



Sampling and Analysis Plan

Volunteer Water Quality Monitoring

Hydrological Trend Monitoring in the Walla Walla Basin

May 2024



This document was prepared with
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Date: _____

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1. Project Management

1.1. Distribution List

The following personnel will be emailed regarding all aspects of this sampling and analysis plan (SAP). Deviations from this SAP must be communicated in writing (email is acceptable) to all individuals identified in Table 1. Final reports from the DEQ Laboratory will be emailed and/or mailed to the project manager, regional monitoring coordinator and laboratory monitoring coordinator/data manager.

Table 1 Distribution List

Name	Phone	Email
Luke Adams, WWBWC Monitoring Program Manager	541-938-2170	luke.adams@wwbwc.org
Nick Haxton-Evans, DEQ Volunteer Monitoring Program Coordinator	971-806-2462	nick.haxton-evans@deq.oregon.gov
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Troy Baker, WWBWC Executive Director	541-938-2170	troy.baker@wwbwc.org

1.2. Project/task organization

Sampling Organization(s): Walla Walla Basin Watershed Council

Analytical Organization: Walla Walla Basin Watershed Council
810 South Main Street
Milton-Freewater, OR 97862
Ph: 541-938-2170
Contact: Luke Adams, Monitoring Program Manager

1.3. Problem definition/background

This project is located in the Oregon portion of the Walla Walla Basin in Umatilla County near the town of Milton-Freewater. The project will measure water temperature and stream flow in the Walla Walla River, its tributaries and distributaries, and also measure water levels in the underlying shallow alluvial aquifer during a 2 year period. Data are needed to guide current planning efforts to address the Basin's inadequate water supply to meet the needs of aquatic life and agricultural and municipal uses. The Walla Walla Watershed is utilized by ESA-listed bull trout, summer steelhead, and reintroduced spring Chinook salmon, which are limited by lack of summertime flow and high water temperatures. Monitoring will document current conditions and describe trends to inform development of projects to restore watershed function and increase in-stream flows. OWEB and BPA are the primary funding partners. Additional partners include private landowners, Confederated Tribes of the Umatilla Indian Reservation, Oregon Water Resources Department, City of Milton-Freewater,

Hudson Bay District Improvement Company, Walla Walla River Irrigation District, Fruitvale Water Users Association, and members of the Walla Walla Water 2050 project and Bi-State Flow Enhancement Study.

1.4. Project/task description

At 25 existing WWBWC surface water monitoring locations, measure streamflow continuously at 15-minute intervals for two years. At 10 sites, telemetry equipment will send hourly data through WWBWC’s radio network to be uploaded to our AQUARIUS Time-Series database, processed, and reported online. The data will be visually checked daily for verification of logging results, and field visits will occur every 2 weeks for manual stage measurements as an accuracy check and to conduct any necessary site maintenance. Manual discharge measurements will be taken every 6 weeks. At 15 stand-alone sites, data will be updated online quarterly, following a routine site visit to collect manual stage and discharge measurements, and to download and process data. Compare results to data from previous years to determine if flow has increased or decreased.

At 30 existing monitoring locations, collect seasonal water temperature data continuously at 15-minute intervals. The sampling locations include the TMDL sampling locations from 2002. Compare results to data from previous years to determine if temperatures have increased or decreased in the Walla Walla River and its tributary streams.

At 63 existing WWBWC groundwater monitoring wells, measure water elevation continuously (15-minute intervals) quarterly at 44 wells. Collect quarterly static water level measurements at 19 wells.

See Table 2 for the project timeline.

Table 2 Project Timeline

Tasks to be completed	Months for year 2024-2025											
	1	2	3	4	5	6	7	8	9	10	11	12
Stage Measurements and Site Maintenance at Telemetry Sites	X	X	X	X	X	X	X	X	X	X	X	X
Discharge Measurements at Telemetry Sites		X	X		X	X		X	X		X	X
Stage Measurements and Site Maintenance at Stand-Alone Sites		X			X			X			X	
Discharge Measurements at Stand-Alone Sites		X			X			X			X	
Stream Flow Data Entry	X	X	X	X	X	X	X	X	X	X	X	X
Stream Flow Data Analysis and Reporting	X											X
QAQC Temperature Loggers				X							X	
Temperature Logger Deployment and Retrieval					X					X		
Temperature and Logger Check						X	X	X	X			
Temperature Data Entry						X	X	X	X	X		
Temperature Analysis and Reporting	X											X
Groundwater Measurements	X			X			X			X		
Groundwater Data Entry	X			X			X			X		
Groundwater Analysis and Reporting	X											X

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1.5. Quality objectives and criteria

WWBWC will aim to produce “A” level water quality data according to the quality assurance targets described in the 2021 ODEQ VOLUNTEER MONITORING PROGRAM QAPP Version 3.0 (Table 3 below).

Table 3. Quality Assurance Targets

Matrix	Parameter	Precision	Accuracy	Measurement Range
Water	Temperature	± 0.5 °C	± 0.5 °C	-5 to 35 °C
Water	Stream Discharge	± 10% RPD	± 10% of known	NA
Water	Water Level (Stage, Streamflow)	± 0.01 feet	± 0.01 feet	0.01 to 10 feet
Water	Water Level (Static, Groundwater)	± 0.01 feet	± 0.01 feet	0.01 to 120 feet

Manual flow measurements and continuous flow monitoring at gauge sites will be conducted according to WWBWC's 2018 SOP V1.3, which is based on the USGS and WDOE methods cited below. Continuous stage will be measured using Campbell Scientific submersible pressure transducers wired to a Campbell Scientific data logger. Data will be transmitted through WWBWC's radio network using a Campbell Scientific radio and managed using LoggerNet software. We have established a local datum and multiple reference points, have conducted level surveys to establish elevations, and will measure the stage using a laser level and stadia rod. Stage and discharge measurements will be conducted to capture the widest possible range of flows. To calculate discharge, depth and velocity will be collected with a FlowTracker and calculated using the mid-section method. High flow measurements will be taken using a bridge board, sounding reel and weight, Price AA current meter, and Aquacalc Pro+. Campbell Scientific CS 451 and Solinst Levelogger 5 sensors will be used to collect the water level data with an accuracy of 0.01 feet. Manual water level measurements (stage) will be compared to the raw water level data and will be corrected (drifted) to the nearest 0.01 foot. Any manual stage measurements that are ≥ 0.1 feet off from the raw data will be further analyzed to determine what may have caused the data to drift like possible sensor failure, inaccurate manual stage measurement, sensor moved, etc. Water level data will be downgraded if the correction is more than 0.1 feet. Rating equations have been produced using the AQUARIUS Rating Development Tool and will be shifted as needed to reflect channel changes due to scour or deposition. AQUARIUS Time-Series software will process stage data through the rating equation to produce a continuous 15-minute discharge dataset. Hydrographs and tabular reports of the provisional data will be updated online hourly at <https://wwbwc.org/index.php/streamflow>.

Kenney, T.A., 2010. Levels at gaging stations: U.S. Geological Survey Techniques and Methods 3-A19, 60 p.

Rantz, S. E., and others., 1982. Measurement and Computation of Streamflow: Volume I. Measurement of Stage and Discharge. U.S. Geological Survey Water-Supply Paper 2175.

Rantz, S. E., and others., 1982. Measurement and Computation of Streamflow: Volume II. Computation of Discharge. U.S. Geological Survey Water-Supply Paper 2175.

Sauer, V.B., and Turnipseed, D.P., 2010. Stage measurement at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A7, 45 p. (Also available at <http://pubs.usgs.gov/tm/tm3-a7/>)

Shedd, J.R., 2018. Standard Operating Procedure for Measuring Gage Height of Streams. Version 1.1. Washington Department of Ecology – Environmental Assessment Program. EAP042.

Shedd, J. R., 2018. Standard Operating Procedure for Measuring and Calculating Stream Discharge. Version 1.3. Washington Department of Ecology – Environmental Assessment Program. EAP056.

Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (Also available at <http://pubs.usgs.gov/tm/tm3-a8/>)

Water temperature monitoring will be conducted according to WWBWC's 2018 SOP V1.3, which was developed based on the methodologies referenced below. Onset Hobo U22 and In-Situ Level TROLL 300 sensors will be used for continuous data logging. All thermistors will be checked for accuracy with a NIST-traceable thermometer in an ice water bath and at room temperature before deployment and after retrieval. Sensors will be deployed within PVC shields and secured to roots, branches, or other stable structures within a well-mixed portion of the stream channel. Staff will conduct monthly field checks with a NIST-traceable thermometer and will download data with a shuttle and field laptop. After a monthly field check, water temperature measurements and logger data will be uploaded to the AQUARIUS Time-Series database and processed before being published. At the end of the water year, hydrographs and logger data will be published online at <https://wwbwc.org/index.php/water-temp>.

Water Quality Monitoring – Technical Guide Book, 2001. Oregon Watershed Enhancement Board. ODEQ, May 2020. Standard Operating Procedure. Continuous Water Monitoring Procedure – Laboratory and Environmental Assessment Division. Version 1.0.

U.S. Geological Survey, 2006. National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chapter 6, available online at https://water.usgs.gov/owq/FieldManual/Chapter6/6.1_ver2.pdf.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; available online at <http://pubs.water.usgs.gov/tm1d3>.

Ward, W., 2018. Standard Operating Procedures for Continuous Temperature Monitoring of Freshwater Rivers and Streams, Version 2.1. WA Dept of Ecology. SOP Number EAP080. <https://fortress.wa.gov/ecy/publications/documents/1803205.pdf>

Groundwater level monitoring will be conducted according to the Groundwater Monitoring portion of WWBWC's 2018 SOP V1.3, which is modified from the 2005 USGS groundwater activities paper by Drost (citation below). To summarize, field staff will visit each site every three months to measure static water level and to download logged data. Measuring points at the top of each well casing have been documented and clearly marked. The vertical distance from measuring point to the land surface is recorded, and the elevation of the land surface has been documented using survey-grade GPS equipment. Manual water level measurements will be taken

with a Solinst water level meter. Pressure transducers deployed in the wells at a fixed elevation with aviation or communication cable will be used for continuous (15-minute) logging of water level data. Solinst Levellogger EDGE sensors will be used to collect the water level data with an accuracy of 0.03 feet. Manual water level measurements (static) will be compared to the raw water level data and will be corrected (drifted) to the nearest 0.01 foot. Any manual stage measurements that are ≥ 0.3 feet off from the raw data will be further analyzed to determine what may have caused the data to drift like possible sensor failure, inaccurate manual static measurement, sensor moved, etc. Water level data will be downgraded if the correction is more than 0.3 feet. After a quarterly field visit, static measurements and logger data will be uploaded to the AQUARIUS Time-Series database and processed before being published online at <https://wwbwc.org/index.php/groundwater>.

Drost, B.W., 2005, Quality-assurance plan for ground-water activities, U.S. Geological Survey, Washington Water Science Center: U.S. Geological Survey Open-File Report 2005-1126, 27 p.

At the end of each water year, the monitoring program manager will review, grade, and approve the water temperature, stream flow, and groundwater data. Finalized datasets will be published online at <https://wwbwc.org>.

1.6. Training Requirements and Certification

The WWBWC has over 20 years of experience measuring stream flow, measuring stage using the laser level, creating reliable rating curves, measuring water levels for monitoring wells, and using water quality meters.

1.7. Documentation and Records

The DEQ QA officer will distribute finalized versions of this SAP and any revisions to the individuals listed in Table 1.

Table 4 Controlled Documents

Document or Record Name and Description	Storage Location	Storage Time
DEQ Quality Assurance Project Plan (QAPP V.3.0) - DEQ04-LAB-0047-QAPP project description and assurance procedures.	DEQ Internet Page	10 years
SAP: Basin Wide Trend Monitoring - specific sampling information for each groups activities.	DEQ Laboratory & WWBWC Office	10 years
DEQ Laboratory Mode of Operations Manual - Methods manual	WWBWC Office	10 years
Equipment Notebooks - records of quality control checks, calibrations and maintenance.	DEQ equipment case, WWBWC Office	10 years
Field Data or Chain of Custody Sheets/Electronic Files – Field forms containing sampling meta data and raw field data.	WWBWC Office	10 years
WWBWC's 2018 SOP V1.3 – Standard Operating Procedures	WWBWC Internet Page	10 years

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2. Data Generation and Acquisition

2.1. Sampling Process Design

Sampling design, collection, methods and handling will be managed by the sampling organization identified in section 1.2. The sampling organization will ensure that all samples will be collected in the appropriate sample containers, preserved as identified in the appropriate reference methods, and transported to the analytical organization within the appropriate sample holding times, with the appropriate documentation, and under the appropriate sample transport conditions. Analytical laboratories assume no responsibility for the quality of data resulting from samples that were collected, shipped, or stored under inappropriate conditions.

Flow monitoring sites were selected to document water production in the South Fork Walla Walla Watershed, tributary inputs to the Walla Walla River, groundwater contributions from springs, trends in the distributary system, and major irrigation diversions.

Water temperature monitoring locations were selected to describe trends throughout the Oregon side of the Walla Walla Basin and to account for tributary and groundwater inputs and diversion locations. Many of the proposed sites have been monitored since 1999, providing a long record of conditions. Several upper watershed sites were added based on preliminary data collected during the summer of 2020. More data are needed upriver to describe current conditions and guide restoration efforts following the 100-year flood event of 2020.

Groundwater monitoring locations are numerous and spread throughout the Oregon portion of the Walla Walla Basin because alluvial groundwater elevations vary widely, even in small geographic regions. In addition, data collection is limited to the availability of groundwater wells at which to monitor. Some purpose-built monitoring wells were drilled to track the impacts of groundwater management projects. Many sites were chosen to provide better coverage across the valley.

The locations to be sampled are summarized in Table 4.

Table 5 Summary of the sampling locations

DEQ Station ID *	Organizational Site ID	Latitude/Longitude	Station Description	Parameters
32807	S-101	45.8305/-118.17087	Water Temperature Monitoring Site	Water temperature
23809	S-103	45.89605/-118.30674	South Fork Walla Walla River at the confluence with the North Fork	Stream flow, water temperature
32808	S-104	45.9005/-118.297	North Fork Walla Walla River at the confluence with the South Fork	Stream flow, water temperature
32007	S-105	45.921431/-118.374101	Water Temperature Monitoring Site	Water temperature
32800	S-106	45.94719/-118.38552	Walla Walla River below Nursery Bridge critical management point	Stream flow, water temperature

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32805	S-107	45.97679/-118.37646	Walla Walla River at the Tum-A-Lum Bridge (lowest measurement point in the Milton-Freewater levee reach)	Stream flow, water temperature
32801	S-110	45.95629/-118.38506	Water Temperature Monitoring Site	Water temperature
32803	S-112	45.97177/-118.38025	Water Temperature Monitoring Site	Water temperature
23492	S-122	45.90086/-118.33454	Water Temperature Monitoring Site	Water temperature
32810	S-123	45.90121/-118.35189	Water Temperature Monitoring Site	Water temperature
40575	S-127	45.85814/-118.22273	Water Temperature Monitoring Site	Water temperature
23493	S-128	45.92753/-118.37888	Water Temperature Monitoring Site	Water temperature
32799	S-129	45.93713/-118.38267	Water Temperature Monitoring Site	Water temperature
40756	S-130	45.95652/-118.38547	Water Temperature Monitoring Site	Water temperature
40722	S-142	45.89538/-118.36957	Couse Creek is an important spawning area for steelhead, also needed for project effectiveness monitoring.	Stream flow, water temperature
23498	S-151	45.99536/-118.37983	Water Temperature Monitoring Site	Water temperature
32806	S-152	45.98605/-118.37651	Water Temperature Monitoring Site	Water temperature
32797	S-153	45.9241/-118.37614	Water Temperature Monitoring Site	Water temperature
32802	S-154	45.96447/-118.38297	Water Temperature Monitoring Site	Water temperature
32804	S-156	45.839617/-118.077709	Water Temperature Monitoring Site	Water temperature
41573	S-160	45.825299/-118.154185	Water Temperature Monitoring Site	Water temperature
41572	S-161	45.844286/-118.104744	Water Temperature Monitoring Site	Water temperature
41751	S-162	45.839582/-118.077691	Water Temperature Monitoring Site	Water temperature
41564	S-163	45.842288/-118.05845	Water Temperature Monitoring Site	Water temperature
41575	S-164	45.842468/-118.058333	Water Temperature Monitoring Site	Water temperature
41574	S-165	45.851780/-118.025112	Water Temperature Monitoring Site	Water temperature
41566	S-166	45.851823/-118.025149	Water Temperature Monitoring Site	Water temperature
41562	S-167	45.876329/-117.98538	Water Temperature Monitoring Site	Water temperature
41565	S-168	45.87579/-117.985281	Water Temperature Monitoring Site	Water temperature
41563	S-169	45.877147/-117.98618	Water Temperature Monitoring Site	Water temperature
41561	S-170	45.941362/-117.968006	Water Temperature Monitoring Site	Water temperature

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	S-202	45.94507/-118.39382	Main diversion location for the Crockett Ditch	Stream flow, water temperature
	S-203	45.94507/-118.39388	Main diversion location for the Ford Ditch	Stream flow, water temperature
	S-204	45.94506/-118.39394	Main Diversion location for the HBDIC Canal	Stream flow, water temperature
	S-211	45.97283/-118.39991	WWRID end of district helps understand ditch seepage	Stream flow, water temperature
33084	S-212	45.96992/-118.41067	WWRID end of district helps understand ditch seepage	Stream flow, water temperature
33083	S-214	45.97435/-118.41723	WWRID end of district helps understand ditch seepage	Stream flow, water temperature
	S-221B	46.00083/-118.42439	Spring-fed, helps track groundwater and surface water interaction	Stream flow, water temperature
32010	S-222	46.0007/-118.43591	Total amount of flow produced by the West Little Walla Walla River as it flows into Washington State	Stream flow, water temperature
	S-228	45.96922/-118.41345	WWRID end of district helps understand ditch seepage	Stream flow, water temperature
	S-233	45.99827/-118.40155	Highly connected spring to the amount of flow in the Walla Walla River.	Stream flow, water temperature
	S-303	46.00374/-118.46511	Spring-fed, helps track groundwater and surface water interaction	Stream flow, water temperature
	S-318	45.97113/-118.41591	Primary year-round diversion; documents water management within the Walla Walla Valley	Stream flow, water temperature
	S-402	45.95671/-118.43863	Johnson Recharge Diversion	Stream flow
	S-403	45.95807/-118.44192	Johnson Recharge Outflow	Stream flow
	S-405	45.97276/-118.45122	Spring-fed, helps track groundwater and surface water interaction	Stream flow, water temperature
	S-408	45.97292/-118.48014	Highly influenced by upgradient alluvial aquifer recharge sites	Stream flow, water temperature
	S-411	45.98992/-118.54774	Spring-fed, helps track groundwater and surface water interaction	Stream flow, water temperature
37696	S-415	45.94736/-118.46599	Main Walla Walla Valley tributary on the Oregon side of the basin	Stream flow, water temperature
37695	S-416T	45.9599/-118.537	Main Walla Walla Valley tributary on the Oregon side of the basin	Stream flow, water temperature
	S-426	45.95978/-118.53853	Needed to document Pine Creek water availability	Stream flow, water temperature
	GW003	45.96578/-118.37481	Monitoring Well Site	Water level
	GW005	45.99495/-118.37187	Monitoring Well Site	Water level
	GW006	45.97676/-118.38564	Monitoring Well Site	Water level
	GW007	45.96913/-118.38384	Monitoring Well Site	Water level

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	GW009	45.94445/-118.38486	Monitoring Well Site	Water level
	GW010	45.96745/-118.39221	Monitoring Well Site	Water level
	GW013	45.98395/-118.41146	Monitoring Well Site	Water level
	GW014	45.95102/-118.39155	Monitoring Well Site	Water level
	GW018	45.98757/-118.46345	Monitoring Well Site	Water level
	GW019	45.97319/-118.40403	Monitoring Well Site	Water level
	GW020	45.9769/-118.37976	Monitoring Well Site	Water level
	GW023	45.94368/-118.41355	Monitoring Well Site	Water level
	GW027	45.94418/-118.40315	Monitoring Well Site	Water level
	GW028	45.95846/-118.41834	Monitoring Well Site	Water level
	GW031	45.98285/-118.48261	Monitoring Well Site	Water level
	GW033	45.9892/-118.44671	Monitoring Well Site	Water level
	GW034	45.98451/-118.50673	Monitoring Well Site	Water level
	GW036	45.96844/-118.48494	Monitoring Well Site	Water level
	GW038	45.99968/-118.38204	Monitoring Well Site	Water level
	GW039	45.95496/-118.4345	Monitoring Well Site	Water level
	GW040	45.95408/-118.43429	Monitoring Well Site	Water level
	GW041	45.95577/-118.43453	Monitoring Well Site	Water level
	GW045	45.95603/-118.43811	Monitoring Well Site	Water level
	GW046	45.95774/-118.44111	Monitoring Well Site	Water level
	GW047	45.95746/-118.44099	Monitoring Well Site	Water level
	GW048	45.95822/-118.43974	Monitoring Well Site	Water level
	GW058	45.96567/-118.45507	Monitoring Well Site	Water level
	GW060	45.95481/-118.44475	Monitoring Well Site	Water level
	GW061	45.95219/-118.44862	Monitoring Well Site	Water level
	GW062	45.94613/-118.42133	Monitoring Well Site	Water level
	GW063	45.97067/-118.50653	Monitoring Well Site	Water level
	GW064	45.96853/-118.5016	Monitoring Well Site	Water level
	GW065	45.96279/-118.45527	Monitoring Well Site	Water level
	GW066	45.96909/-118.49693	Monitoring Well Site	Water level
	GW067	45.98359/-118.56249	Monitoring Well Site	Water level
	GW068	45.97315/-118.55853	Monitoring Well Site	Water level

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	GW069	45.9651/-118.49721	Monitoring Well Site	Water level
	GW073	46.00027/-118.41259	Monitoring Well Site	Water level
	GW075	46.00057/-118.41446	Monitoring Well Site	Water level
	GW092	45.9984/-118.6416	Monitoring Well Site	Water level
	GW098	45.95025/-118.44159	Monitoring Well Site	Water level
	GW115	45.92747/-118.3833	Monitoring Well Site	Water level
	GW116	45.96687/-118.4029	Monitoring Well Site	Water level
	GW117	45.96238/-118.42189	Monitoring Well Site	Water level
	GW118	45.96217/-118.44989	Monitoring Well Site	Water level
	GW119	45.97287/-118.48515	Monitoring Well Site	Water level
	GW120	45.99171/-118.54827	Monitoring Well Site	Water level
	GW135	45.94529/-118.40826	Monitoring Well Site	Water level
	GW140	45.97764/-118.44438	Monitoring Well Site	Water level
	GW141	45.94569/-118.40843	Monitoring Well Site	Water level
	GW142	45.96555/-118.4334	Monitoring Well Site	Water level
	GW143	45.96923/-118.44053	Monitoring Well Site	Water level
	GW144	45.98013/-118.50676	Monitoring Well Site	Water level
	GW151	45.99473/-118.42373	Monitoring Well Site	Water level
	GW152	45.95142/-118.37697	Monitoring Well Site	Water level
	GW160	45.95485/-118.37899	Monitoring Well Site	Water level
	GW161	45.96066/-118.37139	Monitoring Well Site	Water level
	GW162	45.95838/-118.37965	Monitoring Well Site	Water level
	GW165	45.96385/-118.44746	Monitoring Well Site	Water level
	GW166	45.95824/-118.46284	Monitoring Well Site	Water level
	GW169	45.94085/-118.41902	Monitoring Well Site	Water level
	GW170	45.97309/-118.42887	Monitoring Well Site	Water level
	GW171	45.99102/-118.44476	Monitoring Well Site	Water level

*If a Station ID number is not available during QAPP/SAP development, the DEQ Laboratory will generate the unique identifier prior to data processing.

2.2. Sampling methods

Manual flow measurements and continuous flow monitoring at gauge sites will be conducted according to WWBWC's 2018 SOP V1.3, which is based on the USGS and WDOE methods cited below. Continuous stage will be measured using Campbell Scientific submersible pressure transducers wired to a Campbell Scientific

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data logger. Data will be transmitted through WWBWC's radio network using a Campbell Scientific radio and managed using LoggerNet software. We have established a local datum and multiple reference points, have conducted level surveys to establish elevations and will measure the stage using a laser level and stadia rod. Stage and discharge measurements will be conducted to capture the widest possible range of flows. To calculate discharge, depth and velocity will be collected with a FlowTracker and calculated using the mid-section method. High flow measurements will be taken using a bridge board, sounding reel and weight, Price AA current meter, and Aquacalc Pro+. Rating equations have been produced using the AQUARIUS Rating Development Tool and will be shifted as needed to reflect channel changes due to scour or deposition. Using AQUARIUS Time-Series software, stage data will be processed through the rating equation to produce a continuous 15-minute discharge dataset. Hydrographs and tabular reports of the provisional data will be updated online hourly at <https://wwbwc.org/index.php/streamflow>.

Kenney, T.A., 2010. Levels at gaging stations: U.S. Geological Survey Techniques and Methods 3-A19, 60 p.

Rantz, S. E., and others., 1982. Measurement and Computation of Streamflow: Volume I. Measurement of Stage and Discharge. U.S. Geological Survey Water-Supply Paper 2175.

Rantz, S. E., and others., 1982. Measurement and Computation of Streamflow: Volume II. Computation of Discharge. U.S. Geological Survey Water-Supply Paper 2175.

Sauer, V.B., and Turnipseed, D.P., 2010. Stage measurement at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A7, 45 p. (Also available at <http://pubs.usgs.gov/tm/tm3-a7/>)

Shedd, J.R., 2018. Standard Operating Procedure for Measuring Gage Height of Streams. Version 1.1. Washington Department of Ecology – Environmental Assessment Program. EAP042.

Shedd, J. R., 2018. Standard Operating Procedure for Measuring and Calculating Stream Discharge. Version 1.3. Washington Department of Ecology – Environmental Assessment Program. EAP056.

Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (Also available at <http://pubs.usgs.gov/tm/tm3-a8/>)

Water temperature monitoring will be conducted according to WWBWC's 2018 SOP V1.3, which was developed based on the methodologies referenced below. Onset Hobo U22 and In-Situ Level TROLL 300 sensors will be used for continuous data logging. All thermistors will be checked for accuracy with a NIST-traceable thermometer in an ice water bath and at room temperature before deployment and after retrieval. Sensors will be deployed within PVC shields and secured to roots, branches or other stable structures within a well-mixed portion of the stream channel. Staff will conduct monthly field checks with a NIST-traceable thermometer and will download data with a shuttle and field laptop. After a monthly field check, water temperature measurements and logger data will be uploaded to the AQUARIUS Time-Series database and processed before being published. At the end of the water year, hydrographs and logger data will be published online at <https://wwbwc.org/index.php/water-temp>.

Water Quality Monitoring – Technical Guide Book, 2001. Oregon Watershed Enhancement Board. ODEQ, May 2020. Standard Operating Procedure. Continuous Water Monitoring Procedure – Laboratory and Environmental Assessment Division. Version 1.0.

U.S. Geological Survey, 2006. National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chapter 6, available online at https://water.usgs.gov/owq/FieldManual/Chapter6/6.1_ver2.pdf.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; available online at <http://pubs.water.usgs.gov/tm1d3>.

ard, W., 2018. Standard Operating Procedures for Continuous Temperature Monitoring of Freshwater Rivers and Streams, Version 2.1. WA Dept of Ecology. SOP Number EAP080. <https://fortress.wa.gov/ecy/publications/documents/1803205.pdf>

Groundwater level monitoring will be conducted according to the Groundwater Monitoring portion of WWBWC's 2018 SOP V1.3, which is modified from the 2005 USGS groundwater activities paper by Drost (citation below). To summarize, field staff will visit each site every three months to measure static water level and to download logged data. Measuring points at the top of each well casing have been documented and clearly marked. The vertical distance from measuring point to the land surface is recorded, and the elevation of the land surface has been documented using survey-grade GPS equipment. Manual water level measurements will be taken with a Solinst water level meter. Pressure transducers deployed in the wells at a fixed elevation with aviation or communication cable will be used for continuous (15-minute) logging of water level data. After a quarterly field visit, static measurements and logger data will be uploaded to the AQUARIUS Time-Series database and processed before being published online at <https://wwbwc.org/index.php/groundwater>.

Drost, B.W., 2005, Quality-assurance plan for ground-water activities, U.S. Geological Survey, Washington Water Science Center: U.S. Geological Survey Open-File Report 2005-1126, 27 p.

2.3. Sample handling and custody

WWBWC will follow the sample handling and custody procedures described in Section 2.3 of the ODEQ Volunteer Monitoring Program QAPP (See Table 6 below). All sampling and analysis will occur in stream and at the monitoring site. Data from loggers recording water elevation in surface water will be downloaded in the field at least every 3 months to avoid data loss in the case of logger failure. Data from temperature loggers will be downloaded in the field at least every month for the seasonal deployment to avoid data loss in the case of logger failure. Data from loggers recording water level elevation will be downloaded in the field at least every 3 months to avoid data loss in the case of logger failure.

Table 6 Summary of sampling parameters

Sample Type	Container	Preservation	Holding Time
Temperature	In-stream	NA	None
Stream Discharge	In-stream	NA	None
Water Level	In-stream	NA	None

2.4. Analytical methods

WWBWC will conform to the standard methods defined in the ODEQ Volunteer Monitoring Program QAPP (2021). Table 7 includes a summary of analytical parameters and methods to be used.

Table 7 Summary of analytical parameters and methods

Sample Type	Parameter	Reference Method (required)	Equipment
Surface water sample	Field Stream Discharge	Velocity-Area	Top setting rod, tag line, and current meter: Marsh McBirney Flo-Mate, Sontek FlowTracker, Ott MF Pro. For high flow measurements: Bridge crane, Rickly sounding reel with 30-50 lb weight, Price AA meter with Aquacalc Pro+ computer
Surface water sample	Field Stage	Visually read	Staff plate and/or Laser Level
Surface water sample	Continuous Stage	Pressure Transducers	Solinst EDGE Levellogger, Solinst Levellogger 5, Campbell Scientific Pressure Transducer
Surface water sample	Field Temperature	EPA 170.1	NIST Traceable VWR digital thermometer
Surface water sample	Continuous Temperature	EPA 170.1	ONSET U-22 Hobo loggers
Groundwater water sample	Field Water Level	Water Level Meter	Solinst 102M Mini Water Level Meter
Groundwater water sample	Continuous Water Level	Pressure Transducers	Solinst EDGE Levellogger, Solinst Levellogger 5, Campbell Scientific Pressure Transducer

2.5. Quality control

Quality control tests will follow the requirements described in the ODEQ Volunteer Monitoring Program QAPP (2021) including accuracy checks and duplicates.

Stage measurements will be evaluated for accuracy by comparing the stage data and how much of a correction is needed. Sites equipped with a staff plate and control points with a defined local datum will both be used to calculate stage and values then will used to evaluate precision. In addition to using a staff plate and control points to calculate stage, sites with a control point on a bridge tied into the local datum will have a distance to water measurement as another check. Discharge measurements will be evaluated for precision by comparing duplicate measurements.

Precision of continuous temperature data will be measured with a NIST traceable thermometer at the monitoring site to compare the results of the thermometer and continuous monitoring device results at the time the sample was collected. One audit will be done at the time of deployment and one at the time of retrieval to assess data quality. At least one mid-season audit will be done. The accuracy of continuous data requires pre-

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and post-deployment checks. To check the accuracy of continuous temperature data loggers, we will follow the procedures described in ODEQ's 2020 SOP for Continuous Water Monitoring Procedures for warm and cold water baths monitored with a NIST traceable thermometer.

Water level measurements taken in monitoring wells will be evaluated for accuracy by comparing the water level data and how much of a correction is needed if a correction is within 0.3 feet. If a correction is over 0.3 feet, the first measurement will be evaluated for human error and may or may not be used. A second water level measurement will be taken and recorded for each site visit and will be evaluated for precision. The second water level measurement will be taken about 3 to 5 minutes after the first water level measurement.

Corrective action for data that is failing to meet QA targets will be undertaken by the project manager and may include actions such as retraining, or recalibrating or replacing malfunctioning equipment. If persistent problems arise and can not be resolved the DEQ volunteer coordinator will be contacted for assistance.

2.6. Instrument/equipment testing, inspection, and maintenance requirements

Instrument testing and maintenance will occur according to ODEQ's Volunteer Monitoring Program QAPP (2021). In addition, FlowTracker operation is tested prior to each measurement with the instrument's built-in BeamCheck function.

2.7. Instrument calibration and frequency

Instrument calibration and frequency will follow the procedures from Table 10 in the ODEQ Volunteer Monitoring Program QAPP (2021).

2.8. Non-direct measurements

WWBWC will follow the data acquisition procedures and requirements for non-direct measurements as described in section 2.9 of the ODEQ Volunteer Monitoring Program QAPP (2021).

2.9. Data management

Waterproof field data sheets are used and are stored in the office after completely filling out the datasheet. Monitoring data are entered/uploaded into WWBWC's AQUARIUS Time-Series database. Provisional flow data from telemetry sites is updated hourly at <https://wwbwc.org/index.php/streamflow>. Flow data from stand-alone sites and groundwater level data are updated quarterly online. Temperature data are published online each fall, following the monitoring season. At the conclusion of each water year, stage and discharge, temperature and groundwater data are reviewed, graded, and the final datasets are published online. Data summaries are reported annually in separate flow, temperature, and groundwater reports that are submitted to funders and made available online. An online map interface on our website allows the general public to quickly find relevant data near their home or across the valley.

Stream Flow Analysis: AQUARIUS Time-Series will be used to create daily average datasets and plot them alongside historical data for spatial and temporal comparison. For base flow analysis, August and September flow data from the SF Walla Walla River will be converted to volume and compared to the historical volumes. Volume conversion will be used to compare annual spring production and tributary flows to previous data sets to determine if they are stable, increasing, or decreasing.

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Temperature Analysis: Using AQUARIUS Time-Series, data will be plotted for spatial and temporal analysis. The 7-day average of daily maximum water temperatures at each site will be calculated, plotted, and compared to data from previous years to evaluate if peak temperatures are stable, increasing or decreasing.

Groundwater Level Analysis: AQUARIUS Time-Series will be used to plot groundwater levels alongside historical data for spatial and temporal comparison. The software's analysis tools will be used to evaluate water level data sets, compare current and historic data, determine trends, and describe whether groundwater levels are steady, increasing or decreasing and whether the trend is uniform or regional.

In addition, data are analyzed, interpreted, and applied to inform future actions by agencies other than the WWBWC.

All data and quality control results will be checked for completeness, reasonableness, transcription, and calculation errors by the project manager on a weekly basis and reviewed again at the end of the project period. Data will then be submitted for inclusion in the AWQMS database using the most current DEQ templates for submitting continuous and grab sample data. For water temperature, uncorrected data will be submitted (raw values, prior to offset or drift corrections applied).

3. Assessment and Oversight

Project assessment and oversight, including field activities, will be the responsibility of the project manager.

3.1. Assessment and response actions

WWBWC will follow the assessment and oversight procedures described in the ODEQ Volunteer Monitoring Program QAPP (2021). Problems identified during the assessments will be resolved by resampling, checking for unusual sampling conditions, inspecting equipment, and reviewing procedures.

3.2. Reports to management

Accuracy and precision results will be documented daily on field sheets. Any data quality problems will be reported to the project manager as soon as possible. Accuracy and precision data will be included in the data submitted to DEQ at the end of the project period.

4. Data validation and usability

Data quality levels (DQL) will be assigned in accordance to DEQ guidance document *Data Validation and Qualification* (DEQ09-LAB-0006-QAG). Generally, only targeted DQLs of "A", or "B" will be acceptable unless the basis for the data acceptability is approved and documented by the project manager and DEQ Volunteer Monitoring Coordinator. All data verification, validation, and assessment activities for project purposes are the responsibility of the project manager.

4.1. Data review, validation, and verification

WWBWC will follow the data review, validation, and verification procedures described in Section 4.1 of the ODEQ Volunteer Monitoring Program QAPP (2021).

4.2. Validation and verification methods

WWBWC will follow the data validation and verification procedures described in Section 4.2 of the ODEQ Volunteer Monitoring Program QAPP (2021). Data will be reviewed for transfer errors, completeness and reasonableness when the data is entered into AQUARIUS Time-Series database. QC during data entry and at the end of the water year.

4.3. Reconciliation with data quality objectives

WWBWC will follow the data reconciliation procedures described in Section 4.3 of the ODEQ Volunteer Monitoring Program QAPP (2021).

5. Revision History

Table 8 Revision History

Revision	Date	Changes	Editor
1.0	5/6/2024	Creation of new document	Luke Adams

Figure 1 WWBWC Stream Gauge Station Log, page 1



WWBWC Stream Gauge Station Log

Station Name: _____ Station Number _____ Water Year _____

Party					
Date					
Time					
Staff Gauge Stage (ft)					
Control Point Stage (ft)					
Tape Down Stage (ft)					
Logger Stage (ft)					
Water Temp (°C)					
Logger Water Temp (°C)					
Spec Conductance (µS/cm)					
Air Temp (°C)					
Logger Air Temp (°C)					
Battery Voltage					
Replaced Batt (Y/N)					
Replaced Desiccant (Y/N)					
Downloaded (Y/N)					
Logger Time					
Standard Time					
Syncoed Time (Y/N)					
Rated Q					
Measured Q					
Stage After Mmt					
Time After Mmt					
Mmt Rating					
Mmt Method					
Mmt Location					
Max Depth					
Gauge Height of Zero Flow					
(Section/Channel) Control					
Control Condition: Vegetation, Aggregated, Scoured, Modified, Cleaned (note gauge height before/after)					
In AQ?					

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Figure 2 WWBWC Stream Gauge Station Log, page 2



WWBWC Gauge Height Field Notes

Station Name: _____ Station Number _____ Water Year _____
 CP 1 = _____ CP 2 = _____ CP 3 = _____ CP_s = _____ Tape Down = _____ Staff Gauge Corr = _____

Party					
Date					
Time					
Time After Mnt					
Staff Gauge (Feet)					
Staff Gauge Reading					
Correction Factor					
Corrected Stage					
Staff Reading After Mnt					
Correction Factor					
Corrected Stage					
Tape Down (Feet)					
Tape Down					
Correction Factor					
Corrected Tape Down					
Tape Down Elevation					
- Corrected Tape Down					
= WS Elevation					
Tape Down After Mnt					
Correction Factor					
Corrected Tape Down					
Tape Down Elevation					
- Corrected Tape Down					
= WS Elevation					
Laser Level (Feet)					
Streambed to LL					
- Water Surface					
= WS to LL					
- CP () to LL					
= CP () to WS					
Streambed to LL After Mnt					
- Water Surface					
= WS to LL					
- CP () to LL					
= CP () to WS					
Staff CP (CP _s) to LL					
CP () to LL					
CP () to LL					

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Figure 3 WWBWC Groundwater Monitoring Datasheet, page 1

WALLA WALLA BASIN WATERSHED COUNCIL		WWBWC Shallow Aquifer Monitoring Network - Oregon Monitoring Datasheet												
Well_ID	Name	Date	Time	Static	Pump	Static(2)	Offset	Temp	Cond	Time After	Logger Time	Restart	S#	Batt
GW_03	Biocort						1.20							
GW_05	Bier						0.75							
GW_06	Humbert						0.42							
GW_07	Posse						-4.42							
GW_09	LeFore						3.30							
GW_10	Mason						1.70							
GW_13	Prest						0.50							
GW_14	Rodighiero						-3.10							
GW_18	Courtney						2.76							
GW_19	E. Ransom						3.38							
GW_20	G. Ransom						0.40							
GW_23	Zerba						-9.00							
GW_27	Townsend						-0.60							
GW_28	Brown						0.30							
GW_31	David Lee						0.50							
GW_33	Andrews						0.80							
GW_34	NW Umapine						0.90							
GW_36	Brough						2.05							
GW_38	Swingleton						-0.90							
GW_39	Recharge 1						2.00							
GW_40	Recharge 2						0.00							
GW_41	Recharge 3						1.58							
GW_45	OBS #3						-0.40							
GW_46	OBS #1						-0.35							
GW_47	OBS #2						-0.35							
GW_48	OBS#4						-0.30							
GW_58	McGown						0.62							
GW_60	Pesciallo						0.83							
GW_61	Wondra						0.00							
GW_62	Alarcon						0.95							
GW_63	Givens Field						0.40							
GW_64	Givens Pump						2.25							
GW_65	Burlingame						2.30							
GW_66	Klaun						1.25							
GW_67	DeRuwe Home						4.00							
GW_68	Windmill						1.10							

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