



King County

Protecting Our Waters

Doing our part on rainy days

Lake Union/Ship Canal Water Quality Assessment: Current Conditions and Trends

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Science Seminar

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Photo by Frank H. Nowell

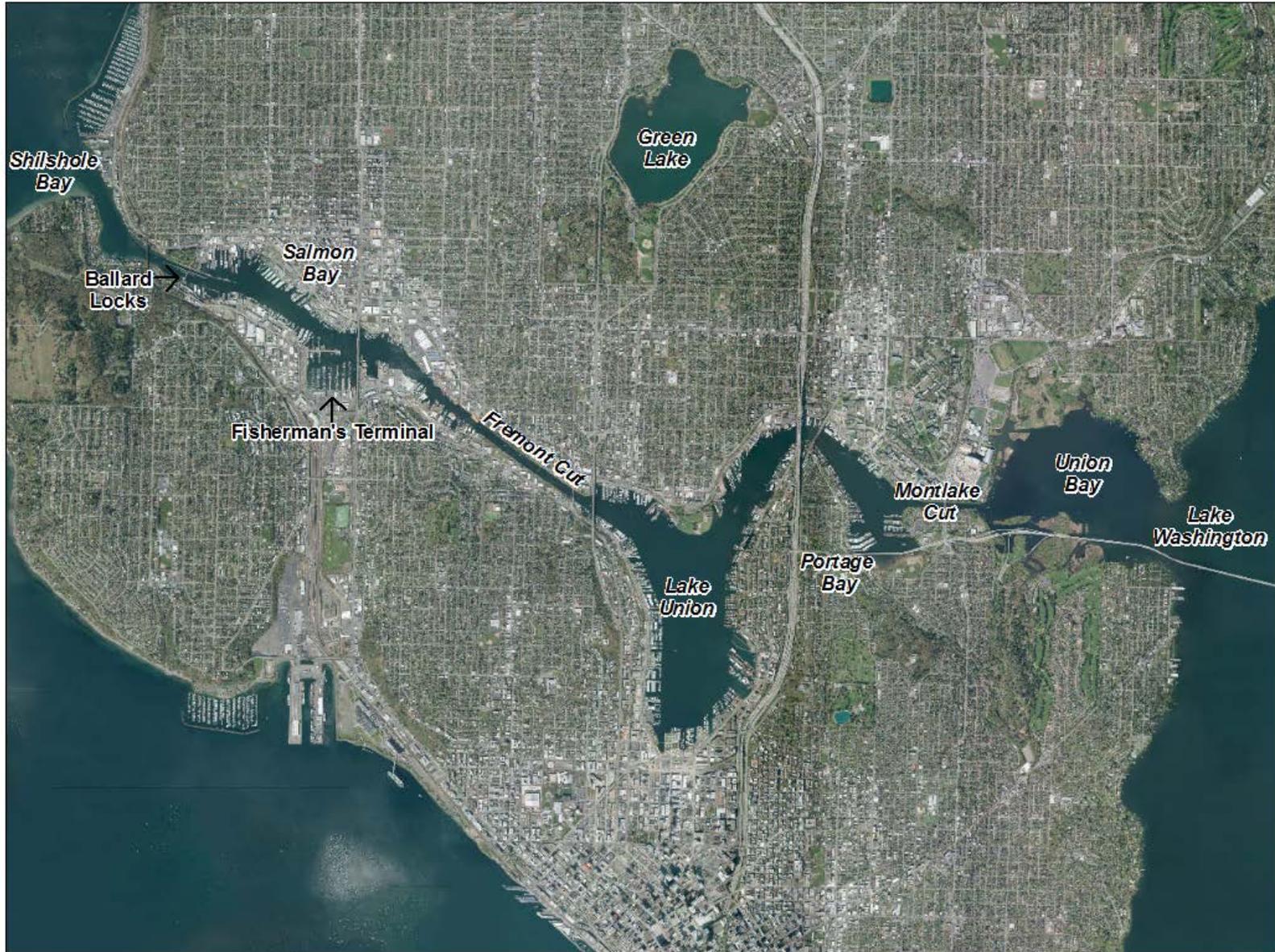
CANAL LOCKS, SECOND TO PANAMA.



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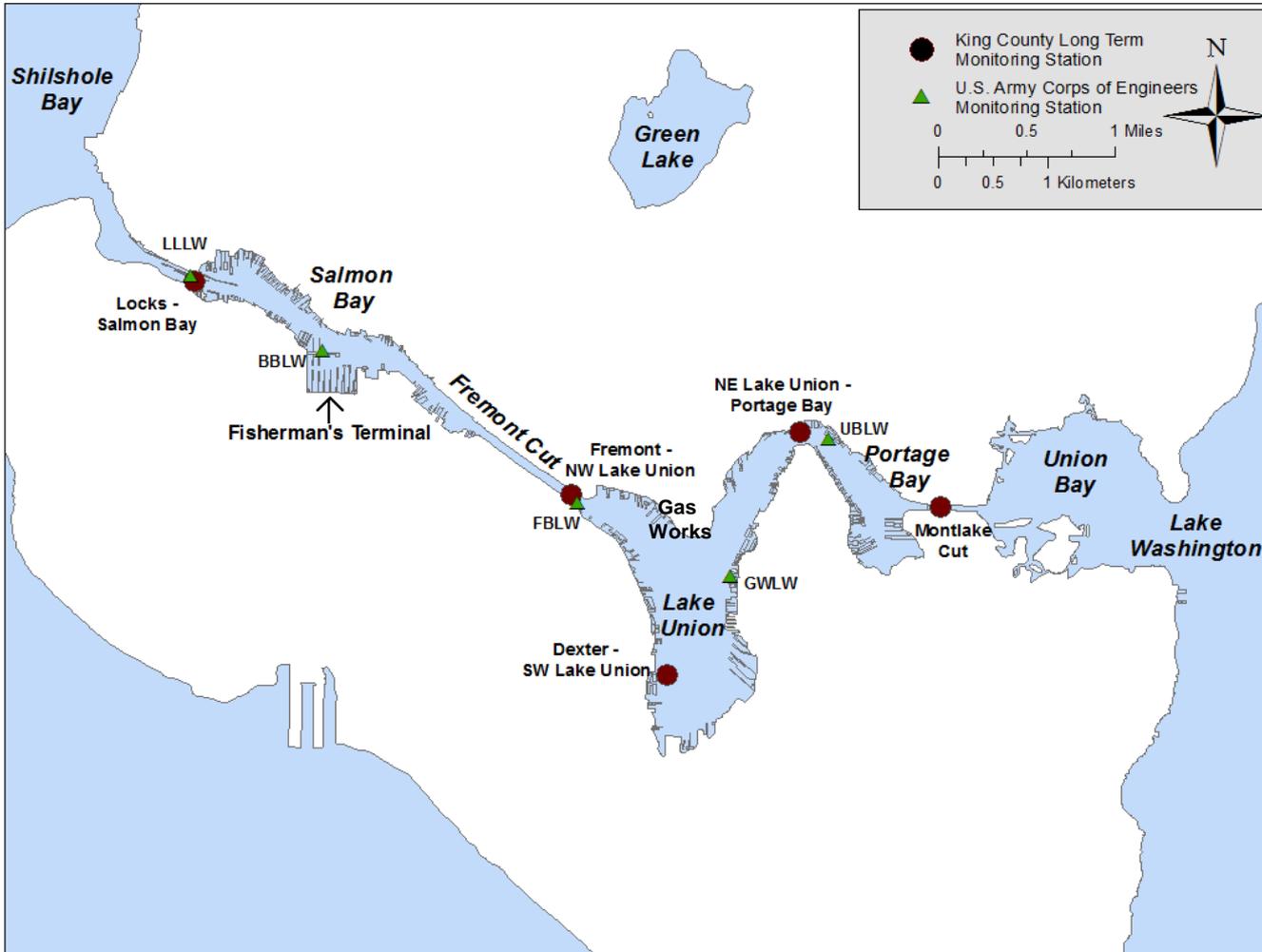
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Water Quality Monitoring Stations



- Monthly /bi-monthly April-October
- 3 sites in greater Lake Union/Ship Canal in last 5 yrs
- 2 sites discontinued in 2008
- KC data goes back to 1970s and 80s.
- 5 US ACOE sites since ~2000
 - Temperature, conductivity, salinity



Lake Union/Ship Canal Current Conditions

Water Quality

- Bacteria is the biggest human health concern
- High temperature and low dissolved oxygen in summer may threaten migrating salmon
- Mesotrophic (moderately productive)

Sediment Quality

- High PAHs, PCBs, metals (mercury, silver, arsenic), butyltins, and phthalates may threaten benthic species. Potential for upward movement through the food web.

Saltwater Intrusion

- Strengthened and prolonged stratification
- Low to no dissolved oxygen, build-up of nutrients
- Increases in organic compounds detected

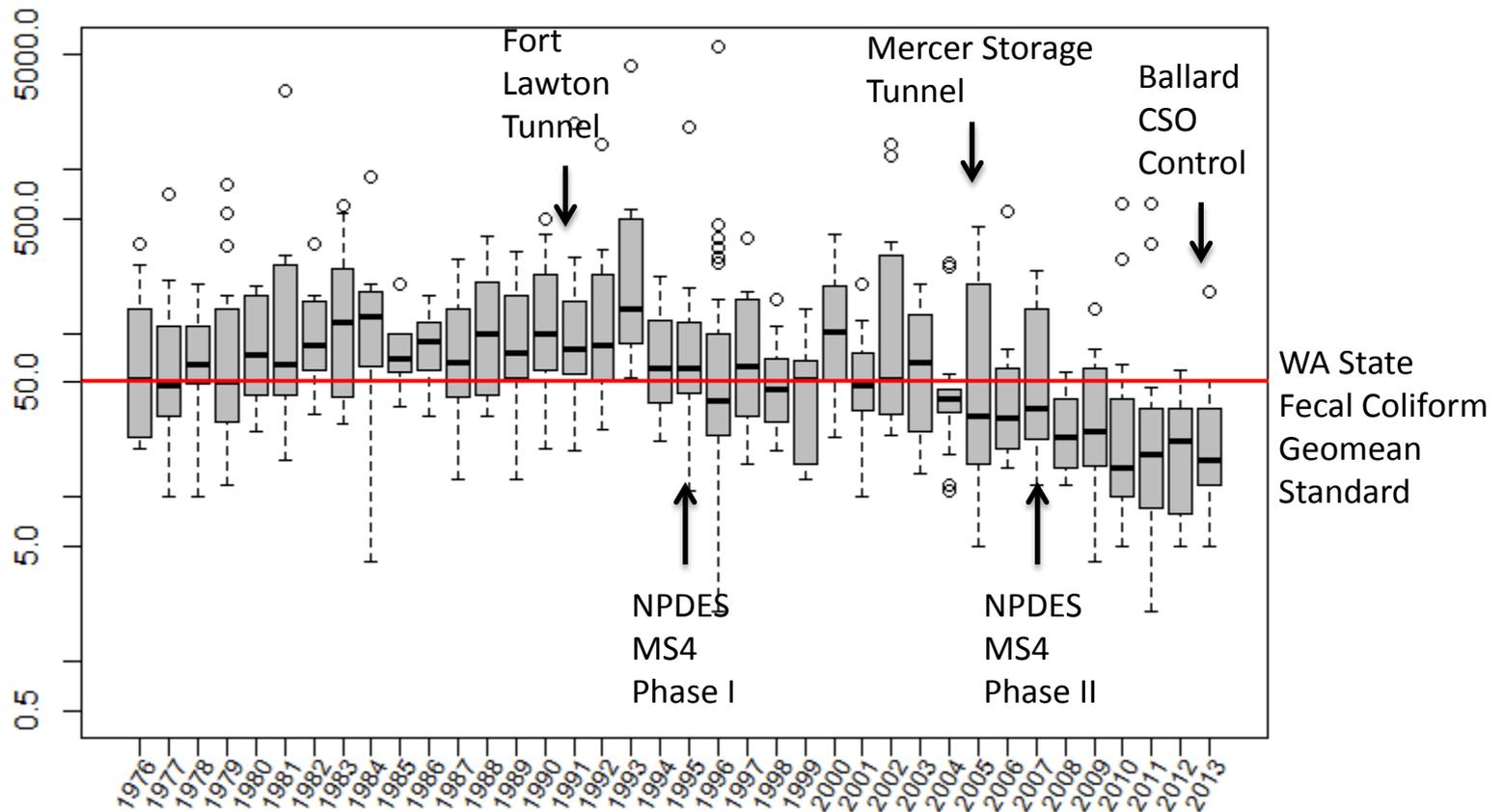


Long-term Trends (mid-1970s-2013)

- **Nutrients Declining**
 - Phosphorus (SRP & Total)
 - Each at ~0.2 ppb per year
 - Nitrogen (NH₄ & NO₃/NO₂)
 - NO₃/NO₂: ~0.9 to 1.0 ppb per year
 - NH₄: ~0.2-0.3 ppb per year
- **Bacteria Declining**
 - ~1-2 CFU/100 mL per year
- **Temperature Increasing**
 - 0.02 to 0.04 °C per year
- **Dissolved oxygen NOT decreasing**
 - Would expect with increasing temperatures
 - Decline in BOD input and productivity?

Water Quality: Bacteria

Locks-Salmon Bay Fecal Coliforms

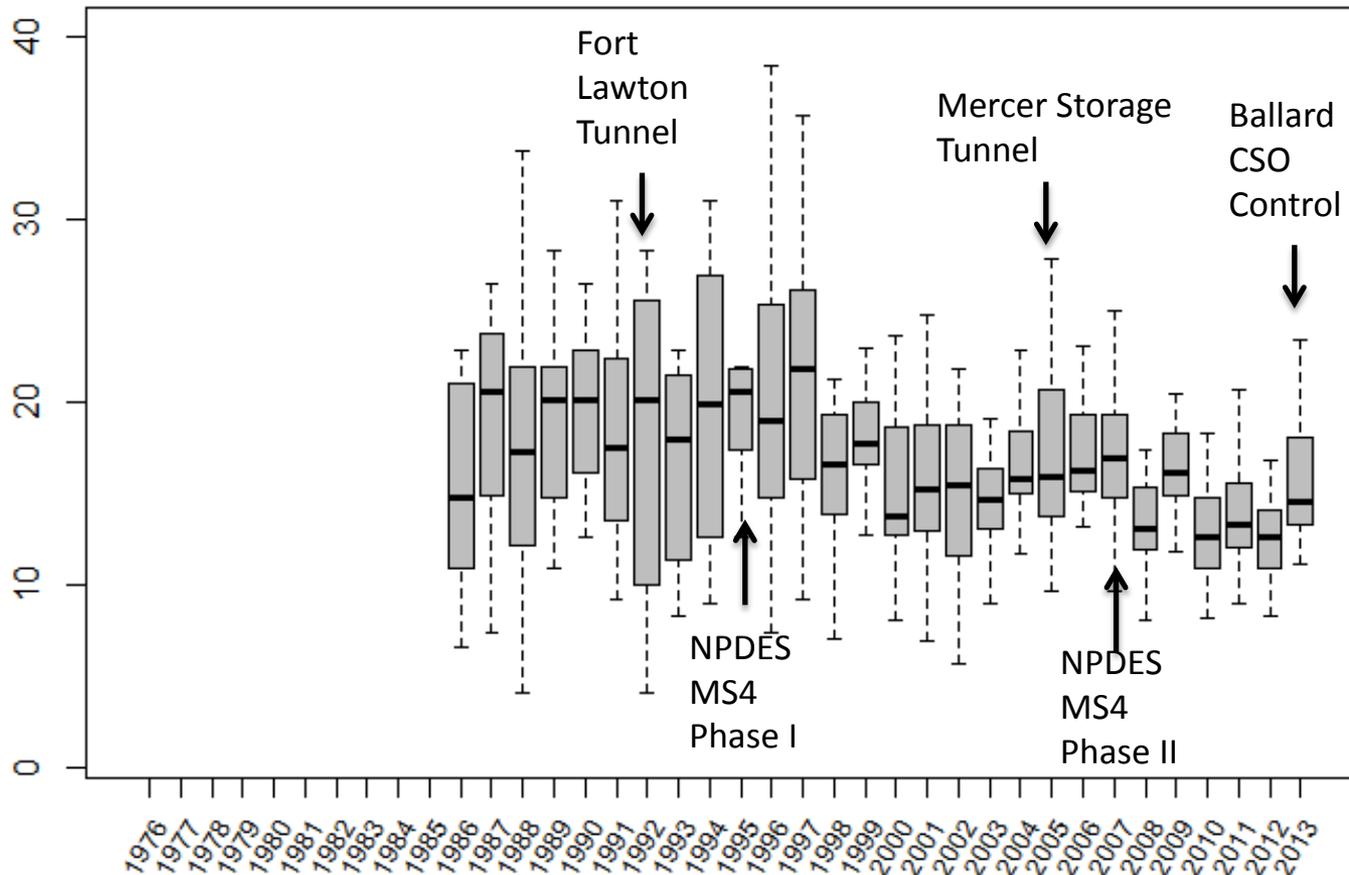


- ~2 CFU per year



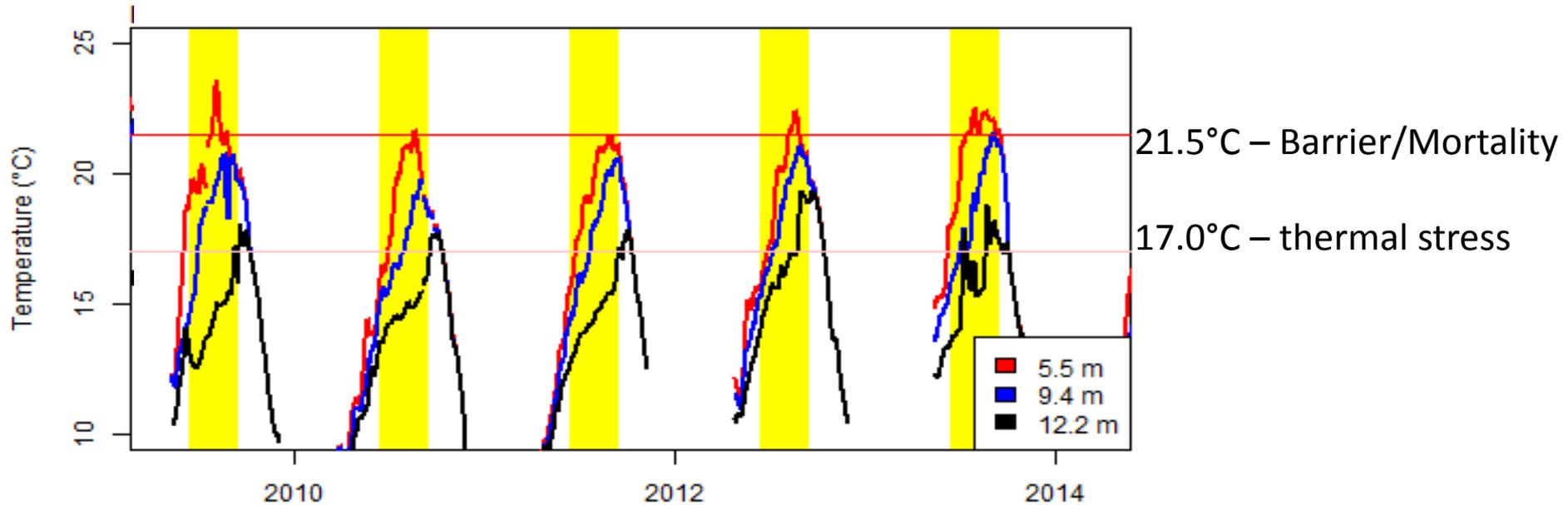
Water Quality: TP

Locks-Salmon Bay TP



- ~0.2 ppb per year

Water Quality: Temperature



ACOE Fremont Bridge – 7-Day average of daily maximum (7-DADMax)

Red – 5.5 m depth

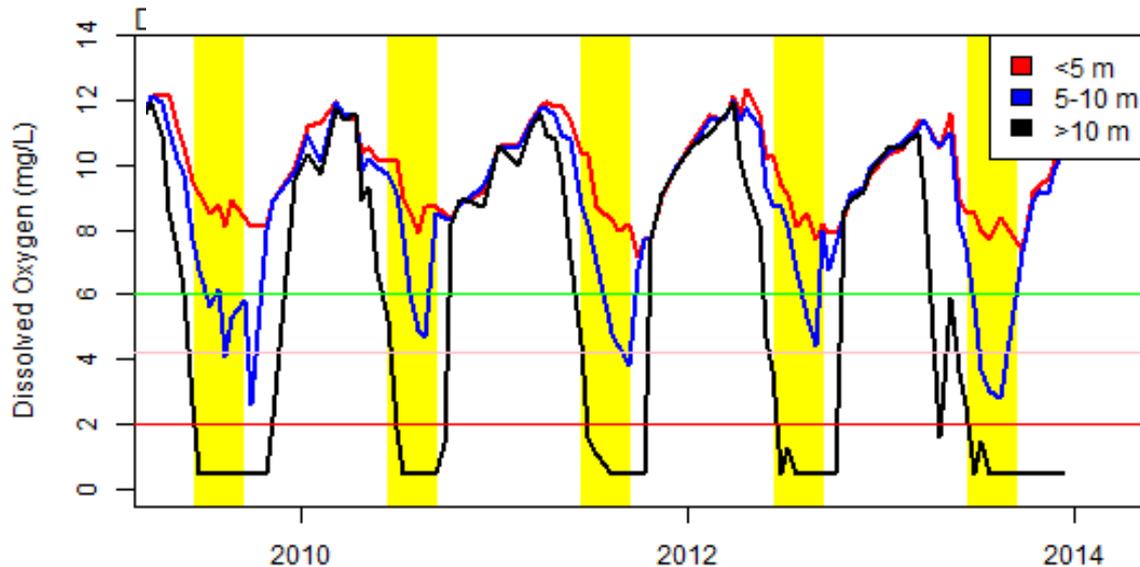
Blue – 9.4 m

Black – 12.2 m depth

Period of salmonid presence highlighted (**June 15 to September 15**)



Water Quality: Dissolved Oxygen



>6 mg/L – Optimal for salmonids
<4.25 mg/L – Stress salmonids
<2 mg/L – Lethal to salmonids

KC SW Lake Union (Dexter) – twice-monthly profiles

Red – Surface (<5 m)

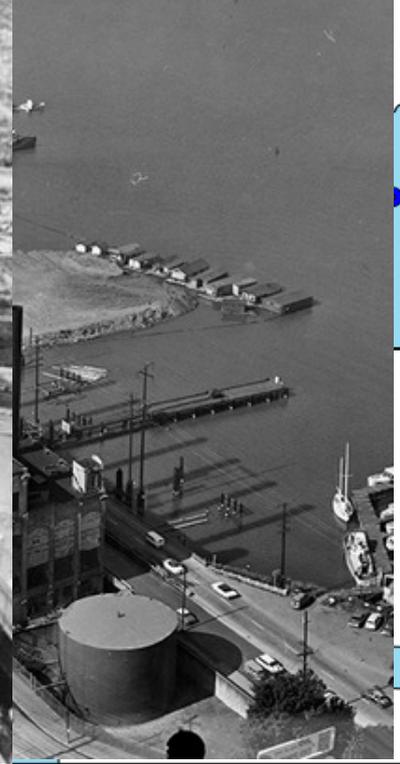
Blue – Mid-depths (5-10 m)

Black – Bottom (>10 m)

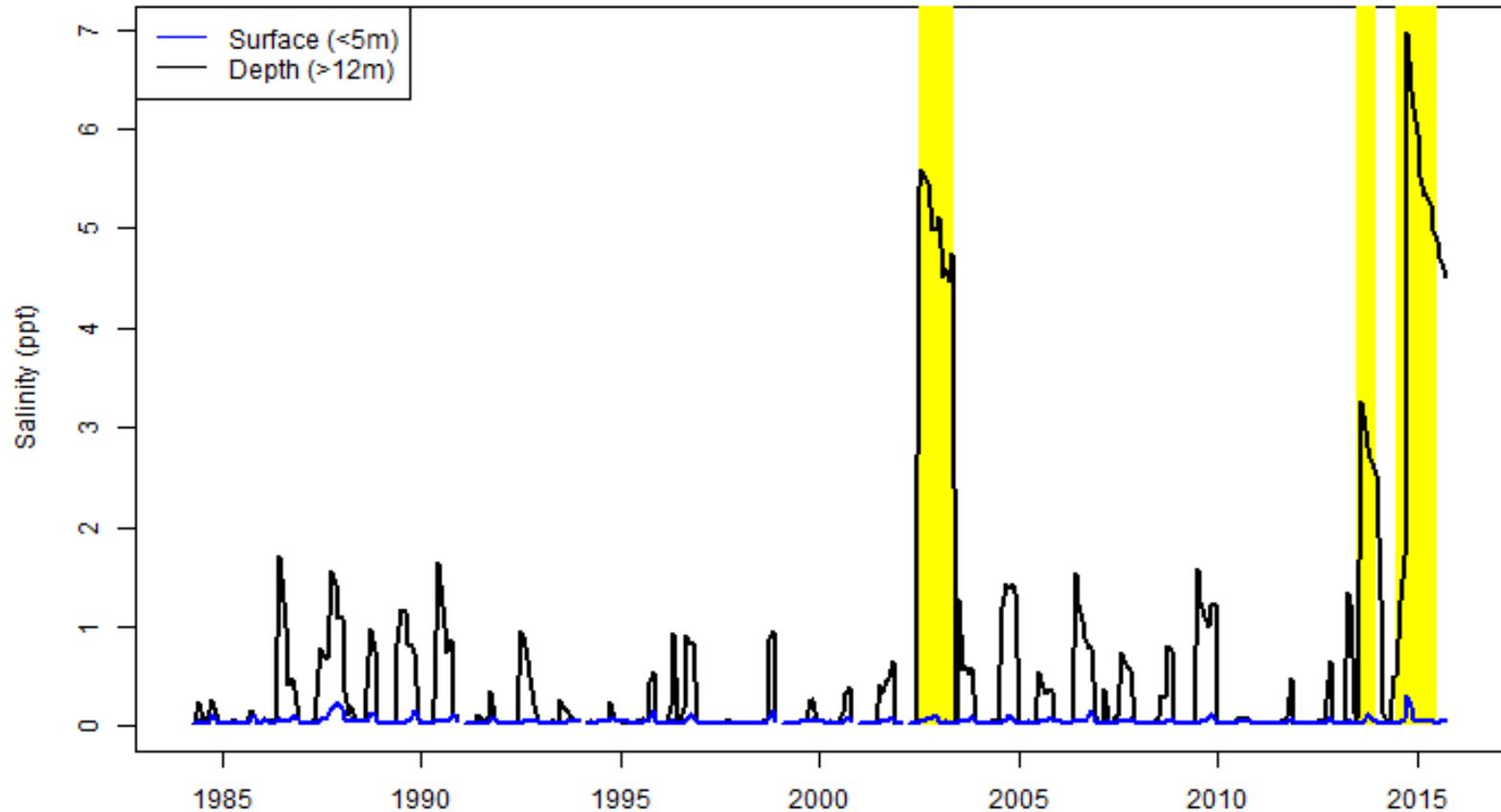
Period of salmonid presence highlighted

Sediment

Most
exceedances
of WA Criteria
for the
benthic



Saltwater Intrusion



KC site in SW Lake Union

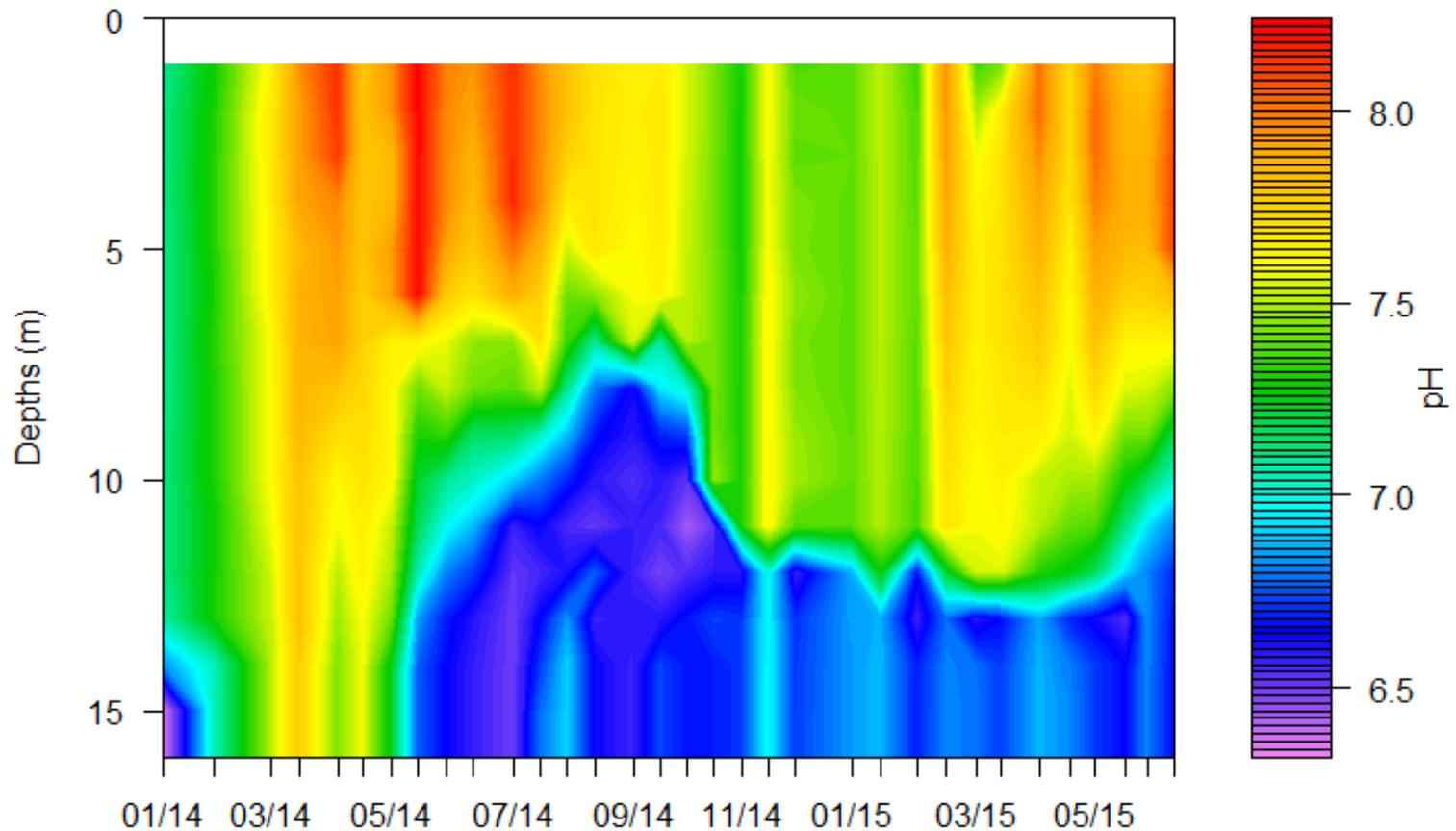


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Saltwater Intrusion





Impacts of Saltwater Intrusion

- **Alteration of the physical conditions near the sediments may lead to the release of organic compounds.**
- **Buildup of nutrients in saltwater layer (SRP & ammonia – order of magnitude above typical summer values)**
 - Due to reduction of iron, manganese in sediments. No nitrification of ammonia in hypolimnion.
- **Elevated PAHs, carbazole, and dibenzofuran were identified in 2002.**
 - PAHs detected in 2015. Other organic compounds not tested.



Key Findings

Water Quality

- Decreasing trends in
 - Bacteria
 - Nutrients
- Bacteria still exceeds water quality standards

Sediment Quality

- High PAHs, PCBs, metals, and phthalates may impede benthic species. Potential for movement through trophic levels for bioaccumulative chemicals.

Saltwater intrusion

- May allow sediment recontamination of the water column through the alteration of physical conditions.
- May elongate hypoxia/anoxic conditions and remove a cold-water refuge for salmonids

