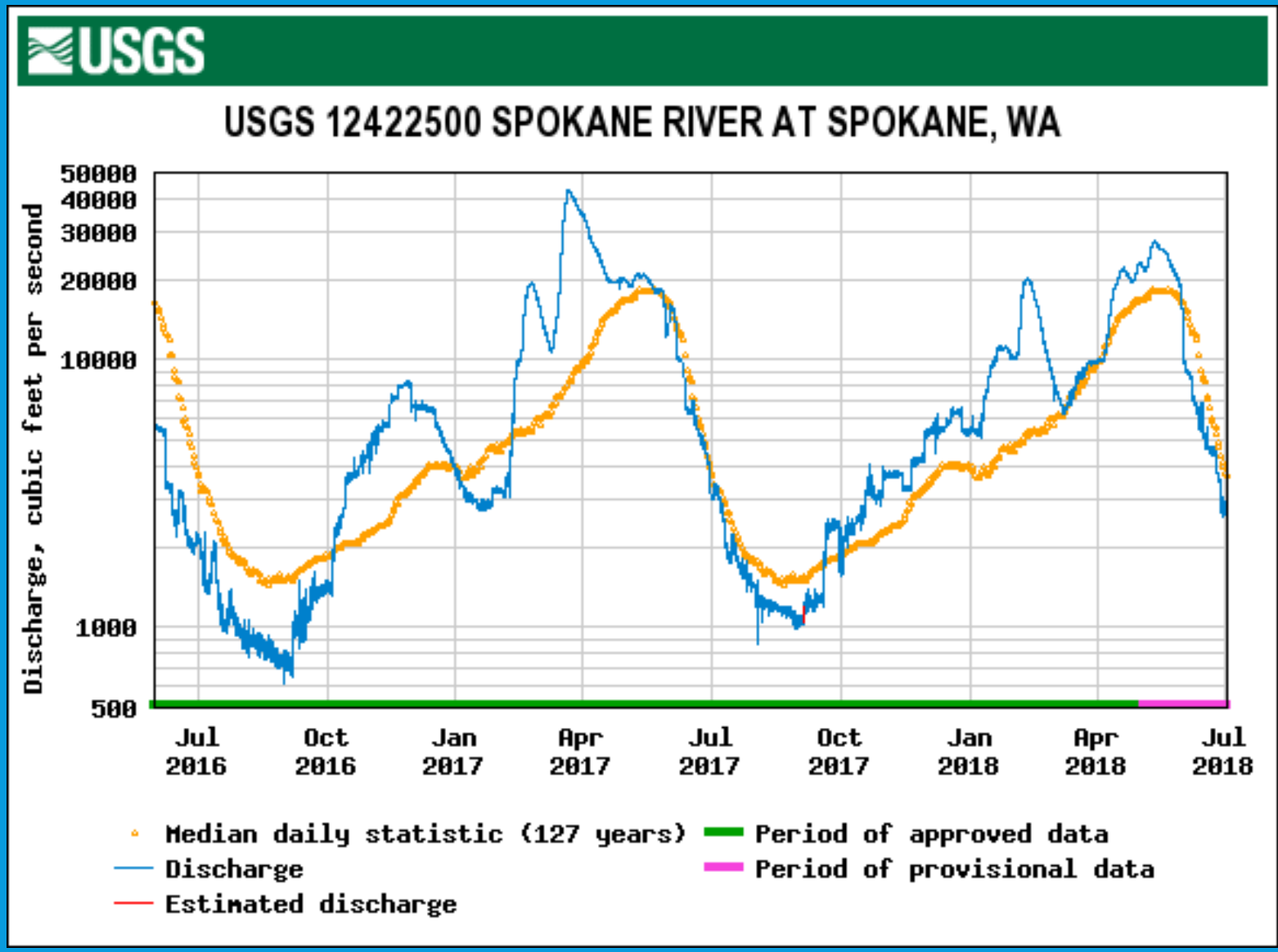
Update for Spokane River DO Monitoring Workgroup

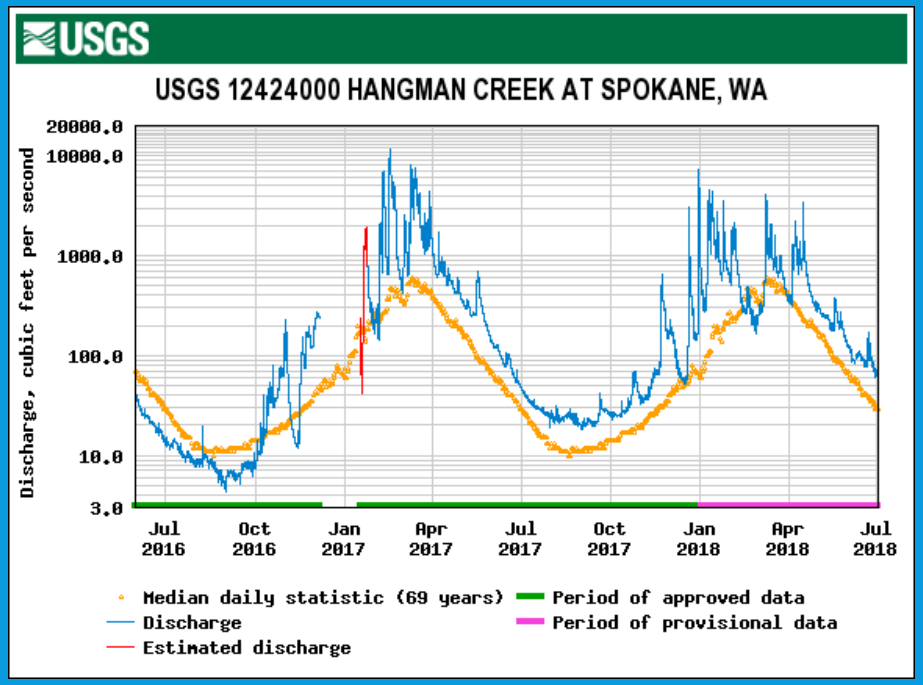
July 17, 2018

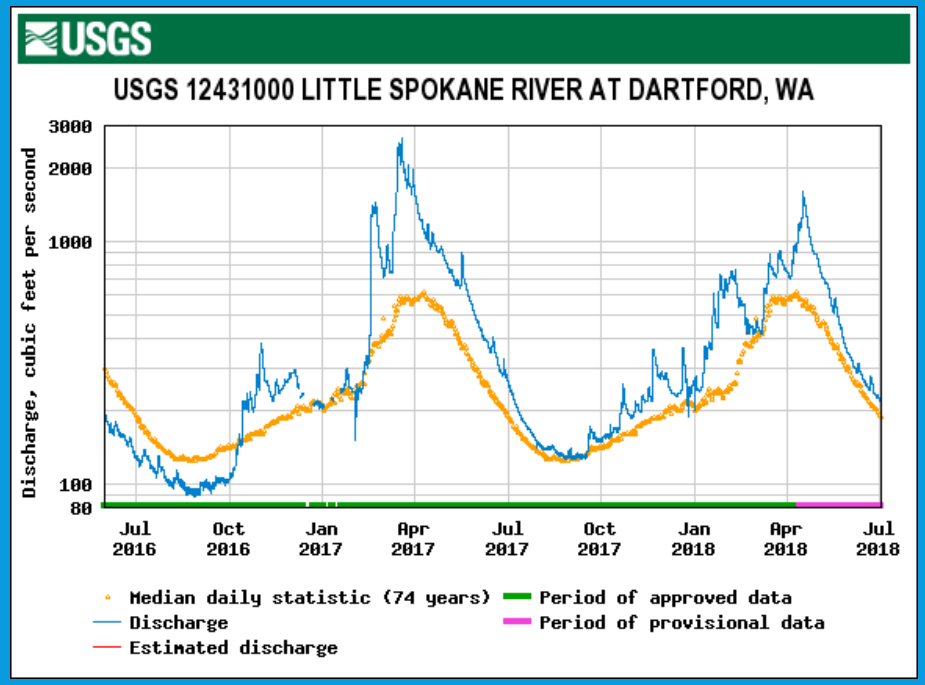
Cathrene Glick – Ecology EAP

SPOKANE RIVER BASIN

MONITORING & STUDIES


USGS
USGS 12422500 SPOKANE RIVER AT SPOKANE, WA
Discharge, cubic feet per second
50000
40000
30000
20000
10000
1000
500
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Median daily statistic (127 years)
Discharge
Estimated discharge
Period of approved data
Period of provisional data

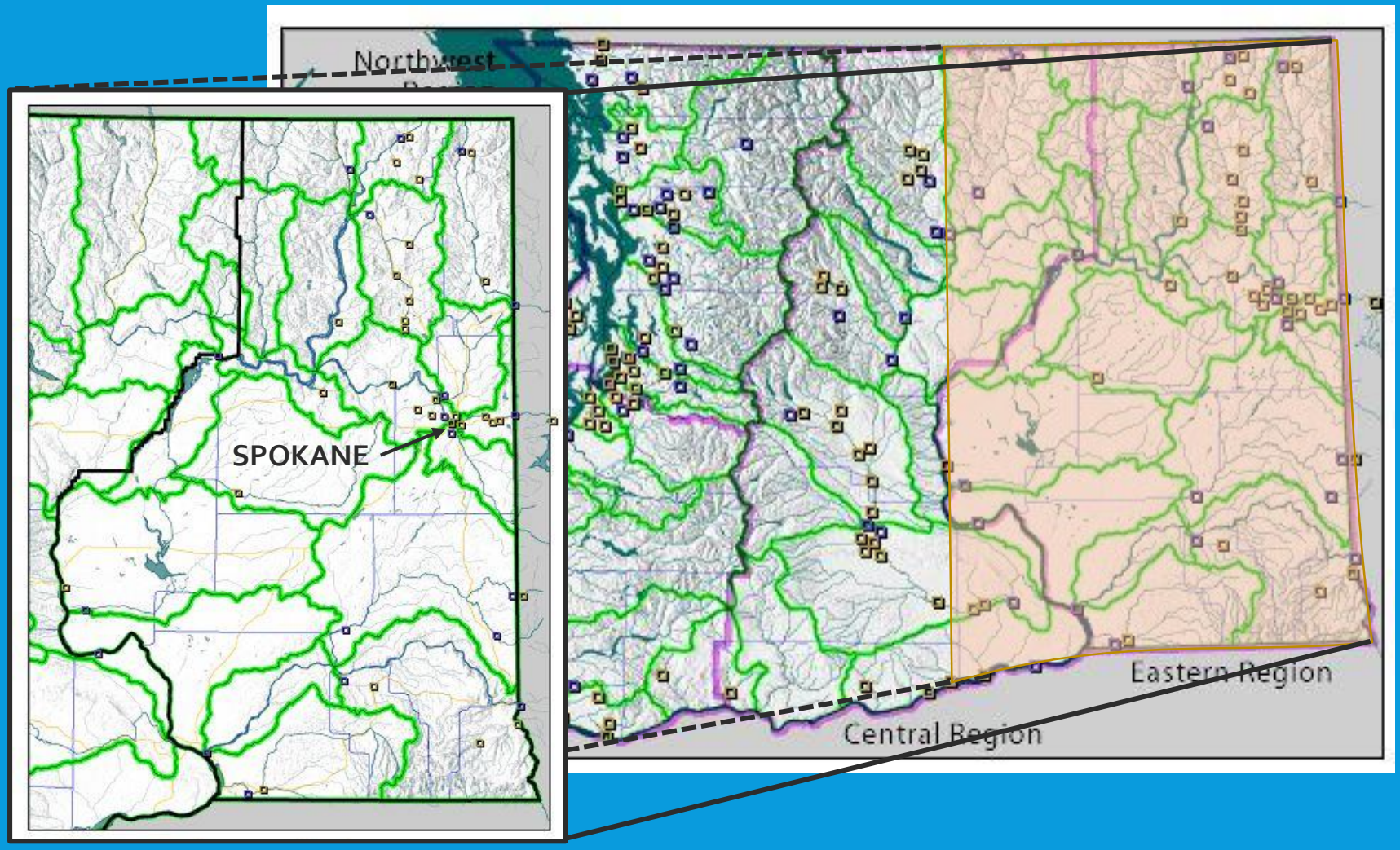

USGS
USGS 12424000 HANGMAN CREEK AT SPOKANE, WA
Discharge, cubic feet per second
20000.0
10000.0
1000.0
100.0
10.0
3.0
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Median daily statistic (69 years)
Discharge
Estimated discharge
Period of approved data
Period of provisional data


USGS
USGS 12431000 LITTLE SPOKANE RIVER AT DARTFORD, WA
Discharge, cubic feet per second
3000
2000
1000
100
80
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Median daily statistic (74 years)
Discharge
Estimated discharge
Period of approved data
Period of provisional data

ECOLOGY "LONG TERM" AND "BASIN STATION" MONITORING SITES

HTTPS://FORTRESS.WA.GOV/ECY/EAP/RIVERWQ/REGIONS/STATE.ASP?SYMTYPE=1

HTTPS://FORTRESS.WA.GOV/ECY/EAP/RIVERWQ/REGIONS/STATE.ASP?MODE=ERO



SPOKANE RIVER WATER QUALITY MONITORING SITES

"BLUE" = LONG TERM SITES **"YELLOW" = 2017-2018 BASIN SITES**

"TYPICAL DATA" FROM WQ DATA WEBSITE

Spokane River @ Stateline

Conventional parameters

Parameter, unit, and data-qualifier descriptions

date	time	COND (umhos/cm)		DOC (mg/L)		FC (#/100ml)		NH3_N (mg/L)		NO2_NO3 (mg/L)		OP_DIS (mg/L)		OXYGEN (mg/L)		PH (pH)		PRESS (mm/Hg)		SUSSOL (mg/L)		TEMP (deg C)		TOC (mg/L)		TP_P (mg/L)		TPN (mg/L)		TURB (NTU)	
10/4/2016	13:00	54				6		0.01		0.142		0.003	U	9.4		7.64		705.6		1		16				0.0078		0.22		0.7	
11/15/2016	12:55	53				4		0.01	U	0.04		0.003	UJ	10.2		7.60		701.8		1		10.9				0.0076		0.111		0.5	U
12/6/2016	13:55	54				1	U	0.01	U	0.07		0.003	U	10.9		7.43		709.4		1	U	6.9				0.0061		0.132		0.5	U
1/10/2017	15:00	55				3		0.01	UJ			0.0054		12.5		7.72		700.5		3		2.4				0.0113		0.163	J	0.5	U
2/7/2017	13:45	58				3		0.01	U	0.109		0.003	U	13.4		7.17		699.8		1	U	1.6				0.0103		0.178		0.6	
3/7/2017	13:25	56				1	U	0.01	U	0.072		0.0037		13.5		7.36		709.2		1		1.9				0.0104		0.145		1.4	
4/4/2017	12:35	50				1	U	0.012		0.1		0.0075	J	13.8		7.31		710.9		3		4.3				0.0202		0.155		5.8	
5/2/2017	12:40	46				2		0.01	U	0.037		0.0037		12.5		7.51		713.2		3		8.3				0.014		0.088		2.5	
6/6/2017	13:15	44				3		0.01	U	0.014		0.003	U	9.8		7.54		706.4		2		16.4				0.0106		0.073		1.1	
7/11/2017	13:05	49				9		0.012		0.099		0.0042		7.6		7.72		706.1		1		25.1				0.0113		0.188		0.7	
8/8/2017	12:15	57				49		0.015		0.204		0.0074		8.1		7.96		705.6		1		24.3				0.0109		0.306		1.4	
9/12/2017	13:00	55				5		0.011		0.212		0.003	U	8.1		7.78		704.1		1	U	21.4				0.0096		0.303		0.5	U
10/10/2017	10:15	52		1		1	U							9.2		7.65		703.8		1		13.5		1							
11/14/2017	09:10	50		1.31	J	5		0.028		0.062		0.007		10.2		7.55		710.7		1	UJ	7.8		1.56		0.0115		0.152		0.6	
12/5/2017	10:15	50		1.48		1	U	0.014		0.045		0.0084		10.8		7.46		722.9		1	U	6.4		1.41		0.0105		0.124		0.5	U
1/9/2018	10:00	51		1.33		14		0.036		0.052		0.0044		12.3		8.02		696.5		1	U	4.5		1.38		0.0111		0.147		0.6	
2/6/2018	10:15	52		1.48		1	U	0.01	U	0.051		0.0033		12.3		7.73		714		3		4		1.26		0.0107		0.133		1.6	
3/6/2018	10:30	55		1.64		5	J	0.029		0.08		0.0038		12.6		7.44		714.5		1		2.8		1.6				0.192		1.2	
4/10/2018	10:20			1.73		2		0.01	U	0.079		0.0044								2				1.76		0.0122		0.148		1.7	

Common data qualifiers: U - not detected at the reported level, J - estimated value
Times are local (Pacific Standard or Pacific Daylight Savings).
Colored background ☐ indicates that result exceeded water quality standards -OR- contrasted strongly with historical results. The November 2006 amendment to the water quality standards was incorporated beginning in January 2009.

Metals

Parameter, unit, and data-qualifier descriptions

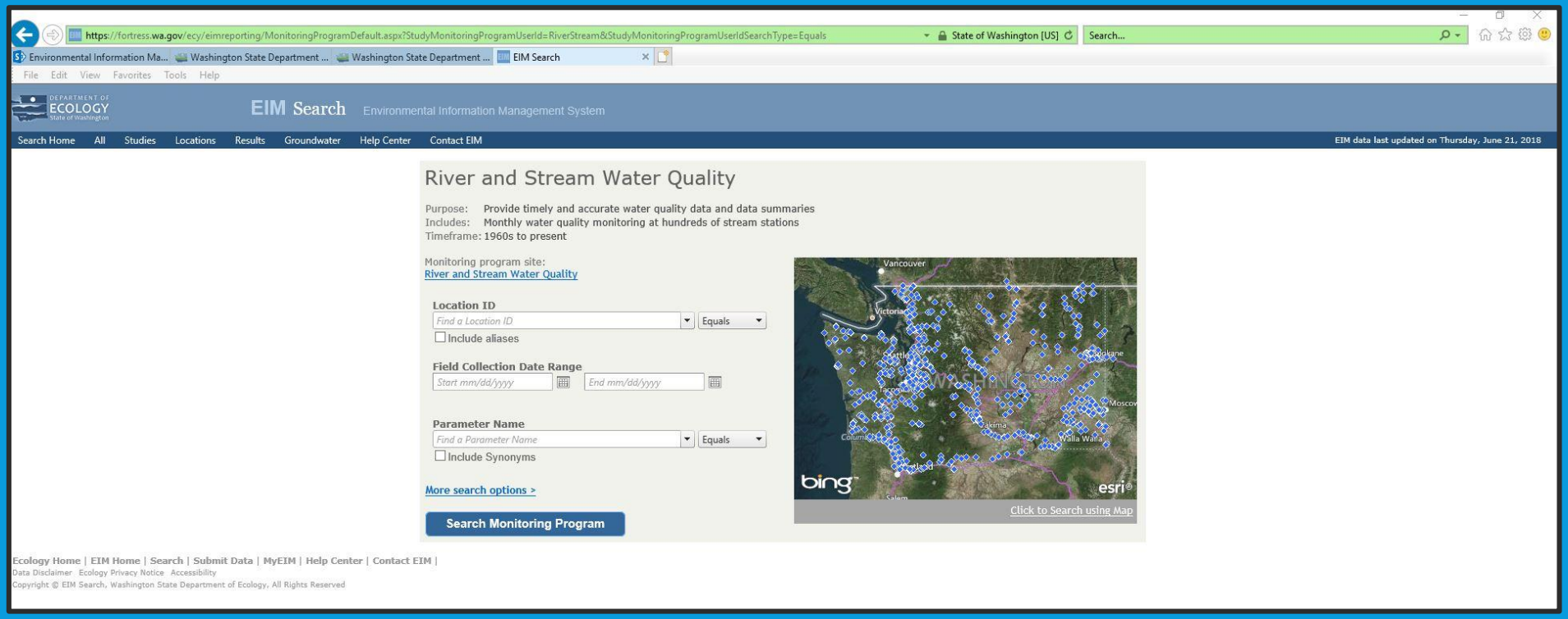
date	time	Ag_DIS (ug/L)		Ag_TR (ug/L)		As_DIS (ug/L)		As_TR (ug/L)		Cd (ug/L)		Cd_DIS (ug/L)		Cr (ug/L)		Cr_DIS (ug/L)		Cu (ug/L)		Cu_DIS (ug/L)		HARD (mg/L)		Hg_AA (ug/L)		NI_DIS (ug/L)		NI_TR (ug/L)		Pb (ug/L)		Pb_DIS (ug/L)		Zn (ug/L)		Zn_DIS (ug/L)	
10/4/2016	13:00	0.02	U	0.1	U	0.44		0.44		0.12		0.079		0.1	U	0.1	U	0.54		0.4		20.9		0.0011		0.13		0.22		1.12		0.141		29.8		25	
12/6/2016	13:55	0.02	U	0.1	U	0.43		0.49		0.16		0.131				0.1	U	0.59		0.42		21.2		0.0007		0.19		0.22		0.65		0.066		48.2		45.2	
2/7/2017	13:45	0.02	U	0.1	U	0.43		0.53		0.19		0.144		0.15		0.1	U	0.69		0.45		22.6		0.001		0.19		0.25		1.33		0.325		57.9		49.2	
4/4/2017	12:35	0.02	U	0.1	U	0.48		0.66		0.25		0.184		0.3		0.17		0.96		0.7		19.5		0.0057		0.29		0.44		12.1		3.79		55.5		48.6	
6/6/2017	13:15	0.02	U	0.1	U	0.31		0.36		0.19		0.134		0.11		0.14		0.54		0.44		18				0.17		0.18		2.05		0.434		35.2		30.5	
8/8/2017	12:15	0.02	U	0.1	U	0.45		0.45		0.1	U	0.063		0.1	U	0.1	U	0.48		0.45		21.4		0.0006		0.13		0.16		0.57		0.1		20.9		17	
10/10/2017	10:15																					20												24		21	
12/5/2017	10:15	0.02	U	0.1	U	0.42		0.47		0.14		0.118		0.1	U	0.1	U	0.55		0.49		20		0.0006		0.19		0.23		0.46		0.087		39.3		37.5	
2/6/2018	10:15	0.02	UJ	0.1	U	0.41	J	0.5		0.22		0.144	J	0.15		0.1	UJ	0.69		0.47	J	21.3		0.0014		0.23	J	0.31		2.36		0.235	J	52.4		43.6	J
4/10/2018	10:20	0.02	U	0.1	U	0.36		0.47		0.21		0.163		0.19				0.79		0.56		21.1		0.0014		0.26		0.32		2.12		0.832		53.7		48.1	

Common data qualifiers: U - not detected at the reported level, J - estimated value
Times are local (Pacific Standard or Pacific Daylight Savings).
Colored background ☐ indicates that result exceeded water quality standards -OR- contrasted strongly with historical results. The November 2006 amendment to the water quality standards was incorporated beginning in January 2009.

NOTE: Data May Be "Preliminary"

ENVIRONMENTAL INFORMATION MANAGEMENT (EIM) SYSTEM

HTTPS://FORTRESS.WA.GOV/ECY/EIMREPORTING/MONITORINGPROGRAMDEFAULT.ASPX?STUDYMONITORINGPROGRAMUSERID=RIVERSTREAM&STUDYMONITORINGPROGRAMUSERIDSEARCHTYPE=EQUALS



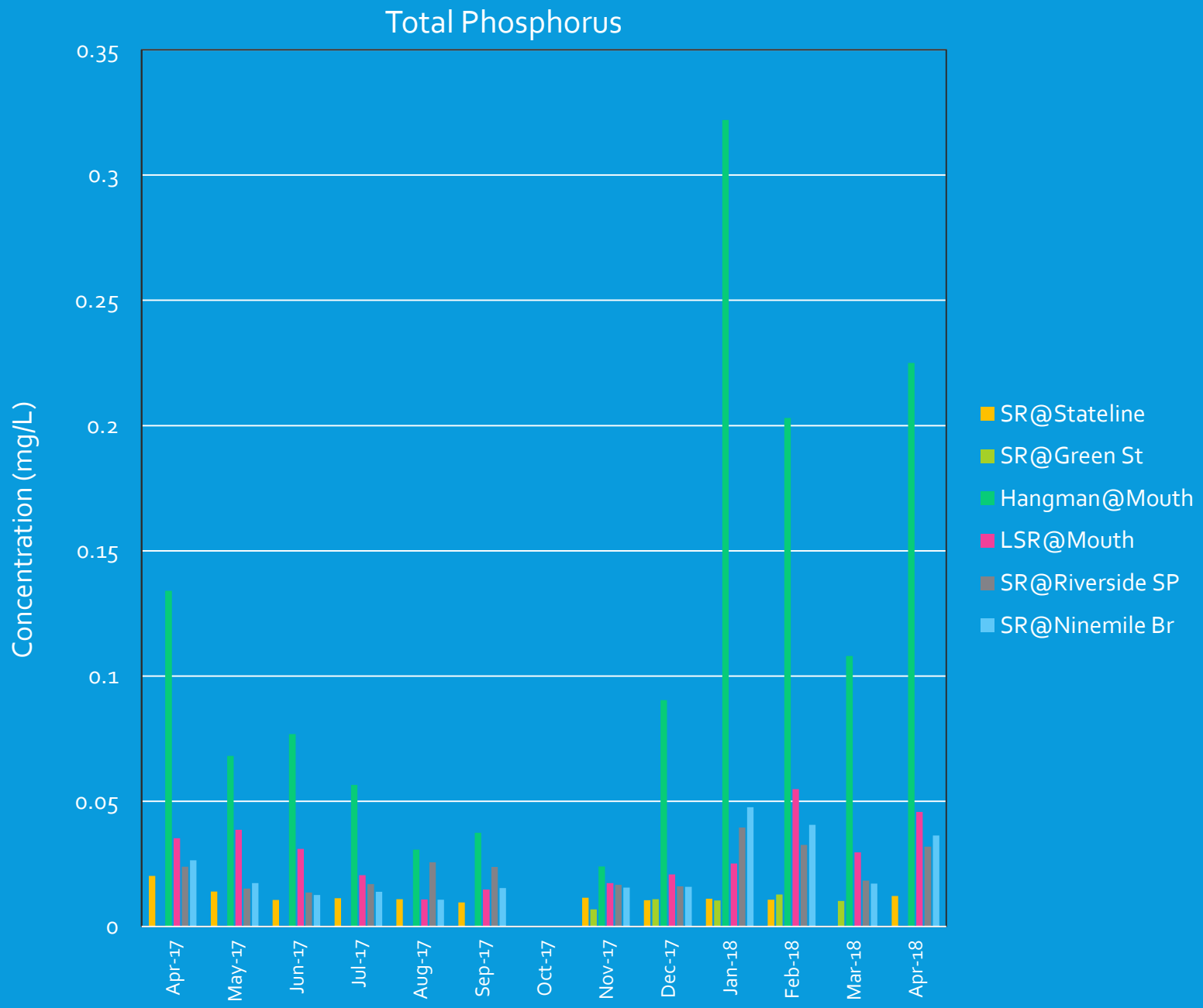
EIM DATA "CLIP" FOR SPOKANE RIVER AT STATELINE SITE

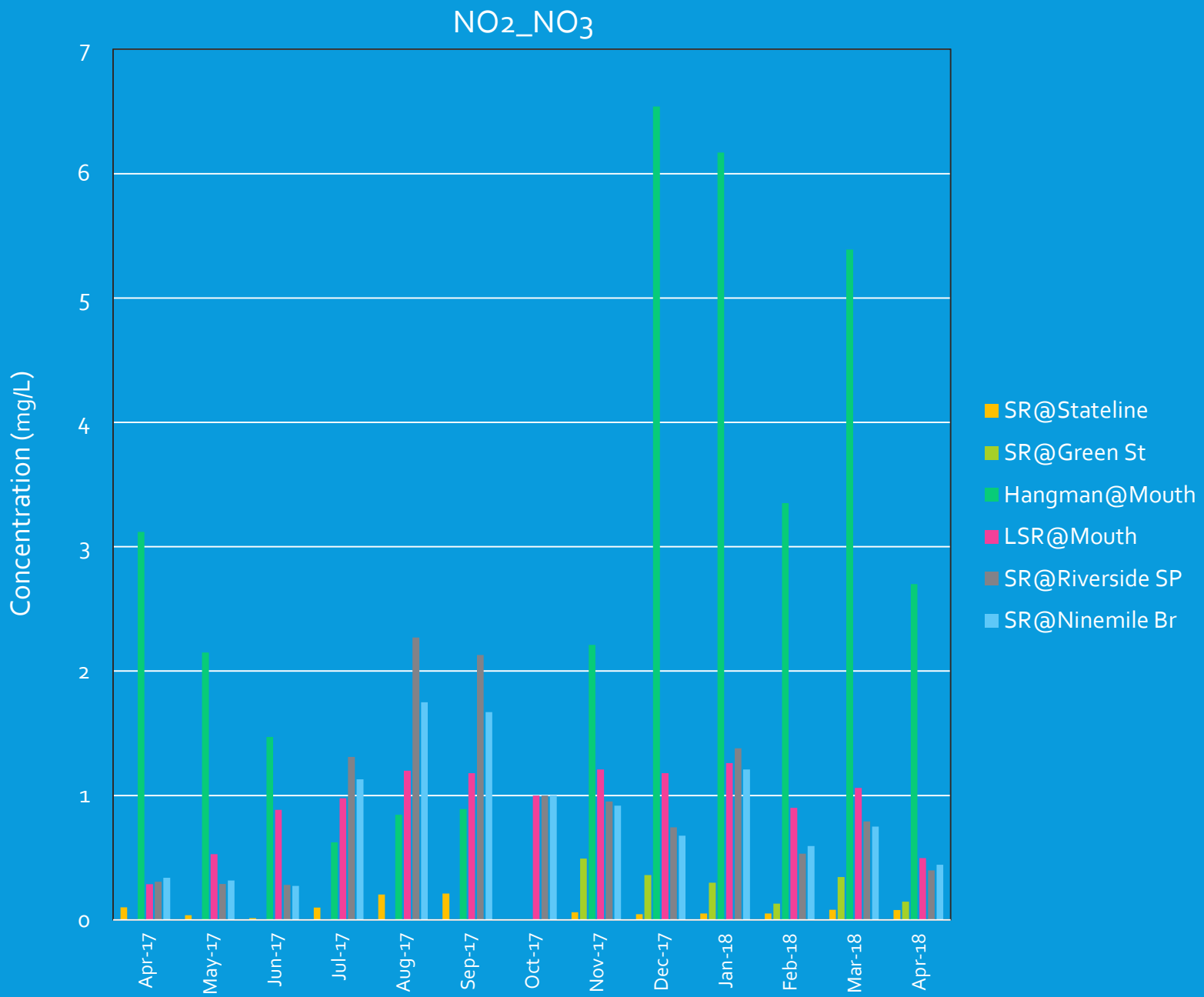
Results List

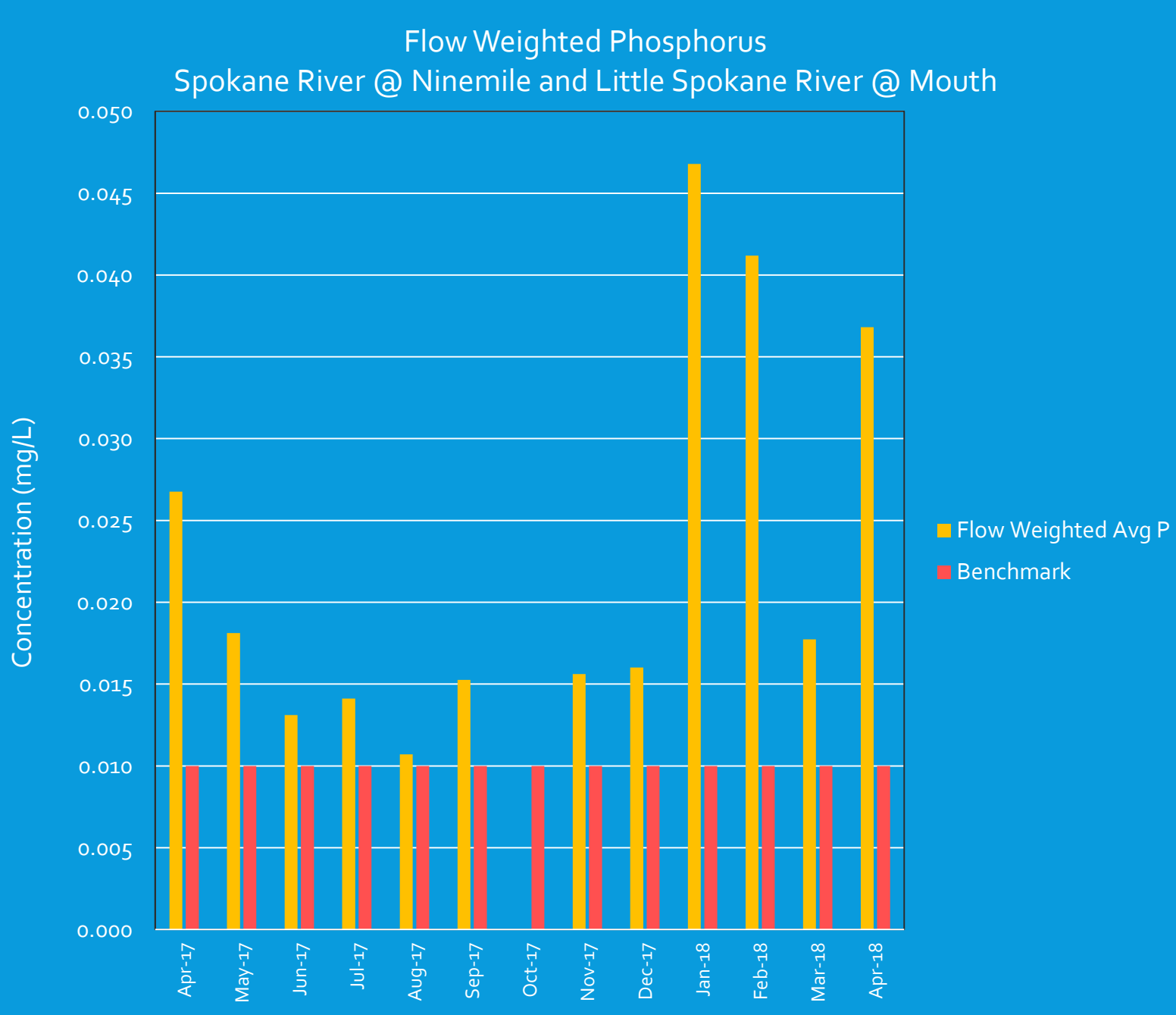
Results | Time Series Results | Water Column Profiles | Summarized Results

Study ID	Location ID	Study-Specific Location ID	Field Collection Start Date	Sample Matrix	Sample Source	Result Parameter Name	Result Value	Result Value Units	Result Data Qualifier	Result Measurement Basis Code	Result Method Code	Result Sample Fraction
AJOH0002	STATELIN	STATELIN	May 20, 1997	Water	Fresh/Surface Water	Cadmium	0.275	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Cadmium	0.282	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Lead	9.2	ug/L			EPA200.8	Tot Recoverable
AJOH0002	STATELIN	STATELIN	Apr 08, 1997	Water	Fresh/Surface Water	Lead	1.41	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Zinc	87.4	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Cadmium	0.283	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	Jun 03, 1997	Water	Fresh/Surface Water	Copper	0.64	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 20, 1997	Water	Fresh/Surface Water	Copper	0.591	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 20, 1997	Water	Fresh/Surface Water	Zinc	79.5	ug/L			EPA200.8	Tot Recoverable
AJOH0002	STATELIN	STATELIN	Apr 08, 1997	Water	Fresh/Surface Water	Cadmium	0.44	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Zinc	63.9	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	Jun 03, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	16.3	mg/L			SM2340B	
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Copper	0.61	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	Jun 03, 1997	Water	Fresh/Surface Water	Zinc	78.9	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 20, 1997	Water	Fresh/Surface Water	Zinc	59.9	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Copper	0.58	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Cadmium	0.37	ug/L			EPA200.8	Tot Recoverable
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	18.8	mg/L			SM2340B	
AJOH0002	STATELIN	STATELIN	May 20, 1997	Water	Fresh/Surface Water	Lead	12.2	ug/L			EPA200.8	Tot Recoverable
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Zinc	64.8	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	Apr 08, 1997	Water	Fresh/Surface Water	Copper	0.86	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	Jun 03, 1997	Water	Fresh/Surface Water	Lead	1.65	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Zinc	62.7	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	20	mg/L	C		SM2340B	
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	19.3	mg/L			SM2340B	
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Zinc	75.8	ug/L			EPA200.8	Tot Recoverable
AJOH0002	STATELIN	STATELIN	Apr 08, 1997	Water	Fresh/Surface Water	Zinc	119	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Lead	2.5	ug/L	C		EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	20.3	mg/L			SM2340B	
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Cadmium	0.326	ug/L	C		EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Lead	1.93	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Hardness, Total as CaCO3	18.9	mg/L			SM2340B	
AJOH0002	STATELIN	STATELIN	May 06, 1997	Water	Fresh/Surface Water	Lead	12.3	ug/L			EPA200.8	Dissolved
AJOH0002	STATELIN	STATELIN	May 12, 1997	Water	Fresh/Surface Water	Cadmium	0.275	ug/L			EPA200.8	Dissolved

EIM provides the ability to "sort" on specific parameters or dates


Total Phosphorus
Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
SR@Stateline
SR@Green St
Hangman@Mouth
LSR@Mouth
SR@Riverside SP
SR@Ninemile Br


NO2_NO3
Concentration (mg/L)
0
1
2
3
4
5
6
7
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
SR@Stateline
SR@Green St
Hangman@Mouth
LSR@Mouth
SR@Riverside SP
SR@Ninemile Br


Flow Weighted Phosphorus
Spokane River @ Ninemile and Little Spokane River @ Mouth
Concentration (mg/L)
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
Flow Weighted Avg P
Benchmark

RECENT & ONGOING STUDIES……

- Evaluation of Fish Hatcheries as Sources of PCBs to the Spokane River – Publication No. 18-03-014 April 2018
- Lake Spokane Measuring Improvement in Dissolved Oxygen and Ecosystem Health – A Literature Review – Publication No. 18-03-008 May 2018
- Little Spokane River Dissolved Oxygen, pH, and total Phosphorus TMDL – Water Quality Improvement Report and Implementation Plan (*Field Work Complete and Report In Progress*)
- Tekoa Receiving Water Study & Hangman Creek Springtime “High Flow” Runoff Watershed Study & Lower Hangman Creek “Low-Flow” and Groundwater Study

LSR DO, PH, TOTAL P TMDL STUDY…

Background

- Ecology initiated TMDLs studies in the LSR watershed in the early 2000s. The initial effort focused on addressing fecal coliform bacteria, temperature, and turbidity impairments. This TMDL was completed and approved by EPA in 2012 (Joy & Jones, 2012).
- The LSR and its tributaries are also impaired by low dissolved oxygen (DO) and high pH. Historical data collection efforts indicate some locations have been impaired since the 1990s and have been listed on sequential state 303(d) lists of impaired waterbodies.
- In addition, the Spokane River DO TMDL set total phosphorus, ammonia, and carbonaceous biological oxygen demand (CBOD) allocations at the mouth of the Little Spokane River (Moore & Ross, 2010). This TMDL has been developed to address both the in-watershed DO and pH impairments in the watershed and the allocations at the mouth.

Objectives

Conduct a TMDL assessment study, develop TMDL allocations, and develop a water quality improvement implementation plan, with the ultimate goals of:

- Meeting the load allocation for phosphorus at the mouth of the Little Spokane River, established in the Spokane River TMDL (Moore and Ross, 2010).

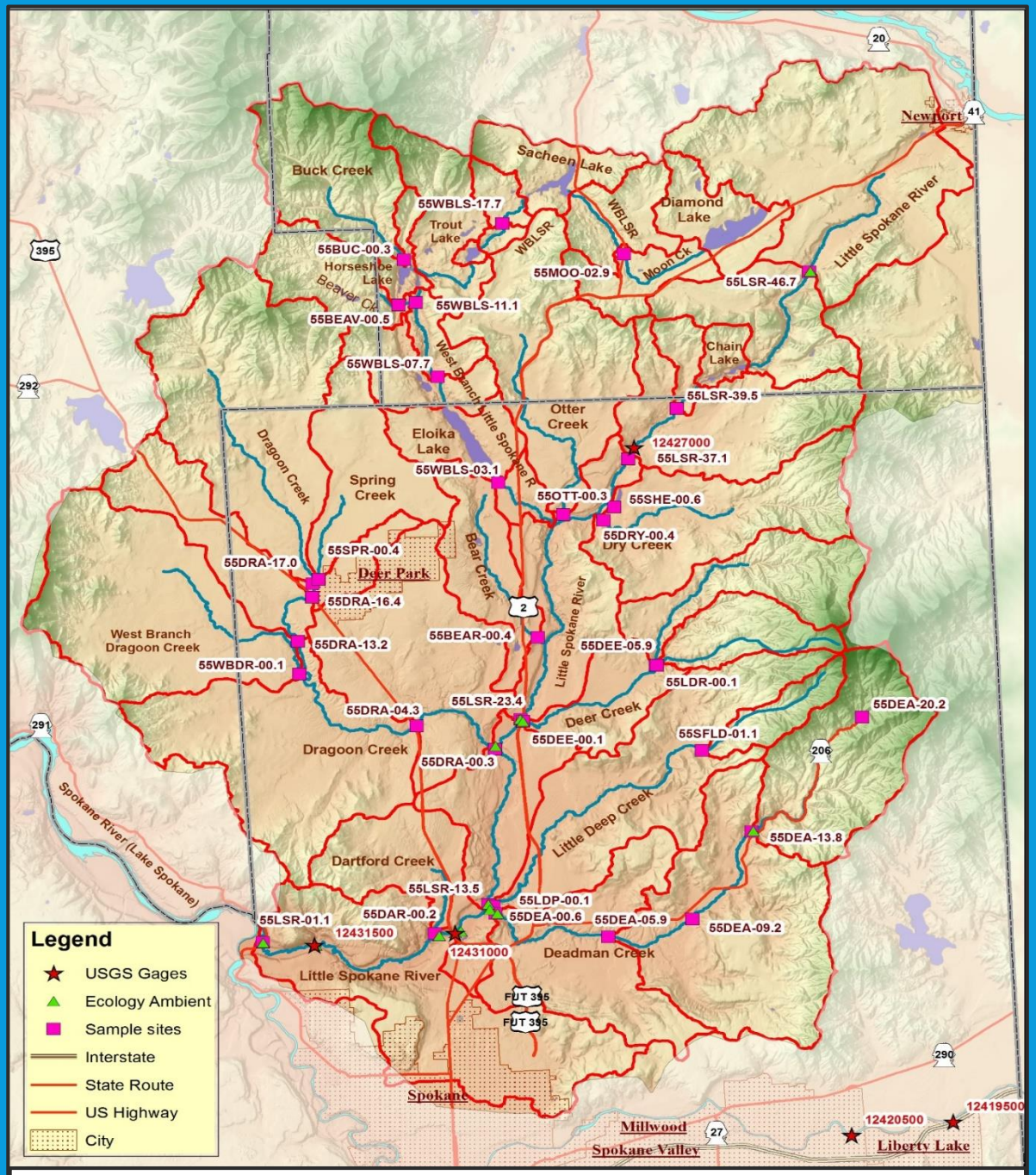
Bringing the Little Spokane River and its tributaries into compliance with dissolved oxygen and pH water quality standards where impairments have been identified.

Scope of Work

- Conduct two synoptic water quality surveys along the mainstem Little Spokane River during the low-flow season (July – August) to generate data needed by the QUAL2Kw computer model.
- Collect one year of nutrient, suspended sediment, streamflow, and other related data at approximately one-month intervals and for storm events from a network of sites distributed throughout the Little Spokane River watershed.
- Sample each of five lakes once during late summer for epilimnion and hypolimnion nutrients, and collect temperature, dissolved oxygen, and pH profiles, to assist in understanding the role of lakes in nutrient transport, especially in the West Branch Little Spokane River.

Scope of Work (cont'd)

- Collect diel dissolved oxygen and pH data at locations throughout the Little Spokane River watershed.
- Use the River Metabolism Analyzer (RMA) model to assess nutrient impacts to dissolved oxygen and pH in tributaries and in the upper portion of the Little Spokane River.
- Assess nutrient impacts to dissolved oxygen and pH in the middle and lower Little Spokane River using the QUAL2Kw model framework.
- Assess watershed nutrient loading using monthly data collected throughout the watershed.
- Establish load and wasteload allocations throughout the watershed based upon the more restrictive of: (1) loading that allows the attainment of water quality standards for dissolved oxygen and pH in streams within the Little Spokane watershed or (2) loading that meets the load allocation for total phosphorus set for the mouth of the Little Spokane River in the Spokane River and Lake Spokane Dissolved Oxygen and Phosphorus TMDL.



LSR Watershed with Sub-watersheds and Monitoring Stations

WHAT IS PROJECT TIMELINE?

Timeframe	Study Aspect
June 2015 - October 2015	"Dry Season" Sampling (*Complete*)
November 2015 – May 2016	"Wet Season" Sampling (*Complete*)
June 2016 – May 2018	Data Entry, Data Analytics and Modeling (*Complete*)
January - June 2018	Draft Report for Internal Review (Delayed)
August 2018	Final Report (Delayed)

HANGMAN CREEK STUDIES…

An extensive study of the Hangman Creek watershed

Objectives

- To assess the Hangman Creek watersheds contribution of pollutants affecting dissolved oxygen in the Spokane River.
- To determine the nutrient and CBOD loads from the Tekoa Wastewater Treatment Plant (WWTP) that will protect dissolved oxygen and pH in Hangman Creek.
- Assess nutrient loads from Latah Wastewater Treatment Plant
- Assess Groundwater Quality Contribution to Lower Hangman

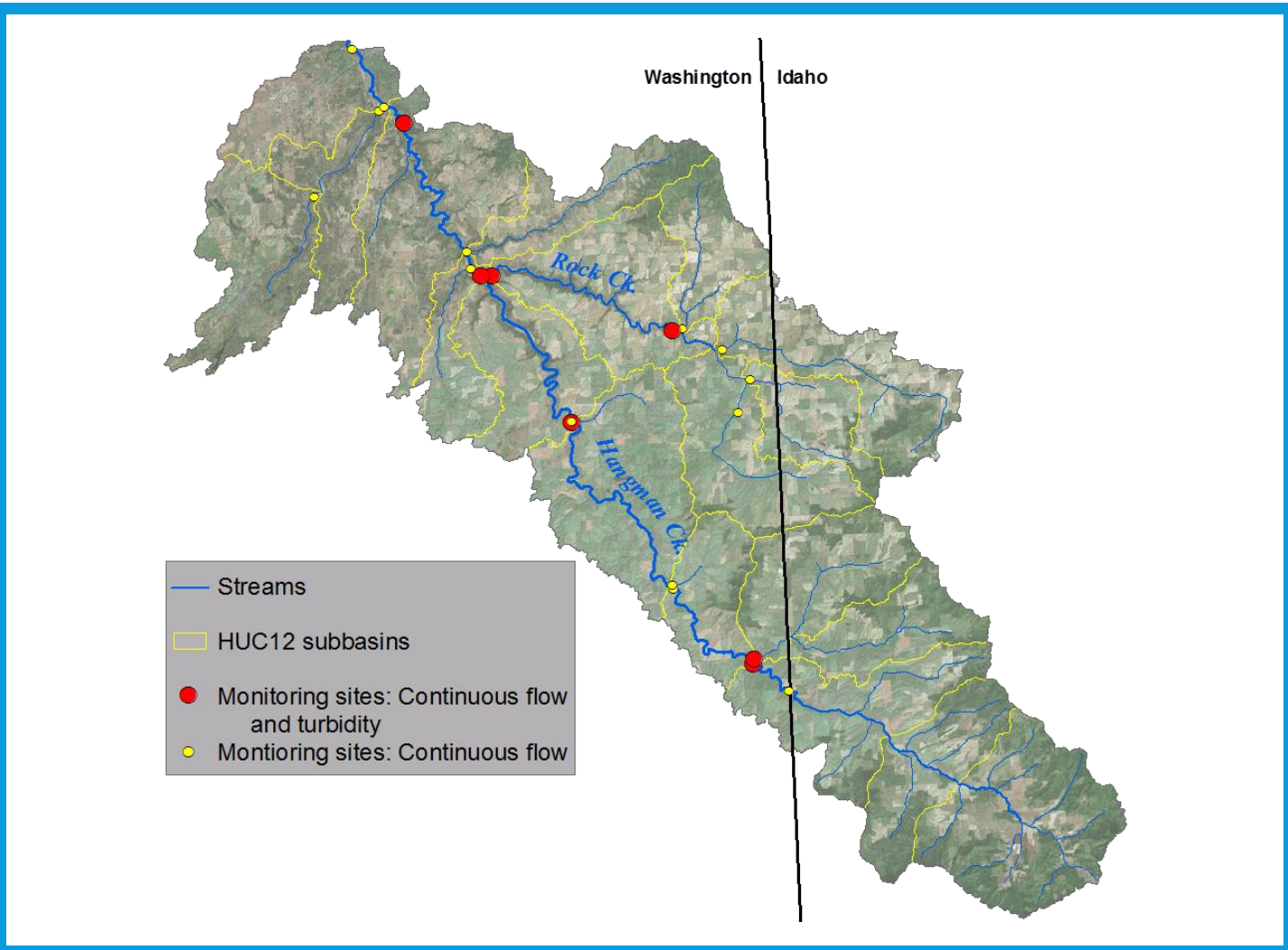
Tekoa receiving water study

- Assess impact of Tekoa WWTP effluent on DO and pH in Hangman Creek. Provide information that can be used to set permit limits for nutrients.
- Define seasonal window when Tekoa WWTP effluent has the potential so cause a significant impact to DO and pH in Hangman Creek.
- Provide assessment of 303(d) listed areas of Hangman Creek in/near Tekoa, upstream of WWTP.

Watershed springtime runoff study

- Determine relative contributions of various parts of the watershed to sediment and phosphorus load.
- Use to set load reductions necessary to meet LA at Hangman mouth for Spokane TMDL, for March-May season.
- Provide up-to-date total suspended solids (TSS)/suspended sediment concentration (SSC) dataset for comparison to older datasets collected by the Spokane Conservation District and USGS during the late 1990s and 2000s.

WATERSHED SPRINGTIME RUNOFF
A LITTLE MORE DETAIL…



Lower watershed groundwater study

- Define the gaining reaches in the area of interest to determine where groundwater is flowing into Hangman Creek.
- In these gaining reaches, characterize nutrient concentrations of groundwater inputs to the last 9 miles of Hangman Creek.
- Locate and quantify nutrient loads from groundwater in this reach.
- Quantify what portion of low-flow TP load to Spokane River comes from lower watershed groundwater.

Lower watershed low-flow study

- Provide accounting of sources of nutrients reaching the Spokane River at low flow in order to set load reductions needed to meet the load allocation at Hangman mouth for the Spokane TMDL, for the June and July-October seasons.
- Provide more instream confirmation as to whether impacts from the Latah (Hangman Hills) WWTP have been eliminated as a result of facility upgrades in 2011.

WHAT IS PROJECT TIMELINE?

Timeframe	Study Aspect
May – October 2017	Tekoa receiving water study (*Complete*)
January – May 2018	Watershed spring "high flow" runoff study (*Complete*)
May – October 2018	Lower watershed "low flow" study (*In Progress*)
May – October 2018	Hangman Hills groundwater study (*In Progress*)
May 2020	Final Report

Thank You

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