Portland's Year-Long *Cryptosporidium* Monitoring Program

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PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

CITY OF PORTLAND, OREGON 1851

Presentation Overview

1. Background of LT2 Issue in Portland

2. Portland's Year-long *Cryptosporidium* Monitoring Program

3. Results of Monitoring Program/ Preparations for a Variance Request

LT2 Rule Background

1993 Milwaukee Waterborne Disease Outbreak

- *Cryptosporidium* eventually identified as cause
- Chlorine-resistant pathogenic protozoa
- Over 50 deaths, hundreds of thousands of illnesses

- Sources generally attributed to human sewage
- Drinking water treatment problems also a factor

1996 Safe Drinking Water Act Amendments

- Congress mandates a rule to address *Cryptosporidium*
- EPA rule mandates that water suppliers collect data on *Cryptosporidium* and other pathogens
- Data collected leads to rule-making for Interim Enhanced Surface Water Treatment Rule—precursor to LT2

Long Term 2 Enhanced Surface Water Treatment Rule (LT2)

- 2003 Proposed rule mandated removal or inactivation of *Cryptosporidium*
- Unfiltered systems must treat to same level as filtered systems (minimum 2-logs)
- Multiple treatment technologies feasible
- Final rule published in January 2006
- Portland challenges rule in Federal Court of Appeals.
- Court rejects challenge in November 2007

Portland's LT2 Compliance Approach

- 2005 and 2008, Portland City Council directed PWB to seek alternative methods of LT2 compliance

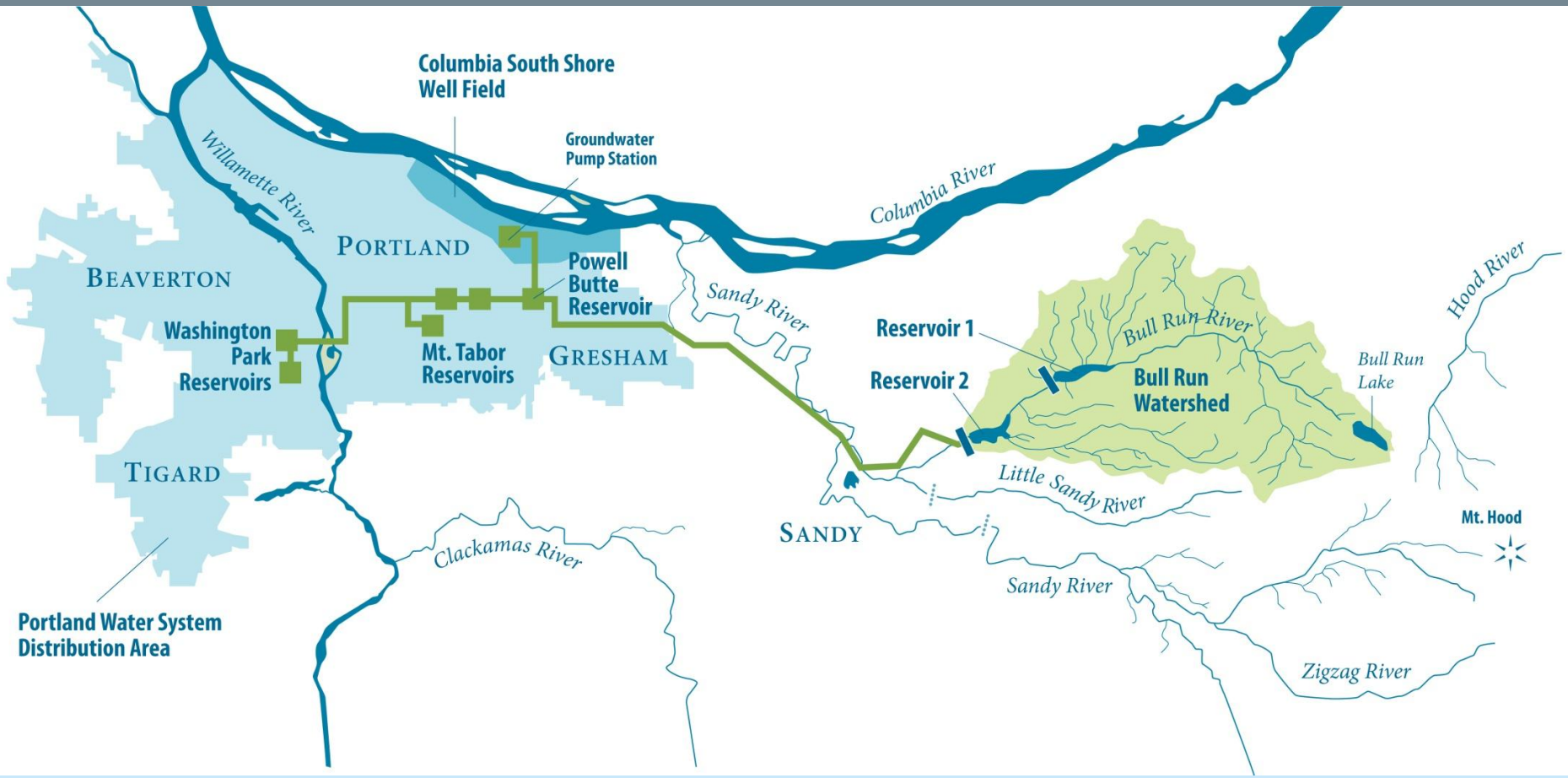
- Dual tracks
  - Conventional treatment compliance—plan and design ultraviolet (UV) treatment plant
  - Pursue alternative compliance—seek a variance to the *Cryptosporidium* treatment requirements of LT2 under the Safe Drinking Water Act (SDWA)

SDWA Variance

- SDWA contains provision for a variance if a system can demonstrate that, “due to the nature of its source,” a treatment technique is unnecessary

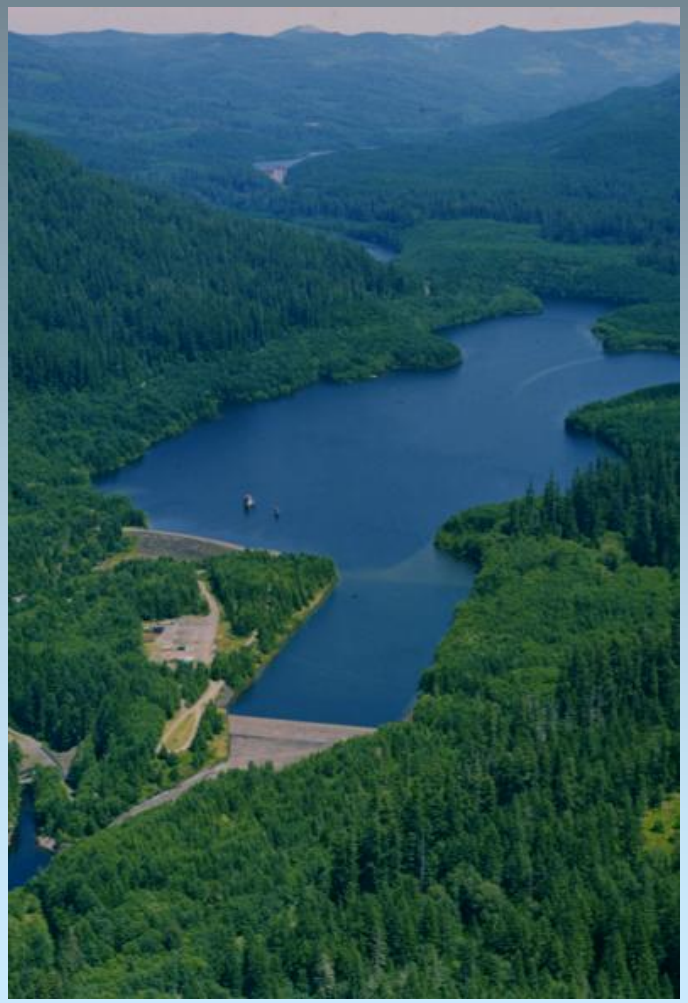
- Variance process requires water quality data and other information documenting the quality of the source water

Portland's combined retail and wholesale service area is served by the Bull Run watershed.



Approximately 900,000 retail and wholesale customers.

Portland's Bull Run Water Source



- Protected by federal regulations for more than a century
- Closed to public access
- Unfiltered, high-quality water source

Watershed Protection – Wildlife only Potential Significant *Cryptosporidium* Source

- Over 100 years of Federal protection
- Limited public access
  - No sewage treatment plants
  - No residential runoff
  - No agriculture
  - No farm animals
  - No logging
  - No camping
  - No hunting
  - No boating
  - No swimming

Portland's Case for a Variance

- Strictly controlled and protected watershed
- Very good water quality
  – low fecal coliforms
- Extremely low risk for most common human infectious *Cryptosporidium*
- No evidence of cryptosporidiosis illness related to drinking water
- Monitoring history – PWB has detected no *Cryptosporidium* oocysts since August 2002

PWB LT2 Sampling and Study Plan

Purpose: To demonstrate the nature of the Bull Run water source by sampling for pathogens such as *Cryptosporidium* and *Giardia*

Developed in collaboration with EPA

- High volumes of raw water intake samples (at least 10,250 L)
- Additional supplemental information
  - Sampling at 9 watershed locations upstream of the intake
  - Sampling scat from wildlife as inputs for a model on pathogen fate and transport
- Supplemental information to capture “worst-case scenarios” in the watershed

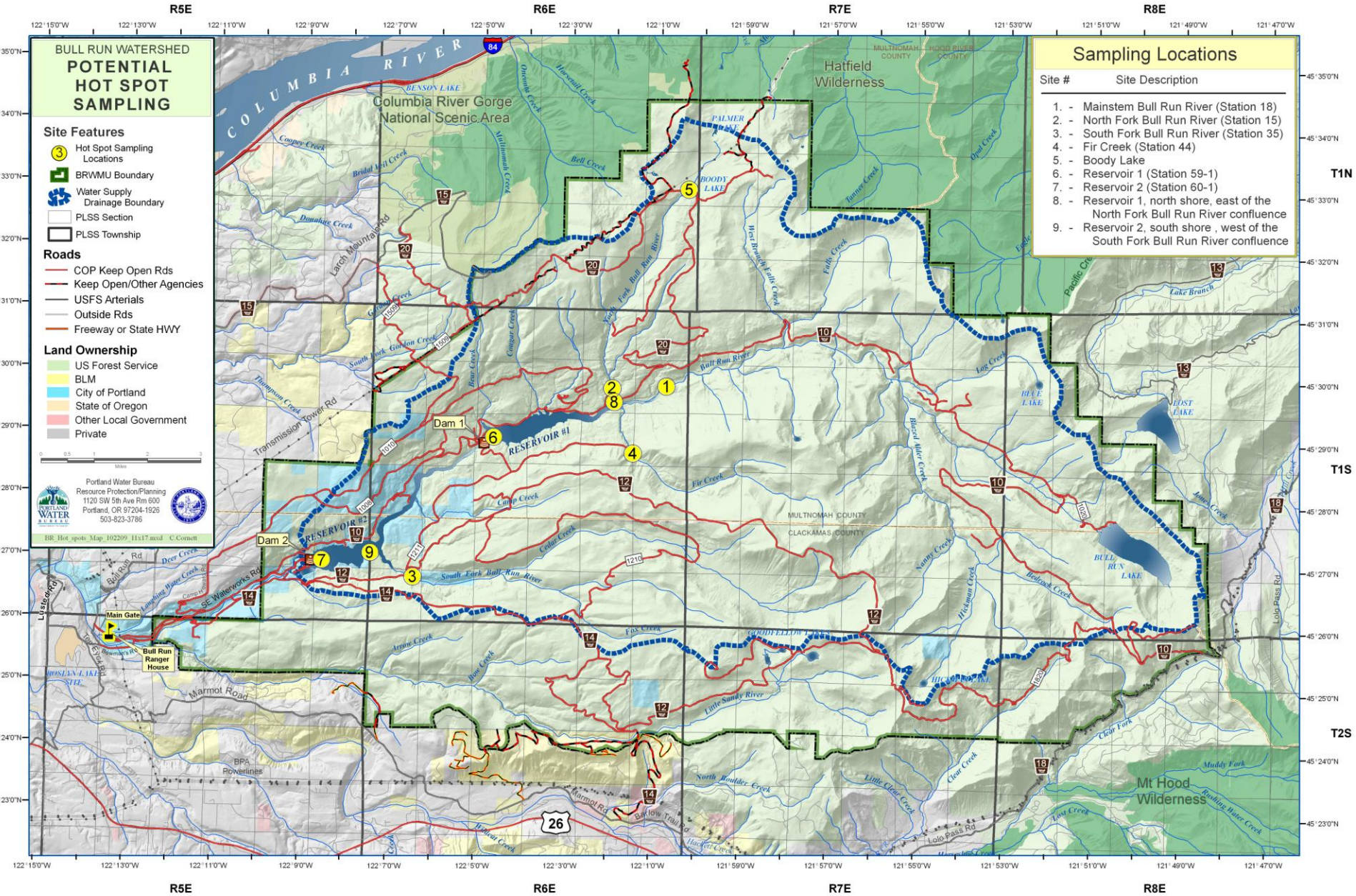
Raw Water Intake Sampling

- 50-liter (or 5x10L) samples collected 4 days/week for one year (December 2009-December 2010)
- 10,271 liters were analyzed (449 samples) for *Cryptosporidium* and *Giardia*
- Analysis by an EPA-approved laboratory using EPA's Method 1623
- EPA threshold for *Cryptosporidium*: "All samples will be less than 0.075 oocysts/1000L"

Upstream Sampling

- Nine locations (formerly characterized as "potential 'hot spots'" by EPA)
- Total of 3,384 liters (315 samples) analyzed for *Cryptosporidium*, *Giardia,* and *E.coli*
- **Monthly sampling**: All sites (when accessible)
- **Weekly sampling**: Major tributaries (Sites 1-4) (March – December)
- **Event-driven sampling:** 8 of the 9 sites

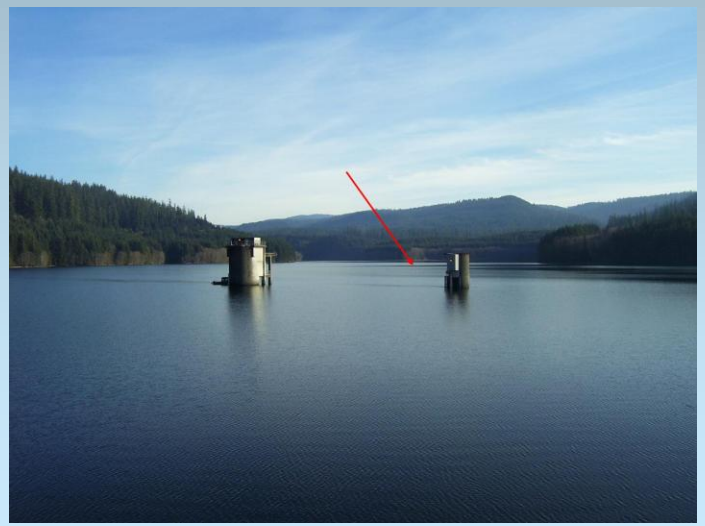
Upstream Sampling Locations



Upstream Sampling Locations

Major tributary Key Station 18

Meadow in upper part of the watershed



Deepest part of Reservoir 2

Potential grazing area Reservoir 1

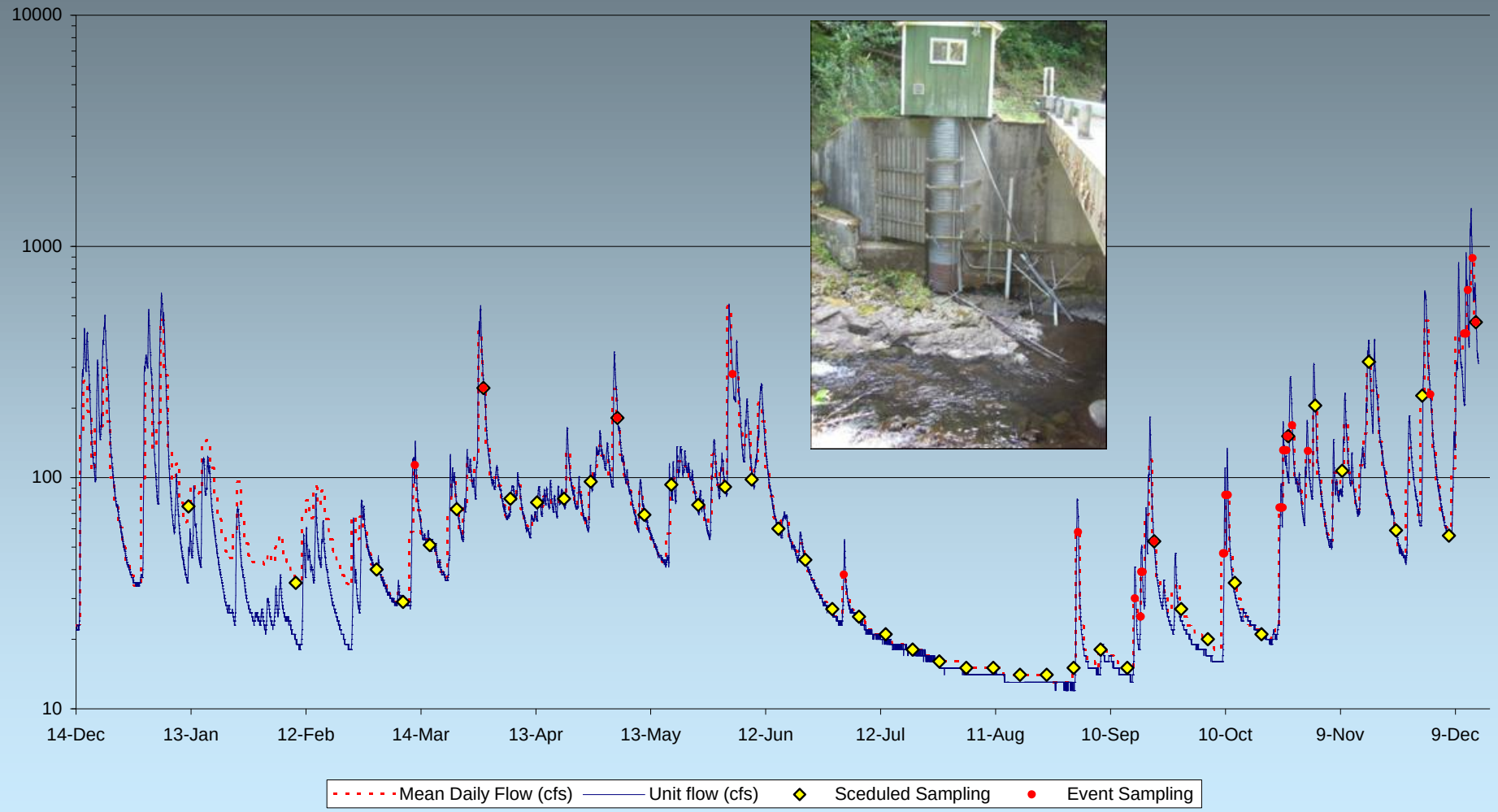
Event-Driven Sampling

- High flow events in the major tributaries
  - >95% of historical mean daily flow (5 seasons)
- High intake turbidity (>2 NTU) in the reservoirs
- First rain after dry period (daily rainfall > 0.5” at Headworks): potential grazing areas
- In late summer, PWB added intensive fall storm sampling

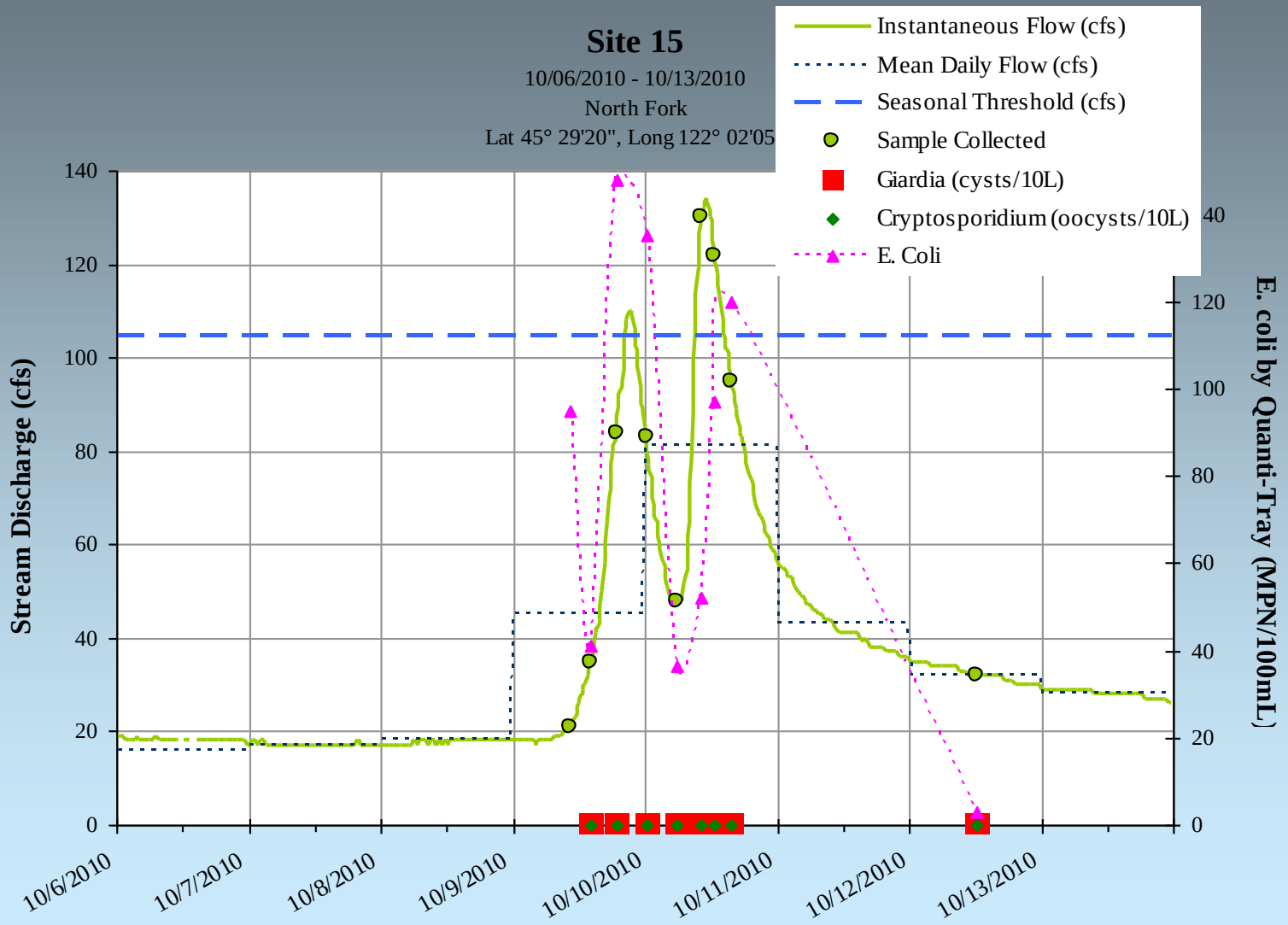
Intensive Fall Storm Sampling

- Fall is when large amounts of material flush into streams after the summer dry period
- PWB wanted to understand at what point on a hydrograph *Cryptosporidium* is mobilized and transported
- Fall storm sampling represented a higher probability of finding *Cryptosporidium* if it is present
- Multiple samples taken during a storm; required sampling through the night(s) at two locations for some events

Scheduled and Event sampling at tributaries captured a variety of stream flow conditions throughout the year.



PWB collected multiple stream samples during worst case "first flush" flow events and found no *Cryptosporidium*



Source: USGS Real-Time Streamflow Data

Adaptation of the Pathogen Catchment Budget (PCB) Model

- Upon EPA's recommendation, PWB hired Christobel Ferguson of Ecowise to adapt the PCB model to the Bull Run watershed
- PCB model has undergone significant adaptations:

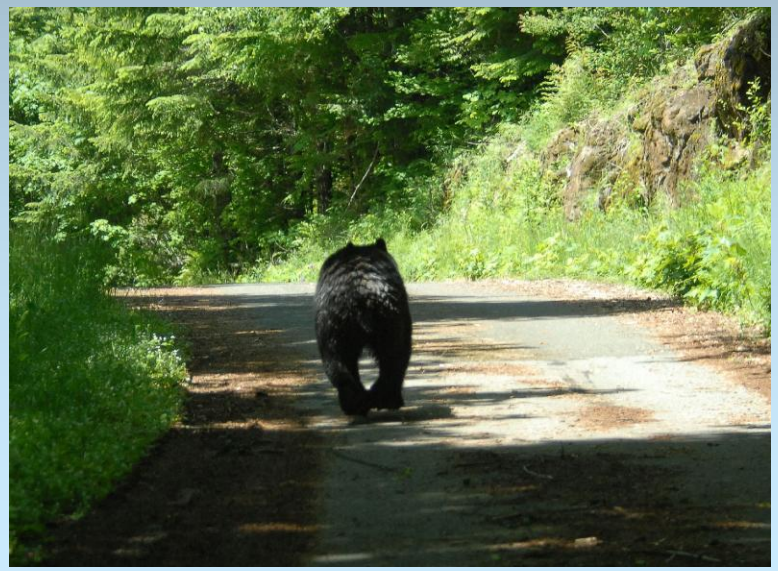
– **Inputs:** no development, no sewers/wastewater treatment plants, no livestock, no human access—only wildlife

– **Hydrology:** snow, subsurface flow

– **Zoology:** PNW animals (bear, deer, etc).

– **Limnology:** 2 deep reservoirs in the BR system

– **Vegetation cover:** dense second-growth conifer forests



PCB Model Review

- PWB has contracted with an expert peer review panel
  - Dr. Rob Atwill (UC Davis) wildlife expert
  - Dr. Amy Sullivan (County Health Dept.) epidemiologist
  - Dr. Scott Wells (Portland State) hydrodynamic modeler
- Panel is tasked with reviewing and making recommendations regarding the model's applicability to the Bull Run watershed
- EPA provided input and review of the model as adaptations were made

Additional Aspects of the PCB Model Work

- Wildlife consultant
- Scat collection program
  - Fall, winter, birthing season (spring), summer
  - Scat from 11 species types sampled: bear, bobcat, cougar, coyote, deer, elk, goose, otter, rodents
  - Beaver scat sampling
  - Fall trapping for hares and rodents

Portland's Cryptosporidium Monitoring Results (December 2009 – December 2010)

Sample Location(s)	Number of Samples	Total Volume Sampled	Samples Positive for Crypto	Samples Positive for Giardia
Raw Water Intake	449	10,271 L	0	44
Upstream Locations (nine sites)	315	3,383 L	0	22
Wildlife Scat (throughout watershed)	251	--	1 (coyote) – outside hydrologic boundary	14

Interim Sampling Plan

- Interim sampling started at the end of the one-year sampling period

- Raw water intake sampling:
  - Continue sampling 50 L per week
  - Triggered sampling
    - High turbidity
    - During high tributary inflows

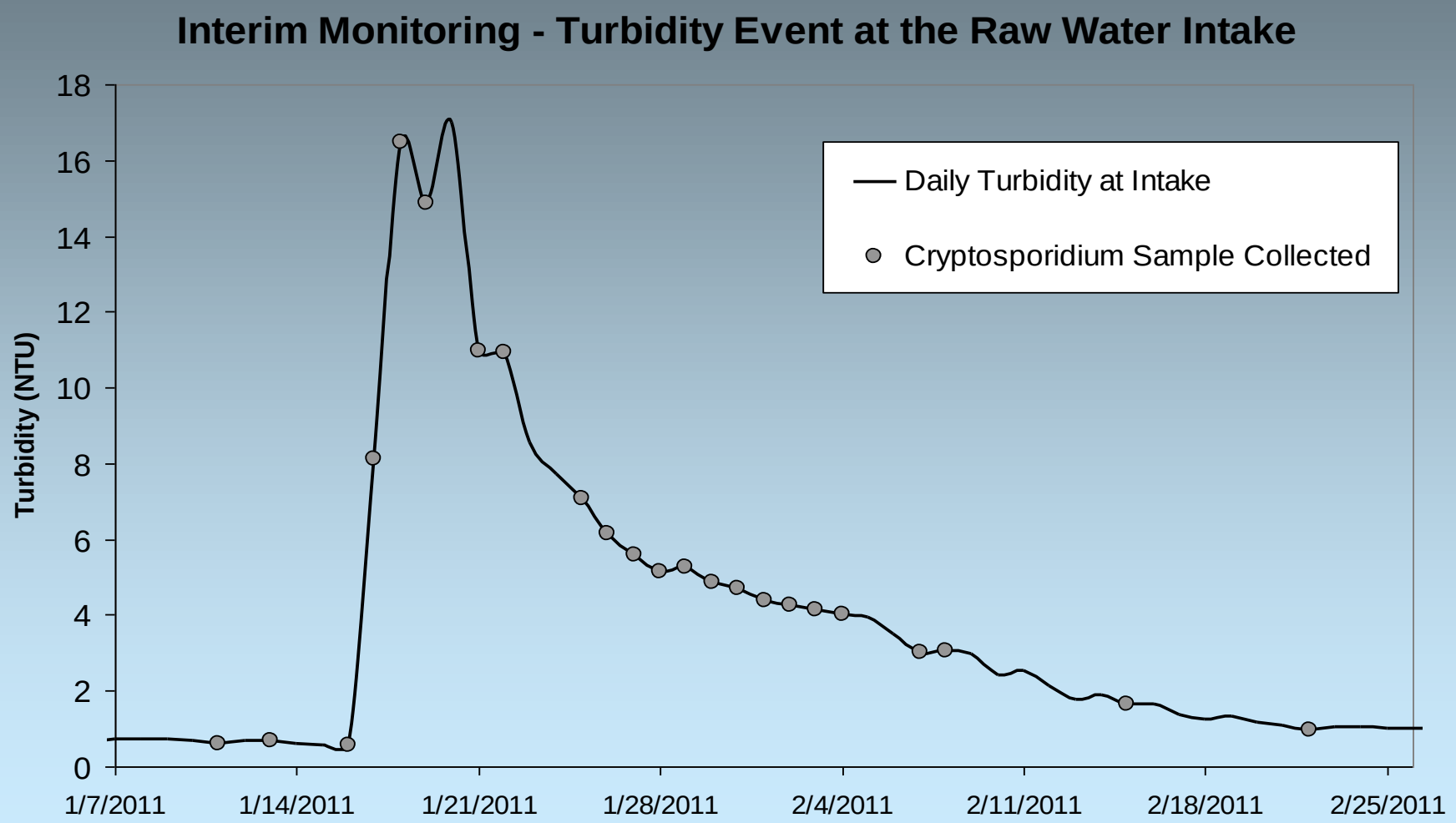
Interim Sampling Plan

- Upstream tributary locations, Sites 1-4 (key stations):
  - Continue scheduled sampling 10 L per week
- Triggered event sampling at 8 sites
    - Elevated stream flows (tributaries, 1-4)
    - Elevated turbidity levels (reservoirs (deep), 6-7)
    - Precipitation (upper res grazing areas, 8-9)

Interim Sampling Results

Sample Location(s)	Number of Samples	Total Volume Sampled	Samples Positive for Crypto	Samples Positive for Giardia
Raw Water Intake	45	2251 L	0	8 (9 cysts)
Upstream Locations (nine sites)	122	1292 L	0	7 (12 cysts)
Wildlife Scat (throughout watershed)	42	--	0	5 (4900 cysts)

PWB sampled a large turbidity event in Jan. 2011 and found no *Cryptosporidium*



Variance Request

- Formally submit to Oregon Health Authority - Drinking Water Program
- PWB anticipates submitting a request for a variance in June 2011.
- Variance request will be the first of its kind.
- If the State grants a variance, EPA will likely establish the conditions necessary for PWB to maintain the variance.

Implications for Source Water Protection

- Portland has conducted the most intensive drinking water monitoring program for *Cryptosporidium* in U.S.
- Results of study may provide insights on effects and effectiveness of source water protection measures.
- Study has helped Portland better understand its watershed.

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