Google Map



Lat: N 47 ° 16 ' 25 " ( 47.274 ° )  
 Lon: W 122 ° 28 ' 55 " ( -122.482 ° )  
 Elevation: 300 ft  
 Station Hardware: WM-918  
 Software: wx200d

- [View Full Conditions and Forecast](#)
- [Visit the Tworoads Home website.](#)

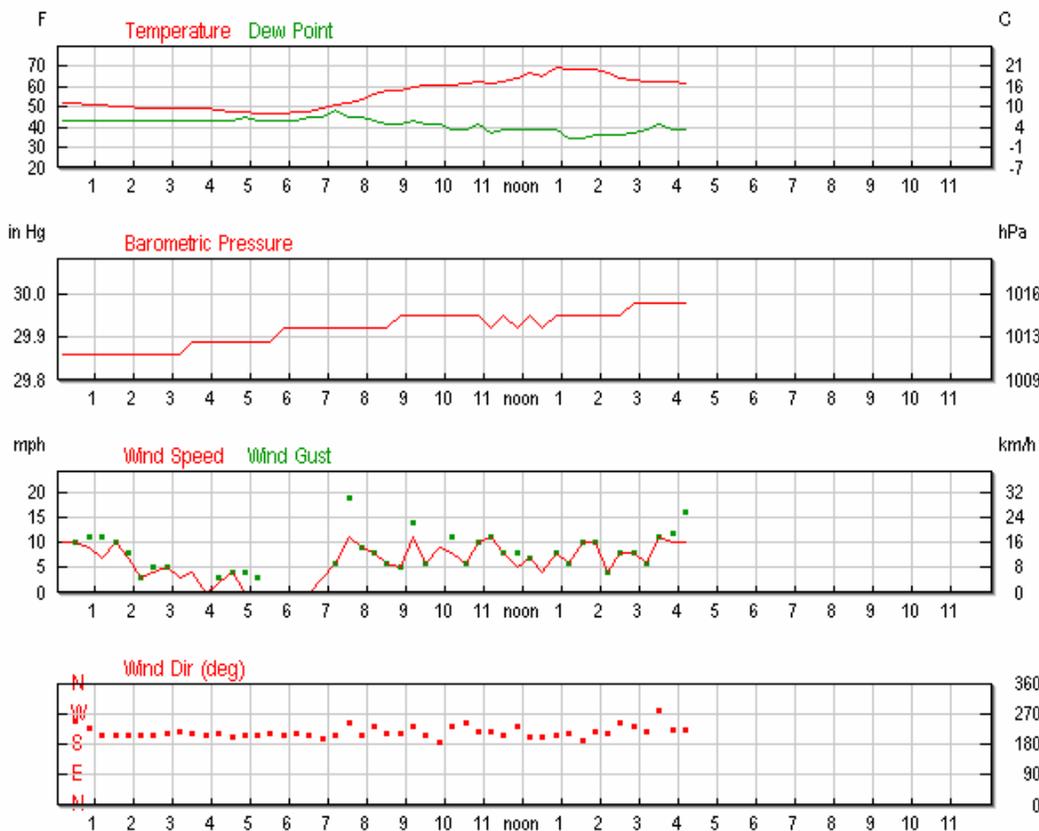


This page has been viewed 127 times since June 1, 2007

June 6 2007 Go



### KWATACOM25 Weather Graph for 6/6/2007



Select Specific Date:

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- [Previous Year](#) or [Next Year](#)

Select Data Span:

- [Daily](#)
- [Week](#)
- [Month](#)
- [Past Three Months](#)
- [Past Six Months](#)
- [One Year](#)
- [Custom](#)

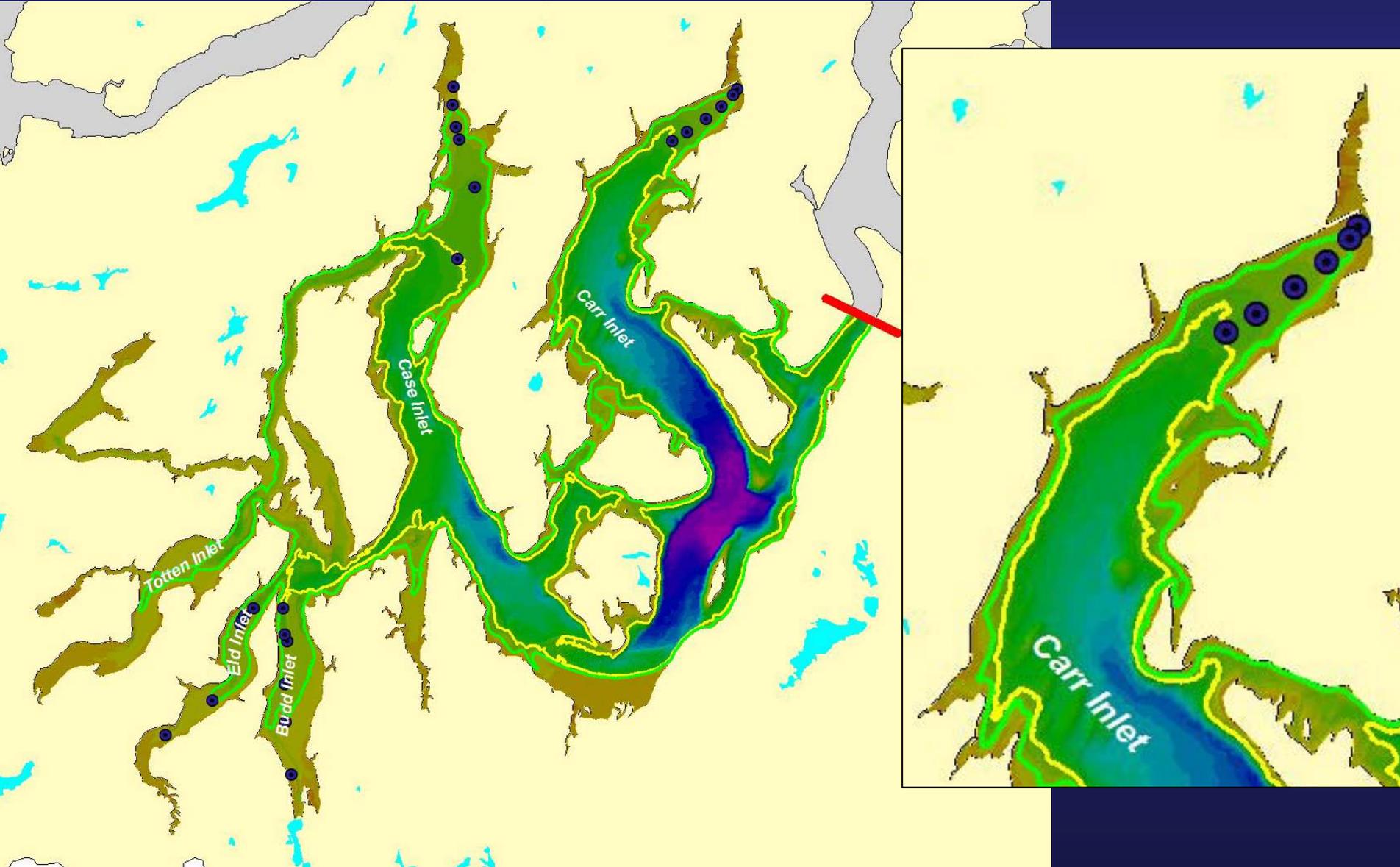
# Questions for TAC

- Any experience with these networks?
- Any experience with this equipment?
- Any ideas for installation locations?

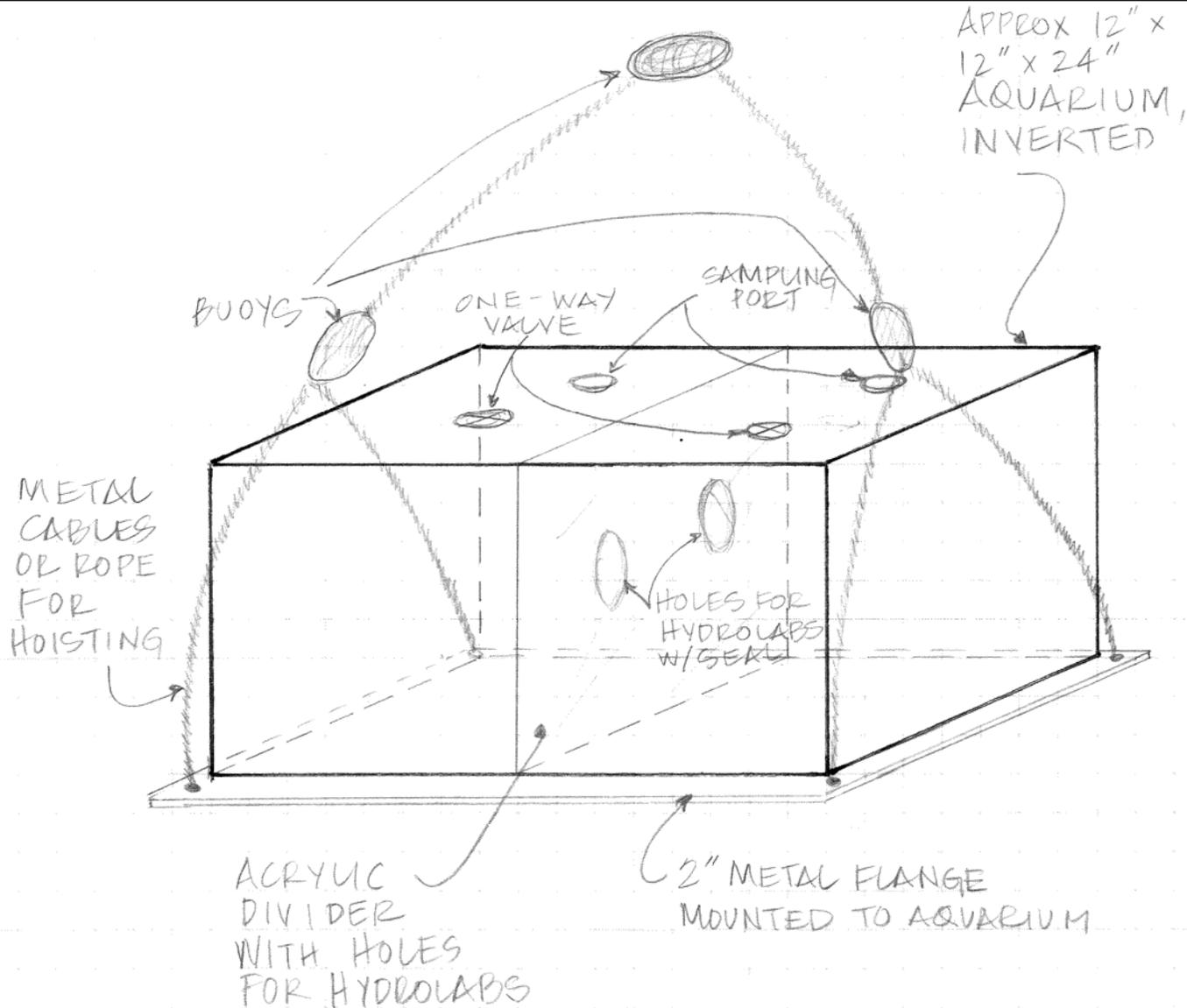
# Sediment flux study (from 3/07)

- \$100k from EPA (good!)
- Consultant to be selected
  - SOP/QAPP development
  - Field work and lab analyses
  - Data summary report and database
- AI Devol reviewing plan

# Deployment strategy

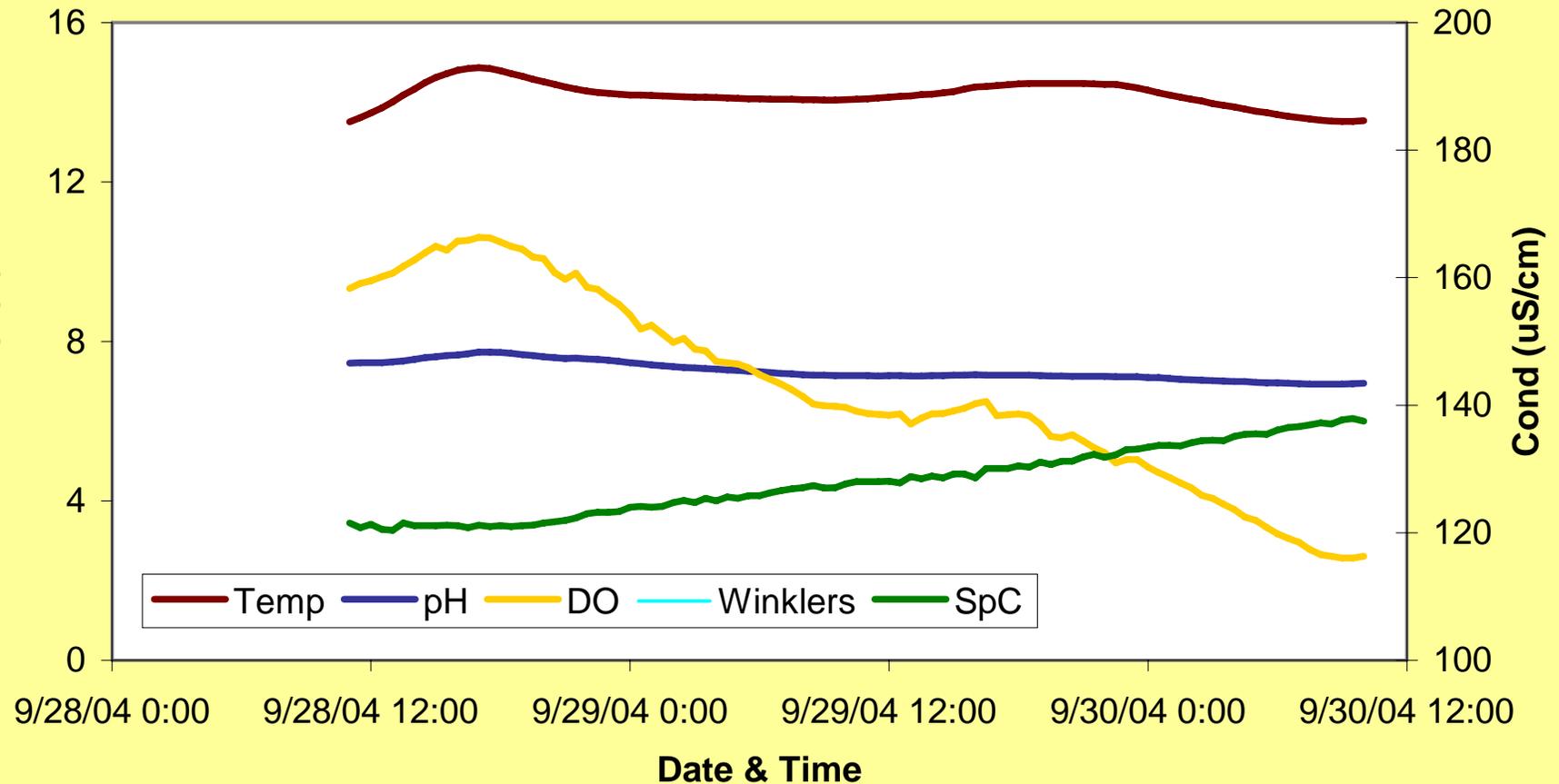


# Benthic flux chambers



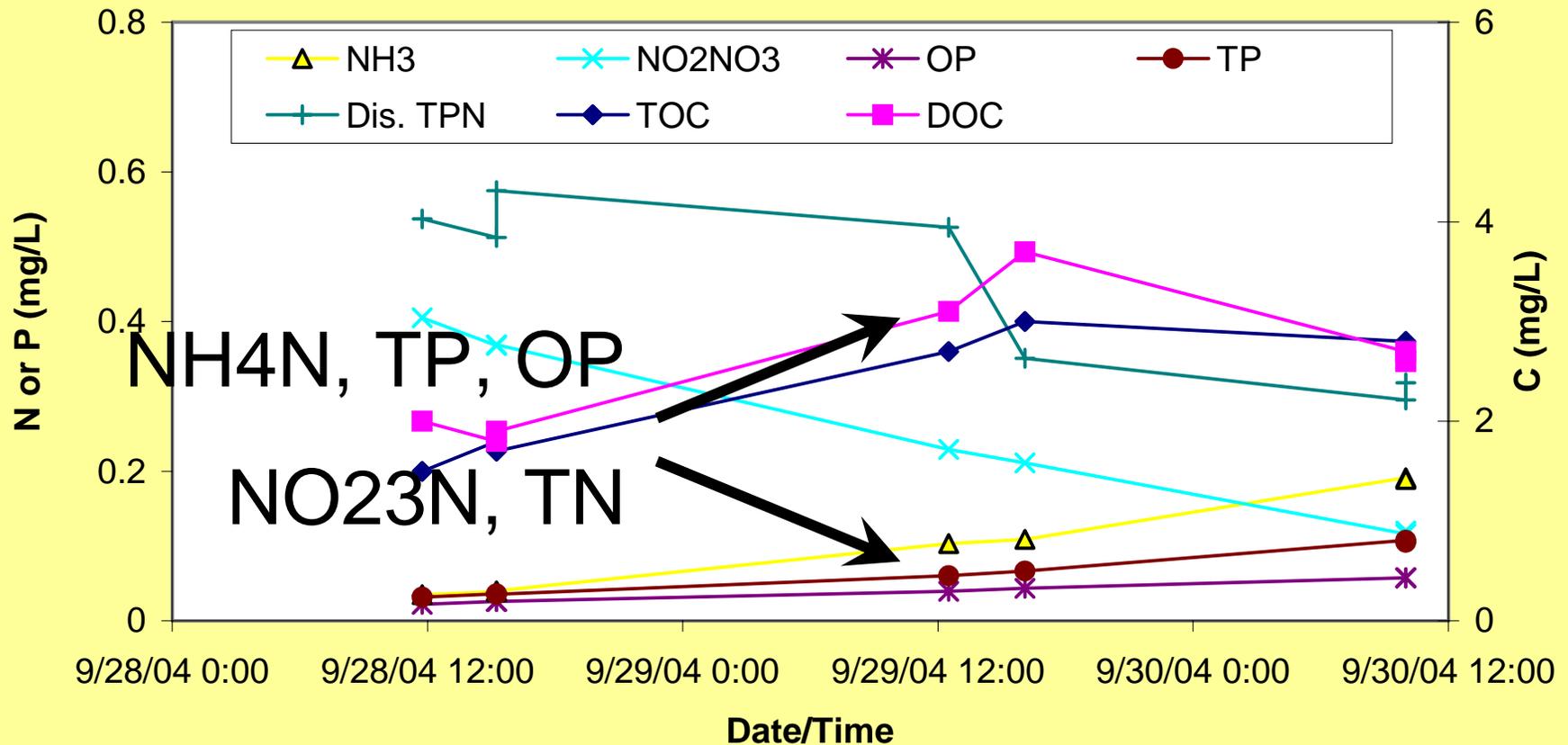
# Example benthic flux data

Hydrolab Data for Capitol Flux Chamber 1A



# Example benthic flux data

## Nutrient Data from Capitol Flux Chamber 1A



# Revised sediment study design

- August, September, October 2007
- **1 round per month**
- 3 to 4 nutrient grabs per round
- Continuous DO, temperature, pH
- **24 hours per deployment**

# Status of sediment flux study

- Draft protocol under review
- EPA about to release RFP
- Work with contractor to develop program
- Building additional chambers

# Questions?

[www.ecy.wa.gov/puget\\_sound](http://www.ecy.wa.gov/puget_sound)

[mrob461@ecy.wa.gov](mailto:mrob461@ecy.wa.gov)

# South Puget Sound Dissolved Oxygen Study

Technical Advisory Committee

June 11, 2007

Andrew Kolosseus

360-407-7543

[akol461@ecy.wa.gov](mailto:akol461@ecy.wa.gov)

# Agenda

- 10:00 Marine data update
- 10:50 WWTP data, tributary data, and other updates
- 11:20 “What-if” scenarios – get feedback from group
- 11:40 Communication plan – get feedback from group
- 11:50 Set next meeting, etc

# “What-if” Scenarios

- What if all human sources of nitrogen were removed? (“natural conditions” vs “current conditions”)
- What if one source of nitrogen was “turned off”?
- What if all nitrogen sources increased by 25%? By 50%

# “What-if” Scenarios

- What if nitrogen from WWTPs increased 25%, 50%, or decreased 50%, 90%?
- What if nitrogen reduction efforts were targeted to certain locations?
- What if nitrogen was only reduced during certain times of the year?

# Communication Plan

Objective: Special focus on informing key decision makers / stakeholders of the South Puget Sound Dissolved Oxygen Study.

Who: City councils, county councils, etc.

# Communication Plan

When: Later 2007 to 2008.

How: Ideas?