Deschutes River, Capitol Lake, and Budd Inlet Total Maximum Daily Load Study

Water Quality Study Findings

Briefing for Implementation Advisory Group

February 13, 2009

Mindy Roberts (Ecology)

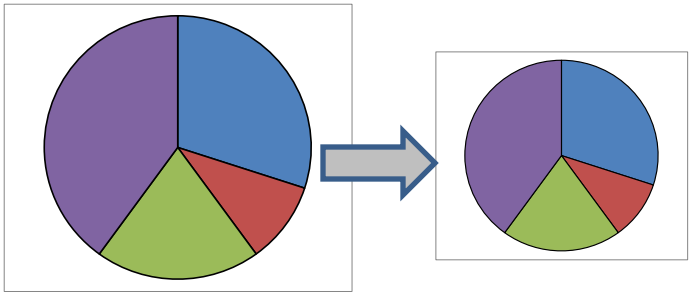
Topics covered

- Project background
- **Model and data results**
  - Deschutes River, Capitol Lake, and Budd Inlet watershed
  - Budd Inlet and Capitol Lake water quality
  - *Introduction only; more details as needed*
- Summary of scientific findings to support implementation development

91 waterbodies x parameters

Project Background

Total Maximum Daily Load (TMDL)

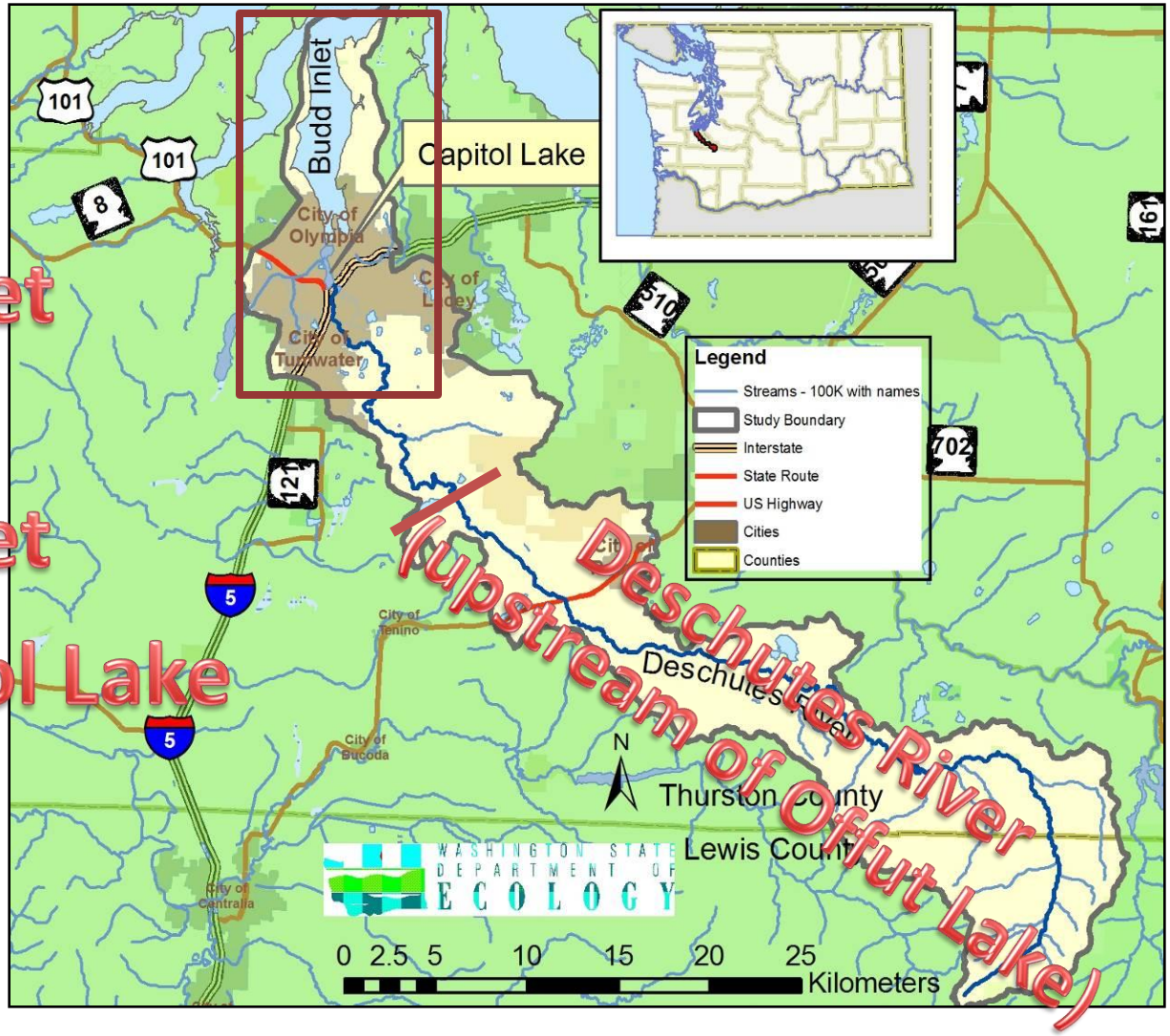


- Clean Water Act language
- Basic premise:
  - How much ___ can a water body receive and still meet water quality standards?
  - Applied to many constituents (bacteria, heat, nutrients, BOD, copper, PCBs)
- Establish water-quality-based limits for NPDES discharges (*but also collateral benefits*)
- Involves both data collection and <u>modeling</u>

Water Quality Standards

- Clean Water Act
- Developed to protect *beneficial uses* of waterbodies
  - Human health (bacteria)
  - Aquatic life (DO, pH, temperature, sediment)
- Numeric values (thresholds, changes)
- Waterbody-specific standards
- Related parameters (DO vs. nutrients)

Project area and WQS



Impaired waters (CWA §303(d) list)

- Budd Inlet
- Capitol Lake
- Percival Creek and Black L
- Deschutes River
- *Budd Inlet tributaries*: Indian, Moxlie, Adams, Schneider, Butler, Mission creeks
- *Deschutes River tributaries*: Reichel, Ayer (Elwanger), Spurgeon, Huckleberry, Tempo Lake outlet, Chambers creeks

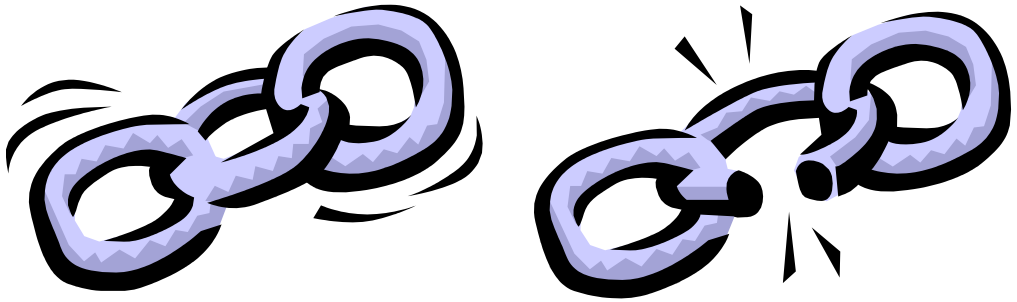
Fecal coliform bacteria
Temperature (heat)
Dissolved oxygen (nutrients)
pH
Fine sediment

91 waterbodies x parameters

Why so many parameters at once???

- Comprehensive community strategies are needed
- Management activities that improve conditions in the Deschutes River and Percival would benefit Capitol Lake and Budd Inlet
- Capitol Lake or Deschutes Estuary influence Budd Inlet

Parameter relationships:



Watershed
(Deschutes River, Capitol Lake, Budd Inlet)

Fecal Coliform Bacteria

Temperature

DO and pH

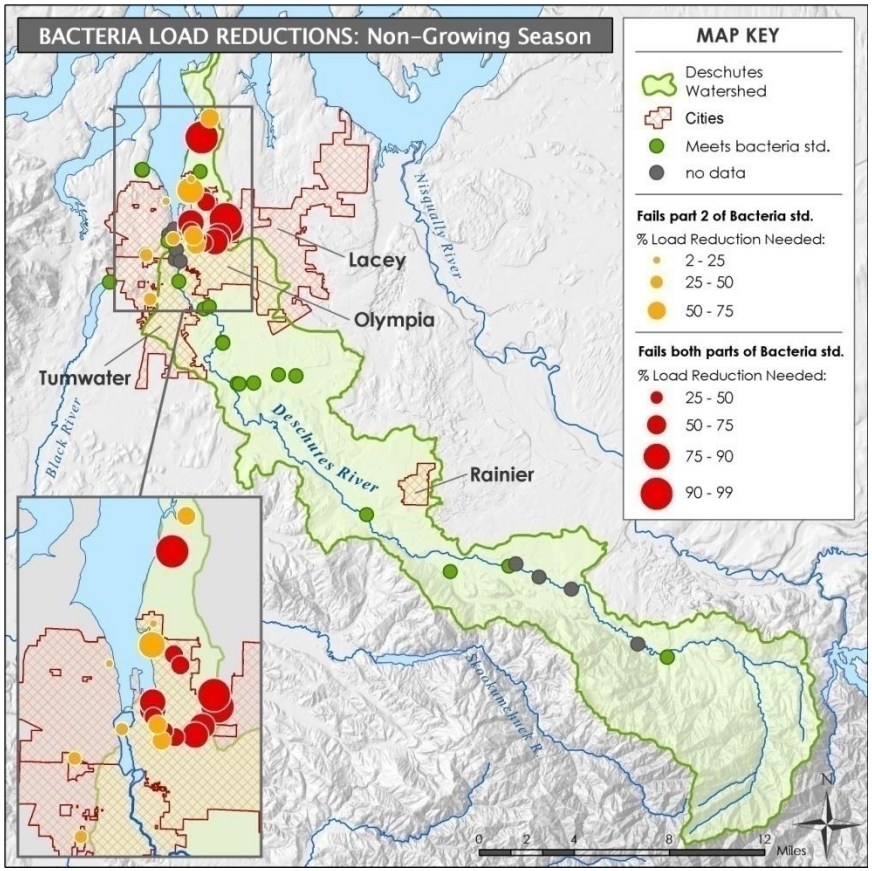
Fine Sediment

Fecal Coliform Bacteria

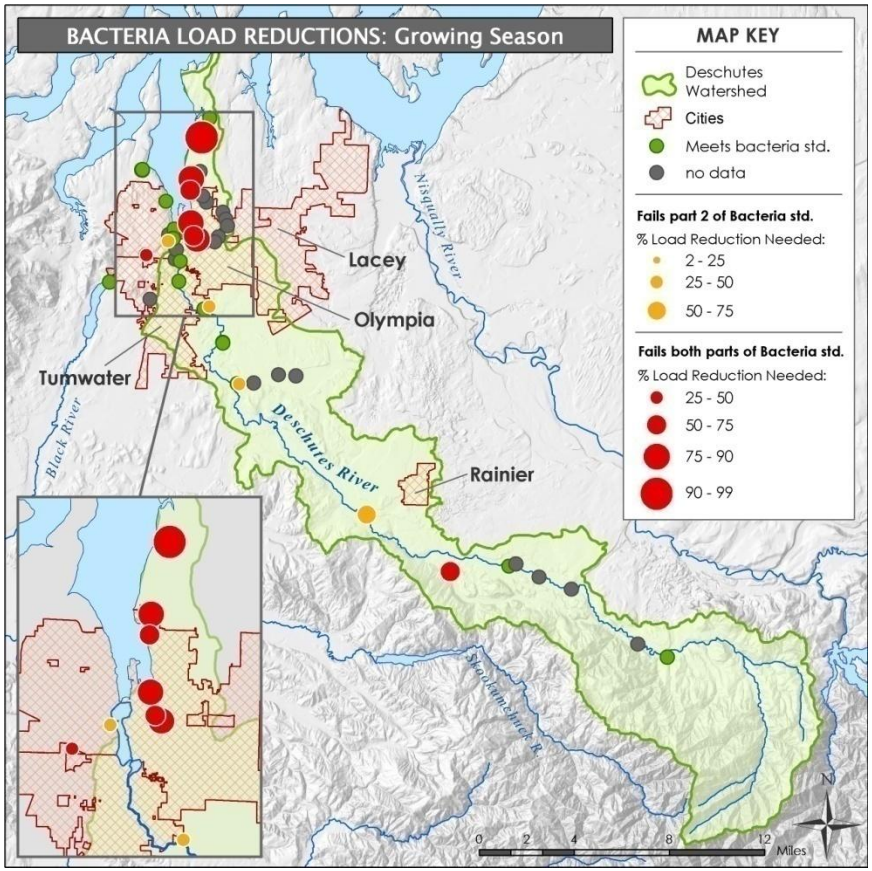
(data and calculations)

Fecal coliform bacteria reduction targets

Winter



Summer

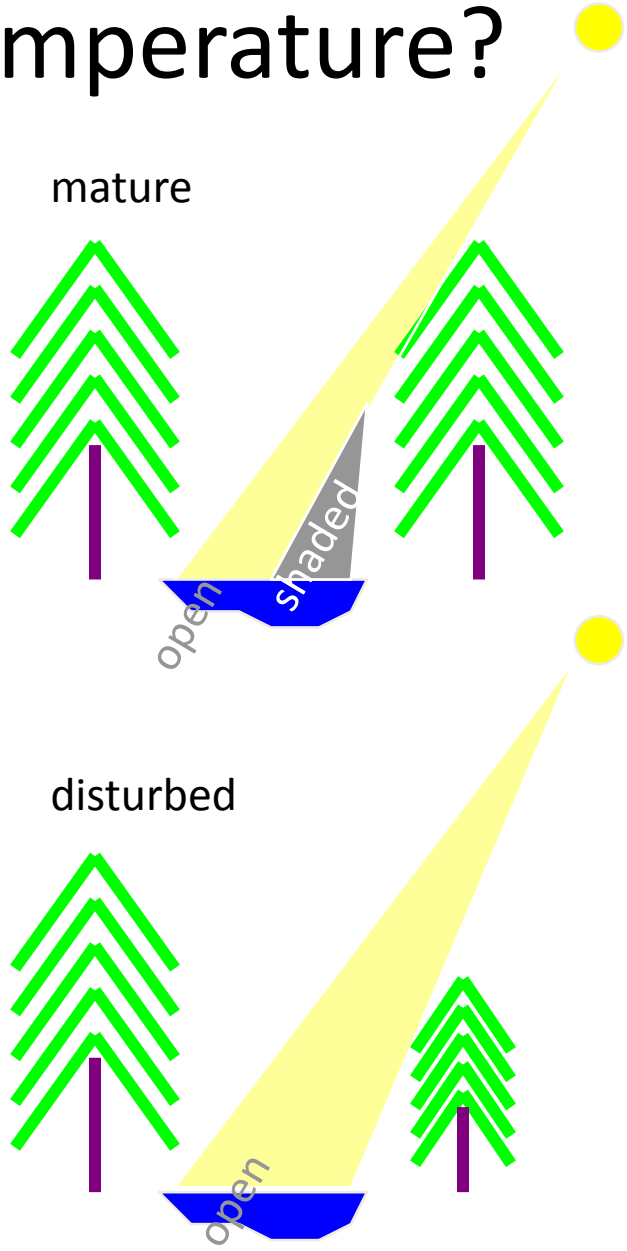


Deschutes River Temperature

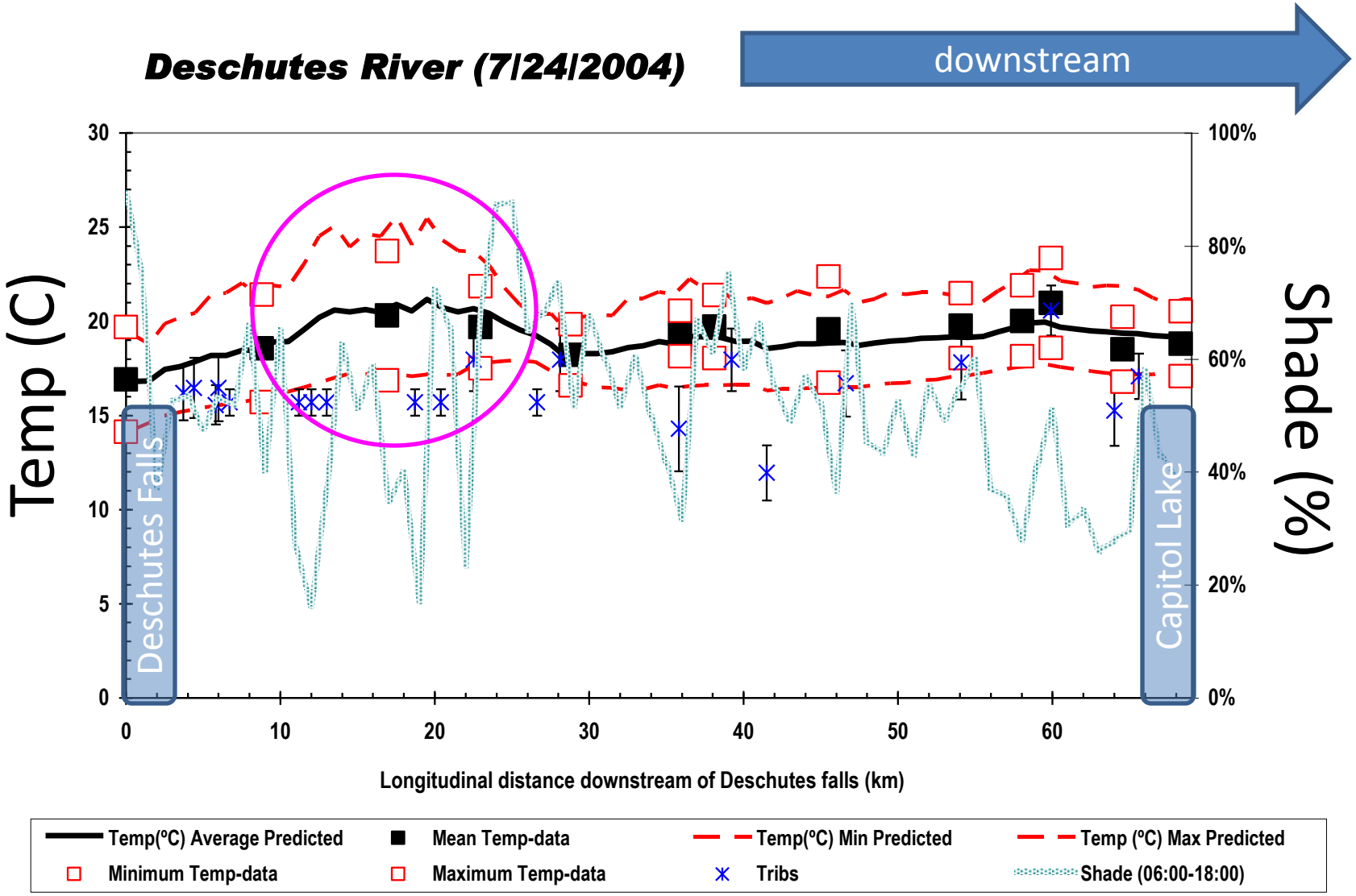
(data and model)

What affects stream temperature?

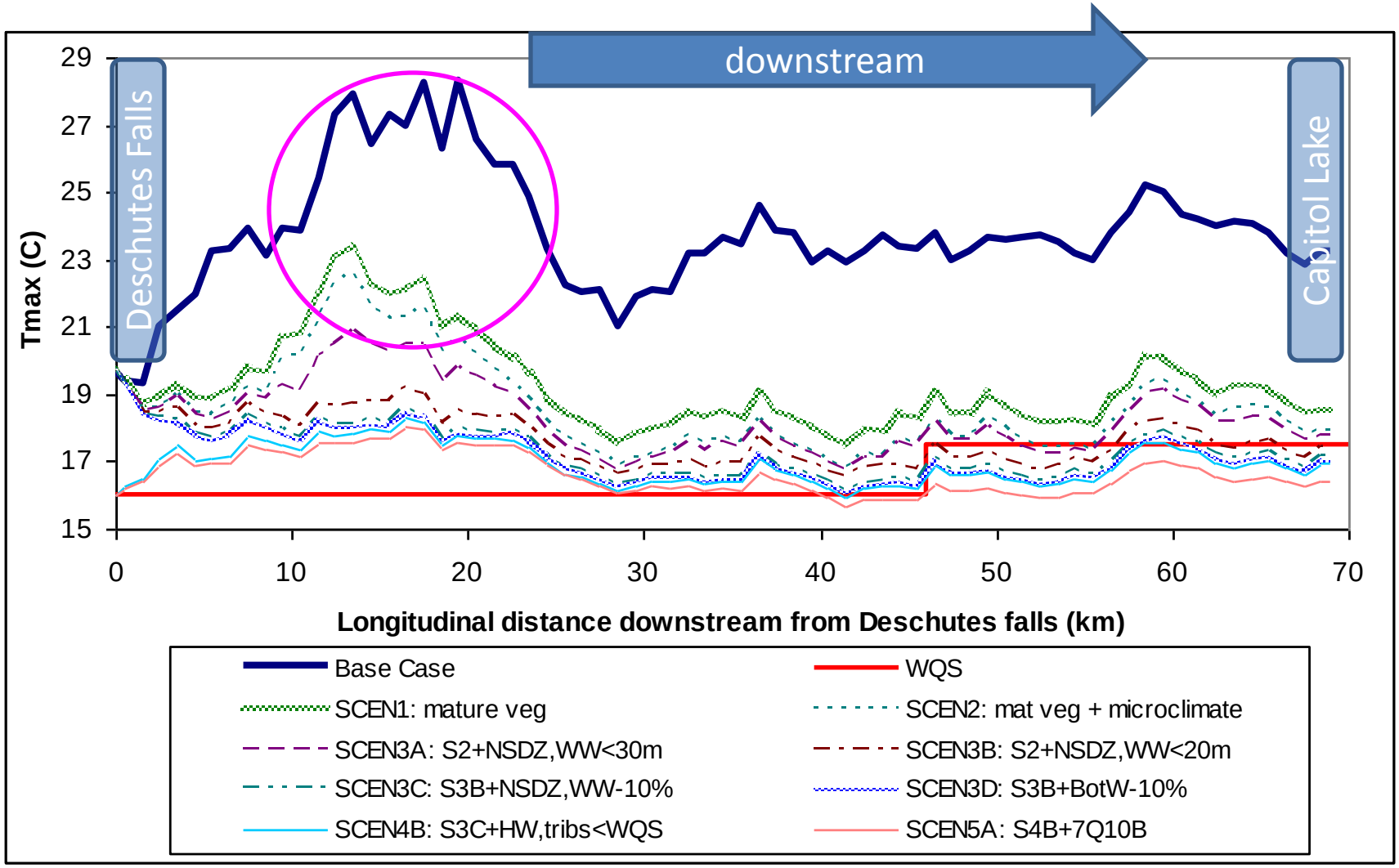
- Solar radiation
- Shade
  - Vegetation/Topography
  - Stream width
- Hot discharges
- Cool groundwater
- Cooling in gravels
- Air temperature



Temperature profile



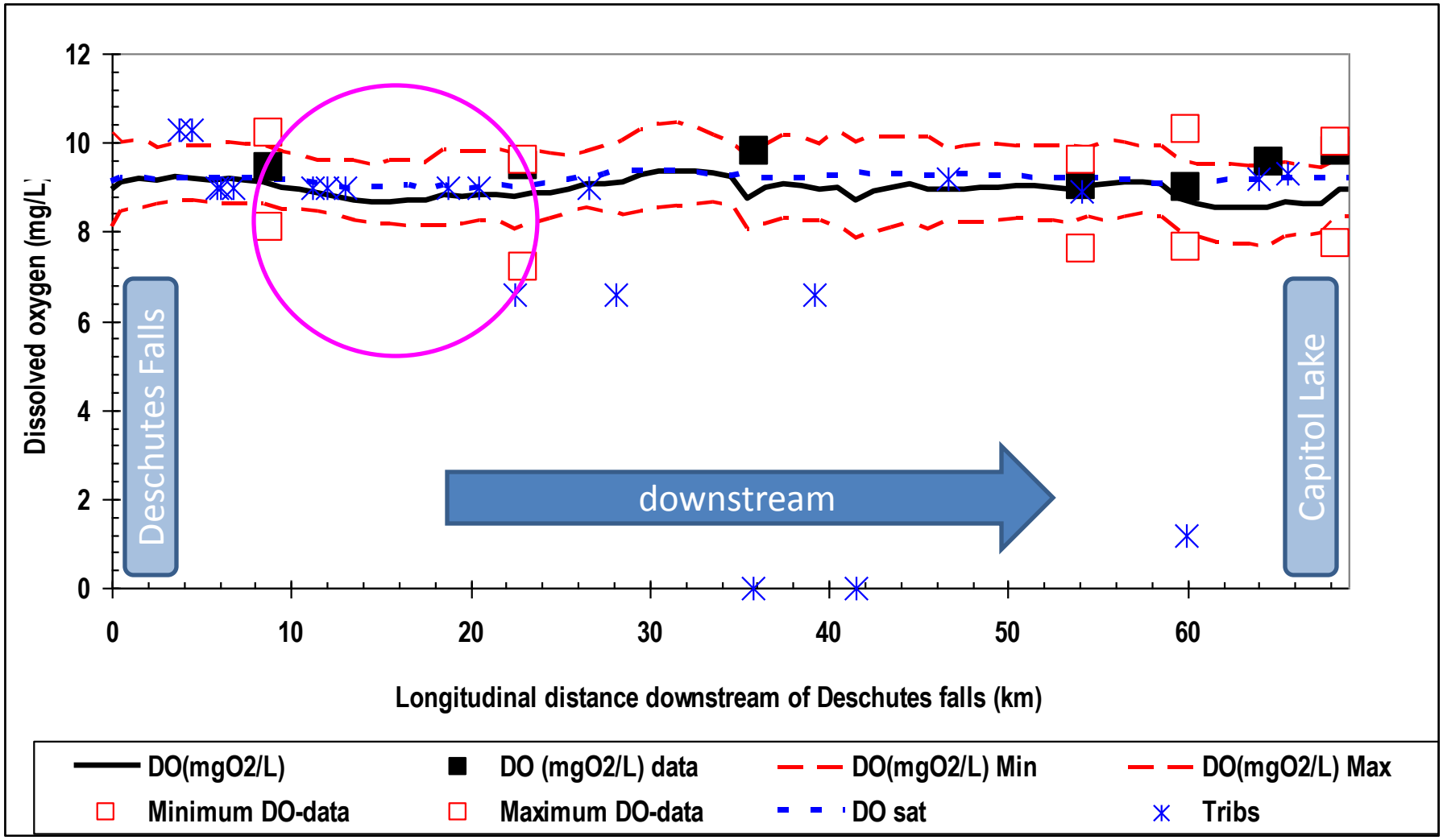
Temperature benefits of management actions



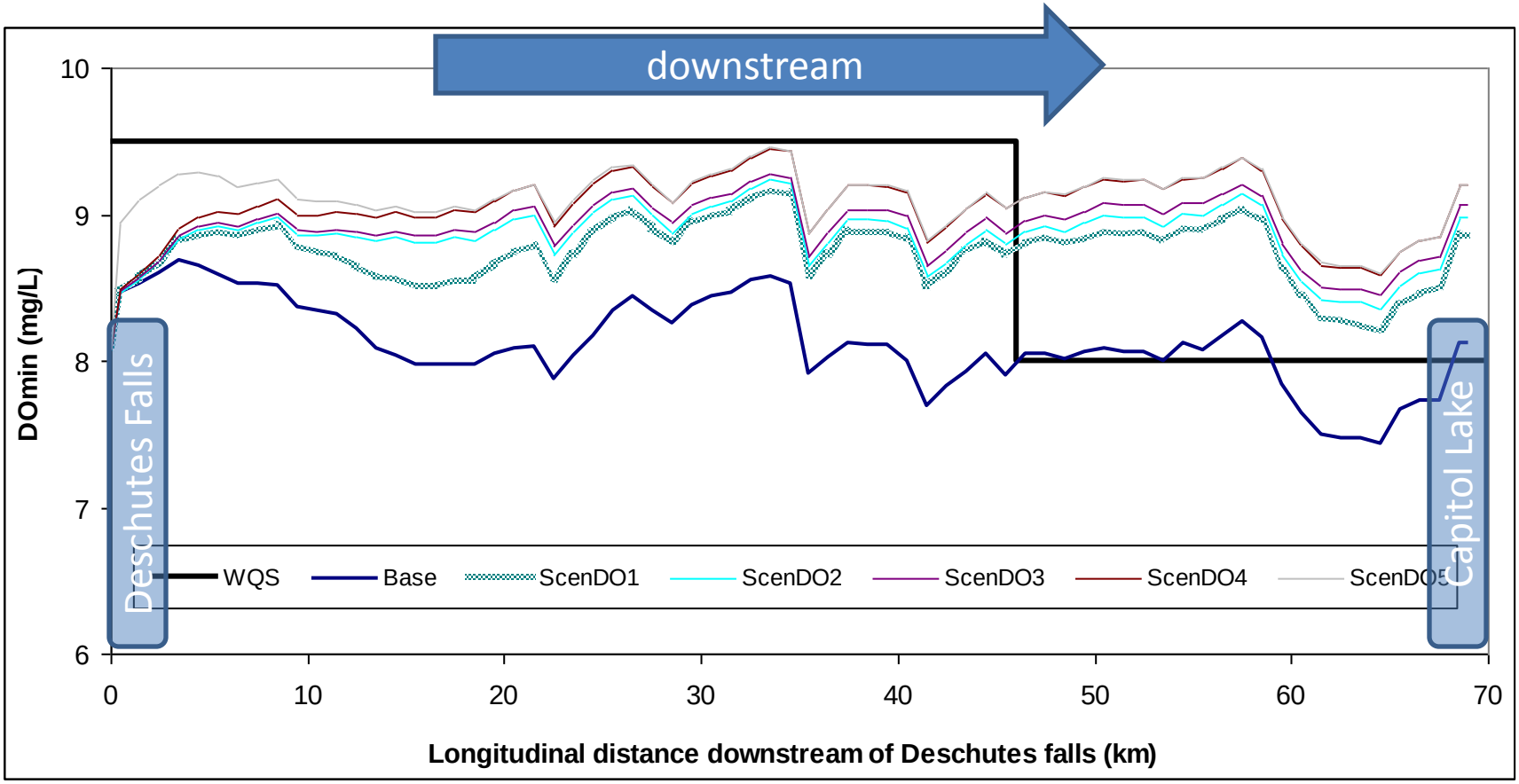
Deschutes River Dissolved Oxygen and pH

(data and model)

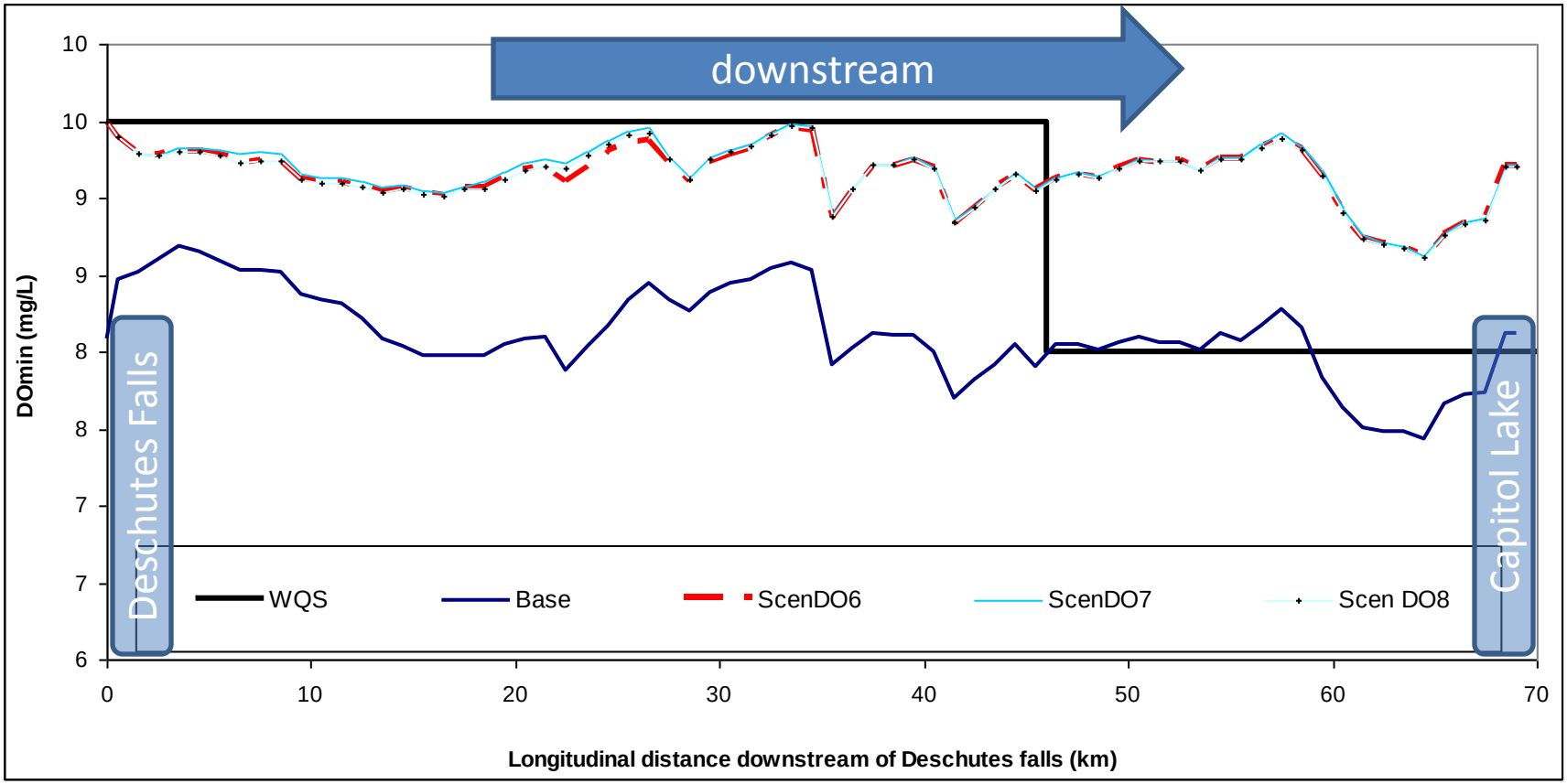
Dissolved oxygen profile



Deschutes River DO_{min} improvements (temperature scenarios)



Deschutes River DO_{min} improvements (nutrient scenarios)



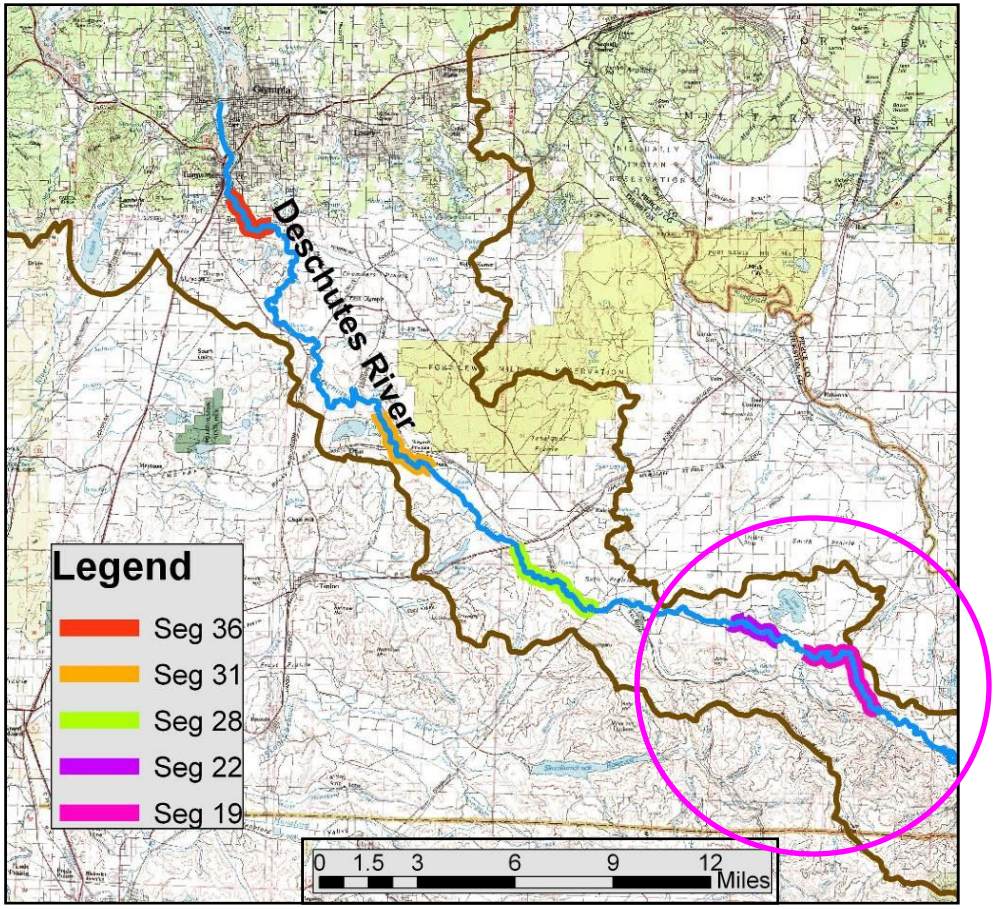
Deschutes River Fine Sediment

(data, model, sediment budget)

Fine Sediment

- Squaxin Island Tribe
- EPA $$
- QA Project Plan
- Re-occupy historical stations
- Gravel samples
- Percent fines (<0.85 mm)

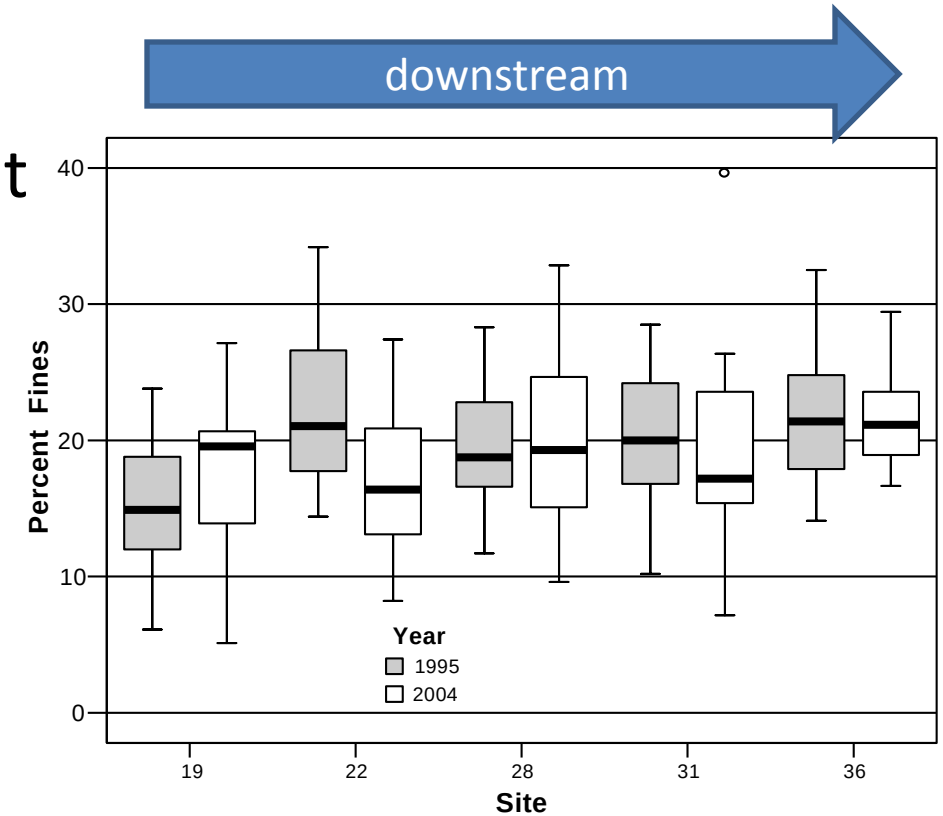
***other* parameter (phosphorus)**



Source: Konovsky and Puhn, 2005

Konovsky and Puhn (2005)

- No trend with time
- High levels throughout
- Weak trend (increasing fines) downstream
- Do not meet healthy levels



Source: Konovsky and Puhn, 2005

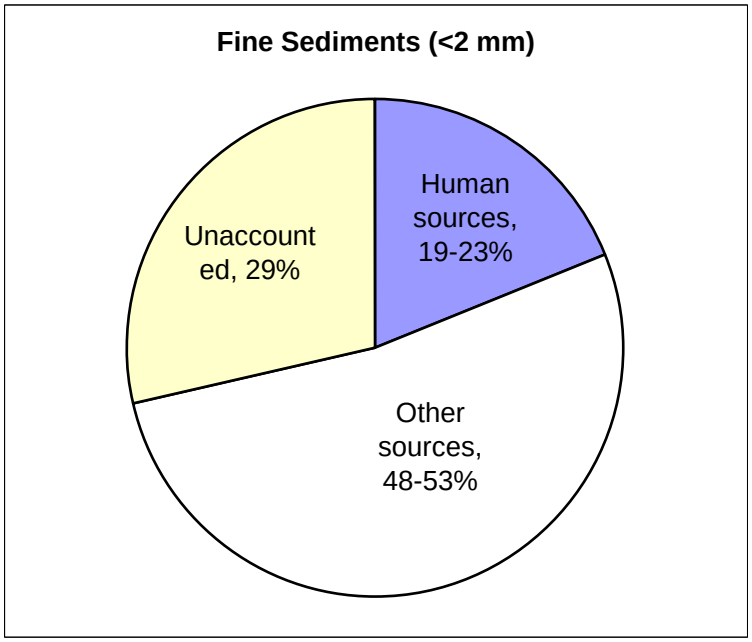
Sediment Budget

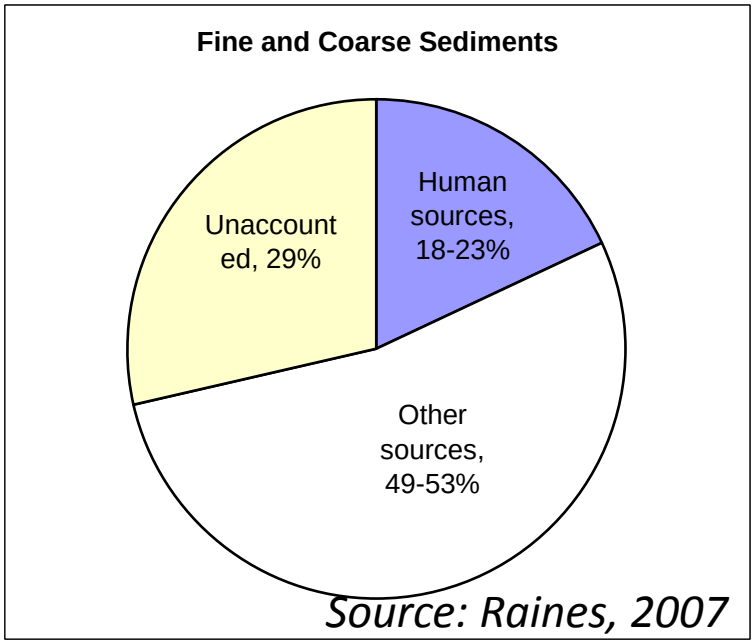
Natural sources

- Landslides
- Bank erosion

Human sources

- Landslides associated with roads
- Unpaved roads

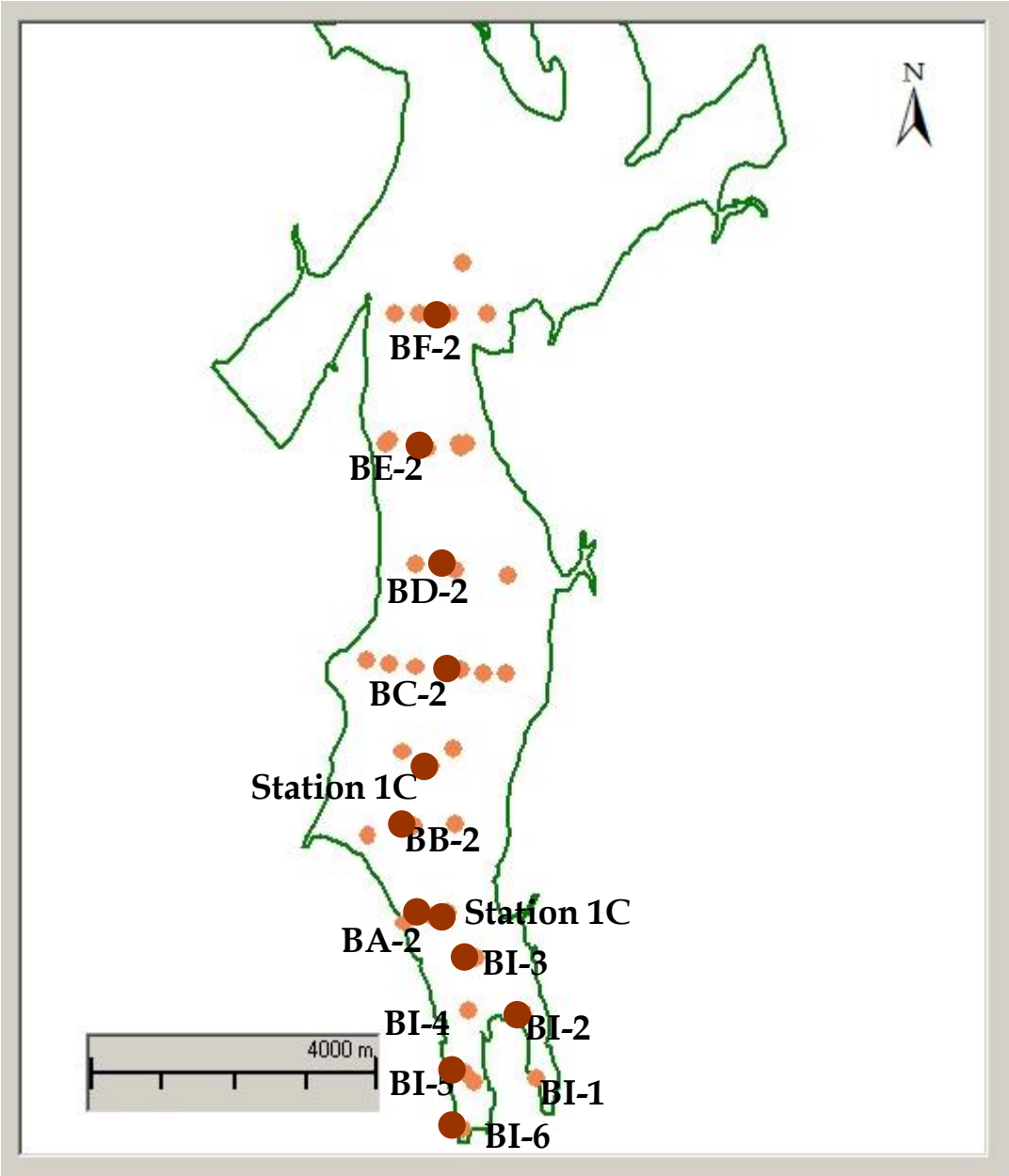




Source: Raines, 2007

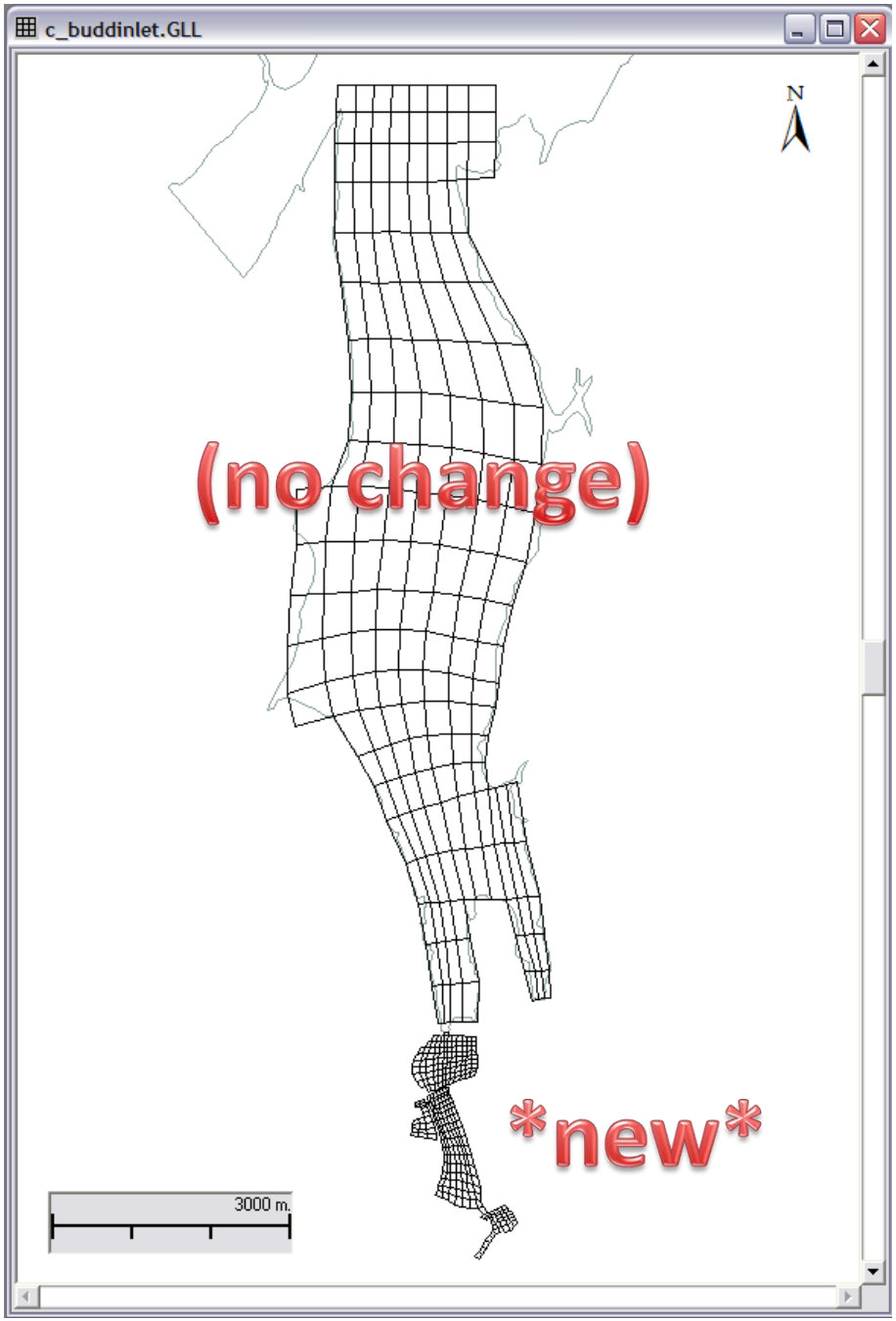
Budd Inlet and Capitol Lake

(models and data)

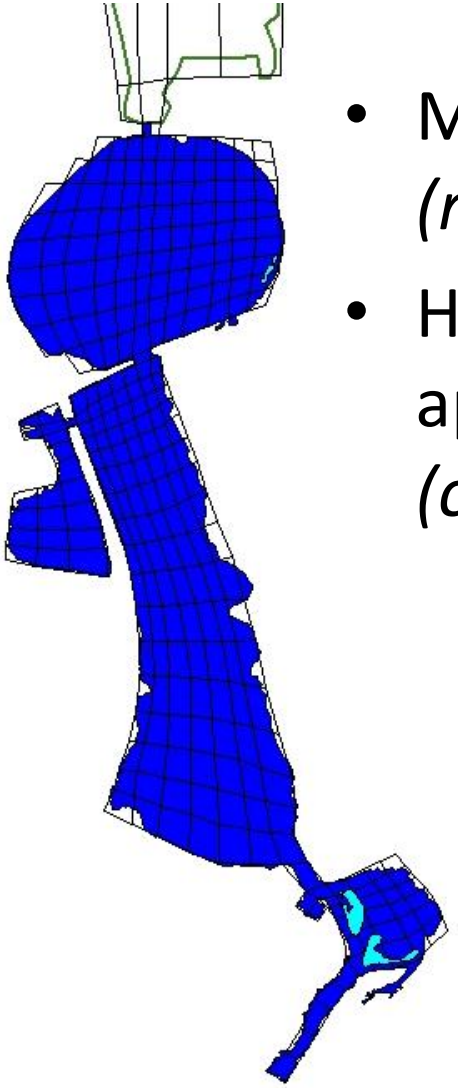


Budd Inlet Scientific Study (1998)

- Data
- Model



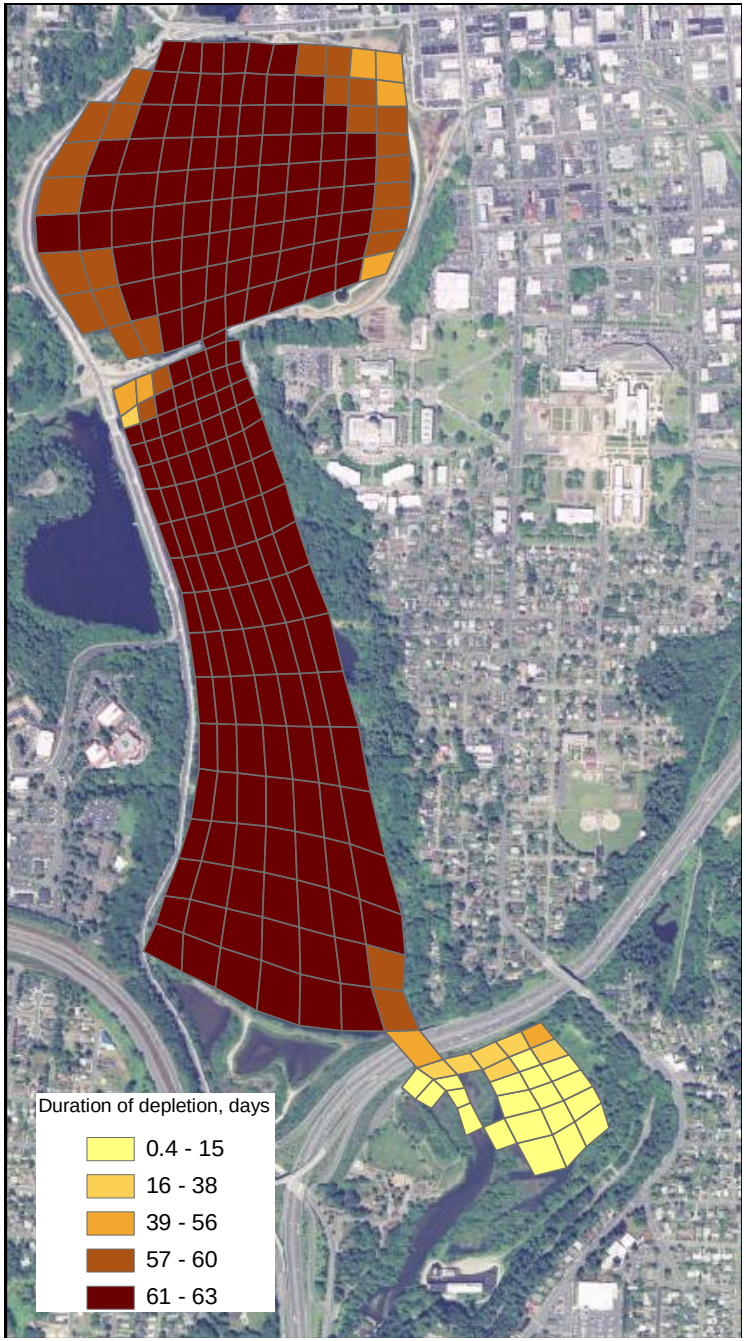
2008 updates



- Macrophytes *(rooted plants)*
- Herbicide application *(calibration)*

Capitol Lake Water Quality

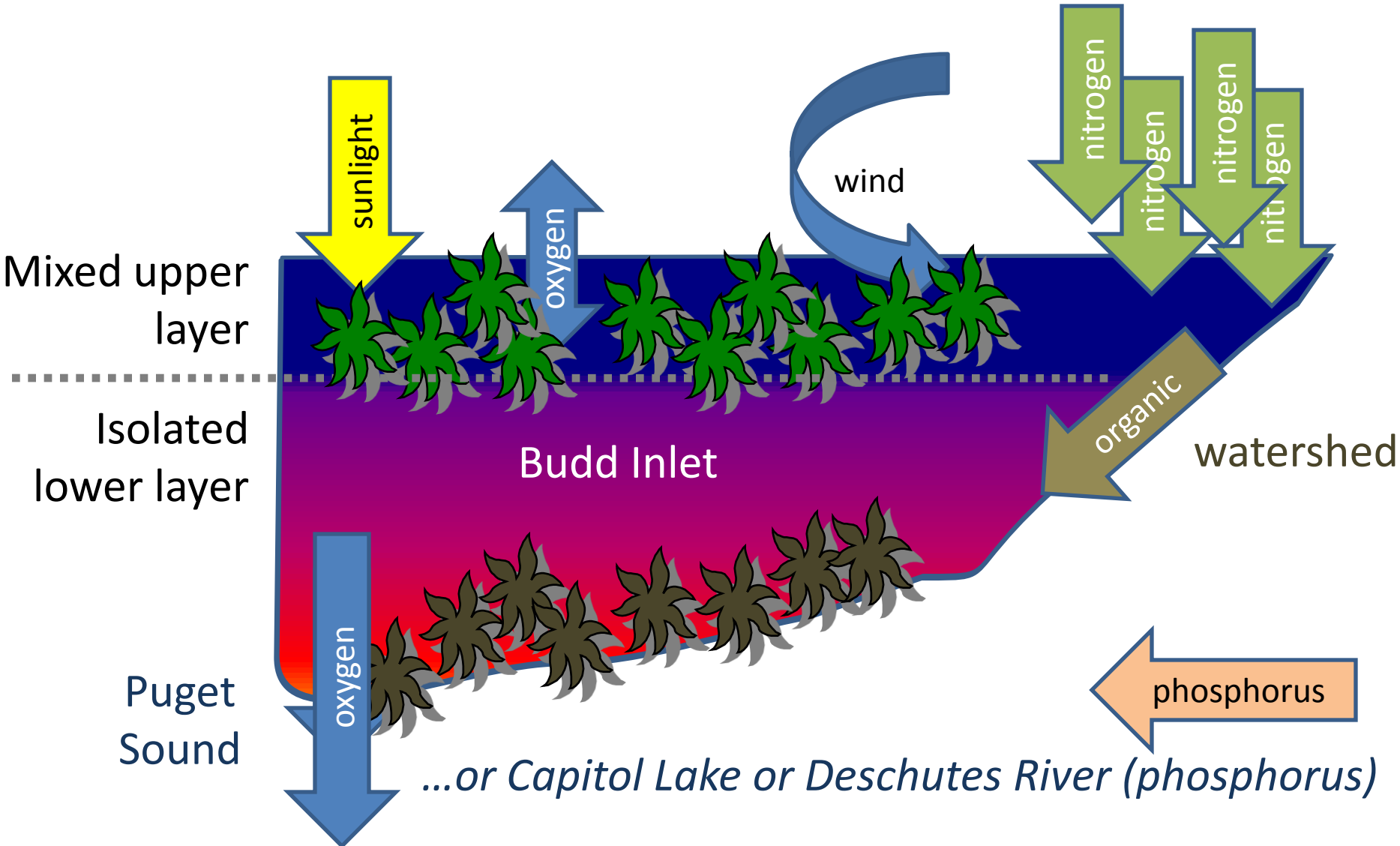
Critical conditions: summer



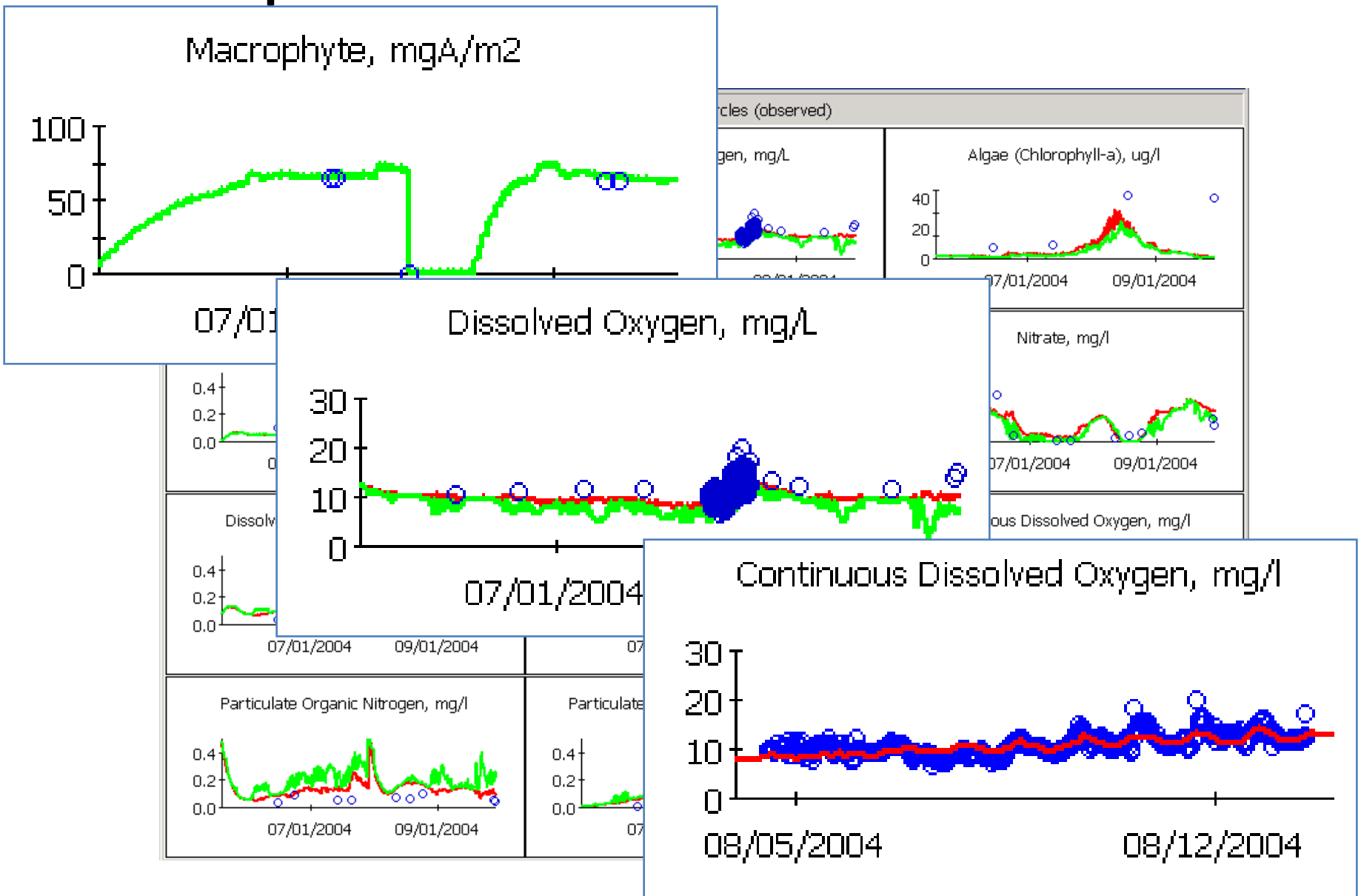
Lake standards

- No more than 0.2 mg/L change in DO from natural conditions
- *Effect of current nonpoint sources causes >0.2 mg/L depletion throughout Capitol Lake*

Science 101

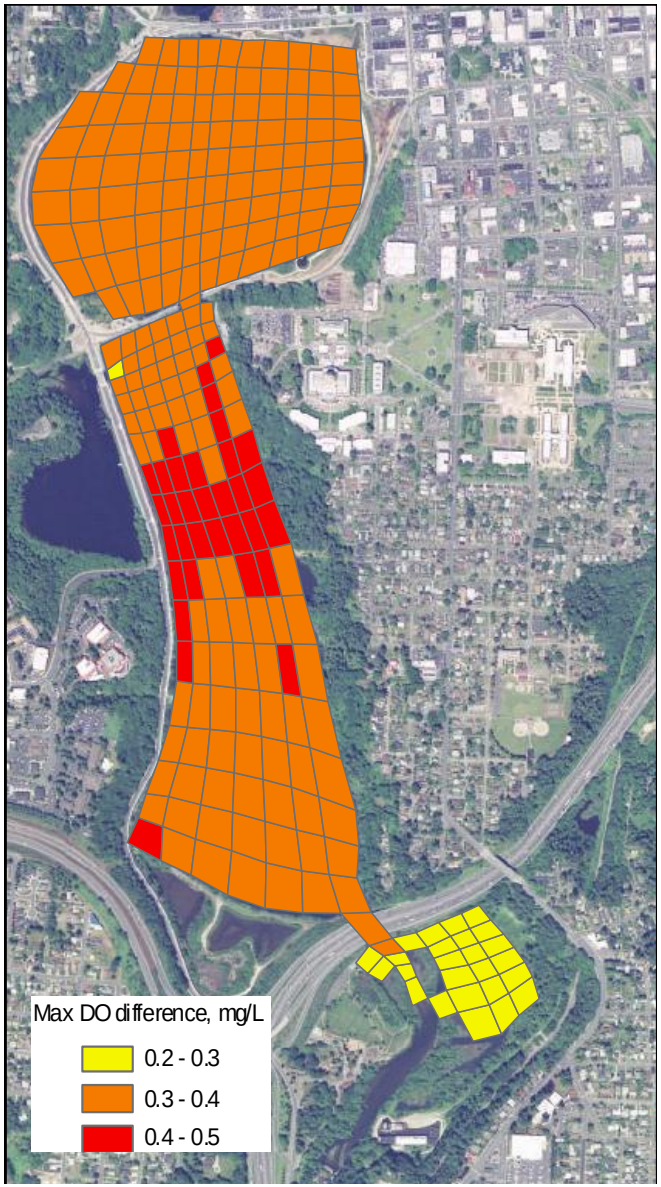

sunlight
oxygen
wind
nitrogen
nitrogen
nitrogen
nitrogen
Mixed upper layer
Isolated lower layer
Budd Inlet
organic
watershed
oxygen
Puget Sound
phosphorus
…or Capitol Lake or Deschutes River (phosphorus)

Capitol Lake model calibration



Nonpoint sources of nutrients are too high

- Scenario 1: natural conditions
- Scenario 2: current nonpoint sources in Deschutes River and Percival Creek
- Scenario 2 – Scenario 1 = effect of nonpoint sources

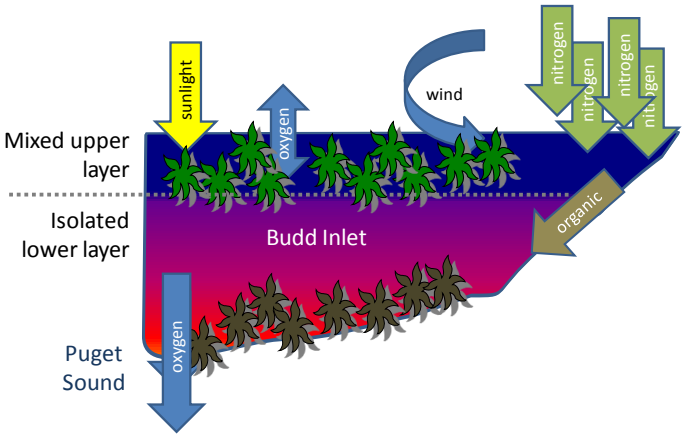


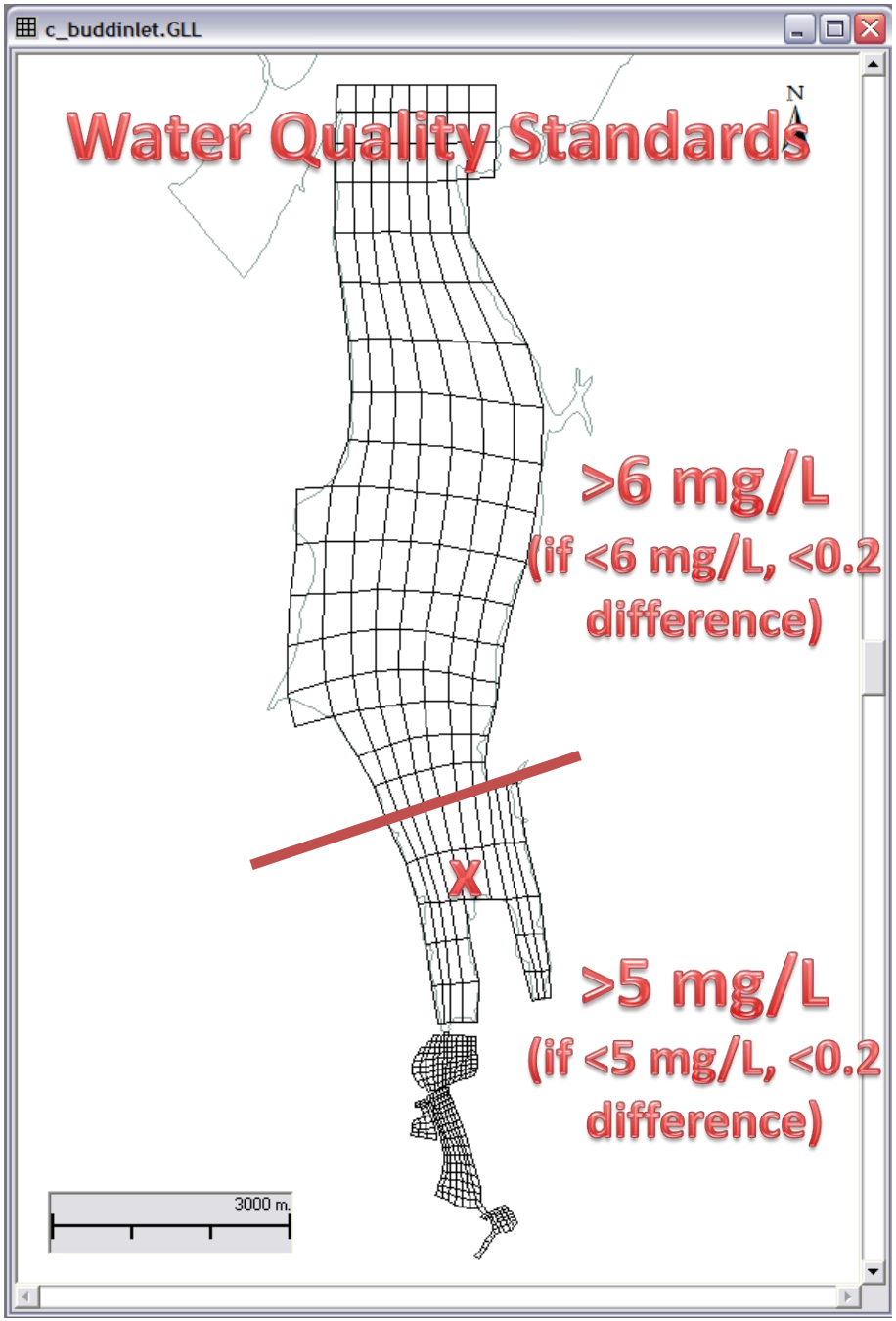
Factors affecting Capitol Lake

- Low circulation
- Shallow water depths
- Warm temperatures
- High phosphorus from sediments, watershed
- High macrophyte biomass
- Algae blooms
- *Ideal growing conditions*

Budd Inlet Dissolved Oxygen

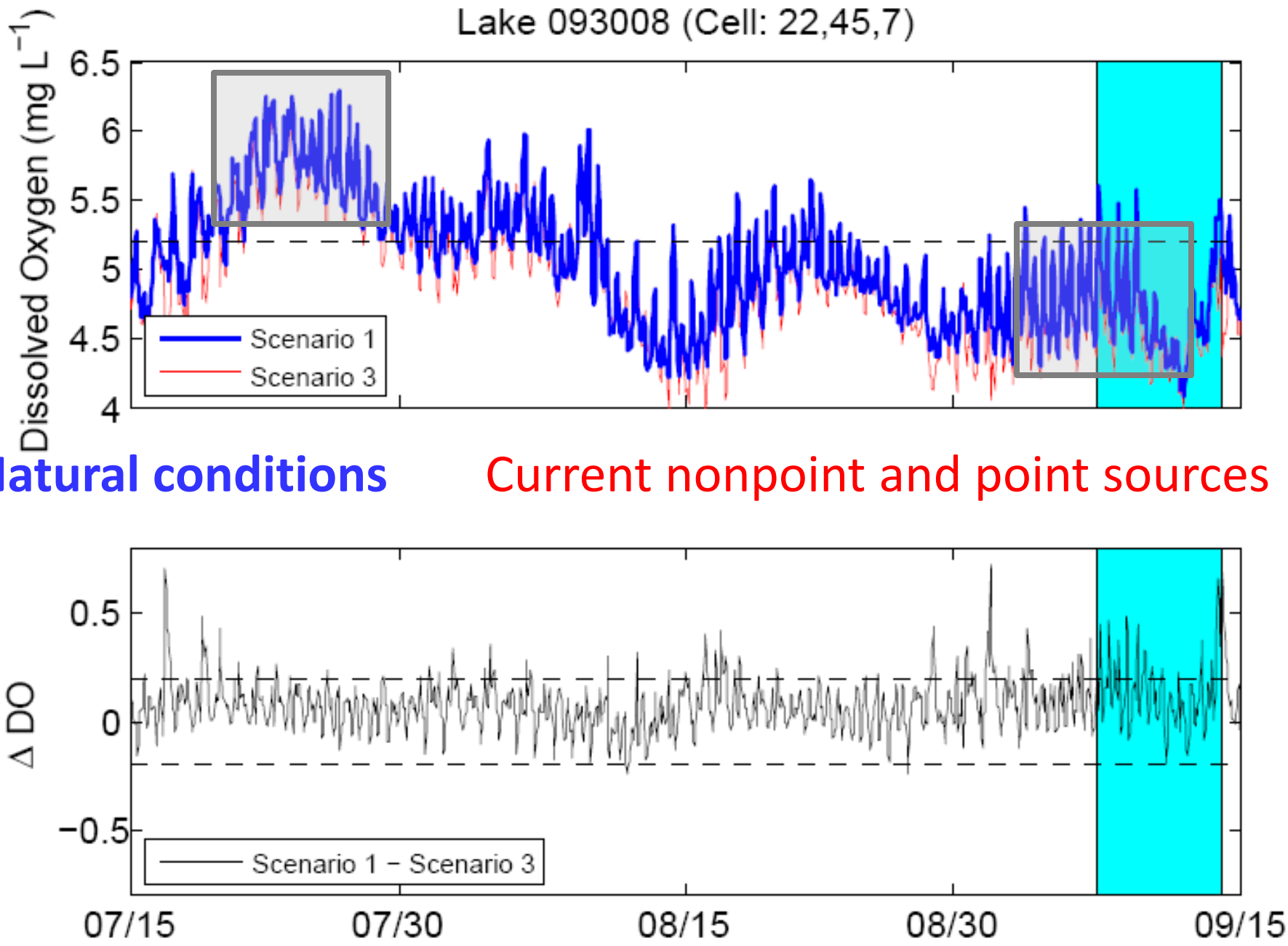
Critical conditions: summer

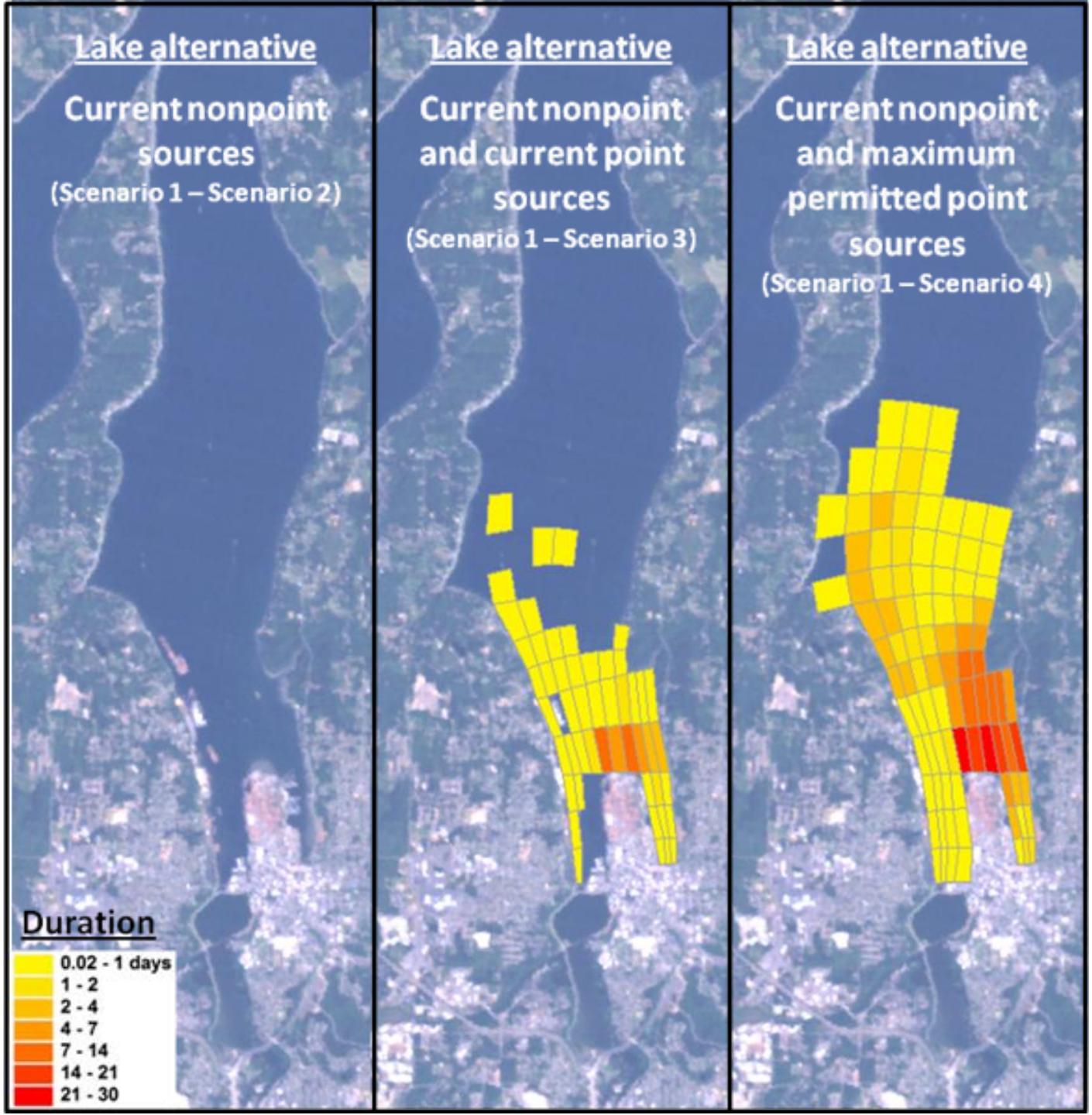


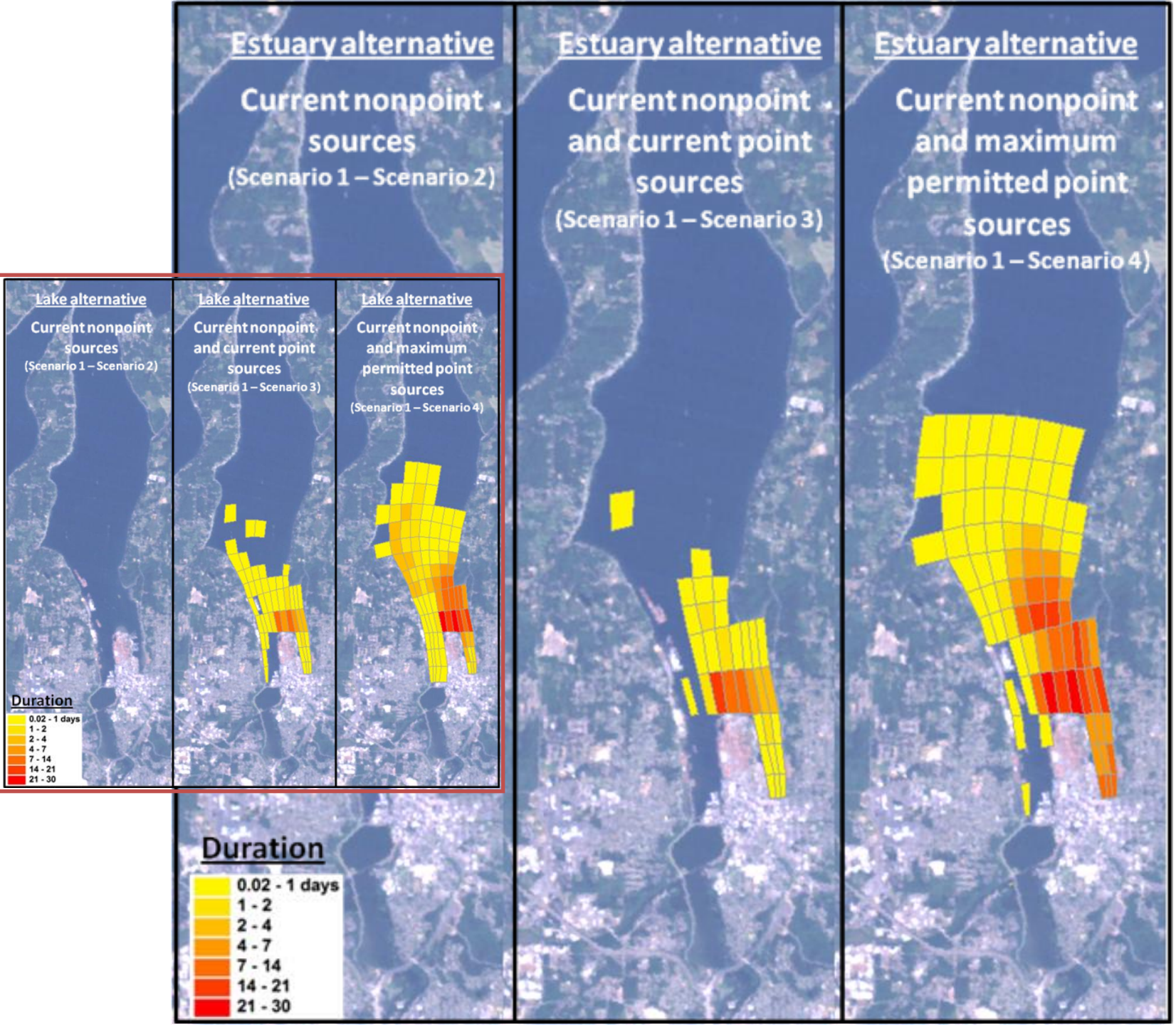


Scenarios

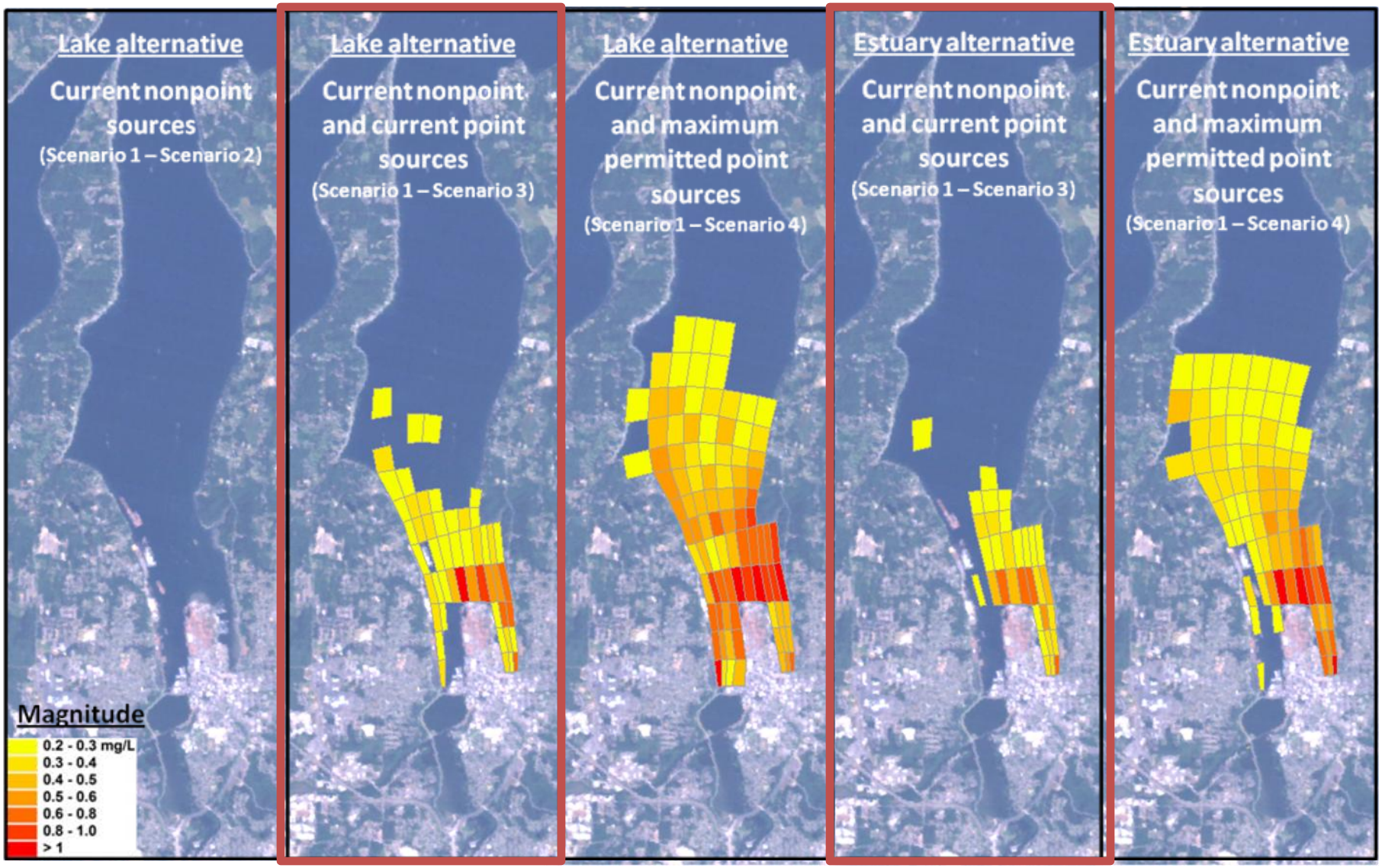
- 1: natural conditions (no point or nonpoint sources)
- 2: current nonpoint sources and no point sources
- 3: current nonpoint and current point sources
- 4: current nonpoint and maximum permitted point sources


Lake 093008 (Cell: 22,45,7)
Dissolved Oxygen (mg L^{-1})
6.5
6
5.5
5
4.5
4
Scenario 1
Scenario 3
Natural conditions
Current nonpoint and point sources
Δ DO
0.5
0
−0.5
Scenario 1 − Scenario 3
07/15
07/30
08/15
08/30
09/15


Lake alternative
Current nonpoint sources
(Scenario 1 – Scenario 2)
Lake alternative
Current nonpoint and current point sources
(Scenario 1 – Scenario 3)
Lake alternative
Current nonpoint and maximum permitted point sources
(Scenario 1 – Scenario 4)
Duration
0.02 - 1 days
1 - 2
2 - 4
4 - 7
7 - 14
14 - 21
21 - 30


Estuary alternative
Current nonpoint sources
(Scenario 1 – Scenario 2)
Estuary alternative
Current nonpoint and current point sources
(Scenario 1 – Scenario 3)
Estuary alternative
Current nonpoint and maximum permitted point sources
(Scenario 1 – Scenario 4)
Lake alternative
Current nonpoint sources
(Scenario 1 – Scenario 2)
Lake alternative
Current nonpoint and current point sources
(Scenario 1 – Scenario 3)
Lake alternative
Current nonpoint and maximum permitted point sources
(Scenario 1 – Scenario 4)
Duration
0.02 - 1 days
1 - 2
2 - 4
4 - 7
7 - 14
14 - 21
21 - 30

Magnitude (mg/L DO difference)



Summary of Findings

- *Under the Lake or Estuary alternative, the combined effect of current nonpoint (river) and point source (wastewater treatment plant) nitrogen loads violate the water quality standards for dissolved oxygen in Budd Inlet.*

Summary of Findings (cont'd)

- Maximum permitted loads would cause further violations.
- Current loads must be reduced for a healthy Budd Inlet.
- Nonpoint source loads must be reduced for a healthier Capitol Lake.
  - Deschutes watershed = large source of sediment
  - Capitol Lake sediments release large amounts of phosphorus

Summary of Findings (cont'd)

- Based on current nonpoint (river) and point source (wastewater treatment plant) loads:
  - An estuary would…
    - reduce the area violating water quality standards compared with a lake
    - reduce the number of days Budd Inlet violates water quality standards
  - … compared with the current lake
- *How this translates to nutrient load reductions will be evaluated in the next step.*

Summary of findings

<u>Budd Inlet</u>

- Current nutrient loads are too high
- Lake vs. estuary
- Tributary bacteria too high

<u>Capitol Lake</u>

- Current nutrient loads are too high

<u>Deschutes River</u>

- Temperatures are too hot
- DO levels are too low
- Fine sediment too high

<u>Percival Creek</u>

- Temperatures are too hot
- DO levels are too low

Reductions are needed– *How much? Where? How?*

Questions?