

# Portland's *Cryptosporidium* Detections: Investigation and Outcome

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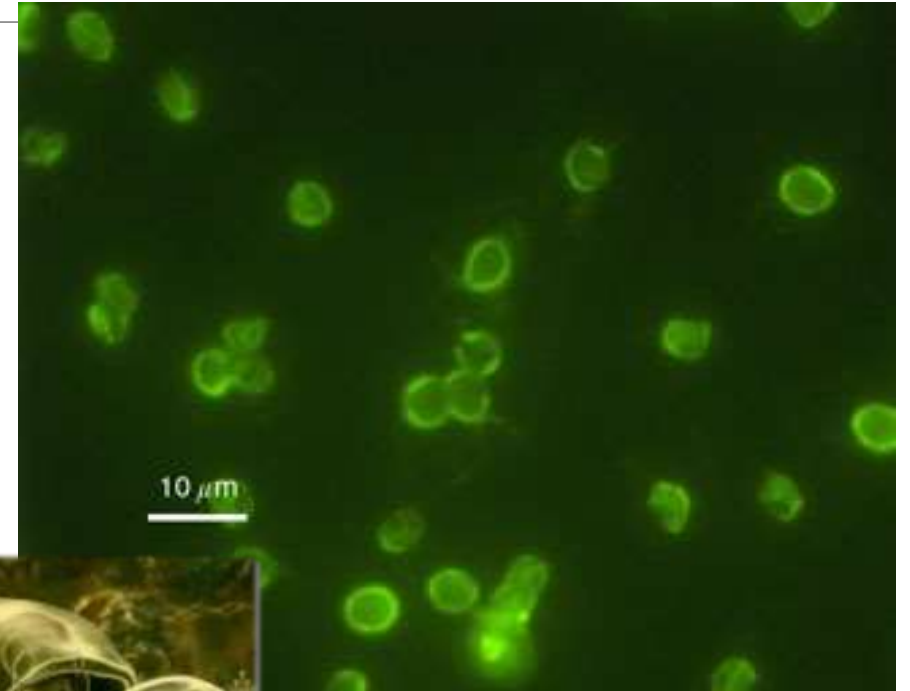
AWWA-PNWS

APRIL 27, 2018










# *Cryptosporidium*

- Chlorine-resistant pathogenic protozoan
- Sources include human sewage, livestock, wildlife.
- *C. hominis* and *C. parvum* cause the vast majority of cases in humans
- PWB's LT2 Variance granted in 2012; revoked 2017



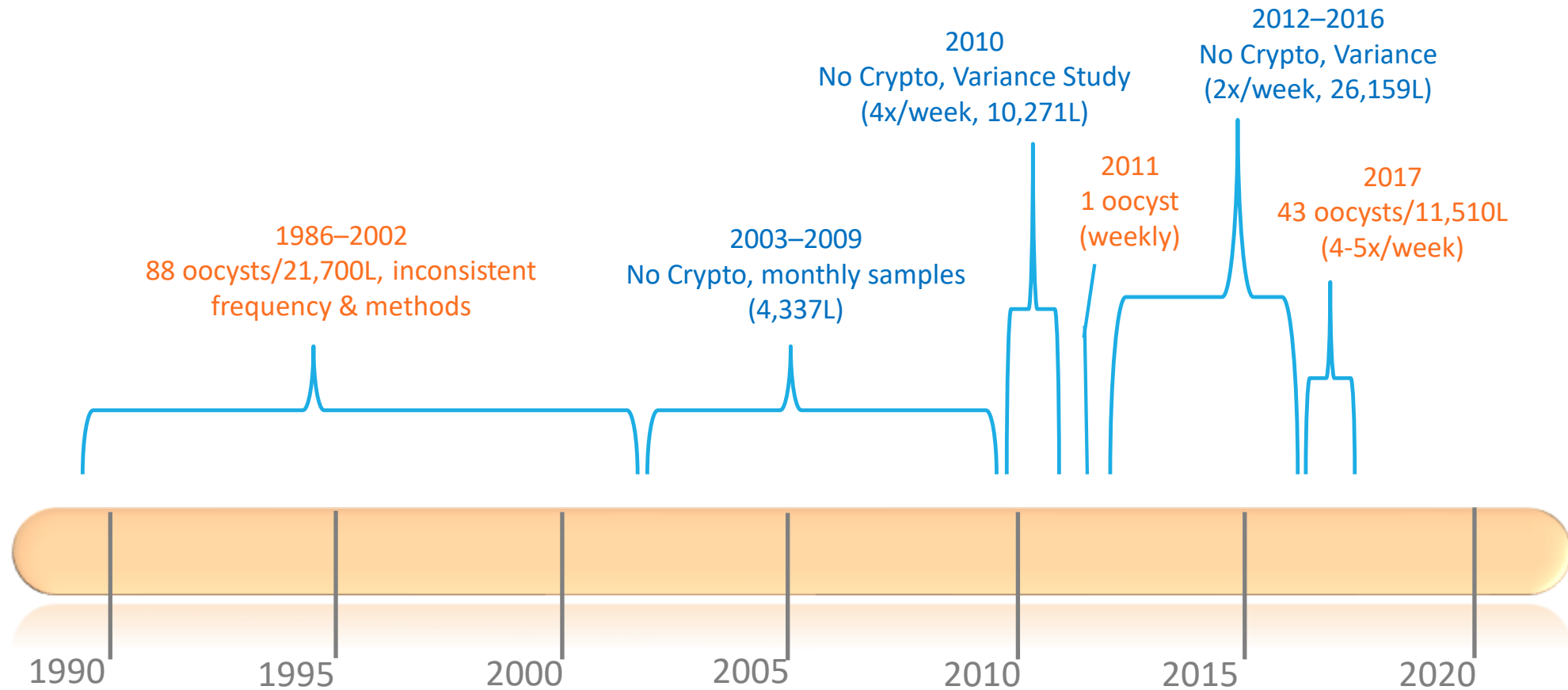
# Portland's Water System



- |  |   |
|--|---|
|  Water Storage Facility   |  Portland Water System Distribution Area |
|  Water Supply Pipes       |  Water Source                            |
|  Water Treatment Facility |  Protected Area                          |
|  Dam                      |   |

- Serves approximately 970,000 people
- 19 wholesale water districts
- 101 million gallons per day average (80 – 160 mgd)

# Historical *Cryptosporidium* Monitoring (Raw Water Intake)



# Treatment Variance Conditions

## Intake Monitoring:

- Observation Monitoring
  - Two 50-liter samples per week
- If Crypto is detected, then Demonstration Monitoring
  - Notifications, Press release
  - Increased Monitoring For 1 year
    - 250 L per week
    - Variance revoked if  $>0.075$  oocysts / 1000 L

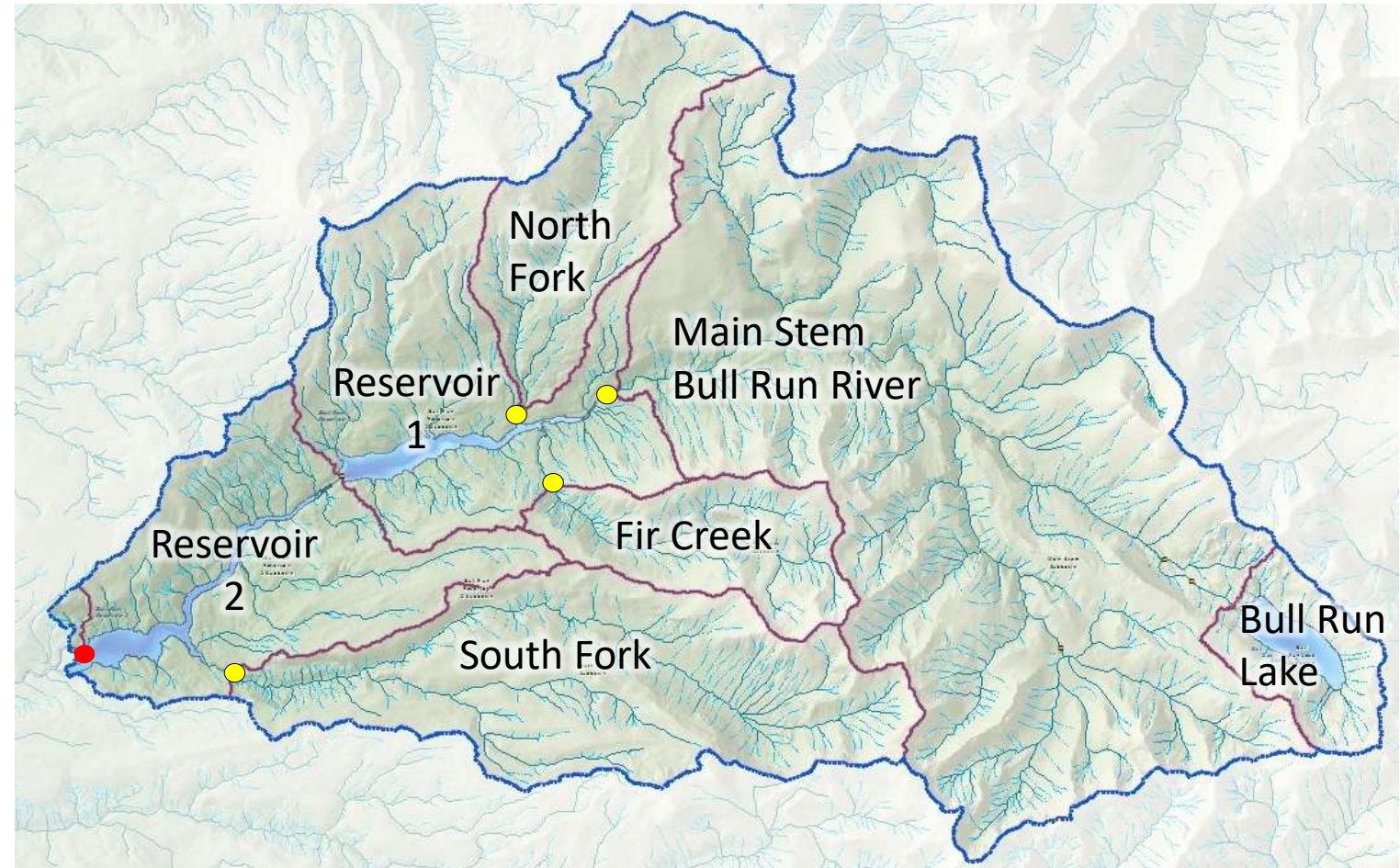
## Watershed Protection:

- Maintain Protections
- Monitor Trespass
- Contain Human Waste
- Annual Watershed Report:
  - Sampling:
    - Tributary Monitoring
    - Scat Monitoring
  - Inspections:
    - Security, Diversion Pool Fence, Wildlife, Landslides, Sanitary Facilities



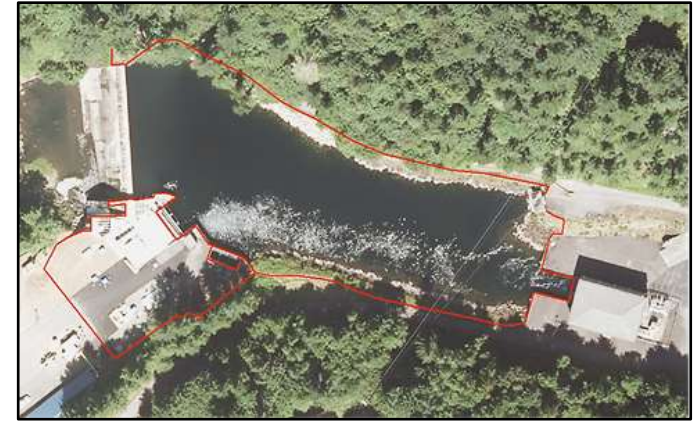
# Types of *Cryptosporidium* Sampling at PWB

- Raw Water Intake
  - 50-L samples (or 5 x 10-L)
  - 2-4 x/week
  - 100-200L/week
- Major Tributaries
  - 10-50-L samples
  - Monthly
  - 6-8 rain events/year
- Wildlife Scat
  - Over 150 samples/year



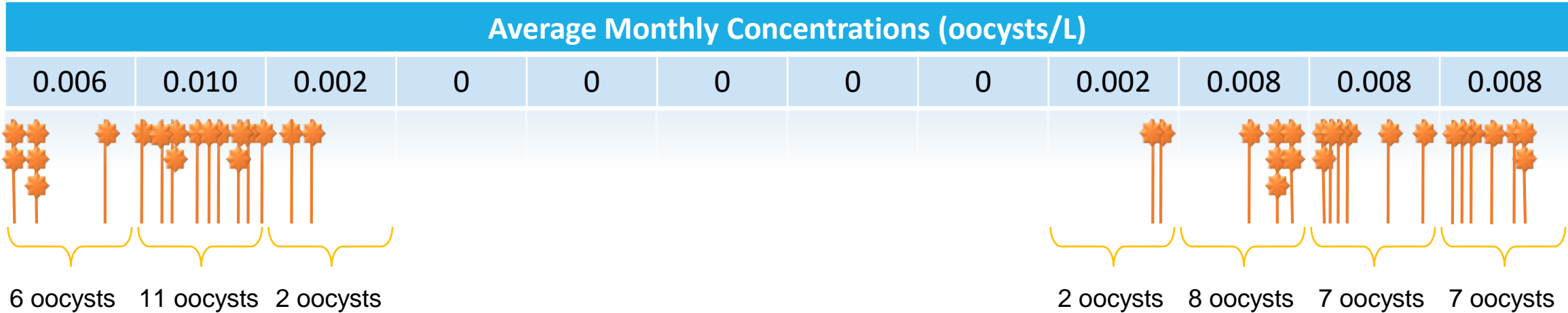
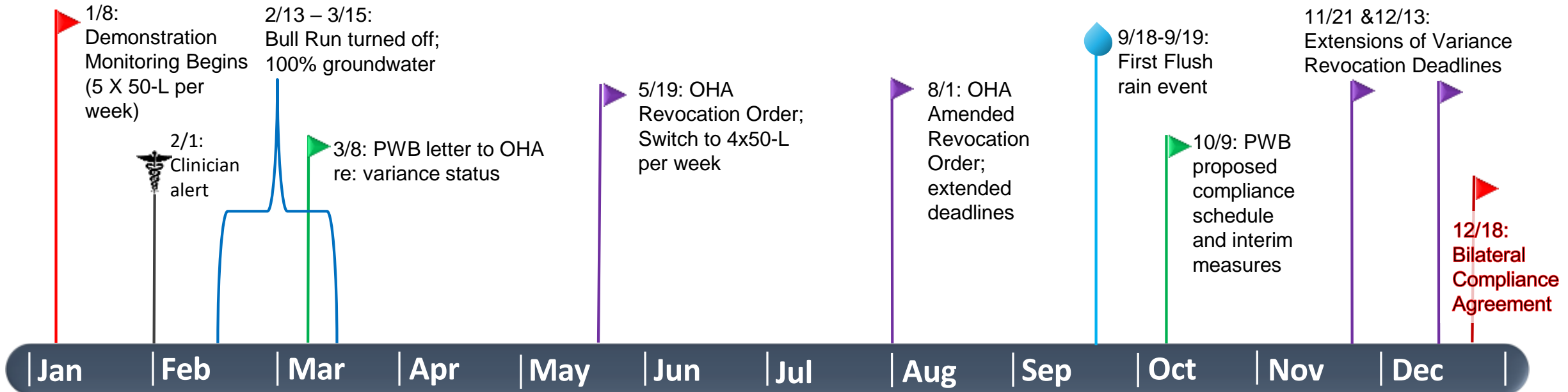
# Types of Watershed Inspections

- ❑ Watershed Security Patrols
- ❑ Diversion Pool Fence Inspections
- ❑ Sanitary Facility Inspections
- ❑ Wildlife Surveys
- ❑ Landslide Surveys



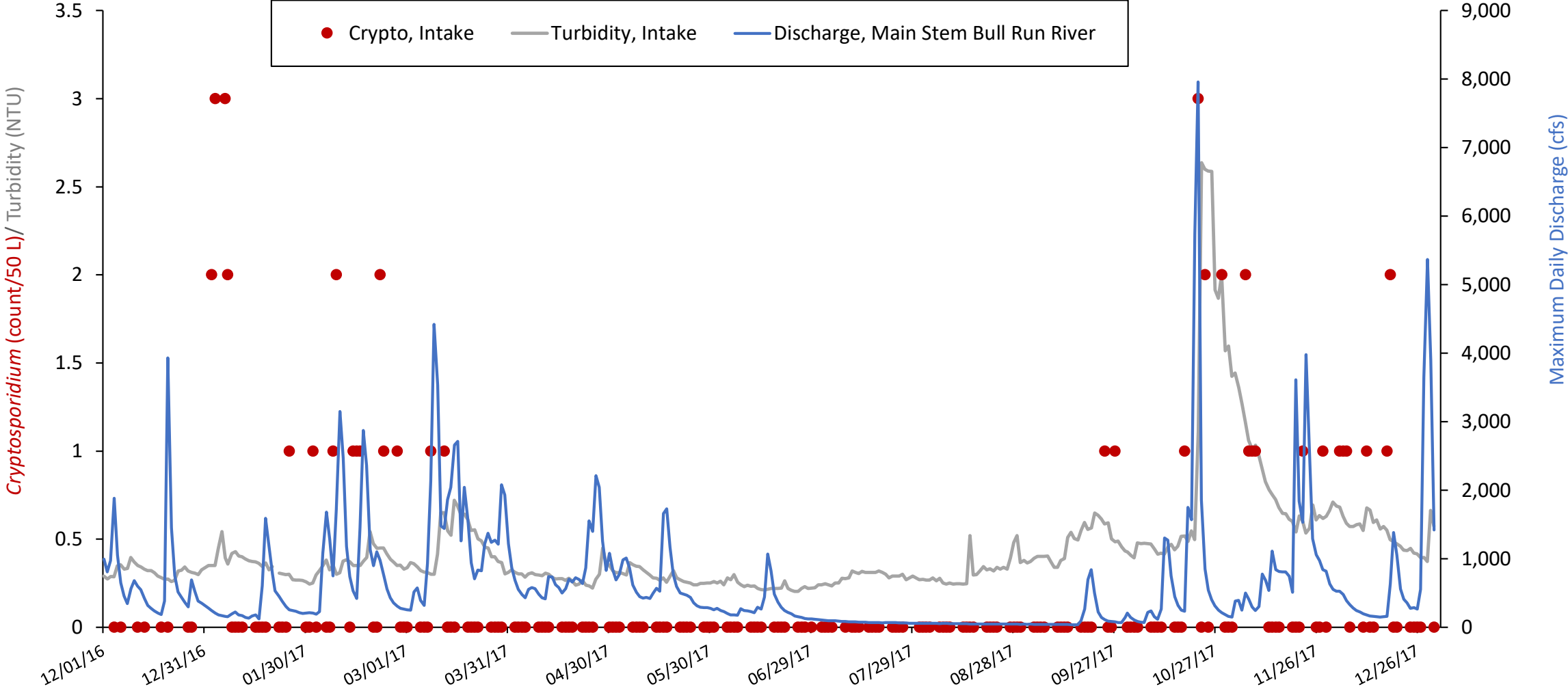


# Timeline of 2017 *Crypto* Detections and Follow-Up

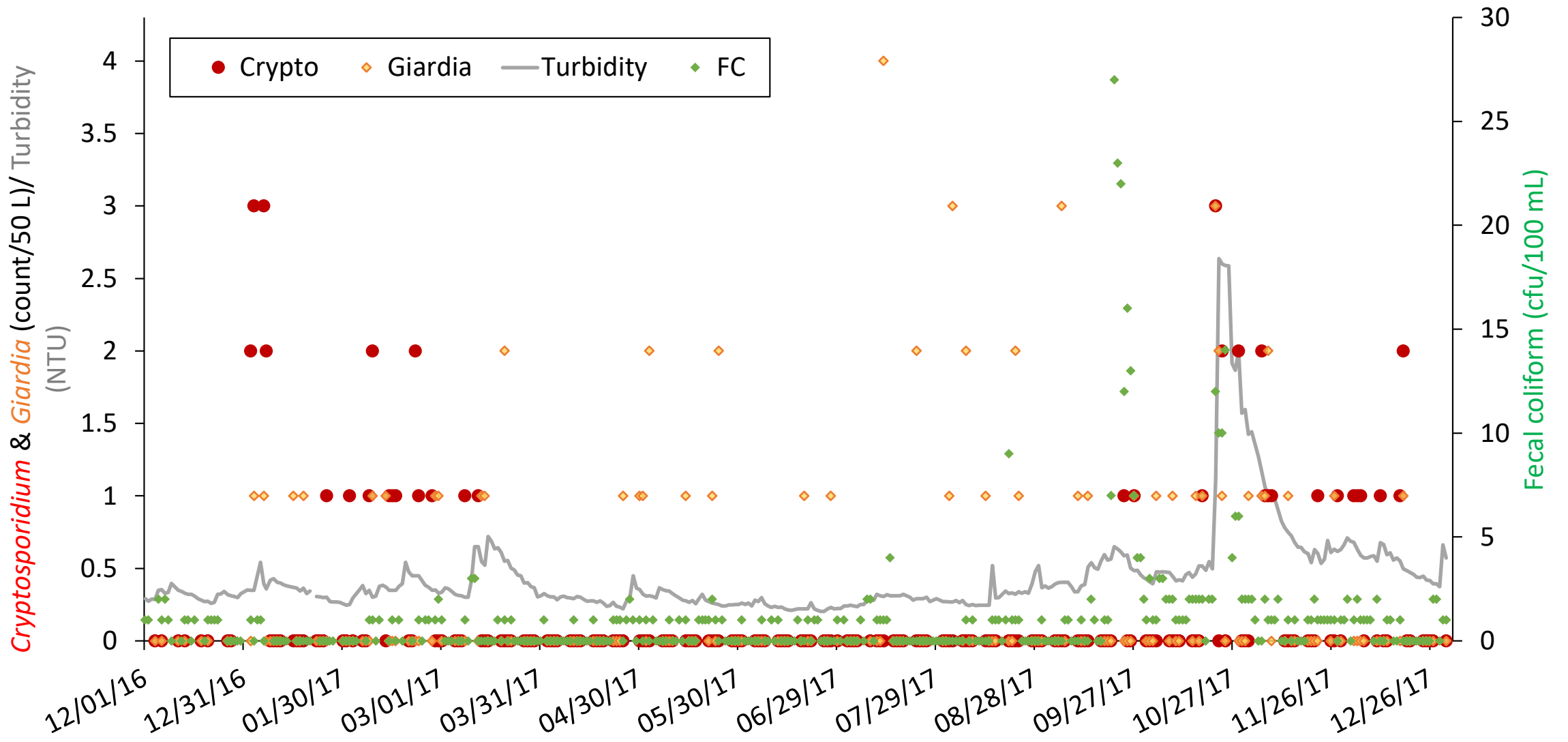




# Cryptosporidium, Turbidity and Main Stem Flow, 2017



# Cryptosporidium, Giardia, Fecal Coliform, and Turbidity, 2017



# Cryptosporidium Source / Location Investigations (Winter – Spring 2017)

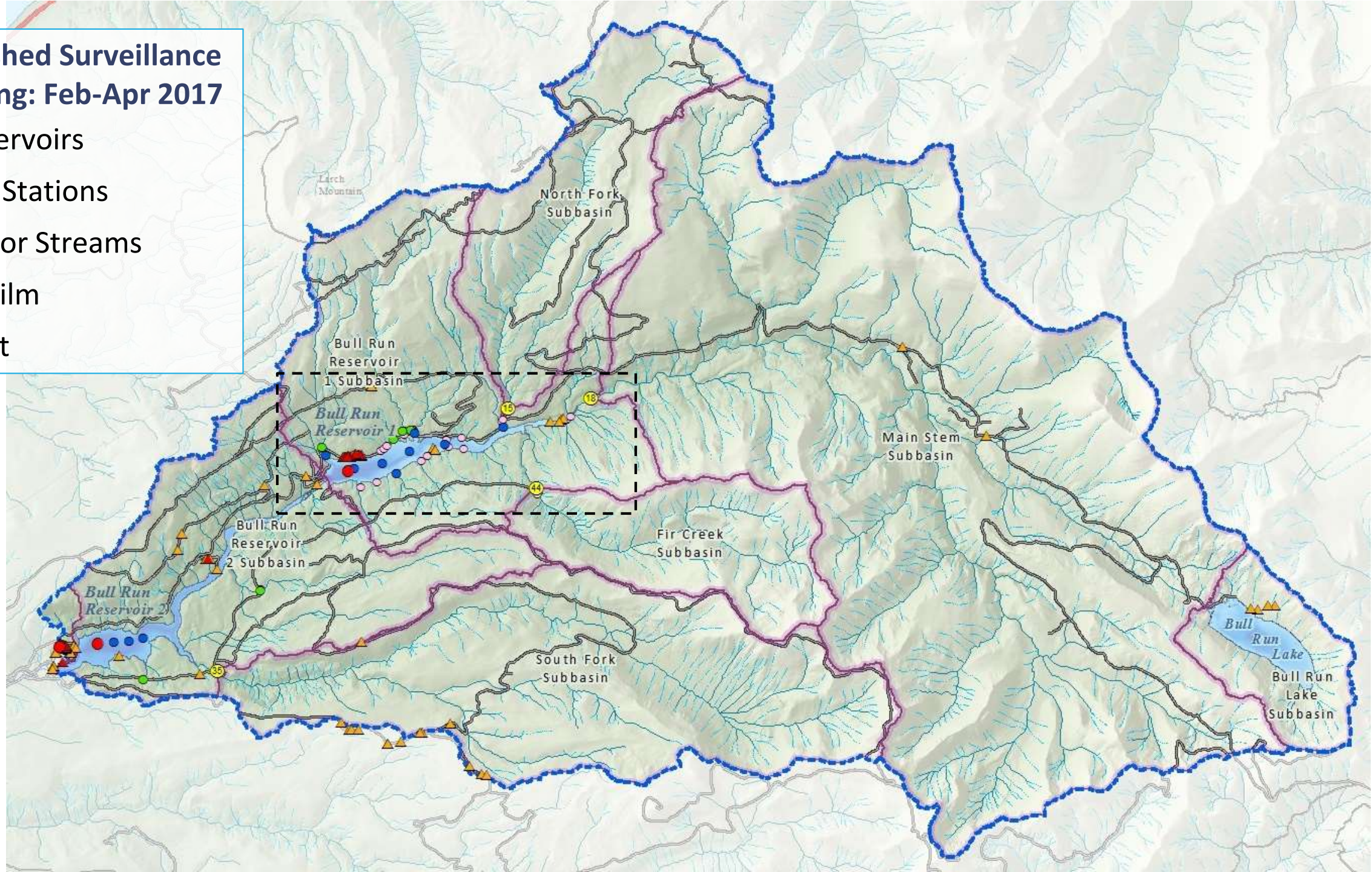
Possible Source / Location	Investigation	Conclusions / Comments
Lab Effect	Reviewed relevant lab QC data, etc.	Reasonably ruled out
Apparatus / Sample Line Biofilm	Flushed line, cleaned / replaced tubing	Reasonably ruled out
Diversion Pool	Multiple site inspections; camera inspection of intake	Unlikely
Reservoirs (obvious signs)	Shoreline inspections; camera inspection of North Tower	Unlikely
Human Sewage	Inspected Bear Creek House facilities	Reasonably ruled out
Domesticated Animals	Checked with Watershed Rangers for recent incidents	Reasonably ruled out
Upstream Watershed	Expanded monitoring	<b>Likely – wildlife source(s) + rain event(s)</b>





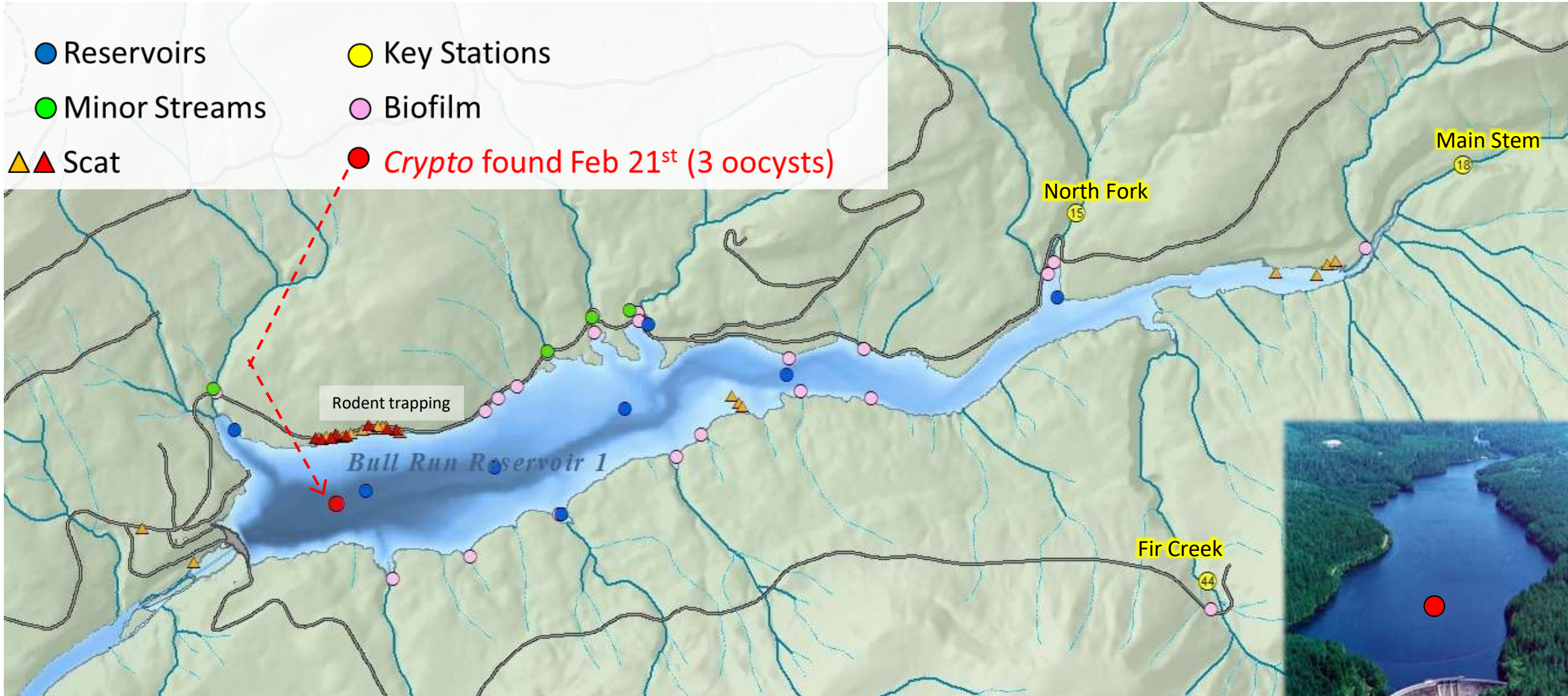
# Watershed Surveillance Sampling: Feb-Apr 2017

- Reservoirs
- Key Stations
- Minor Streams
- Biofilm
- ▲▲ Scat



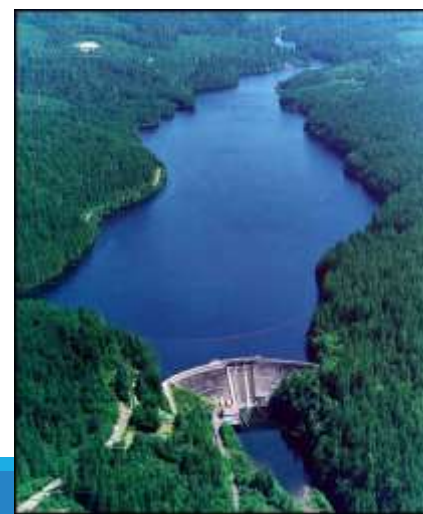


# Reservoir 1 Monitoring: February – April 2017



# Tributary and Reservoir Detections in 2017

Tributaries	Reservoirs
<p>1 out of 99 samples positive (1%)</p> <ul style="list-style-type: none"><li>• Oct. 20, 2017 at South Fork</li></ul>	<p>6 out of 61 samples positive (10%)</p> <ul style="list-style-type: none"><li>• Feb. 21 at Reservoir 1 and Reservoir 2</li><li>• Nov. 6 at Reservoir 1 and Reservoir 2</li><li>• Dec. 13 at Reservoir 1</li></ul>





# *Cryptosporidium* Genotyping

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- EPA Method 1623 only identifies oocysts by microscopy; does not determine viability, infectivity, or species/genotype
- Genotyping may provide information on:
  - Public health significance / potential for human infection
  - Possible wildlife source(s)
- *C. hominis* and *C. parvum* cause most human infections (~95%)
- Many types carried by wildlife are considered low risk



# Genotyping – PWB scat and water samples

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## Scat Samples

- Analyzed for *Cryptosporidium* presence by PCR
- PCR DNA products are sequenced



## Water Samples

- Genotyping is attempted on all *Crypto*-positive water samples
- Positive Method 1623 slides are scraped, DNA extracted, and PCR attempted
- DNA sequences compared with:
  - GenBank reference DNA sequences, &
  - PWB wildlife scat data from Bull Run
- Less than 50% success rate (Jan – Mar 2017 = 22%; Sep – Dec 2017 = 0%)





# Genotypes found in Bull Run Wildlife Scat 2013-2018

Species/Genotype	Bull Run Host(s)	Total #	# in WY 2017
<b>PNW17a</b>	<b>Deer mouse (15), Bobcat (1), Deer (1)</b>	17	<b>14</b>
<b>PNW17b</b>	<b>Deer mouse (7), Coyote (2), Bobcat (1)</b>	10	<b>8</b>
Novel (no match 99.5% or better)	Bobcat (3), Deer (1), Deer Mouse (3), Skunk (1)	8	1
Generic (not classified)	Deer (3), Bobcat (2), Coyote (1), Deer mouse (1)	7	2
<i>C. andersoni</i>	Bobcat, Shrew	5	1
Deer genotype	Deer	3	1
<i>C. parvum</i>	Deer Mouse, Deer, Elk	3	0
PNW17c	Bobcat, Coyote, Deer mouse	3	3
PNW15a	Mountain beaver	3	0
<i>C. canis</i>	Cougar or Coyote	2	0
Bear genotype	Bear	2	2
<i>C. ubiquitum</i>	Mt. Beaver, Bobcat	2	0
PNW17d	Deer mouse	2	2
<i>C. felis</i>	Bobcat	1	0
Skunk genotype	Snowshoe Hare	1	0
Mink genotype	Bobcat	1	0

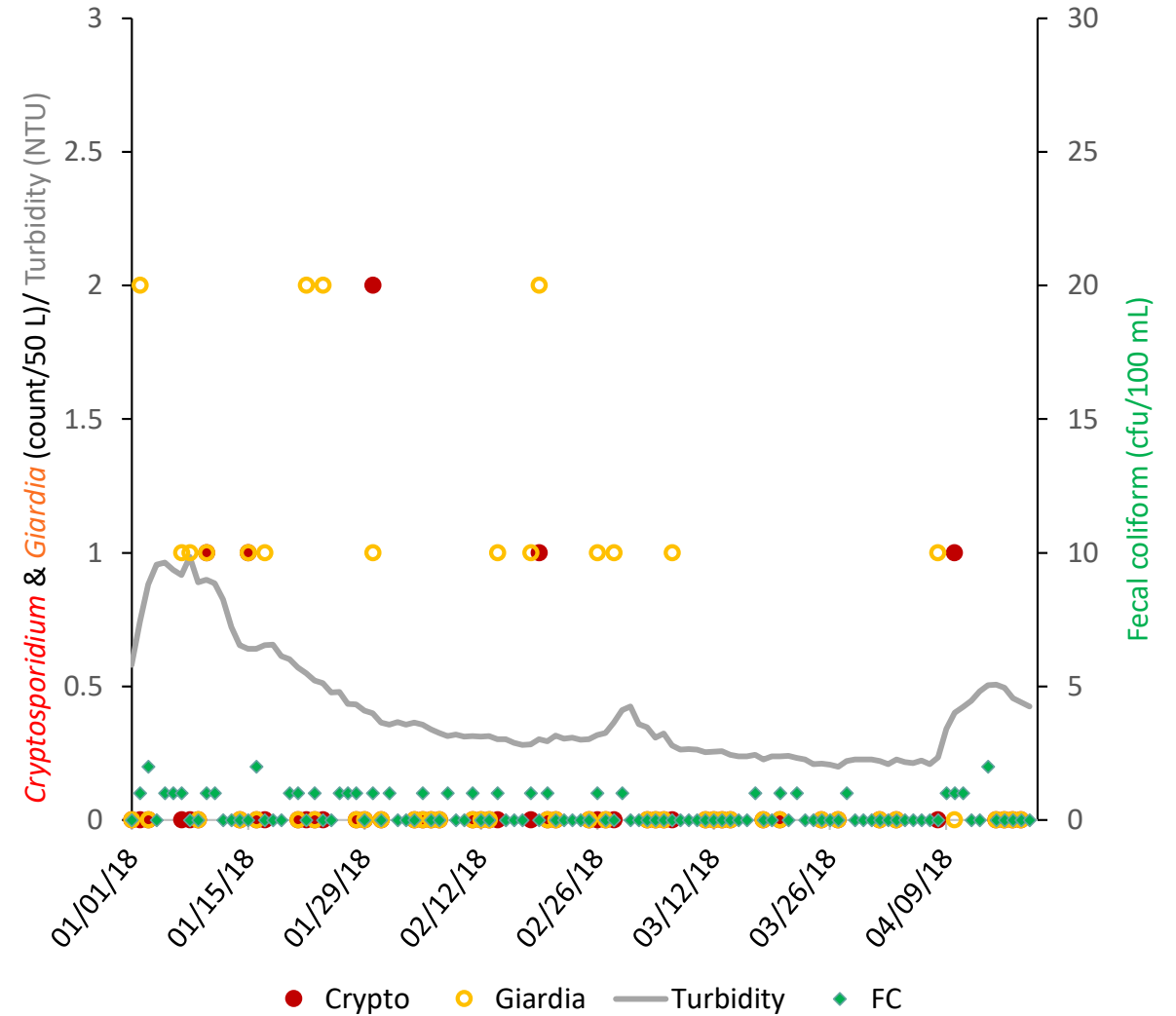
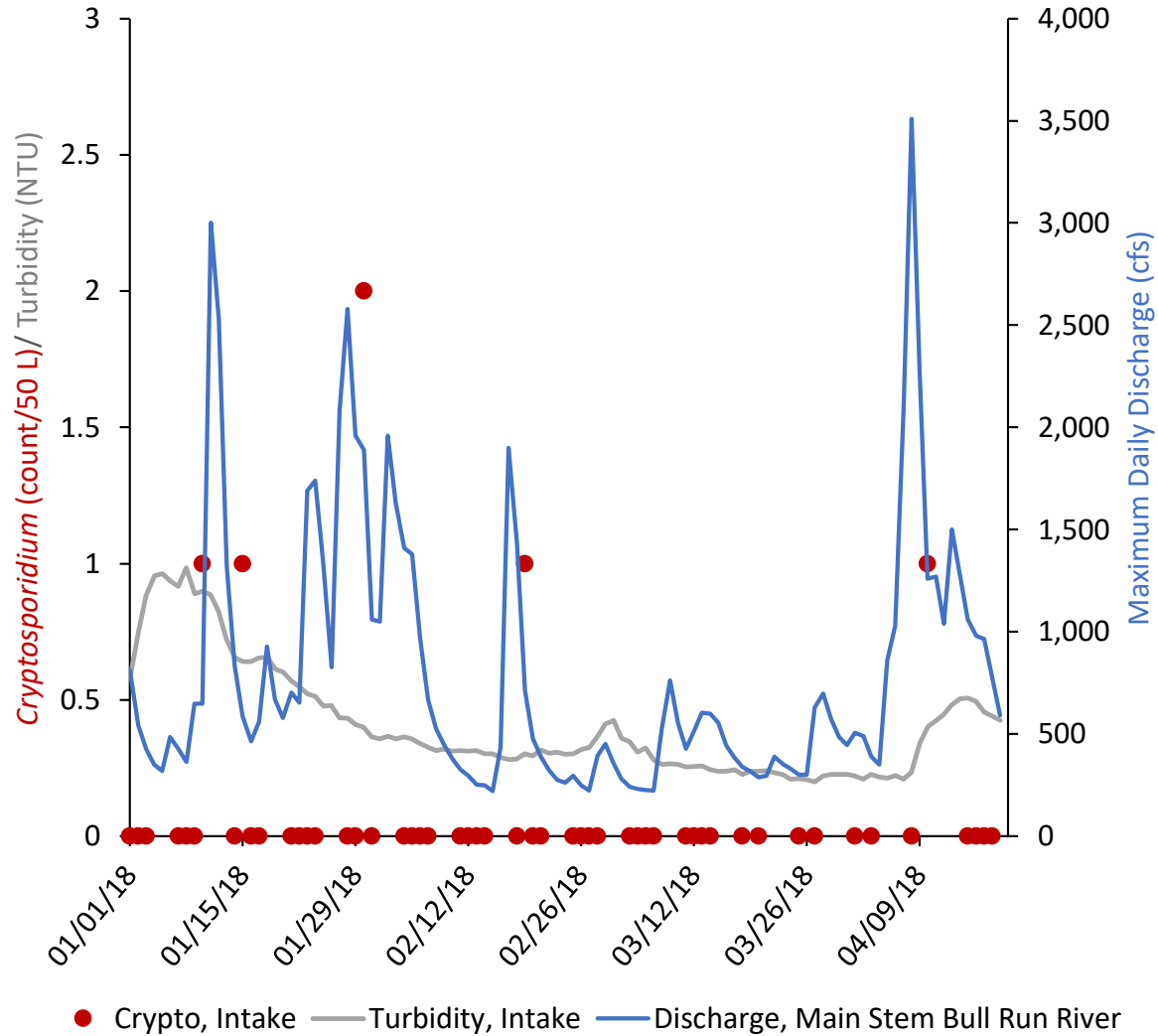


# Genotyping Results: 2017 Water Samples

Water Sample	DNA Sequencing Results	Similar Bull Run Scat Samples	References in Scientific Literature
Jan. 3	<ul style="list-style-type: none"> <li>Novel wildlife type,</li> <li>Closest to Rat Genotype I</li> </ul>	None	None (or rat)
Feb. 1 & Feb. 21	<ul style="list-style-type: none"> <li>Match each other 100%</li> <li>Unclassified rodent genotype, <i>possibly</i> Squirrel Genotype IV</li> </ul>	Cluster PNW17a <ul style="list-style-type: none"> <li>13 <b>Deer Mouse</b> and 1 <b>Bobcat</b> from 2017</li> <li>1 <b>Deer</b> sample from 2016</li> <li>2 <b>Rodent</b> from 2014</li> </ul>	<ul style="list-style-type: none"> <li>Belding's ground squirrel</li> <li>Deer Mouse</li> <li>Wild rodent</li> </ul>
Feb 14	<ul style="list-style-type: none"> <li>Close (99.4%) to Deer Mouse Genotype IV</li> </ul>	Cluster PNW17b <ul style="list-style-type: none"> <li>6 <b>Deer Mouse</b> and 2 <b>Coyote</b> from 2017</li> <li>1 <b>Bobcat</b> from 2016</li> <li>1 2014 <b>Deer Mouse</b></li> </ul>	Deer Mouse



# Cryptosporidium Detections in 2018



# Regulatory Outcome

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2017 *Crypto* concentration  $>0.075$  oocysts/1000 L annual limit for the variance  
OHA revoked the variance as of December 18, 2017

## **Bilateral Compliance Agreement**

- Treatment plan – Filtration by 2027
- Interim control measures and sampling schedule





# Filtration Decisions

Conventional

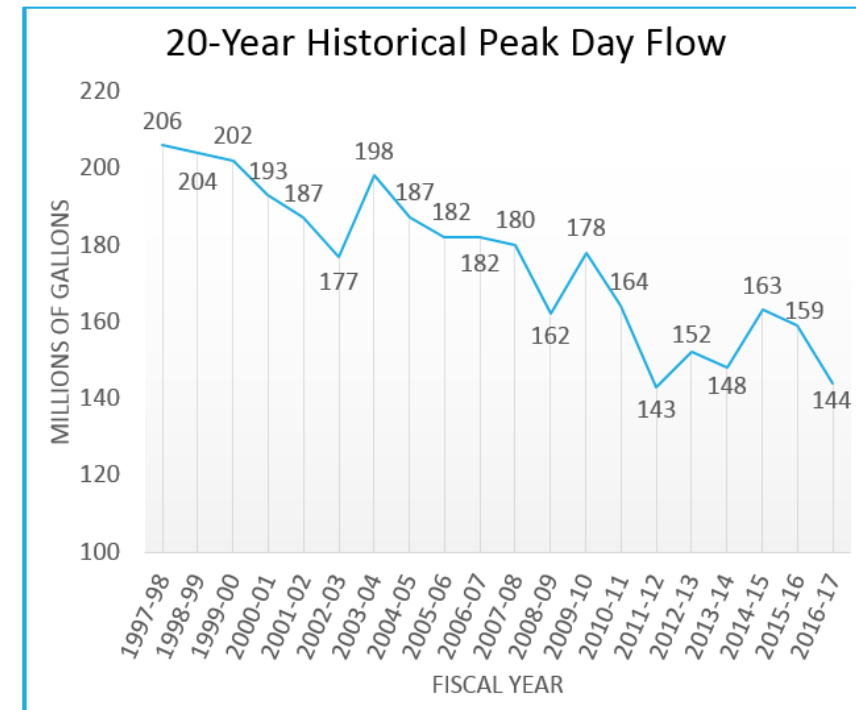
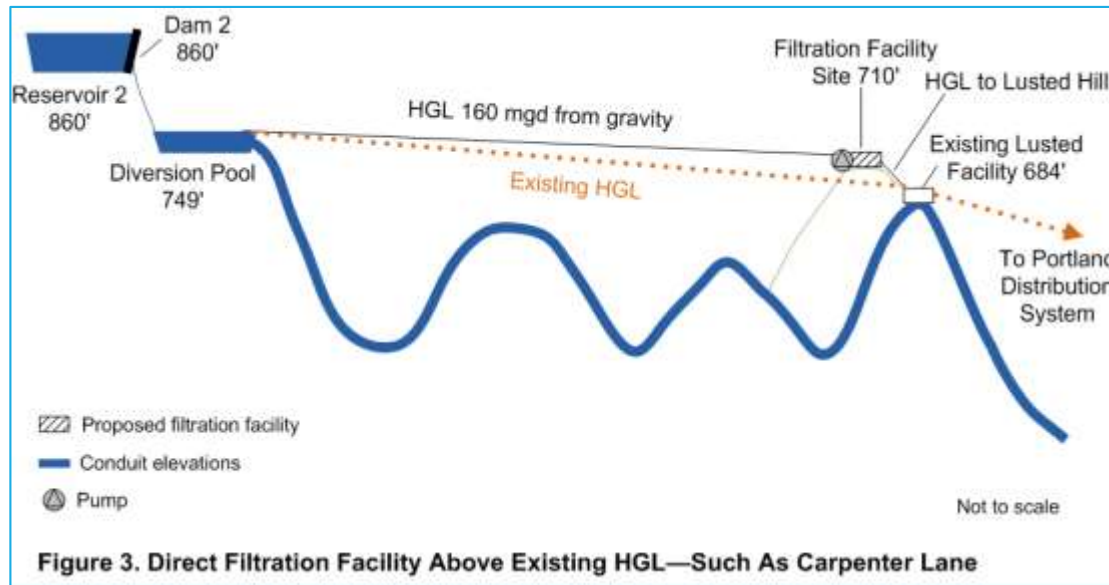
Direct

Membrane

Slow Sand

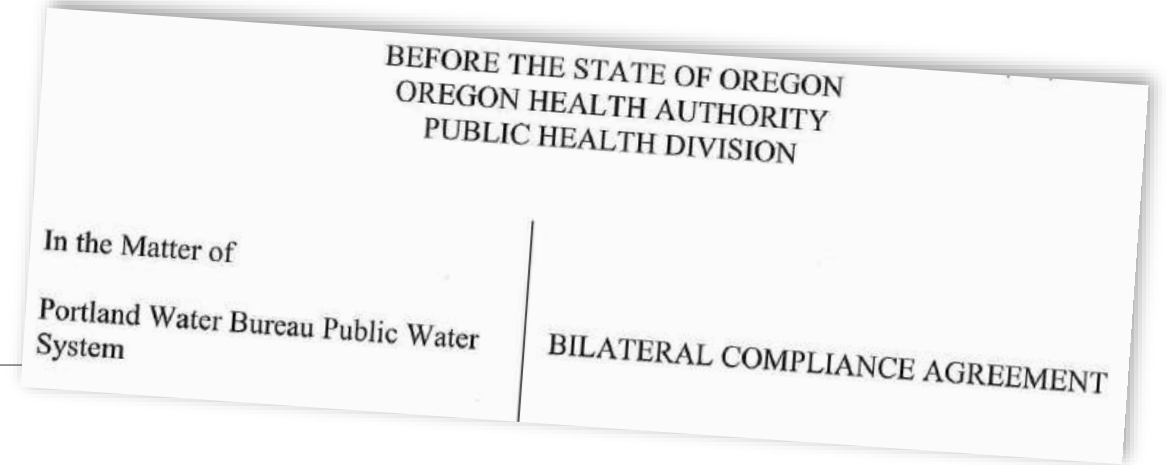
## 10 year schedule

- Capacity – April 2018
- Location – May 2018
- Type of filtration – June 2018



# Interim Measures

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- Continuing with same watershed protections and monitoring
  - Sampling for Crypto at the intake (100 - 200L/week)
  - Continuing to gather genotyping data
  - Monthly, quarterly and annual reports
  - Public notices, required language
  - Outreach plan for vulnerable populations
- 
- **Public Health Surveillance Implementation Project**
    - Working with EPA, CDC and local health officials





Title and End Photos by Roman Johnston

Thank You

