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Quality-Assurance Plan for Water-Quality Activities in the U.S. Geological Survey Washington Water Science Center

Open-File Report 2017–1044

U.S. Department of the Interior
U.S. Geological Survey

Cover:
Top left: U.S. Geological Survey hydrologist collecting a width and depth-integrated water quality sample across the mouth of Burnt Bridge Creek, Washington. Photograph by James Foreman, U.S. Geological Survey, November 2010.

Bottom left: U.S. Geological Survey field personnel collecting a water-quality sample from the Duwamish River, Washington (station No. 12113390). Photograph by Kathy Conn, U.S. Geological Survey, April 29, 2013.

Top right: U.S. Geological Survey hydrologic technician collecting a groundwater sample, Keyport, Washington. Photograph by Greg Justin, U.S. Geological Survey, June 22, 2010.

Bottom right: U.S. Geological Survey hydrologic technician collecting a water-quality sample from a cableway above the Yakima River at Kiona, Washington (station No. 12510500). Photograph by Ben Holman, U.S. Geological Survey, April 4, 2017.

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Mass	
pound, avoirdupois (lb)	0.4536	kilogram (kg)

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
	Volume	
liter (L)	33.81402	ounce, fluid (fl. oz)
liter (L)	2.113	pint (pt)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as °F = (1.8 × °C) + 32.

Supplemental Information

Concentrations of chemical constituents in water are given in either milligrams per liter (mg/L) or micrograms per liter (µg/L). Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Acronyms

ASR	Analytical Services Request
BQS	Branch of Quality Systems
CVO	Cascades Volcano Observatory
DBA	Database Administrator
DOC	Dissolved organic carbon
DOI	Department of the Interior
DQI	Data-Quality Indicator
EDI	Equal-Discharge Increment
EWI	Equal-Width Increment
FSP	Fundamental Science Practices
GWDBA	Groundwater Database Administrator
GWSI	Groundwater Site-Inventory System
HIF	Hydrologic Instrumentation Facility
IM	Instructional Memoranda
JHA	Job Hazard Analysis
LEP	Laboratory Evaluation Program
NFM	National Field Manual for the Collection of Water-Quality Data
NFQA	National Field Quality Assessment
NWIS	National Water Information System
NWIS-TS	National Water Information System – Time Series
NWQL	National Water Quality Laboratory
OSW	Office of Surface Water
OWQ	Office of Water Quality
PCFF	Personal Computer Field Form
PT	Performance Testing
QA	Quality Assurance
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	Quality Control
QWDBA	Water-Quality Database Administrator
SIMS	Site Information Management System
SLAR	Sediment Laboratory Analysis Request
SWDBA	Surface-Water Database Administrator
USGS	United States Geological Survey
WAWSC	Washington Water Science Center
WMA	Water Mission Area
WRD	Water Resources Division
WSC	Water Science Center
WSFT	Water Science Field Team

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Abstract

In accordance with guidelines set forth by the Office of Water Quality in the Water Mission Area of the U.S. Geological Survey, a quality-assurance plan has been created for use by the Washington Water Science Center (WAWSC) in conducting water-quality activities. This quality-assurance plan documents the standards, policies, and procedures used by the WAWSC for activities related to the collection, processing, storage, analysis, and publication of water-quality data. The policies and procedures documented in this quality-assurance plan for water-quality activities complement the quality-assurance plans for surface-water and groundwater activities at the WAWSC.

1.0 Introduction

The U.S. Geological Survey (USGS) was established by an act of Congress on March 3, 1879, to provide a permanent Federal agency to perform the systematic and scientific "classification of the public lands, and examination of the geologic structure, mineral resources, and products of the national domain." The Water Mission Area (WMA) of the USGS is the Nation's principal water-resources information agency. The objectives of the WMA's Basic Hydrologic Data Program are to collect and provide unbiased, scientifically based information that describes the quantity and quality of waters in the Nation's streams, lakes, reservoirs, and aquifers. Water-quality activities in the Washington Water Science Center (WAWSC) are part of the WMA overall objective of appraising the Nation's water resources.

To assure water-quality data are reported, published, and released by the WMA, and to address quality-control issues related to water-quality activities, policies and procedures were designed to ensure that all scientific work conducted by or for the WMA is consistent and of documented quality. The Office of Water Quality (OWQ) is responsible for providing a quality-assurance (QA) plan that documents the policies and procedures that apply to the water-quality activities in each Water Science Center (WSC) in the WMA.

A QA plan is a document that describes the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation procedures for ensuring quality. Quality assurance, quality control, and quality assessment are all components of a QA plan. These terms are defined as follows:

Quality assurance (QA).—The systematic management of data-collection systems by using prescribed guidelines and criteria for implementing technically approved methods and policies. Quality assurance incorporates a comprehensive plan that outlines the overall process for providing a product or service that will satisfy the given requirements for quality.

Quality control (QC).—The specific operational techniques and activities used to obtain the required quality of data. Quality control consists of the application of technical procedures to achieve prescribed standards of performance and to document the quality of collected data. Quality-control data that do not meet required standards are used to evaluate and implement corrective actions necessary to improve performance to acceptable levels.

Quality assessment.—The overall process of assessing the quality of environmental data by reviewing (1) the appropriate implementation of QA policies and procedures and (2) analyzing the QC data. Quality assessment encompasses both the measurable and unmeasurable factors that affect the quality of environmental data. Assessment of these factors may indicate limitations that require modifications to protocols or standard operating procedures for sample collection and analysis, or that affect the interpretation and use of the environmental data. Quality-assurance, quality-control, and quality-assessment systems complement each other to provide a comprehensive QA program that ensures that quality objectives are identified and integrated into all levels of water-quality activities. Integrating these components into a discipline-wide QA guidance document will enhance water-quality data collected by the USGS by providing for the following:

- **Consistency** in data quality across all levels of the WMA.
- **Accountability** to clients, the scientific community, regulatory agencies, and the general public.
- **Comparability** of results among samples, sites, and laboratories;
- **Traceability** from the end product back to its origins, and to all supplementary information, through written records.
- **Application** of appropriate and documented techniques that lead to similar results time and again.
- **Representativeness** of the data in describing the actual chemical composition of the biological or physical conditions at a sampling site for a given point or period in time.
- **Adequacy** of the amount of data obtained to meet data objectives.

The purpose of this QA plan for water-quality activities is to document the standards, policies, and procedures used by the WAWSC for activities related to the collection, processing, analysis, storage, and publication of water-quality data. This plan identifies responsibilities for ensuring that stated policies and procedures are executed. The plan also serves as a guide for all WAWSC personnel who are involved in water-quality activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

The scope of this QA plan includes discussions of the policies and procedures followed by the WAWSC for the collection, processing, analysis, storage, and publication of water-quality data. Although procedures and products of interpretive investigations are subject to the criteria discussed in this plan, some interpretive investigations may require separate and complete QA plans. The policies and procedures documented in this QA plan for water-quality activities are intended to complement the WAWSC QA plans for surface-water and groundwater activities.

2.0 Organization and Responsibilities

Quality assurance is an active process of achieving and maintaining high-quality standards for water-quality data. Consistent quality requires that specific actions are carried out systematically in accordance with established policies and procedures. Errors and deficiencies can result when individuals fail to carry out their responsibilities. Clear and specific statements of responsibilities promote an understanding of each person's duties in the overall process of ensuring the quality of water-quality data.

2.1 Organizational Chart

The WAWSC's organizational structure is similar to those of other WSCs in the WMA, but different program requirements from one WSC to another contribute to the unique character of these organizational structures. The chart in figure 2-1 illustrates the organization of WAWSC personnel.

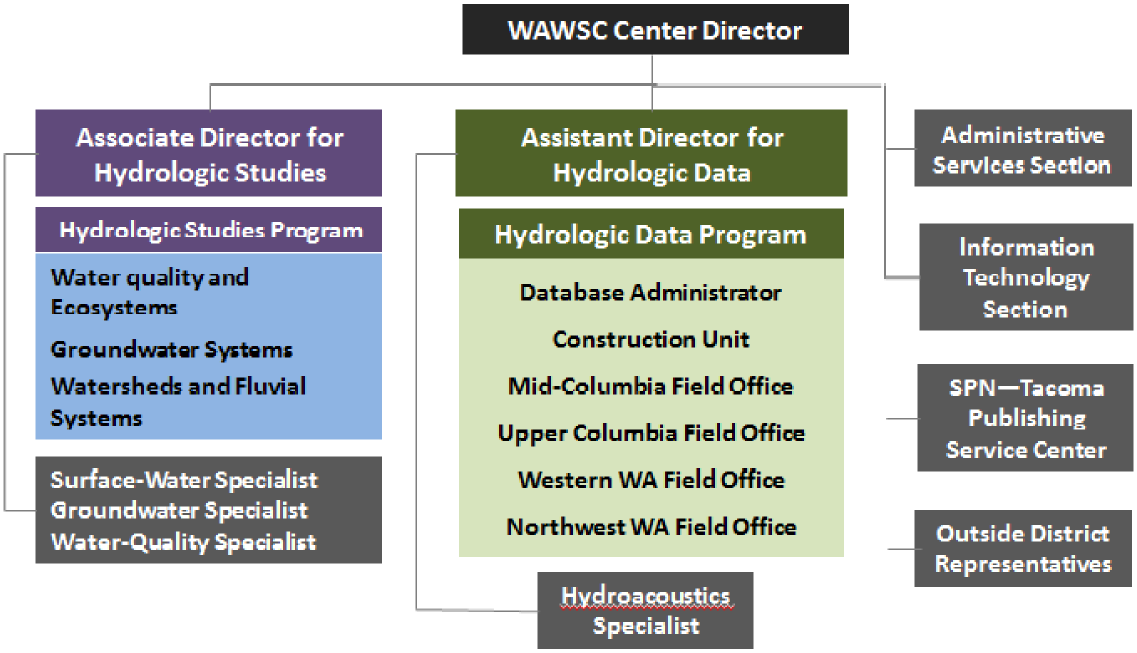

Figure 2-1. Washington Water Science Center organizational chart, January 2017.

2.2 Responsibilities

The final responsibility for the preparation and implementation of and adherence to the QA policies that are described in this QA plan lies with the Director of the WAWSC (Schroder and Shampine, 1992, p. 7). Following is a list of responsibilities for selected WAWSC personnel who are involved in the collection, processing, storage, analysis, and publication of water-quality data:

WAWSC Director or designated management personnel:

- Manages and directs the WAWSC program, including designation of personnel responsible for managing all water-quality activities.
- Ensures that water-quality activities in the WAWSC meet the needs of the Federal government, the WAWSC, cooperating State and local agencies, and the general public.
- Ensures that all aspects of this QA plan are understood and followed by WAWSC personnel either directly or through clearly stated delegation of this responsibility to other personnel in the WAWSC.
- Provides final resolution, in consultation with the Water-Quality Specialist, of any conflicts or disputes related to water-quality activities within the WAWSC.
- Briefs and updates subordinates on procedural and technical communications from the water science field teams (WSFT) and Headquarters technical offices.
- Participates in technical reviews of all water-quality programs on a semiannual basis.

- Ensures that all publications and other technical communications released by WAWSC personnel are accurate and comply with USGS policy.
- Approves the use of laboratories other than the National Water Quality Laboratory (NWQL) through the Laboratory Evaluation Program (LEP).
- Approves training opportunities for WAWSC personnel.

WAWSC Water-Quality Specialist or designated representative:
- Ensures that water-quality activities in the WAWSC meet the needs of the Federal government, the WAWSC, cooperating State and local agencies, and the general public.
- Prepares and implements the WAWSC water-quality QA plan.
- Ensures that the WAWSC QA plan is reviewed and revised at least once every 3 years to document current responsibilities, methodologies, and ongoing procedural improvements.
- Ensures that all aspects of this QA plan are understood and followed by WAWSC personnel.
- Briefs WAWSC personnel on procedural and technical communications from the WSFT and Headquarters technical offices.
- Provides technical assistance and review of the water-quality aspects of project proposals to ensure that proposed work is technically sound and meets WAWSC priorities and WMA objectives.
- Participates in technical reviews of all WAWSC water-quality programs on a semiannual basis.
- Ensures that all publications and other technical communications released by the WAWSC that relate to and include water-quality information are accurate and comply with USGS policy.
- Assists Project Chiefs in preparing the LEP package for laboratory approval.
- Announces training opportunities and providing in-house training.
- Co-hosts the triennial groundwater/water-quality technical review of the WAWSC.
- Monitors the results of quality control samples such as annual equipment blanks to ensure compliance with WAWSC standards.
- Coordinates WAWSC participation in the National Field Quality Assurance (NFQA) Program; reviews results and conducts follow-up training and re-testing as necessary.
- Provides guidance to WAWSC personnel on workflows of discrete and continuous water-quality to ensure data review and approval within a timely manner.

WAWSC Surface-Water Specialist:
- Ensures that appropriate sampling equipment and field protocols are used for suspended-sediment and bedload sites.

Project Chief and (or) Field Office Chief:
- Develops project proposals and ensures that they contain the required elements, are reviewed by the appropriate personnel, and ultimately reside in the National Proposal Repository.
- Develops a project workplan (or similar, such as a Quality Assurance Project Plan, QAPP).
- Manages and directs the project's field and laboratory water-quality activities.
- Ensures that the project's field and laboratory water-quality activities meet the needs of the Federal government, the WAWSC, cooperating State and local agencies, and the general public.
- Ensures that all aspects of this QA plan that pertain to the project's field and laboratory water-quality activities are understood and followed by project personnel.
- Obtains guidance, as appropriate, for project quality-assurance/quality-control (QA/QC) activities from the WAWSC Water-Quality Specialist;

- Prepares LEPs.
- Ensures that QA/QC activities are properly carried out by the project staff.
- Ensures that project data are reviewed and approved in a timely manner.
- Stays current on relevant water-quality training, including those related to field-, laboratory-, data retrieval/review/records-, and safety-related procedures.

Surface-Water Database Administrator (SWDBA):
- Creates surface-water sites in the USGS National Water Information System (NWIS).

Groundwater Database Administrator (GWDBA):
- Creates groundwater sites in NWIS.

Water-Quality Database Administrator (QWDBA):
- Creates miscellaneous water-quality sites in NWIS.
- Uploads water-quality data to the NWIS database as it arrives from laboratories.
- Notifies appropriate personnel that data have arrived from laboratories.
- Teaches users the correct methods for data entry, data retrieval, and data management procedures.
- Provides guidance for water-quality data checking and analysis programs.
- Ensures all data entered into QWDATA (the portion of NWIS for discrete water-quality data) are complete and that established data management procedures are followed.
- Suggests procedures to improve the flow of water-quality data.
- Assists project personnel in the resolution of specific database problems.
- Participates in reviews of water-quality proposals and projects.
- Fills requests for water-quality data.

Section Chief:
- Manages the workload and priorities of subordinates to support high-quality and timely data collection, review, and publication.
- Reviews water-quality proposals and information products prior to release for colleague review.
- Participates in technical reviews of all WAWSC water-quality programs on a semiannual basis.
- Develops individual training plans with employees during the performance review process to maintain skilled water-quality hydrologists and hydrologic technicians relevant to the areas of program at the WAWSC.

Data Collectors (Hydrologists and Hydrologic Technicians):
- Implements proper QA/QC activities, as provided by the Project Chief, during all tasked aspects of the project, which may include preparation, sample collection and documentation, shipping, database entry, laboratory data tracking, and data review and validation.
- Obtains guidance, as appropriate, for project QA/QC protocols from the Project Chief, WAWSC Water-Quality Specialist, and (or) QWDBA.
- Stays current on relevant water-quality training, including those related to field-, laboratory-, data retrieval/review/records-, and safety-related procedures.

WAWSC Safety Coordinator:

- Serves as a primary focal point for all safety issues at the WAWSC.
- Reviews the Job Hazard Analysis (JHA) for new proposals.
- Coordinates and conducts training and inspections.

3.0 Program and Project Planning

The WAWSC Director has primary responsibility for overall WAWSC program planning and is responsible for ensuring that WAWSC projects support local and national priorities. All water-quality projects require review and approval prior to the commencement of work. QA requirements and QC procedures should be integrated into the project proposal. The need for a project-specific QA plan for a water-quality project will depend on the complexity of the work, the needs of the WAWSC or cooperator, or other criteria as described in Shampine and others (1992).

3.1 Project Proposals

Project proposals are developed by the WAWSC in response to requests by cooperating agencies, needs recognized by the USGS in working closely with other agencies, or national programs. Water-quality elements included in the proposal are:

- A detailed outline of the data-collection activities to be carried out (if new data are needed), that should be described in the proposal Approach section;
- A separate Quality Assurance/Quality Control section, which describes the QA plans and the QC information needed;
- The analytical techniques to be used, which may include field collection and processing, laboratory analysis, and data analysis;
- A separate Data Management section that specifically describes in what publicly-accessible and archivable location the data will be stored, and how models will be archived, if applicable, in accordance to the USGS Fundamental Science Practices (https://www2.usgs.gov/fsp/default.asp) and USGS Office of Water Quality Technical Memorandum 2015.01; and
- A JHA, which describes significant safety concerns related to the project and how the safety concerns will be addressed, including training, equipment, and other actions.

Consultation with local and WSFT specialists is encouraged during the preparation of proposals and the execution of projects. To ensure that program activities do not infringe on work more appropriately done by the private sector, USGS WMA Memorandum 12.01 guides activities that should be included and excluded from the proposed program.

Review of project proposals is given high priority. Project proposals are reviewed by the appropriate WAWSC personnel: author's supervisor, appropriate Discipline Specialist, Safety Officer, Administrative Officer, Tribal Liaison, and Associate Director for Hydrologic Studies and, at the discretion of the WAWSC Director, proposals may be sent to other WSCs for review. The WSFT provides final review and approval of all project proposals.

3.2 Project Workplan

Project workplans are sometimes developed from approved project proposals. The Project or Field Office Chief prepares a detailed workplan that identifies all project work elements and the related technical methods and approaches that are necessary to satisfy project objectives. The workplan links project personnel, tasks, and functions with associated funds and indicates the projected dates for on-time completion of project elements and, ultimately, the project. Workplans for water-quality programs and projects, including programs and projects with water-quality components, should clearly state how the WAWSC's "Quality-Assurance Plan for Water-Quality Activities" will be implemented.

Descriptions of the methods and approaches to be used to complete the technical elements of the project are required and include, for example, the design of environmental sample collection to meet the study objectives. Any new or unapproved field and laboratory methods that will be used must be described in detail. The LEP plan should be cited in the workplan. The workplan also lists the environmental sampling locations and frequency, a description of the sample types and their relevancy to project objectives, and descriptions of laboratory analyses (for example, method, reporting limits, and analytical variability) in relation to expected environmental levels.

Workplans also include a description of the QC sampling design that is required to document bias and variability in the environmental data. The workplan lists QC sample types and intended uses, and frequency of collection. The types of QC samples typically collected include blanks and spikes to estimate bias and replicates to estimate variability (Mueller and others, 1997; U.S. Geological Survey, 2006).

Workplans state anticipated methods for data analysis and presentation, including intended publication types. Accurate cost estimates are needed for personnel, materials, and services related to planned completion dates for properly budgeting the project. Assuring the availability of project personnel is often difficult and can impose serious constraints on completing project tasks; therefore, WAWSC management should be consulted to ensure adequate staff resources are available to avoid the over-commitment of individuals to multiple projects. The project timeline lists major project elements and planned completion dates. Adequate time should be allocated for any publication review process, which generally takes about 6–9 months to complete.

3.3 Project Review

Project reviews are conducted approximately semi-annually by WAWSC management, technical advisors, or discipline specialists to ensure compliance with the project workplan objectives, timeline, and budget. Project reviews are used to ensure that data collection, QA activities, analysis, and reporting are accomplished in accordance with the workplan and with broader WAWSC policies and requirements. Informal reviews are part of ongoing quality assurance, whereby problems and related issues are addressed as they arise. In preparation for the semiannual project review, the Project Chief completes a project review form (appendix A) describing the project status, including major accomplishments and setbacks since the previous review, and plans for the next 3–12 months. In advance of the project reviews, the QWDBA retrieves all data from QWDATA for each project that has not yet been reviewed and approved (described in more detail in section, "7.0 Discrete Water-Quality Samples"). The QWDBA distributes the data (typically as an excel spreadsheet through email) to the Project Chief for review and approval. The status of unapproved data may be discussed during project reviews.

The WAWSC Associate Director for Hydrologic Studies holds the review forms and comments until the next review cycle, at which time progress in addressing previously-identified project problems or deficiencies is noted.

4.0 Water-Quality Laboratories

Analytical laboratories provide data pertaining to WAWSC water-quality studies for physical, chemical, radiochemical, and microbiological analyses. Each water-quality study has unique analytical needs defined by the specific goals of the project, sample collection methods, and the characteristics of the environment being sampled. The laboratories used for studies in the WAWSC "must provide appropriate supporting performance data to allow projects to assess the quality of associated environmental sample results. Review of performance data results is critical to understanding the environmental sample result," (OWQ Technical Memorandum 2014.01).

4.1 Evaluating Laboratory Performance

At the WAWSC, the Project Chief is responsible for obtaining, compiling and evaluating the performance data and information needed to ensure that the data provided by the selected laboratory will meet the project objectives. This is called a Laboratory Evaluation, and is described in OWQ Technical Memorandum 2014.01. A Laboratory Evaluation must be completed at the beginning of and throughout every project, for every project-laboratory pair, including USGS laboratories. The Laboratory Evaluation documentation (paper or electronic) is stored with the project files, and only needs to be formally packaged, reviewed and approved for Level II project/laboratory situations (described later in this section). The Laboratory Evaluation process is summarized in figure 4-1.

The Project Chief obtains laboratory information and recent performance data (analyzed within the previous 6 months) to evaluate the appropriateness of the analytical methods used by a laboratory to provide data within targeted data requirements of the study. For a specified environmental range, targeted data requirements include acceptability criteria for the external performance data, internal (set QC) performance data, field QC samples, detection levels, precision, recoveries, and absence of (or acceptable) bias. A checklist of information to obtain from the laboratory(ies) is provided in figure 4-2 and includes (1) Laboratory information, (2) Method information, (3) Data, and (4) Additional documentation.

External Performance Testing (PT) data is critical to evaluating laboratory analytical precision and bias. PT samples are certified reference materials with known composition, such as standard reference materials or certified standards. They are usually submitted to the laboratory as blind samples (composition unknown to the laboratory) from an external program, project, or entity. For example, laboratories that provide sample analysis and results to WMA-funded projects or programs must participate in the USGS Branch of Quality Systems (BQS) semi-annual Standard Reference Sample (SRS; https://bqs.usgs.gov/srs/) proficiency testing project, per OWQ Technical Memorandum 2016.06. The analytes currently (2016) included in the SRS project are: trace elements, major ions, precipitation analytes (select ions, pH, and specific conductance), nutrients (low-level or regular-level), and mercury in filtered-water samples.

In the absence of external PT data, recent internal QA/QC data may be used instead, including laboratory blanks, replicates, matrix spikes, and matrix spike duplicates. A project-laboratory pair is categorized as Level I if QA data (either external PT data or internal QA/QC data) are available and relevant for the data requirements of the project, including matrix type, method, concentration range, detection level, and time frame. A project-laboratory pair is categorized as Level II if insufficient QA data are available, and therefore the Project Chief does not have enough information to assess laboratory performance relative to the data requirements of the project.

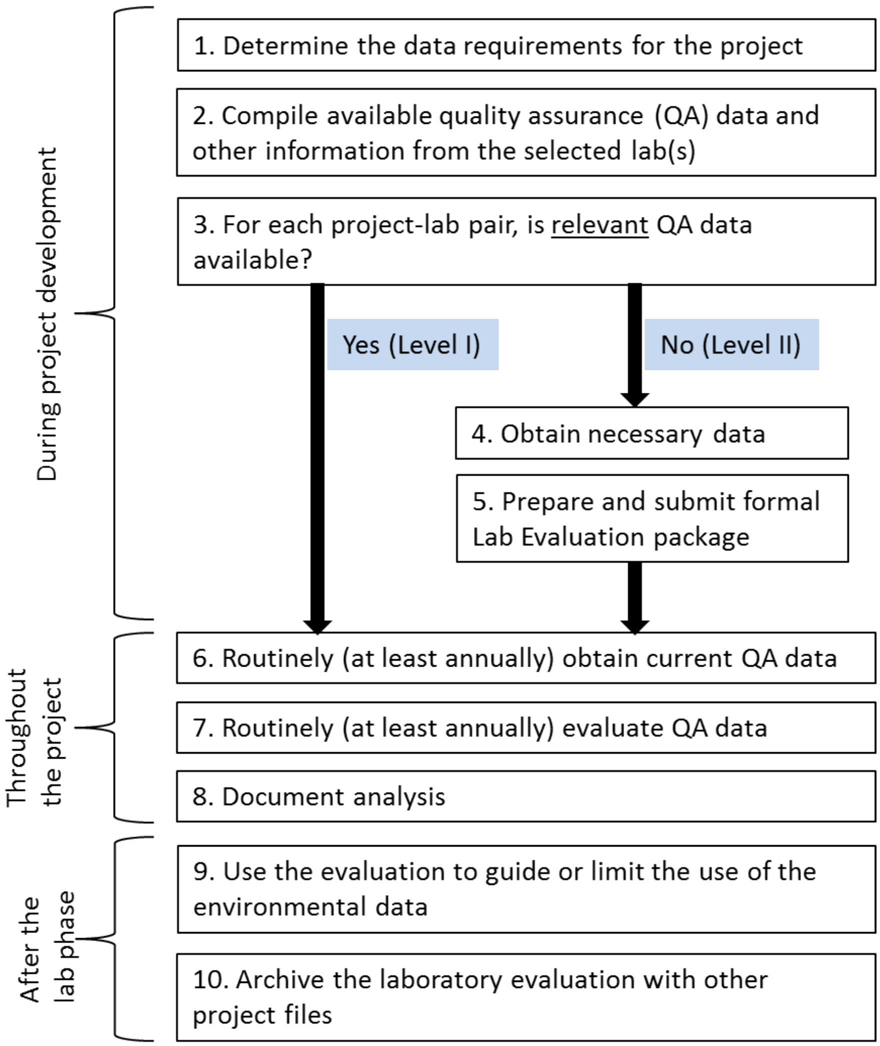

Figure 4-1. Laboratory evaluation process.

Checklist of information to obtain from laboratories		
1. Lab Information		
☐	Lab name	
☐	Website	
☐	Contact name and role	
☐	Contact email	
☐	Contact phone	
☐	Lab physical address	
2. Method information, for each analyte or analyte group		
☐	Method name/number	
☐	Method description and citation	
☐	Reporting level(s) for relevant sample matrix type	
☐	Data qualification approach	
☐	Format of results (example data package)	
☐	Turn-around time	
3. Data (for each analyte in each matrix)		
☐	External Performance Testing (PT) data (e.g., standard reference material)	
	☐	Description of external PT source/sample
	☐	Analyte/Analyte groups in PT sample
	☐	Analysis date
	☐	Results (Lab value, certified value, and measure of deviation or acceptability
☐	Internal Quality Control (QC) data (required only in the absence of external PT data)	
	☐	QC type (e.g., lab blank, lab replicate, lab matrix spike/matrix spike duplicate)
	☐	Analysis date
	☐	Result
	☐	Measure of deviation or uncertainty
4. Additional documentation (optional)		
☐	Documentation of accreditation/certification	
☐	Lab QA plan (other SOPs and demonstrations of capability)	

Figure 4-2. Checklist of information to obtain from laboratories during the laboratory evaluation process.

For Level II situations, the Project Chief must obtain the missing QA data, for example, by submitting relevant PT samples to the laboratory for analysis or requesting that the laboratory join an existing intra-laboratory comparison program. For Level II situations, the Project Chief must prepare and submit a formal LEP package for review by the WAWSC Water-Quality Specialist and the WSFT Water-Quality Specialist and approval by the WAWSC Director. The LEP package includes:

- A list of project analytes and expected environmental concentrations.
- Laboratory method reporting levels, calibration ranges, and measures of variability.
- The initial PT data for the analytes of interest in the concentration ranges of interest.
- A simple evaluation of the initial PT data relative to the project objectives.
- A plan for the on-going PT samples during the analytical phase of the project, including sample sources and composition, frequency of submitting the sample, and the data evaluation process.

Other acceptable formats include annotated graphs or tables. The Project Chief retains the signed, completed LEPs in the project files, and provides copies to the WSFT and BQS for archival.

Field measurements done in accordance with the USGS National Field Manual are exempt from formal LEPs. Analytical methods in development (unapproved) are exempt from formal LEPs. However, projects and programs using data produced by these methods may require extensive laboratory data evaluation for valid interpretation of results. Laboratory users in this situation will need to follow the laboratory-evaluation process for whatever supporting information is available to evaluate the quality of these analyses.

External PT data are available for laboratories participating in the USGS BQS Inorganic Blind Sample Project (https://bqs.usgs.gov/ibsp/) and Organic Blind Sample Project (https://bqs.usgs.gov/obsp/). The Project Chief also may contact the NWQL directly (labhelp@usgs.gov) and request they provide the specific information needed. The NWQL does not regularly run a laboratory replicate or laboratory spike unless requested by the Project Chief through the Enhanced Quality Assurance Program (http://wwwnwql.cr.usgs.gov/qas.shtml?EQAP). It is highly recommended that Project Chiefs enroll in the Enhanced Quality Assurance Program program for projects submitting samples to NWQL for the following analytes/methods (as of 2016): nutrients (by colorimetry), metals, major ions, volatile organic compounds, and pesticides.

Throughout the analytical phase of the project, the Project Chief should routinely (at least annually) obtain current laboratory information including changes to methods and reporting levels, external PT data, and internal QC data. The Project Chief should routinely (at least annually) evaluate existing and project-specific PT sample data to ensure the continued ability of the laboratory to meet project objectives. The evaluation(s) of the quality of the environmental data should be documented and stored within the LEP project files. Contact the WAWSC QW Specialist or BQS for guidance.

After the analytical phase of the project, the Project Chief should use the laboratory-evaluation information to guide or limit use of the environmental data. After project completion, the laboratory-evaluation information should be archived with the other project files

4.2 Laboratories Used for Water-Quality Projects in the Washington Water Science Center

The analytical laboratories currently (2014–16) used by the WAWSC are listed in appendix B. Currently, the 16 laboratories used by the WAWSC are categorized as Level I (sufficient PT data are available to evaluate laboratory performance) and there are no laboratories categorized as Level II.

5.0 Washington Water Science Center Water-Quality Facilities and Instruments

5.1 Facilities

The WAWSC maintains multiple facilities for providing and preparing equipment for field activities, processing samples, performing sample analysis, and preparing samples for shipment to analytical laboratories. The facilities provide field instrumentation maintenance and calibration, and quality assurance for the above activities. The facilities maintain a supply of instruments, equipment, and expendable supplies needed by field personnel for water-quality sample collection and analysis. The facilities are maintained in accordance with standards set forth in the Branch of Operations Technical Memorandum 91.01 which includes coordination of chemical purchases through the Chemical Hygiene Coordinator and waste-disposal practices that are in compliance with State and Federal regulations. The facilities include:

- WAWSC Laboratory, Tacoma, Wash. (Studies and Western Washington Field Office)
- Field Service Unit (FSU), Kennewick, Wash. (Mid-Columbia Field Office)
- FSU, Spokane, Wash. (Upper-Columbia Field Office)
- Water-Quality Preparation (Prep) Area, Ferndale, Wash. (Northwest Washington Field Office)
- Mobile laboratories (5)
- Field vehicles (more than 30)

The criteria and personnel responsible for maintaining and operating the Laboratory, FSU, and Water-Quality Prep Area is detailed in appendix C, including tables of equipment and instrumentation at each facility.

5.2 Mobile Laboratories and Water-Quality Field Vehicles

Mobile laboratories are vehicles that are designed, designated, and outfitted for use during water-quality sample-collection and processing activities at or near sample-collection sites. The WAWSC maintains five vehicles designated for water-quality sample collection and processing, including truck campers customized with groundwater sampling manifolds, deionized (DI) water tanks, power for operating pumps and other features. If one of the WAWSC's other field vehicles is used for water-quality work, portable processing and preservation chambers are used for sample processing, and extra QC samples are collected to document that the data have not been compromised. Procedures for collecting and processing water-quality data are described here in sections, "7 Discrete Water-Quality Samples" and "8 Continuous Water-Quality Monitoring," and in the National Field Manual for the Collection of Water-Quality Data (NFM; U.S. Geological Survey, variously dated).

A field vehicle is designated as a water-quality field vehicle when it meets criteria to maintain a non-contaminating environment for the constituents being sampled. The work area must be maintained to minimize sources of sample contamination. Specifications for vehicles used when sampling for water-quality constituents are discussed by Horowitz and others (1994) and in the NFM (Wilde and others, 2014, chap. A2.3) and include the following:

- Materials used for cabinets, storage, and work surfaces must be easy to maintain, made of or covered with non-contaminating materials, and such that they can be cleaned with water or solvents, as appropriate.

- Cargo must be restricted to equipment and supplies related to water-quality sample collection unless stored in a separate compartment. No potentially contaminating equipment or supplies, such as, sounding weights, solvents, or fuel, may be transported in the interior compartment of the vehicle.
- A dust barrier exists between the cab and work area of the vehicle, as well between the cargo area and work areas of the vehicle.

The Laboratory or FSU Manager or assigned project personnel is responsible for vehicle maintenance, for maintaining the suitability of the vehicle for water-quality sample collection, and for keeping the vehicle supplied.

5.3 Water-Quality Instruments

The WAWSC complies with the WMA policy of providing personnel with high-quality field instruments and equipment that are safe, precise, accurate, durable, reliable, and capable of performing required tasks (WRD Memorandum 95.35). Accordingly, appropriate instruments for use in water-quality projects in the WAWSC should be selected based upon the specifications described in chapter A6 of the NFM (Wilde, variously dated) and the requirements of the project. The Hydrologic Instrumentation Facility (HIF), which provides analyses of precision and bias for water-quality instruments, also should be consulted for recommendations when appropriate. Instrument Evaluation Reports, Technical Information Sheets, and HIF Open-File Reports are available on the HIF website (http://1stop.usgs.gov/uo/index.html) under the Resource Center/Documentation tab. The WAWSC Water-Quality Specialist should be consulted if project personnel need assistance with the selection or use of equipment.

All instruments used by WAWSC personnel for water-quality measurements are to be properly operated, maintained, and calibrated. The manufacturer's operating guidelines should be carefully followed for correct operation of any field or laboratory equipment. Most instruments will be calibrated in the field prior to making the sample measurements, as described later in this section. Calibration standard preparation and storage at each WAWSC facility is described in appendix C.

Thorough documentation of all calibration activities associated with water-quality data collection is a critical element of the WAWSC QA program. Calibration and maintenance records of field equipment need to meet the following criteria:

- Contain records in an electronic format or a bound notebook (instrument logbook) with sequentially numbered pages (no looseleaf).
- Use waterproof ink for all notes and recorded information in the logbook.
- Include the manufacturer, make, model, and serial or property number.
- Include all calibration information, including initials of operator, date of calibration, calibration data, and lot numbers and expiration dates of standards.
- Include all maintenance record information.
- Include any other relevant information pertaining to the operation and maintenance of the equipment.

Similar records for WAWSC laboratory equipment (see appendix C tables) are to be kept by the laboratory or FSU Manager. Calibration and maintenance records for field and laboratory equipment are reviewed and checked periodically throughout the year by the WAWSC Water-Quality Specialist for completeness and accuracy.

Calibration, repair, and maintenance of all single- or multi-parameter water-quality monitors for continuous monitoring also should be recorded in permanent instrument-specific log books. Standard procedures for the installation and operation of such monitors are described in Wagner and others (2006).

Summary information regarding the calibration methods, acceptance criteria, and other information on the use of WAWSC water-quality instruments is provided in section, "7 Discrete Water-Quality Sampling," for discrete parameters and section, "8 Continuous Water-Quality Monitoring," for continuous parameters.

6.0 Site Selection, Establishment, and Documentation

Deciding where to sample is an important initial step toward achieving project objectives and meeting WAWSC QA/QC requirements. Once a site is selected, thorough documentation, usually in the form of a station description, is required.

6.1 Site Selection

Site selection for sampling is important to the validity of water-quality data. Selection of a suitable site can be made only after considering a number of factors, including the need for information in a particular location, the suitability of a site for sampling, and its accessibility and safety. Specific guidelines for site selection are contained in Chapter A1 of the NFM (Wilde, 2005). The Project or Field Office Chief is responsible for the selection of sampling sites, after consultation with the WAWSC Water-Quality Specialist and the Surface-Water or Groundwater Specialist, as appropriate.

If possible, water-quality stations in flowing surface waters should be located at or near streamflow-gaging stations. The objective is to collect samples that represent the stream cross-section; therefore, well-mixed reaches are an ideal location for sample collection. If this is not possible, the water-quality station should be located where the stream discharge can be measured, and water samples can be collected at all stages of flow required to meet project objectives. If the water-quality station is just downstream from either the confluence of two or more streams or a point source of pollution, the collection of a representative sample may be difficult because of incomplete mixing. Under such conditions, the criteria for the minimum number of vertical transects sampled may need to be increased, and lateral mixing should be documented with cross-sectional surveys at various stages of flow.

Additional factors must be considered during site selection for still- or open-water locations such as lakes and reservoirs (Green and others, 2015), or wetlands, estuaries, and coastal waters. Study objectives will determine site placement and sampling strategy. For example, objectives may require sampling at fixed points rather than cross sections and (or) sampling at multiple depths. To obtain a representative sample, natural lakes typically are sampled near the center or at the deepest location in the water body. Other lake studies may focus on water quality of near-shore areas, such as swimming beaches. Reservoirs typically exhibit a longitudinal gradient of water-quality from the shallow headwaters to the deepest water near the dam, and this gradient should be considered when developing a sampling strategy. Sites near structures such as marinas, boat ramps, docks, and piers are avoided, unless these areas are specifically targeted for study.

Site selection for suspended sediment, bed sediment, or biological samples in flowing or still waters will be guided by the same principles as previously described. Project objectives, safety, and accessibility may ultimately determine the location, for example, targeting depositional areas of fine sediment or reaches containing potential spawning habitat.

The selection of wells for groundwater sampling is dependent on many variables, including location, depth and accessibility of the well, type of well completion, availability of geologic and water-use information, and sampling purpose(s). If suitable existing wells cannot be found, new wells will need to be installed, which must be considered and accounted for during project and budget development.

The selection of other sites, such as springs, wet and dry deposition, drinking-water plants, wastewater plants and other facilities, and stormwater conveyance systems is typically driven by project objectives, permissions, and accessibility.

6.2 Site Establishment

A site must be established or updated in the WAWSC Groundwater Site-Inventory (GWSI) system for all discrete and continuous water-quality, data-collection sites prior to sample collection. This site file information is stored in GWSI for both groundwater and surface water sites. The minimum information required for establishing electronic files in NWIS is listed in table 1-1 (for surface waters) and table 1-4 (for groundwater) in Wilde (2005). Creation of surface-water sites in NWIS is the responsibility of the WAWSC surface-water database manager (SWDBA). Creation of groundwater sites in NWIS is the responsibility of the WAWSC GWDBA. Creation of miscellaneous water-quality sites (for example, lakes, estuaries, springs, wet and dry deposition, drinking-water plants, wastewater and other facilities, and storm water conveyance systems) can be done by any of the three WAWSC Database Administrators (DBA; the SWDBA, GWDBA, or QWDBA). Project or data personnel should provide the appropriate DBA with latitude and longitude and datum information. The DBA will determine the station number, create or update the site file in NWIS, and provide the project with new station(s) information. A map-based graphical user interface (MAPS) is used to autopopulate additional site location information (such as, hydrologic unit code or Water Resource Inventory Area) based on latitude and longitude. Consultation with the appropriate discipline specialist during site establishment is advised to ensure that the minimum requirements of the WAWSC are met (Lane, 2006; Kozar and Kahle, 2013; Mastin, 2016).

6.3 Station Documentation

The Project or Field Office Chief constructs a physical and (or) electronic station folder containing descriptive information including a copy of the site file, map and driving logs, land use agreements, JHA, bridge plan, traffic management plan, location of the nearest hospital, photographs, site sketches, purpose of sampling, conditions (such as well construction information and descriptions of installed instrumentation), analyte lists, bottle types, and ancillary information for all new water-quality, data-collection sites. Station Folder checklists are available in figure 6-1 for surface-water sites and figure 6-2 for groundwater sites.

Station description:	
	• Copy of Site File (in GWSI)
	• Copy of current Station Description (in *WA SIMS*) if a gaging station.
	• Location of gaging station (if one is present)
	• Location and description of installed equipment/instrumentation.
	• Name of landowner, tenant, or other responsible party.
	• Signed land use/access agreements and permission forms.
	• Site access instructions (for example, call owner/site operator before arrival, obtain key to unlock security gate).
	• Photographs to document site conditions.
	• Location of sample-collection sites: high and low streamflows.
	• Profiles of cross section of stream channel at sampling location(s).
	• Stream-bottom geometry.
	• Physical and chemical measurements.
	• Hydrologic and geologic sections.
Maps and Road Log to site (State and local)	
Safety information (NFM 9):	
	• Copy of Job Hazard Analysis (JHA)
	• Nearest emergency facilities.
	• Phone numbers (home) of study chief or supervisor.
	• Traffic condition and traffic plan showing where to park, placement of flags and cones.
	• Location of power lines.
	• Environmental hazards, such as weather and animals.
Sampling schedule and instructions:	
	• Project workplan
	• Field-techniques manuals
	• Equipment and supplies checklists, including:
	• Site-specific safety equipment
	• Equipment to use at various flows
	• Laboratory analyses to be requested and associated codes.
	• Conditions triggering sample collection (high or low flow).
	• Quality-control samples – type and sampling schedule.
Bottle types and preservation requirements needed for each analytical schedule.	
Analytical Services Request form(s) and example of a completed form.	
Surface-water field form and an example of completed form.	
	• Completed forms for any on-site analysis, for example, a tabulation sheet for each type of bacteria enumerated at the site (include example with date of sample, streamflow, volumes filtered, dilutions, plate counts).
Historical data (last 5-10 years of record, if applicable):	
	• For example, plots of streamflow vs. various water-quality parameters.
	• Statistical summary of historical water data:
	• Seasonal, maximum-minimum values.
	• Discharge-related maximum-minimum values.
Ancillary discharge information:	
	• Cumulative-discharge curves at about 10-, 50-, and 90-percent duration.
	• Velocity cross sections at about 10-, 50-, and 90-percent duration.
	• Flow-duration curve.
	• Discharge rating curves and (or) tables.
Shipping:	
	• Shipping instructions and holding time requirements for each schedule.
	• Location of nearest post office or shipping agent.
	• Mailing labels to and from laboratory.
	• Shipping supplies (coolers, boxes, ice, packing material, tape, scissors).

Figure 6-1. Station Folder checklist for surface-water sites (modified from Figure 1-2 in Wilde [2005].

Station description:	
	• Copy of Site File (in GWSI)
	• Copy of current Station Description (in *WA SIMS*) if a gaging station.
	• Maps showing location and identification number of well(s).
	• Location and description of installed equipment/instrumentation.
	• Hydrologic and geologic sections.
	• Borehole geophysical logs.
	• Name of landowner, tenant, or other responsible party.
	• Signed land use/access agreements and permission forms.
	• Site access instructions (e.g., call owner, obtain key/tools for security gate, well house, well protective casing).
	• Photographs and land use/land cover forms to document site conditions.
	• Well dimensions and construction.
Maps and Road Log to site (State and local)	
Safety information (NFM 9):	
	• Copy of Job Hazard Analysis (JHA)
	• Nearest emergency facilities.
	• Phone numbers (home) of study chief or supervisor.
	• Traffic condition and traffic plan showing where to park, placement of flags and cones.
	• Location of power lines.
	• Environmental hazards, such as weather and animals.
Sampling schedule and instructions:	
	• Project workplan.
	• Field-techniques manuals.
	• Equipment and supplies checklists, including:
	• Site-specific safety equipment
	• Laboratory analyses to be requested and associated codes.
	• Conditions triggering sample collection.
	• Location of measuring point for water-level measurements.
	• Location of sampler intake during purging and sample collection.
	• Pumping rate for purging and sampling.
	•Purging instructions:
	• Number of well volumes.
	• Rate of pumping; containment and discharge of purge water.
	• Field measurements and stability protocols.
	• Quality-control samples – type and sampling schedule.
Bottle types and preservation requirements for each analytical schedule.	
Analytical Services Request form(s) and example of a completed form.	
Groundwater field form (and an example of completed form) and well-inventory form.	
	• Completed forms for any on-site analysis, for example, a tabulation sheet for each type of bacteria enumerated at the site (include example with date of sample, volumes filtered, dilutions, plate counts).
Historical data (last 5-10 years of record, if applicable):	
	• For example, water-level records, field-measurement and purge-volume records.
	• Statistical summary of historical water data:
	• Seasonal, maximum-minimum values.
Shipping:	
	• Shipping instructions and holding time requirements for each schedule.
	• Location of nearest post office or shipping agent.
	• Mailing labels to and from laboratory.
	• Shipping supplies (coolers, boxes, ice, packing material, tape, scissors).

Figure 6-2. Station Folder checklist for groundwater sites (modified from Figure 1-4 in Wilde [2005].

River and stream sites established at existing surface-water gaging stations commonly will need only supplemental information in addition to the Station Description created for the gaging station (Mastin, 2016). Station-description requirements for continuous water-quality stations are presented by Wagner and others (2006).

The electronic station folder is housed by Station ID on the WAWSC network either by Field Office, for stations managed by the Data Section, or by Studies Section project for non-Field Office stations. The station folder should be accessible during field trips, either electronically accessible or by transporting a paper copy of the station folder to and from the site. There are currently tools such in Site Information Management System (SIMS) and NWIS to facilitate this process. OWQ Technical Memorandum 2016.09 details the handling of electronic station and project files. The electronic site files are maintained by the Information Technology Services (IT) Section. The Project Chief is responsible for assuring that the site file and station folder are maintained for each data-collection site. Archiving is discussed in section, “9.2 Data Lifecycle”.

7.0 Discrete Water-Quality Samples

The WAWSC collects samples for chemical analyses from a variety of environmental matrices, including surface water, groundwater, precipitation, biological samples, sediment samples, and other types of miscellaneous samples. The primary objective in collecting a sample for chemical analysis is to obtain environmental data that are representative of the system being studied. Sampling and processing techniques for specific constituents vary by sample matrix and according to the general class of compound, such as inorganic or organic chemicals. If incorrect sampling procedures produce a non-representative sample, or if the sample is contaminated or degraded before analysis can be completed, the value of the sample is limited and the data are questionable. Therefore, compliance with documented and technically approved sample-collection and processing protocols is critical to ensuring the quality of the data. Although the emphasis of the rest of this section is for water quality sampling efforts, the content can be applied to all matrices collected for chemical analyses.

The Project or Field Office Chief is responsible for the quality of the data collected, and therefore is responsible for seeing that field personnel ensure the quality and integrity of the WAWSC’s discrete water-quality data in the following ways:

- Samples must be collected and processed according to prescribed USGS protocols, as described and referenced later in this section.
- All samples are processed at the field site, or, if unsafe conditions exist, samples are processed nearby or as soon as safe conditions exist.
- All samples are shipped to the laboratory from the field, when applicable, in an expedient manner to be received by the laboratory, according to guidance provided by the laboratory for each analyte or method.
- All samples are logged into NWIS (usually within 7 days of sample collection) prior to the completion of laboratory analyses and transmittal of the results back to the WAWSC.
- All analytical data are to be reviewed in a timely manner and within the required holding times for each analysis (to allow time for re-analysis), as soon as practicable and no later than April 1 of the water year following the water year of sample collection, in accordance OWQ Tech Memo 2012.03.
- Data Quality Indicators (DQI) for reviewed data are set to the appropriate code in accordance with OWQ Tech Memo 2012.03.

Review of sampling procedures for each WAWSC water-quality project is performed upon request by the WAWSC Water-Quality Specialist and is documented with a memorandum to the appropriate Project Chief and (or) Field Office Chief and the WAWSC Director. An independent review of field methods, for at least one WAWSC project, is conducted once every 3 years during the OWQ WAWSC technical review.

Figure 7-1 describes the flow of discrete water-quality data and records in the WAWSC.

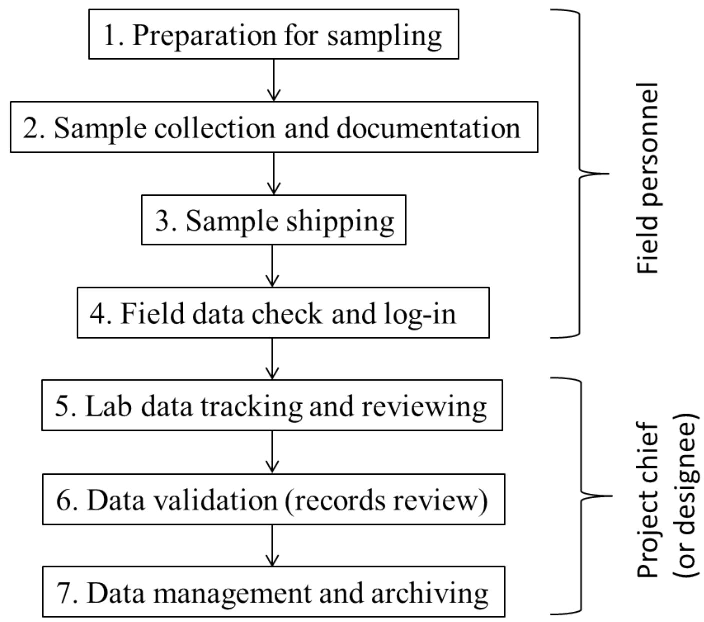

Figure 7-1. Discrete water-quality data processing flow-chart for Washington Water Science Center, November 2016.

7.1 Preparation for Sampling

Before commencing field activities, the Project or Field Office Chief should prepare a field sampling protocol, which may be an excerpt from the QAPP, workplan, or similar. The Project or Field Office Chief selects and indicates in the protocol the appropriate sampling and processing equipment to be used, according to guidance in chapter A2 of the NFM (Wilde, 2004) and Horowitz and others (1994). Sediment sampling equipment design criteria and guidelines are described in Davis (2005). Water-quality sampling equipment, including suspended-sediment sampling equipment, is selected based on the constituents being collected, the type of analyses that are to be performed, and site conditions (for example, velocity and maximum depth of water). Review of equipment selection and sampling protocols by WAWSC technical specialists occurs during proposal and workplan review and during periodic project reviews.

All field personnel must review and follow the sampling protocol for each site. When possible, the Project Chief should assign a lead technician who coordinates the following preparations:

1. Ensure that a site file has been established or is current in NWIS.
2. Prepare bottle packs and labels, including station ID, sample date/time, bottle type, and laboratory codes/schedules.

3. Establish site information and laboratory Analytical Service Request (ASR) form templates using the Personal Computer Field Form (PCFF; https://water.usgs.gov/usgs/owq/pcff.html) or creating paper field forms (https://water.usgs.gov/usgs/owq/Forms.html). If using a non-NWQL laboratory, request the ASR-equivalent from the laboratory. The field form template can be customized for project-specific needs, and should be reviewed by the Water-Quality Specialist. The WAWSC Sediment Field Form (appendix D) must be used during sediment collection.
4. Create and check a site-specific equipment list to ensure that necessary supplies are available, for example, bottles, standards, filters, preservatives, meter batteries, waterproof markers, or shipping containers.
5. Clean and prepare all sampling and processing equipment, per chapter A3 of the NFM (Wilde, 2004). For inorganic analyses, this typically involves a phosphate-free soap scrub, tap water rinse, dilute acid soak (for non-metal equipment), and DI or blank water rinse. For organic analyses, the acid soak is replaced by a methanol rinse. For both the inorganic and organic cleaning procedure, the equipment is allowed to air dry (Wilde, 2004, chap. A3, fig. 3-1). All new equipment acquired for water-quality sampling, as well as equipment that has been in long-term storage, must be cleaned before being used in the field. Similarly, equipment must be cleaned as soon as possible after sample collection and before being used again to avoid cross-contamination between sampling sites. The field rinsing of equipment only with site water just prior to sample collection is not a substitute for proper cleaning.
6. Conduct equipment blank sampling. An equipment blank is obtained by processing appropriate blank water under controlled conditions in the WAWSC laboratory through each component of the sample collection and processing equipment (Horowitz and others, 1994; Wilde, 2004). An equipment blank is a particular type of blank sample that is used to verify that the cleaning of sampling and processing equipment is sufficient for removing contamination and sample handling is not introducing contamination to a sample. Equipment blanks, collected in the office laboratory, are required (1) annually, (2) when a cleaning procedure is followed for the first time, and (3) when new equipment will be used for the first time. Equipment blanks for new projects or studies are collected well in advance of sampling to allow for review and assessment of the blank data prior to data collection activities and annually thereafter. Equipment blanks that indicate detections of constituents at environmentally-relevant levels for the project objectives require submission of blanks for individual components of the equipment to isolate the source of contamination. When the source of contamination has been determined, the necessary maintenance must be performed to eliminate contamination, or the equipment must be replaced. The WAWSC Water-Quality Specialist monitors the results of annual equipment blanks and ensures compliance with WAWSC standards.
7. Check meters and sensors for proper performance and calibration. Refer to the manufacturer's manual and request training from the Laboratory or FSU Manager or the Water-Quality Specialist as needed. See table 7-1 for calibration acceptance criteria.

Further information regarding preparations for water sampling is available in Chapter A1 of the NFM (Wilde, 2005).

Table 7-1. Summary of calibration information for water-quality instruments used to discretely measure selected parameters in the U.S. Geological Survey Washington Water Science Center.

[**Abbreviations:** DO, dissolved oxygen; FSU, Field Services Unit; MCFO, Mid-Columbia Field Office; NIST, National Institute of Standards and Technology; NWFO, Northwest Washington Field Office; °C, degrees Celsius; TWRI, Techniques for Water Resources Investigations; UCFO, Upper-Columbia Field Office; WAWSC, Washington Water Science Center; WWFO, Western Washington Field Office; <, less than; ≤, less than or equal to; ±, plus or minus; mg/L, milligram per liter; mm, millimeter; mV, millivolt; µm, micrometer]

Parameter	Calibration method used	Acceptance criteria and response if not acceptable	Calibration frequency and location	Responsible person	Reference for calibration and use
Tempe-rature	Comparison to an annually NIST-certified thermometer	Within ±0.2 °C, otherwise troubleshoot, return to supplier or discard.	Annual 5-point calibration in WAWSC Laboratory (for WWFO, NWFO, and Studies) or Mid-Columbia FSU (for MCFO and UCFO); Quarterly 2-point calibrations.	5-point calibrations by WAWSC Laboratory Manager (WWFO, NWFO, Studies) or MCFO FSU Manager (MCFO and UCFO); 2-point calibrations by field personnel.	Wilde, 2006; see manufacturer's instructions.
Specific – conductance	2-point calibration with known standards bracketing expected values.	After adjusting instrument to first standard value, acceptable range of second standard check is within ±5 percent, otherwise repeat calibration procedure, then troubleshoot or replace probe.	Daily in field, if appropriate, prior to taking measurements.	Field personnel.	Radtke and others, 2005; see manufacturer's instructions.
pH	Two-point calibration, bracketing expected values	Adjustment in pH 7 buffer ≤0.05 pH units and mV readings between +10 and -10 mV; otherwise, recondition or replace probe. After immersion in second buffer, electrode slope response between 95 – 102 percent of theoretical slope. pH 4 buffer: +165 and +195 mV. pH 10 buffer, -165 and -195 mV. If not, clean, recondition, re-calibrate. Replace probe.	Daily in field, if appropriate, prior to taking measurements.	Field personnel.	Ritz and Collins, 2008; see manufacturer's instructions.
Dissolved oxygen	Calibration at 100 percent oxygen saturation, checked at zero DO, air-saturated water preferred.	Within ±0.2 mg/L or 2 percent of computed 100 percent DO saturation value. Zero-DO solution <0.2 mg/L. Otherwise, replace membrane (if applicable) or replace the probe.	Prior to taking measurements, either at the station or in the WAWSC laboratory. Zero DO is typically measured in the WAWSC laboratory only.	Field personnel.	Rounds and others, 2013; see manufacturer's instrutions.

Parameter	Calibration method used	Acceptance criteria and response if not acceptable	Calibration frequency and location	Responsible person	Reference for calibration and use
Barometric pressure	Mercury barometer	Within 1 mmHg of annually-calibrated hand-held barometer.	Annually.	Laboratory/FSU Manager or field personnel.	Rounds and others, 2013; see manufacturer's instructions.
Turbidity	At least 2 standards, bracketing expected values; formazin-based calibration standards preferred over polymer standards.	0 DI water standard ±0.5 turbidity units; higher standards per manufacturer guidelines, variable between 5–10 percent. Otherwise, clean optical surface and re-check. If calibration is possible, re-calibrate. If not, return to manufacturer for calibration.	Daily, prior to taking measurements.	Field personnel.	Anderson, 2005.

7.2 Field Measurements

Routine field measurements include water temperature, dissolved oxygen concentration, specific conductance (conductivity), pH, and alkalinity. Other types of measurements that also may be necessary for specific projects include air temperature, barometric pressure, acid neutralizing capacity, reduction-oxidation potential (Eh), and turbidity. Procedures for collecting field measurements in surface-water and groundwater systems are provided in chapter A6 of the NFM (Wilde, variously dated), including a section on the use of multi-parameter sondes for field measurements (Gibs and others, 2012). Field measurements should represent, as closely as possible, the natural conditions of the system at the time of sampling. Therefore, the location of sonde deployment should be considered carefully and a sufficient number of measurements should be collected to ensure representative conditions. To ensure quality of the measurements, calibration within the range of field conditions at each site is required for most instruments (table 7-1). Instrument calibrations are documented electronically or in dedicated instrument logbooks as described in section, "5.3 Water-Quality Instruments," of this report and chapter A6 of the NFM (Wilde, variously dated).

Field-measurement data, including methods, equipment, and calibration information are recorded while in the field. Field-measurement data are stored either electronically, for example, on the PCFF (http://water.usgs.gov/usgs/owq/pcff.html), which is preferred, or on paper field forms (http://water.usgs.gov/usgs/owq/Forms.html). The Project or Field Office Chief is responsible for reviewing paper and electronic field records for completeness. To avoid the loss of data because of possible instrument malfunction, the Project or Field Office Chief should ensure that backup sensors or instruments are readily available and in good working condition.

To maintain proficiency and document the quality of field measurements, all WAWSC personnel responsible for water-quality sample collection and field analysis must participate in the National Field Quality Assurance (NFQA) Program (Stanley and others, 1992) for pH and specific conductance. If applicable, the NFQA test also will include alkalinity. Results of the NFQA Program are reviewed by the WSFT Water-Quality Specialist and the WAWSC Water-Quality Specialist. Staff receiving an unsatisfactory rating will be required to satisfactorily analyze a follow-up (Round 2) NFQA sample. Staff unable to receive a satisfactory rating on both the initial and follow-up NFQA samples must retrain in that field measurement and demonstrate the ability to produce an accurate measurement before they may continue collecting water-quality data.

7.3 Sample Collection

7.3.1 Surface-water, Groundwater, and Other Water Samples

Guidelines for the collection of surface-water, groundwater and other water samples are provided in chapter A4 of the NFM (U.S. Geological Survey, 2006). Field personnel are responsible for examining the sampling site carefully and choosing the most appropriate sampling method to collect the best, most representative sample possible under the conditions at the time of sampling. The standard procedure for stream sampling is to collect the sample through the entire depth of the water column at multiple vertical transects by either the equal-discharge increment (EDI) or equal-width increment (EWI) method. These procedures are used to collect a representative cross-sectional sample that is both flow-weighted and depth- and width-integrated (Ward and Harr, 1990; OWQ Technical Memorandum 99.02; Edwards and Glysson, 1999). Occasionally, the use of non-integrated or non-flow-weighted methods may be appropriate because of hydrologic, climatic, or safety conditions, or specific project objectives. The use of non-standard sampling methods, such as dip samples from the centroid, may be acceptable when extreme flood or other conditions preclude the collection of the standard sample. Thorough documentation of sampling equipment and methods that are used is required in field records associated with water-quality samples.

Groundwater sampling procedures (U.S. Geological Survey, 2006) are designed to ensure that the samples represent the water in the aquifer and are not contaminated by well construction material or sampling equipment, and that the composition of the samples is not altered by physical or chemical processes during sampling. It is critical that field personnel are aware of all the factors that can compromise the integrity of groundwater samples and implement consistent strategies to protect sample integrity, for example, by sampling at points prior to a point-of-use treatment system. The standard procedure for groundwater sampling is to purge the well to remove at least three well volumes of standing water while monitoring field measurements for stabilization. However, exceptions to the three-well-volume rule can be made under some circumstances, depending upon project objectives and site characteristics.

At surface-water and groundwater sites, field personnel follow a prescribed order of sample collection, described in Chapter A4 of the NFM (U.S. Geological Survey, 2006), to help ensure the quality of the data collected. In addition, two-person sampling teams are required to implement coordinated clean-handling techniques when collecting water samples for trace elements with ambient concentrations at or near 1 µg/L or when aluminum, iron, or manganese ambient concentrations are up to about 200 µg/L (U.S. Geological Survey, 2006). The two-person sampling protocol may be modified as appropriate for studies in which low-level trace elements are not measured. Such modifications are reviewed and approved by the Water-Quality Specialist during proposal and workplan development. Additional clean-handling techniques should be followed as described in Chapter A5 of the NFM (Wilde, 2004) when sampling for other low-level (parts per billion) analytes such as pharmaceuticals, wastewater indicators, and low-level mercury.

Samples for total organic carbon (TOC) and dissolved organic carbon (DOC) must be collected using equipment that has not been methanol-cleaned, which is a chronic source of contamination. A separate grab sample should be collected into a baked glass container directly from the surface water or directly from the groundwater sampling point (that is, the faucet or end of monitoring well tubing) rather than sampling for carbon from the composited sample in a methanol-cleaned churn splitter or through the methanol-cleaned groundwater sampling manifold. If methanol-cleaned equipment must be used to collect samples for DOC analysis (for example, from well pump tubing), extra QC measures and documentation must be included as described in Chapter A5 of the NFM (Wilde and others, 2004).

Additional factors must be considered during sample collection for still- or open-water locations such as lakes and reservoirs (Green and others, 2015), wetlands, estuaries, and coastal waters. When possible, sample collection protocols for other water sites, such as springs, municipal supply or production wells, wastewater plants and other facilities, and stormwater conveyance systems, should follow the protocols described in chapter A4 of the NFM (U.S. Geological Survey, 2006) for surface-water and groundwater sample collection. Modifications to sampling protocols may need to be implemented, and should be thoroughly documented.

7.3.2 Precipitation

Specific procedures in the WAWSC for collecting precipitation samples are based primarily on the study objectives. Major factors that must be considered when sampling for precipitation chemistry include the location of sampling stations relative to human and natural influences, such as traffic, point sources of air emissions, overhanging trees and vegetation. Other considerations involve the choice of sampling equipment, and special sample-handling procedures that may be necessary. A major decision is whether to collect wet-only samples, requiring an automated wet-only precipitation sampler, or bulk deposition samples where the sampler is exposed to precipitation and dry deposition between precipitation events. Integrated snowpack sampling is another form of precipitation sampling possible where a seasonal snowpack develops. Precipitation chemistry sampling equipment should be composed of inert, nonabsorbent material that will not affect the typically low concentrations of analytes in solution.

Guidelines regarding the collection of precipitation samples are provided in the following references which set standards for sites in the National Atmospheric Deposition Program precipitation chemistry networks:

1. Site Selection and Installation Manual
2. National Trends Network Site Operation Manual—major ions, nutrients, acid anions in precipitation
3. Mercury Deposition Network Site Operation Manual—total and methyl mercury in precipitation

The current version of these and other precipitation-related manuals is available at the National Atmospheric Deposition Program website (http://nadp.sws.uiuc.edu/lib/manuals.aspx).

The USGS BQS operates a Precipitation Quality Assurance Project. Project personnel and project publications should be consulted for guidance on general QA techniques and approaches when sampling precipitation chemistry. Project and contact information are available at the BQS Precipitation Chemistry Quality Assurance Project web page (http://bqs.usgs.gov/Precip/).

Precipitation sampling can involve as many variables and constituents as any other water-quality project, with unique factors associated with precipitation collection. The project proposal and workplan should be consulted for specific guidelines regarding the factors that must be considered in choosing the sample location, the sampling equipment and frequency, and the special sample handling procedures that may be necessary based upon the study objectives.

7.3.3 Biological Sampling

Water-quality activities in the WAWSC can include the collection of biological samples. Biological samples include bacteria, viruses, protozoa, chlorophyll, phytoplankton, periphyton, benthic invertebrates, fish, and tissue (Crawford and Luoma, 1993). In some cases tissue-surrogates, such as passive samplers, are used to evaluate contaminant concentrations that can occur at concentrations below levels that can be analyzed in conventionally-collected samples (Alvarez, 2010). Measurements related to ecological conditions also may include evaluations of stream habitat. Sampling procedures are described in Chapter A7 of the NFM (U.S. Geological Survey, variously dated) and Moulton and others (2002). The WAWSC Water-Quality Specialist can answer questions or re-direct questions to WAWSC biologists regarding sampling procedures, documentation, and QA related to biological sampling.

7.3.4 Suspended-Sediment and Bottom Material

Water-quality activities in the WAWSC include the collection of suspended-sediment and bottom-material samples. The WAWSC adheres to policies related to sediment set forth by the Office of Surface Water (OSW), including quality assurance for the collection and processing of sediment samples (Knott and others, 1993). Fluvial sediment concepts and collection techniques are described in Guy (1970) and Edwards and Glysson (1999), respectively. WAWSC personnel collect suspended-sediment data using a variety of techniques that include the single vertical, EDI, EWI, or the point-sample methods. At times, observers are hired and trained to collect samples. The sediment-records technician and the field technician ensure quality of observer-collected samples.

Policy for the collection and publication of bedload data is provided in OSW Technical Memorandum 90.08. Three cross-sectional procedures are used for bedload sampling: the Single EWI method, the Multiple EWI method, and the Unequal Width Increment method. The field personnel are responsible for selecting the equipment and procedure that are optimal for the local conditions. Typically, bedload samples are highly variable from one event to another, and even from one pass to another within the sample collection event. Generally, until sampling variability for a particular site is understood, point samples across the cross section are analyzed individually.

Sample collection of bottom-material samples for physical (for example, grain size distribution) or chemical analysis is described in Chapter A8 of the NFM (Radtke, 2005) and Shelton and Capel (1994). The WAWSC also collects suspended-sediment for chemical analysis using continuous-flow centrifugation (Conn and others, 2016), passive samplers, and filtration.

Suspended-sediment and bedload samples are typically analyzed by the USGS Cascades Volcano Observatory (CVO) Sediment Laboratory for concentration and either sand to silt distribution (also referred to as "sand break") or complete particle-size distribution per Guy (1969). Suspended sediment and bedload samples may be analyzed individually or as composites. Samples for both suspended sediment and bottom sediment may be analyzed for chemical constituents, including trace elements or organic compounds.

Field personnel should consult the project workplan for specific guidelines for sediment sampling, depending on project objectives. Care and maintenance of the sediment collection equipment is the responsibility of the field personnel that use the specific equipment. The HIF stocks replacement parts such as nozzles and seals. Damaged equipment is returned to HIF for repair. Surface-Water Specialist are responsible for ensuring that appropriate equipment is used at all sampling sites.

Individuals who have questions regarding the collection and handling of sediment samples should contact the Surface Water Specialist. For particular questions concerning sediment chemistry samples, laboratory analyses, and sediment data management, contact the Water-Quality Specialist.

7.3.5 Quality-Control Samples

Quality-control (QC) samples, such as field and laboratory blank, replicate, and spike samples, are collected as integral components of all water-quality studies to determine the acceptability of performance in the data-collection process and provide a basis for evaluating the acceptability of performance and procedures used to obtain data. Guidelines for the collection of specific types of QC samples and the use of QC data are provided in Chapter A4 of the NFM (U.S. Geological Survey, 2006). Specific guidelines for the collection and processing of QC samples must be included in the project workplan. The Project or Field Office Chief is responsible for reviewing QC data in a timely manner and implementing necessary modifications, when appropriate, to sampling and processing techniques. The WAWSC Water-Quality Specialist has the responsibility for advising WAWSC personnel regarding the collection and interpretation of QC samples. WAWSC personnel (Project Chief or Field Office Chief) overseeing the collection of water-quality data should attend the USGS National Training Center (NTC) course QW2034, Quality-Control Sample Design and Interpretation (http://water.usgs.gov/usgs/owq/training.html).

7.4 Sample Processing and Preservation

All water-quality samples are processed at the field site according to procedures described in Chapter A5 of the NFM (Wilde and others, 2004) and as soon as possible following collection. Processing procedures may require deviations from those described in the NFM to properly prepare samples for the constituents of interest or to meet the study objectives. Any deviation from the procedures in the NFM are described in the project workplan. All WAWSC water-quality studies that include the analysis of trace elements in concentrations less than 10 parts per billion (ppb) must use the protocols for sample processing as described in Wilde and others (2004). These techniques require the use of processing and preservation chambers to reduce the potential for contamination from the surrounding environment during sample splitting, filtration, and preservation. Review of sample processing procedures for all water-quality projects occurs during proposal and workplan review and during periodic project reviews by the WAWSC Water-Quality Specialist.

Guidelines for using sample compositors and splitters are in Chapter A5 of the NFM (Wilde and others, 2004). Two types of sample splitters presently in use in the WMA are the churn splitter, which also serves as a compositing device, and the cone splitter, which requires a separate compositing vessel. Each splitter has specific advantages and disadvantages, as described in OWQ Technical Memorandum 97.06. Either splitting method can be applied to inorganic and organic constituents within the technical design limits of the device, provided the equipment is constructed of appropriate materials and properly cleaned.

Filtration is required for many water-quality samples to remove particulates from the water. Selection of the appropriate filter unit and filter characteristics to be used depends on the constituent class of interest and is based on guidance provided in Chapter A5 of the NFM (Wilde and others, 2004). Guidelines for filtration procedures for specific constituent groups are provided in Chapter A5 of the NFM (Wilde and others, 2004). For surface water, the most common filtration system consists of a variable-speed battery-operated peristaltic pump and 0.45-micron pore size disposable capsule filter. For groundwater, the sample is generally pumped directly from the well through a 0.45-micron pore size disposable capsule filter. Parameters requiring filtration through a 0.45-micron include trace elements, mercury, major ions, and nutrients. Filtration of samples for analysis of trace elements in concentrations less than 10 ppb must be done in a processing chamber that encloses the filtering unit and sample bottles in a protected environment (Wilde and others, 2004). Recently (January 2017), a possible nitrogen contamination issue was discovered related to Pall Versapor® GWV High Capacity capsule filters that were pre-conditioned with blank water and stored for any length of time before use. Until further testing is complete, these filters must be used immediately after conditioning.

Surface-water and groundwater samples collected for pesticides are collected in a baked glass jar from the churn or well and are filtered through a disposable 25-mm syringe-tip filter per Section 5.2.2.B of Chapter A5 of the NFM (Wilde and others, 2004). This procedure has largely replaced the use of plate filters; however, other organic analysis may require the use of an aluminum plate filter with a 0.7-micron glass fiber filter. Surface-water samples are pumped through Teflon® tubing using either a ceramic-piston valveless metering pump or Teflon® diaphragm pump head on a peristaltic pump.

Groundwater samples collected for filtered organic analysis are pumped directly from the well through Teflon® tubing through an aluminum plate filter with a 0.7-micron glass fiber filter or a 47-mm diameter Teflon® filter unit with a 0.7-micron glass fiber filter (Wilde and others, 2004). The NFM (Wilde and others, 2004, chap. A5) recommends that filtration of samples for organic analysis take place in a processing chamber that encloses the filtering unit and sample bottles in a protected environment.

Surface-water and groundwater samples collected for analysis of particulate carbon are filtered through triplicate 25-mm glass-microfiber filters as described in Chapter A5 of the NFM (Wilde and others, 2004). Samples for DOC are filtered through either a 25-mm or capsule filter as described in the NFM (Wilde and others, 2004). Samples for these carbon parameters must be processed with equipment that has **NOT** been cleaned with methanol, which requires separate dedicated pump tubing, filtration unit, and filter. If methanol-cleaned equipment must be used to collect samples for DOC analysis (for example, from well pump tubing), extra QC measures and documentation must be included as described in Chapter A5 of the NFM (Wilde and others, 2004).

Processing of other miscellaneous samples should follow the project workplan and the NFM, for example, Chapter A7 of the NFM (U.S. Geological Survey, variously dated) for lake and estuary samples. The WAWSC Water-Quality Specialist and the USGS Water Science Field Team can provide guidance to the Project Chief regarding appropriate protocols.

Sample preservation techniques, such as chilling, freezing, acidifying, and adding formalin, are required for some constituent groups to prevent changes in or loss of target analytes. Guidelines for sample preservation are provided in Chapter A5 of the NFM (Wilde and others, 2004). Because some samples, such as those for bacterial and nutrient analyses, have a very limited holding time even when properly preserved, field personnel must ensure all water-quality samples are shipped to the laboratory as quickly as possible. For details on sample shipping requirements, see section, "7.7 Shipping."

7.5 On-Site Documentation

During a sampling trip, accurate notes MUST be recorded on the PCFF (http://water.usgs.gov/usgs/owq/pcff.html) or paper field forms (http://water.usgs.gov/usgs/owq/Forms.html). The WAWSC Sediment Field Form (appendix D) must be used during sediment collection. Field notes should include, at a minimum, site identification, field personnel names, date, time, sampling equipment, method, type of event, and relevant environmental conditions (including any changes in condition from previous sampling events) and other notations that may impart important information relevant to assessing any unusual chemical characteristics occurring in collected samples or measured field parameters. The discharge and (or) gage height at a co-located streamgage or groundwater level also should be recorded. Original observations should not be erased; data are corrected by crossing out original observations and writing the correct information near the original value.

Sample bottles MUST be labeled and handled appropriately for the intended analysis. Poor sample handling and labeling may result in mislabeled bottles, erroneous data, or destroyed samples. The Project Chief or Field Office Chief is responsible for ensuring that all of the following requirements are implemented by all personnel involved in sample collection:

- Samples are in the required container type and clearly labeled (using a permanent, waterproof marker or preprinted label) with the station identifier, sample date, sample time, bottle type designation, and laboratory schedule.
- Preservative, if required, is applied immediately.
- Field notes are completed before leaving the site, including any instrument calibration information, lot numbers for blank water and preservatives, and documentation of all sampling circumstances and any deviation from standard USGS collection protocols.

7.6 Safety Issues

Because the collection of water-quality data can occur under hazardous conditions, the safety of field personnel is a primary concern. Field teams often work in areas of high traffic, remote locations, and under extreme environmental conditions. Field work involves the transportation and use of equipment and chemicals, and commonly requires working with heavy machinery. Additionally, field personnel may come in contact with snakes, insects, waterborne and airborne chemicals, and pathogens while sampling. Beyond the obvious concerns regarding unsafe conditions for field personnel, such as accidents and personal injuries, the quality of the data also may be compromised when sampling teams are exposed to dangerous conditions. The Project Chief must complete a JHA during proposal development for each new project, which describes significant safety concerns related to the project and how the safety concerns will be addressed, including training, equipment, and other actions.

So that personnel are aware of and follow established procedures and protocols that promote all aspects of safety, the WAWSC communicates information and directives related to safety to all personnel. A Collateral-Duty Safety Coordinator has been designated by the WAWSC. The duties of the Safety Coordinator include serving as a primary focal point for all safety issues, reviewing each project's JHA, coordinating and conducting training and inspections, identification and abatement of hazardous conditions, and promoting safety throughout the WAWSC. Personnel who have questions or concerns pertaining to safety, or who have suggestions for improving some aspects of safety, should direct those questions, concerns, and (or) suggestions to their immediate supervisor or the Safety Coordinator, as appropriate. Training is provided by contract trainers (for example, Hazardous Waste Operation, First Aid, and CPR) or by in-house training classes (for example, hazard communication and laboratory safety).

Guidelines pertaining to safety in field activities are provided in the NFM (Lane and Fay, 1997, chap. A9), Water Resources Policy Memorandums related to safety, and the Department of Interior Safety webpage (https://safetynet.doi.gov/) .

7.7 Shipping

Samples are packaged and shipped to the laboratory for analysis as soon as practical, preferably the same day as collected. The Data Collector should be aware of sample hold times and plan accordingly. For example, samples for some bacterial analysis need to be processed within 24 hours of sampling, and results are determined 24 hours after that. Therefore, sample collection should be planned to occur in the afternoon, Monday–Wednesday, then shipped the same day to arrive at the laboratory the next morning. When possible, avoid shipping ice coolers on Thursdays and Fridays to minimize the chances of a late (warm) sample delivery to the laboratory.

Field personnel should identify nearby shipping locations and the final ship time of the day when planning field trips. Generally, the shorter the time between sample collection and processing and sample analysis, the more reliable the analytical results will be. Before shipping samples to the laboratory, the Project or Field Office Chief or designated lead field technician should complete the following:

1. Check that sample sets are complete and that sample bottles are labeled correctly, with all required information (Station ID, date/time, bottle type, and laboratory codes/schedules).
2. Complete the ASR's for all samples being sent to the NWQL (or equivalent form for non-NWQL labs).
3. Follow the packing and shipping protocols established by the USGS and the receiving laboratory (NWQL Technical Memorandum 2011.01) to avoid bottle breakage, shipping container leakage, and sample degradation. This includes the following protocols:

   a. Line all shipping containers, including those without ice, with a layer of foam on the bottom then doubled heavy-duty plastic bags.
   b. Check that bottle caps are secure.
   c. Pack each glass bottle in a foam sleeve or bubble wrap inside its own plastic bag.
   d. Pack acidified samples separately from non-acidified samples.
   e. Include sufficient ice to maintain sample temperatures at or below 4 °C until the samples are unpacked at the laboratory, but do not exceed maximum shipping weights (usually around 50 pounds).
   f. Tie the doubled plastic bags and fill any extra space with packing material.
   g. Place the ASR(s), a return shipping label (with shipping account number), and other paperwork, as appropriate, in a sealed plastic bag and attach it to the inside of the cooler lid.
   h. Tape the cooler shut. Seal the cooler spigot, if applicable, to avoid leakage from melting ice during shipping.
4. If shipping on Thursday or Friday, the "Saturday delivery" box must be checked on the shipping form. Saturday delivery to the NWQL is suspended during the winter (typically from October to March).
5. Obtain authorization from the laboratory before shipping highly contaminated or potentially hazardous samples for analysis. These coolers are typically identified to the laboratory with yellow duct tape on the outside of the cooler.
6. Shipments that contain dry ice (for example, chlorophyll and some isotope samples) are regulated by the U.S. Department of Transportation and the International Air Transport Association and require certification of the person preparing the shipment, use of non-airtight foam, and a black-and-white diamond label on the shipping container. Refer to shipper's guidance, for example, FedEx® Dry Ice shipping guidance (http://images.fedex.com/us/services/pdf/Dry_Ice_Job_Aid.pdf).
7. Follow U.S. Department of Agriculture regulations when shipping "regulated soils" to any laboratory across state lines.

WAWSC samples collected by the WWFO or Studies personnel for analysis at the CVO Sediment Laboratory typically are stored in the Western Washington Laboratory sediment room (located on the second floor of WAWSC by the back door to the alley) and periodically directly transported to CVO by WAWSC personnel. Sample collectors should coordinate sediment sample delivery through the WAWSC Laboratory Manager.

7.8 Data Log-In and Storage

Information pertaining to the collection of samples and field measurements are recorded in PCFF or on appropriate water-quality field forms and are considered the original record. The field technician reviews the PCFF file(s) and field forms for accuracy. After review, the field technician enters the data into the NWIS QWDATA database (U.S. Geological Survey, 2012a). The data are logged into NWIS either manually through QWDATA or electronically using PCFF or SedLOGIN using the Water-Quality Data Transfer System (QWDX), within 7 days of sampling, preferably sooner. The NWIS is the storage medium for all water-quality, streamflow, well, and water-use information collected by the USGS. Data that cannot be stored in these national databases must be stored in other open-access databases, such as EROS and ScienceBase.

The following header information must be logged in for every sample:

- Station ID
- Start date (and end date, if applicable)
- Start time (and end time, if applicable)
- Medium code (for example, WS, WG, and OAQ; see table 1 of the NWIS Manual, appendix A)
- Sample type (for example, 9 = Regular, 7 = Replicate, and 2 = Blank; see table 4 of the NWIS Manual, appendix A)

Other necessary log-in information includes:

- Project Code (PRJCT; assigned at the start of the project by the Project Chief to aid data tracking and review at the WAWSC).
- Field parameter data (for example, pH, specific conductance, discharge, and water level).
- Other codes (such as sample purpose, sampling method, sampler type, and (or) splitter type).
- Codes for associated quality-control samples.
- Environmental sample data are entered into the WAWSC NWIS QWDATA Database 1 and Quality Control samples (that is, replicates, blanks, and cross-sectional measurements) are logged into Database 2. Common codes are available on the last page of the Water-Quality Field Forms (http://water.usgs.gov/usgs/owq/Forms.html), available on the internal OWQ website. The Project or Field Office Chief should provide a log-in coding sheet to field personnel to ensure log-in consistency throughout a project and across projects.

A unique record number is generated in NWIS for each sample that is logged in. The technician logging in the data is responsible for recording the record number (and whether it is Database 1 or 2) on the field form and in the sample tracking log (see section, "7.9 Sample Tracking").

After the data have been logged in, the field technician should retrieve the records from NWIS and cross check the data against the field form and ASR for errors. If there is an error in the sample header information, make the correction in NWIS and notify the laboratory (for NWQL, labhelp@usgs.gov or lablogin@usgs.gov). Notifying the laboratory is necessary so that the analytical data can be matched and loaded correctly into NWIS.

Finally, the field technician places the original field data by Station ID or Project so it can accessed by authorized WAWSC personnel and preserved for archive. The field data includes, for example, the field form, sensor calibration information, ASRs, and electronic data logger files. A Sediment Laboratory Analysis Request (SLAR) is generated when suspended- or bed-sediment samples are logged in through SedLOGIN. A copy of the SLAR should be stored with the sediment samples being sent to CVO and a second copy should be stored in the site or project folder. Original paper records at the WAWSC (primarily generated for water-quality studies) are stored by Station ID or Project in filing cabinets located on the 2nd floor of the WAWSC Tacoma office. The WAWSC is transitioning to an electronic directory structure for data storage and archiving. Original electronic records at the WAWSC (generated for all continuous and discrete stations managed by the Data Section) are stored by Station ID within the appropriate Field Office directory. Electronic records from projects run by the Studies Section are stored within the Studies folder. The server is backed up weekly, with partial back-ups of changed files throughout the week.

It is important that a record is created for each sample as soon as possible after sampling. Analytical results from analyzing laboratories must match an existing record header in NWIS, otherwise it will not properly load into NWIS and must be corrected by the WAWSC (see section, "7.9 Sample Tracking").

7.9 Sample Tracking

The Project or Field Office Chief is responsible for tracking samples that have been submitted for analysis to determine if analyses are missing and for taking corrective action(s), such as re-run requests, if necessary. The following is a summary of the WAWSC tracking system:

1. The Project Chief or Field Office Chief maintains a sample tracking log, by project, of all samples collected and shipped to a laboratory for analysis.
2. Field personnel update the sample tracking log with shipping dates and log-in notes. The NWQL sends a log-in email to the sample shipper (if a name/email was included on the ASR) and the WAWSC Water-Quality Specialist, documenting the laboratory receipt of the samples, which includes date, sample temperature, and any comments at log-in. The field technician must resolve any log-in errors and update the sample log (for example, noting warm samples or improper preservation of samples). As needed, the field technician should modify future sampling and shipping procedures to minimize missed hold times or improper preservation.
3. The QWDBA ensures that the biweekly (Monday and Thursday morning) retrieval of analytical data by the Washington NWIS database, NWISWA, has run successfully. The QWDBA works with the IT Services Section to separate data by PRJCT into a file called a “watlist”, store each project’s watlist on the Washington network, and notify the project’s designated contact by email. A watlist is generated each time a record is updated (for example, with new analytical results).
4. The Project or Field Office Chief (or designee) reviews the new watlist(s) each time an email is received (up to twice weekly) indicating that new data are available.
5. The Project or Field Office Chief works with the QWDBA to rectify data from the laboratory that could not be entered into NWIS because it did not match an existing header.
6. The Project or Field Office Chief tracks sample status to ensure analytical holding times were not exceeded and re-analyses were requested in a timely manner. Re-analysis requests are made to NWQL. The requester should also update the sample tracking log to track re-analysis results. The re-analysis result(s) will be emailed from the laboratory to the requestor. If, upon review, it is determined that the re-analysis result should replace the original result, the reviewer should reply by email to request that the re-analysis results be loaded into NWIS. The resulting watlist will list both the P (previous) data value and U (updated) data value, and should be archived because only one value is stored in NWIS.
7. The original watlists retrieved from NWIS are maintained in the UNIX directory for 1 year. After 1 year, the IT Services Section archives a copy of the original UNIX directory to maintain files of the original water-quality data. The NWIS QWDATA database receives daily incremental backups and weekly full backups.
8. Data analyzed by laboratories that are not in the QWDX system are entered into NWIS, if possible (Hubbard, 1992), and identified according to analyzing laboratory. Data entry is the responsibility of the Project of Field Office Chief (or designee) and described in section, “9.1 Data Management.”

When chain-of-custody procedures are appropriate or required (for example, when data may be used in legal proceedings), the Project of Field Office Chief should establish, maintain, and document a chain-of-custody system for field samples that is commensurate with the intended use of the data. A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. Every exchange of a sample between people or places that involves a transfer of custody should be recorded on appropriate forms that document the date, time, and person or location from which the sample was released and to which the sample was accepted. The standard USGS ASR is not a chain-of-custody form because it does have a custody section to record the sample exchanges. Each person involved in the release or acceptance of a sample should keep a copy of the transfer paperwork. The Project or Field Office Chief (or designee) is responsible for ensuring that custody transfers of samples are performed and documented according to the requirements listed here.

- The means for identifying custody should be clearly understood (for example, use of forms or stickers).
- Instructions for documenting the transfer of samples and the person responsible for this documentation must be clearly defined.
- A plan must be in place for maintaining records in a specific location for a specific period of time (for example, in the site folder).

Because laboratories should have their own internal chain-of-custody requirements, it is probably not necessary to include information on their procedures. However, individual projects may need laboratory chain-of-custody documentation, but this can be documented in the project workplan.

7.10 Validation (Records Review)

The Project or Field Office Chief (or designee) reviews and validates the water-quality and associated data for completeness and accuracy. All field notes and field measurements are reviewed for completeness and accuracy, ideally within 7 days after the field technician has logged in and cross-checked the data. The watlists are promptly reviewed as the data are returned from the laboratory so that re-analysis requests can be made within sample holding times (see section, “7.9 Sample Tracking”). The watlist includes a copy of the analysis and a report of general validation checks (U.S. Geological Survey, 2012a), including but not limited to the:

- Comparison of determined and calculated values for dissolved solids.
- Comparison of dissolved constituents and total constituents.
- Comparison of specific conductance with dissolved solids, cations, and anions .
- Comparison of constituents with relevant Federal drinking-water standards.
- Comparison of sum of cations with sum of anions (ion balance).

The Project of Field Office Chief (or designee) compares field and laboratory analyses, such as pH, specific conductance, and alkalinity, to confirm agreement of independent measurements. If data from more than one sample are available for a site, the analysis also is compared with previous analyses within a hydrologic context to identify obvious errors, such as decimal errors, and possible sample mix-ups or anomalies warranting analytical re-analysis. These reports and comparisons are reviewed and noted (on the watlist, sample tracking log, or custom review tracking tool). If necessary, corrections or re-analysis may be requested by the Project or Field Office Chief.

When the analytical data have been returned, the Project or Field Office Chief retrieves data from NWIS and imports it into spreadsheets or statistical programs for further review. Some data review tools, such as summary statistics, plots, and diagrams are available in the Applications section of QWDATA. Project QC data, such as blanks, replicates, blind standards, and matrix spikes should be retrieved from Database 2 and periodically tabulated or graphed by the Project or Field Office Chief to facilitate identification of inaccuracies or systematic bias that may not be discernible when reviewing an individual analysis.

A variety of tools are available to assist with data review and validation, including:

- NWIS Reporting Application (https://reporting.nwis.usgs.gov/login.jsp).
- 1-week USGS QW Toolbox course (http://water.usgs.gov/usgs/owq/qw/toolbox/).

- WQ-Review (https://github.com/USGS-R/WQ-Review)—ideal for long-term monitoring sites.
- Other USGS water-quality software and scripts (http://water.usgs.gov/usgs/owq/software.html).
- Commercial visualization products, such as JMP (http://www.jmp.com/en_us/home.html) and Spotfire (http://spotfire.tibco.com/).

Corrective actions, such as further qualifying the data or rejecting values with known error (that is, setting the Data Quality Indictor [DQI] code to "Q" [reviewed and rejected]) are determined by the Project or Field Office Chief. No data are deleted from the database without the consent of the WAWSC QWDBA and Water-Quality Specialist.

After validation, the Project or Field Office Chief notifies the WAWSC QWDBA that the data has been reviewed and validated. The QWDBA finalizes the data record in NWISWA by setting the DQI code from "S" (provisional) to "R" (reviewed and approved) or "Q" (reviewed and rejected). These and other DQI codes are described in appendix A of the NWIS User Manual (http://nwis.usgs.gov/nwisdocs5_2/qw/QW.user.book.html) and OWQ Technical Memorandum 2016.07. The Project or Field Office Chief (or designee) must review data and change DQI codes (with help from the QWDBA) in a timely manner as described on page 2 of OWQ Technical Memorandum 2012.03; specifically regarding field parameters and rapid turn-around laboratory results, "data can be reviewed, approved, and published in NWISWeb within days, weeks, or within a few months of sample or measurement collection." "More time may be needed for review and approval for those samples requiring time consuming laboratory analyses or for groups of related water-quality data that should be withheld from release to NWISWeb until they can be reviewed and approved together. Review and approval can be accomplished either by setting the sample-record analysis-status code to "I" (internal-use only), which will withhold all parameter-result data for that sample record from NWISWeb, or by changing any individual parameter-result DQI to "I" to withhold a particular result from NWISWeb. The review should begin following receipt of all sample data or groups of sample data. This interval should be short enough so that all data can be reviewed and, if approved, released to the public on or before April 1st of the following water year. For both options, after the review period the resulting data in NWISWeb should have a DQI code of 'R.' **This means that all discrete water quality data in NWISWeb should have a code of 'R' no later than and often well before April 1st of the year following the water year of sample collection."**

Review and approval of data should not be delayed until the end of a project during the interpretation and dissemination phase. In advance of biannual WAWSC project reviews, the QWDBA and Water-Quality Specialist will work with the Project or Field Office Chief to review data and flip DQI codes. The status of DQI codes, by Center, is available at the USGS Water-Quality User Group website (http://phoenix.cr.usgs.gov/usa/dqi/usamap.html).

Project management files, such as data analysis spreadsheets, are stored electronically under the Studies folder on the WAWSC network. A full backup is performed once a week and partial backups are performed Tuesday through Thursday. A full set of backup tapes are stored for at least 1 year. Backups are written to LT06 tapes. The server also provides "on-line" backups with the use of shadow copies that are made twice a day.

8.0 Continuous Water-Quality Monitoring

Continuous monitoring of water-quality parameters is a growing program at the WAWSC. Continuous water-quality parameters include water temperature, pH, specific conductance, dissolved oxygen, total dissolved gases (related to dam-controlled surface waters), turbidity, and nitrate. The primary objective of continuous water-quality monitoring is the same as discrete water-quality monitoring: to obtain environmental data that are representative of the system that is being studied. Compliance with documented and technically approved monitoring protocols is critical to ensuring the quality of water-quality data.

The Project or Field Office Chief is responsible for the quality of the data collected, and therefore is responsible for seeing that field personnel ensure the quality and integrity of the WAWSC's continuous water-quality data in the following ways:

- For flowing surface water, the site should be located in a section of the stream that is vertically and horizontally well-mixed and representative of the cross section being measured.
- Location of the sensors must be fully documented, in paper files and SIMS or a similar data management system.
- All pertinent information regarding the site, cross-sectional variability, equipment maintenance, and data shifts are fully documented and included in the station analysis file.
- Sites are operated as described by Wagner and others (2006), including inspection and calibration of monitors as frequently as required to obtain as complete a record as possible.
- Continuous records are processed in accordance with Water Resources Division (WRD) Policy Memo 2010.02.

Refer to Wagner and others (2006) for complete guidance on the operation and maintenance of continuous water-quality monitors. Major steps are summarized in this section.

A variety of water-quality monitors and sensors are available and technologies are rapidly evolving. The Water-Quality Specialist can provide guidance regarding appropriate monitor and sensor selection. The location of the sensor in the aquatic environment will depend on project objectives and logistical limitations. A minimum of two stream cross-sectional surveys per year under different flow conditions is required to assess how representative the monitor location is of the entire cross-section. Similar measurements of variability, such as vertical measurements, are needed for lakes and estuaries. Figure 8-1 describes the flow of continuous water-quality data and records in the WAWSC once a site is selected and equipment is installed.

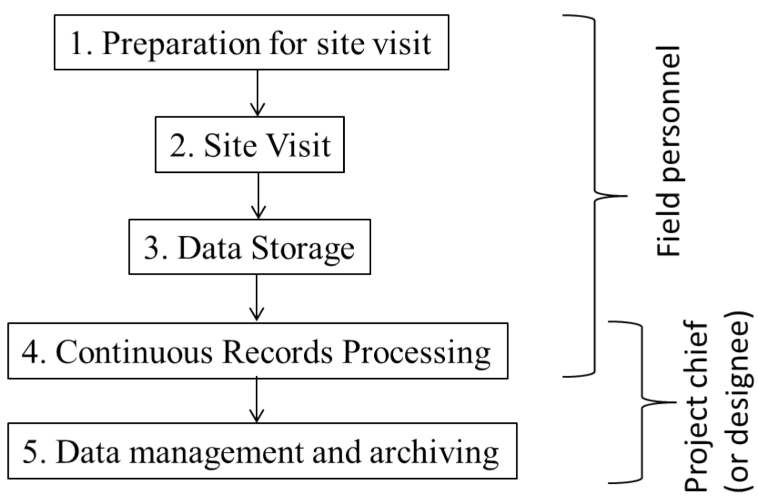

Figure 8-1. Continuous water-quality data processing flow-chart for Washington Water Science Center, November 2016.

8.1 Preparation for Site Visit

After site selection, establishment, and documentation (see section, “6 Site Selection, Establishment, and Documentation”) and station start-up, including equipment installation, the sensor(s) must be regularly maintained to obtain as complete a record as possible. The frequency of maintenance is sensor and site dependent, and can range from a few weeks to up to 1 year between site visits. If the data are transmitted real-time, the hydrologic technician should check real-time conditions daily to verify the accurate transfer of instrument readings to the database and to evaluate and identify erroneous data. Errors can include missing data, for example, because of instrument or transmission problems, truncated values (for example, because default settings were inappropriate for the environmental conditions), and false values (for example, instantaneous spikes in data unrelated to environmental conditions). Daily viewing of the real-time data will aid in rapidly identifying when a sensor needs unexpected maintenance (that is, sensor burial or fouling), and will aid in obtaining a complete a record as possible.

In preparation for a site visit for scheduled or unscheduled maintenance, the field technician should consider the following:

- Ensure that a site file has been established or is current in NWIS.
- View real-time data (if applicable) to identify current environmental and sensor conditions.
- Prepare paper (http://water.usgs.gov/usgs/owq/Forms.html) or electronic continuous water-quality field forms (such as the USGS Continuous Hydrologic Instrumentation Monitoring Program, CHIMP, form).
- Calibrate the field meter(s). A field meter is a meter that, ideally, is identical in make and model of the deployed sensor and is used to check environmental conditions during service and conduct cross-sectional surveys. Refer to the manufacturer’s manual and request training from the Laboratory Manager, FSU Manager or the Water-Quality Specialist as needed for laboratory calibration of the field meter. See table 8-1 for calibration acceptance criteria of continuous water-quality monitors.
- Calibrate a replacement sensor(s). When possible, carry replacement sensors or meters to replace failing equipment immediately.
- Prepare calibration standards and associated equipment (such as, gloves, DI water, and waste container).

Table 8-1. Summary of calibration information for water-quality instruments used to continuously measure selected parameters in the WAWSC.

[Calibration criteria for continuous water-quality monitors is in Wagner and others (2006, table 7). **Abbreviations:** DO, dissolved oxygen; FAA, Federal Aviation Administration; FSU, Field Services Unit; NIST, National Institute of Standards and Technology; TWRI, Techniques for Water Resources Investigations; ºC, degrees Celsius; µS/cm, microsiemens per centimeter at 25 ºC; mg/L, milligram per liter; mm, millimeter; µm, micrometer; <, less than; ≤, less than or equal to; ±, plus or minus; ≥, greater than or equal to**]**

Parameter	Calibration method used	Acceptance criteria and response if not acceptable	Calibration frequency and location	Responsible person	Reference for calibration and use
Temperature	Field thermistor checked with a NIST-certified thermometer	After field cleaning, within ±0.2 °C of field thermistor, otherwise troubleshoot, return or discard.	At deployed field site, every 4–12 weeks.	Field personnel.	Wagner and others, 2006; see manufacturer's instructions.
Specific conductance	1-point calibration with known standard ≥1000 µS/cm and 1-point check bracketing expected values; Also, a zero check (dry sensor in air).	After checking against three standards and field cleaning, acceptable range is within ±5 µS/cm or ±3 percent of the measured value, whichever is greater. Otherwise calibrate. If still unacceptable, repeat calibration procedure, troubleshoot, replace probe.	At deployed field site, every 4–12 weeks.	Field personnel.	Wagner and others, 2006; Radtke and others, 2005 ;see manufacturer's instructions.
pH	Two- to three-point calibration, bracketing expected values	After field cleaning and checking against 3 buffer solutions, ±0.2 pH units. Otherwise, calibrate. If slope adjustment has affected the calibration (7 ±0.1 units), repeat calibration. If repeated calibration and troubleshooting steps fail, replace sensor.	At deployed field site, every 4–12 weeks.	Field personnel.	Wagner and others, 2006; Ritz and Collins, 2008; see manufacturer's instructions.
Dissolved oxygen	Calibration at 100 percent oxygen saturation, checked at zero DO, air-saturated water preferred.	After checking at 100 percent and zero-DO and field cleaning, within ±0.3 mg/L of computed 100 percent DO saturation value. Zero-DO solution <0.2 mg/L. Otherwise, calibrate, then replace membrane or replace probe.	At deployed field site, every 4–12 weeks.	Field personnel.	Wagner and others, 2006; Rounds and others, 2013; see manufacturer's instructions.

Parameter	Calibration method used	Acceptance criteria and response if not acceptable	Calibration frequency and location	Responsible person	Reference for calibration and use
Barometric pressure	Mercury barometer	Within 1 mmHg of annually-calibrated hand-held barometer.	At deployed field site, every 4–12 weeks.	Field personnel.	Rounds and others, 2013; see manufacturer's instructions.
Total dissolved gases (TDG)	Two-point calibration, bracketing expected values	Within 2 mmHg at ambient, +100, +200, and +300 mmHg. Otherwise, calibrate. Then troubleshoot and replace.	At laboratory, before deployment.	FSU manager or field personnel.	See manufacturer's instructions.
Turbidity	At least 2 standards, bracketing expected values; formazin-based calibration standards preferred over polymer standards.	After field cleaning and checking in 3 standards, 0 standard (deionized water) ±0.5 turbidity units; higher standards per manufacturer guidelines, variable between 5-10 percent. Otherwise, clean optical surface and re-check. If calibration is possible, re-calibrate. If not, return to manufacturer for calibration.	At deployed field site, per manufacturer guidance, typically every 4–12 weeks.	Field personnel.	Wagner and others, 2006; Anderson 2005; see manufacturer's instructions.
Nitrate	Inorganic blank water (optional: certified or reagent grade standards, bracketing expected concentrations)	After original readings and field cleaning, baseline calibration check within manufacturer- and wavelength-specific criteria (Pellerin and others, 2013, table 5); otherwise, repeat measurement with fresh blank water then correct to new baseline.	At deployed site, every 4–12 weeks.	Field personnel.	Pellerin and others, 2013; Wagner and others, 2006; see manufacturer's instructions.

8.2 Site Visit

The standard protocol for operation and maintenance of a continuous water-quality monitor is the following (Wagner and others, 2006):

1. Record initial (pre-service) sensor readings (side-by-side live meter and field meter);
2. Remove live meter and clean sensors;
3. Return live meter and record environmental readings (difference in readings = fouling) for both the live meter and field meter;
4. Remove meter and perform a field calibration check;
5. Recalibrate as needed (difference in readings = calibration drift);
6. Troubleshoot and replace sensors as needed; and
7. Return meter and record post-service environmental readings (live meter and field meter).

Field notes and instrument logs are the basis for the accurate and verifiable computation of water-quality monitoring records. Legible, detailed, and in-depth field notes and instrument logs are essential for accurate and efficient record processing. Minimum on-site documentation includes the following (Wagner and others, 2006):

- Station name and number
- Data collector name(s)
- Date, time, and time datum of each set of measurements
- Serial numbers of deployed meters and field meter
- Lot numbers and expiration dates of calibration standard solutions
- Purpose of the site visit
- Horizontal and vertical locations of sensors in the cross-section
- Recorded values (initial pre-service, cleaned, calibration checks, calibrations, and final post-service instream readings) and associated times
- Cross-sectional survey data
- Pertinent gage-height, discharge, or water level data
- Observations (that is, site, channel and sensor conditions)
- Battery voltage (replacement?)
- Notes on sensor changes, troubleshooting, etc. (e.g. serial number of sensor removed and new sensor deployed)

Sensor history must be tracked for each field meter and water-quality monitor, as described in section, "5.3 Water-Quality Instruments." Information contained electronically or in a paper logbook includes details of field and laboratory calibrations (dates, locations, readings, calibration lot numbers, expiration dates), sensor repair, replacement, and deployment history. OWQ Technical Memorandum 2016.09 allows the use of electronic format for collection and archival of original water-quality-data records. Two methods for electronically recording data from a remote location are by (1) transmitting data by land line or radio telemetry to a central location where they are recorded on magnetic tape, disk, or solid-state memory device, and (2) recording data at the location on a solid-state memory device. During a site visit, data are downloaded from the data logger and the data are graphically screened to detect any problems. In the case of real-time telemetry, the data are processed through the real-time data collection system directly into the NWIS Time-Series (NWIS-TS) database.

8.3 Data Storage

Electronic records include continuous monitor inspections (paper or electronic) and continuous monitoring data collected onsite by electronic sensors and data loggers. Inspections are imported (from CHIMP) or directly entered into SiteVisit, a software application for storing site visit information in the NWIS-TS database. Cross-sectional information is discrete data that is stored in QWDATA rather than NWIS-TS. Cross-sectional data is loaded into the quality-control database (Database 2 of NWISWA QWDATA) using a WAWSC formatted Excel® sheet that is batch loaded by the QWDBA.

Continuous water-quality data are entered in the NWIS-TS database. Electronically-recorded data are transferred from the data logger or storage device into the WAWSC database at the office, or, in the case of real-time telemetry, the data are processed through the real-time data collection system directly into the NWIS-TS database. Initial data processing in the office is for the purpose of obtaining a copy of the original data for archiving (see section, "9.2 Data Lifecyle"). Data are not manipulated by the field instrument or a computer except to convert recorded signals into data in commonly used units or to display data in a convenient format. The transfer of data from the electronic storage medium to NWIS requires thorough verification to ensure that the data have transferred successfully or that as much data as possible have been recovered and errors identified (WRD Memorandum 87.85). A copy of the raw file is stored in the appropriate Field Office or Project directory, and this directory is backed up weekly according to WAWSC IT Services policy. A copy of the raw data is processed using DECODES to enter the data into an NWIS-compatible form, and the processed DECODES file is stored in NWIS.

8.4 Continuous Records Processing

Review of continuous monitoring data is completed by the Primary Record Worker, typically the hydrologic technician responsible for operation and maintenance of the sensor, according to the procedure described by Wagner and others (2006). The WAWSC Continuous Records Processing Water-Quality Checklist (fig. 8-2) facilitates the record review process. The USGS is transitioning to a new software package, NWIS-TS, for storage and processing of continuous, or time-series, data. The process described in this section may be modified to reflect this transition.

Record review documentation is stored under the station Record_Review sub-folder on the WAWSC network, for example, \\gs\tacomawa-w\Data\western_washington\stations\12113390\Record_Review. The electronic directory structure and naming conventions are described in appendix E of Mastin (2016). Steps for completing the primary record include:

1. Reviewing and updating the record to rectify anomalous values, date, and times.
2. Applying data corrections in NWIS-TS, for example, for fouling and calibration drift, as described by Wagner and others (2006).
3. Ensuring that cross-sectional data have been entered in QWDATA and cross-checked for accuracy.
4. Updating the Station Description (in SIMS).
5. Running the "wqmreview" function, then reviewing, notating, and storing the output in the Record_Review folder.
6. Reviewing Unit Value and Daily Value plots and tables, including updating partial days.
7. Updating the "Station Manuscript" (only for complete water years).
8. Updating the "Station Analysis" (in RMS) to describe the instrumentation, methods, shifts, missing records, and record quality.

WAWSC CRP Water-Quality Checklist

Last updated Feb. 6, 2015

STATION NUMBER:	PARAMETER:	PERIOD:	
STATION NAME:			

	WORKED BY	CHECKED BY	REVIEWED BY
Enter Initials:			
REVIEW WEBPAGE FOR ACCURACY (e.g., station notes, funding sources, other parameters such as precipitation, stage, etc. Note: use a separate progress sheet for streamflow parameters)			
READ LAST REVIEW NOTES			
UPDATE STATION DESCRIPTION			
ENTER/VERIFY FIELD DATA IN SITE VISIT			
ENTER/VERIFY FIELD DATA IN SPREADSHEET			
APPLY CORRECTIONS (note on spreadsheet which applied)			
STATION ANALYSIS REPORT (from SWReview or ADAPS PR-17)			
ACCURACY RATING (dq_rating.pl) - print out if necessary			
DELETE ALL BAD UV DATA FROM ALL DD'S			
UNIT VALUE MONTHLY PLOTS			
PRIMARY RUN (Include max/min verification, field values), Review			
RETRIEVE AND REVIEW DAILY VALUES			
PLOT DAILY VALUES, MAX, MIN, MEAN (+ Q) FOR PERIOD			
PLOT ANY OTHER COMPARISON PLOTS			
RETRIEVE & VERIFY PERIOD SUMMARY (PR-12)			
WRITE STATION ANALYSIS (IN RMS)			
WRITE STATION MANUSCRIPT - year end only			
CROSS SECTION INFORMATION			
CROSS SECTION DATA IN NWIS {QWDATA2 (Y/N)}			
COPY OF field meter CALIBRATIONS			
COPY OF deployed meter CALIBRATIONS			
COPY OF 5-POINT AND 2-POINT THERMISTOR CHECKS			
COPY OF BAROMETER CALIBRATION CHECKS (for DO & TDG only)			
UPDATE AGING STATUS			
DATE COMPLETED			

Worker notes:

Checker notes:

Reviewer Notes:

Add Note Sheets As Necessary

Figure 2-2. Continuous records processing water-quality checklist.

Once the data are edited, the record is submitted to a second data-reviewer for review. The "Checker" reviews the contents of the Record_Review folder and compares the original data with the worked record. The Checker notates the checklist and documents, as appropriate. Good communication between the Primary Record Worker and the Secondary Checker is important to resolve issues. After the Checker approves the record, the Field Office Chief (or designee) provides a final review to confirm that the Checker's comments have been addressed before approving the record. Continuous monitor data are finalized within the timelines established in WRD Policy Memorandum 2010.02, and no later than April 1 of the year following the water year of collection.

8.5 Estimates of Continuous Constituent Concentrations and Loads

In some instances, discrete water-quality data are collected at sites where continuous water-quality data are collected to develop regression models to estimate real-time constituent concentrations and loads. Sediment regression model development and use should adhere to the guidelines described in OWQ Technical Memorandum 2016.10, Landers and others (2016) and Rasmussen and others (2009). Other constituent models should follow the general principles outlined in Rasmussen and others (2009) and Helsel and Hirsch (2002). Many tools are available for concentration and load estimation, including the following:

- USGS course (1-week)—Sediment Records Computation and Interpretation, SW 2096 (http://water.usgs.gov/usgs/owq/qw/toolbox/)
- USGS course (1-week)—Statistical Techniques for Trend and Load Estimation, QW 2306, which includes applications of LOADEST
- Tools on the Office of Surface Water Fluvial Sediment page (http://water.usgs.gov/osw/techniques/sediment.html), including:
  - Turbidity load computation worksheet (Rasmussen and others,2009)
  - GCLAS—Graphical Constituent Loading and Analysis System
  - SAID—Surrogate Analysis and Indicator Development tool (http://water.usgs.gov/osw/SALT/SAID/downloads.html; handles acoustic backscatter surrogate data as well as other surrogate data sets

9.0 Data Management and Archival

The USGS Public Access Plan for digital data and scholarly data (http://www.usgs.gov/quality_integrity/open_access/) describes new policies regarding data management, release, accessibility, and preservation that are being implemented October 1, 2016 in response to the 2013 Office of Science and Technology Policy Memorandum on Increasing Access to the Results of Federally Funded Scientific Research and the 2013 Office of Management and Budget Open Data Policy Memorandum M-13-13. The USGS Manual incorporated four Office of Science Quality and Integrity Instructional Memoranda (IM) on January 13, 2017, describing new policies regarding:

- Fundamental Science Practices: Scientific Data Management (SM 502.6);
- Fundamental Science Practices: Metadata for USGS Scientific Information Products Including Data (SM 502.7);
- Fundamental Science Practices: Review and Approval of Scientific Data for Release (SM 502.8); and
- Fundamental Science Practices: Preservation Requirements for Digital Scientific Data (SM 502.9).

Taken together, these IMs provide interim guidance, until permanent changes to the Survey Manual are made, on the USGS transition to a data lifecycle model. Data created by or on behalf of the USGS are the property of the Federal Government, and the USGS is required to retain and preserve an authoritative or original copy of all data for which it is responsible. USGS scientific data shall be managed through the data lifecycle and when approved, the data must be released to the public in a machine-readable format under the authority of USGS Fundamental Science Practices (FSP) requirements (SM 502.1). Guidance and procedures that support this interim policy are available at the USGS Data Management website (http://www.usgs.gov/datamanagement). In addition, three web pages on the USGS Fundamental Science Practices (FSP) frequently-asked questions provide guidance to Science Centers on:

- Release of Scientific Data
- Metadata for USGS Scientific Data
- Data Management Planning

Major components are highlighted in the following subsections.

9.1 Data Management

In accordance with WMA policy, all sediment and water-quality data collected by the WMA are stored in the NWIS database: discrete data in QWDATA and continuous data in NWIS-TS. Biological data including aquatic community- and population-level taxon identification and enumeration, and associated habitat data are placed in the Aquatic Bioassessment Data Management System (BioData, https://aquatic.biodata.usgs.gov/), according to OWQ Technical Memorandum 2016.03. Data collected in Washington State by others, such as cooperators, universities, or consultants, which are used to support published USGS documents and are not published or archived elsewhere, also are entered into NWIS or BioData. However, these data are entered into their own record and flagged with the appropriate data elements to assign the data as collected by non-USGS personnel. This requires that, at the time of record creation during sample log-in, the appropriate collecting agency and analyzing agency are entered in the database at the sample level. The Project or Field Office Chief are responsible for ensuring the collecting agency codes and the analyzing agency codes are available (OWQ Technical Memorandum 2006.03). Requests for new collecting agency, analyzing agency, method, and parameter codes are made by filling out and submitting the Parameter and Method Code Request Form at the internal OWQ website. The codes for NWIS are updated quarterly. Other outside data may be entered into these databases at the discretion of the WAWSC Water-Quality Specialist if data-collection methods and quality have been reviewed and determined acceptable.

Sometimes data collected by project personnel cannot be entered into NWIS because NWIS cannot accept the type of data that are generated by the project (for example, GIS data). Electronically-stored data that cannot be entered into NWIS or BioData are stored in an alternate publicly-accessible repository such as ScienceBase that meets USGS data storage and accessibility standards, as described in the FSP Standards for Establishing Trusted Repositories for USGS Digital Assets (http://internal.usgs.gov/fsp/toolbox/trusted_respositories_digital_assets.html). One of the new requirements is that metadata must accompany all USGS scientific data, software, and other information products approved for release. Metadata guidance is available at the USGS Data Management and FSP FAQs web pages (http://www.usgs.gov/datamanagement/describe.php and http://www.usgs.gov/fsp/faqs_metadata_for_scientific_data.asp). NWIS meets these metadata requirements. Data that are stored in alternate repository must have accompanying metadata and be assigned a DataCite digital object identifier (DOI), described in more detail in section, "10 Publication of Water-Quality Data."“

The Project or Field Office Chief has responsibility of ensuring that all electronic records are backed up and stored according to rules for Federal Records Management (USGS Manual Section 432-1-S2). There are currently tools such as SIMS and NWIS to facilitate this process. In addition to electronically stored data, the Project or Field Office Chief is responsible for maintaining paper station folders while the project is active, which includes field notes, ASRs, and watlists.

9.2 Data Lifecycle

According to WMA policy, all original data that are published or support published scientific analyses shall be both accessible to authorized WAWSC personnel and preserved for archive (SM 502.9; WRD Memorandums 92.59 and 99.33; Hubbard, 1992). Original data—from automated data-collection sites, laboratories, outside sources, and non-automated field observations—are unmodified data as collected or received and in conventional units (engineering units, generally with a decimal). Original data should be preserved in this form, no matter how they may be modified later (Hubbard, 1992). Original water-quality data include:

- paper and electronic field notes,
- field measurements,
- images,
- ASRs including SLARs,
- watlists,
- continuous water-quality monitoring records, and
- instrument calibration information.

Original data are stored at the WAWSC either by Station ID (for Data-managed stations) or by project (for Studies projects). After water-quality data are logged into NWIS, original paper records at the WAWSC (primarily generated for water-quality studies) are stored by Station ID or project in filing cabinets located on the 2nd floor of the WAWSC Tacoma office. The WAWSC Data Section has transitioned to an electronic directory structure for data storage and archiving. Original electronic records generated for all Data-managed continuous and discrete stations are stored by Station ID. The electronic directory structure for Data-managed "Continuous Surface-Water and Related Records" is described in appendix E of Mastin (2016).

The WAWSC Studies Section is transitioning to an electronic directory structure for project management, data storage, and archiving. Until a Center-wide Data Management Plan has been developed, water-quality data will be stored by Studies project. One proposed electronic directory structure includes five mandatory sub-folders under each Studies project network folder:

- Project Management (for example, proposal, budget, laboratory evaluation, safety, workplan)
- Field (for example, electronic field folder for each station, label templates, ASR templates, field form templates)
- Data (for example, completed field forms, downloaded data logger files, site visit measurements, watlists, sample tracking log)
- Record Review (for example, review checklist, spreadsheets, visualizations)
- Information Products (for example, literature, abstracts, reports, presentations)

Within each of these five mandatory sub-folders, the structure and content can be customized as relevant to the project (for example, to accommodate both a groundwater network of 300 wells each sampled once for water levels and a water-quality project at one site sampled regularly for 300 different analytes). This structure simplifies the long-term data storage and permanent archival process, as all components are contained within a single project folder. It should include a summary sheet of all Station IDs to facilitate future data retrieval by Station ID. In addition, a note should be added in the Station Manuscript of a Data-managed station where data is also being collected for a Studies project(s), including the dates, project name and Project Chief of the Studies project for cross-reference.

The server is backed up weekly, with partial back-ups of changed files throughout the week. Original electronic records are to be preserved in a format that allows them to be retrieved at a later date. Electronic data are annually archived by the WAWSC IT Services Section on Linear Tape Open 6 and DVDs. Two copies are made—one for off-site storage (in a temperature-controlled, fire-resistant safe at the WAWSC warehouse facility in Lakewood, WA), and one for onsite storage (in a temperature-controlled, locked server room in the IT Services Section). This annual archive is done for all WAWSC station folders, typically after records are worked by April 1, and includes data from the most recently-completed water year and the two previous years.

For Studies projects, the Project or Field Office Chief is responsible for initiating the archive process of studies-related electronic data and results by making a request to the IT Services Section after the project has been completed. The Project Chief also prepares a physical storage box as needed containing original paper records, that is maintained by the Administrative Services Section for 2 years after project completion and then is transferred to the Sand Point Federal Records Center in Seattle, Washington. The disposition schedule (http://www.usgs.gov/usgs-manual/schedule/) for WMA records includes a description of record types and disposal instructions. It is important that the Project Chief understand the disposition schedule for the information they are archiving to ensure future availability of the data if needed. In addition, the Project Chief should not attempt to archive everything. Instead, the archive must be selective, organized, and complete to include, in addition to original data, only important documents that demonstrate milestones in the project and critical data sets and analyses and model runs.

10.0 Publication of Water-Quality Data

The Office of Science and Technology Policy Memo now requires that all data used to support the conclusions in federally-authored and (or) funded scholarly publications be released prior to or simultaneously with the publication. This results in a new dual publishing process with differing requirements, options, and timelines for the data and the report. Interpretation of the interim guidance is available at the USGS Data Management web page (http://www.usgs.gov/datamanagement/share/datarelease.php) and is summarized here. To identify USGS-authored or -funded publications, all authors employed or funded by the USGS are required to obtain an Open Researcher and Contributor ID (refer to the ORCID web page at http://orcid.org/).

Water-quality data are considered published when accessible from NWISWeb and (or) a Data Release. Continuous water-quality data are computed, analyzed, checked, reviewed, and finalized on an ongoing basis and are considered published when they are posted online using NWISWeb and labeled "approved" (WRD 2010.02). All non-proprietary approved discrete water-quality data are published through NWISWeb when possible (OWQ 2012.03) . NWISWeb has a single DOI, and a future goal is to develop project- or dataset-specific DOIs within NWISWeb.

Data Releases make water-quality data available to users without interpretations or conclusions, and are stored in an alternate public repository, such as ScienceBase (https://www.sciencebase.gov/catalog/). The review process in the WAWSC for data releases includes:

- Supervisor review for technical and editorial adequacy and readiness for technical review.
- Technical specialist review for adherence to policy (the specialist review can be limited to relevant sections only).
- A technical peer review (preferably outside of the WAWSC).
- Metadata review by a designated metadata reviewer (see later in this section).
- Author reconciliation of all review comments.
- Editorial review for adequacy of organization, rhetoric, grammar, audience level, consistency, and for verification (not required, but can be requested as appropriate).
- WAWSC Director review for approval.

The data release is assigned a unique DataCite DOI (10.5066, DataCite.org) and is accessed by the public through a landing page that provides background information (such as, introduction and methods) and links to download the file(s) and (or) view the data using a map viewer or a model. Though a data release is not housed at the USGS Publications Warehouse, the approval package must be routed through the internal USGS Information Product Data System (https://insight.usgs.gov/do/osqi/ipds/default.aspx).

All interpretive reports such as USGS Circulars, Professional Papers, Fact Sheets, Scientific Investigations Reports, and Open-File Reports, as well as non-USGS outlets, such as scientific journals, books, and proceedings of technical conferences must have an accompanying Data Release or must reference the NWISWeb DOI as the repository for the data. The review process for reports in the WAWSC includes:

- Supervisor review for technical and editorial adequacy and readiness for technical review.
- Technical specialist review for adherence to policy (the specialist review can be limited to relevant sections only).
- Two technical peer reviews (at least one preferably outside of the WAWSC).
- Metadata review by a designated metadata reviewer (see later in this section).
- Author reconciliation of all review comments.
- Editorial review for adequacy of organization, rhetoric, grammar, audience level, consistency, and for verification.
- Report Specialist review for completeness, adherence to policy, and readiness for approval.
- WAWSC Director review for approval.
- Bureau Approving Official review for approval.

The report is assigned a unique CrossRef DOI (10.3133, CrossRef.org) and is accessed through the report landing page either in USGS Publications Warehouse or through an outside publisher website.

Data Releases and reports (USGS or outside publications) each must be accompanied by metadata. Metadata records must comply with one of the following Federal Geographic Data Committee (FGDC) standards: FGDC Content Standard for Digital Geospatial Metadata or the International Organization for Standardization suite of standards (refer to http://www.fgdc.gov/metadata). Metadata components and examples are available at the USGS Data Management web page (http://www.usgs.gov/datamanagement/describe.php). During the data and (or) report review process, a metadata review must include checking for compliance with metadata standards using a recommended metadata validation tool, when available, and performing quality checks. The metadata review can be done as part of the data review, editorial review, or separately as appropriate. A report of all metadata reviews (reviewer comments and how they were reconciled) must be included in the package in the internal USGS Information Product Data System that is submitted for Bureau approval. A checklist that provides guidelines to reviewers of metadata for data is available at from the USGS Data Management webpage (http://www.usgs.gov/datamanagement/documents/MetadataReviewChecklist_2014.pdf).

The selection of the appropriate publication outlet for water-quality data will be the responsibility of the Project or Field Office Chief. A summary of USGS Fundamental Science Practices and WMA policies pertaining to the publication of data and interpretive reports is contained in the WRD Publications Guides (Alt and Iseri, 1986, p. 382–385; U.S. Geological Survey, 1995; OWQ Technical Memoranda 2007.03, 2007.04, and 2012.03). Some helpful FSP procedures and guidelines include:

- Distinctions Between New Research or Interpretive Information Products and Previously Published or Noninterpretive Information Products.
- Distinguishing Noninterpretive, Interpretive and New Interpretive USGS Information Products workflow diagram.
- Levels of Delegated Bureau Approval Authority for U.S. Geological Survey Information Products.

Other references that should be consulted when writing reports include "Suggestions to Authors of the Reports of the United States Geological Survey, 7th edition" (Hansen, 1991) and the U.S. Government Printing Office Style Manual (U.S. Government Printing Office, 2008).

The term “data” refers to documented observations or measurements or other quantitative measurements that have not been interpreted and usually result from field observations or laboratory analyses of water, sediment, or biota. Data can be released to the public after preliminary review for accuracy by appropriate WMA personnel (WRD Memorandum 90.38). Constituents in water samples collected by or for the USGS that exceed U.S. Environmental Protection Agency drinking water Maximum Contaminant Levels, as specified in the National Primary Drinking Water Regulations, are promptly reported by the Project or Field Office Chief to appropriate agencies, such as County Health Departments that handle drinking water issues, that have a need to know (WRD Memorandum 90.38).

The term “information” refers to interpretations of data or conclusions of investigations. Interpretive results or conclusions require colleague review and Director approval for publication. Release of preliminary interpretations prior to final approval is prohibited to avoid disseminating incomplete and (or) incorrect conclusions, which are subject to change as a result of subsequent technical and policy reviews. There are various situations where releasing preliminary interpretations are acceptable, most often related to an immediate concern for human and environmental health and safety, and these are described in the FSP Guidance for Public Release of Preliminary or Provisional Data and Interpretive Information (http://internal.usgs.gov/fsp/toolbox/provisional_data_information_release.html).

11.0 Water-Quality Training and Reviews

Periodic reviews of data-collection procedures are used to evaluate the effectiveness of training programs and to determine if technical work is being conducted correctly and efficiently. Such reviews also are used to identify and resolve problems before they become widespread and potentially compromise the quality of the data.

11.1 Training

Employee training is an integral part of water-quality activities allowing current employees to maintain and enhance their technical knowledge and new employees to gain the specific skills needed to adequately perform their job. A well-documented training program not only ensures that samples are collected correctly by technically-competent personnel, but also lends legal credibility to data and interpretations. Training is accomplished according to the following policies and protocols.

Individual training plans are developed by the supervisor and employee at least annually as part of the performance review process. The WAWSC Water-Quality Specialist or Assistant Director for Hydrologic Data is responsible for informing WAWSC staff about the availability of training—in-house, USGS, U.S. Government, and other sources of training. The Water-Quality Specialist provides recommendations and advice to supervisors and their staff as needed for routine data and sample collection efforts as well as for special projects and data analyses. The WAWSC Center Director has authority and responsibility for approving training opportunities. In addition, staff are responsible for taking full advantage of the training provided.

Primary sources of water-quality training are USGS courses, usually taught at the USGS NTC at the Denver Federal Center and from Western Region regional training opportunities, cyberseminars, and WAWSC seminars or in-house training courses. A list of the currently scheduled water-quality training courses is available at the Office of Water Quality Training Courses & Resources web page (http://water.usgs.gov/usgs/owq/training.html) or the DOI Learn (https://gm2.geolearning.com/geonext/doi/login.geo) course catalog. The Water-Quality Specialist plays an important role in providing in-house training. Training documents are maintained by the Administrative Support Section in WSC personnel files and by the Personnel Office in the Western Region.

The WAWSC policy is that all personnel involved in collecting and processing water-quality data will be adequately informed and trained regarding water-quality data-collection and processing procedures established by the WMA. The USGS NTC two-week field methods course (QW1028) is highly recommended for all staff collecting water-quality data and required for those collecting NAWQA program samples. After the completion of the two-week field methods course, staff who remain active or resume water-quality data collection activities should attend the USGS NTC one-week field methods refresher course (QW3190) about every 5 years. The one-week course (QW2298), Guidelines for the Operation and Computation of Records of Continuous Water-Quality Monitors, is highly recommended for all staff operating continuous water-quality monitors and (or) working continuous water-quality records.

Because of rapid changes in technology, new and improved methods for sample collection and processing are continually being developed. All WAWSC personnel who are involved in water-quality sampling must be aware of changing requirements and recommendations. The Project or Field Office Chief, with the assistance of the WAWSC Water-Quality Specialist, is responsible for providing current information to field personnel on the correct protocols to follow when collecting and processing water-quality samples. Table 11-1 lists USGS training courses relevant to water-quality.

Table 11-1. USGS training courses for water-quality personnel.

Course	Description	Category
QW1028 [1]	Field Water-Quality Methods for Groundwater and Surface Water	Field
QW3190 [1]	Water Quality Field Methods Refresher	Field
QW1638 [1]	Water Quality Probes: Installation, Operation, Calibration, and Maintenance	Field
QW2298 [1]	Guidelines for the Operation and Computation of Records of Continuous Water-Quality Monitors	Field, Records
QW1022	Water-Quality Principles (Blended)	Fundamentals
QW2032	Aquatic Chemistry	Fundamentals
QW2034	Quality Control Sample Design and Interpretation	Project Planning
QW1297	Water-Quality Data Toolbox for NWIS Users	Analysis
QW1075	Statistical Methods for Environmental Data Analysis	Analysis
QW2306	Statistical Techniques for Trend and Load Estimation	Analysis
none	Introduction to R	Analysis
QW1562	Introduction to Water-Quality Modeling	Analysis
H1863	Passive Samplers: Theory and Practical Uses	Specialty
SW1091	Sediment Data-Collection Techniques	Sediment
QW1169	Geomorphic Analysis of Fluvial Systems	Sediment
SW2096	Sediment Records Computation and Interpretation	Sediment
QW2303	Ecological Field Methods	Field
GW3021	Geochemistry for Groundwater Systems	Groundwater
GW3305	Geochemistry Modeling Workshop	Groundwater
GW2238N	Principles and Applications of Estimating the Age of Young Groundwater	Groundwater
SW1004	Basic Hydraulic Principles	Surface Water
SW1660	Surface-Water Procedures and Policies	Surface Water
ID2015	Groundwater/Surface-Water Interactions	Interdisciplinary
ID2015F	Field Techniques for Groundwater/Surface-Water Interactions	Interdisciplinary
ID2019	Isotope Hydrology	Interdisciplinary
ID3045	Multivariate Analysis for Hydrological, Biological, and Chemical Data	Interdisciplinary
ID2312	USGS-WRD Report Planning, Writing, Policy, and Peer Review	Interdisciplinary
ID1837	Field Methods for the Collection of Sediment and Water-Quality Samples with Large Samplers from Boats on Large Rivers	Interdisciplinary
QW1840	Personal Computer Field Forms (PCFF) 7.2	
ID1682	Finding and Using Scientific Literature and Data from the USGS Library	Interdisciplinary
DOIU-3003	Scientific Integrity	Interdisciplinary

[1] Highly recommended course.

11.2 Reviews

Reviews of water-quality data-collection activities are conducted by the Water-Quality Specialist or designee, upon request by the Project or Field Office Chief for each project in the WAWSC actively involved in water-quality data collection.

Reviews should be completed in a timely manner, and comments are documented by the reviewer in a memorandum to the immediate supervisor of the Project or Field Office Chief with copies distributed to the Project or Field Office Chief and the WAWSC Center Director. Reviews address sample collection and processing techniques, compliance with WMA, OWQ, and WAWSC policies, the condition of the work environment (for example, the field vehicle), and any other activities pertaining to the collection of high-quality data. When deficiencies are noted, the reviewer, in consultation with the Water-Quality Specialist, is responsible for identifying corrective actions. The immediate supervisor is responsible for ensuring that, once identified, corrective actions are implemented and completed in a timely manner.

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13.0 USGS Memoranda Applicable to Water-Quality Activities

USGS Water Mission Area (WMA) / Water Resources Division (WRD) Memoranda:

- 87.85 Programs and Plans—Policy for the collection and archiving of electronically recorded data
- 90.38 Programs and Plans—Policy for reporting maximum contaminant level exceedances
- 92.59 Policy for the management and retention of hydrologic data of the U.S. Geological Survey
- 95.35 Programs and Plans—Transmittal of an Instrumentation Plan for the Water Resources Division and the Water Resources Division Hydrologic Field Instrumentation and Equipment Policy and Guidelines
- 99.33 Preservation of original digital field-recorder time-series data
- 2010.02 Continuous records processing of all water time series data
- 12.01 Avoiding competition with the private sector

USGS Office of Water Quality (OWQ) Technical Memoranda:

- 97.06 Comparison of the suspended-sediment splitting capabilities of the churn and cone splitters
- 99.02 Guidance for collecting discharge-weighted samples in surface water using an isokinetic sampler
- 2006.03 National Water Information System – Notice of enhancements planned for the QWDATA software that will affect NWIS QWDATA batch file formats
- 2007.03 Changes to the NWISWeb aggregation and display of water-quality data
- 2007.04 Controlling flow of water-quality data to NWISWeb
- 2012.03 Update of policy on review and publication of discrete water data
- 2015.01 Policy and Guidelines for Archival of Surface-Water, Groundwater, and Water–Quality Model Applications
- 2016.03 Policy and Guidelines for Storing Data in the Aquatic Bioassessment Data Management System (BioData)
- 2016.06 Required participation in the Branch of Quality Systems Standard Reference Sample Semi-Annual Proficiency Testing Project
- 2016.07 Revision of terminology for Data-Quality Indicator Codes in NWIS 5.2.
- 2016.09 Guidance for the Collection and Disposition of USGS Water-Quality-Data Records: Specifically Addressing Electronic Records for Field Notebooks and Calibration Notebooks
- 2016.10 Policy and guidance for approval of surrogate regression models for computation of time series suspended-sediment concentrations and loads

USGS Manual:

- SM 502.6 Fundamental Science Practices: Scientific Data Management
- SM 502.7 Fundamental Science Practices: Metadata for USGS Scientific Information Products Including Data
- SM 502.8 Fundamental Science Practices: Review and Approval of Scientific Data for Release
- SM 502.9 Fundamental Science Practices: Preservation Requirements for Digital Scientific Data

Other Memoranda or Policies:

- Branch of Operation Technical Memorandum 91.01—Safety—Chemical Hygiene Plan
- Office of Science, Technology, and Policy Memoranda on Increasing Access to the Results of Federally Funded Scientific Research
- Office of Management and Budget Memorandum M-13-13—Open Data Policy
- USGS Fundamental Science Practices
- USGS Science Strategy
- USGS Cooperative Water Program
- USGS Public Access to Results Public Access to Results of Federally Funded Research at the U.S. Geological Survey

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Appendix A. Washington Water Science Center Project Review Form

PROJECT REVIEW FORM (revised October 2016)				
Project Short Title:				
Date Prepared:			**By**:	
Period of Review:			**Project No.**:	
Project Chief:		**Cooperator(s)**:		
Project Members:				
FY: 2017	**FY Funding**: $		**Scheduled completion date**:	
What were the major accomplishments for this project since the last review?				
Were there any significant problems or setbacks since the last review?				
What do you plan to accomplish during:				
▪ the next 3 months:				
▪ the next year:				
Is the project on schedule to be completed as planned? Have timelines been met? (If not, discuss)				
What reports are planned? (For each, list pub type, target date for 1st draft, target date for final)				
Do you have/foresee any problems that may hinder the successful completion of this project?				
▪ Are the scope, objectives, and approach still consistent with the time and budget remaining?				
▪ Do you have enough staff to complete the work?				
▪ Are expenditures in accord with funds?				

Reviewer initials and date:

Reviewer comments:

Appendix B. Laboratories used by the Washington Water Science Center, 2014-16

This table summarizes the laboratories used by the Washington Water Science Center between 2014–16. There were 16 Level 1 laboratories and no Level 2 laboratories used between 2014–16.

Analytical laboratory	Analyses provided (by general category)	Project	Frequency of Ongoing QC Sample Submission	QC Program and (or) Sample Description	Date Range
USGS National Water Quality Laboratory (NWQL)	General, inorganic, organic, biology	Multiple (NAWQA, Lake Spokane, PNSQA)	Regular	Participation in inter-laboratory comparisons	Ongoing
USGS Cascades Volcano Observatory Sediment Laboratory (CVO)	Sediment concentration and particle-size distribution	Multiple (Nooksack, Elwha, Cedar, Stillaguamish, NAWQA, PNSQA, Nisqually)	Regular (A and B set field replicates)	Participation in inter-laboratory comparisons	Ongoing
USGS National Mercury Research Laboratory	Low-level mercury	NAWQA, Sinclair Inlet, PNSQA	Regular (field blanks and reps, acid analyses)	Participation in inter-laboratory comparisons	Ongoing
Kansas Organic Geochemistry Research Laboratory (OGRL)	Glyphosate, antibiotics, algal toxins	NAWQA, PNSQA	Determined by NAWQA	Determined by NAWQA	Ongoing
Ohio Water Microbiology Laboratory	Bacteria	NAWQA	Determined by NAWQA	Determined by NAWQA	Ongoing
USGS Columbia Environmental Research Laboratory	POCIS for organics	PNSQA	Determined by NAWQA	Determined by NAWQA	2015
USGS Reston Chlorofluorocarbon Laboratory	CFC and dissolved gases	NAWQA	Determined by NAWQA	Determined by NAWQA	Ongoing
USGS Reston Stable Isotope Laboratory	Stable isotopes	NAWQA, PNSQA	Determined by NAWQA	Determined by NAWQA	Ongoing
USGS Noble Gas Laboratory, Denver, Colorado	3H/3He Noble gases	NAWQA	Determined by NAWQA	Determined by NAWQA	Ongoing

Analytical laboratory	Analyses provided (by general category)	Project	Frequency of Ongoing QC Sample Submission	QC Program and (or) Sample Description	Date Range
USGS Crustal Geophysics and Geochemistry Science Center, Denver, Colorado	Microbeam	UCR	Regular	Laboratory produces and distributes reference materials	2015
LabCor Inc., Portland, Oregon	Asbestos	Sumas	Regular	Participation in inter-laboratory comparisons as part of accreditation	2015
University of California, Davis, Stable Isotope Laboratory	Nitrogen isotopes	Lake Spokane	Regular	Participation in inter-laboratory comparisons	2015
Rithron Laboratory, Missoula, MT	Algae and Invertebrates	RSMP	Regular	Participation in inter-laboratory comparisons	2015
Washington Department of Ecology Manchester Environmental Laboratory	Inorganics, organics, biology	RSMP	Regular	Participation in inter-laboratory comparisons as part of accreditation	Ongoing
AXYS Analytical, LTD	Organic (high-resolution mass spectrometry for PCB congeners, dioxins/furans, others)	Multiple, including Stillaguamish Emerging Contaminants, Green River Toxic Loads, Urban CHIPS	Regular	NIST, Puget Sound Sediment Reference Material, field and laboratory QC	Ongoing
Analytical Resources, Inc., Tukwila, Washington	Organics, inorganics	Green River Toxic Loads	Regular	NIST, Puget Sound Sediment Reference Material, field and laboratory QC	2014–17

Appendix C. Washington Water Science Center Water-Quality Facilities

WAWSC Laboratory, Tacoma, Washington

The WAWSC maintains a laboratory located in the WAWSC in Tacoma, Washington that serves Studies personnel and the Western Washington Field Office. The laboratory contains laboratory benches, glassware, sinks, fume hoods, chemical storage cabinets, and other equipment and instruments listed in table C1. The Laboratory Manager, under supervision by the Laboratory Supervisor, is responsible for maintaining the laboratory space, equipment (table C1) and supplies (table C2). The laboratory maintains QA records of laboratory equipment and supplies, such as calibration standards, chemical reagents, sample preservatives, and sample bottles that are provided to field personnel. Projects staff personnel, in consultation with the WAWSC Laboratory Manager and Laboratory Supervisor, are responsible for repair and maintenance of project water-quality equipment and instruments.

The Laboratory Manager orders and stocks supplies generally intended for short-term, small-scale, and common usage. The Project Chief or designated project personnel are responsible to determine the need for project-specific field equipment and supplies. If large quantities of supplies are needed, Projects must purchase these directly. If multiple sets of meters or equipment are needed, or if meters and equipment are needed for longer periods, special accommodations must be made through the Laboratory Manager.

The facility is maintained in accordance with standards set forth in the WAWSC chemical-hygiene plan; Branch of Operations Technical Memorandum 91.01). Chemical purchases must be coordinated through the Chemical Hygiene Coordinator, as described in the Center Chemical Hygiene Plan. The Chemical Hygiene Coordinator oversees the WAWSC waste-disposal practices to ensure that procedures are in compliance with State and Federal regulations. The operation of the laboratory is reviewed annually by the Water-Quality Specialist and every 3 years by the OWQ.

Table C1. Equipment and instruments, and quality assurance guidelines of the Western Washington Laboratory in Tacoma, Washington.

[OWQ, Office of Water Quality; °C, degrees Celsius.]

Laboratory equipment and instruments	Quality assurance guidelines
Laboratory balances (2-place and 4-place)	Calibration checked annually.
Refrigerator at 4 oC (3)	Temperature monitored monthly.
Fume hoods (2)	Calibrated annually.
Laminar flow hood	Calibrated annually during active projects
Supply of deionized water	Maintained per OWQ Tech. Memo 92.01.
Reverse osmosis water system	Continuous readout of resistivity.
Point-of-use Elga water filter.	Per manufacturer's instructions.
Ventilated acid cabinets	Inspected annually for wear.
Flammables storage cabinets	Inspected annually for wear.
Wash sink with drying rack	Inspected weekly; cleaned as needed.
Acid bath sink	Inspected weekly; cleaned as needed.
Vacuum pump	Inspected annually.
Drying ovenand muffle furnace	Calibration monitored annually.
Autoclave	Maintained per manufacturer's instructions.
Incubators	Calibration monitored annually.
Freezer	Temperature monitored monthly.
Emergency safety showers (2)	Operation checked monthly.
Emergency eye washes (4)	Operation checked monthly.
Water-quality sondes and meters	Calibrated each use.
Water bath	Drained between uses; Inspected annually for wear.
Microscopes	Inspected prior to use.

Table C2. Summary of information on supplies, equipment, and instruments in the WAWSC Laboratory, Tacoma, Washington.

[OWQ, Office of Water Quality; NIST, National Institute of Standards and Technology; NWQL, National Water Quality Laboratory; WAWSC, Washington Water Science Center]

Supplies, equipment, and instruments	Source and guidelines for Quality Assurance	Responsible party
Sample bottles	One-stop shopping	Laboratory Manager or Project Chief (large quantities)
Coolers/shipping containers	Local vendors, per OWQ Technical Memorandum 92.06, NWQL Technical Memorandum 2011.01	Laboratory Manager or Project Chief (large quantities)
Sample preservatives	One-stop shopping	Laboratory Manager or Project Chief (large quantities)
pH calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	Laboratory Manager or Project Chief (large quantities)
Specific conductance calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	Laboratory Manager or Project Chief (large quantities)
Blank water	One-stop shopping, per NWQL Technical Memorandum 92.01	Laboratory Manager or Project Chief (large quantities)
Deionized water	Reverse-osmosis system maintained by WAWSC, per OWQ Technical Memorandum 92.01.	Laboratory Manager
Isokinetic water-quality samplers	One-stop shopping	Laboratory Manager or Project Chief (long-term use)
Splitting devices	One-stop shopping	Laboratory Manager or Project Chief (long-term use)
Specific conductance meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	Laboratory Manager or Project Chief
pH meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	Laboratory Manager or Project Chief
Dissolved oxygen meters	Manufacturers. Calibrated prior to use, per manufacturer guidelines.	Laboratory Manager or Project Chief
Barometers	Manufacturers. Calibrated every 3 years.	Laboratory Manager or Project Chief

Supplies, equipment, and instruments	Source and guidelines for Quality Assurance	Responsible party
Water temperature meters	Manufacturers. Annual 5-point calibrations and quarterly 2-point calibrations are required.	Laboratory Manager or Project Chief
Turbidity meters	Manufacturers. Calibrated prior to use, per manufacturer guidelines and Center laboratory calibration protocol.	Laboratory Manager or Project Chief
Nitrate meters	Manufacturers. Calibrated prior to use, per manufacturer guidelines and Pellerin and others, 2013.	Laboratory Manager or Project Chief

Mid-Columbia Field Office, Field Services Unit, Kennewick, Washington

The WAWSC maintains a Field Services Unit (FSU) located in the Mid-Columbia Field Office in Kennewick, Washington, that supports water-quality activities including discrete NAWQA surface-water sampling and continuous temperature and total dissolved gas monitoring. The FSU contains laboratory benches, glassware, sinks, chemical storage cabinets, and other equipment and instruments listed in table C3. The FSU is managed by an FSU Manager, under supervision by the Field Office Chief, who is responsible for maintaining the laboratory space, equipment (table C3), and supplies (table C4). The FSU maintains QA records of laboratory equipment and supplies, such as calibration standards, chemical reagents, sample preservatives, and sample bottles that are provided to field personnel. Field Office personnel, in consultation with the Field Manager and Field Office Chief, are responsible for repair and maintenance of water-quality equipment and instruments.

Table C3. Equipment and instruments, and quality assurance guidelines of the Mid-Columbia Field Services Unit in Kennewick, Washington.

[OWQ, Office of Water Quality; °C, degrees Celsius.]

Laboratory equipment and instruments	Quality assurance guidelines
Refrigerator at 4 °C	Temperature monitored monthly.
Fume hood	Calibrated annually.
Reverse osmosis water system	Continuous readout of resistivity. Maintained per OWQ Tech. Memo 92.01.
Ventilated acid cabinets	Inspected annually for wear.
Flammables storage cabinets	Inspected annually for wear.
Wash sink with drying rack	Inspected weekly; cleaned as needed.
Acid bath sink	Inspected weekly; cleaned as needed.
Freezer	Temperature monitored monthly.
Emergency safety showers	Operation checked monthly.
Emergency eye washes	Operation checked monthly.
Water-quality sondes and meters	Calibrated each use.

The facility is maintained in accordance with standards set forth in the WAWSC chemical-hygiene plan; Branch of Operations Technical Memorandum 91.01). Chemical purchases are coordinated through the WAWSC Chemical Hygiene Coordinator, as described in the Center Chemical Hygiene Plan. The FSU Manager coordinates chemical waste-disposal, with guidance from the Chemical Hygiene Coordinator, to ensure that procedures are in compliance with State and Federal regulations. The operation of the unit is reviewed annually by the Water-Quality Specialist and every 3 years by the OWQ.

Table C4. Summary of information on supplies, equipment, and instruments in the Mid-Columbia Field Office, Field Services Unit, Kennewick, Washington.

[FSU, Field Services Unit; OWQ, Office of Water Quality; NIST, National Institute of Standards and Technology; NWQL, National Water Quality Laboratory; WAWSC, Washington Water Science Center.]

Supplies, equipment, and instruments	Source and guidelines for Quality Assurance	Responsible party
Sample bottles	One-stop shopping	FSU Manager
Coolers/shipping containers	Local vendors, per OWQ Tech. Memo 92.06, NWQL Technical Memorandum 2011.01	FSU Manager
Sample preservatives	One-stop shopping	FSU Manager
pH calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	FSU Manager
Specific conductance calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	FSU Manager
Blank water	One-stop shopping, per NWQL Technical Memorandum 92.01	FSU Manager
Deionized water	Reverse-osmosis system maintained by WAWSC, per OWQ Technical Memorandum 92.01.	FSU Manager
Isokinetic water-quality samplers	One-stop shopping	FSU Manager
Splitting devices	One-stop shopping	FSU Manager
Specific conductance meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	FSU Manager
pH meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	FSU Manager
Dissolved oxygen meters	Manufacturers. Calibrated prior to use, per manufacturer guidelines.	FSU Manager
Barometers	Manufacturers. Calibrated every 3 years.	FSU Manager
Water temperature meters	Manufacturers. Annual 5-point calibrations and quarterly 2-point calibrations are required.	FSU Manager

Upper-Columbia Field Office, Field Services Unit, Spokane, Washington

The WAWSC maintains a FSU located in the Upper-Columbia Field Office in Spokane, Washington, that supports water-quality activities including discrete NAWQA surface-water sampling and continuous temperature and total dissolved gas monitoring. The FSU contains laboratory benches, glassware, sinks, and other equipment and instruments listed in table C5. The FSU is managed by an FSU Manager, under supervision by the Field Office Chief, who is responsible for maintaining the laboratory space, equipment (table C5), and supplies (table C6). The FSU maintains QA records of laboratory equipment and supplies, such as calibration standards, chemical reagents, sample preservatives, and sample bottles that are provided to field personnel. Field Office personnel, in consultation with the manager and Field Office Chief, are responsible for repair and maintenance of water-quality equipment and instruments.

Table C5. Equipment and instruments, and quality assurance guidelines of the Upper-Columbia Field Services Unit, Spokane, Washington.

[OWQ, Office of Water Quality; °C, degrees Celsius.]

Laboratory equipment and instruments	Quality assurance guidelines
Refrigerator at 4 °C	Temperature monitored monthly.
Fume hood	Calibrated annually.
Reverse osmosis water system	Continuous readout of resistivity. Maintained per OWQ Tech. Memo 92.01.
Wash sink with drying rack	Inspected weekly; cleaned as needed.
Freezer	Temperature monitored monthly.
Emergency eye washes	Operation checked monthly.
Temperature meters and barometers	Calibrated per manufacturer instructions.

The facility is maintained in accordance with standards set forth in the WAWSC chemical-hygiene plan; Branch of Operations Technical Memorandum 91.01). Chemical purchases are coordinated through the WAWSC Chemical Hygiene Coordinator, as described in the Center Chemical Hygiene Plan. The FSU Manager coordinates chemical waste-disposal, with guidance from the Chemical Hygiene Coordinator, to ensure that procedures are in compliance with State and Federal regulations.

Table C6. Summary of information on supplies, equipment, and instruments in the Upper-Columbia Field Office, Field Services Unit, Spokane, Washington.

[FSU, Field Services Unit; NIST, National Institute of Standards and Technology; NWQL, National Water Quality Laboratory; OWQ, Office of Water Quality; WAWSC, Washington Water Science Center.]

Supplies, equipment, and instruments	Source and guidelines for Quality Assurance	Responsible party
Sample bottles	One-stop shopping	FSU Manager
Coolers/shipping containers	Local vendors, per OWQ Technical Memorandum 92.06, NWQL Technical Memorandum 2011.01	FSU Manager
Sample preservatives	One-stop shopping	FSU Manager
pH calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	FSU Manager
Specific conductance calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	FSU Manager
Blank water	One-stop shopping, per NWQL Technical Memorandum 92.01	FSU Manager
Deionized water	Reverse-osmosis system maintained by WAWSC, per OWQ Technical Memorandum 92.01.	FSU Manager
Specific conductance meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	FSU Manager
pH meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	FSU Manager
Dissolved oxygen meters	Manufacturers. Calibrated prior to use, per manufacturer guidelines.	FSU Manager
Barometers	Manufacturers. Calibrated every 3 years.	FSU Manager
Water temperature meters	Manufacturers. Annual 5-point calibrations and quarterly 2-point calibrations are required.	FSU Manager

Northwest Washington Field Office, Water-Quality Prep Area, Ferndale, Washington

A new Water-Quality Preparation Area (Prep Area) was constructed in 2016 at the Northwest Washington Field Office in Ferndale, Washington, that supports water-quality activities including continuous turbidity, temperature and other water-quality parameter monitoring and future discrete water-quality sampling. The Prep Area contains laboratory benches, glassware, sinks, and other equipment and instruments listed in table C7. The Prep Area is managed by a Prep Area Manager, under supervision by the Field Office Chief, who is responsible for maintaining the space, equipment (table C7), and supplies (table C8). The Northwest Washington Field Office maintains QA records of laboratory equipment and supplies, such as calibration standards, chemical reagents, sample preservatives, and sample bottles that are provided to field personnel. Field Office personnel, in consultation with the manager and Field Office Chief, are responsible for repair and maintenance of water-quality equipment and instruments.

Table C7. Equipment and instruments and quality assurance guidelines for the Northwest Washington Field Office, Water-Quality Prep Area, Ferndale, Washington.

[°C, degrees Celsius.]

Laboratory equipment and instruments	Quality assurance guidelines
Refrigerator at 4 °C	Temperature monitored monthly.
Vent snorkle	Calibrated annually.
Wash sink with drying rack	Inspected weekly; cleaned as needed.
Freezer	Temperature monitored monthly.
Emergency eye washes	Operation checked monthly.
Temperature meters and barometers	Calibrated per manufacturer instructions.
Turbidity sensors	Calibrated prior to deployment

The facility is maintained in accordance with standards set forth in the WAWSC chemical-hygiene plan; Branch of Operations Technical Memorandum 91.01). Chemical purchases are coordinated through the WAWSC Chemical Hygiene Coordinator, as described in the Center Chemical Hygiene Plan. The Prep Area Manager coordinates chemical waste-disposal, with guidance from the Chemical Hygiene Coordinator, to ensure that procedures are in compliance with State and Federal regulations.

Table C8. Summary of information on supplies, equipment, and instruments in the Northwest Washington Field Office, Water-Quality Prep Area, Ferndale, Washington.

[NIST, National Institute of Standards and Technology; NWQL, National Water Quality Laboratory; OWQ, Office of Water Quality.]

Supplies, equipment, and instruments	Source and guidelines for Quality Assurance	Responsible party
Sample bottles	One-stop shopping	Prep Area Manager
Coolers/shipping containers	Local vendors, per OWQ Tech. Memo 92.06, NWQL Technical Memorandum 2011.01	Prep Area Manager
Specific conductance calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material.	Prep Area Manager
Blank water	One-stop shopping, per NWQL Technical Memorandum 92.01	Prep Area Manager
Specific conductance meters	Manufacturers. Routine calibrations and participation in the National Field Quality Assurance tests are required.	Prep Area Manager
Water temperature meters	Manufacturers. Annual 5-point calibrations and quarterly 2-point calibrations are required.	Laboratory Manager (5-pt) and Prep Area Manager (2-pt)
Turbidity meters	Manufacturers. Calibrated prior to deployment, per manufacturer guidelines and Center protocol.	Prep Area Manager

Appendix D. Washington Water Science Center Sediment Field Form

US GEOLOGICAL SURVEY
WASHINGTON WATER SCIENCE CENTER
SEDLOGIN Coding Sheet

Sta. Number___________________________

Sta. Name____

Date_________________________________

Sample Medium: **WS SS SB** QA/QC: **YES NO**

Hydrologic Event: **SNOWMELT FLOOD ROUTINE STORM N/A**

Sample Set: **Single-container Samples Multi-container Samples**

Analysis Requested: **C - Concentration SF - Sand-fine break SA - Sand Analysis T - Turbidity LOI - Loss on Ignition DS - Dissolved Solids SC - Specific Conductance Z - Full-size fractions**

SEDIMENT SAMPLE INFORMATION

Begin Date:	End Date:	Collecting Agency:
Begin Time:	End Time:	Initials of collector(s):

Hydrologic Condition: **4 - Stable low stage 5 - falling stage 6 - Stable, high stage 7 - Peak stage 8 - Rising stage 9 - Stable, normal stage A - Not determined X - Not applicable**

Hydrologic Event: **4 - Snowmelt 7 - Flood 9 - Routine sample J - Storm X - Not applicable**

Sample Type: **1 - Spike 2 - Blank 3 - Reference 4 - Blind 5 - Duplicate 6 - Reference material 7 - Replicate 8 - Spike 9 - Regular A - Not determined B - Other QA H - Composite**

Analysis Status: **U - Unrestricted I - Internal P - Proprietary**

Sample Purpose: **10 - Routine 15 - NAWQA 170 - Quality Assurance**

Sampling Method: **10 - EWI 15 - EWI Non--isokinetic 20 - EDI 30 - Single vertical 40 - Multiple-vertical 50 - Point 55 - Composite, multiple-point 70 - Grab 900 - Suspended, pumping 920 - Suspended, box**

Sampler Type:	Location in cross section: **LB RB**
Sampling depth:	Stream width:
Mean depth:	

Field sample comment (M2LAB, Message to lab):

Instantaneous discharge:	Method:
Water temp:	Number of sampling points:
Air temp:	Gage Height: Time:
Specific Conductance:	Turbidity: **NTU NTRU FNU**

BAG SAMPLERS ONLY

Velocity for transit rate:	Duration:
Sample Volume:	Nozzel material: **BRASS PLASTIC TFE**
Nozzel diameter: **3/16 1/4 5/16**	

Additional comments/instructions:

Entered by:	Event (i.e. jforeman-129):
Date:	

US GEOLOGICAL SURVEY
WASHINGTON WATER SCIENCE CENTER
Sediment Field Sheet

Sta. Number___________________________

Sta. Name____

Date_________________________________

Party________________________________

Weather____

Air temp__________________ Water temp____________

Discharge__________ Velocity______________

Starting GH____________________ Time________

Ending GH_____________________ Time________

SEDIMENT COLLECTION

Sampling Method: **EDI EWI PUMP GRAB POINT 0.2 0.6 0.8**

LEW at:______ REW at:_____ Width of Channel:_________

Sampler: **DH-48 DH-59 D-74 D-74AL P-61 Other:** ____________

Number of Bottles:____ Number of Sets:________ Transit RT:______________

Sta No. ____	Dist. From ____	%Q at stn.	Bottle no.	Time		Station	Dist. From ____	Depth	Bottle no.	Time

Comments:

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