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

Tim Clark
Science Seminar
November 5, 2015
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 (NH$_4$ & NO$_3$/NO$_2$)
    - NO$_3$/NO$_2$ : ~0.9 to 1.0 ppb per year
    - NH$_4$ : ~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

• ~2 CFU per year
Water Quality: TP

- Approximately 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)

21.5°C – Barrier/Mortality
17.0°C – thermal stress
Water Quality: Dissolved Oxygen

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

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

Most exceedances of WA Criteria for the benthic community in Lake Union for BEHP, PCBs, Silver, PAHs were the most common contaminants.
Saltwater Intrusion

KC site in SW Lake Union
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
QUESTIONS?