DEPARTMENT OF ECOLOGY
ENVIRONMENTAL ASSESSMENT PROGRAM
Quarterly Report

December 31st, 2012

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FROM:	Greg Pelletier, Project Manager, Environmental Assessment Program Nuri Mathieu, Principal Investigator, Environmental Assessment Program
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SUBJECT:	White River pH TMDL, Quarterly Report #1: August - November 2012 Project Code: 12-015

Introduction

Several areas of the White River are on Washington State′s list of polluted waters (303(d) list) for pH and require a cleanup plan, or total maximum daily load (TMDL). Past studies have documented excursions of the upper pH criteria (8.5) and suggest these conditions are the result of nutrient inputs to the river.

To develop a TMDL for the river, the Washington State Department of Ecology (Ecology) conducted a series of water quality surveys between August and October of 2012. Ecology will use this data to develop and calibrate a numerical water quality model of the river to simulate continuous pH and other water quality parameters.

This quarterly report summarizes the field work completed in the summer and fall of 2012, as well as progress with data quality review and analysis to date. The report also provides some preliminary results. All results presented are provisional and have not yet been fully reviewed for data quality.

Progress to Date

Communications

During this quarter the project team:

- Obtained permission from USGS Tacoma Office and the City of Sumner to install two continuous water quality (Hydrolab) stations in the watershed. Ecology installed:
    - An upstream, boundary-conditions station at ~River Mile (RM) 28 at the USGS gage house below Mud Mountain Dam.
    - A downstream station at ~RM3.7 just upstream of the Lake Tapps tailrace on the City of Sumner golf course.
- Requested, and received, raw continuous data files from USGS for their water quality stations in the watershed.
- Discussed and coordinated the use of Rhodamine WT dye for time of travel studies with the Muckleshoot Indian Tribe.
- Requested, and received, files associated with previously developed models in the watershed from Muckleshoot Indian Tribe, including a calibrated HEC-RAS model containing detailed cross sections of the river.
- Received laboratory results and case narratives for all samples collected for the study from Manchester Environmental Laboratory (MEL). MEL delivered results within 2-4 weeks of each sample collection event, with data arriving intermittently between the third week of August and last week of November.

Data Collection

During this quarter the project team:

- Conducted two full synoptic surveys on the weeks of August 20th and September 24th. Synoptic survey data collection included nutrient sampling and water quality measurements at mainstem, point source, and tributary sites in the watershed (Table 1; Figure 1). In addition, periphyton samples were collected at a subset of mainstem sites.
- Conducted two scaled-back synoptic surveys on October 11th and 25th. Two full surveys were scheduled for the weeks of October 15th and 30th; however, due to a large storm event on October 14th, and frequent precipitation in the following weeks, these full surveys were canceled. The high flows resulted in less than ideal conditions for a synoptic survey (increased water depth and turbidity; and decreased pH and solar radiation).
- Responded to the forecasted rain on October 14th, by collecting as much data as possible on October 11th. Unfortunately, due to another project's synoptic survey that week, the equipment and staff were not available for a full synoptic. An additional scaled-back survey was conducted on October 25th, during a brief period of dry weather and lower flows. The surveys on October 11th and 25th consisted of:
    - Water quality sampling on the mainstem at RMs 28, 25.2, 20.4, 8, 6.3, and 4.9.

- Periphyton sampling on the mainstem at RMs 25.2, 20.4, 8, and 6.3.
- Water quality sampling at one upper watershed tributary (Boise Creek) and one lower watershed tributary (Bowman Creek).

- Retrieved additional composite water quality samples in October from the two major point sources, the Buckley and Enumclaw WWTPs. The samples were collected to supplement the scaled-back synoptic surveys. Ecology retrieved the composite samples from the treatment plants and delivered them to the laboratory.
  - For Buckley:
    - On October 11th, Ecology collected a subsample from the routine 24hr composite collected by the plant on the 10th (from midnight to midnight).
    - The plant collected additional composites on the 28th and 29th.
  - For Enumclaw:
    - On October 11th, Ecology retrieved a 24hr composite sample collected by the plant from 8am on the 10th to 8am on the 11th. The composite was collected at Ecology's request.
    - The plant collected additional composites on the 29th, 30th, and 31st.
- Conducted two groundwater surveys, August 21st to 22nd and October 23rd to 24th. Groundwater surveys consisted of nutrient sampling and water quality measurements at:
  - All piezometers classified as "gaining" at the time of the site visit.
  - Sumner and Coal Creek Springs at the municipal water supply source locations.
  - One shallow, off-stream, private well during the October survey.
- Installed, maintained, and removed a network of in-stream piezometers and continuous temperature monitoring equipment throughout the watershed.
- Conducted one time of travel study on August 8th. An additional time of travel study was scheduled for the first week of October, but was postponed to the week of October 15th due to concerns about the potential impact to tribal fisheries. Unfortunately, steady-state, low-flow conditions did not return during this period for long enough to conduct a second study.
- Conducted eight light extinction surveys over the course of the project.
- Collected additional nutrient samples from RM28 during non-synoptic weeks to provide more data points for estimating a continuous nutrient input at the boundary condition.

Provisional Results

The following provides a summary of some provisional results of interest:

- pH results:
  - RM 28 boundary station:

        - Data from this station has undergone a preliminary data quality review, but results are still provisional. Multiple sediment fouling events, caused by fluctuating water levels and glacial sediment loads, created some data gaps.
        - Observed pH fell between 7.4 and 7.6 for most of the data collection period.
        - Maximum daily pH values between 7.6 and 7.7 occurred frequently from late August to mid-October. The maximum pH value observed was 7.71.
        - Diel pH swings fell between 0.1 and 0.2 for most of the data collection period.
        - Observed pH values decreased in the second half of October, ranging from 6.99 to 7.54.
    - RM 3.7 downstream station:
        - Data from this station has not yet undergone data quality review. Multiple sediment fouling events, caused by fluctuating water levels and glacial sediment loads, created some data gaps.
        - A maximum pH of 8.72 was observed on 10/11/12. No other days during the study period had pH values greater than 8.5. The diel pH swing on October 11th was 1.0.
        - At the USGS station at RM 7.6, the maximum pH was 8.61 on 10/11/12 with a diel swing of 1.07 (raw provisional data).
- Nutrient samples:
    - Nitrite-Nitrate Results (NO_2-NO_3):
        - Mainstem:
            - Groundwater from piezometers, range= 10 to 105 µg/L
            - Surface water at RM 28 boundary, range= 13 to 60 µg/L
            - Surface water, downstream of boundary, range= 15 to 92 µg/L
        - Tribs/springs:
            - Groundwater springs, range= 1,050 to 2,220 µg/L
            - Surface water tribs, range= 10 to 6,120 (TR15.6) µg/L
        - Point source composites:
            - Buckley WWTP range= 3,250 to 6,320 µg/L, median= 4,800 µg/L
            - Enumclaw WWTP range= 1,250 to 4,660 µg/L, median= 3,755 µg/L
            - Muckleshoot Hatchery = 53 and 75 µg/L
            - Sonoco = 14,800 and 1,610 µg/L
    - Orthophosphate (SRP):
        - Mainstem:

        - Groundwater from piezometers range= 3 to 17.3 µg/L, with the exception of the piezometer at RM 3.7 on 10/24/12, which equaled 427 µg/L.
        - Surface water at RM 28 boundary range= 7.9 to 14.8 µg/L
        - Surface water downstream range= 8.7 to 17.1 µg /L
    - Tribs/springs:
        - Groundwater springs range= 15.6 to 21.2 µg /L
        - Surface water tribs range= 3 to 436 (SW0.9) µg/L
    - Point source composites:
        - Buckley WWTP range= 143 to 3,340 µg/L, median= 1,740 µg/L
        - Enumclaw WWTP range= 50 to 2,670 µg/L, median= 177 µg/L
        - Muckleshoot Hatchery = 12.6 and 19.2 µg/L
        - Sonoco = 122 and 21.5 µg/L
- Table 2 provides more detailed groundwater results.

Data Quality Review and Modeling Progress

During this quarter the project team:

- Initiated data quality review of continuous water quality and temperature data. All data has been downloaded and entered into project databases. Preliminary cleanup, quality rating, and adjustment of data have begun.
- Initiated setup of the QUAL2Kw model:
    - Used segments from HEC-RAS model for preliminary segmentation. May combine segments to optimize model run time.
    - Used HEC-RAS model to generate a range of flow scenarios. Used results to develop initial rating curves for flow coefficients, providing channel geometry for the model.
    - QUAL2Kw model updated to include effects of longwave radiation from cloud cover. This update was necessary to accurately model temperature during cloudy periods of the study.

Project Schedule and Upcoming Tasks

Based on the project timeline, the project is currently ahead of schedule with QA/QC analysis and model setup started well ahead of schedule (Table 4); these will be the primary tasks in the upcoming quarter. All lab data has been received and field data processing and external data retrieval should be completed by the end of January 2013. The next quarterly report will be available by 4/30/2013 and will cover progress during the period of 1/1/2013 to 3/31/2013.

Tables

Table 1. Lower White River pH TMDL sampling location information for the 2012 study.

Station ID	Map #	Synoptic water quality sampling	Synoptic Hydrolab Deployment	Periphyton surveys	Riparian Vegetation Surveys	Water & Air Temp	rH probe*	Piezometer/ GW sampling*	Light Extinction Surveys	Ecology Continuous Water Quality*	USGS Continuous Water Quality	USGS Continuous Flow	Description	NAD83 Latitude	NAD83 Longitude
Mainstem Stations															
10-WHT-28.0	1	x	x		x	x	x			x			White River below Mud Mtn Dam	47.154781	-121.952230
10-WHT-25.2	2	x	x	x	x	x		x					White River at Rainier School	47.166145	-121.993169
10-WHT-24.5	3										x	x	White River above diversion	47.169870	-122.003115
10-WHT-20.4	4	x	x	x	x	x	x	x					White River below Buckley	47.186953	-122.065263
10-WHT-16.2	5	x	x	x	x	x	x	x					White River above Muckleshoot	47.225095	-122.112797
10-WHT-10.3	6	x	x			x							White River above Auburn	47.279533	-122.172101
10-WHT-9.0	7	x	x			x	x	x					Whit River at Game Farm Park	47.283576	-122.192863
10-WHT-8.0	8	x	x	x	x						x	x	White River at R Street	47.274822	-122.208588
10-WHT-6.2	9	x	x	x	x	x	x	x					White River at A Street	47.266400	-122.228836
10-WHT-4.9	10	x	x		x	x							Whtie River at 8th St	47.249867	-122.243828
10-WHT-4.0	11							x					White River at Sumner warehouses	47.241343	-122.234391
10-WHT-3.7	12							x		x			White River at Sumner goflcourse	47.239318	-122.233689
10-WHT-1.4	13	x	x	x	x	x		x					White River above Fryar Ave	47.213016	-122.241886
10-WHT-0.5	14								x				White River at Valley Ave	47.203935	-122.245508
10-WHT-0.1	15	x	x		x	x	x	x					White River at mouth	47.200209	-122.255270
Lake Tapps Diversion Stations (Trib/Spring Network)															
10-LTD-Diversion	16	x											Lake Tapps Diversion Canal at diversion	47.169745	-122.006965
10-LTD-Tailrace	17	x											Lake Tapps Tailrace at 148th Ave E	47.238115	-122.231473
10-LTD-FishRtrn	18	x											Fish Return at Diversion Canal Rd	47.169874	-122.032950
Point Source Stations															
10-EC-WWTP-Eff	19	x											Enumclaw WWTP effluent at plant	47.188147	-122.004970
10-BK-WWTP-Eff	20	x											Buckley WWTP effluent at plant	47.168470	-122.034588
10-MuckFishHatch	21	x											Muckleshoot Fish Hatchery effluent	47.170934	-122.003817
10-Sonoco-Eff	22	x											Sonoco effluent at facility	47.212403	-122.242440
Significant Tributaries (Trib/Spring Network)															
10-WHT-Trib27.6	23	x				x							Red Creek at Mud Mtn Rd	47.156853	-121.954614
10-BOI-0.1	24	x				x							Boise Creek at Mud Mtn Rd	47.176027	-122.018478
10-WHT-Trib15.6	25	x				x							Unnamed trib to LWR at RM Hwy 164	47.233464	-122.105504
10-WHT-Trib8.0	26	x				x							Bowman Creek at Kersey Wy	47.273133	-122.207703
10-WHT-Trib5.3	27	x				x							Government Canal at Butte Ave	47.258496	-122.245056
10-WHT-Trib2.1	28	x				x							Salmon Creek at E. Valley Hwy	47.217585	-122.226496
10-WHT-Trib1.3	29	x				x							Milwaukee Ditch near mouth	47.211879	-122.244981
Minor Tributaries/Springs(Trib/Spring Network)															
10-WHT-SW25.1	30	x											Unnamed trib/spring to LWR at RM 25.1	47.166400	-121.993826
10-WHT-Trib20.6	31	x											Unnamed trib/spring to LWR at RM 20.6	47.185099	-122.062634
10-WHT-Trib15.7	32	x											Second Creek; trib to LWR at RM 15.7	47.223745	-122.104929
10-WHT-Trib8.5	33	x											Coal Creek; trib to LWR at RM 8.5	47.277524	-122.199424
10-WHT-SW6.2	34	x											Auburn stormwater pump outfall at RM 6.2	47.266874	-122.228841
10-WHT-Trib5.1	35	x											Outlet of wetlands complex to LWR at RM 5	47.253182	-122.242705
10-WHT-Trib4.3	36	x											Unnamed trib/spring to LWR at RM 4.3	47.249916	-122.237218
10-WHT-SW3.3	37	x											Stormwater outfall to LWR at RM 3.3	47.235578	-122.236303
10-WHT-Trib2.9	38	x											Unnamed trib/spring to LWR at RM 2.9	47.231183	-122.225322
10-WHT-SW0.9	39	x											Stormwater outfall to LWR at RM 0.9	47.207456	-122.243357

Table 2. Groundwater measurement and sample results (abbreviations and units of measurement described in Table 3).

Location ID	River Mile	Well Tag ID Number	Sample Date	Groundwater Field Parameters [2]					Groundwater Laboratory Analyses [3]								
				VHG	WT	pH	Cond	DO	ALK	CL	OP	TP	NO2-NO3	NH3	TPN	DOC	Iron
10-WHT-0.2	0.2	AHT056	07/17/2012	0.062	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/22/2012	0.050	12.83	6.06	-	0.37	133	16.4	0.0146	0.0391	0.01 U	0.315	0.327	2.6	5.71
			09/17/2012	0.047	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/24/2012	0.049	12.51	6.35	301.6	0.42	123	13.4	0.0118	0.0387	0.01 U	0.274	0.289	2.2	5.02
			11/16/2012	0.055	-	-	-	-	-	-	-	-	-	-	-	-	-
10-WHT-1.4	1.4	AHT057	07/17/2012	-0.016	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/22/2012	-0.111	-	-	-	-	-	-	-	-	-	-	-	-	-
			09/17/2012	0.054	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/24/2012	-0.092	-	-	-	-	-	-	-	-	-	-	-	-	-
10-WHT-3.7	3.7	AKY467	07/19/2012	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/22/2012	0.003	14.08	6.82	-	8.42	117	1.81	0.0308	0.247	0.04	0.416	0.356	2.9	6.04
			09/17/2012	-0.002	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/24/2012	0.002	10.26	6.99	239.3	1.76	285	2.39	0.427	1.28	0.018	3.85	3.84	11.8	21.9
			11/16/2012	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-
10-WHT-4.0	4	AHT062	07/18/2012	-0.030	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/22/2012	-0.010	-	-	-	-	-	-	-	-	-	-	-	-	-
			09/17/2012	-0.012	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/23/2012	-0.010	-	-	-	-	-	-	-	-	-	-	-	-	-
10-WHT-6.3	6.3	AHT058	07/17/2012	0.018	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/21/2012	-0.012	-	-	-	-	-	-	-	-	-	-	-	-	-
			09/17/2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/24/2012	-0.013	-	-	-	-	-	-	-	-	-	-	-	-	-
10-WHT-9.0	9	AHT059	07/17/2012	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/21/2012	-0.011	-	-	-	-	-	-	-	-	-	-	-	-	-
			09/17/2012	-0.336	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/23/2012	-0.032	-	-	-	-	-	-	-	-	-	-	-	-	-

Location ID	River Mile	Well Tag ID Number	Sample Date	Groundwater Field Parameters [2]					Groundwater Laboratory Analyses [3]								
				VHG	WT	pH	Cond	DO	ALK	CL	OP	TP	NO2-NO3	NH3	TPN	DOC	Iron
10-WHT-16.0	16	AHT061	07/18/2012	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/21/2012	0.016	13.29	6.17	-	2.53	25.6	1.58	0.0099	0.011	0.082	0.01 U	0.078	1	0.05 U
			09/18/2012	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/24/2012	0.016	11.54	6.68	100.2	3.21	33.3	2.41	0.0101	0.008	0.105	0.01 U	0.119	1.0 U	0.05 U
10-WHT-20.4	20.4	AHT060	07/18/2012	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/21/2012	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/22/2012	0.013	11.25	7.03	-	0.77	104	6.55	0.0191	0.0198	0.024	0.01 U	0.048	1.0 U	0.05 U
			09/18/2012	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/23/2012	0.013	9.94	7.34	266.5	0.75	95.9	6.2	0.0173	0.0197	0.032	0.01 U	0.047	1.0 U	0.05 U
10-WHT-25.5	25.5	AHT063	07/19/2012	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-
			08/21/2012	0.008	13.57	6.12	-	0.28	13.6	1.35	0.0036	0.005 U	0.067	0.01 U	0.073 J	1.0 U	0.445
			09/18/2012	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-
			10/23/2012	0.008	10.11	6.28	105	0.45	13.6	1.79	0.003 U	0.005 U	0.063	0.01 U	0.061	1.0 U	0.583
Well at Coal Ck spring		ACQ739	08/22/2012	-	11.76	6.28	-	5.79	52.9	3.7	0.0109	0.0192 J	0.947	0.01 U	1	1.0 U	0.441
			10/23/2012	-	10.99	6.32	127.5	5.78	49.9	3.69	0.0117	0.0108	1.05 J	0.01 U	1.07	1.0 U	0.124
Coal creek springs			08/22/2012	-	10.76	6.43	-	7.77	56.4	3.71	0.0178	0.0188 J	1.05	0.01 U	1.12	1.0 U	0.05 U
			10/23/2012	-	10.01	6.56	135.3	7.44	54.6	3.59	0.0156	0.0153	1.14	0.01 U	1.15	1.0 U	0.05 U
Sumner springs			08/22/2012	-	10.34	6.79	-	9.34	113	5.44	0.0187	0.0231 J	2.21	0.01 U	2.29	1.0 U	0.05 U
			10/24/2012	-	9.99	7.08	249.8	9.11	108	5.4	0.0212	0.0181	2.22	0.01 U	2.2	1.0 U	0.05 U
Johnsons well			10/24/2012	-	11.22	6.52	81.9	1.85	24.8	1.79	0.0122	0.011	0.11	0.01 U	0.108	1.0 U	0.05 U

1 - Negative vertical hydraulic gradient values indicate the potential for loss of stream water to groundwater storage. Positive values indicate the potential for groundwater discharge to the stream.
2 - Low producing wells were pre-purged dry the day before sampling. Field parameters for these wells are reported as estimates (J-coded) since they may not represent true in situ GW conditions.
3 - Data qualifier codes:
J - the analyte was positively identified, the reported numeric result is an estimate
U - analyte was not detected at or above the reported value

Table 3. Parameter abbreviations.

Abbreviation	Parameter	Unit of Measurement
VHG	Vertical hydraulic gradient	dimensionless
WT	Water temperature	Degrees Celsius
pH	pH	Standard units
Cond	Specific Conductance	microSiemens/centimeter
DO	Dissolved Oxygen	Milligrams/liter
ALK	Alkalinity	Milligrams/liter
CL	Chloride	Milligrams/liter
OP	Orthophosphate	Milligrams/liter
TP	Dissolved Total Phosphorus	Milligrams/liter
NO2-NO3	Dissolved Nitrite + Nitrate	Milligrams/liter
NH3	Dissolved Ammonia	Milligrams/liter
TPN	Dissolved Total Persulfate Nitrogen	Milligrams/liter
DOC	Dissolved Organic Carbon	Milligrams/liter
Iron	Dissolved Iron	Milligrams/liter

Table 4. Project tasks within the upcoming quarter (January to March 2013).

Task	Start Date	End Date
Process field data and receive all lab and external data	10/31/2012	1/31/2013
QA/QC of analysis of data	1/31/2013	3/15/2013
Setup and Calibration of QUAL2K w/WASP	3/15/2013	12/15/2013

Figures

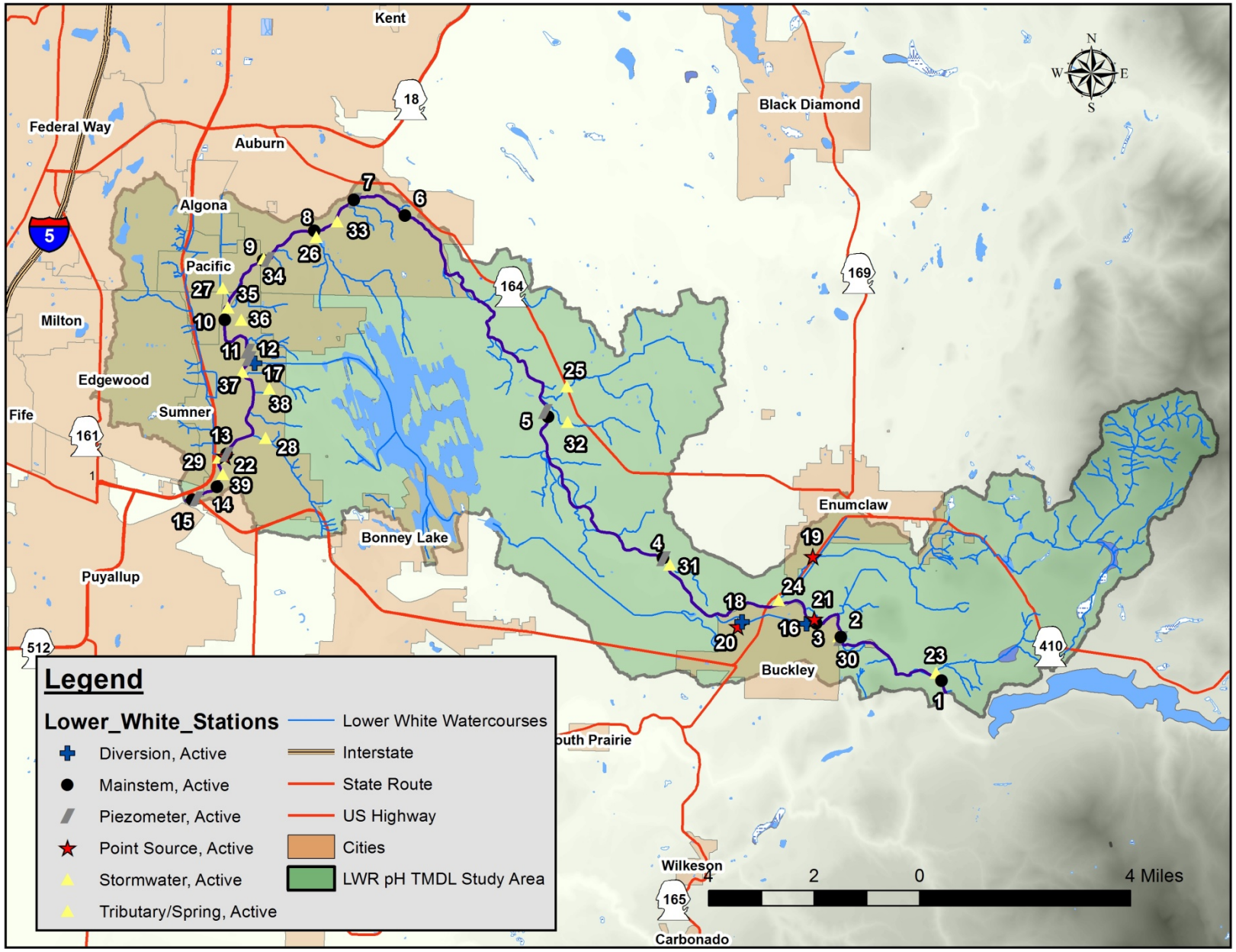

Figure 1. Lower White River pH TMDL sampling locations for the 2012 study.