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Prepared in cooperation with the U.S. Department of Energy

Field Methods, Quality-Assurance, and Data Management Plan for Water-Quality Activities and Water-Level Measurements, Idaho National Laboratory, Idaho

Open-File Report 2026–1008

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

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By Kerri C. Treinen, Allison R. Trcka, Jeffrey A. Zingre, and Amy J. Wehnke

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeters (mm)
foot (ft)	0.3048	meter (m)
	Flow rate	
gallon per minute (gal/min)	0.06309	liter per second (L/s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F = (1.8 × °C) + 32

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C = (°F – 32) / 1.8

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD83).

Supplemental Information

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given in either milligrams per liter (mg/L) or micrograms per liter (µg/L).

Activities for radioactive constituents in water are given in picocuries per liter (pCi/L). Annual dose limits are given in millirems per year (mrem/yr).

Abbreviations

µS/cm	microsiemens per centimeter
AQS	Aquarius Samples
AQTS	Aquarius Time Series
ASR	Analytical Services Request
DO	dissolved oxygen
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HIF	Hydrologic Instrumentation Facility
IDWSC	Idaho Water Science Center
INL	Idaho National Laboratory
MCL	maximum contaminant level
MLMS	multilevel monitoring systems
MP	measurement point
mV	millivolt
NRF	Naval Reactors Facility
NWQL	National Water Quality Laboratory (USGS)
QA	quality assurance
QADM	quality assurance and data management plan
QAP	quality assurance plan
QWDX	Water-Quality Data Transfer System
RESL	U.S. Department of Energy’s Radiological and Environmental Sciences Laboratory
RMS	Record Management System
USGS	U.S. Geological Survey
VOC	volatile organic compound
WL	water level

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By Kerri C. Treinen, Allison R. Trcka, Jeffrey A. Zingre, and Amy J. Wehnke

Introduction

Water-quality activities and water-level measurements conducted by the U.S. Geological Survey (USGS) Idaho National Laboratory (INL) Project Office coincide with the USGS mission of evaluating the quantity and quality of the Nation's water resources. The activities are conducted in cooperation with the U.S. Department of Energy's (DOE) Idaho Operations Office. Results of water-quality and hydraulic head research efforts are presented in various USGS and scientific journal publications (refer to Fisher, 2022). These data are stored internally in the Aquarius Time Series and Aquarius Samples databases and are publicly accessible through National Water Quality Monitoring Council (2025) and U.S. Geological Survey (2025). Data collected from our studies are used by researchers, Federal and State agencies, water management and regulatory organizations, as well as the public.

This quality assurance plan (QAP) describes the methods and processes for field methods, data collection, data management, data auditing, and equipment management for both the water-quality and water-level programs at the USGS INL Project Office (hereto referred to as INL Project Office). A comprehensive quality assurance (QA) plan ensures that the processes defined in this document will guide the program staff to collect and publish reliable, useful, and defensible data products for stakeholders. This QAP supersedes previous versions of this document and is intended to complement the Quality Assurance and Data Management (QADM) Plan for the Idaho Water Science Center (IDWSC; Christopher Mebane and Lauren Zinsser, written commun., 2024).

Purposes of, and Responsibility for, Maintaining the Quality-Assurance Plan

The purpose of the INL Project Office QAP for water-quality and water-level activities is to ensure the quality of technical products and to provide formal standardization, documentation, and review of the activities that lead to these products. The principles of this plan are as follows:

1. Water-quality and water-level programs will be planned with technically robust methods and activities will be monitored for compliance with stated objectives and approaches. The objectives and approaches are defined in an annual project task plan.
2. Field, laboratory, and office activities will be performed in a conscientious and professional manner in accordance with USGS Water Mission Area practices and procedures by supervised and well-trained personnel. If USGS practices and procedures are unspecified or inadequate—the procedures used, and the assessment of data quality—are documented.
3. All water-quality and water-level activities will be reviewed for completeness, reliability, credibility, and conformity with specified standards and guidelines.
4. A record of actions will be kept, documenting the activities and the assigned responsibilities of personnel.
5. Remedial action will be taken to correct activities that are unsatisfactory.

The INL Project Office Chief has overall responsibility for implementing this QAP; however, the QA Specialist, principal investigator for geochemistry, and lead personnel for the water-quality and water-level monitoring networks are directly responsible for day-to-day QAP maintenance. This QAP will be formally revised and reprinted as necessary. Any changes that take place in the interim will be communicated by memoranda to project office personnel and the Idaho Water Science Center Water-Quality Specialist on an as-needed basis. Copies of those memoranda will be stored internally in the QA folder on the INL Project Office internal data-storage site.

Scope

This QAP for the water-quality activities and water-level measurements of the INL Project Office defines procedures and tasks performed by project-office personnel that ensure the reliability of water-quality and water-level measurement data. Most of the principles of the plan have been in effect during past and current operations (as of 2026), but this QAP provides a method for formalizing and communicating the plan to all employees of the project office and to users of hydrologic data and interpretive reports. The first QAP was implemented in 1989 and revised in 1992, and further revised by Mann (1996), Bartholomay and others (2003), Knobel and others (2008, 2014), Bartholomay and others (2014), and Bartholomay and others (2021). This version of the QAP incorporates the revisions made to the water-quality and water-level monitoring programs since 2021. A comprehensive list of references containing procedures used for data collection, analytical methods, and data interpretation is given in the "References Cited" section.

Information on water-quality sampling schedules, water-level measurement schedules, data-quality objectives, water-quality field equipment, and the field-audit checklist are included in appendixes 1, 2, 3, 4, 5, 6, 7, and 8.

Description of Water-Level Monitoring Networks

The USGS has maintained a water-level monitoring program at the INL since 1949 to systematically measure water levels (WLs) to provide long-term information on the eastern Snake River Plain aquifer for groundwater recharge, discharge, movement, and storage. As of 2026, the INL Project Office measures water levels in over 200 monitoring well sites (31 perched and 174 aquifer wells; appendix 2) and 12 multilevel monitoring systems (MLMS) sites; MLMS sites include 190 discrete pressure/temperature ports located at various vertical depths (Fisher and Twining, 2024).

Collection of water-level data are obtained manually by use of electronic (e)-tapes and continuous data loggers. Water levels are collected monthly, quarterly, semi-annually, or annually depending on historical data, research needs, and changes in hydrologic conditions (appendix 2). Within the USGS water-level monitoring network, there are 12 continuous-data loggers as of 2026, 2 of which are equipped with real-time data. Information and serial numbers for continuous data loggers can be found in the USGS site information management system and appendix 7.

The MLMS network provides detailed monitoring of the vertical distribution of pressure gradients within the aquifer. Each of the 12 MLMS wells are equipped with multiple pressure/temperature measurement ports (ranging from 8 to 23) to help improve the INL Project Office groundwater-modeling studies (Twining and others, 2021; table 1). Pressure and (or) temperature profiles are collected either quarterly or annually depending on the location of the well and the need for information (appendix 2). Additionally, 5 wells (USGS 30, 139, 145, HWY 1, and NRF-15) have been equipped with piezometer nests (measures groundwater pressure) at different levels of the aquifer to better define vertical groundwater level distribution (appendix 2).

Description of Water-Quality Monitoring Networks

The USGS has maintained a water-quality monitoring program at the INL since 1949 to define:

1. The quality and availability of water for human consumption;
2. The usability of the water for supporting the construction of facilities and for industrial purposes, such as cooling systems and diluting concentrated waste streams;
3. The sources of recharge to the eastern Snake River Plain aquifer;
4. The processes controlling the origin and distribution of contaminants and naturally occurring constituents in the eastern Snake River Plain aquifer;
5. The location and movement of contaminants in the eastern Snake River Plain aquifer that were contained in wastewater discharged at the INL either to the eastern Snake River Plain aquifer or to the overlying perched groundwater zones; and
6. An early detection network for contaminants moving past the INL boundaries.

Historical subsurface and surface disposal of contaminants at the INL has taken place through deep disposal wells, shallow infiltration ponds, and disposal ditches (Bartholomay, 2022). Currently, facility operators dispose of wastewater primarily through lined evaporation ponds or disposal ditches according to INL wastewater-disposal guidelines. More information can be found in Idaho Environmental Coalition (2025).

A network of approximately 350 water-quality monitoring wells has been sampled in the past by the INL Project Office. As of 2025, the water-quality network consists of 152 wells and 5 surface-water sites (appendix 1). Approximately 20 of those wells are part of the perched groundwater-monitoring network. Additional monitoring sites will be selected as needed to better document the distribution and migration of contaminants in either the aquifer or perched groundwater zones. Most of the monitoring wells are open boreholes (without a screen), but select wells have perforations or wire-wrapped screened intervals. In general, monitoring wells at the INL are open throughout the entire well depth below the water table, with variable completion depths. This type of construction is useful for identifying the time of arrival of contaminant plumes and for delineating the horizontal extent of contaminants; however, it is not conducive for identifying the vertical distribution of contaminants.

To better identify the vertical distribution of contaminants in the aquifer, multilevel water-quality sampling, along with pressure- and temperature-profiling networks, were initiated in 2005. Westbay packer-based, vertical MLMS were installed at multiple locations across the INL to achieve this

Table 1. U.S. Geological Survey multilevel monitoring sampling systems site information, Idaho National Laboratory and vicinity, eastern Idaho.

[Current water-quality ports can be found in appendix 1. USGS, U.S. Geological Survey; no., number; ft, feet; °, degrees]

Site name	USGS site no.[1]	Latitude (decimal degrees)	Longitude (decimal degrees)	Borehole depth (ft)	Measurement ports	Year installed
Middle 2050A	433409112570500	43.56921°	–112.95233°	1,427	15	2005
Middle 2051	433217113004900	43.53794°	–113.01455°	1,179	12	2005
USGS 103	432714112569701	43.45368°	–112.93598°	1,307	23	2007
USGS 105	432703113001801	43.45085°	–113.00577°	1,409	18	2009
USGS 108	432659112582601	43.44957°	–112.97481°	1,218	16	2010
USGS 131A	433036112581800	43.51019°	–112.97188°	1,189	16	2012
USGS 132	432906113025000	43.48509°	–113.04831°	1,238	23	2006
USGS 133	433605112554300	43.60142°	–112.92965°	818	13	2007
USGS 134	433611112595800	43.60300°	–113.00035°	949	19	2006
USGS 135	432753113093600	43.46476°	–113.16073°	1,198	14	2009
USGS 137A	432701113025800	43.45076°	–113.04962°	1,058	8	2012
USGS 149	433524112390800	43.58992°	–112.65230°	974	12	2019

[1] Site number listed is for the main site number for the well. Each water-quality port has its own unique site number with available data. Refer to appendix 1 for specific site numbers. Data are available at Fisher and Twining, 2024.

objective (Fisher and Twining, 2024; table 1; appendix 1). As with open-borehole construction, the packer-based construction allows for identifying the time of arrival of contaminant plumes and for delineating the horizontal extent of contaminants. Additionally, this construction allows for sampling discrete zones of water and collecting pressure, temperature, and water-quality data at isolated depths within each well. Measurement ports, which are specific points within these zones, are used for data collection. All ports in each MLMS are sampled for pressure and temperature profiles, while selected ports are sampled for water quality (table 1; appendix 1).

The monitoring wells (aquifer and perched) and surface-water sites in the INL routine monitoring networks and in the MLMS network are sampled annually as indicated in appendix 1. The Radioactive Waste Management Complex production well is sampled for volatile organic compounds (VOCs) monthly. In addition to the routine sampling constituents in appendix 1, some wells may be sampled periodically for other constituents, including iodine-129, trace metals, VOCs, dissolved gases, isotopes, and constituents used for groundwater age-dating.

In addition to the groundwater and surface-water sites sampled annually for the routine-monitoring networks and the sites sampled for vertical determination of contaminants in the aquifer, the USGS INL Project Office personnel collect water samples from wells near the Naval Reactors Facility (NRF) on a semiannual basis (appendix 1). The purpose of this data-collection program is to provide the Department of Energy's (DOE) Pittsburgh Naval Reactors Office, Idaho Branch Office, with chemical and radiochemical data to evaluate the effect of NRF activities on the water quality of the eastern Snake River Plain aquifer.

Field Methods for Water-Quality Activities

Sample containers, sample-preservation methods, field-equipment maintenance and monitoring, well-head decontamination, and quality-control and environmental sample-collection procedures are important components in assuring that data-quality objectives are achieved at the field level.

Sample Containers and Preservation Methods

Sample containers and preservation methods differ depending on the chemistry of the constituents being analyzed. Samples analyzed by the USGS National Water Quality Laboratory (NWQL) are containerized and preserved in accordance with laboratory requirements summarized in the USGS National Field Manual (U.S. Geological Survey, [variously dated], chapter A5; table 2). Containers and chemical preservatives are supplied by NWQL. At the NWQL, these chemical preservatives undergo rigorous quality-control measures to ensure that they are free of contamination (Pritt and Raese, 1995; U.S. Geological Survey, [variously dated]; table 2). Samples analyzed by the DOE Radiological and Environmental Sciences Laboratory (RESL)

Table 2. Containers and preservatives used for water samples, U.S. Geological Survey Idaho National Laboratory and vicinity.

[mL, milliliter; NWQL, U.S. Geological Survey National Water Quality Laboratory; L, liter; GEL, Gel Laboratories, LLC; HNO_3, nitric acid; N, nitrogen; HCl, hydrochloric acid; °, degrees; H_2SO_4, sulfuric acid; VOCs, volatile organic compounds; mg, milligrams; RESL, U.S. Department of Energy's Radiological and Environmental Sciences Laboratory; ARS, ARS International, LLC; O, oxygen; H, hydrogen; RSIL, U.S. Geological Survey's Reston Stable Isotope Laboratory; C, carbon; CFC, chlorofluorocarbon; PRIME, Purdue Rare Isotope Measurement Laboratory]

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size[1]	Type	Volume		
Anions, dissolved	Polyethylene	250 mL	None	None	Filter	NWQL
	Polyethylene	1 L	None	None	Filter	GEL
Cations, dissolved	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	Filter	NWQL
Cations, total	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	NWQL
Metals, dissolved	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	Filter	NWQL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	Filter	GEL
Metals, total	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	None	NWQL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	GEL
Mercury, dissolved	Glass, acid rinsed	250 mL	6N HCl	2 mL	Filter	NWQL
Mercury, total	Glass, acid rinsed	250 mL	6N HCl	2 mL	None	NWQL
Chromium, dissolved	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	Filter	NWQL
Nutrients, dissolved	Polyethylene, brown	125 mL	None	None	Filter, Chill, 4°C	NWQL
	Polyethylene, acid rinsed	125 mL	H_2SO_4	2 mL	Chill, 4°C	GEL
Nutrients, total	Polyethylene, acid rinsed	125 mL	H_2SO_4	2 mL	Chill, 4°C	GEL
VOCs	Glass, baked	40 mL (3)	HCl	5 drops	Chill, 4°C	NWQL
	Glass	40 mL (3)	HCl	25 mg	Chill, 4°C	GEL
Semi-VOCs	Glass, baked	1 L (2)	None	4 mL/bottle	Chill, 4°C	GEL
Gross alpha/beta-particle	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Nickel-63	Polyethylene, acid rinsed	2 L	HNO_3	4 mL	None	GEL
Strontium-90	Polyethylene, acid rinsed	2 L	HNO_3	4 mL	None	GEL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Gamma spectroscopy	Polyethylene, acid rinsed	2 L	HNO_3	4 mL	None	GEL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Tritium	Polyethylene	500 mL	None	None	None	Menlo Park Tritium Laboratory
	Polyethylene	500 mL	None	None	None	RESL
	Polyethylene	1 L	None	None	None	ARS
Transuranics (including plutonium isotopes)	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	None	RESL
Uranium isotopes	Polyethylene, acid rinsed	1 L	None	None	Filter	RESL

Table 2. Containers and preservatives used for water samples, U.S. Geological Survey Idaho National Laboratory and vicinity.—Continued

[mL, milliliter; NWQL, U.S. Geological Survey National Water Quality Laboratory; L, liter; GEL, Gel Laboratories, LLC; HNO_3, nitric acid; N, nitrogen; HCl, hydrochloric acid; °, degrees; H_2SO_4, sulfuric acid; VOCs, volatile organic compounds; mg, milligrams; RESL, U.S. Department of Energy's Radiological and Environmental Sciences Laboratory; ARS, ARS International, LLC; O, oxygen; H, hydrogen; RSIL, U.S. Geological Survey's Reston Stable Isotope Laboratory; C, carbon; CFC, chlorofluorocarbon; PRIME, Purdue Rare Isotope Measurement Laboratory]

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size[1]	Type	Volume		
O-18/O-16 and H-2/H-1	Glass, with polyseal cap	60 mL	None	None	None	RSIL
C-13/C-12	Glass, with plastic coating, polyseal cap	1 L	None	None	None	RSIL
Dissolved gases	Glass, with rubber stopper	150 mL	None	None	Relieve pressure with needle	Reston CFC Laboratory
CFC Age-dating	Glass, with white plastic caps, aluminum foil liner	125 mL	None	None	None	Groundwater Dating Laboratory
Iodine-129	Polyethylene	1 L	None	None	Filter	PRIME Lab

[1] Numbers within parentheses denote the number of bottles to collect if greater than 1.

use sample containers that are preserved in accordance with requirements specified by the laboratory's Analytical Chemistry Measurements Team (RESL, 2022, 2024). Any changes in sample-collection procedures are documented in writing. Containers and preservatives for selected constituents are supplied by the NWQL and are summarized in table 2. Containers and preservatives for selected constituents are supplied by GEL Laboratories, LLC, and are summarized in table 2. Samples analyzed as part of the INL Project Office NRF sample program are containerized and preserved in accordance with requirements specified by ARS Laboratories and GEL Laboratories, LLC (GEL Laboratories, LLC, 2015).

Field Equipment

Field personnel utilize a variety of analytical and associated equipment, including pH meters, thermistors, turbidity meters, barometers, multiparameter instruments, titrators for alkalinity measurements, peristaltic pumps, inline disposable filter capsules with a 0.45-micron filter that is certified to be constituent-free, and associated glassware and tubing. The analytical equipment is housed in the sample preparation area and typically operated in mobile-field laboratories. These mobile laboratories serve three main purposes:

1. To provide a clean environment for measuring field parameters, reducing the risk of sample contamination or degradation from wind, dust, rain, snow, and sunlight;
2. To offer storage for samples, shipping containers, chemical reagents and preservatives, analytical instruments, and deionized water used for decontaminating field equipment; and
3. To facilitate the containerization, preservation, and secure storage of samples in a refrigerator or transportation container within minutes of collection from wells and (or) surface-water sites.

Calibrations, Maintenance, and Equipment Storage Procedures

Multiparameter instruments used to measure field water-quality parameters, including pH, specific conductance, dissolved oxygen (DO), and oxidation-reduction potential are maintained and calibrated following the manufacturer's procedures. The frequency at which INL Project Office personnel calibrate field equipment depends on the specific needs and usage of the equipment. Calibrations of pH meters and multiparameter instruments are performed at least once each week during multiweek sampling campaigns, followed by calibration checks on the subsequent sampling days. The instruments that require calibration include multiparameter instruments, thermistors, turbidity meters, and barometers (U.S. Geological Survey, [variously dated], chapter A6).

Calibration is essential for ensuring accurate and reliable measurements, which are vital for maintaining data integrity. Regular calibration aligns the instruments with known standards, which minimizes errors and ensures consistency. Proper maintenance and storage of the instruments prevent damage and degradation, thereby extending their lifespans. Taking steps to ensure the multiparameter instrument wires are not too tight and regularly inspecting the wires for any signs of wear and (or) damage (which may include replacing the wires) on the probe and handheld device prevents equipment damage. Additionally, it is important to check the probes and sensors for any obvious wear and (or) damage and address any issues to ensure accurate measurements. Instrument integrity is essential for accurate measurements during water-quality operations as well as maintaining backup instrumentation if equipment does not fall within manufacturer specifications. If calibrations fail and cannot be fixed through cleaning, resetting the probes using the manufacturer's software, ensuring the firmware is up to date, replacing the instruments' batteries, or contacting the manufacturer for further assistance, the probe(s) should be replaced.

Calibration data are recorded in the Site Visit Mobile Aquarius (SVMAQ) program and stored internally in the Aquarius Time Series (AQTS) program for access and QA analysis are reviewed biannually by the INL Project Chief and QA Specialist using the Office of Quality Assurance's Water Quality Calibration Dashboard. Any changes to equipment, replacement equipment, or updated consumable materials are also documented in SVMAQ. An inventory of field equipment is provided in appendix 7.

Thermistors and Barometers

The INL Calibration Facility personnel calibrate the thermistors and barometers annually using calibration instructions specific to the make and model of the instrument being calibrated, subject to the manufacturer's guidance and National Institute of Standards and Technology-certified standards. The annual calibration files for calibrated field equipment are maintained by the INL Project Office.

Turbidity

The INL Project Office personnel calibrate the turbidity meters in the sample preparation area or at the first well site where samples are collected for the day. Calibration is conducted only when project objectives include collecting turbidity samples; this step is not required for every sampling campaign. The probe is calibrated using a four-step process with Formazin turbidity standard (U.S. Geological Survey, [variously dated], chapter 6.7). The calibration standards are gently inverted several times to ensure they are thoroughly mixed. The calibration and potential recalibration data are not currently supported in SVMAQ; therefore, calibration data are documented on the field observation sheet. Turbidity readings are recorded before and after calibration of the turbidity meters. To obtain accurate readings, there should be no scratches, fingerprints, water, or any contaminants on the glass surface of the container.

pH

The INL Project Office personnel calibrate the pH electrode used for alkalinity titration and the pH sensor in the multiparameter instruments in a similar manner. The instruments are calibrated using a 3-step calibration with buffer solutions with pH values of 7, 10, and 4, respectively. The calibration and potential recalibration data are recorded in SVMAQ. Temperature, pH, slope, and millivolt (mV) readings are recorded before and after calibration with each buffer. The acceptable millivolt tolerance buffer for pH 4 is 180 plus or minus (±)50 mV; for pH 7, 0±50 mV; and for pH 10, –180±50 mV (U.S. Geological Survey, [variously dated], chapter 6.4). Properly working electrodes should yield a slope of 95 to 101 percent. The pH is checked and potentially recalibrated if the initial readings at a well differ by more than 1 pH unit from the previous two readings recorded at the site. The measured value of the pH 7 buffer is recorded for the appropriate site before recalibration.

Depending on use, the typical lifespan of pH electrodes in environmental field operations is approximately 12 to 18 months. To help extend the lifespan of the pH electrode, it is crucial not to store the electrode in deionized water, as doing so can damage the internal reference electrode. Instead, store the pH electrode in a moist environment using a special electrode-storage solution. The pH electrode should be stored in its own container, and the multiparameter instrument should be filled up to 25% of the storage volume (but make sure not to fully submerge the electrodes) with either tap water or pH 7 if used daily, or a liquid with pH 4 for extended storage. Over time, pH electrodes should be evaluated more frequently to ensure their mV-response slope remains within the acceptable range of 95 to 101 percent. If the response slope deviates outside this range or is slow and cannot be corrected through cleaning, reconditioning, resetting the probes using the manufacturer's software, ensuring the firmware is up to date, replacing the instrument batteries, or contacting the manufacturer for further assistance, the pH electrode should be replaced.

Specific Conductance

The INL Project Office personnel calibrate the specific-conductance sensor in the multiparameter instrument when necessary, depending on the sampling campaign schedule. The instruments are calibrated using a 2-step calibration with a dry probe (0 microsiemens per centimeter [µS/cm]) using a 1,000 µS/cm solution. This ensures that a range of possible conductivity values are accounted for. The calibration and potential recalibration data are recorded in SVMAQ. Temperature and specific-conductance readings are recorded before and after calibration with each solution. The specific conductance is checked and potentially recalibrated if the initial readings at a well differ by more than five percent from the previous two readings recorded at the site. The measured value of the 1,000 µS/cm solution is recorded for the corresponding site before recalibration. The specific-conductance meter is recalibrated if, at any time, the measurement reading of the solution is off by ±5 percent for specific conductivity less than or equal to (≤)100 µS/cm or ±3 percent for specific conductivity greater than 100 µS/cm (U.S. Geological Survey, [variously dated], chapter 6.3).

Dissolved Oxygen

INL Project Office personnel calibrate the DO sensor in the multiparameter instruments. The probe is calibrated using a 1-step calibration to create a 100-percent saturated oxygen environment using the air-saturated water procedure (U.S. Geological Survey, [variously dated], chapter 6.3). The calibration and potential recalibration data are recorded in SVMAQ. Temperature, barometric pressure and DO (in milligrams per liter) readings are recorded before and after calibration.

Depending on use, the sensor's life span is approximately two years, even if the sensor is idle. If there is peeling and (or) flaking of the cap coating or moisture under the cap, the probe should be replaced. If calibrations fail and cannot be corrected through cleaning, resetting the probes using the manufacturer's software, ensuring the firmware is up to date, replacing the batteries, or contacting the manufacturer for further assistance, the DO sensor should be replaced.

Oxygen-Reduction Potential

INL Project Office personnel calibrate the oxygen-reduction potential sensor in the multiparameter instruments. This sensor is the same as the pH probe. Calibration is performed monthly whenever water-quality samples are collected. The probe is calibrated using a 1-step calibration using ZoBells solution. The calibration and potential recalibration data are not currently supported in SVMAQ; however, these data are documented in a field observation sheet. Temperature and oxygen-reduction potential (mV unit) readings are recorded before and after calibration.

Decontamination Procedures

Wells that are equipped with dedicated submersible or line-shaft turbine pumps do not require decontamination, but the equipment attached to the discharge pipe for water-quality sample collection does. To remove stagnant water, rinse the pump and delivery line with groundwater, and equilibrate the field parameters by pumping at least one wellbore volume of water from the well.

To facilitate sample collection and divert excess water away from the wellhead, wells with dedicated pumps are fitted with a portable-discharge stainless-steel pipe approximately 2 feet long. This discharge pipe, with an approximate 1.5-inch (in.) inside diameter, is equipped with a gate valve to control the flow rate. A series of joints, nipples, pipe sections, and valves are attached to the portable-discharge line to split the well discharge into three streams. Two of these streams are reduced to a 0.25-in. diameter port which allows for attaching Tygon tubing, and the third stream, which carries excess water, is diverted away from the well. The first port connects to a flow-through chamber for measuring temperature, pH, specific conductance, DO, and oxygen-reduction potential using a multiparameter instrument, and the second port is used for filling water-quality sample bottles.

All fittings and pipes are made of stainless steel and are rinsed with deionized water before installation at the wellhead. For most wells, flushing with several hundreds to thousands of gallons of purged well water further reduces the risk of cross-contamination from previously sampled wells during a sampling campaign. After sample collection, the fittings and pipes are rinsed with deionized water and capped before storage to minimize the chance of cross-contamination between wells. To extend the lifespan of the pumps, a frequency-reduction system is installed between the generator and the well pump to control the speed of the variable-horsepower pumps.

Production wells typically have a spigot at or near the wellhead and do not require special sample-collection equipment. Decontamination of production wells involves rinsing the spigot with pumped groundwater to remove any foreign materials.

For wells without dedicated pumps, a dedicated bailer can be used to collect water samples. Dedicated and maintained bailers are necessary to minimize the risk of cross-contamination between wells. Once a year, before the fall or spring sampling campaign, the bailer and the bailing line are washed with water and detergent (Liquinox), then rinsed with deionized water. Before and after each use, the bailer is rinsed with deionized water. Periodic collection and analysis of decontamination rinsate (as an equipment blank) ensures the bailing equipment is not contaminated by constituents of interest during use.

At multilevel monitoring wells, stainless-steel thief-sampling devices are used to collect samples. Samples are transferred directly from these devices to pre-cleaned Teflon containers for the filling of appropriate sample bottles. Before sampling at each port, the thief-sampling devices are washed with water and Liquinox detergent, then rinsed with deionized water. At the end of the day during a sampling campaign, the equipment is washed and rinsed again before placed in storage to further reduce the chance of cross-contamination between sampling sites. For surface-water sites, surface-water (grab) samples are collected from the stream bank or lake shores using either a precleaned Teflon container or a precleaned churn splitter. The selected container is washed with water and Liquinox detergent, then rinsed with deionized water before and after sample collection.

Sample Collection

Sample collection by the USGS at the INL generally follows protocols outlined in the USGS National Field Manual (U.S. Geological Survey, [variously dated], chap. A4) or in the USGS IDWSC QADM for water-quality activities (Chris Mebane and Lauren Zinsser, U.S. Geological Survey, written commun., 2024). However, protocols could be modified to collect the best representative water-quality sample. Any sample-collection modifications are documented and validated (when appropriate) because compliance with documented and technically approved sample-collection and processing protocols is critical to ensuring the quality of water-quality data (Chris Mebane and Lauren Zinsser, U.S. Geological Survey, written commun., 2024). Annual and as-needed training in water-quality sampling procedures, whether through National USGS programs or field-based efforts—is conducted by the INL Project Chief, INL Quality Assurance (QA) Specialist, or Water-Quality Lead to ensure consistency and compliance during sample collection.

At wells equipped with a dedicated pump, a volume of water equivalent to at least one wellbore volume is pumped before sample collection. Often, more than one wellbore volume is pumped to allow time for the collection of three stable readings of field parameters. This modification, compared to the USGS National Field Manual recommendation of purging three well volumes, helps limit the amount of purged water that needs to be containerized at select INL wells (U.S. Geological Survey, [variously dated], chapter 4.2). Studies by Bartholomay (1993) and Knobel (2006) have shown that constituent concentrations are not significantly affected by the volume of water purged from the wells evaluated. The diameter of the borehole, rather than the volume of the casing, is used to calculate the minimum volume due to the potentially large difference between the two values (U.S. Geological Survey, [variously dated], chapter 4.2).

The USGS National Field Manual recommends using sample-processing chambers to minimize atmospheric contamination of water-quality samples (U.S. Geological Survey, [variously dated]). However, due to the design of the portable-discharge pipe and its associated fittings, samples are collected directly from the discharge ports. This setup ensures that the groundwater has minimal exposure to air from the moment it exits the discharge pipe until it is captured in the sample container. The discharge pipe is equipped with gate valves that provide precise control over the flow rate of each discharge stream, allowing adjustments to be made (if needed) for the specific analytical requirements (U.S. Geological Survey, [variously dated], chapter 5.2).

The USGS National Field Manual recommends specific field-rinse techniques for sample bottles to ensure any residual contaminants are removed (U.S. Geological Survey, [variously dated], chapter 5.2). Typically, bottles are rinsed with deionized water and then with well water. Because the filter's pore space can become blocked due to sediment loading or mineral precipitation, limiting the amount of water that passes through the filter is necessary. The well water at INL has very low average turbidity levels (≤5 nephelometric turbidity units), which means the nominal pore size of the filter media is not significantly affected by the volume of sample passed through the filter. This allows for more water to be run through a single filter without the need for additional filters. Therefore, the INL protocol involves rinsing sample containers three times with well water (minimizing the need for additional filters) and ensuring efficient sample collection. Only one filter is typically used unless there is a filter failure or observed sediment buildup.

Temperature, specific conductance, pH, DO, and oxygen-reduction potential are monitored periodically during pumping using methods described by Wood (1981), Hardy and others (1989), and U.S. Geological Survey, [variously dated, chapter A6]. Readings are taken every 3 minutes and must meet stability criteria; pH measurements are within ±0.1 standard units, water temperature is ±0.2 degrees Celsius (°C), and specific-conductance readings are within 5 percent for at least 4 consecutive readings before a water sample is collected, which likely indicates hydraulic and chemical stability (U.S. Geological Survey, [variously dated], chapter A6). If stability criteria are not met, readings continue until 4 consecutive stable readings are achieved. The fourth consecutive stable reading represents the field parameters for the environmental sample and indicates hydraulic and chemical stability of the aquifer (U.S. Geological Survey, [variously dated], chapter A6).

The steps outlined for sample collection are specific to the stainless-steel sampling ports that the INL Project Office utilizes for sample collection. Samples are collected using the following steps:

1. Field personnel are responsible for collecting the water-quality sample. Personnel wear disposable gloves and stand in a position where neither the collector nor the sample can become contaminated.
2. The entire sample-delivery line and the Tygon tubing (if used) are thoroughly rinsed with water pumped from the well.
3. A new, disposable capsule filter with a 0.45-micron-membrane is used at each site. The capsule filter is inverted to clear trapped air and bubbles, and two liters of deionized water are used to rinse the capsule filter prior to sample collection; this removes any surfactants that could be adhered to the filter. If appropriate, sample containers for grab samples, thief samples, and bailer samples are thoroughly rinsed with deionized water.
4. For groundwater, the capsule filter is connected to the sample port with precleaned Tygon tubing, and unfiltered samples are collected directly from the sample port. For grab samples, thief samples, and bailer samples, sample water is collected in a precleaned container that has been triple-rinsed with sample water. The precleaned inlet tubing of a peristaltic pump is placed into the container to supply sample water to the capsule filter. Unfiltered samples are collected by drawing water directly from the sample-delivery line. All sample bottles are triple-rinsed with sample water before sample collection (filtered or unfiltered water, as appropriate).
5. At surface-water sites, either a precleaned Teflon container or a precleaned churn splitter is used to take grab samples.
6. Wells completed in the perched-water zones do not contain or produce enough water to be sampled with a pump. For these wells, a 1,000-mL Teflon bailer is used for sample collection.
7. Samples are capped and moved into the mobile-field laboratory where they are uncapped and preserved (if appropriate) as described in table 2. A new pair of gloves, safety glasses, and a laboratory apron are worn while preserving samples.
8. The bottles are capped and labeled. Alternatively, an additional method for labeling bottles is to record information directly on the sample container using a permanent marker. Recording the information both on a label and directly on the bottle is preferable. If the bottle is made of glass, the information is placed on top of the cap—not directly on the glass.
9. Field measurements are taken again after samples are collected. If the temperature differs by more than 0.5 °C, the pH differs by more than 0.1 units, or the specific conductance differs by more than 5 percent, the measurements are verified, and a second set of samples may be collected (subject to determination in the field). The second set of samples replaces the original set of samples.
10. An Analytical Services Request (ASR) form is completed for use by each laboratory to which the sample(s) will be sent for analysis. This form includes the field conditions, sample identification, analyses requested, and contact information for the lead sampling personnel.
11. Water samples are chilled to 4 °C when necessary and stored in the field laboratory’s refrigerator or cooler until they can be transferred to the sample preparation area.
12. Samples are shipped biweekly (or as needed) to the USGS NWQL, GEL Laboratories, LLC, and ARS International, LLC, for analysis. They are transported in sealed coolers by a contract carrier, with overnight delivery required for samples intended for nutrient, VOC, and other time-sensitive analyses. Samples sent to RESL are hand-carried to the laboratory at the end of the sampling event.

13. All equipment is decontaminated with deionized water and, if necessary, organic-free water or detergent, depending on the sampling equipment.

At MLMS wells, the evacuated stainless-steel thief-sampling devices are lowered to the zone to be sampled, connected to the sampling port, and filled with groundwater. The collected water is placed in a precleaned container as described in step 4 of the sample-collection process. This process is repeated until sufficient water has been collected to fill all the required sample bottles and to make all necessary field measurements. After all the sample bottles are filled with either raw or filtered water, samples are preserved appropriately, labeled, stored, and shipped following the procedures outlined in steps 5–11 of the sample-collection process.

Sampling specific wells inside the Advanced Test Reactor Complex and the boundary of the Resource Conservation and Recovery Act Listed Waste Polygon (Knobel, 2006), located downgradient of the Idaho Nuclear Technology and Engineering Center, requires containerization of all purged water. These wells are purged at slow rates to minimize the volume of purged water that needs containerization. At sites where purged-water containerization is required, a different discharge-pipe setup is used. The sampling stream is split to accommodate field measurements and collect samples. Additionally, excess water from the flow-through chamber of the multiparameter instrument is collected and emptied into a trailer-mounted container. Excess discharge water is routed through canvas hoses to these containers. Once the containers are full, the containerized purge water is then transported to an approved disposal site.

Production wells at the INL are generally connected to water-distribution systems and cycle on and off in response to system water demands. Due to these frequent pumping cycles, the water in the system is representative of aquifer water. Only the sample-collection lines (tubing connected to a spigot to facilitate sample-collection) require purging prior to sampling. To avoid stagnant water in the pipes, the pump needs to be turned on when sampling and collecting field measurements. In many cases, the production well cycles off before the field measurements can stabilize. When this occurs, the requirement for stable readings is considered, and the well may be sampled before stabilized readings have been acquired. Conditions at the well during sample collection are recorded at each site on the field observation sheet.

Data Management for Water Quality

Electronic- and physical-data collection related to water-quality sampling by INL Project Office personnel must be appropriately managed to ensure data integrity. The data-management workflow for water-quality starts with an electronic data-tracking sheet, followed by field observations, analytical requests to the laboratory, laboratory delivery of data, and finally, reviewed analytical results that are released to public-data repositories.

Data management is documented in an internal data-tracking spreadsheet and includes tracking requested analyses at each data-collection site as well as if any problems are encountered during sampling or sample submission to the laboratory (for example, delayed delivery of samples to the laboratory or a miscoded constituent). All field conditions and information related to the collection of water-quality samples are recorded on paper field observation sheets. These data are then transcribed into the groundwater Superfly application—a spreadsheet template created by the USGS Water Mission Area and modified by INL Project Office personnel for electronic archiving and production of essential documentation.

Superfly automatically generates the ASR forms with the field conditions, name of sample-collection site, and requested analytical methods. These ASRs act as both analytical service request forms and chain-of-custody records. The original ASR forms are sent to the laboratory with the preserved samples, and a copy is kept on the internal data-storage site. Copies of the ASRs and any other field-collected data can be provided to co-sampling entities and cooperators upon request. If other chain-of-custody forms are required for subprojects within the INL Project Office scope, those documents are supplied to, and completed by, USGS field personnel and transferred to the appropriate cooperator and laboratory as required.

All data are entered into the AQS database. Field-measurement data and associated metadata recorded in Superfly are automatically generated into AQS-compatible batch files that are entered into AQS at the end of water-quality sampling events. Field parameters need to be preloaded in AQS for lab results to be uploaded successfully. The method by which the lab results are entered varies owing to the capabilities of the laboratory that performed the analyses. The USGS NWQL and other USGS laboratories load their data in the Water Quality Data Transfer System (QWDX). Data within QWDX is uploaded into AQS and the import reports and associated AQS-compatible batch files are uploaded into the Water Science Center's Water Quality Data Management internal data-storage site and separated by project for archiving. Some contract laboratories will provide analysis results or data packages in a spreadsheet format, tab-delimited text files, or a PDF. In these instances, these data are formatted into AQS-compatible batch files using internal R scripts created by INL Project Office personnel and loaded into AQS.

When new data are received, they are validated by review for consistency by comparing to historical values, laboratory-detection limits, and by utilizing water-quality data checks using internal analytical data-review programs. Laboratory reruns may be requested for data results of questionable accuracy. When the data have been reviewed, the analyst can decide to accept or reject the results. This decision is reflected by applying the result-grade parameter (historical, provisional, reviewed and approved, and [or] reviewed and rejected) in the AQS database. Water-quality data are reviewed by the INL Project Office Water-Quality lead and the QA Specialist within 180 days after the data are available in AQS.

Field Methods for Water-Level Measurements

Field personnel utilize a variety of equipment to obtain water-level measurements, including electronic (e)-tapes and data loggers. The Idaho National Lab (INL) Project Office started the use of e-tapes in 2003 to measure groundwater WLs. Prior to 2003, stainless-steel tapes were used. Fluid-pressure measurements are made at the MLMS wells and data loggers have been installed in designated wells. The e-tapes are housed and stored within the office at INL or in field vehicles, while the data loggers are installed within the dedicated boreholes. Calibration of WL measurement equipment and use of appropriate field procedures are important for ensuring reliable WL data are collected. All sites are surveyed with known measuring points, and the WL is calculated from a known land surface datum. An inventory of e-tapes and steel tapes is given in appendix 7.

E-tapes

All e-tapes are calibrated before use in the field and recalibrated annually (or more frequently) if used extensively, if the tape has been subjected to abnormal stress that may have caused it to stretch, or if the e-tape needs to be repaired. E-tape calibration at the INL follows protocols outlined in the USGS Groundwater Technical Procedures Document (Cunningham and Schalk, 2011; Bartholomay and others, 2021; appendix 9). E-tapes are calibrated against a reference steel tape that is maintained in the office for calibration use only. Calibration is conducted downhole in designated wells that span the range of depths to water that is anticipated in and around the INL. With the establishment of the USGS Technical Memorandum GW2015.03 (U.S. Geological Survey, 2015), the INL Project Office started sending e-tapes for calibration at the Hydrologic Instrumentation Facility (HIF). Results from HIF raised questions about reproducibility of the calibrations, so the INL Project Office decided to keep current calibration procedures to maintain long-term data comparability. Discussion with HIF and the INL Project Office field team are included in Bartholomay and others (2021; appendix 9). The steps outlined below for WL calibrations are specific to open boreholes and include the following steps:

1. The distance from the probe's sensor to the nearest foot marker on the tape is checked to ensure that this distance puts the sensor at the zero-foot point for the tape. If it does not, a correction is applied to all depth-to-water measurements.

2. A check of the circuitry of the e-tape is performed before lowering the probe into the well by dipping the probe into tap water and observing whether the indicator light and beeper are functioning properly (indicating a closed circuit).

3. The WL measurements obtained using the e-tape are compared to those taken with the reference steel tape. Measurements should agree within ±0.02 feet (ft). If measurements are not repeatable to this standard, then a correction factor based on a regression analysis is developed and applied to measurements made with the e-tape. The e-tape correction files are stored on the INL Project Office internal data-storage site and are available as hard copies for field personnel to reference during field work.

All water-level measurements taken with an e-tape have a calibration and a measurement point (MP) correction applied to them. Several wells also have deviation corrections applied; these corrections have been calculated from geophysical deviation log files. The steps outlined here for WL collection are specific to open boreholes and include the following steps (Cunningham and Schalk, 2011):

4. Field personnel ensure the same deflection point on the indicator scale (which represents the sensitivity of the reading) is used for each well to ensure water levels are consistent between measurements.

5. The electrode probe is slowly lowered into the well until the indicator shows that the circuit is closed and contact with the water surface is made, indicated by a solid beep and the light turning on. A second reading is taken to check if measurements are within 0.02 ft of each other at the known MP; known as the depth to water. Documentation of the depth to water and date and time of the measurement are recorded on the water level trip sheet (internal field document).

6. The WL is recorded on the water level trip sheet and into SVMAQ with an MP correction applied to get the depth to water in feet below the land surface datum, while also applying any deviation and (or) e-tape corrections to the WL measurement in SVMAQ. Viewing historical data and the hydrograph on the SVMAQ program can verify if the WL is reasonable.

7. The tape is rewound and rinsed at the end of the tape with deionized water prior to storage for travel to the next well. If particulate residue is present, the e-tape cable is rinsed with deionized water and wiped down.

Data Loggers

The INL Project Office maintains 12 data logger sites established in observation wells for long-term continuous monitoring of WLs (appendix 2). Data loggers are installed by measuring the depth of the water below the land surface with a calibrated e-tape and correcting for any deviations before lowering the data logger into the well. Data loggers are subject to drift, offset, and slippage of the suspension system; therefore, their readings are checked against the e-tape WL during routine visits and reset if necessary. Data loggers are inspected and recalibrated annually in July by resetting the data logger to match the WL measured by the e-tape.

Wells equipped with data loggers are scheduled for quarterly visits to download data. Water-level measurements for data loggers are made to the nearest 0.01 ft. The accuracy of a data logger differs with the manufacturer, measurement range, and depth to water. The measurement error and accuracy standard for most situations for the transducer is 0.01 ft. The procedure for retrieving WL measurements from data loggers and maintaining the data logger is as follows (Cunningham and Schalk, 2011):

1. Retrieve groundwater data by using the data logger software.
2. Inspect the equipment to confirm that the data logger is operating properly. Document the current WL recorded by the sensor.
3. Measure the depth to water in the well using a calibrated e-tape to obtain an accurate WL measurement to compare with the WL measured by the data logger. If the WL measurement and data logger reading differ, slightly raise the data logger in the well and take a reading to confirm that the sensor is working. Observe the e-tape for possible cable kinks or slippage. Return the data logger to its original position.
4. Reset the position of the data logger if necessary.
5. Make sure the data logger is operating properly prior to departure from the site.

Multilevel Monitoring Systems

For each of the measurement ports on the 12 MLMS wells, profile measurements are collected. These ports are installed by measuring the depth of the port below land surface with a calibrated e-tape and correcting the depth due to deviation as described by Fisher and Twining (2024). The MLMS is a sealed modular system, so measuring the WL (pressure) requires specialized equipment and tooling. Instead, profile measurements, including fluid pressure, atmospheric pressure, and water temperature are recorded and the WL is calculated from those values using a wireline-sampling probe capable of accessing ports located at discrete depths. The procedure for retrieving profile measurements is as follows (Fisher and Twining, 2011):

1. The sampling probe is lowered to the deepest measuring port.
2. The probe is coupled with the monitoring port to continuously monitor fluid pressure and temperature.
3. Measurements of fluid pressure, atmospheric pressure, and water temperature are recorded after temperature readings stabilize with fluctuations of less than 0.1°C. Atmospheric pressure is monitored at the land surface using a handheld barometric sensor.
4. The probe is decoupled from the port and raised to the next highest measuring port.
5. The process is repeated until all ports are measured and final measurements are recorded.

Data Management for Water Levels

The INL Project Office manages both electronic- and physical-data collection for water levels to ensure data integrity. For WLs collected using e-tapes, all measurements and associated information are recorded on paper water level trip sheets and simultaneously entered into SVMAQ. SVMAQ is designed for groundwater site-visit data and outputs data in a format suitable for loading into AQTS. Multilevel pressure measurements are collected using electronic field forms and postprocessed using *mlms*, a customized software (Fisher and Twining, 2024). Raw data for continuous water level sites are downloaded in comma-separated values (.csv) format. Both sets of data are then formatted appropriately for loading into AQST. All files are archived on the INL Project Office's internal storage site.

The data-management workflow involves different personnel handling specific roles to ensure data accuracy and integrity. Field Personnel process the files into AQTS within one week of field visits. This includes reviewing the period of record, applying corrections to discrete water levels, examining the instantaneous values record, and editing the record as needed. The initial cleanup of instantaneous values involves checking thresholds set in the database and removing anomalous values such as spikes that were not automatically removed by thresholds. Water-level data do not estimate missing instantaneous or daily values.

A data approver (different from the field personnel who collects the data) checks field notes and hydrographs and applies corrections before approving these data. All water-level data are considered provisional until they have been reviewed and approved. A station analysis report, generated in Auto Station Analysis (AutoSA) is completed for the period of analysis in the Record Management System (RMS). After verifying that corrections and edits are complete and after evaluating hydrograph comparisons, the period of record is approved in AQTS and RMS. Discrete water levels are reviewed and approved within 90 days of collection. Multilevel monitoring system water levels are reviewed and approved within 120 days of collection. Data-logger water-level data are reviewed and approved within 150 days after collection. After data are approved, any additional examination of groundwater-level records would be considered an audit.

Nonroutine audits are conducted when necessary and documented in the RMS. The details in RMS include the date of the audit, the auditor, data examined, reason for examination, and outcome of the audit, including potential revisions. Nonroutine audits of groundwater-level records occur anytime an aspect of an approved record is reexamined. For example, an end user may question a published period of unusually low water levels or a series of spikes in the historical water-level record. Errors found during nonroutine audits are subject to internally defined error-threshold criteria for revisions. Nonroutine audits do not have any required tasks aside from documentation of the audit—which includes the date of the audit, the auditor, data examined, reason for examination, and the outcome of the audit, including a discussion of potential revisions (if any). Another example of a nonroutine audit would be a record that is examined during an external review by the USGS Office of Quality Assurance. In this case, most aspects of a designated-analysis period are examined (at a high level or in detail), and the documentation should include the notes or forms filled out by the reviewer. Nonroutine audits are to be documented by filling out the audit template in RMS.

Quality Assurance for Water-Quality Activities

The USGS QA Program at the INL Project Office incorporates the review of previously described methods of sample collection and processing along with the following functions:

1. Reviewing analytical methods used by the laboratories;
2. Evaluating quality-control samples and data-quality objectives;
3. Reviewing analytical results and metadata from the laboratories;
4. Reviewing analytical results and metadata from the field;
5. Auditing of performance in the field and in the laboratory;
6. Enacting corrective actions to resolve problems with field and laboratory methods;
7. Auditing analytical data with internally developed criteria;
8. Completing validation and reporting of data; and
9. Developing and implementing training and site-safety requirements for personnel.

The successful implementation of these functions ensures that water-quality data collected are reliable and reproducible, compatible with data collected by other oversight organizations at INL, and applicable to the programmatic needs of the DOE, DOE contractors, and the scientific and regulatory communities.

Analytical Methods and Quality-Control Samples

Analytical methods used by the USGS NWQL for selected organic and inorganic constituents are described by Goerlitz and Brown (1972), Thatcher and others (1977), Skougstad and others (1979), Wershaw and others (1987), Fishman and Friedman (1989), Faires (1993), Fishman (1993), Garbarino and Struzeski (1998), Garbarino and Hoffman (1999), Garbarino (2000), Garbarino and Damrau (2001), and Rose and others (2016). Additional publications that describe analytical methods currently used at the USGS NWQL can be found at NWQL. Other analytical methods from the U.S. Environmental Protection Agency (EPA) that are currently used at the USGS NWQL can be found at U.S. Environmental Protection Agency (2026). Analytical methods from Advancing Standards Transforming Markets (ASTM) International that are used at the USGS NWQL can be found at ASTM (2026). The type of analysis and the analytical procedure are described on the USGS NWQL ASR. A discussion of procedures used by the DOE RESL for the analysis of radionuclides in water is provided by Bodnar and Percival (1982), U.S. Department of Energy (1995), and RESL (2022, 2024). The type of analysis to be performed on a water sample is specified on the RESL sample-submittal sheet. A discussion of procedures and quality control used by USGS NRF laboratories (GEL Laboratories, LLC, and ARS International, LLC) is given in appendix 5.

A detailed description of internal quality control and of the overall QA practices used by the USGS NWQL is provided by Mueller and others (2015). Historical quality-control methods and practices are provided by Friedman and Erdmann (1982) and Pritt and Raese (1995); quality-control methods and practices at the laboratory are described by Jones (1987); and QA data for routine water analyses are presented by Maloney and others (1993, 2005) and Ludtke and others (2000). The NWQL verifies minimum detection limits and (or) minimum reporting limits (MRL) for a rotating subset of constituents on a yearly basis, if applicable (Foreman and others, 2021). Quality-control samples collected by the INL Project Office include collection and analysis of the following:

- Replicate samples—two or more samples from the same well collected concurrently or sequentially and sent to the same laboratory;
- Source-solution blank samples—samples of the stock solution of deionized water, organic-free water, or inorganic-free water;
- Equipment blanks—samples of deionized water, organic-free water, or inorganic-free water that is passed sequentially through each component of the

equipment system to be used for sample collection in a controlled environment, such as the mobile-field laboratory;

- Field blanks—samples of deionized water, organic-free water, or inorganic-free water that are collected in the field during the sampling campaign;
- Splits—large sample volumes divided into two or more equal volumes and sent to different laboratories for analysis;
- Trip blanks—laboratory-supplied samples of boiled, deionized water that travel with water samples from the time of collection to the time of analysis; and
- Spiked samples—samples to which a known concentration of a constituent is added.

Generally, about 10 percent of the samples collected are dedicated to QA. That is, for every 10 samples submitted to laboratories for analysis, at least 1 is a replicate, a blank, a spike, or another type of quality-control sample. For samples that are to be analyzed for nonroutine constituents, 15 to 20 percent of the samples are dedicated to QA.

Comparative studies to determine agreement among analytical results for water-sample pairs analyzed by laboratories involved in the INL Project Office QA program are summarized in Wegner (1989), Williams (1996, 1997), Williams and others (1998), Knobel and others (1999), Carkeet and others (2001), Swanson and others (2002, 2003), Rattray and Campbell (2004), Rattray and others (2005), Rattray (2012), Davis and others (2013), Rattray (2014), Bartholomay and others (2015), Bartholomay and others (2017), Bartholomay and others (2020), and Treinen and others (2024). Additional QA studies by personnel at the INL Project Office include an evaluation of field-sampling and preservation methods for strontium-90 (Cecil and others, 1989), a comparison of different pump types used for sampling VOCs (Knobel and Mann, 1993), an analysis of tritium and strontium-90 concentrations in water from wells after purging different borehole volumes (Bartholomay, 1993), an analysis of the effect of different preservation methods on nutrient concentrations (Bartholomay and Williams, 1996), an analysis of two analytical methods for the determination of gross alpha- and beta-particle radioactivity (Bartholomay and others, 1999), an evaluation of well-purging effects on water-quality of samples collected from the eastern Snake River Plain aquifer (Knobel, 2006), and an analysis of the effect of different preservation methods on VOC concentrations in groundwater (Treinen and Bartholomay, 2022).

Data-Quality Objectives

Data-quality objectives are qualitative and quantitative criteria that describe the data needed by: (1) managers and (or) regulators to support environmental decisions and actions; or (2) scientists to study natural and (or) induced chemical processes in the eastern Snake River Plain aquifer. The first steps of the scientific method are somewhat comparable to, and supported by, data-quality objectives. Identifying problems is followed by developing potential solutions. Unbiased and thorough scientific experiments are proposed, conducted, analyzed, and published in peer-reviewed literature for use by others.

Laboratory data-quality objectives for routine water samples analyzed by the USGS NWQL are included in appendix 3, and data-quality objectives for radionuclides in water samples analyzed by RESL are provided in appendix 4. Quality-control requirements for GEL Laboratories, LLC, are given in appendix 5. Data-quality objectives for quality-control data (which include both field and laboratory procedures for replicates and blanks) are included in appendix 6.

Review of Analyses

After the analytical results are obtained from the analyzing laboratory, the concentration of each constituent is reviewed by personnel at the INL Project Office for consistency, variability, and bias. Factors considered during the review are:

1. The comparison of historical constituent-concentration data at the site where the sample was collected;
2. The concentrations of the constituent in replicate, split, blank, or other quality-control samples;
3. The concentrations of the constituent in nearby wells that obtain water from the same aquifer or perched water zone;
4. A review of waste-disposal records and changes in disposal techniques, land use, and recharge that may influence the concentration of a constituent(s);
5. The cation-anion balance of analyses for which common ions are analyzed; and
6. Other accepted tests for accuracy of analytical results, when appropriate (Hem, 1985, p. 163–165).

Constituents for which previous analyses have been made are reviewed for consistency with the first three factors previously listed. Under certain circumstances, a reanalysis by the laboratory is requested or a second sample is collected and analyzed to verify the concentration of the constituent in the water. Circumstances that may warrant a reanalysis or resampling may include:

- A constituent concentration differs from historical data;
- A constituent concentration differs markedly from the concentrations in water from nearby wells; and (or)
- An initial analysis for a constituent concentration exceeds 80 percent of the MCL for that constituent set by the EPA.

If resampling is necessary, replicates or split samples are generally collected to evaluate field and laboratory variability, while spiked and reference samples are used to measure bias. Constituents for which MCLs have been proposed or established are shown in tables 3, 4, 5, 6, and 7.

If analytical results indicate that concentrations in samples from one site vary by more than 50 percent from the historical record (such as the mean concentration) at that well for no obvious reason, reruns are requested, and the results are evaluated by replicate sampling during the next sample period. If the analytical results for the replicates do not agree outside of estimated long-term laboratory-analytical uncertainties, the source of the discrepancy is investigated.

Table 3. Maximum contaminant levels of types of radioactivity and selected radionuclides in water.

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2026) for community-water systems and are included for comparison purposes only. The maximum contaminant level given for gross alpha-particle radioactivity includes radium-226 but excludes radon and uranium. The maximum contaminant level given for gross beta-particle and gamma radioactivity excludes radioactivity from natural sources and is included for comparison purposes only. Maximum contaminant levels given for strontium-90 and tritium are average activities that are assumed to produce a total body or organ dose of 4 millirems per year of beta-particle radiation. pCi/L, picocuries per liter; mrem/yr, millirems per year; µg/L, micrograms per liter]

Radionuclide or type of radioactivity	Maximum contaminant level
Gross alpha-particle radioactivity	15 pCi/L
Gross beta-particle and gamma radioactivity	4 mrem/yr
Iodine-129	1 pCi/L
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L
Uranium	30 µg/L

Table 4. Maximum contaminant levels, secondary maximum contaminant levels, and reporting limits of selected trace elements in water.

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2026) for community-water systems and are for comparison purposes only. Secondary maximum contaminant levels—shown in brackets—are from U.S. Environmental Protection Agency (2026). The reporting limits are based on method detection limits and are taken from the Laboratory Information Management System used by the National Water Quality Laboratory, U.S. Geological Survey. More than one reporting level is given for constituents analyzed by different schedules (refer to appendix 1). Units are in micrograms per liter (µg/L). MCL, maximum contaminant levels; SMCL, secondary maximum contaminant levels; –, maximum contaminant level has not been established]

Trace element	MCL [SMCL]	Reporting level
Aluminum	[50–200]	3.0
Antimony	6	0.06
Arsenic	10	0.1
Barium	2,000	0.01; 0.6
Beryllium	4	0.01
Boron	–	2.0
Cadmium	5	0.03
Chromium	100	1.0; 0.5
Cobalt	–	0.03
Copper	*	0.4
Iron	[300]	10
Lead	†	0.02
Lithium	–	0.15
Manganese	[50]	0.4
Mercury	2	0.005
Molybdenum	–	0.05
Nickel	–	0.2
Selenium	50	0.05
Silver	[100]	0.03; 1.0
Strontium	–	0.5
Thallium	2	0.04
Uranium	30	0.03
Vanadium	–	0.1
Zinc	[5,000]	2.0

*Copper has an action level of 1,300 µg/L.

†Lead has an updated action level of 10 µg/L, effective in 2027.

Table 5. Maximum contaminant levels, secondary maximum contaminant levels, and reporting levels of selected common ions in water.

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2026) for community-water systems and are for comparison purposes only. Secondary maximum contaminant levels—shown in brackets—are from U.S. Environmental Protection Agency (2026). The reporting limits are based on method detection limits and are taken from the Laboratory Information Management System used by the National Water Quality Laboratory, U. S. Geological Survey. Bromide's reporting level is based on the detection limit; others are based on long-term method detection limits. Units are in milligrams per liter (mg/L). Symbols: MCL, maximum contaminant levels; SMCL, Secondary maximum contaminant levels; –, maximum contaminant level has not been established]

Constituent	MCL [SMCL]	Reporting level
Bromide	–	0.01
Calcium	–	0.022
Chloride	[250]	0.02
Fluoride	4.0 [2.0]	0.004
Magnesium	–	0.01
Potassium	–	0.3
Silica	–	0.05
Sodium	–	0.4
Sulfate	[250]	0.02

Table 6. Maximum contaminant levels and reporting levels of selected nutrients in water.

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2026) for community-water systems and are for comparison purposes only. The reporting limits are based on method detection limits and are taken from the Laboratory Information Management System used by the National Water Quality Laboratory, U.S. Geological Survey. Reporting levels for nitrite and nitrite+nitrate are based on method detection limits; others are based on long-term method detection levels (Foreman and others, 2021). Units are in milligrams per liter (mg/L). MCL, maximum contaminant level; –, maximum contaminant level has not been established]

Constituent	MCL	Reporting level
Ammonia (as nitrogen)	–	0.01
Nitrite (as nitrogen)	1	0.001
Nitrite+nitrate (as nitrogen)	10	0.04
Orthophosphate (as phosphorus)	–	0.04

Table 7. Maximum contaminant levels and minimum reporting levels of selected volatile organic compounds in water.

[Analyses performed by the U.S. Geological Survey National Water Quality Laboratory using an analytical method equivalent to U.S. Environmental Protection Agency (1992). MCL's were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2026) for community-water systems and are included for comparison purposes only. MRL's are from the Laboratory Information Management System (LIMS) used by the National Water Quality Laboratory, U.S. Geological Survey (Rose and others, 2016). Units are in micrograms per liter (µg/L). MCL, maximum contaminant level; MRL, minimum reporting level; –, maximum contaminant level has not been established or proposed; —, blank]

Compound	MCL	MRL	Compound	MCL	MRL
Acrylonitrile	–	2.5	Trichloroethylene (-ethene)	5	0.1
Benzene	5	0.1	Trichlorofluoromethane	–	0.2
Bromobenzene	–	0.2	Trichloromethane (Chloroform)	*	0.1
Bromochloromethane	–	0.2	Vinyl chloride	2	0.2
Bromodichloromethane	*	0.2	Xylenes, all isomers	10,000	0.3
Bromomethane	–	0.3	1,1,1,2-Tetrachloroethane	–	0.2
Butylbenzene	–	0.2	1,1,1-Trichloroethane	200	0.1
Chlorobenzene (mono-)	100	0.1	1,1,2,2-Tetrachloroethane	–	0.2
Chloroethane	–	0.2	1,1,2-Trichloroethane	5	0.2
Chloromethane	–	0.2	1,1,2-Trichlorotrifluoroethane	–	0.1
cis-1,2-Dichloroethene (-ethylene)	70	0.1	1,1-Dichloroethane	–	0.1
cis-1,3-Dichloropropene	–	0.2	1,1-Dichloroethene (-ethylene)	7	0.1
Dibromochloromethane	*	0.2	1,1-Dichloropropene	–	0.2
Dibromomethane	–	0.2	1,2,3-Trichlorobenzene	–	0.2
Dichlorodifluoromethane	–	0.2	1,2,3-Trichloropropane	–	0.2
Dichloromethane	5	0.2	1,2,4-Trichlorobenzene	70	0.2
Ethylbenzene	700	0.1	1,2,4-Trimethylbenzene	–	0.2
Hexachlorobutadiene	–	0.2	1,2-Dibromo-3-chloropropane	–	0.5
Isopropylbenzene	–	0.2	1,2-Dibromoethane	–	0.2
Methyl tert-butyl ether (MTBE)	–	0.2	1,2-Dichlorobenzene (ortho-)	600	0.1
n-Propylbenzene	–	0.2	1,2-Dichloroethane	5	0.2
Naphthalene	–	0.5	1,2-Dichloropropane	5	0.1
sec-Butylbenzene	–	0.2	1,3,5-Trimethylbenzene	–	0.2
Styrene	100	0.1	1,3-Dichlorobenzene	–	0.1
tert-Butylbenzene	–	0.2	1,3-Dichloropropane	–	0.2
Tetrachloroethylene	5	0.1	1,4-Dichlorobenzene (para-)	75	0.1
Tetrachloromethane (Carbon tet)	5	0.2	2,2-Dichloropropane	–	0.2
Toluene	1,000	0.2	2-Chlorotoluene	–	0.2
trans-1,2-Dichloroethylene	100	0.1	4-Chlorotoluene	–	0.2
trans-1,3-Dichloropropene	–	0.24	4-Isopropyl-1-methylbenzene	–	0.2
Tribromomethane (Bromoform)	*	0.2	—		

*Total trihalomethanes—which include bromoform, chlorodibromomethane, chloroform, and dichlorobromomethane in community-water systems serving 10,000 or more persons cannot exceed 80 µg/L (U.S. Environmental Protection Agency, 2025).

Performance Audits

Performance audits are conducted routinely at three levels: (1), at field-collection; (2), at the laboratory; and (3), through National Field QA tests. At the field level, the Project Chief, QA Specialist, or a qualified designee accompanies the field personnel to a selected number of sites to ascertain whether proper field techniques are performed to collect water-quality and water-level data, and, when necessary, to evaluate the training of new employees. The field auditor's example checklist for water-quality sample collection is shown in appendix 8. Water-quality and water-level auditing are conducted using internal electronic forms. Written results of the field audits are provided to the employee, and copies of the field audits are stored in the INL Project Office QA files on the internal data-storage site.

Performance audits at the laboratory level are done in compliance with the process outlined in the individual laboratory's QA manuals or procedures. The QA Specialist may request project-specific performance audits to test constituents or analytical methods, depending on the project. Periodically, or when new laboratories are selected to perform analyses, the QA Specialist compiles a laboratory-evaluation package to evaluate analytical performance related to the project goals and data-quality objectives (U.S. Geological Survey, 2021a).

The INL Project Office participates in the USGS National Field QA Program to evaluate the accuracy of water-quality field measurements (Stanley and others, 1998; U.S. Geological Survey, 2021b). Quality-assurance blind samples (sample concentrations are blind to the field personnel being evaluated but known by the USGS National Field QA Program) are sent to field personnel for testing. Each participant receives two samples for each field parameter and performs the measurements with the same techniques and instruments that are used in the field. The results are sent back to the water-quality service unit for evaluation. Personnel receiving an unsatisfactory or marginal rating will need to recheck the conditions of the instrument and calibration techniques and take corrective actions as appropriate.

In addition to the routine field-based performance audits, water-quality activities and internal technical-review processes at the INL Project Office are periodically reviewed by other USGS personnel, including the Water-Quality Specialist for the USGS Idaho Water Science Center and personnel at the USGS Office of QA. Documentation and process reviews by personnel at the USGS Idaho Water Science Center take place at 1- to 2-year intervals, and reviews by the Office of QA take place at approximately 3-year intervals. The reviews are summarized in reports, and these reports are available to the INL Project Office, Idaho Water Science Center, and to the Office of QA. Formal memorandums are used to note documented deficiencies and necessary corrective actions. If necessary, those actions should be facilitated through the INL Project Chief or Water-Quality Specialist.

Corrective Actions

If any performance audits indicate inconsistencies or inadequacies in field methods or in analytical results by the laboratories, the problems are documented, and the field personnel and (or) laboratories are notified in writing of the inconsistencies or inadequacies. Training is provided to the field personnel as needed, and the frequency of performance audits is increased until the performance evaluated by the INL Project Chief is suitable and consistent with written guidelines and procedures.

Inconsistencies and inadequacies in laboratory analyses are discussed with, or submitted in writing to, the appropriate laboratory director, who is responsible for initiating the appropriate action to resolve the problem. In the meanwhile, the frequency and numbers of replicate, blank, spikes, or other quality-assurance samples are increased until it is demonstrated that problems in the laboratory methods are resolved.

If INL Project Office personnel discover a problem with sampling procedures, well integrity, field consumables, equipment calibration, or data-review analyses and interpretations that cannot be resolved at the project level with the QA Specialist, the Water-Quality Specialist is notified of the problem. If the Water-Quality Specialist cannot resolve the problem in consultation with the USGS Office of QA, the problem may be referred to the USGS's research hydrologists and chemists to help in resolving the problem.

Reporting of Data

Most water-quality and water-level data collected by the INL Project Office are publicly available after review, and most data are published in data releases and used in investigative reports as part of data interpretation and analysis. Water-quality data (subsequent to their review) are entered into an internal USGS database, Aquarius Samples, and released data are periodically updated to Water Data for the Nation (U.S. Geological Survey, 2025), a National, publicly accessible database. Data that suggest possible human health or environmental concerns are available for operational agencies, such as the DOE, and to regulatory agencies, such as the State of Idaho's Department of Environmental Quality and the EPA for review and further action as necessary.

Quality Assurance for Water-Level Measurements

Routine measurements are collected with an internally calibrated e-tape and are checked by taking 2 readings that need to be within ±0.02 ft of each other (Bartholomay and others, 2021). While in the field, the final measurement is compared to historical measurements to ensure the readings are reasonable. If the readings do not seem reasonable, a measurement is retaken. Well integrity for wells measured routinely is checked with downhole video and geophysical logs whenever pumps are pulled.

Multilevel monitoring system pressure measurements are checked at each site by taking a second pressure reading from two duplicate ports after all the pressure readings have been taken from the ports that are being checked. Historical pressure readings are reviewed in the field to ensure probe location and consistent readings are collected.

Training Requirements and Site Safety

Training and site safety are components of the INL Project Office QAP. Employees are only assigned tasks for which they are adequately trained, and all employees have a stop-work authority if they feel that working conditions are unsafe. The responsibility for ensuring that employees are adequately trained is shared jointly by the employee and the employee's supervisor. A more detailed description of INL Project Office personnel training requirements and site safety requirements are given in the INL Site Safety and Job Hazard Analysis Document (B. Twining, USGS, December 2024, written commun.). Employee training records are maintained on an internal INL Project Office data-storage site, which is maintained by the Idaho Water Science Center.

INL Project Office personnel are occasionally called to sample or measure wells for which no historical USGS-collected data are available. When this situation occurs, an effort will be made to ascertain if samples have been collected by other environmental-monitoring programs to determine if there is any potential health risk to sample-collection personnel or laboratory-analysis personnel. To minimize the risk of contaminating low-level environmental laboratories, the laboratory analytical request form and the sample bottles will be noted as containing either samples with unknown or expected concentrations of contaminants that are potentially hazardous.

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Appendix 1. Field Schedule Showing Well and Pump Information and Sampling Schedules for Selected Wells and Streamflow Sites

Codes for Types of Analyses (Number of Bottles Needed in Parentheses)

1. ^{3}H, Cl^{-} (2)
2. ^{3}H, α, β, Cl^{-}, Na^{+}, NO^{3-} (5)
3. ^{3}H, Cl^{-}, α, β, (3)
4. ^{3}H, ^{90}Sr, Cl^{-}, Cr, SO$_{4}^{2-}$ (4)
5. ^{3}H, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (4)
6. ^{3}H, Cl^{-}, Na^{+}, NO^{3-} (4)
7. ^{3}H, Cl^{-}, Cr, Na^{+}, SO$_{4}^{2-}$ (3)
8. ^{3}H, Cl^{-}, Cr, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (4)
9. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Na^{+}, SO$_{4}^{2-}$ (4)
10. ^{3}H, ^{90}Sr, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (5)
11. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+} (5)
12. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (5)
13. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, SO$_{4}^{2-}$ (4)
14. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (5)
15. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$ (5)
16. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, VOC's (7)
17. ^{3}H, Cl^{-}, Cr, Na^{+}, NO^{3-}, VOCs, SO$_{4}^{2-}$ (8)
18. ^{3}H, α, β, Cl^{-}, Na^{+}, Cr, NO^{3-}, SO$_{4}^{2-}$, F^{-}, VOCs (9)
19. ^{3}H, α, β, Cl^{-}, Na^{+}, Cr, SO$_{4}^{2-}$, NO^{3-} (5)
20. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO^{3-}, (6)
21. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, Cr, NO^{3-}, F^{-}, SO$_{4}^{2-}$, VOCs, (10)
22. ^{3}H, α, β, Cl^{-}, Na^{+}, Cr, NO^{3-}, SO$_{4}^{2-}$, VOC's, (9)
23. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, Cr, NO^{3-}, SO$_{4}^{2-}$, VOCs (10)
24. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, NO^{3-}, VOCs, Hg, metals (SH 1050) + As, Tl (13)
25. ^{3}H, α, β, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$, VOCs, Hg, metals (SH 1050) + As, Se (10)
26. ^{3}H, α, β, Cl^{-}, Na^{+}, Cr, NO^{3-} (5)
27. VOCs (4)
28. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, NO^{3-}, SO$_{4}^{2-}$, VOCs, Hg, metals (SH 1050) + As, Se (13)
29. New well: Alkalinity, ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, NO^{3-}, VOCs, Hg, anions (SH 670), metals and cations (SH 2126) + B, U-isotopes, H^{2}/O^{18} (13)
30. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, SO$_{4}^{2-}$, metals (SH 1281) (7)
31. DI Source Solution: ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, NO^{3-}, Hg, anions (SH 670), metals and cations (SH 2126) + B (7)

Table 1.1. Field schedule showing well site, method of sampling, well information, and sampling schedules for selected wells and streamflow sites. Routine sampling schedules are shown in the codes for types of analyses, below. Wells for Naval Reactors Facility are subject to annual changes in sampling schedules and can be provided upon request.

[ANP, Auxiliary Nuclear Plant; hp, horsepower; –, blank; ARA-MON, Auxiliary Reactor Area monitoring well; BLR, Big Lost River; CFA, Central Facilities Area; CPP, Chemical Processing Plant; GIN, insert definition here; ICPP, Idaho Chemical Processing Plant; MTR, Materials Testing Reactor; NRF, Naval Reactors Facility; NPR, New Production Reactor; PBF, Power Burst Facility; PW, production well; RWMC, Radioactive Waste Management Complex; SPERT, special power excursion reactor test; TAN, Test Area North; TRA, Test Reactor Area; Disp., insert definition here; W.S. INEL, water sample Idaho National Engineering Laboratory; USGS, U.S. Geological Survey; A, aquifer; <, indicates the diameter is less than the hole depth indicated; >, indicates the diameter is greater than the hole depth indicated]

Local site identifier	Method of sampling	Hole diameter (inches)[1]	Well depth (feet)	Routine sampling schedule		Multilevel monitoring wells
				April	October	Schedule; zone
ANP 6	5 hp, submersible pump	10	295	–	5	–
ARA-MON-A-002	5 hp, submersible pump	6	620	–	19	–
AREA 2	Submersible pump	16	876	–	5	–
BLR (near Mackay)	Grab (surface water)	–	–	–	3	–
[2]BLR (INEL Div.)	Grab (surface water)	–	–	3	–	–
[2]Birch Creek	Grab (surface water)	–	–	–	1	–
[2]CFA 1	Production well spigot	16*	639	10	–	–
[2]CFA 2	Production well spigot	16*	681	–	10	–
CFA LF 2-10	5 hp, submersible pump	6	716	20	–	–
CPP 1	5 hp, submersible pump	16	586	18	–	–
[2]Cross Road	5 hp, submersible pump	8	796	19	–	–
CWP 1	Open-top bailer	6*	58	4	–	–
CWP 8	Open-top bailer	6*	63.5	4	–	–
GIN 2	Redi-Flo submersible pump	2	381	–	24	–
[2, 3]Highway 3	Production well spigot	8*	750	–	22	–
[2]ICPP-MON-A-166	5 hp, submersible pump	6	527	14	–	–
ICPP-MON-V-200	5 hp, submersible pump	6	127	–	14	–
[2]Little Lost River	Grab (surface water)	–	–	–	1	–
MTR Test	5 hp, submersible pump	8	588	8	–	–
[2]Mud Lake	Grab (surface water)	–	–	–	1	–
[4]Middle 2050A	Multi-depth thief sampler	(6)*	1,376	–	–	19; zone 15
[2, 4]Middle 2051	Multi-depth thief sampler	(6)*	1,177	–	–	19; zones 3,9
No Name 1	5 hp, submersible pump	12	550	24	–	–
[5]NRF 3	5 hp, submersible pump	16	546	–	–	–
[2, 5]NRF 6	5 hp, submersible pump	8	417	–	–	–
[5]NRF-6-PS1	Open-top bailer	2.5*	–	–	–	–
[5]NRF-6-PS5	Open-top bailer	2.5*	–	–	–	–
[5]NRF-6-PS7	Open-top bailer	2.5*	–	–	–	–
[5]NRF 7	5 hp, submersible pump	10	417	–	–	–
[5]NRF 8	5 hp, submersible pump	8	423	–	–	–
[2, 5]NRF 9	5 hp, submersible pump	8	422	–	–	–
[4]NRF 10	5 hp, submersible pump	8	427	–	–	–
[2, 5]NRF 11	5 hp, submersible pump	8	417	–	–	–
[2, 5]NRF 12	5 hp, submersible pump	8	421	–	–	–
[5]NRF 14	5 hp, submersible pump	10	550	–	–	–
[5]NRF 16	5 hp, submersible pump	5	422	–	–	–

Table 1.1. Field schedule showing well site, method of sampling, well information, and sampling schedules for selected wells and streamflow sites. Routine sampling schedules are shown in the codes for types of analyses, below. Wells for Naval Reactors Facility are subject to annual changes in sampling schedules and can be provided upon request.—Continued

[ANP, Auxiliary Nuclear Plant; hp, horsepower; –, blank; ARA-MON, Auxiliary Reactor Area monitoring well; BLR, Big Lost River; CFA, Central Facilities Area; CPP, Chemical Processing Plant; GIN, insert definition here; ICPP, Idaho Chemical Processing Plant; MTR, Materials Testing Reactor; NRF, Naval Reactors Facility; NPR, New Production Reactor; PBF, Power Burst Facility; PW, production well; RWMC, Radioactive Waste Management Complex; SPERT, special power excursion reactor test; TAN, Test Area North; TRA, Test Reactor Area; Disp., insert definition here; W.S. INEL, water sample Idaho National Engineering Laboratory; USGS, U.S. Geological Survey; A, aquifer; <, indicates the diameter is less than the hole depth indicated; >, indicates the diameter is greater than the hole depth indicated]

Local site identifier	Method of sampling	Hole diameter (inches)[1]	Well depth (feet)	Routine sampling schedule		Multilevel monitoring wells
				April	October	Schedule; zone
[5]NRF 17	5 hp, submersible pump	6	461	–	–	–
[5]NRF 18	5 hp, submersible pump	8	461	–	–	–
NPR Test	5 hp, submersible pump	6	600	–	19	–
PBF-MON-A-003	5 hp, submersible pump	5	575	–	19	–
[2]P and W 2	5 hp, submersible pump	10	378	19	–	–
PW-8	Redi-Flo submersible pump	6	166	13	–	–
[2]PW-9	Open-top bailer	6*	200	–	13	–
Rifle Range	5 hp, submersible pump	5	620	–	14	–
RWMC M3S	5 hp, submersible pump	6	633	–	17	–
RWMC M7S	5 hp, submersible pump	6	628	–	17	–
RWMC M12S	5 hp, submersible pump	6	572	–	19	–
RWMC M14S	5 hp, submersible pump	6	635	–	19	–
[2, 6]RWMC Production	Production well spigot	10*	685	–	17	–
Site 4	5 hp, submersible pump	8	495	7	–	–
[5]Site 6	5 hp, submersible pump	10	523	–	–	–
Site 9	5 hp, submersible pump	10	1,057	10	–	–
[3, 5]Site 17	5 hp, submersible pump	15	600	5	–	–
SPERT 1	5 hp, submersible pump	14	653	6	–	–
TAN 2271	Redi-Flo submersible pump	10	282	–	24	–
TAN 2312	5 hp, submersible pump	10	522	–	24	–
TRA 3	5 hp, submersible pump	20	602	–	8	–
TRA Disp.	5 hp, submersible pump	8	1,267	–	14	–
W.S. INEL-1	5 hp, submersible pump	6	490	7		–
[3]USGS 1	5 hp, submersible pump	5	630	–	19	–
USGS 2	5 hp, submersible pump	5	699	5	–	–
[3]USGS 5	5 hp, submersible pump	6	494	26	–	–
USGS 7	5 hp, submersible pump	6	903	24	–	–
[2]USGS 8	5 hp, submersible pump	6	812	19	–	–
USGS 9	5 hp, submersible pump	6	654	–	19	–
[2, 3]USGS 11	5 hp, submersible pump	6	704	19	–	–
[5]USGS 12	5 hp, submersible pump	10	563	19	–	–
[2, 3]USGS 14	5 hp, submersible pump	5	751	–	2	–
[5]USGS 17	5 hp, submersible pump	5	498	19	–	–
[2]USGS 18	5 hp, submersible pump	4	329	5	–	–
[2]USGS 19	5 hp, submersible pump	6	399	19	–	–
USGS 20	5 hp, submersible pump	6	658	10	–	–

Table 1.1. Field schedule showing well site, method of sampling, well information, and sampling schedules for selected wells and streamflow sites. Routine sampling schedules are shown in the codes for types of analyses, below. Wells for Naval Reactors Facility are subject to annual changes in sampling schedules and can be provided upon request.—Continued

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Local site identifier	Method of sampling	Hole diameter (inches)[1]	Well depth (feet)	Routine sampling schedule		Multilevel monitoring wells
				April	October	Schedule; zone
USGS 23	5 hp, submersible pump	6 < 430 5 > 430	457	–	19	–
[2]USGS 27	5 hp, submersible pump	6	312	19	–	–
USGS 31	5 hp, submersible pump	8 < 306 10 > 306	428	5	–	–
USGS 32	5 hp, submersible pump	6 < 324 5.5 > 324	392	5	–	–
USGS 34	5 hp, submersible pump	10	700	18	–	–
USGS 37	5 hp, submersible pump	6	572	–	15	–
USGS 38	5 hp, submersible pump	4	724	18	–	–
USGS 42	5 hp, submersible pump	6	678	10	–	–
USGS 43	1.5 hp, submersible pump	6	564	–	15	–
USGS 44	5 hp, submersible pump	6	650	12	–	–
USGS 46	5 hp, submersible pump	6	651	12	–	–
USGS 47	5 hp, submersible pump	6	651	–	15	–
USGS 48	5 hp, submersible pump	6	750	10	–	–
USGS 51	5 hp, submersible pump	6	647	10	–	–
USGS 52	5 hp, submersible pump	6	602	–	10	–
USGS 53	Open-top bailer	6*	72	–	13	–
USGS 54	Redi-Flo submersible pump	6	81	–	13	–
[2]USGS 55	Open-top bailer	6*	81	13	–	–
USGS 56	Open-top bailer	6*	79	–	13	–
USGS 57	5 hp, submersible pump	6	582	–	12	–
USGS 58	5 hp, submersible pump	6	503	13	–	–
USGS 59	5 hp, submersible pump	6	587	10	–	–
USGS 60	Open-top bailer	6	117	–	13	–
USGS 61	Redi-Flo submersible pump	4	123	13	–	–
[2]USGS 62	Redi-Flo submersible pump	8	165	13	–	–
USGS 63	Redi-Flo submersible pump	10	109	–	13	–
[2]USGS 65	5 hp, submersible pump	4	498	28	–	–
USGS 66	Open-top bailer	4*	201	–	13	–
USGS 67	5 hp, submersible pump	4	694	–	10	–
[2]USGS 68	Open-top bailer	10	128	30	–	–
USGS 69	Redi-Flo submersible pump	4	115	–	9	–
USGS 70	Redi-Flo submersible pump	8	100	13	–	–
USGS 71	Open-top bailer	5*	171	–	13	–
USGS 72	Open-top bailer	4*	174	30	–	–

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Local site identifier	Method of sampling	Hole diameter (inches)[1]	Well depth (feet)	Routine sampling schedule		Multilevel monitoring wells
				April	October	Schedule; zone
[2]USGS 73	Open-top bailer	6*	127	–	13	–
USGS 76	5 hp, submersible pump	6	718	14	–	–
USGS 77	5 hp, submersible pump	6	586	–	21	–
USGS 79	5 hp, submersible pump	6	702	7	–	–
USGS 82	5 hp, submersible pump	6	693	10	–	–
USGS 84	5 hp, submersible pump	6	505	–	25	–
[2]USGS 85	5 hp, submersible pump	6	614	10	–	–
USGS 86	5 hp, submersible pump	8	691	–	19	–
[2]USGS 87	1.5 hp, submersible pump	4	673	23	–	–
USGS 88	5 hp, submersible pump	4	663	–	23	–
USGS 89	1.5 hp, submersible pump	6	637	17	–	–
[3, 5]USGS 97	5 hp, submersible pump	4	510	25	–	–
[5]USGS 98	5 hp, submersible pump	4	508	–	25	–
[2, 5]USGS 99	5 hp, submersible pump	4	440	–	8	–
[2]USGS 100	5 hp, submersible pump	6	750	8	–	–
USGS 101	5 hp, submersible pump	4	842	–	19	–
[3, 5]USGS 102	5 hp, submersible pump	6	444	5	–	–
[2, 4]USGS 103	Multi-depth thief sampler	(6)*	1,297	–	–	19; zones 1,3,6,9
[2]USGS 104	5 hp, submersible pump	8	700	–	6	–
[2, 4]USGS 105	Multi-depth thief sampler	(6)*	1,300	–	–	19; zones 5,8,11
USGS 106	5 hp, submersible pump	8	760	–	6	–
USGS 107	5 hp, submersible pump	8	690	26	–	–
[2, 4]USGS 108	Multi-depth thief sampler	(6)*	1,196	–	–	19; zones 1,9
USGS 110A	5 hp, submersible pump	6	644	–	19	–
USGS 111	5 hp, submersible pump	8	560	10	–	–
[2]USGS 112	5 hp, submersible pump	8	507	–	10	–
USGS 113	5 hp, submersible pump	6	556	12	–	–
2USGS 114	5 hp, submersible pump	6	560	–	10	–
[2]USGS 115	1.5 hp, submersible pump	6	581	–	10	–
USGS 116	5 hp, submersible pump	6	572	10	–	–
USGS 117	5 hp, submersible pump	6.5	655	–	17	–
[3]USGS 119	5 hp, submersible pump	6.5	705	17	–	–
[2]USGS 120	5 hp, submersible pump	6.5	705	–	23	–
USGS 123	5 hp, submersible pump	6	514	–	10	–
[2, 3]USGS 124	5 hp, submersible pump	4	800	6	–	–
USGS 127	5 hp, submersible pump	6	596	20	–	–

Table 1.1. Field schedule showing well site, method of sampling, well information, and sampling schedules for selected wells and streamflow sites. Routine sampling schedules are shown in the codes for types of analyses, below. Wells for Naval Reactors Facility are subject to annual changes in sampling schedules and can be provided upon request.—Continued

[ANP, Auxiliary Nuclear Plant; hp, horsepower; –, blank; ARA-MON, Auxiliary Reactor Area monitoring well; BLR, Big Lost River; CFA, Central Facilities Area; CPP, Chemical Processing Plant; GIN, insert definition here; ICPP, Idaho Chemical Processing Plant; MTR, Materials Testing Reactor; NRF, Naval Reactors Facility; NPR, New Production Reactor; PBF, Power Burst Facility; PW, production well; RWMC, Radioactive Waste Management Complex; SPERT, special power excursion reactor test; TAN, Test Area North; TRA, Test Reactor Area; Disp., insert definition here; W.S. INEL, water sample Idaho National Engineering Laboratory; USGS, U.S. Geological Survey; A, aquifer; <, indicates the diameter is less than the hole depth indicated; >, indicates the diameter is greater than the hole depth indicated]

Local site identifier	Method of sampling	Hole diameter (inches)[1]	Well depth (feet)	Routine sampling schedule		Multilevel monitoring wells
				April	October	Schedule; zone
USGS 128	5 hp, submersible pump	4.5	615	–	18	–
USGS 130	5 hp, submersible pump	4.5	636	–	19	–
[2, 4]USGS 131A	Multi-depth thief sampler	(6)*	1,198	–	–	19; zones 8, 12
[2, 4]USGS 132	Multi-depth thief sampler	(6)*	1,238	–	–	19; zone 14
[4]USGS 133	Multi-depth thief sampler	(6)*	798	–	–	19; zone 10
USGS 136	5 hp, submersible pump	6	560	–	14	
[2, 4]USGS 137A	Multi-depth thief sampler	(6)*	1,317	–	–	19, zones 4, 5
[2]USGS 140	5 hp, submersible pump	6	546	–	14	–
USGS 143	5 hp, submersible pump	6	801	19	–	–
USGS 144	5 hp, submersible pump	6	627	19	–	–
USGS 146	5 hp, submersible pump	6	800	–	19	–
USGS 147	5 hp, submersible pump	8	729	19	–	–
[2]USGS 148A	5 hp, submersible pump	4	759	–	19	–
[4]USGS 149	Multi-depth thief sampler	(6)*	970	–	–	19, zones 1,3,5,8
USGS 153	5 hp, submersible pump	6	840	–	8	–

[1] Asterisk indicates hole diameter is not required for borehole volume calculations. Parentheses indicate well diameter is the same for all the zones for multilevel monitoring wells.

[2] Well is co-sampled with representative from the State of Idaho Department of Environmental Quality Idaho National Laboratory Oversight Program.

[3] Well is co-sampled with representative from Shoshone/Bannock Tribe.

[4] Site-sample schedules for the multi-depth sampler are subject to change from year to year; code 29 after installation; routinely will sample for code 19 at select zones.

[5] Well sampled for NRF (including some USGS routine sampled wells); schedule subject to change, but may include the following during May or November compliance sampling: ^{3}H (tritium), ^{90}Sr (strontium-90), ^{63}Ni (nickel-63), ϒ Spec (gamma spectrometry), raw metals, raw and filtered nutrients, anions, volatile organic compounds, Semi-vols, and pH/TDS (14).

[6] Well is sampled monthly for volatile organic compounds (sample code 27).

Table 1.2. Constituent and type of sample.

[SH, custom laboratory schedule; As, arsenic; Tl, thallium, NWQL, National Water Quality Laboratory; FA, filtered, acidified; mL, millimeter; LC, lab code; HNO_3, nitric acid; RU, raw, unacidified; ^{3}H, tritium; RESL, Radiological and Environmental Services Laboratory; ^{90}SR, strontium-90; RA, raw, acidified; –, not applicable; γ Spec, gamma spectrometry; α, alpha; β, beta; ^{241}Am, americium-241; ^{238}Pu, plutonium-238; $^{239,240}Pu$, plutonium-239 plus plutonium-240, L, liter; F^-, fluorine FU, filtered, unacidified; Na^+, sodium; Cr, chromium; Cl^-, chlorine; SO_4^{2-}, sulfate; Hg, mercury; FAM, filtered, acidified; N, normality; ^{13}C, carbon-13; ^{12}C, carbon-12; RSIL, Reston Stable Isotope Laboratory; FUS, filtered, unacidified, polyseal cone cap; NO^{3-}, nitrate; FCC, filtered, chilled; Se, selenium; ^{234}U, uranium-234; ^{235}U, uranium-235; ^{238}U, uranium-238; FAR, filtered, acidified, rinsed; VOCs, volatile organic compounds; GCV, 40-mL amber glass bottles; HCl, hydrochloric acid; TCLP, toxicity characteristic leaching procedure; B, boron; ^{129}I, iodine-129; PRIME, Purdue Rare Isotope Measurement Laboratory; CFC, chlorofluorocarbons; GW, groundwater; GEL, GEL Laboratory; RAR, raw water, pre-acidified bottles; MOD, modified; DOE, Department of Energy; TDS, total dissolved solids; HSO_4, hydrogen sulfate; TOC, total organic carbon; VOA, volatile organic analysis]

Analyses	Lab	Bottle type	Size	Schedule or lab code	Sample treatment
SH 1050 metals, As, Tl	NWQL	FA	250 mL	SH 1050, LC 3122, 2508	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
		RU	250 mL	SH 1050	Raw water, unacidified, rinse poly bottle
^{3}H	Menlo Tritium Lab	RU	250–500 mL	LSC05 (new well)	Raw water, unacidified, rinse poly bottle
^{3}H	RESL	RU	500 mL	(April, October)	Raw water, unacidified, rinse bottle
^{90}Sr	RESL	RA	500 mL	–	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, γ Spec	RESL	RA	500 mL	–	Raw water, preserved with 2 mL HNO_3, no rinse
α, β	RESL	RA	500 mL	–	Raw water, preserved with 2 mL HNO_3, no rinse
^{241}Am, ^{238}Pu, $^{239,240}Pu$	RESL	RA	500 mL	–	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, γ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$	RESL	RA	1 L	–	Raw water, preserved with 4 mL HNO_3, no rinse
γ Spec	RESL	RA	500 mL	–	Raw water, preserved with 2 mL HNO_3, no rinse
$F^{-\dagger}$	NWQL	FU	250 mL	LC 651	Filtered, unacidified, rinse poly bottle
Na^{+}*	NWQL	FA	250 mL	LC 675	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
Cr*	NWQL	FA	250 mL	LC 722	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
$Cl^{-\dagger}$	NWQL	FU	250 mL	LC 1571	Filtered, unacidified, rinse poly bottle
$SO_4^{2-\ \dagger}$	NWQL	FU	250 mL	LC 1572	Filtered, unacidified, rinse poly bottle
Hg	NWQL	FAM	250 mL	LC 2707	Filtered, preserved with 2 mL 6N HCl, rinse, clear glass bottle
^{13}C,^{12}C	RSIL	FUS	1 L	LC 1851	Filtered, unacidified, plastic coated glass bottle fitted with polyseal cone cap, chill, provide alkalinity & pH
NO^{3-}	NWQL	FCC	125 mL	SH101	Filtered, chilled, brown poly bottle, rinse bottle
SH 670 anions	NWQL	FU	250 mL	SH 670	Filtered, unacidified, rinse poly bottle
SH 670 anions continued	NWQL	FU	250 mL	SH 670	Raw water, unacidified, rinse poly bottle
SH 1050 metals, As, Se	NWQL	FA	250 mL	SH 1050, LC 3122, 3132	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
		RU	250 mL	SH 1050	Raw water, unacidified, rinse, poly bottle
^{234}U, ^{235}U, ^{238}U	RESL	FAR	1 L	SH 1130	Filtered, acidified with 4 mL Ultrex HNO_3, rinse poly bottle
Oxygen; deuterium isotopes	RSIL	RUS	60 mL	SH 1142	Raw water, unacidified, no rinse
VOCs	NWQL	GCV	40 mL	SH1380	Raw water, chilled, preserved with 5 drops HCl, rinse glass bottle, amber

Table 1.2. Constituent and type of sample. —Continued

[SH, custom laboratory schedule; As, arsenic; Tl, thallium, NWQL, National Water Quality Laboratory; FA, filtered, acidified; mL, millimeter; LC, lab code; HNO_3, nitric acid; RU, raw, unacidified; ^{3}H, tritium; RESL, Radiological and Environmental Services Laboratory; ^{90}SR, strontium-90; RA, raw, acidified; –, not applicable; γ Spec, gamma spectrometry; α, alpha; β, beta; ^{241}Am, americium-241; ^{238}Pu, plutonium-238; $^{239,240}Pu$, plutonium-239 plus plutonium-240, L, liter; F^-, fluorine FU, filtered, unacidified; Na^+, sodium; Cr, chromium; Cl^-, chlorine; SO_4^{2-}, sulfate; Hg, mercury; FAM, filtered, acidified; N, normality; ^{13}C, carbon-13; ^{12}C, carbon-12; RSIL, Reston Stable Isotope Laboratory; FUS, filtered, unacidified, polyseal cone cap; NO^{3-}, nitrate; FCC, filtered, chilled; Se, selenium; ^{234}U, uranium-234; ^{235}U, uranium-235; ^{238}U, uranium-238; FAR, filtered, acidified, rinsed; VOCs, volatile organic compounds; GCV, 40-mL amber glass bottles; HCl, hydrochloric acid; TCLP, toxicity characteristic leaching procedure; B, boron; ^{129}I, iodine-129; PRIME, Purdue Rare Isotope Measurement Laboratory; CFC, chlorofluorocarbons; GW, groundwater; GEL, GEL Laboratory; RAR, raw water, pre-acidified bottles; MOD, modified; DOE, Department of Energy; TDS, total dissolved solids; HSO_4, hydrogen sulfate; TOC, total organic carbon; VOA, volatile organic analysis]

Analyses	Lab	Bottle type	Size	Schedule or lab code	Sample treatment
SH 1281 TCLP metals	NWQL	RA	250 mL	SH 1281	Raw, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
		RAM	250 mL	SH 1281	Raw water, preserved with 2 ml 6N HCl, rinse clear glass bottle
SH 2126 metals & cations, B	NWQL	FA	250 mL	SH 2126, LC 2110	Filtered, preserved with 2 ml Ultrex HNO_3, rinse poly bottle
		RU	250 mL	SH 2126	Raw water, unacidified, rinse poly bottle
^{129}I	PRIME	FA	1 L	–	Filtered, unacidified, rinse, polyseal cap, no head space, amber glass or poly
CFC	Reston GW dating lab	RU	125 mL	–	Raw water, unacidified, rinse glass bottle in beaker, no head space, no bubbles, aluminum foil lined caps only
Radiochemistry	GEL	RAR	2 L	901.1, 905.0 MOD, DOE RESL Ni-1 MOD	Raw water, pre-acidified HNO_3 poly bottle
^{3}H	ARS	RU	1 L	906.0	Raw water, unacidified, rinse poly bottle
Cl^-, SO_4^{2-}, NO^{3-}, pH, conductivity	GEL	FU	1 L	300.0, 150.1, 120.1	Filtered water, unacidified, rinse poly bottle
TDS	GEL	RU	125 mL	160.1	Raw water, unacidified, rinse poly bottle
Total metals	GEL	RA	500 mL	7470A, 3010A/6020A	Raw water, pre-acidified HNO_3 poly bottle
Dissolved metals	GEL	FA	500 mL	7470A, 3010A/6020A	Filtered water, pre-acidified HNO_3 poly bottle
Total nitrate + nitrite	GEL	RA	500 mL	353.2	Raw water, pre-acidified HSO_4 poly bottle
Dissolved nitrate + nitrite	GEL	FA	500 mL	353.2	Filtered water, pre-acidified HSO_4 poly bottle
TOC	GEL	RA	250 ML	SW846 9060A	Raw water, pre-acidified HSO_4, amber glass bottle
Hexavalent Chromium	GEL	FU	125 mL	SW846 7196A	Filtered water, unacidified, rinse poly bottle (24-hour hold time)
VOA (Acetone)	GEL	RA	40 mL	8260B	Raw water, chilled, pre-acidified with HCl, glass bottle
Semi-Volatiles	GEL	RU	1 L	8270, 8270 SIM	Raw water, unacidified, rinse amber glass bottle

*Analysis can be requested from the same bottle.

†Analysis can be requested from the same bottle.

Appendix 2. Water-Level Measurement Schedule

Table 2.1. Water-level measurement schedule as of April 2026.

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
USGS 1	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	S	[1]R	–
USGS 2	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 4	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 5	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 6	A	[1]AQ	–	[1]AQ	–	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 7	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 8	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 9	A	–	[1]R	–	–	[1]R	–	–	R	–	S	[1]R	–
USGS 11	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 12	A	–	[1]R	–	S	[1]R&S	–	–	R	–	–	[1]R	–
USGS 13	A	–	–	–	AA	–	–	–	–	–	–	–	–
USGS 14	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
USGS 15	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 17	A	[1]AQ	–	–	[1]S	ANRF	–	[1]AQ	–	–	[1]AQ	ANRF	–
USGS 18	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 19	A	–	[1]R	–	S	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 20	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 21	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 22	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 23	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	S	[1]AM	AM
USGS 24	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 25	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 26	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 27	A	–	[1]R	–	S	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 28	A	–	–	[1]AS	–	–	–	–	–	[1]AS	–	–	–
USGS 29	A	–	–	[1]AS	–	–	–	–	–	–	[1]AS	–	–
USGS 30A	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
USGS 30C	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
USGS 31	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 32	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 34	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 37	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 38	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 39	A	[1]AQ	–	[1]AQ	–	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 41	A	–	–	–	AA	–	–	–	–	–	–	–	–
USGS 42	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 43	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 44	A	–	–	–	S	–	–	–	–	–	–	–	–

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
USGS 46	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 48	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 51	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 52	A	–	–	–		–	–	–	–	–	S	–	–
USGS 53	P	–	–	–	[1]PS	–	–	–	–	–	[1]S	–	–
USGS 54	P	[1]PQ	–	[1]PQ	–	–	–	[1]PQ	–	–	[1]S	–	–
USGS 55	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 56	P	–	–	–	–	–	–	–	–	–	S	–	–
USGS 57	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 58	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 59	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 60	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
USGS 61	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 62	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 63	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
USGS 65	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 66	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
USGS 67	A	–	–	[1]AS	–	–	–	–	–	–	[1]S	–	–
USGS 68	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 69	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	S	–	–
USGS 70	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 71	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
USGS 72	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
USGS 73	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
USGS 76	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 77	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 78	P	PM	[1]PM	PM	PM	[1]PM	PM	PM	[1]PM	PM	PM	[1]PM	PM
USGS 79	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 82	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 83	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 84	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
USGS 85	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 86	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
USGS 87	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 88	A	–	–	–		–	–	–	–	–	S	–	–
USGS 89	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 97	A	AM	[1]AM	AM	S	[1]ANRF	AM	AM	[1]AM	AM	AM	[1]ANRF	AM
USGS 98	A	–	–	–	–	[1]ANRF	–	–	–	–	[1]S	ANRF	–
USGS 99	A	–	–	–	–	[1]ANRF	–	–	–	–	[1]S	ANRF	–
USGS 100	A	AM	[1]AM	AM	S	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 101	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
USGS 102	A	–	–	–	S	[1]S	–	–	–	–		ANRF	–
USGS 104	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
USGS 106	A	–	–	[1]AS	–	–	–	–	–	–	[1]S	–	–
USGS 107	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 109	A	–	–	–	AA	–	–	–	–	–	–	–	–
USGS 110A	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
USGS 111	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 112	A	–	–	[1]AS	–	–	–	–	–	–	[1]S	–	–
USGS 113	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 114	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 115	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 116	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 117	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
USGS 119	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 120	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	S	[1]R	–
USGS 121	A	–	–	–	AA	–	–	–	–	–	–	–	–
USGS 123	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 124	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
USGS 125	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 126B	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 127	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 128	A	–	–	[1]AS	–	–	–	–	–	–	[1]S	–	–
USGS 129	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ		–	[1]AQ
USGS 130	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
USGS 131	A	–	–	–	AA	–	–	–	–	–	–	–	–
USGS 136	A	–	–	–	–	–	–	–	–	–	S	–	–
USGS 138	A	–	[1]R	–	–	[1]R	–	–	[1]R	–	–	[1]R	–
USGS 139A	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 139B	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 140	A	–	–	–		–	–	–	–	–	S	–	–
USGS 142	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 142A	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 143	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
USGS 144	A	–	–	–	S	–	–	–	–	–	–	–	–
USGS 145A	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 145B	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 146	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	S	[1]AM	AM
USGS 147	A	AM	[1]AM	AM	S	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
USGS 148A	A	–	–	–	–	–	–	–	–	–	[1]S	–	–
USGS 153	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
A11A31	A	–	–	AA	–	–	–	–	–	–	–	–	–

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
ANL MON A 014	A	–	–	AA	–	–	–	–	–	–	–	–	–
ANP 5	A	–	–	–	AA	–	–	–	–	–	–	–	–
ANP 6	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
ANP 7	A	–	–	–	AA	–	–	–	–	–	–	–	–
ANP 9	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
ANP 10	A	–	–	–	AA	–	–	–	–	–	–	–	–
ARA-MON-A-002	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
ARBOR TEST	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
AREA 2	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
CERRO GRANDE	A	–	–	AA	–	–	–	–	–	–	–	–	–
CFA 1932	A	–	–	[1]AS	–	–	–	–	–	–	[1]AS	–	–
CFA LF 2-10	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
CFA LF 2-11	A	–	–	AA	–	–	–	–	–	–	–	–	–
CORE-HOLE 1	A	[1]AQ	–	[1]AQ	–	–	–	[1]AQ	–	–	[1]AQ	–	–
CORE-HOLE 2A	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
CWP 1	P	–	–	–	S	–	–	–	–	–	–	–	–
CWP 2	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 3	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 4	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 5	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 6	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 7	P	–	–	–	PA	–	–	–	–	–	–	–	–
CWP 8	P	–	–	–	S	–	–	–	–	–	–	–	–
CWP 9	P	–	–	–	PA	–	–	–	–	–	–	–	–
DH 1B	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
DH 2A	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
FIRE STATION 2	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
GIN 2	A	–	–	–	–	–	–	–	–	–	–	–	–
GIN 3	A	–	–	AA	–	–	–	–	–	–	–	–	–
HWY 1A PIEZO 3	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
HWY 1B PIEZO 2	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
HWY 1C PIEZO 1	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
HWY 2	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
ICPP-MON-A-166	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
ICPP-MON-V-200	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
INEL 1	A	–	–	AA	–	–	–	–	–	–	–	–	–
MTR TEST	A	AM	[1]AM	AM	S	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
NO NAME 1	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
NPR TEST	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]S	–	–
NRF 2	A	–	–	–	–	[1]ANRF	–	–	–	–	–	[1]ANRF	–
NRF 3	A	–	–	–	–	[1]S	–	–	–	–	–	[1]S	–
NRF 5	A	–	–	–	–	[1]ANRF	–	–	–	–	–	[1]ANRF	–
NRF 6	A	S	S	S	S	[1]S	S	S	S	S	S	[1]S	S
NRF-6-PS1	P	S	S	S	S	[1]S	S	S	S	S	S	[1]S	S
NRF-6-PS5	P	S	S	S	S	[1]S	S	S	S	S	S	[1]S	S
NRF-6-PS7	P	S	S	S	S	[1]S	S	S	S	S	S	[1]S	S
NRF 7	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 8	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 9	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 10	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 11	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 12	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 13	A	–	–	–	–	[1]ANRF	–	–	–	–	–	[1]ANRF	–
NRF 14	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
NRF 15-A	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
NRF 15-B	A	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM	AM	[1]AM	AM
NRF 16	A	–	–	–	–	[1]S	–	–	–	–	–	[1]S	–
NRF 17	A	–	–	–	–	[1]S	–	–	–	–	–	[1]S	–
NRF 18	A	–	–	–	–	[1]S	–	–	–	–	–	[1]S	–
PandW 1	A	–	–	–	AA	–	–	–	–	–	–	–	–
PandW 2	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
PandW 3	A	–	–	–	AA	–	–	–	–	–	–	–	–
PBF-MON-A-003	A	–	–	[1]AS	–	–	–	–	–	–	[1]S	–	–
PSTF TEST	A	–	–	–	[1]AS	–	–	–	–	–	[1]AS	–	–
PW 8	P	[1]PQ	–	–	[1]S	–	–	[1]PQ	–	–	[1]PQ	–	–
PW 9	P	[1]PQ	–	–	[1]PQ	–	–	[1]PQ	–	–	[1]S	–	–
RWMC M3S	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
RWMC M6S	A	–	–	–	AA	–	–	–	–	–	–	–	–
RWMC M7S	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
RWMC M12S	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
RWMC M14S	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
SITE 6	A	–	–	–	–	[1]S	–	–	–	–	–	[1]ANRF	–
SITE 9	A	[1]AQ	–	–	[1]S	–	–	[1]AQ	–	–	[1]AQ	–	–
SITE 14	A	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–
SITE 15	A	–	–	–	AA	–	–	–	–	–	–	–	–
SITE 17	A	–	[1]R	–	S	[1]R&S	–	–	[1]R	–	–	[1]R	–
SITE 19	A	–	–	[1]AS	–	–	–	–	–	–	[1]AS	–	–
TAN CH 2 piezo B	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
TAN 14	A	–	–	[1]AS	–	–	–	–	–	[1]AS	–	–	–
TAN 15	A	–	–	[1]AS	–	–	–	–	–	[1]AS	–	–	–
TAN 17	A	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ	–	–	[1]AQ
TAN 2312	A	–	–	–	[1]AS	–	–	–	–	–	[1]S	–	–
TRA DISP	A	–	–	–	–	–	–	–	–	–	S	–	–
WS INEL 1	A	–	–	–	[1]S	–	–	–	–	–	[1]AS	–	–
04N 35E 31DAA1	A	–	–	–	AA	–	–	–	–	–	–	–	–
02N 26E 22DDA1	A	–	–	–	AA	–	–	–	–	–	–	–	–
02N 26E 22DDA2	A	–	–	–	AA	–	–	–	–	–	–	–	–
Monthly totals		77	30	51	134	49	30	77	30	33	124	49	30
Sampled wells		4	4	4	63	17	4	4	4	4	58	11*	4
Water levels only		73	26	47	71	32	26	73	26	29	66	41*	26

Table 2.1. Water-level measurement schedule as of April 2026. —Continued

[Jan, January; Feb, February; Mar, March; Apr, April; Jun, June; Aug, August; Sep, September; Oct, October; Nov, November; Dec, December; –, no data; A, aquifer; R, well equipped with continuous data logger; AQ, aquifer well measured quarterly; S, water sample and water level collected. AA, aquifer well measured annually; ANRF, aquifer well measured for NRF; AM, aquifer measured monthly; AS, aquifer well measured semi-annually; PQ, perched well measured quarterly; PM, perched well measured monthly; PA, perched well measured annually; PS, perched well measured semi-annually; RT, continuous recorded real time]

Well Name	Type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Total perched	**31**	–	–	–	–	–	–	–	–	–	–	–	–
Total aquifer	**175**	–	–	–	–	–	–	–	–	–	–	–	–
Total wells	**207**	–	–	–	–	–	–	–	–	–	–	–	–

[1] Indicates water level data are entered into the records management system (RMS).

Appendix 3. Data-Quality Objectives for Routine Water Samples Analyzed by the National Water Quality Laboratory

Table 3.1. Data-quality objectives for routine water samples analyzed by the National Water Quality Laboratory.

[Coefficient of variance measured by replicate analysis; reporting level based on method detection limits. µg/L, micrograms per liter; ±, plus or minus; SH, lab schedule; LC, lab code; N, nitrogen; P, phosphorus]

Constituent	Reporting level (µg/L)	Precision (± percent)	Accuracy (percent)	Lab code/schedule
Volatile organic compounds				
Constituents	Variable	30	70–130	SH 1380
Inorganic compounds (filtered)				
Aluminum	3.0	10	90–110	SH 1050
Antimony	0.06	10	90–110	SH 1050
Arsenic	0.1	10	90–110	LC 3122
Barium	0.6	10	90–110	SH 1050
Beryllium	0.01	10	90–110	SH 1050
Boron	2.0	10	90–110	LC 2110
Bromide	10	10	90–110	SH 670
Cadmium	0.03	10	90–110	SH 1050
Calcium	22	10	90–110	SH 2126
Chloride	20	10	90–110	LC 1571
Chromium	0.6	10	90–110	LC 722
Cobalt	0.03	10	90–110	SH 1050
Copper	0.4	10	90–110	SH 1050
Fluoride	10	10	90–110	LC 651
Iron	10	10	90–110	SH 2126
Lead	0.02	10	90–110	SH 1050
Lithium	0.15	10	90–110	SH 2126
Magnesium	0.01	10	90–110	SH 2126
Manganese	0.40	10	90–110	SH 1050
Mercury	0.005	10	90–110	LC 2707
Molybdenum	0.05	10	90–110	SH 1050
Nickel	0.20	10	90–110	SH 1050
Potassium	300	10	90–110	SH 2126
Selenium	0.05	10	90–110	LC 3132
Silica	50	10	90–110	SH 2126
Silver	1.0	10	90–110	SH 1050
Sodium	200	10	90–110	LC 675
Strontium	0.5	10	90–110	SH 2126
Sulfate	20	10	90–110	LC 1572
Thallium	0.04	10	90–110	LC 2508
Tungsten	0.03	10	90–110	SH 2126
Uranium	0.03	10	90–110	SH 1050

Table 3.1. Data-quality objectives for routine water samples analyzed by the National Water Quality Laboratory.—Continued

[Coefficient of variance measured by replicate analysis; reporting level based on method detection limits. µg/L, micrograms per liter; ±, plus or minus; SH, lab schedule; LC, lab code; N, nitrogen; P, phosphorus]

Constituent	Reporting level (µg/L)	Precision (± percent)	Accuracy (percent)	Lab code/schedule
Inorganic compounds (filtered)				
Vanadium	0.1	10	90–110	SH 2126
Zinc	2.0	10	90–110	SH 1050
Ammonia (as N)	10	40	60–140	SH 101
Nitrite (as N)	1.0	10	90–110	SH 101
Nitrite + Nitrate (as N)	40	10	90–110	SH 101
Orthophosphate (as P)	4.0	10	90–110	SH 101

Appendix 4. Data-Quality Objectives for Radionuclides in Water Samples Analyzed by the Radiological and Environmental Sciences Laboratory

Concentrations of radionuclides are reported with an estimated sample standard deviation (*s*), which is obtained by propagating sources of analytical uncertainty in measurements and depends on analytical methods and instrumentation. This reported analytical uncertainty (*s*) is calculated such that there is a 67-percent probability that the true concentration of a radionuclide in a sample is in the range of the reported concentration plus or minus (±) the analytical uncertainty. For example, given an analytical result of 1.0±0.2 pCi/L (picocuries per liter), there is a 67-percent probability that the true concentration of a radionuclide is in the range of 0.8 to 1.2 pCi/L. Some laboratories report the analytical uncertainty as 2*s*, at which there is a 95-percent probability that the true concentration is in the range of 0.6–1.4 pCi/L. Therefore, unlike analyses for most inorganic or organic constituents, the analytical uncertainty is specified for each analysis for a specified radionuclide. The following guidelines for interpreting analytical results are based on an extension of the method described by Currie (1968).

In an analysis for a selected radionuclide, laboratory measurements are made on a prepared sample and a prepared blank. Instrument signals for the sample and the blank vary randomly within analytical sessions and from day to day. Therefore, it is essential to distinguish between two key aspects of the determination of detection: (1), the instrument signal for the sample must be greater than the signal observed for the blank before a decision that a selected radionuclide was detected; and (2), an estimation must be made of the minimum-radionuclide concentration that will yield a sufficiently high enough observed signal to make a correct decision of "detect" or "nondetect" of that radionuclide. The first aspect, (1) is a qualitative decision based on an observed signal and a definite criterion for detection based on instrument background, signal intensity, and the concentration of a prepared sample. The second aspect, (2), is an estimation of the detection capabilities of a given measurement process and analyte during a given analytical session.

In the laboratory, instrument signals must exceed a critical level of 1.6*s* before the qualitative decision can be made as to whether the radionuclide was detected. Using the 1.6*s* critical level, there is about a 95-percent probability that the correct conclusion, "not detected," will be made for samples not containing the radionuclide. Given a high sample throughput of water samples, as many as 5 percent of the water samples with measured concentrations greater than or equal to 1.6*s* concluded as "detected," might not contain the radionuclide. These measurements are referred to as false positives and are errors of the first kind in hypothesis testing (also referred to as a Type I error, when the null hypothesis was incorrectly rejected).

Once the critical level of 1.6*s* has been defined, the minimum detectable concentration may be established. Radionuclide concentrations that are equal to or greater than 3*s* represent a measurement of the minimum detectable concentration. For true concentrations of 3*s* or greater, there is a 95 percent or more probability of correctly concluding that a selected radionuclide was detected in a sample. When given a high throughput of samples, up to 5 percent of the samples with true concentrations greater than or equal to 3*s*, which were concluded as being "nondetect," could contain the selected radionuclide at the minimum-detectable concentration. These measurements are referred to as false negatives and are errors of the second kind in hypothesis testing (also called a type II error, when a null hypothesis that was false was not rejected). Inclusion of the 3*s* criterion reduces the probability of a false negative to 5 percent or less.

True radionuclide concentrations between 1.6*s* and 3*s* have larger errors of the second kind. That is, there is a greater than 5-percent probability of false negative results for samples with true concentrations between 1.6*s* and 3*s*, and although the selected radionuclide might not have been detected, the nondetection may not be reliable; at 1.6*s*, the probability of false negative is about 50 percent.

These guidelines are based on counting statistics alone and do not include systematic or random errors inherent in laboratory procedures. The values 1.6*s* and 3*s* vary slightly with background or blank counts, with the number of gross counts for individual analyses and for different selected radionuclides. The use of the critical level and minimum-detectable concentration aid in the interpretation of analytical results and does not represent absolute concentrations of radioactivity, which may or may not have been detected. The minimum detectable concentration should not be confused with the detection limit, which is based on instrument sensitivity, sample volumes, analytical procedures, and counting times used in the laboratory.

Detection limits for selected types of radioactivity and nuclides as a function of sample size and detection method are shown on table 4.1; the limits are intended as guides to order-of-magnitude sensitivities and, in practice, can easily change by a factor of two or more, even for the conditions specified.

Table 4.1. Detection limits for selected types of radioactivity and nuclides measured by the Radiological and Environmental Sciences Laboratory.

[Guy Backstrom, U.S. Department of Energy, written commun., 2020. bkgd, background; HPGe, high purity Germanium radiation detector, 2020]

Type of radioactivity or nuclide	Sample material	Size of sample (milliliter)	Counting time (minutes)	Detection method or instrument	Detection limit (picocuries per liter)
Gross alpha	Water	250	100	Low bkgd counter	3
Gross beta	Water	250	100	Low bkgd counter	2
Strontium-90	Water	400	200	Liquid scintillation	2
Tritium	Water	10	100	Liquid scintillation	200
Thorium-230	Water	500	1,000	Alpha spectrometry	0.05
Uranium-234	Water	500	1,000	Alpha spectrometry	0.05
Plutonium-238 + Plutonium-239/240	Water	500	1,000	Alpha spectrometry	0.05
Americium-241	Water	500	1,000	Alpha spectrometry	0.05
Technicium-99	Water	400	100	Liquid scintillation	8
Tellurium-132	Water	400	60	HPGe	60
Selenium-75	Water	400	60	HPGe	80
Antimony-125	Water	400	60	HPGe	200
Ruthenium-103	Water	400	60	HPGe	10
Thallium-108	Water	400	60	HPGe	200
Antimony-124	Water	400	60	HPGe	100
Cobalt-60	Water	400	60	HPGe	60
Potassium-40	Water	400	60	HPGe	1,000
Cerium-144	Water	400	60	HPGe	400
Cerium-141	Water	400	60	HPGe	90
Chromium-51	Water	400	60	HPGe	600
Iodine-131	Water	400	60	HPGe	60
Barium-140	Water	400	60	HPGe	200
Ruthenium-106	Water	400	60	HPGe	500
Cesium-137	Water	400	60	HPGe	60
Cesium-134	Water	400	60	HPGe	60
Molybdenum-99	Water	400	60	HPGe	50
Mercury-203	Water	400	60	HPGe	60
Krypton-85	Water	400	60	HPGe	21,000
Zirconium-95	Water	400	60	HPGe	90
Cobalt-58	Water	400	60	HPGe	60
Manganese-54	Water	400	60	HPGe	50
Silver-110	Water	400	60	HPGe	70
Actinium-228	Water	400	60	HPGe	200
Iron-59	Water	400	60	HPGe	100
Zinc-65	Water	400	60	HPGe	100

Reference Cited

Currie, L.A., 1968, Limits for qualitative detection and quantitative determination—Application to radiochemistry: Analytical Chemistry, v. 40, no. 3, p. 586–593. [Also available at https://pubs.acs.org/doi/10.1021/ac60259a007.]

Appendix 5. Data-Quality Objectives for Water Samples Analyzed by GEL Laboratories, LLC, and ARS International, LLC

The U.S. Environmental Protection Agency (1994) has established six primary analytical data-quality objectives for environmental studies. These objectives are precision, accuracy, representativeness, completeness, comparability, and detectability. GEL Laboratories, LLC's approach to each data quality objective is given in a report by GEL Laboratories, LLC, (2015). The method of analyses, minimum reporting levels, and method detection limits for constituents analyzed by GEL and for tritium analysis done at the ARS International, LLC for the U.S. Geological Survey Idaho National Laboratory Project Office are given in table 5.1 (GEL Laboratories, LLC, 2015).

Table 5.1. Methods for analyses, minimum reporting levels, and method detection limits for constituents analyzed by the GEL Laboratories, LLC, and ARS International, LLC.

[Tritium analyses were done by ARS International, LLC. µg/L, micrograms per liter; N, nitrogen; pCi/L, picocuries per liter; DOE RESL, Department of Energy Radiological and Environmental Sciences Laboratory; –, no data; Mod, modified]

Constituent	Method for analyses	Reporting level (µg/L)	Method detection limit (µg/L)
Organic compounds			
Volatile organic compounds	8260B	Variable	Variable
Semi-volatile organic compounds	8270 SIM	Variable	Variable
Total organic carbon	SW846 9060A	1	0.33
Inorganic compounds			
Aluminum	3010A/6020A	50.0	19.3
Antimony	3010A/6020A	3.00	1.0
Arsenic	3010A/6020A	5.00	2.0
Barium	3010A/6020A	2.00	0.67
Beryllium	3010A/6020A	0.5	0.2
Cadmium	3010A/6020A	1.00	0.3
Calcium	3010A/6020A	2,000	800
Chloride	300.0	1,000	335
Chromium	6020	10.0	3.0
Copper	3010A/6020A	1.00	0.3
Iron	3010A/6020A	100	33
Lead	3010A/6020A	2.00	0.5
Magnesium	3010A/6020A	30.0	10
Manganese	3010A/6020A	5.00	1.0
Mercury	7470A	0.200	0.067
Nickel	3010A/6020A	2.00	0.600
Potassium	3010A/6020A	300	80
Selenium	3010A/6020A	5.00	2.0
Silver	3010A/6020A	1.00	0.30
Sodium	3010A/6010A	250	80
Sulfate	300.0	2,000	665
Thallium	3010A/6020A	2.00	0.6
Zinc	3010A/6020A	10.0	3.3
Nitrite (as N)	300.0	100	33
Nitrate/Nitrite (as N)	353.2	100	35

Table 5.1. Methods for analyses, minimum reporting levels, and method detection limits for constituents analyzed by the GEL Laboratories, LLC, and ARS International, LLC. —Continued

[Tritium analyses were done by ARS International, LLC. µg/L, micrograms per liter; N, nitrogen; pCi/L, picocuries per liter; DOE RESL, Department of Energy Radiological and Environmental Sciences Laboratory; –, no data; Mod, modified]

Constituent	Method for analyses	Reporting level (µg/L)	Method detection limit (µg/L)
Radionuclides			
Tritium	Liquid scintillation	3 pCi/L	–
Gamma	901.1	5 pCi/L	–
Cobalt-60	901.1	5 pCi/L	–
Nickel-63	DOE RESL Ni-1, Mod	5 pCi/L	–
Strontium-90	905.0 Mod	1 pCi/L	–

References Cited

GEL Laboratories, LLC, 2015, Quality assurance plan—GL-QS-B-001 revision 29: U.S. Environmental Protection Agency, prepared by GEL Laboratories, LLC, Charleston, S.C., under contract no. GL-QS-B-001, 109 p., accessed August 18, 2025, at https://www.nrc.gov/docs/ML1629/ML16293A187.pdf.

U.S. Environmental Protection Agency, 1994, Guidance for the data quality objectives process: U.S. Environmental Protection Agency Report no. 600R-96/005, 69 p. [Also available at https://literature.wolkersdorfer.info/literature/GuidancefortheDataQualityObjectivesProcess.pdf.]

Appendix 6. Data-Quality Objectives for Quality-Control Data

Data-quality objectives for quality-control data are presented as criteria for acceptable variability (measured as reproducibility and reliability from replicates) and contamination bias (measured from blanks; Rattray, 2012, 2014).

The reproducibility of a constituent is considered acceptable if:

1. The normalized absolute difference of radiochemical constituents from a replicate is less than or equal to 1.96;
2. The relative standard deviation of inorganic and organic constituents from a replicate is less than 14 percent (this corresponds to a relative-percent difference of less than 20 percent);
3. Both replicate measurements of a constituent are censored and (or) estimated because these values are less than the reporting level for that analysis; or
4. One replicate measurement of a constituent is censored or estimated, the other replicate measurement of the constituent is within one detection limit of the larger of the estimated value or the reporting level, or the replicate measurements of a constituent are within one detection limit of each other.

If the percentage of replicates with acceptable reproducibility for a constituent is greater than or equal to 90 percent, then the reproducibility for that constituent is considered acceptable. If the percentage is less than 90 percent for a constituent, then the results for that constituent are investigated.

The reliability for a constituent is considered acceptable if the pooled relative standard deviation for that constituent is less than 14 percent (Rattray, 2014). If the pooled relative standard deviation is greater than or equal to 14 percent for a constituent, then the results for that constituent will be investigated.

An example that could warrant an investigation into variability results is if variability for a constituent does not meet the criteria for acceptable reproducibility or reliability because of low constituent concentrations that are near the detection limits relative to specified analytes. Variability is known to increase as concentration decreases (Rattray, 2014), and the criteria for acceptable variability are not intended to apply to concentrations at or near the method detection limits.

Contamination bias, rather than instrument-background uncertainty (sometimes referred to as “noise”), is considered present in a blank (and potentially a water-quality sample) when a detectable concentration of a constituent is measured from a blank. This corresponds to a concentration exceeding the reporting level of 3*s* for radiochemical constituents and the reporting level for inorganic (method detection limits) and organic constituents (minimum reporting limits; tables 3.1, 4.1, 5.1, and appendix 4). If a constituent is detected in a blank, then the results for that constituent are investigated.

References Cited

Rattray, G.W., 2012, Evaluation of quality-control data collected by the U.S. Geological Survey for routine water-quality activities at the Idaho National Laboratory, Idaho, 1996–2001: U.S. Geological Survey Scientific Investigations Report 2012–5270, 74 p. [Also available at https://doi.org/10.3133/sir20125270.]

Rattray, G.W., 2014, Evaluation of quality-control data collected by the U.S. Geological Survey for routine water-quality activities at the Idaho National Laboratory and vicinity, southeastern Idaho, 2002–2008: U.S. Geological Survey Scientific Investigations Report 2014–5027, 66 p. [Also available at https://doi.org/10.3133/sir20145027.]

Appendix 7. Inventory of Water-Quality and Water Level Field Equipment

Table 7.1. Water-quality and water level field equipment.

[USGS, U.S. Geological Survey; ft, feet; –, not applicable]

Type of meter	Model	Manufacturer	Serial number
Multi-parameter	HL4	Hydrolab	20252h404882
Multi-parameter	HL4	Hydrolab	23286H405610
Multi-parameter	YSI	EXO1	26A106911
Multi-parameter	YSI	EXO1	26B103020
Turbidity	2100Q IS	Hach Environmental	25050D000103
Turbidity	2100P	Hach Environmental	971200016277
pH	HQ1110	Hach Environmental	251131110003
pH	Orion 3 Star	Thermo Scientific	A16054
Conductivity	122	Orion	0905040
Transducers (data loggers) - USGS 1	CS 451 SDI-12	Campbell Scientific	70011134
Transducers (data loggers) - USGS 4	CS 451 SDI-12	Campbell Scientific	14510007
Transducers (data loggers) - USGS 9	CS 451 SDI-12	Campbell Scientific	70011141
Transducers (data loggers) - USGS 12	CS 451 SDI-12	Campbell Scientific	70011549
Transducers (data loggers) - USGS 19	CS 451 SDI-12	Campbell Scientific	14012529
Transducers (data loggers) - USGS 21	CS 451 SDI-12	Campbell Scientific	14010418
Transducers (data loggers) - USGS 24	CS 451 SDI-12	Campbell Scientific	29010123
Transducers (data loggers) - USGS 25	CS 451 SDI-12	Campbell Scientific	29010124
Transducers (data loggers) - USGS 27	CS 451 SDI-12	Campbell Scientific	14012523
Transducers (data loggers) - USGS 120	CS 451 SDI-12	Campbell Scientific	14012524
Transducers (data loggers) - USGS 138	CS 451 SDI-12	Campbell Scientific	29010125
Transducers (data loggers) - Site 17	CS 451 SDI-12	Campbell Scientific	14011960
Transducers (data loggers) - USGS 1	CS 451 SDI-12	Campbell Scientific	70011134
Transducers (data loggers) - USGS 4	CS 451 SDI-12	Campbell Scientific	14510007
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	72068284
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	61733096
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	221276207
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	101476820

Table 7.1. Water-quality and water level field equipment. —Continued

[USGS, U.S. Geological Survey; ft, feet; –, not applicable]

Type of meter	Model	Manufacturer	Serial number
E-tape-1	Water level Indicator – 1000 ft	Durham Geo Slope Indicator	2139336
E-tape-2	Water level Indicator – 1000 ft	Durham Geo Slope Indicator	2139337
E-tape-3	Water level Indicator – 1000 ft	Durham Geo Slope Indicator	2500113
E-tape-4	Water level Indicator – 700 ft	Durham Geo Slope Indicator	2137338
E-tape-5	Water level Indicator – 1250 ft	Durham Geo Slope Indicator	2437326
E-tape-6	Water level Indicator – 1000 ft	Durham Geo Slope Indicator	1637402
Stainless steel tape	Calibration tape – 800 ft	Cooper Tools	–
Stainless steel tape	Calibration tape – 1000 ft	Cooper Tools	–
Stainless steel tape	Calibration tape – 1200 ft	Cooper Tools	–

Appendix 8. Auditor's Checklist for Quality Assurance Field Audits

QUALITY-ASSURANCE FIELD AUDITS

AUDITOR'S CHECKLIST

Auditor's name ______________________________

1. Date __________ **Sampler's name** ________________ **Site Name**__________________

2. Vehicle:

Was the vehicle clean and well maintained? Yes / No
Was the vehicle well stocked? Yes / No
Were the field computer and printer working properly? Yes / No

3. Site Inspection? Yes / No Details ______________________________

4. Water-level measurement? Yes / No

Recorded on WL trip sheet and
laptop computer? Yes / No

Electric tape

Depth 1 below MP ________
Tape correction 1 ________
Depth 2 below MP ________
Tape correction 2 ________
MP ________

5. Portable discharge lines rinsed with DI water? Yes / No

6. Generator:

Grounded? Yes / No
Parked downwind from well? Yes / No

7. Time pump started? ______ Discharge measured? Yes / No Q = _________ gpm
Purge time calculated? Yes / No T = _________ min/vol
Time readings stabilized? _________

8. Field safety equipment:

Shovel? Yes / No
Bucket? Yes / No
First-aid kit? Yes / No
Fire extinguisher? Yes / No
Eye-wash kit? Yes / No
Hearing protection? Yes / No

Site-safety plan? Yes / No
QA plan? Yes / No
Body-fluids kit? Yes / No
Safety vest (if required)? Yes / No
Cell phone? Yes / No
Jumper cables and ice scrapper? Yes / No

9. Constituents? ____

Number of bottles and designations ________________________________

10. Calibrations:

Specific conductance? Yes / No
pH? Yes / No
DO or ORP? Yes / No
Recorded in SVMaq? Yes / No
Other? Yes / No Specify__________________

11. Field Measurements:

Temperature, water? Yes / No Value = __________
Temperature, air? Yes / No Value = __________
Specific conductance? Yes / No Value = __________
pH? Yes / No Value = __________
DO / ORP? Yes / No Value = __________
Other (Specify)? Yes / No Value = __________

12. Sample Collection:

Time started ____________________
Gloves Yes / No
Filter rinsed with DI and sample water? Yes / No
Air purged from filter? Yes / No
Bottles rinsed with sample if appropriate? Yes / No
Order of filling bottles? Correct/Incorrect List __________________
Number of rinses? List __________________

13. Preservation:

Safety equipment?
  Eye shielding? Yes / No
  Rubber apron? Yes / No
  Protective gloves? Yes / No
Correct preservatives added? Yes / No
Was the correct order followed? Yes / No

14. Sample Handling:

Were sample bottles properly sealed? Yes / No
Were sample bottles properly labeled? Yes / No
Were sample bottles properly stored? Yes / No
Was proper security of sample bottles maintained? Yes / No

15. Decontamination:

Were portable discharge lines rinsed with DI water prior to storage? Yes / No

16. Site Clean-up and Security:

Was the well properly secured after sampling? Yes / No
Was the Site properly cleaned prior to departure? Yes / No

17. Paperwork copies?

	Requested?	Delivered?
Field observation worksheet?	Yes / No	Yes / No
Analytical service request form?	Yes / No	Yes / No
Water-level trip sheet?	Yes / No	Yes / No
SVMAQ Calibration files?	Yes / No	Yes / No
SVMAQ Water level file?	Yes / No	Yes / No
Superfly field form?	Yes / No	Yes / No
Other? (Specify______________)	Yes / No	Yes / No

18. Comments

For information about the research in this report, contact
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