

Whipple Creek Watershed Microbial Identification and Source Tracking

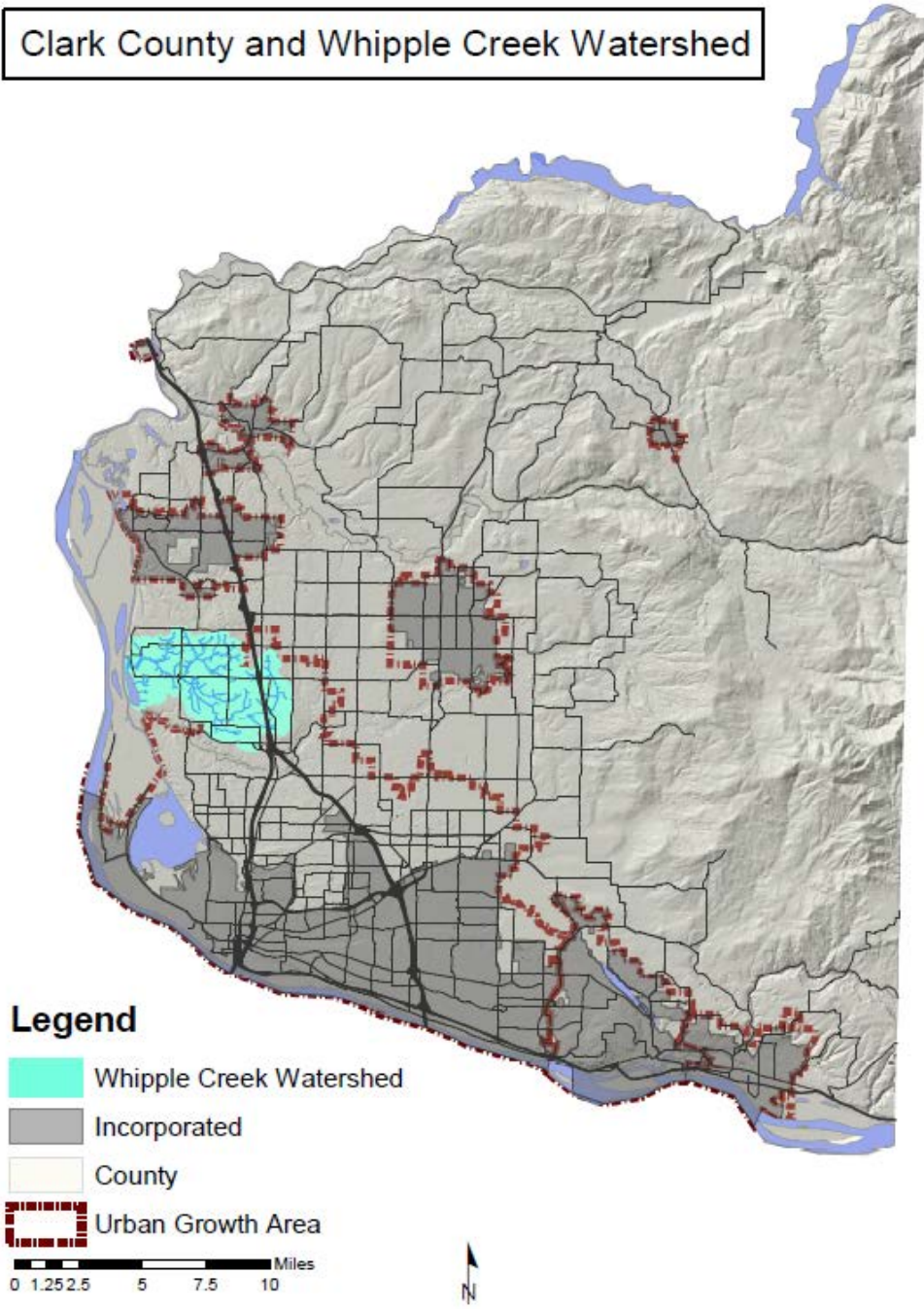
Clark County Clean Water Division

Marlena Milosevich





May 6th 2019



Clark County and Whipple Creek Watershed



Legend

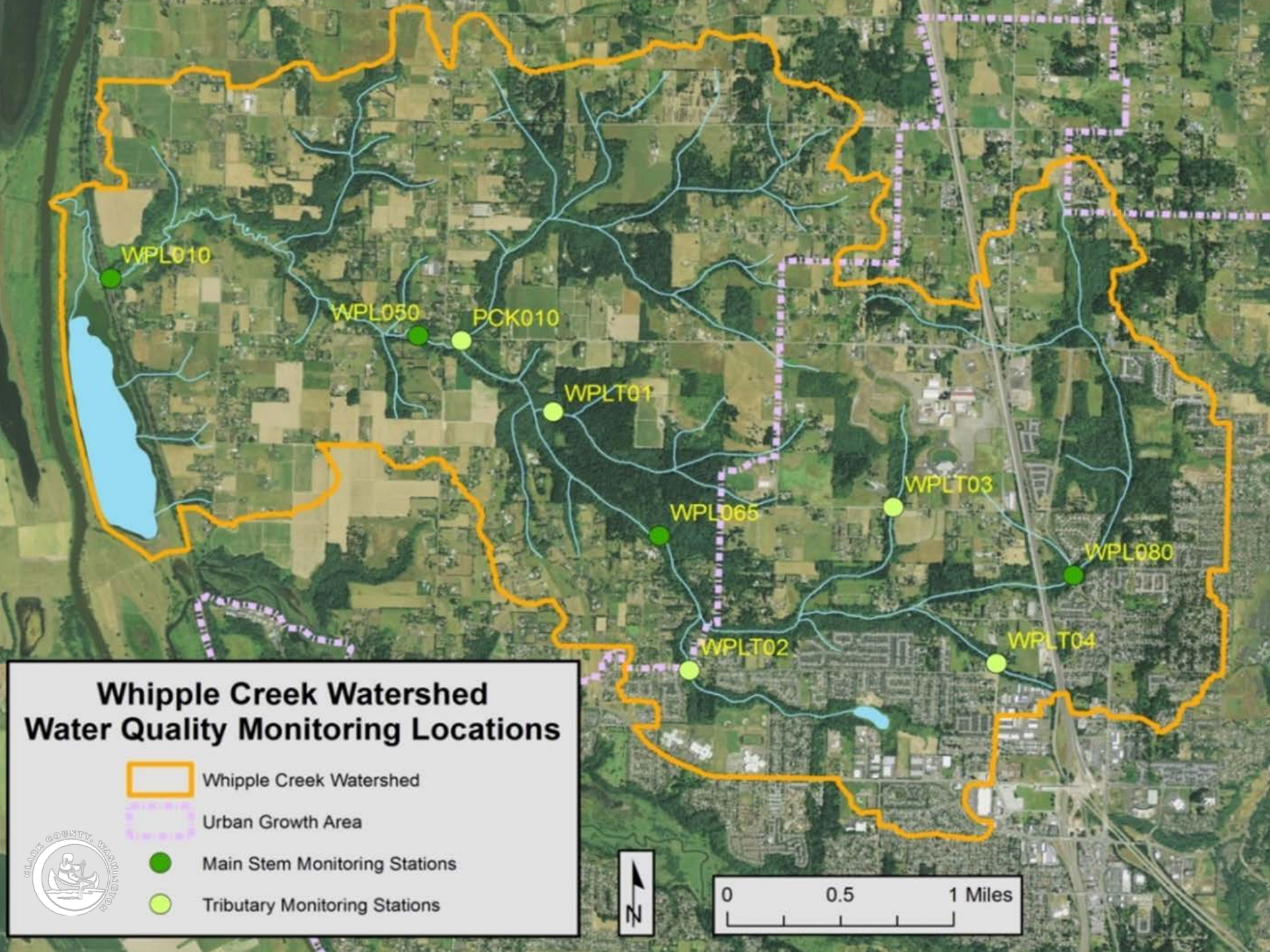
-  Whipple Creek Watershed
-  Incorporated
-  County
-  Urban Growth Area

0 1.25 2.5 5 7.5 10 Miles



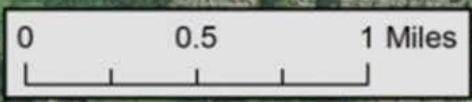
Historical Whipple Creek Watershed Fecal Coliform Sampling





Whipple Creek Watershed Water Quality Monitoring Locations

-  Whipple Creek Watershed
-  Urban Growth Area
-  Main Stem Monitoring Stations
-  Tributary Monitoring Stations



Whipple Creek Monitoring Results (2014 - 2015)

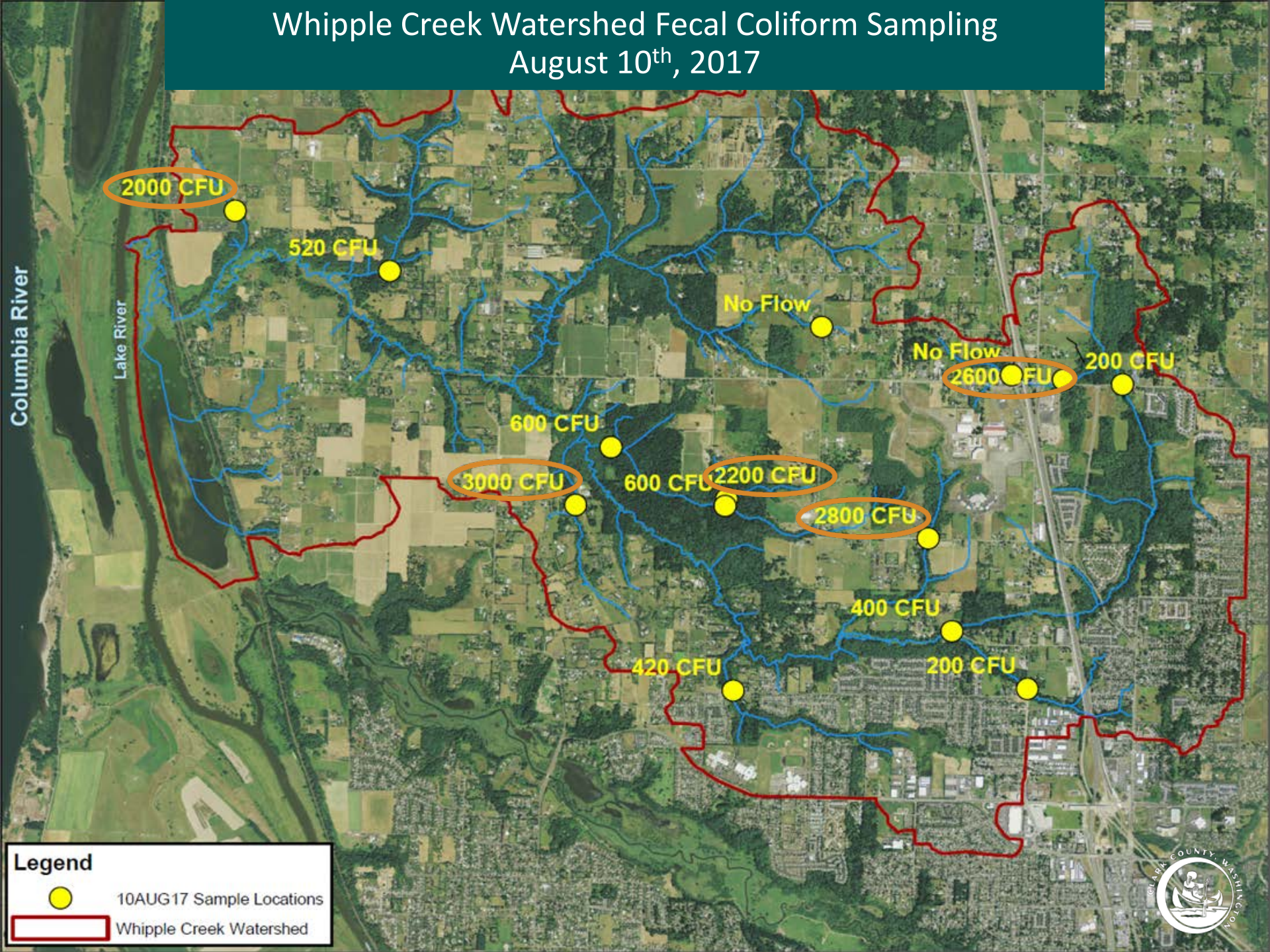
Whipple Creek Main Stem Subwatersheds Water Quality Medians															
Station	WPL010 Medians				WPL050 Medians				WPL065 Medians			WPL080 Medians			
Monitoring Period	WY12 Monthly, July'14-May '15				WY'02-'15 Monthly, July '14 - May '15				July '14 - May '15			WY12 Monthly, July'14-May '15			
Flow Type	Base	Storm	Unclassif.	Overall	Base	Storm	Unclassif.	Overall	Base	Storm	Overall	Base	Storm	Unclassif.	Overall
Sample Size *	12	12	12	36	12	12	*	*	12	12	24	12	12	12	36
Parameter (units)															
Water Temperature (degrees C)	11	10.9	12.6	11.3	11	10.6	11.2 (164)	11.1 (188)	11.4	10.7	10.7	10.8	11	13.4	11.3
Turbidity (NTU)	8.9	35.3	14.5	13.5	7.6	39.6	8.2 (165)	8.6 (189)	7.6	24.5	11.1	6.2	20.7	6	8.4
pH	7.48	7.37	7.22	7.4	7.89	7.5	7.53 (158)	7.53 (182)	7.52	7.26	7.46	7.54	7.41	7.37	7.38
Dissolved Copper (ug/L)	0.71	1.32	NA	0.87 (24)	0.76	1.28	1.14 (31)	1.13 (55)	0.9	1.86	1.17	0.96	1.82	NA	1.22 (24)
Dissolved Zinc (ug/L)	1.5	0.9	NA	1.0 (24)	1	1	1.1 (34)	1.0 (58)	1.5	2.3	1.8	1.4	3.1	NA	2.3 (24)
Fecal Coliform (CFU/100 mL)	340	800 (11)	335	420 (35)	262	1865 (10)	275 (136)	315 (158)	203	390 (8)	265 (20)	57	280 (11)	76	100 (35)

Whipple Creek Tributary Subwatersheds Water Quality Medians																
Station	PCK010 Medians				WPLT01 Medians			WPLT02 Medians			WPLT03 Medians			WPLT04 Medians		
Monitoring Period	WY12 Monthly, July'14-May '15				July '14 - May '15			July '14 - May '15			July '14 - May '15			July '14 - May '15		
Flow Type	Base	Storm	Unclassif.	Overall	Base	Storm	Overall	Base	Storm	Overall	Base	Storm	Overall	Base	Storm	Overall
Sample Size *	12	12	12	36	12	11	23	12	11	23	8	11	19	12	11	23
Parameter (units)																
Water Temperature (degrees C)	10.8	10.5	12.3	11.1	10.5	10.7	10.7	11.1	11.1	11.1	6.1	10.5	9.8	11.5	11.5	11.5
Turbidity (NTU)	9.6	56	13.2	17.3	11.7	50.9	20.8	4.6	32	6.9	9.9	38.6	22.6	9.6	37.9	12.5
pH	7.69	7.6	7.5	7.6	7.89	7.56	7.74	7.65	7.37	7.57	7.46	7.52	7.47	7.2	7.37	7.32
Dissolved Copper (ug/L)	0.82	1.69	NA	1.32 (24)	0.67	1.25	0.8	0.74	1.73	1.25	1.15	1.93	1.85	0.66	2.44	0.88
Dissolved Zinc (ug/L)	0.8	1	NA	1.0 (24)	0.5	0.7	0.6	1.7	6	2.2	2.4	3.3	2.9	2.1	11.2	3.1
Fecal Coliform (CFU/100 mL)	395	3350	276	650	485	1040	760	780	665 (10)	695 (22)	31	660	280	71	740 (9)	250 (21)

* Common sample size across all station parameters unless noted otherwise in parentheses after median value.



Whipple Creek Watershed Fecal Coliform Sampling August 10th, 2017



Whipple Creek Watershed Septic System Analysis



Whipple Creek Watershed Tax lots with Septic Systems

Columbia River

Lake River

Legend

-  Taxlots in Whipple Creek
-  Taxlots with Septic

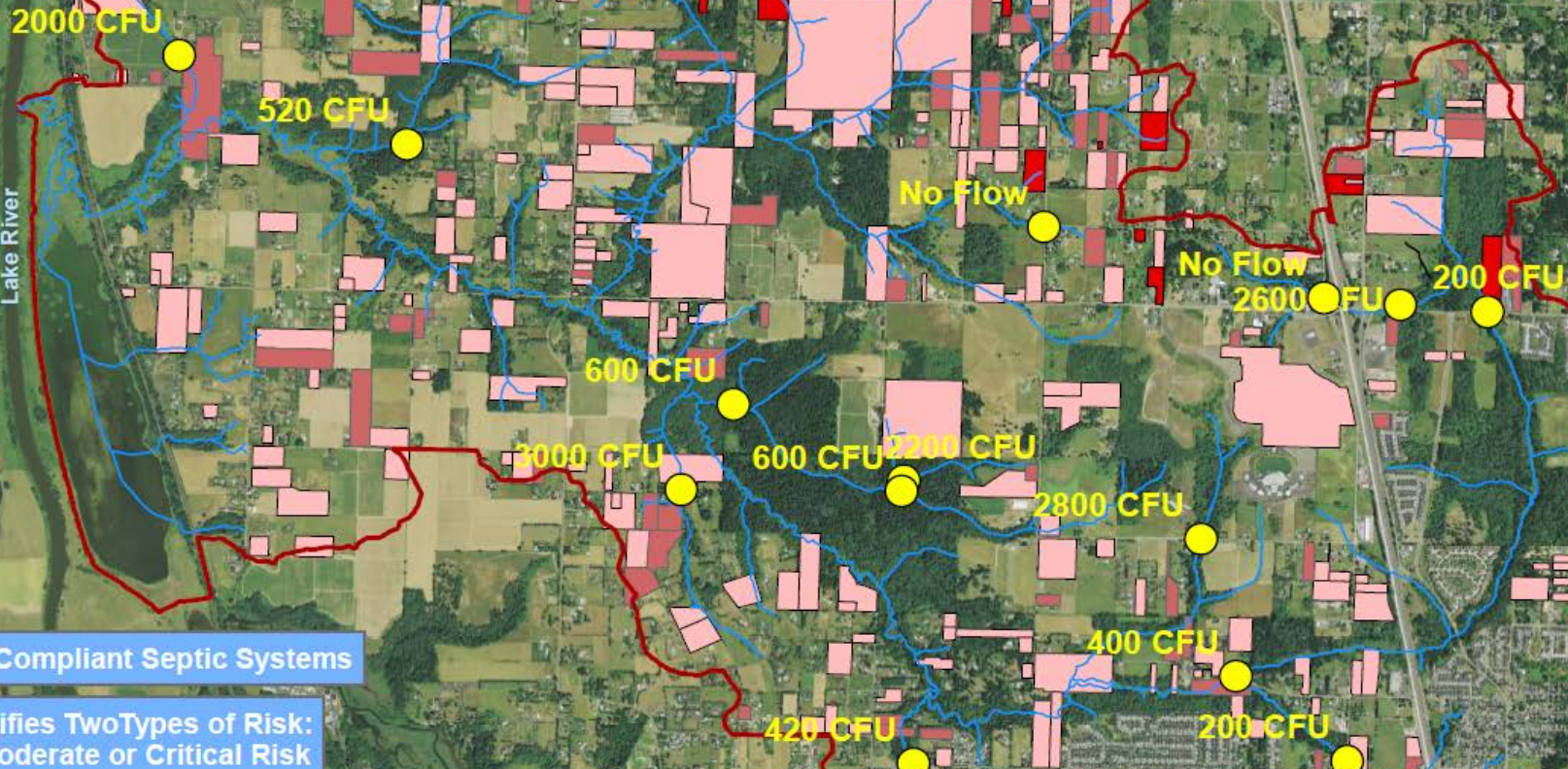
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Whipple Creek Watershed Non-Compliant Septic Systems

Columbia River

Lake River



303 Non-Compliant Septic Systems

PH Classifies Two Types of Risk:
* 18 Moderate or Critical Risk
* 75 Low Risk
* 210 Unknown Risk

Legend

- 10AUG17 Sample Locations
- Non-Compliant Septic Systems with Moderate or Critical Risk of Failing
- Non-Compliant Septic Systems with Low Risk of Failing
- Non-Compliant Septic Systems Unknown Status
- Whipple Creek Watershed



Whipple Creek Watershed Microbial Source Tracking (MIST) Sampling



Columbia River

Lake River

METLER

WPLTHB

WPLTFA

WPLT1N

WPLT03

Legend

 Sampling Site



Sampling Dates

	Dry Season			Wet Season		
Sampling Date	14-AUG-18	5-SEP-18	26-SEP-18	10-OCT-18	28-NOV-18	8-JAN-19
Site						
WPLTFA	X	X	X	X	X	X
WPLT1N	X	X	X	X	X	X
WPLT03	X	NA	NA	X	X	X
WPLTHB	X	X	X	X	X	X
METLER	NA	X	X	X	X	X



Methods

Sampling Parameters:

- qPCR Fecal DNA Biomarkers
- Fecal Coliform
- Escherichia Coliform (*E. coli*)
- Optical Brightener
- Sediment
- Temperature
- Conductivity
- Turbidity
- Dissolved Oxygen
- pH



MIST Fecal Biomarkers

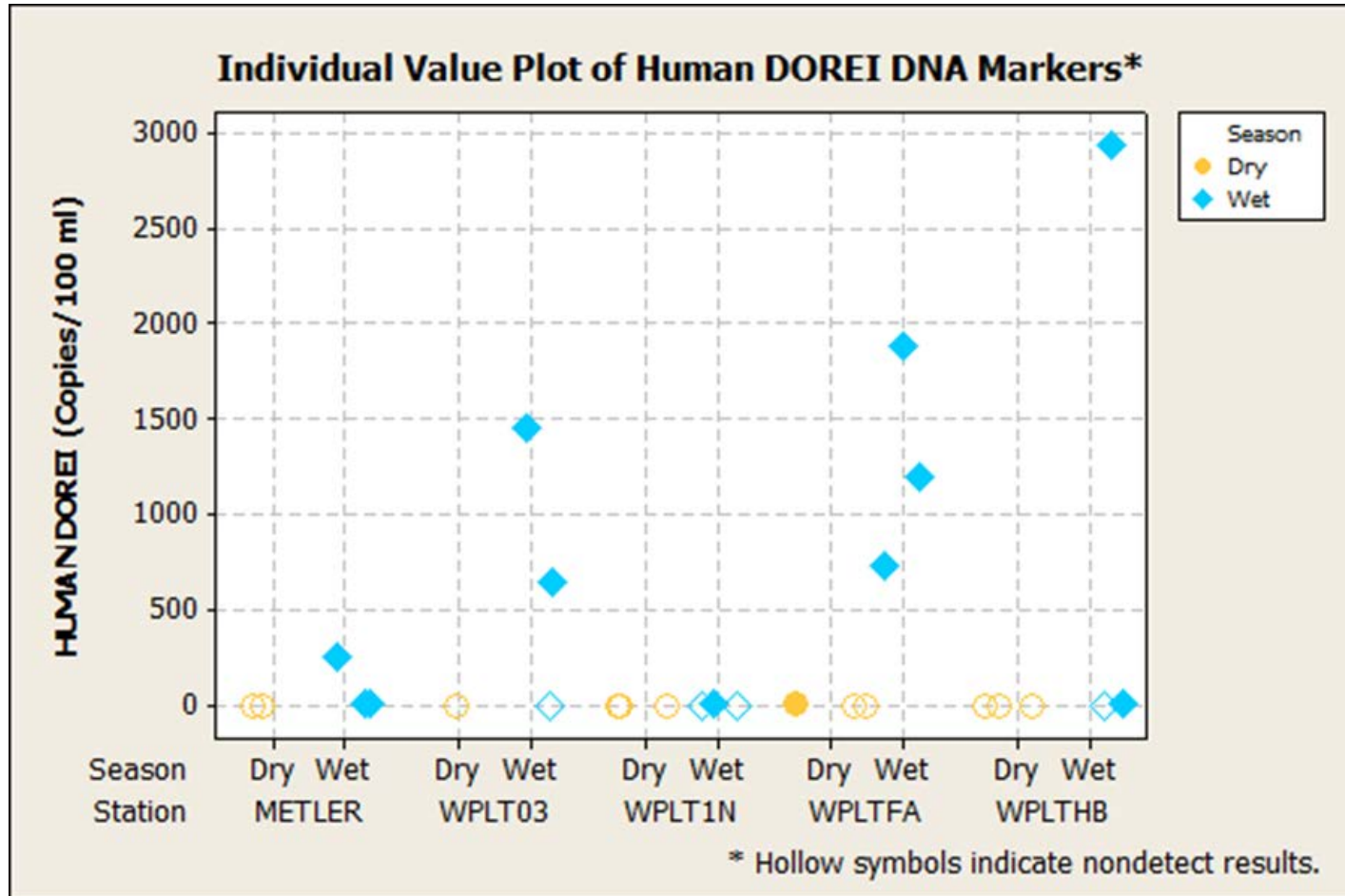
Fecal biomarkers selected for each sampling site based on land use, data analysis, and field observations.

Site	Human Dorei	Human EPA	Beaver	Dog*	Horse	Bird	Ruminant	Pig	Poultry Litter
WPLTFA	X	X	X	X		X			
WPLT1N	X	X	X	X	X				
WPLT03	X	X	X	X			X	X	X
WPLTHB	X	X	X	X	X				
METLER	X	X	X	X		X			

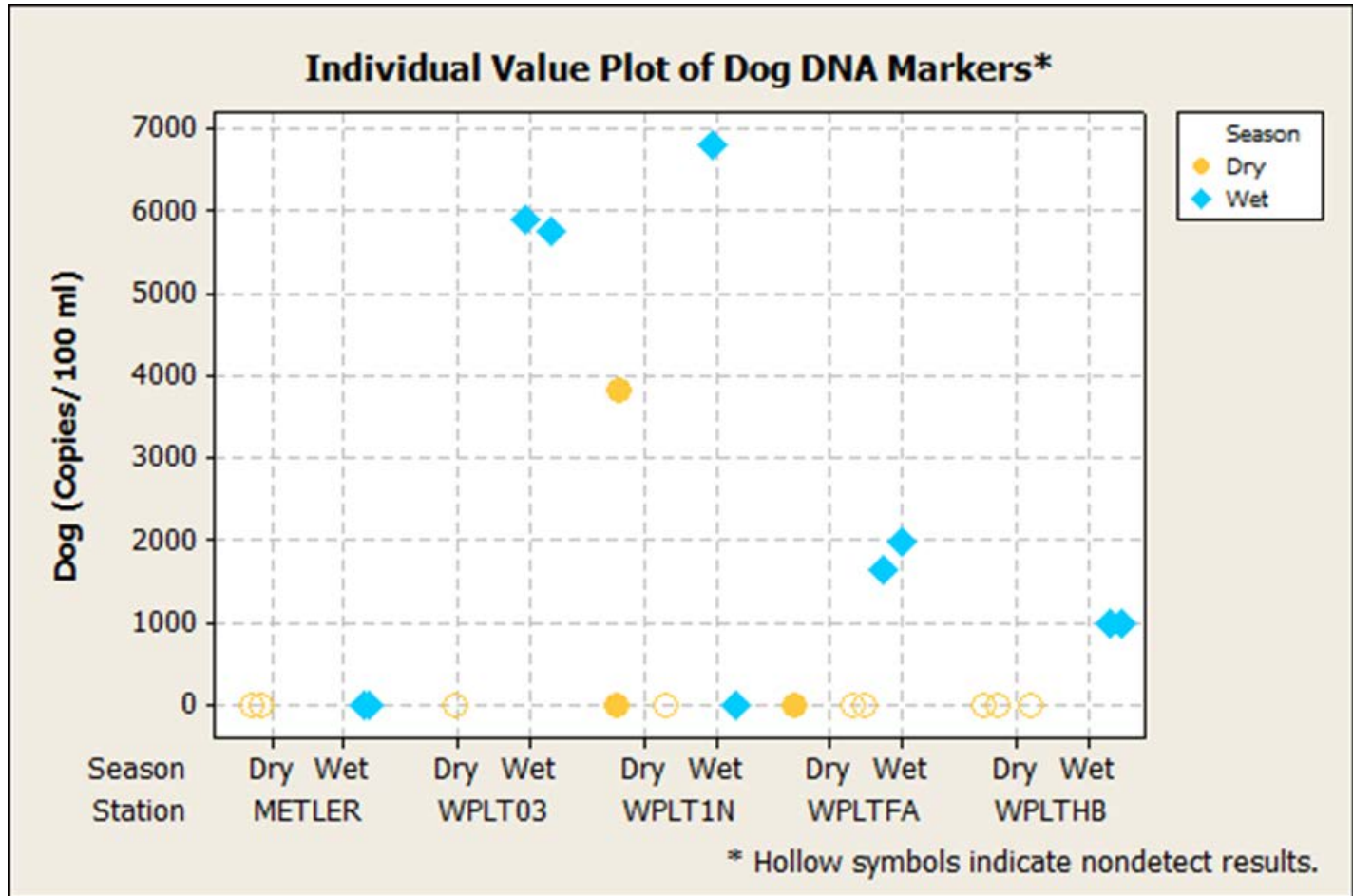
*Dog DNA marker analyzed for three dry season and two wet season sampling events



Human Dorei Fecal Biomarker



Dog Fecal Biomarker



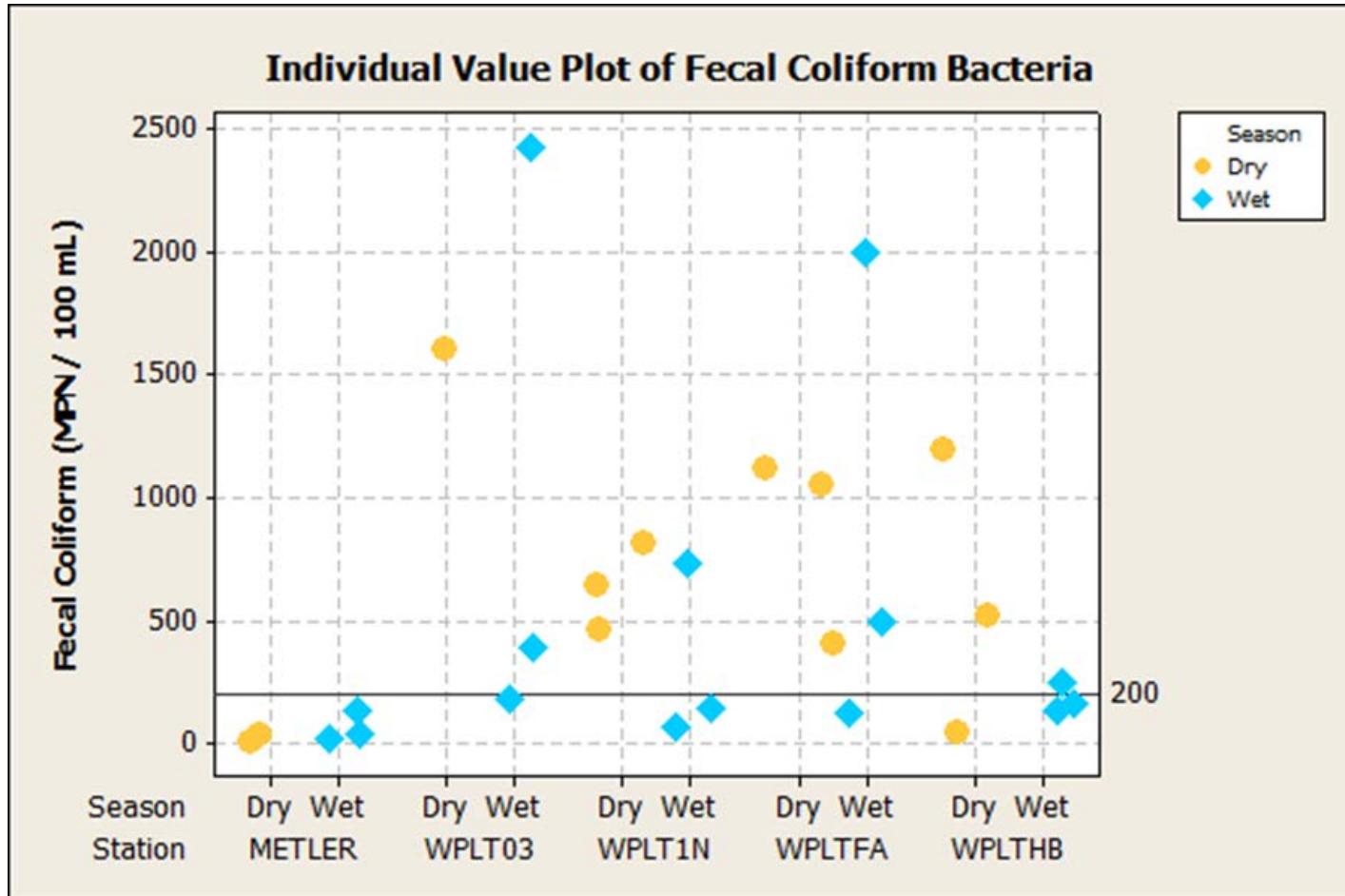
Additional Fecal Biomarkers

Additional DNA markers were important to assess in these tributaries. This will also help with planning efforts on future investigations.

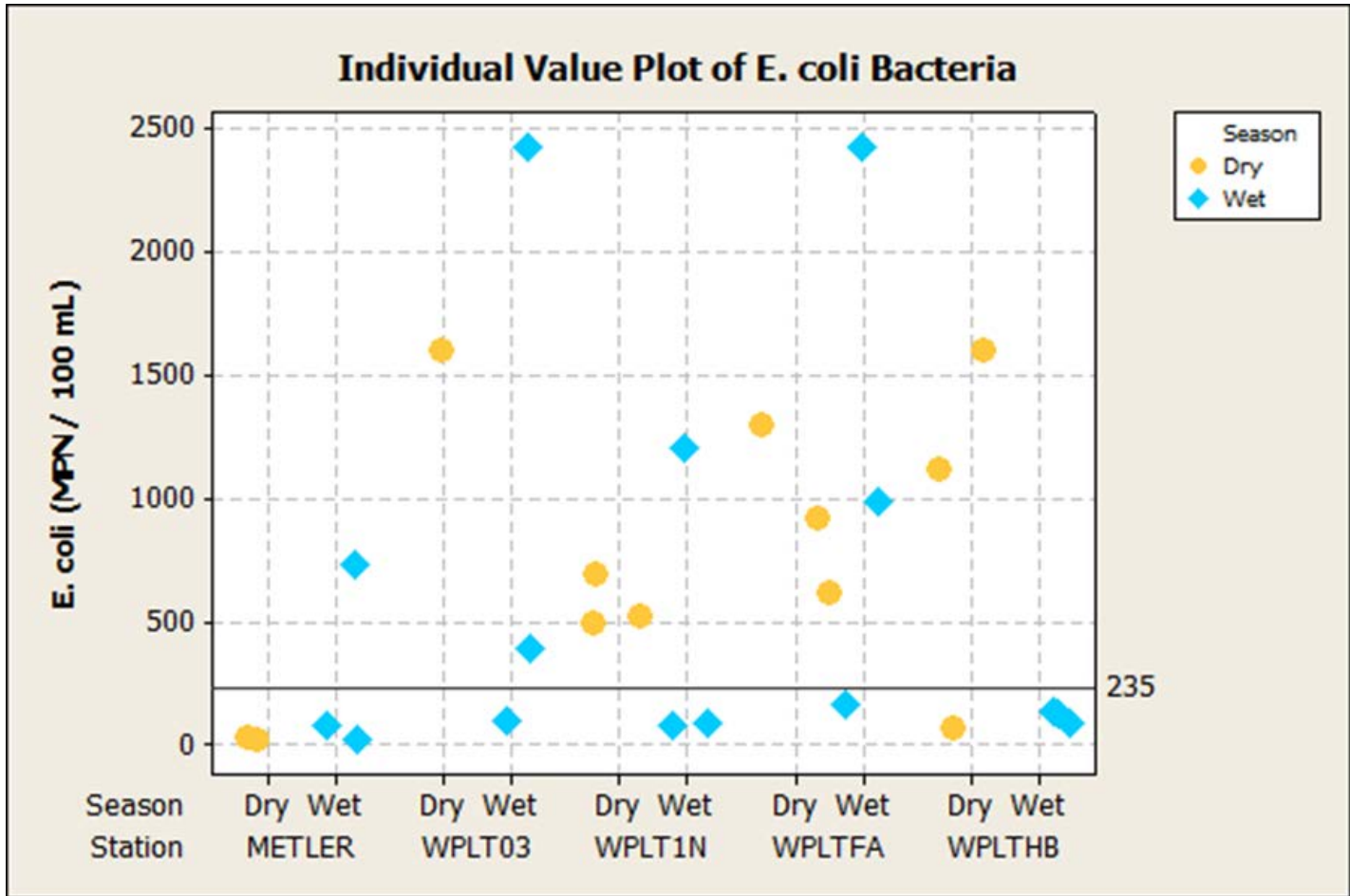
- Only one beaver fecal DNA marker at WPLTHB detected
- Bird fecal DNA marker at both WPLTFA and METLER
- Only one horse fecal DNA marker at WPLT1N detected
- Only one detection of ruminant fecal DNA marker at WPLT03
- There was no detection of pig or poultry fecal DNA marker



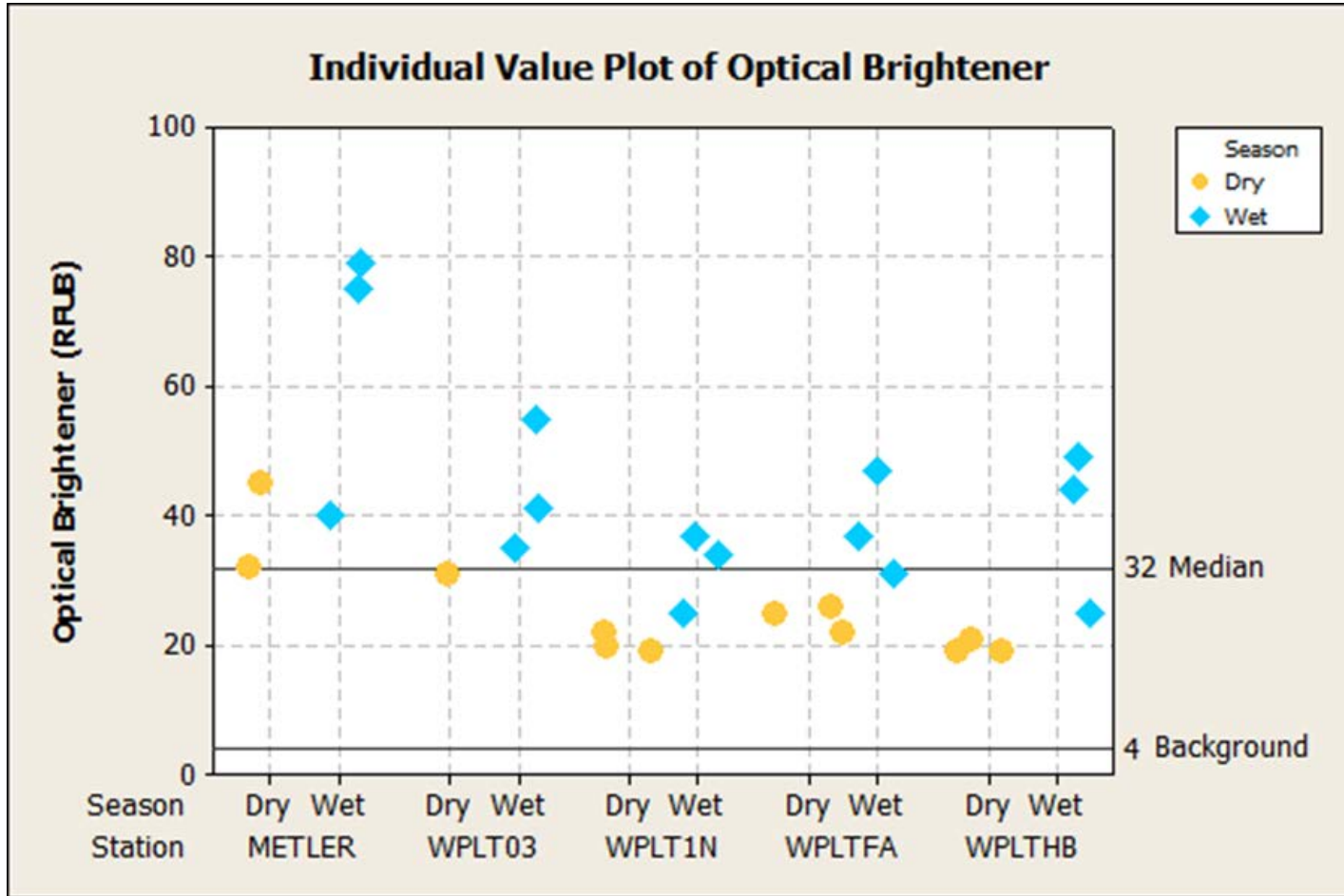
Fecal Coliform



Escherichia Coliform



Optical Brightener



Weight of Evidence Approach



Human DNA markers Dorei and EPA, fecal coliform, *E. coli*, and optical brightener results from the three wet season sampling events

Columbia River

Lake River

METLER







WPLTFA

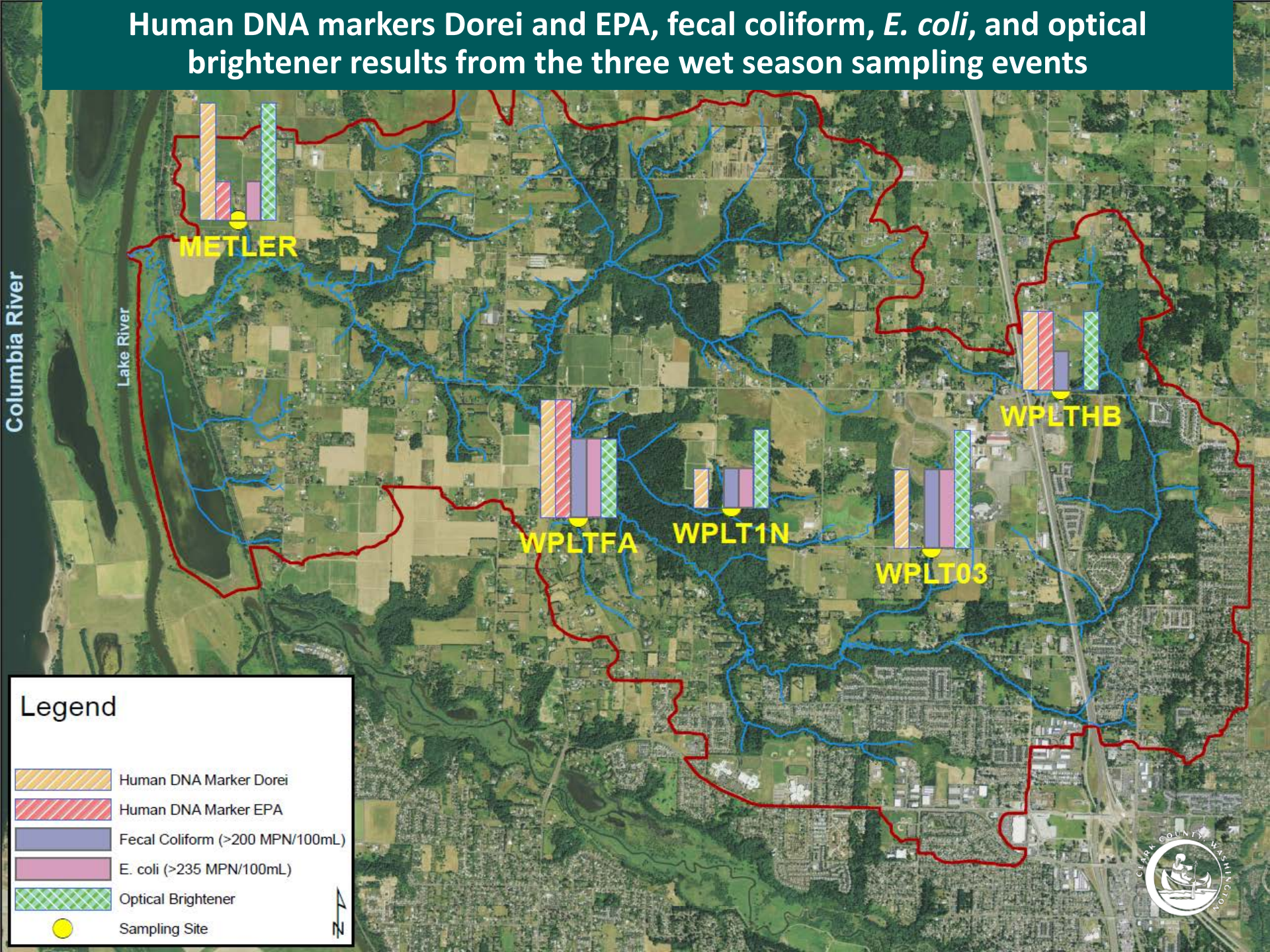
WPLT1N

WPLT03

WPLTHB

Legend

-  Human DNA Marker Dorei
-  Human DNA Marker EPA
-  Fecal Coliform (>200 MPN/100mL)
-  *E. coli* (>235 MPN/100mL)
-  Optical Brightener
-  Sampling Site



Conclusions

- Human DNA markers and elevated optical brightener were detected at all five sites with higher results occurring more frequently in the wet season.
- Detection of dog DNA marker also occurred at all five sampling sites.
- Results do suggest a problem since fecal coliform and *E. coli* levels exceed state standards and human fecal marker detections at each of the five sampling locations.
- Because of the ambiguity with DNA quantification, a weight of evidence approach may be the best course of action to take.
- DNA markers, fecal coliform and *E. coli* enumeration, and optical brightener together could provide greater data certainty and better identify waters of public health concern.



Future Considerations

Overall, this pilot project's detection of bacterial markers in a watershed with known fecal coliform challenges was effective. To address these challenges, the following actions are recommended:

- Perform a site specific in depth analysis with additional GIS work, prioritizing WPLTFA first, to find and eliminate sources of bacteria.
- Increase inspections of non-compliant septic systems, including maintenance and/or repairs to reduce the human sources of fecal coliform in Whipple Creek.
- Increase Clark County Clean Water public outreach (e.g., Canines for Clean Water) to help reduce dog fecal coliform.
- Resample sites after septic system compliance and education outreach campaign to measure effectiveness.



Thank you!

Comments and questions

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