LAKE WHATCOM NORTH SHORE ON-SITE SEWAGE SYSTEM LEACHATE DETECTION PROJECT

Rob Zisette, Herrera Environmental Consultants

LAKE WHATCOM POLICY GROUP MEETING

2/5/2018

Presentation Outline

- Project setting/need
- Site conditions
- Study design
- Monitoring results
- Correlation analysis
- Study conclusions
- Next steps

Project Setting

- Lake Whatcom supplies water to ~100,000 people in Bellingham, WA area
- TMDL implementation plan for phosphorus and fecal coliform bacteria requiring 20-96% reduction in streams
- Entire watershed is a sensitive area that is mostly sewered with 650 OSS

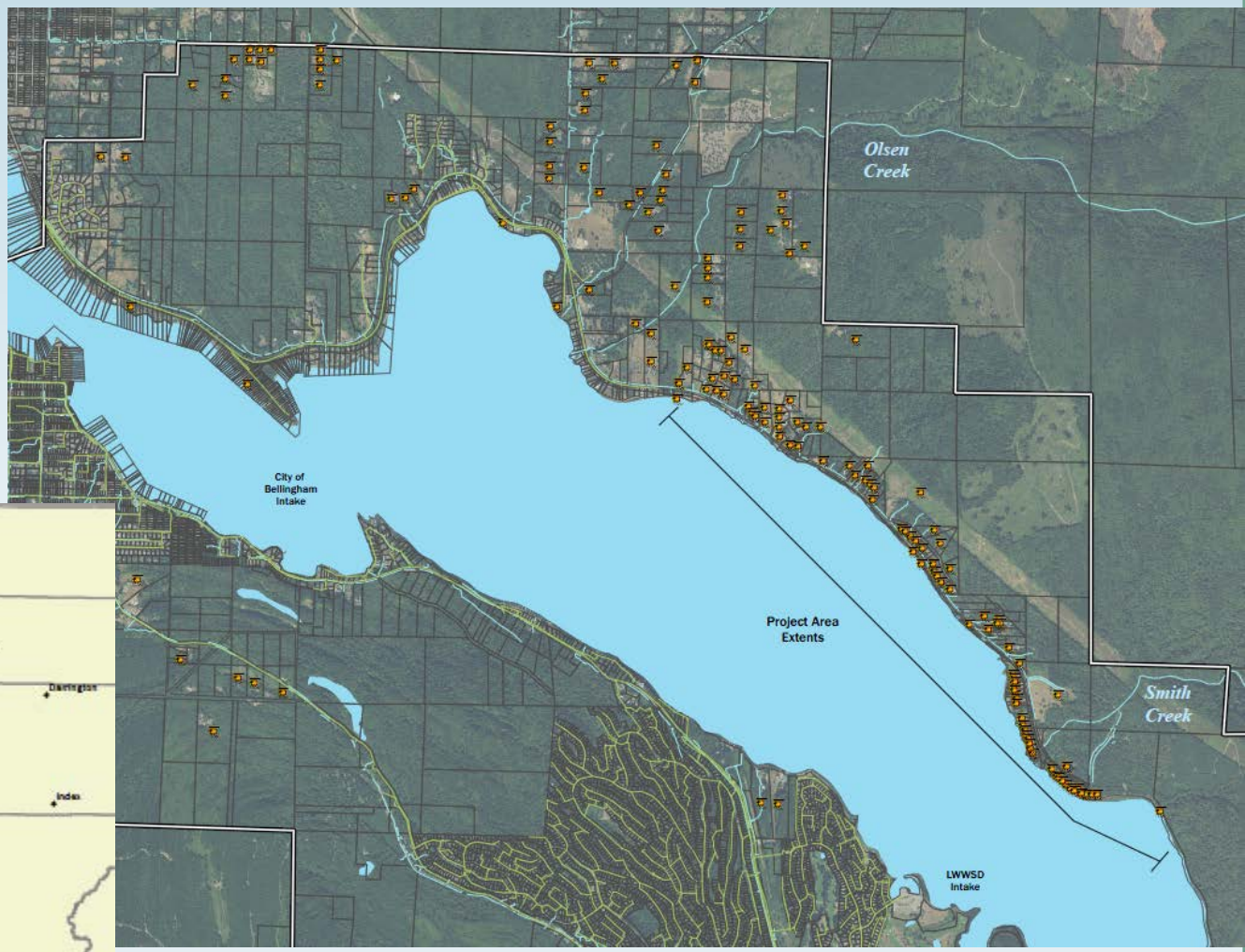
Project Need

- Lake Whatcom Water and Sewer District (LWWSD) is working with other jurisdictions to protect lake water quality, and is concerned about OSS contamination and eutrophication of their water supply.
- LWWSD is investigating a sewer extension to over 99 homes with OSS on 2.5 miles of North Shore Road.
- Sewer extension would require a conditional use permit for existing Rural Residential land use with evidence that the sewer is **necessary to protect both public health and environmental impacts to Lake Whatcom.**

HERRERA

North Shore Road Study Area

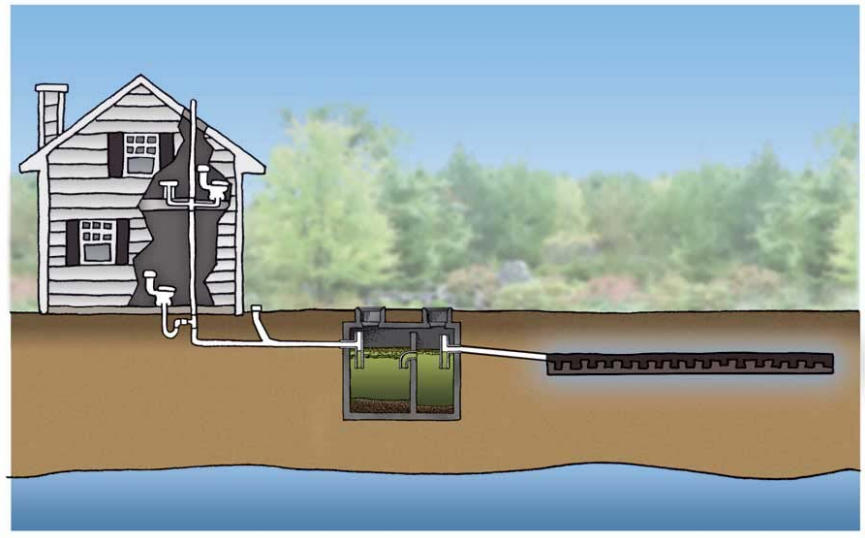
- 99 OSS with 50% built before 1990 regulations



2015 OSS Inspection Records

- 55 inspected 2013-2015
- 39 inspected 2009-2012
- 2 never inspected
- 20 inspected by homeowner
- 20 needed maintenance:
  - 8 needed pumping
  - 11 needed minor repairs
  - 1 had failed pump

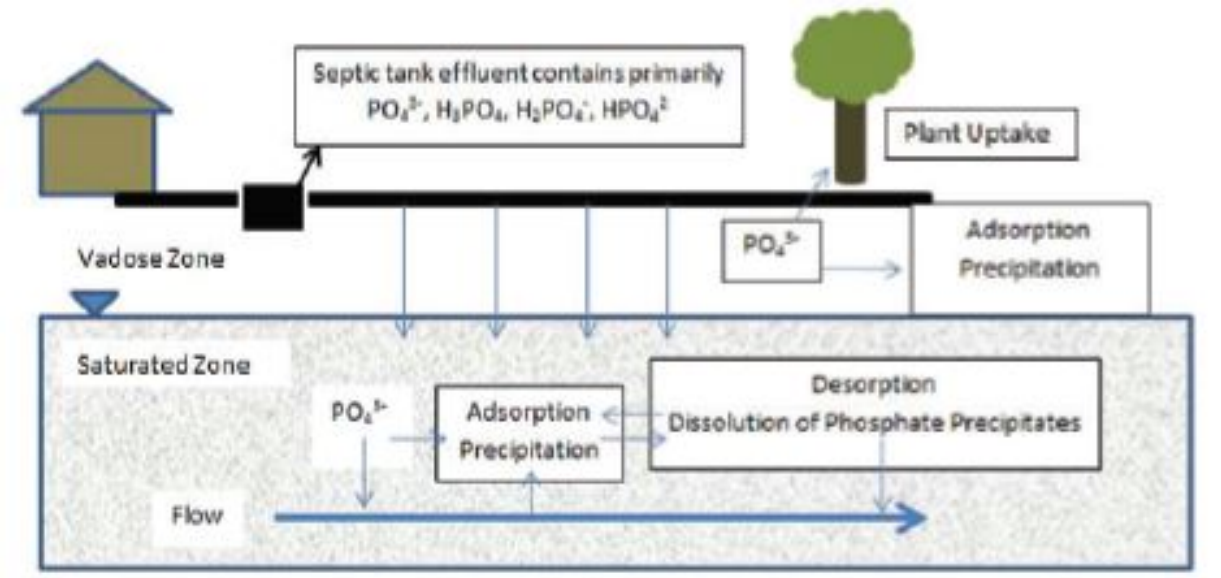
WCHD OSS compliance emphasis began in 2016



High Seepage Contamination Risk

- Old systems
- Close to lake
- High rainfall
- Steep slope
- Underlying bedrock

- Shallow soils with P saturation
- Shallow water table with anoxic Fe-P dissolution



OSS Detection Study Design

1. Target winter wet weather with highest OSS detection potential due to:
   - Soil saturation
   - High shallow ground water table
   - High lake level

   For increased transport of effluent to drainages and lake via:
   - Shallow groundwater seepage
   - Overland flow of surfacing system failures
2. Cost-effective use of field data to identify hot spots in lake and drainages for sampling and lab analysis
3. Human fecal sources in lake and drainages are from OSS in the subbasin

HERRERA

OSS Detection Methods

- Optical brighteners
- Conductivity/multimeter
- Fecal bacteria
- Total phosphorus
- Chloride/bromide
- Microbial Source Tracking (MST) using two human Bacteroidetes methods by digital quantitative polymerase chain reaction (dPCR)

Experimental Design

1. Three boat surveys along shore in winter wet weather
2. Continuously log field measurements and position
3. Use field data to sample hot spots in lake and drainages
4. Sample lake control sites first and OSS site last
5. Event 1 for field tests and 23 fecal bacteria samples
6. Events 2 and 3 for field tests and 18 fecal bacteria sample results to select analysis of 15 samples for:
    a. Total phosphorus
    b. Chloride and bromide
    c. MST Bacteroidetes qPCR for B. dorei and B. EPA

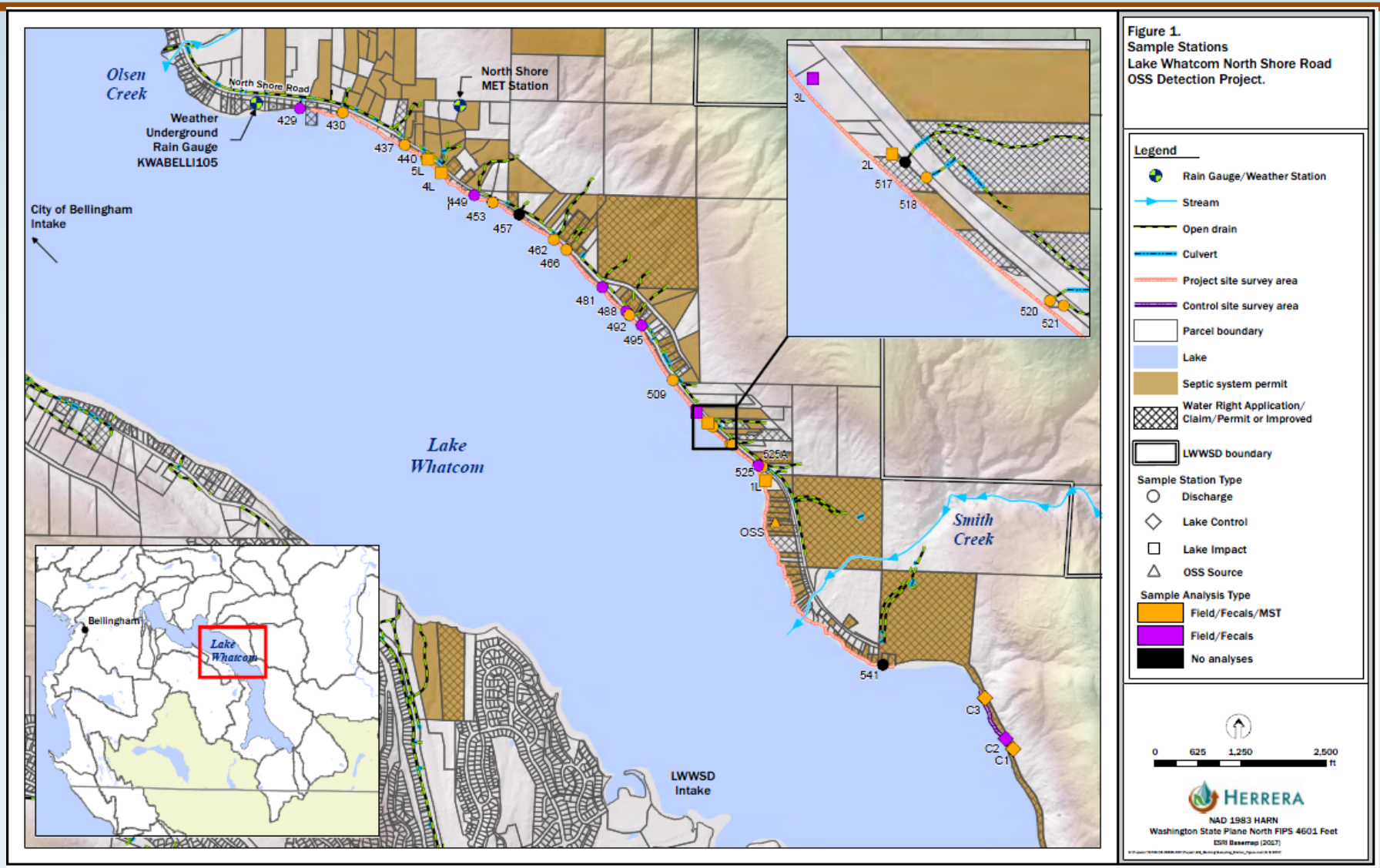
HERRERA

Sample Collection

- Monitored three events:
  1. January 19, 2017 (48-hour rain = 2.20 in, lake level = 312.0 ft)
  2. March 15, 2017 (48-hour rain = 0.87 in, lake level = 313.9 ft)
  3. March 29, 2017 (48-hour rain = 1.86 in, lake level = 314.6 ft)
- Continuous field parameters for each event:
  - YSI Multimeter (position, temp, DO, pH, conductivity, turbidity)
  - Turner Cyclops-7 fluorometer (optical brighteners)
- Samples collected by peristaltic pump from field probe location at:
  - 2-3 lake control stations
  - 1-3 lake impact stations
  - 11-14 discharge stations
  - 1 OSS station

HERRERA

Sampling Station Locations



HERRERA

MST Method Accuracy and Precision

- Method comparison study using 27 labs:
  - B. dorei has high sensitivity, low false negatives
  - B. EPA has high selectivity, low false positives
- Source Molecular analysis of 3 years of data:
  - 85% of samples had B. dorei detected and B. EPA not detected or at lower concentration
- dPCR increases sensitivity by amplifying multiple droplets versus one aliquot by qPCR
- Each sample analyzed in duplicate and re-analyzed if COV exceeds 30%

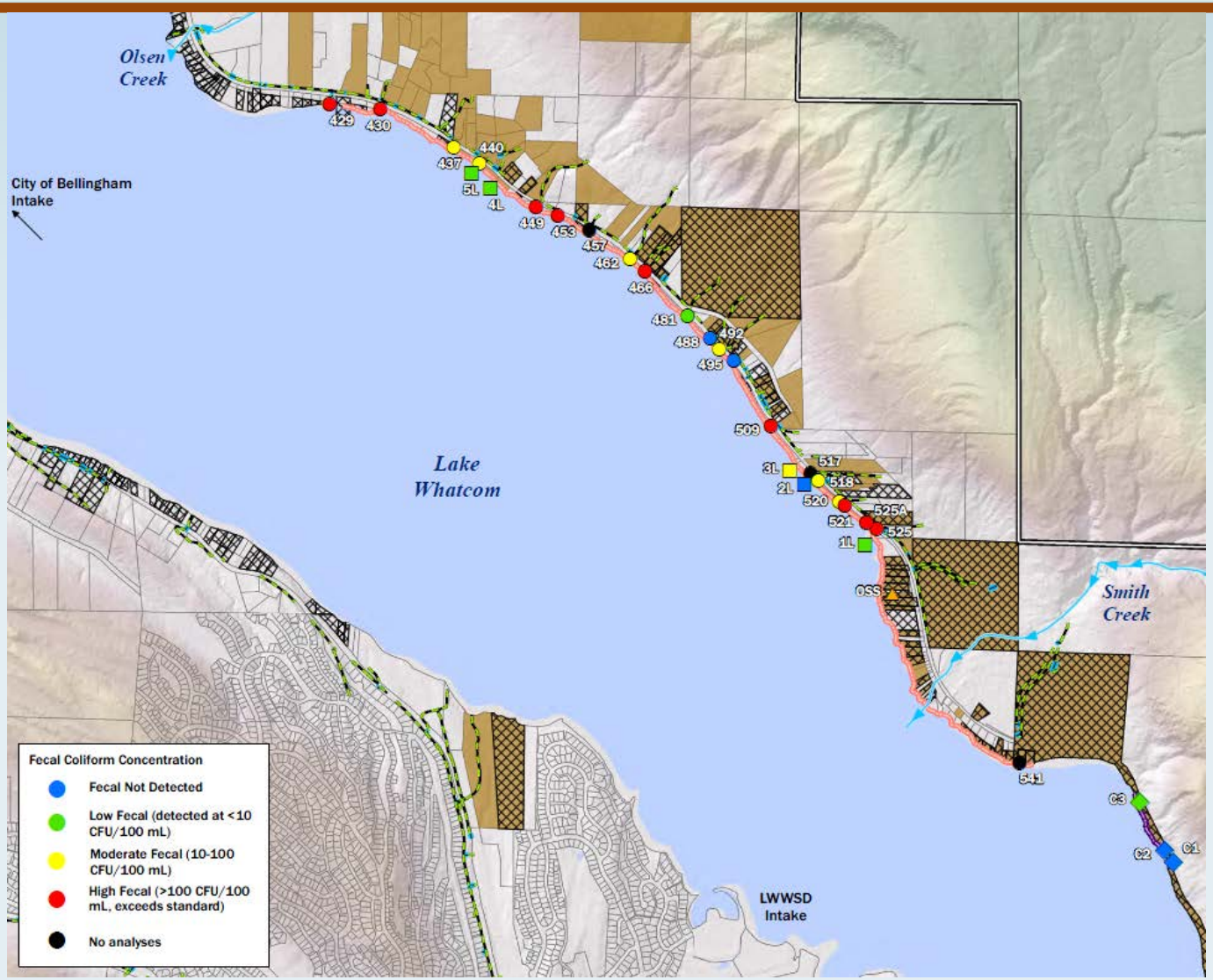
HERRERA

Results – Medians/Geomeans

Parameter	Lake Control	Lake Impact	Discharge	OSS
Conductivity (µS/cm)	57.3	60.9	59.0	954
Optical brighteners (RFUB)	43.4	81.2	189	660
Total phosphorus (mg/L)	<0.008	0.021	0.054	10.3
Fecal coliform (CFU/100 mL)	3	10	36	2,470,000
E. coli (CFU/100 mL)	3	10	28	2,470,000
B. dorei (copies/100 mL)	1.4	3.7	8.4	1,230
B. EPA (copies/100 mL)	0	0	4.6	88,100

HERRERA

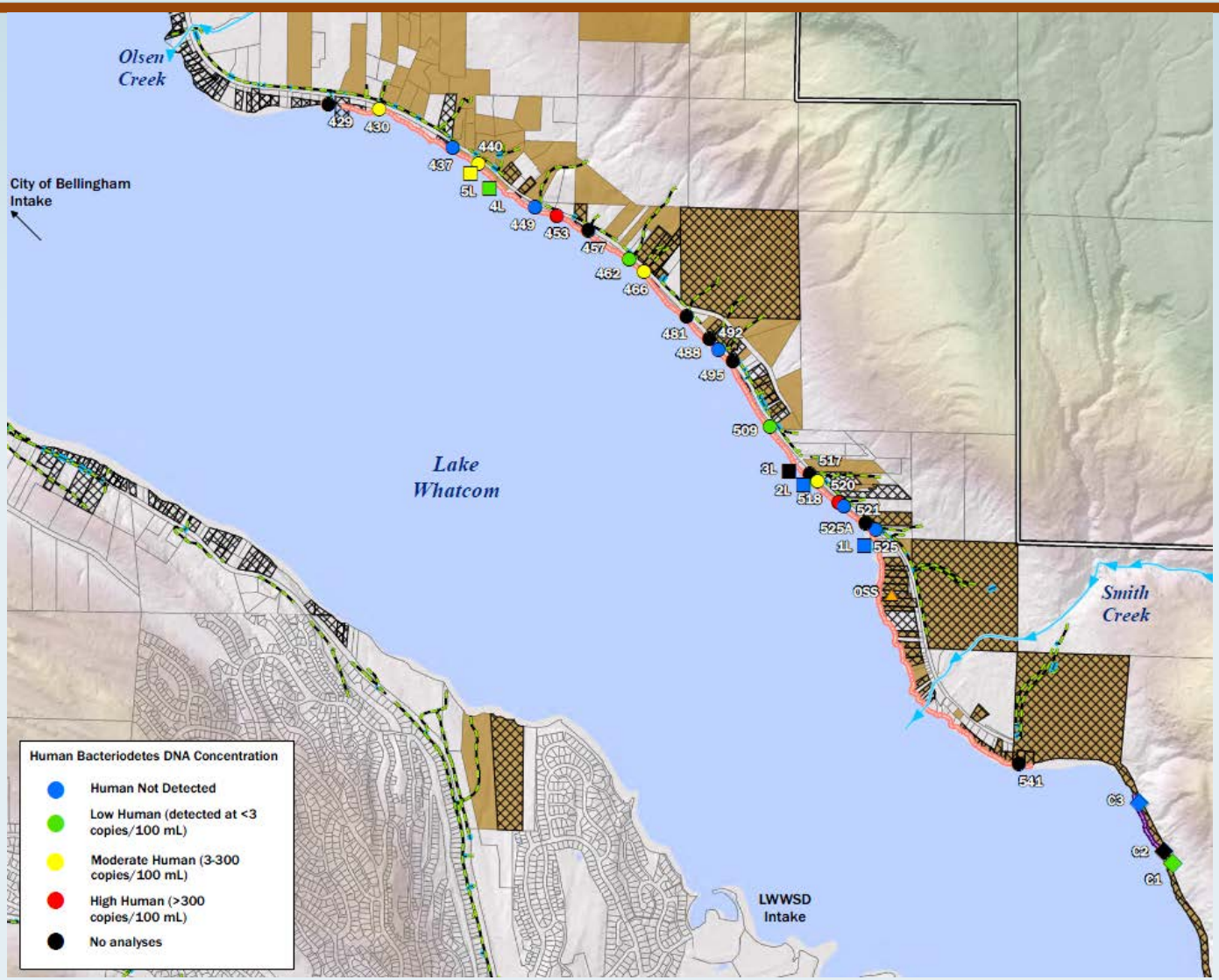
Fecal Coliform Bacteria Results



- Rated relative to Recreation Standard (100)
- High (>std) in 9/18 discharges in 5 areas, but no lake samples
- Maximum (800) less than typical stormwater

HERRERA

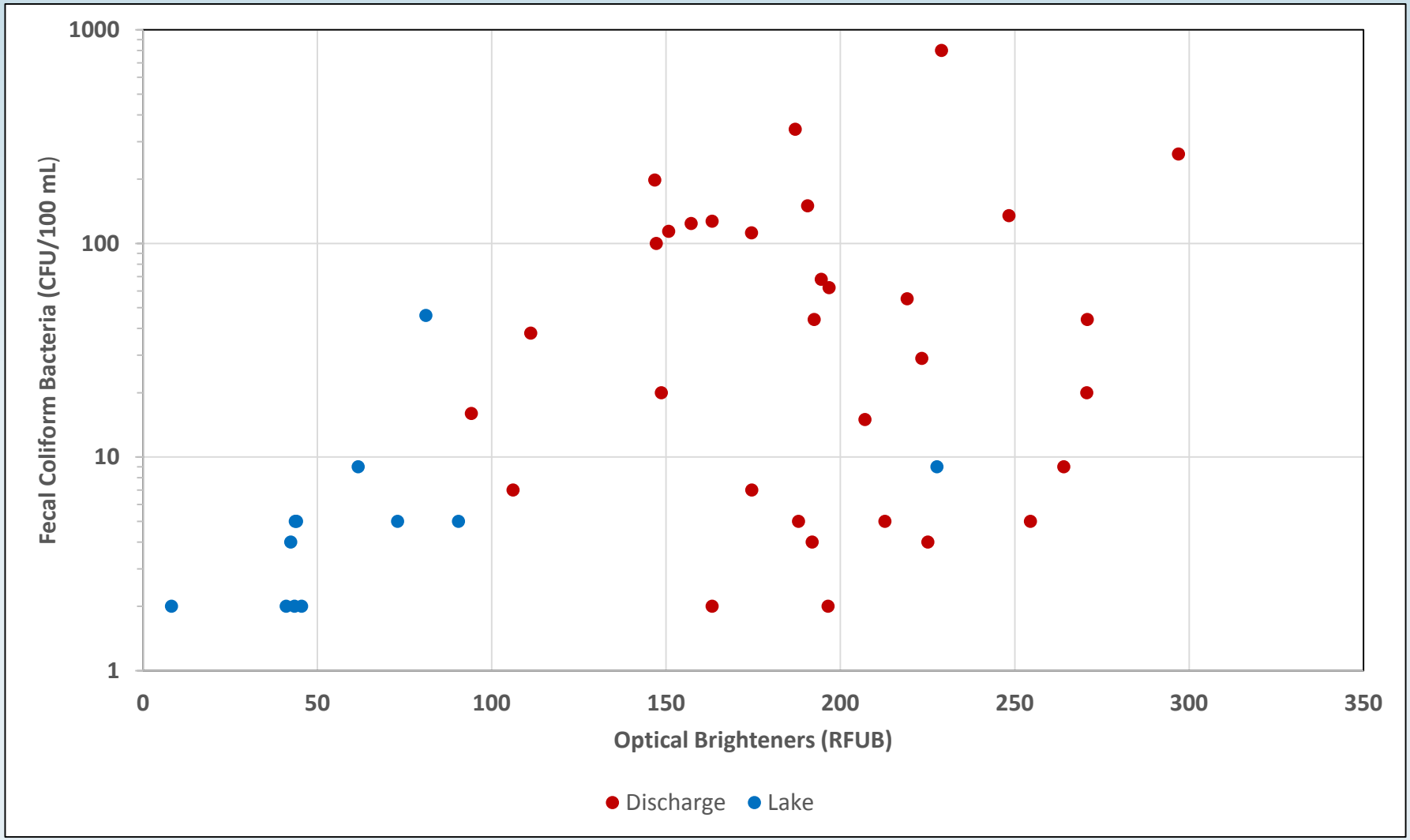
Human Bacteroidetes Results



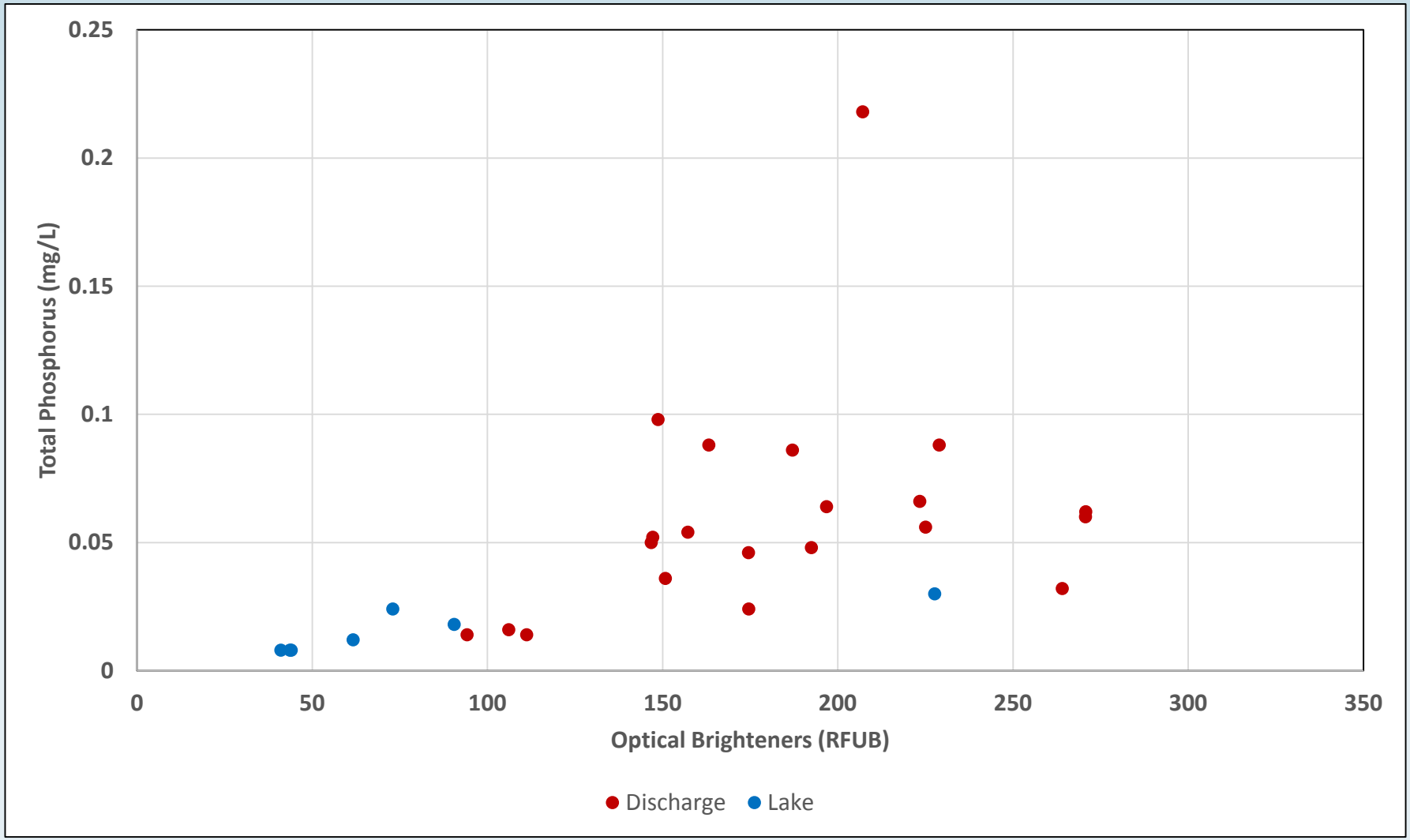
- High (>100 DL) at 2 discharges (1~OSS but with moderate fecals)
- Moderate (>DL) at 4 discharges and 1 lake station

HERRERA

Fecal Coliform vs. Optical Brighteners



Total Phosphorus vs. Optical Brighteners



Conclusions

- Indications that OSS are impacting the lake with fecal bacteria and phosphorus in the study area
- Human fecal bacteria were detected at moderate to high DNA concentrations at 6 of 18 discharges to lake in study area, with one discharge containing amounts found in OSS samples
- Fecal bacteria concentrations are not good indicators of human sources in the lake or discharges
- Optical brightener fluorescence is a good indicator of fecal bacteria and total phosphorus

HERRERA

Next Steps

- WCHD is conducting OSS regulation compliance investigation and enforcement
- Herrera will complete OSS phosphorus loading analysis
- Lake Whatcom Management Team will lead modified OSS input sampling in winter of 2018/2019 to confirm findings and evaluate OSS investigation effectiveness

HERRERA

Questions? rzisette@herrerainc.com

HERRERA

Phosphorus Loading Analysis Method

- Contaminated and uncontaminated discharges based on human fecal marker detection
- Flow-weighted average TP concentration for existing and OSS-corrected discharges, by reducing TP in contaminated discharges to typical TP in uncontaminated discharges.
- Apply percent reduction in TP for all discharges from existing to OSS-corrected to the TMDL TP loading from North Shore subbasin.
- Add 25 percent OSS loading from direct seepage to lake

HERRERA